www.battery university.eu

Am Sportplatz 30
63791 Karlstein
Tel. +49 (0)6188 99410-0
Fax +49 (0)6188 99410-20
mail@batteryuniversity.eu
www.batteryuniversity.eu

TEST REPORT

Environmental Tests

LITHIUM-ION BATTERY

2S1P NCR-18650A

Rheintacho Messtechnik GmbH · 2S1P NCR-18650A

Report No. BU-2011-000179-UN

▪ Altitude Simulation ▪ Thermal Test ▪ Vibration ▪
▪ Shock ▪ External Short Circuit ▪ Overcharge ▪

SUMMARY

Model designation: 2S1P NCR-18650A (7.2V / 3.1 Ah)

Reference Number: BMZ 17065 · N001.271A

Attachments

Additional Information for the Transportation of Lithium Batteries

PRODUCT DESCIPTION AND PICTURES

Model designation: **2S1P NCR-18650A (7.2V / 3.1 Ah)**

Front view:

Customer	Product Description	Ref.-No.	
Rheintacho Messtechnik GmbH	2S1P NCR-18650A	17065	N001.271A

CYCLE CONDITIONING

- Test unit packs cycled by BU –

TEST UNIT NO.	STATE OF CHARGE AFTER CONDITIONING	BATTERY TEST SYSTEM
1	1st cycle - 100 %	Cadex
2	1st cycle - 100 %	Cadex
3	1st cycle - 100 %	Cadex
4	1st cycle - 100 %	Cadex
5	50 cycles - 100 %	Cadex
6	50 cycles - 100 %	Cadex
7	50 cycles - 100 %	Cadex
8	50 cycles - 100 %	Cadex
9	1st cycle - 100 %	Cadex
10	1st cycle - 100 %	Cadex
11	1st cycle - 100 %	Cadex
12	1st cycle - 100 %	Cadex
13	50 cycles - 100 %	Cadex
14	50 cycles - 100 %	Cadex
15	50 cycles - 100 %	Cadex
16	50 cycles - 100 %	Cadex

The *batteryuniversity.eu* (BU) utilizes different battery test systems for cycling.

Please see the different battery test systems that come into operation listed with manufacturer, type and serial-no. on the next page.

EQUIPMENT OF BATTERY CYCLING

EQ-No.	Description	Manufacturer / Type	Serial No.:
00064	**Battery Analyser**	BMZ GmbH/ ATGB 1200	44
00065	**Battery Analyser**	BMZ GmbH/ ATGB 1200	31
00066	**Battery Analyser**	BMZ GmbH/ ATGB 1200	36
00067	**Battery Analyser**	BMZ GmbH/ ATGB 1200	34
00068	**Battery Analyser**	BMZ GmbH/ ATGB 1200	45
00069	**Battery Analyser**	BMZ GmbH/ ATGB 1200	48
00070	**Battery Analyser**	BMZ GmbH/ ATGB 1200	14
00071	**Battery Analyser**	BMZ GmbH/ ATGB 1200	1
00072	**Battery Analyser**	BMZ GmbH/ ATGB 1200	3
00073	**Battery Analyser**	BMZ GmbH/ ATGB 1200	4
00074	**Battery Analyser**	BMZ GmbH/ ATGB 1200	47
00075	**Battery Analyser**	BMZ GmbH/ ATGB 1200	43
00076	**Battery Analyser**	BMZ GmbH/ ATGB 1200	38
00077	**Battery Analyser**	BMZ GmbH/ ATGB 1200	37
00078	**Battery Analyser**	BMZ GmbH/ ATGB 1200	35
00044	**Battery Test System**	Digatron/ BTS 600	6680992
00045	**Battery Test System**	BaSyTec	BA V1.61.40.0181
00079	**Battery Analyser**	Cadex	C7E00529
00080	**Battery Analyser**	Cadex	C7EC00453
00081	**Battery Analyser**	Cadex	C7EC00447
00082	**Battery Analyser**	Cadex	C7EC00448

TEST REPORT
for the information of the applicant

This test report contains the result of a singular investigation carried out on the product submitted. A sample of this product was tested to found the accordance with the thereafter listed standards or clauses of standards respective.

The results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the issuing testing laboratory.

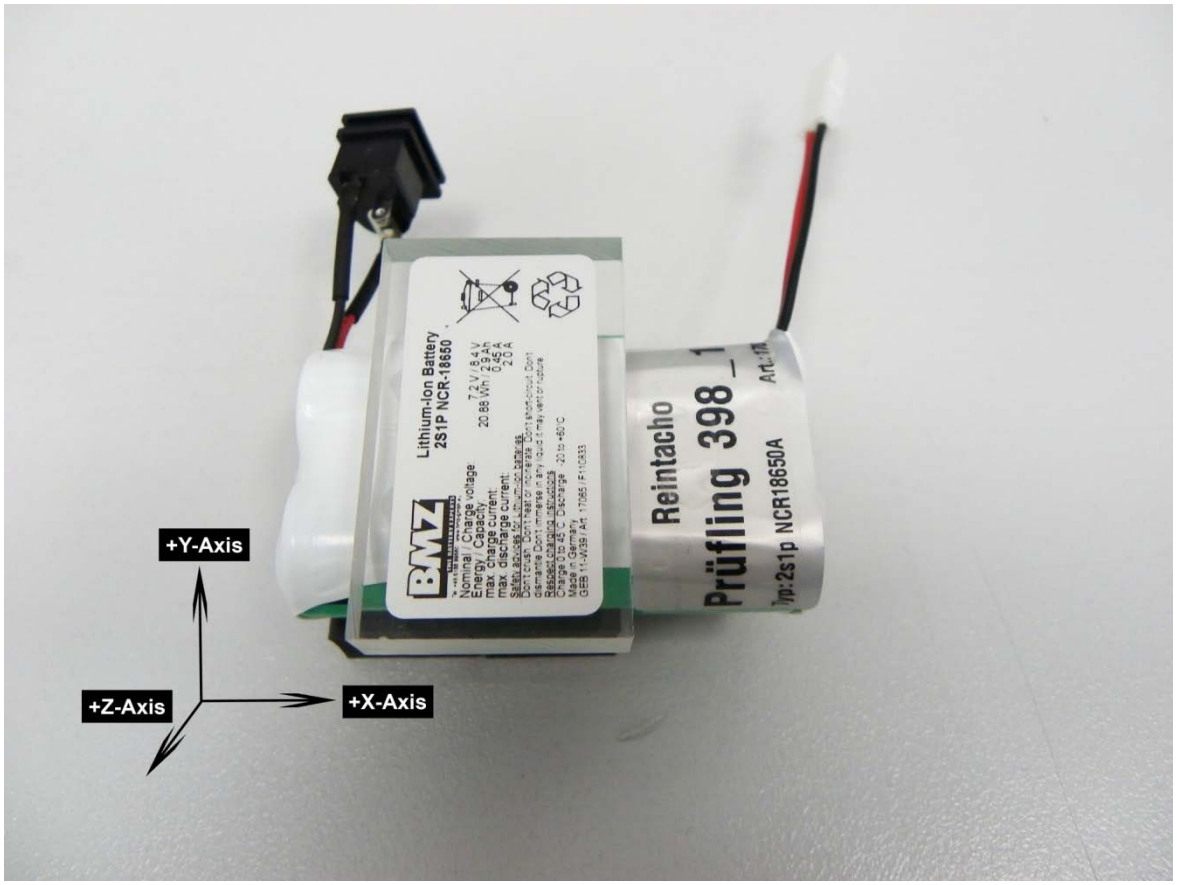
REPORT REFERENCE NO.	:	**BU-2011-000179-UN**
DATE OF ISSUE	:	**02.Nov.2011**
TOTAL NUMBER OF PAGES	:	**39 pages**
PRODUCT	:	**BATTERY WITH RECHARGEABLE LITHIUM-ION CELLS - -**
MODEL DESIGNATION	:	**2S1P NCR-18650A (7.2V/3.1 Ah)**
ARTICLE NUMBER	:	**17065 · N001.271A**
TEST UNIT NO. 1-4	:	four small batteries (with a gross mass of not more than 12 kg) at first cycle, in fully charged states
TEST UNIT NO. 5-8	:	four small batteries (with a gross mass of not more than 12 kg) after 50 cycles ending in fully charged states
TEST UNIT NO. 9-12	:	four small batteries (with a gross mass of not more than 12 kg) at first cycle, in fully charged states
TEST UNIT NO. 13-16	:	four small batteries (with a gross mass of not more than 12 kg) after 50 cycles ending in fully charged states

TEST SPECIFICATION	:	**UN Standard for Transport of Dangerous Goods:** **UN Manual of Tests and Criteria, fifth revised edition,** **Part III, Section 38.3 - Lithium batteries** **(ST/SG/AC.10/11/Rev.5)**
PERFORMED TESTS	:	**T.1 Altitude Simulation** according to DIN EN IEC 60068-2-13 **T.2 Thermal Test** according to DIN EN IEC 60068-2-14 **T.3 Vibration** according to DIN EN IEC 60068-2-6 **T.4 Shock** according to DIN EN IEC 60068-2-27 **T.5 External Short Circuit** **T.7 Overcharge**
ACCURACY OF MEASURMENT DEVICES	:	According to DIN EN IEC 60051 (all parts)
CUSTOMER	:	**Rheintacho Messtechnik GmbH** **Waltershofener Straße 1** **D-79111 Freiburg** **Deutschland**
TEST LABORATORY	:	**batteryuniversity.eu GmbH**
TEST LOCATION	:	Am Sportplatz 30 D – 63791 Karlstein am Main Germany
TEST SAMPLES RECEIPT	:	14.Oct.2011
TEST PERIOD	:	**14.Okt.2011 until 02.Nov.2011**
TESTED BY	:	H.-P. Grimm
APPROVED BY	:	Sven Bauer

TEST EQUIPMENT

EQ-No.	Description	Manufacturer / Type	Serial No.:
00921	**Altitude Chamber**	Memmert, VO 500	S507.0017
00038	**Temperature Chamber**	ESPEC, EGNX-12-7,5CWL	1710748
00021	**Vibration Test System**	RMS, SW2-1240APP	14960
------	**Digital Vibration Control System**	RMS, SWR 1200	14982
00027	**Control Sensor**	PCB, 353B03	128056
00022	**Shock Tester**	MTS, 886	JJ090260B
00039	**Shock Control Sensor**	PCB, 352C03	86584
00040	**Conditioning Amplifier**	PCB, 482C	341
00041	**Software Package**	DASY Lab	V10.00.0
00042	**Multifunction Module**	IO-T Personal DAQ/3005	196147A-01
00017	**Power Supply**	EA, PS8080-60	1049920001
00018	**Power Supply**	EA, PS8080-60	1049920002
00035	**Power Supply**	EA, PS8080-60	1051670001
00036	**Power Supply**	EA, PS8080-60	1051670002
00003	**Digital Multimeter**	Metrawatt, Metra Tech	TB2971
00002	**Digital Multimeter**	Metrawatt, Metra Tech	TB2937
00004	**Digital Multimeter**	Metrawatt, Metra Hit	TB1934
00005	**Digital Multimeter**	Metrawatt, Metra Tech	TB1928
00019	**Precision Balance**	Kern, KB2400-2N	WO93485
00020	**Precision Balance**	Kern, CKE36K0.2	WO90754

AXIS DEFINITION



OVERVIEW: TEST PROCEDURES

38.3.4	Procedure (Referring to rechargeable batteries only)

Each cell and battery type shall be subjected to tests 1 to 5 and test 7.
Tests 1 to 5 shall be conducted in sequence on the same cell or battery. Test 7 may be conducted using undamaged batteries previously used in Tests 1 to 5 for purposes of testing on cycled batteries.

38.3.4.1	Test T.1 : Altitude simulation
Pressure:	11.6 kPa
Temperature:	20 ± 5 °C
Duration:	6 h
Number of test units:	16

38.3.4.2	Test T.2 : Thermal test
Temperatures:	75 ± 2 °C / -40 ± 2 °C
Temperature change rate:	max. 30 min.
Storage time at each temperature:	6 h
Number of cycles:	10
Number of test units:	16

38.3.4.3	Test T.3 : Vibration	
Frequency range:	7 Hz – 200 Hz	
Profile:	**Sinusoidal:**	**Amplitude:**
	7 Hz –18 Hz	1 g_n
	18 Hz –50 Hz	1.6 mm total excursion
	50 Hz – 200 Hz	8 g_n
Number of sweeps per axis:	24 (12 up and 12 down)	
Total test time:	3 h	
Axis:	X; Y; Z	
Number of test units:	16	
Number of control sensors:	1	
Test conditions:	room temperature	

38.3.4.4 Test T.4 : Shock		
	Small cells / batteries	**Large cells / batteries**
Shock form:	halfsine	halfsine
Acceleration / duration:	150 g_n / 6 ms	50 g_n / 11 ms
Number of pulses / half axis:	3	
Axis:	± X; ± Y; ± Z	
Number of test units:	16	
Number of control sensors:	1	
Test conditions:	room temperature	

38.3.4.5 Test T.5 : External Short Circuit	
Temperature:	+55 ± 2 °C
Total external resistance:	Less than 0.1 ohm
Test duration:	1 h
Observation time after test:	6 h
Number of test units:	16

38.3.4.7 Test T.7 : Overcharge	
Temperature:	+23 ± 2 °C
Test duration:	24 h
Test Voltage:	recommended charge voltage <18 V: the minimum test voltage shall be lesser of two times the maximum charge voltage of the battery or 22V recommended charge voltage >18 V: the minimum test voltage shall be 1.2 times the maximum charge voltage
Observation time after test:	7 days
Number of test units:	16

Test Documentation

TEST 1: ALTITUDE SIMULATION

38.3.4.1 Test T.1: Altitude simulation

38.3.4.1.1 Purpose

This test simulates air transport under low-pressure conditions.

38.3.4.1.2 Test procedure

Test cells and batteries shall be stored at a pressure of 11.6 kPa or less for at least six hours at ambient temperature (20 ± 5 °C).

38.3.4.1.3 Requirement

Cells and batteries meet this requirement if there is no mass loss, no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.

38.3.4.1 Test 1: Altitude Simulation - Protocol chart

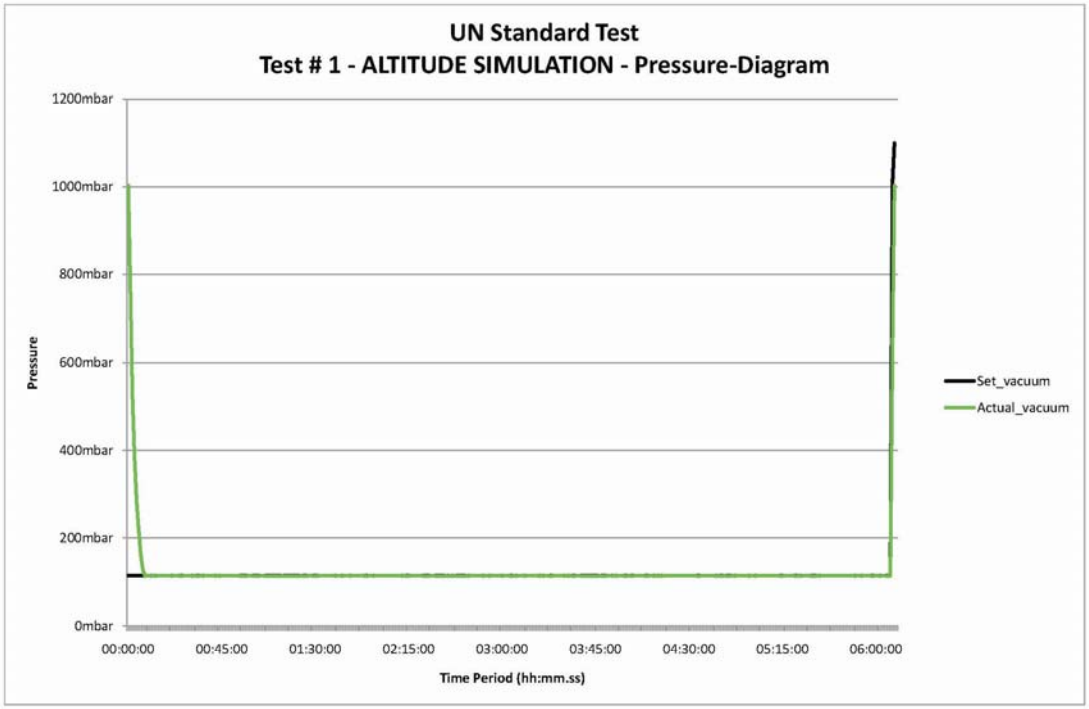
T1-7_Rheintacho Messtechnik GmbH 2s1p NCR-18650A 17065.xlsx

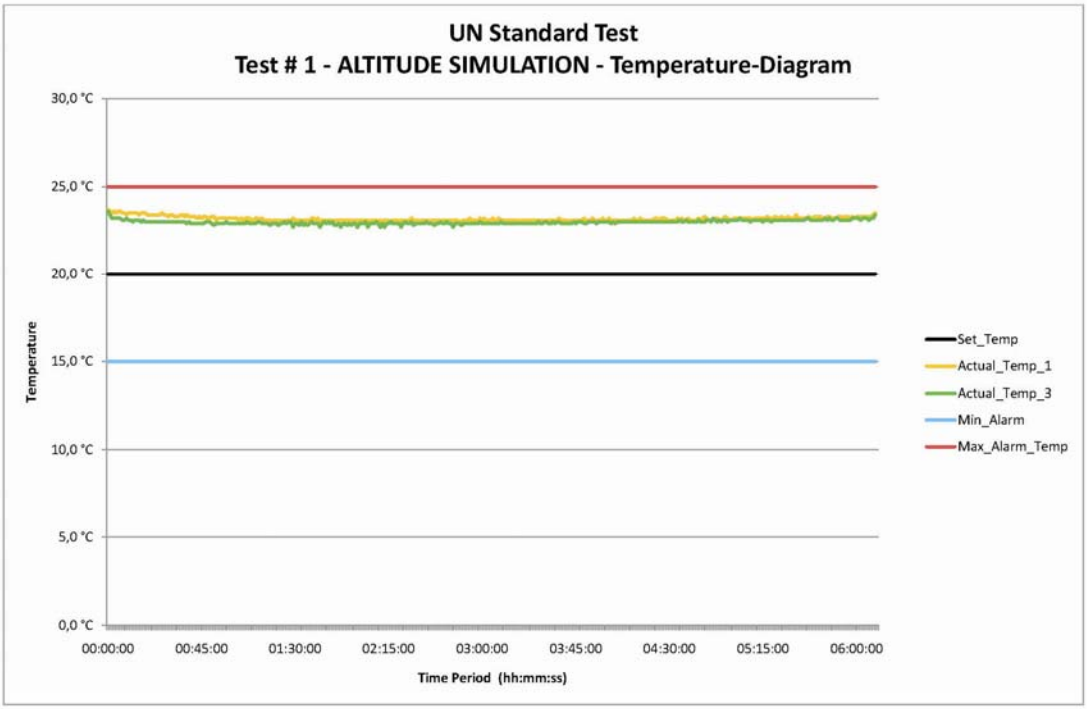
Test # 1: Altitude Simulation (11,6 kPa, 6hrs)

Test Unit No.	Cycle / State	Test Parameter														
		Voltage [V]		Min. Value Voltage [%]	No Voltage Loss	Mass [g]		Max. Mass loss [%]	No Mass Loss	No Leakage	No Venting	No Disassembly	No Rupture	No Fire	Total Result
		Before Test	After Test			Before Test	After Test								
1	1st / fully charged	8,23	8,23	90	Passed	123,79	123,78	0,1	Passed	Passed	Passed	Passed	Passed	Passed	Passed
2	1st / fully charged	8,25	8,25		Passed	124,10	124,08		Passed	Passed	Passed	Passed	Passed	Passed	Passed
3	1st / fully charged	8,22	8,22		Passed	123,73	123,72		Passed	Passed	Passed	Passed	Passed	Passed	Passed
4	1st / fully charged	8,22	8,22		Passed	123,76	123,74		Passed	Passed	Passed	Passed	Passed	Passed	Passed
5	50th / fully charged	8,28	8,27		Passed	124,47	124,46		Passed	Passed	Passed	Passed	Passed	Passed	Passed
6	50th / fully charged	8,26	8,25		Passed	124,18	124,18		Passed	Passed	Passed	Passed	Passed	Passed	Passed
7	50th / fully charged	8,20	8,19		Passed	124,05	124,03		Passed	Passed	Passed	Passed	Passed	Passed	Passed
8	50th / fully charged	8,22	8,21		Passed	124,38	124,38		Passed	Passed	Passed	Passed	Passed	Passed	Passed

Date: 17.10.2011 Operator: Grimm

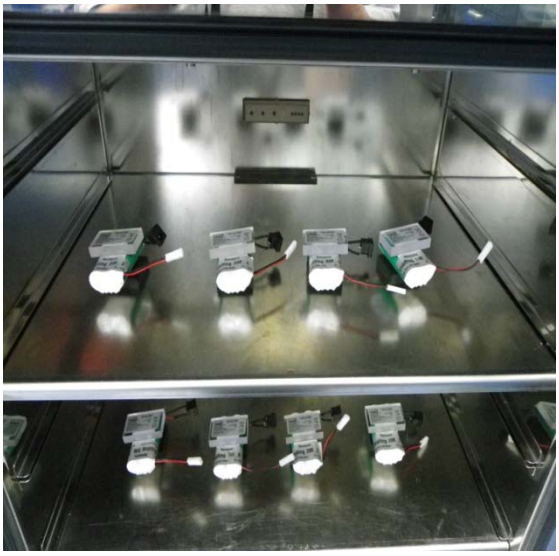
38.3.4.1 Test 1: Altitude Simulation - Diagram





38.3.4.1 Set-up of test 1: Altitude Simulation

Altitude Chamber



Batteries inside altitude chamber

Test Documentation

TEST 2: THERMAL TEST

38.3.4.2 Test T.2: Thermal test

38.3.4.2.1 Purpose

This test assesses cell and battery seal integrity and internal electrical connections. The test is conducted using rapid and extreme temperature changes.

38.3.4.2.2 Test procedure

Test cells and batteries are to be stored for at least six hours at a test temperature equal to 75 ± 2 °C, followed by storage for at least six hours at a test temperature equal to -40 ± 2 °C. The maximum time interval between test temperature extremes 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 ± 5 °C). For large cells and batteries the duration of exposure to the test temperature extremes should be at least 12 hours.

38.3.4.2.3 Requirement

Cells and batteries meet this requirement if there is no mass loss, no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.

38.3.4.2 Test 2: Thermal Test - Protocol chart

T1-7_Rheintacho Messtechnik GmbH 2s1p NCR-18650A 17065.xlsx

Test # 2: Thermal Test (+75 °C / -40 °C, 120 hrs)

Test Unit No.	Cycle / State	Test Parameter												
		Voltage [V]		Min. Value Voltage [%]	No Voltage Loss	Mass [g]		Max. Mass loss [%]	No Mass Loss	No Leakage	No Venting	No Disassembly	No Rupture	No Fire	Total Result
		Before Test	After Test			Before Test	After Test								
1	1st / fully charged	8,23	8,15	90	Passed	123,78	123,69	0.1	Passed	Passed	Passed	Passed	Passed	Passed	Passed
2	1st / fully charged	8,25	8,17		Passed	124,08	124,00		Passed	Passed	Passed	Passed	Passed	Passed	Passed
3	1st / fully charged	8,22	8,15		Passed	123,72	123,65		Passed	Passed	Passed	Passed	Passed	Passed	Passed
4	1st / fully charged	8,22	8,15		Passed	123,74	123,69		Passed	Passed	Passed	Passed	Passed	Passed	Passed
5	50th / fully charged	8,27	8,18		Passed	124,46	124,40		Passed	Passed	Passed	Passed	Passed	Passed	Passed
6	50th / fully charged	8,25	8,17		Passed	124,18	124,10		Passed	Passed	Passed	Passed	Passed	Passed	Passed
7	50th / fully charged	8,19	8,12		Passed	124,03	123,99		Passed	Passed	Passed	Passed	Passed	Passed	Passed
8	50th / fully charged	8,21	8,14		Passed	124,38	124,32		Passed	Passed	Passed	Passed	Passed	Passed	Passed

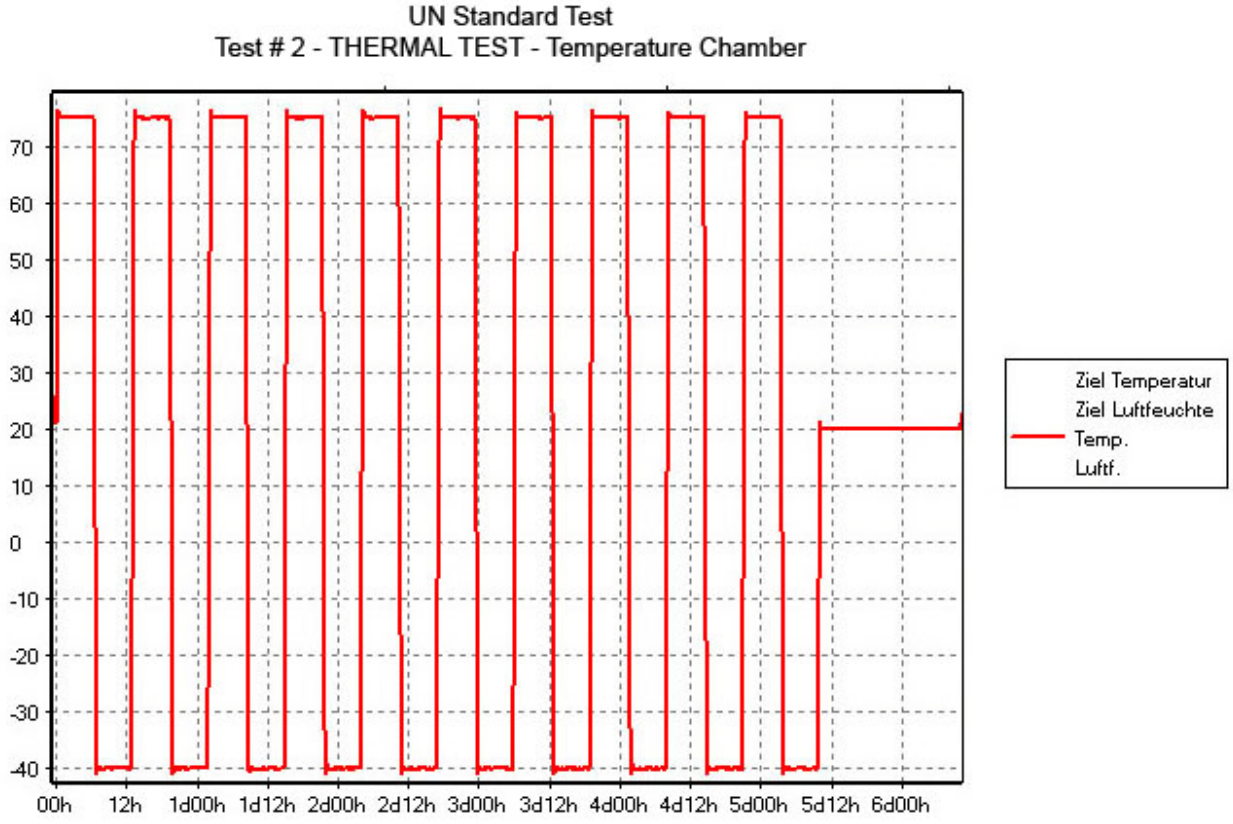
EGNX

Date: 24.10.2011 Operator: Grimm

38.3.4.2 Test 2: Thermal Test - Diagram

Temperature Chamber

Manufacture	ESPEC
Series	EGNX-12
Model	7,5CWL
Serial Number	1710748



38.3.4.2 Set-up of test 2: Thermal Test

Temperature Chamber

Batteries inside temperature chamber

Test Documentation

TEST 3: VIBRATION

38.3.4.3 Test T.3: Vibration

38.3.4.3.1 Purpose

This test simulates vibration during transport.

38.3.4.3.2 Test procedure

Cells and batteries are firmly secured to the platform of the vibration machine without distorting the cells in such a manner as to faithfully transmit the vibration. The vibration shall be a sinusoidal waveform with a logarithmic sweep between 7 Hz and 200 Hz and back to 7 Hz traversed in 15 minutes. This cycle shall be repeated 12 times for a total of 3 hours for each of three mutually perpendicular mounting positions of the cell. One of the directions of vibration must be perpendicular to the terminal face.

The logarithmic frequency sweep is as follows: from 7 Hz a peak acceleration of 1 g_n is maintained until 18 Hz is reached. The amplitude is then maintained at 0.8 mm (1.6 mm total excursion) and the frequency increased until a peak acceleration of 8 g_n occurs (approximately 50 Hz). A peak acceleration of 8 g_n is then maintained until the frequency is increased to 200 Hz.

38.3.4.3.3 Requirement

Cells and batteries meet this requirement if there is no mass loss, no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.

38.3.4.3 Test 3: Vibration - Protocol chart

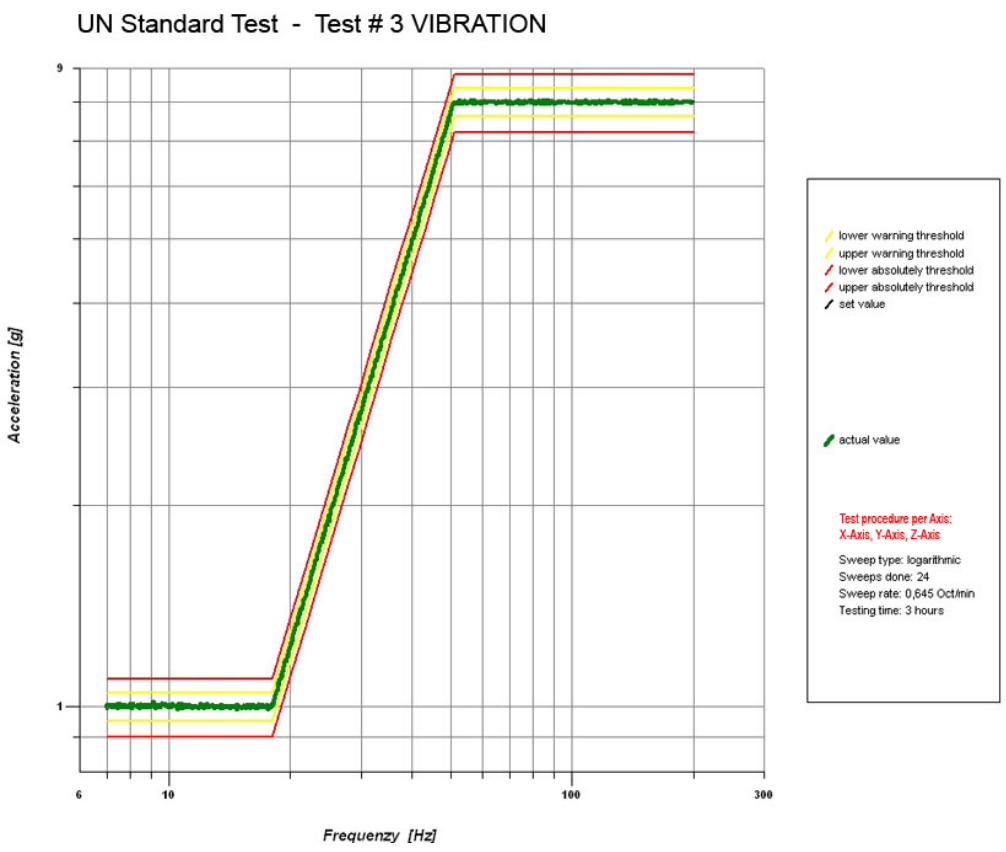
T1-7_Rheintacho Messtechnik GmbH 2s1p NCR-18650A 17065.xlsx

Test # 3: Vibration (7 to 200 Hz)

Test Unit No.	Cycle / State	Test Parameter												
		Voltage [V]		Min. Value Voltage [%]	No Voltage Loss	Mass [g]		Max. Mass loss [%]	No Mass Loss	No Leakage	No Venting	No Disassembly	No Rupture	No Fire	Total Result
		Before Test	After Test			Before Test	After Test								
1	1st / fully charged	8,15	8,16	90	Passed	123,69	123,70	0.1	Passed	Passed	Passed	Passed	Passed	Passed	Passed
2	1st / fully charged	8,17	8,18		Passed	124,00	124,03		Passed	Passed	Passed	Passed	Passed	Passed	Passed
3	1st / fully charged	8,15	8,16		Passed	123,65	123,65		Passed	Passed	Passed	Passed	Passed	Passed	Passed
4	1st / fully charged	8,15	8,16		Passed	123,69	123,70		Passed	Passed	Passed	Passed	Passed	Passed	Passed
5	50th / fully charged	8,18	8,19		Passed	124,40	124,42		Passed	Passed	Passed	Passed	Passed	Passed	Passed
6	50th / fully charged	8,17	8,17		Passed	124,10	124,13		Passed	Passed	Passed	Passed	Passed	Passed	Passed
7	50th / fully charged	8,12	8,13		Passed	123,99	123,99		Passed	Passed	Passed	Passed	Passed	Passed	Passed
8	50th / fully charged	8,14	8,14		Passed	124,32	124,32		Passed	Passed	Passed	Passed	Passed	Passed	Passed

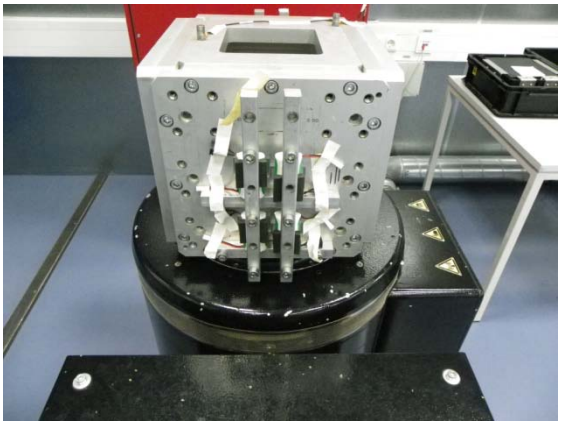
Date: 26.10.2011 Operator: Grimm

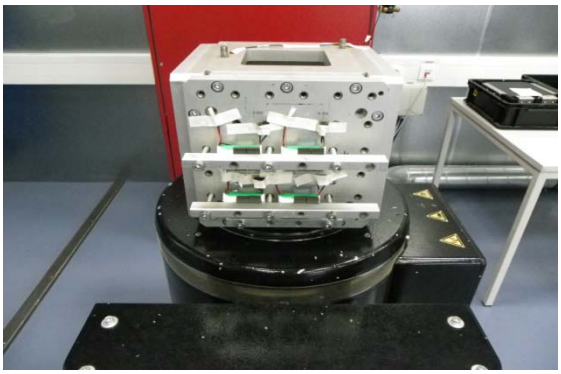
38.3.4.3 Test 3: Vibration - Diagram

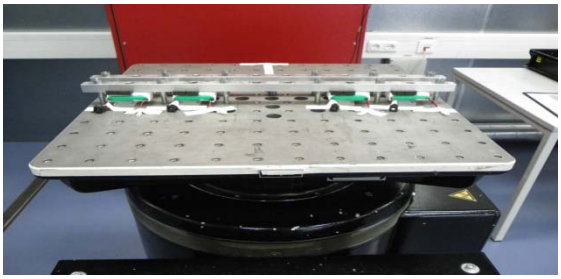


38.3.4.3 Set-up of test 3: Vibration

Shaker Test System







Set-up with batteries on slip plate (top view)

1. X-Axis
2. Y-Axis
3. Z-Axis

Test Documentation

TEST 4: SHOCK

38.3.4.4 Test T.4: Shock

38.3.4.4.1 Purpose

This test simulates possible impacts during transport.

38.3.4.4.2 Test procedure

Test cells and batteries shall be secured to the testing machine by means of a rigid mount which will support all mounting surfaces of each test battery. Each cell or battery shall be subjected to a halfsine shock of peak acceleration of 150 g_n and pulse duration of 6 milliseconds. Each cell or battery shall be subjected to three shocks in the positive direction followed by three shocks in the negative direction of three mutually perpendicular mounting positions of the cell or battery for a total of 18 shocks.

However, large cells and large batteries shall be subjected to a half-sine shock of peak acceleration of 50 g_n and pulse duration of 11 milliseconds. Each cell or battery is subjected to three shocks in the positive direction followed by three shocks in the negative direction of each of three mutually perpendicular mounting positions of the cell for a total of 18 shocks.

38.3.4.4.3 Requirement

Cells and batteries meet this requirement if there is no mass loss, no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.

38.3.4.4 Test 4: Shock - Protocol chart

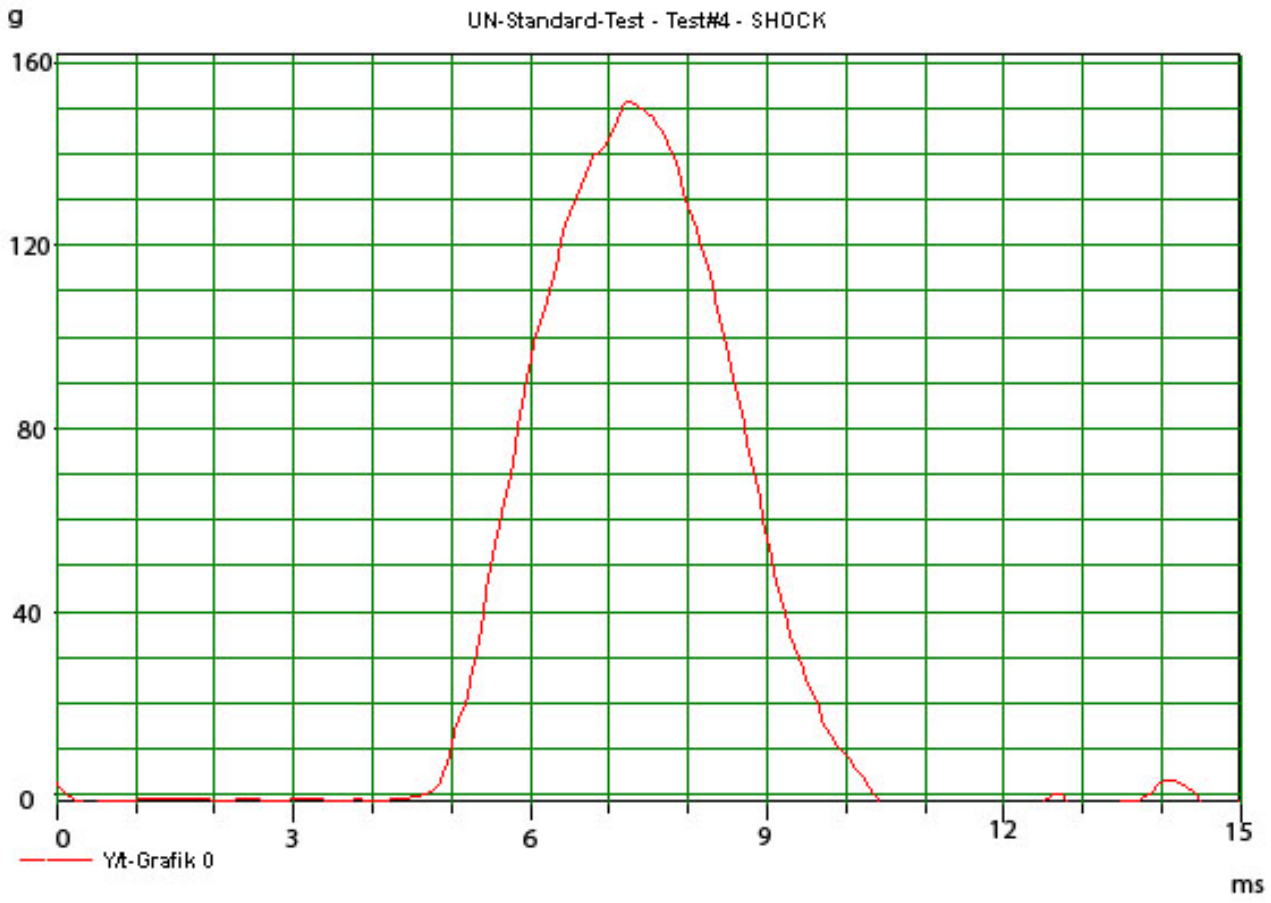
T1-7_Rheintacho Messtechnik GmbH 2s1p NCR-18650A 17065.xlsx

Test # 4: Shock (150 g / 6 ms)

Test Unit No.	Cycle / State	Test Parameter													
		Voltage [V]		Min. Value Voltage [%]	No Voltage Loss	Mass [g]		Max. Mass loss [%]	No Mass Loss	No Leakage	No Venting	No Disassembly	No Rupture	No Fire	Total Result
		Before Test	After Test			Before Test	After Test								
1	1st / fully charged	8,16	8,16	90	Passed	123,70	123,70	0,1	Passed	Passed	Passed	Passed	Passed	Passed	Passed
2	1st / fully charged	8,18	8,18		Passed	124,03	124,03		Passed	Passed	Passed	Passed	Passed	Passed	Passed
3	1st / fully charged	8,16	8,16		Passed	123,65	123,65		Passed	Passed	Passed	Passed	Passed	Passed	Passed
4	1st / fully charged	8,16	8,16		Passed	123,70	123,70		Passed	Passed	Passed	Passed	Passed	Passed	Passed
5	50th / fully charged	8,19	8,19		Passed	124,42	124,42		Passed	Passed	Passed	Passed	Passed	Passed	Passed
6	50th / fully charged	8,17	8,17		Passed	124,13	124,13		Passed	Passed	Passed	Passed	Passed	Passed	Passed
7	50th / fully charged	8,13	8,13		Passed	123,99	123,99		Passed	Passed	Passed	Passed	Passed	Passed	Passed
8	50th / fully charged	8,14	8,14		Passed	124,32	124,32		Passed	Passed	Passed	Passed	Passed	Passed	Passed

Date: 27.10.2011 Operator: Grimm

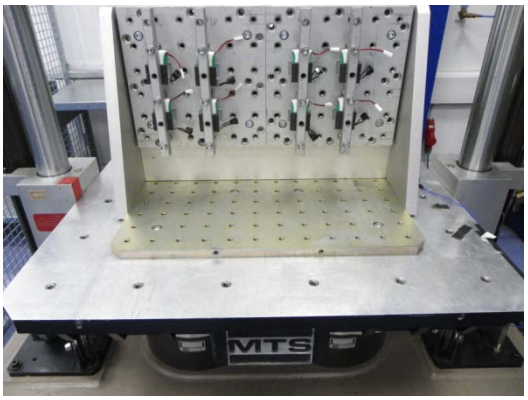
38.3.4.4 Test 4: Shock - Diagram

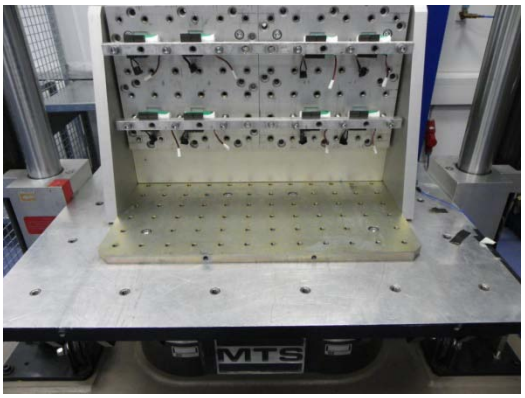


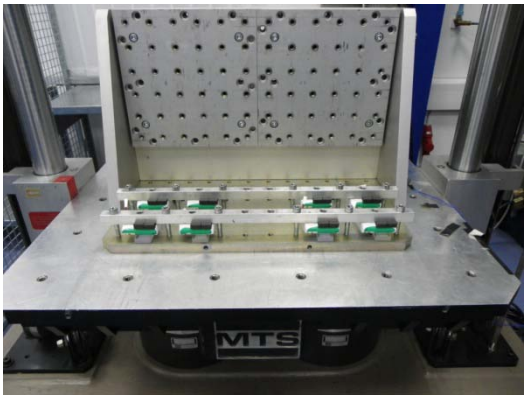
38.3.4.4 Set-up of test 4: Shock

Shock Test System

38.3.4.4 Set-up of test 4: Shock

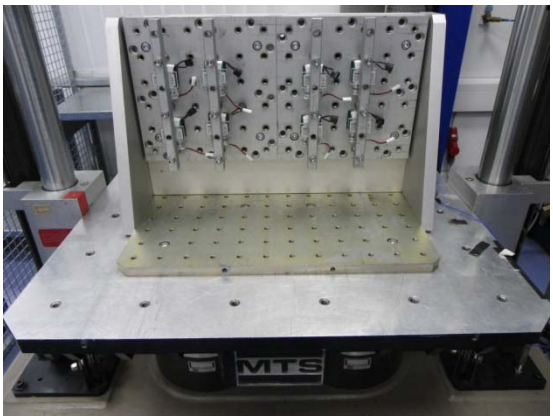


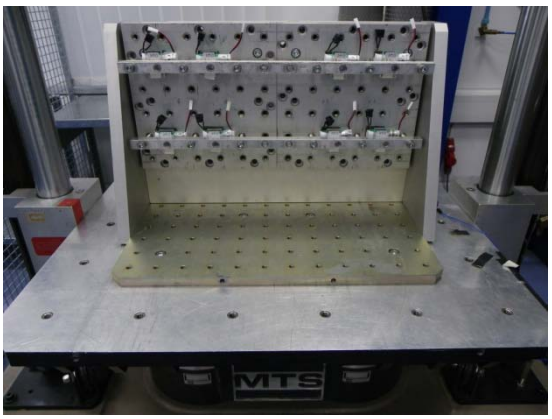


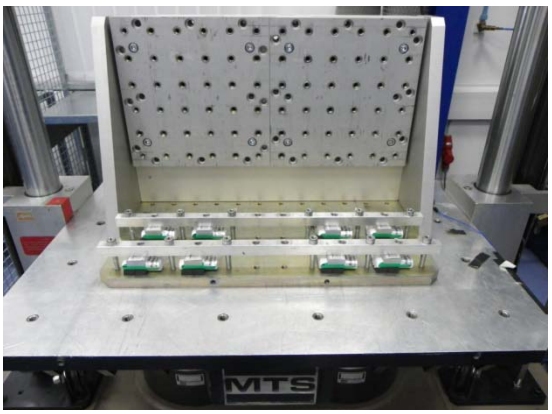


Shock machine with test units (top view)

1. +X-Axis
2. +Y-Axis
3. +Z-Axis







Shock machine with test units (top view)

1. -X-Axis
2. -Y-Axis
3. -Z-Axis

Test Documentation

TEST 5: EXTERNAL SHORT CIRCUIT

38.3.4.5 Test T.5: External short circuit

38.3.4.5.1 Purpose

This test simulates an external short circuit.

38.3.4.5.2 Test procedure

The cell or battery to be tested shall be temperature stabilized so that its external case temperature reaches 55 ± 2 °C and then the cell or battery shall be subjected to a short circuit condition with a total external resistance of less than 0.1 ohm at 55 ± 2 °C. This short circuit condition is continued for at least one hour after the cell or battery external case temperature has returned to 55 ± 2 °C. The cell or battery must be observed for a further six hours for the test to be concluded.

38.3.4.5.3 Requirement

Cells and batteries meet this requirement if their external temperature does not exceed 170 °C and there is no disassembly, no rupture and no fire within six hours of this test.

38.3.4.5 Test 5: External Short Circuit - Protocol chart

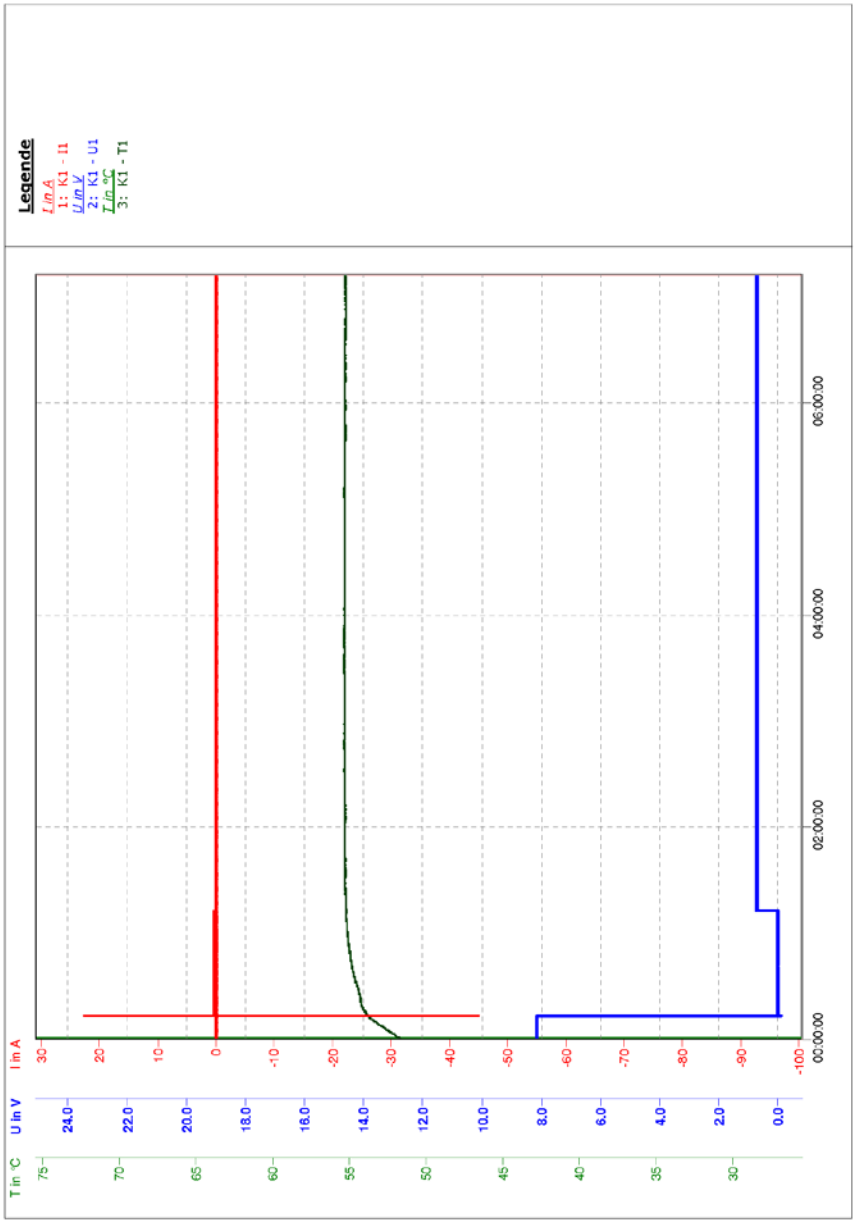
T1-7_Rheintacho Messtechnik GmbH 2s1p NCR-18650A 17065.xlsx

Test # 5: External Short Circuit (+ 55°C, 1h)

Test Unit No.	Cycle / State	Test Parameter									Total Result
						Temp. < 170°C	No Disassembly	No Rupture	No Fire		
1	1st / fully charged					Passed	Passed	Passed	Passed		Passed
2	1st / fully charged					Passed	Passed	Passed	Passed		Passed
3	1st / fully charged					Passed	Passed	Passed	Passed		Passed
4	1st / fully charged					Passed	Passed	Passed	Passed		Passed
5	50th / fully charged					Passed	Passed	Passed	Passed		Passed
6	50th / fully charged					Passed	Passed	Passed	Passed		Passed
7	50th / fully charged					Passed	Passed	Passed	Passed		Passed
8	50th / fully charged					Passed	Passed	Passed	Passed		Passed

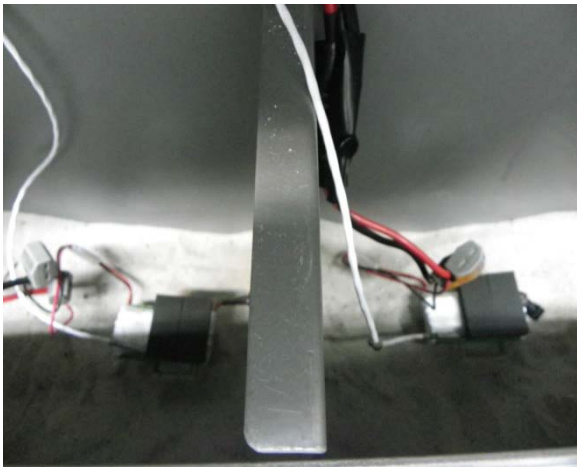
Date: 02.11.2011 Operator: Grimm

38.3.4.5 Test 5: External Short Circuit - Diagram



38.3.4.5 Set-up of test 5: External Short Circuit

Temperature Chamber
(Temperature +55°C)



Shorted battery inside chamber

Test Documentation

TEST 7: OVERCHARGE

38.3.4.7 Test T.7: Overcharge

38.3.4.7.1 Purpose

This test evaluates the ability of a rechargeable battery to withstand an overcharge condition.

38.3.4.7.2 Test procedure

The charge current shall be twice the manufacturer's recommended maximum continuous charge current. The minimum voltage of the test shall be as follows:

(a) when the manufacturer's recommended charge voltage is not more than 18 V, the minimum voltage of the test shall be the lesser of two times the maximum charge voltage of the battery or 22 V.

(b) when the manufacturer's recommended charge voltage is more than 18 V, the minimum voltage of the test shall be 1.2 times the maximum charge voltage.

Tests are to be conducted at ambient temperature. The duration of the test shall be 24 hours.

38.3.4.7.3 Requirement

Cells and batteries meet this requirement if their external temperature does not exceed 170 °C and there is no disassembly, no rupture and no fire within six hours of this test.

38.3.4.7 Test 7: Overcharge - Protocol chart

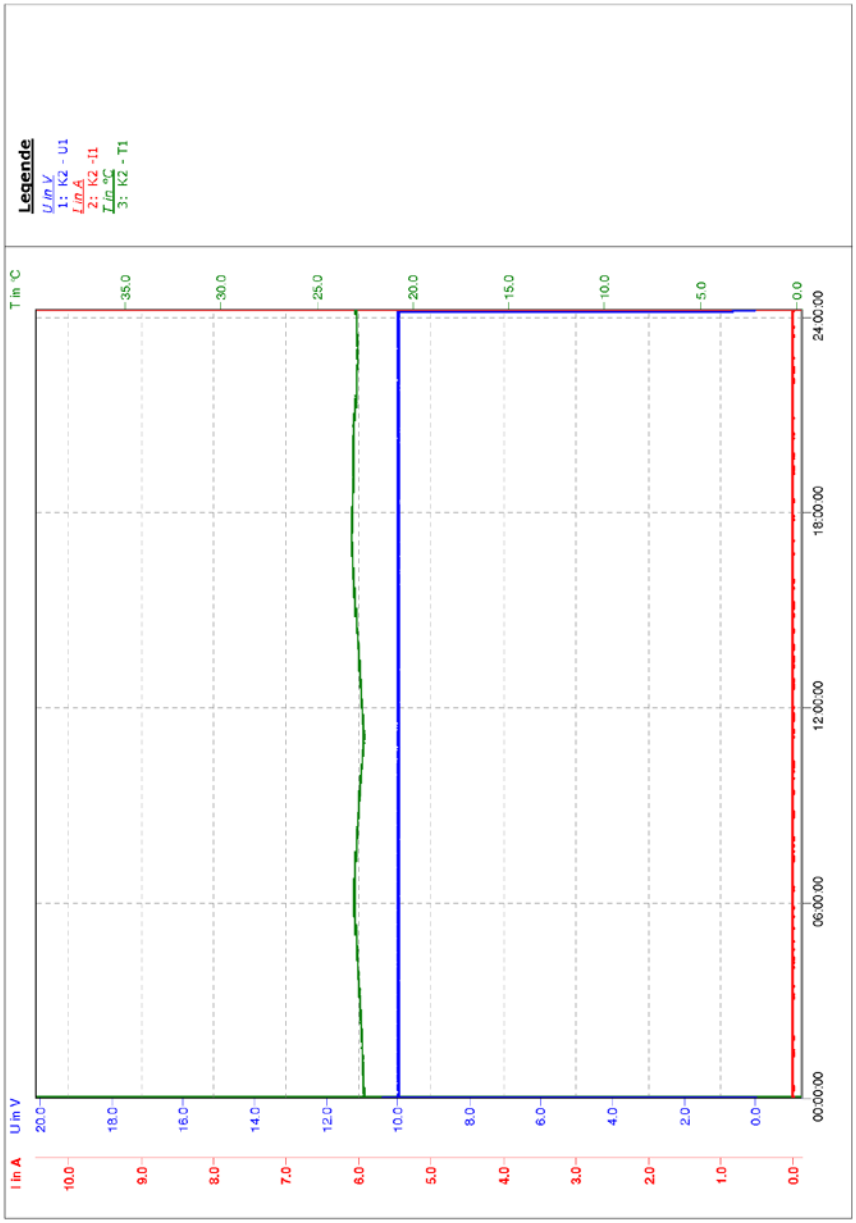
T1-7_Rheintacho Messtechnik GmbH 2s1p NCR-18650A 17065.xlsx

Test # 7: Overcharge (+ 20°C, 24h), Test-Charge-Voltage: 10V, Test-Charge-Current: 0,9A

Test Unit No.	Cycle / State	Test Parameter													
												No Disassembly		No Fire	Total Result
9	1st / fully charged	8,24				123,84						Passed		Passed	Passed
10	1st / fully charged	8,24				123,51						Passed		Passed	Passed
11	1st / fully charged	8,24				124,61						Passed		Passed	Passed
12	1st / fully charged	8,25				124,28						Passed		Passed	Passed
13	50th/ fully charged	8,26				123,96						Passed		Passed	Passed
14	50th/ fully charged	8,27				124,42						Passed		Passed	Passed
15	50th / fully charged	8,25				123,89						Passed		Passed	Passed
16	50th / fully charged	8,20				124,25						Passed		Passed	Passed

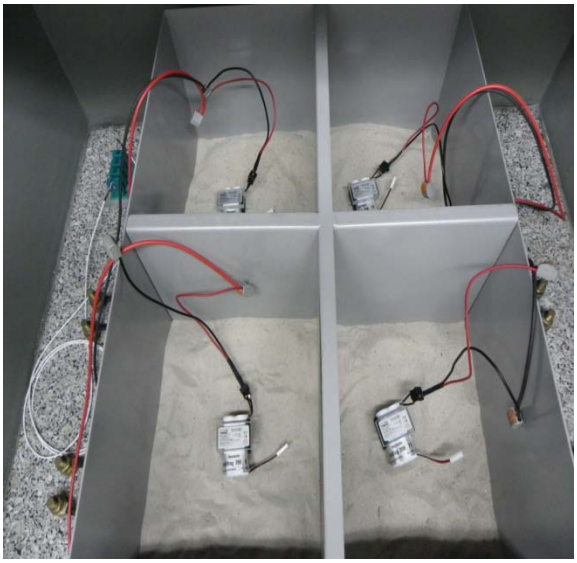
Date: 26.10.2011 Operator: Grimm

38.3.4.7 Test 7: Overcharge - Diagram



38.3.4.7 Set-up of test 7: Overcharge

Power Supplies and DVMS



Test units cabling

Additional Information
(Specifications subject to change without notice · Errors excepted)

INFORMATION FOR THE TRANSPORTATION OF LITHIUM BATTERIES

The information contained in this document is intended to give you a general awareness of battery shipping regulations and does not constitute legal advice.

ALL SHIPMENTS CONTAINING LITHIUM BATTERIES ARE SUBJECT TO DANGEROUS GOODS REGULATIONS FOR AIR, ROAD, RAIL AND SEA TRANSPORT!

General requirements for the admittance of Lithium cells / batteries for transportation:

All Lithium batteries / cells must have passed successfully the test procedures of the UN Manual of Tests and Criteria, Part III, Sub-Section 38.3 – the tests have to be certificated. Regardless whether the exemptions for the eased transportation can be used or the batteries / cells are classified as class 9 goods, the dangerous goods regulations must comply in all.

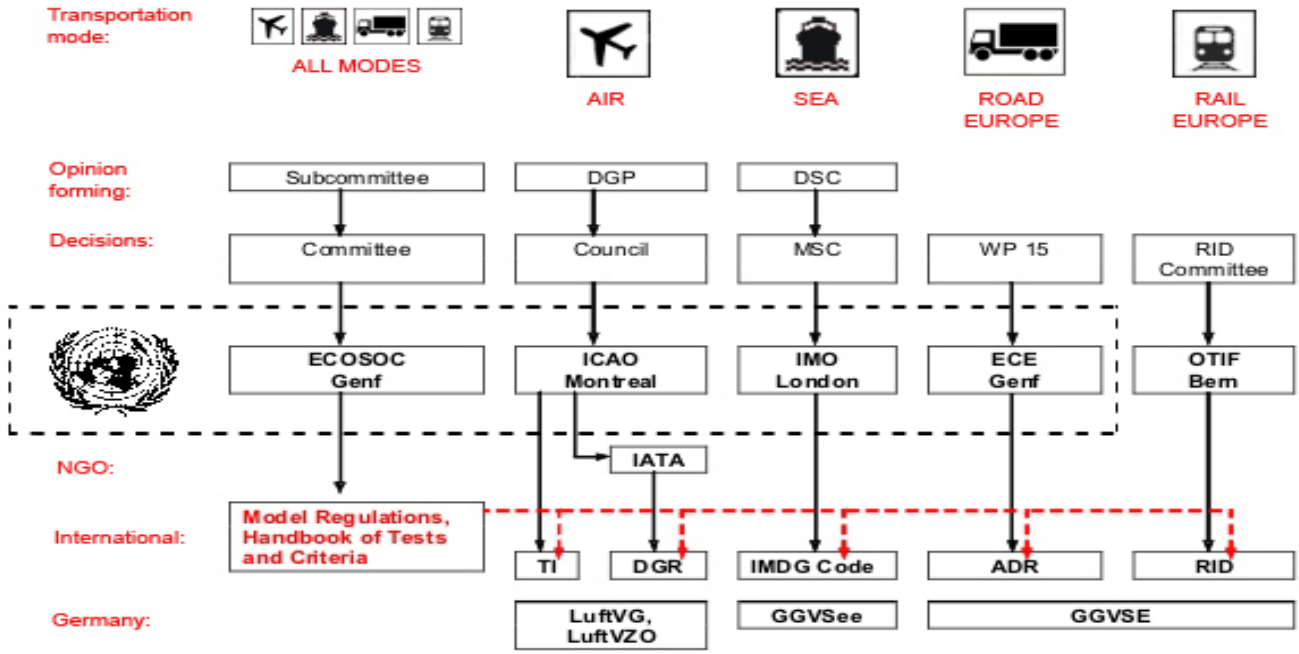
UN Numbers for Lithium Batteries:

UN No.	Proper Shipping Name	Definition
UN 3480	**LITHIUM ION BATTERIES (including lithium polymer batteries)**	**secondary lithium ion batteries** = rechargeable batteries *(that are not packed with or installed in equipment)*
UN 3481	Lithium ion batteries PACKED WITH equipment	***secondary lithium ion batteries*** *packed together with equipment but not attached to the device*
UN 3481	Lithium ion batteries CONTAINED IN equipment	***secondary lithium ion batteries*** *contained in equipment, i.e. installed/integrated in the device*
UN 3090	**LITHIUM METAL BATTERIES**	**primary lithium batteries** = non-rechargeable batteries *(that are not packed with or installed in equipment)*
UN 3091	Lithium metal batteries PACKED WITH equipment	***primary lithium batteries*** *packed together with equipment but not attached to the device*
UN 3091	Lithium metal batteries CONTAINED IN equipment	***primary lithium batteries*** *contained in equipment, i.e. installed/integrated in the device*

Packing Regulations

Important: Any person packing lithium cells or batteries for transport must receive adequate instruction in terms of IATA-DGR on these requirements commensurate with their responsibilities. Now, this is explicitly demanded in the packaging regulations.

INTERNATIONAL REGULATIONS FOR TRANSPORT OF DANGEROUS GOODS



IMPORTANT FOR REGISTRATION, PACKAGING, LABELING, HANDLING AND ACCOMPANYING DOCUMENTS:

We expressly draw attention to the fact that the most current actual regulations and standards in their original language should be reviewed and used for all business, legal, and product compliance purposes:

ADR	European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR)
ADN	European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways
IATA DGR	IATA (International Air Transport Association) Dangerous Goods Regulations
ICAO	International Civil Aviation Organization, Technical Instructions for the Safe Transport of Dangerous Goods by Air
IMDG CODE	International Maritime Code for Dangerous Goods
RID	Regulations Concerning the International Carriage of Dangerous Goods by Rail (RID)
UN	· United Nations Recommendations on the Transport of Dangerous Goods · UN Manual of Tests and Criteria
U.S. DOT	U.S. Department of Transportation

IATA DGR : Special provisions A48, A88, A99, A154, A164 and packing instructions 965-970
ADR / RID / IMDG-Code: Special provisions 188, 230, 310, 636 and packing instructions 903, 903a, 903b

Additional Information
(Specifications subject to change without notice · Errors excepted)

LINKS ABOUT DANGEROUS GOODS TRANSPORT

ADR	http://www.unece.org/trans/danger/publi/adr/adr_e.html
IATA DGR	http://www.iata.org/whatwedo/cargo/dangerous_goods/index.htm
ICAO	http://www.icao.int/anb/FIs/DangerousGoods/
IMDG CODE	http://www.imo.org/Publications/IMDGCode/Pages/Default.aspx
ADN	http://www.unece.org/trans/danger/publi/adn/adn_e.html
RID	http://www.otif.org/
UN	www.unece.org/trans/danger/danger.htm http://www.unece.org/trans/danger/publi/manual/manual_e.html
U.S. DOT	http://safetravel.dot.gov/larger_batt.html