Lithium-ion Battery UN38.3 Test Report

Recommendations on the TRANSPORT OF DANGEROUS GOODS

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

Customer: Lenovo
Model: L15M4E01
Rating: 14.6V , 41Wh / 2800mAh

Approved By	Checked By	Prepared By
	Fu-long.	

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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, Fifth 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 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, Fifth revised edition, Amend 1, Section 38.3.

3.2 Test flow shall be followed as below.

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4. Test Result：

4.1 T.1 ~T.4 Test result: **Passed**

4.1.1 All batteries could meet the requirement, mass loss was less than 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.

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5. Test Equipment：

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Revised Date: 2015-03-27

Test Instruments Reference List

Used	Instrument ID	Instrument Name	Type	Range Used	Manufacturer	Calibration Date_Last	Calibration Date_Next	Remarks
	Pretest							
V	ML-761	Learning	715C	0~18V 0~8A	SMP	2015/3/6	2016/3/6	
V	ML-762	Learning	715C	0~18V 0~8A	SMP	2015/3/6	2016/3/6	
V	ML-763	Learning	715C	0~18V 0~8A	SMP	2015/3/6	2016/3/6	
V	ML-764	Learning	715C	0~18V 0~8A	SMP	2015/3/6	2016/3/6	
	ML-838	Learning	PCP535	1.5V~5.5V 0~2.5A	SMP	2014/9/24	2015/9/24	
	T.1 Altitude Simulation							
	ML-308	Altitude		Kpa:30~90	HSIN JIANG	2014/8/7	2015/8/7	
V	ML-522	Altitude	SVT-120	Kpa:30~90	HSIN JIANG	2014/8/7	2015/8/7	
V	ML-257	Multimeter	HP 34401A	Note 1	Agilent	2015/3/9	2016/3/9	
V	ML-494	Electronic Balance	XS1220M-SCS	1-1200 gf	CHUANHUA	2014/8/7	2015/8/7	
	ML-523	Electronic Balance	MTW-30K	30*0.005Kg		2014/10/1	2015/10/1	
V	ML-550	Data logger	313	15~35 ℃; 30~80 %RH	CENTER	2014/9/29	2015/9/29	
	T.2 Thermal Test							
V	ML-789	Thermal Shock	GTST-080-65-AW	T:-40 to 120℃	GF	2015/1/8	2016/1/8	
V	ML-257	Multimeter	HP 34401A	note 1	Agilent	2015/3/9	2016/3/9	
V	ML-494	Electronic Balance	XS1220M-SCS	1-1000 gf	CHUANHUA	2014/8/7	2015/8/7	
	ML-523	Electronic Balance	MTW-30K	30*0.005Kg		2014/10/1	2015/10/1	
	T.3 Vibration							
V	ML-233	Vibration	KD-9636-EM-300F2K-30N80	F:5~2000Hz G:0.2~20G	King Design	2014/9/23	2015/9/23	
V	ML-257	Multimeter	HP 34401A	note 1	Agilent	2015/3/9	2016/3/9	
V	ML-494	Electronic Balance	XS1220M-SCS	1-1000 gf	CHUANHUA	2014/8/7	2015/8/7	
	ML-523	Electronic Balance	MTW-30K	30*0.005Kg		2014/10/1	2015/10/1	
V	ML-552	Data logger	313	15~35 ℃; 30~80 %RH	CENTER	2014/9/29	2015/9/29	
	T.4 Shock							
V	ML-056	Shock	DP-1200-25	G:10~600G	King Design	2014/9/23	2015/9/23	
V	ML-257	Multimeter	HP 34401A	note 1	Agilent	2015/3/9	2016/3/9	
V	ML-494	Electronic Balance	XS1220M-SCS	1-1000 gf	CHUANHUA	2014/8/7	2015/8/7	
	ML-523	Electronic Balance	MTW-30K	30*0.005Kg		2014/10/1	2015/10/1	
V	ML-551	Data logger	313	15~35 ℃; 30~80 %RH	CENTER	2014/9/29	2015/9/29	
	T.5 External Short Circuit							
V	ML-534	mΩ Hitester	3540	1mΩ ~ 30kΩ	HIOKI	2014/9/30	2015/9/30	
V	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2014/10/3	2015/10/3	
V	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2014/10/3	2015/10/3	
V	ML-521	Oven	9031	30~80 ℃	YEOW LONG	2014/10/3	2015/10/3	
	T.6 Impact (Component cell) / Crush							
V	ML-339	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2014/5/29	2015/5/29	
	ML-076	Impact Tester			JYI SHENG	2015/1/9	2016/1/9	
V	ML-553	Crush Tester	BCT-01		Simplo	2014/10/3	2015/10/3	
	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2014/10/3	2015/10/3	
	T.7 Overcharge							
V	ML-481	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2014/5/27	2015/5/27	
V	ML-482	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2014/5/27	2015/5/27	
V	ML-483	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2014/5/27	2015/5/27	

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Revised Date: 2015-03-27

Test Instruments Reference List

Used	Instrument ID	Instrument Name	Type	Range Used	Manufacturer	Calibration Date_Last	Calibration Date_Next	Remarks
V	ML-484	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2014/5/27	2015/5/27	
V	ML-485	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2014/5/27	2015/5/27	
V	ML-486	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2014/5/27	2015/5/27	
V	ML-487	Programmable DC Source	DS6024	1-60 Vdc, 0.3-24A	MOTECH	2014/5/27	2015/5/27	
V	ML-488	Programmable DC Source	DS6024	1-60 Vdc, 0.3-24A	MOTECH	2014/5/27	2015/5/27	
V	ML-489	Programmable DC Source	DS6024	1-60 Vdc, 0.3-24A	MOTECH	2014/5/27	2015/5/27	
V	ML-490	Programmable DC Source	DS6024	1-60 Vdc, 0.3-24A	MOTECH	2014/5/27	2015/5/27	
V	ML-550	Data logger	313	15~35 ℃; 30~80 %RH	CENTER	2014/9/29	2015/9/29	
V	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2014/10/3	2015/10/3	
V	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2014/10/3	2015/10/3	
	T.8 Forced Discharge							
V	ML-132	Electronic Load	3311C	60V,55A, 300W	Prodigit	2015/3/5	2016/3/5	
V	ML-133	Electronic Load	3311C	60V,55A, 300W	Prodigit	2015/3/5	2016/3/5	
V	ML-136	Electronic Load	3311C	60V,55A, 300W	Prodigit	2015/3/5	2016/3/5	
V	ML-192	Electronic Load	3311C	60V,55A, 300W	Prodigit	2015/3/5	2016/3/5	
V	ML-269	Electronic Load	3311C	60V,55A, 300W	Prodigit	2015/3/5	2016/3/5	
V	ML-532	DC Electronic Load	33511-01	120V, 240A, 3600W	Prodigit	2014/8/7	2015/8/7	
V	ML-481	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2014/5/27	2015/5/27	
V	ML-482	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2014/5/27	2015/5/27	
V	ML-483	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2014/5/27	2015/5/27	
V	ML-484	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2014/5/27	2015/5/27	
V	ML-485	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2014/5/27	2015/5/27	
V	ML-486	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2014/5/27	2015/5/27	
V	ML-487	Programmable DC Source	DS6024	1-60 Vdc, 0.3-24A	MOTECH	2014/5/27	2015/5/27	
V	ML-488	Programmable DC Source	DS6024	1-60 Vdc, 0.3-24A	MOTECH	2014/5/27	2015/5/27	
V	ML-489	Programmable DC Source	DS6024	1-60 Vdc, 0.3-24A	MOTECH	2014/5/27	2015/5/27	
V	ML-490	Programmable DC Source	DS6024	1-60 Vdc, 0.3-24A	MOTECH	2014/5/27	2015/5/27	
V	ML-550	Data logger	313	15~35 ℃; 30~80 %RH	CENTER	2014/9/29	2015/9/29	
V	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2014/10/3	2015/10/3	
V	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2014/10/3	2015/10/3	

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

Control No.: SLEU-1503010

UN 38.3 Test Datasheet

Customer: Lenovo | Model Name: L15M4E01 4S1P | Test Duration: 2015/02/03~2015/03/27 | Reviewer: Esmond

Test Sample Identification:

Battery						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 Cycle, Fully charged	V	01C ~ 05C	1 Cycle, 50% charged
V	09 ~ 12	1 Cycle, Fully charged	V	13 ~ 16	50 Cycle, Fully charged	V	06C ~ 15C	1 Cycle, 0% charged
		25Cycle, Fully charged			25Cycle, Fully charged	V	16C ~ 25C	50 Cycle, 0% charged

T.1 Altitude Simulation

Ambient temp.: 23.4 ℃ Operator: Stephy

Sample No.: 01	Before	After	Variation		Results	Sample No.: 02	Before	After	Variation		Results
Mass (g)	227.6	227.6	Mass loss %	0.00%	P	Mass (g)	227.1	227.1	Mass loss %	0.00%	P
OCV (V)	16.71	16.71	Residual OCV %	100.00%		OCV (V)	16.71	16.71	Residual OCV %	100.00%	
Sample No.: 03	Before	After	Variation		Results	Sample No.: 04	Before	After	Variation		Results
Mass (g)	227.8	227.8	Mass loss %	0.00%	P	Mass (g)	227.4	227.4	Mass loss %	0.00%	P
OCV (V)	16.70	16.70	Residual OCV %	100.00%		OCV (V)	16.71	16.71	Residual OCV %	100.00%	
Sample No.: 05	Before	After	Variation		Results	Sample No.: 06	Before	After	Variation		Results
Mass (g)	227.3	227.3	Mass loss %	0.00%	P	Mass (g)	228.0	228.0	Mass loss %	0.00%	P
OCV (V)	16.70	16.70	Residual OCV %	100.00%		OCV (V)	16.71	16.71	Residual OCV %	100.00%	
Sample No.: 07	Before	After	Variation		Results	Sample No.: 08	Before	After	Variation		Results
Mass (g)	227.9	227.9	Mass loss %	0.00%	P	Mass (g)	227.1	227.1	Mass loss %	0.00%	P
OCV (V)	16.70	16.70	Residual OCV %	100.00%		OCV (V)	16.70	16.70	Residual OCV %	100.00%	

T.2 Thermal Test

Ambient temp.: 24.3 ℃ Operator: Stephy

Sample No.: 01	Before	After	Variation		Results	Sample No.: 02	Before	After	Variation		Results
Mass (g)	227.6	227.5	Mass loss %	0.04%	P	Mass (g)	227.1	227.0	Mass loss %	0.04%	P
OCV (V)	16.71	16.46	Residual OCV %	98.50%		OCV (V)	16.71	16.47	Residual OCV %	98.56%	
Sample No.: 03	Before	After	Variation		Results	Sample No.: 04	Before	After	Variation		Results
Mass (g)	227.8	227.7	Mass loss %	0.04%	P	Mass (g)	227.4	227.4	Mass loss %	0.00%	P
OCV (V)	16.70	16.46	Residual OCV %	98.56%		OCV (V)	16.71	16.48	Residual OCV %	98.62%	
Sample No.: 05	Before	After	Variation		Results	Sample No.: 06	Before	After	Variation		Results
Mass (g)	227.3	227.3	Mass loss %	0.00%	P	Mass (g)	228.0	227.9	Mass loss %	0.04%	P
OCV (V)	16.70	16.46	Residual OCV %	98.56%		OCV (V)	16.71	16.47	Residual OCV %	98.56%	
Sample No.: 07	Before	After	Variation		Results	Sample No.: 08	Before	After	Variation		Results
Mass (g)	227.9	227.9	Mass loss %	0.00%	P	Mass (g)	227.1	227.1	Mass loss %	0.00%	P
OCV (V)	16.70	16.47	Residual OCV %	98.62%		OCV (V)	16.70	16.46	Residual OCV %	98.56%	

T.3 Vibration

Ambient temp.: 24.1 ℃ Operator: Stephy

Sample No.: 01	Before	After	Variation		Results	Sample No.: 02	Before	After	Variation		Results
Mass (g)	227.5	227.5	Mass loss %	0.00%	P	Mass (g)	227.0	227.0	Mass loss %	0.00%	P
OCV (V)	16.46	16.45	Residual OCV %	99.94%		OCV (V)	16.47	16.46	Residual OCV %	99.94%	
Sample No.: 03	Before	After	Variation		Results	Sample No.: 04	Before	After	Variation		Results
Mass (g)	227.7	227.7	Mass loss %	0.00%	P	Mass (g)	227.4	227.3	Mass loss %	0.04%	P
OCV (V)	16.46	16.46	Residual OCV %	100.00%		OCV (V)	16.48	16.47	Residual OCV %	99.94%	
Sample No.: 05	Before	After	Variation		Results	Sample No.: 06	Before	After	Variation		Results
Mass (g)	227.3	227.3	Mass loss %	0.00%	P	Mass (g)	227.9	227.9	Mass loss %	0.00%	P
OCV (V)	16.46	16.45	Residual OCV %	99.94%		OCV (V)	16.47	16.45	Residual OCV %	99.88%	
Sample No.: 07	Before	After	Variation		Results	Sample No.: 08	Before	After	Variation		Results
Mass (g)	227.9	227.9	Mass loss %	0.00%	P	Mass (g)	227.1	227.1	Mass loss %	0.00%	P
OCV (V)	16.47	16.46	Residual OCV %	99.94%		OCV (V)	16.46	16.45	Residual OCV %	99.94%	

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T.4 Shock Ambient temp.: 22.9 ℃ Operator: Stephy

Sample No.: 01	Before	After	Variation		Results
Mass (g)	227.5	227.5	Mass loss %	0.00%	P
OCV (V)	16.45	16.45	Residual OCV %	100.00%	

Sample No.: 02	Before	After	Variation		Results
Mass (g)	227.0	227.0	Mass loss %	0.00%	P
OCV (V)	16.46	16.46	Residual OCV %	100.00%	

Sample No.: 03	Before	After	Variation		Results
Mass (g)	227.7	227.7	Mass loss %	0.00%	P
OCV (V)	16.46	16.46	Residual OCV %	100.00%	

Sample No.: 04	Before	After	Variation		Results
Mass (g)	227.3	227.3	Mass loss %	0.00%	P
OCV (V)	16.47	16.47	Residual OCV %	100.00%	

Sample No.: 05	Before	After	Variation		Results
Mass (g)	227.3	227.3	Mass loss %	0.00%	P
OCV (V)	16.45	16.45	Residual OCV %	100.00%	

Sample No.: 06	Before	After	Variation		Results
Mass (g)	227.9	227.9	Mass loss %	0.00%	P
OCV (V)	16.45	16.45	Residual OCV %	100.00%	

Sample No.: 07	Before	After	Variation		Results
Mass (g)	227.9	227.9	Mass loss %	0.00%	P
OCV (V)	16.46	16.46	Residual OCV %	100.00%	

Sample No.: 08	Before	After	Variation		Results
Mass (g)	227.1	227.1	Mass loss %	0.00%	P
OCV (V)	16.45	16.45	Residual OCV %	100.00%	

T.5 External Short Circuit Ambient temp.: 21.4 ℃ Operator: Stephy

	Sample No.: 01		Sample No.: 02		Sample No.: 03		Sample No.: 04		Sample No.: 05		Sample No.: 06		Sample No.: 07		Sample No.: 08	
Resistance (<100mΩ)	56.8		54.2		53.7		58.0		54.3		56.1		57.5		54.8	
OCV before test/ after short circuit(V)	16.45	0.00	16.46	0.00	16.46	0.00	16.47	0.00	16.45	0.00	16.45	0.00	16.46	0.00	16.45	0.00
Max Temp. (< 170℃)	55.3		55.6		55.5		55.4		55.3		55.6		55.5		55.2	
Results	P		P		P		P		P		P		P		P	

T.6 Impact / Crush (Component Cell) Ambient temp.: 21.3 ℃ Operator: Stephy

☐ Impact-Cylindrical cells greater than 20mm in diameter
■ Crush- Prismatic, pouch, coin/button cells and cylindrical cells not more than 20mm in diameter

	Sample No.: 01C	Sample No.: 02C	Sample No.: 03C	Sample No.: 04C	Sample No.: 05C
OCV before test(V)	3.61	3.62	3.61	3.61	3.62
Max Temp. (< 170℃)	23.1	28.4	21.4	24.0	43.1
Results	P	P	P	P	P

T.7 Overcharge Ambient temp.: 20.8 ℃ Operator: Stephy

	Sample No.: 09	Sample No.: 10	Sample No.: 11	Sample No.: 12	Sample No.: 13	Sample No.: 14	Sample No.: 15	Sample No.: 16
OCV before test(V)	16.71	16.70	16.71	16.71	16.71	16.72	16.71	16.69
Results	P	P	P	P	P	P	P	P

T.8 Forced Discharge (Component Cell) Ambient temp.: 21.0 ℃ Operator: Stephy

	Sample No.: 06C	Sample No.: 07C	Sample No.: 08C	Sample No.: 09C	Sample No.: 10C
OCV before test(V)	3.05	3.04	3.04	3.03	3.04
Results	P	P	P	P	P
	Sample No.: 11C	Sample No.: 12C	Sample No.: 13C	Sample No.: 14C	Sample No.: 15C
OCV before test(V)	3.04	3.05	3.05	3.03	3.04
Results	P	P	P	P	P
	Sample No.: 16C	Sample No.: 17C	Sample No.: 18C	Sample No.: 19C	Sample No.: 20C
OCV before test(V)	3.03	3.04	3.03	3.04	3.04
Results	P	P	P	P	P
	Sample No.: 21C	Sample No.: 22C	Sample No.: 23C	Sample No.: 24C	Sample No.: 25C
OCV before test(V)	3.03	3.03	3.04	3.04	3.05
Results	P	P	P	P	P

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7. Equipment for Test:

Pretest

T.1 Altitude Simulation

T.2 Thermal Test

T.3 Vibration

T.4 Shock

T.5 External Short Circuit

T.6 Impact / Crush

T.7 Overcharge

T.8 Forced Discharge

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