Prüfbericht-Nr.: *Test Report No.:*	**10048440 002**	**Auftrags-Nr.:** *Order No.:*	114068062	Seite 1 von 10 *Page 1 of 10*
Kunden-Referenz-Nr.: *Client Reference No.:*	N/A	**Auftragsdatum:** *Order date:*	2017-08-02	
Auftraggeber: *Client:*	**Phoenix Battery Corporation Bldg G,No.1,Sec.6,Zhonghua Road,Hsinchu Taiwan**			
Prüfgegenstand: *Test item:*	Rechargeable Lithium Cell			
Bezeichnung / Typ-Nr.: *Identification / Type No.:*	PC40138-LFP-K			
Auftrags-Inhalt: *Order content:*	Test report of UN 38.3			
Prüfgrundlage: *Test specification:*	UN Manual of Tests and Criteria (Fifth revised edition + Amendment 1 + Amendment 2), Part III, sub-section 38.3			

Wareneingangsdatum: *Date of receipt:*	2014-10-13
Prüfmuster-Nr.: *Test sample No.:*	A000119005
Prüfzeitraum: *Testing period:*	2014-10-13 to 2014-11-03
Ort der Prüfung: *Place of testing:*	Refer to following pages
Prüflaboratorium: *Testing laboratory:*	TÜV Rheinland Taiwan Ltd.
Prüfergebnis*: *Test result*:*	Pass

See appendix to this report for photo documentation

geprüft von / *tested by:*			**kontrolliert von** / *reviewed by:*		
2017-08-14	Burce Tsai / PE		2017-08-14	Paul Lin / Reviewer	
Datum *Date*	**Name / Stellung** *Name / Position*	**Unterschrift** *Signature*	**Datum** *Date*	**Name / Stellung** *Name / Position*	**Unterschrift** *Signature*

Sonstiges / *Other*:

- Change and replace the client's name & address as mentioned above, no further test is considered to be necessary.

Zustand des Prüfgegenstandes bei Anlieferung: Prüfmuster vollständig und unbeschädigt
Condition of the test item at delivery: *Test item complete and undamaged*

* Legende:	1 = sehr gut	2 = gut	3 = befriedigend	4 = ausreichend	5 = mangelhaft
	P(ass) = entspricht o.g. Prüfgrundlage(n)		F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
Legend:	*1 = very good*	*2 = good*	*3 = satisfactory*	*4 = sufficient*	*5 = poor*
	P(ass) = passed a.m. test specification(s)		*F(ail) = failed a.m. test specification(s)*	*N/A = not applicable*	*N/T = not tested*

Test item description .....:	Rechargeable Lithium Cell
Trade Mark .....:	PSI
Manufacturer.....:	Phoenix Battery Corporation Bldg G,No.1,Sec.6,Zhonghua Road,Hsinchu Taiwan
Model/Type reference .....:	PC40138-LFP-K
Ratings .....:	3.3Vdc/18Ah

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

- Photo Documentation

Total number of pages in each attachment is indicated in each individual attachment.

Summary of testing:

Tests performed (name of test and test clause):

38.3.4.1 Test T.1: Altitude simulation
38.3.4.2 Test T.2: Thermal Test
38.3.4.3 Test T.3: Vibration
38.3.4.4 Test T.4: Shock
38.3.4.5 Test T.5: External short circuit
38.3.4.6 Test T.6: Impact
38.3.4.8 Test T.8: Forced discharge

Testing location:

TÜV Rheinland Taiwan Ltd., Taichung Laboratory
No. 9, Ln. 36, Sec. 3, Minsheng Rd., Daya District, Taichung City, 428 Taiwan CHINESE TAIPEI

Copy of marking plate:

Test item particulars ..... :	
Weight of cell or battery ..... :	404 g
Number of series connected cells ..... :	Single cell
EODV ..... :	2.1
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 ..... :	See page 1
Date (s) of performance of tests ..... :	See page 1

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.
"(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 point is used as the decimal separator.

ND: No disassembly	NT: No excessive temperature rise
NF: No fire	NV: No venting
NL: No leakage	NVD: 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.
NM: No mass loss	
NR: No rupture	

General product information:

Rated capacity (Ah)	18
Manufacturer declared charging procedure	CC/CV 1C, CV=3.65Vdc
Manufacturer recommended charging current (A)	3.6A (0.2C)
Category of lithium cells and batteries (categorized by their chemical composition)	LFP
Information given in the relevant specification:	
Pre-discharge current specified by the manufacturer for primary cells and batteries	N/A
Charge and discharge conditions specified by the manufacturer for optimum performance and safety of secondary (rechargeable) cells and batteries	Charge: CC/CV 1C, CV=3.65Vdc Discharge: 0.2C=3.6A
Manufacturer's recommended maximum continuous charge current	18A
Manufacturer's recommended charge voltage	3.65Vdc
Maximum charge voltage	4.5Vdc
Maximum continuous discharge current specified by the manufacturer	18A

Clause	Requirement + Test	Result - Remark	Verdict
38.3.3	**TEST METHODS AND REQUIREMENTS**		P
	Pre-discharge and pre-cycling	Small secondary Cell: 10 at first cycle, fully charged; 5 at first cycle, at 50 % DOD; 10 at first cycle, fully discharged; 10 after 50 cycles, fully discharged	P
38.3.4.1	Test T-1: Altitude		P
	Cells or batteries are stored at a pressure of 11,6 kPa or less for at least 6 h at ambient temperature.	Compliance checked.	P
	Results: no mass loss, no leakage, no venting, no disassembly, no rupture and no fire during this test. 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.	See appended Table T.1 NM, NL, NV, ND, NR, NF, NVD	P
38.3.4.2	Test T-2: Thermal cycling		P
	Cells or batteries previously subjected to altitude test.		P
	Cells or batteries are stored for at least 6 h at a test temperature of 72 °C±2C°, followed by storage for at least 6 h at a test temperature of -40 °C. Maximum time for transfer is 30 minutes. This procedure is executed 10 times.	Compliance checked.	P
	For large cells or batteries the duration of exposure to the test temperatures is at least 12 h instead of 6 h.	Not large cells.	N/A
	Storage for at least 24 h at ambient temperature (20 ± 5 °C).		P
	Results: no mass loss, no leakage, no venting, no disassembly, no rupture and no fire during this test. 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.	See appended Table T.2 NM, NL, NV, ND, NR, NF, NVD	P
38.3.4.3	Test T-3: Vibration		P
	Cells or batteries previously subjected to thermal cycling test		P
	Cells or batteries are subjected to sinusoidal vibration during transport.		P
	Cycle is repeated 12 times for a total of 3 h for each of three mutually perpendicular mounting positions. One of the directions is perpendicular to the terminal face.		P
	Results: no mass loss, no leakage, no venting, no disassembly, no rupture and no fire during this test. 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.	NM, NL, NV, ND, NR, NF, NVD. See appended Table T.3	P
38.3.4.4	Test T-4: Shock		P
	Cells or batteries previously subjected to vibration test.		P
	Each cell or battery is subjected to three shocks in each direction of three mutually perpendicular mounting positions of the cell or battery for a total of 18 shocks.	Compliance checked.	P
	Results: no mass loss, no leakage, no venting, no disassembly, no rupture and no fire during this test. 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.	See appended Table T.4 NM, NL, NV, ND, NR, NF, NVD	P
38.3.4.5	Test T-5: External short-circuit		P

Clause	Requirement + Test	Result - Remark	Verdict
	Cells or batteries previously subjected to shock test.		P
	Each cell or battery is stabilized at an external case temperature of 55 ± 2 °C.		P
	Cell or battery is subjected to a short-circuit condition with a total external resistance of less than 0,1 ohm at 55± 2 °C. Short-circuit condition is continued for at least 1 h after the cell or battery external case temperature has returned to 55 ± 2°C.	Compliance checked.	P
	The test sample is observed for a further 6 h.	Compliance checked.	P
	Results: The external temperature dose not exceed 170 °C, no rupture, no disassembly and no fire during this test and within the 6 h of observation.	ND, NR, NF. See appended Table T.5	P
38.3.4.6	Test T-6: Impact / crush		P
	The test is conducted using test cells or component cells that have not been previously subjected to other transport tests.	Test cells that have not been previously subjected to other transport tests.	P
	Each test cell or component cell shall be subjected to one impact / crush only.		P
	Cylindrical cells not less than 18.0 mm in diameter is tested with impact test procedure.	Diameter: 40 mm Impact test performed.	P
	Test cell or component cell is placed on a flat smooth surface. A stainless steel bar with a diameter of 15,8 mm ± 0,1 mm and a length of at least 60 mm or of the longest dimension of the cell, whichever is greater, is placed across the centre of the test sample. A mass of 9,1 kg ± 0,1 kg is dropped from a height of 61 cm ± 2,5 cm at the intersection of the bar and the test sample using a vertical sliding track or channel. The vertical track is oriented 90 degrees from the horizontal supporting surface.	See appended Table T.6a	P
	The test sample is impacted with its longitudinal axis parallel to the flat surface and perpendicular to the longitudinal axis of the steel bar lying across the centre of the test sample.		P
	Prismatic, pouch, coin/button cells and cylindrical cells less than 18.0 mm in diameter is tested with crush test procedure.	Not applicable.	N/A
	A cell or component cell is crushed between two flat surfaces. The crushing is to be gradual with a speed of approximately 1,5 cm/s at the first point of contact.		N/A
	A prismatic or pouch cell shall be crushed by applying the force to the widest side. A button/coin cell shall be crushed by applying the force on its flat surfaces. For cylindrical cells, the crush force shall be applied perpendicular to the longitudinal axis.		N/A
	The crushing is to be continued until one of the three conditions below is reached: - the applied force reaches 13 kN ± 0,78 kN; - the voltage of the cell drops by at least 100 mV; - the cell is deformed by 50 % or more of its original thickness. As soon as one of the above conditions has been obtained, the pressure shall be released.		N/A
	The test sample is observed for a further 6 h.		N/A
	Results: The external temperature dose not exceed 170 °C, no disassembly and no fire during this test and within the 6 h of observation.		N/A

Clause	Requirement + Test	Result - Remark	Verdict
38.3.4.7	Test T-7: Overcharge	Not applicable.	N/A
	The charge current of the battery is twice the manufacturer's recommended maximum continuous charge current.		N/A
	The manufacturer's recommended charge voltage is not more than 18 V, the minimum voltage of the test is the lesser of two times the maximum charge voltage of the battery or 22 V.		N/A
	The manufacturer's recommended charge voltage is more than 18 V. The voltage of the test is not less than 1,2 times the maximum charge voltage.		N/A
	The test is conducted at ambient temperature. The charging condition is maintained for at least 24 h.		N/A
	The test sample is observed for a further 7 days.		N/A
	Results: no disassembly and no fire during this test and within the 7 days of observation.		N/A
38.3.4.8	Test T-8: Forced discharge		P
	Each cell is forced discharged at ambient temperature by connecting it in series with a 12 V direct current power supply at an initial current equal to the maximum continuous discharge current specified by the manufacturer. Time interval for discharging equals to rated capacity divided by the initial test current.	Cells were forced discharged by connecting 12V direct current power supply.	P
	The test sample is observed for a further 7 days.		P
	Results: no disassembly and no fire during this test, nor within the 7 days of observation.	ND, NF. See appended Table T.8	P

Clause	Requirement + Test	Result - Remark	Verdict

T.1	TABLE: Altitude							P
Sample No.	Precondition	Open circuit voltage before test (V)	Mass before test (g)	Open circuit voltage after test (V)	Mass after test (g)	Mass loss (%)	Mass loss limit (%)	Results
1	A	3.29	406	3.29	406	0	10	P
2	A	3.29	406	3.29	406	0	10	P
3	A	3.29	406	3.29	406	0	10	P
4	A	3.29	404	3.29	404	0	10	P
5	A	3.29	406	3.29	406	0	10	P
6	A	3.29	404	3.29	404	0	10	P
7	A	3.29	406	3.29	406	0	10	P
8	A	3.29	410	3.29	410	0	10	P
9	A	3.29	402	3.29	402	0	10	P
10	A	3.29	406	3.29	406	0	10	P
Supplementary information: A – Cells at first cycle, in fully charged states.								

T.2	TABLE: Thermal cycling							P
Sample No.	Precondition	Open circuit voltage before test (V)	Mass before test (g)	Open circuit voltage after test (V)	Mass after test (g)	Mass loss (%)	Mass loss limit (%)	Results
1	A	3.29	406	3.29	406	0	10	P
2	A	3.29	406	3.29	406	0	10	P
3	A	3.29	406	3.29	406	0	10	P
4	A	3.29	404	3.29	404	0	10	P
5	A	3.29	406	3.29	406	0	10	P
6	A	3.29	404	3.29	404	0	10	P
7	A	3.29	406	3.29	406	0	10	P
8	A	3.29	410	3.29	410	0	10	P
9	A	3.29	402	3.29	402	0	10	P
10	A	3.29	406	3.29	406	0	10	P
Supplementary information: A – Cells at first cycle, in fully charged states.								

T.3	TABLE: Vibration							P
Sample No.	Precondition	Open circuit voltage before test (V)	Mass before test (g)	Open circuit voltage after test (V)	Mass after test (g)	Mass loss (%)	Mass loss limit (%)	Results
1	A	3.29	406	3.29	406	0	10	P
2	A	3.29	406	3.29	406	0	10	P

Clause	Requirement + Test	Result - Remark	Verdict

3	A	3.29	406	3.29	406	0	10	P
4	A	3.29	404	3.29	404	0	10	P
5	A	3.29	406	3.29	406	0	10	P
6	A	3.29	404	3.29	404	0	10	P
7	A	3.29	406	3.29	406	0	10	P
8	A	3.29	410	3.29	410	0	10	P
9	A	3.29	402	3.29	402	0	10	P
10	A	3.29	406	3.29	406	0	10	P

Supplementary information:
A – Cells at first cycle, in fully charged states.

T.4	**TABLE: Shock**							P
Sample No.	Precondition	Open circuit voltage before test (V)	Mass before test (g)	Open circuit voltage after test (V)	Mass after test (g)	Mass loss (%)	Mass loss limit (%)	Results
1	A	3.29	406	3.29	406	0	10	P
2	A	3.29	406	3.29	406	0	10	P
3	A	3.29	406	3.29	406	0	10	P
4	A	3.29	404	3.29	404	0	10	P
5	A	3.29	406	3.29	406	0	10	P
6	A	3.29	404	3.29	404	0	10	P
7	A	3.29	406	3.29	406	0	10	P
8	A	3.29	410	3.29	410	0	10	P
9	A	3.29	402	3.29	402	0	10	P
10	A	3.29	406	3.29	406	0	10	P

Supplementary information:
A – Cells at first cycle, in fully charged states.

T.5	**TABLE: External short-circuit**					P
Sample No.	Precondition	Open circuit voltage before test (V)	Open circuit voltage after test (V)	Maximum case temperature (°C)	Total external resistance (mΩ)	Results
1	A	3.29	0.0	110.0	86.4	P
2	A	3.29	0.0	113.5	85.3	P
3	A	3.29	0.0	110.4	85.2	P
4	A	3.29	0.0	114.8	70.5	P
5	A	3.29	0.0	61.8	72.8	P
6	A	3.29	0.0	103.1	86.4	P
7	A	3.29	0.0	118.5	85.3	P
8	A	3.29	0.0	110.1	85.2	P
9	A	3.29	0.0	118.5	70.5	P
10	A	3.29	0.0	108.3	72.8	P

Clause	Requirement + Test	Result - Remark	Verdict

Supplementary information:
A – Cells at first cycle, in fully charged states.

T.6a	**TABLE: Impact**		P
Sample No.	Open circuit voltage before test (V)	Maximum case temperature (°C)	Results
16	3.38	21.7	P
17	3.54	23.3	P
18	3.59	23.6	P
19	3.59	23.4	P
20	3.58	22.1	P

Supplementary information:
Five cell at first cycle at 50% of the design rated capacity.

T.8	**TABLE: Forced discharge**				P
Sample No.	Precondition	Open circuit voltage before test (V)	Measured reverse charging current (A)	Total time for reversed charging application (min)	Results
16	A	2.73	18	90	P
17	A	2.75	18	90	P
18	A	2.73	18	90	P
19	A	2.67	18	90	P
20	A	2.74	18	90	P
21	A	2.76	18	90	P
22	A	2.76	18	90	P
23	A	2.74	18	90	P
24	A	2.74	18	90	P
25	A	2.76	18	90	P
26	B	2.50	18	90	P
27	B	2.49	18	90	P
28	B	2.50	18	90	P
29	B	2.51	18	90	P
30	B	2.50	18	90	P
31	B	2.50	18	90	P
32	B	2.51	18	90	P
33	B	2.53	18	90	P
34	B	2.62	18	90	P
35	B	2.49	18	90	P

Supplementary information:
A – Cells at first cycle, fully discharged
B – Cells after 50 cycles, fully discharged

Clause	Requirement + Test	Result - Remark	Verdict

List of test equipment used:

ID#	Type	Model	Calib. until
04-2004-0358	Milli Ohm Meter	CMR-128TC	08/01/2015
04-2005-0384	Digital Multimeters	73303	14/08/2015
04-2005-0406	Mobile Corder	MV220	15/10/2015
04-2011-0693	Programmable DC Power Supply	62150H-600	-
04-2011-0694	Programmable DC Power Supply	62150H-100	-
04-2013-0817	Shock Tester	Shock-2	21/11/2015
04-2013-0818	Thermal Cycle Chamber	GCT-150-45	12/11/2015
04-2013-0819	Thermal Abuse Chamber	RHD-602WP	15/10/2015
04-2013-0820	Altitude Chamber	A-1 (MC-24	15/10/2015
04-2013-0821	Crush Tester	AT-1 (AT-1	04/11/2015
04-2013-0822	Impact Tester	IB-5	04/11/2018
04-2013-0823	Charger	CTE-MCF-17	28/07/2015
04-2013-0824	Explosion-Proof Cabinet	GPO-1200	-
04-2013-0826	Vibration Tester	VS-300V	22/12/2015
04-2014-0829	Digital Humidity Temp. Clock	DTM-301A	25/02/2016
04-2014-0830	Digital Humidity Temp. Clock	DTM-301A	-
04-2014-0831	Digital Humidity Temp. Clock	DTM-301A	-
04-2014-0853	Dial Caliper	ZA-500-196	15/04/2017
04-96-0170	Electronic Weighing Scale	GC-12K	08/01/2015

- End of Test report-

Product: Rechargeable Lithium Cell

Type Designation: PC40138-LFP-K

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