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TwinFlow Fire Pump 90.00

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TwinFlow Fire Pump 90.00

General Information

General Description

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

The TwinFlow fire pump consists of the following major components:

- · A cast-iron pump body
- A bronze impeller(s) and a stainless steel shaft
- A pump gearbox (See Fig. 2)
- · A priming system
- A 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.

Bearings support and align the impeller shaft and other components. The bearings must be maintained on a scheduled basis. See **Group 90** of the *Business Class® M2 Maintenance Manual*.

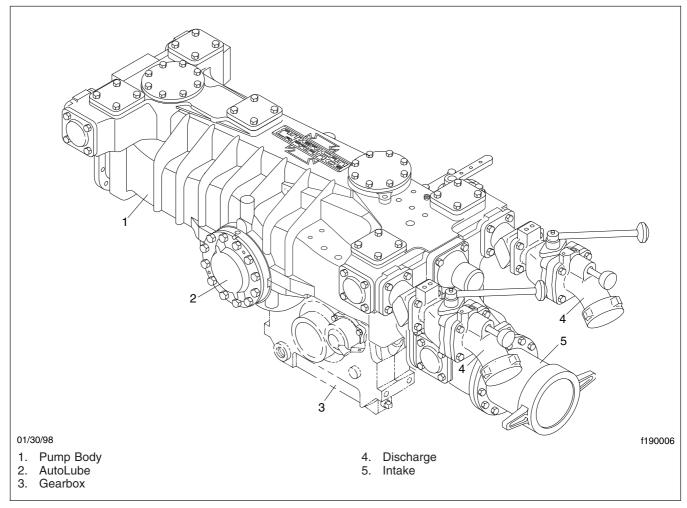


Fig. 1, American LaFrance TwinFlow Fire Pump (single-stage shown)

General Information

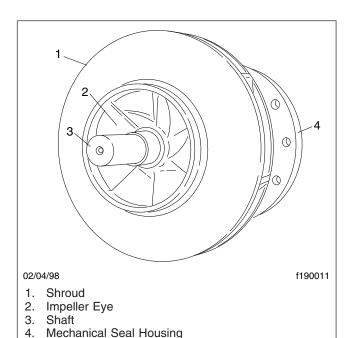


Fig. 2, Fire Pump Gearbox

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

The pump gearbox 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

TwinFlow centrifugal pumps operate on the principle of centrifugal force, created by a rapidly spinning disk, (impeller). Water is routed to the center of the impeller, which throws the water outward. 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, as well as 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.
- 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).



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. Also, 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." See Fig. 1.

- Remove the 1/2–13 x 2 capscrews that attach the AutoLube to the pump body, then gently pry the AutoLube from the pump body and impeller shaft.
- 6. Place the AutoLube face down on a workbench, then 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 lockring.
- 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 part 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 (side opposite the impeller). Install the bushing from the impeller side of the inner half of the AutoLube. See Fig. 1.

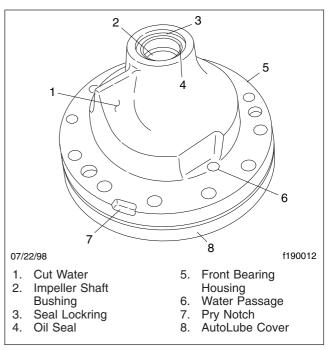


Fig. 1, Impeller Side of the AutoLube



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 a new oil seal in the inner half of the AutoLube.
- 15. Install the seal lockring.
- 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 the capscrews 30 lbf·ft (41 N·m).
- 18. Install a 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 them to 80 lbf·ft (108 N·m).

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 to the pump.

19. Fill the AutoLube with 90W oil, by pumping it in from the bottom plug opening until the oil spills from the top opening. This will eliminate air pockets and false readings.



A 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 front gear-box 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.
- Drain the gearbox lubricant to prevent contamination.
- 4. Disconnect the pressure lubrication line to the gearbox cover. Plug the pressure lubrication line.
- 5. Disconnect the driveshafts from the gearbox.
- Disconnect the electrical switches and the air lines. Mark the switches and air lines for assembly.
- 7. Disconnect the pump gearbox cooling lines.

A 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.
- 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.
- 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

- Remove and disassemble the intermediate shaft assembly. See Fig. 3.
 - 1.1 Disconnect the oil suction line from the lubrication pump.
 - 1.2 Remove the capscrews that attach the front bearing housing to the lubrication pump. Remove the housing and pump assembly.

IMPORTANT: The rear bearing housing has threaded holes for 1/4–20 jackscrews to assist in removal. Hold the intermediate gear to prevent it from falling.

- 1.3 Remove the capscrews that attach 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.

Fire Pump Gearbox Removal, Disassembly, Assembly, and Installation

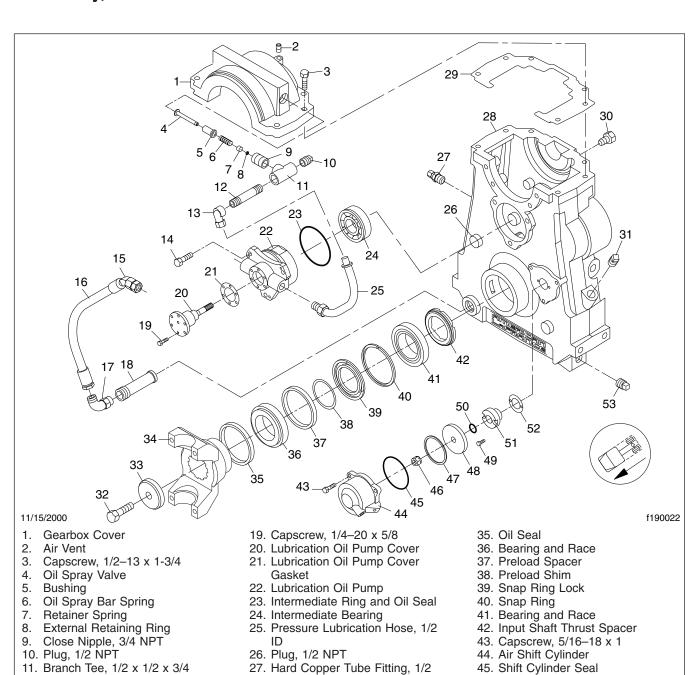


Fig. 1, Front Gearbox Assembly (exploded view)

NPT x 3/8

31. Plug, 3/4 NPT

33. Yoke Washer

34. Driveline Yoke

28. Gearbox Assembly

29. Gearbox Cover Gasket

30. Gearbox Oil Level Indicator

32. Capscrew, 3/4-10 x 1-1/2

12. Nipple, 1/2 NPT x 3-1/2

16. Oil Suction Line

14. Capscrew, 7/16-14 x 1-1/4

15. JIC 45 Elbow, 1/2 NPT x 1/2

17. JIC 90 Elbow, 1/2 NPT x 1/2

18. Gearbox Lubrication Oil Filter

13. Compression Elbow, 1/2 NPT x

46. Hex Locking Nut, 1/2-13

49. Capscrew, 1/4-20 x 1-5/8

47. Piston Seal Ring

48. Air Shift Piston

50. Vee Block Seal

51. Air Cylinder Bushing

52. Shifter Bushing Gasket

53. Magnetic Plug, 3/4 NPT

Fire Pump Gearbox Removal, Disassembly, Assembly, and Installation

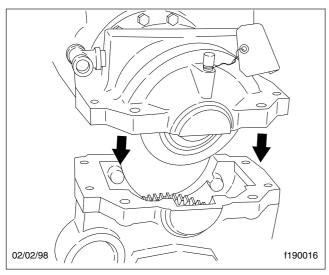


Fig. 2, Lowering the Fire Pump Gearbox

- 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.
- 1.8 Using a centerpunch, mark the lubrication pump position, then 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.
- 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 from the output shaft housing.

NOTE: Bolts may be different lengths.

- 2.4 Remove the 7/16–14 x 2-1/4 capscrews that retain the output shaft, then 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 that retains the rear driveline yoke to the output shaft, then 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).

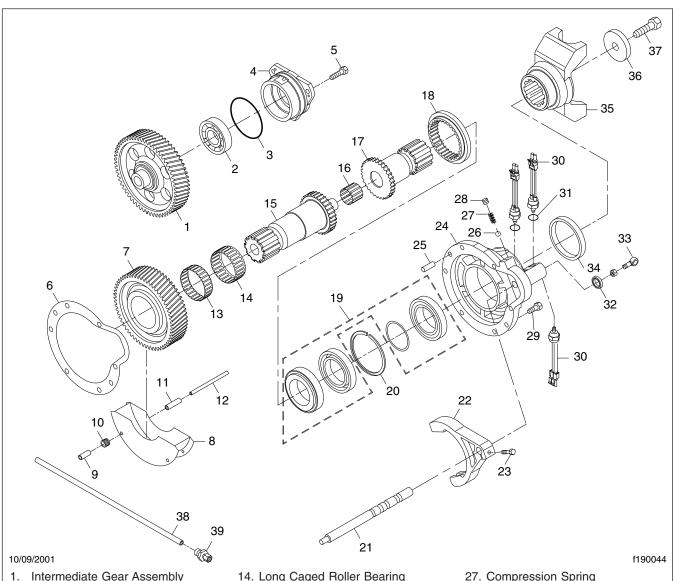


Bearing cups, cones, and spacers are factory pre-set for end play, and are only provided as a matched set. It is important that bearing cups, bearing cones, and spacers, when removed, be kept together in matched sets. Input and output shaft bearing and spacer sets are different. Failure to keep matched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

IMPORTANT: Note the orientation of the bearings before disassembly.

- 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, 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. See Fig. 3.

Fire Pump Gearbox Removal, Disassembly, Assembly, and Installation



Intermediate Shaft Bearing

Intermediate Shaft Bearing

- Cover Oil Seal Intermediate Shaft Bearing
- Cover
- 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 Dowel Pin
- 26. Gearshift Shaft Ball

- 28. Allen-Head Setscrew, HD, Self-Locking
- 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
- 38. Gearbox Cooling Tube
- 39. Cooling Tube Connector

Fig. 3, Rear Gearbox Assembly (exploded view)

Fire Pump Gearbox Removal, Disassembly, Assembly, and Installation

- 3.1 Remove the three 5/16–18 x 1 capscrews from the shift cylinder, then carefully slide the shift cylinder from the piston.
- 3.2 Remove the nut, then remove the piston from the shift shaft. Remove the seal ring from the piston.

A CAUTION

Do not remove the piston from the shift yoke shaft unless it is damaged (and replacement is mandatory). When installing a new piston, install a new locknut and snugly tighten it, 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 that attaches 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.



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 the 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. 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 oil filter from the suction inlet on the gearbox housing.
- 6. Clean and inspect each component of the gear-box 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 gearbox oil filter.
- 2. Assemble and install the input shaft assembly.

Fire Pump Gearbox Removal, Disassembly, Assembly, and Installation

A 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 the warranty and may result in gearbox failure.

- 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.

A 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 gearbox failure.

- 2.6 Coat the new drive bearings with oil, then install the bearings in the drive gear.
- 2.7 Coat the inner bearing cone with oil, and install it. Then, install the thrustwasher.
- 2.8 Reaching through the top of the transmission housing, install the drive gear in 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, 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 capscrew. Install the capscrew and washer, then tighten them to 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), then slide the new shift fork on the shift shaft. Align the shift fork with the groove in the shaft, then 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 to 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.



When installing the piston, use a new locknut and tighten snugly but do not overtighten. Over-

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Fire Pump Gearbox Removal, Disassembly, Assembly, and Installation

tightening 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, then 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 them to 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.



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 the warranty and may result in gearbox 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, 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, 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. Install the capscrew and washer, then tighten to 225 lbf·ft (305 N·m).
- 3.10 Install a new gasket on 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. Install the output shaft and housing, sliding the housing onto the shift yoke shaft. Install the capscrews, then 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 Allenhead 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.
- 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.



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.

Fire Pump Gearbox Removal, Disassembly, Assembly, and Installation

- 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 them to 96 lbf in (1085 N·cm).
- 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 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 to 53 lbf·ft (72 N·m)
- Connect the oil suction line to the lubrica-4.8 tion pump.
- Rotate the input shaft and manually shift 4.9 the transmission to check for proper movement and operation.

Installation

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.

- 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 driveshafts. 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
- 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

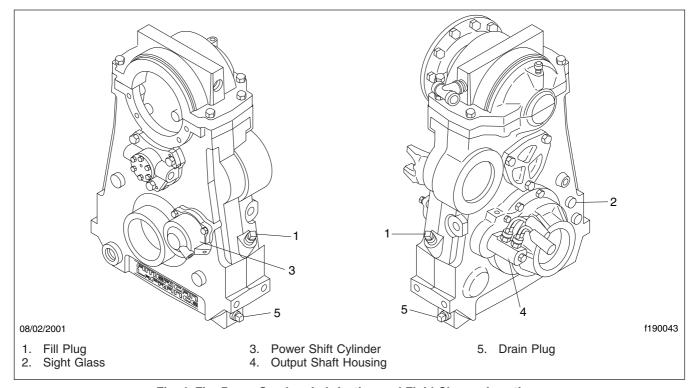


Fig. 4, Fire Pump Gearbox Lubrication and Fluid Change Locations

Mechanical Seal Replacement

Replacement

- 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.



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.

- Remove the gearbox. See Subject 110 for instructions.
- 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. 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.
- 7. Install two 1/2–13 x 3 jackscrews into the 1/2–13 threaded holes provided in the rear bearing housing. See **Fig. 1**, Ref. 15.
- 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 American LaFrance mechanical seal assembly.



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.
- 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, then slide them over the end of the impeller shaft. Make sure the mechanical seal remains seated in the bore of the cover.

Mechanical Seal Replacement

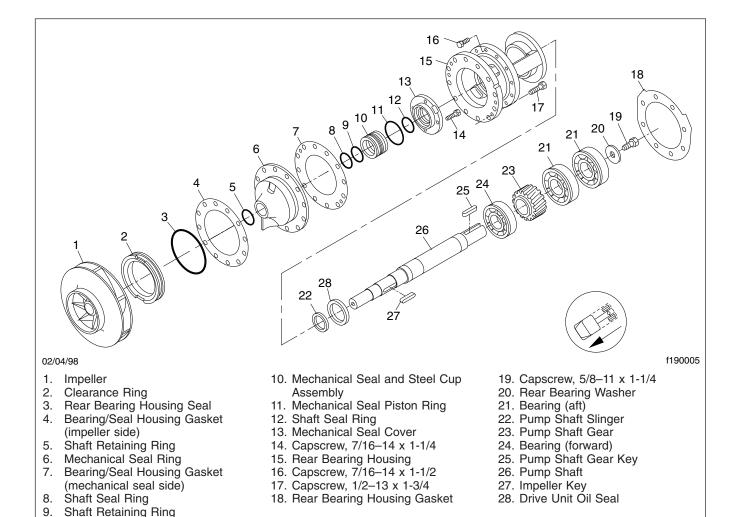


Fig. 1, Impeller Shaft Assembly (exploded view)

- 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 them to 53 lbf·ft (72 N·m).
- 24. Install the new slinger on the impeller shaft. Remove the retaining bolts.
- 25. Install the new gasket and oil seal in the rear bearing housing. Slide the housing and front

- bearing on the rear impeller shaft. The bearing is a press-fit on 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 on the shaft. The 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.

Mechanical Seal Replacement

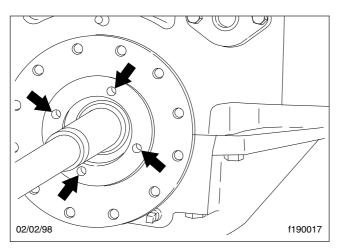


Fig. 2, Remove Four Capscrews

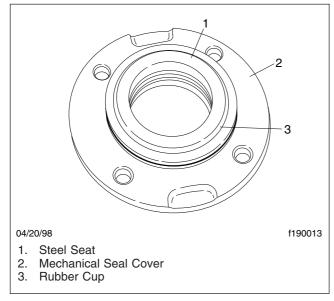


Fig. 3, Mechanical Seal Assembly

- 28. Slide one of the two rear bearings onto the impeller shaft and into the housing. The rear bearings are a press-fit on the shaft and a slip-fit in the housing.
- 29. Using a series of different length capscrews, attach 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 it to 80 lbf-ft (108 N·m).
- 33. Apply Loctite® 242 to the twelve 1/2–13 x 1-3/4 capscrews. Install, and tighten them to 80 lbf·ft (108 N·m).
- Install the gearbox. See Subject 110 for instructions.
- 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

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



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.

- Remove the gearbox. See Subject 110 for instructions.
- 4. Remove the drain lines from the lower pump body.
- 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.

A 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.

- 8. Position the lifting device 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.
- 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.



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, 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 "build up" material so that the new clearance ring will seat properly.

NOTE: Pitting of the clearance rings may occur from the "build up" 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 on the lower pump body, trimming as necessary to fit.



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.

 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.

Impeller Assembly Removal and Installation

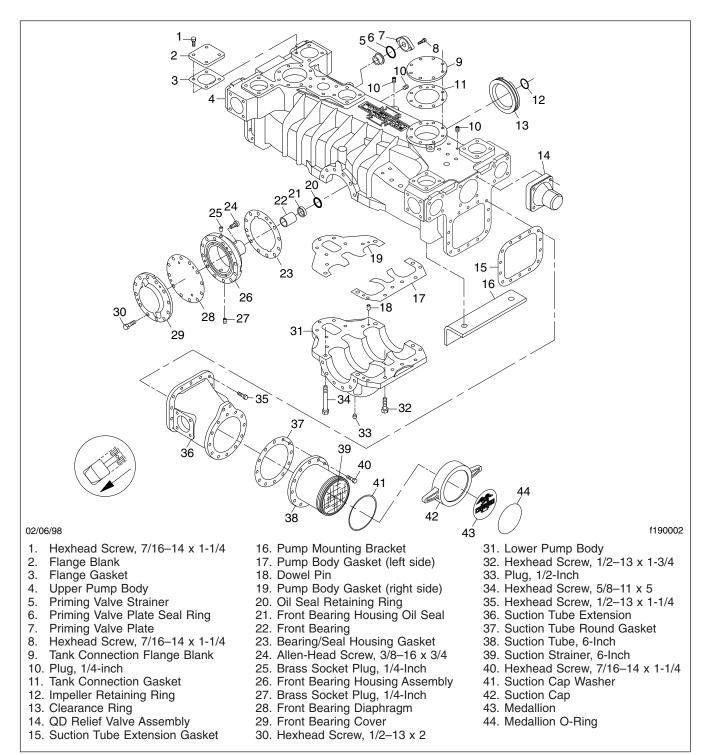


Fig. 1, Fire Pump Body Assembly (exploded view)

Impeller Assembly Removal and Installation

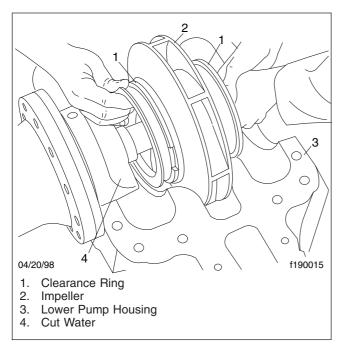


Fig. 2, Lifting the Impeller Assembly from the Lower Pump Housing

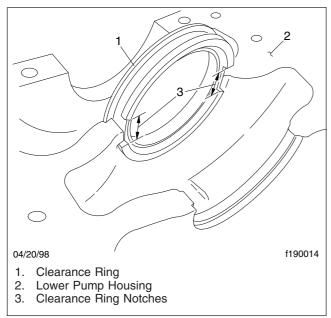


Fig. 3, Clearance Ring Mounted in Pump Housing

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 that 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 them to 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).
- 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.

Impeller Shaft Disassembly and Assembly

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.
- Remove the AutoLube. See Subject 100 for instructions.
- Remove the fire pump gearbox. See Subject 110 for instructions.
- 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.



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



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.
- 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.
- Allow the components to cool to room temperature.
- 11. Remove the inner clearance ring.
- 12. Remove the key.
- 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.
- Check the waterway in the mechanical seal housing for restrictions.
- 3. Install the mechanical seal housing on 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.



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

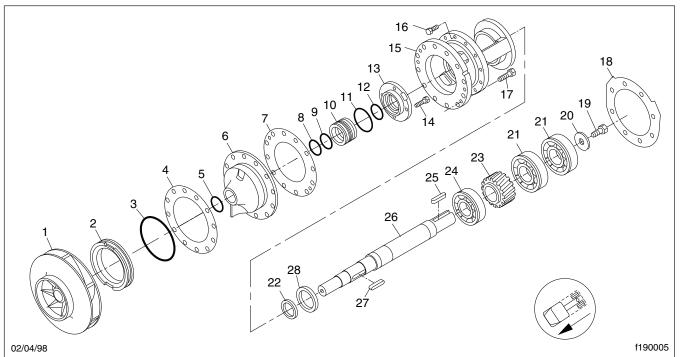
7. Install the inner clearance ring.

A WARNING

Wear protective, heat-resistant gloves while heating the impeller to install it on 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.
- Install the impeller assembly. See Subject 130 for instructions.
- 11. Install the outer clearance ring.
- 12. Install the impeller shaft assembly.
- Install the fire pump gear box. See Subject 110 for instructions.
- Install the AutoLube. See Subject 100 for instructions.
- 15. Remove the chocks from the front and rear tires.

Impeller Shaft Disassembly and Assembly



- 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

- 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)

Two-Stage Pump

Disassembly

- Park the vehicle on a level surface. Shut down the engine. Set the parking brake and chock the front and rear tires.
- Remove the AutoLube. See Subject 100 for instructions.
- Remove the fire pump gear box. See Subject 110 for instructions.
- 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, then remove the mechanical seal housing.



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

Impeller Shaft Disassembly and Assembly



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.

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.
- Remove the mechanical seal housing, 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

- Clean the impeller shaft, the keyway, 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.



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 on 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 on the shaft. If an impeller does not fully slide on the shaft, allow the assembly to cool to room temperature before reheating.
- 7. Install the outer retaining ring.
- 8. Install the outer clearance ring.
- Install the impeller assembly. See Subject 130 for instructions.
- Install the mechanical seal housing on the impeller shaft.
- 11. Install the impeller shaft assembly.
- 12. Install the fire pump gearbox. See **Subject 110** for instructions.
- Install the AutoLube. See Subject 100 for instructions.
- 14. Remove the chocks from the front and rear tires.

TwinFlow Fire Pump 90.00

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 that attach the adjustment handwheel to the adjustment shaft. Then, remove the handwheel.



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 that attach 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 that secure the control body to the rear of the spring housing. Then, remove the control body.



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, then separate them
- Clean all the pilot valve components. Inspect and lubricate with grease the threads on the adjustment shaft.
- 8. Assemble the pilot valve.

A 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.



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, then install the assembly in the spring housing. Align the 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.

- 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 that attach the control body to the rear of the spring housing.
- 9. Holding the pilot valve, align the cover plate, then install the four 1/4–20 x 5/8 machine screws that attach the pilot valve and cover plate to the Pump Operator's Panel.
- Attach the pump discharge pressure line and relief valve line to the control body of the pilot valve.
- Slide the adjustment handwheel on the adjustment shaft, then install the retaining capscrew and nut.
- 12. Fill the pump, then test the valve for proper operation and leaks.

Transfer Valve

NOTE: For an exploded view of the trasfer valve, see **Fig. 1**.

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.

- Turn the adjustment handwheel clockwise until it stops. The transfer indicator should be at the top of the slotted guide in the cover plate.
- Remove the two Allen-head setscrews from the transfer indicator guide. Slide the transfer indica-

- tor 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.
- Remove the four 7/16–14 x 1-1/4 capscrews that retain 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, and the mating surfaces of the transfer valve drum and sleeve. Clean and inspect the transfer bracket bushings, and the 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 in 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 in the transfer drum stem. Install the transfer drum gear

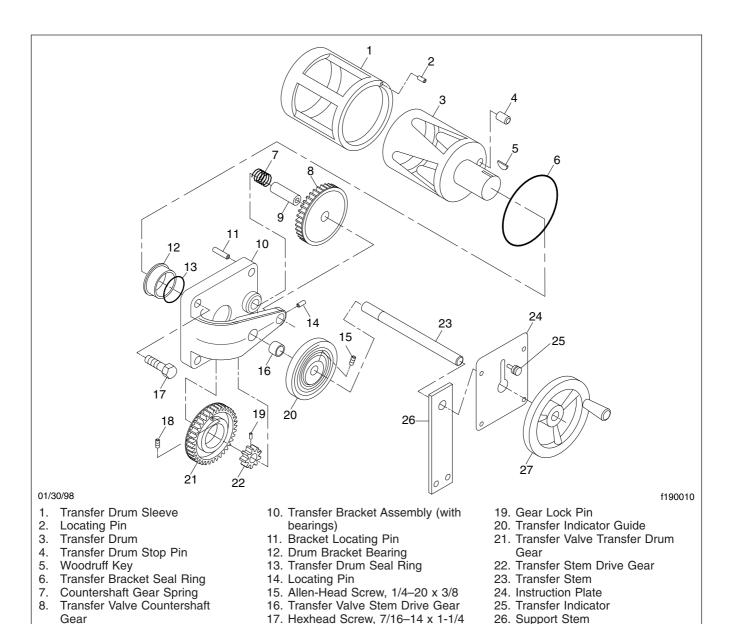


Fig. 1, Transfer Valve (exploded view)

18. Sockethead Setscrew, #10-32 x

1/2

on the transfer drum stem. Apply Loctite® 242 to the Allen-head setscrew, then install the transfer drum gear.

7.5 Assemble the countershaft gear spring in the countershaft gear, and position the assembly in the transfer bracket. Then

install the countershaft and the countershaft locating pin to lock the countershaft in place.

27. Adjusting Wheel Assembly

8. Install the transfer valve.

Transfer Countershaft

- 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. 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 in the transfer bracket, 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 setscrews. Install, but do not tighten them.
- 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 setscrew in the transfer indicator guide, and recheck the movement of the transfer indicator.
- Fill the pump, then 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-topump valve.

 Disconnect both ends of the flexible hose that connects 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 vehicles 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 that retain 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. 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 the capscrews to 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.
- Attach the tank-to-pump valve controls and linkage.
- 14. Fill the pump, then test the valve for proper operation and leaks.

Valve Removal, Disassembly, Assembly, and Installation

Sensing Valve

- 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
- Remove the 7/16–14 x 2 sensing valve mounting capscrew.
- 3. Remove the four 5/16–18 x 1 capscrews that attach 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.
- Unscrew the sensing valve from the diaphragm, being careful not to damage the control valve. Remove the diaphragm.
- Before installing the sensing valve, clean all components.

A 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 242 to the threads on the control valve, then install the control valve in the sensing valve body.
- Install the sensing valve spring in the valve body cover.
- Apply Loctite® 242 to the four 5/16–18 x 1 capscrews, then 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.
- Fill the pump, then test the valve for proper operation and leaks.

TPM Relief Valve

- 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 that attach the relief valve assembly to the pump body.
- Using a twisting motion, remove the relief valve assembly.
- 5. To disassemble the valve, remove the indicator light switch, remove the cover retaining ring then slide the cover out of the relief valve body.
- 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.
- Clean all sealing surfaces and install new O-rings seals.
- 11. Install the relief valve in the relief valve body.
- 12. Install the piston spring by sliding the piston in the relief valve body while at the same time sliding the piston on the relief valve stem.
- 13. Apply light pressure to the piston to compress the piston spring, then install the piston retaining ring.
- 14. Slide the cover into the relief valve body. Then install the cover retaining ring.
- 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 242 to the jamnut and tighten it.

- 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, then install the assembly in the pump body. Tighten the capscrews to 53 lbf·ft (72 N·m).
- 18. Connect the indicator light switch.
- Fill the pump, then test the valve for proper operation and leaks.

QD Relief Valve

NOTE: For an exploded view of the QD relief valve, see **Fig. 2**.

- Drain the pump.
- 2. Note the location of the wires, then disconnect the indicator light switch.
- 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 that attach the relief valve indicator light switch and the mounting bracket assembly to the relief valve cover. Remove the light switch and the bracket.
- Compress the relief valve return spring (by hand), and remove the E-clip and washer. Then, remove the return spring.
- Remove the two remaining 7/16–14 x 1-1/4 capscrews that retain the relief valve cover to the pump body. Using a twisting motion, carefully remove the relief valve cover.

A 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 that secures the relief valve piston to the relief valve. Gently push the relief valve into the pump body approximately 1 inch (25 mm), then pull it back out in a snapmotion. 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).

- Clean and inspect all of the relief valve assembly components.
- 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 on 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.
- 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 them opposite of each other. Tighten, but do not torque them
- 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 7/16–14 x 1-1/4 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.
- Fill the pump, then test the valve for proper operation and leaks.

TPM Dump Valve

- 1. Drain the pump.
- 2. Disconnect the indicator light switch.

Valve Removal, Disassembly, Assembly, and Installation

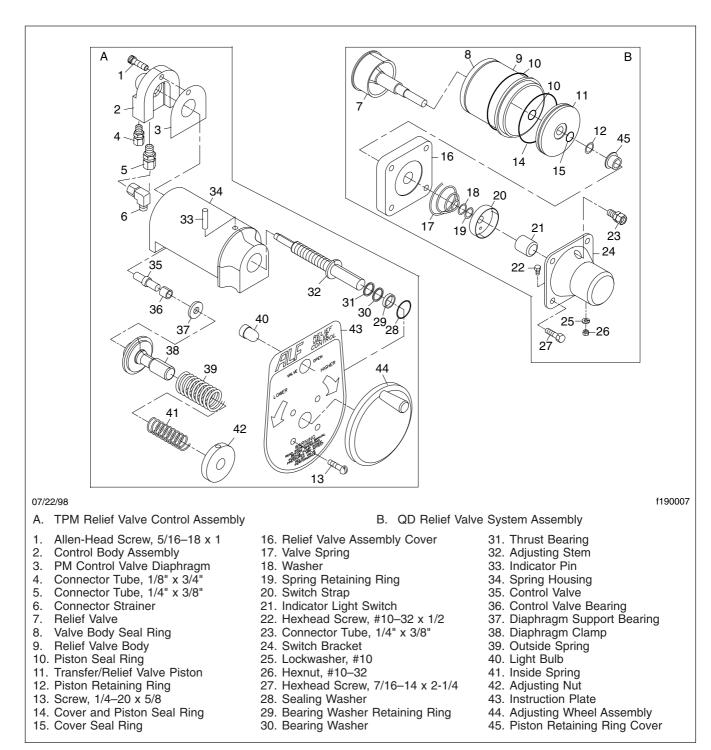


Fig. 2, TPM and QD Relief Valve (exploded view)

3. Disconnect the line to the sensing valve.

Valve Removal, Disassembly, Assembly, and Installation

- 4. Remove one 7/16–14 x 2 sensing valve mounting capscrew.
- 5. Remove the four 7/16–14 x 1-3/4 capscrews that retain the relief valve assembly to the atmosphere dump.
- 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.
- Remove the four 7/16–14 x 1-3/4 capscrews that retain the relief valve cover to the relief valve body.
- 9. Remove the indicator light switch assembly.
- 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 remove it.
- 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.
- Before assembling and installing the valve, clean and inspect all components of the relief valve assembly.
- Clean all sealing gasket surfaces and install new O-rings and gaskets.
- 17. Install the relief valve in 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, then install the cover on 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 that were 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 and the relief valve on the pump surface.
- 25. Apply Loctite® 242 to the four 7/16–14 x 1-1/2 capscrews, then install the new gasket and relief valve assembly on 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 the capscrews 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.
- Fill the pump, then 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.
- Remove the check valve.
- 4. Clean the gasket surfaces, and inspect the check valve pivots and pivot sockets.
- Install the check valve.
- 6. Install the new gasket in the pump body.
- Apply Loctite® to the four capscrews, then 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 the capscrews to 53 lbf·ft (75 N·m).
- 8. Fill the pump, then test the valve for proper operation and leaks.

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Valve Removal, Disassembly, Assembly, and Installation

SPV Priming Valve

- 1. Drain the pump.
- 2. Disconnect the 3/4-inch (19-mm) vacuum hose that connects the priming valve to the primer.
- 3. Remove two 7/16–14 nuts that attach 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, then remove the eight 5/16–18 x 3/4 capscrews that secure the diaphragm cover to the valve body. Remove the diaphragm cover and the diaphragm.
- 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.
- Install the valve into the valve body from the pump side of the body.
- Install the valve spring and diaphragm washer on the valve. Apply Loctite® 242 to the diaphragm washer retaining screw, compress the valve spring with the diaphragm washer, and install the valve.
- 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 the capscrews 17 lbf·ft (23 N·m).
- 10. Install the valve strainer and O-ring seal on 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 the mounting nuts 40 lbf·ft (54 N·m).
- 12. Connect the vacuum hose to the primer.
- 13. Fill the pump, then test the valve for proper operation and leaks.

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Troubleshooting

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, or, 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 a simple 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). 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 American LaFrance 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 batteries, 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. | |

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Troubleshooting

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 or 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, lock up has not occurred. Check engine speed or driveshaft 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 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. |

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Troubleshooting

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 (running the pump dry, heating up the seal, 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

Cap all intakes. Close and uncap all discharge valves

1. Open all the intake valves.

Troubleshooting

- 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 1000 ft. (305 m) of elevation of the test site above 2000 ft (610 m).

NOTE: The vacuum should not drop more than 10 inHg (33.9 kPa) in 5 minutes. Do not operate the pump priming device once the five-minute test has begun.

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Specifications

See **Table 1** for TwinFlow fire pump input and output shaft run-out specifications.

| TwinFlow Fire Pump Input and Output Shaft Run-Out | | |
|---|-----------------------------|--|
| Description Allowable Range: inch (n | | |
| Radial Run-Out | 0.002-0.004 (0.0508-0.0102) | |
| Axial Run-Out | 0.000-0.020 (0.000-0.508) | |

Table 1, TwinFlow Fire Pump Input and Output Shaft Run-Out

90.01

PowerFlow Fire Pump

Contents

| Subject | Subject Number |
|--|------------------------|
| General Information | |
| Service Operations | |
| Fire Pump Gearbox Removal, Disassembly, Assen | nbly, and Installation |
| Mechanical Seal Replacement | |
| Impeller and Clearance Ring Removal and Installa | tion |
| Air Shift Cylinder Overhaul | |
| Troubleshooting | 300 |

90.01

General Information

General Description

The American LaFrance midship-mounted Power-Flow fire pump (see **Fig. 1**) is a high-speed, single-stage, centrifugal pumping system designed to deliver large volumes of water under pressure.

The pump consists of the following major components:

- · A cast-iron pump body
- · A bronze impeller and a stainless steel shaft
- A pump gearbox
- · A priming system
- · A pressure-control device
- Valves
- Mechanical Seal

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.

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

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.

Principles of Operation

The American LaFrance PowerFlow pump operates on the principle of centrifugal force. Water is routed to the center of the impeller, which throws the water outward from its center. Because the water is confined in a closed container, in this instance, the pump body, the shrouds, and the vane of the impeller, the water pressure increases. The pressure level depends on how fast the impeller is rotating.

Water entering the pump intake is routed to the center of the rapidly spinning impeller, which is confined by the shrouds and vanes in the impeller, which builds pressure. The vanes guide the water away from the inlet to the discharge manifold to reduce the water's turbulence.

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

General Information

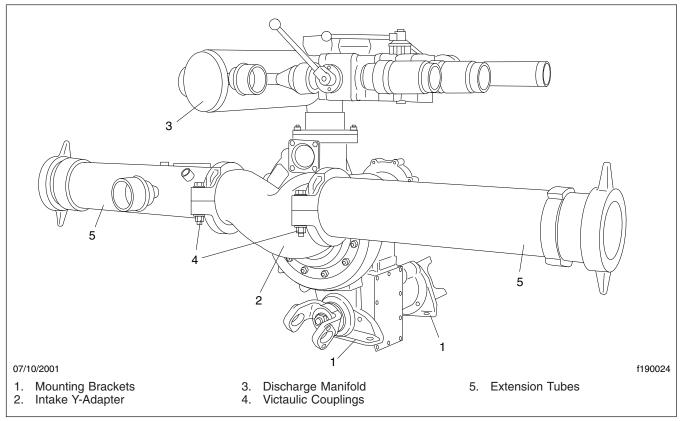


Fig. 1, American LaFrance PowerFlow Fire Pump

Removal



Many of the components on the fire pump are heavy and awkward to handle. Always use the proper support equipment during removal and installation of the fire pump. Failure to do so could result in an assembly falling, which could result in personal injury or property damage.

NOTE: Due to the design of the PowerFlow fire pump, with the pump being supported by mounts located on the gearbox, the entire pump will have to be removed for complete gearbox disassembly and assembly. If repairs are only being made on the input/output shaft assembly, the pump and gearbox can be disassembled in the vehicle through the access cover on the side of the gearbox.

For a cross-section view of the gearbox, see Fig. 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.
- Drain the gearbox lubricant to prevent contamination.

NOTE: Also check for water.

- 4. Disconnect the driveshafts from the gearbox.
- 5. Disconnect the air lines to the shift cylinder.
- 6. Label and disconnect the electrical switches from the pump.
- 7. Disconnect the pump master drain.
- Disconnect the intake Y-adapter. Remove the eight 3/8–24 nuts that secure the intake Y-adapter to the suction head. See Fig. 2. Lay the Y-adapter aside.
- 9. Unbolt the discharge manifold from the top of the pump housing.
- 10. Remove both gearbox cooler lines.
- 11. Remove all eight bolts from the cooler, noting the different lengths, and remove the gearbox cooler.
- 12. Place a supporting device under the pump gearbox and secure the pump to it.

- 13. Remove the front and rear mounting bolts.
- 14. Due to the application and design of the pump mounting system, one or both crossmember supports for the pump may have to be removed. Remove one or both as needed.
- 15. Lower the pump, then move it to a work area.

Disassembly

Disassemble the pump body (suction head, impeller, and seal). See Subject 120.

IMPORTANT: Once the three bolts that attach the volute housing to the gearbox have been removed, the volute housing is free and must be secured to prevent it from falling and being damaged.

- Secure the pump gearbox to prevent the gearbox from shifting position, then remove the three 3/4–10 x 2 bolts that attach the volute housing to the pump gearbox. Separate the volute housing from the pump gearbox. Remove and discard the mechanical seal. Set it aside.
- 3. Remove the air shift cylinder and set it aside. See **Subject 130**.
- 4. Remove the shift switches and switch bracket from the input shaft bearing cover.
- 5. Remove both retaining rings from the front of the shift rod. See **Fig. 3**.
- Remove all eight Allen-head bolts that secure the output shaft housing to the pump gearbox housing. Carefully separate the output shaft housing from the pump gearbox housing, taking care not to drop or damage the pilot bearing or the sliding shift gear.
- 7. Remove the locknut that secures the yoke to the output shaft then, remove the yoke. Remove the four 3/8–16 x 1-3/4 bolts that attach the rear bearing cover to the output shaft housing. Remove and set aside the cover. From the rear, press out the output shaft. Remove the bearings and bearing retaining ring. See **Fig. 4**.

NOTE: The shift rod will slide out of the gearbox rearward as the output shaft housing is separated. See **Fig. 5**.

8. Remove shift shaft O-ring from case.

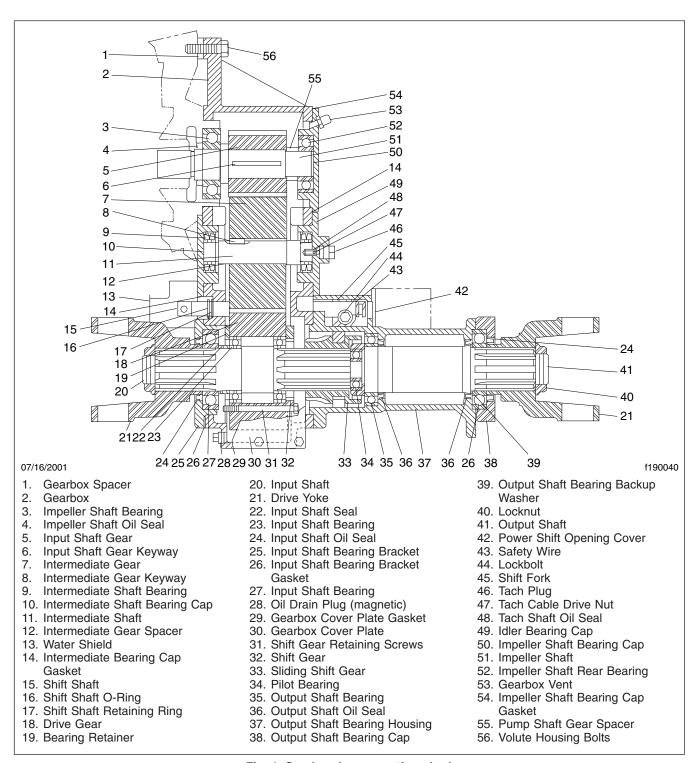


Fig. 1, Gearbox (cross-section view)

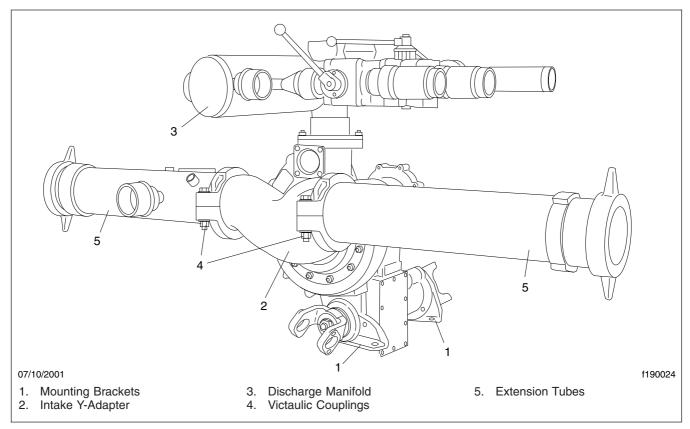


Fig. 2, American LaFrance PowerFlow Fire Pump

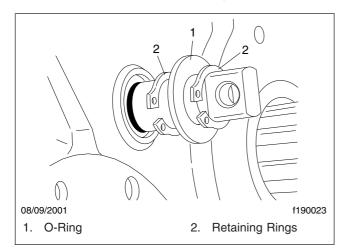


Fig. 3, Pump Gearbox Shift Rod

9. Remove the shift rod, fork, and sliding shift gear from the gearbox.

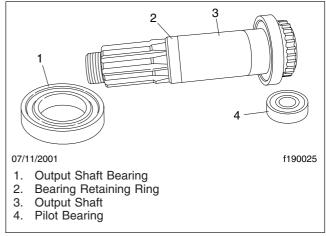


Fig. 4, Output Shaft

10. Remove the ten 5/16–18 x 1-3/4 bolts that secure the side cover to the gearbox. Remove the side cover and gasket. Discard the gasket.

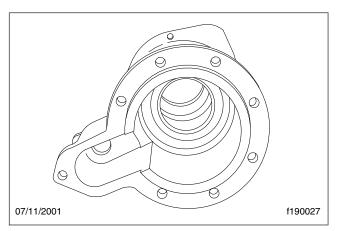


Fig. 5, Output Shaft Housing (rear view)

- 11. Remove the locknut and yoke from the input shaft, and discard the locknut.
- 12. Through the rear opening in the pump gearbox (see Fig. 6), remove all six bolts that attach the shift gear to the main drive gear. Slide the input shaft off the main drive gear and remove it through the front of the pump gearbox. Remove the bearings and spacer from the input shaft. Through the side opening in the pump gearbox, remove the shift gear, shift gear bolts, main drive gear, and bearing retainer. See Fig. 7.
- 13. Remove the four bolts that secure the input shaft bearing cover to the gearbox. Install two jack bolts in the appropriate holes and remove the input shaft bearing cover.
- 14. Remove the four 3/8–16 x 1 bolts that secure the impeller shaft bearing cap to the pump gearbox. Insert jack bolts into the appropriate holes and remove the bearing cover.

NOTE: Take note of the locations of the different sizes of spacers on the impeller shaft.

- 15. Press the impeller shaft out of the pump gearbox from the front to the rear. Take care not to damage the seal area. See Fig. 8.
- 16. Press the rear bearing from the impeller shaft.
- 17. Press the impeller shaft out of the impeller gear from the rear to the front. Remove the key and the spacer.
- 18. Remove all four bolts from the rear intermediate shaft bearing cover. Insert jack bolts in the appropriate holes and remove the cover. Repeat

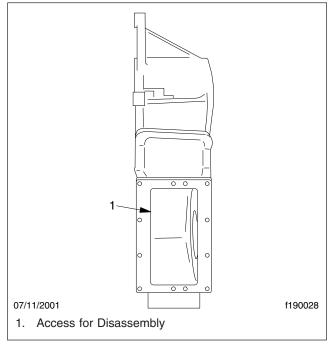


Fig. 6, Gearbox Side Access

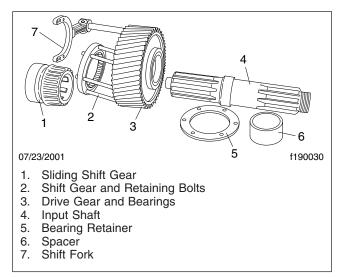


Fig. 7, Input Shaft and Related Components

the procedure to remove the front intermediate shaft bearing cover. See Fig. 9.

 Remove the spacer from the front of the intermediate shaft. Press the intermediate shaft out of the intermediate gear from the front to the rear. See Fig. 10.

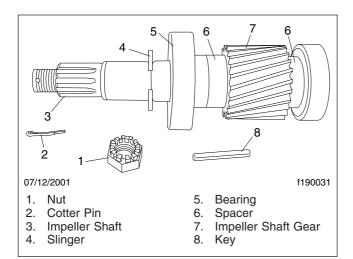


Fig. 8, Impeller Shaft and Related Components

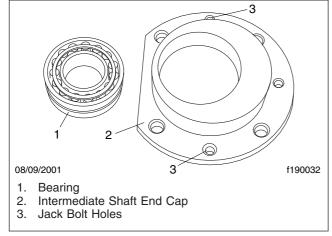


Fig. 9, Intermediate Shaft Bearing Cover

NOTE: The intermediate gear is a tight pressed fit and is keyed to the shaft.

- 20. Press the front bearing off of the impeller shaft towards the seal area.
- 21. Clean all components, seal areas, and gasket surfaces. Check for wear or damage.

Assembly

NOTE: When rebuilding the gearbox, replace all seals, bearings, and gaskets. Care must be taken, as most of the components of the gearbox use O-ring type seals (not gaskets) that can

be easily damaged. Petroleum jelly can be used as a lubricant to ease the assembly process. Gasket cements or glues are not required.

- Install the intermediate shaft. Place the intermediate gear in position. Install the key in the intermediate shaft and slide the intermediate shaft through the gear from the front of the gearbox. Install the spacer. Install the front bearing cover and tighten the bolts to 28 lbf·ft (38 N·m). Install the rear bearing cover and tighten the bolts. Check the intermediate shaft assembly for ease of rotation.
- 2. Install the main drive gear through the opening in the side of the gearbox. Install the drive gear bearings on the input shaft and slide the input shaft through the main drive gear from the rear to the front. Attach the bearing retainer and shift gear to the main drive gear and tighten the bolts. Slide the spacer on the input shaft from the front of the gearbox.
- 3. Install the front bearing retainer and tighten the bolts to 28 lbf·ft (38 N·m).
- 4. Install the input shaft yoke and tighten the new locknut 200 lbf·ft (271 N·m).
- 5. Install shift shaft O-ring into case.
- Install the shift rod, shift fork, and sliding shift gear from the rear of the gearbox. See Fig. 11.
- Install the retaining rings. Install the shift indicator switches.

NOTE: The output housing Allen-head attaching bolts are two different lengths. Be sure to install the short bolt in the correct location.

- 8. Install the output housing assembly. Slide the output housing assembly over the input shaft, being careful not to damage the pilot bearing. Install the attaching bolts and tighten them to 28 lbf-ft (38 N·m).
- 9. Install the air shift cylinder and tighten the bolts to 10 lbf-ft (13 N·m).
- Install the rear bearing cover and bearing for the impeller shaft. Tighten the bolts to 28 lbf·ft (38 N·m).
- 11. Install the impeller shaft assembly from the front to the rear.
- 12. Install the side cover on the gearbox with a new gasket and tighten the bolts to 22 lbf·ft (30 N·m).

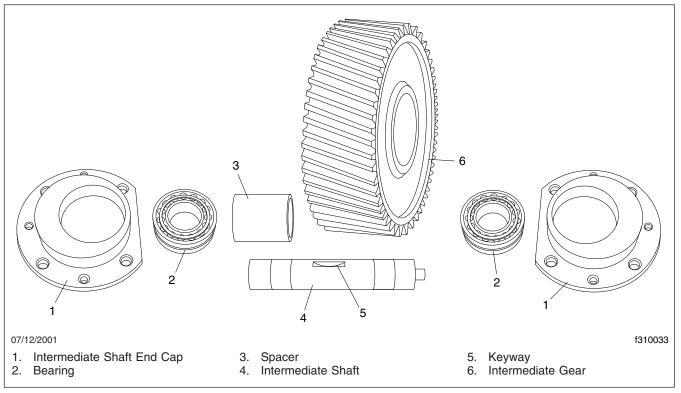


Fig. 10, Intermediate Shaft and Related Components

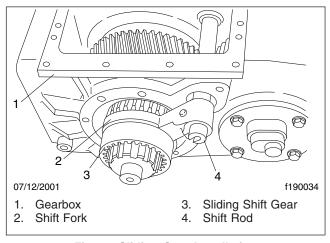


Fig. 11, Sliding Gear Installation

- Install the oil seal in the volute housing. If the slinger was removed, install a new slinger. See Fig. 12.
- 14. Carefully slide the volute housing over the impeller shaft. Align the slinger with the impeller shaft. Align the front impeller shaft bearing with the

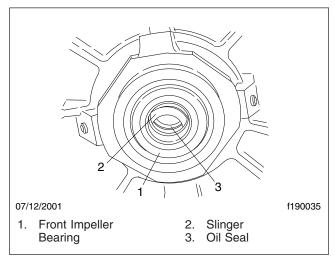


Fig. 12, Volute Housing (rear view)

cavity in the rear of the volute housing and slide together. Install the attaching bolts with spacers and tighten the bolts to 70 lbf·ft (95 N·m).

IMPORTANT: Extreme care MUST be taken when installing the volute housing on the impeller shaft to prevent damage to the oil seal.

- Install the mechanical seal seat in the volute housing. See Subject 110.
- 16. Install the impeller, clearance rings, suction head, and Y-adapter. See **Subject 120**.
- 17. Install the gearbox cooler and connect the cooling lines.

Installation

- Apply Loctite® 242 to the discharge manifold attaching bolts (3/8–16 bolts). Tighten them to 40 lbf-ft (54 N·m).
- Clean the intake Y-adapter and install a new seal. The seal may be lubricated with petroleum jelly to ease installation. Install the intake Y-adapter.
- Install the intake Y-adapter being careful not to damage the seal. Apply Loctite 242 to all studs and install the eight 3/8–24 nuts. Tighten them to 30 lbf·ft (41 N·m).
- 4. Connect the pump master drain.
- 5. Connect the electrical switches.
- Connect the air lines to the shift cylinder.
- Connect the driveshafts. Tighten the yoke fasteners to 225 lbf·ft (305 N·m). Tighten the bearing retaining strap capscrews to 40 to 48 lbf·ft (54 to 65 N·m).
- 8. Fill the gearbox with the necessary lubricant.
- Fill the pump with water, test, and check for leaks.
- 10. Remove the chocks from the front and rear tires.

90.01

Mechanical Seal Replacement

Replacement



CAUTION -

DO NOT TOUCH the sealing surfaces of the seal as contamination will result in premature failure.



Many of the components on the fire pump are heavy and awkward to handle. Always use the proper support equipment during removal and installation of the fire pump. Failure to do so could result in an assembly falling which could result in personal injury or property damage.

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

NOTE: If the clearance rings are not defective, they do not need to be replaced when replacing the mechanical seal.

3. Remove the pump impeller. See Subject 120.

NOTE: The mechanical seal is exposed once the impeller is removed.

- 4. Remove the mechanical seal from the impeller shaft, being careful not to damage the impeller shaft. See **Fig. 1**.
- 5. Remove the volute housing from the gearbox.
 - 5.1 Secure the pump gearbox to prevent it from shifting position.
 - 5.2 Remove the three 1/2–13 x 2 bolts that connect the volute housing to the pump gearbox.
 - 5.3 Separate the volute housing from the pump gearbox.
- 6. Lay the volute housing front side down. With a 1/4-inch diameter roll pin punch, push the mechanical seal seat out of the seal box.



The use of any petroleum product to lubricate the mechanical seal will result in damage to the mechanical seal.

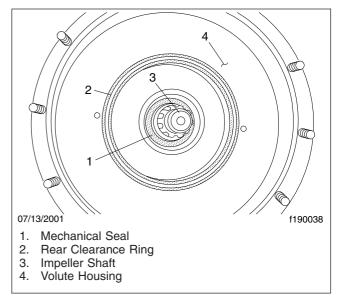


Fig. 1, Volute Housing (impeller removed)

7. Clean the impeller shaft with a fine Scotchbrite pad. Wipe off the impeller shaft, then lubricate it with a mixture of water and liquid soap.

NOTE: If the oil seal in the volute housing is damaged in the process of removing the mechanical seal seat, install a new oil seal.

- 8. Install the volute housing.
 - 8.1 Carefully slide the volute housing over the impeller shaft.
 - 8.2 Align the slinger with the impeller shaft.
 - 8.3 Align the front impeller shaft bearing with the cavity in the rear of the volute housing, then slide them together.
 - 8.4 Install the attaching bolts, with spacers, then tighten the bolts to 70 lbf·ft (95 N·m).



The use of any petroleum product to lubricate the mechanical seal will result in damage to the mechanical seal.

9. Lubricate the new seal seat with a mixture of water and liquid soap, then slide it on the impeller shaft and seat it in the mechanical seal box. See Fig. 2.

Mechanical Seal Replacement

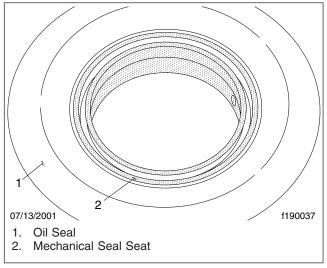


Fig. 2, Volute Housing (rear view)

- 10. Lubricate the mechanical seal, then carefully slide it on the impeller shaft until it bottoms against the seal seat.
- 11. Install the pump impeller. See Subject 120.
- 12. Fill the pump with water, check the oil, and run the pump. Inspect it for leaks.

90.01

Impeller and Clearance Ring Removal and Installation

Removal



Many of the components on the fire pump are heavy and awkward to handle. Always use the proper support equipment during removal and assembly of the fire pump. Failure to do so could result in an assembly falling which could result in personal injury or property damage.

For a cross-sectional view of the pump, see Fig. 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.
- Disconnect the intake extension pipes by removing the bolts in both victaulic couplings, separating the halves of the victaulic couplings, then sliding the sealing donuts on the extension tubes.
- 4. Disconnect the gearbox cooler line from the suction head and the gearbox cooler.
- 5. Remove the intake Y-adapter by removing the eight 3/8–24 nuts that secure it to the suction head. See **Fig. 2**.
- 6. Remove the suction head housing by removing the twelve 3/8 x 24 nuts. Carefully remove the suction head.
- Remove the stainless steel cotter pin from the nut that secures the impeller on the impeller shaft. Remove the nut and impeller shaft washer. See Fig. 3.
- Grasp the impeller and slide it off the impeller shaft. If the impeller is tight on the impeller shaft, install two bolts in the jack bolt holes, tighten the bolts evenly, and push the impeller off of the impeller shaft.
- To remove the front clearance ring (located in the suction head) block the suction head up on two blocks of wood. Then using a small ball peen hammer and small diamond chisel, drive the clearance ring out. See Fig. 4.
- To remove the rear clearance ring (located in the volute housing), use the same small ball peen hammer and small diamond chisel and drive the clearance ring out. See Fig. 5.

NOTE: When removing clearance rings be careful not to damage the clearance ring seating areas in both the suction head and volute housing.

11. Clean the seating areas for the clearance rings.

Installation

NOTE: Freezing the clearance rings prior to installation will greatly enhance installation and reduce the chances of damaging the clearance rings.



The clearance ring is soft brass. Therefore, driving the clearance ring into place with a solid object will result in a damaged and distorted clearance ring that will damage the impeller.

NOTE: When installing the clearance rings, be careful to install them square with the clearance ring seat.

- 1. Using a soft hammer, tap the clearance ring into place. Be sure the clearance ring seats fully and is square with the clearance ring seat.
- 2. Clean the impeller shaft.
- 3. Carefully side the impeller on the impeller shaft until it bottoms in the inner clearance ring.
- 4. Install the impeller shaft washer (bevel side out).
- Install the impeller shaft nut. While tightening the impeller shaft nut, align the cotter pin hole. Tighten it to 50 lbf·ft (68 N·m).

IMPORTANT: You must use a stainless steel cotter pin to prevent electrolysis of fastening components, resulting in damage to pump components.

- 6. Install a new stainless steel cotter pin.
- Clean the suction head, then install new seals, after lubricating the seals with petroleum jelly to ease installation.
- Install the suction head, being careful not to damage the seals. Apply Loctite® 242 to all studs, then install the twelve 3/8–24 nuts. Tighten them to 30 lbf·ft (41 N·m).

Impeller and Clearance Ring Removal and Installation

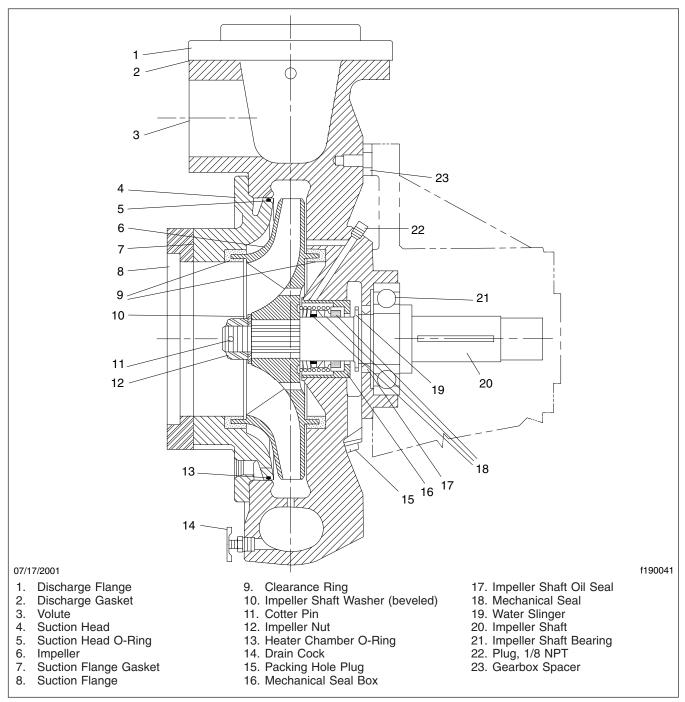


Fig. 1, PowerFlow Fire Pump (cross-sectional view)

9. Clean the intake Y-adapter, then install a new seal after lubricating the seal with petroleum jelly to ease installation.

Impeller and Clearance Ring Removal and Installation

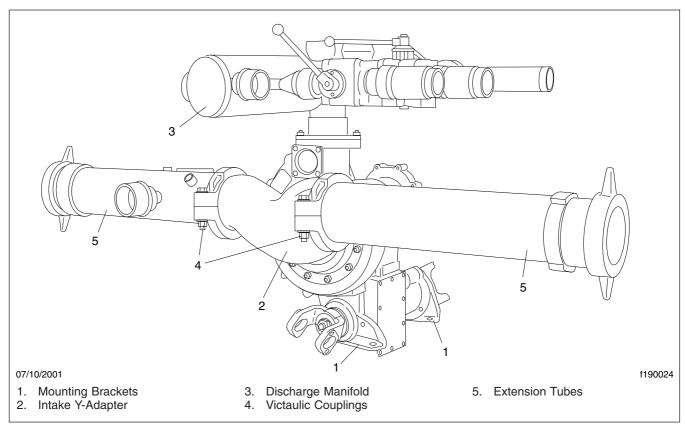


Fig. 2, American LaFrance PowerFlow Fire Pump

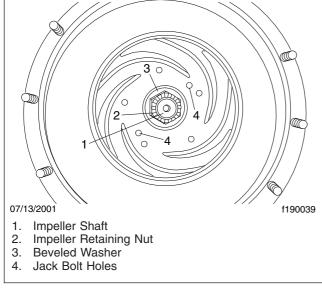


Fig. 3, Impeller and Related Components

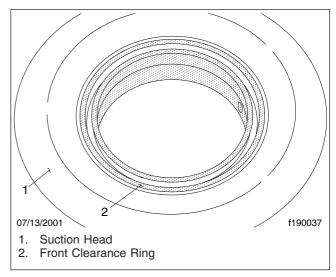


Fig. 4, Suction Head (rear view)

Impeller and Clearance Ring Removal and Installation

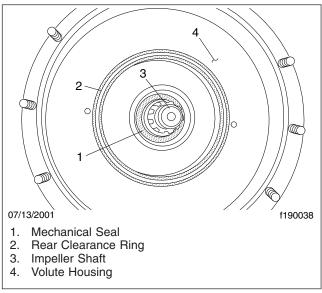


Fig. 5, Volute Housing (impeller removed)

- Install the intake Y-adapter, being careful not to damage the seal. Apply Loctite 242 to the eight 3/8–24 nuts. Install and tighten them to 30 lbf·ft (41 N·m).
- 11. Slide the extension tubes in until they meet the intake Y-adapter. Slide the sealing donuts on the intake Y-adapter until they are evenly spaced on both the extension tubes and the intake Y-adapter.
- Install both halves of the victaulic coupling around the sealing donut. Install and tighten the clamping bolts. Repeat the procedure for the other side.

NOTE: Impeller and/or clearance ring replacement will necessitate a complete pump service test as detailed in NFPA 1911, Standard for Service Tests of Fire Pump Systems on Fire Apparatus.

- 13. Fill the pump with water, run it, and inspect it for leaks.
- 14. Remove the chocks.

Air Shift Cylinder Overhaul

Overhaul

NOTE: The air cylinder is three separate pieces; cylinder head, cylinder end, and cylinder. All of the separate pieces are held together by three bolts. During this procedure care must be taken as these components will separate when the bolts are removed. See **Fig. 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 air from the air system.
- 3. Disconnect the air lines from the air shift cylinder. Mark the air lines for ease of reassembly.
- 4. Remove the three 5/16–18 bolts that secure the air cylinder to the gearbox.

NOTE: The piston rod in the air cylinder is notched and slides into a slotted yoke attached to the gearbox shift rod. The air cylinder must be shifted sideways to remove it from the shift rod yoke.

5. Remove the air cylinder from the gearbox.

- Check the cylinder and piston for damage, clean and replace all seals. Lubricate the seal with petroleum jelly for ease of assembly.
- 7. To reassemble the air cylinder, hold the cylinder head, cylinder end and cylinder together while sliding the piston rod into the shift rod yoke.
- 8. Apply Loctite® 242 to the three 5/16–18 screws and secure the air cylinder to the gearbox. Tighten them to 20 lbf·ft (27 N·m).
- Reconnect the air lines to the air cylinder and test it.

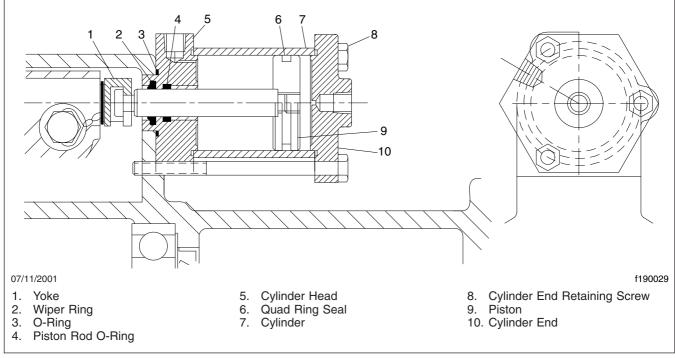


Fig. 1, Air Shift Cylinder (cut-away view)

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Troubleshooting

Troubleshooting

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

IMPORTANT: The entire pumping system should be exercised 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 a simple 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). 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 American LaFrance 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 batteries, 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. |

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Troubleshooting

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 driveshaft 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, or 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, lock up 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 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. |

Troubleshooting

Problem—Mechanical Seal Leaks

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| 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 (running the pump dry, heating up the seal, then opening to a cool or cold water supply); the seal may shatter. |

Problem—Pump Gear Box Does Not Function Properly

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|--|---|--|--|--|
| 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.
- Cap all intakes, and close and uncap all discharge valves.
- 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.

NOTE: Reduce the maximum vacuum attained by 1 inHg (3.4 kPa) for each 1000 ft (305 m) of elevation of the test site above 2000 ft (610 m).

4. The vacuum should not drop more than 10 inHg (33.9 kPa) in 5 minutes. Do not operate the pump priming device once the 5-minute test has begun.