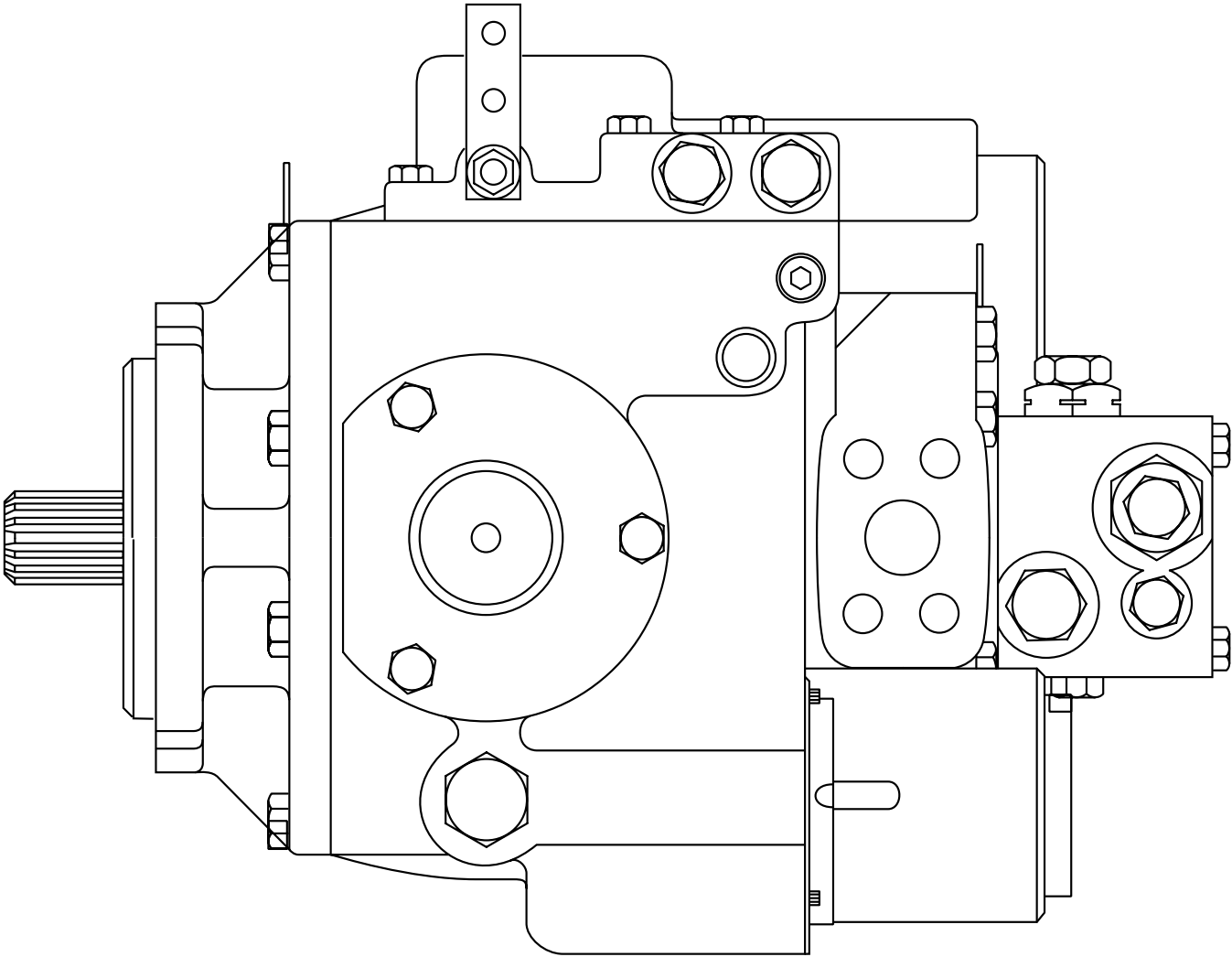




## Repair Information



**Series 1 Models 33-64**  
**Hydrostatic Variable Motors**

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## ID Tag

### A - Displacement (cu.in./rev.)

0033 = 3.3  
0039 = 3.9  
0046 = 4.6  
0054 = 5.4  
0064 = 6.4  
0076 = 7.6

### B - Identifies Type of Product

21 = Variable Displacement Pump  
31 = Fixed Displacement Motor  
41 = Variable Displacement Motor

### C - Identifies Specific Unit Configuration

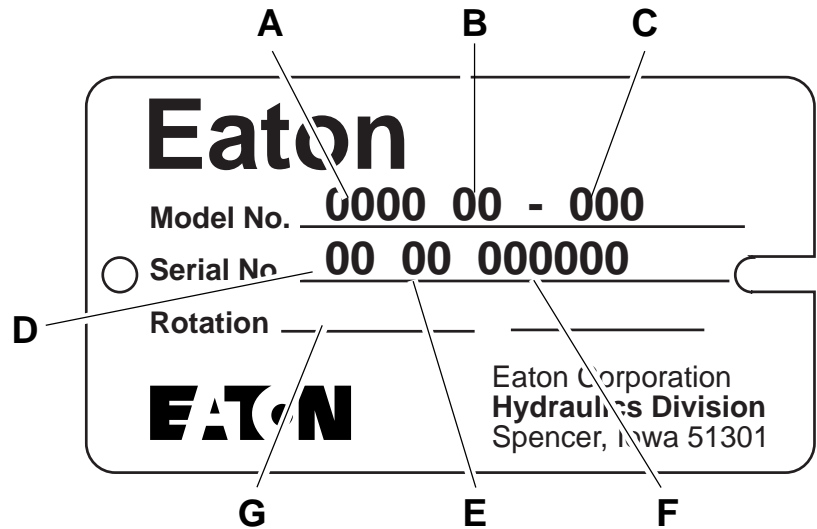
### D - Month of Manufactur

### E - Year of Manufacture

### F - Specific Serial Number of Unit

### G - Identifies Direction of Input Shaft (Pumps Only) Rotation

Observed from Shaft End of Unit  
CW = Clockwise  
CCW = Counterclockwise



## Required Tools

- 9/64 in. Hex Key
- 1/4 in. Hex Key
- 1/2 in. Socket
- 9/16 in. Socket
- 5/8 in. Socket
- 3/4 in. Socket
- 7/8 in. Socket
- 1 in. Socket
- 1-3/8 in. Socket
- Dial Indicator with Magnetic Base
- Spring Compression Scale (0-10 lbs)
- No. 5 or 7 Retaining Ring Pliers
- Adjustable joint Pliers
- 3 in.X 1/4-20 Bolt
- Breaker Bar or Ratchet Wrench
- Torque Wrench (200 lb-ft capacity)
- 18 to 20 in. Adjustable Wrench
- Small Screwdriver (1/8 in. Blade)
- Hammer ( steel and Plastic)
- Depth Micrometer
- Slide Hammer
- Split Blade Bearing Puller
- Prick Punch
- Scribe
- Punch
- Arbor Press
- Clean, Lint Free Cloths
- Loctite
- Light Petroleum Jelly
- Suitable Solvents and Cleaners
- Rotating Seal Puller (Special)
- Low Clearance Bearing Puller (Special)
- Bearing Cone Driver (Special)

Special Tools are shown on pages 28 and 29.

## Introduction and Part Names

### Introduction

This manual provides service information for Eaton Models 33 thru 64 Variable Motors. It's divided into two main sections: the first covers minor repairs and the second gives instructions for the complete disassembly, inspection and reassembly of the motor.

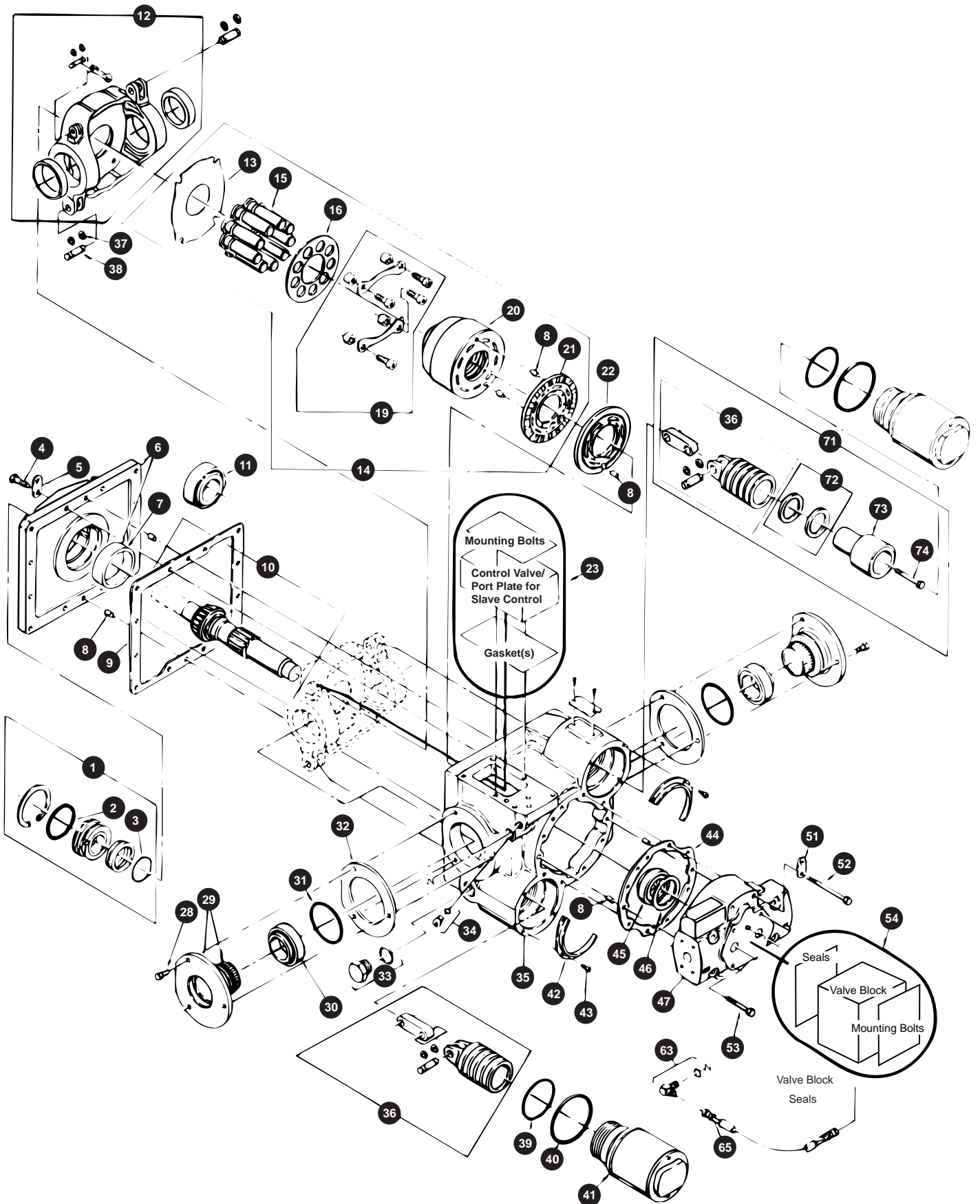
The following recommendations apply to both minor and major repairs:

- Most repairs require the removal of the motor from the vehicle.
- Cleanliness is extremely important.
- Clean the port areas thoroughly before disconnecting the hydraulic lines.
- Plug the motor ports and cover the open end of the hydraulic line immediately after they're disconnected.
- Drain the oil and clean the exterior of the motor before making repairs.
- Wash all metal parts in clean solvent.
- Use compressed air to dry the parts. Do not wipe them dry with paper towels or cloth; Lint in a hydraulic system will cause damage.
- The compressed air should be filtered and moisture free.
- Always use new seals when reassembling hydraulic motors.
- For replacement parts and ordering information refer to parts list 6-132.
- Lubricate the new seals with a petroleum jelly like Vaseline before installation.
- Torque all bolts over gasketed joints, then repeat the torquing sequence to make-up for gasket compression.
- **Verifying the accuracy of motor repairs on an authorized test stand is essential.**

### Models 33 thru 64 Variable Motor Parts

Item No.	Description	Qty.	Item No.	Description	Qty.
1	Shaft Seal Kit	1	32	Trunnion Shims	◆
2	O-ring	1	34	Plug and O-ring	1
3	O-ring	1	35	Motor Housing	1
4	Mounting Flange Bolt	12	36	Servo Piston S/A	2
5	Shipping Strap	2	37	Retaining Ring	4
6	Mounting Flange S/A	1	38	Pin	2
7	Bearing Cup	1	39	O-ring	2
8	Dowel Pin	7	40	O-ring	2
9	Mounting Flange Gasket	1	41	Servo Sleeve	2
10	Drive Shaft S/A	1	42	Servo Sleeve Retainer	2
11	Replacement Bearing Kit	◆	43	Cap Screw	6
12	Swashplate S/A	1	44	End Cover Gasket	1
13	Thrust Plate	1	45	Replacement Bearing Kit	◆
14	Rotating Group	1	46	Shaft Shims	◆
15	Piston and Slipper S/A	9	47	End Cover	1
16	Slipper Retainer Plate	1	52	End Cover Bolt	6
19	Retaining Strap and Bolts	2	53	End Cover Bolt	2
20	Cylinder Barrel	1	54	Valve Block Option	1
21	Bearing Plate	1	63	Hose Fitting	◆
22	Valve Plate	1	65	Hose	◆
23	Control Valve Option	1	71	Servo Piston with Spacer	1
28	Trunnion Bolt	6	72	Spacer Shims	◆
29	Trunnion S/A	2	73	Servo Piston Spacer	1
30	Replacement Bearing Kit	◆	74	Spacer Bolt	1
31	O-ring	2			

◆ Parts used as required.



## Minor Repair: Control Valve Inspection

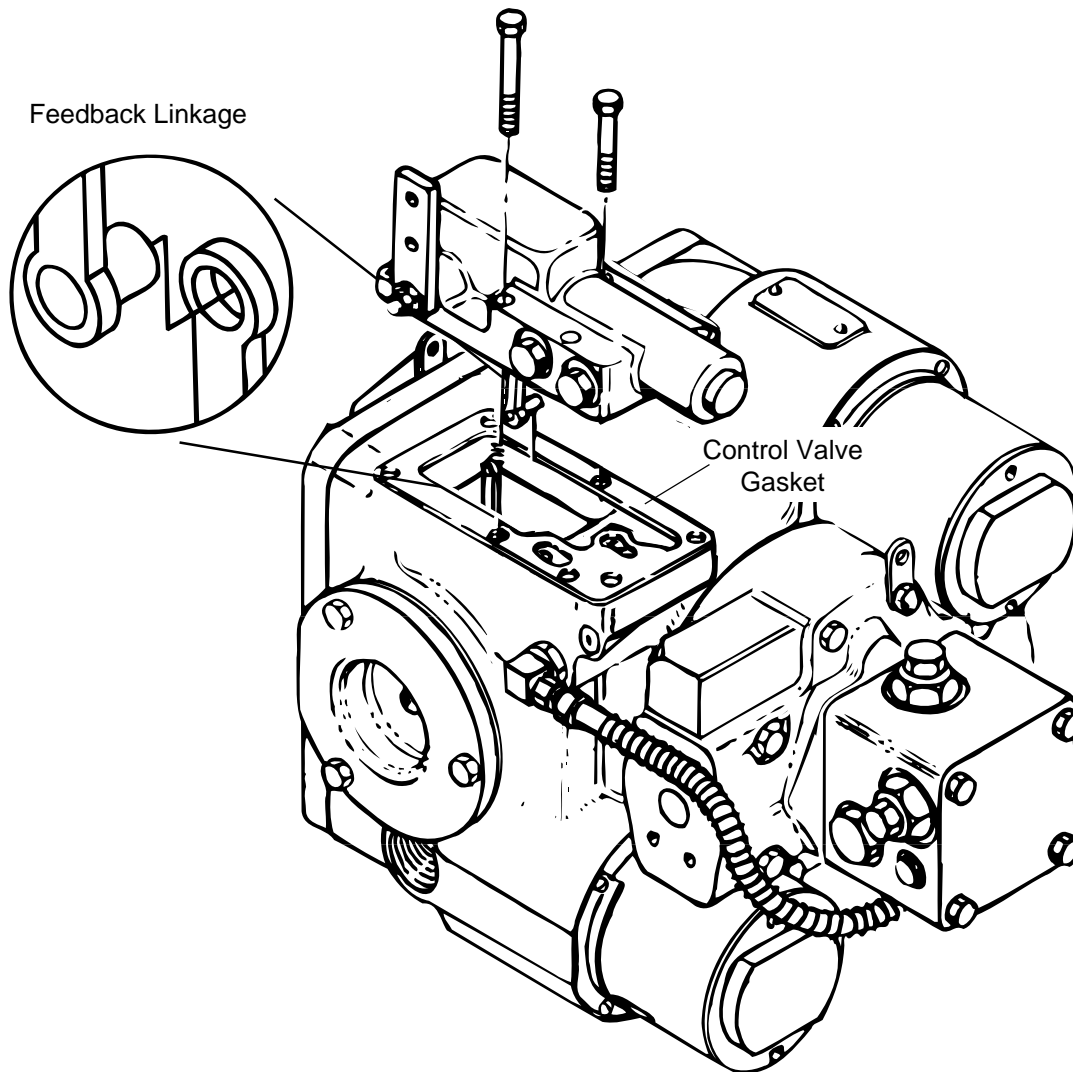


Figure 2

This section describes the removal, inspection, and installation of the control valve.

**1** Clean the control valve and the area around where it attaches to the motor.

**Important:** Cleanliness is extremely important; be sure that no contaminants get into the motor.

**2** Remove the six hex head bolts that hold the control valve to the motor.

**3** Lift the control valve away from the motor and disengage the feedback linkage, see figure 2.

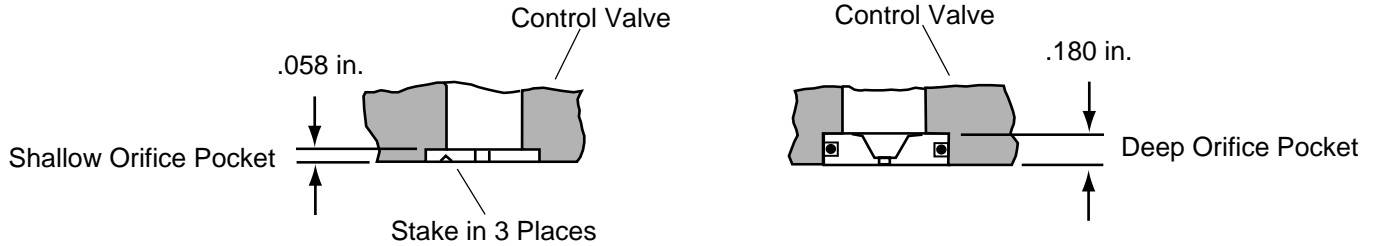
**4** Remove the control valve gasket.

**5** Inspect the control valve: Start by thoroughly flushing the control valve with clean solvent. Then blow it dry with compressed air. Be sure to blow through all of the control valve's internal passages.

Inspect the control valve linkage. Move the control lever back and forth; it should move freely without binding. There should be no free play in the feedback link or control lever.

Check the control valve orifice; if it is plugged after flushing replace it.

**Note:** There are two types of control valve orifices:



The plate orifice is used in control valves that have a shallow orifice pockets.

The orifice size is stamped on the orifice in thousandths of an inch, example: 57 = .057 in.

Install the plate orifice so the orifice size is visible. Stake it in three places with a center punch. Insure that the orifice is properly seated after staking.

The plug is used in control valves that have a deep orifice pockets.

Before installing the plug orifice be sure that the o-ring is in place. Apply petroleum jelly to the edge of the plug orifice and o-ring.

Carefully insert the plug orifice into the orifice pocket; The large opening in the plug must go into the control valve.

**6** Place a new control valve gasket on the motor.

**7** Connect the feedback linkage and position the control valve on the motor.

**Important:** When the control valve is positioned on the motor make sure the feedback linkage points towards the motor's end cover.

**8** Install the six hex head bolts and tighten them finger tight.

**9** Move the control lever back and forth; it should move freely in both directions and self-center. If it doesn't recheck the feedback linkage.

**10** Tighten the six hex head bolts to 16 lb-ft [22 Nm].

This section describes the removal, inspection, and installation of the control valve.

**1** Clean the control valve and the area around where it attaches to the motor.

**Important:** Cleanliness is extremely important; be sure that no contamination gets into the motor.

**2** Remove the six hex head bolts that hold the control valve to the motor.

**3** Lift the control valve away from the motor and disengage the feedback linkage, see figure 2.

**4** Remove the control valve gasket.

**5** Inspect the control valve: Start by thoroughly flushing the control valve with clean solvent. Then blow it dry with compressed air. Be sure to blow through all of the control valve's internal passages.

Inspect the control valve linkage. Move the control lever back and forth; it should move freely without binding. There should be no free play in the feedback link or control lever.

Check the control valve orifice; if it is plugged after flushing replace it.

**6** Place a new control valve gasket on the motor.

## Minor Repair: Seal Shaft Inspection

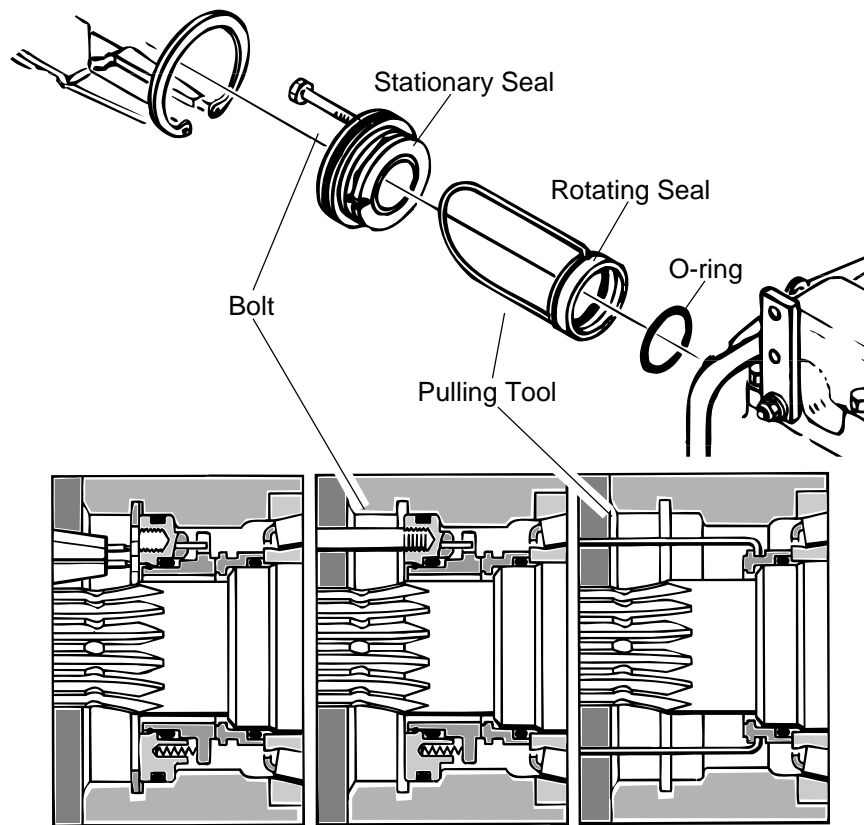


Figure 1

This section describes the removal and installation of the motor's shaft seal.

- 1 Drain the oil from the motor.
  - 2 Position the motor so the shaft seal is accessible.
  - 3 Clean the area around the motor shaft and seal.
- Important:** Cleanliness is extremely important; be sure that no contaminants get into the motor.
- 4 Using a retaining ring pliers remove the retaining ring.
  - 5 Screw a 3 in. X 1/4-20 bolt into the threaded hole in the stationary seal. Pull on the bolt to remove the seal.
  - 6 Use the special pulling tool, Owatonna Tool Co. P/N CAS 1844, to remove the rotating seal, see figure 1. If the special tool is not available pull out the rotating seal with a wire bent to the shape of the puller.

**Note:** Detailed drawings of all special tools are given in the back of this manual.

- 7 Remove the o-ring; it will either be in the rotating seal or on the shaft.

**Note:** Eaton recommends replacing the entire shaft seal. Use Shaft Seal Kit P/N 990231.

**Important:** The metal-to-metal sealing surfaces are critical. Clean the areas of contact with a suitable solvent then blow them dry. The solvent must evaporate without leaving a residue. Do not touch the sealing surfaces after cleaning.

- 8 Apply petroleum jelly to the o-ring and install it in the rotating seal
- 9 Apply a light coating of clean hydraulic oil to the cleaned metal sealing surface of the rotating seal.
- 10 Install the rotating seal using the special pulling tool (CAS 1844).
- 11 Screw a 3 in. X 1/4-20 bolt into the threaded hole in the new stationary seal. The bolt provides a convenient means for holding the seal.
- 12 Apply petroleum jelly to the o-ring that is around the largest part of the stationary seal.
- 13 Apply a light coating of clean hydraulic oil to the cleaned metal sealing surface of the stationary seal.
- 14 Install the stationary seal.
- 15 Using the retaining ring pliers install the retaining ring with the beveled side out.



This section describes the removal, inspection, and installation of the valve block.

1 Clean the valve block and the area around where it attaches to the motor.

**Important:** Cleanliness is extremely important; be sure that no contaminants get into the motor.

2 Position the motor so the valve block is accessible.

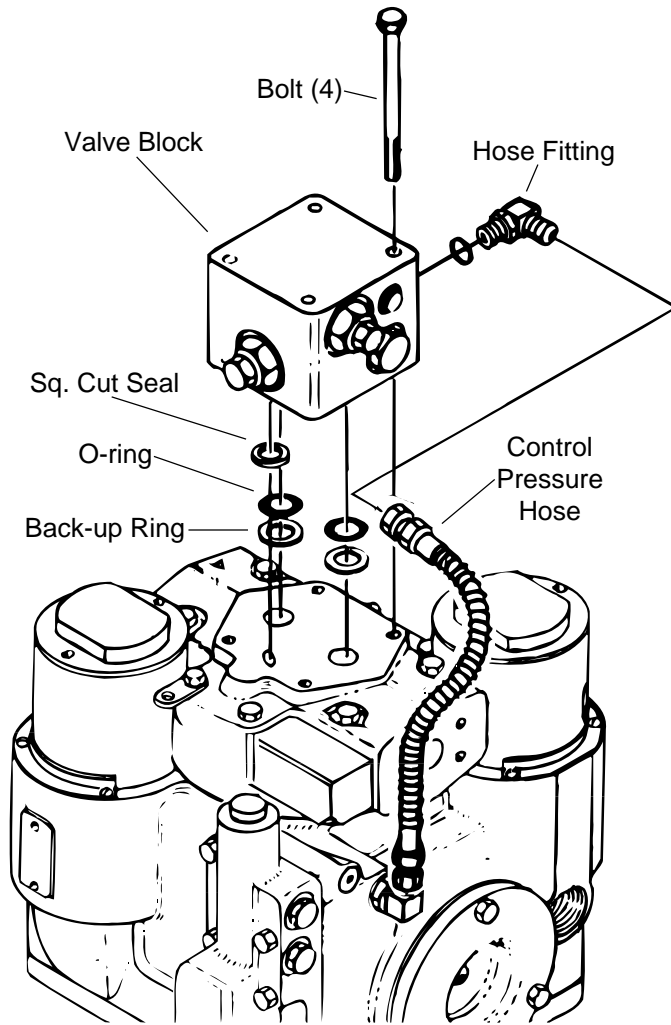


Figure 3

3 If the motor gets control pressure from the valve block disconnect the hose at the valve block and remove the hose fitting.

4 Loosen the plugs and relief valves that are screwed into the valve block.

5 Remove the four hex head bolts that hold the valve block to the motor.

6 Remove the valve block.

7 Remove the two o-rings and back-up rings, and the square cut seal from between the valve block and motor, see figure 3.

8 Remove the low pressure relief valve (also called the charge pressure relief valve).

**Note:** The low pressure relief valve can be identified by the notches machined into its large hex head, see figure 4.

9 Mark the high pressure relief valves so they can be reinstalled in the same ports.

**Note:** The three digit number stamped on each relief valve indicates its pressure setting. Multiply this number by ten to get the actual pressure setting (in PSI). Examples:

Number Stamped on Relief Valve	Multiplier	Relief Valve Pressure Setting
500	x10	5000 PSI
016	x10	160 PSI

10 Remove the high pressure relief valves.

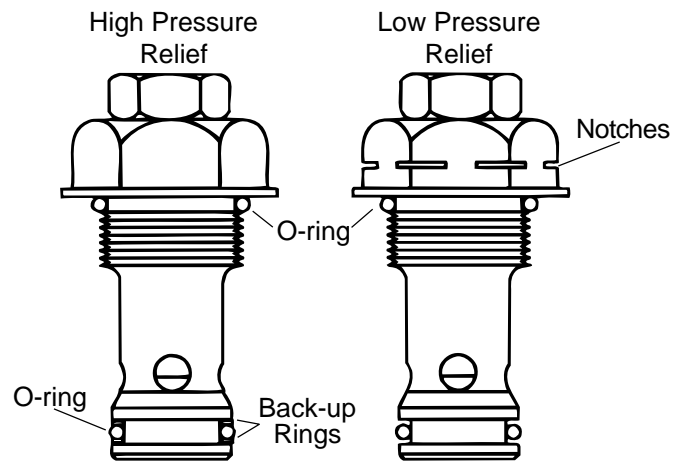


Figure 4

11 Remove the o-rings and back-up rings from the relief valves. The small o-ring on each high pressure relief has a back-up ring on each side. The small o-ring on the low pressure relief valve doesn't have back-up rings.

12 Inspect the relief valves for damage and replace as necessary.

## Minor Repair: Valve Block Inspection

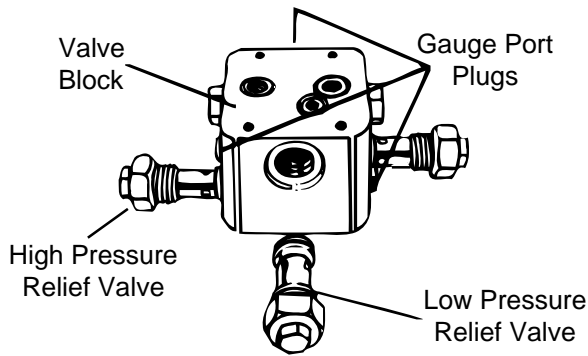


Figure 5

13 Remove the gauge port plugs and o-rings.

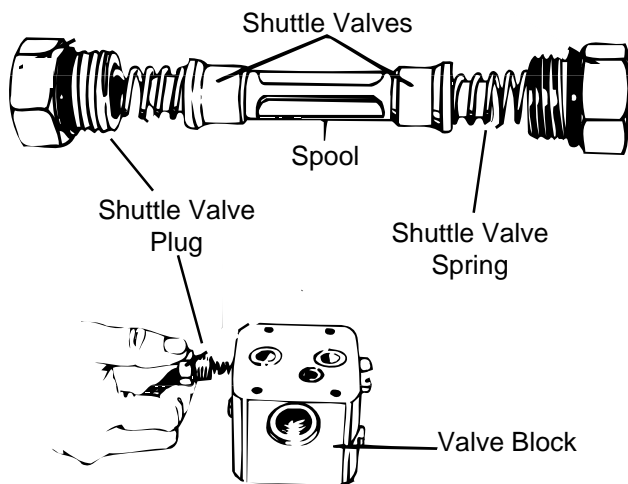


Figure 6

14 Remove the shuttle valve plugs and o-rings.

15 Remove the shuttle valve springs, spool, and valves.

16 Wash the relief valves, plugs, and shuttle valve in clean solvent. Flush out the valve block. Blow dry the parts with compressed air. Be sure to blow through the internal passages of the valve block. Inspect the parts for damage and replace as necessary.

17 Install the relief valves, shuttle valve, and plugs. Use new o-rings and back-up rings.

Install back-up rings around the small o-rings on the high pressure relief valves, see figure 4.

Lubricate the new o-rings with petroleum jelly before installation.

Tighten all plugs and relief valves finger tight. They will be torqued after the valve block is mounted on the motor.

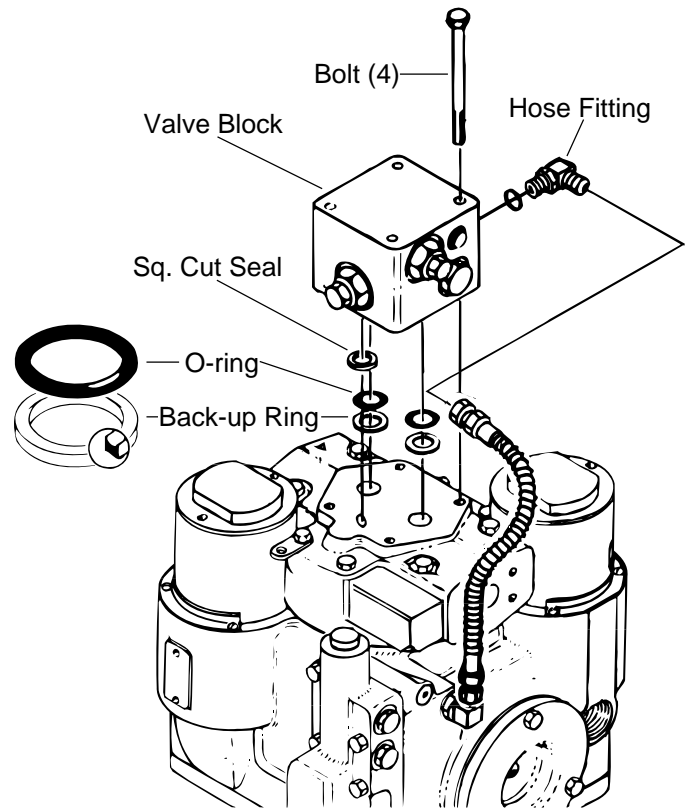


Figure 7

18 Install new o-rings and back-up rings in the grooves around the high pressure ports as shown in figure 7. Install a square-cut seal in the groove around the low pressure port. Use petroleum jelly to hold these sealing rings in place while the valve block is installed.

19 Position the valve block on the motor. Install the four hex head bolts and tighten them to 28 lb-ft [38 Nm].

20 Tighten the high pressure relief valves to 25 lb-ft [34 Nm].

Tighten the low pressure relief valve, and shuttle valve plugs to 80 lb-ft [108 Nm].

Tighten the gauge port plugs and control pressure fitting, if used, to 17 lb-ft [23 Nm].

21 Connect the control pressure hose to the valve block fitting, if used.

**Note:** The control pressure hose is now obsolete. Poor motor control characteristics may be experienced when the motor gets control pressure from the valve block. It is best to run a separate control pressure line from the charge pump to the motor. If possible re-plumb the application so the control pressure hose is no longer used. Be sure to plug the port in the valve block.

**Disassembly**

This section describes the complete disassembly, inspection, and reassembly of the motor. Due to the complexity of the heavy duty motor certain subassemblies are disassembled, inspected, and reassembled upon removal from the motor. This procedure insures repair accuracy and helps avoid the loss of small parts.

When major repairs are planned it is recommended that the process laid out in this section be followed from start to finish.

- 1 Clean the exterior of the motor and drain the oil.
- 2 Position the motor so the shaft seal is accessible.

**Important:** Cleanliness is extremely important; be sure that no contaminants get into the motor.

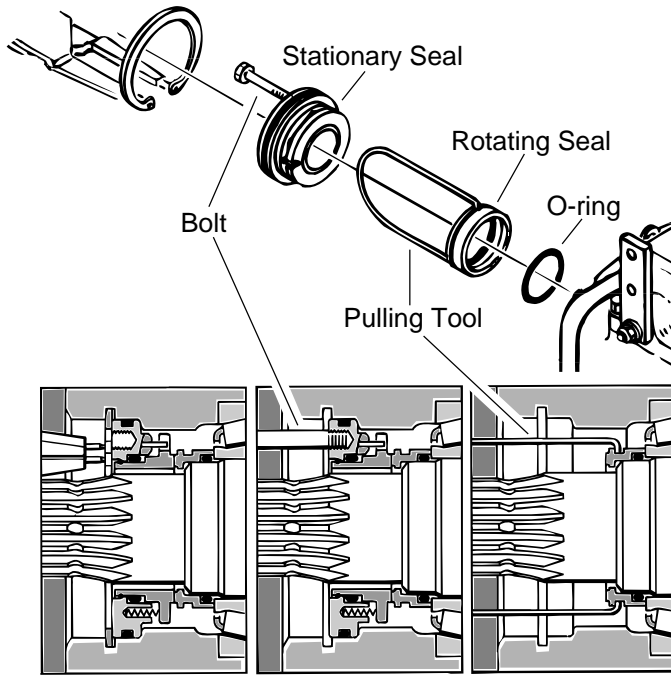


Figure 8

- 3 Using a retaining ring pliers remove the retaining ring.
- 4 Screw a 3 in. X 1/4-20 bolt into the threaded hole in the stationary seal. Pull on the bolt to remove the seal.
- 5 Use the special pulling tool, Owatonna Tool Co. P/N CAS 1844, to remove the rotating seal, see figure 8. If the special tool is not available pull out the rotating seal with a wire bent to the shape of the puller.

**Note:** Detailed drawings of all special tools are given in the back of this manual.

- 6 Remove the o-ring; it will either be in the rotating seal or on the shaft.

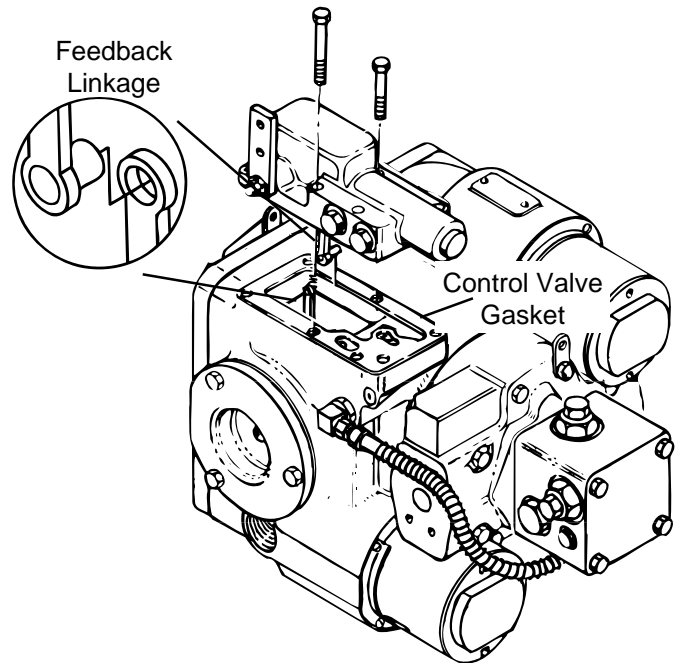


Figure 9

- 7 Remove the six hex head bolts that hold the control valve to the motor.
- 8 Lift the control valve away from the motor and disengage the feedback linkage, see figure 9.
- 9 Remove the control valve gasket.
- 10 Inspect the control valve: Start by thoroughly flushing the control valve with clean solvent. Then blow it dry with compressed air. Be sure to blow through all of the control valve's internal passages.

Inspect the control valve linkage. Move the control lever back and forth; it should move freely without binding. There should be no free play in the feedback link or control lever.

Check the control valve orifice; if it is plugged after flushing replace it.

## Major Repairs: Valve Block

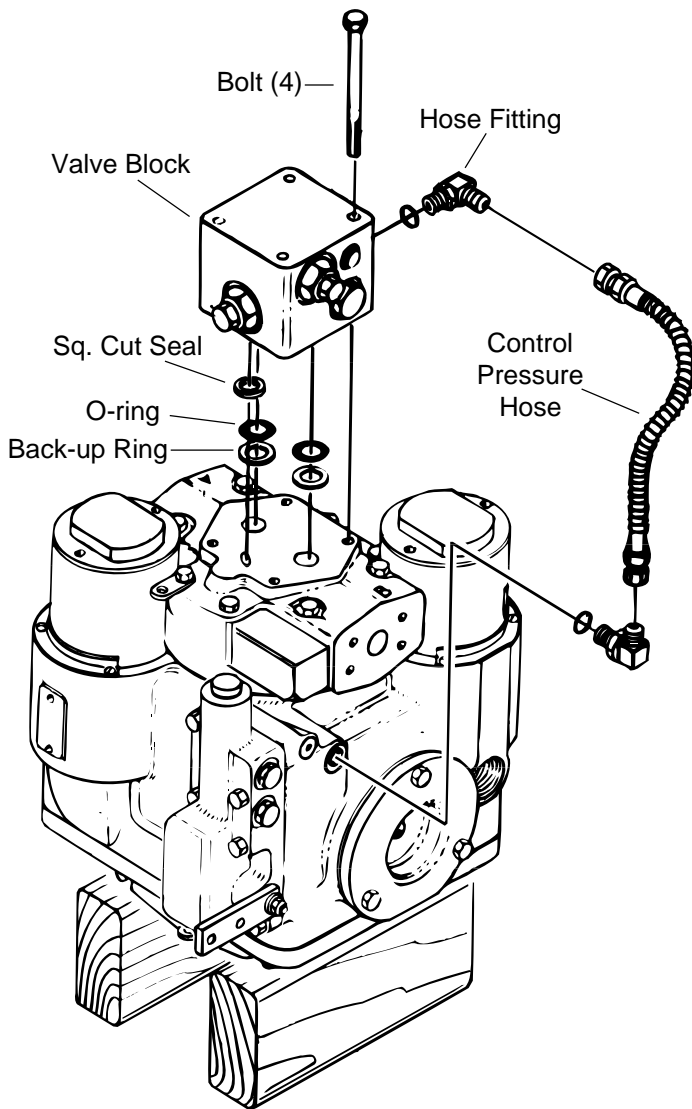


Figure 10

**11** Reposition the motor so the shaft is vertical and the valve block is on top. Stand the motor on two blocks of wood as shown in figure 10.

**12** If the motor gets control pressure from the valve block remove the control pressure hose and fittings.

**13** Loosen the plugs and relief valves that are screwed into the valve block.

**14** Remove the four hex head bolts that hold the valve block to the motor.

**15** Remove the valve block.

**16** Remove the two o-rings and back-up rings, and the square cut seal from between the valve block and motor, see figure 10.

**17** Remove the low pressure relief valve (also called the charge pressure relief valve).

**Note:** The low pressure relief valve can be identified by the notches machined into its large hex head, see figure 11.

**18** Mark the high pressure relief valves so they can be reinstalled in the same ports.

**Note:** The three digit number stamped on each relief valve indicates its pressure setting. Multiply this number by ten to get the actual pressure setting (in PSI). Examples:

Number Stamped on Relief Valve	Multiplier	Relief Valve Pressure Setting
500	x10	5000 PSI
016	x10	160 PSI

**19** Remove the high pressure relief valves.

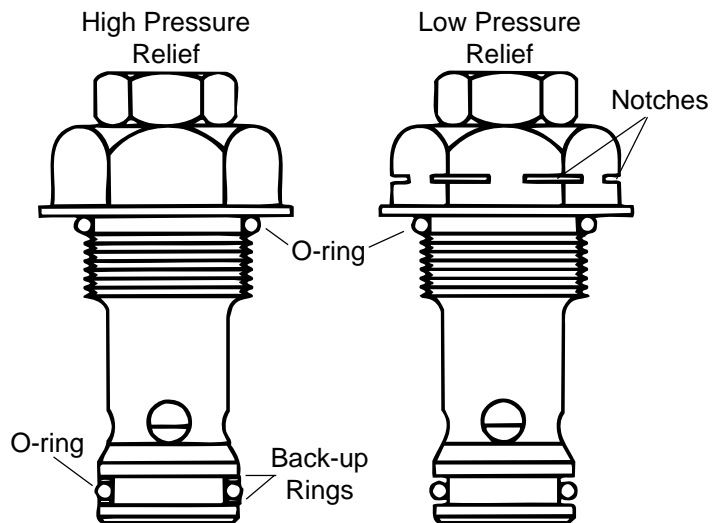


Figure 11

**20** Remove the o-rings and back-up rings from the relief valves. The small o-ring on each high pressure relief valve has a back-up ring on each side. The small o-ring on the low pressure relief valve doesn't have back-up rings.

**21** Inspect the relief valves for damage and replace as necessary.

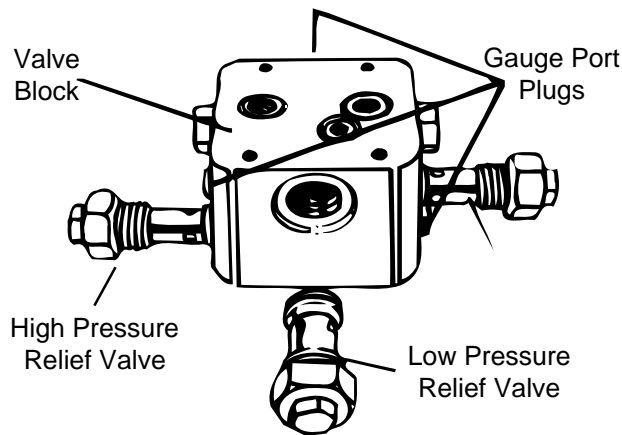


Figure 12

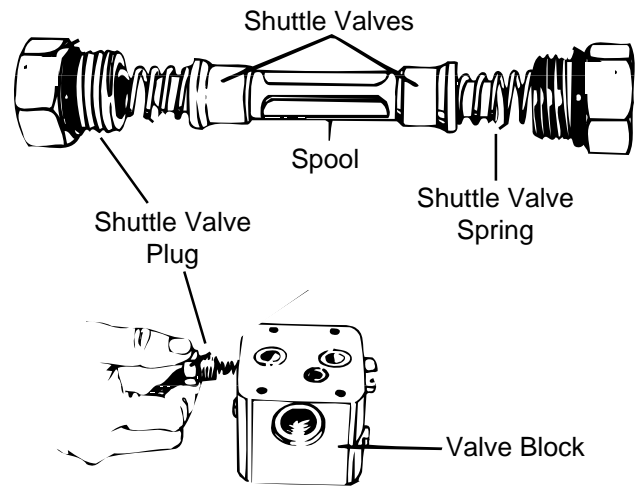


Figure 13

- 22** Remove the gauge port plugs and o-rings.
- 23** Remove the shuttle valve plugs and o-rings.
- 24** Remove the shuttle valve springs, spool, and valves.
- 25** Wash the relief valves, plugs, and shuttle valve in clean solvent. Flush out the valve block. Blow dry the parts with compressed air. Be sure to blow through the internal passages of the valve block. Inspect the parts for damage and replace as necessary.

- 26** Install the relief valves, shuttle valve, and plugs. Use new o-rings and back-up rings.

Install back-up rings around the small o-rings on the high pressure relief valves, see figure 11.

Lubricate the new o-rings with petroleum jelly before installation.

Tighten all plugs and relief valves finger tight. They will be torqued after the valve block is mounted on the motor.

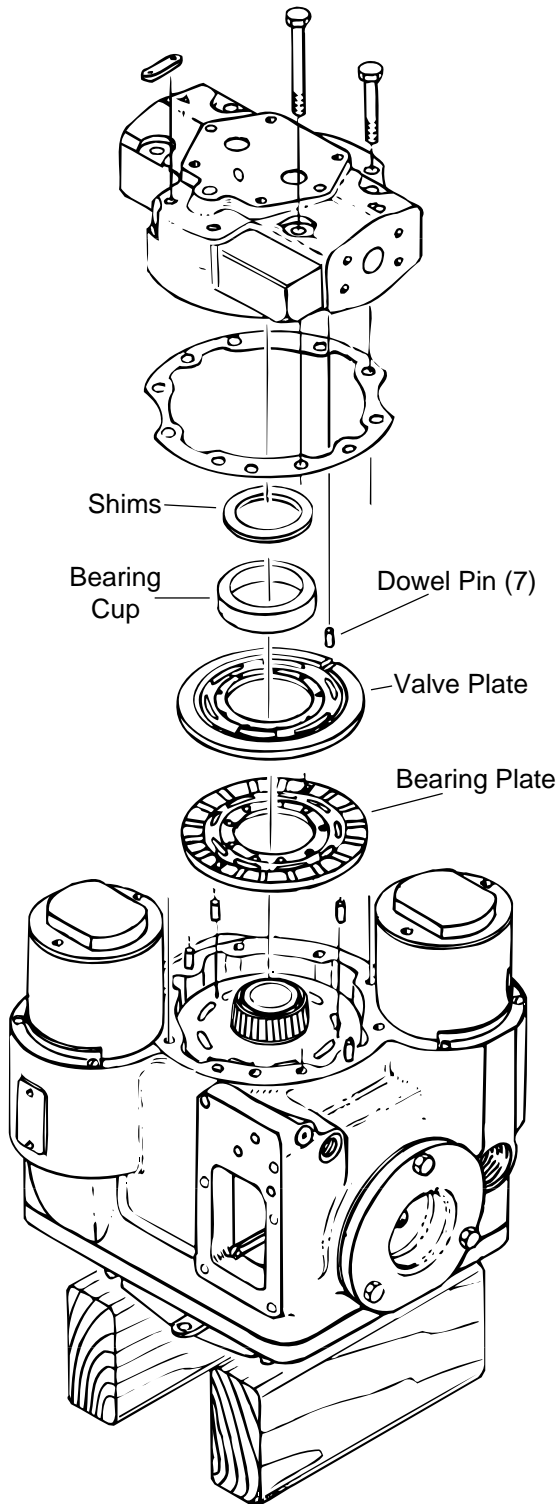


Figure 14

**27** Remove the end cover.

**Caution:** The cylinder barrel spring pre-load will damage the motor's internal parts if the end cover is removed incorrectly.

Start by removing six of the eight bolts that hold the end cover to the motor. Leave two bolts that are directly across from each other tight.

Next, loosen the two remaining bolts one or two turns. The end cover should rise as the bolts are loosened. If it doesn't tap it with a plastic hammer to break the gasket seal.

After the gasket seal is broken loosen the bolts gradually and evenly until the cylinder barrel spring pre-load is relieved.

Remove the bolts and lift the end cover from the motor. Be careful; do not drop the valve plate, it may lift away with the end cover.

**Important:** Use care when handling the motor's internal parts. They are machined to extremely close tolerances.

**28** Turn the end cover over and set it on a clean cloth.

**Important:** Always protect machined surfaces.

**29** Remove the valve plate; it will either be on the end cover or bearing plate.

**Note:** Keep track of the dowel pins, see figures 14 and 17. There is a total of seven dowel pins in the motor. It is a good idea to put them in a small box so they don't get lost.

**30** The bearing cup is slip-fit into the end cover. The shims under the bearing cup adjust the shaft end play. It is not necessary to remove these parts at this time.

**31** Remove the bearing plate.

**32** Remove the end cover gasket.

**33** Remove the two dowel pins from cylinder barrel face.

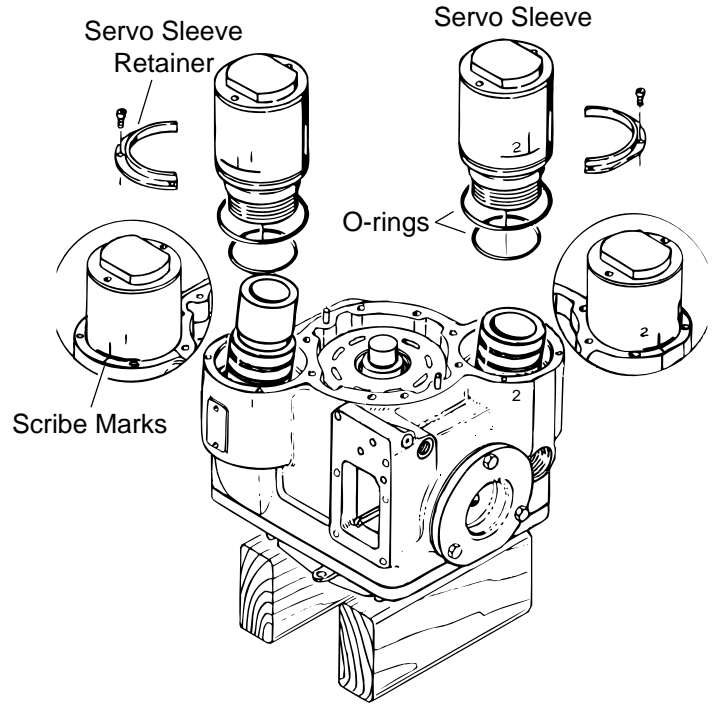
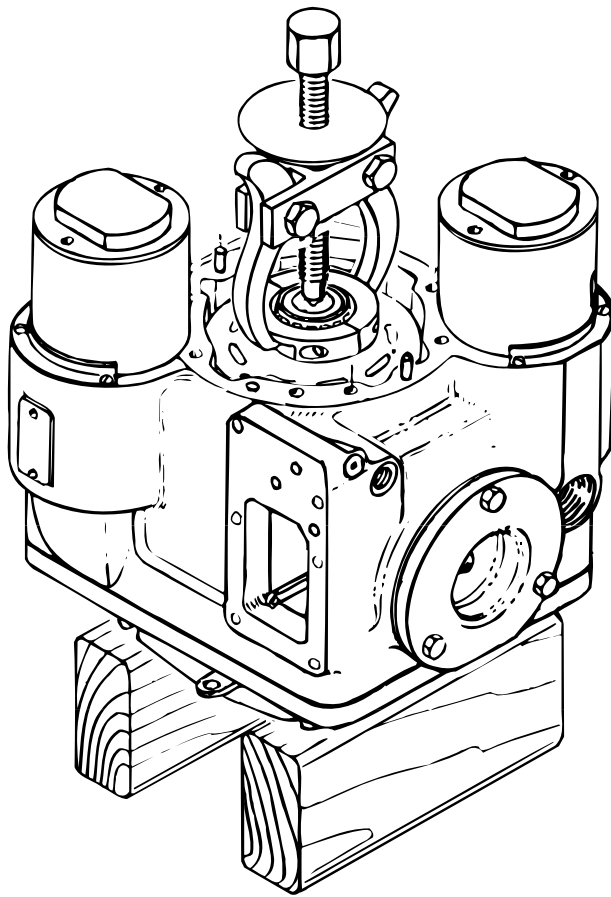


Figure 16

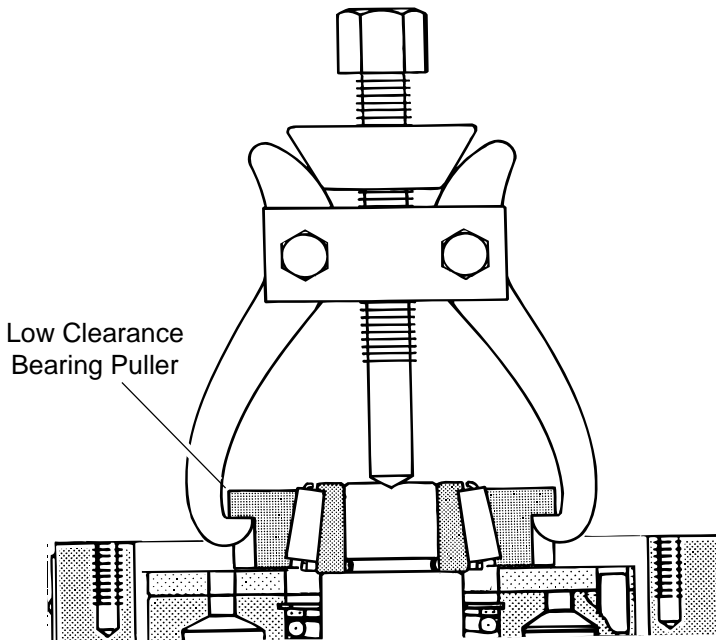


Figure 15

**34** Use a low clearance bearing puller to remove the end cover bearing cone. Protect the cylinder barrel.

**Note:** A detailed drawing of the low clearance bearing puller is given in the back of this manual.

**35** Mark the motor housing and servo sleeves so they can be reinstalled in the same locations.

**36** Remove the servo sleeve retainers.

**37** Scribe position marks on each servo sleeve; Make a horizontal line where the servo sleeve and motor housing meet. Then make a vertical line that starts on the servo sleeve and ends on the housing, see figure 16. These marks will indicate how far to screw the servo sleeves in during reassembly.

**38** Remove the servo sleeves.

**39** Remove two o-rings from each servo sleeve.

## Major Repairs: Mounting Flange, Servo Pistons and Trunnions

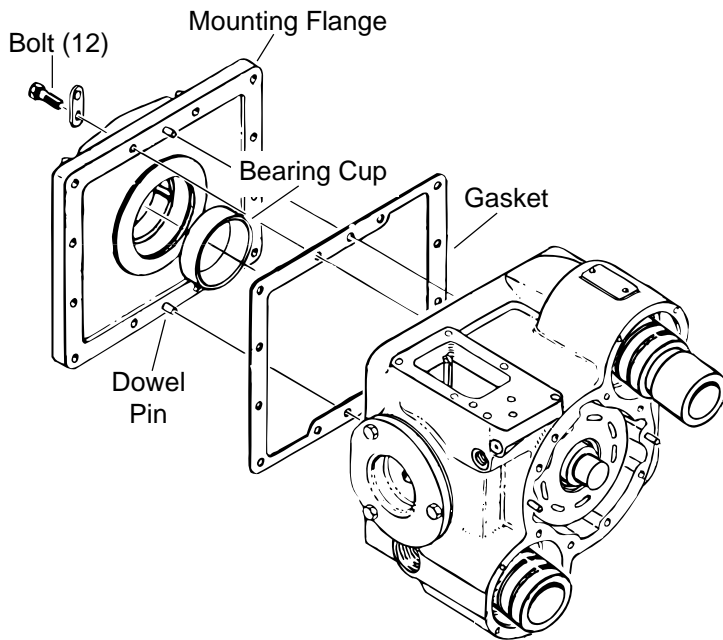


Figure 17

**40** Reposition the motor so the control valve mount is on top. Be careful; do not let the cylinder barrel slide out of the motor.

**41** Remove the twelve hex head bolts that hold the mounting flange to the motor.

**42** Remove the mounting flange, tapping it with a plastic hammer will help to break it loose.

**43** Remove the mounting flange gasket.

**Note:** Do not remove the bearing cup from the mounting flange unless it is damaged. Go to step 46 if the bearing cup is undamaged.

**44** Use an internal bearing puller or a long punch to remove the old bearing cup. Be careful; do not damage the mounting flange.

**45** Press the new bearing cup into the mounting flange. Be sure that it is pressed all the way to the bottom of the recess.

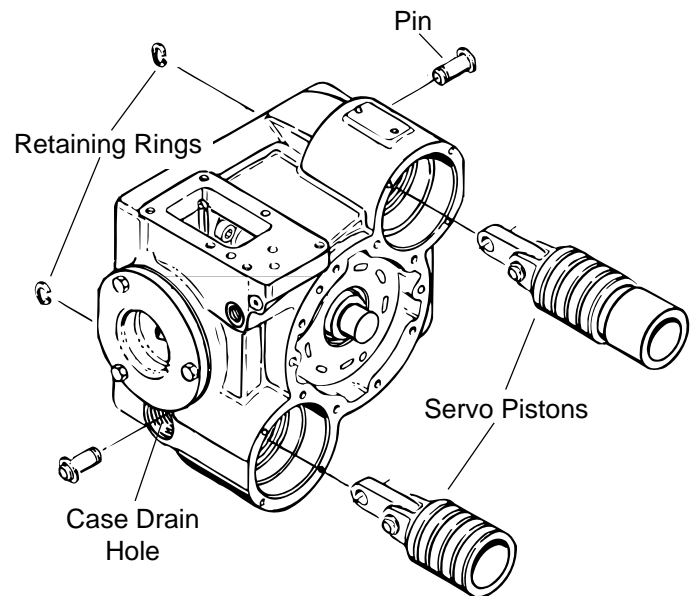


Figure 18

**46** Remove the inside retaining ring from each of the pins that connect the servo piston links to the swashplate. Slide the pins out through the case drain holes and remove the servo pistons, see figure 18.

**Note:** Disassembly of the servo pistons is not required unless they are damaged or the motor's minimum displacement is being changed.



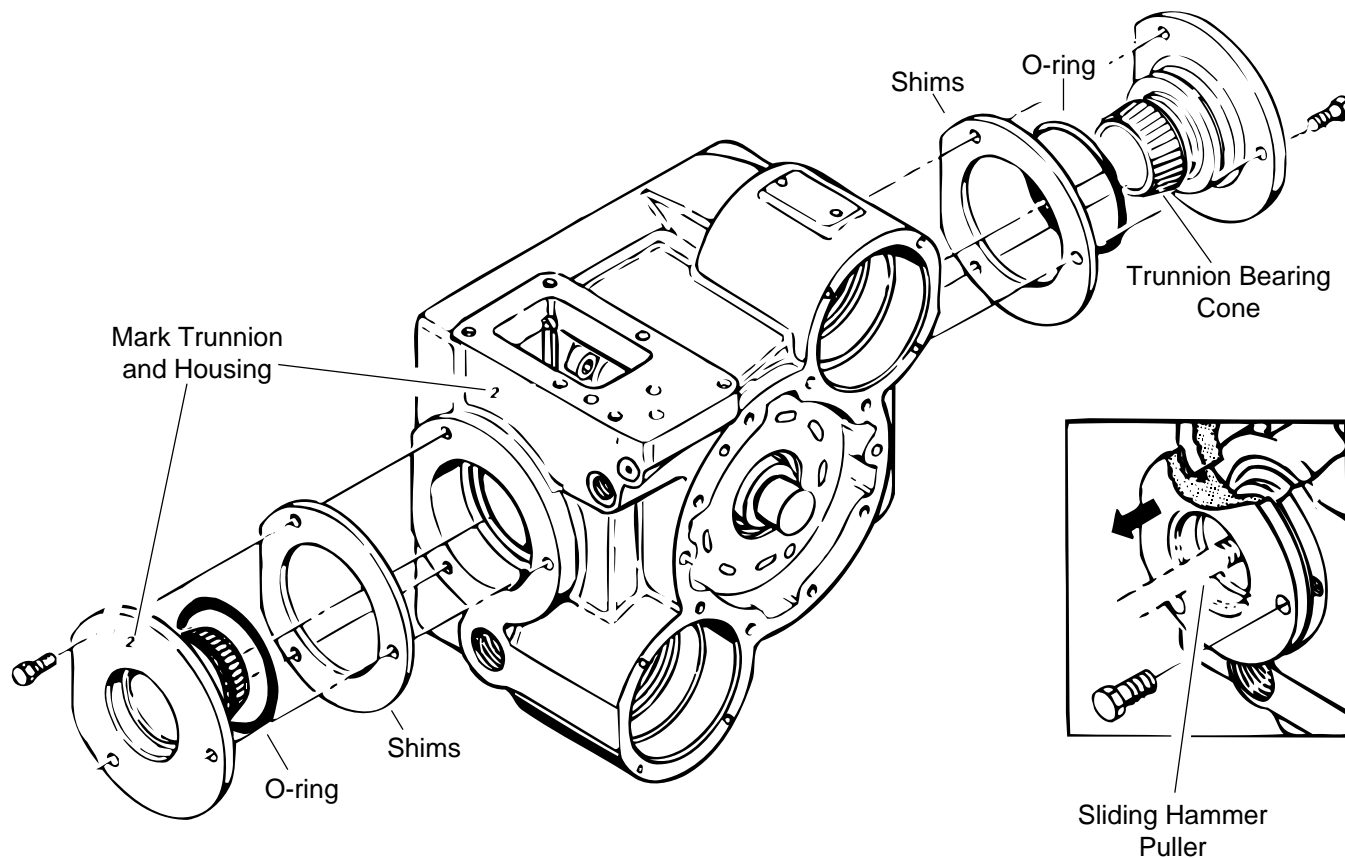


Figure 19

**47** Mark the motor housing and the trunnions so they can be reinstalled in the same locations.

**48** Repeat the following steps to remove each trunnion:

Remove the three hex head bolts that hold the trunnion to the motor

The trunnion fits into the motor tightly; use a slide hammer to loosen it. Screw the slide hammer into the threaded hole in the trunnion. The sizes of the threaded trunnion holes are listed below:

Model Number	Screw Size
33, 39, 46	3/8-16
54, 64	7/16-14

Remove the trunnions and shims.

**Important:** Keep the shims with each trunnion; they must be reinstalled on the same trunnion during reassembly. The shims pre-load the trunnion bearings.

Remove the o-ring from the trunnion, see figure 19.

**49** If the trunnion bearings are damaged replace them. A split blade bearing puller will be needed to remove the bearing cone from the trunnion. Use a press to install the new bearing cone.

**50** Carefully remove the swashplate, cylinder barrel and shaft through the mounting flange end of the housing.

## Major Repairs: Swashplate, Shaft and Cylinder Barrel

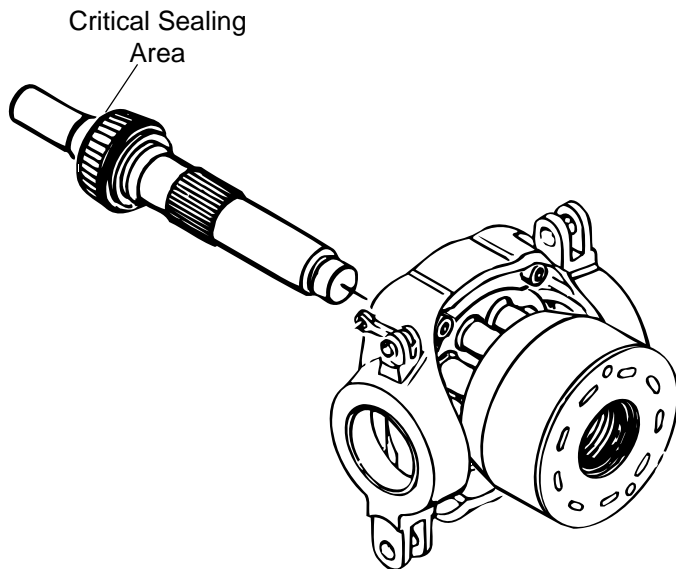


Figure 20

**51** Remove the shaft and bearing assembly from the swashplate and cylinder barrel. Keep the cylinder barrel and pistons together.

**Note:** Do not remove the bearing cone from the shaft unless it is damaged. Go to step 54 if the bearing cone is undamaged.

**52** Press the old bearing cone from the shaft.

**Caution:** Do not damage the sealing area of the shaft, see figure 20. The shaft sealing area is between the bearing journal and the key way or splined end of the shaft. This area is extremely critical.

**53** Press the new bearing cone onto the shaft. Use the special stop limit tool shown in the back of this manual. The position of the bearing cone on the shaft is important.

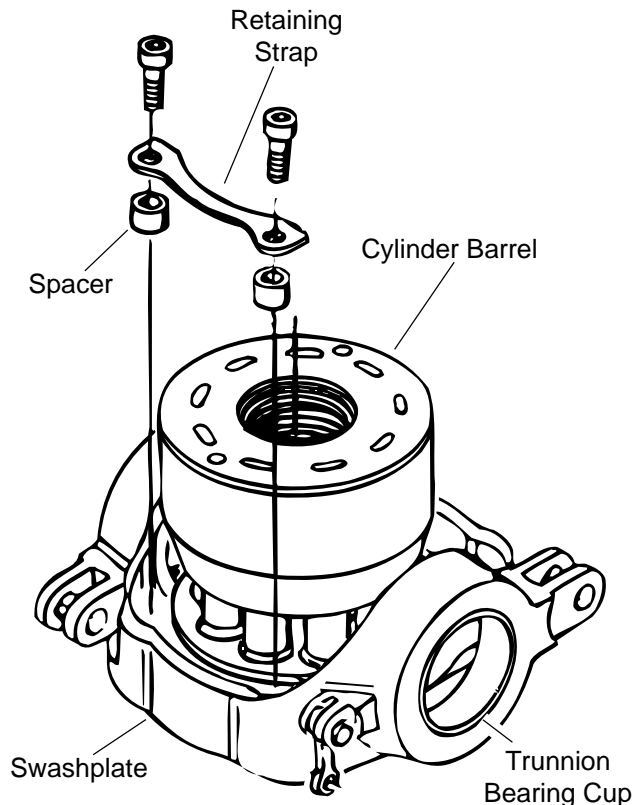


Figure 21

**54** Set the swashplate and cylinder barrel assembly on the trunion; in this position it will be easier to break the retaining strap bolts loose. Remove one of the retaining straps and loosen the other.

**Important:** keep the cylinder barrel and pistons together.

**55** Reposition the swashplate and cylinder barrel assembly so the cylinder barrel is on the bottom. Remove the swashplate by lifting it slightly and sliding it over to disengage the retaining strap.

**56** Remove the retaining strap and thrust plate from the swashplate.

**57** Replace the trunion bearing cups if they are damaged. Use a long punch to remove the old bearing cups, then carefully press the new bearing cups into the swashplate.

**Reassembly**

Inspect the cylinder barrel, pistons, piston slippers, and thrust plate. Replace any worn or damaged parts. Check all mating surfaces; replace any parts with scratches or burrs that could cause leakage. Inspect parts for excessive wear and replace as necessary. Wash all metal parts in clean solvent and blow them dry with compressed air. Do not wipe parts dry with paper towels or cloth. Lint in a hydraulic system will cause damage.

Always use new seals when reassembling hydraulic motors. Refer to parts list 6-132 for seal part numbers, replacement parts, and ordering information.

**Important:** During reassembly lubricate the new seals with a petroleum jelly like Vaseline. Also lubricate all machined surfaces and bearings with clean hydraulic fluid.

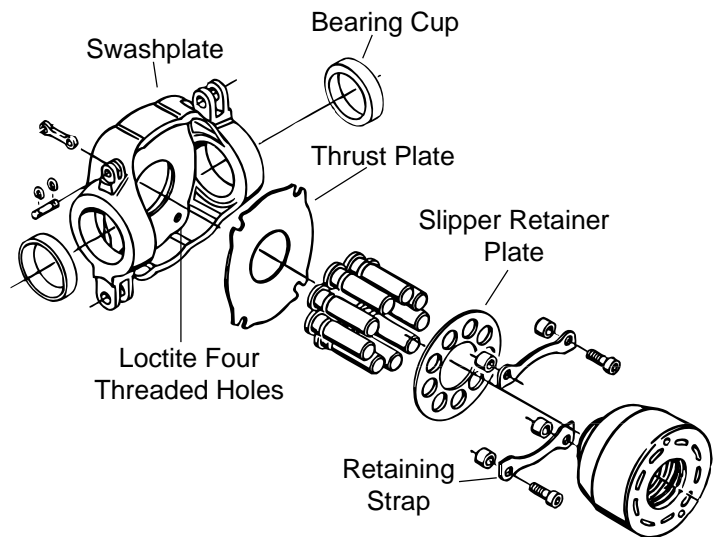


Figure 23

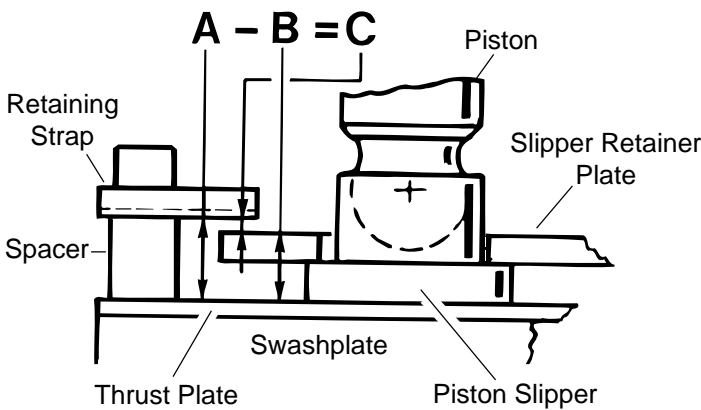


Figure 22

**58** Before beginning reassembly check the piston slipper clearance:

First, use a vernier calipers to measure the spacer height, height “A” in figure 21.

Next, measure the thickness of the slipper retainer plate and piston slippers, Thickness “B” in the figure.

Finally, calculate the piston slipper clearance “C” by subtracting thickness “B” from height “A”.

**Clearance “C” must not exceed .008 in. [,20 mm].**

If the piston slipper clearance is too large replace worn parts: the thrust plate and/or piston slipper assemblies. Do not file or grind the spacers to adjust the slipper clearance.

**59** Position the cylinder barrel, pistons, and slipper retainer so the piston slippers are on top.

**60** Apply two drops of Loctite 271 in each of the four retaining strap holes in the swashplate. Apply the Loctite on closer than two threads from the running surface. Do not apply loctitie to the retaining strap bolts.

**Caution:** Remove all excess Loctite, it will contaminate the motor if not removed.

**61** Place the thrust plate in the swashplate.

**62** Install one of the retaining straps, and leave the bolts loose.

**63** Apply a light coating of clean hydraulic fluid to the thrust plate.

**64** Fit the swashplate onto the cylinder barrel assembly. Be sure the slipper retainer plate is between the swashplate and retaining strap.

**65** Turn the swashplate and cylinder barrel over so the swashplate is on the bottom.

**66** Install the second retaining strap and tighten all four retaining strap bolts to 18 lb-ft [25 Nm]. Remove all excess Loctite.

**67** Liberally lubricate the piston slippers, thrust plate, retainer plate, pistons, and cylinders. These parts must have sufficient start-up lubrication.

**68** Slide the shaft and bearing assembly through the swashplate into the cylinder barrel.

## Major Repairs: Trunnions and Servo Pistons

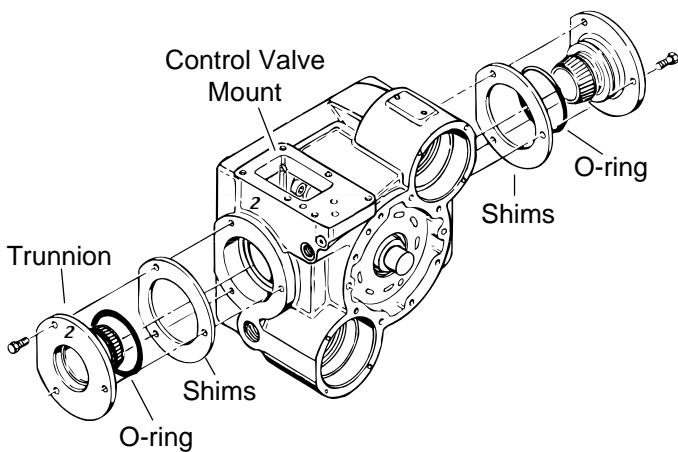


Figure 24

**69** Carefully, put the swashplate, cylinder barrel, and shaft into the motor housing. Be sure the feedback linkage is by the control valve mount.

**70** Lubricate and install a new o-ring on each trunnion.

**71** Install the trunnions and shims in their original locations.

**72** Install the trunnion bolts and tighten them to the specified torque given below:

Model Number	Trunnion Bolt Torque
33, 39	28 lb-ft [38 Nm]
46, 54, 64	44 lb-ft [60 Nm]

**73** After the bolts are torqued strike one of the trunnions to free up the swashplate's movement.

**74** Measure the swashplate breakaway force with a spring compression scale. Attach the scale to the feedback linkage as shown in figure 25. A swashplate breakaway force of 2 to 5 lb [9 to 2,3 Kg] is required. Add or subtract trunnion shims as needed.

**Important:** The trunnion shims on each side of the motor should be equal thickness. The maximum allowable difference between the sides is .010 in. [.3 mm].

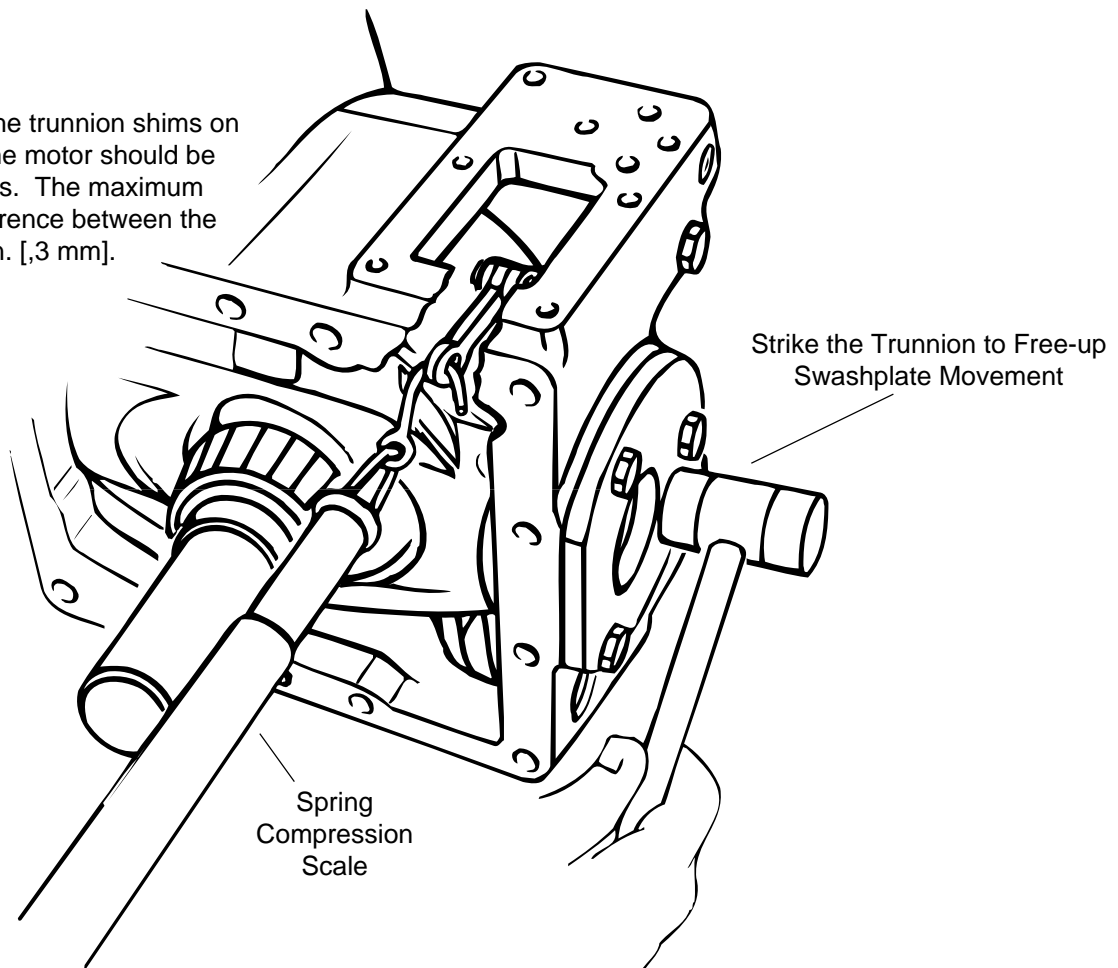


Figure 25

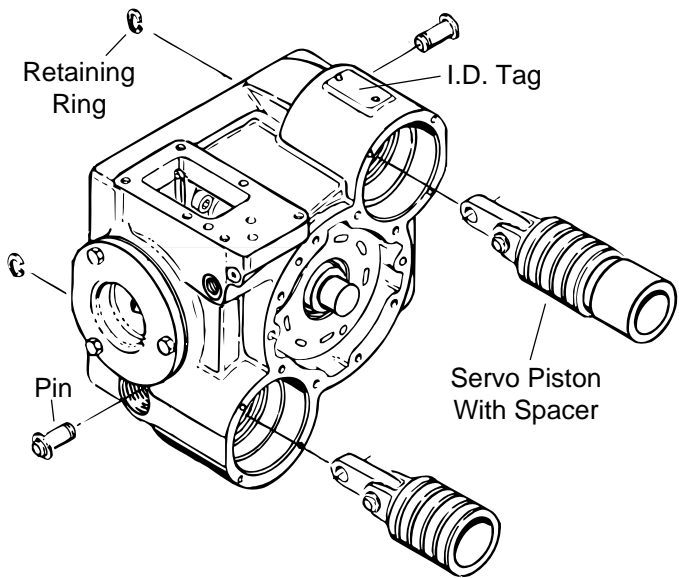


Figure 26

**75** Install the servo pistons. The servo piston with the spacer goes in the servo sleeve opening with the I.D. tag, as shown in figure 26.

**Note:** If the motor's minimum displacement is being changed the number of shims under the servo piston spacer may need to be adjusted, see the table below.

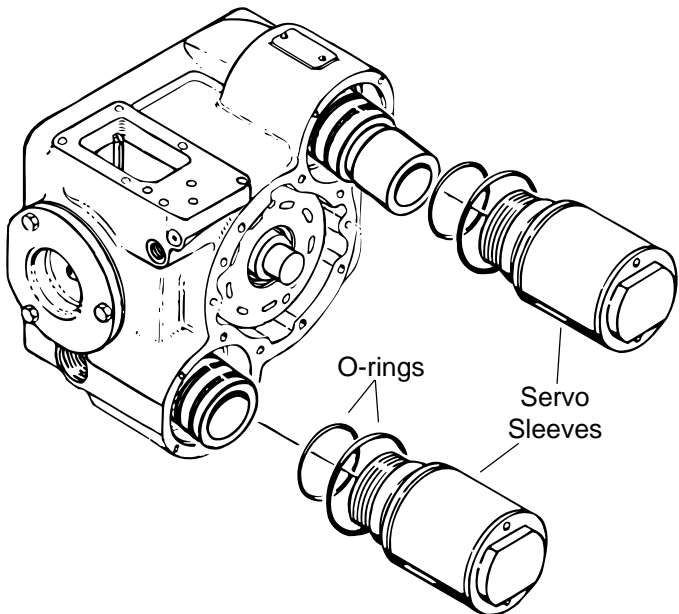


Figure 27

**76** Lubricate and install new o-rings on the servo sleeves.

**77** Install the servo sleeves in their original locations. Screw them in until the scribe marks line up. This should give an accurate minimum displacement adjustment.

**Note:** If the motor's minimum displacement needs to be checked or adjusted do steps 78 through 83. If not skip ahead to step 84.

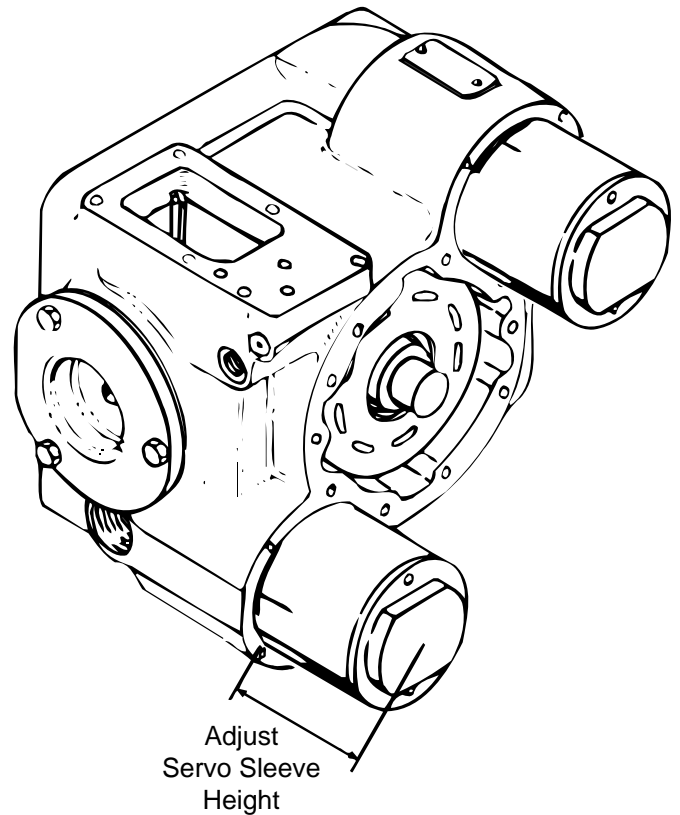


Figure 28

**78** Adjust the height of the servo sleeve that is over the piston without the spacer. Measure the height from the top of the servo sleeve to the end cover surface of the motor housing, see figure 28. The servo sleeve heights are given below:

Model Number	Servo Sleeve Height
33, 39, 46	2.785 in. [70,74 mm]
54, 64	3.750 in. [95.25 mm]

## Major Repairs: Trunnions and Servo Pistons

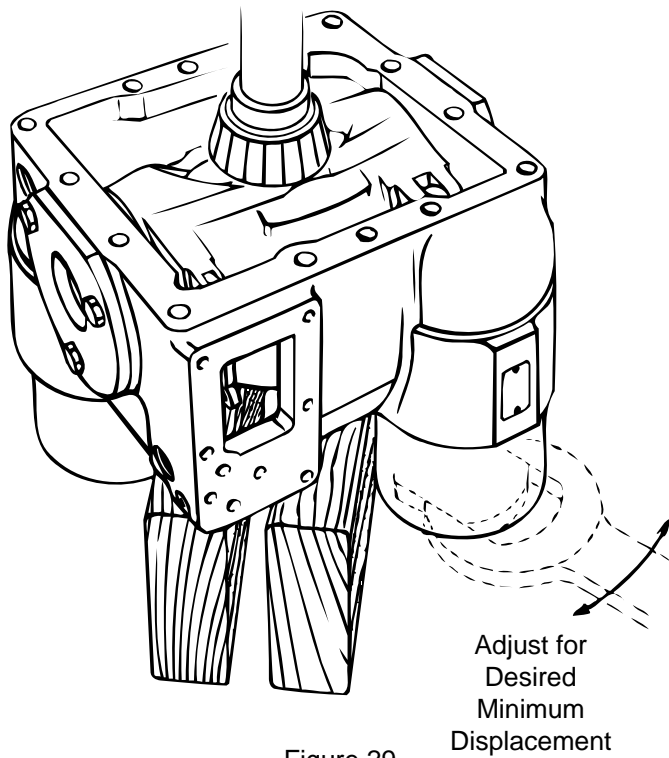


Figure 29

**79** Position the motor so the mounting flange end is on top. Stand it on wooden blocks so the other servo sleeve can be adjusted. While the motor is in this position the cylinder barrel will be setting on the wooden blocks. Be sure to protect it from damage or contamination.

**80** Tilt the swashplate to the minimum displacement position; the servo piston spacer should touch the bottom of the servo sleeve.

**81** Place the depth gauge on the mounting flange surface so the gauge point is over the swashplate stop pad.

The depth gauge must be a precise distance from the center of the dowel pin hole in the motor housing, see figure 30. Depth gauge positioning information is given below:

Model Number	Distance of Depth Gauge From Dowel Pin Center
33, 39, 46	1.315 in. [33,40 mm]
54, 64	1.670 in. [42,42 mm]

**82** Adjust the servo sleeve that is over the piston with the spacer to get the desired depth gauge reading. Be sure the swashplate is in the minimum displacement position; the servo piston spacer must be touching the bottom of the servo sleeve. Choose the depth gauge reading for the desired minimum swashplate angle from the table below figure 30.

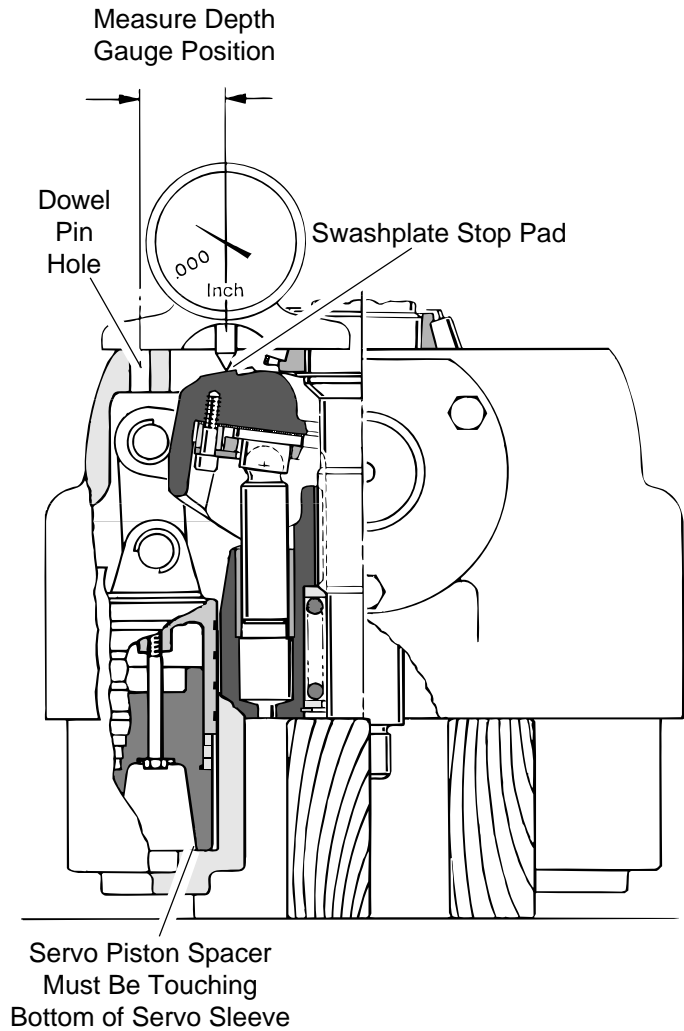


Figure 30

### Depth Gauge Reading in. [mm]

Minimum Swash - plate Angle	Model 33 *	Models 39 & 46	Models 54 & 64
0°	.559 [14,2]	.632 [16,0]	.642 [16,3]
1°	.526 [13,4]	.599 [15,2]	.609 [15,5]
2°	.492 [12,5]	.567 [14,4]	.577 [14,7]
3°	.459 [11,7]	.534 [13,6]	.544 [13,8]
4°	.425 [10,8]	.500 [12,7]	.510 [12,9]
5°	.390 [9,89]	.467 [11,9]	.476 [12,1]
6°	.355 [9,02]	.433 [11,0]	.442 [11,2]
7°	.320 [8,12]	.398 [10,1]	.407 [10,3]
8°	.284 [7,21]	.363 [9,23]	.372 [9,44]
9°	.248 [6,29]	.328 [8,33]	.336 [8,53]
10°	.211 [5,37]	.292 [7,42]	.299 [7,61]
11°	.174 [4,43]	.256 [6,50]	.263 [6,67]
12°	.136 [3,47]	.219 [5,57]	.225 [5,72]
13°	.098 [2,50]	.182 [4,63]	.187 [4,76]
14°	.059 [1,50]	.144 [3,67]	.149 [3,78]
15°	.020 [,51]	.106 [2,70]	.110 [2,78]
16°		.067 [1,70]	.070 [1,77]
17°		.028 [,71]	.029 [,74]
18°		.000 [,00]	.000 [,00]

\*The maximum swashplate angle on model 33 motors is 15.5°

**83** If the motor's minimum displacement is being changed the number of shims under the servo piston spacer may need to be adjusted. The following table shows the required number of shims and the spacer bolt

length for each minimum swashplate angle. Theoretical displacements are also given for each swashplate angle.

**Important:** Verifying the motor's minimum displacement on an authorized test stand is essential.

Minimum Swash - plate Angle	Number of Shims			Bolt Length in. [mm]		
	Model 33 *	Models 39 & 46	Models 54 & 64	Model 33 *	Models 39 & 46	Models 54 & 64
0°	0	0	0	1.5 [38]	1.5 [38]	1.5 [38]
1°	0	0	0	1.5 [38]	1.5 [38]	1.5 [38]
2°	0	0	0	1.5 [38]	1.5 [38]	1.5 [38]
3°	1	1	0	1.5 [38]	1.5 [38]	1.5 [38]
4°	1	1	1	1.5 [38]	1.5 [38]	1.75 [45]
5°	2	2	1	1.75 [45]	1.75 [45]	1.75 [45]
6°	2	2	1	1.75 [45]	1.75 [45]	1.75 [45]
7°	3	3	2	1.75 [45]	1.75 [45]	2 [51]
8°	3	3	2	1.75 [45]	1.75 [45]	2 [51]
9°	4	4	2	2 [51]	2 [51]	2 [51]
10°	4	4	3	2 [51]	2 [51]	2.25 [57]
11°	5	5	3	2 [51]	2 [51]	2.25 [57]
12°	5	5	3	2 [51]	2 [51]	2.25 [57]
13°	6	6	4	2.25 [57]	2.25 [57]	2.5 [64]
14°	6	6	4	2.25 [57]	2.25 [57]	2.5 [64]
15°	7	7	4	2.25 [57]	2.25 [57]	2.5 [64]
16°		7	5		2.25 [57]	2.5 [64]
17°		8	5		2.25 [57]	2.5 [64]
18°		8	5		2.25 [57]	2.5 [64]

**Theoretical Displacement vs Swashplate Angle**

cu.in./rev. [cu.cm./rev.]

Swash - plate Angle	Model 33 *	Model 39	Model 46	Model 54	Model 64
1°	.209 [3,42]	.209 [3,42]	.247 [4,05]	.292 [4,79]	.346 [5,67]
2°	.418 [6,84]	.418 [6,84]	.494 [8,10]	.585 [9,58]	.692 [11,3]
3°	.627 [10,3]	.627 [10,3]	.742 [12,2]	.877 [14,4]	1.04 [17,0]
4°	.836 [13,7]	.836 [13,7]	.989 [16,2]	1.17 [19,2]	1.38 [22,7]
5°	1.05 [17,1]	1.05 [17,1]	1.24 [20,3]	1.46 [24,0]	1.73 [28,4]
6°	1.26 [20,6]	1.26 [20,6]	1.49 [24,4]	1.76 [28,8]	2.08 [34,1]
7°	1.47 [24,1]	1.47 [24,1]	1.74 [28,5]	2.06 [33,7]	2.43 [39,8]
8°	1.68 [27,5]	1.68 [27,5]	1.99 [32,6]	2.35 [38,5]	2.78 [45,6]
9°	1.89 [31,0]	1.89 [31,0]	2.24 [36,7]	2.65 [43,4]	3.14 [51,4]
10°	2.11 [34,6]	2.11 [34,6]	2.50 [40,9]	2.95 [48,4]	3.49 [57,2]
11°	2.32 [38,1]	2.32 [38,1]	2.75 [45,1]	3.25 [53,3]	3.85 [63,1]
12°	2.54 [41,6]	2.54 [41,6]	3.01 [49,3]	3.56 [58,3]	4.21 [69,0]
13°	2.76 [45,2]	2.76 [45,2]	3.27 [53,5]	3.87 [63,3]	4.57 [74,9]
14°	2.98 [48,9]	2.98 [48,9]	3.53 [57,8]	4.17 [68,4]	4.94 [80,9]
15°	3.20 [52,5]	3.20 [52,5]	3.79 [62,1]	4.49 [73,5]	5.31 [87,0]
16°		3.43 [56,2]	4.06 [66,5]	4.80 [78,7]	5.68 [93,1]
17°		3.66 [59,9]	4.33 [70,9]	5.12 [83,9]	6.05 [99,2]
18°		3.89 [63,7]	4.60 [75,3]	5.44 [89,1]	6.44 [105]

\*The maximum swashplate angle on model 33 motors is 15.5°.

## Mounting Flange, End Cover Bearing and Shaft End Play

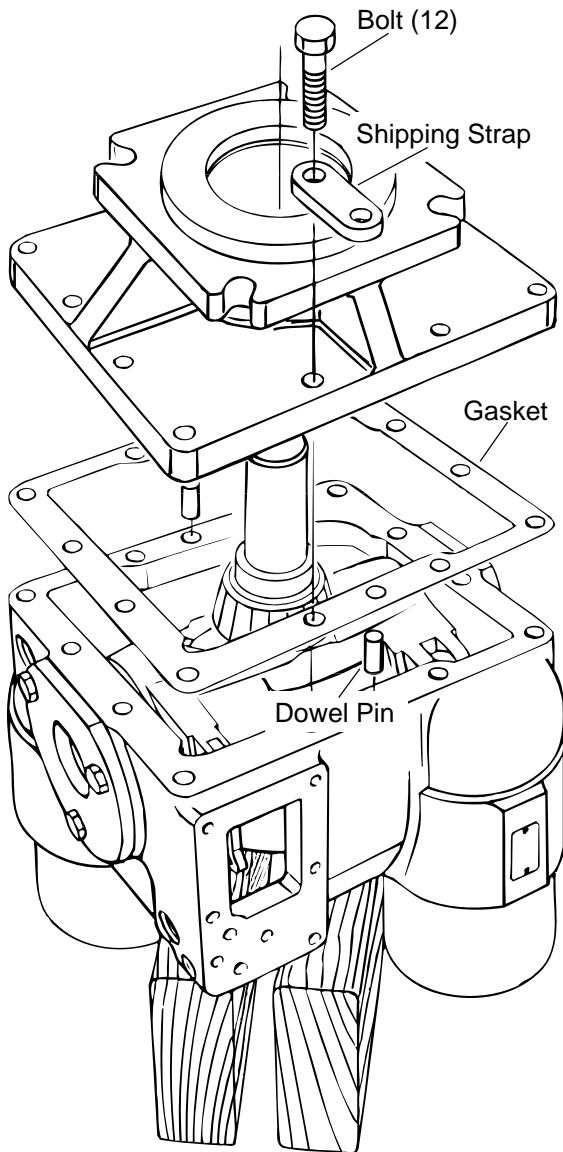


Figure 31

- 84** Install two dowel pins in the holes in the mounting flange surface of the motor housing.
- 85** Place a new mounting flange gasket on the motor housing. Hold it in place with petroleum jelly.
- 86** Place the mounting flange on the motor.
- 87** Install the twelve mounting flange bolts. Remember to install the shipping strap. Tighten the bolts to the torque specified in the table below:

Model Number	Mounting Flange Bolt Torque
33, 39	28 lb-ft [38 Nm]
46, 54, 64	44 lb-ft [60 Nm]

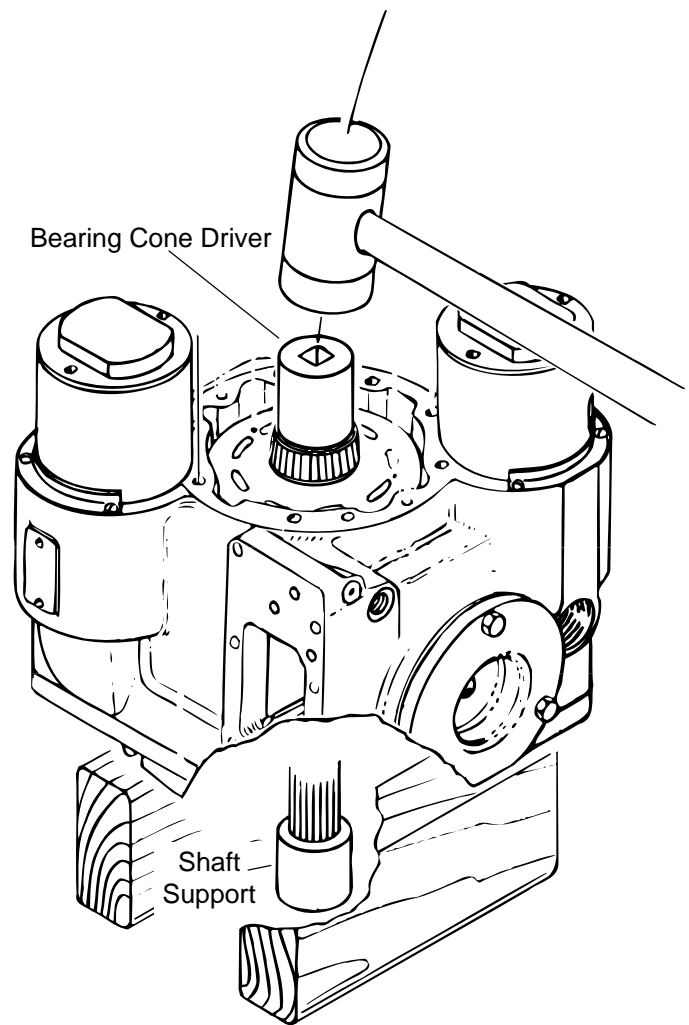


Figure 32

- 88** Turn the motor over so the shaft is vertical and the mounting flange is down.
- 89** Install and stake the servo sleeve retainers.
- 90** Support the motor's shaft and use a bearing driver to install the end cover bearing cone, see figure 32. Be sure the bearing cone is seated against the shoulder of the shaft.
- Note:** A detailed drawing of the bearing cone driver is shown in the back of this manual.
- 91** Remove the shaft support.



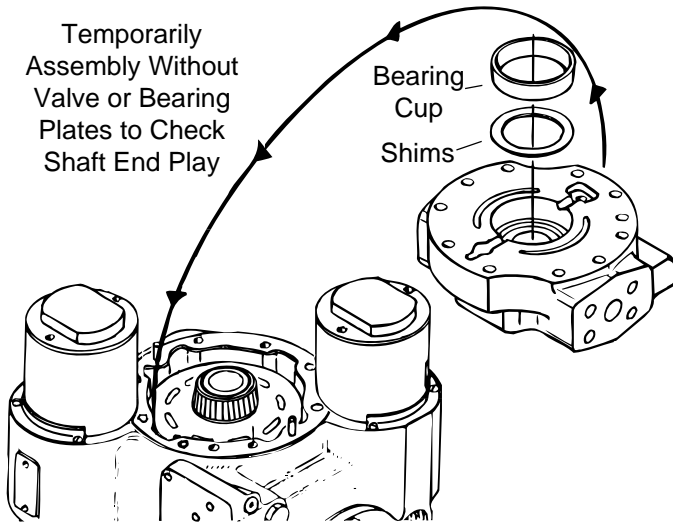


Figure 33

**92** Install two dowel pins in the holes in the end cover surface of the motor housing.

**93** Install a new end cover gasket.

**94** Check the motor shaft end play before installing the bearing and valve plates.

Be sure the bearing cup and shims are in the end cover and place it on the motor.

Install the eight end cover bolts and tighten them alternately to the torque specified in the table below:

Model Number	End Cover Bolt Torque
33, 39	39 lb-ft [53 Nm]
46, 54, 64	63 lb-ft [85 Nm]

Turn the motor over so the mounting flange and shaft are on top. Place a block of wood under the end cover so the weight of the motor is not on the servo sleeves.

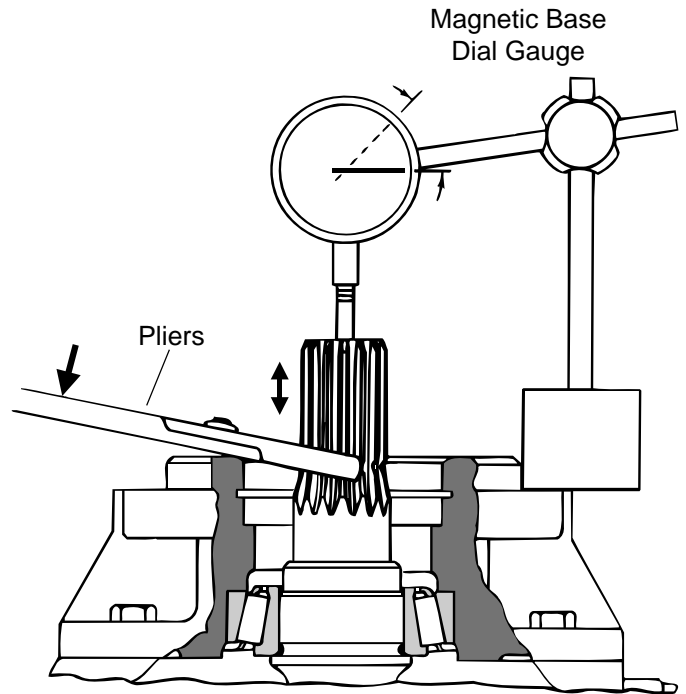


Figure 34

Gently tap the shaft into the motor with a plastic hammer to seat the bearings.

Place a dial gauge, with a magnetic base over the shaft as shown in figure 34. Grasp the shaft low with a pliers and pry it up to get the end play reading.

**The motor shaft end play must be from .002 in. to .007 in. [.05 mm to .17 mm].**

Adjust the end play by adding or subtracting shims from under the end cover bearing cup.

**95** Turn the motor over and remove the end cover.

## End Cover, Valve Block and Control Valve

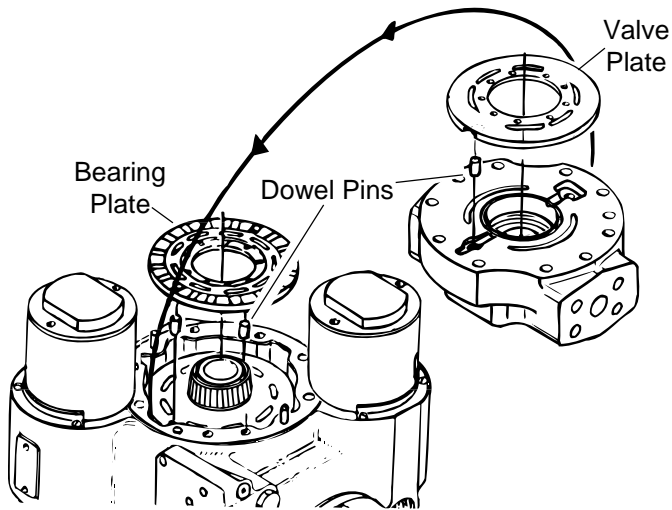


Figure 35

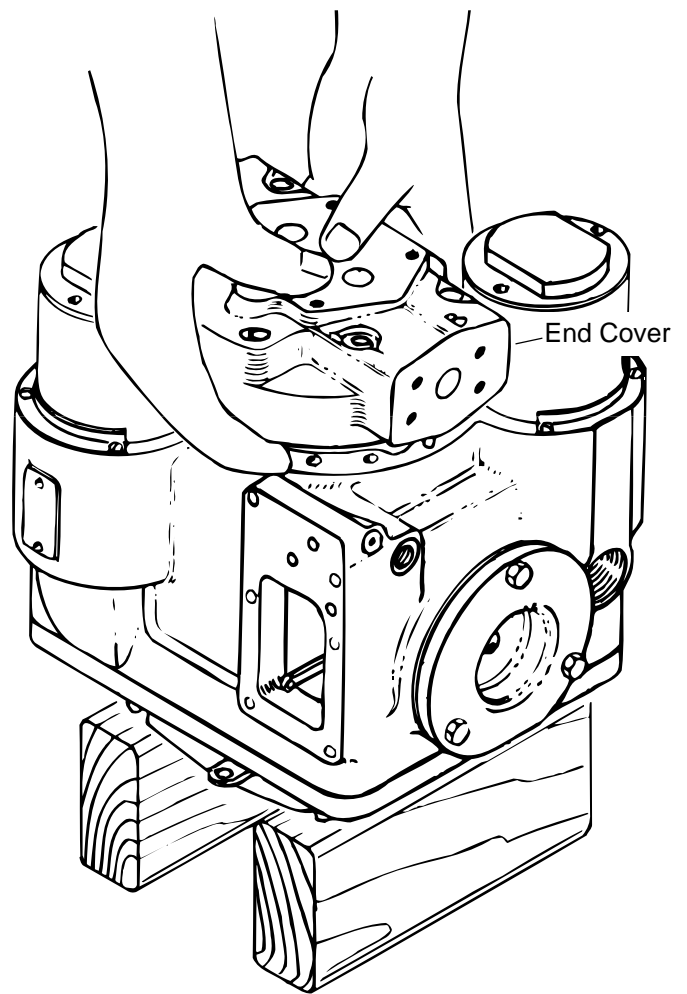


Figure 36

**96** Install two dowel pins in the holes in the cylinder barrel face.

**97** Place the bearing plate on the cylinder barrel and engage it with the dowel pins.

**98** Liberally lubricate the bronze surface of the bearing plate with clean hydraulic fluid.

**99** Install the last dowel pin in the hole in the end cover.

**100** Place the valve plate on the end cover. Be sure it engages with the dowel pin.

**101** Holding the valve plate in place carefully install the end cover.

**Note:** Use petroleum jelly to help hold the valve plate to the end cover.

**102** Install the eight end cover bolts, remember the shipping strap.

**103** Tighten the end cover bolts evenly so the Cylinder barrel spring pre-load is taken-up gradually. Torque them alternately to the specifications given in the table below:

Model Number	End Cover Bolt Torque
33, 39	39 lb-ft [53 Nm]
46, 54, 64	63 lb-ft [85 Nm]

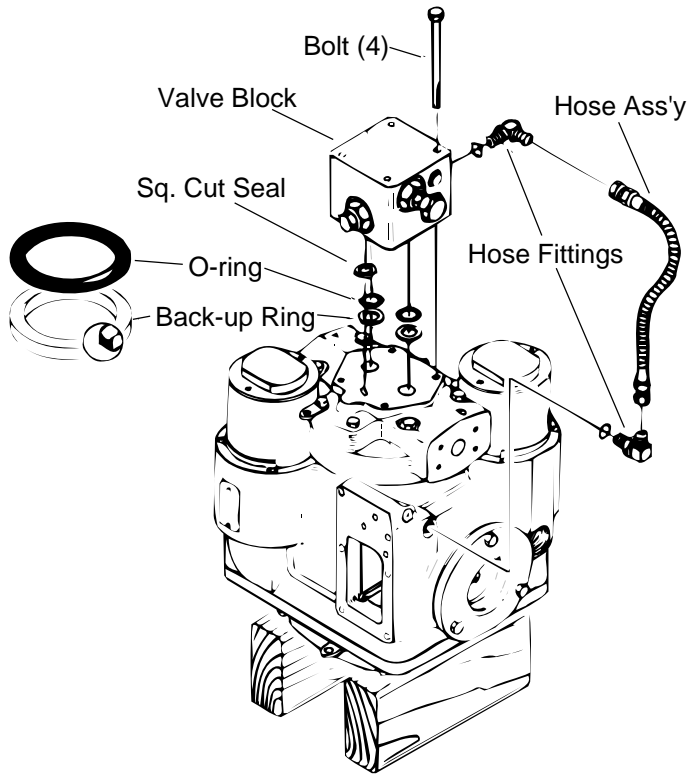


Figure 37

**104** Install new o-rings and back-up rings in the grooves around the high pressure ports as shown in figure 37. Install a square-cut seal in the groove around the low pressure port. Use petroleum jelly to hold these sealing rings in place while the valve block is installed.

**105** Position the valve block on the motor. Install the four hex head bolts and tighten them to 28 lb-ft [38 Nm].

**106** Tighten the high pressure relief valves to 25 lb-ft [34 Nm].

Tighten the low pressure relief valve, and shuttle valve plugs to 80 lb-ft [108 Nm].

Tighten the gauge port plugs and control pressure hose fittings, if used, to 17 lb-ft [23 Nm].

**107** Connect the control pressure hose between the motor housing and valve block fittings, if used. Tighten both ends to 7.5 lb-ft [10 Nm].

**Note:** The control pressure hose is now obsolete. Poor motor control characteristics may be experienced when the motor gets control pressure from the valve block. It is best to run a separate control pressure line from the charge pump to the motor. If possible re-plumb the application so the control pressure hose is no longer used. Be sure to plug the port in the valve block.

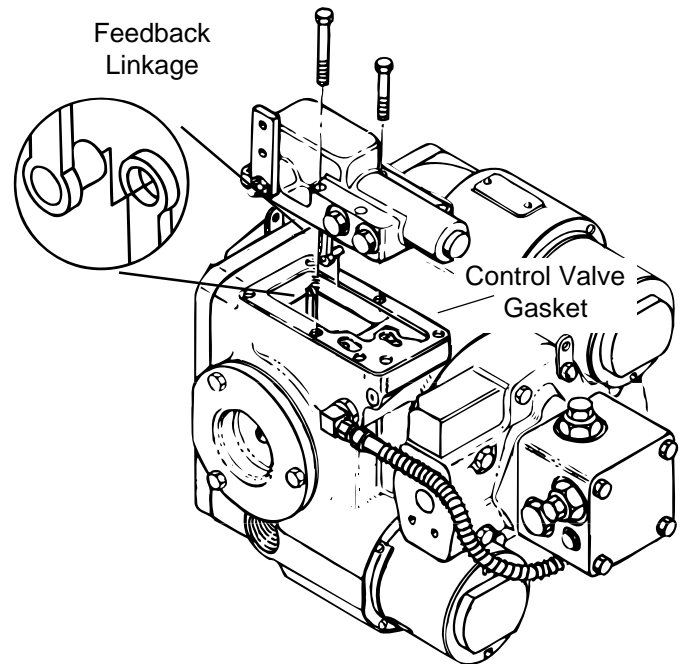


Figure 38

**108** Reposition the motor so the control valve mount is on top.

**109** Place a new control valve gasket on the motor.

**110** Connect the feedback linkage and position the control valve on the motor.

**Important:** When the control valve is positioned on the motor make sure the feedback linkage points towards the end cover.

**111** Install the six hex head bolts and tighten them finger tight.

**112** Move the control lever back and forth; it should move freely in both directions and self-center. If it doesn't, recheck the feedback linkage.

**113** Tighten the six hex head bolts to 16 lb-ft [22 Nm].

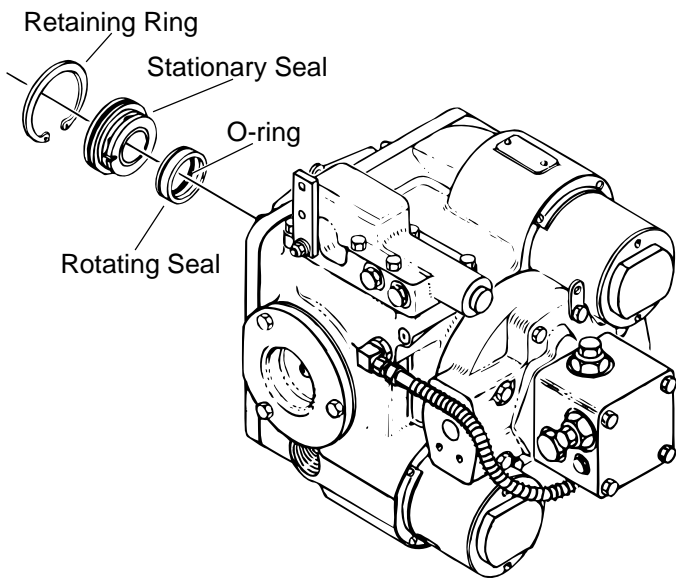


Figure 39

**114** Reposition the motor so the shaft seal can be installed.

**Note:** Eaton recommends replacing the entire shaft seal. Use Shaft Seal Kit P/N 990231.

**Important:** The metal-to-metal sealing surfaces are critical. Clean the areas of contact with a suitable solvent then blow them dry. The solvent must evaporate without leaving a residue. Do not touch the sealing surfaces after cleaning.

**115** Apply petroleum jelly to the o-ring and install it in the rotating seal

**116** Apply a light coating of clean hydraulic oil to the cleaned metal sealing surface of the rotating seal.

**117** Install the rotating seal using the special pulling tool (CAS 1844).

**118** Screw a 3 in. X 1/4-20 bolt into the threaded hole in the new stationary seal. The bolt provides a convenient means for holding the seal.

**119** Apply petroleum jelly to the o-ring that is around the largest part of the stationary seal.

**120** Apply a light coating of clean hydraulic oil to the cleaned metal sealing surface of the stationary seal.

**121** Install the stationary seal.

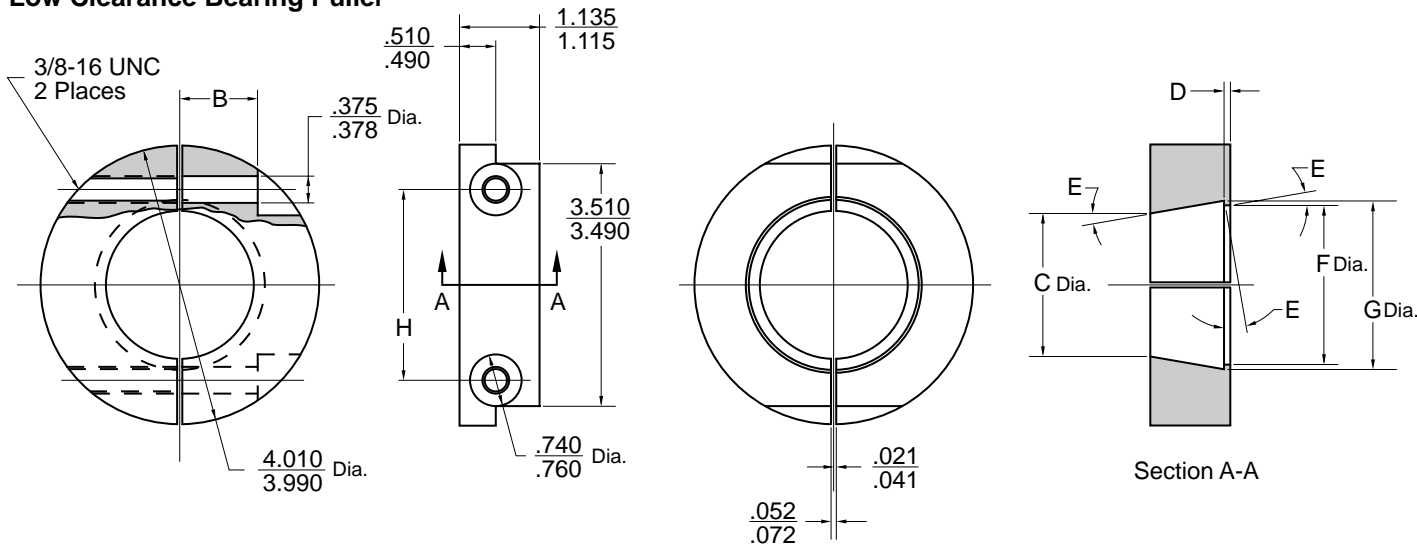
**122** Using the retaining ring pliers install the retaining ring with the beveled side out.

**Caution: Verifying the accuracy of repairs on an authorized test stand is essential.**

## Special Tools

( All dimensions are given in inches.)

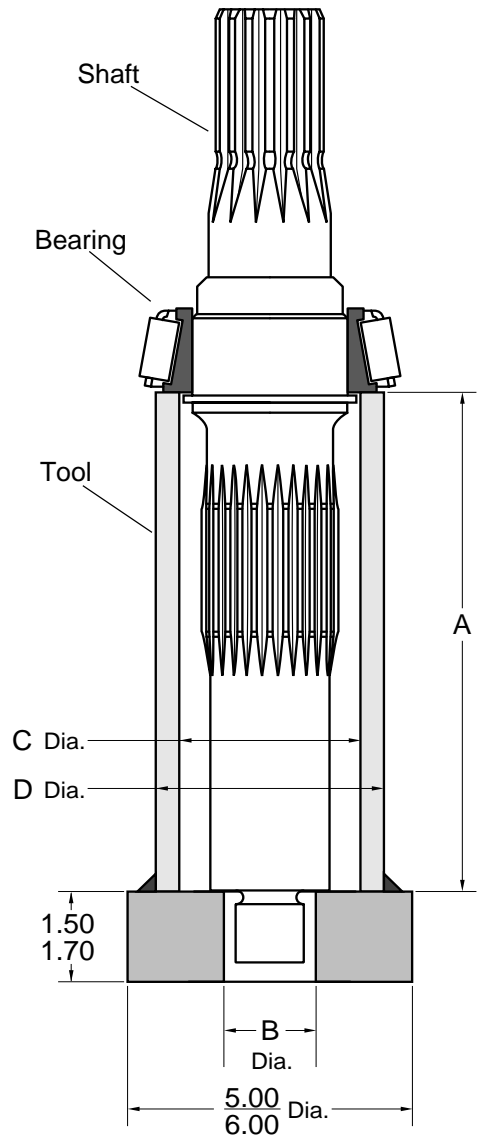
### Low Clearance Bearing Puller



Model	B	C	D	E	F	G
33, 39, 46	$\frac{1.050}{1.070}$	1.565 Ref.	$\frac{1.35}{1.29}$	$\frac{12^{\circ}-45'}{13^{\circ}-15'}$	$\frac{1.907}{1.913}$	$\frac{2.020}{2.026}$
54, 64	$\frac{1.115}{1.135}$	2.071 Ref.	$\frac{.131}{.125}$	$\frac{10^{\circ}-5'}{10^{\circ}-35'}$	$\frac{2.310}{2.316}$	$\frac{2.432}{2.438}$

Material / Heat Treatment;  
Stentor / 45-55 Rc

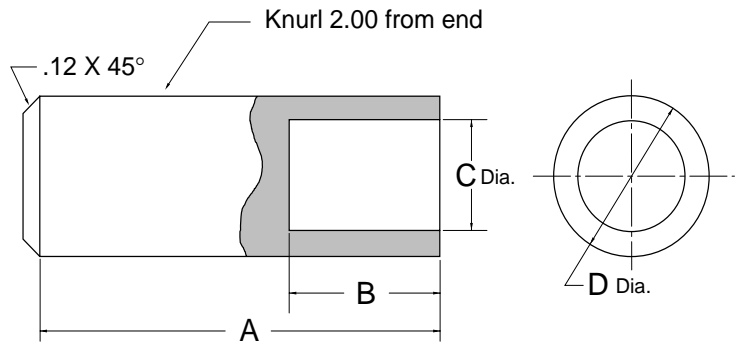
**Stop Limit Tool**



	Model	
	33, 39, 46,	54, 64
<b>A</b> ±.001	5.803	6.682
<b>B</b>	$\frac{1.00}{1.20}$	$\frac{1.30}{1.32}$
<b>C</b>	$\frac{2.20}{2.30}$	$\frac{2.20}{2.30}$
<b>D</b>	3.00 min.	3.00 min.

Material; Steel

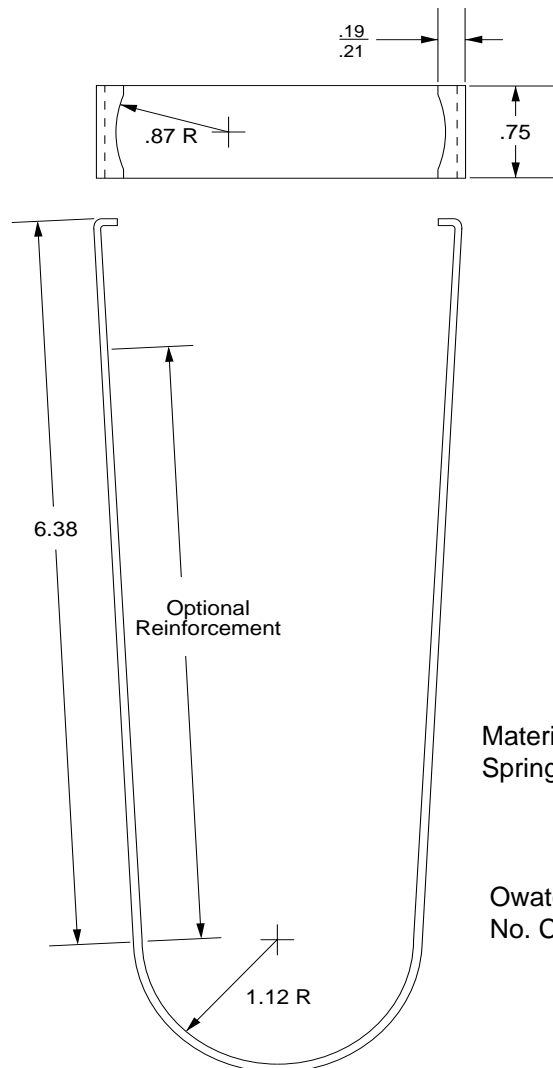
**Bearing Cone Driver**



Model	A	B	C	D
33, 39, 46	4.0	1.5	1.01	1.25
54, 64	4.0	1.5	1.30	1.48

Material / Heat Treatment; C.R.S. / 50-55 Rc

**Rotating Seal Puller**



Material; SAE 1074  
Spring Steel 16 Ga.

Owatonna Tool Co.  
No. CAS 1844

## Hydraulic Fluid Recommendations

A reputable supplier can help you make the best selection of hydraulic fluid for use in Eaton hydrostatic products.

For satisfactory operation the following recommendations apply:

1. The filter system used in the hydraulic circuit should be capable of cleaning and maintaining the hydraulic fluid to meet ISO Cleanliness Code 18/13 per SAE J1165. This code allows a maximum of 2500 particles per milliliter greater than 5  $\mu\text{m}$  and a maximum of 80 particles per milliliter greater than 15  $\mu\text{m}$ .
2. At normal operating temperatures optimum viscosity ranges from 80-180 SUS (16-39 cSt). Viscosity should never fall below 60 SUS (10 cSt) and, at the lowest expected start-up temperature, should not exceed 10,000 SUS (2158 cSt).
3. The fluid should be chemically stable, incorporating rust and oxidation inhibitors.

### Specific types of fluid that meet these requirements are:

- Premium quality, industrial anti-wear type hydraulic fluid
- Engine crankcase oil — SAE 10w, SAE 20w-20, SAE 30
- Automatic transmission oil
- Hydraulic transmission oil
- Synthetic fire resistant fluid — Quintolubric, Cosmolubric, or equivalent

**Note:** If the natural color of the fluid has become black or milky it is possible that an overheating or water contamination problem exists.

Take level readings when fluid is cold.

## Notes

Information contained in this catalog is accurate as of the publication date and is subject to change without notice. Performance values are typical values. Customers are responsible for selecting products for their applications using normal engineering methods.

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