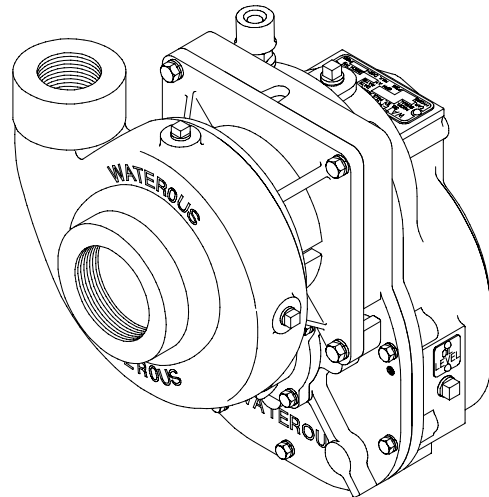


# CP-1, CP-2, CP-2L, CPD-2, E301-A and E302-A Series Fire Pumps

## Overhaul Instructions

| Form No. | Section | Issue Date | Rev. Date |
|----------|---------|------------|-----------|
| F-1031   | 4205.1  | 02/88      | 01/18/08  |

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**WATEROUS**  
*Fire Pumps – Since 1886*



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# Safety Information

Please read through the safety information and operating instructions carefully before using your Waterous Fire Pump.



## WARNING

Death or serious personal injury might occur if proper operating procedures are not followed. The pump operator, as well as individuals connecting supply or discharge hoses to the apparatus must be familiar with these pump operating instructions as well as other operating instructions and manuals for the apparatus, water hydraulics and component limitation.



## WARNING

### Pressure Hazard. May result in personal injury.

Prior to connection or removal of hoses, caps or other closures with pump intake or pump discharge connections, relieve pressure by opening drains or bleeder valves. Bleeder valves should also be used while filling a hose connected to an intake with water.



## WARNING

### Scalding Water Hazard. May result in serious burns.

When operating the pump, be sure to open at least one discharge valve slightly to prevent the pump from overheating. If the pump runs for a few minutes completely closed, it may heat the water enough to scald someone when the valve is opened. Overheating can damage the packing, seals and other pump parts. If the apparatus builder has installed a by-pass system or other provision designed to prevent overheating, opening a discharge valve may be unnecessary.



## WARNING

### Unexpected Truck Movement. May result in serious personal injury or death.

Failure to properly shift transmission in accordance to the transmission operating instructions may result in unexpected truck movement which may result in serious personal injury or death.



## WARNING

### Rotating Parts Hazard or Unexpected Truck Movement. May result in serious personal injury or death.

Stop the engine, set parking brake and chock the wheels before going under the truck to adjust packing or to check packing gland temperature.



## WARNING

### Packing Gland and Pump Body Temperature Hazard. May result in serious burns.

Heat is dissipated through the cross-section of the packing, transferring the heat to the packing gland and pump body.

## Introduction

This section contains overhaul instructions for Waterous CP-1, CP-2, CP-2L and CPD-2 centrifugal fire pumps. Although several types of transmissions are used with the CP-1 and CP-2 pumps (CP-2L is used only with the TA transmission, CPD-2 is pedestal mounted), only the K-series transmission is covered in this instruction. NOTE that this instruction is written to cover several variations of the CP-1 and CP-2 pumps, not all steps will apply to any one pump.

Also refer to the Service Parts List (SPL documents) furnished with your pump to aid in further part identification and repair parts ordering.

E301-A and E302-A models are CP-1 and CP-2 pumps mounted on Kubota diesel engines from the factory. Any of the following instructions for CP-1 and CP-2 models apply to E301-A and E302-A models (respectively).

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## General Description

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The CP series pumps are designed to provide a wide range of pressures and capacities and can be driven by a truck transmission mounted power take-offs or other suitable drives. All CP-1 and CP-2 pumps have an integral speed increasing transmission with proper gear ratios to provide required impeller

speeds at available input speeds, whether pumping from tank, draft or in relay operation. CP pumps may be operated independently, simultaneously or in series with the main pump on the apparatus.

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## General Overhaul Information

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### ***Tools and Equipment***

The following tools and equipment are needed to overhaul a pump:

1. Usual automotive mechanic's hand tools.
2. An arbor press for assembling or disassembling components.
3. An engine lathe for turning impeller hubs.
4. A suitable hoist and slings.
5. Torque capability up to 325 lb-ft.

While no special tools and equipment are required, a few special items are illustrated or described so the mechanic can make them or they are available from the apparatus manufacturer or the Waterous Company. These special items are not absolutely necessary, but they will make the mechanic's work much easier.

### ***Preliminary Testing***

Before disassembling a pump, test it thoroughly, if possible, and record the results. A comparison of this test with periodic tests recommended in form F-1031, Section 1000 can often reveal specific pump troubles. Excessive speed, for instance, indicates that impellers and/or wear rings are probably worn.

### ***Cleaning***

The continued satisfactory operation of a pump depends to a great extent upon the cleanliness of its internal parts. Sand, dirt or other abrasive material will wear bearings, gears and related parts. Before disassembling a pump for repairs, be sure to clean its exterior. Make sure the working space, benches and tools are clean. Use only clean, lint-free cloths to wipe off components. Before reassembling a pump or its components, be sure to clean them thoroughly.

### ***Pump Bodies and Impellers***

Flush out these components and related parts with clean water. Use a stiff brush to remove loose scale, caked sediment, etc. Be sure to remove all traces of old gaskets. Examine pump bodies, covers, adapters and fittings for cracks, severe corrosion or other damage. Almost all damage to these parts results from improper use or maintenance, or from freezing. Replace defective parts.

### ***Bearings, Gaskets, Seals and O-rings***

Parts of this nature are frequently damaged during removal or disassembly. In addition, they sometimes deteriorate or lose their effectiveness because of age or misuse. Replacing these parts whenever overhauling a pump is a good policy.

### ***Impeller Shafts***

Examine shaft for severe scratches, grooves or corrosion - especially under packing or mechanical seals. If scratches are not severe, and are not under packing and seals, clean them with a fine-cut file. Grooves under the packing are usually permissible if they are not sharp or too deep. Even slight longitudinal scratches will cause leaks and should be removed.

### ***Installing Ball Bearings***

Most Waterous pumps are designed so that ball bearings fit tightly on their shafts and have relatively loose fits in the bearing housings. When mounting these bearings on shafts, always apply force to the inner races. When bearings have a tight fit in the housings, and a heavy force is necessary to install them, be sure to apply force only to the outer bearing races. For either type of fit, applying force to the wrong bearing race may damage the balls and race.

### ***Installing Body Gaskets***

To provide added sealing for gaskets between body halves, or between bodies and intake adapters, coat both sides of these gaskets with a suitable sealant. A compound such as Permatex Super 300 is recommended for this application. Be sure all traces of previous gaskets and sealant are removed before installing new gaskets.

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## **Disassembly**

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The disassembly instructions are divided into the following sections:

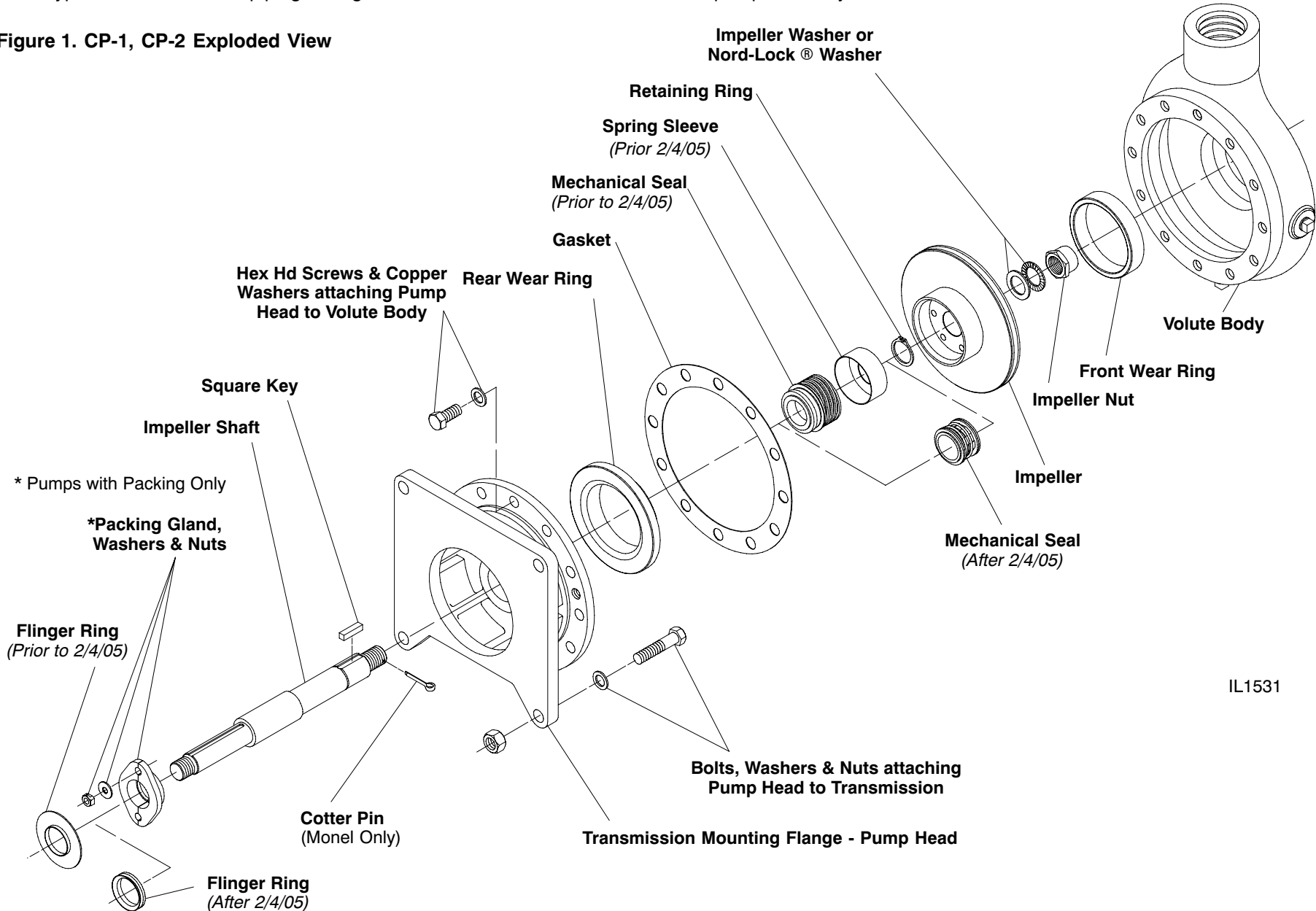
- ▣ CP-1, CP-2 Pumps
- ▣ CP-2L Pumps
- ▣ CPD-2 Pumps

## CP-1 and CP-2 Pumps

A CP-1 and CP-2 pumps may be disassembled in several ways, depending on the type of transmission or piping arrangement.

Removing the pump and transmission together and then disassembling the pump is usually the easiest method.

Figure 1. CP-1, CP-2 Exploded View



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## Removal of Volute Body from Pump Head

1. Remove the twelve (12) hex head screws and copper washers that attach the pump head to the volute body.

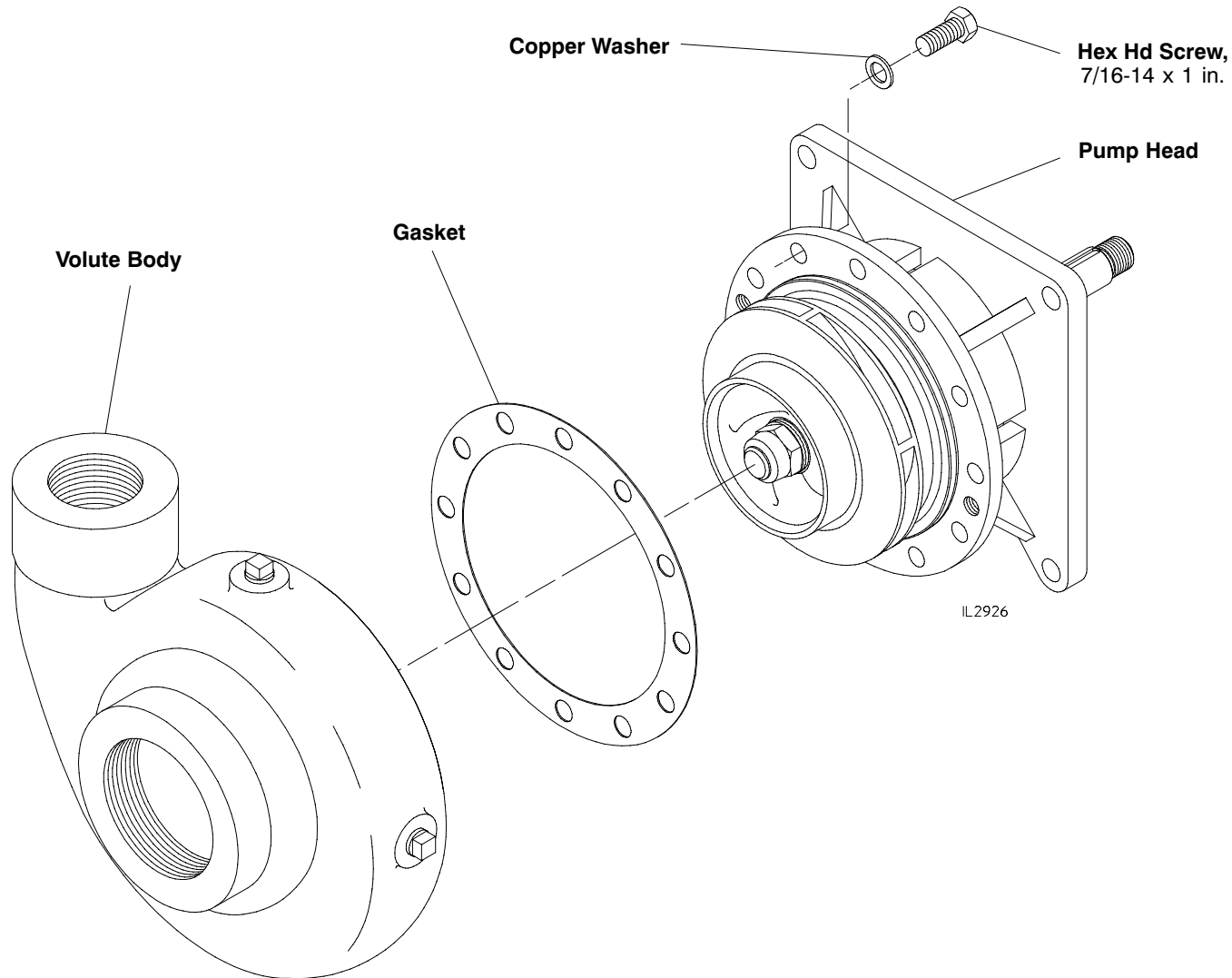
**NOTE: Self-locking hex head screws (nylok) are used on pumps with bronze bodies.**

2. Separate the pump head from the volute body.

3. Remove and discard the gasket.

**NOTE: The wear rings will remain in the volute body and pump head. Removing the wear rings from the body or head is necessary only if they are damaged or badly worn. (See page 19).**

**Figure 2. Volute Body Removal from Pump Head**



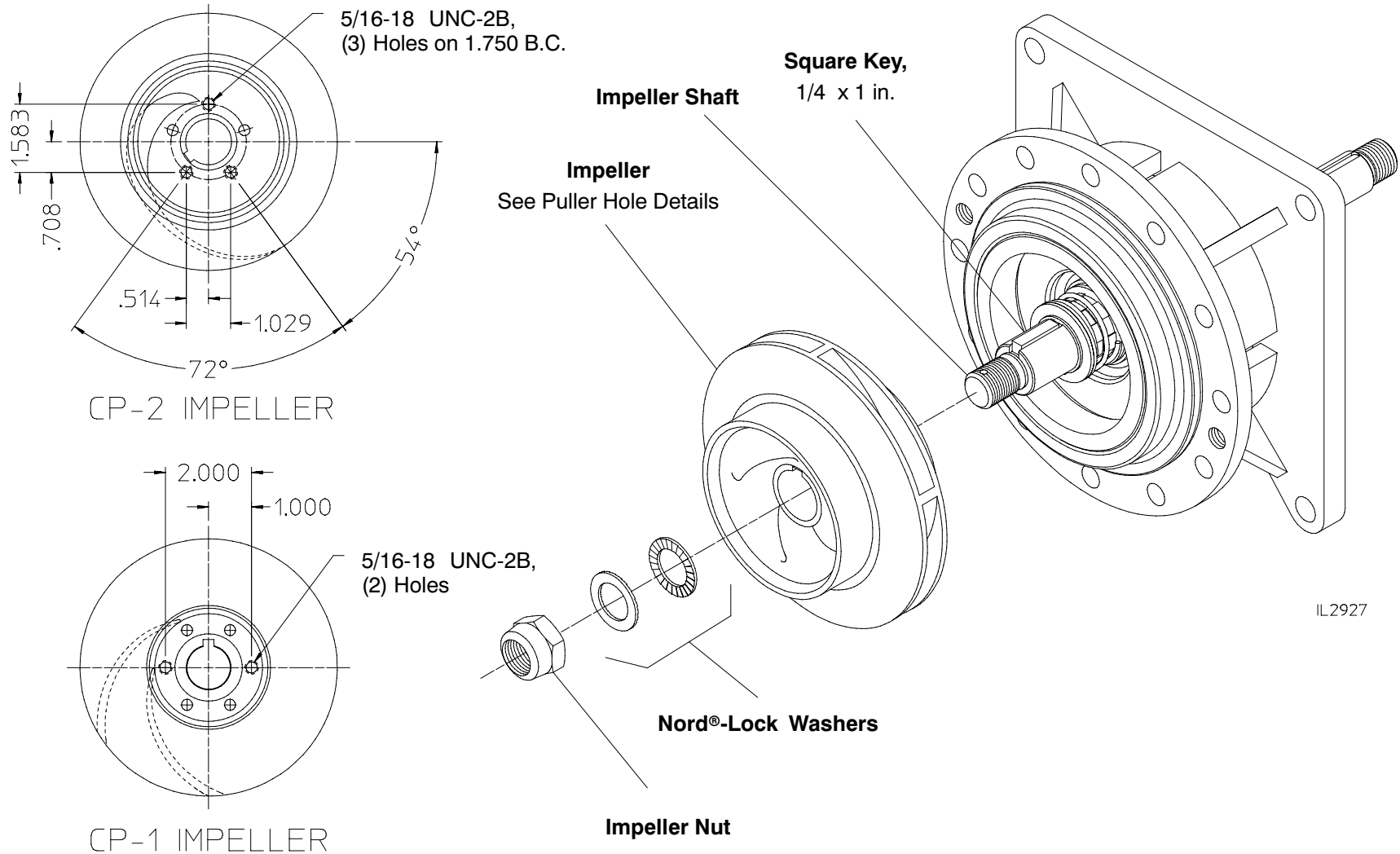
## Removal of Impeller

1. Remove the impeller nut and washers.

**NOTE: Nord®-Lock washers are used on pumps manufactured after 2/04/05.**

2. Remove impeller using puller holes.
3. Remove square key from impeller shaft.

Figure 3. Impeller Removal

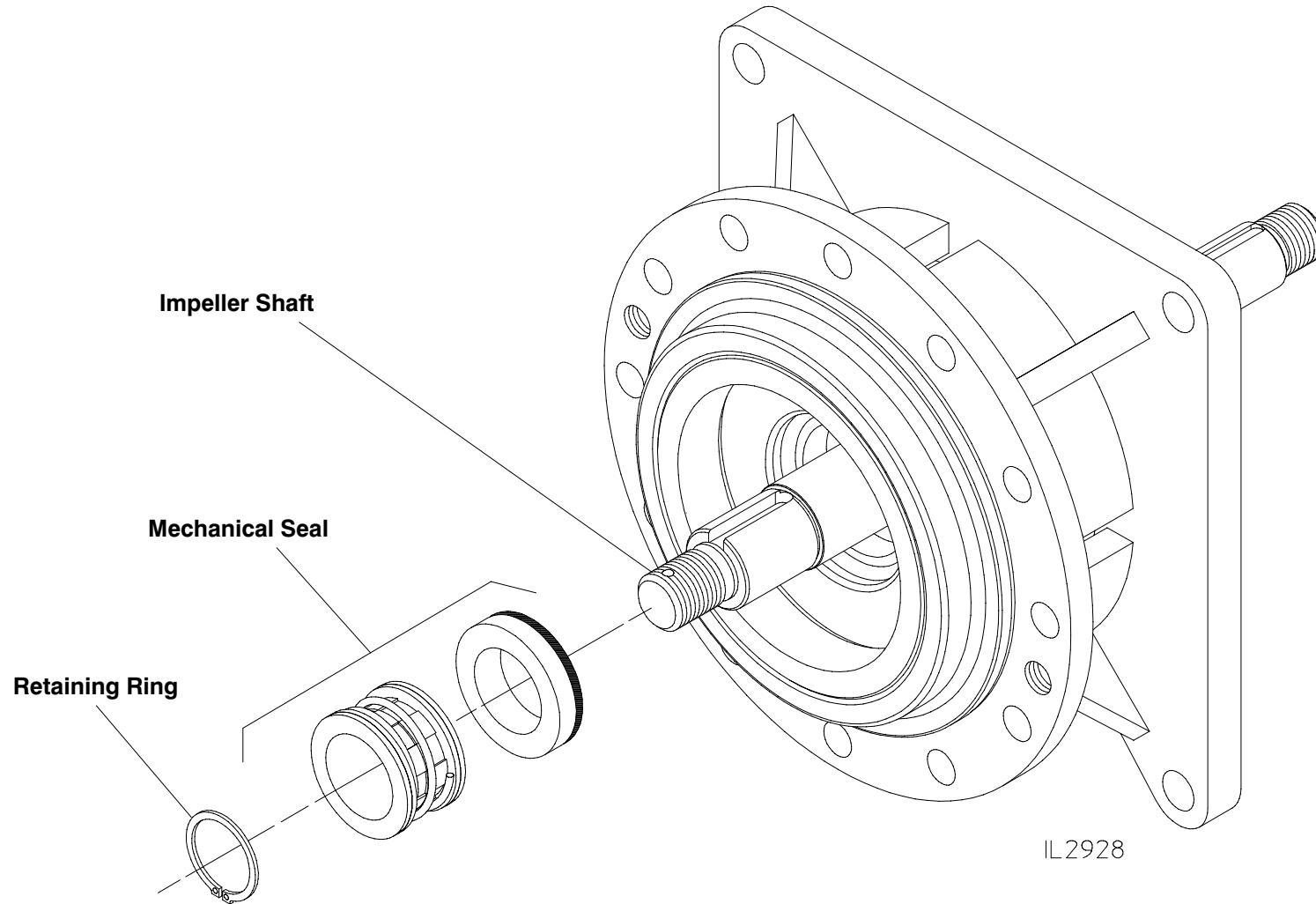


### ***Removal of Mechanical Seal***

1. Remove the retaining ring from the impeller shaft.
2. Lubricate the impeller shaft.

3. Slide the mechanical seal off the impeller shaft.

**Figure 4. Mechanical Seal Removal**





### **Removal of Pump Packing**

*(Not available on pumps manufactured after 02/04/05)*

For removal of the pump packing, follow **Packing - Braided Flexible Graphite (BFG)** section of this manual. Note that the packing removal procedure requires the pump and transmission to remain as one piece.

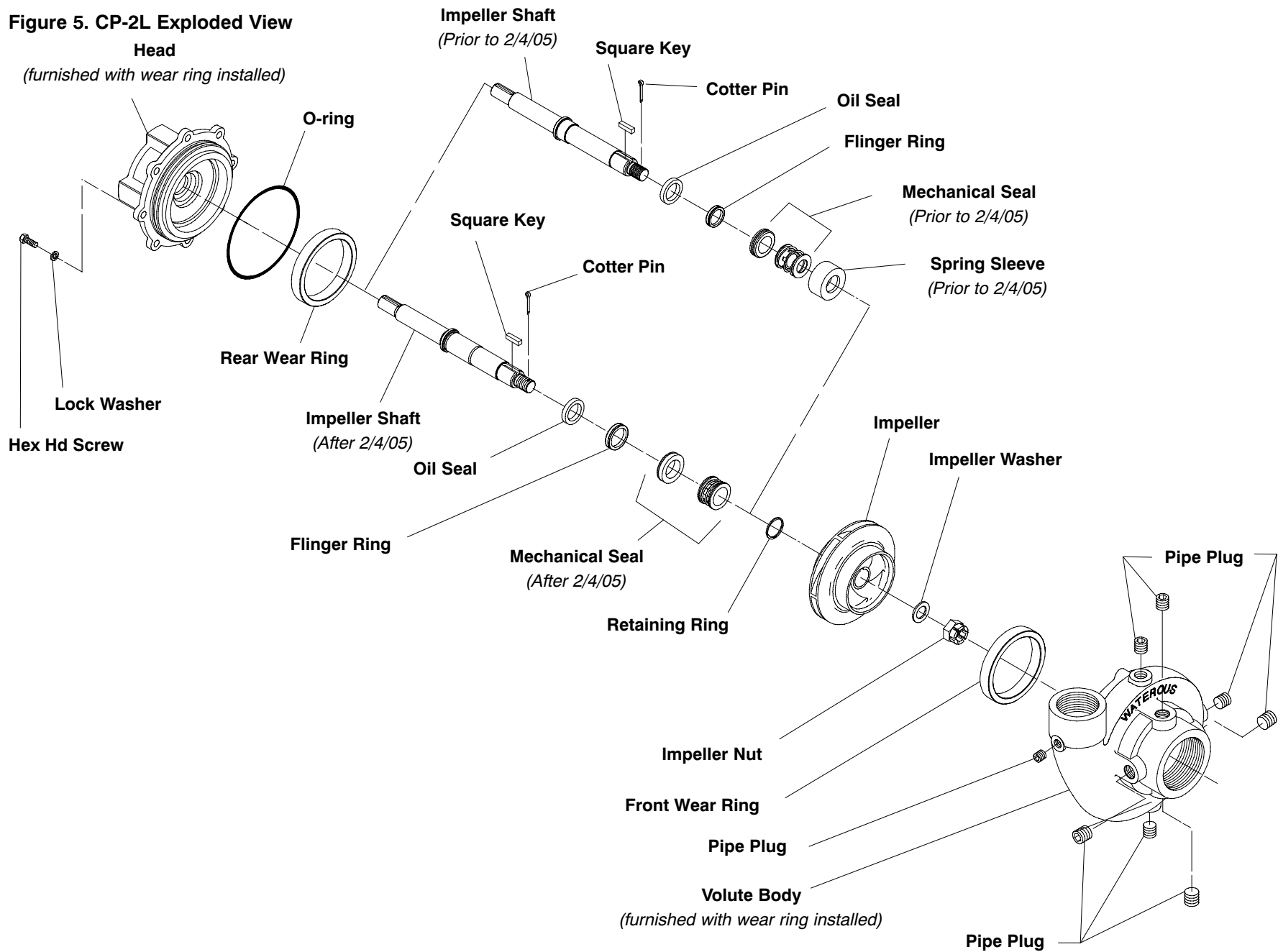
### **Removal of Impeller Shaft**

**NOTE: Removing the impeller shaft from the pump transmission is not necessary unless it is damaged. If impeller shaft removal is necessary, see the appropriate pump transmission overhaul instructions.**

# CP-2L Pumps

Removing the CP-2L pump and TA transmission together and then disassembling the pump is usually the easiest method for overhauling.

**Figure 5. CP-2L Exploded View**

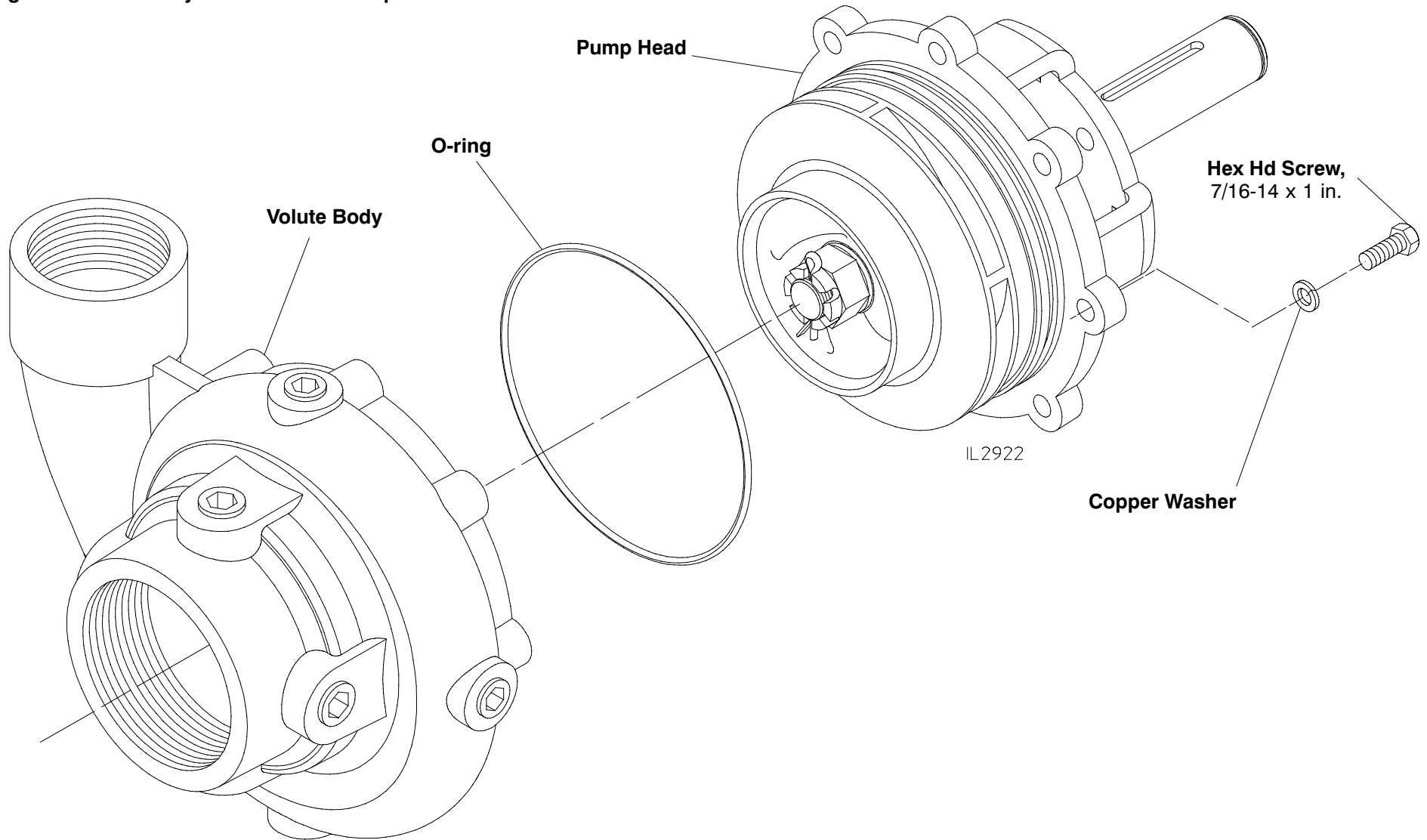


## Removal of Volute Body from Pump Head

1. Remove the twelve (12) hex head screws and copper washers that attach the pump head to the volute body.
2. Separate the pump head from the volute body.
3. Remove and discard O-ring.

**NOTE: The wear rings will remain in the volute body and pump head. Removing the wear rings from the body or head is necessary only if they are damaged or badly worn. (See page 19).**

**Figure 6. Volute Body Removal from Pump Head**

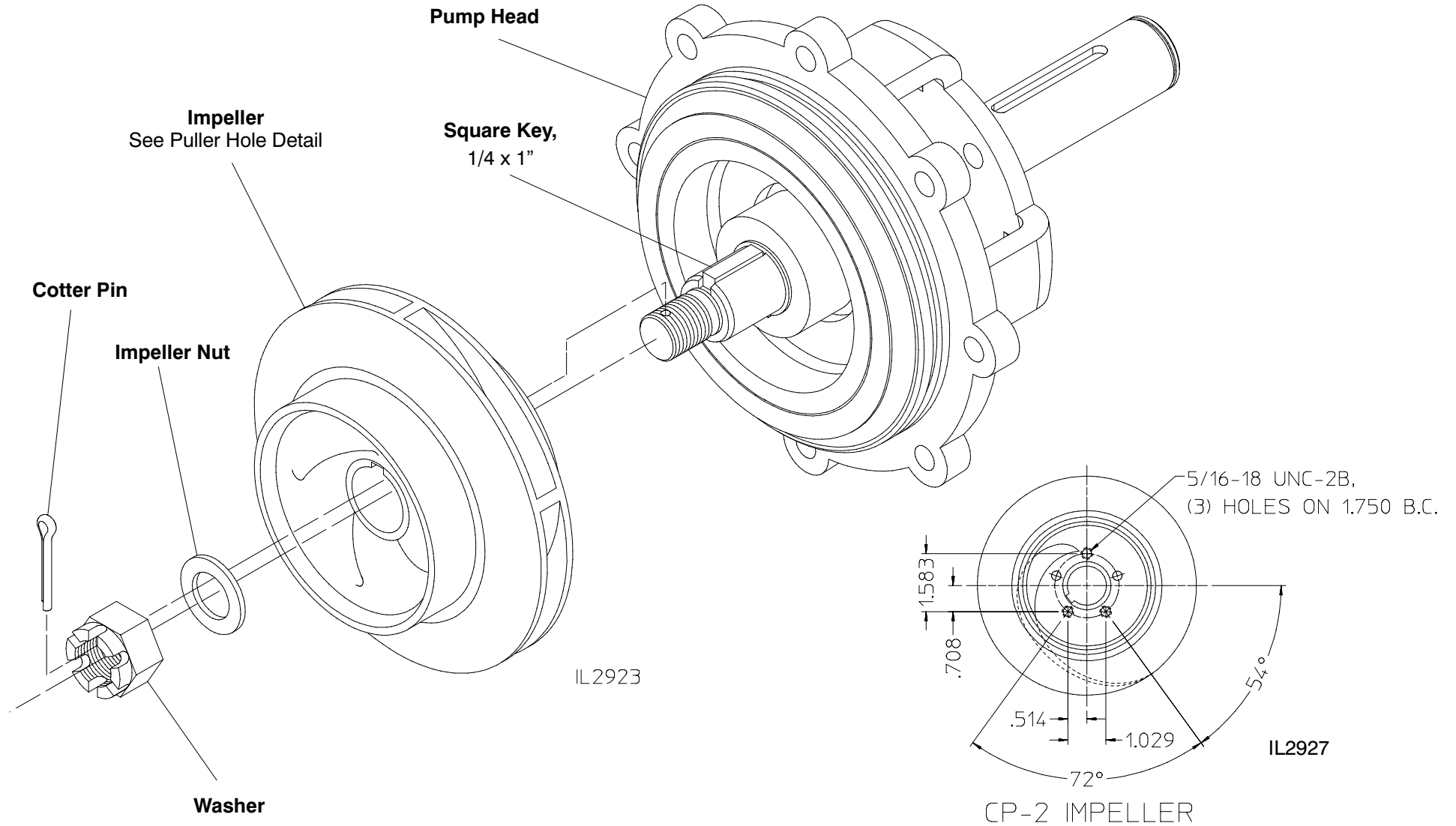


## Removal of Impeller

1. Remove cotter pin, impeller nut and washer.
2. Remove impeller using puller holes.

3. Remove square key from impeller shaft.

Figure 7. Impeller Removal

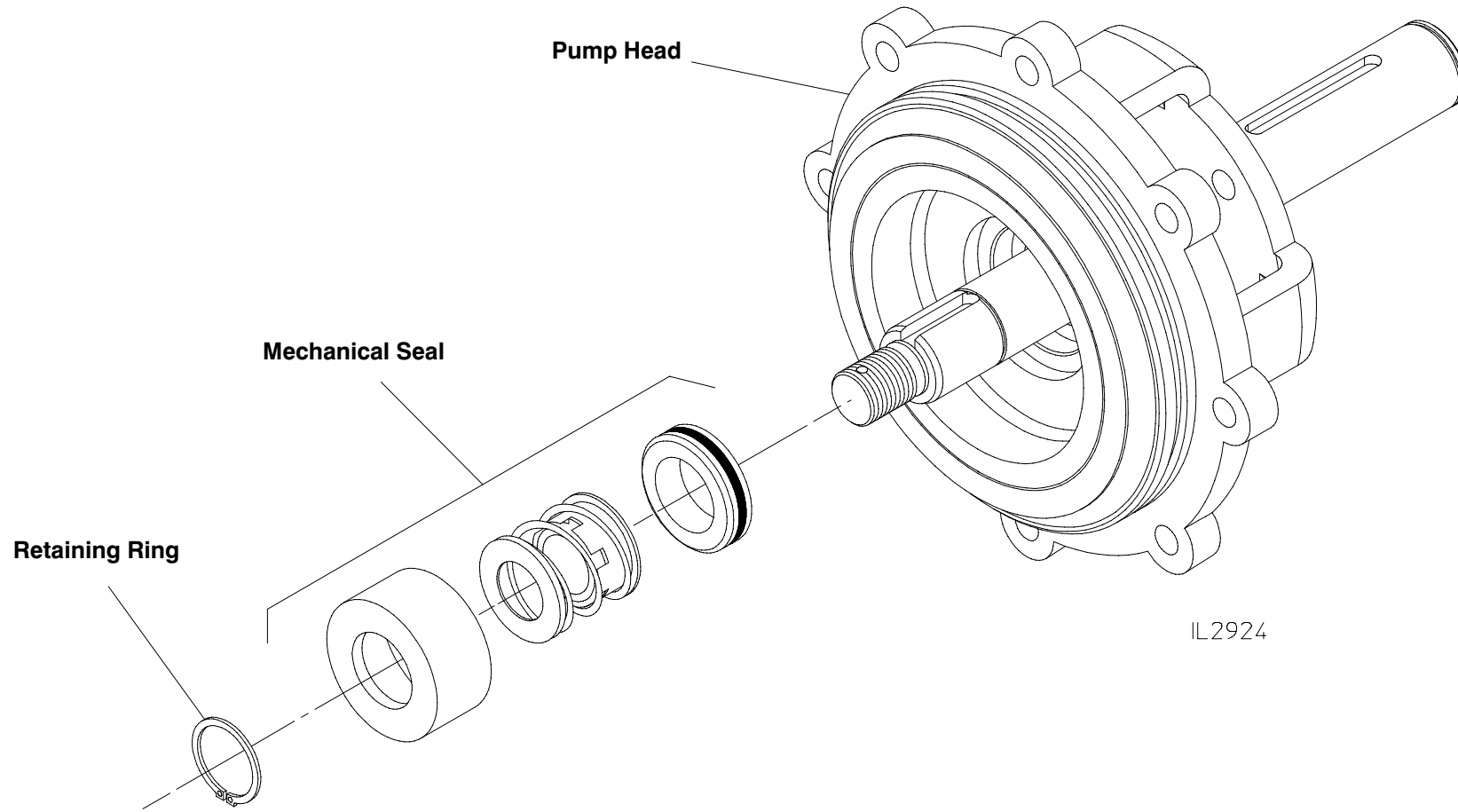


### ***Removal of Mechanical Seal***

1. Remove the retaining ring from the impeller shaft.
2. Lubricate the impeller shaft.

3. Slide the mechanical seal off the impeller shaft.

**Figure 8. Mechanical Seal Removal**



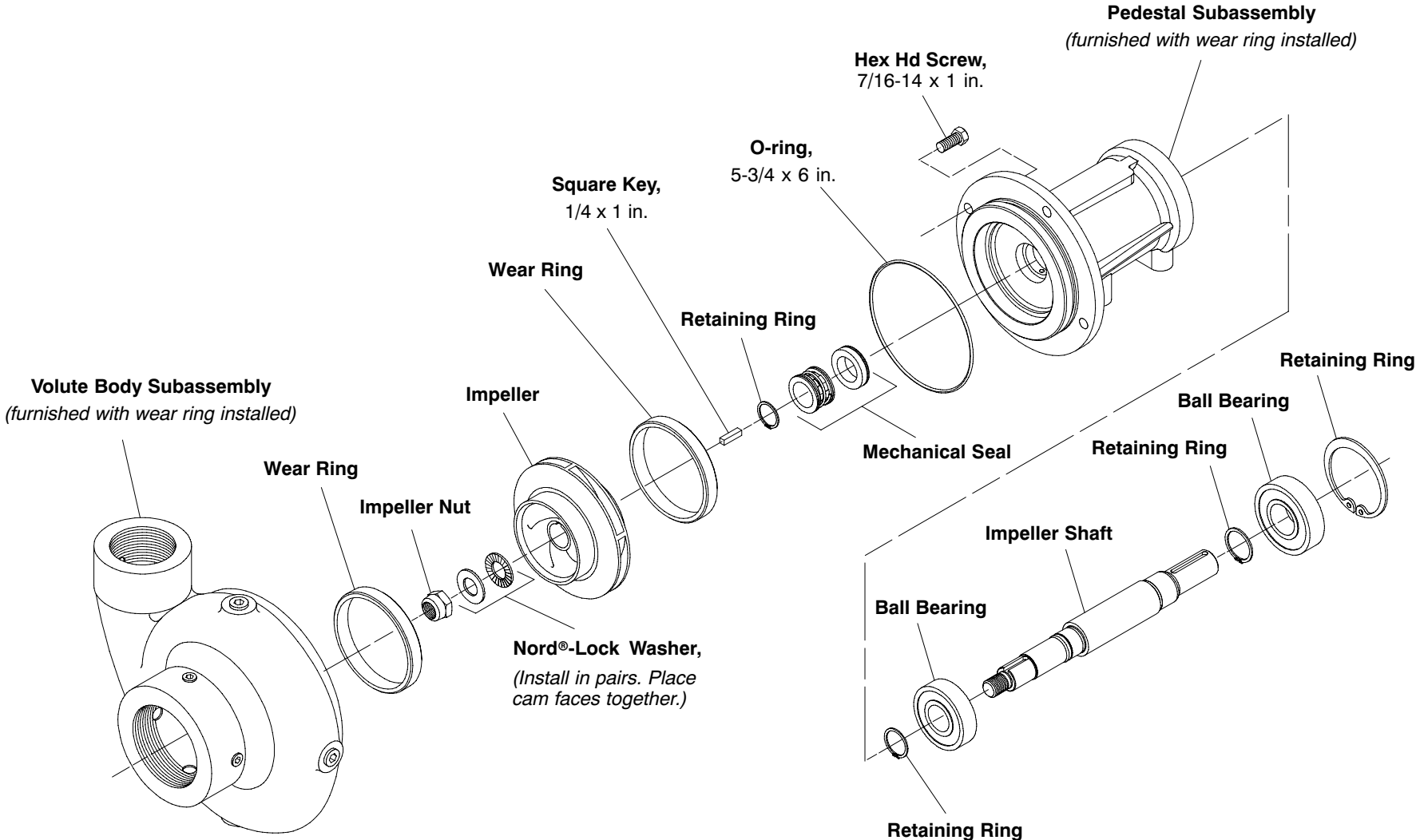
### ***Removal of Impeller Shaft***

**NOTE:** Removing the impeller shaft from the pump transmission is not necessary unless it is damaged. If impeller shaft removal is necessary, see the appropriate pump transmission overhaul instructions.

# CPD-2 Pumps

Removing the CPD-2 pump and pedestal together and then disassembling the pump is usually the easiest method for overhauling.

**Figure 9. CPD-2 Exploded View**

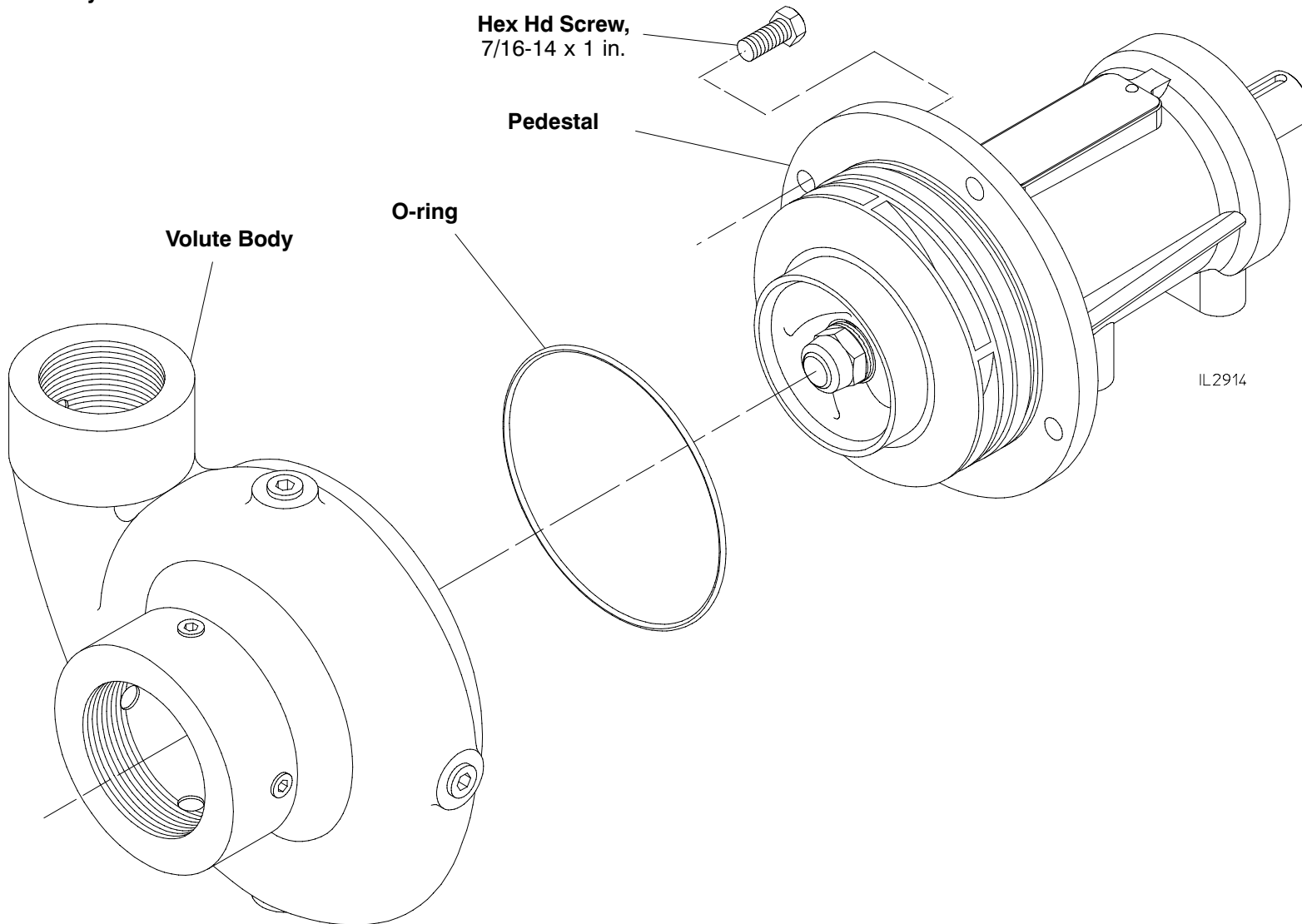


## Removal of Volute Body from Pedestal

1. Remove the four (4) hex head screws that attach the pedestal to the volute body.
2. Separate the pedestal from the volute body.
3. Remove and discard O-ring.

**NOTE: The wear rings will remain in the volute body and pedestal. Removing the wear rings from the body or pedestal is necessary only if they are damaged or badly worn. (See page 19).**

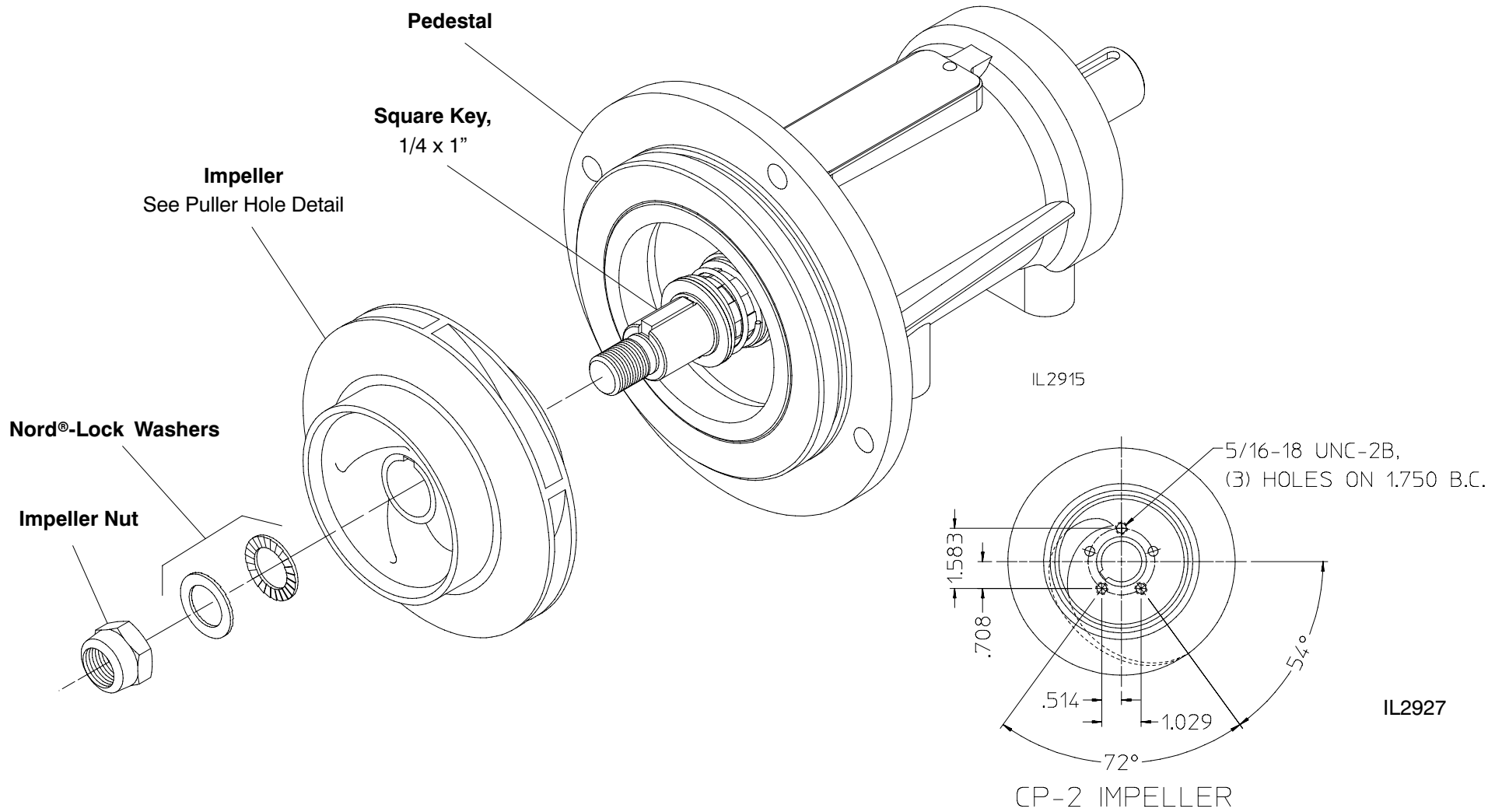
**Figure 10. Volute Body Removal from Pedestal**



## Removal of Impeller

1. Remove cotter pin, impeller nut and washer.
2. Remove impeller using puller holes.
3. Remove square key from impeller shaft.

Figure 11. Impeller Removal



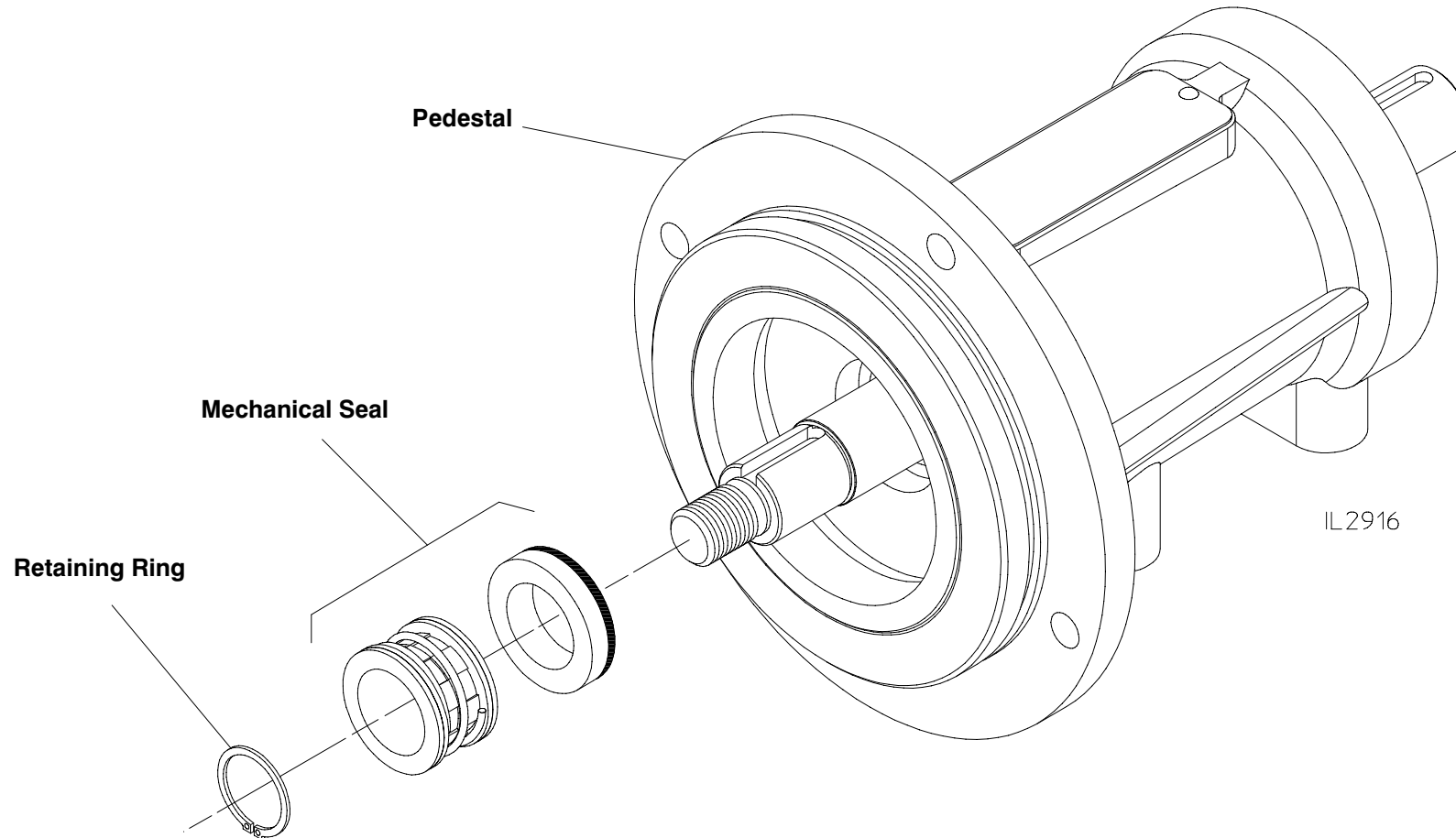


## ***Removal of Mechanical Seal***

1. Remove the retaining ring from the impeller shaft.
2. Lubricate the impeller shaft.

3. Slide the mechanical seal off the impeller shaft.

**Figure 12. Mechanical Seal Removal**

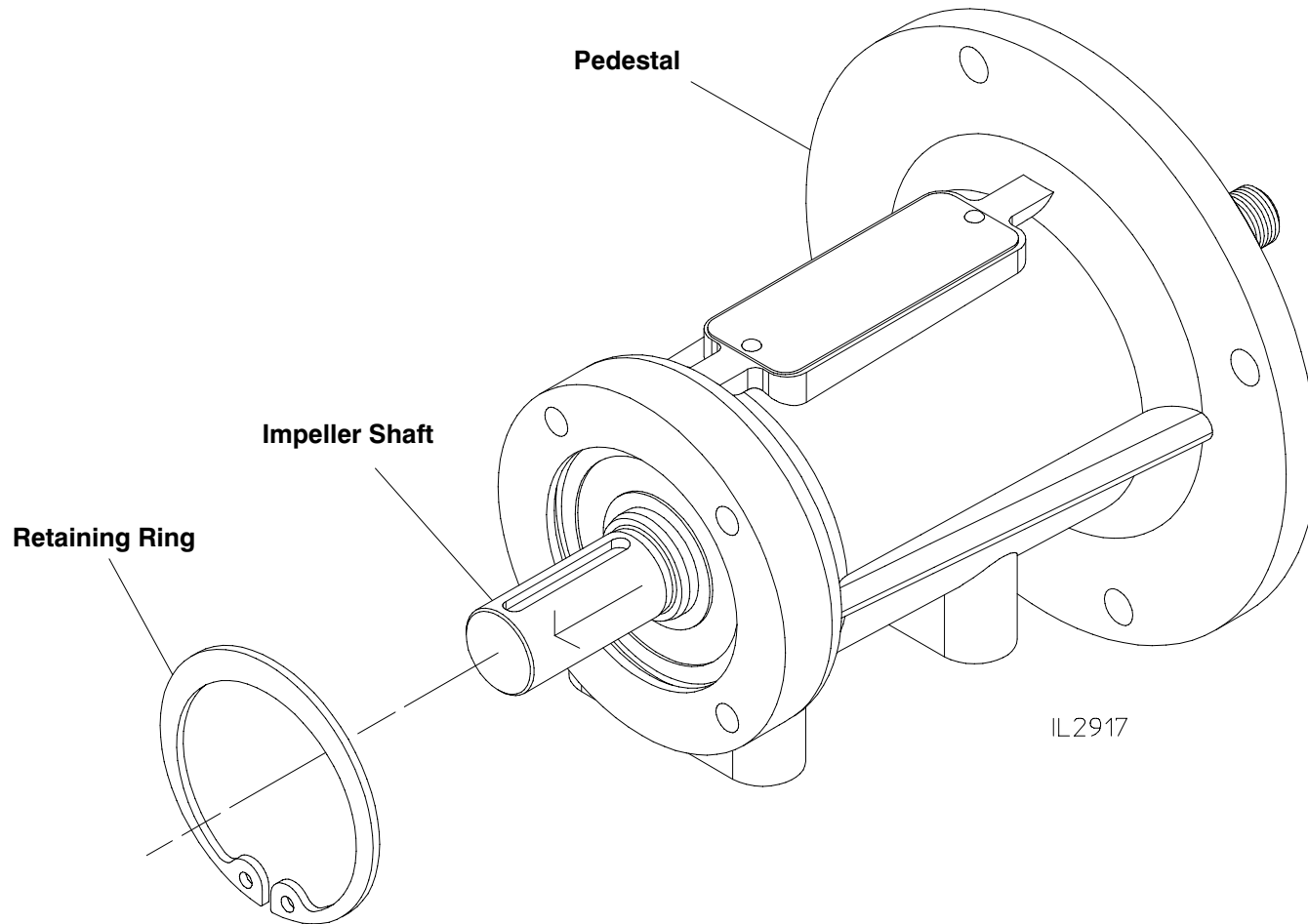


### ***Removal of Impeller Shaft Assembly***

**NOTE:** Removing the impeller shaft from the pedestal is not necessary unless it is damaged. If impeller shaft removal is necessary, follow the step outlined below.

1. Remove the retaining ring from the pedestal.
2. Press the impeller shaft assembly out of the pedestal in the direction shown in Figure 13.

**Figure 13. Impeller Shaft Assembly Removal**

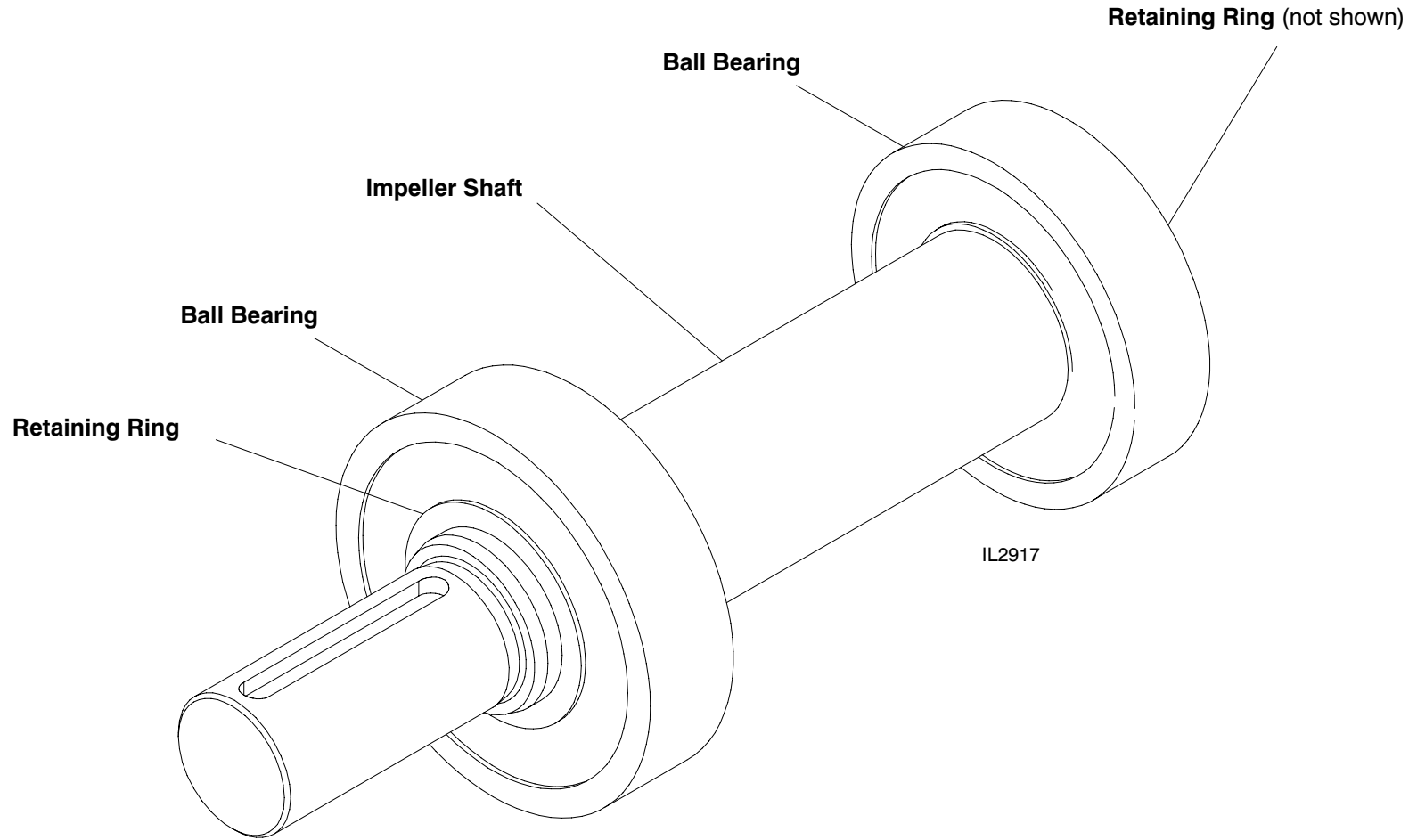


**Disassembly of Impeller Shaft Assembly**

1. Remove the retaining rings from the impeller shaft assembly.

2. Press ball bearings from shaft.

**Figure 14. Impeller Shaft Assembly Disassembly**



## Inspection and Repair

The following points cover inspection and repair of the major components of CP pumps. Check all parts that are not covered in this instruction in accordance

with standard automotive shop practices. If the slightest doubt exists about the actual condition of any part, replace the part as a precautionary measure.

### Mechanical Seal

If a pump has a mechanical seal, always install a new mechanical seal during reassembly. Follow Mechanical Seal Installation Instructions carefully.

### Impellers

Check wear rings and impeller hubs for deep grooves or scratches. Carefully measure the outside diameter of the impeller hubs and the inside diameter of the wear rings installed in the body and head. If the difference between these two measurements exceeds 0.020 in., replace the wear rings as directed below.

**NOTE: Wear rings may be removed by crisscrossing two pry bars under opposite sides of the wear ring. Pry up the wear ring by applying equal pressure to both pry bars.**

#### **Installing Undersize Wear Rings**

For all impellers for CP-1, CP-2 and CP-2L pumps which have separate wear rings, the replacement rings are available as follows:

- ❑ 0.025 in. undersize
- ❑ 0.050 in. undersize
- ❑ 0.075 in. undersize

If inspection shows that the wear ring clearances are excessive or the impeller hubs are scored or grooved, turn the impeller hub on a lathe to an acceptable dimension. Table 1 shows the original hub dimensions for each impeller and the rework dimensions for each degree of undersize.

*Table 1. Impeller and Wear Ring Repair Dimensions*

| Pump Model   | Impeller Part No.                | Original Impeller Hub Diameter | Original Wear Ring Part No. | New Wear Ring Part No.           | Rework Diameter of Impeller Hub                 |
|--------------|----------------------------------|--------------------------------|-----------------------------|----------------------------------|-------------------------------------------------|
| CP-1, E301-A | 70224<br>70481                   | 1.9930 / 1.9910                | 50716                       | 50716-25                         | 1.968 / 1.966                                   |
|              | 70603<br>70604                   | 2.874 / 2.872                  | 61436<br>61444              | 61436-25<br>61444-25             | 2.849 / 2.847                                   |
|              | 72244<br>72245                   | 2.875 / 2.874                  | 61436<br>61444              | 61436-50<br>61444-50             | 2.824 / 2.822                                   |
| CP-2, E302-A | 70476<br>70485                   | 3.745 / 3.743                  | No Wear Rings               | -                                | -                                               |
|              | 70476AL<br>70485AL               | 3.741 / 3.739                  |                             |                                  |                                                 |
|              | 70823<br>70824<br>70966<br>70967 | 3.748 / 3.747                  | 61363                       | 61363-25<br>61363-50<br>61363-75 | 3.723 / 3.721<br>3.698 / 3.696<br>3.673 / 3.671 |
| CP-2L, CPD-2 | 70966                            | 3.748 / 3.747                  | 61363                       |                                  |                                                 |

Keep the hub diameters within 0.015 in. TIR of the impeller shaft bore. If the impeller hubs do not clean up at first undersize dimension, turn the hub down to the next degree of undersize. Replace the impeller if the hubs do not clean up at the last undersize dimension.

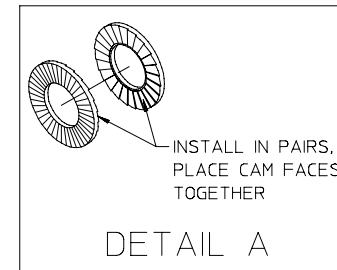
Before pressing new wear rings in place, remove all corrosion from body and head counterbores and apply a generous amount of lubriplate or similar lubricant to the outer ring surfaces. With a suitable arbor, carefully press the rings into the body and head counterbores. Make sure the rings are seated firmly against the counterbore shoulders.

## Reassembly

Reassembly of the CP- 1, CP- 2, CP- 2L and CPD- 2 pumps are essentially the same as the disassembly procedure, except it is reversed. NOTE that if undersize wear rings are required, they should be installed during reassembly. Also, if a new impeller is needed, install new standard size wear rings for the impeller.

**NOTE: If using a Nord-Lock® washer, see Detail A for proper assembly.**

**NOTE: Apply Loctite® 242 to shaft and nut threads. Tighten impeller nut until seated against impeller. Do not torque over 75 ft.-lbs (102 N.m).**



## Mechanical Seal

Install the mechanical seal as follows (See Figure 15 on the next page for different mechanical seal designs):

### 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.

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

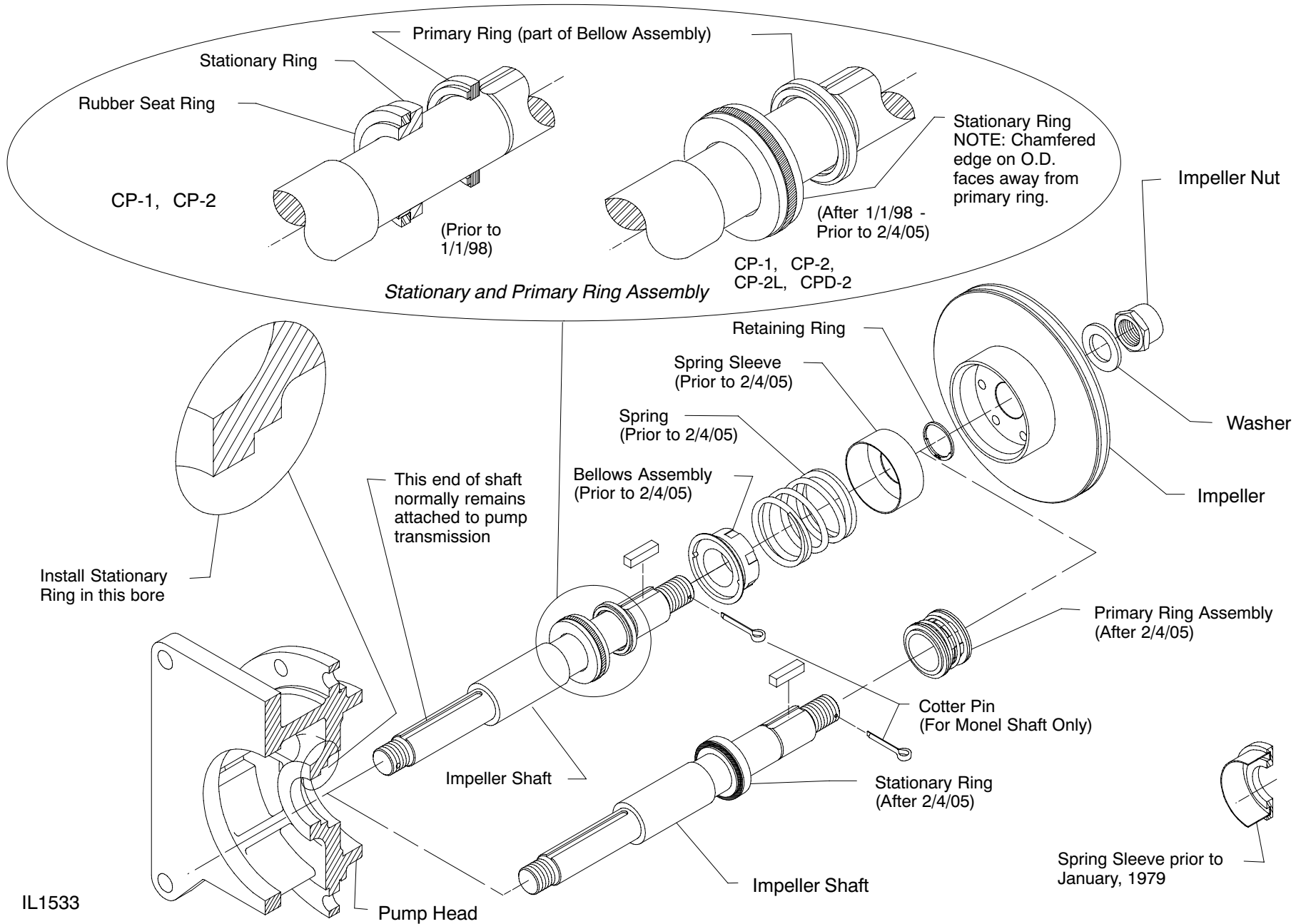
1. Apply a light coating of seal lubricant to the rubber seat ring or o-ring on the stationary ring assembly.  
**NOTE: To protect the rubber bellows of the mechanical seal, place a piece of masking tape over the keyway on the impeller shaft, making sure that the tape is able to be removed after bellows has passed over the keyway.**
2. Protect sealing surface and press assembly squarely into bore of pump head until it is seated. Ensure sealing surface faces primary ring. See the following page for proper stationary ring orientation.
3. CP-1 and CP-2 only (Pre 1/1/98 pumps only): Check the stationary ring assembly to make sure the rubber seat ring is tight on the metal seat. Also make sure rounded corner (side with identification dot) of seat ring faces away from the shoulder of the stationary ring.

**NOTE: For CP-1 and CP-2 (Pre 1/1/98) only: If mechanical seal stationary ring assembly will not enter the pump head under finger**

**pressure, install only the rubber seat ring in the pump head. Using finger pressure, the stationary ring can then be installed in the seat ring.**

4. Wipe seal surface with denatured alcohol and a clean cloth.  
**NOTE: It is very important to keep the sealing surfaces clean. Dirt and oil on the sealing surfaces will prevent a good seal and can cause premature wear.**
5. Slide pump head over the impeller shaft.
6. Secure with bolts, hex nuts, screws and lock washers.
7. Lubricate impeller shaft with mechanical seal lubricant.
8. Ensure that primary ring is retained in the bellows assembly. (If the ring is loose use a small amount of grease between the ring and bellows assembly as needed).
9. Apply light coating of seal lubricant to the inside of bellows assembly.
10. Press assembled bellows and primary ring tightly against the stationary ring assembly.  
**NOTE: To press the bellows assembly on the shaft, use a smooth sleeve with an inner diameter of approximately 1-3/32 in. Make sure the sleeve applies pressure only to the bellows and inner rings.**
11. **(Pumps built prior to 2/4/05 only)** Slide the spring and spring sleeve over the end of the impeller shaft so the small end of the spring fits over the shell of the bellows assembly.
12. Install the retaining ring.

**Figure 15. Mechanical Seal Installation**



## Packing - Braided Flexible Graphite (BFG)

Waterous uses a braided graphite fiber, with reinforced flexible graphite yarns and high purity graphite filament yarns that appear on the corners as well as throughout the body of the packing. The graphite reinforcement allows the flexible graphite yarns to provide greater tensile strength.

This type of packing reduces the frictional heat created between the shaft and the I.D. of the packing. By dissipating the heat through the cross section of the packing, the heat is transferred to the packing gland and the pump body.

### WARNING

**Packing Gland and Pump Body Temperature Hazard. May result in serious burns.**

Heat is dissipated through the cross-section of the packing, transferring the heat to the packing gland and pump body.

### Packing Removal

### WARNING

**Truck movement hazard.  
May cause serious personal injury.**

Stop engine, set the parking brake and chock the wheels before going under truck to remove packing.

1. Remove the unbalanced nuts, flat washers and packing gland halves.
2. Engage the pump per appropriate operating instructions. Operate the pump gradually increasing the discharge pressure until the packing is forced out of the stuffing box. Pressure in excess of 300 psi (20.7 bar) may be required.

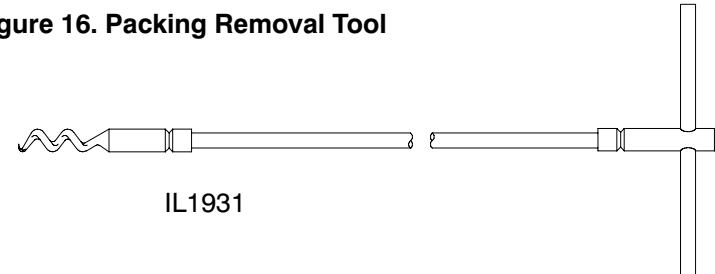
### CAUTION

**Pump overheating hazard.  
May cause damage to the pump.**

Circulate enough water through the pump to prevent overheating. Do not pressurize the pump over the rated maximum discharge pressure of the pump.

3. If all the packing is not forced out, it may be necessary to remove the remaining packing by hand, using a pick or similar device. Waterous has a packing removal tool (P/N 5782) available for this purpose, see Figure 16.
4. Replace packing per instructions on the next page.

Figure 16. Packing Removal Tool



### Packing Installation

1. Before installing the new packing, be sure that all of the old packing is removed from the stuffing box.
2. Be sure that the stuffing box and the shaft are clean and free of any packing residue.
3. Lightly lubricate the packing ring I.D. and O.D. with mineral oil, automotive grease or engine oil for installation purposes.
4. Make sure the packing is clean.
5. Carefully install one ring of packing. With the aid of packing glands, push the packing into the stuffing box as far as possible. Repeat this operation with each ring, staggering the joints at least 90° apart. Install the packing rings until the top of the last ring is about 1/4 inch from the end of the stuffing box (at least 1/8 inch is required for the packing gland nose entrance into the stuffing box), see Figure 17.

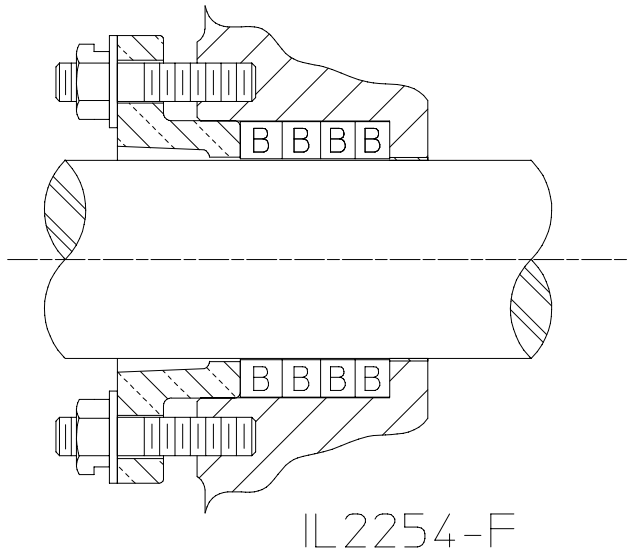
**NOTE: Be sure that the packing joints are staggered at least 90° apart.**

6. Install packing glands, nuts and washers. Tighten gland nuts one flat beyond finger tight, see Figure 17.

**NOTE: The milled slot on the nut should face the gland.**

7. Adjust packing as required per instructions on the next page.

Figure 17. Packing and Gland Installation



### Packing Adjustment

The pump packing is designed and adjusted to drip slightly during operation. This is to cool and lubricate the packing. It is desirable to adjust the stuffing box to maintain a leakage rate of 10 to 120 drops per minute when operating at a discharge pressure of 150 psi (10.3 bar).

Leakage through the braided flexible graphite (BFG) packing may be at zero or diminish to zero leakage and may not respond to loosening of the packing nuts to restore leakage, see Adjustment Step 3. While the packing gland and stuffing box and pump body may reach high temperatures during this time, the impeller shaft will be protected from heat damage.

#### CAUTION

**Pump overheating hazard.  
May cause damage to the pump.**

Circulate enough water through the pump to prevent overheating.



#### WARNING

**Truck movement hazard.  
May cause serious personal injury.**

Stop engine, set the parking brake and chock the wheels before going under truck to adjust packing.

1. Engage pump per appropriate operating instructions. Operate the pump at the capacity pressure shown on the serial plate for ten (10) minutes.

#### CAUTION

**Observe the stuffing box drip rate from the side of the truck.**

2. Observe leakage. Normal leakage is 10-120 drops per minute.
3. If drip rate is considered high, stop the engine and tighten the packing gland nuts 1/2 to 1 flat (maximum of 1/6 of a revolution). Make appropriate adjustments starting with 1 flat, when approaching the final adjustment reduce to 1/2 flat. This reduces the possibility of over tightening. **Tighten the gland nuts equally to ensure that the packing gland goes on straight.** Gradually reducing leakage during the first hour of operation will result in a better seal over a longer period of time.

#### CAUTION

**Stopping the leakage entirely at this point will cause the packing to overheat.**

4. Operate the pump at the capacity pressure shown on the serial plate for two (2) minutes to let packing run in, then observe the drip rate.



#### WARNING

**Packing Gland and Pump Body Temperature Hazard. May result in serious burns.**

Heat is dissipated through the cross-section of the packing, transferring the heat to the packing gland and pump body.

5. Repeat steps 3 and 4 until the drop rate is acceptable.

**NOTE: After adjusting the packing, the pump must pass the vacuum test described on page 24.**



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## Final Assembly

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To complete final assembly, perform the following:

1. Connect the propeller or drive shaft to the pump transmission.
2. Connect the intake and discharge piping.

3. Connect the cooling and drain lines, electrical wiring and similar equipment to the pump and accessories.
4. Fill the pump transmission with lubricant as directed in the transmission operation and maintenance instructions.

**NOTE: After reassembling pump, perform vacuum test per NFPA 1911 before truck is placed back in service.**

### Vacuum Test

1. Remove all caps except openings without valves. Close all discharge, intake and drain valves and other similar openings. Operate priming device to create a vacuum of about 22 in. Hg/.735 atmosphere in pump, then stop primer and engine.

2. Watch the pressure gauge; if vacuum drops more than 10 in. Hg/.334 atmospheres in five (5) minutes, listen for air leaks around the packing gland, gaskets, valves, etc.
3. Replace gaskets, re-adjust packing, repack or otherwise repair source of trouble.
4. Repeat test.

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## Testing

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Before a pump can be returned to service, it is advisable to give the pump a hydrostatic and operational tests to check it for leaks and to make sure the pump operates properly.

### Hydrostatic Testing

1. Connect the pump to a hydrant or other pressurized water supply.
2. Close all drain lines and open the discharge and priming valves.
3. Open hydrant until the water runs out through the discharge valves and discharge pipe in priming pump (if used).
4. Close all valves. Be sure to evacuate all air from the pump.
5. Check for leaks with a portable light. If leaks are discovered, tighten connections or attaching parts as necessary. Repeat until all leaks are eliminated.

**NOTE: If a mechanical seal is used, the seal may leak under hydrostatic pressure; however, it should stop leaking after the seal faces are run in during operational testing.**

6. Shut hydrant valve after all leaks are eliminated.
7. Drain pump completely and disconnect intake hose.

### Operational Testing

1. Adjust packing as described in packing section.



#### WARNING

Do not adjust gland nuts while pump is running. Observe stuffing box leakage by watching drippage from the side of the truck.

2. Operate the pump at its maximum intended service pressure. If desired, a CP-1 or CP-2 pump may be tested at discharge pressure up to 900 psig when operated in series from the main pump. The intake pressure on the CP-1 or CP-2 when operated in series should be 400 to 500 psi (27.6 to 34.5 bar).
3. Check for leaks with a portable light. If leaks are discovered, stop the pump and tighten connections or tighten attaching parts as necessary. Repeat until all leaks are eliminated.
4. Check for unusual noises, oil leaks, overheated bearings, etc. while the pump is running. If anything unusual is discovered, stop the pump immediately and determine the cause of the problem.

