



GM Locomotive Group

# **M.I. 3912 MAINTENANCE INSTRUCTION**

Rev. A

## **TRACTION MOTOR ROLLER SUPPORT BEARING**

January 1992

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## INTRODUCTION

This maintenance instruction will cover the assembly of traction motor support bearings of the anti-friction type to a locomotive axle, gear and wheel assembly. This will include:

- Section 1 - TAPERED ROLLER SUPPORT BEARINGS
- Section 2 - CYLINDRICAL ROLLER SUPPORT BEARINGS

The roller support bearing and supporting housing are contained on the locomotive axle between the inner traction gear face and the opposite wheel hub face, Figure 1 and Figure 13.

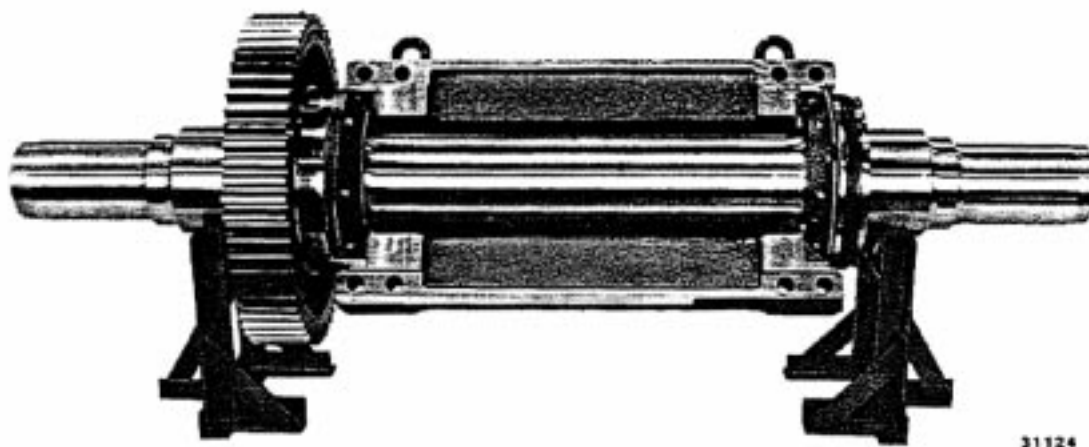


Figure 1. Tapered Roller Support Bearing

The roller support bearing assembly eliminates the conventional axle caps and bronze friction bearings and utilizes roller bearings that are shrunk fit on the axle and assembled into the housing as part of the wheel/axle/gear assembly.

The bearings are sealed and grease lubricated without need for periodic maintenance. The motor is bolted to the wheel/axle/gear assembly through the axle bearing housing without regard for serial number matching. The gear case attaches to the motor and axle bearing housing in the conventional manner.

### NOTE

Gear ratios lower than 55/22 can not be used with tapered roller bearings. The cylindrical bearing application has its own specific ratios.

**CAUTION**

Unprotected assemblies should not be transported or stored outside with housing hanging below axle (open end up). Housing can fill with water and result in excessive damage.

**SECTION I TAPERED ROLLER SUPPORT BEARING**

This arrangement is completely interchangeable with a conventional motor without requiring truck or locomotive modifications.

**Assembly Of Wheel Axle Gear Assembly**

The first step in the assembly of a wheel axle gear assembly is to mount the axle gear onto the axle. Mounting of the gear is the same as for a conventional assembly except that the gear hub is positioned 483.39 mm (19.031") from the center of the axle. The gear used for the tapered roller bearing assembly has a different hub configuration than the conventional gear with a different part number even though the gear ratio may be the same.

Refer to M.I. 1518 for wheel, gear and axle assembly and maintenance.

**CAUTION**

Some of the dimensions and procedures in M.I. 1518 for wheel and gear mounting are not the same for an assembly with a tapered roller support bearing. Therefore the dimensions and procedures described below must be followed.

Mount the axle gear on the axle as follows:

1. Locate the center of the axle in the same manner as described in M.I. 1518.

**NOTE**

Wheel mounting compound may be used as a lubricant when mounting the axle gear to the axle.

2. Press axle gear onto the axle with a pressure of between 50 and 114 tonnes (55 and 125 tons), while locating the gear hub 483.39 mm (19.031") from the center of the axle. Figure 2.

**CAUTION**

Unprotected assemblies should not be transported or stored outside with housing hanging below axle (open end up). Housing can fill with water and result in excessive damage.

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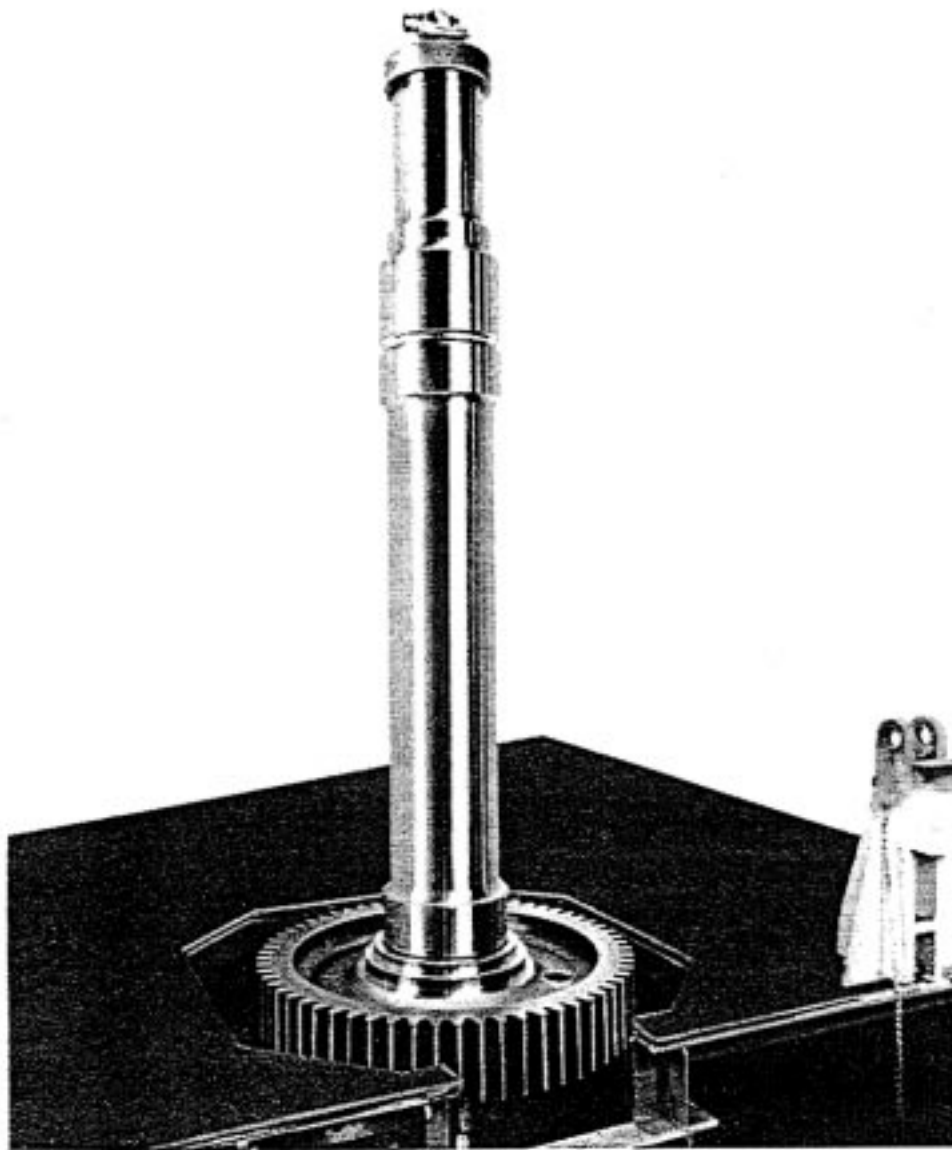
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31125

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Figure 3. Axle in Assembly Position

### NOTE

All machined parts to be washed with soap and water solution and blow dried with filtered air before assembly.

During the assembly procedure of the roller support bearings, refer to exploded view in Figure 4 on page 6, which shows the orientation of the pieces in addition to the buildup sequence.

The following step by step buildup sequence will refer to piece parts (item numbers) of the exploded view drawing and also provide pictures for clarity.

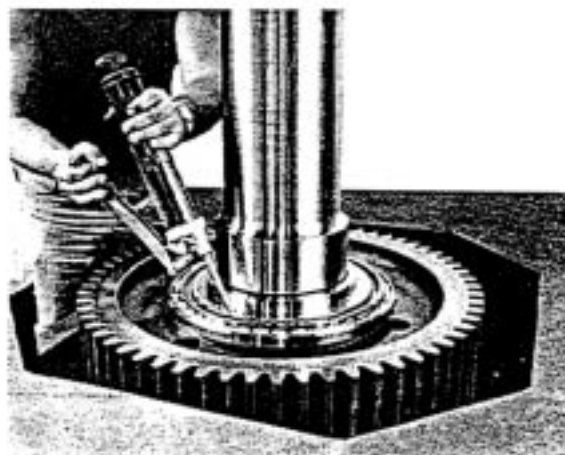
1. Heat the gear seal, Item 1 of Figure 4 in an oven to 93° C (200° F) over ambient temperature.
2. Place the gear seal (1) over the upper end of the axle, grooves upward, and slide down and install on the machined seat on the gear hub, step 2. To insure the gear seal is seated on the hub, rotate the ring back and forth as it cools.
3. When the gear seal (1) cools, apply 198.5 g (7 oz) of Exxon RB 290 EP grease in the labyrinth grooves. Apply grease in dabs as shown in step 3 and spread to form a thin coat. Do not fill grooves.



**Step 2**

Assemble gear seal

31125



**Step 3**

Apply grease to gear seal

31127

4. Place O-ring seal, Item 3 of exploded view in the groove of the bearing cap (2), step 4.
5. Place the pinion end (P.E.) bearing cap (2) over the end of the axle and move down to engage with the gear seal (1) step 5. Position the drain slot of the bearing cap so that it will be located at the bottom or 6 o'clock position of the bearing housing, when the bearing housing is dropped into position over the axle.

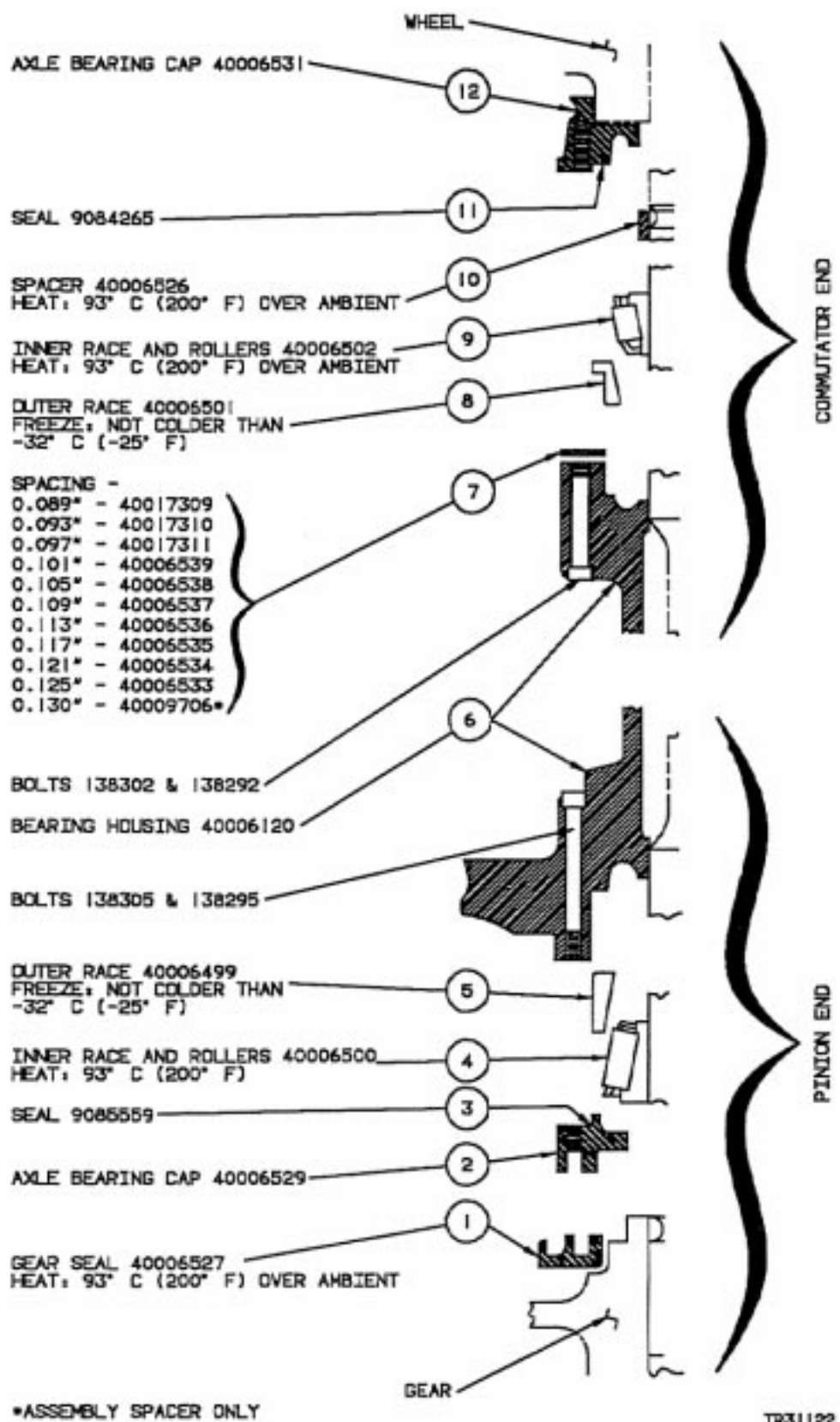


Figure 4. Tapered Roller Support Bearing, Exploded View

6. Fill the P.E. inner race and roller assembly (4) with 312 g (11 oz) of Exxon RB 290 EP grease. Use a grease gun with a small tip to completely fill the cavities between the rollers so that the grease will extrude between the lip of the cage and the race rib at the small end of the bearing and between the rollers and the cage. Smooth out the grease to a level even with the end of the cage at the large end of the bearing so that the roller ends are completely covered, step 6.
7. Heat the P.E. inner race and roller assembly with the grease applied (4) in an oven to 93° C (200° F) over ambient for sufficient time to achieve uniform temperature throughout. **PREGREASING IS REQUIRED SINCE BEARING IS INACCESSIBLE ONCE APPLIED ON THE AXLE.**

**CAUTION**

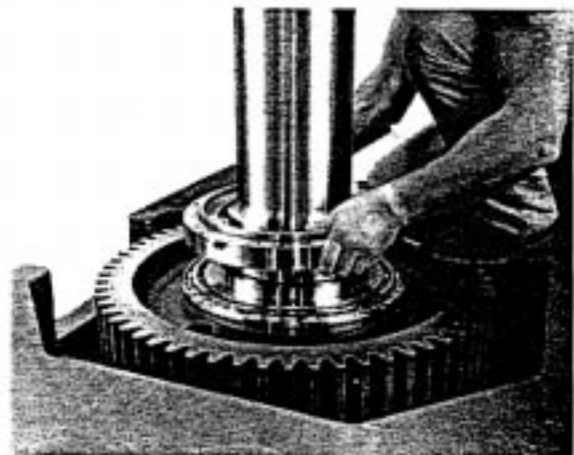
Do not exceed 149° C (300° F). At no time should bearings be left in oven for extended periods such as more than a work shift or overnight.



31128

**Step 4**

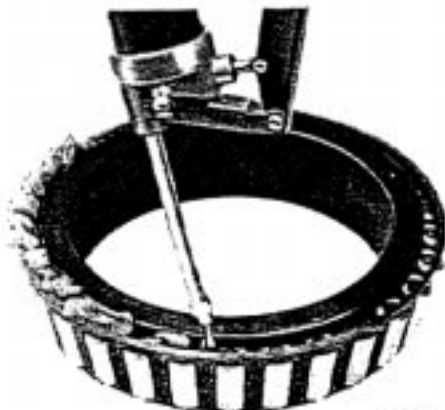
O-ring seal to bearing cap



31128

**Step 5**

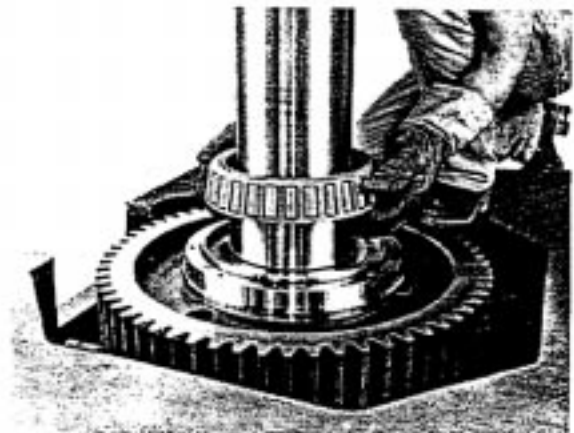
Assemble bearing cap



31130

**Step 6**

Grease bearing inner race



31131

**Step 8A**

Assemble bearing inner race

- Place the heated P.E. bearing inner race and roller assembly (4) over the upper end of axle with the small end up and move down to seat against the gear hub, step 8A. When the race has cooled ensure it is seated firmly against the gear hub by driving it with a mild steel drift and hammer, step 8B.

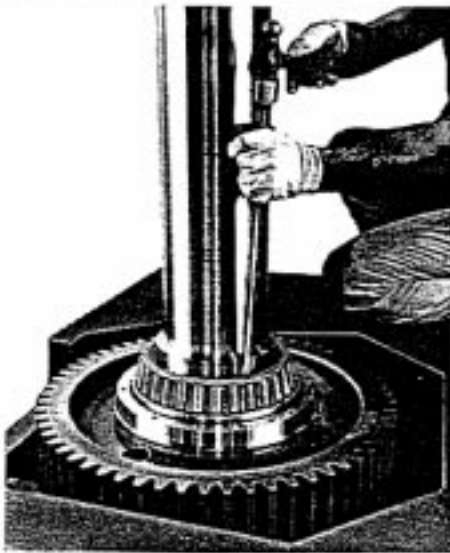
**CAUTION**

Ensure drift is made of mild steel. Hardened steel will damage the race and a soft material such as brass could chip and contaminate the bearing. The drift should also be tapered at one end so that it will not contact the bearing cage.

- Apply a thin coating of Exxon RB 290 EP grease to the rollers of the pinion end bearing, step 9.
- Position the bearing housing (6) with the pinion end up (end with arm).
- Place the pinion end outer race in the freezer and shrink the outer race (5) into the bore of the bearing housing (6) step 11A. Shrink temperature is not to be colder than  $-32^{\circ}\text{C}$  ( $-25^{\circ}\text{F}$ ).

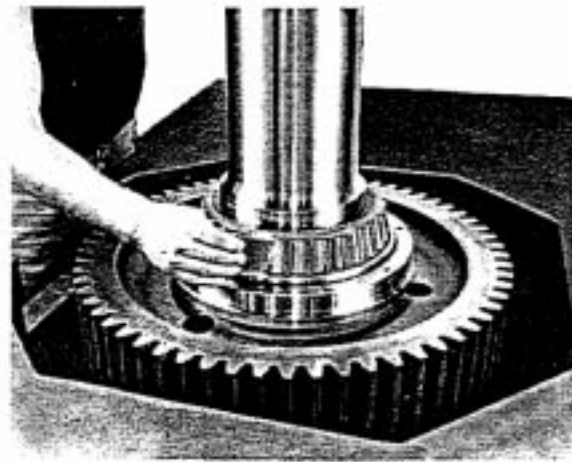
**CAUTION**

Do not leave outer race at this temperature for extended periods such as more than a work shift or overnight.



**Step 8B**  
Seat bearing

31132

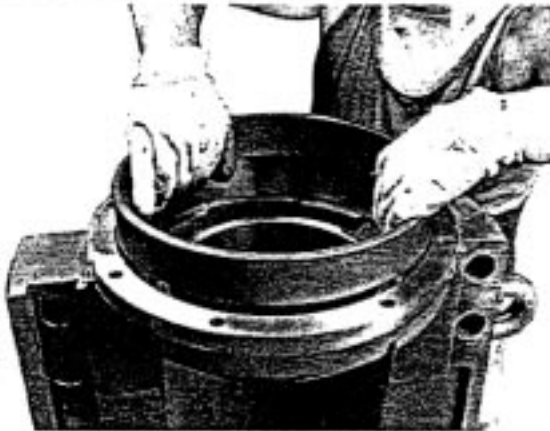


**Step 9**  
Grease bearing outer race

31133

Ensure the P.E. outer race (5) is firmly seated by driving it with a mild steel drift. Check for seating with a 0.025 mm (0.001") feeler gauge between the thick end of the bearing race and the bottom of the

bearing housing bore, step 11B. A (0.001") feeler gauge should not be able to be inserted between the race and housing.



**Step 11A**

Shrink P.E. outer race into bearing housing

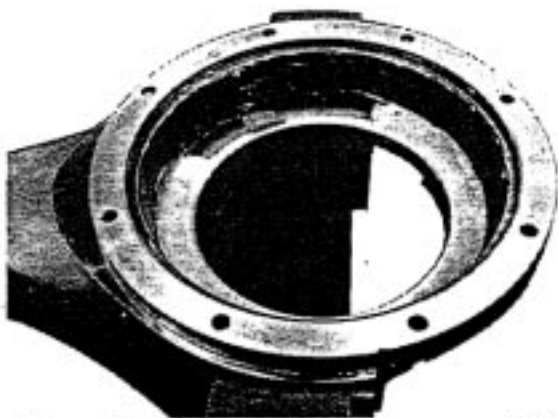
31134



**Step 11B**

Check outer race seating

31135



**Step 12**

Applying grease to P.E. bearing housing

31136



**Step 15**

Shrink C.E. outer race into bearing housing

31137

12. Fill the lower portion of the P.E. grease cavity in the bearing housing (6) with Exxon RB 290 EP grease in a 360° arc, step 12 shows this cavity partially filled. Completely fill the the grease side pocket and the drilled passages leading to the pocket. Smear grease over the rolling surface of the outer race of the P.E. bearing.
13. Turn over bearing housing (6) so that the commutator end is up.
14. Position the 3.3 mm (0.130") spacers (40009706) on the commutator end (C.E.) of the bearing housing. Use at least three spacers around the circumference between the bolt holes.

**NOTE**

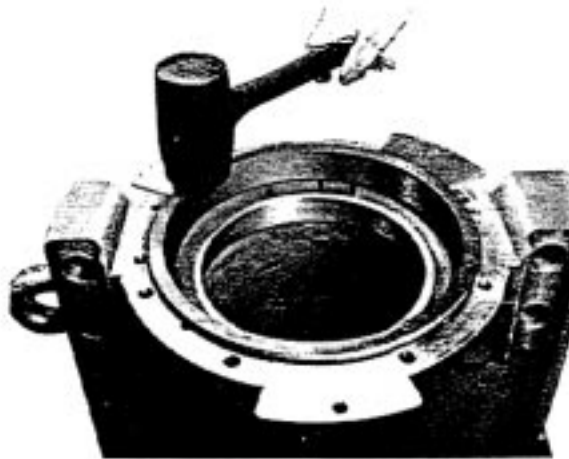
The 3.3 mm (0.130") spacers are for assembly purposes only and not for final end play adjustment. If left in place, they will interfere with proper fit-up of the bearing housing to the traction motor frame.

15. Place the C.E. end outer race in the freezer and shrink the outer race (8) into the C.E. bore of the bearing housing, step 15. Shrink temperature not to be colder than -32°C (-25°F).

**CAUTION**

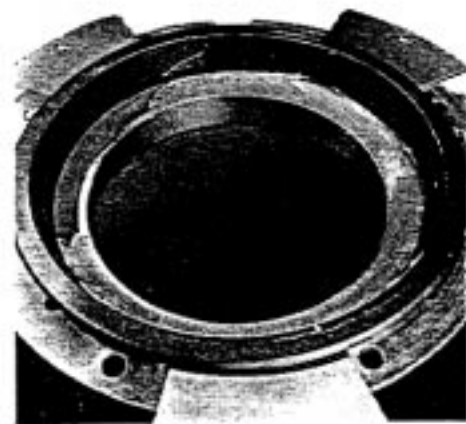
Do not leave bearing outer race at this temperature for extended periods such as more than a work shift or over night.

16. Seat the bearing outer race flange against the spacers with a mild steel drift or a plastic coated mallet. The spacers must be tight against the outer race flange, step 16.
17. Fill the lower portion of the C.E. grease cavity in the bearing housing with Exxon RB 290 EP grease in a 360° arc. The grease level should come up to the thick end of the bearing outer race. Completely fill the grease side pocket and the drilled passages leading to the pocket. Pump grease into the passages until the grease level comes up to the thick end of the bearing race. Smear grease over the rolling surface of the outer race of the C.E. bearing, step 17.



**Step 16**  
Seat C.E. outer race

31138



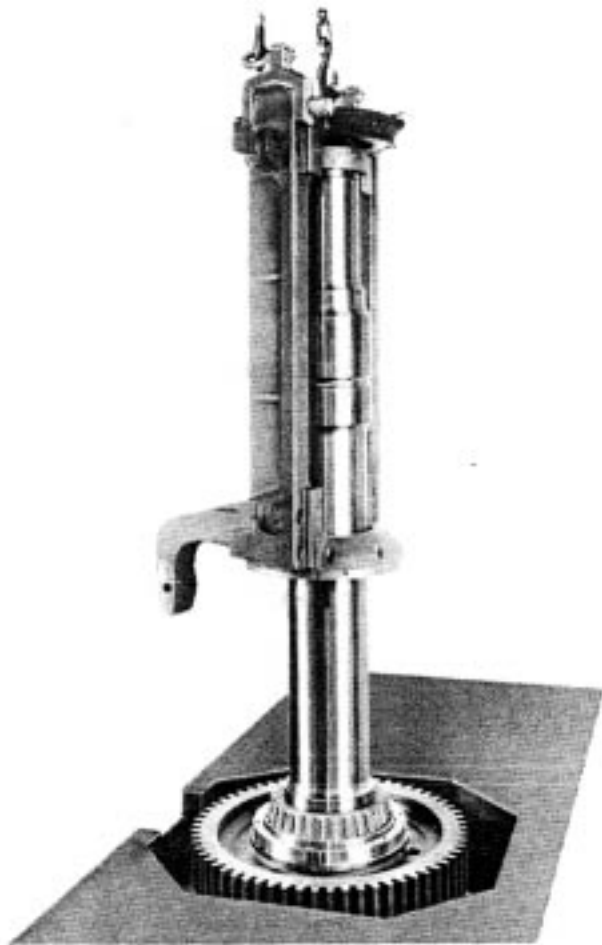
**Step 17**  
Applying grease to C.E. bearing housing

31139

18. Lift up the bearing housing with the pinion end down and lower over the axle until the housing rests on the P.E. bearing (4), step 18. A housing lifting fixture is shown in Figure 12. Position the housing so

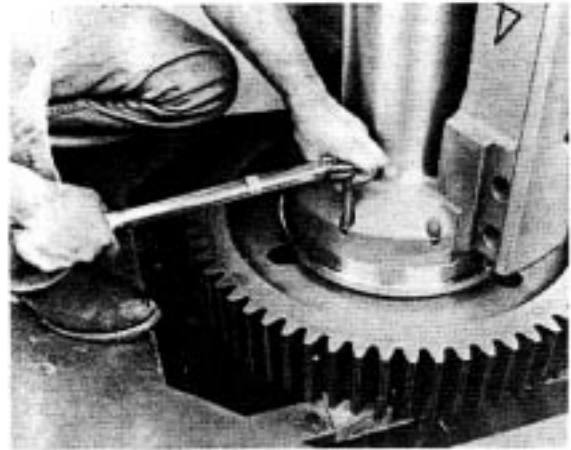
that the drain in item 2 is at the 6 o'clock position of the housing or toward the roadbed (opposite side to lifting eye).

19. Bolt the P.E. bearing cap, Item 2 of exploded view, to the bearing housing. Rotate the bearing housing to ensure there is no binding or rubbing. Torque the 8 bolts to 136 N·m (100 ft-lbs), step 19.



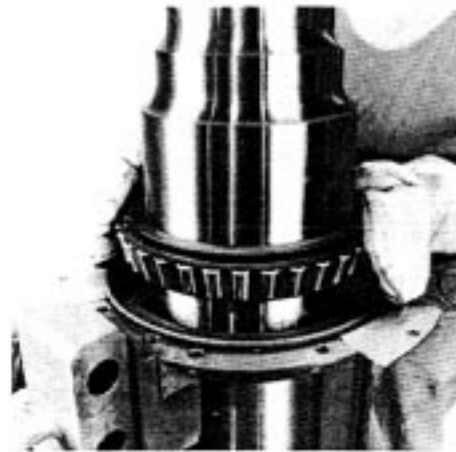
**Step 18**  
Assemble bearing housing

31140



**Step 19**  
Bolt P.E. bearing cap to housing

31141



**Step 22**  
Assemble bearing inner race

31142

#### NOTE

The cavities between the rollers of the C.E. bearing (9) are small and require a special tip for the grease gun to completely fill the cavities with the bearing on the axle. If tooling is available, the bearing may be greased with the bearing on the axle and the next step may be skipped. If tooling is not available, the bearing must be pre-greased on the bench prior to heating and assembly on the axle.

20. When pre-greasing on the bench, apply 227 g (8 oz) of Exxon RB 290 EP grease to the C.E. bearing inner race and roller assembly (9). Use a grease gun to completely fill the cavities between the rollers so that the grease will extrude between the lip of the cage and the race rib at the small end of the bearing and between the rollers and the cage. Smooth out the grease to a level even with the end of the cage at the large end of the bearing so that the roller ends are completely covered.
21. Heat the C.E. inner race and roller assembly (9) to 93° C (200° F) over ambient.

#### CAUTION

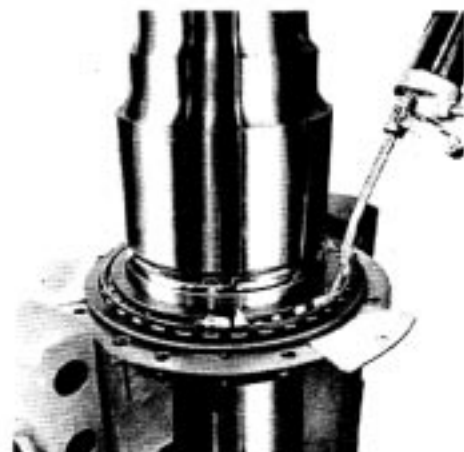
Do not exceed 149° C (300° F). At no time should bearings be left in oven for extended periods such as more than a work shift or overnight.

22. Place the C.E. bearing inner race and roller assembly (9) over the axle and seat into place against the C.E. outer race (8), step 22.



**Step 23**  
Seat bearing inner race

31143



**Step 24**  
Apply grease to bearing

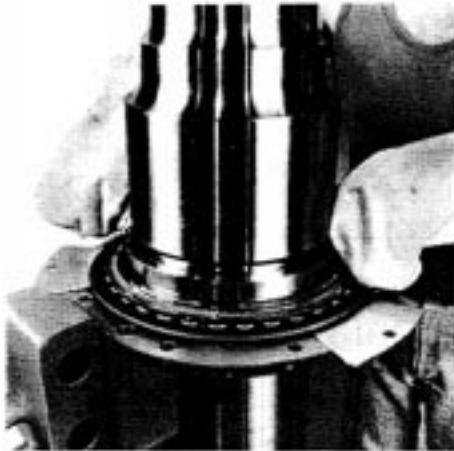
31144

23. When the inner race and roller assembly (9) has cooled, drive it tightly against the outer race (8) with a mild steel drift and hammer or a mild

steel ring, step 23. Oscillate the bearing housing while seating the bearing. The bearing is sufficiently seated when all rollers rotate and resistance to oscillation becomes noticeable.

**NOTE**

A mild steel ring can be used as a driving tool to seat the bearing inner race. Any mild steel ring can be used with a bore approximately 236 mm (9.300").



**Step 25**  
Assemble spacer

31145



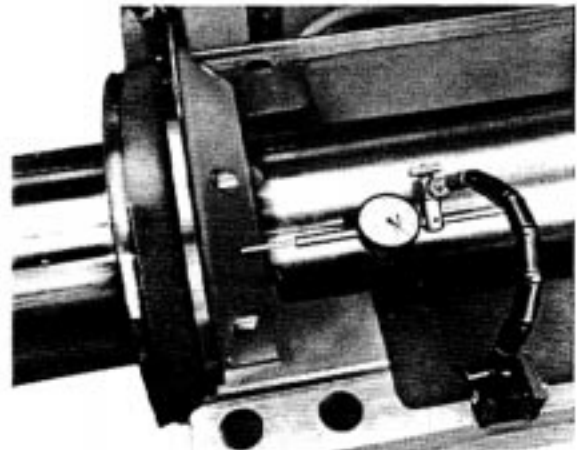
**Step 26**  
O-ring seal to bearing cap

31146



**Step 27**  
Assemble bearing bearing cap

31147



**Step 31A**  
Wheel mounting indicator

31148

24. If the C.E. bearing inner race and roller assembly (9) was not pre-greased on the bench prior to assembly, Fill the inner race and roller assembly (9) with 227 g (8 oz) of Exxon RB 290 EP grease, step 24. Use a grease gun with a small tip to completely fill the cavities between the rollers so that the grease will extrude between the lip of

the cage and the race rib at the small end of the bearing and between the rollers and the cage. Smooth out the grease to a level even with the end of the cage at the large end of the bearing so that the roller ends are completely covered.

25. Heat the C.E. spacer (10) to 93° C (200° F) over ambient and install over the end of the axle. Seat the spacer (10) against the C.E. bearing inner race and roller assembly (9), step 25.
26. Install the O-ring seal (11) in the C.E. bearing cap (12), step 26.
27. Place the bearing cap (12) over the axle and engage with the C.E. bearing flange outer diameter (8). Position the drain hole in the bearing cap downward or in the 6 o'clock position. Secure with at least four bolts finger tight, step 27.
28. Apply Exxon RB 290 EP grease to the labyrinth area of the bearing cap (12) that engages the wheel hub to assist in preventing dirt ingress.

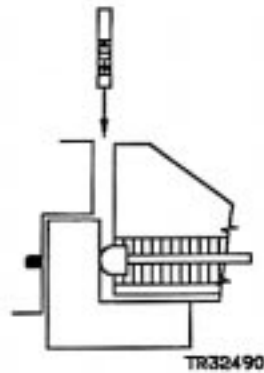
**CAUTION**

In next step, do not pickup the assembly by the bearing housing without the 3.3 mm (0.130") spacers (40009706) in place. Also leave the bolts engaged with the C.E. bearing cap to keep the cap in position preventing dislocation of the O-ring.

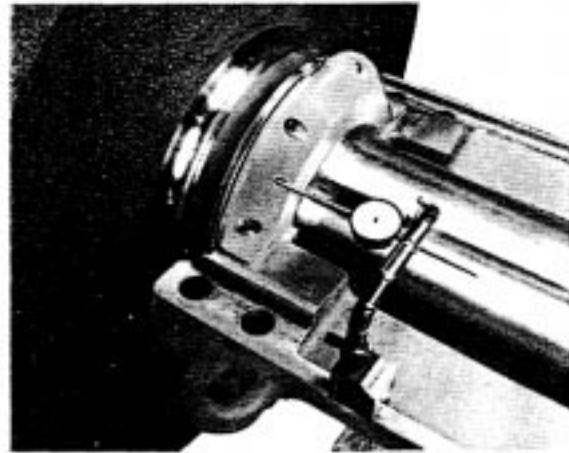
29. Remove the assembly from the assembly stand and move to the wheel press, and position horizontally for wheel application.
30. Loosen but do not remove the bolts securing the C.E. bearing cap and remove the 3.3 mm (0.130") spacers.
31. With the assembly in position in the press, set up a dial indicator to measure the relative movement between the C.E. outer race (8), and the bearing housing (6). Position the indicator stem through one of the jacking bolt holes in the bearing housing (6) so that the indicator stem contacts the back of the bearing flange (8), steps 31A and 31B.
32. Verify indicator contact by inserting a 0.25 mm (0.010") feeler gauge between the indicator stem and the bearing flange. Leave dial indicator in place, while pressing on the C.E. wheel.
33. Press the C.E. wheel onto the axle. The wheel hub must contact the bearing inner race (9), through the spacer (10). Because the wheel-hub-to-spacer interface is concealed from view by the bearing cap (12), movement of the outer race flange (8) is the only indication that contact with the bearing has been achieved.

Press the wheel slowly until the dial indicator indicates bearing flange movement. Limit this movement to a 0.15 mm (0.006") maximum. This amount of movement will provide the greatest margin for final spacer selection (7), step 33.

Excessive movement should be avoided and limits the final spacer selection and extreme movement, greater than 0.64 mm (0.025"), can prevent application of a final spacer, which requires the repositioning of the C.E. bearing inner race on the axle.



**Step 31B**



**Step 33**

Wheel mounted

31149

**NOTE**

When replacing worn wheels, three additional commutator end (non-gear end) bearing spacers are available for service applications only. These three spacers are thinner than the original equipment spacers used in initial build-up. The purpose of these additional thinner shims is to allow the application of a new wheel without requiring the repositioning of the C.E. bearing should the thinnest (.101 inch) original equipment spacer not fit behind the bearing outer race flange. Should the gap behind the bearing flange start at .101 inches or greater, a new wheel can now contact and move the C.E. bearing with greater assurance that a spacer will fit behind the bearing flange. With the new spacers a gap as low as .089 inches is now possible behind the bearing flange. This allows greater latitude in positioning the new wheel.

It should be emphasized again that these spacers, while they will work, are not intended for initial buildup. Rather, they are intended to provide latitude in positioning a new or second wheel to the assembly. Under no circumstances should a spacer thinner than .089 inches be used due to potential loss of running clearance within the assembly and failure.

34. Press on gear side wheel to the appropriate back to back spacing.

### CAUTION

Again, do not pick up the assembly by the housing without having the C.E. bearing flange backed up with spacers as the weight of the assembly can cause movement of the outer race.

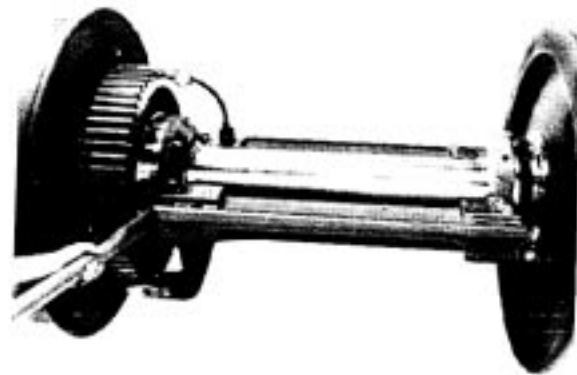
35. Check the gap behind the bearing flange (8) in three or four locations around the circumference with feeler gauges, step 35. Set the bearing end play to .001 to .005 inches by selecting and installing a thinner FINAL ASSEMBLY spacer behind the C.E. bearing flange. Select a spacer that will fit snugly behind the flange. Under no circumstances can the halves of the spacers be of different thicknesses. Assembly experience will govern which spacer thickness should be stocked in quantity.
36. After applying the appropriate shim halves, bolt the bearing cap (12) to the bearing housing (6).
37. Oscillate the bearing housing on the axle several times to seat the bearing rollers.
38. Set up a dial indicator between the bearing housing and the gear, step 38.



**Step 35**

Gap check for shim

31150



**Step 38**

End play check

31181

39. Measure the end play by moving the bearing housing on the axle with a pry bar, step 39.

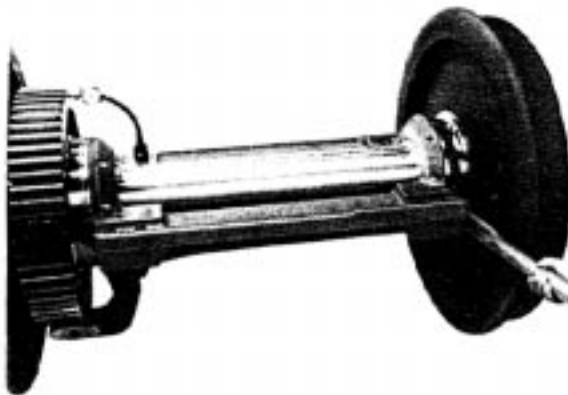
If the end play is less than 0.025 mm (0.001"), remove the spacers and install the next thinner spacer. Recheck the end play.

If the end play is greater than 0.13 mm (0.005"), remove the spacers and install spacers thick enough to bring the end play to within 0.025 mm to 0.13 mm (0.001" to 0.005").

**NOTE**

To install a thicker spacer, it will be necessary to move the bearing flange towards the wheel with four jacking bolts (1/2-13) in the bearing housing.

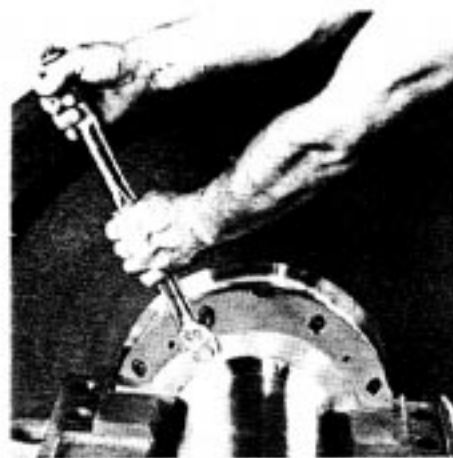
40. When the end play is set, torque the bearing cap bolts to 100 ft-lbs, step 40. The two lower housing jacking holes should have 1/2 - 13 set screws (223156) added flush with housing to keep threads clear of dirt and such making jacking easier. Also on the bottom of the housing are two 1/8 - NPT holes which should have plugs (103877) applied to keep threads free from dirt. These holes are not for adding grease. The two grease plug holes need to have 3/8 inch plugs (8348619) inserted. Two odor bomb holes are available.



**Step 39**

End play check

31152



**Step 40**

Torque bearing cap bolts

31153

This completes the installation of the roller support bearing components to the wheel axle gear assembly. The wheel assembly is now ready for mounting to a roller support bearing traction motor frame.

## Mounting Wheel Axle Gear Assembly To Traction Motor Frame

1. Make sure mounting rails and surfaces on both the housing tube and motor frame are clean and free of chips. WHEEL AXLE HOUSING ASSEMBLIES DO NOT REQUIRE ANY SERIAL NUMBER MATCHING TO THE TRACTION MOTOR FRAME.
2. Apply approximately 24" lengths of self-adhesive rubber strip 40017293 to both ends of the motor frame in the cutouts for the axle housing per Figure 5. Position the strips 1/2 inch from the edge of the frame along the circumference of the machined cutouts. Bring the end of each strip up onto the flat ledges to the points where the ledges stop and steps begin. Trim the ends of the strips if necessary, then at the C.E. apply two 14 inch lengths of the rubber strip along the corners formed by the ledges at the steps. Butt against the ends of the strip in the axle housing cutout. Similarly apply two 9 inch lengths of the rubber strip at the P.E., again both top and bottom.
3. Engage the housing assembly with the motor. The lower rail is a piloted fit between the housing tube and motor and locates the two vertically with respect to each other. Longitudinal location is achieved through the mounting bolt clearance.

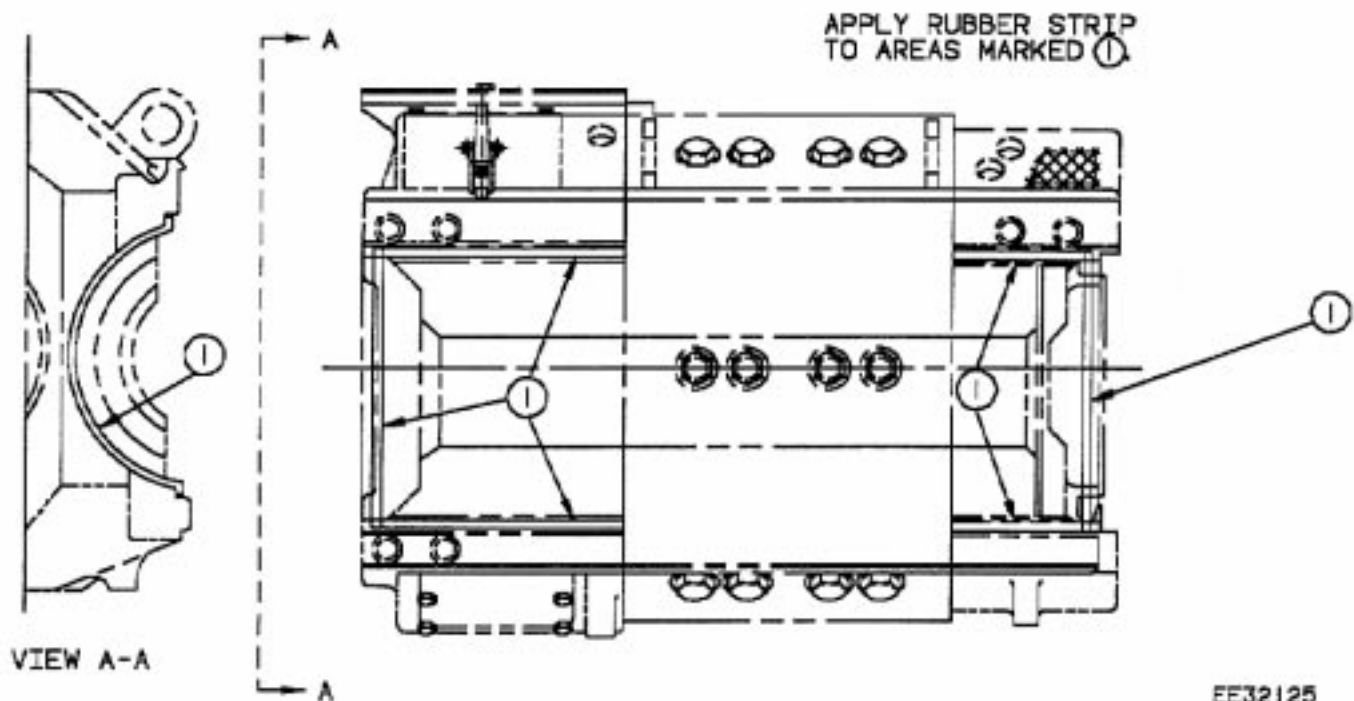


Figure 5. Rubber Strip Application (D87BTR)

4. All mounting bolts must be lubricated with an equivalent of Threadtex and torqued to 1200 ft-lbs. An impact wrench may be used only to seat the housing tube onto the motor frame. During this seating process the bolts should be tightened in an X pattern so that the tube is drawn down uniformly. After the housing assembly is seated, the final torque on every bolt should be applied by hand with a calibrated 4 to 1 torque multiplier\* and a calibrated clicker type torque wrench or with a suitably calibrated hydraulic tightening device.
5. After the housing assembly is mounted, apply a bead of 8366747 sealing compound across the top of the housing tube per Figure 6. This bead should fill the cavity between the top of the housing tube and the underside of the motor upper mounting rail lip. The bead should extend completely from end to end of the mounting rail.
6. Next apply the gear case. Application of gear case seals are made the same as the conventional gear case ref: MI 1520. However, because of the special machined gear hub, inner axle seal p/n 40006689 must be used along with outer axle seal 9535375. The method of gear case lubrication should be maintained per customer's established interval.

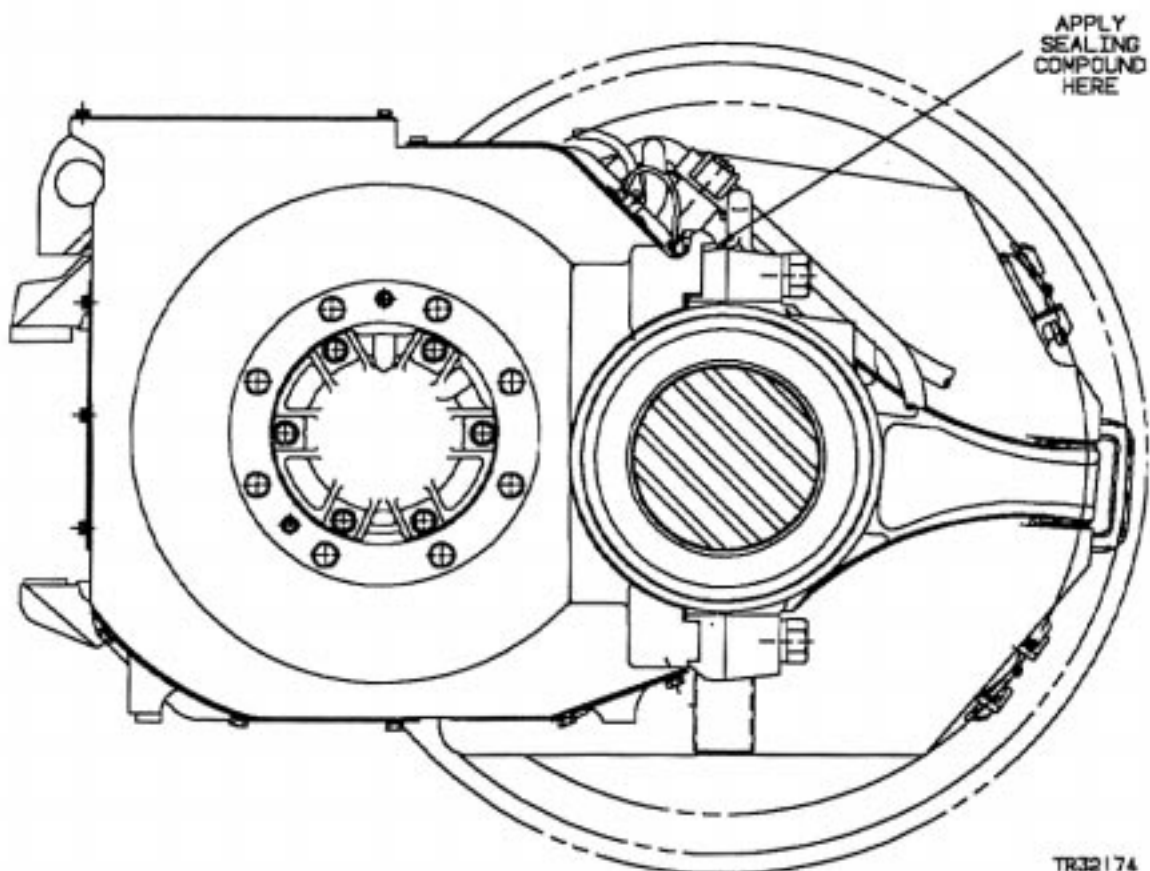


Figure 6. Sealing Compound Application (D87BTR)

\*Nominal 4:1 torque multipliers generally have a 3.5:1 ratio when calibrated.

## Maintenance Requirements

1. The tapered and cylindrical roller support bearings are sealed and grease lubricated and do not require periodic maintenance (such as, maintaining lubricant levels and inspecting wicks as with the conventional friction type bearings).
2. At wheel change the roller bearings and housing should be removed, inspected, relubricated and reapplied back into the assembly. The axle and gear must be qualified for reuse as per MI 1518.
3. Note that the roller bearing seat diameters on the axle are listed for reference and no reduction in diameter is allowed.

|               |                    |
|---------------|--------------------|
| gear side     | 9.270" +.001 -.000 |
| non-gear side | 9.251" +.001 -.000 |

4. Experience may prove that bearing inspections may not be necessary after the first wheel change and only after the second wheel change if axle inspection requirements allow this. Grease additions at first wheel change can be made to the rollers through the two 3/8 - NPT plug holes at the bottom of the housing.
5. Whenever a gear needs to be removed, all roller bearings will need to be removed.
6. Whenever the bearing outer races need to be removed, the housing bearing bores should be checked. For reference, the housing bore diameters are provided.

|                                       | PINION END            | COMMUTATOR END        |
|---------------------------------------|-----------------------|-----------------------|
| Tapered Bearing Housing (40006120)    | 13.247 +.002 -.000    | 12.373 +.002 -.000    |
| Cylindrical Bearing Housing (9565092) | 14.1686 +.0020 -.0000 | 12.5938 -.0020 -.0000 |

## Guidelines for Rebuild

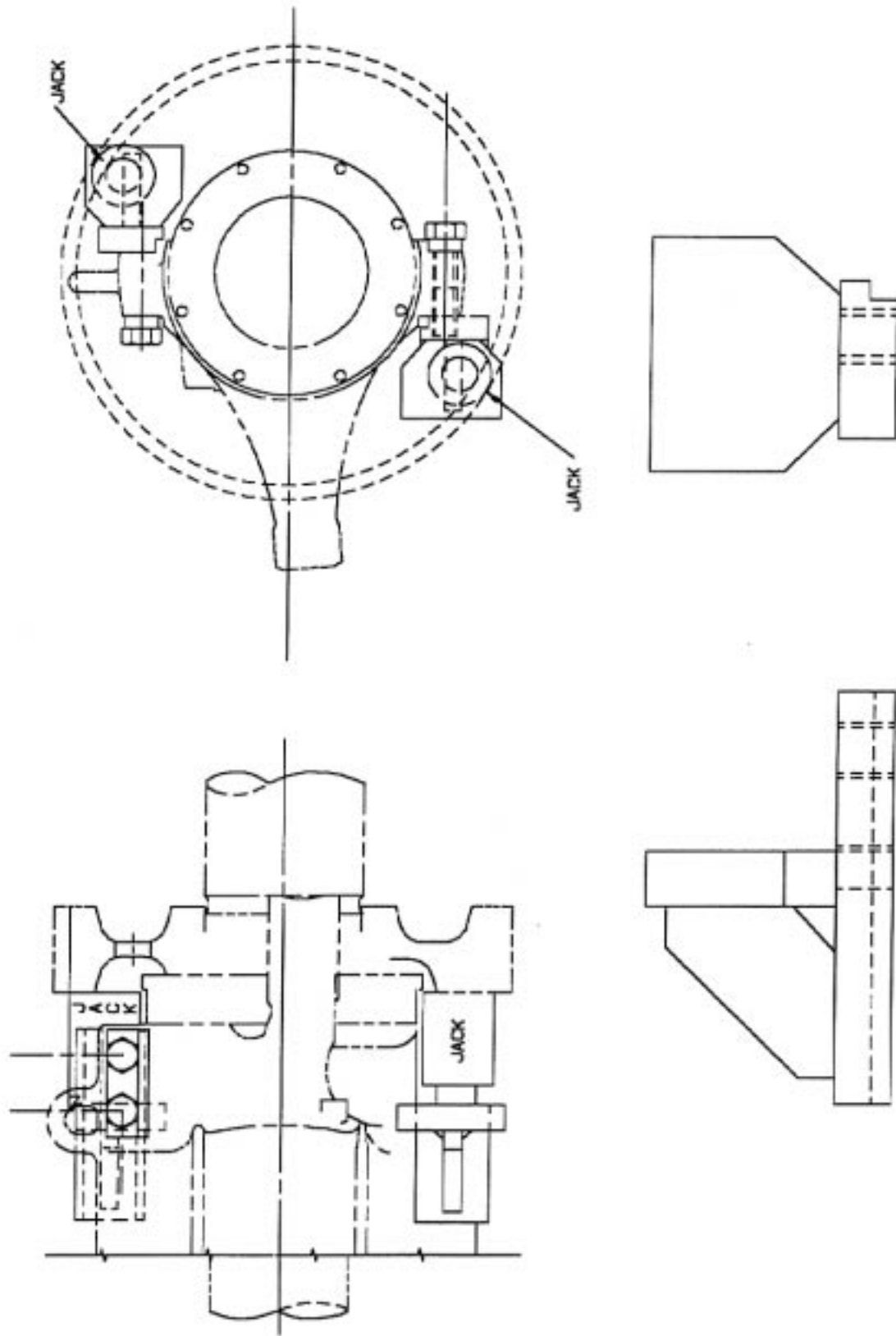
The following guidelines should be used to determine what rework is required.

- A. Conditions under which complete teardown is **not** required.
  1. First wheel replacement since last teardown or initial assembly.
  2. Second wheel replacement since last teardown or initial assembly if less than 50,000 miles since first wheel replacement.

### NOTE

If there is any doubt as to these conditions the assembly should receive a complete teardown.

ORIENTATION OF JACKING PADS



JACKING PADS (WS45394)

Figure 7. Tapered Bearing Disassembly Fixture (Two Required). (Reference WS45394)

- B. Conditions under which the assembly **requires complete teardown** (removal of axle housing and bearings).
  - 1. Damaged or worn gear. Inspect per M.I. 1518.
  - 2. End play exceeding .019 inch.
  - 3. Second wheel change since last teardown or initial assembly. Inspect wheels per M.I. 1518.
  - 4. Wreck damage or other damage judged to impair operation of assembly (i.e., housing does not turn freely on axle, structural damage to housing).

### **Wheel Replacement Only**

- A. Remove the end journal bearings and remanufacture.
- B. Remove the wheels.
- C. Prepare to apply new wheels.
  - 1. Remove the shims from behind the C.E. bearing flange.
  - 2. Measure the shim thickness or use a feeler gauge to measure the gap behind the flange. If the gap is greater than .110 inches it is likely that new wheels can be applied without repositioning the C.E. bearing (the minimum shim thickness is .089).

#### **NOTE**

It is recommended that the C.E. bearing cap not be allowed to fall away from the housing or become disengaged from the bearing flange as the O ring seal can fall out of its groove in the cap. If this happens the cap should be removed entirely and the O ring seal carefully repositioned in the cap.

- 3. If the bearing requires repositioning, move the assembly to an upright position and jack the bearing towards the end of the axle as described in disassembly procedure. Move the bearing sufficiently to allow the installation of .130 assembly spacers behind the bearing flange. Once positioned with the assembly spacers in place, seat the bearing as described in steps 16 thru 25. Reapply the C.E. cap and O ring seal.
- 4. Apply Exxon RB 290EP grease to the labyrinth area of the C.E. bearing cap.
- 5. Apply the new wheels as described with step 28 on page 14 through step 40 on page 17.

#### **NOTE**

Only new or reconditioned end journal bearings should be used.

- 6. Apply Exxon RB 290EP grease to each bearing through the grease fitting holes in the housing. Use a grease gun and appropriate fittings. Continue to apply new grease to each bearing until new grease appears along the

gap between the axle and housing at each bearing. Wipe off any excess grease after completion of the operation.

7. Stamp axle to identify rework performed.

## **Assembly Identification**

### **A. Axles**

1. Each time a new set of wheels is applied to an axle the axle should be stamped with an "R" on the identification land at the end of the axle.
2. Each time the axle is magnafluxed or similarly inspected for cracks the axle should be stamped with the inspection date on the identification land at the end of the axle next to the last wheel replacement mark.

### **B. Housings**

1. Paint out any prior markings on the inside surface of the housing or the surface next to the motor.
2. With paint or similar indelible marking record the following information:
  - a. Location of rebuild
  - b. Date of rebuild
  - c. Shim thickness (for tapered bearings)
  - d. End play measurement

- C. Maintain above records with records of wheel and gear press-on tonnages.

## **Procedure For Complete Disassembly Of Tapered Bearing Suspension Unit**

- A. Remove the journal bearings and remanufacture.
- B. Remove the wheels.
- C. Remove the bearing housing and bearings.
  1. Place assembly in a vertical position with the gear end down in an assembly fixture. Refer to exploded view Figure 4 on page 6 for identity of parts.
  2. Attach two jacking pads to pinion end of axle housing (6) per Figure 7. Place hydraulic jacks between the pads and the gear rim. Connect the jacks to a common pump.
  3. Remove the cap screws holding the P.E. bearing cap (2) to the housing. The cap will fall loose preventing removal of the P.E. bearing while the C.E. bearing is removed.
  4. Remove the C.E. bearing cap (12) and the spacer halves (7) from behind the C.E. outer race flange.
  5. Raise the axle housing with the jacks such that the axle housing comes into

contact with the C.E. inner race. If the spacer halves are not removed contact and jacking pressure will be transmitted through the rollers, damaging the bearing. Continue to apply pressure with the jacks until the C.E. spacer (10) and C.E. inner race are forced off the axle seat.

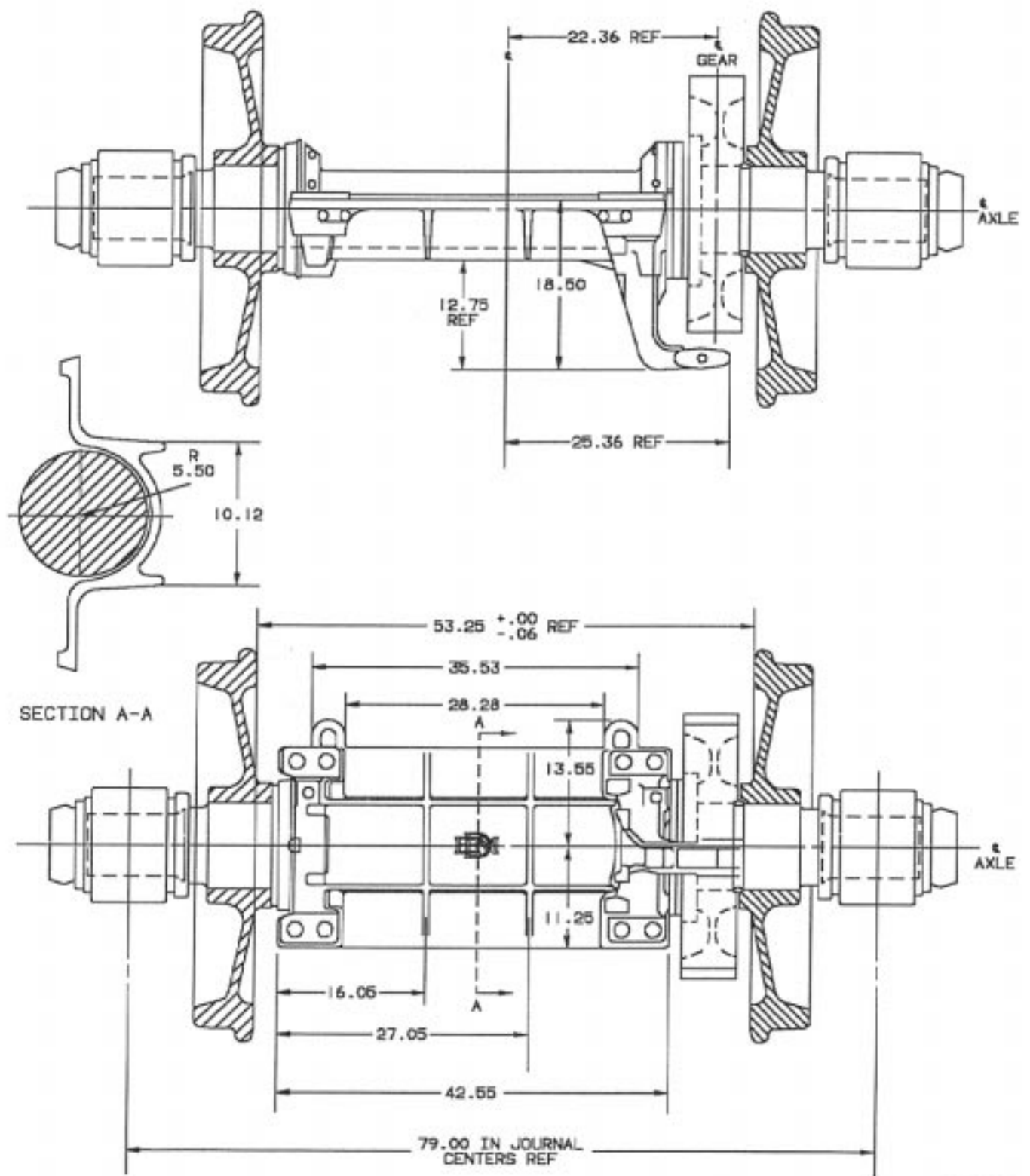
6. When the C.E. spacer and inner race are free of the axle seat allow the housing to fall back onto the P.E. bearing. Remove the C.E. spacer and inner race.
  7. Re-attach the P.E. bearing cap to the axle housing with all eight cap screws. Tighten but do not torque the screws.
  8. Raise the axle housing with the jacks. Pressure will be applied to the P.E. inner race through the P.E. bearing cap (2). Continue to apply pressure with the jacks until the P.E. inner race is forced off the axle seat.
  9. When the P.E. inner race comes loose, free the housing from the P.E. bearing cap by removing the cap screws. Lift the axle housing off of the axle and set down on end. Remove the P.E. inner race and bearing cap.
  10. If necessary to remove, remove the C.E. outer race from the axle housing using the jacking holes behind the outer race flange.
  11. Turn the axle housing end for end, if necessary, to remove the P.E. outer race. Three cutouts are provided in the housing behind the outer race to accept a conventional three-jaw puller.
  12. If it is necessary to remove the P.E. seal (1) from the gear, it can be removed by evenly and gently heating it with a cutting torch (avoid burn marks or "blueing") and prying it off its seat. For assembly rebuilding where the gear is left in place the P.E. seal need not be removed.
- D. Clean the bearing housing and all bearing parts.
1. Scrap damaged parts.
  2. Bearings can be reused if free of pits, scratches, rust and bent or otherwise damaged cages. Cleaned bearings should have a coating of oil applied to surfaces to prevent corrosion. Cover to prevent accumulation of dirt.
  3. Remove and requalify the gear if required.
  4. Inspect the axle and prepare for reuse.
  5. Reassemble the assembly and follow axle assembly identification procedure.

**NOTE**

Only new or reconditioned journal bearings should be used.

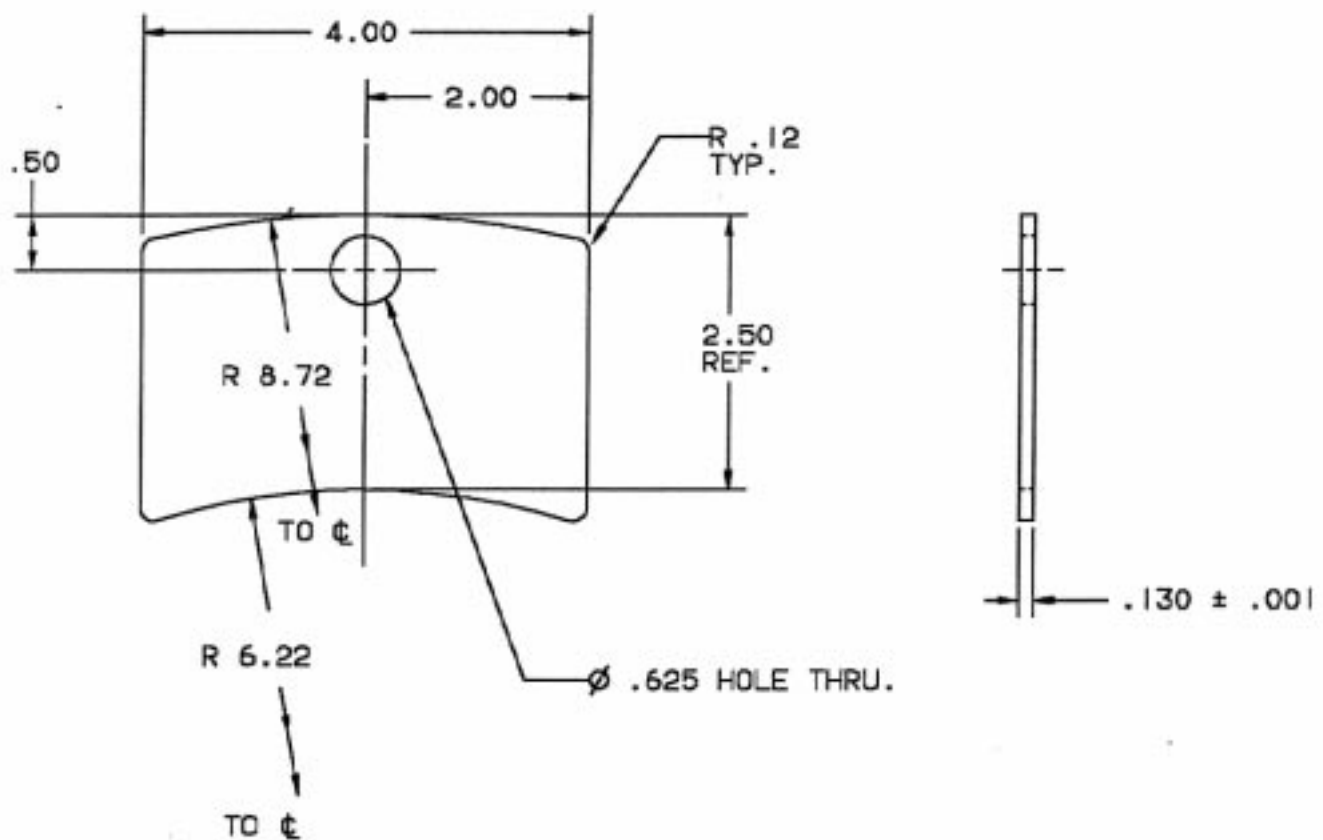
## Tooling and Fixturing Requirements

1. Mounting wheels and gear on the roller support bearing wheel axle assembly can be done on the same wheel press used for conventional wheel axle gear assemblies provided the following exist.
  - A. Proper clearance exist on the wheel press. The roller support bearing assembly has a bearing housing mounted on the axle between the wheels. This bearing housing may result in an interference with the wheel press structure and should be dimensionally checked with Figure 8 to assure that the axle ends can be lined up with the wheel press rams.
  - B. The roller support bearing assembly mounted on the wheel axle gear assembly results in an increase weight of approximately 500 lbs. The wheel press carrier table that supports the wheel assembly must be capable of operating with the additional weight.
2. Need at least one dozen assembly spacers 3.3 mm (.130") p/n 40009706 shown in Figure 9, to accommodate the assembly of more than one wheel assembly at a time. Thicker spacers of .140 or .150 inches could be used to provide additional clearance and allow more final assembly spacer correction after pressing on wheel.
3. The assembly of the rollers and bearing housing can only be applied with the axle in the vertical position. The assembly requires that the bearing housing (44.5" long) be lifted over the end of the axle (91" long). Depending on the crane height capabilities, either a platform can be constructed as shown on Figure 3, or a pit can be made in the floor which will allow the gear end of the axle to be lowered into the pit and reduce the overall height by approximately 20.5 inches.
4. Need an oven to heat the bearing parts 200 °F rise (over ambient) with an accurate thermostat setting and large enough to hold roller bearings and seals for one assembly is necessary.
5. A freezer with a thermostatic control (-25 °F.) to hold seals and races is necessary to shrink bearing parts during assembly.
6. Disassembly fixture (Figure 7), two required. Details for assembly on WS45394, which will be provided upon request.
7. Provide a means to lift axle assembly such as an axle end lifting cap fixture (cap can be bolted onto end of axle that includes a lifting eyelet to lift axle assembly).
8. A mild steel ring that can be used as a driving tool to seat the bearing inner race. Any mild steel ring can be used with a bore approximately 236 mm (9.300").
9. Exxon RB290EP grease with a grease gun that has a small 1/8" tip for inserting between rollers.



EE32127

Figure 8. D87BTR TM Wheel Set Assembly Clearance



EE32126

Figure 9. Assembly Spacer

10. Various spacers should be available for final assembly.

| Spacing | Part No. |
|---------|----------|
| 0.089"  | 40017309 |
| 0.093"  | 40017310 |
| 0.097"  | 40017311 |
| 0.101"  | 40006539 |
| 0.105"  | 40006538 |
| 0.109"  | 40006537 |
| 0.113"  | 40006536 |
| 0.117"  | 40006535 |
| 0.121"  | 40006534 |
| 0.125"  | 40006533 |

11. Dial indicator with approximately a 6" stem to monitor internal clearance during wheel press assembly.

12. Bearing housing lifting fixture, two required - figure 12.

## Conversion of D77/D87 Motors To D77BTR/D87BTR Roller Support Motors

### Introduction

This section will describe the conversion of D77/D87 motors with conventional lined bronze support bearings to the new D77BTR/D87BTR roller support arrangement. The D77BTR/D87BTR motors offer maintenance free roller support bearings in the same dimensional envelope as the conventional motors and will fit into the same applications without requiring truck or locomotive modifications. The roller support motors use most of the same components as the conventional motors, making conversion a straight forward process.

Rather than having axle caps and lined bronze bearings the roller support motors use tapered roller bearings mounted in a housing as shown in Figure 13 on page 39. The bearings are shrunk fit on the axle and assembled into the housing as part of the wheel/axle/gear assembly. The bearings are sealed and grease lubricated without need for periodic maintenance. The motor is bolted to the wheel/axle/gear assembly through the axle bearing housing without regard for serial number matching. The gear case attaches to the motor and axle bearing housing in the conventional manner. The same D77/D87 gear ratios are used although the gear itself is different only in hub configuration. Gear ratios lower than 56/19 will not work with this tapered bearing arrangement.

### D87B To D87BTR Conversion

The D87BTR motor uses the same armature and bearing parts as the D87B with the exception of requiring a new pinion end armature bearing housing. Much of the same stator components are used although new main field coils and a new motor frame are required. In addition, slightly longer motor cables are required because of a revised clamping arrangement. The main field coils are new in that the leads have been shortened to accommodate the slightly reduced internal length of the new frame. While the motor frame is entirely different from the old frame it is possible to rework an old frame to the new configuration as outlined in drawings WS-45427 and WS-45456 (available upon request). Although physically possible, the process may not be economically justifiable.

## New Parts Required For D87BTR

Table 1.

| Part Number | Quantity | Description         |
|-------------|----------|---------------------|
| 40006215*   | 1        | T.M. Frame          |
| 40006429    | 2        | Coil Asm 1-3        |
| 40006430    | 2        | Coil Asm 2-4        |
| 40002692    | 1        | Cable Asm - Cross A |
| 9565202     | 1        | Cable Asm AA        |
| 40012693    | 1        | Cable Asm F         |
| 9565204     | 1        | Cable Asm FF        |
| 9565097     | 1        | Cable Asm           |
| 40006434    | 1        | Housing - P.E. Brg. |
| 40008230    | 1        | Sheet Asm           |
| 40007235    | 1        | Sheet Asm           |
| 40009480**  | 1        | Gear 70T            |
| 40009121    | 1        | Axle                |
| 40006120    | 1        | Housing - Axle Brg  |
| 40006499    | 1        | Outer Race          |
| 40006500    | 1        | Inner Race & RLS    |
| 40006501    | 1        | Outer Race          |
| 40006502    | 1        | Inner Race & RLS    |
| 40006527    | 1        | Seal - Gear         |
| 40006529    | 1        | Cap - P.E. Brg      |
| 40006526    | 1        | Spacer - C.E.       |
| 40006531    | 1        | Cap - C.E. Brg      |
| 9084265     | 1        | Seal                |
| 9085559     | 1        | Seal                |
| 40006532    |          | Spacer Chart        |
| 138302      | 4        | Screw 1/2-13        |
| 138292      | 4        | Screw 1/2-13        |
| 138295      | 4        | Screw 1/2-13        |
| 138305      | 4        | Screw 1/2-13        |
| 8348619     | 2        | Plug - 3/8 Pt       |
| 103877      | 2        | Plug - 1/8 Pt       |
| EMS 1032    | 4lbs     | Grease              |
| 8141664     | 2        | Heat Indicator      |
| 8141662     | 2        | Snap Ring           |
| 40008103    | 1        | Support Asm         |
| 8195958     | 1        | Cleat               |
| 8218764     | 4        | Cover - Cable       |
| 9095753     | 8        | Bolt 1 3/8-6        |
| 8495681     | 8        | Washer - Spl        |
| 9535375     | 1        | Seal - Outer        |
| 40006689    | 1        | Seal - Inner        |
| 40008417    | 1        | Clamp-Hex Worm      |
| 40006358    | 1        | Gear Case Lwr       |
| 40006391    | 1        | Gear Case Up        |

\* Can be made from conventional frame by extensive welding, stress relieving and complete remachining per drawings WS-45427 and WS-45456.

\*\* Can be made from 9520045 or 9556134 70T gears by machining the hub to dimensions on Figure 10.

**NOTE**

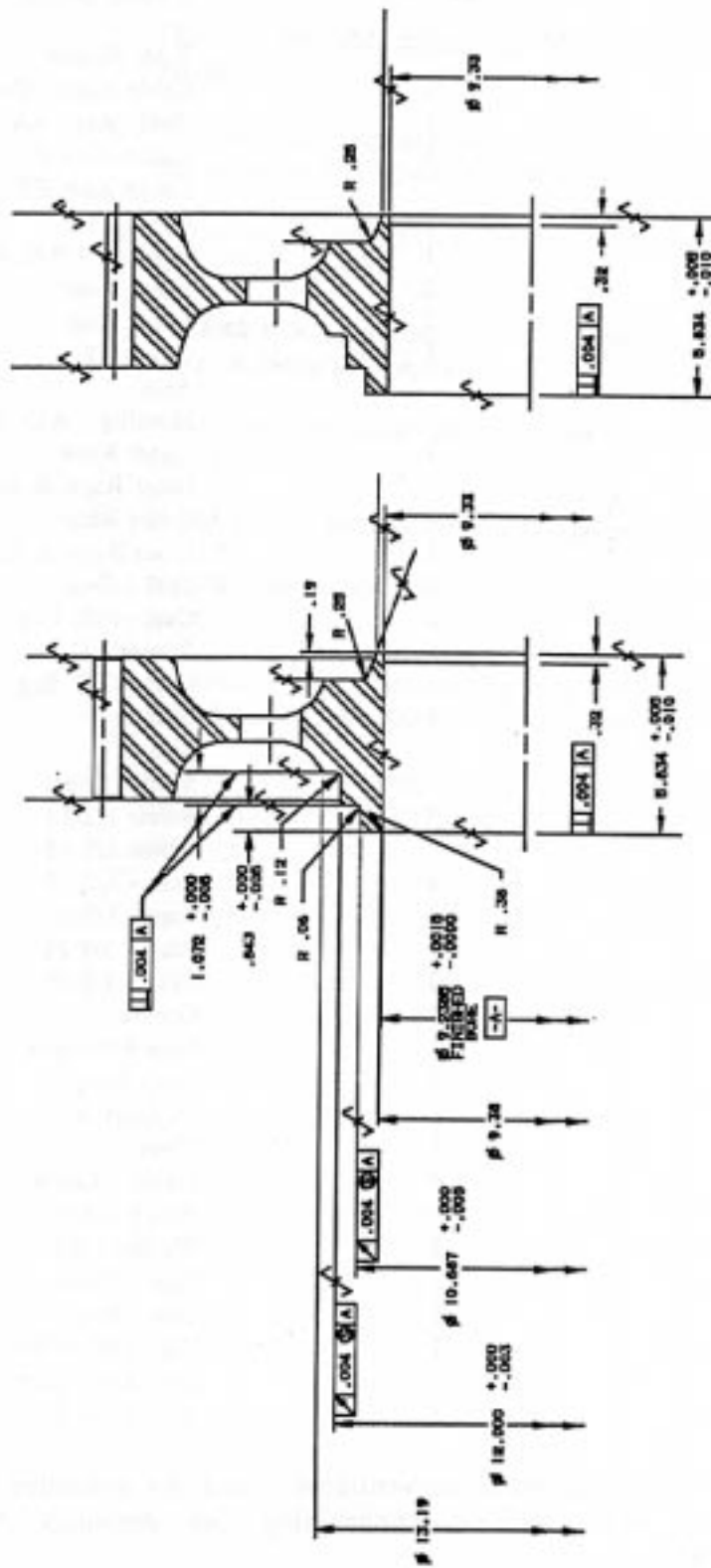
In addition to machining the gear seal steps in the hub, the width of the bore is reduced from 6.110" to 5.834" (+.005 -.010).

To achieve this new bore width machine off from the wheel side of the gear (tapered portion) 1/8". For D77 series gears machining off 1/8" will result in the tapered portion flush with the gear teeth. For D87 series gears machining off 1/8" will result in the tapered portion extending out .190" instead of previous 5/16". In both cases the remainder will be machined off on the opposite side to achieve the 5.834 (see Figure 10).

This also applies for other gear ratios in the D87 series.

**D77 To D77BTR Conversion**

As with the D87 version the D77BTR motor uses the same armature and bearing parts as the D77B except that a new pinion end armature bearing housing is required. Unlike the D87 version, new main field coils are not required. The D77BTR uses the same frame as the D87BTR which, again, can be modified from the conventional frame if deemed economically justified. Finally, other than the gear ratio series the roller support bearing application is identical to the D87BTR motor.



D87 SERIES      D77 SERIES

TAPERED PORTION MACHINED 1/8" EXTENDING BEYOND GEAR TEETH BY .19      TAPERED PORTION MACHINED 1/8" FLUSH WITH GEAR TEETH

REMAINDER OF BORE MACHINED TO 5.634 DIMENSION

TR32175

Figure 10. D77 And D87 Machined Gear Dimensions

## New Parts Required For D77BTR

Table 2.

| Part Number | Quantity | Description         |
|-------------|----------|---------------------|
| 40006215*   | 1        | T.M. Frame          |
| 40002692    | 1        | Cable Asm - Cross A |
| 9565202     | 1        | Cable Asm AA        |
| 40012693    | 1        | Cable Asm F         |
| 9565204     | 1        | Cable Asm FF        |
| 9565097     | 1        | Cable Asm           |
| 40008703    | 1        | Housing - P.E. Brg. |
| 40008230    | 1        | Sheet Asm           |
| 40007235    | 1        | Sheet Asm           |
| 40009793**  | 1        | Gear 62T            |
| 40009121    | 1        | Axle                |
| 40006120    | 1        | Housing - Axle Brg  |
| 40006499    | 1        | Outer Race          |
| 40006500    | 1        | Inner Race & RLS    |
| 40006501    | 1        | Outer Race          |
| 40006502    | 1        | Inner Race & RLS    |
| 40006527    | 1        | Seal - Gear         |
| 40006529    | 1        | Cap - P.E. Brg      |
| 40006526    | 1        | Spacer - C.E.       |
| 40006531    | 1        | Cap - C.E. Brg      |
| 9084265     | 1        | Seal                |
| 9085559     | 1        | Seal                |
| 40006532    |          | Spacer Chart        |
| 138302      | 4        | Screw 1/2-13        |
| 138292      | 4        | Screw 1/2-13        |
| 138295      | 4        | Screw 1/2-13        |
| 138305      | 4        | Screw 1/2-13        |
| 8348619     | 2        | Plug - 3/8 Pt       |
| 103877      | 2        | Plug - 1/8 Pt       |
| EMS 1032    | 4lbs     | Grease              |
| 8141664     | 2        | Heat Indicator      |
| 8141662     | 2        | Snap Ring           |
| 40008103    | 1        | Support Asm         |
| 8195958     | 1        | Cleat               |
| 8218764     | 4        | Cover - Cable       |
| 9095753     | 8        | Bolt 1 3/8-6        |
| 8495681     | 8        | Washer - Spl        |
| 9535375     | 1        | Seal - Outer        |
| 40006689    | 1        | Seal - Inner        |
| 40008417    | 1        | Clamp-Hex Worm      |
| 40006358    | 1        | Gear Case Lwr       |
| 40006391    | 1        | Gear Case Up        |

\* Can be made from conventional frame by extensive welding, stress relieving and complete remachining per drawings WS-45427 and WS-45456.

\*\* This gear can be made from the standard 8109579 62T gear by modifying the hub to dimensions on Figure 10. Other gears in the D77 series can be modified in the same manner.

#### Conversion Procedure

1. Disassemble old motor per M.I. 3900 series. Requalify parts to be reused.
2. If new roller support motor frame is not to be used rework old frame per drawing WS-45427 and WS-45456.
3. Build stator out of new frame and appropriate reused components per M.I. 3900 series.
4. Assemble new pinion end bearing housing and new or requalified bearing parts to armature per M.I. 3900 series.
5. Assemble armature and bearing assembly to stator per M.I. 3900 series.
6. If old gear is reused, requalify and machine hub per Figure 10.
7. Mount gear on axle per "Assembly Of Wheel Axle Gear Assembly" on page 2.
8. Assemble roller support bearings and wheels on axle per "Assembly Of Wheel Axle Gear Assembly" on page 2.
9. Mount wheel/axle/gear assembly and gear case to motor per "Mounting Wheel Axle Gear Assembly To Traction Motor Frame" on page 18.

## Section II CYLINDRICAL ROLLER SUPPORT BEARING

This arrangement is not interchangeable with a conventional motor. An extensive modification is necessary.

### Bearing Assembly Procedure

Mount the axle gear on the axle in the same manner as a conventional assembly, with the gear hub positioned 18.875 inches to axle center. Refer to Maintenance Instruction M.I. 1518 for procedure.

#### NOTE

The gear is pressed on the axle, but the wheels are not pressed on until after the installation of the roller support bearing assembly.

#### NOTE

All machined parts to be washed with soap and water solution and blow dried with filtered air before assembly.

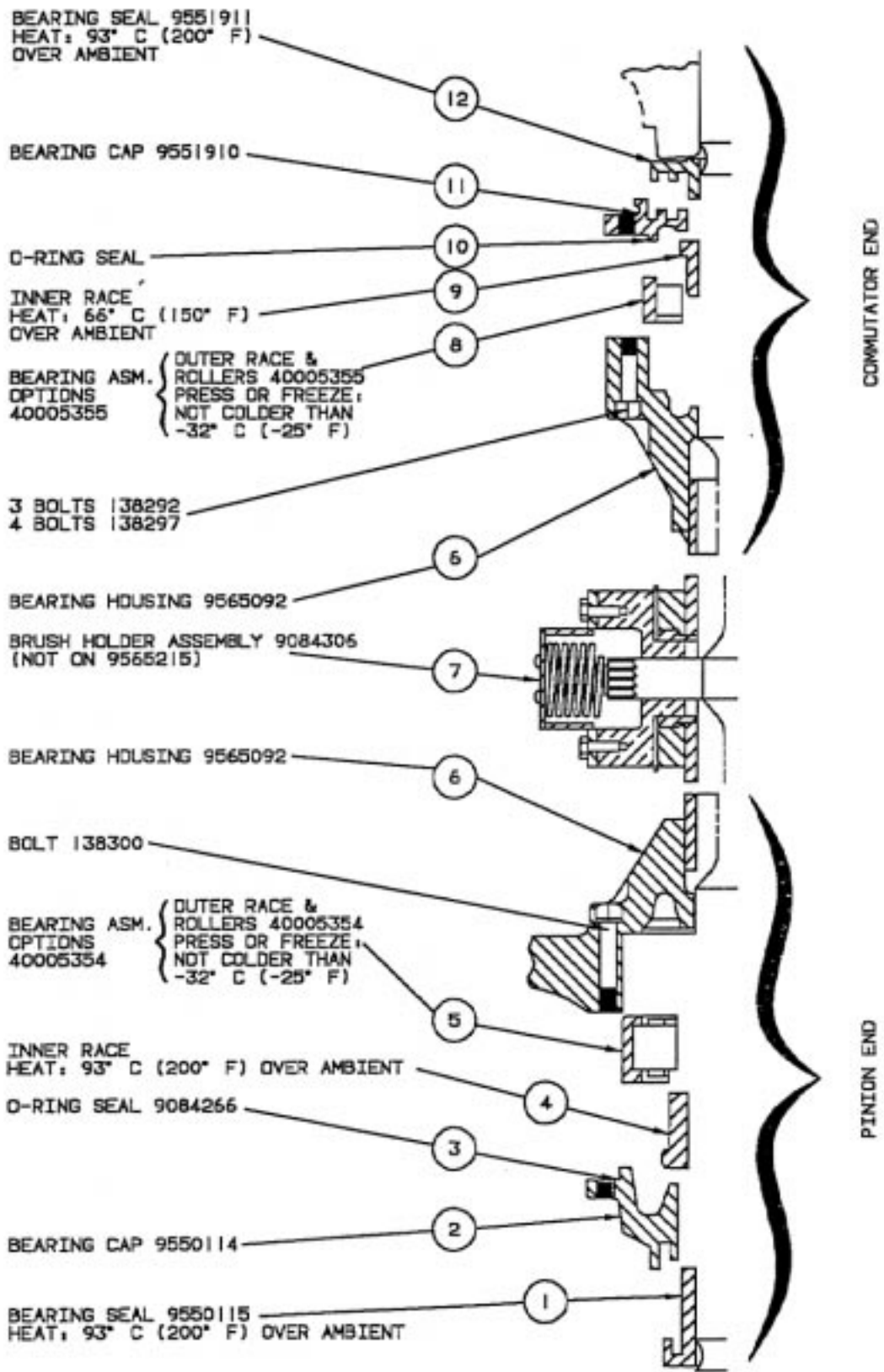
During assembly of the roller support bearing, refer to exploded view, Figure 11 on page 33.

1. Place the axle and gear assembly in a vertical position with the gear end down, in an assembly stand, Figure 3 on page 4.

#### NOTE

The roller support bearing housing is one piece and is approximately 1 119 mm (44.5") long. The housing must be raised over the vertical axle which is 2 312 mm (91") high. If building height is sufficient, a platform can be built as shown in Figure 3 on page 4. or, the portion of the axle below the gear could be placed in a hole in the floor approximately 560 mm (22") deep (distance from bottom of gear to end of axle is 521 mm (20.5")).

2. Heat the pinion end (P.E.) bearing seal, Item 1 of exploded view, to 93° C (200° F) over ambient temperature.
3. Place the bearing seal (1) over the upper end of the axle, flat side down, and slide down and install against the machined seat on the gear hub. To insure the gear seal is seated against the hub, rotate the ring back and forth as it cools. Do not tap in place.
4. Fill lower portion of grease cavity in bearing cap (2) with 425 g (15 oz) of Exxon RB 290 EP. Place grease in a 240° arc of sufficient depth to solidly contact the bearing cage when it is installed.



TR31123

Figure 11. Cylindrical Roller Support Bearing, Exploded View

6. Fill labyrinth grooves in P.E. bearing cap (2) with Exxon RB 290 EP grease.
7. Place bearing cap (2) over the upper end of the axle and move down to engage with the bearing seal ring (1).
8. Heat the P.E. bearing inner race (4) to 93° C (200° F) over ambient temperature.

**CAUTION**

At no time should bearings be left in oven for extended periods such as more than a work shift or overnight.

9. Place P.E. bearing inner race (4) over upper end of axle with flange side down and move down to seat against the bearing seal ring (1). Do not tap into place.
10. Fill the lower portions of the grease cavities in the bearing housing (6) with Exxon RB 290 EP grease. Use 369 g (13 oz) in the pinion end and 170 g (6 oz) in the commutator end. Place grease in a 240 ° arc of sufficient depth to solidly contact the bearing cages when they are installed.
11. Press or shrink the outer race and roller assemblies (5 and 8) into their respective bores in the bearing housing (6). Ensure the outer races are firmly seated at the bottom of each bore. Shrink temperature is not to be colder than -32° C (-25° F)

**CAUTION**

Do not leave outer race at this temperature for extended periods such as more than a work shift or overnight.

12. Coat the inside diameter of each roller set with 57 g (2 oz) of Exxon RB 290 EP grease. Work as much grease as possible into the cage pockets and between the cage and outer ring pathway to assure start-up lubrication.

Coat the roller path of the P.E. inner race (4), which is now on the axle, with a thin layer of grease.

13. Pick up the bearing housing (6) by the commutator end (small bearing end) using an appropriate lifting fixture which will allow the bearing housing to hang exactly vertical.
14. Raise the bearing housing and lower the housing slowly over the axle being careful not to bump the roller set in either end of the bearing housing.

Lower the bearing housing until the P.E. rollers have fully engaged the bearing inner race.

P.E. rollers must be in contact with outer race and the bearing housing must hang straight and rotate freely while engaging the P.E. inner race to prevent damage to the race and rollers.

15. Remove lifting fixture from the bearing housing. Ensure no dirt falls into the open commutator end (C.E.) bearing.
16. Place two jacks between the side of the gear and the bearing housing. Raise the bearing housing 1.93 mm (0.076") with the jacks.
17. Heat C.E. inner race bearing (9) to 66°C (150°F) over ambient temperature.
18. Place inner race (9) over upper end of axle with the flange side up.
19. Slide inner race (9) onto the bearing seat and carefully engage with the outer race and rollers (8).

After engagement is obtained with rollers, rotate race continuously and push down until race is in solid contact with the C.E. roller ends.

Because of the small diametral clearances involved, all rollers must be back against the outer race and the inner race must be the correct temperature to complete the operation.

20. Remove jacks from the assembly.
21. Fill the lower portion of the grease cavity in the C.E. bearing cap (11) with 113 g (4 oz) of Exxon RB 290 EP grease in a 240° arc of sufficient depth to solidly contact the bearing cage.  
Fill labyrinth grooves in the C.E. bearing cap (11) with Exxon RB 290 EP grease.
22. Place O-ring seal (10) in the groove in the bearing cap (11).
23. Place the bearing cap (11) over the upper end of the axle and move down to engage the bearing housing (6).
24. Align holes in the P.E. and C.E. bearing caps (2 and 11) with holes in the bearing housing (6) and install bolts. Torque bolts to 136N·m (100 ft-lbs) dry.

25. Heat the C.E. bearing seal (12) to 93°C (200°F) over ambient temperature.
26. Place the bearing seal (12) over the upper end of the axle and slide down to seat against the bearing inner race (9).
27. While the axle and bearing housing are still in the vertical assembly position, check axial movement of the bearing housing (6) relative to the axle with a dial indicator. The total end play must be within 1.22-1.93mm (0.052"-0.076").

On roller support bearing assemblies utilizing grounding brush, place plugs in the drilled and tapped holes for the brush holder assembly (7)

and tape over the grounding brush hole, if the assembly is to be stored without the brush assembly in place.

28. Move assembly to the wheel press and install the C.E. wheel (wheel opposite the gear end). Refer to Maintenance Instruction M.I. 1518 for procedure.

Press wheel into contact with the bearing seal face (12) without moving the bearing seal and inner race (9). The gap, if any, between the wheel hub face and bearing seal face must not exceed 0.05mm (0.002").

29. Recheck the axial end play between the bearing housing (6) and axle with a dial indicator. The total end play must remain within 1.22-1.93mm (0.048"-0.076").
30. Press gear end wheel onto axle. Refer to Maintenance Instruction M.I. 1518 for procedure.
31. Recheck the axial end play between the bearing housing (6) and axle with a dial indicator. The total end play must remain within 1.22-1.93mm (0.048"-0.076").

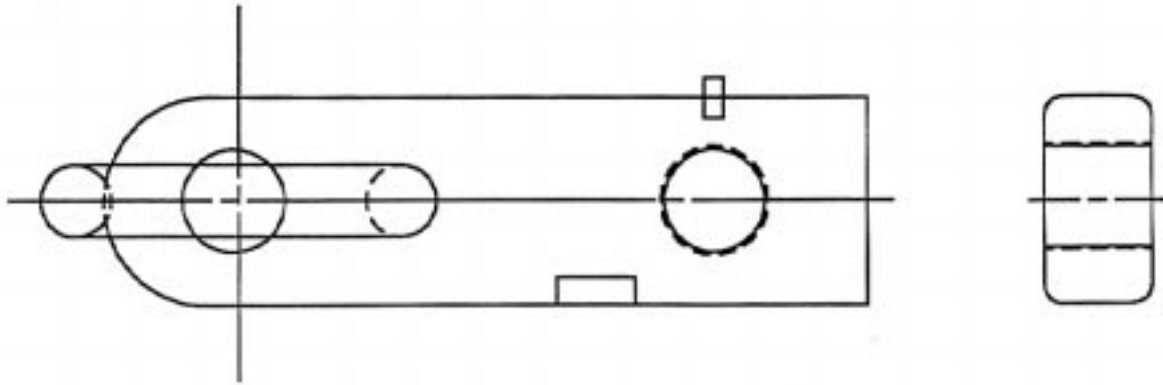
### Bearing Disassembly Procedure

#### NOTE

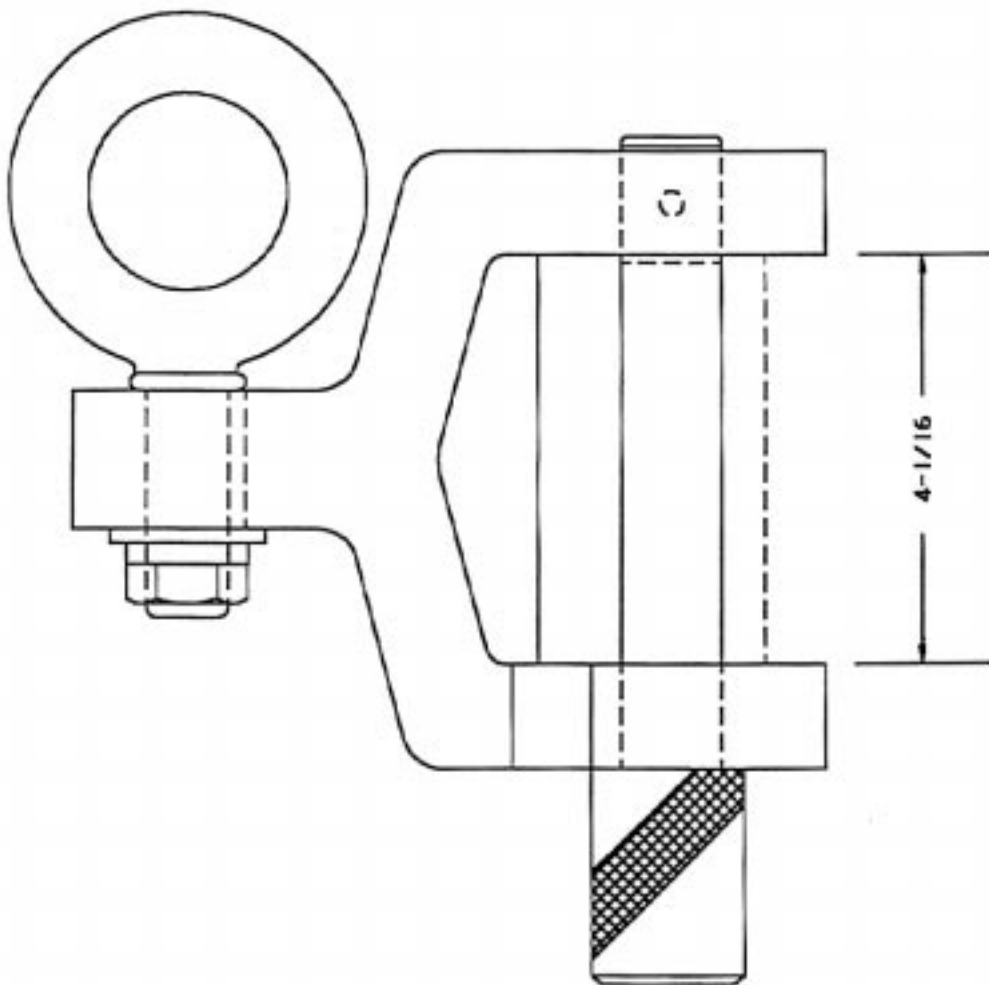
At wheel replacement, cylindrical bearing assemblies should be disassembled for regreasing.

1. Remove wheels from wheel/ axle assembly.
2. Place assembly in a vertical position with the gear end down in an assembly fixture. Refer to exploded view Figure 11.
3. Place two hydraulic jacks between the housing and gear rim, positioned roughly 180° apart. Connect the jacks to a common pump.
4. Remove the cap screws holding the pinion end bearing cap (2) to the housing. The cap will fall loose preventing removal of the P.E. bearing while the C.E. bearing is removed.
5. Raise the housing with the jacks such that the end play is taken up. Continue applying pressure to push the C.E. inner race and (2) seal off the axle seat.
6. When the C.E. inner race and seal are free of the axle seat allow the housing to drop back on the P.E. bearing. Remove the C.E. inner race and seal.
7. Reattach the P.E. bearing cap to the housing with all eight cap screws. Tighten but do not torque the screws.

8. Raise the housing with the jacks. Pressure will be applied to the P.E. inner race through the the P.E. bearing cap. Continue to apply pressure with the jacks until the P.E. inner race is forced off the axle seat.
9. When the P.E. inner race (4) is free of the axle seat, detach the P.E. cap (2) from the housing and lift the housing off the axle. Set the housing down on end. Remove the inner race and cap from the axle.
10. Only when necessary, remove the C.E. and P.E. outer races and rollers from the housing using bearing pullers.
11. If it is necessary to remove the P.E. seal (1) from the axle it can be removed by gently heating it with a cutting torch and prying it off its axle seat. For assembly rebuilding where the gear is left in place the P.E. seal need not be removed.



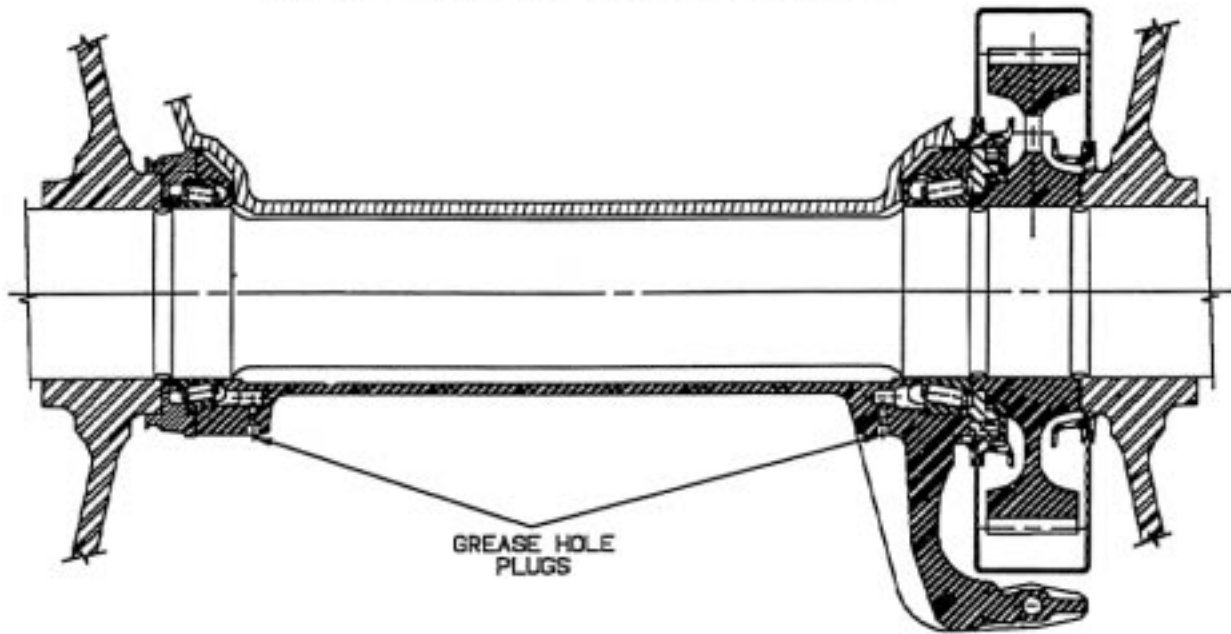
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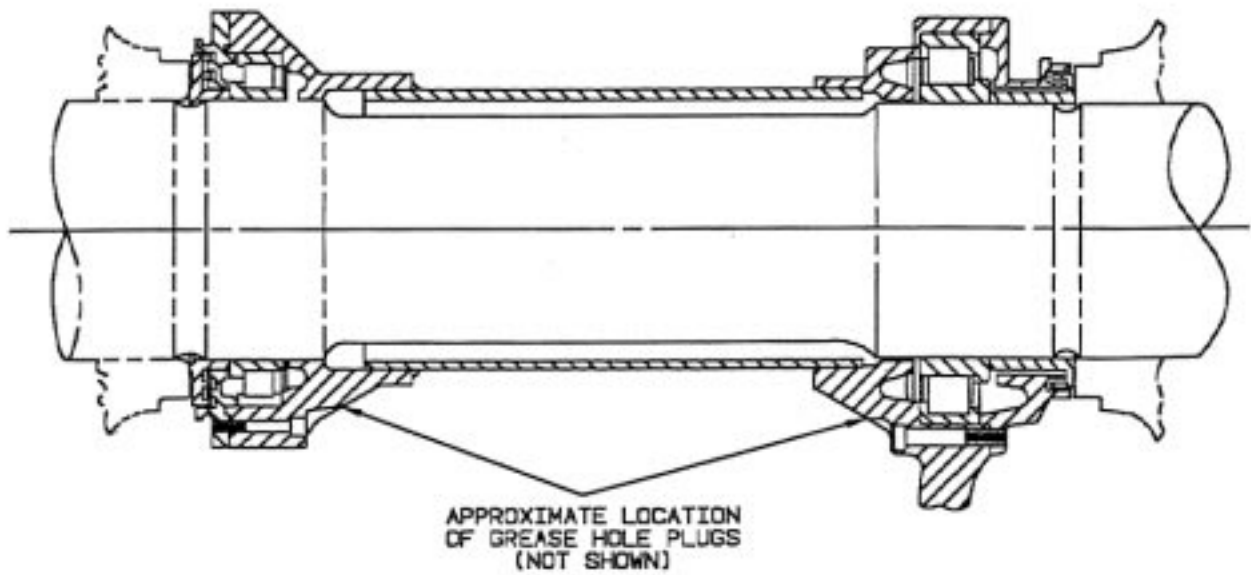
MAX LIFT 680 LBS.

Figure 12. Housing Lifting Fixture (Two Required)

TAPERED ROLLER SUPPORT BEARING



CYLINDRICAL ROLLER SUPPORT BEARING



TR32506

Figure 13. Tapered And Cylindrical Cross Section