

## Test Report

Battery Model	LFP12150FTHT (High temp,gel, 12V,150Ah)	Sample Q'ty	1pcs	Date	2020.10.25
Test item	Endurance in cycles				
Applicable Standard	Refer to IEC 60254-1-2005 @35°C				

<p><b>Test method</b></p>	<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 <math>t_0</math> 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 style="text-align: center;"><b>4.3 Characteristics of a fully charged cell or battery (unless the state of a fully charged battery is otherwise stated by the manufacturer)</b></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 <math>I_N</math> (see 3.1.2) This current shall be maintained constant within <math>\pm 1\%</math> throughout the whole discharge time.</p> <p><b>3 Functional characteristics</b></p> <p><b>3.1 Capacity (for the test, see 5.2)</b></p> <p><b>3.1.1</b> The most essential characteristic of a traction battery is its ability to store electric energy. This is expressed as capacity <math>C</math>, measured in ampere hours (Ah), which varies with the conditions of use.</p> <p><b>3.1.2</b> The nominal capacity <math>C_N</math> 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 <math>U_f = 1,70</math> 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><b>4.1.1.2 Voltage measurement</b></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 <math>\Omega/V</math>.</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 ( $35^{\circ}\text{C}$ ), the capacity C, in accordance with 5.2.6, shall be corrected to the actual capacity  $C_a$  by the equation:

$$C_a = C \cdot \left[ \frac{273 + T_0}{273 + t_r} \right]^{0.006}$$

Where  $T_0$  is the initial temperature;

$t_r$  is the reference temperature ( $35^{\circ}\text{C}$ )  $= 0.006(^{\circ}\text{C})^{-1}$  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  $C_a = 0.95 C_N$  at the first cycle;

$C_a = 1.00 C_N$  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"><li>- discharge at a current of <math>I(A) = 0.1CA (A)</math> for 8hours.</li><li>- 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)</li></ul> <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 <math>\pm 1</math> 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 <math>C_a</math> resulting from this test is less than <math>0.8 C_N</math> during two successive series of 50 cycles <math>\pm 5</math> 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>
<b>Technical Requirement</b>	<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 <math>I = 1.0 \times I_{10}</math> 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	15A	35°C		120.0
25	8h00"00	15A	36°C		120.0
50	8h00"00	15A	35°C		120.0
75	8h00"00	15A	38°C		120.0
100	8h00"00	15A	38°C		120.0
10hrs	10h30'25"	15A	33°C	10.80v	159.5
125	8h00"00	15A	35 °C		120.0
150	8h00"00	15A	33°C		120.0
175	8h00"00	15A	35 °C		120.0
200	8h00"00	15A	35 °C		120.0
10hrs	10h25'07"	15A	37°C	10.80v	154.4
225	8h00"00	15A	36°C		120.0
250	8h00"00	15A	35°C		120.0
275	8h00"00	15A	38°C		120.0
300	8h00"00	15A	38°C		120.0
10hrs	10h35'07"	15A	37°C	10.80v	156.8
325	8h00"00	15A	35 °C		120.0
350	8h00"00	15A	35 °C		120.0
375	8h00"00	15A	37°C		120.0



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400	8h00"00	15A	37°C		120.0
10hrs	10h08'07"	15A	33°C	10.80v	153.8
425	8h00"00	15A	33°C		120.0
450	8h00"00	15A	35 °C		120.0
475	8h00"00	15A	35 °C		120.0
500	8h00"00	15A	37°C		120.0
10hrs	10h03'34"	15A	34 °C	10.80v	151.8
525	8h00"00	15A	35 °C		120.0
550	8h00"00	15A	35°C		120.0
575	8h00"00	15A	38°C		120.0
600	8h00"00	15A	38°C		120.0
10hrs	9h54'20	15A	35°C	10.80v	148.5
625	8h00"00	15A	35 °C		120.0
650	8h00"00	15A	35 °C		120.0
675	8h00"00	15A	37°C		120.0
700	8h00"00	15A	37°C		120.0
10hrs	9h41'00"	15A	33°C	10.80v	147.0
725	8h00"00	15A	37°C		120.0
750	8h00"00	15A	33°C		120.0
775	8h00"00	15A	35 °C		120.0
800	8h00"00	15A	35°C		120.0



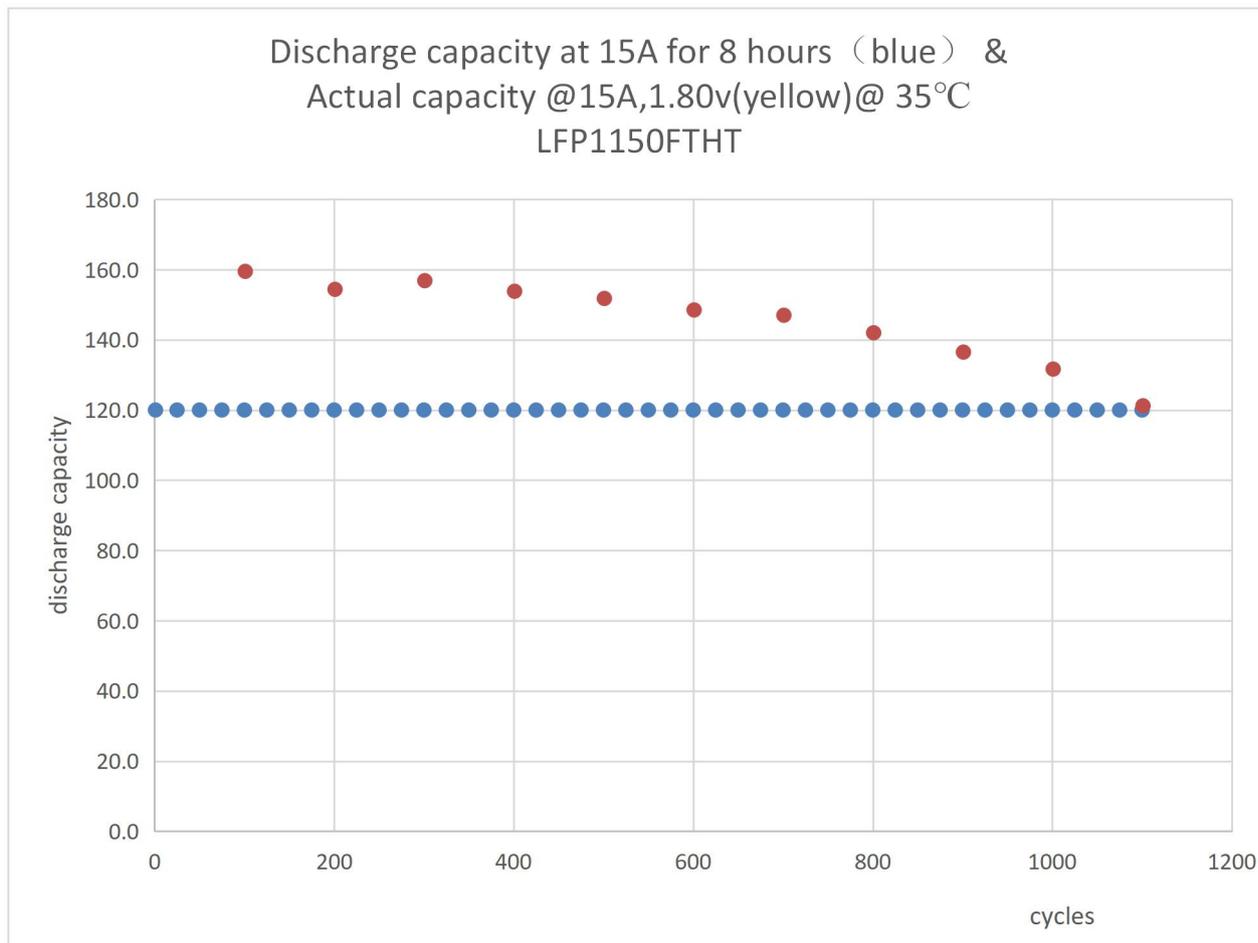
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10hrs	9h28'30"	15A	35 °C	10.80v	142.0
825	8h00"00	15A	38°C		120.0
850	8h00"00	15A	35 °C		120.0
875	8h00"00	15A	35 °C		120.0
900	8h00"00	15A	37°C		120.0
10hrs	9h16'30"	15A	38°C	10.80v	136.5
925	8h00"00	15A	34 °C		120.0
950	8h00"00	15A	33°C		120.0
975	8h00"00	15A	36°C		120.0
1000	8h00"00	15A	37°C		120.0
10hrs	8h52'54"	15A	37°C	10.80v	131.7
1025	8h00"00	15A	38°C		120.0
1050	8h00"00	15A	37°C		120.0
1075	8h00"00	15A	36°C		120.0
1100	8h00"00	15A	33°C		120.0
10hrs	8h05'41"	15A	35°C	10.80v	121.0

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

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Authorized Signature(s)

**Data analysis**



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)

**Conclusion: Passed**

Tested by: LHZ

Checked by: **CYH**

Date: 2020/11/06