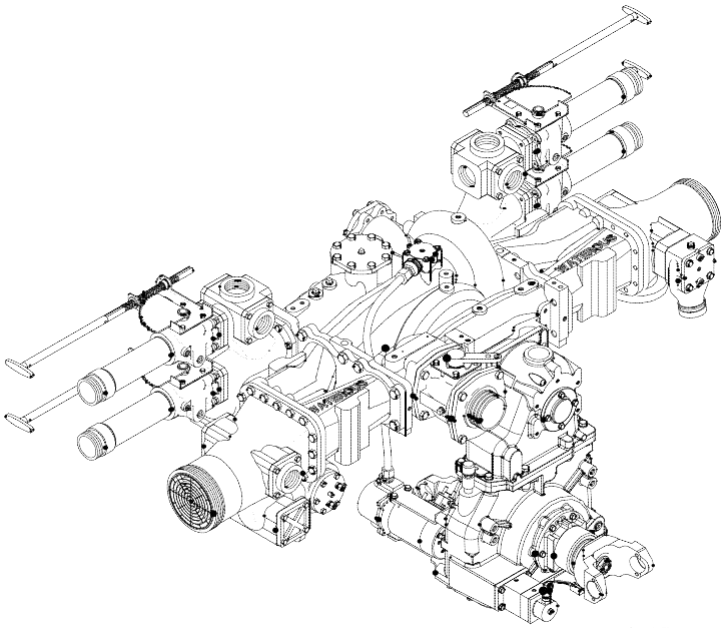
Replacement of Mechanical Seals for CM, CMU, CS and CSU Series Pumps

Installation Instructions

Form No.	Section	Issue Date	Rev. Date
F-1031	5013	03/01/85	9/4/24



WATEROUS

Fire Pumps – Since 1886

Mechanical Seal Replacement

Waterous Company 125 Hardman Avenue South, South St. Paul, Minnesota 55075 USA (651) 450-5000

Contents

General Information

Before replacing the mechanical seals, flush cooling water supply lines and clear passageways in the pump body. See Pages 2 through 6 for details.

Supplies Needed for Mechanical Seal Replacement

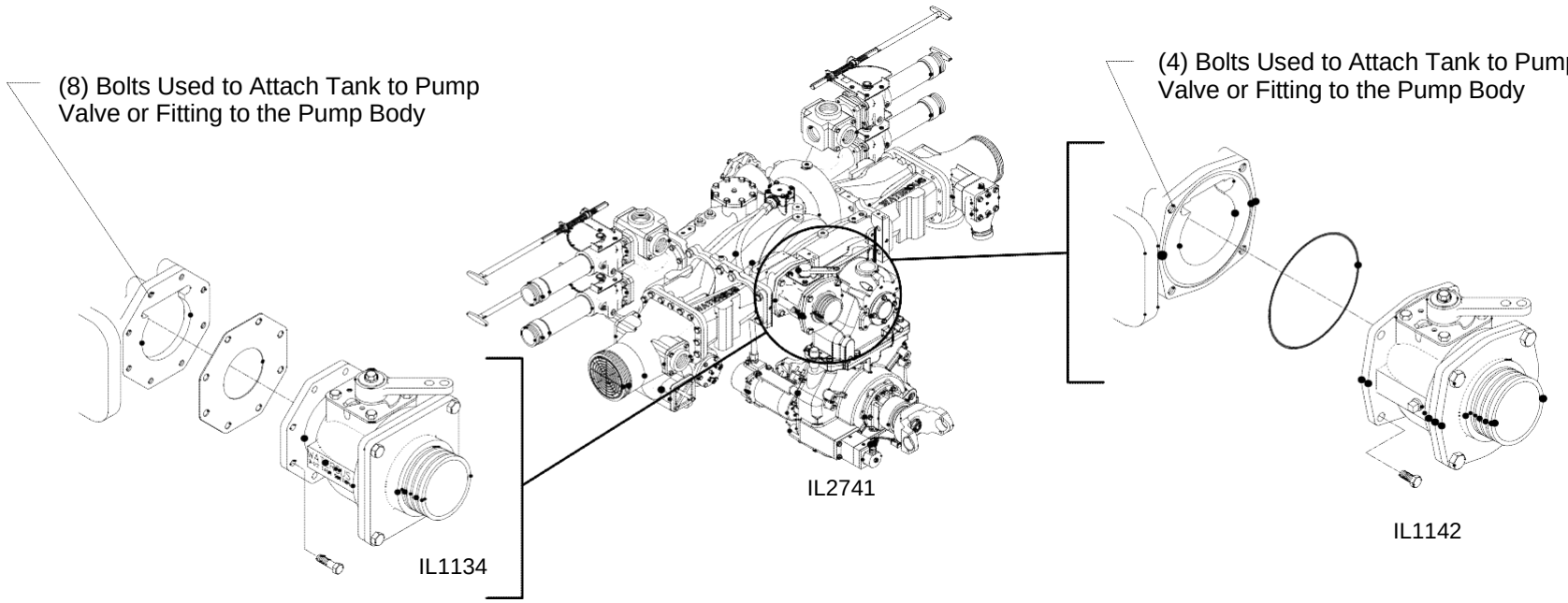
- Two mechanical seals
- Grease/oil seals, gaskets, O-rings
- Seal installation lubricant

Note: Contact Waterous for appropriate repair kit (Kits vary based on the pump drive, material, etc.). Have pump serial number available when contacting Waterous.

Tools

- Outboard bearing removal/installation tool, Waterous Part No. K956
- Mechanical seal removal/installation tool, Waterous Part No. K628

Method of Determining Type of Pump Seal Housings

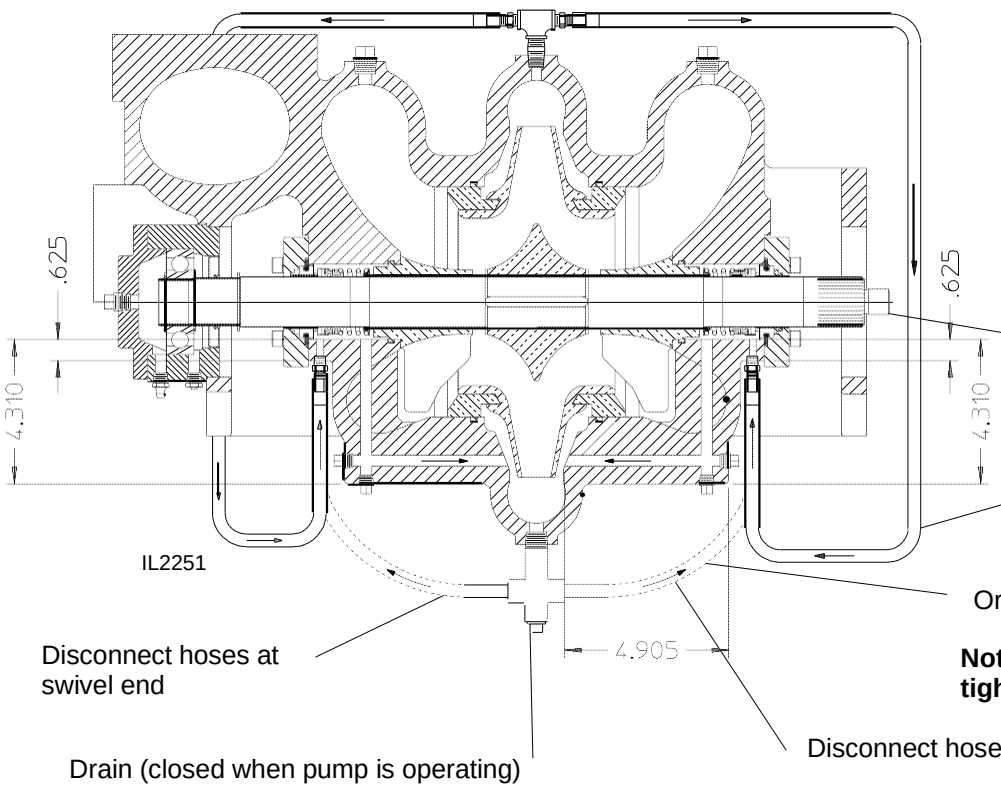


Pumps Without Separate Seal Housings
Built 1956 Through 1994
Identified by Tank to Pump Flange with (8) Bolts

Pumps With Separate Seal Housings
***Built Starting in 1994**
Identified by Tank to Pump Flange with (4) Bolts

***Note: Pumps Built in 1994 May Have Either Type of Seal Housing, Use the Number of Bolts on the Tank to Pump Flange to Determine Which Type.**

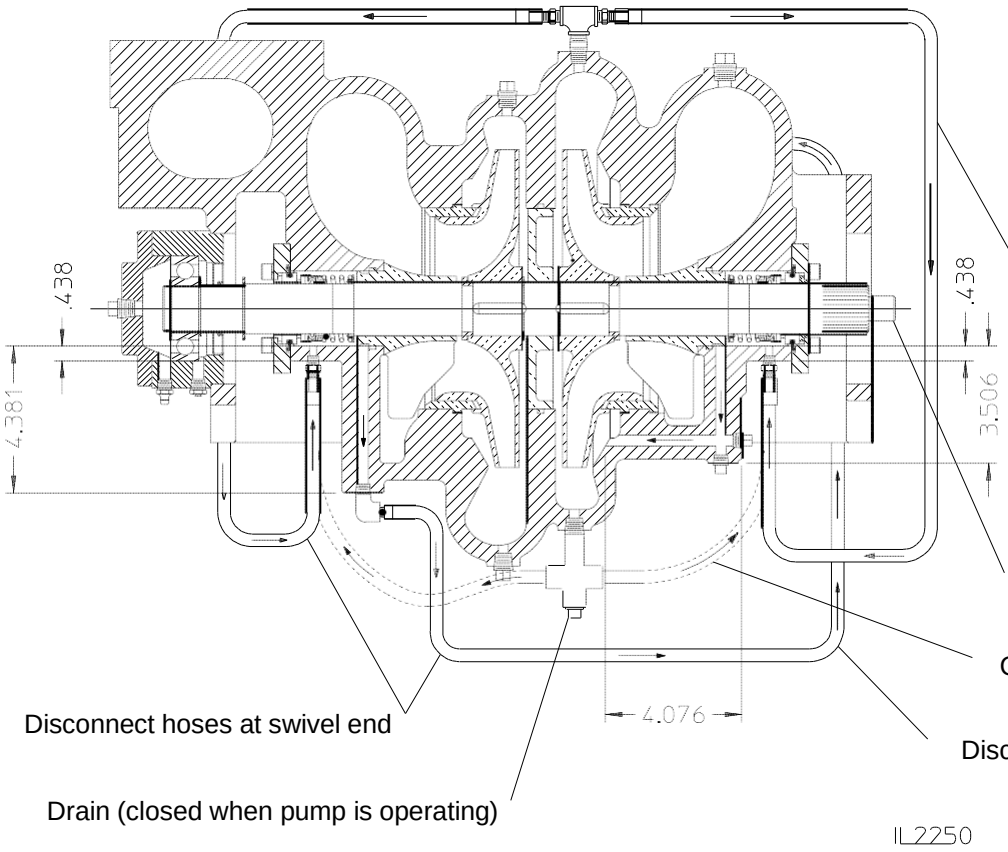
Seal Cooling Line Flush - CS Series Pumps without Separate Seal Housings



Before replacing the mechanical seals, flush the cooling water supply lines. Remove the hoses and fittings and flush the pump by connecting to a hydrant or other pressurized water source. Also, pass water through the hoses to check for blockages. Waterous also recommends the passages in the body be checked for blockages. Pass a steel rod or other suitable device through the openings. The dimensions shown on the diagram can be used to determine that full length of the passageways are clear.

Note: To reconnect hoses at swivel end, tighten hose swivel finger tight on adapter, then tighten an additional 1/4 to 1/2 turn.

Seal Cooling Line Flush - CM Series Pumps without Separate Seal Housings



Before replacing the mechanical seals, flush the cooling water supply lines. Remove the hoses and fittings and flush the pump by connecting to a hydrant or other pressurized water source. Also, pass water through the hoses to check for blockages. Waterous also recommends the passages in the body be checked for blockages. Pass a steel rod or other suitable device through the openings. The dimensions shown on the diagram can be used to determine that full length of the passageways are clear.

Cooling Line Location
if Pump was Modified with
Conversion Kit K816

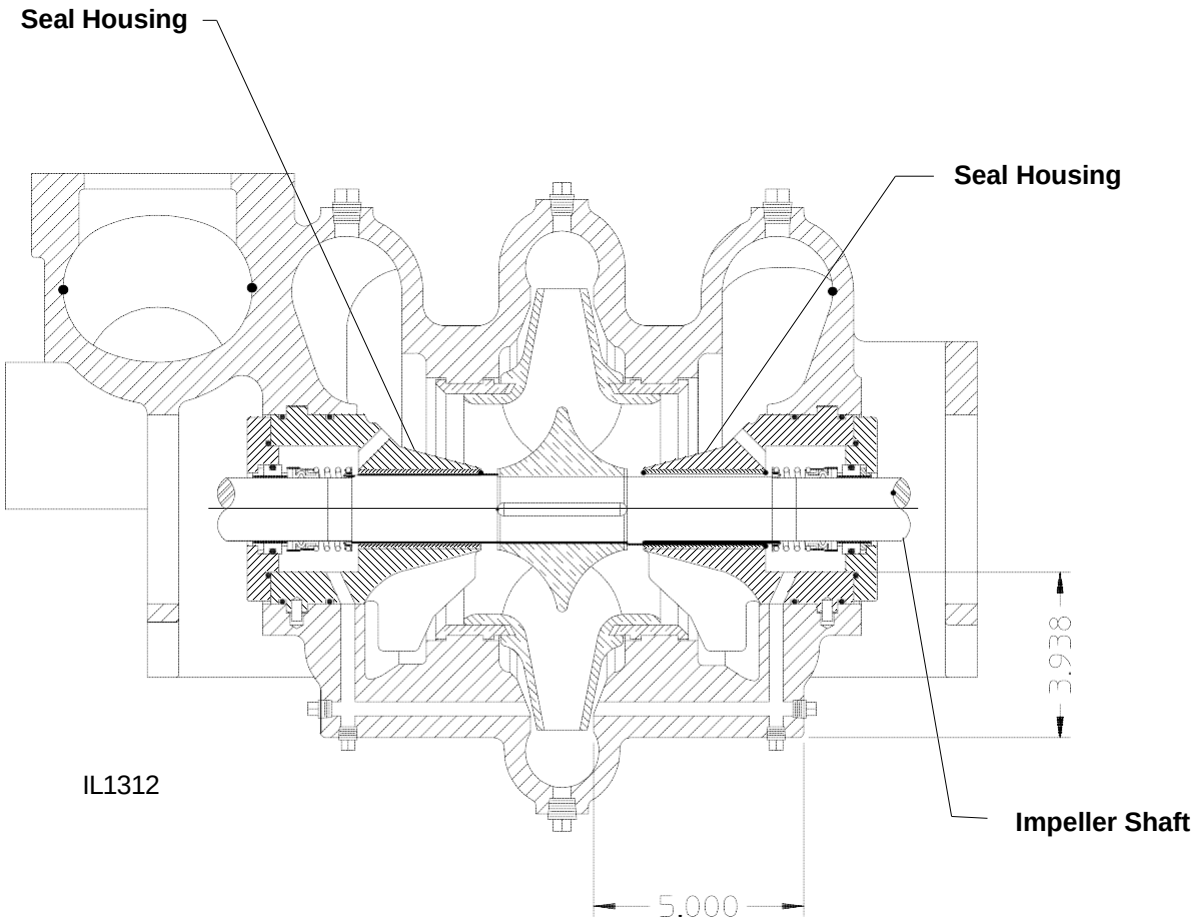
Transmission Side

Original Cooling Line Location

Disconnect hoses at swivel end

Note: To reconnect hoses at swivel end, tighten hose swivel finger tight on adapter, then tighten an additional 1/4 to 1/2 turn.

Seal Cooling Line Flush - CS Series Pumps without Separate Seal Housings



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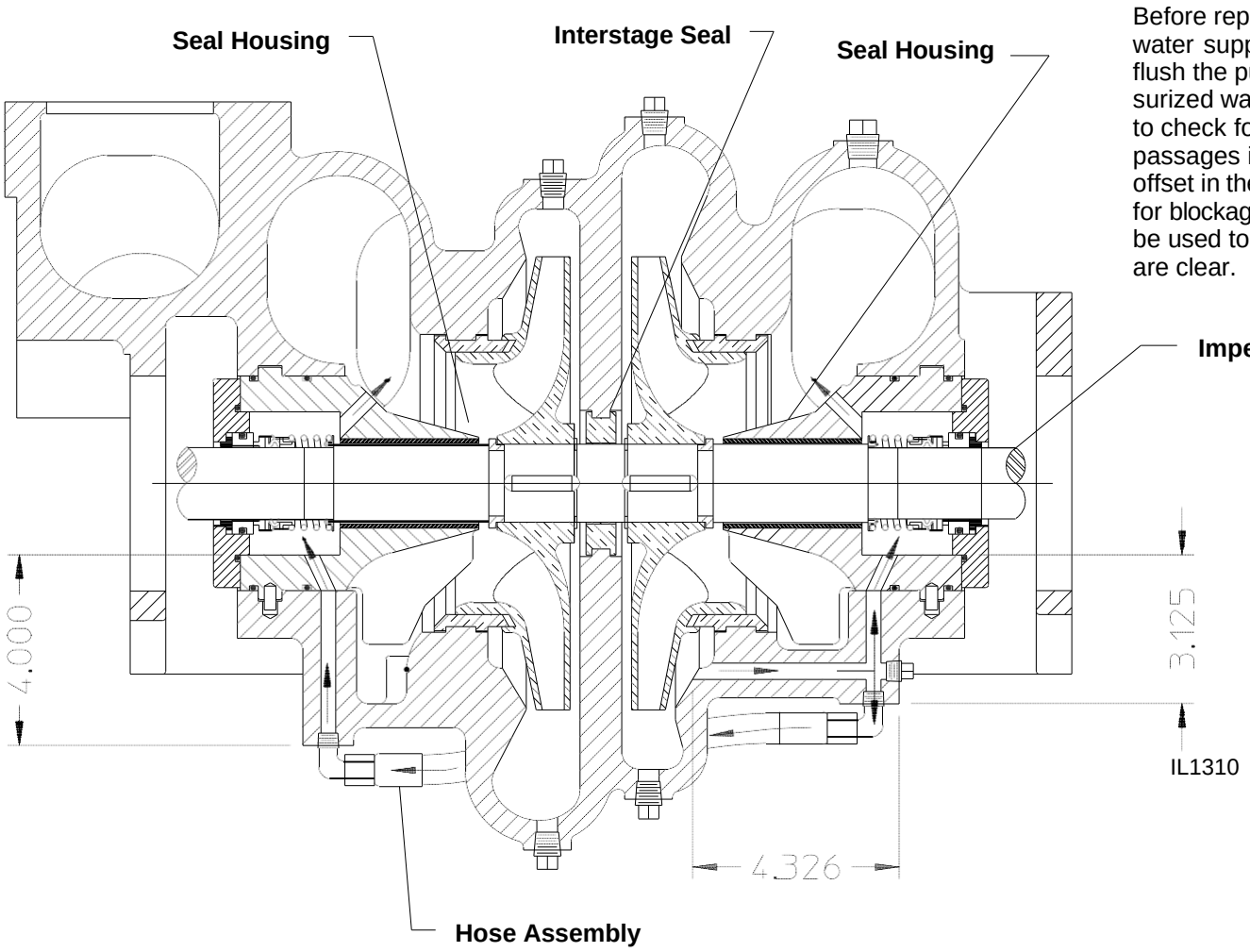
Before replacing the mechanical seals, flush the cooling water supply lines. Waterous also recommends the passages in the body be checked for blockages. Due to offset in the seal housing hole, use a flexible tool to check for blockages. The dimensions shown on the diagram can be used to determine that full length of the passageways are clear.

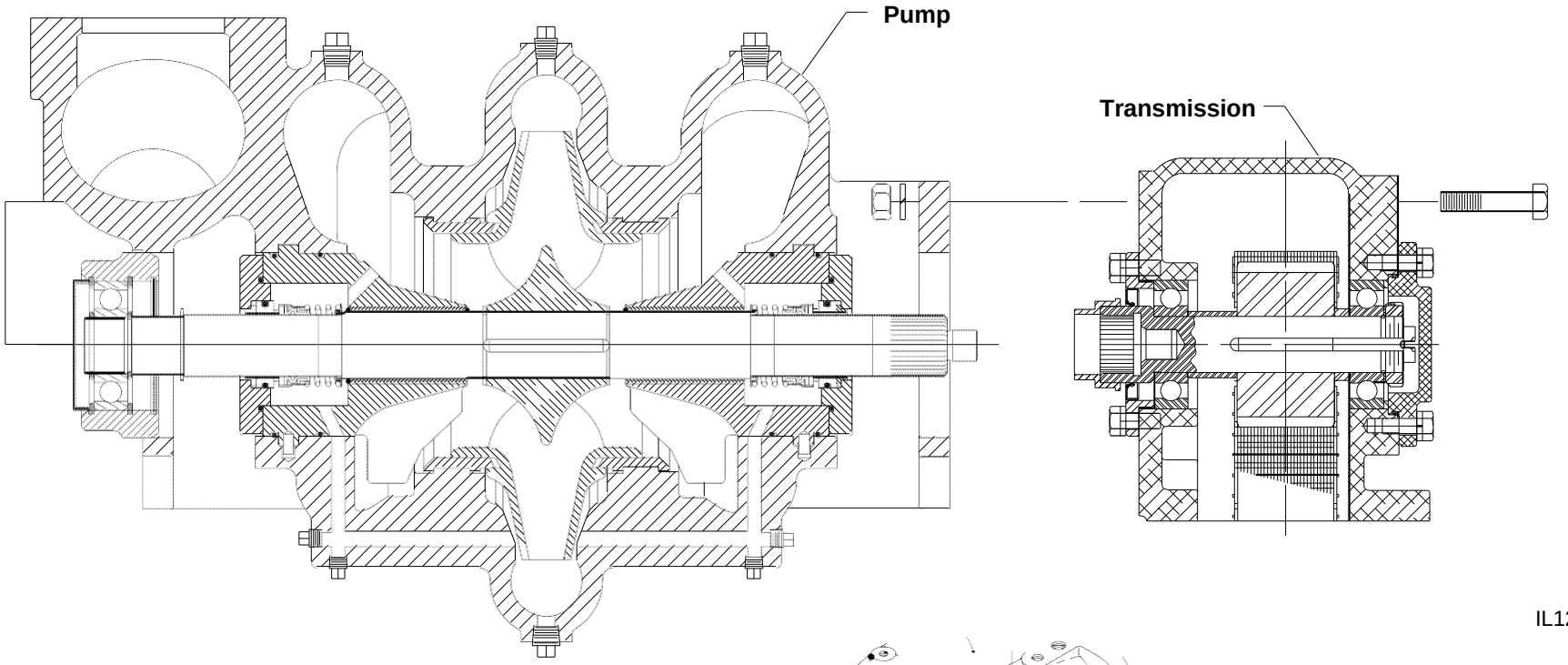
Seal Cooling Line Flush - CM Series Pumps without Separate Seal Housings



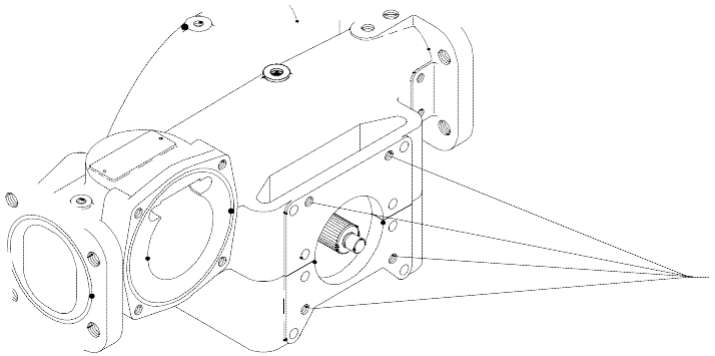
Before replacing the mechanical seals, flush the cooling water supply lines. Remove the hoses and fittings and flush the pump by connecting to a hydrant or other pressurized water source. Also, pass water through the hoses to check for blockages. Waterous also recommends the passages in the body be checked for blockages. Due to offset in the seal housing hole, use a flexible tool to check for blockages. The dimensions shown on the diagram can be used to determine that full length of the passageways are clear.

Transmission Removal / Installation

(Transmission Mounted Directly to the Rear of the Pump)



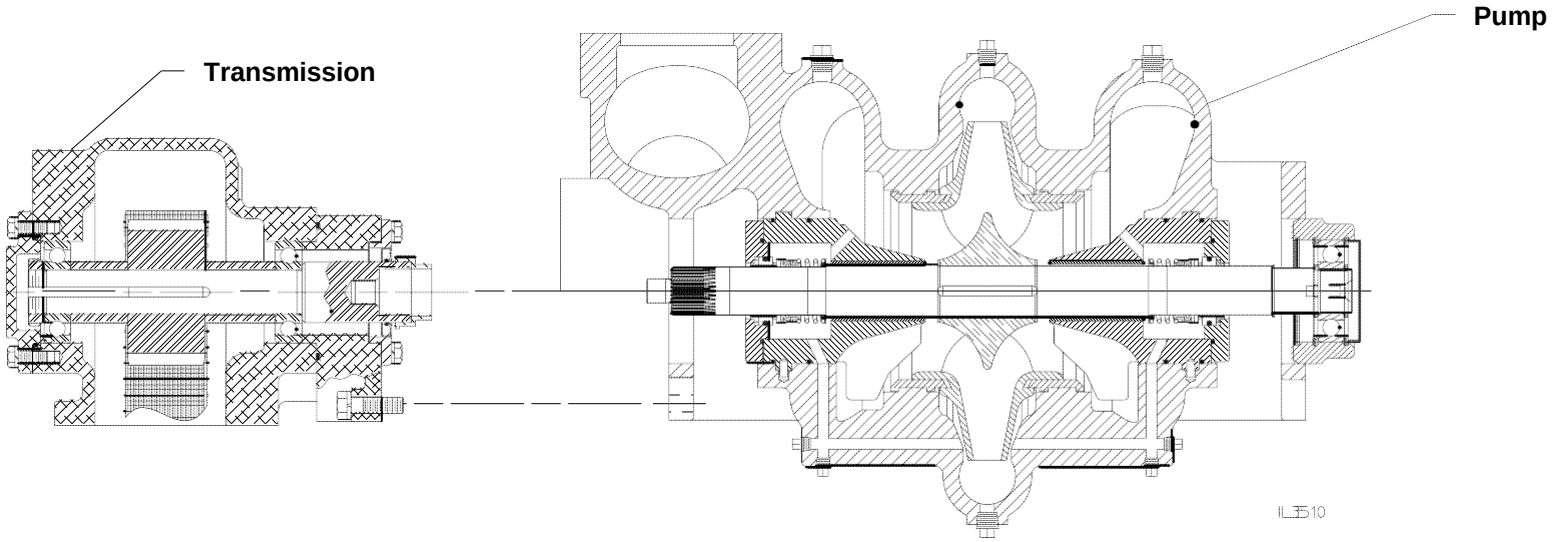
IL1211

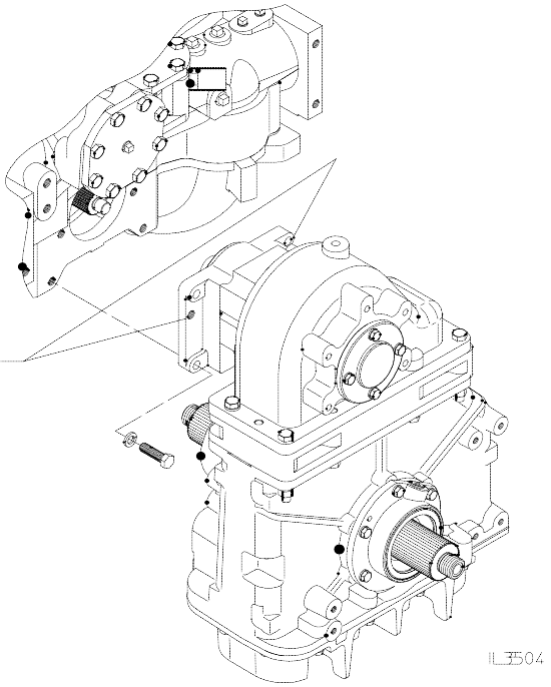


1. Remove the four cap screws and lock washers that attach the transmission to the pump.
2. Apply Loctite #242 (blue) to threads when transmission is reattached to the pump.
3. Use the jacking screw holes to separate the transmission from the pump body.
4. Support transmission and pull straight back from pump.

Transmission Removal / Installation

(Transmission Mounted Directly to the Front of the Pump)





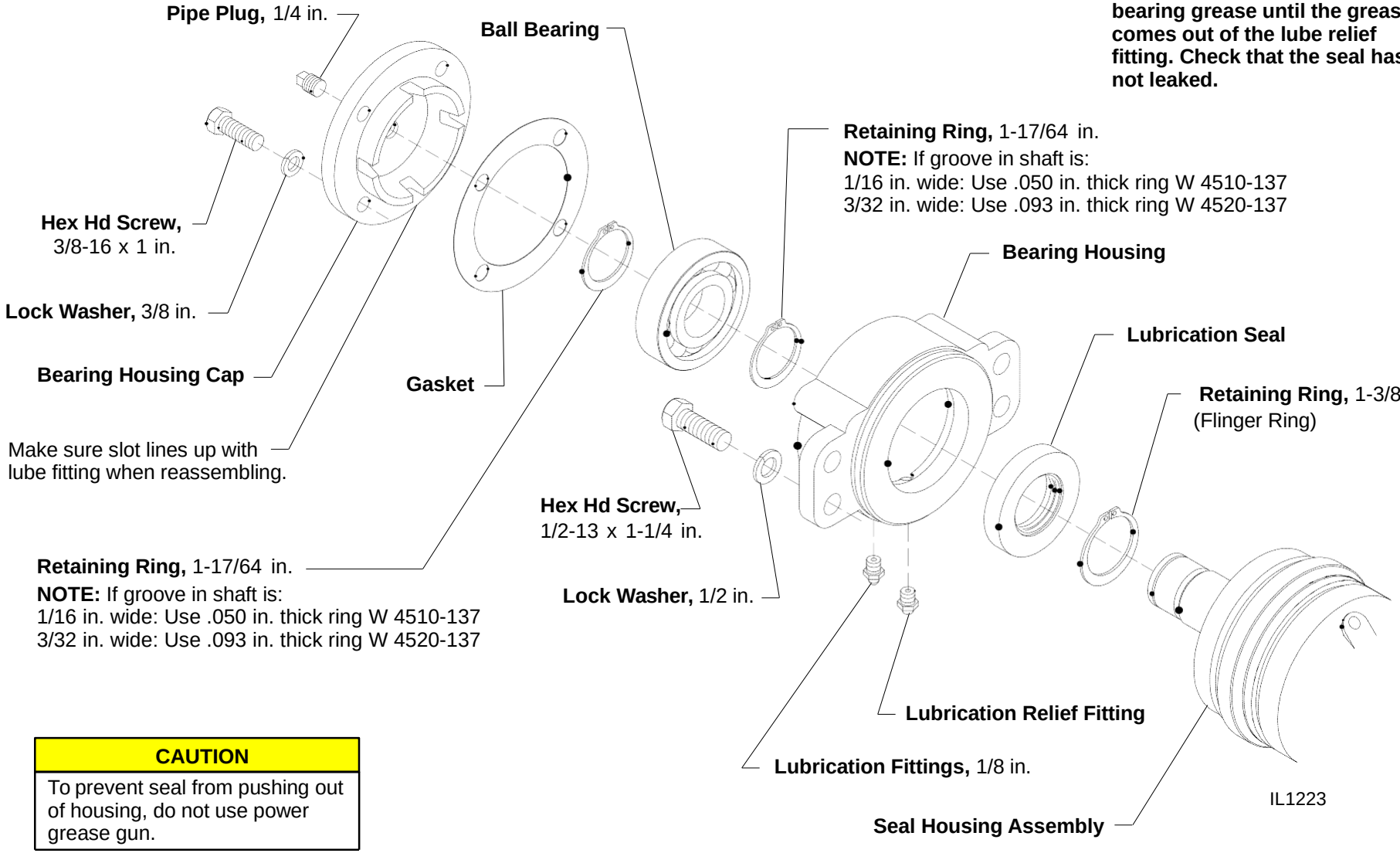
1. Remove the four cap screws and lock washers that attach the transmission to the pump.
2. Apply Loctite #242 (blue) to threads when transmission is reattached to the pump.
3. Use the jacking screw holes to separate the transmission from the pump body.
4. Support transmission and pull straight back from pump.

Outboard Bearing Removal / Installation - Prior 4/21/2006

(Transmission Mounted Pumps with Mechanical Seals or Direct Drive Pumps without Tachometer with Mechanical Seals)

(Reference Pages 15, 16 and 19)

NOTE: Fill the bearing housing chamber with a medium consistancy ball and roller bearing grease until the grease comes out of the lube relief fitting. Check that the seal has not leaked.



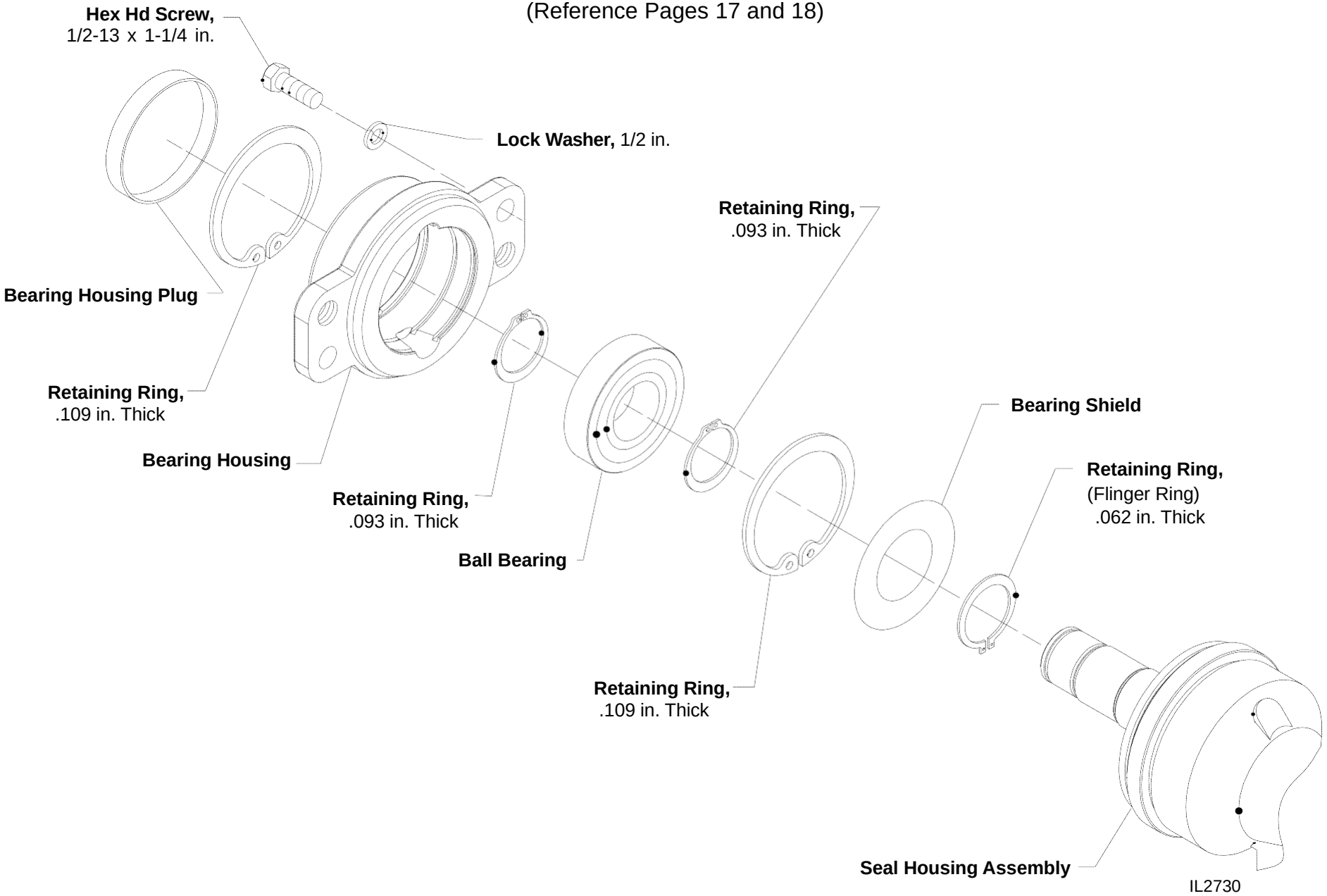
CAUTION

To prevent seal from pushing out of housing, do not use power grease gun.

Outboard Bearing Removal / Installation - After 4/21/2006

(Transmission Mounted Pumps with Mechanical Seals)

(Reference Pages 17 and 18)



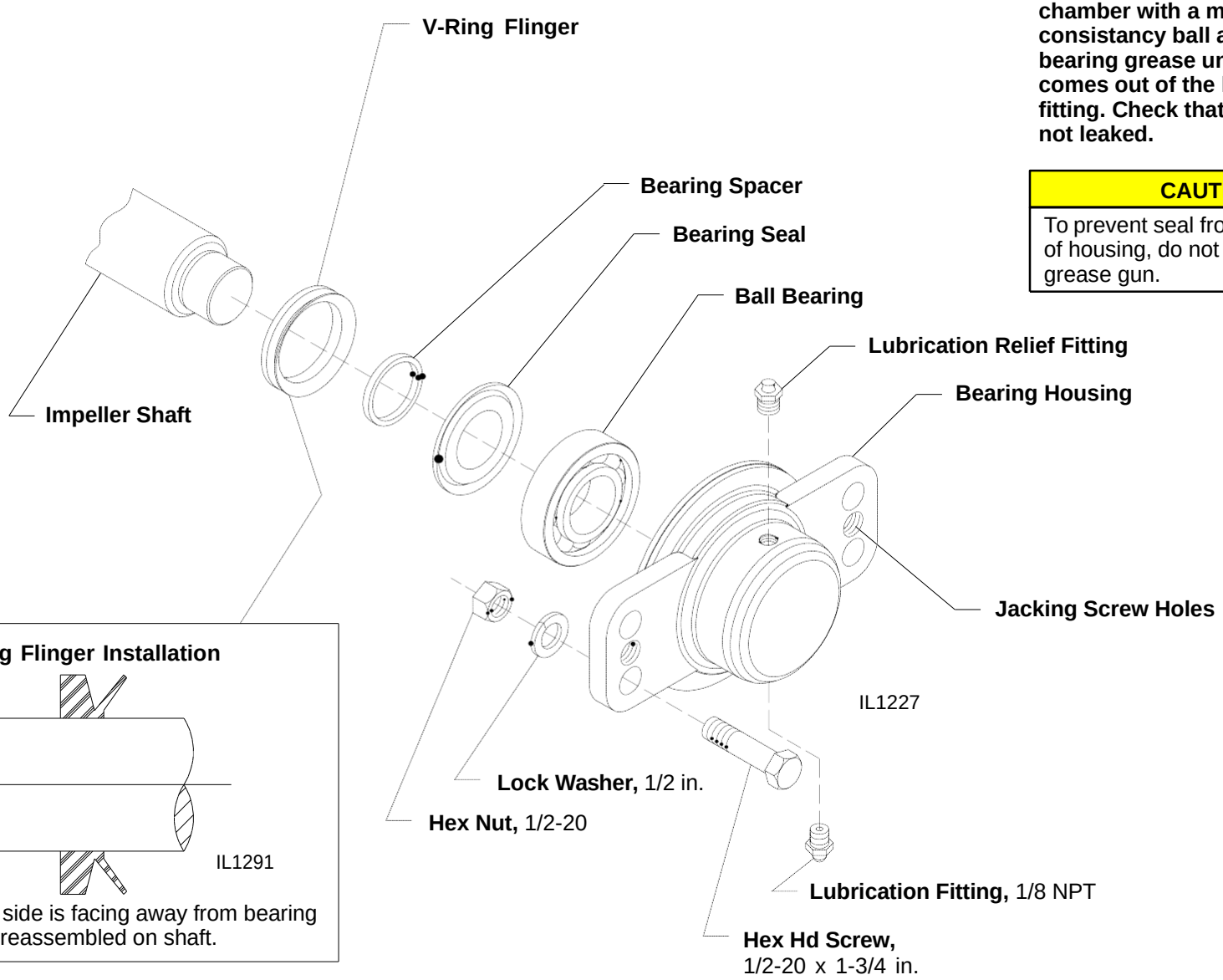
Outboard Bearing Removal / Installation

(Direct Drive Pumps - Front Drive with Tachometer)

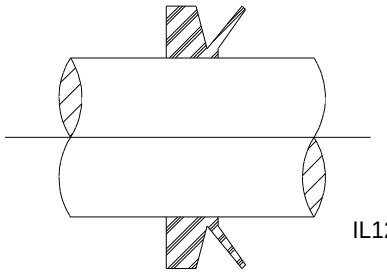
NOTE: Fill the bearing housing chamber with a medium consistancy ball and roller bearing grease until the grease comes out of the lube relief fitting. Check that the seal has not leaked.

CAUTION

To prevent seal from pushing out of housing, do not use power grease gun.



V-Ring Flinger Installation



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Make sure flat side is facing away from bearing housing when reassembled on shaft.

Outboard Bearing Removal (Prior to 4/21/2006)

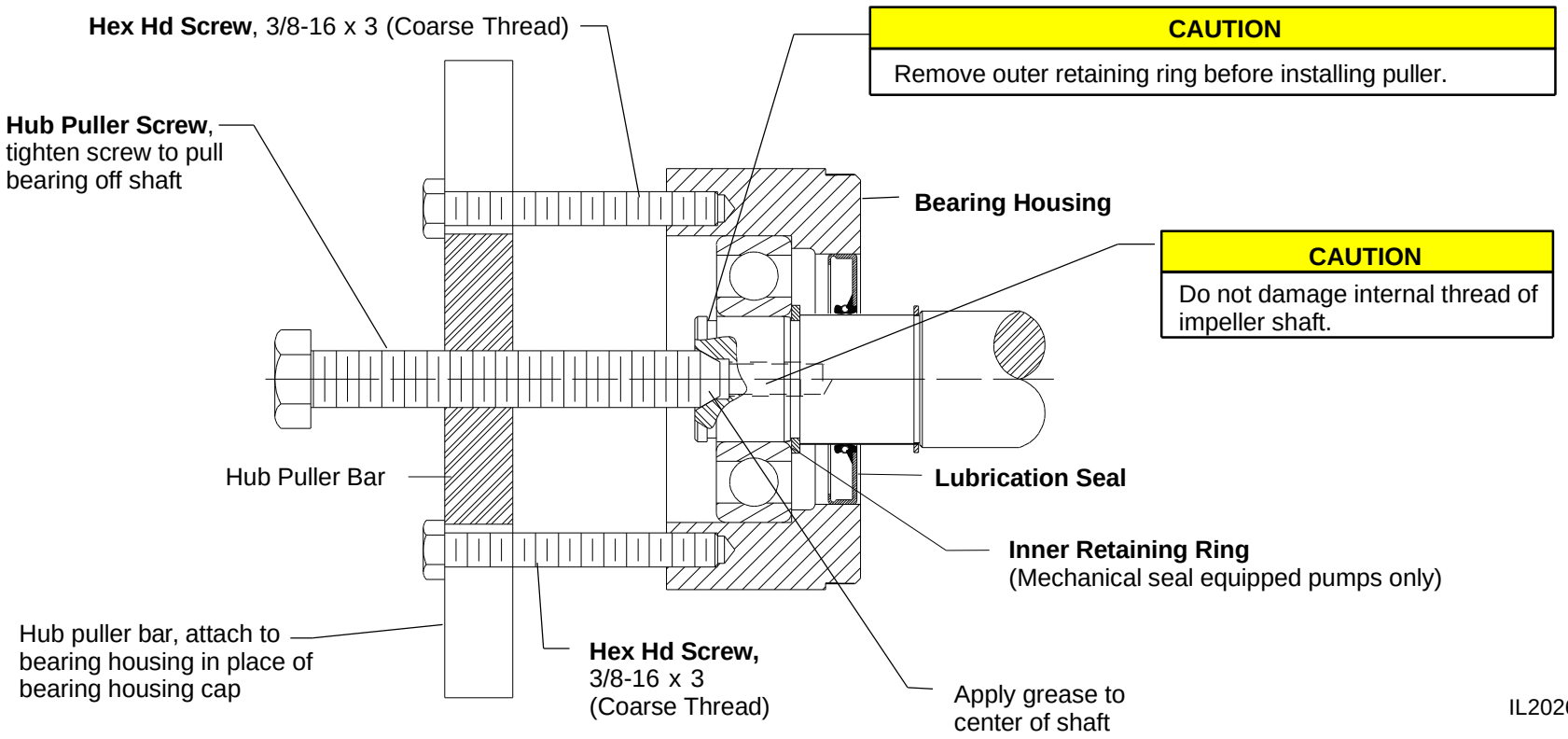
1. Remove the oil pump (if so equipped) and the bearing housing cap.
2. Remove the bearing outer retaining ring from the impeller shaft
3. Remove the (4) hex hd screws attaching the bearing housing to the pump body.
4. Install hub puller bar. (Use bearing removal tool if removing outboard bearing on units equipped with oil pump - See Page 16).

CAUTION

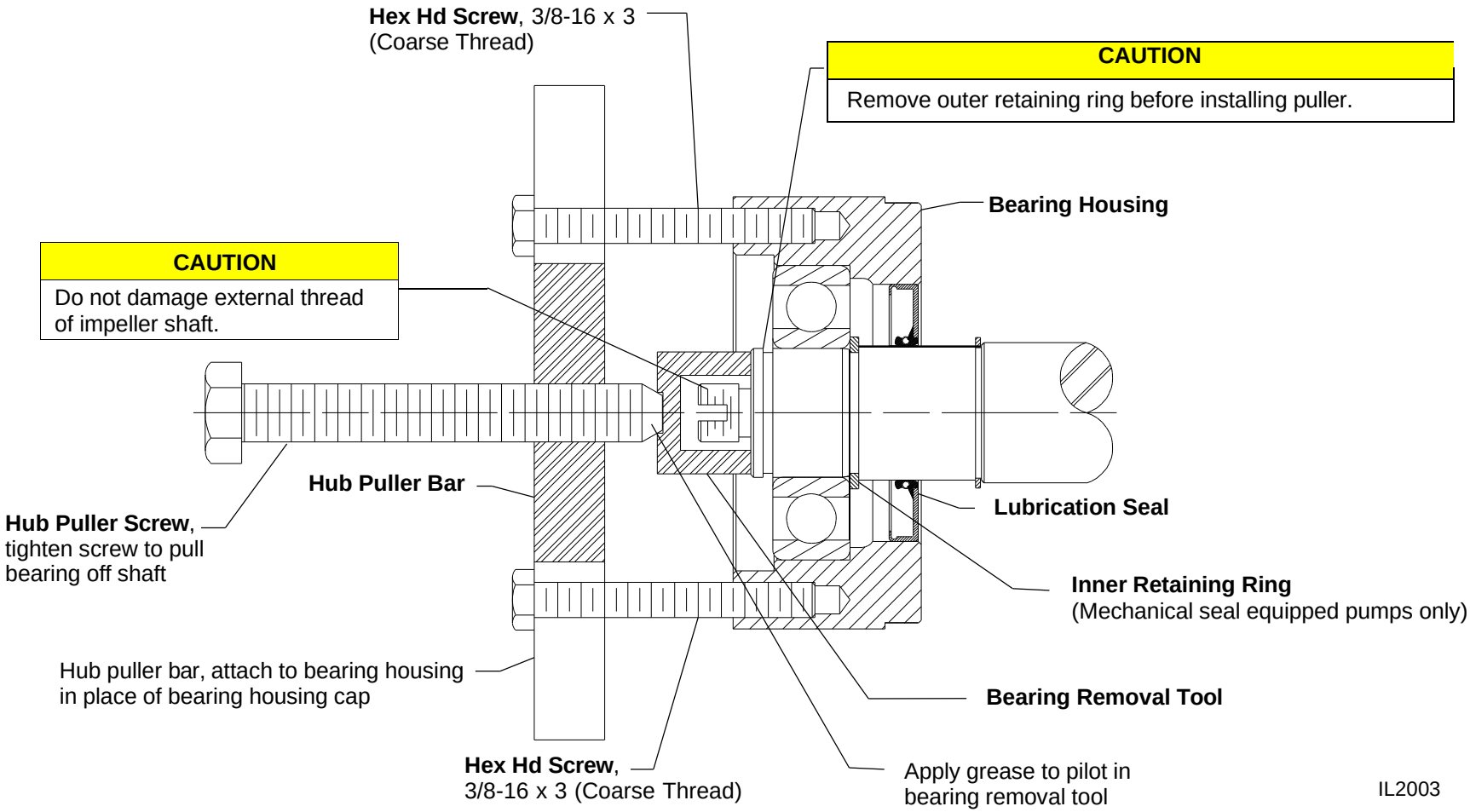
Make sure center of hub puller screw does not damage the threaded center of shaft. Apply grease to shaft center or bearing removal tool before installing hub puller.

5. Tighten hub puller screw, causing the bearing housing to pull the bearing off of the end of the impeller shaft.
6. Remove inner bearing retaining ring from impeller shaft. (Note: Inner retaining ring not used on pumps with packing).
7. Remove and discard lubrication seal. Remove bearing from bearing housing. Completely clean bearing housing of grease and replace bearing.
8. Remove inner bearing retaining ring from impeller shaft. (Note: Inner retaining ring not used on pumps with packing).

Outboard Bearing Removal (without Lube pump, Prior to 4/21/2006)



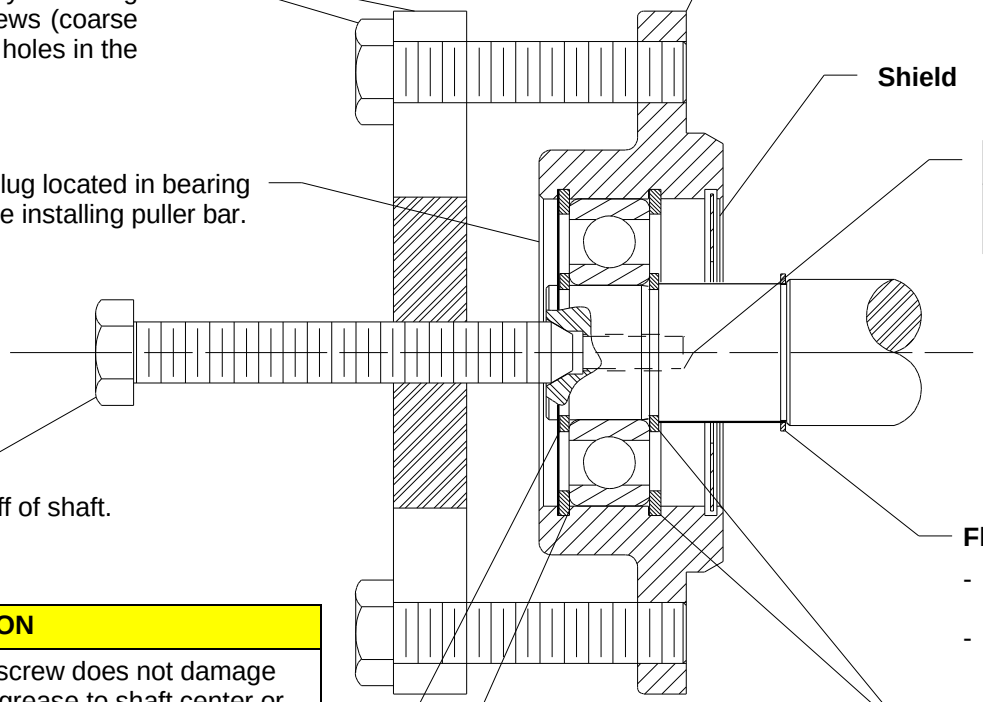
Outboard Bearing Removal with Lube Pump (Prior to 4/21/2006)



Outboard Bearing Removal (After 4/21/2006)

1. Remove plug from bearing housing.
2. Remove the outer retaining rings. Note that the ring on the shaft must be removed. The ring in the bearing housing may be left in place, but it must be removed before the new bearing is installed.
3. Remove (4) 3/8-16 hex hd screws attaching the bearing housing to the pump body.
4. Install hub puller bar. (Use bearing removal tool if removing outboard bearing on units equipped with oil pump - See Page 16).
5. Tighten hub puller screw, causing the bearing housing to pull the bearing off of the end of the impeller shaft.
6. Remove inner bearing retaining rings from impeller shaft and bearing housing. **(Note: Inner retaining ring on shaft is not used on pumps with packing).**
7. Remove the outer retaining ring from the bearing housing if it was left in place during step no. 2.
8. Remove bearing from bearing housing.

Outboard Bearing Removal (After to 4/21/2006)

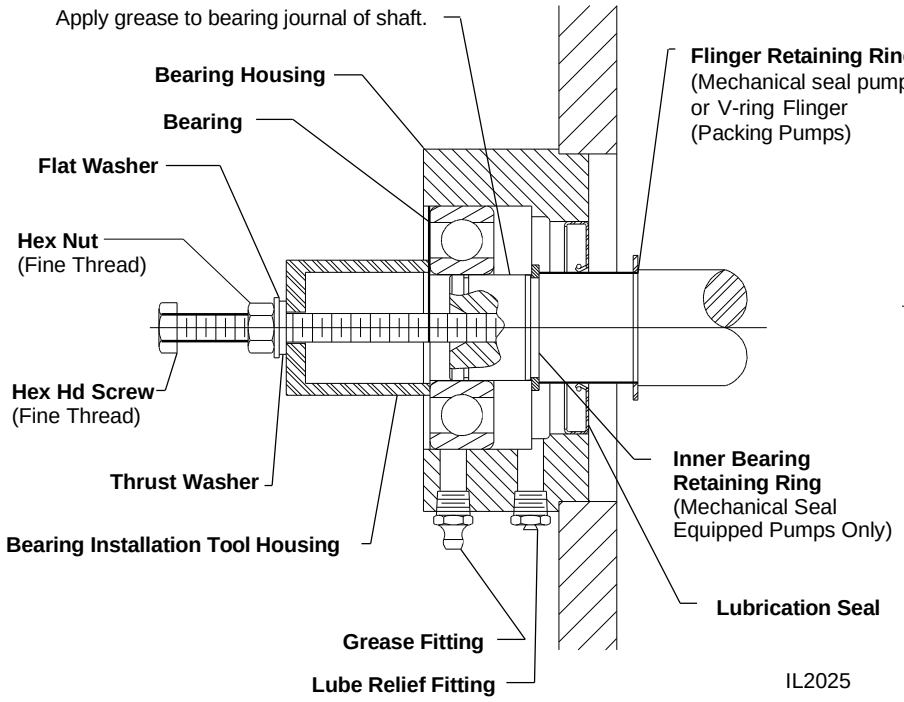


Outboard Bearing Installation (Prior to 4/21/2006)

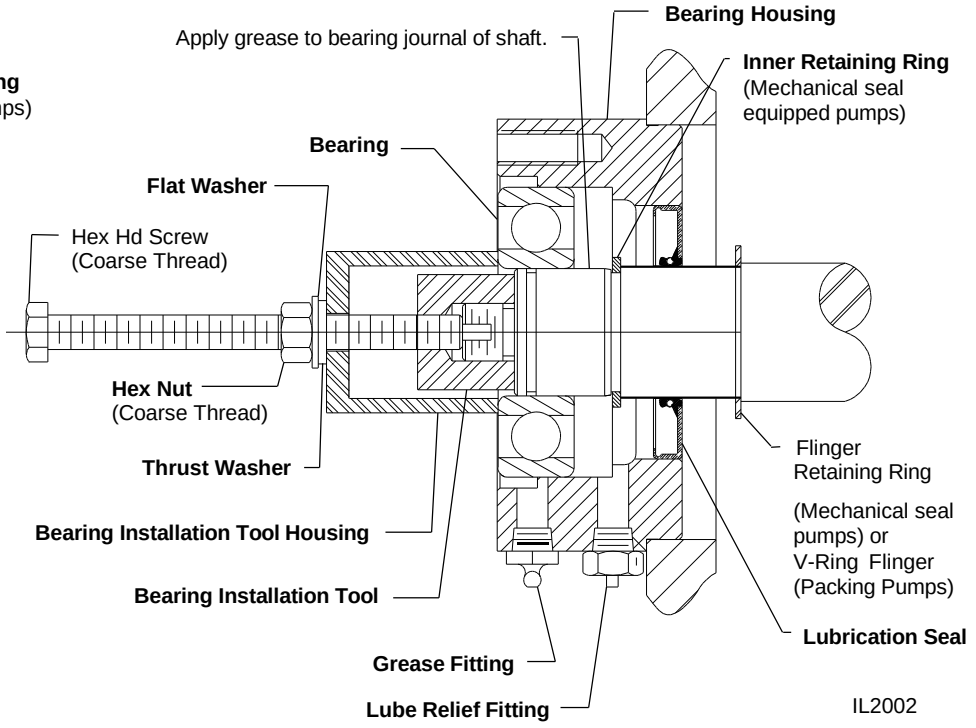
1. Packed Pumps: Install v-ring flinger on impeller shaft. Mechanical Seal Pumps: Install (flinger) retaining ring on impeller shaft.
2. Install new lubrication seal in bearing housing and reinstall bearing housing on pump.
3. Install inner bearing retaining ring. (Note: Inner retaining ring not used on pumps with packing). Ensure correct retaining ring is used.

   NOTE: Retaining rings changed 7/1/95. If groove width is 1/16" wide use W 4510-137, if 3/32" wide use W 4520-137.
4. Apply grease to the bearing journal of the impeller shaft to aid in assembly and slide the bearing into the bearing housing until it contacts the impeller shaft.
5. Screw hex nut onto hex hd screw and slide flat washer, thrust washer and bearing installation tool housing onto screw.
   a. For units equipped without an oil pump attach assembled tool to the impeller shaft by threading hex hd screw completely into the internal thread of the impeller shaft.
   b. For units equipped with and oil pump, thread bearing installation tool onto the external thread of the impeller shaft. Attach assembled tool to the bearing installation tool by threading hex hd screw completely into the internal thread of the bearing installation tool.
6. Push the bearing onto the impeller shaft until it seats against the inner retaining ring (or shaft shoulder) by tightening the hex nut against the bearing installation tool housing. It may be necessary to hold the hex hd screw to prevent it from turning with the hex nut.
7. Remove the tool and install the bearing outer retaining ring. Ensure correct retaining ring is used.
8. Install the bearing housing cap and gasket. Make sure the slot on the cap lines up with the grease fitting. Install oil pump and gasket (if so equipped). Make sure the drive tang on the oil pump lines with the slot in the impeller shaft.
9. Fill the bearing housing chamber with a medium consistency ball and roller bearing grease (such as Amoco Super Permalube) until the grease comes out of the lube relief fitting. Check that lubrication seal has not leaked.

Outboard Bearing Installation (without Lube Pump) Prior to 4/21/2006



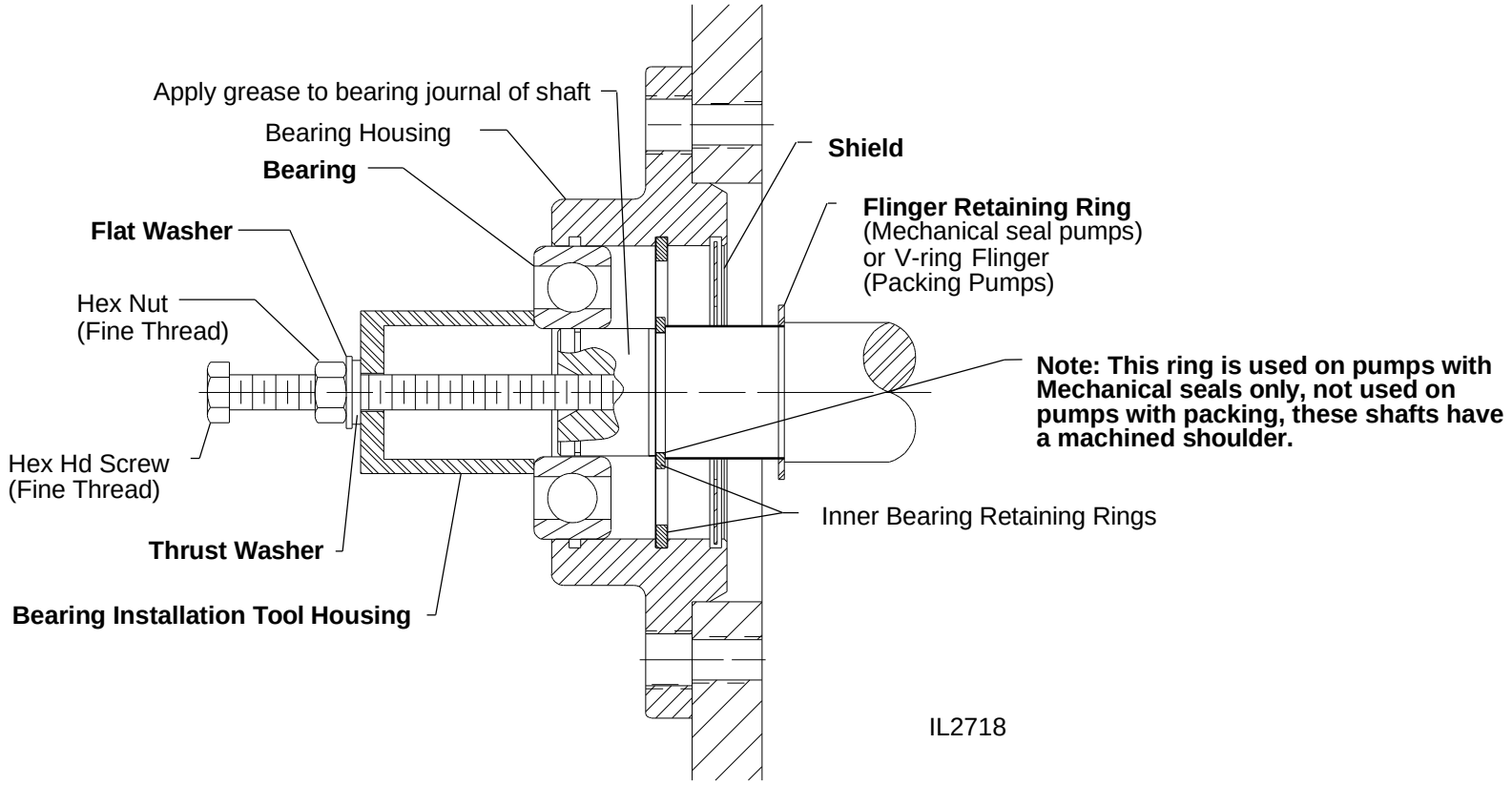
Outboard Bearing Installation (with Lube Pump) Prior to 4/21/2006



Outboard Bearing Installation (After 4/21/2006)

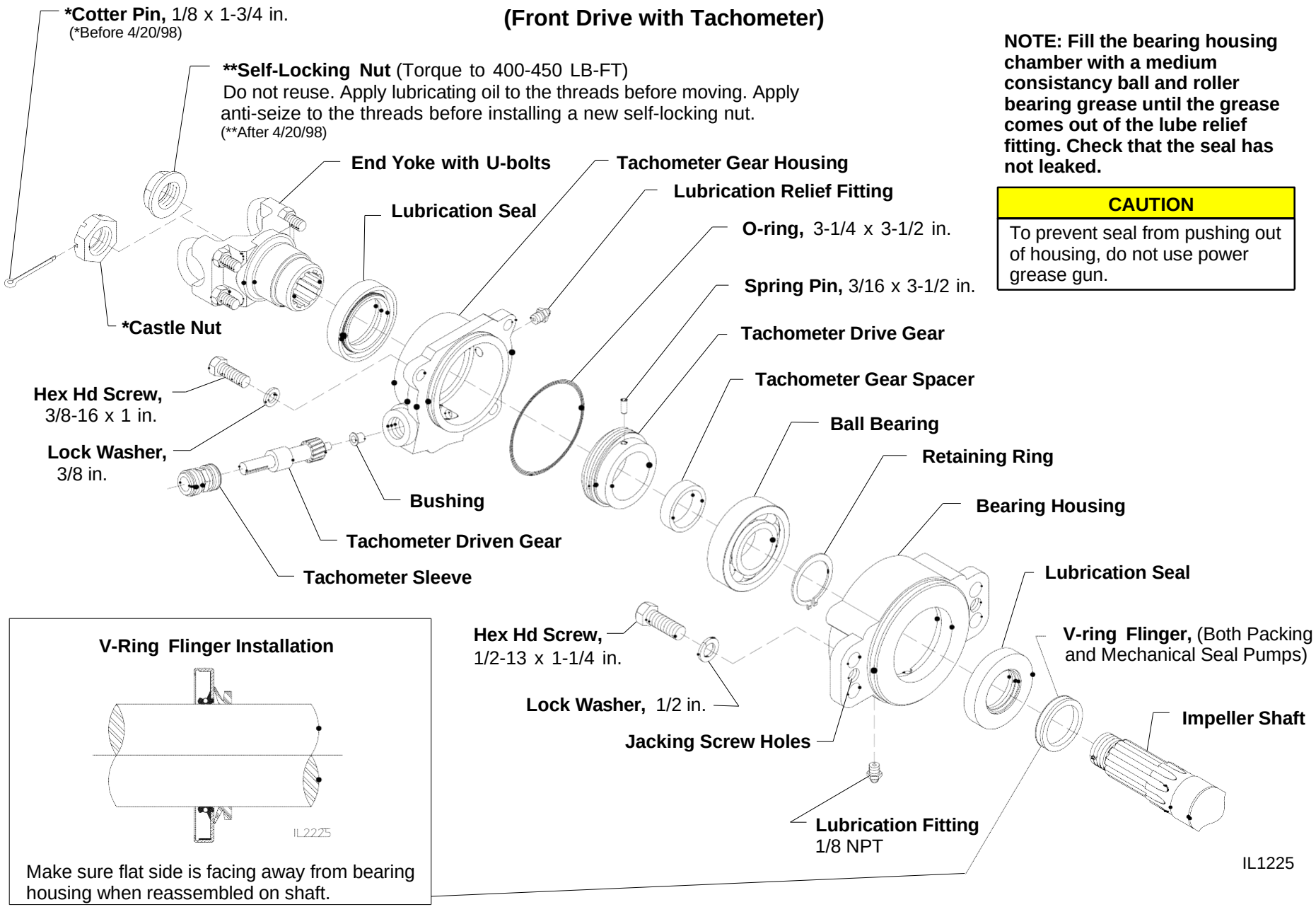
1. **Packed Pumps**: Install v-ring flinger on impeller shaft.
   Mechanical Seal Pumps: Install (flinger) retaining ring on impeller shaft.
2. Install new shield seal in bearing housing and reinstall bearing housing on pump.
3. Install inner bearing retaining rings. **(Note: Inner retaining ring on shaft is not used on pumps with packing).**
4. Apply grease to the bearing journal of the impeller shaft to aid in assembly and slide the bearing into the bearing housing until it contacts the impeller shaft.
5. Screw hex nut onto hex hd screw and slide flat washer, thrust washer and bearing installation tool housing onto screw.
6. Push the bearing onto the impeller shaft until it seats against the inner retaining ring (or shaft shoulder) by tightening the hex nut against the bearing installation tool housing. It may be necessary to hold the hex hd screw to prevent it from turning with the hex nut.
7. Remove the tool and install the bearing outer retaining rings.
8. Install plug in outside of bearing housing.
9. Note that bearing is sealed and does not required external lubrication.

Outboard Bearing Installation (after 4/21/2006)



End Yoke Removal/Installation on Drive End

(Front Drive with Tachometer)



NOTE: Fill the bearing housing chamber with a medium consistancy ball and roller bearing grease until the grease comes out of the lube relief fitting. Check that the seal has not leaked.

CAUTION

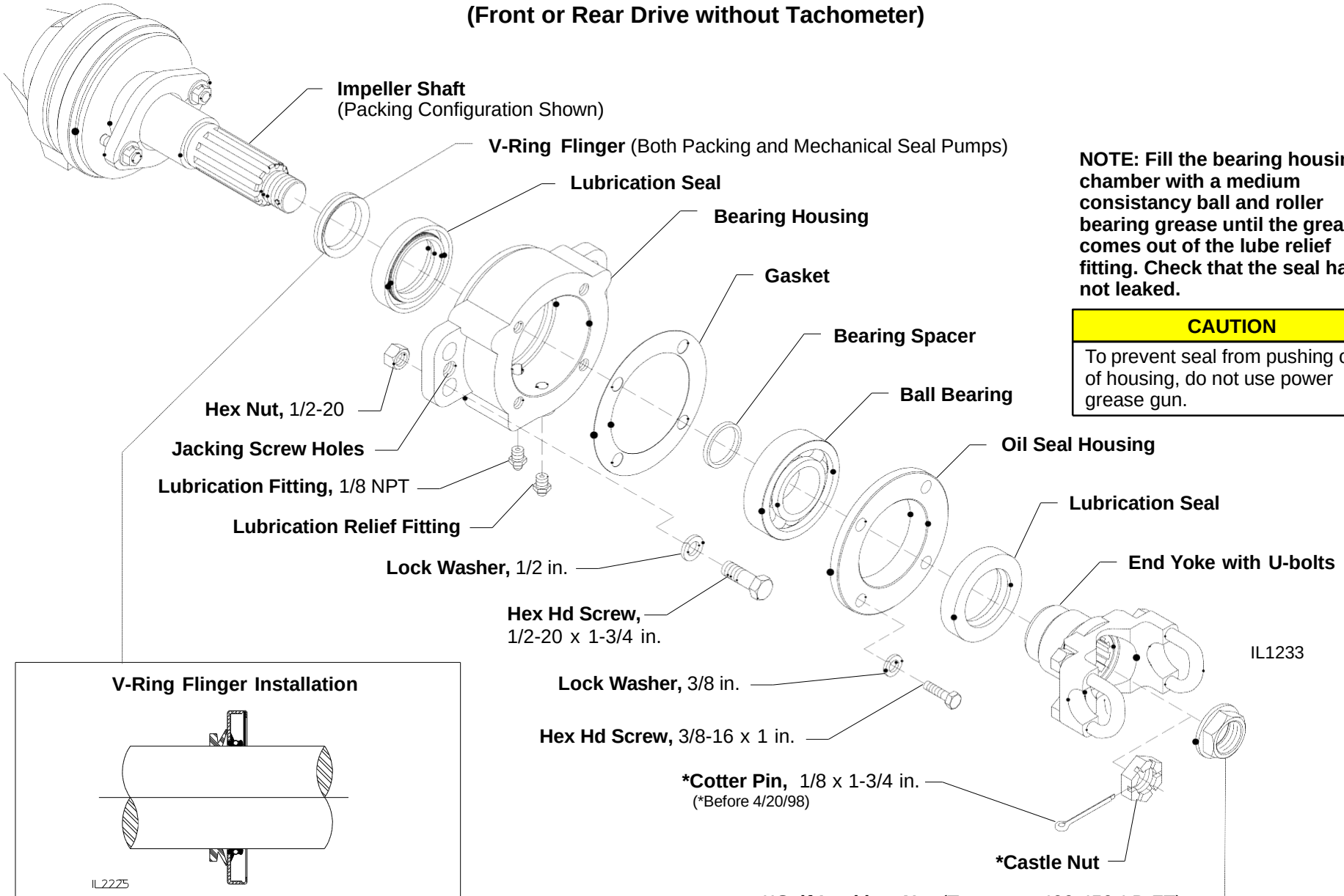
To prevent seal from pushing out of housing, do not use power grease gun.

V-Ring Flinger Installation

Make sure flat side is facing away from bearing housing when reassembled on shaft.

End Yoke Removal / Installation on Drive End

(Front or Rear Drive without Tachometer)



NOTE: Fill the bearing housing chamber with a medium consistancy ball and roller bearing grease until the grease comes out of the lube relief fitting. Check that the seal has not leaked.

CAUTION

To prevent seal from pushing out of housing, do not use power grease gun.

V-Ring Flinger Installation

Make sure flat side is facing away from bearing housing when reassembled on shaft.

****Self-Locking Nut** (Torque to 400-450 LB-FT)
Do not reuse. Apply lubricating oil to the threads before moving. Apply anti-seize to the threads before installing a new self-locking nut. (**After 4/20/98)

Mechanical Seal Removal

(Without Disassembling the Pump)

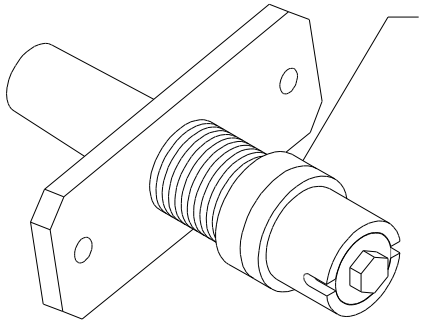
1. Replacing the mechanical seal will be easier when using the special tools designed by Waterous Company. These tools may be purchased from Waterous Company or fabricated by the user.

   K956 *Outboard bearing removal/installation tools*

   K628 *Mechanical seal removal/installation tools*

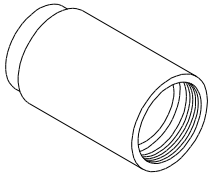
Parts of Kit K 628

Mechanical Seal Removal / Installation Tools



REMOVAL TOOL

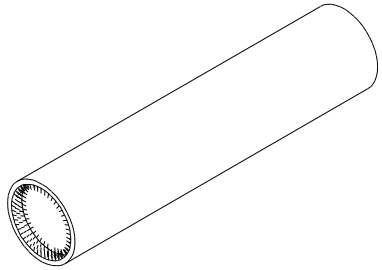
P/N 72385



TOOL PROTECTION SLEEVE/INSTALLATION TOOL

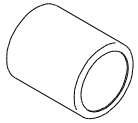
(Use as a cover to protect removal tool threads when not in use)

P/N 62896 PART OF 72385



IMPELLER SHAFT BRUSH

P/N V 2633

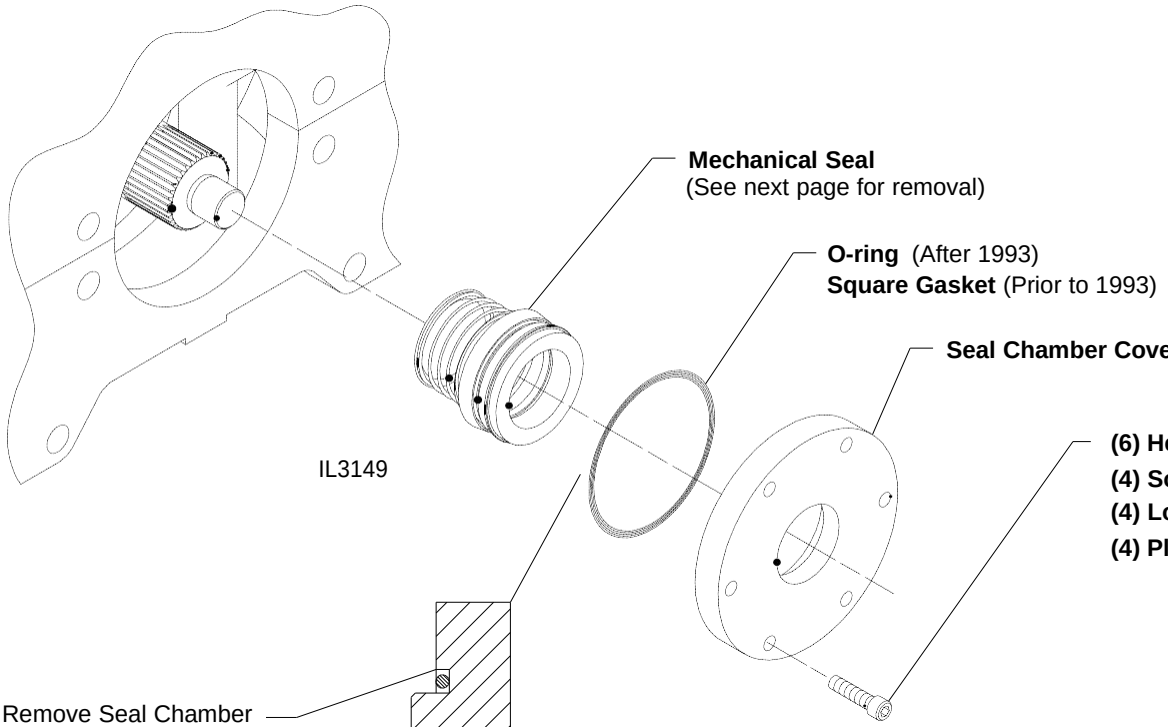


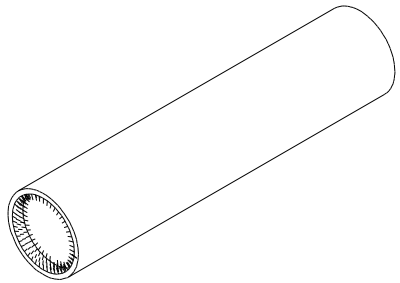
INSTALLATION SLEEVE
P/N 52280

2. Whenever a mechanical seal requires replacement, the Waterous Service Department strongly recommends replacing both seals; outboard bearing and drive end. **Note: Always replace the outboard seal and bearing assembly first.**

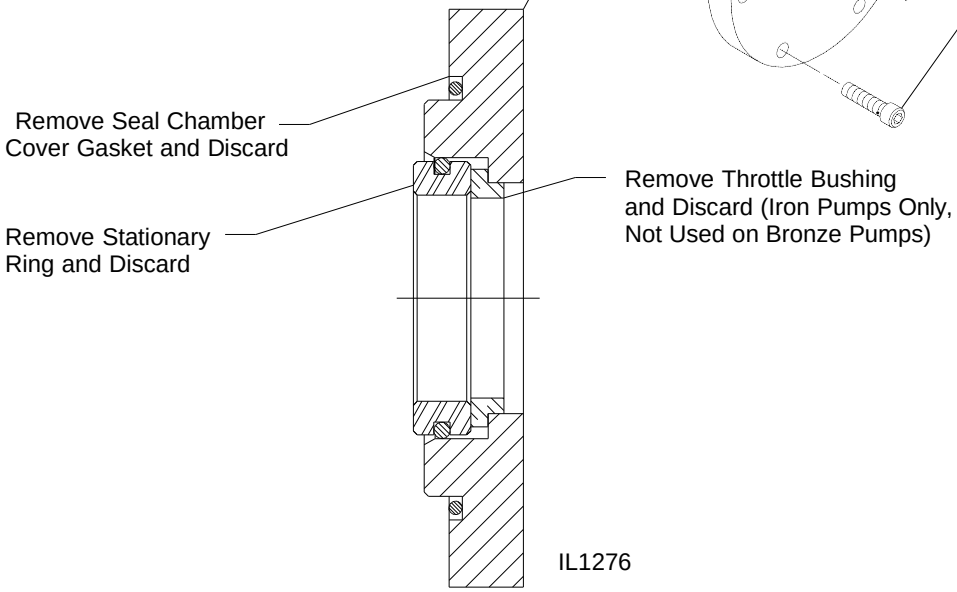
Mechanical Seal Removal

(Without Disassembling the Pump)





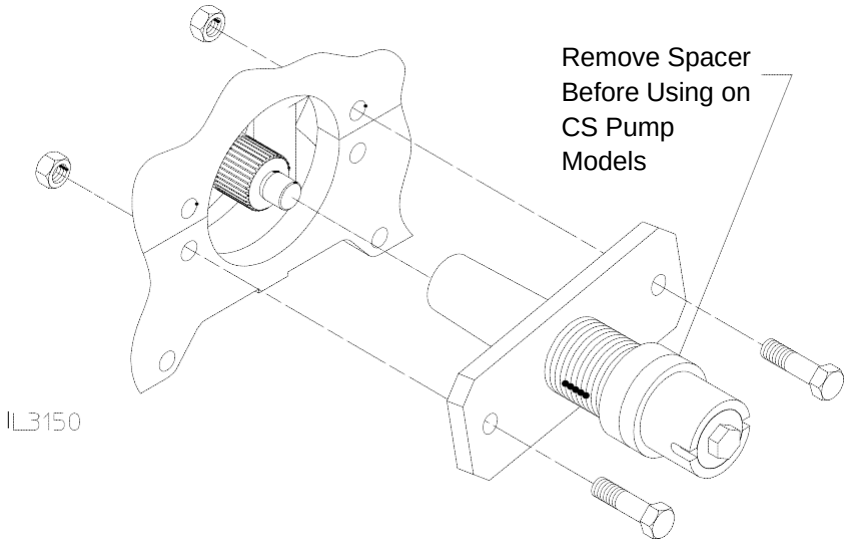
Brush (P/N V 2633)

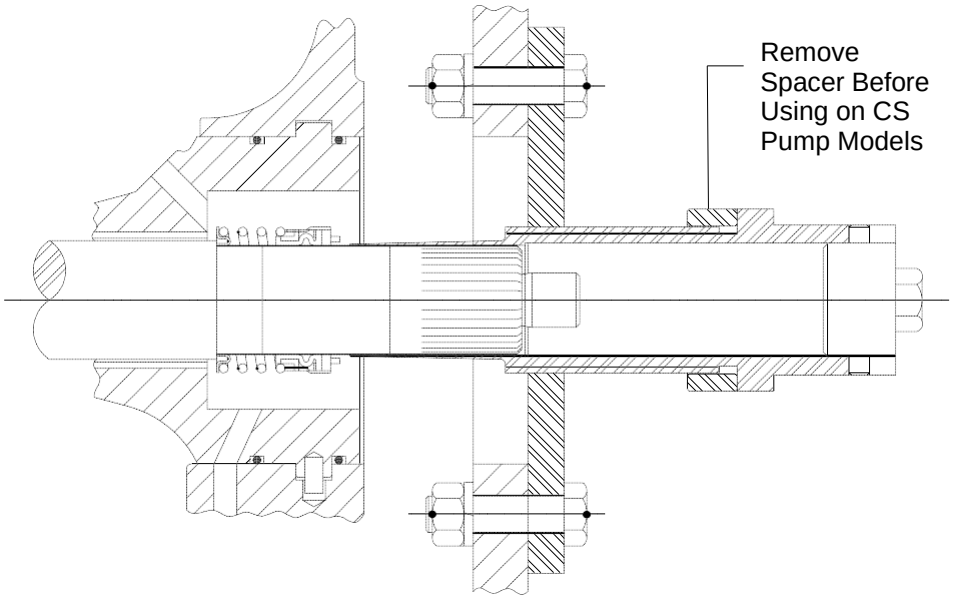


3. **Clean the impeller shaft**, using the impeller shaft brush (P/N V2633)/.
4. Remove the screws (and washers if applicable) that attach the seal chamber cover to the seal housing and remove the cover.
5. **Clean the impeller shaft** again to remove any debris that may remain.
6. Remove the stationary ring from the seal chamber cover by clamping the protruding diameter of the stationary ring in a vise, then pulling the seal chamber cover away from the vise.
7. Remove throttle bushing and discard.
8. Discard the O-ring from seal chamber cover. Clean seal chamber cover.

Mechanical Seal Removal

(Without Disassembling the Pump)





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9. Attach the mechanical seal removal tool to the pump body using two of the mounting holes in the body and the screws and nuts from the bearing housing. The plate must be flush with the pump body, but tighten screws hand-tight only.
10. Turn the hex head on the removal tool clockwise until it touches seal, then 1 inch to 1-1/4 inch further (the primary ring in the mechanical seal may break from the force).
11. Turn the hex head on the removal tool counterclockwise to remove the seal.
12. Remove the tool and the seal.
13. Remove spring retainer and spring if they do not come out with the seal. Clean seal chamber and impeller shaft.
14. Clean the sealing surface behind the seal chamber cover on the seal housing.

CAUTION
Remove spacer between removal tool and mounting plate before using on CS pump models. The spacer is used on two-stage CM models.

Mechanical Seal Installation

CAUTION

The entire mechanical seal installation procedure shall be completed without interruption. Delays may cause seal bellows to seat improperly.

Whenever a mechanical seal requires replacement, the Waterous Service Department strongly recommends replacing both seals; outboard bearing and drive end.
Note: Always replace the seal and bearing on outboard end first.

1. Inspect the new primary ring and stationary ring sealing surfaces. These surfaces should be "mirror smooth" and without scratches. To identify the stationary ring sealing surface examine the outside diameter of the ring. There is a chamfer towards the backside and the o-ring is close to the back.

CAUTION

Try not to touch the "mirror smooth" surfaces. If surfaces are touched clean surface with denatured alcohol and a soft cloth.

CAUTION

The mechanical seal primary and stationary rings are made of brittle material. The material can be cracked or chipped. Extra care must be taken when handling these rings.

2. Sub- Assemble seal chamber cover. See Figure 1. Install a new throttle bushing in the seal chamber cover. (A throttle bushing is not used on bronze pumps.) Install new stationary ring with new O- ring in the seal chamber cover, the mirror smooth seal surface should be visible, the chamfered O.D. edge should seat on the throttle bushing. Install new seal chamber cover O- ring gasket in the seal chamber cover.

CAUTION

The throttle bushing must be seated peroperly to avoid misalignment of the mating surfaces of the mechanical seal.

3. Install seals. See Figures 2 and 3.
   a. On the outboard end of the pump, install the installation sleeve on the shaft which will allow the seal to slip over the shaft shoulder. Failure to use the installation sleeve may cause damage to the seal. Liberally coat shaft and sleeve with lubricant (supplied with kit) before installing the mechanical seal.
   b. Place spring retainer and spring on the shaft. Coat inside of mechanical seal bellows with lubricant and push seal on with installation tool until the spring retainer makes contact with shaft shoulder. Continue pushing the seal until the spring is fully compressed. Remove the installation tool slowly allowing the spring to relax. Remove the protection sleeve from the shaft (outboard end only).

CAUTION

Do not get lubricant on the sealing surfaces on the stationary ring or primary ring. If surfaces get lubricant on them clean with a soft cloth and denatured alcohol.

Note: If Waterous Mechanical Seal Lubricant part no. 52608 is not available, P80 rubber lubricant, straight dish soap or glycerin may be substituted.

4. Install seal chamber cover. See Figure 4.
   a. Be sure the stationary ring, O-ring, throttle bushing and O-ring gasket are installed in seal chamber cover (See Step 2).
   b. Install the seal chamber cover on the shaft and slowly push on with installation tool. The seal chamber cover will guide the mechanical seal into place. When the cover contacts the pump body, attach with the screws previously removed during disassembly.

   Note: Before proceeding, both replacement seals (outboard and drive end) and the outboard bearing should be installed. As recommended earlier, both seals should be replaced at the same time. Outboard end seal and bearing assembly should be completed first.

5. Turn impeller shaft by hand at least two revolutions in both a clockwise and counterclockwise direction to seat seals.

6. Hydrostatically test pump at 150 P.S.I.G. Observe impeller shaft at throttle bushing and intersection of the seal chamber cover with pump body split line for leaks. Turn impeller shaft by hand while retaining the hydrostatic pressure to see if there is leakage between the throttle bushing and impeller shaft. If leakage persists, after one or two minutes of rotation (10 to 12 turns) disassemble and inspect.

Mechanical Seal Installation - Continued

Figure 1. Seal Chamber Cover Sub-Assembly

1. Install new throttle bushing (iron Pumps Only)
2. Install new seal stationary ring.
3. Install new gasket or O-ring.

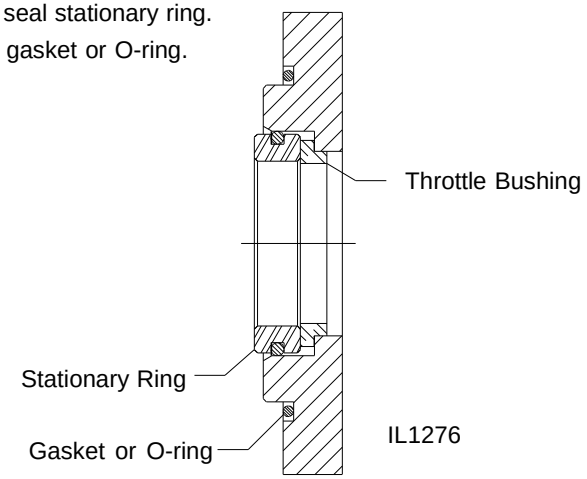


Figure 3. Transmission End Seal Installation

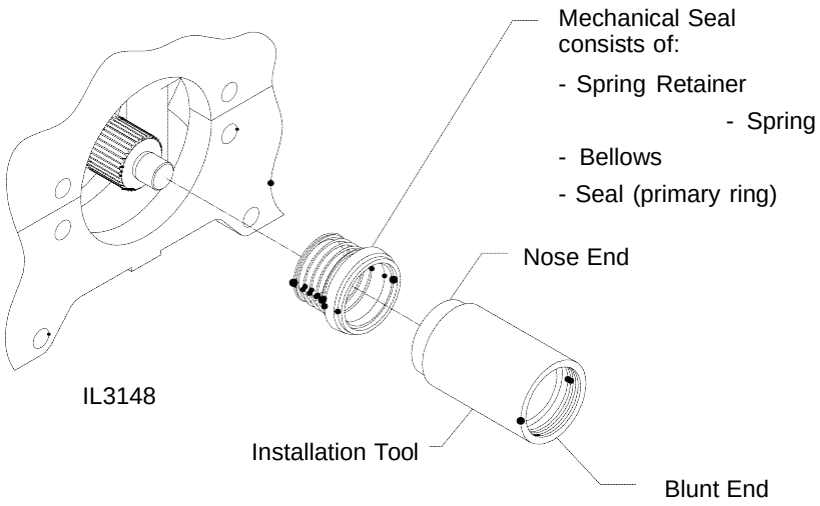


Figure 2. Outboard Bearing End Seal Installation

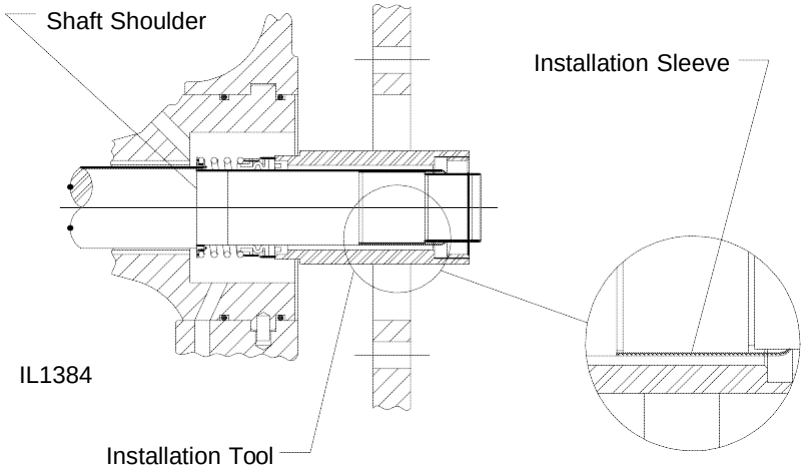
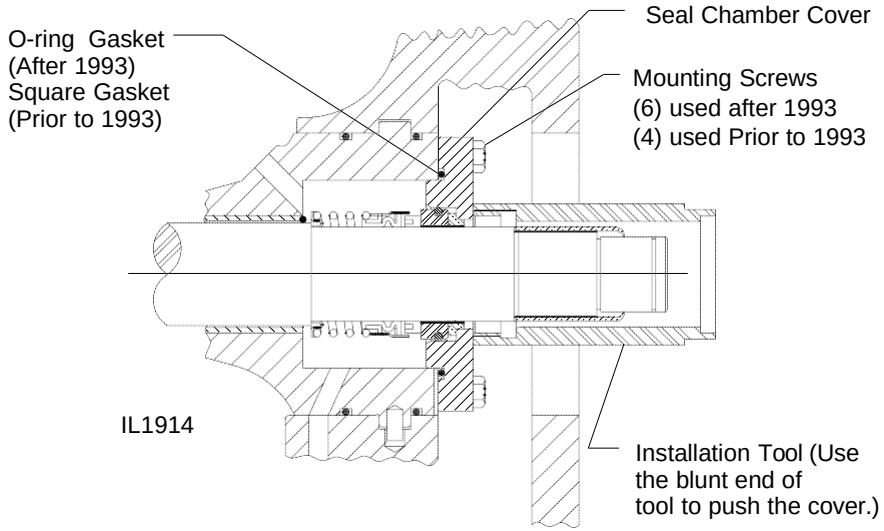


Figure 4. Seal Chamber Cover Installation



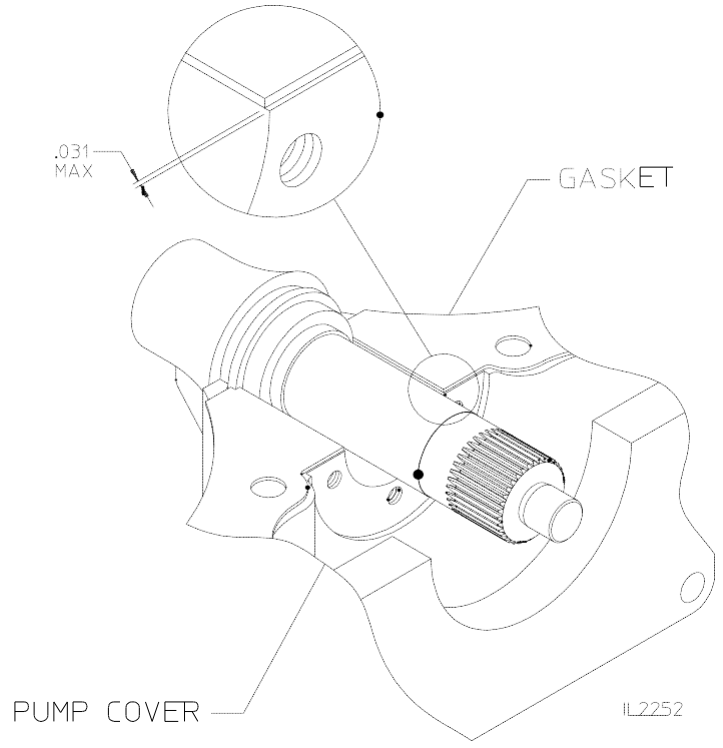
Body Gasket Installation when the Pump Body is Disassembled

Pumps without Separate Seal Housings

(See page 2 for method of determining which type of seal housings your pump has)

The mechanical seals should be installed in the pump after the impeller shaft has been installed and the body halves are bolted together. Before bolting body halves together, pay special attention to the body gasket in the seal cover area on both ends of the pump as follows:

- The seal chamber cover seal (square cross-section rubber ring) can seal into gaps at the pump body split line a maximum of 1/16 inch deep. The sealing capability depends on gap width, seal hardness, etc.
- The pump body gasket should come as close as possible to being flush (without protruding) with the edge of the pump body at the seal chamber cover sealing surface. It is recommended that the gasket be within 1/32 inch of the edge of the pump body. This applies to both ends of the pump.

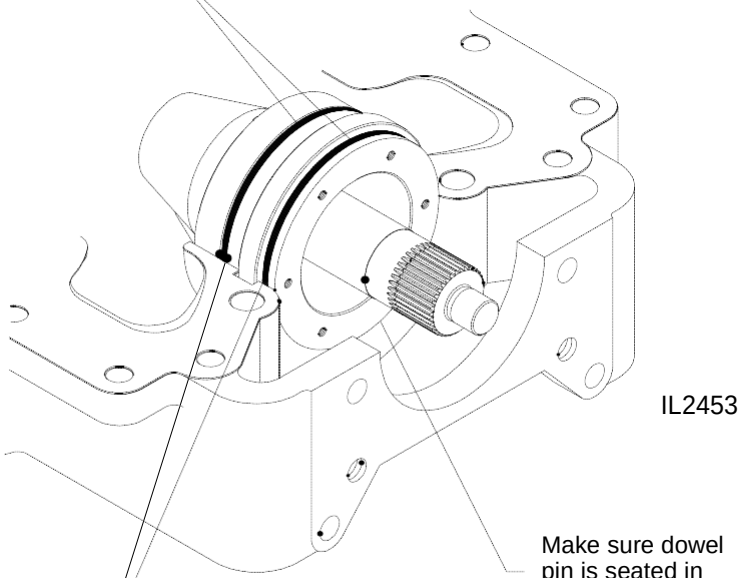


Body Gasket Installation when the Pump Body is Disassembled

Pumps with Separate Seal Housings

(See page 2 for method of determining which type of seal housings your pump has)

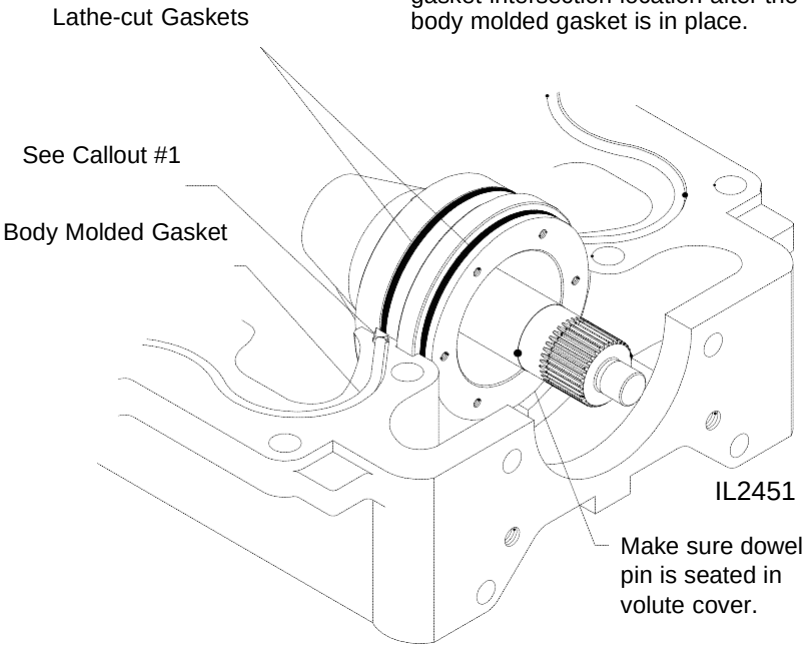
The mechanical seals should be installed in the pump after the impeller shaft has been installed and the body halves are bolted together. Before bolting body halves together, pay special attention to the flat body gasket or the body molded O-ring gasket in the seal housing area on both ends of the pump as follows:



Flat Gasket

Callout #1

Apply a pea size drop of 100% silicone RTV sealant at the inter-section between the body molded gasket groove and the lathe-cut gasket (2 locations per seal housing). Add another pea size drop of silicone sealant at each of the body molded gasket and lathe-cut gasket intersection location after the body molded gasket is in place.



Molded O-ring Gasket