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# TEST REPORT

No. YDTEST180924 Date: 24th. Sep. 2018 Page: 1 of 7

**Battery Model : LFPG12100FT (Gel,12V,100Ah)**
**Sample Q'ty : 1pcs**
**Test item : Endurance in cycles**
**Applicable Standard : Capacity test : Refer to IEC60896-21;**
**Cycle test : Refer to YD/T 799-2010**

**Test Method :**

**1 Capacity test**

6.11.1 The test shall be carried out with five times six cells or five times six monobloc batteries.

6.11.2 The test units shall be selected and prepared according to 5.2.

6.11.3 The test for the actual capacity Ca, at the moment of dispatch, shall be carried out at each of the following discharge rates each time with six fully charged units. These units shall not have been previously submitted to any discharge.

The capacities shall be determined with the following rates to the following end-of-discharge voltages:

C10 10h rate with current I10 to Ufinal = 1,80 Vpc (ë= 0,006)

C8 8h rate with current I8 to Ufinal = 1,75 Vpc (ë= 0,006)

C3 3h rate with current I3 to Ufinal = 1,70 Vpc (ë = 0,006)

C 1h rate with current I1 to Ufinal = 1,60 Vpc (ë= 0,01)

C0,25 0,25h rate with current I0,25 to Ufinal = 1,60 Vpc (ë= 0,01)

(where ë is the rated temperature correction factor of the capacity at the relevant rate)

6.11.4 The test shall be carried out with the units fully charged and with each unit temperature between 18 °C and 27 °C measured immediately prior the discharge.

This initial temperature q of the unit shall be used for the correction of its capacity in function of temperature.

NOTE 1 It is desirable that the initial average cell or monobloc battery temperature and the ambient temperature be as near to the reference temperature of either 20 °C or 25 °C as practically possible.

NOTE 2 For several applications the knowledge of the performance of the units under constant power discharge conditions is necessary. These performance data shall be gathered with actual discharges where the power delivered from a unit is held constant and not by means of calculation from average discharge voltage levels.

6.11.5 The discharge shall be started within 1 h to 24 h after termination of charge and with the discharge current Idis held constant within 1 % throughout the whole discharge duration.

6.11.6 The voltage measured at the terminals, including one intercell connector length, of all the units shall be either recorded automatically against time or by taking the readings manually with a voltmeter. In the latter case readings shall be made at least at 25 %, 50 % and 80 % of the calculated discharge time with:
t = Crt / Irt (h)

and then at suitable time intervals, which permits the detection of the transition to the final discharge voltage Ufinal.

6.11.7 In a type test for the determination of the actual capacity Ca at the moment of dispatch with five discharge rates (this subclause), the discharge shall be terminated when the following value has been recorded from each unit:

**Test Method** :

tdisch = elapsed time of discharge of each unit, with n cells, to a final voltage of

Ufinal = n× Ufinal (V).

6.11.8 The six individual capacity data, normalized to 20 °C and 25 °C for each of the five discharge rates shall be reported.

6.11.9 In the type test for determination of the actual capacity Ca preceding or following a particular test routine, the discharge shall be terminated, if not specified otherwise, when the elapsed time of discharge tdisch of each unit with ncells to a final voltage of Ufinal = n × Ufinal (V) has been recorded.

6.11.10 In an acceptance or commissioning test the discharge, at one rate only, shall be terminated when one of the following values tdisch, whichever comes first, has been recorded:

tdisch = the elapsed time of discharge of the string, with ncells, to a voltage of n× Ufinal (V) or tdisch = the elapsed time when the first of the unit in the string reached a voltage of U = (Ufinal – × 0,2) in volts with the value of ( ×0,2) as shown below, or as agreed between the battery manufacturer and the battery user. Individual unit voltages can be use d to assess variability within the lot.

Table 8 – Final voltage de-rating factor in commissioning or acceptance test

Unit voltage V × 0,2

2 1.000× 0,20V=0.200

4 1.414× 0,20V=0.282

6 1.732× 0,20V=0.346

8 2.000×0,20V=0.400

10 2.236× 0,20V=0.447

12 2.449× 0,20V=0.489

16 2.828× 0,20V=0.565

48 4.989× 0,20V=0.979

EXAMPLE: In a string of eight 12 V monobloc batteries the discharge (e.g. at the I3 rate to Ufinal 1,70 Vpc) shall be terminated when a string voltage of 48 × 1,70 Vpc = 81,6 V is reached or when one of the eight monobloc batteries of the string reached a unit voltage of 10,2 V – 0,489 V = 9,711 V.

6.11.11 The measured capacity Ca (Ah) at the initial temperature q shall be calculated as the product of the discharge current (A) and tdisch i.e. the discharge time (h).

6.11.12 If the initial temperature q is different from the reference temperature of either 20 °C or 25 °C, the measured capacity shall be corrected by means of the following equation to obtain the actual capacity Ca at the selected reference temperature:

Ca20 °C = C /[1+ l(q - 20)] in Ah or Ca25 °C = C /[1+l (q-25)] in Ah

The coefficient ë shall be taken always as shown in 6.11.3 and according to the relative discharge rate.

Cycle test

7.23.3 cycle endurance test

Follow these steps to carry out the experiment.

**Technical Requirement** :

a) The test shall be carried out with six cells or three monobloc batteries.

The test units shall be selected and prepared according to 7.7.

The test units shall have, before starting the test, an actual capacity Ca of at least 100% Crt (10 h – Ufinal 1,80 Vpc at the selected reference temperature) and be fully charged.

The units shall be connected to a device whereby they undergo a series of discharge and charge cycles. In case of test equipment voltage limitations, 2 V or 4 V units can be grouped together in series to form a larger voltage string. However the number of individual cycle performance data points should be kept constant.

Each cycle shall comprise:

A discharge for 2 h with a current of I = 2.0 I10 maintained constant within ±1 % where I10 = [C10] / [10] in A and followed immediately by A charge for 22 h with a current limited to I = 2.0 I10 and a voltage limited to the float voltage specified by the manufacturer for either 20 °C or 25 °C.

b) The cells and monobloc batteries shall be operated at a temperature between 18 °C and 27 °C and the discharge–charge cycle routine a) and b) continued until, during a discharge of step a), a voltage of Ufinal 1,80 Vpc× n cells per string is reached in a time shorter than 2 h.

d) The unit or string voltages and number of cycles achieved with the discharge–charge cycle routine a) and b) shall be recorded.

NOTE This cycle number represents the amount of cycles which can be achieved in one single sequence without any prolonged charge or boost charge treatment and when the unit is subjected to a 24 h back-to-back sequence of a 2 h discharge to 40 % d.o.d (C10) followed by 22 h of charge and when recharged exclusively with the maximum charge voltage equivalent to the float voltage. This test is designed to more closely simulate the type of cycle service a battery experiences during constant voltage float service where no boost charge

**LFPG12100FT (12v100Ah) weight 35.65KG**

| | |
|---|---|
| Capacity test 10hour rate (10A discharge to 10.80v) | 10h36'54" 25℃ |
| Capacity test 5hour rate (17A discharge to 10.80v) | 5h56'42" 25℃ |
| Capacity test 3hour rate (25A discharge to 10.80v) | 3h42'22" 25℃ |
| Capacity test 1hour rate (55A discharge to 10.80v) | 1h27'40" 25℃ |

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## Test Data

| Cycle | Discharge time | Discharge current | Final terminal voltage | Capacity@25℃ |
|---|---|---|---|---|
| 1 | 2h | 20A | 12.130V | |
| 10 | 2h | 20A | 11.960V | |
| 20 | 2h | 20A | 11.956V | |
| 30 | 2h | 20A | 11.942V | |
| 40 | 2h | 20A | 11.974V | |
| 49 | 2h | 20A | 11.995V | |
| 50 | 10h24' | 10A | 10.8V | 104Ah |
| 51 | 2h | 20A | 12.100V | |
| 60 | 2h | 20A | 12.030V | |
| 70 | 2h | 20A | 12.040V | |
| 80 | 2h | 20A | 12.010V | |
| 90 | 2h | 20A | 12.030V | |
| 99 | 2h | 20A | 12.020V | |
| 100 | 10h52' | 10A | 10.8V | 108.7Ah |
| 101 | 2h | 20A | 12.110V | |
| 110 | 2h | 20A | 11.950V | |
| 120 | 2h | 20A | 11.980V | |
| 130 | 2h | 20A | 11.990V | |
| 140 | 2h | 20A | 12.020V | |
| 149 | 2h | 20A | 12.010V | |
| 150 | 10h51' | 10A | 10.8V | 108.5Ah |
| 151 | 2h | 20A | 12.140V | |
| 160 | 2h | 20A | 12.060V | |
| 170 | 2h | 20A | 12.040V | |
| 180 | 2h | 20A | 12.050V | |
| 190 | 2h | 20A | 12.000V | |
| 199 | 2h | 20A | 12.050V | |
| 200 | 12h05' | 10A | 10.8V | 120.8Ah |
| 201 | 2h | 20A | 12.120V | |
| 210 | 2h | 20A | 12.070V | |
| 220 | 2h | 20A | 12.040V | |
| 230 | 2h | 20A | 12.030V | |

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## Test Data

| Cycle | Discharge time | Discharge current | Final terminal voltage | Capacity@25℃ |
|---|---|---|---|---|
| 240 | 2h | 20A | 12.030V | |
| 249 | 2h | 20A | 12.020V | |
| 250 | 11h47' | 10A | 10.8V | 117.8Ah |
| 251 | 2h | 20A | 12.130V | |
| 260 | 2h | 20A | 12.050V | |
| 270 | 2h | 20A | 12.030V | |
| 280 | 2h | 20A | 12.030V | |
| 290 | 2h | 20A | 12.040V | |
| 299 | 2h | 20A | 12.030V | |
| 300 | 11h20' | 10A | 10.8V | 113.3Ah |
| 301 | 2h | 20A | 12.120V | |
| 310 | 2h | 20A | 12.040V | |
| 320 | 2h | 20A | 12.030V | |
| 330 | 2h | 20A | 12.020V | |
| 340 | 2h | 20A | 12.010V | |
| 349 | 2h | 20A | 12.020V | |
| 350 | 11h01' | 10A | 10.8V | 110.2Ah |
| 351 | 2h | 20A | 12.110V | |
| 360 | 2h | 20A | 12.070V | |
| 370 | 2h | 20A | 12.020V | |
| 380 | 2h | 20A | 12.010V | |
| 390 | 2h | 20A | 12.020V | |
| 399 | 2h | 20A | 12.000V | |
| 400 | 10h41' | 10A | 10.8V | 106.8Ah |
| 401 | 2h | 20A | 12.110V | |
| 410 | 2h | 20A | 12.050V | |
| 420 | 2h | 20A | 12.020V | |
| 430 | 2h | 20A | 12.010V | |
| 440 | 2h | 20A | 11.990V | |
| 449 | 2h | 20A | 11.990V | |
| 450 | 10h23' | 10A | 10.8V | 103.8Ah |

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| Cycle | Discharge time | Discharge current | Final terminal voltage | Capacity@25℃ |
|---|---|---|---|---|
| 451 | 2h | 20A | 12.070V | |
| 460 | 2h | 20A | 12.020V | |
| 470 | 2h | 20A | 12.020V | |
| 480 | 2h | 20A | 11.960V | |
| 490 | 2h | 20A | 11.950V | |
| 499 | 2h | 20A | 11.890V | |
| 500 | 9h49' | 10A | 10.8V | 98.2Ah |
| 501 | 2h | 20A | 12.010V | |
| 510 | 2h | 20A | 11.980V | |
| 520 | 2h | 20A | 11.900V | |
| 530 | 2h | 20A | 11.880V | |
| 540 | 2h | 20A | 11.840V | |
| 549 | 2h | 20A | 11.830V | |
| 550 | 9h38' | 10A | 10.8V | 96.3Ah |
| 551 | 2h | 20A | 12.020V | |
| 560 | 2h | 20A | 11.900V | |
| 570 | 2h | 20A | 11.850V | |
| 580 | 2h | 20A | 11.710V | |
| 590 | 2h | 20A | 11.720V | |
| 599 | 2h | 20A | 11.690V | |
| 600 | 8h21' | 10A | 10.8V | 83.5Ah |
| 601 | 2h | 20A | 12.040V | |
| 610 | 2h | 20A | 11.830V | |
| 620 | 2h | 20A | 11.730V | |
| 625 | 2h | 20A | 11.430V | |
| 630 | 2h | 20A | 9.830V | |
| 633 | 2h | 20A | 9.810V | |
| 634 | 3h43' | 10A | 10.8V | 37.2Ah |

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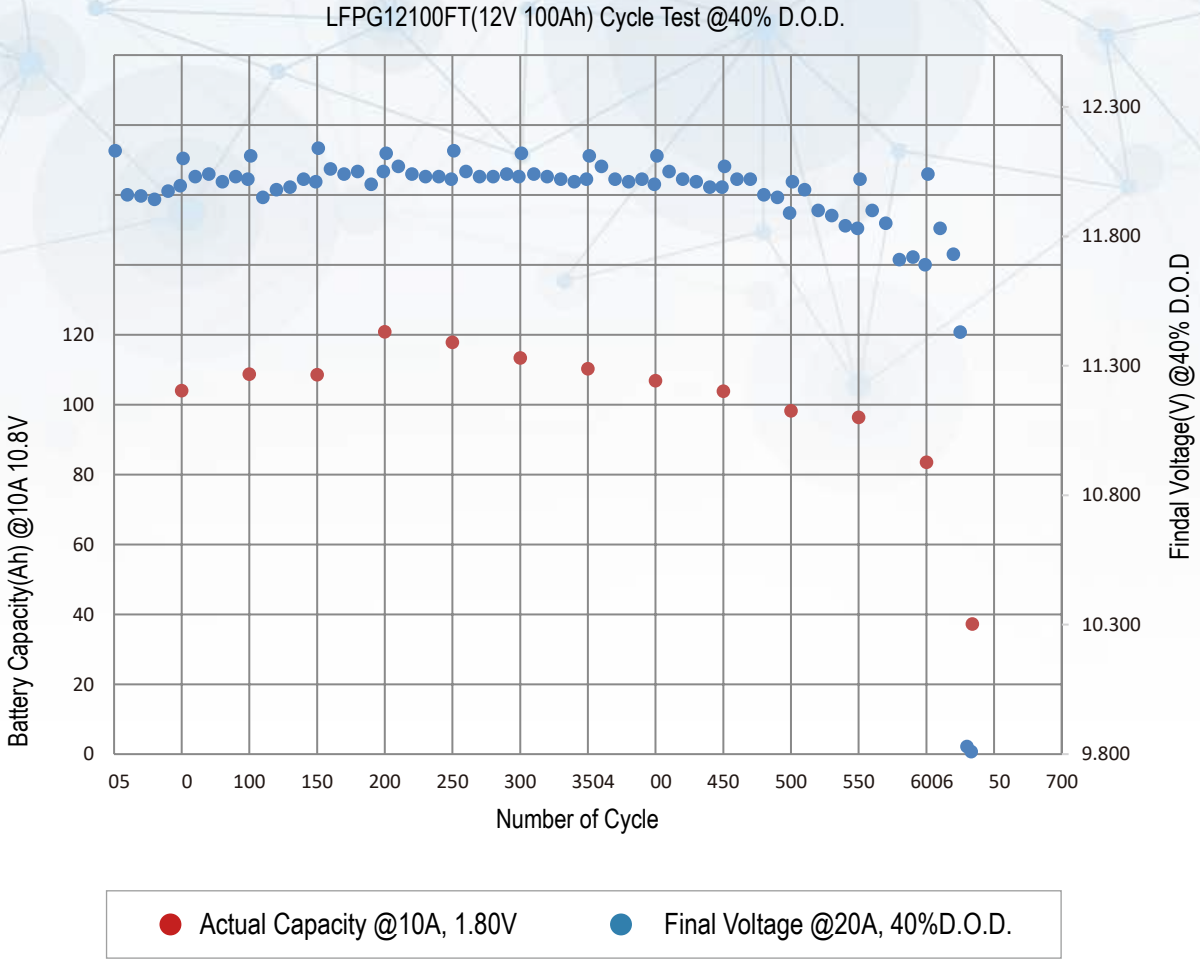
No. YDTEST180924 Date: 24th. Sep. 2018 




Tested by: LHZ

Checked by: CYH

Date: 2018/9/24