M.I. 1252 *REV. A

Maintenance Instruction

Service Department

ELECTRO-MOTIVE

HEAD END POWER GEAR BOXES 9096722 AND 9333500

DESCRIPTION

The Head End Power (HEP) System on F40PH and F40PH-2 Locomotives generates AC power for passenger car heating, lighting, air conditioning, etc. The system is directly driven by the accessory end of the engine and incorporates a HEP gear box, Fig. 1, to split engine output between the air compressor and the HEP alternator. The gear box allows the air compressor to turn at normal engine speed, while the alternator rotates at twice engine speed.

The gears are mounted on fixed centers provided by ball and roller bearing assemblies in the gear case, as illustrated in the gear box cutaway drawing, Fig. 2. Lubrication to the gears and bearings is provided by splash oil from an oil pan trough that surrounds the bottom of the input gear. To maintain the gear box lubricating oil at a uniform operating temperature, the oil is circulated by an electric pump to a cooler mounted on the accessory rack.

The 9096722 gear box is used with a 500 kW generator and the 9333500 gear box is used with an 800 kW generator. The only difference between the two drive systems is that the 9333500 gear box has a dowel and dowel hole at the input stubshaft to accept a different length engine-to-gear-box drive shaft, which also has a dowel and dowel hole at each end.

MAINTENANCE

The HEP gear box requires little scheduled maintenance. Due to the nature of the design, maintenance is limited to periodic oil level inspections and oil changes. Gear box oil level should be checked during normal servicing. With the locomotive shut down, oil level should be maintained to the center of the minimum and maximum markings on the sight glass.

OIL CHANGE PROCEDURE

1. Open drain valve (under gear box input drive shaft), and allow oil to completely drain from the gear box.

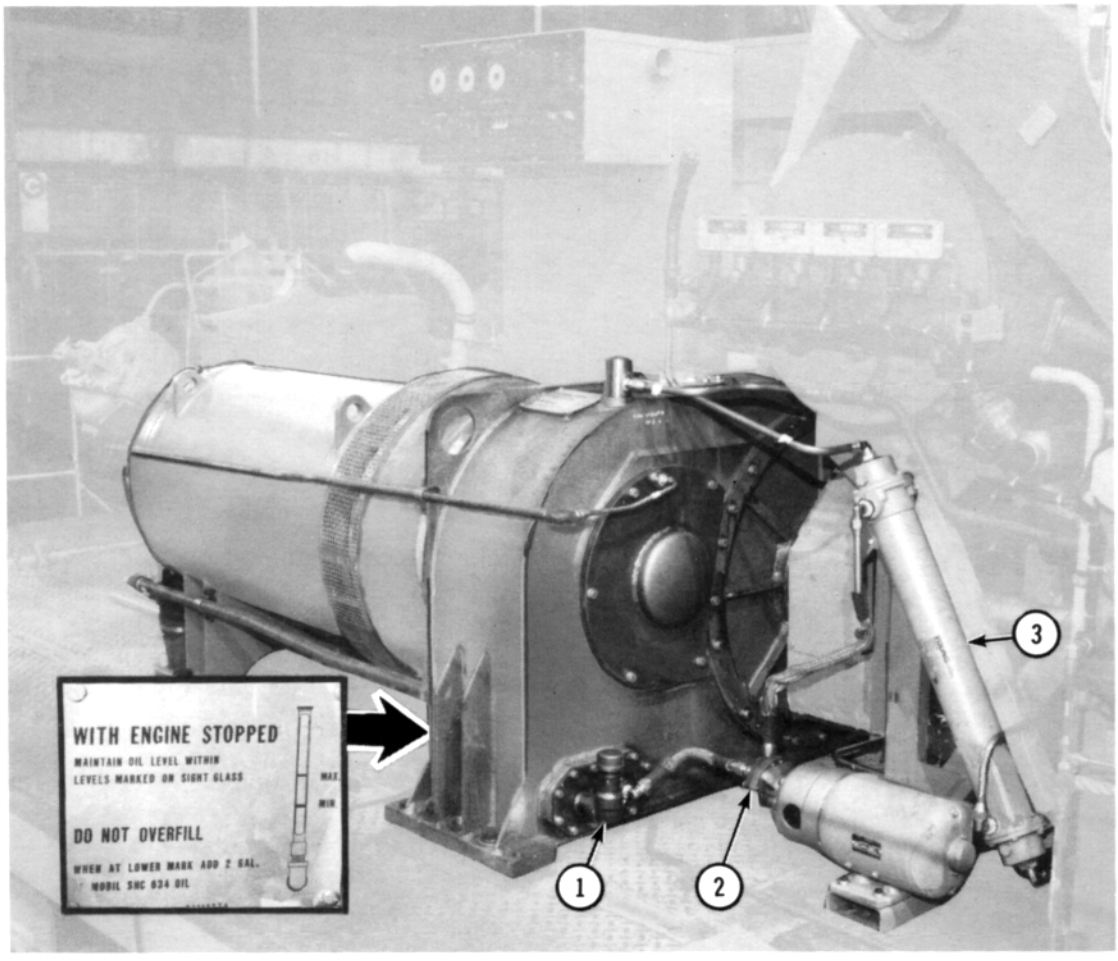
2. Remove cover assembly 9338721 from top of the gear box. Be sure not to damage gasket 8346289.

3. Check visible mating surfaces of gears for burrs, nicks or other imperfections. Inspect gear teeth for chips or fretting by barring over the engine. Abnormal or excessive gear wear may necessitate gear box replacement.

4. Install cover assembly and gasket with the original 3/8"-16 by 1" bolts and 3/8" spring lockwashers, making sure that the cover is oriented properly as indicated by the instruction plate on the cover. The oil feed pipe should be directed towards the ball bearing.

5. Fill the gear box through the bottom filler pipe with Mobil SHC 634 oil (nominally 18 gallons [68 litres]) until the oil level reaches the center of the minimum and maximum markings on the sight glass. Using the bottom filler pipe assures a uniform oil level and minimizes the possibility of overfilling.

*This bulletin is revised and supersedes previous issues of this number. Areas of change are indicated by vertical bars.



1. Bottom Filler Pipe
2. Oil Circulating Pump
3. Oil Cooler

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Fig.1 – Head End Power Overall Layout

6. Maintain the oil level in the gear box at the center between the minimum and maximum markings on the sight glass (when engine is not running).

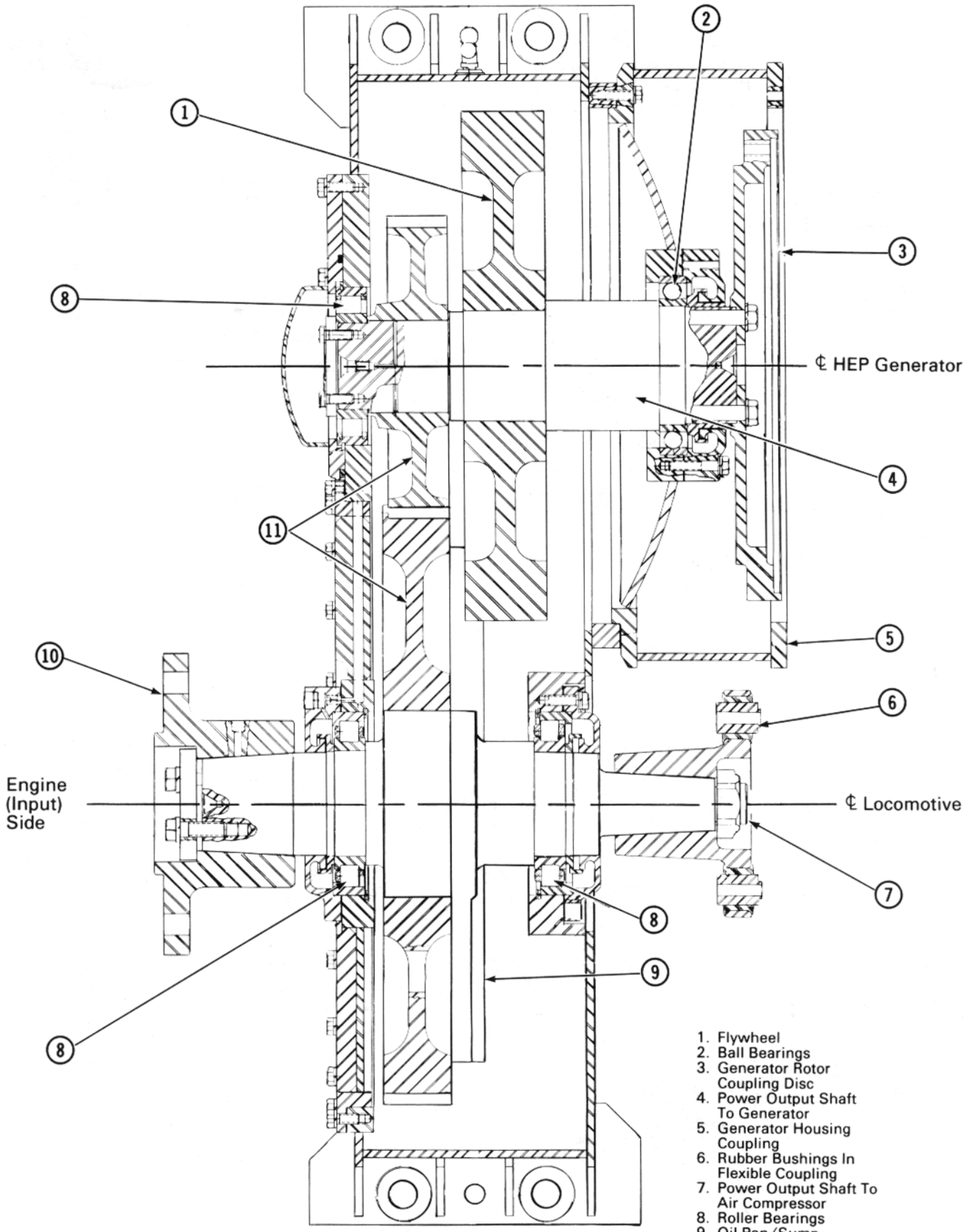
HEAD END POWER DRIVE ALIGNMENT

This section details the steps necessary to align the entire head end power gear box drive system. Basic alignment information and measurement techniques are discussed in M.I. 1753, "Alignment Of Locomotive Rotating Equipment."

Two adjustments are required to ensure proper alignment of the flexible couplings between the engine, gear box/alternator and air compressor. One adjustment limits the angular misalignment between the flexible coupling flanges for the purpose of limiting the axial displacement of the coupling rubber bushings per revolution. The other adjustment sets the axial spacing between the flanges of the flexible couplings in the air compressor drive and also the axial position of the gear box housing for the purpose of accommodating thermal growth.

Angular alignment can be determined by either of the following methods:

1. By attaching the base of a dial indicator to one coupling flange and indicating against the face of the mating coupling flange. The location of



1. Flywheel
2. Ball Bearings
3. Generator Rotor Coupling Disc
4. Power Output Shaft To Generator
5. Generator Housing Coupling
6. Rubber Bushings In Flexible Coupling
7. Power Output Shaft To Air Compressor
8. Roller Bearings
9. Oil Pan/Sump
10. Power Input Shaft
11. Speed Increasing Gears

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Fig.2 – Head End Power Gearbox Cross-Section

the indicating point on the face of the mating flange must be at a diameter not less than 508 mm (20″) for couplings on the engine to gear box drive shaft, and 215.9 mm (8.5″) for couplings on the gear box to air compressor drive shaft. The shafts are rotated to give dial readings.

2. By measuring the "gap" distance between adjacent coupling flanges at 90° intervals. Two sets of measurements are required. After measuring the first set, rotate the couplings 180° and measure the second set. The measurements (8 at each coupling) must not differ by more than 0.51 mm (.020″) to be equivalent to 0.51 mm (.020″) maximum indicator movement.

The gear box housing must be located in a position such that the input shaft roller bearings will be under no thrust load during normal operation. The position of the input shaft relative to the gear box housing is determined by measuring the distance between surfaces X-X and Y-Y at the air compressor side of the input shaft. Refer to Fig. 3.

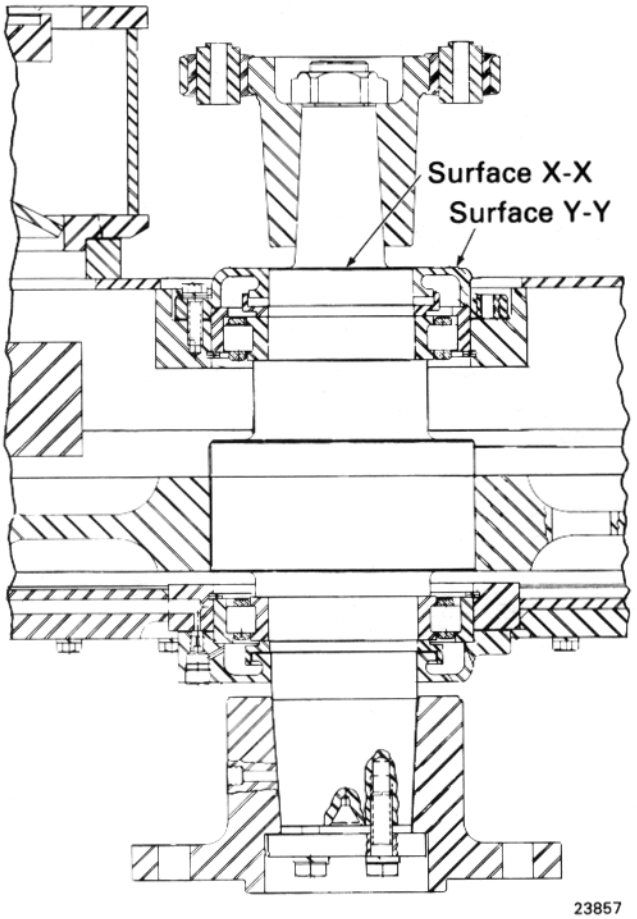

Fig.3 – Gearbox End Thrust Measurement X-X, Y-Y

The total range of output shaft end play (the distances between surfaces X-X and Y-Y) must be determined before the gear box input shaft is connected to either the engine or air compressor shafts. If the range of end play has been previously stamped on the side of the housing, this step is not required. With the input shaft pulled by hand as far as possible out of the air compressor side of the gear box, measure and record as "B" the distance between surfaces X-X and Y-Y. With the input shaft pushed by hand as far as possible into the air compressor side of the gear box, measure and record as "A" the distance between surfaces X-X and Y-Y. The measurement should be considered positive if surface X-X protrudes out of surface Y-Y, and negative if surface X-X is recessed into surface Y-Y.

The gear box must be positioned axially so the distance between surfaces X-X and Y-Y, with the engine cold, is in the following range.

(A +0.64 mm [.025″]) to (B –5.33 mm [.210″])

The following are the steps required to install and align the head end power system:

1. Install gear box assembly 9096722 or 9333500. Use original mounting shims 9313110, 9313111, 9313112 and pads 9313109. Apply the four 1″-8 mounting bolts 271703 and lockwashers 8137697, and align gear box to original dowel holes. Do not install the dowels or torque the bolts.

2. Install engine to gear box drive shaft assembly 9098374. Secure the drive shaft by applying the 1″-8 hex coupling bolts 223486 and washers 8492772 to the accessory end engine crankshaft coupling and the gear box input coupling. Bolts should be torqued to 942 N·m (695 ft-lbs). Next torque the gear box mounting bolts to 617 N·m (455 ft-lbs). Finally tighten the 9/16″-18 hex head "donut" bolts, which extend through the rubber bushings in the drive shaft, to 136 N·m (100 ft-lbs).

3. Check the angular alignment of the couplings. Refer to Fig. 4. The angular misalignment between the two flanges of each of the two flexible couplings must not exceed 0.51 mm (.020″) maximum indicator movement. Shim or reposition gear box to eliminate misalignment.

4. Install air compressor. Use original mounting shims 8156920, 8156921, 8156922. Apply the four 3/4″-10 mounting bolts 271613 and washers 8293623, and align air compressor to

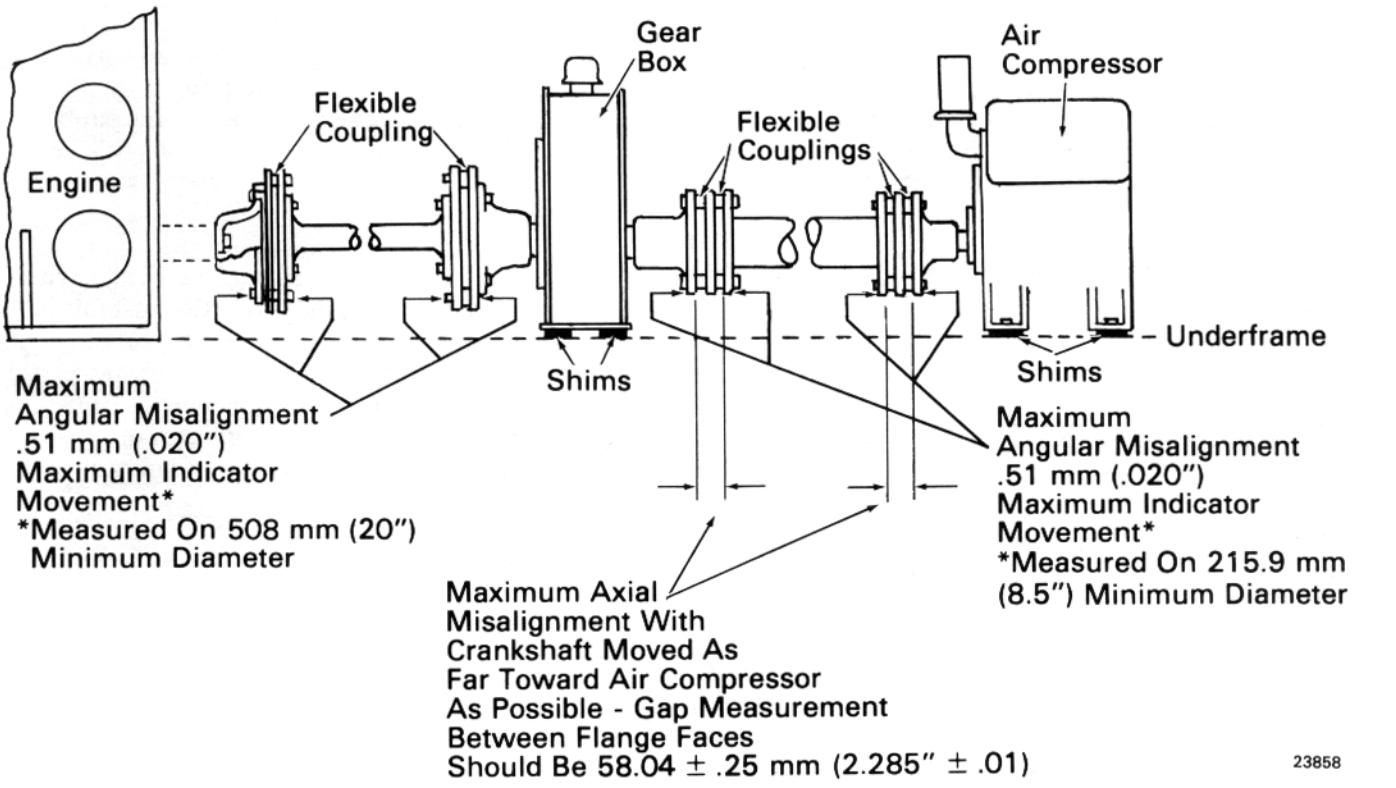

Fig.4 – Basic Flexible Coupling Alignment Diagram

original dowel holes. Do not install the dowels or torque the mounting bolts at this time.

5. Install the gear box to air compressor drive shaft assembly 9098550 using 9/16"-18 hex head "donut" bolts. Next torque the air compressor mounting bolts to 278 N·m (205 ft-lbs). Finally torque the "donut" bolts to 136 N·m (100 ft-lbs).

6. Check the axial alignment of the gear box to air compressor couplings. Refer to Fig. 4. The engine crankshaft should be moved as far as possible towards the air compressor. The average axial spacing between facing flange surfaces of the flexible couplings must be 58.04 ± 0.25 mm (2.285" ± .010"). Reposition the air compressor to eliminate misalignment.

NOTE

If the engine has been running and is hotter than engineroom temperature, the distance between facing flange surfaces may be found as low as 55 mm (2.165").

7. Check the angular alignment of the gear box to air compressor drive shaft couplings. The angular misalignment between the two flanges of each of the two flexible couplings must not exceed 0.51 mm (.020") maximum indicator movement. Shim or reposition air compressor to eliminate misalignment.

8. Check the position of the gear box input shaft relative to the gear box housing at the air compressor side of the input shaft. The gear box must be positioned axially so the distance between the input shaft and the gear box housing falls within the (A +0.64 mm [.025"]) to (B –5.33 mm [.210"]) range. Reposition gear box if necessary.

9. Move the generator into position, and attach the rotor to the gear box generator drive coupling using 5/8"-11 bolts and 5/8" washers. Torque these bolts to 224 N·m (165 f-lbs).

10. Engage pilot on generator frame with counter bore in gear box housing, using 1/2"-13 bolts and lockwashers. Leave sufficient space between generator and gear box flange to make gap readings at 12, 3, 6 and 9 o'clock positions. Install 1"-8 bolts 271703 and lockwashers 8137697 in the generator mounting feet holes, using existing shims. Torque these bolts to 617 N·m (455 ft-lbs). Take gap readings between generator and gear box flange. Gap readings must not vary more than 0.13 mm (.005"). Gap corrections are made by changing shim combinations. After determining correct shim thickness, loosen generator mounting feet bolts and torque the 1/2"-13 generator-to-gear-box housing bolts to 81 N·m (60 ft-lbs). Retorque the generator feet mounting bolts to 617 N·m (455 ft-lbs).

11. If the air compressor and gear box dowel holes line up exactly with the underframe holes, reinstall the dowels. If not, the holes will have to be reamed oversize so that the component and underframe holes are concentric. Oversize dowels and nuts should then be applied.

NOTE

All new gear box assemblies have dowel holes which have a 5/16″ nominal diameter. Thus, the dowel hole must be reamed to facilitate dowel installation.

RUBBER BUSHING REPLACEMENT

The flexible drive couplings do not require any routine maintenance or lubrication. However, it may be necessary or desirable to replace the bonded rubber bushings 8234958. The need for replacement is evidenced by accumulations of small rubber particles directly under the coupling. If the bushings have torn flanges, excessive stiffness, or cracks, they should be replaced. It is recommended that the gear box and drive shaft assemblies be inspected to insure that another, more serious problem is not causing bushing failures.

To facilitate the removal and installation of the rubber bushings, a puller tool may be used. As shown in Fig. 5, the tool parts are used on opposite sides of the coupling for removal and installation of the bushings.

When installing the rubber bushings, a small amount of rubber lubricant 8258834 should be applied on the leading pressed rubber edge of the bushing. This lubricant is mixed with three to five parts of water before use, and stirred occasionally while in use. Other lubricants, which are not detrimental to the rubber bushing may be used.

CAUTION

After bushing installation, allow at least 24 hours before attaching the coupling. This waiting period is required to allow the rubber lubricant to dry. When the lubricant is still wet, the bushing can easily move from its proper location.

The bushing must be installed past its normal location to properly seat the lips of the bushing. The bushing puller tool must be reversed and the bushing moved until the 11.94 mm ± .25 (.470″ ± .010″) dimension shown in Fig. 6 is obtained, to maintain the bushing faces in the same plane. If a tool is not available, a press may be used.

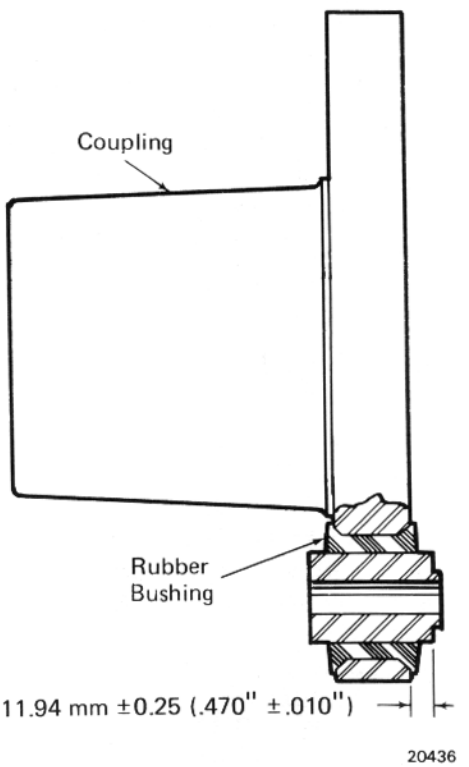

Fig.6 – Bushing To Coupling Application

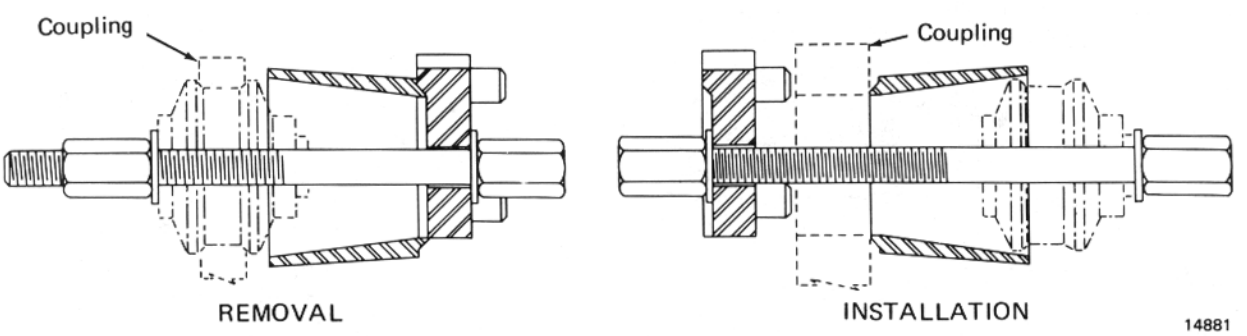

Fig.5 – Rubber Bushing Puller Tool Application

A bushing application gage, Fig. 7, is available to measure the 11.94 mm ± .25 (.470″ ± .010″) dimension. This gage consists of a tripod-legged base supporting a lever indicating arrangement at its center. To measure the 11.94 mm ± .025 (.470″ ± .010″) dimension, the gage is positioned so its large tripod legs rest on the flange of the coupling and its center actuating disc contacts the metal sleeve of the bushing, inside the locating prongs. If the bushing is properly located, the pointer of the gage will be within the limiting scribe marks on the gage scale.

A calibration fixture having three calibrating discs 11.68 mm (.460″) 11.94 mm (.470″), and 12.19 mm (.480″) is part of this gage to provide a check on the pointer accuracy. A large disc simulates the coupling and the smaller discs are placed on the large disc. The gage is placed on this assembly to check the pointer positioning.

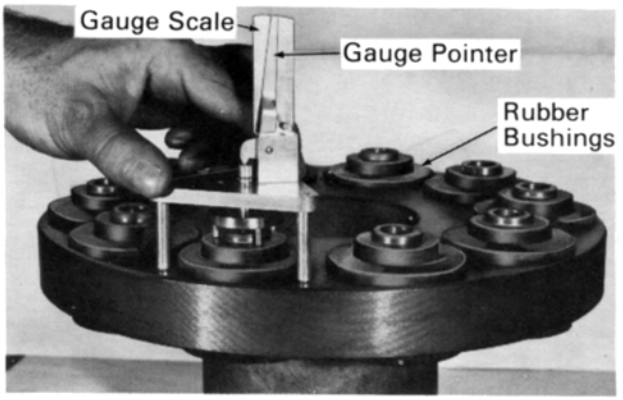

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Fig.7 – Bonded Joint Bushing Application Gage

SERVICE DATA

TORQUE AND BOLT INFORMATION

Description	Bolt Size	*Torque (N·m)	*Torque (ft-lbs)
Generator Mounting Bolts	280-M 1″-8	617	455
Gear Box Mounting Bolts	280-M 1″-8	617	455
Coupling "Donut" Bolts	280-M 9/16″-18	136	100
Input Coupling Bolts	300-M 1″-8	942	695
Air Compressor Mounting Bolts	280-M 3/4″-10	278	205
Generator Coupling Bolts	300-M 5/8″-11	224	165
Generator Gear Box Hsng. Bolts	280-M 1/2″-13	81	60

*Bolt threads and washers to be lubricated with Texaco Threadtex 8307731.

EQUIPMENT LIST

	Part No.
Bushing Puller	8239562
Rubber Lubricant – 1 Pint	8258834
Bushing Application Gage	8254465
Gauge Set, Master (Base Plate And .460″, .470″ And .480″ Calibration Discs)	8254466
Dial Indicator	8255423
Dial Indicator (Low Profile)	8460472

REFERENCES

Lubricant Specifications	M.I. 1756
Scheduled Maintenance Program	M.I. 1740
Alignment Of Locomotive Rotating Equipment	M.I. 1753

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