BTO Sp. z o.o.
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TEST REPORT
BL/0004/(1 – 8)/ 2020/1

Test Object/Product: Lithium Battery Pack Fanuc (non-rechargeable) 6.0V
Model: BR-CCF2TH BR-CCF2TE

	NAME / POSITION	SIGNATURE / STAMP
TEST RESULTS AUTHORIZED BY	Norbert Smoliński *Test Engineer*	Norbert Smoliński Test Engineer
TEST REPORT VALIDATED BY	Roman Gozdur *Laboratory Manager*	Roman Gozdur Laboratory Manager
Date of test report: 03 / 10 / 2022		Distribution list: I copy for Customer, I copy a/a

BTO Sp. z o.o. BTO Battery Lab

1. *This test report presents results of non-accredited tests*
2. *These test results refer to the tested samples only.*
3. *This test report cannot be reproduced without BTO Laboratory's written consent.*
4. *Customer are entitled to submit their claims up to 14 days after reception of this test report.*
5. *Test reports with no accreditation marking means that all tests therein are non-accredited.*
6. *Test summary (refers only to UN TESTS).*

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GENERAL INFORMATION	
Customer / Manufacturer	**Document**
Name: **BTO Sp. z o.o.** Address: **Fabryczna 25 Str.** **90341PL Łódź, Poland, PL**	Order / agreement No: 007/2020 date: 26.11.2020

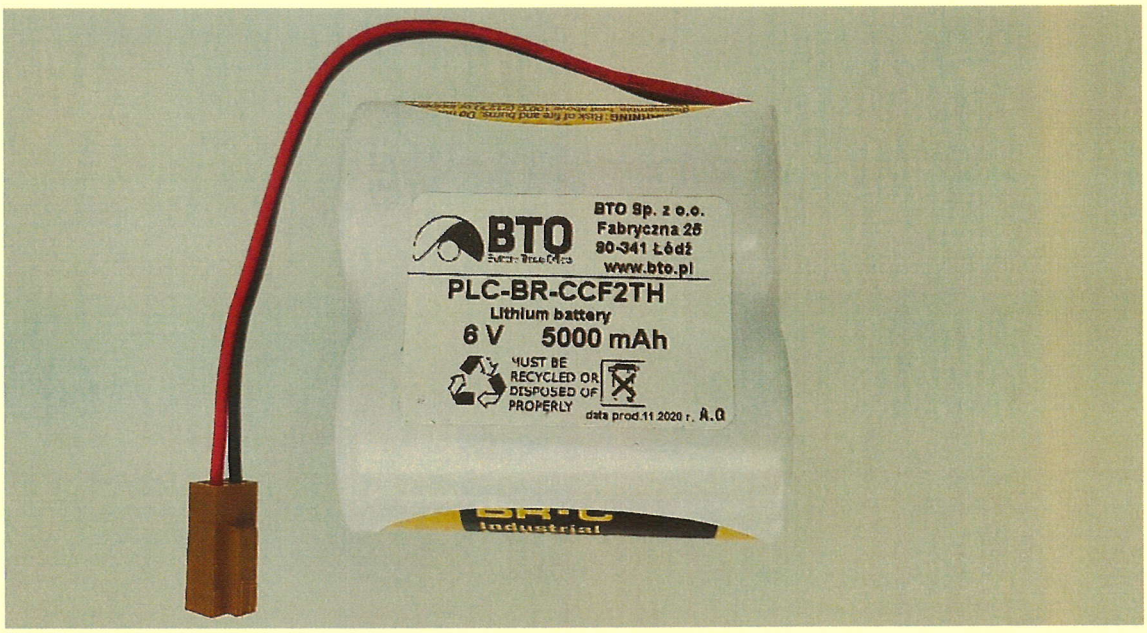
TESTED OBJECT / PRODUCT	
Name:	**Lithium Battery Fanuc (non-rechargeable) 6.0V** **Model: BR-CCF2TH BR-CCF2TE**
Description / state:	Rated capacity: 5.0Ah Rated voltage: 6.0 V
Sampling / sample delivery method:	Sample delivered by Customer
Sample size:	8 pieces

Sample collection date: 16.11.2020	Sample production date: 11.2020
Test initiation date: 23.11.2020	Test completion date: 20.02.2021

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, Lithium-Metal and Lithium-Ion batteries - (*hereinafter referred to as* **UN TEST**)

SAMPLE IDENTIFICATION NUMBERS:	
Laboratory Identification Numbers (sample ID): BL / 0004 / (1 - 8)	
(fully discharged at **BTO Lab.**) **BL/0004/(1 - 4)**	(fully charged **BTO Lab.**) **BL/0004/(5 - 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/0004/(1-8)	4
2.	T2. Thermal test	A	UN TEST paragraph 38.3.4.2.2	BL/0004/(1-8)	5
3.	T3. Vibration	A	UN TEST paragraph 38.3.4.3.2	BL/0004/(1-8)	6
4.	T4. Shock	A	UN TEST paragraph 38.3.4.4.2	BL/0004/(1-8)	7
5.	T5. External short circuit	A	UN TEST paragraph 38.3.4.5.2	BL/0004/(1-8)	8

* Battery Packs assigned as BL / 0004 / (1-8), BL / 0004 / (2-8), BL / 0004 / (3-8), BL / 0004 / (4-8) were fully discharged before the test,

1. ALTITUDE SIMULATION

Test procedure *(document):* UN TEST paragraph 38.3.4.1.2 **Sample ID:** BL/0004/(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[%]	
BL/0004/ (1-8)	Fully discharged	0.3568	0.3559	0.25%	87.72	87.72	0.00%	O
BL/0004/ (2-8)	Fully discharged	1.3644	1.3602	0.31%	87.93	87.92	0.01%	O
BL/0004/ (3-8)	Fully discharged	0.2741	0.2722	0.69%	87.14	87.14	0.00%	O
BL/0004/ (4-8)	Fully discharged	0.5360	0.5354	0.11%	87.45	87.45	0.00%	O
BL/0004/ (5-8)	Fully charged	6.871	6.873	0.03%	87.95	87.95	0.00%	O
BL/0004/ (6-8)	Fully charged	6.868	6.870	0.03%	87.45	87.45	0.00%	O
BL/0004/ (7-8)	Fully charged	6.822	6.823	0.01%	87.04	87.05	0.01%	O
BL/0004/ (8-8)	Fully charged	6.863	6.865	0.03%	87.85	87.85	0.00%	O
Measurement uncertainty:		± 0.002 V				± 0.03 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/0004/(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/0004/ (1-8)	Fully discharged	0.349	0.348	0.29%	87.72	87.69	0.03%	O
BL/0004/ (2-8)	Fully discharged	1.390	1.387	0.22%	87.92	87.86	1.08%	O
BL/0004/ (3-8)	Fully discharged	0.273	0.273	0.00%	87.14	87.07	0.08%	O
BL/0004/ (4-8)	Fully discharged	0.534	0.534	0.00%	87.45	87.43	0.02%	O
BL/0004/ (5-8)	Fully charged	6.873	6.922	0.71%	87.95	87.94	0.01%	O
BL/0004/ (6-8)	Fully charged	6.870	6.920	0.73%	87.45	87.43	0.02%	O
BL/0004/ (7-8)	Fully charged	6.823	6.888	0.95%	87.05	87.03	1.02%	O
BL/0004/ (8-8)	Fully charged	6.865	6.918	0.77%	87.85	87.84	0.87%	O
Measurement uncertainty:		± 0.002 V			± 0.03g			
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 test

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

Test equipment:	Dynamic climate chamber DGBell BTT – 150D
	Voltmeter FLUKE 8845A
	Electronic balance RADWAG PS 200/2000.X2
NOTE: -	

3. VIBRATIONS

Test procedure *(document)*: **UN TEST** paragraph 38.3.4.3.2 **Sample ID:** BL/0004/(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/0004/ (1-8)	Fully discharged	0.348	0.347	0.29%	87.72	87.72	0.00%	O
BL/0004/ (2-8)	Fully discharged	1.367	1.369	0.15%	87.92	87.92	0.00%	O
BL/0004/ (3-8)	Fully discharged	0.273	0.272	0.37%	87.14	87.14	0.00%	O
BL/0004/ (4-8)	Fully discharged	0.533	0.531	0.38%	87.45	87.46	0.01%	O
BL/0004/ (5-8)	Fully charged	6.873	6.910	0.54%	87.95	87.96	0.01%	O
BL/0004/ (6-8)	Fully charged	6.870	6.910	0.58%	87.45	87.46	0.01%	O
BL/0004/ (7-8)	Fully charged	6.823	6.886	0.92%	87.05	87.05	0.00%	O
BL/0004/ (8-8)	Fully charged	6.865	6.915	0.73%	87.85	87.87	0.02%	O
Measurement uncertainty:		± 0.002 V			± 0.03 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/0004/(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/0004/ (1-8)	Fully discharged	0.347	0.347	0.00%	87.72	87.72	0.00%	O
BL/0004/ (2-8)	Fully discharged	1.354	1.352	0.15%	87.92	87.93	0.01%	O
BL/0004/ (3-8)	Fully discharged	0.273	0.272	0.37%	87.14	87.14	0.00%	O
BL/0004/ (4-8)	Fully discharged	0.532	0.530	0.38%	87.46	87.46	0.00%	O
BL/0004/ (5-8)	Fully charged	6.910	6.907	0.04%	87.96	87.96	0.00%	O
BL/0004/ (6-8)	Fully charged	6.910	6.907	0.04%	87.46	87.46	0.00%	O
BL/0004/ (7-8)	Fully charged	6.886	6.883	0.04%	87.05	87.05	0.00%	O
BL/0004/ (8-8)	Fully charged	6.915	6.911	0.06%	87.87	87.87	0.00%	O
Measurement uncertainty:		± 0.002 V			± 0.03 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/0004/(1-8)

Test conditions: Heating time t = 6h; temperature: 57±4°C
External resistance < 0.1Ohm; 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/0004/ (1-8)	Fully discharged	56.8	57.4	O
BL/0004/ (2-8)	Fully discharged	57.2	57.8	O
BL/0004/ (3-8)	Fully discharged	57.2	57.4	O
BL/0004/ (4-8)	Fully discharged	57.4	57.8	O
BL/0004/ (5-8)	Fully charged	57.8	57.9	O
BL/0004/ (6-8)	Fully charged	57.2	57.2	O
BL/0004/ (7-8)	Fully charged	57.7	58.3	O
BL/0004/ (8-8)	Fully charged	57.5	56.8	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
	Ohmmeter FLUKE 8845A
	Electronic thermometer Keysight 34972A
NOTE: **The T5 test was repeated after improvements of the battery pack. The battery pack has been equipped with fuse protection against a short circuit.**	

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TEST SUMMARY

Product name: **Lithium Battery Fanuc (non-rechargeable) 6.0V**
Model/type/Configuration: **BR-CCF2TH BR-CCF2TE**
Rated parameters: **6.0 V, 5.0Ah; 87 g;**
Lithium content: **3.6 g**
Manufacturer */name, address/:* **BTO Sp. z o.o.; Fabryczna 25 Str.; 90341PL Łódź, Poland, PL**

Based on the following test results:

UN TEST ID	*TEST NAME*	*RESULT, CONFIRMATION OF CONFORMITY*
38.3.4.1.2	T.I 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, 38.3.4.8.2.

Norbert Smoliński
Test Engineer
Test Engineer
Eng. Norbert Smoliński

BTO Sp. z o.o. BTO Battery Lab

Roman Gozdur
Laboratory Manager
Laboratory Manager
PhD Eng. Roman Gozdur

Place and date of issue: Łódź, October 5th, 2022