



## Test Protocol UN Transportation Test

### UN Manual of Tests and Criteria, PART III, Sub-Section 38.3, Rev. 6 A1

#### Protocol

Protocol No..... : 1129-17-MM-18-PP004

Tested by (+ signature)..... : Harmel

*F. Harmel*

Approved by (+ signature)..... : Stein

*M. Stein*

Date of issue..... : 15.10.2018

Contents..... : 11 pages

#### Testing laboratory

Name..... : SLG Prüf- und Zertifizierungs GmbH

Address..... : Burgstädter Straße 20, 09232 Hartmannsdorf, Germany

Email..... : [service@slg.de.com](mailto:service@slg.de.com)

Phone..... : +49 (0)3722 7323-0

Testing location..... : as above

#### Applicant

Name..... : Akku Power GmbH

Address..... : Paul-Strähle-Straße 26

..... : 73614 Schorndorf, Deutschland

#### Test specification

Standard..... : UN Manual of Tests and Criteria  
PART III, Sub-Section 38.3, Rev. 6 A1

Test procedure..... : Test of battery pack, see above

Protocol update..... : 2018-01

#### Test item

Description..... : Akku

Brand / Type..... : 104300 APAL 25,2V / 5,0Ah / 7S2P

Manufacturer..... : Akku Power GmbH

Paul-Strähle-Straße 26

73614 Schorndorf, Deutschland

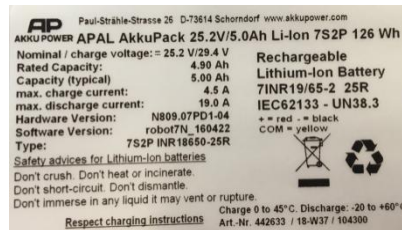
#### Testing

Date of receipt of test item..... : 2018-08-24

Date(s) of performance of test..... : Aug-2018...Oct-2018

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**Copy of marking plate**



**Possible test case verdicts**

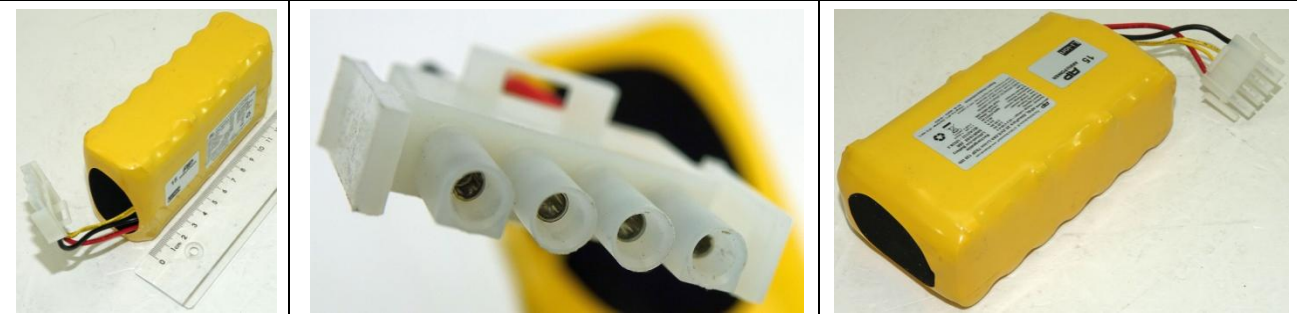
test case does not apply to the test object ..... : N/A  
 test object does meet the requirement..... : P(Pass)  
 test object does not meet the requirement..... : F(Fail)

**General remarks**

The test 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.  
 Throughout this report a point is used as the decimal separator.

**General product information**

Battery Name..... : 104300 APAL 25,2V / 5,0Ah / 7S2P  
 SLG Reference Number..... : 1129-17-M/32...39



Composition Description:  
 Battery assembled for use in mobile applications with a rated voltage of 25.2 V and a capacity of 5.0 Ah, with 14 single cells a 2.5 Ah, Samsung SDI INR18650-25R (successful UN-Test, Document No. MT0080405)

**Summary of test results**

Test number	Test description	Result
38.3.4.1	Altitude Simulation (Unterdrucktest)	P
38.3.4.2	Thermal Cycle Test (Thermischer Zyklentest)	P
38.3.4.3	Vibration (Vibrationstest)	P
38.3.4.4	Shock (Mechanischer Stoß)	P
38.3.4.5	External Short Circuit (Äußerer Kurzschlussstest)	P
38.3.4.6	Impact (Schlagprüfung)	N/A
38.3.4.7	Overcharge (Überlaststest)	P
38.3.4.8	Forced Discharge (Erzwungene Entladung)	N/A



<b>CYCLE CONDITIONING</b>
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The preparation of the battery pack/single cells in accordance with the provisions in the UN Manual of Test and Criteria Part III, Sub-Section 38.3, Paragraph 38.3.3 was carried out by the contracting authority.
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<b>TEST DESCRIPTION</b>
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<b>TABLE 1: Important Battery Data before start of test</b>
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Battery	Voltage [V]	Weight [g]
1129-17-M/032	28.9	701
1129-17-M/033	29.2	700
1129-17-M/034	29.3	704
1129-17-M/035	29.3	704
1129-17-M/036	29.3	702
1129-17-M/037	29.3	702
1129-17-M/038	29.4	704
1129-17-M/039	29.2	702

Samples 36 - 39 are in the first charging/discharging cycle.
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Samples 32 - 35 have completed 50 charging/discharging cycles.
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TEST 1: LOW PRESSURE TEST (38.3.4.1)



Figure 1: Pressure level in test chamber with the batteries inside

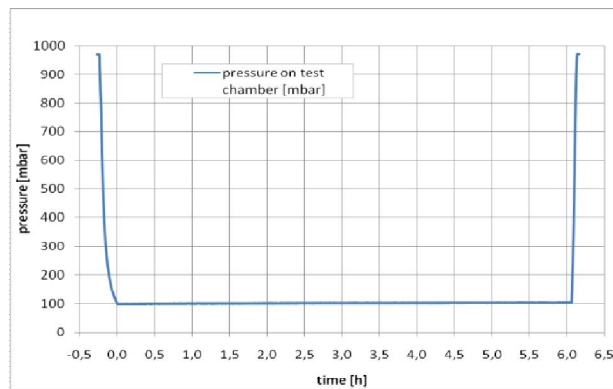


Figure 2: Diagram of pressure level in test chamber with the batteries inside

TABLE 2   Test results low pressure test					
Battery	Voltage [V] before test	Weight [g] before test	Voltage [V] after test	Weight [g] after test	Result
1129-17-M/032	28.9	701	28.9	702	P
1129-17-M/033	29.2	700	29.1	700	P
1129-17-M/034	29.3	704	29.2	703	P
1129-17-M/035	29.3	704	29.1	704	P
1129-17-M/036	29.3	702	29.2	702	P
1129-17-M/037	29.3	702	29.2	701	P
1129-17-M/038	29.4	704	29.2	703	P
1129-17-M/039	29.2	702	29.1	701	P

TEST 2: THERMAL TEST (38.3.4.2)



Figure 3: Thermal test in climate cabinet with the batteries inside

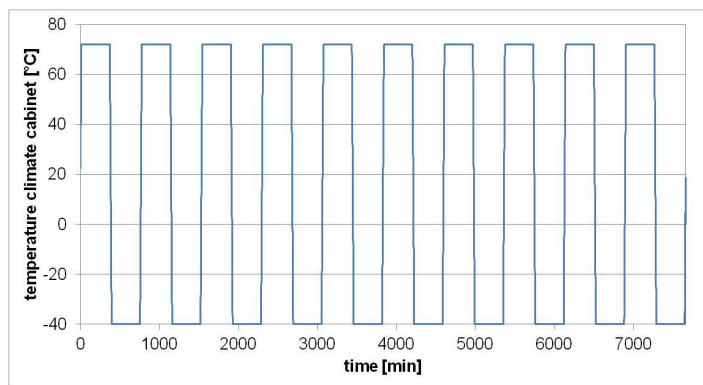


Figure 4: Temperature profile in climate cabinet with the batteries inside

TABLE 3 Test results thermal test					
Battery	Voltage [V] before test	Weight [g] before test	Voltage [V] after test	Weight [g] after test	Result
1129-17-M/032	28.9	702	28.6	702	P
1129-17-M/033	29.1	700	28.5	700	P
1129-17-M/034	29.2	703	28.6	703	P
1129-17-M/035	29.1	704	28.6	704	P
1129-17-M/036	29.2	702	28.6	702	P
1129-17-M/037	29.2	701	28.5	701	P
1129-17-M/038	29.2	703	28.6	703	P
1129-17-M/039	29.1	701	28.6	701	P

TEST 3: VIBRATION TEST (38.3.4.3)

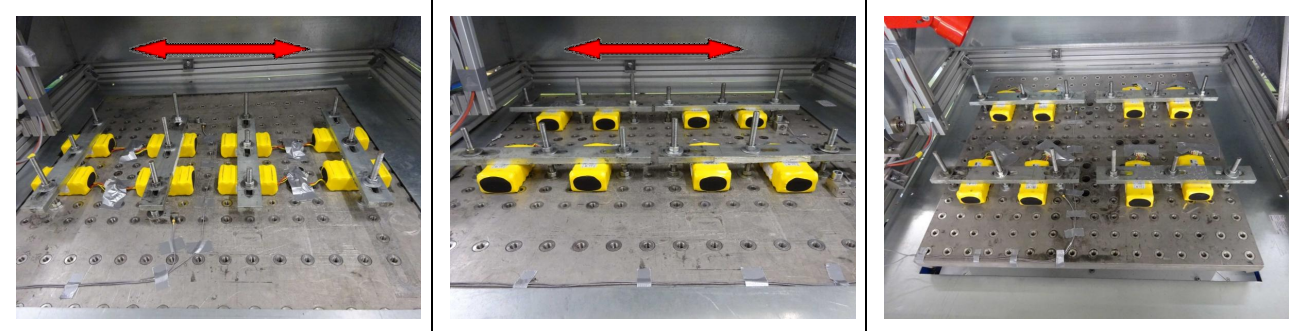


Figure 5: Vibration test on shaker table with the batteries

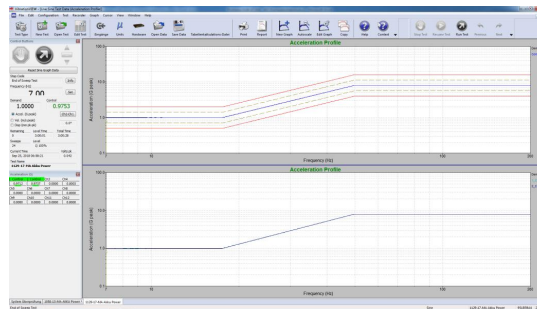


Figure 6: Vibration profile on shaker table with the batteries

TABLE 4		Test results vibration test			
Battery	Voltage [V] before test	Weight [g] before test	Voltage [V] after test	Weight [g] after test	Result
1129-17-M/032	28.6	702	28.5	702	P
1129-17-M/033	28.5	700	28.2	701	P
1129-17-M/034	28.6	703	28.6	704	P
1129-17-M/035	28.6	704	28.6	703	P
1129-17-M/036	28.6	702	28.5	702	P
1129-17-M/037	28.5	701	28.3	702	P
1129-17-M/038	28.6	703	28.5	702	P
1129-17-M/039	28.6	701	28.5	700	P

TEST 4: SHOCK TEST (38.3.4.4)



Figure 7: Shock test on shaker table with the batteries

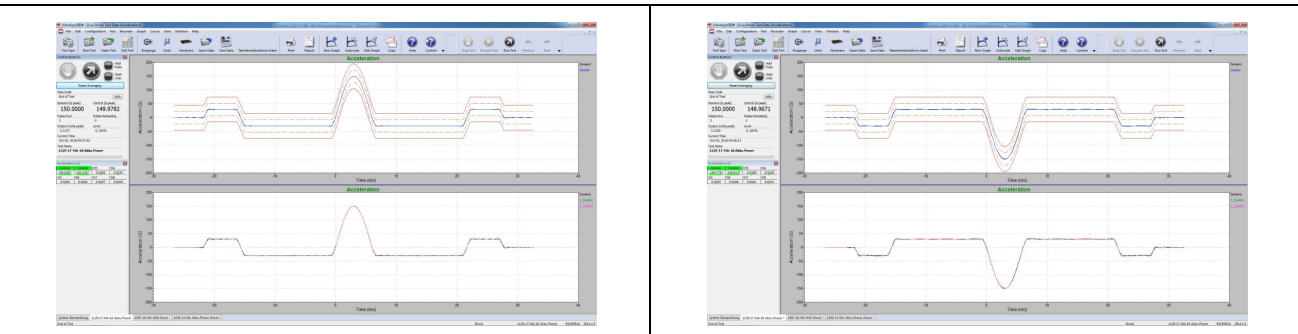


Figure 8: Vibration profile on shaker table with the batteries

TABLE 5   Test results shock test					
Battery	Voltage [V] before test	Weight [g] before test	Voltage [V] after test	Weight [g] after test	Result
1129-17-M/032	28.5	702	28.5	701	P
1129-17-M/033	28.2	701	28.1	701	P
1129-17-M/034	28.6	704	28.6	704	P
1129-17-M/035	28.6	703	28.6	704	P
1129-17-M/036	28.5	702	28.5	702	P
1129-17-M/037	28.3	702	28.2	702	P
1129-17-M/038	28.5	702	28.5	702	P
1129-17-M/039	28.5	700	28.5	701	P



TEST 5: SHORT-CIRCUIT TEST (38.3.4.5)



Figure 9: Short-circuit test in heat cabinet at 55 °C with the batteries

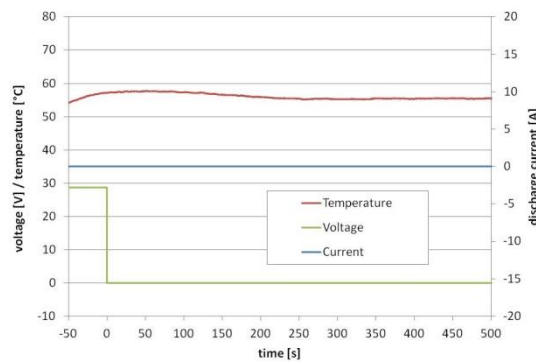


Figure 10: Short-circuit test diagram in heat cabinet at 55 °C with the batteries (at time 0 discharge current was switched on)

TABLE 6 Test results short-circuit test						
Battery	Voltage [V] before test	Weight [g] before test	Maximum temperature [°C]	Voltage [V] after test	Weight [g] after test	Result
1129-17-M/032	28.5	701	< 60	0.0	701	P
1129-17-M/033	28.1	701	< 60	0.0	701	P
1129-17-M/034	28.6	704	< 60	0.0	703	P
1129-17-M/035	28.6	704	< 60	0.0	703	P
1129-17-M/036	28.5	702	< 60	0.0	702	P
1129-17-M/037	28.2	702	< 60	0.0	702	P
1129-17-M/038	28.5	702	< 60	0.0	702	P
1129-17-M/039	28.5	701	< 60	0.0	701	P



TEST 7: OVERCHARGE TEST (38.3.4.7)



Figure 11: Overcharge test in safety cabinet with charge equipment (overcharge current 16 A, overcharge voltage 35.1 V)

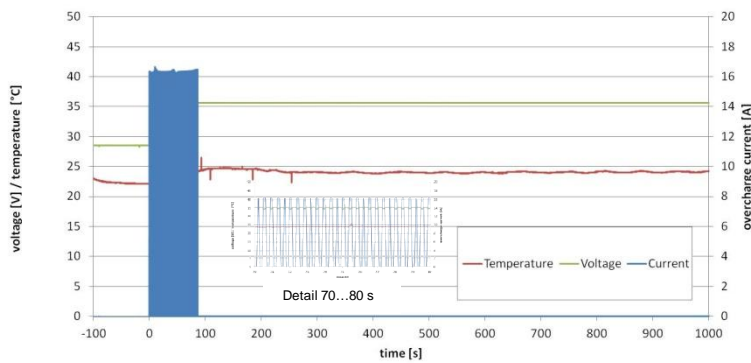


Figure 12: Overcharge test diagram (overcharge current 16 A, overcharge voltage 35.1 V, at time 0 overcharge current was switched on)

TABLE 7		Test results overcharge test					
Battery	Voltage [V] before test	Weight [g] before test	Damage	Fire	Voltage [V] after test	Weight [g] after test	Result
1129-17-M/032	28.5	701	No	No	0.0	701	P
1129-17-M/033	28.1	701	No	No	0.0	701	P
1129-17-M/034	28.5	703	No	No	0.0	703	P
1129-17-M/035	28.6	703	No	No	0.0	703	P
1129-17-M/036	28.5	702	No	No	0.0	702	P
1129-17-M/037	28.1	702	No	No	0.0	702	P
1129-17-M/038	28.5	702	No	No	0.0	702	P
1129-17-M/039	28.5	701	No	No	0.0	701	P



TABLE 8: List of Critical Components					
Object/Part No.	Manufacturer/ Trademark	Type/Model	Technical Data	Standard	Mark(s) of Conformity <sup>1)</sup>
Battery Pack:					
Enclosure material (all models)	Not stated	Not stated	Not stated	-	-
Cell holder	Not stated	Not stated	Not stated	-	-
PCB material	Not stated	Not stated	Not stated	-	-
Single cell	Samsung	INR18650-25R	3.6 V 2500 mAh	-	CB-Certificate IEC62133 DK-34607-UL
NTC	Not stated	Not stated	Not stated	-	-
Charger					

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End of test protocol



ANNEX Test Equipment				
Clause	Test	Equipment		Range used
38.3.4.1	Low pressure	Temperature controlled room (IEC17025) Low pressure chamber	20°C ± 5 K  Low pressure chamber Inv. no. 1499	20°C ± 5 K  Low pressure ≤ 11.6 kPa
38.3.4.2	Cycling temperature change	Conditioning cabinet	Vötsch VC4034 Inv. no. 1400	-20 °C ± 2 K...75 °C ± 2 K
38.3.4.3	Vibration	Vibration test system	Vibration test system TIRA TV 59335/AIT-440 with slip table. Inv. no. 1544 Rated peak force 35 kN Fluke 179 Inv. no. 5005	Sinusoidal vibration test Frequency range: 10 Hz to 55 Hz; Displacement amplitude: 0.76 mm; Acceleration amplitude: 3 to 91 m/s <sup>2</sup>
38.3.4.4	Mechanical shock (crash hazard)	Vibration test system	Vibration test system TIRA TV 59335/AIT-440 Inv. no. 1544	20 °C ± 5 K Shock test (halfsine) Max. shock amplitude from 125 g to 175 g (remark: test can only be realized for small test samples)
38.3.4.5	Outer short circuit	Conditioning cabinet contactor; test sample in steel box	Memmert ULE500 Inv. no. 0469 Contactor Steel box	-20°C ± 5 K...55°C ± 5 K ≤ 100 mΩ
38.3.4.6	Impact	Test equipment impact		
38.3.4.7	Overcharge	Charging power station	Elektro-Automatik GmbH EA-532-100. Inv. no. 2731  Hioki LR8400-20 inv.no.: 2429	$I_{\text{charge}} = 2 I_{\text{nominal}}$ Max. DC voltage 54 V, current 40 A Max. DC voltage 54 V, current 20 A
38.3.4.8	Forced discharge	Discharge power station	Höcherl&Hackerl ZS1406	Max. DC voltage 60 V, current 150 A Max. DC voltage 44 V, current 40 A Max. DC voltage 44 V, current 20 A
38.3.4.1 – 38.3.4.8	All tests	Voltage measurement Current measurement	Data Logger Hioki LR8431-20 inv.no.: 2856, 2422, 2423  Current probe Z202A, inv.-no. 2425	Max. DC voltage 60 V