MAINTENANCE INSTRUCTION
M. I. 3317-1
Revision F

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

SCHEDULED MAINTENANCE AND OVERHAUL INSTUCTIONS AR and TA-TYPE TRACTION ALTERNATORS

SAFETY PRECAUTIONS

Please refer to the EMD Safety Precautions in the 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 AR and TA-type Main Generators 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 AR and TA-type main generators. 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 the AR and TA-type main generators. Component renewal provisions are consistent with traditional overhaul procedures.

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

AR and TA Series Main Generators:
High Speed Service: 16 years / 2,500,000 miles /4,022,500 Kilometers
Heavy Haul Service: 8 years / 2,000,000 miles /3,218,000 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

The main generator consists of an AR or TA-type traction alternator and a companion alternator (D14, D18 or CA series). The companion alternator is physically connected to, but electrically independent of the traction alternator.

NOTE

The TA12-8 Main Generator assembly as applied to DE/DM30AC locomotives does not have a Companion Alternator. The Exciter Generator supplies excitation for the Main Generator field.

The AR-type Main Alternators are being used on DC traction locomotives, and supply DC power directly to the DC Traction Motors through motorized switchgear and contactors.

The TA-type Main Alternators are used on AC traction locomotives, and supply High Voltage DC power (up to 2900 volts) to two inverters which convert DC into variable three-phase AC to control the speed and traction effort of the three-phase AC Traction Motors.

Differences between traction alternator models will be identified throughout this maintenance instruction, but this instruction will apply to all models unless specifically identified.

The main generator consists of two, three-phase, alternating current generators with a single bearing. The spiders of the two machines are bolted together and the coupling disc of the companion alternator is bolted to the coupling of the engine. The outboard end of the rotor assembly is supported by a bearing.

The rotating field of the traction alternator consists of 10 poles. Each series-connected field coil is wound on a laminated pole, which is bolted to a drum-type spider. The spider is connected to the rotor shaft, which is supported by the bearing mounted in the main generator end housing.

The field coils are insulated with class "F" insulation, and are electrically connected to the two inboard collector rings mounted in the air box at the bearing end of the assembly. The companion alternator field coils are electrically connected to the two outboard collector rings. The collector rings and associated brush holders provide the means of exciting the fields of the two machines.

Current production models are equipped with an air box cover, which includes diode-viewing windows and access door(s), Figure 1. The door(s) provide easy access to the collector rings and brushes, for inspection and replacement of brushes. Another feature includes the collector ring cover, Figure 2, used to prevent snow or water from entering the collector ring area.

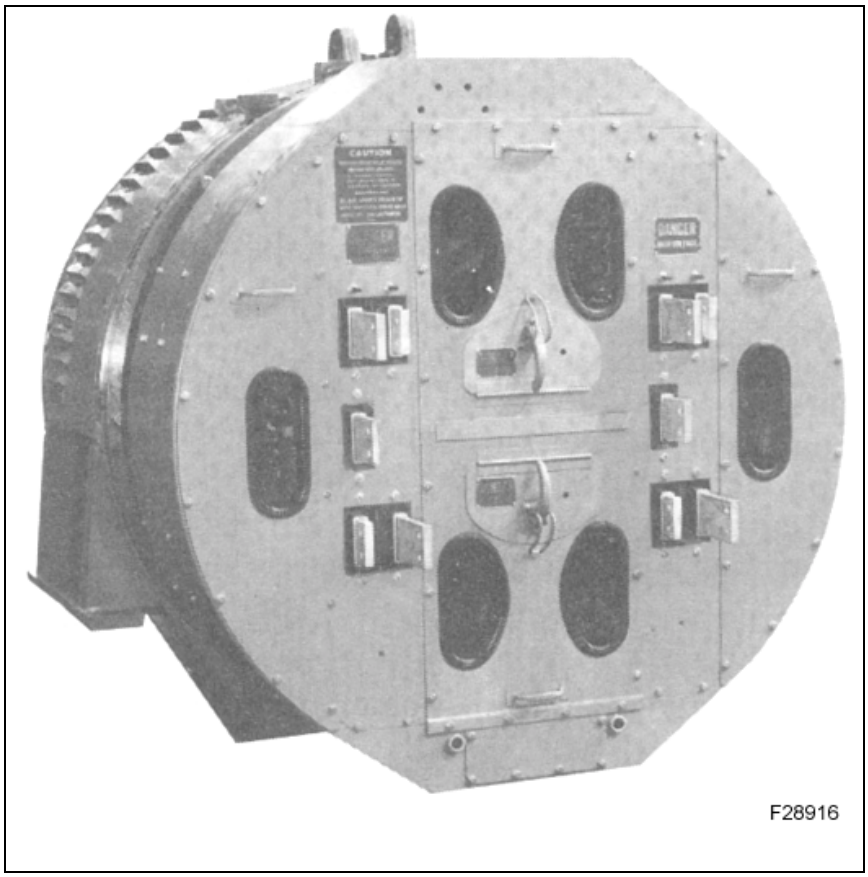

Figure 1 Typical Main Generator (AR11)

The traction alternator stator frame and core assembly, utilizing welded construction, provides a rigid structure, which houses the stator windings and supports the end housing and companion alternator stator assemblies. The class "H" insulated traction alternator stator coils are internally connected at the bearing end of the stator into two sets of three-phase "Y" connected windings.

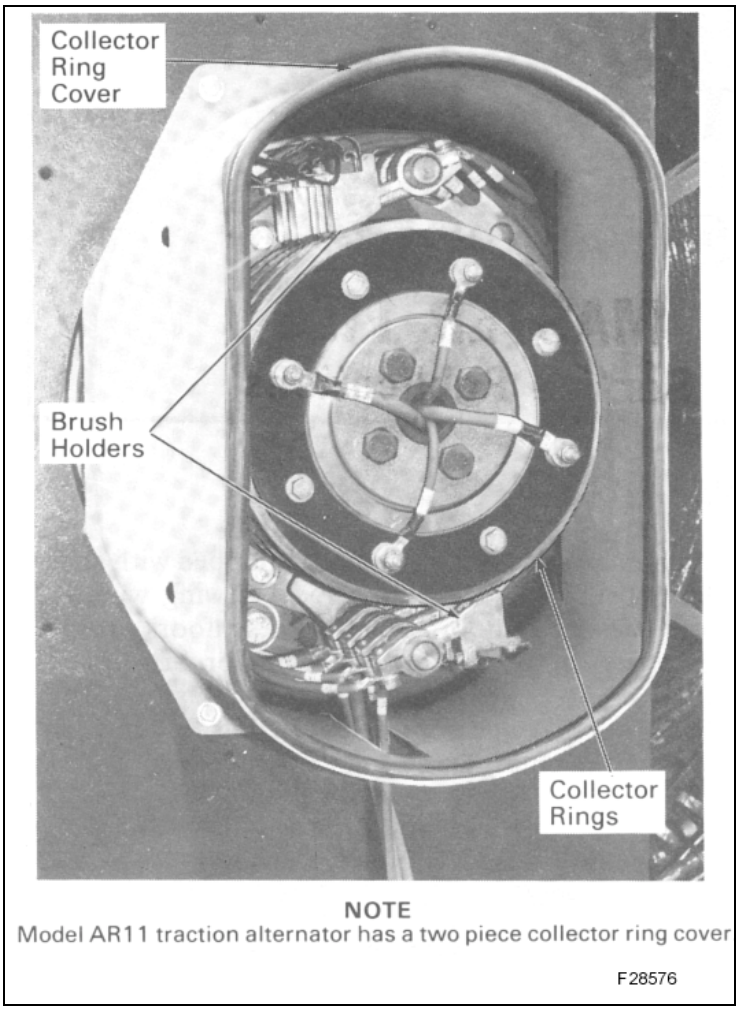

Figure 2 Typical Brush Holders/Collector Rings and Cover Arrangement

NOTE

Some traction alternator models have a two-piece collector ring cover.

Two rectifier assemblies mounted on the front of the main generator provide a means of converting the three-phase AC power to DC power. Each assembly consists of high-current, high-voltage, silicon diodes connected in a three-phase, full wave, rectifier circuit, and mounted on heat sinks capable of providing adequate cooling.

NOTE

For information on the AR10, AR12, AR15, AR16, AR17 and TA series Rectifier Banks and Suppression Circuit, refer to M.I. 3317-2. For information on the AR8, AR11 and AR20 Rectifier Banks and Suppression Circuit, refer to M.I. 3317-3. AR5 main generator is covered by MI 3318 and AR6 by MI 3323. Main generators equipped with a Head End Power alternator (HE) are covered under MI 3319. For information on the D14 alternator, refer to MI 3306. For information on the D18 alternator, refer to MI 3307. For information on the CA series alternators refer to MI 3308.

2.0 INSPECTION AND MAINTENANCE

The traction alternator is designed and manufactured to provide a long service life, and optimum performance with a minimum of maintenance. The types of operation and service to which the alternator is subjected largely determine the extent of the maintenance required. Inspections and maintenance should be performed at the time intervals specified in the Scheduled Maintenance Program.

Both the interior and exterior of the traction alternator should be kept clean and free of dust, dirt, oil, and water, which are likely to have a detrimental effect on insulation and performance.

If alternator is not disassembled, do not clean with a liquid cleaner. Dry compressed air at low pressure 207-345 kPa (30-50 psi) may be used to blow out dirt from the stator and rotor assembly. Clean bound-edge, lint-less wiping cloths should be used as necessary to remove oil, grease, and accumulation of dirt. It is essential that the rectifier section be kept as clean as possible at all times.

CAUTION!

Do not use high air pressure since there is danger of loosening the insulation binding and blowing particles which may damage the insulation.

Where the use of low air pressure and dry cloths proves ineffective in removing imbedded deposits of dirt, a stiff brush, soft wood, or fiber scrapers may be used. In severe cases, (to prevent surface creepage), dampen a cloth in solvent such as Stoddards Solvent to loosen and remove the dirt from rotating field terminals and connectors.

CAUTION!

Ensure there is adequate ventilation and that safety precautions are observed when handling inflammable fluids such as Stoddards Solvent, which has a flash point of 46°C (115°F).

After cleaning, paint connectors and field coil connections with red air-drying enamel. When enamel has dried, apply black air-drying varnish. Refer to Service Data for red air-drying enamel and black air-drying varnish part numbers.

2.1 CABLES AND TERMINAL BOARD

Ensure tightness of all mechanical and electrical connections. Cable connections to the terminal board and brush holders should be intact. Using dry cloths, wipe away any accumulation of dirt.

2.2 RECTIFIER BANKS AND SUPPRESSION CIRCUIT

Ensure tightness of all mechanical and electrical connections (Diodes, Fuses, Resistors and Capacitors). Check for open fuses (indicating pins protruding). Check for open, shorted and grounded Suppression Circuit resistors and capacitors. For detailed information on the AR10, AR12, AR15, AR16, AR17 and TA series Rectifier Banks and Suppression Circuit, refer to MI 3317-2. For information on the AR11, AR20, and AR8 Rectifier Banks and Suppression Circuit, refer to MI 3317-3.

2.3 COLLECTOR RINGS, BRUSHES AND BRUSH HOLDERS

Collector rings and brushes, Figure 3, should be frequently checked for sparking while the generator is in operation. It is normal for the negative collector ring to wear more rapidly than the positive ring. Reversing the polarity of the slip rings every six months can minimize the unequal wear. Refer to Service Data for the minimum length of the Brushes, and the minimum diameter of the Slip Rings.

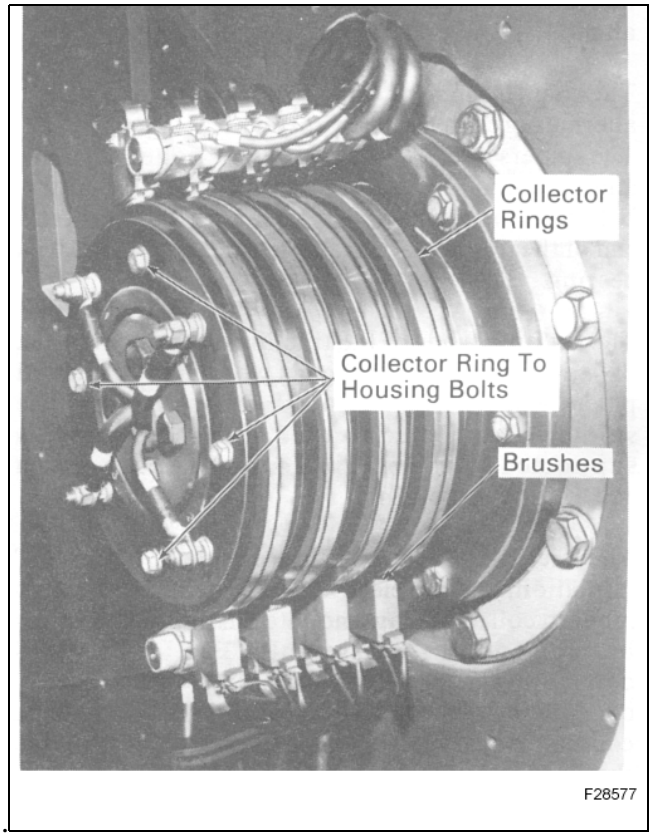

Figure 3 Typical Collector Ring and Brush Arrangement

2.3.1 COLLECTOR RING SPARKING

Sparking on collector rings should be corrected immediately to prevent failure of the generator. The various causes of sparking and their remedies are discussed in the following sections.

2.3.1.1 Oil On Surface Of Collector Ring

If collector ring surfaces are oily, wipe off the surface of the rings and brushes with a clean, dry, lint-less cloth.

2.3.1.2 Loose Brush Holder

The generators are generally equipped with eight constant pressure brush holders, four mounted at the top of the collector ring assembly, and four at the bottom. If a brush holder is not mounted securely to the brush holder stud or the stud itself is loose, it will allow the brushes to bounce on and off the collector ring, resulting in sparking. Tighten all mounting bolts.

NOTE

In certain applications there are 10 brushes, six for the main alternator and four for the companion alternator. The two extra holders are for the higher field current required in the main generator. These models include: AR17 (GP60), AR20 (SD70/75), TA17 (SD70MAC), TA20 (SD90MAC Phase II), TA22 (SD80/90MAC). The TA12 applied to the DE/DM30AC locomotive does not have a companion alternator, and therefore has only two slip rings and 2 double brush holders on top, one for each slip ring.

Check that each brush is centered to within 1.6 mm (1/16") of the mating collector ring, when facing the brush holders. The right-hand side of all brush holders is set closer to the collector rings than the left side. Check that the right-hand side is 1.6 mm ± 0.8 mm (1/16" ± 1/32") closer. Clearance between the slip rings and the brush holders should be set at 3 mm ± 0.8 mm (1/8" ± 1/32").

2.3.1.3 Damaged Brush Holders and Springs

Brush holders with traces of arcing and burrs should be cleaned and repaired. Make certain that brushes are free to move up and down in their slots. The springs should be removed to inspect, and replaced if found defective. Spring pressure, on constant pressure brush holders, is preset and cannot be adjusted. The pressure will remain constant throughout the brush life, regardless of brush wear. Main Generator brush spring pressure is 1.5 kg (3.3 lbs) and Companion Alternator spring pressure is 0.68 kg (1.5 lbs.).

2.3.1.4 Eccentric or Pitted Collector Rings

If collector ring eccentricity exceeds 0.15 mm (0.006"), total indicator reading (ring assembly installed), the ring will have to be machined to bring it into tolerance. A rough or pitted collector ring surface should also be cleaned up by machining.

The above conditions can usually be corrected by grinding. However, the minimum acceptable diameter of collector rings is 260 mm (10 1/4"). If rings cannot be cleaned up without going below minimum diameter, they should be renewed. Rings should also be renewed if lateral run-out exceeds 0.8 mm (1/32").

A collector ring grinder is available (8219264), which must be mounted to the generator with an adapter. Adapter 9506268 is used on large bearing (260 mm) generators, and adapter 8364940 is used on small bearing (215 mm) generators. (See Service Data)

2.3.2 COLLECTOR RING GRINDING

Use the following procedure to grind the collector ring surface.

CAUTION

Never use emery cloth to polish collector rings, or to sand new brushes.

1. Remove the collector ring cover (snow guard), the 12 o'clock brush holders, and remove diode fuses as required, to provide clearance for the grinder and adapter. If brushes are to be reinstalled, label them so that they may be reinstalled in their original positions.
2. Mount applicable adapter assembly at the 2 o'clock position on the bearing housing flange, using two of the eight 3/4"–10 bearing housing bolts.

CAUTION

Use care to avoid damage or loss of the insulating washers, insulating strip, or bolt hole insulating tubes (surrounding the bearing housing to end housing bolts) so that electrical isolation of the bearing is maintained.

3. Mount collector ring grinder to grinder adapter.
4. Position grinder so that there is 3 mm (1/8") clearance between the grinder and the collector ring to be ground.
5. Install grinding stones in position on grinder. Ensure there is enough travel to grind the rings. Figure 4 shows the grinding equipment in place.

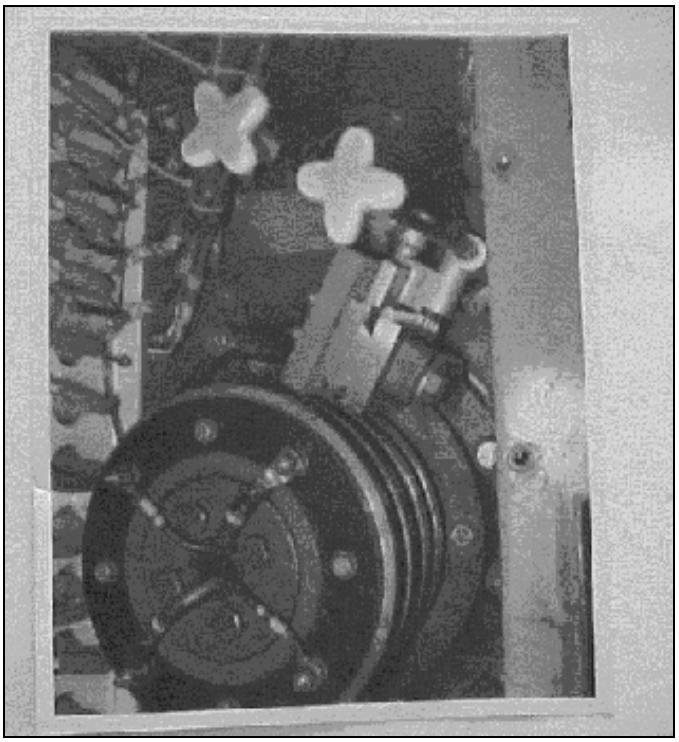

Figure 4 Grinding Equipment Installation

CAUTION

Make certain that grinding stones do not contact collector ring surface until generator begins rotating.

6. Make necessary preparations to start engine. Start the engine and run it at approximately 600 R.P.M.
7. Gradually bring stones in contact with ring surface. Grind ring surface until it is smooth. After grinding, stop engine and recheck eccentricity with a dial indicator. Do not exceed 0.15 mm/.006 in.
8. When grinding operation is complete, stop engine and remove grinding equipment. Blow all grinding dust from stator and rotor assemblies. Use high volume low-pressure air.
9. Reassemble brush holder assemblies in their proper positions. Renew brushes if necessary; refer to Brush Inspection and Renewal (2.3.4).

NOTE

Current model generators are equipped with eight constant pressure brush holders, four mounted at the top of the collector ring assembly, and four at the bottom. Earlier model generators had four double arm brush holders mounted at the top of the collector ring assembly. The brushes riding on the two inside collector rings are for the main generator, and the brushes riding on the two outside collector rings are for the companion alternator. The spring pressure is preset and cannot be adjusted. The pressure will remain constant throughout the brush life, regardless of brush wear.

In certain applications there are 10 brushes, six for the main alternator and four for the companion alternator. The two extra holders are for the higher field current required in the main generator. These models include: AR17 (GP60) AR20 (SD70/75), TA17 (SD70MAC), TA20 (SD90MAC Phase II), TA22 (SD80/90MAC).

The TA12 main generator assembly applied to the DE/DM30AC locomotive does not have a companion alternator, and therefore has only two slip rings and 2 double brush holders on top, one for each slip ring.

2.3.3 SLIP RING RENEWAL

If it is necessary to remove the entire slip ring assembly, follow steps 1 - 8 discussed in Section 2.5.1 - Large Bearing Maintenance.

To reapply the slip ring assembly:

1. Place collector ring assembly on induction heater and heat to 104° C (220° F). Pyrometer readings (with current off) should be taken periodically. After heating, place collector ring assembly on rotor shaft, against outer seal. Rotate ring assembly on shaft to properly position the lead connection to the terminals of ring assembly.

WARNING

If work involving collector ring connections has been performed, use a continuity tester (with all field leads disconnected and all brushes lifted), to check that collector ring terminals marked 1 through 4 on the steel hub adjacent to the terminals, are connected to the appropriate collector rings (No. 1 outboard, No. 4 inboard). All four slip rings are identical, but slip ring stud length differs:

Stud 1 is 2-3/8" long

Stud 2 is 4" long

Stud 3 is 5-5/8" long

Stud 4 is 7-1/4" long.

2. Place retainer plate over leads, and on to the end of rotor shaft. Torque the 5/8"-11 retainer plate mounting bolts to 149-163 N.m (110-120 ft-lbs).
3. Install cable grommet over four field leads and insert grommet into retainer plate.
4. Connect large field leads (traction alternator) to collector ring terminals 3 and 4, and smaller field leads (companion alternator) to terminals 1 and 2. Secure leads by torquing mounting bolts to 10-12 N.m (7-9 ft-lbs).

2.3.4 BRUSH INSPECTION AND RENEWAL

Inspect brushes for wear, and replace when reaching the minimum length of 3.81 cm. (1.5 in.) on the longest vertical side. Replace brushes that are too short to run until the next scheduled inspection. Move brushes up and down in brush holders to release carbon dust, and replace chipped or broken brushes, or brushes with loose or broken pigtails.

Brushes must fit the collector rings arc. If brushes are not contoured to fit the collector ring, they must be sanded in. This can be done by placing a piece of No. 00 grade sandpaper on the surface of the ring with the rough side against the brush. Then, move sandpaper in direction of normal rotation of rotor shaft until brush conforms to ring surface. Lift the brush when moving the paper back, and keep the paper close to the rings to avoid rounding the edges of the brush. Seat one brush at a time; repeat the procedure for the remainder of the brushes.

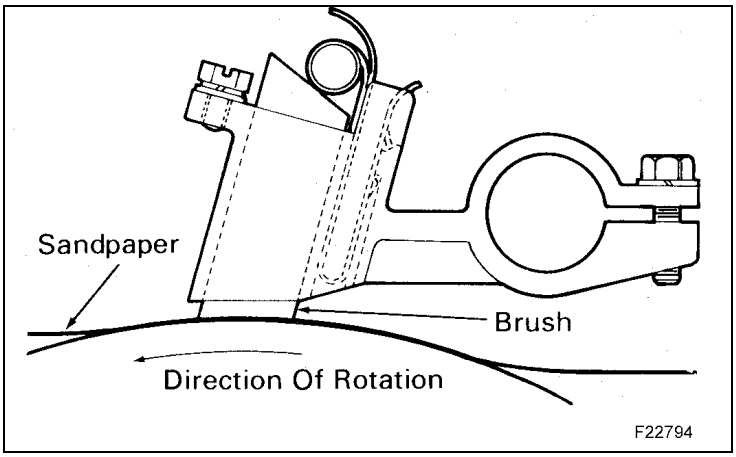

Figure 5 "Sanding-In" New Brushes

CAUTION!

Do not use carborundum, emery cloth, or emery paper for "sanding-in" brushes.

NOTE

EMD provides brushes whose contact surfaces have a pre-sanded contour and do not require the "sanding-in" process. This process is only necessary for brushes that have a flat surface, not the contoured surface.

2.4 HIGH POTENTIAL TEST

The insulation used in the AR and TA-type generators is designed to withstand somewhat higher voltages than those experienced during normal operation.

High potential tests are normally used when it is necessary to qualify new equipment installations, or to determine the location of an insulation breakdown on older equipment. High potential tests can be destructive to equipment being tested, and therefore, are not recommended as a normal routine maintenance item.

In some cases, such as national or local code requirements, company policy, or a suspected insulation breakdown, high potential tests are required. In these instances, adhere to all cautions listed in the Safety Precautions section, while performing test.

NOTE

Always refer to the applicable Locomotive Service Manual before proceeding to megger or hi-pot the main generator, or the high voltage circuitry.

2.4.1 SAFETY PRECAUTIONS

Whenever possible, high potential tests should be performed by one man. All others should be kept away from the test area.

A thorough knowledge and understanding of equipment and procedures involved is essential.

To prevent dangerous over-voltage surges, test electrodes must be firmly connected to the item being tested before voltage is applied. In addition, the voltage should be removed before the electrodes are removed.

Discharge residual voltage to ground after removing tester.

Before high potential tests are made, it is highly desirable to check first with a megohmmeter. A megohmmeter reading of 2 megohm, when tested with a 1000-volt megger is satisfactory for hi-pot test. An accumulation of dirt and moisture sometimes is sufficient to cause leakage, and if high potential is applied, it will cause an actual breakdown of the insulation. The condition may be aggravated by sudden temperature changes. If the equipment has been standing outside during cold weather before being brought inside a warm building, the equipment will tend to sweat and the condensed moisture will add to the leakage effect. Reference 4.2 for electrical testing.

2.5 BEARING

A sealed, grease lubricated, self-aligning bearing is assembled into an insulated housing. The bearing housing is insulated to prevent damage from electrical arcing. No additional lubrication, other than recommendations in the Scheduled Maintenance Program, is required.

Occasional checks of bearing temperature during operation will give an indication of bearing condition. Obtain temperature readings by applying a pyrometer to the outside surface of the bearing cover. Bearing temperature should not exceed a 25°C (45°F) rise. High bearing temperature may be caused by:

- Contamination of grease.
- Excessive thrust due to misalignment.
- Pounding caused by worn rollers of bearing being loose on shaft.
- Actual bearing failure caused by bearing fatigue or wear.

Model AR10 generators manufactured prior to November 1971, were equipped with a 215.001 mm (8.4646") bearing with a phenolic-lined bearing housing. Model AR10 generators manufactured after November 1971, and all the other generators models covered in this Maintenance Instruction, have a 259.999 mm (10.2362") bearing.

The large bearing will operate for a longer service period than the smaller bearing, and will require maintenance at intervals recommended in the Scheduled Maintenance Program. The small bearing should not require maintenance, but should be replaced with a new bearing and bearing housing, at intervals recommended in the Scheduled Maintenance Program.

2.5.1 LARGE BEARING MAINTENANCE

The large bearing, 259.999 mm (10.2362") requires maintenance at intervals recommended in the Scheduled Maintenance Program. This can be accomplished either by removing the main generator from the installation and following the procedure in Section 3.0 - Generator Disassembly, or by maintaining the bearing with the generator in place as follows:

1. Remove the center section (s) of the air box assembly.
2. Disconnect collector ring brush holder connections and tape leads away from work area.
3. Remove top and bottom brush holders from mounting studs.
4. Disconnect field leads from collector ring studs, Figure 6 or Figure 7 , as applicable.
5. Remove the four bolts securing the retainer plate to the end of the shaft, and remove retainer plate, Figure 6 or Figure 7, as applicable.

NOTE

All puller tools used to remove the collector ring assembly and outer seal may be fabricated as detailed in the File Drawings listed in Service Data.

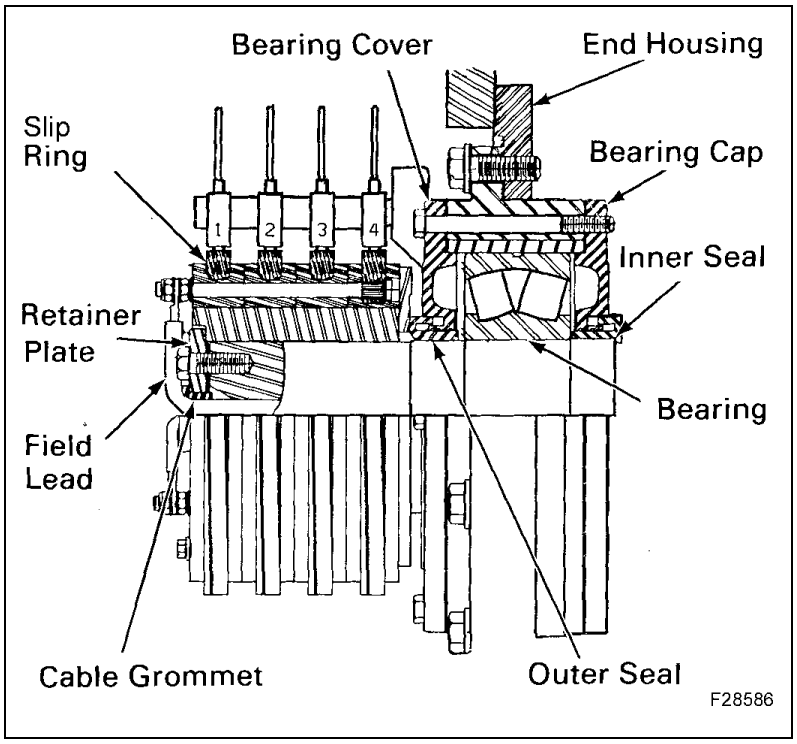

Figure 6 Standard Type Collector Ring Assembly

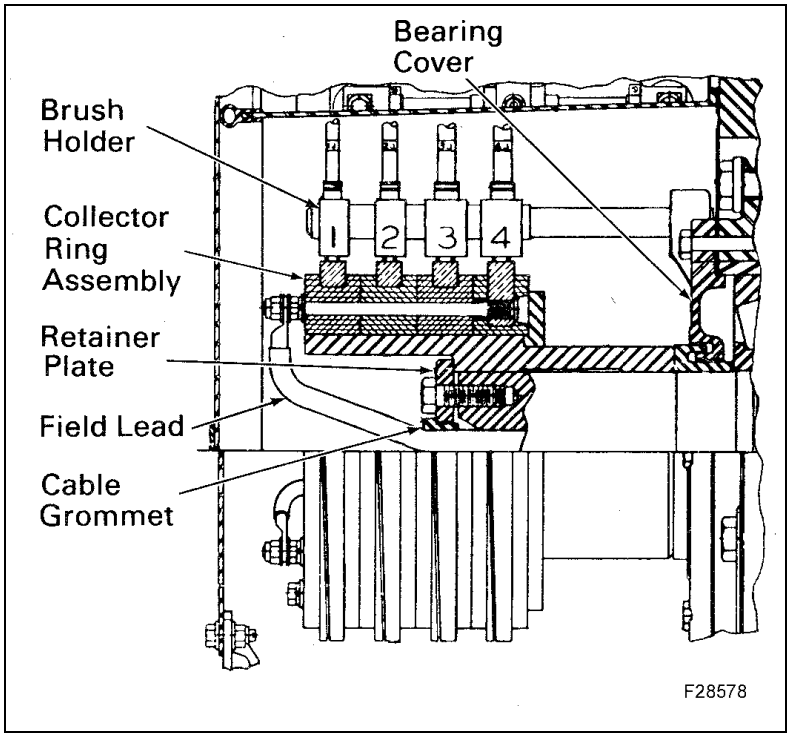

Figure 7 Extended Type Collector Ring Assembly

NOTE

Two types of slip rings exist on AR and TA-Main Generators:

The Standard type (Figure 6) is applied to AR10, AR12, AR15, AR17, TA12 and TA17 Main Generators.

The Extended Type (Figure 7) is applied to AR8, AR11, AR16, AR20, TA20 and TA22 Main Generators.

6. Remove four 3/8"–16 bolts securing the collector rings to the collector ring hub. The bolts are located on the collector ring face between the lead connection terminals, 3. Place extension cup around field leads and bolt cup to shaft as shown in Figure 8.

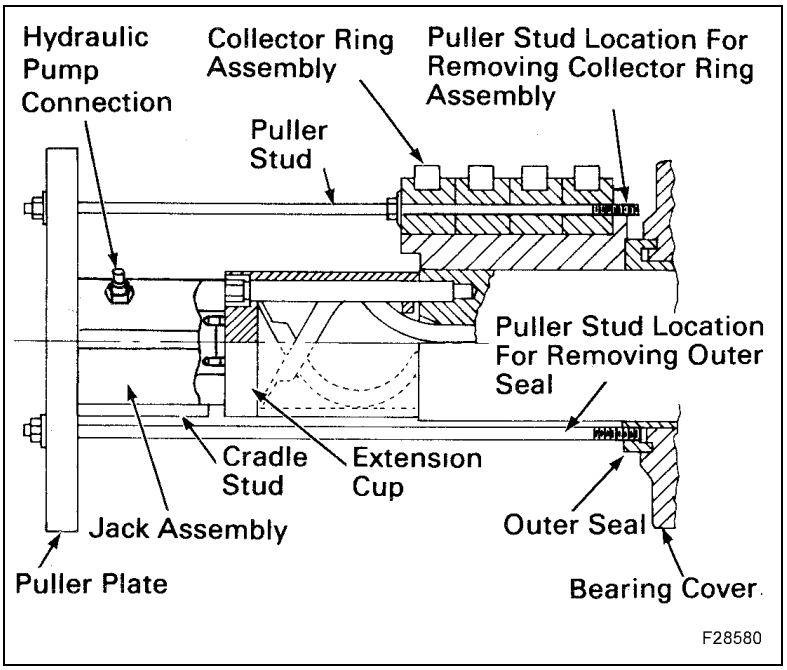

Figure 8 Collector Ring and Outer Bearing Seal Removal

7. Install puller plate and puller studs to remove collector ring assembly, as shown in Figure 8. Place jack assembly between the extension cup and the puller plate, supported by cradle studs of the puller plate. Connect hydraulic pump to jack assembly. Ensure puller is pulling equally on all studs to prevent damage to collector ring. Apply hydraulic pressure to jack assembly to remove collector ring assembly.
8. Remove puller studs from collector ring assembly.

9. Install puller plate and puller studs to remove outer seal, as shown in Figure 8. Place jack assembly between extension cup and puller plate, supported by cradle studs of the puller plate.
10. Connect hydraulic pump to jack assembly. Ensure puller is pulling equally on all studs to prevent damage to outer seal. Apply hydraulic pressure to jack assembly to remove outer seal. Remove jack assembly, hydraulic pump, puller plate, and puller studs.
11. Remove bolts from bearing cover, and remove cover, Figure 6 or Figure 7. If cover is stuck to bearing housing, hit outer periphery of cover with a rawhide mallet or similar tool to loosen.
12. Inspect grease in the bearing cover, and inspect exposed side of the bearing. Look for metal particles in the grease, excessive wear in the housing of the bearing, fatigue damage on the rollers or roller path, or evidence of overheating. Replace bearing with a new bearing, if required, and replace any associated parts found in distress.
13. If no bearing or associated parts problems are found, thoroughly clean the bearing cover.
14. Fill the labyrinth grooves in the bearing cover with Esso Unirex N-2 grease. This grease need not be measured.
15. Weigh the piece of paper that will be used in handling the grease to fill the groove in bearing cover. The weight of the paper must be compensated for when weighing the grease.
16. Carefully weigh the Esso Unirex N-2 grease for the bearing cover groove. Refer to Service Data for proper quantity.

NOTE

Adequate lubrication depends upon precise weight of grease. Too much grease is as detrimental to the service life of the bearing as too little grease.

17. Pack grease into bearing cover groove. Leave a space free of grease at the top of the bearing cover to limit churning and liquefaction of the grease. Form grease to proper contour as shown in Figure 9.
18. Using only a putty knife and your fingers, remove old grease from exposed side of bearing, and as much as possible from between the rollers and cage. **Do not use a solvent.** Be careful not to introduce dirt, or any other foreign substance into the bearing. Repack all spaces on the exposed side of the bearing with grease. If Shell Cyprina grease is present in the bearing, Esso Unirex N-2 grease may be added.
19. Install the bearing cover using a new gasket. Ensure the space free of grease is at the top of the cover. Tighten bearing cover bolts to 68 – 75 N•m (50-55 ft-lbs.).

CAUTION

In Step 19, do not allow seal to be heated above 105°C (220°F). Overheating may result in warping or damaging the metal.

20. Heat the bearing outer seal in an oil bath, electric oven, or induction heater for half an hour at 105°C (220°F). If an oil bath is used for heating, remove oil from seal with clean, bound-edge cloths prior to shrinking to the shaft. When using an induction heater, pyrometer readings (with current off) should be taken periodically. After heating, shrink the seal to the shaft and allow it to cool to room temperature.
21. Place collector ring on induction heater and heat to 105°C (220°F). Pyrometer readings (with current off) should be taken periodically. After heating, place collector ring against outer seal. Rotate ring assembly on shaft to line up slip ring stud numbers with field leads, for proper position of lead connections to terminals of ring assembly.

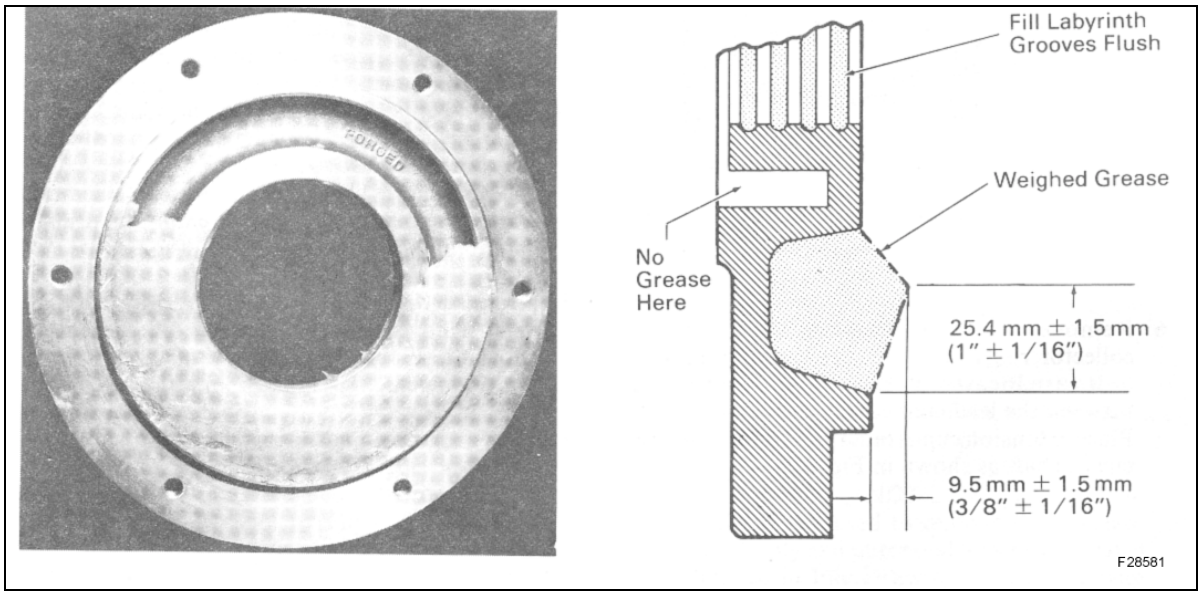

Figure 9 Application of Grease to Bearing Cover

WARNING

If work involving collector ring connections has been performed, use a continuity tester (with all field leads disconnected and all brushes lifted), to check that collector ring terminals marked 1 through 4 on the steel housing adjacent to the terminals, are connected to the appropriate collector rings (No. 1 outboard, No. 4 inboard).

22. Misapplication of generator and alternator collector ring leads can result in continuous excitation of the main generator from the alternator field leads. This condition could result in a serious accident when the diesel engine is running and placed on the line. If power contactors are picked up, the locomotive can inadvertently move when the Isolation Switch is placed in "RUN" position.
23. Place retainer plate over leads and on to the end of the rotor shaft. Tighten 5/8"–11 bolts to 149 to 163 N•m (110–120 ft-lbs.).
24. Connect the large leads from the traction alternator to collector ring terminals 3 and 4, and the smaller leads from the companion alternator to terminals 1 and 2. Torque to 9.5 to 12.2 N•m (7 to 9 ft-lbs).
25. Replace any damaged insulating tubes over the upper and lower brush holder mounting studs. Install the large brush holders (traction alternators) over collector ring positions 3 and 4 (inboard), and small brush holders (companion alternator), over collector ring positions 1 and 2 (outboard).
26. Attach jumper leads, J1, J2, J3, and J4 between top and bottom brush holders having the same numbers. The jumper leads attach to brush holder locking screws, which secure holder to insulated studs.
27. Route leads to the left of the collector ring assembly. Secure leads with the cable clamps bolted to the threaded holes in the bearing housing.
28. Connect external leads 1, 2, 3, and 4 to corresponding lower brush holder terminals.
29. Adjust brush holders to have 3 mm (1/8") clearance over collector rings. In addition, ensure that brush holder is centered over the collector ring. Torque brush holder locking screws to 14-20 N•m (10-15 ft-lbs). Assemble brushes in holders. If used brushes are reinstalled, ensure that the original positions are maintained. Check that each brush is centered within 1.6 mm (1/16") of the mating collector ring.
30. Install collector ring cover, and sections of air box covers removed during disassembly.

2.5.2 BEARING CHANGEOUT

NOTE

Early Model AR10 traction alternators which have the small bearing, require bearing replacement at intervals recommended in the Scheduled Maintenance Program.

Current traction alternators, which have the large bearing, require bearing replacement when inspection has determined that the bearing is defective, or at intervals recommended in the Scheduled Maintenance Program.

The following procedure is applicable to both the current large bearing traction alternators, and the early Model AR10 traction alternators with the small bearing.

The traction alternator bearing can be changed out either by removing the alternator from the installation and following procedure outlined in Section 3.0 - Generator Disassembly, or by changing out the bearing with the generator in place as described in Section 2.5.2.1 – Bearing Removal (Generator in Place).

2.5.2.1 Bearing Removal (Generator in Place)

NOTE

All puller tools used to remove the collector rings, outer seal, and bearing may be fabricated as detailed in File Drawings and Work Sketch Drawing listed in Service Data.

1. Perform steps 1 - 8 discussed in Section 2.5.1 - Large Bearing Maintenance.
2. Install support tube as shown in Figure 10. Support shaft through a "V" block with an adjustable jack.
3. Remove the eight 3/4"–10 bolts securing bearing housing to the end housing, Figure 10. Insert four 3/4"–10 jacking bolts equally spaced around the bearing housing in jacking holes provided. Rotate jacking bolts equally until bearing housing is separated from the end housing.

NOTE

Some early generator bearing housings had 5/8"–18 jacking holes. Ensure proper bolts are used.

4. Slowly and carefully lower the adjustable supporting jack until rotor rests on stator. Remove the jack and shaft support tube. Slide bearing housing off the shaft. Remove any burrs from end housing, which may have been caused by jacking bolts.

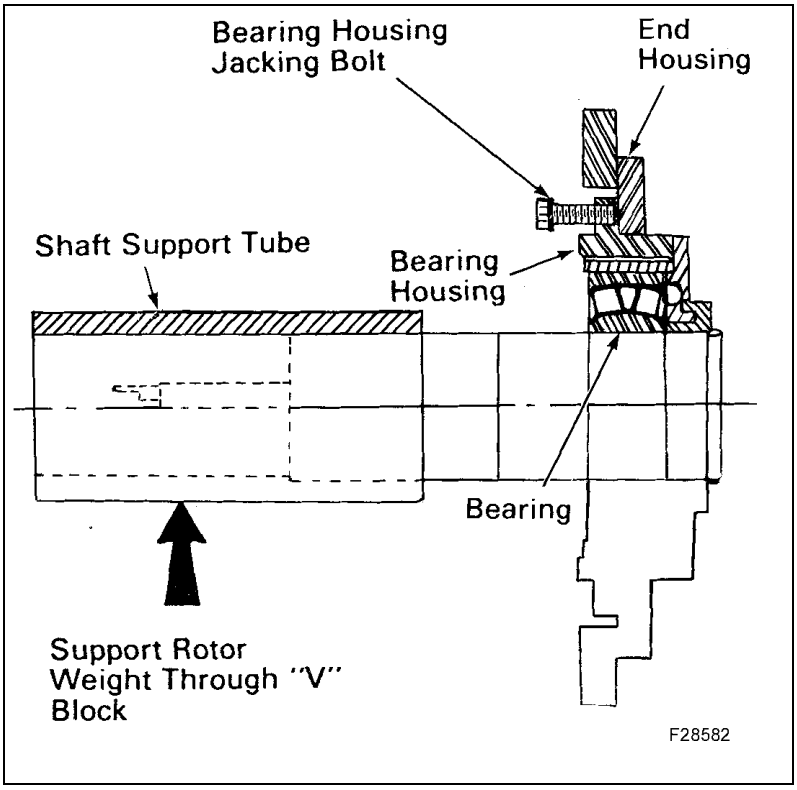

Figure 10 Bearing Housing Removal

5. With the bearing housing removed, install rotor shaft jacking fixture as shown in Figure 11. Raise rotor until bearing is approximately centered in the bore of the housing.

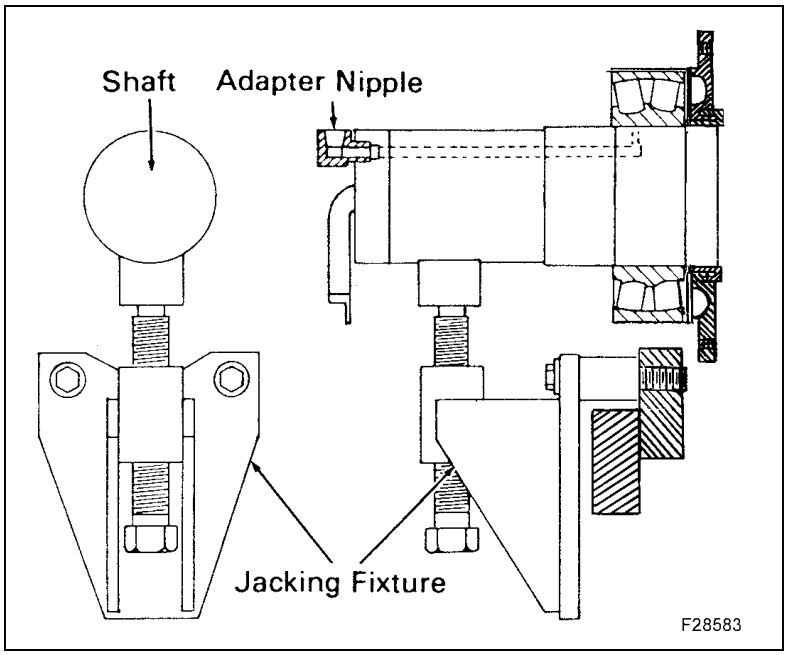

Figure 11 Rotor Shaft Jacking Fixture

6. If rotor shaft has a tapped hole in the end of the shaft for hydraulic bearing removal, perform the following procedure. Two hydraulic pumps are required to perform the following procedure.
7. Ensure threads and pressure-fitting seat in the drilled passage in the shaft are cleaned.
8. Screw a 1/8"–27 adapter nipple, Figure 12, into tapped hole in shaft, and tighten. Refer to Service Data for adapter nipple part number.
9. Connect hydraulic pump, Figure 12, to adapter nipple.

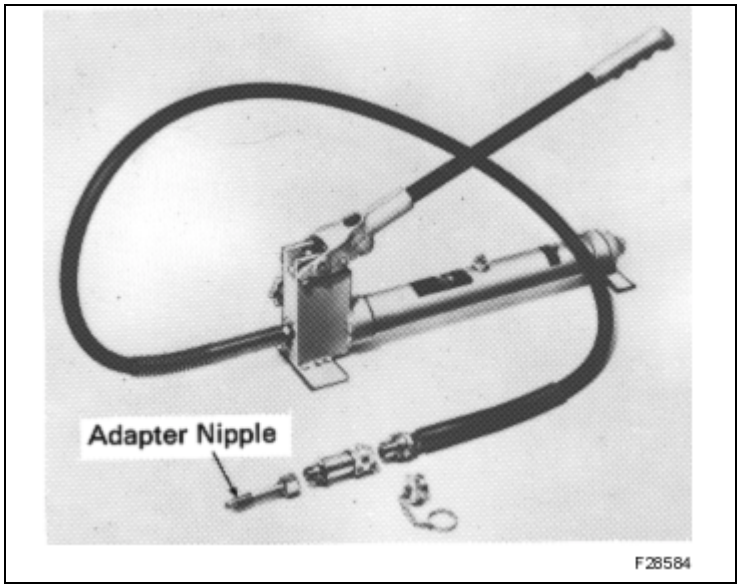

Figure 12 Hydraulic Pump

10. If shaft is not equipped for hydraulic bearing removal, it is necessary to protect the stator and rotor windings, and remove the outer race and cage with a cutting torch.
11. Thread six puller studs into flange of bearing cap. Install six spacer tubes and centering ring as shown in Figure 13.
12. Place extension yoke around field leads and bolt extension yoke to shaft as shown in Figure 13.
13. Install puller plate. Place assembly jack between extension yoke and puller plate, supported by cradle studs of puller plate, as shown in Figure 13.
14. If rotor shaft is equipped for hydraulic bearing removal, apply hydraulic pressure to expand inner bearing race. Maintain this pressure while applying hydraulic pressure to the jack assembly until the bearing slides off the shaft seat, approximately 63.5 mm (2-1/2"). Ensure that puller is pulling equally on all studs to prevent damage to bearing.
15. Slowly and carefully lower the rotor with the jacking fixture until it contacts the stator. Remove jacking fixture and pulling equipment. Slide bearing and bearing cap off the rotor shaft.
16. Examine bearing inner seal for evidence of rubbing. If rubbing appears excessive, remove bearing inner seal, using a small heating torch and pry bars.

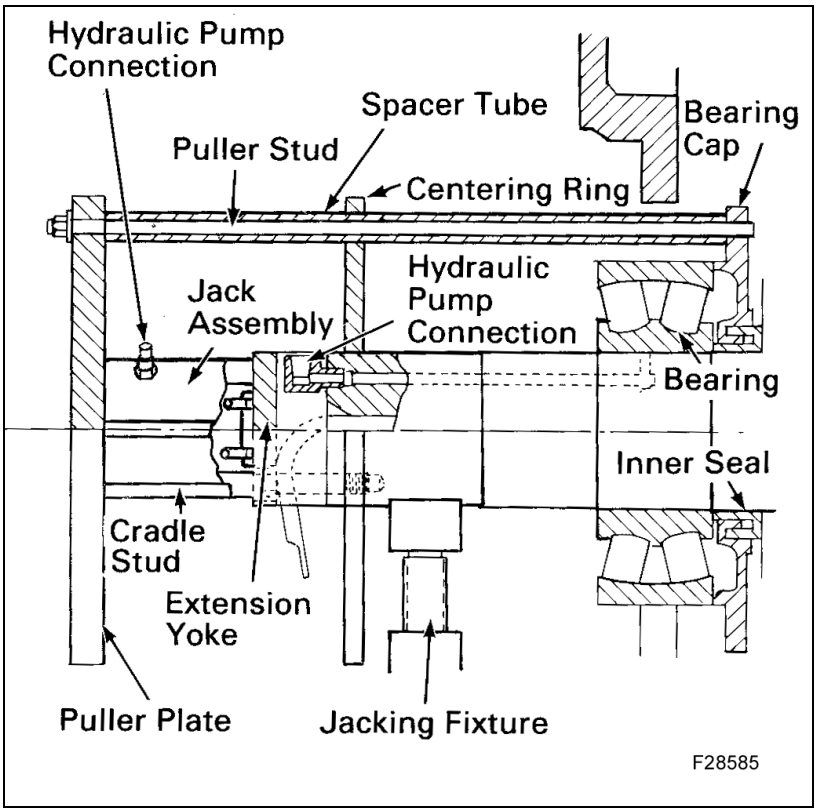

Figure 13 Bearing Removal

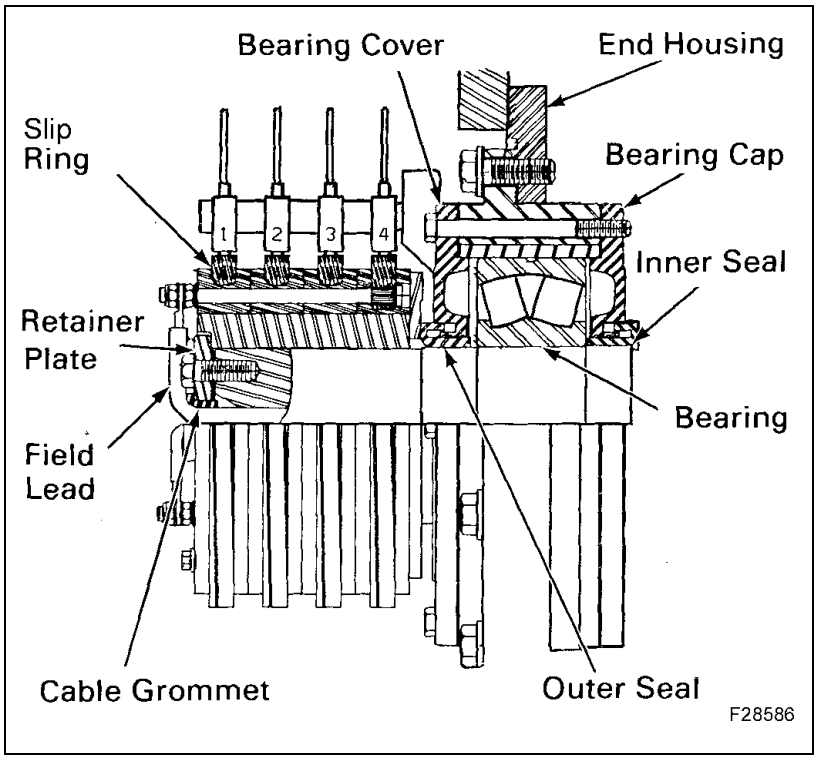

Figure 14 Bearing and Collector Ring Assembly Cross-Section

2.5.3 BEARING INSPECTION

On all bearings with appreciable service, some dents, nicks, pits, and craters will be found. If these are small and scattered, they should not be cause for rejection; however, they should be evaluated carefully, taking into account the overall condition of the bearing. All questionable parts should be discarded. Failed parts should be replaced with either new or acceptable reconditioned parts. If one part of an assembly has been subjected to excessive stress, which results in a visible defect severe enough to reject the part, the rest of the assembly requires a detailed inspection and evaluation before reuse.

The roller bearing should be thoroughly inspected for possible evidence of impending failure. The following inspections are to be used when qualifying bearing components for reuse.

2.5.3.1 Cleaning

Before attempting to make any inspection, a bearing must be thoroughly cleaned. Stoddards solvent or similar non-corrosive solvent having a flash point of 46°C (115°F) or higher may be used.

A clean brush or lint-less cloth can be used to facilitate cleaning. Gasket surfaces should be given special attention to remove all traces of remaining gasket material.

NOTE

If bearing components are not to be used immediately after inspection, they should be coated with Esso Unirex N-2 grease to prevent corrosion while in storage.

2.5.3.2 Operating Surfaces

All exposed operating surfaces must be inspected visually to ensure that they contain none of the following defects, which will be cause for rejection:

- Wear – A properly lubricated bearing not subjected to misalignment, dirt, or distortion will show no evidence of wear. The internal radial clearance of the bearing may be checked by passing a feeler gauge between the rollers and race of the unloaded side of the bearing. Do not roll a feeler through a bearing. For limits, see Service Data.

- Fatigue Failure – Signs of fatigue failure will most usually appear on the bearing surface. Fatigue failure is usually evidenced as ragged craters, and may be of any size. Any bearing showing any sign of cracks or craters of any size, regardless of how small they may be, should be replaced. This type of failure is more likely to occur on either the rollers or inner race.

- Protrusions above the normal surface.

NOTE

Protrusions should be reduced to the normal surface by light honing with Arkansas stone (novaculite), or grade 240 abrasive cloth. Likewise, the sharp edges should be smoothed. Care must be taken to work down to the normal surface only, to prevent reduction of contact area, and to work around the circumference so as to prevent the formation of flats.

- Cracks and flats.

- Ruptures, tears or seams (2.4 mm [3/32"] or more in length; or more than hairline width).

- Scores or deep scratches which extend more than 3/4 the length of the operating surface, and are inclined at less than 10° to the axis.

- Corrosion pits (0.8 mm [1/32"] or more in diameter).

- Craters or pits from electrical arcing (0.8 mm [1/32"] or more in diameter).

- Profuse denting.

- Overheating.

- Pattern of pits or dents at the ends of the roller path around the circumference.

- Fatigue pits, flaking, shelling or galling.

2.5.4 BEARING INSTALLATION (Generator in Place)

When all associated bearing parts have been cleaned and inspected, the bearing is ready for assembly. Before shrinking bearing to rotor shaft, it is very important to try the bearing in the housing. Place bearing housing on the floor, and slide bearing through the bore of the housing. Ensure bearing enters bearing housing squarely, and is not cocked. Refer to Service Data for bearing dimensions and tolerances.

1. Inspect the bearing housing sleeve. If it is heavily worn (step worn in sleeve by bearing), replace sleeve or rotate housing as follows as follows:
2. Rotate the bearing housing 180° in the end frame, so that the worn area of sleeve is at the top (12 o'clock).
3. Press the old bearing sleeve out of the bearing housing, and replace with a new one.
4. Inspect the insulator on the housing flange for damage.
5. Use the following procedure to assemble the bearing. Refer to Figure 15 and Figure 16 during assembly.

CAUTION

Care should be used when heating bearing parts. Overheating may result in warping or damaging the metal.

6. If the bearing inner seal was removed because of rubbing, heat a new inner seal in an oil bath, electric oven, or induction heater for half an hour at 105°C (220°F). If an oil bath is used for heating, remove oil from seal with clean, bound-edge cloths prior to shrinking to the shaft. When using an induction heater, pyrometer readings (with current off) should be taken periodically. After heating, shrink the seal to the shaft and allow it to cool to room temperature.
7. Fill labyrinth grooves in the bearing cap with Esso Unirex N-2 grease. This grease need not be measured. The bearing cap can be distinguished from the bearing cover by noting that the bearing cap has tapped holes in the flange, while the bearing cover has holes that are not tapped.

NOTE

Esso Unirex N-2 grease must be used exclusively to lubricate a new or cleaned bearing. Adequate lubrication depends upon the precise weight of grease. Too much grease is as detrimental to service life of the bearing as too little grease. Bearing replacement kits include pre-weighed amounts of grease.

8. Carefully weigh the Esso Unirex N-2 grease to be applied to the bearing cap groove. Refer to Service Data for proper quantity.
9. Pack the grease into bearing cap groove. Leave a space at the top of the bearing, as shown in Figure 9, to limit churning and liquefaction of the grease. Form grease to proper contour as shown in Figure 9.
10. Install greased bearing cap and a new gasket onto shaft.
11. Carefully weigh the Esso Unirex N-2 grease for the new bearing. Refer to Service Data for the proper quantity. Pack the bearing rollers and the space in between the two rows of rollers with grease.
12. Heat roller bearing with an induction heater to 105°C (220°F). Take pyrometer readings (with current off) at outside face of inner race only. Shrink bearing to shaft with the part number toward the outside. Do not cock the bearing when placing it on the shaft. Use a brass pipe to push bearing on shaft, and seat firmly against inner seal. Let bearing cool to room temperature.
13. Thread two 1/2"–13 studs, 180° apart, into bearing cap flange to correctly position cap during installation of the bearing housing. Ensure gasket is in place. Slide bearing housing into shaft.

14. Apply Molykote paste 9517921 to inside diameter of bearing housing. Install two 3/4"–10 aligning studs 180° apart into two of the eight bearing housing mounting bolt holes in the end housing. The aligning studs will help prevent the bearing from cocking (damaging insulation material), when assembling bearing housing to end housing.

NOTE

Early Model AR10 traction alternator with the small bearing has a bearing housing with an inner and outer phenolic sleeve, and does not require additional insulation. This phenolic sleeve version for the small bearing has been discontinued for parts sale. In the event these components require replacement a new bearing kit is now available, which is similar to the large bearing components. Reference Service Data.

15. On traction alternators equipped with the large bearing, position new insulating ring, Figure 15, over aligning studs so that holes in the ring line up with holes in the end housing.
16. Slide bearing housing over shaft.
17. Install shaft support tube and supporting jack as shown in Figure 10 and Figure 11. Raise rotor until bearing is centered in the bore of the bearing housing.

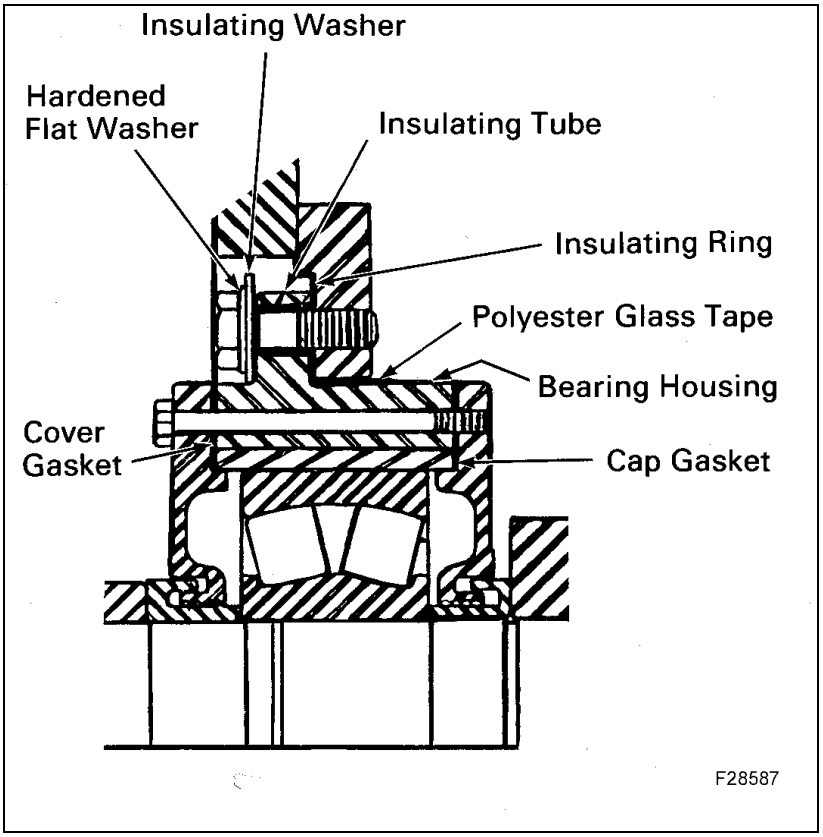

Figure 15 Large Bearing Insulation (NOTE: Similar to new small bearing housing kit)

18. Position bearing housing so that bearing housing and bearing cover bolt hole pattern relationship is as shown in Figure 16. This relationship is important to position brush holder studs at top and bottom positions.

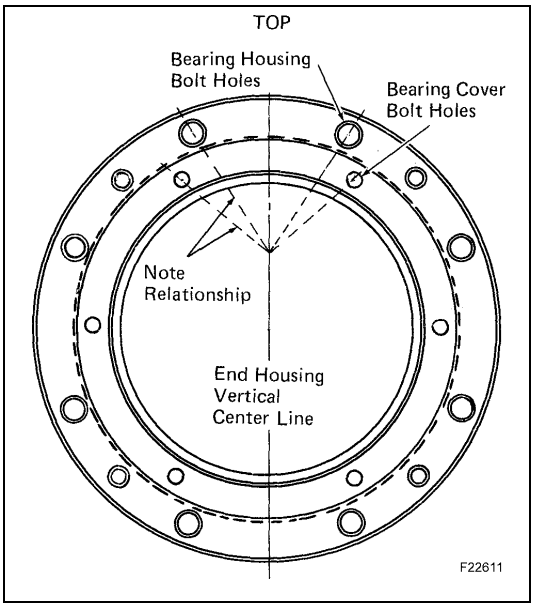

Figure 16 Installing Bearing Housing

19. Align bearing cap to bearing housing, and bearing housing to end housing using the aligning studs. Move bearing housing part way onto bearing. Install special 3/4"–10 x 5" pulling studs through the bearing housing mounting holes and into the end housing.

NOTE

DO NOT ALLOW THE BEARING OUTER RACE TO BECOME TILTED IN THE BEARING HOUSING. Keep the bearing housing parallel to the end housing by sequentially tightening 180° opposite pairs of pulling bolts only a partial turn before proceeding to the next pair. Continue to tighten bolts evenly until the bearing housing is seated. Remove aligning studs and pulling studs.

20. On the traction alternator equipped with the large bearing, install eight insulating tubes into bearing housing mounting bolt holes.
21. On the traction alternator equipped with the large bearing, apply one insulating washer under each hardened flat washer 9531331, and install bolts to bearing housing. Torque bearing housing bolts to 203 N•m (150 ft-lbs).
22. Check insulation resistance between bearing housing and end housing, using a 1000-volt megohmmeter. Reading must be a minimum of 1 megohm. If reading is not satisfactory, remove bearing housing and inspect insulating material for damage, and renew if necessary.

23. Carefully weigh the Esso Unirex N-2 grease for the bearing cover groove. Refer to Service Data for proper quantity.
24. Pack the grease into the bearing cover groove. Leave a space at the top of the bearing cover to limit churning and liquefaction of the grease. Form grease to proper contour as shown in Figure 9.
25. To reinstall the bearing outer seal, collector rings and brush holders, perform steps 18–28 discussed in Section 2.5.1 - Large Bearing Maintenance.

NOTE

Changing the generator bearing in this manner does not affect engine/generator alignment; however, it is recommended that the alignment be checked before returning the unit to service.

26. If the stator has been moved or disturbed, realign generator as per M.I. 1753.

2.5.5 NEW VENTED BEARING HOUSING APPLICATION

A potential for alternator bearing failures on SD70/75/80/90 series locomotives due to loss of lubrication after 3+ years of service was discovered. Testing has shown that an air pressure differential exists across the bearing, which could result in grease migration from the bearing and eventual failure of the bearing. Pressure differentials of up to 3.6" H2O have been measured during testing. The pressure is higher on the snow guard side of the bearing, causing grease to be pushed out of the bearing, cover, and cap, toward the engine end of the alternator.

During investigation of the grease migration problem, it was determined that by adding holes to the airbox brush holder cover sheet, the air pressure inside the snow guard can be reduced, which decreases the pressure differential across the bearing. With the correct number of holes, the pressure differential can be reduced to an acceptable level. It was also determined that the number of holes required to balance pressure across the bearing varies considerably from unit to unit. In order to balance the pressure across the bearing, it was necessary to test each unit for pressure, and add the correct number of holes to the cover sheet, creating a custom sheet for each alternator.

This field modification has left all model generators in units listed above with the vent holes in the cover. All new delivered locomotives (2001 plus) are now equipped with a production version of the vent holes where the holes are drilled in the bearing housing instead in the airbox cover sheet. Reference Figure 18 showing field fix with holes in airbox cover plate and Figure 17 showing production fix with 16 – 7/8 inch holes drilled completely through the bearing housing and end frame.

If these version generators are being completely disassembled, it would be recommended to have the 16 – 7/8 inch holes drilled through the bearing housing and end housing. Once this has been completed, the airbox inspection cover must either be replaced or the existing holes plugged.

NOTE

It is important that the generator have one of the two fixes, but not both on the same machine or the pressure differential will cause grease purging and potential for bearing failure.

The bearing housing can either be drilled or a new predrilled housing can be purchased. Reference Service Data for part numbers. Once the bearing housing has been drilled, or a new predrilled replacement provided, insert the housing into the end frame and tighten down with a couple housing to end frame bolts. Using the housing as a tempplate, mark the 16 holes onto the end frame. Then remove the bearing housing and drill the matching 16 7/8 inch holes in the end frame. Reference Figure 19 showing new version bearing housing drilling pattern.

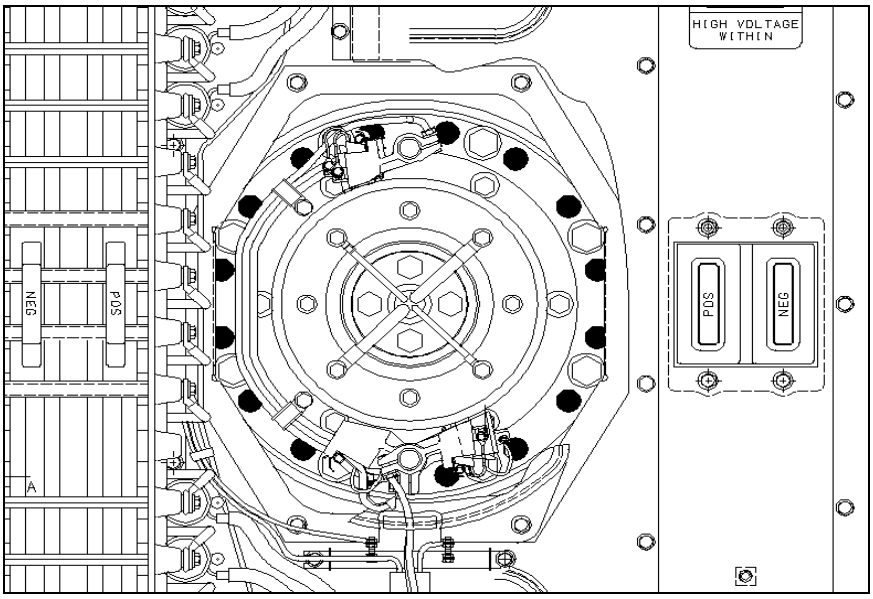

Figure 17 The 16 black holes represent the production fix (new and remanufactured generators).

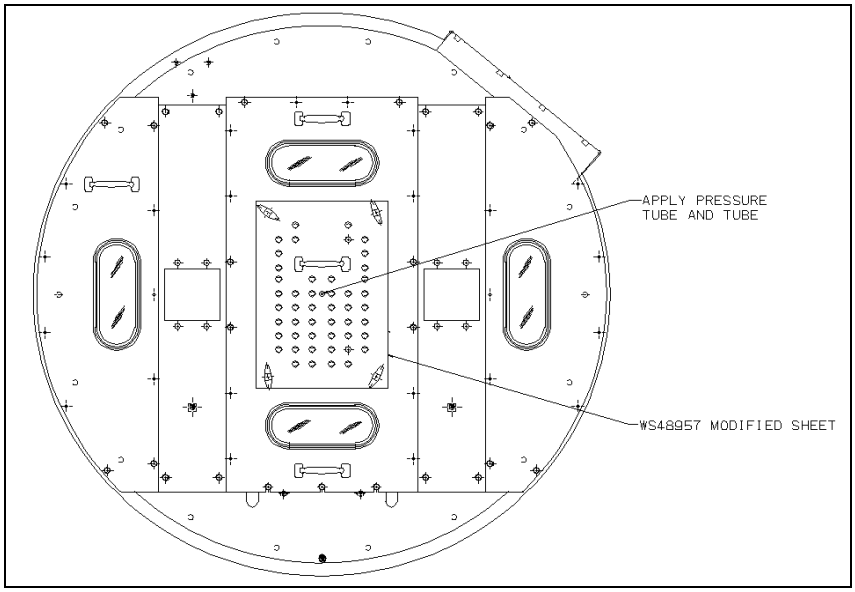

Figure 18 Drilled holes in cover represent field modification. Replace cover or plug holes if production fix above has been performed.

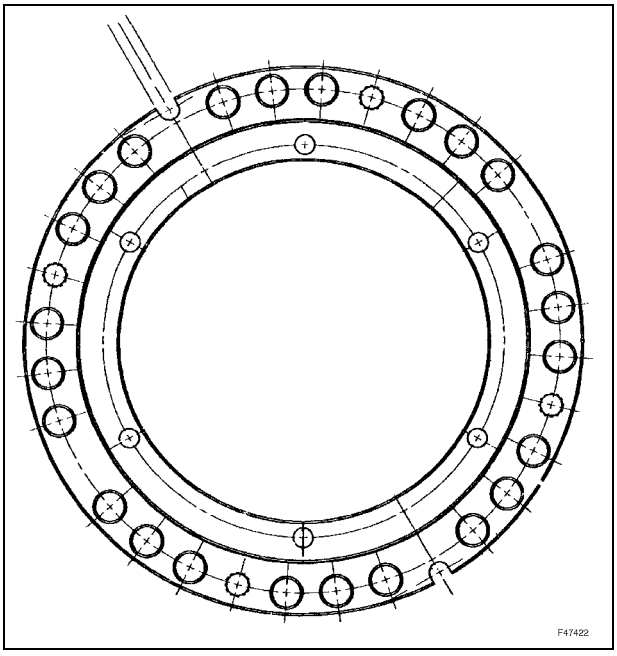

Figure 19 New version bearing housing drilling pattern.

3.0 GENERATOR DISASSEMBLY

NOTE

If equipment for disassembly and assembly is not available, generator should be returned to the Electro-Motive Division for repair, either as a rebuild and return item, or unit exchange basis.

Before the generator is removed from its location, place strips of fish paper approximately 2 mm x 80 mm x 900 mm (1/16" x 3" x 36") in the bottom air gap between the rotor assembly and stator coils. When removing the generator, be sure to tag shims used under mounting pads so they may be replaced in their original position.

The following steps apply to disassembling the generator. Refer to Figure 20 to Figure 32 as applicable during disassembly.

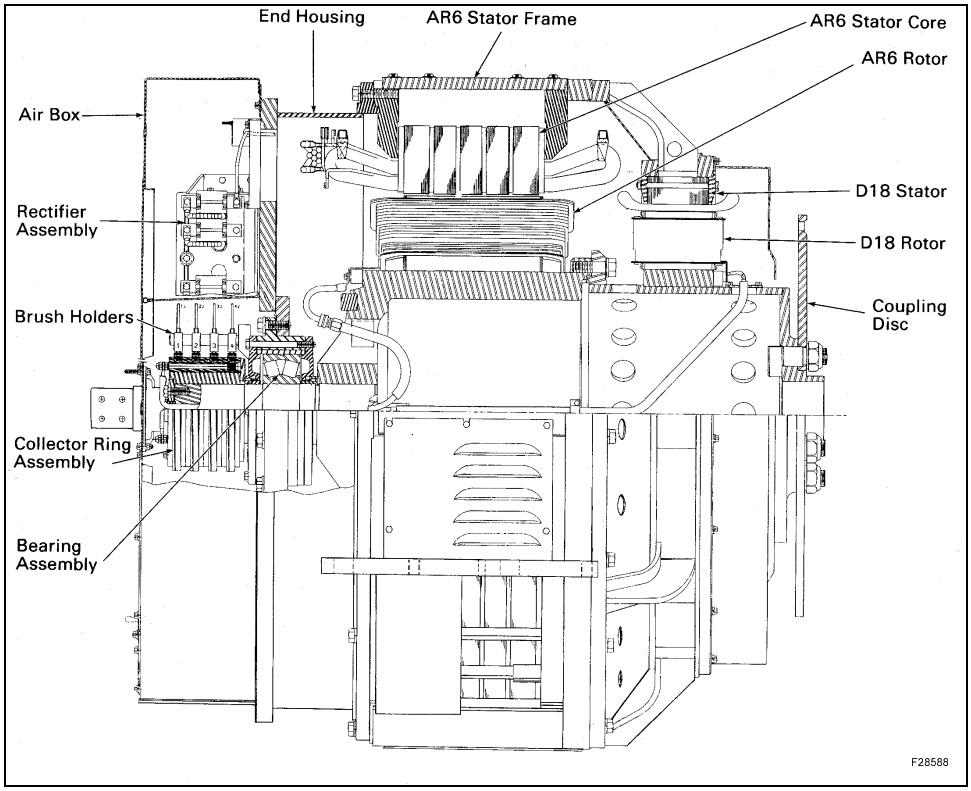

Figure 20 AR6-D18 Main Generator Cross-Section

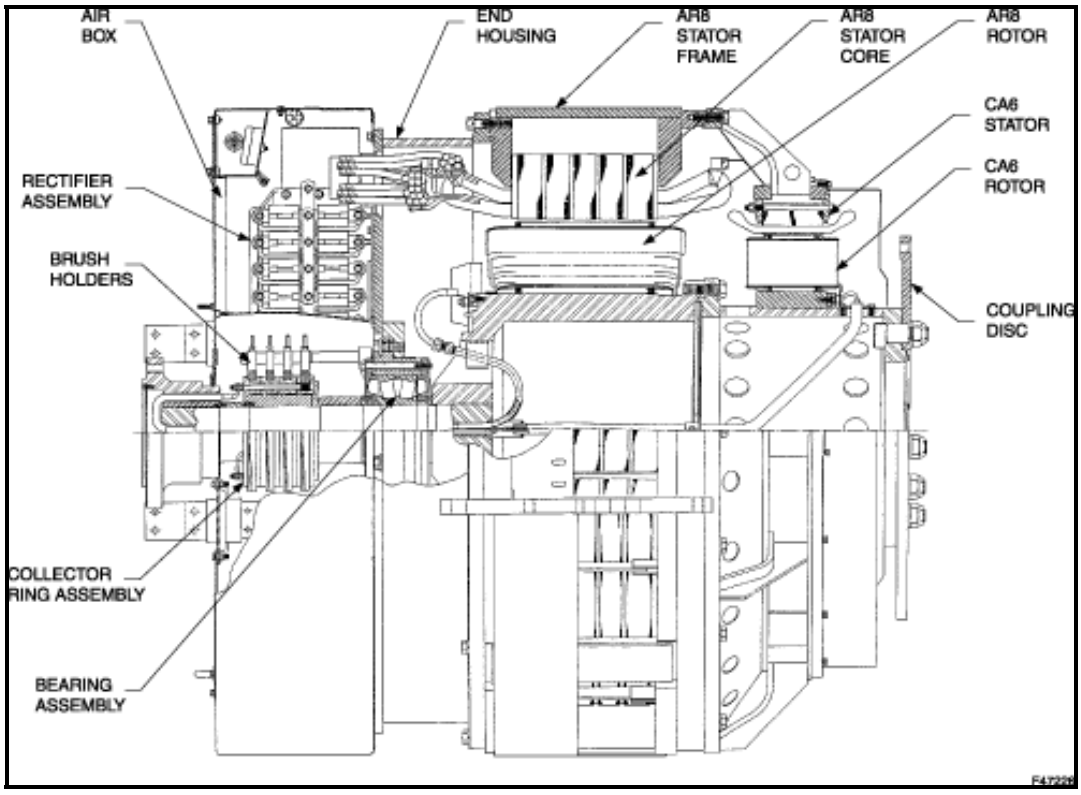

Figure 21 AR8-CA6 Main Generator Cross Section

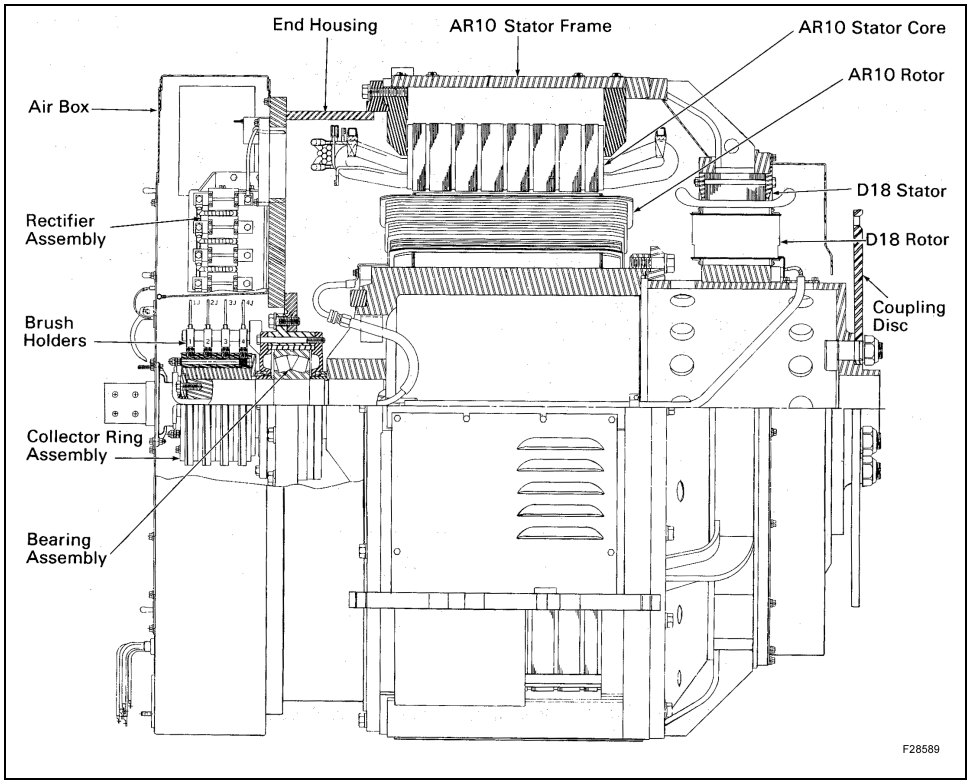

Figure 22 AR10-D18 Main Generator Cross-Section

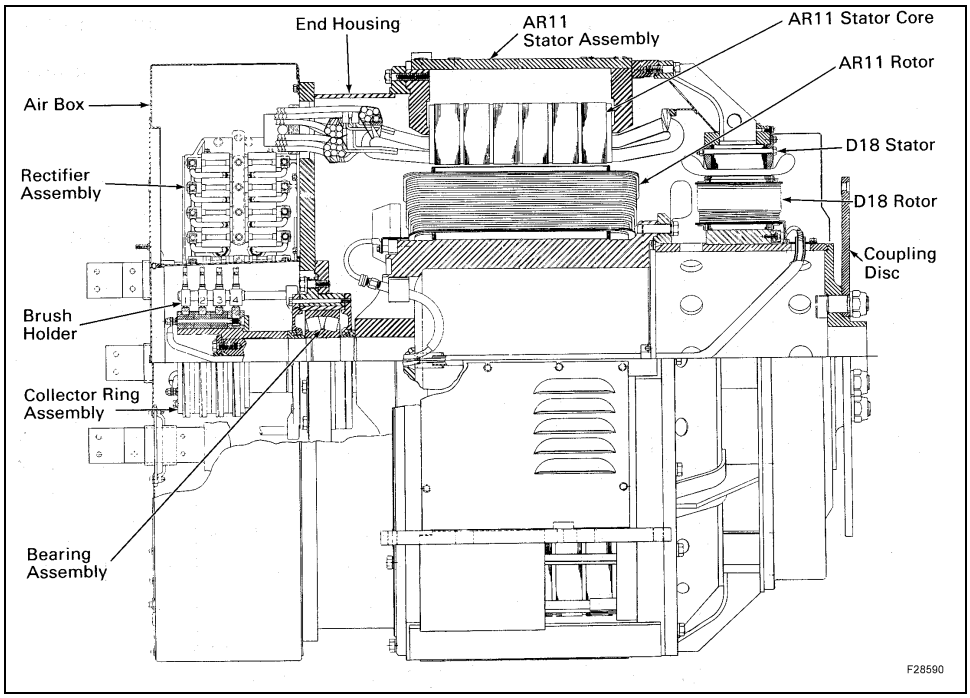

Figure 23 AR11-D18 Main Generator Cross-Section

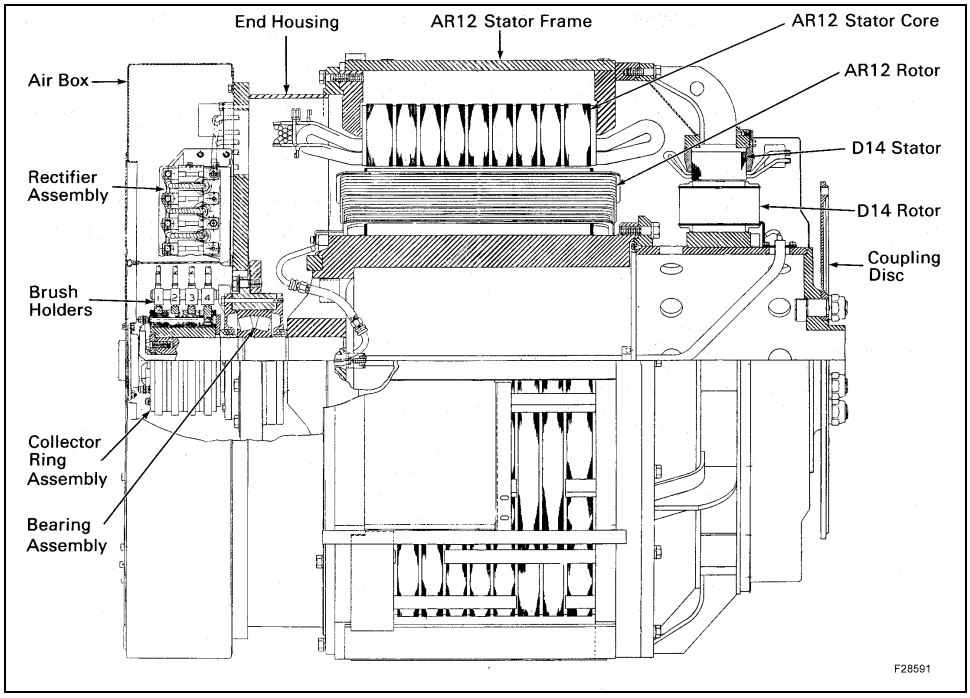

Figure 24 AR12-D14 Main Generator Cross-Section

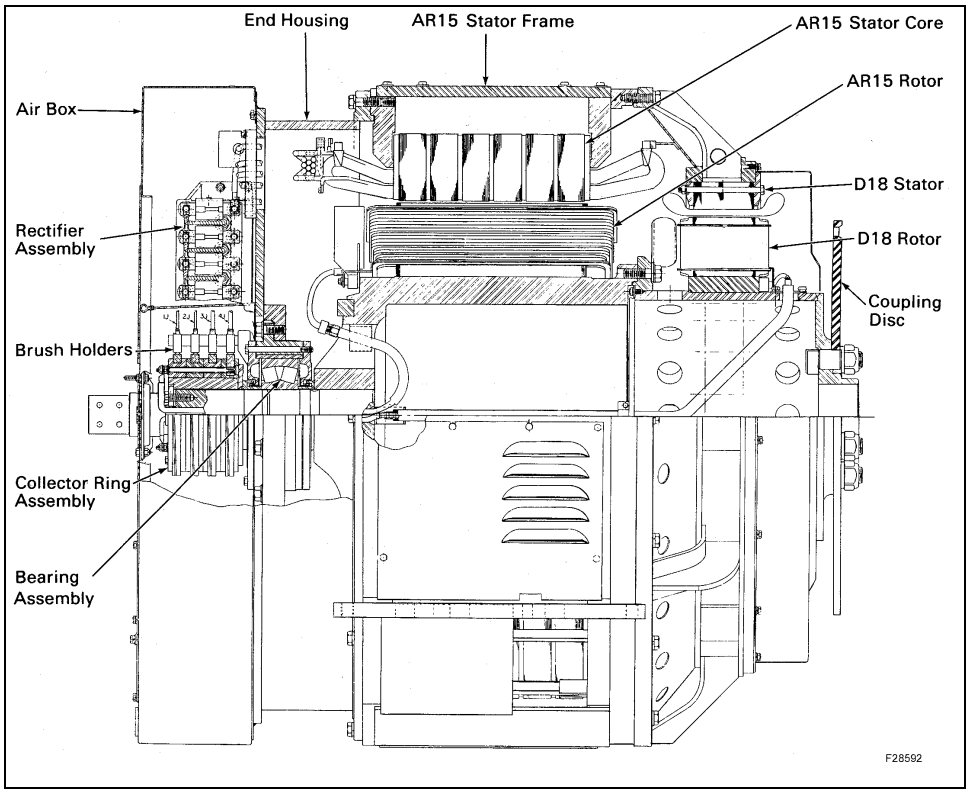

Figure 25 AR15-D18 Main Generator Cross-Section

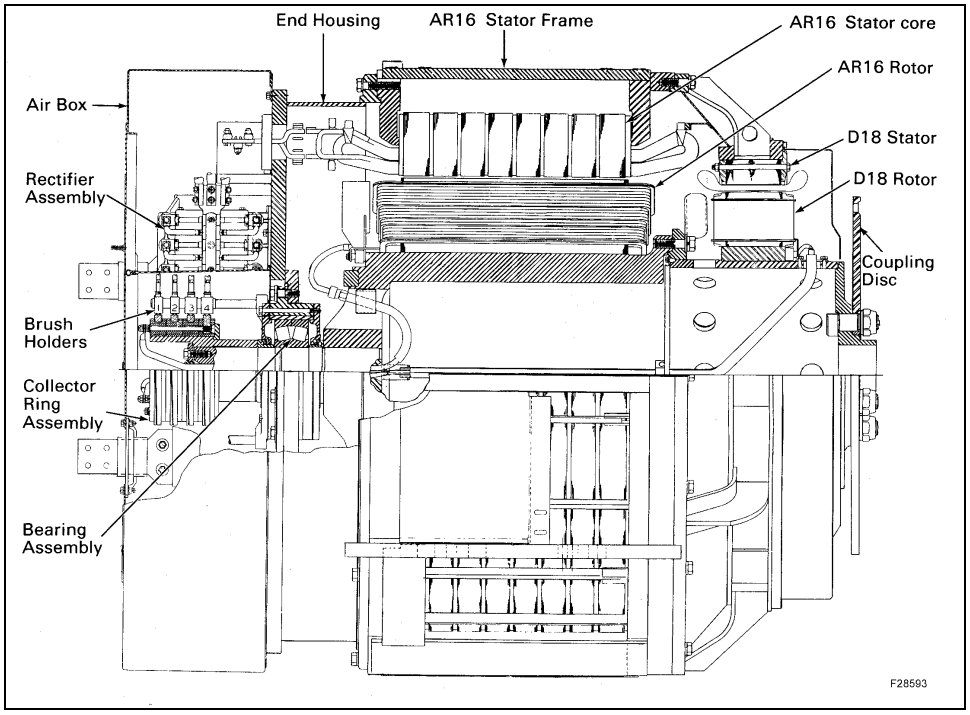

Figure 26 AR16-D18 Main Generator Cross-Section

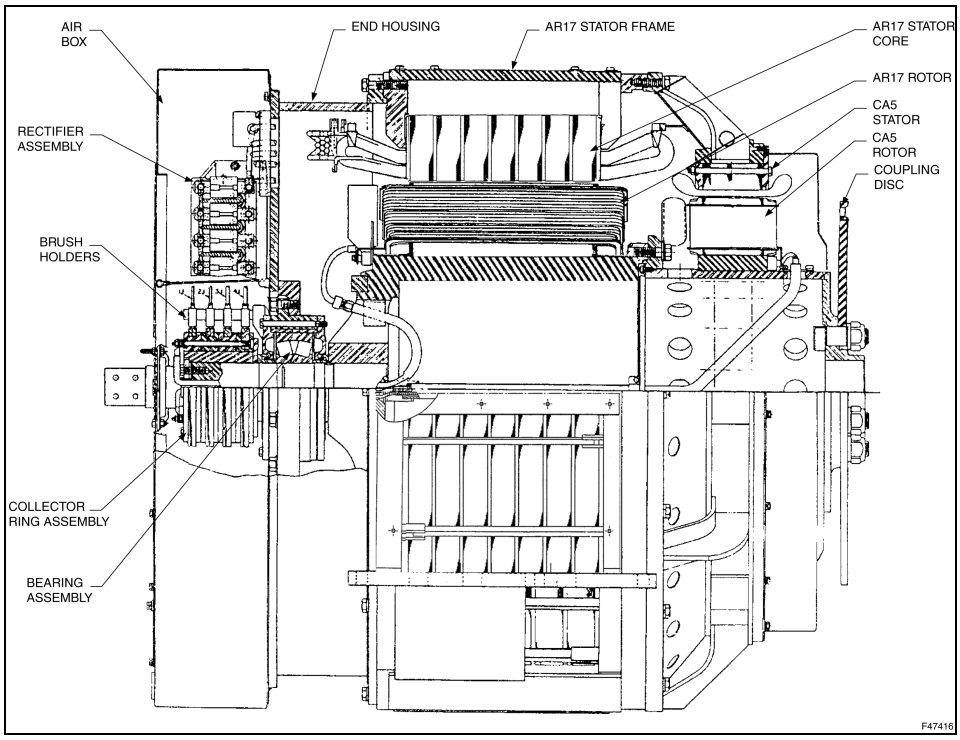

Figure 27 AR17-CA5 Main Generator Cross-Section

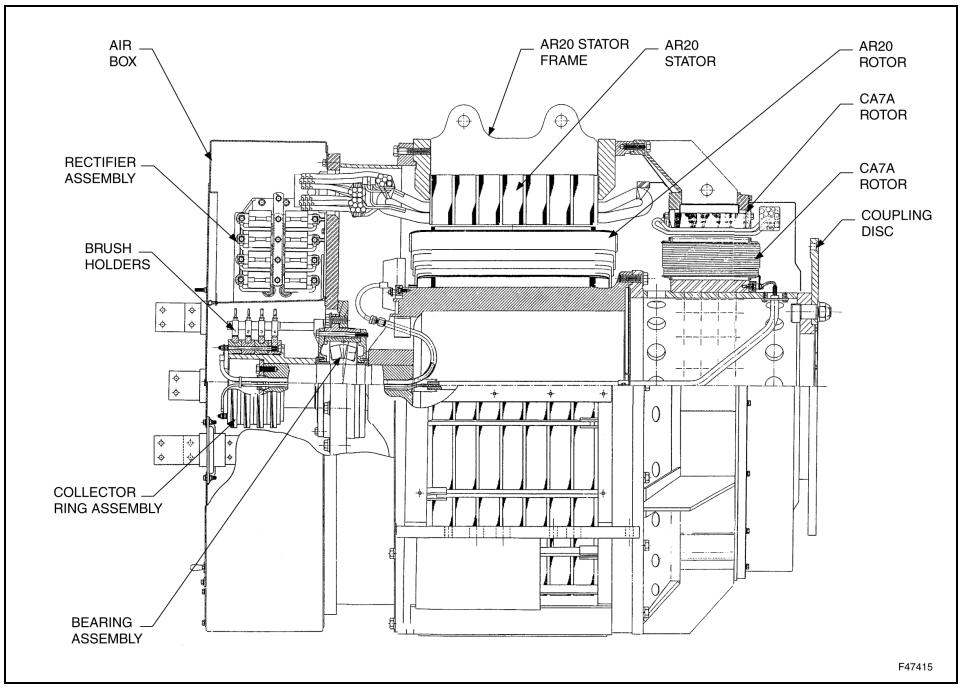

Figure 28 AR20ABE-CA7A Main Generator Cross-Section

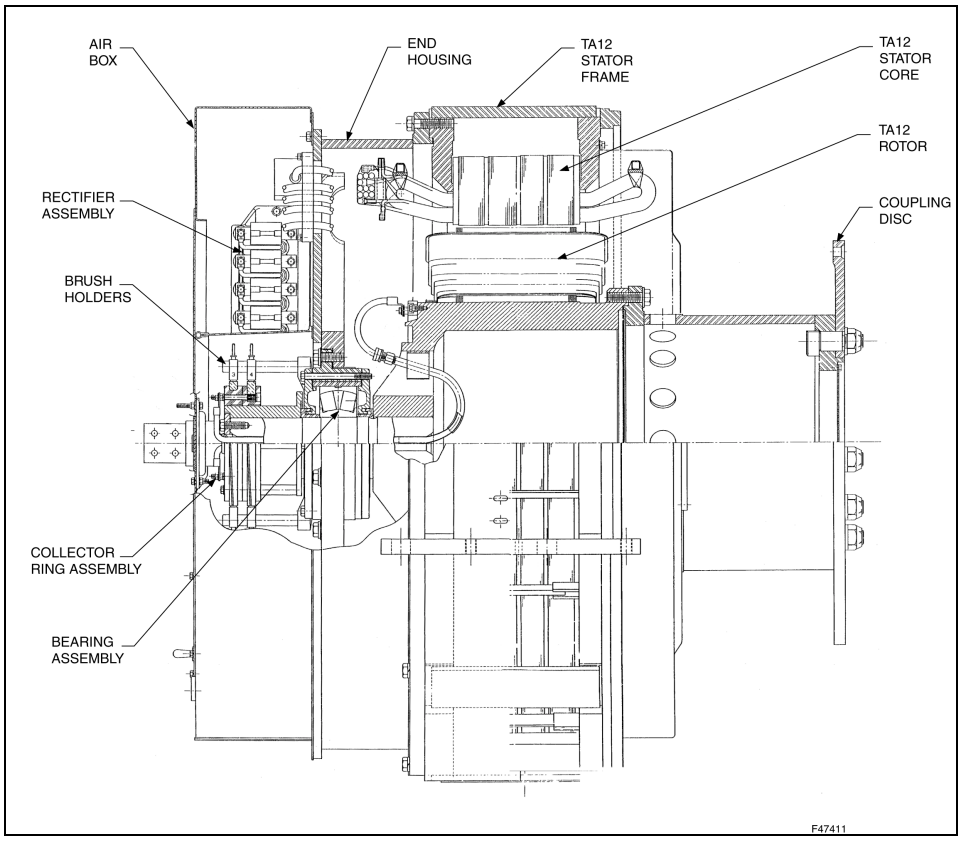

Figure 29 TA12-8QBE Main Generator Cross-Section

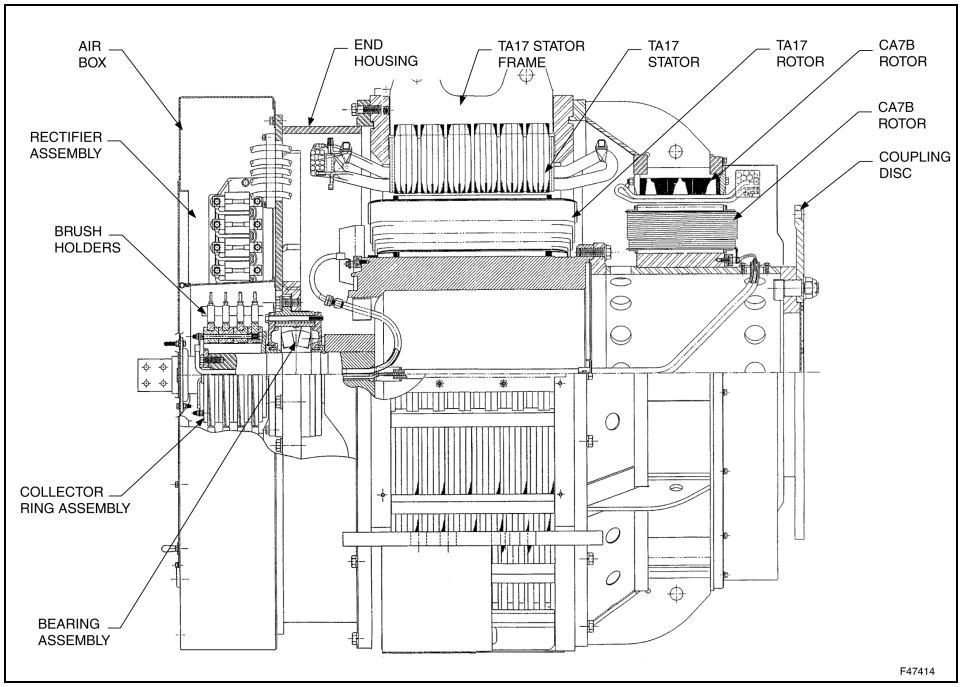

Figure 30 TA17-6JBE-CA7B Main Generator Cross-Section

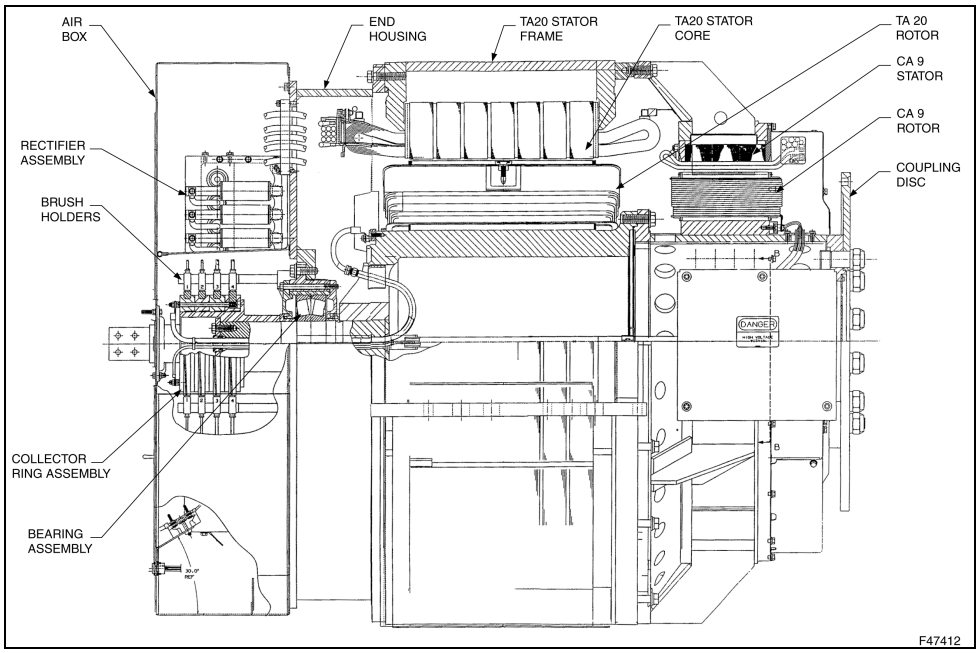

Figure 31 TA20MBF-CA9C Main Generator Cross-Section

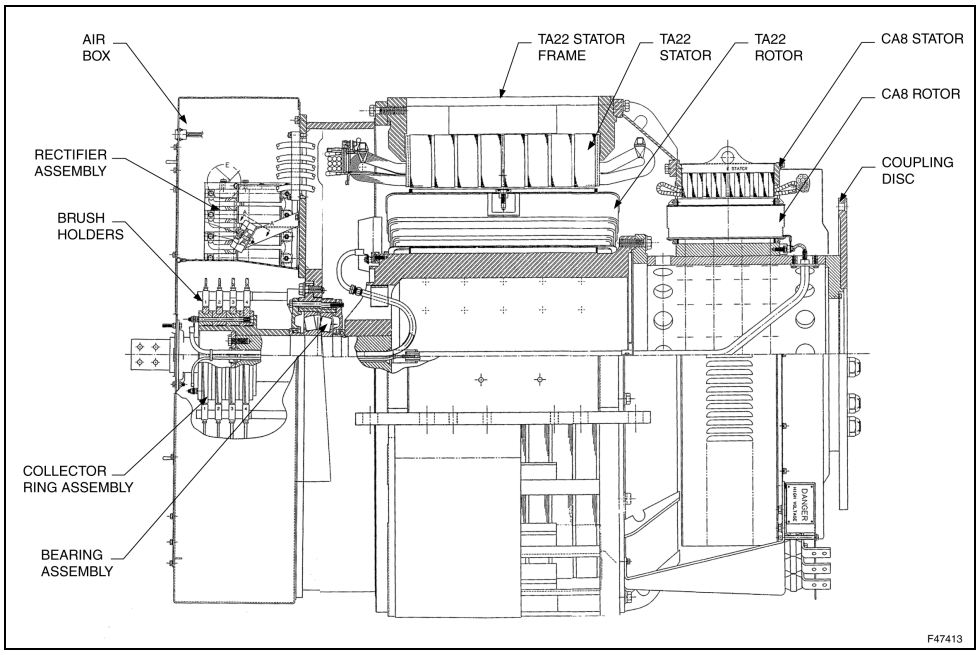

Figure 32 TA22-9MBF-CA8B Main Generator Cross-Section

1. Mount generator on a sturdy stand at a suitable working height. Remove dust, dirt, oil and grease from outside of generator. This will prevent dirt from entering during disassembly.
2. Remove all covers from the generator assembly.
3. Disconnect leads to brush holder and filter assemblies.

4. Remove bolts holding air box to end housing, and carefully remove air box.
5. Remove collector ring cover, brush holders and brush holder bracket assembly.
6. Disconnect the phase lead connections and suppression circuit connections at the bus bars of each rectifier bank assembly. Remove the cable cleats securing suppression circuit leads to the sides and ends of each rectifier bank assembly. Remove rectifier banks.
7. Remove cleat assemblies securing stator leads to end housing.
8. Apply an arbor fixture to spider bore of companion alternator rotor, Figure 33. Attach crane cable to end of fixture.

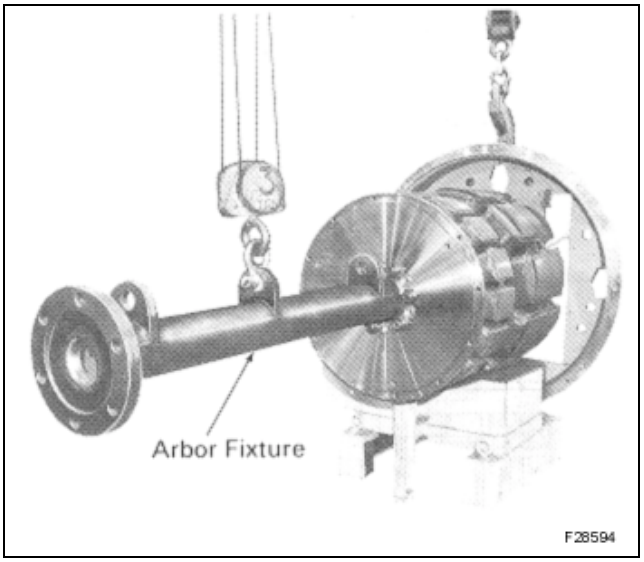

Figure 33 Application of Arbor Fixture

9. Support end housing with another crane cable and end housing holding fixture, Figure 34. Remove eight 3/4"–10 bolts securing end housing to stator frame.

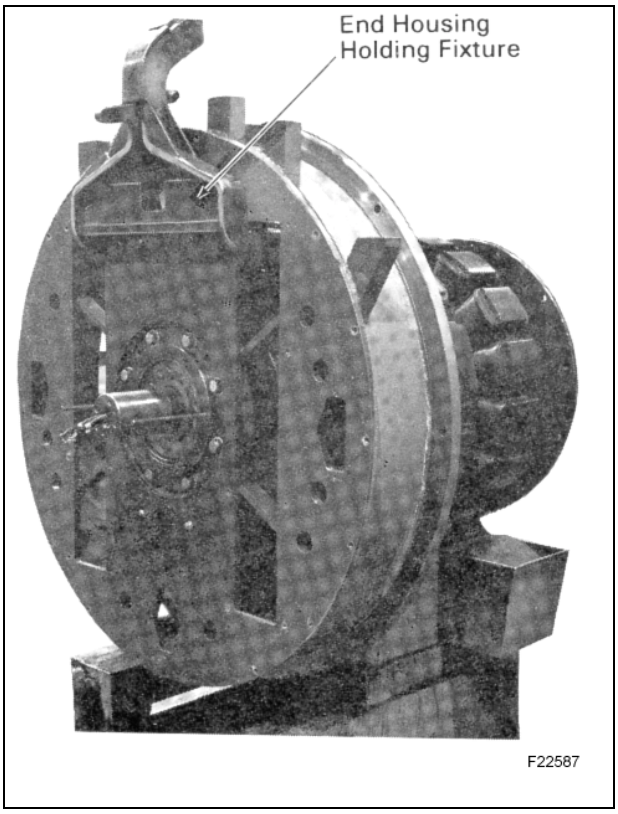

Figure 34 Attaching Crane Cable to End Housing

NOTE

End housing holding fixture may be fabricated as detailed in File Drawing referenced in Service Data.

10. Insert three 3/4"–10 jacking bolts equally spaced around end housing in bolt holes, from which end housing mounting bolts were removed. Turn jacking bolts equally until end housing is separated from stator frame.
11. Raise arbor fixture until air gap is equal around circumference of rotor. Raise cable at end housing until taut.

CAUTION

Use extreme care to ensure that laminations and windings are not damaged when removing rotor.

12. Carefully remove rotor and end housing assembly from stator, moving it towards bearing end of assembly until it clears stator, Figure 35.

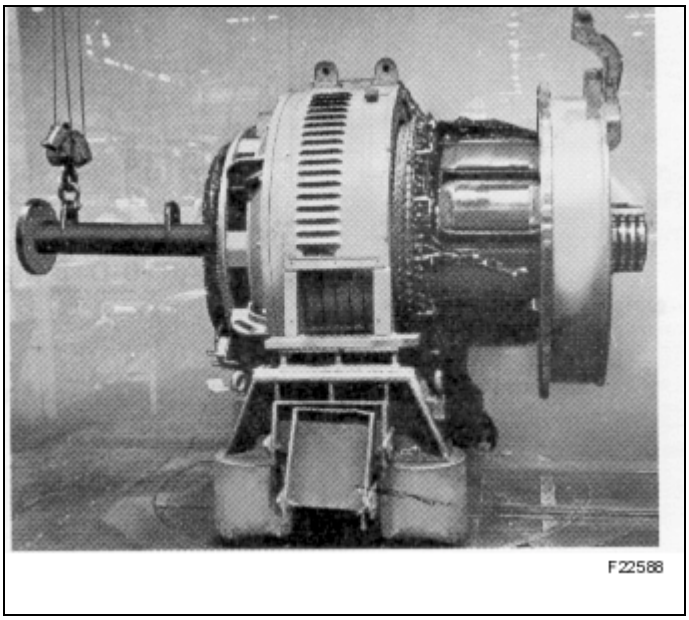

Figure 35 Removing Rotor and End Housing from Stator

NOTE

If necessary, the coupling disc and the companion alternator rotor can be removed from the traction alternator rotor.

13. Place rotor assembly on a cradle stand, Figure 36, with strips of fish paper between rotor and cradle.
14. To remove the collector ring assembly and the bearing outer seal, perform steps 4 – 9 discussed in Section 2.5.1 - Large Bearing Maintenance.

NOTE

All puller tools used to remove collector ring, bearing outer seal, bearing, and bearing inner seal may be fabricated as detailed in File Drawings and Work Sketch Drawing listed in Service Data.

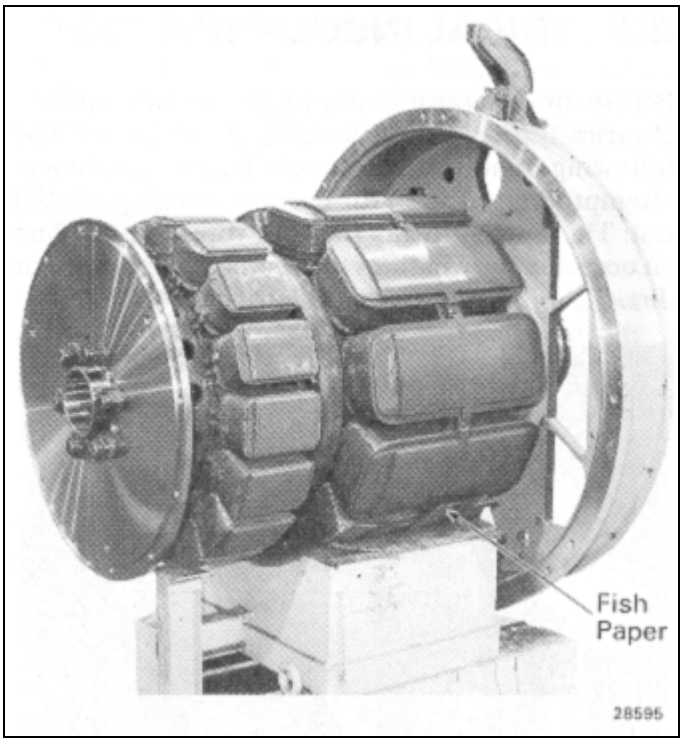

Figure 36 Rotor Assembly Removed From Stator

CAUTION

Use extreme care to ensure that bearing housing bore is not damaged when removing the bearing housing from the end housing.

15. Remove eight 3/4"–10 bolts securing bearing housing to end housing, Figure 37. Insert four 3/4"–10 jacking bolts equally spaced around the bearing housing in special holes provided. Turn jacking bolts equally until bearing housing is separated from the end housing.

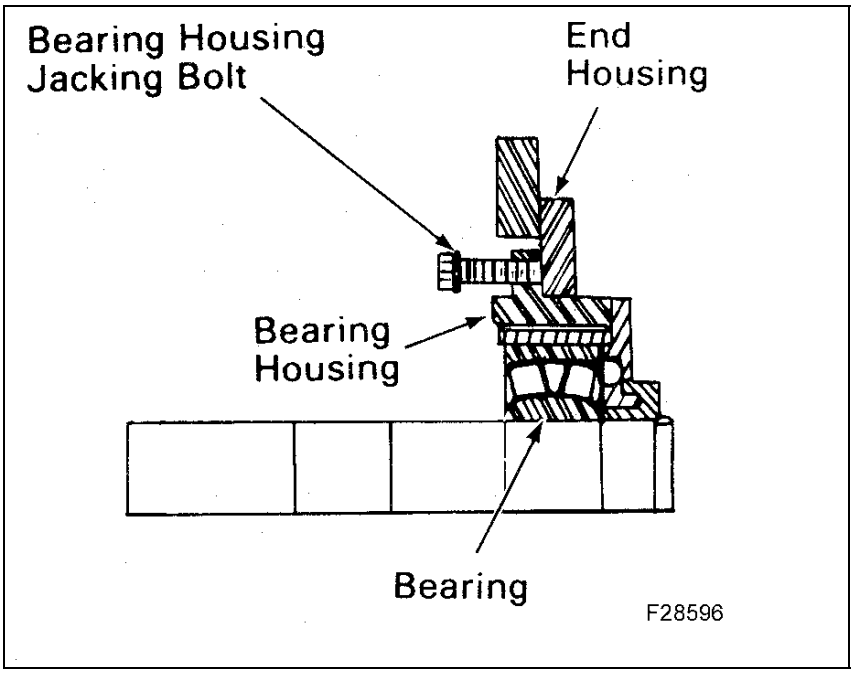

Figure 37 Bearing Housing Removal

CAUTION

Do not wash bearing housing in caustic solution or cob blast the housing bore. The bearing housing and housing bore dimensions are extremely critical and may be damaged.

16. If rotor shaft has a tapped hole in the end of the shaft for hydraulic bearing removal perform the following procedure (Two hydraulic pumps are required):
17. Ensure threads and pressure-fitting seat are cleaned in the drilled passage in the shaft.
18. Screw a 1/8"-27 adapter nipple, Figure 9into tapped hole in shaft and tighten. Refer to Service Data for adapter nipple part number.
19. Connect hydraulic pump, Figure 10, to adapter nipple.
20. If shaft is not equipped for hydraulic bearing removal, it is necessary to protect the stator and rotor windings, and remove the outer bearing race and cage with a cutting tool.
21. Thread six puller studs into flange of bearing cap. Install six spacer tubes and centering ring as shown in Figure 11.
22. Place extension yoke around field leads and bolt extension yoke to shaft as shown in Figure 11.

23. Install puller plate. Place hydraulic jack between extension yoke and puller plate, supported by cradle studs of puller plate as shown in Figure 11.
24. If rotor shaft is equipped for hydraulic bearing removal, apply hydraulic pressure to expand inner bearing race. Maintain this pressure while applying hydraulic pressure to the jack assembly until bearing slides off the shaft seat (approximately 63.5 mm [2-1/2"]). Ensure puller is pulling equally on all studs to prevent damage to bearing.
25. Remove bearing inner seal using small heating torch and pry bars.
26. Remove companion alternator stator closure assembly, if necessary.
27. Ensure the companion alternator stator assembly is properly supported, and remove bolts securing the companion alternator stator assembly to the traction alternator stator assembly. Install 3/4"-10 jack bolts and remove the companion alternator stator assembly.
28. Qualify bearing according to Section 2.5.2.2 - Bearing Inspection.

4.0 ROTOR AND STATOR OVERHAUL PROCEDURES

4.1 ROTOR and STATOR CLEANING

After separating the generator rotor and stator from the companion alternator rotor and stator, perform either of the following cleaning procedures in preparation for varnish treatment. Position the stator and rotor to allow access to all areas during the cleaning process.

4.1.1 WET METHOD

The rotor and stator may be cleaned with a steam cleaner such as Dober Chemical Corporation Cleaner 6006 or Turco Chemical Company Steamfas.

When operating the steamer, use an 85-g per 3.79-liter (3-oz./gal.) mixture of cleaner and water, and maintain a tank temperature of approximately 60°C to 71°C (140°F to 160°F).

WARNING!

Protect skin and clothing while steam cleaning. Operator should wear rubber apron, boots, gloves, and a plastic face shield.

Steam clean the stator or rotor assembly as follows:

NOTE

The solution tank should be approximately 0.9 m x 1.2 m x 0.9 m (3" x 4" x 3"). Two steam guns are required such as Hurriclean Steam Guns, Model 551.

1. Regulate a No. 1 steam gun to obtain a good soapy solution.
2. Steam clean stator or rotor by holding No. 1 steam gun nozzle at an angle to the stator or rotor of about 100 mm to 150 mm (4" to 6") away.
3. Rinse the stator or rotor thoroughly, using a No. 2 steam gun with a combination of clean water and steam to remove all traces of cleaner.
4. Blow off stator or rotor using high volume, low pressure, clean, dry, compressed air.
5. Thoroughly dry rotor or stator by placing in an oven at a regulated temperature of 150° C (302°F) for 8 hours.

4.1.2 DRY METHOD

An alternate satisfactory cleaning method employs the use of granulated corncob material applied with a controlled air blast. This method produces a clean, oil free surface ready for immediate varnish treatment.

When using this method, care should be exercised, as it is possible to remove varnish and cut into the layers of insulation by prolonged application of the blast material. Pressure used should be between 300 to 400 kPa (45 to 60 psi).

NOTE

The corn cob material trapped in the pockets or crevices of the rotor and stator assemblies should be removed by a straight air blast at reduced air pressure.

4.2 ELECTRICAL TESTS

4.2.1 PREPARATION FOR TESTING

Before the stator and rotor are varnished, it is advisable to electrically qualify the stator, Figure 38, and rotor. The resistance values of the stator and rotor assemblies should match the ones shown in the Service Data section before proceeding with a megger check. The following qualifications should be met before any attempt to perform a high potential test on the stator and rotor. This applies to any stator or rotor that has had an occasion for windings to accumulate moisture or dirt.

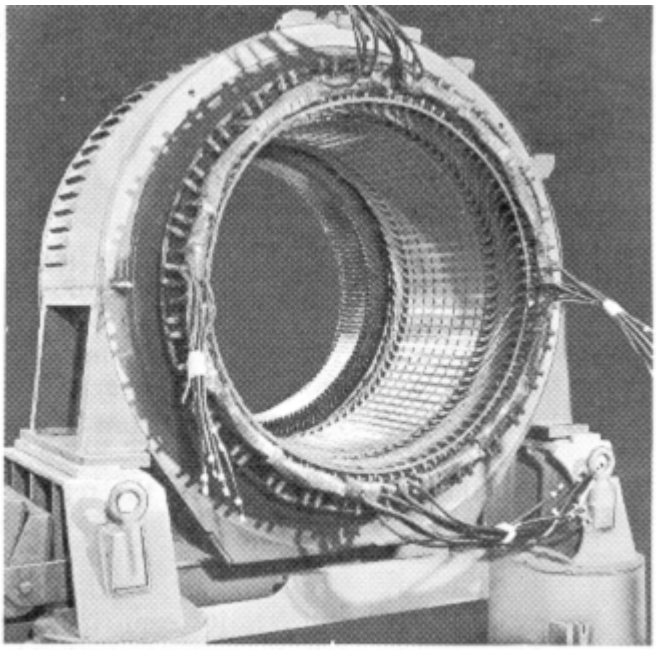

Figure 38 Typical AR10 Stator Assembly

4.2.2 STATOR INSULATION RESISTANCE AND HIGH POTENTIAL TEST

Perform an insulation and resistance test to the stator windings using a megger. If megger indicates less than 2 megohms at 1000 volts, bake stator in an oven at 125°C (257°F) for 4 hours, to remove any moisture. If minimum of 2 megohms is obtained, proceed with high potential test. (Reference Service Data) Perform high potential test to ground at 3200 volts for 10 seconds on new and 2400 volts for 10 seconds on used machines. (Reference service data)

4.2.3 PHASE-TO-PHASE RESISTANCE TEST

Perform a phase-to-phase resistance test between the stator phase leads. Ensure the readings taken are compared with the appropriate model listed in 7.2.3 Cold Resistance Limits Table in the Service Data Section. (Reference Service Data)

4.2.4 ROTOR INSULATION RESISTANCE AND HIGH POTENTIAL TEST

Perform an insulation and resistance test to the rotor windings using a megger. If megger indicates less than 2 megohms at 1000 volts, bake rotor in an oven at 125°C (257°F) for 4 hours, to remove any moisture. If minimum of 2 megohms is obtained, proceed with high potential test.(Reference Service Data)

Perform high potential test to ground at 1500 volts for 10 seconds on new and 1000 volts for 10 seconds on used assemblies. (Reference Service Data)

If the stator or rotor fails to qualify either the resistance check, or the high potential test, the generator should be returned to the Electro-Motive Division due to the special tooling and facilities needed to make corrections.

NOTE

Generators which have been stored for a considerable period of time, should be given an insulation resistance check before being put into service.

4.3 ROTOR AND STATOR ASSEMBLY VARNISH TREATMENT

Rotor and stator assemblies which pass the inspection and electrical test after all repairs have been complete, should be given a varnish treatment discussed in Sections 4.3.1 – Rotor Assembly, and 4.3.2 Stator Assembly.

Varnish should be thinned to maintain Ford Cup No. 4 orifice viscosity at 250 – 325 seconds at 21.1°C (70°F) and a minimum specific gravity of 0.900.

4.3.1 ROTOR ASSEMBLY

1. Heat rotor in a convection oven to 130°C ± 10°C (266°F ± 18°F) for a minimum of 2 hrs.
2. Remove rotor from oven and megger test immediately. If megger indication is less than 2 megohms, the rotor will have to be repaired. If megger indication is 2 megohms or more, continue with procedure. Do not allow rotor to cool below 100°C (212°F) prior to dip operation.
3. Dip rotor in varnish tank and allow it to soak for 5 minutes.
4. Remove rotor from varnish tank and allow it to drain for 5 minutes.
5. Clean varnish from mounting surfaces using a cloth saturated with solvent.
6. Bake rotor for 5 hrs in an oven set not to exceed 160°C (320°F).
7. When rotor has been allowed to cool to room temperature, check with megger. Rotor must measure a minimum of 15 megohms.

4.3.2 STATOR ASSEMBLY

1. Heat stator in a convection oven to 130°C ± 10°C (266°F ± 18°F) for a minimum of 2 hrs.
2. Remove stator from oven and megger test immediately. If megger indication is less than 2 megohms, the stator will have to be repaired. If megger indication is 2 megohms or more, continue with procedure. Do not allow stator to cool below 100°C (212°F) prior to dip operation.
3. Immerse stator in varnish tank for 10 minutes.
4. Remove stator from varnish tank and allow it to drain for 10 minutes.
5. Heat stator for 2 hrs at 160°C (320°F) maximum oven temperature.
6. While stator is 100° to 120°C (212° to 248°F), dip stator in varnish tank for 2 minutes.
7. Remove stator from varnish tank and allow it to drain for 5 minutes.
8. Heat stator for 3 hrs @ 160°C (320°F) maximum oven temperature.
9. While stator is 100° to 120°C (212° to 248°F), dip stator in varnish for 2 minutes.
10. Remove stator from varnish tank and allow it to drain for 5 minutes.
11. Heat stator for 5 hrs at 160°C (320°F) maximum oven temperature.
12. Clean varnish from all machined surfaces, tapped holes, and mounting pads immediately after oven-bake while stator remains hot and varnish is soft.

5.0 GENERATOR REASSEMBLY

NOTE

With the exception of TA12-8, which does not have a companion alternator, all the other main generator assemblies covered in this document consist of an AR or TA-type traction alternator and a companion alternator.

After the generator stator and rotor have been cleaned, varnished and checked, the inside of the stator and the outside of the rotor should be painted with red air-drying enamel.

When all of the component parts have been cleaned, checked, inspected, and painted, the generator is ready for assembly.

Before shrinking bearing to rotor shaft, it is very important to try the bearing in its housing. Place bearing housing on floor and slide bearing through bore of housing. Ensure bearing enters the housing bore squarely, and is not cocked. See Service Data for bearing dimensions and tolerances.

Refer to Figure 20 through Figure 32 as applicable during assembly.

5.1 BEARING AND END HOUSING ASSEMBLY

1. Fill labyrinth grooves in the bearing cap and cover with Esso Unirex N-2 grease. This grease need not be measured.

NOTE

Esso Unirex N-2 grease must be used exclusively to lubricate a new or cleaned bearing. Adequate lubrication depends upon precise weight of grease. Too much grease is as detrimental to service life of the bearing as too little grease. Bearing replacement kits include pre-weighed amounts of grease.

2. Carefully weigh the Esso Unirex N-2 grease for the bearing cap and cover groove. Refer to Service Data for proper quantity.
3. Pack the grease into bearing cap and cover groove. Leave a space at the top of the bearing, as shown in Figure 7, to limit churning and liquefaction of the grease. Form grease to proper contour.
4. Clean armature shaft and remove burrs or gall marks.

CAUTION

Care should be used when heating bearing parts. Overheating may result in warping or damaging the metal.

5. Heat the inner seal in an oil bath, electric oven, or induction heater for half an hour at 104°C (220°F). If an oil bath is used for heating, remove the oil from the seal with clean, bound-edge cloths prior to shrinking to the shaft. When using an induction heater, pyrometer readings (when current off) should be taken periodically. After heating, shrink the seal to the shaft and let it cool to room temperature.
6. Install greased bearing cap with gasket onto shaft.
7. Pack the bearing rollers and the space between the two rows of rollers with the quantity and type of grease specified in Service Data. On large bearings, fill groove in outer race with additional grease if so equipped.

NOTE

If Shell Cyprina grease is present in the bearing, Esso Unirex N-2 may be added.

8. Heat roller bearing with an induction heater to 105°C (220°F). Take pyrometer readings (with current off) at outside face of inner race only. Also see Caution before Step 5. Shrink bearing to shaft with the bearing part number toward the outside. Do not cock the bearing when placing it on shaft. Use a brass pipe to push bearing on shaft up to and against inner seal. Let bearing cool to room temperature.
9. Place end housing in a horizontal position with mounting flange down, and install two 3/4"-10 aligning studs 180° apart into two of the eight tapped bearing housing bolt holes in the end housing. The aligning studs will help prevent the bearing from cocking (damaging insulation material) when assembling bearing housing to end housing.

NOTE

Small bearing Model AR10 traction alternator has a bearing housing with an inner and outer phenolic sleeve and does not require additional insulation, unless it is equipped with the new version housing kit similar to the large bearing housing. (See Service Data)

10. On traction-alternator equipped with large bearing, position new insulating ring, Figure 13, over aligning studs so that holes in the ring line up with the holes in the end housing.
11. Apply Molykote paste to inside diameter of bearing housing, prior to assembling bearing housing to bearing.
12. Position bearing housing so that bearing housing and bearing cover bolt hole pattern relationship is as shown in Figure 14. This relationship is important to position brush holder studs at top and bottom position.
13. Carefully lower bearing housing into position guided by aligning studs. Gently tap bearing housing until bearing housing bottoms out on the end housing. Remove aligning studs.

14. On the traction alternator equipped with the large bearing, install eight insulating tubes into bearing housing mounting bolt holes.
15. On the traction alternator equipped with the large bearing, apply one insulating washer under each hardened flat washer 9531331, and install bolts to bearing housing. Torque bearing housing bolts to 203 N•m (150 ft-lbs).
16. Check insulation resistance between bearing housing and end housing, using a 1000-volt megohmmeter. Reading must be a minimum of 1 megohm. If reading is not satisfactory, remove bearing housing and inspect insulating material for damage and renew if necessary.
17. Insert two 1/2"-13 aligning studs, Figure 35, 180° apart in the threaded holes in the bearing cap. The purpose of the studs is to guide the bearing housing to the bearing cap. A bearing alignment disc, Figure 39, may also be used in installing the end housing.

NOTE

Bearing alignment disc may be fabricated as detailed in the File Drawing referenced in Service Data.

18. Lift end housing and place over rotor shaft. Align bearing housing to bearing cap using the aligning studs. Being careful not to cock bearing housing on bearing, gently push end housing onto bearing until housing is snug against bearing cap. Remove aligning disc.
19. Apply new gasket to bearing cover, Figure 13. Mount bearing cover to bearing housing with brush holder studs located at top and bottom positions. Remove aligning studs and secure cover with 1/2"-13 cover mounting bolts hand tightened. When all bolts are installed hand tight and the cover is not cocked, torque bolts to 68-75 Nm (50 – 55 ft-lbs) using a minimum of three passes.

CAUTION

Do not heat seal above 104°C (220°F). Overheating may result in warpage or other damage to seal.

20. Heat outer seal in an oil bath or electric oven, for half an hour at 104°C (220°F). If oil bath method is used, remove oil from seal with clean bound-edge cloths prior to shrinking to rotor shaft. When using an induction heater, pyrometer readings (with current off) should be taken periodically. After heating, shrink outer seal to rotor shaft by letting it cool to room temperature.
21. Place collector ring assembly on induction heater and heat to 104°C (220°F). Pyrometer readings (with current off) should be taken periodically. After heating, place collector ring assembly on rotor shaft, against outer seal. Rotate ring assembly on shaft for proper position of lead connection to terminals of ring assembly.

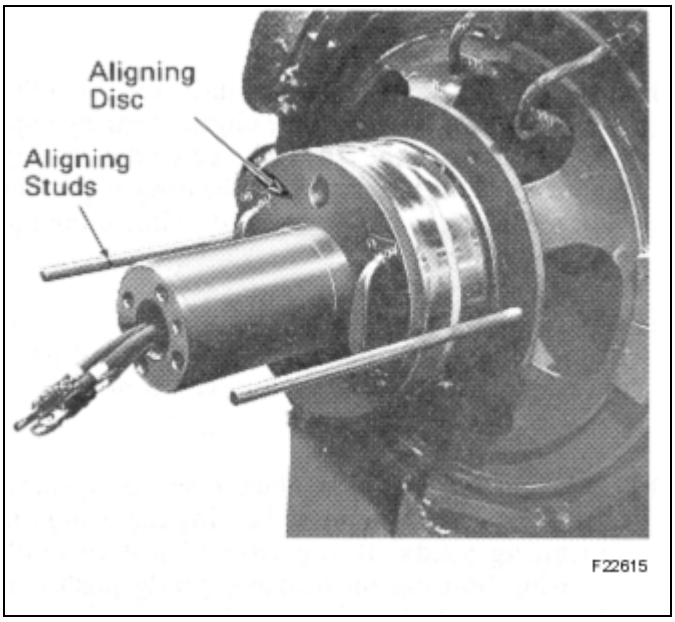

Figure 39 Applying End Housing to Rotor Assembly

WARNING

If work involving collector ring connections has been performed, use a continuity tester (with all field leads disconnected and all brushes lifted), to check that collector ring terminals marked 1 through 4 on the steel hub adjacent to the terminals are connected to the appropriate collector rings (No. 1 outboards, No. 4 inboard).

22. Place retainer plate over leads and on to the end of rotor shaft. Torque the 5/8"-11 retainer plate mounting bolts to 149-163 N•m (110 –120 ft-lbs).
23. Install cable grommet over four field leads and insert grommet into retainer plate.
24. Connect large field leads (traction alternator) to collector ring terminals 3 and 4, and smaller field leads (companion alternator) to terminals 1 and 2. Secure leads by torquing mounting bolts to 10 – 12 N•m (7 – 9 ft-lbs).

5.2 ROTOR AND STATOR ASSEMBLIES

1. If companion alternator rotor assembly was removed from main generator rotor, align mating bolt holes and bolt rotors together using 7/8"-9 bolts removed during disassembly. Be sure companion alternator cable leads are threaded through the traction alternator rotor shaft. Torque bolts to 508 – 542 Nm (375 – 400 ft-lbs) using a minimum of three passes.
2. Bolt companion alternator stator assembly to traction alternator stator frame assembly. Torque mounting bolts to 271 Nm (200 ft-lbs).

NOTE

A new generator/engine coupling arrangement designed to reduce vibration levels has been applied since January 1983.

3. The new coupling arrangement uses an engine coupling with a thin cross-section, and a generator coupling disc with a thick cross-section, rather than the thick engine coupling/thin generator coupling disc arrangement. The mating surfaces of the new arrangement are designed to prevent misapplication. Refer to Figure 40.

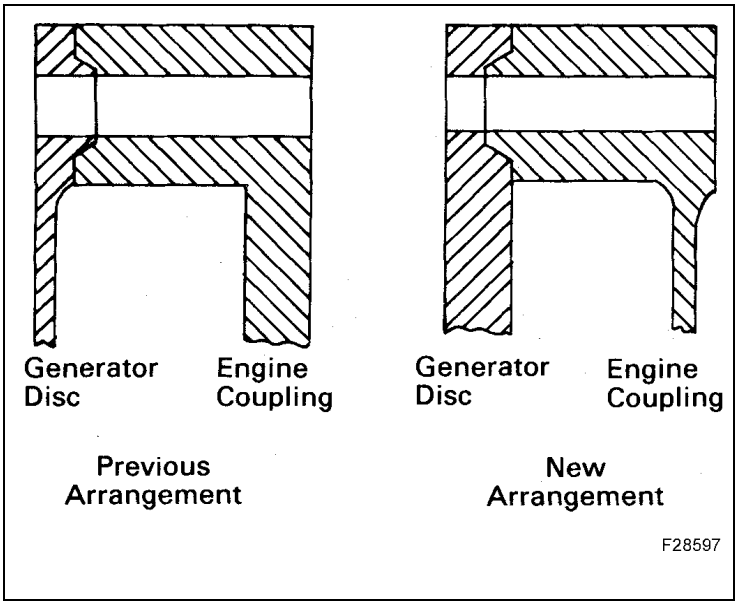

Figure 40 Engine/Generator Coupling Arrangement

4. Apply coupling disc to companion alternator rotor hub. Lubricate threads, washer, and washer face of self-locking nut with Molykote. Torque mounting nuts to 1898-2034 Nm (1400 – 1500 ft-lbs).
5. Place stator assembly and rotor assembly on their stands close enough to each other so that when the arbor fixture is placed in the flange bore of the companion alternator rotor, the end of the fixture protrudes through the stator assembly, as shown in Figure 41.

NOTE

Arbor fixture may be fabricated as detailed in the File Drawing referenced in Service Data.

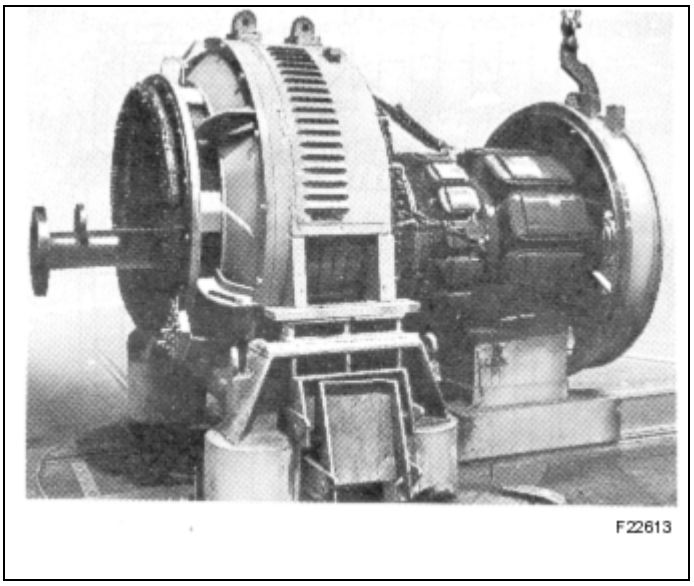

Figure 41 Preparation to Install Rotor in Stator

6. Support end housing with a crane cable and end housing holding fixture, Figure 42. Support end of arbor fixture with another crane cable. Carefully lift and guide rotor assembly into stator. Avoid damaging insulation. When end housing is flush against stator frame, install 3/4"-10 bolts, and lock washers, to hold end housing to stator frame. Torque bolts to 271 Nm (200 ft-lbs) using a minimum of three passes.

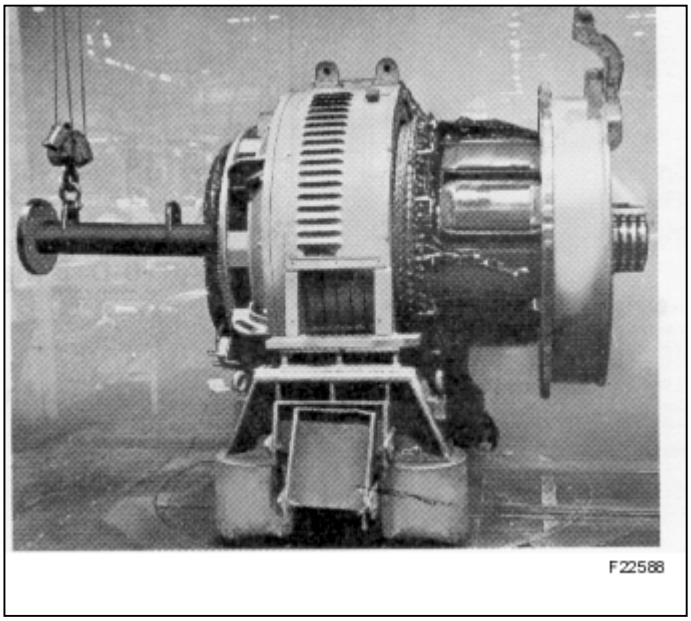

Figure 42 Installing Rotor in Stator

NOTE

When manufactured, the total end movement measurement of the bearing within the bearing housing is stamped on the generator end housing. On current generators, this dimension is 9.5 mm ± 0.4 (3/8" ± 1/64"). A few early generators had a total end movement less than 9.5 mm, which can be verified by the figure stamped on the generator end housing. This dimension is required to determine that the bearing has the necessary clearance.

7. During manufacture, measurement is also taken to determine bearing thrust clearance (called the "X" dimension), and is stamped on the generator end housing. This dimension is used to position the generator when being connected to the engine, to provide bearing thrust clearance to prevent bearing damage.
8. Center the rotor assembly in the stator and check the total end movement of the bearing outer race in the bearing housing. A few early generators had a total end movement of less than 9.5 mm ± 0.4 mm (3/8" ± 1/64"), which can be verified by the figure stamped on the generator housing. All current generators and most earlier models have a total end movement of 9.5 mm ± 0.4 mm (3/8" ± 1/64"). If the original parts are reused, this figure may be the same as the original figure, which was stamped on the face of the generator end housing. If the total end movement measurement differs from the number stamped on the generator end housing, Figure 43, remove the original number and stamp the new number adjacent to it.

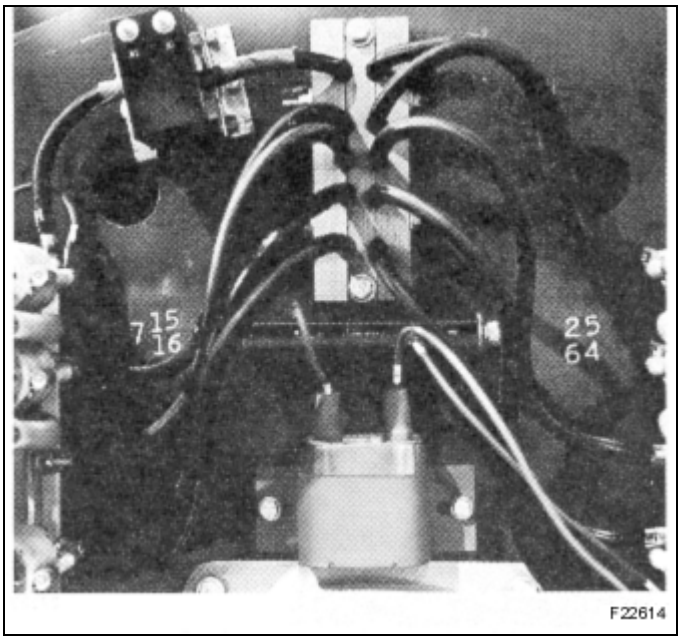

Figure 43 Stamped Dimensions on Generator End Housing

9. Position the rotor so that all the end movement is taken up in the direction of the coupling disc.
10. On early model AR10 generators with the small bearing application, measure the distance from the machined surface of the bearing housing between the mounting bolts to the outer surface of the collector ring assembly, Figure 44. This measurement is the "X" (protrusion) dimension. Stamp this measurement, to the nearest 0.40 mm (1/64"), on the generator end housing, Figure 43. This dimension should be approximately 224.6 mm (8-7/8").
11. On the other model generators with the large bearing application, measure the distance from the bearing housing bolt head at the 1 o'clock position to the outer surface of the collector ring assembly, Figure 45. This measurement is the "X" (protrusion) dimension. Stamp this measurement, to the nearest 0.40 mm (1/64"), on the generator end housing, Figure 43.
12. On AR6, 10, 12, 15, and TA12, 17 generators, this dimension should be approximately 203 mm (8"), and on the AR8, 11, 16, 20 and TA20, 22, generators, approximately 300 mm (11-13/16").
13. Place fish paper strips 2 mm x 80 mm x 900 mm (1/16" x 3" x 36") in air gap between rotor assembly and stator. Remove crane cables and end housing holding fixture.

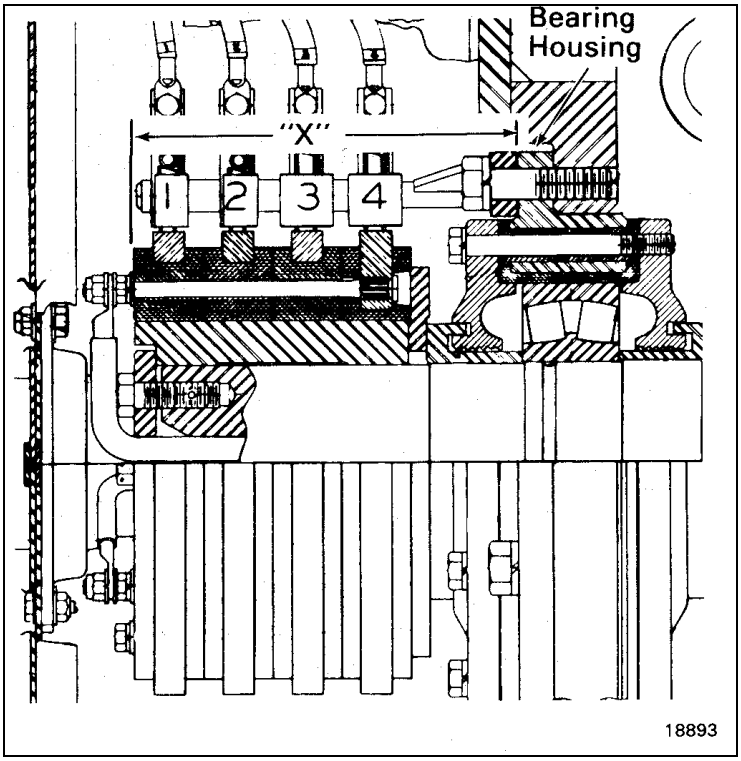

Figure 44 Model AR10 Small Bearing "X" (Protrusion) Measurement

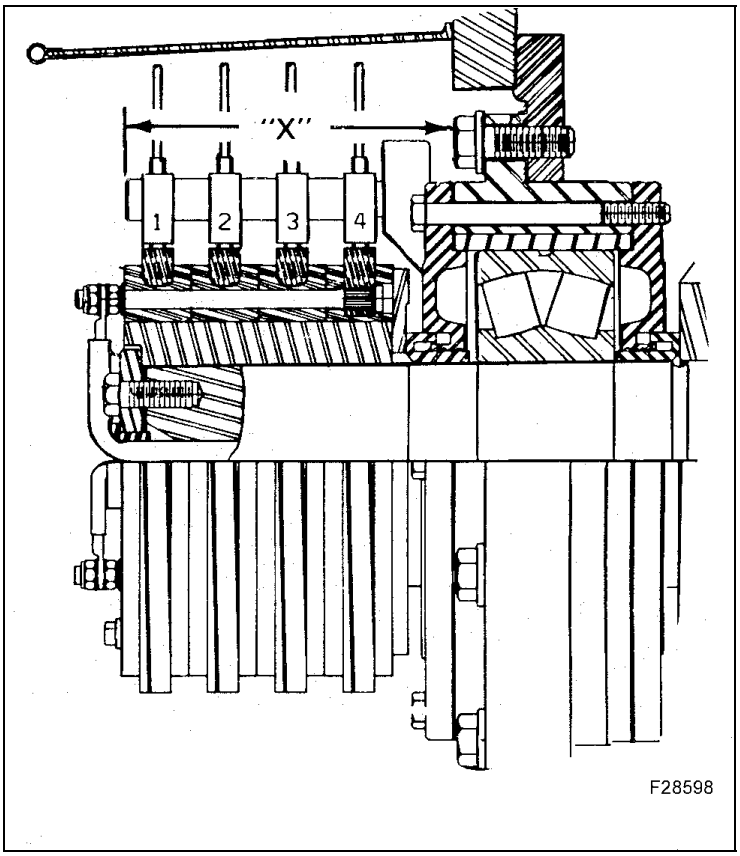

Figure 45 Large Bearing "X" (Protrusion) Measurement

14. Install brush holders, Figure 4 or Figure 5 as applicable. Install large brush holders (traction alternator) over collector ring positions 3 and 4, and install small brush holders (companion alternator) over collector ring positions 1 and 2.
15. Mount jumper leads J1, J2, J3, and J4 between top and bottom brush holders having the same position numbers. The jumper leads attach to brush holder locking screws, which secure holder to insulated stud.
16. Route leads to the left of collector ring assembly. Secure leads with three cable clamps bolted into threaded holes in bearing housing.
17. Connect external leads 1, 2, 3, and 4 to corresponding lower brush holder terminals.
18. Adjust brush holders to have 3.2-mm (1/8") clearance over collector rings. In addition, ensure that holder is centered over collector ring. Torque holder locking screws to 14–20 N•m (10 15 ft-lbs). Assemble brushes in holders; if used brushes are reinstalled, ensure that their original positions are maintained. Check that each brush is centered within 1.59 mm (1/16") in relation to mating collector ring.
19. Install rectifier banks on end housing.
20. Install stator lead cleat assemblies to face of end housing, and connect stator leads to rectifier bank assemblies.

21. Install collector ring cover and air box cover assembly, which was removed during disassembly.
22. Connect all loose leads to proper connections, and secure with tape to prevent movement. Route remaining external leads through hole on lower face of air box.
23. Generator is now ready to be installed. Refer to Section 6.0 - Installation Procedures (Locomotive).

6.0 INSTALLATION PROCEDURES (LOCOMOTIVE)

The installation of the main generator is similar to its removal, with the exception that it requires more time, care, and skill. Use the following procedure as a guide to generator installation:

1. Before a main generator is installed, check and clean the mounting plates. Be sure these plates are smooth, free of burrs and high spots.
2. Before lifting the generator into the unit, check and clean the mounting pads on the locomotive bed frame. Be sure these pads are clean and free of burrs.
3. Check the surface on the engine and generator coupling discs, both must be smooth and clean. Add a little oil or mounting compound to the fitting surfaces. Check that bolt holes in couplings are clean and smooth.
4. Apply 2 – 3/8" socket wrench to the engine and generator coupling bolt nuts, to make sure they are tightened to the proper torque as specified in Service Data.
5. Inspect and clean shims. Shims must be smooth, free from burrs and kinks. Shims should have been tagged after removal of generator so they may be installed in their original position at this time.
6. Lift generator and guide slowly and carefully into engine room. Set generator on mounting pads as close to engine coupling disc as possible.
7. Line up hole patterns in the engine and generator coupling discs by barring or jacking engine over. Push generator toward engine until engine coupling fits into the beveled groove in the generator coupling disc.
8. Check all coupling bolts to see that they are smooth and clean. Place a little oil or mounting compound on 3/4" coupling bolts, and install all bolts through the generator and engine coupling discs from the engine side. Check to be sure the generator coupling is not cocked and is properly mated to the engine coupling disc.
9. Once the generator is attached to the engine, do not bar or jack engine over until all fish paper strips are removed from between the rotor assembly and the stator coils.
10. Line up dowel holes and base bolt holes. Do not insert dowels or base bolts until generator is aligned with engine. See M.I. 1753 for alignment of generator to engine. Install dowels and base bolts. Use Texaco Threadtex as a lubricant on the bolts and washers.

7.0 SERVICE DATA

7.1 REFERENCES

AR10, AR12, AR15, AR16, AR17 and all TA-type Main Generators
Rectifier Bank Assemblies and Suppression Circuits..... M.I. 3317-2
AR11 and AR20 Traction Generator Rectifier Bank Assemblies
and Suppression Circuit..... M.I. 3317-3
Traction Alternators with Head End Power.....M.I. 3319
AR5 Traction Generator.....M.I. 3318
AR6 Traction Generator.....M.I. 3323
D14 Alternator.....M.I. 3306
D18 Alternator.....M.I. 3307
CA series alternators.....M.I. 3308
Alignment of Locomotive Rotating Equipment .....M.I. 1753

7.2 SPECIFICATIONS

7.2.1 WEIGHTS

AR6.....6,284 kg (13,780 lbs)
AR8.....6,668 kg (14,7000 lbs)
AR9HE7-CA6 .....8,454kg (18,600 lbs)
AR10.....7,120 kg. (15,700 lbs.)
AR11.....7,440 kg. (16,400 lbs.)
AR12.....8,225 kg. (18,130 lbs.)
AR15.....6,985 kg. (15,400 lbs.)
AR16.....8,330 kg (18,360 lbs.)
AR17.....7,938 kg (17,500 lbs)
AR20.....8,709 kg(19,200 lbs)
TA12-8.....5,352 kg(11,800 lbs)
TA17-6.....8,709 kg (19,200 lbs.)
TA20 .....8,500 kg (18,720 lbs)
TA22-8.....8,951 kg (19,735 lbs.)
TA22-9.....8,951 kg (19,735 lbs.)

7.2.2 BRUSHES

Number of Brushes .....4 to 6
Grade.....N-39 Or DE869
Brush Part Number
Used with Single Brush Holder 8413189 and Double 9577092
(Current Model) ..... (N-39) 40034666
Will Replace N-39 40034666 (2002) ..... (DE869) 40096504
Used with Double Brush Holder 8283003.....8329691
Used with Double Brush Holder 8455030.....8456279
Brush Size
40034666 (N-39) 40096504 (DE869)
(Current Model) .....54 mm x 32 mm x 13 mm (2-1/8" x 1-1/4" x 1/2")
8329691, 8456279..... 51 mm x 32 mm x 13 mm (2" x 1-1/4" x 1/2")
Wear Limit (Measured on long side of brush)..... (Minimum)19 mm (3/4")

Brush Holder 8413189 (Current Model Single) 9577092 (Double)
Number.....Double (2) Single (4)
Spring Pressure .....1.50 kg. ± 0.15 kg. (3.3 ± 0.33 lbs.)

Brush Holder 8283003
Number 2
Spring Pressure .....1.49 kg. ± 0.11 kg. (3.29 ± 0.25 lbs.)

Brush Holder 8455030
Number 2
Spring Pressure .....1.50 kg. ± 0.15 kg. (3.3 ± 0.33 lbs.)
(For D14 brushes and brush holders, see M.I. 3306)
(For D18 brushes and brush holders, see M.I. 3307)
(For CA series brushes and brush holders see M.I. 3308)

Collector Rings
Maximum Ring Eccentricity .....0.15 mm (0.006")
Maximum Lateral Ring Runout .....0.8 mm (1/32")
Condemning Limit on Ring Outside Diameter ..... 260 mm (10-1/4")

7.2.3 COLD RESISTANCE LIMITS (in Ohms at 75°C [167°F])

Resistance at 75°C = Measured resistance x $\frac{309.5}{234.5 + \text{Stator Core temp.°C}}$

MODEL AR 6	Nominal	Max	Min
Rotor Collector Ring to Collector Ring	1.020	1.061	0.979
Stator Line-to-Neutral Per 5 Phase Group	0.00476	0.00485	0.00466
Stator Line-to-Line Per 5 Phase Group	0.00903	0.00921	0.00885
Stator Line-to-Neutral Per Paralleled 10 Phase Group	0.00272	0.00294	0.00250
Stator Line-to-Line Per Paralleled 10 Phase Group	0.00497	0.00537	0.00457

MODEL AR 8	Nominal	Max	Min
Rotor Collector Ring to Collector Ring	1.133	1.156	1.110
Stator Line-to-Neutral Per 5 Phase Group	0.00133	0.00136	0.00130
Stator Line-to-Line Per 5 Phase Group	0.00215	0.00219	0.00211

MODEL AR 10	Nominal	Max	Min
Rotor Collector Ring to Collector Ring	1.238	1.288	1.88
Stator Line-to-Neutral Per 5 Phase Group	0.00308	0.00314	0.00302
Stator Line-to-Line Per 5 Phase Group	0.00568	0.00579	0.00557
Stator Line-to-Neutral Per Paralleled 10 Phase Group	0.00176	0.00190	0.00162
Stator Line-to-Line Per Paralleled 10 Phase Group	0.00312	0.00328	0.00296

MODEL AR 11	Nominal	Max	Min
Rotor Collector Ring to Collector Ring	1.384	1.439	1.328
Stator Line-to-Neutral Per 5 Phase Group	0.000915	0.000988	0.000841
Stator Line-to-Line Per 5 Phase Group	0.00145	0.00148	0.00142

MODEL AR 12	Nominal	Max	Min
Rotor Collector Ring to Collector Ring	1.48	1.52	1.44
Stator Line-to-Neutral Per 5 Phase Group	0.00242	0.00247	0.00237
Stator Line-to-Line Per 5 Phase Group	0.00444	0.00453	0.00435
Stator Line-to-Neutral Per Paralleled 10 Phase Group	0.00138	0.00145	0.00131
Stator Line-to-Line Per Paralleled 10 Phase Group	0.00253	0.00266	0.00240

MODEL AR 15	Nominal	Max	Min
Rotor Collector Ring to Collector Ring	1.238	1.288	1.188
Stator Line-to-Neutral Per 5 Phase Group	0.00300	0.00306	0.00294
Stator Line-to-Line Per 5 Phase Group	0.00555	0.00566	0.00544

MODEL AR 16	Nominal	Max	Min
Rotor Collector Ring to Collector Ring	1.635	1.701	1.570
Stator Line-to-Neutral Per 5 Phase Group	0.001455	0.001484	0.001426
Stator Line-to-Line Per 5 Phase Group	0.002729	0.002784	0.002674

MODEL AR 17	Nominal	Max	Min
Rotor Collector Ring to Collector Ring	0.876	0.911	0.841
Stator Line-to-Neutral Per 5 Phase Group	.00315	.00321	.00309
Stator Line-to-Line Per 5 Phase Group	.00582	.00595	.00571

MODEL AR 20	Nominal	Max	Min
Rotor Collector Ring to Collector Ring	1.525	1.570	1.480
Stator Line-to-Neutral Per 5 Phase Group	0.000995	0.001050	0.000940
Stator Line-to-Line Per 5 Phase Group	0.001565	0.001610	0.001520

MODEL TA 12-8	Nominal	Max	Min
Rotor Collector Ring to Collector Ring	1.330	1.365	1.294
Stator Line-to-Neutral Per 5 Phase Group	0.00476	0.00485	0.00466
Stator Line-to-Line Per 5 Phase Group	0.00903	0.00921	0.00885

MODEL TA 17-6	Nominal	Max	Min
Rotor Collector Ring to Collector Ring	1.384	1.439	1.328
Stator Line-to-Neutral Per 5 Phase Group	0.00300	0.00306	0.00294
Stator Line-to-Line Per 5 Phase Group	0.00568	0.00579	0.00557

MODEL TA 20	Nominal	Max	Min
Rotor Collector Ring to Collector Ring	.903	.921	.885
Stator Line-to-Neutral Per 5 Phase Group	0.00900	0.00918	0.00882
Stator Line-to-Line Per 5 Phase Group	0.01750	0.01785	0.01715

MODEL TA 22-8	Nominal	Max	Min
Rotor Collector Ring to Collector Ring	.962	1.000	.924
Stator Line-to-Neutral Per 5 Phase Group	0.00609	0.00621	0.00597
Stator Line-to-Line Per 5 Phase Group	0.01160	0.01184	0.01136

MODEL TA 22-9	Nominal	Max	Min
Rotor Collector Ring to Collector Ring	.962	1.000	.924
Stator Line-to-Neutral Per 5 Phase Group	0.00773	0.00789	0.00758
Stator Line-to-Line Per 5 Phase Group	0.01495	0.01525	0.01465

7.2.4 TORQUE VALUES

Coupling Disc (Lubricated with Texaco Threadtex)
- Six Bolt Application ..... 2440 N•m (1800 ft-lbs)
- Twelve Bolt Application ..... 1830 N•m (1350 ft-lbs)

Engine to Generator Coupling Bolt Nut ..... 400 N•m (295 ft-lbs)

7.3 EQUIPMENT LIST

Pyrometer 8364533
Induction Heater 8041446
Stone (1" x 1-1/2" x 5") required 8204167
Collector Ring Grinder 8219264
Collector Ring Grinder Adapter:
- Small Bearing (215mm) Generator 8364940
- Large Bearing (260 mm) Generator 9506268

NOTE

Two hydraulic pumps are required for bearing removal, if rotor shaft has tapped hole for hydraulic bearing removal.

Megger, Insulation Resistance Test Set
(250, 500, 1000volt) 8174880
Leads, 3.7 m (12 ft.) 8174878
Carrying Case 8174879
Megger, Insulation Resistance Test Set
(500, 1000, 2500, 5000volt) 40058161
(Carrying Case and 12 ft leads included)
Digital Low Ohm Resistance Tester Kit
(Range 0 to 1.999 miliohms) 9322573
(Includes AC – DC Power Supply and 6 foot test leads)

Hydraulic Pump 8174285
Hydraulic Pump Hose Assembly 8152395
Hydraulic Pump Oil, 1 gal. 8246430
Adapter Nipple, 1/8" – 27 8458505
Jacking Bolt (3/4" – 10 x 5") 8458523
Generator Lifting Shackle – Includes Pin – 2 required 8249739
Shackle Base – 2 required 8072352
Shackle Base Bolts – 8 required 272563
Rotor Shaft Jacking Fixture ..... *Work Sketch 16288

Grease Contour Mask, Bearing Cap and Cover ..... *File Drawing 919
End Housing Holding Fixture ..... *File Drawing 753
Arbor Fixture ..... *File Drawing 754
Collector Ring, Seals, and Bearing Puller Assembly..... *File Drawing 755
Bearing Alignment Disc..... *File Drawing 920

*File and Work Sketch numbers represent facility drawings that are available (at no charge) from EMD Service Publication Department. These drawings include construction details of tooling that can be manufactured by the customer.

7.4 MATERIAL LIST

Texaco Threadtex 18.93 liters (5 gallons).....8307731
Red Air-Drying Enamel (Water Based)
95 liters (1 quart) 8061130
18.93 liters (5 gallons).....8084876
Black Air-Drying Varnish
3.78 liters (1 gallon) 8122347
208 liters (55 gallons).....8116521
Molykote Lubricant .473 liters (1 pint) paste.....9517921
Bearing Lubricant Esso Unirex N-2
13.61 kg. (35 lbs.).....9507146
54.43 kg. (120 lbs.).....9507147

Bearing Housing Kit (For small 8 ½" Bearing) 40060516
New Vented Bearing Housing.....All Models) 40086499
(TA20 Only) 40086501

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