MAINTENANCE INSTRUCTION
M.I. 4105
Revision B

Service Department
ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION
October, 2001

SCHEDULED MAINTENANCE
Single and 2-Speed 48" & 52" AC Motor Driven
Quiet (Q") Cooling Fan / Dynamic Brake Grid Blower Fan

SAFETY PRECAUTIONS

Please refer to the EMD Safety Precautions in appendix to the Locomotive Service Manual whenever routine service or maintenance work is to be performed on any AC traction equipped locomotive.

The maintenance procedure as outlined in this instruction is specific to AC Auxiliary/Exciter Alternators and is offered for planning purposes only. As written, this document reflects current EMD product design and service experience for this design. The content of this M.I. reflects maintenance requirements based on time from delivery or miles in service. This recommendation is consistent with present fleet performance and remains within the EMD experience envelope.

This Maintenance Instruction is intended to serve as a guide when establishing maintenance schedules to meet the particular requirements of individual operations and planned economic life of the Single 48", 2-Speed 48", and 2 – Speed 52" AC Motor Driven Quiet (Q") Cooling Fan plus, Dynamic Brake Grid Blower Fan used on DE/DM30 locomotives. It provides average recommendations, which should ensure satisfactory locomotive operation, and economical maintenance costs where average load factors and climatic conditions are encountered.

The scheduled inspection and maintenance items defined herein are specific to these machines. Component renewal provisions are consistent with traditional overhaul procedures.

For planning purposes, EMD has established the following overhaul interval recommendations, based on whichever event occurs first: time or miles.

Single 48", 2-Speed 48", and 2–Speed 52" AC Motor Driven Quiet (Q") Cooling Fan plus Dynamic Brake Grid Blower Fan.

High Speed Service: 6 years / 750,000, miles /1 206 975 Kilometers

Heavy Haul Service: 6 years / 600,000 miles / 965 580 Kilometers

NOTE

Mileage values referenced above are defined by Microprocessor Archive Data when the locomotive is equipped with a locomotive control computer system.

As usual, when specific operating conditions severely impact locomotive performance and/or reliability, maintenance schedules must be adjusted accordingly.

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1.0 DESCRIPTION

Five configurations (4, 5, 6, 8 and 9 blade) of AC motor drive "Q" cooling fans are used in locomotives. In addition, a 9-blade version of this machine is used as the Dynamic Brake Grid Blower for DE/DM30 AC locomotives. The part numbers of these fans and blowers are listed in the Service Data. This publication includes data covering both the single-speed and the two-speed "Q" cooling fans, as well as the grid blower application.

NOTE

Unless otherwise noted, all data in this document applies to both the cooling fan application and the grid blower application. It must be noted that the grid blower motor as described is used for cooling the dynamic brake grids, however, it is the exact same “Q” fan assembly used for radiator cooling, so the data for both will be the same.

The "Q" cooling fans, Figure 1, and Figure 2 basically consist of an inverted squirrel-cage type induction motor. The motor differs in construction from conventional squirrel-cage motors by having the rotor located outside of the stator, and rotating with the fan.

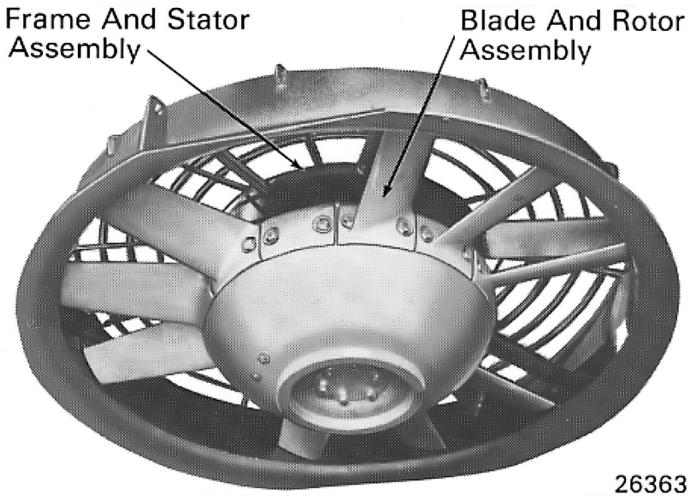

Figure 1 Typical ("Q") Cooling Fan Assemblies (Single Speed)

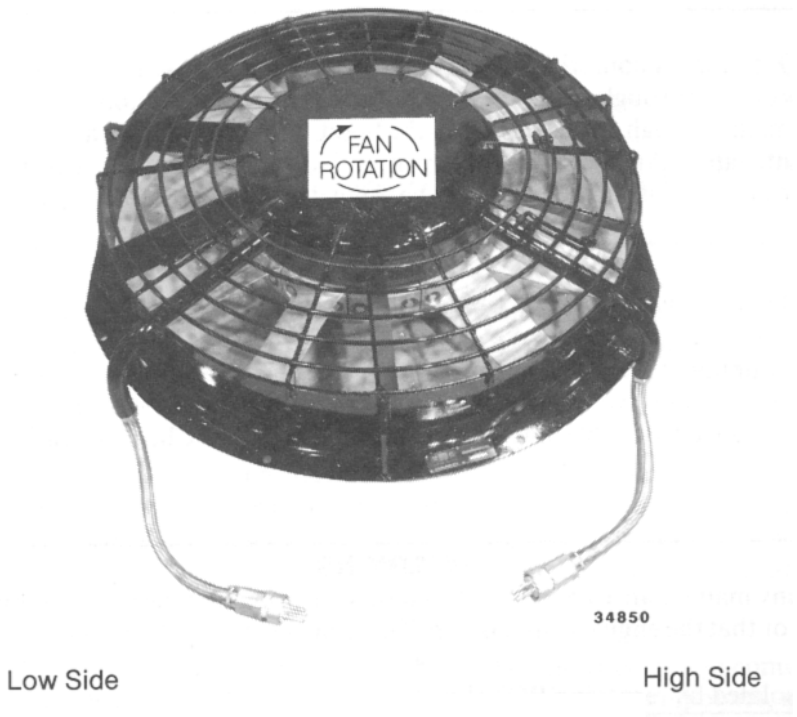

Figure 2 Typical ("Q") Cooling Fan Assemblies (2 Speed)

2.0 OPERATION

2.1 COOLING FANS

During circulation through the diesel engine, oil cooler, and air compressor, the cooling system water picks up heat. This heat is dissipated, and the water temperature controlled by a radiator assembly and AC motor driven cooling fans. The number of fans used, as well as the number of blades on each fan, depends upon the locomotive model, engine size, and cooling requirements.

Most locomotive fans are mounted in a hatch, Figure 3, located in the roof of the locomotive above the engine cooling system. When operating, the fans draw air through the radiator assemblies, removing heat from the circulating water. The heated air is discharged through the roof of the locomotive. On some locomotives, the fans are mounted in the cooling compartment below the radiators to force cooling air up through the radiator cores (tunnel operation locomotives).

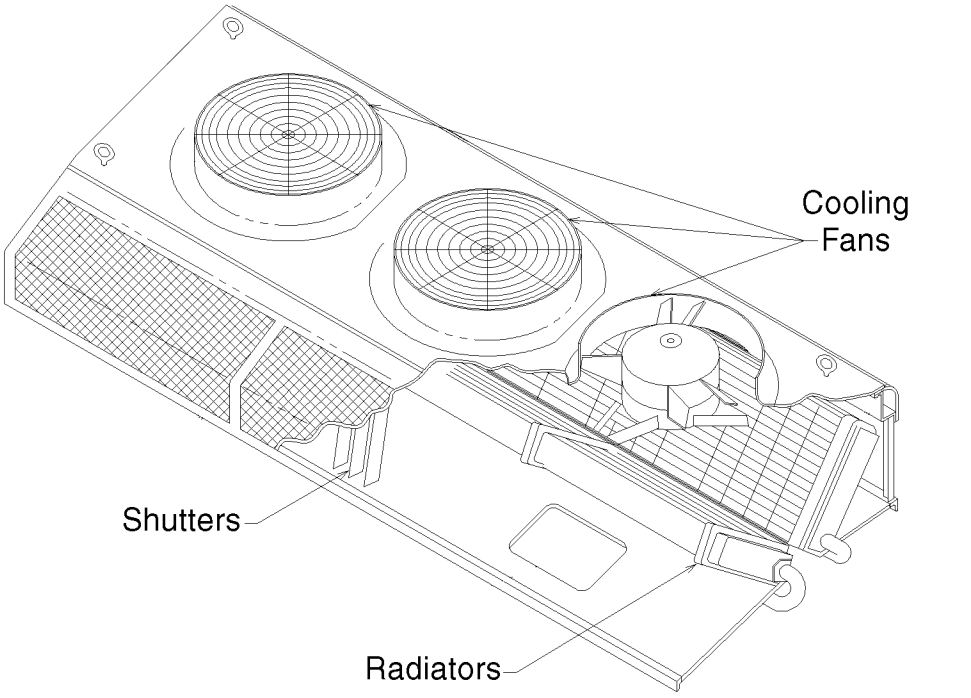

Figure 3 Typical Cooling Fan Application

Fan operation is controlled by temperature sensitive switches and by electrical power contactors that function with changes in cooling system temperature. On microprocessor equipped locomotives, a computer receives signals from temperature probes to operate the fans. The computer also equalizes fan duty cycles to avoid excessive use of any one fan.

Fan speed is directly proportional to the AC frequency which, in turn, depends on the engine (and alternator) speed. Dual speed fans run at approximately 1900 RPM when connected for high speed operation at 950 RPM engine (and alternator) speed. Low speed operation is approximately 950 RPM at 950 RPM engine speed. At 900 RPM engine speed, fan speed is approximately 1800 RPM when connected for high speed operation and approximately 900RM when connected for low speed operation. Selection of high-speed or low-speed operation is automatic. Single-speed fans operate at full speed only.

For further information concerning cooling system operation, refer to the applicable Locomotive Service Manual.

2.2 DYNAMIC BRAKE GRID BLOWER

During dynamic brake operation of the DE and DM series of locomotives, the traction system is configured to convert the momentum of the locomotive and train into electrical energy. The AC power generated by the traction motors is converted to DC by the traction inverter system and supplied to the dynamic brake grids for dissipation as heat energy. The AC grid blower motor forces cooling air through the grids to assist in this dissipation of heat, and to prevent over-heating of the grids.

NOTE

The two speed blower is used on the DE/DM grid blower. EM2000 will control the speed of this blower depending on dynamic brake system requirements. . It must be noted that the grid blower motor as described, is used for cooling the dynamic brake grids, however, it is the exact same "Q" fan assembly used for radiator cooling, so all data for both will be the same.

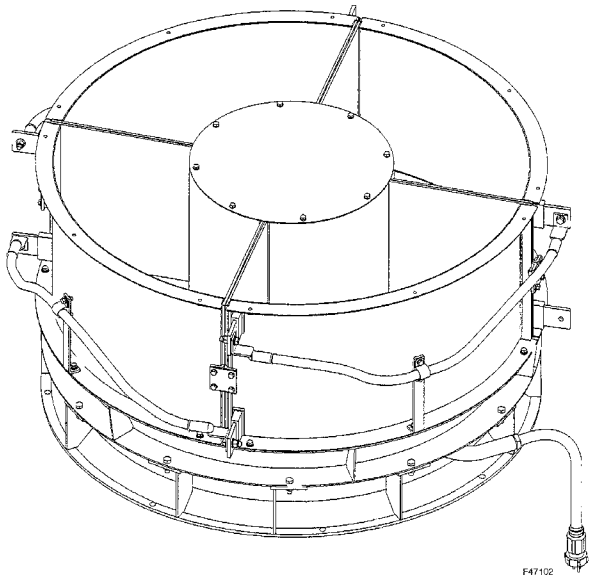

Figure 4 Dynamic Brake Grid Blower Application

On the DE and DM locomotives, the blower is mounted below the grids as part of the brake grid assembly, Figure 4. This assembly is attached to a hatch, located in the roof of the locomotive above the battery compartment. When operating, the blower draws air through louvers on the sides of the carbody and forces it upwards through the grids. The cooling air removes heat from resistance grids and is discharged through the roof of the locomotive.

For further information concerning dynamic brake system operation, refer to the applicable Locomotive Service Manual.

3.0 MAINTENANCE

For maintenance required, inspection intervals, and overhaul period, refer to the applicable Scheduled Maintenance Program.

3.1 LUBRICATION

Ball bearings used on cooling fans are the sealed and shielded prelubricated type. The bearings are packed with grease at the factory and protected by inner and outer seals or shields. When fans are overhauled, the bearings should be removed and replaced with new factory packed bearings that also require an additional amount of grease to be applied to the bearing housing cavity of the larger bearing. Refer to the Service Data for type and quantity of grease.

3.2 OPERATING INSPECTION

Periodic inspection of the cooling fans / grid blower fan should be made as follows:

1. Inspect to see that the fan is securely fastened. If the fan is located on the roof hatch, ensure the access door of the fan guard is securely fastened in place. For grid blower applications, ensure all inspection covers are secured.

NOTE

Current model "Q" fans on locomotives which have the roof hatch mounting, incorporate a door on the fan guard to allow direct "through-fan" access to the fan electrical connection. On earlier model "Q" fans, fan connection is made through an access hole in the hood. This proved to be an inconvenience when "Q" fans required maintenance. An access door retrofit kit is available for "Q" fans with the earlier guard design. The existing cover plate in the hood may be welded to the hood. Refer to Service Data for retrofit kit part number.

2. Make sure that there are no restrictions to fan rotation or air flow.

3. **Cooling Fans Only** - With the engine running, complete a circuit through the thermostatic switch to operate the fans; on computer controlled locomotives initiate the Cooling Fan self test program to sequence the fans. Check for proper direction of rotation and listen for unusual noises that could indicate possible internal or external trouble. Check for vibration or other signs of unbalance.

WARNING

Do not perform any maintenance on a fan without first ensuring that the fan is completely isolated from the power source or that the engine is shut down. This will prevent the fan from being inadvertently started.

The fan may be isolated by removing **BOTH** fuses in the fan motor circuit at the AC electrical cabinet.

NOTE

If an inspection reveals a single blown fuse, always renew both fuses in the fan motor circuit. The second fuse, while good in appearance, will in all probability be degraded and will open the next time the fan is called upon to start. Also, depending on when the single fuse had blown, the fan could have been operating in a single phase condition. Electrically inspect the fan stator windings for single phase burning. Perform an insulation resistance check to determine condition of stator insulation and windings before applying new fuse and releasing fan for service.

4. **DB Grid Blower Only** – With the engine running, the operation of the grid blower may be checked with the EM2000 AC Grid Blower self test. With the self test in operation, check for proper direction of rotation and listen for unusual noises that could indicate possible internal or external trouble. Check for vibration or other signs of unbalance.

4.0 OVERHAUL PROCEDURES

4.1 PRELIMINARY INSPECTION

When the cooling fan is removed from the locomotive for reconditioning, a preliminary inspection should be performed before disassembly.

1. Place fan and motor on a suitable stand, with the fan end up. Be careful not to damage the flexible conduit or connection plug.

2. Slowly rotate the fan manually to check the freedom of rotation.

3. Test the stator winding insulation resistance, using a 500 volt DC megger. The allowable minimum indication is 1 meg-ohm. If a megger indication of 1 meg-ohm cannot be obtained, the stator may have to be dried by placing it in a 120ºC (248ºF) oven for four to six hours. After drying, if the megger indication is still less than 1 meg-ohm, further testing should be made after disassembly.

4. Mount the motor with the fan facing down in a suitable fixture designed to prevent air flow through the fan during the running test. EMD recommends an enclosed fixture to eliminate any potential safety hazard that could occur during the test operation due to the speed of the fan blades. Reference Figure 18.

5. Connect the motor leads to a 115 volt AC, 3-phase, 60 cycle power source, or to the locomotive alternator. Connect the high and low speed leads independently on the two speed fans.

NOTE

When testing the high speed operation of the two speed fans, the low speed plug must be shorted out. This can be done by wrapping a piece of bare wire around each of the low speed plug pins so that they are all connected together.

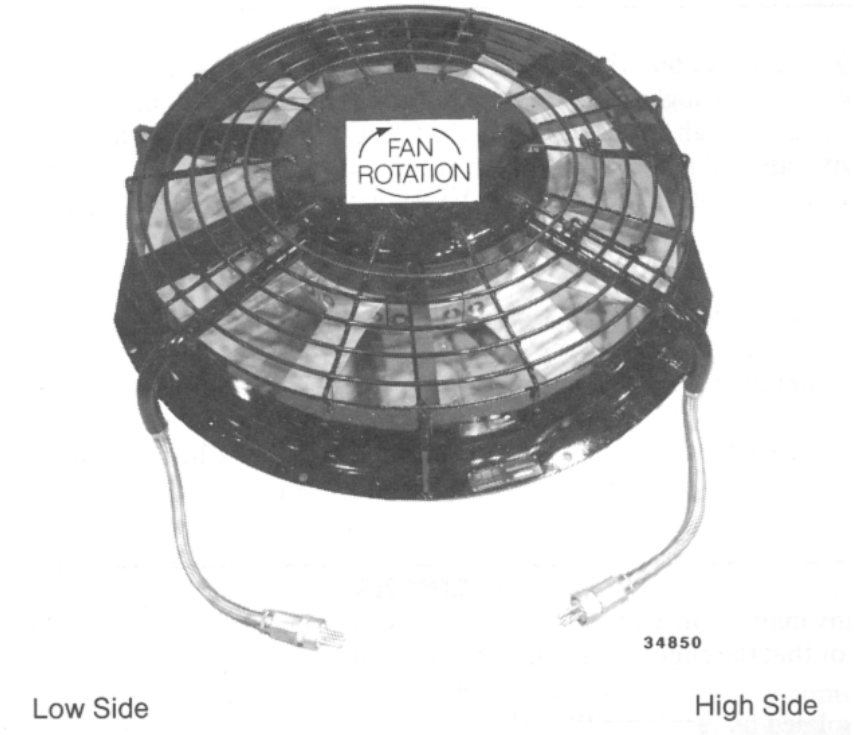

Figure 5 Low Side vs. High Side Plug (older style)

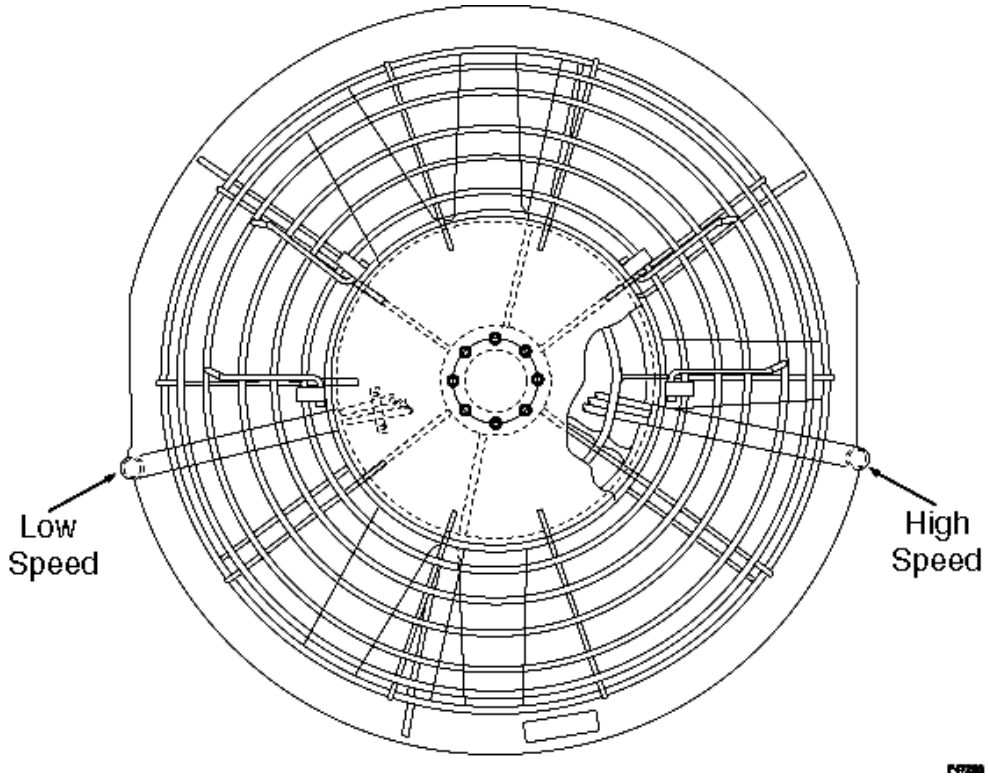

Figure 6 Low Side vs. High Side Plug (top view of new style)

NOTE

On two speed fans the high speed connection is on the right as you face the acute angle between the conduit for both the low and the high speed connections. Refer to Figure 5 and Figure 6 for the location of the high and low speed connections.

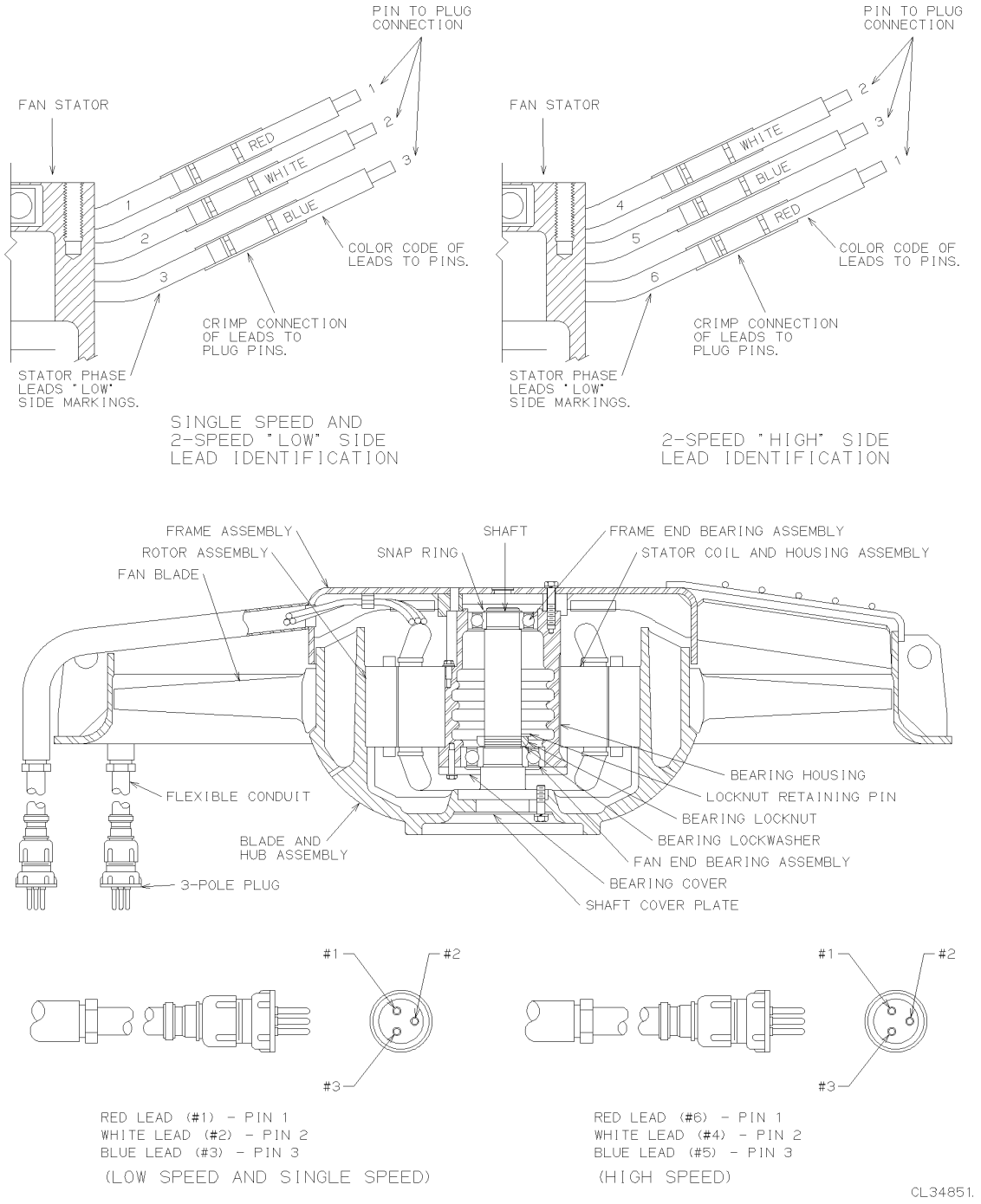

Figure 7 "Q" Fan Assembly Cross Section

6. With the motor running, check the current in each phase with an ammeter. The current in each phase should be within 10%. If a greater difference exists, it may be assumed that the stator coils are shorted between turns (turn-to-turn) shorts).

7. With the motor running, check for the correct direction of the fan rotation. The fan rotates clockwise, as seen from above.

4.2 DISASSEMBLY

Position the cooling fan upside down (frame assembly down) in a suitable fixture and disassemble as follows. Refer to Figure 7.

1. Remove the six bolts and lock washers from the fan hub and remove the shaft cover plate.

2. Remove blade and hub assembly (with the rotor assembly) from the shaft hub. If necessary, lightly tap the center of the shaft hub with a soft mallet to loosen the fan pilot from the hub. Mark the stator winding assembly and frame so that they can be assembled in the same relative position and for proper lead insertion (routing) into the conduit upon re-assembly.

3. Remove the 1/4"-20 nuts and cable cleat(s) retaining leads to the fan frame.

4. Unscrew the flexible conduit locknuts and unscrew the plug components, sliding the components back along the flexible conduit. Separate the connector inserts from the plug bodies, exposing the snap rings on the terminals, Figure 8. Identify the leads and tag for later re-assembly to the proper plug and terminal position. Refer to Figure 7 and Figure 9.

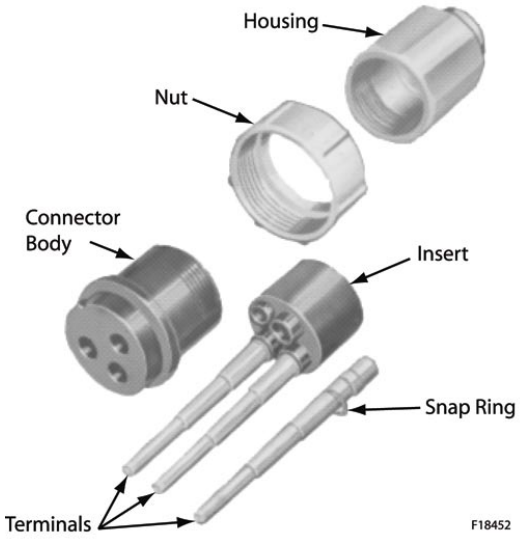

Figure 8 Fan Motor Connector

5. Lift the fan frame and stator assembly up high enough to make access (underside of frame) and remove the eight hex head bolts and spring lock washers holding the fan frame to the stator bearing housing (scrape the silicone rubber sealing compound from the bolt heads before removal).

6. Lower the assembly to the floor and connect the lifting device to the stator assembly. Lift the stator out of the frame and carefully pull the cables through the conduit(s). Position the stator on the work bench for further disassembly.

7. Remove the eight hex socket head screws and flat washers holding the cover to the bearing housing.

8. Remove the shaft, with the bearing cover and bearing assemblies, out of the bearing housing of the stator. This may be done by tapping the small end of the shaft with a soft mallet.

NOTE

A standard bearing puller or arbor press may be used to remove the bearings in Steps 9 and 10.

9. Remove the snap ring holding the small (lower) bearing and remove the small bearing.

10. Remove the locknut retaining pin and remove the locknut holding the large (upper) bearing and remove the large bearing and bearing cover.

4.2.1 CLEANING OF THE STATOR ASSEMBLY

The stator assembly should be cleaned of all dirt and grease. The stator should be blown out with clean, dry, compressed air at a reasonably low pressure. If high pressure is used, there is a danger of loosening insulation or protective coating on various parts.

The stator assembly may also be cleaned with steamed water and a mild (non-alkaline) soap cleaner. The stator must then be dried out in a suitable oven for four hours at 120ºF to remove all the moisture before performing any electrical tests.

If deposits of dirt are caked or difficult to remove, it may be necessary to clean the stator with a cloth dampened with a solvent. Most solvents require some time to evaporate so no electrical test or varnish treatment should be attempted immediately after cleaning.

WARNING

Use the usual safety precautions that apply to flammable fluids. Provide adequate ventilation when any type of solvent is being used.

4.3 INSPECTION

4.3.1 STATOR

1. Check the stator for visible signs of damage to the windings, such as single phasing, overheating, or bearing failure damage. (rubbed laminations).

2. Check the stator windings to ground with a megger. If the megger indicates less than 1 megohm, clean and dry the stator. Recheck with a megger. If the megger still indicates less than 1 megohm, the stator should be rewound or replaced with a new stator.

3. Check the stator for turn-to-turn shorts with a surge comparison tester The test voltage should be 800 V RMS for both single and two speed fan motor stators. This may be accomplished by following the steps outlined below:

   a. Place the stator in its normal horizontal position at least six inches away from large magnetic objects such as other stators or structural beams.

   b. For single speed stators (2802589 and 2802795), leads #1, #2, and #3 will be used in the test (phase notation same as the lead notation).

      For two speed stators (2803187, 2801875, 22089691, 2805198, and 2805713) short circuit leads #1, #2, and #3 with a bare piece of copper wire wrapped around the plug prongs. Leads #4, #5, and #6 will be used during the test and correspond to phases #1, #2, and #3 respectively in single speed stators. On 2 speed stator (2805640) although 2 speed, has 2 separate independent windings, so the test will be the same as a single speed, except both independent windings require the test.

   c. During testing, two phases will be compared with the third phase as the common return path.

   For single speed fan stators compare:

   - phase #2 and #2 with #1 as return
   - phase #1 and #2 with #3 as return
   - phase #1 and #3 with #2 as return

   For two speed fan stators compare:

   - phase #2 and #3 with #1 as return (leads #6 and #5 with #4 as return)
   - phase #1 and #2 with #3 as return (leads #4 and #6 with #5 as return)
   - phase #1 and #3 with #2 as return (leads #4 and #5 with #6 as return)

The attached Figure 21 through Figure 23 in the Service Data Section are oscilloscope traces for a good single speed fan stator and are also representative of a good two speed fan stator. Figure 24 through Figure 26 are of oscilloscope traces for a single speed fan stator with shorted turns in phase #2. Note that in Figure 26, the return phase is the shorted #2 phase and no fault is indicated in the trace. Due to this possible masking of shorted turns it is important to check all combinations as outlined above.

NOTE

If external leads are to be replaced with new leads, it is advisable to replace them after varnish treatment.

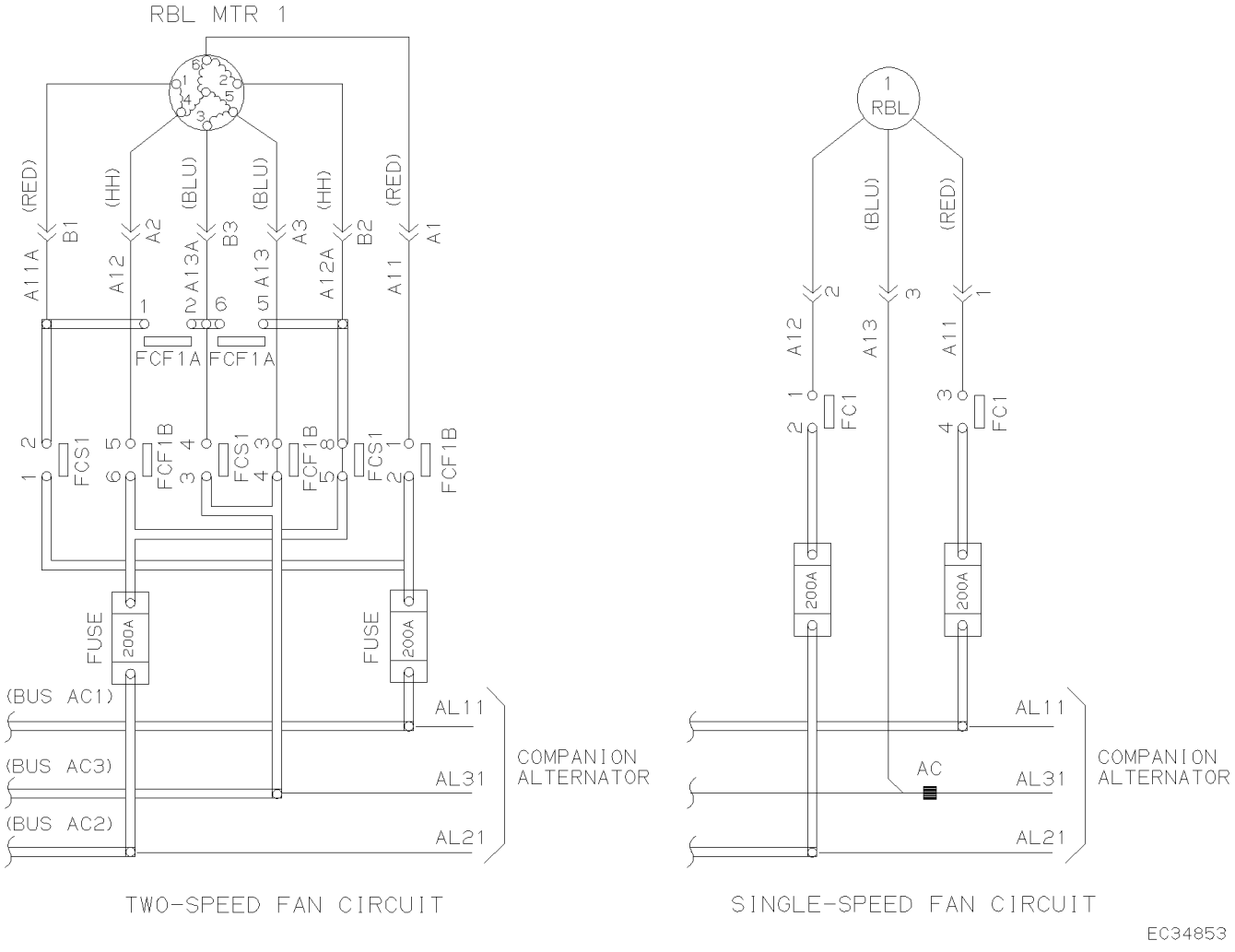

Figure 9 Typical Fan Motor Electrical Connections

4. Check the stator external leads. If external leads are damaged or too short and the stator windings are satisfactory, it is permissible to replace the leads at the crimp (located approximately 2" to 3" away from the stator windings). Remove the crimp and strip the leads. Crimp wires together using a two way connector. Refer to Service Data for the connector and crimping tool. Take care not to damage the stator windings. Insulate over the lead splice connection with a piece of 13 mm (1/2") inside diameter vinyl tubing. Refer to Service Data for tubing part number, and Figure 7 for proper lead connections to the stator.

4.3.2 FAN MOTOR CONNECTOR PINS

Visually inspect the terminals of the fan motor connectors. If the terminals show signs of arcing, pitting, or wear, replace the terminals and their female counterparts in the locomotive plug receptacle.

4.3.3 FAN BLADE, HUB, AND ROTOR

Visually inspect the hub and fan blades for defects or cracks. Other than weather coloration, the fan blades should be in a like-new condition and free from all but the most superficial nicks.

Under extremely severe conditions of sand impingement, erosion of the fan blades can occur. Under special order the fan blades can be precoated with urethane at the factory to greatly increase their service life.

If the hub or fan blades fail to meet these requirements, the defective assembly or defective fan blades should be replaced with a new assembly or new blades. If damaged blades are replaced with new blades, refer to the Fan Assembly Balance section of this Maintenance Instruction.

Check the rotor for visual signs of damage or rubbing. This us usually the case if the fan has had a bearing failure and there is also an indication of rubbing on the stator lamination. If the rotor has excessive rubbing, the rotor must be removed from the fan hub and a new rotor applied. Also visually inspect the rotor conductor brazing at the short circuit rings at both ends of the rotor. These conductors (copper rods) must show a good brazed connection and still in one piece. If a burnt or overheated condition is found, the rotor should be replaced. Do not attempt to re-braze any conductors. DO NOT use rotors with missing or broken conductors as the fan will draw more than normal current and overheat the stator windings. Refer to the Rotor Removal section of this Maintenance Instruction.

4.3.4 BEARING COVER

1. Remove all old grease from cover and clean cover.

2. Check the bearing cover for wear. If there is no wear on the cover where the bearing outer race contacts the cover, the cover may be reused. If there is any sign of wear caused by the outer race turning or rubbing against the cover, replace the bearing cover with a new cover. The maximum dimension for the large bearing side is 5.1189" and 4.3314" for the small bearing side.

4.3.5 BEARING HOUSING AND STATOR

Remove any grease which has accumulated inside the bearing housing, and ensure both bearing bores are clean. Paint bearing housing and outside of stator laminations with red air-dry enamel paint after any varnish treatment. Refer to Service Data for red air-dry paint part number. Allow painted areas to dry thoroughly.

4.4 FAN ROTOR REMOVAL

If the rotor has been rubbed, damaged, or missing copper rods (conductors), the rotor should be replaced. There are four 1/4 x 1-1/4 spring roll pins evenly spaced around the rotor that secure the rotor to the fan hub assembly. These pins must be removed before attempting to remove the rotor from the hub. These pins are located at the centerline of a fan blade bolt hole in the fan hub. Refer to Figure 10 for location of the pins. Fan blades at these locations must be removed to aid in removal and application of new pins. Remove the pins and then heat the fan rotor hub assembly to 350ºF and the rotor should slide out of the fan hub. Again, heat the fan hub assembly to 350ºF and reapply the new rotor into the fan hub making sure the rotor bottoms out inside the hub. Drill a 1/4" hole through the existing holes in the hub into the rotor 1/2" deep and apply pins.

NOTE

Do not drill more than 1/2" deep or the pin will be inserted too far and may not be removed if the rotor requires future removal. Position a punch through the fan blade bolt holes in the fan hub to drive the pin into the rotor. Reapply the fan blades and dynamically balance the fan assembly as referenced under Section 4.5 in Assembly Balance in this Maintenance Instruction.

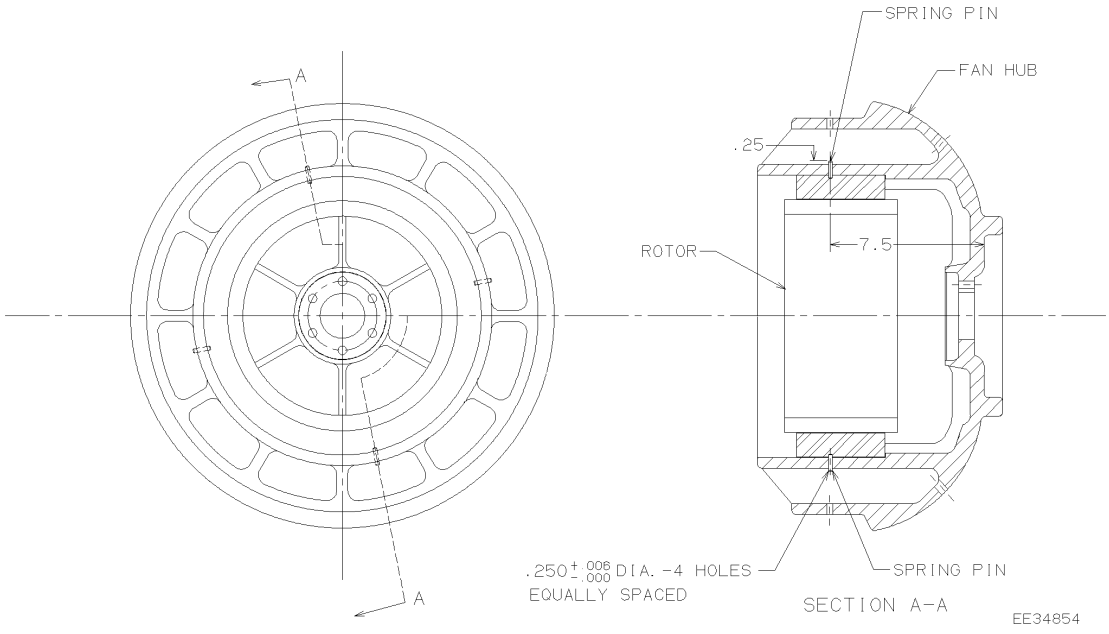

Figure 10 Rotor to Hub Application (Spring Pin Location)

4.5 FAN ASSEMBLY BALANCE

Fan blade 9534306 has a fully machined base and drilled holes. Fan blade 90965524 has a "cast-in" relieved base, cast holes, and is heavier. this blade was used on "Q" fans manufactured prior to August 1981.Balancing will be more easily facilitated by using all blades of the same design. If the blades must be mixed, ensure that blades of the same type are positioned in pairs, 180º apart. The two blades can be distinguished by the part number stamped on the base.

All fan blades should be fastened with standard zinc-plated SAE Grade 8 hex nuts (P/N 9418753) with 1/2 - 13 bolts and washers (one or both the nut and bolt head sides), and should be torqued to 129 - 149 N•m (95 1- 110 ft.-lbs.) without lubricant. Fans manufactured prior to December 1981 had the blades applied with 1/2 - 13 bolts and cone-lock type nuts. To improve consistency in clamp load and fastening quality, P/N 9418753 nut is recommended and torque increased from 75 to 95 ft.-lbs.

Dynamically balance the fan assembly to within 1800 mg. m. (2.5 in. oz.) per balance plane at 750 RPM. Balancing the fan assembly is accomplished by adding washers as necessary to the fan hub at points "A" and "B", Figure 11. Point "A" is at any point around the outside of the hub inner wall and at 279 mm (11") above the inner recess of the casting bottom. Point "B" is at any point at the 190 mm (7-1/2") radius from the hub centerline. Application of balance washers requires drilling a 10 mm (13/32") clearance hole for the 3/8" - 16 bolts and nuts applied. Torque balance bolts to 102 N•m (75 ft.-lbs.) without lubricant. After balance bolts are properly torqued, ensure that two full threads protrude beyond the nut. Reference Figure 12 for recommended type of balancing equipment used to balance the fan hub assembly.

NOTE

DO NOT paint the fan hub and blade assembly as it could result in an out of balance condition.

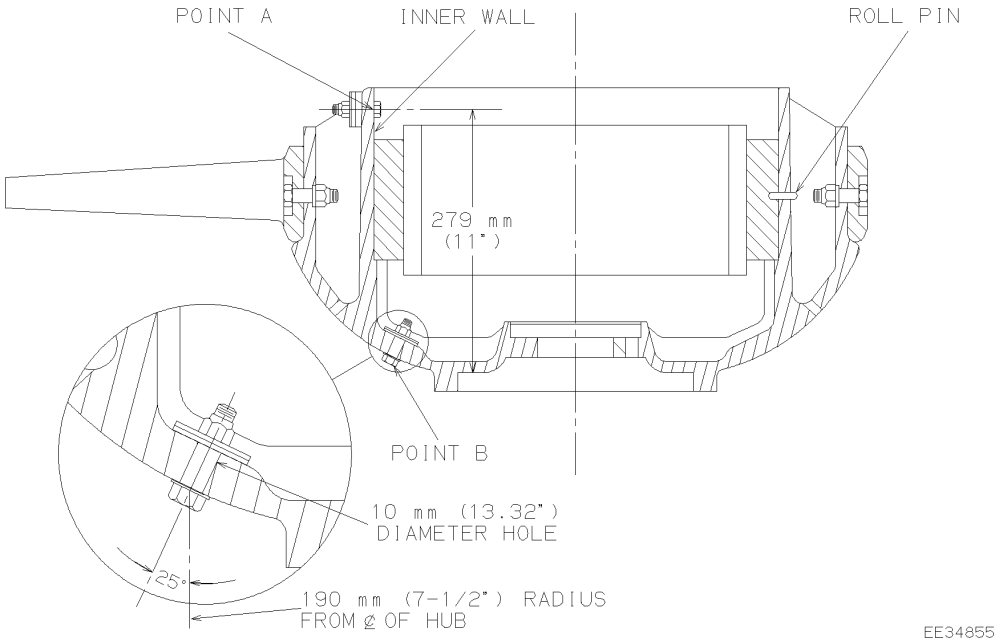

Figure 11 Balancing the Blade and Hub Assembly

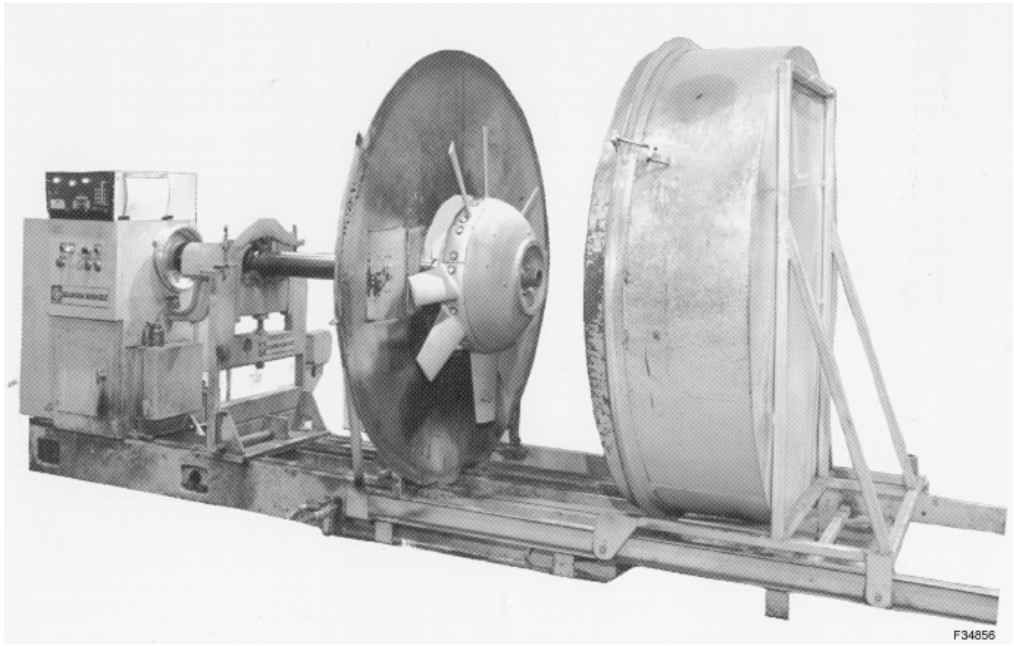

Figure 12 Balancing Equipment for Fan Hub Assembly

4.6 VARNISH TREATMENT OF THE STATOR

Stators which have passed inspection and have been cleaned should be given a varnish treatment.

Varnish should be thinned to maintain Ford Cup No. 4 orifice viscosity at 100 to 130 seconds at 21.1ºC (70ºF). Refer to Service Data for varnish and thinner information.

Perform varnish treatment as follows:

1. Mask off machined surface of bearing housing and apply protective covering to the main leads to prevent varnish from getting on the leads.

2. Preheat the stator in a convection type oven until the copper temperature reaches 135ºC (275ºF), then continue to heat for two hours at a temperature of 135ºC to 140ºC (275º to 284ºF). The oven temperature should not exceed 160ºC (320ºF) during the heating cycle.

3. Remove the stator from the oven and while still hot (minimum temperature of 100º to 120ºC (212º to 248ºF), dip the stator into the varnish and allow it to soak for three minutes.

4. Remove the stator from the varnish, drain, and bake the stator for five hours, maintaining the stator temperature at 135º to 140ºC (275º to 284ºF). The oven temperature should not exceed 160ºC (320ºF) during the bake cycle.

4.6.1 CLEANING THE STATOR AFTER VARNISH TREATMENT

1. Remove the protective material from the main leads and machined surface of bearing housing. If necessary, clean varnish from the machined surface using a cloth saturated with mineral spirits.

2. Clean off excess varnish from the outside of the stator laminations. This cleaning can be accomplished with a power driven wire brush, being careful not to damage the windings.

3. Tap out the threaded holes.

4.7 SHAFT AND BEARING ASSEMBLY

NOTE

The 9-blade single speed cooling fans and all two speed cooling fans operate at higher temperatures than the 4, 5, 6, or 8-blade single speed cooling fans and require a different bearing and grease to withstand the higher temperature (see Service Data). All new bearings are greased at the factory and DO NOT require any additional grease applied internally.

1. Ensure bearing housing bores and shaft are clean and free of burns.

2. Install the bearing cover on the large end of the shaft. the 3 mm (1/8") recess must face the bearing.

3. Press a new large bearing on the large end of the shaft. The 9-blade single speed and all two speed cooling fans receive the large bearing 908440 and the 4, 5, 6, and 8-blade single speed fans receive the large bearing 908486. Both bearings have a Viton seal on one side and a steel shield on the other side. Be certain to assemble with the Viton seal next to the bearing cover away from the stator, Figure 13.

NOTE

The 9 blade 52” fan (40085791) has an even larger fan side bearing 908497.

Apply pressure (straight and square) directly to the face of the bearing inner race, and drive solidly up against the shaft shoulder.

4. Apply the bearing locknut. Tighten the locknut using a spanner wrench. With the shaft securely anchored, ensure the locknut is tight by striking the spanner wrench with a hammer.

5. Install the locknut retainer pin and tap in place.

6. Press a new (small) bearing 9440292 on the small end of the shaft. Apply pressure (straight and square) directly to the face of the bearing inner race, and drive solidly up against the shaft should. Apply the snap ring in the groove of the shaft to hold the bearing in place. This bearing has a Viton seal on one side and a steel shield on the other side. This bearing must be assembled with the Viton seal facing flange end (shaft flange) towards the stator, Figure 13.

NOTE

Supermill MI25 grease is white in color and SRI-2 grease is blue-green. The grease application in Steps 7 and 8 on what becomes the top side of each bearing in the operating position, are to provide a supply of grease from which free oil will leak into the bearing. (Perform steps 7 and 8 prior to assembling the shaft and bearing assembly into the bearing housing of the stator).

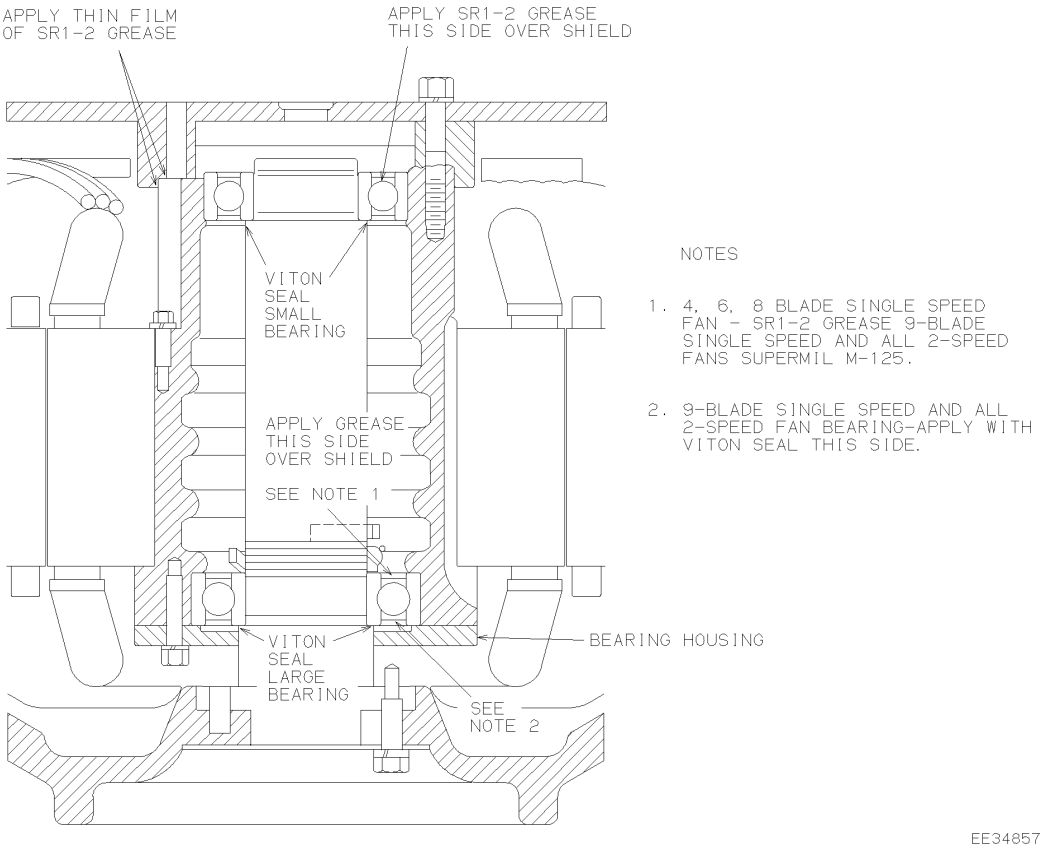

Figure 13 Grease Application

7. Apply grease over the shield area of the large bearing. This amount of grease over the shield area should bring its level at least to the top of the locknut. The 9-blade single speed fans and all two speed fans require Supermil MI25 grease and all 4, 5, 6, and 8-blade single speed fans require SR1-2 grease. Refer to Service Data for quantity and part numbers. Apply grease to the top of the bearing (locknut side) as shown in Figure 13.

8. Apply SR1-2 grease on top of the small bearing shield area that is closest to the small end of the shaft. Refer to Service Data for the quantity and part number. Apply grease to the top of the bearing (frame side) as shown Figure 13.

4.8 BEARING HOUSING AND STATOR ASSEMBLY

NOTE

All 48" cooling fans manufactured prior to 1982 are to have a 1/4" vent hole drilled in the frame stator mounting ring. All cooling fans made after 1982 should already have this hole. This hole need not be drilled parallel to the tank head. Refer to Figure 14.

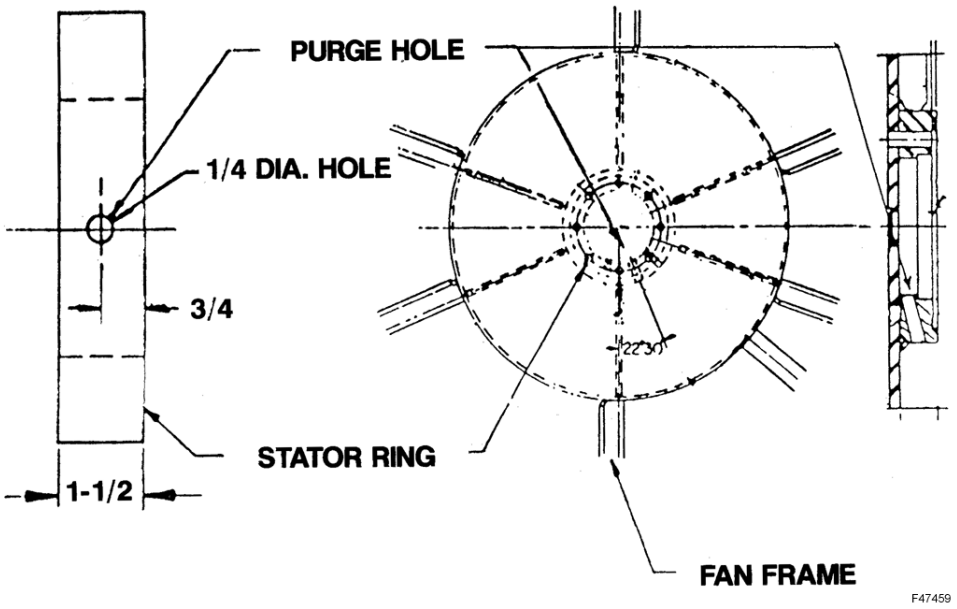

Figure 14 Air Purge Hole Location

1. Assemble the bearing and shaft assembly into the bearing housing of the stator winding assembly.

2. Apply a sealing compound (Loctite) 8494711 to the thread area of the eight socket head cap screws (plus flat washers) used to hold the bearing cover to the bearing housing and stator assembly. Torque the screws to 44 - 49 ft.-lbs.

3. Make certain that the shaft turns freely, and wipe off any excess grease that may be thrown out against the stator windings.

4. Install the stator assembly down into the fan frame. Guide the leads through the lead opening in the conduit(s) for the leads. Position the leads around the inside of the frame and secure with cable cleats and 1/4 x 20 nuts to retain leads to the frame. Also, insert Nomex insulation pieces between the leads and gussets of the frame and hold in place with RTV sealant. Refer to Figure 15 for proper positioning of the stator and routing of the leads and positioning of Nomex insulation. Check that the 1-1/4" diameter lead insulator(s) are in place at the entrance to the conduit(s) prior to inserting the leads and replace if they are damaged or missing.

NOTE

Figure 15 shows the application of a 2-speed stator. On a single speed stator application, perform the same operations, however, only the high side leads require routing and securing.

5. Apply eight bolts and spring lock washers to fasten the frame to the bearing housing. Torque bolts to 95 - 102 N•m (70 - 75 ft.-lbs.).

6. Apply a liberal coating of silicon rubber sealing compound to the bolt heads.

7. Arrange the stator leads evenly and slide the flexible conduit(s) over the leads, if previously removed. Tighten the flexible conduit locknut.

8. Slide the connector housing over cables. Insert terminals into the connector insert. Install snap rings on terminals and complete assembly of the connector. If terminals require replacement, perform steps a, b, and c.

    a. Remove insulation from 12 mm ± 0.8 (1/2" ± 1/32") of cable.

    b. Apply a cable into the terminal and place in a die, such as a Thomas & Betts die #33, with shoulder of terminal against die face.

    c. Crimp the terminal onto the cable as shown in Figure 16.

9. Ensure that the fan rotor inner diameter and stator outer diameter are free of varnish and any other foreign particles that could cause binding.

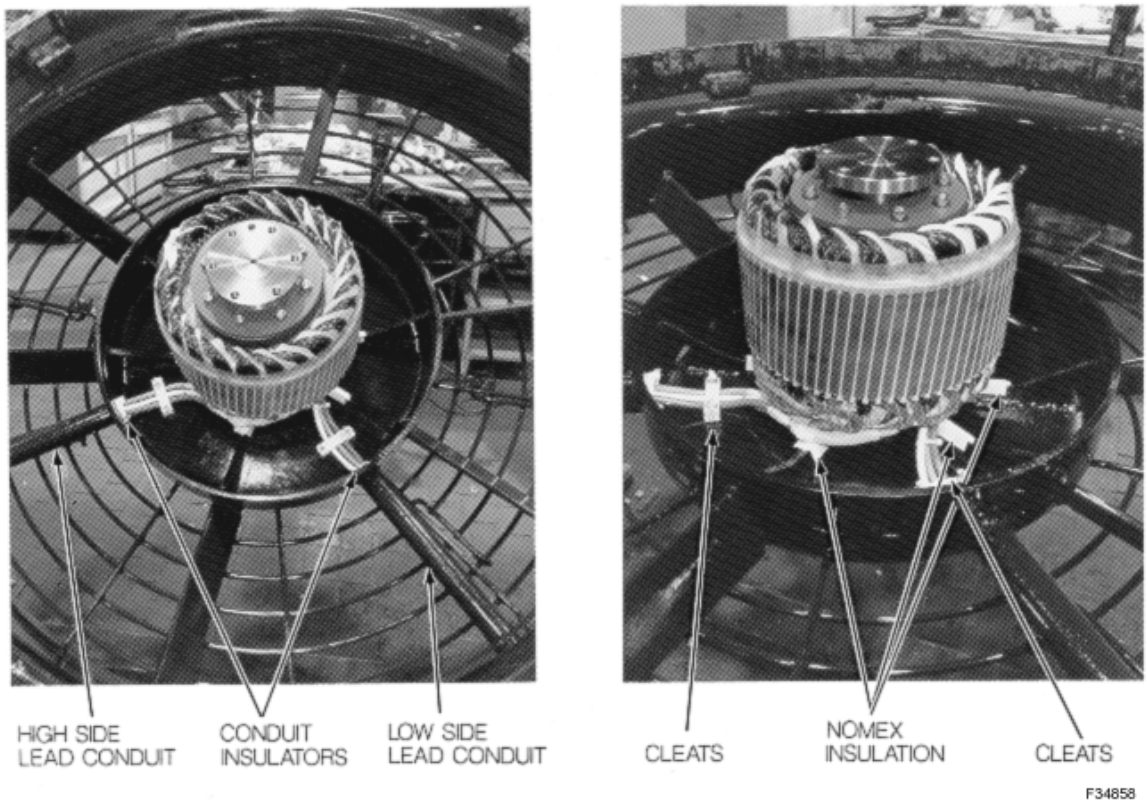

Figure 15 Stator Application & Positioning in Fan Frame

10. Thread two 1/2" - 13 dowels 16" long into the shaft mounting flange to guide the fan hub during assembly. Remove the dowels afterward. Refer to Figure 17.

11. Ensure the balance weights on the fan are tight.

12. Apply the fan hub and blade assembly to the motor shaft flange. Assemble the shaft cover plate and six 1/2" - 13 bolts and lock washers to the fan hub. Torque bolts to 95 - 101 N•m (70 - 75 ft.-lbs.). Make certain the fan hub and blade assembly rotates freely.

13. Seal around the edge of the bolt heads with silicon rubber sealing compound. See Service Data for compound.

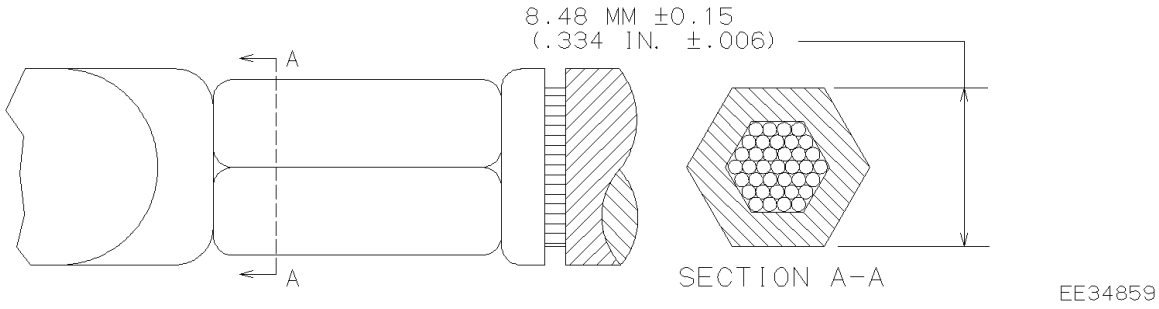

Figure 16 Plug Terminal Crimp

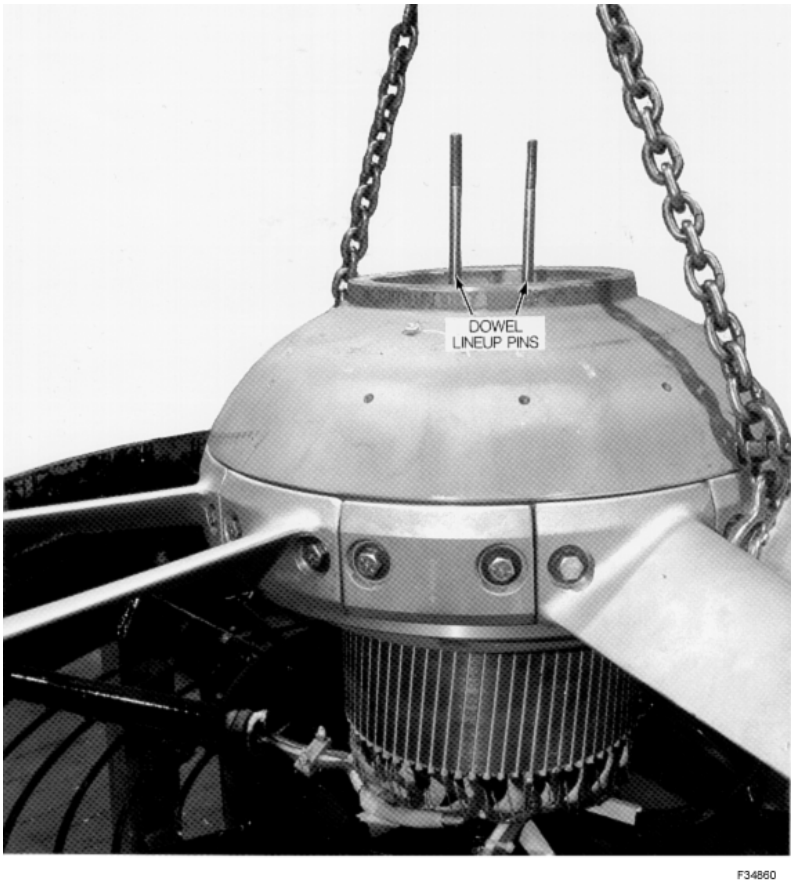

Figure 17 Apply Fan Blade Hub Assembly to Stator

14. Place the fan assembly on a suitable fixture with the fan facing down. EMD recommends an enclosed fixture to eliminate any potential safety hazard that could occur during the test operation due to the speed of the fan blades. Refer to Figure 18 for type of fixture recommended for this running test.

Perform a half hour running test as specified in Preliminary Inspection, steps 4, 5, 6, and 7. During the running test, the fan should run smoothly without noticeable vibration. Refer to Service Data for maximum allowable unbalance. If the vibration is excessive, the fan and rotor assembly should be removed and dynamically balanced. Refer to Fan Assembly section.

If the fan runs backward in either low speed operation on 2-speed fans or high speed on 2 and single speed fans, the phase lead connection to the plug pins is incorrect. Disassemble and check for the correct lead to pin connection at the fan plug assembly. Refer to Figure 5 and Figure 7. The fan should rotate clockwise as seen from above.

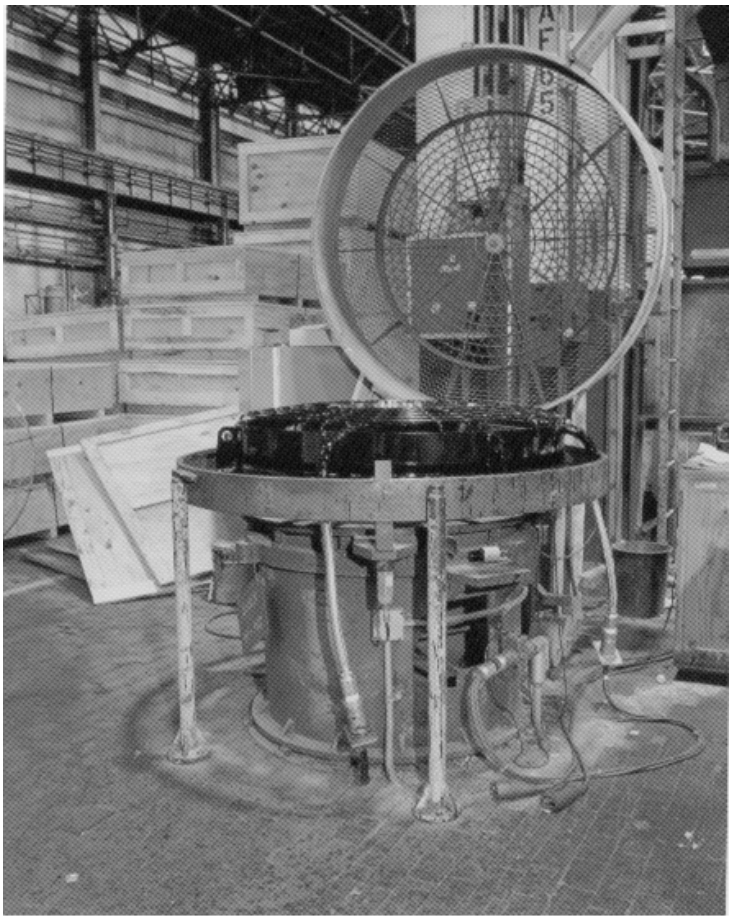

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Figure 18 Running Test Stand View A

Figure 19 Running Test Stand View B

4.9 HIGH POTENTIAL TESTING

4.9.1 HI-POT GENERAL INFORMATION

It is extremely important that the high potential tester be reliable to ensure adequate testing without unnecessarily overstressing the insulation.

In regard to the features which should be incorporated in the tester, the following points are pertinent; wave form, surges and voltage regulation.

4.9.2 WAVE FORM

Voltages specified in high potential testing are, unless otherwise specified, root-mean-square (RMS) voltages. The wave form should have a limit of 5% third harmonic. This limitation fixes the peak voltage for any RMS voltage.

Wave form may be influenced by the capacity of the testing apparatus used relative to the size of the piece of equipment being tested. A serious peak on the voltage wave may result if the test box being used is too small for the piece of equipment tested. Also, it is possible that the leakage and charging current may be sufficient to trip the relay when testing a piece of equipment with a test box which is too small.

4.9.3 SURGES

Harmful surges may occur if special attention is not paid to the method of changing voltages on the primary when testing.

4.9.4 REGULATION

Specifications for regulation of high potential equipment state that the secondary voltage drop should not exceed 20% under actual test conditions.

4.9.5 SAFETY PRECAUTIONS

WARNING

ELECTRICAL RATINGS of the test equipment are values that should be considered EXTREMELY DANGEROUS to personnel.

The following safety considerations should be carefully observed when performing hi-pot testing.

1. Except for the person performing the hi-pot test, all personnel should maintain a safe distance from the equipment being tested before applying voltage.

2. Do not make or break the high voltage circuit with the electrodes. Dangerous over-voltage surges may result.

4.9.6 FINAL HIGH POTENTIAL TEST

Perform a stator high potential test to the fully assembled motor. Refer to Service Data for test voltage and time.

4.10 PHASE-TO-PHASE RESISTANCE TEST

Perform a phase-to-phase stator resistance test at plug assembly, both single and 2-speed fans at 25ºC. Refer to Service Data for specifications.

4.11 FAN MOTOR CONNECTOR AND CONNECTION TO RECEPTACLE

A new fan plug connector has been designed to eliminate potential loosening in service resulting in plug pin burning and failure to fan the stator. This new assembly incorporates longer machined pins for greater insertion into the female receptacle. An "O" ring gasket helps keep the plug tight and a new insulator body eliminates cracking. Refer to Figure 20 showing the new plug assembly.

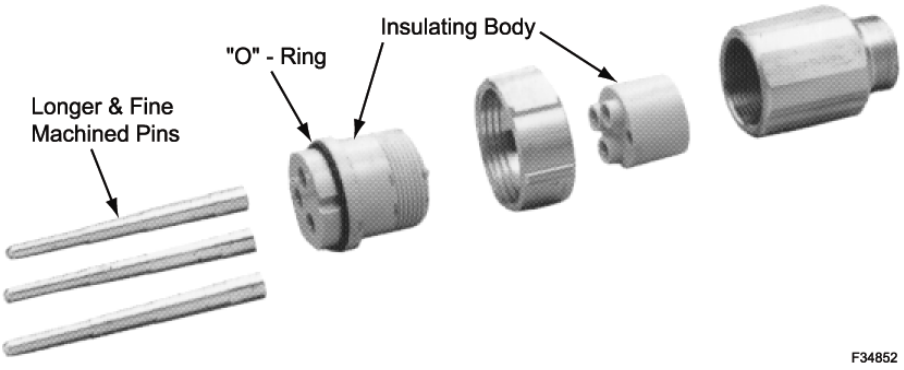

Figure 20 New Design Fan Plug Assembly

Application of the fan on the locomotive requires the use of a threadlock compound when connecting the fan plug to the receptacle. This compound will also aid in eliminating plugs from loosening up in service. Application of this threadlock is as follows:

1. Before proceeding, make sure that the plug and receptacle are free of dirt (especially the plug pins).

2. Spray the receptacle body threads with a small amount of Locktite Primer N taking care not to spray the insulator components and receptacle sockets. Allow the primer to dry five minutes before proceeding. The primer serves the purpose of cleaning the threads and priming the thread surface.

3. Insert the plug body into the receptacle so that the plug insulator body seats against the face of the receptacle surface.

4. Apply approximately .5 cubic centimeters of Loctite 222 to the receptacle threads near the end of the plug. This application should be about the size of a quarter. The Loctite will slowly run down the threads as aided by gravity. Take care not to get Loctite on the plug insulation body.

5. Apply the plug nut to the receptacle threads by hand. The Loctite will spread due to the nut being applied. Continue to tighten the nut (by hand or by pliers) until the insulating body of the nut is clamped between the nut and the receptacle. It is very important that the plug be clamped between the nut and receptacle to prevent vibration. Generally the nut should be able to be tightened to this point by hand. Correct any problems before proceeding.

6. Once the plug insulating body has been clamped, the nut should be tightened at least 1/4th of an additional turn until a force of approximately 25 foot pounds has been applied through the tightening device. Care must be taken not to over tighten, as both the plug nut and the receptacle threads are aluminum and can be stripped rather easily. Refer to Service Data for material part numbers.

4.12 SINGLE SPEED COOLING FAN STATOR

4.12.1 SURGE COMPARISON TEST TRACES (GOOD STATOR)

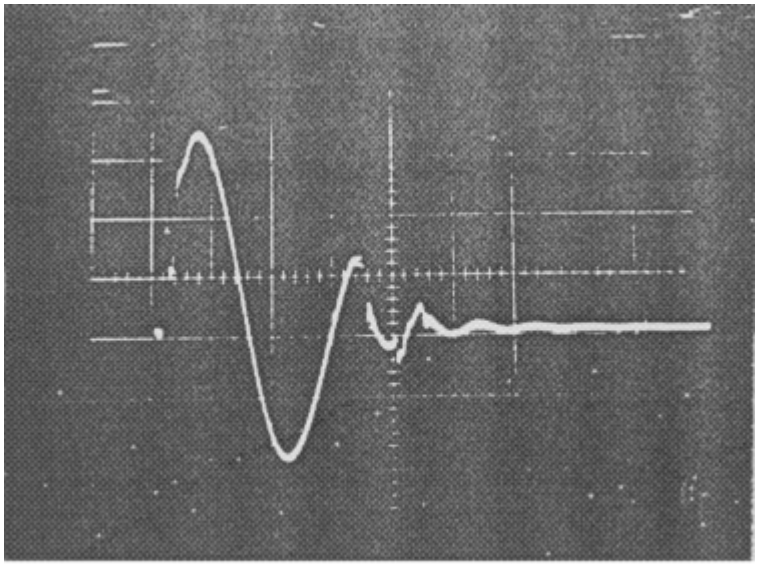

Figure 21 Phase #2 vs. Phase #3
Phase #1 as common return
VERTICAL SCALE 50 mV/div
HORIZONTAL SCALE 5u sec/div

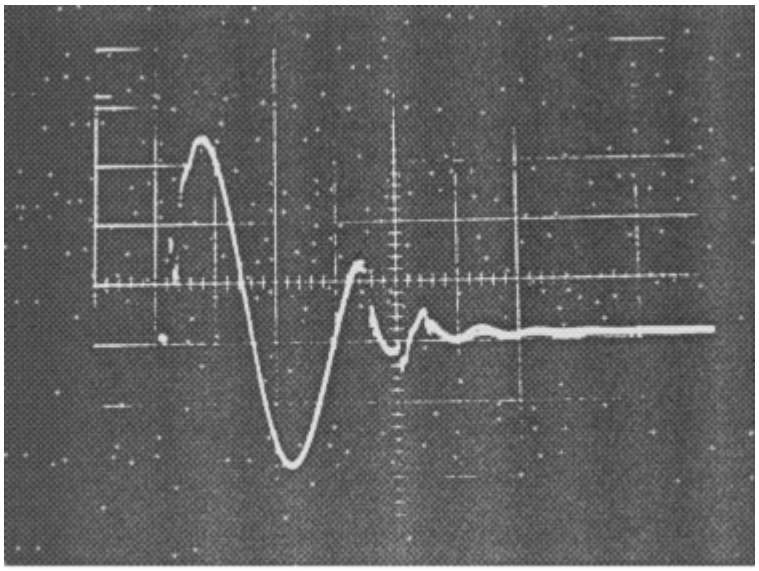

Figure 22 Phase #1 vs. Phase #2
Phase #3 as common return
VERTICAL SCALE 50 mV/div
HORIZONTAL SCALE 5u sec/div

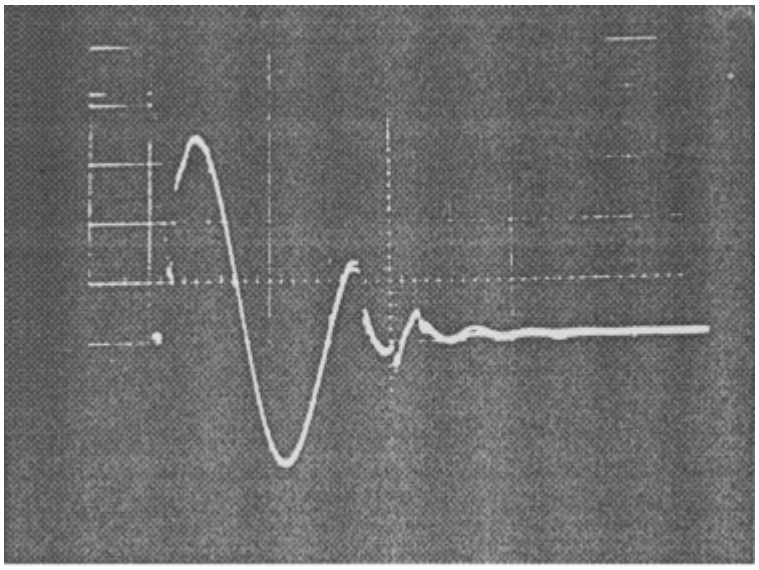

Figure 23 Phase #1 vs. Phase #3
Phase #2 as common return
VERTICAL SCALE 50 mV/div
HORIZONTAL SCALE 5u sec/div

4.12.2 SURGE COMPARISON TEST TRACES (SHORTED TURNS IN PHASE #2)

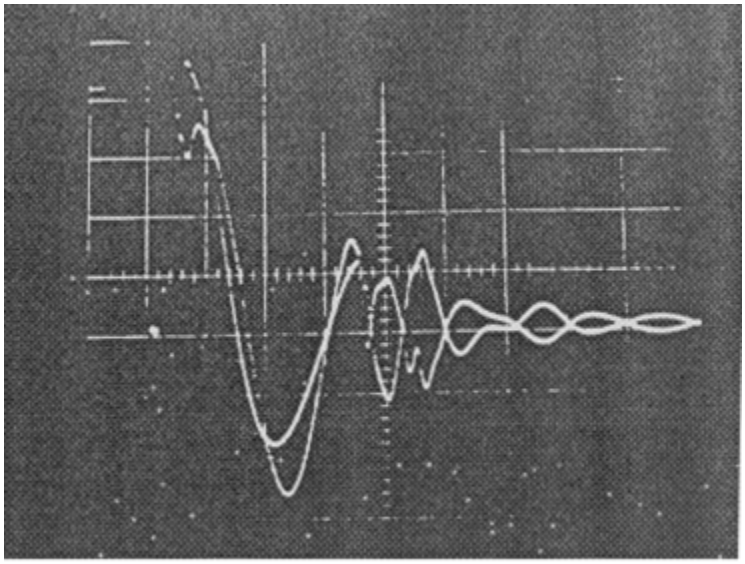

Figure 24 Phase #2 vs. Phase #3
Phase #1 as common return
VERTICAL SCALE 50 mV/div
HORIZONTAL SCALE 5u sec/div
(shorted turn identified)

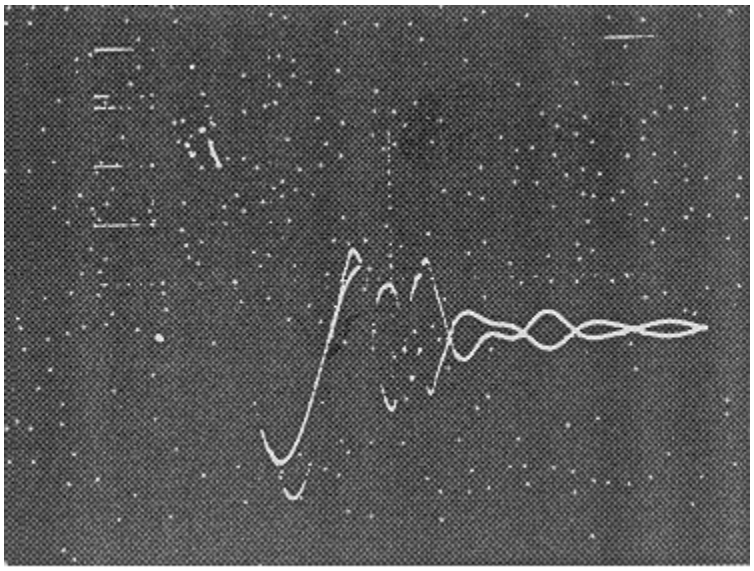

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Figure 25 Phase #1 vs. Phase #2
Phase #3 as common return
VERTICAL SCALE 50 mV/div
HORIZONTAL SCALE 5u sec/div
(shorted turn identified)

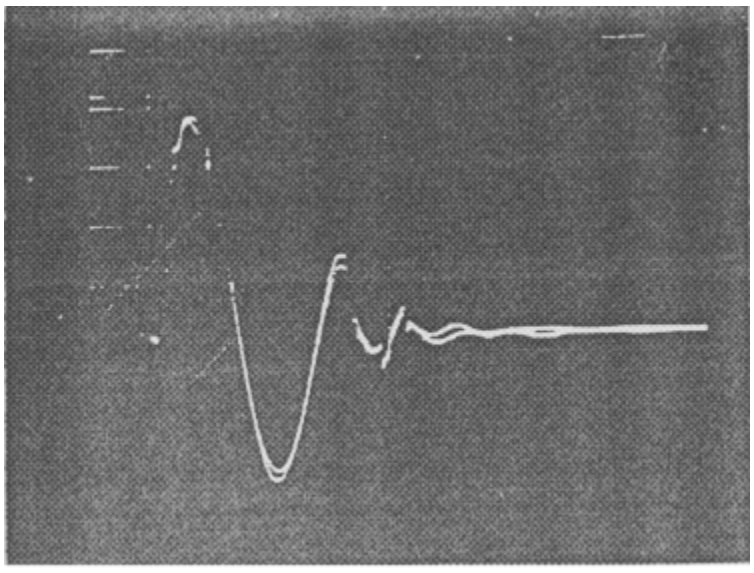

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Figure 26 Phase #1 vs. Phase #3
Phase #2 as common return
VERTICAL SCALE 50 mV/div
HORIZONTAL SCALE 5u sec/div
(shorted turn hidden since in common return path)

5.0 SERVICE DATA

5.1 SPECIFICATIONS

5.1.1 FAN ASSEMBLY

	FAN ASSEMBLY PART NUMBER	NUMBER OF FAN BLADES	REMARKS
2-Speed Fans	9544015	4	
	9544058	5	Originally equipped with Stator 2803187
	9544940	6	
	9544938	8	Replaced with Stator 22089691
	9561434	9	
		Replaced By	
	9576049	4	Originally equipped with Stator 2803187
	9576050	5	
	9576051	6	Replaced with Stator 22089691
	9576052	8	
	9576053	9	
	40021738	9	Replaces 9-Blade Fan Assembly 9576053
Single Speed Fans	9530899	9	No Fan Guard. Special Frame
	9522997	9	Fan Guard.
	9512427	9	No Fan Guard. Special Frame
	9517833	8	
	9528718	6	
	9536663	4	
DB Grid Blower	40071291	9	Used on DE/DM-30AC

NEW ASSY PART NUMBER	PART NUMBER & DESCRIPTION		APPLICATION	Diam. Ins.	No. Blade	2 Speed	Stator Part Number
9528718	9533148	Cooling Fan Asm	GP39X, SD40-2, SD50, SD50S	48"	6		2802795
9517833	9521880	Cooling Fan Asm	F40PH, F40PH-2, GP38-2, GP40-2, SD38-2, SD40-2, SD40-2(SS)	48"	8		2802795
9512227 9522997	9517909	Cooling Fan Asm	GP39-2, GP40X, GP50, SD40X	48"	9		2802795
9544015	9550572	Cooling Fan Asm	SD40-2, SD50, SD50S48	48"	4	X	22089691
9576049	9576985	Cooling Fan Asm	SD40-2, SD50, SD50S	48"	4	X	22089691
9576052	9576988	Cooling Fan Asm	GP50, SD60	48"	8	X	22089691
9561434	9565341	Cooling Fan Asm	GP60, GP60M, SD60, SD60M	48"	9	X	22089691
9576053	9576989	Cooling Fan Asm	GP60, GP60M, SD60, SD60M	48"	9	X	22089691
40021738	40028647	Cooling Fan Asm	SD60, SD60M, GP60M	48"	9	X	22089691
9519427	9536057	Cooling Fan Asm	F59PHI	48"	9		2802795
40037007	40041841	Cooling Fan Asm (New style frame 190 degree conduits)	SD70/75 - SD70MAC	48"	5	X	22089691
40054978	40078984	Cooling Fan Asm. W/Motor - (400V)	90MAC	52"	4	X	40057375
40051427	40061797	Cooling Fan Asm. W/Motor - (New style frame 180 degree conduits)	GT46 CWM	48"	8	X	22089691
40056814	40078985	Cooling Fan Asm. W/Motor - (400V)	SD80MAC	52"	5	X	40057375
40068158	40076064	Cooling Fan Asm. W/Motor - (480V) Grid Blower Fan Asm-W/Motor	DE30/DM30	48"	9	X	40066064
40085791	40096751	Cooling Fan Asm.	90MAC (Phase II)	52"	9	X	40064059

5.1.2 FAN BALANCING

Maximum unbalance 1800 mg•m (2.5 in.-oz. per balance plane) at 750 RPM

Fan Guard Access Door Retrofit Kit.....9540596

5.1.3 BLADE ASSEMBLY

Blade Mounting Bolt Torque ..... 129 -149 N•m (95 - 110 ft.-lbs.)
Balance Weight Bolt Torque..... 95 -109 N•m (70 - 80 ft.-lbs.)

5.1.4 STATOR ASSEMBLY

High Potential Test ..... 1200 Volts to ground, 10 seconds
Turn-to-Turn Short Test` ..... 800 Volts RMS
Phase-to-Phase Resistance Test at 25ºC (+ or – 5%)

STATOR P/N 2802795 (200V)

Single Speed Fan - Pin 1 to Pin 2, Pin 1
to Pin 3 and Pine 2 to Pin 3……. .028 ohms

STATOR P/N 22089691 (200V)

2-Speed Fan - Low Side - Pin 1 to Pin 2,
Pin 1 to Pin 3, and Pin 2 to Pin 3 (With pins 4, 5, 6, open)…… .091 ohms

2-Speed Fan - High Side - Pin4 to Pin 5,
Pin 4 to Pin 6, and Pin 5 to Pin 6 (With pins 1, 2, 3, shorted)……. .046 ohms

STATOR P/N 2805198 (400V)

2-Speed Fan - Low Side - Pin 1 to Pin 2,
Pin 1 to Pin 3, and Pin 2 to Pin 3 (With pins 4, 5, 6, open)……. .340 ohms

2-Speed Fan - High Side - Pin4 to Pin 5,
Pin 4 to Pin 6, and Pin 5 to Pin 6 (With pins 1, 2, 3, shorted)……. .175 ohms

STATOR P/N 2805713 (480V)

2-Speed Fan - Low Side - Pin 1 to Pin 2,
Pin 1 to Pin 3, and Pin 2 to Pin 3 (With pins 4, 5, 6, open)…… .9350 ohms

2-Speed Fan - High Side - Pin4 to Pin 5,
Pin 4 to Pin 6, and Pin 5 to Pin 6 (With pins 1, 2, 3, shorted)… .2338 ohms

STATOR P/N 2805640 (445V)

2-Speed Fan - Low Side - Pin 1 to Pin 2,
Pin 1 to Pin 3, and Pin 2 to Pin 3 (With pins 4, 5, 6, open)…… .120 ohms

2-Speed Fan - High Side - Pin4 to Pin 5,
Pin 4 to Pin 6, and Pin 5 to Pin 6 (With pins 1, 2, 3, open)… .033 ohms

NOTE

At any measurement temperature the resistance combinations lead set should not vary by more than plus or minus 5 % on any of the phases measured.

Weights (8-Blade, 2-Speed) (approximate) ..... 365 kg. (805 lbs.)

5.1.5 PLUG ASSEMBLY

Plug, 100 Amperes, 250 Volts 8323955
Terminals (male contacts), size 125/24.....8327717
Terminals (female receptacles), size 125/24.....8319657
Terminal Crimping Tool .....Thomas & Betts Co. Die No. 33
Wire Lead Connector (2-way butt) 8200889
Wire Lead Crimping Tool.....8166676

5.1.6 BEARING ASSEMBLY

Fan End Bearing (large)
Single Speed 9-Blade and all 2-Speed Fans 908440
Single Speed 4, 5, 6, and 8-Blade Fans.....908486

Frame End Bearing (small)
All "Q" Type Fans.....9440292

Fan End Bearing (large)
9-Blade 2-Speed 52” Fan (40085791) 908497

5.1.7 GREASE

Fan End Bearing (large) - Single Speed 9-Blade and all 2-Speed Fans
Supermil MI25, 0.45 kg. (1 lb.) can.....9318549
Amount added over Shield of Large Bearing ..... 85 g. (3 oz.)

Fan End Bearing (large) 9-Blade 2-Speed 52" Fan (40085791)
Supermil MI25, 0.45 kg. (1 lb.) can.....9318549
Amount added over Shield of Large Bearing ..... 85 g. (4 oz.)

Frame End Bearing (small) - All "Q" Type Fans - Fan End Bearing (large)
Single Speed 4, 6, 8-Blade Fan
Chevron SRI-2, 2 kg. (5 lb.) can.....8398924
Amount added over Shield of Bearings..... 85 g. (3 oz.)

5.2 MATERIAL LIST

Sealing Compound (Loctite) 250 cc. (8.45 oz.).....8494711
Enamel Paint, Red Air Drying
1 liter (1 quart).....8061130
19 liters (5 gal.).....8084876
RTV, Silicone Compound, 170 g. (6 oz.), cartridge 8345495
Tubing, Vinyl Sleeving 13 mm(.450")I.D.x3-1/2" 2801757
Cleats 9098146
Insulation (Nomex) Frame 9521996
Insulation, Lead-Conduit.....9520559
Megger, Insulation Resistance Test Set 8174880
Leads, 3.7 m (12 ft.) 8174878
Carrying Case.....8174879
Ohmmeter, Phase-to-Phase Resistance Test Kit.....9322571
Loctite Primer N (plug receptacle)(6 oz.)Aerosol..... 40033690
Loctite Threadlocker 222 (plug receptacle)(50ml) 40034088

NOTE

Each container of Primer and Threadlocker will be enough material for approximately 100 applications.

Varnish, Electrical Insulating - Modified Polyester Y-432
(Sterling Varnish Co.) 19 liters (5 gal.).....8489774

NOTE

Varnish mixture to have viscosity at 100 to 130 seconds using Ford Cup No. 4 at 21.1ºC (70ºF).

Thinner Solvent for above Varnish

*Chevron No. 1300 Solvent

*Thompson-Hayward Chemical Company No. 2026 Solvent

**Xylol Thinner

NOTE

Butyl acetate or butyl cellosolve is used with the following two thinner solvents because the varnish sets up in the tank when mineral spirits thinner is used alone.

An alternate thinner solvent may be blended using the following materials.....9083470

*Mineral Spirits (Rule 66 Type Thinner) 80%

*Butyl Acetate - Technical Grade 20%

Alternate Thinner.....9544540

*Mineral Spirits (Rule 66 Type Thinner) 70%

*Butyl Cellosolve 30%

*To be used where compliance with pollution control regulation is required.

**Xylol may be used as a substitute thinner, however, Xylol DOES NOT comply with pollution control regulations.

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