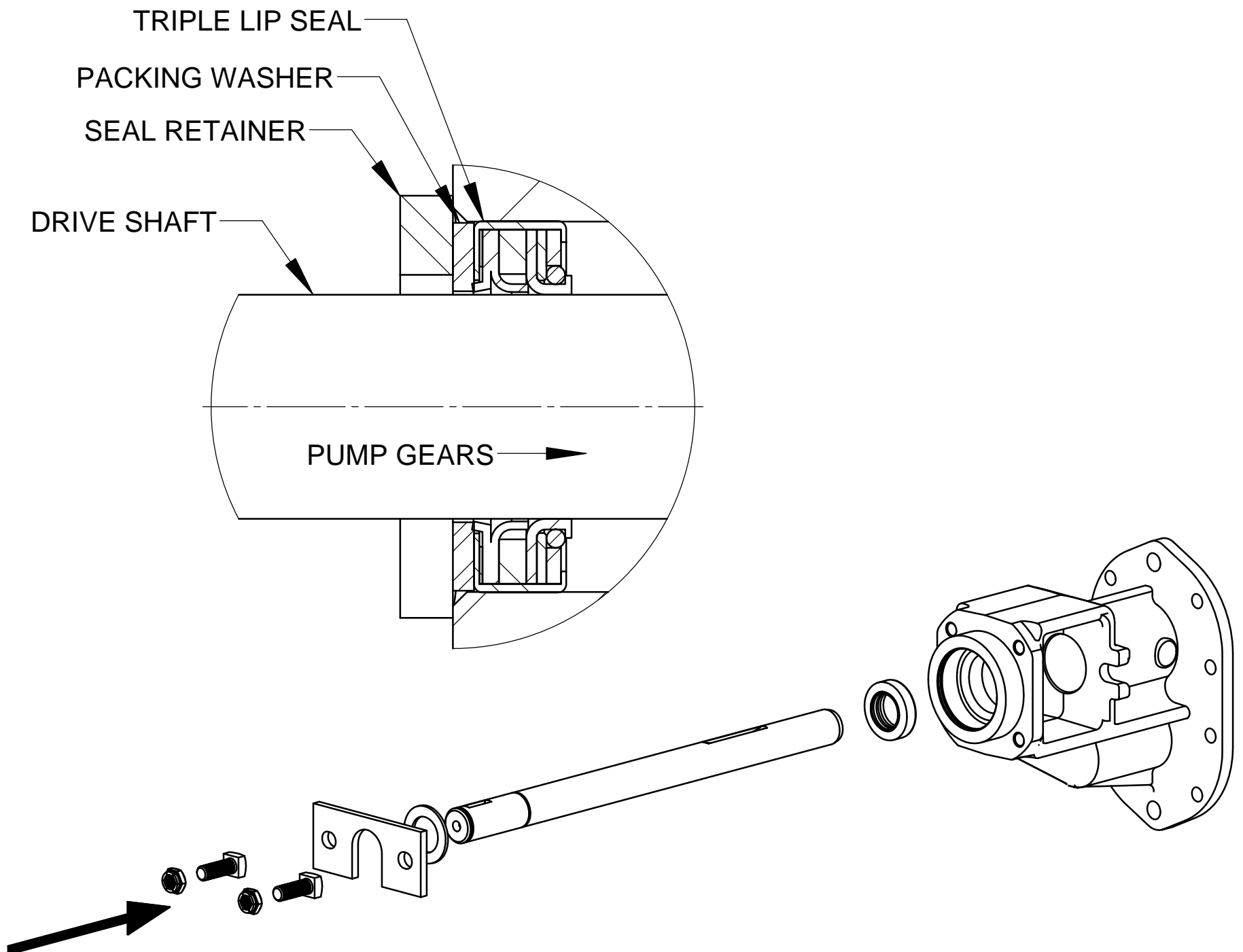


3511 - 4522 GHB VOP

CROSS SECTION OF INSTALLED SEAL

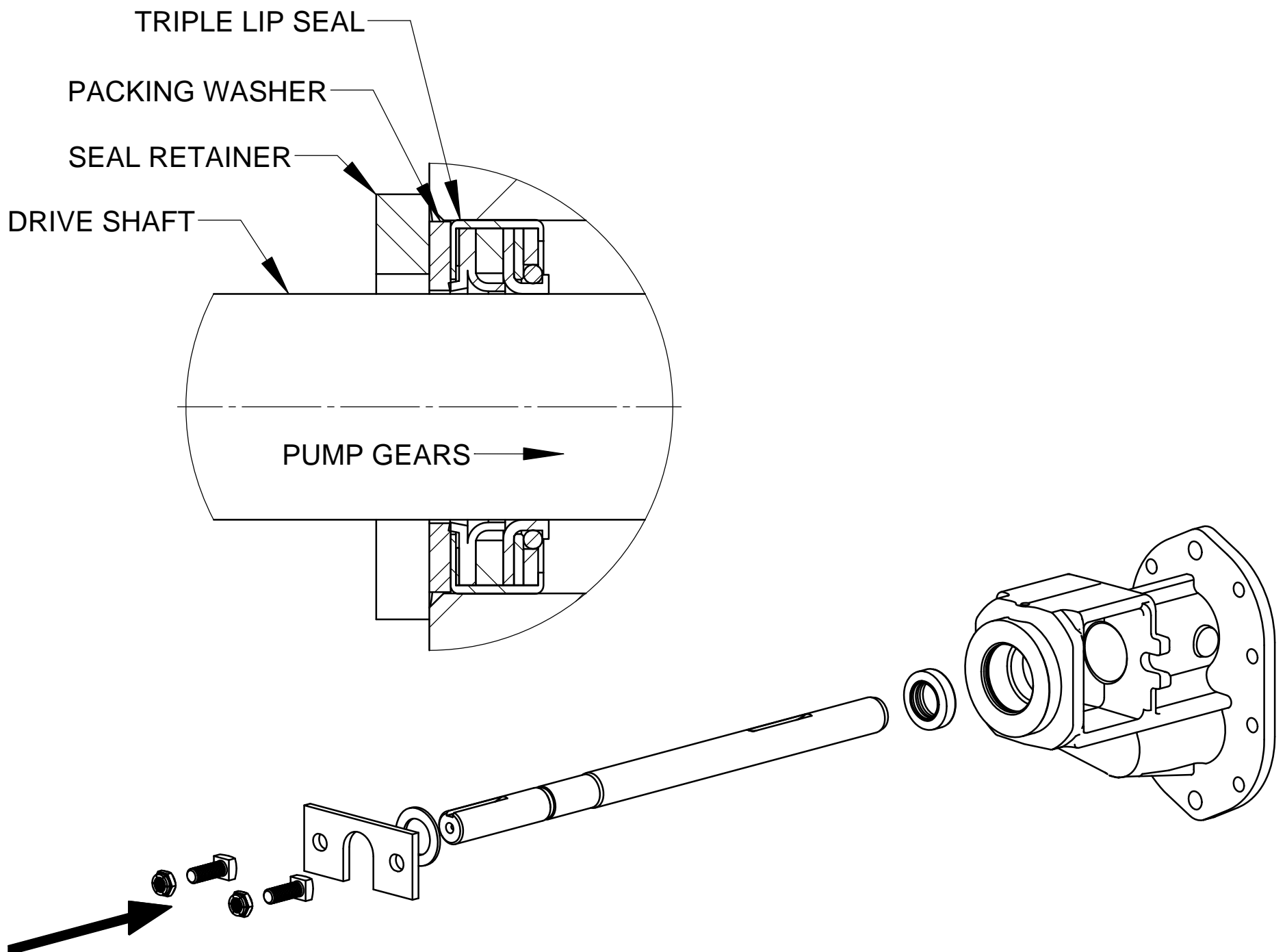


INSTALLATION OF TRIPLE LIP SEAL

1. It is very important the triple lip seal is not installed in such a way that it would have to slide over any retaining ring or grooves. Use a small file or stone to break sharp edges of drive shaft keyway that will be under pump drive gear.
2. Prior to installing the backplate assembly and driveshaft on the pump. Place the triple lip seal with two lips facing toward seal chamber onto opening of seal chamber in backplate. Press triple lip seal into seal chamber until back side of seal is flush with face of seal chamber. Take care to use a tool that will not damage or distort seal casing. Install one packing washer. Secure seal retainer in place. Continue assembling pump.

3511 - 4522 HB VOP

CROSS SECTION OF INSTALLED SEAL



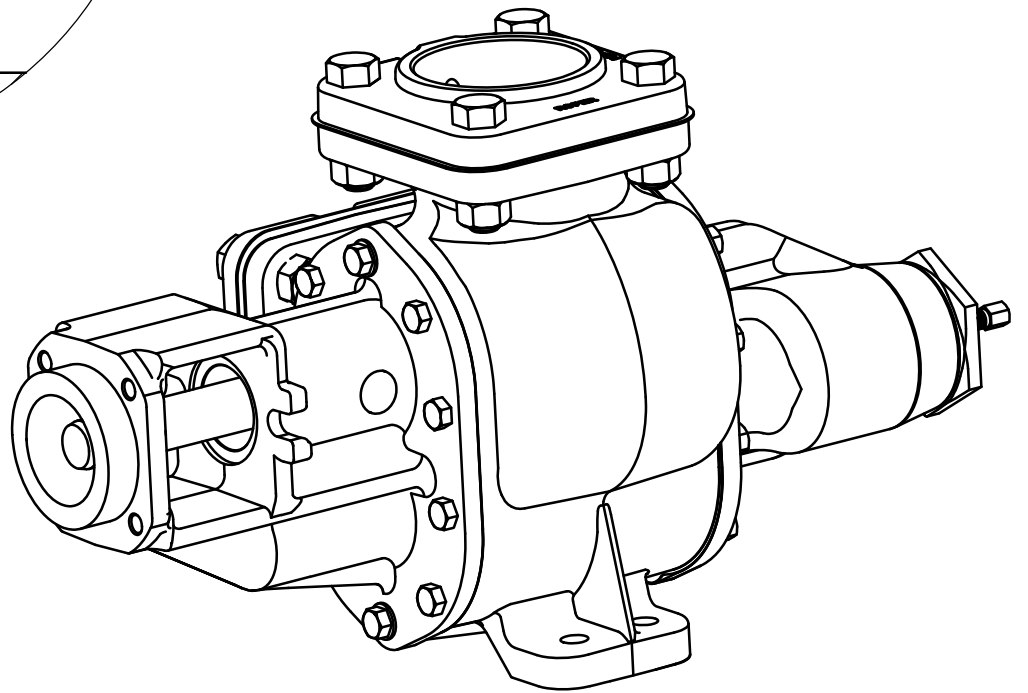
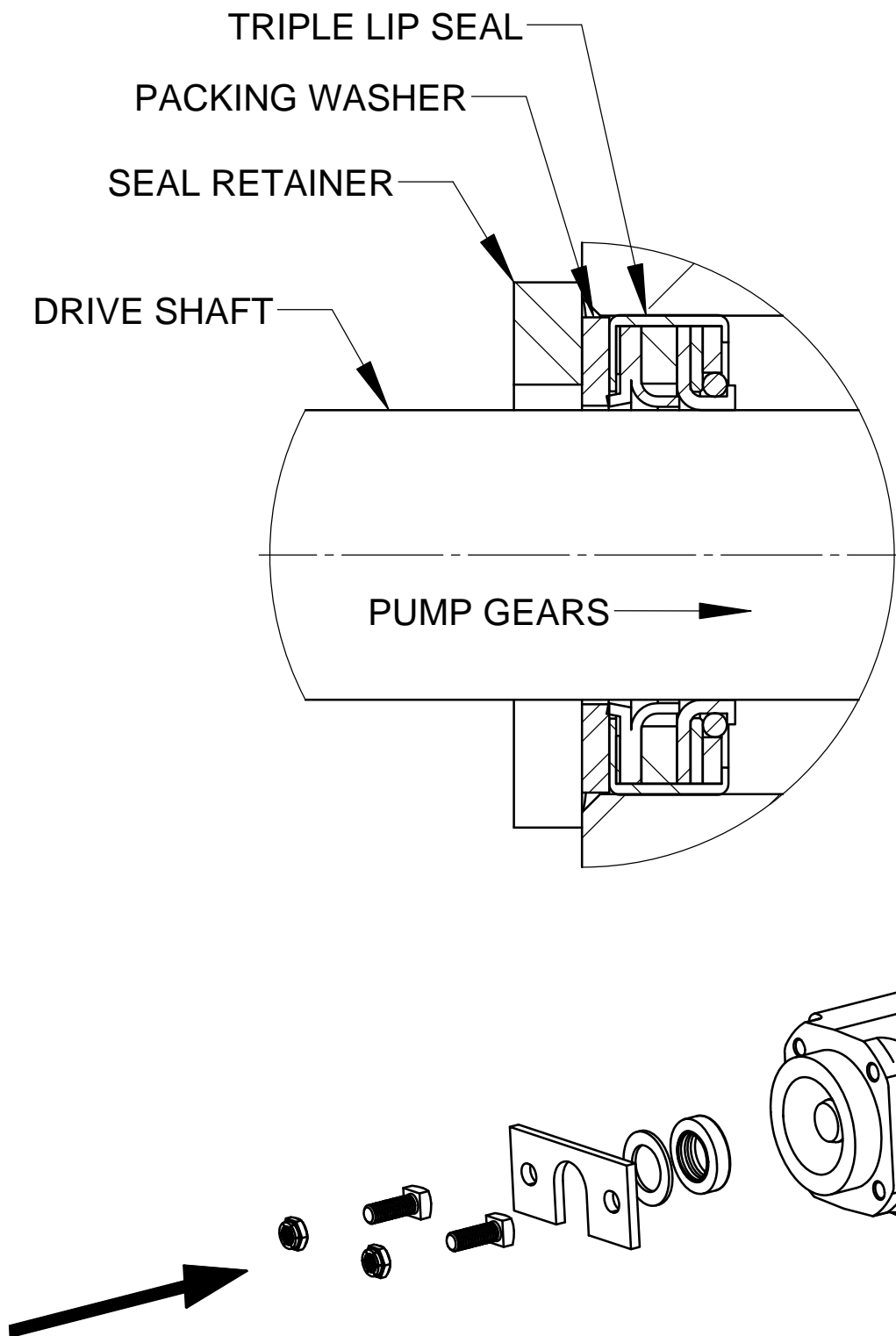
INSTALLATION OF TRIPLE LIP SEAL

1. It is very important the triple lip seal is not installed in such a way that it would have to slide over any retaining ring or set screw grooves. Use a small file or stone to break sharp edges of drive shaft keyway that will be under pump drive gear.
2. Prior to installing the backplate assembly and drive shaft on the pump. Place the triple lip seal with two lips facing toward seal chamber onto opening of seal chamber in backplate. Press triple lip seal into seal chamber until back side of seal is flush with face of seal chamber. Take care to use a tool that will not damage or distort seal casing. Install one packing washer. Secure seal retainer in place. Continue assembling pump.

On the "HB" 11-22 sizes only, the triple lip seal can also be installed in the same method as the "BH" (with the backplate assembly and drive shaft already attached to the case).

3511 - 4558 BH VOP

CROSS SECTION OF INSTALLED SEAL

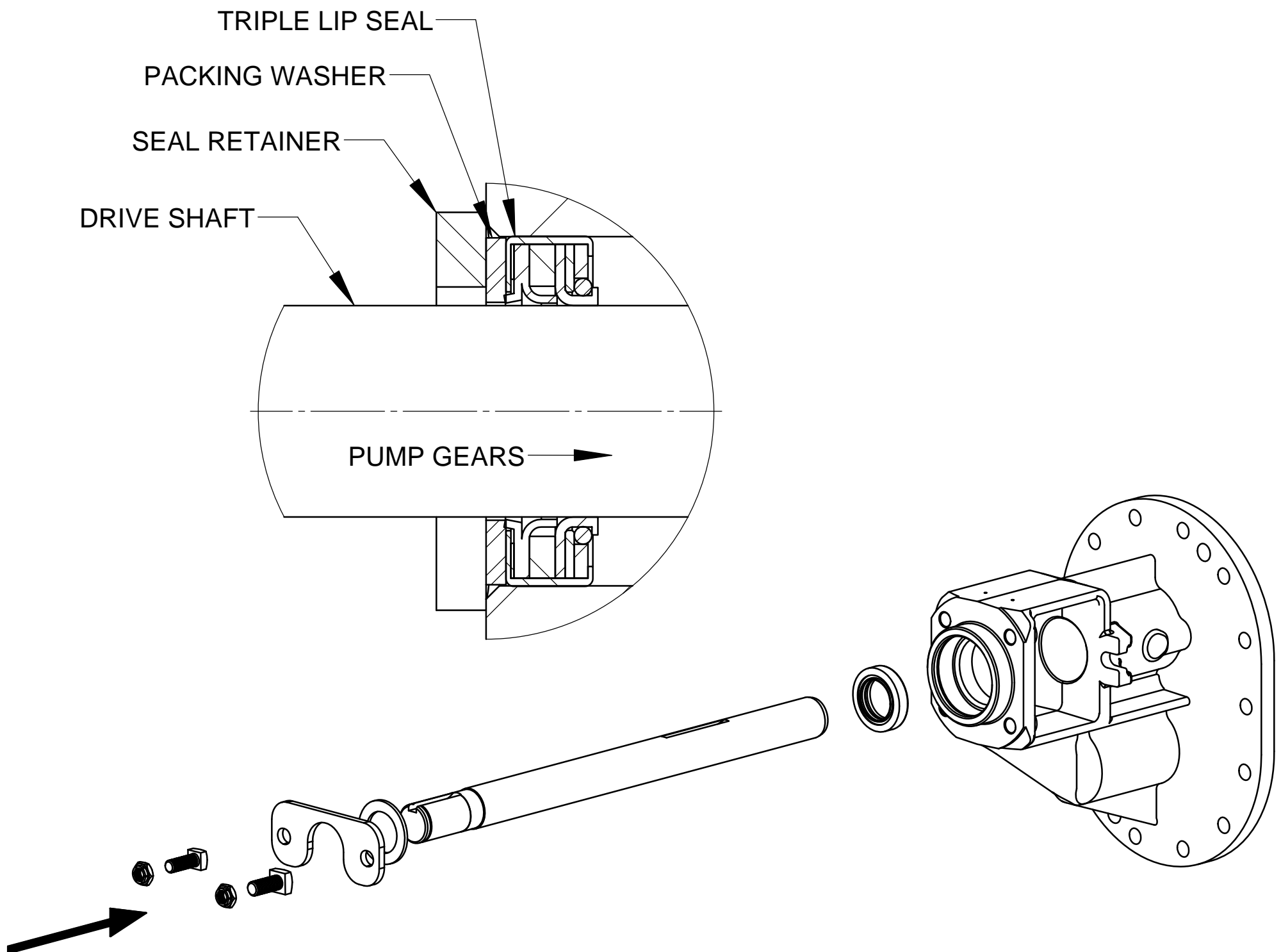


INSTALLATION OF TRIPLE LIP SEAL

1. It is very important the triple lip seal is not installed in such a way that it would have to slide over any retaining ring grooves. Use a small file or stone to break sharp edges of drive shaft keyway that will be under pump drive gear.
2. Fully assemble pump with the exception of the triple lip seal. Lubricate drive end of drive shaft and triple lip seal with a light oil. Slide triple lip seal over shaft with two lips facing toward pump gears. Gently push seal past tapered area of shaft and down to front of seal chamber. Press triple lip seal into bore until back side is flush with face of seal chamber. Take care to use a tool that will not damage or distort seal casing. Install one packing washer. Secure seal retainer in place.

3532 - 4558 GHB VOP

CROSS SECTION OF INSTALLED SEAL

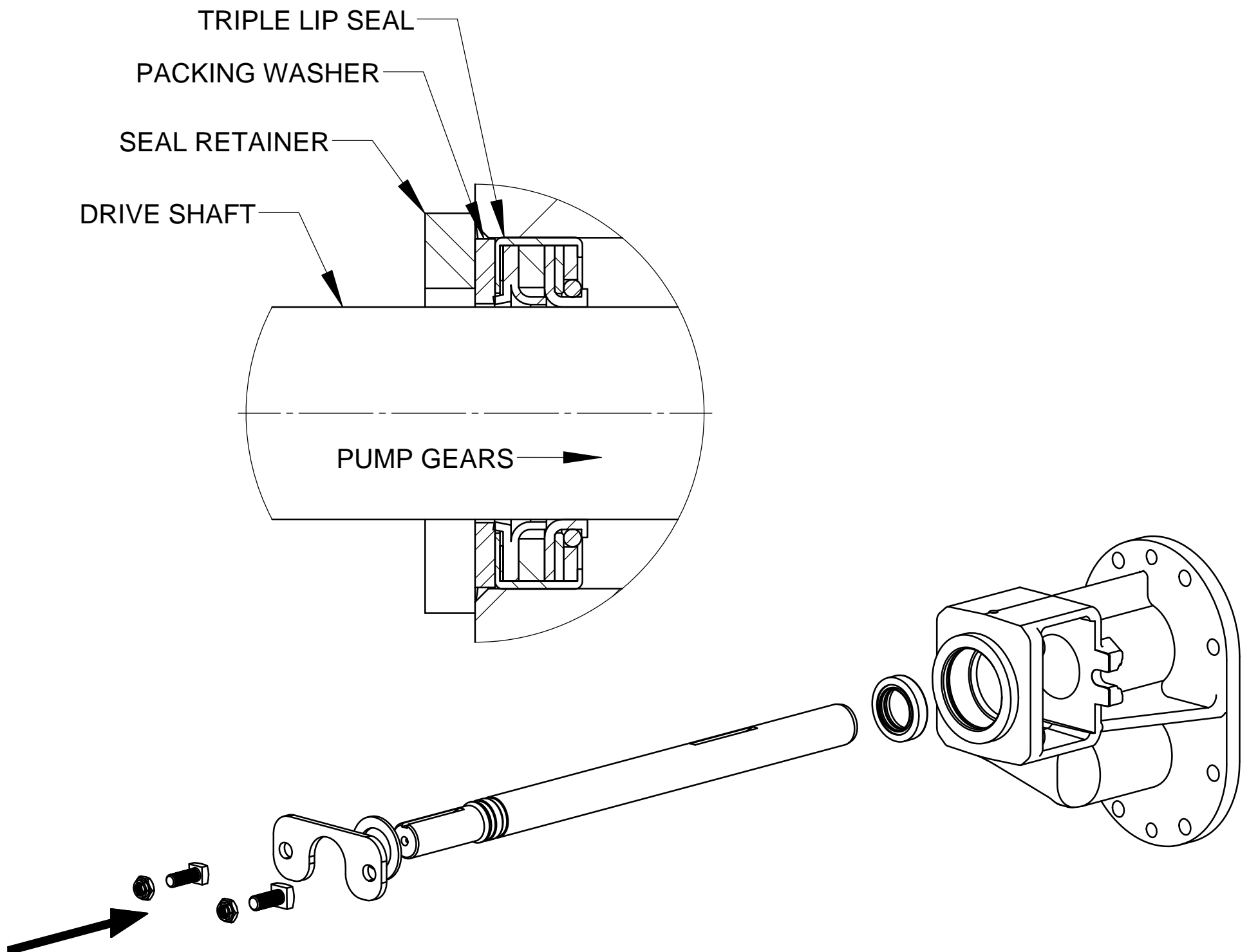


INSTALLATION OF TRIPLE LIP SEAL

1. It is very important the triple lip seal is not installed in such a way that it would have to slide over any retaining ring or grooves. Use a small file or stone to break sharp edges of drive shaft keyway that will be under pump drive gear.
2. Prior to installing the backplate assembly and driveshaft on the pump. Place the triple lip seal with two lips facing toward seal chamber onto opening of seal chamber in backplate. Press triple lip seal into seal chamber until back side of seal is flush with face of seal chamber. Take care to use a tool that will not damage or distort seal casing. Install one packing washer. Secure seal retainer in place. Continue assembling pump.

3532 - 4558 HB VOP

CROSS SECTION OF INSTALLED SEAL



INSTALLATION OF TRIPLE LIP SEAL

1. It is very important the triple lip seal is not installed in such a way that it would have to slide over any retaining ring or set screw grooves. Use a small file or stone to break sharp edges of drive shaft keyway that will be under pump drive gear.
2. Prior to installing the backplate assembly and driveshaft on the pump. Place the triple lip seal with two lips facing toward seal chamber onto opening of seal chamber in backplate. Press triple lip seal into seal chamber until back side of seal is flush with face of seal chamber. Take care to use a tool that will not damage or distort seal casing. Install one packing washer. Secure seal retainer in place. Continue assembling pump.



3532 – 4758 GHB and BHB Supplement to G12-210 OWNERS MANUAL

G12-437

11/30/11



SAFETY INSTRUCTIONS

This is an industrial component. Only a qualified systems integrator should be allowed to design it into a system. The integrator must determine proper plumbing, mounting, driveline and guard components.

Improper installation or use could lead to a serious, even fatal, accident. The system integrator must communicate all safe operation procedures to the end user(s).

Before operation, fully understand and follow the instructions shown in this manual and any instructions communicated by the system integrator. No one should be allowed to operate or maintain this pump who has not been fully trained to work safely according to the configuration of the pump system and in accordance with all applicable government and industry regulations.

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Plumbing

1. The inlet pipe should be as short and straight as possible to minimize suction pressure losses. Excessive restrictions at the inlet can cause cavitation resulting in poor performance, noise, vibration, or pump damage.
2. Slope the inlet plumbing appropriately to avoid air pockets.
3. Plumbing weight, misalignment with the ports or thermal expansion can exert excessive force on the pump. Plumbing must be properly supported and aligned with expansion joints, if required, to minimize these forces.
4. To prevent over pressure situations, install a relief valve as close to the pump outlet as possible. Install the relief valve before any shut-off valves.

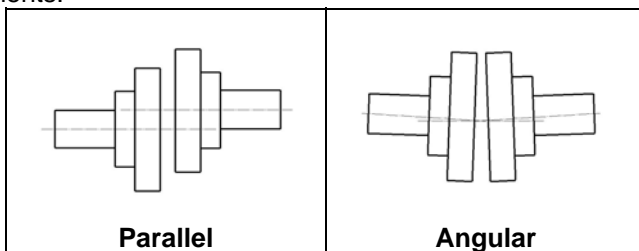
Separate Pump and Drive Assemblies

Driveline Guards

1. Assure adequate guards have been installed to prevent personnel contacting moving components.
2. Follow all OSHA, Federal, state and local codes.

Check Alignment of Pump to Driveline

Excessive misalignment can overload the pump input shaft and cause premature failure. The figures below show parallel and angular misalignments.



Mounting Base

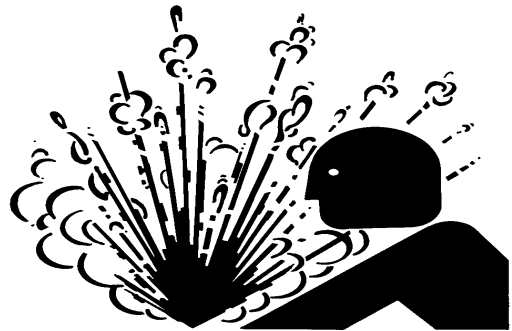
1. Mount the unit on a rigid, heavy base to provide support and absorb shock. Bases should be designed for high rigidity, not just strength.
2. The pump feet were not designed for mounting to concrete and do not have enough contact area to prevent concrete from failing. When mounting to cement or concrete, use a steel base plate (supplied by others) to distribute the mounting stress over an area large enough to prevent the cement from failing. The base plate should be at least as thick as the pump feet. Grout it in place.

Roper Pumps' Close Coupled Drives

Hydraulic drive units where the drive mounts directly to the pump

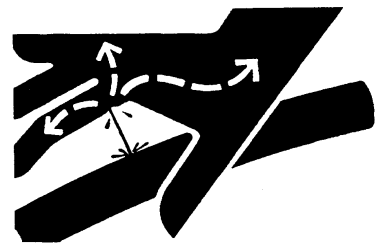
- Driveline is not exposed and does not require guards.
- Alignment between pump and drive line is maintained by the assembly.
- Because the assembly absorbs reaction forces of the driveline, the mounting base does not need to be as robust. The level of rigidity and strength is determined by the piping stresses from the system.

! WARNING



Over-pressure may burst pump or system components. Always include a relief valve in installation. Do not over pressurize pump or block discharge line while running.

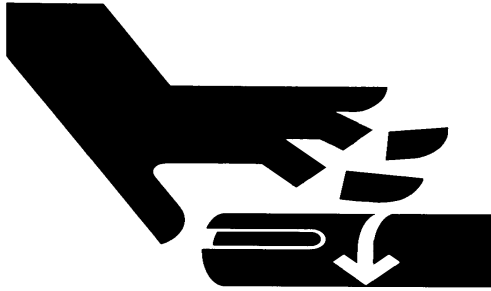
! WARNING



Injection Hazard: Do not try to stop a leak with your hand! Avoid any close contact with hydraulic fluid jets. Escaping fluid can penetrate skin, causing serious injury. In case of accident, see a doctor immediately for removal of fluid.



WARNING



**Operating without guards could result in serious injury or death.
Machinery in operation can grab, crush, cut, mangle and dismember.
Do not operate without adequate guards in place.**

INSTALLATION

Check Ports Vs Rotation:

Make sure the inlet and discharge ports have been correctly plumbed corresponding to the direction of rotation and the relief valve, if present, is properly positioned. See following drawings for various configurations.

	W	LW	Z	LZ
3x35-58 GHB				
3x32-48 GHB				
4x58 GHB				
	X	LX	Y	LY
3x35-58 GHB				
3x32-48 GHB				

DIRECTION OF ROTATION FOR GHB PUMP CONFIGURATIONS USING THE RV STYLE RELIEF VALVE
Figure A

	W	LW	Z	LZ
3x35-58 BHB				
3x32-48 BHB				
4x58 BHB				
	X	LX	Y	LY
3x35-58 BHB				
3x32-48 BHB				

**DIRECTION OF ROTATION FOR BHB PUMP CONFIGURATIONS USING THE RV STYLE RELIEF VALVE
Figure B**

1. RECOMMENDED TOOL LIST

NOTE: Tools not furnished with pump.

Tools for all Pumps:

- (1) Safety Glasses
- (1) Rubber Mallet
- (1) ¾" Combination Wrench
- (1) 6" Adjustable Wrench
- (1) CG-45 Snap-On® Tool Bearing Puller
- (1) 6" to 10" Three Square File
- (1) Pliers
- (1) ½ " Combination Wrench

Additional Tools for Pumps with an RV Type Relief Valve:

- (1) 1-3/8" Combination Wrench
- (1) 1-5/8" Combination Wrench

Additional Tools for Pumps with Flanges:

- (2) 15/16" Combination Wrench

Additional Tools for Pumps with Shaft Packing:

Packing Hook for .41" square packing rings

Additional Tools for Pumps with Mechanical Seals:

- (1) 0400 External Retaining Ring Pliers

Additional Tools for BHB Pumps:

- (1) 5/16" Hex Key

2. INSTRUCTIONS FOR PUMP DISASSEMBLY

Refer to Section 7, **PARTS LIST**, (Figures 7.1 and 7.2).

1. Read **WARNINGS** before starting to disassemble pump. While disassembling pump, always inspect disassembled parts and adjacent parts to see if further disassembly is needed. Replace worn or damaged parts as required.
2. If you do not know which pump arrangement you have, collect nameplate data and refer to the Owners Manual for 3532-58 (G12-210) to determine what you have. Consult a Roper distributor or Roper Pump Company if you have any questions.
3. When cleaning or lubricating, use only cleaning solutions and lubricants that are compatible with products being pumped and with sealing elastomers. **DO NOT** use petroleum base products with seals with EPR elastomers. Use a nonpetroleum base lubricant with EPR elastomers.
4. Turn off pump and lock out energy source to driver. **DO NOT** proceed further with disassembly of pump if there is the slightest possibility that driver may be started.
5. If used, turn off and disconnect flush from mechanical seal.
6. Close inlet and discharge valves.
7. Remove guard and disconnect coupling between driver and pump.
8. Drain inlet and discharge lines. Disconnect lines from pump inlet and discharge.
9. Follow the procedure in the Owners Manual for 3532-58 (G12-210), **INSTRUCTIONS FOR DRAINING PUMP**.
10. A.) For 3500-4700 "BHB" pumps, go to Section 4, **INSTRUCTIONS FOR DISASSEMBLY OF A TYPE "BHB" HYDRAULIC DRIVE**. After disassembling hydraulic drive, return to this section and follow steps 11 – 20.
B.) For 3500-4700 "GHB" gear reduction unit, follow steps 21 – 32. After disassembling gear reduction unit, return to this section and follow steps 11 – 20.
C.) For 3500-4700 "GHBO" pumps, follow steps 11 – 20.
11. Remove fourteen hex head cap screws (L) for the 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps securing faceplate (23A, B, C) to case (19A, B, C). Remove faceplate (23A, B, C).
12. Remove two dowel pins (J) from case.
13. Remove case gaskets (20).
14. Remove drive gear (34) and key (B1) from drive shaft (32).
15. Remove idler gear (35) and key (B2) from idler shaft (33). Remove idler shaft.
16. Remove fourteen hex head cap screws (L) for the 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps securing backplate (6A, B) to case (19A, B, C). Separate parts.
17. Remove case gaskets (20) from opposite side of case (19A, B, C).
18. Remove two dowel pins (J) from opposite sides of case (19A, B, C).
19. Remove drive key (A) from drive shaft (32).
20. A.) For 3600/4600 "BHB", "GHB", and "GHBO" pumps, follow steps 33 – 40.
B.) For 3500/4500 or 3700/4700 "BHB", "GHB", and "GHBO" pumps, follow steps 41 – 47.

3500 THRU 4700 “GHB” Gear Reduction Unit (See Figures 7.1 and 7.2)

21. Drain oil from gear reduction unit.
22. Remove drive key (A). Remove four hex head cap screws (U) and four lock-washers (V). Slide seal retainer (37) assembled with lip seal (39) off end of pinion shaft (42).
23. Remove seal retainer gasket (38) between seal retainer (37) and gear case (44).
24. Remove pinion shaft (42) assembly with ball bearing (41) and retaining ring (40).
25. Remove six hex head cap screws (W), twelve flat washers (X), and six lock-washers (Y).
26. Remove gear case (44). Remove gear case gasket (48).
27. Remove needle bearing (43). This bearing is installed with a press fit.
28. Remove retaining ring (45).
29. Remove drive gear (46). A gear puller may be necessary in removing gear, as a close fit is maintained between gear and shaft.
30. Remove drive gear key (Z).
31. Remove four socket head cap screws (AD) securing cover (49) to backplate (6A, B). Remove cover gasket (50).
32. Remove spacer (47).

3600/4600 “GHB”, “GHBO” and “BHB” Pumps (See Figure 7.1)

33. Remove retaining ring (3) securing ball bearing (2) in place.
34. Remove two locknuts (F) from square head bolts (G) securing packing gland (14) in place. Remove packing gland clip (13), packing gland (14), spring clip (15), and two square head bolts (G).
35. Remove packing rings (16) and packing washer (18). Remove lantern ring (17) if used. Packing hooks are commercially available to assist in removal of packing.
36. Remove drive shaft (32) along with ball bearing (2) from backplate (6A, B).
37. Remove ball bearing (2) from drive shaft (32).
38. Remove lip seal (5) from backplate (6A, B) and discard. It will be damaged during disassembly.
39. Clean drive shaft and adjacent parts. Examine shaft. Replace drive shaft if excessively worn or scored.
40. Visually inspect all parts. Replace all worn or damaged parts before reassembling pump. It is recommended that new gaskets (20, 22, 38, 48, 50) and new lip seals (5, 39) be installed each time the pump is disassembled and reassembled.

3500/4500 or 3700/4700 “GHB”, “GHBO” and “BHB” Pumps (See Figure 7.1)

41. Remove retaining ring (3) securing ball bearing (2) in place.
42. Clean and lubricate drive shaft (32) with a compatible lubricant prior to removing mechanical seal or triple lip seal (10), making sure that drive shaft is smooth and free from all burrs. Loosen setscrew (if present) on mechanical seal. Remove seal (11). If 3700/4700 pump, inspect sealing surfaces of stationary seal face and inspect rotating element of mechanical seals. If 3500/4500 pump, remove packing washer (18) and triple lip seal (10). It is recommended that new gaskets (20, 22, 25) be installed each time pump is disassembled and re assembled. Triple lip seal (10) must be replaced any time it is removed from backplate (6A, 6B). Remove retaining ring (12) from drive shaft (32), if applicable.
43. Remove drive shaft (32) along with ball bearing (2) from backplate (6A, B).
44. Remove ball bearing (2) from drive shaft (32).
45. Remove lip seal (5) from backplate (6A, B) and discard. It will be damaged during disassembly.
46. Remove two locknuts (F) from square head bolts (G) securing seal retainer (9) to backplate (6A, B). Remove seal retainer (9).
47. Visually inspect all parts. Replace all worn or damaged parts before reassembling pump. It is recommended that new gaskets (20, 22, 25, if applicable) and new lip seals (5, 10, 39) be installed each time pump is disassembled and reassembled.

3. INSTRUCTIONS FOR PUMP ASSEMBLY

Refer to Section 7, **PARTS LIST**.

Refer to Section titled "Check Ports Versus Rotation" (Figures A and B) to assure proper configuration for pump rotation, port location, and relief valve position prior to assembling pump.

1. Read and understand all safety instructions and warnings before assembling pump. Visually inspect all parts during assembly. Replace all worn or damaged parts. Although they may appear reusable, it is recommended that new gaskets (20, 22, if applicable, 38, 48, 50) and lip seals (5, 39) be installed when pump is being reassembled.
 - **WARNING!** Only use genuine Roper gaskets. Gasket thickness determines proper clearances. Always check quantity of gaskets removed and replace with exact quantity. Proper material must be used based on application.
2. When cleaning or lubricating, only use products that are compatible with product being pumped and elastomers within pump. **DO NOT** use petroleum base products with seals with EPR elastomers. Clean and lubricate parts with light oil unless EPR elastomers are used. Use a nonpetroleum base lubricant with EPR elastomers.
3. Mechanical seals are precision pieces of equipment. Use extreme care not to damage seal faces or elastomers during assembly.
4. Install two dowel pins (J) on each side of case (19A, B, C). Place appropriate number of case gaskets (20) on faceplate side of case. Align faceplate (23A, B, C,) on dowel pins (J). Secure faceplate to case using fourteen hex head cap screws (L) for the 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps.
5. Place idler gear (35) into case bore. Install key (B2) in keyway on idler shaft (33). Slide idler shaft into I.D. of idler gear.
6. A.) For 3600/4600 "GHBO," "GHB," and "BHB" pumps with shaft packing, follow steps 7 – 17.
B.) For 3500/4500 or 3700/4700 "GHBO," "GHB," and "BHB" pumps with a triple lip seal or a standard mechanical seal, follow steps 27 – 36.
C.) For 3700/4700 "GHBO," "GHB," and "BHB" pumps with a positive drive mechanical seal, follow steps 37 – 50.

3600/4600 “GHB” “GHBO” and “BHB” Pumps (See Figure 7.1)

7. Place drive gear (34) into case bore. Install key (B1) in keyway of drive shaft (32). Slide drive shaft into bore of drive gear.
8. Place appropriate number of case gaskets (20) on backplate side of case (19A, B, C). Align backplate (6A, B) on dowel pins (J). Secure backplate to case using fourteen hex head cap screws (L) for the 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps.
9. Install packing washer (18) over drive shaft (32) into packing bore of backplate.
10. Install packing rings (16) and lantern ring (17), if used, in packing bore of backplate. Stagger joints on each ring 180° apart. Seat each ring before adding next ring. Rings must not be tamped or seated too tightly.
11. Check drive shaft (32) for free movement after each ring is installed.
12. When packing box is sufficiently full to allow entry of packing gland (14) about ¼ of an inch [6 mm], reassemble packing gland.
13. Place one square head bolt (G) through each slot in backplate (6A, B) and through each hole in packing gland (14). Install packing gland (14) into packing box about ¼ of an inch [6 mm]. Slide packing gland clip (13) over square head bolts (G). Using two locknuts (F), secure packing gland (14) in place. Install spring clip (15) across square head bolts (G). Draw locknuts up evenly on packing gland to assure proper seating of packing (16), then loosen locknuts about ½ turn. **DO NOT** cock packing gland. This could cause binding or heating of drive shaft.
14. Install lip seal (5) in backplate (6A, B).
15. Install ball bearing (2) on drive shaft (32) and into backplate (6A, B) using retaining ring (3) to secure ball bearing (2) in place as shown in the sectional drawing (Figure 7.1). The fit between the drive shaft and ball bearing may be a light press fit. **DO NOT** strike or press on the outer race of the bearing. This could damage the bearing.
16. Install spacer (47).
17. A.) For “GHB” gear reduction unit, follow steps 18 – 26.
B.) For “BHB” hydraulic drive assembly, go to Section 5, **INSTRUCTIONS FOR ASSEMBLY OF A TYPE “BHB” HYDRAULIC DRIVE.**

3500 THRU 4700 “GHB” Gear Reduction Unit (See Figure 7.2)

18. Install cover gasket (50) and cover (49) on backplate (6A, B) using four socket head cap screws (AD).
19. Install key (Z) in keyway of drive shaft (32). Place drive gear (46) on drive shaft (32). Secure in place using retaining ring (45).
20. Install needle bearing (43). The needle bearing is a press fit bore.
21. Install gear case (44) and gear case gasket (48) using six hex head cap screws (W), twelve flat washers (X), and six lockwashers (Y).
22. Press ball bearing (41) onto pinion shaft (42) and install retaining ring (40).
23. Install pinion shaft assembly by sliding small end of pinion shaft into needle bearing (43) at same time gears are meshed together.
24. Slide bearing retainer (37) assembled with lip seal (39) and bearing retainer gasket (38) into place. Secure bearing retainer (37) to gear case (44) using four hex head cap screws (U) and four lockwashers (V).
25. Install drive key (A).
26. Read and understand all safety instructions and warnings before installing and operating pump.

**3500/4500 or 3700/4700 “GHB”, “GHBO”, and “BHB” Pumps (Std Mech Seal or Triple Lip Seal)
(See Figure 7.1)**

27. Place drive gear (34) into case bore. Install key (B1) in keyway of drive shaft (32). Slide drive shaft into bore of drive gear.
28. Place appropriate number of case gaskets (20) on backplate side of case (19A, B, C). Align backplate (6A, B) on dowel pins (J). Secure backplate to case using fourteen hex head cap screws (L) for the 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps.
29. Carefully remove all burrs and sharp edges from shaft over which rotating element of the mechanical seal or triple lip seal will slide.
30. A.) If 3500/4500 pump, place triple lip seal (10) with two lips facing toward seal chamber onto opening of seal chamber in backplate (6A, B). Press triple lip seal into seal chamber until back side of seal is flush with face of seal chamber. Take care to use a tool that will not damage or distort seal casing. Install one packing washer (18).

B.) If 3700/4700 pump, install retaining ring (12) on drive shaft (25). Lubricate drive shaft and mechanical seal bore with a compatible lubricant. Install mechanical seal (11) on drive shaft and position seal back against retaining ring (12). Care must be taken not to nick o-ring. Be sure lapped (polished) faces of stationary seal face and rotating element are together.
31. Install lip seal (5) in backplate (6A, B).
32. Install ball bearing (2) on drive shaft (32) and into backplate (6A, B). **DO NOT** strike or press on the outer race of the bearing. This could damage the bearing. Install retaining ring (3) to secure ball bearing (2) in place. The fit between drive shaft and ball bearing may be a light press fit. **DO NOT** damage seal parts while pressing ball bearing on drive shaft.
33. Place one square head bolt (G) through each slot in backplate (6A, B) and through each hole in seal retainer (9). Secure seal retainer against backplate using two locknuts (F).
34. Install spacer (47).
35. A.) For “GHB” gear reduction unit follow steps 18 – 26.

B.) For “BHB” hydraulic drive assembly, go to Section 5, **INSTRUCTIONS FOR ASSEMBLY OF A TYPE “BHB” HYDRAULIC DRIVE.**

3700/4700 “GHBO,” “GHB,” and “BHB” Pumps (Positive Drive Mech Seal) (See Figure 7.1)

36. Place drive gear (34) into case bore.
37. Install retaining ring (12) on drive shaft (32) to locate mechanical seal.
38. Carefully remove all burrs and sharp edges on shaft over which the rotating element of seal will slide.
39. Apply a compatible lubricant to seal I.D. and O.D. of drive shaft (32).
40. Slide rotating element of mechanical seal (11) onto drive shaft (32) before removing three or four clips that are taped to rotating element. Push rotating element back against retaining ring (12), tighten set screws in seal, and remove clips that are taped to seal.
41. Slide faceplate end of drive shaft (32), with mechanical seal attached, into backplate (6A, B) through bore for ball bearing (2).
42. Place appropriate number of case gaskets (20) on backplate side of case (19A, B, C). Install key (B1) in keyway of drive shaft (32). Slide drive shaft into bore of drive gear while aligning backplate (6A, B) on dowel pins (J). Secure backplate (6A, B) to case (19A, B, C) using fourteen hex head cap screws (L) for the 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps.
43. Lubricate o-ring on stationary seal face and seal chamber bore with a compatible lubricant. Slide stationary seal face over keyway end of drive shaft (32) and down to seal chamber. Be sure lapped (polished) face is toward rotating member of seal. Push stationary seal face into seal chamber.
44. Install lip seal (5) in backplate (6A, B).
45. Install ball bearing (2) on drive shaft (32) and into backplate (6A, B) using retaining ring (3) to secure ball bearing (2) in place. The fit between drive shaft and ball bearing may be a light press fit. **DO NOT** damage seal parts while pressing ball bearing on drive shaft.
46. Install anti-rotation pin (T) in locator ring (60).
47. Position locator ring (60) with anti-rotation pin (T) toward seal face. Align anti-rotation pin (T) with slot in back of stationary seal face and push into counter-bore of backplate (6A, B).
48. Place one square head bolt (G) through each slot in backplate (6A, B) and through each hole in seal retainer (9). Secure seal retainer against backplate using two locknuts (F).
49. A.) For 3700/4700 “GHB” gear reduction unit, follow steps 18 – 26.
B.) For 3700/4700 “BHB” hydraulic drive assembly, go to Section 5, **INSTRUCTIONS FOR ASSEMBLY OF A TYPE “BHB” HYDRAULIC DRIVE.**

4. INSTRUCTIONS FOR DISASSEMBLY OF A TYPE “BHB” HYDRAULIC DRIVE

Refer to Section 7, **PARTS LIST**, (Figures 7.1 and 7.3).

1. Read and understand all safety instructions and warnings before starting to disassemble hydraulic drive components from pump. While disassembling, always inspect disassembled parts and adjacent parts to see if further disassembly is needed. Replace worn or damaged parts as required.
2. Turn off pump and lock out energy source to hydraulic motor. **DO NOT** proceed further with disassembly of pump if there is the slightest possibility that hydraulic motor may be started.
3. Close inlet and discharge valves.
4. A.) Refer to Section 7, (Figure 7.1), pump sectional drawing for “**GHBFORV**”.
B.) If used, turn off and disconnect flush for packing or mechanical seal.
C.) To drain pump, follow the procedures in the Owners Manual for 3632-58 (G12-210), **INSTRUCTIONS FOR DRAINING PUMP**.
D.) Disconnect lines from pump inlet and discharge.
5. Remove six socket head cap screws (AE) and six lock-washers (AF) that secure bracket (51) and bracket (52) together. Slide apart.
6. Remove cap screws that secure hydraulic motor to bracket (52).
7. Rotate bracket (52) until hole for loosening setscrew lines up with setscrew in coupling half (54). Loosen setscrew and remove coupling half.
8. Remove coupling spider (55).
9. Rotate drive shaft of pump (32) until setscrew in coupling half (53) lines up with hole for loosening setscrew. Loosen setscrew. Remove retaining ring (45) from drive shaft and remove coupling half.
10. Remove drive key (Z).
11. Remove four socket head cap screws (AD) that secure bracket (51) to backplate (6A, B). Remove bracket.
12. For further disassembly of the pump, refer to Section 2, **INSTRUCTIONS FOR PUMP DISASSEMBLY**, steps 1 - 20. Also, refer to steps 33 - 40 for pumps with packing, or steps 41 - 47 for pumps with mechanical or triple lip seals.

5. INSTRUCTIONS FOR ASSEMBLY OF A TYPE “BHB” HYDRAULIC DRIVE

1. Refer to Section 3, **INSTRUCTIONS FOR PUMP ASSEMBLY**, steps 1 - 6. For installing packing, refer to steps 7 - 17. For installing mechanical or triple lip seal, refer to steps 27 - 36.
2. Refer to Section 7, (Figure 7.3), sectional drawing for **TYPE “BHB” HYDRAULIC DRIVE COUPLING ASSEMBLY**.
3. Secure bracket (51) to backplate (6A, B) using four socket head cap screws (AD).
4. Install key (Z) in shaft keyway. Place coupling half (53) on drive shaft (32). Install retaining ring (45). Rotate drive shaft (32) until setscrew lines up with hole in bracket (51), then tighten setscrew.
5. Install coupling spider (55).
6. Place bracket (52) onto pilot of hydraulic motor. **DO NOT** secure bracket into place at this time.
7. Place coupling half (54) onto shaft of hydraulic motor to dimension shown. Rotate bracket (52) until hole in bracket lines up with setscrew on coupling half. Tighten setscrew.
8. Rotate bracket on motor to line up motor mounting holes with bracket holes. Secure bracket (52) to hydraulic motor using appropriate fasteners.
9. Secure bracket (52) to bracket (51) using six socket head cap screws (AE) and six lock-washers (AF).
10. Read and understand all safety instructions and warnings before installing and operating pump.

6. GEAR REDUCTION UNIT

ALIGNING GHB PINION SHAFT HEIGHT, Refer to Section 7, PARTS LIST, (Figure 7.2).

The pinion shaft of the GHB gear reducer can be positioned at any location over a full 360°. This must be done before the gear reducer oil is added. The pinion shaft can be positioned in the following manner.

1. Loosen six hex head cap screws (W).
2. Rotate gear case (44) on six slots in cover (49).
3. If pinion shaft (42) cannot be moved to proper position at this point, remove six hex head cap screws (W) along with washers (X and Y).
4. Rotate pinion shaft to desired position and reinstall and tighten six hex head cap screws (W) along with six flat washers (X) and six lock-washers (Y).
5. If six threaded holes in gear case (44) are not fully visible within cast slots on cover (49), gear reducer will have to be partially disassembled so that cover (49) can be rotated.
6. Slide gear case (44) off of cover (49).
7. Remove retaining ring (45) from end of pump drive shaft (32).
8. Remove drive gear (46). A gear puller may be necessary.
9. Remove four socket head cap screws (AD).
10. Rotate cover (49) 90° and reinstall and tighten four socket head cap screws.
11. Install drive gear (46) on drive shaft (32).
12. Install retaining ring (45).
13. Replace gasket (48) and slip gear case (44) complete with pinion assembly onto cover (49).
14. Rotate pinion to desired position. Install and tighten six hex head cap screws (W) along with six flat washers (X) and six lock-washers (Y).
15. If necessary, reposition plugs (AA), petcock (AC), and oil cup (AB). Oil cup should be at uppermost point and petcock at second hole from bottom.
16. Refill with oil to level of petcock (AC) using Gulf® Senate 375, Mobil® 600 W Cylinder Oil, or AGMA No. 7 compounded oil.

LUBRICATION INSTRUCTIONS FOR INITIAL START-UP

The oil cup (AB) is shipped separately to prevent breakage. Before placing the gear reduction unit in operation, install the oil cup (AB) and check the oil level in unit. The oil level should be maintained even with petcock (AC) at all times.

SERVICING INSTRUCTIONS

The oil should be clean and free from sludge at all times and should be changed at regular intervals. A drain plug (AA) has been provided near the bottom of the gear case (44) for this purpose. The oil (Gulf® Senate 374, Mobil® 600 W Cylinder Oil, or AGMA No. 7 compounded oil) should be changed every 1000 hours or every four months, whichever comes first. Where operating conditions are severe, such as rapid rise and fall of temperature, or the atmosphere is moist or dusty, it may be necessary to change the oil every one or two months or sooner. The oil cup (AB) at the front of the gear case (44) is for filling the unit with oil and also serves as a breather. **DO NOT** allow the oil cup (AB) to become clogged. This could cause excessive pressure inside the gear case (44).

CHANGING RATIO OF GEAR REDUCTION UNIT

Refer to appropriate sectional drawing (Figure 7.2) showing internal construction of the gear reduction assembly. The internal construction for all ratios are identical, except for the drive gear (46) and pinion shaft (42), which determines the gear ratio of that particular unit. The drive gear (46) and pinion shaft (42) are interchangeable in pairs only. See **GEAR RATIO CHART** for ratios available. It is recommended that new gaskets (38, 48) and new lip seal (39) be installed each time unit is disassembled and reassembled.

1. Turn off pump and lock out energy source to driver. **DO NOT** proceed further with disassembly of gear reduction unit if there is the slightest possibility that driver may be started.
2. Drain oil from gear reduction unit.
3. If unit is assembled on a baseplate, directly connected to a motor, it will be necessary to remove flexible coupling as follows:
 - A.) Loosen setscrew on motor half of coupling.
 - B.) Slide motor coupling half towards motor to clear pump coupling half. (In case coupling cannot be removed in this manner, it will be necessary to remove either motor or pump in order to remove pump coupling half.)
4. Loosen six hex head cap screws (W) and rotate gear case (44) in slots provided until pump coupling half is clear of motor coupling half.
5. Remove pump coupling half.
6. Remove drive key (A). Remove four hex head cap screws (U) and four lock-washers (V). Slide seal retainer (37) assembled with lip seal (39) off the end of pinion shaft (42).
7. Remove seal retainer gasket (38) between seal retainer (37) and gear case (44).
8. Remove pinion shaft (42) assembly with ball bearing (41) and retaining ring (40).
9. Remove six hex head cap screws (W), twelve flat washers (X), and six lock-washers (Y).
10. Remove gear case (44). Remove gear case gasket (48).
11. Remove retaining ring (45).
12. Remove drive gear (46). A gear puller may be necessary in removing gear, as a close fit is maintained between gear and shaft.
13. Refer to gear ratio chart to select desired gear ratio.
14. Slide drive gear (46) on drive shaft (32) securing in place using retaining ring (45). Make sure key (Z) and spacer (47) are in place. The number of teeth is stamped on drive gear (46).
15. Install gear case (44) and gear case gasket (48) using six hex head cap screws (W), twelve flat washers (X), and six lock-washers (Y).
16. Press ball bearing (41) onto pinion shaft (42) and install retaining ring (40). **DO NOT** strike or press on the outer race of the bearing. This could damage the bearing.
17. Install pinion shaft assembly by sliding small end of pinion shaft into needle bearing (43) at same time gears are meshed together.
18. Slide bearing retainer (37) assembled with lip seal (39) and bearing retainer gasket (38) into place. Secure bearing retainer (37) to gear case (44) using four hex head cap screws (U) and four lock-washers (V).
19. Install drive key (A).
20. Install pump coupling half and tighten setscrews on drive key (A).
21. Rotate gear case (44) until coupling halves are accurately aligned. Tighten six hex head cap screws (W). Assemble coupling and tighten setscrew in motor coupling half.

22. Refill with oil to level of petcock (AC) using Gulf® Senate 375, Mobil® 600 W Cylinder Oil, or AGMA No. 7 compounded oil.

GEAR REDUCTION RATIOS AND CAPABILITIES

Gear reducers are rated to transmit up to the horsepower's (kW) shown below. Three interchangeable gear ratios are available.

GEAR RATIO CHART

PUMP MODELS	GEAR RATIOS	60 HZ OPERATION			50 HZ OPERATION		
		MOTOR RPM	PUMP RPM	MAX. HP ALLOWED	MOTOR RPM	PUMP RPM	MAX. KW ALLOWED
3532 THROUGH 4758	5.66:1	580	102	4.1	485	86	2.7
	4.88:1		119	4.9		99	3.2
	4.26:1		136	5.5		114	3.6
	5.66:1	870	154	6.3	730	129	4.2
	4.88:1		178	7.3		150	4.9
	4.26:1		204	8.5		171	5.6
	5.66:1	1150	203	8.5	950	168	5.8
	4.88:1		235	10.0		194	6.6
	4.26:1		270	11.0		223	7.3
	5.66:1	1750	309	13.0	1450	256	8.6
	4.88:1		360	15.0		297	9.9
	4.26:1		410	15.0		340	10.0
5.66:1	3450	609	15.0	2850	54	10.0	

7. PARTS LIST

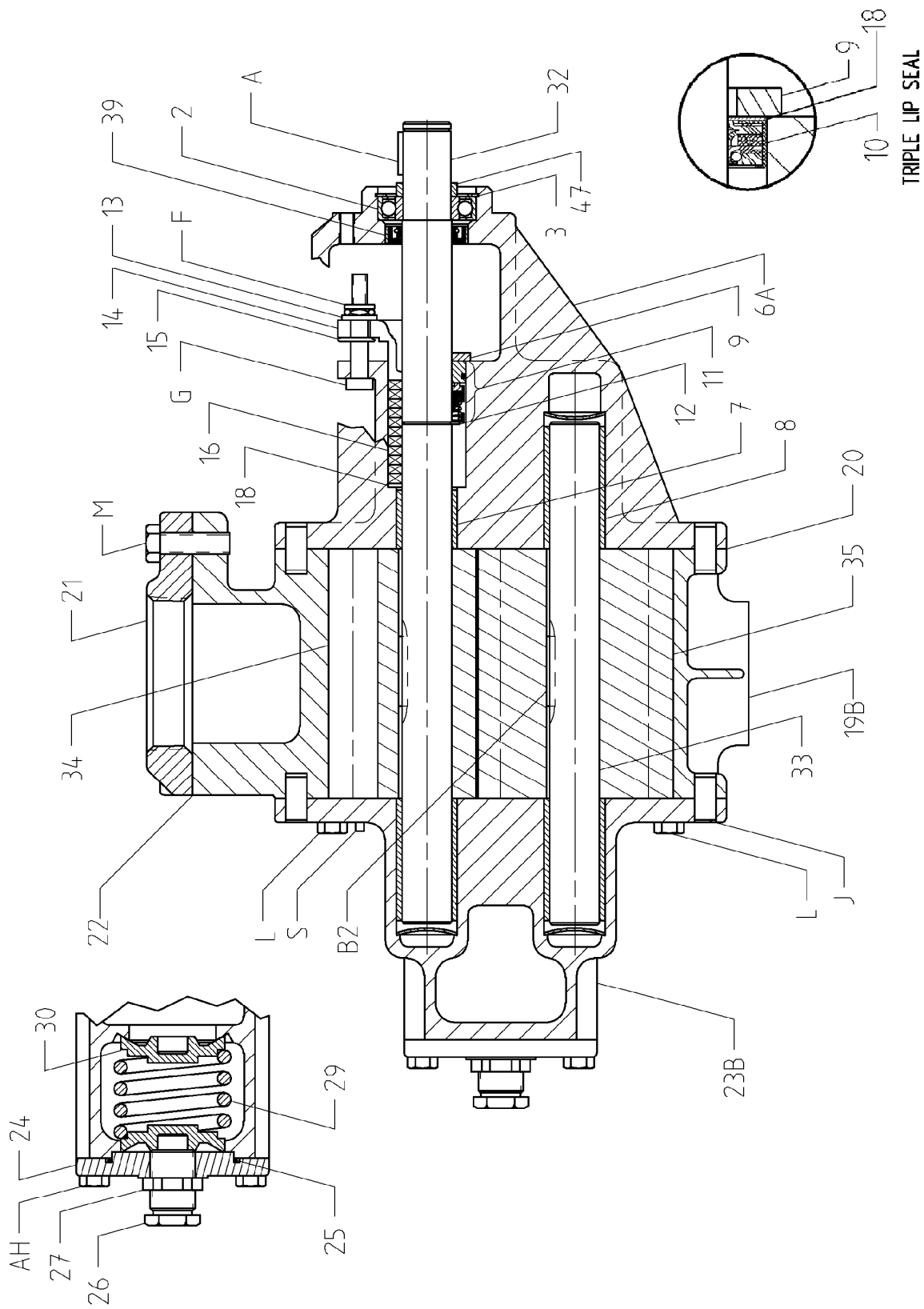
- .2. Ball Bearing
- 3. Retaining Ring, Bearing Cage
- 5. Lip Seal (GHB)
- 6. Backplate
 - A. Standard
 - B. Jacketed
- 7. Bearing, Short
- 8. Bearing, Long
- 9. Seal Retainer
- 10. Triple Lip Seal
- 11. Mechanical Seal
- 12. Retaining Ring, Mechanical Seal
- 13. Packing Gland Clip
- 14. Packing Gland
- 15. Spring Clip
- 16. Packing Ring
- 17. Lantern Ring (Not Shown)
- 18. Packing Washer
- 19. Case
 - A. Threaded Port Case – Right Angle
 - B. Flanged Case – Right Angle
 - C. Flanged Case – Straight Through
- 20. Case Gasket
- 21. Flange
- 22. Flange Gasket
- 23. Faceplate
 - A. Plain
 - B. RV Style Relief Valve
 - C. Jacketed RV Style Relief Valve
- 24. Relief Valve Cap
- 25. Relief Valve Cap, O-ring
- 26. Adjusting Screw
- 27. Nut, Lock and Seal
- 29. Spring
- 30. Poppet/Spring Guide
- 32. Drive Shaft
- 33. Idler Shaft
- 34. Drive Gear
- 35. Idler Gear
- 57. Expansion Washer
- 60. Locator Ring
- WRN2 Warning Plate, RV Style Relief Valve
- WRN3 Warning Plate, RV Style Relief Valve
- WRN4 Warning Plate, RV Style Relief Valve
- A. Drive Key
- B1. Key, Drive Gear
- B2. Key, Idler Gear
- D. Lube Fitting
- E. Hex Head Cap Screw, Seal Retainer to Backplate
- F. Locknut
- G. Square Head Bolt
- H. Pipe Plug, Backplate
- J. Dowel Pin
- L. Hex Head Cap Screw, Endplates to Case
- M. Hex Head Cap Screw, Flange
- N. Nut, Flange
- S. Pipe Plug, Faceplate
- T. Anti-rotation Pin
- AG. Stud
- AH. Hex Head Cap Screw
- AJ. Drive Screw
- AK. Nut

Gear Reduction Assembly only

- 37. Bearing Retainer
- 38. Bearing Retainer Gasket
- 39. Lip Seal
- 40. Retaining Ring, Ball Bearing
- 41. Ball Bearing
- 42. Pinion Gear and Shaft
- 43. Needle Bearing
- 44. Gear Case
- 45. Retaining Ring, Drive Gear
- 46. Drive Gear
- 47. Spacer
- 48. Gear Case Gasket
- 49. Cover
- 50. Cover Gasket
- U. Hex Head Cap Screw, Bearing Retainer to Gear Case
- V. Lock-washer, Bearing Retainer
- W. Hex Head Cap Screw, Cover to Gear Case
- X. Flat Washer, Gear Case
- Y. Lock-washer, Gear Case
- Z. Key, Drive Gear
- AA. Pipe Plug, Gear Case
- AB. Oil Cup, Gear Case
- AC. Petcock, Gear Case
- AD. Socket Head Cap Screw, Cover to Backplate

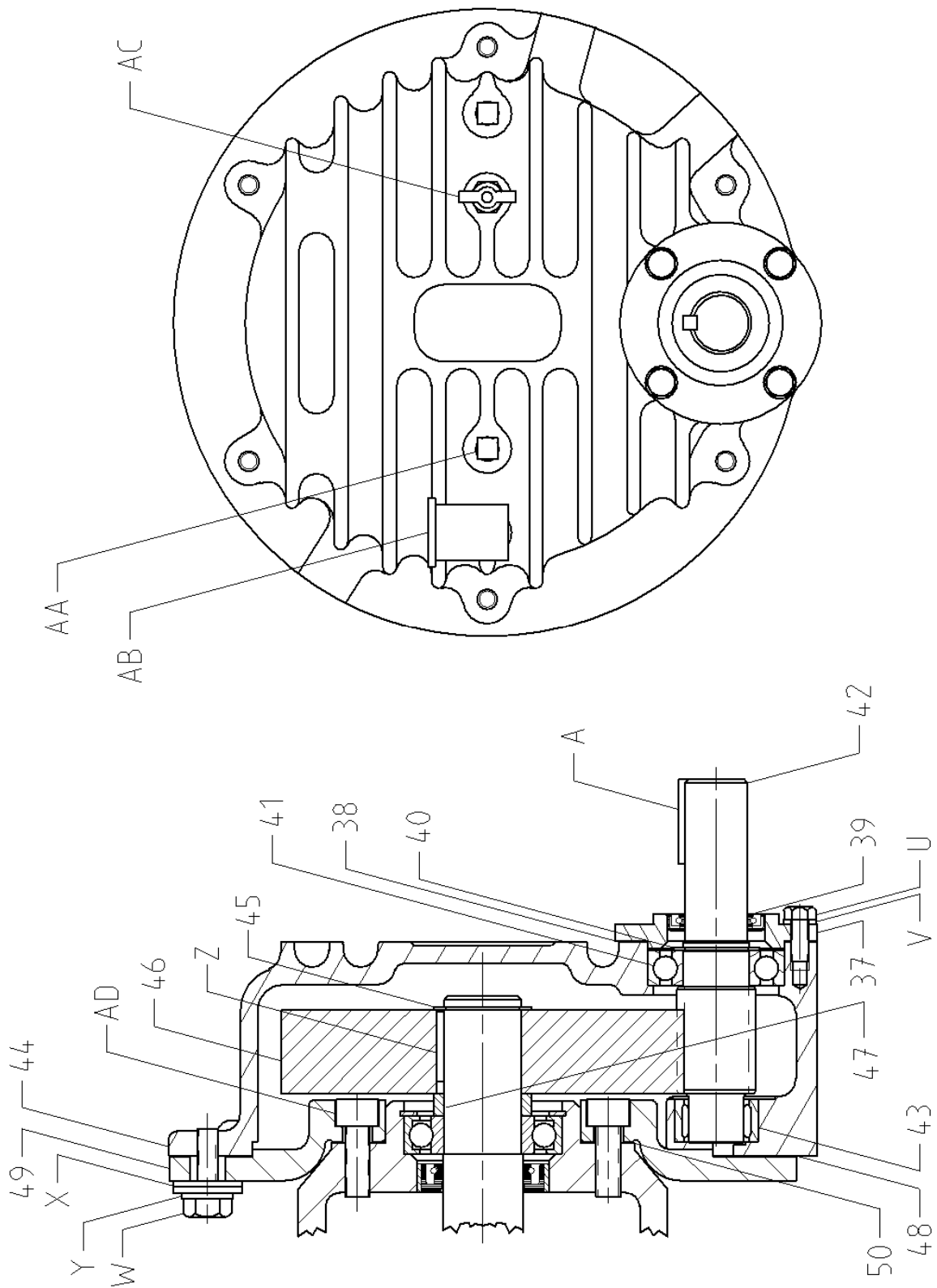
Type BHB Hydraulic Drive Bracket Assembly only

- 51. Bracket Half, Pump
- 52. Bracket Half, Motor
- 53. Coupling Half, Pump
- 54. Coupling Half, Motor
- 55. Spider Coupling
- AE. Socket Head Cap Screw, Bracket to Bracket
- AF. Lock-washer

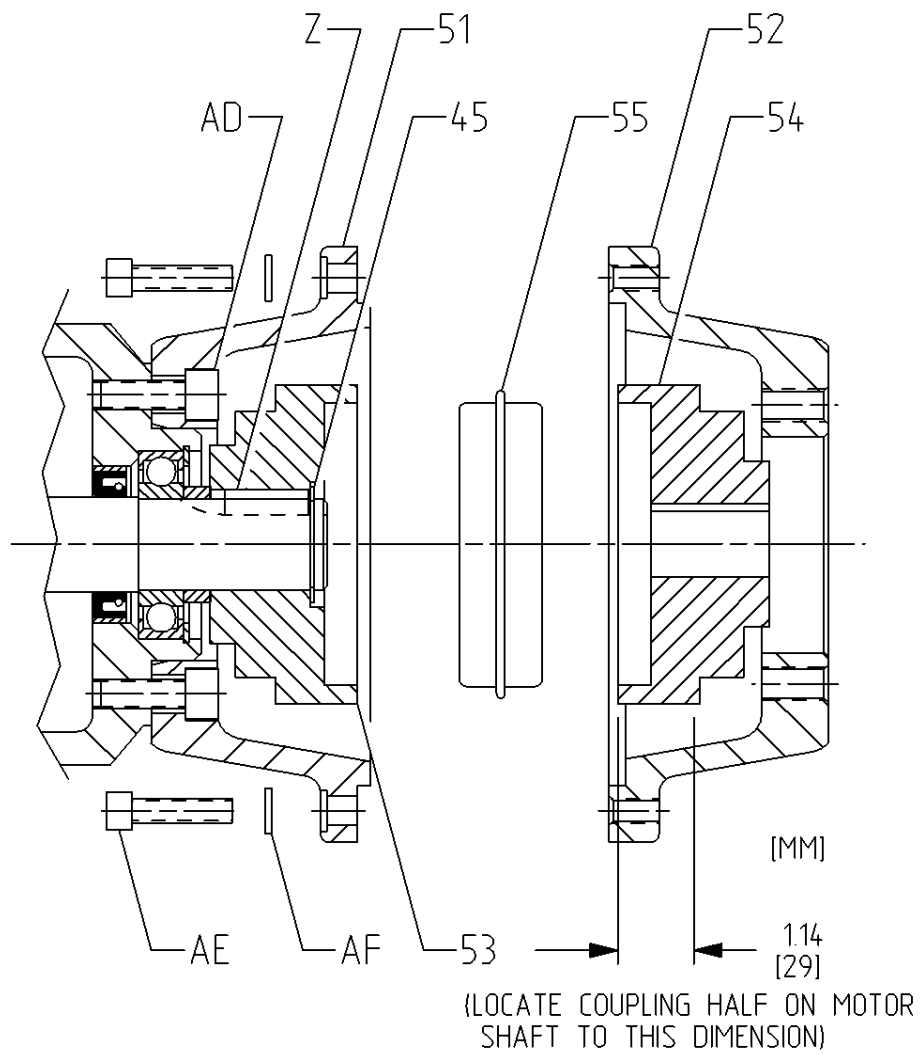


GHBFORV
FIGURE 7.1

3X35-4X58 GHB.F.O.RV



**GEAR REDUCTION ASSEMBLY
FIGURE 7.2**



**TYPE BHB
HYDRAULIC DRIVE COUPLING ASSEMBLY
FIGURE 7.3**

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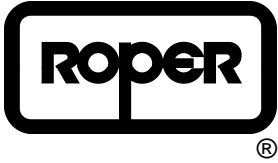
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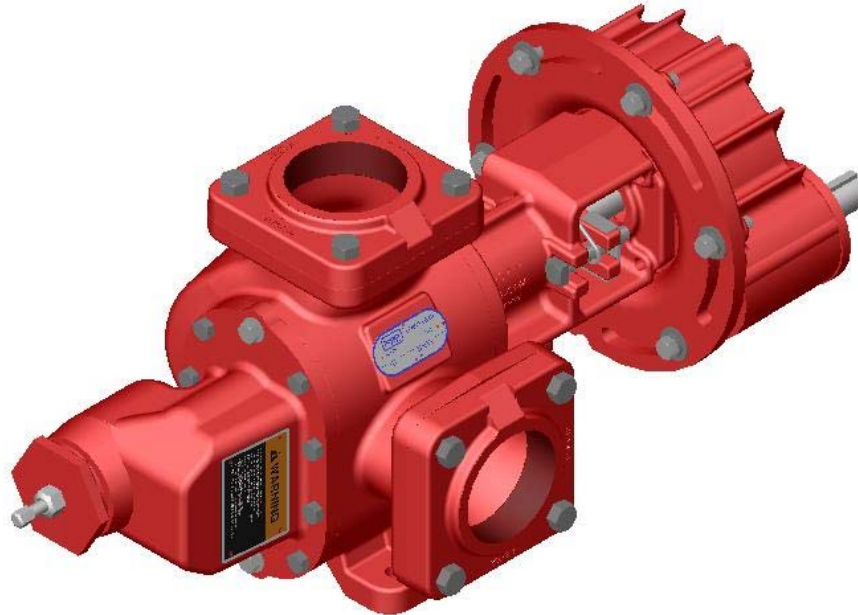
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11/29/11



SAFETY INSTRUCTIONS

This is an industrial component. Only a qualified systems integrator should be allowed to design it into a system. The integrator must determine proper plumbing, mounting, driveline and guard components.

Improper installation or use could lead to a serious, even fatal, accident. The system integrator must communicate all safe operation procedures to the end user(s).

Before operation, fully understand and follow the instructions shown in this manual and any instructions communicated by the system integrator. No one should be allowed to operate or maintain this pump who has not been fully trained to work safely according to the configuration of the pump system and in accordance with all applicable government and industry regulations.

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Good Practice

NOTE: These are general guidelines and do not cover all possible situations.

It is the responsibility of the system integrator to apply this product properly.

Plumbing

1. The inlet pipe should be as short and straight as possible to minimize suction pressure losses. Excessive restrictions at the inlet can cause cavitation resulting in poor performance, noise, vibration, or pump damage.
2. Slope the inlet plumbing appropriately to avoid air pockets.
3. Plumbing weight, misalignment with the ports or thermal expansion can exert excessive force on the pump. Plumbing must be properly supported and aligned with expansion joints, if required, to minimize these forces.
4. To prevent over pressure situations, install a relief valve as close to the pump outlet as possible. Install the relief valve before any shut-off valves.

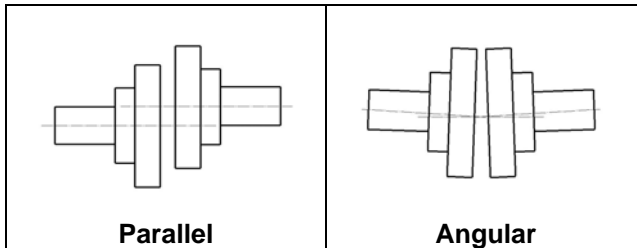
Separate Pump and Drive Assemblies

Driveline Guards

1. Assure adequate guards have been installed to prevent personnel contacting moving components.
2. Follow all OSHA, Federal, state and local codes.

Check Alignment of Pump to Driveline

Excessive misalignment can overload the pump input shaft and cause premature failure. The figures below show parallel and angular misalignments.



Mounting Base

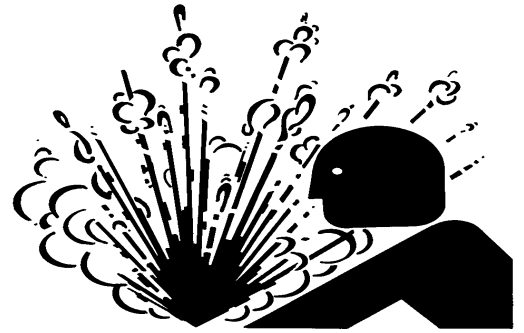
1. Mount the unit on a rigid, heavy base to provide support and absorb shock. Bases should be designed for high rigidity, not just strength.
2. The pump feet were not designed for mounting to concrete and do not have enough contact area to prevent concrete from failing. When mounting to cement or concrete, use a steel base plate (supplied by others) to distribute the mounting stress over an area large enough to prevent the cement from failing. The base plate should be at least as thick as the pump feet. Grout it in place.

Roper Pumps' Close Coupled Drives

Hydraulic drive units where the drive mounts directly to the pump

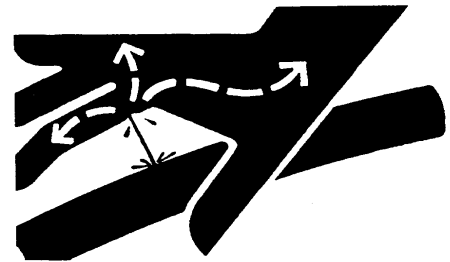
- Driveline is not exposed and does not require guards.
- Alignment between pump and drive line is maintained by the assembly.
- Because the assembly absorbs reaction forces of the driveline, the mounting base does not need to be as robust. The level of rigidity and strength is determined by the piping stresses from the system.

! WARNING



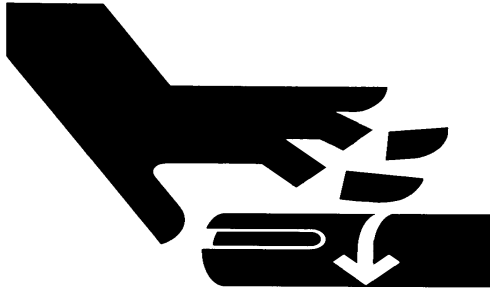
Over-pressure may burst pump or system components. Always include a relief valve in installation. Do not over pressurize pump or block discharge line while running.

! WARNING



Injection Hazard: Do not try to stop a leak with your hand! Avoid any close contact with hydraulic fluid jets. Escaping fluid can penetrate skin, causing serious injury. In case of accident, see a doctor immediately for removal of fluid.

⚠ WARNING

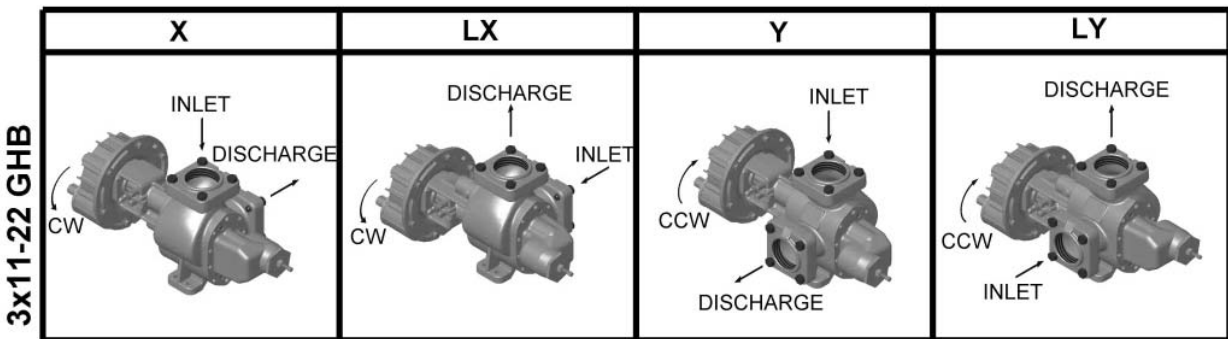
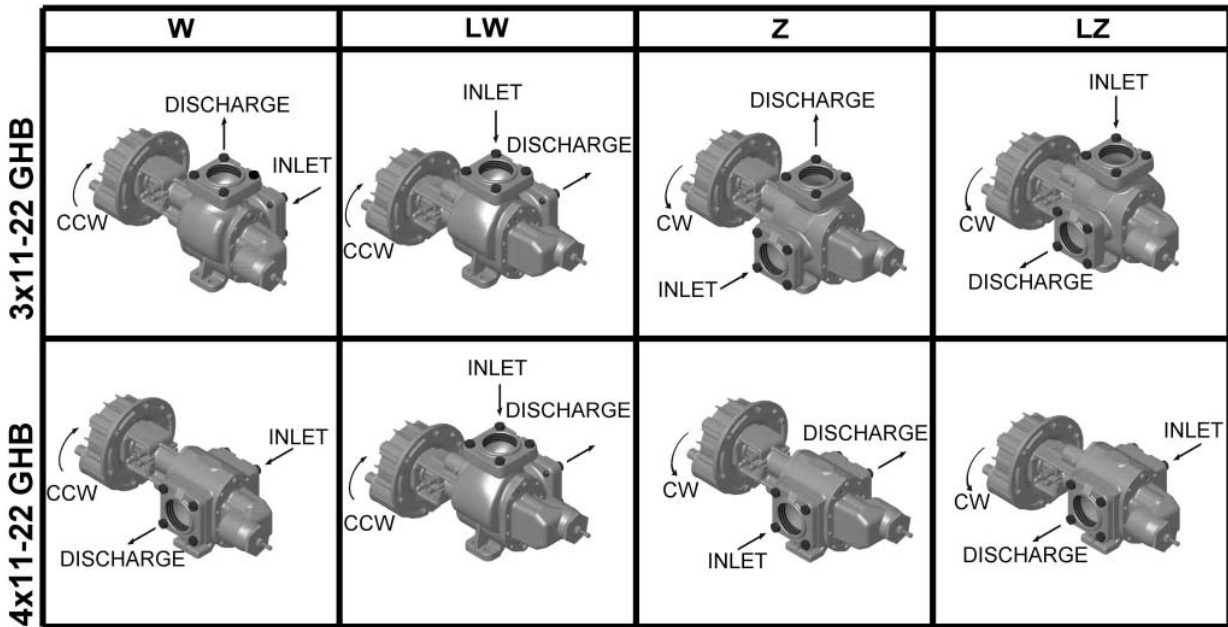


**Operating without guards could result in serious injury or death.
Machinery in operation can grab, crush, cut, mangle and dismember.
Do not operate without adequate guards in place.**

INSTALLATION

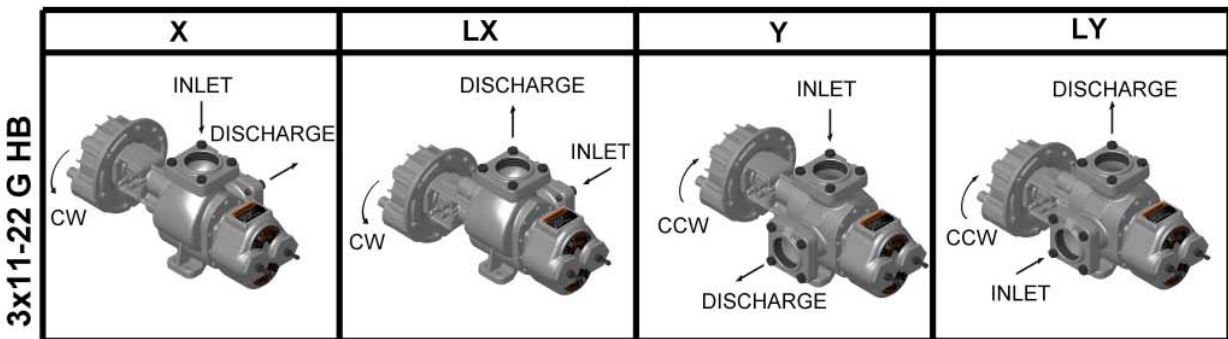
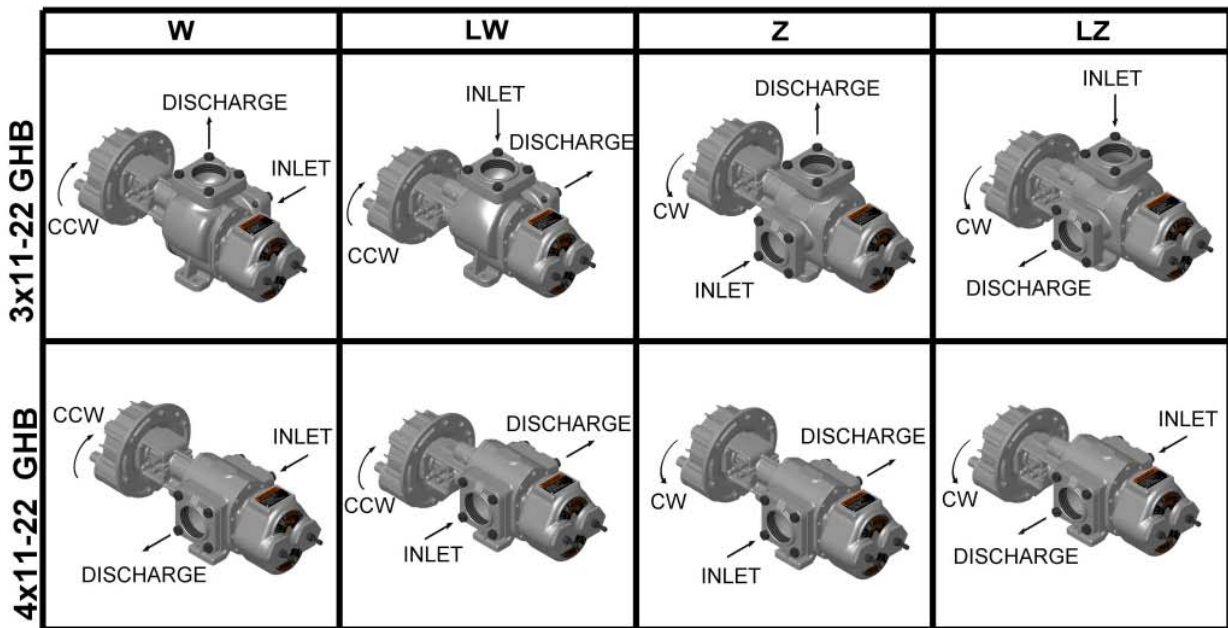
Check Ports Versus Rotation:

Make sure the inlet and discharge ports have been correctly plumbed corresponding to the direction of rotation and the relief valve, if present, is properly positioned. See following drawings for various configurations.



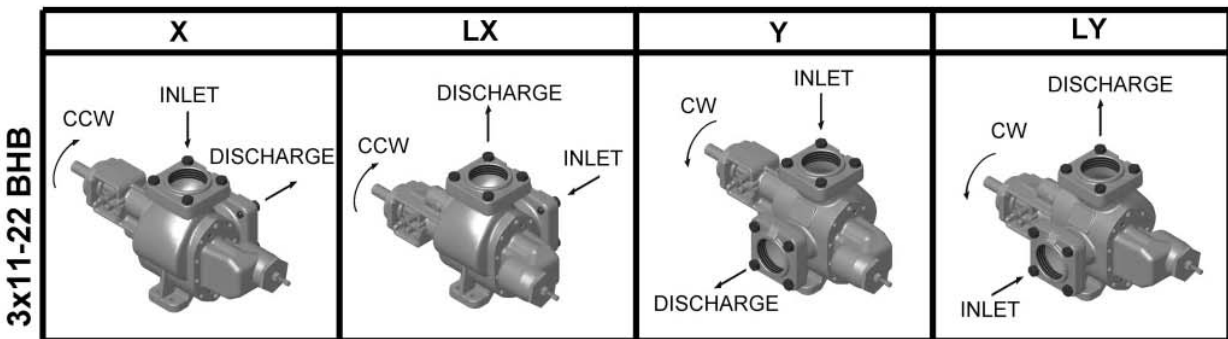
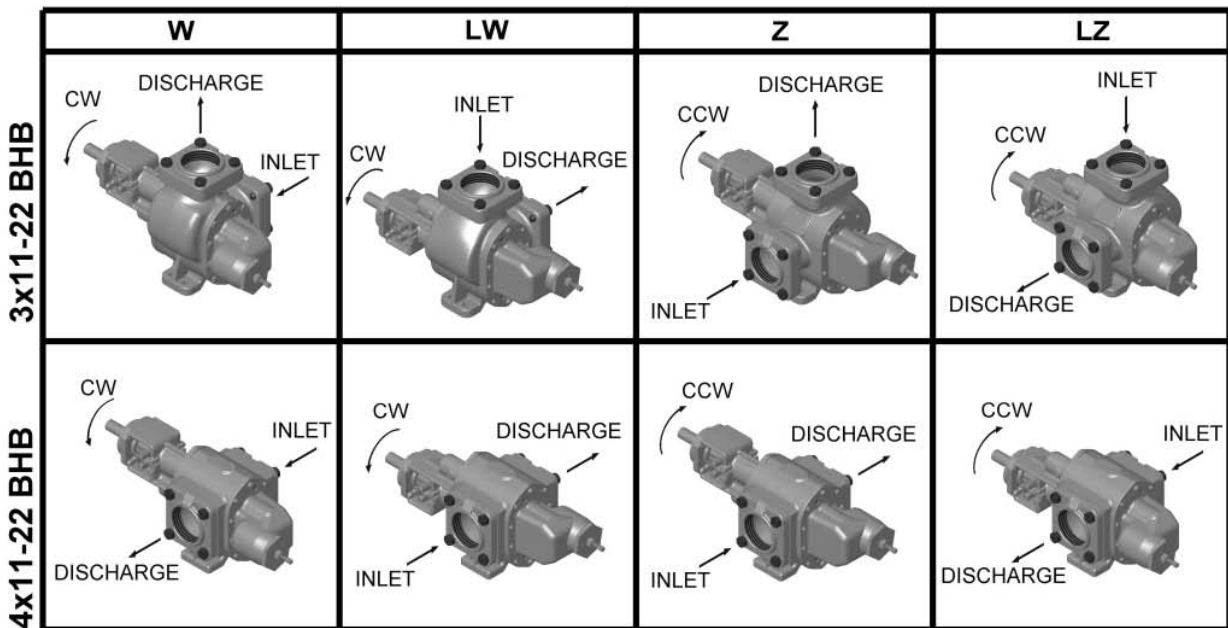
DIRECTION OF ROTATION FOR 3511 TO 4722 GHB PUMPS WITH AND WITHOUT THE RV STYLE SINGLE DIRECTION RELIEF VALVE

Figure A



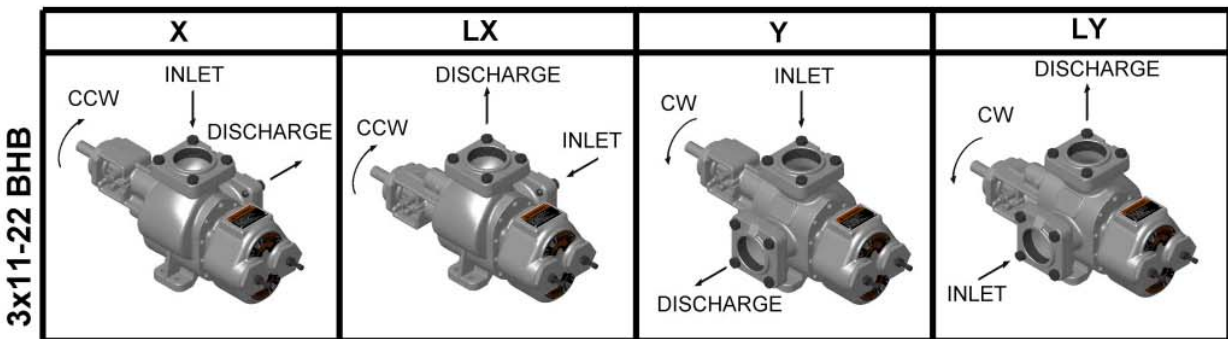
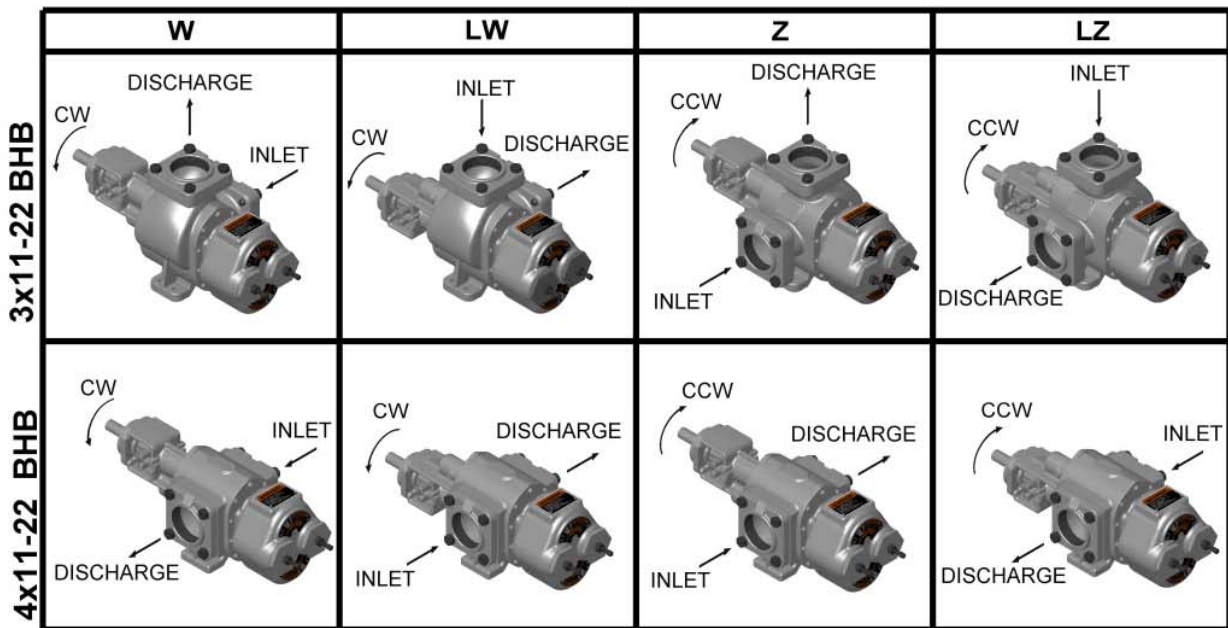
DIRECTION OF ROTATION FOR 3511 TO 4722 GHB PUMPS WITH AND WITHOUT THE BV STYLE SINGLE DIRECTION RELIEF VALVE

Figure B



DIRECTION OF ROTATION FOR 3511 TO 4722 BHB PUMPS WITH AND WITHOUT THE RV STYLE SINGLE DIRECTION RELIEF VALVE

Figure C



DIRECTION OF ROTATION FOR 3511 TO 4722 BHB PUMPS WITH AND WITHOUT THE BV STYLE SINGLE DIRECTION RELIEF VALVE

Figure D

1. RECOMMENDED TOOL LIST

NOTE: Tools not furnished with pump.

Tools for all Pumps:

- (1) Safety Glasses
- (1) 9/16" Combination Wrench
- (1) 3/4" Combination Wrench
- (1) 6" Adjustable Wrench
- (1) CG-45 Snap-On® Tool Bearing Puller
- (1) 6" to 10" Three Square File
- (1) Pliers

Additional Tools for GHB Pumps:

- (1) 1/2" Combination Wrench

Additional Tools for Pumps with an RV or BV Type Relief Valve:

- (1) 7/16" Combination Wrench
- (1) 18" Pipe Wrench

Additional Tools for Pumps with Flanges:

- (2) 15/16" Combination Wrench

Additional Tools for Pumps with Shaft Packing:

Packing Hook for .34" square packing rings

Additional Tools for Pumps with Mechanical Seals:

- (1) 0400 External Retaining Ring Pliers

Additional Tools for BHB and GHB Pumps:

- (1) 5/16" Hex Key

2. INSTRUCTIONS FOR PUMP DISASSEMBLY

Refer to **PUMP SECTIONAL DRAWINGS, (Figures 7.1 and 7.2)**

1. Read **WARNINGS** before starting to disassemble pump. While disassembling pump, always inspect disassembled parts and adjacent parts to see if further disassembly is needed. Replace worn or damaged parts as required.
2. If you do not know which pump arrangement you have, collect nameplate data and refer to the Owners Manual for 3511-22 (G12-209), to determine what you have. Consult a Roper distributor or Roper Pump Company if you have any questions.
3. When cleaning or lubricating, use only cleaning solutions and lubricants that are compatible with products being pumped and with sealing elastomers. **DO NOT** use petroleum base products with seals with EPR elastomers. Use a non-petroleum base lubricant with EPR elastomers.
4. Turn off pump and lock out energy source to driver. **DO NOT** proceed further with disassembly of pump if there is the slightest possibility that driver may be started.
5. If used, turn off and disconnect flush from mechanical seal.
6. Close inlet and discharge valves.
7. Remove guard and disconnect coupling between driver and pump.
8. Drain inlet and discharge lines. Disconnect lines from pump inlet and discharge.
9. Follow the procedure in the Owners Manual for 3511-22 (G12-209), **INSTRUCTIONS FOR DRAINING PUMP**.
10. A.) For 3500-4700 "BHB" pumps, go to Section 4, **INSTRUCTIONS FOR DISASSEMBLY OF A TYPE "BHB" HYDRAULIC DRIVE**. After disassembling hydraulic drive, return to this section and follow steps 11 – 20.
B.) For 3500-4700 "GHB" gear reduction unit, follow steps 21 – 32. After disassembling gear reduction unit, return to this section and follow steps 11 – 20.
C.) For 3500-4700 "GHBO" pumps, follow steps 11 – 20.
11. Remove two washer head cap screws (K) and eight hex head cap screws (L) securing faceplate (23A, B, C, D) to case (19A, B, C, D). Remove faceplate (23A, B, C, D).
12. Remove two dowel pins (J) from case.
13. Remove case gaskets (20).
14. On "BHB", "GHB", & "GHBO" pumps, remove drive gear (34) and key (B) from drive shaft (32).
15. Remove idler gear (35) and key (B) from idler shaft (33). Remove idler shaft.
16. Remove two washer head cap screws (K) and eight hex head cap screws (L) securing backplate (6A, B) to case (19A, B, C, D). Separate parts.
17. Remove case gaskets (20) from opposite side of case (19A, B, C, D).
18. Remove two dowel pins (J) from opposite side of case (19A, B, C, D).
19. Remove drive key (A) from drive shaft (32).
20. A.) For 3500/4500 or 3700/4700 "BHB", "GHB", and "GHBO" pumps, follow steps 33 – 40.
B.) For 3600/4600 "BHB", "GHB", and "GHBO" pumps, follow steps 41 – 49.

3500-4700 ‘GHB’ Gear Reduction Unit (See Figures 7.1 and 7.2)

21. Drain oil from gear reduction unit.
22. Remove drive key (A). Remove four hex head cap screws (U) and slide seal retainer (37) assembled with lip seal (39) off end of pinion shaft (42).
23. Remove seal retainer gasket (38) between seal retainer (37) and gear case (44).
24. Remove pinion shaft (42) assembly with ball bearing (41) and retaining ring (40).
25. Remove six hex head cap screws (W), twelve flat washers (X), and six lockwashers (Y).
26. Remove gear case (44). Remove gear case gasket (48).
27. Remove needle bearing (43). This bearing is installed with a press fit.
28. Remove retaining ring (45).
29. Remove drive gear (46). A gear puller may be necessary in removing gear, as a close fit is maintained between gear and shaft.
30. Remove drive gear key (Z).
31. Remove four socket head cap screws (AD) securing cover (49) to backplate (6A, B). Remove cover gasket (50).
32. Remove spacer (47).

3500/4500 or 3700/4700 “BHB”, “GHB”, and “GHBO” Pumps (See Figure 7.1)

33. Remove retaining ring (3) securing ball bearing (2) in place.
34. Remove drive shaft (32) along with ball bearing (2) and retaining ring (4) from backplate (6A, B).
35. Remove ball bearing (2) from drive shaft (32).
36. Remove retaining ring (4) from drive shaft (32).
37. If lip seal (5) is damaged or worn, remove from backplate (6A, B) and discard.
38. Remove two locknuts (F) from square head bolts (G) securing seal retainer (9) to backplate (6A, B). Remove seal retainer (9). If 3500/4500 pump, remove packing washer (18).
39. Clean and lubricate drive shaft (32) with a compatible lubricant prior to removing mechanical seal or triple lip seal (10), making sure that drive shaft is smooth and free from all burrs. Loosen setscrew (if present) on mechanical seal. Remove seal (11). If 3700/4700 pump, inspect sealing surfaces of stationary seal face and inspect rotating element of mechanical seals. If 3500/4500 pump, it is recommended that new gaskets (20, 22, 25) be installed each time pump is disassembled and reassembled. Triple lip seal (10) must be replaced any time it is removed from backplate (6a). Remove retaining ring (12) from drive shaft (32), if applicable.
40. Visually inspect all parts. Replace all worn or damaged parts before reassembling pump. It is recommended that new gaskets (20, 22, 25, if applicable) and new lip seals (5, 10, 39) be installed each time pump is disassembled and reassembled.

3600/4600 “ BHB”, “GHB, and “GHBO” Pumps (See Figure 7.1)

41. Remove retaining ring (3) securing ball bearing (2) in place.
42. Remove two locknuts (F) from square head bolts (G) securing packing gland (14) in place. Remove packing gland clip (13), packing gland (14), spring clip (15), and two square head bolts (G).
43. Remove packing rings (16) and packing washer (18). Remove lantern ring (17) if used. Packing hooks are commercially available to assist in removal of packing.
44. Remove drive shaft (32) along with ball bearing (2) and retaining ring (4) from backplate (6A, B).
45. Remove ball bearing (2) from drive shaft (32).

46. Remove retaining ring (4) from drive shaft (32).
47. Remove lip seal (5) from backplate (6A, B) and discard. It will be damaged during disassembly.
48. Clean drive shaft and adjacent parts. Examine shaft. Replace drive shaft if excessively worn or scored.
49. Visually inspect all parts. Replace all worn or damaged parts before reassembling pump. It is recommended that new gaskets (20, 22, 25, if applicable, 38, 48, 50) and new lip seals (5, 39) be installed each time the pump is disassembled and reassembled.

3. INSTRUCTIONS FOR PUMP ASSEMBLY

Refer to Section 7, **PARTS LIST, (Figures 7.1 and 7.2).**

Refer to Section titled "Check Ports Versus Rotation" (Figures A and B) to assure proper configuration for pump rotation, port location, and relief valve position prior to assembling pump.

1. Visually inspect all parts during assembly. Replace all worn or damaged parts. Although they may appear reusable, it is recommended that new gaskets (20, 22, 25, if applicable, 38, 48, 50) and lip seals (5, 39) be installed when pump is being reassembled.
 - **WARNING!** Only use genuine Roper gaskets. Gasket thickness determines proper clearances. Always check quantity of gaskets removed and replace with exact quantity. Proper material must be used based on application.
2. When cleaning or lubricating, only use products that are compatible with product being pumped and elastomers within pump. **DO NOT** use petroleum base products with seals with EPR elastomers. Clean and lubricate parts with light oil unless EPR elastomers are used. Use a non-petroleum base lubricant with EPR elastomers.
3. Mechanical seals are precision pieces of equipment. Use extreme care not to damage seal faces or elastomers during assembly.
4. Install two hollow dowel pins (J) on each side of case (19A, B, C, D). Place appropriate number of case gaskets (20) on faceplate side of case. Align faceplate (23A, B, C, D) on hollow dowel pins (J). Secure faceplate to case using two washer head cap screws (K) and eight hex head cap screws (L).
5. Place idler gear (35) into case bore. Install key (B) in keyway on idler shaft (33). Slide idler shaft into I.D. of idler gear.
6. A.) For 3500/4500 "BHB", "GHB", and "GHBO" pumps with a Triple Lip seal, follow steps 7-19.
 B.) For 3600/4600 "BHB", "GHB," and "GHBO" pumps with shaft packing, follow steps 20-31.
 C.) For 3700/4700 "BHB," "GHB," and "GHBO" pumps with a standard mechanical seal, follow steps 32-42.
 D.) For 3700/4700 "BHB," "GHB," and "GHBO" pumps with a positive drive mechanical seal, follow steps 43-57.

3500/4500 "BHB," "GHB," and "GHBO" Pumps (Triple Lip Seal) (See Figure 7.1)

7. Place drive gear (34) into case bore.
8. Install two hollow dowel pins (J) in backplate end of case. Place appropriate number of case gaskets (20) on backplate side of case (19A, B, C, D, E).
9. Set case assembly aside and build backplate assembly as described in following steps.
10. Place triple lip seal (10) with two lips facing toward seal chamber onto opening of seal chamber in backplate (6A, B). Press triple lip seal into seal chamber until back side of seal is flush with face of seal chamber. Take care to use a tool that will not damage or distort seal casing. Install one packing washer (18).
11. Place one square head bolt (G) through each slot in backplate (6A, B) and through each hole in seal retainer (9). Using two locknuts (F), secure seal retainer in place.

12. Use a small file or stone to break sharp edges of drive shaft (32) keyway that will be under pump drive gear (34).
13. Lubricate triple lip seal (10) in backplate and shaft on end that will slide through triple lip seal with a light oil. Carefully slide shaft through backplate and triple lip seal from outboard bearing end until ball bearing (2) seats in bearing bore.
14. Install lip seal (5) in backplate (6A, B).
15. Install retaining ring (4) on drive shaft (32).
16. Install ball bearing (2) on drive shaft (32) and into backplate (6A, B) using retaining ring (3) to secure ball bearing (2) in place. The fit between drive shaft and ball bearing may be a light press fit. **DO NOT** damage seal parts while pressing ball bearing on drive shaft.
17. Install spacer (47).
18. Install key (B) in keyway of drive shaft (32). Slide drive shaft into bore of drive gear while aligning backplate (6A, B) on dowel pins (J). Secure backplate (6A, B) to case (19A, B, C, D) using two washer head cap screws (K) and eight hex head cap screws (L).
19. A.) For 3500/4700 “GHB” gear reduction unit, follow steps 58 – 66.
 B.) For 3500/4700 “BHB” hydraulic drive assembly, go to Section 5, **INSTRUCTIONS FOR ASSEMBLY OF A TYPE “BHB” HYDRAULIC DRIVE**, in the following pages.

3600/4600 “BHB”, “GHB”, and “GHBO” Pumps (See Figure 7.1)

20. Place drive gear (34) into case bore. Install key (B) in keyway of drive shaft (32). Slide drive shaft into bore of drive gear.
21. Place appropriate number of case gaskets (20) on backplate side of case (19A, B, C, D). Align backplate (6A, B) on dowel pins (J). Secure backplate to case using two washer head cap screws (K) and eight hex head cap screws (L).
22. Install packing washer (18) over drive shaft (32) into packing bore of backplate.
23. Install packing rings (16) and lantern ring (17), if used, in packing bore of backplate. Stagger joints on each ring 180° apart. Seat each ring before adding next ring. Rings must not be tamped or seated too tightly.
24. Check drive shaft (32) for free movement after each ring is installed.
25. When packing box is sufficiently full to allow entry of packing gland (14) about ¼ of an inch [6 mm], reassemble packing gland.
26. Place one square head bolt (G) through each slot in backplate (6A, B) and through each hole in packing gland (14). Install packing gland (14) into packing box about ¼ of an inch [6 mm]. Slide packing gland clip (13) over square head bolts (G). Using two locknuts (F), secure packing gland (14) in place. Install spring clip (15) across square head bolts (G). Draw locknuts up evenly on packing to assure proper seating of packing (16), then loosen locknuts about ½ turn. **DO NOT** cock packing gland. This could cause binding or heating of drive shaft.
27. Install lip seal (5) in backplate (6A, B).
28. Install retaining ring (4) on drive shaft (32).
29. Install ball bearing (2) on drive shaft (32) and into backplate (6A, B) using retaining ring (3) to secure ball bearing (2) in place as shown in sectional drawing Figure 7.1. The fit between the drive shaft and ball bearing may be a light press fit.
30. Install spacer (47).
31. A.) For 3600/4600 “GHB” gear reduction unit, follow steps 58 –66.
 B.) For 3600/4600 “BHB” hydraulic drive assembly, go to Section 5, **INSTRUCTIONS FOR ASSEMBLY OF A TYPE “BHB” HYDRAULIC DRIVE**, in the following pages.

3700/4700 “BHB,” “GHB,” and “GHBO” Pumps (Standard Mechanical Seal) (See Figure 7.1)

32. Place drive gear (34) into case bore. Install key (B) in keyway of drive shaft (32). Slide drive shaft into bore of drive gear.
33. Place appropriate number of case gaskets (20) on backplate side of case (19A, B, C, D). Align backplate (6A, B) on dowel pins (J). Secure backplate to case using two washer head cap screws (K) and eight hex head cap screws (L).
34. If mechanical seal pump, install retaining ring (12) on drive shaft (32).
35. Carefully remove all burrs and sharp edges from shaft over which rotating element of seal will slide.
36. Lubricate drive shaft and mechanical seal bore with a compatible lubricant. Install mechanical seal (11) on drive shaft. Position mechanical seal back against retaining ring (12). For mechanical seal, care must be taken not to nick o-ring. Lapped (polished) faces of stationary seal face and rotating element must be together.
37. Install lip seal (5) in backplate (6A, B).
38. Install retaining ring (4) on drive shaft (32).
39. Install ball bearing (2) on drive shaft (32) and into backplate (6A, B) using retaining ring (3) to secure ball bearing (2) in place. The fit between drive shaft and ball bearing may be a light press fit. **DO NOT** damage seal parts while pressing ball bearing on drive shaft.
40. Place one square head bolt (G) through each slot in backplate (6A, B) and through each hole in seal retainer (9). Secure seal retainer against backplate using two locknuts (F).
41. Install spacer (47).
42. A.) For 3700/4700 “GHB” gear reduction unit, follow steps 58 – 66.
B.) For 3700/4700 “BHB” hydraulic drive assembly, go to Section 5, **INSTRUCTIONS FOR ASSEMBLY OF A TYPE “BHB” HYDRAULIC DRIVE**, in the following pages.

3700/4700 “BHB,” “GHB,” and “GHBO” Pumps (Positive Drive Mechanical Seal) (See Figure 7.1)

43. Place drive gear (34) into case bore.
44. Install retaining ring (12) on drive shaft (32) to locate mechanical seal.
45. Carefully remove all burrs and sharp edges on shaft over which the rotating element of seal will slide.
46. Apply a compatible lubricant to seal I.D. and O.D. of drive shaft (32).
47. Slide rotating element of mechanical seal (11) onto drive shaft (32) before removing three or four clips that are taped to rotating element. Push rotating element back against retaining ring (12), tighten setscrews in seal, and remove clips that are taped to seal.
48. Slide faceplate end of drive shaft (32), with mechanical seal attached, into backplate (6A, B) through bore for ball bearing.
49. Place appropriate number of case gaskets (20) on backplate side of case (19A, B, C, D). Install key (B) in keyway of drive shaft (32). Slide drive shaft into bore of drive gear while aligning backplate (6A, B) on dowel pins (J). Secure backplate (6A, B) to case (19A, B, C, D) using two washer head cap screws (K) and eight hex head cap screws (L).
50. Lubricate o-ring on stationary seal face and seal chamber bore with a compatible lubricant. Slide stationary seal face over keyway end of drive shaft (32) and down to seal chamber. Be sure lapped (polished) face is toward rotating member of seal. Push stationary seal face into seal chamber.
51. Install lip seal (5) in backplate (6A, B).
52. Install retaining ring (40) on drive shaft (32).

53. Install ball bearing (2) on drive shaft (32) and into backplate (6A, B) using retaining ring (3) to secure ball bearing (2) in place. The fit between drive shaft and ball bearing may be a light press fit. **DO NOT** damage seal parts while pressing ball bearing on drive shaft.
54. Install anti-rotation pin (T) in locator ring (60).
55. Position locator ring (60) with anti-rotation pin (T) toward seal face. Align anti-rotation pin (T) with slot in back of stationary seal face and push into counterbore of backplate (6A, B).
56. Place one square head bolt (G) through each hole in seal retainer (9). Secure seal retainer against backplate using two locknuts (F).
57. A.) For 3700/4700 “GHB” gear reduction unit, follow steps 58 – 66.
 B.) For 3700/4700 “BHB” hydraulic drive assembly, go to Section 5, **INSTRUCTIONS FOR ASSEMBLY OF A TYPE “BHB” HYDRAULIC DRIVE.**

3500-4700 “GHB” Gear Reduction Unit (See Figures 7.1 and 7.2)

58. Install cover gasket (50) and cover (49) on backplate (6A, B) using four socket head cap screws (AD).
59. Install key (Z) in keyway of drive shaft (32). Place drive gear (46) on drive shaft (32). Secure in place using retaining ring (45).
60. Install needle bearing (43). The needle bearing is a press fit bore.
61. Install gear case (44) and gear case gasket (48) using six hex head cap screws (W), twelve flat washers (X), and six lockwashers (Y).
62. Press ball bearing (41) onto pinion shaft (42) and install retaining ring (40).
63. Install pinion shaft assembly by sliding small end of pinion shaft into needle bearing (43) at same time gears are meshed together.
64. Slide bearing retainer (37) assembled with lip seal (39) and bearing retainer gasket (38) into place. Secure bearing retainer (37) to gear case (44) using four hex head cap screws (U) and four lockwashers (V).
65. Install drive key (A).
66. Read and understand all safety instructions and warnings before installing and operating pump.

4. INSTRUCTIONS FOR DISASSEMBLY OF A TYPE “BHB” HYDRAULIC DRIVE

Refer to Section 7, **PARTS LIST**.

1. Read **WARNINGS** before starting to disassemble hydraulic drive components from pump. While disassembling, always inspect disassembled parts and adjacent parts to see if further disassembly is needed. Replace worn or damaged parts as required.
2. Turn off pump and lock out energy source to hydraulic motor. **DO NOT** proceed further with disassembly of pump if there is the slightest possibility that hydraulic motor may be started.
3. Close inlet and discharge valves.

4. If pump is to be disassembled:
 - A.) Refer to pump sectional drawing for “**GHBFORV**”.
 - B.) If used, turn off and disconnect flush for packing or mechanical seal.
 - C.) Follow the procedures in the Owners Manual for 3511-22 (G12-209), **INSTRUCTIONS FOR DRAINING PUMP**.
 - D.) Disconnect lines from pump inlet and discharge.
5. Remove six socket head cap screws (AE) and six lockwashers (AF) that secure bracket (51) and bracket (52) together. Slide apart.
6. Remove cap screws that secure hydraulic motor to bracket (52).
7. Rotate bracket (52) until hole for loosening setscrew lines up with setscrew in coupling half (54). Loosen setscrew and remove coupling half.
8. Remove coupling spider (55).
9. Rotate drive shaft of pump (32) until setscrew in coupling half (53) lines up with hole for loosening setscrew. Loosen setscrew. Remove retaining ring (45) from drive shaft and remove coupling half.
10. Remove drive key (Z).
11. Remove four socket head cap screws (AD) that secure bracket (51) to backplate (6A, B). Remove bracket.
12. For further disassembly of the pump, refer to Section 2, **INSTRUCTIONS FOR PUMP DISASSEMBLY**, steps 1 – 20. Also, refer to steps 41 – 49 for pumps with packing, or steps 33 – 40 for pumps with mechanical seals or triple lip seals.

5. INSTRUCTIONS FOR ASSEMBLY OF A TYPE “BHB” HYDRAULIC DRIVE

1. Refer to Section 3, **INSTRUCTIONS FOR PUMP ASSEMBLY**, steps 1 – 5. For installing triple lip seal, refer to steps 7 – 19. For installing packing, refer to steps 20 – 32. For installing mechanical seal, refer to steps 32 – 57.
2. Refer to sectional drawing (Figure 7.3) for **TYPE “BHB” HYDRAULIC DRIVE COUPLING ASSEMBLY**.
3. Secure bracket (51) to backplate (6A, B) using four socket head cap screws (AD).
4. Install key (Z) in shaft keyway. Place coupling half (53) on drive shaft (32). Install retaining ring (45). Rotate drive shaft (32) until setscrew lines up with hole in bracket (52), then tighten setscrew.
5. Install coupling spider (55).
6. Place bracket (52) onto pilot of hydraulic motor. **DO NOT** secure bracket into place at this time.
7. Place coupling half (54) onto shaft of hydraulic motor to dimension shown. Rotate bracket (52) until hole in bracket lines up with setscrew on coupling half. Tighten setscrew.
8. Rotate bracket on motor to line up motor mounting holes with bracket holes. Secure bracket (52) to hydraulic motor using appropriate fasteners.
9. Secure bracket (52) to bracket (51) using six socket head cap screws (AE) and six lockwashers (AF).
10. Read and understand all safety instructions and warnings before installing and operating pump.

6. GEAR REDUCTION UNIT

ALIGNING GHB PINION SHAFT HEIGHT

Refer to Section 7, **PARTS LIST**.

The pinion shaft of the GHB gear reducer can be positioned at any location over a full 360°. This must be done before the gear reducer oil is added. The pinion shaft can be positioned in the following manner.

1. Loosen six hex head cap screws (W).
2. Rotate gear case (44) on six slots in cover (49).
3. If pinion shaft (42) cannot be moved to proper position at this point, remove six hex head cap screws (W) along with washers (X and Y).
4. Rotate pinion shaft to desired position. Reinstall and tighten six hex head cap screws (W) along with six flat washers (X) and six lockwashers (Y).
5. If six threaded holes in gear case (44) are not fully visible within cast slots on cover (49), gear reducer will have to be partially disassembled so that cover (49) can be rotated.
6. Slide gear case (44) off of cover (49).
7. Remove retaining ring (45) from end of pump drive shaft (32).
8. Remove drive gear (46). A gear puller may be necessary.
9. Remove four socket head cap screws (AD).
10. Rotate cover (49) 90° and reinstall and tighten four socket head cap screws.
11. Install drive gear (46) on drive shaft (32).
12. Install retaining ring (45).
13. Replace gasket (48) and slip gear case (44) complete with pinion assembly onto cover (49).
14. Rotate pinion to desired position. Install and tighten six hex head cap screws (W) along with six flat washers (X) and six lockwashers (Y).
15. If necessary, reposition plugs (AA), petcock (AC), and oil cup (AB). Oil cup should be at uppermost point and petcock at second hole from bottom.
16. Refill with oil to level of petcock (AC) using Gulf® Senate 375, Mobil® 600 W Cylinder Oil, or AGMA No. 7 compounded oil.

LUBRICATION INSTRUCTIONS FOR INITIAL START-UP

The oil cup (AB) is shipped separately to prevent breakage. Before placing the gear reduction unit in operation, install the oil cup (AB) and check the oil level in unit. The oil level should be maintained even with petcock (AC) at all times.

SERVICING INSTRUCTIONS

The oil should be clean and free from sludge at all times and should be changed at regular intervals. A drain plug (AA) has been provided near the bottom of the gear case (44) for this purpose. The oil (Gulf® Senate 374, Mobil® 600 W Cylinder Oil, or AGMA NO. 7 compounded oil) should be changed every 1000 hours or every four months, whichever comes first. Where operating conditions are severe, such as rapid rise and fall of temperature, or the atmosphere is moist or dusty, it may be necessary to change the oil every one or two months or sooner. The oil cup (AB) at the front of the gear case (44) is for filling the unit with oil and also serves as a breather. **DO NOT** allow the oil cup (AB) to become clogged. This could cause excessive pressure inside the gear case (44).

CHANGING RATIO OF GEAR REDUCTION UNIT

Refer to appropriate sectional drawing (Figure 7.2) showing internal construction of the gear reduction assembly. The internal construction for all ratios are identical, except for the drive gear (46) and pinion shaft (42), which determines the gear ratio of that particular unit. The drive gear (46) and pinion shaft (42) are interchangeable in pairs only. See **GEAR RATIO CHART** for ratios available. It is recommended that new gaskets (38, 48) and new lip seal (39) be installed each time unit is disassembled and reassembled.

1. Turn off pump and lock out energy source to driver. **DO NOT** proceed further with disassembly of gear reduction unit if there is the slightest possibility that driver may be started.
2. Drain oil from gear reduction unit.
3. If unit is assembled on a baseplate, directly connected to a motor, it will be necessary to remove flexible coupling as follows:
 - A.) Loosen setscrew on motor half of coupling.
 - B.) Slide motor coupling half towards motor to clear pump coupling half. (In case coupling cannot be removed in this manner, it will be necessary to remove either motor or pump in order to remove pump coupling half.)
4. Loosen six hex head cap screws (W) and rotate gear case (44) in slots provided until pump coupling half is clear of motor coupling half. Remove pump coupling half.
5. Remove drive key (A). Remove four hex head cap screws (U) and four lockwashers (V). Slide seal retainer (37) assembled with lip seal (39) off the end of pinion shaft (42).
6. Remove seal retainer gasket (38) between seal retainer (37) and gear case (44).
7. Remove pinion shaft (42) assembly with ball bearing (41) and retaining ring (40).
8. Remove six hex head cap screws (W), twelve flat washers (X), and six lockwashers (Y).
9. Remove gear case (44). Remove gear case gasket (48).
10. Remove retaining ring (45).
11. Remove drive gear (46). A gear puller may be necessary in removing gear, as a close fit is maintained between gear and shaft.
12. Refer to gear ratio chart to select desired gear ratio.
13. Slide drive gear (46) on drive shaft (32) securing in place using retaining ring (45). Make sure key (Z) and spacer (47) are in place. The number of teeth or part number is stamped on drive gear (46). On standard units, last two numbers of part number represent number of teeth on gear.
14. Install gear case (44) and gear case gasket (48) using six hex head cap screws (W), twelve flat washers (X), and six lockwashers (Y).
15. Press ball bearing (41) onto pinion shaft (42) and install retaining ring (40).
16. Install pinion shaft assembly by sliding small end of pinion shaft into needle bearing (43) at same time gears are meshed together.
17. Slide bearing retainer (37) assembled with lip seal (39) and bearing retainer gasket (38) into place. Secure bearing retainer (37) to gear case (44) using four hex head cap screws (U) and four lockwashers (V).
18. Install drive key (A).
19. Install pump coupling half and tighten setscrews on drive key (A).
20. Rotate gear case (44) until coupling halves are accurately aligned. Tighten six hex head cap screws (W). Assemble coupling and tighten setscrew in motor coupling half.
21. Refill with oil to level of petcock (AC) using Gulf® Senate 375, Mobil® 600 W Cylinder Oil, or AGMA No. 7 compounded oil.

GEAR REDUCTION RATIOS AND CAPABILITIES

Gear reducers are rated to transmit up to the horsepowers (kW) shown below. Three interchangeable gear ratios are available.

3511 THRU 4722 PUMPS			60 Hz OPERATION			50 Hz OPERATION		
GEAR RATIO	NUMBER OF TEETH		MOTOR RPM	PUMP RPM	MAX HP ALLOWED	MOTOR RPM	PUMP RPM	MAX KW ALLOWED
	HIGH SPEED GEAR	LOW SPEED GEAR						
4.60	15	69	580	126	2.8	485	105	1.7
3.94	17	67		147	3.3		123	2.2
3.20	20	64		181	4.0		152	2.7
4.60	15	69	870	189	4.2	760	159	2.8
3.94	17	67		221	4.9		185	3.3
3.20	20	64		272	6.1		228	4.0
4.60	15	69	1150	250	5.5	950	206	3.6
3.94	17	67		290	6.5		241	4.3
3.20	20	64		360	8.0		296	5.3
4.60	15	69	1750	380	8.5	1450	315	5.6
3.94	17	67		445	10.0		368	6.6
3.20	20	64		545	10.0		453	6.6
4.60	15	69	3450	750	10.0	2850	620	6.6

7. PARTS LIST

- | | |
|---|--|
| 2. Ball Bearing | 27. Nut, Lock and Seal |
| 3. Retaining Ring, Bearing Cage | 28. Spring Guide |
| 4. Retaining Ring, Ball Bearing | 29. Spring |
| 5. Lip Seal (GHB) | 30. Poppet |
| 6. Backplate | 31. Adapter |
| A. Standard | 32. Drive Shaft |
| B. Jacketed | 33. Idler Shaft |
| 7. Bearing, Short | 34. Drive Gear |
| 8. Bearing, Long | 35. Idler Gear |
| 9. Seal Retainer | 57. Expansion Washer |
| 10. Triple Lip Seal | 58. Cam, Double Setting Relief Valve only |
| 11. Mechanical Seal | 59. Operating Piston, Double Setting Relief Valve only |
| 12. Retaining Ring, Mechanical Seal | 60. Locator Ring |
| 13. Packing Gland Clip | WRN2 Warning Plate, RV Style Relief Valve |
| 14. Packing Gland | WRN3 Warning Plate, RV Style Relief Valve |
| 15. Spring Clip | WRN4 Warning Plate, RV Style Relief Valve |
| 16. Packing Ring | B. Key, Gear |
| 17. Lantern Ring (Not Shown) | E. Hex Head Cap Screw, Seal Retainer to Backplate |
| 18. Packing Washer | F. Locknut |
| 19. Case | G. Square Head Bolt |
| A. ANSI Flanged – Straight Through | H. Pipe Plug, Backplate |
| B. Threaded Port Case – Right Angle | J. Dowel Pin |
| C. Flanged Case – Right Angle | K. Washer Head Cap Screw, Endplates to Case |
| D. Flanged Case – Straight Through | L. Hex Head Cap Screw, Endplates to Case |
| 20. Case Gasket | M. Hex Head Cap Screw, Flange Nut, Flange |
| 21. Flange | S. Pipe Plug, Faceplate |
| 22. Flange Gasket | T. Anti-rotation Pin |
| 23. Faceplate | AJ. Drive Screw |
| A. Plain | AK. Ball Handle, Double Setting Relief Valve only |
| B. RV Style Relief Valve | AL. Stud, Double Setting Relief Valve only |
| C. Jacketed RV Style Relief Valve | |
| D. BV Style Bi-Directional Relief Valve | |
| 24. Relief Valve Cap | |
| 25. Relief Valve Cap, Gasket | |
| 26. Adjusting Screw | |

AM. Self Locking Nut, Double Setting Relief Valve only

AN. Hex Head Cap Screw, Double Setting Relief Valve only

AP. O-Ring, Double Setting Relief Valve only

Gear Reduction Assembly only

37. Seal Retainer

38. Bearing Retainer Gasket

39. Lip Seal

40. Retaining Ring, Ball Bearing

41. Ball Bearing

42. Pinion Gear and Shaft

43. Needle Bearing

44. Gear Case

45. Retaining Ring, Drive Gear

46. Drive Gear

47. Spacer

48. Gear Case Gasket

49. Cover

50. Cover Gasket

U. Hex Head Cap Screw,
Bearing Retainer to Gear Case

V. Lockwasher, Bearing Retainer

W. Hex Head Cap Screw, Cover to Gear Case

X. Flat Washer, Gear Case

Y. Lockwasher, Gear Case

Z. Key, Drive Gear

AA. Pipe Plug, Gear Case

AB. Oil Cup, Gear Case

AC. Petcock, Gear Case

AD. Socket Head Cap Screw, Cover to Backplate

Type BHB Hydraulic Drive Bracket Assembly only

51. Bracket Half, Pump

52. Bracket Half, Motor

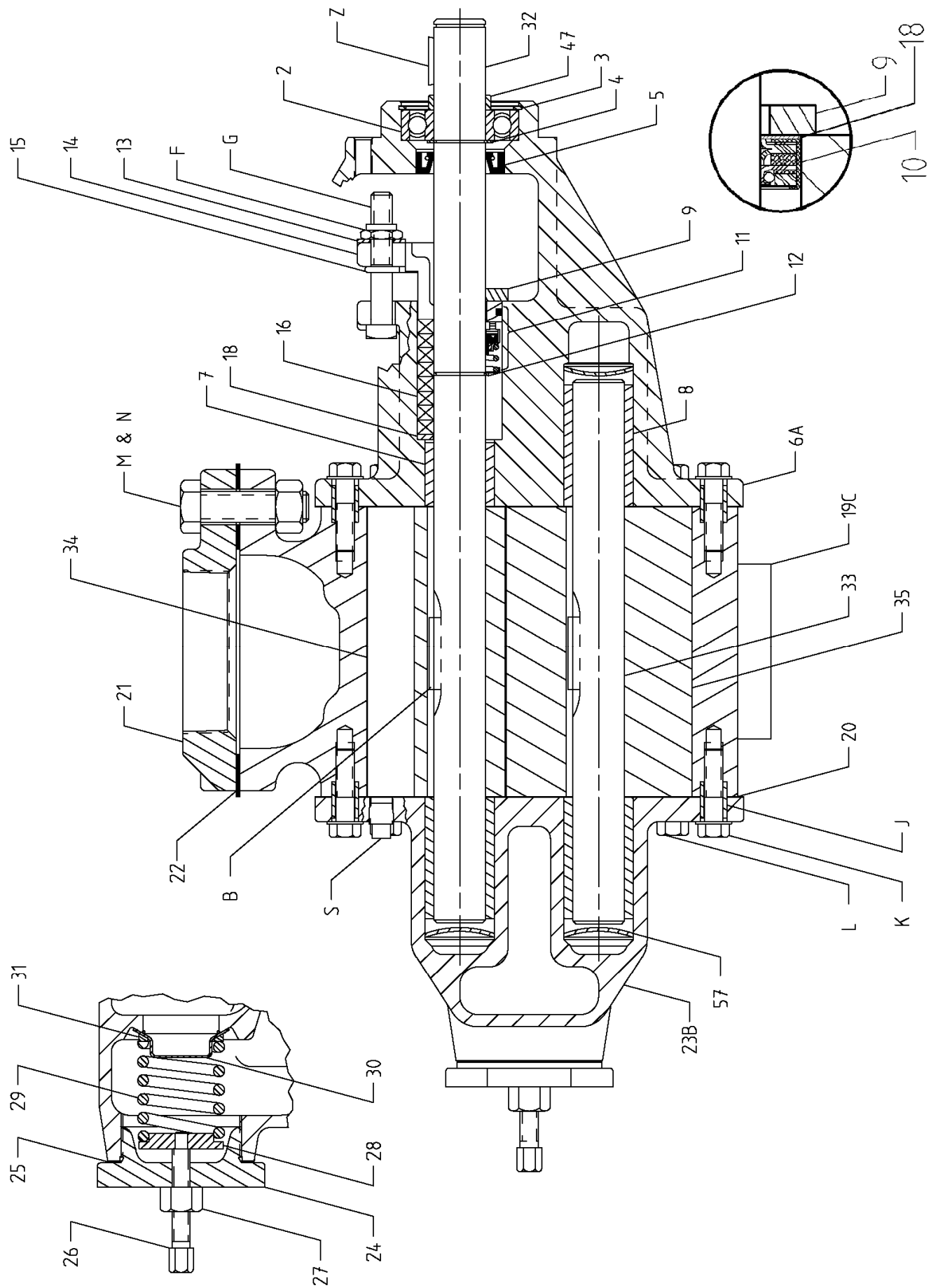
53. Coupling Half, Pump

54. Coupling half, Motor

55. Spider Coupling

AE. Socket Head Cap Screw, Bracket to Bracket

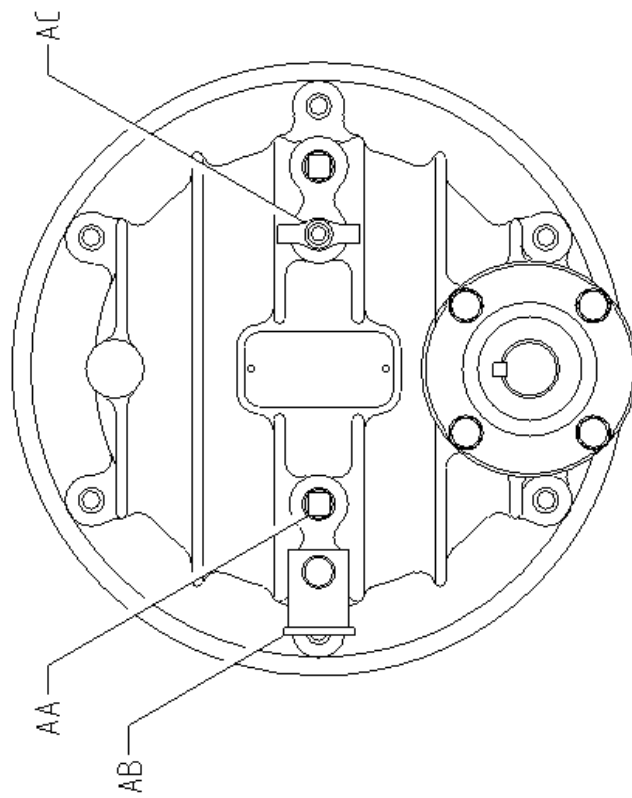
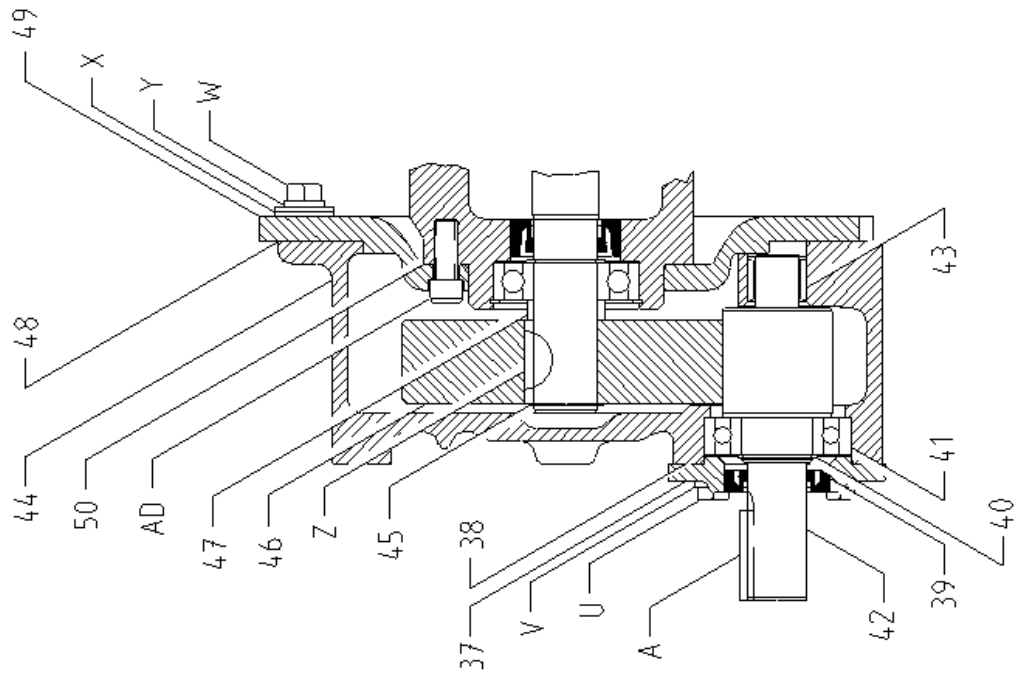
AF. Lockwasher



TRIPLE LIP SEAL

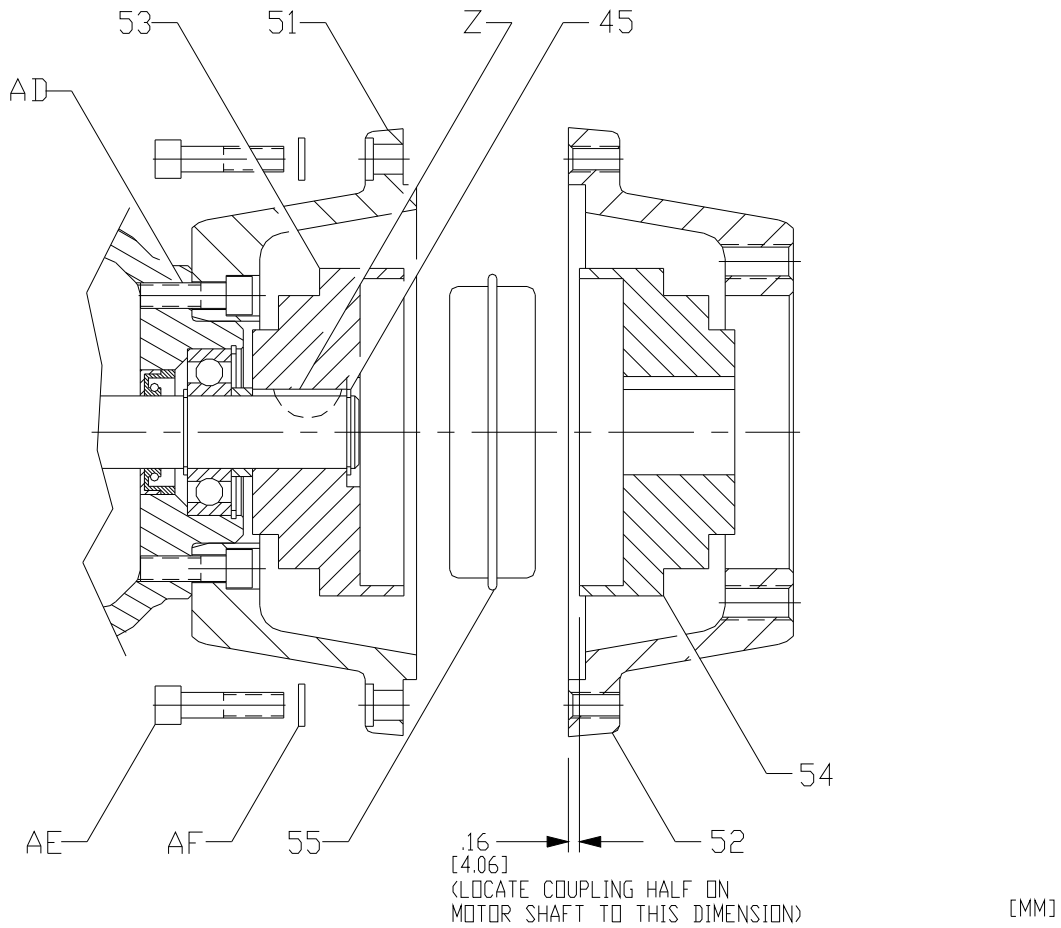
3511-4722 GH.B,F.O.RV

Figure 7.1



GEAR REDUCTION ASSEMBLY

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3532 - 4758

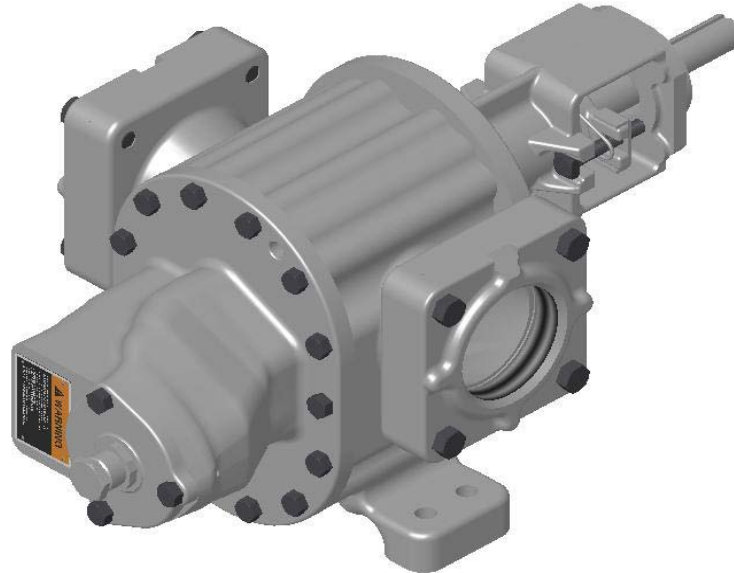
G12-210

HB and BH

11/29/11

OWNERS MANUAL

(Use with Supplement Owners Manual
G12-437 for GHB and BHB Pumps)



SAFETY INSTRUCTIONS

This is an industrial component. Only a qualified systems integrator should be allowed to design it into a system. The integrator must determine proper plumbing, mounting, driveline and guard components.

Improper installation or use could lead to a serious, even fatal, accident. The system integrator must communicate all safe operation procedures to the end user(s).

Before operation, fully understand and follow the instructions shown in this manual and any instructions communicated by the system integrator. No one should be allowed to operate or maintain this pump who has not been fully trained to work safely according to the configuration of the pump system and in accordance with all applicable government and industry regulations.

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www.roperpumps.com

Good Practice

NOTE: These are general guidelines and do not cover all possible situations.

It is the responsibility of the system integrator to apply this product properly.

Plumbing

1. The inlet pipe should be as short and straight as possible to minimize suction pressure losses. Excessive restrictions at the inlet can cause cavitation resulting in poor performance, noise, vibration, or pump damage.
2. Slope the inlet plumbing appropriately to avoid air pockets.
3. Plumbing weight, misalignment with the ports or thermal expansion can exert excessive force on the pump. Plumbing must be properly supported and aligned with expansion joints, if required, to minimize these forces.
4. To prevent over pressure situations, install a relief valve as close to the pump outlet as possible. Install the relief valve before any shut-off valves.

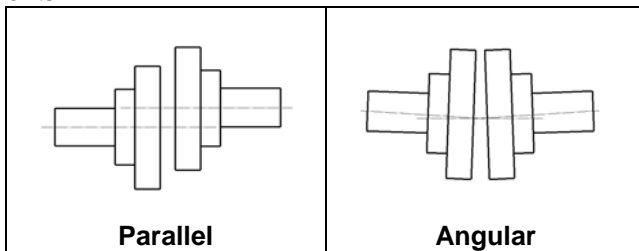
Separate Pump and Drive Assemblies

Driveline Guards

1. Assure adequate guards have been installed to prevent personnel contacting moving components.
2. Follow all OSHA, Federal, state and local codes.

Check Alignment of Pump to Driveline

Excessive misalignment can overload the pump input shaft and cause premature failure. The figures below show parallel and angular misalignments.



Mounting Base

1. Mount the unit on a rigid, heavy base to provide support and absorb shock. Bases should be designed for high rigidity, not just strength.
2. The pump feet were not designed for mounting to concrete and do not have enough contact area to prevent concrete from failing. When mounting to cement or concrete, use a steel base plate (supplied by others) to distribute the mounting stress over an area large enough to prevent the cement from failing. The base plate should be at least as thick as the pump feet. Grout it in place.

Roper Pumps' Close Coupled Drives

Hydraulic or Gearmotor units where the drive mounts directly to the pump

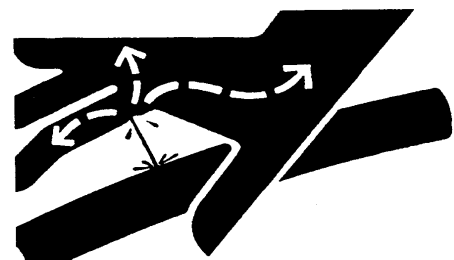
- Driveline is not exposed and does not require guards.
- Alignment between pump and drive line is maintained by the assembly.
- Because the assembly absorbs reaction forces of the driveline, the mounting base does not need to be as robust. The level of rigidity and strength is determined by the piping stresses from the system.

! WARNING



Over-pressure may burst pump or system components. Always include a relief valve in installation. Do not over pressurize pump or block discharge line while running.

! WARNING



Injection Hazard: Do not try to stop a leak with your hand! Avoid any close contact with hydraulic fluid jets. Escaping fluid can penetrate skin, causing serious injury. In case of accident, see a doctor immediately for removal of fluid.

Guarding PTO Drive Shafts

PTO drive systems can be dangerous and when used, additional safety precautions, including guarding, may be required and must be provided by the drive system installer. Roper Pump Company has no responsibility for recommending or providing proper guarding or other safety measures in any particular application.

The installation of proper guards for the power take-off and its associated equipment is the responsibility of the drive system designer and the installer who know the particular product application and the user's exposure to danger. *The ultimate responsibility for the safe application and installation is the user's.*

! WARNING


<p>Operating without guards could result in serious injury or death. Machinery in operation can grab, crush, cut, mangle and dismember. Do not operate without adequate guards in place.</p>

1. NAMEPLATE DATA

Roper Pump Company identifies each pump manufactured by a metal nameplate attached to the pump. This nameplate describes the pump as built at the factory. Copy the nameplate data from your pump in the area provided below. Use this for ready reference when ordering repair parts or when consulting with a Roper distributor or Roper Pump Company about this pump.

MODEL NUMBER: _____
SPEC NUMBER: _____
TYPE: _____
SERIAL NUMBER: _____

PUMP NOMENCLATURE

MODEL 3735 GHBFORVLX

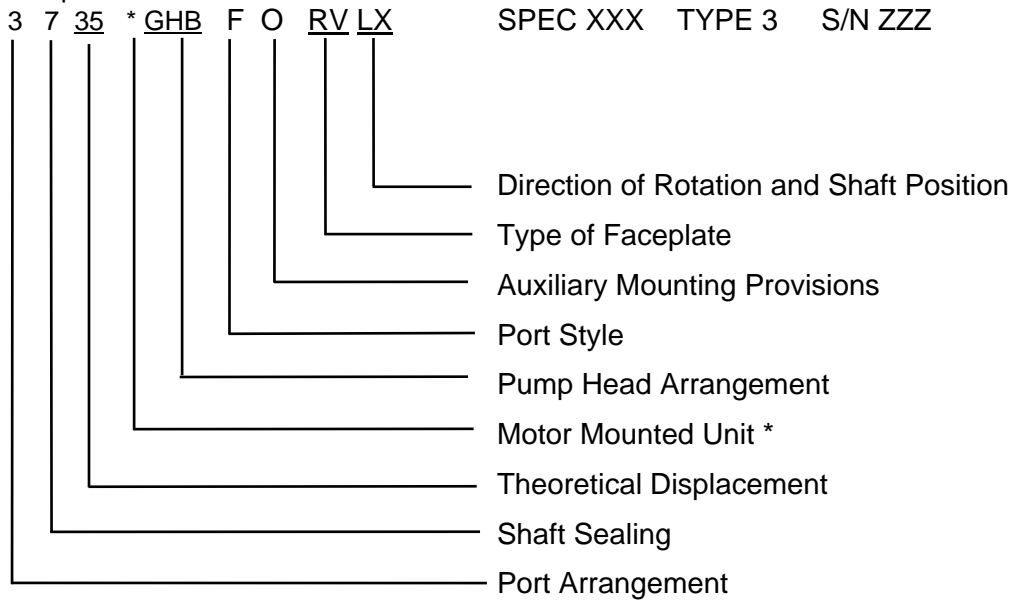
SPEC XXX **TYPE** 3

SERIAL NUMBER ZZZ

1. The Model number consists of a thirteen digit number.
 - The first digit (3) indicates the port arrangement.
 - 3 – 3600 Series with right angle ports
 - 4 – 4600 Series with straight through ports
 - The second digit (7) indicates shaft sealing.
 - 5 – Triple Lip Seal
 - 6 – Packing
 - 7 – Mechanical Seal
 - The third and fourth digits (35) indicate the approximate theoretical displacement in U.S. gallons per 100 revolutions. Gallons/100 Rev. [Liters/100 Rev.]
 - 32 [121.1]
 - 35 [132.5]
 - 43 [162.8]
 - 48 [181.7]
 - 58 [219.6]
 - The letter or group of letters (GHB) indicates the pump head arrangement.
 - H – Pump without outboard bearing
 - HB – Pump with outboard bearing
 - GHB – Pump with outboard bearing and built-on gear reduction unit
 - BHB – Pump with outboard bearing and bracket assembly to accommodate hydraulic drive auxiliaries through a flexible coupling
 - BH – Pump without outboard bearing to accommodate close coupled hydraulic drive auxiliaries through a rigid coupling
 - The letter (F) indicates port style.
 - No letter – Pump with threaded ports
 - F – Pump with Roper standard flange ports
 - On GHB pumps, the letter (O) indicates pump with outboard bearing and auxiliary mounting provisions. (Does not include built-on gear reduction unit.)
 - The letters (RV) indicate type of faceplate on pump.
 - See Section 3.4, **DIRECTION OF ROTATION AND RELIEF VALVES**, for an explanation of the types of valves available.
 - No letters – Plain faceplate
 - RV – RV style relief valve faceplate (Standard RV, Jacketed RV)
 - BC – BC style bi-directional relief valve case

- The letter or group of letters (X, LX) indicates direction of rotation and shaft position. The letter (L) indicates low drive unit. If the letter (L) is not used, the shaft will be in a high drive position.
 - No letter or W – Clockwise Rotation (Standard Rotation)
 - X – Counterclockwise Rotation
 - Y – Clockwise Rotation
 - Z – Counterclockwise Rotation
 - LW – Clockwise Rotation
 - LX – Counterclockwise Rotation
 - LY – Clockwise Rotation
 - LZ – Counterclockwise Rotation

Example:



- * The letter (M) may be used in this space indicating the pump is mounted with motor. The letter (E) may be used in this space indicating the pump is mounted on a base with or without engine.

As stated in the explanation of the pump nomenclature, all characters may not appear on every pump nameplate.

NOTE: The preceding description of the figure number is to assist in identifying your Roper 3600 series pump only. **DO NOT** attempt to derive any ratings or performance from the figure number. **DO NOT** use the explanation of the figure number to construct your own pump. Not all combinations are possible. For assistance in pump selection, it is recommended that you consult Roper Pump Company or an authorized distributor.

- Occasionally, special pumps or configurations are required which are unique for a particular application. These modifications are clarified by a SPECification number. Identification of any items different than a standard pump can be made by consulting Roper Pump Company or an authorized distributor.
- The TYPE number is a number used by Roper Pump Company for in-house identification of construction and hydraulics. Always include the type number in any references to the pump.
- The SERIAL number is a unique number assigned to each pump built by Roper Pump Company.

In any communication concerning this pump, always be sure to include the Figure, Spec, Type, and Serial numbers, so proper identification of the pump can be assured.

2. MAXIMUM PUMP RATINGS

The maximum pressure, speed, and temperature limits for this pump SERIES are shown below.

The maximum rating of a pump with a SPEC number may be different depending on the materials of construction.

Maximum limits for this SERIES:

Pressure

- 125 psi [862 kPa] Maximum Inlet
- 125 psi [862 kPa] Maximum Discharge
- 124 psi [855 kPa] Maximum Differential

Speed

- 750 rpm Maximum on the 3x35 and 3x58
- 900 rpm Maximum on the 3x32, 3x43, and 3x48

Temperature

- Mechanical Seal Pumps: 212°F [100°C]
- Packed Box Pumps: 250°F [121°C]
- Triple Lip Seal: 250°F [121°C]

3. PREOPERATION CHECKS

Read and understand the instructions and recommendations contained in this manual.

Disconnect the coupling between the driver and pump.

Test the rotation of the driver to make sure it will operate the pump in the desired direction of rotation. Rotation is shown on the pump in relation to the integral relief valve. When an integral relief valve is used, make sure it is positioned and adjusted as discussed in the section titled, **DIRECTION OF ROTATION AND RELIEF VALVES**. After the unit is mounted and the piping is connected, the pump should be checked to be sure it operates freely without binding. After operation is proved satisfactory, both pump and driver should be tightly secured and the alignment rechecked before operation.

Before starting, make sure all guards are in place and the inlet and discharge valves are opened.

After starting the unit, check to see that the pump is delivering liquid. If not, stop the driver immediately. After the pump is delivering liquid, check the unit for excessive vibration, localized heating, and excessive shaft seal leakage. Check the pressure or vacuum by installing gauges at both the inlet and discharge sides of the pump to make sure the pressure or vacuum conform to specifications.

4. RECOMMENDED TOOL LIST

NOTE: Tools not furnished with pump.

Tools for all Pumps:

- (1) Safety Glasses
- (1) Rubber Mallet
- (1) 3/4" Combination Wrench
- (1) 6" Adjustable Wrench
- (1) CG-45 Snap-On® Tool Bearing Puller
- (1) 6" to 10" Three Square File
- (1) Pliers

Additional Tools for HB Pumps:

- (1) 1/8" Hex Key
- (1) Flat Tip Screwdriver, 1/4" wide x 4" long blade

Additional Tools for GHB Pumps:

- (1) 1/2" Combination Wrench

Additional Tools for Pumps with an RV Type Relief Valve:

- (1) 1-3/8" Combination Wrench
- (1) 1-5/8" Combination Wrench

Additional Tools for Pumps with Flanges:

- (2) 15/16" Combination Wrench

Additional Tools for Pumps with Shaft Packing:

Packing Hook for .41" square packing rings

Additional Tools for Pumps with Mechanical Seals:

- (1) 0400 External Retaining Ring Pliers

Additional Tools for BHB and BH Pumps:

- (1) 5/16" Hex Key

5. DIRECTION OF ROTATION AND RELIEF VALVES

There are three types of integral relief valves available. The standard RV and jacketed RV are designated by the letters “RV” in the pump nomenclature. The standard BC is designated by the letters “BC” in the pump nomenclature. The spec number is used when a jacketed RV relief valve is used.

STANDARD RV or STANDARD BC

This relief valve is externally adjustable by means of an adjusting screw located in the center of the relief valve cap. The range of adjustment is approximately 30 psi [207 kPa] to 125 psi [862kPa]. The actual capability is dependent on pump speed and liquid viscosity. The settings are for full bypass; that is, all of the fluid is circulating back to the inlet through the relief valve. The end user must set the relief valve for conditions that exactly match the application.

JACKETED RV

This relief valve operates in exactly the same manner as the standard RV except that the faceplate is jacketed to allow provisions for heating or cooling of the relief valve. The 48 size pump does not offer a jacketing option. The range of adjustment is approximately 30 psi [207 kPa] to 125 psi [862 kPa].

DIRECTION OF ROTATION TAGS



FIGURE 5.1
TYPICAL DIRECTION OF ROTATION
TAG FOUND ON RV STYLE
SINGLE DIRECTION RELIEF VALVES



FIGURE 5.2
TYPICAL DIRECTION OF ROTATION
TAG FOUND ON BC STYLE
BI-DIRECTION RELIEF VALVES

RELIEF VALVE ORIENTATION

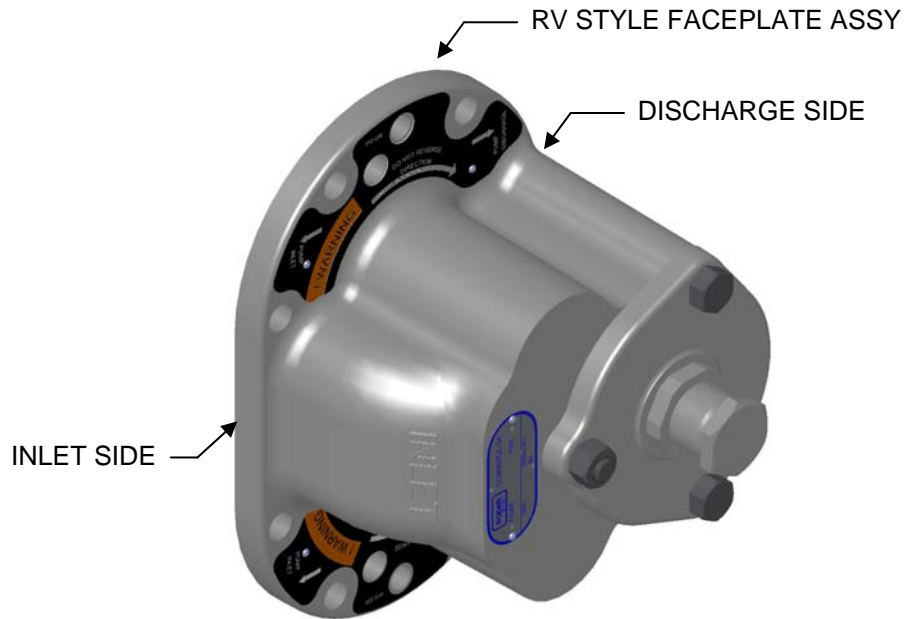


FIGURE 5.3

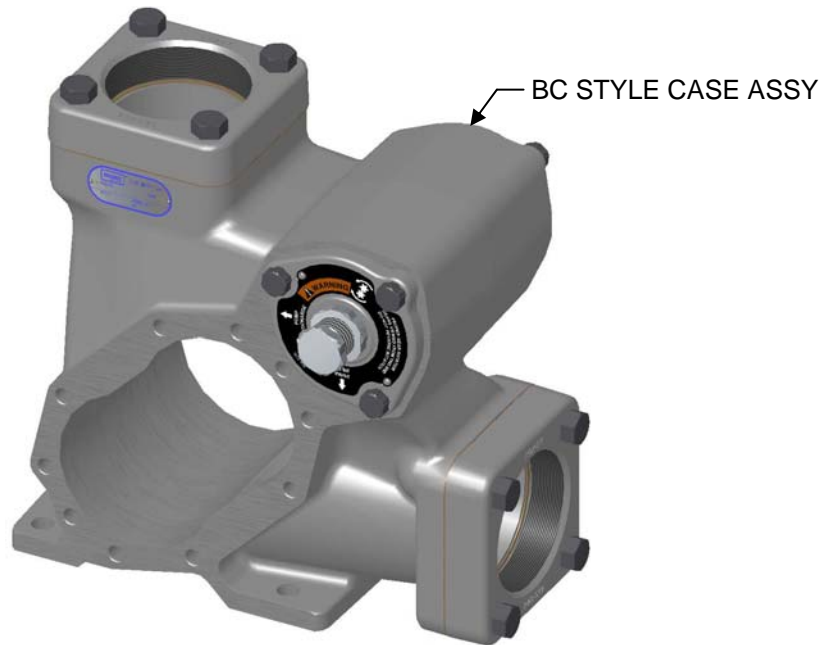


FIGURE 5.4

PROPER PUMP GEAR ROTATION

Proper gear rotation is shown on the warning tags attached to the relief valve faceplate.

PUMP INLET and PUMP DISCHARGE

On the RV and BC style relief valve, either the “pump inlet” or “pump discharge” arrow will always point directly to one side port on the cases that have one side port and one top port. The top port is connected to the side of the pump that is opposite the side port. The “pump inlet” and “pump discharge” arrows will always point directly to the inlet and discharge ports on the pump with straight through port cases.

An integral relief valve should not be used on applications where the discharge must be closed for more than one minute. Prolonged operation of the pump with the discharge closed will cause rapid heating of the liquid circulating through the relief valve, this resulting in possible damage.

DIRECTION OF ROTATION FOR THE RV STYLE RELIEF VALVE

The drawings showing **DIRECTION OF ROTATION FOR PUMP CONFIGURATIONS USING THE RV STYLE RELIEF VALVE** (Figure 5.5) and position of relief valve with the letter “L” in the designation are for low drive applications (the drive shaft is lower than the side port). All other drawings shown are for high drive applications (the drive shaft is above the side port).

The arrow in the drawing at the end of the drive shaft indicates the direction of rotation needed to achieve proper operation of the pump and relief valve when using the pump and relief valve orientation shown in the drawing.

CW indicates clockwise rotation and CCW indicates counterclockwise rotation when viewed from the drive shaft end of the pump.

To determine the correct relief valve position for any of the pump orientations, use the drawings shown titled **DIRECTION OF ROTATION FOR PUMP CONFIGURATIONS USING THE RV STYLE RELIEF VALVE** (Figure 5.5):

1. Find the group of drawings with the proper drive shaft position (high or low drive). Drawings with W, Z, X, or Y rotation are high drive pumps. Drawings with LW, LZ, LX, or LY rotation are low drive pumps. Eliminate all other drawings.
2. In the drawings remaining, find the group of drawings with the proper direction of rotation arrow at the end of the drive shaft. Eliminate all other drawings. CW indicates clockwise rotation and CCW indicates counterclockwise rotation when viewed from the drive shaft end of the pump.
3. In the drawings remaining, find the group of drawings with the proper port positions (straight through or right angle). Eliminate all other drawings.
4. In the remaining drawings, find the drawing with the proper inlet and discharge port locations. This drawing will show the proper relief valve position for the pump configuration chosen. Note the position of the words “PUMP INLET” printed on the end of the rotation plates fastened on the relief valve faceplate. The words “PUMP INLET” must be on the inlet “side” of the pump in order for the relief valve to work opposite each other; the top port of the right angle pump is connected to the “side of the pump via an internal passage.”



DIRECTION OF ROTATION TAG FOUND ON 3632 – 3748 BV STYLE BI-DIRECTION RELIEF VALVES

FIGURE 5.5

NOTE: The fact that the pump has the correct rotation and pumps liquid in the correct direction does not insure that the relief valve is installed in the correct position, or that it has the correct setting for the application.

NOTE: Some older RV style faceplates **DO NOT** have the rotation plates fastened to the faceplate; however, the position of the relief valve is the same, i.e., relief valve cap and adjusting screw are offset to the discharge side of the pump.

	W	LW	Z	LZ
3x35-58 HB, BH				
3x32-48 HB, BH				
4x58 HB, BH				
	X	LX	Y	LY
3x35-58 HB, BH				
3x32-48 HB, BH				

**DIRECTION OF ROTATION FOR HB & BH PUMP CONFIGURATIONS
USING THE RV STYLE RELIEF VALVE
FIGURE 5.6**

CHANGING RV STYLE RELIEF VALVE POSITION

Refer to the sectional drawing (Figure 5.6).

You should have already checked the drawings (Figure 5.5) to find the correct way to position your relief valve, based on the pump's direction of shaft rotation and position and the location of the inlet and discharge ports. If you have not checked, do it now to decide whether or not you should change the position of your relief valve.

If the relief valve position needs to be changed, follow the instructions below and refer to Section 14, **PARTS LIST** (Figure 14.1 and 14.2) and the **RV STYLE RELIEF VALVE** (Figure 5.6).

1. Turn off pump and lock out energy source to driver.
2. Close inlet and discharge valves.
3. To drain pump, follow the procedure in Section 7, **INSTRUCTIONS FOR DRAINING PUMP**.
4. Remove fourteen hex head cap screws (L) for the 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps securing faceplate (23B) to case. Remove faceplate.
5. While viewing faceplate (23B) from end with relief valve cap (24), turn faceplate so that orientation of relief valve cap to pump matches **DIRECTION OF ROTATION** drawing previously selected from charts.
6. Install two dowel pins (J) on faceplate end of case (19A, B, C) if they were removed during disassembly. Place appropriate number of case gaskets (20) on end of case. Align faceplate (23B) on dowel pins maintaining proper orientation as determined above. Secure faceplate to case using fourteen hex head cap screws (L) for the 35 and 58 size pumps or eight hex head cap screw (L) for the 32, 43, and 48 size pumps.

DISASSEMBLY OF RV STYLE RELIEF VALVE

Refer to Section 14, **PARTS LIST** (Figure 14.1 and 14.2) and the **RV STYLE RELIEF VALVE** (Figure 5.6) for correct pump configuration.

1. Turn off pump and lock out energy source to driver.
2. Close inlet and discharge valves.
3. To drain pump, follow the procedure in Section 7, **INSTRUCTIONS FOR DRAINING PUMP**.
4. Decrease pressure on spring (29) by loosening lock and seal nut (27) and unscrewing adjusting screw (26) until adjusting screw turns freely.
5. After decreasing pressure on spring (29), remove the relief valve cap (24) by unscrewing three hex head cap screws (AH) for the 35 and 58 size pumps or two hex head screws (AH) and one hex nut (AK) for the 32, 43, and 48 size pumps from faceplate (23B). Remove o-ring (25).
6. Remove poppet/spring guide (30), spring (29), and the other poppet/spring guide (30).
7. Inspect all parts and replace worn or damaged parts as required.

ASSEMBLY OF RV STYLE RELIEF VALVE

1. Install poppet/spring guide (30) into faceplate (23B) making sure that angled side is against the relief valve seat.
2. Install spring (29) into faceplate (23B) making sure that spring is centered on poppet/spring guide (30).
3. Place pilot of poppet/spring guide (30) into I.D. of spring (29).
4. Screw adjusting screw (26) with lock and seal nut (27) assembled into hole in relief valve cap (24).
5. Replace O-ring (25) on relief valve cap (24).
6. Place small end of adjusting screw (26) in hole in spring guide (30) and secure relief valve cap (24) to faceplate (23B) using three hex head cap screws (AH) for the 35 and 58 size pumps or two hex head cap screws (AH) and one hex nut (AK) for the 32, 43, and 48 size pumps.

- Adjust relief valve by following steps in next section on how to **ADJUST THE RV STYLE RELIEF VALVE**.

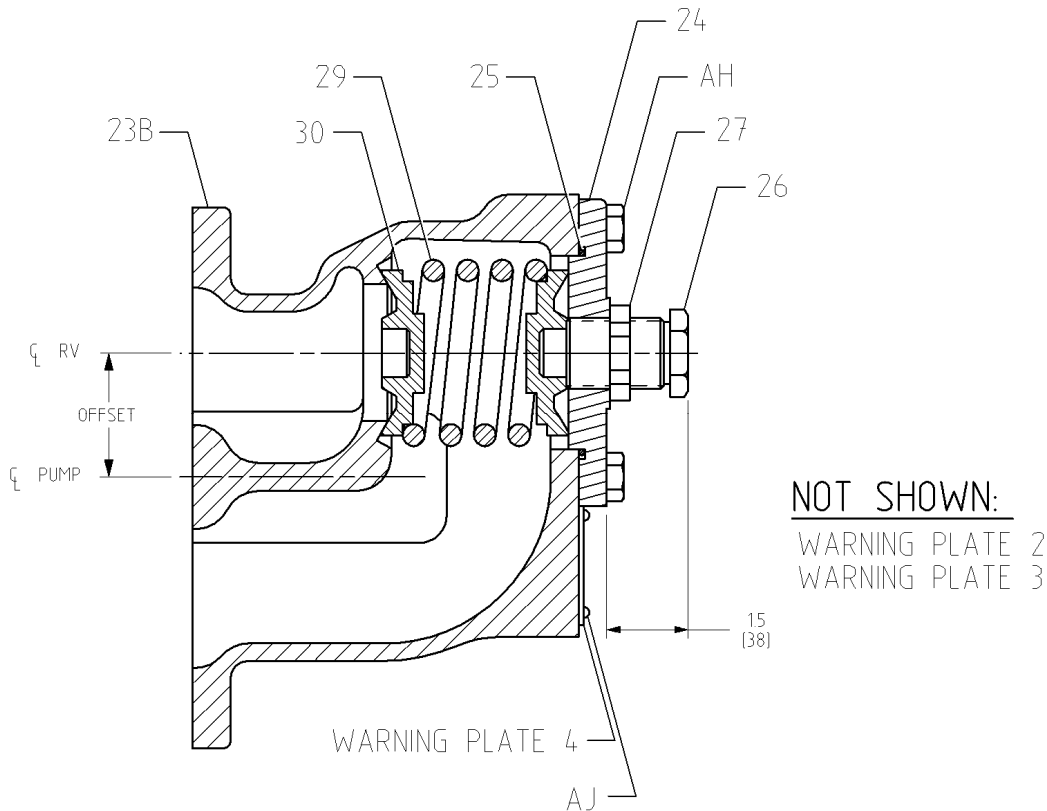
TO ADJUST THE RV STYLE RELIEF VALVE

Refer to the sectional drawing, Figure 5.6, **RV STYLE RELIEF VALVE**.

- WARNING!** Take necessary precautions to prevent personal injury or physical damage that could be caused by any loss of the product being pumped while adjusting the relief valve. **DO NOT** adjust the relief valve without coupling guards in place.

The relief valve must be adjusted under conditions identical to the operating conditions (viscosity, rpm, etc.).

- Connect a pressure gauge near pump in discharge line between pump and point where discharge line will be closed.
- Loosen locknut (27) on the adjusting screw (26).
- Back adjusting screw (26), out to point where end of adjusting screw will be 1-1/2 inches [38 mm] from relief valve cap (24). See **RV STYLE RELIEF VALVE** (Figure 5.6).
- WARNING! DO NOT** start the pump until all rotating shafts and couplings are properly guarded. After all rotating shafts and couplings are properly guarded, start the pump and close the discharge line slowly. **DO NOT** exceed the pressure rating of pump or other equipment between the pump and the discharge line valve. If this pressure is reached while closing the discharge valve, **DO NOT** close any further. **DO NOT** run the pump with a closed discharge line for more than one minute at a time because it will result in rapid overheating.
- With discharge valve closed, turn adjusting screw clockwise in 1/2 turn increments until pressure gauge shows desired pressure setting.
- Tighten locknut (27).
- Open discharge line and turn off pump.



**RV STYLE RELIEF VALVE
FIGURE 5.7**

DISASSEMBLY OF BC STYLE RELIEF VALVE

Refer to Section 14, **PARTS LIST** (Figure 14.1 and 14.2) and the **BC STYLE RELIEF VALVE** (Figure 5.7) for correct pump configuration.

1. Turn off pump and lock out energy source to driver.
2. Close inlet and discharge valves.
3. To drain pump, follow the procedure in Section 7, **INSTRUCTIONS FOR DRAINING PUMP**.
4. Decrease pressure on spring (29) by loosening lock and seal nut (27) and unscrewing adjusting screw (26) until adjusting screw turns freely.
5. After decreasing pressure on spring (29), remove the relief valve cap (24) by unscrewing three hex head cap screws (AH) from case (19). Remove gasket (25).
6. Remove poppet/spring guide (30A), spring (29), and the other poppet/spring guide (30B).
7. Remove shuttle assembly (31). Repeat steps 1 – 7 to disassemble other side of BC style relief valve.
8. Inspect all parts and replace worn or damaged parts as required.

ASSEMBLY OF BC STYLE RELIEF VALVE

1. Install shuttle assembly (31) into case (19).
2. Install poppet/spring guide (30B) into case (19) making sure that angled side is against the relief valve seat.
3. Install spring (29) into case (19) making sure that spring is centered on poppet/spring guide (30B).
4. Place pilot of poppet/spring guide (30A) into I.D. of spring (29).
5. Screw adjusting screw (26) with lock and seal nut (27) assembled into hole in relief valve cap (24).
6. Replace gasket (25) on relief valve cap (24).
7. Place small end of adjusting screw (26) in hole in spring guide (30A) and secure relief valve cap (24) to case (19) using three hex head cap screws (AH).
8. Repeat steps 2 – 7 to assemble other side of BC style relief valve.
9. Adjust relief valve by following steps in next section on how to **ADJUST THE BC STYLE RELIEF VALVE**.

TO ADJUST THE BC STYLE RELIEF VALVE

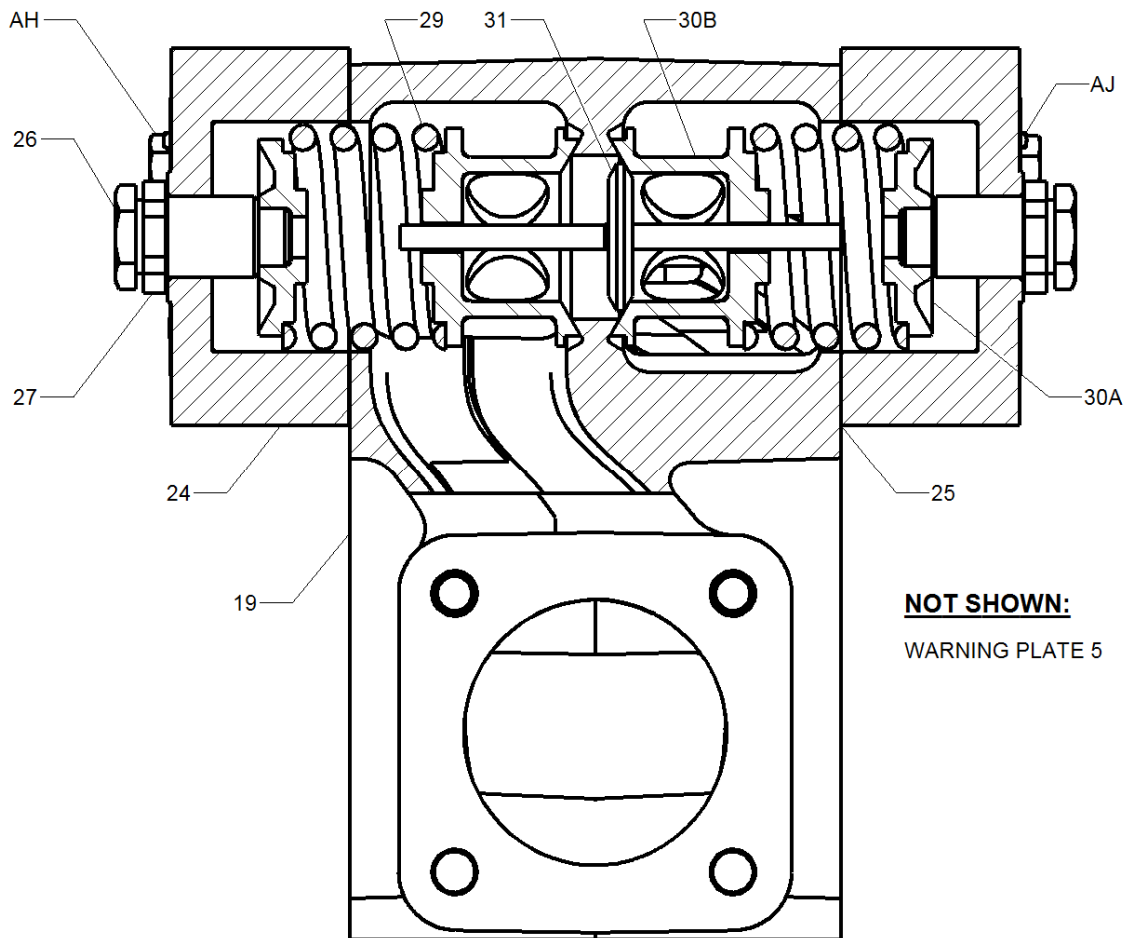
Refer to the sectional drawing, Figure 5.7, **BC STYLE RELIEF VALVE**.

- **WARNING!** Take necessary precautions to prevent personal injury or physical damage that could be caused by any loss of the product being pumped while adjusting the relief valve. **DO NOT** adjust the relief valve without coupling guards in place.

The relief valve must be adjusted under conditions identical to the operating conditions (viscosity, rpm, etc.).

1. Connect a pressure gauge near pump in discharge line between pump and point where discharge line will be closed.
2. Loosen locknut (27) on the adjusting screw (26).
3. Back adjusting screw (26), out to point where end of adjusting screw will be 1-1/2 inches [38 mm] from relief valve cap (24). See **BC STYLE RELIEF VALVE** (Figure 5.7).

4. **WARNING! DO NOT** start the pump until all rotating shafts and couplings are properly guarded. After all rotating shafts and couplings are properly guarded, start the pump and close the discharge line slowly. **DO NOT** exceed the pressure rating of pump or other equipment between the pump and the discharge line valve. If this pressure is reached while closing the discharge valve, **DO NOT** close any further. **DO NOT** run the pump with a closed discharge line for more than one minute at a time because it will result in rapid overheating.
5. With discharge valve closed, turn adjusting screw clockwise in 1/2 turn increments until pressure gauge shows desired pressure setting.
6. Tighten locknut (27).
7. Open discharge line and turn off pump.



**BC STYLE RELIEF VALVE
FIGURE 5.8**

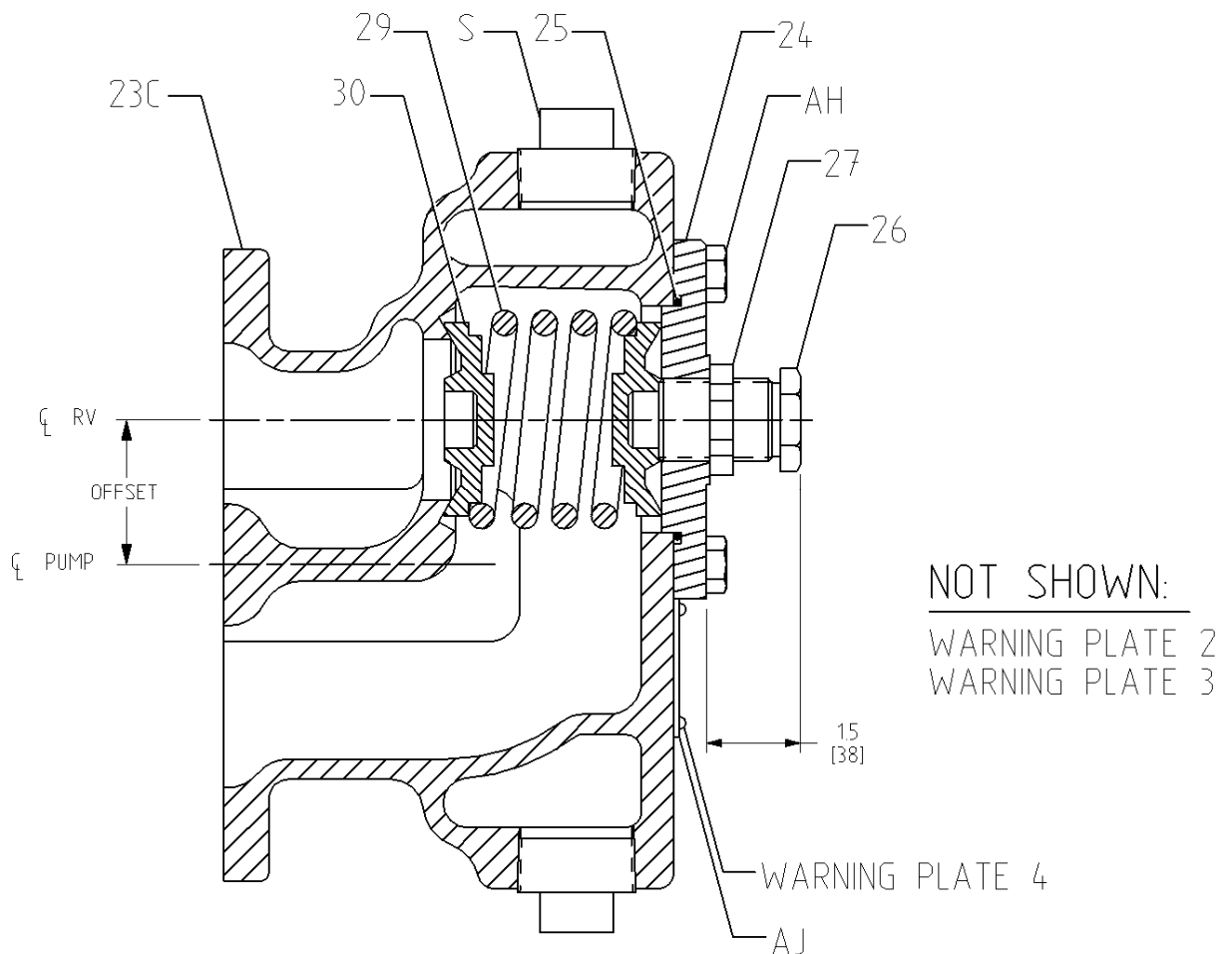
JACKETED PUMPS

Jacketed faceplates and backplate are available on 3500, 3600, 3700, 4500, 4600, and 4700 series pump in the 35 and 58 sizes. They look similar to the standard non-jacketed ones described in this manual except for the four threaded taps on the jacketed faceplates and backplates. Two of the four taps are piped as inlet and outlet for the heating or cooling medium. It is recommended that steam, when used, be piped into the jacket from a top tap and out through a bottom tap. Liquid, when used, should be piped into the jacket from a bottom tap and out a top tap. In addition to the two taps on both endplates not used for piping, two 1/4" NPT taps on the jacketed backplate are provided to facilitate clean out of scale.

The heating or cooling medium should be steam or a noncorrosive, non-clogging liquid. A steam medium is limited to 350°F [177°C] maximum. A liquid medium is limited to 450°F [232°C] maximum. The jacketing is limited to 125 psi [862 kPa] maximum.

- **WARNING!** Other special parts will be required to operate at temperatures up to 450°F [232°C].

The jacketed RV style relief valve faceplate, similar to non-jacketed, must have the adjusting screw offset toward the discharge side of the pump.



**JACKETED RV STYLE RELIEF VALVE FACEPLATE
FIGURE 5.9**

6. HIGH DRIVE TO LOW DRIVE

Prior to operating pump, make sure that the shaft rotation, pipe connections, and the relief valve position are in accordance with the appropriate illustrations (Figure 5.6). In order to change the rotation and/or piping orientation, it may be necessary to remove the piping from the pump or the pump from the mounting. [Fittings (21) and flange gaskets (22), when provided, can be removed from pump.]

Whenever changing rotation, inspect all parts before reassembly. Replace all worn parts and install new gaskets in appropriate numbers as removed.

1. Remove coupling or universal joint and drive key (A) from drive shaft (32). Remove all burrs and sharp edges from drive shaft and keyway.
2. A.) To reverse pump rotation and keep piping arrangement the same, drive shaft (32) position must be changed. Follow steps 3 - 10.
B.) To reverse pump rotation and leave drive shaft (32) and case (19A, B, C) in same position; liquid flow through pump will be reversed. Follow steps 11 - 12.
C.) To change port to opposite side on pumps with right angle port arrangement and maintain same pump rotation, follow steps 13 - 20.
D.) To change port to opposite side, maintain same pump rotation and drive shaft (32) in same position; liquid flow through pump will be reversed. Follow steps 21 - 26.

REVERSE ROTATION, SAME PIPING ARRANGEMENT

3. To reverse pump rotation and keep piping arrangement the same, it is necessary to change from high drive to low drive or low drive to high drive (3500-3700 series with right angle ports: W to LX, X to LW, Z to LY, Y to LZ; 4500 - 4700 series with straight through ports: W to LZ, Z to LW) or vice versa.
4. Remove fourteen hex head cap screws (L) for the 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps securing backplate (6A, B) to case (19A, B, C) and separate backplate assembly from case assembly. On 3500 - 4700 "H" and "BH" pumps, drive gear (34) will pull out with backplate assembly. On "HB," "GHB," and "BHB" pumps, drive gear (34) may remain in case assembly.
5. Switch drive gear (34) and idler gear/shaft (35 and 33) position in case (19A, B, C).
6. Position appropriate number of case gaskets (20) on case (19A, B, C) (oil or grease may be used to hold gaskets in place.)
7. Rotate backplate (6A, B) assembly 180°.
8. Slide drive shaft (32) and gear key (B1) into shaft hole of drive gear (34).
9. Slide backplate (6A, B) assembly into position and secure.
10. On 3500 – 4700 series with gear reduction unit, mount oil cup (AB) in top hole in gear case (44) and petcock (AC) in second hole from bottom.

REVERSE ROTATION, SAME DRIVE SHAFT AND CASE ARRANGEMENT

11. To reverse flow of liquid through pump ports, reverse rotation of drive shaft (32), maintain the original positions of the drive shaft and case (19A, B, C). (3500-3700 series with right angle ports: W to X, LW to LX, Z to Y, LX to LY; 4500 - 4700 series with straight through ports: W to Z, LW to LZ) or vice versa.
12. On pumps with relief valve, relief valve faceplate (23B) or (23C) must be removed and rotated 180° and remounted.

CHANGE PORT AND DRIVE SHAFT LOCATION, SAME ROTATION

13. To change the port to the opposite side and maintain same pump rotation, change drive shaft (32) from high drive to low drive (3500-3700 series with right angle ports: W to LY, Y to LW, Z to LX, X to LZ) or vice versa.
14. Remove fourteen hex head cap screws (L) for the 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps securing backplate (6A, B) to case (19A, B, C) and separate backplate assembly from case assembly. On 3500 - 4700 "H" and "BH" pumps, drive gear (34) will pull out with backplate assembly. On "HB," "GHB," and "BHB" pumps, drive gear (34) may remain in case assembly.
15. Remove the faceplate (23A, B, C).
16. Rotate case (19A, B, C) 180°, (front to back).
17. Switch drive gear (34) and idler gear/shaft (35 and 33) positions in case (19A, B, C).
18. If plain faceplate (23A) is used, remount to case (19A, B, C) in same position, If a relief valve faceplate (23B, C) is used, rotate faceplate 180° and remount to case (19A, B, C).
19. Rotate backplate (6A, B) assembly 180° and remount on case (19A, B, C).
20. On pumps with gear reduction unit, mount oil cup (AB) in top hole of gear case (44) and petcock (AC) on next to bottom hole.

SAME ROTATION, CHANGE PORT LOCATION, SAME DRIVE SHAFT LOCATION

21. To change port to opposite side, maintain same pump rotation and drive shaft (32) in same position; the flow of liquid through the pump will be reversed. (3500-3700 series with right angle ports: W to Y, LW to LY, Z to X, LZ to LX) or vice versa.
22. Remove fourteen hex head cap screws (L) for the 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps securing backplate (6A, B) to case (19A, B, C) and separate backplate assembly from case assembly. On 3500 - 4700 "H" and "BH" pumps, drive gear (34) will pull out with backplate assembly. On "HB," "GHB," and "BHB" pumps, drive gear (34) may remain in case assembly.
23. Remove faceplate (23A, B, C).
24. Rotate case (19A, B, C) 180°, (front to back).
25. Remount and secure case (19A, B, C) to faceplate (23A, B, C).
26. Remount backplate (6A, B) assembly to case (19A, B, C).

7. INSTRUCTIONS FOR DRAINING PUMP

Refer to Section 14, **PARTS LIST**.

The extent to which a pump can be drained is dependent upon the product being pumped. Low viscosity products such as solvents will drain quickly and easily. High viscosity products such as molasses and tar will drain very slowly. Also, the draining of high viscosity products will be less complete.

Regardless of the product pumped, the areas at the blind end of the bearing bores and the mechanical seal chamber will not drain.

FOR PUMPS EQUIPPED WITH DRAIN PLUGS

1. Read and understand all safety instructions and warnings before starting draining procedure.
2. There are two pipe plugs (S) in the faceplate (23A, B, C). Remove one that is in lowest position.
3. Rotate drive shaft very slowly by hand. Each time that flow from drain increases, stop turning shaft until flow stops; then resume until flow increases again. Be sure to rotate shaft several complete revolutions in each direction until all flow from drain has stopped.
4. Reinstall and tighten pipe plug (S).

FOR PUMPS NOT EQUIPPED WITH DRAIN PLUGS

1. Read and understand all safety instructions and warnings before starting procedures.
2. Loosen fourteen hex head cap screws (L) for the 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps securing faceplate (23A, B, C) to allow a gap of 1/8 of an inch [3 mm] between faceplate and case (19A, B, C) for draining.
3. Rotate drive shaft very slowly by hand. Each time that flow from drain increases; stop turning shaft until flow stops; then resume until flow increases again. Be sure to rotate shaft several complete revolutions in each direction until all flow from drain has stopped.
4. After draining has been completed, examine case gaskets (20) making sure gasket is not torn prior to tightening the fourteen hex head cap screws (L) for the 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps. If gasket is torn or further disassembly is required, follow steps in Section 8, **INSTRUCTIONS FOR PUMP DISASSEMBLY** to replace gaskets.

8. INSTRUCTIONS FOR PUMP DISASSEMBLY

Refer to Section 14, **PARTS LIST**.

1. Read and understand all safety instructions and warnings before starting to disassemble pump. While disassembling pump, always inspect disassembled parts and adjacent parts to see if further disassembly is needed. Replace worn or damaged parts as required.
2. If you do not know which pump arrangement you have, collect nameplate data and refer to Section 1, **NAMEPLATE DATA**, to determine what you have. Consult Roper Pump Company or an authorized distributor if you have any questions.
3. When cleaning or lubricating, use only cleaning solutions and lubricants that are compatible with products being pumped and with sealing elastomers. **DO NOT** use petroleum base products with seals with EPR elastomers. Use a nonpetroleum based lubricant with EPR elastomers.
4. Turn off pump and lock out energy source to driver. **DO NOT** proceed further with disassembly of pump if there is the slightest possibility that driver may be started.
5. If used, turn off and disconnect flush from mechanical seal.
6. Close inlet and discharge valves.
7. Remove guard and disconnect coupling between driver and pump.
8. Drain inlet and discharge lines. Disconnect lines from pump inlet and discharge.
9. Follow the procedure in Section 7, **INSTRUCTIONS FOR DRAINING PUMP**.
10. A.) For 3500/3600/3700/4500/4600/4700 "HB" pumps, follow steps 11 - 20.
B.) For 3700/4700 "BH" pumps, go to Section 12, **INSTRUCTIONS FOR DISASSEMBLY OF A TYPE "BH" HYDRAULIC DRIVE**. After disassembling hydraulic drive, return to this section and follow steps 11 - 20.
11. Remove fourteen hex head cap screws (L) for the 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps securing faceplate (23A, B, C) to case (19A, B, C). Remove faceplate (23A, B, C).
12. Remove two dowel pins (J) from case.
13. Remove case gaskets (20).
14. A.) On "BH" pumps, remove faceplate end retaining ring (36) from drive shaft (32). Remove drive gear (34) and key (B1).
B.) On "HB" pumps, remove drive gear (34) and key (B1) from drive shaft (32).
15. Remove idler gear (35) and key (B2) from idler shaft (33). Remove idler shaft.
16. Remove fourteen hex head cap screws (L) for the 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps securing backplate (6A, B) to case (19A, B, C) and separate parts.
17. Remove case gaskets (20) from opposite side of case (19A, B, C).
18. Remove two dowel pins (J) from opposite side of case (19A, B, C).
19. Remove drive key (A) from drive shaft (32).
19. A.) On BH pumps, remove backplate end retaining ring (36) from driveshaft (32).
20. A.) For 3500/4500 "BH" pumps, follow steps 21 - 24.
B.) For 3500/4500 "HB" pumps, follow steps 25 - 29.
C.) For 3600/4600 "BH" pumps, follow steps 30 - 33.
D.) For 3600/4600 "HB" pumps, follow steps 34 - 39.
E.) For 3700/4700 "BH" pumps, follow steps 40 - 43.
F.) For 3700/4700 "HB" pumps, follow steps 44 - 49.

3500/4500 “BH” Pumps (See Figure 14.1)

21. Remove two locknuts (F) from square head bolts (G) securing seal retainer (9) to backplate (6A, B). Remove the seal retainer (9).
22. Remove drive shaft (32) by sliding it out from case side of backplate.
23. Remove packing washer (18) and triple lip seal (10) from backplate (6A, B) by prying out.
24. Visually inspect all parts. Replace all worn or damaged parts before reassembling pump. It is recommended that new gaskets (20, 22, 25) be installed each time pump is disassembled and reassembled. Triple lip seal (10) must be replaced anytime it is removed from backplate (6A, B).

3500/4500 “HB” Pumps (See Figure 14.2)

25. Remove retaining ring (3) from backplate (6A, B).
26. Loosen setscrews in ball bearing (2). Remove ball bearing.
27. Remove two locknuts (F) from square head bolts (G) securing seal retainer (9) to backplate (6A, B). Remove the seal retainer (9).
28. Remove drive shaft (32) by sliding it out from case side of backplate.
29. Remove packing washer (18) and triple lip seal (10) from backplate (6A, B) by prying out.

Visually inspect all parts. Replace all worn or damaged parts before reassembling pump. It is recommended that new gaskets (20, 22, 25) be installed each time pump is disassembled and reassembled. Triple lip seal (10) must be replaced anytime it is removed from backplate (6A, B).

3600/4600 “BH” Pumps (See Figure 14.1)

30. Remove two locknuts (F) from square head bolts (G) securing packing gland (14) in place. Remove packing gland clip (13) and packing gland (14).
31. Remove packing rings (16) and packing washer (18). Remove lantern ring (17) if used. Packing hooks are commercially available to assist in removal of packing rings.
32. Remove drive shaft (32). Clean drive shaft and adjacent parts. Examine drive shaft. Replace drive shaft if excessively worn or scored.
33. Visually inspect all parts. Replace all worn or damaged parts before reassembling pump. It is recommended that new gaskets (20, 22, 25 if applicable) be installed each time pump is disassembled and reassembled.

3600/4600 “HB” Pumps (See Figure 14.2)

34. Remove retaining ring (3) from backplate (6A, B).
35. Loosen setscrews in ball bearing (2). Remove ball bearing.
36. Remove two locknuts (F) from square head bolts (G) securing packing gland (14) in place. Remove packing gland clip (13), packing gland (14), spring clip (15), and two square head bolts (G).
37. Remove packing rings (16) and packing washer (18). Remove lantern ring (17) if used. Packing hooks are commercially available to assist in removal of packing.
38. Remove drive shaft (32). Clean drive shaft and adjacent parts. Examine drive shaft. Replace drive shaft if excessively worn or scored.
39. Visually inspect all parts. Replace all worn or damaged parts before reassembling pump. It is recommended that new gaskets (20, 22, 25 if applicable) be installed each time pump is disassembled and reassembled.

3700/4700 “BH” Pumps (See Figure 14.1)

40. Remove two locknuts (F) from square head bolts (G) securing seal retainer (9) to backplate (6A,B). Remove seal retainer (9).
41. Remove drive shaft (32) along with mechanical seal (11) and retaining ring (12) from backplate (6A, B).
42. When removing following types of single seals (John Crane® Type 21, Type 8-1, Type 9; Pac-Seal® Type 21; Sealol® Type 43), clean and lubricate drive shaft (32) prior to removing mechanical seal making sure that drive shaft is smooth and free from all burrs. Loosen setscrews (if present) on mechanical seal. Remove mechanical seal (11). Inspect sealing surfaces of stationary seal face and inspect rotating element. Replace as required. Remove retaining ring (12) from drive shaft (32), if applicable.
43. Visually inspect all parts. Replace all worn or damaged parts before reassembling pump. It is recommended that new gaskets (20, 22, 25 if applicable) be installed each time the pump is disassembled and reassembled.

3700/4700 “HB” Pumps (See Figure 14.2)

44. Remove retaining ring (3) from backplate (6A, B).
45. Loosen setscrews in ball bearing (2). Remove ball bearing.
46. Remove two locknuts (F) from square head bolts (G) securing seal retainer (9) to backplate (6A, B). Remove seal retainer (9).
47. Remove drive shaft (32) along with mechanical seal (11) and retaining ring (12) from backplate (6A, B).
48. When removing following type of single seals (John Crane® Type 21, Type 8-1, Type 9; Pac-Seal® Type 21; Sealol® Type 43), clean and lubricate drive shaft (32) prior to removing mechanical seal making sure that drive shaft is smooth and free from all burrs. Loosen setscrews (if present) on mechanical seal. Remove mechanical seal (11). Inspect sealing surfaces of stationary seal face and inspect rotating element. Replace as required. Remove retaining ring (12) from drive shaft (32), if applicable.
49. Visually inspect all parts. Replace all worn or damaged parts before reassembling pump. It is recommended that new gaskets (20, 22, 25 if applicable) be installed each time the pump is disassembled and reassembled.

9. BEARING REMOVAL AND INSTALLATION

BEARING REMOVAL

Pump bearings are available in bronze, iron, carbon, and glass/graphite impregnated PTFE. Any of these bearings may be removed using a Snap-On® tool puller, part number CG45. This tool may be purchased through your local tool dealer or through Roper Pump Company. If you **DO NOT** have this bearing puller, any of the bearings may be removed by using a hacksaw blade to cut through the bearing in two places 180° apart. This procedure will usually loosen the bearing enough to be pulled out. If this procedure is used, take care to prevent damage to the bore into which the bearing is pressed.

Carbon bearings may also be removed by carefully chipping the bearing out with a chisel. Take care not to scar the endplate bores during the bearing removal process.

After removing the bearings, always check the endplate bores for nicks and burrs caused by the removal process. The bores must be clean, smooth, and free of burrs before attempting to install new bearings.

BEARING INSTALLATION

1. Remove all burrs and raised edges from bores for bearings.
2. Place faceplate or backplate on a press base with milled face upward. Support endplate so that milled face is perpendicular (square) with press ram.
3. Position endplate so that one bearing bore is located directly under press ram.
4. A.) If iron or bronze bearings are to be installed, lubricate endplate bores with a light oil that is compatible with product to be pumped.
B.) If carbon bearings are to be installed, lubricate bearings by submerging them in cold water prior to installation.
C.) If glass/graphite filled PTFE bearings are to be installed, no lubricant should be used.
5. Place end of new bearing at entrance of bore in endplate, taking care to align grooves in bearing with the grooves in face of endplate.
6. Press bearing into endplate bore. *When carbon bearings are being installed, it is important to press them in with one slow uninterrupted stroke to prevent cracking* It is best to use a stepped arbor with a few thousandths of an inch clearance between arbor and bore of bearing. Be sure to press bearings in until they are flush to .005 of an inch [.127 mm] below milled face of endplate.
7. Repeat procedure for second bearing.
8. Using a three square file, file shallow grooves in ends of bearings to connect grooves inside bearings with groove on milled face of endplate. If your bearings or endplates **DO NOT** have grooves, omit this step.

10. DIMENSIONAL DATA FOR INTERNAL PARTS

Nominal dimensions are given below. With the exception of gasket thickness and lateral clearance, your actual measurements should not vary from these numbers by no more than .002". Use properly calibrated measuring equipment when measuring parts.

ITEM	PUMP SIZE				
	32	35	43	48	58
Bore for Brgs.	1.751	1.751	1.751	1.751	1.751
Shaft O.D.	1.4365	1.4365	1.4365	1.4365	1.4365
Case Bores	5.011	5.669	5.011	5.011	5.669
Gear O.D.	4.999	5.657	4.999	4.999	5.657
Gear O.D. to Case Bore Dia. Clearance	.012	.012	.012	.012	.012
Brz. Brg. O.D.		1.7525		1.7525	1.7525
Brz. Brg. Press Fit	.0015 min.	.0015 min.	.0015 min.	.0015 min.	.0015 min.
Brz. Brg. I.D. (free)	1.446	1.446	1.446	1.446	1.446
Brz. Brg. I.D. (installed)	1.4445	1.4445	1.4445	1.4445	1.4445
Shaft to Iron Brg. Dia. Clearance	.008	.008	.008	.008	.008
Iron Brg. O.D.	1.752	1.752	1.752	1.752	1.752
Iron Brg. Press Fit	.001 min.	.001 min.	.001 min.	.001 min.	.001 min.
Iron Brg. I.D. (free)	1.444	1.444	1.444	1.444	1.444
Iron Brg. I.D. (installed)	1.443	1.443	1.443	1.443	1.443
Shaft to Iron Brg. Dia. Clearance	.0065	.0065	.0065	.0065	.0065
Carbon Brg. O.D.	1.7535	1.7535	1.7535	1.7535	1.7535
Carbon Brg. Press Fit	.0025 min.	.0025 min.	.0025 min.	.0025 min.	.0025 min.
Carbon Brg. I.D. (free)	1.4455	1.4455	1.4455	1.4455	1.4455
Carbon Brg. I.D. (installed)	1.4432	1.4432	1.4432	1.4432	1.4432
Shaft to Carbon Brg. Dia. Clearance	.0067	.0067	.0067	.0067	.0067
Case Width	4.691	4.343	6.301	7.501	7.194
Gasket Thickness (one)	.006	.012	.006	.006	.012
Compressed Gasket Thickness (three)	.013	.024	.013	.013	.024
Gear Face Width	4.689	4.344	6.299	7.499	7.194
Lateral Clearance (three compressed gaskets)	.015	.023	.015	.015	.024

11. INSTRUCTIONS FOR PUMP ASSEMBLY

Refer to Section 14, **PARTS LIST**.

Refer to Section 5, **DIRECTION OF ROTATION AND RELIEF VALVES**, to assure proper configuration for pump rotation, port location, and relief valve position prior to assembling pump.

1. Read and understand all safety instructions and warnings before assembling pump. Visually inspect all parts during assembly. Replace all worn or damaged parts. Although they may appear reusable, it is recommended that new gaskets (20, 22, if applicable, 38, 48, 50) and lip seals (5, 39) be installed when pump is being reassembled.
 - **WARNING!** Only use genuine Roper gaskets. Gasket thickness determines proper clearances. Always check quantity of gaskets removed and replace with exact quantity. Proper material must be used based on application.
2. When cleaning or lubricating, only use products that are compatible with product being pumped and elastomers within pump. **DO NOT** use petroleum base products with seals with EPR elastomers. Clean and lubricate parts with light oil unless EPR elastomers are used. Use a nonpetroleum base lubricant with EPR elastomers.
3. Mechanical seals are precision pieces of equipment. Use extreme care not to damage seal faces or elastomers during assembly.
4. Install two dowel pins (J) on each side of case (19A, B, C). Place appropriate number of case gaskets (20) on faceplate side of case. Align faceplate (23A, B, C) on dowel pins (J). Secure faceplate to case using fourteen hex head cap screws (L) for the 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps.
5. Place idler gear (35) into case bore. Install key (B2) in keyway on idler shaft (33). Slide idler shaft into I. D. of idler gear.
6. A.) For 3500/4500 "BH" pumps with triple lip seal, follow steps 7 - 13.
B.) For 3500/4500 "HB" pumps with triple lip seal, follow steps 14 - 26.
C.) For 3600/4600 "BH" pumps with shaft packing, follow steps 27 - 36.
D.) For 3600/4600 "HB" pumps with shaft packing, follow steps 37 - 46.
E.) For 3700/4700 "BH" pumps with a standard mechanical seal, follow steps 47 - 55.
F.) For 3700/4700 "BH" pumps with a positive drive mechanical seal, follow steps 56 - 70.
G.) For 3700/4700 "HB" pumps with a standard mechanical seal, follow steps 71 - 79.
H.) For 3700/4700 "HB" pumps with a positive drive mechanical seal, follow steps 80 - 94.

3500/4500 "BH" Pumps (See Figure 14.1)

7. Install backplate end retaining ring (36) on drive shaft (32). Install key (B) on drive shaft. Slide drive gear (34) onto drive shaft. Install faceplate end retaining ring (36) on drive shaft to secure drive gear.
8. Place appropriate number of case gaskets (20) on backplate side of case (19A, B, C). Slide drive gear (34) assembled with drive shaft (32), and backplate (6A, B) into case bore. Align backplate (6A, B) on hollow dowel pins (J). Secure backplate (6A, B) to case (19A, B, C) using fourteen hex head cap screws (L) for the 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps.
9. Lubricate drive end of drive shaft (32) and triple lip seal (10) with a light oil. Slide triple lip seal over shaft with two lips facing toward pump gears (34, 35). Gently push seal past tapered area of shaft and down to front of seal chamber. Press triple lip seal into bore until back side is flush with face of seal chamber. Take care to use a tool that will not damage or distort seal casing. Install one packing washer (18).
10. Place one square head bolt (G) through each slot in backplate (6A, B) and through each hole in seal retainer (9). Using two locknuts (F), secure seal retainer in place.

11. Install drive key (A).
12. For 3500/4500 “BH” hydraulic drive assembly, go to Section 13, **INSTRUCTIONS FOR ASSEMBLY OF A TYPE “MBH” HYDRAULIC DRIVE.**
13. Read and understand all safety instructions and warnings before installing and operating pump.

3500/4500 “HB” Pumps (See Figure 14.2)

14. Place drive gear (32) into case bore.
15. Place appropriate number of case gaskets (20) on backplate side of case (19A, B, C).
16. Set case assembly aside and build backplate assembly as described in following steps.
17. Place triple lip seal (10) with two lips facing toward seal chamber onto opening of seal chamber in backplate (6A, B). Press triple lip seal into seal chamber until back side of seal is flush with face of seal chamber. Take care to use a tool that will not damage or distort seal casing. Install one packing washer (18).
18. Place one square head bolt (G) through each slot in backplate (6A, B) and through each hole in seal retainer (9). Using two locknuts (F), secure seal retainer in place.
19. Use a small file or stone to break sharp edges of drive shaft (32) keyway that will be under pump drive gear (34).
20. Install outboard ball bearing (2) on drive shaft (32) as shown in Figure 14.2. Bearings are pre-lubricated and do not require lubrication at time of initial installation. A small amount of grease will be required during regular maintenance. Align setscrews in inner race of ball bearing with wide groove in shaft. Tighten setscrews in ball bearing (2) to secure bearing to drive shaft (32).
21. Lubricate triple lip seal (10) in backplate and shaft on end that will slide through triple lip seal with a light oil. Carefully slide shaft through backplate and triple lip seal from outboard bearing end until ball bearing (2) seats in bearing bore.
22. Install retaining ring (3) to secure ball bearing (2) to backplate.
23. Install key (B) in keyway of drive shaft that will be under gear.
24. Align key in shaft of backplate assembly with keyway in drive gear of case assembly and slide backplate assembly together with case assembly.
25. Secure backplate (6A, B) to case (19A, B, C) using fourteen hex head cap screws (L) for the 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps.
26. Read and understand all safety instructions and warnings before installing and operating pump.

3600/4600 “BH” PUMPS (See Figure 14.1)

27. Install backplate end retaining ring (36) on drive shaft (32). Install key (B1) on drive shaft. Slide drive gear (34) onto drive shaft. Install faceplate end retaining ring (36) on drive shaft to secure drive gear.
28. Place appropriate number of case gaskets (20) on backplate side of case (19A, B, C). Slide drive gear (34) assembled with drive shaft (32), and backplate (6A, B) into case bore. Align backplate (6A, B) on dowel pins (J). Secure backplate (6A, B) to case (19A, B, C) using fourteen hex head cap screws (L) for the 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps.
29. Install packing washer (18) over drive shaft (32) and into packing bore of backplate (6A, B).
30. Install packing rings (16) and lantern ring (17), if used, in backplate bore. Stagger joints on each packing ring 180° apart. Seat each ring before adding next ring. Rings must not be tamped or seated too tightly.
31. Check drive shaft (32) for free movement after each ring is installed.
32. When packing box is sufficiently full to allow entry of packing gland (14) about 1/4 of an inch [6 mm], reassemble packing gland.

33. Place one square head bolt (G) through each slot in backplate (6A, B) and through each hole in packing gland (14). Insert packing gland (14) into packing box about 1/4 of an inch [6 mm]. Slide packing gland clip (13) over studs (AG) or square head bolts (G). Using two locknuts (F), secure packing gland (14) in place. Draw locknuts up evenly on packing gland to assure proper seating of packing (16), then loosen locknuts (F) about 1/2 turn. **DO NOT** cock packing gland. This could cause binding or heating of drive shaft.
34. Install drive key (A).
35. For 3600/4600 “BH” hydraulic drive assembly, go to Section 13, **INSTRUCTIONS FOR ASSEMBLY OF A TYPE “BH” HYDRAULIC DRIVE.**
36. Read and understand all safety instructions and warnings before installing and operating pump.

3600/4600 “HB” Pumps (See Figure 14.2)

37. Place drive gear (34) into case bore. Install key (B1) in keyway of drive shaft (32). Slide drive shaft into bore of drive gear.
38. Place appropriate number of case gaskets (20) on backplate side of case (19A, B, C). Align backplate (6A, B) on dowel pins (J). Secure backplate to case using fourteen hex head cap screws (L), for the 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps.
39. Install packing washer (18) over drive shaft (32) into packing bore of backplate.
40. Install packing ring (16) and lantern ring (17), if used, in packing bore of backplate. Stagger joints on each packing ring 180° apart. Seat each ring before adding next ring. Rings must not be tamped or seated too tightly.
41. Check drive shaft (32) for free movement after each ring is installed.
42. When packing box is sufficiently full to allow entry of packing gland (14) about 1/4 of an inch [6 mm], reassemble packing gland.
43. Place one square head bolt (G) through each slot in backplate (6A, B) and through each hole in packing gland (14). Install packing gland (14) into packing box about 1/4 of an inch [6 mm]. Slide packing gland clip (13) over square head bolts (G). Using two locknuts (F), secure packing gland (14) in place. Install spring clip (15) across square head bolts (G). Draw locknuts up evenly on packing gland to assure proper seating of packing (16), then loosen locknuts about 1/2 turn. **DO NOT** cock packing gland. This could cause binding or heating of drive shaft.
44. Install ball bearing (2) on drive shaft (32) and into backplate (6A, B) as shown in the sectional drawing (Figure 14.2). **DO NOT** strike the outer race of the bearing or the grease seal just inside the outer race. This could damage the bearing. The bearings are pre-lubricated and **DO NOT** require lubrication at time of initial installation. A small amount of a good quality bearing grease will be required during regular maintenance. Align setscrews in inner race of ball bearing with wide groove in shaft. Tighten setscrews in ball bearing (2) to secure bearing to drive shaft (32). Install retaining ring (3) into backplate (6A, B) to secure ball bearing (2) to backplate.
45. Install drive key (A).
46. Read and understand all safety instructions and warnings before installing and operating pump.

3700/4700 “BH” Pumps (Standard Mechanical Seal) (See Figure 14.1)

47. Install backplate end retaining ring (36) on drive shaft (32). Install key (B1) on drive shaft. Slide drive gear (34) onto drive shaft. Install faceplate end retaining ring (36) on drive shaft to secure drive gear.
48. Place appropriate number of gaskets (20) on backplate side of case (19A, B, C). Slide drive gear (34) assembled with drive shaft (32), and backplate (6A, B) into case bore. Align backplate (6A, B) on dowel pins (J). Secure backplate (6A, B) to case (19A, B, B) using fourteen hex head cap screws (L) for the 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps.
49. Install retaining ring (12) on drive shaft (32).
50. Carefully remove all burrs and sharp edges from shaft over which rotating element of seal will slide.

51. Lubricate drive shaft and mechanical seal bore with a compatible lubricant. Install mechanical seal (11) on drive shaft and position seal back against retaining ring (12). Care must be taken not to nick O-ring. Be sure lapped (polished) faces of stationary seal face and rotating element are together.
52. Install seal retainer (9). Secure seal retainer in place using two hex head cap screws (E).
53. Install drive key (A).
54. For 3700/4700 “BH” hydraulic drive assembly, go to Section 13, **Instructions for Assembly of a Type “BH” Hydraulic Drive.**
55. Read and understand all safety instructions and warnings before installing and operating pump.

3700/4700 “BH” Pumps (Positive Drive Mechanical Seal) (See Figure 15.1)

56. Install retaining ring (12) on drive shaft (32) to locate mechanical seal.
57. Carefully remove all burrs and sharp edges on shaft over which rotating element of seal will slide.
58. Apply a compatible lubricant to seal I.D. and to O.D. of drive shaft (32).
59. Slide rotating element of mechanical seal (11) onto drive shaft (32) before removing three or four clips that are taped to rotating element. Push rotating element back against retaining ring (12), tighten setscrews in seal, and remove clips that are taped to seal.
60. Slide faceplate end of drive shaft, with rotating element attached, into backplate (6A, B).
61. Install backplate end retaining ring (36) on drive shaft (32). Install key (B1) in keyway on drive shaft. Install faceplate end retaining ring (36) to secure drive gear.
62. Place appropriate number of gaskets (20) on backplate side of case (19A, B, C). Slide drive gear (34), assembled with drive shaft (32), and backplate (6A, B) into case bore. Align backplate (6A, B) on dowel pins (J). Secure backplate (6A, B) to case (19A, B, C) using fourteen hex head cap screws (L) for 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps.
63. Lubricate O-ring on stationary seal face and seal chamber bore with a compatible lubricant. Slide stationary seal face over keyway end of drive shaft (32) and down to seal chamber. Be sure lapped (polished) face is toward rotating member of seal. Push stationary seal face into seal chamber.
64. Install anti-rotation pin (T) in locator ring (60).
65. Position locator ring (60) with anti-rotation pin (T) toward seal face. Align anti-rotation pin (T) with slot in back of stationary seal face and push into counter-bore of backplate (6A, B).
66. Install seal retainer (9). Secure seal retainer in place using two hex head cap screws (E).
67. Install drive key (A).
68. For 3700/4700 “BH” hydraulic drive assembly, go to Section 13, **INSTRUCTIONS FOR ASSEMBLY OF A TYPE “BH” HYDRAULIC DRIVE.**
69. Read and understand all safety instructions and warnings before installing and operating pump.

3700/4700 “HB” Pumps (Standard Mechanical Seal) (See Figure 14.2)

70. Place drive gear (34) into case bore. Install key (B1) in keyway of drive shaft (32). Slide drive shaft into bore of drive gear.
71. Place appropriate number of case gaskets (20) on backplate side of case (19A, B, C). Align backplate (6A, B) on dowel pins (J). Secure backplate to case using fourteen hex head cap screws (L) for the 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps.
72. Install retaining ring (12) on drive shaft (32).

73. Carefully remove all burrs and sharp edges from shaft over which rotating element of seal will slide.
74. Lubricate drive shaft and mechanical seal bore with a compatible lubricant. Install mechanical seal (11) on drive shaft and position seal back against retaining ring (12). Care must be taken not to nick O-ring. Be sure lapped (polished) faces of stationary seal face and rotating elements are together.
75. Install ball bearing (2) on drive shaft (32) and into backplate (6A, B) as shown in the sectional drawing (Figure 14.2). **DO NOT** strike the outer race of the bearing or the grease seal just inside the outer race. This could damage the bearing. The bearings are pre-lubricated and **DO NOT** require lubrication at time of initial installation. A small amount of grease will be required during regular maintenance. Align setscrews in inner race of ball bearing with wide groove in shaft. Tighten setscrews in ball bearing (2) to secure bearing on drive shaft (32). Install retaining ring (3) into backplate (6A, B) to secure ball bearing (2) to backplate (6A, B).
76. Place one square head bolt (G) through each slot in backplate (6A, B) and through each hole in seal retainer (9). Secure seal retainer against backplate using two locknuts (F).
77. Install drive key (A).
78. Read and understand all safety instructions and warnings before installing and operating pump.

3700/4700 “HB” Pumps (Positive Drive Mechanical Seal) (See Figure 15.1)

79. Place drive gear (34) into case bore.
80. Install retaining ring (12) on drive shaft (32) to locate mechanical seal.
81. Carefully remove all burrs and sharp edges on shaft over which rotating element of seal will slide.
82. Apply a compatible lubricant to seal I.D. and to O.D. of drive shaft (32).
83. Slide rotating element of mechanical seal (11) onto drive shaft (32) before removing three or four clips that are taped to rotating element. Push rotating element back against retaining ring (12), tighten setscrews in seal, and remove clips that are taped to seal.
84. Slide faceplate end of drive shaft (32), with rotating element of mechanical seal attached, into backplate (6A, B) through bore for ball bearing (2).
85. Place appropriate number of case gaskets (20) on backplate side of case (19A, B, C). Install key (B) in keyway of drive shaft (32). Slide drive shaft into bore of drive gear while aligning backplate (6A, B) on dowel pins (J). Secure backplate (6A,B) on dowel pins (J). Secure backplate (6A, B) to case (19A, B, C) using fourteen hex head cap screws (L) for the 35 and 58 size pumps or eight hex head cap screws (L) for the 32, 43, and 48 size pumps.
86. Lubricate O-ring on stationary seal face and seal chamber bore with a compatible lubricating. Slide stationary seal face over keyway end of drive shaft (32) and down to seal chamber. Be sure lapped (polished) face is toward rotating member of seal. Push stationary seal face into seal chamber.
87. Slide ball bearing (2) over drive shaft (32). **DO NOT** strike or press on the outer race of the bearing. This could damage the bearing. Align setscrews in ball bearing (2) with groove in drive shaft and tighten setscrews. The bearings are pre-lubricated and **DO NOT** require lubrication at time of initial installation. A small amount of grease will be required during regular maintenance.
88. Install retaining ring (3) into backplate (6A, B) to secure ball bearing (2) to backplate (6A, B).
89. Install anti-rotation pin (T) in locator ring (60).
90. Position locator ring (60) with anti-rotation pin (T) toward seal face. Align anti-rotation pin (T) with slot in back of stationary seal face and push into counter-bore of backplate (6A, B).
91. Place one square head bolt (G) through each slot in backplate (6A, B) and through each hole in seal retainer (9). Secure seal retainer against backplate using two locknuts (F).
92. Install drive key (A).
93. Read and understand all safety instructions and warnings before installing and operating pump.

12. INSTRUCTIONS FOR DISASSEMBLY OF A TYPE “BH” HYDRAULIC DRIVE

Refer to Section 14, **PARTS LIST**.

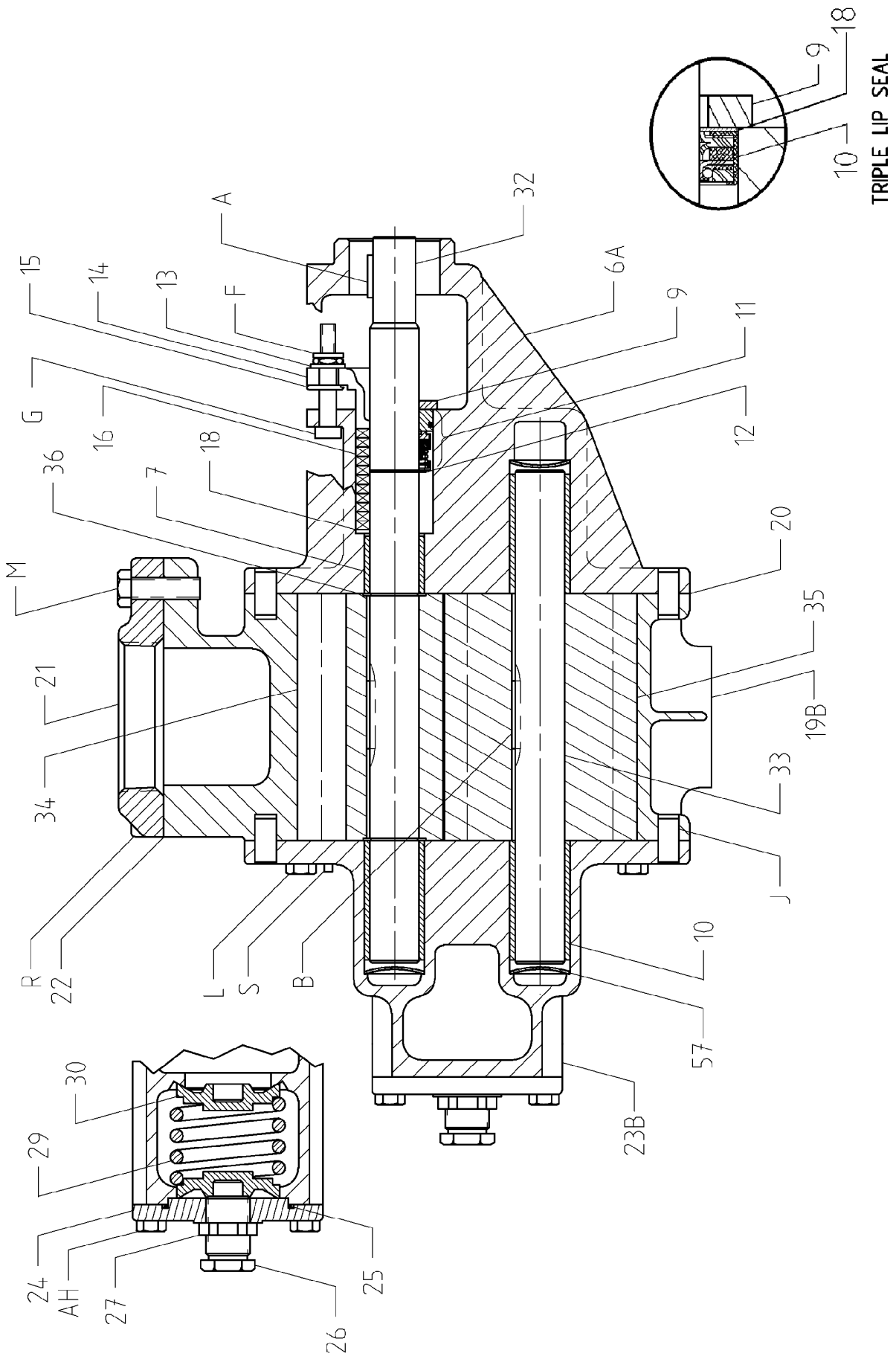
1. Read and understand safety instructions and warnings before starting to disassemble hydraulic drive components from pump. While disassembling, always inspect disassembled parts and adjacent parts to see if further disassembly is needed. Replace worn or damaged parts as required.
2. Turn off pump and lock out energy source to hydraulic motor. **DO NOT** proceed further with disassembly of the pump if there is the slightest possibility that the hydraulic motor may be started.
3. Close inlet and discharge valves.
4. If pump is to be disassembled:
 - A.) Refer to Section 14 (Figure 14.1) pump sectional drawing for “**BHFRV**.”
 - B.) If used, turn off and disconnect flush for packing or mechanical seal.
 - C.) To drain pump, follow the procedures in Section 7, **INSTRUCTIONS FOR DRAINING PUMP**.
 - D.) Disconnect lines from pump inlet and discharge.
5. Remove two or four cap screws securing hydraulic motor to bracket (61).
6. Slide hydraulic motor out of bracket. The rigid coupling (62) is a slip fit on both shafts; therefore, it may remain on pump shaft or motor shaft.
7. Remove four socket head cap screws (64) securing bracket (61) to backplate (6A, B). Remove bracket.
8. For further disassembly of the pump, refer to Section 8, **INSTRUCTIONS FOR PUMP DISASSEMBLY**, steps 1 - 20. Also, refer to steps 21 - 24 for pumps with triple lip seals, steps 30 - 33 for pumps with packing, or steps 40 - 43 for pumps with mechanical seals.

13. INSTRUCTIONS FOR ASSEMBLY OF A TYPE “BH” HYDRAULIC DRIVE

1. Refer to Section 14, **PUMP SECTIONAL DRAWINGS**, (Figure 14.1), for 3500-4700 “**BHFRV**” for pump assembly. If pump requires assembly, refer to Section 11, **INSTRUCTIONS FOR PUMP ASSEMBLY**, steps 1 - 6. Also, refer to steps 7 - 13 for pumps with triple lip seals, steps 27 - 36 for pumps with packing, or steps 47 - 70 for pumps with mechanical seals.
2. Refer to Section 14, (Figure 14.3), sectional drawing for **TYPE “BH” HYDRAULIC DRIVE COUPLING ASSEMBLY** for assembly of bracket and coupling.
3. Install retaining ring (63) in rigid coupling (62).
4. Install key (A) in pump shaft keyway. Slide rigid coupling (62) onto shaft until end of the shaft is against retaining ring (63).
5. Place bracket (61) onto pilot of backplate (6A, B). Secure bracket with four socket head cap screws (64).
6. Slide rigid coupling (62) back until outboard end of coupling is even with outboard end of bracket (61).
7. Install key in hydraulic motor shaft. Line up shaft key and rigid coupling keyway and slide units together. Rotate hydraulic motor to align motor mounting holes and secure motor with two or four cap screws as required.
8. Read and understand safety instructions and warnings before installing and operating pump.

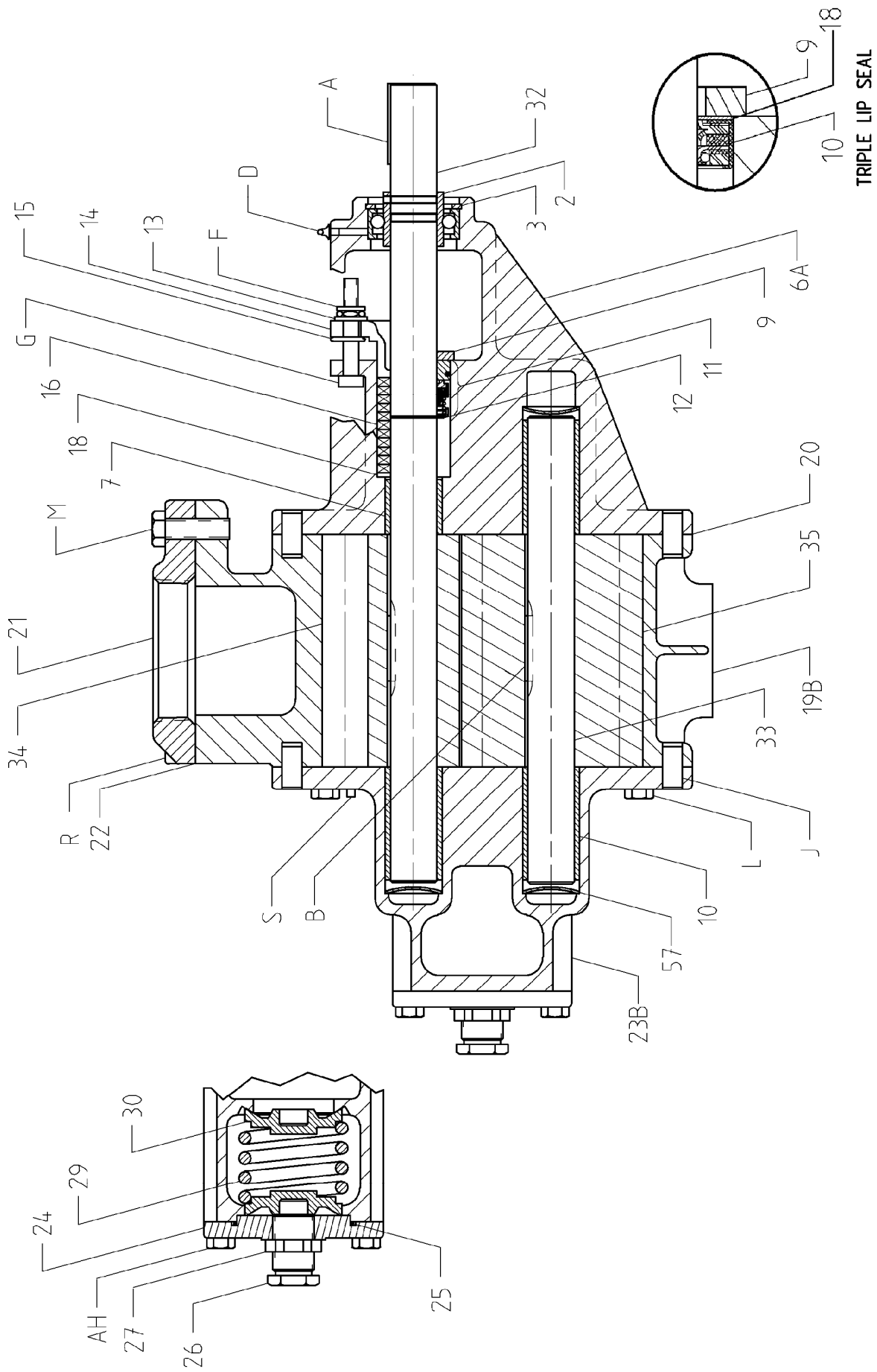
14. PARTS LIST

- | | | |
|-------------------------------------|---|--|
| 2. Ball Bearing | 23. Faceplate | A1. Drive Key |
| 3. Retainer Ring, Ball Bearing | A. Plain | B1. Key, Drive Gear |
| 6. Backplate | B. RV Style Relief Valve | B2. Key, Idler Gear |
| A. Standard | C. Jacketed RV Style Relief Valve | D. Lube Fitting |
| B. Jacketed | 24. Relief Valve Cap | E. Hex Head Cap Screw, Seal Retainer to Backplate |
| 7. Bearing, Short | 25. O-ring or Gasket Relief Valve Cap | F. Locknut |
| 8. Bearing, Long | 26. Adjusting Screw | G. Square Head Bolt |
| 9. Seal Retainer | 27. Nut, Lock, and Seal | H. Pipe Plug, Backplate |
| 10. Triple Lip Seal | 29. Spring | J. Dowel Pin |
| 11. Mechanical Seal | 30. Poppet/Spring Guide | L. Hex Head Cap Screw, Endplates to Case |
| 12. Retaining Ring, Mechanical Seal | 31. Shuttle Assembly | M. Hex Head Cap Screw, Flange |
| 13. Packing Gland Clip | 32. Drive Shaft | N. Nut, Flange |
| 14. Packing Gland | 33. Idler Shaft | R. Pipe Plug, Flange |
| 15. Spring Clip | 34. Drive Gear | S. Pipe Plug, Faceplate |
| 16. Packing Ring | 35. Idler Gear | T. Anti-rotation Pin |
| 17. Lantern Ring (Not Shown) | 36. Retaining Ring, Gear (H) | AG. Stud |
| 18. Packing Washer | 57. Expansion Washer | AH. Hex Head Cap Screw |
| 19. Case | 60. Locator Ring | AJ. Drive Screw |
| A. Threaded Port Case - Right Angle | WRN2 Warning Plate, RV Style Relief Valve | AK. Nut |
| B. Flanged Case - Right Angle | WRN3 Warning Plate, RV Style Relief Valve | Type BH Hydraulic Drive Bracket Assembly only |
| C. Flanged Case - Straight Through | WRN4 Warning Plate, RV Style Relief Valve | 61. Bracket |
| 20. Case Gasket | WRN5 Warning Plate, BC Style Relief Valve | 62. Rigid Coupling |
| 21. Flange | | 63. Retaining Ring |
| 22. Flange Gasket | | 64. Socket Head Cap Screw |



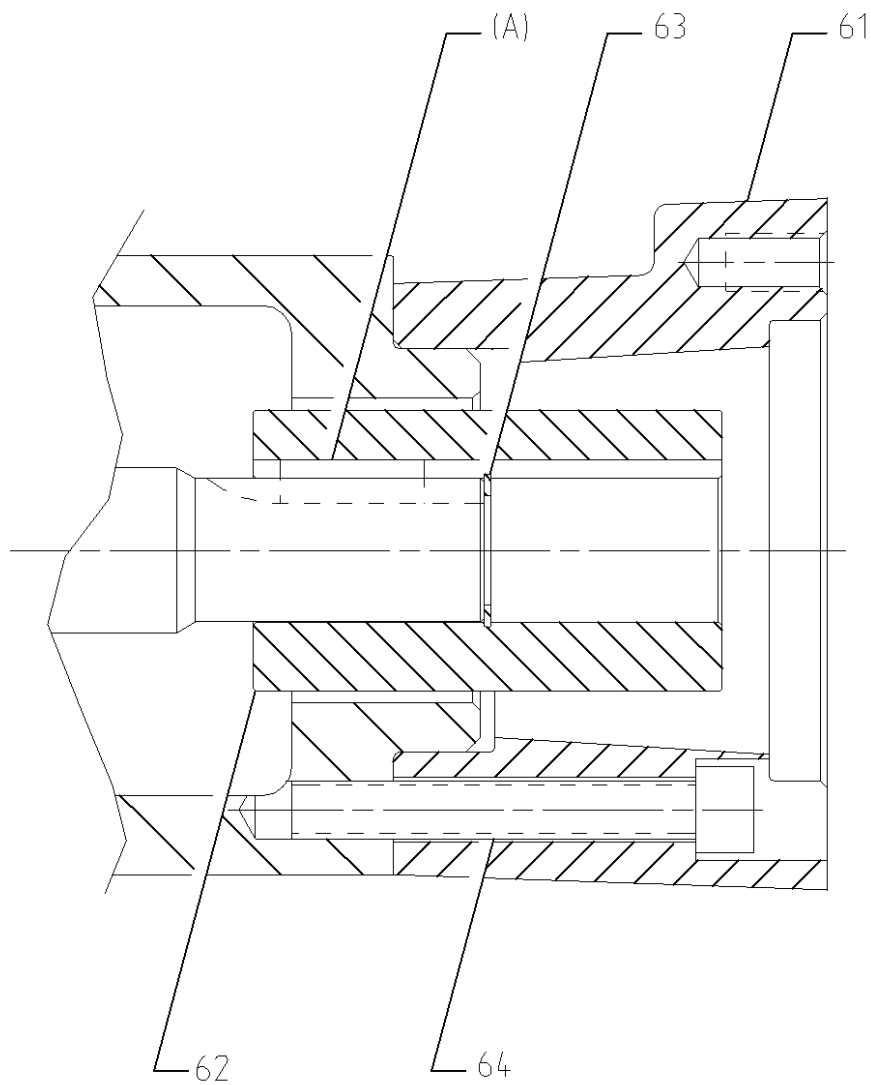
**BHFRV
FIGURE 14.1**

3535-4758 BH.F.RV



**HBFV
 FIGURE 14.2**

3535-4758 HB,F,RV



**TYPE BH
HYDRAULIC DRIVE COUPLING ASSEMBLY
FIGURE 14.3**

15. SHAFT SEALING

STANDARD COMPRESSION PACKING

One type of shaft sealing used in these pumps is formed ring packing with or without a lantern ring. When using a packed box pump, use formed packing rings. **DO NOT** use a one piece spiral wrap of packing. Packing rings are available in a wide selection of materials for various applications and temperatures. Previous experience with the pumped fluid is the best guide in selecting the proper packing ring material for your particular application.

Some backplates are furnished with tapped holes on the stuffing box to provide access to the lantern ring or packing set for either flushing or grease lubrication. An external flush or lubrication of the packing may be necessary for proper operation and to help prolong the life of the packing and shaft.

A flush is recommended when the fluid to be pumped is abrasive or the pump operates with negative inlet pressure (suction lift). Clean water is often used to flush the packing. On applications where clean water is not available or where it is incompatible with the fluid being pumped, other clean, nonhazardous liquids may be used for flushing the packing. The flush should be supplied to the stuffing box at a rate of 1/4 to 1/2 gallons per hour (1 to 2 liters per hour). The pressure of the flushing liquid should exceed the sum of the inlet pressure and half of the differential pressure by 10 to 15 psi [70 to 100 kPa].

If the packing is to be grease lubricated, a good grade of bearing grease should generally be used. Should bearing grease be unacceptable or incompatible with the fluid being pumped, another paste type lubricant may be used. Lubrication of the packing must be performed with the pump stopped. Before daily start-up, if applicable, is a good time.

To lubricate the packing, stop the pump. Carefully clean the stuffing box pipe plugs of any contaminants. After removing the pipe plugs from the stuffing box, install a lubrication fitting into one of the tapped holes. Lubricant now may be injected into the stuffing box through the lube fitting. Inject clean, fresh unused lubricant until it is seen coming out of the other tapped hole. Clean up any excess lubricant and remove the lube fitting. Replace the pipe plugs. This procedure should be performed daily, prior to start-up if the pump is purchased with provisions for grease lubrication. In certain applications, more frequent lubrication of the packing may be necessary. Experience will provide a guide as to how frequently the packing should be lubricated. Applying lubricant often will extend the life of the packing and shaft.

CARE OF PACKING

Packing hooks are commercially available to help in removing packing rings from the stuffing box. It is generally not recommended to reuse old packing rings. When installing packing, use formed packing rings. **DO NOT** use a one piece spiral wrap of packing. Before installing packing, carefully clean the stuffing box and shaft.

Packing rings should be installed one ring at a time, with the joints of adjacent rings staggered approximately 180°. Each ring should be seated firmly before the next ring is installed. **DO NOT** forget to install the lantern ring if applicable. Three rings of packing, followed by the lantern ring, should allow the lantern ring to be approximately aligned with the flush/lube holes in the stuffing box.

The packing gland nuts should first be evenly tightened with a wrench to seat the packing firmly in the stuffing box and against the shaft. **DO NOT** over-tighten the packing. The gland nuts should then be backed off until finger-tight. Connect the flush or lubricate the packing if either method is used. After the pump is started, note the stuffing box. If the packing leakage exceeds ten drops per minute, stop the pump and adjust the gland nuts. The gland nuts should be adjusted evenly in 1/6 to 1/3 turn (1 to 2 flats on the nut) increments. Start the pump and allow it to operate for several minutes.

Again, visually examine the stuffing box for excessive leakage. Repeat the above procedure until the stuffing box leakage is between five to ten drops per minute.

DO NOT over tighten the packing. Slight leakage is a necessary requirement for proper packing operation. Leakage of five to ten drops per minute when the pump is operating is desirable, as it will preserve the packing and avoid scoring of the shaft. Over-tight packing may score shafts, increase torque requirements of the pump, damage couplings and drivers, and generate excessive heat.

The pump should be stopped and the packing gland adjusted whenever leakage exceeds ten drops per minute. The condition of the packing should be checked at regular intervals, the frequency depending on the type of service. Experience will dictate how frequently the inspections should be made.

MECHANICAL SEALS

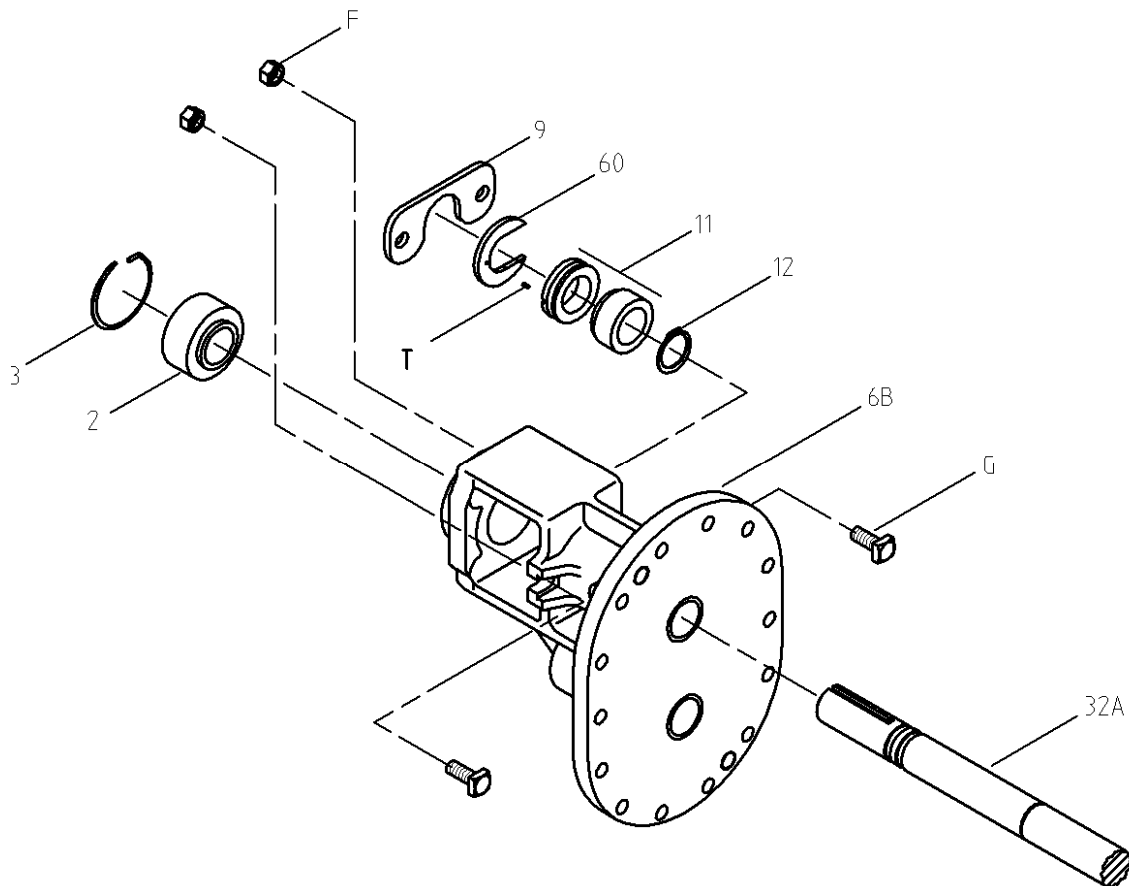
Various types of mechanical seals are available to fit most pumps. (See **VARIOUS SEALING ARRANGEMENTS** shown in Figure 15.4 and 15.5). Due to the various seal types and styles available, the seal manufacturer's instructions for installation and setting should be followed when available.

NOTE: Not all seals will fit or function in all pumps. Modification to the pump backplate, drive shaft, and/or retainer may be required. Consult with Roper Pump Company or an authorized distributor if you are considering a seal change in your pump.

For removal or installation of mechanical seals, refer to disassembly and assembly procedures for pumps.

CONVERSION FROM PACKED BOX TO MECHANICAL SEAL OR MECHANICAL SEAL TO PACKED BOX

Conversion kits are available to convert from a packed box pump to a mechanical seal pump or vice versa. Contact your authorized distributor or Roper Pump Company for availability of conversion kits



**MECHANICAL SEAL
FIGURE 15.1**

INSTALLATION OF A POSITIVE DRIVE SEAL (JOHN CRANE® TYPE 8-1 AND TYPE 9)

Refer to the exploded parts drawing (Figure 15.1) and to the appropriate seal chamber dimensional drawing (Figure 15.3).

1. Machine a counter-bore at entrance to seal chamber of backplate (6A, B) as shown in dimensional drawing (Figure 15.3).
2. With drive shaft (32) out of pump, install retaining ring (12) on drive shaft to locate mechanical seal.
3. Carefully remove all burrs and sharp edges on the shaft over which rotating element of seal will slide.
4. Apply a lubricant to seal I.D. and to drive shaft O.D. that is compatible with product being pumped and elastomers within pump. **DO NOT** use petroleum base products with seals with EPR elastomers. Clean and lubricate parts with light oil unless EPR elastomers are used. Use a nonpetroleum base lubricant with EPR elastomers.
5. Slide rotating element of mechanical seal (11) onto drive shaft (32) before removing three or four clips that are taped to rotating element. Push rotating element back to retaining ring (12), tighten setscrews in seal, and remove clips that are taped to seal.
6. Slide faceplate end of drive shaft, with rotating element attached, into backplate (6A, B) through bore for outboard ball bearing (2).
7. Lubricate O-ring on stationary seal face and seal chamber bore with a compatible lubricant. Slide stationary seal face over keyway end of drive shaft (32) and down to seal chamber. Be sure lapped (polished) face is toward rotating member of seal. Push stationary seal face into seal chamber.
8. Install outboard ball bearing (2) to position drive shaft (32) as shown in appropriate sectional drawing (Figure 14.2).
9. Install anti-rotation pin (T) in locator ring (60).
10. Position locator ring (60) with anti-rotation pin (T) toward seal face. Align anti-rotation pin (T) with slot in back of stationary seal face and push into counter-bore of backplate (6A, B).
11. Place one square head bolt (G) through each slot in backplate (6A, B) and through each hole in seal retainer (9). Secure seal retainer against backplate using two locknuts (F).
12. Assemble backplate assembly to remainder of pump following correct steps in **INSTRUCTIONS FOR PUMP ASSEMBLY**, Section 11.

TRIPLE LIP SEAL

A triple lip seal can be used in the same backplates used for shaft packing and mechanical seals. Different drive shafts are required for the triple lip seal pumps.

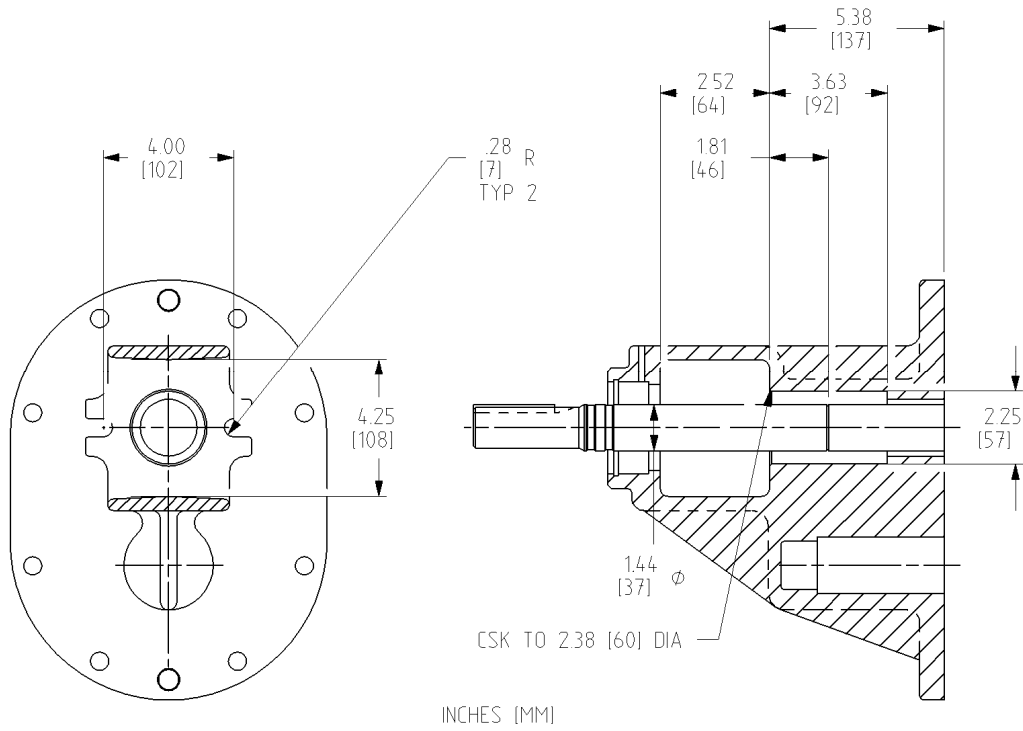
The triple lip seal comes from the manufacturer with a small amount of grease between the lips. Do not remove this grease as it is necessary to provide lubrication to the inner lips on startup.

DO NOT distort the metal casing around the triple lip seal when installing the seal. Be very careful not to damage or distort the seal lips during installation. Follow the assembly instructions in Section 11 and you will have good service from the seal.

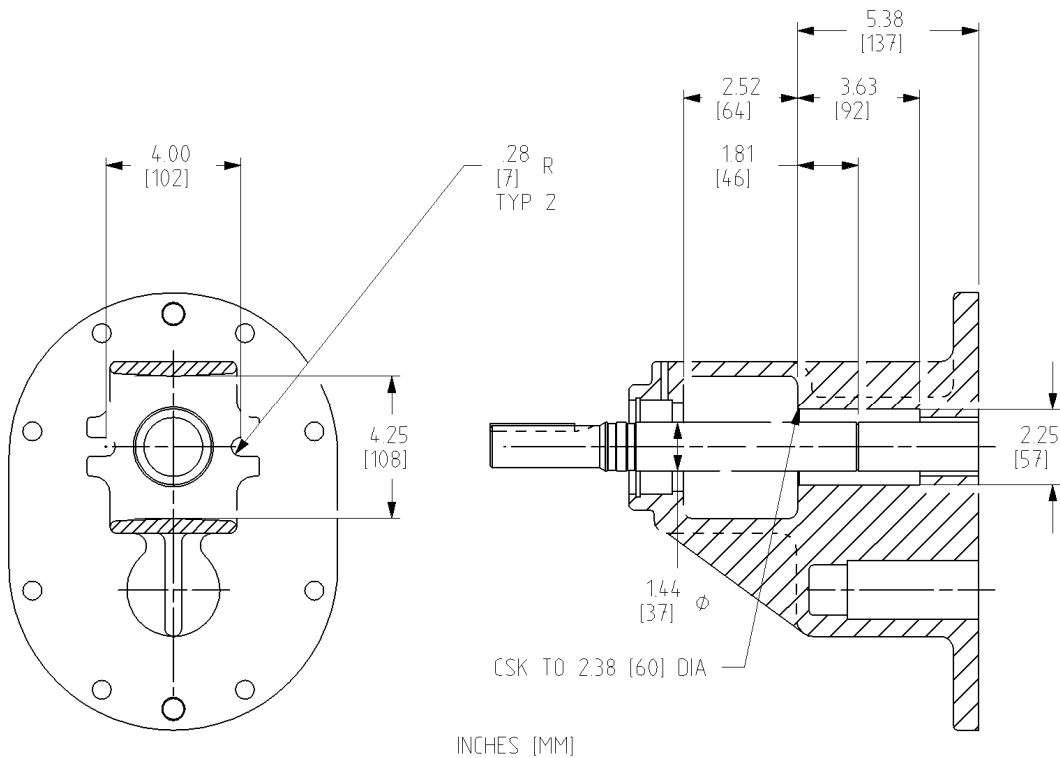
The standard triple lip seal arrangement is good for products that will not solidify when exposed to air. Optional arrangements are available where a barrier fluid or flush is required to prevent exposure of the triple lip seal to air.

SEAL CHAMBER DIMENSIONALS

JOHN CRANE® TYPE 21 - SINGLE & DOUBLE FIGURE 15.2



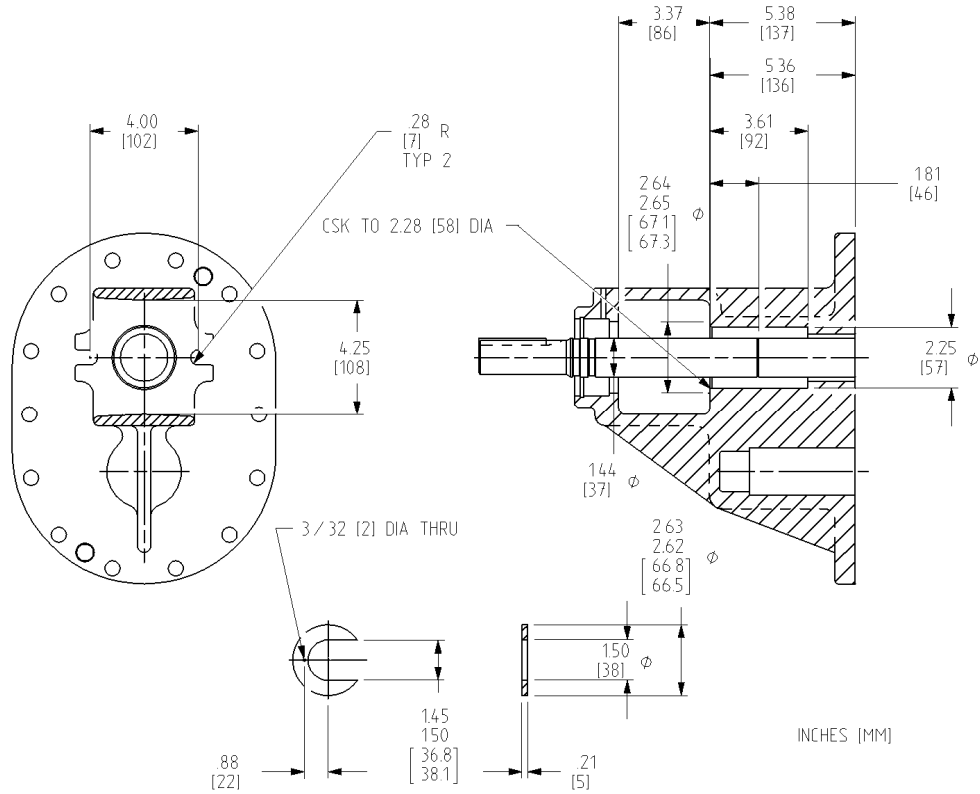
3735 AND 3758 SIZE PUMPS



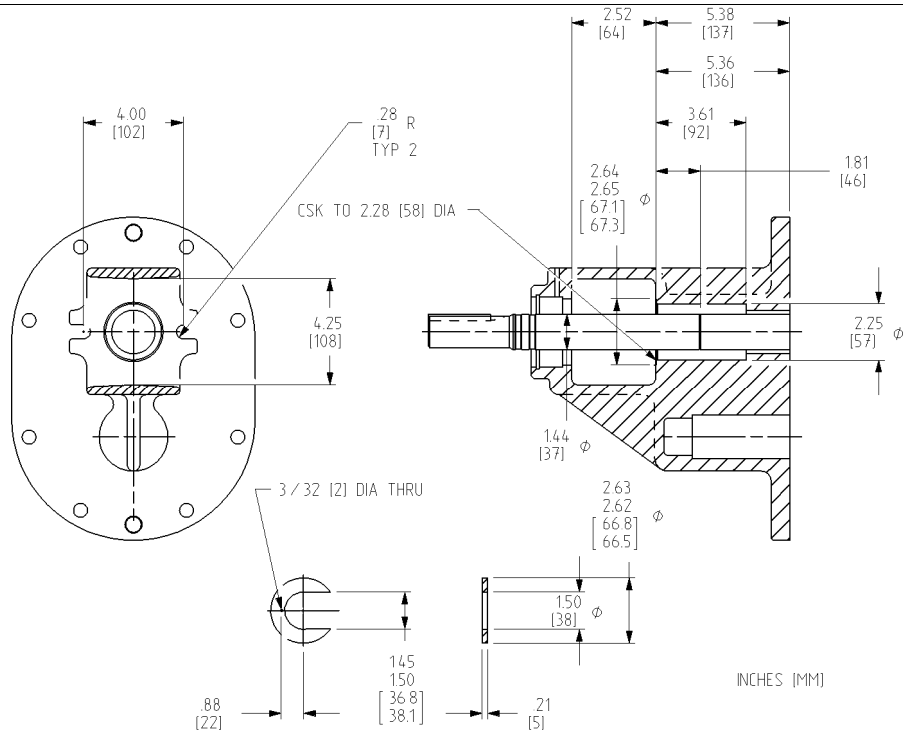
3732, 3743, AND 3748 SIZE PUMPS

SEAL CHAMBER DIMENSIONALS

CRANE® TYPE 8 - 1 & TYPE 9 - SINGLE & DOUBLE FIGURE 15.3

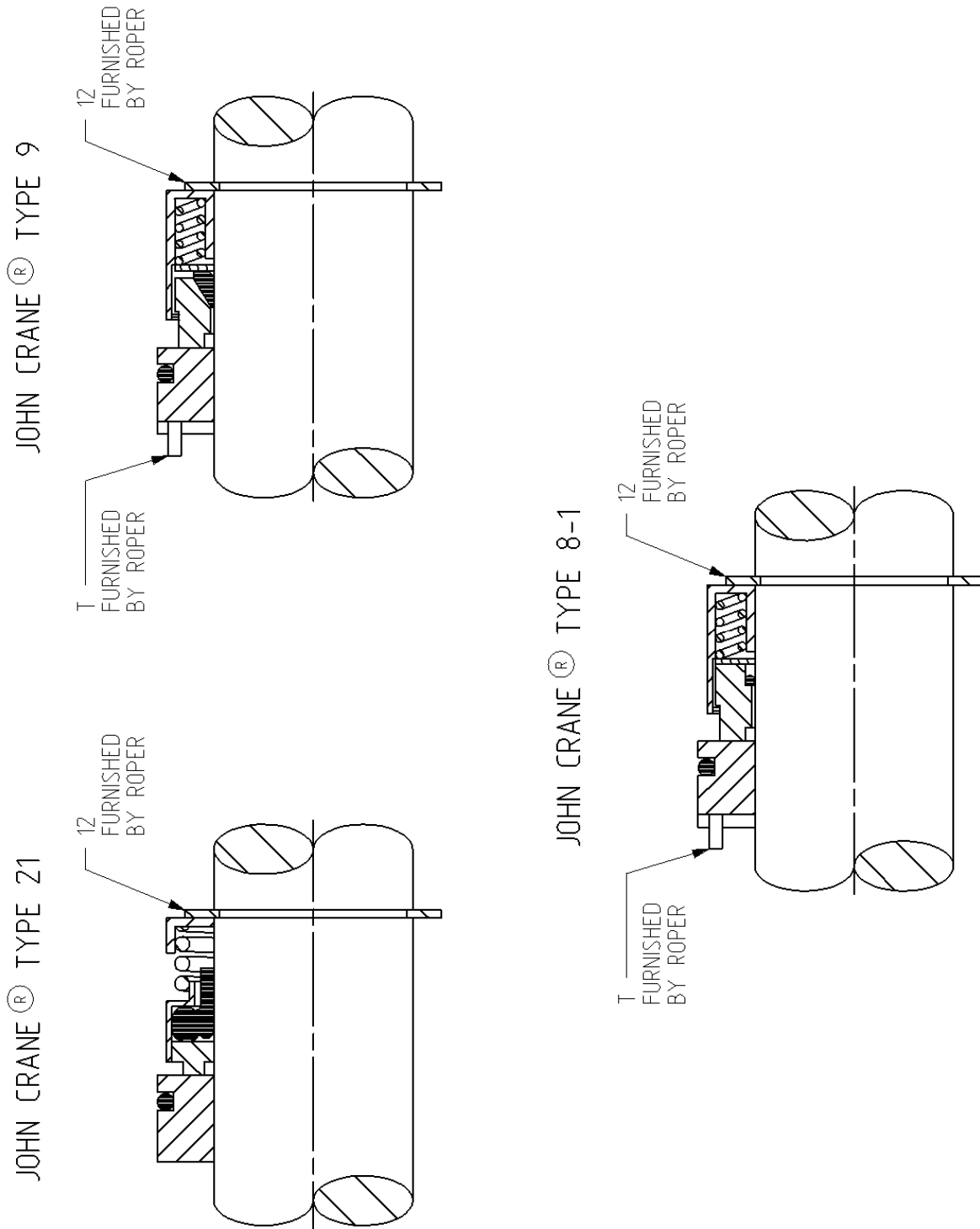


3735 AND 3758 SIZE PUMPS



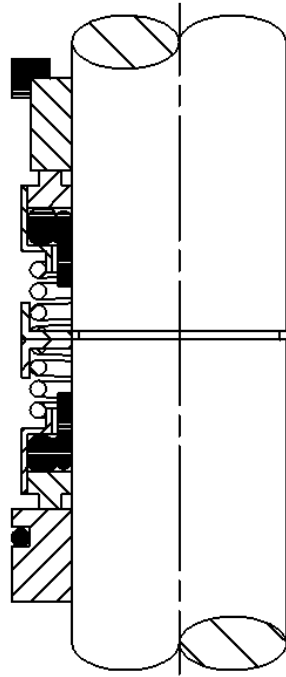
3732, 3743, AND 3748 SIZE PUMPS

VARIOUS SEALING ARRANGEMENTS

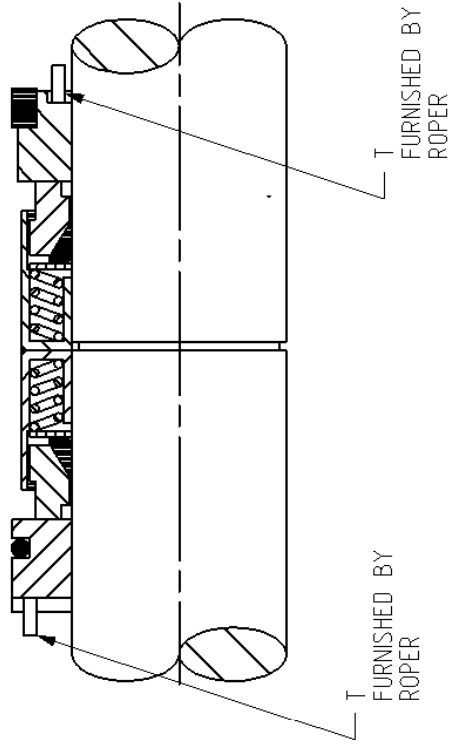


**SINGLE MECHANICAL SEAL
FIGURE 15.4**

JOHN CRANE® TYPE 21 DOUBLE



JOHN CRANE® TYPE 9 DOUBLE



DOUBLE MECHANICAL SEAL
FIGURE 15.5

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HB, SB, and BH TYPE 3

OWNERS MANUAL

**(Use with Supplement Owners Manual
G12-436 for GHB and BHB Pumps)**

**G12-209
11/29/11**



SAFETY INSTRUCTIONS

This is an industrial component. Only a qualified systems integrator should be allowed to design it into a system. The integrator must determine proper plumbing, mounting, driveline and guard components.

Improper installation or use could lead to a serious, even fatal, accident. The system integrator must communicate all safe operation procedures to the end user(s).

Before operation, fully understand and follow the instructions shown in this manual and any instructions communicated by the system integrator. No one should be allowed to operate or maintain this pump who has not been fully trained to work safely according to the configuration of the pump system and in accordance with all applicable government and industry regulations.

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Good Practice

NOTE: These are general guidelines and do not cover all possible situations.

It is the responsibility of the system integrator to apply this product properly.

Plumbing

1. The inlet pipe should be as short and straight as possible to minimize suction pressure losses. Excessive restrictions at the inlet can cause cavitation resulting in poor performance, noise, vibration, or pump damage.
2. Slope the inlet plumbing appropriately to avoid air pockets.
3. Plumbing weight, misalignment with the ports or thermal expansion can exert excessive force on the pump. Plumbing must be properly supported and aligned with expansion joints, if required, to minimize these forces.
4. To prevent over pressure situations, install a relief valve as close to the pump outlet as possible. Install the relief valve before any shut-off valves.

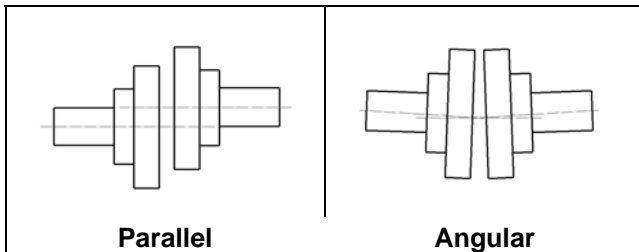
Separate Pump and Drive Assemblies

Driveline Guards

1. Assure adequate guards have been installed to prevent personnel contacting moving components.
2. Follow all OSHA, Federal, state and local codes.

Check Alignment of Pump to Driveline

Excessive misalignment can overload the pump input shaft and cause premature failure. The figures below show parallel and angular misalignments.



Mounting Base

1. Mount the unit on a rigid, heavy base to provide support and absorb shock. Bases should be designed for high rigidity, not just strength.
2. The pump feet were not designed for mounting to concrete and do not have enough contact area to prevent concrete from failing. When mounting to cement or concrete, use a steel base plate to distribute the mounting stress over an area large enough to prevent the cement from failing. The base plate should be at least as thick as the pump feet. Grout it in place.

Roper Pumps' Close Coupled Drives

Hydraulic or Gearmotor units where the drive mounts directly to the pump

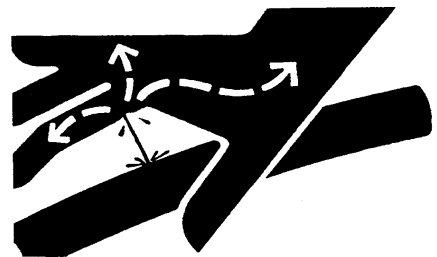
- Driveline is not exposed and does not require guards.
- Alignment between pump and drive line is maintained by the assembly.
- Because the assembly absorbs reaction forces of the driveline, the mounting base does not need to be as robust. The level of rigidity and strength is determined by the piping stresses from the system.

! WARNING



Over-pressure may burst pump or system components. Always include a relief valve in installation. Do not over pressurize pump or block discharge line while running.

! WARNING



Injection Hazard: Do not try to stop a leak with your hand! Avoid any close contact with hydraulic fluid jets. Escaping fluid can penetrate skin, causing serious injury. In case of accident, see a doctor immediately for removal of fluid.

Guarding PTO Drive Shafts

PTO drive systems can be dangerous and when used, additional safety precautions, including guarding, may be required and must be provided by the drive system installer. Roper Pump Company has no responsibility for recommending or providing proper guarding or other safety measures in any particular application.

The installation of proper guards for the power take-off and its associated equipment is the responsibility of the drive system designer and the installer who know the particular product application and the user's exposure to danger. *The ultimate responsibility for the safe application and installation is the user's.*



1. NAMEPLATE DATA

Roper Pump Company identifies each pump manufactured by a metal nameplate attached to the pump. This nameplate describes the pump as built at the factory. Copy the nameplate data from your pump in the area provided below. Use this for ready reference when ordering repair parts or when consulting with a Roper distributor or Roper Pump Company about this pump.

MODEL NUMBER: _____
SPEC NUMBER: _____
TYPE: _____
SERIAL NUMBER: _____

PUMP NOMENCLATURE

MODEL 3722 GHBFORVLX

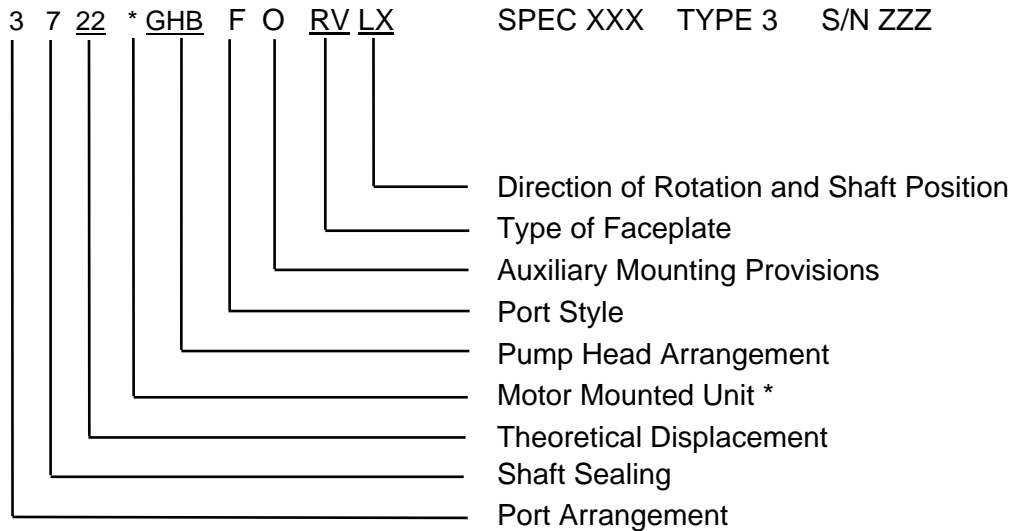
SPEC XXX **TYPE** 3

SERIAL NO. ZZZ

1. The Model Number consists of an eleven digit number.
 - The first digit (3) indicates the port arrangement.
 - 3 – 3600 Series with right angle ports
 - 4 – 4600 Series with straight through ports
 - The second digit (7) indicates shaft sealing.
 - 5 – Triple Lip Seal
 - 6 – Packing
 - 7 – Mechanical Seal
 - The third and fourth digits (22) indicate the approximate theoretical displacement in U.S. gallons per 100 revolutions.
 - Gallons/100 Rev. [Liters/100 Rev.]
 - 11 [41.6]
 - 17 [64.4]
 - 22 [83.3]
 - The letter or group of letters (GHB) indicates the pump head arrangement.
 - HB – Pump with outboard bearing
 - SB – Suspended pump with outboard bearing and auxiliary piping
 - GHB – Pump with outboard bearing and built-on gear reduction unit
 - BHB – Pump with outboard bearing and bracket assembly to accommodate hydraulic drive auxiliaries through a flexible coupling
 - BH – Pump without outboard bearing to accommodate close coupled hydraulic drive auxiliaries through a rigid coupling
 - The letter (F or A) indicates port style
 - No letter – Pump with threaded ports
 - F – Pump with Roper standard flange ports
 - A – Pump with flange facings to accept ANSI flanges
 - On GHB pumps, the letter (O) indicates pump with outboard bearing and auxiliary mounting provisions. (Does not include built-on gear reduction unit).
 - On SB pumps, the letter (O) indicates pump without auxiliary piping.
 - The letters (RV) indicate type of faceplate on pump.
 - See Section 5, **DIRECTION OF ROTATION AND RELIEF VALVES**, for an explanation of the types of valves available.
 - No letters – Plain faceplate
 - RV – RV style single direction relief valve faceplate (Standard RV, Jacketed RV, or Double Setting RV)
 - BV – BV style bi-directional relief valve faceplate

- The letter or group of letters (X, LX) indicates direction of rotation and shaft position. The letter (L) indicates low drive unit. If the letter (L) is not used, the shaft will be in a high drive position.
 - No letter or W – Clockwise Rotation (Standard Rotation)
 - X – Counterclockwise Rotation
 - Y – Clockwise Rotation
 - Z – Counterclockwise Rotation
 - LW – Clockwise Rotation
 - LX – Counterclockwise Rotation
 - LY – Clockwise Rotation
 - LZ – Counterclockwise Rotation

Example:



- * The letter (M) may be used in this space indicating the pump is mounted with motor. The letter (E) may be used in this space indicating the pump is mounted on a base with or without engine.

As stated in the explanation of the pump nomenclature, all characters may not appear on every pump nameplate.

NOTE: The preceding description of the figure number is to assist in identifying your Roper 3600 series pump only. **DO NOT** attempt to derive any ratings or performance from the figure number. **DO NOT** use the explanation of the figure number to construct your own pump. Not all combinations are possible. For assistance in pump selection, it is recommended that you consult Roper Pump Company or an authorized distributor.

- Occasionally, special pumps or configurations are required which are unique for a particular application. These modifications are clarified by a SPECification number. Identification of any items different than a standard pump can be made by consulting Roper Pump Company or an authorized distributor.
- The TYPE number is a number used by Roper Pump Company for in-house identification of construction and hydraulics. Always include the type number in any references to the pump.
- The SERIAL number is a unique number assigned to each pump built by Roper Pump Company.

In any communication concerning this pump, always be sure to include the Model, Spec, Type, and Serial numbers so proper identification of the pump can be assured.

2. MAXIMUM PUMP RATINGS

The maximum pressure, speed, and temperature limits for this pump SERIES are shown below.

The maximum rating of a pump with a SPEC number may be different depending on the materials of construction.

Maximum limits for this SERIES:

Pressure

- 125 psi [862 kPa] Maximum Inlet
- 125 psi [862 kPa] Maximum Discharge

Speed

- 750 rpm Maximum

Temperature

- Mechanical Seal Pumps: 212°F [100°C]
- Packed Box Pumps: 250°F [121°C]

3. PREOPERATION CHECKS

Read and understand the instructions and recommendations contained in this manual.

Disconnect the coupling between the driver and pump.

Test the rotation of the driver to make sure it will operate the pump in the desired direction of rotation. Rotation is shown on the pump faceplate if the pump has an integral relief valve. When an integral relief valve is used, make sure it is positioned and adjusted as discussed in Section 5, **DIRECTION OF ROTATION AND RELIEF VALVES**. After the unit is mounted and the piping is connected, the pump should be checked to be sure it operates freely without binding. After operation is proved satisfactory, both pump and driver should be tightly secured and the alignment rechecked before operation.

Before starting, make sure all guards are in place and the inlet and discharge valves are opened.

After starting the unit, check to see that the pump is delivering liquid. If not, stop the driver immediately and correct the problem. After the pump is delivering liquid, check the unit for excessive vibration, localized heating, and excessive shaft seal leakage. Check the pressure or vacuum by installing gauges at both the inlet and discharge sides of the pump to make sure the pressure or vacuum conforms to specifications.

4. RECOMMENDED TOOL LIST

NOTE: Tools not furnished with pump.

Tools for all Pumps:

- (1) Safety Glasses
- (1) 9/16" Combination Wrench
- (1) 3/4" Combination Wrench
- (1) 6" Adjustable Wrench
- (1) CG-45 Snap-On® Tool Bearing Puller
- (1) 6" to 10" Three Square File
- (1) Pliers

Additional Tools for HB Pumps:

- (1) 1/8" Hex Key
- (1) Flat tip Screwdriver, 1/4" wide X 4" long blade

Additional Tools for Pumps with an RV Type Relief Valve:

- (1) 7/16" Combination Wrench
- (1) 18" Pipe Wrench

Additional Tools for Pumps with Flanges:

- (2) 15/16" Combination Wrench

Additional Tools for Pumps with Shaft Packing:

Packing Hook for .34" square packing rings

Additional Tools for Pumps with Mechanical Seals:

- (1) 0400 External Retaining Ring Pliers

Additional Tools for BH Pumps:

- (1) 5/16" Hex Key

5. DIRECTION OF ROTATION AND RELIEF VALVES

There are four types of integral relief valves available. The standard RV, jacketed RV, and double setting RV are all designated by the letters "RV" in the pump nomenclature. The bi-directional relief valve is designated by the letters "BV" in the pump nomenclature. Spec numbers are used to help identify some non-standard relief valves.

STANDARD RV

This relief valve is externally adjustable by means of an adjusting screw located in the center of the relief valve cap. The range of adjustment is approximately 30 psi [207 kPa] to 125 psi [862 kPa]. The actual capability is dependent on pump speed and liquid viscosity. The settings are for full bypass; that is, all of the fluid is circulating back to the inlet through the relief valve. The end user must set the relief valve for conditions that exactly match the application.

JACKETED RV

This relief valve operates in exactly the same manner as the standard RV except that the faceplate is jacketed to allow provisions for heating or cooling of the relief valve.

DOUBLE SETTING RV

This relief valve is externally adjustable by means of an adjusting screw located in the center of the relief valve cap. The adjusting screw is fitted with a two position lever to quickly change the relief valve setting. This is accomplished by moving the lever from one position to the other. The relief valve is set with the lever in the high pressure position so that the relief valve setting can be quickly reduced by approximately 10 to 30 psi [30 to 207 kPa] by moving the lever from the high pressure position to the low pressure position. Actual drop in pressure resulting from moving the lever from the high to the low position is dependent on the application.

BI-DIRECTIONAL BV

This relief valve is externally adjustable by means of adjusting screws located in the center of the relief valve caps. The range of adjustment is approximately 30 psi [207 kPa] to 125 psi [862 kPa]. The actual capability is dependent on pump speed and liquid viscosity. The settings are for full bypass; that is, all of the fluid is circulating back to the inlet through the relief valve. The end user must set the relief valves for conditions that exactly match the application.

DIRECTION OF ROTATION TAGS



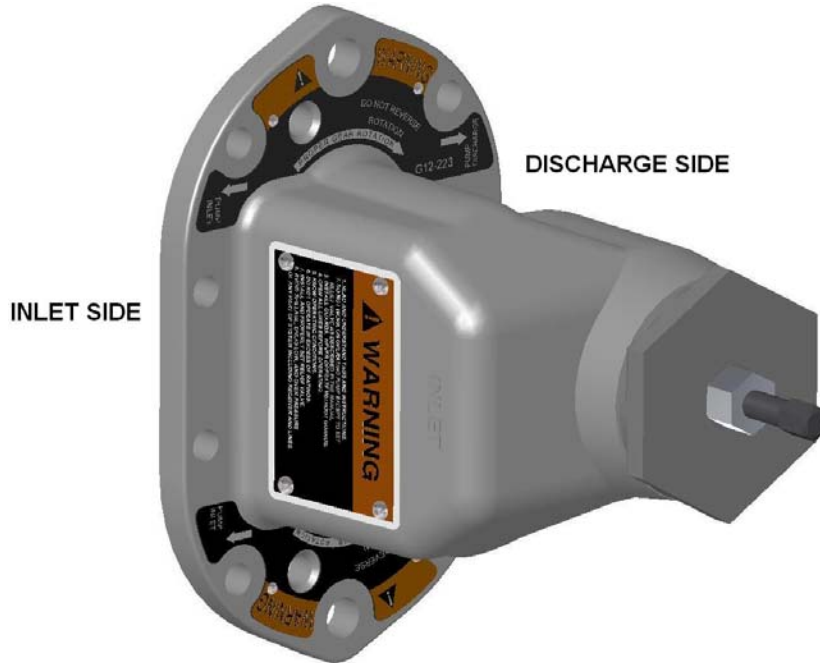
Figure 5.1
TYPICAL DIRECTION OF ROTATION TAG
FOUND ON RV STYLE
SINGLE DIRECTION RELIEF VALVES



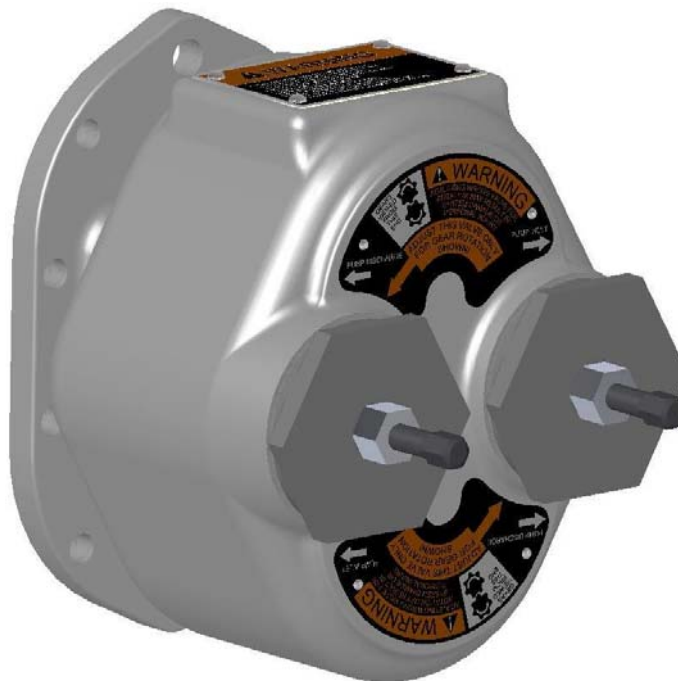
Figure 5.2
TYPICAL DIRECTION OF ROTATION TAG
FOUND ON BV STYLE
BI-DIRECTION RELIEF VALVES

RECOGNIZING THE RELIEF VALVE

FACEPLATE ASSEMBLY FOR
RV STYLE SINGLE DIRECTION RELIEF VALVE
FIGURE 5.3



FACEPLATE ASSEMBLY FOR
BV STYLE BI-DIRECTION RELIEF VALVE
FIGURE 5.4



PROPER PUMP GEAR ROTATION

Proper gear rotation is shown on the warning tags attached to the relief valve faceplate.

PUMP INLET and PUMP DISCHARGE

On the RV and BV style relief valve, either the “pump inlet” or “pump discharge” arrow will always point directly to one side port on the cases that have one side port and one top port. The top port is connected to the side of the pump that is opposite the side port. The “pump inlet” and “pump discharge” arrows will always point directly to the inlet and discharge ports on the pump with straight through port cases.

An integral relief valve should not be used on applications where the discharge must be closed for more than one minute. Prolonged operation of the pump with the discharge closed will cause rapid heating of the liquid circulating through the relief valve, thus resulting in possible damage.

DIRECTION OF ROTATION FOR THE RV STYLE RELIEF VALVE

The drawings showing **DIRECTION OF ROTATION FOR PUMP CONFIGURATIONS USING THE RV STYLE RELIEF VALVE** and position of relief valve with the letter “L” in the designation are for low drive applications (the drive shaft is lower than the side port). All other drawings shown in Figure 5.5 are for high drive applications (the drive shaft is above the side port).

The arrow in the drawing at the end of the drive shaft indicates the direction of rotation needed to achieve proper operation of the pump and relief valve when using the pump and relief valve orientation shown in the drawing. CW indicates clockwise rotations and CCW indicates counterclockwise rotation when viewed from the drive shaft end of the pump.

To determine the correct relief valve position for any of the pump orientations, use the drawings shown in Figure 5.5 titled **DIRECTION OF ROTATION FOR PUMP CONFIGURATIONS USING THE RV STYLE RELIEF VALVE**:

1. Find the group of drawings with the proper drive shaft position (high or low drive). Drawings with W, Z, X, or Y rotation are high drive pumps. Drawings with LW, LZ, LX, or LY rotation are low drive pumps. Eliminate all other drawings.
2. In the drawings remaining, find the group of drawings with the proper direction of rotation arrow at the end of the drive shaft. Eliminate all other drawing. CW indicated clockwise rotation and CCW indicates counterclockwise rotation when viewed from the drive shaft end of the pump.
3. In the drawings remaining, find the group of drawings with the proper port positions (straight through or right angle). Eliminate all other drawings.
4. In the remaining drawings, find the drawing with the proper inlet and discharge port locations. This drawing will show the proper relief valve position for the pump configuration chosen. Note the position of the word “INLET” cast on the side of the relief valve faceplate. The word “INLET” must be on the inlet “side” of the pump in order for the relief valve to work properly. The discharge and inlet “sides” of the pump are always directly opposite each other; the top port of the right angle pump is connected to the “side” of the pump via an internal passage.

	W	LW	Z	LZ
3x11-22 HB & BH				
4x11-22 HB & BH				
3x22 SB				
	X	LX	Y	LY
3x11-22 HB & BH				
3x22 SB				

DIRECTION OF ROTATION FOR 3511 TO 4722 HB, BH, AND SB PUMPS WITH AND WITHOUT THE RV STYLE SINGLE DIRECTION RELIEF VALVE
Figure 5.5

	W	LW	Z	LZ
3x11-22 HB & BH				
4x11-22 HB & BH				
3x22 SB				
	X	LX	Y	LY
3x11-22 HB & BH				
3x22 SB				

**DIRECTION OF ROTATION FOR 3511 TO 4722 HB, BH, AND SB PUMPS
WITH THE BV STYLE BI-DIRECTIONAL RELIEF VALVE
Figure 5.6**

CHANGING THE RV STYLE RELIEF VALVE POSITION

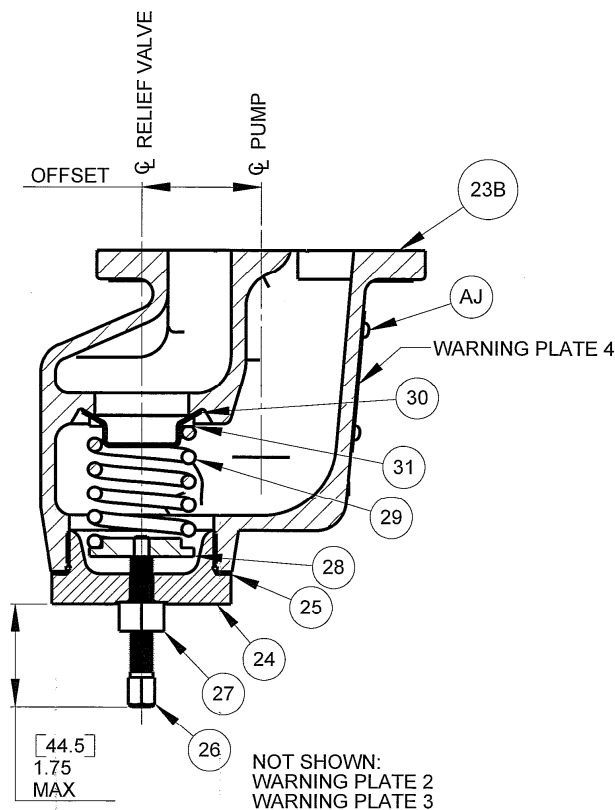
Refer to the sectional drawing shown in Figure 5.7.
(Not required on a pump with the BV Style Bi-Directional Relief Valve).

You should have already checked the drawings in Figure 5.5 to find the correct way to position your relief valve, based on the pump's direction of shaft rotation and position and the location of the inlet and discharge ports. If you have not checked, do it now to decide whether or not you should change the position of our relief valve.

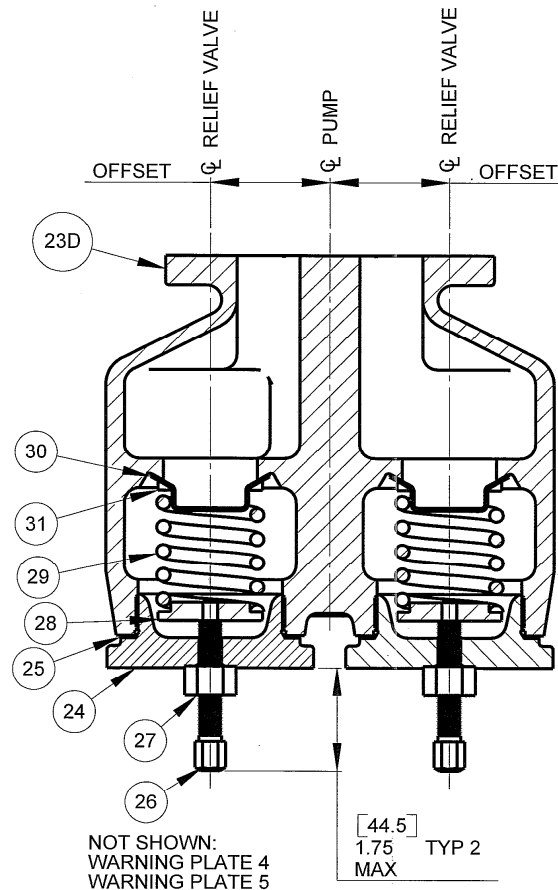
If the relief valve position needs to be changed, follow the instructions below and refer to Section 14, **PARTS LIST** and the **RV STYLE SINGLE DIRECTION RELIEF VALVE** drawing shown in Figure 5.7.

1. Turn off pump and lock out energy source to driver.
2. Close inlet and discharge valves.
3. To drain pump, follow procedure in Section 7, **INSTRUCTIONS FOR DRAINING PUMP**.
4. Remove two washer head cap screws (K) and eight hex head cap screws (L) securing faceplate (23B) to case. Remove faceplate.
5. While viewing faceplate (23B) from end with relief valve cap (24), turn faceplate so that orientation of relief valve cap to pump matches **DIRECTION OF ROTATION** drawing previously selected from charts in Figure 5.5.
6. Install two hollow dowel pins (J) on faceplate end of case (19A, B, C, D, E) if they were removed during disassembly. Place appropriate number of case gaskets (20) on end of case. Align faceplate (23B) on hollow dowel pins, maintaining proper orientation as determined above. Secure faceplate to case using two washer head cap screws (K) and eight hex head cap screws (L).

RV STYLE SINGLE DIRECTION RELIEF VALVE
FIGURE 5.7



BV STYLE BI-DIRECTIONAL RELIEF VALVE
FIGURE 5.8



DISASSEMBLY OF RV STYLE SINGLE DIRECTION RELIEF VALVE AND BV STYLE BI-DIRECTIONAL RELIEF VALVE

Refer to the sectional drawing shown in Figure 5.7 and Figure 5.8.

1. Turn off pump and lock out energy source to driver.
2. Close inlet and discharge valves.
3. To drain pump, follow the procedure in Section 7, **INSTRUCTIONS FOR DRAINING PUMP**.
4. Decrease pressure on spring (29) by loosening lock and seal nut (27) and unscrewing adjusting screw (26) until adjusting screw turns freely.
5. After decreasing pressure on spring (29), remove the relief valve cap (24) by unscrewing it from faceplate (23B).
6. Remove spring (29), poppet (30), spring washer (32), and spring guide (28).
7. Inspect all parts and replace worn or damaged parts as required.

ASSEMBLY OF RV STYLE SINGLE DIRECTION RELIEF VALVE AND BV STYLE BI-DIRECTIONAL RELIEF VALVE

Refer to the sectional drawing shown in Figure 5.7 and Figure 5.8.

1. Install poppet (30) into faceplate (23B).
2. Install spring (29) into faceplate (23B) making sure spring is centered on poppet (30) and resting on spring washer (31).
3. Place pilot of spring guide (28) into I.D. of spring (29).
4. Screw adjusting screw (26) with lock and seal nut (27) assembled into hole in relief valve cap (24).
5. Place small end of adjusting screw (26) in hole in spring guide (28) and screw relief valve cap (24) into faceplate (23B).
6. Adjust relief valve by following steps shown in how **TO ADJUST THE RV STYLE RELIEF VALVE**.

TO ADJUST THE RV STYLE SINGLE DIRECTION RELIEF VALVE OR BV STYLE BI-DIRECTIONAL RELIEF VALVE

Refer to the sectional drawing shown in Figure 5.7 and Figure 5.8.

- **WARNING!** Take necessary precautions to prevent personal injury or physical damage that could be caused by any loss of the product being pumped while adjusting the relief valve. **DO NOT** adjust the relief valve without coupling guards in place.

The relief valve must be adjusted under conditions identical to the operating conditions (viscosity, rpm, etc.)

1. Connect a pressure gauge near pump in discharge line between pump and point where discharge line will be closed.
2. Loosen locknut (27) on the adjusting screw (26).
3. Back adjusting screw (26) out to point where end of adjusting screw will be 1-3/4 inches [44.5 mm] from plug cap (24). See **RELIEF VALVE** drawings shown in Figures 5.7 and 5.8.
4. **WARNING! DO NOT** start the pump until all rotating shafts and couplings are properly guarded. After all rotating shafts and couplings are properly guarded, start the pump and close the discharge line slowly. **DO NOT** exceed the pressure rating of pump or other equipment between the pump and the discharge line valve. If this pressure is reached while closing the discharge valve, **DO NOT** close any further. **DO NOT** run the pump with a closed discharge line for more than one minute at a time.

5. With discharge valve closed, turn adjusting screw clockwise in ½ turn increments until pressure gauge shows desired pressure setting.
6. Tighten locknut (27).
7. Open discharge line and turn off pump.

DISASSEMBLY OF DOUBLE SETTING RV STYLE RELIEF VALVE

Refer to the sectional drawing shown in Figure 5.9.

1. Turn off pump and lock out energy source to driver.
2. Close inlet and discharge valves.
3. To drain pump, follow the procedure in Section 7, **INSTRUCTIONS FOR DRAINING PUMP**.
4. Loosen lock and seal nut (27). Decrease pressure on spring (29) by turning adjusting screw (26) counterclockwise until it turns freely.
5. After decreasing pressure on spring (29), remove relief valve cap (24) by unscrewing it from faceplate (23B).
6. Remove spring (29), spring guide (28), poppet (30), and spring washer (31).
7. Remove operating piston (59). Remove o-ring (AP) if required.
8. After several pump disassemblies, it is necessary to change locking seal nut (27). Remove adjusting screw (26) from relief valve cap (24). Remove locking seal nut (27) from adjusting screw (26). Keep threads on adjusting screw clean and free from dirt. Also remove any nicks or dents from damaged threads to prevent damage to sealing surfaces of seal nut.
9. Usually there is no need to disassemble ball handle (AK) and its components from adjusting screw (26) except if parts need replacement.
10. Inspect all parts and replace all worn or damaged parts as required.

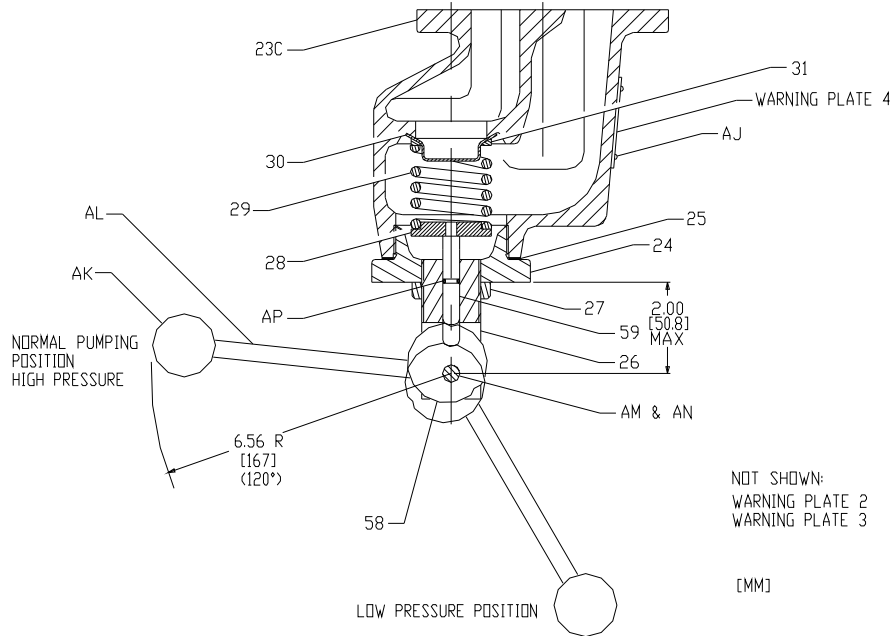
ASSEMBLY OF DOUBLE SETTING RV STYLE RELIEF VALVE

Refer to the sectional drawing shown in Figure 5.9.

1. Install poppet (30) and spring washer (31) into faceplate (23B).
2. Install spring (29) into faceplate (23B) making sure that spring is centered on poppet (30) and resting on the spring washer (31).
3. Place pilot of spring guide (28) into spring (29).
4. Turn adjusting screw (26) down into relief valve cap (24) with lever in high pressure position. Move lever to low pressure position; this should leave operating piston (59) out past edge of relief valve cap (24). (O-ring friction should hold operating piston temporarily). Place new relief valve cap gasket (25) on relief valve cap (24).
5. Slide tip of operating piston (59) into spring guide (28) while holding double setting relief valve mechanism by adjusting screw (26) and ball handle (AK).
6. Hold adjusting screw (26) and turn relief valve cap (24) to engage it into threads of faceplate (23B).
7. Tighten relief valve cap (24), but **DO NOT** allow adjusting screw (26) to come out of relief valve cap or engagement of operating piston (59) in spring guide (28) will be lost.
8. Adjust relief valve by following steps shown in how **TO ADJUST THE DOUBLE SETTING RV STYLE RELIEF VALVE**. Tighten lock and seal nut (27). Check operation of lever.

DOUBLE SETTING RV STYLE RELIEF VALVE

Figure 5.9



TO ADJUST THE DOUBLE SETTING RV STYLE RELIEF VALVE

- **WARNING!** Take necessary precautions to prevent injury or physical damage that could be caused by any loss of the product being pumped while adjusting the relief valve. **DO NOT** adjust the relief valve without coupling guards in place.

The relief valve must be adjusted under conditions identical to the operating conditions. (Viscosity, rpm, etc.)

1. Connect a pressure gauge near pump in discharge line between pump and point where discharge line will be closed.
2. Loosen lock and seal nut (27) on adjusting screw (26).
3. Back adjusting screw (26) out to minimum setting by turning ball handle (AL) counterclockwise to the point where hex head cap screw (AN) in adjusting screw (26) will be 2 inches [50.8 mm] from relief valve cap (24). (See **DOUBLE SETTING RELIEF VALVE** drawing shown in Figure 5.9.)
4. Move ball handle (AL) to normal pumping position as shown in Figure 5.9.
5. **WARNING! DO NOT** start the pump until all rotating shafts and couplings are properly guarded. After all rotating shafts and couplings are properly guarded, start the pump and close the discharge line slowly. **DO NOT** exceed the pressure rating of the pump or other equipment between the pump and discharge line valve. If this pressure is reached while closing the discharge valve, **DO NOT** close any further. **DO NOT** run the pump with a closed discharge line for more than one minute at a time.
6. With discharge valve closed and using ball handle (AL), turn adjusting screw (26) clockwise until pressure gauge shows desired pressure setting.
7. Tighten lock and seal nut (27).
8. The relief valve is now set at desired high pressure setting.
9. Move ball handle (AL) to low pressure setting as shown in Figure 5.9 and note low pressure setting.
10. Open discharge line and turn off pump.

Relief valve is now set.

CONVERTING FROM RV STYLE RELIEF VALVE TO DOUBLE SETTING RV STYLE RELIEF VALVE

1. On standard RV style relief valve, loosen lock and seal nut (27).
2. Turn adjusting screw (26) counterclockwise to decrease pressure on spring (29).
3. Remove relief valve cap (24) and gasket (25) along with lock and seal nut (27) and adjusting screw (26).
4. Install double setting relief valve mechanism in accordance with instructions in **ASSEMBLY OF DOUBLE SETTING RV STYLE RELIEF VALVE**.

JACKETED PUMPS

Jacketed faceplates and backplate are available on 3500, 4500, 3600, 3700, 4600, 4700 series pumps. They look similar to the standard nonjacketed ones described in this manual except for the four threaded taps on the jacketed faceplates and backplates. Two of the four taps are piped as inlet and outlet for the heating or cooling medium. It is recommended that steam, when used, be piped into the jacket from a top tap and out through a bottom tap. Liquid, when used, should be piped into the jacket from a bottom tap and out a top tap. In addition to the two taps on both endplates not used for piping, two ¼" NPT taps on the jacketed backplate are provided to facilitate clean out of scale.

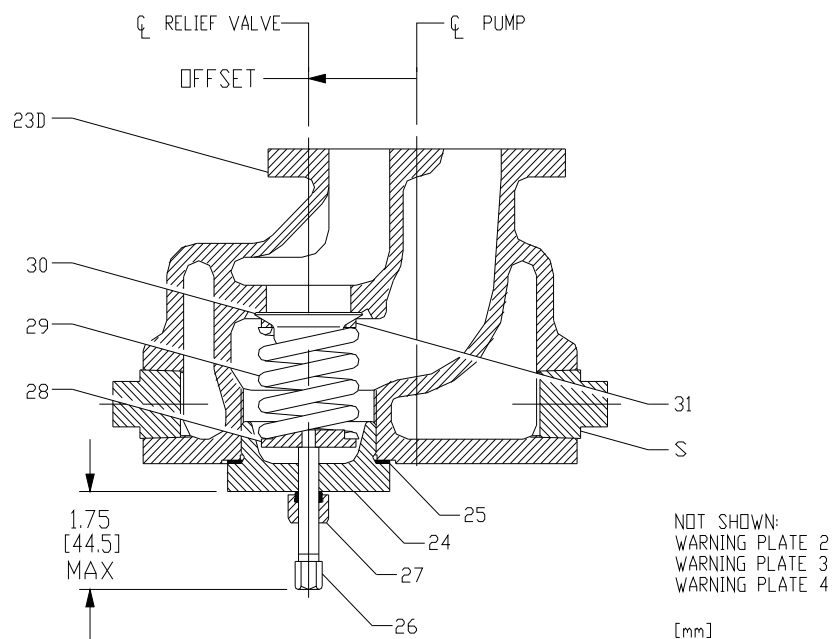
The heating or cooling medium should be steam or a noncorrosive, nonclogging liquid. A steam medium is limited to 350°F [177°C] maximum. A liquid medium is limited to 450°F [232°C] maximum. The jacketing is limited to 125 psi [862 kPa] maximum.

- **WARNING!** Other special parts will be required to operate at temperatures up to 450°F [232°C].

The jacketed RV style relief valve faceplate, similar to non-jacketed, must have the adjusting screw offset toward the discharge side of the pump.

JACKETED RV STYLE RELIEF VALVE FACEPLATE

Figure 5.10



6. HIGH DRIVE TO LOW DRIVE

Prior to operating pump, make sure that the shaft rotation, pipe connections, and the relief valve position are in accordance with the appropriate illustrations shown in Figures 5.5 and 5.6. In order to change the rotation and/or piping orientation, it may be necessary to remove the piping from the pump or the pump from the mounting. [Fittings (21) and flange gaskets (22), when provided, can be removed from pump.]

Whenever changing rotation, inspect all parts before reassembly. Replace all worn parts and install new gaskets in appropriate numbers as removed.

1. Remove coupling or universal joint and drive key (A) from drive shaft (32). Remove all burrs and sharp edges from drive shaft and keyway.
2. A.) To reverse pump rotation and keep piping arrangement the same, drive shaft (32) position must be changed. Follow steps 3 – 10.
B.) To reverse pump rotation and leave drive shaft (32) and case (19A, B, C, D, E) in same position; liquid flow through pump will be reversed. Follow steps 11 – 12.
C.) To change port to opposite side on pumps with a right angle port arrangement and maintain same pump rotation, follow steps 13 – 20.
D.) To change port to opposite side, maintain same pump rotation and drive shaft (32) in same position; liquid flow through pump will be reversed. Follow steps 21 – 26.

REVERSE ROTATION, SAME PIPING ARRANGEMENT

3. To reverse pump rotation and keep piping arrangement the same, it is necessary to change from high drive to low drive or low drive to high drive (3500-3700 series with right angle ports: W to LX, X to LW, Z to LY, Y to LZ; 4500-4700 series with straight through ports: W to LZ, Z to LW) or vice versa.
4. Remove two washer head cap screws (K) and eight hex head cap screws (L) securing backplate (6A, B) to case (19A, B, C, D, E) and separate backplate assembly from case assembly. On 3600-4700 "H" and "BH" pumps, drive gear (34) will pull out with backplate assembly. On "HB", "SB", "GHB", and "BHB" pumps, drive gear (34) may remain in case assembly.
5. Switch drive gear (34) and idler gear/shaft (35 and 33) positions in case (19A, B, C, D, E).
6. Position appropriate number of case gaskets (20) on case (19A, B, C, D, E) (oil or grease may be used to hold gaskets in place).
7. Rotate backplate (6A, B) assembly 180°.
8. Slide drive shaft (32) and gear key (B) into shaft hole of drive gear (34).
9. Slide backplate (6A, B) assembly into position and secure.
10. On 3600-4700 series with gear reduction unit, mount oil cup (AB) in top hole in gear case (44) and petcock (AC) in second hole from bottom.

REVERSE ROTATION, SAME DRIVE SHAFT AND CASE ARRANGEMENT

11. To reverse flow of liquid through pump ports, reverse rotation of drive shaft (32), maintain the original positions of the drive shaft and case (19A, B, C, D, E) (3500-3700 series with right angle ports: W to X, LW to LX, Z to Y, LX to LY; 4500-4700 series with straight through ports: W to Z, LW to LZ) or vice versa.
12. On pumps with relief valve, relief valve faceplate (23B or 23C) must be removed, rotated 180°, and remounted.

CHANGE PORT AND DRIVE SHAFT LOCATION, SAME ROTATION

13. To change the port to the opposite side and maintain same pump rotation, change drive shaft (32) from high drive to low drive (3500-3700 series with right angle ports: W to LY, Y to LW, Z to LX, X to LZ) or vice versa.
14. Remove two washer head cap screws (K) and eight hex head cap screws (L) securing backplate (6A, B) to case (19A, B, C, D, E) and separate backplate assembly from case assembly. On 3500-4700 "H" and "BH" pumps, drive gear (34) will pull out with backplate assembly. On "HB", "SB", "GHB", and "BHB" pumps, drive gear (34) may remain in case assembly.
15. Remove the faceplate (23A, B, C, D).
16. Rotate case (19A, B, C, D, E) 180°, (front to back).
17. Switch drive gear (34) and idler gear/shaft (35 and 33) positions in case (19A, B, C, D, E).
18. If plain faceplate (23A) is used, remount to case (19A, B, C, D, E) in same position. If a relief valve faceplate (23B, C, D) is used, rotate faceplate 180° and remount to case (19A, B, C, D, E).
19. Rotate backplate (6A, B) assembly 180° and remount on case (19A, B, C, D, E).
20. On pumps with gear reduction unit, mount oil cup (AB) in top hole of gear case (44) and petcock (AC) on next bottom hole.

SAME ROTATION, CHANGE PORT LOCATION, SAME DRIVE SHAFT LOCATION

21. To change port to opposite side, maintain same pump rotation and drive shaft (32) in same position; the flow of liquid through the pump will be reversed (3500-3700 series with right angle ports: W to Y, LW to LY, Z to X, LZ to LX) or vice versa.
22. Remove two washer head cap screws (K) and eight hex head cap screws (L) securing backplate (6A, B) to case (19A, B, C, D, E) and separate backplate assembly from case assembly. On 3500-4600 "H" and "BH" pumps, drive gear (34) may remain in case assembly.
23. Remove faceplate (23A, B, C, D).
24. Remove case (19A, B, C, D, E) and rotate 180° (front to back).
25. Remount and secure case (19A, B, C, D, E) to faceplate (23A, B, C, D).
26. Remount backplate (6A, B) assembly to case (19A, B, C, D, E).

7. INSTRUCTIONS FOR DRAINING PUMP

Refer to Section 14, **PARTS LIST**.

The extent to which a pump can be drained is dependent upon the product being pumped. Low viscosity products such as solvents will drain quickly and easily. High viscosity products such as molasses and tar will drain very slowly. Also, the draining of high viscosity products will be less complete.

Regardless of the product pumped, the areas at the blind end of the bearing bores and the mechanical seal chamber will not drain.

1. Read and understand all safety instructions and warnings before starting draining procedure.
2. There are two pipe plugs (S) in the faceplate (23A, B, C, D). Remove one that is in lowest position.
3. Rotate drive shaft very slowly by hand. Each time that flow from drain increases, stop turning shaft until flow stops; then resume until flow increases again. Be sure to rotate shaft several complete revolutions in each direction until all flow from drain has stopped.
4. Reinstall and tighten pipe plug(s).

8. INSTRUCTIONS FOR PUMP DISASSEMBLY

Refer to Section 14, **PARTS LIST**.

- 1) Read and understand all safety instructions and warnings before starting to disassemble pump. While disassembling pump, always inspect disassembled parts and adjacent parts to see if further disassembly is needed. Replace worn or damaged parts as required.
- 2) If you do not know which pump arrangement you have, collect nameplate data and refer to Section 1, **NAMEPLATE DATA**, to determine what you have. Consult a Roper distributor or Roper Pump Company if you have any questions.
- 3) When cleaning or lubricating, use only cleaning solutions and lubricants that are compatible with products being pumped and with sealing elastomers. **DO NOT** use petroleum base products with seals with EPR elastomers. Use a non-petroleum base lubricant with EPR elastomers.
- 4) Turn off pump and lock out energy source to driver. **DO NOT** proceed further with disassembly of pump if there is the slightest possibility that driver may be started.
- 5) If used, turn off and disconnect flush from mechanical seal.
- 6) Close inlet and discharge valves.
- 7) Remove guard and disconnect coupling between driver and pump.
- 8) Drain inlet and discharge lines. Disconnect lines from pump inlet and discharge.
- 9) Follow the procedure in Section 7, **INSTRUCTIONS FOR DRAINING PUMP**.
- 10) A.) For 3500/3600/3700/4500/4600/4700 “HB” and “SBFO” pumps, follow steps 11 – 20.
B.) For 3700/4700 “BH” pumps, go to Section 12, **INSTRUCTIONS FOR DISASSEMBLY OF A TYPE “MBH” HYDRAULIC DRIVE**. After disassembling hydraulic drive, return to this section and follow steps 11 – 20.
11. Remove two washer head cap screws (K) and eight hex head cap screws (L) securing faceplate (23A, B, C, D) to case (19A, B, C, D, E). Remove faceplate (23A, B, C, D).
12. Remove two dowel pins (J) from case.
13. Remove case gaskets (20).
14. A.) On “BH” pumps, remove faceplate end retaining ring (36B) from drive shaft (32). Remove drive gear (34) and key (B). Remove backplate end retaining ring (36A).
B.) On “HB” and “SBF” pumps, remove drive gear (34) and key (B) from drive shaft (32).
15. Remove idler gear (35) and key (B) from idler shaft (33). Remove idler shaft.
16. Remove two washer head cap screws (K) and eight hex head cap screws (L) securing backplate (6A, B) to case (19A, B, C, D, E) and separate parts.
17. Remove case gaskets (20) from opposite side of case (19A, B, C, D, E).
18. Remove two dowel pins (J) from opposite side of case (19A, B, C, D, E).
19. Remove drive key (A) from drive shaft (32).
20. A.) For 3500/4500 “BH” pumps, follow steps 21 – 24.
B.) For 3500/4500 “HB” pumps, follow steps 25 – 30.
C.) For 3600/4600 “BH” pumps, follow steps 31 – 34.
D.) For 3600/4600 “HB” and 3622 “SBFO” pumps, follow steps 35 – 40.
E.) For 3700/4700 “BH” pumps, follow steps 41 - 44.
F.) For 3700/4700 “HB” and “SBFO” pumps, follow steps 45 – 50.

3500/4500 “BH” Pumps (See Figure 14.1)

21. Remove two locknuts (F) from square head bolts (G) securing seal retainer (9) to backplate (6A, B). Remove the seal retainer (9).
22. Remove drive shaft (32) by sliding it out from case side of backplate.
23. Remove packing washer (18) and triple lip seal from backplate (6A, B) by prying out.
24. Visually inspect all parts. Replace all worn or damaged parts before reassembling pump. It is recommended that new gaskets (20, 22, 25) be installed each time pump is disassembled and reassembled. Triple lip seal must be replaced anytime it is removed from backplate.

3500/4500 “HB” AND 3522 “SBFO” Pumps (See Figure 14.2)

25. Remove retaining ring (3) from backplate (6A, B).
26. Loosen setscrews in ball bearing (2). Remove ball bearing.
27. Remove two locknuts (F) from square head bolts (G) securing seal retainer (9) to backplate (6A, B). Remove the seal retainer (9).
28. Remove drive shaft (32) by sliding it out from case side of backplate.
29. Remove packing washer (18) and triple lip seal from backplate (6A, B) by prying out.
30. Visually inspect all parts. Replace all worn or damaged parts before reassembling pump. It is recommended that new gaskets (20, 22, 25) be installed each time pump is disassembled and reassembled. Triple lip seal must be replaced anytime it is removed from backplate.

3600/4600 “BH” Pumps (See Figure 14.1)

31. Remove two locknuts (F) from square head bolts (G) securing packing gland (14) in place. Remove packing gland clip (13) and packing gland (14).
32. Remove packing rings (16) and packing washer (18). Remove lantern ring (17) if used. Packing hooks are commercially available to assist in removal of packing rings.
33. Remove drive shaft (32). Clean drive shaft and adjacent parts. Examine drive shaft. Replace drive shaft if excessively worn or scored.
34. Visually inspect all parts. Replace all worn or damaged parts before reassembling pump. It is recommended that new gaskets (20, 22, 25) be installed each time pump is disassembled and reassembled.

3600/4600 “HB” AND 3622 “SBFO” Pumps (See Figure 14.2)

35. Remove retaining ring (3) from backplate (6A, B).
36. Loosen setscrews in ball bearing (2). Remove ball bearing.
37. Remove two locknuts (F) from square head bolts (G) securing packing gland (14) in place. Remove packing gland clip (13), packing gland (14), spring clip (15), and two square head bolts (G).
38. Remove packing rings (16) and packing washer (18). Remove lantern ring (17) if used. Packing hooks are commercially available to assist in removal of packing.
39. Remove drive shaft (32). Clean drive shaft and adjacent parts. Examine drive shaft. Replace drive shaft (32) if excessively worn or scored.
40. Visually inspect all parts. Replace all worn or damaged parts before reassembling pump. It is recommended that new gaskets (20, 22, 25) be installed each time pump is disassembled and reassembled.

3700/4700 “BH” Pumps (See Figure 14.1)

41. Remove two locknuts (F) from square head bolts (G) securing seal retainer (9) to backplate (6A, B). Remove the seal retainer (9).
42. Remove drive shaft (32) along with mechanical seal (11) and retaining ring (12) from backplate (6A, B).
43. When removing following types of single seals (John Crane® Type 21, Type 8-1, Type 9; Pac-Seal® Type 21; Sealol® Type 43), clean and lubricate drive shaft (32) prior to removing mechanical seal making sure that drive shaft is smooth and free from all burrs. Loosen setscrews (if present) on mechanical seal. Remove mechanical seal (11). Inspect sealing surfaces of stationary seal face and inspect rotation element. Replace as required. Remove retaining ring (12) from drive shaft (32) if applicable.
44. Visually inspect all parts. Replace all worn or damaged parts before reassembling pump. It is recommended that new gaskets (20, 22, 25) be installed each time the pump is disassembled and reassembled.

3700/4700 “HB” and 3722 “SBFO” Pumps (See Figure 14.2)

45. Remove retaining ring (3) from backplate (6A, B).
46. Loosen setscrews in ball bearing (2). Remove ball bearing.
47. Remove two locknuts (F) from square head bolts (G) securing seal retainer (9) to backplate (6A, B). Remove seal retainer (9).
48. Remove drive shaft (32) along with mechanical seal (11) and retaining ring (12) from backplate (6a, b).
49. When removing following type of single seals (John Crane® Type 21, Type 8-1, Type 9; Pac-Seal® Type 21; Sealol® Type 43), clean and lubricate drive shaft (32) prior to removing mechanical seal making sure that drive shaft is smooth and free fro all burrs. Loosen setscrews (if present) on mechanical seal. Remove mechanical seal (11). Inspect sealing surfaces of stationary seal face and inspect rotation element. Replace as required. Remove retaining ring (12) from drive shaft (32), if applicable.
50. Visually inspect all parts. Replace all worn or damaged parts before reassembling pump. It is recommended that new gaskets (20, 22, 25) be installed each time pump is disassembled and reassembled.

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Sealol® is a registered trademark of EG & G Sealol.

9. BEARING REMOVAL AND INSTALLATION

BEARING REMOVAL

Pump bearings are available in bronze, iron, carbon, and glass/graphite impregnated PTFE. Any of these bearings may be removed using a Snap-On® tool puller, part number CG45. This tool may be purchased through your local tool dealer or through Roper Pump Company. If you do not have this bearing puller, any of the bearings may be removed by using a hacksaw blade to cut through the bearing in two places 180° apart. This procedure will usually loosen the bearing enough to be pulled out. If this procedure is used, take care to prevent damage to the bore into which the bearing is pressed.

Carbon bearings may also be removed by carefully chipping the bearing out with a chisel. Take care not to scar the endplate bores during the bearing removal process.

After removing the bearings, always check the endplate bores for nicks and burrs caused by the removal process. The bores must be clean, smooth, and free of burrs before attempting to install new bearings.

BEARING INSTALLATION

1. Remove all burrs and raised edges from bores for bearings.
2. Place faceplate or backplate on a press base with milled face upward. Support endplate so that milled face is perpendicular (square) with press ram.
3. Position endplate so that one bearing bore is located directly under press ram.
4. A.) If iron or bronze bearings are to be installed, lubricate endplate bores with a light oil that is compatible with product to be pumped.
B.) If carbon bearings are to be installed, lubricate bearings by submerging them in cold water prior to installation.
C.) If glass/graphite filled PTFE bearings are to be installed, no lubricant should be used.
5. Place end of new bearing at entrance of bore in endplate, taking care to align grooves in bearing with the grooves in face of endplate.
6. Press bearing into endplate bore. *When carbon bearings are being installed, it is important to press them in with one slow uninterrupted stroke to prevent cracking.* It is best to use a stepped arbor with a few thousandths of an inch clearance between arbor and bore of bearing. Be sure to press bearings in until they are flush to .005 of an inch [.127 mm] below milled face of endplate.
7. Repeat procedure for second bearing.
8. Using a three square file, file shallow grooves in ends of bearings to connect grooves inside bearings with groove on milled face of endplate. If your bearings or endplates do not have grooves, omit this step.

10. DIMENSIONAL DATA FOR INTERNAL PARTS

Nominal dimensions are given below. With the exception of gasket thickness and lateral clearance, your actual measurements should vary from these numbers by no more than .002". Use properly calibrated measuring equipment when measuring parts.

ITEM	PUMP SIZE		
	11	17	22
Bore for Bearings	1.4375	1.4375	1.4375
Shaft O.D.	1.0620	1.0620	1.0620
Case Bores	3.8490	3.8490	3.8490
Gear O.D.	3.8410	3.8410	3.8410
Gear O.D. to Case Bore Diametral Clearance	.0080	.0080	.0080
Bronze Bearing O.D.	1.4385	1.4385	1.4385
Bronze Bearing Press Fit	.0010 min.	.0010 min.	.0010 min.
Bronze Bearing I.D. (Free)	1.0680	1.0680	1.0680
Bronze Bearing I.D. (Installed)	1.0670	1.0670	1.0670
Shaft to Bronze Bearing Diametral Clearance	.005	.005	.005
Iron Bearing O.D.	1.4385	1.4385	1.4385
Iron Bearing Press Fit	.0010 min.	.0010 min.	.0010 min.
Iron Bearing I.D. (Free)	1.0675	1.0675	1.0675
Iron Bearing I.D. (Installed)	1.0665	1.0665	1.0665
Shaft to Iron Bearing Diametral Clearance	.0045	.0045	.0045
Carbon Bearing O.D.	1.4400	1.4400	1.4400
Carbon Bearing Press Fit	.0025 min.	.0025 min.	.0025 min.
Carbon Bearing I.D. (Free)	1.0710	1.0710	1.0710
Carbon Bearing I.D. (Installed)	1.0690	1.0690	1.0690
Shaft to Carbon Bearing Diametral Clearance	.0067	.0067	.0067
Case Width	2.994	4.494	5.994
Gasket Thickness (One)	.012	.012	.012
Compressed Gasket Thickness (Two)	.016	.016	.016
Gear Face Width	3.001	4.501	6.001
Lateral Clearance (Two Compressed Gaskets)	.009	.009	.009

11. INSTRUCTIONS FOR PUMP ASSEMBLY

Refer to Section 14, **PARTS LIST**.

Refer to Section 5, **DIRECTION OF ROTATION AND RELIEF VALVES**, to assure proper configuration for pump rotation, port location, and relief valve position prior to assembling pump.

1. Read and understand all safety instructions and warnings before assembling pump. Visually inspect all parts during assembly. Replace all worn or damaged parts. Although they may appear reusable, it is recommended that new gaskets (20, 22, 25) and lip seals (5, 39) be installed when pump is being reassembled.
 - **WARNING!** Only use genuine Roper gaskets. Gasket thickness determines proper clearances. Always check quantity of gaskets removed and replace with exact quantity. Proper material must be used based on application.
2. When cleaning or lubricating, only use products that are compatible with product being pumped and elastomers within pump. **DO NOT** use petroleum base products with seals with EPR elastomers. Clean and lubricate parts with light oil unless EPR elastomers are used. Use a non-petroleum base lubricant with EPR elastomers.
3. Mechanical seals are precision pieces of equipment. Use extreme care not to damage seal faces or elastomers during assembly.
4. Install two hollow dowel pins (J) on each side of case (19A, B, C, D, E). Place appropriate number of case gaskets (20) on faceplate side of case. Align faceplate (23A, B, C,) on hollow dowel pins (J). Secure faceplate to case using two washer head cap screws (K) and eight hex head cap screws (L).
5. Place idler gear (35) into case bore. Install key (B) in keyway on idler shaft (33). Slide idler shaft into I.D. of idler gear.
6. A.) For 3500/4500 “BH” pumps with triple lip seal, follow steps 7 – 13.
B.) For 3500/4500 “HB” and 3522 “SBFO” pumps with triple lip seal, follow steps 14 – 26.
C.) For 3600/4600 “BH” pumps with shaft packing, follow steps 27 – 36.
D.) For 3600/4600 “HB” and 3622 “SBFO” pumps with shaft packing, follow steps 37 – 46.
E.) For 3700/4700 “BH” pumps with standard mechanical seal, follow steps 47 – 55.
F.) For 3700/4700 “BH” pumps with positive drive mechanical seal, follow steps 56 – 70.
G.) For 3700/4700 “HB” and 3722 “SBFO” pumps with standard mechanical seal, follow steps 71 – 79.
H.) For 3700/4700 “HB” and 3722 “SBFO” pumps with positive drive mechanical seal, follow steps 80 – 94.

3500/4500 “BH” Pumps (See Figure 14.1)

7. Install backplate end retaining ring (36A) on drive shaft (32). Install key (B) on drive shaft. Slide drive gear (34) onto drive shaft. Install faceplate end retaining ring (36B) on drive shaft to secure drive gear.
8. Place appropriate number of case gaskets (20) on backplate side of case (19A, B, C, D, E). Slide drive gear (34) assembled with drive shaft (32), and backplate (6a, B) into case bore. Align backplate (6A, B) on hollow dowel pins (J). Secure backplate (6A, B) to case (19A, B, C, D, E) using two washer head cap screws (K) and eight hex head cap screws (L).
9. Lubricate drive end of drive shaft (32) and triple lip seal (10) with a light oil. Slide triple lip seal over shaft with two lips facing toward pump gears (33, 34). Gently push seal past tapered area of shaft and down to front of seal chamber. Press triple lip seal into bore until back side is flush with face of seal chamber. Take care to use a tool that will not damage or distort seal casing. Install one packing washer (18).
10. Place one square head bolt (G) through each slot in backplate (6A, B) and through each hole in seal retainer (9). Using two locknuts (F), secure seal retainer in place.

11. Install drive key (A).
12. For 3500/4500 “BH” hydraulic drive assembly, go to Section 13, **INSTRUCTIONS FOR ASSEMBLY OF A TYPE “MBH” HYDRAULIC DRIVE.**
13. Read and understand all safety instructions and warnings before installing and operating pump.

3500/4500 “HB” and 3622 “SBFO” Pumps (See Figure 14.2)

14. Place drive gear (34) into case bore.
15. Install two hollow dowel pins (J) in backplate end of case. Place appropriate number of case gaskets (20) on backplate side of case (19A, B, C, D, E).
16. Set case assembly aside and build backplate assembly as described in following steps.
17. Place triple lip seal (10) with two lips facing toward seal chamber onto opening of seal chamber in backplate (6A, B). Press triple lip seal into seal chamber until back side of seal is flush with face of seal chamber. Take care to use a tool that will not damage or distort seal casing. Install one packing washer (18).
18. Place one square head bolt (G) through each slot in backplate (6A, B) and through each hole in seal retainer (9). Using two locknuts (F), secure seal retainer in place.
19. Use a small file or stone to break sharp edges of drive shaft (32) keyway that will be under pump drive gear (34).
20. Install outboard ball bearing (2) on drive shaft (32) as shown in Figure 14.2. Bearings are pre-lubricated and do not require lubrication at time of initial installation. A small amount of grease will be required during regular maintenance. Align setscrews in inner race of ball bearing with wide groove in shaft. Tighten setscrews in ball bearing (2) to secure bearing to drive shaft (32).
21. Lubricate triple lip seal (10) in backplate and shaft on end that will slide through triple lip seal with a light oil. Carefully slide shaft through backplate and triple lip seal from outboard bearing end until ball bearing (2) seats in bearing bore.
22. Install retaining ring (3) to secure ball bearing (2) to backplate.
23. Install key (B) in keyway of drive shaft that will be under gear.
24. Align key in shaft of backplate assembly with keyway in drive gear of case assembly and slide backplate assembly together with case assembly.
25. Secure backplate to case using two washer head cap screws (K) and eight hex head cap screws (L).
26. Read and understand all safety instructions and warnings before installing and operating pump.

3600/4600 “BH” Pumps (See Figure 14.1)

27. Install backplate end retaining ring (36A) on drive shaft (32). Install key (B) on drive shaft. Slide drive gear (34) onto drive shaft. Install faceplate end retaining ring (36B) on drive shaft to secure drive gear.
28. Place appropriate number of case gaskets (20) on backplate side of case (19A, B, C, D, E). Slide drive gear (34) assembled with drive shaft (32), and backplate (6a, B) into case bore. Align backplate (6A, B) on hollow dowel pins (J). Secure backplate (6A, B) to case (19A, B, C, D, E) using two washer head cap screws (K) and eight hex head cap screws (L).
29. Install packing washer (18) over drive shaft (32) and into packing bore of backplate (6A, B).
30. Install packing rings (16) and lantern ring (17), if used, in backplate bore. Stagger joints on each packing ring 180° apart. Seat each ring before adding next ring. Rings must not be tamped or seated too tightly.
31. Check drive shaft (32) for free movement after each ring is installed.
32. When packing box is sufficiently full to allow entry of packing gland (14) about ¼ of an inch [6 mm], reassemble packing gland.

33. Place one square head bolt (G) through each slot in backplate (6A, B) and through each hole in packing gland (14). Install packing gland (14) into packing box about $\frac{1}{4}$ of an inch [6 mm]. Slide packing gland clip (13) over square head bolts (G). Using two locknuts (F), secure packing gland (14) in place. Install spring clip (15) across square head bolts (G). Draw locknuts up evenly on packing gland to assure proper seating of packing (16), then loosen locknuts (F) about $\frac{1}{2}$ turn. **DO NOT** cock packing gland. This could cause binding or heating of drive shaft.
34. Install drive key (A).
35. For 3600/4600 "BH" hydraulic drive assembly, go to Section 13, **INSTRUCTIONS FOR ASSEMBLY OF A TYPE "MBH" HYDRAULIC DRIVE**.
36. Read and understand all safety instructions and warnings before installing and operating pump.

3600/4600 "HB" and 3622 "SBFO" Pumps (See Figure 14.2)

37. Place drive gear (34) into case bore. Install key (B) in keyway of drive shaft (32). Slide drive shaft into bore of drive gear.
38. Place appropriate number of case gaskets (20) on backplate side of case (19A, B, C, D, E). Align backplate (6A, B) on dowel pins (J). Secure backplate to case using two washer head cap screws (K) and eight hex head cap screws (L).
39. Install packing washer (18) over drive shaft (32) into packing bore of backplate.
40. Install packing ring (16) and lantern ring (17), if used, in packing bore of backplate. Stagger joints on each packing ring 180° apart. Seat each ring before adding next ring. Rings must not be tamped or seated too tightly.
41. Check drive shaft (32) for free movement after each ring is installed.
42. When packing box is sufficiently full to allow entry of packing gland (14) about $\frac{1}{4}$ of inch [6 mm], reassemble packing gland.
43. Place one square head bolt (G) through each slot in backplate (6A, B) and through each hole in packing gland (14). Install packing gland (14) into packing box about $\frac{1}{4}$ of an inch [6 mm]. Slide packing gland clip (13) over square head bolts (G). Using two locknuts (F), secure packing gland (14) in place. Install spring clip (15) across square head bolts (G). Draw locknuts up evenly on packing gland to assure proper seating of packing (16), then loosen locknuts about $\frac{1}{2}$ turn. **DO NOT** cock packing gland. This could cause binding or heating of drive shaft.
44. Install ball bearing (2) on drive shaft (32) and into backplate (6A, B) as shown in the sectional drawing in Figure 14.2. The bearings are pre-lubricated and do not require lubrication at time of initial installation. A small amount of grease will be required during regular maintenance. Align setscrews in inner race of ball bearing with wide groove in shaft. Tighten setscrews in ball bearing (2) to secure bearing to drive shaft (32). Install retaining ring (3) into backplate (6A, B) to secure ball bearing (2) to backplate.
45. Install drive key (A).
46. Read and understand all safety instructions and warnings before installing and operating pump.

3700/4700 "BH" Pumps (Standard Mechanical Seal) (See Figure 14.1)

47. Install faceplate end retaining ring (36B) on drive shaft (32). Install key (B) in keyway on drive shaft. Slide drive gear (34) onto drive shaft. Install backplate end retaining ring (36A) on drive shaft to secure drive gear.
48. Place appropriate number of gaskets (20) on backplate side of case (19A, B, C, D, E). Slide drive gear (34) assembled with drive shaft (32), and backplate (6A, B) into case bore. Align backplate (6A, B) on hollow dowel pins (J). Secure backplate (6A, B) to case (19A, B, C, D, E) using two washer head cap screws (K) and eight hex head cap screws (L).
49. Install retaining ring (12) on drive shaft (32).

50. Carefully remove all burrs and sharp edges from shaft over which rotating element of seal will slide.
51. Lubricate drive shaft and mechanical seal bore with a compatible lubricant. Install mechanical seal (11) on drive shaft and position seal back against retaining ring (12). Care must be taken not to nick o-ring. Be sure lapped (polished) faces of stationary seal face and rotating element are together.
52. Install seal retainer (9). Place one square head bolt (G) through each slot in backplate (6A, B) and through each hole in seal retainer (9). Using two locknuts (F), secure seal retainer in place.
53. Install drive key (A).
54. For 3700/4700 "BH" hydraulic drive assembly, go to Section 13, **INSTRUCTIONS FOR ASSEMBLY OF A TYPE "MBH" HYDRAULIC DRIVE.**
55. Read and understand all safety instructions and warnings before installing and operating pump.

3700/4700 "BH" Pumps (Positive Drive Mechanical Seal) (See Figure 15.1)

56. Install retaining ring (12) on drive shaft (32) to locate mechanical seal.
57. Carefully remove all burrs and sharp edges on shaft over which rotating element of seal will slide.
58. Apply a compatible lubricant to seal I.D. and to O.D. of drive shaft (32).
59. Slide rotating element of mechanical seal (11) onto drive shaft (32) before removing three or four clips that are taped to rotating element. Push rotating element back against retaining ring (12), tighten setscrews in seal, and remove clips that are taped to seal.
60. Slide faceplate end of drive shaft, with rotating element attached, into backplate (6A, B).
61. Install backplate end retaining ring (36A) on drive shaft (32). Install key (B) in keyway on drive shaft. Slide drive gear (34) onto drive shaft. Install faceplate end retaining ring (36B) to secure drive gear.
62. Place appropriate number of gaskets (20) on backplate side of case (19A, B, C, D, E). Slide drive gear (34), assembled with drive shaft (32), and backplate (6A, B) into case bore. Align backplate (6A, B) on hollow dowel pins (J). Secure backplate (6A, B) to case (19A, B, C, D, E) using two washer head cap screws (K) and eight hex head cap screws (L).
63. Lubricate o-ring on stationary seal face and seal chamber bore with a compatible lubricant. Slide stationary seal face over keyway end of drive shaft (32) and down to seal chamber. Be sure lapped (polished) face is toward rotating member of seal. Push stationary seal face into seal chamber.
64. Install anti-rotation pin (T) in locator ring (60).
65. Position locator ring (60) with anti-rotation pin (T) toward seal face. Align anti-rotation pin (T) with slot in back of stationary seal face and push into counterbore of backplate (6A, B).
66. Install seal retainer (9). Place one square head bolt (G) through each slot in backplate (6A, B) and through each hole in seal retainer (9). Using two locknuts (F), secure seal retainer in place.
67. Install drive key (A).
68. For 3700/4700 "BH" hydraulic drive assembly, go to Section 13, **INSTRUCTIONS FOR ASSEMBLY OF A TYPE "MBH" HYDRAULIC DRIVE.**
69. Ball bearing (2) and retaining ring (3) are not used in this configuration.
70. Read and understand all safety instructions and warnings before installing and operating pump.

3700/4700 "HB" and 3722 "SBFO" Pumps (Standard Mechanical Seal) (See Figure 14.2)

71. Place drive gear (34) into case bore. Install key (B) in keyway of drive shaft (32). Slide drive shaft into bore of drive gear.

72. Place appropriate number of case gaskets (20) on backplate side of case (19A, B, C, D, E). Align backplate (6A, B) on dowel pins (J). Secure backplate to case using two washer head cap screws (K) and eight hex head cap screws (L).
73. Install retaining ring (12) on drive shaft (32).
74. Carefully remove all burrs and sharp edges from shaft over which rotating element of seal will slide.
75. Lubricate drive shaft and mechanical seal bore with a compatible lubricant. Install mechanical seal (11) on drive shaft and position seal back against retaining ring (12). Care must be taken not to nick o-ring. Be sure lapped (polished) faces of stationary seal face and rotating elements are together.
76. Install ball bearing (2) on drive shaft (32) and into backplate (6A, B). The bearings are prelubricated and do not require lubrication at time of initial installation. A small amount of grease will be required during regular maintenance. Tighten setscrews in ball bearings (2) to secure bearing on drive shaft (32). Install retaining ring (3) into backplate (6A, B) to secure ball bearing (2) to backplate (6A, B).
77. Place one square head bolt (G) through each slot in backplate (6A, B) and through each hole in seal retainer (9). Secure seal retainer against backplate using two locknuts (F).
78. Install drive key (A).
79. Read and understand all safety instructions and warnings before installing and operating pump.

3700/4700 “HB” and 3722 “SBFO” Pumps (Positive Drive Mechanical Seal) (See Figure 15.1)

80. Place drive gear (34) into case bore.
81. Install retaining ring (12) on drive shaft (32) to locate mechanical seal.
82. Carefully remove all burrs and sharp edges on shaft over which rotating element of seal will slide.
83. Apply a compatible lubricant to seal I.D. and to O.D. of drive shaft (32).
84. Slide rotating element of mechanical seal (11) onto drive shaft (32) before removing three or four clips that are taped to rotating element. Push rotating element back against retaining ring (12), tighten setscrews in seal, and remove clips that are taped to seal.
85. Slide faceplate end of drive shaft (32) with rotating element of mechanical seal attached, into backplate (6A, B) through bore for ball bearing (2).
86. Place appropriate number of case gaskets (20) on backplate side of case (19A, B, C, D, E). Install key (B) in keyway of drive shaft (32). Slide drive shaft into bore of drive gear while aligning backplate (6A, B) on dowel pins (J). Secure backplate (6A, B) to case (19A, B, C, D, E) using two washer head cap screw (K) and eight hex head cap screws (L).
87. Lubricate o-ring on stationary seal face and seal chamber bore with a compatible lubricant. Slide stationary seal face over keyway end of drive shaft (32) and down to seal chamber. Be sure lapped (polished) face is toward rotating member of seal. Push stationary seal face into seal chamber.
88. Slide ball bearing (2) over drive shaft (32). Align setscrews in ball bearing (2) with groove in drive shaft and tighten setscrews. The bearings are prelubricated and do not require lubrication at time of initial installation. A small amount of grease will be required during regular maintenance.
89. Install retaining ring (3) into backplate (6A, B) to secure ball bearing (2) to backplate (6A, B).
90. Install antirotation pin (T) in locator ring (60).
91. Position locator ring (60) with antirotation pin (T) toward seal face. Align antirotation pin (T) with slot in back of stationary seal face and push into counterbore of backplate (6A, B).
92. Place one square head bolt (G) through each slot in backplate (6A, B) and through each hole in seal retainer (9). Secure seal retainer against backplate using two locknuts (F).
93. Install drive key (A).
94. Read and understand all safety instructions and warnings before installing and operating pump.

12. INSTRUCTIONS FOR DISASSEMBLY OF A TYPE “MBH” HYDRAULIC DRIVE

Refer to Section 14, **PARTS LIST**.

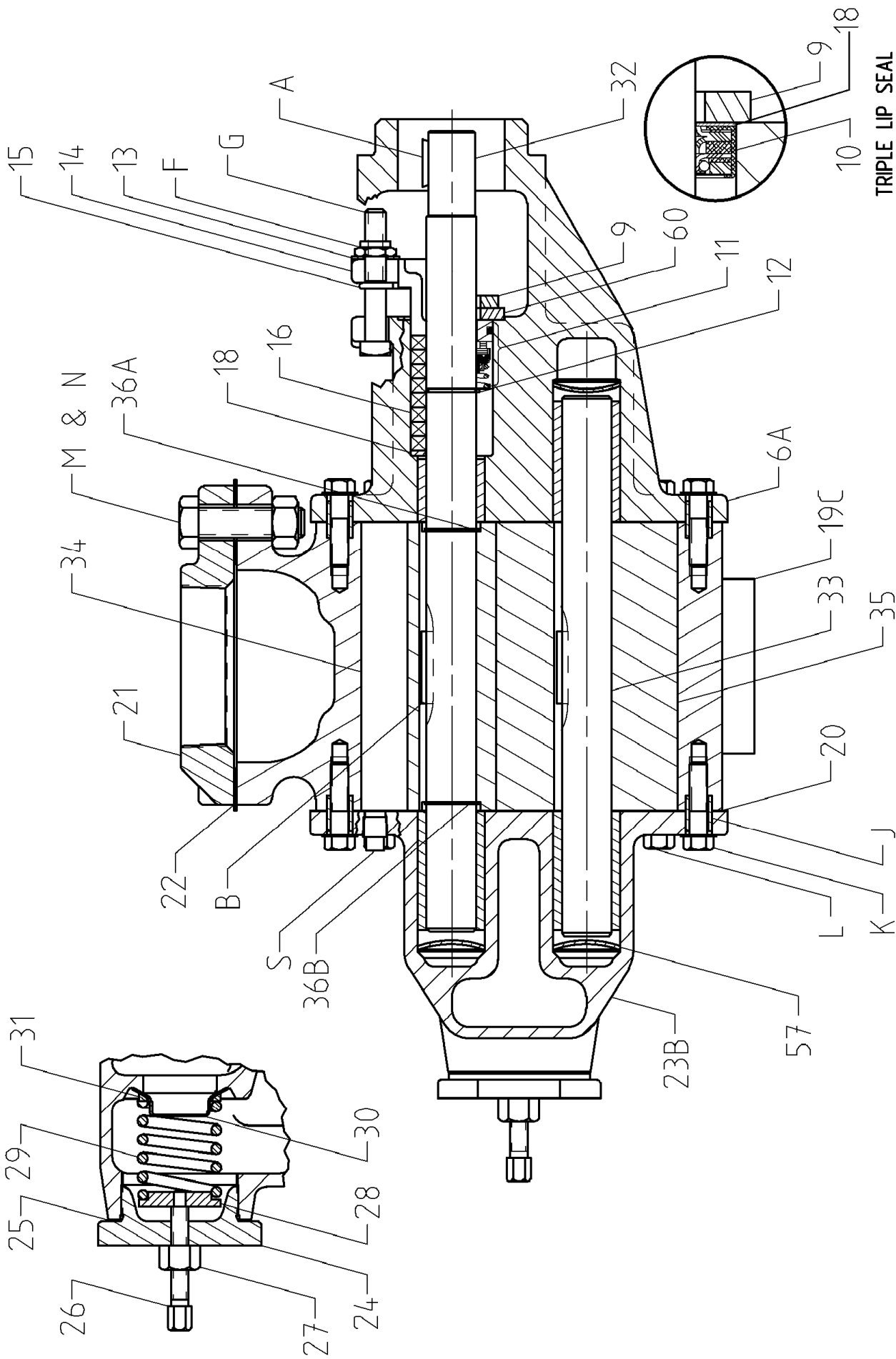
1. Read and understand all safety instructions and warnings before starting to disassemble hydraulic drive components from pump. While disassembling, always inspect disassembled parts and adjacent parts to see if further disassembly is needed. Replace worn or damaged parts as required.
2. Turn off pump and lock out energy source to hydraulic motor. **DO NOT** proceed further with disassembly of the pump if there is the slightest possibility that the hydraulic motor may be started.
3. Close inlet and discharge valves.
4. If pump is to be disassembled:
 - A.) Refer to Figure 14.1, pump sectional drawing for “**BHFRV**” and Figure 14.3, “**MBH**” **HYDRAULIC DRIVE COUPLING ASSEMBLY**.
 - B.) If used, turn off and disconnect flush for packing or mechanical seal.
 - C.) To drain pump, follow the procedures in Section 7, **INSTRUCTIONS FOR DRAINING PUMP**.
 - D.) Disconnect lines from pump inlet and discharge.
5. Remove two cap screws securing hydraulic motor to bracket (61).
6. Slide hydraulic motor out of bracket. The rigid coupling (62) is a slip fit on both shafts; therefore, it may remain on pump shaft or motor shaft.
7. Remove four socket head cap screws (64) securing bracket (61) to backplate (6A, B). Remove bracket.
8. For further disassembly of the pump, refer to Section 8, **INSTRUCTIONS FOR PUMP DISASSEMBLY**, steps 1 – 20. Also, refer to steps 21 – 24 for pumps with triple lip seal, steps 31 – 34 for pumps with packing, or steps 41 – 44 for pumps with mechanical seals.

13. INSTRUCTIONS FOR ASSEMBLY OF A TYPE “MBH” HYDRAULIC DRIVE

1. Refer to Section 14, **PARTS LIST**, for 3500-4700 “**BHFRV**” for pump assembly. If pump requires assembly, refer to Section 11, **INSTRUCTIONS FOR PUMP ASSEMBLY**, steps 1 – 6. Also, refer to steps 7 – 13 for pumps with triple lip seal, steps 27 – 36 for pumps with packing, or steps 47 – 70 for pumps with mechanical seals.
2. Refer to Figure 14.3, “**MBH**” **HYDRAULIC DRIVE COUPLING ASSEMBLY** for assembly of bracket and coupling.
3. Install retaining ring (63) in rigid coupling (62).
4. Install key (Z) in pump shaft keyway. Slide rigid coupling (62) onto shaft until end of the shaft is against retaining ring (63).
5. Place bracket (61) onto pilot of backplate (6A, B). Secure bracket with four socket head cap screws (64).
6. Slide rigid coupling (62) back until outboard end of coupling is even with outboard end of bracket (61).
7. Install key in hydraulic motor shaft. Line up shaft key and rigid coupling keyway and slide units together. Rotate hydraulic motor to align motor mounting holes and secure motor with two or four cap screws as required.
8. Read and understand all safety instructions and warnings before installing and operating pump.

14. PARTS LIST

2. Ball Bearing	25. Relief Valve Cap, Gasket	E. Hex Head Cap Screw, Seal Retainer to Backplate
3. Retaining Ring, Bearing Cage	26. Adjusting Screw	F. Locknut
6. Backplate A. Standard B. Jacketed	27. Nut, Lock and Seal	G. Square Head Bolt
7. Bearing, Short	28. Spring Guide	H. Pipe Plug, Backplate
8. Bearing, Long	29. Spring	J. Dowel Pin
9. Seal Retainer	30. Poppet	K. Washer Head Cap Screw, Endplates to Case
10. Triple Lip Seal	31. Adapter	L. Hex Head Cap Screw, Endplates to Case
11. Mechanical Seal	32. Drive Shaft	M. Hex Head Cap Screw, Flange Nut, Flange
12. Retaining Ring, Mechanical Seal	33. Idler Shaft	S. Pipe Plug, Faceplate
13. Packing Gland Clip	34. Drive Gear	T. Anti-rotation Pin
14. Packing Gland	35. Idler Gear	AJ. Drive Screw
15. Spring Clip	36. Retaining Ring, Gear (H) A. Backplate End B. Faceplate End	AK. Ball Handle, Double Setting Relief Valve only
16. Packing Ring	57. Expansion Washer	AL. Stud, Double Setting Relief Valve only
17. Lantern Ring (Not Shown)	58. Cam, Double Setting Relief Valve only	AM. Self Locking Nut, Double Setting Relief Valve only
18. Packing Washer	59. Operating Piston, Double Setting Relief Valve only	AN. Hex Head Cap Screw, Double Setting Relief Valve only
19. Case A. ANSI Flanged – Straight Through B. Threaded Port – Right Angle C. Flanged – Right Angle D. Flanged – Straight Through E. Flanged – Footless (22 SB only)	60. Locator Ring	AP. O-Ring, Double Setting Relief Valve only
20. Case Gasket	WRN2 Warning Plate, RV Style Relief Valve	
21. Flange	WRN3 Warning Plate, RV Style Relief Valve	Type MBH Hydraulic Drive Bracket Assembly only
22. Flange Gasket	WRN4 Warning Plate, RV Style Relief Valve	61. Bracket
23. Faceplate A. Plain B. RV Style Relief Valve C. Jacketed RV Style Relief Valve D. BV Style Bi-Directional Relief Valve	WRN5 Warning Plate, BV Style Relief Valve	62. Rigid Coupling
24. Relief Valve Cap	A. Drive Key	63. Retaining Ring
	B. Key, Gear	64. Socket Head Cap Screw
	D. Lube Fitting	



TRIPLE LIP SEAL

3511-4722 BH.F.RV

Figure 14.1

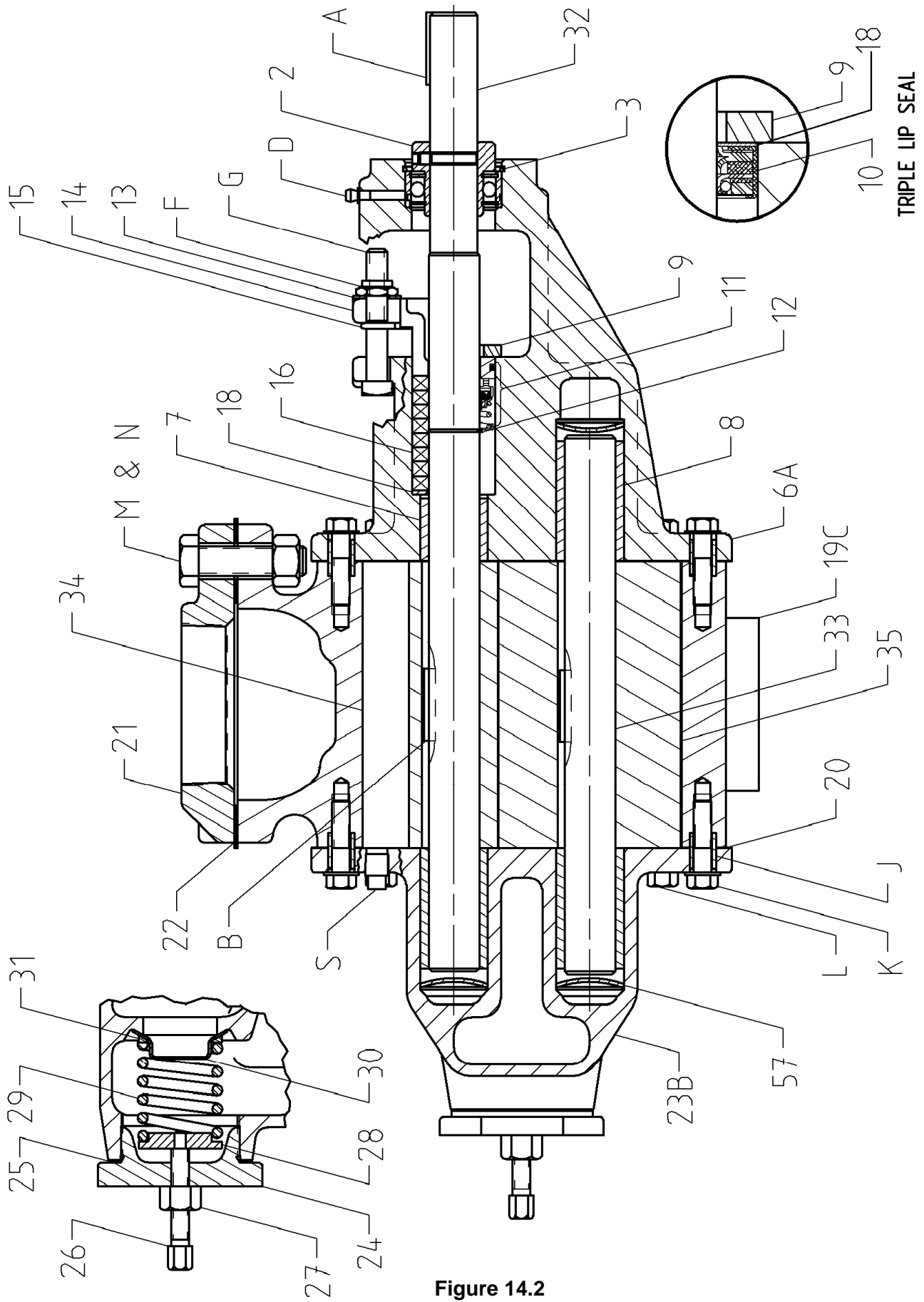
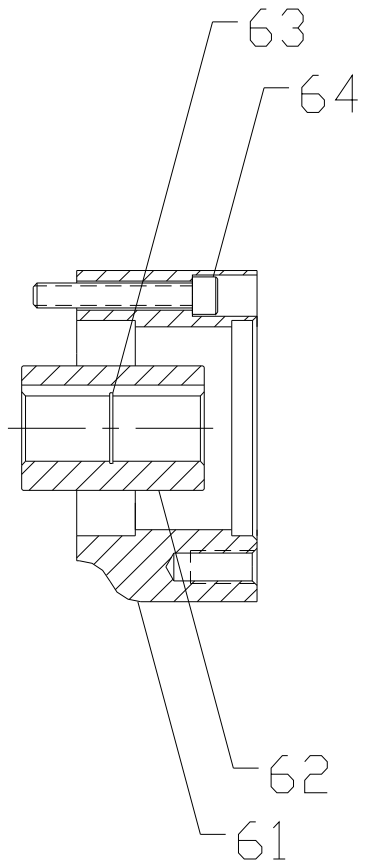


Figure 14.2

3511-4722 HB.F.RV



3611- 4722 MBH,F,RV
HYDRAULIC DRIVE COUPLING ASSEMBLY
Figure 14.3

15. SHAFT SEALING

STANDARD COMPRESSION PACKING

One type of shaft sealing used in these pumps is formed ring packing with or without a lantern ring. When using a packed box pump, use formed packing rings. **DO NOT** use a one piece spiral wrap of packing. Packing rings are available in a wide selection of materials for various applications and temperatures. Previous experience with the pumped fluid is the best guide in selecting the proper packing ring material for your particular application.

Some backplates are furnished with tapped holes on the stuffing box to provide access to the lantern ring or packing set for either flushing or grease lubrication. An external flush or lubrication of the packing may be necessary for proper operation and to help prolong the life of the packing and shaft.

A flush is recommended when the fluid to be pumped is abrasive or the pump operates with negative inlet pressure (suction lift). Clean water is often used to flush the packing. On applications where clean water is not available or where it is incompatible with the fluid being pumped, other clean, nonhazardous liquids may be used for flushing the packing. The flush should be supplied to the stuffing box at a rate of $\frac{1}{4}$ to $\frac{1}{2}$ gallons per hour (1 to 2 liters per hour). The pressure of the flushing liquid should exceed the sum of the inlet pressure and half of the differential pressure by 10 to 15 psi [70 to 100 kPa].

If the packing is to be grease lubricated, a good grade of bearing grease should generally be used. Should bearing grease be unacceptable or incompatible with the fluid being pumped, another paste type lubricant may be used. Lubrication of the packing must be performed with the pump stopped. Before daily start-up, if applicable, is a good time.

To lubricate the packing, stop the pump. Carefully clean the stuffing box pipe plugs of any contaminants. After removing the pipe plugs from the stuffing box, install a lubrication fitting into one of the tapped holes. Lubricant now may be injected into the stuffing box through the lube fitting. Inject clean, fresh unused lubricant until it is seen coming out of the other tapped hole. Clean up any excess lubricant and remove the lube fitting. Replace the pipe plugs. This procedure should be performed daily, prior to start-up if the pump is purchased with provisions for grease lubrication. In certain applications, more frequent lubrication of the packing may be necessary. Experience will provide a guide as to how frequently the packing should be lubricated. Applying lubricant often will extend the life of the packing and shaft.

CARE OF PACKING

Packing hooks are commercially available to help in removing packing rings from the stuffing box. It is generally not recommended to reuse old packing rings. When installing packing, use formed packing rings.

DO NOT use a one piece spiral wrap of packing. Before installing packing, carefully clean the stuffing box and shaft.

Packing rings should be installed one ring at a time, with the joints of adjacent rings staggered approximately 180°. Each ring should be seated firmly before the next ring is installed. **DO NOT** forget to install the lantern ring, if applicable. Three rings of packing, followed by the lantern ring, should allow the lantern ring to be approximately aligned with the flush/lube holes in the stuffing box.

The packing gland nuts should first be evenly tightened with a wrench to seat the packing firmly in the stuffing box and against the shaft. **DO NOT** over-tighten the packing. The gland nuts should then be backed off until finger-tight. Connect the flush or lubricate the packing if either method is used. After the pump is started, note the amount of leakage from the stuffing box. If the packing leakage exceeds ten drops per minute, stop the pump and adjust the gland nuts. The gland nuts should be adjusted evenly in $\frac{1}{6}$ to $\frac{1}{3}$ turn (1 to 2 flats on the nut) increments. Start the pump and allow it to operate for several minutes. Again, visually examine the stuffing box for excessive leakage. Repeat the above procedure until the stuffing box leakage is between five to ten drops per minute.

DO NOT over-tighten the packing. Slight leakage is a necessary requirement for proper packing operation. Leakage of five to ten drops per minute when the pump is operating is desirable, as it will preserve the packing and avoid scoring of the shaft. Over-tight packing may score shafts, increase torque requirements of the pump, damage couplings and drivers, and generate excessive heat.

The pump should be stopped and the packing gland adjusted whenever leakage exceeds ten drops per minute. The condition of the packing should be checked at regular intervals, the frequency depending on the type of service. Experience will dictate how frequently the inspections should be made.

MECHANICAL SEALS

Various types of mechanical seals are available to fit most pumps. (See **VARIOUS SEALING ARRANGEMENTS** shown in Figure 15.3.) Due to the various seal types and styles available, the seal manufacturer's instructions for installation and setting should be followed when available.

NOTE: Not all seals will fit or function in all pumps. Modification to the pump backplate, drive shaft, and/or retainer may be required. Consult with a Roper distributor or Roper Pump Company if you are considering a seal change in your pump.

For removal or installation of mechanical seals, refer to disassembly and assembly procedures for pumps.

CONVERSION FROM PACKED BOX TO MECHANICAL SEAL OR MECHANICAL SEAL TO PACKED BOX

Conversion kits are available to convert from a packed box pump to a mechanical seal pump or visa versa. Contact your Roper distributor or Roper Pump Company for availability of conversion kits.

INSTALLATION OF A POSITIVE DRIVE SEAL (JOHN CRANE® TYPE 8-1 AND TYPE 9)

Refer to the exploded parts drawing shown in Figure 15.1 and to the appropriate seal chamber dimensional drawing shown in Figure 15.2.

1. Machine a counterbore at entrance to seal chamber of backplate (6A, B) as shown in dimensional drawing in Figure 15.2.
2. With drive shaft (32) out of pump, install retaining ring (12) on drive shaft to locate mechanical seal.
3. Carefully remove all burrs and sharp edges on the shaft over which rotating element of seal will slide.
4. Apply a lubricant to seal I.D. and to drive shaft O.D. that is compatible with product being pumped and elastomers within pump. **DO NOT** use petroleum base products with seals with EPR elastomers. Clean and lubricate parts with light oil unless EPR elastomers are used. Use a nonpetroleum base lubricant with EPR elastomers.
5. Slide rotating element of mechanical seal onto drive shaft before removing three or four clips that are taped to rotating element. Push it back to retaining ring (12), tighten setscrews in seal, and remove clips that are taped to seal.
6. Slide faceplate end of drive shaft, with mechanical seal attached, into backplate (6A, B) through bore for outboard ball bearing (2).
7. Use a compatible lubricant to lubricate o-ring on stationary seal face and seal chamber bore.
8. Slide stationary seal face over keyway end of drive shaft (32) and down to seal chamber. Be sure lapped (polished) face is toward rotating member of seal.
9. Install outboard ball bearing (2) to position drive shaft (32) as shown in appropriate sectional drawing in Figure 14.2.
10. Push stationary seal face into seal chamber.

11. Position locator ring (60) in counterbore of backplate (6A, B). Make sure antirotation pin (T) engages in slot in back of stationary seal face.
12. Place one square head bolt (G) through each slot in backplate (6A, B) and through each hole in seal retainer (9). Secure seal retainer against backplate using two locknuts (F).
13. Assemble backplate assembly to remainder of pump following correct steps in Section 11,
INSTRUCTIONS FOR PUMP ASSEMBLY.

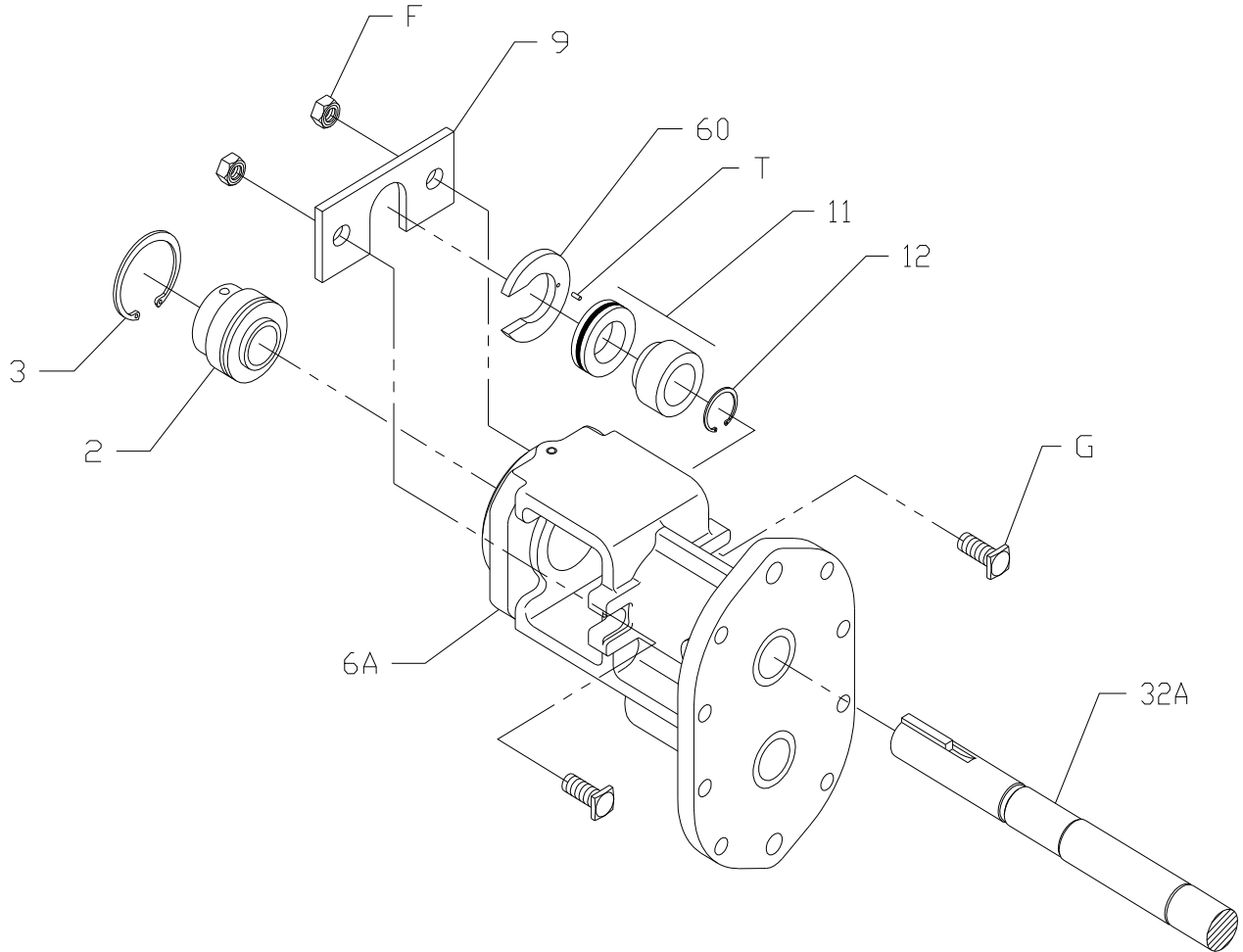


Figure 15.1

TRIPLE LIP SEAL

A triple lip seal can be used in the same backplates used for shaft packing and mechanical seals. Different drive shafts are required for the triple lip seal pumps.

The triple lip seal comes from the manufacturer with a small amount of grease between the lips. Do not remove this grease as it is necessary to provide lubrication to the inner lips on startup.

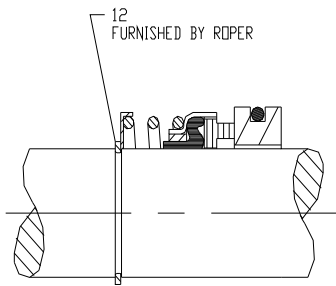
DO NOT distort the metal casing around the triple lip seal when installing the seal. Be very careful not to damage or distort the seal lips during installation. Follow the assembly instructions in the IOM and you will have good service from the seal.

The standard triple lip seal arrangement is good for products that will not solidify when exposed to air. Optional arrangements are available where a barrier fluid or flush is required to prevent exposure of the triple lip seal to air.

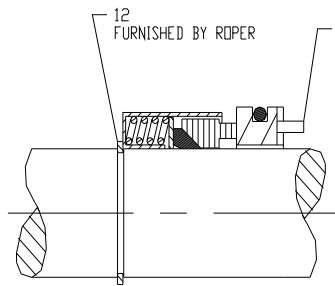
VARIOUS MECHANICAL SEAL ARRANGEMENTS

Figure 15.3

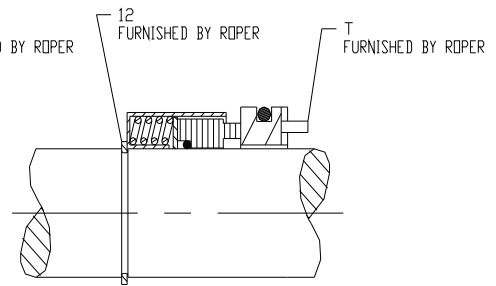
SINGLE MECHANICAL SEALS



JOHN CRANE® TYPE 21

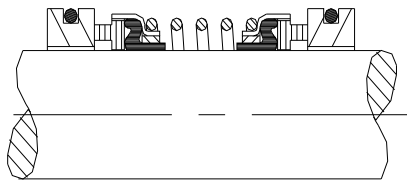


JOHN CRANE® TYPE 9

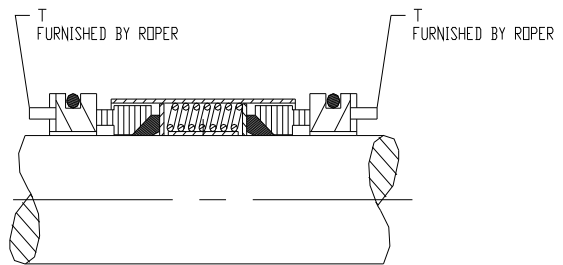


JOHN CRANE® TYPE 8-1

DOUBLE MECHANICAL SEALS



JOHN CRANE® TYPE 21 DOUBLE



JOHN CRANE® TYPE 9 DOUBLE

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SERIES 3600 RF***Installation and
Operating Instructions***

WARNING: Do not operate this equipment in excess of its rated capacity, pressure, speed, and temperature, or other than in accordance with instructions contained in this manual.

Every Roper pump is performance tested before being shipped from our factory. Correctly installed, operated and maintained, it will give long, dependable service. Remember . . . faulty selection and installation form the basis of more pump troubles than all other causes combined . . . no amount of maintenance can compensate for selection and installation mistakes. Read these instructions carefully before installing and operating this pump.

This pump is satisfactory for the conditions for which it is rated, but its operation in excess of these conditions may subject it to stresses and strains which it is not designed to withstand.

On all pumps it is recommended that a relief valve (either a built in valve or an external valve in the line) be used to protect the equipment and personnel from accident due to overpressure. **FOR A PUMP EQUIPPED WITH A BUILT IN RELIEF VALVE, SEE SECTION(S) ON RELIEF VALVES BEFORE OPERATING PUMP. READ SECTION ON PRE-OPERATION CHECKS, ESPECIALLY FOR A PUMP WITH NO BUILT IN RELIEF VALVE.**

It is also recommended that appropriate coupling or belt guards be installed for the protection of personnel.

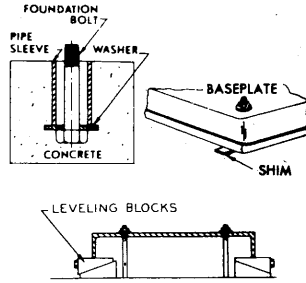
Failure to heed these warnings may result in an accident causing physical damage or personal injury.

If there is any question concerning the ratings or instructions, please consult a distributor, district representative, or the home office of the:

ROPER PUMP COMPANY
COMMERCE, GEORGIA 30529

PREPARATION OF FOUNDATION-BASEPLATE MOUNTED PUMPS

A good foundation is of major importance. Concrete is best, since it is heavy enough to support the baseplate rigidly and absorb strain and shock. Baseplate units must be securely bolted in position, with shims or leveling wedges to correct any angular and/or parallel misalignment. Such misalignment will cause the pump or driver to be out of alignment, thus resulting in heavy stresses on the pump. Accelerated wear or vibration can be caused by a very slight misalignment.



PLACE STRAIGHT EDGE AT TOP, BOTTOM, AND BOTH SIDES TO CHECK ALIGNMENT OF COUPLING MEMBERS	
Correct	STRAIGHT EDGE
Parallel Misalignment	STRAIGHT EDGE
Angular Misalignment	GAUGE FINDER

ALIGNING DRIVER AND PUMP

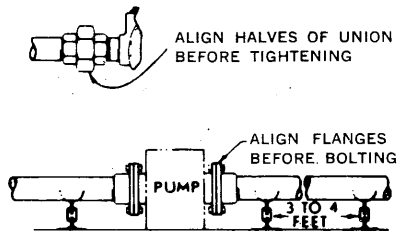
Driver and pump units are factory aligned before shipment, but they must be accurately realigned during and after installation.

To align coupling, use a straight edge and feeler gauges to check for parallel and angular alignment as shown in illustration at left.

Check the alignment at every step during installation: after the unit is mounted on foundation, after piping has been secured, and after pump has run with the liquid at operating temperature. **DO NOT DEPEND ON FLEXIBLE COUPLINGS TO COMPENSATE FOR MISALIGNMENT.**

INSTALLATION OF PIPES

Use of teflon tape for installing pipes may cause damage to pump. PIPING MUST BE CHECKED CAREFULLY, ALLOWING FOR EXPANSION OR CONTRACTION. Pipe strain can distort the pump components, thus increasing wear, causing bearing misalignment, or breaking parts. Pipe supports and expansion joints should be used to avoid weight and stresses on the pump. See that flanges or unions fit without forcing.

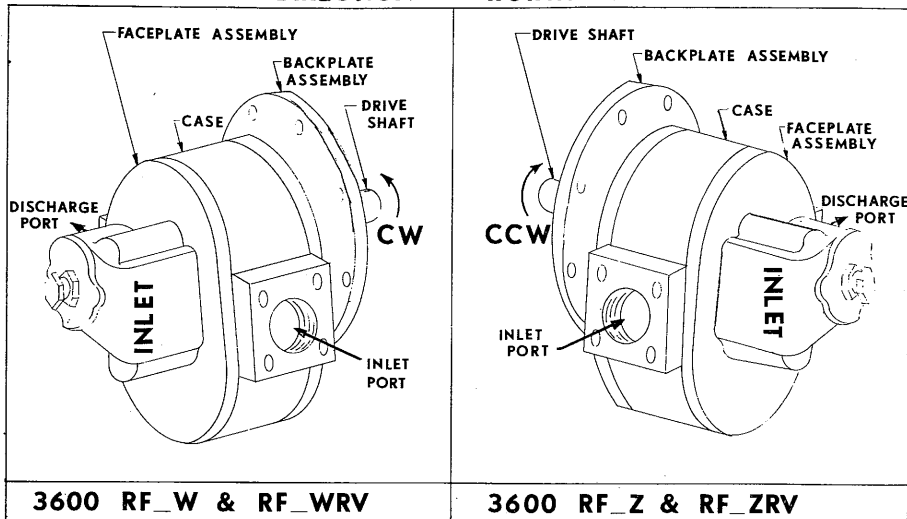


Pump opening size does not necessarily establish correct pipe size. If in doubt as to pipe size to use, check with a Roper Distributor or District Representative. It is recommended that the pump be installed below the liquid level, with a short, large diameter supply line to assure a flooded inlet. Roper pumps, however are self-priming, positive displacement pumps and will prime under the most difficult conditions. Roper pumps are recommended for clean liquid only. A strainer, of ample size and regularly cleaned, should be used in the inlet piping to prevent foreign material from entering the pump.

Prior To Starting The Pump See: **PRE-OPERATION CHECKS**

SERIES 3600 RF

DIRECTION OF ROTATION



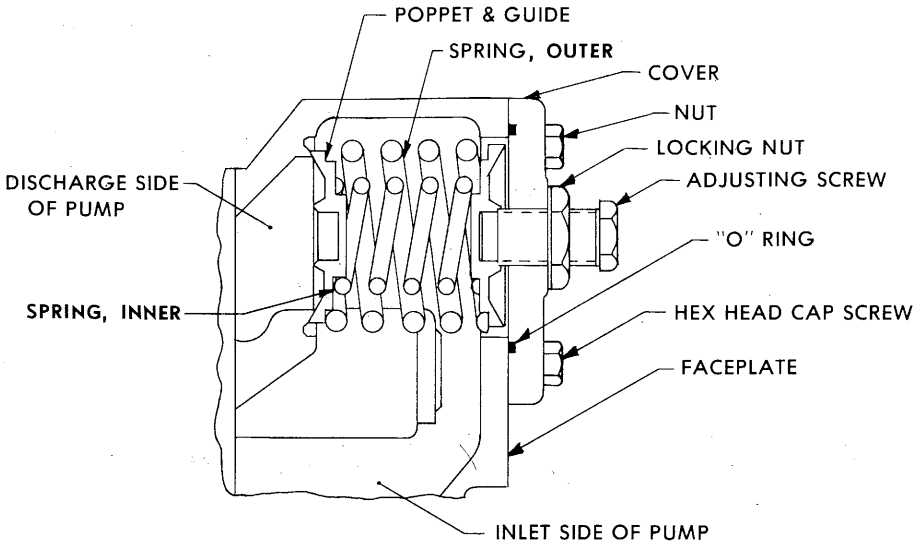
PRIOR TO OPERATING THE PUMP, MAKE SURE THAT THE SHAFT ROTATION, PIPE CONNECTIONS, AND THE RELIEF VALVE POSITION (WHEN USED) IS IN ACCORDANCE WITH THE ABOVE ILLUSTRATIONS.

To reverse the rotation on a pump with a built-in relief valve, remove the cap screws that secure faceplate to the case or backplate. Remove the faceplate and reposition as required, making sure that the gasket(s) is not damaged. Tighten the cap screws. Note: the dowel pins will align parts properly.

Pumps with plain faceplates will operate in both directions of rotation.

For inlet pressures over 10 PSIG, consult a distributor, district representative, or the home office of the ROPER PUMP COMPANY, COMMERCE, GEORGIA.

RELIEF VALVE



The relief valve must be positioned as shown in instructions for Direction of Rotation—otherwise the valve is inoperable and will not give protection.

If the built-in relief valve is used it is mandatory that the relief valve be set **BY THE USER**, since maximum relief valve pressure depends upon the viscosity and specific gravity of the liquid, the flow rate (Pump RPM), and also the initial relief valve setting. If not specified otherwise, the relief valve on this pump is factory set for full by-pass at a differential pressure of 80 PSIG, at a pump speed of 330 RPM on liquid with a viscosity of approximately 35 SSU. This setting would only apply if all of these conditions are duplicated.

Built in relief valves sense differential pressures only (Difference between inlet and outlet pressures).

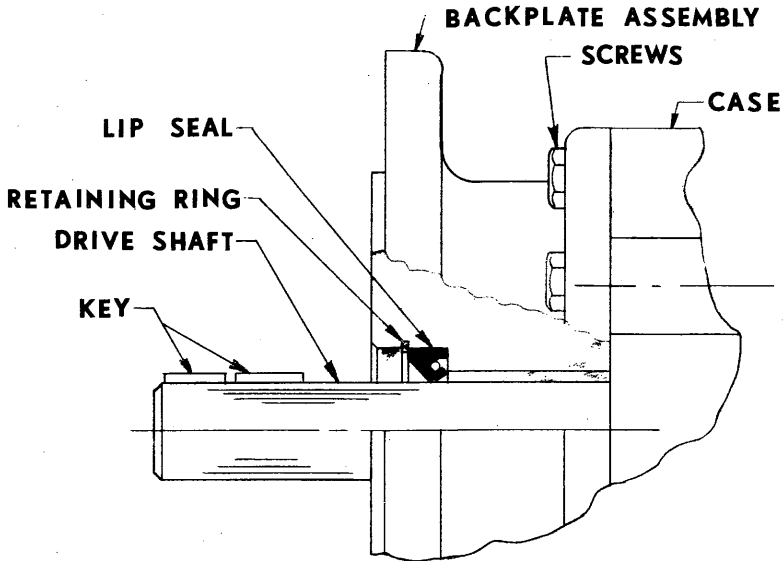
A built-in relief valve should not be used on applications where the discharge must be closed for more than a few minutes. Prolonged operation with the relief valve fully by-passing will cause heating of the liquid circulating thru the valve, thus resulting in possible damage.

To adjust, loosen the locking nut. Turn adjusting screw clockwise to increase the pressure and counter-clockwise to reduce the pressure. Make adjustments in $\frac{1}{2}$ turn increments until desired pressure is obtained. Tighten locking nut.

To replace spring(s), poppet, or guide decrease the pressure on the spring(s) and remove the cover by loosening the cap screws and nut from the faceplate. After inspecting parts and replacing those required reassemble the parts in reverse order to which they were removed, making sure the spring(s) is centered on poppet and guide. Replace gasket. Replace cover with cap screws and nut and adjust spring to desired setting.

SERIES 3600 RF

REPLACEMENT OF LIP SEAL



In order to replace the lip seal the complete pump must be removed from the engine to which it is mounted.

Remove all piping from the inlet and discharge ports and any interference piping. With the use of an appropriate sling and hoist secured in position to lift the pump, remove all screws and/or nuts which secure the pump to the engine and pull the pump away from its mounting surface. Remove the coupling and key(s) from end of drive shaft. Remove all burrs and sharp edges from shaft and keyway(s).

Remove the screws and/or nuts securing the backplate assembly to the case. Slide the backplate assembly, lip seal, and retaining ring off the drive shaft. Remove the retaining ring.

Pry lip seal out of bore making sure that bore is not scored or damaged.

While the pump is disassembled inspect the shafts, gears, bores of the case and bearings, and surfaces of the backplate and faceplate for worn or scored places. Replace parts as required.

Clean bore into which lip seal is to be pressed. Remount the gasket and backplate assembly to the case. Secure in place with screws and nuts.

Lightly oil drive shaft and bore into which lip seal is to be fitted. Slide lip seal onto shaft with open side toward pumping element and press into bore until it touches rear surfaces of bore and install retaining ring.

Replace key(s) and coupling on drive shaft and remount pump to the engine in reverse order to which it was removed.

CHECKING PUMP PERFORMANCE

A summary of the causes of common malfunctions.

NO LIQUID DELIVERED

1. Pump not primed. If pump fails to deliver liquid after a minute, stop the pump and prime it by pouring some liquid into the discharge side of the pump.
2. Rotating in wrong direction.
3. Inlet lift too high. Check this with gauge at pump inlet.
4. Clogged inlet line.
5. Air pockets or vapor lock.
6. Air leaks in inlet line.
7. Foreign matter under valve seat or poppet. Remove and clean poppet and valve seat. Caution: if poppet or seat is damaged it must be re-machined or replaced.

RAPID WEAR

1. Abrasives in liquid.
2. Compatibility of liquid and pump material.
3. Excessive pressure.
4. Non-lubricating liquid.

EXCESSIVE NOISE

1. Starved pump.
2. Air leaks in inlet line.
3. Air or gases in liquid.
4. Pump speed too high.
5. Relief valve chatter. Check pressure setting.
6. Improper mounting. Check alignment thoroughly. See instructions for aligning driver and pump and preparation of foundation for base-plate mounted pumps.

INSUFFICIENT LIQUID DELIVERED

1. Air leaks in inlet line.
2. Air leaks through packing or mechanical seal.
3. Speed too slow.
4. Excessive lift at inlet. Check this with gauge at the pump inlet.
5. Viscosity of liquid too high for size and length of inlet pipe.
6. Foot valve or end of inlet pipe not immersed deeply enough in liquid.
7. Foot valve, if used, too small, stuck, or not working properly.
8. Partial air pockets or vapor lock.
9. Pump damaged by foreign matter or misalignment.
10. Excessive clearance in pump caused by wear or corrosion.
11. Relief valve set too low, or stuck partially open.

PUMP TAKES TOO MUCH POWER

1. Speed too high.
2. Liquid more viscous than previously anticipated.
3. Operating pressure higher than specified. Check this with gauge at the pump outlet.
4. Outlet line obstructed.
5. Mechanical defect, such as bent shaft, packing gland too tight, or misalignment of piping.
6. Relief valve not operating properly.

SAFETY PRECAUTIONS

Safe installation, operation and maintenance must be performed by qualified personnel. Do not work on a pump while it is running, except for minor necessary adjustments such as packing and relief valve. Be careful when working on or near a running pump contacting or being caught in rotating parts could cause serious or fatal injury. Guards should be provided for all exposed rotating parts. WHEN LIQUID BEING PUMPED IS HAZARDOUS OR VOLATILE, PRECAUTIONS SHOULD BE TAKEN AT ALL TIMES INCLUDING THE RUN IN PERIOD AND DURING DISASSEMBLY AND ASSEMBLY OF PUMP.

PRE-OPERATION CHECKS

See instructions on Preparation of Foundation for Base Mounted Pumps, Alignment Driver and Pump, and Pipe Installation.

Determine the proper direction of rotation by using the appropriate instructions and illustrations. When a relief valve is used, make sure it is positioned and adjusted properly. Check the rotation of the driver to make sure it will operate the pump in the desired direction of rotation.

After the unit is mounted and the piping is connected, the pump should be checked to be sure it operates freely, without binding. After operation is proved satisfactory, both pump and driver should be tightly secured and the alignment rechecked before operation.

Before starting, make sure the inlet and discharge valves are open and there is liquid in the pump.

After starting the unit, check to see that the pump is delivering liquid. If not, stop the driver immediately and refer to the section on Checking Pump Performance. If the pump is delivering liquid, check the unit for quiet operation, vibration, localized heating, and excessive seal or packing leakage. It is recommended the pressure and-or vacuum be checked by installing gauges at both sides of the pump to make sure the pressure and-or vacuum conform to specifications.

IF THERE IS NO RELIEF VALVE IN THE SYSTEM NEVER BLOCK THE OUTLET LINE. HIGH PRESSURE WILL OCCUR, RESULTING IN POSSIBLE DAMAGE OR BREAKAGE TO THE PUMP OR SYSTEM PARTS AND POSSIBLE INJURY TO PERSONNEL. EVEN WITH A RELIEF VALVE IN THE SYSTEM, DO NOT OPERATE THE PUMP FOR MORE THAN A FEW MINUTES WITH THE OUTLET LINE BLOCKED. RAPID HEATING AND POSSIBLE DAMAGE WILL OCCUR.

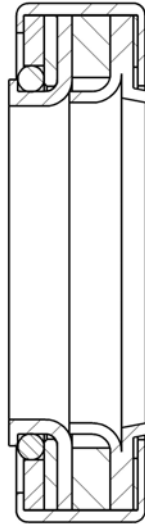
REPAIR PARTS

Use only Roper repair parts. Roper Pump Company takes no responsibility for the use of parts other than those manufactured and supplied by Roper Pump Company. The use of substitutes may result in poor pump performance or in an accident causing physical damage or injury to personnel.



3532, 3535, 3543, 3548, 3558, 4558 TRIPLE LIP SEAL OWNERS MANUAL

(Use with Supplement Owner's Manual
G12-437 for GHB and BHB Pumps or
G12-210 for HB, SB, and BH pumps)



SAFETY INSTRUCTIONS

This is an industrial component. Only a qualified systems integrator should be allowed to design it into a system. The integrator must determine proper plumbing, mounting, driveline and guard components.

Improper installation or use could lead to a serious, even fatal, accident. The system integrator must communicate all safe operation procedures to the end user(s).

Before operation, fully understand and follow the instructions shown in this manual and any instructions communicated by the system integrator. No one should be allowed to operate or maintain this pump who has not been fully trained to work safely according to the configuration of the pump system and in accordance with all applicable government and industry regulations.

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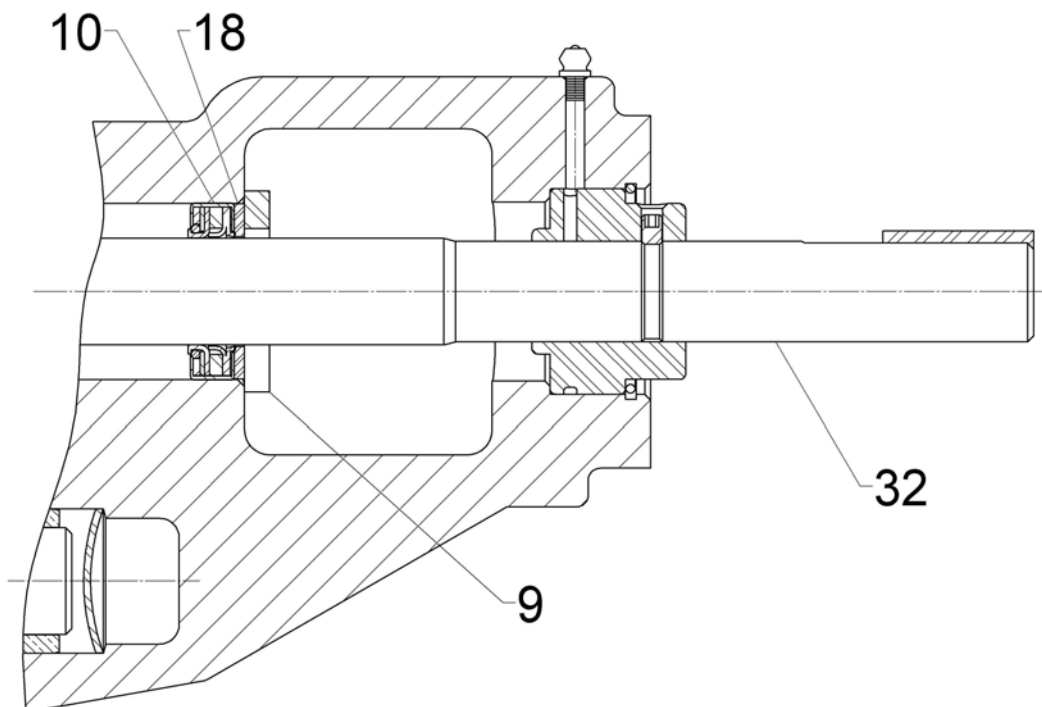
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Installation Instructions for Triple Lip Seal

(STANDARD CONFIGURATION)

3532-3548 and 3535-4558

1. There are many different pump and seal arrangements. Depending on the arrangement, the installation of the triple lip seal could vary. If you do not know which pump or seal arrangement you have, collect nameplate data and refer to the Owner's Manual for 3532-4558 (G12-210), to determine what you have. Consult a Roper distributor or Roper Pump Company if you have any questions.
2. When cleaning or lubricating, use only cleaning solutions and lubricants that are compatible with products being pumped and with sealing elastomers. **DO NOT** use petroleum base products with seals with EPR elastomers. Use a non-petroleum base lubricant with EPR elastomers.
3. It is very important the triple lip seal is not installed in such a way that it would have to slide over any retaining ring grooves. Use a small file or stone to break sharp edges of drive shaft keyway that will be under pump drive gear.
4. For "BH" pumps, the drive shaft should already be installed in pump. Lubricate drive end of drive shaft (32) and triple lip seal (10) with a light oil. Slide triple lip seal over shaft with two lips facing toward pump gears. Gently push seal past tapered area of shaft and down to front of seal chamber. Press triple lip seal into bore until back side is flush with face of seal chamber. Take care to use a tool that will not damage or distort seal casing. Install one packing washer (18). Secure seal retainer (9) in place. Refer to the Owner's Manual for 3532-4558 (G12-210) for further pump disassembly or assembly instructions.
5. For "BHB", "GHB", "GHBO", "HB" and "SBFO" pumps, prior to installing the drive shaft place the triple lip seal (10) with two lips facing toward seal chamber onto opening of seal chamber in backplate. Press triple lip seal into seal chamber until back side of seal is flush with face of seal chamber. Take care to use a tool that will not damage or distort seal casing. Install one packing washer (18). Secure seal retainer (9) in place. For "HB" and "SBFO" refer to the Owner's Manual for 3532-4558 (G12-210) for further pump disassembly or assembly instructions. For "BHB", "GHB", and "GHBO" refer to the Owner's Manual for 3532-4558 (G12-437) for further pump disassembly or assembly instructions.



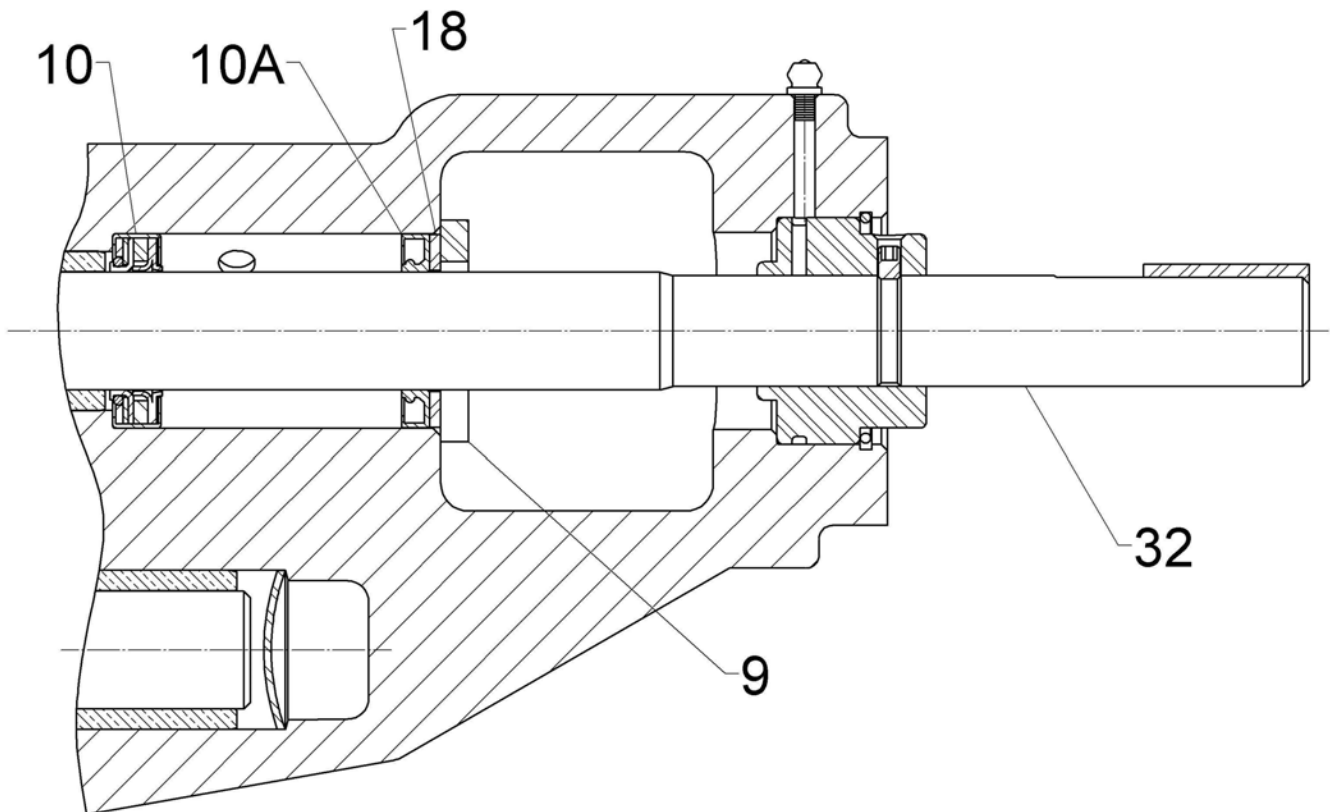
EXAMPLE OF STANDARD CONFIGURATION

Installation Instructions for Triple Lip Seal

(BARRIER FLUID OR FLUSH CONFIGURATION)

3532-3548 and 3535-4558

6. For “**BH**” pumps, the drive shaft should already be installed in pump. Lubricate drive end of drive shaft (32) and triple lip seal (10) with a light oil. Slide triple lip seal over shaft with two lips facing toward pump gears. Gently push seal past tapered area of shaft and down to front of seal chamber. Press triple lip seal into bore until seated in bottom of seal chamber. Take care to use a tool that will not damage or distort seal casing. Press lip seal (10A) into seal chamber bore. Install one packing washer (18). Secure seal retainer (9) in place. Refer to the Owner’s Manual for 3532-4558 (G12-210) for further pump disassembly or assembly instructions.
7. For “**BHB**”, “**GHB**”, “**GHBO**”, “**HB**” and “**SBFO**” pumps, prior to installing the drive shaft place the triple lip seal (10) with two lips facing toward seal chamber onto opening of seal chamber in backplate. Press triple lip seal into seal chamber until seated in bottom of seal chamber. Take care to use a tool that will not damage or distort seal casing. Press lip seal (10A) into seal chamber bore. Install one packing washer (18). Secure seal retainer (9) in place. For “**HB**” and “**SBFO**” refer to the Owner’s Manual for 3532-4558 (G12-210) for further pump disassembly or assembly instructions. For “**BHB**”, “**GHB**”, and “**GHBO**” refer to the Owner’s Manual for 3532-4558 (G12-437) for further pump disassembly or assembly instructions.

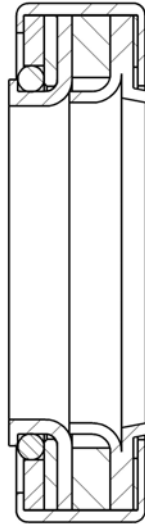


EXAMPLE OF BARRIER FLUID OR FLUSH CONFIGURATION



3511, 3517, 3522, 4511, 4517, 4522 TRIPLE LIP SEAL OWNERS MANUAL

(Use with Supplement Owner's Manual
G12-436 for GHB and BHB Pumps or
G12-209 for HB, SB, and BH pumps)



SAFETY INSTRUCTIONS

This is an industrial component. Only a qualified systems integrator should be allowed to design it into a system. The integrator must determine proper plumbing, mounting, driveline and guard components.

Improper installation or use could lead to a serious, even fatal, accident. The system integrator must communicate all safe operation procedures to the end user(s).

Before operation, fully understand and follow the instructions shown in this manual and any instructions communicated by the system integrator. No one should be allowed to operate or maintain this pump who has not been fully trained to work safely according to the configuration of the pump system and in accordance with all applicable government and industry regulations.

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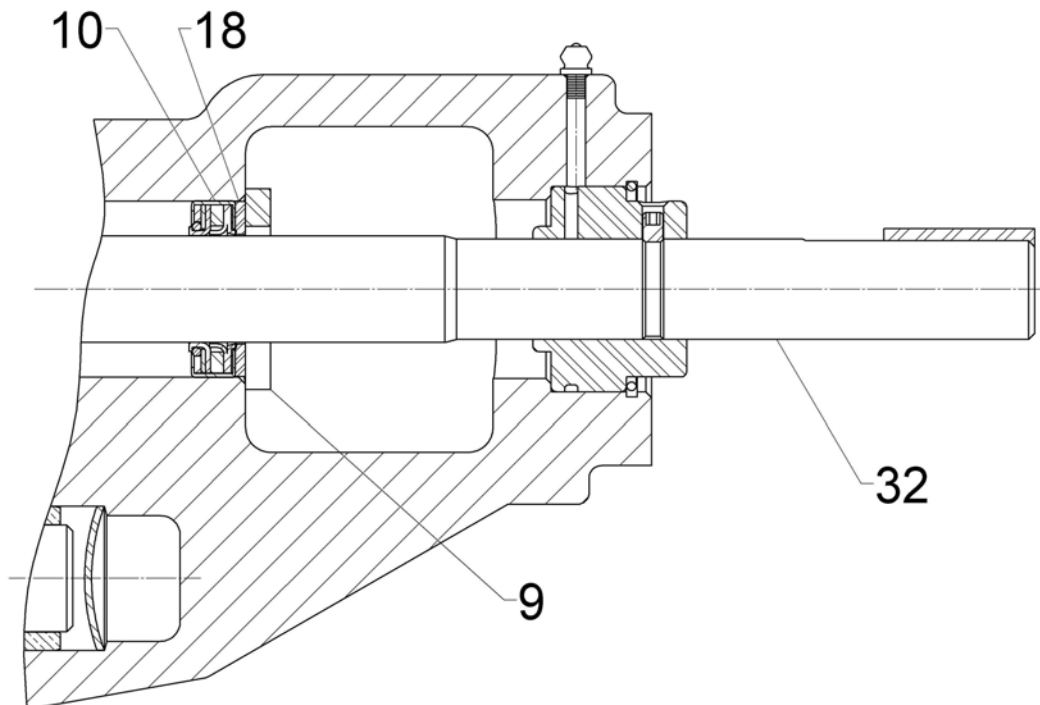
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Installation Instructions for Triple Lip Seal

(STANDARD CONFIGURATION)

3511-4522

1. There are many different pump and seal arrangements. Depending on the arrangement, the installation of the triple lip seal could vary. If you do not know which pump or seal arrangement you have, collect nameplate data and refer to the Owners Manual for 3511-4522 (G12-209), to determine what you have. Consult a Roper distributor or Roper Pump Company if you have any questions.
2. When cleaning or lubricating, use only cleaning solutions and lubricants that are compatible with products being pumped and with sealing elastomers. **DO NOT** use petroleum base products with seals with EPR elastomers. Use a non-petroleum base lubricant with EPR elastomers.
3. It is very important the triple lip seal is not installed in such a way that it would have to slide over any retaining ring grooves. Use a small file or stone to break sharp edges of drive shaft keyway that will be under pump drive gear.
4. For “**BH**” pumps, the drive shaft should already be installed in pump. Lubricate drive end of drive shaft (32) and triple lip seal (10) with a light oil. Slide triple lip seal over shaft with two lips facing toward pump gears. Gently push seal past tapered area of shaft and down to front of seal chamber. Press triple lip seal into bore until back side is flush with face of seal chamber. Install packing washer (10B). Take care to use a tool that will not damage or distort seal casing. Install one packing washer (18). Secure seal retainer (9) in place. Refer to the Owners Manual for 3511-4522 (G12-209) for further pump disassembly or assembly instructions.
5. For “**BHB**”, “**GHB**”, “**GHBO**”, “**HB**” and “**SBFO**” pumps, prior to installing the drive shaft place the triple lip seal (10) with two lips facing toward seal chamber onto opening of seal chamber in backplate. Press triple lip seal into seal chamber until back side of seal is flush with face of seal chamber. Take care to use a tool that will not damage or distort seal casing. Install one packing washer (18). Secure seal retainer (9) in place. For “**HB**” and “**SBFO**” refer to the Owners Manual for 3511-4522 (G12-209) for further pump disassembly or assembly instructions. For “**BHB**”, “**GHB**”, and “**GHBO**” refer to the Owners Manual for 3511-4522 (G12-436) for further pump disassembly or assembly instructions.



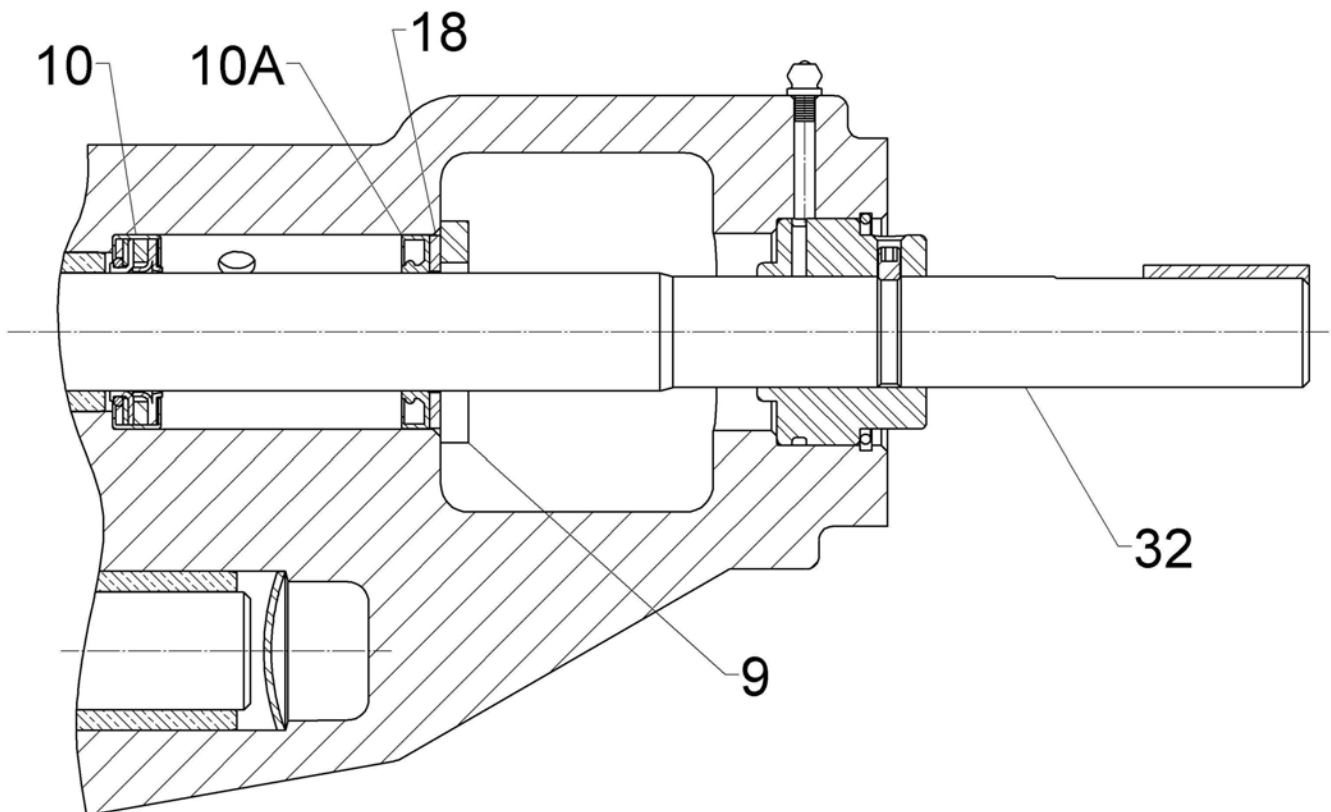
EXAMPLE OF STANDARD CONFIGURATION

Installation Instructions for Triple Lip Seal

(BARRIER FLUID OR FLUSH CONFIGURATION)

3511-4522

6. For “BH” pumps, the drive shaft should already be installed in pump. Lubricate drive end of drive shaft (32) and triple lip seal (10) with a light oil. Slide triple lip seal over shaft with two lips facing toward pump gears. Gently push seal past tapered area of shaft and down to front of seal chamber. Press triple lip seal into bore until seated in bottom of seal chamber. Take care to use a tool that will not damage or distort seal casing. Press lip seal (10A) into seal chamber bore. Install one packing washer (18). Secure seal retainer (9) in place. Refer to the Owners Manual for 3511-4522 (G12-209) for further pump disassembly or assembly instructions.
7. For “BHB”, “GHB”, “GHBO”, “HB” and “SBFO” pumps, prior to installing the drive shaft place the triple lip seal (10) with two lips facing toward seal chamber onto opening of seal chamber in backplate. Press triple lip seal into seal chamber until seated in bottom of seal chamber. Take care to use a tool that will not damage or distort seal casing. Press lip seal (10A) into seal chamber bore. Install one packing washer (18). Secure seal retainer (9) in place. For “HB” and “SBFO” refer to the Owners Manual for 3511-4522 (G12-209) for further pump disassembly or assembly instructions. For “BHB”, “GHB”, and “GHBO” refer to the Owners Manual for 3511-4522 (G12-436) for further pump disassembly or assembly instructions.



EXAMPLE OF BARRIER FLUID OR FLUSH CONFIGURATION

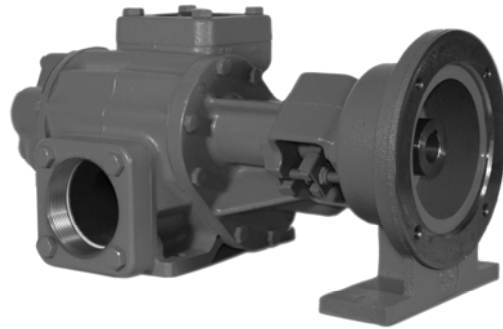


3600 CLOSE COUPLED DRIVE OWNERS MANUAL

Supplement to G12-209/G12-210 Standard 3600 Series Owners Manual

G12-428

03/17/06



SAFETY INSTRUCTIONS

This is an industrial component. Only a qualified systems integrator should be allowed to design it into a system. The integrator must determine proper plumbing, mounting, driveline and guard components.

Improper installation or use could lead to a serious, even fatal, accident. The system integrator must communicate all safe operation procedures to the end user(s).

Before operation, fully understand and follow the instructions shown in this manual and any instructions communicated by the system integrator. No one should be allowed to operate or maintain this pump who has not been fully trained to work safely according to the configuration of the pump system and in accordance with all applicable government and industry regulations.

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ASSEMBLY

1. Make sure the key is installed in the male pump shaft. It should be a tight fit and inserted to the bottom of the key slot.
2. Coat the male pump shaft and key with anti-seize compound. Anti-seize compound is to make assembly easier and to ease disassembly, if required, for maintenance. It is produced by several manufacturers (Permatex[®], Loctite[®], etc.) and can be purchased through most industrial supply companies (WW Grainer, McMaster-Carr, etc.).
3. Place the support bracket on the pump male pilot.
4. Insert the supplied support bracket mounting bolts finger tight.
5. With the bolts finger tight, place the pump feet and the support bracket feet on a flat surface. A flat workbench will suffice. This is to align the pump and bracket feet.
6. Tighten support bracket bolts while sitting on flat surface.
7. Install the key in the male reducer shaft. It should be a tight fit and inserted to the bottom of the key slot.
8. Coat the male reducer shaft with anti-seize compound.
9. Install the retaining ring in the middle of the rigid coupling.
10. Slide the rigid coupling onto the pump shaft.
11. Slide the reducer shaft into the opposite end of the rigid coupling.
12. Push the units together until the flange faces are close enough to use the supplied drive mounting bolts to draw them together. The use of temporary, longer draw bolts (not supplied) may be used if required.

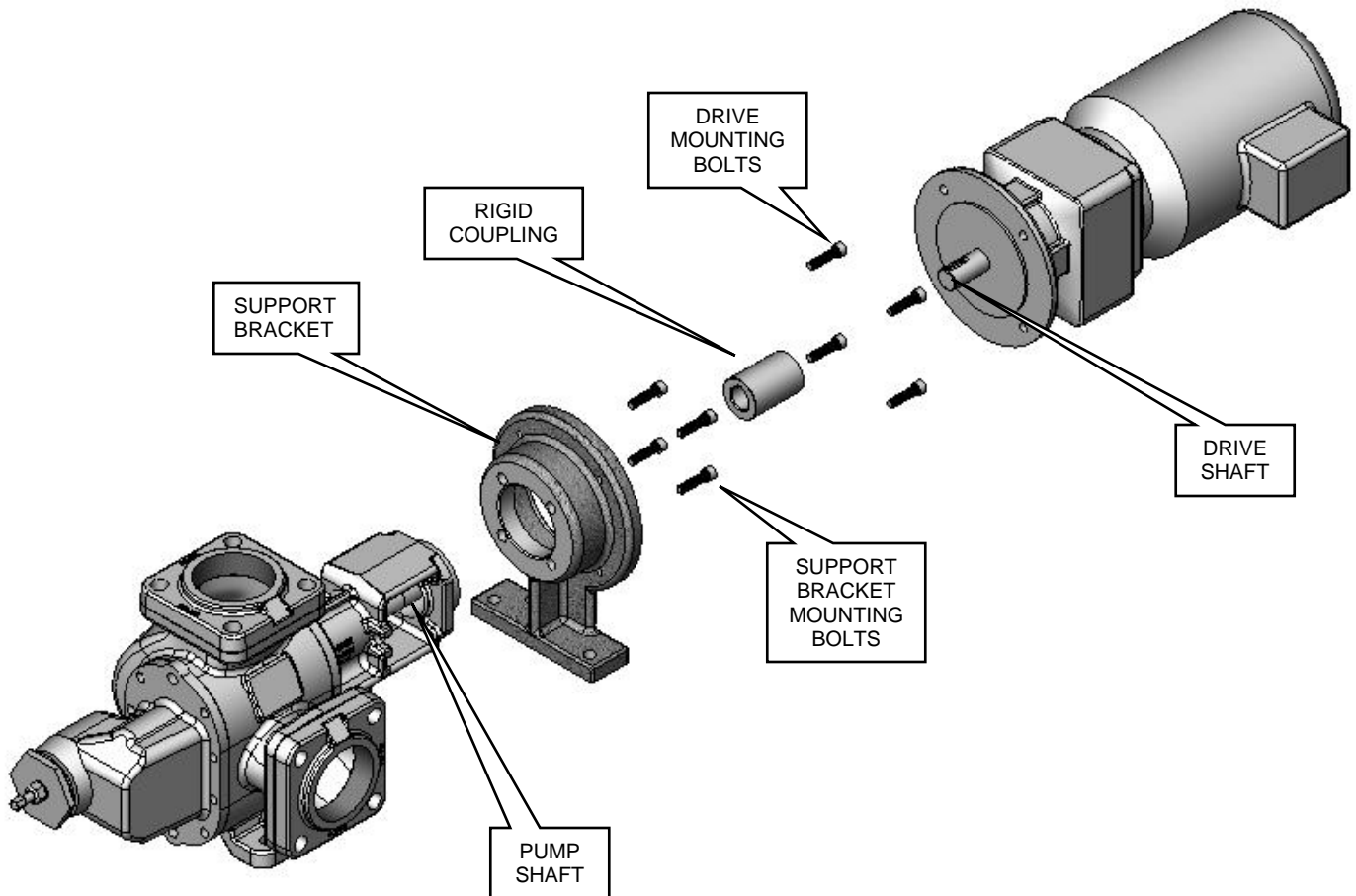


Figure 2: Pump to Drive Connection

INSTALLING ASSEMBLY

HANDLING

To prevent damage or shifting due to an unbalanced load when moving the pump, use a strap (i.e. sling) wrapped around the pump section and a hook or second sling on the reducer section. (See Figure 3 at right.)

MOUNTING BASE

Integral motors and C-face type inputs do not require a base plate for most applications. The reaction forces between the drive components and the pump are contained within the package. The system integrator must determine if plumbing forces require a mounting base.

Male shaft inputs require a base plate to handle the input reaction forces. (See section below on male shaft input.)

Follow these instructions to shim mounting feet to prevent uneven loading:

1. Place the pump and drive on the planned mounting surface. In some configurations, the drive may be heavy enough to lift the pump feet off the mounting surface. It may be necessary to temporarily support the drive to square the assembly.
2. Use a thickness gage set (feeler gage) to probe under the mounting feet to determine if there is a gap at any of them.
3. Shim the feet as required.

DRIVELINE GUARDS

A driveline guard is not required in most applications. There are not exposed snag points. The length of exposed rotating shaft is short and shielded from most accidental contacts by the extensions around the seal chamber. The system integrator must determine if guards are required and that all OSHA, federal, state, and local codes are followed.

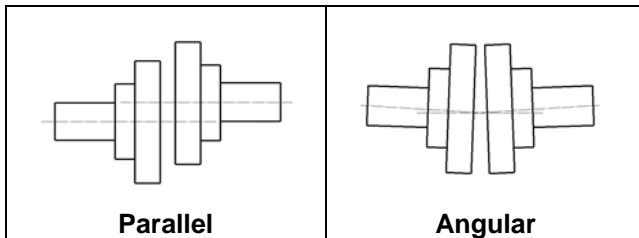
MALE SHAFT INPUT UNITS

DRIVELINE GUARDS

Assure adequate guards have been installed to prevent accidental contact of moving components. Follow all OSHA, federal, state, and local codes.

CHECK ALIGNMENT OF PUMP TO DRIVELINE

Excessive misalignment can overload the pump input shaft and cause premature failure. The figures below show parallel and angular misalignments.



Components installed on the shaft should be fitted to the manufacturer's recommendations.

NOTE: DO NOT hammer on the input shaft. Hammering could damage internal parts.

MOUNTING BASE

Mount the unit on a rigid, heavy base to provide support and absorb shock. Bases should not only be designed for high rigidity, but also for strength.

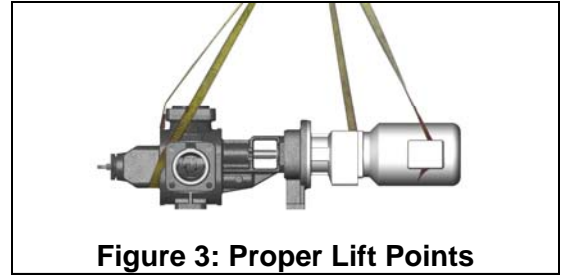


Figure 3: Proper Lift Points

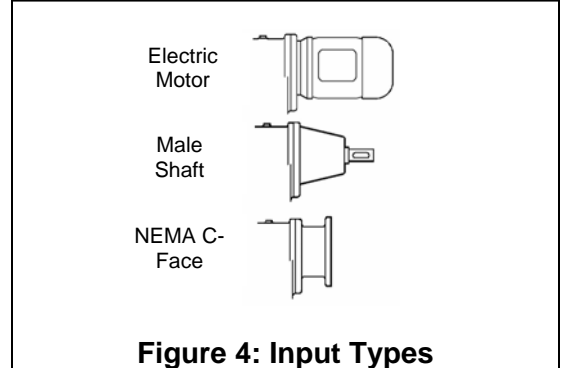
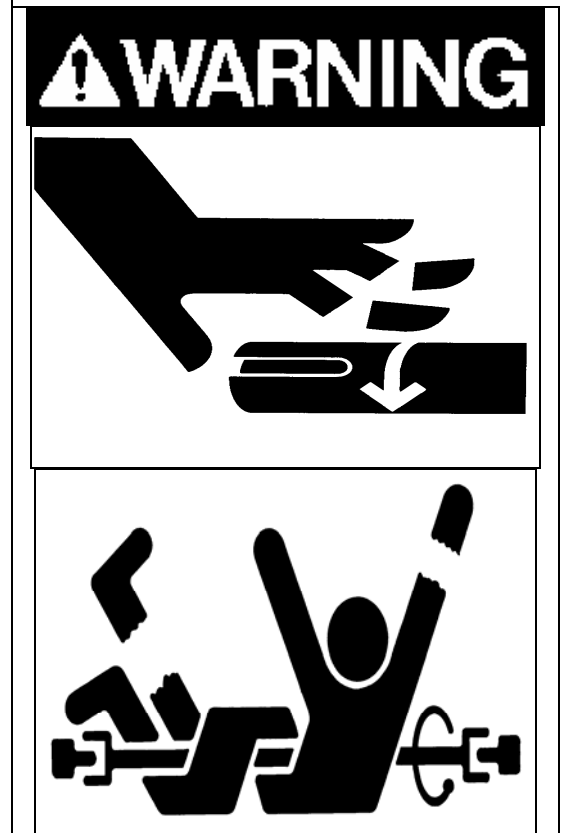


Figure 4: Input Types



Operating without guards could result in serious injury or death. Machinery in operation can grab, crush, cut, mangle and dismember. Do not operate without adequate guards in place.

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