ELECTRO-MOTIVE DIVISION • GENERAL MOTORS CORPORATION

SERVICE DEPARTMENT *MAINTENANCE INSTRUCTION*

AR10 TRACTION GENERATOR OVERHAUL – ASSEMBLY AND TEST

INTRODUCTION

This bulletin details instructions on the lubrication and installation of bearings and the procedures to be followed for complete assembly of the generator. It is quite important that this work be carefully and correctly performed so as to ensure satisfactory generator performance.

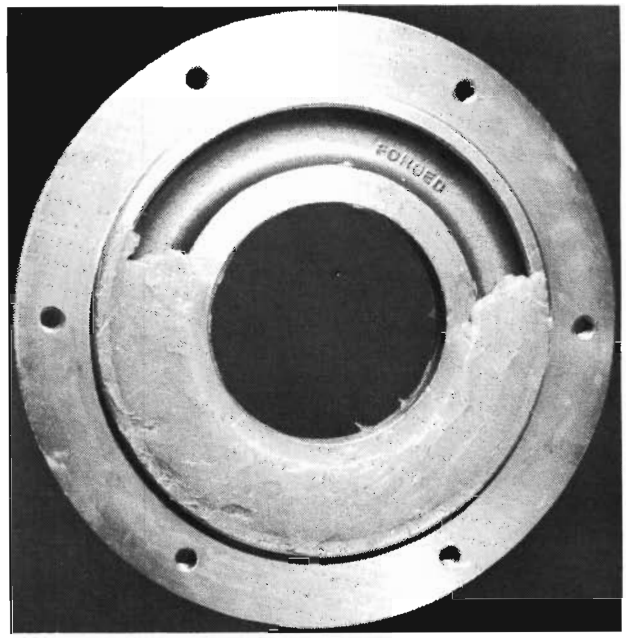
When assembling sealed lubricated bearings, Shell Cyprina RA Grade 3 grease should be used. The importance of following the recommended procedures can be emphasized by a description of how the grease lubricates the bearing during operation.

Fundamentally, lubrication is accomplished in the following way:

1. When applied as recommended, oil bleeds into the required areas by contact with that area. Intimate cage and roller end grease contact softens a small amount of grease, gradually releasing the oil lubricant.
2. Solidly packed grease within the contact area forces the released oil into the bearing.
3. Proper quantities of grease spread on the roller cage assembly (ID and OD) prevent roller skidding and scuffing.
4. By purposely leaving a space free of grease at the top of the bearing cap and cover, Fig. 1, churning and liquefaction is limited.

Particular care and attention should be given to the proper application of grease lubricant to the bearings. The precautions listed below should be observed.

1. All assembly parts must be thoroughly cleaned of all foreign material and previous lubricant. All cleaning solvents must be removed, and all parts perfectly dry before applying grease. Keep new or remanufactured bearings in their wrapping until application of grease. The lubricant applied to these bearings, when packaged, is compatible with Cyprina RA grease, therefore, if kept clean, the bearings need not be washed.
2. Cyprina RA Grade 3 grease must be used exclusively, and not mixed with other lubricants.
3. Adequate lubrication depends upon precise weight of grease as determined by an accurate scale. Too much grease is as detrimental to the service life of the bearing as too little.
4. Cleanliness can be ensured by obtaining grease direct from covered containers by use of a hand or motor driven pump, of a type that will not soften or harden (±5 ASTM penetration) the grease during handling. If a pump is not used, extra precaution must be used to prevent contamination of the grease in the



18929

Fig. 1 – Grease Position

 January 1974

pail or drum. Grease should be handled on a clean piece of oil proof paper.

5. A clean steel-bladed spatula or putty knife should be used during intermediate handling of the grease, and for greasing the bearing parts. Use of bare hands should be avoided, wherever possible, to prevent accidental inclusion of dirt or other contaminants.

GREASE APPLICATION TO BEARING PARTS

1. After thorough cleaning and inspection of all bearing parts, the labyrinth grooves in the bearing cap and the bearing cover should be filled flush with grease, as shown in Fig. 2. This grease need not be measured.

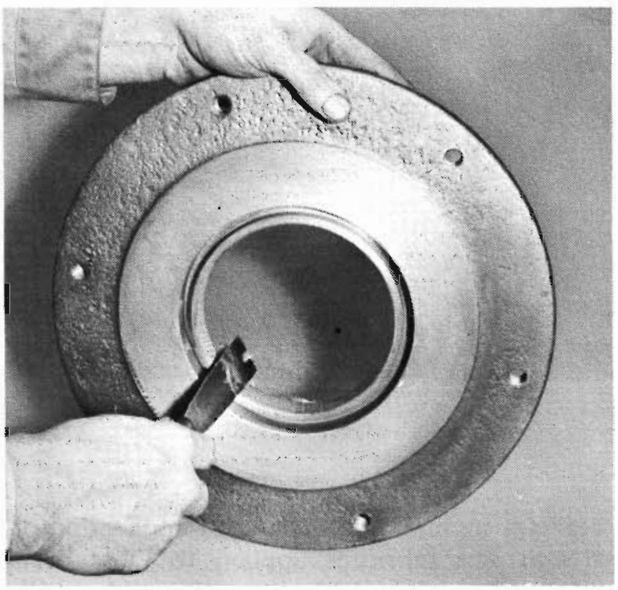


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Fig. 2 – Grease Application To Labyrinth Grooves

2. Weigh the piece of paper that will be used in handling the grease. The weight of the paper must be compensated for when weighing the grease.

3. Carefully weigh grease for the specified bearing part to be greased. See Service Data for proper quantities of grease.

4. Pack the bearing rollers and the space between the rollers with measured grease. On large bearing application, use additional quantity of unmeasured grease to pack groove in bearing outer race.

5. Grease application to bearing caps and covers.

   a. After weighing, use spatula or putty knife to apply grease to the cap or cover. Roughly form the grease, as shown in Fig. 3, into the approximate desired contour.

   b. Grease should be solidly packed only into the lower 180° to 240° (dependent on the part and specified quantity) of the cap or cover keeping the ungreased portion at the top, Fig. 1.

   c. Form grease to proper contour as shown in Fig. 4.

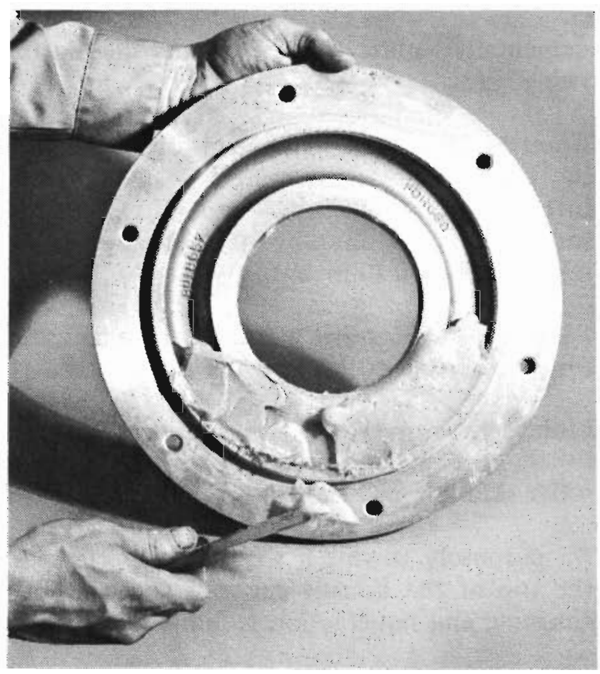

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Fig. 3 -- Roughly Formed Grease Contour

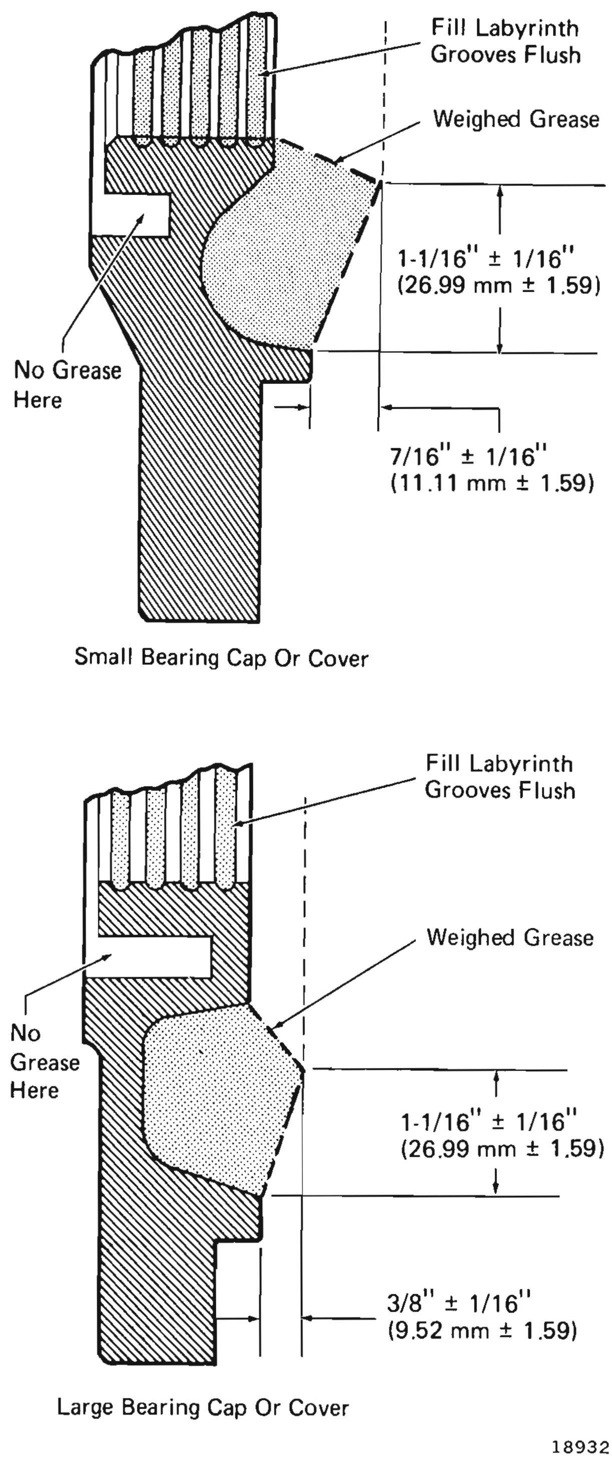

Fig. 4 – Application Of Grease To Bearing Cap And Cover

GENERATOR ASSEMBLY

When all 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 that the bearing be tried in its housing. Place bearing housing on floor and try bearing through bore of housing. Care must be taken to see that the bearing enters the housing bore squarely and is not cocked.

BEARING AND END HOUSING ASSEMBLY

1. Heat the inner seal in an oil bath or electric oven, for half an hour at 220° F. or 105° C. 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 (with current off) should be taken periodically. After heating, shrink the seal to the shaft and let it cool to room temperature.

CAUTION: Care should be used when heating bearing parts. Overheating may result in warping or metallurgical upsetting of the parts.

2. Install bearing cap with gasket onto shaft. The bearing cap can be distinguished from the bearing cover by noting that the cap has tapped holes in the flange while the cover has untapped holes.

3. Heat roller bearing with an induction heater to 220° F. or 105° C. Take pyrometer readings (with current off) at ouside face of inner race only. Also, see Caution in Step 1. Shrink bearing to shaft with the bearing part number toward the ouside. 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.

4. Place end housing in a horizontal position with mounting flange down, and install two guide pins 180° apart into two of the eight tapped bearing housing bolt holes. These guide pins are required to prevent damage to the outside of the bearing housing as the housing is assembled to the end housing.

5. On generators equipped with the large bearing, position insulation ring over the guide pins so holes in ring line up with holes in end housing. Slide four insulating tubes over the guide pins to center the bearing housing holes over the threaded holes in the end housing during assembly.

6. Apply Molykote to bearing housing bore prior to assembling housing to bearing. Allow Molykote to dry before assembling housing to bearing.

7. On large bearing application, position bearing housing so bearing cover studs will be in top and bottom position and the tapped hole for the brush holder cable clamp will be on the left side.

8. Carefully lower bearing housing into position guided by guide pins. Gently tap bearing housing into position until bearing housing bottoms on end housing. Remove guide pins.

NOTE: Steps 9 through 11 are applicable only to generators equipped with large bearing.

9. Install eight insulation tubes into bearing housing bolt holes. These tubes are necessary to prevent bolts from shorting out insulated housing.

10. Position outer insulation ring or insulation sections over bearing housing flange, and line up holes in ring with holes in bearing housing.

11. Position four straps over insulation ring so holes in straps line up with holes in ring.

12. Install eight bolts and washers, and tighten bolts to 200 ft-lbs.

13. On generators equipped with the large bearing, check insulation resistance between bearing housing and end housing, using a 1000 volt megohmmeter. Reading must be 1 megohm minimum.

14. Insert two studs, Fig. 5, 180° apart in the 1/2"-13 UNC-2B threaded holes in the bearing cap. Purpose of the studs is to guide the bearing housing to the bearing cap. An aligning collar, Fig. 5, may also be used in installing the end housing.

15. Lift the end housing and bearing housing assembly with a wire cable or end housing holding fixture and a crane, and align the bearing housing with the aligning studs. Push the end housing onto the shaft until the bearing housing is snug against the bearing cap.

16. Apply a new gasket to bearing cover, mount the bearing cover to the bearing housing with brush holder mounting studs located at top and bottom positions, and install the 1/2"-13 bolts hand tight. Do not remove the two guide studs until all the other bolts have been started. Then the guide studs can be removed and the two bolts put in their place and torqued to 50-55 ft-lbs.

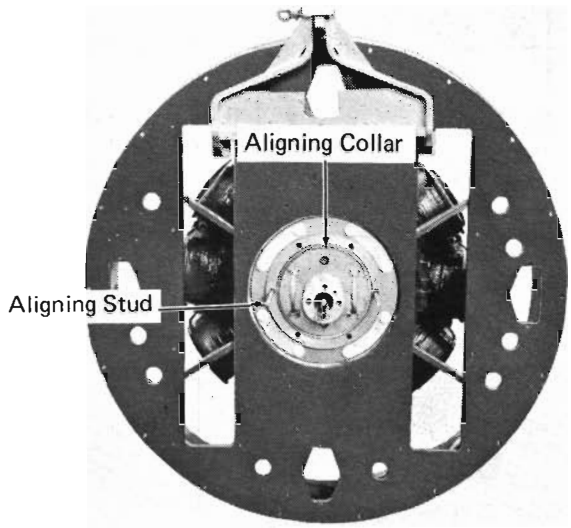

Fig. 5 – Applying End Housing To Rotor Assembly

17. Heat the outer seal in an oil bath or electric oven, for half an hour at 220° F. or 105° C., and repeat the procedure from Step 1.

18. Place collector ring assembly on induction heater for approximately 10 minutes.

CAUTION: The collector ring assembly could be damaged if heated for more than 15 minutes.

Place collector ring assembly against outer bearing seal. Rotate ring assembly on shaft for proper position of lead connections to terminals of ring assembly.

19. Place retainer plate over leads and on to the end of rotor shaft and tighten 5/8"-11 bolts to 100-110 ft-lbs.

20. Install rubber bushing over the four leads and insert the bushing into the retaining plate.

21. Connect large leads from the AR10 to collector ring terminals 3 and 4, and the smaller leads from the D14 to terminals 1 and 2. Torque bolts to 7 to 9 ft-lbs.

ROTOR TO STATOR ASSEMBLY

1. If the D14 rotor assembly was removed from the AR10 rotor, align mating bolt holes of the two assemblies and bolt together using the 7/8"-9 bolts removed during disassembly. Be sure the D14 cable leads are threaded through the AR10 rotor shaft. Tighten bolts to 375-400 ft-lbs.

2. Bolt D14 stator assembly to AR10 stator frame. Torque to 200 ft-lbs.

3. Apply coupling disc to D14 rotor hub, using the bolts removed at disassembly. Torque to values specified in Service Data.

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 arbor fixture protrudes through the stator assembly, as shown in Fig. 6.

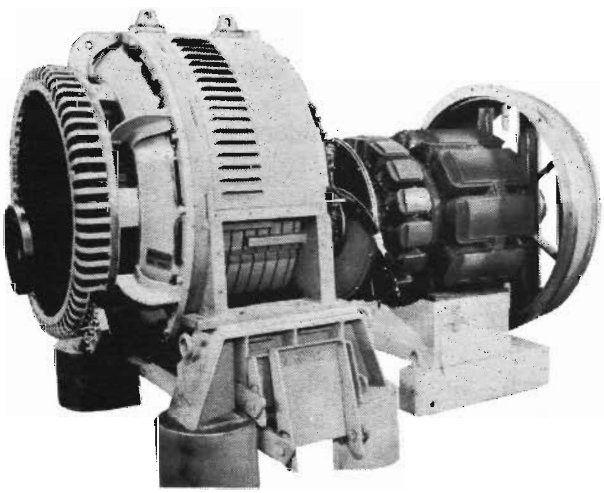

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Fig. 6 – Installing Rotor In Stator

5. Using two wire cable loops, place one loop through the end housing and the other loop around the arbor fixture. With the aid of two cranes, lift and guide the rotor assembly into the stator assembly, slowly and carefully, so the insulation will not be damaged. When the end housing is flush against the stator frame, install the 3/4"-10 bolts to hold the end housing to the stator frame and torque to 200 ft-lbs.

6. Center rotor assembly in stator and check that the total end movement of the bearing outer race in the bearing housing is within 3/8" ± 1/64". If total end movement differs from the number stamped on the end housing, Fig. 7, remove the original number and stamp the new number adjacent to it.

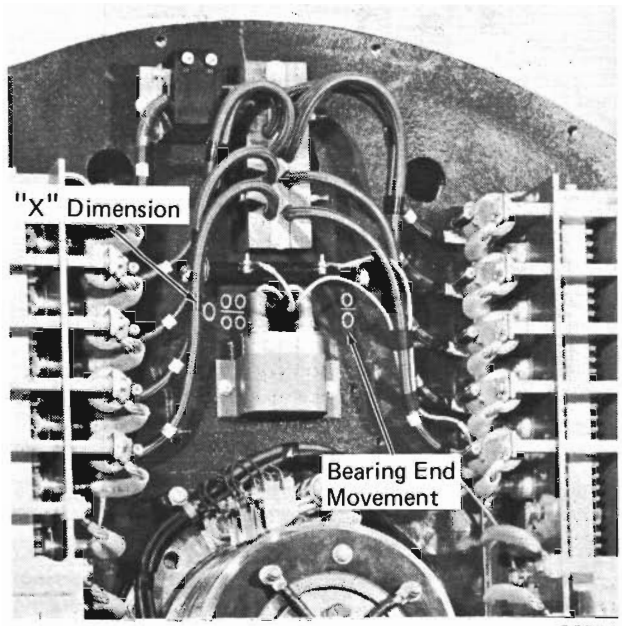

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Fig. 7 – Stamped Dimensions On End Housing

Position the rotor so that all the end movement is taken up in the direction of the coupling disc. On units equipped with the small bearing, measure the distance from the machined face of the bearing housing, between the mounting bolts, to the outer face surface of the collector ring assembly, Fig. 8. On units equipped with the large bearing, measure the distance from the bearing housing bolt head at the one o'clock position to the outer face surface of the collector ring assembly, Fig. 9. Stamp this measurement (approximately 8-27/32" on small bearing applications and 8" on large bearing applications) to the nearest 1/64" on the end housing, Fig. 7.

If the original parts are reused, this number may be the same as the original number which was stamped on the face of the end housing. If the number is not the same, remove the original number and stamp the new number adjacent to it.

7. Place fish paper strips 1/16" x 3" x 36" in air gap between rotor assembly and coils of AR10 alternator only.

8. Remove wire cable loops and arbor fixture after fish paper has been applied.

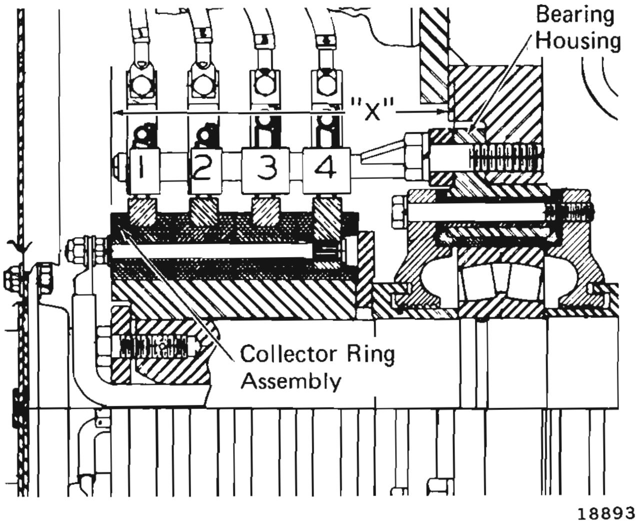

Fig. 8 – Small Bearing 9427171
"X" Dimension
Measurement Points

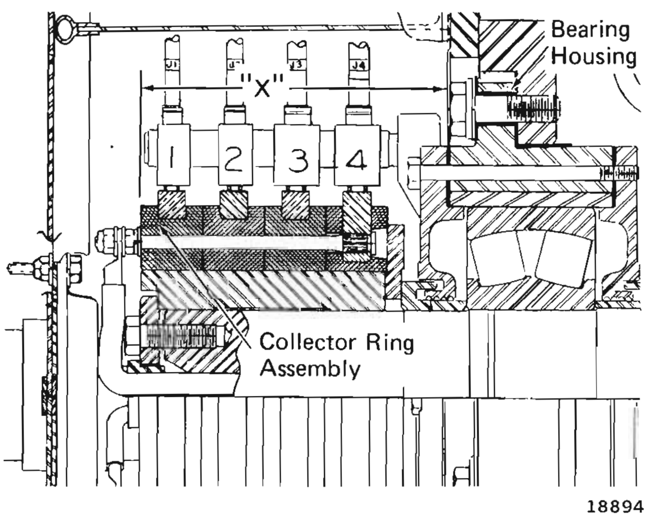

Fig. 9 – Large Bearing 8004475
"X" Dimension
Measurement Points

9. Mount brush holders for specific generator configurations as follows:

   a. For small bearing generator with one brush holder, remove two top bolts securing bearing housing to end housing. Mount brush holder bracket, reinstall bolts, and tighten to 200 ft-lbs.

   b. For small bearing generator with two brush holders, remove two top and two bottom bolts securing bearing housing to end housing. Mount brush holder brackets, reinstall bolts, and tighten to 200 ft-lbs.

10. Install large brush holders over collector ring positions 3 and 4, and small brush holders over collector ring positions 1 and 2.

11. Assemble jumper leads J1, J2, J3, and J4 between the top and bottom brush holders having the same position numbers. The jumper leads attach to the brush holder locking screws, which secure the holder to the insulated bracket.

12. Route leads to the left of the collector ring assembly, and secure with three cable clamps bolted into threaded holes in the bearing housing.

13. Connect external leads 1, 2, 3, and 4 to corresponding lower brush terminals.

14. Adjust brush holders as follows:

    a. Single brush holders to have 1/8" clearance over rings and centered over rings.

    b. Double brush holders to have right-hand brush holders 1/16" ± 1/32" closer to collector rings than the left-hand brush holders when facing the brush holder assemblies.

15. Tighten brush holders from 10-15 ft-lbs.

16. Attach and assemble brushes to holders. Check that brushes are centered within 1/16" in relation to mating collector rings.

17. Install rectifier bank assemblies on end housing.

18. Install the stator lead cleat assemblies to the face of the end housing and connect stator leads to rectifier bank assemblies.

19. Assemble slip ring cover, where used, to end housing.

20. Mount the air box assembly to the end housing using 1/2"-13 bolts.

21. Connect all loose leads to proper connections and secure leads with tape to prevent movement. Route remaining external leads through hole on lower face of air box.

GENERATOR TESTING

Set up the following conditions prior to performing any testing of the generator, then proceed with the test Steps.

Suppression circuitry wiring is to be disconnected from rectifier bridges and AC paralleling bars prior to testing of machine, leave off during all testing.

Generators equipped with current transformers are to have current transformers short circuited during all testing.

One side of the current transformers is tied together with leads X2 AB and X2 BC. Current transformers can be short-circuited for tests by securely bolting together leads CTA, CTB, and CTC on outside of air box.

TEST

1. Take cold resistance readings of rotor slip rings and stator windings at 75° C. Limits are as follows:

NOTE: Jumper 01 and 02 neutral leads together for the following checks.

   a. Rotor slip ring to rotor slip ring indicates 1.238 ohms ± 4%.

   b. "A," "B," or "C" phase group (even numbers to neutral (junction of leads 01 and 02) indicates 0.00308 ohms ± 2%.

   c. "A," "B," or "C" phase group (odd numbers) to neutral indicates 0.00308 ohms ± 2%.

   d. "A," "B," or "C" phase group (even numbers) to "A," "B," or "C" phase group (odd numbers) indicates 0.00568 ohms ± 4%.

2. Measure insulation resistance of stator windings as described in "Electrical Tests" Section 3, and insulation resistance of rotor as described in "Electrical Tests" Section 4.

3. Drive generator at 900 RPM for a 2 hour period. Check and record bearing temperature every 15 minutes during test. Maximum bearing temperature rise shall not exceed 25° C.

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

4. 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 "Stator Wiring Completed" in Section 3.

   c. Remove connection between rotor leads and ground.

5. Perform high-potential test of generator rotor as follows:

   a. Connect stator neutral leads 01 and 02 to stator frame.

   b. Perform high-potential test as outlined in "High Potential Test" in Section 4.

   c. Remove connection between 01 and 02 leads and ground.

6. 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 Steps a and b for three remaining suppression circuits.

   d. Disconnect all jumpers from suppression circuits.

7. Repeat insulation resistance test as performed in Step 2.

8. Remove all jumpers and shorts, and connect all loose leads to proper terminal connections.

9. Install all covers removed during disassembly.
10. Paint exterior of generator with grey enamel.

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.

Apply 2-3/8" socket wrench to the engine to generator coupling bolt nuts to make sure they are tightened to the proper torque as specified in Service Data.

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.

SERVICE DATA

SPECIFICATIONS

BEARING LUBRICANT CAPACITY

Bearing cap 8345691	6 oz.
Bearing 9427171	4 oz.
Bearing cover 8345692	6 oz.
Bearing cap 8418657	10 oz.
Bearing 8004475	13 oz.
Bearing cover 8418656	10 oz.

COUPLING DISC TORQUE (Lubricated With Molykote 8168822)

6 bolt application	1400-1500 ft-lbs.
12 bolt application	750-850 ft-lbs.

EQUIPMENT LIST

Pyrometer	8027937
Induction heater	8041446
Coating, Molykote (1 qt)	8168822
Megohmmeter tester	8306539
High-potential tester	8324253, 8212404, 8212405, 8212406
End housing holding fixture	File Drawing 753
Arbor fixture	File Drawing 754