OPERATION OF POWER PLANT

RADIO RELAY STATIONS

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1. GENERAL

1.01 This issue supercedes Issue L to include corrections to Paragraph 7.06 and 7.08 (a) previously covered in addendum.

1.02 This section describes the various power plants associated with radio relay equipment and covers instructions pertinent to their operation and the maintenance of the associated battery plants.

1.03 The instructions on the power plant equipment apply to all radio stations where applicable. The instructions do not supersede the standard practices, appropriate references are made to such sections and added tests are included that are not covered by other practices.

1.04 The instructions on battery maintenance apply to such equipment located at unattended stations. Except where noted, the instructions covered in Section 157-601-301 do not apply. Batteries at attended offices should be maintained in accordance with the instructions outlined under Section 157-601-301.

1.05 Because of the nature of the plant involved, battery maintenance at unattended stations is placed on a simplified basis. The reduction in maintenance effort is not considered detrimental to plant operation, however, somewhat shorter battery life may be experienced.

1.06 The routine checks are intended to detect defects in infrequently operated parts of the circuit and, insofar as practicable, guard against other circuit failures. They should be made during a period when they will cause the least unfavorable reaction.

1.07 Battery maintenance is of little avail if based on inaccurate instruments. It is important that the accuracy of the meters used in such maintenance be calibrated at periodic intervals.

1.08 Reference should be made to 157-601-301, General Section, as the fundamentals and other helpful data are outlined that will be of benefit in the maintenance of batteries.

1.09 Test leads for individual cell voltage readings and average battery float voltage readings are listed in Section 157-601-701.

Caution Accidental grounding of test leads while making individual cell voltage readings or average battery float voltage readings can result in serious interruption to service. In order to avoid this possibility extreme caution should be taken when taking these readings. Connections at the meter end should be secure and free of any possibility of touching or becoming grounded. In no case should connections at the meter end be removed without first disconnecting the test leads from the battery. The test lead connections at the battery should be removed immediately after each reading is taken.

2. TD-2 POWER PLANT - MAIN ROUTE

(A) 12 VOLT PLANT

2.01 Description of Plant. The 12 volt DC supply is used primarily for filament voltages on the various units of the radio repeater and terminal equipment. The supply is obtained from a 6 cell battery floated by J86244 type rectifiers. Resistances are installed in load leads during normal operation. These resistances are short-circuited when the battery is placed on discharge, thus maintaining near normal voltage at the equipment.

2.02 Rectifier Operation and Maintenance. Information relative to operation and maintenance of the rectifiers will be found in Sections 169-617-301 and 167-646-311. Routine tests covering rectifier operations and alarm features are described in these sections.

2.03 Added Routine Tests.

(a) Annual.

(1) Control Tubes - Test using portable tube test set. For special instructions on V2 and V6 see 169-617-301.

(2) OD3/VR150 Tube - Replace.

12 Volt Battery

2.04 Float Voltage - The float voltage per cell is 2.17, the overall battery float voltage is 13.0.

2.05 Boost Charges - Except as noted below a boost charge should be given when it is known that any appreciable discharge has taken place. Refer to Section 157-601-301 for details on boost charge.

2.06 Frequency of Routine Checks.

(a) Annual.

(1) Meter Calibration - Calibrate the meter on the control panel which is used to read battery voltage. Attach Form P-1931 to the meter and fill in the details required. For the calibration process, establish the specified float voltage at the battery as read on the standard voltmeter. Compare this reading with the reading on the control panel meter. This meter should then be adjusted to correspond to the standard meter reading. For those meters with no adjustment the meter reading corresponding to the standard should be indicated.

(2) Clean and Inspect - Clean and inspect cells, connections and general conditions in accordance with 157-601-701 and 157-601-702.

(b) 6 Month.

(1) Individual Cell Voltage - Check and record individual cell voltages at normal float. If any cell voltage uncorrected for temperature is below 2.13, with float at 2.17 volts per cell, give the battery a boost charge. If necessary, continue boost charges at 3 month intervals, but not to exceed two additional charges, if cell voltages are still low. If not corrected refer to the supervisor. Use Form E-2003 for record of cell voltages and kepp this record at the station for the duration of battery life.

(2) Individual Cell Specific Gravity - Check and record individual cell corrected specific gravity. A drop of more than 6 points (0.006) in a year should be reported to the supervisor Use Form E-2003 for this record.

(3) Boost Charge - For a period of 2 weeks at 13.2 volts.

(c) 4 Month.

(1) Electrolyte Level - Check electrolyte level and add water, if necessary. Note: - The 4M interval may be shortened depending upon local conditions.

(d) 2 Month.

(1) Pilot Cell Specific Gravity - Record pilot cell specific gravity. If a drop of more than 4 points (0.004) in two months cannot be accounted for, give a boost charge to the battery. Use Form P-1659 for recording the reading.

(2) Pilot Cell Voltage - Record pilot cell voltage. If outside the 2.17 volt float limit, check the overall float voltage. If still outside limits refer to the supervisor. Use Form P-1659 for recording the reading.

(e) Each Visit.

(1) Overall Float Voltage - Check overall float voltage as read at the control panel. Readjust charge rate, if necessary Record reading on Form P-1659.

(B) 130 VOLT PLANT

2.07 Description of Plant. The 130 volt DC supply is used primarily for plate potential on electron tubes in the microwave generator, Pre-IF and Main Amplifier of the radio repeater. The supply is also used for emergency lighting and other miscellaneous circuits. The supply is obtained from a 63 cell battery floated by a J86240 rectifier.

2.08 Rectifier Operation and Maintenance. Information relative to the operation and maintenance of the rectifier will be found in Section 167-646-301. Routine tests covering rectifier operation and alarm features are described in this section.

2.09 Added Routine Checks.

(a) Annual.

(1) Control Tubes - Test using portable tube test set.

(2) 354A Tubes - Trouble conditions may warrant periodic replacement.

130 Volt Battery

2.10 Float Voltage - The float voltage per cell is 2.17, the overall battery float voltage is 136.7.

2.11 Boost Charges - Except as noted below a boost charge should be given when it is known that any appreciable discharge has taken place. No annual boost charge is necessary. Refer to Section 157-601-301 for details on boost charge.

2.12 Frequency of Routine Tests.

(a) Annual.

(1) Meter Calibration - See 2.06, a., (1).

(2) Individual Cell Voltage - See 2.06, b., (1).

(3) Individual Cell Specific Gravity - See 2.06, b., (2).

(4) Clean and Inspect - See 2.06, a., (2).

(b) 4 Month.

(1) Electrolyte Level - See 2.06, c., (1).

(c) 2 Month.

(1) Pilot Cell Specific Gravity - See 2.06, d., (1).

(d) Each Visit.

(1) Overall Float Voltage - See 2.06, e., (1).

(C) 250 VOLT PLANT

2.13 Description of Plant

The 250 volt DC supply is used primarily for the plate potential on 416 type electron tubes in the microwave generators, transmitter modulators and transmitter amplifiers. This plant is actually a 120 volt power supply in tandem with the 130 volt supply. The supply is obtained from a 63 cell, 130 volt supply in series with 2-56 Cell parallel groups. The 56 cell portion or 120 volt groups are floated by a J86240 rectifier.

2.14 The 120 volt portion of the battery is arranged in two cabinets and through interlock system one parallel battery at a time may be removed from service.

2.15 Rectifier Operation and Maintenance. Information relative to operation and maintenance of the rectifier will be found in 167-646-306. Routine tests covering rectifier operation and alarm features are described in that section.

2.16 Added Routine Checks.

(a) Annual.

(1) Control Tubes - Test using portable tube test set.

(2) 354A Tubes - Trouble conditions may warrant periodic replacement.

120 Volt Battery

2.17 Float Voltage - The float voltage per cell is 2.17, the overall float voltage is 258.2.

2.18 Boost Charges - Except as noted below a boost charge should be given when it is known that any appreciable discharge has taken place. No annual boost charge is necessary. Refer to Section 157-601-301 for details on boost charge.

2.19 Frequency of Routine Tests.

(a) Annual.

(1) Meter Calibration - See 2.06, a., (1).

(2) Individual Cell Voltage - See 2.06, b., (1).

(3) Individual Cell Specific Gravity - See 2.06, b., (2).

(4) Clean and Inspect - See 2.06, a., (2).

(b) 4 Month.

(1) Electrolyte Level - See 2.06, c., (1).

(c) 2 Month.

(1) Pilot Cell Specific Gravity - See 2.06, d., (1).

(d) Each Visit.

(1) Overall Float Voltage - See 2.06, c., (1).

(D) 24 VOLT PLANT (SD-81091-01)

2.20 Description of Plant. The 24 volt DC supply is used for alarm and order wire equipment. The supply is obtained from a 11 cell battery floated by a J86243 type rectifier.

2.21 Rectifier Operation and Maintenance. Information relative to the operation and maintenance of the rectifier will be found in Section 167-767-301. Routine tests covering rectifier operation and alarm features are described in that section.

24 Volt Battery

2.22 Float Voltage - The float voltage per cell is 2.17, the overall battery float voltage is 23.9.

2.23 Boost Charges - Except as noted below a boost charge should be given when it is known that any appreciable discharge has taken place. No annual boost charge is necessary. Refer to Section 157-601-301 for details on boost charge.

2.24 Frequency of Routine Tests.

(a) Annual.

(1) Meter Calibration - See 2.06, a., (1).

(2) Individual Cell Voltage - See 2.06, b., (1).

(3) Individual Cell Specific Gravity - See 2.06, b., (2).

(4) Clean and Inspect - See 2.06, a., (2).

(b) 4 Month.

(1) Electrolyte Level - See 2.06, c., (1).

(c) 2 Month.

(1) Pilot Cell Specific Gravity - See 2.06, d., (1).

(d) Each Visit.

(1) Overall Float Voltage - See 2.06, e., (1).

(E) 24 VOLT PLANT (SD-80753-01 AND SD-80755-01)

2.25 Description of Plant. The 24 volt DC plant is provided at station where added capacity is required to furnish battery to telephone apparatus in addition to alarm and order wire equipment. The supply is obtained from an 11 cell battery floated by a J86263A 30 ampere regulated metallic-type rectifier.

2.26 Rectifier Operation and Maintenance. Information relative to the operation and maintenance of the rectifier will be found in Section 169-620-301 and 167-215-301. Routine tests covering rectifier operation and alarm features are described in that section.

2.27 Added Routine Tests.

(a) Annual.

(1) Control Tubes - Test using portable tube test set.

(2) Grid Battery - Replace

24 Volt Battery

2.28 Float Voltage - The float voltage per cell is 2.17, the overall battery float voltage is 23.9.

2.29 Boost Charge - Except as noted below a charge should be given when it is known that any appreciable discharge has taken place. No annual boost charge is necessary. Refer to Section 157-601-301 for details on boost charge.

2.30 Frequency of Routine Tests.

(a) Annual.

(1) Meter Calibration - See 2.06, a., (1).

(2) Individual Cell Voltage - See 2.06, b., (1).

(3) Individual Cell Specific Gravity - See 2.06, b., (2).

(4) Clean and Inspect - See 2.06, a., (2).

(b) 4 Month.

(1) Electrolyte Level - See 2.06, c., (1).

(c) 2 Month.

(1) Pilot Cell Specific Gravity - See 2.06, d., (1).

(d) Each Visit.

(1) Overall Float Voltage - See 2.06, e., (1).

3. TD-2 POWER PLANT - SECONDARY ROUTE

(A) 130 VOLT PLANT (425B)

3.01 Description of Plant. The 130 volt DC supply is used for the plate supply to various electron tubes in the radio equipment. In addition the supply is used for driving the standby inverter equipment. The supply is obtained from a 63 cell battery floated by a J86240 rectifier.

3.02 Rectifier Operation and Maintenance. Information relative to the operation and maintenance of the rectifiers will be found in Section 167-646-301. Routine tests covering rectifier operation and alarm features are described in that section.

3.03 Added Routine Tests.

(a) Annual.

(1) Control tubes - Test using portable tube tester.

(2) 354A Tubes - Trouble conditions may warrant periodic replacement.

130 Volt Battery

3.04 Float Voltage - The float voltage per cell is 2.17, the overall float voltage is 136.7.

3.05 Boost Charges - Except as noted below a boost charge should be given when it is known that any appreciable discharge has taken place. No annual boost charge is necessary. Refer to Section 157-601-301 for details on boost charge.

3.06 Frequency of Routine Tests.

(a) Annual.

(1) Meter Calibration - See 2.06, a., (1).

(2) Individual Specific Voltage - See 2.06, b., (1).

(3) Individual Specific Gravity - See 2.06, b., (2).

(4) Clean and Inspect - See 2.06, a., (2).

(b) 4 Month.

(1) Electrolyte Level - See 2.06, c., (1).

(c) 2 Month.

(1) Pilot Cell Specific Gravity - See 2.06, d., (1).

(d) Each Visit.

(1) Overall Float Voltage - See 2.06, e., (1).

B. OTHER PLANTS

3.07 Other types of plants used for alarm and order wires may vary depending upon the location. See Part 5 for details concerning various types of Plant that are used.

4. TH POWER PLANT

(A) GENERAL

4.01 This instruction provides for maintenance of the 130 volt battery associated with the 410B plant at unattended TH Radio Stations.

4.02 Batteries associated with TH power plants at attended offices should be maintained in accordance with instructions outlined under Section 157-601-301.

4.03 Description of Plant. All power for the TH radio equipment is obtained at 230 volts AC from motor alternators with provision for switch-in of a hot running spare, or operation from a battery plant in the event of commercial AC power failure. This plant is designated as the 508A Power Plant and information relative to its operation and maintenance is covered under Section 167-672-301.

(B) 410B POWER PLANT

4.04 The 410B power plant provides regulated voltage to operate the DC motors associated with the 508A power plant in the event of commercial AC power failure, or when initially starting the motor Generator sets. The description and operation of the plant is covered under Section 167-643-302. The plant is furnished with a 70 cell battery which is normally floated at 152 volts across the output of a J86240 regulated rectifier.

4.05 Rectifier Operation and Maintenance. Information relative to operation and maintenance of the rectifiers will be found in Section 169-613-301.

(C) 152 VOLT BATTERY

4.06 Float Voltage - The float voltage per cell is 2.17, the overall battery voltage under float conditions is 151.9.

4.07 Boost Charge - Except as noted below a Boost Charge should be given when it is known that any appreciable discharge has taken place. No annual boost charge is necessary. Refer to Section 157-601-301 for details on boost charge.

4.08 Frequency of Routine Checks

(a) Annual.

(1) Meter Calibration - See 2.06, a., (1).

(2) Individual Cell Voltage - See 2.06, b., (1).

(3) Individual Cell Specific Gravity - See 2.06, b., (2).

(4) Clean and Inspect - See 2.06, a., (2).

(b) 4 Month.

(1) Electrolyte Level - See 2.06, c., (1).

(c) 2 Month.

(1) Pilot Cell Specific Gravity - See 2.06, d., (1).

(d) Each Visit.

(1) Overall Float Voltage - See 2.06, e., (1).

5. MISCELLANEOUS TYPE PLANTS

(A) GENERAL

5.01 Various types of small battery plants, wet and dry, are used at secondary or side leg stations for alarm and order wires. Such stations may involve such radio equipment as TD-2, TE, MOTOROLA, etc.

(B) 24 VOLT PLANTS - WET BATTERY TYPE

(1) Plant per SD-80804-01

5.02 Description of Plant. This 24 volt DC supply is obtained from an 11 cell battery floated by a J86207L rectifier. This

rectifier is a full wave type capable of 8 ampere output.

5.03 Rectifier Operation and Maintenance. Information relative to the operation and maintenance of the rectifier will be found in Section 169-230-301.

5.04 Added Routine Tests.

(a) Annual.

(1) Grid Battery - Replace.

24 Volt Battery

5.05 See part 5.10 (4) for battery maintenance.

(2) Plant per SD-81091-01.

5.06 Description of Plant. The 24 volt DC supply is obtained from an 11 cell battery floated by a J86243A 9 ampere regulated mettallic-type rectifier.

5.07 Rectifier Operation and Maintenance. Information relative to the operation and maintenance of the rectifier will be found in 169-616-301.

24 Volt Battery

5.08 See part 5.10 (4) for battery maintenance.

(3) Plant per SD-81179-01.

5.09 Description of Plant. The 24 volt DC supply is obtained from an 11 cell battery floated by a J86241A 1 ampere regulated metallic-type rectifier.

5.10 Rectifier Operation and Maintenance. See (4) for battery maintenance.

(4) 24 Volt Battery.

5.11 Float Voltage - The float voltage per cell is 2.17, the overall battery voltage is 23.9.

5.12 Boost Charges - Except as noted below a boost charge should be given when it is known that any appreciable discharge has taken place. No annual boost charge is necessary. Refer to Section 157-601-301 for details on boost charge.

5.13 Frequency of Routine.

(a) Annual.

(1) Meter Calibration - (SD-80804-01 only) - See 2.06, a., (1).

(2) Individual Cell Voltage - See 2.06, b., (1).

(3) Individual Cell Specific Gravity - See 2.06, b., (2).

(4) Clean and Inspect - See 2.06, a., (2).

(b) 4 Month.

(1) Electrolyte Level - See 2.06, c., (1).

(c) 2 Month.

(1) Pilot Cell Specific Gravity - See 2.06, d., (1).

(d) Each Visit.

(1) Overall Float Voltage - See 2.06, e., (1) read on rectifier control panel meter, if installed, or at REG+ and REG- with a portable volt meter.

(C) 24 VOLT PLANTS - DRY BATTERY TYPE

(1) Raytheon Rectifier Filter.

5.14 Description of Plant. The 24 volt DC supply comes from the output of a Raytheon #1044 HR Rectifier Filter. A dry battery reserve, consisting of 18 #6 cells is used in the event of a power or rectifier failure. Automatic transfer to the reserve is accomplished by a transfer relay in the rectifier.

5.15 Rectifier Operation and Maintenance. The output voltage should be between 23.5 to 25.5 from no load to 1 ampere. Over 1 ampere the load voltage will remain above 22.5 volts. Terminals are provided on the outside of the rectifier so voltages may be read with a portable meter.

5.16 Routine Tests.

(a) Annual.

(1) Batteries - Replace.

(b) 6 Month.

(1) Individual Cell Voltage - Test in accordance with 157-421-501.

(c) 2 Month.

(1) Output Voltage - Check output voltage. Increase in voltage may be necessary due to the aging of the selenium rectifier. Resistor No. 7, as shown on manufacturer drawing DL2-1973 may be adjusted to give correct output voltage at full load.

(D) 130 VOLT PLANTS - DRY BATTERY TYPE

(1) Plant per SD-80605-03.

5.17 Description of Plant. The 130 volt DC power is supplied from the output of a J86207-B2 0.1 ampere rectifier. Dry cell batteries, either KS-6948 or KS-8128, are floated across the rectifier and in case of a power or rectifier failure, current is supplied automatically from the dry cells.

5.18 Rectifier Operation and Maintenance. Information relative to the operation and maintenance of the rectifier will be found in Section 169-603-320.

5.19 Added Routine Tests.

(a) Annual.

(1) Grid Battery - Replace.

(2) 313CC Tube - Replace.

130 Volt Battery

5.20 See Part 5.24 (3) for battery maintenance.

(2) Plant per SD-80659-31

5.21 Description of Plant. The 130 Volt DC power is supplied from the output of a J86207-B2 0.6 ampere rectifier. Dry cell batteries (KS-14367) are floated across the rectifier and in case of a power or rectifier failure, current is supplied automatically from the dry cells.

5.22 Rectifier Operation and Maintenance. Information relative to the operation and maintenance of the rectifier will be found in Section 169-603-302.

5.23 Added Routine Tests.

(a) Annual.

(1) Grid Battery - Replace.

(2) 312CC Tube - Replace.

130 Volt Battery

5.24 See (3) for battery maintenance.

(3) 130 Volt Battery

(a) 2 Years.

(1) Batteries - Somewhat near ordinary shelf life may be expected from the dry cells, however, in order to guard against failure during unattended periods, the batteries should be replaced at least every two years.

(b) 6 Month.

(1) Batteries - Check and record battery voltage (Form P1659). Operate the test switch from NOR to TST and at the pin jacks with a portable volt meter read the voltage. At the end of 10 seconds if the reading is 130 volts or less the entire battery should be replaced.

6. RADIO EQUIPMENT - ASSOCIATED RECTIFIERS

(A) GENERAL

6.01 Various types of AC operated radio relay transmitters and receivers employ individual power supplies to provide the potentials required for the associated radio equipment. In general, the various types of systems used will be covered by Standard Instructions relative to operation and maintenance procedures.

(B) VARIAC TEST

6.02 Pending faulty tubes in a rectifier can be uncovered by a variac test. The frequency of such a test should be governed by routine and trouble results.

6.03 Test Procedure - The rectifier performance can be tested by reducing the a-c input voltage to 105 volts. The test should be made as follows, shut the equipment down and insert a General Radio V10MT Variac in series with the main AC power supply cord. Set the variac to 115 volts, turn equipment on, check input AC voltage with a portable voltmeter, readjust variac if necessary. Set all rectifiers under test on normal output voltage. Reduce the AC input to 105 volts, watch all rectifier outputs as indicated on power control panel meter. Investigate all rectifiers that fail to hold normal output voltage.

7. EMERGENCY ALTERNATOR - RECTIFIERS AND BATTERY PLANT

7.01 Description of Plant. Various emergency engine alternators, depending upon the type, may employ either a 16 volt or 32 volt starting battery. A rectifier, either as part of the engine set or an associated unit is used to trickle charge the battery during normal periods.

7.02 Engine Operation. The normal 2 minute start delay and 5 minute warm up time features of the emergency engine control circuit should be modified to provide quick start if the plant protects:

(1) AC operated radio equipment with no other power back-up.

(2) TD-2 12 Volt Power Plant (425A).

On the AC operated equipment the modification on the time features are necessary to minimize any interruption due to a primary AC power failure. On the TD-2, the change will reduce the time interval the 12 volt battery plant is placed on discharge. Appendix 1 to this section outlines information necessary to modify the standard emergency engine control circuits.

7.03 Rectifier Operation and Maintenance. Information relative to the operation and maintenance of rectifiers that are part of the engine proper will be found under sections covering the engine set.

7.04 The KS-5750 and KS-15521 engine start batteries are charged by means of a separate J86207L rectifier. Information concerning maintenance and operation of this type rectifier will be found in 169-230-301.

7.05 Added Routine Tests (J86207L Rectifier)

(a) Annual.

(1) Grid Battery (if used) - Replace.

Start Battery

7.06 Float Voltage - The optimum float voltage per cell for lead-acid batteries is 2.17V (low-specific gravity type), 2.25V (high specific gravity type), and for nickel cadmium batteries 1.43V per cell. Refer to Sections 157-601-101 and 157-631-101 respectively.

Overall battery float voltages should be as follows:

16 Volt Lead-Acid	- 17.3 ± 0.3V (Low Spec. Grav.)
	- 17.7 ± 0.3V (High Spec. Grav.)
32 Volt Lead-Acid	- 34.5 to 35.0V (Low Spec. Grav.)
	- 35.8 ± 0.3V (High Spec.) Grav.)
32 Volt Nickel Cadmium	- 35.75 ± 0.75V

7.07 Boost Charge - Boost charges should only be given as outlined below. Refer to Section 157-601-301 for details on boost charge time.

7.08 Frequency of Routine

(a) Annual.

(1) Individual Cell Voltage - Check and record individual cell voltage at normal float. If any cell voltage corrected for temperature is below 2.13, with float as 2.17 volts per cell, 2.19 with float at 1.43 volts per cell, give the battery a boost charge. If necessary, continue boost charges at 4 month intervals, but not to exceed two additional charges, if cell voltages are still low. If not corrected refer to supervisor. Use Form E-2003 for record of cell voltages and keep this record at the station for the duration of battery life.

(2) Individual Cell Specific Gravity - (Lead-Acid batteries only). Check and record individual cell corrected specific gravity. A drop of more than 6 points (0.006) in a year should be reported to the supervisor. Use Form E-2003 for this record.

(3) Clean and Inspect - Clean and inspect cells, connections and general condition in accordance with 157-601-701 and 157-601-702.

(b) 4 Month.

(1) Electrolyte Level - Check electrolyte level and add water, if necessary.

Note: The 4M interval may be shortened depending upon local conditions.

Attached
Appendix 1