Group Index, Alphabetical

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TwinFlow Fire Pump	90.00

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General Description

The Twinflow midship-mounted fire pump is a centrifugal pumping system designed to deliver large volumes of water under pressure. See **Fig. 1.**

Generally, the pump consists of the following major components:

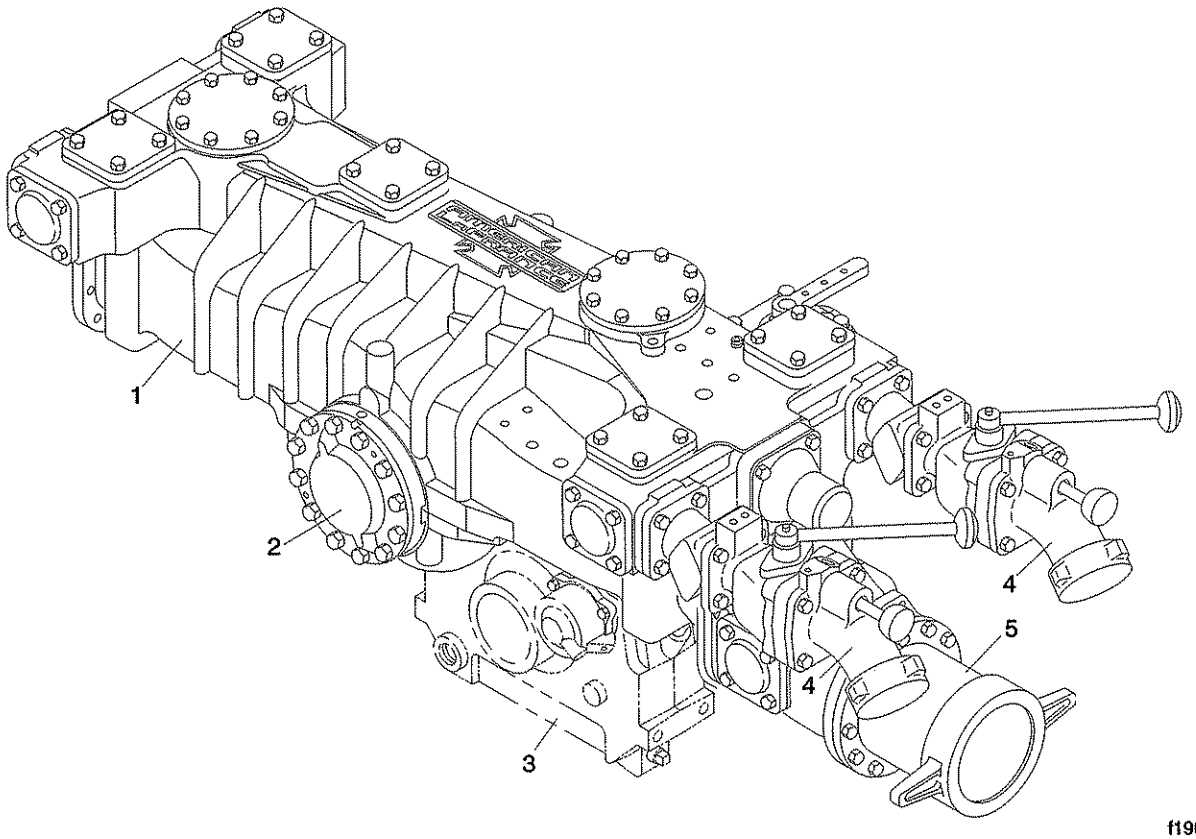
- cast-iron pump body
- bronze impeller(s) and a stainless steel shaft
- pump gear box
- priming system
- pressure control device
- valves

There are numerous other components, such as the AutoLube and the mechanical seal.

Pump type is determined by the number of impellers on a common shaft. The impeller, which is mounted on a shaft rotated by the vehicle's engine via the driveline, provides velocity to the water causing it to build enough pressure and volume to be used for firefighting applications. See **Fig. 2.**

Bearings support and align the impeller shaft and other components. The bearings must be maintained on a scheduled basis.

The pump body is split horizontally in two sections for the ease of removal of the impeller assembly, including the bearings and the clearance rings.

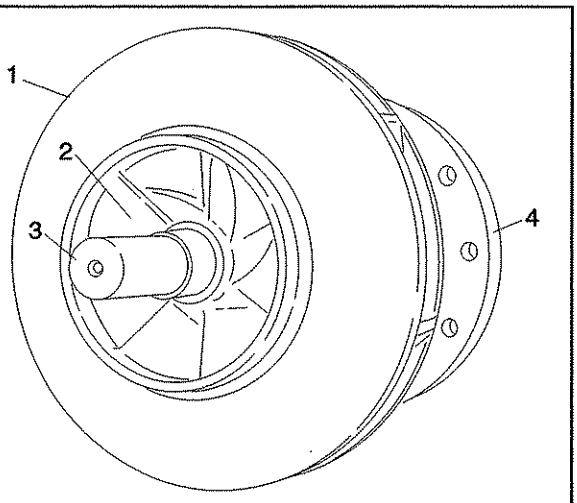


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1. Pump Body
2. AutoLube
3. Gear Box
4. Discharge
5. Intake

Fig. 1, Twinflow Fire Pump (single-stage shown)

General Information



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1. Shroud
2. Impeller Eye
3. Shaft
4. Mechanical Seal Housing

Fig. 2, Twinflow Fire Pump Gear Box

The pump gear box and the impeller assembly are removable from the bottom of the vehicle in order to avoid interference with the pump plumbing and control mechanisms.

The pump has two large suction inlets, one on each side of the vehicle, though other inlets may be present. The inlets and the internal pump outlets are on opposite sides of the pump to balance forces caused by the intake and the discharge of water.

The AutoLube is built into the pump assembly to continuously force oil to the impeller shaft bushing to lubricate and cool the impeller bushing.

Principles of Operation

A centrifugal pump such as the Twinflow fire pump operates on the principle wherein centrifugal force is created by a rapidly spinning disk, or impeller. Water is routed to the center of the impeller, which throws the water outward from the center of the impeller. When water is confined in a closed container, in this instance, the pump body, the water pressure increases. The pressure level depends on how fast the impeller is rotating.

Water enters the spinning impeller at the intake and is confined by shrouds and vanes in the impeller, which, in turn, builds pressure.

The vanes guide the water away from the inlet to the discharge to reduce the water's turbulence and to move the water toward the outer edge of the impeller.

The shrouds serve as the sides of the impeller and confine the water to the centrifugal acceleration.

Single-stage pumps provide the same operating and rating-test pressures as a two-stage pump, but the two-stage pump offers additional operating (water) pressure.

The primary difference between a single-stage and a two-stage pump is that the single-stage has only one impeller and no transfer valve to switch between volume and pressure operation. A transfer valve is a two-position valve that permits the impellers in a two-stage pump to operate in parallel (volume) or series (pressure).

In two-stage pumps, the volume operation results in the pressure at the pump intake being added to the equal pressure developed by the impellers, and the amount of water sent to the discharge being the sum of the flows of the two impellers. The pressure operation features the impellers operating in series, or the output of the primary impeller supplied from the pump intake is supplied to the input of the secondary impeller. Thus, the pressure at the pump discharge is the sum of the pressures of the two impellers plus the pressure at the intake. The flow is then half of the volume operation.

In both types of pumps, the pressurized water is prevented from returning to the intake of the impeller(s) by clearance rings. Centrifugal pumps have clearance rings mounted between the spinning impeller and the pump body. Clearance rings and the hubs of the impeller(s) will, over time, become worn or pitted and may need to be replaced or machined to a smaller diameter.

AutoLube Seal Replacement

Replacement

1. Park the vehicle on a level surface. Shut down the engine. Set the parking brake and chock the front and rear tires.
2. Drain the water from the pump.
3. Remove the fill and drain plugs from the AutoLube reservoir and drain the oil.
4. Use a center punch to mark the AutoLube cover and the front bearing housing for proper alignment during assembly.

⚠ CAUTION

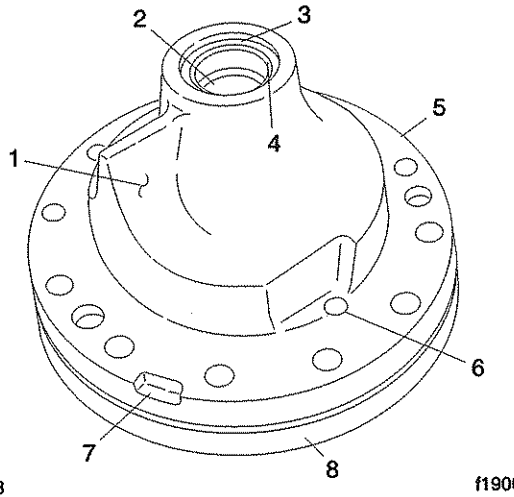
Do not use a chisel to separate the AutoLube from the pump body because the mating surfaces may be scratched or gouged, which could result in a leak. The AutoLube is manufactured from cast metal and if it becomes necessary to pry the AutoLube apart from the pump body, pry between the AutoLube and the pump body or at the AutoLube notches.

5. Remove the 1/2–13 x 2 capscrews attaching the AutoLube to the pump body and gently pry the AutoLube from the pump body and impeller shaft.
6. Place the AutoLube face down on a work bench and remove the two 3/8–16 x 3/4 allen-head capscrews from the impeller side. Separate the two halves and remove the diaphragm.
7. Remove the seal lock ring.
8. Remove the oil seal from the inner half of the AutoLube.
9. Check the impeller shaft bushing for wear.
10. Clean the inner and outer halves of the AutoLube.
11. Clean the gasket surfaces of the AutoLube and the pump body.
12. Check for restrictions in the water passages to the rear half of the AutoLube.
13. If it is necessary to replace the impeller shaft bushing, press the bushing from the inner side of the inner half of the AutoLube (on the side opposite of the impeller). Install the bushing from the impeller side of the inner half of the AutoLube. See **Fig. 1**.

⚠ CAUTION

The impeller shaft bushing seats against a shoulder in the inner half of the AutoLube and can only be removed and installed as described or the AutoLube may be damaged.

14. Install the new oil seal in the inner half of the AutoLube.
15. Install the seal lock ring.
16. Position the diaphragm on the inner half of the AutoLube.
17. Line up the marks and place the outer half of the AutoLube onto the inner half. Apply Loctite® 242 to the two 3/8–16 x 3/4 allen-head capscrews. Tighten 30 lbf·ft (41 N·m).
18. Install the new gasket on the AutoLube and position the assembly (with the top up) onto the impeller shaft. Attach the AutoLube with 1/2–13 x 2 capscrews and tighten 80 lbf·ft (108 N·m).



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1. Cut Water
2. Bushing
3. Lock Ring
4. Seal
5. Front Bearing Housing
6. Water Passage
7. Pry Notches
8. AutoLube Cover

Fig. 1, Impeller Shaft Bushing

AutoLube Seal Replacement

⚠ CAUTION

Do not damage the oil seal. A damaged oil seal could result in damage to the AutoLube assembly as well as the pump.

19. To fill the AutoLube with 90w oil, pump the oil in from the bottom plug opening until the oil spills from the top opening. This eliminates air pockets and false readings.

⚠ CAUTION

Purge the air from the AutoLube while filling it with oil or a "false-fill" situation will develop, which could cause damage to the AutoLube and other components.

20. Add water to the pump.
21. Operate the fire pump and check the AutoLube for water or oil leaks.
22. Remove the tire chocks.

Fire Pump Gearbox Removal, Disassembly, Assembly, and Installation

Removal

NOTE: For an exploded view of the fire pump body assembly, see **Fig. 1**.

1. Park the vehicle on a level surface. Shut down the engine. Set the parking brake and chock the front and rear tires.
2. Drain the water from the pump.
3. Drain the gearbox lubricant to prevent contamination.
4. Disconnect the pressure lubrication line to the gearbox cover. Keep the line primed with lubricant.
5. Disconnect the drive shafts from the gearbox.
6. Disconnect the electrical switches and the air lines. Mark the switches and air lines for assembly.
7. Disconnect the pump gearbox cooling lines.

⚠ WARNING

The gearbox is heavy. Support the gearbox with a lifting or supporting device while removing it from the pump body. Failure to do so could result in the gearbox falling, which could result in personal injury or property damage.

NOTE: Before removing the gearbox, use a center punch to mark the rear bearing housing, the mechanical seal housing, the oil pump cover and the pump body to ensure proper alignment during reassembly.

8. Support the gearbox with an appropriate device.
9. Remove the six 1/2–13 x 1-3/4 capscrews that attach the gearbox cover to the top of the gearbox.
10. Remove the 7/16–14 x 1-1/4 capscrews that attach the gearbox to the rear bearing housing.
11. Lower the gearbox. Be sure to balance the gearbox so that it does not tip from the lowering device. See **Fig. 2**.
12. Remove the gearbox cover.

NOTE: The threaded holes may need to be cleaned.

Disassembly

1. Remove and disassemble the intermediate shaft assembly.

   1.1 Disconnect the oil suction line from the lubrication pump.

   1.2 Remove the capscrews attaching the front bearing housing to the lubrication pump. Then, remove the housing and pump assembly.

   NOTE: The rear bearing housing has threaded holes for 1/4–20 jackscrews to assist in removal.

   1.3 Remove the capscrews attaching the rear bearing housing to the lubrication pump.

   1.4 Reach into the top of the gearbox housing and remove the intermediate gear and shaft assembly. The bearing inner cups are pressed onto the shaft, so care must be taken not to damage the cups during removal.

   1.5 Using a bearing splitter, clamp the halves of the splitter onto the back edge of the intermediate shaft bearing cup. Attach a crossbar puller to the bearing splitter halves and remove the cup. Care must be taken when removing the cup to not damage the lubrication pump spline in the center of the intermediate shaft. Repeat the procedure for the opposite-side bearing cup.

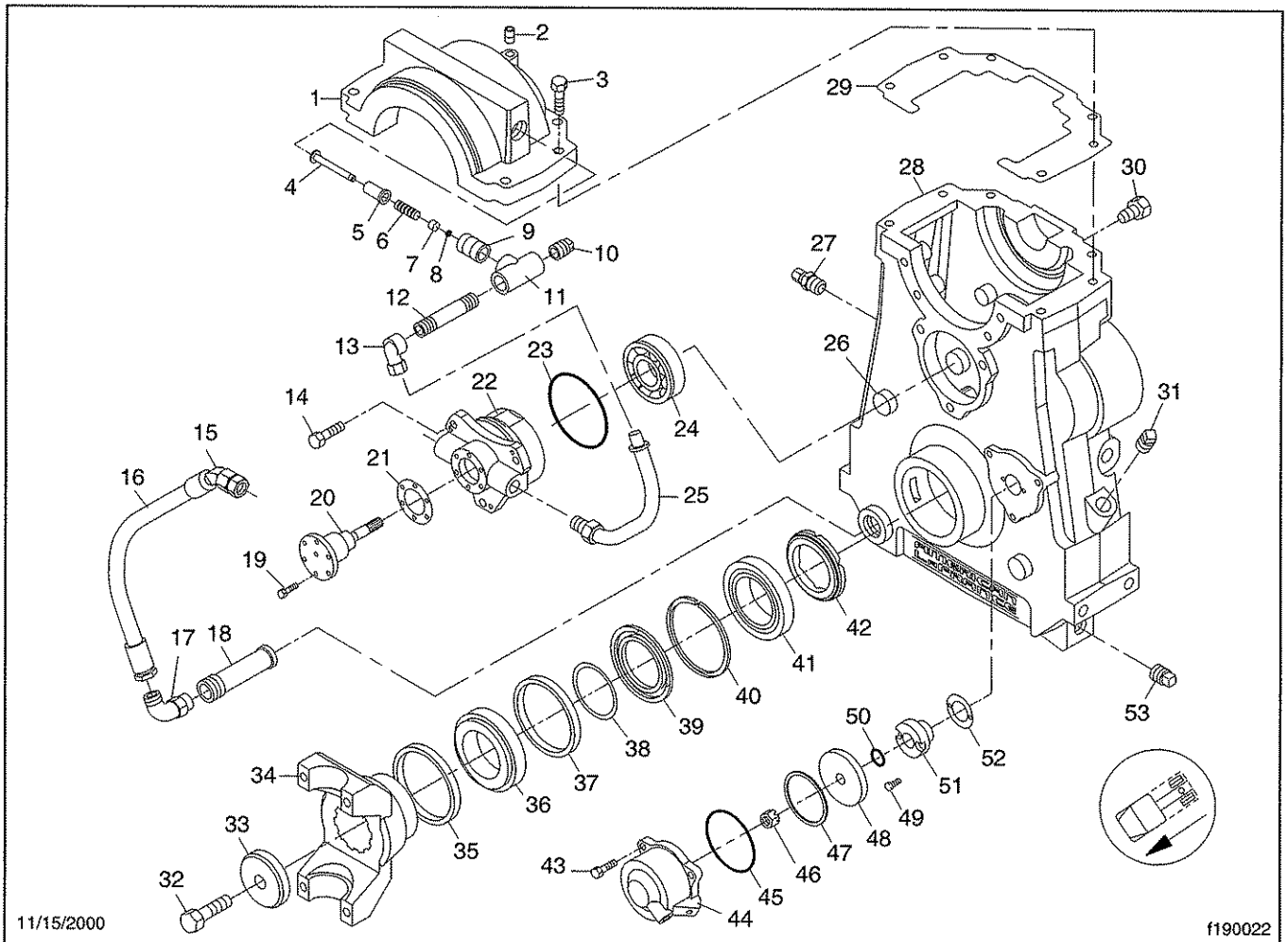
   1.6 Using a gear puller with reversed jaws, remove the intermediate shaft bearing cone from the intermediate shaft rear cover.

⚠ CAUTION

Lubrication pump impeller vanes are fragile, and may break or chip. Impeller vanes are installed only one way. If removal of the vanes is necessary, note the installation direction of the vanes (rounded edge). Failure to install the vanes properly will result in pump gearbox failure.

   1.7 When disassembling the lubrication pump, be sure to note the number of gaskets and shims that are under the cover. Set these components aside for reassembly.

Fire Pump Gearbox Removal, Disassembly, Assembly, and Installation



1. Gearbox Cover
2. Air Vent
3. Capscrew, 1/2–13 x 1-3/4
4. Oil Spray Valve
5. Bushing
6. Oil Spray Bar Spring
7. Retainer Spring
8. External Retaining Ring
9. Close Nipple, 3/4 NPT
10. Plug, 1/2 NPT
11. Branch Tee, 1/2 x 1/2 x 3/4
12. Nipple, 1/2 NPT x 3 1/2
13. Compression Elbow, 1/2 NPT x 1/2
14. Capscrew, 7/16–14 x 1-1/4
15. JIC 90 Elbow, 1/2 NPT x 12
16. Oil Suction Line
17. JIC 45 Elbow, 1/2 NPT x 12
18. Gearbox Lubrication Oil Filter
19. Capscrew, 1/4–20 x 5/8
20. Lubrication Oil Pump Cover
21. Lubrication Oil Pump Cover Gasket
22. Lubrication Oil Pump
23. Intermediate Ring and Oil Seal
24. Intermediate Bearing
25. Pressure Lubrication Hose, 1/2 ID
26. Plug, 1/2 NPT
27. Hard Copper Tube Fitting, 1/2 NPT x 3/8
28. Gearbox Assembly
29. Gearbox Cover Gasket
30. Gearbox Oil Level Indicator
31. Plug, 3/4 NPT
32. Capscrew, 3/4–10 x 1 1/2
33. Yoke Washer
34. Driveline Yoke
35. Oil Seal
36. Bearing and Race
37. Preload Spacer
38. Preload Shim
39. Snap Ring Lock
40. Snap Ring
41. Bearing and Race
42. Input Shaft Thrust Spacer
43. Capscrew, 5/16–18 x 1
44. Air Shift Cylinder
45. Shift Cylinder Seal
46. Hex Locking Nut, 1/2–13
47. Piston Seal Ring
48. Air Shift Piston
49. Capscrew, 1/4–20 x 1-5/8
50. Vee Block Seal
51. Air Cylinder Bushing
52. Shifter Bushing Gasket
53. Magnetic Plug, 3/4 NPT

Fig. 1, Fire Pump Body Assembly (exploded view)

Fire Pump Gearbox Removal, Disassembly, Assembly, and Installation

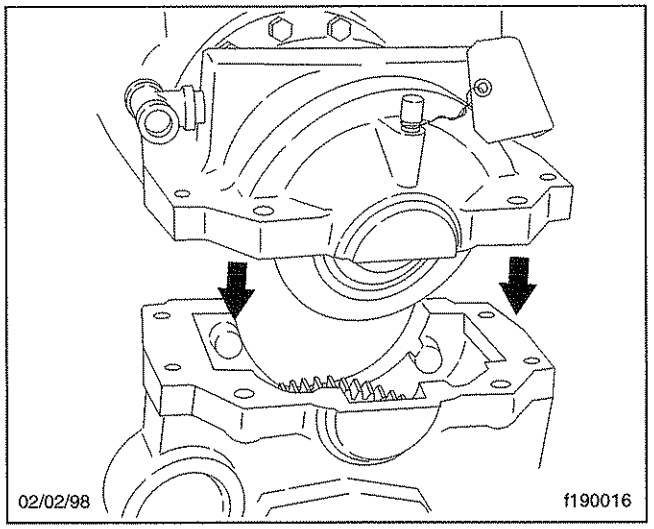


Fig. 2, Lowering the Fire Pump gearbox

1.8 Using a centerpunch, mark the lubrication pump position, and remove the six 1/4–20 x 5/8 capscrews.

1.9 Remove the lubrication pump cover.

1.10 Remove the lubrication pump impeller and the shaft, being careful not to damage the impeller vanes.

1.11 Using a gear puller with reversed jaws, remove the intermediate shaft bearing cone from the intermediate shaft front cover. Care must be taken when removing the cup so as not to damage the lubrication pump spline in the center of the intermediate shaft cover.

2. Remove and disassemble the output shaft assembly. See **Fig. 3.**

2.1 Remove the manual shift eye from the rear of the shift yoke shaft.

2.2 Remove the detent allen-head screw, spring and detent ball from the top of the output shaft housing.

2.3 Remove the shift and interlock switches on the output shaft housing.

2.4 Remove the 7/16–14 x 2-1/4 capscrews retaining the output shaft and the housing to the gearbox housing. Carefully remove the output shaft housing by sliding the housing from the shift yoke shaft.

2.5 Remove the input shaft pilot bearing from the output shaft.

2.6 Remove the 3/4–10 x 1-1/2 capscrew retaining the rear driveline yoke to the output shaft and remove the yoke.

2.7 Remove the output shaft seal.

2.8 Remove the output shaft by sliding it from the output shaft housing from the rear to the front. Use caution when sliding the output shaft through the bearing cones and spacer(s).

⚠ CAUTION

Bearing cups, cones and spacers are factory preset for end play, and are only provided as a matched set. It is important that bearing cups, bearing cones and spacers, when removed, be kept together in matched sets. Input and output shaft bearing and spacer sets are different. Failure to keep matched sets together or to not use factory pre-set and matched bearing and spacer sets will void warranty and may result in gearbox failure.

2.9 Remove the inner and outer bearing cones.

2.10 Using a brass drift, carefully drive out the outer bearing cup from the inside out. Remove the internal retaining ring and then the spacer(s).

2.11 Using a brass drift, carefully drive out the inner bearing cup from the outside in.

2.12 Remove the shaft seal from the output shaft housing.

3. Remove and disassemble the input shaft assembly.

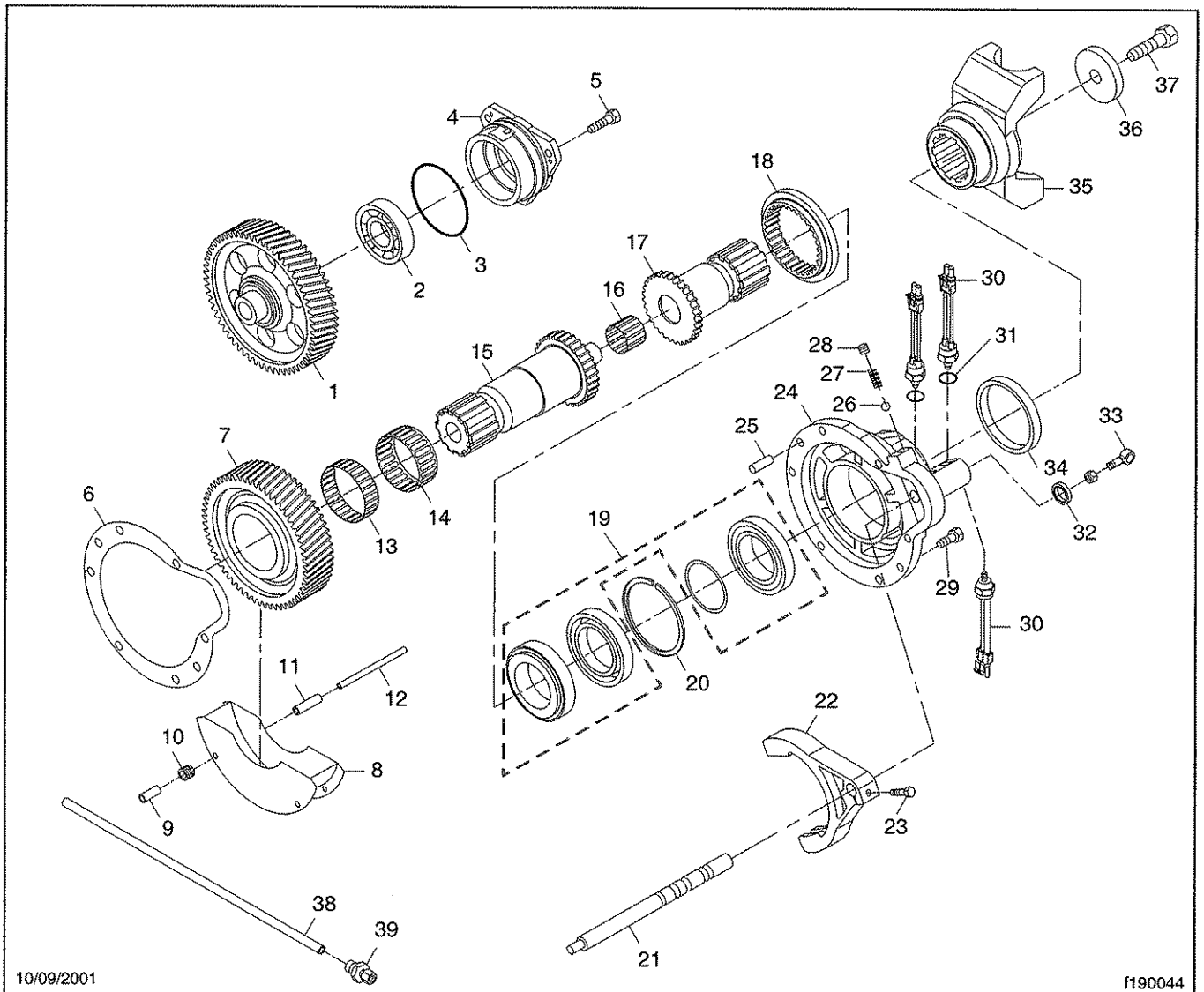
3.1 Remove the three 5/16–18 x 1 capscrews from the shift cylinder, and then carefully slide the shift cylinder from the piston.

3.2 Remove the nut and then remove the piston from the shift shaft. Remove the seal ring from the piston.

⚠ CAUTION

Do not remove the piston from the shift yoke shaft unless it is damaged (and replacement is manda-

Fire Pump Gearbox Removal, Disassembly, Assembly, and Installation



1. Intermediate Gear Assembly
2. Intermediate Bearing
3. Intermediate Shaft Bearing Cover Oil Seal
4. Intermediate Shaft Bearing Cover
5. Screw, 7/16–14 x 1/8 Hex Nylock
6. Bearing Cover Gasket
7. Input Gear
8. Windage Tray
9. Spacer
10. Windage Tray Spring
11. Spacer
12. Windage Tray Rod
13. Short Caged Roller Bearing
14. Long Caged Roller Bearing
15. Input Shaft
16. Input Shaft Needle Bearing
17. Output Shaft
18. Shifting Collar
19. Rear Bearing Shims/Spacers Assembly
20. Internal Retaining Ring
21. Shifting Shaft
22. Shift Fork
23. Screw, 3/8–16 x 1-1/4 Hex Nylock G8
24. Output Shaft Housing
25. Gearbox Dowl Pin
26. Gearshift Shaft Ball
27. Compression Spring
28. Hex Socket Setscrew, HD, Selflock
29. Screw, 7/16–14 x 1-3/4 Hex Nylock
30. Gearshift Switch
31. Switch Seal Ring
32. Wiper/Scraper Seal
33. Manual Shift Eye
34. Lip Seal
35. Driveline Yoke
36. Yoke Washer
37. Capscrew, 3/4–10 x 1-1/2 Hex HD
38. Gearbox Cooling Tube
39. Cooling Tube Connector

Fig. 3, Rear Gearbox Assembly (exploded view)

Fire Pump Gearbox Removal, Disassembly, Assembly, and Installation

tory). When installing a new piston, replace the locknut and tighten snugly, but do not overtighten as the nut can become distorted, which can cause shift failures.

3.3 Remove the shift shaft, the shift fork, and the shift ring assembly from the gearbox. Make sure the shift ring does not get dropped or damaged.

3.4 Note the location and orientation of the shift fork on the shaft, then remove the 3/8–16 x 1-1/4 screw from the shift fork and remove the fork from the shift shaft.

3.5 Remove the shift shaft support block. Then remove the seal from the support block.

NOTE: One ear of the shift yoke is machined and will fit one way. Make a note of the location of the machined ear when removing the shift yoke.

3.6 Remove the 3/4–10 x 1-1/2 capscrew attaching the front driveline yoke to the input shaft. Remove the yoke.

3.7 Remove the input shaft by sliding the input shaft from the output shaft housing opening at the rear of the gearbox. Use caution when sliding the input shaft through the bearing cones, the thrustwasher and the drive gear. Place wooden blocks to support the drive gear and to protect the windage tray, and force the shaft loose.

⚠ CAUTION

Bearing cups, cones and spacers are factory pre-set for end play, and are only provided as a matched set. It is important that bearing cups, bearing cones and spacers, when removed, be kept together in matched sets. Input and output shaft bearing and spacer sets are different. Failure to keep matched sets together or to not use factory pre-set and matched bearing and spacer sets will void warranty and may result in gearbox failure.

There are two bearings of different widths supporting the drive gear on the input shaft. It is important that these bearings be installed in the drive gear in the proper location. Note the location of the bearings when removed. Failure to install the bearings properly can result in gearbox failure.

3.8 Reaching through the top of the gearbox housing, carefully remove the drive gear, the inner bearing cone, and thrustwasher. Remove the drive gear bearings.

3.9 Using a magnet, remove the positioning pins from the windage tray. Then, remove the windage tray and the positioning springs.

3.10 Remove the input shaft seal.

3.11 Remove the outer bearing cone.

3.12 Using a brass drift, carefully drive out the outer bearing cup from the inside out. Remove the internal retaining ring and the spacer(s).

3.13 Using a brass drift, carefully drive out the inner bearing cup from the outside in.

4. Inspect the cooling tube for damage and leaks.
5. Remove the gearbox lubrication oil filter from the suction inlet on the gearbox housing.
6. Clean and inspect each component of the gearbox assembly. Inspect the bearing cups and the cones for wear, pitting and damage. Inspect the gear tooth surfaces for wear damage and pitting. Inspect the shift shaft block for wear. Inspect the gasket surfaces for nicks and gouges. Replace all components that are worn, damaged or pitted.

Assembly

1. Install a new transmission lubrication oil filter.
2. Assemble and install the input shaft assembly.

⚠ CAUTION

Bearing cups, cones and spacers are factory pre-set for end play, and are only provided as a matched set. It is important that bearing cups, bearing cones and spacers, when removed, be kept together in matched sets. Input and output shaft bearing and spacer sets are different. Failure to keep matched sets together or to not use factory pre-set and matched bearing and spacer sets will void warranty and may result in transmission failure.

Fire Pump Gearbox Removal, Disassembly, Assembly, and Installation

2.1 Using a brass drift or a bearing cup installation tool, install the inner bearing cup from the inside out. Then install the spacer(s) and insert the retaining ring.

2.2 Using a brass drift or a bearing cup installation tool, install the outer bearing cup from the outside in.

2.3 Coat the outer bearing cone with oil. Install the outer bearing cone.

2.4 Install the input shaft seal.

2.5 Install the windage tray positioning springs and windage tray. While holding the windage tray in place against the positioning springs, install the windage tray positioning pins.

⚠ CAUTION

There are two bearings of different widths supporting the drive gear on the input shaft. It is important that these bearings be installed in the drive gear in the proper location. The location of the bearings should have been noted when removed from the assembly. Make sure that the lubrication holes are aligned in the center of the larger bearing. Failure to install the bearings properly may result in transmission failure.

2.6 Coat the new drive bearings with oil and install in the drive gear.

2.7 Coat the inner bearing cone with oil and install. Then, install the thrustwasher.

2.8 Reaching through the top of the transmission housing, install the drive gear into position against the thrustwasher, being careful not to dislodge the windage tray.

2.9 Slide the input shaft through the output shaft housing opening at the rear of the transmission through the drive gear, the thrustwasher, and the bearing cones and spacer(s).

2.10 Install the front driveline yoke on the input shaft, being careful not to damage the input shaft seal. Apply Loctite® 242 to the 3/4–10 x 1-1/2 yoke retaining capscrew. Then install the capscrew and washer and tighten 225 lbf·ft (305 N·m).

NOTE: Apply a coat of Loctite® to all screws prior to reassembly.

NOTE: One ear of the shift yoke is machined, and it will only fit one way. Make sure the yoke is oriented on the shaft in the position noted during disassembly.

2.11 Make sure the shift fork is properly aligned (the machined side should be toward the threaded end of the shift shaft) and slide the new shift fork on the shift shaft. Align the shift fork with the groove in the shaft and secure the shift fork in place with a 3/8–16 x 1-1/4 screw. Tighten the screw 33 lbf·ft (45 N·m).

2.12 Install a new seal on the shift shaft support block. Install a new gasket on the shift shaft support block. Install the shift shaft support block and gasket in the gearbox using two 1/4–20 x 5/8 capscrews. Tighten the capscrews 96 lbf·in (1085 N·cm).

2.13 Place the shift ring into the shift fork grooves. While holding the shift ring in place, insert the shift shaft into the gearbox through the bushing. Make sure the teeth on the shift shaft ring line up with the teeth on the input shaft and gear.

2.14 Apply a light coating of grease to the new seal ring, then install the seal ring on the shift piston. Install the piston on the shift shaft end.

⚠ CAUTION

When installing the piston, use a new locknut and tighten snugly but do not overtighten. Overtightening the locknut may distort the piston and cause shift failures.

2.15 Secure the piston in place with a new locknut.

2.16 Apply a light coating of grease to the shift cylinder seal and install the seal in the groove on the shift cylinder.

2.17 Install the shift cylinder using three 5/16–18 x 1 screws. Tighten the screws 17 lbf·ft (23 N·m).

3. Assemble and install the output shaft assembly.

3.1 Install a new shift shaft seal in the output shaft housing.

⚠ CAUTION

Bearing cups, cones and spacers are factory pre-set for end play, and are only provided as a matched set. It is important that bearing cups, bearing cones and spacers, when removed, be kept together in matched sets. Input and output shaft bearing and spacer sets are different. Failure to keep matched sets together or to not use factory pre-set and matched bearing and spacer sets will void warranty and may result in transmission failure.

3.2 Using a brass drift or a bearing cup installation tool, install the inner bearing cup from the inside out. Install the spacer(s). Then install the retaining ring.

3.3 Using a brass drift or a bearing cup installation tool, install the outer bearing cup from the outside in.

3.4 Coat the outer bearing cone with oil and then install it.

3.5 Install the output shaft seal.

3.6 Apply a coating of oil to the inner bearing cone, and install.

3.7 Apply a coating of oil to the input shaft pilot bearing and then install the bearing into the output shaft.

3.8 Install the output shaft by sliding the shaft in through the output shaft housing from the front to the rear. Be careful when sliding the output shaft through the bearing cones and spacer(s).

3.9 Install the rear driveline yoke on the output shaft, taking care not to damage the output shaft seal. Apply Loctite® 242 to the 3/4–10 x 1-1/2 capscrew. Then, install the capscrew and washer and tighten 225 lbf·ft (305 N·m).

3.10 Install a new gasket onto the output shaft housing.

3.11 Apply Loctite® 242 to the two 7/16–14 x 2-1/4 and the four 7/16–14 x 1-3/4 capscrews. Then, install the output shaft and housing, sliding the housing onto the shift yoke shaft. Install and tighten the 2-1/4-inch capscrews 50 lbf·ft (68 N·m) and the 1-3/4-inch capscrews 53 lbf·ft (72 N·m).

3.12 Install the shift and interlock switches on the output shaft housing.

3.13 Apply Loctite® 242 to the detent allen-head screw, and install the detent ball, spring and allen-head screw.

3.14 Install the manual shift eye from the rear of the shift yoke shaft.

3.15 Rotate the input shaft to check for proper movement.

4. Assemble and install the intermediate shaft assembly.

4.1 Press a new bearing cone into the intermediate shaft rear cover, coat the cone with oil and install a new cover seal.

4.2 Press a new bearing cone into the intermediate shaft front cover, coat the cone with oil and install a new cover seal.

⚠ CAUTION

Lubrication pump impeller vanes are fragile, and may break or chip. Impeller vanes are installed only one way. If removal of the vanes is necessary, note the installation of the vanes. Failure to install the vanes properly will result in transmission failure.

IMPORTANT: To ensure proper operation of the oil pump, use the same number of gaskets and shims that were removed when the oil pump was disassembled.

4.3 Install the lubrication pump impeller assembly, vanes and shaft into the front cover, aligning matchmarks. Apply Loctite® 242 to the six 1/4–20 x 5/8 capscrews and tighten 8 lbf·ft (11 N·m).

4.4 Press the new bearing cups onto the intermediate shaft, one on each side of the intermediate gear.

4.5 Reaching through the top of the transmission housing, install the intermediate gear

Fire Pump Gearbox Removal, Disassembly, Assembly, and Installation

and shaft assembly, taking care not to damage the bearing cups.

4.6 Holding the intermediate gear assembly in place, install the rear intermediate shaft cover. Apply Loctite® 242 to the three 7/16–14 x 1-1/4 capscrews and install but do not torque.

4.7 Install the front intermediate shaft cover, aligning the lubrication pump shaft spline with the intermediate shaft spline. Apply Loctite® 242 to the three 7/16–14 x 1-1/4 capscrews and tighten all six capscrews 53 lbf·ft (72 N·m).

4.8 Connect the oil suction line to the lubrication pump.

4.9 Rotate the input shaft and manually shift the transmission to check for proper movement and operation.

Installation

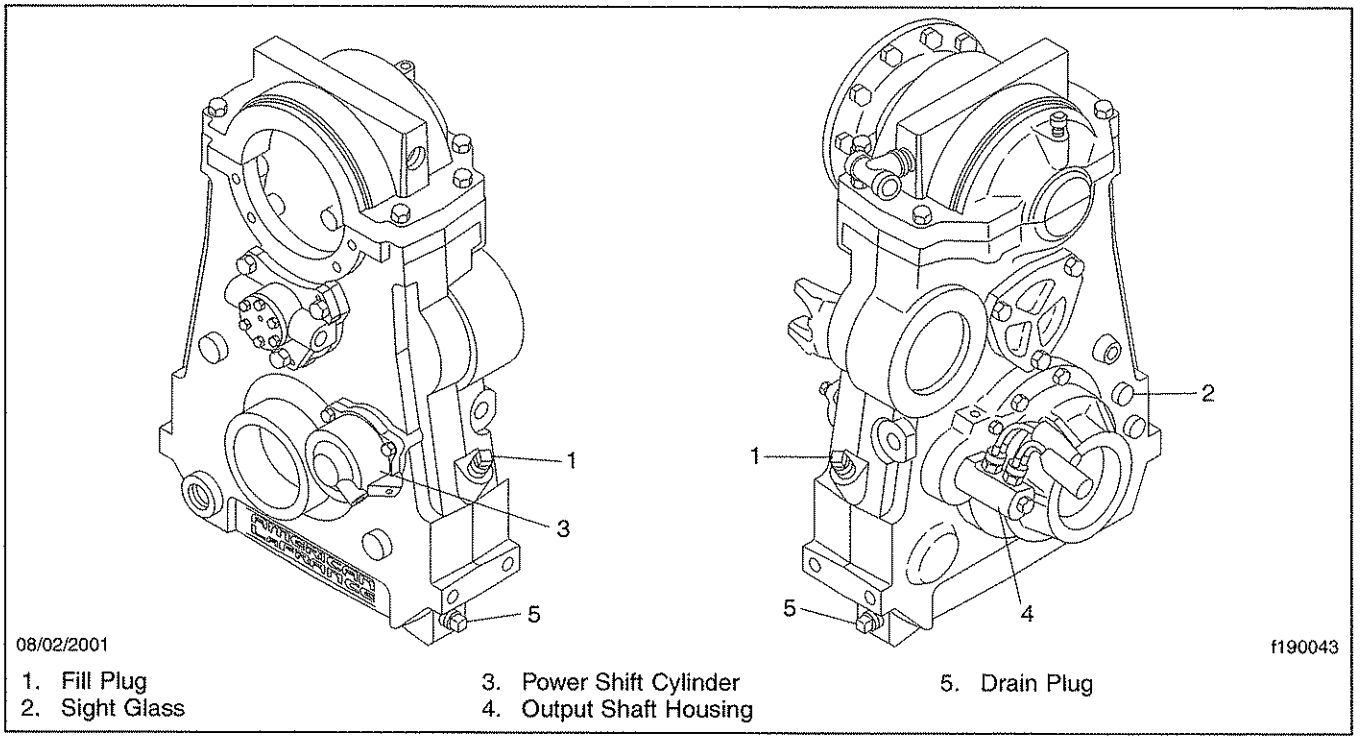
1. Install a new gasket on the seating surface of the rear bearing housing.

⚠ CAUTION

Properly align the rear bearing housing. If the rear bearing housing is not aligned with the matchmarks, the gear tooth mesh could be incorrect and may result in damage to the gearbox.

2. Using a lifting device, lift the gearbox into position (around the rear bearing housing). Apply Loctite® 242 to the six 1/2–13 x 1-3/4 capscrews, and attach the gearbox cover to the gearbox. Tighten finger-tight, but do not torque.
3. Apply Loctite® 242 to the twelve 7/16–14 x 1-1/4 capscrews, and insert the capscrews through the rear bearing housing cover and gasket into the gearbox. Tighten 53 lbf·ft (72 N·m).
4. Tighten the six 1/2–13 x 1-3/4 capscrews 65 lbf·ft (88 N·m).
5. Connect the pump gearbox cooling lines.
6. Connect the air lines and electrical switches.
7. Connect the drive shafts. Tighten the yoke fasteners 225 lbf·ft (305 N·m), and tighten the bearing retaining strap capscrews 40 to 48 lbf·ft (54 to 65 N·m).
8. Connect the lubrication line to the gearbox cover.
9. Fill the gearbox with the necessary lubricant. See **Fig. 4**.
10. Operate the pump and check for leaks. Verify the oil pressure at 25 to 35 psi (172 to 241 kPa) at the oil injection point.
11. Remove the chocks from the front and rear tires.

Fire Pump Gearbox Removal, Disassembly, Assembly, and Installation



1. Fill Plug
2. Sight Glass
3. Power Shift Cylinder
4. Output Shaft Housing
5. Drain Plug

Fig. 4, Fire Pump Gear Box Lubrication and Fluid Change Locations

Replacement

1. Park the vehicle on a level surface. Shut down the engine. Set the parking brake and chock the front and rear tires.
2. Drain the water from the pump.

⚠ WARNING

The gearbox assembly is heavy. Support the lower gearbox assembly with a lifting device. Failure to do so could result in the assembly falling, which could result in personal injury or property damage.

3. Remove the gearbox. See **Subject 110** for information.
4. Remove the 5/8–11 x 1-1/4 capscrew and bearing retaining washer from the end of the impeller shaft.
5. Remove the twelve 1/2–13 x 1-3/4 capscrews that attach the rear bearing housing to the pump body.
6. Install two 1/2–13 x 3 jackscrews into the 1/2–13 threaded holes provided in the rear bearing housing. See **Fig. 1.**
7. Use a centerpunch to mark the rear bearing housing, the mechanical seal housing, and the pump body so that the components are properly aligned during assembly.
8. Turn the two jack screws evenly, clockwise, to push the rear bearing housing from the impeller shaft and pump body.

NOTE: To prevent damage to components as the rear bearing housing is pushed from the impeller shaft, place your hands under the gear opening to catch the gear, key, and bearings.

NOTE: It may be necessary to use pry bars to gently assist in removing the inner bearings and gear.

9. Remove the jack bolts.
10. Remove the slinger from the impeller shaft.
11. Remove the four 7/16–14 x 1-1/4 capscrews from the mechanical seal cover. See **Fig. 2.** Use a center punch to mark the seal cover for proper alignment during installation.
12. Use pry bars if necessary in the provided slots to loosen the mechanical seal cover from the impeller shaft and the pump body.
13. Remove the old mechanical seal, being careful not to damage the impeller shaft. Use two small hook-tools positioned about 180 degrees apart to pull the mechanical seal from the seal cavity if necessary.
14. Clean the seal cavity and the impeller shaft.
15. Inspect the retaining ring on the shaft.
16. Remove the burrs at the gear key slot and the bearing lands, and remove the oil seal in the rear bearing housing. See **Fig. 3.**

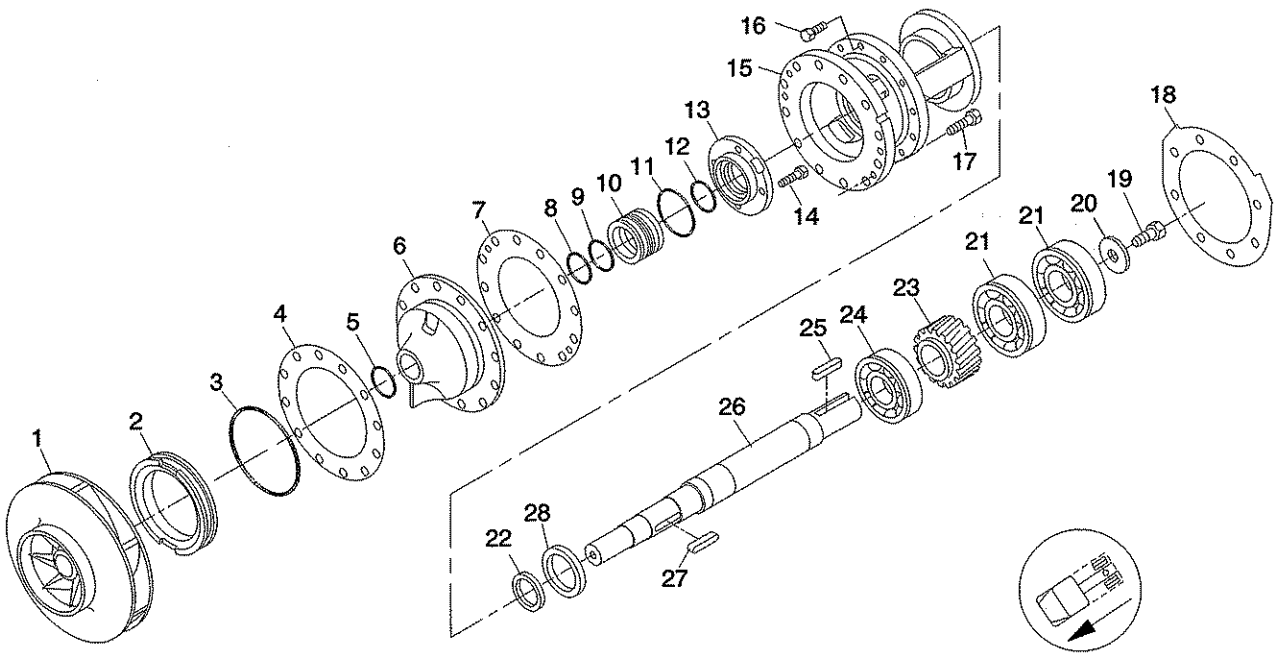
IMPORTANT: Always replace the entire mechanical seal with a new Twinflow mechanical seal assembly.

⚠ CAUTION

When installing a new mechanical seal do not touch the sealing surface of the carbon seal ring or the metal seat while handling or installing. Oil and grease can damage the bellows of the mechanical seal. Use only a soap-and-water solution to lubricate the mechanical seal.

17. Clean the housing and the impeller shaft, and lubricate the impeller shaft and the new mechanical seal with a soap-and-water solution.
18. Install the new mechanical seal bellows over the end of the impeller shaft with the spring oriented toward the impeller. Using a soft pusher tube and keeping your fingers away from the carbon seal, carefully push the mechanical seal assembly into the mechanical seal cavity. If binding occurs, apply more soap-and-water solution to the impeller shaft and the bellows.
19. Install the steel cup and seat it into the mechanical seal cover. Lubricate with a soap-and-water solution.
20. Remove and replace the seal rings in the mechanical seal cover. Apply the soap-and-water solution to the seal rings and then slide over the end of the impeller shaft. Make sure the mechanical seal remains seated in the bore of the cover.

Mechanical Seal Replacement



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1. Impeller
2. Clearance Ring
3. Rear Bearing Housing Seal
4. Bearing/Seal Housing Gasket (impeller side)
5. Shaft Retaining Ring
6. Mechanical Seal Housing
7. Bearing/Seal Housing Gasket (mechanical seal side)
8. Shaft Seal Ring
9. Shaft Retaining Ring
10. Mechanical Seal And Steel Cup Assembly
11. Mechanical Seal Piston Ring
12. Shaft Seal Ring
13. Mechanical Seal Cover
14. Hexhead Screw, 7/16–14 x 1-1/4
15. Rear Bearing Housing
16. Hexhead Screw, 7/16–14 x 1-1/2
17. Hexhead Screw, 1/2–13 x 1-3/4
18. Rear Bearing Housing Gasket
19. Hexhead Screw, 5/8–11 x 1-1/4
20. Rear Bearing Washer
21. Bearing (aft)
22. Pump Shaft Slinger
23. Pump Shaft Gear
24. Bearing (forward)
25. Pump Shaft Gear Key
26. Pump Shaft
27. Impeller Key
28. Drive Unit Oil Seal

Fig. 1, Impeller Shaft Assembly (exploded view)

21. Insert the mechanical seal cover into the mechanical seal cavity aligning it with the bolt holes and the orientation marks.

22. Insert the bolts in the mechanical seal housing to prevent the housing from rotating.

23. Install the four 7/16–14 x 1-1/4 capscrews. Tighten 53 lbf·ft (72 N·m).

24. Install the new slinger onto the impeller shaft. Then remove the retaining bolts.

25. Install the new gasket and oil seal in the rear bearing housing. Slide the housing and front bearing onto the rear impeller shaft. The bearing is a press-fit onto the impeller shaft and slip-fit in the housing.

IMPORTANT: Do not allow the weight of the rear bearing housing to rest on the oil seal.

26. Insert the gear through the opening in the housing and align it with the impeller shaft. Slide the housing, front bearing and gear onto the shaft. The

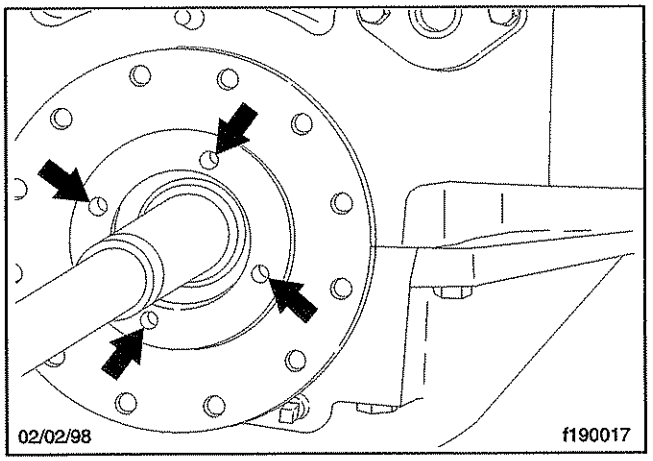
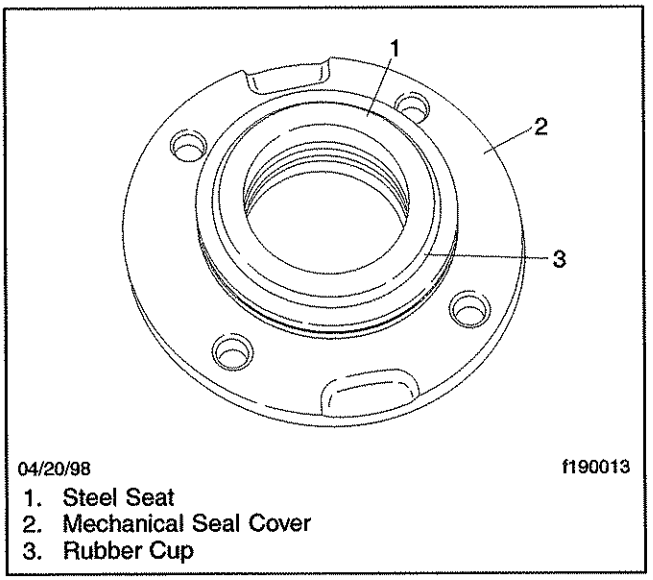


Fig. 2, Remove Four Capscrews



1. Steel Seat
2. Mechanical Seal Cover
3. Rubber Cup

Fig. 3, Mechanical Seal Assembly

front bearing will stop when the inner race contacts the seat on the impeller shaft.

27. Line up the keyway in the gear and install the key into the keyway.

28. Slide one of the two rear bearings onto the impeller shaft and into the housing. The rear bearings are a press-fit onto the shaft and a slip-fit in the housing.

29. Using a series of different length capscrews, install the rear bearing housing to the pump body. When it is possible, install the four capscrews (approximately 90 degrees apart). These bolts, in combination with the rear bearing, will center the housing. Double check to be sure the housing is centered and will clear the mechanical seal assembly.

30. Install the pusher bolt in the rear of the impeller shaft. Tighten the nut on the pusher bolt while holding the pusher bolt, pushing the rear bearing into the housing. Remove the pusher bolt and install the second of the two rear bearings. Then install the pusher bolt and tighten the nut while holding the pusher bolt to install the bearing.

31. Continue to tighten the nut on the pusher bolt while making sure the housing is aligned and centered. Once the pusher bolt is snug, the rear housing assembly, the gear, and the bearings should be in place. Remove the pusher bolt and rotate the impeller assembly by placing a large screwdriver between the housing and the gear. The impeller assembly should rotate.

NOTE: A new impeller will have some resistance when the impeller shaft is rotated.

32. Apply Loctite® 242 to the 5/8–11 x 1-1/4 bearing retainer capscrew. Install and tighten 80 lbf·ft (108 N·m).

33. Apply Loctite® 242 to the twelve 1/2–13 x 1-3/4 capscrews, install and tighten 80 lbf·ft (108 N·m).

34. Install the gearbox. See **Subject 110** for information.

35. Perform the annual service test on the pump. Check for leaks. Verify the oil pressure at 25 to 35 psi (172 to 241 kPa) at the oil injection point.

36. Remove the chocks from the front and rear tires.

Impeller Assembly Removal and Installation

Removal

1. Park the vehicle on a level surface. Shut down the engine. Set the parking brake and chock the front and rear tires.
2. Drain the water from the pump.

⚠ WARNING

The gearbox assembly is heavy. Support the lower gearbox assembly with a lifting device. Failure to do so could result in the assembly falling, which could result in personal injury or property damage.

3. Remove the gearbox. See **Subject 110** for information.

⚠ WARNING

The lower pump body is heavy. Support the lower pump body and impeller assembly with a lifting device. Failure to do so could result in the lower pump body and impeller assembly falling, which could result in personal injury or property damage.

4. Remove the drain lines from the lower pump body. See **Fig. 1.**
5. Drain the oil from the AutoLube and remove the 1/2–13 x 2 capscrews from the upper half of the AutoLube and pump body.
6. Remove the 7/16–14 x 1-1/2 capscrews from the upper half of the rear bearing housing and pump body.
7. Remove the 1/2–13 x 1-1/4 capscrews from the lower pump body.

⚠ WARNING

Do not remove the four capscrews, one in each corner of the lower pump body, until the lifting device is in position. Failure to do so could result in the lower pump body and impeller assembly falling, which could result in personal injury or property damage.

8. Position the lifting device into place with the lower pump body lifting adapter between the lifting device and the lower pump body.
9. Remove the 5/8–11 x 5 capscrews in each corner of the lower pump body.
10. Lower the lower pump body and impeller assembly. Be sure to balance the assembly so that it does not tip from the lifting device.
11. Remove the remaining capscrews from the lower half of the AutoLube, the rear bearing housing, and the lower pump body.

⚠ WARNING

The impeller assembly is heavy. Do not attempt to lift the assembly without the aid of another person or persons, or a lifting device. Failure to do so could result in the impeller assembly falling, which could result in personal injury or property damage.

12. Remove the remaining screws from the rear bearing housing and then from the lower pump body.
13. Lift the impeller assembly from the lower pump housing. See **Fig. 2.** Set the assembly aside.
14. Clean all gasket surfaces of the upper and lower pump bodies, as well as those on the AutoLube and the rear bearing housing face.
15. Clean the clearance ring and clearance ring seats in both the upper and lower pump body halves to remove all the buildup material so that the new clearance ring will seat properly.

NOTE: Pitting of the clearance rings may occur from the buildup material and the effects of corrosion. Once the seats are cleaned, any pitting on the clearance rings is considered normal.

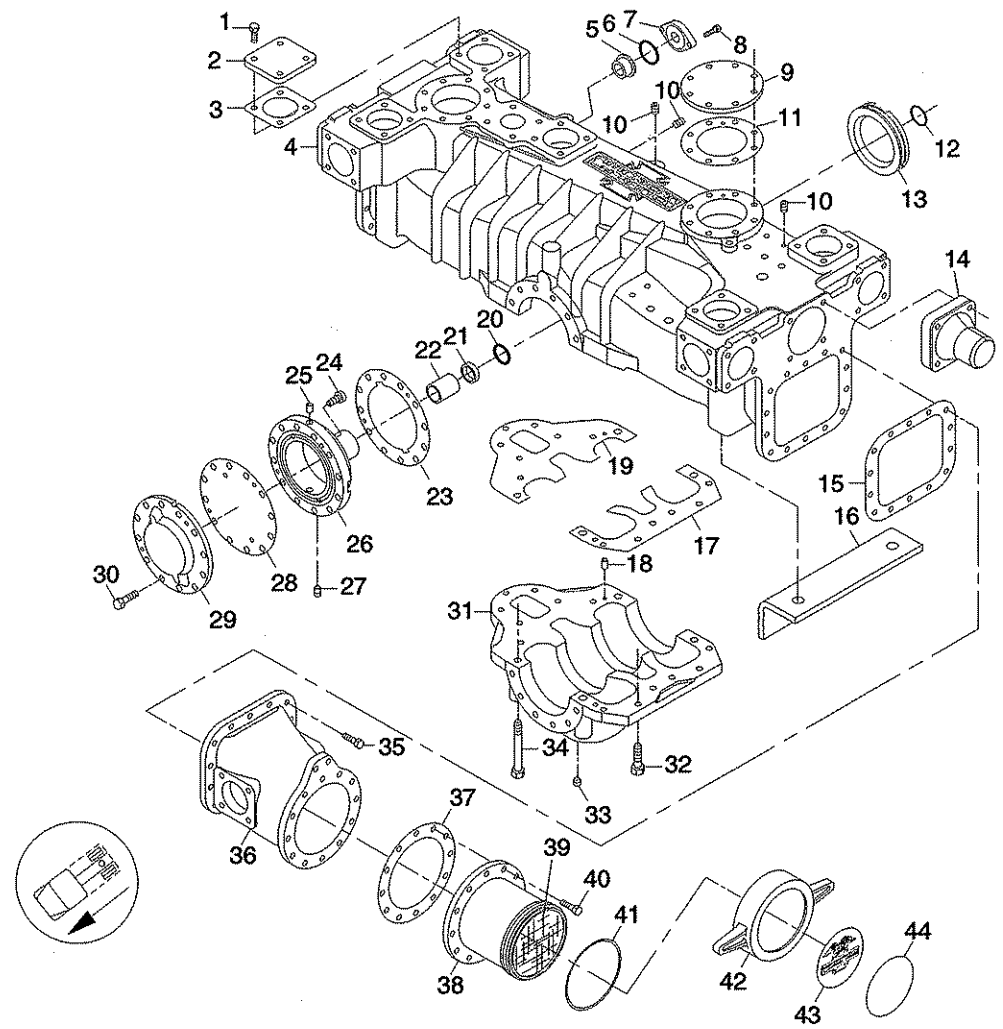
Installation

1. Install the pump body gaskets to the lower pump body, trimming as necessary to fit.

⚠ CAUTION

Failure to line up the clearance ring lock notches with the pump body tabs (as described in the next step) may result in pinched clearance rings, which could result in pump damage and pump failure.

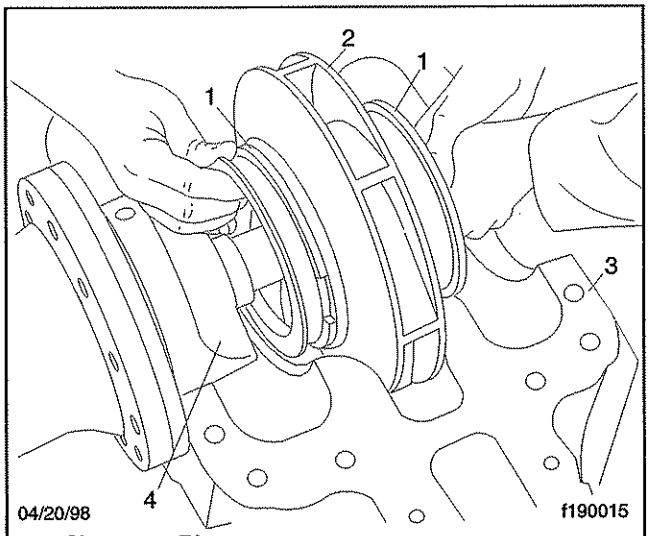
Impeller Assembly Removal and Installation



1. Hexhead Screw, 7/16–14 x 1-1/4
2. Blank Flange
3. Flange Gasket
4. Upper Pump Body
5. Priming Valve Strainer
6. Priming Valve Plate Seal Ring
7. Priming Valve Plate
8. Hexhead Screw, 7/16–14 x 1-1/4
9. Tank Connection Flange
10. Plug, 1/4-inch
11. Tank Connection Gasket
12. Impeller Retaining Ring
13. Clearance Ring
14. QD Relief Valve Assembly
15. Suction Tube Extension Gasket
16. Pump Mounting Bracket
17. Pump Body Gasket (left side)
18. Dowel Pin
19. Pump Body Gasket (right side)
20. Oil Seal Retaining Ring
21. Front Bearing Housing Oil Seal
22. Front Bearing
23. Bearing/Seal Housing Gasket
24. Allen-head Screw, 3/8–16 x 3/4
25. Brass Socket Plug, 1/4-inch
26. Front Bearing Housing Assembly
27. Brass Socket Plug, 1/4-inch
28. Front Bearing Diaphragm
29. Front Bearing Cover
30. Hexhead Screw, 1/2–13 x 2
31. Lower Pump Body
32. Hexhead Screw, 1/2–13 x 1-3/4
33. Plug, 1/2-inch
34. Hexhead Screw, 5/8–11 x 5
35. Hexhead Screw, 1/2–13 x 1-1/4
36. Suction Tube Extension
37. Suction Tube Round Gasket
38. Suction Tube, 6-inch
39. Suction Strainer, 6-inch
40. Hexhead Screw, 7/16–14 x 1-1/4
41. Suction Cap Washer
42. Suction Cap
43. Medallion
44. Medallion O-Ring

Fig. 1, Fire Pump Body Assembly (exploded view)

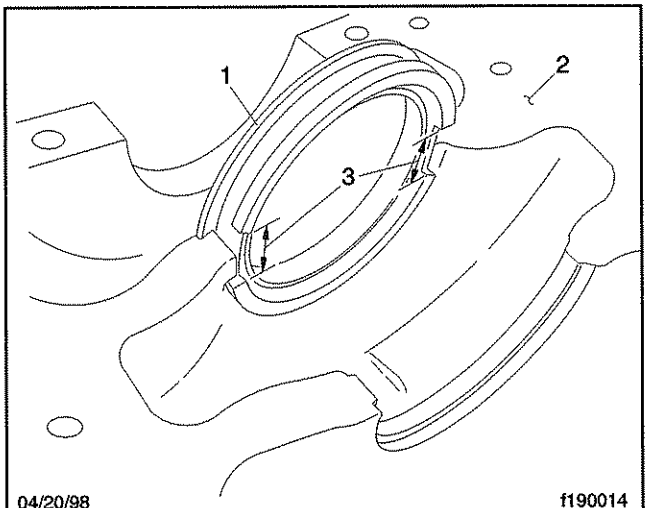
Impeller Assembly Removal and Installation



1. Clearance Ring
2. Impeller
3. Lower Pump Housing
4. Cut Water

Fig. 2, Lifting the Impeller Assembly from the Lower Pump Housing

2. Install the impeller assembly into the lower pump housing carefully aligning the clearance ring lock-notch with the clearance ring lock tabs in the lower pump body. Then rotate the clearance rings to one side to open up lock notches to line up with the lock tabs in the upper pump body. See **Fig. 3.**
3. Install the 1/2–13 x 1-3/4 capscrews through the rear bearing housing and the mechanical seal housing. Do not tighten.
4. Make sure the dowel pins are in the upper pump body to assist in aligning the lower pump body with the upper pump body.
5. Using a lifting device, slowly raise the lower pump body and the impeller assembly into place, making sure that the lower pump body aligns with the dowel pins and the clearance ring notches align with the clearance ring lock tabs in the upper pump body.
6. Rotate the impeller and check for freedom of movement when the lower pump body and the impeller assembly is in place.
7. Apply Loctite® 242 and install the four 5/8–11 x 5 capscrews (one at each corner of the lower pump body). Tighten snug but do not fully torque.
8. Install the 1/2–13 x 1-3/4 screws in the rear bearing housing and mechanical seal housing. Tighten 53 lbf·ft (72 N·m).
9. Remove the lifting device.
10. Apply Loctite® 242 to the 1/2–13 x 1-3/4 lower pump body capscrews and install them. Tighten snug but do not torque.
11. Torque the 5/8–11 x 5 capscrews 150 lbf·ft (203 N·m) then, starting from the center and moving outward, tighten the lower pump body capscrews 65 lbf·ft (88 N·m).
12. Install the AutoLube. See **Subject 100** for instructions.
13. Install the gearbox. See **Subject 110** for instructions.
14. Operate the pump and check for leaks. Verify the oil pressure at 25 to 35 psi (172 to 241 kPa) at the oil injection point.
15. Remove the chocks.



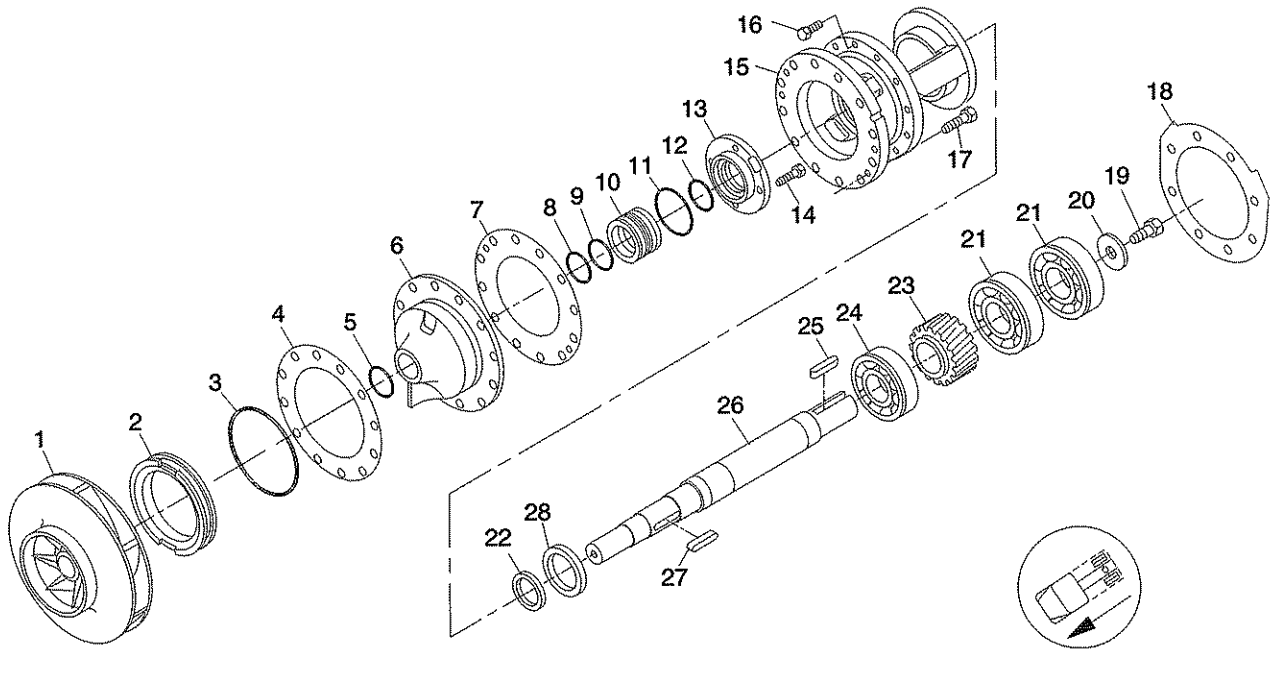
1. Clearance Ring
2. Lower Pump Housing
3. Clearance Ring Notch

Fig. 3, Clearance Ring Mounted in Pump Housing

Single-Stage Pump

Disassembly

1. Park the vehicle on a level surface. Shut down the engine. Set the parking brake and chock the front and rear tires.
2. Remove the AutoLube. See **Subject 100** for instructions.
3. Remove the fire pump gear box. See **Subject 110** for instructions.
4. Remove the impeller assembly. See **Subject 130** for instructions and see **Fig. 1** for an exploded view of the assembly.
5. Place the impeller shaft on a work bench.
6. Note the orientation of the impeller vanes.
7. Remove the outer retaining ring.



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1. Impeller
2. Clearance Ring
3. Rear Bearing Housing Seal
4. Bearing/Seal Housing Gasket (impeller side)
5. Shaft Retaining Ring
6. Mechanical Seal Housing
7. Bearing/Seal Housing Gasket (mechanical seal side)
8. Shaft Seal Ring
9. Shaft Retaining Ring
10. Mechanical Seal And Steel Cup Assembly
11. Mechanical Seal Piston Ring
12. Shaft Seal Ring
13. Mechanical Seal Cover
14. Hexhead Screw, 7/16–14 x 1-1/4
15. Rear Bearing Housing
16. Hexhead Screw, 7/16–14 x 1-1/2
17. Hexhead Screw, 1/2–13 x 1-3/4
18. Rear Bearing Housing Gasket
19. Hexhead Screw, 5/8–11 x 1-1/4
20. Rear Bearing Washer
21. Bearing (aft)
22. Pump Shaft Slinger
23. Pump Shaft Gear
24. Bearing (forward)
25. Pump Shaft Gear Key
26. Pump Shaft
27. Impeller Key
28. Drive Unit Oil Seal

Fig. 1, Impeller Shaft Assembly (exploded view)

Impeller Shaft Disassembly and Assembly

⚠ WARNING

Wear protective, heat-resistant gloves while heating the impeller to remove it from the impeller shaft. Heated metal can cause injury to your hands.

⚠ CAUTION

Do not overheat the impeller. The impeller is constructed of bronze. If the impeller is overheated and turns red or blue during removal from the shaft, it has been weakened and must be replaced.

8. Using an acetylene torch, carefully heat the "eye" of the impeller for approximately two minutes.
9. When heated properly, the impeller will slide free of the shaft. If the impeller moves but does not slide free, do not immediately reheat. Allow the complete assembly to cool to room temperature then reheat and remove the impeller.
10. Allow the components to cool to room temperature.
11. Remove the inner clearance ring.
12. Remove the key.
13. Remove the inner retaining ring and slide the mechanical seal housing from the impeller shaft

Assembly

1. Clean the impeller shaft, the keyway, and the mechanical seal housing and face.
2. Check the waterway in the mechanical seal housing for restrictions.
3. Install the mechanical seal housing onto the impeller shaft.
4. Install the inner retaining ring.
5. Install the new gasket on the mechanical seal housing face.
6. Install the key into the keyway.

⚠ CAUTION

If the impeller or clearance rings are dropped, damaged, or deformed, they will need to be replaced.

7. Install the inner clearance ring.

⚠ WARNING

Wear protective, heat-resistant gloves while heating the impeller to install it onto the impeller shaft. Heated metal can cause injury to your hands.

8. Using the torch, heat the "eye" of the new impeller for approximately two minutes. Then slide the impeller onto the shaft with vanes in proper orientation. If the impeller does not fully slide onto the shaft allow the assembly to cool to room temperature before reheating.
9. Install the outer retaining ring.
10. Install the impeller assembly. See **Subject 130** for instructions.
11. Install the outer clearance ring.
12. Install the impeller shaft assembly.
13. Install the fire pump gear box. See **Subject 110** for instructions.
14. Install the AutoLube. See **Subject 100** for instructions.
15. Remove the chocks from the front and rear tires.

Two-Stage Pump

Disassembly

1. Park the vehicle on a level surface. Shut down the engine. Set the parking brake and chock the front and rear tires.
2. Remove the AutoLube. See **Subject 100** for instructions.
3. Remove the fire pump gear box. See **Subject 110** for instructions.
4. Remove the impeller assembly. See **Subject 130** for instructions.
5. Place the impeller shaft assembly on a work bench.
6. Note the position of the impeller vanes.
7. Remove the inner and the outer retaining rings and then remove the mechanical seal housing.

⚠ WARNING

Wear protective, heat-resistant gloves while heating an impeller to remove it from the impeller shaft. Heated metal can cause injury to your hands.

⚠ CAUTION

Do not overheat the impeller. An impeller is constructed of bronze. If the impeller is overheated and turns red or blue during removal from the shaft, it has been weakened and must be replaced.

8. With an acetylene torch, carefully heat the "eye" of the impellers for approximately two minutes.

IMPORTANT: Mark the impellers as to whether they are the primary or secondary impeller in relation to the AutoLube. Improper or backward installation of the impellers affects pump performance.

9. When heated properly, an impeller will slide free of the shaft. If the impeller moves but fails to slide free, do not immediately reheat. Allow the complete assembly to cool to room temperature then reheat and remove the impellers. Heat the secondary impeller and remove. Then rotate the impeller shaft assembly end for end and heat and remove the primary impeller.
10. Remove the center support bearing.
11. Remove mechanical seal housing and then the inner clearance ring.
12. Remove the key.
13. Remove the inner retaining ring and slide the mechanical seal housing from the impeller shaft.

Assembly

1. Clean the impeller shaft, the keyway, and the mechanical seal housing and face.
2. Check the waterway in the mechanical seal housing for restrictions.
3. Install the new gasket on the mechanical seal housing face.
4. Install the key into the keyway.

⚠ CAUTION

If the impellers or the clearance rings are dropped, damaged, or deformed, they require replacement.

5. Install the inner clearance ring.

⚠ WARNING

Wear protective, heat-resistant gloves while heating the impeller to install it onto the impeller shaft. Heated metal can cause injury to your hands.

6. Using the torch, heat the "eye" of each impeller for approximately two minutes. Then slide the individual impellers onto the shaft. If an impeller does not fully slide onto the shaft allow the assembly to cool to room temperature before reheating.
7. Install the outer retaining ring.
8. Install the outer clearance ring.
9. Install the impeller assembly. See **Subject 130** for instructions.
10. Install the mechanical seal housing onto the impeller shaft.
11. Install the impeller shaft assembly.
12. Install the fire pump gear box. See **Subject 110** for instructions.
13. Install the AutoLube. See **Subject 100** for instructions.
14. Remove the chocks from the front and rear tires.

Valve Removal, Disassembly, Assembly and Installation

Pilot Valve

Park the vehicle on a level surface. Shut down the engine. Set the parking brake and chock the front and rear tires.

1. Drain the fire pump.
2. Rotate the adjustment handwheel counterclockwise to remove the spring tension.
3. Remove the capscrew and nut attaching the adjustment handwheel to the adjustment shaft. Then remove the handwheel.

⚠ CAUTION

Identify and mark the line connections on the control body before removing. Improper connection of lines may result in the failure of the pilot valve, which could cause damage to the fire pump.

4. Remove the pump discharge pressure line and the relief valve line from the control body of the pilot valve.
5. While holding the pilot valve, remove the four 1/4–20 x 5/8 machine screws attaching the valve and cover plate to the Pump Operator's Panel, and separate the valve, plate, and the relief valve setting indicator (if equipped with PMD) from the panel.
6. Disassemble the pilot valve.
   - 6.1 Remove the four 5/16–18 x 1 allen-head capscrews securing the control body to the rear of the spring housing. Then remove the control body.

⚠ CAUTION

Do not use pliers to unscrew the control valve from the diaphragm clamp. Damage to the control valve will render the pilot valve inoperative.

   - 6.2 Unscrew the control valve from the diaphragm clamp. Remove the diaphragm washer and the diaphragm.
   - 6.3 Remove the retaining ring, the seal, and the bearing.

⚠ WARNING

Use a spring compressor to remove the pilot valve spring. The spring is under compression and could become uncompressed, which could result in personal injury.

   - 6.4 Turn the adjustment handwheel clockwise to unscrew the adjustment shaft from the adjustment nut. From the handwheel end, remove the adjustment shaft from the spring housing.
   - 6.5 Remove both springs, the adjustment nut, and diaphragm clamp as an assembly from the spring housing and then separate.
7. Clean all the pilot valve components. Inspect and lubricate with grease the threads on the adjustment shaft.
8. Assemble the pilot valve.

⚠ WARNING

Use a spring compressor to install the pilot valve spring. The spring is under compression and could become uncompressed, which could result in personal injury.

⚠ CAUTION

Always remove the pilot valve discharge pressure inlet screen, which is located in the top of the discharge side of the pump. Clean or replace as necessary. Failure to do so could render the pilot valve inoperative.

   - 8.1 Combine both springs, the adjustment nut and the diaphragm clamp as an assembly and install into the spring housing. Align the guide pin-in adjustment nut with the slot in the spring housing and the indicator plate on the PMD.
   - 8.2 Slide the adjustment shaft into the spring housing from the handwheel end. Turn the adjustment handwheel counterclockwise in order to screw the adjustment shaft into the adjustment nut until it bottoms in the diaphragm clamp. Do not put the springs under tension.

Valve Removal, Disassembly, Assembly and Installation

8.3 Lubricate the new bearing and slide the new bearing and bearing washer over the adjustment shaft into the spring body housing. Install the retaining ring. Then install the new seal washer and rotate the adjustment shaft in both directions to check for freedom of movement.

8.4 Install the new diaphragm washer and diaphragm. Screw the control valve into the diaphragm clamp.

8.5 Install the control body. Apply Loctite® 242 to the four 5/16–18 x 1 allen-head capscrews attaching the control body to the rear of the spring housing.

9. Holding the pilot valve, align the cover plate and install the four 1/4–20 x 5/8 machine screws attaching the pilot valve and cover plate to the Pump Operator's Panel.

10. Install the pump discharge pressure line and relief valve line to the control body of the pilot valve.

11. Slide the adjustment handwheel onto the adjustment shaft and then install the retaining capscrew and nut.

12. Fill the pump and test the valve for proper operation and leaks.

Transfer Valve

See **Fig. 1** for an exploded view of the transfer valve.

1. Drain the fire pump.

IMPORTANT: The transfer valve is a timed device. It is therefore important during disassembly to note the location of the transfer bracket locating pin, the transfer drum stop pin, the transfer drum sleeve locating pin, and the transfer drum stem key. It is not necessary to remove the transfer bracket locating pin, the transfer drum sleeve locating pin, or the transfer drum stop pin during disassembly.

2. Turn the adjustment handwheel clockwise until it stops. The transfer indicator should be at the top of the slotted guide in the cover plate.

3. Remove the two allen-head set screws from the transfer indicator guide. Slide the transfer indicator guide (on an adjustment stem) towards the transfer valve.

4. Remove the stem drive gear lock pin. Slide the adjustment stem from the stem drive, the support, and the transfer indicator guide, being careful not to drop or damage the transfer indicator guide and transfer indicator.

5. Remove the four 7/16–14 x 1-1/4 capscrews retaining the transfer bracket assembly to the pump body. Carefully remove the transfer bracket and the transfer valve drum.

6. Disassemble the valve.

6.1 Remove the locating pin that secures the countershaft in place.

6.2 Remove the countershaft from the countershaft gear.

6.3 Remove the countershaft gear and the countershaft gear spring from the transfer bracket assembly.

6.4 Remove the allen-head set screw from the transfer drum gear. Slide the transfer drum gear from the drum stem. Remove the woodruff key from the transfer drum stem.

6.5 Separate the transfer bracket from the transfer drum by sliding it from the transfer drum stem.

6.6 Slide the transfer drum from the transfer sleeve.

7. Assemble the valve.

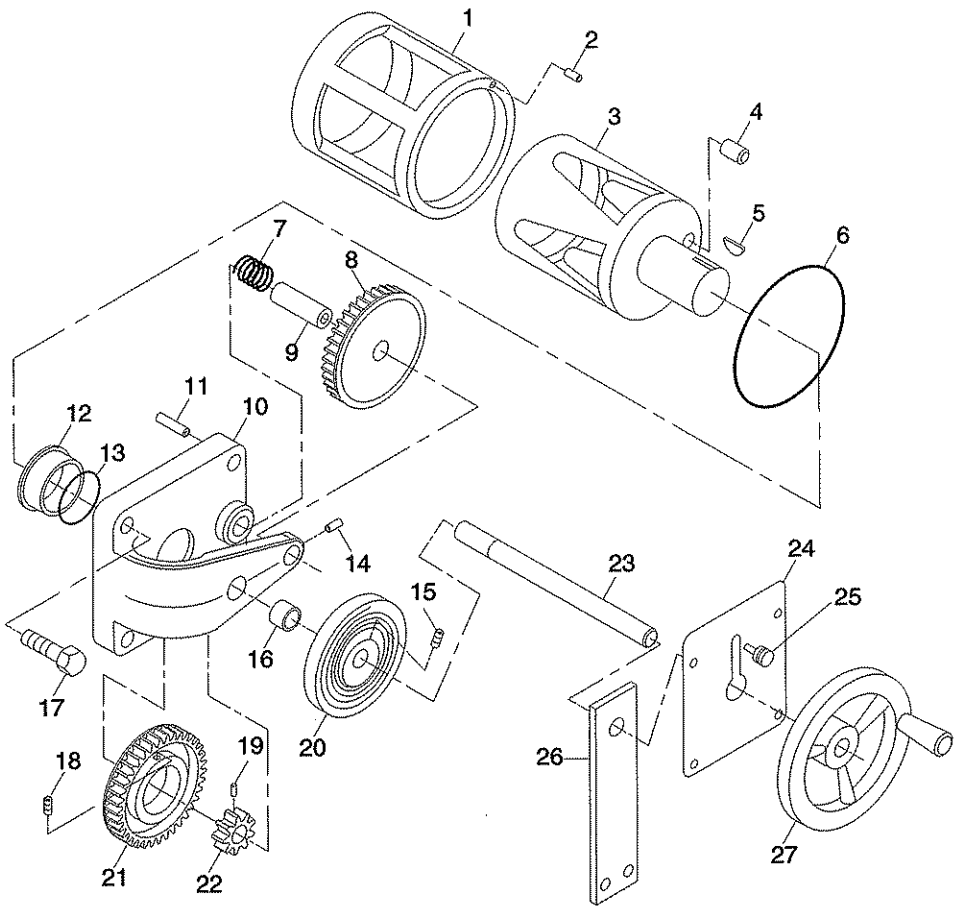
7.1 Clean and inspect all sealing surfaces, the mating surfaces of the transfer valve drum and sleeve. Clean and inspect the transfer bracket bushings and bushing surface on the transfer valve stem and the transfer valve adjustment stem.

7.2 Install new O-ring seals on the transfer valve drum stem and the transfer valve bracket.

7.3 Slide the transfer drum into the transfer bracket, being careful not to damage the bearing surfaces. Then rotate the transfer drum until the drum stop pin is in the correct position.

7.4 Install the woodruff key into the transfer drum stem. Install the transfer drum gear onto the transfer drum stem. Apply Loctite®

Valve Removal, Disassembly, Assembly and Installation



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1. Transfer Drum Sleeve
2. Locating Pin
3. Transfer Drum
4. Transfer Drum Stop Pin
5. Gear Key
6. Transfer Bracket Seal Ring
7. Countershaft Gear Spring
8. Transfer Valve Countershaft Gear
9. Transfer Countershaft
10. Transfer Bracket (with bearings) Assembly
11. Bracket Locating Pin
12. Drum Bracket Bearing
13. Transfer Drum Seal Ring
14. Locating Pin
15. Sockethead Setscrew, 1/4–20 x 3/8
16. Transfer Valve Stem Drive Gear
17. Hexhead Screw, 7/16–14 x 1-1/4
18. Sockethead Setscrew, #10–32 x 1/2
19. Gear Lock Pin
20. Transfer Indicator Guide
21. Transfer Valve Transfer Drum Gear
22. Transfer Stem Drive Gear
23. Transfer Stem
24. Instruction Plate
25. Transfer Indicator
26. Support Stem
27. Adjusting Wheel Assembly

Fig. 1, Transfer Valve

242 to the allen-head set screw and install the transfer drum gear.

7.5 Assemble the countershaft gear spring in the countershaft gear and position the assembly into place in the transfer bracket. Then install the countershaft and the countershaft locating pin to lock the countershaft in place.

8. Install the transfer valve.

Valve Removal, Disassembly, Assembly and Installation

8.1 Align the transfer drum stop pin, the transfer bracket locating pin, and the transfer drum sleeve locating pin into proper position.

8.2 Install the transfer valve drum and bracket assembly into the pump body.

8.3 Apply Loctite® 242 to the four 7/16–14 x 1-1/4 transfer bracket capscrews and install and tighten 53 lbf·ft (72 N·m).

8.4 Slide the adjustment stem through the cover plate, the transfer indicator guide, and the support and transfer bracket.

8.5 Insert the stem drive gear into place in the transfer bracket and then slide the adjustment stem through the stem drive gear.

8.6 Insert the stem drive gear lock pin into place, locking the stem drive gear onto the adjustment stem.

8.7 Apply Loctite® 242 to the transfer indicator guide set screws and install. Do not tighten.

8.8 Turn the adjustment handwheel counterclockwise until it stops. Make sure the transfer indicator is at the top of the slotted guide toward the transfer indicator, making certain that the transfer indicator engages the transfer indicator guide in the top groove. Then tighten the inside set screw in the transfer guide indicator.

8.9 Rotate the adjustment handwheel from stop to stop. The transfer indicator should move freely from the top to the bottom of the slotted guide in the cover plate.

8.10 Tighten the outside set screw in the transfer indicator guide, and recheck the movement of the transfer indicator.

9. Fill the pump and test the valve for proper operation and leaks.

Back Flow Valve

1. Drain the water tank and the pump.
2. Disconnect the control linkage at the Tank-to-Pump valve.
3. Disconnect both ends of the flexible hose connecting the water tank to the tank-to-pump valve. Then slide the flexible hose toward the water tank outlet or the tank-to-pump valve plumbing.

NOTE: If the tank-to-pump valve is air-operated, drain the vehicle's air system and disconnect the supply and the return line on the valve actuator, but do not remove the actuator from the valve. Also, the tank-to-pump valve may be connected to the pump body by capscrews or studs with nuts. If studs are used, it may be necessary to remove some or all of the studs to remove the valve. If so, remove only the studs necessary to remove the valve as any studs left will assist in realigning the valve during installation.

4. Remove the eight 7/16–14 x 1-1/2 capscrews retaining the tank-to-pump valve to the pump body.
5. Remove the tank-to-pump valve and associated plumbing.

NOTE: The back flow valve is a flat butterfly plate with two pivots attached at the top. These pivots fit into two open pivot sockets in the pump body. When the gasket is removed, the back flow valve may fall out.

6. Remove the old gasket from the pump body.
7. Remove the back flow valve.
8. To install the back flow valve, first clean all of the gasket surfaces on the pump body and the tank-to-pump flange.
9. Install the back flow valve. Using two fingers, hold the pivots in the pivot sockets and check the valve for freedom of movement.
10. Install a new gasket.
11. Apply Loctite® 242 to the eight 7/16–14 x 1-1/2 capscrews and attach the tank-to-pump valve to the pump body. Tighten 53 lbf·ft (72 N·m).
12. Slide the flexible connection hose so it is evenly spaced and secured on the water tank outlet and the tank-to-pump valve plumbing.
13. Attach the tank-to-pump valve controls and linkage.
14. Fill the pump and test the valve for proper operation and leaks.

Valve Removal, Disassembly, Assembly and Installation

Sensing Valve

1. Disconnect the following lines at the sensing valve:
   - pilot valve discharge line
   - QG relief valve line
   - PG relief valve line
   - sensing valve pump suction line
   - drain lines
2. Remove the 7/16–14 x 2 sensing valve mounting capscrew.
3. Remove the four 5/16–18 x 1 capscrews attaching the control body to the rear of the spring housing. Remove the control body, being careful not to lose the sensing valve spring.
4. Remove the control valve from the sensing valve body.
5. Unscrew the sensing valve from the diaphragm, being careful not to damage the control valve. Remove the diaphragm.
6. Before installing the sensing valve, clean all components.

⚠ CAUTION

Always remove the sensing valve suction inlet screen. Clean or replace as necessary. The screen is located in the suction side of the pump. Failure to do so may render components inoperative.

7. Install a new diaphragm on the diaphragm clamp. Apply Loctite® to the threads on the control valve and install the control valve into the sensing valve body.
8. Install the sensing valve spring into the valve body cover.
9. Apply Loctite® 242 to the four 5/16–18 x 1 capscrews and attach the control body to the rear of the spring housing. Make sure that the sensing valve spring properly aligns with the diaphragm clamp.
10. Make sure the up arrow is aligned properly.
11. Apply Loctite® 242 to the 7/16–14 x 2 sensing valve mounting capscrew. Tighten 40 lbf·ft (54 N·m).
12. Connect all lines.
13. Fill the pump and test the valve for proper operation and leaks.

TPM Relief Valve

1. Disconnect the line to the sensing valve and drain the fire pump. Make note of the wire connections.
2. Disconnect the indicator light switch.
3. Remove the four 7/16–14 x 1-1/4 capscrews attaching the relief valve assembly to the pump body.
4. Using a twisting motion, remove the relief valve assembly.
5. To disassemble the valve, remove the indicator light switch and remove the cover retaining ring and slide the cover out of the relief valve body.
6. Apply a small amount of pressure to the relief valve piston and remove the piston retaining ring. Carefully release the pressure held to the piston by the spring.
7. Remove the relief valve from the opposite end, sliding the relief valve stem out of the piston.
8. Reach through the center hole of the piston and pull the piston out of the indicator switch end of the relief valve body. Then remove the piston spring.
9. To assemble and install the valve, first clean and inspect all components.
10. Clean all sealing surfaces and install new O-rings seals.
11. Install the relief valve into the relief valve body.
12. Install the piston spring by sliding the piston into the relief valve body while at the same time sliding the piston onto the relief valve system.
13. Apply light pressure to the piston to compress the piston spring and install the piston retaining ring.
14. Slide the cover into the relief valve body. Then install the cover retaining ring.

Valve Removal, Disassembly, Assembly and Installation

15. Using a powered test light, screw the indicator light switch in until the light goes out. Then turn an additional 3/4 to 1-1/4 turn. Apply Loctite® to the jamnut and tighten.
16. Slide the relief valve assembly into the pump body with the side marked "top" up, being careful not to damage the O-rings.
17. Apply Loctite® 242 to the four 7/16–14 x 1-1/4 capscrews and install the assembly in the pump body. Tighten 53 lbf·ft (72 N·m).
18. Connect the indicator light switch.
19. Fill the pump and test the valve for proper operation and leaks.

QD Relief Valve

See **Fig. 2** for an exploded view of the QD relief valve.

1. Drain the pump.
2. Note the location of the wires and disconnect the indicator light switch.
3. Disconnect the relief valve supply line from the pilot valve and drain the line.
4. Remove the two 7/16–14 x 1-1/4 capscrews attaching the relief valve indicator light switch and the mounting bracket assembly to the relief valve cover. Remove the light switch and the bracket.
5. Compress the relief valve return spring by hand and remove the E-clip and washer. Then remove the return spring.
6. Remove the two remaining 7/16–14 x 1-1/4 capscrews retaining the relief valve cover to the pump body. Using a twisting motion, carefully remove the relief valve cover.

⚠ CAUTION

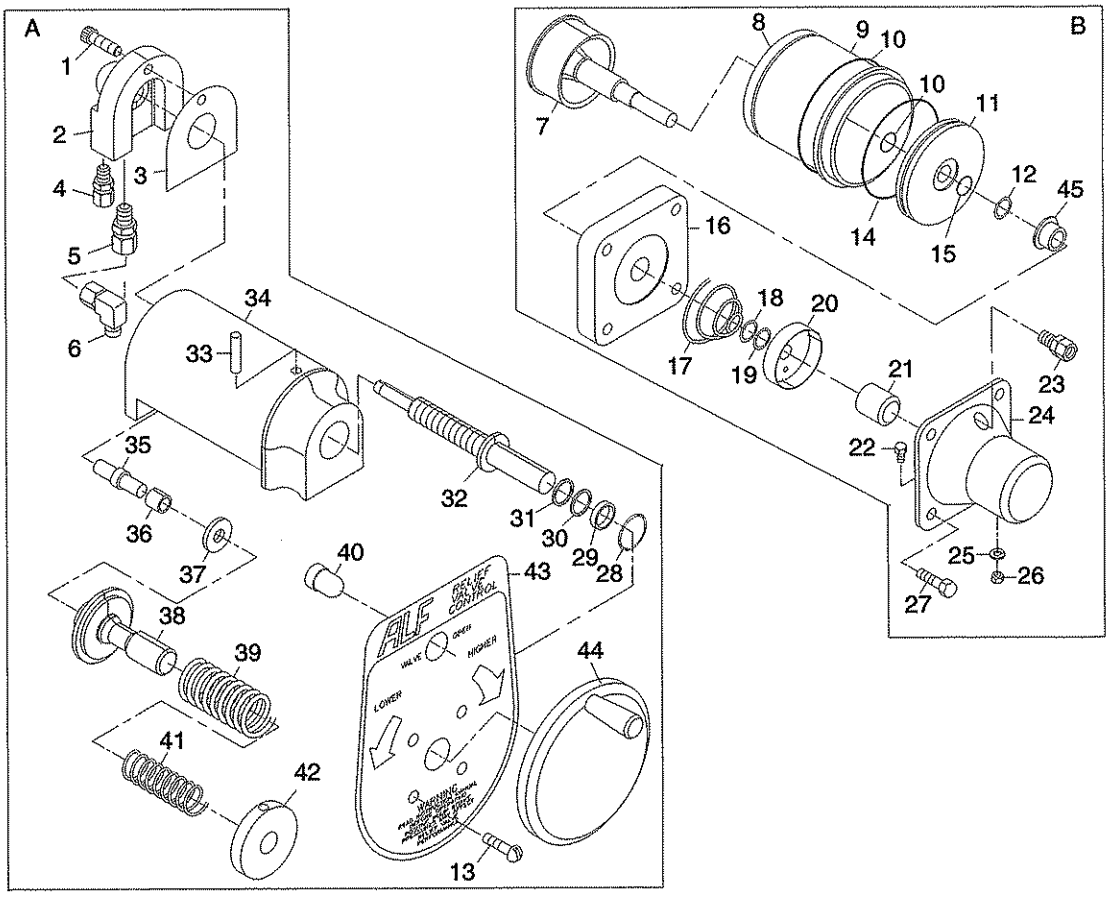
Do not push the relief valve too far into the pump body as it may fall into the pump body and become lodged or damaged. The relief valve is made of brass and is easily damaged by prying or hammering. Damaged valves must be replaced.

7. Remove the retaining ring securing the relief valve piston to the relief valve. Gently push the relief valve into the pump body approximately 1 inch (25 mm) and then pull it back out in a snap-motion. This should pop the relief valve piston out of the relief valve body. Repeat if necessary.

NOTE: It is not necessary to remove the relief valve unless it is damaged. To remove the relief valve, the relief valve body will have to be removed and the complete relief valve assembly will need to be replaced as it will be necessary to pry the relief valve body from the pump body, which will likely damage it.

8. Clean and inspect all of the relief valve assembly components.
9. Clean all sealing surfaces and install new O-rings and Quad-ring seals.
10. Install the relief valve piston in the stem of the relief valve. Do not push the relief valve into the pump body. As it is necessary to start the piston onto the relief valve stem, push the piston until you can grasp the relief valve stem. Then pull the relief valve stem outward while pushing on the relief valve piston. Once the relief valve piston is seated against the shoulder of the relief valve stem, install the retaining ring.
11. Operate the relief valve by hand to check for freedom of movement.
12. Slide the relief valve cover gasket and cover over the top of the relief valve stem to align the relief valve supply line from the pilot valve in the original position. Then apply Loctite® 242 to two 7/16–14 x 1-1/4 capscrews and install opposite of each other. Tighten, but do not torque.
13. Compress and install the return spring and secure it with a washer and E-clip.
14. Align the indicator light switch mounting bracket and switch with the two empty holes in the relief valve cover. Install the two remaining capscrews. Tighten all capscrews 53 lbf·ft (72 N·m).
15. Connect the relief valve supply line from the pilot valve. Also connect the drain line.
16. Connect the indicator light switch.
17. Fill the pump and test the valve for proper operation and leaks.

Valve Removal, Disassembly, Assembly and Installation



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A. PM Relief Valve Control Assembly
B. QD Relief Valve System Assembly

1. Sockethead Screw, 5/16–18 x 1
2. Control Body Assembly
3. PM Control Valve Diaphragm
4. Connector Tube, 1/8–3/4
5. Connector Tube, 1/4–3/8
6. Connector Strainer
7. Relief Valve
8. Valve Body Seal Ring
9. Relief Valve Body
10. Piston Seal Ring
11. Transfer/Relief Valve Piston
12. Piston Retaining Ring
13. Screw, 1/4–20 x 5/8
14. Cover and Piston Seal Ring
15. Cover Seal Ring
16. Relief Valve Cover
17. Valve Spring
18. Washer
19. Spring Retaining Ring
20. Switch Strap
21. Indicator Light Switch
22. Hexhead Screw, #10–32 x 1/2
23. Connector Tube, 1/4" x 3/8"
24. Switch Bracket
25. Lockwasher, #10
26. Hexnut, #10–32
27. Hexhead Screw, 7/16–14 x 2-1/4
28. Sealing Washer
29. Bearing Washer Retaining Ring
30. Bearing Washer
31. Thrust Bearing
32. Adjusting Stem
33. Indicator Pin
34. Spring Housing
35. Control Valve
36. Control Valve Bearing
37. Diaphragm Support Bearing
38. Diaphragm Clamp
39. Outside Spring
40. Light Bulb
41. Inside Spring
42. Adjusting Nut
43. Instruction Plate
44. Adjusting Wheel Assembly

Fig. 2, QD Relief Valve

Valve Removal, Disassembly, Assembly and Installation

TPM Dump Valve

1. Drain the pump.
2. Disconnect the indicator light switch.
3. Disconnect the line to the sensing valve.
4. Remove one 7/16–14 x 2 sensing valve mounting capscrew.
5. Remove the four 7/16–14 x 1-3/4 capscrews retaining the relief valve assembly to the atmosphere dump.
6. Remove the four 7/16–14 x 1-1/2 relief valve mounting capscrews to remove the relief valve from the pump body.
7. Remove the relief valve assembly
8. Remove the four 7/16–14 x 1-3/4 capscrews retaining the relief valve cover to the relief valve body.
9. Remove the indicator light switch assembly.
10. Apply a small amount of pressure to the relief valve spring and remove the spring retaining ring and washer. Carefully release the pressure held on the spring and then remove the spring.
11. Remove the relief valve cover.
12. Remove the piston retaining ring.
13. Remove the relief valve from the opposite end, sliding the relief valve stem out of the piston.
14. Reaching through the center hole of the piston, gently pull the piston from the indicator switch end of the relief valve body.
15. Before assembling and installing the valve, clean and inspect all components of the relief valve assembly.
16. Clean all sealing gasket surfaces and install new O-rings and gaskets.
17. Install the relief valve into the relief valve body.
18. Slide the piston into the relief valve body while at the same time sliding the piston onto the relief valve stem. Then install the piston retaining ring.
19. Install the new gasket and then install the cover onto the relief valve body.
20. Install two 7/16–14 x 1-3/4 capscrews finger-tight to keep the relief valve cover aligned with the valve body.
21. Install the valve spring over the relief valve stem. Then apply pressure to the valve spring to compress the spring.
22. Install the spring washer and the retaining ring.
23. Remove the two 7/16–14 x 1-3/4 capscrews installed to keep the relief valve cover aligned with the valve body. Place the indicator switch assembly into position on the relief valve cover. Apply Loctite® 242 to the four capscrews, install, and tighten 53 lbf·ft (72 N·m).
24. Apply Loctite® 242 to the four 7/16–14 x 1-1/2 capscrews to install the new gasket for the relief valve to the pump surface.
25. Apply Loctite® 242 to the four 7/16–14 x 1-1/2 capscrews and install the new gasket and relief valve assembly to the atmosphere dump. Tighten 53 lbf·ft (72 N·m).
26. Apply Loctite® 242 to the 7/16–14 x 2 capscrew, install the sensing valve and tighten 40 lbf·ft (54 N·m). Make sure the arrow points upward.
27. Connect the indicator light switch.
28. Connect the line to the sensing valve.
29. Fill the pump and test the valve for proper operation and leaks.

Check Valves (two-stage only)

1. Drain the pump.

NOTE: There are two check valves (one on each side) in the suction side on the front of the two-stage pump body. The following procedure is used for both check valves.

2. Remove the four 1/2–13 x 1-1/4 capscrews from the check valve cover on the front side of the pump body.
3. Remove the check valve.
4. Clean the gasket surfaces and inspect the check valve pivots and pivot sockets.
5. Install the check valve.

6. Install the new gasket in the pump body.
7. Apply Loctite® to the four capscrews and secure the check valve cover to the pump body with the capscrews, being careful to align the check valve pivot with the pivot socket in the check valve cover. Tighten 53 lbf·ft (75 N·m).
8. Fill the pump and test the valve for proper operation and leaks.

SPV Priming Valve

1. Drain the pump.
2. Disconnect the 3/4-inch (19 mm) vacuum hose connecting the priming valve to the primer.
3. Remove two 7/16–14 nuts attaching the priming valve to the studs in the pump body. If the studs are damaged, replace them with 7/16–14 x 1-3/4 zinc plated studs.

NOTE: If the valve strainer and O-ring seal remains on the pump body, remove it carefully for cleaning and installation. If the valve strainer is removed as part of the priming valve, remove it from the body and set it aside. Use care as the valve strainer is easily damaged.

4. Note the location of the drain hole on the diaphragm cover and then remove the eight 5/16–18 x 3/4 capscrews securing the diaphragm cover to the valve body. Remove the diaphragm cover and the diaphragm.
5. Hold pressure on the diaphragm washer to compress the valve spring then remove the diaphragm washer retaining screw. Remove the diaphragm washer and valve spring. From the opposite side of the valve body, remove the valve.
6. Clean all the components of the priming valve and mating surfaces. Inspect the valve seat and replace if worn or damaged.
7. Install the valve into the valve body from the pump side of the body.
8. Install the valve spring and diaphragm washer onto the valve. Apply Loctite® 242 to the diaphragm washer retaining screw, compress the valve spring with the diaphragm washer, and install the valve.
9. Align the diaphragm holes with the capscrew holes in the diaphragm cover. Apply Loctite® 242 to the eight 5/16–18 x 3/4 capscrews and install the diaphragm cover and diaphragm valve body. Tighten 17 lbf·ft (23 N·m).
10. Install the valve strainer and O-ring seal onto the pump side of the priming valve.
11. Apply Loctite® 242 on the two 7/16–14 priming valve mounting nuts and install the priming valve into the pump body. Tighten 40 lbf·ft (54 N·m).
12. Connect the vacuum hose to the primer.
13. Fill the pump and test the valve for proper operation and leaks.

Troubleshooting

Lack of use causes many problems for fire pumps and fire pump components.

IMPORTANT: The entire pumping system should be exercised on a regular basis, at least weekly. This routine procedure should include all discharge valves and suction valves.

Abuse of the fire pump is rarely a problem. If the pump and pump components have been abused, indications of problems may be fairly obvious. For example, bent controls are a common indicator.

Simultaneous oil and water leaks are uncommon. Normally, a water leak indicates that a line has come loose or is broken. Gaskets are used between mating surfaces *without* sealant. If a leak is present at a gasket-mating surface, whether oil or water, the components should be disassembled and repaired.

Be certain when a device indicates it is not working that it is not asimple electrical problem, such as a burned-out indicator bulb.

Troubleshooting Tables

Problem—Pump Will Not Engage

Problem—Pump Will Not Engage	
Possible Cause	**Remedy**
Parking brake not set.	Set the parking brake.
Transmission not in neutral.	Shift transmission to neutral.
Insufficient air supply.	Repeat the recommended shift procedure: Check the air pressure gauges. This procedure requires at least 100 psi (689 kPa), and shut the engine down and check for air leaks.
Pump shift or application of parking brake attempted before apparatus was stopped.	Release the braking system momentarily and repeat the recommended shift procedure.*

* This condition is known as "Butt Tooth," which occurs when the transmission shifts and the shift gear-teeth and the teeth on the drive gear do not line up and butt up against each other. The Twinflow fire pump transmission is designed with a sliding shift collar. Therefore, the occurrence of "Butt Tooth" will be rare.

Problem—Pump Will Not Shift

Problem—Pump Will Not Shift	
Possible Cause	**Remedy**
Battery voltage low.	Turn off accessories. Check the charging system of the apparatus. Inspect the batteries. If okay, recharge and try shift again.
Interface/Interlock module not receiving proper inputs.	Check the Officers Information Center output.
Transmission not receiving lock-up input.	Check output to transmission with Prolink.

Problem—Pump Will Not Prime

Problem—Pump Will Not Prime	
Possible Cause	**Remedy**
Low battery voltage.	Increase the engine speed 1000 to 1200 rpm for temporary support for electrical system requirements and primer operation.*
Worn or damaged priming system.	Perform the "Dry Vacuum Test" which follows the troubleshooting tables in this subject. If pump is tight but primer develops less than 22 inches of vacuum, the primer pump, motor, or Priming Valve may be worn or damaged.

Troubleshooting

Problem—Pump Will Not Prime	
Possible Cause	**Remedy**
Primer not operated long enough.	Operate for 30 seconds for pump up to 1250 gpm or for 45 seconds for 1500 and up gpm pump. Add 15 additional seconds if priming from front or rear suction. Do not run primer over 45 seconds. Stop and check for causes.
Suction lifts too high.	Do not attempt lifts exceeding 22 feet, except at low elevations.
Suction strainer blocked.	Check and clean.
Air pocket in suction hose or pump.	Place suction hose lower than suction intake. Slightly open a discharge valve momentarily to release trapped air.
Air leaks.	Perform the "Dry Vacuum Test" which follows the troubleshooting tables in this subject. Then shut engine off and listen for air leaks. Pressurize the discharge side of the pump with approximately 100 psi (689 kPa) from the hydrant and check for water leaks. Check connections and gaskets.

* Electric primer does not require engine speed to be increased for operation. A primer can and will draw in excess of 300 amps and primer operation can last 45 seconds.

Problem—Pump Loses Prime

Problem—Pump Loses Prime	
Possible Cause	**Remedy**
Suction lifts too high.	Do not attempt lifts exceeding 22 feet except at low elevations.
Suction strainer blocked.	Check and clean.
Air leaks.	Check all connections and gaskets. Perform the "Dry Vacuum Test" which follows the troubleshooting tables in this subject.
Pump pressure is too low when discharge appliance is opened.	Prime the pump again. Raise pump pressure higher and open the discharge appliance slowly.

Problem—Pump Primer Does Not Operate Properly

Problem—Pump Primer Does Not Operate Properly	
Possible Cause	**Remedy**
Does not operate electrically.	Check the battery, connections, primer, and primer control. Check the control switch and solenoid on the primer. If the primer has not been used recently, it could be frozen. It should, if contact is still being made internally, show heavy current draw.
Primer is slow or lower than normal.	Check batteries, wiring, and connections. A large quantity of suction hoses or suction pipes can exceed primer capabilities. Too small diameter or too long a length of piping between primer and pump can exceed primer capabilities. Lift not to exceed 20 feet (6 m) and 10 feet (3 m) for testing. The primer pump itself may be worn out.
Pulls some prime.	The primer pump could be in need of repairs or cleaning. Check for air leaks and verify that the Priming Valve is not sticking.
Pulls full prime.	Check for air leaks. Check for clogged inlet strainer and screens. Check that the suction hose is submerged in adequate water supply. Check for air pockets and air accumulation in piping. Check for turbulence in piping. The pump impeller may be damaged or severely worn.

Problem—Insufficient Capacity or Pressure

Problem—Insufficient Capacity or Pressure	
Possible Cause	**Remedy**
Insufficient engine power.	Check engine performance.
Improperly set relief valve.	Readjust the relief valve to a higher pressure setting. If the relief valve is set too low it will open to relieve pressure and reduce capacity.
Transmission in incorrect range.	Check the transmission selector for correct range recommended for pumping procedure. Check that the Fourth range lockup has occurred. If the transmission shifts while increasing engine speed, lock up has not occurred. Check engine speed or drive shaft speed for correct transmission range and inaccurate tachometer.
Air leaks.	Perform the "Dry Vacuum Test" which follows the troubleshooting tables in this subject.
Transfer valve in incorrect position.	Transfer valve must be in the "parallel or volume" setting for capacity in the "series or pressure" setting for pressure. The transfer valve indicator may be out of adjustment. At idle, shift the transfer valve back and forth. You should hear the check valves close and see a change in pressure on the Master Pressure gauge.
Tank fill valve leaking.	Repair the leak.

Problem—Engine Speed Too High for Capacity or Pressure

Problem—Engine Speed Too High for Capacity or Pressure	
Possible Cause	**Remedy**
Impeller blockage.	Check and clean. Backflushing through the discharge side of the pump may clear the obstruction. It may require disassembly of the pump.
Worn impeller or clearance rings.	Overhaul the pump. All other possibilities should be eliminated before overhauling the pump.
Suction strainer blocked.	Clean and check.
Lift too high.	Lifts over 10 feet will cause higher engine speeds and vacuum.
Transmission in incorrect range.	Check the transmission selector for correct range for recommended pumping procedure. Check that Fourth range lockup has occurred. If the transmission shifts while increasing engine speed, lockup has not occurred. Check engine speed or drive shaft speed for correct transmission range and inaccurate tachometer.
Check Valves damaged or missing.	At idle, shift the transfer valve back and forth. You should detect a change in the engine/pump sound, hear the check valves close, and see a change in the pressure on the Master Pressure gauge. If no apparent change occurs, remove the suction inlet cap and visually inspect the check valves. Insert a broom handle in the suction inlet and gently push each check valve open and let it close. Check valves should move freely.
Tank fill valve leaking.	Repair the leak.

Troubleshooting

Problem—Relief Valve Does Not Relieve When Valves are Closed

Problem—Relief Valve Does Not Relieve When Valves are Closed	
Possible Cause	**Remedy**
Incorrect pilot valve setting.	Repeat the proper procedure for setting the relief valve.
Pilot valve inoperative.	Disassemble, clean, and lubricate. Inspect the control valve diaphragm for wear or damage.
Relief valve inoperative.	Disassemble, clean, and lubricate.

Problem—Relief Valve Does Not Recover When Valves are Opened

Problem—Relief Valve Does Not Recover When Valves are Opened	
Possible Cause	**Remedy**
Dirt in system resulting in slow or sticky operation.	Disassemble, clean and lubricate.

Problem—Unable to Attain Proper Setting

Problem—Unable to Attain Proper Setting	
Possible Cause	**Remedy**
Incorrect procedure.	Check procedure and reset.
Blocked strainer.	Disconnect the pilot valve supply line from the discharge side of pump. Remove the 90-degree fitting where the supply line connects to the pump. The strainer is attached to this fitting. Clean or replace the strainer and fitting assembly.
Dirt in pilot valve.	Disassemble, clean, and lubricate.
Hunting condition.	Insufficient water supply to the pilot valve. Check strainer and supply lines. If there is dirt in the pilot valve, disassemble, clean, and lubricate.

Problem—TPM Valve Does Not Relieve

Problem—TPM Valve Does Not Relieve	
Possible Cause	**Remedy**
Sensing valve inoperative.	Disassemble, clean, and lubricate. Inspect the control valve diaphragm for wear or damage.
PG relief valve inoperative.	Disassemble, clean, and lubricate.
PG relief valve sluggish.	Check and clean the discharge and suction strainers in the pump body.

Problem—TPM Valve Does Not Recover

Problem—TPM Valve Does Not Recover	
Possible Cause	**Remedy**
Dirt in system resulting in slow or sticky operation.	Disassemble, clean, and lubricate. Check and clean the discharge and suction strainers in the pump body.

Problem—AutoLube

Problem—AutoLube	
Possible Cause	**Remedy**
External leaks.	External leaks are the result of gasket failures. Disassemble and repair.
Internal leaks.	If water is leaking, replace the diaphragm. If oil is leaking, replace the AutoLube seal and the impeller bushing. Heavy oil usage by the AutoLube or oil present in the water when the pump master drain is opened indicates that the AutoLube seal and possibly the impeller bushing is damaged.

Problem—Mechanical Seal Leaks

Problem—Mechanical Seal Leaks	
Possible Cause	**Remedy**
Leak at mechanical seal.	If the mechanical seal is leaking it will have to be replaced. If properly cared for, the mechanical seal should be almost maintenance free. Water quality will greatly affect seal life. The most common failure of the mechanical seal is from thermal-shock. That is running the pump dry, heating up the seal and then opening to a cool or cold water supply. The seal may shatter. Check the AutoLube. If the bushing is worn or missing, the impeller shaft will wobble and fracture the mechanical seal.

Problem—Pump Gear Box Does Not Function Properly

Problem—Pump Gear Box Does Not Function Properly	
Possible Cause	**Remedy**
Water in gear box.	Locate and repair the leak. Remove and clean the gear box filter. Replace the transmission oil. Water leaking onto the input drive shaft of the pump gear box will actually be screwed into the pump transmission past the oil seals. This is not a seal problem. Be certain the slinger(s) are in place. Check the pump gear box cooling line for internal fractures. Pump gear box will fill with water and overflow through breather.
Whine in gear box.	Check the oil level. If oil is low, helical gears and/or tapered bearings will whine. Check oil pressure. If the filter is clogged, oil pressure will be low. Drain oil and check for metal. Remove filter and check for metal. If metal is detected, pump gear box will have to be disassembled for complete inspection and repairs.
Knock or rattle in gear box.	Check for gears missing teeth. Check for damaged bearings. Disassemble and repair.*

* The cause may include foreign objects, low or contaminated oil, or low oil pressure. Low oil level or pressure will result in the transmission being damaged due to overheating.

Dry Vacuum Test

1. Open all the intake valves.
2. Cap all intakes, and close and uncap all discharge valves.

Troubleshooting

3. Using the pump's priming devices, develop a vacuum of at least 22 inHg (74.5 kPa) for 30 seconds for pumps up to 1250 gpm or 45 seconds for pumps 1500 gpm or greater.
4. Reduce the maximum vacuum attained by 1 inHg (3.4 kPa) for each 1,000 ft. (305 m) of elevation of the test site above 2,000 ft. (610 m).

NOTE: The vacuum should not drop more than 10 inHg (33.9 kPa) in five minutes. Do not operate the pump priming device once the five-minute test has begun.

See **Fig. 1** for the fire pump wiring diagram.

See **Fig. 2** for the fire pump controls wiring diagram.
See **Fig. 3** for a detailed view of the RH switch panel for the fire pump controls and **Fig. 4** for a detailed view of the electrical center.

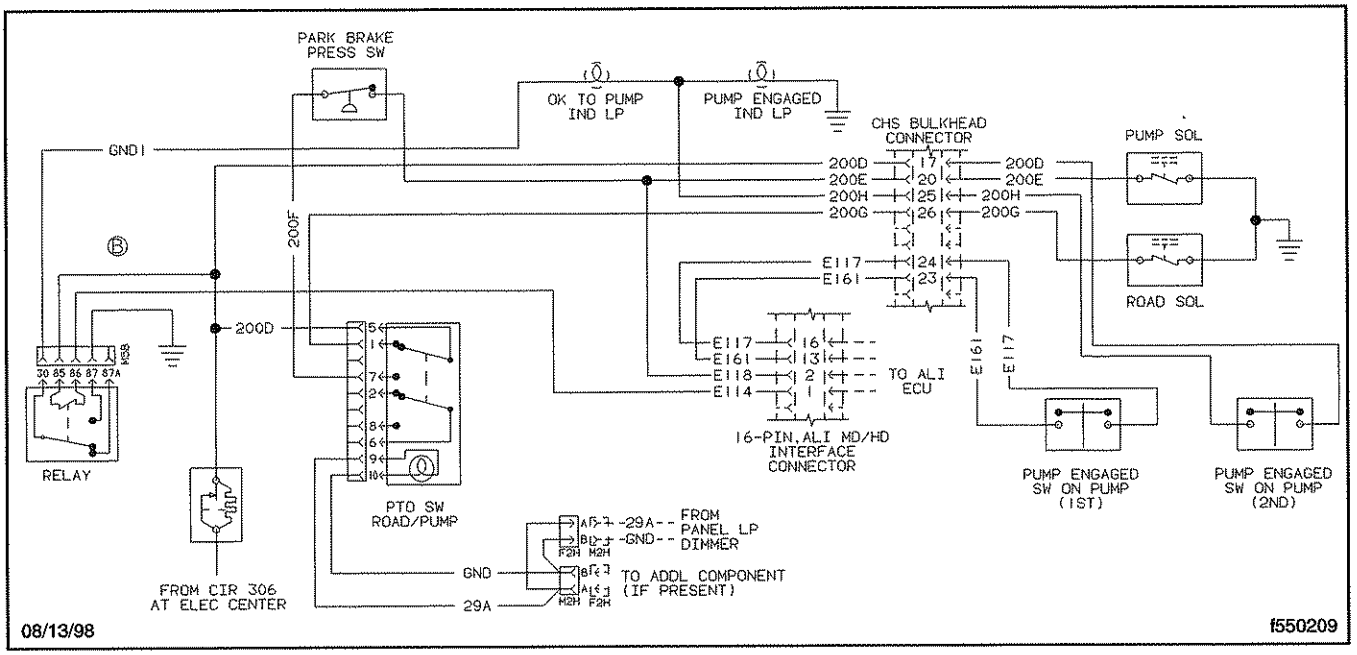


Fig. 1, Fire Pump Wiring Diagram

Specifications

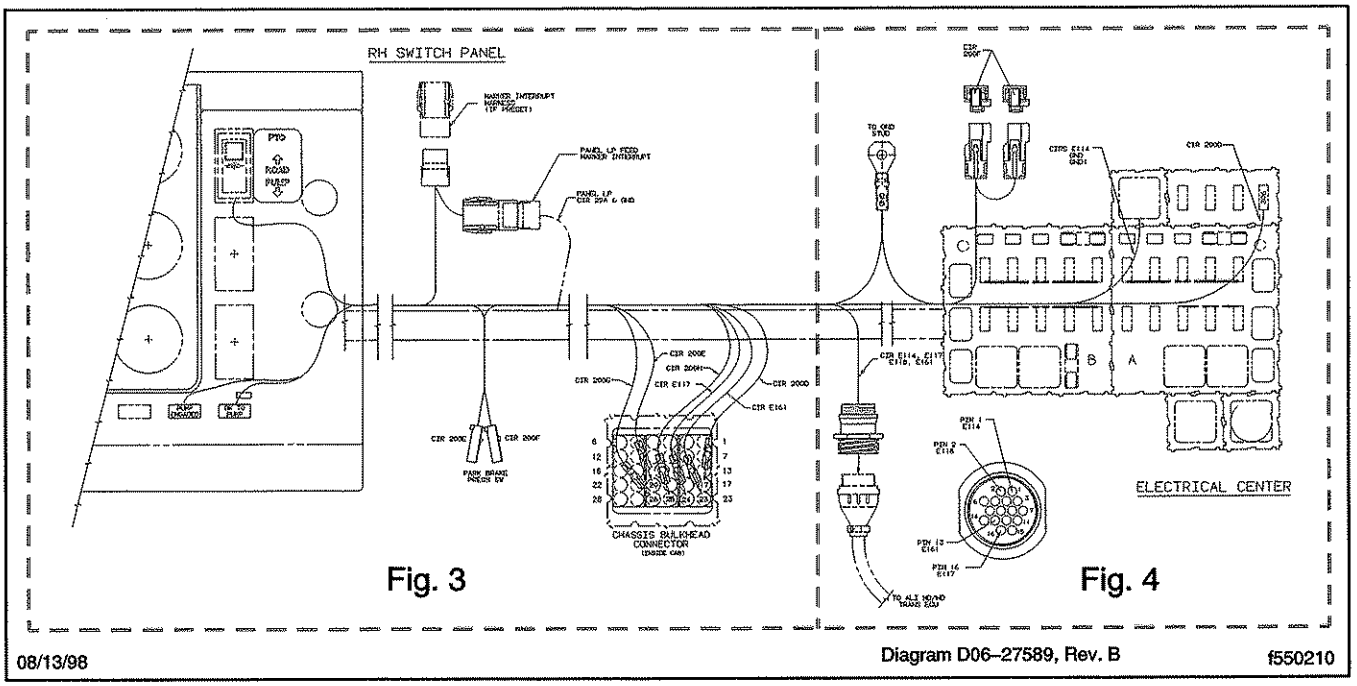


Fig. 2, Fire Pump Controls Wiring Diagram

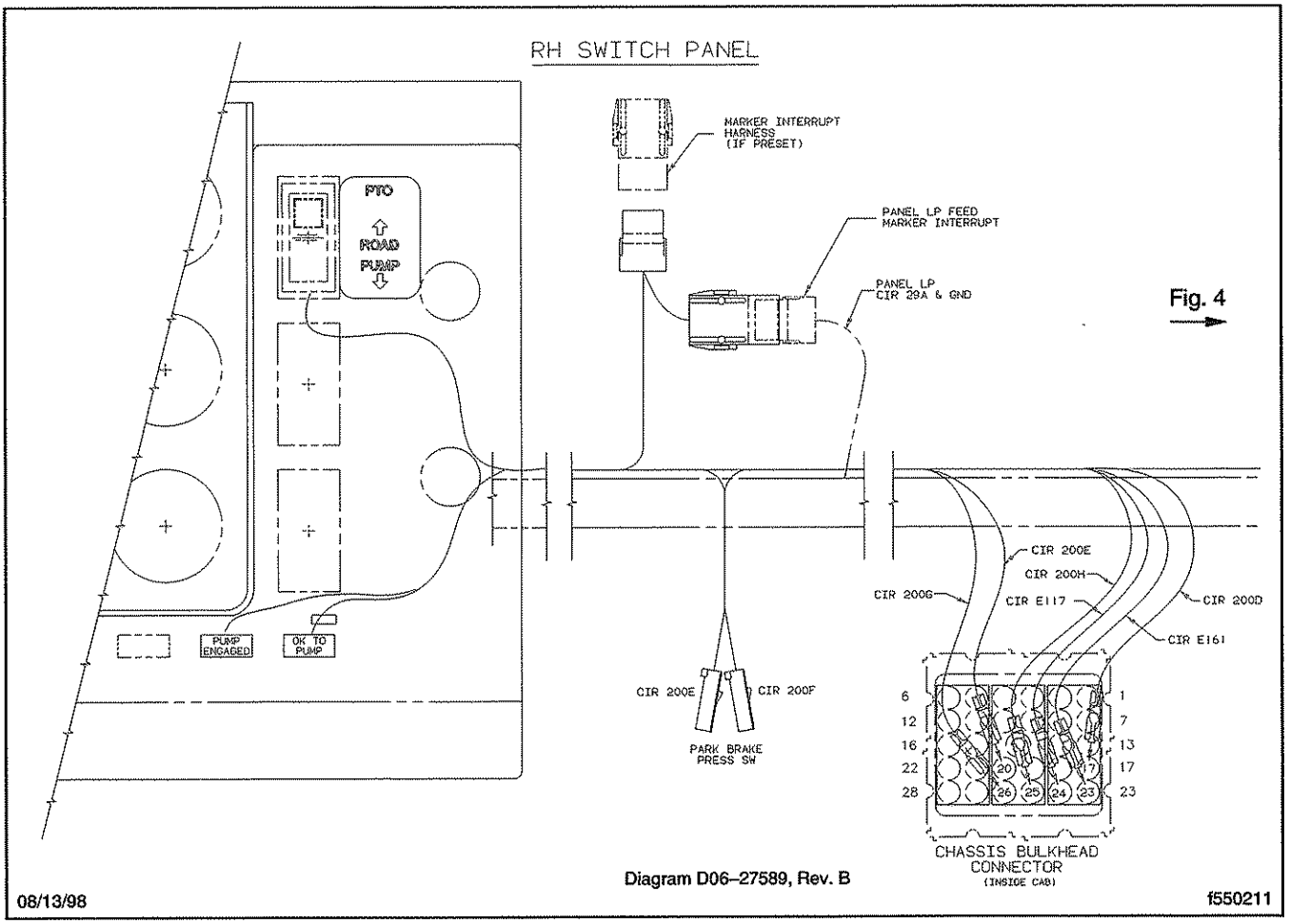


Fig. 3, Fire Pump Controls, RH Switch Panel

Specifications

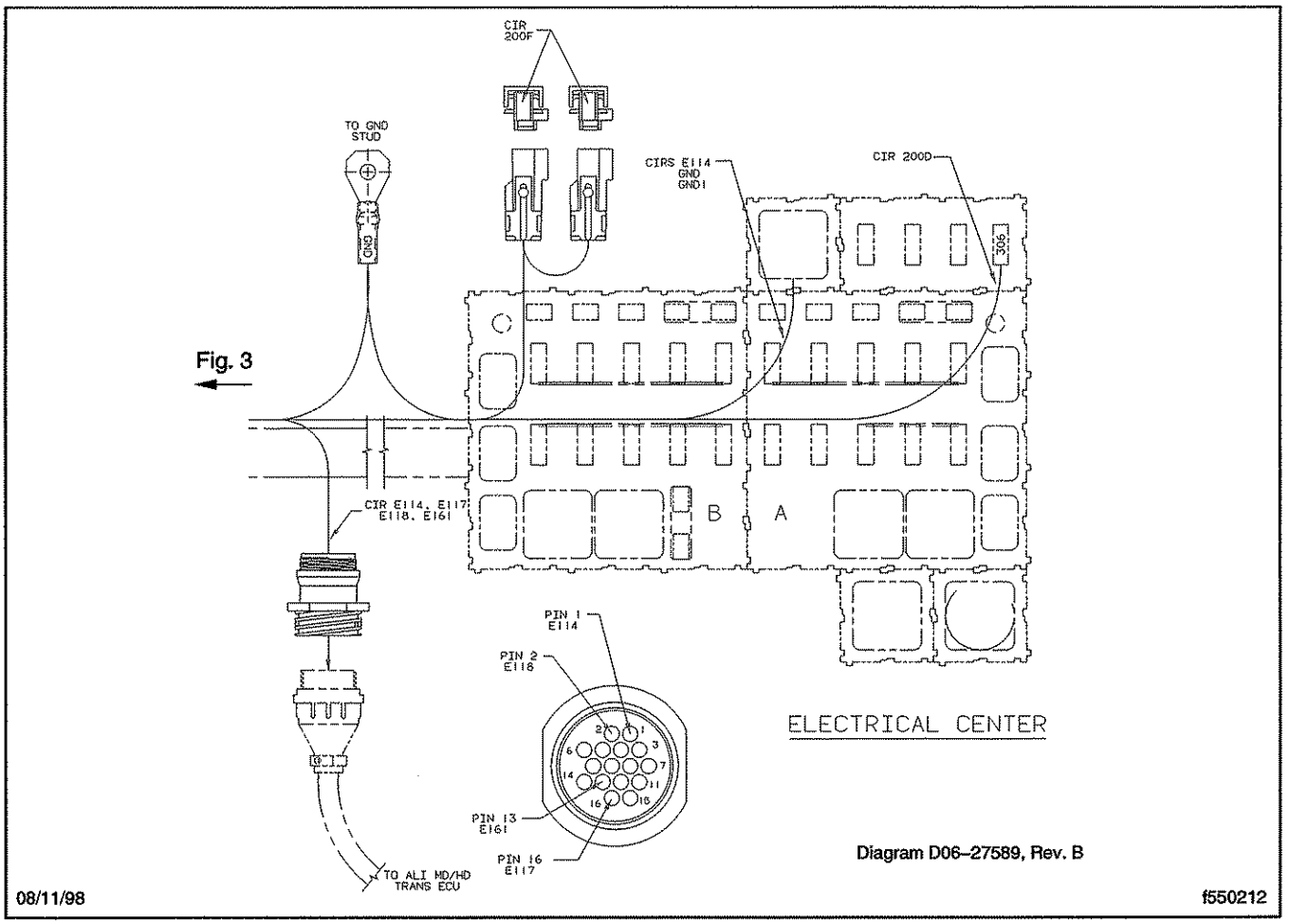


Fig. 4, Fire Pump Controls, Electrical Center