

Model CR Fire Pump

Overhaul Instructions

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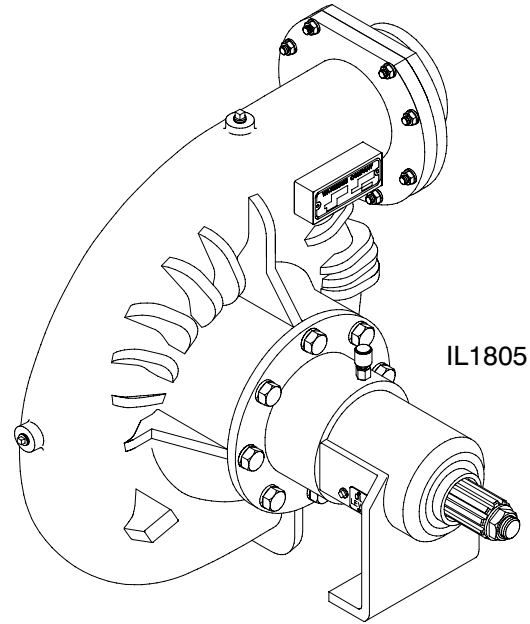


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Introduction

This instruction contains the information needed to overhaul and repair Waterous Model CR centrifugal fire pumps.

The text uses reference numbers when discussing specific parts. These numbers refer to the parts called out on the Service Parts List which is supplied with the pump.

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. 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 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.

Disassembling the Pump

Before disassembling the pump, mark the position of the suction adapter (B1), volute body (B2) and the mounting bracket to each other. Also mark the position of the bearing housing (B6) with the volute body (B4).

Note: The wear rings (S5) in the volute body (B4) and suction adapters (B1) cannot be removed without ruining them. They should only be removed if new wear rings are required.

1. Remove the 3 or 4 screws (B9) that attach the mounting bracket (B2) to the suction adapter (B1) and volute body (B4). Remove balance of screws that fasten the suction adapter to the volute body. Remove O-ring (B3) from the groove in the suction adapter.
2. Remove nut (B15) and washer (B16) from bolt (B14). Remove discharge adapter (B13) from the volute body and remove the O-ring (B17) from the groove in the discharge adapter.
3. Remove cotter pin (S19) and impeller lock nut (S2) and washer (S3).
4. Remove impeller (S6) from impeller shaft (S9). Tapping the impeller lightly with a soft hammer may be necessary to free it from the impeller shaft so it can be removed. There are 3/8-16 UNC tapped holes in the impeller to allow use of a puller if necessary.
5. Remove key (S4) from the impeller shaft.
6. Remove spring from the mechanical seal (S7).
7. Apply a light coating of oil to the portion of the impeller shaft the mechanical seal is on. Grasp the seal by hand and try to remove it with a combined pulling and twisting motion. If it is stuck to the shaft and will not come off, it will come off when the impeller shaft and bearing housing are separated from the volute body.

Note: If only the mechanical seal is to be serviced, proceed through steps 1 thru 10 and then tap out the throttle bushing (S8) from the volute body, which will remove the mechanical seal stationary seal ring in the volute body, being sure not to damage the oil seal (S10) in the volute body.

8. Stand the pump in a vertical position, resting it on the face of the volute body.
9. Remove screws (B10) fastening the bearing housing (B6) to the volute body. Tap the bearing housing lightly with a soft hammer to free it from the volute body.

10. Rig a sling to the end yoke that is attached to the impeller shaft (S9). With a hoist, lift the shaft and housing from the volute body. The impeller shaft will probably adhere to the bellows of the mechanical seal and it will be necessary to jiggle the shaft as it is being removed. If the volute body lifts with the shaft, tap on the volute body with a soft hammer.
11. Remove the O-ring (B5) from the groove in the face of the bearing housing.
12. With the shaft and bearing housing detached from the hoist, remove lock nut (S17) and washer (S16) that attach the yoke to the impeller shaft.
13. Remove the end yoke from the impeller shaft.
14. Slide the bearing housing (B6) off the bearings on the impeller shaft. Remove the breather (B7), snubber (B18), pipe plugs (B8) and oil seal (S15) from the bearing housing.
15. Position the impeller shaft assembly in a vertical position in an arbor press with the spline end of the shaft up and the impeller end of the outer race of bearing (S11) supported by the table of the press. Press the shaft (S9) out of the bearings (S13 & S11), spacer (S12) and oil seal sleeve (S14).

NOTICE

When the shaft is free of bearing (S11) it will fall free. Blocking should be provided under the shaft.

16. Tap out the throttle bushing (S8) from the volute body, which in turn will remove the mechanical seal stationary seal ring from the body. Remove the O-ring from the seal ring.
17. Remove the oil seal (S10) from the volute body.
18. If the wear rings (S5) in the volute body or in the suction adapter are to be replaced they must be driven out of the body or adapter by using a chisel end punch. When they have moved outward approximately 1/8 to 3/16", it may then be possible to pry them out by using a pry bar behind the wear ring.

Inspection and Repair

Impeller and Wear Rings

Check wear rings and impeller hubs for deep grooves or scratches. Spirol grooves or grooves parallel to the impeller shaft increase leakage. Inspect for excessive wear ring clearance. Diametric clearances in excess of .027 inches may warrant wear ring replacement. Original factory clearance is .019 to .023 diametrically. The diametric clearance should be determined by averaging the results of four measurements taken at 90 degree increments as follows:

Clean and remove small burrs or other protrusions from the wear ring inner diameters and the impeller hub O.D. and I.D. Position each wear ring

on the impeller hub on which it was used. Hold the wear ring firmly against one side of the hub and measure total clearance on the opposite side, using a feeler gauge. Do not bottom the wear ring against the bottom of the groove in the impeller.

Impeller hub to wear ring clearance is restored by turning impeller hubs to sizes noted in table and by installing matching undersize wear rings. See table.

Impeller and Wear Ring Repair Dimensions

ORIGINAL HUB DIA	ORIGINAL WEAR RING NO.	REWORKED HUB DIA	NEW WEAR RING NO.
7.501/7.499	72346	7.476/7.474 7.451/7.449	72346-25 72346-50

Ball Bearings

When cleaning bearings, bearing manufacturers recommend placing them in a basket and suspending the basket in a container of solvent, preferably overnight. Avoid rotating the bearings before solid particles are removed, to prevent damaging races and balls.

After cleaning, spin them immediately in light oil and check each one as described below:

1. Examine bearing for rusted or pitted balls, races or cages.

2. Check cage and races for cracks or other damage. Examine balls and races for brinelling, abrasion and serious discoloration. If in doubt about condition of bearing, replace it.
3. Rotate bearing slowly, and check for roughness or excessive internal looseness. If a rough spot is found, it may be dirt caked on a race. Try cleaning it again. If endplay is doubtful, compare it with a new bearing. If the bearings are not to be installed right away, wrap them in clean, oil proof paper.

Impeller Shaft

Examine shaft for signs of severe scratches, grooves or corrosion, especially under the oil seal or mechanical seals. If scratches are not severe, and are not under seals, they can be ignored. Check for cracks, pitting, twisted splines or damaged keyway.

Scratches in the area of the bellows of the mechanical seal can possibly be removed by spinning the shaft in a lathe and polishing with a fine emery cloth.

Installing Oil Seals

Before installing an oil seal in a housing, be sure that the seal, shaft and housing are clean.

Apply force to the outer edge of the seal and press in evenly.

Oil Seal Sleeve

Check for wear and scratches where the seal contacts the sleeve. The journal may be polished with a fine emery cloth, however; any polishing that leaves a spiral pattern may lead to an oil leak. If a groove has been worn in the sleeve, it can be reused by turning it end for end. If question-

able, replace the sleeve or fit with a thin replacement sleeve. This replacement sleeve allows use of the same size oil seal. This type of repair sleeve is available through most sources of oil seals.

Volute Body and Intake Adapter

Examine 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.

Clean out drainage hole in volute body, located between the seat for the throttle bushing and oil seal.

Throttle Bushing

Note: The bushing serves as a restriction to fluid leakage if the mechanical seal fails.

Examine the bore in the bushing for wear due to contact with the shaft. The size of the bore is 2.760/2.762.

Reassembly

Note: These instructions are written based on installation of new wear rings, either standard size or under size. The wear ring hubs on the impeller are sized to suit.

1. Slide both wear rings (S5) onto the impeller with the tapered (concave) end towards the impeller. With the inner wear ring overhanging the impeller by 1/4 inch there should be radial shake between the wear ring and impeller. Similar radial shake should exist between the outer wear ring and impeller with the wear ring overhanging the impeller by 1/8 inch. Do not bottom the wear rings with the impeller when checking for radial shake.
2. Inspect the bore for the wear ring in the suction adapter and volute body for any raised burrs or nicks that may have occurred when removing the old wear rings. Remove any burrs or nicks before installing new wear rings.
3. Position the suction adapter on a bench with the bore for the wear ring facing up. Position the wear ring (S5) in the bore with the square end down. Apply Loctite 609 to assist in wear ring retention. With a soft hammer, begin seating the ring squarely into the bore and then drive it down by hitting it evenly from side to side until it bottoms against the shoulder at the bottom of the bore.
4. Install the wear ring in the volute body the same way as that installed in the suction adapter.
5. Install oil seal (S10) in the volute body. Make sure the lip of the seal is facing toward the bearing housing (B3).
6. Support bearing (S11) on the face of the inner race and press the impeller shaft (S9) spline end first thru the bearing until the shoulder on the shaft is tight against the bearing.
7. Slide spacer (S12) on the shaft, against the bearing (S11). Press bearing (S13) onto shaft by applying force to inner race, tight up against the spacer. Press oil seal sleeve (S14) onto the shaft, tight up against bearing (S13).
8. Position the volute body on the bench, resting it on the face the suction adapter bolts to.
9. Take the previously assembled shaft and temporarily install the end yoke and secure it with the lock nut (S17).
10. Secure a sling to the end yoke and lift the shaft until it hangs vertically above the volute body.

11. Align the shaft with the oil seal (S10) in the volute body and slowly lower the shaft through the oil seal in the body until the outer race of bearing (S11) seats against the hub on the body.

CAUTION

As the journal on the shaft for the oil seal begins to enter the oil seal, make sure the seal lip does not turn under or the garter spring in the seal does not pop out of position.

12. Remove the end yoke locknut (S17) and the end yoke from the shaft.
13. Before installing an oil seal (S15) in a housing, apply a thin coat of sealant to housing oil seal seat. (Waterous recommends Loctite Ultra Blue RTV Silicon Sealant or Permatex Super 300). Be sure that the seal, shaft and housing are clean. Always install a seal with the seal lip facing in. Apply force to the outer edge of the seal and press in evenly.
14. Apply a light film of grease in the groove in the face of the bearing housing (B6). Install O-ring (B5) in this groove.
15. Position the bearing housing (B6) over the shaft, rotating it to its correct relation to the volute body. Slide it down over bearings (S11) and (S13) until it seats against the volute body.

CAUTION

As the journal on the shaft for the oil seal begins to enter the oil seal, make sure the seal lip does not turn under or the garter spring in the seal does not pop out of position.

16. Line up holes and install screws and lock washers (B10) and (B12), torque to 93 lb.ft.
17. Reassembling the bearing housing and impeller shaft to the volute body should restore alignment to each other. To check the alignment, attach an indicator to the impeller shaft and rotate the shaft and indicate the bore in the volute body. The runout should be within .005 T.I.R. If the runout exceeds this, the following should be checked:
 - a) Raised burr or nick on faces of the bolted joint between the bearing housing and volute body.
 - b) Foreign material caught between the joint.
 - c) O-ring out of position and pinched between the joint.

18. Temporarily install the impeller (S6) and rotate the impeller shaft. The impeller should rotate without contact with the wear ring in the volute body. Remove the impeller.
19. Slip the throttle bushing (S8) over the end of the impeller shaft and down onto the bore in the volute body. Tap into position until it seats against the shoulder in the body.

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.

20. Apply a light coating of seal lubricant to the O-ring in the stationary seal ring of the mechanical seal.

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.
21. Slip the seal ring over the end of the impeller shaft, with the finish lapped face of the seal ring facing up (the opposite side of a new seal ring has a mark on it). Slide it along the shaft and push it into and seat it in the bore in the volute body. If it can not be pushed in by hand it may be tapped into place by use of a block of wood between the ring and a hammer.
22. Wipe the face of the previously installed stationary seal ring of the mechanical seal with a clean lint free cloth or tissue paper.
23. Wipe a few drops of seal lubricant on the inside of the bellows of the mechanical seal and wipe the face of the carbon ring with a lint free cloth or tissue paper. Slide the seal onto the shaft until the carbon ring contacts the stationary seal ring.
24. Install the spring over the seal assembly (S7).
25. Install key (S4) in the impeller shaft and then install the impeller (S6), washer (S3) with rib toward the impeller nut and impeller nut (S2). Snug up the nut.

Note: When installing the impeller washer 52632, install so that the rib on the washer faces the impeller nut.

26. Rotate the impeller to assure seating of the mechanical seal spring into the counterbore on the backside of the impeller. If the spring is not properly seated it will snap into place when the impeller is rotated.
27. Tighten impeller nut (S2) and line up slot in the nut with the hole in the shaft. Install and secure cotter pin (S19).
28. Grease O-ring (B3) and install it in the groove in the suction adapter (B1).
29. Position the suction adapter in its original position with the volute body. Line up holes and tap the adapter down into position. Position the mounting bracket (B2) in its original position with the suction adapter and the volute body. Install screws and lockwashers (B9) and (B11). Tighten until the surface of the adapter meets the surface of the volute body. Rotate the impeller shaft. Make sure the wear rings and the impeller are not rubbing against each other.
30. If the impeller turns freely, tighten screws evenly from side to side. Torque to 75 lb.ft.
31. If the impeller rubs against the wear rings, remove the adapter and determine the cause. The following can cause rubbing:
 - a) Raised burr or nick on either the hub of the impeller or on the wear ring.
 - b) Wear ring cocked when installed and is deformed sufficiently to rub on the impeller.
 - c) Impeller hub was not reworked to correct size for use with new undersize wear ring.
32. After correcting the problem of rubbing between the impeller and wear rings, reinstall the suction adapter.
33. Install the two pipe plugs (B8) in the bearing housing. Install the snubber (B18) in the upper hole in the housing and then the breather (B7) into the snubber.
34. Place the end yoke on the impeller shaft. Install washer (S16) and lock nut. **Pumps built prior to April 20, 1998:** Tighten lock nut (S2) and line up slot in nut with hole in the impeller shaft. Install and secure cotter pin (S1). **Pumps built after April 20, 1998:** Tighten lock nut (S17), torque to 400-450 lb-ft.
35. Apply a light film of grease in the O-ring groove in the discharge adapter (B13). Install O-ring (B17) in the groove and position the adapter to the flange on the volute body. Install bolts (B14), lock-washer (B16) and nuts (B15). Torque to 31 lb.ft.
36. Lubrication: Fill bearing housing to the bottom of the oil level plug hole with 30 wt. oil. Capacity is approximately 1/4 qt.