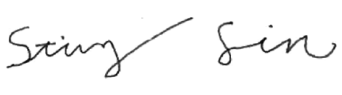
Lithium-ion Battery UN38.3 Test Report

Recommendations on the TRANSPORT OF DANGEROUS GOODS

(Manual of Tests and Criteria, Sixth revised edition, Amend 1)

Customer: Lenovo
Model: L18M3PFB
Rating/ Mass: 11.52V, Typical Capacity 3700mAh/ 42Wh
Rated Capacity 3600mAh/ 41Wh/ 171 (g)
Issue date: 2019/03/28

Approved By	Checked By	Prepared By
Assistant Manager	Authorized Signatory	Test Engineer
		

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Email：Test_Lab@simplo.com.tw **Website：http://www.simplo.com.tw/**

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, Amend 1, Section 38.3.

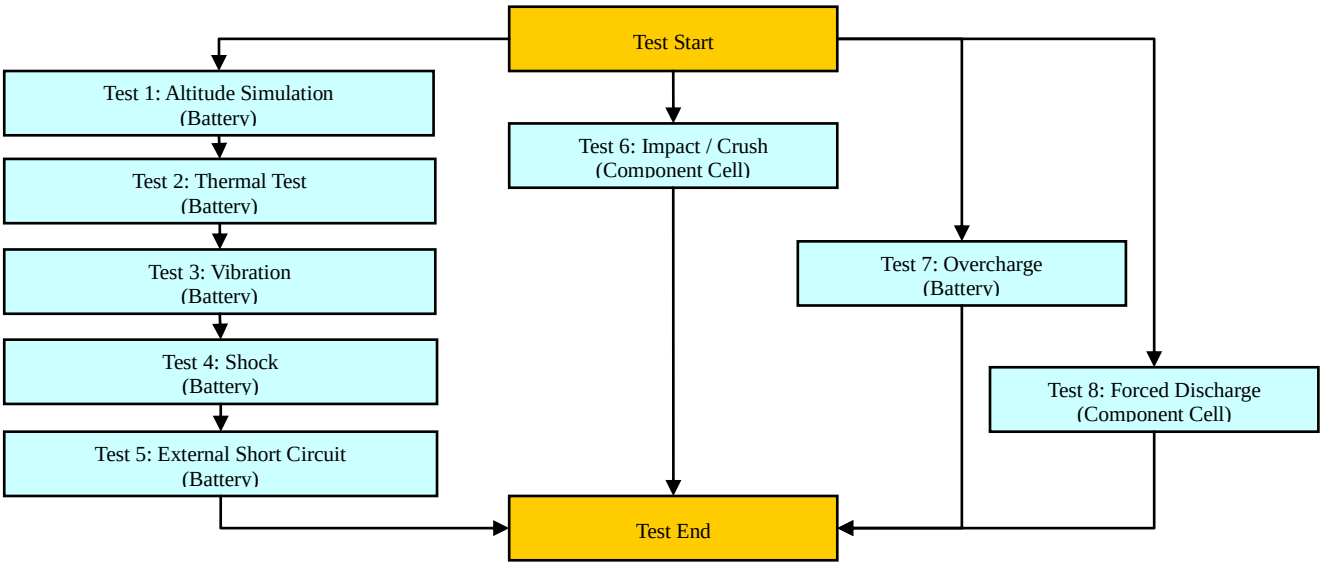
2. Test Quantity：

2.1 Four batteries, at first cycle, in fully charged states. (For T.1~T.5)
2.2 Four batteries, after 25 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 Five component cells, after 25 cycles at 50% of the design rated capacity. (For T.6)
2.5 Four batteries, at first cycle, in fully charged states. (For T.7)
2.6 Four batteries, after 25 cycles ending in fully charged states. (For T.7)
2.7 Ten component cells, at first cycle in fully discharge states. (For T.8)
2.8 Ten component cells, after 25 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, Amend 1, 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 Lab:

Email：Test_Lab@simplo.com.tw **Website：http://www.simplo.com.tw/**

SIMPLO (Taiwan) Laboratory

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6. Test Equipment：

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Revised Date: 2019-03-28

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	2019/2/25	2020/2/25	
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	2019/2/26	2020/2/26	
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	
	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	34401A	Note 1	Agilent	2019/2/26	2020/2/26	
V	ML-494	Electronic Balance	XS1220M-SCS	1-1220 gf	PRECISA	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	
V	ML-555	Barometric Air Pressure	C300	750 to 1100 mbar	Lufft	2018/9/18	2019/9/18	
	T.2 Thermal Test							
V	ML-789	Thermal Shock	GTST-080-65-AW	T:-40 to 100℃	GF	2019/1/3	2020/1/3	
V	ML-257	Multimeter	34401A	note 1	Agilent	2019/2/26	2020/2/26	
V	ML-494	Electronic Balance	XS1220M-SCS	1-1220 gf	PRECISA	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	34401A	note 1	Agilent	2019/2/26	2020/2/26	
V	ML-494	Electronic Balance	XS1220M-SCS	1-1220 gf	PRECISA	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	34401A	note 1	Agilent	2019/2/26	2020/2/26	
V	ML-494	Electronic Balance	XS1220M-SCS	1-1220 gf	PRECISA	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-894	Battery Hitester	BT3562	1mΩ ~ 30kΩ	HIOKI	2018/6/11	2019/6/11	
V	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 200℃	Yokogawa	2018/9/12	2019/9/12	
V	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 200℃	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	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 200℃	Yokogawa	2018/9/12	2019/9/12	

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Revised Date: 2019-03-28

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 200℃	Yokogawa	2018/9/12	2019/9/12	
	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 200℃	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,60A, 300W	Prodigit	2019/2/26	2020/2/26	
	ML-133	Electronic Load	3311C	60V,60A, 300W	Prodigit	2019/2/26	2020/2/26	
	ML-136	Electronic Load	3311C	60V,60A, 300W	Prodigit	2019/2/26	2020/2/26	
	ML-192	Electronic Load	3311C	60V,60A, 300W	Prodigit	2019/2/26	2020/2/26	
	ML-269	Electronic Load	3311C	60V,60A, 300W	Prodigit	2019/2/26	2020/2/26	
	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 200℃	Yokogawa	2018/9/12	2019/9/12	
	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 200℃	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.

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

UN 38.3 Test Datasheet

UN38.3/ST/SG/AC.10/11/Rev.6/Amend.1

Control Number: SLEU-1903003	Customer: Lenovo	Model Name: L18M3PFB	SMP Project Name: S340-PKO
Pack P/N: 928QA285H (A)(B)	Configuration: 3S1P	Test Duration: 2019/03/06~2019/03/27	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	25 Cycles, Fully charged	V	01C~05C	1 Cycle, 50% SOC
V	09~12	1 Cycle, Fully charged	V	13~16	25 Cycles, Fully charged	V	06C~10C	25 Cycles, 50% SOC
						V	11C~20C	1 Cycle, Fully discharged (0% SOC)
						V	21C~30C	25 Cycles, Fully discharged (0% SOC)

T.1 Altitude Simulation

Start time: 2019/03/13 08:40						Ambient temp.: 21.5 ℃		Operator: Martin	
Finish time: 2019/03/13 16:00		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	12.749	12.747	12.743	12.752	12.750	12.748	12.754	12.746
	After	12.732	12.733	12.728	12.735	12.737	12.734	12.739	12.730
	Residual OCV %	99.87%	99.89%	99.88%	99.87%	99.90%	99.89%	99.88%	99.87%
Mass (g)	Before	171.993	170.897	171.586	171.934	170.992	171.819	170.962	171.428
	After	171.987	170.896	171.586	171.930	170.987	171.817	170.961	171.428
	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: 2019/03/13 16:20						Ambient temp.: 21.8 ℃		Operator: Martin	
Finish time: 2019/03/20 09:10		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	12.732	12.733	12.728	12.735	12.737	12.734	12.739	12.730
	After	12.579	12.585	12.576	12.590	12.589	12.584	12.590	12.584
	Residual OCV %	98.80%	98.84%	98.81%	98.86%	98.84%	98.82%	98.83%	98.85%
Mass (g)	Before	171.987	170.896	171.586	171.930	170.987	171.817	170.961	171.428
	After	171.972	170.879	171.574	171.914	170.974	171.799	170.942	171.414
	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: 2019/03/20 09:30						Ambient temp.: 21.9 ℃		Operator: Martin	
Finish time: 2019/03/21 09:20		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08.
OCV (V)	Before	12.579	12.585	12.576	12.590	12.589	12.584	12.590	12.584
	After	12.564	12.568	12.561	12.576	12.575	12.572	12.574	12.567
	Residual OCV %	99.88%	99.86%	99.88%	99.89%	99.89%	99.90%	99.87%	99.86%
Mass (g)	Before	171.972	170.879	171.574	171.914	170.974	171.799	170.942	171.414
	After	171.968	170.879	171.571	171.909	170.972	171.799	170.940	171.411
	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: 2019/03/21 09:40						Ambient temp.: 22.0 ℃		Operator: Martin	
Finish time: 2019/03/21 13:10		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	12.564	12.568	12.561	12.576	12.575	12.572	12.574	12.567
	After	12.553	12.555	12.546	12.567	12.563	12.562	12.560	12.557
	Residual OCV %	99.91%	99.90%	99.88%	99.93%	99.90%	99.92%	99.89%	99.92%
Mass (g)	Before	171.968	170.879	171.571	171.909	170.972	171.799	170.940	171.411
	After	171.966	170.879	171.567	171.906	170.972	171.798	170.938	171.407
	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: 2019/03/21 13:30						Ambient temp.: 21.8 ℃		Operator: Martin	
Finish time: 2019/03/22 09:00		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	12.553	12.555	12.546	12.567	12.563	12.562	12.560	12.557
	After	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Resistance (<100mΩ)		59.4	60.8	61.3	58.8	57.3	59.5	60.1	58.0
Max Temp. (< 170℃)		57.5	57.3	57.7	57.3	57.8	57.4	57.6	57.2
Results		P	P	P	P	P	P	P	P

T.6 Impact / Crush (Component Cell)

UN38.3/ST/SG/AC.10/11/Rev.6/Amend.1

☐ 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: 2019/03/15 08:40			Ambient temp.: 22.4 ℃		Operator: Martin
Finish time: 2019/03/15 16:50	Sample 01C	Sample 02C	Sample 03C	Sample 04C	Sample 05C
Initial OCV (V)	3.805	3.807	3.798	3.793	3.802
Max Temp. (< 170℃)	24.2	23.9	23.6	24.5	23.4
Results	P	P	P	P	P
Sample No.	Sample 06C	Sample 07C	Sample 08C	Sample 09C	Sample 10C
Initial OCV (V)	3.796	3.804	3.799	3.806	3.795
Max Temp. (< 170℃)	23.8	24.1	24.0	23.7	24.1
Results	P	P	P	P	P

T.7 Overcharge

Start time: 2019/03/19 09:00					Ambient temp.: 22.1 ℃		Operator: Martin	
Finish time: 2019/03/27 10:50	Sample 09	Sample 10	Sample 11	Sample 12	Sample 13	Sample 14	Sample 15	Sample 16
Initial OCV (V)	12.752	12.745	12.739	12.755	12.751	12.745	12.758	12.744
Results	P	P	P	P	P	P	P	P

T.8 Forced Discharge (Component Cell)

Start time: 2019/03/18 09:00					Ambient temp.: 22.0 ℃		Operator: Martin	
Finish time: 2019/03/26 11:00	Sample 11C	Sample 12C	Sample 13C	Sample 14C	Sample 15C	Sample 16C	Sample 17C	Sample 18C
Initial OCV (V)	3.463	3.482	3.457	3.466	3.470	3.473	3.486	3.475
Results	P	P	P	P	P	P	P	P
Sample No.	Sample 19C	Sample 20C	Sample 21C	Sample 22C	Sample 23C	Sample 24C	Sample 25C	Sample 26C
Initial OCV (V)	3.459	3.460	3.474	3.485	3.477	3.462	3.454	3.461
Results	P	P	P	P	P	P	P	P
Sample No.	Sample 27C	Sample 28C	Sample 29C	Sample 30C				
Initial OCV (V)	3.479	3.462	3.484	3.453				
Results	P	P	P	P				

8. Test Sample: