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TESTING
CNAS L5998

UN38.3 Test Report

Name of Products: $LiFePO_4$ Battery

Applicant: UltraMax Batteries Ltd

Factory: UltraMax Batteries Ltd

Tester 刘秀丽	**Reviewer** 文朝纯	**Approver** 关炳
Project Engineer	**Senior Engineer**	**Chief Engineer**

GUANGDONG UTL CO., LTD.

Address: Liandong Testing Building, No.18 Center Road of Yayuan Industrial Zone, Nancheng District, Dongguan, Guangdong, China.
Tel：86-769-3893 3228 Email：utl@gdutl.com http：//www.gdutl.com

TEST REPORT

UN38.3, Seventh Edition Recommendations on transport of dangerous goods, manual of test and criteria, Section 38.3 - Lithium metal and lithium ion Batteries	
Report Reference No. ..... :	PNS230411076 05002
Date of issue ..... :	2023-07-09
Total number of pages..... :	19 pages
Testing Laboratory ..... .:	GUANGDONG UTL CO., LTD.
Address ..... :	Landing Testing Building, No.18 Center Road of Yayuan Industrial Zone, Nancheng District, Dongguan, Guangdong, China.
Applicant's name……:	UltraMax Batteries Limited
Address ..... :	Watkins House, Pegamoid Road, London N18 2NG
Factory's name..... :	UltraMax Batteries Limited
Address ..... :	Watkins House, Pegamoid Road, London N18 2NG
Phone number..... :	+44-(0)2088038899
Email..... :	sales@ultramax.co.uk
Website..... :	www.ultramax.co.uk
Test specification	
Standard ..... :	ST/SG/AC.10/11/Rev.7/Section 38.3
Test procedure..... :	N/A
Non-standard test method……..:	N/A
Test item description:	$LiFePO_4$ Battery
Trade Mark ..... :	N/A
Model/Type reference..... :	12V 120Ah
Ratings..... :	12.8V, 120Ah, 1536Wh

TEST REPORT

Summary of testing:

Tests performed (name of test and test clause):

Test Conclusion	
Test(s)	Conclusion
T.1: Altitude simulation	Pass
T.2: Thermal test	Pass
T.3: Vibration	Pass
T.4: Shock	Pass
T.5: External short circuit	Pass
T.6: Impact	Pass
T.7: Overcharge	Pass
T.8: Forced discharge	Pass

Sample Status:

Test(s)	Sample Number	Sample Status
T.1~T.5	SLine-2-1 - SLine-2-2	at first cycle, in fully charged states.
	SLine-2-3 - SLine-2-4	after twenty-fifth cycles ending in fully charged states.
T.6	SineL-1-1 - SineL-1-5	at first cycle at 50% of the design rated capacity.
	SineL-1-6 - SineL-1-10	after twenty-fifth cycles ending at 50% of the design rated capacity.
T.7	SLine-2-5 - SLine-2-6	at first cycle, in fully charged states.
	SLine-2-7 - SLine-2-8	after twenty-fifth cycles ending in fully charged states.
T.8	SLine-1-11 - SLine-1-20	at first cycle, in fully discharged states.
	SLine-1-21 - SLine-1-30	after twenty-fifth cycles ending in fully discharged states.

The test results： Pass

Test item particulars

Cell type	32700
Nominal Voltage of cell	3.2V
Rated Capacity of cell	6100mAh
Battery Type	Lithium ion battery
Appearance	Black
Number of cell	80pcs (4S20P)
Dimension(mm)	329.0mm(max) × 172.0mm(max) × 223.0mm(max)

Test case verdicts

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

Testing

Date of receipt of test item	2023-02-22
Date(s) of performance of test	2023-02-22 to 2023-03-14

General remarks

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

The test results presented in this report relate only to the item tested.

"(see remark #)" refers to a remark appended to the report.

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

According to the Standard, a single-cell battery (Battery Pack) is considered a "Cell" (Battery Cell) and shall be tested according to the testing requirements for "Cell". This testing included the samples of Battery Pack and Battery Cell as aforementioned. For testing details, please refer to Table of Test Conclusion and individual test record.

General product information:

The main features of this model are shown as below:

Model	Nominal capacity	Nominal voltage	Nominal Charge Current	Nominal Discharge Current	Maximum Charge Current	Maximum Discharge Current	Maximum Charge Voltage	Cut-off Voltage
Battery								
12.8V120Ah	120Ah	12.8V	25A	25A	120A	120A	14.6V	10.8V
Cell								
32700	6100mAh	3.2V	1220mA	1220mA	6100mA	18A	3.68V	2.0V

Remark: On the basis of the original report, the Chinese and English address of the Applicant and Factory shall be revised, and no other changes shall be made.

Test Procedure:

1. Tests T.1 to T.5 shall be conducted in sequence on the same cell or battery. Tests T.6 and T.8 shall be conducted using not otherwise tested cells. Test T.7 may be conducted using undamaged batteries previously used in Tests T.1 to T.5 for purposes of testing on cycled batteries.

2. In order to quantify the mass loss, the following procedure is provided:

$$\text{Mass loss (\%)} = \frac{(M1 - M2)}{M1} \times 100$$

Where M1 is the mass before the test and M2 is the mass after the test. When mass loss does not exceed the values in Table 38.3.1, it shall be considered as “no mass loss”.

Table 38.3.1 Mass loss limit

Mass M of cell or battery	Mass loss limit
M <1 g	0.5%
1 g $\leqslant$ M $\leqslant$ 75 g	0.2%
M > 75 g	0.1%

UN 38.3			
Clause	Requirement + Test	Result - Remark	Verdict
38.3.4.1	**Test T.1: Altitude simulation**		**P**
	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)/		P
	Cells and 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 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.	No leakage, no venting, no disassembly, no rupture and no fire. See test data for details.	P
38.3.4.2	**Test T.2: Thermal test**		**P**
	Test cells and batteries are to be stored for at least six hours at a test temperature equal to 72±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). /		P
	For large cells and batteries the duration of exposure to the test temperature extremes should be at least 12 hours.		P
	Cells and 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 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.	No leakage, no venting, no disassembly, no rupture and no fire. / See test data for details.	P

UN 38.3			
Clause	Requirement + Test	Result - Remark	Verdict
38.3.4.3	**Test T.3: Vibration**		**P**
	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 vinbration must be perpendicular to the terminal face.		P
	The logarithmic frequency sweep shall differ for cells and batteries with a gross mass of not more than 12 kg (cells and small batteries, and for batteries with a gross mass of more than 12 kg (large batteries). /		P
	For cells and small batteries: from 7 Hz a peak acceleration of 1 gn 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 gn occurs (approximately 50 Hz. A peak acceleration of 8 gn is then maintained until the frequency is increased to 200 Hz.		N/A
	For large batteries: from 7 Hz to a peak acceleration of 1 gn 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 2 gn occurs (approximately 25 Hz. A peak acceleration of 2 gn is then maintained until the frequency is increased to 200 Hz.		P

UN 38.3			
Clause	Requirement + Test	Result - Remark	Verdict
	Cells and 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 cell or battery directly after testing in its third perpendicular mounting position 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.	No leakage, no venting, no disassembly, no rupture and no fire. See test data for details.	P
38.3.4.4	**Test T.4: Shock**		**P**
	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.		P
	Shock: a half-sine shock of peak acceleration of 150 g_n (or Acceleration(g_n)= $\sqrt{\left(\frac{100850}{mass}\right)}$, which is smaller) and pulse duration of 6 milliseconds, large cells and large batteries shall be subjected to a half-sine or peak acceleration of 50 g_n (or Acceleration(g_n)= $\sqrt{\left(\frac{30000}{mass}\right)}$, which is smaller) and pulse duration of 11 milliseconds 中		P
	Each cell or battery shall be subjected to three shocks in the positive direction and to three shocks in the negative direction in each of three mutually perpendicular mounting positions of the cell or battery for a total of 18 shocks.		P

UN 38.3			
Clause	Requirement + Test	Result - Remark	Verdict
	Cells and 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 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.	No leakage, no venting, no disassembly, no rupture and no fire. See test data for details. /	P
38.3.4.5	**Test T.5: External short circuit**		**P**
	The cell or battery to be tested shall be temperature stabilized so that its external case temperature reaches 57±4°C.		P
	The cell or battery at 57 ± 4°C shall be subjected to one short circuit condition with a total external resistance of less than 0.1 ohm. This short circuit condition is continued for at least one hour after the cell or battery external case temperature has returned to 57±4°C, or in the case of the large batteries, has decreased by half of the maximum temperature increase observed during the test and remains below that value.		P
	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 during the test and within six hours after the test.	No disassembly, no rupture and no fire. See test data for details.	P
38.3.4.6	**Test T.6: Impact / Crush**		**P**
	Test procedure – Impact (applicable to cylindrical cells not less than 18.0 mm in diameter) /	Cylindrical cell	P

UN 38.3			
Clause	Requirement + Test	Result - Remark	Verdict
	The sample cell or component cell is to be placed on a flat smooth surface. A 15.8 mm±0.1mm diameter, at least 6 cm long, or the longest dimension of the cell, whichever is greater, Type 316 stainless steel bar is to be placed across the centre of the sample. A 9.1 kg±0.1 kg mass is to be dropped from a height of 61±2.5 cm at the intersection of the bar and sample in a controlled manner using a near frictionless, vertical sliding track or channel with minimal drag on the falling mass. The vertical track or channel used to guide the falling mass shall be oriented 90 degrees from the horizontal supporting surface.		P
	The test sample is to be impacted with its longitudinal axis parallel to the flat surface and perpendicular to the longitudinal axis of the 15.8 mm±0.1mm diameter curved surface lying across the centre of the test sample. Each sample is to be subjected to only a single impact.		P
	Test Procedure – Crush (applicable to prismatic, pouch, coin/button cells and cylindrical cells less than 18.0 mm in diameter).	cylindrical cells	N/A
	A cell or component cell is to be 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. The crushing is to be continued until the first of the three options below is reached.		N/A
	(a) The applied force reaches 13 kN±0.78 kN; /		N/A
	(b) The voltage of the cell drops by at least 100 mV;		N/A
	(c) The cell is deformed by 50% or more of its original thickness.		N/A

UN 38.3			
Clause	Requirement + Test	Result - Remark	Verdict
	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.		P
	Each test cell or component cell is to be subjected to one crush only. The test sample shall be observed for a further 6 h. The test shall be conducted using test cells or component cells that have not previously been subjected to other tests.		P
	Cells and component cells meet this requirement if their external temperature does not exceed 170°C and there is no disassembly and no fire during the test and within six hours after this test.	No disassembly and no fire. / See test data for details. /	P
38.3.4.7	**Test T.7: Overcharge**		**P**
	The charge current shall be twice the manufacturer's recommended maximum continuous charge current. Tests are to be conducted at ambient temperature. The duration of the test shall be 24 hours. The minimum voltage of the test shall be as follows:		P
	(a) When the manufacturer's recommended charge voltage is not more than 18V, the minimum voltage of the test shall be the lesser of two times the maximum charge voltage of the battery or 22V.	The voltage of the test is 22V, and the current is 200A.	P
	(b) When the manufacturer's recommended charge voltage is more than 18V, the minimum voltage of the test shall be 1.2 times the maximum charge voltage.		N/A
	There is no disassembly and no fire during the test and within seven days after the test	No disassembly and no fire. See test data for details. /	P

UN 38.3			
Clause	Requirement + Test	Result - Remark	Verdict
38.3.4.8	**Test T.8: Forced discharge**		**P**
	Each cell shall be forced discharged at ambient temperature by connecting it in series with a 12V D.C. power supply at an initial current equal to the maximum discharge current specified by the manufacturer. The specified discharge current is to be obtained by connecting a resistive load of the appropriate size and rating in series with the test cell. Each cell shall be forced discharged for a time interval (in hours) equal to its rated capacity divided by the initial test current (in ampere).		P
	There is no disassembly and no fire during the test and within seven days after the test.	No disassembly and no fire. See test data for details. /	P

T.1 (Altitude simulation)

Sample No.	Before test		After test		Mass loss	Change ratio(%)	Results
	Mass (g)	Voltage (V)	Mass (g)	Voltage (V)			
SL-1-1	12319	13.46	12319	13.46	0.000	100.000	P
SL-1-2	12320	13.46	12320	13.46	0.000	100.000	P
SL-1-3	12319	13.46	12319	13.46	0.000	100.000	P
SL-1-4	12319	13.47	12319	13.47	0.000	100.000	P

Note:
A. Leakage; B. Venting; C. Disassembly; D. Rupture; E. Fire
P. No leakage, no venting, no disassembly, no rupture, no fire

T.2 (Thermal test)

Sample No.	Before test		After test		Mass loss	Change ratio(%)	Results
	Mass (g)	Voltage (V)	Mass (g)	Voltage (V)			
SL-1-1	12319	13.46	12319	12.61	0.000	93.685	P
SL-1-2	12320	13.46	12320	12.71	0.000	94.428	P
SL-1-3	12319	13.46	12319	12.71	0.000	94.428	P
SL-1-4	12319	13.47	12319	12.64	0.000	93.838	P

Note:
A. Leakage; B. Venting; C. Disassembly; D. Rupture; E. Fire
P. No leakage, no venting, no disassembly, no rupture, no fire

T.3 (Vibration)

Sample No.	Before test		After test		Mass loss (%)	Change ratio(%)	Results
	Mass (g)	Voltage (V)	Mass (g)	Voltage (V)			
SL-1-1	12319	12.61	12319	12.61	0.000	100.000	P
SL-1-2	12320	12.71	12320	12.71	0.000	100.000	P
SL-1-3	12319	12.71	12319	12.71	0.000	100.000	P
SL-1-4	12319	12.64	12319	12.61	0.000	99.763	P

Note:
A. Leakage； B. Venting； C. Disassembly； D. Rupture； E. Fire
P. No leakage, no venting, no disassembly, no rupture, no fire

T.4 (Shock)

Sample No.	Before test		After test		Mass loss (%)	Change ratio(%)	Results
	Mass (g)	Voltage (V)	Mass (g)	Voltage (V)			
SL-1-1	12319	12.61	12319	12.61	0.000	100.000	P
SL-1-2	12320	12.71	12320	12.71	0.000	100.000	P
SL-1-3	12319	12.71	12319	12.70	0.000	99.921	P
SL-1-4	12319	12.61	12319	12.61	0.000	100.000	P

Note:
A. Leakage； B. Venting； C. Disassembly； D. Rupture； E. Fire
P. No leakage, no venting, no disassembly, no rupture, no fire

T.5 (External short circuit)

Sample No.	Total circuit Resistance (mΩ)	Maximum Temperature, （°C）	Results
SL-1-1	74.8	57.7	P
SL-1-2	76.4	57.5	P
SL-1-3	77.2	57.6	P
SL-1-4	82.1	57.6	P

Note:
A. Disassembly; B. Rupture; C. Fire
P. No disassembly, no rupture, no fire within 6 hours after the test.

T.6 (Impact)

Sample No.	Voltage before Test (V)	Maximum Temperature, （°C）	Results
SL-2-1	3.284	23.3	P
SL-2-2	3.283	23.5	P
SL-2-3	3286	22.6	P
SL-2-4	3.291	23.1	P
SL-2-5	3.290	22.5	P
SL-2-6	3.293	23.4	P
SL-2-7	3.284	23.6	P
SL-2-8	3.287	23.7	P
SL-2-9	3.286	22.3	P
SL-2-10	3.285	23.3	P

Note:
A. Disassembly B. Fire
P. No disassembly, no fire within 6 hours after the test

T.7 (Overcharge)

Sample No.	Voltage before Test (V)	Results
SL-1-5	13.45	P
SL-1-6	13.44	P
SL-1-7	13.47	P
SL-1-8	13.42	P

Note:
A. Disassembly; B. Fire
P. No disassembly, no fire within seven days after the test.

T.8 (Forced discharge)

Sample No.	Voltage before Test (V)	Sample No.	Voltage before Test (V)	Results
SL-2-11	2. 652	SL-2-21	2.632	P
SL-2-12	2. 673	SL-2-22	2.615	P
SL-2-13	2. 684	SL-2-23	2.635	P
SL-2-14	2. 664	SL-2-24	2.643	P
SL-2-15	2. 715	SL-2-25	2.685	P
SL-2-16	2.694	SL-2-26	2.645	P
SL-2-17	2.712	SL-2-27	2.635	P
SL-2-18	2.737	SL-2-28	2.645	P
SL-2-19	2.655	SL-2-29	2.651	P
SL-2-20	2.684	SL-2-30	2.645	P

Note:
A. Disassembly; B. Fire
P. No disassembly, no fire within seven days after the test

Figure 1 Overall view I of battery

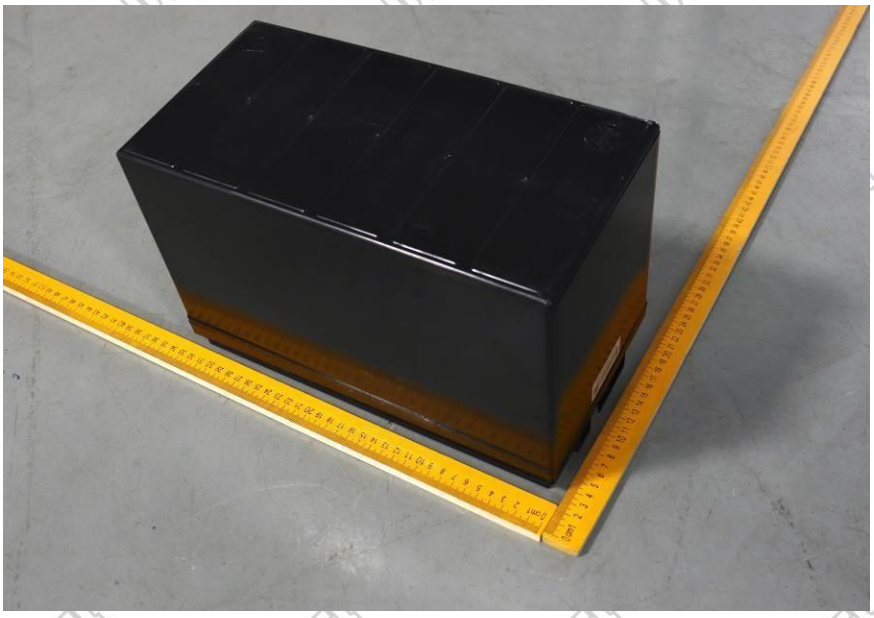

Figure 2 Overall view II of battery

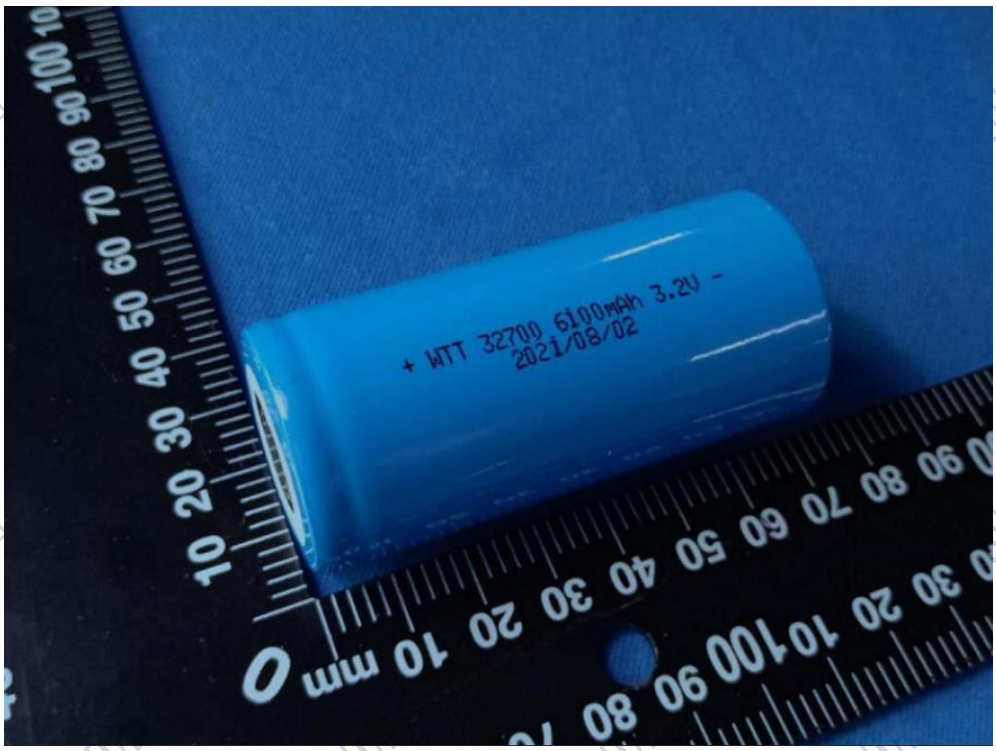

Figure 3 Overall view of cell

Figure 4 Battery Label

Important

1. Nobody is allowed to photocopy or partly photocopy this test report without written permission of UTL.
2. The test report is invalid without the signatures of Approver, Reviewer and Tester.
3. The test report is invalid if altered.
4. Objections to the test report must be submitted to UTL within 15 days.
5. Throughout this report a point is used as the decimal separator.
6. The test report is valid for the tested samples only.
7. The test report does not grant applicant the use of UTL name, trademark or label.
8. UTL's liability under no circumstance will exceed the testing fee received from applicant for test conducted hereof this testing report.
9. The test data and results do not have social proof function.

******** End of Test Report ********