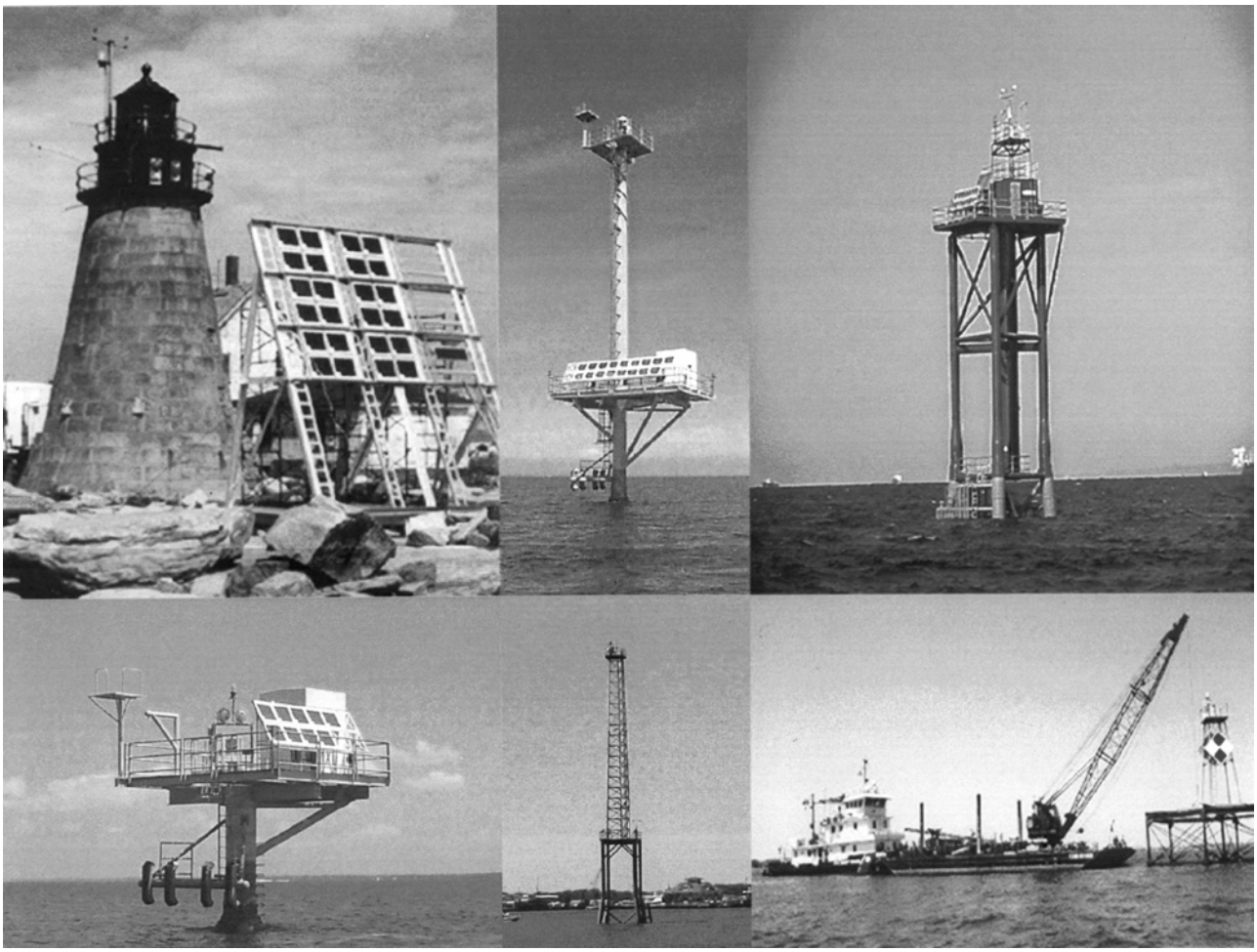
Major Aids to Navigation Preventive Maintenance System Guide

U.S. Department of Transportation

United States Coast Guard



COMDTINST M16500.10A

U.S. Department of Transportation
United States Coast Guard

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COMDTINST M16500.10A
SEP 26 2002

COMMANDANT INSTRUCTION MANUAL

Subj: MAJOR AIDS TO NAVIGATION PREVENTIVE MAINTENANCE SYSTEM GUIDE

Ref: (a) Lighthouse Preventive Maintenance System Manual, COMDTINST M16500.10

1. PURPOSE. The purpose of this instruction is to promulgate the Major Aids to Navigation Preventive Maintenance System (PMS) Guide, M16500.10A. This guide expands and modernizes the preventive maintenance guidance previously provided in reference (a).

2. ACTION. District commanders and unit commanding officers shall ensure that the provisions of this Instruction are followed.

3. DIRECTIVES AFFECTED. The Lighthouse Preventive Maintenance System Manual, COMDTINST M16500.10, is canceled.

4. DISCUSSION. The lighthouse preventive maintenance system (PMS) was established in 1981 to sustain the equipment and systems installed as part of the Lighthouse Automation and Modernization Program (LAMP). This major update of the PMS manual provides expanded guidance to sustain the equipment and systems deployed as part of the lighthouse and other major aids solarization and range modernization programs, and updates the long-standing guidance for the older LAMP systems.

5. POLLUTION PREVENTION (P2) CONSIDERATIONS. Pollution Prevention considerations were examined in the development of this directive and have been fully addressed.

6. FORMS/REPORTS. The optional Lighthouse PMS Feedback Report, Form CG-5333, is canceled.

J. A. KINGHORN
Assistant Commandant for Systems

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CHAPTER 1. **INTRODUCTION**

A. **General**.

The Major Aids to Navigation PMS Guide contains detailed preventive maintenance procedures. These procedures cover all tests and inspections required by current directives, manufacturers' recommendations, and developments made in reaction to material failure and casualty experience at Coast Guard major aids using standard equipment.

B. **Purpose**.

The primary objective of major aid PMS is to provide for managing maintenance and maintenance support in a manner that will ensure satisfactory equipment operation. Using major aid PMS will achieve the following goals:

1. Uniform preventive maintenance standards.

2. More effective use of manpower and material resources by team leaders.

3. Improvement of reliability and maintainability of equipment through better preventive maintenance and analysis of both preventive and corrective maintenance feedback information.

C. **Limitations**.

Due to many different configurations and equipment at lighthouses and ranges, one standardized major aid PMS covering all sites cannot be provided by Commandant. This Instruction covers only the standard solarization and LAMP (lighthouse Automation and Modernization Program) equipment furnished by Commandant. Also, servicing personnel should note that not all automated lighthouses and ranges have all the equipment listed in this guide due to different major aid signal and power requirements.

D. **Description**.

The system is based on separate maintenance procedures (PM action) for all standard solarization and LAMP equipment. Separate procedures are also used for each maintenance interval. Personnel performing PM can use this guide to identify tools, parts, materials, and test equipment they will need at the site. Personnel scheduling PM visits can use the frequency interval in each procedure to organize an overall schedule for each individual major aid.

Administrative control of maintenance can be achieved by being able to identify maintenance tasks that were not completed.

E. **Requirements**.

In order for PMS to work and to achieve the best operational system, servicing personnel shall sequentially follow the PMS procedures and perform the PM at the prescribed intervals. No reduction in the scope of a procedure is authorized. If deviation must be made in order to perform a PM task, it shall be reported via chain of command to District (oan) or (Aoww), with an explanation and corrections needed.

Servicing personnel shall use one PMS guide per major aid. Equipment PMS procedures that are not required (e.g., for equipment not installed) should be omitted from or in some other way disregarded in the PMS guide. However, the omitted procedures should be saved in the event new equipment is installed or aid configuration is changed (e.g., solarized).

F. **Revisions**.

Although the formal reporting system has been discontinued, the procedures outlined in the PMS guide will be revised and/or corrected as necessary on the basis of discrepancies reported via the chain of command to Commandant (G-SEC-2). Commandant will automatically distribute revisions to all major aid to navigation PMS guide users.

G. **Glossary of Terms**.

1. Aids to Navigation Manual - Technical, COMDTINST M16500.3(series): Describes operation, parts support, and maintenance philosophy for standard aids to navigation equipment; each hardware item is covered by a data sheet.

2. Annual: Once every year; abbreviated "**A**."

3. Biennial: Once every two years; abbreviated "**BE**."

4. Corrective Maintenance: Maintenance performed to replace a part or repair or correct a malfunction. The need for corrective maintenance is usually discovered as a result of performing a PM procedure; work done in addition to regular PM.

5. Deferrals: Checks or tasks not performed or completed due to lack of time, funds, materials, or manpower.

6. G-SEC-2: Ocean Engineering Division, USCG Headquarters.

7. LAMP: Lighthouse Automation and Modernization Program.

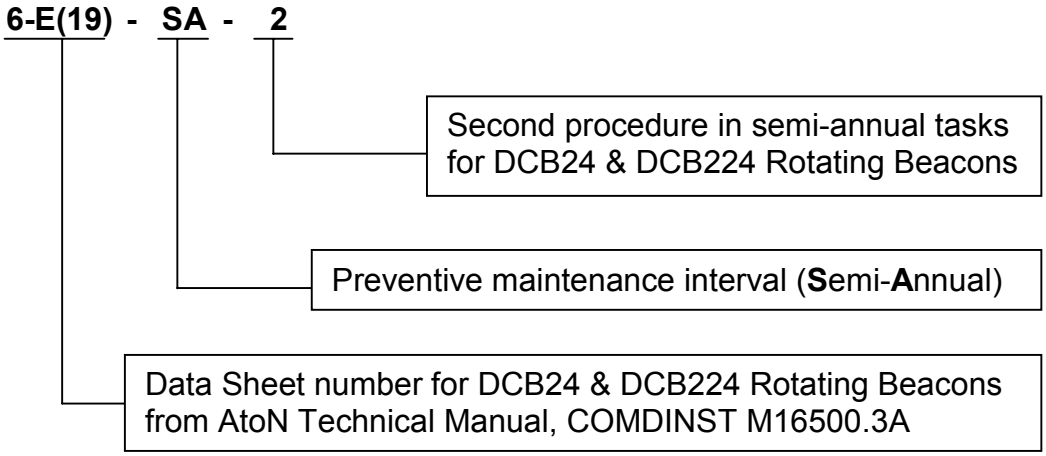
8. Major Aids to Navigation: Lighthouses and ranges, either solar or conventionally powered, with complex control, power, and, sometimes, monitor systems.

9. PMS: Stands for **P**reventive **M**aintenance **S**ystem, a system of scheduled maintenance for Coast Guard major aids to navigation.

10. Preventive Maintenance: Maintenance performed to prevent malfunctions and parts breakdowns by systematically and periodically checking out each system or subsystem. By performing preventive maintenance you cut back on the need for corrective maintenance; abbreviated PM.

11. Procedure Number. Each PMS procedure is identified by a combination of letters and numbers. The procedure number identifies equipment found in the Aids to Navigation Manual - Technical, COMDTINST M16500.3(series) corresponding to its data sheet. The procedure number also identifies the PM interval for the equipment and the task number for that interval.

    Example:



12. Quarterly: Any three-month period or ¼ of a calendar year; abbreviated "**Q**."

13. Semi-Annual: Twice a year; abbreviated "**SA**."

14. Standard Major Aid Equipment: Equipment which was centrally procured and distributed by Commandant (G-SEC-2). This includes solarization and LAMP equipment. This is the only equipment covered in this guide.

CHAPTER 2. **PMS PROCEDURES INDEX**

A. **Index of PMS Procedures**.

Specific maintenance procedures provided by Commandant for standard solarization and LAMP equipment are listed below. This listing includes all individual PMS Procedures by procedure number for each system.

Procedure Number *	Sub-System

- ***Lighted Structures, Structural, and Safety***

SA-1	Inspection and Maintenance

- ***250mm Lantern and 300mm Lantern w/12Vdc Marine Signal Lamp***

6-E(15), 6-E(16)-A-1	Electrical Hardware and Connections
6-E(15), 6-E(16)-A-2	Optical
6-E(15), 6-E(16)-A-3	Lampchanger and Lamps

- ***VRB-25 Rotating Beacon***

6-E(17)-A-1	General

- ***FA-251-AC Rotating Beacon***

6-E(18)-SA-1	Cage Bearings, Air Filter, and Lens Cover
6-E(18)-A-1	Photocontrol (Daylight Control - DLC) Operation
6-E(18)-A-2	CG-4P Lampchanger and Lamps
6-E(18)-BE-1	Rotation Motor

- ***DCB-24 and DCB-224 Rotating Beacon***

6-E(19)-SA-1	Motor and Speed Reducer Rotation Detector
6-E(19)-SA-2	Sliprings and Electrical Wiring
6-E(19)-A-1	Speed Reducer
6-E(19)-A-2	Lampchanger and Lamps
6-E(19)-A-3	Optical

* See Glossary

- ***RL-14 Range Lantern***

6-E(20)-A-1	Optical
6-E(20)-A-2	CG-6P 12VDC Lampchanger and Lamps
6-E(20)-A-3	CG-4P 120VAC Lampchanger and Lamps

- ***RL-24 Range Lantern***

6-E(21)-A-1	Optical
6-E(21)-A-2	Lampchanger and Lamps

- ***FA-232 and FA-232/02 Sound Signal Systems***

7-E(1)-SA-1	Electrical

- ***SA-850 and SA-850/02 Sound Signal Systems***

7-E(2)-SA-1	Electrical

- ***CG-1000, ELG-300/02, and ELG-300/04 Sound Signal Systems***

7-E(3)-SA-1	Electrical

- ***CG-1000, ELG-500/02, and ELG-500/04 Sound Signal Systems***

7-E(4)-SA-1	Electrical

- ***ACMS Monitoring System***

8-E(2)-SA-1	ACMS Master Unit
8-E(3)-SA-1	ACMS Transfer Unit
8-E(4)-SA-1	ACMS Remote Unit
8-E(5)-SA-1	LEACMS Remote Unit

- ***Audio Visual Controller (AVC), GCF-RWL-2098***

8-E(6)-SA-1	CG-181 or CG-493 Flasher
8-E(6)-SA-2	Automatic Power Reset
8-E(6)-SA-3	Fog Detector Reset Function
8-E(6)-A-1	30-Minute Off Delay Timer
8-E(6)-A-2	Main Light Current Sensor (or Detector)
8-E(6)-A-3	CG-181 or CG-493 Flasher
8-E(6)-A-4	Wiring and Enclosure

- ***NAVAID Sensor Module, GCF-RWL-2076***

8-E(7)-SA-1	Sound Signal System
8-E(7)-SA-2	Light Signal System

- ***NAVAID Sensor Module Panel, GCF-RWL-2241***

8-E(8)-A-1	Terminal Strip Connectors, Enclosure, and Wiring

- ***VM100 Fog Detector***

8-E(9)-SA-1	Various Checks

- ***AC Flash Controller, GCF-RWL-2106***

8-E(10)-A-1	Operational and Wiring Checks

- ***Engine-Generator, Standard High Endurance***

9-E(1)-Q-1	Generator
9-E(1)-Q-2	Engine, Lube Oil Tank
9-E(1)-Q-3	Engine-Generator Regulator
9-E(1)-A-1	Engine, Lube Oil
9-E(1)-A-2	Engine, Lube Oil
9-E(1)-A-3	Engine, Lube Oil
9-E(1)-A-4	Engine, Air Cleaner (SR Model)
9-E(1)-A-5	Mounts and Fasteners
9-E(1)-A-6	Engine
9-E(1)-A-7	Wiring System
9-E(1)-A-8	Engine, Fuel System
9-E(1)-A-9	Engine, Fuel System (ST-3 Model)
9-E(1)-A-10	Engine, Fuel System
9-E(1)-A-11	Engine
9-E(1)-A-12	Engine, Air Cleaner (ST Model)
9-E(1)-A-13	Engine, Exhaust System
9-E(1)-A-14	Lube Oil Tank
9-E(1)-BE-1	Engine
9-E(1)-BE-2	Generator
9-E(1)-BE-3	Engine, Exhaust System
9-E(1)-BE-4	Engine
9-E(1)-BE-5	Engine
9-E(1)-BE-6	Engine, Fuel System (SR Model)
9-E(1)-BE-7	Engine, Fuel System (ST Model)
9-E(1)-BE-8	Engine, Fuel System (Model SR 2&3)
9-E(1)-BE-9	Engine, Fuel System (ST Model)
9-E(1)-BE-10	Engine, Fuel System (SR Model)

9-E(1)-BE-11	Engine, Fuel System (ST Model)
9-E(1)-BE-12	Engine

- ***Environmental Control Unit (ECU), Standard***

9-E(2)-Q-1	Intake Air Filter
9-E(2)-Q-2	Modutrol Damper Motors

- ***Fuel Daytank, Standard***

9-E(3)-Q-1	Fuel Filter
9-E(3)-Q-2	Fuel Filter
9-E(3)-SA-1	Transfer Pumps, Float Switches
9-E(3)-A-1	Fuel Pump, Electric Motors

- ***Lighthouse Power Controller and Transfer Switch***

9-E(4)-SA-1	Calibration Circuit - Prime Power
9-E(4)-SA-2	Calibration Circuit - Commercial
9-E(4)-A-1	Contactor

- ***Battery Charger, 24 Volt***

9-E(5)-SA-1	24V CDSA-IBC-24-20A 24V SAB NIFE SCBF101-24-10C

- ***Nickel-Cadmium Storage Battery for Diesel Starting, 24 Volt***

9-E(6)-Q-1	24 Volt, 20 Cell (use Saft Nife SBH102 or Alcad XHP100, HED-100 is discontinued)

- ***Battery Charger, 12 Volt***

9-E(7)-SA-1	12V CDSA-IBC-12-30A 12V SAB NIFE SCB100-12-25

- ***Nickel-Cadmium Storage Battery for Emergency Power, 12 Volt***

9-E(8)-Q-1	12 Volt, 10 Cells in Series (Edison ED-80, ED-240, and ED-400)

- ***Standard Aids to Navigation Power Supply, High Watt***

9-E(9)-A-1	Electrical

- ***Solar Array (Main)***

9-E(24)-A-1	Solar Panels (10 Watt, 20 Watt, and 35 Watt) - Glass Surface
9-E(24)-A-2	Solar Panels (10 Watt, 20 Watt, and 35 Watt) - Cable and Electrical

- ***Solar Panel for Emergency Batteries (SM50-H and M75)***

9-E(26)-A-1	Glass Surface
9-E(26)-A-2	Cable

- ***Local Terminal Box (LTB)***

9-E(29)-A-1	Terminal Strip Connectors

- ***Photovoltaic Combiner Box (PVCB)***

9-E(30)-A-1	Terminal Strip Connectors

- ***Solar Charge Controller (SCC)***

9-E(31)-A-1	General

- ***Range Power Box (RPB)***

9-E(32)-A-1	General

- ***Solar Distribution Box (SDB)***

9-E(35)-A-1	Solar Aid Controller II (SACII)

- ***Low Voltage Drop Kit (LVDK)***

9-E(39)-A-1	Terminal Strip Connectors

- ***Large Lead-Acid Storage Batteries, 12 Volt***

9-E(46)-SA-1	12 Volt, Six 2-volt Cells in Series (Yuasa/Exide E55 & E120)
9-E(47)-SA-1	12 Volt, Six 2-volt Cells in Series (Fulman Solar)
9-E(48)-SA-1	12 Volt, Six 2-volt Cells in Series (Sonnenschein Dryfit A600)
9-E(49)-SA-1	12 Volt, Six 2-volt Cells in Series (GNB Absolyte IIP)

B. **Schedule**.

Due to the many different locations, configurations, and types of gear at lighthouses and ranges, a single standard preventive maintenance schedule covering all sites is not possible. All maintenance procedures listed in this guide should be evaluated and a balanced PM schedule developed that will reflect the actual servicing requirement of each major aid to navigation in your area of operation (AOR).

PMS Procedures, as outlined in Section 2-A, follow (in Chapter 3).

CHAPTER 3. **PMS PROCEDURES**

(The procedures start on next page)

- SYSTEM: ***Lighted Structures***
- SUBSYSTEM: **Structural and Safety**
- TRAINING: **ANC-ANT**
- PMS INTERVAL: **Semi-Annual**

Digest of Work: Inspection and maintenance of structural and safety components.

Safety Precautions: Ensure compliance with all applicable safety requirements as outlined in federal and manufacturers' publications. If structure appears unsafe to climb or work on, do not climb it. Notify your OinC to initiate a CASREP message and suspend servicing signals on the structure until safe conditions are restored.

Tools, Test Equipment, Materials, and References:

Aids to Navigation Manual - Technical, COMDTINST M16500.3(series), Chapter 4;
Civil Engineering Manual, COMDTINST M11000.11(series), Chapter 17;
Tower Manual, COMDTINST M11000.4(series), Chapters 2 & 3;
Lighthouse Maintenance Management Manual, COMDTINST M16500.6(series); and
Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19(series), for megger test.

Troubleshooting References: N/A.

PROCEDURE:

Platform. The platform decking or grating shall be inspected for structural integrity and soundness and repaired or replaced if/when necessary. Platform protective railings shall be inspected for deterioration and replaced if/when broken, severely bent, or otherwise considered unsafe.

Tower. All structural components of the tower shall be checked for structural stability and repaired or replaced if/when necessary.

Safety Climbing Device. The safety climbing device shall be inspected to ensure that it is in proper working condition and replaced when necessary. Any structures higher than twenty feet that are not equipped with a safety climbing device shall be reported to the CEU via the District Commander (oan).

Ladder. Ladders shall be inspected for decay, missing rungs, and improper or broken mountings, and fasteners and shall be replaced if/when necessary.

Battery Box. Battery boxes shall be inspected to ensure that they are intact and securely fastened to the platform. Battery boxes shall not be used for storing tools, combustibles, or other unauthorized materials.

Wiring. All wiring and terminals (lugs) shall be inspected for cracking, corrosion, and deterioration. Any wire not in “like-new” condition shall be replaced. A megohmmeter test shall be performed to check the insulation of the wire. Stuffing tubes and glands shall be inspected and replaced if found to be damaged.

Weight Handling Equipment and Rigging. All weight handling equipment and related rigging shall be checked for loose and worn parts, worn or frayed rigging, and ease of operation prior to each use. Defects shall be corrected prior to use. Weight handling equipment shall be load tested in accordance with Chapter 17 of Civil Engineering Manual, COMDTINST M11000.11(series).

Shore Station Maintenance Record (SSMR). The Shore Station Maintenance Record (SSMR), Form CG-4094, serves to identify, quantify, specify, request, and schedule work which is beyond the capability of servicing units and which must be accomplished by higher maintenance levels. SSMRs should be submitted to the CEU via the District Commander (oan).

- SYSTEM: ***250mm Lantern and 300mm Lantern w/12Vdc Marine Signal Lamp***
- SUBSYSTEM: **Electrical Hardware and Connections**
- TRAINING: **ANC-AC, ANC-MAM**
- PMS INTERVAL: **Annual**

Digest of Work: Verify characteristic and check photoresistor (daylight control - DLC) operation.

Safety Precautions: N/A.

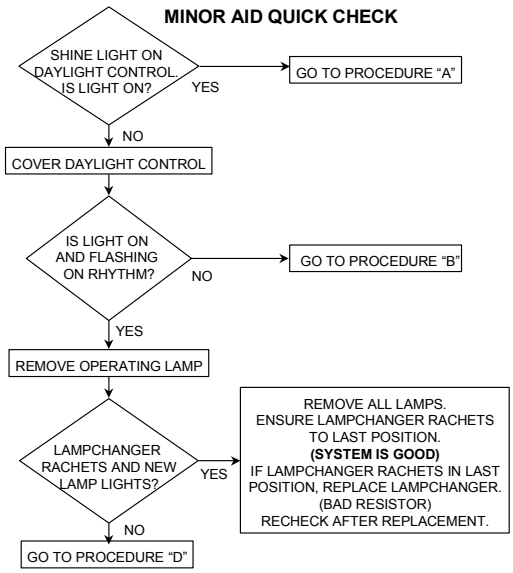
Tools, Test Equipment, Materials, and References:

Screwdriver, 5/16" flat tip.

Troubleshooting References: Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19(series), pages 3-7 and 3-16.

PROCEDURE:

Perform the MINOR AID QUICK CHECK procedure starting on page 4-9 of Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19(series):



- SYSTEM: ***250mm Lantern and 300mm Lantern w/12Vdc Marine Signal Lamp***
- SUBSYSTEM: **Optical**
- TRAINING: **ANC-AC, ANC-MAM**
- PMS INTERVAL: **Annual**

Digest of Work: Clean lens, focus system, and level system.

Safety Precautions: N/A.

Tools, Test Equipment, Materials, and References:

Clean cloth;
Denatured alcohol;
Focus fixture;
Focus lens (for 300mm lantern only);
Spirit level NSN: 5210-00-516-3356, or 18" carpenter's level; and
Screwdriver, 5/16" flat tip.

Troubleshooting References: Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19(series), pages 3-7 and 3-16.

PROCEDURE:

1. Clean lens, inspect for cracks and deterioration.
2. Check levelness of lantern with carpenter's level. Check on two perpendicular lines.
3. Check focus. The focus fixture shall be installed in the lampchanger and viewed along perpendicular axes through sighting marks on the lens. A focusing lens should be used in conjunction with the focus fixture for the 300mm lens.

- SYSTEM: ***250mm Lantern and 300mm Lantern w/12Vdc Marine Signal Lamp***
- SUBSYSTEM: **Lampchanger and Lamps**
- TRAINING: **ANC-AC, ANC-MAM**
- PMS INTERVAL: **Annual**

Digest of Work: Verify that lampchanger rotates, all lamps are good, and all lamps are the correct size (current/power rating).

Safety Precautions: Tungsten-Halogen lamps operate at high pressures and may explode without warning while operating. Wear heat resistant gloves and eye protection when handling lamps. Lamps may be HOT.

Tools, Test Equipment, Materials, and References:

New 12VDC marine signal lamps;
Clean cloth; and
Denatured alcohol.

Troubleshooting References: Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19(series), pages 3-7 and 3-16.

PROCEDURE:

1. Verify that lampchanger rotates systematically from #1 to #6 position without lamps.
2. Verify lamp current (or power) rating (e.g., 2.03a, 3.05a, 75W).
3. Relamp: Discard burned out lamps and the operating one; remove and reinstall other lamps up toward #1 position; and, install new lamps as needed. Clean all bulbs with a clean cloth and alcohol.
4. Rotate the #1 lamp (red-colored socket face) into operating position.

- SYSTEM: ***VRB-25 Rotating Beacon***
- SUBSYSTEM: **General**
- TRAINING: **ANC-SP, ANC-MAM**
- PMS INTERVAL: **Annual**

Digest of Work: Check focus, operation of lampchanger, and lamps.

Safety Precautions: Tungsten-Halogen lamps operate at high pressures and may explode without warning while operating. Wear heat resistant gloves and eye protection when handling lamps. Lamps may be HOT.

Tools, Test Equipment, Materials, and References:

New 12VDC marine signal lamps;
Clean cloth;
Denatured alcohol;
Mild detergent and water; and
Focus fixture.

Troubleshooting References: Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19(series), pages 3-33 to 3-69.

PROCEDURE:

1. Remove and discard lamp in operating position and all burned out lamps.
2. Install focus fixture in #1 position and check focus.
3. Verify that lampchanger rotates systematically from #1 to #6 position without lamps.
4. Verify proper-sized lamps are being used by checking its rating (e.g., 2.03a, 3.05a, 75W).
5. Reinstall unused or new lamps as needed in all six lampchanger positions. Clean all bulbs with a clean cloth and alcohol.
6. Rotate the #1 lamp (red-colored socket face) into operating position.
7. Clean lens cover with mild detergent and water. DO NOT use ammonia- or solvent-based cleaners as these cause crazing in the lens cover.
8. Check for levelness using bubble level on turntable. Adjust if necessary.
9. Check beacon for smooth rotation.

- SYSTEM: ***FA-251-AC Rotating Beacon***
- SUBSYSTEM: **Cage Bearings, Air Filter, and Lens Cover**
- PMS INTERVAL: **Semi-Annual**

Digest of Work: Inspect lens cage bearings, replace air filter, and clean lens cover.

Safety Precautions: Disconnect 120VAC electrical power before opening; until power is disconnected,120VAC is present on exposed terminal strip in the base and under rain hood.

Tools, Test Equipment, Materials, and References:

Hand tools, as required;
Clean dry cloth;
Glass cleaner;
FRAM CA-140PL air filter or equivalent; and
Three (3) lens cage bearings.

Troubleshooting References: Automatic Power Inc., FA-251-AC Rotating Beacon Instruction Manual; and Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17(series), page 3-1.

PROCEDURE:

1. While the cage is rotating, check the three (3) bearings riding on the lens ring. The bearings should rotate freely and should not have any flat spots. If all bearings are in good condition, go to procedure 6.
2. If a bad bearing is found, disconnect power and open the beacon. Remove the red, black, and green wires powering the rotation motor connected to the terminal strip in the base of the beacon. Remove the cap to the cable gland and pull the three wires out of the base of the beacon.
3. Remove the twelve screws securing the lens cover to the lens ring. Remove the lens cover and lens cage.
4. Replace the worn bearings (note washers on bearings supporting cage). Commandant (G-SEC-2) can provide replacement nylon bearings. If a replacement bearing is not available, exchange the cage-support bearing with the cage-centering bearing. These bearings are not as critical and can be replaced at the next scheduled visit.
5. Install the cage on the lens ring, spin it, and check the operation of the bearings. When installing the lens cover, make sure that the square drive on the rotation motor fits into the drive arm in the lens cage. Rewire the drive motor to the terminal strip in

the base of the beacon in accordance with Figure 3-3 of Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17(series).

6. Disconnect power to beacon (if not already disconnected). Remove rain hood and replace air filter.
7. Replace rain hood.
8. Clean lens cover with glass cleaner.
9. Reconnect power to the beacon and check operation.

- SYSTEM: ***FA-251-AC Rotating Beacon***
- SUBSYSTEM: **Photocontrol (Daylight Control - DLC) Operation**
- PMS INTERVAL: **Annual**

Digest of Work: Check operation of photocontrol (daylight control).

Safety Precautions: Disconnect 120VAC electrical power before servicing; until power is disconnected,120VAC is present on exposed terminal strip within the beacon.

Tools, Test Equipment, Materials, and References:

Screwdriver, ¼" flat tip;
Screwdriver, short flat tip or 3/8" open end wrench;
Wrench, 1" open end;
Intermatic K4121 photocontrol;
Spade terminals (lugs) for a #6 stud and 18AWG wire; and
Crimping tool.

Troubleshooting References: Automatic Power Inc., FA-251-AC Rotating Beacon Instruction Manual; and Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17(series), page 3-1.

PROCEDURE:

1. Cover the photoelectric "eye" of the photocontrol. After a delay of up to five minutes, the photocontrol will switch on the lamp, the cooling fan, and rotation motor.
2. Uncover the photoelectric "eye" of the photocontrol. The beacon should shut down after a delay of up to five minutes.
3. Replace photocontrol if necessary.

- SYSTEM: ***FA-251-AC Rotating Beacon***
- SUBSYSTEM: **CG-4P Lampchanger and Lamps**
- PMS INTERVAL: **Annual**

Digest of Work: Check operation of lampchanger, relamp, and focus.

Safety Precautions: Disconnect 120VAC electrical power before servicing; until power is disconnected,120VAC is present on exposed terminal strip within the beacon.
Lamps may be hot; internal pressure of lamp is high while operating.
Do not operate the beacon while open – drive mechanism may become damaged.

Tools, Test Equipment, Materials, and References:

Screwdrivers, ¼" flat tip, and short flat tip (or 3/8" open end wrench);
Safety glasses;
Denatured alcohol with clean wiping cloth;
150-watt focus fixture; and
Q150DC/CL, 120-Volt, 150-watt, tungsten-halogen lamps.

Troubleshooting References: Automatic Power Inc., FA-251-AC Rotating Beacon Instruction Manual; and Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17(series), page 3-1.

PROCEDURE:

1. Disconnect power to the beacon.
2. Remove rain hood and disconnect double blue wire from rotation motor at center terminal of the terminal strip. This will disable the drive mechanism.
3. Open the beacon, remove the lampchanger and set it in the base of the beacon. Keep the focusing ring isolated from the terminal strip.
4. Remove and discard all used and burned out lamps, advance other lamps towards the #1 position, install new lamps in vacant positions, and wipe all lamps clean with cloth and denatured alcohol.
5. WHILE WEARING SAFETY GLASSES, reconnect power to the beacon and test each lamp using the "test" button on the lampchanger. Continue testing until the #1 lamp is in the operating position again.
6. Disconnect power, reinstall lampchanger and check focus according to procedure on page 3-7 of the Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17(series).
7. Close beacon and reconnect the double blue wire to the terminal strip located on top of the beacon.
8. Reconnect power.

- SYSTEM: ***FA-251-AC Rotating Beacon***
- SUBSYSTEM: **Rotation Motor**
- PMS INTERVAL: **Biennial**

Digest of Work: Replace rotation motor.

Safety Precautions: Disconnect 120VAC electrical power before servicing; until power is disconnected,120VAC is present on exposed terminal strip under rain hood.

Tools, Test Equipment, Materials, and References:

Hand tools, as required;
Rotation Motor (correct speed). (Suggested motor brand: Hurst Mfg. Part numbers 3002-001 (1 rpm) through 3002-010 (10 rpm); motor can be obtained through local electrical suppliers; visit Hurst Manufacturing's website www.myhurst.com or call G-SEC-2A at 202-267-1892 for ordering information); and
Stop watch.

Troubleshooting References: Automatic Power Inc., FA-251-AC Rotating Beacon Instruction Manual; and Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17(series), page 3-1.

PROCEDURE:

Note: When using a Hurst motor as a replacement for an API motor, spade terminals (lugs) must be first soldered to the motor and capacitor leads. The existing square drive fitting can be reused with the Hurst motor. These steps will not be necessary if using an API motor.

1. Disconnect power to the beacon.
2. Remove the rain hood and filter.
3. Remove the red, blue, and black wire from the terminal strip and the screws securing the motor to the top of the beacon; access is limited because of the rain hood support.
4. Install the new motor and capacitor; do not force – the square drive should fit into the arm on top of the lens cage. Reconnect motor wiring to the terminal strip.
5. Reinstall the air filter and rain hood.
6. Reconnect electrical power and test beacon operation. Verify that the rotation speed is the correct number of revolutions in 56 to 64 seconds.

- SYSTEM: ***DCB-24 and DCB-224 Rotating Beacon (24-inch)***
- SUBSYSTEM: **Motor and Speed Reducer Rotation Detector**
- TRAINING: **ANC-AC**
- PMS INTERVAL: **Semi-Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM**

Digest of Work: Check rotation speed, check operation of rotation detector, and lubricate.

Safety Precautions: Beacon *does not* have a clutch. DANGER! It will crush personnel or equipment trapped between beacon and wall. Before servicing, set rotation switch to OFF; 120VAC electrical power is present; and, lamps may be HOT.

Tools, Test Equipment, Materials, and References:

Grease gun and Dow Corning silicon grease #33, medium grade;
Stopwatch;
Mutlimeter with continuity tester;
10A clamp-on ammeter; and
Rags.

Troubleshooting References: Carlisle and Finch Manual M24B341 (single drum) pages 6-8, & 14; Carlisle and Finch Manual M24B342 (double drum) pages 6, 7, & 14; and Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17(series), page 3-22.

PROCEDURE:

1. Measure the rotation speed. Verify that it is within 6% (correct number of revolutions in 56 to 64 seconds) of the rated RPM.
2. Verify that the rotation detector opens and closes on each turn by checking for channel activity between terminals 23 and 25 using the continuity setting on the multimeter.
3. Verify that beacon continues to rotate with daylight control in the ON and OFF positions.
4. Apply Dow Corning #33 medium grade silicone grease to spindle bearing with grease gun until it comes out of the relief hole.
5. Motor current should be less than 4.9 amps at 120VAC with low wind loading.

- SYSTEM: ***DCB-24 and DCB-224 Rotating Beacon (24-inch)***
- SUBSYSTEM: **Sliprings and Electrical Wiring**
- TRAINING: **ANC-AC**
- PMS INTERVAL: **Semi-Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM**

Digest of Work: Clean sliprings, check brush tension, and check wires and electrical connections.

Safety Precautions: Beacon *does not* have a clutch. DANGER! It will crush personnel or equipment trapped between beacon and wall. Before servicing, set rotation switch to OFF; 120VAC electrical power is present; and, lamps may be HOT.

Tools, Test Equipment, Materials, and References:

Clean dry cloth;
No. 600 grit sandpaper;
Spring tension scale, measuring 0 to 3 lbs.;
Five (5) lengths of 18 inch long #12 and #14 AWG high temperature flexible multi-stranded insulated wire; and
Flat tip screwdriver.

Troubleshooting References: Carlisle and Finch Manuals M24B341 (single drum) and M24B342 (double drum) pages 3, 8, & 13; and Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17(series), page 3-22.

PROCEDURE:

1. Clean sliprings with a dry cloth, if dirty; if pitted use No. 600 grit sandpaper.
2. Using the spring tension scale, ensure brush spring tension is between 1 and 1½ lbs.
3. Tighten all electrical connections.
4. Check wires for fraying and/or deterioration.

- SYSTEM: ***DCB-24 and DCB-224 Rotating Beacon (24-inch)***
- SUBSYSTEM: **Speed Reducer**
- TRAINING: **ANC-AC**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM**

Digest of Work: Replace oil in speed reducer.

Safety Precautions: Beacon *does not* have a clutch. DANGER! It will crush personnel or equipment trapped between beacon and wall. Before servicing, set rotation switch to OFF; 120VAC electrical power is present; and, lamps may be HOT.

Tools, Test Equipment, Materials, and References:

One gallon Peerless-Winsmith 51-000 high-low temperature synthetic gear lube, or equivalent; and
Rags.

Troubleshooting References: Carlisle and Finch Manuals M24B341 (single drum) and M24B342 (double drum) pages 6-8, & 14; and Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17(series), page 3-26.

PROCEDURE:

1. Replace the oil in the speed reducer annually. Be sure not to overfill.

- SYSTEM: ***DCB-24 and DCB-224 Rotating Beacon (24-inch)***
- SUBSYSTEM: **Lampchanger and Lamps**
- TRAINING: **ANC-AC**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM**

Digest of Work: Relamp, verify lampchanger rotates properly, and verify that spare lamp is powered.

Safety Precautions: Beacon *does not* have a clutch. DANGER! It will crush personnel or equipment trapped between beacon and wall. Before servicing, set rotation switch to OFF; 120VAC electrical power is present; and, lamps may be HOT.

Tools, Test Equipment, Materials, and References:

New lamps, NSN 6240-00-905-7512;
Five (5) lengths of 18 inch long #12 and #14 AWG high temperature flexible multi-stranded insulated wire;
Knife and cloth to scrape away and clean off any corrosion; and
5/16 inch flat tip screwdriver.

Troubleshooting References: Carlisle and Finch Manuals M24B341 (single drum) and M24B342 (double drum) pages 6 and 13; and Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17(series), starting page 3-14.

PROCEDURE:

1. Inspect wires. Replace frayed or deteriorated wires.
2. Tighten each electrical connection. Clean off any corrosion.
3. Verify that the primary lamp is in the operating position (in both drums, if applicable).
4. Verify that lampchanger rotates spare lamp into operating position when primary lamp is removed and then electrical power is applied.
5. Replace burned-out and operating lamps. If available, advance unused spare lamp to operating position. Be sure lamps fit snugly in bi-post sockets.
6. Verify that mode detection contacts open and close.
7. Verify that current sensor contacts open and close when operating lamp is powered.
8. Verify that covering and uncovering the daylight control turns operating lamp on and off.

- SYSTEM: ***DCB-24 and DCB-224 Rotating Beacon (24-inch)***
- SUBSYSTEM: **Optical**
- TRAINING: **ANC-AC**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM**

Digest of Work: Check focus, levelness, cover glass, and mirror.

Safety Precautions: Beacon *does not* have a clutch. DANGER! It will crush personnel or equipment trapped between beacon and wall. Before servicing, set rotation switch to OFF; 120VAC electrical power is present; and, lamps may be HOT.

Tools, Test Equipment, Materials, and References:

18" carpenters' spirit level;
Focus fixture (supplied with beacon);
9-5/8" inch rod about 1/16" diameter;
Fresh water; and
Clean cloth.

Troubleshooting References: Carlisle and Finch Manuals M24B341 (single drum) and M24B342 (double drum) pages 11-12, & 3; and Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17(series), starting page 3-14.

PROCEDURE:

LEVELNESS

1. Using an 18" carpenters' level (or larger), verify that each drum face is vertical by placing the level vertically, on edge, up against the drum face. Ensure bubble is centered on appropriate leveling gauge.
2. Check spirit levels in each drum for agreement and adjust if not in agreement.

FOCUS

1. Without removing the spherical mirrors (reflectors), install focus fixture in place of operating lamp.
2. Verify that distance from rear of large mirror to the center tip of the focus fixture is 9-5/8" ± 1/16." Since this is a maintenance and not a set-up procedure, verification of distance from focus fixture to spherical reflector is not necessary.

MIRROR
1. Verify that the mirror is not cracked or broken and that the finish is untarnished.

COVER GLASS
1. Clean, replace if damaged.
2. Verify that correct color is being used.

DRUMS
1. Verify that the relative azimuth position angular separation in the horizontal plane of the drums on the double drum beacon is correct.

- SYSTEM: ***RL-14 Range Lantern*** ***(or Tideland RL-355)***
- SUBSYSTEM: **Optical**
- TRAINING: **ANC-AC, ANC-MAM**
- PMS INTERVAL: **Annual**

Digest of Work: Check and clean front window or spread lens; check and clean mirror; and, check lantern installation.

Safety Precautions: Ensure electrical power is OFF. Tungsten-Halogen lamps operate at high pressures and may explode without warning while operating. Wear heat resistant gloves and eye protection when handling lamps. Lamps may be HOT.

Tools, Test Equipment, Materials, and References:

Heat resistant gloves and safety glasses;
Front door gasket P/N: 2951011-00, window gasket P/N: 3031163-00, and mirror gasket P/N: 3031164-00;
Mild dishwashing liquid and distilled water (for cleaning reflector);
Non-alcohol based glass cleaner (for cleaning front cover window); and
Soft cloth or other suitable materials for glass cleaning.

Troubleshooting References: Carlisle and Finch Instruction Manual for RL14; Tideland Signal Corp. Instruction manual P/N: 011.1094-00; Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17(series), starting page 4-1; and Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19(series), page 3-28.

PROCEDURE:

1. Verify window and mirror are seated properly on the circular rim; and verify that the mirror is not tarnished or damaged. Verify that mirror gasket is in place and not damaged (no cuts or cracks). Clean the mirror with distilled water and mild dishwashing liquid. Skim the surface but don't push on the mirror. Rinse thoroughly to remove soapy surface film.
2. Clean the acrylic front window with the non-alcoholic glass cleaner.
3. Inspect the gasket that seals the front door to the drum. Replace if damaged.
4. Check the color and type of window (transparent or spread lens). Spread lens ribs must be oriented vertically and on the outside surface.
5. Check that the bolts for the lantern are secure (tight) and that the lantern is locked in the direction aimed. If play (looseness) is detected, leveling and aim of the lantern is

accomplished by viewing the maximum intensity from the far end of the channel. This is usually required only upon installation.

6. The lantern is pre-focused. The beacon will remain focused even if parts are interchanged.

- SYSTEM: ***RL-14 Range Lantern*** ***(or Tideland RL-355)***
- SUBSYSTEM: **CG-6P 12VDC Lampchanger and Lamps**
- TRAINING: **ANC-AC, ANC-MAM**
- PMS INTERVAL: **Annual**

Digest of Work: Verify proper lampchanger operation and relamp.

Safety Precautions: Ensure electrical power is OFF. Tungsten-Halogen lamps operate at high pressures and may explode without warning while operating. Wear heat resistant gloves and eye protection when handling lamps. Lamps may be HOT.

Tools, Test Equipment, Materials, and References:

Heat resistant gloves and safety glasses;
Spare lamps (properly sized);
Denatured alcohol with clean wiping cloth;
Various hand tools; and
Black electrical tape.

Troubleshooting References: Carlisle and Finch Instruction Manual for RL14; Tideland Signal Corp. Instruction Manual P/N: 011.1094-00; and Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19(series), page 3-28.

PROCEDURE:

1. Inspect wiring. Replace frayed or deteriorated wires.
2. Clean and verify tightness of all electrical connections.
3. Remove and discard operating and burned out lamps. Advance unused lamps to forward turret positions and wipe all lamps clean with cloth and denatured alcohol.
4. Rotate turret so red-colored face is in the operating position. Cover photoresistor with electrical tape and verify that the lamp lights and flashes with the proper rhythm. Remove lamp from the operating position and verify that the turret rotates to the next position and the lamp there flashes. Repeat for each lamp position. (CAUTION: WEAR HEAT RESISTANT GLOVES AND EYE PROTECTION WHEN HANDLING LAMPS!).
5. Replace the lamps and rotate the turret back to the first operating position (red-colored face). Remove electrical tape.

- SYSTEM: ***RL-14 Range Lantern*** ***(or Tideland RL-355)***
- SUBSYSTEM: **CG-4P 120VAC Lampchanger and Lamps**
- TRAINING: **ANC-AC, ANC-MAM**
- PMS INTERVAL: **Annual**

Digest of Work: Verify proper lampchanger operation and relamp.

Safety Precautions: 120VAC is present!. Ensure electrical power is OFF. Tungsten-Halogen lamps operate at high pressures and may explode without warning while operating. Wear heat resistant gloves and eye protection when handling lamps. Lamps may be HOT.

Tools, Test Equipment, Materials, and References:

Heat resistant gloves and safety glasses;
Spare lamps (properly sized);
Denatured alcohol with clean wiping cloth;
Various hand tools; and
Black electrical tape.

Troubleshooting References: Carlisle and Finch Instruction Manual for RL14; Tideland Signal Corp. Instruction Manual P/N: 011.1094-00; and Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17(series), page 4-4.

PROCEDURE:

1. Inspect wiring. Replace frayed or deteriorated wires.
2. Clean and verify tightness of all electrical connections.
3. Remove and discard operating and burned out lamps. Advance unused lamps to forward turret positions and wipe all lamps clean with cloth and denatured alcohol.
4. Rotate turret so red-colored face is in the operating position. Cover photoresistor with electrical tape and verify that the lamp lights and flashes with the proper rhythm. Push test button on the lampchanger and verify that the turret rotates to the next position and the lamp flashes. Repeat for each lamp position.
5. Reset the turret so that the red-colored face holds the operating lamp. Remove electrical tape.

- SYSTEM: ***RL-24 Range Lantern***
- SUBSYSTEM: **Optical**
- TRAINING: **ANC-AC, ANC-MAM**
- PMS INTERVAL: **Annual**

Digest of Work: Check focus, levelness, cover glass, and mirror.

Safety Precautions: 120VAC is present! Ensure electrical power is OFF. Use caution when handling HOT lamps and wear heat resistant gloves and eye protection.

Tools, Test Equipment, Materials, and References:

18" carpenters' level to verify that the mirror is vertical;
Focus fixture supplied with beacon;
9-5/8" rod about 1/16" in diameter (for use with focus fixture); and
Clean rags and window cleaner for glass, or fresh water for acrylic.

Troubleshooting References: Carlisle and Finch Instruction Book RL4816 (1000W); and COMDTINST M16500.17, A/C Aids to Navigation Servicing Guide, starting page 4-13.

PROCEDURE:

Levelness.

1. Using an 18" carpenters' level (or larger), verify that the drum face is vertical by placing the level vertically, on edge, up against the drum face. Ensure bubble is centered on appropriate leveling gauge.

Focus.

1. Without removing secondary mirrors, install focus fixture in place of the operating lamp. Using the 9-5/8" rod, verify that the distance from rear of primary mirror to the tip of the focus fixture is 9-5/8" ± 1/16."
2. Remount focus fixture into the standby lamp position. Manually trip the lampchanger so the focus fixture swings into the operating position. Using the 9-5/8" rod, verify that the distance from the rear of primary mirror to the tip of the focus fixture is 9-5/8" ± 1/16." If not, focus in accordance with Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17(series).
3. After adjustments, remove the focus fixture and reset the lampchanger to the cocked, or operating, position.

Mirror.
1. Verify that the mirror is not cracked or broken and that the finish is in “like-new” condition.

Cover Glass.
1. Clean, or replace if damaged.
2. Verify correct color is used.

Latch the lantern door, turn power back on, and verify that the primary lamp turns on.

- SYSTEM: ***RL-24 Range Lantern***
- SUBSYSTEM: **Lampchanger and Lamps**
- TRAINING: **ANC-AC, ANC-MAM**
- PMS INTERVAL: **Annual**

Digest of Work: Relamp, verify lampchanger rotates properly, and verify that spare lamp is powered.

Safety Precautions: 120VAC is present!. Ensure electrical power is OFF. Use caution when handling HOT lamps and wear heat resistant gloves and eye protection.

Tools, Test Equipment, Materials, and References:

Spare lamps, Mogul Bipost, T-20, CC-8, 120VAC, 1000W, NSN: 6240-00-905-7512;
Five (5) 18" lengths each of #12 and #14 AWG high temperature flexible multi-stranded insulated wire with ring terminals (lugs) for a #8 screw (required for replacing lampchanger wiring, if necessary); and
Clean rags and window cleaner for glass, or fresh water for acrylic.

Troubleshooting References: Carlisle and Finch Manual MRL352 for 24" range lights; and Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17(series), starting page 4-13.

PROCEDURE:

WITH ELECTRICAL POWER SECURED TO THE BEACON

1. Inspect lampchanger wiring. Replace any frayed or deteriorated lampchanger wires.
2. Clean corrosion from and verify tightness of all electrical connections.
3. Replace burned-out and operating lamps. Advance unused spare lamp, if any, to the operating position. Be sure that lamps fit snugly in bipost sockets.

WITH ELECTRICAL POWER APPLIED AND DAYLIGHT CONTROL COVERED

1. Verify that the lampchanger rotates spare lamp into operating position when the primary lamp fails (simulate failure by applying power after removing primary lamp).
2. Secure power, replace primary lamp and rotate it back to the operating position. Latch the lantern door. Reapply power, uncover the daylight control and verify that the primary lamp remains in the operating position.

- SYSTEM: ***FA-232 and FA-232/02 Sound Signal Systems***
- SUBSYSTEM: **Electrical**
- TRAINING: **ANC-LT, ANC-AC**
- PMS INTERVAL: **Semi-Annual**

Digest of Work: Check and adjust.

Safety Precautions: Wear hearing protectors.

Tools, Test Equipment, Materials, and References:

Hearing protectors;
Voltmeter; and
Wristwatch or stopwatch.

Troubleshooting References: Manufacturers' operating manual for the FA-232073 half-mile sound signal; and Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19(series), starting page 3-70.

PROCEDURE:

1. Remove any debris from emitters.
2. Energize sound signal (FA-232).
3. Check signal characteristic with stopwatch or wristwatch.
4. Remove the fiberglass dome from the top of the sound signal (or signals).
5. Check the emitter level switch on the oscillator circuit board to see if it's set to HIGH (½ nmi) or LOW (¼ nmi). It should be in the position specified in the aid log.
6. Check the dc voltage across the (+) and (-) terminals of the oscillator circuit board. This voltage should be somewhere between 11VDC and 15VDC, depending on the battery's state of charge.
7. Check the ac voltage to the driver across the (D) and (D) terminals on the oscillator circuit board. This voltage should be somewhere between 20VAC and 30VAC, or about twice the battery input voltage.
8. While wearing hearing protection, verify that all emitters are working simultaneously by approaching each emitter one at a time and listening for the simultaneous audible signal.
9. Replace the fiberglass dome.

- SYSTEM: ***SA-850 and SA-850/02 Sound Signal Systems***
- SUBSYSTEM: **Electrical**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Semi-Annual**

Digest of Work: Check and adjust.

Safety Precautions: Wear hearing protectors.

Tools, Test Equipment, Materials, and References:

Hearing protectors;
Voltmeter; and
Wristwatch or stopwatch.

Troubleshooting References: Manufacturers' operating manual for the SA-850 half-mile sound signal; and Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19(series), starting page 3-70.

PROCEDURE:

1. Remove any debris from emitters.
2. Energize sound signal (SA-850).
3. Check signal characteristic with stopwatch or wristwatch.
4. Remove the access plate from the side of the emitter (or emitters).
5. Check the emitter level switch on the oscillator circuit board to see if it's set to HIGH (½ nmi) or LOW (¼ nmi). It should be in the position specified in the aid log.
6. Check the dc voltage across the (+) and (-) terminals of the oscillator circuit board. This voltage should be somewhere between 11VDC and 15VDC, depending on the battery's state of charge.
7. Check the ac voltage to the driver across the (D) and (D) terminals on the oscillator circuit board. This voltage should be somewhere between 20VAC and 30VAC, or about twice the battery input voltage.
8. While wearing hearing protection, verify that all emitters are working simultaneously by approaching each emitter one at a time and listening for the simultaneous audible signal.
9. Replace the access plate.

- SYSTEM: ***CG-1000, ELG-300/02, and ELG-300/04 Sound Signal Systems***
- SUBSYSTEM: **Electrical**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Semi-Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Check and adjust.

Safety Precautions: *Caution: High voltage present*; and wear hearing protectors.

Tools, Test Equipment, Materials, and References:

Hearing protectors;
Voltmeter;
Wristwatch or stopwatch; and
#18 AWG wire for cleaning emitter drain holes.

Troubleshooting References: Manufacturer's operating instructions for the 120VAC 3-mile and 4-mile directional sound signals; and Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17(series), starting page 5-1.

PROCEDURE:

1. Remove any debris from emitters and clean drain holes between emitter bells with a piece of wire.
2. Energize sound signal at fog detector if not running.
3. Check characteristic with stop or wristwatch and insure tone is a smooth, pure tone.
4. Turn on the AC Ammeter in the power supply. Hold the Coding Switch in the MANUAL position and ensure measured current is within the green range of the meter (approximately 9 amps for a single emitter configuration). Note: Some aids are set at a lower current to reduce range. Usually the meter will be marked with the correct setting; otherwise, consult the aid file (or aid log).
5. Measure ac input voltage to the emitter – should be about 400VAC (TB1-7 to TB1-8).
6. Measure ac voltage across power factor capacitors – should be about 35-55 volts less than that across emitter.
7. While wearing hearing protection, verify that all emitters are working simultaneously by approaching each emitter one at a time and listening for the simultaneous audible signal.

8. Set the emitter current to the level specified by manufacturer's instruction manual or as specified in the aid file (aid log).
9. Reset sound signal to normal operational mode.

- SYSTEM: ***CG-1000, ELG-500/02, and ELG-500/04 Sound Signal Systems***
- SUBSYSTEM: **Electrical**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Semi-Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Check and adjust.

Safety Precautions: *Caution: High voltage present*; and wear hearing protectors.

Tools, Test Equipment, Materials, and References:

Hearing protectors;
Voltmeter;
Wristwatch or stopwatch; and
#18 AWG wire for cleaning emitter drain holes.

Troubleshooting References: Manufacturer's operating instructions for directional sound signals; and Alternating Current Aids to Navigation Servicing Guide, COMDTINST M16500.17(series), starting page 5-1.

PROCEDURE:

1. Remove any debris from emitters and clean drain holes between emitter bells with a piece of wire.
2. Energize sound signal at fog detector if not running.
3. Check characteristic with stop or wristwatch and insure tone is a smooth, pure tone.
4. Turn on the AC Ammeter in the power supply. Hold the Coding Switch in the MANUAL position and ensure that measured current is approximately 5 amps for a single emitter configuration and 10 amps for a dual. Note: Some aids are set at a lower current to reduce range. Usually the meter will be marked with the correct setting; otherwise, consult the aid file (or aid log).
5. Measure ac input voltage to the emitter; should be about 400VAC (TB1-7 to TB1-8).
6. Measure ac voltage across power factor capacitors – should be about 35-55 volts less than that across emitter.
7. While wearing hearing protection, verify that all emitters are working simultaneously by approaching each emitter and listening for the simultaneous audible signal.
8. Set the emitter current to the level specified by manufacturer's instruction manual or as specified in the aid file (aid log).
9. Reset sound signal to normal operational mode.

- SYSTEM: ***ACMS Monitoring System***
- SUBSYSTEM: ***ACMS Master Unit (MU)***
- TRAINING: **ANC-LT, ANC-ANT**
- PMS INTERVAL: **Semi-Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Clean, check connections, and test system.

Safety Precautions: Caution: 120VAC present; refer to Electronics Manual, COMDTINST M10550.25(series), chapter 4, for safety precautions for radio energy and electrical connections.

Tools, Test Equipment, Materials, and References:

Cleaning solution; and
Clean, lint-free cloth.

Troubleshooting References: ACMS Manual AN/USQ-91(V).

PROCEDURE:

1. Clean all surfaces with the lint-free cloth and cleaning solution.
2. Check all cable connections (phone, computer, radio, etc.) for tightness and condition.
3. Interrogate all Remote Unit (RU) and Transfer Unit (TU) systems. Ensure all RU and/or TU status page(s) are normal. Report any alarms or problems to the watchstander and/or your ESU.
4. Verify proper system operation by sending a few STATION RESET commands and observing that the remote resets have been carried out properly.

- SYSTEM: ***ACMS Monitoring System***
- SUBSYSTEM: ***ACMS Transfer Unit (TU)***
- TRAINING: **ANC-LT, ANC-ANT**
- PMS INTERVAL: **Semi-Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Clean, check connections, and test system.

Safety Precautions: Caution: 120VAC present; refer to Electronics Manual, COMDTINST M10550.25(series), chapter 4, for safety precautions for radio energy and electrical connections.

Tools, Test Equipment, Materials, and References:

Cleaning solution;
Clean, lint-free cloth;
Handheld multimeter; and
Burr-Brown handheld terminal, model TM-76.

Troubleshooting References: ACMS Transfer Unit technical manual.

PROCEDURE:

Note: Please contact and alert the watchstander at the ACMS Master location to the testing about to commence.

1. Clean all surfaces with the lint-free cloth and cleaning solution.
2. Ensure all connections are adequately sealed. Ensure that all hardware is free of corrosion and that the enclosure is adequately sealed.
3. Using the multimeter, measure voltage to the TU to ensure that adequate voltage is present: ac voltage must be between 108VAC and 132VAC; or, dc voltage must be between 12VDC and 16VDC.
4. Connect the Burr-Brown TM-76 handheld terminal to the DB 25-pin connector and perform a comms link test. Once the link is successfully established and verified, disconnect the TM-76 and press the push button reset switch on the first circuit card on the left side of the card cage to reset and return system to normal ops mode.

- SYSTEM: ***ACMS Monitoring System***
- SUBSYSTEM: ***ACMS Remote Unit (RU)***
- TRAINING: **ANC-LT, ANC-ANT**
- PMS INTERVAL: **Semi-Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Clean, check connections, and test system.

Safety Precautions: Caution: 120VAC present; refer to Electronics Manual, COMDTINST M10550.25(series), chapter 4, for safety precautions for radio energy and electrical connections.

Tools, Test Equipment, Materials, and References:

Cleaning solution;
Clean, lint-free cloth;
Handheld multimeter; and
Burr-Brown handheld terminal, model TM-76.

Troubleshooting References: ACMS Remote Unit technical manual.

PROCEDURE:

Note: Please contact and alert the watchstander to the testing about to commence.

1. Clean all surfaces with the lint-free cloth and cleaning solution.
2. Ensure all connections are adequately sealed. Ensure that all hardware is free of corrosion and that the enclosure is adequately sealed.
3. Using the multimeter, measure voltage to the RU to ensure that adequate voltage is present: ac voltage must be between 108VAC and 132VAC; or, dc voltage must be between 12VDC and 16VDC.
4. Check the I/O opto board's LED light status and report any failures or unusual observations to the watchstander. Refer to the ACMS Remote Unit technical manual for correct I/O status LED configurations.
5. Connect the Burr-Brown TM-76 handheld terminal to the DB 25-pin connector and perform a comms link test. Once the link is successfully established and verified, disconnect the TM-76 and press the push button reset switch on the first circuit card on the left side of the card cage to reset and bring system to normal ops mode.

- SYSTEM: ***ACMS Monitoring System***
- SUBSYSTEM: ***LEACMS Remote Unit (LE RU)***
- TRAINING: **ANC-SP**
- PMS INTERVAL: **Semi-Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Clean, check connections, and test system.

Safety Precautions: Please refer to Electronics Manual, COMDTINST M10550.25(series), chapter 4, for safety precautions for radio energy and electrical connections.

Tools, Test Equipment, Materials, and References:

Cleaning solution;
Clean, lint-free cloth;
Handheld multimeter; and
Burr-Brown handheld terminal, model TM-76.

Troubleshooting References: LEACMS Remote Unit technical manual.

PROCEDURE:

Note: Please contact and alert the watchstander to the testing about to commence.

1. Clean all surfaces with the lint-free cloth and cleaning solution.
2. Ensure all connections are adequately sealed. Ensure that all hardware is free of corrosion and that the enclosure is adequately sealed.
3. Using the multimeter, measure voltage to the LE RU to ensure that adequate voltage is present: voltage must be between 11.5VDC and 16VDC.
4. Check the I/O opto board's LED light status and report any failures or unusual observations to the watchstander. Refer to the LEACMS Remote Unit technical manual for correct I/O status LED configurations.
5. Connect the Burr-Brown TM-76 handheld terminal to the DB 25-pin connector and perform a comms link test. Once the link is successfully established and verified, disconnect the TM-76 and press the push button reset switch on the first circuit card on the left side of the card cage to reset and bring system to normal ops mode.

- SYSTEM: ***Audio Visual Controller (AVC), GCF-RWL-2098***
- SUBSYSTEM: **CG-181 Flasher (or new CG-493 Programmable Flasher)**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Semi-Annual**

Digest of Work: Characteristic (rhythm) check (for flashing lights only).

Safety Precautions: 120VAC is present! Please refer to Electronics Manual, COMDTINST M10550.25(series), chapter 4, for safety precautions for radio energy and electrical connections.

Tools, Test Equipment, Materials, and References:

Stopwatch.

Troubleshooting References:

PROCEDURE:

1. Time the flash characteristic (rhythm) to ensure it is correct by checking the number of flashes within a period of 56 to 64 seconds and that it is in accordance with the Light List. Replace or reprogram the flasher if characteristic is not correct.

- SYSTEM: ***Audio Visual Controller (AVC), GCF-RWL-2098***
- SUBSYSTEM: **Automatic power reset**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Semi-Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Automatic power reset check.

Safety Precautions: 120VAC is present! Please refer to Electronics Manual, COMDTINST M10550.25(series), chapter 4, for safety precautions for radio energy and electrical connections.

Tools, Test Equipment, Materials, and References:

Basic hand tools; and
Multimeter.

Troubleshooting References: Audio Visual Controller Technical Manual.

PROCEDURE:

1. Lower the hinged front panel of the AVC.
2. Attach multimeter set to dc volts between 2TB7-12 and 2TB7-15 (2TB7-12 is +). Observed reading should not be zero volts.
3. Secure AC power to the AVC for five minutes, then reapply power.
4. Observe multimeter. Reading should indicate zero volts for 120 seconds.
5. If the zero-volt period is not maintained for 120 seconds, rotate knob on 1RY4 fully clockwise.
6. If timing needs adjusting, repeat from step two.
7. Remove multimeter and close AVC.

- SYSTEM: ***Audio Visual Controller (AVC), GCF-RWL-2098***
- SUBSYSTEM: **Fog Detector Reset Function**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Semi-Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Fog detector reset function check and fog detector failure check. Failure indication check.

Safety Precautions: 120VAC is present! Please refer to Electronics Manual, COMDTINST M10550.25(series), chapter 4, for safety precautions for radio energy and electrical connections.

Tools, Test Equipment, Materials, and References:

Basic hand tools as required.

Troubleshooting References:

PROCEDURE:

1. Open AVC door. Observe that the fog detector fail light is out and the sound signal is off (not foggy). If the sound signal is on, the following checks cannot be completed. If the sound signal is off, proceed with procedures two through six.
2. Secure the power to the fog detector.
3. The fog detector fail light should illuminate and the sound signal should turn on.
4. Turn on the fog detector power.
5. Press the fog detector reset button. The fog detector fail light should extinguish and the sound signal should stop blasting.
6. Correct any deficiencies.

- SYSTEM: ***Audio Visual Controller (AVC), GCF-RWL-2098***
- SUBSYSTEM: **Thirty-Minute Off Delay Timer**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Check thirty-minute off delay time.

Safety Precautions: 120VAC is present! Please refer to Electronics Manual, COMDTINST M10550.25(series), chapter 4, for safety precautions for radio energy and electrical connections.

Tools, Test Equipment, Materials, and References:

Watch;
Screwdrivers; and
Multimeter.

Troubleshooting References:

PROCEDURE:

1. Note the time set on the 1K5 timer (0 to 30 minutes).
2. Lower the hinged front panel of the AVC.
3. Attach multimeter set to dc volts between 2TB4-5 and 2TB4-6 (2TB4-5 is +). Observe a 12-volt reading.
4. Secure ac power and note the time.
5. When the timer times out, 1K5 will open and the voltage between 2TB4-5 and 2TB4-6 will become 0-volts.
6. Note the time that the voltage goes to zero.
7. Compute the delay time and compare to the value noted in step 1.
8. Replace 1K5 if the timer is defective.
9. Close the hinged front panel.
10. Reapply ac power.

- SYSTEM: ***Audio Visual Controller (AVC), GCF-RWL-2098***
- SUBSYSTEM: **Main Light Current Sensor (or Detector)**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Sensor check.

Safety Precautions: 120VAC is present! Please refer to Electronics Manual, COMDTINST M10550.25(series), chapter 4, for safety precautions for radio energy and electrical connections.

Tools, Test Equipment, Materials, and References:

Hand tools, as required;
12VDC power supply; and
Resistor, approximately 200 ohms, 1-watt

Troubleshooting References: Field Changes No. 3 and 4, Audio Visual Controller.

PROCEDURE:

After proper installation, the solid-state current detector requires no maintenance. In those applications with the DCB-224 (Dual Rotating Beacon), the following checks must be made:

1. Secure power to the main light.
2. Disable one of the drums by removing the operating lamp from its socket. Also remove the spare lamp from its socket. CAUTION MUST BE USED WHEN HANDLING THE LAMPS TO AVOID BURNS AND DAMAGE TO THE LAMPS.
3. Turn on power to the main light.
4. Observe that the remaining light has remained off and the ACMS indicates a failed main light.
5. If the check fails, i.e., if the remaining light continues to illuminate and no main light failure is indicated, re-adjust the current sensor in accordance with the installation instructions contained in Field Changes No. 3 and 4.

- SYSTEM: ***Audio Visual Controller (AVC), GCF-RWL-2098***
- SUBSYSTEM: **CG-181 Flasher (or new CG-493 Programmable Flasher)**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: CG-181 (or CG-493) flasher shutoff check (for flashing lights only).

Safety Precautions: 120VAC is present! Please refer to Electronics Manual, COMDTINST M10550.25(series), chapter 4, for safety precautions for radio energy and electrical connections.

Tools, Test Equipment, Materials, and References:

Screwdriver;
Multimeter; and
Clip leads.

Troubleshooting References:

PROCEDURE:

1. Lower the hinged front panel.
2. Attach multimeter set to dc volts to the SS terminals of the CG-181 or CG-493 flasher. Reading should not indicate zero volts.
3. Secure power to the main light at the circuit breaker in the AVC.
4. Observe reading on the multimeter. Reading should indicate zero volts.
5. Observe that the emergency light has turned on. Check with the ACMS master to ensure main light FAIL indicator is on and the emergency light ON indicator is also on.
6. Correct any deficiencies.
7. Remove test equipment.
8. Close the hinged front panel.
9. Turn on the main light circuit breaker.

- SYSTEM: ***Audio Visual Controller (AVC), GCF-RWL-2098***
- SUBSYSTEM: **Wiring and Enclosure**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Inspect wiring and check condition of enclosure.

Safety Precautions: 120VAC is present! Please refer to Electronics Manual, COMDTINST M10550.25(series), chapter 4, for safety precautions for radio energy and electrical connections.

Tools, Test Equipment, Materials, and References:

Basic hand tools, as required.

Troubleshooting References:

PROCEDURE:

1. Visually inspect AVC's wiring, wire terminations, relay terminations, barrier strip terminations, 1CD1 terminations, and bulkhead mounting and conduit connections. Tighten all loose connections. Replace or repair any defective items.
2. Visually inspect the condition of enclosure, gasket, clips, hinges, and screws and nuts. Replace or repair defective items.

- SYSTEM: ***NAVAID Sensor Module, GCF-RWL-2076***
- SUBSYSTEM: **Sound Signal System**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Semi-Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Sound signal transfer and monitor check.

Safety Precautions:

Tools, Test Equipment, Materials, and References:

Stopwatch or clock.

Troubleshooting References: NAVAID Sensor Module Technical Manual.

PROCEDURE:

1. Determine the period of the sound signal.
2. Ensure that the sensor module's switches (S1, S2, S3, and S4) are in the correct position for the aid being monitored (reference Table 2-2 of the NAVAID Sensor Module Technical Manual).
3. (Skip this step if no fog detector is installed). Secure the fog detector by turning off the circuit breaker in the Audio-Visual Controller (AVC).
4. Ensure that the fog signal comes on and that the proper data is displayed at the ACMS master.
5. Secure sound signal #1 by turning off circuit breaker CB-2 in the #1 sound signal power supply cabinet. Ensure proper data is displayed at the ACMS master (sound signal "SECONDARY").
6. Turn the circuit breaker back on and momentarily depress the NAVAID reset in the AVC. Ensure that the ACMS master shows proper data (sound signal "PRIMARY").
7. Secure sound signal #2 by turning off circuit breaker CB-2 in the #2 sound signal power supply cabinet. Ensure proper data is displayed at the ACMS master (sound signal "SECONDARY").
8. Secure sound signal #1 by turning off circuit breaker CB-2 in the #1 sound signal power supply cabinet. Ensure that the emergency sound signal comes on after the proper time delay and that the ACMS master shows the proper data.
9. Turn on circuit breaker CB-2 in both sound signal power supply cabinets (#1 and #2). Momentarily depress the NAVAID reset in the AVC.
10. Ensure that the main sound signal is on and the emergency sound is off.

11. Ensure that the ACMS master is displaying the proper data.
12. (Delete steps 12 and 13 if no fog detector is installed). Turn on the fog detector circuit breaker in the AVC. Press the fog detector fail reset button in the AVC.
13. Ensure that the sound signal is off and that the ACMS master is displaying the proper data.

- SYSTEM: ***NAVAID Sensor Module, GCF-RWL-2076***
- SUBSYSTEM: **Light Signal System**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Semi-Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Main to emergency light signal transfer and monitor check.

Safety Precautions:

Tools, Test Equipment, Materials, and References:

Multimeter; and
Stopwatch or clock.

Troubleshooting References: NAVAID Sensor Module Technical Manual.

PROCEDURE:

1. Determine period of the light signal.
2. Ensure that the Sensor Module's switches (S1, S2, S3, and S4) are in the correct position for the aid being monitored (reference Table 2-2 of the NAVAID Sensor Module Technical Manual).
3. Secure power to the main light by turning off the main light circuit breakers in the Audio-Visual Controller.
4. Ensure that the emergency light illuminates after a delay (determined by NAVAID switch setting) and that the proper data is displayed at the ACMS master.
5. Manually trip the lampchanger in the main light to secondary lamp position. Turn on main light circuit breakers and momentarily depress the NAVAID reset button located in the Audio-Visual Controller. Ensure that the proper data is displayed at the ACMS master.
6. Secure power to the main light by turning off the circuit breakers in the Audio-Visual Controller and return the lampchanger to the primary lamp position.
7. Turn on the circuit breakers for the main light, press the NAVAID Sensor Module's reset button in the AVC, and ensure the proper data is displayed at the ACMS master.

- SYSTEM: ***NAVAID Sensor Module Panel, GCF-RWL-2241***
- SUBSYSTEM: **Terminal Strip Connections, Enclosure, and Wiring**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Inspect barrier strip terminations and hinged card connector; inspect enclosure mounting and gasket integrity; check for frayed, chafed, and/or loose wiring and components.

Safety Precautions: Secure power prior to performing PM.

Tools, Test Equipment, Materials, and References:

Screwdriver; and
Pencil eraser.

Troubleshooting References: NAVAID Sensor Module Technical Manual.

PROCEDURE:

1. Secure power to the NAVAID Sensor Module panel.
2. Visually inspect the outside of the enclosure to ensure that it's undamaged and that all mounting hardware is in place.
3. Open the NAVAID sensor module panel.
4. Visually inspect the inside of the unit for:
   a. Corrosion;
   b. Loose wires;
   c. Frayed wires;
   d. Chafing;
   e. Loose components;
   f. Gasket integrity
   g. Stuffing tube integrity; and
   h. PC cards secure.
5. Correct all discrepancies.
6. Fold down each sensor module.
7. Inspect sensor module edge connections for signs of corrosion. Should corrosion be evident, remove the sensor module(s) from their socket(s) and use an ordinary

pencil eraser to clean the contact surfaces at the edge of the NAVAID sensor module(s). Insert the module(s) back into their respective socket(s).

8. Ensure that the old barrier strip terminators are secure and free from corrosion.
9. Return each sensor module to normal position.
10. Reapply power to the NAVAID Sensor Module panel and press the NAVAID Sensor Module reset button in the AVC.
11. Close cover and secure.

- SYSTEM: ***VM100 Fog Detector***
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Semi-Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Various checks.

Safety Precautions: Danger: High-voltage components inside fog detector – exercise extreme caution when working inside the housing. Please refer to Electronics Manual, COMDTINST M10550.25(series), chapter 4, for safety precautions for radio energy and electrical connections.

Tools, Test Equipment, Materials, and References:

Lens paper;
Lint-free cloth;
Glass cleaner;
Cleaning solution;
Replacement desiccant bags;
Self-vulcanizing tape;
Silicone grease;
Philips head screwdriver;
Handheld multimeter; and
Calibration box for VM100.

Troubleshooting References: VM100 technical manual.

PROCEDURE:

Note: Please contact and alert the watchstander at the ACMS Master Unit to the testing about to commence.

1. Clean all surfaces with the lint-free cloth and cleaning solution. Clean lenses with lens paper and glass cleaner.
2. Check condition of the self-vulcanizing tape around all connectors. If tape is missing or damaged, remove connector and check condition of pins and socket. If hardware is found to be corrosion free, reconnect and reseal the connector with fresh self-vulcanizing tape.

3. Check for cracks and signs of water intrusion, such as condensation or moisture on inside windows, lenses, or red glass view port on rear of unit. If water intrusion is detected, contact your ESU to launch repair efforts.
4. Remove back cover. CAUTION: Exposed high-voltage capacitor (*800 volts*) is mounted inside the unit on left side.
5. Measure dc input voltage to the VM100 at the power input connector and ensure that it's between 11.5VDC and 16VDC.
6. Replace both desiccant bags.
7. Attach the cal box on unit, wait ten minutes for circuits to stabilize, and ensure the calibration factor equals the number on the side of cal box times two (x2). (Note: sound signal will turn on during this check if set point is above 4 miles.) The calibration should fall somewhere between 4 and 6. If not, recalibrate using procedures in the VM100 tech manual.
8. Remove the cal box and allow ten minutes for detector to return to normal (stabilize).
9. Check LED display in back of unit to ensure that the visibility sampling has returned to normal; i.e., visibility reading matches the apparent visibility in the area.
10. Apply a light coat of silicone grease on the cover gasket.
11. Replace cover and tighten all screws in a cross-pattern (alternating) fashion to ensure even compression of the gasket.
12. Ensure sound signal is off if visibility appears to be above 4 miles in the local region.
13. Ensure the visibility set point (alarm threshold) is restored to the value entered in the aid file (aid log). The visibility set point for most (but not all) locations is 4 nmi.

- SYSTEM: ***AC Flash Controller, GCF-RWL-2106***
- SUBSYSTEM: **Operational and Wiring Checks**
- TRAINING: **ANC-AC**
- PMS INTERVAL: **Annual**

Digest of Work: Daylight control operation check, characteristic check, and main circuit breaker check; and inspect wiring, wiring terminations, bulkhead mounting, conduit connections, the enclosure, and all gaskets.

Safety Precautions: Secure 120VAC power before working inside the controller.

Tools, Test Equipment, Materials, and References:

Stopwatch; and
Assorted hand tools and screwdrivers.

Troubleshooting References:

PROCEDURE:

1. If aid is equipped with a daylight control (photoresistor), cover daylight control to simulate darkness and cause the light to illuminate.
2. Time the characteristic of the light with a stopwatch.
3. Secure incoming AC power.
4. Check bulkhead mounting, external conduit or cable connections, and the enclosure.
5. Open the enclosure door and switch the circuit breaker to the off position to make sure the circuit breaker is not corroded internally or frozen in the on position.
6. Check for missing or damaged door gasket.
7. Check all electrical connections for tightness.
8. Check for any damaged or frayed wires.
9. Switch the circuit breaker to the on position.
10. Close the enclosure door and secure; restore incoming power.
11. Re-check for proper light characteristic.
12. Uncover and clean the daylight control if dirty. If daylight conditions exist, light should turn off.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Generator**
- PMS INTERVAL: **Quarterly**
- SPECIFIC PERSONNEL REQUIRED: **MK or EM**

Digest of Work: Feel generator bearing housing for overheating.

Safety Precautions:

Tools, Test Equipment, Materials, and References:

Troubleshooting References: Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

1. This check shall be performed while the engine-generator is operating and after it's been operating for at least ½ hour under load.
2. Carefully touch the rear bearing housing with the palm of your hand. It should NOT feel hot.
3. If the bearing housing is hot to the touch, the bearing is defective and must be replaced. Refer to the engine-generator instruction manual for procedure.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine, Lube Oil Tank**
- PMS INTERVAL: **Quarterly**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Check lube oil level and add when necessary.

Safety Precautions: Wipe up any spilled lube oil from the deck.

Tools, Test Equipment, Materials, and References:

Clean wiping rags; and
Lube oil conforming to MIL-L-2104C (30 grade) or MIL-L-46152 (10W-30 grade or 20W-40 grade).

Troubleshooting References: Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

1. The addition of lube oil shall be performed only after all lube oil testing and sampling for analysis is completed.
2. The lube oil tank is equipped with a lube oil dipstick and shall be used for measuring the quantity of lube oil in the tank.
3. Fill the lube oil tank to the full mark on the dipstick.
4. Record the amount of lube oil added to the tank.

NOTE: If the *engine* has a dipstick, DO NOT use this dipstick for measuring lube oil level; the system is of a dry sump type.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Regulator**
- PMS INTERVAL: **Quarterly**
- SPECIFIC PERSONNEL REQUIRED: **MK or EM**

Digest of Work: Adjust and record output voltage and frequency while operating under load.

Safety Precautions:

Tools, Test Equipment, Materials, and References:

4-inch common screwdriver; and
Combination wrenches, 5/16, ½, and 9/16 inch.

Troubleshooting References: Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

1. Adjust engine RPM (frequency) while under load until 60Hz is reached;
   a. Loosen the locknut on the threaded rod that projects through the front cover (governor) at the front of the engine. This rod is near the camshaft guard.
   b. Turn the threaded rod:
      Clockwise (↻) decreases engine speed (decreases frequency)
      Counterclockwise (↺) increases engine speed (increases frequency)
   c. Secure the locknut on the threaded rod.
2. Adjust generator voltage by turning the rheostat-adjusting screw located on the generator control panel (normal: 120VAC).
   a. To decrease voltage, turn adjusting screw counterclockwise (↺).
   b. To increase voltage, turn adjusting screw clockwise (↻).
3. It may be necessary to readjust the engine RPM (frequency) after the voltage adjustment is made.

Note: Upon completion of this procedure, conduct the operational checks outlined in PMS procedure nos. 9-E(4)-SA-1 or 9-E(4)-SA-2.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine, Lube Oil**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Test lube oil for fuel dilution.

Safety Precautions: Wipe up any spilled oil from the deck.

Tools, Test Equipment, Materials, and References:

Clean wiping rags;
Two clean containers (pint size); and
Visgauge / falling ball indicator.

Troubleshooting References: Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

This test shall be taken with the engine operating at normal temperature and prior to the addition of new lube oil to the engine lube oil tank. Fuel dilution of the engine lube oil can be taken by using either a visgauge or falling ball indicator.

1. Draw approximately ½ pint of lube oil from the sampling petcock into a clean container to flush the line and ensure a good sample.
2. Draw the lube oil sample from the sampling petcock into a second clean container.
3. Test the lube oil and record the test results. Compare the results with the previous test results. An increase in viscosity indicates sludge buildup. A decrease in viscosity indicates an internal fuel leak.
4. Return the lube oil from both containers (from flushing the line and testing) back to the engine lube oil tank.

If dilution is suspected check all internal fuel connections, high pressure fuel pumps, and injector connections for tightness. **USE TWO (2) WRENCHES** when tightening fuel lines – using only one wrench will cause the line to twist slightly – engine vibration may cause the line to straighten, allowing fuel to leak again. Note: The maximum allowable fuel dilution of lube oil is 5%. If greater than 5%, change lube oil and lube oil filter.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine, Lube Oil**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Draw lube oil sample for submission to lube oil analysis lab.

Safety Precautions: Wipe up any spilled oil from the deck.

Tools, Test Equipment, Materials, and References:

Clean wiping rags;
Lube oil analysis lab sample bottle;
Clean container (pint size); and
Naval Engineering Manual, COMDTINST M9000.6(series), Chapter 262.2.

Troubleshooting References: Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

Note: Compliance with this program is at the option of the CEU equipment managers. Standby engine-generators shall be sampled annually or at 250 operating hours.

1. Draw approximately ½ pint of lube oil from the sampling petcock into a clean container prior to filling the sample bottle. This will ensure a good clean sample for submission to the lab.
2. Using the clean sample bottle draw a sample for submission to the test lab.
3. Return the lube oil, drawn to flush the sample line, back into the engine lube oil tank.
4. Ensure that the sample petcock valve is tightly closed.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine, Lube Oil**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Change lube oil filter.

Safety Precautions: Engine-generator set must be secured and tagged; and, wipe up any spilled lube oil from the deck.

Tools, Test Equipment, Materials, and References:

Clean wiping rags;
Oil filter removal tool; and
Oil filter.

Troubleshooting References: Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

The lube oil filter is located on the crankcase door.

1. Secure the engine-generator set and tag as being secured.
2. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.
3. Place the filter removal tool over the filter and turn counter clockwise to remove. Discard the used oil filter.
4. Clean the filter mounting surface with a clean wiping rag.
5. Lightly oil the gasket surface of the new oil filter with engine oil.
6. Install the new oil filter: screw the filter clockwise until the rubber gasket just makes contact with the crankcase door gasket surface.
7. Turn the filter an additional ½ to ¾ turn clockwise.
8. Reconnect the quick disconnect cable to the 24-volt distribution panel and remove the secured tag.
9. Start the engine and check for any leaks.
10. Wipe up any lube oil that may have spilled during the maintenance task.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine, Air Cleaner (SR Model)**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Clean oil bath air cleaner.

Safety Precautions: Engine-generator set must be secured and tagged; and, wipe up any spilled lube oil from the deck.

Tools, Test Equipment, Materials, and References:

Container for disposing of used oil (one gallon size);
Clean wiping rags;
Four-inch common screwdriver; and
Lube oil conforming to MIL-L-2104C (30 grade) or MIL-L-46152 (10W-30 grade or 20W-40 grade), same lube oil as that used in the engine.

Troubleshooting References: Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

1. Secure the engine-generator set and tag as having been secured.
2. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.
3. Unscrew the wing nut from the top of the air cleaner and remove the upper half of the air cleaner.
4. Unscrew the clamp holding the lower part of the air cleaner and remove from the intake manifold. Ensure no foreign matter enters the intake manifold. Drain the oil from the air cleaner into the oil-disposing container.
5. Wash the filter element and filter bowl with diesel fuel and shake dry.
6. Install the filter bowl (lower part of air cleaner) onto the air intake manifold and tighten the securing clamp.
7. Fill the filter bowl to the full mark on the side of the bowl with lube oil, using the same type of lube oil as used in the engine.
8. Install upper half of the air cleaner to the lower half, install and tighten the wing nut.
9. Wipe up any spilled lube oil from the deck.
10. Reconnect the quick disconnect cable to the 24-volt distribution panel, and remove the secured tag from the engine.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Mounts and Fasteners**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Tighten engine and generator mounts. Tighten or replace loose or missing bolts, nuts, or pins.

Safety Precautions: Engine-generator set must be secured and tagged.

Tools, Test Equipment, Materials, and References:

Various size wrenches, screwdrivers, and pliers;
Various size bolts, nuts, pins, and lock washers; and
½-inch drive socket set.

Troubleshooting References: Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

1. Check all nuts and bolts on the engine and generator mounts. Tighten as necessary.
2. Secure the engine-generator set and tag as having been secured.
3. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.
4. Normal engine vibration during operation will tend to cause loosening of fasteners.
5. The engine-generator set shall be thoroughly checked.
6. Hose clamps on hoses shall be checked.
7. All piping connections shall be checked.
8. All screens and guards shall be checked.
9. Replace all bolts, nuts, and pins found to be missing during inspection.
10. Reconnect the quick disconnect cable to the 24-volt distribution panel and remove the secured tag from the engine.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Replace deteriorated flexible fuel and lube oil hoses.

Safety Precautions: Engine-generator set must be secured and tagged; and wipe up any spilled lube oil or diesel fuel from the deck.

Tools, Test Equipment, Materials, and References:

Various hand tools (assorted size wrenches, screwdrivers, and pipe wrenches); and
Clean wiping rags;
Hoses, as required; and
Hose clamps, as required.

Troubleshooting References: Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

1. Secure the engine-generator set and tag as having been secured.
2. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.
3. A good hose will have some flexibility depending on diameter, type, and length.
4. Hoses are not to be painted and shall be replaced if painted.
5. Hoses showing signs of cracking, swelling, flaking, unusual hardness, or chafing are indications of hose deterioration and shall be replaced to prevent a possible casualty.
6. Connect the quick-disconnect cable to the 24-volt distribution panel and remove the secured tag from the engine.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Wiring System**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM**

Digest of Work: Tighten or replace loose or damaged wiring and/or wiring connectors.

Safety Precautions: Prior to working on any electrical wiring or wiring connectors, the electrical circuit shall be de-energized and tagged by the person performing the check; and Engine-generator set must be secured and tagged.

Tools, Test Equipment, Materials, and References:

Wire crimping tool; and
Wire connectors, as necessary.

Troubleshooting References: Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

1. Secure the engine-generator set and tag as being secured.
2. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.
3. Check all wiring connectors for loose connections at the terminal strip in the control panel.
4. Check all engine safety device connections for tightness.
5. Tighten any connections found to be loose; and, replace or clean any connections found to have corroded.
6. Replace any wiring found frayed or otherwise damaged.
7. Reconnect the quick disconnect cable to the 24-volt distribution panel and remove the secured tag from the engine.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine Fuel System (for all engines except ST-3 model)**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Change engine-mounted fuel filter.

Safety Precautions: Engine-generator set must be secured and tagged; and wipe up any spilled diesel fuel from the deck.

Tools, Test Equipment, Materials, and References:

Combination wrench, 7/16 inch;
Wiping rags;
Container to catch spilled fuel while disassembling filter;
Fuel filter element (AC Delco # ACD60), Lister part no. 201-13117 (1 each); and
"O" ring (washer), Lister part no. 662-10450 (2 each) bleed screws.

Troubleshooting References: Lister parts book 1028PL (SR model); Lister parts book 1705PL (ST model); and Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

1. Secure engine-generator and tag.
2. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.
3. Secure diesel fuel supply to the engine.
4. Unscrew the bolt in the base of the filter bowl.
5. Remove the filter bowl from the filter housing, remove filter and discard.
6. Clean filter bowl with diesel fuel and dry.
7. Remove the filter bowl gasket from the filter housing and install a new gasket.
8. Install a new fuel filter element in the filter bowl and install to the filter housing.
9. Install the filter bowl bolt up through the filter bowl and tighten.
10. Open the fuel supply to the engine-generator.
11. Loosen the two (2) bleed screws on top of the filter housing assembly.
12. Operate the hand priming lever on the side of the fuel lift pump. Pump fuel until a steady stream of fuel flows from the bleed screws.
13. Finger tighten the bleed screws snugly. DO NOT use pliers to tighten the bleed screws. Replacement of the screws' "O" rings may be necessary.

14. Check for any fuel leaks.
15. Wipe up any diesel fuel that may have spilled on to the engine and deck.
16. Reconnect the quick-disconnect cable to the 24-volt distribution panel, and remove the secured tag from the engine.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine Fuel System (ST-3 model)**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Change engine-mounted fuel filter.

Safety Precautions: Engine-generator set must be secured and tagged; and wipe up any spilled diesel fuel from the deck.

Tools, Test Equipment, Materials, and References:

Combination wrenches, 7/16 inch and ½ inch;
Wiping rags;
Container to catch spilled fuel while disassembling filter; and
Fuel filter element, Lister part no. 351-29760 (1 each).

Troubleshooting References: Lister parts book 1705PL (ST model); and Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

1. Secure engine-generator and tag.
2. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.
3. Secure diesel fuel supply to the engine.
4. Unscrew the bolt in the top of the filter housing.
5. Remove filter element from the lower filter base and discard.
6. Clean lower filter base.
7. Install a new fuel filter element between the upper and lower filter housings.
8. Install bolt through top of the filter housing and tighten.
9. Open the fuel supply to the engine-generator.
10. Loosen the bleed plug on the upper filter housing.
11. Operate the hand priming lever on the fuel lift pump. Pump fuel until a steady stream of fuel flows from the bleed plug.
12. Finger tighten the bleed screws snugly.
13. Check for fuel leaks and wipe up any spilled diesel fuel from the engine or deck.
14. Reconnect the quick-disconnect cable to the 24-volt distribution panel, and remove the secured tag from the engine.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine Fuel System**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Change remote-mounted fuel filter.

Safety Precautions: Engine-generator set must be secured and tagged; and wipe up any spilled diesel fuel from the deck.

Tools, Test Equipment, Materials, and References:

Combination wrenches, 9/16, 7/16, and ½ inch;
Wiping rags; and
Fuel filter elements, Fram part nos. CC1133PL and CS1133PL (1 each).

Troubleshooting References:

PROCEDURE:

1. Secure engine-generator and tag.
2. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.
3. Secure diesel fuel supply to the filter unit.
4. Unscrew the bolt in the top of each housing while holding the filter cartridge.
5. Remove the filter element and discard.
6. Clean the filter cartridge with diesel fuel and dry.
7. Remove the old filter cartridge gaskets from the filter housing and install new gaskets.
8. Install a new fuel filter element in each filter cartridge and install to the filter housing.
9. Install the bolt in each filter cartridge and tighten.
10. Open the fuel supply to the filter unit.
11. Remove the bleed plug from each filter cartridge bolt to bleed air from the unit.
12. Bleed air from each filter unit until all air is expelled. The filter is bled of all air when a steady stream of fuel flows from the bleed plug hole.
13. Install the bleed plugs and tighten.
14. Check for fuel leaks and wipe up any spilled fuel from the deck.
15. Reconnect the quick-disconnect cable to the 24-volt distribution panel, and remove the secured tag from the engine.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Clean and replace leaky cover gaskets.

Safety Precautions: Engine-generator set must be secured and tagged; and wipe up any spilled diesel fuel from the deck.

Tools, Test Equipment, Materials, and References:

Wiping rags;
Gasket scraper;
Gasket compound (#2 non-hardening);
Combination wrenches, 5/16, 7/16, ½, and 9/16 inch;
Gaskets, as needed (refer to Lister parts book or E/G set Instruction Manual);
Water tube manometer;
4-inch common screwdriver; and
Two 12-inch pipe wrenches.

Troubleshooting References: Lister parts book 1028PL (SR model); Lister parts book 1705PL (ST model); and Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

All lube oil leaks on the engine shall be stopped. Wipe off the lube oil from the engine to help determine the source of the leak. It is difficult to determine the source of a leak in an air-cooled engine due to the cooling air flow which may carry the leaking lube oil to another area of the engine.

1. After determining the source of the leak, secure engine-generator and tag.
2. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.
3. Check cover bolts for tightness and tighten if loose.
4. Reconnect the quick-disconnect cable to the 24-volt distribution panel, start up the engine, and check for leaks.
5. If the gasket is still leaking, secure the engine and disconnect the quick disconnect cable from the 24-volt distribution panel.

6. Remove the leaking cover. Inspect the cover for cracks or warping. If damaged, replace cover with a new one.
7. Remove the old gasket from the cover and the gasket surface of the engine. Use a gasket scraper to ensure all of the old gasket material is removed.
8. Install a new gasket using non-hardening #2 gasket compound (sealer) on the cover and engine gasket surfaces. Install cover and tighten.
9. Reconnect the quick-disconnect cable to the 24-volt distribution panel, start up the engine, and check for leaks.
10. Repeat steps 1 through 9 until all lube oil leaks are corrected.
11. If the engine's front lube oil seal leaks, remove the governor cover and replace the seal. Prior to removing the governor cover, remove the fuel door cover and remove the speeder spring from the governor rack arm (refer to the engine-generator instruction manual).
12. If the rear seal is suspected, remove the exhaust manifold, intake manifold, and the air cowling. Inspect the inside of the air cowling for lube oil film or residue. If no oily film is detectable, then the rear seal is good. If there is a film of oil on the inside of the air cowling, then the rear oil seal is defective. Refer to the engine-generator instruction manual for the proper seal replacement procedure.

NOTE: Remember that lube oil is contained in the crankcase by seals and gaskets. A slight crankcase vacuum is maintained by breather pipe(s) located under the valve cover(s). A simple water tube manometer will show if there is crankcase vacuum. One (1) to four (4) inches of water are acceptable limits. DO NOT LOOK ANY FURTHER for the cause of oil leaks until the crankcase vacuum is between these limits.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine, Air Cleaner (ST Model)**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Change air filter element.

Safety Precautions: Engine-generator set must be secured and tagged.

Tools, Test Equipment, Materials, and References:

Wiping rags; and
Air cleaner element Lister part no. 366-06227

Troubleshooting References: Lister parts book 1705PL (ST); and Lister workshop manual 2001.

PROCEDURE:

Ensure no foreign matter enters the air intake manifold.

1. Secure the engine-generator set and tag.
2. Unscrew the wing nut from the top of the air cleaner and remove the upper half.
3. Remove and discard the old air cleaner element.
4. Wipe away any foreign matter from the air cleaner body.
5. Install a new air cleaner element.
6. Install the air cleaner upper half and screw wing nut back on air cleaner until snug.
7. Remove the secured tag from the engine-generator set.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine, Exhaust System**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Clean muffler, free exhaust pipe rain cap.

Safety Precautions: Engine-generator set must be secured and tagged; wear eye protection as necessary to protect eyes from airborne carbon deposit particles, especially during wire brush use.

Tools, Test Equipment, Materials, and References:

Two pipe wrenches, 12-inch;
Combination wrenches, ½, 9/16 inch;
Hand wire brush; and
Eye goggles or face shield.

Troubleshooting References:

PROCEDURE:

1. Secure the engine-generator and tag.
2. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.
3. Remove the soot cap from the muffler and remove all the carbon.
4. Check the exhaust pipe rain cap for freeness; free as necessary.
5. Reconnect the quick-disconnect cable to the 24-volt distribution panel, and remove the secured tag from the engine.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Lube Oil Tank**
- PMS INTERVAL: **Annual** (Note: Lube oil should be changed every **five (5)** years unless analysis reveals excessive dilution)
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Drain and clean lube oil tank.

Safety Precautions: Engine-generator set must be secured and tagged; and wipe up any spilled lube oil from the deck.

Tools, Test Equipment, Materials, and References:

Wiping rags;
Hand pump (to pump lube oil from tank);
55 gallon drum or equivalent in smaller containers;
4" common screwdriver;
Combination wrenches, various;
Two (2) 10" pipe wrenches;
Gasket, rubber, lube oil tank cover 8"x 10"x 0.03" thick;
Hole punch, 5/16"; and
40 gallons lube oil conforming to MIL-L-2104C (30 grade) or MIL-L-46152 (10W-30 or 20W-40 grades).

Troubleshooting References: Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

1. Secure the engine-generator and tag.
2. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.
3. Drain the lube oil from the tank using a portable pump.
4. Disconnect the lube oil drain line, lube oil suction line, and lube oil tank/engine vent line.
5. Remove the lube oil tank stops and remove the lube oil tank by sliding the tank from the front of the engine.
6. Remove the inspection cover plate from the lube oil tank top and wipe the inside of the tank.

NOTE: Ensure that the inside of the lube oil tank is FREE of any contaminants (e.g., wiping rags) before replacing the tank cover plate.

7. Install the cover plate. Slide the lube oil tank into the E/G set skid base.
8. Install the lube oil tank stops. Attach the lube oil drain, suction, and vent lines back to the lube oil tank fittings.
9. Fill the lube oil tank to the full mark on the dipstick.
10. Reconnect the quick-disconnect cable to the 24-volt distribution panel and remove the secured tag.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine**
- PMS INTERVAL: **Biennial**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Clean engine cooling air fan blades.

Safety Precautions: Engine-generator set must be secured and tagged.

Tools, Test Equipment, Materials, and References:

Combination wrenches, 7/16, and ½ inch;
4-inch common screwdriver; and
Small stiff cleaning brush (to fit between air fins on flywheel).

Troubleshooting References:

PROCEDURE:

1. Secure engine-generator and tag.
2. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.
3. Remove the guard screen from the generator adapter housing and clean screen.
4. Decompress the engine with the decompression levers and turn the engine by hand as necessary to clean the flywheel air cooling fan with the small brush.
5. Install the guard screen to the generator adapter housing.
6. Move the decompression levers towards the front of the engine.
7. Reconnect the quick-disconnect cable to the 24-volt distribution panel, and remove the secured tag from the engine.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Generator**
- PMS INTERVAL: **Biennial**
- SPECIFIC PERSONNEL REQUIRED: **MK or EM**

Digest of Work: Clean generator air inlet screen.

Safety Precautions: Engine-generator set must be secured and tagged.

Tools, Test Equipment, Materials, and References:

Combination wrench 7/16 inch;
Stiff cleaning brush; and
Wiping rags.

Troubleshooting References:

PROCEDURE:

1. Secure engine-generator and tag.
2. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.
3. Unbolt the air inlet screen and remove from engine.
4. Using a stiff cleaning brush, remove all dirt from the screen and wipe it clean.
5. Install the inlet screen to the generator.
6. Reconnect the quick-disconnect cable to the 24-volt distribution panel, and remove the secured tag from the engine.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine, Exhaust System**
- PMS INTERVAL: **Biennial**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Decarbonize engine exhaust manifold and exhaust piping.

Safety Precautions: Engine-generator set must be secured and tagged; wear eye protection while chipping/scraping carbon deposits.

Tools, Test Equipment, Materials, and References:

Two pipe wrenches, 12-inch;
Combination wrenches, 7/16, ½, 9/16 inch;
Wiping rags;
Flashlight;
Scraping tool;
Eye goggles or face shield;
Gasket scraper; and
Manifold gaskets (exhaust).** (see table)

** Model	P/N	Qty
SR1	201-51040	1
SR2	201-51040	2
SR3	201-51040	3
ST1	201-80660	1
ST2	201-80660	2
ST3	201-80660	3

Troubleshooting References: Lister parts book 1028PL (SR model); Lister parts book 1705PL (ST model); and Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

1. Secure the engine-generator and tag.
2. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.
3. Remove engine exhaust manifold and exhaust piping.
4. Scrape all excess carbon from the exhaust manifold and exhaust piping.
5. Remove all old exhaust manifold gasket and scrape clean from the engine and exhaust manifold.
6. Install new exhaust manifold gaskets and install exhaust manifold.
7. Reconnect the quick-disconnect cable to the 24-volt distribution panel, and remove the secured tag from the engine.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine**
- PMS INTERVAL: **Biennial**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Clean crankcase breather pipes.

Safety Precautions: Engine-generator set must be secured and tagged; and wipe up any spilled lube oil from the deck.

Tools, Test Equipment, Materials, and References:

Combination wrenches, 7/16, and ½-inch;
Wiping rags;
Wood dowel, 1/8-inch dia. x 8-inches long;
Socket wrench with ½-inch deep socket;
Gasket compound, #2 non-hardening;
Gasket scraper; and
Valve cover gasket (1 per cyl.), 201-80180 for ST model, 201-10510 for SR model.

Troubleshooting References: Lister parts book 1028PL (SR model); Lister parts book 1705PL (ST model); Lister instruction book 1028 (SR model); Lister workshop manual 2001 (ST model); and Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

NOTE: A crankcase breather consists of a short pipe screwed into the top of each cylinder head. This breather connects to the intake port. Oil vapor is drawn into the inlet manifold and this creates a partial vacuum in the crankcase. This partial vacuum helps to prevent oil leaks through the seals and gaskets. In order for these breathers to work properly, they must be kept clean and free of obstructions.

1. Secure the engine-generator and tag.
2. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.
3. Remove the cylinder head valve covers.
4. Unscrew and remove the breather pipe from each cylinder head using the ½-inch deep socket and socket wrench.

5. Clean the inside of each breather pipe using the wood dowel.
6. Install and screw a breather pipe back onto each cylinder head.
7. Replace the cylinder head valve cover gasket if necessary. Install the cylinder head valve cover. Tighten the nuts snuggly; DO NOT over tighten.
8. Reconnect the quick-disconnect cable to the 24-volt distribution panel, and remove the secured tag from the engine.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine**
- PMS INTERVAL: **Biennial**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Check / adjust valve clearances.

Safety Precautions: Engine-generator set must be secured and tagged; and wipe up any spilled lube oil from the deck.

Tools, Test Equipment, Materials, and References:

Hand tools as required.

Troubleshooting References: Lister parts book 1028PL (SR model); Lister parts book 1705PL (ST model); Lister instruction book 1028 (SR model); Lister workshop manual 2001 (ST model); and Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

1. Secure the engine-generator and tag.
2. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.
3. Remove the cylinder head valve covers.
4. Decompress the engine by applying light downward pressure to the exhaust valves. Using the hand crank rotate the engine until the piston for the cylinder you choose to adjust first is at Top Dead Center (TDC). (Both valves closed, firing stroke.)
5. Check valve clearance. If the valves are in need of adjustment, proceed as follows:
   a. Loosen the adjustment screw locknut and turn the adjusting screw until proper clearance is obtained.
   b. While holding the adjusting screw, tighten the locknut.
   c. Recheck valve clearance to insure proper valve clearance has been maintained.
6. Repeat steps 3 and 4 for each cylinder.
7. Replace the valve cover gaskets if required and install valve covers. Tighten the valve cover hold-down nuts firmly. DO NOT OVER TIGHTEN.
8. Reconnect the quick-disconnect cable to the 24-volt distribution panel, and remove the secured tag from the engine.

Valve Clearance COLD: Intake and exhaust valve clearances are the same.

	Go	No Go
SR Model:	0.008”	0.010”
ST Model:	0.006”	0.008”

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine Fuel System (SR)**
- PMS INTERVAL: **Biennial**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Remove and service fuel injector assemblies.

Safety Precautions: Engine-generator set must be secured and tagged; fuel leaving the injector is under extreme pressure and can penetrate the skin; fuel is in the form of a mist and is easily ignited; wear eye protection; and wipe up any spilled fuel from equipment and deck.

Tools, Test Equipment, Materials, and References:

Wiping rags;
Hand tools, as required;
Torque wrench;
Valve cover gasket (1 per cylinder), Lister P/N 201-10510;
Injector oil seal ring (1 per injector), Lister P/N 201-11080;
Injector nozzle gasket (1 per cylinder), Lister P/N 201-11720;
Scraping tool;
Cooling fin scraper or wire brush; and
Safety goggles or face shield.

Troubleshooting References: Lister parts book 1028PL (SR model); Lister instruction book 1028 (SR model); and Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

1. Secure the engine-generator and tag.
2. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.
3. Remove the cylinder head valve cover(s).
4. Disconnect the fuel supply and leak-off pipes from the injector(s).
5. Remove injector hold-down clamp nuts and remove injector(s).
6. On multi-cylinder engines, all injectors shall be removed and tested together for comparison using the following method:

   NOTE: ENSURE THAT ALL SAFETY PRECAUTIONS ARE FOLLOWED.

a. Invert injector(s) so spray nozzle is in the upright position and reconnect supply and leak-off pipes.
b. Place engine throttle control to the full fuel position.
c. Using the hand crank, rotate the engine at about 60 RPMs and observe spray pattern of all injectors. The spray pattern should be uniform in length and in the form of a fine mist emitted from the three spray holes. The injector must be cleaned or replaced if the spray pattern is streaky or if fuel dribbles.
d. If the injector checks out, clean the injector cooling fins and replace the injector oil seal and nozzle gasket. Insure that the old nozzle gasket is removed from the cylinder head.
e. Torque the injector capnut to 65 ft-lbs.
f. Install the injector and reconnect the fuel supply and leak-off pipes. DO NOT TIGHTEN.
g. Install the injector hold-down clamp and torque evenly to 15 ft-lbs. THE INJECTOR HOLD-DOWN CLAMP MUST BE TIGHTENED EVENLY.
h. Tighten the fuel supply and leak-off pipes.
i. Perform a visual inspection of the fuel supply and leak-off pipes making sure that they will not come in contact with the valve cover or rocker assemblies.
j. Slightly depress the cylinder exhaust valves and rotate the engine by hand checking the fuel supply and leak-off pipes for leakage.
k. Reinstall the cylinder head valve cover(s).
l. Reconnect the quick-disconnect cable to the 24-volt distribution panel, and remove the secured tag from the engine.
m. Start up the engine to insure that the fuel system has been purged of air.
n. Secure the engine and place in appropriate operating mode.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine Fuel System (ST)**
- PMS INTERVAL: **Biennial**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Remove and service fuel injector assemblies.

Safety Precautions: Engine-generator set must be secured and tagged; fuel leaving the injector is under extreme pressure and can penetrate the skin; fuel is in the form of a mist and is easily ignited; wear eye protection; and wipe up any spilled fuel from equipment and deck.

Tools, Test Equipment, Materials, and References:

Wiping rags;
Hand tools, as required;
Torque wrench;
Valve cover gasket (1 per cylinder), Lister P/N 201-80180;
Injector oil seal ring (1 per injector), Lister P/N 351-51540;
Injector nozzle gasket (1 per cylinder), Lister P/N 351-40230;
Scraping tool;
Cooling fin scraper or wire brush; and
Safety goggles or face shield.

Troubleshooting References: Lister parts book 1705PL (ST model); Lister instruction book 2001 (ST model); and Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

1. Secure the engine-generator and tag.
2. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.
3. Remove the cylinder head valve cover(s).
4. Disconnect the fuel supply and leak-off pipes from the injector(s).
5. Remove injector hold-down clamp nuts and remove injector(s).
6. On multi-cylinder engines, all injectors shall be removed and tested together for comparison using the following method:

   NOTE: ENSURE THAT ALL SAFETY PRECAUTIONS ARE FOLLOWED.

a. Invert injector(s) so spray nozzle is in the upright position and reconnect supply and leak-off pipes.
b. Place engine throttle control to the full fuel position.
c. Using the hand crank, rotate the engine at about 60 RPMs and observe spray pattern of all injectors. The spray pattern should be uniform in length and in the form of a fine mist emitted from the three spray holes. The injector must be cleaned or replaced if the spray pattern is streaky or if fuel dribbles.
d. If the injector checks out, clean the injector cooling fins and replace the injector oil seal and nozzle gasket. Insure that the old nozzle gasket is removed from the cylinder head.
e. Torque the injector capnut to 65 ft-lbs.
f. Install the injector and reconnect the fuel supply and leak-off pipes. DO NOT TIGHTEN.
g. Install the injector hold-down clamp and torque evenly to 15 ft-lbs. THE INJECTOR HOLD-DOWN CLAMP MUST BE TIGHTENED EVENLY.
h. Tighten the fuel supply and leak-off pipes.
i. Perform a visual inspection of the fuel supply and leak-off pipes making sure that they will not come in contact with the valve cover or rocker assemblies.
j. Slightly depress the cylinder exhaust valves and rotate the engine by hand checking the fuel supply and leak-off pipes for leakage.
k. Reinstall the cylinder head valve cover(s).
l. Reconnect the quick-disconnect cable to the 24-volt distribution panel, and remove the secured tag from the engine.
m. Start up the engine to insure that the fuel system has been purged of air.
n. Secure the engine and place in appropriate operating mode.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine Fuel System (Engine Models SR-2 and SR-3)**
- PMS INTERVAL: **Biennial**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Time the engine fuel pumps (H.P.).

Safety Precautions: Engine-generator set must be secured and tagged; and wipe up any spilled diesel fuel from equipment and deck.

Tools, Test Equipment, Materials, and References:

Wiping rags;
Combination wrenches, 7/16", ½", 9/16", 14mm, 13/16", 18mm;
Torque wrench with 6" extension;
Socket, deep 18mm;
Gasket compound #2 non-hardening;
Gasket, valve cover, Lister P/N 201-10510 (1 per cylinder);
Gasket, fuel pump housing door, Lister P/N 202-11583 (SR-2A);
Gasket, fuel pump housing door, Lister P/N 203-11580 (SR-3A);
Shim, fuel pump, Lister P/N 201-11520 (0.005"), as required; and
Shim, fuel pump, Lister P/N 201-11530 (0.010"), as required.

Troubleshooting References: Lister parts book 1028PL (SR model); Lister instruction book 1028 (SR model); and Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

1. Secure the engine-generator and tag.
2. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.
3. Disconnect the engine cooling air ducting from the ductwork. Remove cooling air duct from the engine.
4. Remove the fuel pump housing door cover.
5. Remove the cylinder head valve covers.

   NOTE: Only one (1) cylinder shall be timed at one time. The parts in the high-pressure fuel pumps are mated and shall not be mixed with another pump.
6. Set the fuel control lever to the "start" position.

7. Rotate the flywheel to the firing position. On the Lister SR-2A and SR-3A engines, the flywheel is in the firing position when this mark (⟋) is opposite the arrow on the back of the engine cowling fan cover near the fuel pumps. Both the intake and exhaust valves will be closed for that cylinder being timed. (NOTE: Each cylinder has its own T.D.C. and injection marks on the flywheel).
8. Disconnect the fuel injector pipe from the injector and fuel pump, remove.
9. Remove the delivery valve holder, delivery valve, and spring from the high-pressure fuel pump to be timed (checked). If fuel flows from the pump, rotate the crankshaft until the flow stops.
10. Install the delivery valve holder and tighten slightly.
11. Rotate the crankshaft clockwise until fuel begins to flow. Then SLOWLY rotate the crankshaft counterclockwise until the fuel flow stops. Blow the fuel from the top of the valve holder to be sure the flow has stopped completely. At this point the firing mark (⟋) on the flywheel should be aligned with the arrow on the cooling fan cover. If it is not, the fuel pump will have to be retimed by adding or subtracting shims from underneath the fuel pump. Repeat this step until the fuel pump is correctly timed.
12. Remove shims to advance the timing.
13. Add shims to retard the timing.

    NOTE: Shims 0.005” and 0.010” thick added in combination to a thickness of about 0.035” are normally inserted below each fuel pump.

14. After the fuel pump is correctly timed, install the delivery valve, and spring. TORQUE the delivery valve holder to 40 ft-lbs. DO NOT OVER TORQUE the delivery valve holder.
15. Install the fuel injection pipe to the injector and high-pressure fuel pump. Use two (2) wrenches when tightening this line to the pump and injector.
16. Replace the gasket on the fuel pump housing door cover. Use #2 non-hardening gasket compound, install cover.
17. Install the cylinder head valve cover(s).
18. Install the engine cooling air ducting.
19. Reconnect the quick-disconnect cable to the 24-volt distribution panel and remove the secured tag.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine Fuel System (Engine Model ST)**
- PMS INTERVAL: **Biennial**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Time the engine fuel pumps (H.P.).

Safety Precautions: Engine-generator set must be secured and tagged; and wipe up any spilled diesel fuel from equipment and deck.

Tools, Test Equipment, Materials, and References:

Wiping rags;
Combination wrenches, 7/16", ½", 9/16", 14mm, 18mm;
Torque wrench with 6" extension;
Socket, deep 18mm;
Gasket compound #2 non-hardening;
Gasket, valve cover, Lister P/N 201-80180 (1 per cylinder);
Gasket, fuel pump housing door, Lister P/N 201-11581 (ST-1);
Gasket, fuel pump housing door, Lister P/N 202-11583 (ST-2);
Gasket, fuel pump housing door, Lister P/N 203-11580 (ST-3);
Shim, fuel pump, Lister P/N 201-11520 (0.005"), as required; and
Shim, fuel pump, Lister P/N 201-11530 (0.010"), as required.

Troubleshooting References: Lister parts book 1705PL (ST model); Lister instruction book 2001; and Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

1. Secure the engine-generator and tag.
2. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.
3. Disconnect the engine cooling air ducting from the ductwork. Remove cooling air duct from the engine.
4. Remove the fuel pump housing door cover.
5. Remove the cylinder head valve cover.

NOTE: Only one (1) cylinder shall be timed at one time. The parts in the high-pressure fuel pumps are mated and shall not be mixed with another pump.

6. Set the fuel control lever to the “start” position.
7. Rotate the flywheel to the firing position. On the Lister ST-1A model engine, the flywheel is in the firing position when this mark (N→) is opposite the timing mark on top of the fan shroud. On the ST-2A and ST-3A engines, the flywheel is in the firing position when this mark (N→) is opposite the arrow on the back of the engine cowling fan cover near the fuel pumps. Both the intake and exhaust valves will be closed for that cylinder being timed. (NOTE: Each cylinder has its own T.D.C. and injection marks on the flywheel).
8. Disconnect the fuel injector pipe from the injector and fuel pump, remove.
9. Remove the delivery valve holder, delivery valve, and spring from the high-pressure fuel pump to be timed (checked). If fuel flows from the pump, rotate the crankshaft until the flow stops.
10. Install the delivery valve holder and tighten slightly.
11. Rotate the crankshaft clockwise until fuel begins to flow. Then SLOWLY rotate the crankshaft counterclockwise until the fuel flow stops. Blow the fuel from the top of the delivery valve holder to be sure the flow has stopped completely. At this point the firing mark (N→) on the flywheel should be aligned with the arrow on the cooling fan cover. If it is not, the fuel pump will have to be retimed by adding or subtracting shims from underneath the fuel pump. Repeat this step until the fuel pump is correctly timed.
12. Remove shims to advance the timing.
13. Add shims to retard the timing.

    NOTE: Shims 0.005” and 0.010” thick added in combination to a thickness of about 0.035” are normally inserted below each fuel pump.

14. After the fuel pump is correctly timed, install the delivery valve, and spring. TORQUE the delivery valve holder to 40 ft-lbs. DO NOT OVER TORQUE the delivery valve holder.
15. Install the fuel injection pipe to the injector and high-pressure fuel pump. Use two (2) wrenches when tightening this line to the high-pressure fuel pump and injector.
16. Replace the gasket on the fuel pump housing door cover. Use #2 non-hardening gasket compound, install cover.
17. Install the cylinder head valve cover(s).
18. Install the engine cooling air ducting.
19. Reconnect the quick-disconnect cable to the 24-volt distribution panel and remove the secured tag.

- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine Fuel System (Engine Model SR)**
- PMS INTERVAL: **Biennial**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Check and/or adjust fuel control.

Safety Precautions: Engine-generator set must be secured and tagged; and wipe up any spilled diesel fuel from equipment and deck.

Tools, Test Equipment, Materials, and References:

Wiping rags;
Combination wrenches, 5/16”, 7/16”, ½”, 9/16”, ¾”;
Flashlight or trouble light;
Feeler gauge (0.017”);
Ruler, steel machinist 6”;
8” piece of heavy wire, bend a small hook on one end;
Oil seal assembly tool, Lister P/N 317-00082
Gasket compound #2 non-hardening;
Gasket, crankcase end cover, Lister P/N 201-11211;
Gasket, fuel pump housing door, Lister P/N 201-11581 (SR-1A);
Gasket, fuel pump housing door, Lister P/N 202-11583 (SR-2A); and
Gasket, fuel pump housing door, Lister P/N 203-11580 (SR-3A).

Troubleshooting References: Lister parts book 1028PL (SR model); Lister instruction book 1028 (SR model); and Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

1. Secure the engine-generator and tag.
2. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.
3. Disconnect the engine cooling air ducting from the ductwork. Remove cooling air duct from the engine.
4. Remove the fuel pump housing door cover.

   NOTE: The diagram on page 3 shows the layout of parts referred to in this procedure.

5. Disconnect the governor speeder spring from the governor link (use an 8" piece of wire shaped with a small hook on the end). Refer to "M" and "N" in the diagram.
6. Remove the camshaft guard and crankcase end cover.
7. Set the fuel control, "F," to the run position.
8. Adjust linkage "A" so that all of the calibration marks "B" align with the sides of the fuel pumps to within 0.005." The linkage connecting the fuel pumps (fuel pump racks) should move freely after this adjustment.

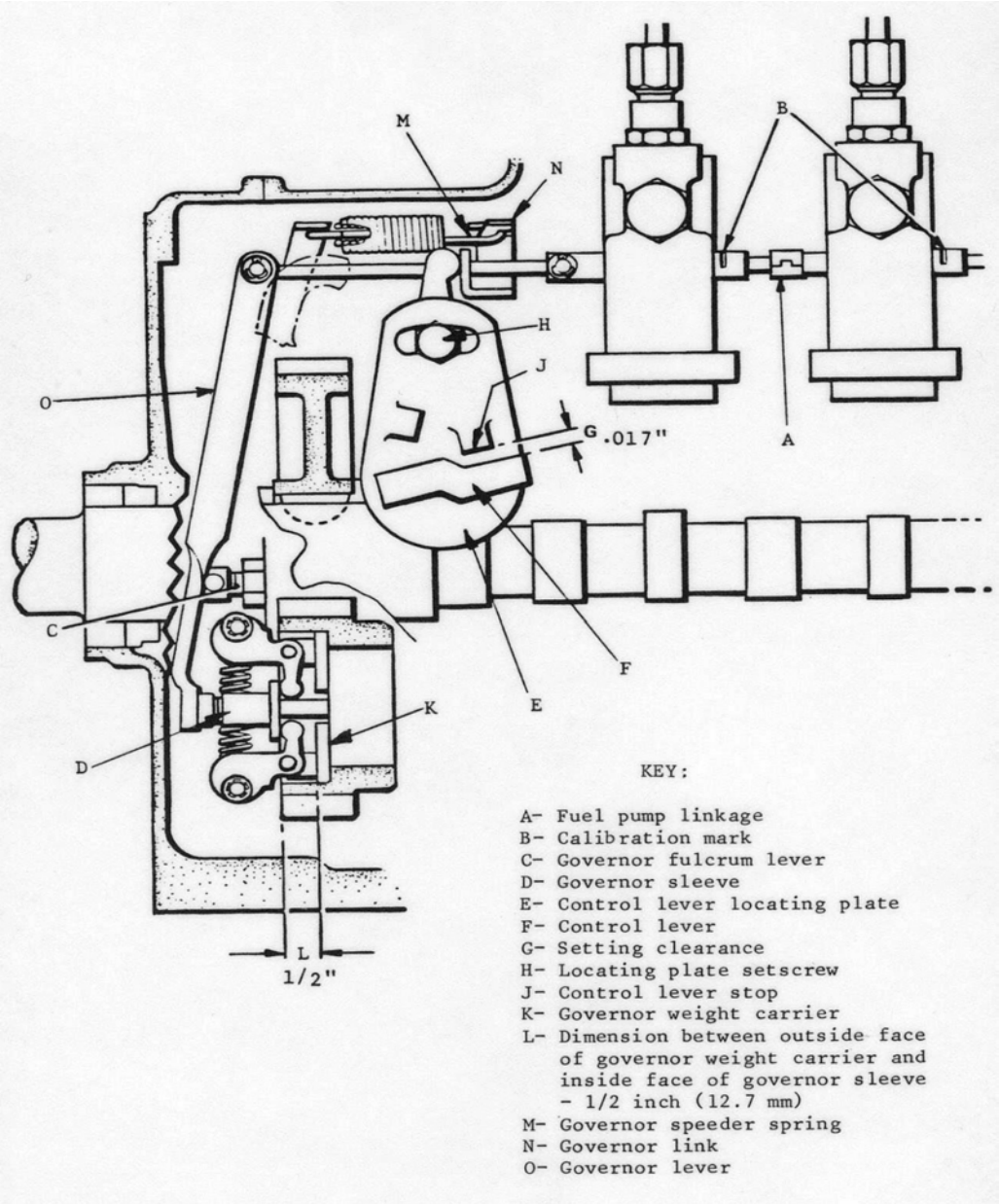
   NOTE: The slightest rack bind will cause engine hunting and erratic operation.

9. Check the governor fulcrum lever, "C," by proceeding as follows:
   a. The calibration marks, "B," are against the sides of the fuel pumps.
   b. The distance at "L" between the inside of the governor weight carrier "K" and the inside surface of the governor sleeve "D" is ½."

   NOTE: This check will determine if the governor fulcrum lever is out of adjustment; and by adjusting will increase or decrease the response time of the governor. Being out of adjustment could also cause engine hunting.

10. To adjust the governor fulcrum lever proceed as follows:
    a. Loosen the locknut holding the governor fulcrum lever.
    b. Remove the cotter pins (2) in the governor lever "O" and remove.
    c. Turn the governor fulcrum lever "C" ½ turn and tighten the locknut.
    d. Install the governor lever; install the cotter pins.
    e. Take the measurement at "L" with the ruler, repeat steps "a" through "d" until the measurement is correct.
11. Insert a 0.017" feeler gauge at point "G" between the stop "J" and the control lever "F". Loosen the bolt "H" and rotate the locating plate "E" so that, with the feeler gauge in place, the calibration marks on the fuel pump linkage "B" are against the pump sides. The full width of each mark on the fuel pump racks should be visible.
12. Tighten the bolt "H" for the locating plate "E."
13. Lightly oil the camshaft extension shaft, and slide the oil seal assembly tool onto the camshaft extension.
14. Replace the crankcase end-cover gasket if damaged; use #2 non-hardening gasket compound. Slide the crankcase end cover over the camshaft and oil seal assembly tool. Use CAUTION when sliding the crankcase end cover over the camshaft extension or else the crankcase end cover oil seal may become damaged. Remove the oil seal assembly tool.
15. Install the camshaft guard assembly.
16. Connect the governor speeder spring to the governor link "M" & "N"; use the 8" piece of heavy wire with a hook on the end.

17. Install fuel pump housing door.
18. Install the engine cooling air exhaust ducting.
19. Reconnect the quick-disconnect cable to the 24-volt distribution panel and remove the secured tag.



- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine Fuel System (Engine Model ST)**
- PMS INTERVAL: **Biennial**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Check and/or adjust fuel control.

Safety Precautions: Engine-generator set must be secured and tagged; and wipe up any spilled diesel fuel from equipment and deck.

Tools, Test Equipment, Materials, and References:

Wiping rags;
Combination wrenches, 5/16”, 7/16”, ½”, 9/16”, ¾”;
Flashlight or trouble light;
Feeler gauge (0.016”);
Ruler, steel machinist 6”;
8” piece of heavy wire, bend a small hook on one end;
Oil seal assembly tool, Lister P/N 317-00082
Gasket compound #2 non-hardening;
Gasket, crankcase end cover, Lister P/N 201-11211;
Gasket, fuel pump housing door, Lister P/N 201-11581 (ST-1A);
Gasket, fuel pump housing door, Lister P/N 202-11583 (ST-2A); and
Gasket, fuel pump housing door, Lister P/N 203-11580 (ST-3A).

Troubleshooting References: Lister parts book 1705PL (ST model); Lister instruction book 2001; and Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

1. Secure the engine-generator and tag.
2. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.
3. Disconnect the engine cooling air ducting from the ductwork. Remove the cooling air duct from the engine.
4. Remove the fuel pump housing door cover.

   NOTE: The diagram on page 3 shows the layout of parts referred to in this procedure.

5. Disconnect the governor speeder spring from the governor link (use an 8" piece of wire shaped with a small hook on the end). Refer to "M" and "N" in the diagram.
6. Remove the camshaft guard and crankcase end cover.
7. Set the fuel control, "F," to the run position.
8. Adjust linkage "A" so that all of the calibration marks "B" align with the sides of the fuel pumps to within 0.005." The linkage connecting the fuel pumps (fuel pump racks) should move freely after this adjustment.

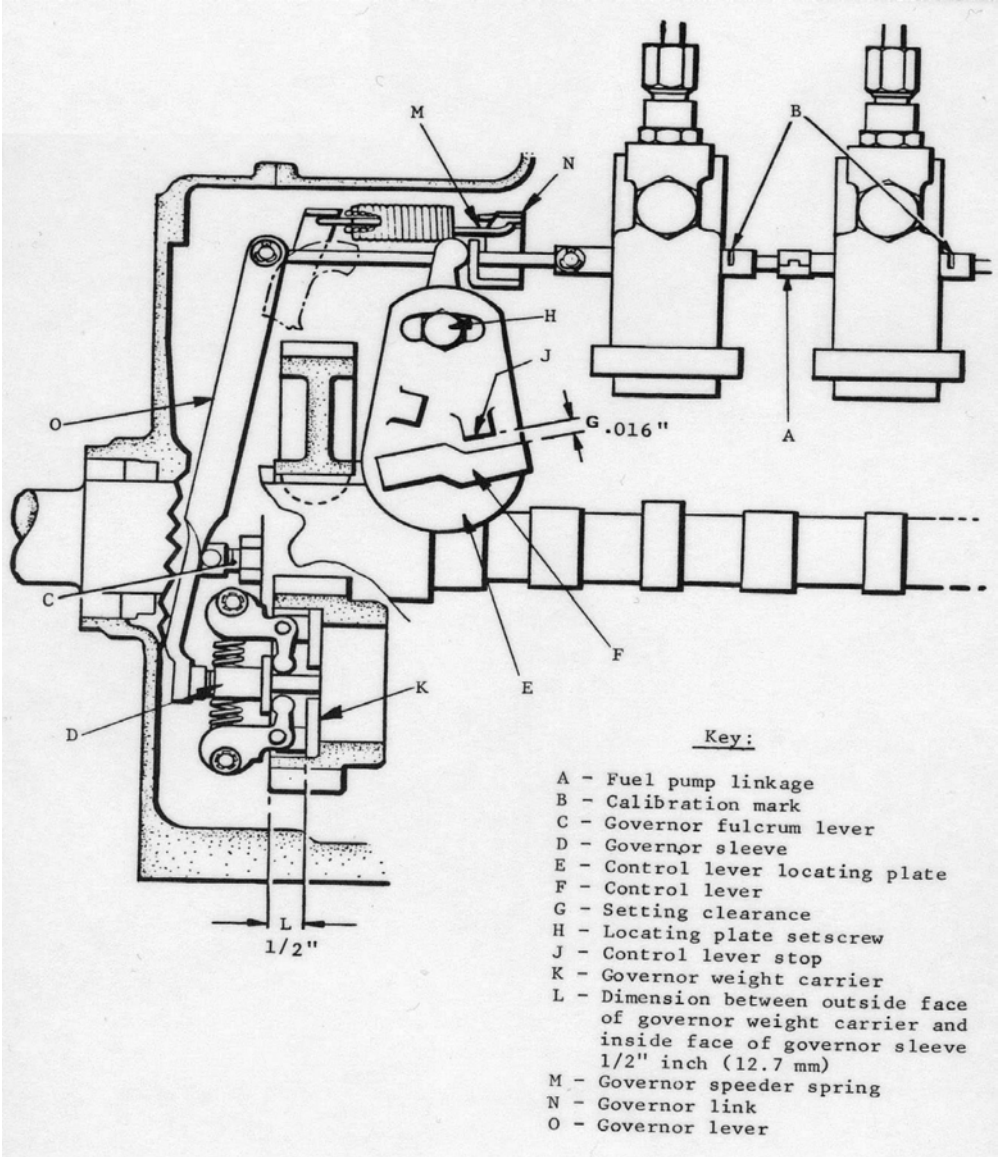
   NOTE: The slightest rack bind will cause engine hunting and erratic operation.

9. Check the governor fulcrum lever, "C," by proceeding as follows:
   a. The calibration marks, "B," are against the sides of the fuel pumps.
   b. The distance at "L" between the inside of the governor weight carrier "K" and the inside surface of the governor sleeve "D" is ½."

   NOTE: This check will determine if the governor fulcrum lever is out of adjustment; and by adjusting will increase or decrease the response time of the governor. Being out of adjustment could also cause engine hunting.

10. To adjust the governor fulcrum lever proceed as follows:
    a. Loosen the locknut holding the governor fulcrum lever.
    b. Remove the cotter pins (2) in the governor lever "O" and remove.
    c. Turn the governor fulcrum lever "C" ½ turn and tighten the locknut.
    d. Install the governor lever; install the cotter pins.
    e. Take the measurement at "L" with the ruler, repeat steps "a" through "d" until the measurement is correct.
11. Insert a 0.016" feeler gauge at point "G" between the stop "J" and the control lever "F". Loosen the bolt "H" and rotate the locating plate "E" so that, with the feeler gauge in place, the calibration marks on the fuel pump linkage "B" are against the pump sides. The full width of each mark on the fuel pump racks should be visible.
12. Tighten the bolt "H" for the locating plate "E."
13. Lightly oil the camshaft extension shaft, and slide the oil seal assembly tool onto the camshaft extension.
14. Replace the crankcase end-cover gasket if damaged; use #2 non-hardening gasket compound. Slide the crankcase end cover over the camshaft and oil seal assembly tool. Use CAUTION when sliding the crankcase end cover over the camshaft extension or else the crankcase end cover oil seal may become damaged. Remove the oil seal assembly tool.
15. Install the camshaft guard assembly.
16. Connect the governor speeder spring to the governor link "M" & "N"; use the 8" piece of heavy wire with a hook on the end.

17. Install the fuel pump housing door.
18. Install the engine cooling air exhaust ducting.
19. Reconnect the quick-disconnect cable to the 24-volt distribution panel and remove the secured tag.



- SYSTEM: ***Engine-Generator***
- SUBSYSTEM: **Engine**
- PMS INTERVAL: **Biennial**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Check and/or adjust decompression levers.

Safety Precautions: Engine-generator set must be secured and tagged.

Tools, Test Equipment, Materials, and References:

Wiping rags;
4" or 6" common screwdriver; and
Combination wrench, ½".

Troubleshooting References: Lister instruction book 1028 (SR model); Lister workshop manual 2001 (ST model); and Oswald Standard High Endurance Engine-Generator Instruction Manual.

PROCEDURE:

1. Secure the engine-generator and tag.
2. Disconnect the quick-disconnect cable from the 24-volt distribution panel to prevent accidental engine starting.

   NOTE: Access to each decompressor's adjustment screw is through the oil fill cap in each cylinder head valve cover.

3. Decompress the engine by moving the decompression levers to the rear (flywheel end) of the engine.
4. Turn the engine to the cylinder selected for check. The piston is to be at Top Dead Center (T.D.C.).
5. Loosen the locknut and turn the decompression adjustment screw down (clockwise) until the exhaust valve JUST touches the piston.
6. Turn the decompression screw back (counterclockwise) ½ turn and tighten the locknut.
7. Repeat steps 4 through 6 for each cylinder (each decompression lever).
8. Reconnect the quick-disconnect cable to the 24-volt distribution panel and remove the secured tag.

- SYSTEM: ***Environmental Control Unit (ECU), Standard***
- SUBSYSTEM: **Intake Air Filter**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Quarterly**
- SPECIFIC PERSONNEL REQUIRED: **EM or MK**

Digest of Work: Clean intake unit filter.

Safety Precautions: Power must be secured to the intake unit fan.

Tools, Test Equipment, Materials, and References:

Combination wrenches, various; and
Step ladder, 4-foot.

Troubleshooting References:

PROCEDURE:

1. Secure power to the intake unit fan.
2. Remove exhaust duct from filter.
3. Loosen three wing nuts holding filter to the intake unit.
4. Swing down filter unit on its hinge.
5. Remove any debris from the filter.
6. Swing the filter to operating position and install bolts and wing nuts.
7. Reconnect exhaust duct to filter.
8. Re-energize power to the intake unit fan.

- SYSTEM: ***Environmental Control Unit (ECU), Standard***
- SUBSYSTEM: **Modutrol Damper Motors**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Quarterly**
- SPECIFIC PERSONNEL REQUIRED: **EM or MK**

Digest of Work: Check operation of Modutrol motors.

Safety Precautions:

Tools, Test Equipment, Materials, and References:

All-purpose grease.

Troubleshooting References:

PROCEDURE:

1. Secure power to the Modutrol motors – the motors are spring loaded and should return to their rest position.
2. Energize the motors and adjust the thermostats (intake 76°F, exhaust 72°F).
3. Lubricate the linkage on the louver motors.

- SYSTEM: ***Fuel Daytank, Standard***
- SUBSYSTEM: **Fuel Filter**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Quarterly**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Inspect bowl for water / drain.

Safety Precautions: Wipe up any spilled diesel fuel from the deck.

Tools, Test Equipment, Materials, and References:

Wiping rags; and
Bucket.

Troubleshooting References: Instruction booklet for fuel oil daytank assembly.

PROCEDURE:

1. Inspect the sediment bowl for water and/or contaminants.
2. Fill fuel oil daytank using hand or electric pump.
3. Secure necessary fuel valves; DO NOT secure fuel supply to engines.
4. Secure all power to daytank assembly.
5. Drain sediment bowl.
6. Restore power to daytank assembly and line up fuel valves for normal operation.

- SYSTEM: ***Fuel Daytank, Standard***
- SUBSYSTEM: **Fuel Filter**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Quarterly**
- SPECIFIC PERSONNEL REQUIRED: **MK**

Digest of Work: Change fuel filter.

Safety Precautions: Secure all power to Daytank Assembly; and wipe up any spilled diesel fuel from the deck.

Tools, Test Equipment, Materials, and References:

Wiping rags;
Plastic bag (for old filter);
Racor filter element, P/N 2020SM (1 each);
Cover gasket, P/N 1113 (2 each);
"T" handle gasket, P/N 1102 (1 each);
Bowl gasket, P/N 1112; and
Gasket "T" handle, P/N 1102A.

Troubleshooting References: Instruction booklet for fuel oil daytank assembly.

PROCEDURE:

1. Fill daytank; ensure daytank is topped off with fuel prior to performing PM.
2. Secure power to daytank.
3. Secure valves to daytank. (DO NOT secure valves for the engines.)
4. Remove "T" handle, and cover.
5. Remove old filter and place in plastic bag for disposal.
6. Install new filter.
7. Remove old gasket from cover; install new one.
8. Install cover gasket.
9. Install new "T" handle gaskets and "T" handle. Tighten handle (DO NOT OVERTIGHTEN or else damage to the gaskets and "T" handle may result).
10. Open fuel valves; restore power to daytank.
11. Check operation of fuel filter.

- SYSTEM: ***Fuel Daytank, Standard***
- SUBSYSTEM: **Transfer Pumps / Float Switches**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Semi-Annual**
- SPECIFIC PERSONNEL REQUIRED: **MK or EM**

Digest of Work: Check automatic operation of pumps.

Safety Precautions: Wipe up any spilled diesel fuel from the deck.

Tools, Test Equipment, Materials, and References:

Clean bucket;
Wiping rags;
Combination wrench;
Hose clamps;
Garden hose in length adequate for draining tank; and
Funnel (if needed to pour fuel back into main tank).

Troubleshooting References:

PROCEDURE:

1. Hook up garden hose to drain connection.
2. Drain fuel from tank until transfer pump energizes; let daytank refill.
3. Continue draining fuel until the other pump energizes.
4. Pour all fuel drained during checkout procedure back into main fuel storage tank.

- SYSTEM: ***Fuel Daytank, Standard***
- SUBSYSTEM: **Fuel Pump and Electric Motors**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **MK or EM**

Digest of Work: Oil electric motors.

Safety Precautions:

Tools, Test Equipment, Materials, and References:

30 weight oil, non-detergent.

Troubleshooting References:

PROCEDURE:

1. Apply ten drops of oil to each motor bearing (by the bearing housing oil hole).

- SYSTEM: ***Lighthouse Power Controller (LPC) and Transfer Switch***
- SUBSYSTEM: **Calibration Circuit – Prime Power**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Semi-Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Operational checks of primary and standby generator power.

Safety Precautions: Observe safety precautions when measuring AC or DC voltages.

Tools, Test Equipment, Materials, and References:

Digital multimeter;
Standard hand tools;
Small non-metallic (e.g., plastic) adjustment tools; and
Safety shield and goggles.

Troubleshooting References: Operator's Manual for CEVV-LPC-20032 Lighthouse Power Controller; and Aids to Navigation Manual - Technical, COMDTINST M16500.3(series).

PROCEDURE:

1. Open Lighthouse Power Controller (LPC) door to the digital fluorescent display.
2. To ensure that the system resets properly, turn the LPC power switch off and on and press FAIL/RESET to clear any failures.
3. Write down the actual readings on the display when power returns. If the readings fall between the limits shown below you do not need to change the calibration at this time. The ideal line parameters are l20VAC @ 60Hz.

   LPC *VOLTAGE* LIMITS:
   Normal (no trip) -- Between 110VAC and 125VAC
   Delay Trip --------- Between 90VAC and 110VAC **or** 125VAC and 140VAC
   Quick Trip --------- Less than 90VAC **or** Greater than 140VAC

   LPC *FREQUENCY* LIMITS:
   Normal (no trip) -- Between 57Hz and 62Hz
   Delay Trip --------- Between 50Hz and 57Hz **or** 62Hz and 65Hz
   Quick Trip --------- Less than 50Hz **or** Greater than 65Hz

4. Measure AC voltage present between terminals TB3-3 and TB3-4 and ensure that: (1) it's within the specified range, and (2) it tracks the voltage reading on the display within ±1 volt. If the voltage is within the specified range continue without making adjustments. If adjustments are required then stop PM and refer to the LPC Operator's Manual, chapter 4, to align AC monitor module channel 17 to compensate for these marginal conditions. This allows the system to operate uncalibrated until correct line parameters are restored.
5. Turn off the main engine switch on the genset. This will cause the standby generator to warm-up and take the load. If the generator does not start, then check the troubleshooting section 4-2 of the LPC Operator's Manual.
6. Measure AC voltage between terminals TB3-8 and TB3-9 and ensure that: (1) it's within the specified range, and (2) it tracks the voltage reading on the display within ±1 volt. If the voltage is within the specified range continue without making any adjustments. If adjustments are required then stop the PM and refer to chapter 4 of the LPC Operator's Manual to align AC monitor module channel 9 to compensate for these marginal conditions. This allows the system to operate uncalibrated until correct line parameters are restored.
7. Turn the main genset switch back on.
8. Turn LPC power switch off and on and press FAIL/RESET to clear any failures.
9. Start up the primary generator and ensure it takes the load within ten minutes. If the generator does not start, check the troubleshooting section 4-2 of the LPC Operator's Manual.
10. Allow the generator power to stabilize for about ten minutes and call the duty officer to check the status of the aid. All systems should indicate normal.
11. Inspect, clean, and tighten all connections in the LPC and carefully dust off the circuit card assemblies if necessary.

- SYSTEM: ***Lighthouse Power Controller (LPC) and Transfer Switch***
- SUBSYSTEM: **Calibration Circuit – Commercial**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Semi-Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Operational checks of commercial and standby generator power.

Safety Precautions: Observe safety precautions when measuring AC or DC voltages.

Tools, Test Equipment, Materials, and References:

Digital multimeter;
Standard hand tools;
Small non-metallic (e.g., plastic) adjustment tools; and
Safety shield and goggles.

Troubleshooting References: Operator's Manual for CEVV-LPC-20032 Lighthouse Power Controller; and Aids to Navigation Manual - Technical, COMDTINST M16500.3(series).

PROCEDURE:

1. Open Lighthouse Power Controller (LPC) door to the digital fluorescent display.
2. To ensure that the system resets properly, turn the LPC power switch off and on and press FAIL/RESET to clear any failures.
3. Write down the actual readings on the display when power returns. If the readings fall between the limits shown below you do not need to change the calibration at this time. The ideal line parameters are l20VAC @ 60Hz.

   LPC *VOLTAGE* LIMITS:
   Normal (no trip) -- Between 110VAC and 125VAC
   Delay Trip --------- Between 90VAC and 110VAC **or** 125VAC and 140VAC
   Quick Trip --------- Less than 90VAC **or** Greater than 140VAC

   LPC *FREQUENCY* LIMITS:
   Normal (no trip) -- Between 57Hz and 62Hz
   Delay Trip --------- Between 50Hz and 57Hz **or** 62Hz and 65Hz
   Quick Trip --------- Less than 50Hz **or** Greater than 65Hz

4. Measure AC voltage present between terminals TB3-3 and TB3-4 and ensure that: (1) it's within the specified range, and (2) it tracks the voltage reading on the display within ±1 volt. If the voltage is within the specified range continue without making adjustments. If adjustments are required then stop PM and refer to the LPC Operator's Manual, chapter 4, to align AC monitor module channel 16 to compensate for these marginal conditions. This allows the system to operate uncalibrated until correct line parameters are restored.
5. Turn off the main commercial AC breaker. This will cause the standby generator to warm-up and take the load. If the generator does not start, then check the troubleshooting section 4-2 of the LPC Operator's Manual.
6. Measure AC voltage between terminals TB3-8 and TB3-9 and ensure that: (1) it's within the specified range, and (2) it tracks the voltage reading on the display within ±1 volt. If the voltage is within the specified range continue without making any adjustments. If adjustments are required then stop the PM and refer to chapter 4 of the LPC Operator's Manual to align AC monitor module channel 9 to compensate for these marginal conditions. This allows the system to operate uncalibrated until correct line parameters are restored.
7. Switch the main commercial power breaker back on.
8. Turn LPC power switch off and on and press FAIL/RESET to clear any failures.
9. Allow commercial power to stabilize for about ten minutes and call the duty officer to check the status of the aid. All systems should indicate normal.
10. Inspect, clean, and tighten all connections in the LPC and carefully dust off the circuit card assemblies if necessary.

- SYSTEM: ***Lighthouse Power Controller (LPC) and Transfer Switch***
- SUBSYSTEM: **Contactor**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Inspection and maintenance of main contactors (Transfer Switch).

Safety Precautions: Prior to any maintenance of the transfer switch, ensure *ALL AC POWER SOURCES* are secured.

Tools, Test Equipment, Materials, and References:

Various hand tools including burnishing tool.

Troubleshooting References: Operator's Manual for CEVV-LPC-20032 Lighthouse Power Controller; and Aids to Navigation Manual - Technical, COMDTINST M16500.3(series).

PROCEDURE:

1. Secure the LPC power source and trip main AC breaker if using commercial power. If using generators secure generator power circuit breakers to both generators.
2. Wait ten minutes to ensure all stray input capacitance voltages have discharged.
3. VISUALLY INSPECT ALL CABLE CONNECTIONS AND CABLE MARKINGS ON THE TRANSFER SWITCH TO ENSURE TIGHT CONNECTIONS AND CORRECT LABELING. DISCONNECT ALL CABLE JUST TO THE TRANSFER SWITCH.
4. After ensuring that **ALL AC POWER SOURCES** are secured, carefully remove the top cover of the primary power contactor and expose the electrical contacts. Check for signs of arcing or overheating. If the contacts show signs of deterioration then schedule a repair or replacement of both contactors or internal electric contacts and springs. If only a small amount of arcing has occurred then remove it with the burnishing tool. If the primary power contactor shows no signs of deterioration then place the top cover back on ensuring free movement of the center contactor.
5. Inspect the secondary power contactor using same method used to inspect primary.
6. Reconnect all cables to the transfer switch ensuring correct position as labeled and tight connections.
7. Turn on the main LPC power switch.
8. Clear all failures by pressing the FAIL/RESET button.
9. Wait thirty minutes and note final power reading on the LPC display.

- SYSTEM: ***Battery Charger, 24-Volt***
- SUBSYSTEM: **24V EDISON CDSA-IBC-24-20A and 24V SAB NIFE SCBF101-24-10C**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Semi-Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Check, adjust, float, and equalize voltage.

Safety Precautions:

Tools, Test Equipment, Materials, and References: Digital multimeter.

Troubleshooting References: SAB NIFE battery charger technical manual; and McGraw-Edison battery charger technical manual.

PROCEDURE:

NOTE: If room temperatures are below 60°F or above 80°F, the below PMS must be accomplished with procedures given in the manufacturers' technical manual.
NOTE: Do not use battery charger voltmeter for setting float or equalize voltages.

1. Disconnect all dc loads from the battery, usually at a distribution panel.
2. Observe the ammeter on the battery charger. If the float current is LESS than 4-amps, proceed as below. If the current is OVER 4-amps, apply equalize charge using the equalize timer on the charger until the float current is less than 4 amps. The purpose is to bring the battery to near full charge.
3. When the float current is LESS than 4 amps, measure the voltage across each individual cell using a calibrated digital voltmeter (multimeter). The voltage should be in the range of 1.45 to 1.47 volts per cell at normal room temperature. The voltage across the battery should read 29.0 to 29.4 volts; if not, adjust as indicated in Table 2 of PMS Procedure 9-E(6)-Q-1.
4. Set the equalize timer for 24 hours. Measure the voltage across each cell, using a calibrated digital voltmeter (multimeter). The voltage across each cell should be in the range of 1.55 to1.57 volts at room temperature; If not, refer to your specific battery charger technical manual and adjust the equalize voltage using the equalize voltage adjustment, marked either PEAK ADJ, HIGH RATE, or EQUALIZE (depending on the make and model), located on the control printed circuit card to achieve an equalizing voltage across each cell of 1.55 to 1.57 volts (31.0 to 31.4 volts across the battery bank).
5. Reconnect all dc loads back to the battery, usually at a distribution panel.

- SYSTEM: ***Nickel-Cadmium Storage Battery for Diesel Starting, 24-Volt***
- SUBSYSTEM: **24-Volt, 20 Cell (use Saft Nife SBH102 or Alcad XHP100, HED-100 is discontinued)**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Quarterly**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Check and adjust electrolyte level, clean battery cells, and measure voltage.

Safety Precautions: Wear face shield, rubber gloves, and rubber apron; use insulated tools (DO NOT use tools, hydrometers, or utensils which have been previously used with lead-acid batteries); and never allow open flames or sparks to come near the cells.

Tools, Test Equipment, Materials, and References:

Calibrated digital multimeter;
Hand tools as necessary (insulated);
Hydrometer;
Spirit thermometer;
Plastic container (gal. capacity);
Face shield;
Rubber gloves and rubber apron;
Household vinegar;
Distilled water;
Storage battery maintenance record;
Filler bulb;
Battery oil; and
Nickel-Cadmium battery renewal electrolyte.

Troubleshooting References: COMDTINST M16500.3A, Aids to Navigation Technical Manual, Description Sheet 9-E(6).

PROCEDURE:

WARNING: NICKEL-CADMIUM STORAGE BATTERIES CONTAIN CAUSTIC POTASH, A POISONOUS AND CORROSIVE LIQUID THAT WILL BURN OR INJURE SKIN, EYES, AND PROPERTY. DO NOT ALLOW CONTACT WITH SKIN OR

PROPERTY. IN CASE OF PERSONAL INJURY, APPLY THE FOLLOWING ANTIDOTES AND SEEK MEDICAL ATTENTION IMMEDIATELY.

SKIN: Flush immediately with plenty of water and apply wet compresses of household vinegar. DO NOT apply ointments, salves, or oils before treatment by a physician.
EYES: Flush with plenty of water for at least fifteen minutes and get immediate medical attention.

NOTE: The presence of a light film of oil on top of the electrolyte is normal and reduces evaporation.

1. Clean the outside of each cell of dirt and corrosion. Wipe all cell surfaces, lugs, and intercell connectors with an oily rag. Apply a light coating of oil.
2. Electrolyte solution levels are plainly visible through the transparent plastic cases used for all types of nickel-cadmium storage batteries. Each cell is marked with two solution level lines which appear on two opposite sides of the cell. The top line is the MAXIMUM recommended solution level; the bottom line is the MINIMUM recommended solution level. For measuring the solution level the measurement should always be taken from the top line. Record the level in the Storage Battery Maintenance Record. Use the letter “A” preceding the reading if the level was found above the top line.
3. Using a hydrometer that has been thoroughly cleaned, insert the tip of the hydrometer making sure the rubber tip of the nozzle is resting firmly on plate tops of the cell, then squeeze and release the bulb. This method will insure that clean solution is drawn into the hydrometer.
4. Allow the float to move freely and tap the glass barrel gently to insure float is not sticking to sides of the barrel (so as to ensure an accurate reading). Read the specific gravity and return electrolyte sample back to the cell from which it was taken and immediately replace and tighten vent caps.
5. To correct specific gravity reading for solution level, ADD 0.005 to specific gravity for every ¼ inch of solution level above the top solution level mark. If the solution level is below the top mark, then SUBTRACT 0.005 for every ¼ inch.
6. Check solution temperature with a clean thermometer. The corrected specific gravity reading for the solution level should be above the temperature and solution level corrected in Table 1. Record the reading in the Storage Battery Maintenance Record.

Table 1
Specific Gravity (w/ Solution at Recommended Level)

Temperature of Electrolyte		Nominal Recommended Gravity	Minimum Recommended Gravity
120°F	49°C	1.174	1.144
110	43	1.177	1.147
100	38	1.180	1.150
90	32	1.182	1.152
80	27	1.185	1.155
70	21	1.187	1.157
60	16	1.190	1.160
50	10	1.192	1.162
40	4	1.195	1.165
30	-1	1.197	1.167
20	-7	1.200	1.170
10	-12	1.202	1.172
0	-18	1.205	1.175
-10	-23	1.207	1.177
-20	-29	1.210	1.180

7. After test has been performed and readings properly recorded, bring solution level to the top solution level line. If adding water in cold weather, agitate solution with a syringe to prevent water from freezing above the electrolyte.

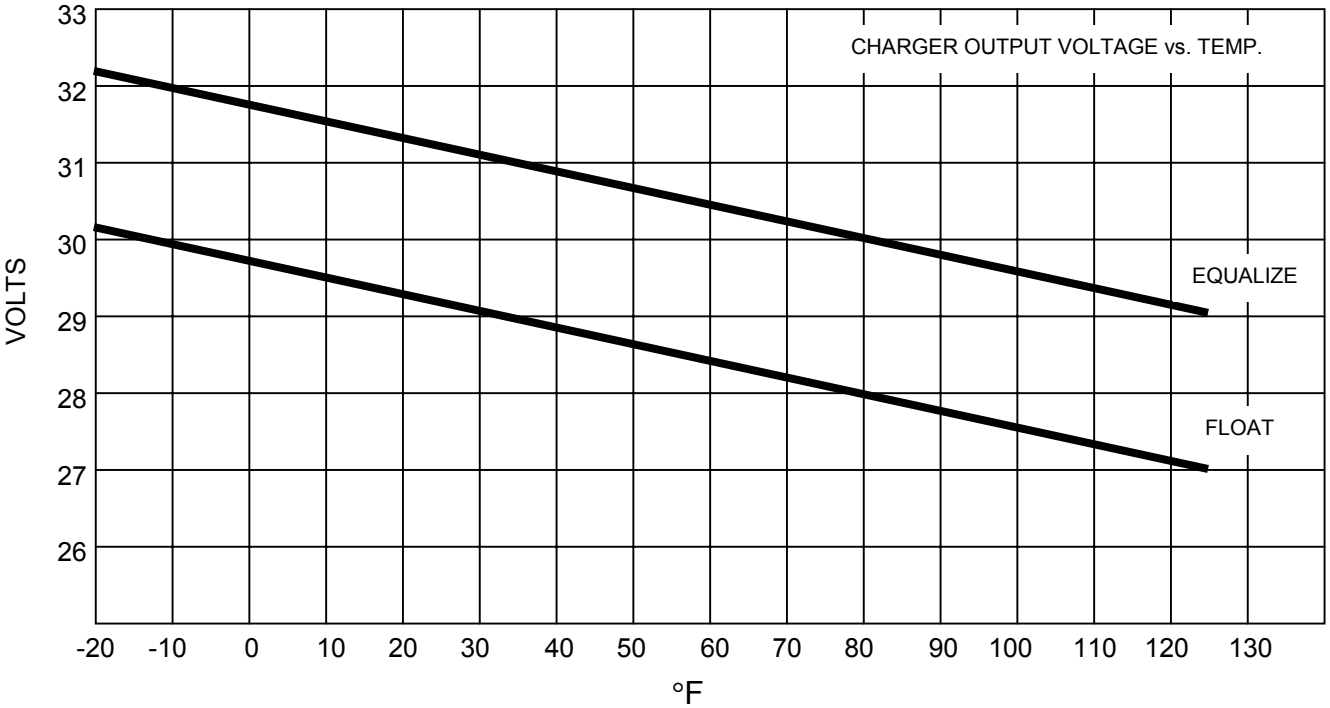
   a. If solution levels are found to be no more than 3/16” below the top line, it will be satisfactory to use distilled water to bring levels to the top line.
   b. If solution levels are found to be ¼” or lower, the level should be brought to the top line by adding REFILL electrolyte of 1.190 specific gravity only.
   c. If solution levels are found to be below the top plates, cells should be kept tightly closed. Partial or complete loss of electrolyte for a limited period (not to exceed 60 days) is not damaging but should be replaced with RENEWAL electrolyte of 1.218 specific gravity as soon as possible.

8. When the corrected specific gravity of nickel-cadmium storage batteries falls below the minimum recommended specific gravity, as shown in Table 1, the electrolyte should be renewed by Coast Guard personnel or a qualified contractor.

a. Wearing protective rubber gloves, rubber apron, and face shield, empty the cells into an approved plastic container. Emptying shall be accomplished by using a Filler Bulb that has been thoroughly flushed with distilled water. With the Filler Bulb, empty the electrolyte to the lowest point obtainable (normally the plate tops). Assure that an adequate number of plastic containers are on hand to receive the spent electrolyte. Discharge of the storage battery is not necessary. Refill immediately with nickel-cadmium battery renewal electrolyte having a specific gravity of 1.218 to the maximum solution level line of each cell. Then add battery oil to a depth of 1/8" above the solution.
b. Spent electrolyte is considered hazardous waste – it's both toxic and corrosive. Chapter 9, Section D.3.b, of the Aids to Navigation Manual - Technical, COMDTINST M16500.3(series), gives guidelines for disposal of the electrolyte. Contact District Hazardous Waste Coordinator for approved disposal methods and sites. Ocean or other water dumping or neutralization at CG facilities is expressly forbidden!

9. Clean and tighten all connections. Measure the total battery bank voltage with a calibrated digital voltmeter. If the measured voltage is between 29.0 and 29.4 volts at normal room temperature, no battery charger adjustments are required. If the voltage is below 29.0 volts, the battery charger must be adjusted. Proper float and equalize settings as functions of electrolyte temperature for **20-cell** battery banks are shown in Table 2. See PMS procedures for the specific battery charger installed to determine how to adjust the charger.

Table 2



- SYSTEM: ***Battery Charger, 12-Volt***
- SUBSYSTEM: **12V EDISON CDSA-IBC-12-30A and 12V SAB NIFE SCB100-12-25**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Semi-Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Check, adjust, float, and equalize voltage.

Safety Precautions:

Tools, Test Equipment, Materials, and References: Digital multimeter.

Troubleshooting References: SAB NIFE battery charger technical manual; and McGraw-Edison battery charger technical manual.

PROCEDURE:

NOTE: If room temperatures are below 60°F or above 80°F, the below PMS must be accomplished with procedures given in the manufacturers' technical manual.
NOTE: Do not use battery charger voltmeter for setting float or equalize voltages.

1. Disconnect all dc loads from the battery, usually at a distribution panel.
2. Observe the ammeter on the battery charger. If the float current is LESS than 4 amps, proceed as below. If the current is OVER 4 amps, apply equalize charge using the equalize timer on the charger until the float current is less than 4 amps. The purpose is to bring the battery to near full charge.
3. When the float current is LESS than 4 amps, measure the voltage across each individual cell using a calibrated digital voltmeter (multimeter). The voltage should be in the range of 1.45 to 1.47 volts per cell at normal room temperature. The voltage across the battery should read 14.5 to 14.7 volts; if not, adjust as indicated in Table 2 of PMS Procedure 9-E(8)-Q-1.
4. Set the equalize timer for 24 hours. Measure the voltage across each cell, using a calibrated digital voltmeter (multimeter). The voltage across each cell should be in the range of 1.55 to1.57 volts at room temperature. If not, adjust the equalize voltage using the equalize voltage adjustment, marked PEAK ADJ on the Edison and FLOAT on the Sab Nife, located on the control printed circuit card to achieve an equalizing voltage across each cell of 1.55 to 1.57 volts (15.5 to 15.7 volts across the battery bank).
5. Reconnect all dc loads back to the battery, usually at a distribution panel.

- SYSTEM: ***Nickel-Cadmium Storage Battery for Emergency Power, 12-Volt***
- SUBSYSTEM: **12-Volt, 10 Cells in Series (Edison ED-80, ED-240, and ED-400)**
- TRAINING: **ANC-LT**
- PMS INTERVAL: **Quarterly**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Check and adjust electrolyte level, clean battery cells, and measure voltage.

Safety Precautions: Wear face shield, rubber gloves, and rubber apron; use insulated tools (DO NOT use tools, hydrometers, or utensils which have been previously used with lead-acid batteries); and never allow open flames or sparks to come near the cells.

Tools, Test Equipment, Materials, and References:

Calibrated digital multimeter;
Hand tools as necessary (insulated);
Hydrometer;
Spirit thermometer;
Plastic container (gal. capacity);
Face shield;
Rubber gloves and rubber apron;
Household vinegar;
Distilled water;
Storage battery maintenance record;
Filler bulb (Edison part no. 198170);
Battery oil; and
Nickel-Cadmium battery renewal electrolyte.

Troubleshooting References: Aids to Navigation Manual - Technical, COMDTINST M16500.3(series), Description Sheet 9-E(6).

PROCEDURE:

WARNING: NICKEL-CADMIUM STORAGE BATTERIES CONTAIN CAUSTIC POTASH, A POISONOUS AND CORROSIVE LIQUID THAT WILL BURN OR INJURE SKIN, EYES, AND PROPERTY. DO NOT ALLOW CONTACT WITH SKIN OR

PROPERTY. IN CASE OF PERSONAL INJURY, APPLY THE FOLLOWING ANTIDOTES AND SEEK MEDICAL ATTENTION IMMEDIATELY.

SKIN: Flush immediately with plenty of water and apply wet compresses of household vinegar. DO NOT apply ointments, salves, or oils before treatment by a physician.
EYES: Flush with plenty of water for at least fifteen minutes and get immediate medical attention.

NOTE: The presence of a light film of oil on top of the electrolyte is normal and reduces evaporation.

1. Clean the outside of each cell of dirt and corrosion. Wipe all cell surfaces, lugs, and intercell connectors with an oily rag. Apply a light coating of oil.
2. Electrolyte solution levels are plainly visible through the transparent plastic cases used for all types of Edison nickel-cadmium storage batteries. Each cell is marked with two red solution level lines which appear on two opposite sides of the cell. The top line is the MAXIMUM recommended solution level; the bottom line is the MINIMUM recommended solution level. For measuring the solution level the measurement should always be taken from the top line. Record the level in the Storage Battery Maintenance Record. Use the letter “A” preceding the reading if the level was found above the top red line.
3. Using a hydrometer that has been thoroughly cleaned, insert the tip of the hydrometer making sure the rubber tip of the nozzle is resting firmly on plate tops of the cell, then squeeze and release the bulb. This method will insure that clean solution is drawn into the hydrometer.
4. Allow the float to move freely and tap the glass barrel gently to insure float is not sticking to sides of the barrel (so as to ensure an accurate reading). Read the specific gravity and return electrolyte sample back to the cell from which it was taken and immediately replace and tighten vent caps.
5. To correct specific gravity reading for solution level, ADD 0.005 to specific gravity for every ¼ inch of solution level above the top red solution level mark. If the solution level is below the top mark, then SUBTRACT 0.005 for every ¼ inch.
6. Check solution temperature with a clean thermometer. The corrected specific gravity reading for the solution level should be above the temperature and solution level corrected in Table 1. Record this reading in the Storage Battery Maintenance Record.

Table 1
Specific Gravity (w/ Solution at Recommended Level)

Temperature of Electrolyte		Nominal Recommended Gravity	Minimum Recommended Gravity
120°F	49°C	1.174	1.144
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50	10	1.192	1.162
40	4	1.195	1.165
30	-1	1.197	1.167
20	-7	1.200	1.170
10	-12	1.202	1.172
0	-18	1.205	1.175
-10	-23	1.207	1.177
-20	-29	1.210	1.180

7. After test has been performed and readings properly recorded, bring solution level to the top red solution level line. If adding water in cold weather, agitate solution with a syringe to prevent water from freezing above the electrolyte.

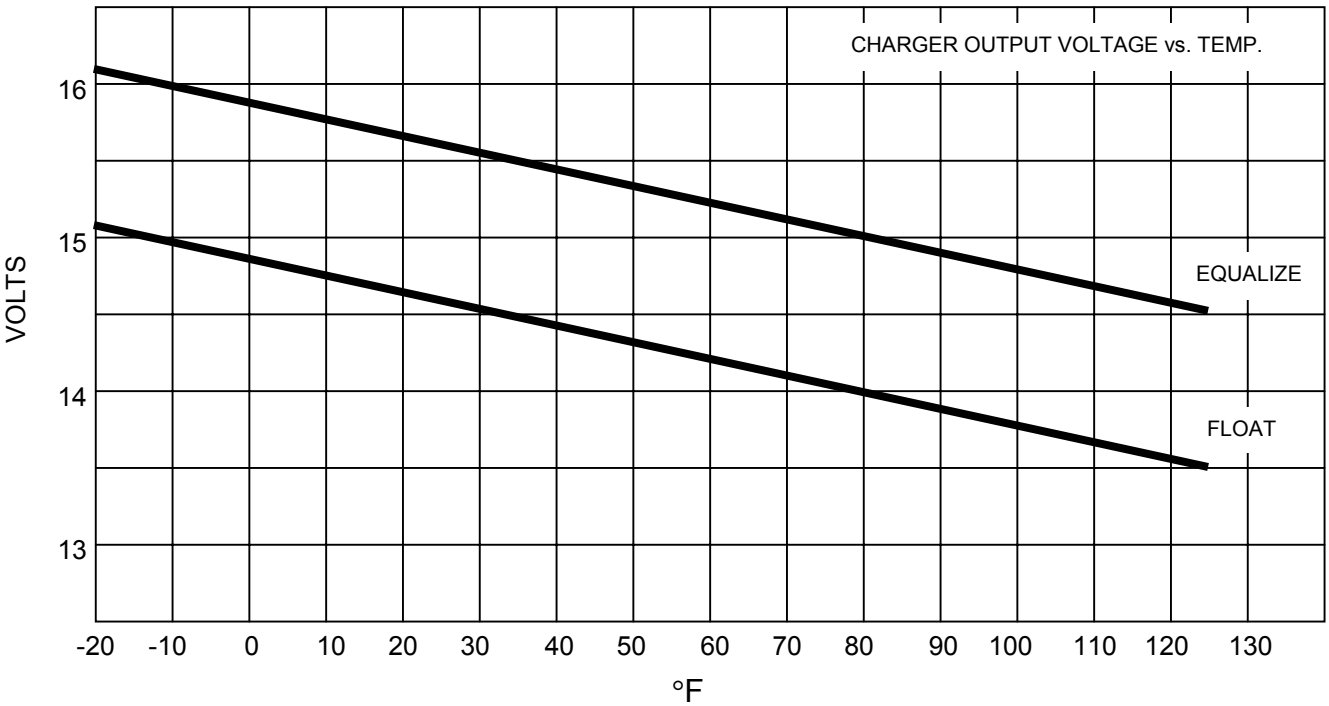
   a. If solution levels are found to be no more than 3/16” below the top line, it will be satisfactory to use distilled water to bring levels to the top red mark.
   b. If solution levels are found to be ¼” or lower, the level should be brought to the top red line by adding REFILL electrolyte of 1.190 specific gravity only.
   c. If solution levels are found to be below the top plates, cells should be kept tightly closed. Partial or complete loss of electrolyte for a limited period (not to exceed 60 days) is not damaging but should be replaced with RENEWAL electrolyte of 1.218 specific gravity as soon as possible.

8. When the corrected specific gravity of nickel-cadmium storage batteries falls below the minimum recommended specific gravity, as shown in Table 1, the electrolyte should be renewed by Coast Guard personnel or a qualified contractor.

a. Wearing protective rubber gloves, rubber apron, and face shield, empty the cells into an approved plastic container. Emptying shall be accomplished by using a Filler Bulb that has been thoroughly flushed with distilled water. With the Filler Bulb, empty the electrolyte to the lowest point obtainable (normally the plate tops). Assure that an adequate number of plastic containers are on hand to receive the spent electrolyte. Discharge of the storage battery is not necessary. Refill immediately with nickel-cadmium battery renewal electrolyte having a specific gravity of 1.218 to the maximum solution level line of each cell. Then add battery oil to a depth of 1/8" above the solution.
b. Spent electrolyte is considered hazardous waste – it's both toxic and corrosive. Chapter 9, Section D.3.b, of the Aids to Navigation Manual - Technical, COMDTINST M16500.3(series), gives guidelines for disposal of the electrolyte. Contact District Hazardous Waste Coordinator for approved disposal methods and sites. Ocean or other water dumping or neutralization at CG facilities is expressly forbidden!

9. Clean and tighten all connections. Measure the total battery bank voltage with a calibrated digital voltmeter. If the measured voltage is between 14.5 and 14.7 volts at normal room temperature, no battery charger adjustments are required. If the voltage is below 14.5 volts, the battery charger must be adjusted. Proper float and equalize settings as functions of electrolyte temperature for **10-cell** battery banks are shown in Table 2. See PMS procedures for the specific battery charger installed to determine how to adjust the charger.

Table 2



- SYSTEM: ***Standard Aids to Navigation Power Supply, High Watt (HWPS)***
- SUBSYSTEM: **Electrical**
- TRAINING: **ANC-AC**
- PMS INTERVAL: **Annual**

Digest of Work: Check and adjust output voltage.

Safety Precautions: High ac voltage present inside; proceed with extreme caution if voltage adjustment is necessary.

Tools, Test Equipment, Materials, and References:

Calibrated Multimeter; and
Hand tools, as required;

Troubleshooting References: HWPS O&M manual developed by Delta Integration.

PROCEDURE:

1. Check voltage at destination (e.g., flasher, fog detector, etc.). In the case of a day/night load, measure voltage during greatest load condition (most likely during daytime) as this causes the greatest voltage drop. Voltage to the lamps themselves must be 12.0VDC or very close to 12VDC; to achieve this, the measured voltage at the flasher's (+) and (-) terminals should be about 12.3VDC or so.
2. If voltage adjustment is necessary, remove the HWPS's cover to expose the circuit board. Trim the ***voltage-adjust*** potentiometer with a small screwdriver to raise/lower voltage at destination (usually a CG-181, CG-493, or CG-481 flasher) to achieve 12.3VDC during greatest load condition.

Note: If your commercially-powered major aid system is running the standard 12VDC solar load package via a Power Supply Monitor Box (PSMB) and Solar Distribution Box (SDB), you must trim the ***voltage-adjust*** potentiometer to achieve **14.0VDC** at the HWPS output.

- SYSTEM: ***Solar Array (Main)***
- SUBSYSTEM: **Solar Panels (10 Watt, 20 Watt, and 35 Watt) - Glass Surface**
- TRAINING: **ANC-MAM**
- PMS INTERVAL: **Annual**

Digest of Work: Inspect and clean.

Safety Precautions: Handle solar panels with care; they must not be dropped or subjected to unnecessary shock or vibration.

Tools, Test Equipment, Materials, and References:

Detergent or soap and clean water;
Stiff-bristle non-metallic brush; and
Sponge or soft rags;

Troubleshooting References: Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19(series), page 2-1.

PROCEDURE:

1. Clean the active part of each solar panel in the solar array with soap and water. Use a brush to remove guano build-up if necessary. Rinse panel with clean water.
2. Visually inspect each panel for obvious damage, shattered or broken glass, and water inside the panel. Replace panels if damage found.
3. Replace damaged or missing bird deterrents. Check to see that all bird deterrents are properly installed.

- SYSTEM: ***Solar Array (Main)***
- SUBSYSTEM: **Solar Panels (10 Watt, 20 Watt, and 35 Watt) – Cable and Electrical**
- TRAINING: **ANC-MAM**
- PMS INTERVAL: **Annual**

Digest of Work: Inspect and check voltages.

Safety Precautions: Handle solar panels with care; they must not be dropped or subjected to unnecessary shock or vibration.

Tools, Test Equipment, Materials, and References:

Calibrated digital multimeter (voltmeter);
Insulated hand tools, as required; and
Dow Corning RTV caulk.

Troubleshooting References: Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19(series), page 2-1.

PROCEDURE:

1. Inspect all wiring for fraying, deterioration, corrosion, or other damage. Replace damaged wiring as indicated. Replace the panel if wiring is damaged in an area precluding wire replacement (e.g., between the panel and the junction box).
2. Inspect junction boxes and stuffing tubes. Repair cracks with RTV caulk. Ensure the output cable is properly supported with a strain relief.
3. Disconnect only the positive (+) panel leads from their termination points. DO NOT ALLOW THE POSITIVE AND NEGATIVE LEADS TO COME INTO CONTACT. Test the panel output voltage using the multimeter. Voltage must be between 15 and 19 volts dc.
4. Diode check. Use the MULTIPLE SOLAR PANEL SERVICING FLOWCHART on page 2-5 of COMDTINST M16500.19A to check condition of the diodes (the diodes are mounted inside the junction box, out of view of the user).

   NOTE: Panel output voltage must be checked during daylight hours. Full-on sunlight is not necessary; overcast conditions okay. However, the entire top surface of the panel must be exposed to the sky with no partial shading. It is not necessary to measure panel current.

- SYSTEM: ***Solar Panel for Emergency Batteries (SM50-H and M75)***
- SUBSYSTEM: **Glass Surface**
- TRAINING: **ANC-SP**
- PMS INTERVAL: **Annual**

Digest of Work: Inspect and clean.

Safety Precautions: Handle solar panels with care; they must not be dropped or subjected to unnecessary shock or vibration.

Tools, Test Equipment, Materials, and References:

Detergent or soap and clean water;
Stiff-bristle non-metallic brush; and
Sponge or soft rags;

Troubleshooting References: Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19(series), page 2-1.

PROCEDURE:

1. Clean the active part of the solar panel with soap and water. Use a brush to remove guano build-up if necessary. Rinse panel with clean water.
2. Visually inspect the panel for obvious damage, shattered or broken glass, and water inside the panel. Replace the panel if damage found.
3. Replace damaged or missing bird deterrents. Check to see that all bird deterrents are properly installed.
4. Verify that the panel orientation toward true South is ± 5°. Rotate the panel bracket, if necessary.

- SYSTEM: ***Solar Panel for Emergency Batteries (SM50-H and M75)***
- SUBSYSTEM: **Cable and Electrical**
- TRAINING: **ANC-SP**
- PMS INTERVAL: **Annual**

Digest of Work: Inspect and check voltages.

Safety Precautions: Handle solar panels with care; they must not be dropped or subjected to unnecessary shock or vibration.

Tools, Test Equipment, Materials, and References:

Calibrated digital multimeter (voltmeter);
Insulated hand tools, as required; and
Dow Corning RTV caulk.

Troubleshooting References: Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19(series), page 2-1.

PROCEDURE:

1. Inspect all wiring for fraying, deterioration, corrosion, or other damage. Replace damaged wiring as indicated. Replace the panel if wiring is damaged in an area precluding wire replacement (e.g., between the panel and the junction box).
2. Inspect junction boxes and stuffing tubes. Repair cracks with RTV caulk. Ensure the output cable is properly supported with a strain relief.
3. Disconnect only the positive (+) panel lead from the termination point. DO NOT ALLOW THE POSITIVE AND NEGATIVE LEADS TO COME INTO CONTACT. Test the panel output voltage using the multimeter. Voltage must be between 17 and 22 volts dc.
4. Diode check. Use the SOLAR PANEL SERVICING FLOWCHART on page 2-4 of COMDTINST M16500.19A to check condition of diode (the diode is mounted inside the junction box, out of view of the user).

   NOTE: Panel output voltage must be checked during daylight hours. Full-on sunlight is not necessary; overcast conditions okay. However, the entire top surface of the panel must be exposed to the sky with no partial shading. It is not necessary to measure panel current.

- SYSTEM: ***Local Terminal Box (LTB)***
- SUBSYSTEM: **Terminal Strip Connectors**
- TRAINING: **ANC-SP**
- PMS INTERVAL: **Annual**

Digest of Work: Inspect terminals for corrosion.

Safety Precautions: Be careful not to accidentally bridge the positive (+) and (-) terminal strips with a screwdriver or other metal tool.

Tools, Test Equipment, Materials, and References:

Basic hand tools; and
Electrical contact cleaner.

Troubleshooting References: Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19(series), page 2-7.

PROCEDURE:

1. Check all terminals and wire terminations for signs of corrosion. Clean or replace if necessary. Wires may be moved to unused terminals on the terminal strip if necessary.
2. Check all electrical connections for tightness.
3. Check for any damaged or frayed wires.
4. Replace desiccant bag, if equipped.

- SYSTEM: ***Photovoltaic Combiner Box (PVCB)***
- SUBSYSTEM: **Electrical Terminals**
- TRAINING: **ANC-SP**
- PMS INTERVAL: **Annual**

Digest of Work: Inspect varistors, varistor terminations, wire terminals, and fuse holders for corrosion.

Safety Precautions: Be careful not to accidentally bridge the positive (+) and (-) terminal strips with a screwdriver or other metal object.

Tools, Test Equipment, Materials, and References:

Basic hand tools;
Multimeter with continuity test feature; and
Electrical contact cleaner.

Troubleshooting References:

PROCEDURE:

1. Secure power to the Solar Charge Controller (SCC) by turning off each array circuit breaker in the SCC (CB1, CB2, and CB3).
2. Check all terminals and wire terminations for signs of corrosion. Clean or replace if necessary.
3. Check fuses and fuse holders for signs of corrosion. Clean if necessary.
4. Test each fuse for continuity. Using a screwdriver, pry one end of the fuse out of its holder and check for continuity using the multimeter's continuity tester. Reinsert fuse.
5. Ensure all varistors are fastened securely to the terminal strip and that there are no burned out (visibly charred) varistors. Replace any varistors that are visibly charred.
6. Check all electrical connections for tightness.
7. Check for any damaged or frayed wires.
8. Turn on all three array circuit breakers in the SCC.

- SYSTEM: ***Solar Charge Controller (SCC)***
- SUBSYSTEM: **General**
- TRAINING: **ANC-SP**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Check terminals, temperature sensor, and various electrical readings and settings.

Safety Precautions:

Tools, Test Equipment, Materials, and References:

Hand tools, as required;

Troubleshooting References: Installation & Operating Instructions (use the manual corresponding to your specific SCC: either SCI, PAC, or Valcon).

PROCEDURE:

1. Ensure terminal screws are tight.
2. Ensure that a temperature sensor is attached to the battery.
3. For SCI model, check to see that the charge set-point selector is in the “B” position. For PAC model, check to see that “Charge” is set at 15.0 for wet batteries or 14.7 for Absolyte II or Dryfit batteries. For Valcon model, voltage settings are determined at installation (consult with I & O manual for proper switch positions).
4. Ensure that the Low Voltage Disconnect (LVD) is in the “Auto” position (“LD-Auto” on the PAC model). On the Valcon model, ensure LVD override is OFF. Do not use LVD feature when using Solar Distribution Box (SDB).
5. For SCI and PAC models, if battery voltage is not at 95% State of Charge (SoC), the “Charging” light should be on. On the Valcon model, if “BATTERY LEVEL” is “GOOD” or “LOW” the “AT REGULATION” light should be off.
6. Use the SCC’s display to measure battery voltage, load current, and array current (when charging the battery).

- SYSTEM: ***Range Power Box (RPB)***
- SUBSYSTEM: **General**
- TRAINING: **ANC-AC**
- PMS INTERVAL: **Annual**

Digest of Work: Check terminals, temperature sensor, and various electrical readings and settings.

Safety Precautions:

Tools, Test Equipment, Materials, and References:

3/16" flat blade screwdriver; and
Hand tools, as required.

Troubleshooting References: Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19(series), page 2-35.

PROCEDURE:

1. Ensure terminal screws are tight.
2. Ensure that a temperature sensor is attached to the battery.
3. Check to see that the charge set-point selector is in the "B" position.
4. Ensure that the Low Voltage Disconnect (LVD) is in the "Auto" position. Do not use LVD feature when using Solar Distribution Box (SDB).
5. If battery voltage is not at 95% State of Charge (SoC), the "Charging" light should be on.
6. Use the RPB's display to measure battery voltage, load current, and array current (when charging the battery).

- SYSTEM: ***Solar Distribution Box (SDB)***
- SUBSYSTEM: **Solar Aid Controller II (SACII)**
- TRAINING: **ANC-SP**
- PMS INTERVAL: **Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Systems check.

Safety Precautions: Secure power prior to making adjustments to equipment.

Tools, Test Equipment, Materials, and References:

Hand-held calibrated digital multimeter;
Basic hand tools, as required; and
Logic probe (optional).

Troubleshooting References: Aids to Navigation Manual - Technical, COMDTINST M16500.3(series).

PROCEDURE:

1. Ensure SDB is energized and all circuit breakers are on. Using on-board rotary switch, check the following voltages: Main Power Voltage (12.0–15.5 VDC), Auxiliary Array Voltage (14.0–16.0 VDC), and Auxiliary Battery Voltage (13.0–15.5 VDC).
2. Using the hand-held digital multimeter check Main Power voltage across the (+) and (-) MAIN POWER terminals. Ensure this reading is same as on on-board analog voltmeter (with rotary switch in MAIN POWER position).
3. During daylight hours (when light is normally off) cover photoresistor and confirm main light turns on. Uncover the photoresistor and confirm light turns off.
4. Using the hand-held digital multimeter in diode-check mode (multimeter selector switch on the diode symbol (—▶|—)), conduct the following SACII system check with the photoresistor first uncovered then covered: With the negative test lead connected to MAIN BATT (-) terminal, check logic status at each of the four output terminals (TBl-7, 8, 9, and 10) with the positive lead.

Photoresistor	TB1-7	TB1-8	TB1-9	TB1-10
Uncovered	0.5 **to** 0.6v	OL / OPEN	OL / OPEN	OL / OPEN
Covered	0.5 **to** 0.6v	0.5 **to** 0.6v	OL / OPEN	OL / OPEN

5. Visually inspect SDB's physical condition. With power secured, check all wiring terminations and connections. Tighten all loose connections. Repair, clean, or replace all defective and/or corroded hardware.
6. Emergency signal test. Cover the photoresistor to turn on main light and switch fog detector off to turn on main sound, if necessary. Ensure that both main sound and main light signals are on and watching properly. Then either:

   a. Check emergency system operation by tripping the MAIN LIGHT and MAIN SOUND circuit breakers (circuit breakers #1 and #3 in the SDB) and ensuring that the emergency light and sound signals turn on within 100 seconds.
      Turn MAIN LIGHT and MAIN SOUND circuit breakers back on and manually rotate the MAIN LIGHT lampchanger back to its first operating position (*CAUTION – lamp(s) may be HOT*).
      To reset the SACII's and return system back to primary mode of operation, either (1) turn off circuit breaker #9 in the SDB for about 15 seconds then turn it back on, (2) provide a momentary ground to TB1-6 terminals of each SACII, (3) in newer SACII models, simply depress the red reset button, (4) firmly depress and hold the large load transfer relay (inside the SDB) in the "energized" position for about 10 seconds and release (this will work only if the ARM module is installed in the SDB), or (5) conduct a remote A/V system reset from your ACMS Master, if applicable.

      OR (*applicable only if your system has an auxiliary battery*)

   b. Firmly depress and continuously hold the large load transfer relay (inside the SDB) in the "energized" position until the emergency light and sound signals turn on (within about 100 seconds). After confirming that the emergency signals have been activated, release the load transfer relay and ensure the system resets to primary mode of operation by confirming that both the main sound and light signals are back on and watching properly (this will work only if the ARM module is installed and properly connected in the SDB).

7. Uncover the photoresistor and switch the fog detector back on to return system back to normal mode of operation.

- SYSTEM: ***Low Voltage Drop Kit (LVDK)***
- SUBSYSTEM: **Terminal Strip Connectors**
- TRAINING: **ANC-SP**
- PMS INTERVAL: **Annual**

Digest of Work: Inspect LVD boxes and terminals for corrosion.

Safety Precautions: Be careful not to accidentally bridge the positive (+) and (-) terminal strips with a screwdriver or other metal tool.

Tools, Test Equipment, Materials, and References:

Basic hand tools; and
Electrical contact cleaner.

Troubleshooting References:

PROCEDURE:

1. Check all terminals and wire terminations for signs of corrosion in both LVD boxes. Clean or replace as necessary.
2. Check to ensure that all electrical connections are neat and tight. The very reason for having the LVDK is to prevent excessive voltage drop between the power distribution point and the loads.
3. Check for any damaged or frayed wires and replace as necessary.

- SYSTEM: ***Large Lead-Acid Storage Battery, 12-Volt***
- SUBSYSTEM: **12-Volt, Six 2-Volt Cells in Series (Yuasa/Exide E55 & E120, Fulman Solar, Sonnenschein Dryfit A600, and GNB Absolyte IIP)**
- TRAINING: **ANC-SP**
- PMS INTERVAL: **Semi-Annual**
- SPECIFIC PERSONNEL REQUIRED: **EM or ET**

Digest of Work: Measure voltages, specific gravity, and clean case and connections.

Safety Precautions:

1. Open door to battery room or battery box and allow it to ventilate for at least five (5) minutes before working on battery.
2. Remove all metallic jewelry, framed glasses, belt buckles, and writing instruments before approaching battery.
3. Do not smoke, use an open flame, or create sparks in the vicinity of the battery. Discharge static electricity from your body before working on the battery by touching a grounded metallic surface such as a metallic doorframe, water pipe, etc.
4. Be sure hydrometers for lead-acid and NiCad batteries are kept separated from each other and never interchanged.
5. Wear either goggles or a full face shield (recommended), a rubber apron, and rubber gloves while servicing the battery.
6. Use only insulated hand tools. Do not rest tools on battery.
7. WARNING: LEAD-ACID BATTERIES CONTAIN SULFURIC ACID ELECTROLYTE, A HIGHLY TOXIC AND ACIDIC LIQUID. DO NOT ALLOW CONTACT WITH SKIN, EYES, OR PROPERTY.

FIRST AID FOR ELECTROLYTE CONTACT

EXTERNAL:
1. Immediately flush affected area with free running water for at least fifteen (15) minutes.
2. Apply baking soda to neutralize acid on skin, clothing, or other material. Continue to apply baking soda until bubbling stops. Then rinse with clear water.
3. Severe skin burns should be examined by a physician.

EYES:
1. Immediately flush with water for at least fifteen (15) minutes.
2. Cover both eyes with sterile compresses and get medical attention immediately.

INGESTION:
1. Drink large quantities of water or milk.
2. Follow with milk of magnesia or vegetable oil.
3. Seek medical attention immediately.

Tools, Test Equipment, Materials, and References:

Digital Multimeter;
Torque wrench;
Goggles or full face shield;
Rubber apron & rubber gloves;
Various hand tools;
Abrasives, brushes, and rags, as required;
Five (5) gallons distilled water (quantity will change based on experience);
Two (2) gallon bucket and plastic funnel;
Lead-acid battery hydrometer;
Battery thermometer;
One (1) pound box of baking soda;
Isopropyl alcohol;
One (1) pound tub of No-Oxide grease or petroleum jelly and application brush; and
FIRST AID KIT TO INCLUDE ALL MATERIALS NECESSARY TO NEUTRALIZE ACID BURNS.

Troubleshooting References: Various manufacturers' Instruction for Installing and Operating Solar Batteries; Short Range Aids to Navigation Servicing Guide, COMDTINST M16500.19(series), page 2-20; and Solar Design Manual, COMDTINST M16500.24(series).

PROCEDURE:

1. Measure and record the charge voltage of each cell (interconnections do not have to be disconnected) while the solar array is charging and the loads turned off. The voltages should be 2.30 to 2.35 volts per cell; however, low readings may be due to lack of sun. Cell to cell variation should be within ±0.02 volts for a fully charged battery.
2. Disconnect the solar array and wait at least ten minutes. Measure and record the open circuit voltage of each cell. The voltages should be 2.05 to 2.14 volts per cell. Cell to cell variation should be within ±0.02 volts for a fully charged battery.
3. With the solar array and loads connected, measure and record the closed circuit voltage of each cell. The voltages should be within 1.96 to 2.13 volt range per cell with a maximum cell to cell variation of ±0.02 volts for a fully charged battery.
4. Measure and record the specific gravity and temperature of each cell. DO NOT USE THE NICAD HYDROMETER OR SERIOUS DAMAGE WILL RESULT TO THE LEAD-ACID BATTERY. Find the appropriate battery correction factor, as shown on the following table, to calculate the state of charge:

Temperature Deg., F (C)	Correction Points	Temperature Deg., F (C)	Correction Points
20 (-6.7)	-0.024	70 (21.1)	-0.004
25 (-3.9)	-0.022	75 (23.9)	-0.002
30 (-1.1)	-0.020	80 (26.7)	0
35 (1.7)	-0.018	85 (29.4)	+0.002
40 (4.4)	-0.016	90 (32.2)	+0.004
45 (7.2)	-0.014	95 (35.0)	+0.006
50 (10.0)	-0.012	100 (37.8)	+0.010
55 (12.8)	-0.010	105 (40.6)	+0.012
60 (15.6)	-0.008	110 (43.0)	+0.014
65 (18.3)	-0.006	115 (46.1)	+0.016

The specific gravity of a fully charged Yuasa/Exide battery is **1.300** and a Fulmen Solar is **1.240** (temp. corrected).

5. The estimated state of charge can be found by either the corrected specific gravity (preferred) or the open circuit voltage methods. The system is designed so that the state of charge never falls below 80%; however, extended cloudy and overcast conditions may cause it to fall as low as 60%. If the state of charge falls below 60% and system checks indicate no apparent cause, contact your district training team chief. The following specific gravity table applies to **Yuasa/Exide** batteries:

Open Circuit Voltage (Voc)	Specific Gravity	State of Charge (SoC)
12.7	1.300	100%
12.6	1.265	90%
12.5	1.244	80%
12.4	1.218	70%
12.3	1.194	60%
12.2	1.170	50%
12.1	1.148	40%
12.0	1.122	30%
11.9	1.098	20%
11.8	1.073	10%
11.7	1.040	0%

The following specific gravity table applies to **Fulmen Solar** batteries:

Open Circuit Voltage (Voc)	Specific Gravity	State of Charge (SoC)
12.5	1.240	100%
12.3	1.200	75%
12.0	1.165	50%
11.8	1.130	25%
11.6	1.095	0%

6. Check each cell for sediment buildup. This is a sign of the amount of cycling or overcharge that the battery received. It is also an indication of the end of the battery's useful service life. A battery with one half of its sediment space full will operate for a number of years. When sediment touches the plates, shorts develop causing low voltage cells.
7. Add distilled water to each cell to bring the electrolyte level to the HIGH mark on the cell jar. The flame arrestors have built-in funnels; simply remove the dust cover to access. Record the amount of water added to each cell in the aid log.
8. Remove dust or other contaminates from the cell covers and jars with a clean cloth dampened with potable water. Do not use cleaning solutions or detergents as they may damage the plastic. Isopropyl alcohol, used to dampen a clean cloth, is the only approved cleaning solution.
9. Dirty intercell connectors are a common cause of excessive cell-to-cell voltage variations. If necessary, remove intercell connections and clean with a bristle brush and solution of bicarbonate of soda (one (1) pound of baking soda to one (1) gallon of water). Terminal posts may be cleaned with fine emery paper. Do not allow solution to enter cells as it will neutralize the acid and ruin the cell. TO PREVENT SPARKS, ALL LOADS AND THE ARRAY MUST BE DISCONNECTED FROM THE BATTERY PRIOR TO REMOVING CONNECTORS OR CABLES. Apply No-Oxide grease to contact surfaces and connectors.
10. Retorque all intercell connector bolts according to manufacturers' recommended in.-lbs. THESE BATTERIES ARE A SOURCE OF VERY HIGH CURRENT. Extreme caution must be exercised when using metal tools on them. Insulated tools provide an added margin of safety.
11. The battery must be charged on-site if either a scheduled or unscheduled visit reveals that the state of charge has fallen below 60%. The cause of low state of charge must be found and corrected prior to returning the aid to normal operation. Charging may be accomplished with a portable engine-generator set or any charger capable of charging 12-volt batteries. Do not exceed the battery manufacturers' pre-determined maximum charge current. The battery shall be monitored during the

charging process to ensure cell temperature does not exceed 110 degrees F. Should this occur, charging must be stopped and the cell allowed to cool down to 90 degrees F, at which time charging may resume. Charge voltage shall start at 15.0-volts; however, if the maximum charge current is exceeded or if electrolyte floods and spills out onto the cell cover, this voltage may be reduced. All loads and the array must be disconnected during the charging process.