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: L18M4PF4
Rating/ Mass: 15.44V, Typical Capacity 3240mAh/ 50Wh
Rated Capacity 3145mAh/ 48Wh/ 197 (g)
Issue date: 2019/07/30

Approved By	Checked By	Prepared By
Assistant Manager	Authorized Signatory	Test Engineer
Sing Sin	Zosmark Huang	Mia Cheng

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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 Result：

Test results of the UN Recommendations on the Transport of Dangerous Goods

No.	Test Item	Test results
T.1	Altitude simulation	PASS
T.2	Thermal test	PASS
T.3	Vibration test	PASS
T.4	Shock test	PASS
T.5	External short circuit	PASS
T.6	Impact, Crush test	PASS
T.7	Overcharge	PASS
T.8	Forced discharge	PASS

3.Test Lab: Email：Test_Lab@simplo.com.tw Website：http://www.simplo.com.tw/

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4. Product manufacturer : Email：Test_Lab@simplo.com.twWebsite：http://www.simplo.com.tw/

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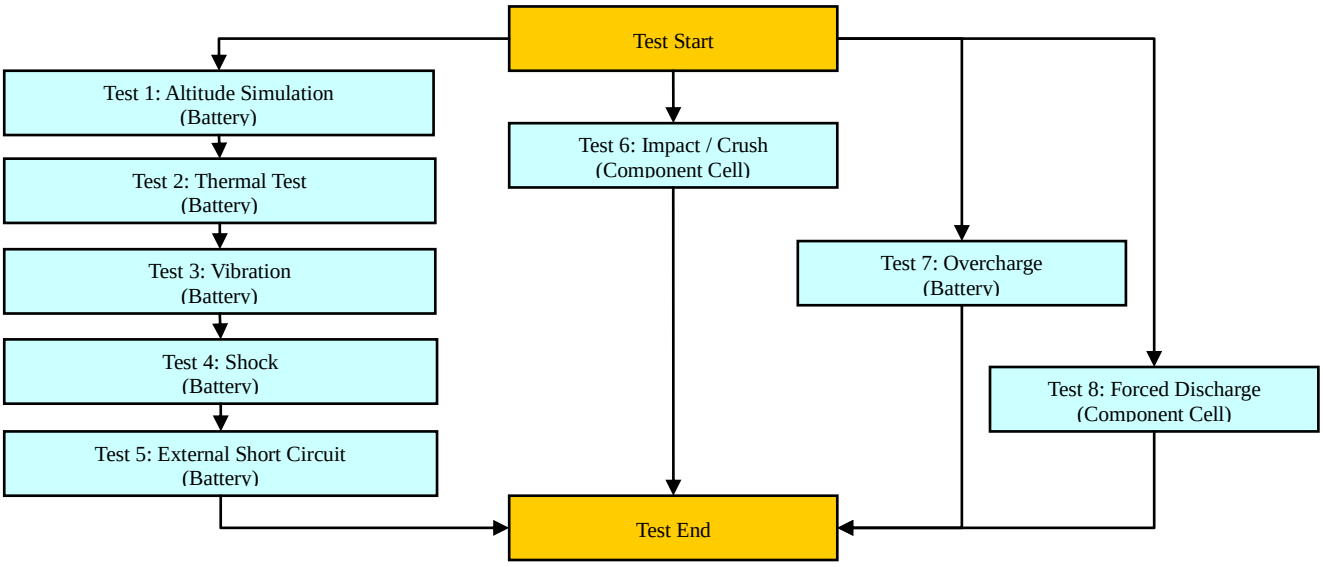
5. Test Quantity：

5.1 Four batteries, at first cycle, in fully charged states. (For T.1~T.5)
5.2 Four batteries, after 25 cycles ending in fully charged states. (For T.1~T.5)
5.3 Five component cells, at first cycle at 50% of the design rated capacity. (For T.6)
5.4 Five component cells, after 25 cycles at 50% of the design rated capacity. (For T.6)
5.5 Four batteries, at first cycle, in fully charged states. (For T.7)
5.6 Four batteries, after 25 cycles ending in fully charged states. (For T.7)
5.7 Ten component cells, at first cycle in fully discharge states. (For T.8)
5.8 Ten component cells, after 25 cycles ending in fully discharged states. (For T.8)

6. Test Procedure：

6.1 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.

6.2 Test flow shall be followed as below.



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

7. Comment：

Follow the requirement of "TRANSPORT OF DANGEROUS GOODS, Manual of Tests and Criteria, Sixth revised edition, Amend 1, Section 38.3", this report was updated. (The control number of old report: SLEU-1809002)

8. Test Equipment：

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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
	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	34401A	Note 1	Agilent	2018/3/1	2019/3/1	
V	ML-494	Electronic Balance	XS 1220M	1-1220 gf	CHUAN HUA	2018/7/18	2019/7/18	
	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	
	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	34401A	note 1	Agilent	2018/3/1	2019/3/1	
V	ML-494	Electronic Balance	XS 1220M	1-1220 gf	CHUAN HUA	2018/7/18	2019/7/18	
	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	
	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	2018/3/1	2019/3/1	
V	ML-494	Electronic Balance	XS 1220M	1-1220 gf	CHUAN HUA	2018/7/18	2019/7/18	
	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	
	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	2018/3/1	2019/3/1	
V	ML-494	Electronic Balance	XS 1220M	1-1220 gf	CHUAN HUA	2018/7/18	2019/7/18	
	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	
	T.5 External Short Circuit							
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	2018/9/13	2019/9/13	
V	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2018/9/13	2019/9/13	
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	
	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	2017/9/13	2018/9/13	

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Revised Date: 2018-09-11

Test Instruments Reference List

	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	2017/9/18	2018/9/18	
	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2018/9/13	2019/9/13	
	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2018/9/13	2019/9/13	
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	
	T.8 Forced Discharge							
	ML-132	Electronic Load	3311C	60V, 60A, 300W	Prodigit	2018/3/1	2019/3/1	
	ML-133	Electronic Load	3311C	60V, 60A, 300W	Prodigit	2018/3/1	2019/3/1	
	ML-136	Electronic Load	3311C	60V, 60A, 300W	Prodigit	2018/3/1	2019/3/1	
	ML-192	Electronic Load	3311C	60V, 60A, 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	2018/9/13	2019/9/13	
	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2018/9/13	2019/9/13	
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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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.6 Impact / Crush							
V	ML-339	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2019/5/10	2020/5/10	
	ML-076	Impact Tester			JYI SHENG	2019/1/3	2020/1/3	
	ML-553	Crush Tester	BCT-01		Simplo	2019/5/10	2020/5/10	
V	ML-866	Crush Tester	M0654		JYI SHENG	2019/4/8	2020/4/8	
	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2018/9/12	2019/9/12	

9. 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-1907004	Customer: Lenovo	Model Name: L18M4PF4	SMP Project Name: S540_4A
Pack P/N: 928QA256H (A)(B)	Configuration: 4S1P	Test Duration: 2018/08/10~2018/09/11 2019/07/22~2019/07/30	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: 2018/08/23 09:00						Ambient temp.: 23.7 ℃		Operator: Martin	
Finish time: 2018/08/23 15:20		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	17.710	17.712	17.712	17.712	17.712	17.712	17.712	17.712
	After	17.704	17.706	17.707	17.706	17.706	17.706	17.706	17.707
	Residual OCV %	99.97%	99.97%	99.97%	99.97%	99.97%	99.97%	99.97%	99.97%
Mass (g)	Before	196.792	197.011	197.021	196.986	196.883	197.002	196.799	197.018
	After	196.792	197.008	197.021	196.986	196.879	197.002	196.799	197.018
	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: 2018/08/23 15:40						Ambient temp.: 24.8 ℃		Operator: Martin	
Finish time: 2018/09/03 08:50		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	17.704	17.706	17.707	17.706	17.706	17.706	17.706	17.707
	After	17.589	17.584	17.581	17.581	17.576	17.577	17.587	17.583
	Residual OCV %	99.35%	99.31%	99.29%	99.29%	99.27%	99.27%	99.33%	99.30%
Mass (g)	Before	196.792	197.008	197.021	196.986	196.879	197.002	196.799	197.018
	After	196.774	196.985	196.997	196.966	196.862	196.981	196.776	196.998
	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: 2018/09/03 09:10						Ambient temp.: 23.5 ℃		Operator: Martin	
Finish time: 2018/09/04 08:50		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	17.589	17.584	17.581	17.581	17.576	17.577	17.587	17.583
	After	17.573	17.569	17.566	17.566	17.560	17.562	17.572	17.568
	Residual OCV %	99.91%	99.91%	99.91%	99.91%	99.91%	99.91%	99.91%	99.91%
Mass (g)	Before	196.774	196.985	196.997	196.966	196.862	196.981	196.776	196.998
	After	196.774	196.982	196.996	196.966	196.857	196.981	196.773	196.997
	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: 2018/09/04 09:20						Ambient temp.: 24.3 ℃		Operator: Martin	
Finish time: 2018/09/04 11:20		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	17.573	17.569	17.566	17.566	17.560	17.562	17.572	17.568
	After	17.572	17.568	17.565	17.565	17.559	17.561	17.571	17.567
	Residual OCV %	99.99%	99.99%	99.99%	99.99%	99.99%	99.99%	99.99%	99.99%
Mass (g)	Before	196.774	196.982	196.996	196.966	196.857	196.981	196.773	196.997
	After	196.772	196.982	196.996	196.963	196.857	196.981	196.772	196.995
	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: 2018/09/04 11:40						Ambient temp.: 23.7 ℃		Operator: Martin	
Finish time: 2018/09/05 09:00		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	17.572	17.568	17.565	17.565	17.559	17.561	17.571	17.567
	After	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Resistance (<100mΩ)		60.3	57.4	59.5	60.8	56.3	59.8	56.8	61.5
Max Temp. (< 170℃)		57.8	57.8	57.6	57.7	57.9	57.9	57.6	57.8
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: 2019/07/30 09:30			Ambient temp.: 24.1 ℃		Operator: Mia
Finish time: 2019/07/30 15:20	Sample 01C	Sample 02C	Sample 03C	Sample 04C	Sample 05C
Initial OCV (V)	3.817	3.822	3.814	3.829	3.825
Max Temp. (< 170℃)	24.2	24.6	23.8	23.4	24.1
Results	P	P	P	P	P
Sample No.	Sample 06C	Sample 07C	Sample 08C	Sample 09C	Sample 10C
Initial OCV (V)	3.812	3.818	3.825	3.810	3.823
Max Temp. (< 170℃)	23.7	23.4	24.3	24.0	23.9
Results	P	P	P	P	P

T.7 Overcharge

Start time: 2018/08/27 09:10					Ambient temp.: 23.8 ℃		Operator: Martin	
Finish time: 2018/09/10 10:00	Sample 09	Sample 10	Sample 11	Sample 12	Sample 13	Sample 14	Sample 15	Sample 16
Initial OCV (V)	17.708	17.713	17.715	17.710	17.713	17.708	17.714	17.714
Results	P	P	P	P	P	P	P	P

T.8 Forced Discharge (Component Cell)

Start time: 2018/08/24 09:40					Ambient temp.: 23.8 ℃		Operator: Martin	
Finish time: 2018/09/03 09:00	Sample 11C	Sample 12C	Sample 13C	Sample 14C	Sample 15C	Sample 16C	Sample 17C	Sample 18C
Initial OCV (V)	3.433	3.445	3.441	3.450	3.438	3.444	3.456	3.437
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)	3.454	3.448	3.436	3.453	3.439	3.446	3.451	3.449
Results	P	P	P	P	P	P	P	P
Sample No.	Sample 27C	Sample 28C	Sample 29C	Sample 30C				
Initial OCV (V)	3.436	3.457	3.453	3.450				
Results	P	P	P	P				

9. Test Sample: