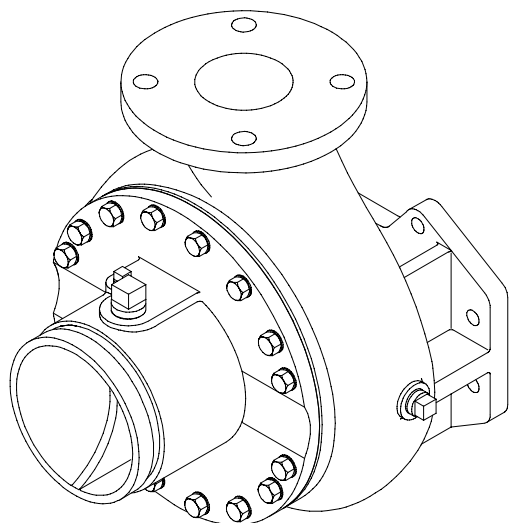


Table of Contents



Safety Information	2
Introduction	3
General Description	3
General Overhaul Information	3
Tools and Equipment	3
Preliminary Testing	3
Cleaning	3
Pump Bodies and Impellers	3
Bearings, Gaskets, Seals and O-rings	4
Impeller Shafts	4
Installing Ball Bearings	4
Installing Body Gaskets	4
Disassembly	4
Inspection and Repair	5
Mechanical Seal	5
Impellers	5
Installing Undersize Wear Rings	6
Reassembly	6
Mechanical Seal	6
Packing	7
Packing Removal	7
Packing Installation	8
Packing Adjustment	8
Final Assembly	9
Testing	10
Hydrostatic Testing	10
Operational Testing	10



Read through the safety information and overhaul instructions carefully before repairing your Waterous CG Series Fire Pump.

NOTE: Instructions subject to change without notice

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 CG Series centrifugal fire pumps. Since several types of transmissions are used with the CG 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 CG 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.

General Description

The CG series pumps are single stage centrifugal pumps. Depending on the type of transmission used, the pump may be used as a front-mounted pump (driven from the engine crankshaft), power take-off driven, direct-engine driven (bellhousing mounted) or midship mounted. They are available in capacities up to 750 gpm (2850 l/m). The CGVG is a midship or PTO mounted pump with a curved intake cross pipe. CGN (not available after

4/21/06) pumps are front-mounted, direct-engine mounted or PTO-driven with a 5 inch flanged intake fitting. CGV pumps are front, direct-engine mounted to PTO driven with a Victaulic® intake fitting. CGR (not available after 4/21/06) pumps are front-mounted, direct-engine mounted or PTO-driven with a threaded intake fitting.

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.

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.

Disassembly

A CG Series pump may be disassembled in several ways, depending on the following:

- ▣ Type of transmission
- ▣ Piping arrangement

Removing the pump and transmission together, and then disassembling the pump is usually the easiest method. Refer to service parts list (SPL) furnished with your pump for component identification.

► **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 drive shafts from the pump transmission.
4. Disconnect the intake and discharge piping from the pump.

NOTE: Unless the body and/or the front wear ring is damaged, it may be easier to leave the piping connected and go to Step 6.

5. Remove the pump and transmission.
6. Remove the cap screws and copper washers, attaching the intake adapter to the body.
7. Remove Intake and discard gasket.
8. Remove the impeller shaft cotter pin and nut.
9. Remove the impeller and square key.

NOTE: The impeller has three tapped holes in the eye to allow a puller to be used to remove it.

- 10a. **Pumps with Mechanical Seals:** If the pump has a mechanical seal, remove bolts, washers and nuts attaching pump head to the transmission. Lubricate impeller shaft. The mechanical seal and pump head may now be removed as a unit. NOTE that the rear wear ring will come off with the head.

NOTE: Care must be taken not to damage the impeller shaft.

- 10b. **Pumps with Packing:** If the pump has packing, loosen unbalanced nuts and remove the packing gland. Packing gland is split into two halves for removal. The studs, unbalanced nuts and washers will remain attached to the pump head.

Remove the caps screws, bolt and nut attaching the pump head to the transmission.

Remove the pump head. NOTE that the rear wear ring will come off with the head.

11. Remove flinger ring.

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

NOTE: Removing wear rings from the body or head is necessary only if they are damaged or badly worn. (See impellers section of inspection and repair).

Inspection and Repair

The following points cover inspection and repair of the major components of CG Series 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, installing a new seal during reassembly is required.

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. The wear rings also have two tapped holes in them to allow a puller to be used to remove them.

Installing Undersize Wear Rings

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.

Flame plated impeller hub wear ring clearance is usually restored by installing a replacement wear ring with the same dimensions as the original wear ring since most wear occurs on the wear ring, not the impeller hub. Flame plated impellers are the numbers with the "T" suffix.

Table 1. Impeller and Wear Ring Repair Dimensions

Impeller Number	Original HUB Diameter	Original Wear Ring Number	Reworked HUB Diameter	New Wear Ring Number
7309-F 70690	4.623 / 4.621	61269	4.598 / 4.596 4.573 / 4.571 4.548 / 4.546	61269-25 61269-50 61269-75
70423 70689	5.5015 / 5.4995	61029	5.476 / 5.474 5.451 / 5.449 5.426 / 5.424	61029-25 61029-50 61029-75
71887 71899	5.500 / 5.498	62363 62364	5.492 / 5.494 5.467 / 5.469 5.442 / 5.444	62363-25 62363-50 62363-75 62364-25 62364-50 62364-75

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 CG and CGVG 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. Also, if a

new impeller is needed, install new standard size wear rings for the impeller.

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.

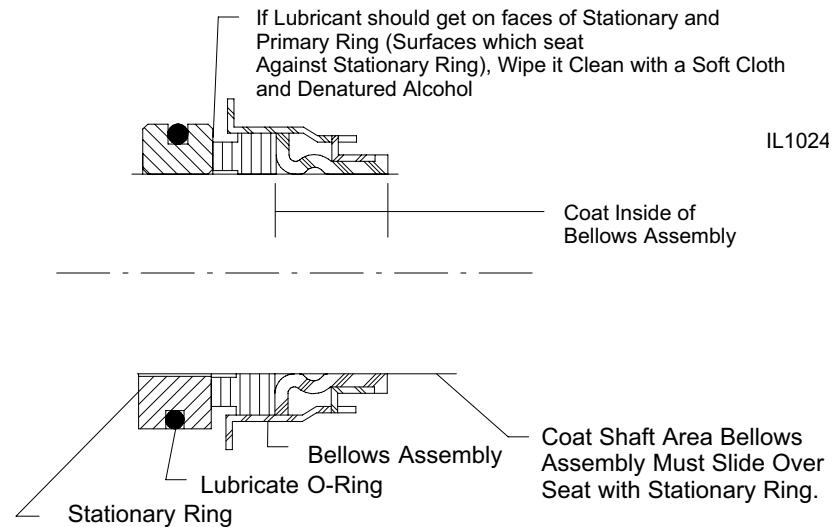
NOTE: If Waterous Mechanical Seal Lubricant part no. 52608 is not available, P80 rubber lubricant, straight dish soap or glycerin may be substituted.

1. Install mechanical seal after volute body has been reattached to transmission.

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. Apply a light coating of seal lubricant to the O-ring on the stationary ring assembly. 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 mechanical seal housing. 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. (Protect sealing surface).
3. Wipe the face of the previously installed stationary ring of the mechanical seal with a clean cloth and denatured alcohol.
4. Apply a light coating of seal lubricant to the inside of the bellows assembly and wipe the face of the carbon ring with a soft cloth and denatured alcohol. Liberally coat impeller shaft with seal lubricant. Slide the bellows assembly onto the shaft until the carbon ring contacts the stationary seal ring. Install spring on bellows assembly.
5. Slide impeller on the shaft. The mechanical seal is held in place by notches in the impeller. (Retaining ring used prior to 4/11/91).

Figure 1. Mechanical Seal Lubrication Application



Packing (No Longer Available After 2/4/05)

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.

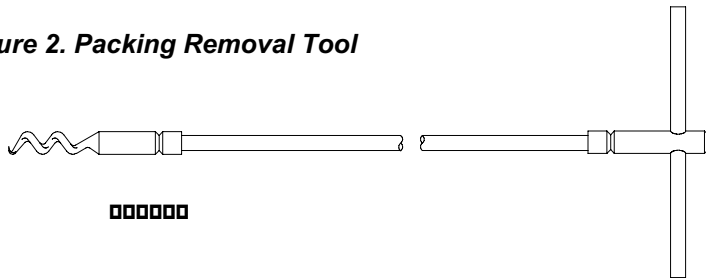
CAUTION

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 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 2.
4. Replace packing per instructions on the next page.

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 stuffing box.
2. Be sure that the stuffing box and the shaft are clean and free of any packing residue.
3. Lightly lubricate that 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 3.

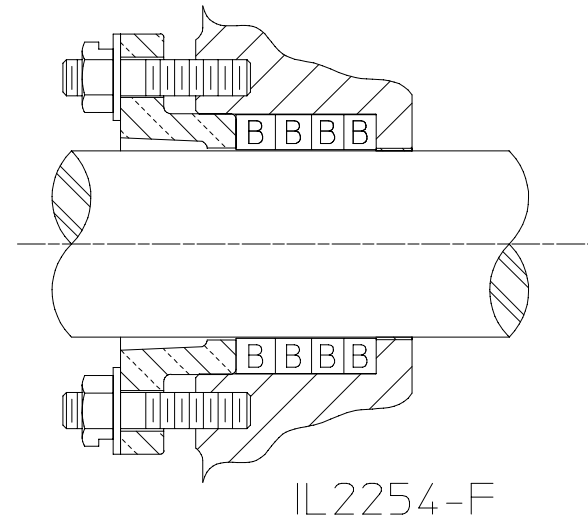
NOTE: Be sure that the packing joints are staggered at least 90° apart.

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 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.

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 the next page.

Final Assembly

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.

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 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. Do not exceed 350 psi (450 psi with positive pressure).
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.

NOTE: After reassembling pump, perform vacuum test per NFPA 1911, before the 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.