ELECTRO-MOTIVE

MAINTENANCE INSTRUCTION

M.I. 4102
*Rev. C

48" AC MOTOR DRIVEN COOLING FAN

DESCRIPTION

Refer to Service Data for part numbers of AC motor driven cooling fans covered in this Maintenance Instruction.

Most current production locomotives are equipped with "Q" (quiet) cooling fans. Refer to M.I. 4105 for maintenance instruction for "Q" AC motor driven cooling fans.

The AC motor driven cooling fan, Fig. 1, basically consists 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.

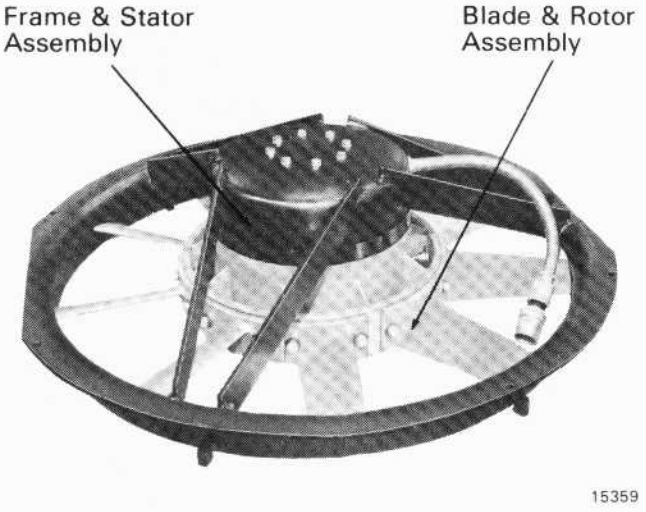

Fig.1 – Nine Blade Cooling Fan Assembly

OPERATION

During circulation through the diesel engine 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 depends upon the locomotive model, engine size, and cooling requirements.

On most locomotives, the fans are mounted in a hatch, 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.

The fans, which operate independently, are controlled automatically by thermostatic switches and contactors, which function with changes in the cooling system temperature.

Motor and fan speed is directly proportional to the AC frequency which, in turn, depends on the engine (and alternator) speed. The cooling fans run at approximately 600 RPM at engine speed of 315 RPM and approximately 1700 RPM at engine speed of 900 RPM. Rotation is clockwise when looking down at the fan.

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

*This bulletin is revised and supersedes previous issues of this number.

MAINTENANCE

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

LUBRICATION

Ball bearings used on cooling fans are the double shielded prelubricated type. The bearings, protected by inner and outer seals, are packed and sealed at the factory with grease, and are designed to operate without further lubrication. On overhaul, the bearing should be removed and replaced with new factory packed bearings.

OPERATING INSPECTION

Periodic inspection of the cooling fans should be made as follows:

1. Inspect to see that the fan is securely fastened.

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

3. With the engine running, complete a circuit through the thermostat switch to operate the fan. 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 fan from being inadvertently started.

The fan may be isolated by removing BOTH fuses in the fan motor circuit.

If 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.

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 flexible conduit or connection plug.

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

3. Test stator winding insulation resistance, using a 500 volt DC megger. The allowable minimum indication is 1 megohm. If a megger indication of 1 megohm cannot be obtained, stator may have to be dried by placing it in a 120° C (248° F) oven for 4 to 6 hours.

   After drying, if the megger indication is still less than 1 megohm, further testing should be made after disassembly.

4. Mount motor in a fixture designed to prevent air flow through the fan during running test.

5. Connect motor leads to a 115 volt AC, 3-phase, 60Hz power source, or to the locomotive alternator.

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

DISASSEMBLY

With the fan and motor positioned with the fan end up, refer to Fig. 2, and disassemble as follows:

1. Remove the cap screws from the fan hub, and remove the cover plate.

2. Remove fan and rotor assembly from shaft hub. If necessary, lightly tap center of shaft hub to loosen fan pilot from shaft hub.

3. 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.

   If 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.

NOTE

Blade replacement requires dynamic balance to within 3600 mg·m (5 in.-oz.). Do not paint the fan blades or hub.

4. Unscrew flexible conduit locking nut from connector and push back conduit. Loosen

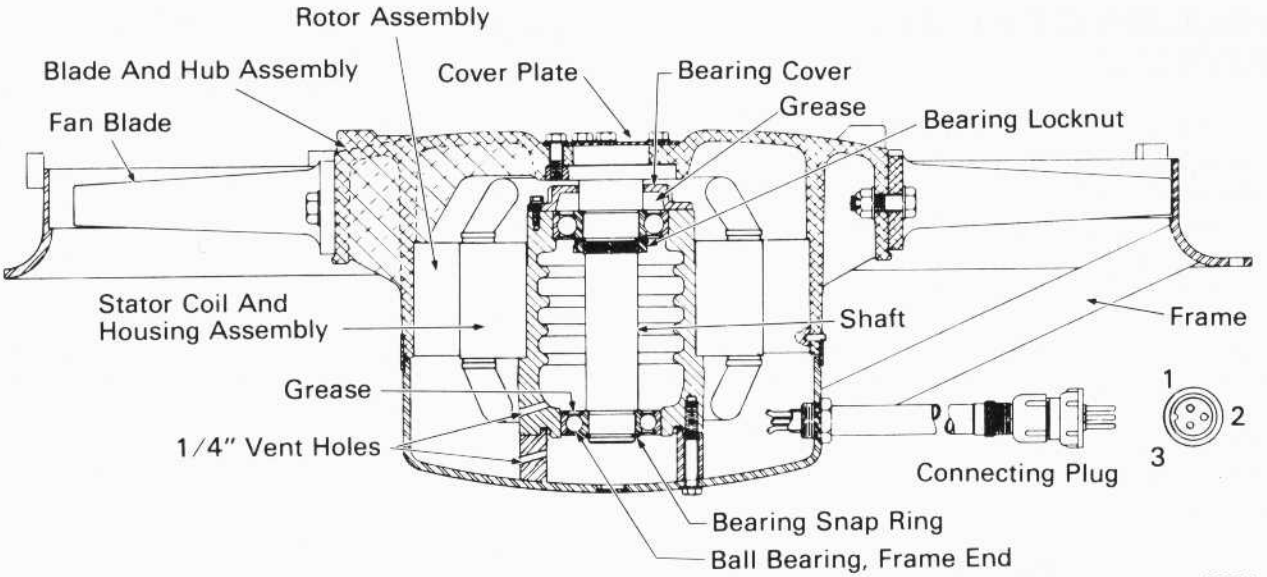

Fig.2 - Cross-Section Of Cooling Fan Assembly

connector housing and push back along leads. Separate connector insert from body, exposing snap rings on terminals, Fig. 3. Identify leads and tag as follows: terminal No. 1, red tracer; terminal No. 2, no tracer; and terminal No. 3, blue tracer.

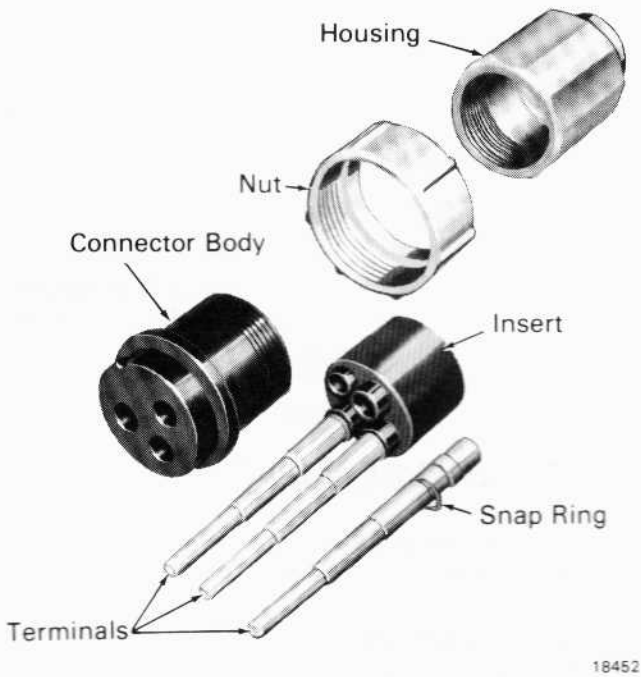

Fig.3 - Fan Motor Connector

5. Remove snap rings, and slide terminals out of connector insert. Retain snap rings for reassembly. Remove connector parts from cable. Loosen conduit fasteners from the frame, and remove fasteners and flexible conduit from the leads.

6. Turn stator and frame assembly upside down, and place blocks under shaft to support stator winding assembly.

7. Remove cap screws from frame to stator winding assembly. Remove frame from bearing housing and stator assembly.

8. Remove stator assembly and place on a clean work bench in preparation for removal of bearing assembly.

REMOVAL OF BEARING ASSEMBLY FROM SHAFT

1. Remove the cap screws holding bearing cover to housing. Remove bearing assembly from hub end of shaft.

2. Remove bearing assembly and shaft from housing by tapping with a soft mallet on the small end of the shaft.

3. After removal of bearing assembly and shaft from housing in stator assembly, remove snap ring from small bearing end of shaft, and remove bearing by applying pressure to the inner race.

4. Remove bearing lockwasher and nut from shaft and remove bearing cover and large bearing simultaneously from shaft. Discard bearing.

5. Inspect the hub portion of the fan frame, and the bearing housing for 1/4" vent holes, Fig. 2. If holes are not present, drill in locations indicated.

CLEANING OF STATOR ASSEMBLY

The stator assembly should be cleaned of all dirt and grease prior to varnish treatment. 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 of protective coating on various parts.

If deposits of dirt are caked or difficult to remove, it may be necessary to clean 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.

VARNISH TREATMENT OF 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 21.1° C (70° F). 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 stator in a convection type oven until copper temperature reaches 135° C (275° F), then continue to heat for two hours at a temperature of 135° to 140° C (275° to 284° F). Oven temperature should not exceed 160° C (320° F) during heating cycle.

3. Remove stator from oven and while still hot (minimum temperature of 100° to 120° C [212° to 248° F]), dip stator into varnish and allow to soak for three minutes.

4. Remove stator from varnish, drain, and bake stator for five hours, maintaining stator temperature at 135° to 140° C (275° to 284° F). Oven temperature should not exceed 160° C (320° F) during baking cycle.

FAN ASSEMBLY BALANCE

The current fan blade 9534306 has a solid base. The previous fan blade 9096524 had a relieved base. Balancing will be facilitated by using all blades of the same design. If blades must be mixed, ensure that blades of the same type are positioned in pairs, 180° apart, because of the weight difference.

Dynamically balance the fan assembly to within 3600 mg·mm(5 in.-oz.). One washer is used against the casting of the blade and hub assembly. When balancing, additional washers (4 washers per bolt for balance weights maximum) are to be used for balance weights with a longer bolt. The bolt must be of a length so that at least two full threads protrude beyond end of nut.

Torque fan blade mounting bolts to 129 - 149 N·m (95 - 110 ft-lbs).

CLEANING AND PAINTING OF STATOR ASSEMBLY

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

2. Clean off excess varnish from outside of 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. Paint bearing housing and outside of laminations with red air drying enamel. Refer to Service Data for part numbers.

5. Allow painted areas to dry thoroughly.

SHAFT AND BEARING ASSEMBLY

1. Make sure that shaft and housing bore are clean and free of burrs. Refer to Fig. 2.

2. Apply additional grease to the cavity in the bearing cover and install cover on shaft, small diameter of bearing cover toward shaft flange. Refer to Service Data for type and quantity of grease.

3. Press a new fan end bearing assembly on shaft. Apply pressure to face of inner race, and drive solidly up against the shaft shoulder. Apply lock plate and nut. Tighten nut and bend up lip of lock plate into nut slot to lock nut in place.

4. Install the small bearing assembly on the shaft. Apply pressure directly (straight and square) to face of inner race, and drive bearing solidly up against the shaft shoulder. Apply snap ring in groove of shaft to hold the bearing in place.

5. Apply additional grease to the side of the bearing facing the fan end bearing. Refer to Service Data for type and quantity of grease.

FINAL ASSEMBLY OF MOTOR

1. Apply a thin film of grease to the fits between frame and bearing housing. Install stator winding assembly in frame so that the leads will be in lie with the conduit hole in the frame.

2. Check tightness of balance weights on fan and rotor.

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

4. Mount the fan and rotor assembly on shaft hub of stator assembly. Use two pilot bolts in hub holes to guide fan assembly onto shaft hub.

5. Clean the cover plate and apply red insulating enamel to the cover. While paint is still wet, apply cover plate over pilot bolts. Remove pilot bolts. Do not paint fan blades.

NOTE

The paint on cover plate is used for sealing.

6. Apply lockwashers and cap screws to fasten the cover plate to fan assembly. Tighten cap screws evenly to 95-102 N·m (70-75 ft-lbs).

7. Raise fan and stator assembly off of frame and place on suitable fixture with fan facing down.

8. Check clearance between rotor and stator. Check full length of stator surface at four points, 90° apart. Rotate fan at each check point. Minimum clearance should be 0.30 mm (.012"). If clearance is less 0.30 mm (.012"), fan assembly should be removed and repositioned 180° and rechecked. If minimum clearance is not obtained, replace fan assembly rotor with a new rotor and recheck clearance.

9. Lower frame onto fan and stator assembly so that leads will be in line with conduit hole in the frame. Pull leads through hole as assembly is being lowered into frame.

10. Apply lockwashers and cap screws to fasten the frame to stator winding assembly. Tighten cap screws evenly to 95-102 N·m (70-75 ft-lbs).

11. Arrange stator leads evenly and slide the flexible conduit and conduit fastener over leads. Tighten conduit fastener to frame.

12. Slide connector housing over cable. Insert terminals into connector insert. Install snap rings on terminals and complete assembly of connector. If terminals require replacement perform Steps a, b, and c.

    a. Bare 12 mm ± 0.8 (1/2" ± 1/32) of cable.

    b. Apply cable into terminal and place in a die, such as a Thomas & Betts die No. 33, with shoulder of terminal against die face.

    c. Crimp terminal onto cable as shown in Fig. 4.

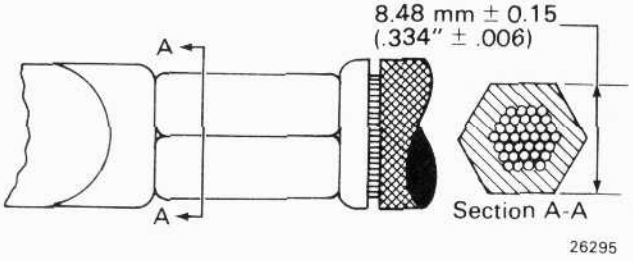

Fig.4 - Plug Terminal Crimp

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

FINAL INSPECTION AND TEST

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

SERVICE DATA

SPECIFICATIONS

FAN ASSEMBLY

Fan Assembly Part Number	Number Of Fan Blades
8379212	9
8392515	9
8310416	8
8480544	8
8495693	8
8311479	6
9310126	6

Maximum unbalance . . . . . 3600 mg·m (5 in. oz.) at 750 RPM

BLADE ASSEMBLY

Blade mounting bolt torque . . . . . 129-149 N·m (95-110 ft-lbs)

STATOR ASSEMBLY

Hi-pot test . . . . . 1200 volts to ground, 10 seconds

PLUG ASSEMBLY

Plug, 100 Amp, 250 volt 8323955
Terminals (male contacts), size 125/24 8327717
Crimping tool . . . . . Thomas & Betts Co. Die No. 33

BEARING ASSEMBLY

Fan end bearing 908354
Frame end bearing 907931

GREASE

Chevron SRI-2, 2 kg (5 lbs) 8398924
To be added to bearing cavity . . . . . 85 g (3 oz.)

MATERIAL LIST

Enamel, Red Air Drying
1 litre (1 qt) 8061130
19 litre (5 gal) 8048876
Varnish, Electric Insulating - Modified Polyester Y-432 (Sterling Varnish Co.)
Thinner Solvent For Above Varnish
*Chevron No. 1300 Solvent
*Thompson – Hayward Chemical Company No. 2026 Solvent
**Xylol Thinner
An alternate thinner solvent may be blended using the following materials:
*Mineral Spirts (Rule 66 Type Thinner) 80%
*Butyl Acetate – Technical Grade 20%

NOTE

The above blend is required because the varnish sets up in the tank when mineral spirits thinner is used alone. Butyl acetate prevents this.

*To be used where compliance with pollution control regulations is required.
**Xylol may be used as a substitute thinner, however, Xylol DOES NOT comply with pollution control regulations.