

# CX Series Fire Pumps

# Overhaul Instructions

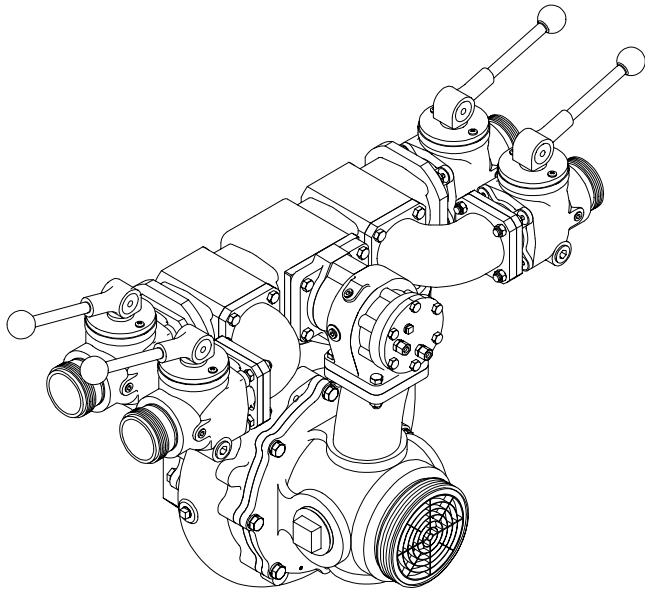
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**WATEROUS**

*Fire Pumps – Since 1886*



## Introduction

This section contains overhaul instructions for Waterous CX Series centrifugal fire pumps. Since several types of transmissions are used with the CX Series pumps, the transmissions are covered in separate sections beginning with number 4300.

Note that this instruction is written to cover several variations of the CX Series 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.

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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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## General Description

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The CX series pumps are single stage centrifugal pumps. The combination of single-stage design and vertically-split volute and pump transmission provide a simple to operate, easy to maintain pump. The use of heavy duty gears, bearings and shafts provides longer, more trouble-free service and a high reserve capacity. CX pumps are available with five transmission options, most providing pump-and-roll performance, in addition to its unique

mounting. The pump may be driven from engine crankshaft (front mounted), power take-off driven, or direct engine driven (bellhousing mounted). Using the "KC" style transmission, the CX provides easy access to water supply when drafting and in hydrant operation. In addition, front mounted pumps allow easy maintenance and repair.

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## Disassembly

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A CX Series pump may be disassembled in several ways, depending on the type of transmission used, the piping arrangement and similar factors.

The following instructions offer one of several means of removing and disassembling a CX pump.

1. Disconnect drain lines, electrical wiring and similar connections to pump and transmission.
2. Drain lubricant from transmission.
3. Disconnect propeller or drive shaft(s) from transmission.
4. Remove hex hd bolts (B5) and lock washers (B6) attaching suction adapter (B7) to volute body (B3). Separate the adapter from the body and replace O-ring (B8).

**NOTE: On pumps with F, K or T transmissions, separating pump head with transmission attached from the volute body might be easier than the separation described below, space permitting.**

5. Remove impeller nut (S13) and with a puller, remove impeller (S10). Also remove key (S12). (Three puller holes in impeller have 1/4-20 NC thread.)
6. **Packing:** Loosen unbalanced nuts (S4) and remove packing gland (S6), if used.

**Mechanical Seal:** Lubricate impeller shaft & slide bellows assembly from impeller shaft. Seal can also be removed when removing head (B2) from pump transmission. Remove stationary ring from pump head.

7. Remove hex hd bolts (B5) and lock washer (B6) attaching volute body (B3) to head (B2). Slide volute body carefully from head.
8. Remove hex hd bolts attaching head (B2) to pump transmission. Slide head (B2) from impeller shaft.
9. Removing impeller shaft from transmission is not necessary unless it is damaged. If impeller shaft removal is necessary, see the appropriate transmission overhaul instructions.

## Inspection and Repair

### Mechanical Seal

If a pump has a mechanical seal, installing a new seal during reassembly is required. Check impeller shaft (S1) for damage. Make sure the shaft end

and the edges of the keyway are free of burrs which will damage seal components during reassembly.

### Impellers

Check impeller hubs and wear rings for deep grooves or scratches. Position each wear ring on impeller hub on which it was used, hold wear ring firmly against one side of hub and measure total clearance on opposite side (original) factory clearance is from 0.008 to 0.012 in.). If clearance exceeds

0.020 in., then turn impeller hubs and install undersize wear rings as directed below. If replacing an impeller is necessary, be sure to install new, standard size wear rings. Examine lock nut and key for corrosion and other damage and replace if condition is doubtful.

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

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 at which they will clean up and install undersize wear rings during reassembly. These repair rings are available 0.025, 0.050 or 0.075 in. undersize.

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**

Impeller Number	Original HUB Diameter	Original Wear Ring Number	Reworked HUB Diameter	New Wear Ring Number
71830/71831	6.375/6.373	62298/62299	6.350/6.345	62298-25/62299-25
71830-T/71831-T	6.375 Max.		6.325/6.320	62298-50/62299-50
			6.300/6.295	62298-75/62299-75
71888/71896	6.750/6.748	62420	6.725/6.720	62420-25
71888-T/71896-T	6.750 Max.		6.700/6.695	62420-50
			6.675/6.670	62420-75

## Reassembly

Reassembly is essentially the reverse of disassembly. If undersize wear rings are required, install them at this time. If a new impeller is needed, also install new standard size wear rings for it. Refer to the following instructions on repacking pump or replacing mechanical seal.

### Mechanical Seal

#### 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 O-ring on the stationary seal ring of the mechanical seal.

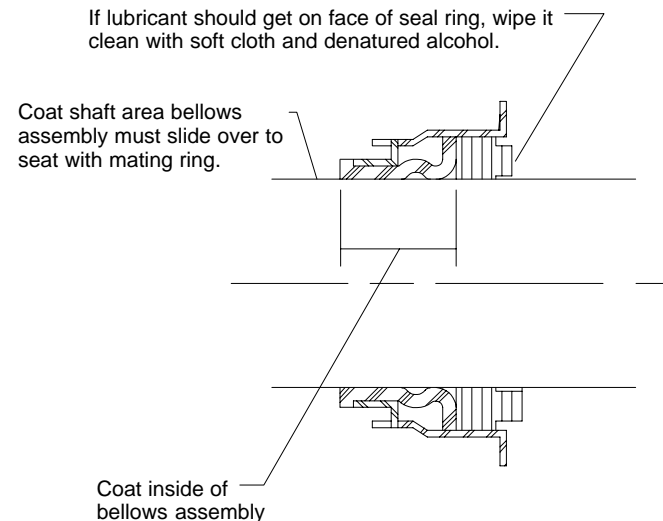
**Note: To protect the rubber bellows of the mechanical seal, place a piece of masking tape over the keyway on the impeller shaft, making sure that the tape is able to be removed after bellows has passed over the keyway.**

2. Slip the ring over the end of the impeller shaft, with the finish lapped face of the 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 pump head. 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.
3. Wipe the face of the previously installed stationary ring of the mechanical seal with a clean lint free cloth or tissue paper and denatured alcohol.
4. 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 and denatured alcohol. Liberally coat impeller shaft with seal lubricant. Slide the seal onto the shaft until the carbon ring contacts the stationary seal ring. Install spring assembly.

5. Slide impeller on the shaft. The mechanical seal is held in place by notches in the impeller. Continue pump assembly.

**Figure 1. Mechanical Seal Lubrication Application**



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## 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 seal housing.



### 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 from one end of the pump.
2. Engage the pump per appropriate operating instructions. Operate the pump gradually increasing the discharge pressure until the packing is forced out of the seal housing. Pressure in excess of 300 psi (20.7 bar) may be required.

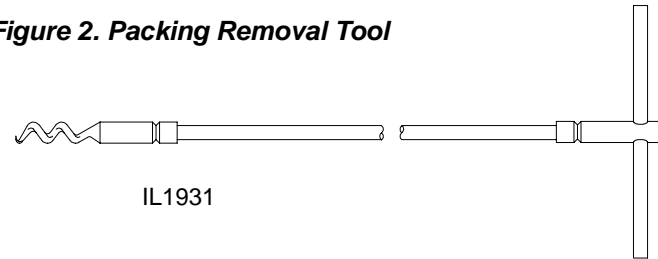
### CAUTION

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

Circulate enough water through the pump to prevent overheating. Do not pressurize the pump over 600 psi (41.4 bar).

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 1.
4. Replace packing per instructions below, repeating the procedure for the opposite end of the pump.

**Figure 2. Packing Removal Tool**



### Packing Installation

1. Before installing the new packing, be sure that all of the old packing is removed from the seal housing.
2. Be sure that the seal housing 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 seal housing 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 seal housing (at least 1/8 inch is required for the packing gland nose entrance into the stuffing box), see Figure 3.

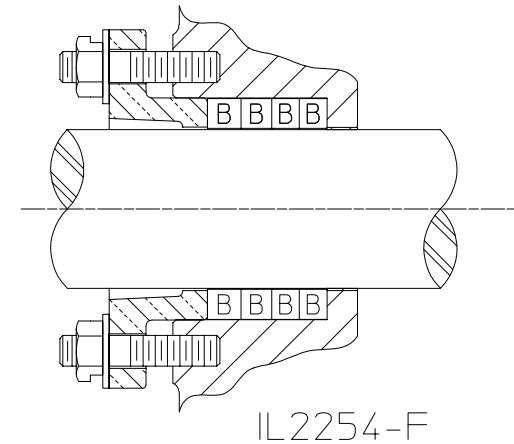
**NOTE: Be sure that the packing joints are staggered at least 90° apart.**

6. Install packing glands, nuts and washers. Tighten gland nuts one flat beyond finger tight, see Figure 3.

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

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

**Figure 3. Packing Gland Tightening**



## Final Assembly

1. Connect pump to intake and discharge piping.
2. Connect propeller or drive shaft transmission.
3. Connect drain lines, electrical wiring and similar equipment to pump and accessories.
4. Fill gear case with lubricant as described in transmission operation and maintenance instructions.

## 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. (Leakage may be zero or diminished to zero occasionally).

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.

## 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.

## Testing

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

### **Hydrostatic Testing**

1. Connect pump to a hydrant or other pressurized water supply.
2. Close all drain lines and open discharge and priming valves.
3. Open hydrant until water runs out through discharge valves and discharge pipe in priming pump. Close all valves. Be sure to evacuate all air from pump.
4. Apply water pressure to pump for 15 minutes. Do not exceed 350 psi (24.2 bar). With a portable light, check pump for leaks. If leaks are discovered, tighten connections or attaching parts as necessary.

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



### 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 following vacuum test described below.**

5. After all leaks are eliminated, shut hydrant valve, drain pump completely and disconnect intake hose.

### **Operational Testing**

1. Operate pump at its maximum intended service pressure. Do not exceed 350 psi (24.2 bar) (450 psi, 31 bar with positive intake).
2. With a portable light, check pump for leaks. If leaks are discovered, stop pump and tighten connections or attaching parts as necessary. Repeat until all leaks are eliminated.
3. While pump is running, check for unusual noises, oil leaks, overheated bearings, etc. If anything unusual is discovered, stop pump immediately and determine the cause.