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: L16M4PB3
Rating: 7.68V , 6268mAh / 48Wh
6080mAh / 46Wh

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.

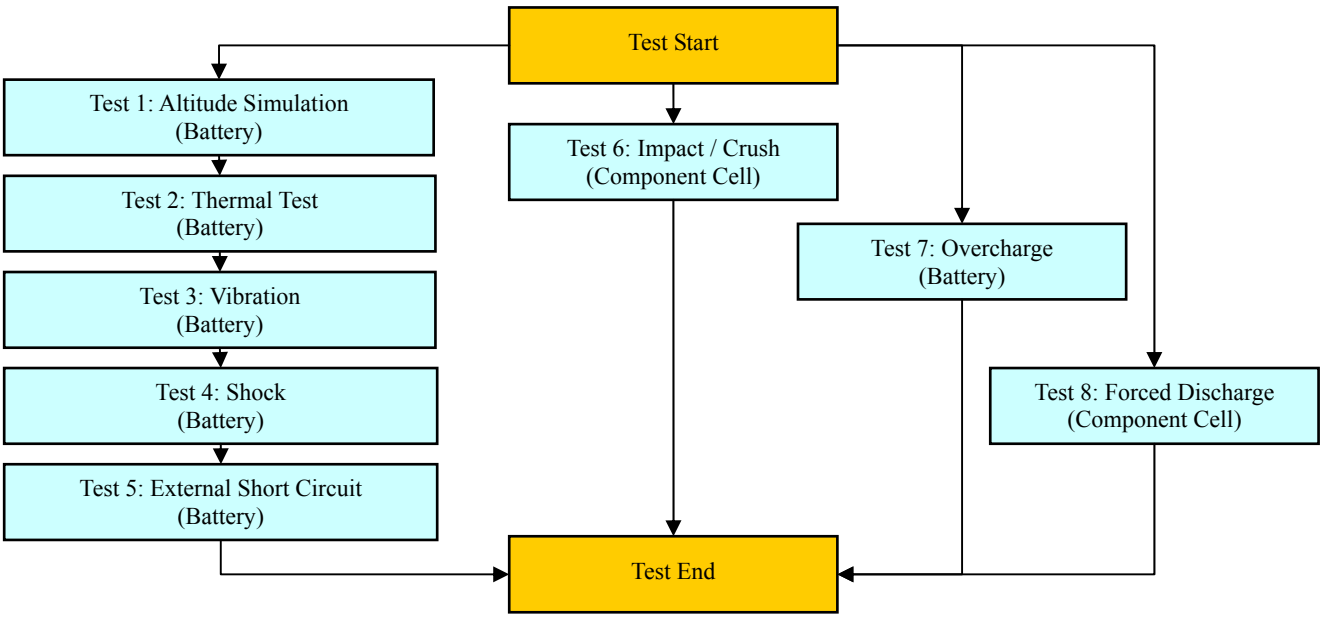
2. Test Quantity：

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: 2017-01-16

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	2016/3/2	2017/3/2	
V	ML-762	Learning	715C	0~18V 0~8A	SMP	2017/1/4	2018/1/4	
V	ML-763	Learning	715C	0~18V 0~8A	SMP	2016/3/2	2017/3/2	
V	ML-764	Learning	715C	0~18V 0~8A	SMP	2017/1/4	2018/1/4	
	T.1 Altitude Simulation							
V	ML-522	Altitude	SVT-120	Kpa:30~90	HSIN JIANG	2016/7/28	2017/7/28	
V	ML-257	Multimeter	HP 34401A	Note 1	Agilent	2016/3/4	2017/3/4	
	ML-494	Electronic Balance	XS1220M-SCS	1-1200 gf	CHUANHUA	2016/7/28	2017/7/28	
V	TD-166	Electronic Balance	PG603-S	1-610 gf	METTLER TOLEDO	2016/9/21	2017/9/21	
	ML-523	Electronic Balance	MTW-30K	30*0.005Kg		2016/9/21	2017/9/21	
V	ML-550	Data Logger	313	15~35 ℃; 30~80 %RH	CENTER	2016/9/21	2017/9/21	
	T.2 Thermal Test							
V	ML-789	Thermal Shock	GTST-080-65-AW	T:-40 to 120℃	GF	2017/1/4	2018/1/4	
V	ML-257	Multimeter	HP 34401A	note 1	Agilent	2016/3/4	2017/3/4	
	ML-494	Electronic Balance	XS1220M-SCS	1-1000 gf	CHUANHUA	2016/7/28	2017/7/28	
V	TD-166	Electronic Balance	PG603-S	1-610 gf	METTLER TOLEDO	2016/9/21	2017/9/21	
	ML-523	Electronic Balance	MTW-30K	30*0.005Kg		2016/9/21	2017/9/21	
	T.3 Vibration							
V	ML-233	Vibration	KD-9636-EM-300F2K-30N80	F:5~2000Hz G:0.2~20G	King Design	2016/9/2	2017/9/2	
V	ML-257	Multimeter	HP 34401A	note 1	Agilent	2016/3/4	2017/3/4	
	ML-494	Electronic Balance	XS1220M-SCS	1-1000 gf	CHUANHUA	2016/7/28	2017/7/28	
V	TD-166	Electronic Balance	PG603-S	1-610 gf	METTLER TOLEDO	2016/9/21	2017/9/21	
	ML-523	Electronic Balance	MTW-30K	30*0.005Kg		2016/9/21	2017/9/21	
V	ML-552	Data Logger	313	15~35 ℃; 30~80 %RH	CENTER	2016/9/21	2017/9/21	
	T.4 Shock							
V	ML-056	Shock	DP-1200-25	G:10~600G	King Design	2016/9/2	2017/9/2	
V	ML-257	Multimeter	HP 34401A	note 1	Agilent	2016/3/4	2017/3/4	
	ML-494	Electronic Balance	XS1220M-SCS	1-1000 gf	CHUANHUA	2016/7/28	2017/7/28	
V	TD-166	Electronic Balance	PG603-S	1-610 gf	METTLER TOLEDO	2016/9/21	2017/9/21	
	ML-523	Electronic Balance	MTW-30K	30*0.005Kg		2016/9/21	2017/9/21	
V	ML-551	Data Logger	313	15~35 ℃; 30~80 %RH	CENTER	2016/9/21	2017/9/21	
	T.5 External Short Circuit							
V	ML-534	mΩ Hitester	3540	1mΩ ~ 30kΩ	HIOKI	2016/9/23	2017/9/23	
V	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2016/9/21	2017/9/21	
V	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2016/9/21	2017/9/21	
V	ML-521	Oven	9031	30~80 ℃	YEOW LONG	2016/9/21	2017/9/21	
	T.6 Impact / Crush							
V	ML-339	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2016/5/19	2017/5/19	
	ML-076	Impact Tester			JYI SHENG	2017/1/3	2018/1/3	
	ML-553	Crush Tester	BCT-01		Simplo	2016/6/1	2017/6/1	
V	ML-866	Crush Tester	M0654		JYI SHENG	2016/4/28	2017/4/28	
	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2016/9/21	2017/9/21	

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Revised Date: 2017-01-16

Test Instruments Reference List

Used	Instrument ID	Instrument Name	Type	Range of use	Manufacturer	Calibration Date_Last	Calibration Date_Next	Remarks
	T.7 Overcharge							
V	ML-482	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2016/5/19	2017/5/19	
V	ML-483	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2016/5/19	2017/5/19	
V	ML-484	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2016/5/19	2017/5/19	
V	ML-486	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2016/5/19	2017/5/19	
V	ML-487	Programmable DC Source	DS6024	1-60 Vdc, 0.3-24A	MOTECH	2016/5/19	2017/5/19	
V	ML-488	Programmable DC Source	DS6024	1-60 Vdc, 0.3-24A	MOTECH	2016/5/19	2017/5/19	
V	ML-550	Data Logger	313	15~35 ℃; 30~80 %RH	CENTER	2016/9/21	2017/9/21	
V	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2016/9/21	2017/9/21	
V	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2016/9/21	2017/9/21	
	T.8 Forced Discharge							
V	ML-132	Electronic Load	3311C	60V,55A, 300W	Prodigit	2016/3/4	2017/3/4	
V	ML-133	Electronic Load	3311C	60V,55A, 300W	Prodigit	2016/3/4	2017/3/4	
V	ML-136	Electronic Load	3311C	60V,55A, 300W	Prodigit	2016/3/4	2017/3/4	
V	ML-192	Electronic Load	3311C	60V,55A, 300W	Prodigit	2016/3/4	2017/3/4	
V	ML-269	Electronic Load	3311C	60V,55A, 300W	Prodigit	2016/3/4	2017/3/4	
V	ML-532	DC Electronic Load	33511-01	120V, 240A, 3600W	Prodigit	2016/7/29	2017/7/29	
V	ML-482	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2016/5/19	2017/5/19	
V	ML-483	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2016/5/19	2017/5/19	
V	ML-484	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2016/5/19	2017/5/19	
V	ML-486	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2016/5/19	2017/5/19	
V	ML-487	Programmable DC Source	DS6024	1-60 Vdc, 0.3-24A	MOTECH	2016/5/19	2017/5/19	
V	ML-488	Programmable DC Source	DS6024	1-60 Vdc, 0.3-24A	MOTECH	2016/5/19	2017/5/19	
V	ML-550	Data Logger	313	15~35 ℃; 30~80 %RH	CENTER	2016/9/21	2017/9/21	
V	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2016/9/21	2017/9/21	
V	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2016/9/21	2017/9/21	

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-1701001	Customer: Lenovo	Model Name: L16M4PB3	SMP Project Name: 720S-13
Pack P/N: 928QA180H (A)(B)	Configuration: 2S2P	Test Duration: 2016/12/20~2017/01/16	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% charged
V	09~12	1 Cycle, Fully charged	V	13~16	50 Cycles, Fully charged	V	06C~15C	1 Cycle, 0% discharged
		25Cycles, Fully charged			25 Cycles, Fully charged	V	16C~25C	50 Cycles, 0% discharged

T.1 Altitude Simulation

Start time: 2017/01/04 09:30						Ambient temp.: 20.4 ℃		Operator: Stephy	
Finish time: 2017/01/04 15:50		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	8.706	8.701	8.703	8.707	8.699	8.706	8.697	8.709
	After	8.702	8.696	8.699	8.703	8.694	8.702	8.693	8.705
	Residual OCV %	99.95%	99.94%	99.95%	99.95%	99.94%	99.95%	99.95%	99.95%
Mass (g)	Before	198.699	199.541	198.751	198.826	199.034	198.729	199.245	198.853
	After	198.697	199.541	198.750	198.825	199.034	198.727	199.245	198.851
	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: 2017/01/04 16:10						Ambient temp.: 22.1 ℃		Operator: Stephy	
Finish time: 2017/01/11 09:00		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	8.702	8.696	8.699	8.703	8.694	8.702	8.693	8.705
	After	8.594	8.605	8.598	8.595	8.594	8.607	8.592	8.598
	Residual OCV %	98.76%	98.95%	98.84%	98.76%	98.85%	98.91%	98.84%	98.77%
Mass (g)	Before	198.697	199.541	198.750	198.825	199.034	198.727	199.245	198.851
	After	198.679	199.513	198.728	198.801	199.007	198.706	199.212	198.824
	Mass loss %	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.02%	0.01%
Results		P	P	P	P	P	P	P	P

T.3 Vibration

Start time: 2017/01/11 09:20						Ambient temp.: 20.5 ℃		Operator: Stephy	
Finish time: 2017/01/12 09:00		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	8.594	8.605	8.598	8.595	8.594	8.607	8.592	8.598
	After	8.584	8.595	8.590	8.586	8.584	8.598	8.584	8.589
	Residual OCV %	99.88%	99.88%	99.91%	99.90%	99.88%	99.90%	99.91%	99.90%
Mass (g)	Before	198.679	199.513	198.728	198.801	199.007	198.706	199.212	198.824
	After	198.677	199.513	198.725	198.800	199.007	198.702	199.209	198.824
	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: 2017/01/12 09:20						Ambient temp.: 20.9 ℃		Operator: Stephy	
Finish time: 2017/01/12 11:10		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	8.584	8.595	8.590	8.586	8.584	8.598	8.584	8.589
	After	8.583	8.594	8.589	8.585	8.583	8.597	8.583	8.588
	Residual OCV %	99.99%	99.99%	99.99%	99.99%	99.99%	99.99%	99.99%	99.99%
Mass (g)	Before	198.677	199.513	198.725	198.800	199.007	198.702	199.209	198.824
	After	198.677	199.510	198.725	198.800	199.005	198.702	199.208	198.824
	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: 2017/01/12 11:30						Ambient temp.: 20.1 ℃		Operator: Stephy	
Finish time: 2017/01/13 09:00		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	8.583	8.594	8.589	8.585	8.583	8.597	8.583	8.588
	After	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Resistance (<100mΩ)		59.6	50.4	57.2	53.4	58.6	60.8	51.3	55.0
Max Temp. (< 170℃)		57.2	57.4	57.3	57.1	57.1	57.2	57.0	57.3
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: 2017/01/07 09:50			Ambient temp.: 20.0 ℃		Operator: Stephy
Finish time: 2017/01/07 16:50	Sample 01C	Sample 02C	Sample 03C	Sample 04C	Sample 05C
Initial OCV (V)	3.816	3.821	3.814	3.822	3.813
Max Temp. (< 170℃)	20.1	20.1	20.3	20.1	20.2
Results	P	P	P	P	P

T.7 Overcharge

Start time: 2017/01/05 09:00					Ambient temp.: 20.2 ℃			Operator: Stephy
Finish time: 2017/01/16 15:00	Sample 09	Sample 10	Sample 11	Sample 12	Sample 13	Sample 14	Sample 15	Sample 16
Initial OCV (V)	8.707	8.698	8.705	8.705	8.701	8.704	8.698	8.705
Results	P	P	P	P	P	P	P	P

T.8 Forced Discharge (Component Cell)

Start time: 2017/01/06 09:20					Ambient temp.: 20.1 ℃			Operator: Stephy
Finish time: 2017/01/16 17:40	Sample 06C	Sample 07C	Sample 08C	Sample 09C	Sample 10C	Sample 11C	Sample 12C	Sample 13C
Initial OCV (V)	3.396	3.410	3.387	3.403	3.391	3.388	3.376	3.401
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)	3.386	3.377	3.403	3.411	3.398	3.378	3.395	3.406
Results	P	P	P	P	P	P	P	P
Sample No.	Sample 22C	Sample 23C	Sample 24C	Sample 25C				
Initial OCV (V)	3.390	3.401	3.384	3.393				
Results	P	P	P	P				

7. Test Sample: