Battery Pack Test Report
(Package Drop & UN38.3)

Customer: Makita

Pack Model: BL1815N

Nominal voltage: 18V dc

Nominal capacity: 1.5Ah/27Wh

Configuration: 5S1P

Customer P/N: BL1815N

Celxpert P/N: 912900026

Cell Type: LG HB4 1500mAh

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Approved by

Reviewed by

Prepared by

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Figure photo of the pack.

1. Package Drop Test Report

Test Period	2013/09/06		Test Spec.	IATA A54 & QS-3Q-043	
Sample Level	Mass Production	Sample Mode	Finished Product	Quantity	2 PCS

1.1 DECSRIPTION OF TEST EQUIPMENTS

Kingdom Technology KD-128AS drop tester. Description of performance:

Payload capacity: 160 lbs. (72.6 kg)

Payload dimensions: Length: 61 cm / Width: 76 cm / Height: 90cm

Drop height range: 30 - 180 cm

Base Plate Material: Solid Steel (Std.)

Base Plate Size: 76.2×114.3×1.3cm

1.2 TEST CONDITION

Drop height: 120cm

Drop weight:1.102Kg

Drop position: One corner, three edges and three faces with 1 time. (Total: 7 drops).

Drop Position and sequence: Ref. attachment 1

1.3 SUMMARY OF TEST

Concluding the follow check items, the result of the test is **pass**.

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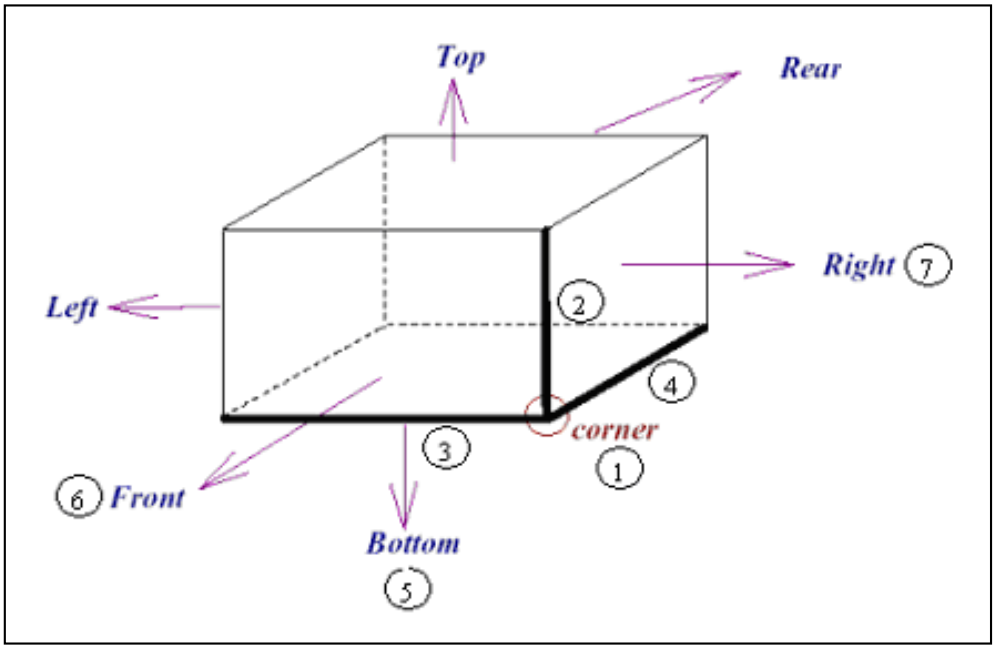
Check items	Before	After
Battery pack function	■Normal□ Fail	■Normal□ Fail
Battery pack appearance	■Normal□ Fail	■Normal□ Fail
Package internal status	■Normal□ Fail	■Normal□ Fail
Package outside status	■Normal□ Fail	■Normal□ Fail

Test photographs please refer to Attachment 2

Function Check details please refer to Attachment 3

Attachment 1:

DROP POSITION



DROP SEQUENCE

DROP	*IMPACT SURFACE*
1	Corner (2-3-4)
2	Edge 1 (2)
3	Edge 2 (3)
4	Edge 3 (4)
5	Bottom (Flat 5)
6	Front (Flat 6)
7	Right (Flat 7)

Attachment 2:

Drop Sequence	Test Setup	Test Result
1		
2		
3		
4		

Drop Sequence	Test Setup	Test Result
5		
6		
7		

Open Package check for internal after drop test

2. UN38.3 Test Report

Test Period	2013/09/16 ~2013/10/12		Test Spec.	ST/SG/AC.10/11/Rev.5	
Parts Name	Battery Pack	Application	NB	Quantity	16PCS

2.1 Test Summary

Item	Test Item	Test Result	Details
T1	Altitude simulation test (UN38.3-1)	Pass	Page 9
T2	Thermal test (UN38.3-2)	Pass	Page 10
T3	Vibration test (UN38.3-3)	Pass	Page 11
T4	Shock test (UN38.3-4)	Pass	Page 12
T5	Short Circuit test (UN38.3-5)	Pass	Page 13
T6	Impact Test (UN38.3-6)	Pass	Page 13
T7	Overcharge test (UN38.3-7)	Pass	Page 14

The battery pack passes UN38.3 test.

2.2 Test sample list

No.	Pack S/N	Test item	No.	Cell Num.	Test item
1	Sample No:1/16	38.3.1~5	1	LG HB4	38.3.6
2	Sample No:2/16	38.3.1~5	2	LG HB4	38.3.6
3	Sample No:3/16	38.3.1~5	3	LG HB4	38.3.6
4	Sample No:4/16	38.3.1~5	4	LG HB4	38.3.6
5	Sample No:5/16	38.3.1~5	5	LG HB4	38.3.6
6	Sample No:6/16	38.3.1~5			
7	Sample No:7/16	38.3.1~5			
8	Sample No:8/16	38.3.1~5			
9	Sample No:9/16	38.3.7			
10	Sample No:10/16	38.3.7			
11	Sample No:11/16	38.3.7			
12	Sample No:12/16	38.3.7			
13	Sample No:13/16	38.3.7			
14	Sample No:14/16	38.3.7			
15	Sample No:15/16	38.3.7			
16	Sample No:16/16	38.3.7			

2.3 Test result

Item	Test Item	Test specification	Judge criteria	Sample(s)
T1	Altitude Simulation (UN38.3-1)	1-1. 4 batteries are standard charged. 4 batteries are 1C cycled 50 times, ending in fully charged state. All batteries weight is measured. The charged batteries voltage are measured and recorded. 1-2. Batteries shall be stored at a pressure of 11.6Kpa or less for at least six hours at ambient temperature 20+/-5 ℃. 1-3. Vacuum is released. All cells weight is measured. The charged cell voltage are measured and recorded.	No mass loss (<0.1%), no leakage, no venting, no disassembly, no rupture and no fire. Battery voltage drop < 10%. Battery resistance change < ±10%.	4 packs are standard charged (Pack#1~4) 4 packs 50 cycled ending in fully charged states (Pack#5~8)
Test Period		Start: 2013/09/16 End: 2013/09/16		
Test Equipment		數位電表 Q153, 電子天平 Q090, 真空烘箱 Q146		
Major Problem		-		
Warning Point		-		
Recommendation		The battery packs pass the test.		

Raw Data

Altitude Simulation Test on Charged Packs

No.	Before			After			Difference			Result
	OCV (V)	Resistance(mΩ)	Weight (g)	OCV (V)	Resistance(mΩ)	Weight (g)	Volt (%)	Resistance(%)	Weight (%)	
1	20.9821	125.38	393.52	20.982	125.68	393.51	0.00%	0.24%	0.00%	Pass
2	20.9824	125.64	395.63	20.981	125.94	395.62	0.00%	0.24%	0.00%	Pass
3	20.9816	125.39	394.25	20.982	125.19	394.24	0.00%	-0.16%	0.00%	Pass
4	20.9831	125.41	396.87	20.979	125.91	396.86	-0.02%	0.40%	0.00%	Pass
5	20.9827	125.82	396.57	20.981	126.22	396.56	-0.01%	0.32%	0.00%	Pass
6	20.9826	125.54	396.69	20.980	126.04	396.68	-0.01%	0.40%	0.00%	Pass
7	20.9822	125.33	396.85	20.981	125.73	396.84	0.00%	0.32%	0.00%	Pass
8	20.9824	125.34	396.24	20.982	125.64	396.23	0.00%	0.24%	0.00%	Pass

Item	Test Item	Test specification	Judge criteria	Sample(s)
T2	Thermal test (UN38.3-2)	2-1. Packs are stored for 6 hours at 75±2℃, followed by storage for 6 hours at -40±2℃. The maximum time interval between test temperature extremes is 30 minutes. 2-2.Repeat 2-1 for 10 times. Then store the packs at ambient for 24 hours. All packs weight are measured. The charged battery voltage are measured and recorded.	No mass loss (<0.1%), no leakage, no venting, no disassembly, no rupture and no fire. Battery voltage drop < 10%. Battery resistance change < ±10%.	4 packs are standard charged (Pack#1~4) 4 packs 50 cycled ending in fully charged states (Pack#5~8)

Test Period	Start: 2013/09/17 End: 2013/09/25
Test Equipment	數位電表 Q153, 電子天平 Q090, 冷熱衝擊機 Q336
Major Problem	-
Warning Point	-
Recommendation	The packs pass the test.

Raw Data

Thermal Test on Charged Packs

No.	Before			After			Difference			Result
	OCV (V)	Resistance(mΩ)	Weight (g)	OCV (V)	Resistance(mΩ)	Weight (g)	Volt (%)	Resistance(%)	Weight (%)	
1	20.9821	125.68	393.51	20.913	126.18	393.41	-0.33%	0.40%	0.03%	Pass
2	20.9814	125.94	395.62	20.905	126.44	395.51	-0.36%	0.40%	0.03%	Pass
3	20.9821	125.19	394.24	20.907	125.59	394.13	-0.36%	0.32%	0.03%	Pass
4	20.9786	125.91	396.86	20.905	126.31	396.76	-0.35%	0.32%	0.03%	Pass
5	20.9807	126.22	396.56	20.910	126.82	396.46	-0.34%	0.48%	0.02%	Pass
6	20.9796	126.04	396.68	20.905	126.44	396.59	-0.36%	0.32%	0.02%	Pass
7	20.9812	125.73	396.84	20.913	126.33	396.75	-0.32%	0.48%	0.02%	Pass
8	20.9824	125.64	396.23	20.907	126.14	396.14	-0.36%	0.40%	0.02%	Pass

Item	Test Item	Test specification	Judge criteria	Sample(s)
T3	Vibration test (UN38.3-3)	3-1. Packs are firmly secured to the platform of the vibration machine without distorting the packs in such a manner as to faithfully transmit the vibration. The vibration shall be a sinusoidal waveform with a logarithmic sweep between 7 and 200 Hz and back to 7 Hz traversed in 15 minutes. This cycle shall be repeated 12 times for a total of 3 hours for each of 3 mutually perpendicular to the terminal face. 3-2. The logarithmic frequency sweep is as follows: 7-18 Hz ➔ 1gn 18-50 Hz ➔ 0.8mm amplitude 50-200 Hz ➔ 8gn 3-3. All packs weight are measured. The charged packs voltage are measured and recorded.	No mass loss (<0.1%), no leakage, no venting, no disassembly, no rupture and no fire. Battery voltage drop < 10%. Battery resistance change < ±10%	4 packs are standard charged (Pack#1~4) 4 packs 50 cycled ending in fully charged states (Pack#5~8)

Test Period	Start: 2013/09/26 End: 2013/09/28
Test Equipment	數位電表 Q153, 電子天平 Q090, 振動測試機 Q300
Major Problem	-
Warning Point	-
Recommendation	The packs pass the test.

Raw Data

Vibration Test on Charged Packs

No.	Before			After			Difference			Result
	OCV (V)	Resistance(mΩ)	Weight (g)	OCV (V)	Resistance(mΩ)	Weight (g)	Volt (%)	Resistance(%)	Weight (%)	
1	20.9131	126.18	393.41	20.906	126.78	393.38	-0.03%	0.48%	0.01%	Pass
2	20.9054	126.44	395.51	20.898	127.04	395.49	-0.03%	0.47%	0.01%	Pass
3	20.9071	125.59	394.13	20.899	126.09	394.11	-0.04%	0.40%	0.01%	Pass
4	20.9046	126.31	396.76	20.897	127.01	396.74	-0.04%	0.55%	0.01%	Pass
5	20.9097	126.82	396.46	20.902	127.52	396.44	-0.04%	0.55%	0.01%	Pass
6	20.9046	126.44	396.59	20.899	126.94	396.56	-0.03%	0.40%	0.01%	Pass
7	20.9132	126.33	396.75	20.904	126.73	396.72	-0.04%	0.32%	0.01%	Pass
8	20.9074	126.14	396.14	20.900	126.74	396.11	-0.03%	0.48%	0.01%	Pass

Item	Test Item	Test specification	Judge criteria	Sample(s)
T4	Shock test (UN38.3-4)	4-1. Packs shall be secured to the testing machine by means of a rigid mount, which will support all mounting surfaces. 4-2. Packs shall be subjected to a half-sine shock of peak acceleration 150gn and pulse duration of 6 milliseconds. Each pack shall be subjected to 3 shocks in the positive direction followed by three shocks in the negative direction of three mutually perpendicularly mounting positions of the pack for a total of 18 shocks. 4-3. All batteries weight are measured. The charged cell voltage are measured and recorded.	No mass loss (<0.1%), no leakage, no venting, no disassembly, no rupture and no fire. Battery voltage drop < 10%. Battery resistance change < ±10%.	4 packs are standard charged (Pack#1~4) 4 packs 50 cycled ending in fully charged states (Pack#5~8)

Test Period	Start: 2013/10/04 End: 2013/10/04
Test Equipment	數位電表 Q153, 電子天平 Q090,衝擊測試機 Q154
Major Problem	-
Warning Point	-
Recommendation	The packs pass the test.

Raw Data

Shock Test on Charged Packs

No.	Before			After			Difference			Result
	OCV (V)	Resistance(mΩ)	Weight (g)	OCV (V)	Resistance(mΩ)	Weight (g)	Volt (%)	Resistance(%)	Weight (%)	
1	20.9061	126.78	393.38	20.900	127.28	393.37	-0.03%	0.39%	0.00%	Pass
2	20.8984	127.04	395.49	20.893	127.54	395.48	-0.02%	0.39%	0.00%	Pass
3	20.8991	126.09	394.11	20.894	126.49	394.10	-0.02%	0.32%	0.00%	Pass
4	20.8966	127.01	396.74	20.891	127.31	396.73	-0.03%	0.24%	0.00%	Pass
5	20.9017	127.52	396.44	20.898	128.02	396.43	-0.02%	0.39%	0.00%	Pass
6	20.8986	126.94	396.56	20.892	127.34	396.56	-0.03%	0.32%	0.00%	Pass
7	20.9042	126.73	396.72	20.898	127.33	396.71	-0.03%	0.47%	0.00%	Pass
8	20.9004	126.74	396.11	20.895	127.24	396.11	-0.02%	0.39%	0.00%	Pass

Item	Test Item	Test specification	Judge criteria	Sample(s)
T5	Short Circuit Test (UN38.3-5)	5-1.Packs are placed in to a 55±2℃ oven, and exterior packs temperature are monitored 5-2.When packs exterior reach 55±2℃, they are shorted by connecting terminals with a copper wire of resistance less than 100m Ohm. 5-4. The short was continued for more than 1hour or the cell temperature return to 55℃. The packs are observed for a further 6 hours.	No rupture, no disassembly, no explosion, no fire, no smoke. Packs exterior peak temperature <170℃.	4 packs are standard charged (Pack#1~4) 4 packs 50 cycled ending in fully charged states (Pack#5~8)
Test Period	Start: 2013/10/08 End: 2013/10/10			
Test Equipment	數位電表 Q153, 資料收集器 Q078, 烘箱 Q171			
Recommendation	The packs pass the test.			

Raw Data

Short Circuit Test on Charged Packs

No.	Max. Temp.(℃)	Visual	Result
1	54.1	OK	Pass
2	52.5	OK	Pass
3	53.7	OK	Pass
4	54.3	OK	Pass
5	55.2	OK	Pass
6	52.6	OK	Pass
7	55.3	OK	Pass
8	55.4	OK	Pass

Item	Test Item	Test specification	Judge criteria	Sample(s)
T6	Impact test (UN38.3-6)	6-1. The test sample is to be placed on a flat surface. A 15.8mm diameter bar is to be placed across the center of the sample. A 9.1 Kg mass is to be dropped from a height of 61±2.5cm onto the sample. 6-2. A cylindrical or prismatic cell is to be impacted with its longitudinal axis parallel to the flat surface.	External temperature of cell does not exceed 170℃ and there is no disassembly and no fire within 6 hours of the test.	5 cells are 50% charged (Cell #1~5) For prismatic cell, The amount double
Test Period	Start: 2013/10/05 End: 2013/10/05			
Test Equipment	數位電表 Q153, 資料收集器 Q160, 撞擊試驗機 Q231			
Recommendation	The Cells pass the test.			

Raw Data

Impact Test on 50% Charged Cells

No.	Max. Temp.(℃)	Visual	Result
1	48.9	OK	Pass
2	51.2	OK	Pass
3	53.6	OK	Pass
4	39.4	OK	Pass
5	40.7	OK	Pass

Item	Test Item	Test specification	Judge criteria	Sample(s)
T7	Overcharge test (UN38.3-7)	7-1. The charge current shall be twice the Spec's recommended maximum continuous charge current. 7-2.The minimum voltage of the test shall be as follows: (a) When the Spec's recommended charge voltage is not more than 18V, the minimum voltage of the test shall be the lesser of two times the maximum charge voltage of the battery or 22V. (b) When the Spec's recommended charge voltage is more than 18V, the minimum voltage of the test shall be 1.2 times the maximum charge voltage. 7-3. Tests are to be conducted at ambient temperature. The duration of the test shall be 24 hours.	No disassembly, no fire within seven days of the test.	4 packs are fully charged (Pack#9~12) 4 packs are 50 times cycled ending in fully charged state (Pack #13~16)
Test Period		Start: 2013/10/07 End: 2013/10/12		
Test Equipment		數位電表 Q153, 資料收集器 Q160,電源供應器 Q236/Q237/Q147		
Major Problem		-		
Warning Point		-		
Recommendation		The packs pass the test.		

Raw Data

Overcharge Test on Charged Packs

No.	Charge Voltage(V)	Charge Current(A)	Max. Temp.(℃)	Visual	Result
9	22.0 V	4.0	22.2	OK	Pass
10			22.3	OK	Pass
11			23.6	OK	Pass
12			24.1	OK	Pass
13			21.9	OK	Pass
14			21.7	OK	Pass
15			22.4	OK	Pass
16			21.1	OK	Pass