

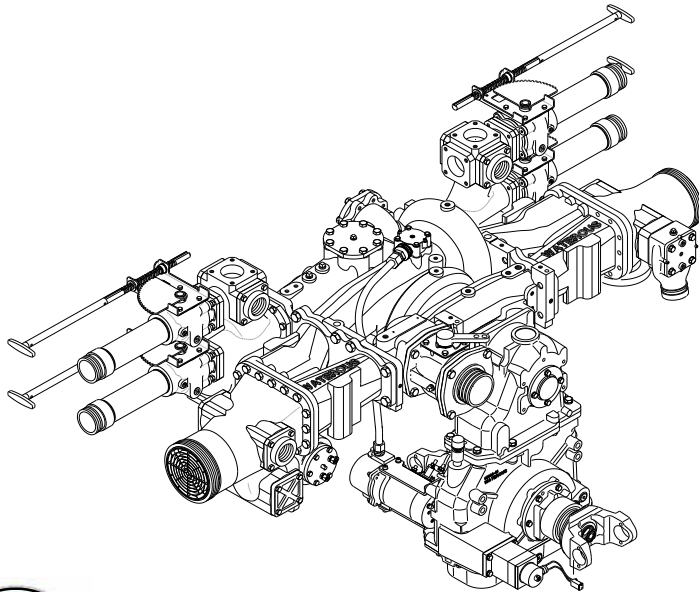
CS Series Centrifugal Fire Pumps

Operation and Maintenance

Form No.	Section	Issue Date	Rev. Date
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Read through the safety information and operating instructions carefully before using your Waterous Fire Pump.



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Safety Information



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.

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.

Safety Information



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



WARNING

Hose Testing Hazard. May result in serious personal injury.

Due to a potential for catastrophic hose failure during service testing of fire hose, it is vital that safety precautions be taken to prevent exposure of anyone to this danger. Fire pumps on fire department apparatus are not designed for and should not be used for service testing of fire hoses. Hose testing machines should be used for service testing of fire hoses.



WARNING

Pressure Hazard. May result in serious personal injury.

If a fire pump on a fire department apparatus is used for service testing of fire hoses, the procedures in NFPA 1962 **MUST be followed** including the use of a fire department gate valve with a ¼-inch (6 mm) hole drilled through the gate installed between the fire apparatus discharge outlet and the hose test layout to prevent a volume surge from the pump in the event a hose bursts during testing.



WARNING

Scalding Water Hazard. May result in serious burns.

If a fire pump on a fire department apparatus is used for service testing of fire hoses, pump discharge water must be circulated through a by-pass system or discharged through a slightly open discharge valve, or some other provision must be used to prevent overheating. If the pump runs for a few minutes without adequate flow through the pump, water may be heated enough to scald someone when a valve is opened.

Introduction

This instruction contains the information needed for operation and maintenance of CS Series centrifugal pumps. Since there are several types of transmissions available for these pumps, they are covered in separate instructions.

General Description

The CS Series pumps are single stage centrifugal fire pumps. They are designed for midship mounting and are available in capacities ranging from 750 to 2250 gpm (2850 to 8500 l/m). A variation of the basic pump is the CSH pump. This two stage pump has an extra pressure stage designed for high pressure operation. It is identical to the CS except for the added stage and piping.

OPERATION LIMITS: Do not operate pump beyond max. pressure (400 psi) or max. speed (4800 rpm).

Fail to do that may result in personal injury or premature pump failure.

Components

Body Assembly

This assembly includes the body, cover, intake adapters and related parts. The body, cover and adapters are either cast iron or bronze.

Impeller Shaft Assembly

This assembly consists of the bronze impeller mounted on a stainless steel shaft with wear rings, packing or mechanical seal and related parts. The impeller is balanced and the impeller shaft is supported by ball bearings.

Options

Mechanical Seals

A mechanical seal consists of a flat, highly polished (lapped), spring-fed carbon ring that is sealed to and rotates with the impeller shaft. It presses against a highly polished (lapped), silicone carbide, stationary ring that is sealed in the pump body. This seals the shaft and prevents air from entering and water from leaving. A mechanical seal does not leak or drip water, even when pumping.

Flame-Plated Impellers

Approximately 75% of the pump wear due to pumping sand, occurs on the impeller hubs. For this reason, the Waterous Company adopted the policy of offering a flame plated impeller as an option (standard on CSU pumps).

The flame-plating process consists of adding tungsten carbide to the surfaces to be protected from wear. This unique process produces extremely hard, well bonded, wear-resistant coatings which consistently outwear hard chrome plating, tool steel and solid tungsten carbide.

Monarch Intake Valve

The Monarch intake valve is a package including an extra short intake fitting, an intake butterfly valve and an intake nipple with integral relief valve mounting pad, all designed to fit behind the pump panel. The Monarch intake valve also features a provision for a pre-valve relief valve and choice of manual worm gear, pneumatic or 12 or 24 volt electric actuator. For operation and maintenance instructions for the Monarch intake valve, see the following instructions:

- F-1031, Section 2318, *Operation, Maintenance and Installation Instructions for Butterfly Valves*
- F-1031, Section 2319, *Operation, Maintenance and Installation Instructions for Butterfly Valve Pneumatic Actuator*

Extra Pressure Stage

The extra pressure stage provides extra pressure without the need of a separate PTO driven pump. When the extra pressure stage control valve is opened, water enters the extra pressure stage intake from the main pump discharge, and is discharged at a higher pressure. With the extra pressure stage in operation, the CSH pump develops pressure up to 500 psi (1900 l/m) for two or more booster lines. The extra pressure body mounts on the main body opposite the pump drive end. The impeller is mounted on the same shaft as the other impeller and rotates whenever the pump is in operation. When the extra pressure stage is not in use, water from the first stage lubricates and cools the extra pressure stage stuffing box.

Intake Screens

Zinc die cast screens are normally used in the intake fittings, with brass screens available optionally. Although the screens are chemically treated (coated) to inhibit corrosion, the water being pumped may still corrode the screens. Such corrosion is "sacrificial"; that is, it will help prevent corrosion in the rest of the pump the same way the magnesium anodes protect the metal parts of a water heater.

Anodes

As additional corrosion protection for iron body pumps, Waterous has anodes available to fit any unused intake pad, 2-1/2 inch or 3 inch pipe tap in the intake fittings. Anodes provide additional surface to the water to supplement the intake screens.

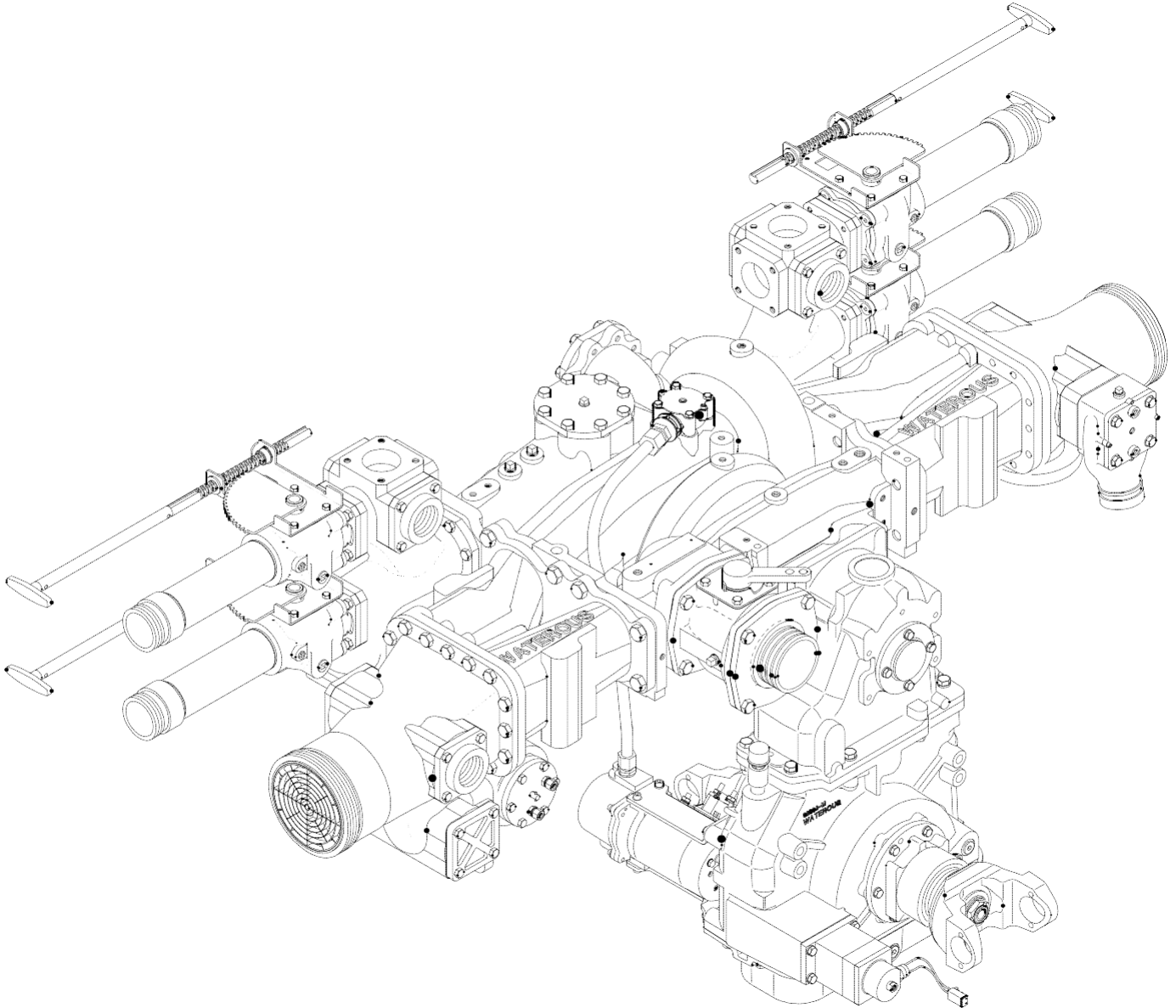
Tank to Pump Valve

The tank to pump valve is a full-flow 3-1/2 inch diameter ball valve which is attached directly to the pump.

Overheat Protection Manager (OPM)

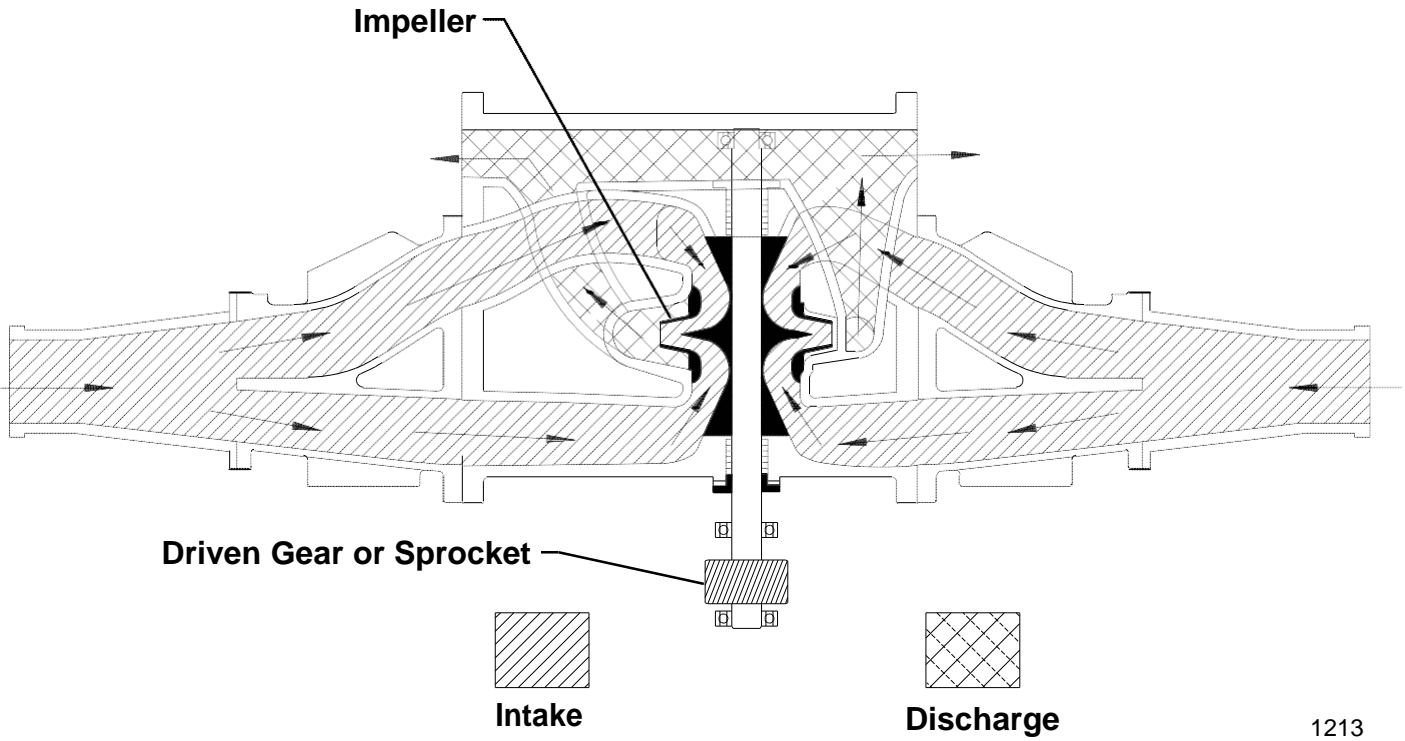
The Overheat Protection Manager (OPM) acts as a safety device by releasing hot water to the ground or back to the water tank from the discharge area of the pump.

CS Pump with C20 Transmission



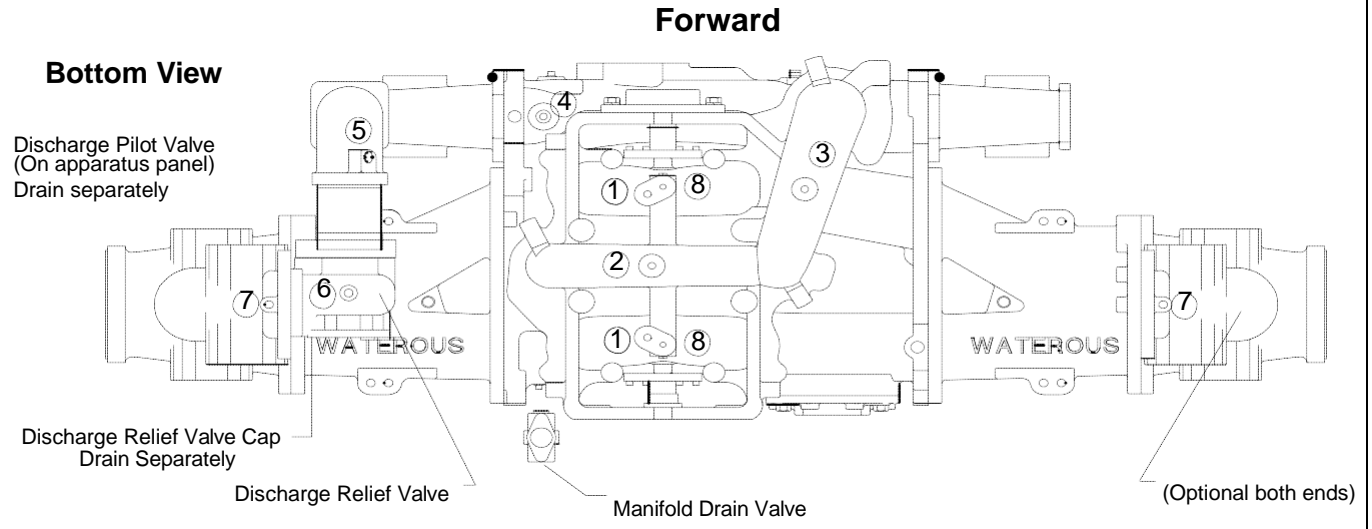
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Water Flow Diagram

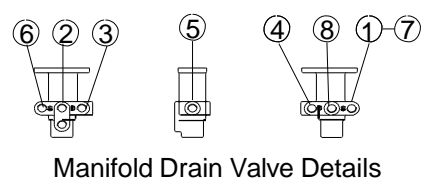


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Drain Locations



- ① Intake Volutes
- ② Discharge Volute
- ③ Crossover Passage
- ④ Main Discharge Barrel
- ⑤ Relief Valve Elbow or Adapter
- ⑥ Relief Valve Body
- ⑦ Intake Fittings (Depends on type of Intake fitting)
- ⑧ Mechanical Seal/Packing Chambers



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Note: If the pump has a foam manifold, its drains should be plumbed into a separate drain valve. Do not plumb into drain valve used for the pump.

Operating Instructions

Transmission Operation

Because of the variety of transmissions available for these pumps, the methods of operating them are not explained in this section. For information on Waterous transmissions, refer to transmission operation instructions.

Pumping from Water Tank

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.

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.

1. Engage pump in accordance with transmission instructions.
2. Open valve(s) in piping between water tank and pump intake and at least one discharge valve.
3. Allow about 30 seconds for water to flow into pump.

NOTE: Priming the pump may be necessary because of air trapped in piping.

4. Accelerate engine to obtain desired discharge pressure and capacity.
5. Set relief valves or other pressure governing device to desired pressure.

NOTE: For extra pressure stage pumping instructions, see page 8.

After Pumping

WARNING

Pressure Hazard. May result in personal injury or death.

Prior to removal of hoses, caps or other closures with pump intake or pump discharge connections, relieve pressure by opening drains.

1. Disengage pump drive in accordance with transmission instructions.
2. If pumping anything but clean water, remove all intake and discharge caps, open all valves and open all drains. Flush entire system with clean, fresh water for several minutes to remove all traces of impurities.
3. If pump is kept full of water when not in use, make sure water is clean and non-corrosive. Make sure the pump is completely full or completely drained - never partially full.

NOTICE

If the pump is exposed to freezing temperatures, drain all water from pump, lines and accessories.

4. Close all drains and install intake and discharge caps.

Pumping from Hydrant or in Relay

WARNING

Pressure Hazard. May result in personal injury or death.

Prior to connection of hoses, caps or other closures with pump intake or pump discharge connections, relieve pressure by opening drains.

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 even 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 personal injury or death.

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

1. Engage pump in accordance with transmission instructions.
2. Open intake, hydrant and other valves as necessary to allow water to enter the pump.
NOTE: Bleeder valves should be used while filling a hose connected to an intake with water.
3. Open discharge valves and accelerate engine to obtain desired discharge pressure and capacity.
4. Set relief valves or other pressure governing device to desired pressure.

NOTE: Do not attempt to pump more water than is available from the hydrant or relaying pumper. Always make sure the intake pressure compound-gage reading stays above zero.

Some fire departments operate at a minimum intake pressure of 10 psi (.7 bar) when pumping from hydrant or in relay to prevent a “soft” intake hose from collapsing.

NOTE: For extra pressure stage pumping instructions, see page 8.

After Pumping

WARNING

Pressure Hazard. May result in personal injury or death.

Prior to removal of hoses, caps or other closures with pump intake or pump discharge connections, relieve pressure by opening drains.

1. Disengage pump drive in accordance with transmission instructions.
2. If pumping anything but clean water, remove all intake and discharge caps, open all valves and open all drains. Flush entire system with clean, fresh water for several minutes to remove all traces of impurities.
3. If pump is kept full of water when not in use, make sure water is clean and non-corrosive. Make sure the pump is completely full or completely drained - never partially full.

NOTICE

If the pump is exposed to freezing temperatures, drain all water from pump, lines and accessories.

4. Close all drains and install intake and discharge caps.

Pumping from Draft

WARNING

Pressure Hazard. May result in personal injury or death.

Prior to connection of hoses, caps or other closures with pump intake or pump discharge connections, relieve pressure by opening drains.

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 even 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 personal injury or death.

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

To get full capacity, quick prime and maintain pump efficiency:

- a) Position vehicle as near as possible to water supply.
- b) Avoid humps and sharp bends in intake hose. Make sure no part of hose is higher than pump intake inlet. (Air pockets in intake hose may cause loss of prime or erratic pump action, and may reduce pump capacity.)
- c) Make sure all intake connections are tight and discharge valves are closed.
- d) Immerse intake strainer at least two feet below water surface to prevent pump from drawing air. (Whirlpools forming above intake strainer indicate that strainer is too close to surface of water.)
- e) Make sure intake strainer is far enough from bottom to prevent sand, gravel and other foreign matter from being drawn into the pump.

1. Engage pump in accordance with transmission instructions.
2. Prime the pump (see separate instructions supplied with primer).
3. Open discharge valves, and accelerate engine to obtain desired discharge pressure and capacity.
4. Set relief valves or other pressure governing device to desired pressure.

NOTE: For extra pressure stage pumping instructions, see page 8.

After Pumping

WARNING

Pressure Hazard. May result in personal injury or death.

Prior to removal of hoses, caps or other closures with pump intake or pump discharge connections, relieve pressure by opening drains.

1. Disengage pump drive in accordance with transmission instructions.
2. If pumping anything but clean water, remove all intake and discharge caps, open all valves and open all drains. Flush entire system with clean, fresh water for several minutes to remove all traces of impurities.
3. If pump is kept full of water when not in use, make sure water is clean and non-corrosive. Make sure the pump is completely full or completely drained - never partially full.

NOTICE

If the pump is exposed to freezing temperatures, drain all water from pump, lines and accessories.

4. Close all drains and install intake and discharge caps.

Extra Pressure Stage Operation - CSH Pumps Only

WARNING

Pressure Hazard. May result in personal injury or death.

Prior to connection of hoses, caps or other closures with pump intake or pump discharge connections, relieve pressure by opening drains.

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 even 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 personal injury or death.

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

1. Open (or close) extra pressure stage control valve and discharge valve(s) slowly (at least 3 seconds). Engine speed may need to be reduced to ease manual operation of control valve.
2. Accelerate engine to obtain desired discharge pressure and capacity.
3. Set relief valves or other pressure governing device to desired pressure.

After Pumping

WARNING

Pressure Hazard. May result in personal injury or death.

Prior to removal of hoses, caps or other closures with pump intake or pump discharge connections, relieve pressure by opening drains.

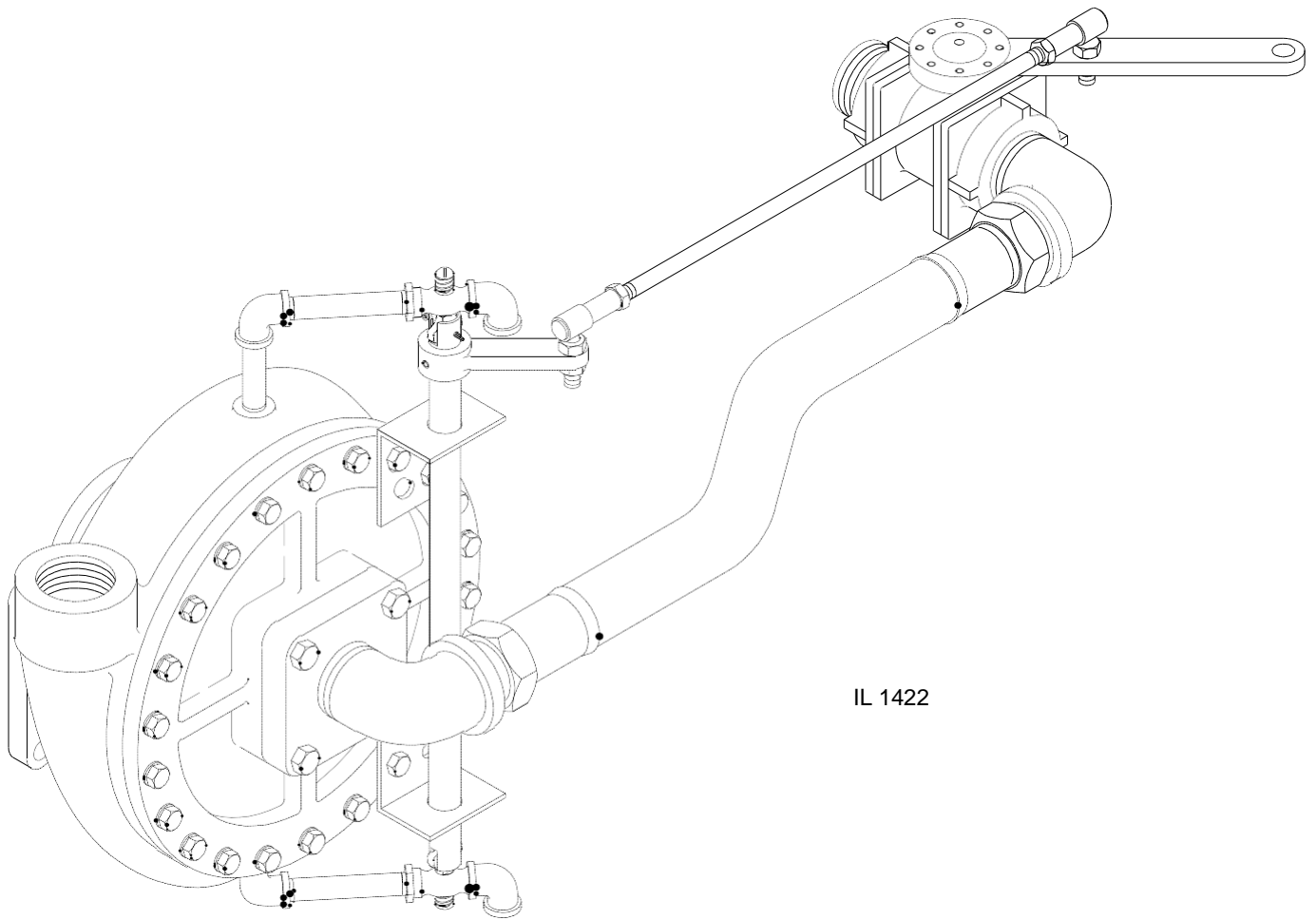
1. Disengage pump drive in accordance with transmission instructions.
2. If pumping anything but clean water, remove all intake and discharge caps, open all valves and open all drains. Flush entire system with clean, fresh water for several minutes to remove all traces of impurities.
3. If pump is kept full of water when not in use, make sure water is clean and non-corrosive. Make sure the pump is completely full or completely drained - never partially full.

NOTICE

If the pump is exposed to freezing temperatures, drain all water from pump, lines and accessories.

4. Close all drains and install intake and discharge caps.

Extra Pressure Stage



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Fire Hose Testing



WARNING

Hose Testing Hazard. May result in serious personal injury.

Due to a potential for catastrophic hose failure during service testing of fire hose, it is vital that safety precautions be taken to prevent exposure of anyone to this danger. Fire pumps on fire department apparatus are not designed for and should not be used for service testing of fire hoses. Hose testing machines should be used for service testing of fire hoses.

NFPA 1962 *Standard for the Inspection, Care, and use of Fire Hose, Couplings, and Nozzles and the Service Testing of Fire Hose* provides requirements and testing procedures for service-testing fire hose at least annually. NFPA 1962 includes procedures for service testing with either a hose testing machine or with a pump on a fire department fire apparatus.



WARNING

Pressure Hazard. May result in serious personal injury.

If a fire pump on a fire department apparatus is used for service testing of fire hoses, the procedures in NFPA 1962 **MUST be followed** including the use of a fire department gate valve with a ¼-inch (6 mm) hole drilled through the gate installed between the fire apparatus discharge outlet and the hose test layout to prevent a volume surge from the pump in the event a hose bursts during testing.

During fire hose testing with a fire pump on a fire department fire apparatus, the fire pump is required to be operated at high discharge pressure with little or no flow out of the apparatus.



WARNING

Scalding Water Hazard. May result in serious burns.

If a fire pump on a fire department apparatus is used for service testing of fire hoses, pump discharge water must be circulated through a by-pass system or discharged through a slightly open discharge valve, or some other provision must be used to prevent overheating. If the pump runs for a few minutes without adequate flow through the pump, water may be heated enough to scald someone when a valve is opened.

NOTICE

If a fire pump on a fire department apparatus is used for service testing of fire hoses, operating the pump at high discharge pressure with little or no flow may result in severe damage to the pump.

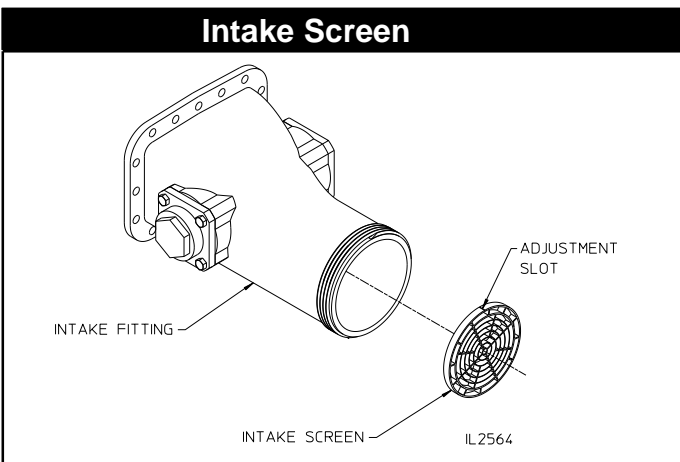
Maintenance

Corrosion Protection

Optional Intake Screens

Once per month check to make sure the intake screens are not clogged or damaged. Also check for corrosion, and replace screens if damage is severe. For the screen to adequately control corrosion, there must be a strong electrical contact between the screen and the fitting. Remove any corrosion, debris or paint from the counter bore that will insulate the screen from the intake fitting. If the screen does not fit tightly, adjust the gap of the slot on the outside diameter of the screen to ensure a tight fit.

NOTE: These screens are die-cast which results in a slight taper from one side to the other. Install the screen with the thinner cross-section facing out to minimize flow restriction.



Optional Anodes

Twice per year, remove the anodes and check for erosion of the replaceable elements. Replace the elements if more than half of either of the elements has eroded. Anodes are normally mounted on the pump intake piping, but they may also be installed in the discharge piping if no intake mounting locations were available. Physical mounting of the anode may be via an NPT tap or bolt-on flange as described below.

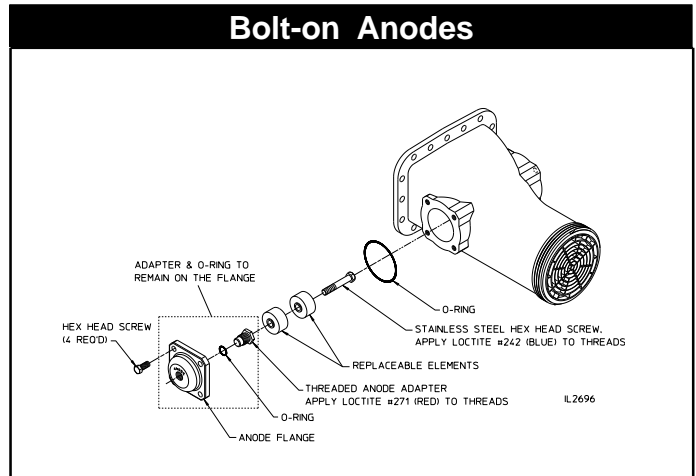
NOTE: The replaceable elements must make contact with water to be effective. Do not paint or use any other coating on the replaceable elements.

Bolt-on Anodes

Unscrew the (4) hex head screws from the pump. If elements require replacement, unscrew the hex head cap screw.

NOTE: There is no need to remove the threaded anode adapter from the anode flange for element replacement. The screw was installed using thread sealant so higher force than normal may be necessary to remove.

Replace one or both elements as necessary. Install the hex head screw using Loctite 242 (blue) on the screw threads. Mount the anode assembly back on the fitting.



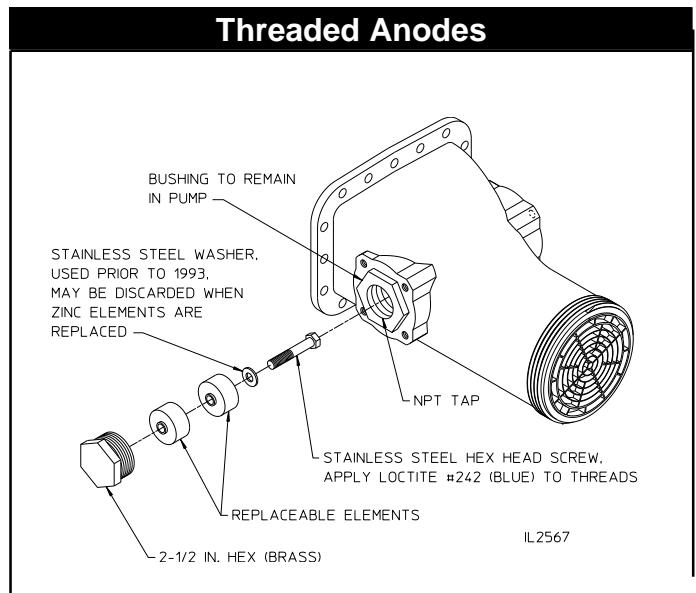
Threaded Anodes

NOTE: The 2- 1/2 in. hex is threaded into a bushing that should remain on the pump. Be sure to restrain the bushing when removing the 2- 1/2 in. hex.

Unscrew the 2- 1/2 in. hex from the pump. If the elements require replacement, unscrew the hex head cap screw.

NOTE: The screw was installed using thread sealant so higher force than normal may be necessary to remove.

Replace one or both elements as necessary. Install the hex head screw using Loctite 242 (blue) on the screw threads. Remove any paint or corrosion from the face around the NPT tap on the pump. Apply thread sealant to the threads and screw the 2- 1/2 in. hex into the pipe tap until tight.



Lubrication

Outboard Bearing (All Models Except CSD and CSH)

The outboard bearing is located at the end of the pump opposite the drive end of pump.

On pumps built prior to 4/21/2006, add a good quality, medium consistency, ball bearing grease through the lubrication fitting until it comes out of the relief fitting. Add grease after every 100 hours of pump operation, or every six months, whichever comes first.

On pumps built after 4/21/2006, the outboard bearing is sealed and requires no lubrication.

Inboard and Outboard Bearing (CSD Pumps Only)

The inboard bearing is located at the drive end of the pump. The outboard bearing is located on the end opposite of the drive end.

Add a good quality, medium consistency, ball bearing grease through the lubrication fitting until it comes out of the relief fitting. Add grease after every 100 hours of pump operation, or every six months, whichever comes first.

Extra Pressure Stage Bearing (CSH Pumps Only)

For pumps built prior to 11/13/03: The impeller shaft is supported at the extra pressure stage by a double row, ball bearing. A fitting permits lubrication of this bearing.

A relief groove, cut in the threads of the lubrication fitting allows surplus grease to escape without causing excessive pressure. Add a good quality, medium consistency, ball bearing grease until it comes out of the relief groove of the lubrication fitting. Add grease after every 100 hours of pump operation, or every six months, whichever comes first.

For pumps built after 11/13/03: Lubrication of bearing is not required as the bearing is a sealed self-lubricating design. Note that the pumps upgraded in the field to the sealed self-lubricating design do not require lubrication. The lube fitting should be plugged when upgraded.

Packing - Braided Flexible Graphite (BFG)

Waterous pumps use 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

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.

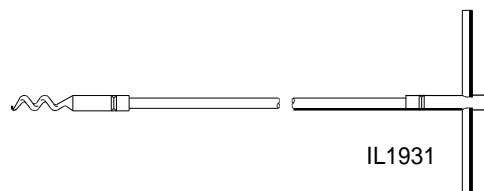
NOTICE

**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.

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 stuffing box. Pressure in excess of 300 psi (20.7 bar) may be required.
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 Packing Removal Tool).
4. Replace packing per instructions below.

Packing Removal Tool



Packing Installation

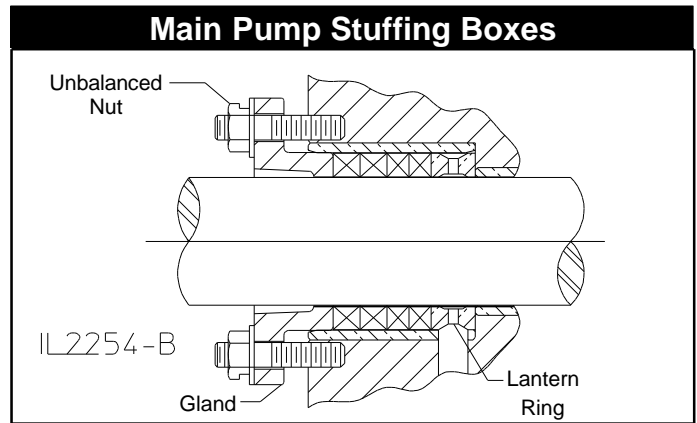
1. Before installing the new packing, be sure that all of the old packing is removed from the seal housing.
2. Be sure that the seal housing and the shaft are clean and free of any packing residue.
3. Lightly lubricate the packing ring I.D. and O.D. with mineral oil, automotive grease or engine oil for 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,
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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).

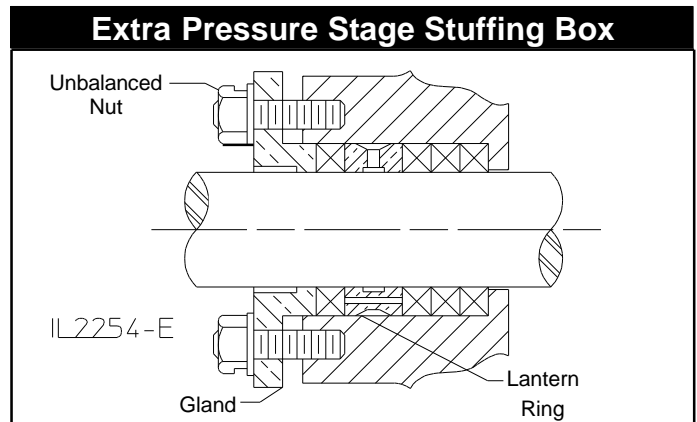
NOTE: Be sure that the packing joints are staggered at least 90° apart.

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.



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



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.

NOTICE

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

Circulate enough water through the pump to prevent overheating.

WARNING

Truck Movement Hazard. 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.

1. Engage pump per appropriate operating instructions. Operate the pump at 150 psi (10.3 bar) for ten (10) minutes.

NOTICE

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

Observe leakage. Normal leakage is 10- 120 drops per minute. (Leakage may be at 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.

NOTICE

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

4. Operate the pump at 150 psi (10.3 bar) for 10 to 15 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 drip rate is acceptable.
NOTE: After adjusting the packing, the pump must pass the following vacuum test described below.

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.

Overheat Protection Manager (OPM)

Check the electrical circuit by pressing the test button located on the panel plate every 100 hours of pump operation or every six months, whichever comes first.

If the light does not flash, the light bulb or flasher may need replacement (provided all wire connections are solid).

Butterfly Valve (BFV)

Operate valve once a week for optimal performance.