

SERVICE DEPARTMENT



# Maintenance Instruction

## AR6-D14 TRACTION GENERATOR

AR6-D14 traction generator maintenance and overhaul instructions are presented in six sections, each under separate cover. General maintenance instructions are included for the AR6-D14 combination. In addition, detailed instructions to completely disassemble, inspect, recondition, assemble, and test the AR6 traction generator are included. Performance of a specific procedure may require, as a prerequisite, the completion of a procedure contained in another section. In each case this procedure will be referenced.

<u>Section No.</u>	<u>Title</u>
1	Maintenance And Disassembly
2	Bearing Component Maintenance And Inspection
3	Stator Inspection, Reconditioning, And Test
4	Rotor Inspection, Reconditioning, And Test
5	Rectifier Bank Assemblies And Suppression Circuits
▶6	Assembly And Test

## SECTION 6

### ASSEMBLY AND TEST

#### INTRODUCTION

After individual parts have been reconditioned and inspected as outlined in M.I. 3323 sections, 2, 3, 4, and 5, the generator may be reassembled using the following procedures. Instructions for installation of the main generator into the locomotive are also included.

#### GENERATOR ASSEMBLY

Generator assembly is presented in two separate procedures that correspond to the two disassembly procedures in M.I. 3323-1. Assembly Procedure A may be used after performing bearing maintenance, while the generator is in place, which involves only partial part removal. Assembly Procedure B is a complete generator assembly procedure.

#### PROCEDURE A

**NOTE:** Bearing components must be properly lubricated before final assembly. Refer to M.I. 3323-2.

1. Apply a new grease gasket to bearing cover, Fig. 1. Mount bearing cover to bearing

housing with brush holder studs located at top and bottom positions. 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 N·m (50-55 ft-lbs) using a minimum of three passes.

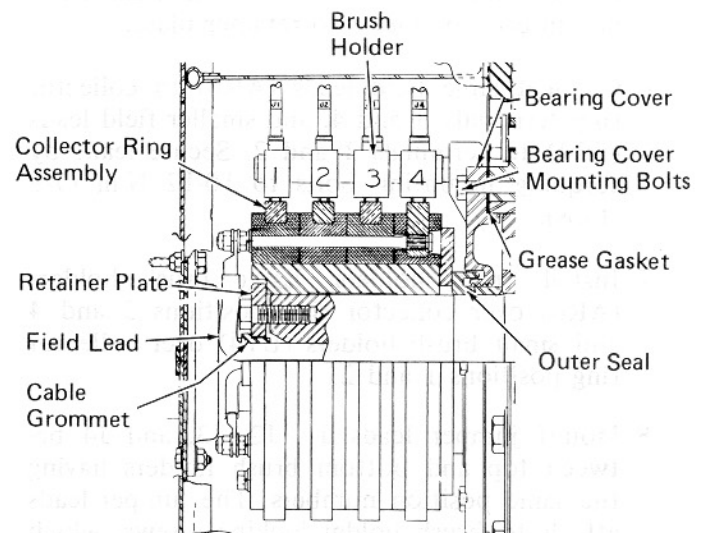


Fig. 1 - Assembly Of Generator After Bearing Maintenance

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

2. Heat outer seal in an oil bath or electric oven, for half an hour at 104° C (220° C). 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.
3. 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 on rotor shaft, against outer seal. Rotate ring assembly on shaft for proper position of lead connection to 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 housing adjacent to the terminals are connected to the appropriate collector rings (No. 1 outboard, No. 4 inboard).

4. Place retainer plate over leads and on to end of rotor shaft. Torque the 5/8"-11 retainer plate mounting bolts to 149-163 N·m (110-120 ft-lbs).
5. Install cable grommet over four field leads and insert grommet into retainer plate.
6. Connect large field leads (AR6) to collector ring terminals 3 and 4, and smaller field leads (D14) to terminals 1 and 2. Secure leads by torquing mounting bolts to 10-12 N·m (7-9 ft-lbs).
7. Install brush holders. Large brush holders (AR6) over collector ring positions 3 and 4 and small brush holders (D14) over collector ring positions 1 and 2.
8. 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.

9. Route leads to left of collector ring assembly. Secure leads with three cable clamps bolted into threaded holes in bearing housing.
10. Connect external leads 1, 2, 3, and 4 to corresponding lower brush holder terminals.
11. 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.
12. Install collector ring cover and any sections of the air box cover removed during disassembly.

Assembly is complete; return generator to service.

## **PROCEDURE B**

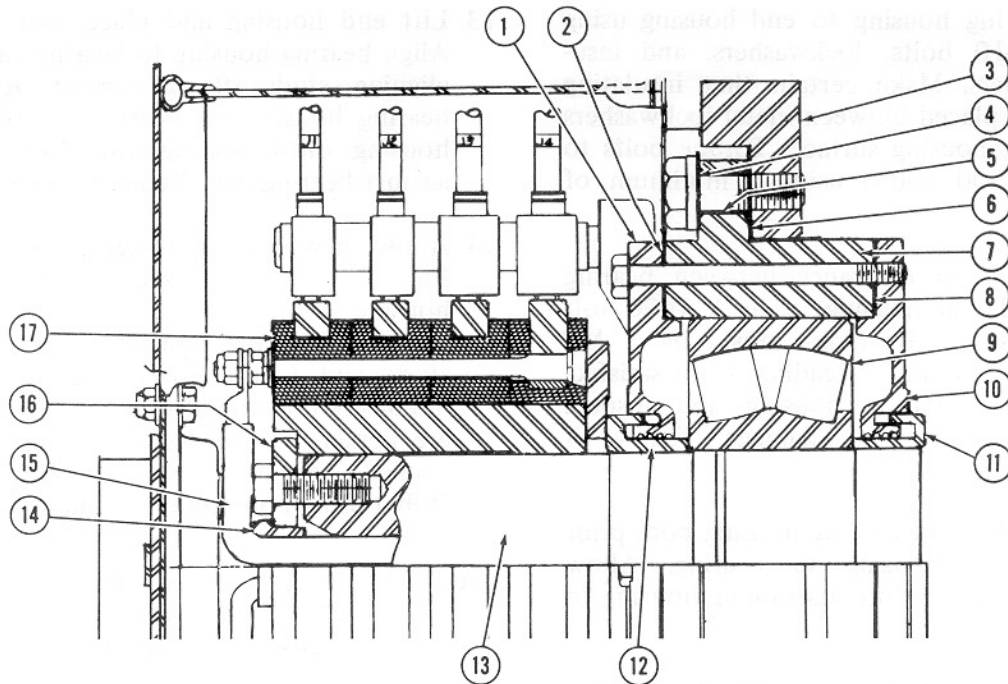
### **BEARING AND END HOUSING ASSEMBLY**

**CAUTION:** Do not overheat bearing parts. Overheating may result in warpage or other damage to the part.

1. Heat inner 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 on rotor shaft, Fig. 2. 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.
2. Install bearing cap on rotor shaft. Apply new grease gasket to bearing cap.

Before installing bearing on rotor shaft, it is very important that the bearing be tried in its housing. Place bearing housing on a level surface and slide bearing through bore of housing. Ensure that bearing enters housing bore squarely, and is not cocked.

3. Heat roller bearing with an induction heater to 104° C (220° F). Take pyrometer readings (with current off) at outside face of inner race only. Avoid overheating; see Caution above. Shrink bearing on rotor shaft with bearing part number toward outside. Do not cock bearing when placing on shaft. Use a



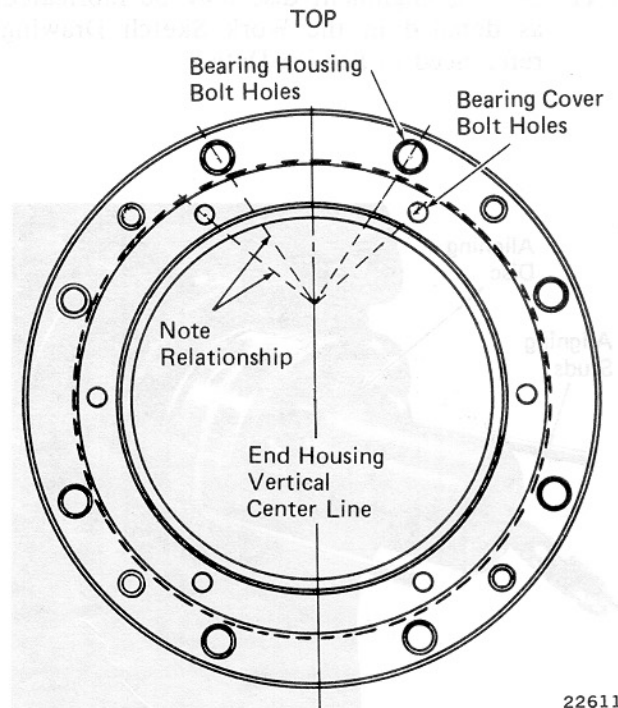
- |                      |                    |                             |
|----------------------|--------------------|-----------------------------|
| 1. Bearing Cover     | 7. Bearing Housing | 13. Rotor Shaft             |
| 2. Grease Gasket     | 8. Grease Gasket   | 14. Cable Grommet           |
| 3. End Housing       | 9. Bearing         | 15. Field Lead              |
| 4. Insulating Washer | 10. Bearing Cap    | 16. Retainer Plate          |
| 5. Insulating Tube   | 11. Inner Seal     | 17. Collector Ring Assembly |
| 6. Insulating Ring   | 12. Outer Seal     |                             |

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Fig. 2 - Generator Bearing End Cross-Section

brass pipe to push bearing on shaft up to and against inner seal. Bearing will shrink to motor shaft when cooled to room temperature.

4. Place end housing in a horizontal position with mounting flange down. Install two 3/4"-10 aligning studs 180° apart into two of the eight bearing housing mounting bolt holes. The aligning studs will help prevent the bearing from cocking (damaging insulation material), when assembled to end housing.
5. Position new insulating ring over aligning studs, so that holes in ring line up with holes in end housing.
6. Carefully position bearing housing so that housing and cover bolt hole pattern relationship, Fig. 3, is at the top and in line with end housing vertical center line. This relationship is important to keep brush holder studs at top and bottom positions.
7. Lower housing into position guided by aligning studs. Gently tap housing into position until it bottoms on end housing. Remove aligning studs.



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Fig. 3 - Installing Bearing Housing

8. Install eight insulating tubes, Fig. 2, into bearing housing bolt holes. The tubes prevent mounting bolts from shorting out insulated bearing housing.

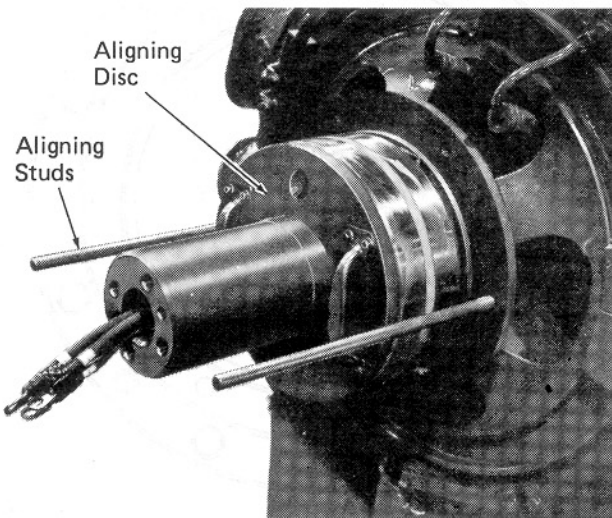
9. Secure bearing housing to end housing using eight 3/4"-10 bolts, lockwashers, and insulating washers. Make certain that insulating washers are placed between metal lockwashers and bearing housing surface. Torque bolts to 271 N·m (200 ft-lbs) using a minimum of three passes.
10. Check insulation resistance between bearing housing and end housing, using a 1000 volt megohmmeter. Reading must be 1 MΩ (megohm) minimum. If reading is not satisfactory, remove bearing housing and inspect insulating material for damage. Renew if necessary.
11. Apply Molykote to bearing housing bore prior to assembling housing to bearing. Allow Molykote to dry before assembling housing to bearing.
12. Insert two 1/2"-13 aligning studs, Fig. 4, 180° apart into the bearing cap. These studs will help align the bearing housing to the bearing cap during assembly. In addition, a bearing alignment disc may also be used during end housing installation.

NOTE: Bearing alignment disc may be fabricated as detailed in the Work Sketch Drawing referenced in Service Data.

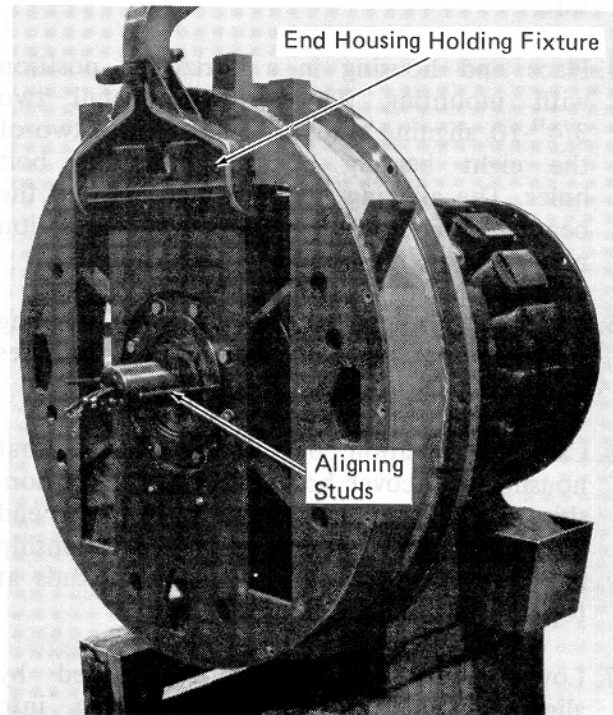
13. Lift end housing and place over rotor shaft. Align bearing housing to bearing cap using the aligning studs. Being careful not to cock bearing housing on bearing, gently push end housing onto bearing until housing is snug against bearing cap. Remove aligning disc.
14. Apply new grease gasket to bearing cover, Fig. 2. 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 N·m (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.

15. 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.



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Fig. 4 - Apply End Housing To Rotor

16. 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 on rotor shaft, against outer seal. Rotate ring assembly on shaft for proper position of lead connection to 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 housing adjacent to the terminals are connected to the appropriate collector rings (No. 1 outboard, No. 4 inboard).

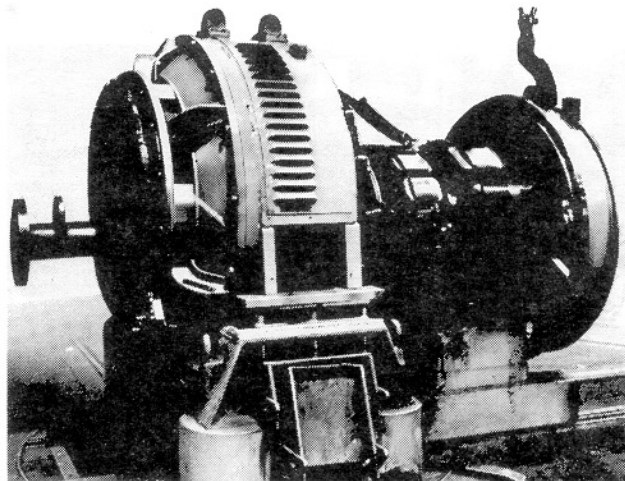
17. Place retainer plate over leads and on to the end of rotor shaft. Torque the 5/8"-11 retainer plate mounting bolts to 149-163 N·m (110-120 ft-lbs).
18. Install cable grommet over four field leads and insert grommet into retainer plate.
19. Connect large field leads (AR6) to collector ring terminals 3 and 4, and smaller field leads (D14) to terminals 1 and 2. Secure leads by torquing mounting bolts to 10-12 N·m (7-9 ft-lbs).

## ROTOR AND STATOR ASSEMBLIES

1. If D14 rotor assembly was removed from AR6 rotor, align mating bolt holes and bolt rotors together using 7/8"-9 bolts removed during disassembly. Be sure D14 cable leads are threaded through the AR6 rotor shaft. Torque bolts to 508-542 N·m (375-400 ft-lbs) using a minimum of three passes.
2. Bolt D14 stator assembly to AR6 stator frame assembly. Torque mounting bolts to 271 N·m (200 ft-lbs).
3. Apply coupling disc to D14 rotor hub. Lubricate threads, washer and washer face of self locking nut with Molykote. Torque mounting nuts to 1898-2034 N·m (1400-1500 ft-lbs).
4. 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 D14 rotor, the end of the fixture protrudes through the stator assembly, as shown in Fig. 5.

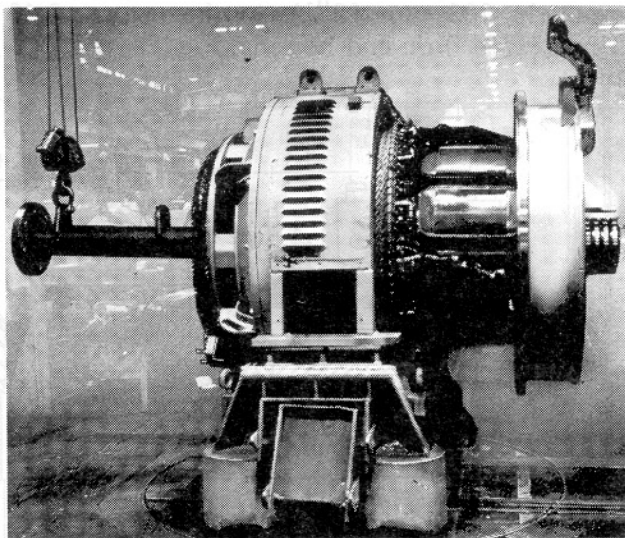
**NOTE:** Arbor fixture may be fabricated as detailed in the File Drawing referenced in Service Data.



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Fig. 5 - Preparation To Install Rotor In Stator

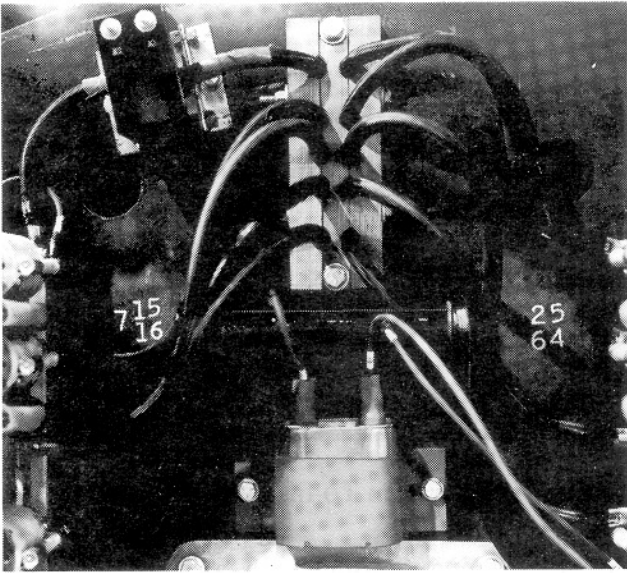
5. Support end housing with a crane cable and end housing holding fixture, Fig. 6. Support end of arbor fixture with another crane cable. Carefully lift and guide rotor assembly into stator. Avoid damaging insulation. When end housing is flush against stator frame, install 3/4"-10 bolts, and lockwashers,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



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Fig. 6 - Installing Rotor In Stator

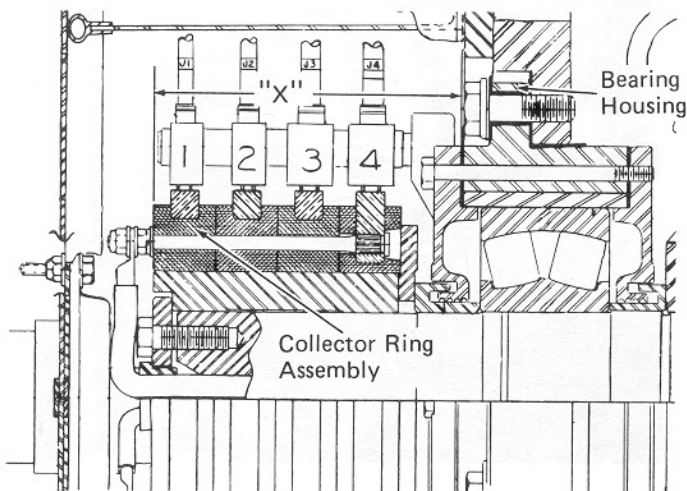
6. Center rotor assembly in stator and check that the total end movement of the bearing outer race in the bearing housing is within  $9.53 \text{ mm} \pm 0.40 \text{ mm}$  ( $3/8'' \pm 1/64''$ ). If total end movement differs from number stamped on the end housing, Fig. 7, remove original number and stamp new number adjacent to it.



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Fig. 7 - Stamped Dimensions On End Housing

7. Position rotor so that all end movement is taken up in direction of coupling disc. Measure distance from bearing housing bolt head at the 1 o'clock position to the outer surface of the collector ring assembly, Fig. 8. This measurement is the "X" (protrusion) dimension. Stamp this measurement (approximately 203 mm [8"]), to the nearest 0.40 mm ( $1/64''$ ) on end housing, Fig. 7.



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Fig. 8 - Measuring "X" (Protrusion) Dimension

8. Place fish paper strips  $1.6 \text{ mm} \times 76 \text{ mm} \times 914 \text{ mm}$  ( $1/16'' \times 3'' \times 36''$ ) in air gap between rotor assembly and AR6 stator. Remove crane cables and end housing holding fixture.
9. Install brush holders, Fig. 2. Large brush holders (AR6) over collector ring positions 3 and 4, and small brush holders (D14) over collector ring positions 1 and 2.
10. 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.
11. Route leads to left of collector ring assembly. Secure leads with three cable clamps bolted into threaded holes in bearing housing.
12. Connect external leads 1, 2, 3, and 4 to corresponding lower brush holder terminals.
13. Adjust brush holders to have  $3.2 \text{ mm}$  ( $1/8''$ ) clearance over collector rings. In addition ensure that holder is centered over collector ring. Torque holder locking screws to  $14\text{-}20 \text{ N}\cdot\text{m}$  ( $10\text{-}15 \text{ ft}\cdot\text{lbs}$ ). Assembly brushes in holders, if used brushes are reinstalled ensure that their original positions are maintained. Check that each brush is centered within  $1.59 \text{ mm}$  ( $1/16''$ ) in relation to mating collector ring.
14. Install rectifier banks on end housing.
15. Install stator lead cleat assemblies to face of end housing and connect stator leads to rectifier bank assemblies.
16. Install collector ring cover and air box cover assembly removed during disassembly.
17. 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.

Generator is now ready to be tested, refer to Generator Testing. When tests are complete, refer to Installation Of Main Generator Into Locomotive Unit.

## GENERATOR TESTING

1. Prepare generator for testing by performing the following preliminary steps:

- a. Disconnect suppression circuitry from rectifier bridges and AC paralleling bars.
  - b. Short circuit current transformers, by securely bolting together leads CTA, CTB, and CTC on outside of air box.
2. Clean out and inspect generator for stray material, and steel cuttings. Check all nuts and screws for tightness.
  3. Take cold, 75° C (167° F), resistance readings. Limits are as follows:
    - a. AR6 rotor collector ring to collector ring, 1.020 ± 4%.
    - b. AR6 stator line-to-neutral per 5 phase group, .00567 ± 2%.
    - c. AR6 stator line-to-line per 5 phase group, .00846 ± 2%.
    - d. AR6 stator line-to-neutral per paralleled 10 phase group, .003240 ± 8%.
    - e. AR6 stator line-to-line per paralleled 10 phase group, .004655 ± 5%.
    - f. D14 rotor collector ring to collector ring, 2.21 ± 3.7%.
    - g. D14 phase-to-phase, .01005 ± 4%.

NOTE: Maximum variation in resistance allowable between any two phases on one machine, .0001 ohms.

4. Check insulation resistance of stator windings as described in M.I. 3323-3, Electrical Tests section. In addition, check rotor insulation resistance as described in M.I. 3323-4 Electrical Tests section.

CAUTION: Remove fish paper strips from between rotor and stator before performing bearing run test.

5. Drive generator at 900 RPM for a 2 hour period. Check and record bearing temperature every 15 minutes. Maximum bearing temperature rise shall not exceed 25° C (45° F).
6. Perform high potential test of generator stator windings as follows:
  - a. Connect rotor leads to stator frame (ground).

- b. Perform high potential test as outlined in M.I. 3323-3, High Potential Testing section.
  - c. Remove connection between rotor leads and ground.
7. Perform high potential test of generator rotor as follows:
    - a. Connect stator neutral leads 01 and 02 to stator frame (ground).
    - b. Perform high potential test as outlined in M.I. 3323-4, High Potential Testing section.
    - c. Disconnect stator leads 01 and 02 from stator frame.
  8. Perform high potential test of suppression circuitry as follows:
    - a. Short circuit condenser terminals of suppression hardware circuitry.
    - b. Jumper all four leads of each suppression circuit together and apply one tester lead to this junction, and the other tester lead to ground. Test at 3700 volts for one minute.
    - c. Repeat 6a and 6b for three remaining suppression circuits.
    - d. Return circuit to normal condition.
  9. Repeat insulation resistance test as performed in Step 2.
  10. Remove all jumpers and shorts, and connect all loose leads to proper terminal connections.

## INSTALLATION OF MAIN GENERATOR INTO LOCOMOTIVE UNIT

The installation of main generator and alternator is similar to removal, with the exception that it requires more time, care, and skill.

Before a main generator is installed, check and clean the mounting plates. Be sure these plates are smooth, free of burrs and high spots.

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.

Check the surface on the engine and generator coupling discs, both must be smooth and clean. Add a little oil or white lead to the fitting surfaces. Check that bolt holes in couplings are clean and smooth.

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.

Lift generator and guide slowly and carefully into engineroom. Set generator on mounting pads as close to engine coupling disc as possible.

Line up hole patterns in the engine and generator coupling discs by barring or jacking engine over. Push generator toward engine until its coupling fits into the beveled groove in the engine coupling disc.

Check all coupling bolts to see that they are smooth and clean. Place a little oil with white lead 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.

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.

Line up dowel holes and install base bolts. 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.

### SERVICE DATA

### REFERENCES

Alignment Of Locomotive Rotating Equipment . . . . . M.I. 1753

### EQUIPMENT LIST

Pyrometer . . . . .	8027937
Induction Heater . . . . .	8041446
Megohmmeter Tester . . . . .	8306539
High Potential Tester . . . . .	8212404, 8212405, 8212406, 8324253
End Housing Holding Fixture . . . . .	File Drawing 753
Arbor Fixture . . . . .	File Drawing 754
Bearing Alignment Disc . . . . .	Work Sketch 19391
Molykote Lubricant 0.5 litre (16 ozs) Spray Can . . . . .	9316707

**INSTALLATION OF MAIN GENERATOR INTO LOCOMOTIVE UNIT**

The installation of main generator is similar to removal with the exception that it requires more care and attention before a main generator is installed. Before the mounting plates are set, the surfaces are smooth, free of burrs and nicks. Before lifting the generator into the unit, clean the mounting pads on the generator and frame. Be sure these pads are free of burrs and nicks.

CAUTION: Remove fish paper strips from between rotor and stator before starting bearing run test.

5 Drive generator at 900 RPM for a 2 hour period. Check and record bearing temperature every 15 minutes. Maximum bearing temperature shall not exceed 25°C (45°F).

6 Perform high potential test of generator stator windings as follows:

a. Connect rotor leads to stator frame (ground).