TEST REPORT
IEC 62619
Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications

Report Number..... :	68.280.17.851.02
Date of issue ..... :	2019-07-25
Total number of pages..... :	16 pages
Name of Testing Laboratory preparing the Report..... :	TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch Building 12&13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District 518052 Shenzhen, CHINA
Applicant's name ..... :	Power Crank Batteries P/L.
Address ..... :	1271 The Horsley Drive, Weatherill Park,NSW 2164,Australia
Test specification:	
Standard ..... :	IEC 62619: 2017 (First Edition)
Test procedure..... :	TÜV Mark
Non-standard test method..... :	N/A
Test Report Form No. ..... :	IE62619A
Test Report Form(s) Originator.... :	UL(Demko)
Master TRF ..... :	Dated 2017-11-16

This report is not valid as a CB Test Report unless signed by an approved CB Testing Laboratory and appended to a CB Test Certificate issued by an NCB in accordance with IECEE 02.

General disclaimer:

The test results presented in this report relate only to the object tested.
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Test item description :	Rechargeable Li-ion Cell
Trade Mark :	
Manufacturer :	**Power Crank Batteries P/L** **1271 The Horsley Drive, Weatherill Park,** **NSW 2164, Australia.**
Model/Type reference :	PF37M
Ratings :	3.2Vd.c., 37Ah

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):

Testing Laboratory:	TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch	
Testing location/ address :	Building 12&13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District 518052 Shenzhen, CHINA	
Tested by (name, function, signature) :	Tim Yan (Project Handler)	Tim Yan
Approved by (name, function, signature) :	Joyce Lian (Designated Reviewer)	

List of Attachments (including a total number of pages in each attachment):

N/A

Summary of testing:

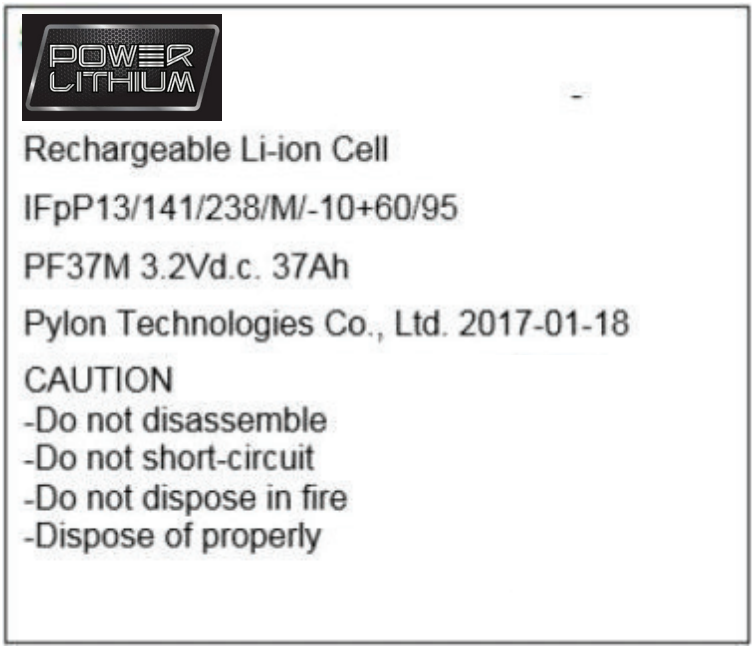
Tests performed (name of test and test clause):	**Testing location:**
In section 7, each test clause below is performed with three cells except for clause 7.3.2 with five cells. - Cl. 7.2.1 External short-circuit test (cell or cell block) - Cl. 7.2.2 Impact test (cell or cell block) - Cl. 7.2.3.2 Whole drop test (cell or cell block, and battery system) - Cl. 7.2.4 Thermal abuse test (cell or cell block) - Cl. 7.2.5 Overcharge test (cell or cell block) - Cl. 7.2.6 Forced discharge test (cell or cell block) - Cl. 7.3.2 Internal short-circuit test (cell) The samples comply with the above requirements of IEC 62619:2017 (First Edition).	TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch Address: No.11, Jukeng Rd., Juling Village, Jutang District, Guanlan, Longhua New District, 518110 Shenzhen, P.R. China

Summary of compliance with National Differences: N/A

List of countries addressed: N/A

Copy of marking plate:

Below marking plate will be pasted on the surface of the cell,



Remark:

"2017-01-18" represent the date of manufacture. It represents the cell manufactured on January 18th, 2017. This manufacture date is not the manufacture date of actual samples and only for examples.

Test item particulars .....:	
Classification of installation and use.....:	Use in energy storage applications
Supply Connection .....:	Supply by tabs
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)
Testing ..... :	
Date of receipt of test item..... :	2019-06-17
Date (s) of performance of tests ..... :	2017-06-12 to 2017-07-10, 2019-06-30 to 2019-07-25

General remarks:

"(See Enclosure #)" refers to additional information appended to the report.
"(See appended table)" refers to a table appended to the report.

Throughout this report a ☐ comma / ☒ point is used as the decimal separator.

Remark:

1. Photo Documentation (2 pages).
2. This report is based on original test report 68.280.17.851.01 for below modifications:
   1) The charging temperature range is changed from -10°C-60°C to -10°C-62°C;
   2) The address for the manufacture and the factory is changed from
   Building 5, No. 182, Xuanchun Road, Sanzao Industrial Park, 201203 Pudong, Shanghai, PEOPLE'S REPUBLIC OF CHINA

   to

   Plant 8, No.505 Kunkai Road, JinXi Town, 215324 Kunshan City, Jiangsu Province, PEOPLE'S REPUBLIC OF CHINA

   The tests could be covered by the tests in original test report 68.280.17.851.01.
3. Full test report 68.280.17.851.02 is re-issued to replace original test report 68.280.17.851.01. and all the test data come from original test report 68.280.17.851.01.

Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:	
The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided .....:	☐ **Yes** ☒ **Not applicable**

When differences exist; they shall be identified in the General product information section.

Name and address of factory (ies)..... :	**P**ower Crank Batteries **P/L**. 1271 The Horsley Drive, Weatherill Park,NSW 2164，Australia

POWER LITHIUM

LifePO4 LITHIUM ION

General product information and other remarks:

The Rechargeable Li-ion Cell, model no. PF37M, used in energy storage applications.

For detail information of cell, please refer to below table:

Product name	Rechargeable Li-ion Cell
Type/model	PF37M
Nominal voltage	3.2Vd.c.
Rated capacity	37Ah
Recommended charging voltage by manufacturer	3.65V
Upper limit charging voltage	3.65V
Recommended charging current by manufacturer	7.4A
Maximum charging current	74A
Charge temperature range	-10°C-62°C
Charge method declared by manufacturer	Charge at constant current 7.4A until the voltage reaches 3.65V, then charge at 3.65V till charge current is 0.74A
Charging procedure for internal short-circuit test	Charge at constant current 74A until the voltage reaches 3.65V, then charge at 3.65V till charge current is 0.05I_tA (1.85A)
Maximum discharging current	111A
Final discharge voltage	2.5V
Dimension	12.5mm x 141mm x 238mm
Weight	Approx. 790g

The final evaluation of the cell must be conducted in the end products for which the cell will be used.

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
4	**PARAMETER MEASUREMENT TOLERANCES**		P
	Parameter measurement tolerances		P
5	**GENERAL SAFETY CONSIDERATIONS**		P
5.1	**General**		P
	Cells and batteries are safe under conditions of both intended use and reasonably foreseeable misuse..:		P
5.2	**Insulation and wiring**		P
	Voltage, current, altitude, and humidity requirements		P
	Adequate clearances and creepage distances between connectors		N/A
	The mechanical integrity of internal connections		N/A
5.3	**Venting**		P
	Pressure relief function		P
	Encapsulation used to support cells within an outer casing		N/A
5.4	**Temperature/voltage/current management**		N/A
	The design prevents abnormal temperature-rise		N/A
	Voltage, current, and temperature limits of the cells		N/A
	Specifications and charging instructions for equipment manufacturers		N/A
5.5	**Terminal contacts of the battery pack and/or battery system**		N/A
	Polarity marking(s)		N/A
	Capability to carry the maximum anticipated current		N/A
	External terminal contact surfaces		N/A
	Terminal contacts are arranged to minimize the risk of short circuits		N/A
5.6	**Assembly of cells, modules, or battery packs into battery systems**		N/A
5.6.1	General		N/A
	Independent control and protection method(s)		N/A
	Recommendations of cell operating limits by the cell manufacturer		N/A
	Batteries designed for the selective discharge of a portion of their series connected cells		N/A
	Protective circuit component(s) and consideration to the end-device application		N/A
5.6.2	Battery system design		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	The voltage control function		N/A
	The voltage control for series-connected batteries		N/A
5.7	**Operating region of lithium cells and battery systems for safe use**		P
	The cell operating region.....:	See page 5	P
	Designation of battery system to comply with the cell operating region		N/A
5.8	**Quality plan**		P
	Manufacturing quality plan (for example: ISO9001, etc.) prepared and implemented.....:	See ISO 9001 Certificate	P
	The process capabilities and the process controls		P
6	**TYPE TEST CONDITIONS**		P
6.1	**General**		P
6.2	**Test items**		P
	Cells or batteries that are not more than six months old (See Table 1 of IEC62619)		P
	Capacity confirmation of the cells or batteries		P
	Default ambient temperature of test, 25 °C ± 5 °C		P
7	**SPECIFIC REQUIREMENTS AND TESTS**		P
7.1	**Charging procedure for test purposes**		P
	The battery discharged to a specified final voltage prior to charging		P
	The cells or batteries charged using the method specified by the manufacturer ..... :	See page 5	P
7.2	**Reasonably foreseeable misuse**		P
7.2.1	External short-circuit test (cell or cell block)		P
	Short circuit with total resistance of 30 m 10 m at 25 °C ± 5 °C		P
	Results: no fire, no explosion	See table 7.2.1	P
7.2.2	Impact test (cell or cell block)		P
	Cylindrical cell, longitudinal axis impact		N/A
	Prismatic cell, longitudinal axis and lateral axis impact		P
	Results: no fire, no explosion.		P
7.2.3	Drop test (cell or cell block, and battery system)		P
7.2.3.1	General		P

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
7.2.3.2	Whole drop test (cell or cell block, and battery system)		P
	Description of the Test Unit ..... :	Cell	—
	Mass of the test unit (kg) ..... :	0.79	—
	Height of drop (m)..... :	1.00	—
	Results: no fire, no explosion		P
7.2.3.3	Edge and corner drop test (cell or cell block, and battery system)		N/A
	Description of the Test Unit ..... :		—
	Mass of the test unit (kg) ..... :		—
	Height of drop (m)..... :		—
	Results: no fire, no explosion		N/A
7.2.4	Thermal abuse test (cell or cell block)		P
	Results: no fire, no explosion		P
7.2.5	Overcharge test (cell or cell block)		P
	For those battery systems that are provided with only a single protection for the charging voltage control		—
	Results: no fire, no explosion ..... :	See Table 7.2.5.	P
7.2.6	Forced discharge test (cell or cell block)		P
	Upper limit charge voltage of the cell ..... :	3.65V	P
	Cells connected in series in the battery system ..... :	-	N/A
	Redundant or single protection for discharge voltage control provided in battery system ..... :	-	N/A
	Target Voltage..... :	-3.65V	P
	Maximum discharge current of the cell, I_m ..... :	111A	P
	Discharge current for forced discharge, 1.0 It ..... :	37A	P
	Discharging time, t = (1 It / I_m) x 90 (min.)..... :	90min	P
	Results: no fire, no explosion ..... :	See Table 7.2.6.	P
7.3	**Considerations for internal short-circuit – Design evaluation**		P
7.3.1	General		P
7.3.2	Internal short-circuit test (cell)		P
	Samples preparation procedure: a), in accordance with 8.3.9 of IEC62133:2012; or b), the nickel particle inserted before charging, or c), the nickel particle was inserted before electrolyte filling ..... :	a	P

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Clause	Requirement + Test	Result - Remark	Verdict
	Tested according to Cl. 8.3.9 of IEC 62133:2012 test method, except all tests were carried out in an ambient temperature of 25 °C ± 5 °C.		P
	The appearance of the short-circuit location recorded by photograph or other means ..... :	Photograph	—
	The pressing was stopped - When a voltage drop of 50 mV was detected; or		N/A
	- The pressing force of 800 N (cylindrical cells) or 400 N (prismatic cells) was reached	400N	P
	Results: no fire, no explosion ..... :	See Table 7.3.2.	P
7.3.3	**Propagation test (battery system)**	Select cl.7.3.2	N/A
	Method to create a thermal runaway in one cell ... :	See Annex B	N/A
	Results: No external fire from the battery system or no battery case rupture ..... :	See Table 7.3.3	N/A
8	**BATTERY SYSTEM SAFETY (CONSIDERING FUNCTIONAL SAFETY)**		**N/A**
8.1	**General requirements**		N/A
	Functional safety analysis for critical controls		N/A
	Conduct of a process hazard, risk assessment and mitigation of the battery system		N/A
8.2	**Battery management system (or battery management unit)**		N/A
8.2.1	Requirements for the BMS		N/A
	The safety integrity level (SIL) target of the BMS		N/A
	The charge control evaluated by tests in clauses 8.2.2 to 8.2.4		N/A
8.2.2	Overcharge control of voltage (battery system)		N/A
	The exceeded charging voltage applied to the whole battery system		N/A
	The exceeded charging voltage applied to only a part of the battery system, such as the cell(s) ..... :		N/A
	Results: no fire, no explosion ..... :	See Table 8.2.2	N/A
	The BMS interrupted the overcharging before reaching 110% of the upper limit charging voltage		N/A
8.2.3	Overcharge control of current (battery system)		N/A
	Results: no fire, no explosion ..... :	See Table 8.2.3	N/A
	The BMS detected the overcharging current and controlled the charging to a level below the maximum charging current		N/A
8.2.4	Overheating control (battery system)		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	The cooling system, if provided, was disconnected		N/A
	Elevated temperature for charging, 5 °C above maximum operating temperature..... :		N/A
	Results: no fire, no explosion ..... :	See Table 8.2.4	N/A
	The BMS detected the overheat temperature and terminated charging		N/A
	The battery system operated as designed during test		N/A
9	**INFORMATION FOR SAFETY**		P
	The cell manufacturer provides information about current, voltage and temperature limits of their products		P
	The battery system manufacturer provides information regarding how to mitigate hazards to equipment manufacturers or end-users.		N/A
10	**MARKING AND DESIGNATION (REFER TO CLAUSE 5 OF IEC 62620)**		P
	The marking items shown in Table 1 in IEC 62620 indicated on the cell, battery system or instruction manual.		P
	Cell or battery system has clear and durable markings		P
	Cell designation		P
	Battery designation		N/A
	Battery structure formulation		N/A

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Clause	Requirement + Test	Result - Remark	Verdict

ANNEX A	OPERATING REGION OF CELLS FOR SAFE USE		P
A.1	General		P
A.2	Charging conditions for safe use		P
A.3	Consideration on charging voltage		P
A.4	Consideration on temperature		P
A.5	High temperature range		N/A
A.6	Low temperature range		N/A
A.7	Discharging conditions for safe use		P
A.8	Example of operating region		P

ANNEX B	PROCEDURE OF 7.3.3 PROPAGATION TEST		N/A
B.1	General		N/A
B.2	Test conditions:		N/A
	– The battery fully charged according to the manufacturer recommended conditions..... :		—
	– Target cell forced into thermal runaway ..... :		—
	– A specially prepared sample (e.g. a heater or a hole for nail penetration provided) used for ease of testing ..... :		—
B.3	Method used for initiating the thermal runaway. 1) Heater (Heater, Burner, Laser, Inductive heating 2) Overcharge 3) Nail penetration of the cell 4) Combination of above methods 5) Other methods ..... :		—

ANNEX C	PACKAGING		P
	The materials and pack design chosen in such a way as to prevent the development of unintentional electrical conduction, corrosion of the terminals and ingress of environmental contaminants		P

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

5.1 – 5.6	TABLE: Critical components information				P
Object/part no.	**Manufacturer/ trademark**	**Type/model**	**Technical data**	**Standard**	**Mark(s) of conformity**
1.Cell	Power Crank Batteries P/L	PF37M	3.2Vd.c., 37Ah	-	-
-Electrolyte	UBE INDUSTRIES, LTD.	206.0	$LiPF_6$, EC, EMC, DMC, PA	-	-
-Separator	Power Lithium	25μm	25μm×222mm×10.5m, PP	-	-
-Positive electrode	Power Lithium	E60	$LiFePO_4$, PVDF, CNT 129μmx 214mm x 134mm	-	-
-Negative electrode	Shanshan Technology	FSN	Graphite SBR、CMC 104μmx218mm x 136mm	-	-
-Positive electrode tab	KAKUEN ELECTRONICS TECHNOLOGY(SHANGHAI)CO., LTD.	AL-0.3*40*32*6	Aluminium belt	-	-
-Negative electrode tab	KAKUEN ELECTRONICS TECHNOLOGY(SHANGHAI)CO., LTD.	Ni-0.3*40*32*6	Nickel belt	-	-
-Aluminium plastic film	BLESSING-TECH LTD.	C8	153μm, Nylon, PP, Aluminum	-	-
-Insulation tape	-	-	Pet, 30μm	-	-
Supplementary information: N/A					

7.2.1	TABLE: External short-circuit test (cell or cell block)				P
Sample No.	**Ambient (at 25°C ± 5°C)**	**OCV at start of test (V dc)**	**Resistance of Circuit (mΩ)**	**Maximum Case Temperature Rise ΔT (K)**	**Results**
PF37M	24.4	3.484	0.039	21.2	A, E
PF37M	24.4	3.481	0.036	21.2	A, E
PF37M	24.4	3.483	0.032	22.2	A, E

Supplementary information:

A - No fire or Explosion
B - Fire
C - Explosion
D - The test was completed after 6 h
E - The test was completed after the cell casing cooled to 20% of the maximum temperature rise
F - Other (Please explain): N/A

7.2.5	TABLE: Overcharge test (cell or cell block)					P
Sample No.	**OCV at start of test (V dc)**	**OCV at end of test (V dc)**	**Measured Maximum Charging Current (A)**	**Measured Maximum Charging Voltage (V dc)**	**Max. Cell Case Temperature, (°C)**	**Results**
PF37M	2.896	3.356	74.0	4.38	43.5	A, E
PF37M	2.931	3.353	74.0	4.38	42.3	A, E
PF37M	2.879	3.366	74.0	4.38	42.9	A, E

Supplementary information:

Results:
A - No fire or Explosion
B - Fire
C - Explosion
D - Test concluded when temperature reached a steady state condition
E - Test concluded when temperature returned to ambient
F - Other (Please explain): N/A

7.2.6	TABLE: Forced discharge test (cell or cell block)				P
Sample No.	**OCV before applying reverse charge, (V dc)**	**Target Voltage (V dc)**	**Measured Reverse Charge Current It, (A)**	**Total Time for Reversed Charge Application (min)**	**Results**
PF37M	2.901	-3.65	37.0	90.0	A
PF37M	2.855	-3.65	37.0	90.0	A
PF37M	2.887	-3.65	37.0	90.0	A

Supplementary information:

Results:
A - No fire or Explosion
B - Fire
C - Explosion
D - Other (Please explain): N/A

7.3.2	TABLE: Internal short-circuit test (cell)	P

Sample No.	OCV at start of test, (V dc)	Particle location [1)]	Maximum applied pressure, (N)	Results
PF37M	3.407	1	400.0	A, E
PF37M	3.420	1	400.0	A, E
PF37M	3.419	1	400.0	A, E
PF37M	3.437	1	400.0	A, E
PF37M	3.418	1	400.0	A, E

Supplementary information:

[1)] Identify one of the following:

1: Nickel particle inserted between positive and negative (active material) coated area.

2: Nickel particle inserted between positive aluminium foil and negative active material coated area.

Results:

A - No fire or explosion
B – Fire
C - Explosion
D – Test concluded when 50 mV voltage drop occurred prior to reaching force limit
E – Test concluded when 800/400 N pressure was reached and 50 mV voltage drop was not achieved
F – Test was concluded when fire or explosion occurred
G - Other (Please explain): N/A

Remark: There is no particle location 2 in this product.

7.3.3	TABLE: Propagation test (battery system)	N/A

Sample No.	OCV of Battery System Before Test, (V dc)	OCV of Target Cell Before Test, (V dc)	Maximum Cell Case Temperature, (°C)	Maximum DUT Enclosure Temperature, (°C)	Results
-	-	-	-	-	

Method of cell failure [1)]	Location of target cell	Area for fire protection (m^2)
-	-	

Supplementary information:

1) Cell can be failed through applied heat, overcharge, nail penetration or combinations of these failures or other acceptable methods. See supporting documentation for details on cell failure method

2) If the battery system has no outer covering, the manufacturer is required to specify the area for fire protection.

Results:
A – No fire external to DUT enclosure or area for fire protection or no battery case rupture
B – Fire external to DUT enclosure or area for fire protection
C – Explosion
D – Battery case rupture
E - Other (Please explain): N/A

8.2.2	TABLE: Overcharge control of voltage (battery system)				N/A
Sample No.	**OCV at start of test for Cell/Cell Blocks, (V dc)**	**Maximum Charging Current, (A)**	**Max. Charging Voltage of Battery System, (V dc)**	**Max. Voltage of Cell/Cell Blocks, (V dc)**	**Results**
-	-	-	-	-	-
			Charge Voltage Applied Battery System: 1)		
			Whole	**Part**	
			-	-	

Supplementary information:

Results:
A - No Fire or Explosion
B – Fire
C - Explosion
D - The voltage of the measured cells or cell blocks did not exceed the upper limit charging voltage
E - The voltage of the measured cells or cell blocks did exceed the upper limit charging voltage
F - All function of battery system did operate as intended during the test.
G - All function of battery system did not operate as intended during the test.
H - Other (Please explain): N/A

8.2.3	TABLE: Overcharge control of current (battery system)			N/A
Sample No.	**OCV at start of test, (V dc)**	**120% of Max. Charging Current, (A)**	**Max. Charging Voltage, (V dc)**	**Results**
-	-	-	-	-

Supplementary information:

Results:
A – No fire or Explosion
B – Fire
C – Explosion
D - Overcurrent sensing function of BMU did operate and then charging stopped
E - Overcurrent sensing function of BMU did not operate and then charging stopped
F - All function of battery system did operate as intended during the test.
G - All function of battery system did not operate as intended during the test.
H - Other (Please explain): N/A

8.2.4	TABLE: Overheating control (battery system)		N/A
Sample No.	**OCV at start(SOC 50%) of test, V dc**	**Maximum Charging Current, A**	**Maximum Charging Voltage, V dc**
-	-	-	-
Maximum Specified Temperature of Battery System, °C		**Maximum Measured Battery Case Temperature, °C**	**Results**
-		-	-

Supplementary information:

Results:
A – No fire or Explosion
B – Fire
C – Explosion
D - Temperature sensing function of BMU did operate and then charging stopped
E - Temperature sensing function of BMU did not operate and then charging stopped
F - All function of battery system did operate as intended during the test.
G - All function of battery system did not operate as intended during the test.
H - Other (Please explain): N/A

--- End of test report ---