TEST REPORT
FOR
TERRA SUPREME
BI-POLAR BATTERY

Performed at:

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INTRODUCTION

Merlin Power Systems, L.L.C. (Merlin) is an industry leader in generating, monitoring and managing power for vehicle and RE systems. As new energy storage technologies emerge, Merlin analyzes new devices to determine the feasibility of productization.

TERRA SUPREME BI-POLAR BATTERY

Terra Supreme has developed a Bi-Polar, lead-acid, automotive-style battery in a Group 31 form factor. Batteries of this size are used in heavy machinery, such as large trucks, as well as armored military vehicles and renewable energy (RE) storage. This battery uses time-proven lead-acid chemistry. Lead is America's most recycled non-precious metal. The unique bi-polar construction permits superior high current performance (e.g. engine starting), long service life and mechanical robustness. The battery's construction also allows for deep-cycle discharge, which is important for electric industrial machines (e.g. forklifts) and RE storage.

MERLIN'S APPROACH

One battery was received by Merlin Power Systems to evaluate. The aims were to confirm the manufacturer's capacity claims and to assess that capacity over several full discharge cycles.

TEST EQUIPMENT

Merlin Power Systems supplied test equipment that included the Bitrode Cycle Life Tester model LCN2-25-24, S/N: 112300 and Test Equity Temperature Chamber, Model 1007C.

Figure 1 – Bitrode Battery Life Cycle Tester

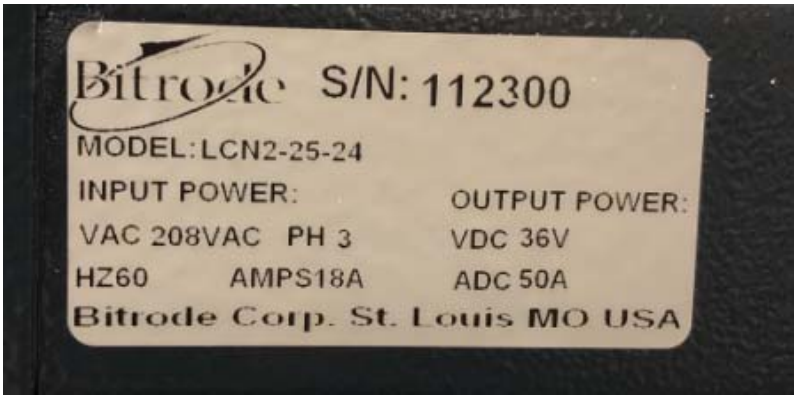

Figure 2 – Bitrode serial number plate

Test Equity Model 1007C Temperature Chamber, Serial Number: 11091

Figure 3 – Test Equity Temperature Chamber

ITEM UNDER TEST

The item under test was the following:

- Terra Supreme Bi-Polar Battery
  Part Number: TSB-31000
  Serial Number: 25319-0940-0023

Figure 4 – Unit Under Test

COLLECTED DATA

The following data was captured during all testing:

1. Total Time
2. Cycle Number
3. Step Time
4. Current – Charge current is positive and discharge is negative

5. Voltage
6. Power – Charge power is positive and discharge is negative
7. Battery Temperature in °C
8. Ampere-Hours – AH
9. Watt-Hours – WH

TEST PROCEDURE

The battery was placed in the temperature chamber and connected to the Bitrode battery cycler. The temperature was set to 26.7°C(80°F) and the battery was allowed to soak for several hours. A series of six charge/discharge cycles was executed with the following parameters:

Charge – Apply a constant current of 25A until the battery reached 14.8V. Apply a constant voltage of 14.8V until the total charge delivered was 125Ah.

Rest – Allow the battery to rest for four hours.

Discharge – Apply a constant current draw of 10.2A until the battery dropped to 10.5V.

Rest – Allow the battery to rest for four hours.

Temperature Tests

The battery was fully charged, as above, at 20°C. The temperature chamber was then set to 0°C and allowed to soak overnight. The battery was discharged while still at 0°C and the capacity recorded. This was repeated at the following temperatures: -30°C; -40°C; +30°C, +50°C; +60°C; and +70°C.

TEST RESULTS

These six cycles yielded an average capacity of 105.72Ah with a cycle-to-cycle variation of 0.46Ah after the first discharge.

The measured capacities, in Ah, for each cycle were as follows:

Cycle #	Capacity (Ah)
1	107.26
2	105.31
3	105.31
4	105.52
5	105.57
6	105.32

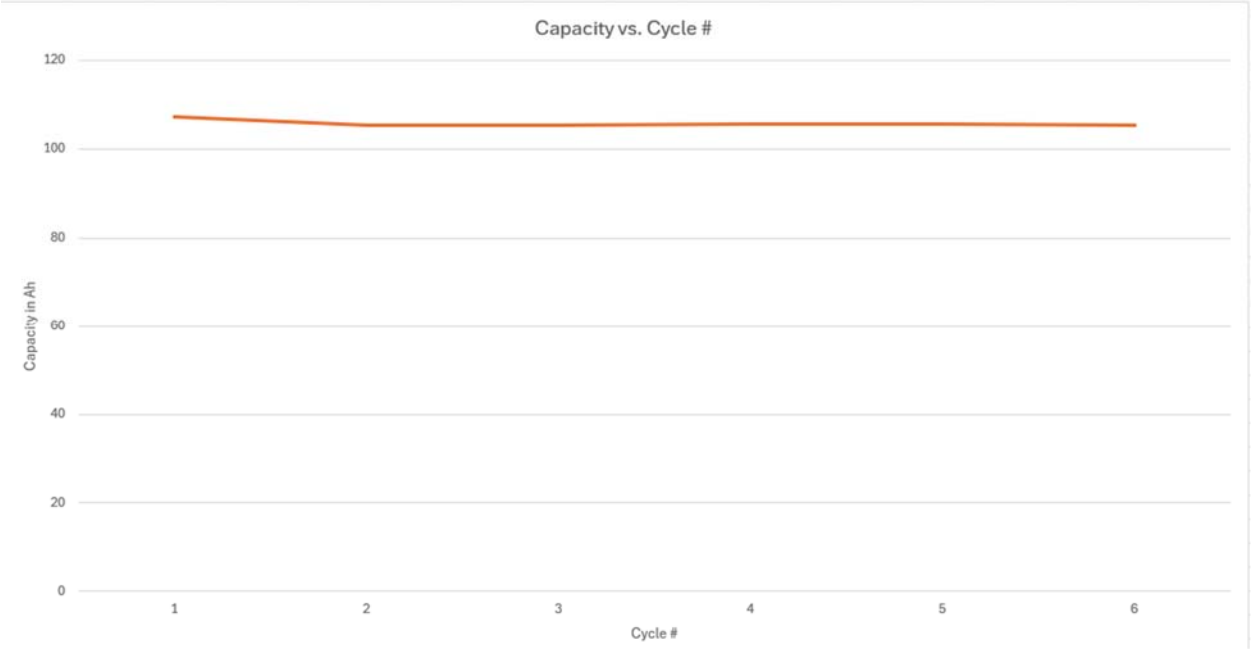

Figure 5 – Capacity vs. Cycle #

CONCLUSIONS

This battery is designed to be used in ANY application that requires a Group 31 battery. Unlike lithium or sodium based chemistries, no modification or adjustment to the charging equipment is required. The constant capacity over several full discharge cycles not only demonstrates its suitability for deep discharge applications, but also indicates an extremely long service life in vehicular use.