

# PRÜFUNGSZUSAMMENFASSUNG FÜR LITHIUM ZELLEN/BATTERIEN UND LIEFERANTENABFRAGE

GEMÄSS UNTERABSCHNITT 38.3 DES UN-PRÜFHANDBUCHS

N/A = nicht zutreffend

<b>1. Name der Zelle / Batterie</b>
Akku 24V JETVAC

<b>2. Hersteller der Zelle / Batterie</b>	
Name	BMZ GmbH
Adresse	Am Sportplatz 28-30, 63791 Karlstein
Telefon	
Email	
Website	

<b>3. Prüflabor</b>	
Name	batteryuniversity.eu GmbH
Adresse	Am Sportplatz 30, 63791 Karlstein
Telefon	
Email	
Website	batteryuniversity.eu

<b>4. ID-Nummer und Datum</b>			
Eindeutige Prüfberichtsidentifikations-Nr.	BU-2019000465-UN	Datum des Prüfberichts	04.03.2013

## BESCHREIBUNG DER ZELLE / BATTERIE

<b>5. Markieren Sie den Zell- oder Batterietyp mit "•"</b>			
<input checked="" type="radio"/>	Lithium-Ionen-Zelle	Lithium-Metall-Zelle	<input type="radio"/>
<input type="radio"/>	Lithium-Ionen-Batterie	Lithium-Metall-Batterie	<input type="radio"/>
<input type="radio"/>	Lithium-Hybrid-Batterie		

6. Parameter	Zelle	Batterie
Masse in Gramm (g):		
Lithium-Ionen: Watt-Stunden-Bewertung (Wh):		
Lithium-Metall: Lithium-Gehalt in Gramm (g):		
Lithium-Hybrid: Lithiumgehalt in Gramm (g) und Watt-Stunden-Bewertung (Wh)		g Wh

# PRÜFUNGSZUSAMMENFASSUNG FÜR LITHIUM ZELLEN/BATTERIEN UND LIEFERANTENABFRAGE

GEMÄSS UNTERABSCHNITT 38.3 DES UN-PRÜFHANDBUCHS

Name der Zelle/Batterie (von Feld 1)

Akku 24V JETVAC

## 7. Physikalische Beschreibung der Zelle / Batterie

## 8. Modellnummern

## PRÜFUNGEN UND ERGEBNISSE

9. Liste der durchgeführten Prüfungen und Ergebnisse Markieren Sie ‚N/A‘, ‚bestanden‘ oder ‚nicht bestanden‘ mit „●“	N/A	bestanden	nicht bestanden
T1 - Höhensimulation	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
T2 - Thermische Prüfung	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
T3 - Schwingung	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
T4 - Schlag	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
T5 - Äußerer Kurzschluss	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
T6 - Aufprall / Quetschung	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
T7 - Überladung	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
T8 - Erzwungene Entladung	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## 10. Verweis auf Prüfanforderungen für zusammengesetzte Batterien

	N/A
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## 11. Verweis auf die verwendete überarbeitete Ausgabe des Handbuchs über Prüfungen und Kriterien und etwaige Änderungen dazu

# PRÜFUNGSZUSAMMENFASSUNG FÜR LITHIUM ZELLEN/BATTERIEN UND LIEFERANTENABFRAGE

GEMÄSS UNTERABSCHNITT 38.3 DES UN-PRÜFHANDBUCHS

Name der Zelle/Batterie (von Feld 1)
Akku 24V JETVAC

## ZUSÄTZLICHE LIEFERANTENABFRAGE

<b>12. Qualitätsmanagementsystem für die Herstellung der Zellen/Batterien</b> Erfolgt die Herstellung der Zelle / Batterie nach einem dokumentierten QMSystem, das den Vorgaben der Vorschriften entspricht?	<input checked="" type="radio"/>	JA	NEIN	<input type="radio"/>
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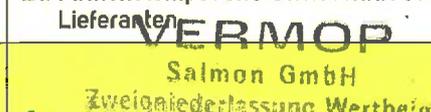
<b>13. Sind folgende Kenngrößen überschritten?</b> Lithium-Ionen-Zelle: mehr als 20 Wh Lithium-Ionen-Batterie: mehr als 100 Wh Lithium-Metall-Zelle: mehr als 1 g Lithium Lithium-Metall-Batterie: mehr als 2 g Lithium Lithium-Hybrid-Batterie: Mehr als 1,5 g Lithium und/oder mehr als 10 Wh	<input checked="" type="radio"/>	JA	NEIN	<input type="radio"/>
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<b>Punkt 14-16 müssen beantwortet werden, wenn die Kenngrößen in Punkt 13 überschritten sind:</b>						
<b>14.</b> Ist jede Zelle / Batterie mit einer Schutzeinrichtung gegen inneren Überdruck versehen oder so ausgelegt, dass ein Gewaltbruch unter normalen Beförderungsbedingungen verhindert wird?	<input checked="" type="radio"/>	JA	NEIN	<input type="radio"/>		
<b>15.</b> Ist jede Zelle / Batterie mit einer wirksamen Vorrichtung zur Verhinderung von Kurzschlüssen ausgerüstet?	<input checked="" type="radio"/>	JA	NEIN	<input type="radio"/>		
<b>16.</b> Ist jede Batterie mit parallel geschalteten Zellen oder parallel geschalteten Reihen von Zellen, mit wirksamen Einrichtungen ausgerüstet, die einen gefährlichen Rückstrom verhindern (z. B. Dioden, Sicherungen usw.)?	<input type="radio"/>	N/A	<input checked="" type="radio"/>	JA	NEIN	<input type="radio"/>

<b>17. Nur für Lithium-Ionen-Zellen/-Batterien und Lithium-Polymer-Zellen/-Batterien im Luftverkehr:</b> Ladezustand (SoC) für UN 3480				
Ladezustand (SoC) max. 30 %	<input checked="" type="radio"/>	JA	NEIN	<input type="radio"/>

## ZELLEN/BATTERIEN, DIE IN GERÄTEN EINGEBAUT SIND

<b>18. Punkt 18 muss beantwortet werden, wenn Zellen / Batterien in Geräten eingebaut sind:</b>						
<b>18.a)</b> Nur Knopfzellen enthalten?	<input type="radio"/>	JA	NEIN	<input type="radio"/>		
<b>18.b) Anzahl enthaltener Zellen (andere als Knopfzellen) bzw. Batterien pro Gerät</b>						
	Enthaltene Zellen pro Gerät		Enthaltene Batterien pro Gerät			
Wenn das Gerät während des Transportes absichtlich aktiv/eingeschaltet ist, z.B. Datenlogger:						
<b>18.c)</b> Bestätigung, dass das Gerät keine gefährliche Hitzeentwicklung erzeugen kann	<input type="radio"/>	N/A	<input type="radio"/>	JA	NEIN	<input type="radio"/>
<b>18.d)</b> Bestätigung, dass das Gerät für den Versand im Luftverkehr die festgelegten Standards für elektromagnetische Strahlung gemäß DO-160 erfüllt	<input type="radio"/>	N/A	<input type="radio"/>	JA	NEIN	<input type="radio"/>

<b>19. Ort, Datum</b>	<b>20. Name, Vorname</b>	<b>21. Firmenstempel und Unterschrift des Lieferanten</b>
Wertheim, 18.12.2019	Flor, Tim	 <i>i.A. Flor</i>





## TRANSPORTATION CERTIFICATE

Concerning the transport according to the dangerous goods regulations of the different transport modes as in force since January, 1st 2003 and changes effective from 2013

WE HEREWITH CERTIFY THAT EACH BATTERY PACK IS OF THE TYPE PROVED TO MEET THE REQUIREMENTS OF EACH APPLICABLE TEST IN THE UN MANUAL OF TESTS AND CRITERIA, PART III, SUB-SECTION 38.3, REV. 5, AMEND. 1

**CERTIFICATE/REPORT NO.: BU-2013-000465-UN**

UN No. / Shipping name:	UN 3480 LITHIUM ION BATTERY UN 3481 LITHIUM ION BATTERY packed with equipment / contained in equipment
Certified Product:	LITHIUM ION BATTERY (rechargeable)
Model Designation:	7S8P NCR-18650A (25.2V/24.8Ah)
Article Number:	13146-1
Certificate Holder:	VERMOP Salmon GmbH Kiesweg 4-6 · D-97877 Wertheim · Germany

PERFORMED TESTS	RESULTS
38.3.4.1 Test 1: Altitude Simulation	passed
38.3.4.2 Test 2: Thermal Test	passed
38.3.4.3 Test 3: Vibration	passed
38.3.4.4 Test 4: Shock	passed
38.3.4.5 Test 5: External Short Circuit	passed
38.3.4.6 Test 6: Impact/Crush	not applicable
38.3.4.7 Test 7: Overcharge	passed
38.3.4.8 Test 8: Forced Discharge	not applicable

▶ Watt-hour rating of the battery pack: 624,96 Wh ◀

As the Watt-hour rating of the battery pack is more than 100 Wh, this lithium ion battery pack has to be declared and shipped as **DANGEROUS GOODS "Class 9"**. According to Packing Instruction 965 (UN 3480) or 966/967 (UN 3481), Section I – Fully Regulated Class 9 Lithium Ion Cells and Batteries - of the IATA-DGR and Packing Instruction P903 of the ADR and IMDG Code. ▶ **THE DANGEROUS GOODS LABEL "CLASS 9" IS REQUIRED** ◀



09.Jul.2013

Date of issue

Signature: Sven Bauer, CEO

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# TEST REPORT

UN 38.3



## LITHIUM-ION BATTERY IN HOUSING

**7S8P NCR-18650A**

**BMZ/VERMOP Salmon GmbH ·**

**Report No. BU-2013-000465-UN**

- Altitude Simulation • Thermal Test • Vibration •
- Shock • External Short Circuit • Overcharge •

## SUMMARY

Model Designation: 7S8P NCR-18650A (25.2V/24.8Ah)

Reference Number: BMZ 13146-1

Test Specification: UN Standard for Transport of Dangerous Goods

Test Result: PASSED

TABLE OF CONTENTS	PAGE
Summary	2
Product Description and Pictures	3
Test Documentation	4
Cycling Equipment	6
Cycle Conditioning	7
Overview Test Procedures	8
Axis Definition	10
Test Equipment	11
Test Procedures	12

### Attachment

Information for the Transportation of Lithium Batteries

## PRODUCT DESCRIPTION AND PICTURES

Applicant/  
Customer: BMZ/VERMOP Salmon GmbH

Model designation: 7S8P NCR-18650A (25.2V/24.8Ah)

Reference number: 13146-1 ·

Front view:



## TEST DOCUMENTATION

**TEST SPECIFICATION** : **UN Standard for Transport of Dangerous Goods:  
UN Manual of Tests and Criteria, Part III, Section 38.3 -  
Lithium batteries (ST/SG/AC.10/11/Rev.5, Amend.1)**

**PERFORMED TESTS** : **T.1 Altitude Simulation**  
**T.2 Thermal Test**  
**T.3 Vibration**  
**T.4 Shock**  
**T.5 External Short Circuit**  
**T.7 Overcharge**

**CUSTOMER/APPLICANT** : **VERMOP Salmon GmbH / BMZ GmbH**  
**Kiesweg 4-6** **Am Sportplatz 28-30**  
**D-97877 Wertheim** **D-63791 Karlstein**  
**Germany** **Germany**

**TEST LABORATORY** : **batteryuniversity.eu GmbH**

**TEST LOCATION** : **Am Sportplatz 30**  
**D-63791 Karlstein am Main**  
**Germany**

**TEST SAMPLES RECEIVED** : **04.Mar.2013**

**TEST PERIOD** : **25.Apr.2013 until 02.Jul.2013**

**TESTED BY** : **H.-P. Grimm, Test engineer**

**APPROVED BY** : **Dr. Jochen Mähliß, Director**



This test report contains the result of a singular investigation carried out on the test samples submitted. The test samples were tested to found the accordance with the thereafter listed standards or clauses of standards respective.

This report shall not be reproduced, except in full, without the written approval of the issuing testing laboratory.

**REPORT REFERENCE NO. : BU-2013-000465-UN**

**DATE OF ISSUE : %%Jul.2013**

**TOTAL NUMBER OF PAGES : 39 pages**

**PRODUCT : BATTERY WITH RECHARGEABLE LITHIUM-ION CELLS  
- IN HOUSING -**

**MODEL DESIGNATION : 7S8P NCR-18650A (25.2V/24.8Ah)**

**ARTICLE NUMBER : 13146-1**

**TEST SAMPLES NO. 1-4 : four small batteries (with a gross mass of not more than  
12 kg) at first cycle, in fully charged states**

**TEST SAMPLES NO. 5-8 : four small batteries (with a gross mass of not more than  
12 kg) after 50 cycles ending in fully charged states**

## **CYCLING EQUIPMENT**

<b>EQ-No.</b>	<b>Description</b>	<b>Manufacturer / Type</b>	<b>Serial No.:</b>
00064	<b>Battery Analyser</b>	BMZ GmbH/ ATGB 1200	44
00065	<b>Battery Analyser</b>	BMZ GmbH/ ATGB 1200	31
00066	<b>Battery Analyser</b>	BMZ GmbH/ ATGB 1200	36
00067	<b>Battery Analyser</b>	BMZ GmbH/ ATGB 1200	34
00068	<b>Battery Analyser</b>	BU GmbH/ ATGB 1200	141200189
00069	<b>Battery Analyser</b>	BMZ GmbH/ ATGB 1200	48
00070	<b>Battery Analyser</b>	BU GmbH/ ATGB 1200	141200188
00071	<b>Battery Analyser</b>	BMZ GmbH/ ATGB 1200	11
00072	<b>Battery Analyser</b>	BU GmbH/ ATGB 1200	141200187
00073	<b>Battery Analyser</b>	BU GmbH/ ATGB 1200	141200186
00114	<b>Battery Analyser</b>	BMZ GmbH/ ATGB 1200	33
00089	<b>Battery Analyser</b>	BMZ GmbH/ ATGB 1200	42
00074	<b>Battery Analyser</b>	BMZ GmbH/ ATGB 1200	47
00075	<b>Battery Analyser</b>	BMZ GmbH/ ATGB 1200	43
00076	<b>Battery Analyser</b>	BMZ GmbH/ ATGB 1200	38
00077	<b>Battery Analyser</b>	BMZ GmbH/ ATGB 1200	37
00078	<b>Battery Analyser</b>	BMZ GmbH/ ATGB 1200	35
00044	<b>Battery Test System</b>	Digatron/ BTS 600	6680992
00045	<b>Battery Test System</b>	BaSyTec	BA V1.61.40.0181
00079	<b>Battery Analyser</b>	Cadex	C7E00529
00080	<b>Battery Analyser</b>	Cadex	C7EC00453
00081	<b>Battery Analyser</b>	Cadex	C7EC00447
00082	<b>Battery Analyser</b>	Cadex	C7EC00448
00236	<b>Datenlogger Master</b>	Delphin AG, ADFT & ADVT	29080580
00237	<b>Datenlogger Slave</b>	Delphin AG, ADVT & ADVT	29080590
00238	<b>Datenlogger Slave</b>	Delphin AG, ADVT & ADIT	29080600

## CYCLE CONDITIONING

TEST UNIT NO.	STATE OF CHARGE AFTER CONDITIONING	BATTERY TEST SYSTEM
1	1 cycle - 100%	ATGB
2	1 cycle - 100%	ATGB
3	1 cycle - 100%	ATGB
4	1 cycle - 100%	ATGB
5	50 cycles - 100%	ATGB
6	50 cycles - 100%	ATGB
7	50 cycles - 100%	ATGB
8	50 cycles - 100%	ATGB

The *batteryuniversity.eu* 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.

## OVERVIEW TEST PROCEDURES

### 38.3.4 Procedure (referring to rechargeable batteries only)

Each 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 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
Test samples:	1-8

#### 38.3.4.2 Test T.2 : Thermal test

	<b>Small Batteries</b>
Temperatures:	72 ± 2 °C / -40 ± 2 °C
Maximum time intervall between temperature extends:	30 min.
Storage time at each temperature:	6 h
Number of cycles:	10
Test samples:	1-8

#### 38.3.4.3 Test T.3 : Vibration

Frequency range:	7 Hz – 200 Hz	
Profile:	<b>Sinusoidal:</b>	<b>Amplitude:</b>
	7 Hz –18 Hz	1 g <sub>n</sub>
	18 Hz –50 Hz	1.6 mm total excursion
	50 Hz – 200 Hz	8 g <sub>n</sub>
Number of sweeps per axis:	24 (12 up and 12 down)	
Total test time:	3 h	
Axis:	X; Y; Z	
Test samples:	1-8	
Number of control sensors:	1	
Test conditions:	room temperature	

**38.3.4.4 Test T.4 : Shock**

	Small batteries
Shock form:	halfsine
Acceleration / duration:	150 g <sub>n</sub> / 6 ms
Number of pulses / half axis:	3
Axis:	± X; ± Y; ± Z
Test conditions:	room temperature
Number of control sensors:	1
Test samples:	1-8

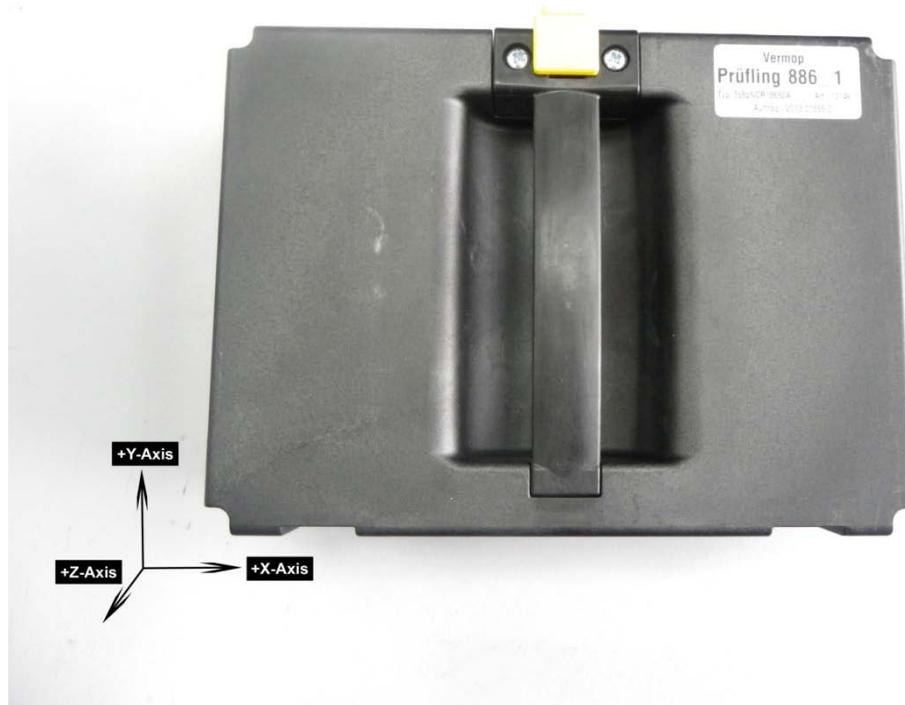
**38.3.4.5 Test T.5 : External Short Circuit**

Temperature:	+55 ± 2 °C
Total external resistance:	less than 0.1 Ohm
Test duration:	1 h
Observation time after test:	6 h
Test samples:	1-8

**38.3.4.7 Test T.7 : Overcharge**

Temperature:	+23 ± 2 °C
Test duration:	24 h
Test current:	twice the manufacturer`s recommended maximum continuous charge current
Test voltage:	<u>recommended charge voltage &lt;18 V:</u> the minimum test voltage shall be lesser of two times the maximum charge voltage of the battery or 22V <u>recommended charge voltage &gt;18 V:</u> the minimum test voltage shall be 1.2 times the maximum charge voltage
Observation time after test:	7 days
Test samples:	1-8

## AXIS DEFINITION



## TEST EQUIPMENT

<b>EQ-No.</b>	<b>Description</b>	<b>Manufacturer / Type</b>	<b>Serial No.:</b>
00921	<b>Altitude Chamber</b>	Memmert, VO 500	S507.0017
00038	<b>Temperature Chamber</b>	ESPEC, EGNX-12-7,5CWL	1710748
00021	<b>Vibration Test System</b>	RMS, SW2-2320	15489
-----	<b>Digital Vibration Control System</b>	RMS, SWR 1200	14982
00027	<b>Control Sensor</b>	PCB, 353B03	128056
00025	<b>Control Sensor</b>	PCB, 353B34	132461
00022	<b>Shock Tester</b>	MTS, 886	JJ090260B
00039	<b>Shock Control Sensor</b>	PCB, 352C03	86584
00040	<b>Conditioning Amplifier</b>	PCB, 482C	341
00041	<b>Software Package</b>	DASY Lab	V10.00.0
00042	<b>Multifunction Module</b>	IO-T Personal DAQ/3005	196147A-01
00017	<b>Power Supply</b>	EA, PS8080-60	1049920001
00018	<b>Power Supply</b>	EA, PS8080-60	1049920002
00035	<b>Power Supply</b>	EA, PS8080-60	1051670001
00036	<b>Power Supply</b>	EA, PS8080-60	1051670002
00004	<b>Digital Multimeter</b>	Metrawatt, Metra Hit	TB1934
00088	<b>Digital Multimeter</b>	Metrawatt, Metrahit One	SH6467
00019	<b>Precision Balance</b>	Kern, KB2400-2N	WO93485
00020	<b>Precision Balance</b>	Kern, CKE36K0.2	WO90754

## Test Procedures

# 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 batteries shall be stored at a pressure of 11.6 kPa or less for at least six hours at ambient temperature ( $20 \pm 5$  °C).

#### 38.3.4.1.3 Requirement

Batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test battery after testing is not less than 90% of its voltage immediately prior to this procedure.

**38.3.4.1 Test 1: Altitude Simulation - Protocol chart**

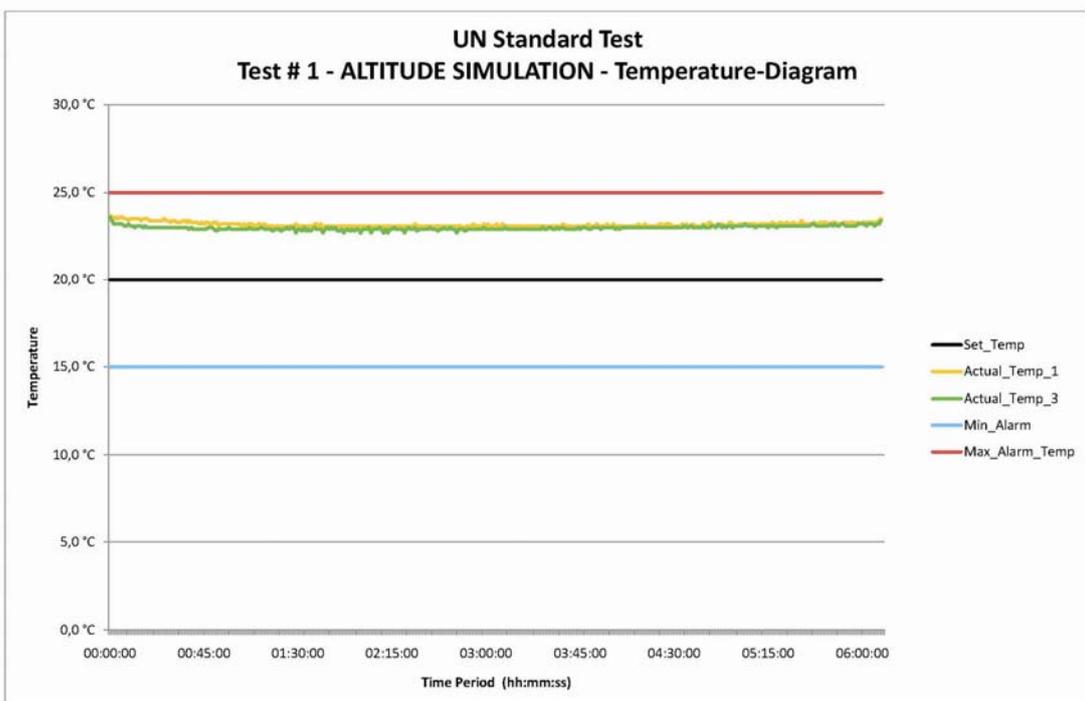
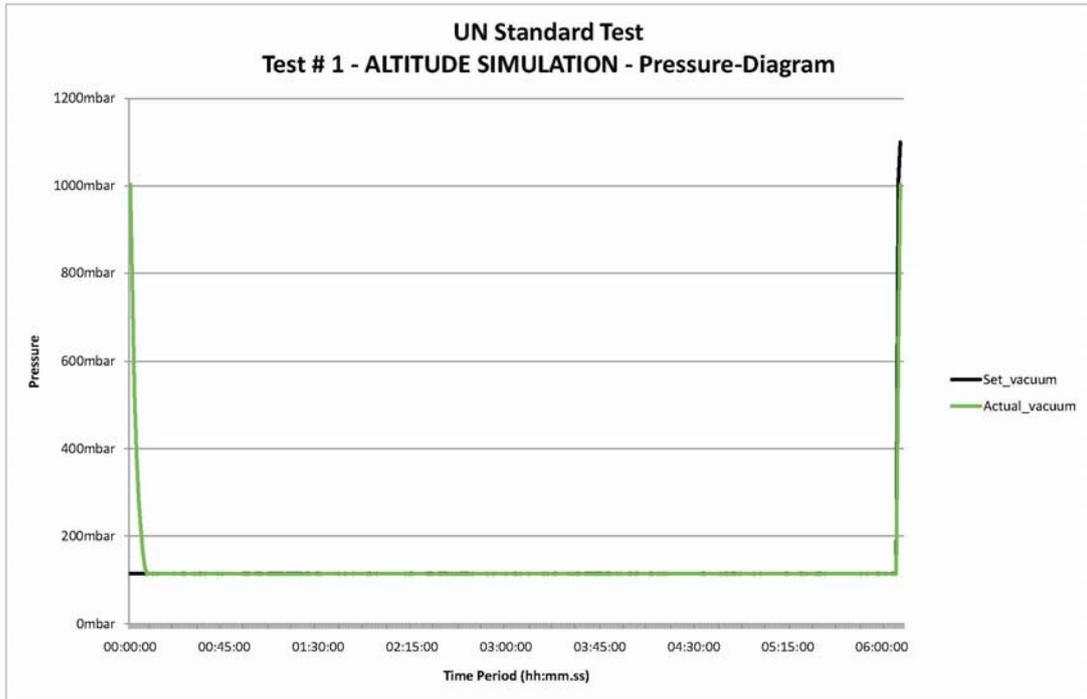
T1-7\_Vermop 7s8p NCR18650A Prüfungsnummer 886.xlsx

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

Test Unit No.	Cycle / State	Voltage [V]		Min. Value Voltage [%]	No Voltage Loss	Mass [g]		Max. Mass loss [%]	No Leakage	No Venting	No Disassembly	No Rupture	No Fire	Total Result	
		Before Test	After Test			Before Test	After Test								
		Test Parameter													
1	1st / fully charged	28,90	28,87	90	Passed	3269,40	3269,20	0,1	Passed	Passed	Passed	Passed	Passed	Passed	
2	1st / fully charged	28,83	28,80		Passed	3277,40	3277,20		Passed	Passed	Passed	Passed	Passed	Passed	Passed
3	1st / fully charged	28,90	28,87		Passed	3275,40	3275,40		Passed	Passed	Passed	Passed	Passed	Passed	Passed
4	1st / fully charged	28,89	28,86		Passed	3277,40	3277,40		Passed	Passed	Passed	Passed	Passed	Passed	Passed
5	50th / fully charged	28,90	28,87	90	Passed	3280,80	3280,80	0,1	Passed	Passed	Passed	Passed	Passed	Passed	
6	50th / fully charged	28,80	28,77		Passed	3273,20	3273,20		Passed	Passed	Passed	Passed	Passed	Passed	Passed
7	50th / fully charged	28,90	28,87		Passed	3277,00	3276,80		Passed	Passed	Passed	Passed	Passed	Passed	Passed
8	50th / fully charged	28,89	28,86		Passed	3281,00	3280,90		Passed	Passed	Passed	Passed	Passed	Passed	Passed

Date: 26.04.2013 Operator: Habermann

**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 Procedures

# TEST 2: THERMAL TEST

### 38.3.4.2 Test T.2: Thermal test

#### 38.3.4.2.1 Purpose

This test assesses 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 batteries are to be stored for at least six hours at a test temperature equal to  $72 \pm 2$  °C, followed by storage for at least six hours at a test temperature equal to  $-40 \pm 2$  °C. The maximum time interval between test temperature extremes is 30 minutes. This procedure is to be repeated until 10 total cycles are complete, after which all test batteries are to be stored for 24 hours at ambient temperature ( $20 \pm 5$  °C).

#### 38.3.4.2.3 Requirement

Batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test battery after testing is not less than 90% of its voltage immediately prior to this procedure.

**38.3.4.2 Test 2: Thermal Test - Protocol chart**

T1-7\_Vermop 7s8p NCR18650A Prüfungsnummer 886.xlsx

**Test # 2: Thermal Test (+72 °C / -40 °C, 120 hrs)**

Test Unit No.	Cycle / State	Test Parameter											Total Result						
		Voltage [V]		Mn. Value Voltage [%]	No Voltage Loss	Mass [g]		Max. Mass loss [%]	No Leakage	No Venting	No Disassembly	No Rupture		No Fire					
		Before Test	After Test			Before Test	After Test												
1	1st / fully charged	28,87	28,62	90	Passed	3269,20	3268,20	0.1	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed			
2	1st / fully charged	28,80	28,57		Passed	3277,20	3276,00		Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	
3	1st / fully charged	28,87	28,63		Passed	3275,40	3274,20		Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	
4	1st / fully charged	28,86	28,62		Passed	3277,40	3276,23		Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	
5	50th / fully charged	28,87	28,65	90	Passed	3280,80	3280,00	0.1	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed		
6	50th / fully charged	28,77	28,58		Passed	3273,20	3272,20		Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	
7	50th / fully charged	28,87	28,65		Passed	3276,80	3276,00		Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed
8	50th / fully charged	28,86	28,64		Passed	3280,90	3280,00		Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed

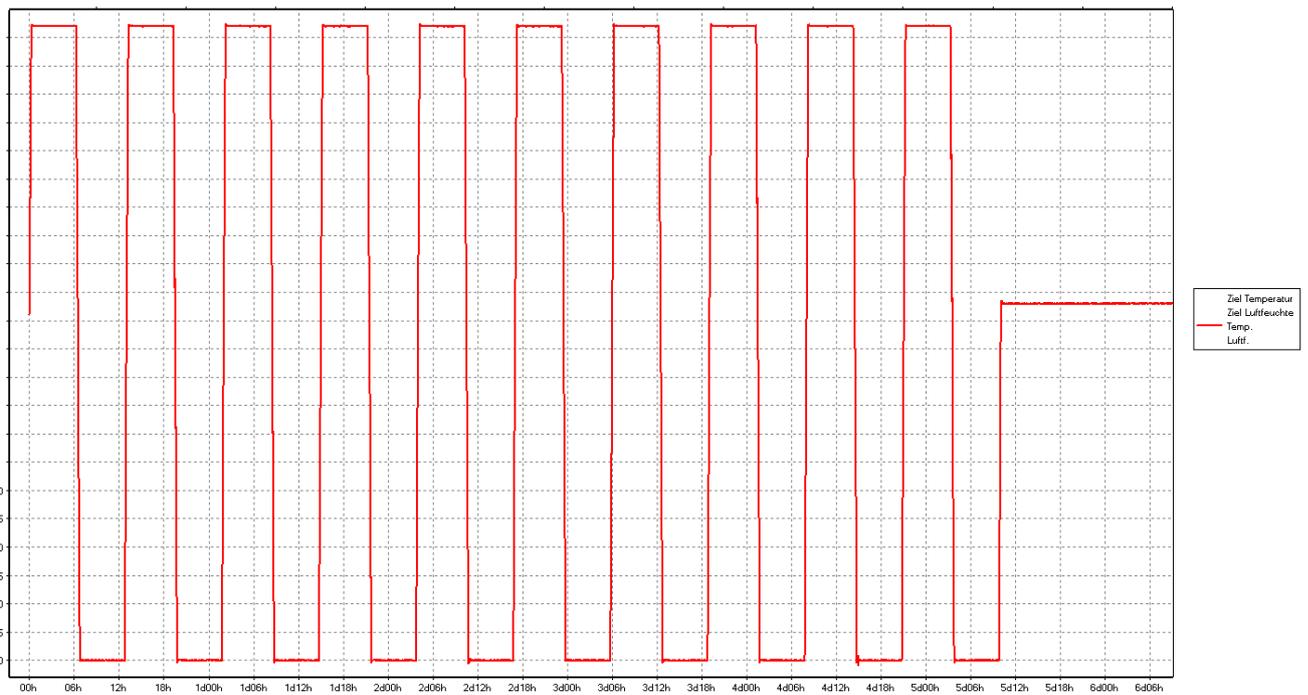
Date: 03.05.2013

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 Procedures

# 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

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 battery. 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

Batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire during the test and after the test and if the open circuit voltage of each test battery directly after testing in its perpendicular mounting position is not less than 90% of its voltage immediately prior to this procedure.

**38.3.4.3 Test 3: Vibration - Protocol chart**

T1-7\_Vermop 7s8p NCR18650A Prüfungsnummer 886.xlsx

**Test # 3: Vibration (7 to 200 Hz)**

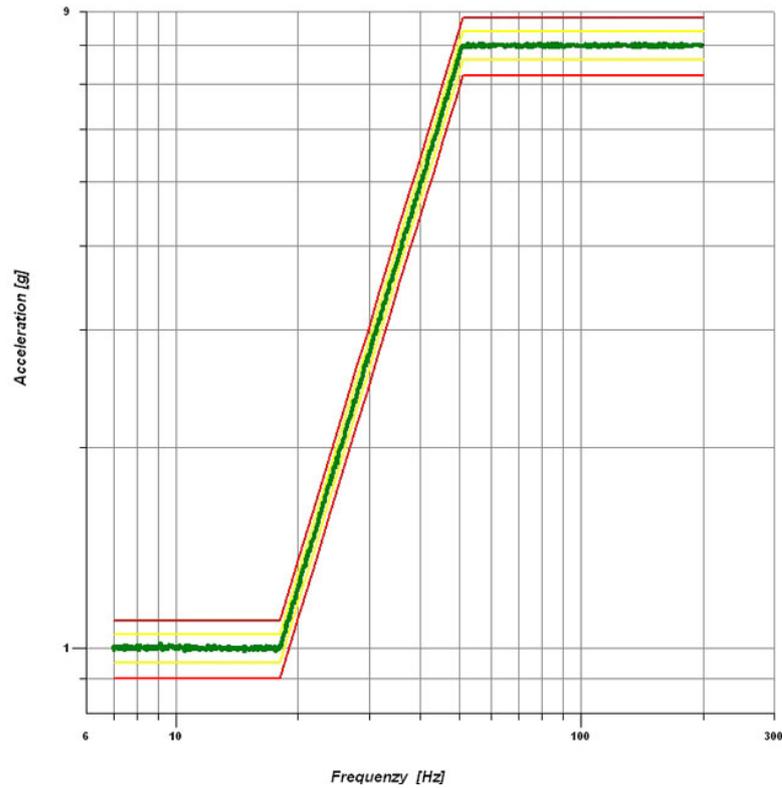
Test Unit No.	Cycle / State	Voltage [V]		Min. Value Voltage [%]	No Voltage Loss	Mass [g]		Max. Mass loss [%]	No Leakage	No Venting	No Disassembly	No Rupture	No Fire	Total Result	
		Before Test	After Test			Before Test	After Test								
1	1st / fully charged	28,62	28,62	90	Passed	3268,20	3268,80	0.1	Passed	Passed	Passed	Passed	Passed	Passed	
2	1st / fully charged	28,57	28,57		Passed	3276,00	3276,80		Passed	Passed	Passed	Passed	Passed	Passed	Passed
3	1st / fully charged	28,63	28,62		Passed	3274,20	3275,00		Passed	Passed	Passed	Passed	Passed	Passed	Passed
4	1st / fully charged	28,62	28,61		Passed	3276,23	3276,80		Passed	Passed	Passed	Passed	Passed	Passed	Passed
5	50th / fully charged	28,65	28,65	90	Passed	3280,00	3280,40	0.1	Passed	Passed	Passed	Passed	Passed	Passed	
6	50th / fully charged	28,58	28,57		Passed	3272,20	3272,80		Passed	Passed	Passed	Passed	Passed	Passed	Passed
7	50th / fully charged	28,65	28,64		Passed	3276,00	3276,60		Passed	Passed	Passed	Passed	Passed	Passed	Passed
8	50th / fully charged	28,64	28,63		Passed	3280,00	3280,60		Passed	Passed	Passed	Passed	Passed	Passed	Passed

Date: 10.05.2013 Operator: Grimm

**38.3.4.3 Test 3: Vibration - Diagram**

Abschalt	Beschl.	Abbruch
Pegel		
-1 dB	<b>0.00 dB</b>	+1 dB
Prüfzeit:	Rest:	
<b>00:02:59:58</b>	<b>---</b>	
Lastw.	Zyklus	
<b>622026</b>	<b>12</b>	
Frequenz	Aussteu.	
<b>7.48 Hz</b>	<b>0.00 %</b>	
Beschl.	<b>0.966 g</b>	
Geschw.	<b>7.932 inch/s</b>	
Weg	<b>0.169 inch</b>	

**UN Standard Test - Test # 3 VIBRATION**



- lower warning threshold
- upper warning threshold
- lower absolutely threshold
- upper absolutely threshold
- set value

actual value

Test procedure per Axis:  
X-Axis, Y-Axis, Z-Axis

Sweep type: logarithmic  
Sweeps done: 24  
Sweep rate: 0,645 Oct/min  
Testing time: 3 hours

### 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 Procedures

# 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 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 battery shall be subjected to a halfsine shock of peak acceleration of 150 g<sub>n</sub> and pulse duration of 6 milliseconds. Each 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 battery for a total of 18 shocks.

#### 38.3.4.4.3 Requirement

Batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test battery after testing is not less than 90% of its voltage immediately prior to this procedure.

**38.3.4.4 Test 4: Shock - Protocol chart**

T1-7\_Vermop 7s8p NCR18650A Prüfungsnummer 886.xlsx

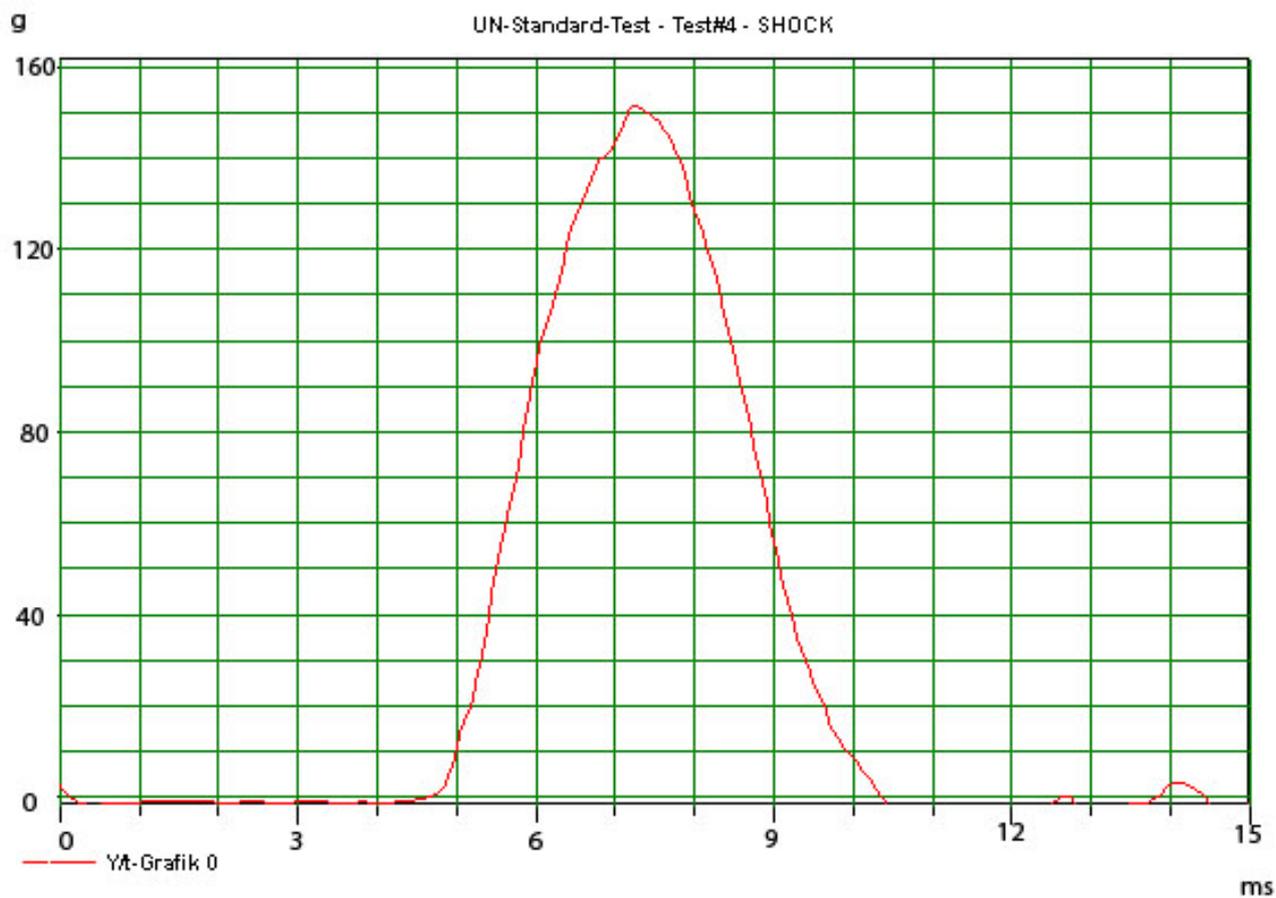
**Test # 4: Shock (150 g / 6 ms)**

Test Unit No.	Cycle / State	Test Parameter													
		Voltage [V]		Min. Value Voltage [%]	No Voltage Loss	Mass [g]		Max. Mass loss [%]	No Leakage	No Venting	No Disassembly	No Rupture	No Fire	Total Result	
		Before Test	After Test			Before Test	After Test								
1	1st / fully charged	28,62	28,50	90	Passed	3268,80	3268,40	0,1	Passed	Passed	Passed	Passed	Passed	Passed	
2	1st / fully charged	28,57	28,51		Passed	3276,80	3277,00		Passed	Passed	Passed	Passed	Passed	Passed	Passed
3	1st / fully charged	28,62	28,57		Passed	3275,00	3275,20		Passed	Passed	Passed	Passed	Passed	Passed	Passed
4	1st / fully charged	28,61	28,56		Passed	3276,80	32772,00		Passed	Passed	Passed	Passed	Passed	Passed	Passed
5	50th/fully charged	28,65	28,60	90	Passed	3280,40	3280,80	0,1	Passed	Passed	Passed	Passed	Passed	Passed	
6	50th/fully charged	28,57	28,50		Passed	3272,80	3273,00		Passed	Passed	Passed	Passed	Passed	Passed	Passed
7	50th / fully charged	28,64	28,59		Passed	3276,60	3277,00		Passed	Passed	Passed	Passed	Passed	Passed	Passed
8	50th / fully charged	28,63	28,58		Passed	3280,60	3281,20		Passed	Passed	Passed	Passed	Passed	Passed	Passed

Date: 17.05.2013

Operator: Grimm

38.3.4.4 Test 4: Shock - Diagram

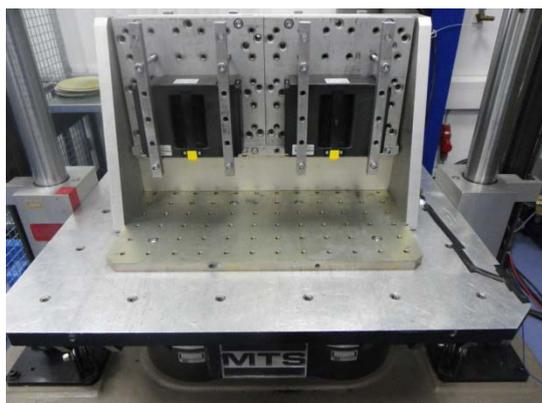
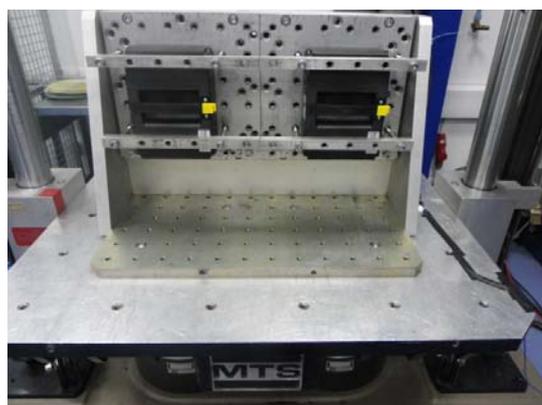


#### 38.3.4.4 Set-up of test 4: Shock

##### Shock Test System



38.3.4.4 Set-up of test 4: Shock



Shock machine with test samples (top view)

Shock machine with test samples (top view)

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

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

## Test Procedures

# 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 battery to be tested shall be temperature stabilized so that its external case temperature reaches  $55 \pm 2$  °C and then the battery shall be subjected to a short circuit condition with a total external resistance of less than 0.1 ohm at  $55 \pm 2$  °C. This short circuit condition is continued for at least one hour after the battery external case temperature has returned to  $55 \pm 2$  °C.

#### 38.3.4.5.3 Requirement

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

**38.3.4.5 Test 5: External Short Circuit - Protocol chart**

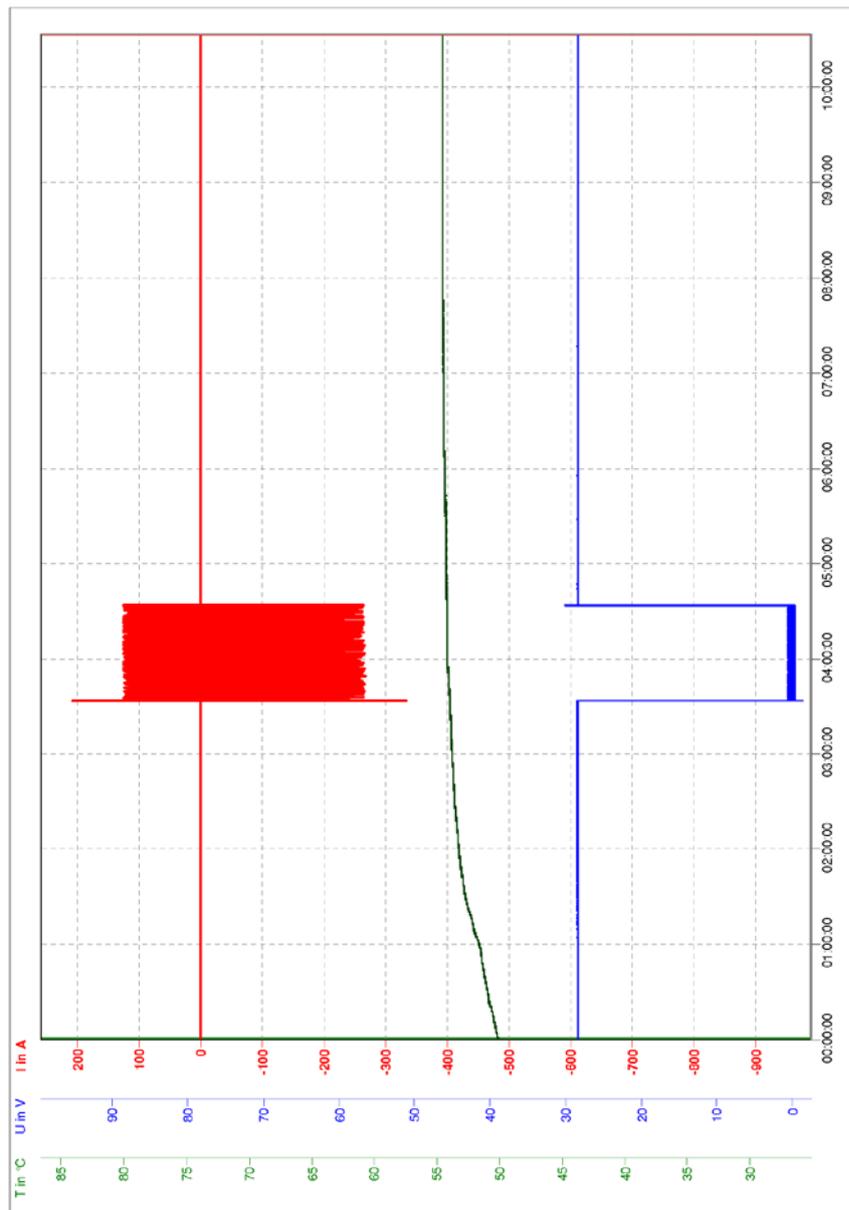
T1-7\_Vermop 7s8p NCR18650A Prufingsnummer 886.xlsx

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

Test Unit No.	Cycle / State	Test Parameter										Total Result				
1	1st / fully charged											Temp. < 170°C	No Disassembly	No Rupture	No Fire	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: 28.05.2013 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 Procedures

# 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

Rechargeable batteries meet this requirement if there is not disassembly and no fire during the test and within seven days after the test.

**38.3.4.7 Test 7: Overcharge - Protocol chart**

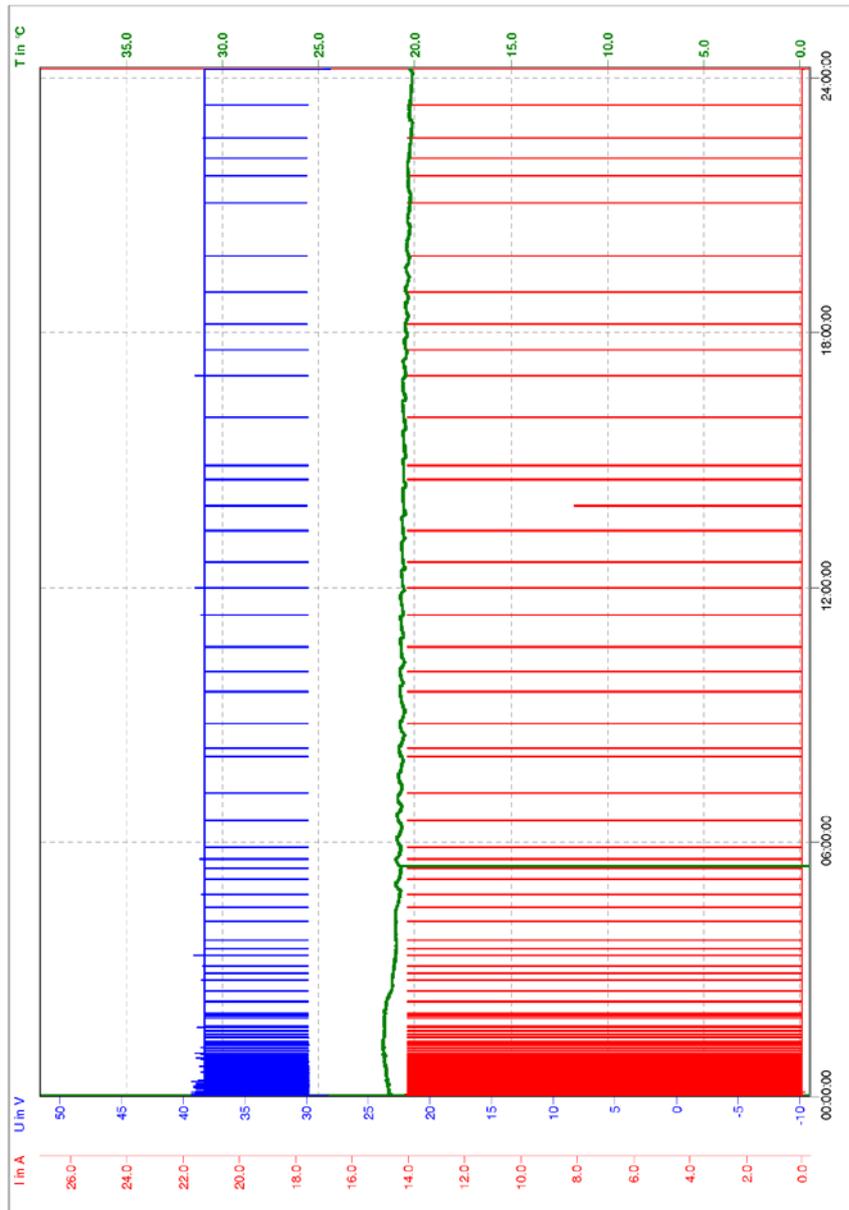
T11-7\_Vermop 7s8p NCR18650A Prüfungsnummer 886.xlsx

**Test # 7: Overcharge (+ 20°C, 24h), Test-Charge-Voltage: 38.22 V, Test-Charge-Current: 14A**

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

Date: 02.07.2013 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 samples 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.

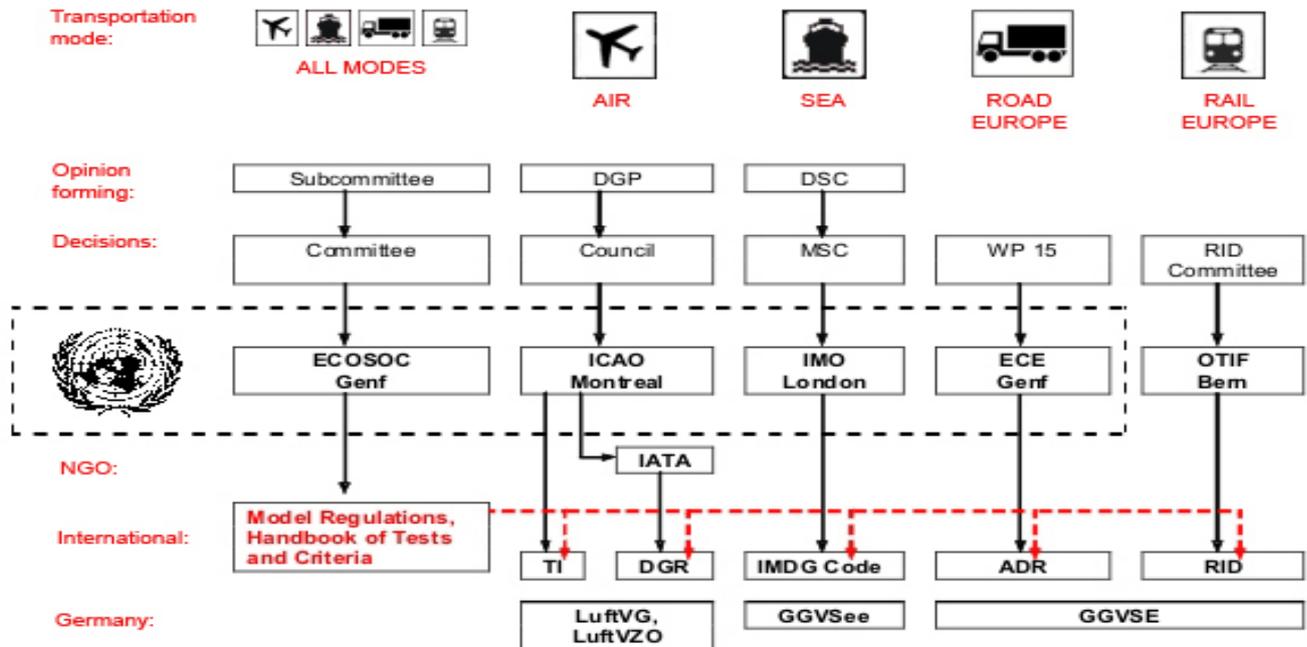
**UN Numbers for Lithium Batteries:**

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:

	<b>ADR</b>	European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR)
	<b>ADN</b>	European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways
	<b>IATA DGR</b>	IATA (International Air Transport Association) Dangerous Goods Regulations
	<b>ICAO</b>	International Civil Aviation Organization, Technical Instructions for the Safe Transport of Dangerous Goods by Air
	<b>IMDG CODE</b>	International Maritime Code for Dangerous Goods
	<b>RID</b>	Regulations Concerning the International Carriage of Dangerous Goods by Rail (RID)
	<b>UN</b>	<ul style="list-style-type: none"> <li>• United Nations Recommendations on the Transport of Dangerous Goods</li> <li>• UN Manual of Tests and Criteria</li> </ul>
	<b>U.S. DOT</b>	U.S. Department of Transportation



**IATA DGR:** Special provisions A48, A51, A88, A99, A154, A164, A181, A183, A185 and packing instructions 965-970

**ADR / RID / IMDG-Code:** Special provisions 188, 230, 310, 348, 636, 661 and packing instructions 903, 903a, 903b

**Additional Information**

(Specifications subject to change without notice · Errors excepted)

**LINKS ABOUT DANGEROUS GOODS TRANSPORT**

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