



CE MARKING

*ELECTROMAGNETIC COMPATIBILITY
ELECTRICAL SAFETY
LASER SPECTROSCOPY
ENVIRONMENTAL PHYSICS*

G.S.D. S.r.l.
Certified in accordance with
UNI EN ISO 9001:2015
by
TÜV Rheinland Italia S.r.l.
Certificate N. 39 00 1850509

Test Report n. 19101B

Manufacturer: **IP CLEANING S.p.A.**
Viale Treviso, 63
30026 Summaga di Portogruaro (VE)
Italy

Eut: **CT5 3P BMZ PN BAAC00185**
Li-Ion Battery

Pisa, 2019 February 12

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1 MANUFACTURER AND EUT IDENTIFICATION¹

Manufacturer: **IP CLEANING S.p.A.**
Viale Treviso, 63
30026 Summaga di Portogruaro (VE)
Italy

Eut: **CT5 3P BMZ PN BAAC00185**
Li-Ion Battery

Complete EUT Id: **CT5 3P BMZ PN BAAC00185**

Sample receiving date: 2019 January 08

Test date: 2019 January 08 - 2019 January 28

Description: Li-Ion Battery

Battery pack specification: Model: Battery CT5 3P BMZ P/N BAAC00185
Capacity: 8.25 Ah
Energy: 297 Wh
Type: 3P10S
Technology: Li-Ion
Nominal voltage: 36 V
Charge voltage: 42 V
Basic cell: Sony UST180BMNC1

¹A detailed documentation is preserved in the internal fascicle.

EUT identification:

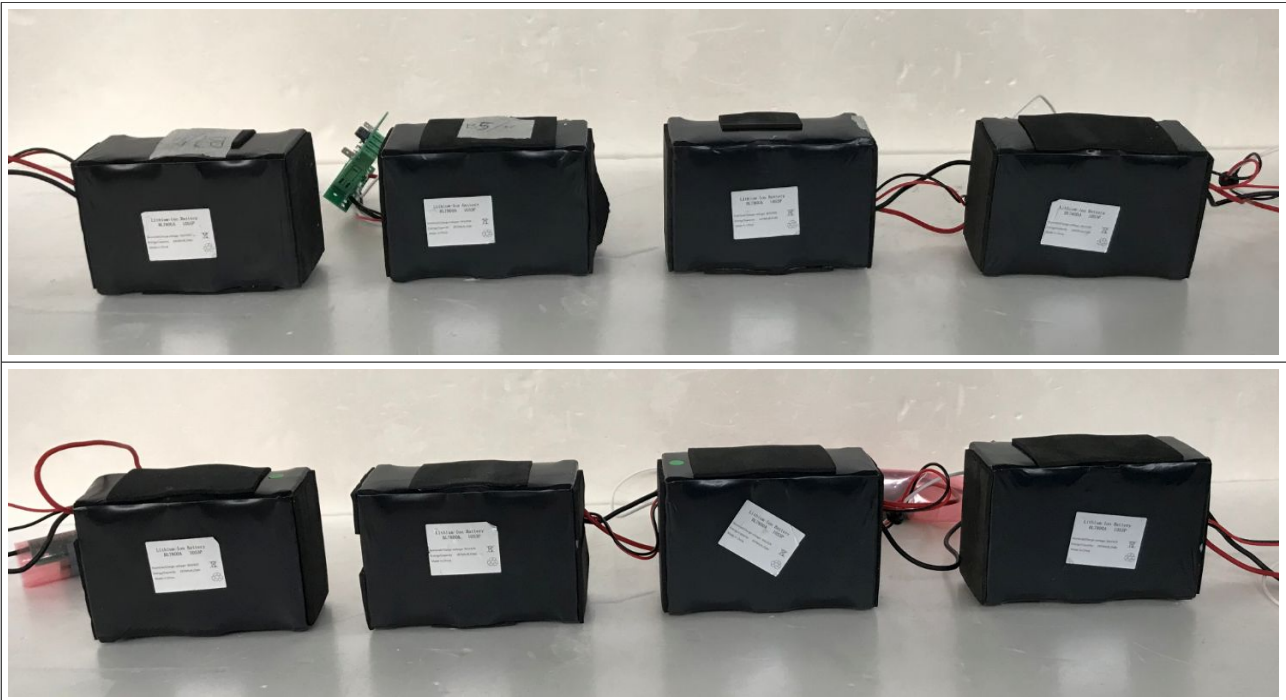


Fig. 1.1
CT5 3P BMZ PN BAAC00185



2 PHOTO



*Fig. 2.1
Batteries in T.1 Ref.1 and Ref.2b Test setup
(Altitude Simulation test)*



*Fig. 2.2
Batteries in T.2 Ref.1 and Ref.2b, §7.2.2 Ref. 2a Test setup
(Thermal test, case stress)*

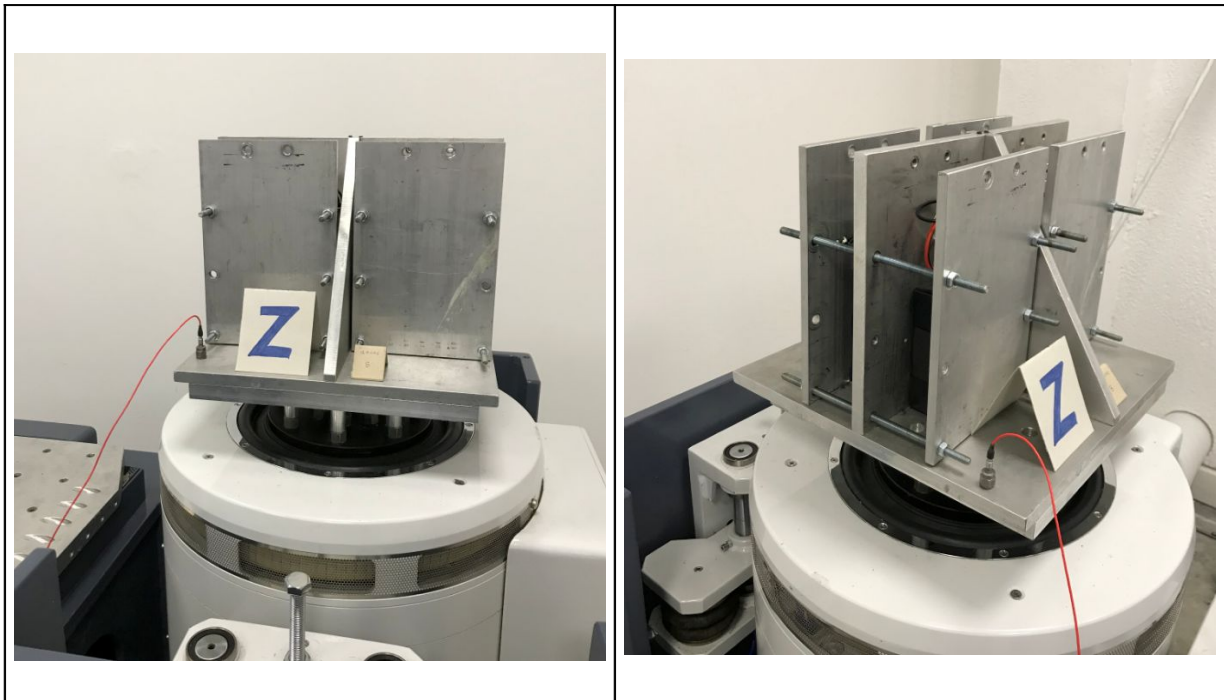
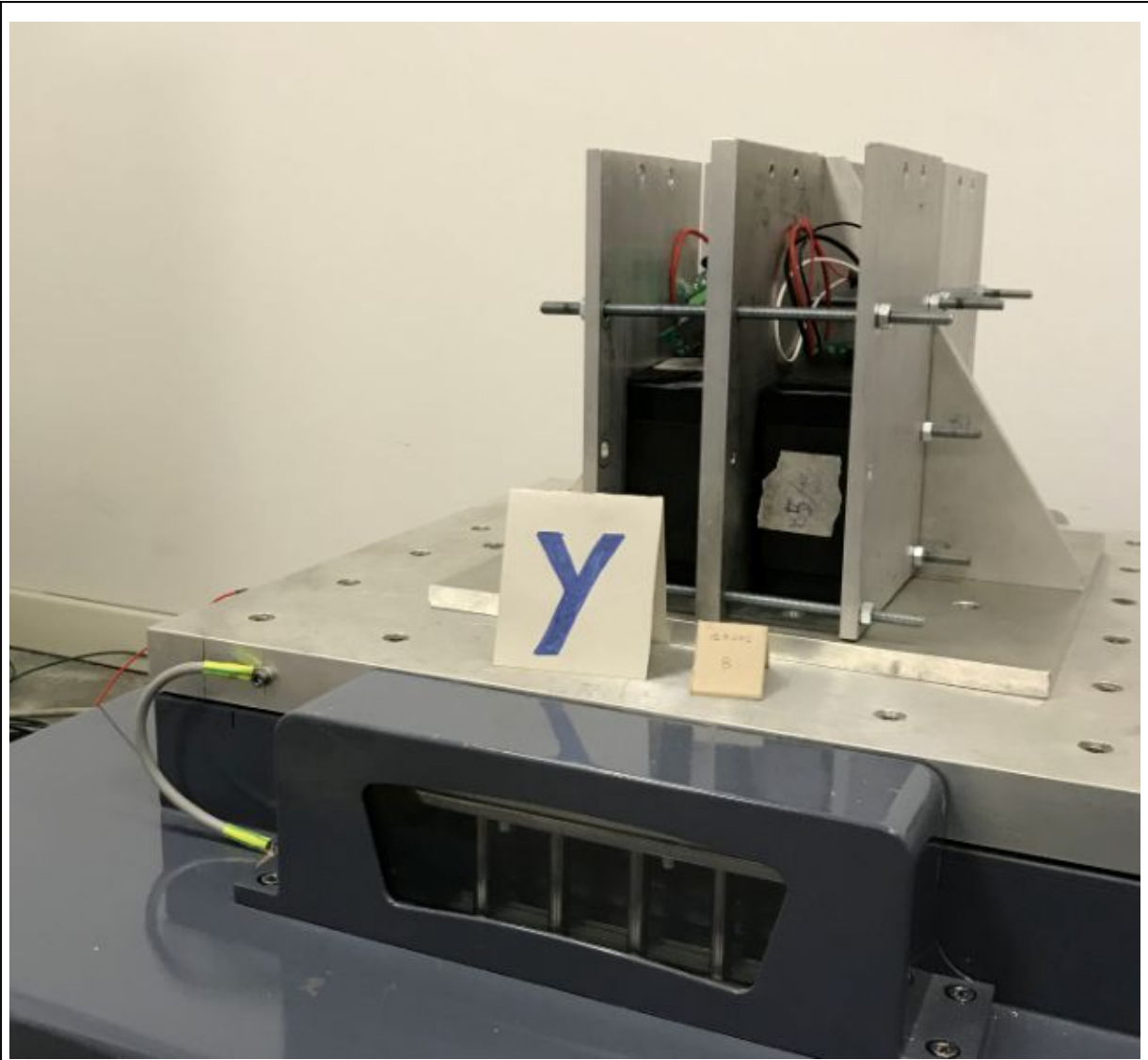
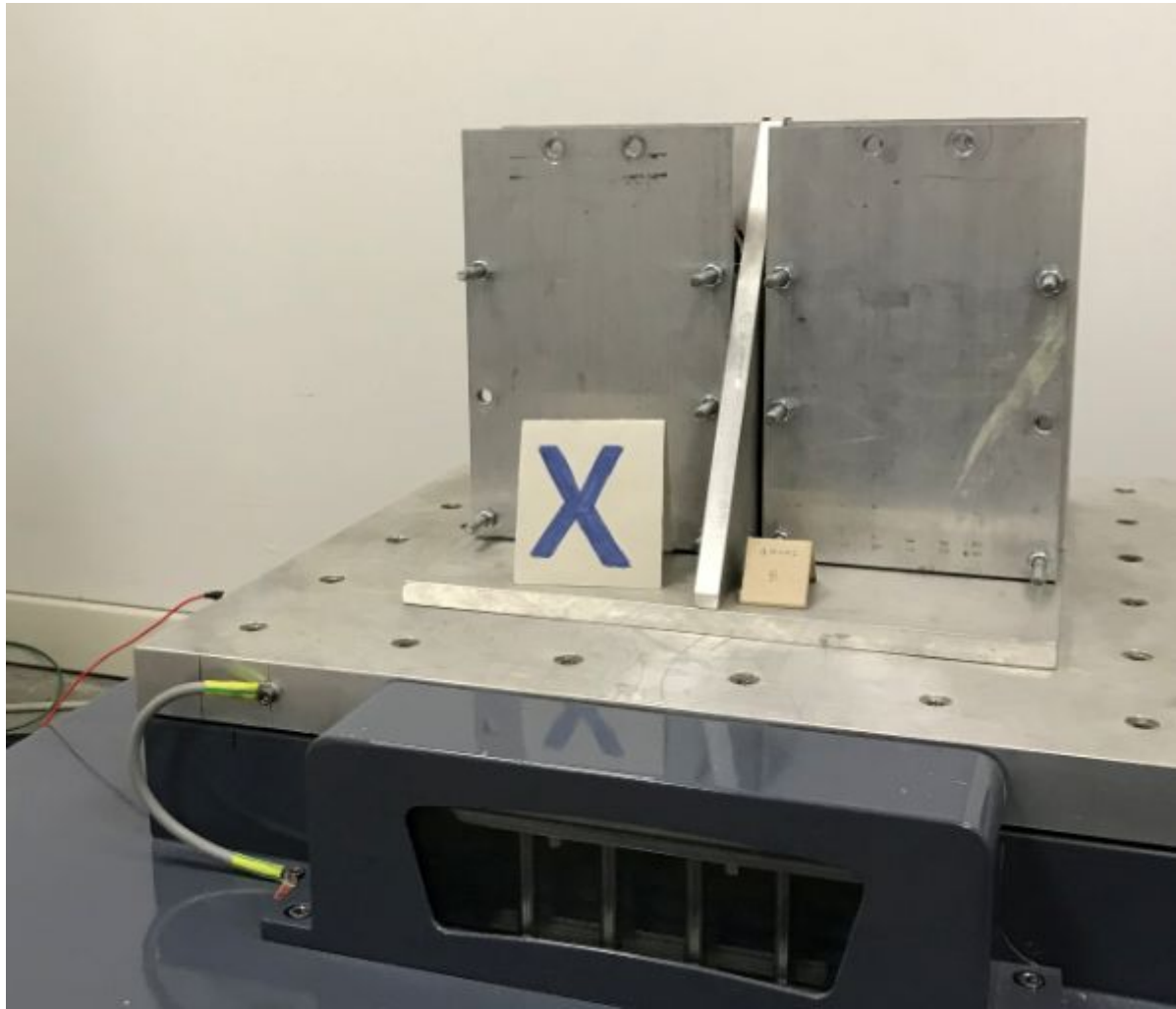


Fig. 2.3
Battery in T.3 Ref.1 and Ref.2b , §7.3.8.1 Ref. 2A and
T.4 Ref.1 and Ref.2b, §7.3.8.2 Ref. 2A Test setup
(Vibration/Shock test Z-Axis)



*Fig. 2.4
Battery in T.3 Ref.1 and Ref.2b , §7.3.8.1 Ref. 2A and
T.4 Ref.1 and Ref.2b, §7.3.8.2 Ref. 2A Test setup
(Vibration/Shock test Y-Axis)*



*Fig. 2.5
Battery in T.3 Ref.1 and Ref.2b , §7.3.8.1 Ref. 2A and
T.4 Ref.1 and Ref.2b, §7.3.8.2 Ref. 2A Test setup
(Vibration/Shock test X-Axis)*

3 TEST GENERALITY

The following documents are applicable and governed the preparation of the tests performed:

Ref.	Standard / Document Title
1.	<i>ST/SG/AC.10/11/Rev.6 Recommendations on the Transport of Dangerous Goods. Manual of tests and Criteria – Sixth revised edition</i> <i>UN Manual of Tests and Criteria - PART III - CLASSIFICATION PROCEDURES, TEST METHODS AND CRITERIA RELATING TO CLASS 2, CLASS 3, CLASS 4, DIVISION 5.1, CLASS 8 AND CLASS 9 § 38.3 Sixth revised edition: this section presents the procedures to be followed for the classification of lithium metal and lithium ion cells and batteries (see UN Nos. 3090, 3091, 3480 and 3481, and the applicable special provisions of Chapter 3.3 of the Model Regulations)</i>
2.	<i>a) IEC 62133-2 Rev2 - 2017</i> <i>Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications – Part 2.</i> <i>and</i> <i>b) EN 62281 - 2017</i> <i>Safety of primary and secondary lithium cells and batteries during transport</i>

The following table gives the summary of all test.

TEST	
<i>T.1 Ref.1 and Ref.2b</i>	<i>Altitude simulation</i>
<i>T.2 Ref.1 and Ref.2b, §7.2.2 Ref. 2a</i>	<i>Thermal test, case stress</i>
<i>T.3 Ref.1 and Ref.2b, §7.3.8.1 Ref. 2a</i>	<i>Vibration</i>
<i>T.4 Ref.1 and Ref.2b, §7.3.8.2 Ref. 2a</i>	<i>Shock</i>
<i>T.5 Ref.1 and Ref.2b, §7.3.2 Ref. 2a</i>	<i>External short circuit</i>
<i>T.7 Ref.1 and Ref.2b, §7.3.6 Ref. 2a</i>	<i>Overcharge</i>
<i>§7.3.3 Ref. 2a</i>	<i>Free Fall</i>

Evaluation criteria:

Requirements 1:

- no mass;
- no leakage;
- no venting;
- no disassembly;
- no rupture;
- no fire
- open circuit voltage of each test cell or battery after testing have to be not less than 90% of its voltage immediately prior to procedure².

²This requirement is not applicable to test cells and batteries at fully discharged state

Requirements 2:

- External cells or batteries temperature have to be less than 170°C and
- no disassembly;
- no rupture;
- no fire

within 6 hours of test finish

Environmental Conditions

Temperature = (297 ± 3) K

Relative humidity = (50 ± 5) %

Samples under test:

n. 8 samples (4+4): CT5 3P BMZ PN BAAC00185 (see Fig. 1.1)

four small batteries at first cycle, in fully charged states

four small batteries after 50 cycles ending in fully charged states

8 batteries were tested for test:

T.1 Ref.1 and Ref.2b

T.2 Ref.1 and Ref.2b, §7.2.2 Ref. 2a

T.5 Ref.1 and Ref.2b, §7.3.2 Ref. 2A

T.7 Ref.1 and Ref.2b, §7.3.6 Ref. 2a

8 batteries were tested for test:

T.3 Ref.1 and Ref.2b, §7.3.8.1 Ref. 2a

T.4 Ref.1 and Ref.2b, §7.3.8.2 Ref. 2a

3 batteries were tested for test:

§7.3.3 Ref. 2a

Disposition of test and measure

Test and/or measure disposition is compliance with the relative reference standard.

Test site:

Tests were performed in G.S.D. S.r.l. - PISA Italy

4 SUMMARY OF TEST RESULTS

<i>TEST [REF. 1, REF.2]</i>		<i>RESULT</i>
<i>T.1 Ref.1 and Ref.2b</i>	<i>Altitude simulation</i>	<i>Pass</i>
<i>T.2 Ref.1 and Ref.2b, §7.2.2 Ref. 2a</i>	<i>Thermal test, case stress</i>	<i>Pass</i>
<i>T.3 Ref.1 and Ref.2b , §7.3.8.1 Ref. 2a</i>	<i>Vibration</i>	<i>Pass</i>
<i>T.4 Ref.1 and Ref.2b, §7.3.8.2 Ref. 2a</i>	<i>Shock</i>	<i>Pass</i>
<i>T.5 Ref.1 and Ref.2b, §7.3.2 Ref. 2a</i>	<i>External short circuit</i>	<i>Pass</i>
<i>T.7 Ref.1 and Ref.2b, §7.3.6 Ref. 2a</i>	<i>Overcharge</i>	<i>Pass</i>
<i>§7.3.3 Ref. 2a</i>	<i>Free Fall</i>	<i>Pass</i>

Extensions:

The results refer only to the sampled EUT and under the specified conditions.

5 TEST T.1 REF.1 AND REF.2B: ALTITUDE SIMULATION

According to §38.3.4.1 Ref.1, purpose of this test, is to simulates air transport under low -pressure conditions.

Procedure:

Apparatus shall be stored at 11,6kPa (or less) for at least 6 hours in ambient temperature (20±5°C)

Test Equipment:

<i>EQUIPMENT DESIGNATION</i>	<i>MANUFACTURER</i>	<i>MODEL, TYPE</i>	<i>NEXT CALIBRATION</i>
VACUUM CHAMBER	Officine Galileo	V4aq	JAN 2020
DATA ACQUISITION UNIT	HP	34970A	JAN 2020

Evaluation criteria: Requirements 38.3.4.1 Ref. 1

Results

After the test the equipment continued to be full functionally, no malfunction as on requirements were founded. Equipment complied with the test specifications.

6 TEST T.2 REF.1 AND REF.2B, §7.2.2 REF. 2A: THERMAL TEST

According to §38.3.4.2 Ref.1, §7.2.2 Ref.2a purpose of this test, is to assesses cell and battery seal integrity and internal connections Test performs rapid and extreme temperature changes.

Procedure:

Cells and Batteries are to be stored for at least 7 hours at a test temperature equal to $72\pm 2^{\circ}\text{C}$ followed by storage for at least 7 hours at a test temperature equal to $-40\pm 2^{\circ}\text{C}$.

Maximum time interval between test temperature extreme is 30 minutes.

This procedure is to be repeated 10 times after which all test cells and batteries are to be stored for 24 hours at ambient temperature ($20\pm 5^{\circ}\text{C}$)³.

Test Equipment:

<i>EQUIPMENT DESIGNATION</i>	<i>MANUFACTURER</i>	<i>MODEL, TYPE</i>	<i>NEXT CALIBRATION</i>
THERMAL CHAMBER	ACS	CH1200C	JAN 2020
DATA ACQUISITION UNIT	HP	34970A	JAN 2020

Evaluation criteria: Requirements §38.3.4.2 Ref.1, §7.2.2 Ref.2a

Results

After the test the equipment continued to be full functionally, no malfunction as on requirements were founded. No physical distortion of the battery case resulting in exposure of internal components. Equipment complied with the test specifications.

³For large cells and batteries the duration of exposure to the temperature extremes should be at least 12 hours.

7 TEST T.3 REF.1 AND REF.2B , §7.3.8.1 REF. 2A: VIBRATIONS

According to §38.3.4.3 Ref.1, §7.3.8.1 Ref. 2a purpose of this test, is to simulates vibration during transport.

Cells and Batteries are subjected to sinusoidal vibration with specified sweep and duration as in table below, for each of three mutually perpendicular mounting position of the cell. One of the directions of vibration must be perpendicular to terminal face.

<i>FREQUENCY RANGE</i> [Hz]	<i>SWEEP</i>	<i>DURATION</i> [MINUTES]	<i>REPETITION</i>	<i>TOTAL TIME</i> [HOUR]
7 – 200	logarithmic	15	12	3/axis
7 – 200	traversed			

Test Equipment:

<i>EQUIPMENT DESIGNATION</i>	<i>MANUFACTURER</i>	<i>MODEL, TYPE</i>	<i>NEXT CALIBRATION</i>
VIBRATING TABLE	DONGLING	ES-10-240	JAN 2020
AMPLIFIER	DONGLING	SDA-10	JAN 2020
ACCELEROMETER REFERENCE	DYTRAN	3055B4	JAN 2020
DIGITAL CONTROLLER	LMS INSTRUMENTS	SC310V	JAN 2020

Evaluation criteria: Requirements §38.3.4.3 Ref.1, §7.3.8.1 Ref. 2a

Results

After the test the equipment continued to be full functionally, no malfunction as on requirements were founded. Equipment complied with the test specifications.

8 TEST T.4 REF.1 AND REF.2B, §7.3.8.2 REF. 2A: SHOCK

According to §38.3.4.4 Ref.1, §7.3.8.2 Ref. 2a purpose of this test, is to simulates possible impact during transport.

Cells and Batteries are subjected to a half-sine shock of peak acceleration, pulse duration as specified in table below for each of three mutually perpendicular mounting position of the cell.

<i>PEAK ACCELERATION</i> [g _n]	<i>POLARITY</i>	<i>DURATION</i> [MILLISECONDS]	<i>REPETITION</i>	<i>AXE</i>	<i>TOTAL SHOCK</i>
150	positive	6	3	X	18
150	negative			Y	
				Z	

Test Equipment:

<i>EQUIPMENT DESIGNATION</i>	<i>MANUFACTURER</i>	<i>MODEL, TYPE</i>	<i>NEXT CALIBRATION</i>
VIBRATING TABLE	DONGLING	ES-10-240	JAN 2020
AMPLIFIER	DONGLING	SDA-10	JAN 2020
ACCELEROMETER REFERENCE	DYTRAN	3055B4	JAN 2020
DIGITAL CONTROLLER	LMS INSTRUMENTS	SC310V	JAN 2020

Evaluation criteria: Requirements §38.3.4.4 Ref.1, §7.3.8.2 Ref. 2a

Results

After the test the equipment continued to be full functionally, no malfunction as on requirements were founded. Equipment complied with the test specifications.

9 TEST §7.3.3 REF. 2A: FREE FALL

According to §7.3.3 Ref.2a, purpose of this test: dropping a battery (for example, from a bench top) shall not cause fire or explosion.

Free fall test is conducted at an ambient temperature of $20\text{ °C} \pm 5\text{ °C}$, by using cells or batteries that are charged to a fully charged state, in accordance with the first procedure in 7.1.1. Each cell or battery is dropped three times from a height of 1,0 m onto a flat concrete floor or metal floor. The cells or batteries are dropped so as to obtain impacts in random orientations. After the test, the cell or battery shall be put on rest for a minimum of 1 h and then a visual inspection shall be performed.

Test Equipment:

N.A.

Evaluation criteria: Requirements §7.3.3 Ref.2a

Results

*After the test: No fire, no explosion.
Equipment complied with the test specifications.*

10 TEST T.5 REF.1 AND REF.2B, §7.3.2 REF. 2A: EXTERNAL SHORT CIRCUIT

According to §38.3.4.5 Ref.1, §7.3.2 Ref.2a, purpose of this test, is to simulates possible external short circuit.

Cells and Batteries have to be temperature stabilized so that its external case temperature reaches $55\pm 2^{\circ}\text{C}$.

Short circuit have to be realized with a total external resistance of less than $0,08\Omega$ at $55\pm 2^{\circ}\text{C}$.

This short circuit condition is continued for at least 1 hour after the cell or battery external case temperature returned to $55\pm 2^{\circ}\text{C}$.

Cells and batteries must be observed for a further 6 hour for the test to be concluded

Test Equipment:

<i>EQUIPMENT DESIGNATION</i>	<i>MANUFACTURER</i>	<i>MODEL, TYPE</i>	<i>NEXT CALIBRATION</i>
DATA ACQUISITION / SWITCH UNIT	HP	34970A	JAN 2020
THERMAL CHAMBER	ACS	CH1200C	JAN 2020
DATA ACQUISITION UNIT	HP	34970A	JAN 2020

Evaluation criteria: Requirements §38.3.4.5 Ref.1, §7.3.2 Ref.2a

Results

After the test external temperature did not exceed 170°C and there was no disassembly, no rupture and no fire and no explosion within six hours of this test.

Equipment complied with the test specifications.

11 TEST T.7 REF.1 AND REF.2B, §7.3.6 REF. 2A: OVERCHARGE

According to §38.3.4.7 Ref.1, §7.3.6 Ref.2a, purpose of this test, is evaluates the ability of a rechargeable battery to withstand an overcharge condition.

The minimum voltage of the test shall be the lesser of two times the maximum charge voltage of the battery or 22V. Tests were conducted at ambient temperature $20\text{ °C} \pm 5\text{ °C}$. The duration of the test was 24 hours.

Voltage test: 50,4 V

Test Equipment:

<i>EQUIPMENT DESIGNATION</i>	<i>MANUFACTURER</i>	<i>MODEL, TYPE</i>	<i>NEXT CALIBRATION</i>
POWER SUPPLY	AGILENT	6574A	JAN 2020
THERMAL CHAMBER	ACS	CH1200C	JAN 2020
DATA ACQUISITION UNIT	HP	34970A	JAN 2020

Evaluation criteria: Requirements §38.3.4.7 Ref.1, §7.3.6 Ref.2a

Results

*After the test no disassembly and no fire were and no explosion observed.
Equipment complied with the test specifications.*

12 REPORT REVISION HISTORY

Revision details		
Date	Page No.(s)	Details
2019 February 12	21	Rev. 00-draft00 Initial draft issue