INSPECT, TEST AND RECONDITION DC PROPULSION GENERATORS & MOTORS IN-PLACE

1. SCOPE

1.1 Intent. This work item describes the requirements for the Contractor to visually inspect, test, and recondition (clean, dry and varnish-treat) a direct current (DC) generator or motor of 75 to 6000 horsepower. This specification applies to the following Coast Guard vessels:

1.1.1 Main propulsion generators and motors:

- BAY class ice breaking tugs (WTGB)
- POLAR STAR (WAGB-10) & POLAR SEA (WAGB-11) – main propulsion motor only

1.1.2 Auxiliary motors:

- 175' Keeper class coastal buoy tenders (WLM) – bow thruster
- 225' JUNIPER class seagoing buoy tenders (WLB) – bow and stern thrusters
- POLAR STAR & POLAR SEA – oceanographic and trawl/core winches

1.2 Alternate terminology. The term "machine", when used in this specification, shall imply a generator or motor.

2. REFERENCES

COAST GUARD DRAWINGS

None

COAST GUARD PUBLICATIONS

Surface Forces Logistics Center Standard Specification 2351 (SFLC Std Spec 2351), 2018, Overhaul DC Generators & Motors.

OTHER REFERENCES

American National Standards Institute (ANSI/EASA) AR100, 2010, Recommended Practice for the Repair of Rotating Electrical Apparatus

MIL-E-22118, Jul 1974, Enamel, Electrical-Insulating

MIL-I-24092/1, Sep 1993, Insulating Varnish, Solvent Containing, Air-Dry for Spot Patching and Emergency Repairs, Grades CA, Class 130 and 155 Thermal Class Requirements

3. REQUIREMENTS

3.3 General.

3.3.1 Notification and documentation. Abide by the following requirements for all inspections, tests, and cleaning operations specified herein.

3.3.1.1 Advance notice. Notify the Coast Guard Inspector at least 24 hours before performing each test, inspection, and cleaning operation.

3.3.1.2 Documentation. Submit a CFR after completion of each inspection and test, along with a completed copy of each applicable test data sheet.

3.3.2 Original equipment manufacturer's guidance. Adhere to the requirements, cautions, and warnings stated in the machine manufacturer's instruction book during the performance of this work.

3.3.3 Protective measures. Furnish and install suitable covering to seal off and protect all non-affected surfaces/equipment and spaces in the vicinity of the work area against contamination during the performance of work. Upon completion of work, remove protective material and inspect for the presence of contamination. Clean all equipment and spaces, contaminated due to improper protection, to original condition of cleanliness.

3.3.4 Machine Protection.

3.3.4.1 Particular care should be taken so that no foreign materials or dust are allowed to lodge on the machine, particularly the commutator. Ensure that supply air to the compartment is filtered to preclude entry of paint over spray, dust, and industrial grit.

3.3.4.2 Absolutely no silicone or silicone based insulations, cables, paints, varnishes, laminates, tapes, compounds, rubber, greases, or other products shall be used within the interior of the machine. Mechanics using protective hand creams containing conductive or silicone materials shall not handle internal machine parts. Even small amounts of silicone materials will cause greatly increased brush wear.

3.3.4.3 Take adequate security measures to ensure that foreign objects do not enter a machine at any time. A small bolt, nut, or other object in the air gap may cause damage that could require weeks to repair. Small, loose objects shall not be permitted in the pockets of workers within the compartment while a machine is uncovered. Account for all tools and fasteners entering and leaving a machine. Protect each open machine with stock or temporary covers during periods when no shipboard work is actively in progress on the internals.

3.3.5 Technical representative. Provide the services of a Technical Representative (Tech Rep), who is familiar with DC machines and shall be present during the performance of this work. The technical representative shall be employed by a shop that is a member of the Electrical Apparatus Service Association (EASA) and that shop shall adhere to the association's standards, including ANSI/EASA AR100. Both the technical representative and the Coast Guard Inspector shall be present to witness the performance of all tests, inspections, and cleaning operations performed under this specification.

3.3.6 Shop work. Components that can be removed from the cutter through existing accesses or those created by other work items may be inspected, cleaned, and dried ashore. Protect removed components to prevent damage while in transit.

3.3.7 Power. When authorized by the work item, power for temporary shipboard equipment may be taken from the ship service electrical distribution system.

3.3.8 Water and air. When authorized by the work item, hot and cold potable water and compressed tool air may be obtained from shipboard systems. A backflow preventer must be installed between each shipboard potable water connection point and the Contractor's equipment. Tool air that is to be blown into a machine shall be filtered for particulate, water, and oil prior to discharge.

3.4 Pre-cleaning procedures. Prior to performing cleaning requirements, accomplish the following:

3.4.1 Access cover removal. Remove, clean, and retain all machine access covers and fasteners.

3.4.2 Air gap clearances. Measure all main pole and interpole air gap clearances as follows, ensuring that the amount of removed varnish is kept to a minimum, and varnish residuals from the iron on the pole and the iron on the armature are removed, wherever measurements will be taken:

- Choose and non-destructively mark the centerline of each main pole on both ends (fore and aft), as well as a single point on each end of the armature.
- Align the mark on the armature with the mark on the number one main pole (arbitrarily chosen). Carefully measure the air gaps with a tapered feeler gauge to the nearest thousandth of an inch; record the readings in the "Main Pole" section, "A" columns (Fore and Aft) of the DATA SHEET 1 (Air Gap Readings) provided herein.
- Repeat the above procedures, until the mark on the armature has been aligned with the marks on each of the remaining main poles.
- Measure the interpole air gaps, as specified above for the main poles; record the readings in the "Interpole" section, "A" columns (Fore and Aft) of the DATA SHEET 1 (Air Gap Readings) provided herein.

3.4.3 Disassembly and inspections. Disassemble the machine, and accomplish the following inspections:

3.4.3.1 Visual inspections. Perform a visual inspection of the machine components, for the presence of contamination by dust, dirt, moisture, oil, and foreign matter (carbon, copper, and mica). Attempt to determine the origin, such as leaking seals, or any unusual conditions prior to the start of cleaning. Inspect the commutator for signs of surface roughness, loose bars, uneven bar height, mica degradation, and cracked or broken risers. Inspect insulation surfaces and welded bars, including interpole and commutating field windings. Note all abnormal conditions on the armature, field windings, risers, commutator, brush holders, brushes, and brush holder springs. Carefully examine the interior of the machine for loose objects such as, nuts, tools, and cleaning rags; remove all such items. Inspect all electrical connections for tightness. Check all wedges, bands, and soldered connections and correct any minor deficiencies. Check for evidence of overheating, both general and localized. Record all findings, including the types of contaminants (oil, water, carbon, dirt, etc.) found.

3.4.3.2 Brush removal. Remove and retain all brushes. Brushes with any of the following characteristics shall be replaced with new brushes:

- Worn or chipped to such an extent that they will not move properly in their holders.
- Damaged shunts, shunt connections, or hammer clips.
- Worn to one-half or less of the original length of the brush

3.4.3.3 Ventilation. As needed to perform the work, remove blower(s) and duct sections to separate the machine from its ventilation system. Clean air stream surfaces of the removed components and the first 3 feet of ductwork in each direction from each break. Renew all filter media.

3.4.3.4 Initial insulation resistance test. Measure and record the insulation resistance of each circuit listed in Table 1A, 1B, or 1C below, as applicable. Apply a test voltage of 500 VDC for all circuits. Temperature correct all insulation resistance readings to 25°C using the nomograph of Figure 1. Record uncorrected insulation resistance reading, winding temperature, and corrected insulation resistance for each measurement taken. The following formula can be used as a cross check on the nomograph temperature correction:

$$R_{25} = R_T \, 10^{0.0305(T-25)}$$

where	R_{25}	is the corrected insulation resistance
	R_T	is the uncorrected insulation resistance
	T	is the winding temperature (°C)

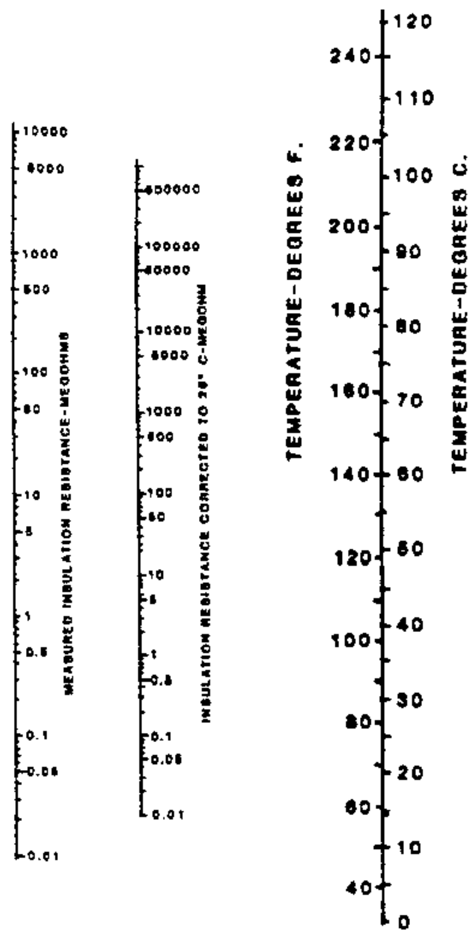

FIGURE 1 – INSULATION RESISTANCE TEMPERATURE CORRECTION NOMOGRAPH

3.4.3.5 Insulation resistance polarization index (PI) test. Measure and record the PI tests as follows:

- Measure and record the insulation resistances of the windings after applying the test voltage specified in paragraph 3.4.3.3 above for one minute. Separately test the armature, interpole, and main field winding circuits. Apply armature voltage between the copper conductors and the rotor structure to eliminate the insulating effect of the bearing lubricant film.
- If the value of the one minute insulation resistance is between the values shown in Table 1A, 1B, or 1C below, as applicable, continue applying test voltage until a steady state value is reached. Measure and record the insulation resistance each minute during the test and more frequently when results are changing quickly. Plot the insulation resistance as a function of time on log-log paper for each winding tested. A PI value of less than 2.0 indicates that the windings are moist or dirty.

TABLE 1A – POLARIZATION INDEX APPLICABILITY FOR 500 VDC MAIN PROPULSION GENERATORS & MOTORS

Windings	Minimum Resistance	Maximum Resistance
Complete armature circuit	0.2 MΩ	12 MΩ
Armature alone	0.2 MΩ	20 MΩ
Armature circuit less armature	0.2 MΩ	20 MΩ
Complete field circuit	1.0 MΩ	45 MΩ

TABLE 1B – POLARIZATION INDEX APPLICABILITY FOR 900 VDC MAIN PROPULSION GENERATORS & MOTORS (BAY & POLAR)

Windings	Minimum Resistance	Maximum Resistance
Complete armature circuit	0.4 MΩ	22 MΩ
Armature alone	0.4 MΩ	34 MΩ
Armature circuit less armature	0.4 MΩ	34 MΩ
Complete field circuit	1.7 MΩ	78 MΩ

TABLE 1C – POLARIZATION INDEX APPLICABILITY FOR 500 VDC AUXILIARY MOTORS

Windings	Minimum Resistance	Maximum Resistance
Complete armature circuit	0.2 MΩ	10 MΩ
Armature alone	0.4 MΩ	20 MΩ
Armature circuit less armature	0.4 MΩ	20 MΩ
Complete field circuit	1.0 MΩ	25 MΩ

3.4.3.6 Winding cold resistance test. Measure the resistance of each winding at ambient temperature. Take measurements with a four wire micro-ohmmeter or other precision low resistance measuring device. Record the resistance and temperature of each winding shown in Table 1A, 1B, or 1C above, excluding the complete armature circuit. Compare results with manufacturer's design data. Retain readings for use during drying by circulating current in section 3.4.1.3.2 below.

3.4.3.7 Bearing wear. When specified by the work item, measure and record bearing wear. Temporarily support the armature while a bearing is removed for measurement. For each bearing wear measurement, also record the manufacturer's acceptable range of values. Circle any measured values that are outside the manufacturer's acceptable tolerances.

3.4.3.8 Commutator measurements. When specified by the work item, measure and record commutator wear and concentricity.

3.4.3.9 Armature removal. When specified by the work item, remove and support the armature such that the windings bear no weight. Match mark each coupling prior to disassembly for later reconnection. For auxiliary DC motors, the magnet frame (stator) may also be relocated to better facilitate containment of cleaning and rinse solutions.

3.5 Cleaning methods. Sequentially employ all of the following methods for cleaning the machine:

3.5.1 Suction. Use suction to remove abrasive particles such as loose grit, iron dust, carbon and copper particles.

3.5.2 Compressed air. Use compressed air with suction such that material dislodged by the air stream will be captured and exhausted. Remove dry loose dust and foreign particles, particularly from inaccessible locations such as air vents in the armature punchings. Ensure the following:

- The compressed air is clean (oil free with the use of an oil filter) and dry.
- The air pressure does not exceed 30 pounds per square inch.
- The machine is opened from both ends, to allow a path of escape for air and dust.
- Extreme caution is used when using compressed air, particularly if abrasive particles are present.

3.5.3 High pressure water spray. After removal of loose materials above, clean all windings and interior parts of the machine with a hot non-ionic liquid detergent solution as described below. The use of solvents that are not dissolved in water is strictly prohibited.

3.5.3.1 Waste containment. Install temporary containments and plastic sheeting as needed to confine all liquids to the machine interior and collect them for disposal. Dispose of all cleaning, rinse, and waste solutions in accordance with applicable local, regional, state, and federal laws and regulations. No fluid shall be allowed to flow into the bilge or public drains.

3.5.3.2 Temporary ventilation. Install temporary ventilation to exhaust airborne moisture from the compartment during the cleaning operation.

3.5.3.3 Pressure washer. Set up a hot pressure washer capable of delivering at least 0.5 gallons per minute through an adjustable pressure range up to 2500 psig. The equipment shall be of the airless design, i.e., the cleaning solution is atomized by high fluid pressure at the spray nozzle tip and requires no air supply. Observe all spray equipment manufacturer's recommended safety practices. Furnish all personnel in the compartment during the cleaning (including the Coast Guard Inspector) with the personnel protective equipment necessary to work near the hot and alkaline cleaning solution.

3.5.3.4 Before its first use, the water spray equipment shall be cleaned and purged of any dirt or debris in the system. Follow the manufacturer's instructions on initial flushing of the system.

3.5.3.5 The cleaning solution shall consist of liquid non-ionic water soluble general purpose detergent, meeting the requirements of MIL-D-16791, mixed in a proportion of 1 ounce of concentrate to 1 gallon of fresh water. If the cleaning solution is batch prepared, heated the mixing water to 130°F to 150°F prior to dissolving the detergent. If the cleaning equipment is designed to continuously prepare solution (concentrate is siphoned into the cleaning unit), demonstrate that the mixing ratio is properly set to the Coast Guard Inspector. In cold weather, the concentrate may need to be kept warm to prevent undesirable viscosity changes.

3.5.3.6 With the pressure washer ready for use, perform a test run (need not be in the compartment) by discharging spray into a bucket or other suitable container. Adjust the spray pattern to obtain a wide fan shaped distribution. Set the sprayer controls to avoid damaging the insulation by limiting winding impingement pressure to 30 psig. Cleaning and rinse solution temperature shall be no less than 140°F and shall not exceed 194°F.

3.5.3.7 Spray the machine internals until all carbon dust, oil, grease, and foreign deposits are removed. Ensure that all coils, windings, and structural members are thoroughly cleaned. Avoid striking varnished surfaces with the cleaning nozzle or wand. Use clean lint-free cloths to check for cleaning effectiveness. At the conclusion of a wash cycle, rinse the windings using hot fresh water. Do not let cleaning solution dry on machine surfaces. Continue wash and rinse cycles until the machine is clean. The final rinse of the day shall include all machine internals to ensure that any overspray is completely removed from all surfaces.

3.5.3.8 Wipe off accessible wetted surfaces and blow dry or wet vacuum any remaining surface water. Visually inspect the windings for cleanliness and damage.

3.6 Post-cleaning procedures. Perform the following post cleaning procedures:

3.6.1 Drying. Accomplish drying by the following methods:

NOTE

Drying cannot be hurried; past performance has shown that a week or longer may be needed for satisfactory results. A large machine is often difficult to dry satisfactorily when only external heating is used. Typically after several days of external heating, low voltage direct current must be circulated through the windings to complete the drying process.

3.6.1.1 Insulation resistance measurements. Readings shall be taken (see section 3.4.3.3 above) when the drying is started, checked at regular intervals thereafter as long as the drying continues, and plotted on semi-logarithmic paper with the logarithm of insulation resistance ordinate and time as abscissa. Drying shall continue until either the insulation resistance readings show no abrupt changes and do not increase more than 5% over a 12-hour period or the polarization index is greater than 3.0. The final machine winding insulation resistances at the completion of drying, adjusted to 25°C, shall not be less than the values in Table 2 below or those measured during the pre-cleaning test, whichever is greater.

NOTE

The degree to which the properties of insulation are restored by drying may be determined to some extent by measuring the insulation resistance to ground. Usually the resistance will drop as the machine warms up, reach a minimum, and then start to rise rapidly at first and then more slowly as the drying progresses. The value may decrease slightly at times and then increase again at a slower rate as the moisture is driven out, indicating that the drying is nearly completed. An erratic curve may indicate leakage paths to ground or weak insulation. As drying continues, the general trend of the insulation resistance values indicate the progress in eliminating moisture.

TABLE 2 – MINIMUM POST-DRYING WINDING INSULATION RESISTANCES

Windings	Minimum Insulation Resistance (MΩ) for Machine of Rated Voltage (VDC)		
	Main Propulsion		Auxiliary
	500	900	500
Complete armature circuit	0.7	1.3	1.0
Armature alone	1.2	2.2	2.0
Armature circuit less armature	1.2	2.2	2.0
Complete field circuit	2.5	4.4	3.0

3.6.1.2 External heat. Fabricate a temporary oven, using any variety of materials such as heat-insulation panels secured to suitable frames, for the application of external heat. External heaters shall be kept away from any material that may burn or melt. Ensure that the heat is uninterrupted to avoid cooling and subsequent condensation of moisture. If steam is used, ensure there are no leaks, which might introduce moisture into the enclosure or machine. Blow filtered dehumidified heated air through the machine to remove moisture evaporated by the temporary oven and provide ample exhaust ventilation to expel the damp air. Verify that the temporary supply blower and its ductwork are clean prior to energizing the fan. If practicable, periodically rotate the armature to allow trapped water to escape and expedite the drying process. Monitor the temperature of the equipment being dried by means of temperature detectors, permanently or temporarily installed, or by thermometers placed so that they may be easily read at the hottest spots on the equipment. Ensure the following:

- Limit heat input so that winding temperatures do not increase more than 7°F per hour.
- Maintain temporary oven air temperature between 280 and 300 °F until the winding reaches a temperature of 220 to 230 °F or the machine manufacturer's recommended maximum temperature, whichever is lower.

3.6.1.3 Thereafter, adjust the temporary oven air temperature to maintain the winding temperature as recommended by the machine manufacturer, not to exceed 220 to 230 °F, until the winding is dry.

NOTE

The heater power rating will vary with the amount of equipment to be dried, degree of enclosure, and ventilation airflow rate. It is, therefore, impossible to give a rigid rule for determining the exact size heater required. By assuming that the machine is composed entirely of *w* pounds of steel, the energy (*E*) in kWh required to heat the machine from ambient (T_1) to baking temperature (T_2) can be estimated as follows:

$E = 3.5\, w\, (T_2 - T_1) / 100{,}000$

For every 1000 pounds of machine weight, 0.25 kW or 800 BTU/h is required to achieve a 140°F temperature rise in 20 hours. Since this calculation assumes that no heat is lost by radiation or by forced or natural convection, the power rating thus calculated should be increased by a few kilowatts to compensate for heat losses.

3.6.1.4 Circulating currents. After removal of as much moisture as possible by external heating, circulate current throughout the windings from an external, low voltage, direct current source. Current shall not be circulated through any winding that has an insulation resistance of less than 50 kilohms at room temperature. Temporary sources (e.g., arc welder sets) shall be provided with means for adjusting the voltage to limit the current through the windings. Current shall not be conducted into armatures through brushes resting on a stationary commutator. To prevent localized heating of the commutator, the armature shall be rotated continuously by a temporary external prime mover (e.g., air motor) if it is necessary to dry by means of circulating current. If authorized by the work item, an installed prime mover (e.g., engine or turning gear) may be used to spin the armature. If not grease lubricated, circulate lube oil to all affected bearings while the armature is turning.

3.6.1.5 When drying by circulating current, the temperature must be increased slowly. Embedded temperature detectors or thermometers on the outside of the insulation will not indicate the hottest spot or copper temperatures. Temperatures measured by embedded detectors or by the hot resistance method (see paragraph 3.4.1.3.3 below) shall not exceed 195°F. Temperatures measured by thermometers shall not exceed 170°F.

3.6.1.6 Winding hot resistance temperature is determined by comparison of the hot winding resistance with the cold winding resistance measured in paragraph 3.2.3.6 above. A high accuracy instrument, such as a Kelvin bridge shall be used. In the application of this method, accuracy is essential in the measurement of all resistance. The following formula shall be used to compute the temperature of copper conductors by the resistance method:

$$T_h = \frac{R_h}{R_c}(234.5 + T_c) - 234.5$$

where R_h is the hot insulation resistance
R_c is the cold insulation resistance
T_h is the hot winding temperature (°C)
T_c is the cold winding temperature (°C)

3.6.2 Insulation treatment. After the equipment has been fully cleaned and dried, touch up thin and bare spots on the cleaned machine with an air drying varnish or insulating enamel as follows:

3.6.2.1 Protection. Protect adjacent equipment in the affected compartment from overspray. Ensure that temporary ventilation is adequate to maintain a safe working environment within the space.

> **NOTE**
>
> **Aerosol spray cans of air dry varnish and insulating enamel are available and may be useful for small jobs where utilizing a spray gun is not cost effective. The propellant is a petroleum distillate so appropriate health and fire safety precautions shall be taken.**

3.6.2.2 Application. Apply a clear, air-drying varnish (grade CA) that conforms to MIL-I-24092 to the armature and field windings. Insulating enamel that conforms to MIL-E-22118 may be used for other insulated surfaces. Insulate to seal cracks, fill voids, and touch up damaged spots with one or two thin coats. Two coats are usually adequate for satisfactory protection. In no case should more than three coats be applied. Films shall normally be sprayed on surfaces to be insulated; however, the application of air-drying films by brushing is acceptable.

3.6.2.3 Drying. The drying time to be allowed for each of the coats depends to a large extent upon the atmospheric conditions. The first coat of a two-coat application shall be allowed to dry until tack-free, but not more than 24 hours. The final coat shall be allowed to dry at least twice the time required for the material to reach a tack-free condition. Accelerated drying is permitted but in no case shall the temperature of the work be allowed to exceed 158° F.

3.6.2.4 Post-cleaning insulation resistance. Measure and record the insulation resistances (see section 3.2.3.4 above) of the windings listed in Table 3 below. The final machine winding insulation resistances after the varnish cures, adjusted to 25°C, shall not be less than the values in Table 3 below or those measured during the pre-cleaning test, whichever is greater.

TABLE 3 – MINIMUM POST-VARNISHING WINDING INSULATION RESISTANCES

	Minimum Insulation Resistance (MΩ) for Machine of Rated Voltage (VDC)		
	Main Propulsion		**Auxiliary**
Windings	**500**	**900**	**500**
Complete armature circuit	12	22	2.0
Armature alone	20	34	4.0
Armature circuit less armature	20	34	4.0
Complete field circuit	45	78	5.0

3.6.3 Final insulation resistance polarization index test. Upon completion of cleaning and varnish treatment, repeat the insulation resistance PI tests, as specified in section 3.2.3.4 above.

3.7 Reassembly. Reassemble the machine after all tests and inspections have been accepted by the Coast Guard Inspector.

3.7.1 Alignment. If the armature was uncoupled in paragraph 3.2.3.9 above, reinstall the armature and brush rigging assembly. Measure and record air gaps in accordance with section 3.2.2 above.

3.7.2 Brush holders. If removed, reinstall and align the brush rigging insulators, brush holders, and brush holder springs to the factory brush position setting. If such setting is unknown, locate the electrical neutral and adjust brush positions to minimize sparking using the kick or AC Reeder method (see Appendix

A.3.2.3 of SFLC Std Spec 2351). Set all brush holders the same distance from the commutator. In the absence of specific manufacturer instructions, the brush boxes should be adjusted to be 0.080 to 0.10 inch from the commutator. Align all brush holders such that the toes of all brushes on each brush stud line up with each other and with the edge of one commutator segment. Space brush holders evenly around the commutator circumference and stagger axially per the manufacturer's recommendations.

3.7.3 Shaft coupling. Reconnect the shaft coupling. Measure and record shaft coupling angular and parallel alignment readings. Adjust as necessary to within the manufacturer's recommended angular and parallel alignment tolerances. If no manufacturer's data is available, angular misalignment shall not exceed 0.005 inch and parallel misalignment shall be no greater than 0.002 inch.

3.7.4 Brush installation. Install retained or replacement brushes into the brush holders. After the brushes have been installed, check and ensure the following:

- Brushes are free to move in the brush holder without sticking.
- Brush tension is adjusted in accordance with manufacturer's recommendations. If no data is available, adjust brush tension to achieve a pressure of 2½ pounds per square inch of brush cross sectional area.
- The shunt terminals are firmly attached to the brush holders.

3.7.5 Access covers reinstallation. Reinstall the cleaned machine access covers and any other removed equipment. Reuse retained fasteners.

3.7.6 Space heater. Energize the machine space heating system to exclude moisture whenever the unit is not in operation.

3.8 Commutator film restoration. For main propulsion machinery, season the commutator by operating sequentially at the power levels shown in Table 4 below during dock and/or sea trials. Every 15 minutes, record all machine parameters (e.g., voltage, current, rotational speed, winding temperature) shown on the cutter's full power trial maintenance procedure card.

3.8.1 Dock trial. A dock trial shall be performed to verify that the main propulsion or auxiliary machinery affected by this item is operating satisfactorily and to reestablish the commutator carbon film. Limit propeller rotational speed to prevent the ship from pulling away from its mooring. Take appropriate precautions on the cutter and nearby ships to prevent fouling of seawater piping systems when bottom sediment may be stirred up by the propeller.

3.8.2 Sea trial. A sea trial shall be performed to complete the restoration of the commutator film and verify that the main propulsion machinery is operating correctly at all speeds and directions. After commutator seasoning is complete, perform a full power trial in accordance with the cutter's maintenance procedure card. Other tests may proceed concurrently as conditions allow.

TABLE 4 – MAIN PROPULSION GENERATOR AND MOTOR OPERATING PARAMETERS

POWER	DURATION
25%	2 HOURS
35%	1 HOUR
45%	1 HOUR
55%	1 HOUR
65%	1 HOUR
75%	1 HOUR

85%	1 HOUR
95%	1 HOUR
100%	4 HOURS

3.9 Final insulation resistance. Immediately after docking, measure and record the insulation resistance of the complete field and armature circuits (see paragraph 3.2.3.3 above).

3.10 Post sea trial inspection. After the sea trial, visually inspect the machine internals for evidence of overheating, loose fasteners, commutator problems, broken brushes, and other conditions recommended by the tech rep.

3.11 Polarization index test. Polarization index (PI) is the ratio of the 10-minute insulation resistance value to the 1-minute insulation resistance value. The change in insulation resistance with the duration of the test potential application is useful in appraising the cleanliness and dryness of a winding. Insulation resistance of a winding will normally increase with the duration of the test voltage. The measured insulation resistance of a dry winding in good condition will reach a fairly steady value in 10 to 15 minutes. If the winding is wet or dirty, the steady value will usually be reached in 1 or 2 minutes. The slope of the curve (typical winding shown in Figure 2 below) is an indication of insulation condition.

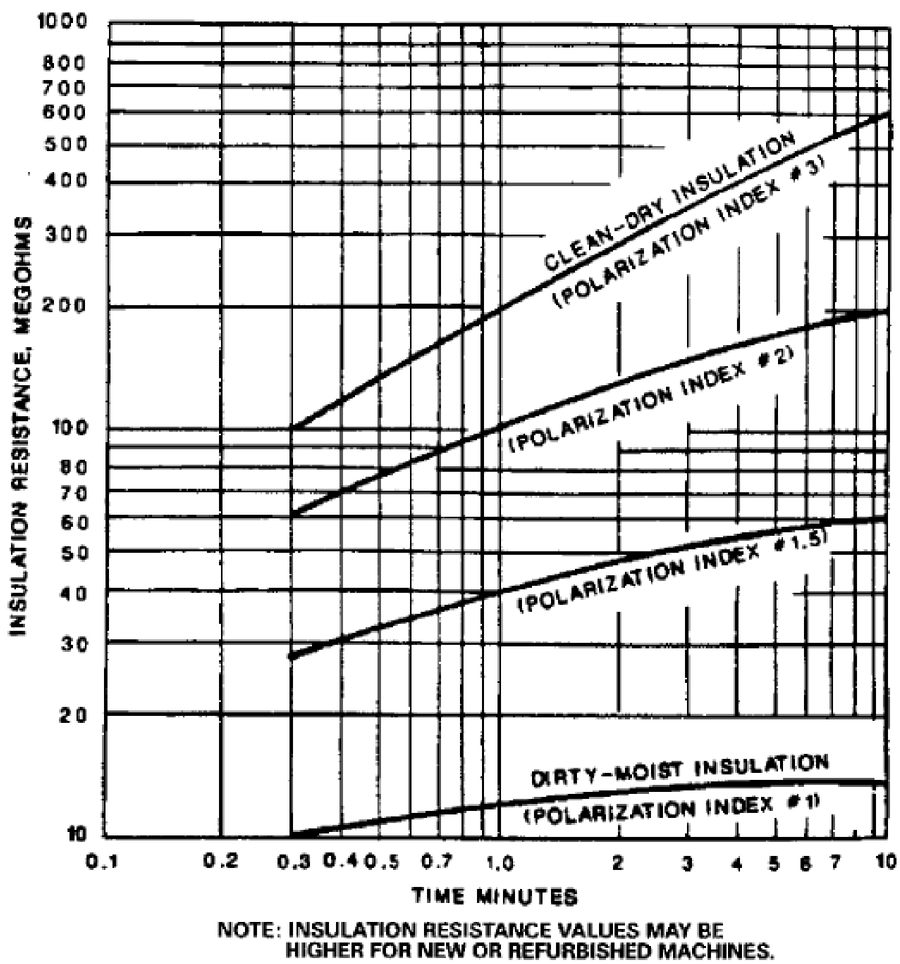

FIGURE 2 – VARIATIONS IN INSULATION RESISTANCE WITH TIME FOR A TYPICAL WINDING

3.12 Machinery operation. Ship's force will operate all machinery during the sea trials and operational tests.

3.13 Sources of supply:

- Air drying varnish: Dolph AC-41, ER-41, or AC-43

  John C. Dolph Company (www.johncdolph.com)
  320 New Road, P.O. Box 267
  Monmouth Junction, NJ 08852
  (732) 329-2333

- Air drying insulating enamel: Glyptal 1201 or 1201A

  Glyptal, Inc. (www.glyptal.com)
  305 Eastern Avenue
  Chelsea, MA 02150
  (800) 457-1201

DATA SHEET 1 – AIR GAP READINGS

VESSEL NAME: ______________________ HULL#:_______________	MPG/MPM/OW No. ___; BT/ST/TCW Serial No. _______________________

POLE NO.	MAIN POLE				INTERPOLE			
	FORE		AFT		FORE		AFT	
	*A	**B	*A	**B	*A	**B	*A	**B
1								
2								
3								
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***Column A is for recording of preliminary air gap clearances.**
****Column B is for recording of post-installation air gap clearances.**

	NAME (Type/Print)	SIGNATURE	DATE
Contractor			
Test conductor			
USCG Inspector			
Ambient conditions:			