

This manual provides detailed instructions on disassembly, parts replacement and reassembly of Type AB right angle and Type A parallel shaft enclosed gear drives.

Table of Contents

Introduction	Page 1
Recommendations	Page 1
Lifting Instructions	Page 1
Required Equipment	Page 1
General Instructions	Page 1
Drive Disassembly	Page 3
Cleaning, Inspection, & Parts Replacement	Pages 4-6
Drive Assembly	Pages 6-9
Installation	Page 10
Oil Pan & Oil Catcher Relocation or Addition	Page 11
General Tightening & Loosening Procedures	Page 12

Introduction

The following instructions apply to standard Type AB horizontal-right angle and Type A horizontal-parallel shaft enclosed gear drives.

Drawings are representative of this series of enclosed gear drives and may not agree in exact detail with all drive sizes. When ordering parts or requesting information, specify M.O. number, drive size, model number, rpm, ratio and date stamped on the drive nameplate.

**CONSULT FACTORY BEFORE CHANGING SPEED.
OPERATE ONLY AT SPEED SHOWN ON NAMEPLATE.**

WARNING: Consult applicable local and national safety codes for proper guarding of rotating members. Lock out power source and remove external loads from drive before servicing drive or accessories.

Recommendations

INPUT SPEED, RATIO, AND GEARING

ASSEMBLY CHANGES — When either the input speed or ratio is changed, contact Factory to determine whether an oil pan or oil catchers must be relocated or added. When turning shafts end for end on drives with offset gearing, the oil catchers and oil pans must be relocated. Shaft assemblies can not be turned end for end on drives with both cooling tubes and offset gears.

REPLACEMENT GEARING — Bevel gearing is manufactured in matched sets and must be replaced as sets. Replacement of both helical pinions and gears is recommended although they may not be manufactured as matched sets. Depending on the cause of replacement, failure or damage to one element of a gearset may have caused inconspicuous damage to the mating element. When replacing gearing, it is recommended that the bearings, seals, and shim-gaskets on both shafts be replaced.

SERVICE — It is recommended that the drive be removed from its operating area for service. Service can be performed in the drive's operating area provided the shaft connections can be removed from the shaft extensions.

Lifting Instructions

Disconnect all attached equipment and drain oil. Lift drive from its foundation by slinging from the four lifting holes in the housing cover.

Required Equipment

In addition to standard mechanics tools, the following equipment is required: hoist, sling, eyebolts, arbor press, wheel puller, feeler gauges, dial indicator with stand, inside and outside micrometers, heavy duty "C" clamp, and heating oven.

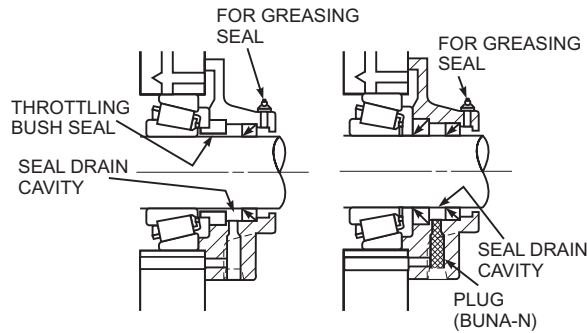
General Instructions

1. **PRE-DISASSEMBLY** — To prevent dirt from falling into the drive, clean all external surfaces before disassembling. Record mounting dimensions of couplings and accessories for reference when reassembling. Record direction of backstop rotation, if so equipped, before removing.
2. **SHIM-GASKETS** — During disassembly, wire tie all shim-gaskets to their respective seal cages or end covers for reference when reassembling.
For complete drive disassembly, start with Step 4.
3. **SEAL REPLACEMENT ONLY** — Seal replacement requires that seal cages be removed from the drive and the shim-gaskets replaced. Bearing adjustment is required when replacing all helical high speed shaft oil seals and all low speed shaft oil seals. Type AB high speed shaft bearing settings are not affected by high seal cage removal and replacement and adjustments are not required when just replacing seals. It is recommended that new oil seals are installed in the seal cages after bearing settings (when required) have been determined, during final assembly of the seal cages.
 - A. Clean the shaft extensions and remove all sharp edges. DO NOT allow abrasive cleaning material on the rubbing surface polished by the seal. New seals will leak if the seal rubbing surface on the shaft is damaged.
 - B. **SHAFT FAN COOLED DRIVES** — Note orientation of fan guard components and fan axial location for reference when reassembling.
 1. Remove fan guard mounting locknuts and remove fan guard.
 2. Record fan mounting dimensions (back of fan blade to fan guard backplate clearance) for reference when reassembling.
 3. Loosen fan hub setscrew over key and loosen fan hub clamping fasteners. Remove fan.
 4. For Type AB, remove the housing shroud fasteners and remove the housing shroud. The housing shroud is partially supported by the fan guard mounting fasteners in the fan guard backplate.
 5. Remove fan guard backplate. NOTE: Fan guard backplate on Type AB and double and triple reduction Type A drives is mounted using four longer seal cage fasteners with spacers

between the seal cage and backplate.

- C. Remove the seal cages when required and save the shim-gaskets for reference when reassembling. Note the type of inner seal (throttling bush or lip) in the seal cage, Figure 1. All lip type seals are installed with the lips facing inward.

Figure 1



- D. Drive inner and outer seals out of seal cage. Do not damage the throttling bush seal (when used) as it will be reused.
- E. Remove old sealing compound, grease, and shim-gasket material from seal cage and housing seal cage face. Do not install new seals at this time. For right angle drive high speed seal cages, proceed to Step 3K.
- F. **BEARING ADJUSTMENT** — All shafts have tapered roller or spherical roller bearings that require axial float or settings as indicated in Tables 1 and 2, pages 13 & 14.

Exception: Sizes 545-585 Types A and AB drive low speed pinion shafts. Place only a .015" (0,38 mm) shim gasket between the housing and end cover on each side. Shaft float need not be checked. Type AB high speed shaft floats do not need to be adjusted when seals are replaced.

Replace shim-gaskets with new ones of the same total thickness and add a .007" (0,18 mm) and .009" (0,23 mm) shim to insure shaft axial float on initial check. Use only one .015" (0,38 mm) shim-gasket per shim pack.

Table 3, page 14, lists shim-gaskets available from Rexnord. Always place the .015" (0,38 mm) thick shim-gasket next to the housing for positive sealing.

CAUTION: During assembly, position seal cages with the word "TOP" in the upright position (except Type A quadruple reduction high speed seal cages and quadruple reduction Type AB Sizes 385AB4 and 405AB4) to permit oil flow to the bearings.

For quadruple reduction Type A high speed shaft seal cages, position seal grease purge fitting towards the high speed end. Sizes 385 and 405A4 will only fit one way.

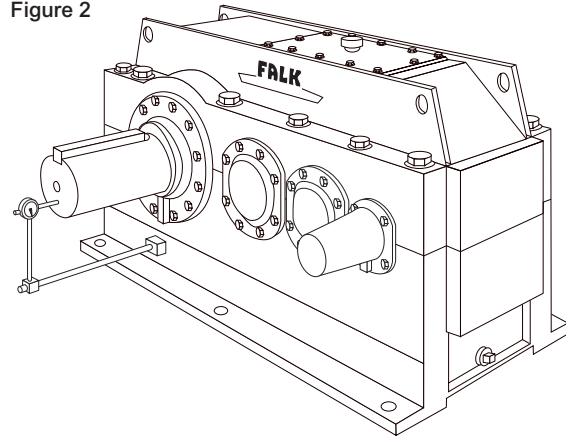
Type AB Sizes 385 and 405AB4, position flat up.

- G. Install seal cages (without seals) with new shim-gaskets. Install fasteners with lock washers and tighten to torque specified in Table 6, page 15.

Type A high speed shaft seal cages of double and triple reduction drives with fans utilize the fan guard backplate spacers and .25" (6,4 mm) of extra washers on the longer fasteners for proper thread engagement.

- H. Check shaft axial float with a dial indicator, Figure 2, and adjust to limits specified in Tables 1 or 2, pages 13 & 14. Rock the shaft back and forth with thrust applied to obtain an accurate float check. Pry the low speed or intermediate gear back and forth through the inspection cover to apply thrust. Do not pry on oil troughs. For Type A high speed shafts, attach a "C" clamp to the extension to apply axial force, if required. Refer to Step 19 for bearing setting examples.

Figure 2



- J. Remove seal cages from drive. DO NOT interchange shim-gaskets after bearing adjustment has been completed.
- K. **LIP TYPE SEALS** — Coat seal seat area of seal cage with Permatex #3 or equivalent sealant and drive seals (with lips facing toward bearing) into seal cage with a square faced cylindrical tool. Install outer seal first.
- L. **THROTTLING BUSH SEAL (when used)** — Clean throttling bush seal element and coat "O" ring and groove with a #2 bearing grease and install in cage. Seal cage bore must be clean, no sealant is used.
- M. **SHAFTS WITH FANS** — If desired, fill outer cavity in seal cage with a #2 bearing grease before installing seal cage.

CAUTION: Protect seal lips from the sharp edges of the shaft keyway and stepped diameters by wrapping thin strong paper (.003" (0,08 mm) thick mylar film is recommended) around the shaft and coating with grease before sliding the seal on or off the shaft.

- N. Grease seal lips and install seal cages. Install seal cage fasteners and tighten to torque specified in Table 6, page 15. Recheck shaft axial floats.
- O. **SHAFT FAN COOLED DRIVES** —

Type AB — Assemble fan guard backplate to drive with one pair of fan guard mounting fasteners in the vertical plane. Install backplate with the long seal cage fasteners with spacers between the backplate and seal cage and tighten

to torque specified in Table 6, page 15. Install housing shroud and tighten fasteners to torque specified in Table 5, Page 15. Install fan in same axial position, Step 3B, as removed and tighten fan hub clamping fasteners and setscrew. Do not over tighten or fan hub will distort. Assemble fan guard onto backplate and install fan guard mounting locknuts, tighten to torque specified in Table 5, page 15.

Type A — Assemble fan guard backplate to drive with one pair of fan guard mounting fasteners in the vertical plane. Install backplate mounting fasteners with spacers between backplate and drive. On double and triple reduction drives, remove the .25" (6,4 mm) of extra washers added in Step 3G and install backplates with the long seal cage fasteners and spacers. Tighten fasteners to torque specified in Table 6, page 15. Recheck shaft axial float. Install fan in same axial position, Step 3B, as removed and tighten fan hub clamping fasteners and setscrew. Do not over tighten or fan hub will distort. Assemble fan guard onto backplate and install fan guard mounting locknuts, tighten to torque specified in Table 5, page 15.

- P. Hand pump grease (user option) into seal cage grease purge cavity (except shaft extensions with fans) until grease appears at the shaft adjacent to the grease fitting. Do not over grease.

Drive Disassembly

4. PRELIMINARY

- A. Drain oil from drive and remove dipstick.
- B. Shaft fan assemblies — Refer to Step 3B and remove.
- C. Remove housing cover fasteners. Some later models of Size 585 drives, may use multi-jackbolt tensioners. See page 12 for loosening procedure.

NOTE: Certain accessories including backstops and top mounted motors may use longer sidebar fasteners. Upon removal, note their position and reinstall in the same position during assembly.

- D. Remove all fasteners above the housing split that hold seal cages, end covers, shaft guards and high speed heads to the housing cover. Loosen fasteners below housing split three or four turns. Do not remove, they hold the bearing outer races in position.
- E. Sizes 485 through 585, tighten nut on taper dowel and remove. Refer to Figure 3. Type A drives have a taper dowel at each end of the housing.
- F. Hitch drive cover to a hoist and lift it STRAIGHT UP. DO NOT DAMAGE GEAR TEETH.
- 5. REMOVAL OF SHAFT ASSEMBLIES — Complete the following procedures for each shaft assembly. Start with the high speed head or shaft (except on quadruple reduction Type A gear drives where the high speed shaft is removed last) and work through to the low speed shaft. Intermediate shafts typically have spacers between the bearing

outer race and the end cover. Note spacer locations for reference when reassembling.

- A. HIGH SPEED HEAD — Place a sling around the high speed head as shown in Figure 4 and take up slack. Remove the remaining high speed head mounting fasteners and lift the shaft assembly out. Do not damage gear teeth.

Figure 3

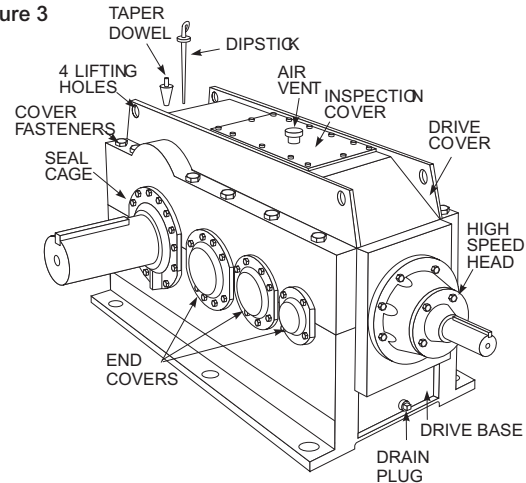


Figure 3

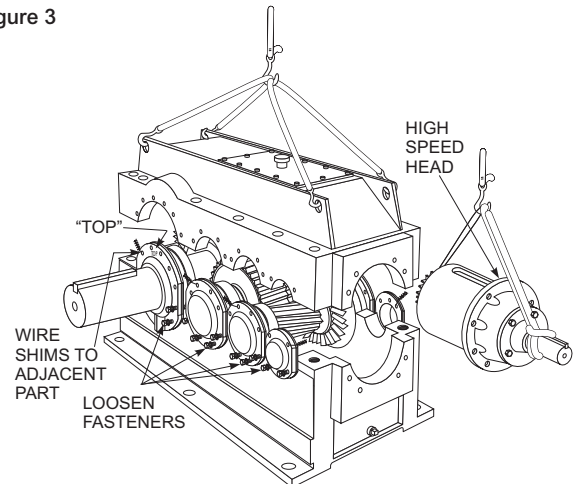
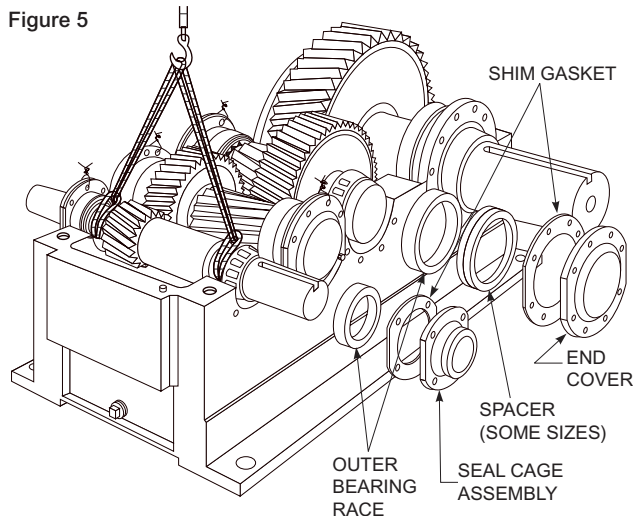


Figure 5



- B. **HELICAL HIGH SPEED, INTERMEDIATE, AND LOW SPEED SHAFT ASSEMBLIES** — Place a sling around the first shaft assembly to be removed, as shown in Figure 5, and take up enough slack to take weight off of the bearings. Do not lift shaft assemblies out of housing at this time. The low speed pinion shaft may be lifted by slinging from a heavy duty “C” clamp attached to the recessed gear face when necessary. Remove the seal cage, end cover or shaft guard, outer bearing races, and shaft spacers. Lift shaft assembly out of base. **CAUTION: DO NOT DAMAGE GEAR TEETH.**
- C. **QUADRUPLE REDUCTION HIGH SPEED SHAFT** — Sling shaft at center, remove seal cages, bearing outer races and feed shaft out of housing through either bearing bore. Sling will require repositioning to outside of housing when shaft is half way out of housing.

Cleaning, Inspection, and Parts Replacement

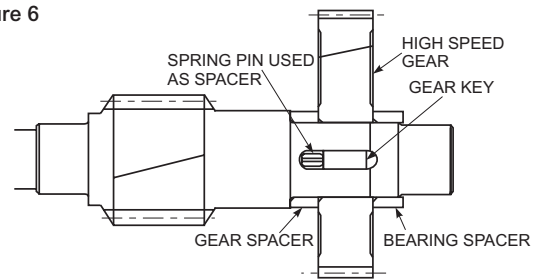
6. **HOUSING BASE AND COVER** — Remove old sealing compound from housing base/cover joint and old shim-gasket material from sealing faces. Clean oil troughs, oil passages, seal drain passages, cooling tube fins (if so equipped), and oil sump with kerosene or solvent and then dry.
7. **AIR VENT** — Wash in kerosene or solvent and squeeze filter element dry. Replace filter if necessary.
8. **OIL SEALS** — Remove throttling bush seal element (when used) and old seals from seal cage. Remove sealing compound from seal cages. **DO NOT** install new seals at this time.
9. **BEARINGS**
- Wash all bearings in clean kerosene or solvent and then dry. Do not spin bearings to dry as they may score due to lack of lubricant.
 - Inspect bearings carefully and replace those that are worn or questionable. Replacement tapered roller bearings must be identical to the original equipment.
 - If bearings need replacement, use a wheel puller or press to remove them. Apply force to the inner race only.
 - To mount new bearings, heat in an oil bath or an oven to a maximum of 275°F (135°C). Slide or press bearing onto shaft tight against shaft shoulder or spacer.
- CAUTION: DO NOT APPLY FLAME DIRECTLY TO BEARINGS OR REST THEM ON THE BOTTOM OF THE HEATED CONTAINER.**
- E. Thoroughly coat all bearings with lubricating oil.
10. **HELICAL PINIONS, GEARS, AND SHAFTS** — All helical pinions are solid on shaft. Note number and location of shaft spacers before disassembly for reference when reassembling. Pinions and gears which are discolored have been softened from excessive heat and must be replaced.
- Wash the pinions and gears in clean kerosene or solvent and inspect for damaged or worn teeth.

- Remove gear from shaft with a press if required.
- Assemble replacement gear to shaft with large chamfer toward shaft shoulder or adjacent spacer. To aid assembly, heat gear to 325°-350°F (163°-177°C) in an oil bath or oven and cool shaft to -90°F (-68°C). **DO NOT** exceed 350°F (177°C) or heat softening will occur. Use a press for final seating of gear hub against shaft shoulder or spacer.

SPECIAL INSTRUCTIONS — Model “C” or later drives only

Size 405 — The 405A3 1st intermediate, 405A4 2nd intermediate, and 405AB4 2nd intermediate pinions require a spacer in the keyway under the gear (see Figure 6). This spacer is a spring pin. Locate the spring pin at the pinion end of the keyway and place the spacer on the shaft over the spring pin. Place the key into the other end of the keyway.

Figure 6



Sizes 405 through 465A2 23:1 and 25:1 —

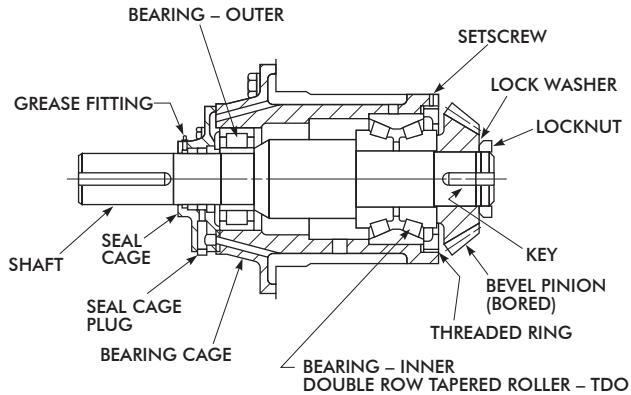
Assemble retaining ring to the high speed shaft and install spacer to the outboard end so that the large chamfer in the spacer (if any) faces away from the retaining ring.

Sizes 545 through 585 — The Size 545A & AB low speed pinion shaft requires a keeper plate on the gear end of the shaft to retain the bearing. Sizes 565 and 585A & AB have keeper plates on both sides of the low speed pinion. Wire tie the heads of the cap screws together to prevent loosening.

11. **BEVEL GEARS** — Solid hub or bolted rim type bevel gears are used depending on bevel gear size. Refer to Steps 10A thru 10C for solid hub gear cleaning, inspection and replacement. Proceed as follows for bolted rim bevel gears.
- Wash the gear in clean kerosene or solvent and inspect for damaged or worn teeth.
 - If helical pinion, shaft, or bevel gear spider are damaged, remove gear rim from spider and then remove gear spider from shaft.
 - Spider must be installed on shaft before gear rim is reinstalled. Refer to Step 10C for gear spider to shaft reassembly procedure.
 - Assemble bevel gear rim onto spider. Assembly may be aided by heating the gear rim to 150oF (66oC). Lower shaft assembly onto the bevel gear mounting flange, use guide pins or long fasteners to align fastener holes. Install fasteners (with threads coated with Loctite #262 high strength thread locking compound on gear rims with tapped holes) and tighten to torque specified in Table 7, page 16.

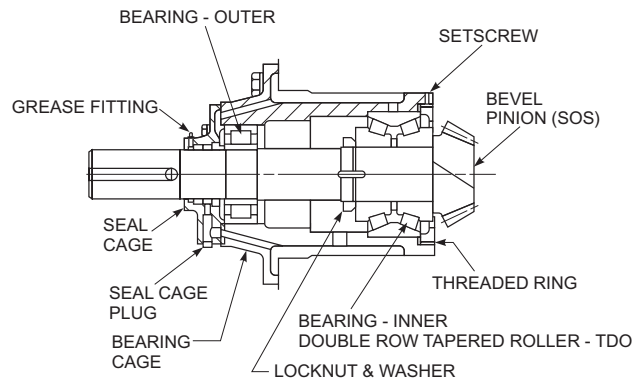
12. BEVEL PINIONS — Figures 7, 8 and 9

CAUTION: The components of the inner bearing in Figures 7 and 8 are NOT interchangeable. Each part is matched marked with a serial number and must be assembled accordingly.

Figure 7

A. BORED PINIONS — Figure 7; All sizes except 545-585AB3

1. Remove seal cage fasteners and seal cage.
2. Remove pinion locknut and lock washer.
3. Remove bevel pinion with a wheel puller (heat may be applied to pinion if pinion is not to be reused). Table 8, page 16, lists approximate removal forces to determine the correct size wheel puller.
4. Remove pinion key.
5. Remove threaded ring locking setscrew and threaded ring.
6. Slide shaft assembly out of bearing cage and remove bearings with a press or wheel puller.
7. Wash pinion in clean kerosene or solvent and inspect for damaged or worn teeth. Replace if worn or damaged.
8. Refer to Step 9 for bearing cleaning, inspection and reassembly.
9. Assemble inner bearing to shaft in the following order: one cone, cone spacer, double cup, and other cone. Seat cones against shaft shoulder.
10. Position shaft assembly vertical with pinion end down. Install outer bearing on shaft and seat against shaft shoulder.
11. Sling bearing cage from eyebolts in seal cage fastener holes and lower onto shaft. Spherical roller bearing outer rings will require guidance when assembling bearing cage onto shaft.
12. Position assembly on its side. CAUTION: Shaft assembly can slide out of pinion end of bearing cage during repositioning.
13. Install threaded ring and tighten against bearing cup. Install locking setscrew and stake.
14. Install pinion key. Heat pinion to 325°-350°F (163°-176°C) maximum and assemble to shaft. Seat with a press.

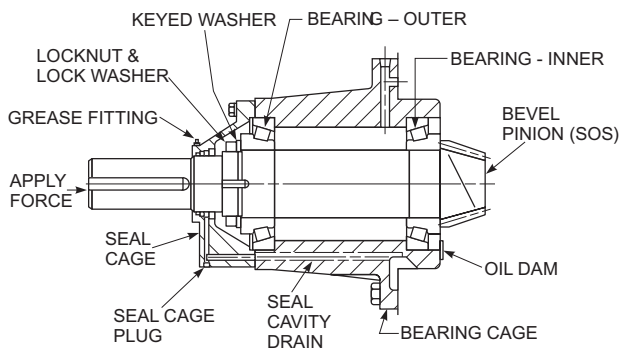
15. Install and lock washer and locknut. Tighten locknut.

Figure 8

B. SOLID ON SHAFT PINIONS — Figure 8; All sizes except 485-525AB2 and 545-585AB3

1. Remove seal cage fasteners and seal cage.
2. Remove threaded ring setscrew and threaded ring.
3. Slide bevel pinion assembly out of bearing cage from pinion end.
4. Remove outer bearing with a bearing puller, apply force to bearing inner ring only.
5. Remove inner bearing locknut and lock washer.
6. Remove inner bearing assembly with a bearing puller or press.
7. Wash the pinion in clean kerosene or solvent and inspect for worn or damaged teeth. Replace pinion or shaft if worn or damaged.
8. Refer to Step 9 for bearing cleaning, inspection, and reassembly.
9. Assemble inner bearing to shaft in the following order: one cone, cone spacer, double cup and other cone, seat cones and cone spacer against shaft shoulder.
10. Install bearing and locknut, tighten against bearing cone. Lock locknut.
11. Install outer bearing, position next to shaft shoulder.
12. Position shaft assembly vertical with pinion end down.
13. Sling bearing cage from eyebolts in seal cage fastener holes and lower onto shaft. Spherical roller bearing outer rings will require guidance when entering bearing cage outer bore.
14. Position assembly on its side. CAUTION: Bevel pinion shaft is free to slide out of bearing cage during repositioning.
15. Install and tighten threaded ring against inner bearing double cup. Install locking setscrew, tighten and stake.

C. BORED OR SOLID ON SHAFT PINIONS — Figure 9; Sizes 485-525AB2 & 545-585AB3

Figure 9



1. Remove seal cage fasteners and seal cage.
2. **BORED PINION ONLY** — Remove pinion locknut and lock washer. Remove bevel pinion with a wheel puller (heat may be applied to pinion if pinion is not to be reused) and remove pinion key. Approximate pinion removal forces are found in Table 8, page 16. Pinion may be removed from shaft after shaft assembly is removed from bearing cage.
3. Remove outer bearing locknut, lock washer and keyed washer.
4. Press shaft out of outer bearing and bearing cage after providing protection for pinion teeth and inner bearing when shaft falls free from outer bearing.
5. Remove inner bearing cone from shaft and bearing cups from bearing cage.
6. Wash pinion and shaft in clean kerosene or solvent and inspect pinion for damaged or worn teeth and shaft for damage. Replace if pinion or shaft is worn or damaged.
7. Refer to Step 9 for bearing cleaning, inspection and assembly.
8. Install bearing cups in bearing cage. Install inner bearing cup first, outer bearing cup may be used as a spacer when installing inner bearing cup.
9. **BORED PINION ONLY** — Assemble pinion key to shaft. Heat pinion to 325-350oF (163-176oC) maximum and assemble to shaft, seat with press. Install keyed lock washer and locknut and tighten against pinion, lock locknut.
10. Heat inner bearing cone as instructed in Step 9D, install on shaft and seat against shaft or pinion shoulder.
11. Position shaft assembly vertical with extension end up.
12. Sling bearing cage from eyebolts in seal cage fastener holes and lower onto bevel pinion shaft.
13. Heat outer bearing cone as instructed in Step 9D, install and allow to cool.
14. Install keyed washer, bearing lock washer and bearing locknut. Tighten locknut until $.003''$ (0,08 mm) to $.005''$ (0,13 mm) shaft axial float is obtained. Check outer bearing cone back

face runout (must be $.0015''$ (0,038 mm) or less, tap high side to adjust) and recheck axial float. Locknut may be loosened and shaft bumped to loosen overly tightened bearings. Lock locknut.

13. **FASTENERS** — All fasteners may be reused. If replacement is required, replace with identical grade, length and type. All housing sidebar fasteners are Grade 8 or ASTM A354 Grade BD.

Drive Assembly

14. **PRELIMINARY**
 - A. Check to see that all spacers and worn parts have been replaced, all shaft spacers are tight (not free to rotate) and all gears and bearings tight (less than $.0015''$ [0,038 mm] clearance) against their respective shaft shoulders.
 - B. Remove all foreign matter from housing base and cover and clean magnetic drain plug(s). Make certain all bearing cages, seal cages, end covers, shaft guards, and oil dams are clean. Housing and component surfaces in contact with Loctite thread locking compounds require degreasing before assembly for maximum effectiveness.
 - C. Replace old shim-gaskets on input side of drive (Type A) or side opposite bevel gear (Type AB) with new shim-gaskets of equal thickness. Replace old shim-gaskets on opposite side of drive with new shim-gaskets of equal thickness and add $.007''$ (0,18 mm) to $.009''$ (0,23 mm) shim to ensure shaft axial float on first float check. Use only one $.015''$ (0,38 mm) thick shim-gasket per located next to housing for positive sealing. Use a $.015''$ (0,38 mm) shim-gasket to seal end covers at unused bores. If the inspection cover has been removed, replace the gasket if it has been torn or damaged. Use only Falk shim-gaskets. Table 3, page 14, lists shim-gaskets with minimum compressibility that are available from Rexnord.

CAUTION: During assembly, position all high speed shaft and intermediate shaft bearing cages, seal cages and end covers with the word "TOP" in the upright position.

Sizes 385 & 405A4: Seal cage will only fit in one position.

Sizes 425 - 525A4: Position the high speed seal cage with the seal grease purge fitting toward the high speed end of drive.

Sizes 385 & 405AB4: Position the flat up.
 - D. Coat all pipe plugs with Permatex #3 or equivalent sealant before installing.
 - E. Refer to Tables 5 and 6, page 15, for fastener tightening torques.
15. **INSTALL SHAFT ASSEMBLIES** — Install shaft assemblies into the housing in the following order: low speed shaft, low speed pinion, intermediate pinions, and high speed head or helical high speed pinion. For quadruple reduction "A" drives, install high speed pinion first.
 - A. **TYPE "A" QUADRUPLE REDUCTION HIGH SPEED PINION** — Install high speed pinion before other assemblies are installed. Insert shaft

assembly through either high speed shaft bore. Install bearing outer races. Install seal cages with shim gaskets as instructed in Step 14C. Install seal cage fasteners with lock washers and tighten to torque specified in Table 6, page 15.

B. ALL OTHER SHAFT ASSEMBLIES

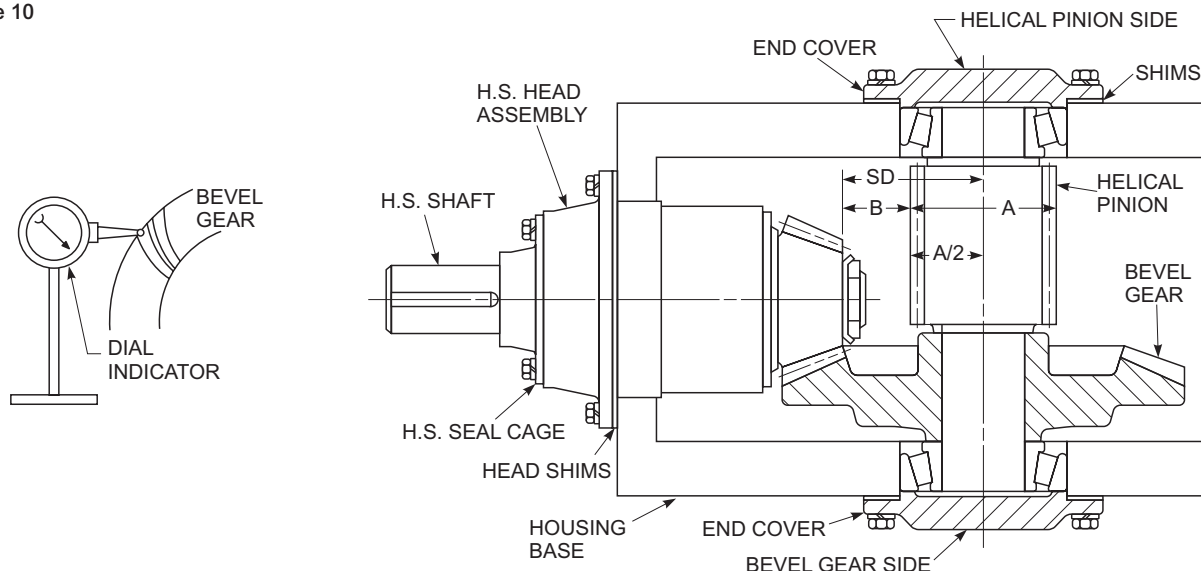
1. Sling shaft assemblies and gently lower into housing. Do not unload sling or damage housing internal accessories (oil pans, cooling tubes, etc.) or gear teeth. The low speed pinion shaft may be lifted by slinging from a heavy duty "C" clamp attached to the recessed gear faces when necessary.
2. Install bearing outer races on shaft and spacers (where used) in housing bores. Install seal cages, end covers, and shaft guards with shim gaskets as instructed in Step 14C. Loosely install cage and cover fasteners with lock washers in housing base. Wire tie the shim gaskets to the tops of cages.
3. Lower shaft assembly into housing and remove sling.
4. Repeat Steps 1 through 3 until all shaft assemblies have been installed.

16. BEVEL GEARSET ADJUSTMENT — Figure 10

- A. Tighten bevel gear shaft end cover and high speed head mounting fasteners to the torque specified in Table 6, page 15. Make certain bevel pinion teeth are free in mesh.
- B. Measure bevel gear shaft axial float with a dial indicator. Remove shims from bevel gear side end cover to obtain .001" (0,03 mm) to .004" (0,10 mm) shaft axial float. Reinstall end cover and tighten end cover fasteners to torque specified in Table 6, page 15.
- C. Obtain bevel pinion setting distance (SD) and bevel gear backlash (BL) by referring to values etched on the bevel gear. The setting distance is from the bevel pinion front face to the center line of the bevel gear shaft.

- D. With a micrometer, measure the outside diameter "A" of the helical pinion having an even number of teeth. To measure the outside diameter "A" of a helical pinion with an odd number of teeth, wrap a wire approximately .062" (1,5 mm) diameter around the periphery of the pinion teeth and at right angle to the pinion centerline. Twist the wire ends together to insure a tight fit over the pinion teeth. Measure the diameter over the wire and subtract two wire diameters from the measured diameter to obtain pinion diameter "A". Remove the wire after the measurement is taken. Subtract half the dimension "A" ($A / 2$) from the recorded setting distance (SD) to get the "Required B" dimension, Figure 10.
- E. Position the helical pinion so that one of the teeth is exactly opposite the vertical center of the bevel pinion. Measure the "Actual B" dimension with an inside micrometer. The required thickness of shims for the bevel pinion head assembly is "Required B" minus "Actual B".
- F. Remove the bevel pinion head and add or subtract head shims equal to the required thickness determined in the previous Step. Reinstall the bevel pinion head and tighten the flange fasteners to specified torque. Recheck setting distance (SD). Repeat adjustment procedure until the "Actual B" dimension is equal to the "Required B". Tolerance range for setting distance is located in Table 9, page 16.
- G. Place a dial indicator on a bevel gear tooth with tip perpendicular to the tooth surface as shown in Figure 10.
- H. Lock bevel pinion and rotate bevel gear back and forth while reading backlash on dial indicator. If pinion can not be locked, the indicator may be located on the pinion and lock the gear. The tolerance range for backlash should be determined from Table 9, page 16.
- I. To adjust backlash, transfer end cover shims from

Figure 10



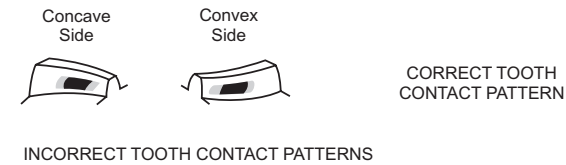
one side to the other. A .003" (0,08 mm) shimpack thickness change is approximately .002" (0,05 mm) change in backlash. Do not add shims. Increase backlash by transferring shims from the helical pinion side end cover to the bevel gear side cover. Backlash is reduced by transferring shims from the bevel gear side to the helical pinion side end cover.

17. BEVEL GEARSET TOOTH CONTACT CHECK- PRELIMINARY & FINAL — Figure 11

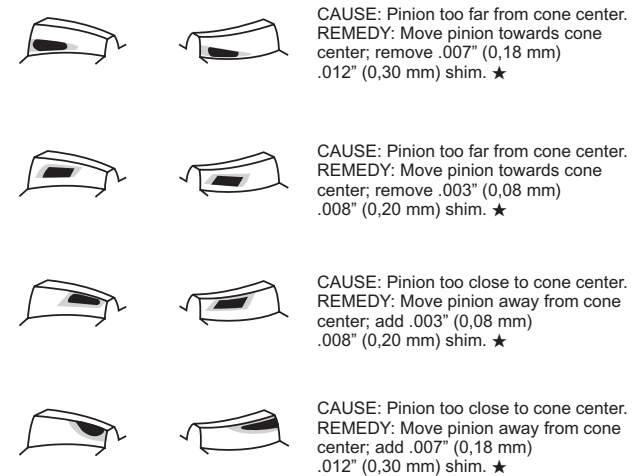
Preliminary bevel gearset contact check is performed with housing cover off, final contact check is performed through inspection opening with drive completely assembled and bearing adjustments completed.

- A. Make certain that the bevel pinion head and bevel gear shaft bearings are properly seated in the housing bores. Coat several bevel pinion teeth with bluing and rotate the coated pinion teeth back and forth through mesh several times to trace a contact pattern on the teeth of both elements.
- B. Correct (and incorrect) bevel pinion tooth contact patterns are shown in Figure 11. Cone distance adjustment is used to obtain correct tooth contact patterns, remove shims at the bevel pinion head flange to move pinion toward cone center (gear shaft) or add shims to move pinion away from cone center. If the bevel pinion head is reshimmed to obtain correct tooth contact, realign marks on bevel teeth and recheck backlash (Steps 16E - 16H).

Figure 11



INCORRECT TOOTH CONTACT PATTERNS



★ Use the smaller tolerance for gear diameters in the 6"-8" (152,4 mm) - (203,2 mm) range. Use the larger tolerances for gear diameters over 20" (508 mm). If correct tooth contact pattern cannot be achieved, consult Rexnord

18. HOUSING COVER TO BASE ASSEMBLY

- A. Loosen fasteners holding seal cages, end covers shaft guards, and high speed head to provide clearance for housing cover when it is lowered into place. Wire tie the upper portion of shims to their respective cages.
- B. Coat housing split surface of base with #3 or equivalent sealant. Keep sealing compound away from bearing bores.
- C. Sling housing cover from hoist and position over housing base. Pull back cages and slowly lower cover over gears. Do not bump gears or catch shim gaskets.
- D. For Sizes 485 - 585A, drive taper dowels in low and high speed ends. For Sizes 485 - 585AB, drive taper dowel in low speed end.
- E. Remove shim gasket wire ties. Tighten seal cage, end cover, shaft guard, and high speed bevel head fasteners in housing base to center housing cover on base. Loosely install remaining cage fasteners.
- F. Install backstop anchor bracket if required.
- G. Coat threads and heads of housing cover sidebar fasteners with 20 or heavier mineral oil and install with hardened flat washers. Pre-tighten fasteners to torque specified in Table 4, page 15. Tighten fasteners at center of housing sidebar first and work toward the end bar fasteners. See Figure 12 for split bolt tightening sequence.

Scribe a line on fastener head and housing cover (Figure 12A) to indicate additional degrees of head rotation required. Complete tightening of fasteners with an impact, slugging, or hydraulic wrench. Housing end bar fasteners are assembled and in the "shop dry" condition per Table 6, page 16.

Figure 12A

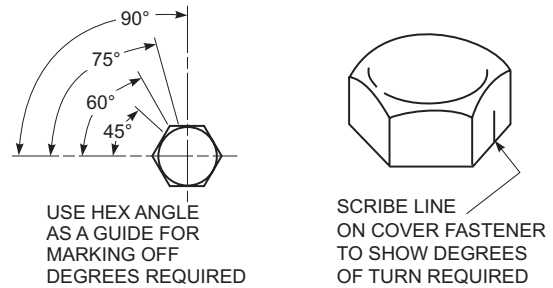
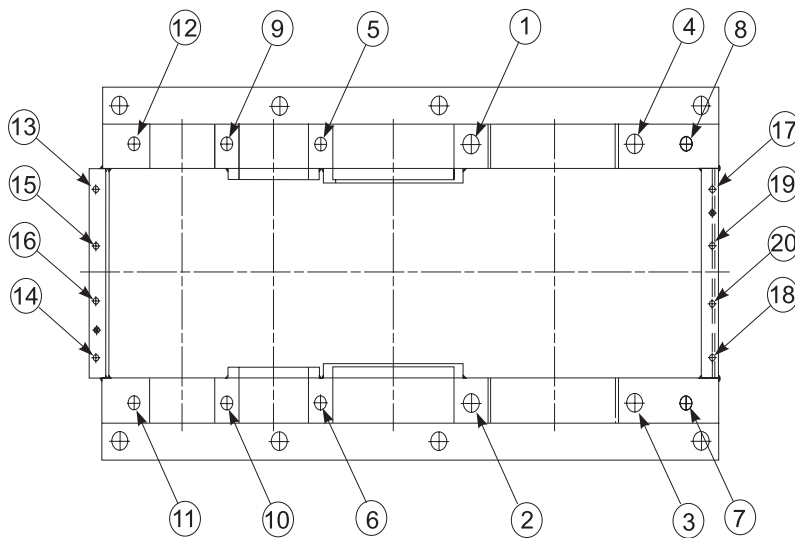


Figure 12



NOTE: On later models of Size 585, the large housing cover fasteners on either side of the low speed shaft are studs with multi-jackbolt tensioners. See page 12 for tightening procedure.

Example: Size 425A2, pre-tighten the 1.250" (31,8 mm) diameter fasteners to 196 lb-ft (266 Nm) with a torque wrench. Mark the fastener heads and housing for the additional 60° head rotation specified in Table 4 and complete tightening of fasteners.

19. **BEARING ADJUSTMENT** — All bearing settings are axial float except the low speed shafts of Sizes 385 - 445 double, triple, and quadruple reduction drives, which are preloaded. Bearing preload is shim removal from a zero float/ zero preload condition. Adjust the low speed shaft bearings first and work through to the high speed shaft on Type A or bevel gear shaft on Type AB. The high speed bearings on Type AB are non-adjustable or previously adjusted. The bevel gear shaft bearings are to be adjusted by adding shims to the bevel gear side end cover only.

EXCEPTION: Size 545 - 585 drives have spherical roller bearings on the low speed pinion shaft. Place only a .015" (0,38 mm) shim-gasket between the housing and end cover on each side.

- A. Tighten all seal cage, end cover, bevel had, and shaft guard fasteners to torque specified in Table 5, page 15. High speed shaft seal cages on double and triple Type "A" drives with fans utilize the fan guard backstop spacers and .25" (6,4 mm) of extra shim washers on the longer than standard fasteners for proper thread engagement at bearing adjustment.
- B. Position dial indicator probe on shaft end (Figure 2) and apply axial force on shaft (in both directions) to measure shaft axial float. Holes are provided in the intermediate shaft end covers for taking indicator readings. Oscillate shaft (with force applied) through gear train to obtain accurate axial float measurements. Pry shafts with gears back and forth through the inspection cover opening. Do not pry on oil troughs.
- C. To adjust bearings, remove shim-gaskets from the cages and covers where the extra shims were installed, Step 14C, so that the float or preload values will be within limits specified in Table 1 or 2, pages 13 & 14.
 1. Make all shim pack adjustments for the bevel gear shaft at the bevel gear side end cover.
 2. Tighten cage and cover fasteners to specified torque before rechecking bearing settings after shimpack adjustments.

Preload example — The measured axial float on a Size 445A3 low speed shaft is .004" (0,10 mm). The specified preload range in Table 1, page 13, is .007" to .010" (0,18 to 0,25 mm). Add the measured axial float to the specified preload range (.004"+.007" (0,10 + 0,18 mm) to .004"+.010" (0,10 + 0,25 mm) = .011" to .014" [0,28 to 0,35 mm]) to determine shim-gasket removal. Remove (2) .007" (0,18 mm) shim-gaskets (.012") (0,30 mm) compressed thickness) to be within limits specified in Table 1, page 13.

Float example — The measured axial float on a Size 505A3 high speed pinion shaft is .015" (0,38 mm). The specified axial float range in Table 1, page 13, is .008" (0,20 mm) to .011" (0,28 mm). Subtract the specified axial float from the measured float (.015"-0,11" (0,38 mm) - (0,28 mm) to .015"-0,08" (0,38mm-0,20 mm)= .004" to .007") (0,10 mm to 0,18 mm) to determine shim-gasket removal. Remove (1) .007" (0,18 mm) shim-gaskets (.006" [0,15 mm] compressed thickness) to be within limits specified in Table 1, page 13.

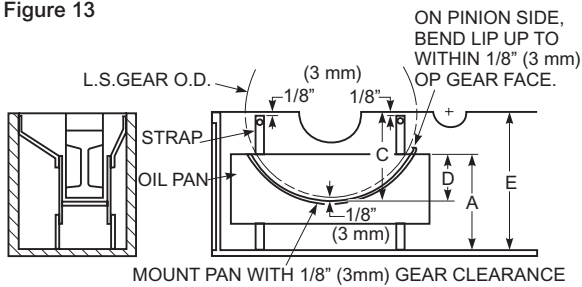
- D. Bevel gear shaft bearing adjustment is to be combined with final bevel gear backlash adjustment, refer to Steps 16 & 17.
 - E. **FINAL BEVEL GEARSET TOOTH CONTACT CHECK** — Figure 11
Refer to Steps 16 & 17. To adjust backlash after bevel gear shaft bearings are properly set, transfer shims from one end cover to the other — DO NOT ADD SHIMS.
20. **INSTALL SEALS** — Remove seal cages, install seals and re-install seal cages, refer to Step 3.

Installation

21. DRIVE INSTALLATION

- A. Coat threads of magnetic drain plugs and air vent with Permatex #3 or equivalent sealant and install. Reinstall accessories. Coat shaft extension for backstops with anti-seize lubricant before installing backstops. Tighten fasteners to specified torque. Reinstall dipstick.
- B. Turn gear train over by hand as a final check for internal or accessory interference. Readjust if necessary.
CAUTION: If lubricant was not applied to bearings (Step 9E), pour a small amount of lubricant into oil troughs through inspection cover prior to rotating gear train by hand.
- C. Reinstall drive. Refer to Manual 138-050 for installation instructions.
- D. Fill Drive with oil to level indicated on dipstick. Refer to Manual 138-050 for recommended lubricants and approximate oil quantities.
IMPORTANT – PRIME OIL TROUGHS. When filling drive with oil, remove inspection cover and pour enough oil into troughs so a generous supply flows to bearing. This will lubricate bearings until oil is circulated by the rotating gears.
- E. Run drive without load to verify satisfactory operation of drive and its lubrication system (including electrical cutouts).
- F. After drive runs satisfactorily, apply load. Inspect periodically until operation is deemed satisfactory. Follow preventive maintenance instructions in Manual 138-050.

Oil Pan & Oil Catcher Relocation or Addition

Figure 13


(See Introduction and Input Speed, Ratio, or Gearing Assembly Changes paragraphs on Page 1.)

22. SINGLE REDUCTION — Figure 13.

Sizes 385, 405, 425, & 525 have centrally located gears and do not require relocation of oil pans or catchers when turning shafts end for end.

Sizes 445, 465, 485, & 505 turn oil pan and oil catchers end for end and reinstall using same fasteners when turning shafts end for end.

Proceed as follows when adding an oil pan or catcher:

- A. Determine C as follows:

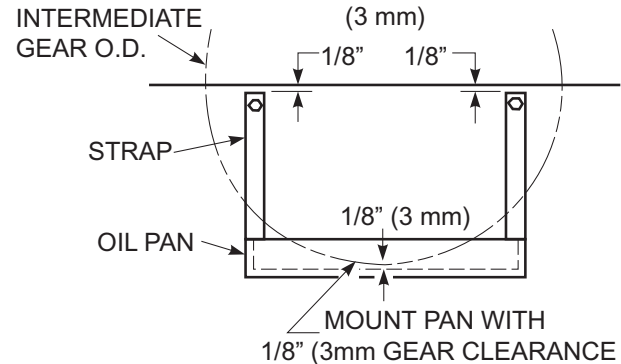
$$C = \frac{\text{Gear O.D.}}{2} + \frac{1}{8}'' (3 \text{ mm})$$

- B. Determine A as follows: $A = E - C + D$. D is inside depth of pan. E is inside depth of housing.

- C. Cut legs of oil pan to obtain height A. Place oil pan into base and recheck D. Place low speed shaft assembly into base and center pan under the low speed gear. Mark strap hole locations on housing wall. Remove low speed shaft assembly and oil pan. If available, use self tapping fasteners. If not available, drill and tap four holes into base. **CAUTION: Drilled holes in the housing must not exceed 5/8" (15,9 mm) deep. Refer to Table 10, page 16, for drill, tap, and fastener sizes.**
- D. Clean out base and install oil pan to base with four fasteners specified in Table 10, page 16. Apply Loctite 242 Threadlocker to fastener threads.
- E. Lower gear assembly into drive and bend lip of pan to within 1/8" (3 mm) of gear face on pinion side as shown in Figure 13.
- F. Install oil catchers on housing cover tie bar with notch of oil catchers over gear mesh. Use fasteners and locknuts provided.

23. DOUBLE REDUCTION — Figure 14

All Sizes turn oil pan and oil catchers end for end when turning shaft assemblies end for end.

Figure 14


Proceed as follows when adding an oil pan or catchers:

- Place oil pan and intermediate shaft assembly into base.
- Center oil pan under gear and level with bottom of pan 1/8" (3 mm) below gear O.D. Mark strap hole locations on housing wall. Remove shaft assembly and oil pan. Drill and tap four holes into base. Refer to Table 10, page 16, for drill and tap sizes.
- Clean out base and install oil pan to base with fasteners with fasteners specified in Table 10, page 16. Apply Loctite 242 Threadlocker to fastener threads.
- Lower shaft assembly into base and recheck clearance.
- Install oil catchers on housing cover tie bar with notch of oil catchers over gear mesh. Use fasteners and locknuts provided.

24. TRIPLE & QUADRUPLE REDUCTION

All Sizes turn oil catchers end for end when turning shaft assemblies end for end. Oil pans are not used.

Proceed as follows when adding oil catchers: Install oil catchers on housing cover tie bar with notch of oil catchers over gear mesh. Use fasteners and locknuts provided.

General Tightening & Loosening Procedures for Multi-Jackbolt Tensioners on Size 585

25. LOOSENING PROCEDURE

Jackbolts should be loosened with care. For longer fasteners, this procedure is even more important. The intent is to slowly release the preload force - DO NOT rush to completely loosen individual jackbolts. All jackbolts should be loosened uniformly.

- A. Loosen each jackbolt no more than one eighth turn following a circular pattern around the tensioner, shown in Figure 15. Perform this step for all studs adjacent to the L.S. bore prior to the next step.
- B. Repeat a second round following the procedure in Step A for all studs, loosening jackbolts no more than on quarter turn.
- C. Continue loosening all jackbolts one quarter turn for the 3rd and successive rounds until all jackbolts are loose.
- D. Usually after 3 or 4 passes, the jackbolts will be loose and the tensioner can be spun off the stud by hand. Long studs will stretch more and may require extra passes.
- E. Before reusing any tensioner, the body, jackbolt threads, and jackbolt tips should be cleaned and relubricated to insure proper jackbolt torque vs. preload performance on reinstallation.

IMPORTANT — MAKE SURE STUDS AND JACKBOLTS ARE LUBRICATED ON THREADS AND BETWEEN HARDENED WASHER AND JACKBOLT TIPS WITH CORRECT SUPERBOLT LUBRICANT (JL-G) PRIOR TO REUSE.

26. TIGHTENING PROCEDURE

Jackbolts should be tightened with care. For longer fasteners, this procedure is even more important. The intent is to slowly increase the preload force – DO NOT rush to completely tighten individual jackbolts. All jackbolts should be tightened uniformly.

- A. Clear any dirt or chips from the threads of the stud and from the main internal thread of the tensioner body.
- B. Check base of tensioner and verify that all jackbolts are flush with the bottom of the tensioner body or slightly recessed.
- C. Slide washer provided over the stud.

IMPORTANT — Apply Superbolt lubricant (JL-G) to the top of the washer, the jackbolt tips, and the stud threads, see Figure 16. There should be plenty of lubricant within the jackbolt threads in

the new condition, but all other critical locations require application of lubricant, ESPECIALLY BETWEEN THE HARDENED WASHER AND THE JACKBOLT TIPS.

- D. Spin the tensioner body down on the main thread of the stud by hand. The tensioner should be in light contact with the hardened washer.
 - E. Tightening is accomplished by tightening jackbolts in multiple passes to the torques and patterns specified in Table 11, page 16. Tightening patterns are described as a star and circular pattern as depicted in Figure 15. The star tightening pattern should follow the locations in order from 12:00 to 6:00 to 9:00 and then to 3:00, to seat the flange. Perform the first tightening pass on all other tensioners on the unit (all four) following the split bolt tightening sequence, depicted in Figure 12A (beginning in the center and working out towards endbars), prior to tightening further.
 - F. Follow the star tightening pattern for the next pass to the torque settings depicted in Table 11, page 16. Again, follow the tightening sequence for all other multi-jackbolt tensioners on the unit (all four) following the split bolt tightening sequence, again, depicted in Figure 12A.
- NOTE:** If using an air impact tool, use a reduced setting or lightly pulse the trigger at the full setting. **USE CAUTION - some impact wrenches can exert up to 450 lb-ft of torque.** If unsure of impact wrench torque capability, calibrate the impact wrench by tightening one jackbolt until socket rotations stops, then check the jackbolt with a torque wrench. The torque required to move the jackbolt further, is the output of the impact wrench as measured by the manufacturer.
- G. For the final tightening passes (3+), set the torque wrench to the specified torque and continue to repeat the circular pattern until all jackbolts are torqued to the same value. Multiple passes may be required. Final seating is achieved by continuing to tighten in a circular pattern until all jackbolts have reached a stabilized condition (considered less than 10° of jackbolt rotation).

Figure 15

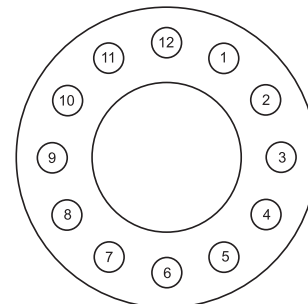


TABLE 1 — Type A Shaft Axial Float - Inches (mm) – Figure 17

DRIVE SIZE	Bore-L.S.		Bore-1			Bore-2		Bore-3		Bore-4
	L.S. A1	L.S. A2, A3, A4	H.S. A1	L.S. PIN A2	L.S. PIN A3, A4	H.S. A2	INT. A3, A4	H.S. A3	INT. A4	H.S. A4
385	.003-.006 (0,08-0,15)	*	.007-.010 (0,18-0,25)	.002-.005 (0,05-0,13)	.001-.004 (0,03-0,10)	.006-.009 (0,15-0,23)	.002-.005 (0,05-0,13)	.005-.008 (0,13-0,20)	.002-.005 (0,05-0,13)	.005-.008 (0,13-0,20)
405	.003-.006 (0,08-0,15)	*	.008-.011 (0,20-0,28)	.001-.004 (0,03-0,10)	.000-.003 (0,00-0,08)	.006-.009 (0,15-0,23)	.001-.004 (0,03-0,10)	.005-.008 (0,13-0,20)	.002-.005 (0,05-0,13)	.005-.008 (0,13-0,20)
425	.004-.007 (0,10-0,18)	*	.010-.013 (0,25-0,33)	.002-.005 (0,05-0,13)	.000-.003 (0,00-0,08)	.006-.009 (0,15-0,23)	.001-.004 (0,03-0,10)	.005-.008 (0,13-0,20)	.002-.005 (0,05-0,13)	.005-.008 (0,13-0,20)
445	.006-.009 (0,15-0,23)	*	.010-.013 (0,25-0,33)	.002-.005 (0,05-0,13)	.000-.003 (0,00-0,08)	.008-.011 (0,20-0,28)	.001-.004 (0,03-0,10)	.006-.009 (0,15-0,23)	.002-.005 (0,05-0,13)	.005-.008 (0,13-0,20)
465	.055-.060 (1,40-1,52)	.055-.060 (1,40-1,52) †	.014-.017 (0,36-0,43)	.002-.005 (0,05-0,13)	.000-.003 (0,00-0,08)	.009-.012 (0,23-0,30)	.001-.004 (0,03-0,10)	.006-.009 (0,15-0,23)	.002-.005 (0,05-0,13)	.005-.008 (0,13-0,20)
485	.060-.065 (1,52-1,65)	.060-.065 (1,52-1,65) †	.015-.018 (0,38-0,46)	.003-.006 (0,08-0,15)	.000-.003 (0,00-0,08)	.010-.013 (0,25-0,33)	.001-.004 (0,03-0,10)	.007-.010 (0,18-0,25)	.002-.005 (0,05-0,13)	.005-.008 (0,13-0,20)
505	.065-.070 (1,65-1,78)	.065-.070 (1,65-1,78) †	.016-.020 (0,41-0,51)	.004-.007 (0,10-0,18)	.001-.004 (0,03-0,10)	.012-.016 (0,30-0,41)	.002-.005 (0,05-0,13)	.008-.011 (0,20-0,28)	.003-.006 (0,08-0,15)	.006-.009 (0,15-0,23)
525	.075-.080 (1,91-2,03)	.075-.080 (1,91-2,03) †	.020-.024 (0,51-0,61)	.004-.007 (0,10-0,18)	.001-.004 (0,03-0,10)	.014-.018 (0,36-0,46)	.002-.005 (0,05-0,13)	.010-.013 (0,25-0,33)	.003-.006 (0,08-0,15)	.006-.009 (0,15-0,23)
545	...	.075-.085 (1,91-2,16)	...	‡	‡	.017-.021 (0,43-0,53)• .012-.016 (0,30-0,41)•	.005-.009 (0,13-0,23)	.012-.016 (0,30-0,41)• .009-.013 (0,23-0,33)•	...	...
565	...	.075-.085 (1,91-2,16)	...	‡	‡	.019-.023 (0,48-0,58)• .013-.017 (0,33-0,43)•	.005-.009 (0,13-0,23)	.017-.021 (0,43-0,53)• .012-.016 (0,30-0,41)•	...	...
585	...	.075-.085 (1,91-2,16)	...	‡	‡	.022-.026 (0,56-0,66)• .018-.022 (0,46-0,56)•	.005-.009 (0,13-0,23)	.017-.021 (0,43-0,53)• .012-.016 (0,30-0,41)•	...	...

★ Preload .007"-.010" (0,18-0,25 mm). Preload is shim removal from a zero float condition.

† Values shown are for spherical roller bearings.

‡ No adjustment required.

● Upper float range for 1820-1050 rpm input.
Lower float range for 1049-0 rpm input.

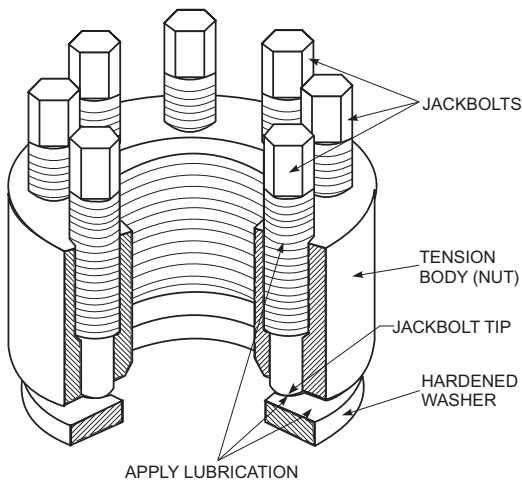
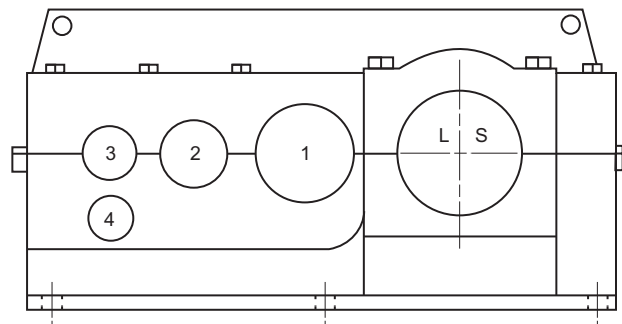
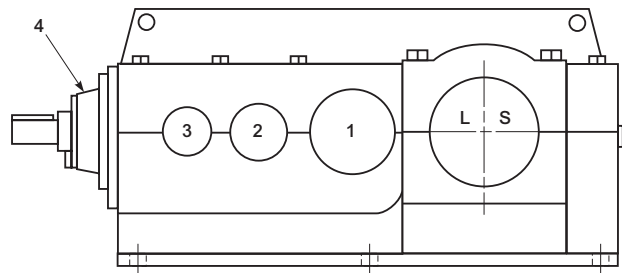
Figure 16 — Multi-Jackbolt Tensioner

Figure 17

Figure 18




TABLE 2 — Type AB Shaft Axial Float – Inches (mm) – Figure 18

DRIVE SIZE	Shaft – L.S.		Shaft 1		Shaft 2		Shaft 3
	L.S. AB2	L.S. AB3 & AB4	L.S. Pin. A2	L.S. Pin. AB3 & AB4	1st Int. AB3	2nd Int. AB4	1st Int. AB4
385	.004-.007 (0,10-0,18) Preload †	.007-.010 (0,18-0,25) Preload †	.004-.007 (0,10-0,18)	.001-.004 (0,03-0,10)	.002-.005 (0,05-0,13)	.001-.004 (0,03-0,10)	.002-.005 (0,05-0,13)
405	.004-.007 (0,10-0,18) Preload †	.007-.010 (0,18-0,25) Preload †	.005-.008 (0,13-0,20)	.001-.004 (0,03-0,10)	.002-.005 (0,05-0,13)	.001-.004 (0,03-0,10)	.002-.005 (0,05-0,13)
425	.004-.007 (0,10-0,18) Preload †	.007-.010 (0,10-0,18) Preload †	.006-.009 (0,15-0,23)	.001-.004 (0,03-0,10)	.002-.005 (0,05-0,13)	.001-.004 (0,03-0,10)	.002-.005 (0,05-0,13)
445	.004-.007 (0,10-0,18) Preload †	.007-.010 (0,10-0,18) Preload †	.006-.009 (0,15-0,23)	.001-.004 (0,03-0,10)	.002-.005 (0,05-0,13)	.001-.004 (0,03-0,10)	.002-.005 (0,05-0,13)
465	.055-.060 † (1,40-1,52)	.055-.060 † (1,40-1,52)	.009-.012 (0,23-0,30). .006-.009 (0,15-0,23) ■	.002-.005 (0,05-0,13)	.003-.006 (0,08-0,15)	.002-.005 (0,05-0,13)	.003-.006 (0,08-0,15)
485	.060-.065 † (1,52-1,65)	.060-.065 † (1,52-1,65)	.007-.010 (0,18-0,25)	.002-.005 (0,05-0,13)	.004-.007 (0,10-0,18)	.002-.005 (0,05-0,13)	.003-.006 (0,08-0,15)
505	.065-.070 † (1,65-1,78)	.065-.070 † (1,65-1,78)	.007-.010 (0,18-0,25)	.003-.006 (0,08-0,15)	.006-.009 (0,15-0,23)	.002-.005 (0,05-0,13)	.004-.007 (0,10-0,18)
525	.075-.080 † (1,91-2,03)	.075-.080 † (1,91-2,03)	.007-.010 (0,18-0,25)	.003-.006 (0,08-0,15)	.006-.009 (0,15-0,23)	.002-.005 (0,05-0,13)	.004-.007 (0,10-0,18)
545	...	.075-.085 † (1,91-2,16)	...	•	.009-.013 (0,23-0,33) .006-.010 (0,15-0,25) ■	.002-.006 (0,05-0,15)	.005-.009 (0,13-0,23)
565	...	.075-.085 † (1,91-2,16)	...	•	.007-.011 (0,18-0,28) .005-.009 (0,13-0,23) ■	.002-.006 (0,05-0,15)	.006-.010 (0,15-0,25)
585	...	.075-.085 † (1,91-2,16)	...	•	.007-.011 (0,18-0,28) .005-.009 (0,13-0,23) ■	.002-.006 (0,05-0,15)	.006-.010 (0,15-0,25)

- ★ BEP — Bench End Play, unassembled TDO bearing, MEP — Mounted End Plate, TDO bearing assembled to shaft.
- † Spherical Roller Bearing
- ‡ Preload is shim removal from zero float condition.
- Spherical roller bearing — not adjustable.
- Upper float range for 1.50 (38,1 mm) bevel ratio. Lower float range for 2.25 (57,2 mm) & 3.38 (85,9) bevel ratios.
- ◆ 1520 RPM max

TABLE 3 — Falk Shim-Gasket Compressibility

Thickness in Inches and (mm)	New	.007	.009	.015	.031
		(0,18)	(0,23)	(0,38)	(0,79)
	Compressed	.006	.008	.013	.028
		(0,15)	(0,20)	(0,33)	(0,71)

TABLE 2 — Type AB Shaft Axial Float – Inches (mm) Continued

DRIVE SIZE	Shaft 4		
	H.S. AB2 ★	H.S. AB3 ★	H.S. AB 4 ★
385	BEP .005-.007 (0,13-0,18) MEP .0021-.0055 (0,05-0,14)	BEP .005-.007 (0,13-0,18) MEP .0017-.0054 (0,04-0,14)	BEP .003-.005 (0,08-0,13) MEP .0011-.0014 (0,03-0,04)
405	BEP .005-.007 (0,13-0,18) MEP .0018-.0057 (0,05-0,14)	BEP .005-.007 (0,13-0,18) MEP .0017-.0054 (0,04-0,14)	BEP .003-.005 (0,08-0,13) MEP .0011-.0014 (0,03-0,04)
425	BEP .009-.011 (0,23-0,28) MEP .0022-.0079 (0,06-0,20)	BEP .005-.007 (0,13-0,18) MEP .0015-.0053 (0,04-0,13)	BEP .005-.007 (0,13-0,18) MEP .0017-.0054 (0,04-0,14)
445	BEP .009-.011 (0,23-0,28) MEP .0028-.0082 (0,07-0,21)	BEP .005-.007 (0,13-0,18) MEP .0021-.0055 (0,05-0,14)	BEP .005-.007 (0,13-0,18) MEP .0017-.0054 (0,04-0,14)
465	BEP .009-.011 (0,23-0,28) MEP .0028-.0082 (0,07-0,21)	BEP .005-.007 (0,13-0,18) MEP .0018-.0057 (0,05-0,14)	BEP .005-.007 (0,13-0,18) MEP .0015-.0053 (0,04-0,13)
485	.003-.005 (0,08-0,13)	BEP .009-.011 (0,23-0,28) MEP .0022-.0079 (0,06-0,20)	BEP .005-.007 (0,13-0,18) MEP .0021-.0055 (0,05-0,14)
505	.003-.005 ◆ (0,08-0,13)	BEP .009-.011 (0,23-0,28) MEP .0028-.0082 (0,07-0,21)	BEP .005-.007 (0,13-0,18) MEP .0018-.0057 (0,05-0,14)
525	.003-.005 ◆ (0,08-0,13)	BEP .009-.011 (0,23-0,28) MEP .0028-.0082 (0,07-0,21)	BEP .005-.007 (0,13-0,18) MEP .0018-.0057 (0,05-0,14)
545	...	.003-.005 (0,08-0,13)	BEP .009-.011 (0,23-0,28) MEP .0028-.0082 (0,07-0,21)
565	...	.003-.005 ◆ (0,08-0,13)	BEP .009-.011 (0,23-0,28) MEP .0028-.0082 (0,07-0,21)
585	...	.003-.005 ◆ (0,08-0,13)	BEP .009-.011 (0,23-0,28) MEP .0028-.0082 (0,07-0,21)

TABLE 4 — Housing Cover Fastener Tightening Torques A & AB Side Bar Fasteners *

FASTENER PRE-TORQUE AND TURN OF THE NUT (LB-FT (Nm)/DEGREES) † ‡													
DRIVE SIZE & REDUCTION	.750	.875	1.000	1.125	1.250	1.375	1.500	1.750	2.000	2.250	2.500	2.750	3.000
385A1 & AB2			99 (134) 60°	99 (134) 50-60°									
385A2-A4 & AB3-4	38 (52) 60°			99 (134) 45°									
405A1 & AB2			146 (198) 60°	196 (266) 60°									
405A2-A4 & AB3-4	54 (73) 80°			99 (134) 45-55°									
425A1 & AB2					340 (460) 60°								
425A2-A4 & AB3-4		99 (134) 60°	99 (134) 60°		196 (266) 60°								
445A1 & AB2					340 (460) 60°	340 (460) 60°							
445A2-A4 & AB3-4	73 (94) 60°			146 (198) 60°		196 (266) 50-60°							
465A1 & AB2					340 (480) 60°		560 (760) 60°						
465A2-A4 & AB3-4			146 (198) 60°		340 (480) 60°		560 (760) 50-60°						
485AB1 & AB2								560 (760) 60°					
485A2-A4 & AB3-4				262(355) 60°		420 (570) 60°		560 (760) 60°					
505A1 & AB2									420 (570) 75°				
505A2-A4 & AB3-4							560 (760) 60°		560 (760) 60°				
525A1 & AB2										560 (760) 75°			
525A2-A4 & AB3-4					340 (460) 75°			560 (760) 60°		560 (760) 75°			
545A2 & A3 545AB3 & A4									560 (760) 75°		560 (760) 75°		
565A2 & A3 565AB3 & A4										560 (760) 75°		560 (760) 75°	
585A2 & A3 585AB3 & A4											560 (760) 90°		560 (760)• 90°

★ Torque values are for Grade 8 or ASTM A354 Grade BD fasteners coated with SAE 20 or heavier mineral oil.

† Tighten fasteners to top value, then apply additional rotation per bottom value.

‡ Tolerance for degrees additional head rotation is ±5° except where degree range is listed.

● 585A2 & A3 and 585AB2 & AB3 include a Multi-Jackbolt Tensioner at this location, see Section 25 and 26 for loosening and tightening procedures.

TABLE 5 — Fan Assembly, Inspection Cover, Oil Catcher, & Oil Pan Fastener Tightening Torque lb-ft (Nm) ±5% *

With Locknuts		Without Locknuts	
Size	Torque	Size	Torque
.250	6 (8.5)	.250	4.5 (6)
.3125	13 (17)	.3125	9.5 (13)
.375	21 (29)	.375	17 (23)
.500	50 (68)	.500	42 (57)

* Fan assembly and oil pan fasteners are Grade 2, inspection cover and oil catcher fasteners are Grade 5.

TABLE 6 — Bevel Head, End Cover, Seal Cage, & Shaft Guard Fastener Tightening Torques (See Note ■ for Size 445 Drives)

Fastener Diameter	.375	.500 †	.625	.750	.875	1.000	1.250
Torque lb-ft †	27	67	134	242	395	590	1060
(Nm)	(37)	(91)	(184)	(330)	(530)	(800)	(1420)

† Except where noted, all fasteners are Grade 5 UNC. Torques are for shop dry conditions.

■ Low speed pinion end cover fasteners for 445A2, A3, A4, AB3 & AB4 are Grade 8. Tightening torque is 95 lb-ft (130 Nm).

◆ Tolerance is ±5%.



TABLE 7 — Bevel Gear Rim Fastener Tightening Torques ★

Fastener Diameter	0.625	0.750	0.875	1.000
Torque lb-ft	190	345	590 ‡	880 ‡
(Nm)	(260)	(465)	(800)	(1200)

★ All fasteners are Grade 8 UNC.

‡ Locknuts are intended for use on these fasteners.

TABLE 10 — Oil Pan Data – Inches

DRIVE SIZE	Strap Hole Diameter	Drive Base Hole	Fastener Size Grade 5
All	7/16	5/16 drill, 5/8 deep	3/8-16UNC x 1/2
		3/8-16UNC-28 tap †	

† If possible, use self tapping fasteners.

TABLE 8 — Bored Bevel Pinion Removal Force

DRIVE SIZE & REDUCTION	Approximate Removal Force — lb (kN)
385 & 405AB3, 425 & 445AB4 425AB3, 465AB4	22000 (98)
	30000 (133)
385AB2, 445AB3, 485AB4	34000 (151)
405AB2, 465AB3, 505 & 525AB4 425B2, 485AB3	50000 (222)
	56000 (249)
445 & 465AB2, 505 & 525AB3, 545AB3, 565 & 585AB4 565 & 585AB3	90000 (400)
	133000 (592)

TABLE 11 — Multi-Jackbolt Tightening Torques – lb-ft (Nm)

Tightening Pass	Torque	Tightening Pattern
1	70-150 (95-200)	Star (2, 6, 9, and 3:00)
2	220-270 (300-370)	Star (12, 6, 9 and 3:00)
3+	220-270 (300-370)	Circular

**TABLE 9 — Bevel Pinion Mounting Distance (SD) Tolerance – Inches
Bevel Gear Set Backlash (BL) Tolerance – Inches**

Bevel Gear Outside Diameter	Setting Distance Tolerance	Backlash Tolerance
Less than 15"	-0.000	-0.001
	+0.002	+0.001
Greater than 15"	-0.000	-0.002
	+0.005	+0.002