

Test Report

Battery Model	LFP12100AFTHT (High temp, gel, 12V, 100Ah)	Sample Q'ty	1 pcs	Date	2018.06.22
Test item	Endurance in cycles				
Applicable Standard	Refer to IEC 60254-1-2005 @35°C				

Test method	<p>5.2 Capacity test</p> <p>5.2.1 To facilitate the temperature readings, one pilot cell is selected per group of six cells, the average of the pilot cells being considered as representative of the average temperature of the battery.</p> <p>The temperature of each of pilot cell shall be read immediately prior to the discharge. The individual readings shall be between 30 and 40°C. The average initial cell temperature t_0 is calculated as the arithmetic mean of the individual values.</p> <p>5.2.2 The battery shall be completely charged in accordance with 4.3.</p> <p>4.3 Characteristics of a fully charged cell or battery (unless the state of a fully charged battery is otherwise stated by the manufacturer)</p> <p>Cells or batteries are considered as fully charged when, during charging at a current/voltage value specified by the manufacturer, the observed voltage/current and electrolyte density where accessible, do not show any appreciable change during a period of 2 h. Changes in temperature shall be taken into account.</p> <p>5.2.3 Within 1h to 24h after the end of charging ,the battery shall be subjected to a discharge at the current I_N (see 3.1.2) This current shall be maintained constant within $\pm 1\%$ throughout the whole discharge time.</p> <p>3 Functional characteristics</p> <p>3.1 Capacity (for the test, see 5.2)</p> <p>3.1.1 The most essential characteristic of a traction battery is its ability to store electric energy. This is expressed as capacity C, measured in ampere hours (Ah), which varies with the conditions of use.</p> <p>3.1.2 The nominal capacity C_N is a reference value, declared by the manufacturer, which is valid for the cell/battery temperature of 30 °C, a discharge time of 5 h, and a cut-off voltage $U_f = 1,70$ V per cell. The corresponding discharge current is</p> <p>5.2.4 The voltage across the terminals of the battery (excluding battery output cables), shall be either recorded automatically against time, or noted at suitable time intervals using a voltmeter(see 4.1.1.2)</p> <p>4.1.1.2 Voltage measurement</p> <p>The instruments used for voltage measurement shall be voltmeters of an accuracy class equal to 0,5 or better. The resistance of the voltmeters used shall be at least 1 000 Ω/V.</p>
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5.2.5 The discharge is discontinued when the average voltage has reached the value of 1.8V per cell. The discharge time shall be noted.

5.2.6 The uncorrected capacity C (Ah) at the initial temperature t_0 is calculated as the product of the discharge current (in amperes) and the discharge time (in hours).

5.2.7 If the initial temperature t_0 (see 5.2.1) is different from the reference temperature (35°C), the capacity C, in accordance with 5.2.6, shall be corrected to the actual capacity C_a by the equation:

$$C_a = C \cdot \left[\frac{273 + t_r}{273 + t_0} \right]^{0.006}$$

Where t_0 is the initial temperature;

t_r is the reference temperature (35°C) $= 0.006(^{\circ}\text{C})^{-1}$ for the 10h capacity.

5.2.8 A new battery, submitted to the rated capacity test, when subjected to repeated CN discharge/charge cycles according to 5.2.2 to 5.2.6 shall supply at least $C_a = 0.95 \text{ CN}$ at the first cycle;

$C_a = 1.00 \text{ CN}$ at or before the tenth cycle.

5.5 Cyclic endurance test

5.5.1 the test shall be carried out on cell samples as specified in 5.1

5.1 Sequence of performance of the tests

5.1.1 The tests for:

- 5 h capacity (see 5.2),
- charge retention (see 5.3),
- 1 h high-rate discharge performance (see 5.4)

may be carried out either on a new complete battery or on a representative part thereof in the order listed here.

For acceptance or commissioning a 5 h capacity test or as agreed upon between battery supplier and battery user shall be selected.

The charge retention test and the high-rate discharge ability test are optional.

5.1.2 The test for endurance in cycles (see 5.5) is a destructive test and shall be executed on a minimum of three cells of the same type.

Suitable packing should be provided for the test samples in order to maintain the same dimensions as when installed in batteries.

5.5.2 After undergoing the actual capacity test of 5.2 and having shown a capacity C_a at least equal to the nominal capacity C_N , the cells shall be recharged as specified in 4.3.

4.3 Characteristics of a fully charged cell or battery (unless the state of a fully charged battery is otherwise stated by the manufacturer)

Cells or batteries are considered as fully charged when, during charging at a current/voltage value specified by the manufacturer, the observed voltage/current and electrolyte density where accessible, do not show any appreciable change during a period of 2 h. Changes in temperature shall be taken into account.

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	<p>5.5.3 The battery shall be connected to a device where they shall undergo a continuous series of cycles throughout the test, each cycle comprising the following:</p> <p>5.5.3.1-----</p> <p>5.5.3.2 Valve regulated cells</p> <ul style="list-style-type: none"> - discharge at a current of $I(A) = 0.1CA$ (A) for 8hours. - recharge for a maximum of 16-20h immediately following the discharge, at a constant voltage not exceeding 2.35V per cell.(charge time: 16h for first 200cycles, and 20h for later cycles) <p>5.5.3.3 Throughout the whole of either test 5.5.3.1 or 5.5.3.2, the temperature of the cells shall be maintained between 30°C and 40 °C.</p> <p>5.5.4 After each series of 25 cycles ± 1 cycles, the battery shall undergo a capacity test as specified in 5.2.</p> <p>The test shall be considered as terminated when the corrected capacity C_a resulting from this test is less than $0.8 C_N$ during two successive series of 50 cycles ± 5 cycles each.</p> <p>5.5.5 The endurance in cycles is the number of cycles completed up to the end of the first of the two final series. This number shall be at least equal to the number stated by the manufacture.</p>
<p>Technical Requirement</p>	<p>This represents the ability of a battery to perform repeated discharge/recharge cycles. This performance shall be tested by a series of cycles under specified conditions with 80 % DOD at $I = 1.0 \times I_{10}$ after which the actual capacity of the battery shall be not less than 80 % of the nominal capacity in ampere-hours (see 6.4). The number of cycles shall be not less than 1000.</p>



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Test data (Ah)

cycle	discharge time	discharge current	temperature	End battery terminal voltage	Discharge capacity Ah@35°C
1	8h00"00	10A	33°C		80
25	8h00"00	10A	33°C		80
50	8h00"00	10A	35 °C		80
75	8h00"00	10A	35 °C		80
100	8h00"00	10A	37°C		80
10hrs	10h18'05"	10A	34 °C	10.80v	103
125	8h00"00	10A	35 °C		80
150	8h00"00	10A	35°C		80
175	8h00"00	10A	35 °C		80
200	8h00"00	10A	35 °C		80
10hrs	10h29'56"	10A	38°C	10.80v	105
225	8h00"00	10A	35 °C		80
250	8h00"00	10A	35 °C		80
275	8h00"00	10A	37°C		80
300	8h00"00	10A	38°C		80
10hrs	10h19'03"	10A	34 °C	10.80v	103
325	8h00"00	10A	33°C		80
350	8h00"00	10A	36°C		80
375	8h00"00	10A	37°C		80



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400	8h00"00	10A	37°C		80
10hrs	9h57'05"	10A	36°C	10.80v	99.5
425	8h00"00	10A	37°C		80
450	8h00"00	10A	37°C		80
475	8h00"00	10A	38°C		80
500	8h00"00	10A	37°C		80
10hrs	10h03'34"	10A	36°C	10.80v	100
525	8h00"00	10A	33°C		80
550	8h00"00	10A	35°C		80
575	8h00"00	10A	38°C		80
600	8h00"00	10A	37°C		80
10hrs	9h50'10	10A	36°C	10.80v	98.2
625	8h00"00	10A	35°C		80
650	8h00"00	10A	38°C		80
675	8h00"00	10A	38°C		80
700	8h00"00	10A	37°C		80
10hrs	9h29'00"	10A	35 °C	10.80v	94.8
725	8h00"00	10A	35 °C		80
750	8h00"00	10A	37°C		80
775	8h00"00	10A	37°C		80
800	8h00"00	10A	36°C		80

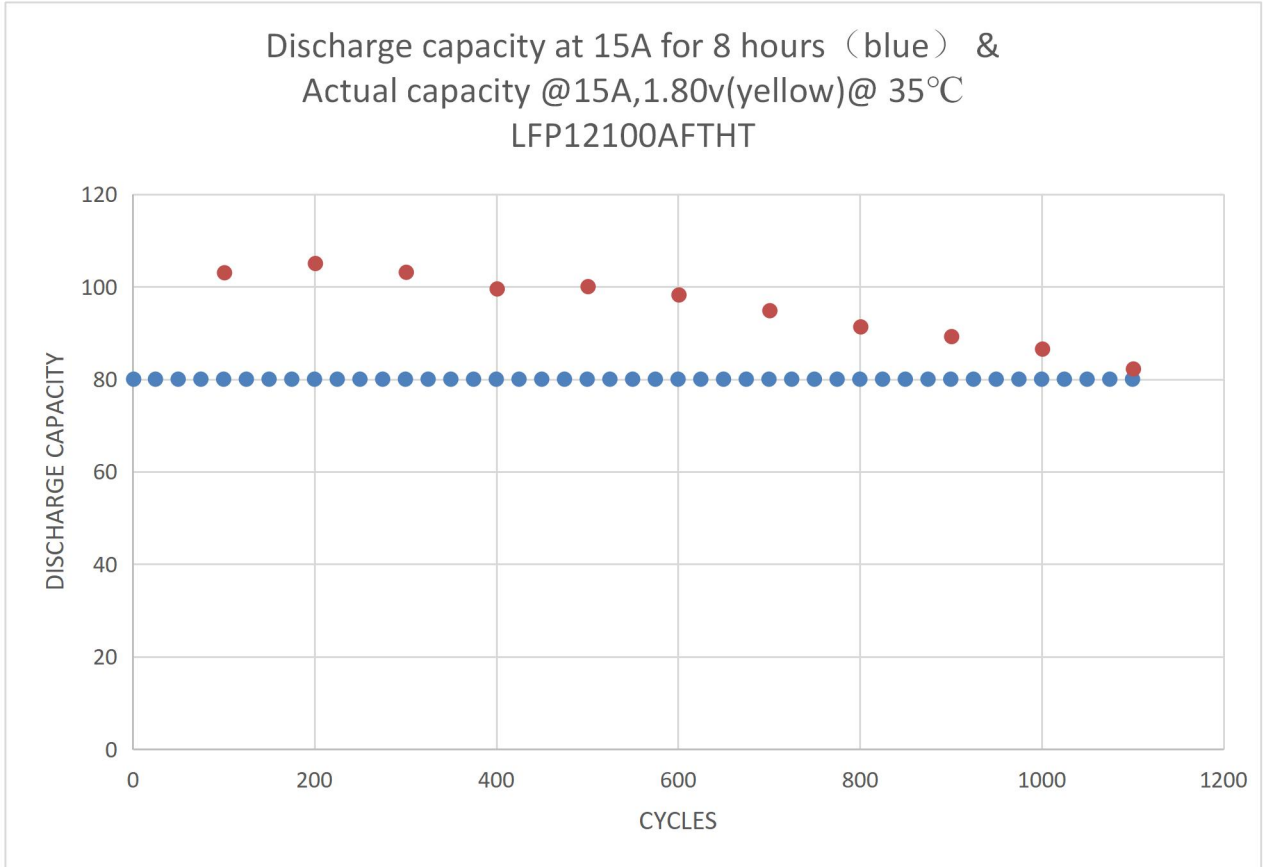


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10hrs	9h08'30"	10A	36 °C	10.80v	91.3
825	8h00"00	10A	35°C		80
850	8h00"00	10A	34 °C		80
875	8h00"00	10A	35 °C		80
900	8h00"00	10A	36°C		80
10hrs	8h55'30"	10A	37°C	10.80v	89.2
925	8h00"00	10A	35°C		80
950	8h00"00	10A	32°C		80
975	8h00"00	10A	32°C		80
1000	8h00"00	10A	35°C		80
10hrs	8h39'54"	10A	36°C	10.80v	86.5
1025	8h00"00	10A	34°C		80
1050	8h00"00	10A	33°C		80
1075	8h00"00	10A	32°C		80
1100	8h00"00	10A	33°C		80
10hrs	8h013'41"	10A	35°C	10.80v	82.2

For and on behalf of
深圳市一电电池技术有限公司
FIRSTPOWER TECHNOLOGY CO., LTD.
.....
Authorized Signature(s)

Data analysis



Conclusion: Passed

For and on behalf of
深圳市一电电池技术有限公司
FIRSTPOWER TECHNOLOGY CO., LTD
.....
Authorized Signature(s)

Tested by: MYR

Checked by: **CYH**

Date: 2018.07.02