



CHEMICAL POWER SOURCES TESTING LABORATORY

TEST REPORT

№ S 80/2019/1

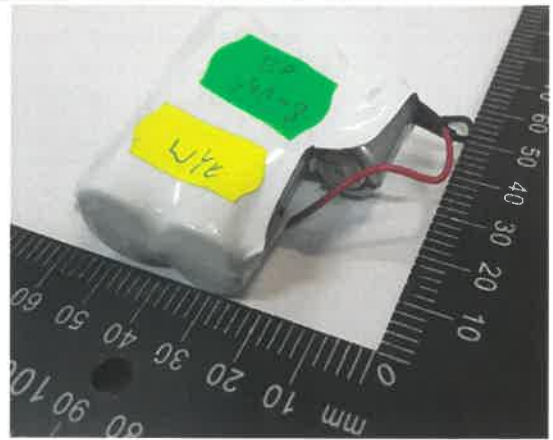
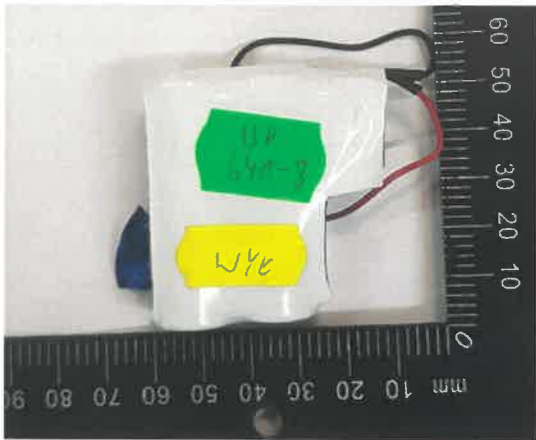
Test object/product: Lithium-thionyl chloride battery pack (primary)

	NAME/POSITION	SIGNATURE/STAMP
TEST RESULTS AUTHORIZED BY	Marek Szymczyk Technician Supervising Tests	Laboratorium Badań Chemicznych Źródeł Prądu TECHNIK NADZORUJĄCY BADAŃIA
TEST REPORT VALIDATED BY	Jędrzej Kałużny Vice-manager	KIEROWNIK Laboratorium Badań Chemicznych Źródeł Prądu W. Z. Jędrzej Kałużny mgr Kamil Frączek
Date of test report: 04/11/2019		Distribution list: 1 copy for Client, 1 copy a/a



1. This test report presents results of accredited tests covered by the scope of Laboratory's accreditation and the not-accredited ones or performed by a subcontractor.
2. Acronyms:
A – accredited test covered by the scope of Laboratory's Accreditation No PCA AB 124, NA – non-accredited test.
3. Chemical Power Sources Testing Laboratory is accredited by Polish Centre for Accreditation, a signatory of EA MLA and ILAC MRA. Accreditation № AB 124.
4. Test results refer only to the tested sample.
5. This test report cannot be reproduced without Laboratory's written consent.
6. Client is entitled to submit his claims up to 14 days after reception of this test report.
7. Test report with no accreditation marking means that all tests therein are non-accredited.
8. Annexe: Test summary (refers only to UN TESTS).

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GENERAL INFORMATION			
CLIENT/MANUFACTURER		DOCUMENT	
Name: WESTERBERG Sp. z o.o. Address: Elektryków 4a, 43-603 Jaworzno		Order / agreement №: 80/2019 date: 11/10/2019	
TESTED OBJECT / PRODUCT			
Name:	Lithium-thionyl chloride battery pack (primary) SCA04+HLC Pack 2 LS17500 + 1 x HLC1520		
Description / state:	Rated capacity: 7,239 Ah Rated voltage: 3,67 V		
Sampling / sample delivery method:	Sample was delivered by the Client		
Sample size:	8 pieces		
Sample collection date: 14.10.2019		Sample production date: -	
Test initiation date: 14.10.2019		Test completion date: 31.10.2019	
SCOPE AND METHODOLOGY			
Tests carried out according to: Recommendations on the Transport Of Dangerous Goods Manual of Tests and Criteria ST/SG/AC.10/11/Rev.6/Amend.1, Section 38.3 Lithium metal and lithium ion batteries (hereinafter referred to as UN TEST)			
SAMPLE IDENTIFICATION NUMBERS			
Laboratory identification numbers (sample ID): BP 64 – (1÷8)			
(undischarged state) BP 640-(1÷4)		(fully discharged at the laboratory) BP 640-(5÷8)	



TEST PROGRAMME

Item	Test name		Methodology	Sample ID:	Page of report
1.	T1. Altitude simulation	A	UN TEST paragraph 38.3.4.1.2 / LPB-08	BP 640-1+8	4
2.	T2. Thermal test	A	UN TEST paragraph 38.3.4.2.2/ LPB-08	BP 640-1+8	5
3.	T3. Vibration	NA	UN TEST paragraph 38.3.4.3.2/ LPB-AO-18	BP 640-1+8	6
4.	T4. Shock	NA	UN TEST paragraph 38.3.4.4.2/ LPB-BP -12	BP 640-1+8	7
5.	T5. External short circuit	A	UN TEST paragraph 38.3.4.5.2/ LPB-09	BP 640-1+8	8

The batteries BP 640-(5+8) were discharged:

- constant current intensity: $I_{const} = 0,1 \text{ A}$
- final voltage: $U = 2,5 \text{ V}$

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T.1 ALTITUDE SIMULATION

Test procedure (document): UN TEST paragraph 38.3.4.1.2 **Sample ID:** BP 640-(1÷8)

Test conditions: pressure in the chamber 11kPa/ time t ≥ 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 [%]	
BP 640-1	undischarged	3,661	3,660	99,97	56,0	56,0	0,00	O
BP 640-2	undischarged	3,665	3,663	99,95	56,0	56,0	0,00	O
BP 640-3	undischarged	3,666	3,665	99,97	55,9	55,9	0,00	O
BP 640-4	undischarged	3,665	3,664	99,97	55,9	55,9	0,00	O
BP 640-5	fully discharged	----	----	----	56,1	56,1	0,00	O
BP 640-6	fully discharged	----	----	----	56,1	56,1	0,00	O
BP 640-7	fully discharged	----	----	----	56,0	56,0	0,00	O
BP 640-8	fully discharged	----	----	----	56,0	56,0	0,00	O
Measurement uncertainty:		± 0,001 V			± 0,1 g			
Result:		PASS						

Description phenomenon: **D** – disassembly; **F** – fire; **L** – leakage; **R** – rupture; **V** – venting; **SN** – the 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:	ATT TD150C vacuum chamber
	METRAHIT X-TRA multimeter
	SARTORIUS PT600 balance

NOTE: No deviation from LPB-08 procedure was employed.

T.2 THERMAL TEST

Test procedure (document): UN TEST paragraph 38.3.4.2.2 **Sample ID:** BP 640-(1÷8)

Test conditions: storage at a test temp. 72±2°C for t ≥ 6h / storage at a test temp. - 40±2°C for t ≥ 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 [%]	
BP 640-1	undischarged	3,660	3,658	99,95	56,0	56,0	0,00	O
BP 640-2	undischarged	3,663	3,662	99,97	56,0	56,0	0,00	O
BP 640-3	undischarged	3,665	3,664	99,97	55,9	55,9	0,00	O
BP 640-4	undischarged	3,664	3,663	99,97	55,9	55,9	0,00	O
BP 640-5	fully discharged	----	----	----	56,1	56,1	0,00	O
BP 640-6	fully discharged	----	----	----	56,1	56,1	0,00	O
BP 640-7	fully discharged	----	----	----	56,0	56,0	0,00	O
BP 640-8	fully discharged	----	----	----	56,0	56,0	0,00	O
Measurement uncertainty:		± 0,001 V			± 0,1 g			
Result:		PASS						

Description phenomenon: D – disassembly; F – fire; L – leakage; R – rupture; V – venting; SN – the 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:	ATT TD150C climatic chamber
	METRAHIT X-TRA multimeter
	SARTORIUS PT600 balance

NOTE: No deviation from LPB-08 procedure was employed.

T.3 VIBRATION

Test procedure (document): UN TEST paragraph 38.3.4.3.2 **Sample ID:** BP 640-(1÷8)

Test conditions: frequency 7Hz ÷ 200Hz ÷ 7Hz/ cycle time 15 minute/ 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 [%]	
BP 640-1	undischarged	3,658	3,660	100,05	56,0	56,0	0,00	O
BP 640-2	undischarged	3,662	3,663	100,03	56,0	56,0	0,00	O
BP 640-3	undischarged	3,664	3,664	100,00	55,9	55,9	0,00	O
BP 640-4	undischarged	3,663	3,664	100,03	55,9	55,9	0,00	O
BP 640-5	fully discharged	----	----	----	56,1	56,1	0,00	O
BP 640-6	fully discharged	----	----	----	56,1	56,1	0,00	O
BP 640-7	fully discharged	----	----	----	56,0	56,0	0,00	O
BP 640-8	fully discharged	----	----	----	56,0	56,0	0,00	O
Measurement uncertainty:		± 0,001 V			± 0,1 g			
Result:		PASS						

Description phenomenon: **D** – disassembly; **F** – fire; **L** – leakage; **R** – rupture; **V** – venting; **SN** – the 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:	TIRA
	METRAHIT X-TRA multimeter
	SARTORIUS PT600 balance
NOTE: No deviation from LPB-AO-18 procedure was employed.	

T.4 SHOCK

Test procedure (document): UN TEST paragraph 38.3.4.4.2

Sample ID: BP 640-(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 [%]	
BP 640-1	undischarged	3,660	3,660	100,00	56,0	56,0	0,00	O
BP 640-2	undischarged	3,663	3,664	100,03	56,0	56,0	0,00	O
BP 640-3	undischarged	3,664	3,664	100,00	55,9	55,9	0,00	O
BP 640-4	undischarged	3,664	3,665	100,00	55,9	55,9	0,00	O
BP 640-5	fully discharged	----	----	----	56,1	56,1	0,00	O
BP 640-6	fully discharged	----	----	----	56,1	56,1	0,00	O
BP 640-7	fully discharged	----	----	----	56,0	56,0	0,00	O
BP 640-8	fully discharged	----	----	----	56,0	56,0	0,00	O
Measurement uncertainty:		± 0,001 V			± 0,1 g			
Result:		PASS						

Description phenomenon: D – disassembly; F – fire; L – leakage; R – rupture; V – venting; SN – the 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:	TIRA
	METRAHIT X-TRA multimeter
	SARTORIUS PT600 balance
NOTE: No deviation from LPB-BP -12 procedure was employed.	

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T.5 EXTERNAL SHORT CIRCUIT

Test procedure (document): UN TEST paragraph 38.3.4.5.2 (1+8) **Sample ID: BP 640 -**

Test conditions: heating time $t \geq 6h$ / temperature $57 \pm 4^\circ C$ / external resistance $< 0,1\Omega$ / short circuit duration $t_z \geq 1h$

TEST RESULTS				
Sample ID	State	Temp. of external case after heating [°C]	Max. temp. of external case during test [°C]	Observation of the sample after 6h
BP 640-1	undischarged	57,4	79,8	O
BP 640-2	undischarged	58,9	82,9	O
BP 640-3	undischarged	59,2	83,3	O
BP 640-4	undischarged	57,2	85,0	O
BP 640-5	fully discharged	56,0	66,0	O
BP 640-6	fully discharged	56,8	64,8	O
BP 640-7	fully discharged	56,3	65,8	O
BP 640-8	fully discharged	56,5	62,0	O
Measurement uncertainty:		$\pm 0,2^\circ C$		
Result:		PASS		

Description phenomenon: **D** – disassembly; **R** – rupture; **F** – fire; **T** - temperature $>170^\circ C$

Acceptance criteria: **O** – none of the above phenomena were observed during the test and within 6 h after the test

Test equipment:	MSK-TE901-UL device to short-circuit tests
	Temperature chamber
	Hioki resistance tester
	Electronic thermometer

NOTE: No deviation from LPB-09 procedure was employed.

END OF TEST REPORT

TEST SUMMARY

Product: **LITHIUM-THIONYL CHLORIDE BATTERY PACK (PRIMARY)**

Model №: **SCA04+HLC Pack**

Product description: **SCA04+HLC Pack 2 LS17500 + 1 x HLC1520**

Mass: **56,5 g** Nominal energy: **26,567 Wh**

Manufacturer (name, address): **WESTERBERG Sp. z o.o.**

Elektryków 4a, 43-603 Jaworzno

Based on the following test results:

UN TEST PARAGRAPH	TEST NAME	RESULT/CONFIRMATION OF CONFORMITY ¹⁾
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

¹⁾ according to Test Report № S 80/2019/1
result: passed/failed/not applicable (not required or not included in the order)

it is confirmed that the product met requirements of:

Recommendations on the Transport Of Dangerous Goods Manual of Tests and Criteria ST/SG/AC.10/11/Rev.6/Amend.1, Lithium metal and lithium ion batteries (Section 38.3) except paragraph 38.3.4.6.2, 38.3.4.6.3, 38.3.4.7.2, 38.3.4.8.2.

Technician supervising test


Marek Szymczyk



Laboratory Manager


mgr inż. Jędrzej Kałużny

Poznań, 04.11.2019