

TEST REPORT

BL/0041/(1 – 8)/2023/16

Test Object/Product: Lithium Battery (non-rechargeable)
4.4Ah, 3.6V, 1S2P+HLC

Model: SL-760-S1P2+HLC-1020P6

	NAME / POSITION	SIGNATURE / STAMP
TEST RESULTS AUTHORIZED BY	Norbert Smoliński Test Engineer	<i>Norbert Smoliński</i> Test Engineer <i>[Signature]</i>
TEST REPORT VALIDATED BY	Roman Gozdur Laboratory Manager	<i>Roman Gozdur</i> Laboratory Manager <i>[Signature]</i>
Date of test report: 16 / 02 / 2024		Distribution list: 1 copy for Customer, 1 copy a/a



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6. Test summary (refers only to UN TESTS).

Test report no: BL/0041/(1-8)/2023/16

Order sign.: BL / 0041 / (1 – 8)

Revision no: 01

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GENERAL INFORMATION	
Tests Requested by	Document
Name: WESTERBERG Sp. z o.o. Address: Elektryków 4a Str. 43600PL Jaworzno, Poland	Order No: 0041/2023 Date of order: 27 / 12 / 2023
Manufacturer	
Name: WESTERBERG Sp. z o.o. Address: Elektryków 4a Str. 43600PL Jaworzno, Poland	
TESTED OBJECT / PRODUCT	
Name:	Lithium Battery (Non-rechargeable) 4.4Ah 3.6V 1S2P+HLC SL-760-S1P2+HLC-1020P6
Description / state:	Rated capacity: 4.4 Ah (the initial full-charge state) Rated voltage: 3.6 V
Sampling / sample delivery method:	Samples delivered by Manufacturer
Sample quantity:	8 pieces
Sample collection date: 27 / 12 /2023	Sample production date: 12 / 2023
Test initiation date: 31 / 01 / 2024	Test completion date: 14 / 02 / 2024
SCOPE AND METHODOLOGY	
Tests carried out according to: UN Recommendations on the Transport of Dangerous Goods. Test Manuals and Criteria: ST/SG/AC.10/11/Rev.7/Amend.1, Section 38.3, <i>Lithium-Metal and Lithium-Ion batteries</i> - (hereinafter referred to as UN TEST)	
SAMPLE IDENTIFICATION NUMBERS:	
Laboratory Identification Numbers (sample ID): BL / 0041 / (1 – 8/8)	
(Samples fully discharged in the BTO Lab.) BL/0041/(1–4/8)	(Initial state of charge of the delivered samples) BL/0041/(5–8/8)

Test Object



SCOPE OF TESTS

Item	Test Name	Test Procedure		Sample ID:	Page of report
1.	T1. Altitude simulation	A	UN TEST paragraph 38.3.4.1.2	BL/0041/(1-8/8)	4
2.	T2. Thermal test	A	UN TEST paragraph 38.3.4.2.2	BL/0041/(1-8/8)	5
3.	T3. Vibration	A	UN TEST paragraph 38.3.4.3.2	BL/0041/(1-8/8)	6
4.	T4. Shock	A	UN TEST paragraph 38.3.4.4.2	BL/0041/(1-8/8)	7
5.	T5. External short circuit	A	UN TEST paragraph 38.3.4.5.2	BL/0041/(1-8/8)	8

Samples assigned as BL / 0041 / (1-4/8) were fully discharged before the tests.

Samples assigned as BL / 0041 / (5-8/8) in the charge state as were delivered.

1. ALTITUDE SIMULATION

Test procedure (document): UN TEST paragraph 38.3.4.1.2 **Sample ID:** BL/0041/(1 - 8)

Test conditions: Pressure in the chamber: 11kPa; time: 6h; ambient temperature: 20±5°C

TEST RESULTS								
Sample ID	State	VOLTAGE [V]			MASS (g)			Sample observation
		Before testing	After testing	change OCV[%]	before testing	after testing	Change mass[%]	
BL/0041/ (1/8)	Discharged	3.556	3.576	0.56%	41.128	41.138	0.02%	O
BL/0041/ (2/8)	Discharged	3.549	3.588	1.10%	41.343	41.341	0.01%	O
BL/0041/ (3/8)	Discharged	3.618	3.657	1.07%	41.301	41.303	0.01%	O
BL/0041/ (4/8)	Discharged	3.523	3.573	1.42%	41.278	41.278	0.00%	O
BL/0041/ (5/8)	Fully-charged	3.673	3.671	0.07%	41.242	41.228	0.03%	O
BL/0041/ (6/8)	Fully-charged	3.670	3.670	0.00%	41.285	41.263	0.05%	O
BL/0041/ (7/8)	Fully-charged	3.651	3.650	0.03%	41.322	41.328	0.01%	O
BL/0041/ (8/8)	Fully-charged	3.702	3.702	0.00%	41.342	41.330	0.03%	O
Measurement uncertainty:		± 0.002 V			± 0.02 g			
Result:		PASS						

Term abbreviations: D - disassembly; F - fire; L - leakage; R - rupture; V - venting; SN - open circuit voltage after testing is not less than 90% of its voltage immediately prior the test

Acceptance criteria: O - none of the above phenomena were observed

Test equipment:	Attitude Simulation Test Chamber Model: BE-8104
	Voltmeter FLUKE 8845A
	Electronic balance RADWAG PS 200/2000.X2
NOTE: -	

2. THERMAL TEST

Test procedure (document): UN TEST paragraph 38.3.4.2.2

Sample ID: BL/0041/(1-8)

Test conditions: Storage at test temp. 72±2°C for 6h
Storage at test temp. - 40±2°C for 6h X 10 cycles

TEST RESULTS								
Sample ID	State	VOLTAGE [V]			MASS [g]			Sample observation
		before testing	after testing	change OCV[%]	before testing	after testing	change mass[%]	
BL/0041/(1/8)	Discharged	3.576	3.503	2.03%	41.138	41.151	0.03%	O
BL/0041/(2/8)	Discharged	3.588	3.557	0.86%	41.341	41.345	0.01%	O
BL/0041/(3/8)	Discharged	3.657	3.599	1.59%	41.303	41.307	0.01%	O
BL/0041/(4/8)	Discharged	3.573	3.550	0.66%	41.278	41.298	0.05%	O
BL/0041/(5/8)	Fully-charged	3.671	3.669	0.04%	41.208	41.213	0.01%	O
BL/0041/(6/8)	Fully-charged	3.670	3.669	0.01%	41.263	41.251	0.03%	O
BL/0041/(7/8)	Fully-charged	3.650	3.651	0.01%	41.328	41.341	0.03%	O
BL/0041/(8/8)	Fully-charged	3.702	3.699	0.07%	41.329	41.331	0.01%	O
Measurement uncertainty:		± 0.002 V			± 0.02g			
Result:		PASS						

Term abbreviations: **D** - disassembly; **F** - fire; **L** - leakage; **R** - rupture; **V** - venting; **SN** - open circuit voltage after testing is less than 90% of its voltage immediately prior the the test

Acceptance criteria: **O** - none of the above phenomena were observed

Test equipment:	Dynamic climate chamber DGBell BTT – 150D
	Thermometer Keithley DAQ6510+7708 TC K-type
	Voltmeter FLUKE 8845A
	Electronic balance RADWAG PS 200/2000.X2
NOTE: The OCV value after testing is not lower than 90% of its value immediately before the test.	

3. VIBRATIONS

Test procedure (document): UN TEST paragraph 38.3.4.3.2 Sample ID: BL/0041/(1 - 8)

Test conditions: Frequency: 7Hz↔ 200Hz / cycle time: 15 minutes / number of cycles: 12 cycles for each axis

TEST RESULTS								
Sample ID	State	VOLTAGE [V]			MASS [g]			Sample observation
		before testing	After testing	change OCV[%]	before testing	after testing	change mass[%]	
BL/0041/ (1/8)	Discharged	3.503	3.533	0.86%	41.151	41.137	0.03%	O
BL/0041/ (2/8)	Discharged	3.557	3.572	0.42%	41.345	41.345	0.00%	O
BL/0041/ (3/8)	Discharged	3.599	3.623	0.69%	41.307	41.310	0.01%	O
BL/0041/ (4/8)	Discharged	3.550	3.606	1.59%	41.304	41.304	0.00%	O
BL/0041/ (5/8)	Fully-charged	3.669	3.671	0.06%	41.213	41.218	0.01%	O
BL/0041/ (6/8)	Fully-charged	3.669	3.681	0.33%	41.251	41.248	0.01%	O
BL/0041/ (7/8)	Fully-charged	3.651	3.685	0.94%	41.341	41.327	0.03%	O
BL/0041/ (8/8)	Fully-charged	3.699	3.719	0.54%	41.331	41.318	0.03%	O
Measurement uncertainty:		± 0.002 V			± 0.02 g			
Result:	PASS							

Term abbreviations: **D** - disassembly; **F** - fire; **L** - leakage; **R** - rupture; **V** - venting; **SN** - the open circuit voltage after testing is less than 90% of its voltage immediately prior the test

Acceptance criteria: **O** - none of the above phenomena were observed

Test equipment:	Vibration tester DGBell EV210VT650
	Voltmeter FLUKE 8845A
	Electronic balance RADWAG PS 200/2000.X2
NOTE: -	

4. SHOCK

Test procedure (document): UN TEST paragraph 38.3.4.4.2 **Sample ID:** BL/0041/(1-8)

Test conditions: Peak acceleration: 150G; pulse duration: 6 ms; 3 shocks for each axis and each direction; total: 18 shocks

TEST RESULTS								
Sample ID	State	VOLTAGE [V]			MASS [g]			Sample observation
		before testing	after testing	change OCV[%]	before testing	after testing	change mass[%]	
BL/0041/(1/8)	Discharged	3.533	3.523	0.30%	41.137	41.139	0.00%	O
BL/0041/(2/8)	Discharged	3.572	3.533	1.10%	41.345	41.337	0.02%	O
BL/0041/(3/8)	Discharged	3.623	3.601	0.62%	41.310	41.304	0.01%	O
BL/0041/(4/8)	Discharged	3.606	3.617	0.31%	41.298	41.301	0.01%	O
BL/0041/(5/8)	Fully-charged	3.671	3.670	0.03%	41.218	41.215	0.01%	O
BL/0041/(6/8)	Fully-charged	3.681	3.682	0.01%	41.248	41.251	0.01%	O
BL/0041/(7/8)	Fully-charged	3.685	3.688	0.09%	41.327	41.321	0.01%	O
BL/0041/(8/8)	Fully-charged	3.719	3.717	0.04%	41.318	41.326	0.02%	O
Measurement uncertainty:		± 0.002 V			± 0.02 g			
Result:		PASS						

Term abbreviations: D - disassembly; F - fire; L - leakage; R - rupture; V - venting; SN - open circuit voltage after testing is less than 90% of voltage immediately prior the test

Acceptance criteria: O - None of the above phenomena were observed

Test equipment:	Shock Tester DGBell SKT50
	Voltmeter FLUKE 8845A
	Electronic balance RADWAG PS 200/2000.X2
NOTE: -	

5. EXTERNAL SHORT CIRCUIT

Test procedure (document): UN TEST paragraph 38.3.4.5.2

Sample ID: BL/0041/(1-8)

Test conditions: Heating time t = 6h; temperature: 57±4°C

External resistance < 0.1Ω; short circuit duration t_{sc} = 1h

TEST RESULTS				
Sample ID	State	Temp. of external case after heating [°C]	Max. temp. of external case during test [°C]	Observation of the sample within 6h
BL/0041/ (1/8)	Discharged	57.3	58.8	O
BL/0041/ (2/8)	Discharged	56.3	58.4	O
BL/0041/ (3/8)	Discharged	56.8	59.0	O
BL/0041/ (4/8)	Discharged	56.2	59.1	O
BL/0041/ (5/8)	Fully-charged	55.5	69.9	O
BL/0041/ (6/8)	Fully-charged	57.4	71.7	O
BL/0041/ (7/8)	Fully-charged	56.4	71.1	O
BL/0041/ (8/8)	Fully-charged	56.8	74.4	O
Measurement uncertainty:		± 1.5°C		
Result:		PASS		

Term abbreviations: D - disassembly; R - rupture; F - fire; T - temperature >170°C

Acceptance criteria: O - None of the above phenomena were observed during the test and within 6 h after the test.

Test equipment:	Temperature chamber and short-circuit tester BE-8102
	MicroOhm Meter Keithley 6220+2182A, Voltmeter FLUKE 8845A
	Electronic thermometer Keithley DAQ6510+7708 TC K-type probes
NOTE: -	

- END OF TEST REPORT -



BTO Sp. z o.o.
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TEST SUMMARY

Product name: Lithium Battery (non-rechargeable)
 Model/type/Configuration: SL-760-S1P2+HLC-1020P6 (1S2P+HLC)
 Rated parameters: 3.6 V; 4.4 Ah; 41 g;
 Tests Requested by: Westerberg Sp. z o.o. Elektryków 4a Str.; 43600PL Jaworzno; Poland
 Manufacturer: Westerberg Sp. z o.o. Elektryków 4a Str.; 43600PL Jaworzno; Poland

Based on the following test results:

UN TEST ID	TEST NAME	RESULT, CONFIRMATION OF CONFORMITY
38.3.4.1.2	T.1 Altitude simulation	Passed
38.3.4.2.2	T.2 Thermal test	Passed
38.3.4.3.2	T.3 Vibration	Passed
38.3.4.4.2	T.4 Shock	Passed
38.3.4.5.2	T.5 External short circuit	Passed
38.3.4.6.2	T.6a Impact	not applicable
38.3.4.6.3	T.6b Crush	not applicable
38.3.4.7.2	T.7 Overcharge	not applicable
38.3.4.8.2	T.8 Forced discharge	not applicable

Test results terms: passed / failed / not applicable (not required or not included in the order)

It is hereby confirmed that the Product, Test Object of this series of tests, and mentioned in the title, meets the requirements of:

UN Recommendations on the Transport Of Dangerous Goods; Manual of Tests and Criteria ST/SG/AC.10/11/Rev.7/Amend.1, Lithium Metal and Lithium Ion batteries (Section 38.3) with the exception of paragraphs 38.3.4.6.2, 38.3.4.6.3, 38.3.4.7.2, 38.3.4.8.2.

Norbert Smoliński
 Test Engineer
 Test Engineer

Eng. Norbert Smoliński



Roman Gozdur
 Laboratory Manager

Laboratory Manager

PhD Eng. Roman Gozdur

Place and date of issue: Łódź, February 16th, 2024