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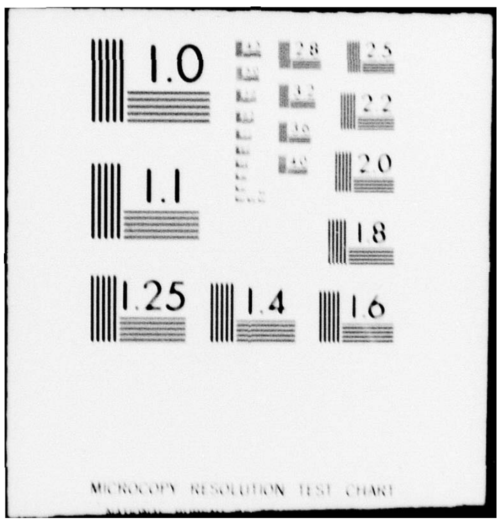
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1842 EEG/EEIS - TR-78-15

TECHNICAL REPORT,

LEAD CALCIUM BATTERY CELL SERVICING AND CHARGING PROBLEMS AND PROCEDURES.

Thomas A. Bennett

14p.

SUPPORT ENGINEERING BRANCH

1842 ELECTRONICS ENGINEERING GROUP (EEG)

SCOTT AIR FORCE BASE, ILLINOIS 62225

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1842 ELECTRONICS ENGINEERING GROUP

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Lead calcium battery cell charging problems were experienced in the field. Record data was submitted for review and recommendations. This report provides an analysis of the problem and recommends servicing and initial charging procedures.

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APPROVAL PAGE

This report has been reviewed and is approved for publication and distribution.

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SUMMARY

Battery charging problems had developed at five European communication stations. Record data was requested to substantiate the field work performed by the installation personnel. An analysis of the submitted data indicated the battery systems did not receive an adequate initial charge due to the manufacturer's instructions not being fully complied with. This report provides procedural guidance which will ensure a fully serviceable lead calcium battery (24 cells) upon completion.

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1. INTRODUCTION.

1.1 In March 1978, the 1844 Electronics Engineering Squadron (EES) Griffiss AFB, NY received test reports from the 485 Electronic Installation Squadron (EIS) Griffiss AFB, NY indicating their inability to fully charge the Digital European Backbone (DEB) battery system. The 485 EIS reported that the lead calcium batteries had been installed and activated in accordance with the battery manufacturer's installation instructions, but they were unable to equalize the battery systems and achieve an acceptable full charge. The 1844 EES requested substantiating data to verify the field work performed by the installation personnel associated with the battery charging operations. The 1844 EES forwarded the field data on Zugspitze, Germany with their recommendations for corrective action for review and necessary action by the 1842 EEG.

1.2 The information in this report reflects the findings and recommendations based on the review of submitted data.

2. FINDINGS.

2.1 The initial battery charge was to be accomplished in two steps at 2.6 to 2.7 volts per cell (VPC) per manufacturer's instructions. The first step consisted of charging cells 1 through 20 for twelve to sixteen hours. Charging was started at a voltage of 54 volts (2.7 VPC); however, this voltage was reduced to 45 volts (2.25 VPC) when the site voltage regulator reacted adversely to the increased rectifier load. The voltage was increased to 50 volts (2.5 VPC) and later to 52 volts (2.6 VPC) during the remainder of the step 1 charging period which lasted 14.5 hours. Upon termination of step 1 charging, the battery was strapped for the charging of cells 6 through 24 (step 2). Step 2 charging was started, but at the end of the first hour the voltage was reduced to lower cell electrolyte temperatures. One hour and a half later, cell ten boiled over and further charging was stopped to allow the cell electrolyte to cool down. After approximately two hours, charging was again commenced at a voltage of 45 volts (2.36 VPC). Three hours later, the voltage was raised to 48.5 volts (2.55 VPC) and cell No. 10 boiled over again after 3.5 hours of charging. Charging was stopped for one hour. When charging was restarted, the voltage was lowered to 48 volts (2.52 VPC) and remained at that setting until step two charging was terminated. Step 2 charging time was approximately 14.5 hours total.

2.2 Upon termination of step 1 charging, only cell 13 had reached the minimum voltage (2.6) that the manufacturer's instructions required of all cells. The remaining cells averaged 2.5 volts per cell. All cells (1 through 20) reflected a specific gravity (SP GR.) reading above 1.200 (1.200 to 1.220 SP GR. is normal for a fully charged cell). Step 2 charging was concluded without any cell obtaining a finishing charge voltage of 2.6. During step 2, cells 6 through 20 improved their SP GR reading after receiving an additional charge; however, cells 21 through 24 never achieved the minimum desired level of 1.200 SP GR and the voltage per cell never exceeded 2.25.

3. CONCLUSIONS.

3.1 Since the manufacturer's instructions were not followed as prescribed, the battery system did not receive an adequate initial charge during the performance of steps 1 and 2; i.e., charging until all cells reached a minimum voltage of 2.6 and continuing the charge until the specific gravity of the lowest cell stopped rising. The circumstance that inhibited the charging operation included the site voltage regulator adversely reacting to the increased load during the start of step 1 and the boilover of electrolyte in cell #10 twice during step 2. These incidents caused a lower voltage to be applied and at times the securing of the charger.

4. ACTION TAKEN.

4.1 With the discovery of the low specific gravity electrolyte in the battery cells (after initial charging was completed at four other Digital European Backbone locations) an inspection team was dispatched to confirm the out-of-specification readings, replace electrolyte, and for the next 24 hours of charging, take specific gravity, voltage and temperature readings. All cells previously deficient were found to be within specifications after this action was taken.

5. PROCEDURAL GUIDANCE.

5.1 The battery manufacturer's installation and operating instructions should be thoroughly understood prior to beginning this phase of work. The specific gravity of the electrolyte provided should be tested with a battery hydrometer before placing the electrolyte in the battery cells; the specific gravity should read between 1.2085 and 1.2185. If the specific gravity of the electrolyte is not in accordance with the manufacturer's specifications, contact the battery manufacturer for further instructions. Unseal and service only one cell at a time with the proper electrolyte. Perform the initial charge phase, paying strict attention to the monitoring of the electrolyte temperature. Do not let the electrolyte temperature rise above 120°F. Terminate charging only after the manufacturer's end of charge requirements have been achieved. Should it be necessary to charge the battery at a lower voltage to control the electrolyte temperature, terminate the charging when the battery manfuacturer's electrolyte specific gravity requirement has been met.

5.2 Completion of the following procedures will insure a fully servicable lead calcium battery (24 cell):

a. Prior to the initial servicing of the battery with electrolyte, take a hydrometer reading of the electrolyte provided. The specific gravity reading should be between 1.2085 to 1.2185. Should the specific gravity be outside these limits, do not service battery cells without checking with battery manufacturer for approval. Cell damage will take place if too high a specific gravity electrolyte is used.

b. Unseal one cell at a time and fill with electrolyte (of proper specific gravity) to the high level mark on the container. Caution: Cell damage will take place if the plates in the cell are not covered with electrolyte within twenty minutes of exposure to the atmosphere.

c. Wait two hours after the initial filling; then refill with electrolyte as required to bring the quantity back up to the high level mark.

d. Connect the positive lead from the charger to the positive post of Cell No. 1 and the negative lead to the negative post of Cell No. 20.

e. Before energizing the charger, take and record the voltage, electrolyte specific gravity and temperature readings of cells 1 through 20. These readings will be used to note the progress of the initial charging cycle.

f. Start the charger and adjust the output voltage for 52 volts (2.6 Volts Per cell).

g. Again, take a voltage reading of each cell and compare it to the readings previously taken during step e. A slight rise in voltage should be noted if the cells are properly charging. A decrease in voltage indicates that a cell is being charged in the reverse direction; if charging is continued, the cell will be ruined. Correct connections on cells being charged improperly.

h. Take and record voltage and electrolyte specific gravity and temperature readings every two hours. Should the electrolyte temperature rise above 110°F., utilize cooling fans to reduce the temperature by directing the air flow at the upper portion of the cells. If the temperature rises to 120°F, turn the charger off and wait until the temperature drops to 100°F before resuming battery charging. Should forced cooling be necessary, reduce the charging voltage to 50 volts. The initial charge duration normally lasts from 12 to 16 hours; however, it will take longer using a lower voltage. At 50 volts, charging time will approximately take one to two days.

i. Terminate the charging when the cell with the lowest specific gravity reading shows no increase in specific gravity for three consecutive readings taken at two hour intervals.

j. Remove the positive lead from Cell No. 1 and connect it to the positive post of Cell No. 6. Remove the negative lead from Cell No. 20 and connect it to the negative post of Cell No. 24.

k. Take and record the voltage and electrolyte specific gravity and temperature readings of Cells 21 through 24.

l. Start the charger and adjust the output voltage for 50 volts.

m. Take voltage readings of Cells 21 through 24 and compare them with the readings taken during Step K; there should be a slight voltage increase noted if the cells are charging properly. Check connections on cells charging improperly (cells showing a decrease in voltage).

n. Take and record voltage and electrolyte specific gravity readings every two hours. Should the electrolyte temperature rise above 110°F, utilize cooling fans to reduce the temperature by directing the air flow at the upper portion of the cells. If the temperature rises to 120°F, turn the charger off and wait until the temperature drops to 100°F before resuming battery charging. Should forced cooling be necessary to maintain the temperature below 120°F, reduce the charging voltage to 48 volts.

o. Terminate the charging when the cell with the lowest specific gravity reading shows no increase in specific gravity for three consecutive readings (taken at the two hour interval).

p. Remove the positive lead from Cell No. 6 and place it back on the positive post of Cell No. 1.

q. Start the charger and adjust the voltage output to 53.5 volts.

r. After one hour of operation, check and record the voltage, electrolyte specific gravity reading and the temperature of all cells. This set of specific gravity readings (with the battery in its fully charged mode) will be used in all future comparisons to determine the batteries state of charge and should be filed in a battery record historical folder. It should be noted that all new batteries show a deviation in cell voltage (± 0.05 volts). The average cell voltage should level off within six months when the cells are placed on float charge.

6. RECOMMENDATIONS.

6.1 It is recommended that the procedures in paragraph five of this report be incorporated in the statement of work Scheme tab "B" by AFCS Area area scheme engineers when applicable. This entry will insure that a battery containing 24 lead calcium cells will receive proper initial servicing and charging prior to its use.

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