JUNG Battery-powered Machine Skates
Powered by non-flammable Lithium-Ion Batteries

Will NOT burn or explode
due to

- External damage
- Internal damage
- Overcharging
- Dropping / shock
- Short circuit
- Heat/cold
- Vibration
- Transport

Engineered for Safety

Battery Technology
Made in Germany

Łukasiewicz Research Network – Institute of
Non-Ferrous Metals Division in Poznań,
ul. Forteczna 12, 61-362 Poznań, Poland
www.claio.poznan.pl

AB 124

CHEMICAL POWER SOURCES TESTING LABORATORY

TEST REPORT

№ S 44/2024/1

Test object/product: rechargeable lithium battery

	NAME/POSITION	SIGNATURE/STAMP
TEST RESULTS AUTHORIZED BY	Jędrzej Kałużny *Technician Supervising Tests*	Laboratorium Badań Chemicznych Źródeł Prądu TECHNIK NADZORUJĄCY BADANIA
TEST REPORT VALIDATED BY	Kamil Frączek *Laboratory Manager*	KIEROWNIK Laboratorium Badań Chemicznych Źródeł Prądu mgr Kamil Frączek
Date of test report: 15/07/2024		Distribution list: 1 copy for Client, 1 copy a/a

Statement:

1. *Information on the method used:*
   ***A/NA** – accredited test / non-accredited test*
   ***A/NA (P)** – accredited test / non-accredited test, performed by a subcontractor.*
2. *Chemical Power Sources Testing Laboratory is accredited by Polish Centre for Accreditation testing laboratory, a signatory of EA MLA and ILAC MRA, confirming compliance with the requirements of PN-EN ISO / IEC 17025. Accreditation № AB 124.*
3. *The test results refer only to the obtained / tested sample.*
4. *This test report cannot be reproduced without Laboratory's written consent.*
5. *Client is entitled to submit his claims up to 14 days after reception of this test report.*
6. *The accreditation stamp is placed on the test report, if at least one test is accredited.*
7. *Annex: Certificate (applies only to UN TEST tests).*

Contact: LABORATORY MANAGER
Tel. (+48) 61 2797 882/ Mobile +48 516 068 981/ Email: kamil.fraczek@imn.lukasiewicz.gov.pl.pl

GENERAL INFORMATION

CLIENT / MANUFACTURER	DOCUMENT
Name: **RKB-REITZ electronic AG** Address: Otto-Hahn-Str. 19 D-75248 Ölbronn-Dürrn, Germany Website: www.rkb-ag.de Email: info@rkb-reitz.de Telephone: +49 (0) 7237/48634-0	Order / agreement №: 44/2024 date: 19/04/2024

TESTED OBJECT / PRODUCT

Name:	**RECHARGEABLE LITHIUM BATTERY:** **LFP rechargeable Battery** **Model: RKB-BAT-LF16S50Ah LiFePo4 Battery**
Description / state:	Nominal voltage: 51,20 V Nominal capacity: 50 Ah Nominal energy: 2560 Wh
Sampling / sample delivery method:	Sample was delivered by the Client
Sample size:	4 pieces

Sample collection date: 18.04.2024	Sample production date: ---
Test initiation date: 18.04.2024	Test completion date: 14.07.2024

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.7/Amend.1, Section 38.3 Lithium metal and lithium ion batteries (hereinafter referred to as UN TEST)

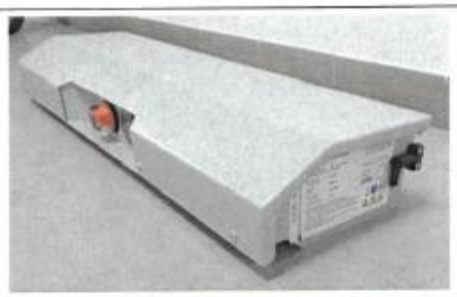
STATING OF COMPLIANCE WITH A SPECIFICATION OR REQUIREMENT

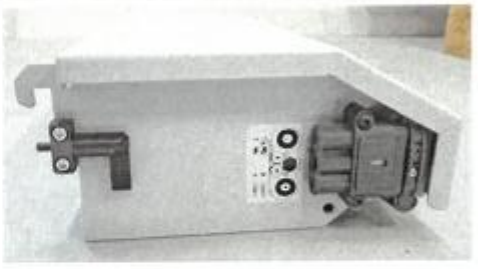
YES / acc. the principle of "simple acceptance"
UN TEST

SAMPLE IDENTIFICATION NUMBERS

Laboratory identification numbers (sample ID): AZ 036 – (01÷04)

(at 1st cycle)	(after 25 cycles performed at the Client)
AZ 036-(01÷02)	**AZ 036-(03÷04)**



TEST PROGRAMME

Test name	Methodology			Sample ID:
	Document number	Test point	A/NA	
T.1 Altitude simulation	UN 38.3, rev.7/amend.1	38.3.4.1	**A**	AZ 036-01÷04
T.2 Thermal test	UN 38.3, rev.7/amend.1	38.3.4.2	**A**	AZ 036-01÷04
T.3 Vibration	UN 38.3, rev.7/amend.1	38.3.4.3	**NA**	AZ 036-01÷04
T.4 Shock	UN 38.3, rev.7/amend.1	38.3.4.4	**NA**	AZ 036-01÷04
T.5 External short circuit	UN 38.3, rev.7/amend.1	38.3.4.5	**A**	AZ 036-01÷04
T.7 Overcharge	UN 38.3, rev.7/amend.1	38.3.4.7	**A**	AZ 036-01÷04

Method: A - accredited / NA - non-accredited

Before the test, the batteries AZ 036-(01÷04) were fully charged

T.1 ALTITUDE SIMULATION (A)

Test procedure *(document)*: UN TEST point 38.3.4.1 **Sample ID:** AZ 036-(01÷04)

Test conditions: pressure in the chamber 11kPa/ time t ≥ 6h/ ambient temperature 20±5°C

TEST RESULTS

Sample ID	Fully charged state	VOLTAGE [V]			MASS [g]			Sample observation
		before testing	after testing	change OCV [%]	before testing	after testing	change mass [%]	
AZ 036-01	at 1st cycle	53,48	53,47	99,98	37774,0	37774,0	0,00	**O**
AZ 036-02	at 1st cycle	54,21	54,21	100,00	37786,0	37786,0	0,00	**O**
AZ 036-03	after 25 cycles	54,97	54,97	100,00	37836,0	37836,0	0,00	**O**
AZ 036-04	after 25 cycles	54,79	54,78	99,98	37826,0	37826,0	0,00	**O**
Measurement uncertainty:		± 0,01 V			± 3 g			
Result:		**PASS**						

Description phenomenon: 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
M – mass loss limit of cell or battery M ≥ 75g: more then 0,1%
Acceptance criteria: O – none of above phenomena were observed

Test equipment:	ATT TD150C vacuum chamber
	Pressure and temperature recorder
	METRAHIT X-TRA multimeter
	RADWAG WLC 120/C2/R
	Timer with alarm

T.2 THERMAL TEST (A)

Test procedure *(document)*: UN TEST point 38.3.4.2 **Sample ID:** AZ 036-(01÷04)

Test conditions: storage at a test temp. 72±2°C for t ≥ 12h / storage at a test temp. - 40±2°C for t ≥ 12h/ x 10 cycles

TEST RESULTS

Sample ID	Fully charged state	VOLTAGE [V]			MASS [g]			Sample observation
		before testing	after testing	change OCV [%]	before testing	after testing	change mass [%]	
AZ 036-01	at 1st cycle	53,27	53,28	100,02	37940,0	37912,0	0,07	**O**
AZ 036-02	at 1st cycle	53,30	53,21	99,83	37922,0	37924,0	0,01	**O**
AZ 036-03	after 25 cycles	53,26	53,21	99,91	37994,0	37978,0	0,04	**O**
AZ 036-04	after 25 cycles	53,27	53,19	99,85	37998,0	37980,0	0,05	**O**
Measurement uncertainty:		± 0,01 V			± 3 g			
Result:		**PASS**						

Description phenomenon: **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
M – mass loss limit of cell or battery M ≥ 75g: more then 0,1%
Acceptance criteria: **O** – none of above phenomena were observed

Test equipment:	ATT TD150C climatic chamber
	METRAHIT X-TRA multimeter
	RADWAG WLC 120/C2/R
	Pressure and temperature recorder
	Timer with alarm

T.3 VIBRATION (NA)

Test procedure *(document)*: UN TEST point 38.3.4.3 **Sample ID:** AZ 036-(01÷04)

Test conditions:

Frequency range [Hz]		Amplitudes	Duration of logarithmic sweep cycle (7 Hz – 200 Hz – 7Hz)	Axis	Number of cycles
from	to				
7	17,62	1 g_n	15 min	X	12
17,62	24,92	0,8 mm		Y	12
24,92	200	2 g_n		Z	12
And back to 7 Hz				Total	36

TEST RESULTS

Sample ID	Fully charged state	VOLTAGE [V]			MASS [g]			Sample observation
		before testing	after testing	change OCV [%]	before testing	after testing	change mass [%]	
AZ 036-01	at 1st cycle	53,28	53,29	100,02	37912,0	37914,0	0,01	**O**
AZ 036-02	at 1st cycle	53,21	53,23	100,04	37924,0	37926,0	0,01	**O**
AZ 036-03	after 25 cycles	53,21	53,22	100,02	37978,0	37984,0	0,02	**O**
AZ 036-04	after 25 cycles	53,19	53,21	100,04	37980,0	37988,0	0,02	**O**
Measurement uncertainty:		± 0,01 V			± 3 g			
Result:		**PASS**						

Description phenomenon: 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
M – mass loss limit of cell or battery M ≥ 75g: more then 0,1%
Acceptance criteria: O – none of above phenomena were observed

Test equipment:	TIRA vibration test system
	SVAN 956 vibration meter
	METRAHIT X-TRA multimeter
	RADWAG WLC 120/C2/R
	Timer with alarm

T.4 SHOCK (NA)

Test procedure *(document)*: UN TEST point 38.3.4.4 **Sample ID:** AZ 036-(01÷04)

Test conditions: peak acceleration 28,1g / pulse duration 11ms / 3 shocks for each axis and each direction/ total 18 shocks

TEST RESULTS

Sample ID	Fully charged state	VOLTAGE [V]			MASS [g]			Sample observation
		before testing	after testing	change OCV [%]	before testing	after testing	change mass [%]	
AZ 036-01	at 1st cycle	53,29	53,29	100,00	37914,0	37914,0	0,00	**O**
AZ 036-02	at 1st cycle	53,23	53,23	100,00	37926,0	37926,0	0,0	**O**
AZ 036-03	after 25 cycles	53,21	53,21	100,00	37984,0	37984,0	0,00	**O**
AZ 036-04	after 25 cycles	53,21	53,21	100,00	37988,0	37988,0	0,00	**O**
Measurement uncertainty:		± 0,01 V			± 3 g			
Result:		**PASS**						

Description phenomenon: 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
M – mass loss limit of cell or battery ≥ 75g: more then 0,1%
Acceptance criteria: O – none of above phenomena were observed

Test equipment:	Impact machine
	Accelerometer
	METRAHIT X-TRA multimeter
	RADWAG WLC 120/C2/R

T.5 EXTERNAL SHORT CIRCUIT (A)

Test procedure *(document)*: UN TEST point 38.3.4.5 **Sample ID:** AZ 036-(01÷04)

Test conditions: heating time t ≥ 12h/ temperature 57±4°C/ external resistance 5,21mΩ/ short circuit duration t_z ≥ 1h

TEST RESULTS				
Sample ID	Fully charged state	Temp. of external case after heating [°C]	Max. temp. of external case during test [°C]	Observation of the sample after **6h**
AZ 036-01	at 1st cycle	53,4	57,1	**O**
AZ 036-02	at 1st cycle	56,9	57,2	**O**
AZ 036-03	after 25 cycles	57,0	58,4	**O**
AZ 036-04	after 25 cycles	57,1	58,7	**O**
Measurement uncertainty:		± 0,1°C		
Result:		**PASS**		

Description phenomenon: **D** – disassembly; **R** – rupture; **F** – fire; **T** - temperature >170°C
Acceptance criteria: **O** – none of above phenomena were observed during the test and within 6 h after the test

Test equipment:	Climatic chamber
	Device to short-circuit tests
	Resistance meters
	Digital thermometer
	Timer with alarm

T.7 OVERCHARGE (A)

Test procedure *(document)*: UN TEST paragraph 38.3.4.7 **Sample ID:** AZ 036-(01÷04)

Test conditions: test duration 24h/ ambient temperature 20±5°C/ if charge voltage > 18V, min. test voltage is 1,2 x max. charge voltage/ charge current = 2x max. charge current recommended by the manufacturer

TEST RESULTS

Charge current $I_t \leq$ 100,00 A			Voltage U_{const} = 69,12 V
Sample ID	Fully charged state	Sample observation	
AZ 036-01	at 1st cycle	O	
AZ 036-02	at 1st cycle	O	
AZ 036-03	after 25 cycles	O	
AZ 036-04	after 25 cycles	O	
Result:		PASS	

Description phenomenon: **D** – disassembly; **F** – fire
Acceptance criteria: **O** – none of above phenomena were observed during the test and within 7 days after the test

Test equipment:	DIGATRON tester
	Timer with alarm

The form of presenting the test results depends on the test method used, the type of tests carried out or the Customer's specification, while maintaining the formal requirements of the ISO/IEC 17025:2018-02 standard.

END OF TEST REPORT

Łukasiewicz Research Network – Institute of Non-Ferrous Metals
Division in Poznań, ul. Forteczna 12, 61-362 Poznań, Poland
tel. (+48) 61 27 97 882/www.claio.poznan.pl

Łukasiewicz
IMN

TEST SUMMARY

Product: **LITHIUM RECHARGEABLE BATTERY**		
Model №: **RKB-BAT-LF16S50Ah LiFePo4 Battery**		
Product description: **LFP rechargeable Battery**		
Mass: **37998 g**		Nominal energy: **2560 Wh**
Manufacturer: *(name, address)*	**RKB-REITZ electronic AG; Otto-Hahn-Str. 19 D-75248 Ölbronn-Dürrn, Germany**	
Website: **www.rkb-ag.de**		
Email: **info@rkb-reitz.de**		Telephone: **+49 (0) 7237/48634-0**

Based on the following test results:

UN TEST PARAGRAPH	TEST NAME	1) RESULT/CONFIRMATION OF CONFORMITY
38.3.4.1	T.1 Altitude simulation	**passed**
38.3.4.2	T.2 Thermal test	**passed**
38.3.4.3	T.3 Vibration	**passed**
38.3.4.4	T.4 Shock	**passed**
38.3.4.5	T.5 External short circuit	**passed**
38.3.4.6	T.6a Impact	**not applicable**
38.3.4.6	T.6b Crush	**not applicable**
38.3.4.7	T.7 Overcharge	**passed**
38.3.4.8	T.8 Forced discharge	**not applicable**

1) according to Test Report № S 44/2024/1
result: passed/failed/not applicable (not required or not included in the order).
This Test Summary is an integral part of the Test Report, which contains detailed test results.

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.7/Amend.1, Lithium metal and lithium ion batteries (Section 38.3) /except paragraph 38.3.4.6, 38.3.4.8

Poznań, 15.07.2024

Technician supervising test
Jędrzej Kałużny

Laboratorium Badań Chemicznych Źródeł Prądu

Laboratory Manager
Kamil Frączek, M.A.