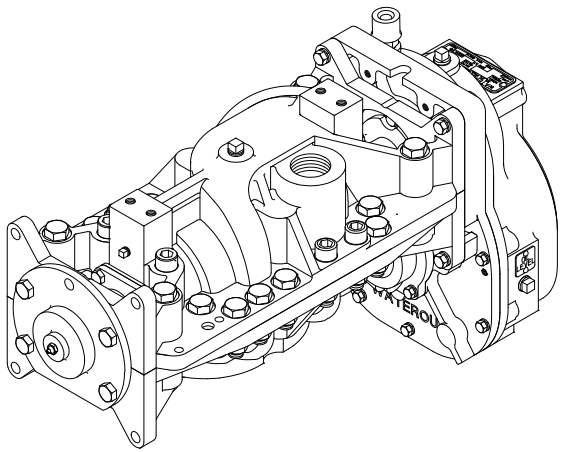
CP-4 Centrifugal Fire Pumps

Overhaul Instructions

Form No.	Section	Issue Date	Rev. Date
F-1031	4207.1	10/79	1/12/21



WATEROUS

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Introduction

This section contains overhaul instructions for Waterous CP-4 centrifugal fire pumps. Several types of transmissions are used with the CP-4 pumps. Refer to separate instructions for the particular transmission you have.

This instruction uses reference numbers when discussing specific parts. These numbers refer to individual parts as shown on in Figures 1 and 2.

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.

General Overhaul Information

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.

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-off or other suitable drive. All CP pumps have an integral speed increasing transmission with proper gear ratio 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.

Figure 1. CP-4 CW Transmission Input Rotation Exploded View

Note: Two gear transmissions are used with CP-4 pumps causing the pump impeller shaft to rotate oppostie the transmission input rotation.

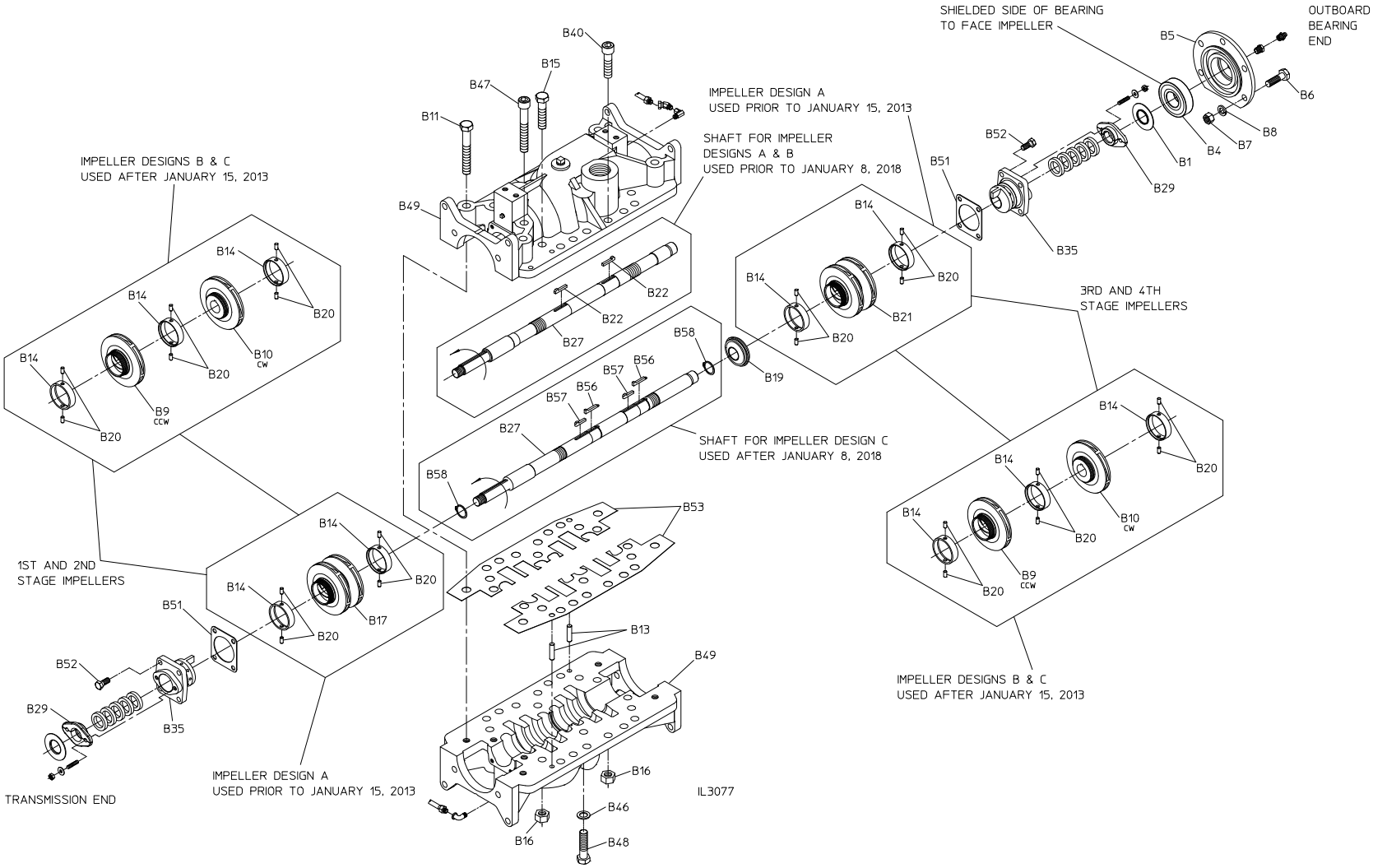
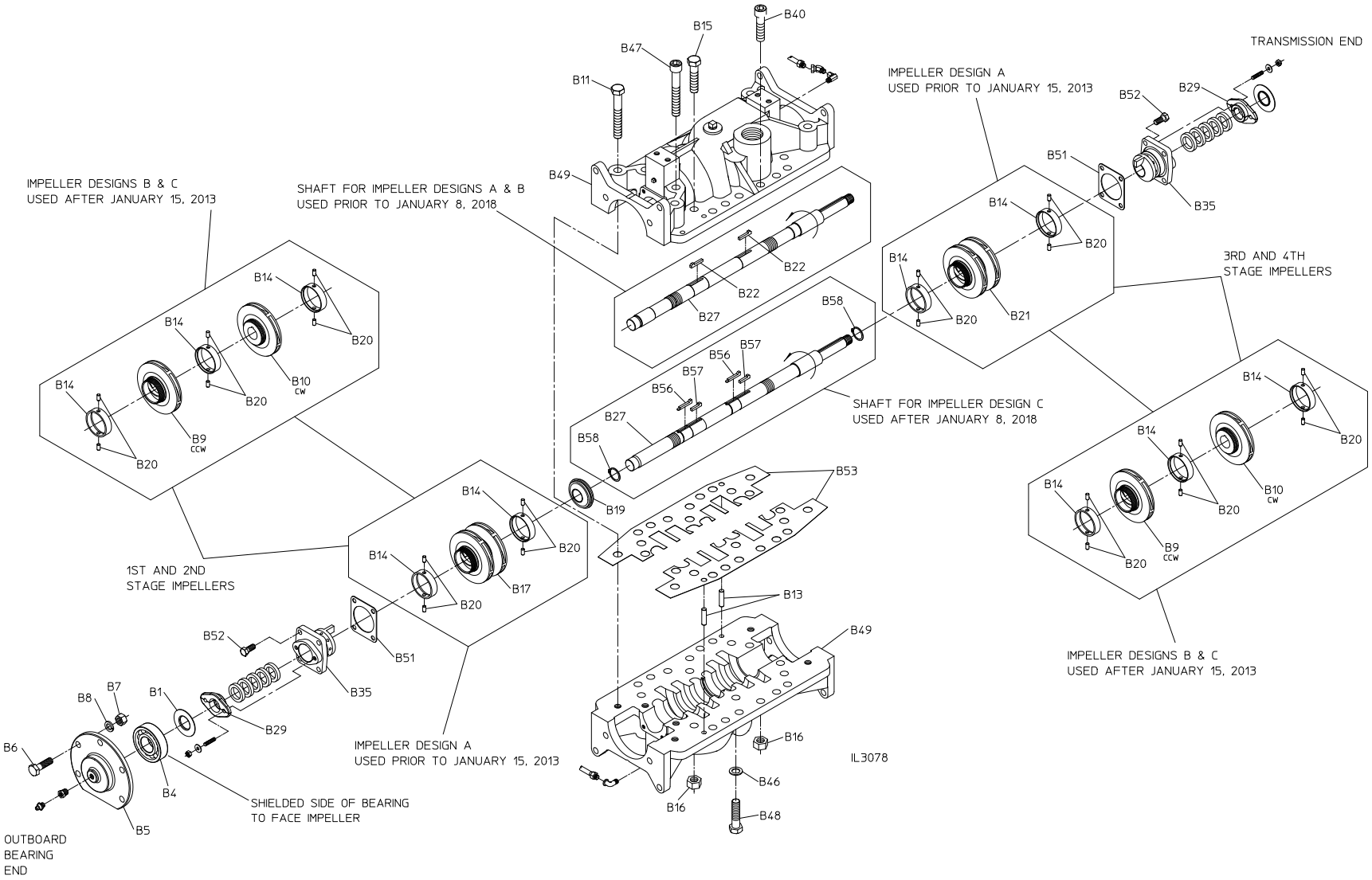


Figure 2. CP-4 CCW Transmission Input Rotation Exploded View

Note: Two gear transmissions are used with CP-4 pumps causing the pump impeller shaft to rotate oppostie the transmission input rotation.



Disassembly

Refer to Figures 1 & 2

▶ **To disassemble the pump, perform the following:**

1. Disconnect the drain lines and similar connections to the pump and pump transmission.
2. Drain the lubricant from the pump transmission by removing the oil drain plug.
3. Disconnect the intake and discharge piping from the pump.
4. Disconnect the drive shaft from the pump transmission if equipped with a K-series transmission. If equipped with a T-series transmission, remove the complete pump and transmission from the engine bell housing.
5. Remove the pump and transmission from the truck.
6. Remove packing glands (B29) from both ends of the pump.
7. Remove bolts (B6), nuts (B7) and lock washers (B8) which attach the outboard bearing housing (B5) to the pump body (B49).
8. Remove cap screws (B52) which attach the packing housings (B35) to the pump body.
9. Drive out two dowel pins (B13).
10. Remove cap screws (B11, B47 and B48), bolts (B15 and B40), nuts (B16) and copper washers (B46) which attach the upper body to the lower body.
11. Lift off upper body. (Seperation may require use of jacking screws.)
12. Remove body gasket (B53) or Permatex on the body flanges.
13. Remove impeller shaft assembly from lower body.
14. Remove bearing (B4), flinger ring (B1), packing housing (B35), seal housing gasket (B51), packing O-ring (B34) and wear ring (B14) from outboard end of the impeller shaft (B27).

(Continued on following page)

▶ **To disassemble the pump, perform the following:** ***(Cont'd)***

15. Impeller Removal

Notes:

1) Impellers are installed on the shaft with a light press fit.
2) The impellers, interstage seal and packing housings cannot be removed from the transmission end of the shaft due to the seal/bearing journal. All components must be removed from the outboard bearing end of the shaft.
3) Marking the impellers relative to their position on the shaft will aid in their re-assembly.

There are three impeller designs as follows:

Design A, Pumps built prior to January 15, 2013:

Two dual back to back impellers. Each set of impellers retained by one gib head key. **Two** wear rings used for each set of impellers.

Design B, Pumps built from January 15, 2013 to January 8, 2018:

Four individual impellers in two groups. Each group of impellers retained by one gib head key. **Three** wear rings used for each impeller group.

Design C, Pumps built after January 8, 2018:

Four individual impellers in two groups. Each group retained by **two** different gib head keys and **one** retaining ring. **Three** wear rings used for each impeller group.

15A. Removal Procedure for Design A (Refer to Firgure 3):

A1. Remove wear ring (B14) from the impeller closest to outboard end of the shaft.

A2. Press the impeller closest to the outboard end of the shaft toward the center of the shaft to expose the gib head key (B57). Remove the key and press the impeller off of the outboard end of the shaft. A3. Remove the interstage seal (B19) and inner wear ring (B14) from both impellers.

A4. Remove the impeller closest to the transmission end of the shaft in the same manner as the first impeller, pressing toward the center of the shaft to remove the gib head key and then off the outboard end of the shaft.

A5. Remove the outer wear ring (B14) from the impeller and inboard packing housing (B35) from the shaft.

15B. Removal Procedure for Design B (Refer to Figure 4):

B1. Remove wear ring (B14) from the impellers closest to outboard end of the shaft.

B2. Press the impeller closest to the outboard end of the shaft toward the center of the shaft to expose the gib head key (B57). Remove the key and press the impellers off of the outboard end of the shaft. The center wear ring (B14) between the impellers will be removed along with the impellers.

B3. Remove the interstage seal (B19) and inner wear ring (B14) from both impellers.

B4. Remove the impellers closest to the transmission end of the shaft in the same manner as the first impellers, pressing toward the center of the shaft to remove the gib head key and then off the outboard end of the shaft.

B5. Remove the outer wear ring (B14) from the impeller and inboard packing housing (B35) from the shaft.

15C. Removal Procedure for Design C (Refer to Figure 5):

C1. Remove wear ring (B14) and retaining ring (B58) from the impellers closest to outboard end of the shaft.

C2. Remove gib head key (B56) from the shaft.

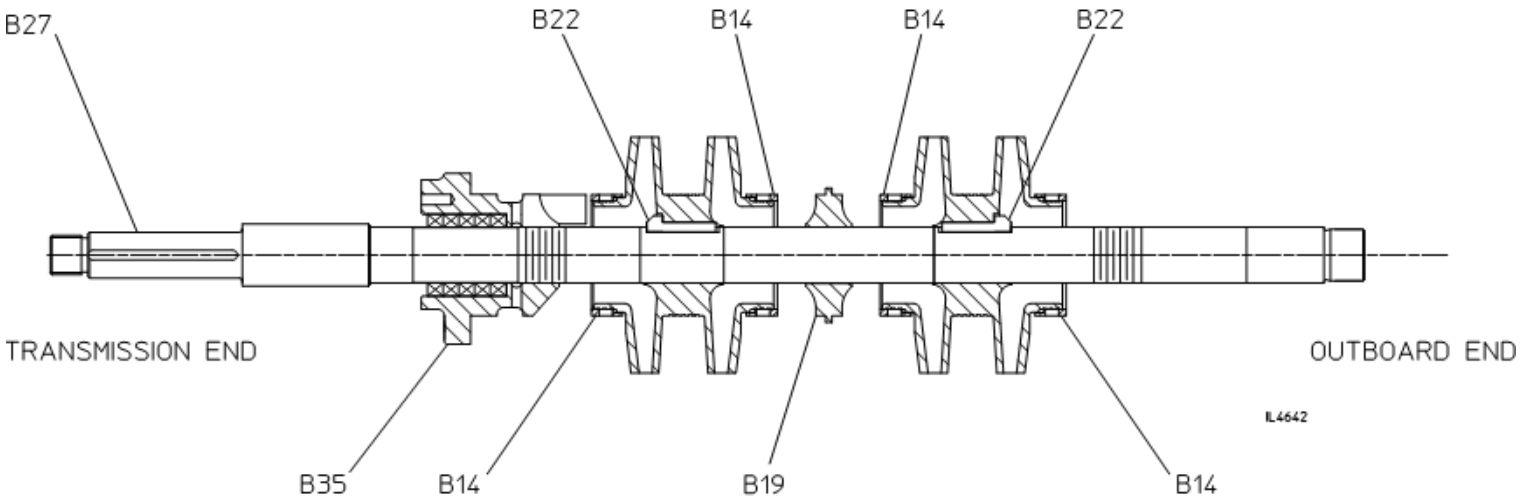
C3. Press the impellers off of the outboard end of the shaft. The center wear ring (B14) between the impellers will be removed along with the impellers.

C4. Remove gib head key (B57) from the shaft.

C5. Remove the interstage seal (B19) and inner wear ring (B14) from both impellers.

C6. Remove the impellers closest to the transmission end of the shaft in the same manner as the first impellers, removing wear ring (B58) and gib head key (B57).

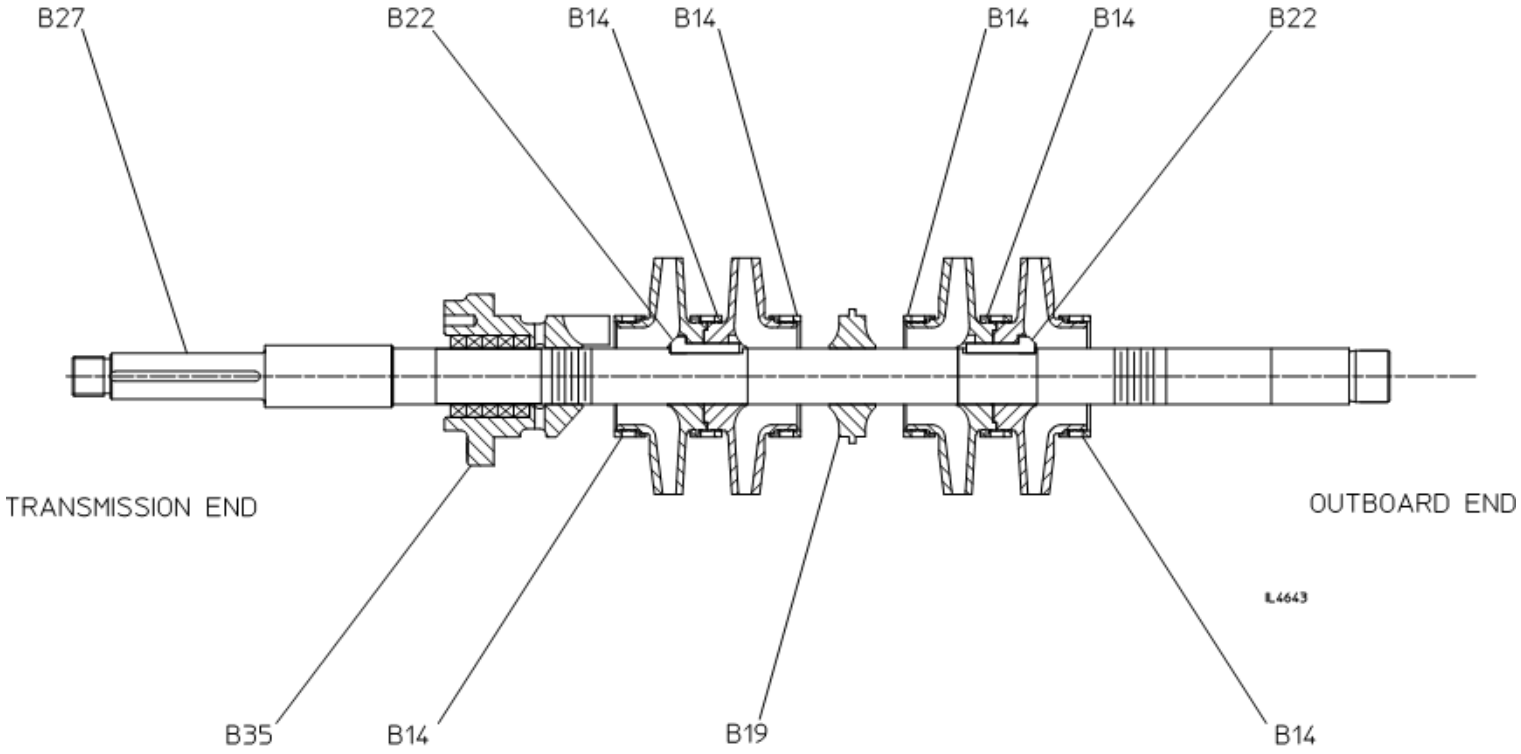
Figure 3. Impeller Design A



CROSS–SECTION VIEW

IMPELLER DESIGN A

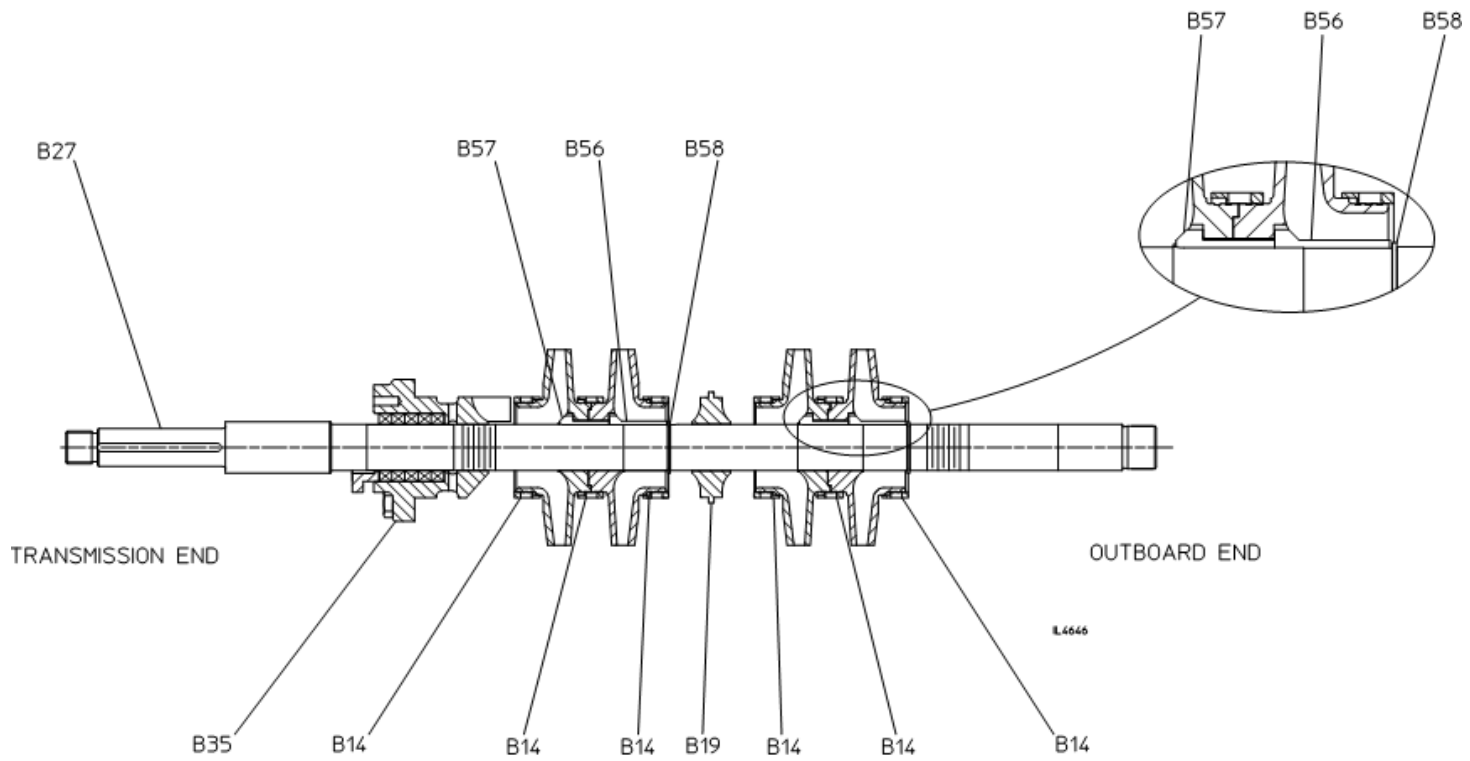
Figure 4. Impeller Design B



CROSS–SECTION VIEW

IMPELLER DESIGN B

Figure 5. Impeller Design C



Inspection and Repair

The following points cover inspection and repair of the major components of CP-4 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.

Impellers

Check wear rings and impeller hubs for deep grooves or scratches. The impellers are supplied from the factory with circular grooves cut into the hubs and center section. Carefully measure the outside diameter of the impeller hubs and the inside diameter of the wear rings. If the difference between these two measurements exceeds 0.015 in., replace the wear rings as directed below.

Installing Undersize Wear Rings

For all impellers for CP-4 pumps which have separate wear rings, the replacement rings are available as follows:

- 0.015 in. undersize
- 0.025 in. undersize

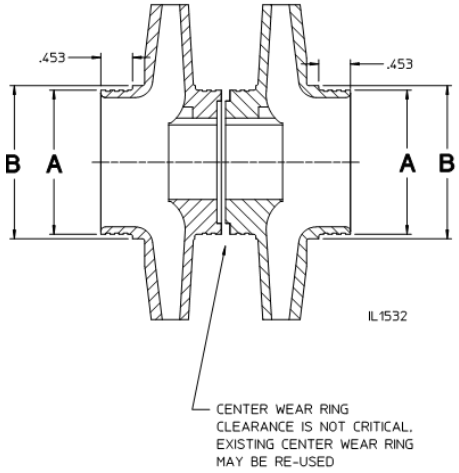
If inspection shows that the wear ring clearances are excessive or the impeller hubs are scored or grooved, turn the impeller hub on a lathe to an acceptable dimension. Table 1 shows the original hub dimensions for each impeller and the rework dimensions for each degree of undersize.

Table 1. Impeller and Wear Ring Repair Dimensions

Design	Impeller Part No.	Original Impeller Hub Diameter	Original Wear Ring Part No.	Reworked Hub Diameter	New Wear Ring Part No.
Two Impeller	71076-A or 71076-B	A - 2.0600 / 2.0585 B - 2.1890 / 2.1880	61578	A - 2.045 / 2.044	61578-15
				B - 2.174 / 2.173	
				A - 2.035 / 2.034	61578-25
				B - 2.164 / 2.163	
Four Impeller	73269 or 73270	A - 2.0600 / 2.0585 B - 2.1890 / 2.1880	61578	A - 2.045 / 2.044	61578-15
				B - 2.174 / 2.173	
				A - 2.035 / 2.034	61578-25
				B - 2.164 / 2.163	

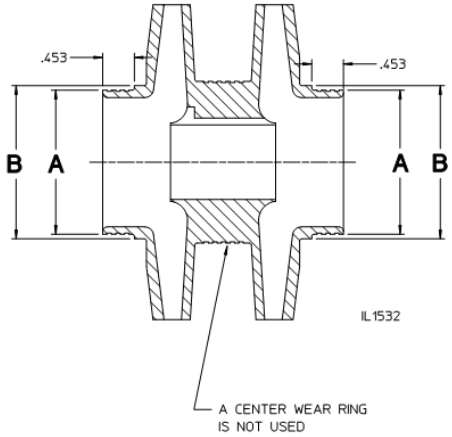
Keep the hub diameters within 0.015 in. TIR of the impeller shaft bore. If the impeller hubs do not clean up at first undersize dimension, turn the hub down to the next degree of undersize. Replace the impeller if the hubs do not clean up at the last undersize dimension.

Figure 3. Impeller Repair Dimensions



Impeller Designs B & C
Four Impeller Design
(Four Individual Impellers Per Pump)
Part No's 73269, 73270

Used After January 15, 2013



Impeller Design A
Two Impeller Design
(Two Dual Impellers Per Pump)
Part No's71076-A, 71076-B

Used After January 15, 2013

Interstage Seal and Packing Housing Replacement

Interstage Seal

Measure the inside diameter of the interstage seal (measurement D) and the outside diameter of the impeller shaft (measurement C) at the location shown. Subtract measurement C from measurement D. If difference is greater that .020 in., replace the interstage seal. Also check the impeller shaft for excessive wear or damage in the area under the interstage seal.

C - D = ____ (Greater than .020 in. replace)
(Less than .020 in. re-use)

Packing Housing

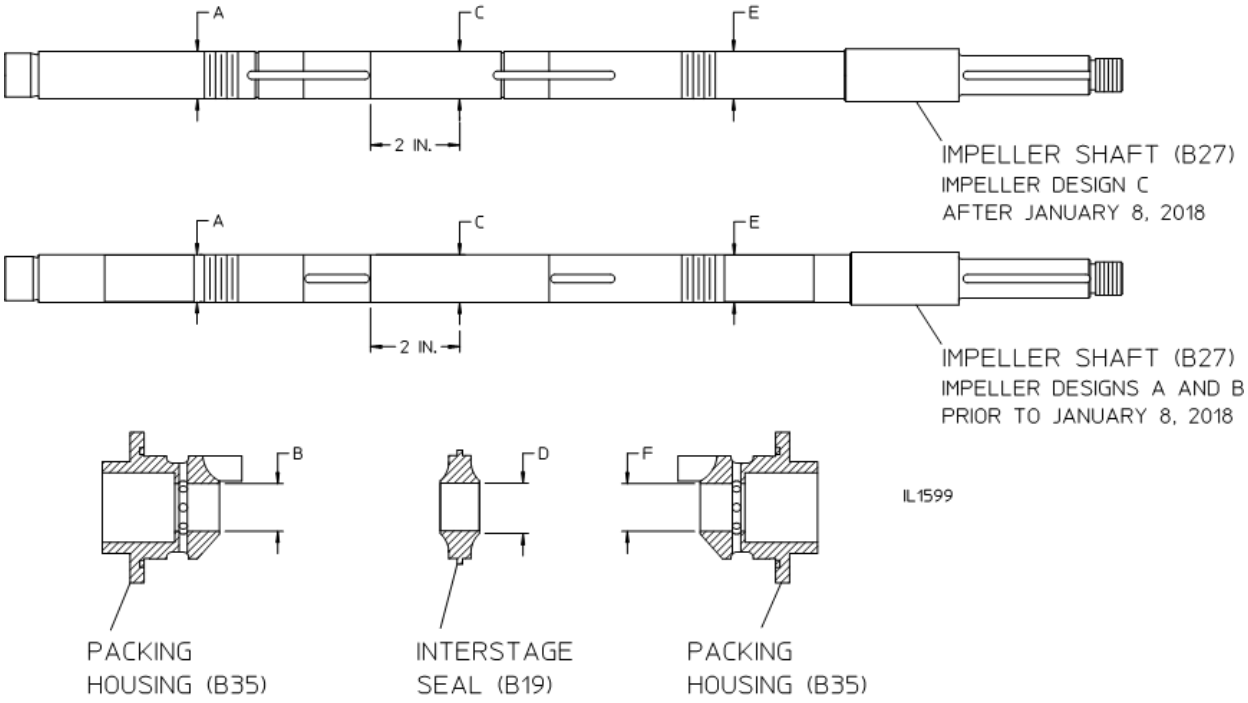
NOTE: Both packing housings are to measured, one on each end of the pump.

Measure the inside diameter of the packing housings (measurements B & F) and the outside diameters of the impeller shaft just behind the threaded portions (measurements A & E). Subtract measurement A from measurement B and measurement E from measurement F. If difference of either is greater than .020 in., replace the packing housing. Also check the impeller shaft for excessive wear or damage in the areas under the packing housings.

B - A = ____ (Greater than .020 in. replace)
(Less than .020 in. re-use)

F - E = ____ (Greater than .020 in. replace)
(Less than .020 in. re-use)

Figure 4. Interstage Seal and Packing Housing Replacement



Reassembly

Refer to Figures 1 & 2

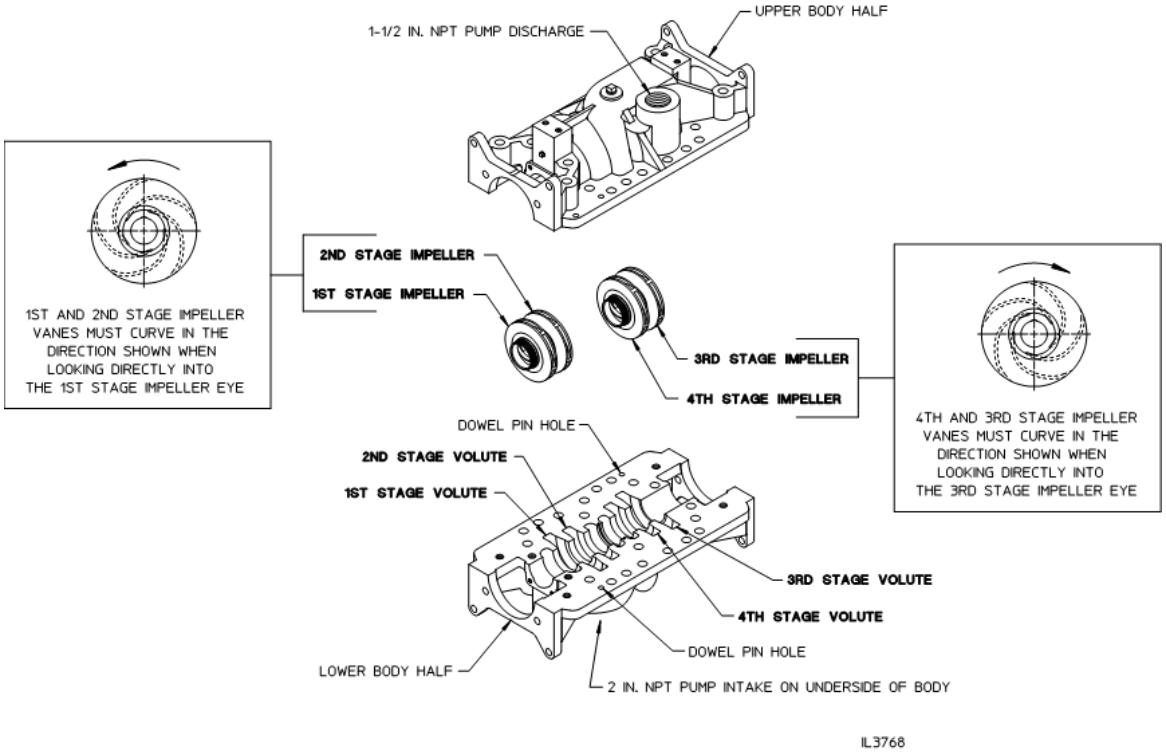
Reassembly of the CP-4 pumps is essentially the same as the disassembly procedure, except it is reversed. Note that if undersize wear rings are required, they should be installed during reassembly. Be certain that the wear rings will seat completely in the bores of the upper and lower volute bodies. Spirol pins (B20) must not protrude into the wear ring bore or be pushed too far into the pump body. Also, if a new impeller is needed, install new standard size wear rings for the impeller.

Be certain that the correct impeller is installed on the transmission end and on the outboard end of the impeller shaft. See Figure 5. Make sure that the impellers fit tightly on the shaft and that the gib head keys are properly seated.

Prior to June 13, 2003, apply Permatex Super 300 or equivalent on body flanges to prevent leakage. After June 13, 2003, apply a bead of silicone sealant on both halves of the body along the seal housing area to hold the body gasket in place and to prevent seepage.

Figure 5. Impeller Installation

The impellers rotate relative to each of the four volute stages in the pump body. Orient the pump body as shown in the diagram to identify each of the four volute stages. Ensure the upper and lower halves are aligned correctly (all bolt holes are aligned). Install the impellers so that the vanes curve in the direction shown in the diagram. See impeller removal diagrams for Gib Head key(s) installation positions.



Packing

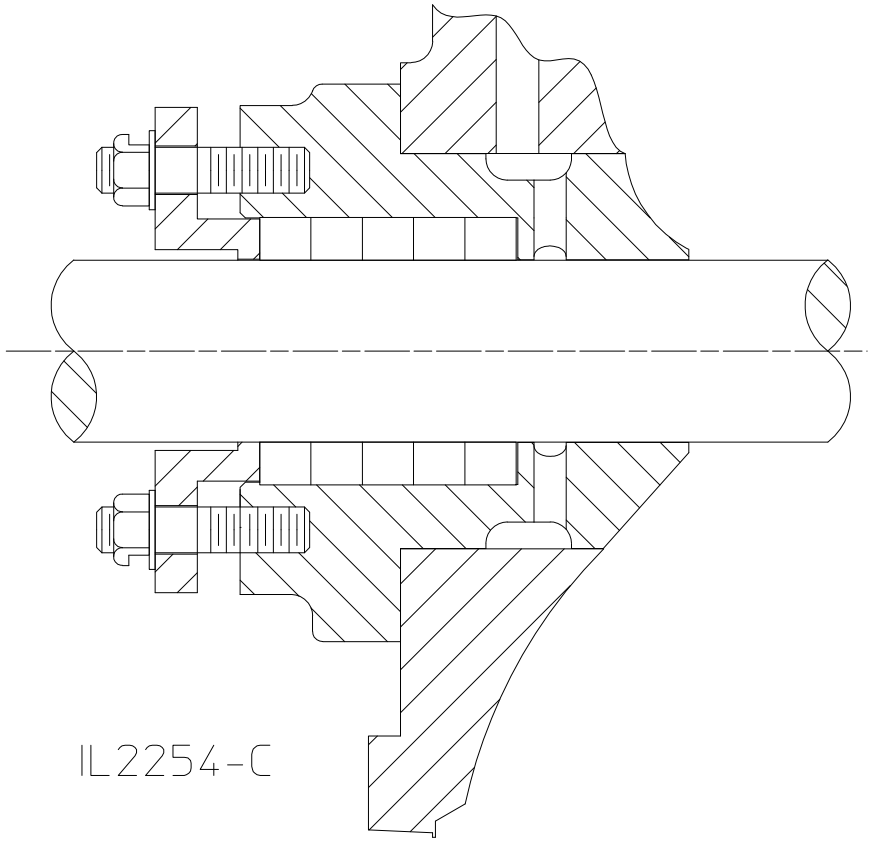
Braided flexible graphite (BFG) split rings are used as both standard and replacement packings.

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 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).

   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.

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

Figure 6. Packing Arrangement



Final Assembly

To complete final assembly, perform the following:

1. Connect the propeller or drive shaft to the pump transmission if equipped with a K series transmission. If equipped with a T series transmission, attach the complete pump and transmission to the engine bell housing.
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.
5. Lubricate outboard ball bearing with a general purpose ball bearing grease.

Testing

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 tighten attaching parts as necessary. Repeat until all leaks are eliminated.
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 F-1031, Section 2113.

⚠ 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. Do not exceed 1000 psig.
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.