OVERHAUL AC ELECTRICAL MOTORS

1. SCOPE

1.1 Intent. This standard specification describes the requirements for the Contractor to overhaul (ashore in a suitable repair facility) an alternating current (AC) induction or synchronous motor removed from a Coast Guard vessel.

1.2 Appendices. The following appendices are part of this standard specification:

PROCESS STANDARD	APPENDIX
Remove and Reinstall AC Motor Aboard Vessel	A
Recondition AC Motor	B
Rewind AC Motor	C
Miscellaneous AC Motor Repairs	D

2. REFERENCES

COAST GUARD DRAWINGS

None.

COAST GUARD PUBLICATIONS

Surface Forces Logistics Center Standard Specification (SFLC Std Spec) 3041, Jan 2009, Shipboard Electric Cable Test

Surface Forces Logistics Center Standard Specification (SFLC Std Spec) 3042, Jan 2009, Shipboard Electrical Cable Removal, Relocation, Splice, Repair, and Installation

OTHER REFERENCES

American National Standards Institute (ANSI/EASA) AR100, 2006, Recommended Practice for the Repair of Rotating Electrical Apparatus

American National Standards Institute (ANSI) S2.19, 1999 (R2004), Mechanical Vibration - Balance Quality Requirements of Rigid Rotors - Part 1: Determination of Permissible Residual Unbalance

Institute of Electrical and Electronics Engineers (IEEE) Std 841, 2009, Premium Efficiency Severe Duty Totally Enclosed Fan-Cooled (Tefc) Squirrel Cage Induction Motors

International Electrotechnical Commission (IEC) 60072-1, Feb 1991, Dimensions and Output Series for Rotating Electrical Machines - Part 1: Frame Numbers 56 to 400 and Flange Numbers 55 to 1080

MIL-D-16791, Jan 1993, Detergents, General Purpose (Liquid Nonionic)

MIL-I-24092/2, Sep 1993, Insulating Varnish, Solvent Containing, Baking, Flexible, for Dip Processing, Grade CB, Class 130 to 180 Thermal Class

MIL-I-24092/5, Sep 1993, Insulating Resin, Solventless, Baking, Flexible, for Dip Processing, Grade SF, Class 130 to 180 Thermal Class

MIL-I-24718/3, Apr 1990, Insulating Resins, Solventless, Vacuum-Pressure-Impregnating Polyester Diallyl Phthalate, Slightly Thixotropic

National Electrical Manufacturers Association (NEMA) MG1, 2006, Motors and Generators

Underwriters Laboratories Inc. (UL) 1446, Feb 2007, Standard for Safety Systems of Insulating Materials – General

U.S. Department of Energy (DOE/GO) 10099-935, Nov 1999, Model Repair Specifications for Low Voltage Induction Motors

3. REQUIREMENTS

3.1 General.

3.1.1 Inspection, test notification, and documentation. Abide by the following requirements for all inspections and tests specified herein.

3.1.1.1 Advance notice. The Coast Guard Inspector shall be present to witness the performance of all inspections and tests performed under this specification. Notify the Coast Guard Inspector at least 24 hours before performing each inspection and test.

3.1.1.2 Documentation. Submit a CFR after completion of each inspection and test.

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

3.1.3 Materials. New material used or installed during work on the motor shall be equal or superior to the material used by the original manufacturer.

3.1.4 Motor overhaul technician. Motor inspection and shop work shall be performed by a firm 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.

3.1.5 Silicone. 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 a motor with slip rings. Mechanics using protective hand creams containing conductive or silicone materials shall not handle internal motor parts. Even small amounts of silicone materials will cause greatly increased brush wear.

3.2 Removal from vessel. When stated in the work item, or if a Change Request has been released and authorized by the KO, remove the designated motor from the vessel per Section A2.1 of Appendix A and ship to a suitable repair facility.

3.3 Initial inspection. Prior to performing the shop work specified by the work item, the motor repair facility shall accomplish the following:

3.3.1 Access cover removal. Remove, clean, and retain all motor access covers and fasteners.

3.3.2 Disassembly and inspections. Unpack the motor assembly removed from the vessel. Disassemble the motor and remove the rotor. For close-coupled units, service the driven load in accordance with the work item. Accomplish the following motor inspections:

3.3.2.1 Visual inspections. Perform a visual inspection of the motor components for the presence of contamination by dust, dirt, moisture, oil, and other foreign matter. Attempt to determine the origin, such as leaking seals, or any unusual conditions prior to the start of cleaning. Note all abnormal conditions on the stator, rotor, windings, and risers, and if installed, collector rings, brush holders, brushes, and brush holder springs. Carefully examine the interior of the motor for loose objects such as, nuts and bolts; 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. Identify any mechanical deficiencies, including non-conformance with Section 2 of ANSI/EASA AR100. Inspect insulation condition in accordance with Section 4.2.1 of ANSI/EASA AR100. Record all findings, including the types of contaminants (oil, water, carbon, dirt, etc.) found.

3.3.2.2 Brush removal. If installed, remove and inspect all brushes, brush rigging insulators, brush holders, and brush holder springs. Dispose of the removed brushes. Clean and retain the remaining components.

3.3.2.3 Collector ring wear and concentricity. For a motor with slip rings, measure and record the collector ring wear and concentricity. Note any corrosion or abnormal wear patterns. Also record the manufacturer's acceptable collector ring runout. Note locations (relative to a reference point) on the collector ring where runout is excessive.

3.3.2.4 Accessories. Inspect any motor accessories, such as temperature sensor, capacitor, tachometer, electromagnetic brake, or space heater, and the associated internal wiring. Test accessory operation and submit a CFR with recommendations for repair or renewal.

3.3.3 Initial insulation resistance tests. Assess insulation system conditions in accordance with Section 4.2 of ANSI/EASA AR100. At a minimum, the following shall be performed:

3.3.3.1 Insulation resistance test. Measure and record the insulation resistance of stator and rotor windings per Section 4.2.2 of ANSI/EASA AR100.

3.3.3.2 Insulation resistance polarization index (PI) test. Measure and record stator and rotor winding PI test data per Section 4.2.3 of ANSI/EASA AR100.

3.3.3.3 Bearing insulation resistance test. Measure and record bearing insulation resistance per Section 4.2.9 of ANSI/EASA AR100.

3.3.4 Initial winding tests. Assess winding conditions in accordance with Section 4.3 of ANSI/EASA AR100.

3.4 Shop work. Perform the following work at the motor repair facility:

3.4.1 Cleaning and reconditioning. When stated in the work item, or if a Change Request has been released and authorized by the KO, clean and recondition the designated motor per Appendix B.

3.4.2 Rewinding. When stated in the work item, or if a Change Request has been released and authorized by the KO, rewind the designated motor per Appendix C.

3.4.3 Bearings. Renew all bearings in accordance with Section 2.2 of ANSI/EASA AR100 and Section 2.11 of DOE/GO 10099-935. Renew bearing insulation if resistance measured in paragraph 3.3.3.3 above is less than 10 megohms.

3.4.4 Miscellaneous repairs. When stated in the work item, or if a Change Request has been released and authorized by the KO, repair the designated motor per the applicable paragraph of Appendix D shown in Table 1 below.

TABLE 1 – MISCELLANEOUS REPAIRS MATRIX

Repair	Appendix D
Shafting	¶ D2.
Slip rings	¶ D2.2
Frame and bearing housings	¶ D2.3
Fan	¶ D2.4
Temperature sensors	¶ D2.5
Leads	¶ D2.6
Space heater	¶ D2.7
Capacitor	¶ D2.8

3.4.5 Balancing. Dynamically balance the rotor assembly per the manufacturer's specifications and the following:

3.4.5.1 For a close-coupled unit, reconnect the driven load. For an externally coupled motor, install a half key in the keyway.

3.4.5.2 In the absence of manufacturer's balancing specifications, balance per ANSI S2.19 to quality grade G as follows:

3.4.5.2.1 Rotors with 4 or more poles shall meet Tolerance G2.5.

3.4.5.2.2 Two pole rotors shall meet Tolerance G1.0.

3.4.6 Reassembly. Reassemble the motor and reinstall all motor access covers and fasteners, except those at the terminal box.

3.4.6.1 Renew all disturbed seals and gaskets.

3.4.6.2 Clean bearing grease passages and lubricate in accordance with Section 2.3 of ANSI/EASA AR100.

3.4.6.3 If equipped with slip rings, reinstall the brush rigging and renew the brushes with the same size, type, and hardness as originally installed. Adjust the brush rigging and seat each brush to fit the slip ring curvature per Sections 2.9 and 2.10 of ANSI/EASA AR100.

3.5 Shop Acceptance Testing. Perform the following shop acceptance tests:

3.5.1 Final shop insulation resistance tests. Assess insulation system conditions in accordance with Section 4.2 of ANSI/EASA AR100. At a minimum, the following shall be performed:

3.5.1.1 Insulation resistance test. Measure and record the insulation resistance of stator and rotor windings per Section 4.2.2 of ANSI/EASA AR100.

3.5.1.2 Insulation resistance polarization index (PI) test. Measure and record stator and rotor winding PI test data per Section 4.2.3 of ANSI/EASA AR100.

3.5.1.3 Bearing insulation resistance test. Measure and record bearing insulation resistance per Section 4.2.9 of ANSI/EASA AR100.

3.5.2 Winding tests. Assess winding conditions in accordance with Section 4.3 of ANSI/EASA AR100.

3.5.3 High potential tests. Perform high potential tests in accordance with Section 4.4 of ANSI/EASA AR100.

3.5.4 Accessory tests. Test accessories in accordance with Section 4.4.2 of ANSI/EASA AR100.

3.5.5 No load tests. For an uncoupled motor or close-coupled assemby that can be run dry, perform no load tests in accordance with Section 4.5 of ANSI/EASA AR100.

3.6 Final assembly. Complete the remaining tasks in Section 1 of ANSI/EASA AR100. Reinstall the terminal box cover plate with new gasket.

3.7 Packaging. Package the motor assembly for transport back to the vessel. If the motor will not be promptly reinstalled, store the packing crate in a climate-controlled environment or pack the container with desiccant and shrink-wrap it with heavy plastic film.

3.8 Reinstallation aboard vessel. When stated in the work item, or if a Change Request has been released and authorized by the KO, transport the designated motor to the vessel, reinstall per Section A2.2 of Appendix A, and test per Section A2.3 of Appendix A.

4. NOTES

4.1 Repair vs. renewal. For standard (NEMA MG 1) motors of 5 HP and lower rating, renewal is typically more time and cost effective than overhaul. If the motor is non-standard or has custom features, repair may be the only practical option.

4.2 Motor renewal. When renewing a motor, it is not always possible to find an exact match with the existing unit. In other cases, long lead times, durability concerns, or legal requirements may also force a change. Consider the following factors when considering motor renewal:

4.2.1 Service Factor. Service factor is the ability of a motor to maintain rated speed under overload conditions. Most new motors have a service factor of 1.15, which means that they can operate satisfactorily at 115% of rated torque without exceeding any temperature limits. For motors that operate for long periods of time, particularly in spaces with hot ambient temperatures, or which are coupled to loads with high starting torque, such as pumps and compressors, avoid units with a service factor of only 1.0. If the motor service factor is reduced, the motor controller overloads may also need to be replaced (fixed heater element) or reset (electronic type).

4.2.2 Environmental. Motors that are exposed to moisture, oil vapor, and other airborne contaminants should be designed for such application. The following substitutions are not permitted without engineering oversight:

- Dripproof with open type having no ventilation restrictions
- Splash-proof with any other open type
- Totally enclosed with any open type (e.g., splash-proof, dripproof)
- Explosion-proof with any other type

4.2.2.1 Severe duty. For longer service life, severe duty motors designed for dirty mill and chemical industry duty per IEEE 841 perform much better in spaces that are cold, damp, or ventilated with salt entrained air. These are totally enclosed, fan cooled (TEFC) designs with corrosion resistant coatings.

4.2.2.2 Washdown duty. For less arduous environmental conditions, open dripproof or washdown duty designs with sealed insulation systems are appropriate.

4.2.2.3 Inverter duty. In some applications (e.g., ventilation fans, cooling pumps, winches), motors may be connected to variable frequency drives (VFD) to allow operation over a large speed range. At low speed and high torque, the fan attached to a standard duty motor shaft may not rotate fast enough to provide adequate cooling airflow. The output waveform of the VFD electronics contains high voltage pulses that can result in the premature insulation failure of standard duty motors. Inverter duty motors should be used in VFD applications, particularly if the existing motor may have failed due to thermal degradation or insulation breakdown.

4.2.3 Insulation system. New motors should generally be wound with UL 1446 temperature class F (155ºC) or H (180ºC) insulation systems. Class A (105ºC) and B (130ºC) insulation systems should be avoided. Class N (200ºC), R (220ºC), and S (240ºC) are also acceptable, but rarely used, typically only in very hot environments. Class F or H insulation with a class B temperature rise is satisfactory for most uses, including many VFD applications with low torque requirements during low speed operation. A vacuum pressure impregnated (VPI) solventless epoxy insulating system is recommended for 460-volt three phase integral horsepower motors in most shipboard applications.

4.2.4 Rotational speed. For induction motors, the slip factor, line frequency, and number of poles determine the rotational speed. In most applications, a slight difference in rated speed (due to slip factor) between the existing and replacement motor is immaterial. Motors should be rated for 50/60 or 60 Hz operation.

4.2.5 Terminal voltage. Three phase motor terminal voltages of 440 to 480 volts are satisfactory for use on 450-volt electrical distribution systems. The use of 230 volt motors in 208-volt applications or vice versa requires engineering evaluation. Single phase motor terminal voltages of 110 to 130 are satisfactory for use on nominal 115 volt power.

4.2.6 Materials. Most integral horsepower motors have cast iron frames. Stainless steel, although more costly, is also acceptable. Type 316L is more corrosion resistant to sea salt than type 304. Fractional horsepower and other low cost motors frequently have rolled steel frames. Unless the existing motor frame is of the same material, aluminum alloy is generally not recommended because of possible galvanic corrosion problems where the aluminum is in contact with steel structure.

4.2.7 Coatings. Most motor housings are coated with baked enamel. More costly products are epoxy or powder coated. The standard topcoat color is gray, except for fire pump motors, which are red.

4.2.8 Dimensions. Motors constructed per NEMA MG 1 have the same critical mounting and coupling dimensions, regardless of manufacturer. Special order motors may have customized features, particularly with respect to mounting or shafting. Non-standard mountings typically have a suffix Y in the frame designator. Shaft length variations, diameter deviations, double ended shafting, or keyway modifications are common deviations from the standard and are usually denoted by a suffix Z in the frame designator. Motors supplied with equipment of European or Asian manufacture may be of IEC 60072 design with metric dimensions.

4.2.9 Bearings. Most motors are designed for horizontal mounting with little or no axial thrust from the load. Premium motors are available with oversized bearings for improved service life and low vibration, typically with expected operating lifetimes in excess of 50,000 hours (belt driven) or 130,000 hours (direct drive). Motors for vertical applications or high thrust must be specially designed for such service.

4.2.10 Winding configuration. Most three phase induction motors have wye-connected windings. In most applications, a delta wound induction motor with the same performance characteristics is also acceptable. Dual voltage motors (e.g., 230/460 or 120/240) are interchangeable with single voltage (e.g., 460 or 240) designs having the same performance characteristics. The winding configuration (wye or delta) and the number of leads should not be changed without engineering oversight for any of the following:

- Motors with wye-delta starters
- Multi-speed motors with reconfigurable leads
- Motors with slip rings (synchronous or wound rotor)

4.2.11 Premium efficiency. The National Energy Policy Act of 2005 and Federal Acquisition Regulations (FAR) Subpart 23.2 require that all motors (1 to 500 HP rating) purchased as part of a Federal acquisition meet Department of Energy premium efficiency standards. For motors that run infrequently, standard efficiency designs may still be purchased if the projected energy savings does not exceed the added cost of a premium efficiency motor. Justification for such a purchase must be documented through a life cycle engineering analysis and retained with the purchase requisition records. See http://www1.eere.energy.gov/femp/procurement/eep_emotors.html#cost for more details.

APPENDIX A

REMOVE AND REINSTALL AC MOTOR ABOARD VESSEL

A1. SCOPE

A1.1 Intent. This appendix describes the requirements for removing and reinstalling an alternating current (AC) motor aboard a vessel. As directed by the work item, the removed motor may be sent to a suitable repair facility for overhaul or replaced by a new motor.

A2. REQUIREMENTS

A2.1 Removal from vessel. Perform the following to remove the motor from the vessel:

A2.1.1 For a medium voltage (greater than 1000 volts) motor, the isolating circuit breaker or disconnect switch shall be padlocked open in addition to being danger tagged. Ensure that power to accessories such as space heaters is also secured.

A2.1.2 Disconnect the motor stator power cable, rotor power cable (if slip rings are installed), and any accessory (e.g., temperature sensor, capacitor, tachometer, electromagnetic brake, space heater) wiring in accordance with SFLC Std Spec 3042.

A2.1.3 Remove the motor to be overhauled from the vessel, retaining all shims, fasteners, and other hardware for reinstallation:

A2.1.4 For an externally coupled unit (e.g., motor and pump), match mark the coupling prior to disassembly. Record angular and parallel misalignment data. Inspect the coupling, shaft, and key for damage.

A2.1.5 For a close-coupled unit (e.g., vaneaxial fan), remove the entire assembly.

A2.1.6 As directed by the work item, perform the following on each designated component or assembly:

A2.1.6.1 Package for transport to a suitable motor repair facility.

A2.1.6.2 Scrap items that will not be reinstalled.

A2.1.6.3 Retain items for future reinstallation and store in a protected location.

A2.1.7 Clean, inspect, and paint the vacated foundation while the motor is not installed.

A2.2 Reinstallation aboard the vessel. Remove the motor assembly from any packaging and reinstall on its foundation using shims, fasteners, and other hardware retained in paragraph A2.1 above.

A2.2.1 For externally coupled loads, remake the coupling and realign the motor with the load. Measure angular and parallel misalignment, adjusting, as necessary, to within manufacturer's tolerances. If such tolerances are unknown, the final misalignment shall be no worse than that measured prior to disassembly in paragraph A2.1.4 above.

A2.2.2 Reconnect cable(s) in accordance with SFLC Std Spec 3042 using retained hook-up data.

A2.3 Final acceptance testing. Perform the following final acceptance tests:

A2.3.1 Measure and record the insulation resistance of the motor and the reconnected stator power cable circuit to ground in accordance with SFLC Std Spec 3041. If equipped with slip rings or accessories, also measure and record the insulation resistance of these reconnected circuits to ground if the applied test voltage will not damage them.

A2.3.2 Operational test. Ship's force will operate all machinery during operational tests. Prior to testing, remove locks that were installed in paragraph A2.1.1 above.

NOTE

In order to run the motor during the next tests, the associated mechanical systems may need to be refilled and vented prior to operation. Ensure that valve or damper lineup supports motor operation before commencing electrical tests. In ventilation systems, dust-producing evolutions may need to be stopped so that temporary protective duct covers can be temporarily removed and the required filters installed. Such industrial debris protection should be reinstalled upon completion of testing.

A2.3.2.1 For a three-phase motor, perform a direction of rotation test in each speed. Start the motor directly in the speed being tested and secure it by going directly to OFF or opening its circuit breaker. Correct any reverse rotation problems.

NOTE

Coordinate motor operational testing with mechanical system retests. To prevent over-pressurization or collapse of tanks used during testing, ensure that their vents are not blocked prior to commencing fluid transfers. Inspect disturbed mechanical joints, including manway covers, in fluid systems for leakage as the system is pressurized for the first time. Frequently sound tanks during fluid transfers and continuously monitor liquid level indicators. Periodically correlate level changes in source and receiving tanks to ensure that boundary valve seat leakage or valve misalignment are not resulting in the inadvertent filling or draining of other tanks.

A2.3.2.2 Perform an operational test of a new or overhauled motor for no less than one hour in each speed. For an intermittent duty motor, the test shall not exceed the duty cycle rating. The Contractor may propose a shorter test period to the COTR for a motor used on a transfer pump, winch, capstan, hoist, or elevator where extended operation is impracticable. Correct any excessive vibration, unusual noise, or overheating conditions. Verify that all motor accessories (e.g., temperature sensor, capacitor, tachometer, electromagnetic brake, space heater) are operating properly.

A3. NOTES

A3.1 For instances where the Contractor is not tasked with removal or reinstallation of the motor, Ship's Force should perform the related steps of this Appendix instead.

APPENDIX B

RECONDITION AC MOTOR

B1. SCOPE

B1.1 Intent. This appendix describes the requirements for reconditioning alternating current (AC) motor windings at a suitable repair facility.

B2. REQUIREMENTS

B2.1 Cleaning. Clean the rotor and stator windings as follows:

B2.1.1 Cleaning solution. All cleaning solutions shall be water based. Dry ice, citrus terpenes, or other waterless organic solvents shall not be used. Prepare one of the following solutions for cleaning:

- 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.
- Steam cleaner, typically in the proportions of 15 to 20 pounds of steam cleaning compound and 1 quart of butyl alcohol to 1,000-gallons of water.

B2.1.2 Cleaning method. Clean the coils, windings, and structural members until all carbon dust, oil, grease, and foreign deposits are removed. Cleaning and rinse solution temperature shall be no less than 140°F and shall not exceed 194°F. Use clean lint-free cloths to check for cleaning effectiveness.

B2.1.2.1 For tank cleaning, place the rotor in the solution with its axis vertical and the slip ring end up. Hold the solution at a constant temperature of 88°C (190°F) and circulate it through the windings with an air agitator or other means.

B2.1.2.2 For steam cleaning or pressure washer applications, ensure that all surfaces are thoroughly wetted. Set the sprayer controls to avoid damaging the insulation by limiting winding impingement pressure to 30 psig. Avoid striking varnished surfaces with the cleaning nozzle or wand.

B2.1.3 Rinse. 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 work day shall include all machine internals to ensure that any overspray is completely removed from all surfaces. Wipe off accessible wetted surfaces and blow dry or wet vacuum any remaining surface water.

B2.1.4 Drying. Immediately after cleaning, rinsing and hand drying, bake the windings in an oven until completely dry. Do not allow winding temperature to exceed 230ºF and maintain oven temperature below 300ºF. Take insulation resistance readings per Section 4.2.2 of ANSI/EASA AR100 when the drying is started and at regular intervals thereafter. Plot the data on semi-logarithmic paper with the logarithm of temperature corrected insulation resistance as ordinate and time as abscissa. Continue drying until either:

- The temperature corrected insulation resistance readings show no abrupt changes and do not increase more than 5% over a 12-hour period.
- The polarization index is greater than 3.0.

B2.2 As recommended by Section 2.8.1 of DOE/GO 10099-935, a shop cleaned and dried motor should have an insulation resistance of at least 20 megohms, temperature corrected to 40ºC, in order to proceed with insulation treatment. If insulation resistance is less than 20 megohms after two clean and dry cycles, submit a CFR. If a Change Request is released and authorized by the KO as a result of this CFR, discontinue further work under this appendix and rewind the motor per Appendix C.

B2.3 Insulation treatment. Upon satisfactory completion of cleaning, drying, and any other authorized repairs, accomplish insulation treatment of the rotor and stator windings per Section 3.4 of ANSI/EASA AR100 using one of the methods below, except that a motor constructed with a sealed insulation system shall only be vacuum pressure impregnated (VPI). The work item may further restrict the choice of materials or methods. The temperature class of the applied treatment shall be no less than that of the existing insulation system.

B2.3.1 Solvent-varnish dip and bake. Varnish shall be of Grade CB per MIL-I-24092/2 when required by the work item; an industrial electrical grade polyester solvent-varnish compatible with the original varnish may be used otherwise.

B2.3.2 Solventless resin dip and bake. Resin shall be of Grade SF per MIL-I-24092/5 when required by the work item; an industrial electrical grade solventless resin compatible with the original varnish may be used otherwise.

B2.3.3 Vacuum-pressure impregnation. Resin shall meet MIL-I-24718/3 when required by the work item; an industrial electrical grade resin compatible with the original insulation may be used otherwise.

B2.4 Cure the treated windings in accordance with the varnish manufacturer's recommendations.

B3. NOTES

B3.1 Solventless varnish. In recent years epoxy-type 100% solid (solventless) varnishes have been used in geographical areas that regulate industrial facility volatile organic air emissions. Such treatment may be applied by the traditional dipping and baking approach or by the VPI method.

B3.2 Vacuum-pressure impregnation. A VPI resin may be successfully applied over windings that were previously varnish dipped and baked. Many motor repair shops now have automated VPI equipment, reducing the cost of such treatment to near that of the traditional dip and bake method. Unless the cost is significantly greater, the windings of a motor constantly exposed to moist salt air (e.g., vaneaxial ventilation supply fans) should be reconditioned using the VPI method.

APPENDIX C

REWIND AC MOTOR

C1. SCOPE

C1.1 Intent. This appendix describes the requirements for rewinding an alternating current (AC) motor at a suitable repair facility.

C2. REQUIREMENTS

C2.1 Core loss test. If not previously accomplished in Section 3.3.3 above, perform an interlaminar insulation resistance test in accordance with Section 4.2.8 of ANSI/EASA AR100 and Section 2.5.3 of DOE/GO 10099-935.

C2.2 Rewinding. Strip, clean, test, and rewind the motor per Section 3 of ANSI/EASA AR100, observing the following:

C2.2.1 Burn out. Strip the old windings in accordance with Section 3.3 of ANSI/EASA AR100 and Section 2.5.4 of DOE/GO 10099-935.

C2.2.2 Cleaning. Clean and dry each core in accordance with Section 2.6.1 of DOE/GO 10099-935.

C2.2.3 Core inspection. Reperform the test of paragraph C2.1 above on the bare core. If results are unsatisfactory or there is visual evidence of damage, submit a CFR with the recommended repair course of action. Reperform the core loss test after any iron restacking or interlaminar insulation repairs.

C2.2.4 Core preparation. Prepare the bare core for winding, touching up the interlaminar insulation, varnishing the iron, and installing ground wall insulation, as necessary, to restore motor to a like new condition.

C2.2.5 Windings. Wind coils in accordance with Sections 3.6 through 3.12 of ANSI/EASA AR100 and Sections 2.7.1 through 2.7.7 of DOE/GO 10099-935.

C2.2.6 Banding. Apply banding in accordance with Section 3.13 of ANSI/EASA AR100. Use the same type of wire or glass banding that was installed by the original manufacturer. Do not substitute one for the other, nor replace magnetic banding wire with non-magnetic or vice versa.

C2.2.7 Quality assurance. Visually inspect and test the windings per Section 2.7.8 of DOE/GO 10099-935 prior to impregnation to ensure that there are no improper connections or shorted turns.

C2.3 Vacuum-pressure impregnation. Upon satisfactory completion of rewinding and any other authorized repairs, accomplish insulation treatment of the rotor and stator windings per Section 3.4 of ANSI/EASA AR100 using the vacuum pressure impregnation (VPI) method. The temperature class of the applied treatment shall be Class F or better and no less than that originally applied by the motor manufacturer. Resin shall meet MIL-I-24718/3 when required by the work item; an industrial electrical grade resin may be used otherwise. Cure the treated windings in accordance with the varnish manufacturer's recommendations.

C3. NOTES

C3.1 Vacuum-pressure impregnation. Many motor repair shops now have automated VPI equipment, reducing the cost of such treatment to near that of the traditional dip and bake method. Unless the cost is significantly greater, a shipboard motor, particularly one frequently exposed to moist salt air (e.g., vaneaxial ventilation supply fans), should be rewound with a sealed insulation system using the VPI method.

APPENDIX D

MISCELLANEOUS AC MOTOR REPAIRS

D1. SCOPE

D1.1 Intent. This appendix describes the requirements for miscellaneous repairs to an alternating current (AC) motor.

D2. REQUIREMENTS

D2.1 Shafting. Correct motor shafting deficiencies in accordance with Section 2.1 of ANSI/EASA AR100 and Section 2.10 of DOE/GO 10099-935. Renew cracked or bent shafts; do not attempt weld repair or straightening unless specifically authorized by the work item or Change Request.

D2.2 Slip rings. True and resurface the collector rings in accordance with Section 2.7 of ANSI/EASA AR100 and Section 2.10 of DOE/GO 10099-935. If insufficient material remains to accomplish such work without reducing the collector ring diameter below the manufacturer's minimum allowable, submit a CFR and do not proceed without COTR concurrence.

D2.3 Frame and bearing housings. Repair the frame and bearing housings in accordance with Section 2.4 of ANSI/EASA AR100 and Section 2.12 of DOE/GO 10099-935.

D2.4 Fan. Renew cracked, bent, unbalanced, or physically damaged fans, including those with excessive corrosion, hub wear or looseness. Accomplish other fan repairs in accordance with Section 2.13.1 of DOE/GO 10099-935.

D2.5 Temperature sensors. Renew temperature sensors in accordance with Section 3.9 of ANSI/EASA AR100 and Section 2.13.2 of DOE/GO 10099-935.

D2.6 Leads. Renew the motor leads in accordance with Section 2.13.3 of DOE/GO 10099-935.

D2.7 Space heater. Renew the motor space heater and its internal wiring in accordance with Section 2.13.5 of DOE/GO 10099-935.

D2.8 Capacitors. Renew any capacitor that is leaking or deformed or that fails testing in accordance with Section 2.13.5 of ANSI/EASA AR100. Alternatively, preemptively renew all capacitors in lieu of performing visual inspections and testing.

D3. NOTES

D3.1 Common repairs. The above are the most common miscellaneous motor repairs. Requirements for correcting other deficiencies shall be placed in the work item.