HYDRO-GEAR®

FORWARD MOTION THROUGH FORWARD THINKING

HGM-H™ Series Motor Service and Repair Manual

BLN-0043
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FOREWORD

Headquartered in Sullivan, Illinois, Hydro-Gear is a world leader in the design, manufacture, and service of quality hydrostatic transaxles for the lawn and garden industry. The mission of our company is to be recognized by our customers and the industry as a world-class supplier and the quality leader in everything we do.

This Service and Repair Manual is designed to provide information useful in servicing and troubleshooting the Hydro-Gear® HGM-H™ series motor.

Also included is a glossary of terms that are frequently used throughout the industry and in Hydro-Gear service publications. Understanding terminology is very important!

It is necessary, and a good shop practice, that your service area be equipped with the proper tools and the mechanics be supplied the latest information available. All repair procedures illustrated in this guide are suggested, but preferred methods of repair.

Internal repair procedures require that the HGM-H series motor be removed from the vehicle.

DESCRIPTION AND OPERATION

INTRODUCTION

The purpose of this manual is to provide information useful in servicing the Hydro-Gear® HGM-H series motor. This manual includes the HGM-H series motor general description, hydraulic schematic, technical specifications, servicing and troubleshooting procedures.

Should servicing be required, the exterior of the motor will need to be thoroughly cleaned before beginning most procedures. Do not wash the transaxle while it is hot. **Do not use a pressure washer to clean the unit.**

GENERAL DESCRIPTION

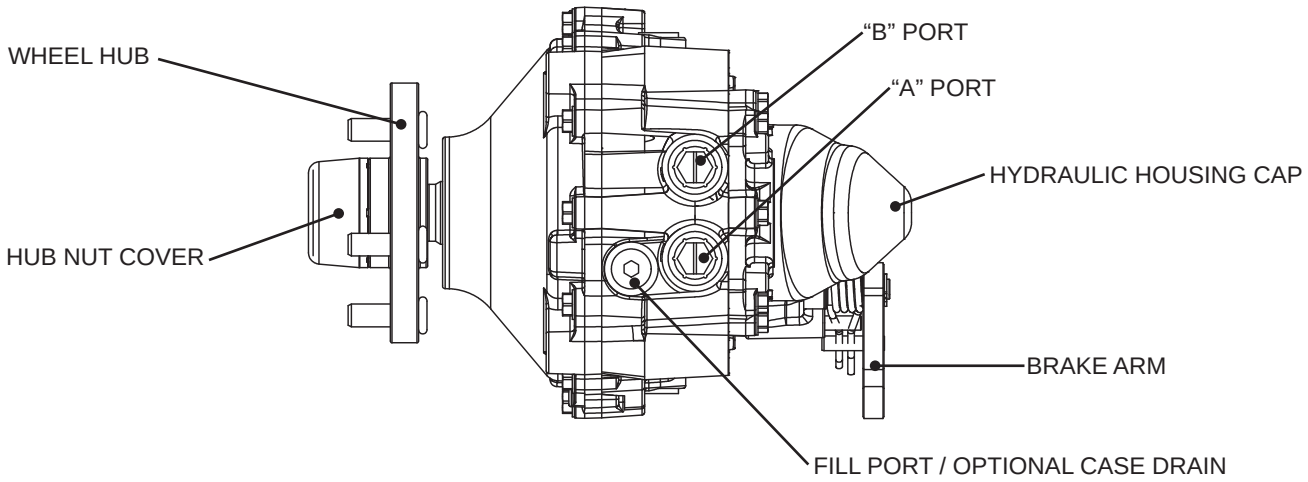
The HGM-H series hydraulic motors are fixed displacement axial piston motors. The motor is designed to convert hydraulic power into rotational power at the axle shaft. It operates at an infinitely variable speed range between zero and maximum axle speed determined by motor displacement and maximum pump flow in both forward and reverse modes of operation.

The HGM-H series motor is available with a fixed displacement of 15 cu. in. or 18 cu. in. (245 to 294 cc) maximum per revolution. The cylinder block pistons in the HGM H series motors are set at a fixed displacement by a swash angle that is integral to the motor housing. Therefore, the motor is always at maximum displacement. As pressurized fluid from the pump pushes against the cylinder block pistons, they forced to rotate with the thrust bearing. As the pistons rotate with the thrust bearing, they create torque and rotory motion that is transmitted to the axle shaft. Torque continues to develop as long as the piston is being pushed out of the cylinder block. When the piston reaches the end of the movement out of the cylinder block, it gets pushed back into the cylinder and fluid inside the piston is discharged through the low pressure port of the motor. Pistons develop torque only through half of the cylinder block rotation cycle. Therefore, multiple pistons are used to provide a constant and continuous torque to the motor shaft. Reversing the direction of the incoming pressurized fluid into the motor reverses the direction of the motor output rotation.

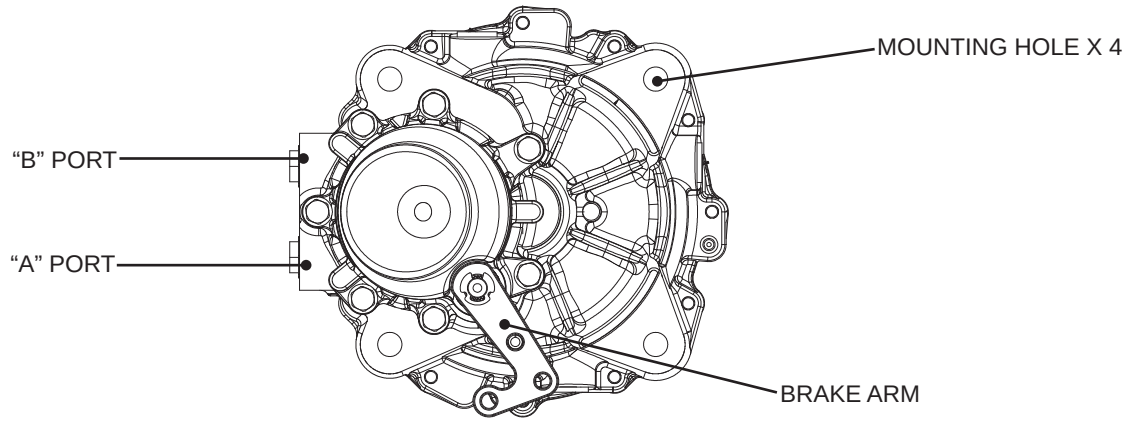
A hydraulic bypass is utilized in a hydraulic system to permit moving the vehicle for a short distance at a maximum of 2 m.p.h. (3.2 Km/h) without starting the engine. The bypass will be located on the hydraulic pump.

The HGM-H series motor utilizes a friction type brake controlled by a cam attached to an external actuating arm.

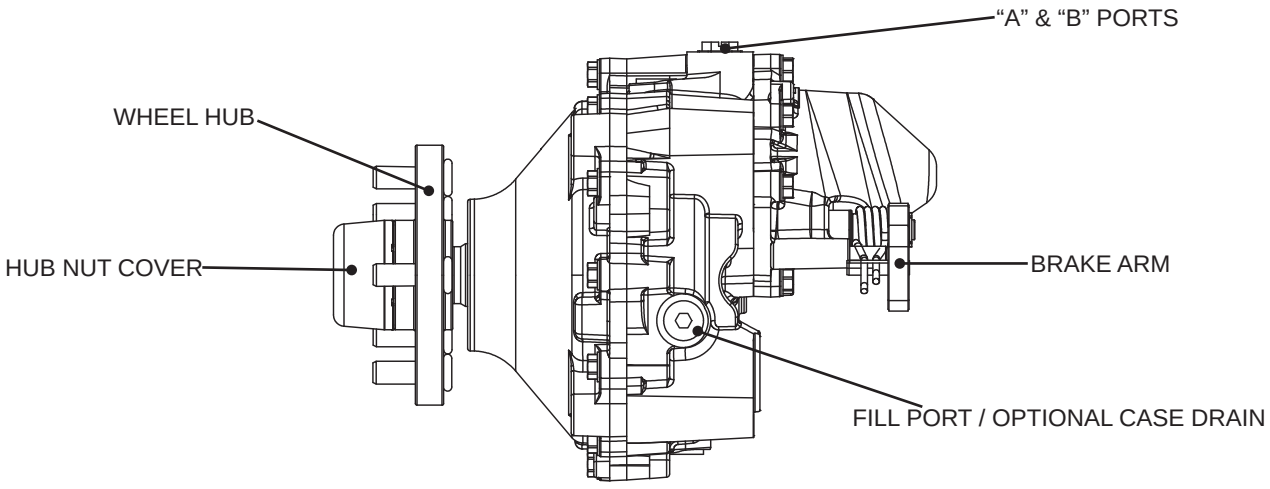
EXTERNAL FEATURES HGM-H SERIES MOTORS



— Top View—



— Back View—



— Side View—

Figure 1, External Features

TECHNICAL SPECIFICATIONS

HGM-H™ Piston Motor TECHNICAL SPECIFICATIONS		
Geometric Displacement	15 in^3/rev (245.81 cc/rev)	18 in^3/rev (294.97 cc/rev)
Maximum Speed		
Continuous	210 rpm	185 rpm
Intermittent	250 rpm	210 rpm
Maximum Torque		
Peak	6600 in-lbf (75 N-m)	7900 in-lbf (89 N-m)
Continuous	2700 in-lbf (30 N-m)	3200 in-lbf (36 N-m)
Intermittent	4900 in-lbf (75 N-m)	5900 in-lbf (64 N-m)
Maximum Oil Flow		
Continuous	9.4 hp (7 KW)	
Intermittent	20.5 hp (15.4 kW)	
Axle Shaft Diameter	1.375 in (34.925 mm)	
Axle Shaft End Options	4 Bolt Flange 5 Bolt Flange	
Parking Brake Type	Internal Wet Disc	
Max. weight applied to shaft/housing		
Wheel Load Force - Radial	840 lbf (381 kg)	
Weight of Unit	38.2 lb (17.3 kg)	

PRODUCT IDENTIFICATION

The model and configuration of the HGM-H can be determined from the label found on the transaxle.

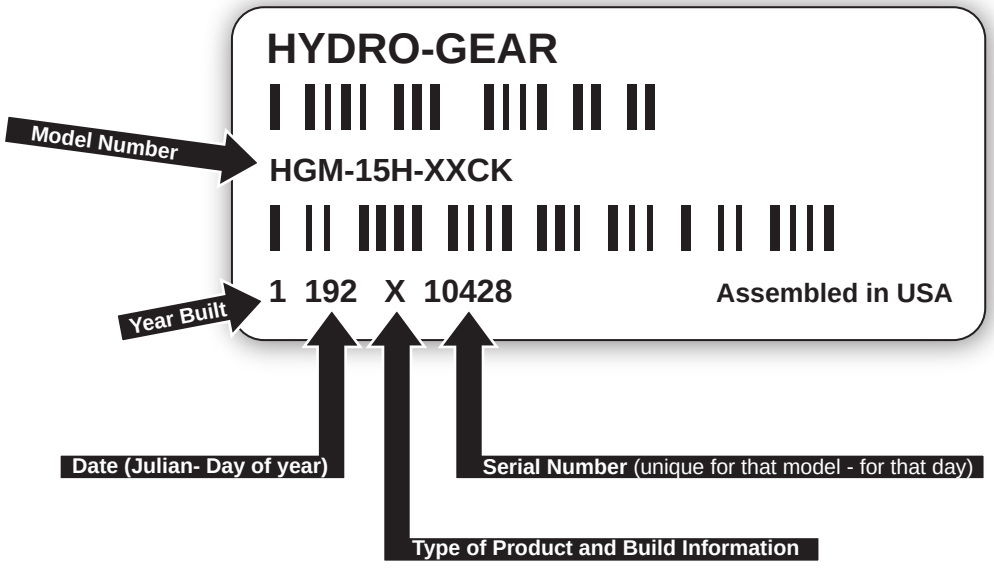


Figure 2, Product Label

SAFETY

This symbol points out important safety instructions which, if not followed, could endanger the personal safety and/or property of yourself and others. Read and follow all instructions in this manual before attempting maintenance on your hydraulic motor. When you see this symbol - **HEED ITS WARNING.**

WARNING

POTENTIAL FOR SERIOUS INJURY

Inattention to proper safety, operation, or maintenance procedures could result in personal injury, or damage to the equipment. Before servicing or repairing the hydraulic motor, fully read and understand the safety precautions described in this section.

PERSONAL SAFETY

Certain safety precautions must be observed while servicing or repairing the hydraulic motor. This section addresses some of these precautions but must not be considered an all-inclusive source on safety information. This section is to be used in conjunction with all other safety material which may apply, such as:

1. Other manuals pertaining to this machine,
2. Local and shop safety rules and codes,
3. Governmental safety laws and regulations.

Be sure that you know and understand the equipment and the hazards associated with it. Do not place speed above safety.

Notify your supervisor whenever you feel there is any hazard involving the equipment or the performance of your job.

Never allow untrained or unauthorized personnel to service or repair the equipment.

Wear appropriate clothing. Loose or hanging clothing or jewelry can be hazardous. Use the appropriate safety equipment, such as eye and hearing protection, and safety-toe and slip-proof shoes.

Never use compressed air to clean debris from yourself or your clothing.

TOOL SAFETY

Use the proper tools and equipment for the task.

Inspect each tool before use and replace any tool that may be damaged or defective.

WORK AREA SAFETY

Keep the work area neat and orderly. Be sure it is well lit, that extra tools are put away, trash and refuse are in the proper containers, and dirt or debris have been removed from the working areas of the machine.

The floor should be clean and dry, and all extension cords or similar trip hazards should be removed.

SERVICING SAFETY

Certain procedures may require the vehicle to be disabled in order to prevent possible injury to the servicing technician and/or bystanders.

The loss of hydrostatic drive line power may result in the loss of hydrostatic braking capability.

Some cleaning solvents are flammable. Use only approved cleaning materials: Do not use explosive or flammable liquids to clean the equipment.

To avoid possible fire, do not use cleaning solvents in an area where a source of ignition may be present.

“Discard used cleaning material in the appropriate containers according to local, state, and federal regulations.”

TROUBLESHOOTING

WARNING

Do not attempt any servicing or adjustments with the engine running. Use extreme caution while inspecting the drive belt assembly and all vehicle linkage!

Follow all safety procedures outlined in the vehicle owner's manual.

In many cases, problems with a hydraulic systems are not related to a defective hydraulic unit, but are caused by slipping drive belts, partially engaged bypass valves, and loose or damaged control linkages. Be sure to perform all operational checks and adjustments outlined in Service and Maintenance, before assuming the hydraulic system is malfunctioning. The table below provides a troubleshooting checklist to help determine the cause of operational problems.

TROUBLESHOOTING CHECKLIST	
Possible Cause	Corrective Action
Unit Operates In One Direction Only	
Control linkage bent or out of adjustment	Repair or replace linkage on vehicle pump assembly, Page 8
Drive belt slipping or pulley damaged	Repair or replace belt/pulley on vehicle pump assembly, Page 8
Vehicle Does Not Drive/Track Straight	
Vehicle tires improperly inflated	Refer to vehicle manufacturer suggested tire pressure
Control linkage bent or out of adjustment	Repair or replace linkage on vehicle pump assembly, Page 8
Drive belt slipping or pulley damaged	Repair or replace belt/pulley on vehicle pump assembly, Page 8
Brake Partially Engaged	Disengage Brake, Replace damaged brake components, Page 14
Unit Is Noisy	
Oil level low or contaminated oil	Fill to proper level or change oil, Page 8
Excessive loading	Reduce vehicle loading, Page 8
Loose parts	Repair or replace loose parts
Air trapped in hydraulic system	Purge hydraulic system, Page 9
Brake Partially Engaged	Disengage Brake, Replace damaged brake components, Page 14
Unit Has No/Low Power	
Engine speed low	Adjust to correct setting
Control linkage bent or out of adjustment	Repair or replace linkage on vehicle pump assembly, Page 8
Drive belt slipping or pulley damaged	Repair or replace belt/pulley on vehicle pump assembly, Page 8
Oil level low or contaminated oil	Fill reservoir to proper level or change oil, Page 8
Excessive loading	Reduce vehicle loading, Page 8
Air trapped in hydraulic system	Purge hydraulic system, Page 9
Brake Partially Engaged	Disengage Brake, Replace damaged brake components, Page 14
Unit Is Operating Hot	
Debris buildup around transaxle	Clean off debris, Page 8
Oil level low or contaminated oil	Fill to proper level or change oil, Page 8
Excessive loading	Reduce vehicle loading, Page 8
Air trapped in hydraulic system	Purge hydraulic system, Page 9
Brake Partially Engaged	Disengage Brake, Replace broken, missing or frozen return spring
Transaxle Leaks Oil	
Damaged seals, housing, or gaskets	Replace damaged components
Air trapped in hydraulic system	Purge hydraulic system, Page 9

SERVICE AND MAINTENANCE

EXTERNAL MAINTENANCE

Regular external maintenance of the hydraulic motor should include the following:

1. Check the vehicle operator's manual for the recommended load ratings. Insure that the current application does not exceed load rating.
2. Check reservoir oil level in accordance with the vehicle manufacturers recommendations.
3. Inspect the vehicle drive belt, idler pulley(s), and idler spring(s). Insure that no belt slippage can occur. Slippage can cause low input speed to the pump resulting in low flow to the hydraulic motor.
4. Inspect the vehicle control linkage to the directional control arm on the vehicles pump assembly.
5. Inspect the hydraulic motors and pumps for debris. Keeping the units debris free is important in the overall performance of the unit.
6. Inspect all external plumbing for possible leaks or loose fittings. An air leak may be difficult to detect on the "suction side" or inlet line to the pump. Refer to Purging Procedure on page 9.

SERVICE AND MAINTENANCE PROCEDURES

Some of the service procedures presented on the following pages can be performed while the transaxle is mounted on the vehicle. Any repair procedures as mentioned in the repair section of this manual must be performed after the unit has been removed from the vehicle.

Cleanliness is a primary means of assuring satisfactory life on repaired units. Thoroughly clean all exposed surfaces prior to any type of maintenance. Cleaning of all parts by using a solvent wash and air drying is usually adequate. As with any precision equipment, all parts must be kept free of foreign material and chemicals.

Protect all exposed sealing surfaces and open cavities from damage and foreign material. The external surfaces should be cleaned before beginning any repairs. **Do not use a pressure washer to clean the transaxle.**

FLUIDS

The fluids used in Hydro-Gear products have been carefully selected, and only equivalent, or better products should be substituted Typically, an engine oil with a minimum rating of 9.0 cSt (55 SUS) at 230°F (110° C) and an API classification of SL is recommended. Refer to the vehicle manufacturer for recommended oil.

"All fluids should be handled and disposed of according to local, state, and federal regulations."

FLUID VOLUME AND LEVEL

Certain situations may require additional fluid to be added or even replaced. **In addition to filling the hydraulic system with fluid, an additional 34 fl. oz. (1000mL) will need to be added to the case via the highest fill point of the HGM-H unit. Reference page 4 for the proper fill location.** Refer to the vehicle manufacturer's recommendations for the proper fill location and level of the complete hydraulic system. After maintenance or oil change, follow purging procedures on page 9 and check the fluid level once the unit has been purged and operated for 1 minute.

FLUID CHANGE

In the event of oil contamination or degradation, oil addition or change may alleviate certain performance problems. Refer to the vehicle manufacturer's recommended oil change frequency. Refer to purging procedures on page 9 after changing fluids.

FILTERS

An inlet filter is required to insure that only clean fluid enter the system. Refer to the vehicle manufacturer for approved filter replacement.

SERVICE AND MAINTENANCE

PURGING PROCEDURE

The HGM-H motor can not be purged of air as a stand alone component. The hydraulic system as a whole will need to be purged after any addition of oil to the system or a complete oil change. This will most likely involve the use of the hydraulic pumps bypass feature. If this is not available, see the manufacturers recommendation for air purging.

Due to the effects air has on efficiency in hydrostatic drive applications, it is critical that air is removed or purged from the system.

These purge procedures must be preformed anytime a hydrostatic system has been opened for maintenance or repair, or if any additional oil has been added to the system.

Air creates inefficiency because it has compression and expansion rates that are higher than that of oil.

Air trapped in the oil may cause the following symptoms:

1. Noisy operation.
2. Lack of power or drive after short-term operation.
3. High operation temperature and excessive expansion of oil.

Before starting, make sure the reservoir is at the proper oil level. If it is not, fill to the vehicle manufacturer's specifications.

The following procedures should be performed with the vehicle drive wheels off the ground, then repeated under normal operating conditions.

WARNING

POTENTIAL FOR SERIOUS INJURY

Certain procedures require the vehicle engine to be operated and the vehicle to be raised off of the ground. To prevent possible injury to the servicing technician and/or bystanders, insure the vehicle is properly secured.

1. With the vehicles pump assembly bypass valve open and the engine running, slowly move the directional control in both forward and reverse directions (10 to 20 times). As air is purged from the unit, the oil level in the reservoir may drop.
2. With the bypass valve closed and the engine running, slowly move the directional control in both forward and reverse directions (10 to 20 times). Check the oil level, and add oil as required after stopping engine.
3. It may be necessary to repeat steps 1 and 2 until all the air is completely purged from the system. When the hydraulic system moves forward and reverse at normal speed and the reservoir oil remains at a constant level, purging is complete.

TEAR DOWN AND REASSEMBLY

HOW TO USE THIS MANUAL

Each subassembly illustrated in this manual is illustrated with an exploded view showing the parts involved. The **item reference numbers in each illustration are for assembly instructions only.** See page 25 for part names and descriptions. A complete exploded view and item list of the transaxle is provided at the end of the repair section.

GENERAL INSTRUCTIONS

Cleanliness is a primary means of assuring satisfactory life on repaired units. Thoroughly clean all exposed surfaces prior to any type of maintenance. Cleaning of all parts by using a solvent wash and air drying is usually adequate. As with any precision equipment, all parts must be kept free of foreign material and chemicals.

Protect all exposed sealing surfaces and open cavities from damage and foreign material. The external surfaces should be cleaned before beginning any repairs. **Do not use a pressure washer to clean the transaxle.**

Upon removal, it is recommended that all seals, O-rings, and gaskets be replaced. During installation lightly lubricate all seals, O-rings and gaskets with a clean petroleum jelly prior to assembly. Also protect the inner diameter of seals during installation by covering the shaft with a cellophane or plastic wrap material. Be sure all remnants of this covering are removed after servicing.

Parts requiring replacement must be replaced from the appropriate kits identified in the Items Listing, found at the end of this manual.

Note: “Any and all Hydro-Gear components removed and replaced during service are recyclable.”

TOOLS

REQUIRED TOOLS	
Miscellaneous	**Sockets**
Three Jaw Puller	1/2”-3/8” Adapter
Flat Blade Screw Driver (2)	3/8” Deep
Torque Wrench	1-1/8” Deep
Air Impact Wrench	1/4” Allen
Rubber or Neoprene Mallet	3/4” Deep
Breaker Bar	
Side Cutters/Snips	
Needle Nose Pliers	
Large External Snap Ring Pliers	
Small Internal Snap Ring Pliers	

TORQUES

REQUIRED TORQUE VALUES			
Item	**Description**	**Torque**	**Operation**
4	Screw, Housing	280-340 in-lbs (31.6-38.4 Nm)	All Housing Screws
10	Nut, Axle, Castlelated	275-350 ft-lbs (372.9-474.5 Nm)	Hub
56	Nut, Brake	600-800 in-lbs (67.8-90.4 Nm)	Brake Shaft
80	Plug 9/16-16 (Metal)	110-170 in-lbs (12.4-19.2 Nm)	Oil Input Port

MOTOR REMOVAL

NOTE: *It is necessary to remove the HGM-H Motor from the vehicle before performing the repair procedures presented in this section.*

Before starting any disassembly, make certain that your work area is neat and clean. Clean the external parts of the transaxle.

The following procedures are presented in the order recommended for a complete tear down of the transaxle.

Do not disassemble the unit any farther than necessary to accomplish the required repairs.

Reassembly is accomplished by performing the "Assembly" portions of the procedures. If the unit has been completely disassembled, a summary of the assembly procedures, in the order in which they should occur, is given on page 23.

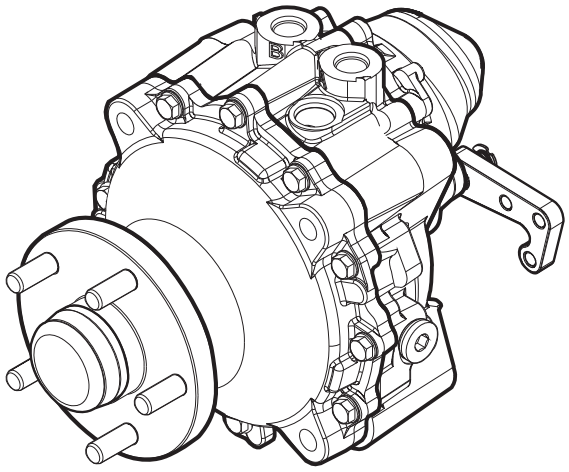


Figure 3, HGM-H Wheel Motor

AXLE HUB ASSEMBLY

Refer to Figure 4

1. Remove the axle cap and discard (9).
2. Remove the cotter pin and discard (18).
3. Remove the castle nut (10).
4. Remove the taper hub assembly (11) and discard.

   NOTE: A new hub will have to be ordered to replace the discarded hub.

5. Remove the axle shaft key (17).

Inspection

1. Check all components for excessive wear or damage. Replace if necessary.

Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. When tightening the castle nut (10)*, refer to the table on page 11 for the required torque values.

NOTE: *As a general rule, use the low end of the torque specification . Once at the specified torque, rotate castle nut clockwise to align with nearest cotter pin hole.*

SEE PAGE 22 FOR ALTERNATE TORQUE METHOD.

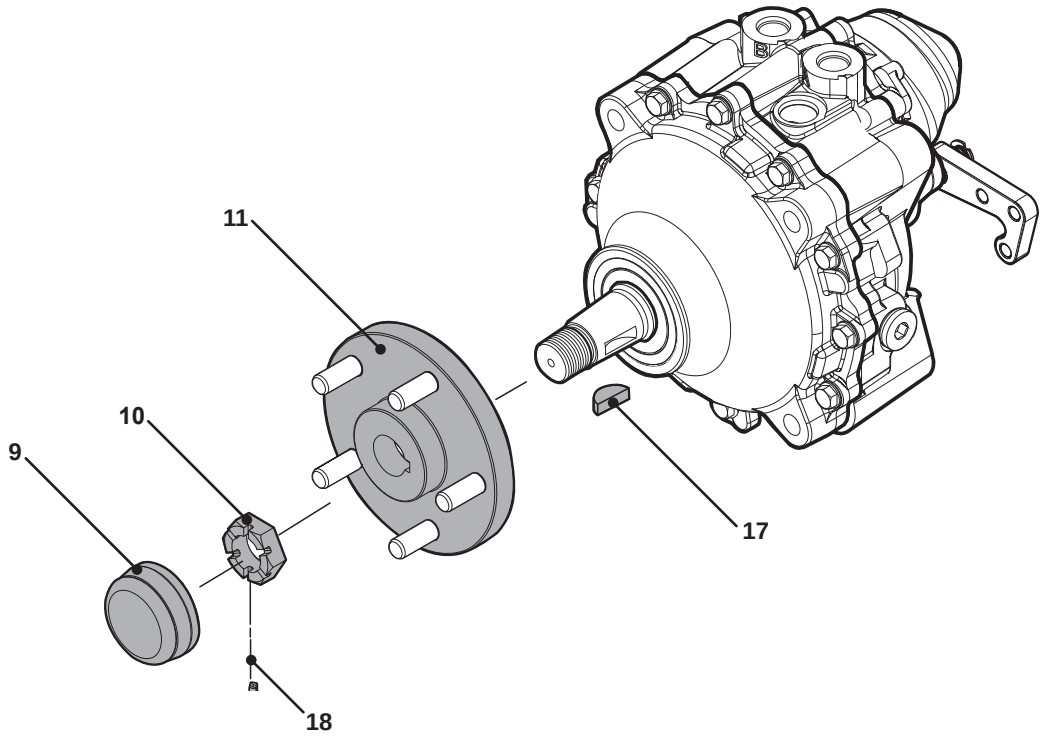


Figure 4, Hub Assembly

BRAKE ARM ASSEMBLY

Refer to Figure 5

Disassembly

1. Remove all items previously discussed in their recommended order.
2. Mark the orientation of the brake arm (59) before removal.
3. Remove the retaining ring (60).
4. Remove the brake handle (59), spring (82) and spring pin (83).
5. Remove the spring spacer (81) and brake spacer (57).
5. Remove the dowel pin (84) and the seal (58). Discard the seal.

NOTE: *Only remove the seal (58) and dowel pin (84) if damaged or worn, or if doing a complete disassembly.*

Inspection

1. Inspect all parts for wear or damage. Replace as necessary.

Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. Install new seal (58) from seal kit.

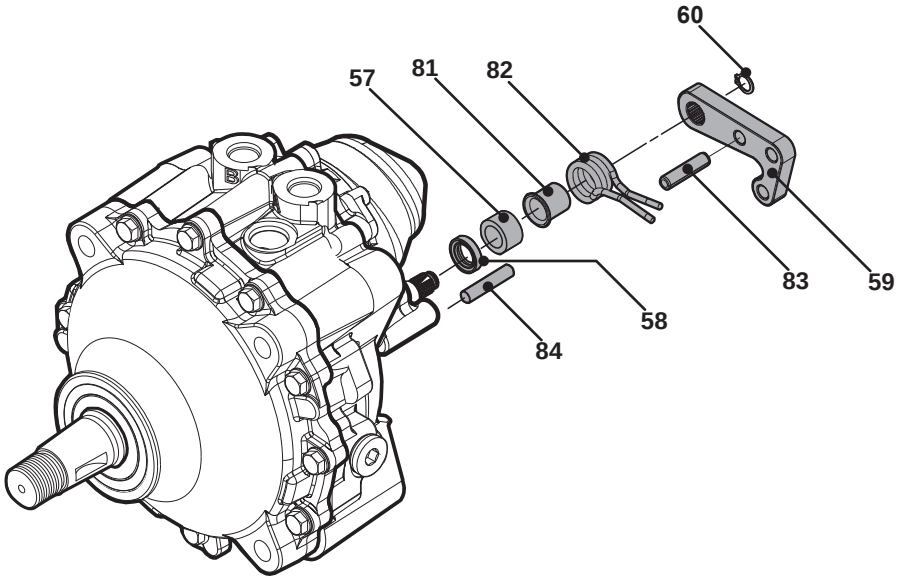


Figure 5, Brake Arm Assembly

SIDE HOUSING

Refer to Figure 6

Disassembly

1. Remove all external items previously discussed in their recommended order.
2. Remove the seal (13) and discard.
3. Remove the twelve housing screws (4), then separate axle housing (1) from middle housing (2).

Inspection

1. Inspect the bearing and bushing areas in the side cover for excessive wear or damage. Replace if necessary.

Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. Apply a bead of sealant around the perimeter of the middle housing face. See “Sealant Application Diagram” on page 21.

NOTE: *Remove all old sealant from the axle housing (1) and the middle housing (2) before applying new sealant.*

3. Align the side housing (2) with the main housing (1). Use care not to smear the sealant bead.
4. Install the twelve housing screws (6). Refer to the screw tightening pattern on page 21.
5. When tightening the fasteners, refer to the table on page 11 for the required torque values.
6. Install a new axle seal (13) from the seal kit.

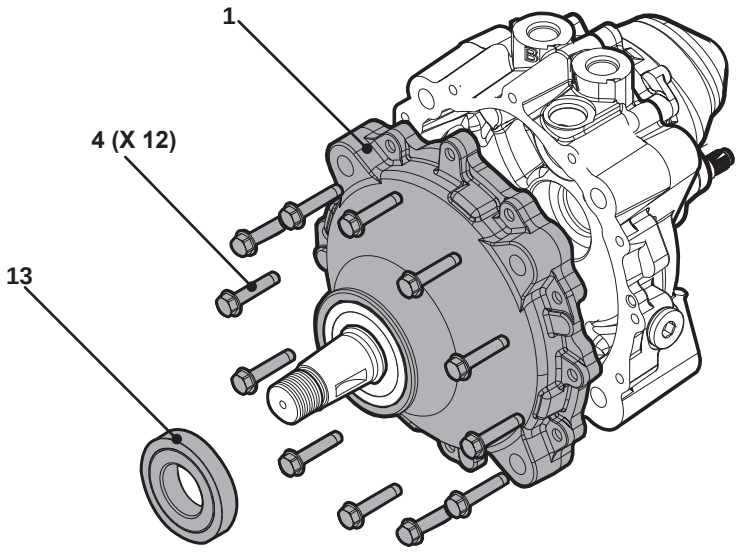


Figure 6, Side Housing

AXLE SHAFT AND PLANETARY GEAR SET

Refer to Figures 7 and 8

Disassembly

1. Remove all external items previously discussed in their recommended order.

NOTE: *Note the location of the ring gear tabs.*

2. Remove the axle bearing (14) and washer (15).
3. Remove the ring gear (21).
4. Remove the axle shaft (16) and planetary assembly from the middle housing (2).
5. Remove the axle retaining ring (26), axle shaft spacer (25), axle gear (24), planet gears (22), sun gear (23) and the carrier (20).

NOTE: *The sun gear (23) and axle gear (24) are pressed as one piece in some models. (Figure 8a)*

Inspection

1. Inspect all items of the planetary gear set for wear and or damage.

Assembly

1. Reassemble all parts in the reverse order of disassembly.

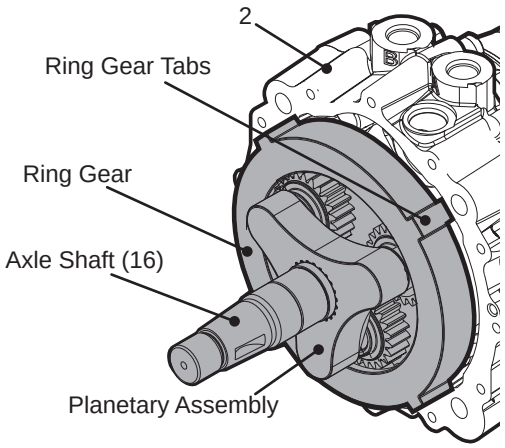


Figure 7, Planetary Gear Set

NOTE: *When installing the ring gear assembly — line up the ring gear tabs with the housing tabs.*

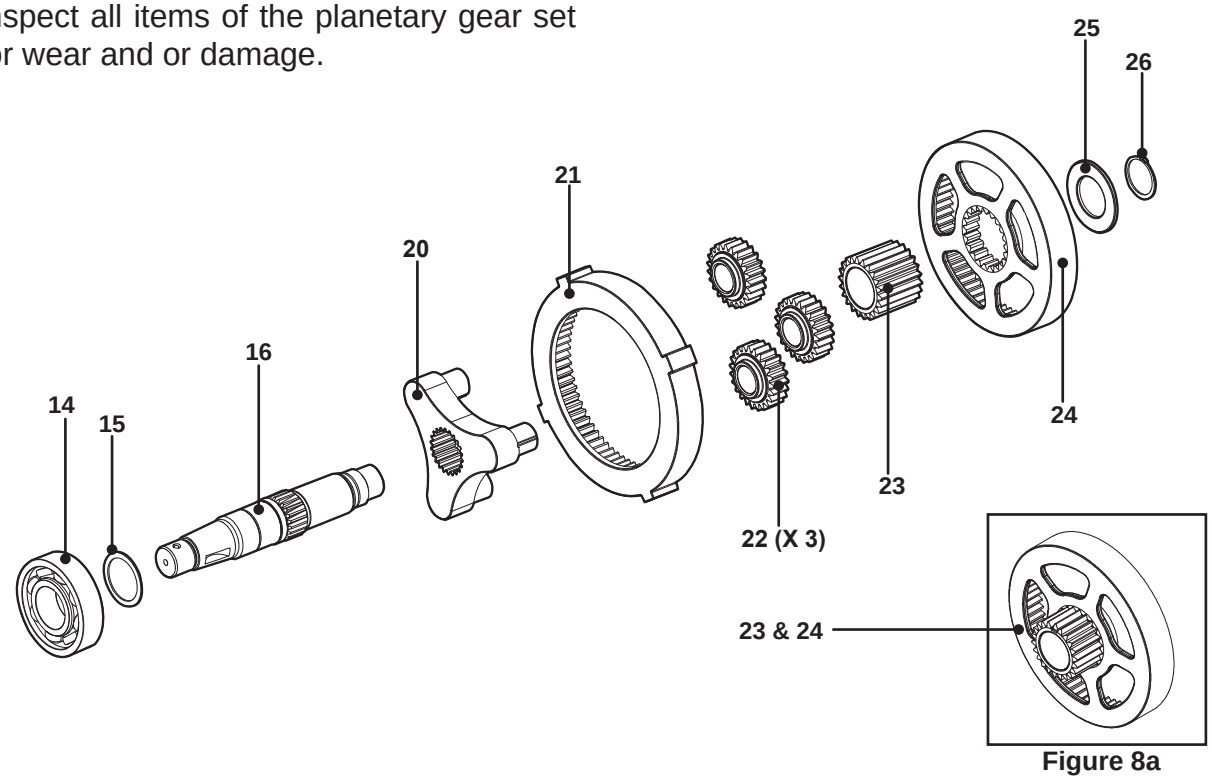


Figure 8a

Figure 8, Planetary Gear Set

BEARING AND MOTOR BLOCK CAP

Refer to Figure 9

Disassembly

1. Remove all external items previously discussed in their recommended order.
2. Remove the seven housing cap screws (4) and the housing cap (3).
3. Remove the o-ring (6) and discard.
4. Remove the thrust bearing (45), retaining ring (47) and washer (46). Discard the retaining ring (47)

Inspection

1. Inspect the races of the thrust bearing (80) for wear or damage.

Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. Install new o-ring (6) and retaining ring (47) from seal kit.
3. Place the thrust bearing assembly (45) so the thick race contacts the motor block pistons.
4. Install the seven housing screws (6). Refer to the screw tightening pattern on page 21.
5. When tightening the fasteners, refer to the table on page 11 for the required torque values.

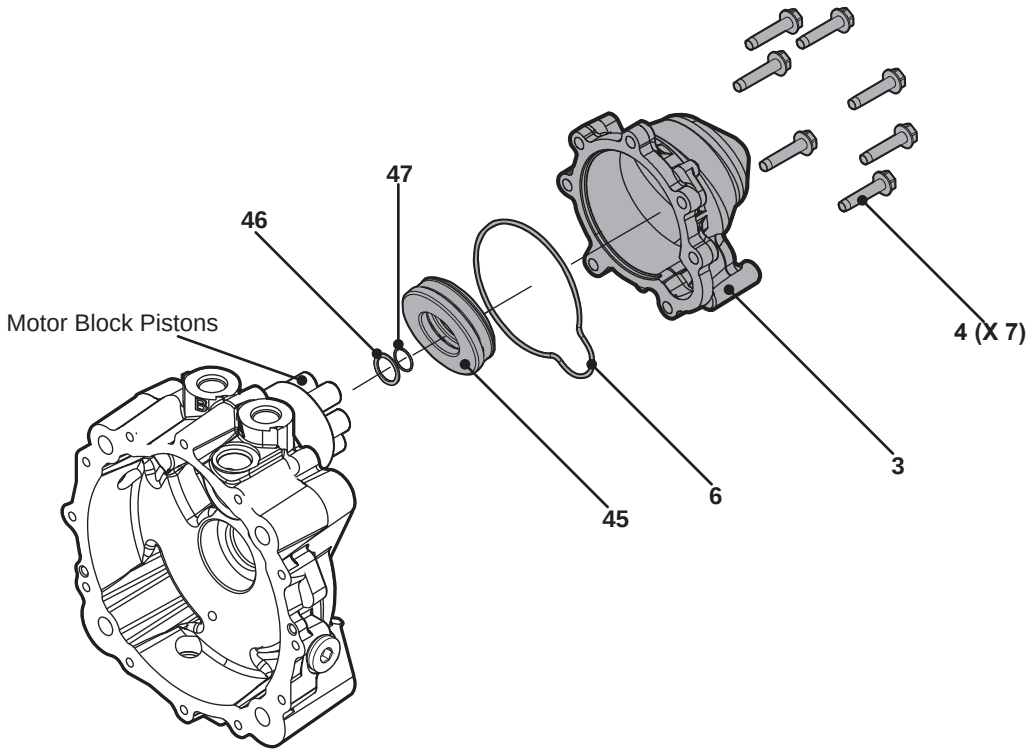


Figure 9, Motor Block Cap and Bearing

MOTOR BLOCK

Refer to Figure 10

Disassembly

1. Remove all external items previously discussed in their recommended order.
2. Remove the motor block assembly (40) from the middle housing (2).
3. Disassemble the motor block assembly and inspect all parts.

Inspection

1. Inspect the pistons (43), piston seats (42), springs (41) and the motor cylinder block (40) of the motor block assembly for scratches and or wear. Replace the motor block assembly if necessary.

Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. Apply a light coating of oil to all running surfaces to prevent scoring during reassembly.

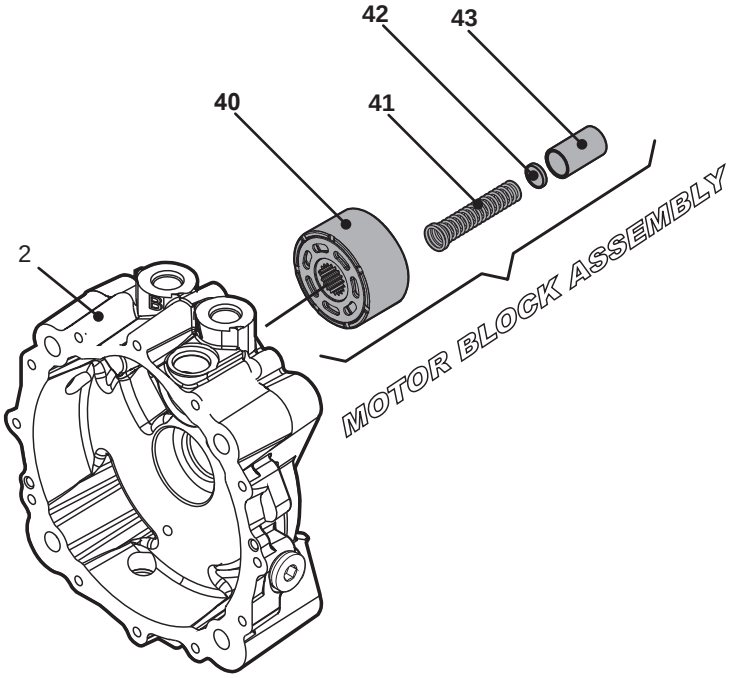


Figure 10, Motor Block

MOTOR SHAFT AND AXLE BEARING

Refer to Figure 11

Disassembly

1. Remove all external items previously discussed in their recommended order.
2. Remove the motor shaft (34), retaining ring (30) and gear (31) out of the middle housing (2).
3. Remove the brake rotor (32) and the washer (33).
4. Remove the inboard axle bearing (27).

Inspection

1. Inspect for scratches and or damage to the brake rotor (32).
3. Inspect the gear (31) and motor shaft (34) for wear or damage.

Assembly

1. Reassemble all parts in the reverse order of disassembly.

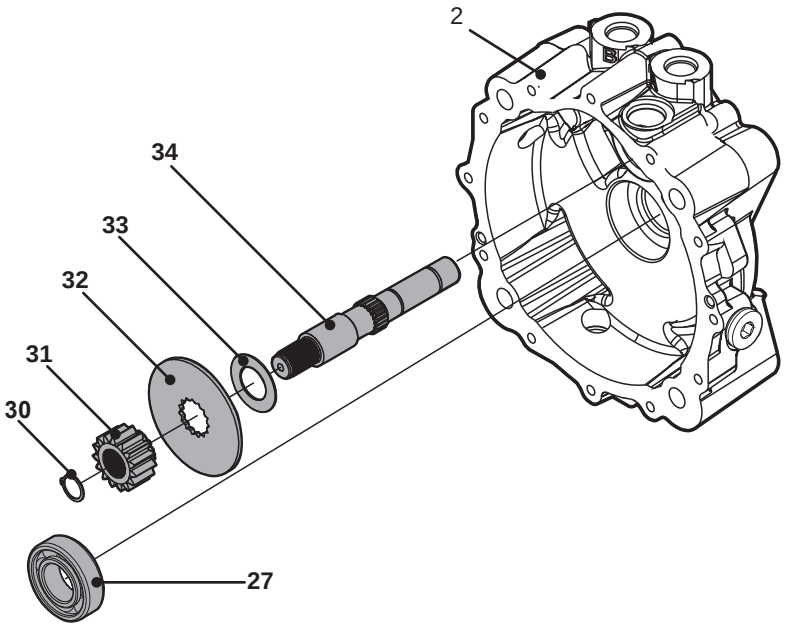


Figure 11, Motor Shaft and Brake Disc

BRAKE SHAFT AND CAM

Refer to Figure 12

Disassembly

1. Remove all external items previously discussed in their recommended order.

NOTE: *If the brake is working properly and the brake components are not damaged, there is no need to remove the brake assembly.*

2. Remove the brake shaft nut (56) and washer (55).
3. Remove the brake shaft (50), the splined cam (51), the puck cam (52) and brake puck (54).
4. Remove the magnet screw (7) magnet (8) and dowel pin (53).

NOTE: *Only remove the dowel pin (53) and magnet components (7, 8) if damage is present.*

Inspection

1. Inspect the puck (54) for excessive wear.
2. Inspect all components for wear or damage.

Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. When tightening the nut (56), refer to the table on page 11 for the required torque values.

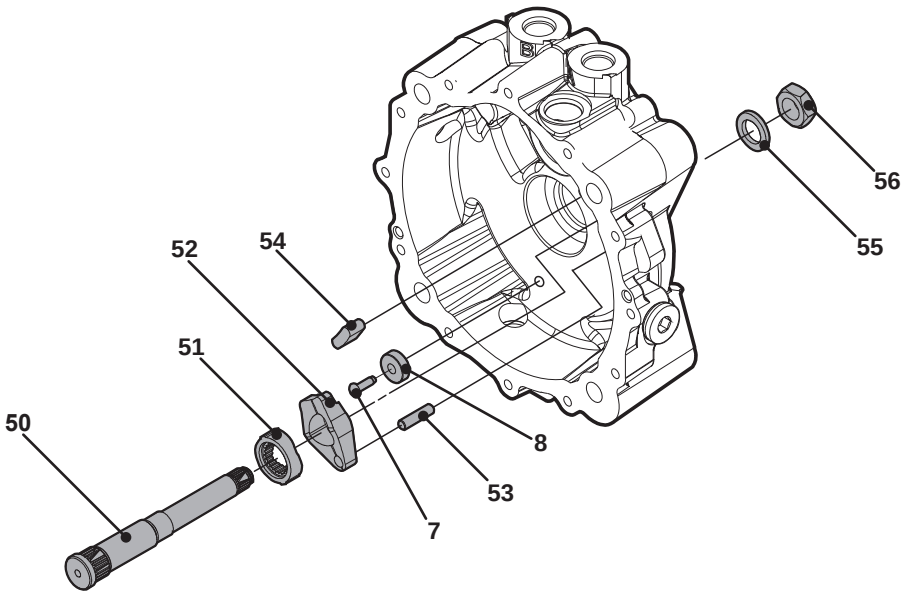


Figure 12, Brake Shaft Assembly

SCREW TIGHTENING SEQUENCE

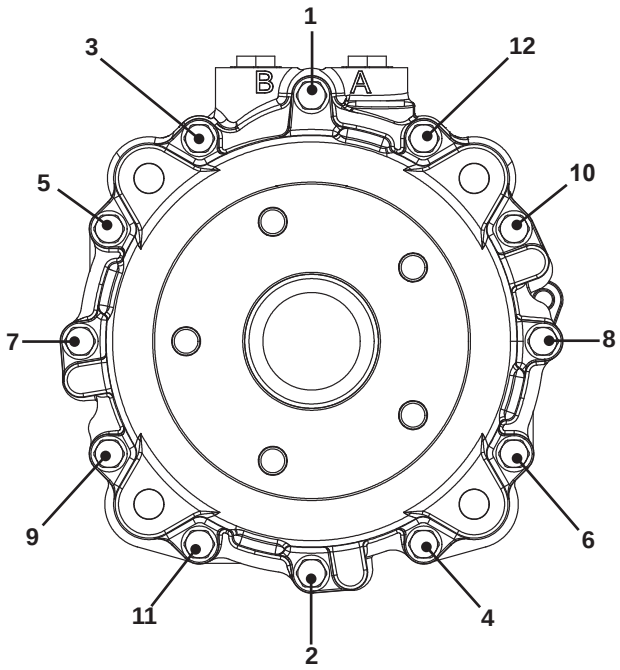


Figure 13, Side Housing Bolt Sequence

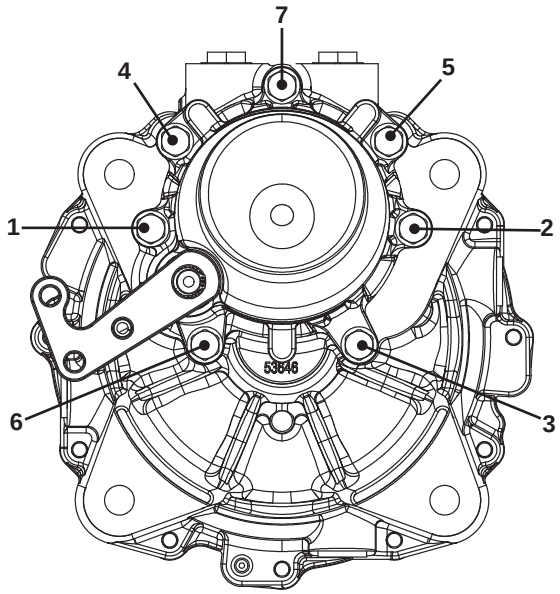


Figure 14, Motor Housing Cap Bolt Sequence

SEALANT PATH

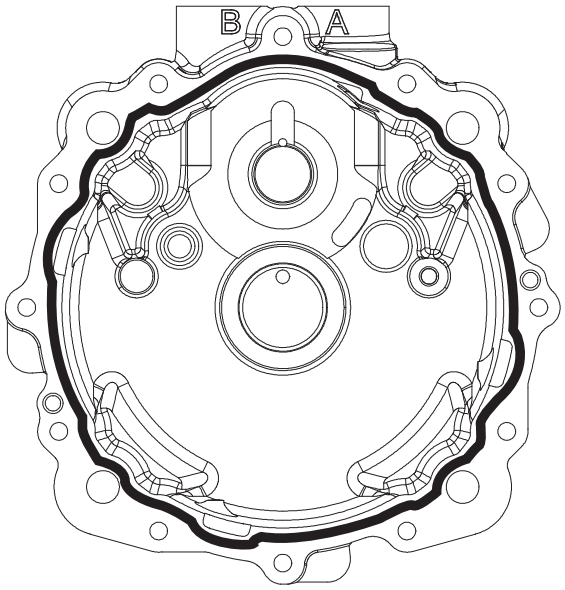


Figure 15, Sealant Path

CASTLE NUT (10) ALTERNATE TORQUE METHOD

NOTE: *The ideal method for installing a new hub and nut is utilizing a torque wrench capable of 275 ft-lbs. If a 275 ft-lbs torque wrench is not available please use the alternative procedure outlined in this document. All parts need to be clean and free of lubrication.*

Tools:

1. Air Compressor and Air Impact Wrench or Electric Impact Wrench (REMOVAL ONLY)
2. 1 7/16” Socket
3. Socket Extension
4. Torque Wrench (Must be capable of achieving 50 ft-lbs)
5. Paint Pen or visible marker.
6. Flash Light

Procedure:

1. Engage machine parking brake.
2. Remove nut cover.
3. Remove existing nut.
4. Install new nut to 50 ft-lbs
5. Mark a point on the new nut and hub per Figure 16. (Point A)
6. Measure 2 nut flats or 120º per Figure 16 and mark hub. (Point B)
7. Turn nut clockwise until mark “A” lines up with mark “B”. (*Figure 17*)
8. Continue turning nut clockwise until the slot lines up with the cross hold of the axle shaft.
9. Install cotter pin.
10. Reinstall nut cover.

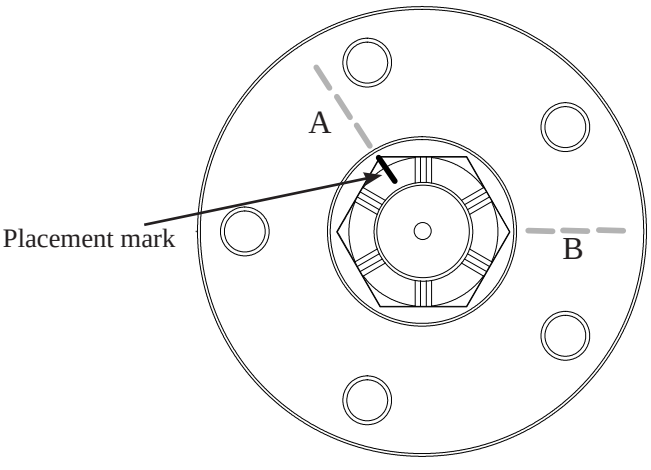


Figure 16

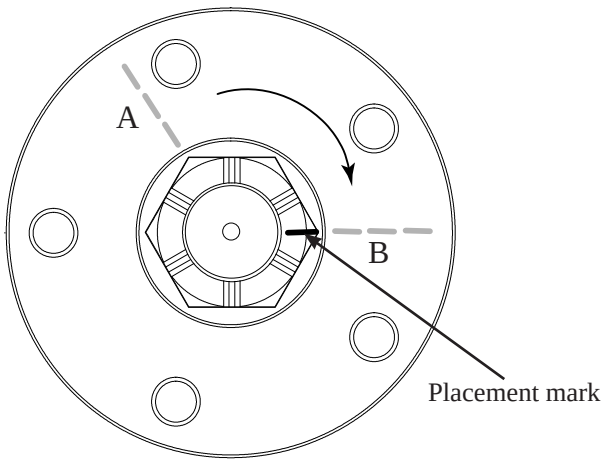


Figure 17

Figure 16 / Figure 17, Alternate Torque Method

ASSEMBLY AFTER A COMPLETE TEARDOWN

If the unit has been torn down completely, the following summary identifies the assembly procedures necessary to completely assemble the unit. Each assembly procedure is located by a page reference.

The part reference numbers provided in each assembly procedure are keyed to the individual exploded views, and are also keyed to the complete unit exploded view on page 24.

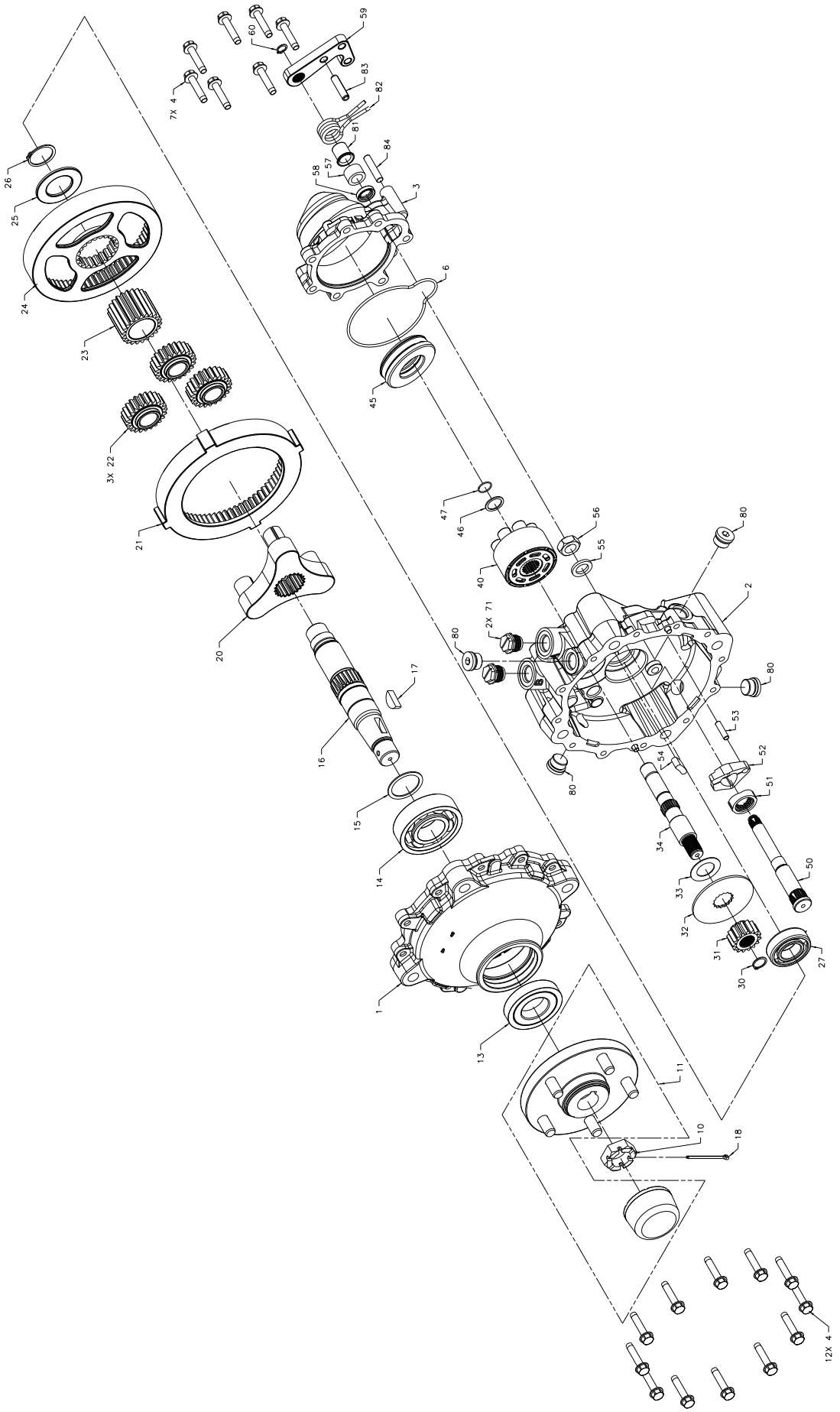
1. Install the brake shaft (50) and cam assembly (51, 52) to the middle housing (2). Page 20
2. Install the inboard axle bearing (27). Page 19
3. Install the motor shaft (34), washer (33), brake rotor (32), motor shaft gear (31), retaining ring (30). Page 19
4. Install the block assembly (40) onto the motor shaft (34). Page 18
5. Install the retaining ring (46) and washer (47) onto the motor shaft (34). Page 17
6. Install the thrust bearing (45), o-ring (6), housing cap (3) and housing cap screws (7). Page 17
7. Install the three planet gears (22) onto the carrier (20) and then onto the axle shaft (16). Install the sun gear (23) onto the axle shaft (16). Install the bull gear (24), thrust spacer (25) and retaining ring (26) onto the axle shaft and set assembly aside. Place the axle assembly into the main housing. Install the ring gear (21) onto the axle shaft so that the teeth mesh with the planet gears and install the washer (15) and axle bearing (14) onto the axle shaft (16). Page 16

Note: *Make sure that two of the tabs on the outer diameter of the ring gear (21) locate between the tabs cast into the main housing.*

- Some models will have the sun gear (23) and the bull gear (24) as one pressed gear.

8. Apply sealant material onto housing middle housing (2). Page 21
9. Install the axle housing (1), the 12 housing screws (4), and the axle seal (13). Page 15
10. Install brake dowel pin (84), brake seal (58), brake spacer (57), and spring spacer (81). Page 14
11. Install the brake arm spring (82), the spring pin (83), the brake arm (59), and the retaining ring (60). Page 14
12. Install the axle key (17), hub assembly (11), axle nut (10), cotter pin (18) and axle cap (9). Page 13
13. Install the unit into the machine and fill the case with 34 fl. oz. of fluid after filling the hydraulic system. Page 8

HGM-H MOTOR EXPLODED VIEW



HGM-H MOTOR PARTS LIST

1	Housing, Axle
2	Housing, Middle
3	Housing, Motor Block
4	Screw, Housing
6	O-ring, Motor Housing
9	Cap, Axle
10	Nut, Axle
11	Hub, Taper (1.25, 4 Bolt / 1.25, 5 Bolt)
13	Seal, Axle
14	Bearing, Axle, Outboard
15	Spacer, Axle
16	Axle
17	Key, Woodruff, Axle
18	Pin, Cotter 5/32 X 2
20	Carrier
21	Gear, Ring
22	Gear, Planet
23	Gear, Sun
24	Gear, Internal, 71T
25	Spacer, Axle, Gear
26	Retaining Ring
27	Bearing, Axle, Inboard
30	Retaining Ring, Motor Shaft
31	Gear, 19T
32	Rotor, Brake
33	Washer, Motor Shaft
34	Shaft, Motor
40	Motor Block Kit, 16cc Cylinder
45	Thrust Bearing
46	Washer
47	Retaining Ring, External
50	Shaft, Brake
51	Splined Cam, Brake
52	Cam Puck, Brake
53	Pin, Ground, Dowel
54	Brake Puck
55	Washer, Flat .63 X 1.0 X.125
56	Nut, Brake
57	Spacer, Brake
58	Seal, Brake
59	Handle, Brake Actuating
60	Retaining Ring, Brake Handle
71	Plug, 3/4 SAE, Plastic
80	Plug, 3/4-16, Metal
81	Spacer, Spring
82	Spring, Torsion
83	Pin, Spring 5/16 X 1.375
84	Pin, Hardened Ground Dowel 5/16 X1.5

GLOSSARY OF TERMS

Axial Piston: Type of design for hydraulic motors and pumps in which the pistons are arranged parallel with the spindle (input or output shaft).

Bypass Valve: A valve whose primary function is to open a path for the fluid to bypass the motor or pump. Also referred to occasionally as the freewheel valve or dump valve.

Case Drain Line (Return Line): A line returning fluid from the component housing to the reservoir.

Cavitation: A concentrated gaseous condition within the fluid causing the rapid implosion of a gaseous bubble.

Center Section: A device which acts as the valve body and manifold of the transmission.

Charge Pump: A device which supplies replenishing fluid to the fluid power system (closed loop).

Charge Pressure: The pressure at which replenishing fluid is forced into a fluid power system.

Charge Relief Valve: A pressure control valve whose primary function is to limit pressure in the charge circuit.

Check Valve: A valve whose primary function is to restrict flow in one direction.

Closed Loop: A sealed and uninterrupted circulating path for fluid flow from the pump to the motor and back.

Decay Rate: The ratio of pressure decay over time.

End Cap: See “Center Section.”

Entrained Air: A mechanically generated mixture of air bubbles having a tendency to separate from the liquid phase.

Gerotor: A formed rotor set operating about an eccentric that provides a fixed displacement for pumps or motors.

Hydraulic Motor: A device which converts hydraulic fluid power into mechanical force and motion by transfer of flow under pressure.

Hydraulic Pump: A device which converts mechanical force and motion into hydraulic fluid power by producing flow.

Hydrostatic Pump: See “Hydraulic Pump.”

Hydrostatic Transaxle: A multi component assembly including a gear case and a hydrostati-transmission.

Hydrostatic Transmission: The combination of a hydraulic pump and motor in one housing to form a device for the control and transfer of power.

Inlet Line: A supply line to the pump.

Integrated Zero-Turn Transaxle: The combination of a hydrostatic transmission and gear case in one housing to form a complete transaxle.

Manifold: A conductor which provides multiple connection ports.

Neutral: Typically described as a condition in which fluid flow and system pressure is below that which is required to turn the output shaft of the motor.

Pressure Decay: A falling pressure.

Priming: The filling of the charge circuit and closed loop of the fluid power system during start up, frequently achieved by pressurizing the fluid in the inlet line.

Purging: The act of replacing air with fluid in a fluid power system by forcing fluid into all of the components and allowing the air a path of escape.

Rated Flow: The maximum flow that the power supply system is capable of maintaining at a specific operating pressure.

Scoring: Scratches in the direction of motion of mechanical parts caused by abrasive contaminants.

Swash Plate: A mechanical device used to control the displacement of the pump pistons in a fluid power system.

System Charge Check Valve: A valve controlling the replenishing flow of fluid from a charge circuit to the closed loop in a fluid power system.

System Pressure: The pressure which overcomes the total resistance in a system, including all efficiency losses.

Valve: A device which controls fluid flow direction, pressure, or flow rate.

Variable Displacement Pump: A pump in which the displacement per revolution can be varied.

Volumetric Displacement: The volume for one revolution.

HYDRO-GEAR®

FORWARD MOTION THROUGH FORWARD THINKING

HEM™ Series Motor Service and Repair Manual

BLN-0083

January 2018

TABLE OF CONTENTS

FOREWORD

Headquartered in Sullivan, Illinois, Hydro-Gear® is a world leader in the design, manufacture, and service of quality hydrostatic transaxles for the lawn and garden industry. The mission of our company is to be recognized by our customers and the industry as a world-class supplier and the quality leader in everything we do.

This Service and Repair Manual is designed to provide information useful in servicing and troubleshooting the Hydro-Gear HEM™ High Efficiency Motor.

Also included is a glossary of terms that are frequently used throughout the industry and in Hydro-Gear service publications. Understanding terminology is very important!

It is necessary, and a good shop practice, that your service area be equipped with the proper tools and the technicians be supplied the latest information available. All repair procedures illustrated in this guide are suggested, but preferred methods of repair.

Repair procedures require that the HEM motor be removed from the machine.

This is not a certification, test or study guide for a certification test. If a technician is interested in certification, they should contact an agent representing the EETC (Equipment and Engine Training Council) at (888) 406-1810 or at EETC@EETC.org. Many distributors will be hosting certification testing. These study guides will cover most of the products and manufacturers in our industry.

For more information about Hydro-Gear or our products, please contact your Central Service Distributor.

DESCRIPTION AND OPERATION

INTRODUCTION

The purpose of this manual is to provide information useful in servicing the Hydro-Gear® HEM™ High Efficiency Motor. This manual includes general descriptions, technical specifications, servicing and troubleshooting procedures.

Should the motor require servicing, the exterior of the motor will need to be thoroughly cleaned before beginning most procedures. Do not wash the motor while it is hot. **It is best to not allow direct spray from a pressure washer to clean the motor.**

GENERAL DESCRIPTION

The HEM is a fixed displacement axial piston motor. The fixed displacement motor design, allows an output speed range between zero and maximum speed in both forward and reverse. Each high speed / low torque motor has a rotating kit utilizing spherical-nosed axial pistons for the transfer and control of power.

The cylinder block pistons in the HEM motor are set at a fixed displacement by a swash plate angle. As pressurized fluid from the pump pushes against the cylinder block pistons, they are forced to rotate with the thrust bearing. As the pistons rotate with the thrust bearing, they create torque and rotary motion that that is transmitted to the motor shaft. Torque continues to develop as long as the piston is being pushed out of the cylinder block. When the piston reaches the end of it's movement out of the cylinder block, it gets pushed back into the cylinder and fluid inside the piston is discharged through the low pressure port of the motor. Pistons develop torque only through half of the cylinder block rotation cycle. Therefore, multiple pistons are used to provide a constant and continuous torque to the motor shaft. Reversing the direction of the incoming pressurized fluid into the motor reverses the direction of the motor output rotation.

EXTERNAL FEATURES

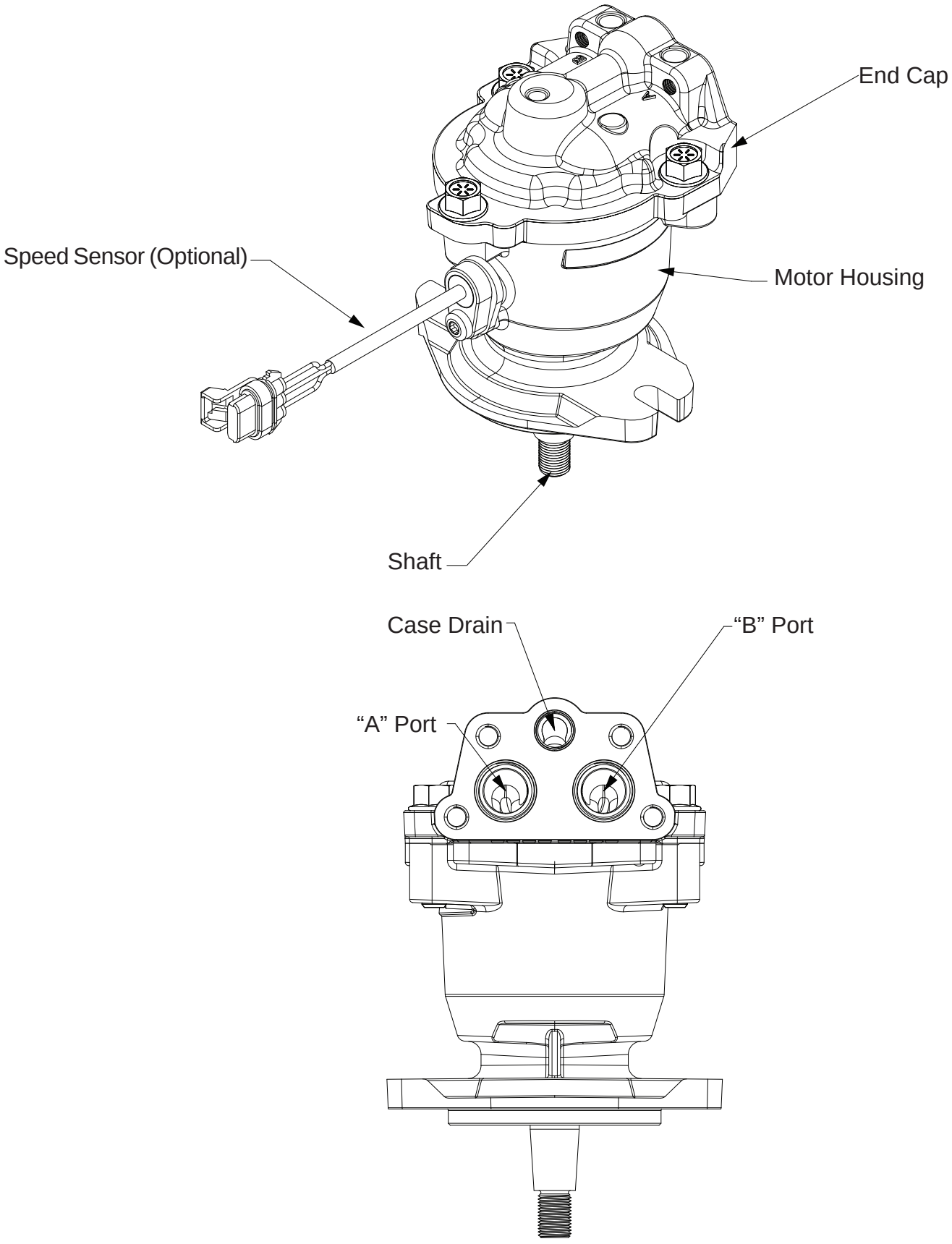


Figure 1, External Features

TECHNICAL SPECIFICATIONS

Product Type	10.2cc	12.0cc
Displacement	0.62 in^3 per rev	0.73 in^3 per rev
System Operating Pressure		
Continuous	261 in-Ibf (29.5 Nm)	310 in-Ibf (35.0 Nm)
Intermittent	324 in-Ibf (36.6 Nm)	386 in-Ibf (43.6 Nm)
Peak	442 in-Ibf (49.9 Nm)	529 in-Ibf (59.8 Nm)
Output Shaft (Diameter)	5/8” Straight Keyed (long)	5/8” Straight Keyed
	3/4” Tapered	3/4” Tapered
	9 Tooth Spline with 16/32 Pitch	9 Tooth Spline with 16/32 Pitch
Output Speed		
Maximum Continuous	3000 rpm	3000 rpm
Minimum Continuous	50 rpm	50 rpm
Maximum Intermittent	4200 rpm	4200 rpm
Weight lb[kg]	7 [3.1]	7 [3.1]

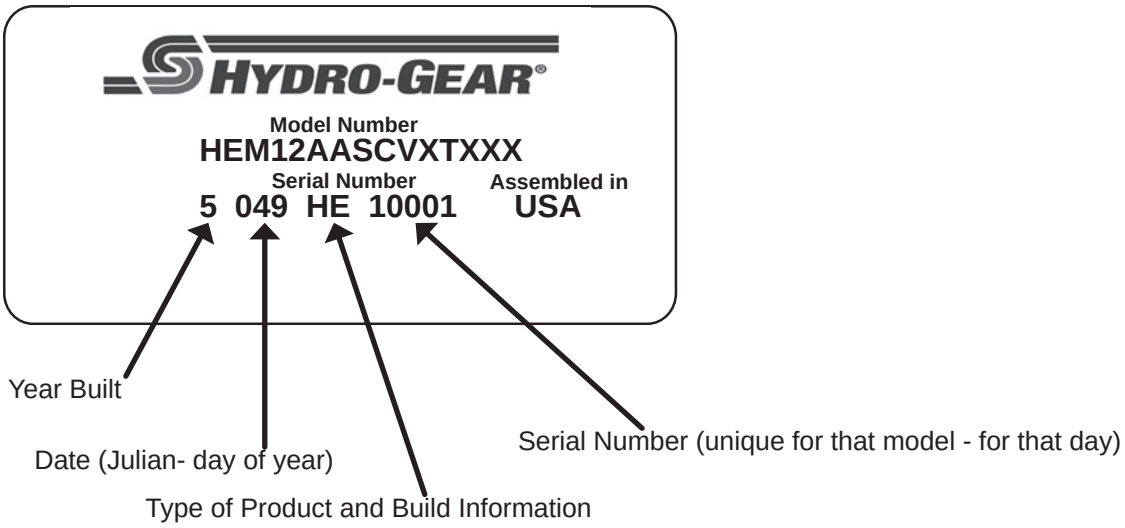


Figure 2, Product Label

SAFETY

This symbol points out important safety instructions which, if not followed, could endanger the personal safety and/or property of yourself and others. Read and follow all instructions in this manual before attempting maintenance on your hydraulic motor. When you see this symbol - **HEED ITS WARNING.**

WARNING

POTENTIAL FOR SERIOUS INJURY

Inattention to proper safety, operation, or maintenance procedures could result in personal injury, or damage to the equipment. Before servicing or repairing the hydraulic motor, fully read and understand the safety precautions described in this section.

PERSONAL SAFETY

Certain safety precautions must be observed while servicing or repairing the hydraulic motor. This section addresses some of these precautions but must not be considered an all-inclusive source on safety information. This section is to be used in conjunction with all other safety material which may apply, such as:

1. Other manuals pertaining to this machine.
2. Local and shop safety rules and codes.
3. Governmental safety laws and regulations.

Be sure that you know and understand the equipment and the hazards associated with it. Do not place speed above safety.

Notify your supervisor whenever you feel there is any hazard involving the equipment or the performance of your job.

Never allow untrained or unauthorized personnel to service or repair the equipment.

Wear appropriate clothing. Loose or hanging clothing or jewelry can be hazardous. Use the appropriate safety equipment, such as eye and hearing protection, and safety-toe and slip-proof shoes.

Never use compressed air to clean debris from yourself or your clothing.

TOOL SAFETY

Use the proper tools and equipment for the task.

Inspect each tool before use and replace any tool that may be damaged or defective.

WORK AREA SAFETY

Keep the work area neat and orderly. Be sure it is well lit, that extra tools are put away, trash and refuse are in the proper containers, and dirt or debris have been removed from the working areas of the machine.

The floor should be clean and dry, and all extension cords or similar trip hazards should be removed.

SERVICING SAFETY

Certain procedures may require the machine to be disabled in order to prevent possible injury to the servicing technician and/or bystanders.

The loss of hydrostatic drive line power may result in the loss of hydrostatic braking capability.

Some cleaning solvents are flammable. Use only approved cleaning materials: Do not use explosive or flammable liquids to clean the equipment.

To avoid possible fire, do not use cleaning solvents in an area where a source of ignition may be present.

“Discard used cleaning material in the appropriate containers according to local, state, and federal regulations.”

TROUBLESHOOTING

WARNING

Do not attempt any servicing or adjustments with the engine running. Use extreme caution while inspecting the drive belt assembly and all vehicle linkage!

Follow all safety procedures outlined in the vehicle owner's manual.

In many cases, problems with a HEM™ motor are not related to a defective motor, but may be pump related problems. Be sure to perform all operational checks and adjustments outlined in Service and Maintenance, before assuming the motor is malfunctioning. The table below provides a troubleshooting checklist to help determine the cause of operational problems.

TROUBLESHOOTING CHECKLIST

Possible Cause	Corrective Action
Unit Is Noisy	
Oil level low or contaminated oil	Fill to proper level or change oil
Excessive loading	Reduce machine loading
Loose parts	Repair or replace loose parts
Air trapped in hydraulic sysytem	Refer to machine manufacturer's recommendations for purging air from the system
Unit Has No/Low Power	
Engine speed low	Adjust to correct setting
Oil level low or contaminated oil	Fill to proper level or change oil
Excessive loading	Reduce machine loading
Air trapped in hydraulic sysytem	Refer to machine manufacturer's recommendations for purging air from the system
Unit Is Operating Hot	
Debris buildup around motor	Clean off debris
Oil level low or contaminated oil	Fill to proper level or change oil
Excessive loading	Reduce machine loading
Air trapped in hydraulic sysytem	Refer to machine manufacturer's recommendations for purgingair from the system
Motor Leaks Oil	
Damaged seals, housing, or gaskets	Replace damaged components
Air trapped in hydraulic sysytem	Refer to machine manufacturer's recommendations for purging air from the system

SERVICE AND MAINTENANCE

NOTE: Any servicing dealer attempting a warranty repair must have prior approval before conducting maintenance of a Hydro-Gear® product unless the servicing dealer is a current Authorized Hydro-Gear Service Center.

EXTERNAL MAINTENANCE

Regular external maintenance of the HEM™ should include the following:

1. **Check the machine operator's manual for the recommended load ratings. Insure that the current application does not exceed load rating.**
2. Check fluid level in drive system reservoir in accordance with the machine manufacturer's recommendations.
3. Inspect all external plumbing for possible leaks or loose fittings.
4. Insure the reservoir is free of contaminants and is properly vented.
5. Remove any obstructions (leaves or dirt).

SERVICE AND MAINTENANCE PROCEDURES

NOTE: Damage to the HEMs may result from external or internal contamination: Heat from excess debris or lack of lubrication and over-pressurization of the product. Follow guidelines established in this manual and the machine manufacturer's recommendations.

Some of the service procedures presented on the following pages can be performed while the motor is mounted on the machine. Any repair procedures as mentioned in the repair section of this manual must be performed after the motor has been removed from the machine. The motor should be thoroughly cleaned before any service procedures are performed.

FLUIDS

The fluids used in Hydro-Gear products have been carefully selected, and only equivalent, or better products should be substituted.

Hydraulic oil in the range of ISO 32 to ISO 68 has been approved for the HEM. At the peak operating temperature, hydraulic oil viscosity is required to be a minimum of 9 cSt [55 SUS].

"All fluids should be handled and disposed of according to local, state, and federal regulations."

FLUID VOLUME AND LEVEL

Certain situations may require additional fluid to be added or even replaced. Refer to the machine manufacturer's recommendations for the proper fill location and level.

FLUID CHANGE

In the event of oil degradation, oil addition or change may alleviate certain performance problems. Refer to the machine manufacturer's recommended oil change frequency.

In the event of oil contamination or hydraulic system component failure, a complete teardown and inspection of the HEM will be required.

Note: Anytime the HEM is drained of oil the motor case should be filled (150 milliliters) prior to system startup.

SERVICE AND MAINTENANCE

PURGING PROCEDURES

The HEM motor cannot be purged of air as a stand alone component. The hydraulic system as a whole will need to be purged after any addition of oil to the system or a complete oil change. When purging the unit, refer to the machine manufacturer's recommendations for purging air from the system.

Air creates inefficiency because its compression and expansion rate is higher than that of the oil.

Due to the effects air has on efficiency in hydrostatic drive applications, it is critical that it is purged from the system.

The resulting symptoms in hydrostatic systems may be:

1. Noisy operation.
2. Lack of power or drive after short term operation.
3. High operation temperature and excessive expansion of oil.

TEAR DOWN AND REASSEMBLY

HOW TO USE THIS MANUAL

Each subassembly illustrated in this manual is illustrated with an exploded view showing the parts involved. The **item reference numbers in each illustration are for assembly instructions only.** See page 19 for part names and descriptions. A complete exploded view and item list of the motor is provided at the end of the repair section.

GENERAL INSTRUCTIONS

Cleanliness is a primary means of assuring satisfactory life on repaired units. Thoroughly clean all exposed surfaces prior to any type of maintenance. Cleaning of all parts by using a solvent wash and air drying is usually adequate. As with any precision equipment, all parts must be kept free of foreign material and chemicals.

Protect all exposed sealing surfaces and open cavities from damage and foreign material. The external surfaces should be cleaned before beginning any repairs. **It is best to not allow direct spray from a pressure washer to clean the motor.**

Upon removal, it is recommended that all seals, O-rings, and gaskets be replaced. During installation lightly lubricate all seals, O-rings and gaskets with a clean petroleum jelly prior to assembly. Also protect the inner diameter of seals during installation by covering the shaft with a cellophane or plastic wrap material. Be sure all remnants of this covering are removed after servicing.

Parts requiring replacement must be replaced from the appropriate kits identified in the Items Listing, found at the end of this manual.

Note: “Any and all Hydro-Gear components removed and replaced during service are recyclable.”

TOOLS

REQUIRED TOOLS	
Miscellaneous	**Sockets**
Flat Blade Screw Driver	9/16 Deep Socket
Torque Wrench	
3/8” Drive Ratchet	
Large External Snap Ring Pliers	
Needle Nose Pliers	
T30 Torx	
1/2” Open Ended Wrench	
Face Seal Driver (Optional)	

TORQUES

REQUIRED TORQUE VALUES			
Item	**Description**	**Torque**	**Operation**
12	3, HFHCS 3/8-16 x 1.5 (PATCH)	470-530 in-lbs (53.10-59.88 Nm)	End Cap Bolts
22	Screw, Pan Head 1/4-20 x .75	100-130 in-lbs (11.30-14.69 Nm)	Speed Sensor

REMOVAL

NOTE: *It is necessary to remove the HEM™ from the machine before performing the repair procedures presented in this section.*

Before starting any disassembly, make certain that your work area is neat and clean. Clean the external parts of the HEM.

The following procedures are presented in the order recommended for a complete tear down of the HEM.

Do not disassemble the unit any farther than necessary to accomplish the required repairs.

Reassembly is accomplished by performing the "Assembly" portions of the procedures. If the unit has been completely disassembled, a summary of the assembly procedures, in the order in which they should occur, is given on page 17.

SPEED SENSOR ASSEMBLY (OPTIONAL)

Refer to Figure 3

1. Remove the screw (22).
2. Remove the speed sensor (21).
3. Remove the shim (20).

Inspection

1. Check all components for excessive wear or damage. Replace if necessary.

Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. When tightening the screw (22), refer to the table on page 10 for the required torque values.

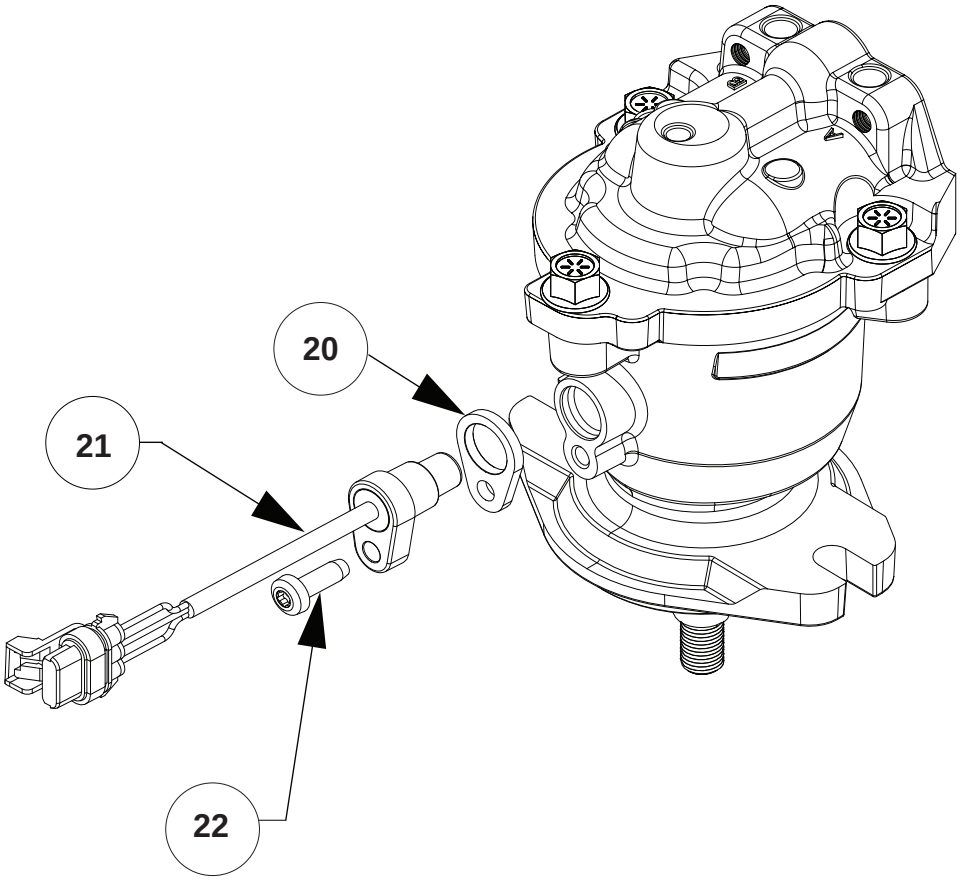


Figure 3, Speed Sensor Assembly

END CAP ASSEMBLY

Refer to Figure 4

Disassembly

1. Remove all items previously discussed in the recommended order.
2. Mark the orientation of the end cap (3) and the motor housing (1).
3. Remove the screws (12).
4. Slowly remove the end cap (3).
5. Remove the O-ring (10).

NOTE: *O-ring (10) is located in the motor housing (1).*

Inspection

1. Inspect all parts for wear or damage. Replace as necessary.

Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. Install O-Ring (10) into housing (1).
3. Install the endcap (3).
4. Install the three endcap screws (12). When tightening the screws (12), refer to the table on page 10 for the required torque values.

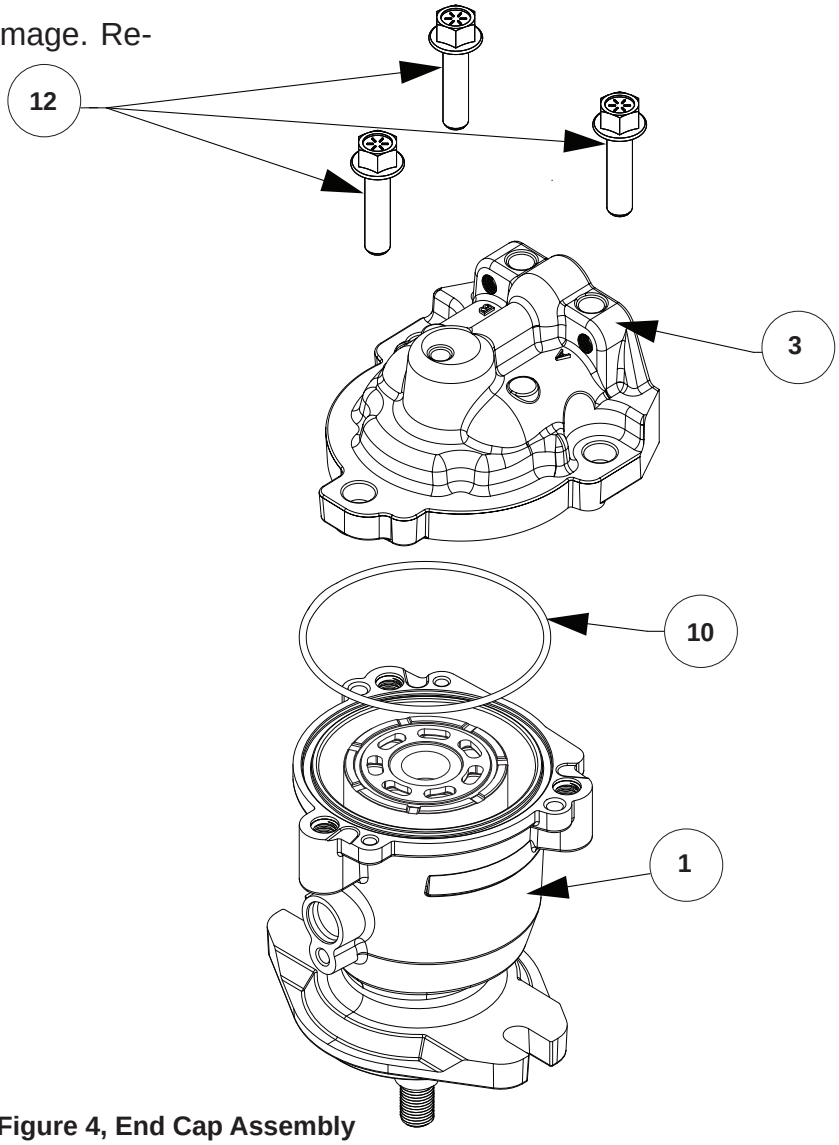


Figure 4, End Cap Assembly

CYLINDER BLOCK ASSEMBLY

Refer to Figure 5

Disassembly

1. Remove all items previously discussed in the recommended order.
2. Tilt the motor on its side and drain the remaining oil. Lift out the cylinder block assembly (7).
3. Remove the pistons, springs and piston seats.

Inspection

1. Inspect the running surface of the cylinder block and piston ends for damage. The running surface may show evidence of minor abrasion. This will be normal wear. If grooved, scratched, or smeared, replace with a new cylinder block assembly.
2. Inspect the pistons and springs for wear or damage.
3. Inspect the piston seats.

Note: Residual oil may cause the piston seats to remain stuck inside of the pistons.

Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. Install the piston seats, pistons and springs into the cylinder block (7).
3. Install the cylinder block assembly (7). Make sure the pistons are contacting the thrust bearing (8).

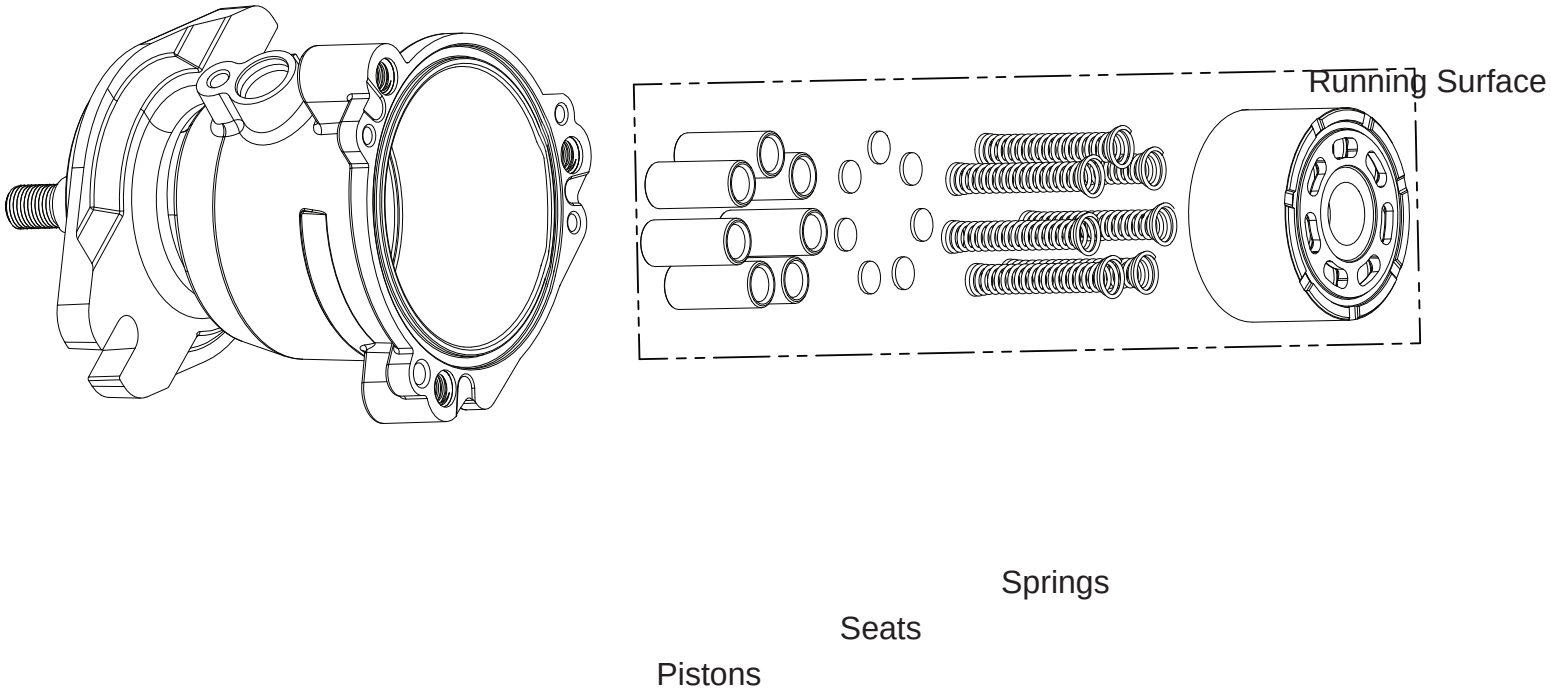


Figure 5, Cylinder Block Assembly

SWASH PLATE AND THRUST BEARING ASSEMBLY

Refer to Figure 6

Disassembly

1. Remove all items previously discussed in the recommended order.
2. Remove the swash plate (2).
3. Remove the thrust bearing and races (8).

Inspection

1. Inspect all components for wear or damage.

Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. Install the thrust bearing and races (8) into the swash plate (2).
3. Install the swash plate (2) into the motor housing (1).

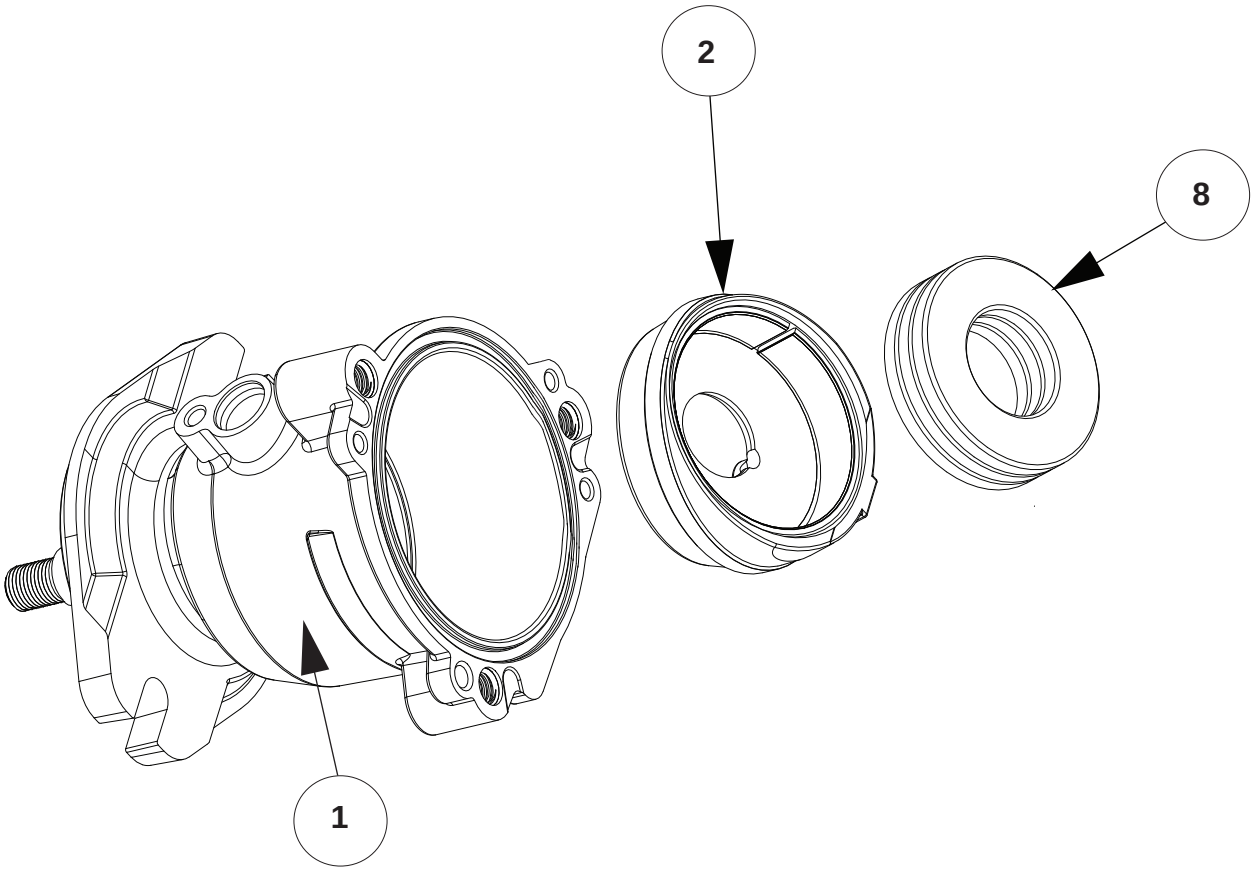


Figure 6, Swash Plate And Thrust Bearing Assembly

SHAFT ASSEMBLY

Refer to Figure 7

Disassembly

1. Remove all items previously discussed in the recommended order.
2. Remove the woodruff key (19).
3. Remove the face seal (18) from the housing (1).
4. Remove the external retaining ring (16).
5. Remove the lip seal (17) and the internal retaining ring (16).
6. Remove the shaft (13).

Inspection

1. Inspect all components for wear or damage.

Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. Install the shaft (13) into the motor housing (1).
3. Install the internal retaining ring (16).
4. Install the lip seal (17).
5. Install the external retaining ring (16) and the face seal (18) into the housing.
6. Install the woodruff key (19) onto the shaft (13).

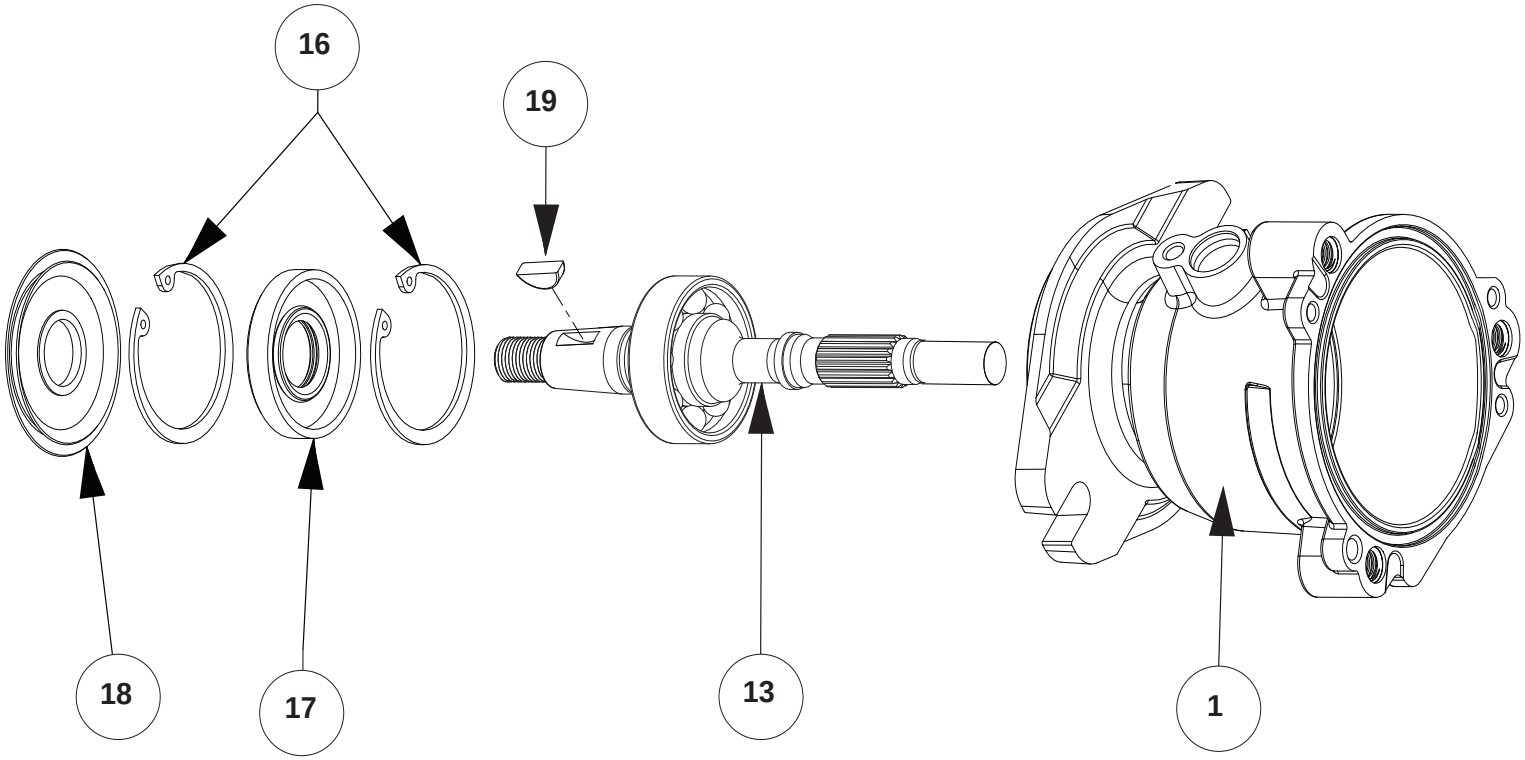


Figure 7, Shaft Assembly

ASSEMBLY AFTER A COMPLETE TEAR DOWN

If the unit has been torn down completely, the following summary identifies the assembly procedures necessary to completely assemble the unit.

The part reference numbers provided in each assembly procedure are keyed to the individual exploded views, and are also keyed to the complete unit exploded view on page 18.

1. Install the shaft (13) with the ball bearing (14) into the motor housing (1).

2. Install one of the internal retaining rings (16), lip seal (17), the final internal retaining ring (16) and the face seal (18).

3. Install the woodruff key (19) onto the shaft (13).

4. **Note: Steps 4-7 will be best accomplished if the HEM motor is in a vertical position with the shaft facing down.**

Install the thrust bearing and race assembly (8) into the fixed swashplate (2). See page 15.

5. Install the swash plate (2) into the motor housing (1). See page 15.

6. Apply a thin layer of clean oil to the pistons and springs.

7. Install the piston seats, pistons and springs into the cylinder block (7). See page 14.

8. With the motor housing tiltled on its side, install the cylinder block assembly (7) with the pistons contacting the thrust bearing. See page 14.

9. Install the o-ring into the seat of the motor housing. See page 13.

10. Lubricate the mating surface of the cylinder block (7) to the end cap (3) with clean oil prior to installation. See page 13.

11. Install the endcap. See page 13.

12. **Note: Before installing the three end cap screws (12), push down on end cap (3) verifying alignment and insuring that the cylinder block pistons spring back and forth.**

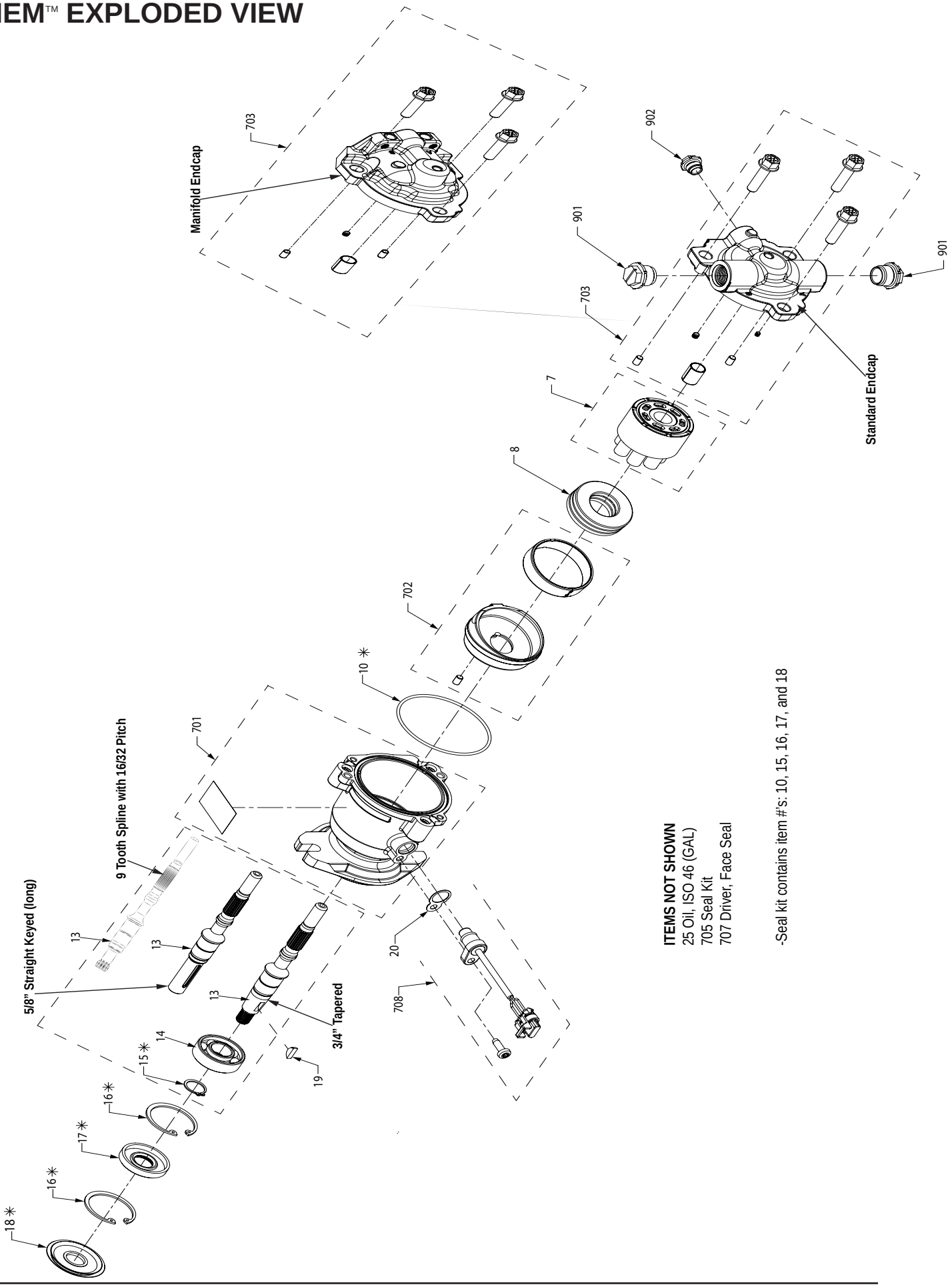
Install the three end cap screws (12). Tighten to the correct torque value. See page 10 for torque specifications.

13. Install the shim (20), speed sensor (21) and pan head screw (22). When tightening the pan head screw (22), see page 10 for torque specifications.

14. Add oil and purge the unit. See pages 7 and 8 for more information.

Important Pages:

HEM™ EXPLODED VIEW



HEM™ PARTS LIST

7	Kit, Cylinder Block
8	Bearing, Thrust
10	O-Ring, 2-153, 3.487 x .375
15	Retaining Ring, Internal
16	Retaining Ring, External
17	Seal, Lip
18	Seal, Face
19	Key, Shaft
20	Shim
25	Oil, ISO 46 (gal)
701	Housing, Motor
702	Kit, Swash Plate
703	Kit, Endcap
704	Kit, Shaft
705	Kit, Seal
706	Kit, Speed Sensor

GLOSSARY OF TERMS

Axial Piston: Type of design for hydraulic motors and pumps in which the pistons are arranged parallel with the spindle (input or output shaft).

Bypass Valve: A valve whose primary function is to open a path for the fluid to bypass the motor or pump. Also referred to occasionally as the freewheel valve or dump valve.

Case Drain Line (Return Line): A line returning fluid from the component housing to the reservoir.

Cavitation: A concentrated gaseous condition within the fluid causing the rapid implosion of a gaseous bubble.

Center Section: A device which acts as the valve body and manifold of the transmission.

Charge Pump: A device which supplies replenishing fluid to the fluid power system (closed loop).

Charge Pressure: The pressure at which replenishing fluid is forced into a fluid power system.

Charge Relief Valve: A pressure control valve whose primary function is to limit pressure in the charge circuit.

Check Valve: A valve whose primary function is to restrict flow in one direction.

Closed Loop: A sealed and uninterrupted circulating path for fluid flow from the pump to the motor and back.

Decay Rate: The ratio of pressure decay over time.

End Cap: See “Center Section.”

Entrained Air: A mechanically generated mixture of air bubbles having a tendency to separate from the liquid phase.

Gerotor: A formed rotor set operating about an eccentric that provides a fixed displacement for pumps or motors.

Hydraulic Motor: A device which converts hydraulic fluid power into mechanical force and motion by transfer of flow under pressure.

Hydraulic Pump: A device which converts mechanical force and motion into hydraulic fluid power by producing flow.

Hydrostatic Pump: See “Hydraulic Pump.”

Hydrostatic Transaxle: A multi component assembly including a gear case and a hydrostatitransmission.

Hydrostatic Transmission: The combination of a hydraulic pump and motor in one housing to form a device for the control and transfer of power.

Inlet Line: A supply line to the pump.

Integrated Zero-Turn Transaxle: The combination of a hydrostatic transmission and gear case in one housing to form a complete transaxle.

Manifold: A conductor which provides multiple connection ports.

Neutral: Typically described as a condition in which fluid flow and system pressure is below that which is required to turn the output shaft of the motor.

Pressure Decay: A falling pressure.

Priming: The filling of the charge circuit and closed loop of the fluid power system during start up, frequently achieved by pressurizing the fluid in the inlet line.

Purging: The act of replacing air with fluid in a fluid power system by forcing fluid into all of the components and allowing the air a path of escape.

Rated Flow: The maximum flow that the power supply system is capable of maintaining at a specific operating pressure.

Scoring: Scratches in the direction of motion of mechanical parts caused by abrasive contaminants.

Swash Plate: A mechanical device used to control the displacement of the pump pistons in a fluid power system.

System Charge Check Valve: A valve controlling the replenishing flow of fluid from a charge circuit to the closed loop in a fluid power system.

System Pressure: The pressure which overcomes the total resistance in a system, including all efficiency losses.

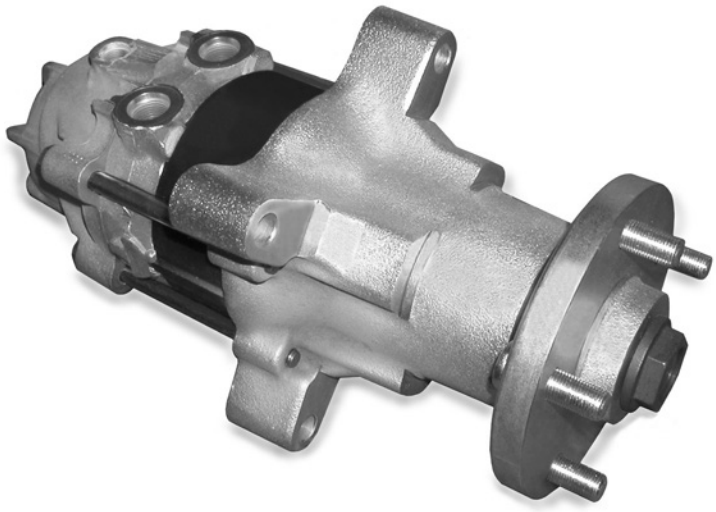
Valve: A device which controls fluid flow direction, pressure, or flow rate.

Variable Displacement Pump: A pump in which the displacement per revolution can be varied.

Volumetric Displacement: The volume for one revolution.

HYDRO-GEAR®

FORWARD MOTION THROUGH FORWARD THINKING



PRM® MOTOR
Service and Repair Manual

TABLE OF CONTENTS

FOREWORD

Headquartered in Sullivan, Illinois, Hydro-Gear® is a world leader in the design, manufacture, and service of quality hydrostatic transaxles for the lawn and garden industry. The mission of our company is to be recognized by our customers and the industry as a world-class supplier and the quality leader in everything we do.

This Service and Repair Manual is designed to provide information useful in servicing and troubleshooting the Hydro-Gear PRM®.

Also included is a glossary of terms that are frequently used throughout the industry and in Hydro-Gear service publications. Understanding terminology is very important!

It is necessary, and a good shop practice, that your service area be equipped with the proper tools and the mechanics be supplied the latest information available. All repair procedures illustrated in this guide are suggested, but preferred methods of repair.

Repair procedures require that the PRM unit be removed from the vehicle.

SECTION 1. DESCRIPTION AND OPERATION

INTRODUCTION

The purpose of this manual is to provide useful information for servicing the Hydro-Gear® PRM® Motor. This manual includes a PRM general description, technical specifications, product identification, safety, troubleshooting, maintenance, and repair procedures.

The PRM Motor normally will not require servicing during the life of the vehicle in which it is installed. Should other servicing be required, the PRM Motor will need to be thoroughly cleaned before beginning most procedures.

Please refer to the instructions titled “How to Use This Manual” in the Repair Section for an explanation of the layout of the disassembly and reassembly portions of this manual.

GENERAL DESCRIPTION

The PRM is a fixed displacement axial piston motor. The motor is designed to convert hydraulic power into rotational power at the axle shaft. It operates at an infinitely variable speed range between zero and maximum axle speed determined by motor displacement and maximum pump flow in both forward and reverse modes of operation.

The PRM motor is available in four different displacements that range from 14 to 20 cu. in. (229 to 327 cc) per revolution.The cylinder block pistons in the PRM Motor are set at a fixed displacement by a fixed swash angle that is integral to the motor housing. Therefore, the motor is always at maximum displacement. As pressurized fluid from the pump pushes against the cylinder block pistons, they are forced to rotate with the thrust bearing. As the pistons rotate with the thrust bearing, they create torque and rotory motion that is transmitted to the axle shaft. Torque continues to develop as long as the piston is being pushed out of the cylinder block. When the piston reaches the end of its movement out of the cylinder block, it gets pushed back into the cylinder and fluid inside the piston is discharged through the low pressure port of the motor. Pistons develop torque only through half of the cylinder block rotation cycle. Therefore, multiple pistons are used to provide a constant and continuous torque to the motor shaft. Reversing the direction of the incoming pressurized fluid into the motor reverses the direction of the motor output rotation.

The PRM motor utilizes a friction type brake controlled by a cam attached to an actuating arm.

EXTERNAL FEATURES
PRM MOTOR

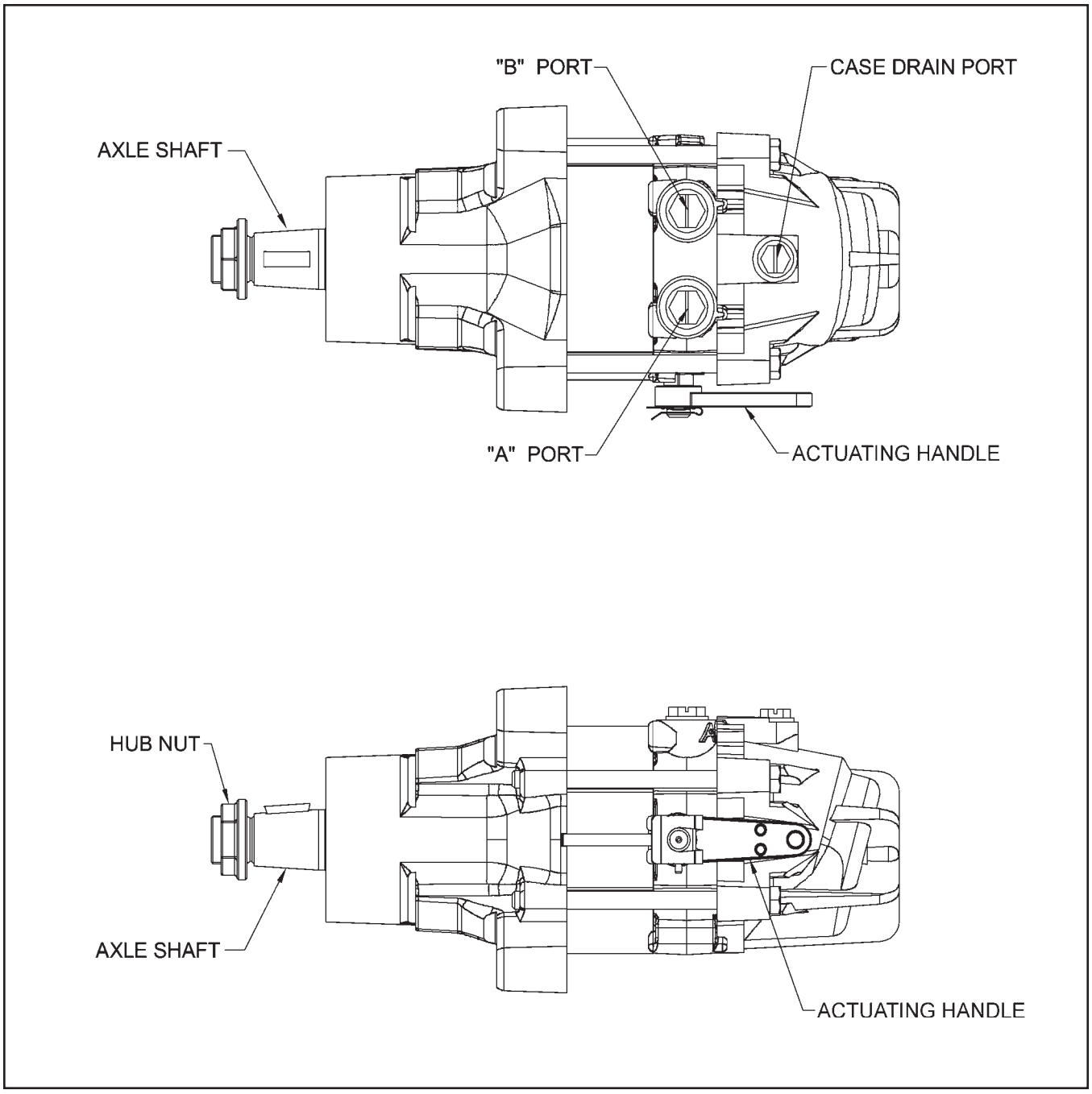


Figure 1. PRM® External Features

TECHNICAL SPECIFICATIONS

Technical specifications for the PRM® are given in Table 1.

	PRM
Geometric Displacements in^3/rev [cc/rev]	14 16 18 20 [229] [262] [294] [327]
Maximum Speed rpm [min-1]	240 [240]
Maximum Torque (@ 3000 psi [206 bar]) lb-ft [daNm]	600 [81]
Shaft (diameter)	1.25" SAE J501 taper
Hub Options	4 bolt with 1/2"-20 studs 5 bolt with 1/2"-20 studs
Weight (filled with oil) lb [kg]	42.4 [19.2]

Table 1. Technical Specifications

PRODUCT IDENTIFICATION

The model and configuration of the PRM can be determined from the label shown in Figure 2.

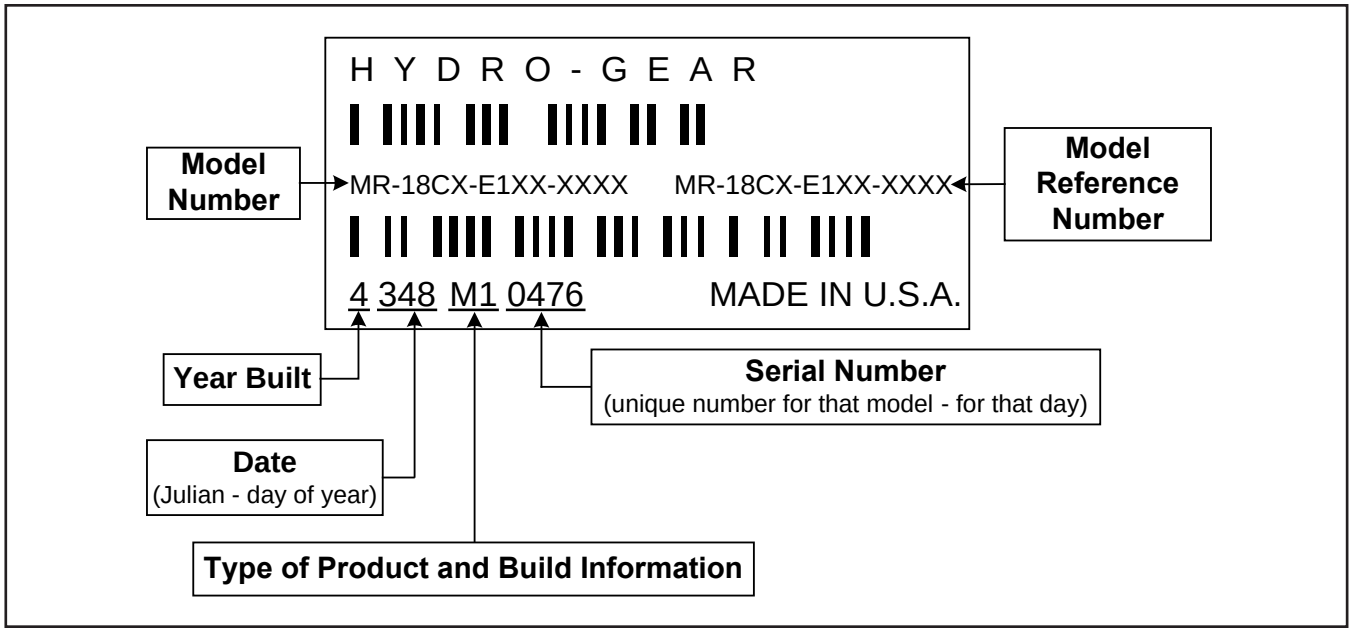


Figure 2. PRM Configuration Label

This symbol points out important safety instructions which, if not followed, could endanger the personal safety and/or property of yourself and others. Read and follow all instructions in this manual before attempting maintenance on your PRM® motor. When you see this symbol - **HEED ITS WARNING.**

WARNING

POTENTIAL FOR SERIOUS INJURY

Inattention to proper safety, operation, or maintenance procedures could result in personal injury, or damage to the equipment. Before servicing or repairing the PRM, fully read and understand the safety precautions described in this section.

PERSONAL SAFETY

Certain safety precautions must be observed while servicing or repairing the PRM. This section addresses some of these precautions but must not be considered an all-inclusive source on safety information. This section is to be used in conjunction with all other safety material which may apply, such as:

1) Other manuals pertaining to this machine

2) Local and shop safety rules and codes

3) Governmental safety laws and regulations

Be sure that you know and understand the equipment and the hazards associated with it. Do not place speed above safety.

Notify your supervisor whenever you feel there is any hazard involving the equipment or the performance of your job.

Never allow untrained or unauthorized personnel to service or repair the equipment.

Wear appropriate clothing. Loose or hanging clothing or jewelry can be hazardous. Use the appropriate safety equipment, such as eye and hearing protection, and safety-toe and slip-proof shoes.

Never use compressed air to clean debris from yourself or your clothing.

TOOL SAFETY

Use the proper tools and equipment for the task.

Inspect each tool before use and replace any tool that may be damaged or defective.

WORK AREA SAFETY

Keep the work area neat and orderly. Be sure it is well lit, that extra tools are put away, trash and refuse are in the proper containers, and dirt or debris have been removed from the working areas of the machine.

The floor should be clean and dry, and all extension cords or similar trip hazards should be removed.

SERVICING SAFETY

Certain procedures may require the vehicle to be disabled in order to prevent possible injury to the servicing technician and/or bystanders.

The loss of hydrostatic drive line power may result in the loss of hydrostatic braking capability. Proper brake maintenance is very important should this condition develop.

Some cleaning solvents are flammable. Use only approved cleaning materials: do not use explosive or flammable liquids to clean the equipment.

To avoid possible fire do not use cleaning solvents in an area where a source of ignition may be present

“Discard used cleaning material in the appropriate containers according to local, state, and federal regulations.”

SECTION 3. TROUBLESHOOTING

WARNING

Do not attempt any servicing or adjustments with the engine running. Use extreme caution while inspecting the drive belt assembly, and all vehicle linkage!

Follow all safety procedures outlined in the vehicle owner's manual!

In many cases problems with the PRM® motor are not related to a defective motor, but may be pump related problems which can be caused by slipping drive belts, partially engaged bypass valves, and loose or damaged control linkages. Be sure to perform all operational checks and adjustments outlined in Section 4 before assuming the unit is malfunctioning. Table 2 below provides a troubleshooting check list to help determine the cause of operational problems.

Possible Cause	Corrective Action	Refer To:
UNIT OPERATES IN ONE DIRECTION ONLY		
Control linkage bent or out of adjustment	Repair or replace linkage	Vehicle Owner's Manual
Drive belt slipping or pulley damaged	Repair or replace drive belt or pulley	Vehicle Owner's Manual
UNIT IS NOISY		
Oil level low or contaminated oil	Fill to proper level or change oil	Fluid Maintenance, Page 7
Excessive loading	Reduce vehicle loading	Vehicle Specifications
Loose parts	Repair or replace loose parts	Appropriate Repair Procedure
Air trapped in hydraulic system	Purge hydraulic system	Pump Manual
Internal gear failure	Complete teardown & reassembly	PRM Service & Repair Manual
UNIT HAS NO/ LOW POWER		
Engine RPM low	Adjust to correct setting	Vehicle Specifications
Control linkage bent or out of adjustment	Repair or replace linkage	Owner's Manual
Drive belt slipping or pulley damaged	Repair or replace drive belt or pulley	Owner's Manual
Oil level low or contaminated oil	Fill to proper level or change oil	Fluid Maintenance, Page 7
Excessive loading	Reduce vehicle loading	Vehicle Specifications
Air trapped in hydraulic system	Purge hydraulic system	Pump Manual
UNIT OPERATING HOT		
Debris buildup around motor	Clean off debris	
Oil level low or contaminated oil	Fill to proper level or change oil	Fluid Maintenance, Page 7
Excessive loading	Reduce vehicle loading	Vehicle Specifications
Air trapped in hydraulic system	Purge hydraulic system	Pump Manual
MOTOR LEAKS OIL		
Damaged seals, housing, or gaskets	Replace damaged component	Appropriate Repair Procedure

Table 2. Troubleshooting Checklist

SECTION 4. SERVICE AND MAINTENANCE

NOTE: Any servicing dealer attempting a warranty repair must have prior approval before conducting maintenance of a Hydro-Gear® product unless the servicing dealer is a current Authorized Hydro-Gear Service Center.

EXTERNAL MAINTENANCE

Regular external maintenance of the PRM® should include the following:

1. **Check the vehicle operator's manual for the recommended load ratings. Insure the current application does not exceed load rating.**
2. Check fluid level in drive system reservoir in accordance with vehicle manufacturer's recommendations.
3. Inspect all external plumbing for possible leaks or loose fittings.
4. Insure the reservoir is free of contaminants and is properly vented.
5. Remove any obstructions (grass clippings, leaves or dirt).
6. Inspect the vehicle control linkage to the brake arm on the PRM motor.

SERVICE AND MAINTENANCE PROCEDURES

NOTE: Damage to PRM's may result from external or internal contamination: Heat from excess debris or lack of lubrication and over-pressurization of the product. Follow guidelines established in this manual and the vehicle manufacturer's recommendations.

Note: "Any and all Hydro-Gear components removed and replaced during service are recyclable."

Cleanliness is a key factor in the successful repair of PRM's. Thoroughly clean all exposed surfaces prior to any type of maintenance. Cleaning of all parts by using a solvent wash and air drying is usually adequate. As with any precision equipment, all parts must be kept free of foreign material and chemicals. Protect all exposed sealing areas and open cavities from damage and foreign material.

Upon removal, all seals, O-rings, and gaskets should be replaced. During installation, lightly lubricate all seals, O-rings, gaskets with clean petroleum jelly prior to assembly. Also, protect the inner diameter of seals by covering the shaft's machined features with plastic wrap or equivalent.

Remove plastic wrap after seal is installed.

FLUIDS

The fluids used in Hydro-Gear products have been carefully selected, and only equivalent, or better products should be substituted.

Typically, an engine oil with a minimum rating of 9.0 cSt (55 SUS) at 230° F (110° C) maximum operating temperature and an API classification of SJ/ CD is allowed. Refer to the vehicle manufacturer for recommended oil.

"All fluids should be handled and disposed of according to local, state, and federal regulations."

FLUID VOLUME AND LEVEL

Certain situations may require additional fluid to be added or even replaced. Refer to the vehicle manufacturer's recommendations for the proper fill location and level.

FLUID CHANGE

In the event of oil degradation, oil addition or change may alleviate certain performance problems. Refer to the vehicle manufacturer's recommended oil change frequency.

In the event of oil contamination or hydraulic system component failure, a complete teardown and inspection of the PRM will be required.

SECTION 5. REPAIR

HOW TO USE THIS MANUAL

The following procedures are presented in the order in which they must be performed to completely disassemble the unit. Each step is provided with an exploded view showing the parts involved. **The item reference numbers in each illustration are for disassembly/assembly instructions only.** See pages 24-25 for part names and descriptions. The disassembly section is followed by the assembly procedure. A complete exploded view and item list of the PRM® is provided at the end of this section.

GENERAL INSTRUCTIONS

Parts requiring replacement must be replaced from the appropriate kits identified in the Items Listing, found at the end of this manual. Use only original Hydro-Gear® replacement parts.

REQUIRED TOOLS

A list of tools required for the repair of the PRM motor is provided in Table 3 below.

TORQUE SPECIFICATIONS

Torque specifications for fasteners used on the PRM are provided in the assembly section of this manual.

PRM MOTOR REMOVAL

It is necessary to remove the PRM motor from the vehicle before performing the repair procedures represented in this section. Use the following procedure to prepare the unit for removal from the vehicle.

1. With the vehicle wheels on the ground, loosen the nut (55, Figure 48) Page 24, retaining the hub (56, Figure 48) Page 24. Use an air impact wrench and a 1-5/16” socket to loosen the nut.
2. Lift the vehicle wheels from the ground and remove the nut completely.
3. Remove the wheel from the hub.
4. Using a wheel or gear puller and the hub puller adapter located in the seal kit, remove the hub from the shaft.

> **NOTE: Anytime a hub nut and/or hub is removed, it must be discarded and replaced with a new hub nut and/or hub.**

5. Disconnect the brake arm linkage at the PRM motor.
6. Disconnect the high pressure hoses and case drain hose at the PRM.
7. Remove the PRM motor from the vehicle.

TOOLS

Miscellaneous	**Sockets**
PRM Motor Service & Repair Manual	9/16”
Torque Wrench	1-5/16”
Impact Wrench	
3/8” Drive Ratchet	**Combination Wrenches**
Scribe, Paint Pen, or Marker	9/16”
Seal Hook with a Magnet	
Flat Blade Screw Driver	
Hub Puller Adapter (included in seal kit)	
Pliers	
Internal Snap Ring	
External Snap Ring	

Table 3. Required Tools

DISASSEMBLY

1. If the hub (56) has not been removed from the PRM®, remove the hex lock nut (55) with an impact wrench and discard. Remove the hub (56) and discard. If the axle shaft (34) turns during nut removal, manually apply the PRM brake actuating handle (36, Fig. 12) to prevent the axle from turning. Use a wheel or gear puller and the hub puller adapter, located in the seal kit, to remove the hub

   NOTE: Anytime a hub nut and/or hub is removed, it must be discarded and replaced with a new hub nut and/or hub.

   from the shaft.

2. Remove the woodruff key (71) from the axle shaft (34).

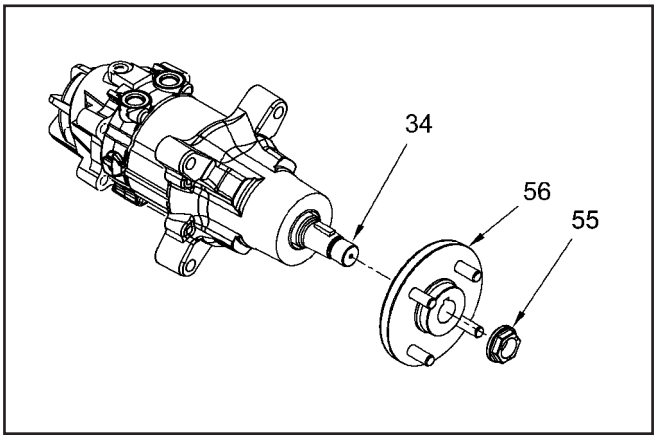


Figure 3 MA04K045

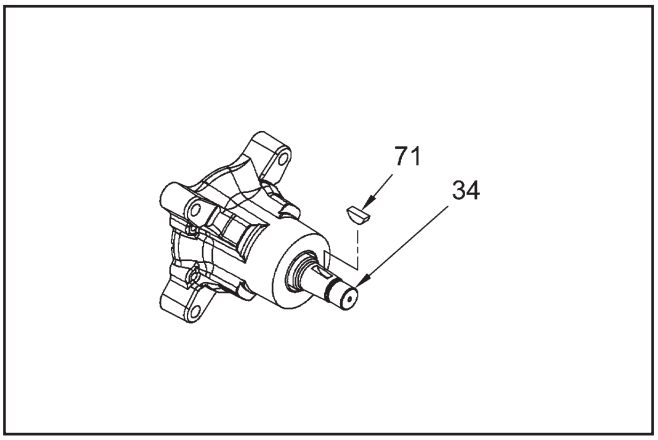


Figure 4 MA04K026

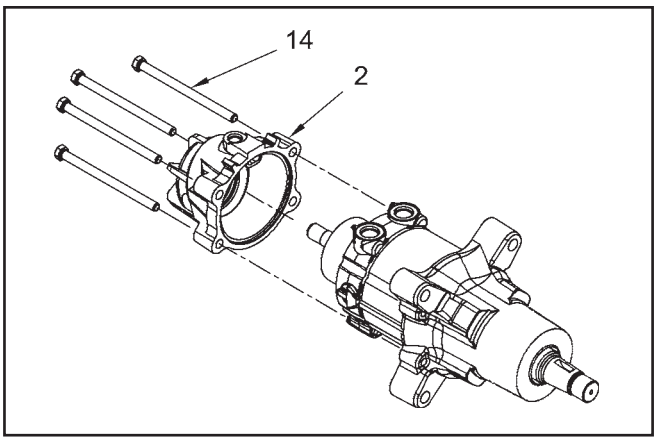


Figure 5 MA04N046

DISASSEMBLY (CONTINUED)

4. Remove the thrust bearing (7), from the motor housing (2).

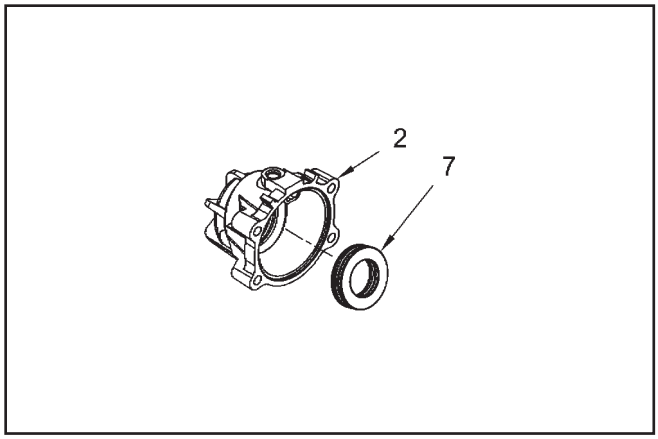


Figure 6 MA04M021

5. Inspect the thrust bearing (7), and motor housing needle bearing for damage or wear.

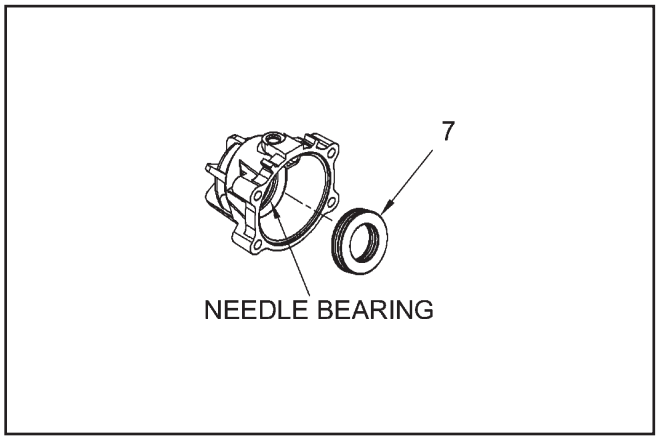


Figure 7 MA04K035

6. Remove the pistons, springs, and seats from the cylinder block (3) and inspect the components for damage or wear.

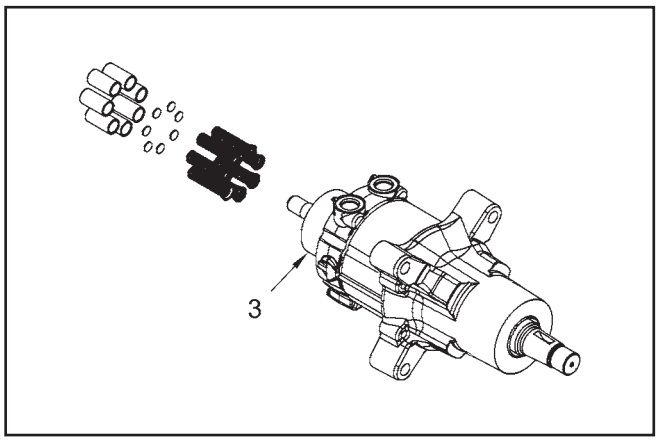


Figure 8 MA04M047

DISASSEMBLY (CONTINUED)

7. Compress the spring (12) and washer (11) to remove the motor shaft retaining ring (71), then remove the block compression spring (12) and washer (11) from the motor shaft (13).

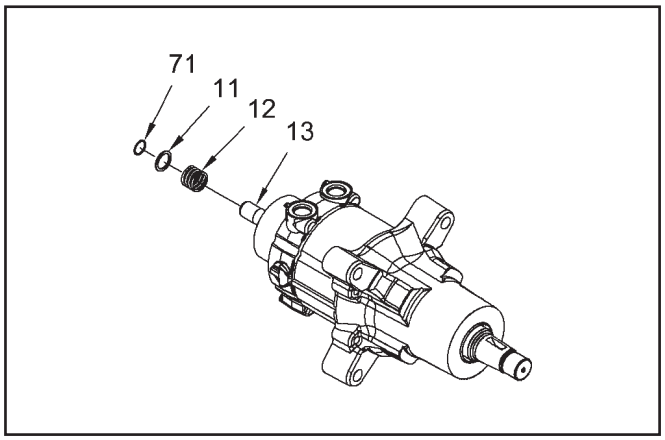


Figure 9 MA04K048

8. Remove the cylinder block (3) from the motor shaft (13). Inspect the cylinder block (3) for damage or wear.

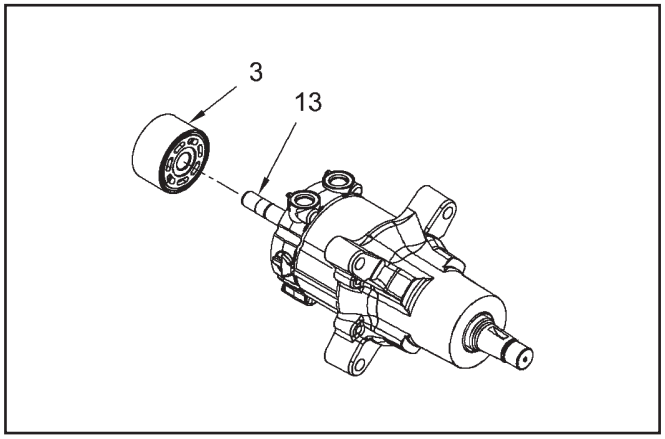


Figure 10 MA04K049

9. To ease reassembly, mark the port block (15), and ring gear (23) prior to disassembly. Also mark the brake actuating handle (36, Fig. 12) and brake cam (31, Fig. 14).

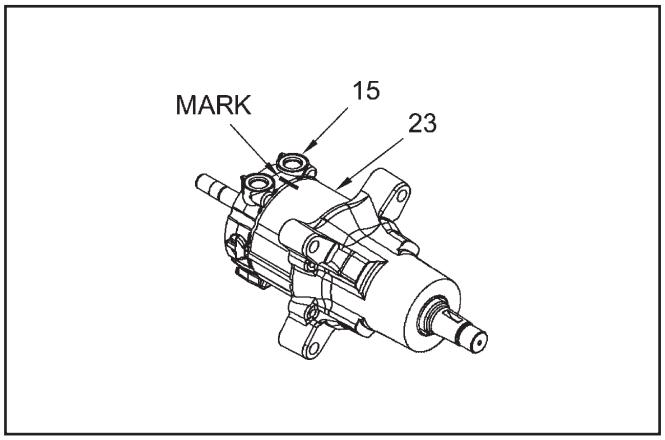


Figure 11 MA04K050

DISASSEMBLY (CONTINUED)

10. Remove the actuating handle retaining clip (38), and actuating handle (36).

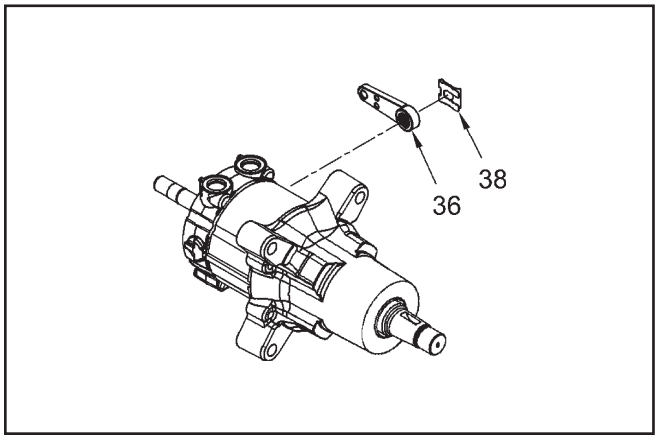


Figure 12 MA04K051

11. Remove the port block (15) and brake puck (42).

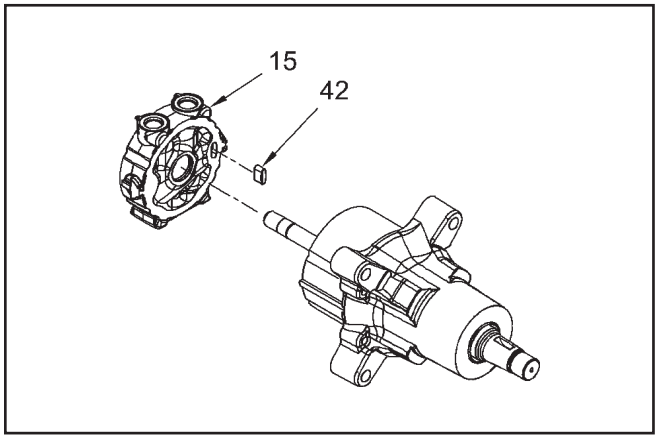


Figure 13 MA04K052

12. Remove the brake cam (31) from the port block (15).

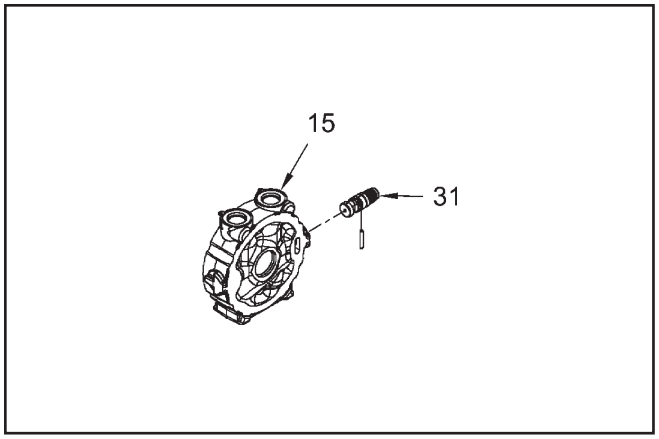


Figure 14 MA04K012

DISASSEMBLY (CONTINUED)

13. Remove the o-ring (71) from the port block (15).

14. Remove the o-ring (71) and stator spacer (29) from the ring gear (23).

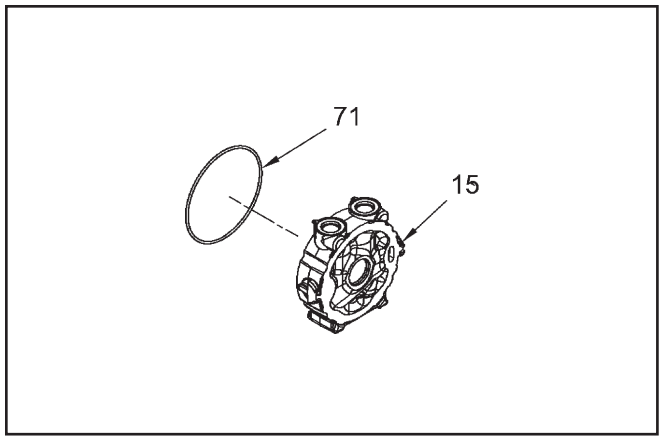


Figure 15 MA04K013

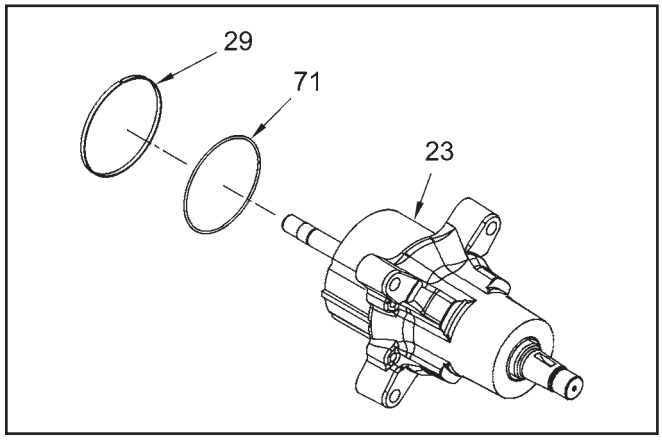


Figure 16 MA04K053

15. Remove the brake rotor (37), stator washer (25) and motor shaft (13). Inspect all for damage or wear.

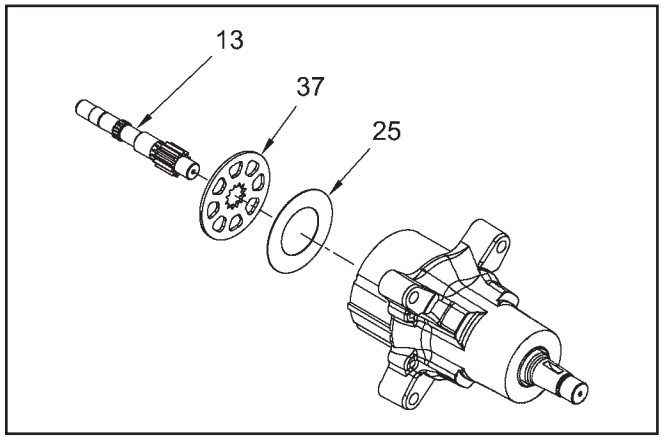


Figure 17 MA04N054

DISASSEMBLY (CONTINUED)

16. Remove the three 18T planetary gears (17), primary planetary carrier (19), three carrier pins (18), and washer (26) from the ring gear (23). Inspect the gears, carrier, pins and washer for wear or damage.

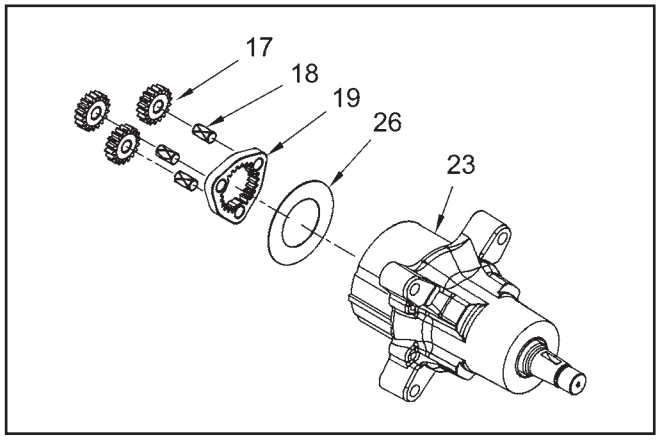


Figure 18 MA04K055

17. Remove the sun gear (20).

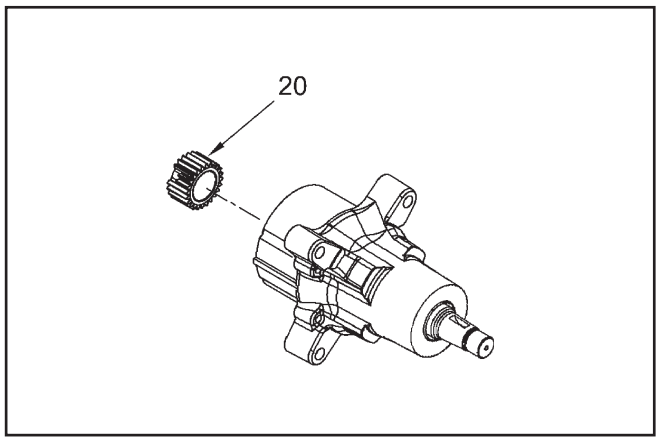


Figure 19 MA04K056

18. Remove the ring gear (23), six planetary gears (21), carrier pins (40), and o-ring (71). Inspect all components for wear or damage.

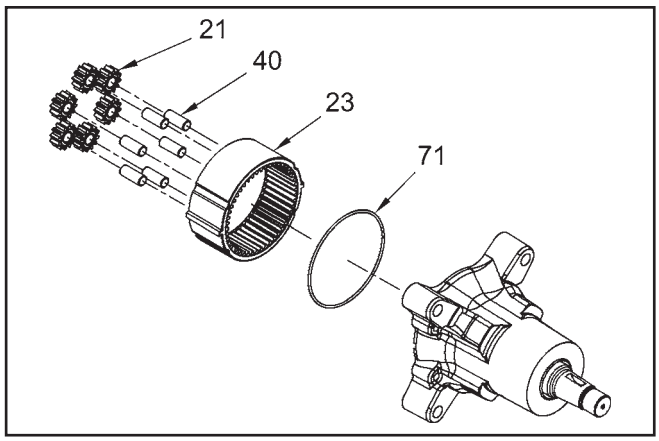


Figure 20 MA04K057

DISASSEMBLY (CONTINUED)

19. Remove the secondary planetary carrier (22), and washer (26) from the axle housing (1). Inspect for wear or damage.

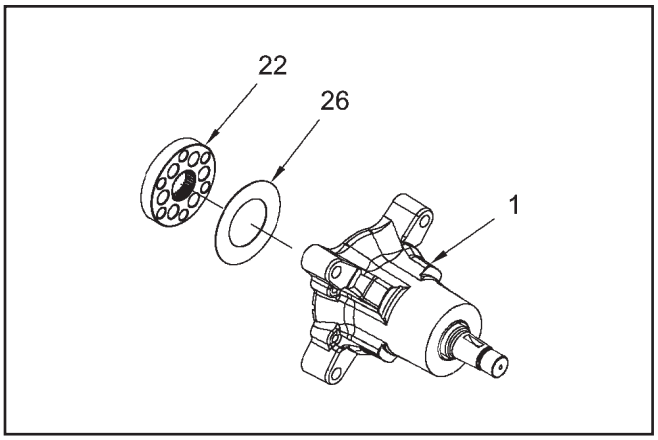


Figure 21 MA04K058

20. Remove the internal retaining ring (39), and axle shaft (34), with ball bearing from the axle housing (1).

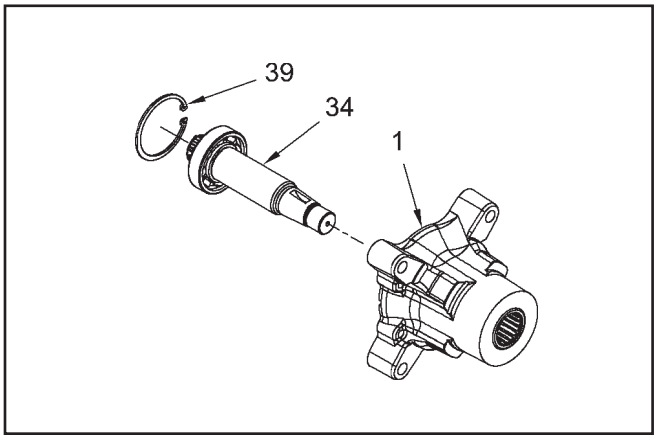


Figure 22 MA04K028

21. Remove the external retaining ring (35) and ball bearing (30) from the axle shaft (34). This is a press fit, so the bearing may be difficult to remove from the shaft. Inspect the bearing and shaft for wear or damage.

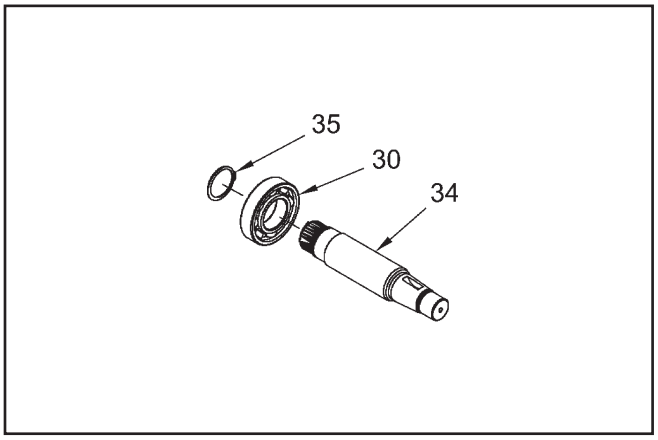


Figure 23 MA04K027

DISASSEMBLY (CONTINUED)

22. Inspect the axle housing needle bearing for damage or wear.

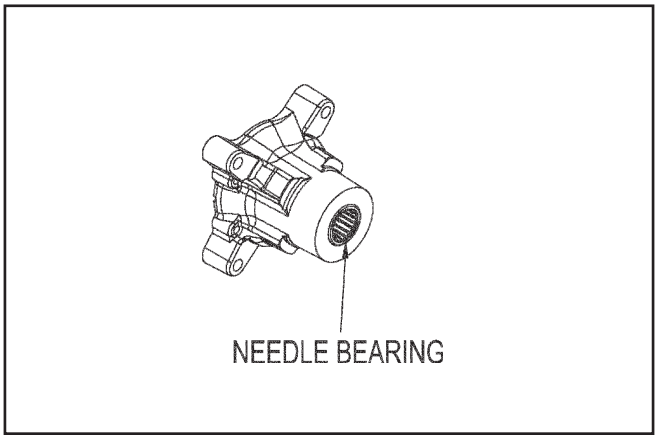


Figure 24 MA04K042

23. Remove the internal retaining ring (71) and lip seal (71) from the axle housing (1).

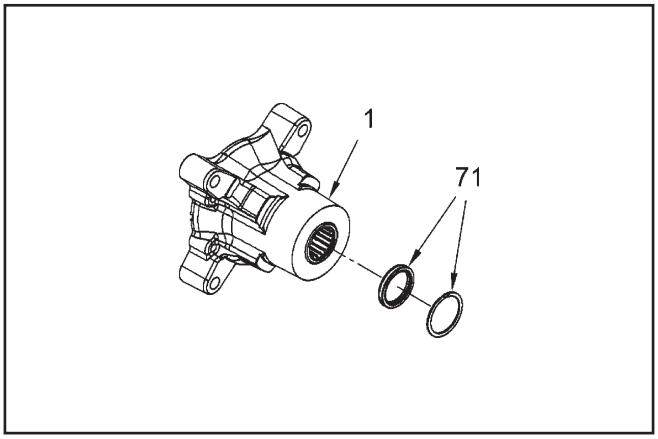


Figure 25 MA04K029

ASSEMBLY

1. Press the ball bearing (30) onto the axle shaft (34). Pressing force must be applied to the inner bearing race only. Secure the bearing with the retaining ring (35).

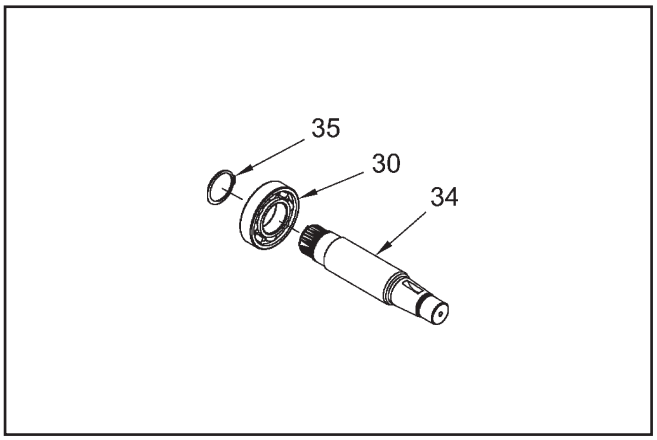


Figure 26 MA04K027

2. Install the lip seal (71)and internal retaining ring (71) into the axle housing.

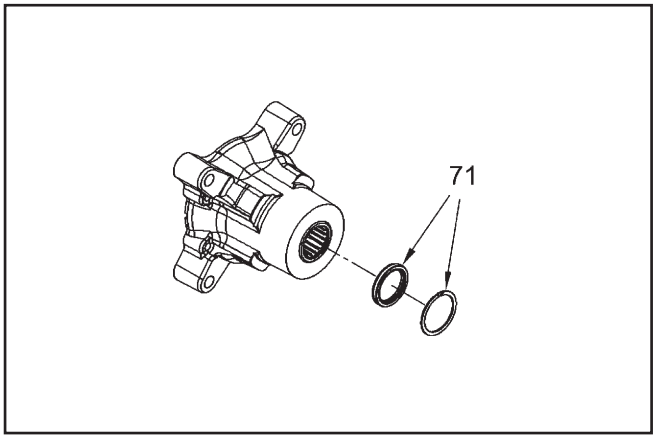


Figure 27 MA04K039

3. Install axle shaft (34) with ball bearing into housing (1) and secure with retaining ring (39).

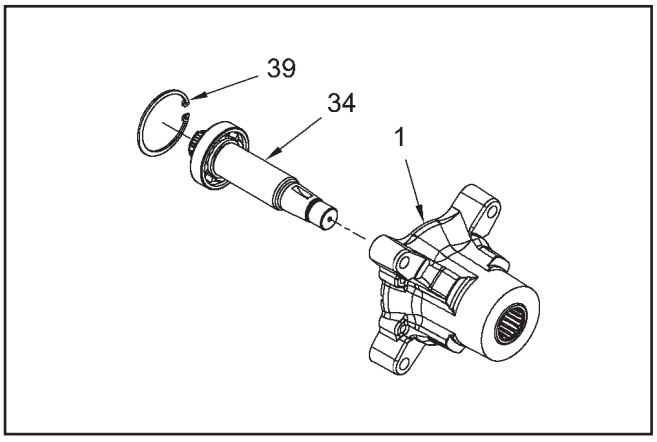


Figure 28 MA04N028

ASSEMBLY (CONTINUED)

4. Note: Steps 4-19 will be best accomplished if the PRM motor is in a vertical position with the axle shaft facing down.

   Install the washer (26) and secondary planetary carrier (22) into the axle housing (1). Make sure the recessed face of the secondary planetary carrier (22) faces away from the axle shaft.

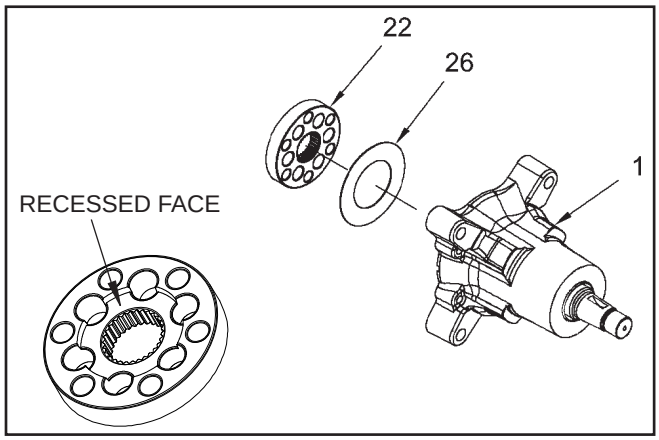


Figure 30 MA04K058

5. Install the o-ring (71), ring gear (23), carrier pins (40) and six planetary gears (21). Make sure the mark that was placed on the ring gear in step 9 of the disassembly is oriented correctly.

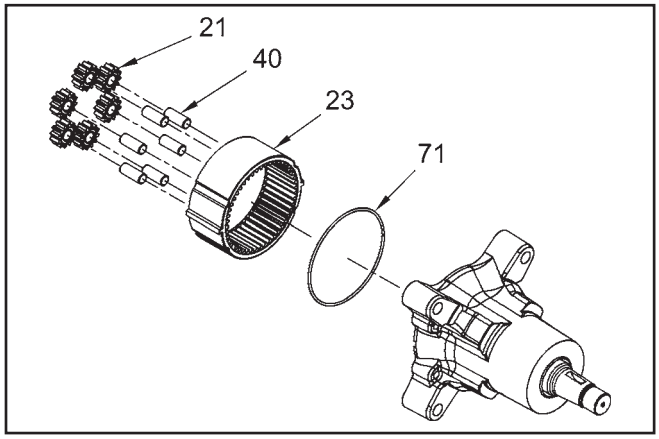


Figure 31 MA04K057

6. Install the sun gear (20).

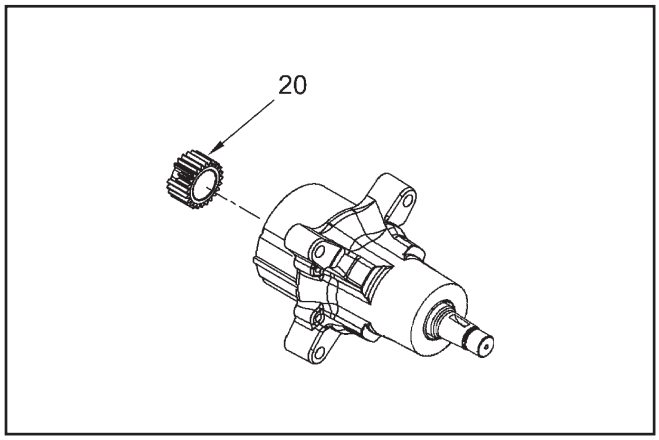


Figure 32 MA04K056

ASSEMBLY (CONTINUED)

7. Assemble the primary carrier (19), three carrier pins (18), and three planetary gears (17). Install the washer (26) and assembly into the ring gear (23).

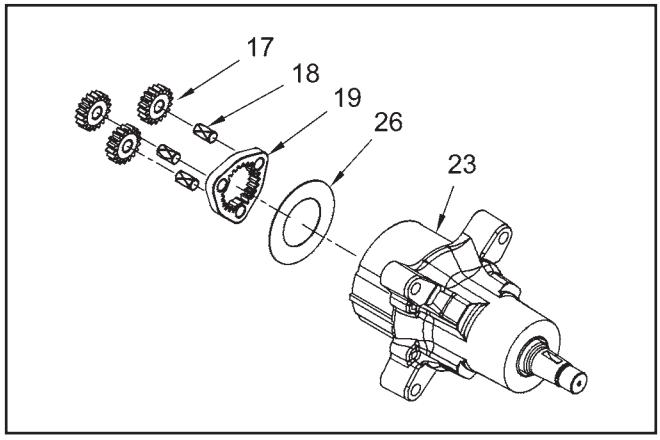


Figure 33 MA04K055

8. Install stator washer (25), brake rotor (37), and motor shaft (13) into the ring gear (23).

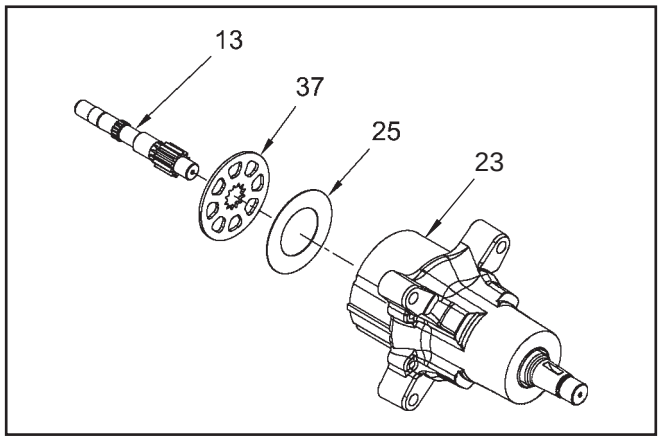


Figure 34 MA04N054

9. Install o-ring (71) and stator spacer (29) into the ring gear (23).

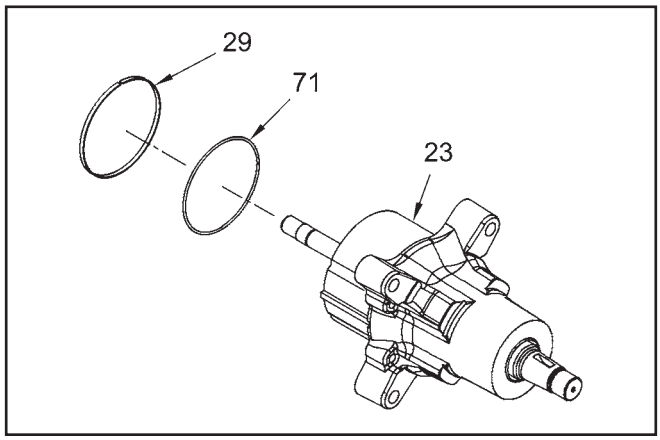


Figure 35 MA04K053

ASSEMBLY (CONTINUED)

10. Install o-ring (71), into the port block (15).

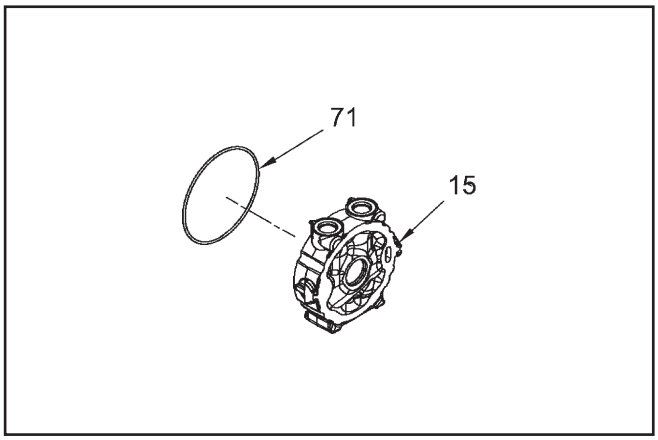


Figure 36 MA04K013

11. Install brake cam (31) into the port block (15).

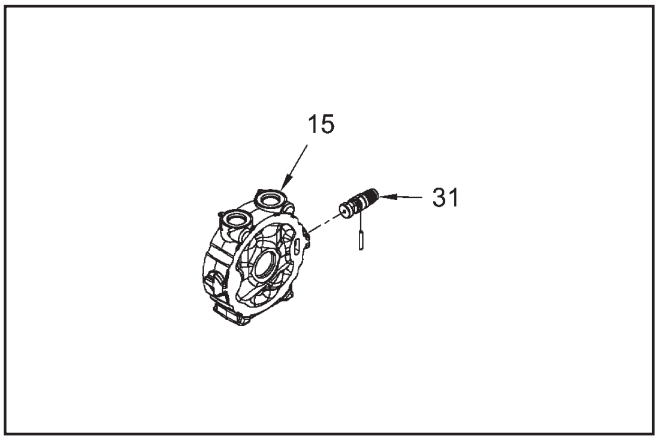


Figure 37 MA04K012

12. Install puck (42) into the port block (15), then install the port block onto the motor shaft (13). Note: When installing the port block assembly, pull on the cam (31, Fig. 37) to keep the puck (42) from falling out of the

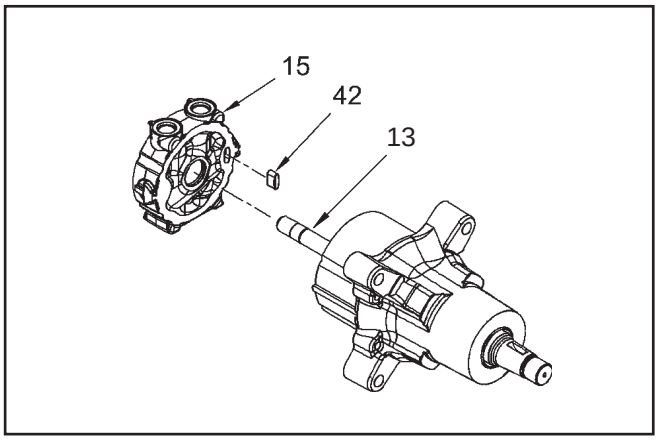


Figure 38 MA04K052

ASSEMBLY (CONTINUED)

13. Make sure the marks on the port block (15) and ring gear (23) are aligned.

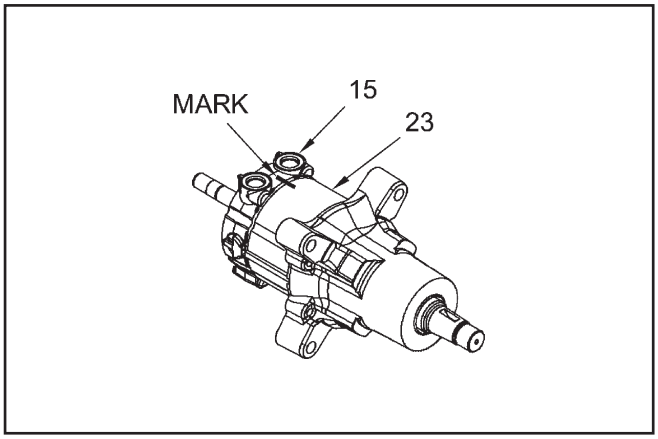


Figure 39 MA04K050

14. Install actuating handle (36) onto the brake cam and secure with retaining clip (38). Make sure the marks on the actuating handle and brake cam are aligned.

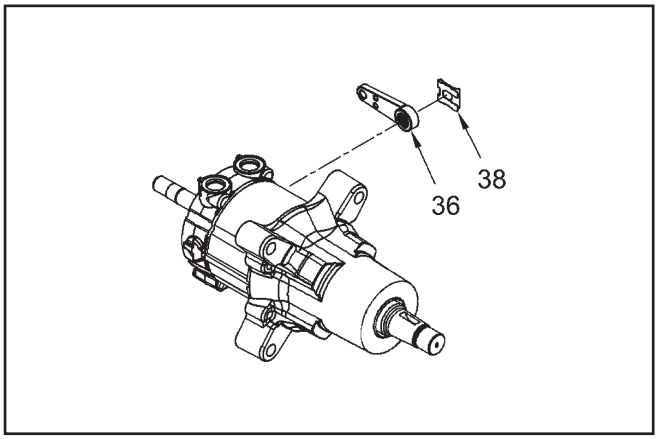


Figure 40 MA04K051

15. Install the cylinder block (3) onto the motor shaft (13).

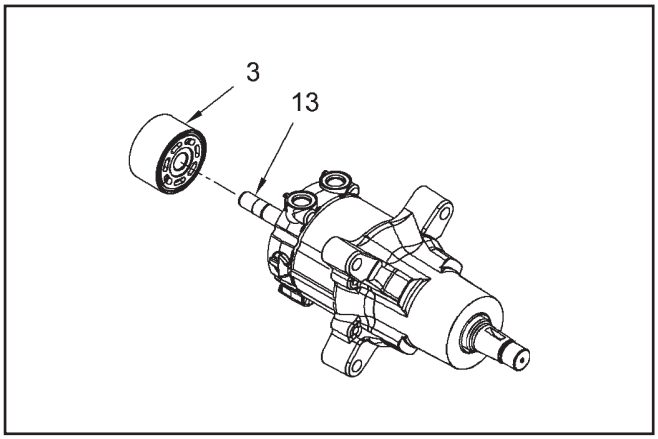


Figure 41 MA04K049

ASSEMBLY (CONTINUED)

16. Install compression spring (12), and washer (11) onto the motor shaft (13) then secure with the retaining ring (71).

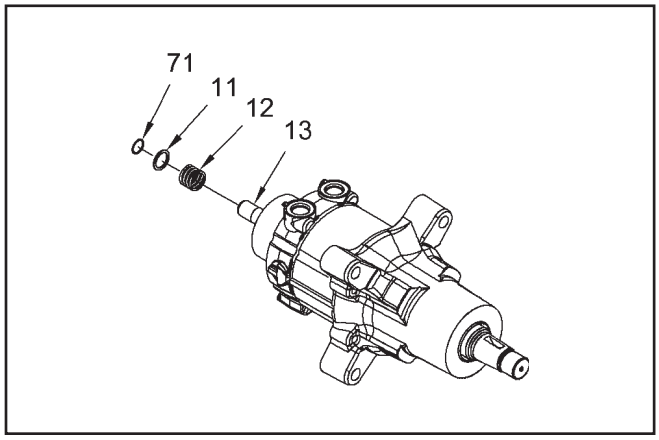


Figure 42 MA04K048

17. Install the springs, piston seats, and pistons into the cylinder block (3).

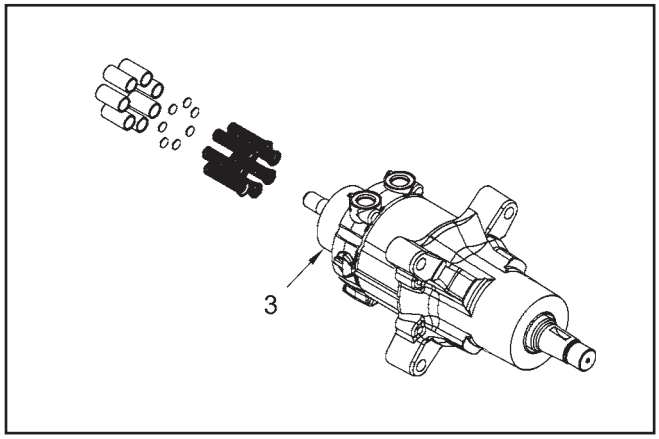


Figure 43 MA04M047

18. Place the thrust bearing (7) on the cylinder block pistons (3) and around the motor shaft (13). Be sure the thick race of the thrust bearing (7) is contacting the pistons.

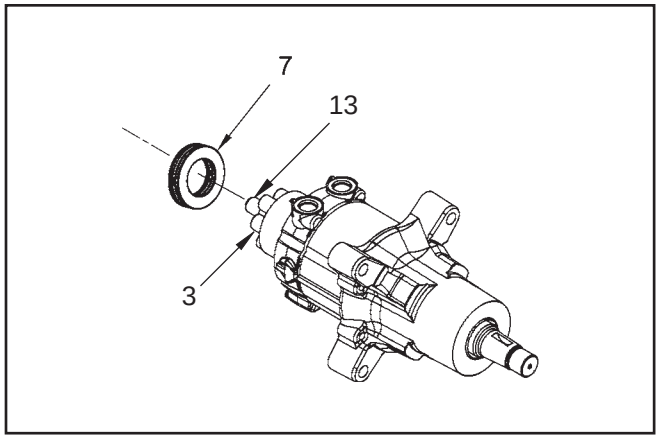


Figure 44 MA04M061

ASSEMBLY (CONTINUED)

19. With the PRM® still in the vertical position, use four housing screws (14) to secure the motor housing (2) to the axle housing (1). Tighten the four housing screws in a criss-cross pattern and evenly to 39-47 ft-lbs (53-64 Nm).

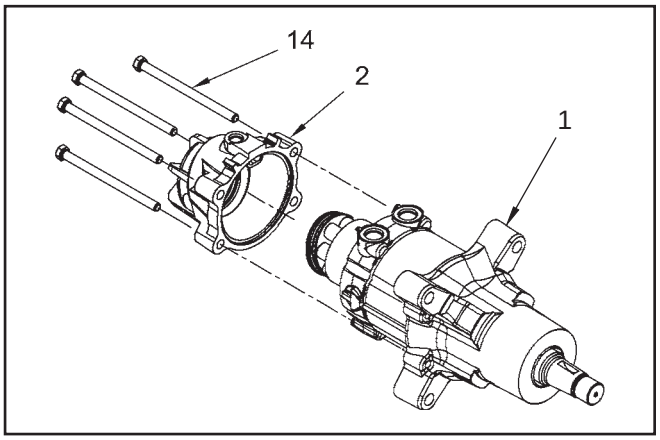


Figure 45 MA04M063

20. Install the woodruff key (71) into the axle shaft (34).

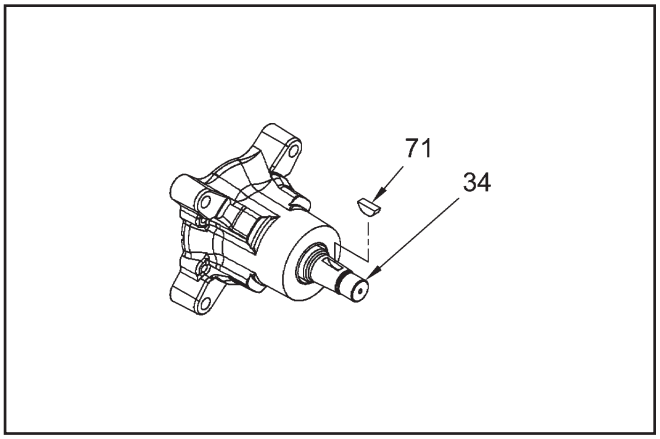


Figure 46 MA04K026

21. Install hub (56) onto the axle shaft (34) and secure with top lock nut (55). Torque the top lock nut or castle nut according to the chart below. Manually apply the brake actuating handle to prevent the axle shaft from turning when tightening the hex lock nut. Final nut tightening can also be accomplished after the PRM and wheel have been installed on the vehicle and the vehicle is setting on the ground.

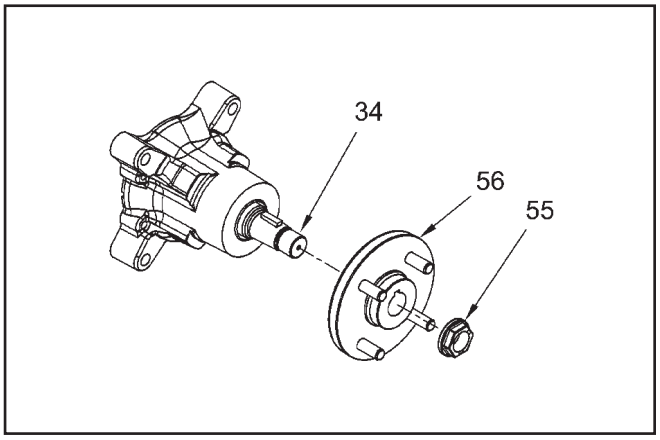


Figure 47 MA04K025

Top Lock Nut (Item 55)- SILVER hub configuration: Prior to serial number 0256Xxxxxx: 210 - 250 ft.lbs.
Top Lock Nut (Item 55)- BLACK hub configuration: Prior to serial number 0256Xxxxxx: 305 - 345 ft.lbs
Castle Nut (Item 55) - BLACK or SILVER hub configuration: On or after serial number 0256Xxxxx: 275 - 345 ft.lbs

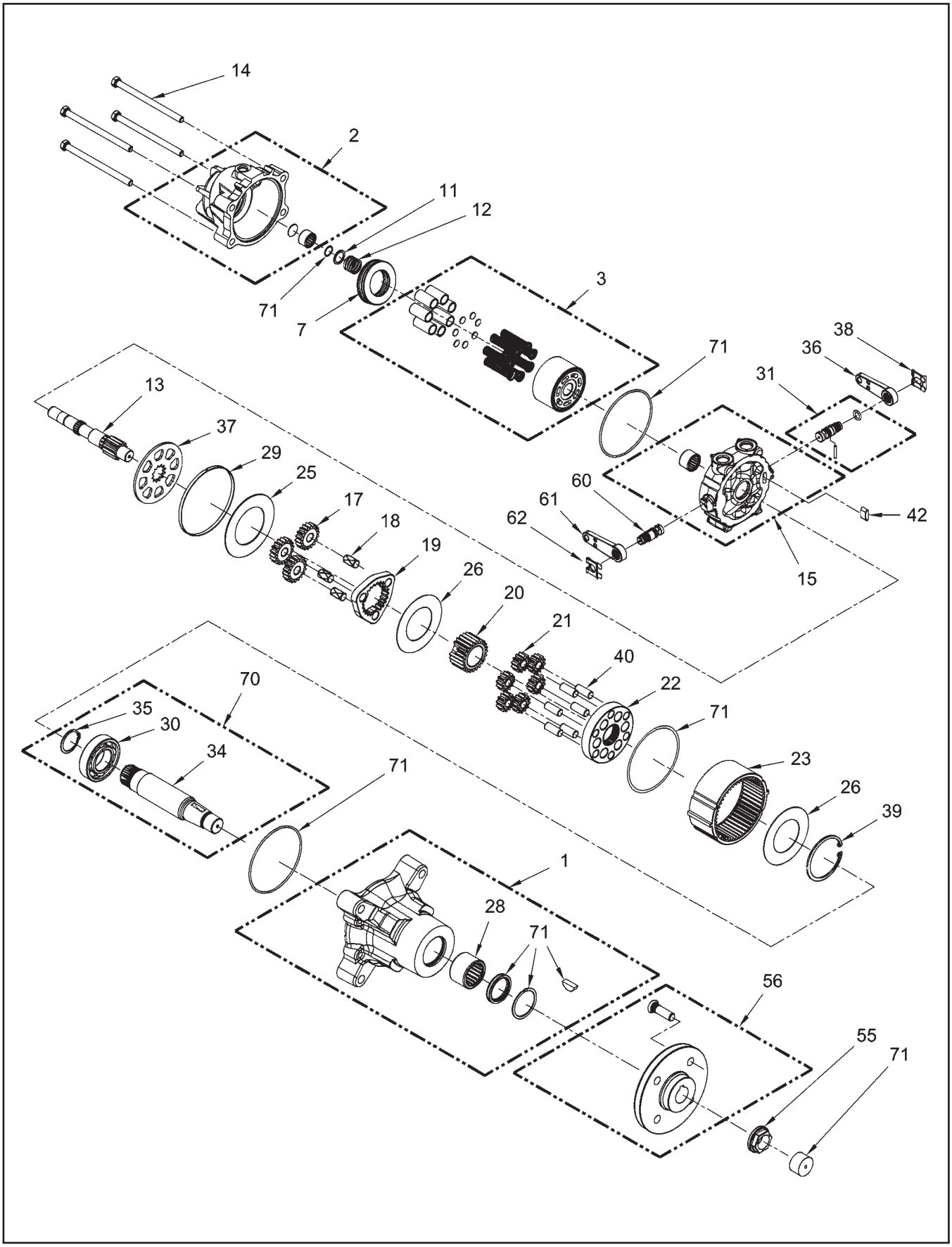


Figure 48

MA04K030

ITEMS LIST

Part numbers are not provided in this manual.

NO.	DESCRIPTION
1	Axle Housing Kit
2	Motor Housing Kit
3	Motor Block Kit
7	Thrust Bearing
11	Washer
12	Spring
13	Shaft, Motor
14	Screw, HFHCS 3/8-16 x 5.5
15	Port Block Kit
17	18T Planet Gear
18	Carrier Pin
19	Primary Planetary Carrier
20	24T Sun Gear
21	12T Planet Gear
22	Secondary Planetary Carrier
23	48T Ring Gear
25	Stator Washer
26	Washer
28	Needle Bearing

NO.	DESCRIPTION
29	Stator Spacer
30	Ball Bearing
31	Brake Cam Kit
34	Shaft, Axle
35	Retaining Ring - External
36	Handle, Actuating
37	Brake Rotor
38	Retaining Clip
39	Retaining Ring - Internal
40	Carrier Pin
42	Brake Puck
55	Nut, Hex Lock
56	Hub Kit
60	Brake Cam Kit
61	Handle, Actuating
62	Retaining Clip
70	Axle Shaft Kit
71	Seal Kit

SECTION 9. GLOSSARY OF TERMS

Axial Piston: Type of design for hydraulic motors and pumps in which the pistons are arranged parallel with the spindle (input or output shaft).

Bypass Valve: A valve whose primary function is to open a path for the fluid to bypass the motor or pump. Also referred to occasionally as the freewheel valve or dump valve.

Case Drain Line (Return Line): A line returning fluid from the component housing to the reservoir.

Cavitation: A concentrated gaseous condition within the fluid causing the rapid implosion of a gaseous bubble.

Center Section: A device which acts as the valve body and manifold of the transmission.

Charge Pump: A device which supplies replenishing fluid to the fluid power system (closed loop).

Charge Pressure: The pressure at which replenishing fluid is forced into a fluid power system.

Charge Relief Valve: A pressure control valve whose primary function is to limit pressure in the charge circuit.

Check Valve: A valve whose primary function is to restrict flow in one direction.

Closed Loop: A sealed and uninterrupted circulating path for fluid flow from the pump to the motor and back.

Decay Rate: The ratio of pressure decay over time.

End Cap: See “Center Section”

Entrained Air: A mechanical mixture of air bubbles having a tendency to separate from the liquid phase.

Gerotor: A positive displacement pump frequently used as a charge pump.

Hydraulic Motor: A device which converts hydraulic fluid power into mechanical force and motion by transfer of flow under pressure.

Hydraulic Pump: A device which converts mechanical force and motion into hydraulic fluid power by producing flow.

Hydrostatic Pump: See “Hydraulic Pump”

Hydrostatic Transaxle: A multicomponent assembly including a gear case and a hydrostatic transmission.

Hydrostatic Transmission: The combination of a hydraulic pump and motor in one housing to form a device for the control and transference of power.

Inlet Line: A supply line to the pump.

Integrated Hydrostatic Transaxle (IHT): The combination of a hydrostatic transmission and gear case in one housing to form a complete transaxle.

Manifold: A conductor which provides multiple connection ports.

Neutral: Typically described as a condition in which fluid flow and system pressure is below that which is required to turn the output shaft of the motor.

Pressure Decay: A falling pressure.

Priming: The filling of the charge circuit and closed loop of the fluid power system during start up, frequently achieved by pressurizing the fluid in the inlet line.

Purging: The act of replacing air with fluid in a fluid power system by forcing fluid into all of the components and allowing the air a path of escape.

Rated Flow: The maximum flow that the power supply system is capable of maintaining at a specific operating pressure.

Scoring: Scratches in the direction of motion of mechanical parts caused by abrasive contaminants.

Swash Plate: A mechanical device used to control the displacement of the pump pistons in a fluid power system.

System Charge Check Valve: A valve controlling the replenishing flow of fluid from a charge circuit to the closed loop in a fluid power system.

System Pressure: The pressure which overcomes the total resistance in a system, including all losses.

Valve: A device which controls fluid flow direction, pressure, or flow rate.

Variable Displacement Pump: A pump in which the displacement per cycle can be varied.

Volumetric Displacement: The volume for one revolution.

HYDRO-GEAR®

FORWARD MOTION THROUGH FORWARD THINKING

BDP-10L (PL)
Hydrostatic Pump
Service and Repair Manual

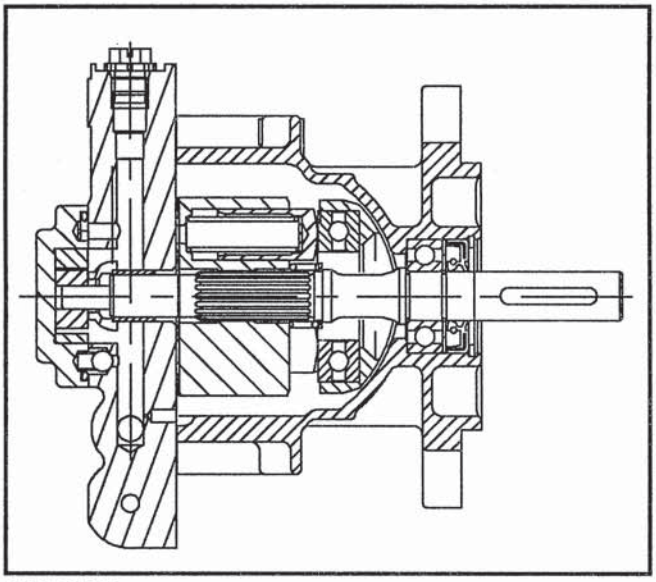
BLN-50231
January 2018

Table of Contents

Introduction

The purpose of this manual is to provide information useful in servicing the Bantam Duty Hydrostatic Pumps. This manual includes unit and component description, troubleshooting, minor repair procedures, and major repair procedures.

A pump normally will not require servicing during the life of the vehicle or machine in which it is installed. Should servicing be required, some repairs can be accomplished without removing the unit from its installed location, provided that the unit is accessible and can be thoroughly cleaned before beginning any procedures. Since dirt or contamination is the greatest enemy of any hydraulic equipment, the greatest possible cleanliness is necessary.



BDP-10L Pump

General Description

The BDP pumps can be combined with motors and other remotely located units. When used in this manner, these units provide an infinitely variable speed range between zero and maximum in both forward and reverse modes of operation.

The BDP-10L is a variable displacement pump designed for vehicle applications where up to six horsepower is required for the propel function, or for auxiliary functions where the system pressure requirements and design life can be met within the pump rating. This variable displacement pump has a maximum displacement of 0.61 in^3/rev (10 cc/rev).

Pumps are of the axial piston design, utilizing spherical nosed pistons. A compression spring, located inside each piston, holds the nose of the piston against a thrust bearing race.

The variable displacement pump features a cradle swashplate with a direct-proportional displacement control. Reversing the direction of tilt of the swashplate reverses the flow of oil from the pump and thus reverses the direction of the motor output rotation.

A fixed displacement gerotor charge pump is provided in the BDP-10L units. Oil from an external reservoir and filter is pumped into the closed loop by a charge pump. Fluid not required to replenish the closed loop flows either into the pump housing through a cooling orifice, or back to the charge pump inlet through the charge pressure relief valve.

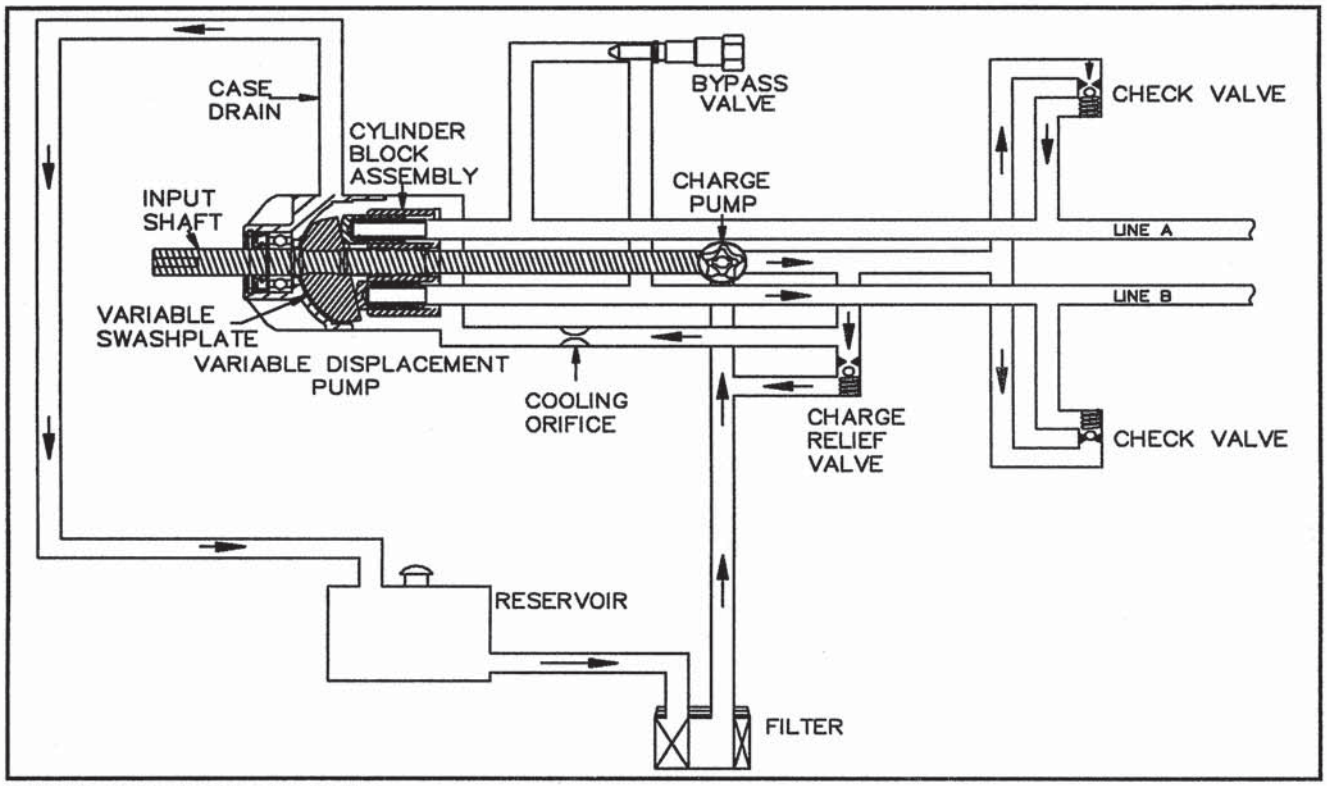
Charge check valves are included in the pump end cap to control the makeup oil flow for the system.

A screw type bypass valve is utilized in the pumps to permit movement of the machine for short distances at low speeds without starting the engine.

Transmission Hydraulic Support System

The charge pump incorporated into the BDP-10L units supplies fluid to keep the closed loop charged, preventing cavitation and providing cooling oil flow for the system. An inlet filter is required to insure that only clean fluid enters the system. The charge relief valve is designed to maintain the charge pressure at 25 to 70 PSI at 3600 RPM input speed.

Since either of the main hydraulic passages can be at high pressure, two (2) charge check valves are used to direct make-up fluid into the low pressure side of the closed loop. These check valves are located in the pump end cap.



BDP-10L Hydraulic Flow Illustration

Safety Precautions

*** The loss of hydrostatic drive line power in any mode of operation may cause a loss of hydrostatic braking capacity. A braking system, redundant to the hydrostatic transmission must, therefore, be provided which is adequate to stop and/or hold the system should the condition develop.**

*** Certain service procedures may require the vehicle/machine to be disabled (wheels raised off the ground, work function disconnected, etc.) while performing them in order to prevent injury to the technician and bystanders.**

*** Use caution when dealing with hydraulic fluid under pressure. Escaping hydraulic fluid under pressure can have sufficient force to penetrate your skin causing serious injury. This fluid may also be hot enough to burn. Serious infection or reactions can develop if proper medical treatment is not administered immediately.**

*** Some cleaning solvents are flammable. To avoid possible fire, do not use cleaning solvents in an area where a source of ignition may be present.**

Controls and Features

Direct Displacement Control

The direct-proportional displacement control (DDC) provides a simple method of control. Movement of the swashplate control shaft produces a proportional swashplate movement and change in pump flow and/or direction.

If difficulties are encountered with the control, inspect the connection of the control linkage to the swashplate control shaft to insure that the linkage is properly attached. The vehicle/machine control system determines the neutral position of the linkage.

Charge Pumps

A fixed displacement gerotor type charge pump is provided as part of the BDP-10L.

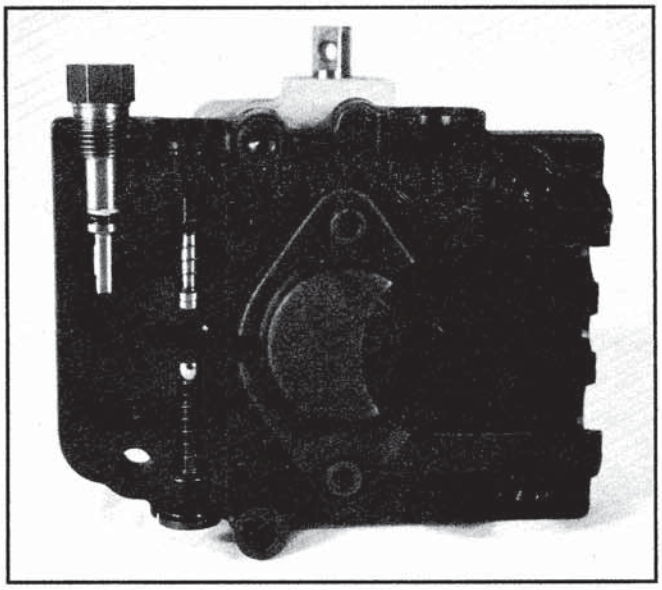
Bypass Valve

In some applications, it is desirable to move the machine for short distances at low speeds without operating the engine. A bypass valve allows oil to be routed from one side of the pump/motor circuit to the other, thus allowing the motor to turn with little resistance.

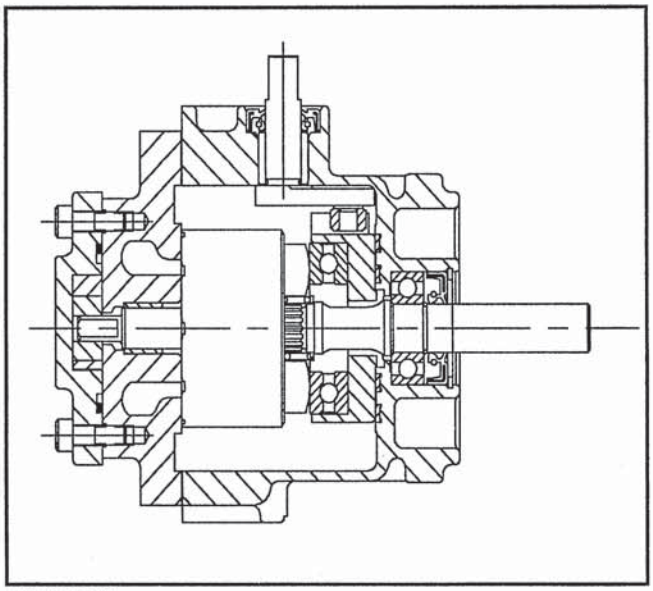
The BDP variable pumps utilize a screw type bypass valve which is fully open when unscrewed two (2) turns maximum. The bypass valve must be fully closed during normal vehicle operation.

WARNING

Opening the bypass valve will result in a loss of hydrostatic braking capacity. Take precautions to prevent machine movement when opening the valve.



BDP-10L Variable Pump with Charge Pump



BDP-10L Pump

Start-Up & Maintenance

Fluids

Fluids used with Hydro-Gear products should be carefully selected with assistance from a reputable supplier.

Typically, an API classification SG/CD engine oil is used with a viscosity range equivalent to 20W50.

Start-Up Procedure

The following start-up procedure should always be followed when starting a new installation or when restarting an installation in which the BDP had been removed from the system.

WARNING

The following procedure may require the vehicle/machine to be disabled (wheels raised off the ground, work function disconnected, etc.) while performing the procedure in order to prevent injury to the technician and bystanders.

Prior to starting the BDP, make certain all system components (reservoir, fittings, etc.) are clean prior to filling with fluid.

Be certain to fill the BDP housing with clean fluid prior to start-up. Fill the housing by pouring filtered oil into the upper case drain port, if possible.

Fill the reservoir with recommended fluid which should be filtered prior to entering the reservoir.

The inlet line and filter leading from the reservoir to the charge pump must be filled prior to start-up. Check inlet line for properly tightened fittings and make sure it is free of restrictions and air leaks.

Pressurizing the inlet 2-4 PSI will aid in start-up. "Jog" or slowly rotate the engine with the swashplate in its neutral (0 angle) position until charge pressure starts to rise (charge pressure is defined as low side loop pressure).

WARNING

Do not start engine unless pump is in the neutral position (0 swashplate angle) or the drive wheels are off the ground.

Start the engine and run at the lowest possible RPM.

With the bypass valve closed, slowly move the displacement control in both the forward and reverse directions. As air is purged from the unit, the oil level in the reservoir will drop and bubbles may appear in the fluid. Refill the reservoir as necessary.

Place the displacement control in the neutral position and open the bypass valve. Slowly move the displacement control in both the forward and reverse directions to purge the air from the closed circuit.

Close the bypass valve and run the unit in both directions for several minutes until any remaining air is purged from the unit. Refill the reservoir as necessary.

Shut down the engine, check for and correct any fluid leaks, and check the reservoir level. Add fluid if necessary. The transmission is now ready for operation.

Maintenance

Check the reservoir daily for proper fluid level, the presence of water (noted by a cloudy to milky appearance, or free water in bottom of reservoir), and rancid fluid odor (indicating excessive heat).

The BDP-10L units normally do not require regular fluid changes. The system filter should be changed per the vehicle/machine manufacturer's recommendations. The fluid and filter should be changed and the system cleaned if the fluid becomes contaminated with foreign matter (water, dirt, grease, etc.) or if the fluid has been subjected to temperature levels greater than the maximum recommended.

Troubleshooting Chart

Symptom	Probable Cause	Suggested Remedy
Vehicle will not attain normal maximum speed.	Engine not operating at correct speed.	Repair engine governor.
	Control linkage damaged or binding.	Repair control linkage.
	Bypass valve stuck partially open.	Repair bypass valve.
	Charge check valve held open. (Problem in one direction only)	Remove foreign material from valve.
Vehicle will not move when vehicle control is moved.	Control linkage damaged or not connected.	Repair or reconnect control linkage.
	Drive between engine and transmission damaged.	Repair drive (replace broken belt, repair sheared key, repair splined coupling, etc.)
	Transmission low on fluid.	Refill reservoir. Purge air from transmission.
Vehicle jerky or operating erratic.	Plugged filter. Inlet air leak.	Inspect inlet condition and filter.
Vehicle is "sluggish" under load (operates OK on level surface).	Loose drive belt between engine and transmission.	Tension drive belt (replace if necessary).
	Transmission low on fluid.	Refill reservoir. Purge air from transmission if necessary.
	Large amount of water in transmission fluid (evaporates when hot, resulting in low fluid level).	Drain fluid from reservoir and unit, replace filter element and refill with new fluid.

Minor Repair

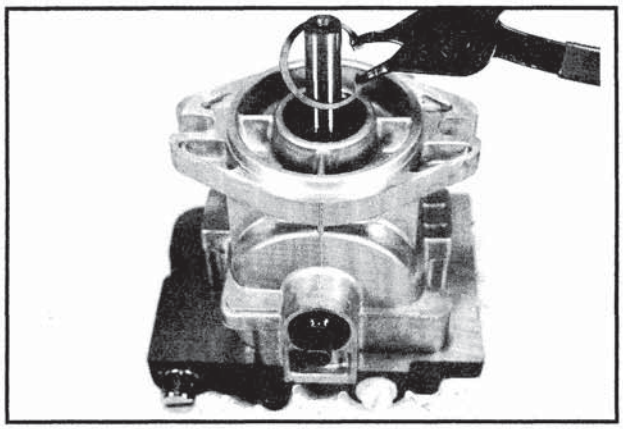
General

Minor repairs may be performed, following the procedures in this section, without voiding the unit warranty.

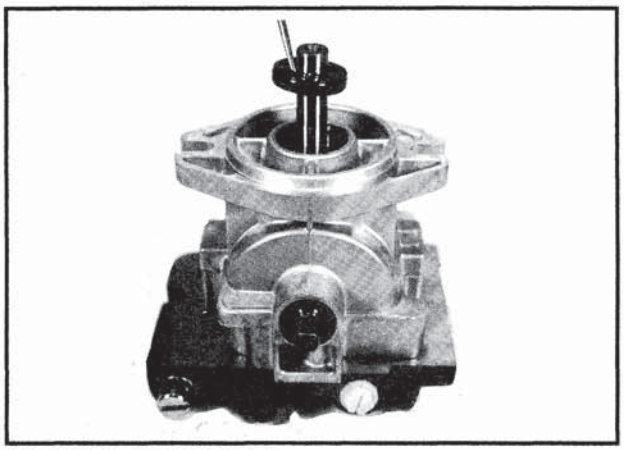
Cleanliness is a primary means of assuring satisfactory life on either new or repaired units. Cleaning parts by using a clean solvent wash and air drying is usually adequate. As with any precision equipment, all parts must be kept free of foreign materials and chemicals.

Protect all exposed sealing surfaces and open cavities from damage and foreign material.

It is recommended that all O-rings be replaced. Lightly lubricate all O-rings with clean petroleum jelly prior to assembly.



Input Shaft Seal Retaining Ring Removal

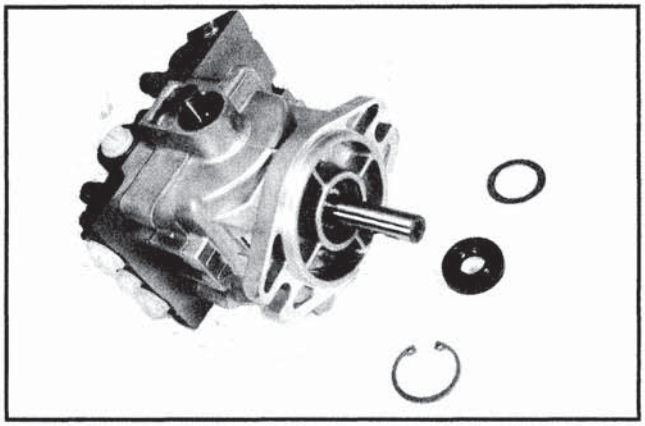


Input Shaft Seal Removal

Plug/Fitting Torques

If any plugs are removed from the housing or end cap during servicing, they should be torqued as indicated in the accompanying tables:

Item	Torque
Case Drain Fitting (9/16-18 O-Ring)	15-20 ft. lbs.
System Ports (3/4-16 O-Ring)	15-20 ft. lbs.
Inlet Fitting/Plug (7/16-20 O-Ring)	8-10 ft. lbs.
Check Valve Plugs (9/16-18 O-Ring)	15-20 ft. lbs
Bypass Valve	7-10 ft. lbs



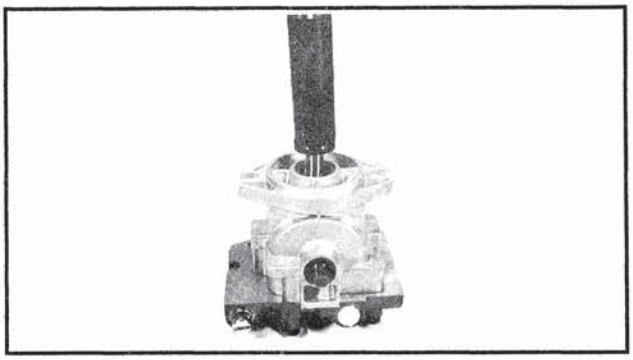
Input Shaft Seal, Spacer Washer, and Retaining Ring Removed

Shaft Seals

Lip type seals are used on the input shaft and displacement control shaft of the BDP-10L variable pumps. These seals can be replaced without major disassembly of the unit. However, replacement of these seals generally requires removal of the pump from the machine.

To replace the pump input shaft seal, first remove the retaining ring from the housing.

Carefully pull the seal out of the housing bore. A "hook" type tool may be used to grasp the seal and pull it out, or a slide hammer type puller may be used to re-move the seal. Care must be taken so as not to damage the housing bore, shaft sealing surface, or bearing. Once removed, the seal is not reusable.



Install Input Shaft Seal

Note: Once the pump input shaft seal is removed, the pump block spring may push the shaft partially out of the housing. Do not attempt to pull the shaft out of the housing. Internal parts could move out of alignment or fall into the transmission, requiring major disassembly of the unit.

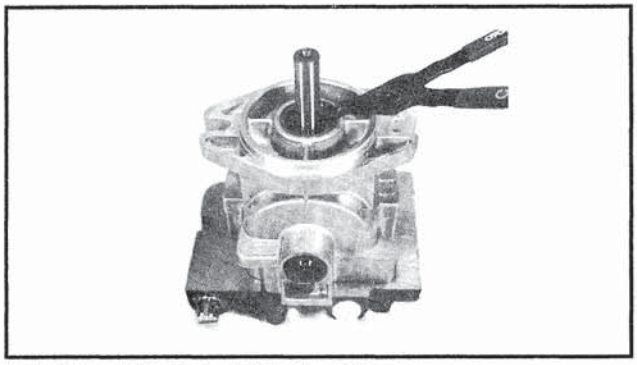
Inspect the sealing area on the shaft for rust, wear or contamination. Polish the sealing area on the shaft if necessary.

Lubricate the new seal with petroleum jelly.

Wrap the spline or key end of the shaft with thin plastic to prevent damage to the seal lip during installation.

Slide the seal over the shaft and press it into the housing bore. Be careful not to damage the seal.

Install the seal retaining ring in the housing.

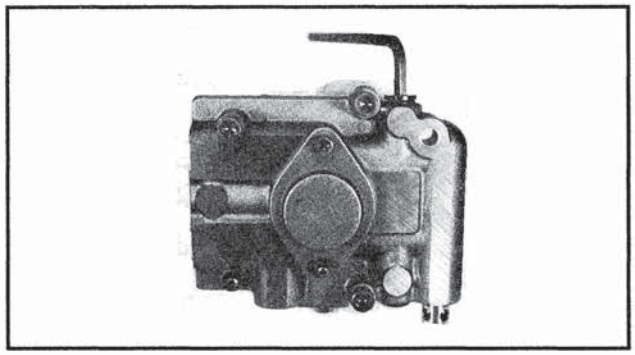


Install Input Shaft Seal Retaining Ring

Charge Check Valves

Remove the check valve plug with a 1/4" internal hex wrench.

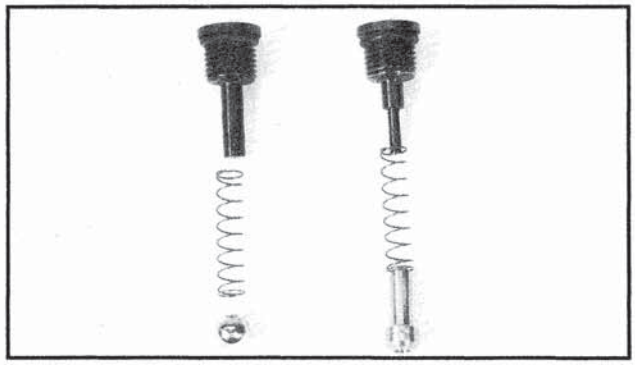
Remove the valve spring and check ball (or poppets) from the pump end cap.



Remove Charge Check Valve Plugs

CAUTION

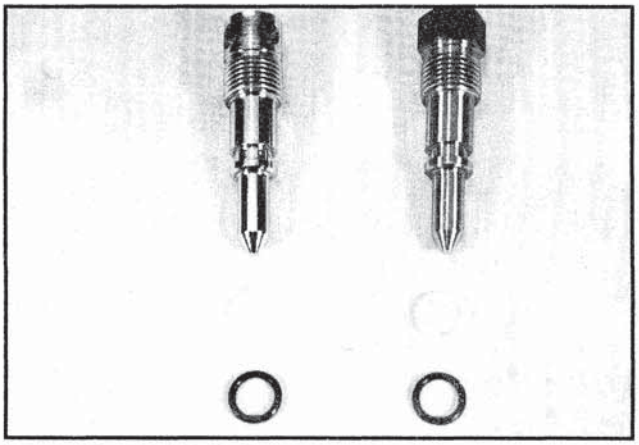
Do not allow the check balls to fall into the closed loop passages in the end cap.



Charge Check Valve Components (Poppets Opt., Balls Std.)

Inspect the check balls (or poppets) and mating seats in the end cap for damage or foreign material.

Lay the pump on its side and reinstall the check ball (or poppets) , spring, and plug (with O-ring) into the end cap. Be certain the check ball does not fall into the closed loop passage. Torque the plug to 15-20 ft.lbs. Turn the unit over and repeat for the other check valve.



Bypass Valve Kit Variations

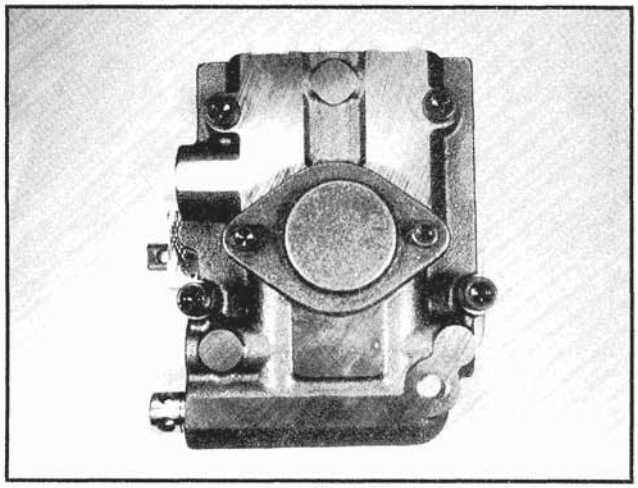
Bypass Valve

Unscrew the bypass valve from the end cap.

NOTE: Some valves have a 5/8" hex end while others have a cross hole.

Inspect the valve and mating seat in the end cap for damage or foreign material. It is recommended that the O-ring and backup ring be replaced.

Reinstall the bypass valve into the end cap. Torque to 7-10 ft.lbs.



Orienting Charge Pump Cover (CCW Rotation)

Charge Pump

The charge pump rotation is determined by the orientation of the charge pump cover on the end cap. The cast boss on the charge pump cover indicates the orientation.

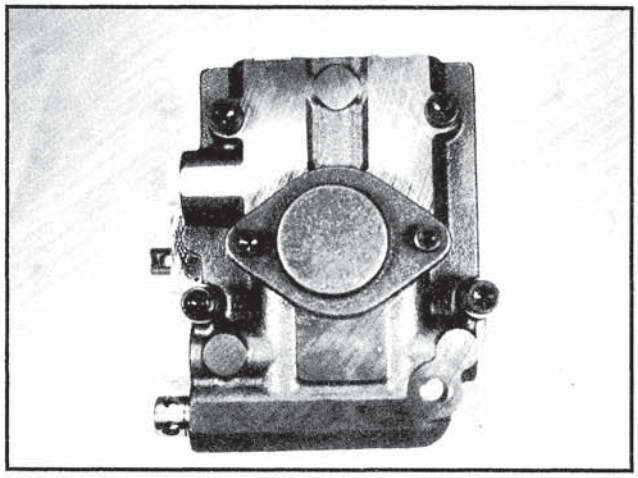
Make note of the correct orientation prior to removing the charge pump cover.

Using a 5 mm internal hex wrench, remove the two (2) screws holding the charge pump cover to the end cap.

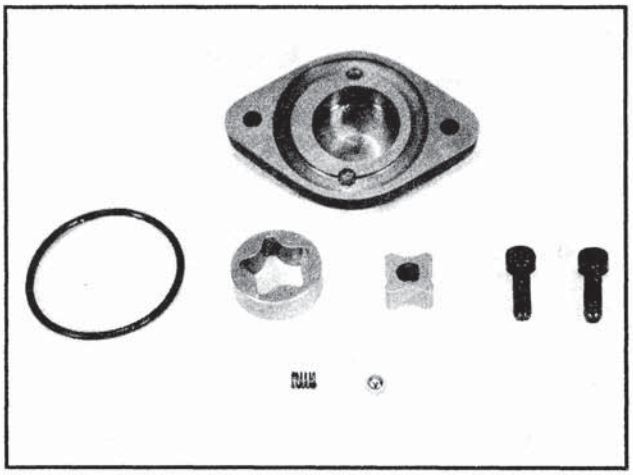
Remove the charge pump cover and O-ring.

Remove the charge pump gerotor assembly.

Remove the charge relief valve spring and ball.



Orienting Charge Pump Cover (CW Rotation)



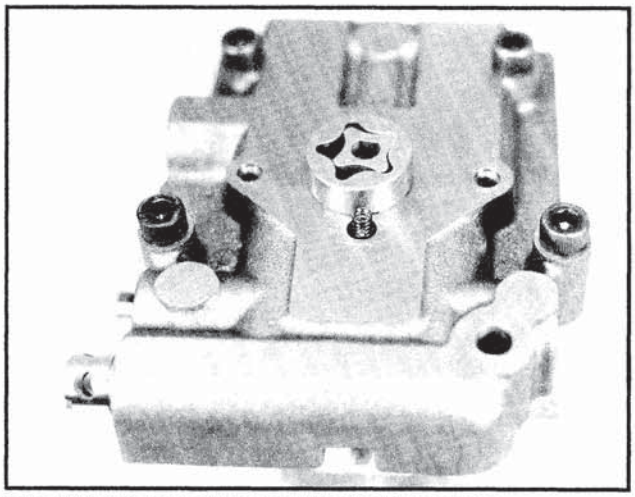
Charge Pump Components

Inspect the gerotor assembly, charge pump cover, and end cap for abnormal wear, damage or foreign material. Inspect the charge relief valve ball and spring. Inspect the charge relief valve seat in the end cap for damage or foreign material.

Prior to installing the charge pump, apply a small quantity of petroleum jelly to the I.D., O.D., and side faces of the gerotor assembly.

Install the charge relief valve ball and spring.

Install the charge pump gerotor assembly.



Install Gerotor Assembly and Charge Relief Valve

Install the charge pump cover and O-ring. The charge relief valve spring must enter the recess in the cover.

Install the charge pump cover screws. Torque each screw to 7-10 ft. lbs.

Major Repair

General

The procedures on the following pages are for the complete disassembly and reassembly (Major Repair) of the BDP-10L variable pump.

Again, cleanliness is a primary means of assuring satisfactory hydraulic unit life on either new or repaired units. Cleaning parts by using a clean solvent wash and air drying is usually adequate. As with any precision equipment, all parts must be kept free of foreign materials and chemicals. Protect all exposed sealing surfaces and open cavities from damage and foreign material.

During reassembly of the pump all surfaces which have relative motion between two parts must be coated with a film of clean oil or a lubricant such as petroleum jelly. This will assure that these surfaces will be lubricated during start-up.

It is recommended that all O-rings and gaskets be replaced. Lightly lubricate all O-rings with clean petroleum jelly prior to assembly. All gasket sealing surfaces must be cleaned prior to installing new gaskets.

Disassembly Procedures for Variable Pump

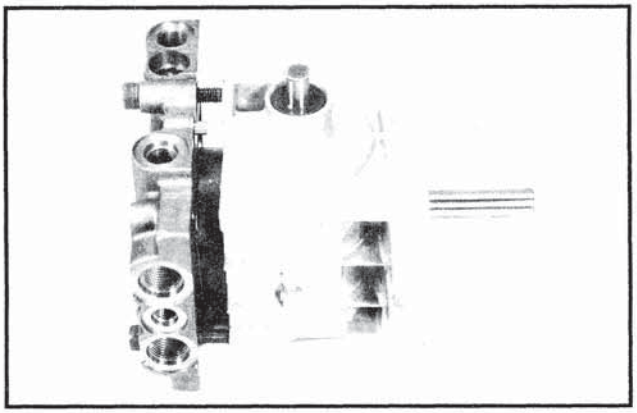
Prior to performing Major Repairs on the pump, remove the external components as described in the "Minor Repair" section of this manual. These include the following:

Bypass valve
Charge Check Valves
Charge Pump

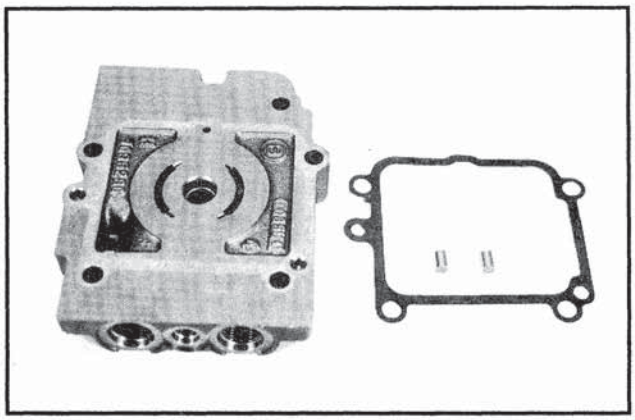
Lay the unit on its side. Using a 6 mm internal hex wrench, remove the four (4) screws which retain the end cap to the pump housing.

The internal springs should separate the end cap from the housing. Remove the end cap from the housing.

CAUTION
The pump cylinder block will stick to the surface of the end cap. Exercise caution to prevent damage to the end cap and cylinder block sealing surfaces.



Remove End Cap from Housing

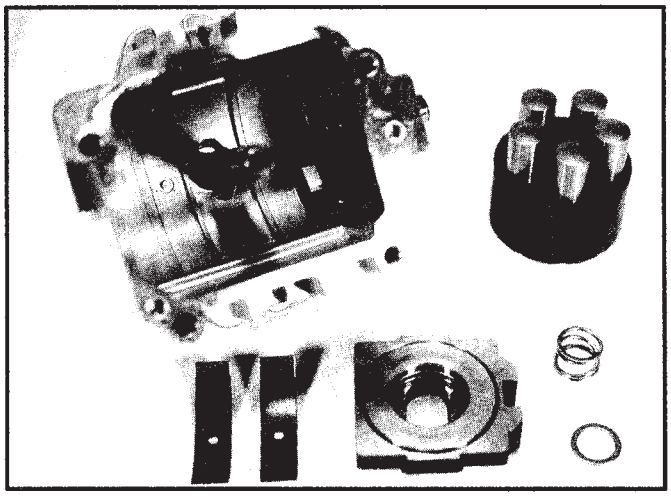


Remove Gasket and Aligning Pins

Remove the gasket and two (2) alignment pins from the housing.

Remove the pump cylinder block kit from the pump shaft.

Remove the pump cylinder block spring and washer from the pump shaft.



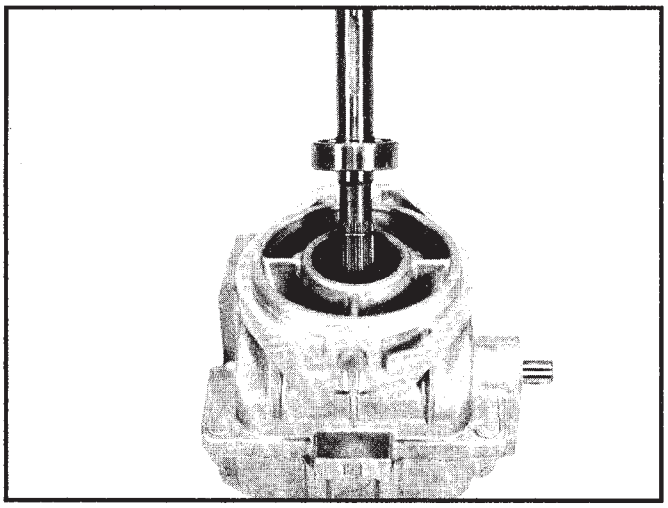
Remove pump cylinder block kit, block spring and washer and swashplate from housing.

Remove the thrust bearing from the swashplate.

Remove the pump swashplate from the housing.

Do not remove the cradle bearings.

Remove the slot guide block from the displacement control shaft.

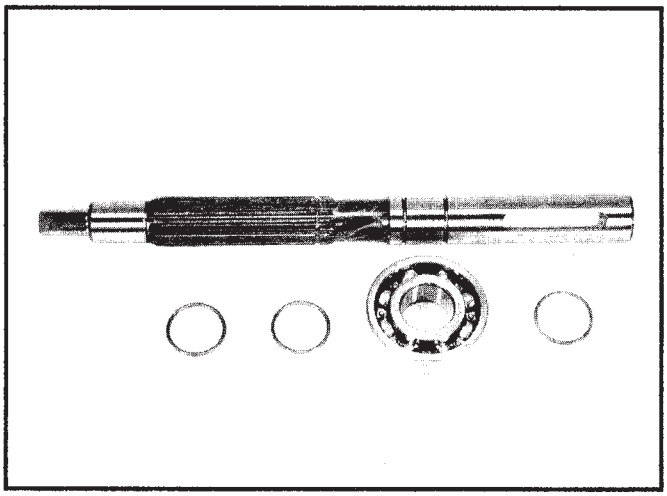


Remove Input Shaft Retaining Ring, Seal and Input Shaft from Housing

Remove the input shaft seal retaining ring.

Carefully pull the input shaft seal out of the housing bore. A hook may be used to pry the seal out, or a slide hammer type puller may be used to remove the seal. Care must be taken so as not to damage the housing bore, shaft sealing surface or bearing. Once removed, the seal is not reusable.

Remove the bearing spacer washer.

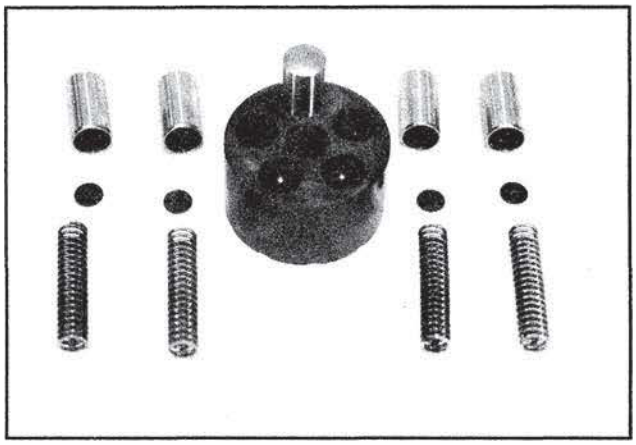


Remove Bearing from Input Shaft

Remove the pump shaft and bearing assembly from the housing.

Remove the outer bearing retaining ring (and washer, if used) and press the shaft out of the bearing.

NOTE: An inner bearing retaining ring is used on most shafts. Remove it from the shaft if necessary.



Cylinder Block Kit Components

If the pump block spring retaining ring requires replacement, remove it from the pump shaft.

Remove the displacement control shaft seal out of the housing. Care must be taken so as not to damage the housing bore.

Reconditioning and Replacement of Parts

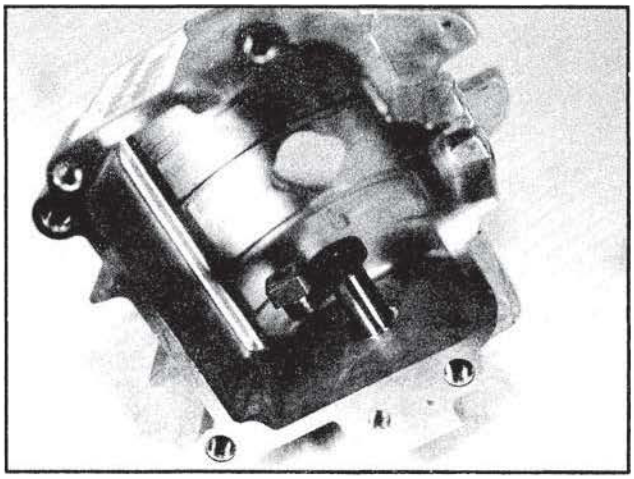
After disassembly, all parts should be thoroughly cleaned in a suitable solvent. Replace all O-rings, gaskets and shaft seals.

Inspect all parts for damage, nicks or unusual wear patterns. Replace all parts having unusual or excessive wear or discoloration.

Inspect the seal surfaces, bearing surfaces and shaft splines. Polish the sealing areas on the shafts if necessary. Replace any worn or damaged parts.

The pump shaft bushing is pressed into the end cap and should not be removed.

The running surfaces of the cylinder blocks must be flat and free from scratches. If scratches or wear are found on the running surface of the cylinder block or end cap, replace the parts.



Install Displacement Control Shaft

Assembly Procedures for Variable Pump

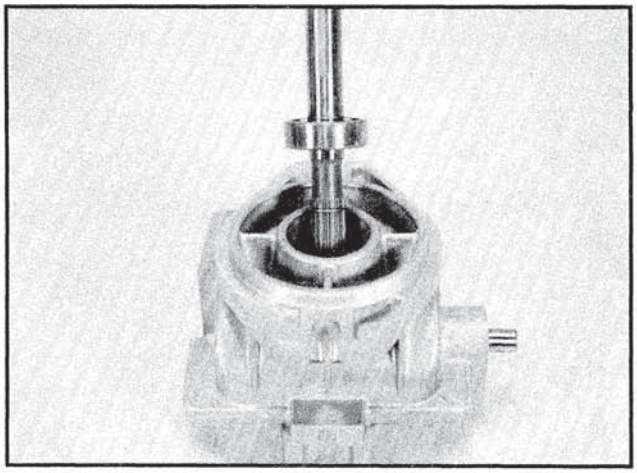
Clean and lightly oil parts prior to assembly of the variable pump. Be sure to torque all threaded parts to recommended torque levels.

CAUTION

Most parts have critical, high tolerance surfaces. Caution must be exercised to prevent damage to these surfaces during assembly. Protect exposed surfaces, openings, and ports from damage and foreign material.

Install the displacement control shaft into the housing.

CAUTION
Do not damage the shaft sealing surface.



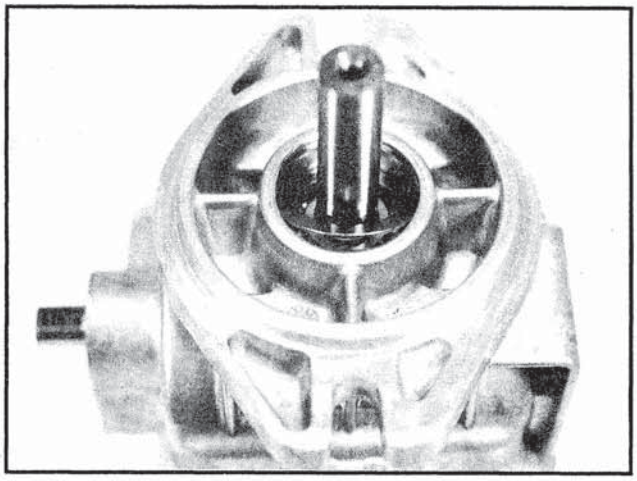
Install Input Shaft

If the block spring retaining ring was removed from the pump shaft, install a new retaining ring onto the shaft.

Install a new inner bearing retaining ring (if used) onto the pump shaft. Press the bearing onto the shaft. Install the washer (if used) and a new outer bearing retaining ring.

NOTE: Do not stretch or deform the retaining ring.

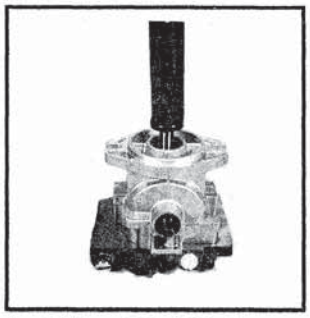
Install the pump shaft and bearing assembly into the housing.



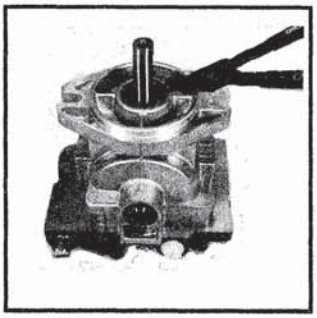
Install Bearing Spacer Washer

Install the bearing spacer washer.

Wrap the spline or key end of pump drive shaft with thin plastic to prevent damage to the seal lip during installation. Lubricate the new pump shaft seal with petroleum jelly.



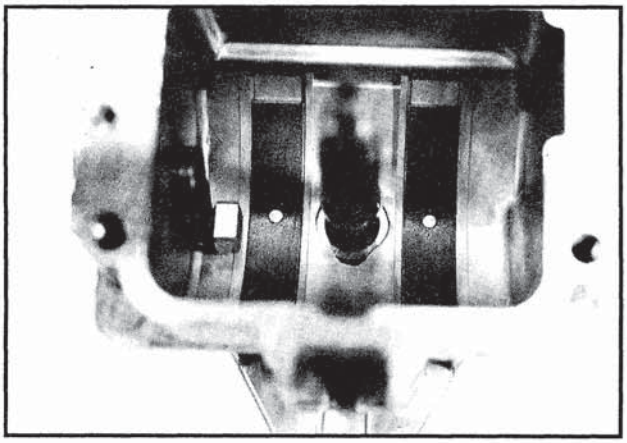
Install Input Shaft Seal



Install Input Shaft Seal Retaining Ring

Slide the seal over the shaft and press it into the housing bore. Be careful not to damage seal.

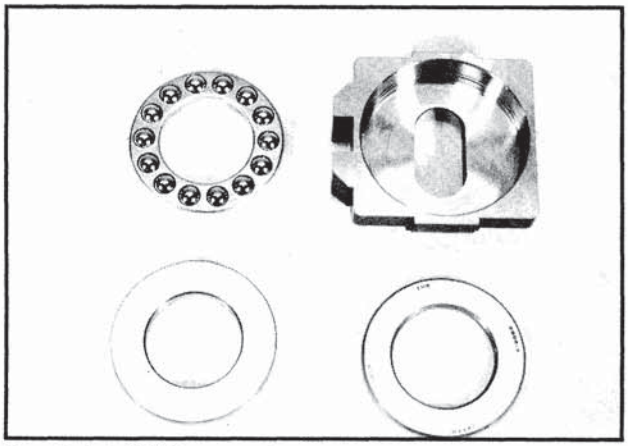
Install the retaining ring.



Install Cradle Bearings and Guide Block

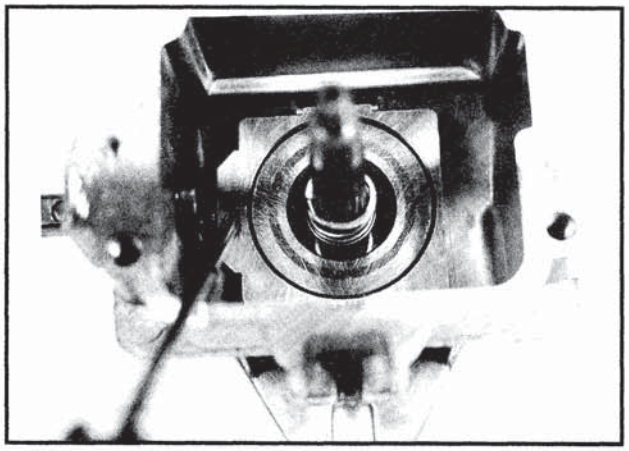
Install the swashplate cradle bearings into the housing, making sure they are located on the cast-in pins in the housing.

Install the slot guide block onto the displacement control shaft.



Swashplate Kit Components

Install the swashplate into the housing. The slot on the swashplate must engage the guide block on the displacement control shaft. Use a tool such as a screwdriver or magnet to hold the guide block in position while installing the swashplate.

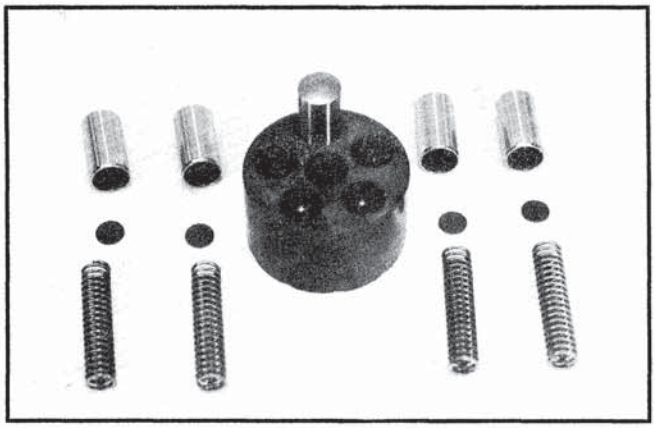


Install Swashplate, Thrust Washer and Block Spring

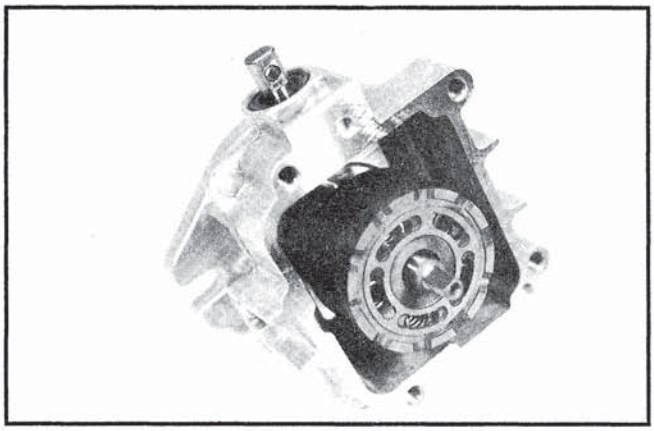
Hold the swashplate in position and measure the side play of the displacement control shaft using a dial indicator or depth gauge. Using a suitable sleeve, press the control shaft bearing into the housing until the control shaft end play is between 0.020 and 0.060 in.

Install the thrust washer and pump cylinder block spring onto the pump shaft.

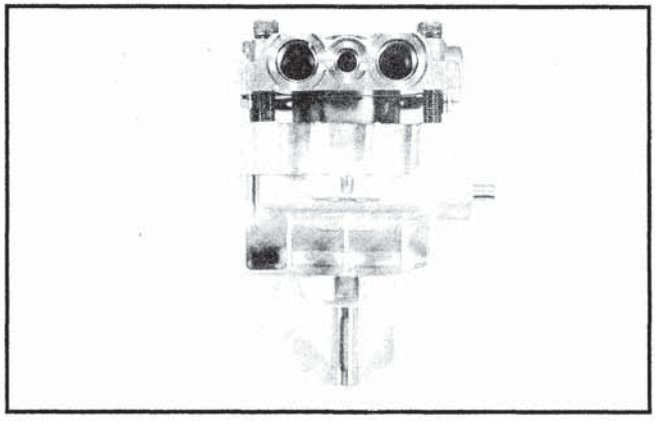
Install the springs, piston washers and pistons into the cylinder block. The pistons must move freely in their bores.



Cylinder Block Kit Components



Install Pump Cylinder Block Kit



Install End Cap

With the pump swashplate in the "neutral" (0 angle) position and the pump housing laying on its side, install the pump cylinder block kit onto the pump shaft in the housing.

Check that the piston springs are centered in the cylinder block bores. If necessary, position them with a small screwdriver.

CAUTION

Do not damage the running surfaces of the cylinder blocks.

Install the two (2) aligning pins, and install a new end cap gasket onto the housing.

Lubricate the running surfaces of the end cap and cylinder blocks. Position the housing with the housing opening UP, and install the end cap onto the housing.

CAUTION

Be certain all parts are properly aligned. Do not force the end cap into position on the housing. Caution must be exercised to prevent damage to the end cap and cylinder block sealing surfaces.

When the end cap is properly installed, the internal springs will hold it away from the housing approximately 3/8 in.

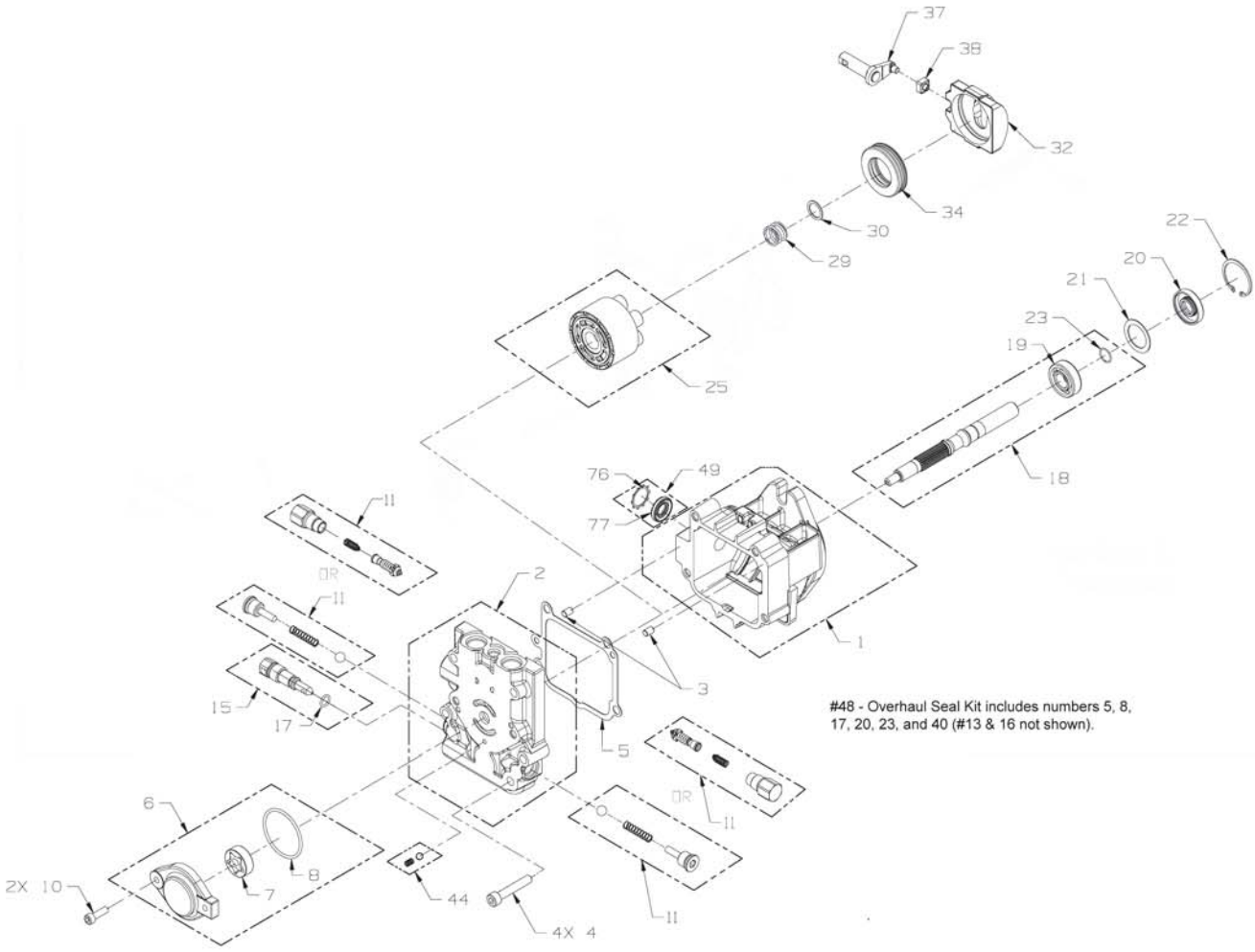
Install the four (4) screws which retain the end cap to the variable pump housing. Torque the screws evenly to 10-15 ft. lbs.

Rotate the shaft to assure correct assembly. When properly assembled, minimal torque should be required to turn the shaft.

Wrap the end of the displacement control shaft with thin plastic to prevent damage to the seal lip during installation. Lubricate the new displacement control shaft seal with petroleum jelly. Slide the seal over the shaft and press it into the housing bore. Be careful not to damage the seal.

Assemble the following components as described in the "Minor Repair" section of this manual:

Charge Pump
Charge Check Valves
Bypass Valve



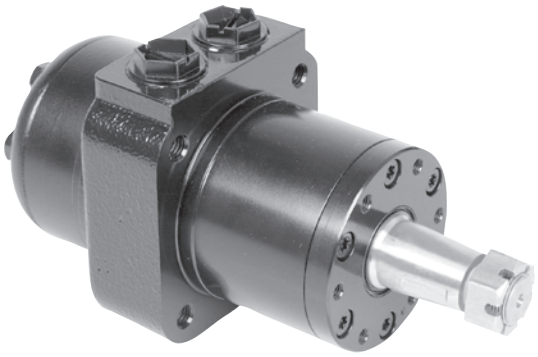
#48 - Overhaul Seal Kit includes numbers 5, 8, 17, 20, 23, and 40 (#13 & 16 not shown).

PARTS LIST

No.	Description	No.	Description
1	**Housing Kit**	17	**Ring, Back Up**
	Sea - Lip	18	**Shaft - Pump**
	Housing	19	**Bearing - Ball**
	Bearing - Journal	20	**Seal - Lip**
2	**End Cap Kit**	21	**Spacer**
	End Cap	22	**Ring - Retaining**
	Bearing - Journal	23	**Ring - Retaining**
3	**Pin, St. Headless**	25	**Cylinder Block Kit**
4	**Screw - Socket Head**		Cylinder Block
5	**End Cap Gasket**		Piston
6	**Charge Pump Kit**		Spring - Piston
	Charge Pump		Washer - Piston
	Assembly		Spring - Block
	Gerotor Assembly		Washer - Block Thrust
	O-Ring		Ring - Retaining
7	**Gerotor Assembly**	29	**Spring - Block**
8	**O-Ring**	30	**Washer - Block Thrust**
10	**Screw - Socket Head**	32	**Swashplate**
11	**Check Valve Kit**	34	**Bearing - Roller Thrust**
	Spring	37	**Trunnion Arm**
	Check Plug	38	**Guide Slot**
	Ball (or)	40	**Seal - Lip**
	Check Valve Orifice	44	**Charge Relief Valve Kit**
15	**Bypass Valve Kit**		Spring - Check Relief
	Bypass Valve		Ball
	Backup Ring	47	**Bearing - Cradle**
	O-Ring	48	**Overhaul Seal Kit**

HYDRO-GEAR®

FORWARD MOTION THROUGH FORWARD THINKING



HGM-12P
LSHT Wheel Motor
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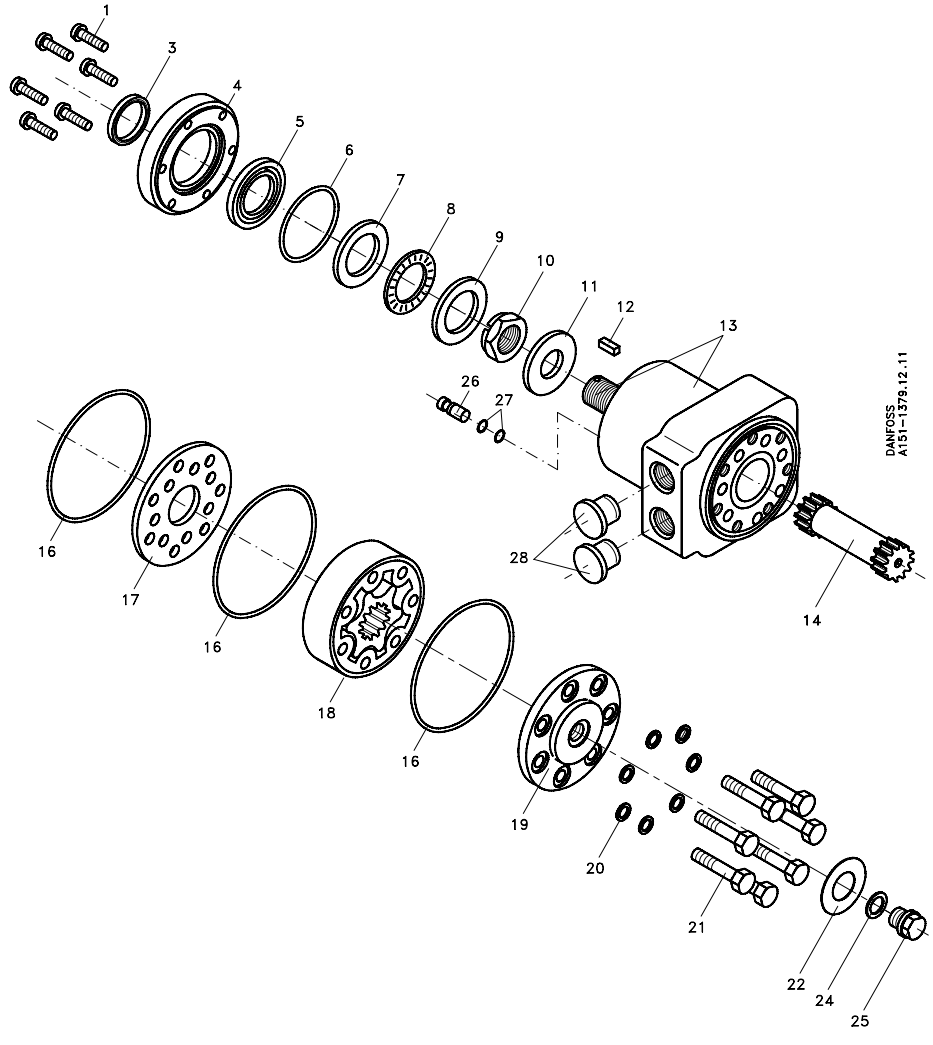
Hydraulic motors
HGM-P

Spare parts list / service manual

Index Page

Exploded view
HGM-P



				Number per motor					
				Series 8*	Series 7 and 8 with separate spigot flange				
Item	Spare parts	Dimension		OMP Flange A2	OMP Flange A2	OMP C Flange A2	OMP Flange A4	OMP Flange C	HGM-P
1	Screw								
		M6: L = 16 mm			6		6		6
		M5: L = 16 mm						6	
		M6: L = 16 mm				6			
3	Dust seal ring								
	∅25 mm, ∅1", 1" spl. shaft	35,0 × 27,5 × 2,2 mm		1					
	∅25 mm, ∅1", 1" spl. shaft 28,5 mm tapered shaft	35,0 × 27,5 × 4,0 mm			1		1	1	1
	∅25 mm shaft	35,0 × 28,5 × 4,0 mm				1			
	∅32 mm shaft,	42,0 × 35,0 × 3,5 mm					1		
4	Spigot flange								
	∅25 mm, ∅1", 1" spl. shaft (HPS)				1		1		
	∅25 mm, ∅1", 1" spl. shaft				1		1		
	∅25 mm shaft					1			
	∅25 mm shaft							1	
	∅25 mm, 28,5 mm tapered shaft								1
	∅32 mm shaft, (HPS)						1		
	∅32 mm shaft						1		
5	Shaft seal								
	∅25 mm, ∅1", 1" spl. shaft (HPS)	39 × 28,6 × 4,9 mm, HSN		1	1		1		
	∅25 mm, ∅1", 1" spl. 28,5 mm tapered shaft	42,0 × 28,6 × 5,5 mm, NBR			1	1	1	1	1
	∅25 mm, ∅1", 1" splined 28,5 mm tapered shaft	42,0 × 28,6 × 5,5 mm, FPM			1	1	1	1	1
	∅32 mm shaft, (HPS)	46 × 35 × 4,9 mm					1		
	∅32 mm shaft,	48,0 × 35,0 × 5,5 mm, NBR					1		
6	O-ring								
	∅25 mm, ∅1", 1" spl. 28,5 mm tapered shaft	47,2 × 3,5 mm, NBR			1	1	1		1
	∅25 mm	48,0 × 2,0 mm, NBR						1	
	∅32 mm shaft	53,0 × 2,0 mm, NBR					1		
7	Bearing race								
	∅25 mm, ∅1", 1" spl. shaft	41,6 × 29 × 4		1					
	∅25 mm, ∅1", 1" spl. shaft	47,5 × 29,5 × 3,0 mm			1	1	1	1	1
	28,5 mm tapered shaft	47,5 × 29,5 × 3,3 mm							1
	∅32 mm shaft	52,0 × 35,0 × 3,5 mm					1		
8	Axial needle bearing								
	∅25 mm, ∅1", 1" spl. shaft	42 × 28,7 × 4,5		1					
	∅25 mm, ∅1", 1" spl. shaft				1	1	1	1	1
	28,5 mm tapered shaft								1
	∅32 mm shaft						1		
9	Bearing race								
	28,5 mm tapered shaft								1
	∅32 mm shaft	52,0 × 35,0 × 3,5 mm					1		
10	Castellated nut								
	28,5 mm tapered shaft	M20 × 1,5							1

NBR: (Buna N, Perbunan) FPM: Viton (ISO 1629) HPS: High pressure shaft seal * Series 8 with integrated spigot flange

				Number per motor					
				Series 8*	Series 7 and 8 with separate spigot flange				
Item	Spare parts	Dimension		OMP Flange A2	OMP Flange A2	OMP C Flange A2	OMP Flange A4	OMP Flange C	HGM-P
11	Washer								
	for 28,5 mm tapered shaft	44,0 × 20,5 × 4,0							1
12	Parallel key								
	for ∅25 mm shaft	A8 × 7 × 32 mm, DIN 6885		1	1		1	1	1
	for ∅25 mm shaft	A8 × 7 × 31 mm				1			
	for ∅1" shaft	¼ × ¼ × 1¼ inch, B.S.46		1	1		1	1	
	for ∅32 mm shaft	A10 × 8 × 45 mm, DIN 6885					1		
	for 28,5 mm tapered shaft	B5 × 5 × 14 mm, DIN 6885							1
13	Housing + output shaft								
14	Cardan shaft								
	OMP 25	L = 73,8 mm		1					
	OMP 25	L = 91,2 mm			1				1
	OMP 32	L = 74,9 mm		1					
	OMP 32	L = 92,3 mm			1				
	OMP 40	L = 76,8 mm		1					
	OMP 40	L = 94,0 mm			1				
	OMP 50	L = 94,0 mm			1		1	1	1
	OMP 50	L = 76,8 mm		1		1			
	OMP 80	L = 98,0 mm			1		1	1	1
	OMP 80	L = 80,7 mm		1		1			
	OMP 100	L = 100,5 mm			1		1	1	1
	OMP 100	L = 83,3 mm		1		1			
	OMP 125	L = 100,5 mm			1		1	1	1
	OMP 125	L = 87,1 mm		1		1			
	OMP 160	L = 108,5 mm			1		1	1	1
	OMP 160	L = 91,2 mm		1		1			
	OMP 200	L = 113,5 mm			1		1	1	1
	OMP 200	L = 96,4 mm		1		1			
	OMP 250	L = 120,0 mm			1		1	1	1
	OMP 250	L = 102,9 mm		1		1			
	OMP 315	L = 128,5 mm			1		1	1	1
	OMP 315	L = 111,4 mm		1		1			
	OMP 400	L = 139,5 mm			1		1	1	1
	OMP 400	L = 122,6 mm		1		1			
16	O-ring	75,9 × 1,8 mm, NBR		3	3	3	3	3	3
17	Distributor plate			1	1	1	1	1	1
18	Gear wheel set								
	OMP 25	W = 4,1 mm		1	1				1
	OMP 32	W = 5,2 mm		1	1				
	OMP 40	W = 6,5 mm		1	1				
	OMP 50	W = 6,5 mm		1	1	1	1	1	1
	OMP 80	W = 10,4 mm		1	1	1	1	1	1
	OMP 100	W = 13,0 mm		1	1	1	1	1	1
	OMP 125	W = 16,3 mm		1	1	1	1	1	1
	OMP 160	W = 20,8 mm		1	1	1	1	1	1
	OMP 200	W = 26,0 mm		1	1	1	1	1	1
	OMP 250	W = 32,5 mm		1	1	1	1	1	1
	OMP 315	W = 40,9 mm		1	1	1	1	1	1
	OMP 400	W = 52,0 mm		1	1	1	1	1	1

NBR: (Buna N, Perbunan) FPM: Viton (ISO 1629) HPS: High pressure shaft seal * Series 8 with integrated spigot flange

				Number per motor					
				Series 8*	Series 7 and 8 with separate spigot flange				
Item	Spare parts	Dimension		OMP Flange A2	OMP Flange A2	OMP C Flange A2	OMP Flange A4	OMP Flange C	HGM-P
19	End cover								
	Side port motor without drain			1	1		1		
	Side port motor				1	1	1		1
	End port motor				1			1	
20	Washer								
	Side port motor	11,9 × 8,2 × 1,0 mm		7	7	7	7		7
	End port motor	11,9 × 8,2 × 1,0 mm			5			5	
21	Screw								
	Side port motor	M8 × 1,25							
	OMP 25	l = 30 mm		7	7				7
	OMP 32	l = 30 mm		7	7				
	OMP40	l = 35 mm		7	7				
	OMP 50	l = 35 mm		7	7	7	7		7
	OMP 80	l = 40 mm		7	7	7	7		7
	OMP 100	l = 40 mm		7	7	7	7		7
	OMP 125	l = 45 mm		7	7	7	7		7
	OMP 160	l = 50 mm		7	7	7	7		7
	OMP 200	l = 55 mm		7	7	7	7		7
	OMP 250	l = 60 mm		7	7	7	7		7
	OMP 315	l = 70 mm		7	7	7	7		7
	OMP 400	l = 80 mm		7	7	7	7		7
	End port motor	M8 × 1,25							
	OMP 50	l = 40 mm			5			5	
	OMP 80	l = 45 mm			5			5	
	OMP 100	l = 45 mm			5			5	
	OMP 160	l = 55 mm			5			5	
	OMP 200	l = 60 mm			5			5	
	OMP 250	l = 65 mm			5			5	
	OMP 315	l = 75 mm			5			5	
	OMP 400	l = 85 mm			5			5	
22	Name plate[a)]								
	Side port motor - aluminium				1	1	1		1
	Side port motor - brass				1	1	1		
	End port motor - aluminium				1			1	
24	Washer	17,5 × 13,5 × 1,5 mm			1	1	1	1	1
25	Drain plug				1	1	1	1	1
26	Check valve incl. item 27 Only for OMP motors with built-in check valves				2	2	2	2	2
27	O-ring	5,0 × 1,5 mm, NBR			4	4	4	4	4
28	Plug								
	Side port motor- plastic plug			2	2	2	2		2
	End port motor - steel plug				2			2	
	End port motor - plastic plug				2			2	

NBR: (Buna N, Perbunan) FPM: Viton (ISO 1629) HPS: High pressure shaft seal * Series 8 with integrated spigot flange

				Number per motor					
				Series 8*	Series 7 and 8 with separate spigot flange				
Item	Spare parts	Dimension		OMP Flange A2	OMP Flange A2	OMP C Flange A2	OMP Flange A4	OMP Flange C	HGM-P
	Spar part bag for motors with HPS and ∅25 mm, ∅1", 1" spl. shaft (Series 7/8)			1					
3	1 pcs. Dust seal	35 x 27,5 x 2,2 mm NBR							
5	1 pcs. Shaft seal (Series 7/8)	39 x 28,6 x 4,9 mm HSN							
6	1 pcs. O-ring	47,2 x 3,5 mm NBR							
6	1 pcs. O-ring	48 x 2 mm NBR							
16	3 pcs. O-ring	75,9 x 1,8 mm NBR							
16	3 pcs. O-ring	90 x 2 mm NBR							
20	7 pcs. Washer	11,9 x 8,2 x 1 mm							
	Spar parts bag for motors with standard shaft seal and ∅25 mm,∅1", 1" spl. shaft 28,5 mm tapered shaft				1	1**	1	1	1
3	1 pcs. Dust seal	35 x 27,5 x 4 mm NBR							
5	1 pcs. Shaft seal (Series 7/8)	42 x 28,6 x 5,5 mm NBR							
5	1 pcs. Shaft seal (Series 6)	48 x 28,6 x 6 mm NBR							
6	1 pcs. O-ring	47,2 x 3,5 mm NBR							
6	1 pcs. O-ring	48 x 2 mm NBR							
16	3 pcs. O-ring	75,9 x 1,8 mm NBR							
20	7 pcs. Washer	11,9 x 8,2 x 1 mm							
24	1 pcs. Washer	17,5 x 13,5 x 1,5 mm							
	Spare part bag for motors with ∅35 mm shaft Series 6/7 and 8)						1		
3	1 pcs. Dust seal	42 x 35 x 3,5 mm NBR							
5	1 pcs. Shaft seal	48 x 35 x 5,5 mm NBR							
6	1 pcs. O-ring	53 x 2 mm NBR							
16	3 pcs. O-ring	75,9 x 1,8 mm NBR							
20	7 pcs. Washer	11,9 x 8,2 x 1mm							
24	17,5 x 13,5 x 1,5 mm	17,5 x 13,5 x 1,5 mm							

NBR: (Buna N, Perbunan) FPM: Viton (ISO 1629) HPS: High pressure shaft seal

* Series 8 with integrated spigot flange
** Excl. dust seal ring

Tightening torque

Item		Torque (daNm)	Torque (lbf in)
1		0,5 - 0,8	45 - 70
		0,5 - 0,8	45 - 70
		0,5 - 1,0	45 - 90
10		9,0 - 11,0	800 - 1000
21		3,0 - 3,5	270 - 315
25		3,0 - 6,0	270 - 540
28		5,0 - 7,0	445 - 620

Dismantling

Item	Part to remove	Comments
10	Castelated nut	
11	Washer	
12	Parallel key	
28	Seal plugs	Put the motor in a holding tool, with the output shaft downward. For end port version use 10 mm hexagon socket spanner.
25, 24	Drain plug, washer (If present)	Use a 19 mm spanner socket.

Dismantling

Item	Part to remove	Comments
21, 20	Screws, washers	Use a 13 mm spanner socket.
19	End cover	Remove end cover sideways.
18, 16	Gear wheel set O-rings (2 off)	Keep fingers under the gearwheel set to prevent the parts from falling out.
14	Cardan shaft	
17,16	Distributor plate O-ring	
13	Output shaft	Motors with integrated spigot flange: Place the motor housing on the work bench and press the shaft out of the motor housing. Shaft and bearings should normally not be removed from HGM-P. However, if necessary for inspection and cleaning, remove the shaft from the back of the housing by gently tapping the axle journal with a plastic hammer. The front bearing can thus remain in the housing. After this, turn the motor.

Dismantling

Item	Part to remove	Comments
1	Screws (6 off) (If present)	Use Torx-spanner type T30, 9 mm screwdriver or 4 mm hexagon socket spanner.
4	Spigot flange	
6, 7	O-ring, bearing race	Motors with integrated spigot flange: Remove bearing and bearing race from the motor housing. Motors with separate spigot flange: Use a 2 mm screwdriver.
8	Needle bearing	
5 3	Shaft seal Dust seal	Motors with integrated spigot flange: With mandrel and plastic hammer, carefully knock out the shaft seal. Motors with separate spigot flange: Knock out the shaft seal / dust seal with a plastic hammer. Use mandrel.

Dismantling

Item	Part to remove	Comments
9	Bearing race	Only HGM-P with ∅32 mm/28,5 mm tapered shaft. Use a 2 mm screwdriver.
26	Check valves (2 off)	Only OMP with check valves Pull the check valve out with, for example, a ground (shortened) 3.5 mm screw tap.

Cleaning
Clean all parts carefully with low aromatic kerosine.
Inspection and replacement
Check all parts carefully and replace if necessary.
Lubrication
Before assembly, lubricate all parts with hydraulic oil and grease rubber parts with vaseline.

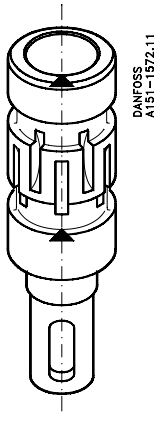
Assembly

Item	Part to mount	Comments
		Place the motor housing in the holding tool with the flange upwards.
26	Check valves (2 off)	Only OMP with check valves Grease the check valves (fitted with new O-rings) and fit them in their bores with light blows using plastic hammer.
9	Bearing race	Only HGM-P with ∅32 mm/28,5 mm tapered shaft.
5	Shaft seal	Motors with integrated spigot flange: Lubricate the shaft seal on the out side with hydraukic oil. Fit the shaft seal correct onto mandrel and carefully press the shaft seal into position in the motor housing. Motors with separate spigot flange: Knock the seal into position in the spigot flange. Check that the seal lies against the cover recess. Use mandrel.

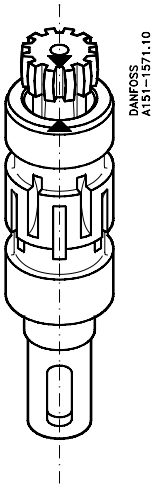
Assembly

Item	Part to mount	Comments
3	Dust seal ring	Place the dust seal ring in the spigot flange and knock it into position with a plastic hammer and appropriate mandrel.
7, 6	Bearing race, O-ring	Motors with integrated spigot flange: Fit bearing and bearing race onto the shaft and mount together with the shaft. Motors with separate spigot flange: Grease the O-ring with vaseline and fit the bearing race and O-ring into the spigot flange.
8	Needle bearing	
4	Spigot flange	Turn so that the holes line up.

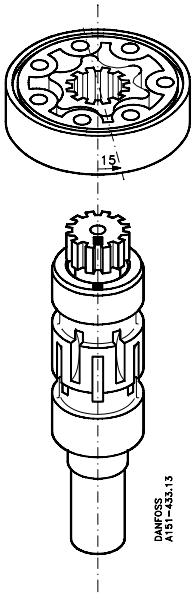
Assembly

Item	Part to mount	Comments
1	Screws (6 off)	*Tightening torque* Torx screws M6 : 0,5-0,8 daNm(45-70 lbf in (in-lbs)) Slotted screws M6 : 0,5-0,8 daNm (45-70 lbf in (in-lbs)) Hexagon socket screws M5: 0,5-1,0 daNm (45-70 lbf in (in-lbs)) After this, turn the motor.
13	Output shaft  	Grease the journals with hydraulic oil. The rear shaft end must be marked before fitted. The mark must be positioned vertically above a commutation slot leading up to the front annular channel. For HGM-P, guide the shaft into the motor housing back with the rear needle bearing fitted on the shaft. Bring the shaft in line with the back of the motor by gently tapping the shaft with a plastic hammer. Check that the shaft rotates easily

Assembly

Item	Part to mount	Comments
16	O-ring	Grease the O-ring and put it in the O-ring groove of the housing.
17	Distributor plate	Turn the distributor plate so that the holes line up.
14	Cardan shaft	
		Guide the cardan shaft down into the motor housing. <u>Only OMP 25, 32, 40</u> Place the assembly tool under the upper splines of the cardan shaft. In case of different splines lengths turn the cardan shaft to ensure the long splines end is fitted in the output shaft. Transfer marking from output shaft to cardan shaft.

Assembly

Item	Part to mount	Comments
18, 16	Gearwheel set, O-rings	
		Place the O-rings (greased) in the O-ring grooves of the gearwheel. In gearwheels with non through splines place the gearwheel with the recess in the spline hole facing down towards the housing. Place the gearwheel set on the cardan shaft so that the top of a tooth in the external teeth of the gearwheel are vertically above the mark on the cardan shaft. Turn the gearwheel set counter clockwise until the cardan shaft and the gearwheel start to mesh (15°). Turn the gearwheel rim so that the holes made for the screws line up.
19	End cover	Turn the end cover so that the holes line up.

Assembly

Item	Part to mount	Comments
20, 21	Washer, screws	Use a 13 mm spanner socket Tightening torque: 3,0-3,5 daNm (265-310 lbf in (in-lbs)).
24, 25	Washer, drain plug (If present)	Use a 19 mm spanner socket. Tightening torque: 3-6 daNm (265-536 lbf in).
28	Seal plugs Threaded plug	*End port version:* Screw plastic plugs into end ports. Screw in the side port plugs using 10 mm hexagon socket spanner. Tightening torque: 5-7 daNm (445-620 lbf in (in-lbs)). *Side port version* Screw in plastic plugs.
12	Parallel key	To be secured with tape or plastic ring.
11	Washer	
10	Castelated nut	

HYDRO-GEAR®

FORWARD MOTION THROUGH FORWARD THINKING

HGM-E
LSHT Wheel Motor
Service and Repair Manual

BLN-52198
January 2018

Table Of Contents

FOREWORD

Headquartered in Sullivan, Illinois, Hydro-Gear® is a world leader in the design, manufacture, and service of quality hydrostatic transaxles for the lawn and garden industry. The mission of our company is to be recognized by our customers and the industry as a world-class supplier and the quality leader in everything we do.

This Service and Repair Manual is designed to provide information useful in servicing and troubleshooting the Hydro-Gear HGM - E Series motor.

It is necessary, and a good shop practice, that your service area be equipped with the proper tools and the mechanics be supplied the latest information available. All repair procedures illustrated in this guide are suggested, but preferred methods of repair.

Internal repair procedures require that the motor be removed from the vehicle.

How to Use This Manual

Each subassembly illustrated in this manual is illustrated with an exploded view showing the parts involved. The **item reference numbers in each illustration are for assembly instructions only.** See page 21 for part names and descriptions. A complete exploded view and item number list of the HGM-E motor is on page 20.

General Instructions

Cleanliness is a primary means of assuring satisfactory life on repaired units. Thoroughly clean all exposed surfaces prior to any type of maintenance. Clean all parts carefully with low aromatic kerosene.

As with any precision equipment, all parts must be kept free of foreign material and chemicals.

Protect all exposed sealing surfaces and open cavities from damage and foreign material. The external surfaces should be cleaned before beginning any repairs.

Upon removal, it is recommended that seal and O-rings be replaced. Before assembly, lubricate all parts with hydraulic oil and grease rubber parts with clean petroleum jelly.

Parts requiring replacement must be replaced from the appropriate parts kits identified on the Service Schematic, found at the end of this manual. Use only original Hydro-Gear® replacement parts found in BLN-51427 (CD).

General Description

Hydro-Gear HGM-E wheel motors convert hydraulic energy (pressure and oil flow) into mechanical energy (torque and speed). Hydro-Gear wheel motors are of a fixed displacement LSHT design. For a given oil flow and given pressure the displacement (size of motor) determines the speed and torque. For a given displacement (size of motor) the speed is determined by the oil flow rate and the torque is determined by the pressure differential.

The operating principle of the motor is based on an internal gearwheel that moves about an eccentric, while rotating and advancing on the rollers in the external gearwheel.

The distributor valve is driven synchronously by the internal gear through a cardan shaft ensuring that the individual chambers of the motor are filled and emptied precisely without losses. The distributor valve in the HGM-E motor is in the form of a disc valve on the output shaft. The cardan shaft rotates the disc valve and transfers mechanical energy from the gearwheel to the output shaft. The hydraulic forces are equalized by the balance plate.

"All fluids and cleaning materials should be handled and disposed of according to local, state, and federal regulations."

Note: "Any and all Hydro-Gear components removed and replaced during service are recyclable."

TOOLS

REQUIRED TOOLS
Flat Blade Screw Driver (2)
Torque Wrench
Mandrel
Rubber or Neoprene Mallet
Blind Bearing Puller
13 mm Socket (15E)
16 mm Socket (18E)
Seal Hook

TORQUES

REQUIRED TORQUE VALUES			
Item	**Description**	**Torque**	**Operation**
1	Castellated nut	160 - 210 ft-lbs [217 - 284 Nm]	Brake Drum Assembly
25	HGM-15E Series Screw, Hex head, (M8 X 110MM)	300 - 380 lb-in [35 - 40 Nm]	HGM-15E Series End Cover
25	HGM-15E Series Screw, Hex head, (M10 X 110MM)	660 - 720 lb-in [75 - 80 Nm]	HGM-15E Series End Cover
25	HGM-18E Series Screw, Hex head, (M8 X 130MM)	310- 354 lb-in [35 - 40 Nm]	HGM-18E Series End Cover
25	HGM-18E Series Screw, Hex head, (M10 X 130MM)	660 - 720 lb-in [75 - 80 Nm]	HGM-18E Series End Cover
29	Bolt 5/16 – 18 x .75 SHCS	180 - 240 in-lbs [20.3 - 27.1 Nm]	Brake Assembly

As a general rule, use the low end of the torque specification on fasteners when reassembling the unit.

DRUM & BRAKE

Refer to Figure 1 and 2

Disassembly

1. Remove the cotter pin (30).
2. Remove the castellated nut (1).

NOTE: *If the drum assembly or hub assembly is removed from the axle shaft, the drum/hub assembly must be discarded and replaced with a new assembly.*

3. Remove the drum/hub assembly (27).
4. Remove the four bolts (29) securing the brake assembly (28) to the HGM-E motor. See figure 2.

5. Remove the brake assembly. See figure 2.

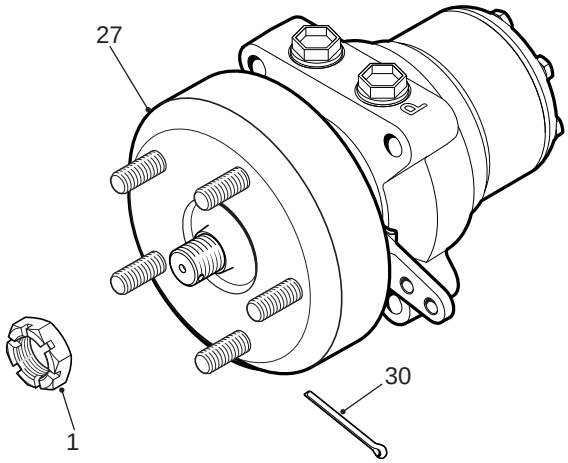


Figure 1, Drum Assembly

Inspection

1. Inspect the studs on drum (27) for wear and/or damage. Replace if necessary.
2. Inspect the brake assembly (28), i.e., the brake shoes for wear and/or damage.

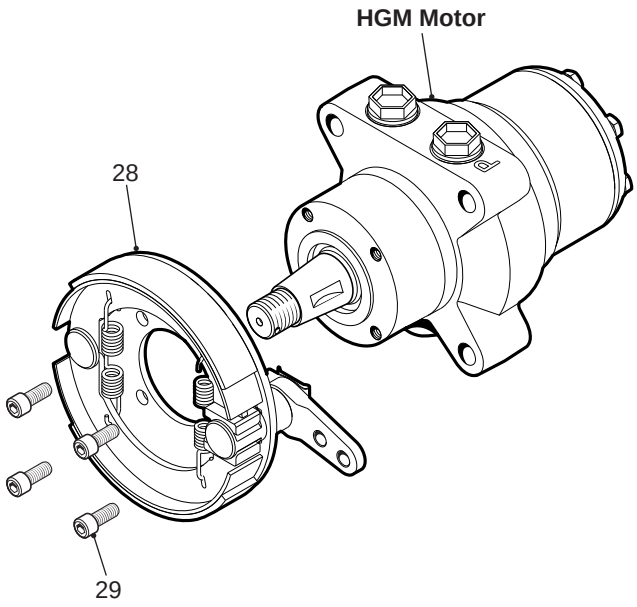


Figure 2, Brake Assembly

END COVER

Refer to Figure 3

Disassembly

1. If removing the motor shaft, remove the woodruff key (10) at this point.
2. Place the motor with the end cover up for disassembly.
3. Mark the orientation of the end cover (22) and gearwheel set (21).
4. Remove the seven end cover screws (25).
5. Remove the seven end cover washers (24) and discard.
6. Remove the end cover (22) — by sliding the end cover (22) sideways, off the gearwheel set. The end cover may be difficult to remove due to oil film causing it to stick.

Inspection

1. Inspect for wear or damage.
2. Inspect screws (25) – threads, for wear or damage.
3. Inspect woodruff key (10) for wear or damage.

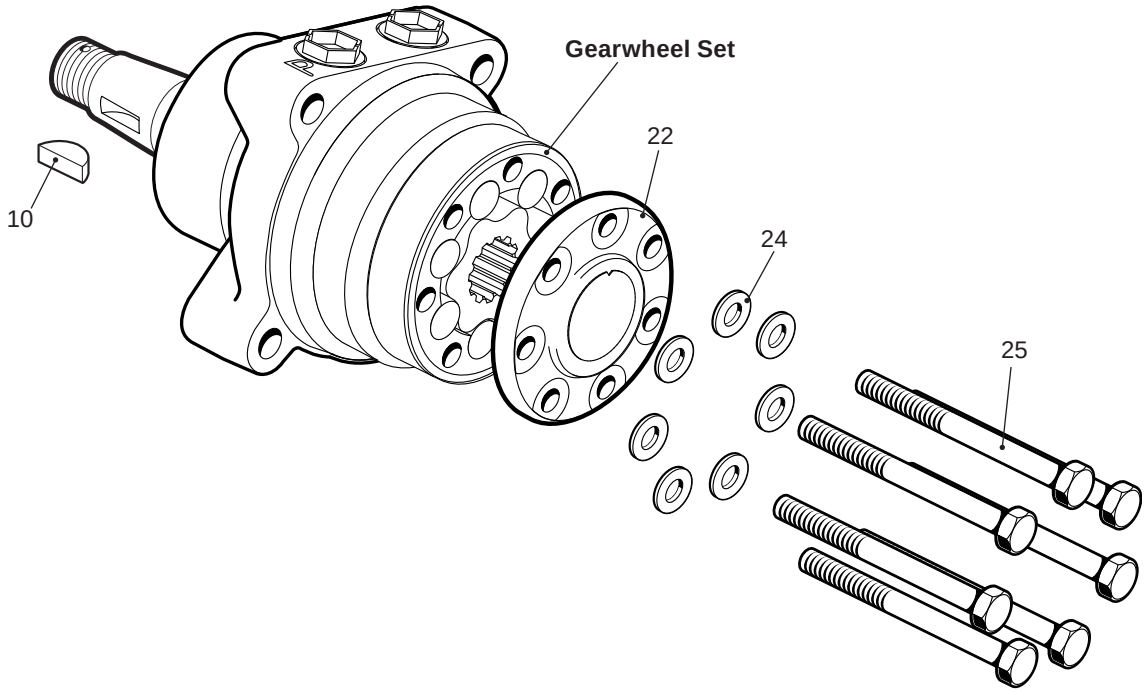


Figure 3, End Cover

GEARWHEEL SET

Refer to Figure 4

Disassembly

1. Remove the screws (25), the washers (24) and the end cover (22). See page 5.
2. Remove the O-ring (20) and discard.
3. Remove the gearwheel set (21).

NOTE: *Placing fingers underneath gearwheel set will help keep parts from falling out.*

4. Remove the second O-ring (20) and discard.
5. Dismantle the gear wheel set for inspection. When removing the inner gearwheel, notice the recess without teeth and its orientation for reassembly.

Inspection

1. Inspect for wear or damage.

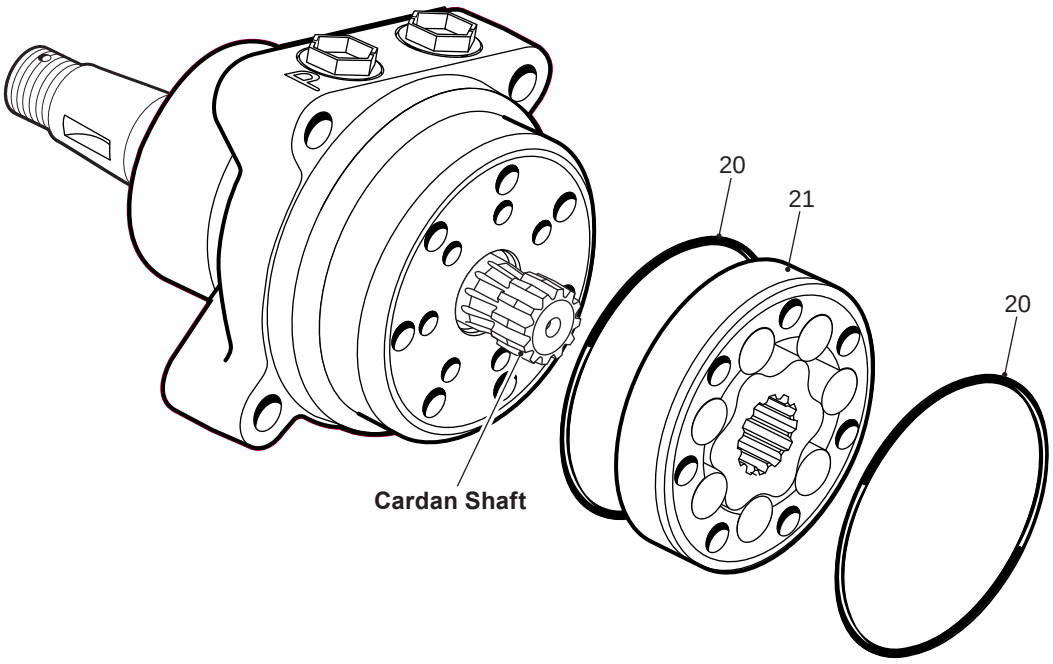


Figure 4, Gear Wheel Set

CARDAN SHAFT

Refer to Figure 5

Disassembly

1. Remove the screws (25), the washers (24), the end cover (22), the O-rings (20) and the gearwheel set (21). See Pages 5 and 6.
2. Remove the cardan shaft (19).
3. Take note of the difference in each end (length and shape of splines).

Inspection

1. Check for wear and/or damage to the individual splines on the cardan shaft (19).

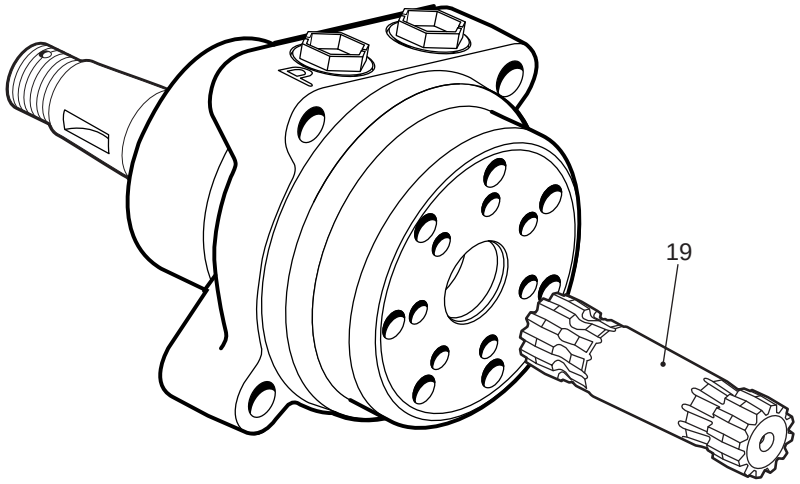


Figure 5, Cardan Shaft

DISTRIBUTOR PLATE

Refer to Figure 6

Disassembly

1. Remove the screws (25), the washers (24), the end cover (22), the O-rings (20), the gearwheel set (21) and the cardan shaft (19). See pages 5, 6 and 7.

2. Remove the distributor plate (18), and the radial needle bearing (16). *Note:* The radial needle bearing (16) is pressed into the distributor plate (18) and does not typically require removal.

NOTE: *The needles may fall out of the needle bearing (16) during dismantling and can be retrieved for re-use.*

Inspection

1. Inspect for wear or damage.

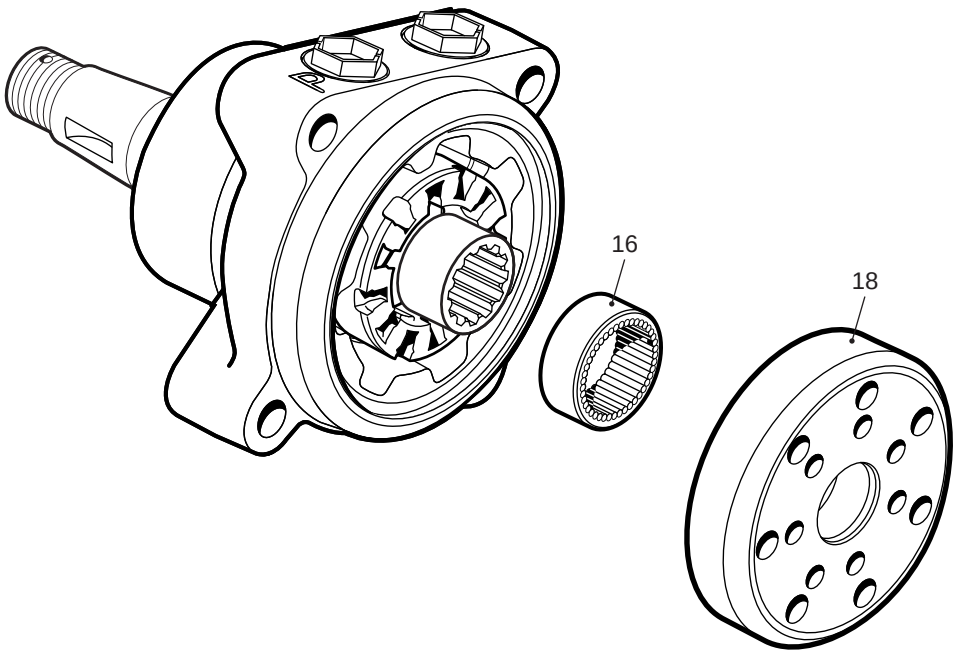


Figure 6, Distributor Plate

DISC VALVE

Refer to Figure 7

Disassembly

1. Remove the screws (25), the washers (24), the end cover (22), the O-rings (20), the gearwheel set (21), the cardan shaft (19), the distributor plate (18), the bearing race (17), the radial needle bearing (16) and the distributor plate (18). See pages 5 – 8.

2 . Remove the disc valve (15). Note the length of the keys in the I.D. of the disc valve.

Inspection

1. Inspect for wear or damage.

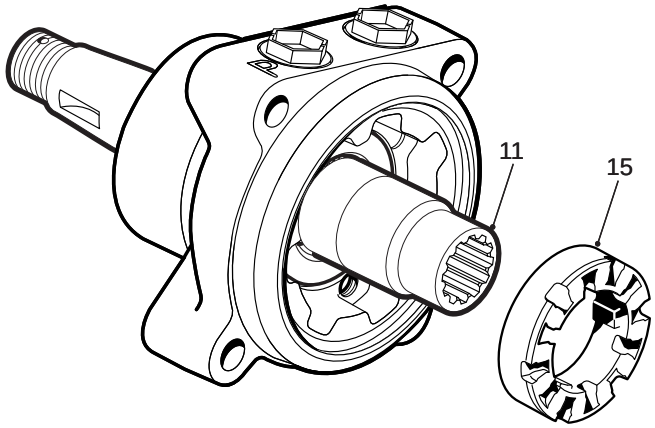


Figure 7, Disc Valve

MOTOR SHAFT

Refer to Figure 8

Disassembly

1. Remove the screws (25), the washers (24), the end cover (22), the O-rings (20), the gearwheel set (21), the cardan shaft (19), the distributor plate (18), the bearing race (17), the radial needle bearing (16), the distributor plate (18) and the disc valve (15).

2. Remove the woodruff key, if installed. See item (10), page 5.

3. With motor housing secure in a holding tool, press out the motor shaft (11).

NOTE: *The needles may fall out of the needle bearing (9) when motor shaft (11) is removed. Retrieve for re-use.*

Inspection

1. Inspect for wear or damage.

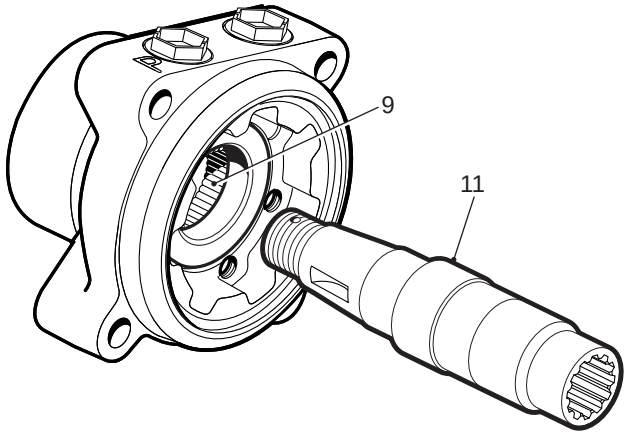


Figure 8, Motor Shaft

BALANCE PLATE

Refer to Figure 9

Disassembly

1. Remove the screws (25), the washers (24), the end cover (22), the O-rings (20), the gearwheel set (21), the cardan shaft (19), the distributor plate (18), the bearing race (17), the radial needle bearing (16), the disc valve (15) and the tapered shaft (11).
2. Remove the balance plate (14).
3. Remove the O-ring (12) and discard.
4. Remove the spring washer (13).
5. Remove the O-ring (5) and discard.

Inspection

1. Inspect for wear or damage.

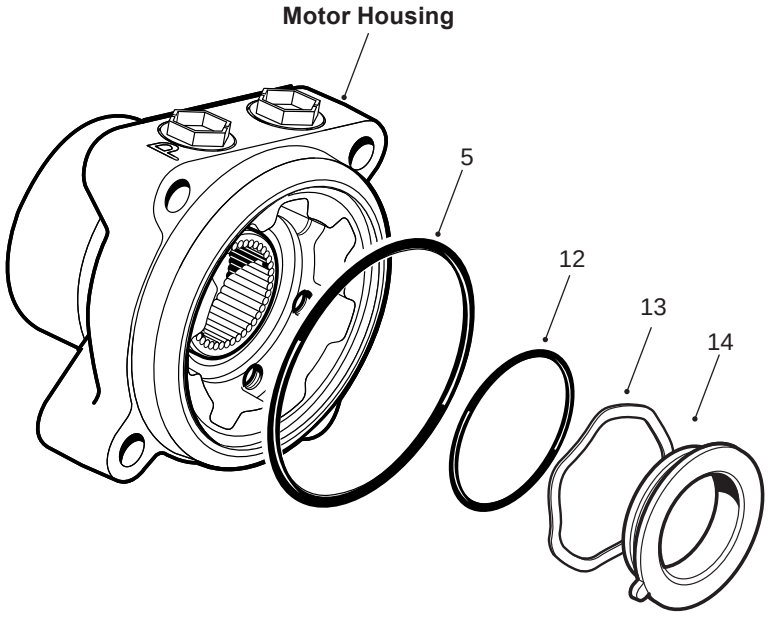


Figure 9, Balance Plate

BEARINGS AND SEALS

Refer to Figure 10

Disassembly

1. Remove the screws (25), the washers (24), the end cover (22), the O-rings (20), the gearwheel set (21), the cardan shaft (19), the distributor plate (18), the bearing race (17), the radial needle bearing (16), the disc valve (15), the tapered shaft (11) and the balance plate (14). See pages 5 – 10.
2. Apply grease to the radial needle bearing (9) to hold needle bearings in place.
3. Flip the unit over to remove the dust seal (3).
4. Using a flat blade screwdriver, gently lever the dust seal (3) from the motor housing and discard.
5. Flip the unit back over to remove the radial needle bearing (9). A blind bearing puller must be used to remove the radial needle bearing (9) from the motor housing.
6. Remove the axial needle bearing (8) and the 2 bearing races (7).
7. Using a small flat blade screwdriver, remove the shaft seal (6) from the bearing housing and discard. Insert the screwdriver into the axle end of the motor housing and pry/push the seal back into the housing until it can be extracted from the inside of the motor housing.

Inspection

1. Inspect for wear or damage.

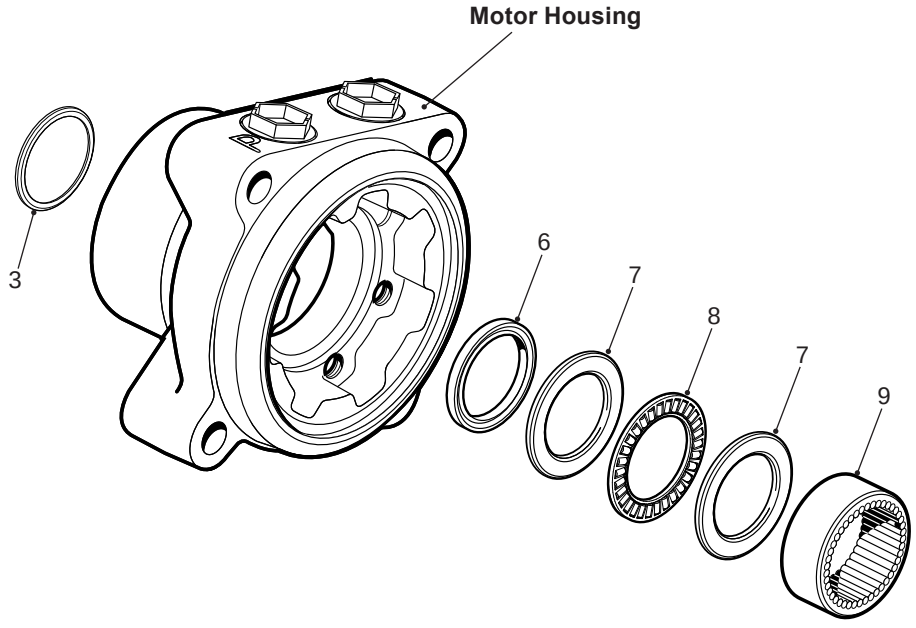


Figure 10, Axial Bearing and Seal

BEARINGS AND SEALS

Refer to Figure 1

Assembly

1. Before assembly, lubricate all parts with clean oil and grease rubber parts with clean petroleum jelly.
2. Using a mandrel, press new seal (6) into motor housing. Seal should go in with metal side facing the motor shaft end of the housing and the cupped side facing toward the interior of the housing.
3. Install the 2 bearing races (7) as depicted, (one on each side of the axial needle bearing) and the axial needle bearing (8).
4. Install the radial needle bearing (9) into the housing — press into place using a mandrel.

NOTE: *Hold the needle bearings in place by applying a light coating of grease to the outer ring and to the needle bearings.*

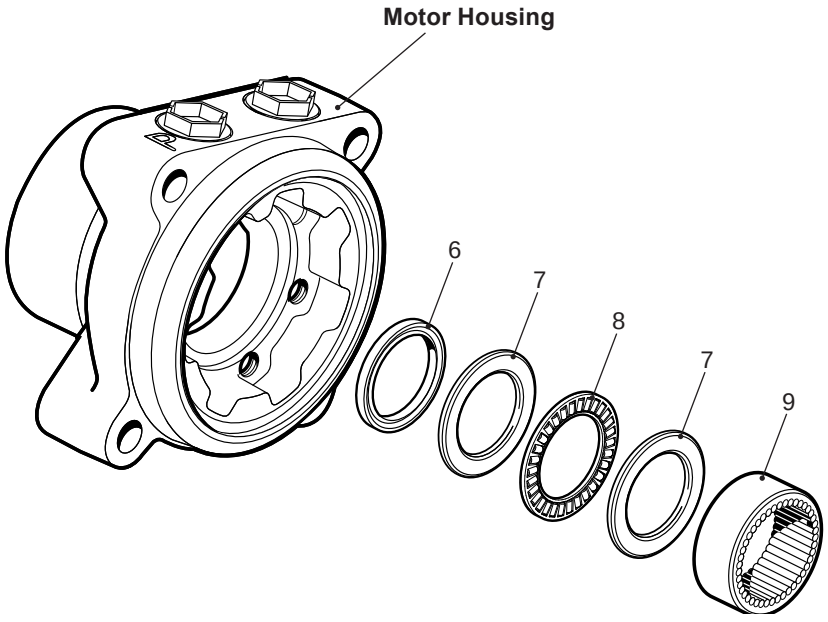


Figure 1, Axial Bearing and Seal

MOTOR SHAFT

Refer to Figure 2

Assembly

1. Carefuly insert the shaft (11) through the motor housing.

NOTE: *Care should be taken when inserting motor shaft (11) through motor housing. Use a mandrel or bullet over shaft end to prevent keyway from cutting seal.*

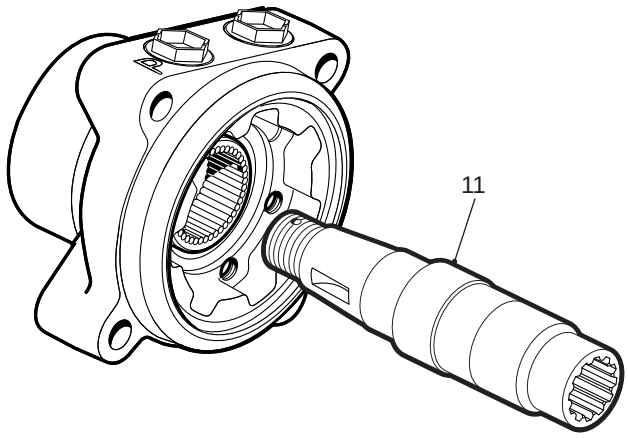


Figure 2, Motor Shaft

BALANCE PLATE

Refer to Figure 3

Assembly

1. Before assembly, lubricate all parts with clean oil and grease rubber parts with clean petroleum jelly.
2. Place the O-ring (5) in the motor housing O-ring recess.
3. Insert O-ring (12) into the recess on the balance plate (14) and lubricate with grease. Place the spring washer (13) on the balance plate. Place balance plate lightly in position so that it engages.

NOTE: *Take care not to damage O-rings during installation.*

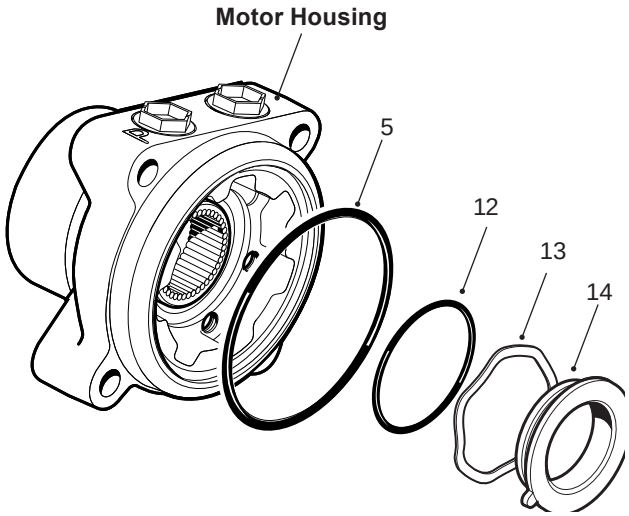


Figure 3, Balance Plate

DISC VALVE

Refer to Figure 4

Assembly

1. Before assembly, lubricate all parts with clean oil.
2. Place disc valve (15) on the motor shaft (11) with channels upwards so that the long tab on the disc valve engages with the slot in the shaft.

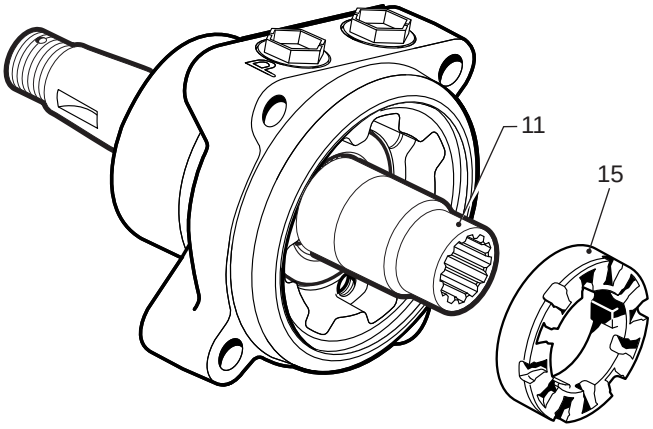


Figure 4, Disc Valve

CARDAN SHAFT

Refer to Figure 5

Assembly

1. Before assembly, lubricate all parts with clean oil.
2. Note the difference in spline length on the cardan shaft (19). Fit the cardan shaft with the long spline end into the axle output shaft (11). After installation mark the top of the cardan shaft spline that lies adjacent to the long tab in the disc valve (15). See Fig. 5a

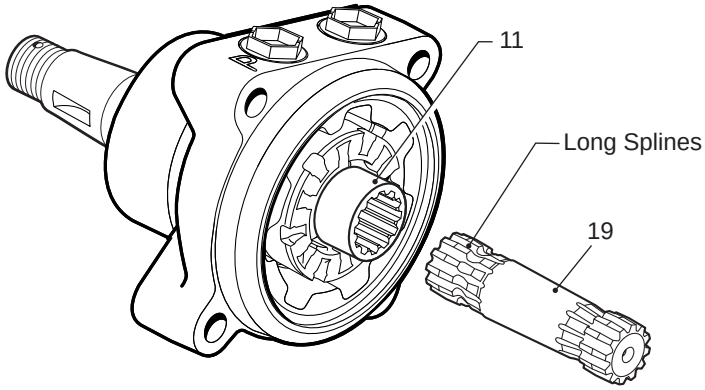


Figure 5, Cardan Shaft

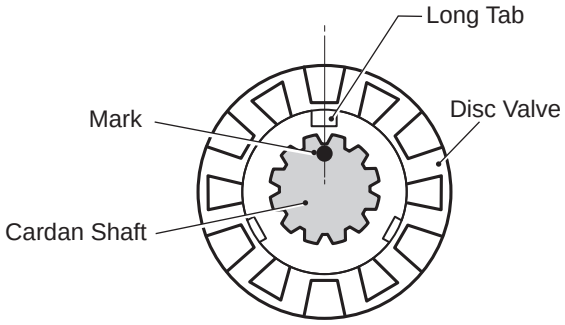


Figure 5a, Cardan Shaft Installation

DISTRIBUTOR PLATE

Refer to Figure 6

Assembly

1. Before assembly, lubricate all parts with clean oil.

2. If removed, press the needle bearing (16) into the distributor plate (18).

NOTE: *Hold the needle bearings in place by applying a light coating of grease to the outer ring and to the needle bearings.*

3. Place the distributor plate (18) on the motor housing so that the shaft enters the bearing (16). Press the distributor plate (18) until it stops on the housing and line up the screw holes.

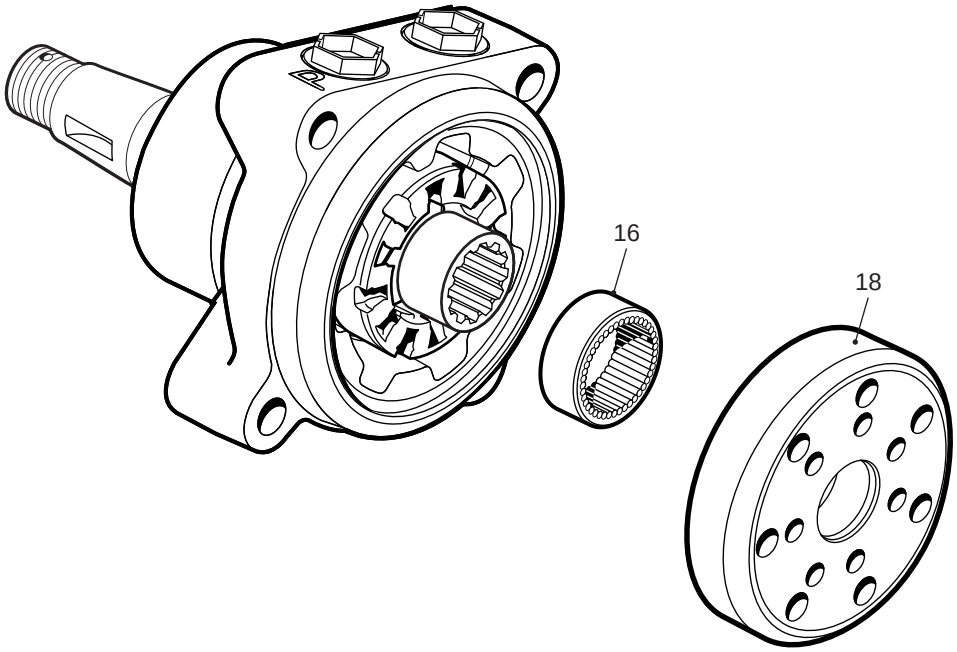


Figure 6, Distributor Plate

GEARWHEEL SET

Refer to Figure 7

Assembly

1. Before assembly, lubricate all parts with clean oil and grease rubber parts with clean petroleum jelly.
2. Place the O-rings (20) (greased) in the gearwheel (21) O-ring recesses. If there is a recess on one end of the inner gearwheel, position and fit the gearwheel set with the recessed splines toward the motor housing (4).
3. Reference the motor ID tag to determine the rotation of the motor.

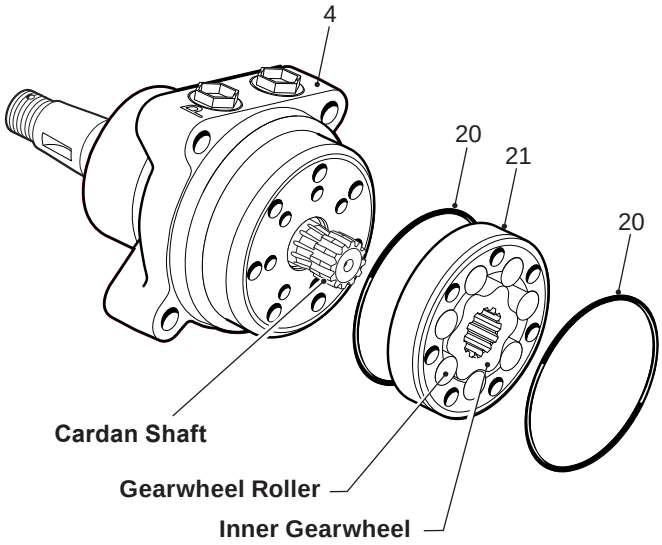
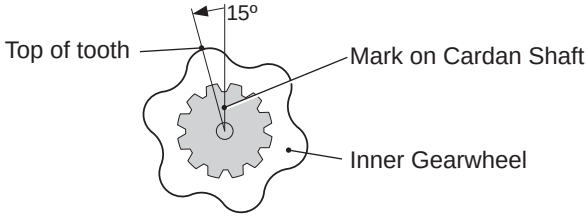


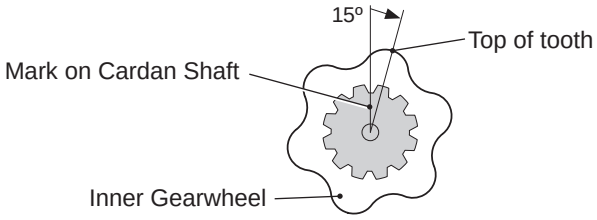
Figure 7, Gear Wheel Set

Clockwise rotation:



4. Fit the gearwheel set (21) on the cardan shaft so that the top of the tooth in the external teeth of the gearwheel is vertically over the mark on the cardan shaft. Turn the gearwheel set counterclockwise until the cardan shaft and internal gearwheel slips over and engages the splines (15°). Turn the external gearwheel rim to line up the screw holes.

Counterclockwise rotation:



Fit the gearwheel set (21) on the cardan shaft so that the top of the tooth in the external teeth of the gearwheel is vertically over the mark on the cardan shaft. Turn the gearwheel set clockwise until the cardan shaft and internal gearwheel slips over and engages the splines (15°). Turn the gearwheel rim to line up the screw holes.

END COVER

Refer to Figure 8

Assembly

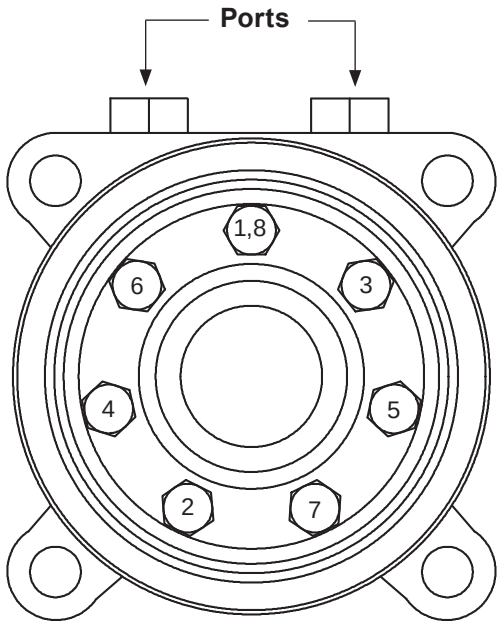
1. Before assembly, lubricate all parts with clean oil and grease rubber parts with clean petroleum jelly.

2. Using new washers (24), reassemble all parts in the reverse order of disassembly.

CAUTION: *Take care to align the holes of the end cover (22) with those of the gear wheel set before inserting the screws (25).*

3. When tightening the screws (25), refer to the table on page 3 for the required torque values. Also refer to the torque sequence illustration on the right for the proper tightening sequence.

NOTE: *As a general rule, use the low end of the torque specification on fasteners when reassembling the unit.*



End Cover Screw Torque Sequence

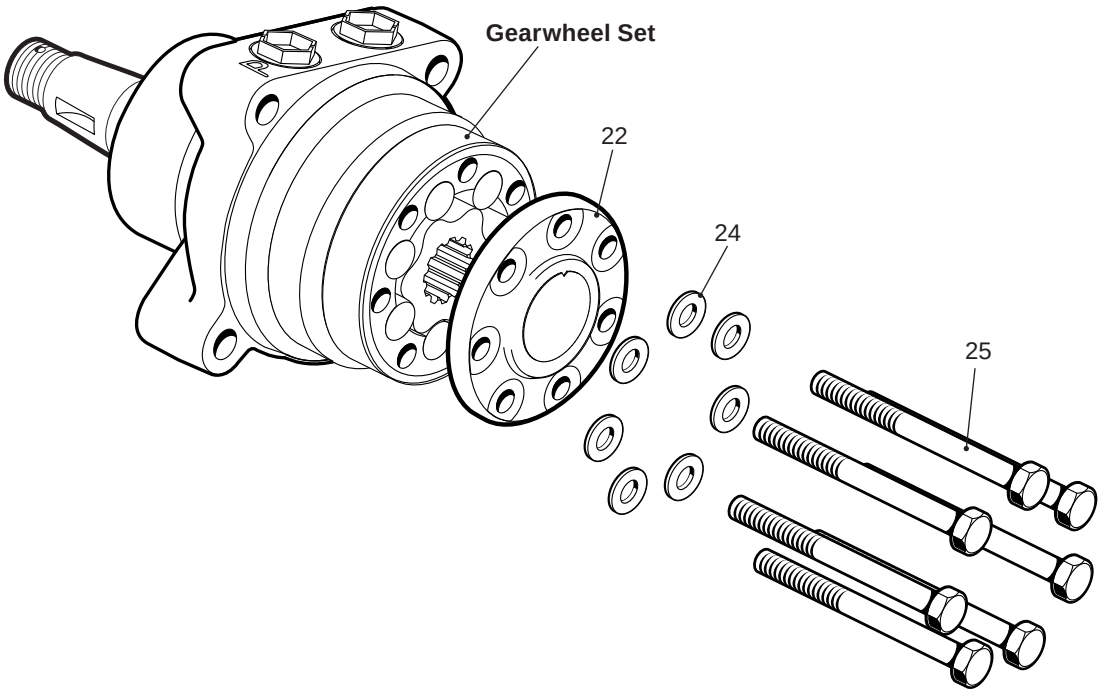


Figure 8, End Cover

DUST COVER AND WOODRUFF KEY

Refer to Figure 9

Assembly

1. Using a rubber or neoprene mallet and mandrel, install a new dust seal (3) into the bearing housing.

2. Install the woodruff key (10) onto the motor shaft (11).

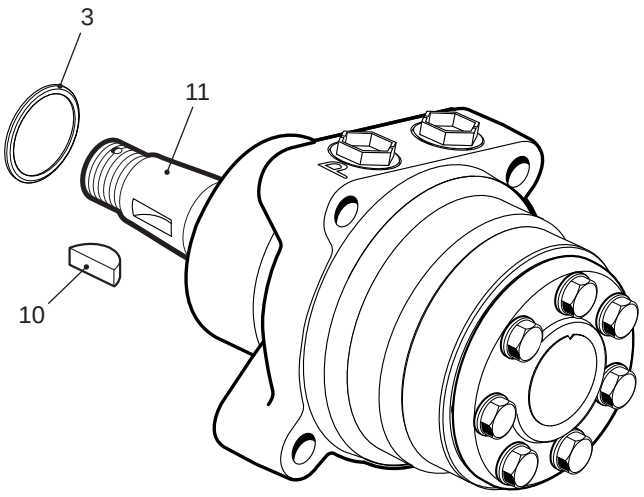


Figure 9, Dust Cover and Woodruff Key

BRAKE AND DRUM

Refer to Figures 10, 11

Assembly

1. Mount the brake assembly (28) onto the HGM Motor by aligning four holes on the brake with those on the HGM motor.
2. Install the four screws (29) and tighten, refer to the table on page 3 for the required torque values.
3. Mount drum assembly (27) onto brake assembly (28).

NOTE: *If the drum assembly or hub assembly is removed from the axle shaft, the drum/hub assembly must be discarded and replaced with a new assembly.*

4. Install the castellated nut (1). Torque castellated nut as required in table on page 3.
5. Install the cotter pin (30).

NOTE: *As a general rule, use the low end of the torque specification on fasteners when reassembling the unit.*

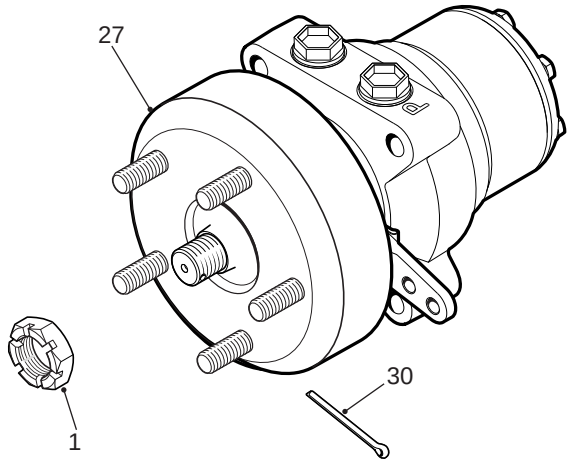


Figure 11, Drum Assembly

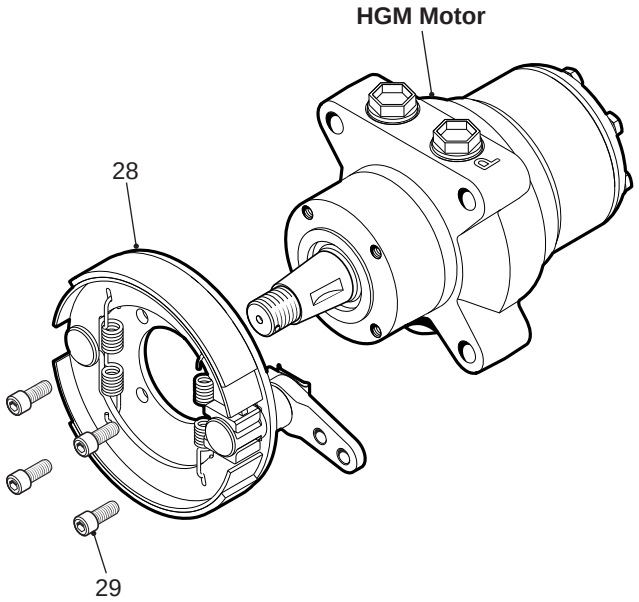
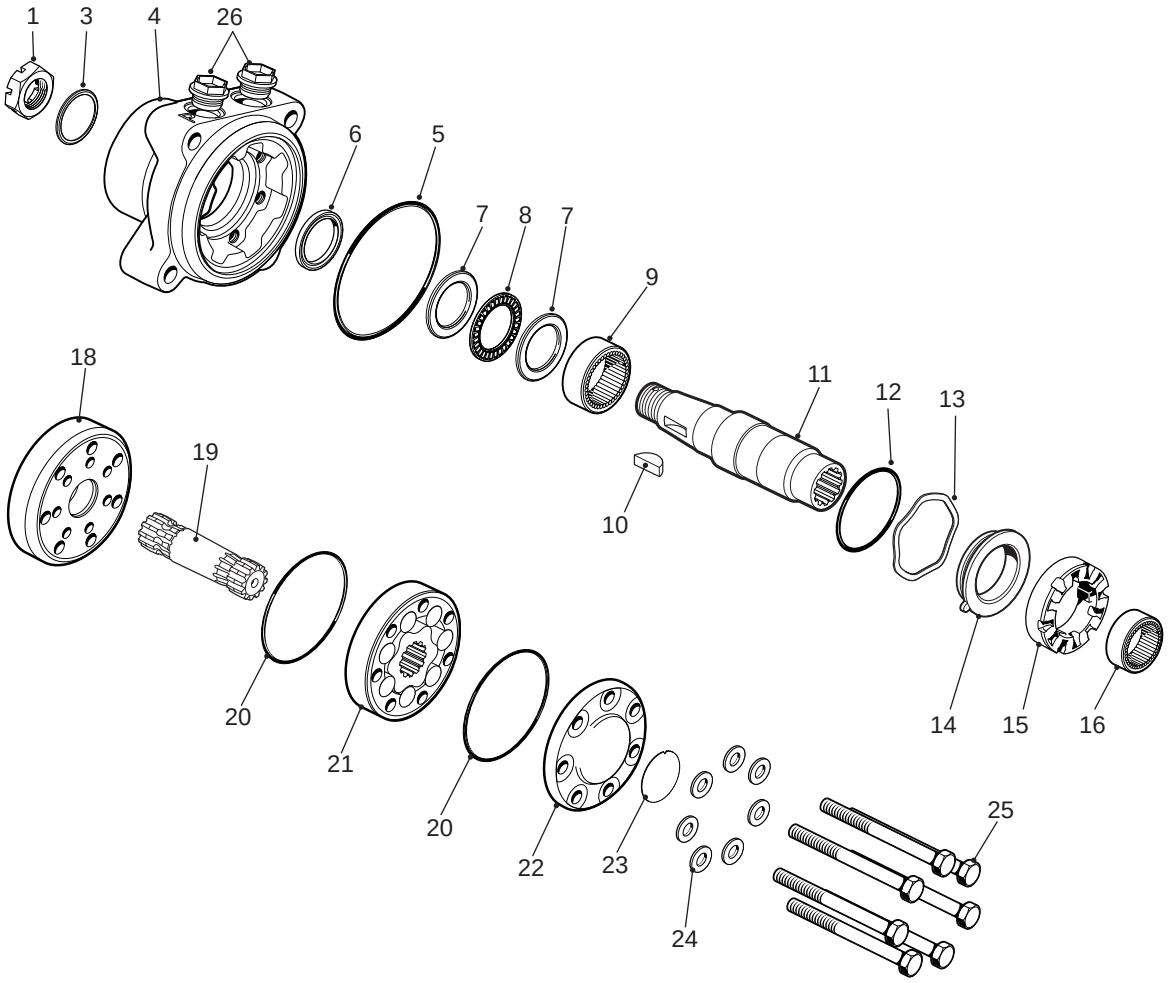
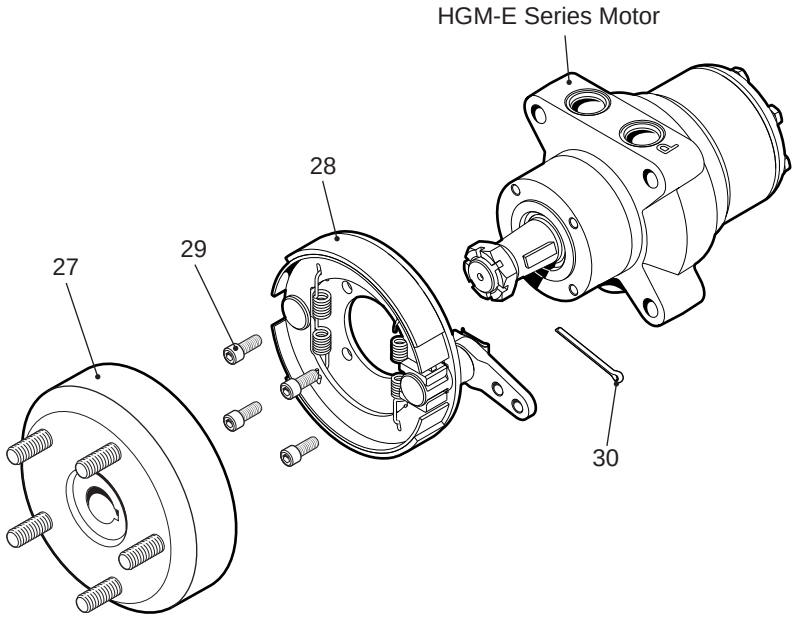


Figure 10, Brake Assembly

HGM – E SERIES EXPLODED VIEW



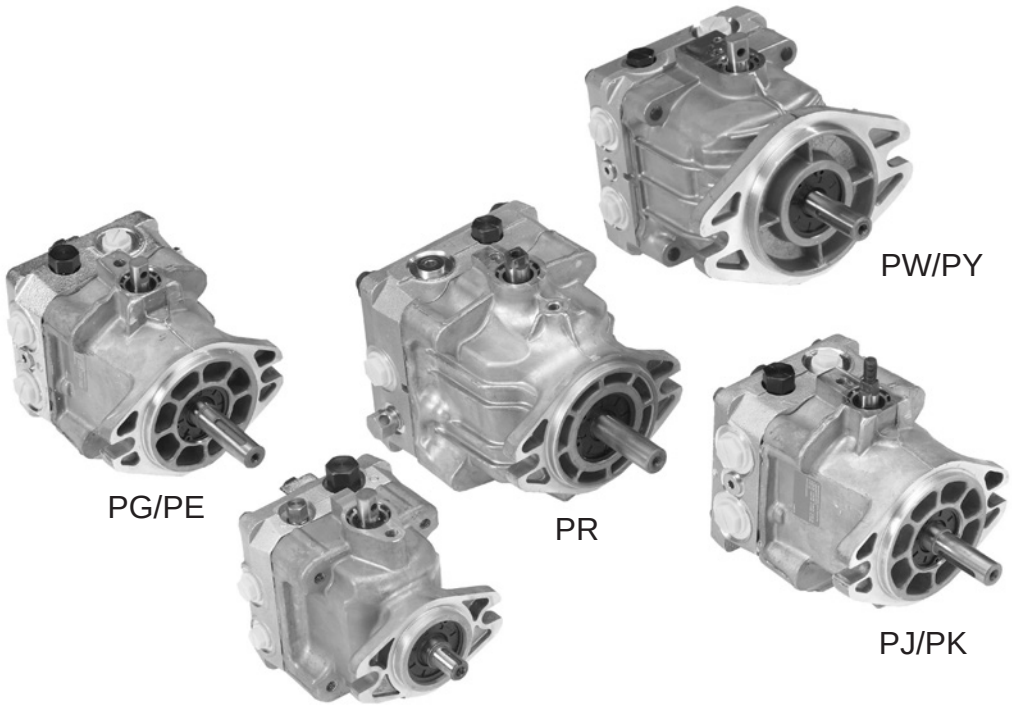


HGM – E PARTS LIST

Item	Description	Quantity
1	Castellated nut	1
3	Dust seal ring	1
4	Housing	1
5	O-ring	1
6	Shaft seal	1
7	Bearing race	2
8	Axial needle bearing	1
9	Radial needle bearing	1
10	Woodruff key	1
11	Shaft tapered	1
12	O-ring	1
13	Spring washer	1
14	Balance plate	1
15	Disc valve	1
16	Radial needle bearing	1
18	Distributor plate	1
19	Cardan shaft	1
20	O-ring	2
21	Gearwheel set	1
22	End cover	1
23	Name plate	1
24	Washer	7
25	Screws	7
26	Plugs	2
27	HGB drum assembly	1
28	HGB brake assembly	1
29	Bolt	4
30	Pin, cotter	1

HYDRO-GEAR®

FORWARD MOTION THROUGH FORWARD THINKING



P Series
Hydrostatic Pumps
Service and Repair Manual

BLN-0093
June, 2018

FOREWORD

Headquartered in Sullivan, Illinois, Hydro-Gear is a world leader in the design, manufacture, and service of quality hydrostatic transaxles for the lawn and garden industry. The mission of our company is to be recognized by our customers and the industry as a world-class supplier and the quality leader in everything we do.

This Service and Repair Manual is designed to provide information useful in servicing the Hydro-Gear 6cc (0.37 cu in.) PC Series, the 10 cc (0.61 cu in.) PG Series, the 12 cc (0.73 cu in.) PJ Series, the 16 cc (0.98 cu in.) PR Series, and the 21 cc (1.28 cu in.) PW Series pumps.

Also included is a glossary of terms that are frequently used throughout the industry and in Hydro-Gear service publications. Understanding terminology is very important!

It is necessary, and good shop practice, that your service area be equipped with proper tools and the mechanics to be supplied with the latest information available. All repair procedures illustrated in this guide are suggested, but preferred methods of repair.

Some repair procedures require that the pump be removed from the vehicle.

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SECTION 1. DESCRIPTION AND OPERATION

INTRODUCTION

The purpose of this manual is to provide information useful in servicing the Hydro-Gear PC, PG, PE PJ, PK, PR. PW and PY Pumps. This manual includes the pump's general descriptions, hydraulic schematics, technical specifications, servicing and troubleshooting procedures for the pumps.

The P Series Pumps normally will not require servicing during the life of the vehicle in which it is installed. Should other servicing be required, the exterior of the pump will need to be thoroughly cleaned before beginning most procedures.

GENERAL DESCRIPTION

The P Series Pumps can be combined with wheel motors and other remotely located units. These pumps provide an infinitely variable speed range between zero and full displacement in both forward and reverse modes of operation.

The P Series Pumps are of the axial piston design, utilizing spherical nosed pistons. A compression spring, located inside each piston, holds the nose of the piston against a thrust bearing race.

The variable displacement pump features a cradle swashplate with a direct-proportional displacement control. Movement of the directional control shaft produces a proportional swashplate movement and a change in pump flow and/or direction.

Reversing the direction of the angle of the swashplate reverses the flow of oil from the pump and thus reverses the direction of motor output rotation.

A fixed displacement gerotor charge pump is provided in P Series Pumps. Oil from an external reservoir and filter is pumped into the closed loop by a charge pump. Fluid not required to replenish the closed loop flows either into the pump housing through a cooling orifice, or back to the charge pump inlet through the charge pressure relief valve.

Check or shock valves are included in the pump end cap to control the makeup oil flow for the system. The size and type of check valve can play an important role on the system pressure, response, and amount of heat generated, due to the recirculation of makeup oil flow. Shock valves are factory preset pressure regulating check valves.

In some applications of the P Series Pumps, it is desirable to move the machine for short distances at low speeds without operating the engine. A screw-type bypass valve is utilized in the pumps to permit movement of the machine. The bypass valve is fully opened when unscrewed two (2) turns maximum. The bypass valve allows oil to be routed from one side of the pump/motor circuit to the other, thus allowing the motor to turn with minimal resistance. An increase in resistance will occur with movement at higher speeds. The bypass valve must be fully closed during normal operation.

WARNING

Actuating the bypass will result in the loss of hydrostatic braking capacity. The machine must be stationary, on a level surface and in neutral when actuating the bypass.

Additionally, some pumps may be equipped with an Auxiliary Pump. The Auxiliary incorporates the principles of the charge gerotor assembly and provides the capability of an external auxiliary flow for an alternate hydraulic circuit to operate accessories without loss of drive.

EXTERNAL FEATURES - PC SERIES

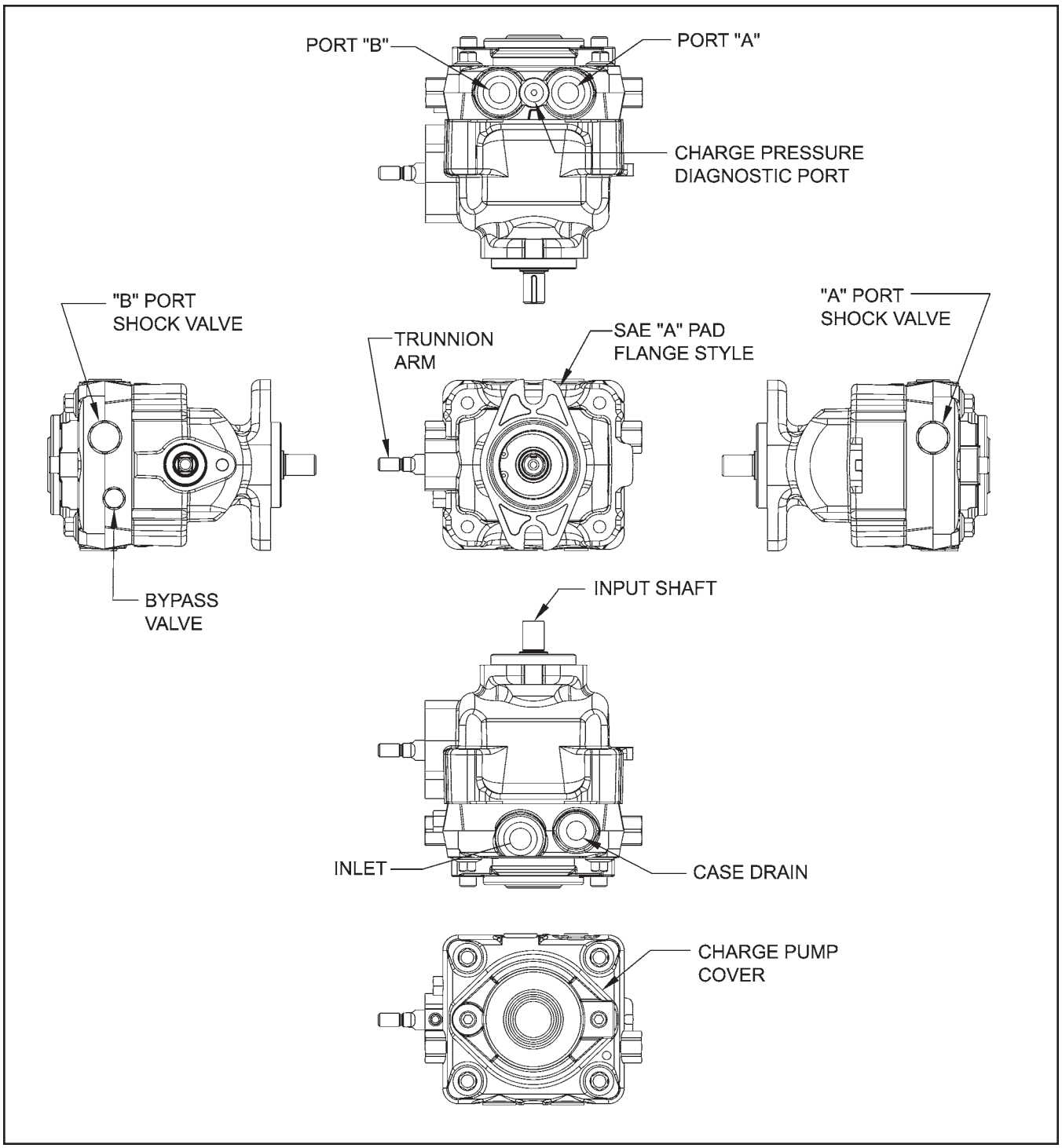


Figure 1. PC Pump with Standard Charge Pump

EXTERNAL FEATURES - PG / PE SERIES

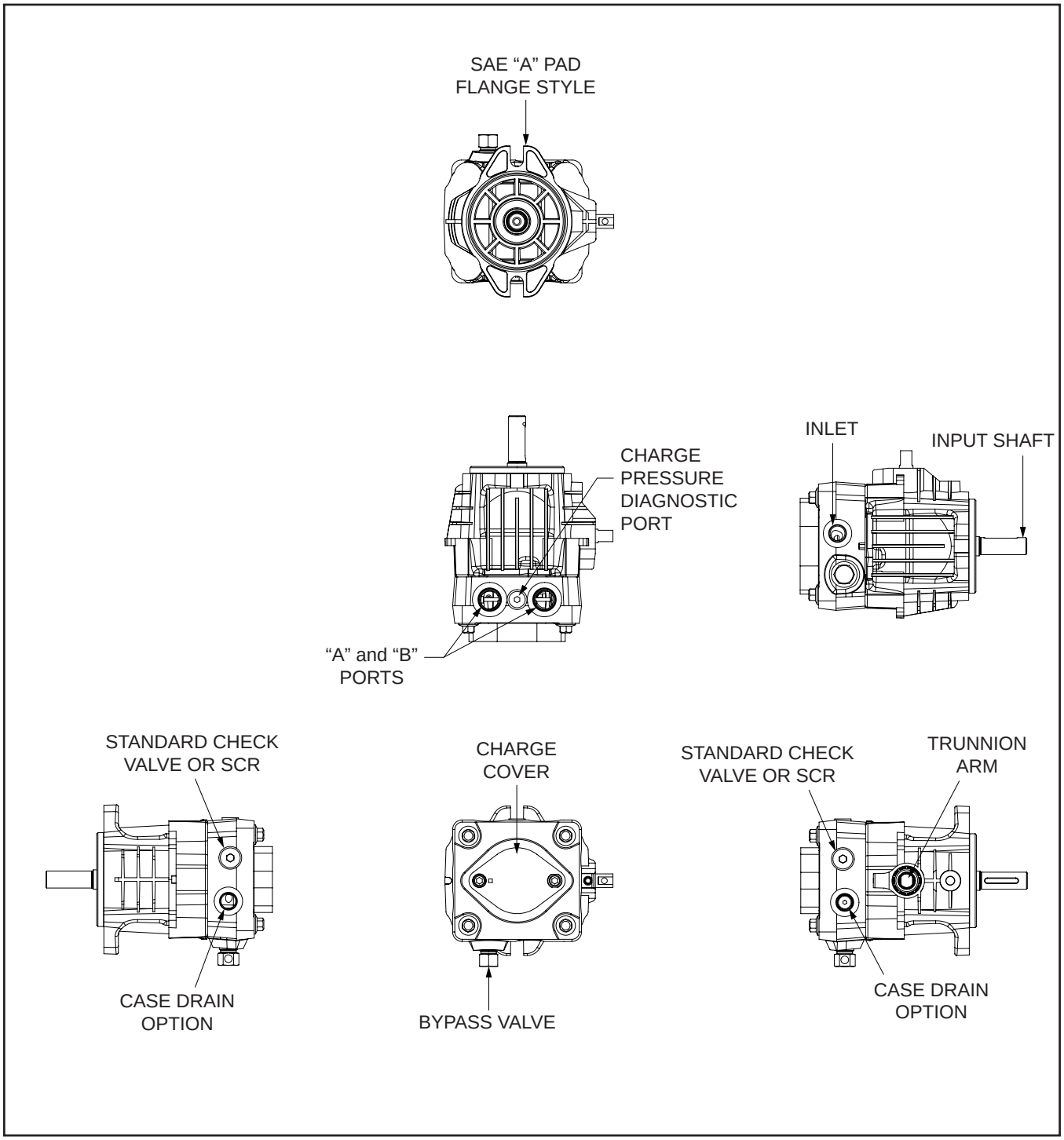


Figure 2. PG Pump With Standard Charge Pump

EXTERNAL FEATURES - PJ SERIES

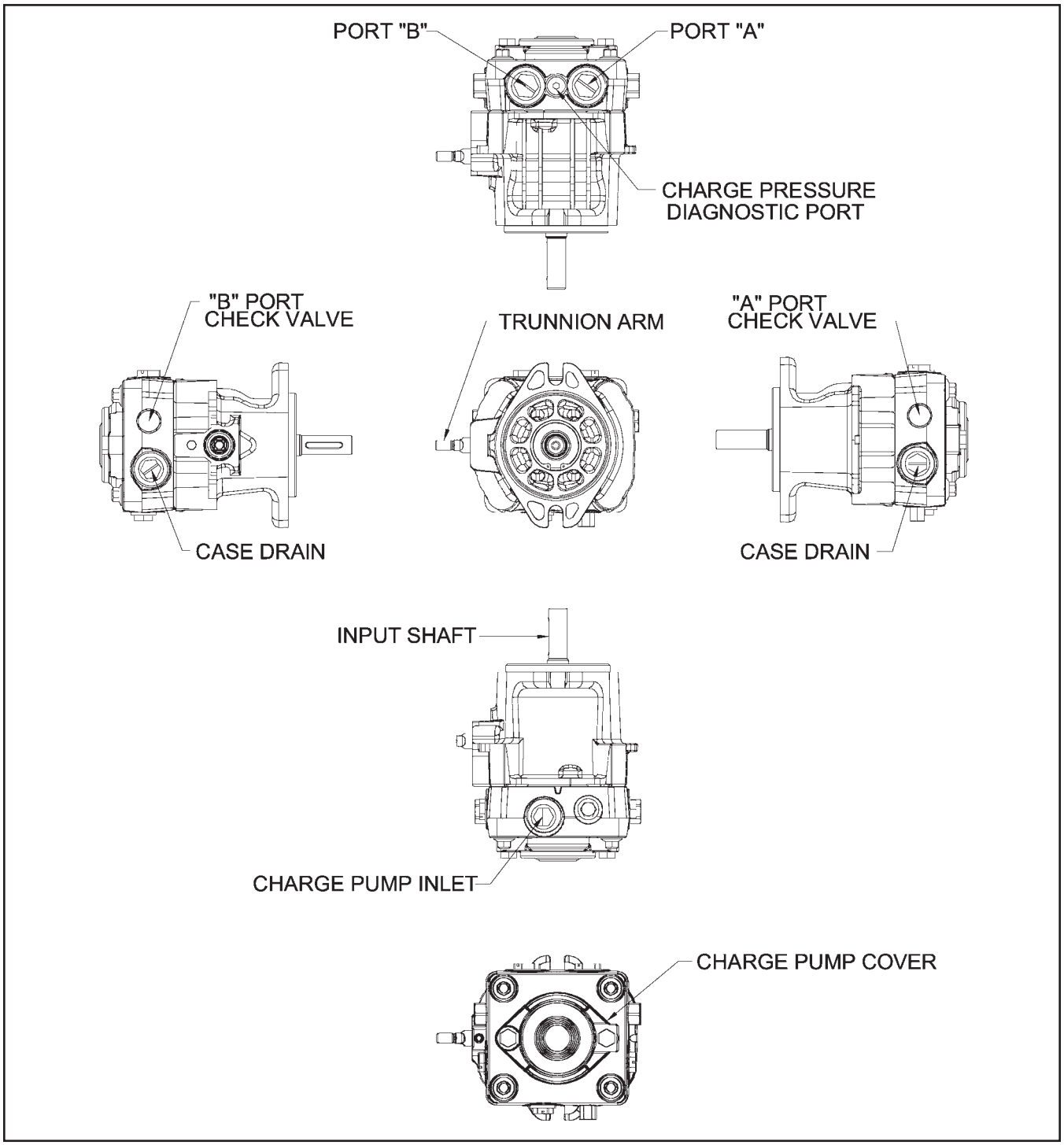


Figure 3. PJ Pump with Standard Charge Pump

EXTERNAL FEATURES - PK SERIES

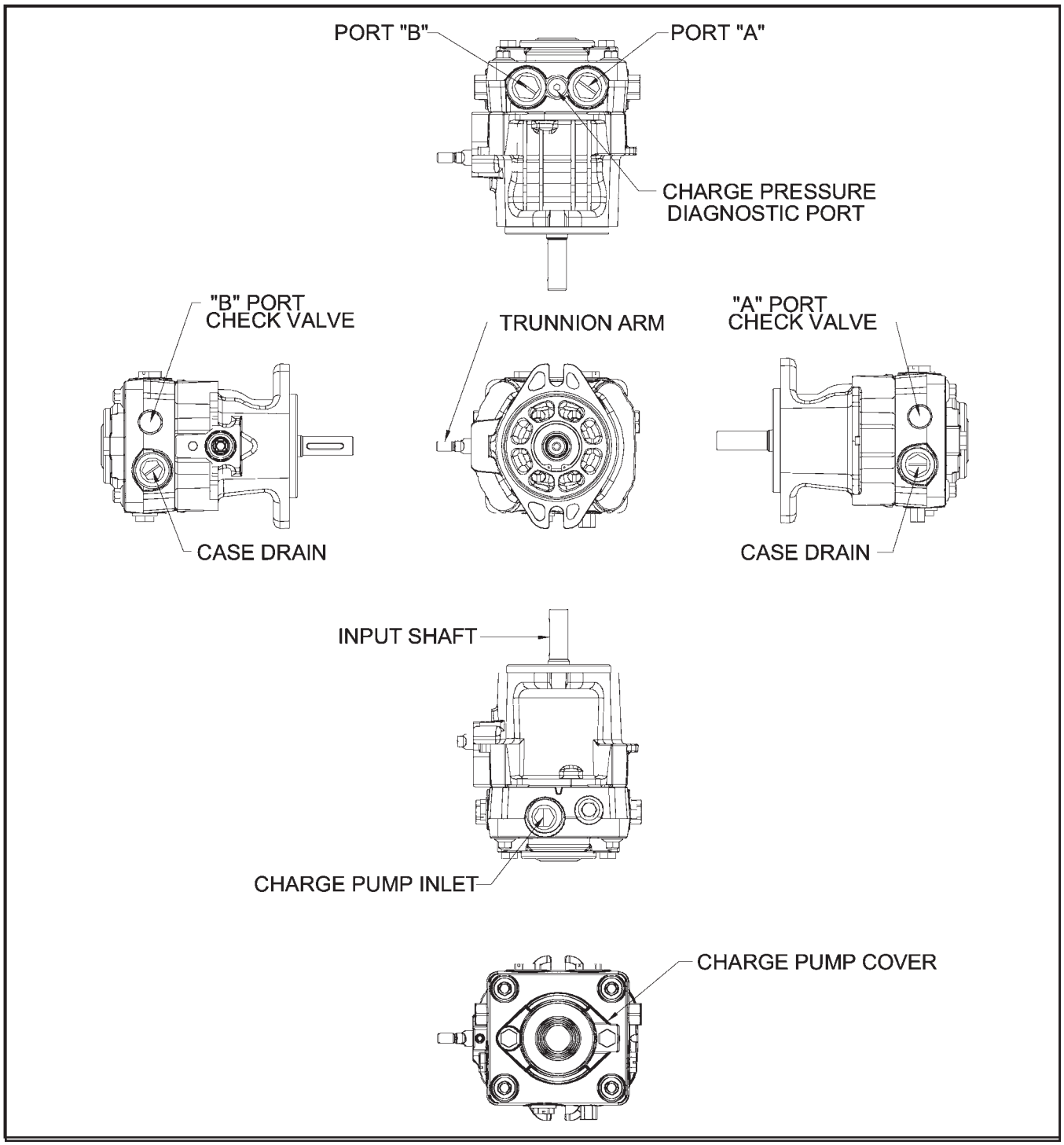


Figure 4. PK Pump With Standard Charge Pump

EXTERNAL FEATURES - PR SERIES

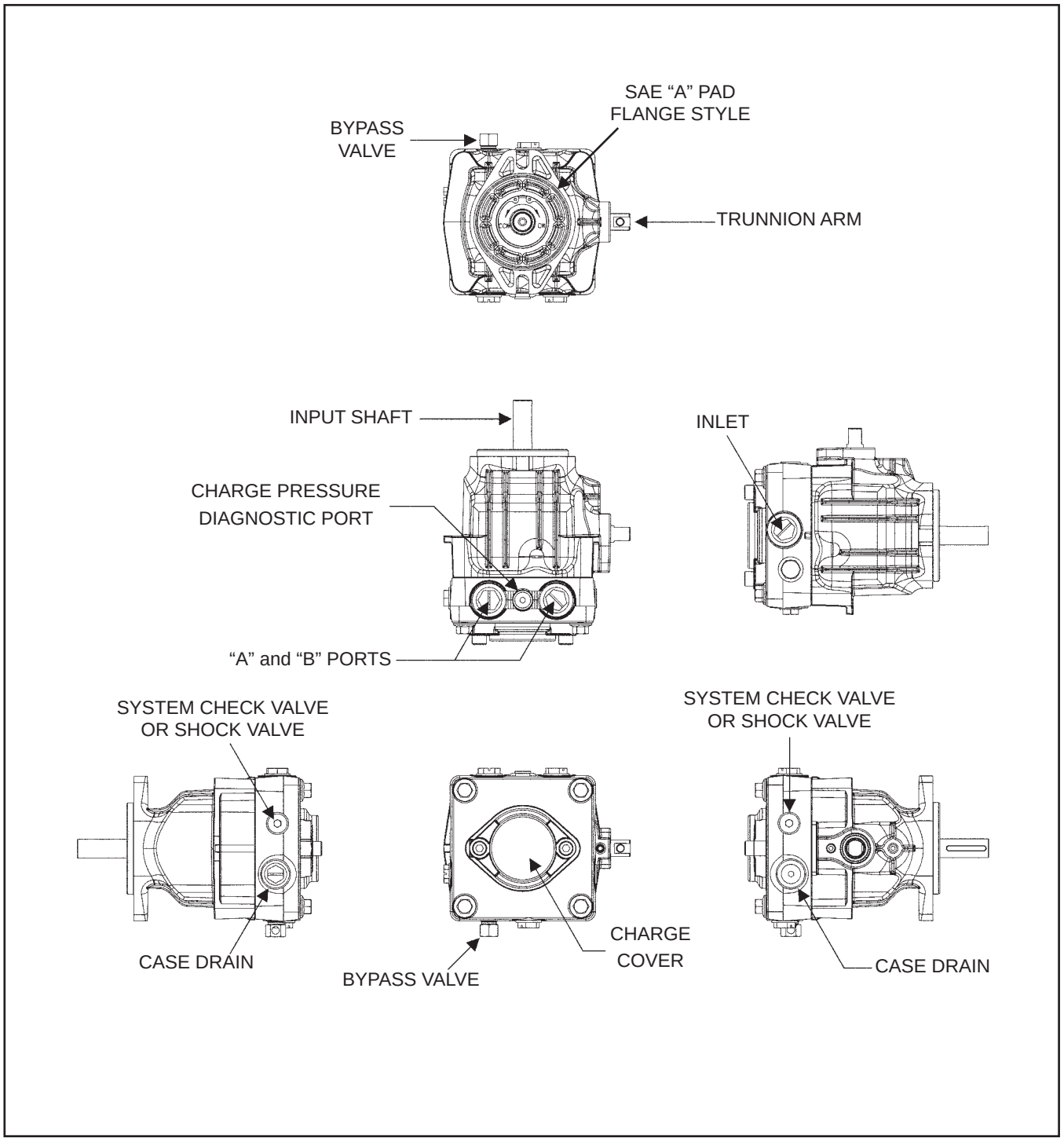


Figure 4. PR Pump With Standard Charge Pump

EXTERNAL FEATURES - PW / PY SERIES

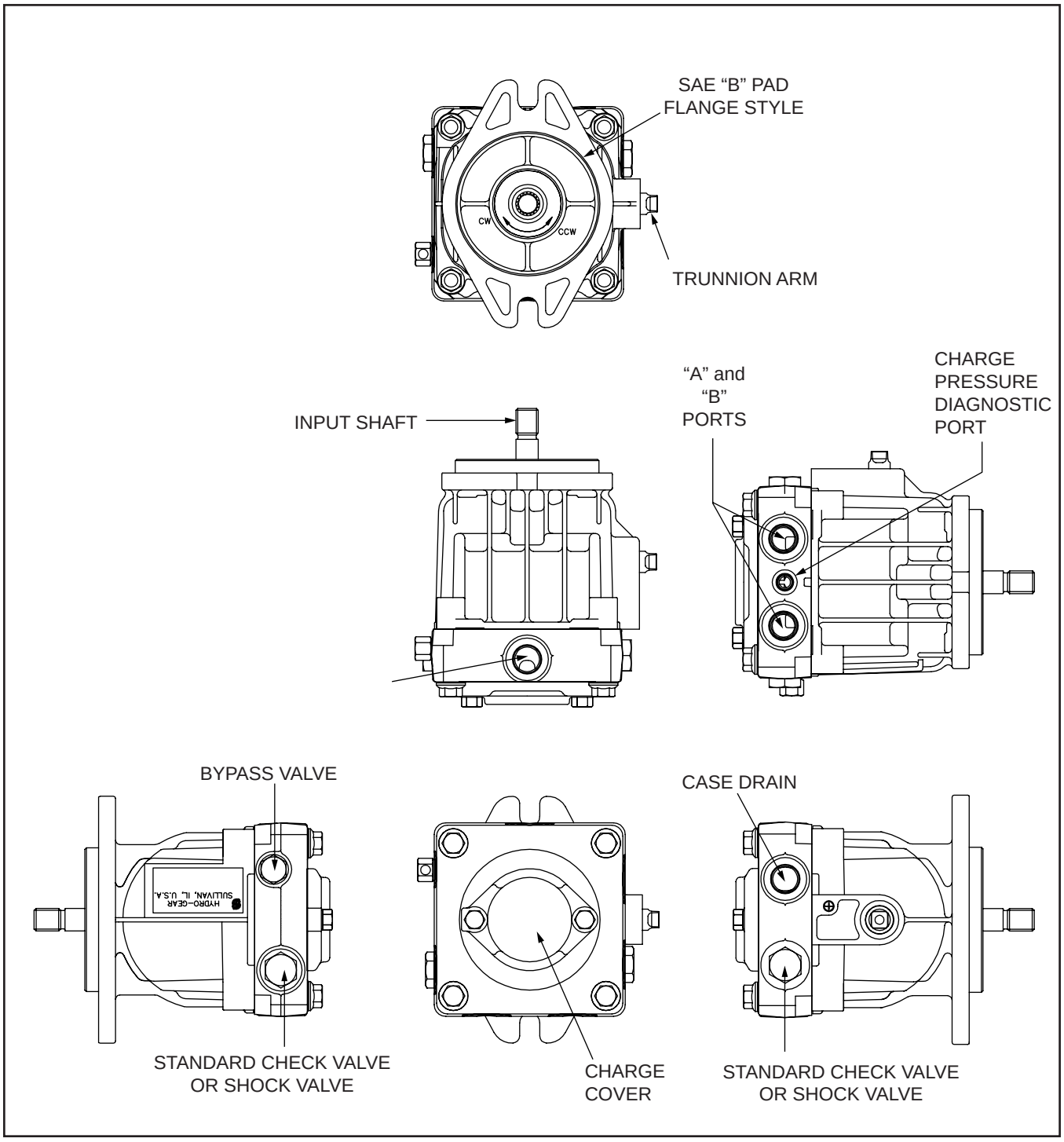


Figure 5. PW / PY Pump With Standard Charge Pump

HYDRAULIC SCHEMATIC

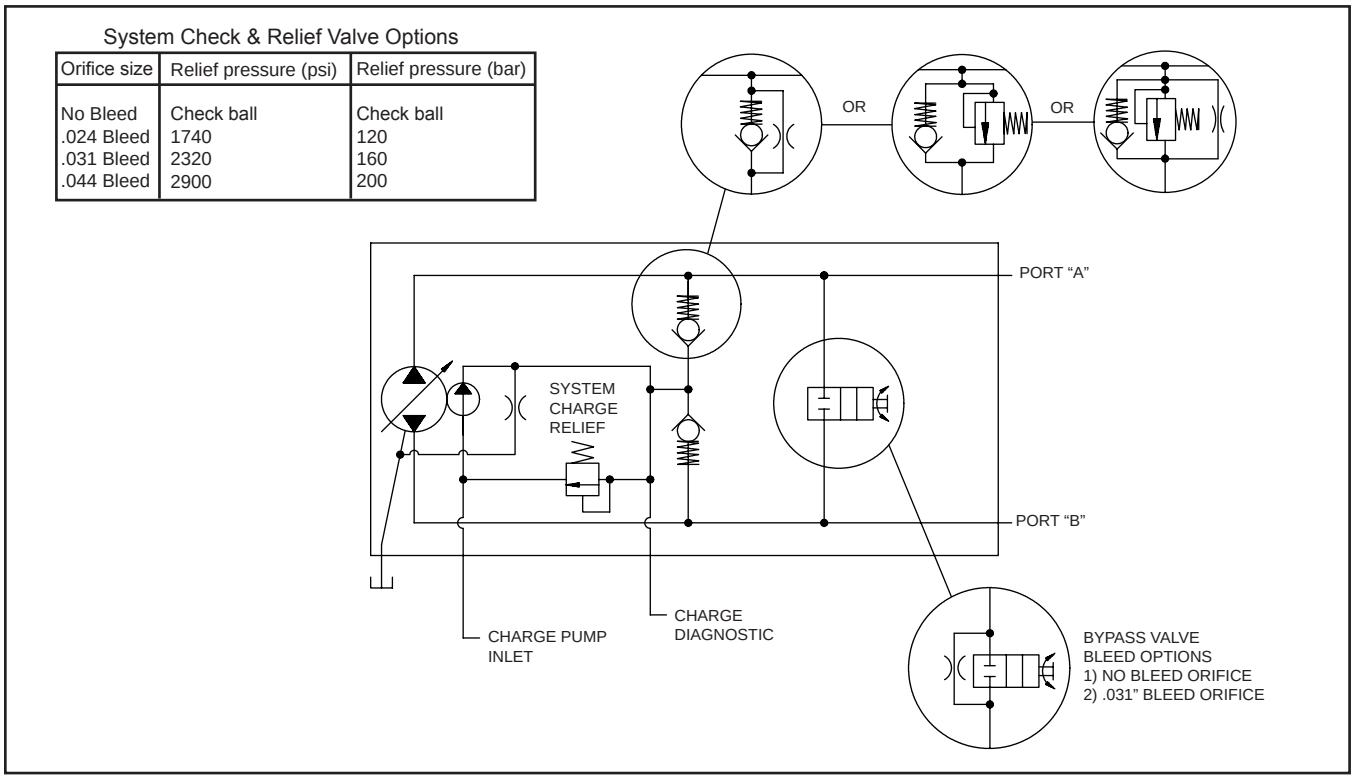


Figure 6. PC, PG, PJ, PK and PR Pumps with Standard Charge Pump

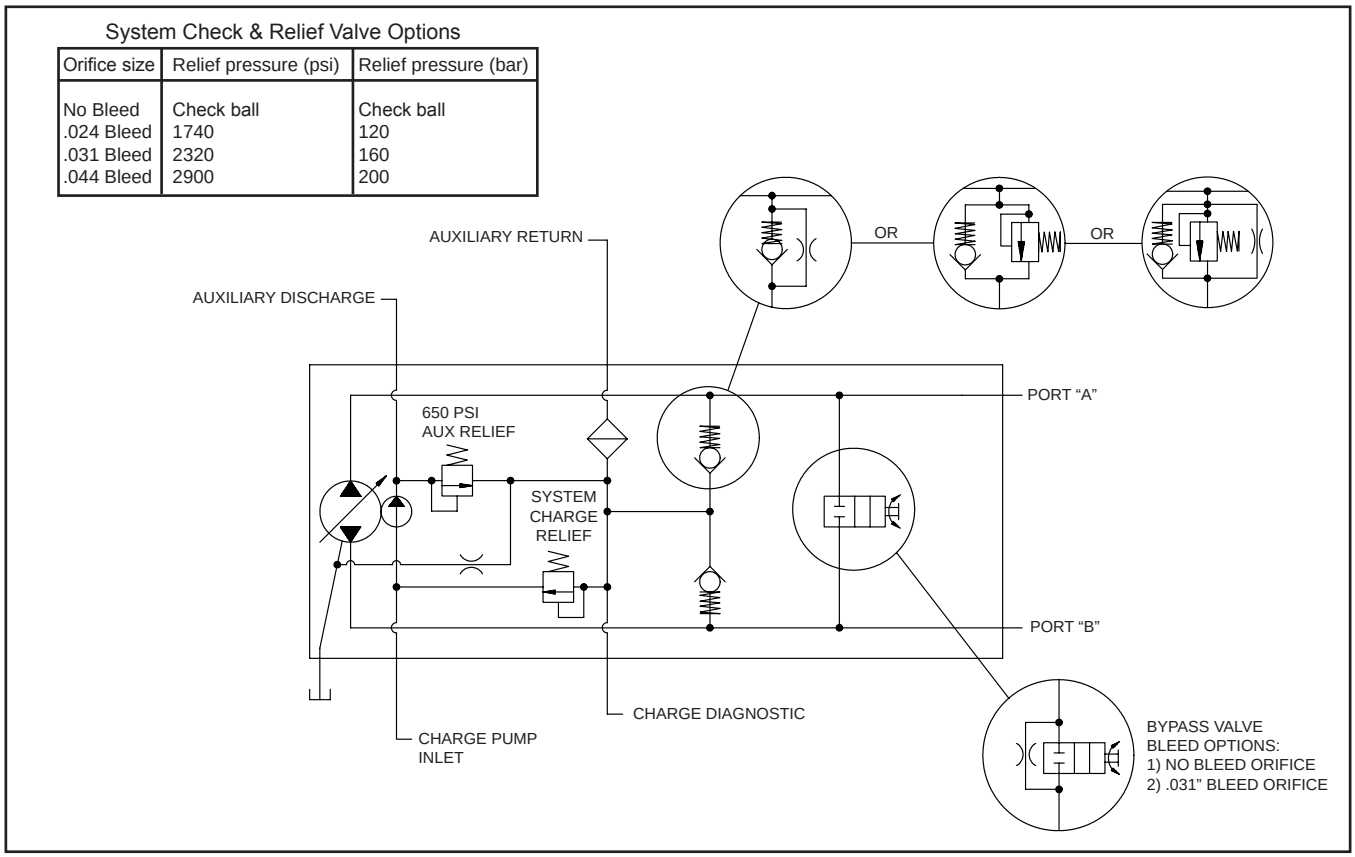


Figure 7. PC, PG, PJ, PK and PR Pumps with AuxiliaryCharge Pump

HYDRAULIC SCHEMATIC

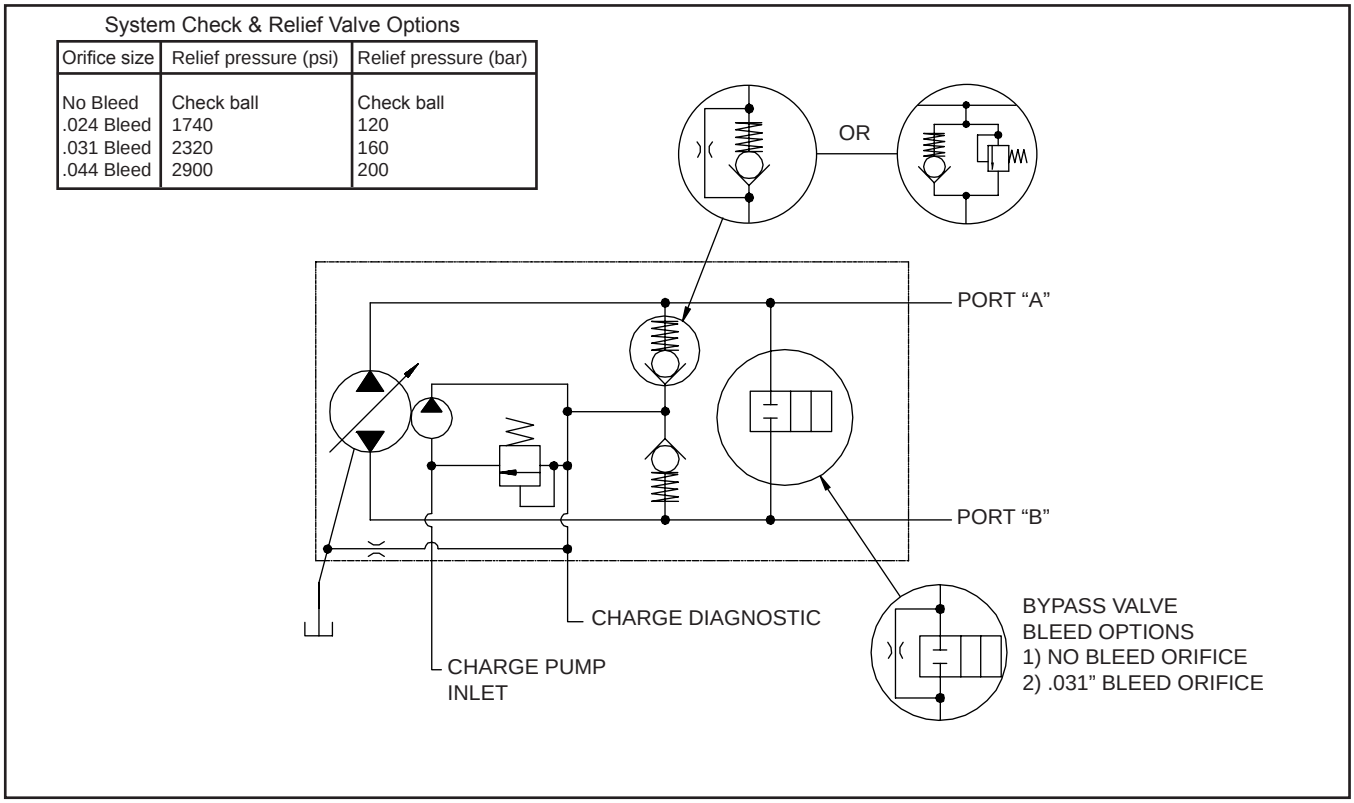


Figure 8. PW / PY Series Pump With Standard Charge Pump

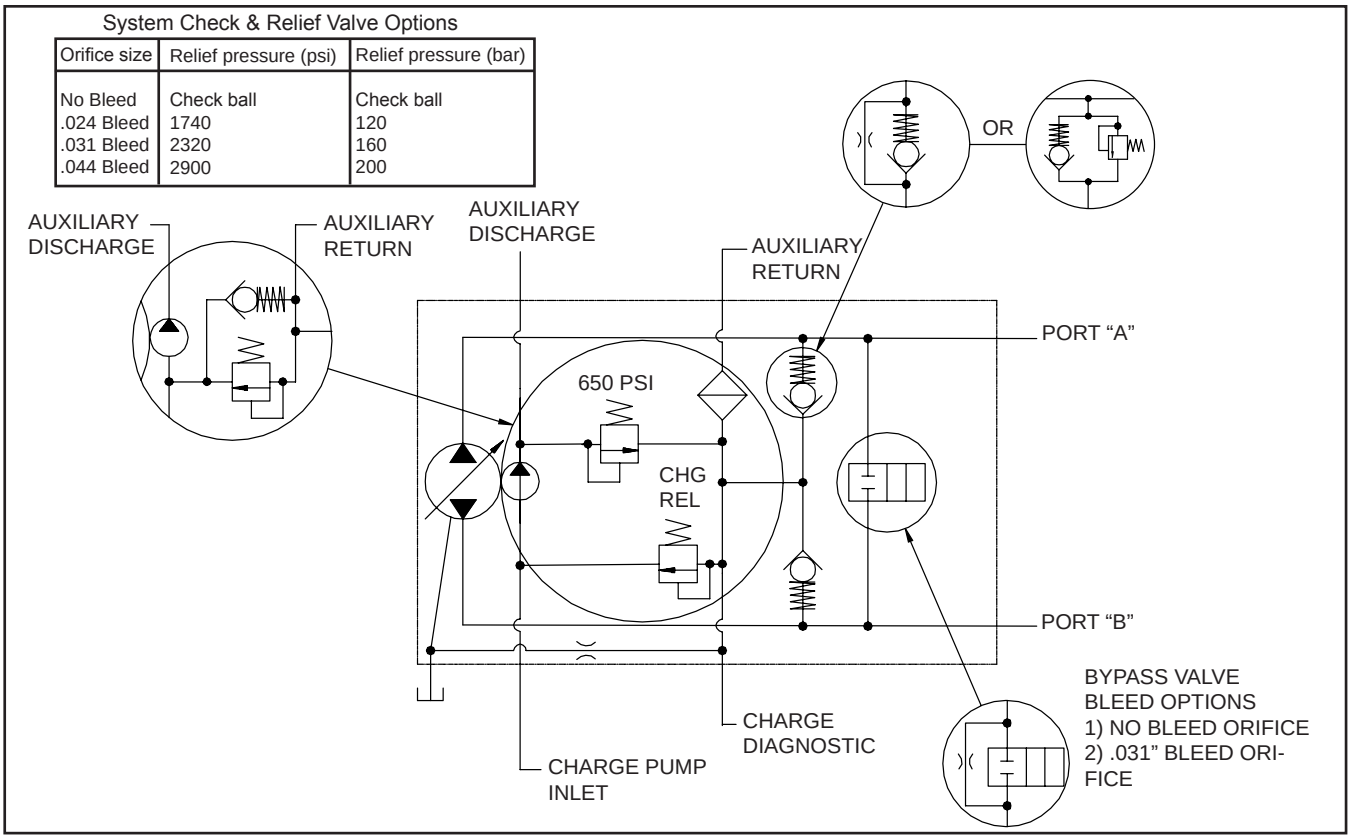


Figure 9. PW / PY Series Pump With Auxiliary Charge Pump

GRAPHICAL SCHEMATIC

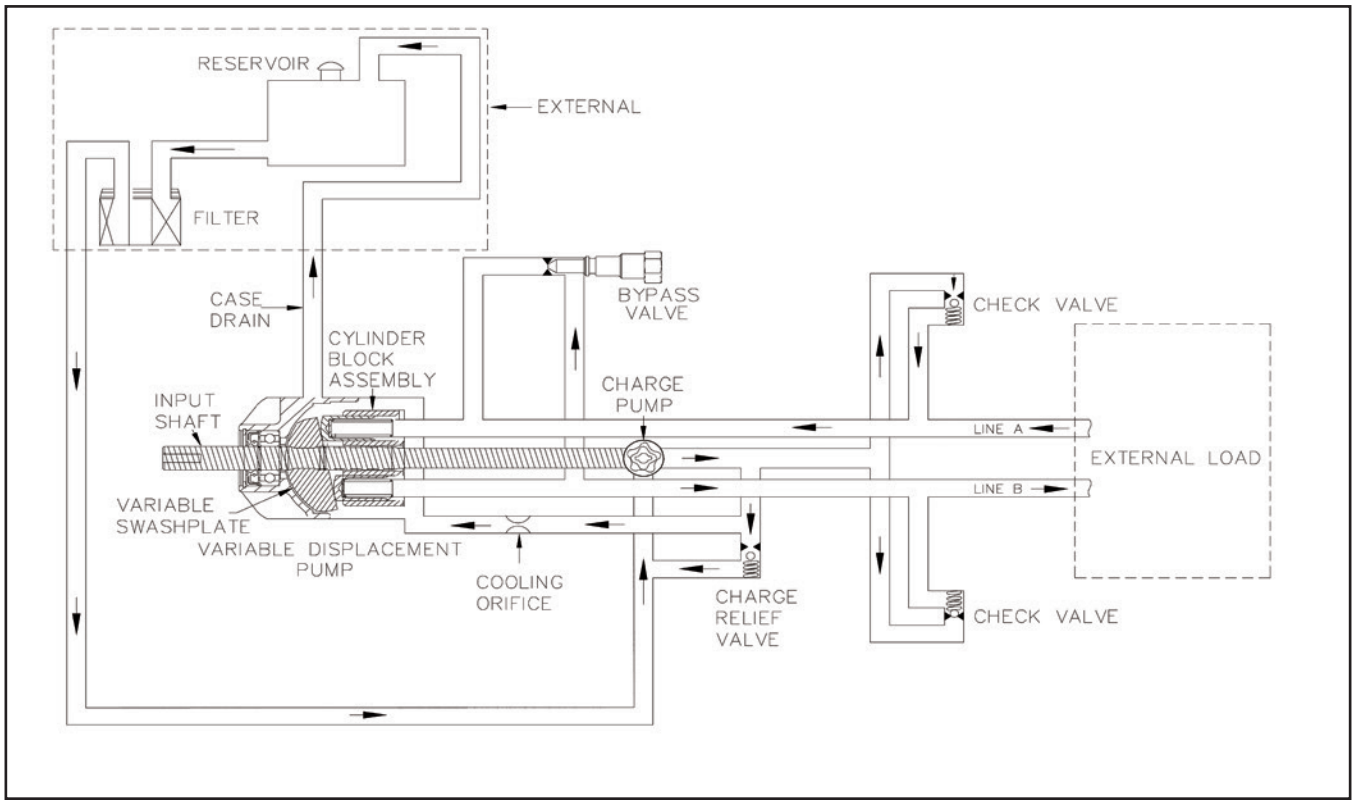


Figure 10. P Series Pump With Standard Charge Pump

Figures 10 represents a graphical schematic of the P Series Pump with standard charge pump. Figure 10 provides a graphical illustration of the hydraulic oil circuit.

The input shaft and pump cylinder block are turned in one direction only by the engine/drive belt/pulley combination or direct drive gear box.

The oil is drawn through an external filter by the charge pump. The filter prevents contaminants within the reservoir from entering into the charge pump gerotor.

The charge pump supplies fluid to keep the closed loop pressurized, preventing cavitation and providing cooling oil flow for the system.

The charge relief valve is used to maintain charge at a predetermined pressure.

Output of the system oil flow is controlled by the direction and amount that the swashplate is angled. As the pump pistons compress, they force oil into one of two passageways (“A” or “B”) in the system hydraulic circuit. Oil is supplied externally under pressure to an external load, (e.g., a vehicle wheel motor).

As the angle of the pump swashplate is increased, the amount of oil being pumped will increase and cause a higher speed output of the wheel motor. Reversing the angle of the swashplate will reverse the direction of the oil flow. During the operation of the pump, fluid is “lost” from the hydraulic loop through leak paths designed into the product for lubrication and cooling purposes (around pistons, under the rotating cylinder block, etc.). This “lost” fluid returns to the reservoir through the case drain. This fluid must be made up in the loop. The charge pump makes up this fluid loss.

The makeup flow is controlled (or directed) by the system check valves. The check valves are used to direct makeup fluid into the low pressure side of the closed loop. Each check valve will either be held open or closed, depending upon the direction of the vehicle operation: Closed in a pressurized system passage, open in a low pressure, “charged” system passage.

TECHNICAL SPECIFICATIONS

Product Type	PC	PG/PE	PJ/PK	PR	PW/PY	PY 6cc Aux
Displacement						
in^3/rev	0.37	0.62	0.73	0.97	1.33	
[cc/rev]	[6.1]	[10.2]	[12]	[16]	[21.8]	
Input Speed						
Maximum Unloaded RPM	3600					
Minimum Loaded RPM	1800					
System Operating Pressure						
Continuous						
psi [bar]	750 [51]	1000 [75]		1250[86]		
Intermittent						
psi [bar]	1750 [120]	2100 [145]		2500 [172]		
Peak						
psi [bar]	2500 172]	3500 [240]		3750 [260]		
Pump Performance						
@2400 rpm/1000 psi gpm [l/min]	3.6 [13.6]	6.1 [23.1]	7.1 [26.8]	9.6 [36.3]	13.1 [49.6]	
@3000 rpm/1000 psi gpm [l/min]	4.5 [17.0]	7.6 [28.8]	8.9 [33.6]	12 [45.4]	16.4 [62.1]	
@3600 rpm/1000 psi gpm [l/min]	5.4 [20.4]	9.2 [34.8]	10.8 [40.8]	14.4 [54.5]	19.6 [74.2]	
Case Pressure						
Maximum @ Cold Start psi [bar						
Continuous - Max. psi [bar]						
Inlet Vacuum	4					
Maximum Continuous Inches Mercury						
Charge Pump Displacement(s)						
in^3/rev	0.13	0.11/0.13	0.19	0.13/0.19		0.25
[cc/rev]	[2.1]	[1.9/2.1]	[3.2]	[2.1/3.2]		[4.1]
Auxiliary Pump Displacement						
in^3/rev [cc/rev]	0.19 [3.2]					0.37 [6.1]
Auxiliary Pump Relief Setting						
psi	650					950-1400
[bar]	[45]					[65.5-96.5]
Auxiliary Pump Performance						
@3200 rpm, 500 psi, 70 SUS						
[13 Cst] oil, & 180°F						
gpm	1.8-2.0					4.4-5.0
[l/min]	[6.8-7.6]					[16.6-18.9]
Control Torque Required to Stroke Pump						
[Approximate - 20°External Stroke Angle]						
lb-in / 1000 psi	75	85		95	105	
[N-m / 70 bar]	[8.5]	[9.6]		[10.7]	[11.9]	
lb-in / 500 psi	55	60		75	85	
[N-m / 35 bar]	[6.2]	[6.8]		[8.5]	[9.6]	
Pump Oil Temperature						
Maximum Intermittent (hottest point)						
°F [°C]	230 [110]					
Normal Operating Range						
°F [°C]	-10 to 200 [-23 to 93]					
Fluid Viscosity Limits @ 230°F [110°C]						
Optimum SUS [cSt]	70 [13]					
Minimum SUS [cSt]	55 [9]					
Weight of Unit						
lbs [kg]	7 [3.2]	8 [3.6]	12.65 [5.7]	12 [5.4]	14 [6.3]	17 [7.7]
Inlet Filtration Requirement						
Nominal micron	25					

Table 1: P Series Pump Technical Specifications

PRODUCT IDENTIFICATION

The label in Figure 11 is located on the pump housing. It identifies the model and configuration of the pump.

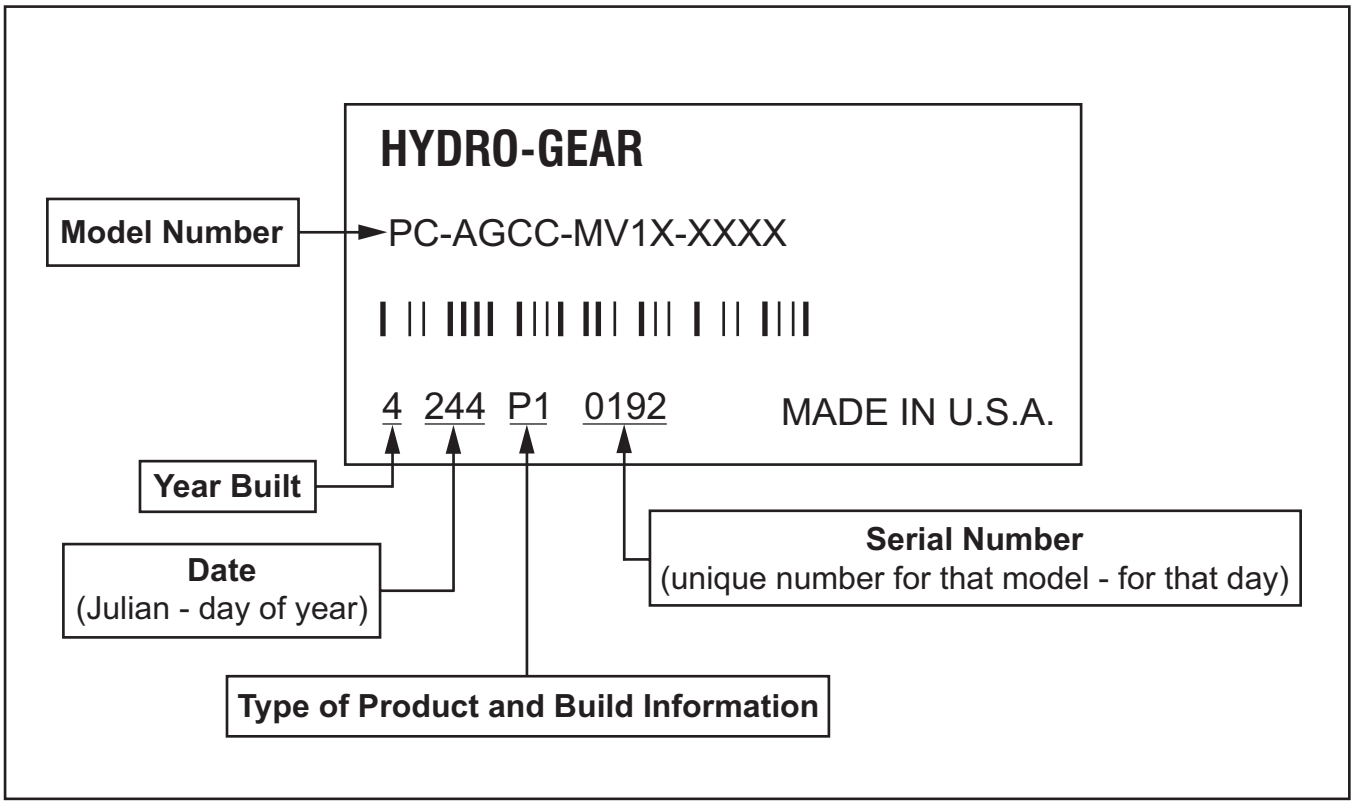


Figure 11. P Series Pump Configuration Label

SECTION 2. SAFETY

This symbol points out important safety instructions which, if not followed, could endanger the personal safety and/or property of yourself and others. Read and follow all instructions in this manual before attempting maintenance on your P Series Pump. When you see this symbol - **HEED ITS WARNING.**

WARNING

POTENTIAL FOR SERIOUS INJURY

Inattention to proper safety, operation, or maintenance procedures could result in personal injury, or damage to the equipment. Before servicing or repairing the P Series Pump, read fully and understand the safety precautions described in this section.

PERSONAL SAFETY

Certain safety precautions must be observed while servicing or repairing the P Series Pump. This section addresses some of these precautions but must not be considered an all-inclusive source on safety information. This section is to be used in conjunction with all other safety material which may apply, such as:

- Other manuals pertaining to this machine
- Local and shop safety rules and codes
- Governmental safety laws and regulations

Be sure that you know and understand the equipment and the hazards associated with it. Do not place speed above safety.

Notify your supervisor whenever you feel there is any hazard involving the equipment or the performance of your job.

Never allow untrained or unauthorized personnel to service or repair the equipment.

Wear appropriate clothing. Loose or hanging clothing or jewelry can be hazardous. Use the appropriate safety equipment, such as eye and hearing protection, and safety-toe and slip-proof shoes.

Never use compressed air to clean debris from yourself or your clothing.

TOOL SAFETY

Use the proper tools and equipment for the task.

Inspect each tool before use and replace any tool that may be damaged or defective.

WORK AREA SAFETY

Keep the work area neat and orderly. Be sure it is well lit, extra tools are put away, trash and refuse are in the proper containers, and dirt or debris have been removed from the working areas of the machine.

The floor should be clean and dry, and all extension cords or similar trip hazards should be removed.

SERVICING SAFETY

Certain procedures may require the vehicle to be disabled in order to prevent possible injury to the servicing technician and/or bystanders.

The loss of hydrostatic drive line power may result in the loss of hydrostatic braking capability.

Some cleaning solvents are flammable. Use only approved cleaning materials: Do not use explosive or flammable liquids to clean the equipment.

To avoid possible fire, do not use cleaning solvents in an area where a source of ignition may be present.

“Discard used cleaning material in the appropriate containers according to local, state, and federal regulations.”

SECTION 3. TROUBLESHOOTING

WARNING

Do not attempt any servicing or adjustments with the engine running. Use extreme caution while inspecting the drive belt assembly and all vehicle linkage!

Follow all safety procedures outlined in the vehicle owner's manual!

In many cases, problems with the P Series Pump are not related to a defective pump but are caused by slipping drive belts, partially engaged bypass valves, and loose or damaged control linkages. Be sure to perform all operational checks and adjustments outlined in Section 3 before assuming the pump is malfunctioning. Table 2 below provides a troubleshooting checklist to help determine the cause of operational problems.

Possible Cause	Corrective Action
VEHICLE DOES NOT DRIVE/TRACK STRAIGHT	
Vehicle tires improperly inflated	Refer to vehicle manufacturer suggested pressure
Control linkage bent, loose or out of adjustment	Repair, adjust or replace vehicle linkage
Bypass loose	Tighten pump bypass per External Maintenance step 9, page 17
Inlet Leak	Check all external lines and connections to pump inlet
UNIT IS NOISY	
Excessive input speed	Adjust input speed above 1800 rpm and below 3600 rpm
Oil level low or contaminated oil	Fill reservoir to proper level or change oil
Excessive loading	Reduce vehicle load
Air trapped in hydraulic system	Purge hydraulic system per Purging Procedures on page 18
Bypass loose	Tighten pump bypass per External Maintenance step 9, page 17
Inlet leak, line or filter partially blocked or damaged	Check all external lines and connections and filter to pump inlet

Table 2. Pump Troubleshooting Checklist

Possible Cause	Corrective Action
UNIT HAS NO/LOW POWER	
Engine speed low	Adjust to correct rpm setting
Control linkage bent, loose or out of adjustment	Repair or replace vehicle linkage
Drive belt slipping or pulley damaged	Repair or replace drive belt or pulley
Oil level low or contaminated oil	Fill reservoir to proper level or change oil
Excessive loading	Reduce vehicle load
Bypass loose	Tighten pump bypass per External Maintenance step 9, page 17
Air trapped in hydraulic system	Purge hydraulic system per Purging Procedures on page 18
Inlet leak	Check all external lines and connections to pump inlet
Inlet filter clogged	Replace inlet filter
Suspected internal damage	Check pump by performing Flow Test on page 15
UNIT OPERATING HOT	
Debris buildup	Remove debris from pump and fan
Cooling fan or heat exchanger damaged	Repair or replace cooling fan or heat exchanger
Oil level low or contaminated oil	Fill reservoir to proper level or change oil
Excessive loading	Reduce vehicle load
Air trapped in hydraulic system	Purge hydraulic system per Purging Procedures on page 18
Inlet leak	Check all external lines and connections to pump inlet
PUMP LEAKS OIL	
Damaged seals and gaskets	Remove debris, replace seals
Air trapped in hydraulic system	Purge hydraulic system per Purging Procedures on page 18

P-SERIES FLOW TEST KIT INSTRUCTIONS - BLN-51334 April 2011
(This Instruction Sheet supersedes all previous flow testing instruction)

Description: P Series Flow Test Kit (Part Number 70661)

(Part Number 70661 Supersedes Part Numbers 70511 and BB-76810)

Purpose: The design purpose of the P Series Flow Test Kit is to allow the customer to isolate the pump from the wheel motor and determine if the pump is acceptable. The following information can be used to install and test the pump by simulating a wheel motor load.

WARNING

CERTAIN PROCEDURES REQUIRE THE VEHICLE ENGINE TO BE OPERATED AND THE VEHICLE TO BE RAISED OFF OF THE GROUND. TO PREVENT POSSIBLE INJURY TO

WARNING

DO NOT ATTEMPT ANY ADJUSTMENTS WITH THE ENGINE RUNNING. USE EXTREME CAUTION WHILE WORKING IN OR AROUND ALL VEHICLE LINKAGE!

INSTALLATION AND TESTING PROCEDURES:

1. Disconnect the system hoses at the wheel motor, or system hoses from the pump and connect the P Series Flow Test Kit. (Special care should be taken to prevent contamination debris from entering pump or wheel motor system ports).

Note: Using the Bi-Directional Flow Test Kit, determination of directional flow is not necessary. The flow meter may be connected in either direction into the forward and reverse high pressure system lines.

CAUTION: Ensure all fittings and hoses are attached securely. This test is being completed on the vehicle's high pressure system lines. Failure to perform this properly could result in bodily injury.

TESTING PROCEDURES:

1. Raise the drive tires off the ground. Block the remaining tires on the ground to prevent accidental vehicle movement.

2. Open the restriction valve all the way.

3. Make certain all external pump directional control stops are removed or backed off on the vehicle linkage to obtain full pump directional control arm travel.

4. Start the engine and engage the drive pulley if necessary.

5. Bring the engine to maximum operating speed.

(This should not exceed 3600 rpm input speed on the PC, PL, PG, PE, PJ and PK Series pumps)
(This should not exceed 3400 rpm input speed on the PR Series pumps)
(This should not exceed 2600 rpm input speed when testing the PW and PY Series pumps)
Engine speed adjustment may be necessary to obtain 2600 rpm.

CAUTION: Damage to the flow meter and/or re-calibration may result from testing at input speeds that exceed 2600 rpm on the PW and 3400 rpm on the PR Pumps.

6. With the directional control lever (on the vehicle) for the pump being tested, move the control arm in full forward motion. (It may be necessary to lock the control arm into full forward position to prevent false readings).

7. Operate without any load for approximately 30 seconds to 1 minute. This allows the system oil temperature to rise.

Note: Raising the system oil temperature will make a difference in the readings you receive. It has been determined that to complete this test accurately, the oil temperature must be near system operating temperatures. Suggested temperature range is 160°- 210°F (71.1° - 98.9°C).

8. On the PC, PG, PJ, PE, PK, PL, PR, PW and PY, tighten the flow meter restriction valve until the gauge reads 300 psi (21bar). Record the flow reading on the Bi-Directional Flow Meter.

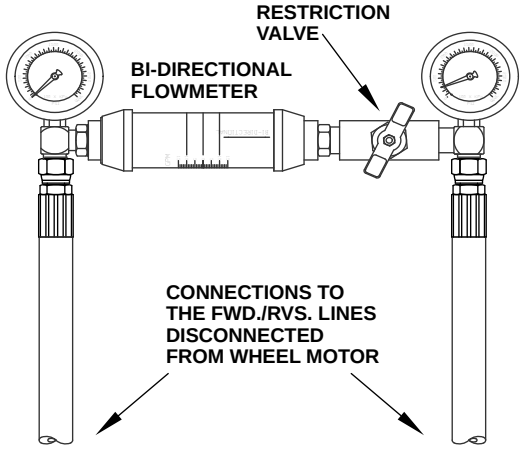
9. Increase the pressure to 1100 PSI (76 bar) for all models (PC, PG, PJ, PE, PK, PL, PR, PW and PY). Record the flow reading on the Bi-Directional Flow Meter.

10. The **acceptable gpm "flow droop" or (difference)** is:

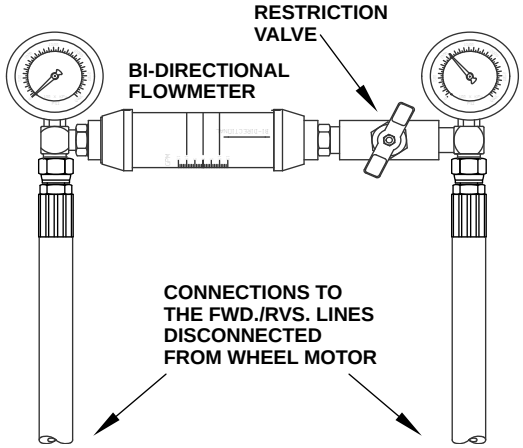
PC	**1.0 gpm (3.7 l/min)**
PG/PL/PE	**1.5 gpm (5.6 l/min)**
PJ/PK	**2.0 gpm (7.6 l/min)**
PR	**2.5 gpm (9.4 l/min)**
PW/PY	**2.5 gpm (9.4 l/min)**

If the difference exceeds these values the pump would not be operating efficiently and should be repaired or replaced.

TEST EXAMPLE: PE/PG/PL



300 psi (21 bar) reading **7 gpm (26 l/min) (1st reading)**



1100 psi (76 bar) reading **3 gpm (11 l/min) (2nd reading)**

(PG/PL)

300 psi (21 bar) reading	**7 gpm (26 l/min) (1st reading)**
1100 psi (76 bar) reading	**– 3 gpm (11 l/min) (2nd reading)**
	4 gpm (15 l/min) (the difference)

Subtract the 1st reading from the 2nd. (In this example, 4 gpm difference would indicate further pump examination).

NOTE: Any servicing dealer attempting a warranty repair must have prior approval before conducting maintenance of a Hydro-Gear product, unless the servicing dealer is a current authorized Hydro-Gear Service Center.

EXTERNAL MAINTENANCE

Regular external maintenance of a P Series Pump should include the following:

1. **Check the vehicle operator's manual for the recommended load ratings. Insure the current application does not exceed load rating.**
2. Check fluid level in reservoir in accordance with vehicle manufacturer's recommendations.

NOTE: After the oil has been drained and maintenance has been performed, clean oil should be poured directly into the pump inlet and high pressure ports prior to plumbing connections and pump start-up.

3. Inspect the vehicle drive belt, idler pulley(s), and idler spring(s). Insure that belt slippage is not causing low input rpm to the pump.
4. Inspect all external plumbing for possible leaks or loose fittings. An air leak may be difficult to detect on the "suction side" or inlet line to the pump. Refer to Purging Procedures page 18.
5. Insure correct inlet filter(s) has been installed in accordance with the vehicle manufacturer recommendations.
6. Insure the reservoir is free of contaminants and is properly vented.
7. Inspect the P Series Pump cooling fan (if applicable) for broken or distorted blades and remove any obstructions (grass clippings, leaves or dirt). Inspect oil cooler (if applicable) for damaged fins and debris.
8. Inspect the vehicle control linkage to the directional control arm on the P Series Pump. Also, insure the control arm is securely fastened to the trunnion arm.
9. Inspect the bypass on the P Series Pump to insure it is properly engaged for operation. If the bypass is not fully engaged (rotated fully clockwise) it will not function properly. For vehicle movement without engine power, the bypass may be backed out (2) turns maximum. This is only recommended for movement of short distances at low speeds.

WARNING

Loosening the bypass will result in loss of hydraulic braking capability.

SERVICE AND MAINTENANCE PROCEDURES

NOTE: Damage to P Series Pumps may result from external or internal contamination, heat from excess debris or lack of lubrication and over-pressurization of the hydrostatic system. Follow guidelines established in this manual and the vehicle manufacturer's recommendations.

All the service procedures presented on the following pages can be performed while the P Series Pump is mounted on the vehicle. Any servicing beyond those presented in this section must be performed after the pump has been removed from the vehicle.

FLUIDS

The fluids used in Hydro-Gear products have been carefully selected, and only equivalent, or better products should be substituted.

Typically, an engine oil with a minimum rating of 55 SUS (9.0 cSt) at 230˚ F (110° C) maximum operating temperature and an API classification of SJ/CD is allowed. Refer to the vehicle manufacturer for recommended oil.

"All fluids should be handled and disposed of according to local, state, and federal regulations."

FLUID VOLUME AND LEVEL

Certain situations may require additional fluid to be added or even replaced. Refer to the vehicle manufacturer's recommendations for the proper fill location and level. After maintenance or oil change, follow purging procedures below and check the fluid level once the unit has been operated for approximately 1 minute.

FLUID CHANGE

In the event of oil contamination or degradation, oil addition or change may alleviate certain performance problems. Refer to the vehicle manufacturer's recommended oil change frequency. Refer to purging procedures below after changing fluids.

FILTERS

An inlet filter is required to insure that only clean fluid enters the system. Refer to the vehicle manufacture for approved filter replacement.

PURGING PROCEDURES

Due to the effects air has on efficiency in hydrostatic drive applications, it is critical that air is removed or purged from the system.

These purge procedures must be preformed anytime a hydrostatic system has been opened for maintenance or repair, or if any additional oil has been added to the system.

Air creates inefficiency because it has compression and expansion rates that are higher than that of oil.

Air trapped in the oil may cause the following symptoms:

1. Noisy operation.
2. Lack of power or drive after short-term operation.
3. High operation temperature and excessive expansion of oil.

Before starting, make sure the reservoir is at the proper oil level. If it is not, fill to the vehicle manufacturer's specifications.

The following procedures should be performed with the vehicle drive wheels off the ground, then repeated under normal operating conditions.

WARNING

POTENTIAL FOR SERIOUS INJURY

Certain procedures require the vehicle engine to be operated and the vehicle to be raised off of the ground. To prevent possible injury to the servicing technician and/or bystanders, insure the vehicle is properly secured.

1. With the bypass valve open and the engine running, slowly move the directional control in both forward and reverse directions (5 to 6 times). As air is purged from the unit, the oil level in the reservoir will drop.
2. With the bypass valve closed and the engine running, slowly move the directional control in both forward and reverse directions (5 to 6 times). Check the oil level, and add oil as required after stopping engine.
3. It may be necessary to repeat steps 1 and 2 until all the air is completely purged from the system. When the P Series Pump moves forward and reverse at normal speed and the reservoir oil remains at a constant level, purging is complete.

Cleanliness is a key factor in the successful repair of pumps. Thoroughly clean all exposed surfaces prior to any type of maintenance. Cleaning of all parts by using a solvent wash and air drying is usually adequate. As with any precision equipment, all parts must be kept free of foreign material and chemicals. Protect all exposed sealing areas and open cavities from damage and foreign material.

Upon removal, all seals, O-rings, and gaskets should be replaced. During installation, lightly lubricate all seals, O-rings, and gaskets with clean petroleum jelly prior to assembly. Also protect the inner diameter of seals by covering the shaft machined features with plastic wrap or equivalent.

Note: "Any and all Hydro-Gear components removed and replaced during service are recyclable."

RETURN TO NEUTRAL SETTING

WARNING

POTENTIAL FOR SERIOUS INJURY

Inattention to proper safety, operation, or maintenance procedures could result in personal injury, or damage to the equipment. Before servicing or repairing the P Series Pump, fully read and understand the safety precautions described in this manual.

WARNING

Do not attempt any servicing or adjustments with the engine running. Use extreme caution while inspecting the drive belt assembly and all vehicle linkage!

Follow all safety procedures outlined in the vehicle owner's manual.

The return to neutral mechanism on the pump is designed to set the directional control into a neutral position when the operator releases the vehicle hand control. Follow the procedures below to properly adjust the return to neutral mechanism on the pump:

1. Confirm the pump is in the operating mode (bypass disengaged). Raise the vehicle's drive tires off the ground to allow free rotation.
2. Remove the Original Equipment Manufacturer's (OEM's) control linkage at the control arm.
3. Start the engine and increase the throttle to full engine speed.
4. Check for axle rotation. If the axle does not rotate, go to Step 5. If the axle rotates, go to Step 6.
5. Stop the vehicle's engine. Reattach and adjust the vehicle's linkage according to the vehicle owner's manual.
6. Note the axle directional movement. Stop the vehicle engine. Loosen the RTN adjustment screw until the control arm can be rotated. Rotate the control arm in the proper direction until neutral is obtained (motor shaft does not rotate). Tighten the RTN adjustment screw. Recheck according to steps 3 and 4. Refer to Figure 12.

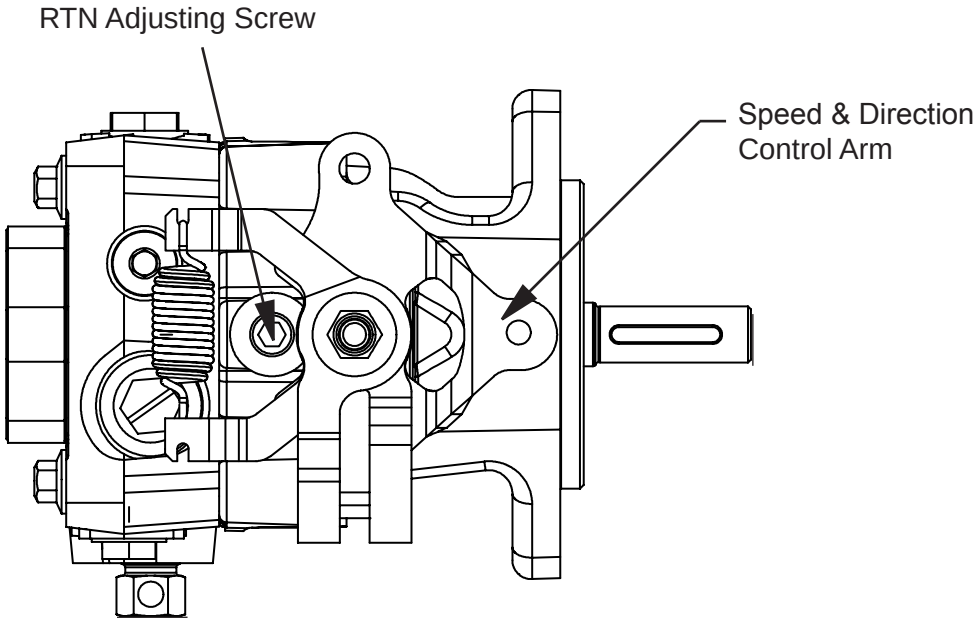


Figure 17. P Series Pump RTN Adjustment

REPAIR - PC SERIES PUMP

HOW TO USE THIS MANUAL

Each assembly is provided with an exploded view showing the parts involved. **The item reference numbers in each illustration are for assembly instructions only.** See pages 34 and 35 for part names and descriptions. A complete exploded view and item list of the pump is provided at the end of this section.

GENERAL INSTRUCTIONS

Cleanliness is a primary means of ensuring satisfactory life on repaired pumps. Thoroughly clean all exposed surfaces prior to any type of maintenance. Cleaning of all parts by using a solvent wash and air drying is usually adequate. As with any precision equipment, all parts must be kept free of foreign material and chemicals.

Protect all exposed sealing surfaces and open cavities from damage and foreign material. The external surfaces should be cleaned before beginning any repairs.

Lip-type seals (shaft seals) are used on the input shaft and directional control shaft of each pump. These seals can be replaced without major disassembly of the unit. However, replacement of these seals generally requires removal of the pump from the machine. Upon removal, it is recommended that all seals, O-rings and gaskets be replaced.

During installation, lightly lubricate all seals, O-rings and gaskets with clean petroleum jelly prior to assembly. Also protect the inner diameter of the seals by covering the shaft with a cellophane (plastic wrap, etc.) material.

Parts requiring replacement must be replaced from the appropriate kits identified in the Items Listing, found at the end of this manual. Use only original Hydro-Gear replacement parts found listed in BLN-51427 (CD).

TOOLS AND TORQUES

Miscellaneous	**3/8-Inch Drive Ratchet and Sockets**
P Series Service & Repair Manual	7/16-inch Socket
Torque Wrench	1/2-Inch Socket
Scribe, Paint Pen, or Marker	11/16-Inch Socket
Seal Hook with a Magnet	10-mm Socket
Flat Blade Screwdriver	**Combination Wrenches**
Pliers	7/16 Inch
Internal Snap Ring	1/2 Inch
Allen Wrenches	11/16 Inch
1/8 inch	10 mm
1/4 inch	

Table 1. Required Tools

Item # and/or Description	**Torque**
Case Drain (fitting torque)	200-250 lb-in (22.6-28.2 Nm)
System Port (fitting torque)	370-470 lb-in (41.8-53.1 Nm)
Inlet (fitting torque)	200-250 lb-in (22.6-28.2 Nm)
Fan Nut, Hex Lock 5/16-24 UNF	120-160 lb-in (13.5-18.1 Nm)
4, End Cap/Adapter Plate Bolts	180-220 lb-in (20.3-24.9 Nm)
10, Cap Screw	180-220 lb-in (20.3-24.9 Nm)
15, Bypass Valve	110-130 lb-in (12.4-14.7 Nm)
42A, 42B, Shock Valves/Check Plugs	180-240 lb-in (20.3-27.1 Nm)
44, System Charge Relief Kit (Aux Chg)	180-240 lb-in (20.3-27.1 Nm)
45, Aux Relief Valve Kit	180-240 lb-in (20.3-27.1 Nm)
56, Diagnostic Plug	84-120 lb-in (9.4-13.5 Nm)
66, Filter Cover Plug	55-85 lb-in (6.2-9.6 Nm)
67, Filter Cover	200-275 lb-in (22.6-31.1 Nm)
103, Screw 5/16 x .875	200-240 lb-in (22.6-27.1 Nm)
106, Nut, Hex Lock 5/16-24 UNF	180-220 lb-in (20.3-24.9 Nm)
164, Plug, Metal 7/16-20	84-120 lb-in (9.4-13.5 Nm)

Table 2. PC Pump Torque Values

REMOVAL, INSPECTION AND/OR REPLACEMENT OF RETURN TO NEUTRAL ASSEMBLY

Refer to Figure 1.

Prior to disassembly, note the position of the scissor arm brackets and the tab on the outer control arm bracket.

Disassembly

CAUTION: The spring used on the return to neutral linkage is under tension. To avoid possible injury, use care and proper protection during disassembly and assembly of the return to neutral linkage.

1. Loosen (but do not remove) the nut (106).
2. To relieve spring tension, carefully pry up on the outer scissor control arm until it releases from the tab on the outer control arm bracket.
3. Remove the spring (102), nut (106) washer (104) and outer scissor control arm bracket.
4. Remove bushing (101), washer (105), and the inner scissor control arm bracket.
5. Remove the outer control arm bracket, bolt (103), washer (104) and the inner return arm bracket.

Inspection

1. With the arm control linkage removed, inspect the trunnion arm (37) and trunnion arm seal (49).
2. Inspect bushing (101) and all other linkage parts for damage, corrosion or wear.

Assembly

1. Install the inner return arm bracket, washer (104) and bolt (103).

NOTE: Do not over tighten the bolt (103). The bracket must move freely.

2. Install the outer control arm bracket, washer (105) and bushing (101).
3. Install the inner scissor control arm bracket, washer (105), and outer scissor control arm bracket.
4. Install washer (104), and nut (106). Tighten to the correct torque value. See page 22.
5. Install the spring (102).

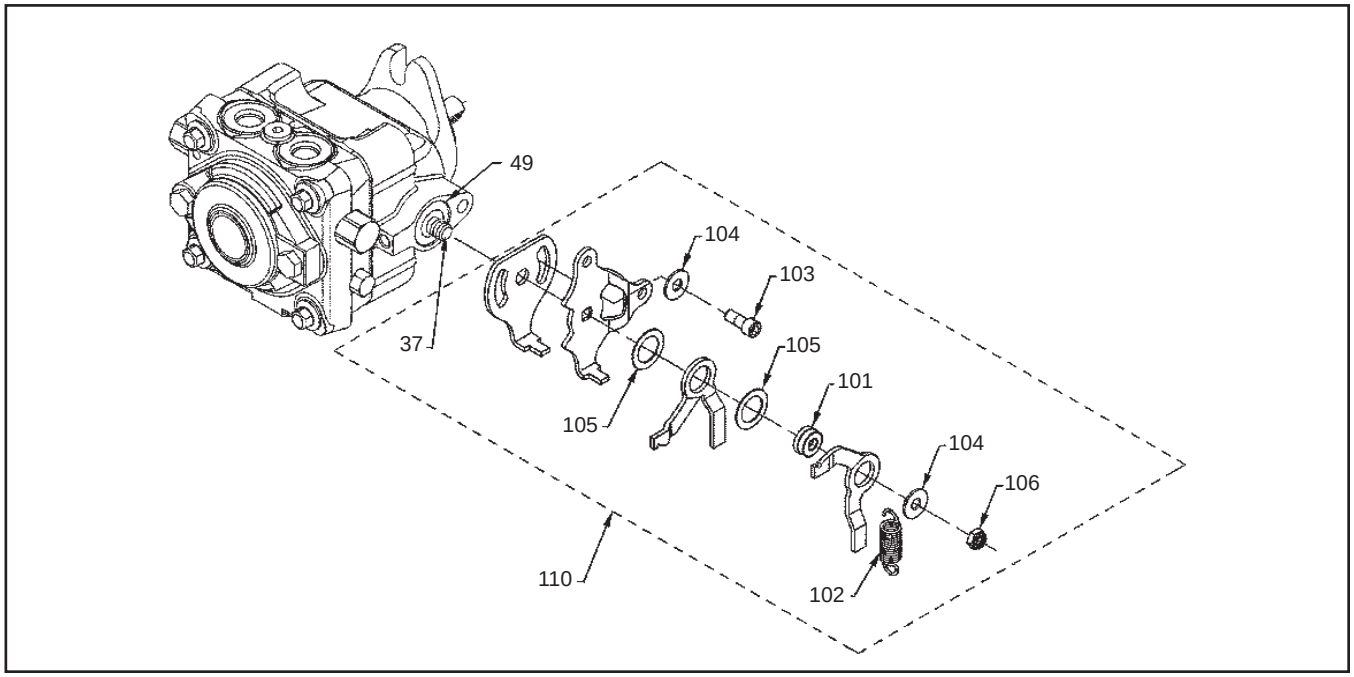


Figure 1. Return to Neutral Assembly

REMOVAL, INSPECTION AND/OR REPLACEMENT OF CONTROL ARM

Refer to Figure 2.

Disassembly

1. Remove the nut (106), washer (104) and bushing (101).
2. Remove the outer control arm bracket.
3. Remove bolt (103), washer (104) and the inner control arm bracket.

Inspection

1. With the arm control linkage removed, inspect the trunnion arm (37) and trunnion arm seal (49).
2. Inspect bushing (101) and all other linkage parts for damage, corrosion or wear.

Assembly

1. Install the inner control arm bracket, washer (104) and bolt (103).

NOTE: Do not over tighten the bolt (103). The bracket must move freely.

2. Install the outer control arm bracket, bushing (101), washer (104) and nut (106). Tighten to the correct torque value. See page 22.

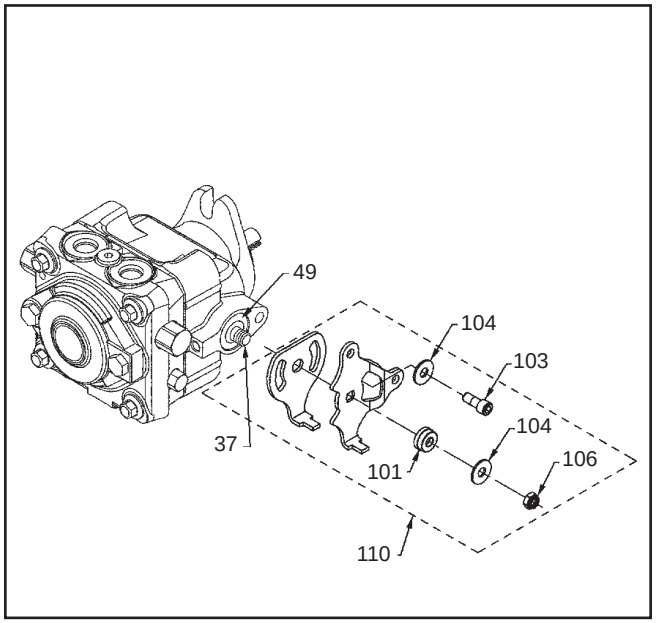


Figure 2. Standard Control Arm

REMOVAL, INSPECTION AND/OR REPLACEMENT OF FAN ASSEMBLY

Refer to Figure 3.

Disassembly

1. Remove the fan shroud (210) from the mounting bracket (209) by carefully pushing down on the shroud tabs.
2. Remove the nut (106) and fan assembly (90).
3. Remove the bolts (10) and bracket (209).

Inspection

Inspect the fan shroud (210), fan assembly (90) and mounting bracket (209) for damage.

Assembly

1. To install the mounting bracket (209), align and insert the bolts (10) into the bracket and charge pump cover. While holding the charge cover in place, tighten the bolts (10) per table 2, page 22.
2. Install the fan and washer assembly onto the shaft.
3. Install the nut (106) and tighten per table 2, page 22.
4. Install the fan shroud (210) onto the mounting bracket (209). Make sure that all shroud lock tabs are fully engaged in the mounting bracket slots.

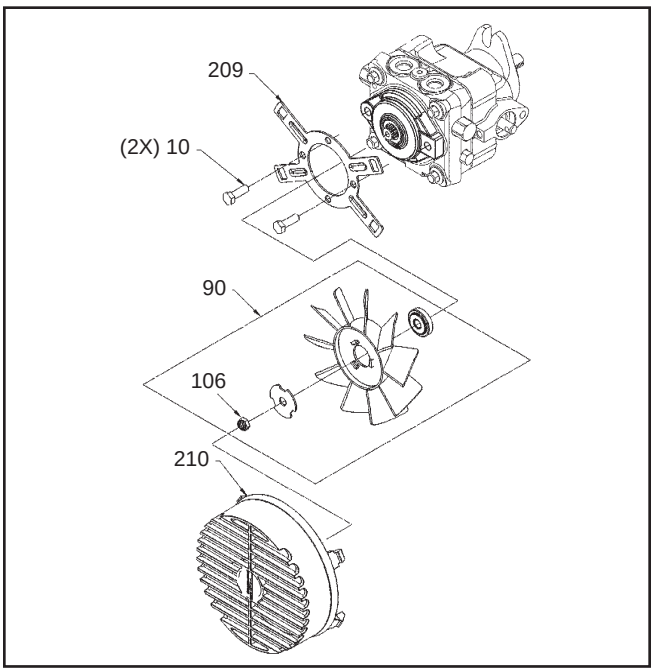


Figure 3. Fan Assembly

REMOVAL, INSPECTION AND/OR REPLACEMENT OF INPUT SHAFT SEAL

Refer to Figure 4.

Disassembly

1. Remove retaining ring (22) from housing.
2. Remove lip seal (20). Care must be taken to prevent damage to the housing bore, shaft sealing surface, or bearing. Once removed, the seal is not reusable.

Inspection

With seal removed inspect the spacer (21) and housing (1) bore for damage, corrosion or wear.

Assembly

1. Lubricate the new lip seal (20) inside diameter with petroleum jelly.
2. Wrap the input shaft (18) with plastic wrap to prevent damage to the inner surface of the lip seal (20).
3. Slide spacer (21) and seal (20) over shaft (18) so that lettering on the seal faces out.
4. Press the lip seal (20) into the housing bore. Insure the lip seal (20), shaft (18) or housing (1) bore do not become damaged. Remove the plastic wrap.
5. Install the retaining ring (22) into the housing (1) bore groove. Refer to Figure 4.

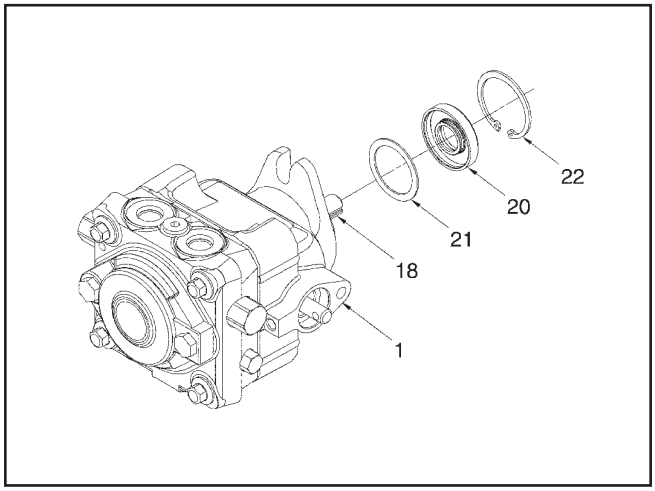


Figure 4. PC Pump Input Shaft Seal

REMOVAL, INSPECTION AND/OR REPLACEMENT OF TRUNNION ARM SEAL

Refer to Figure 5.

Disassembly

1. Remove the RTN assembly or control arm.
2. Remove the retainer and lip seal (49) from the housing. Care must be taken to prevent damage to the housing trunnion bore, trunnion arm and sealing surface. Once removed the retainer and lip seal are not reusable.

Inspection

With the lip seal (49) removed, inspect the area for corrosion and wear. Inspect the trunnion bore area sealing surface for damage or wear.

Assembly

1. Lubricate the new lip seal (49) inside diameter with petroleum jelly.
2. Wrap the trunnion arm with plastic wrap to prevent damage to the inner surface of the lip seal (49).
3. Slide the lip seal (49) over the trunnion arm so that the lettering on the seal (49) faces out.
4. Press the lip seal (49) into the housing bore. Insure the seal (49), trunnion arm, and housing bore do not become damaged. Remove plastic wrap.
5. Install the retainer from (49) over the trunnion arm on top of the lip seal. Press into the trunnion seal bore in the housing until the retainer mates against the trunnion seal.
6. Install the RTN assembly or control arm.

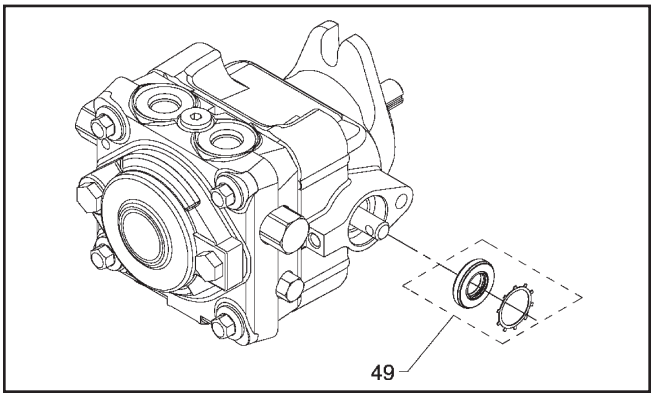


Figure 5. Trunnion Arm Seal

REMOVAL, INSPECTION AND/OR REPLACEMENT OF SHOCK VALVES

Refer to Figure 6.

Perform disassembly, inspection and assembly on shock valve one side at a time. Some units vary in “A” side to “B” side configuration.

Disassembly

1. Remove the shock valve (42) with an 11/16-inch wrench.
2. Remove the shock valve spring and the shock valve from the end cap.

Inspection

Inspect the shock valve (42) and mating seat in the end cap for damage or foreign material.

Assembly

1. Position the pump so the shock valve port is horizontal.
2. Insert the shock valve spring and shock valve as one assembly into the check plug port. Tighten to the correct torque value. See Table 2, page 22 (Torque Values).
3. Repeat disassembly, inspection and assembly for the opposite port.

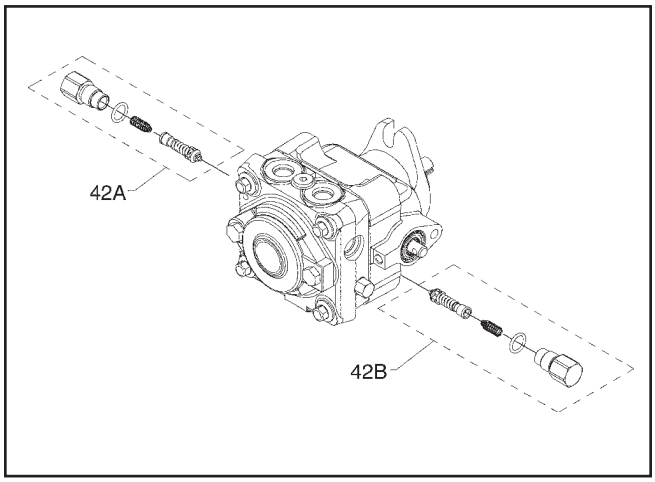


Figure 6. PC Pump Shock Valves

REMOVAL, INSPECTION AND/OR REPLACEMENT OF THE BYPASS

Refer to Figure 7.

Disassembly

1. Loosen the bypass valve (15) using a 7/16-inch wrench.
2. Remove the bypass (15) from the end cap.

Inspection

1. Inspect the bypass O-rings and mating seats in the end cap for damage or foreign material.
2. If damaged or worn, replace bypass (15).

Assembly

1. Position the pump so the bypass port is horizontal.
2. Insert the bypass (15) into the bypass port of the end cap. Tighten to the correct torque value. See Table 2, page 22 (Torque Values).

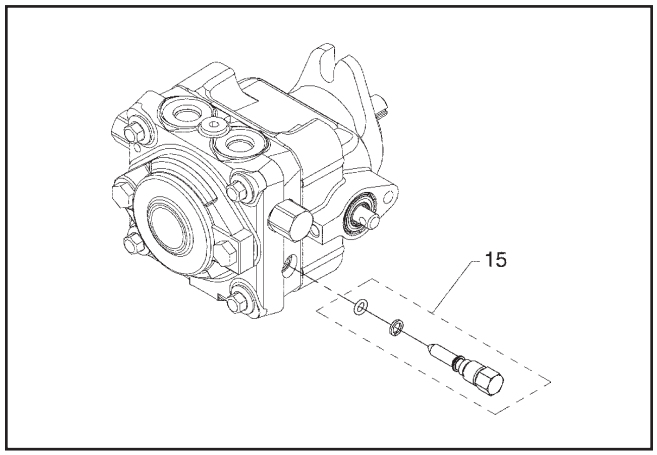


Figure 7. PC Pump Bypass

REMOVAL, INSPECTION AND ASSEMBLY OF THE STANDARD OR THRU SHAFT CHARGE PUMP

Refer to Figure 8.

Disassembly

1. Prior to removal of the charge pump cover, place a mark on the cover and end cap for alignment at assembly.
2. Using a 1/2-inch wrench, loosen the charge pump cover bolts (10) from the end cap (2). While holding the charge cover (6) in place, remove the charge cover bolts (10).
3. Remove the charge cover, O-ring (8) and gerotor items (7). Carefully check for and remove the charge spring and charge ball (44).
4. For thru shaft charge pump, remove the shaft seal.

Inspection

1. Inspect the charge cover O-ring (8) and running surfaces for damage. Inspect the spring, check ball (44), and mating seat in the end cap (2) for damage or foreign material.
2. Inspect the charge cover bore for damage corrosion or wear.

NOTE: If the end cap (2) is to be removed from the housing, do not assemble the charge pump (6) until the end cap is installed on the housing.

NOTE: For thru shaft charge pump assembly, follow steps 1 thru 8. For standard charge pump, follow steps 3 thru 8.

Assembly

1. Lubricate the new shaft seal with petroleum jelly.
2. Press the shaft seal into the charge cover. Be careful not to damage the shaft seal or charge cover bore.
3. Position the pump with the input shaft down, and the end cap (2) horizontal. Place the charge ball (44) in the end cap (2) charge passage so the ball mates to the end cap (2) charge ball seat. Place the charge spring, on top of the charge ball.
4. Insert the inner gerotor over input shaft (18).
5. Align the outer gerotor to fit over the inner gerotor.
6. Insert the O-ring (8) into the groove in the charge cover.
7. Position the charge cover and O-ring with the aligning mark on the end cap. Place the charge cover and O-ring as one piece over the charge spring and gerotor assembly. Insure the spring fits into the charge cover spring retaining groove.
8. Align and insert the charge pump cover bolts (10) into the end cap (2). Tighten to the correct

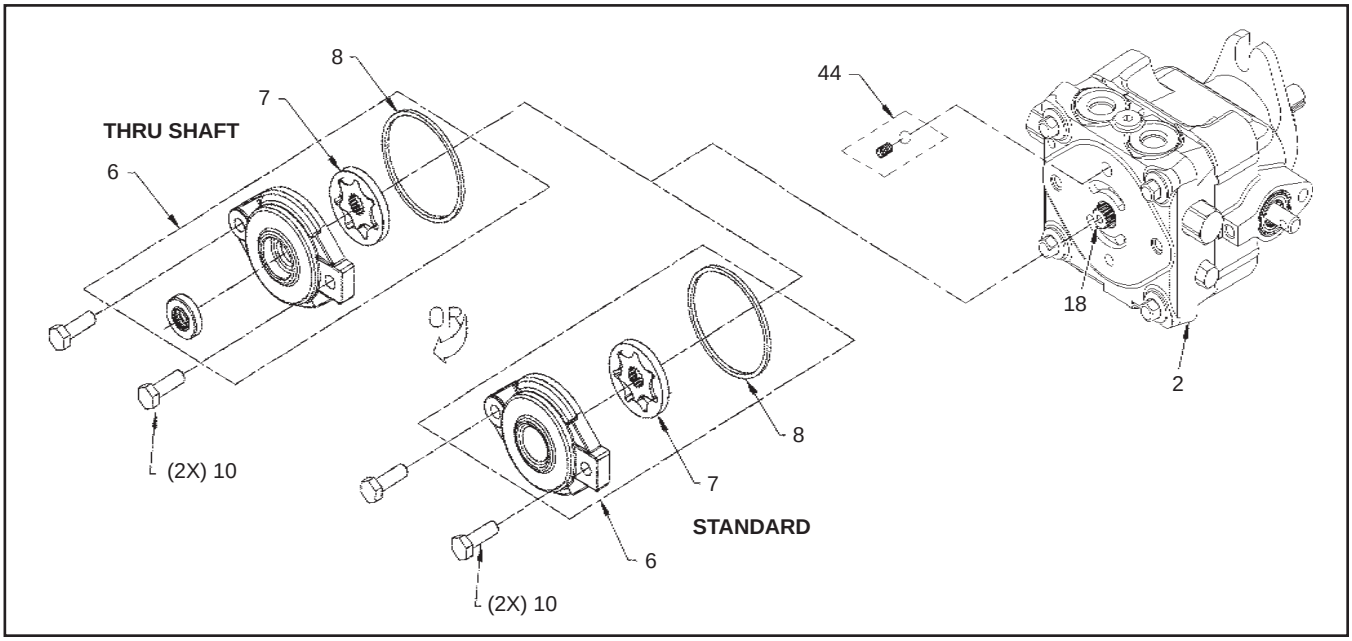


Figure 8. PC Pump Standard or Thru Shaft Charge Pump

REMOVAL, INSPECTION AND/OR REPLACEMENT OF AUXILIARY PUMP (IF EQUIPPED)

Refer to Figure 9.

Disassembly

1. Prior to removal of the auxiliary pump, place a mark on the auxiliary pump (6), charge pump (7) and end cap (2) for alignment at assembly.
2. Use a 10 mm wrench to loosen the auxiliary pump bolts (10) from the end cap (2). While holding the auxiliary pump in place, remove the bolts (10).
3. Remove the auxiliary pump, gasket, O-ring (8) and charge pump (7). While removing the charge pump, be sure to retain the spring and ball (44A) housed in the end cap (2).
4. Remove the plug (66) from the filter cover (67).
5. Use a 7/8 inch wrench to remove the filter cover assembly (67) from the pump.
6. Remove the O-ring and filter (54).
7. Remove the charge relief valve assembly (44) and auxiliary relief valve assembly (45) from the auxiliary pump.

Inspection

1. With the auxiliary pump removed, inspect the pump running surfaces for wear or damage.
2. Inspect all O-rings, gasket and mounting seats.
3. Inspect the filter cover assembly threads and filter for wear, damage or foreign material.

Assembly

1. Install the check ball, spring, and cap as one assembly (45) into the auxiliary relief valve port. Tighten to the correct torque value. See page 22.
2. Install the poppet, spring and cap as one assembly (44) into the charge relief port. Tighten to the correct torque value. See page 22.
3. Install the filter (54) and O-ring into the filter cover assembly (67). Install the assembly (67) into the auxiliary pump and tighten. Install plug (66) into the filter cover (67).
4. Lay the PC pump (input shaft down), so the end cap is horizontal. Install the O-ring (8) into the charge pump (7).
5. Install the gasket onto the auxiliary pump.
6. Make sure that the ball and spring (44A) are seated in the end cap (2), then position the auxiliary pump and gasket with the aligning mark on the charge pump (7). Insure that the pump fully engages the alignment pins (69).
7. Align and insert the bolts (10) into the auxiliary pump. While holding the auxiliary pump and charge pump in place, tighten the bolts (10) per table, page 22.

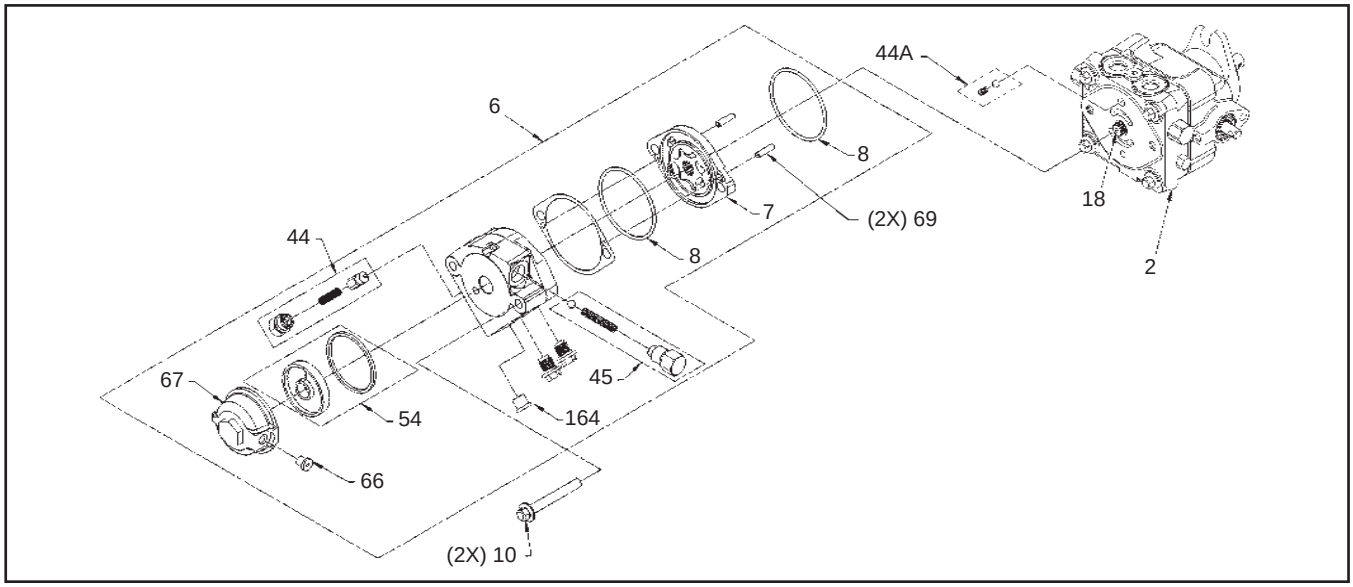


Figure 9. PC Series Auxiliary Pump

REMOVAL, INSPECTION AND ASSEMBLY OF THE END CAP

Refer to Figure 10.

Disassembly

1. Remove charge pump. (See page 27).
2. Using a 10 mm wrench, loosen the end cap bolts (4) evenly.
3. Hold the end cap (2) in place and remove the four end cap bolts (4).
4. Slowly remove the end cap (2).
5. Remove housing gasket (5).

Inspection

1. Inspect the end cap (2) body for damage, nicks or unusual wear patterns. Replace if necessary.
2. Inspect the running surface (side that contacts the cylinder block) (31). The running surface may show evidence of minor abrasive rings, this is normal.

   Grooving in the plate, or material transfer that is evident when the surface is checked by dragging a fingernail across it, would be cause for replacement of the end cap (2).
3. Replace the housing gasket (5) with a new gasket before assembly.

Assembly

1. Install housing gasket (5) into housing gasket seat of housing (1).
2. Lubricate the mating surface of the cylinder block (31) to end cap (2) with clean oil prior to installation.
3. Install end cap (2). Before installing the four end cap bolts (4), push down on end cap (2) verifying alignment and insuring that the cylinder block pistons spring back and forth. Install end cap bolts (4). Tighten to the correct torque value. See Table 2, page 22 (Torque Values)
4. Install the charge pump. (See page 27).

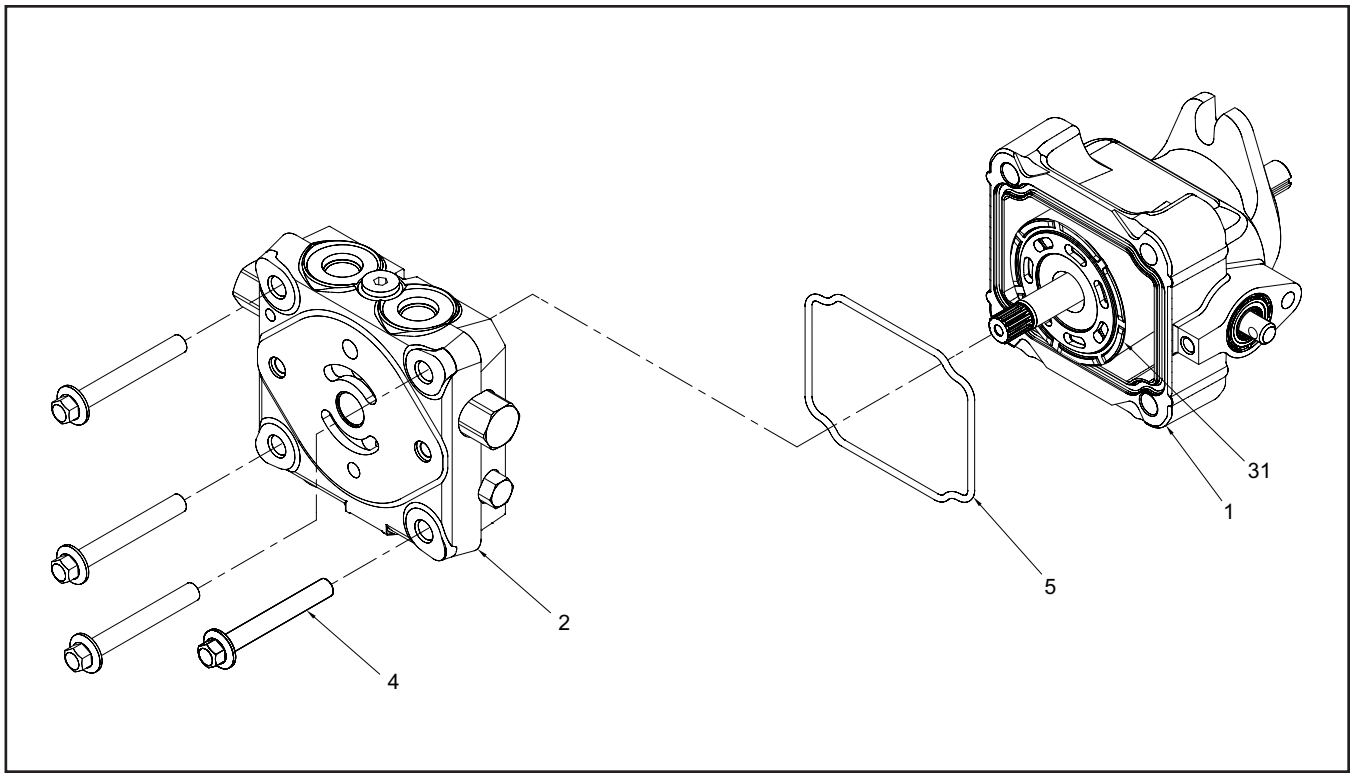


Figure 10. PC Pump End Cap

REMOVAL, INSPECTION AND ASSEMBLY OF THE CYLINDER BLOCK

Refer to Figure 11.

Disassembly

1. Remove charge pump. (See page 27).
2. Remove end cap. (See page 29).
3. Tilt the pump on its side and drain remaining oil. Lift out the cylinder block assembly (25).
4. Remove the pistons, springs and piston seats.

Inspection

1. Inspect the running surface of the cylinder block and piston ends for damage, nicks or unusual wear patterns. The running surface may show evidence of minor abrasion. This will be normal wear. If grooved or smeared, replace with a new cylinder block assembly.
2. Inspect the piston springs for distortion or breaks. If necessary, replace with a new cylinder block kit.
3. Inspect the piston seats. Residual oil may cause these to remain stuck to the inside of the pistons.

Assembly

1. Apply a thin layer of clean oil to the pistons and springs.
2. Install piston seats into the end of the pistons.
3. Install springs into the pistons.
4. Install each piston, spring and seat assembly into the cylinder block.

NOTE: To assist in cylinder block installation, a rubber band can be placed around all of the pistons to hold them in position.

After the cylinder block is installed, cut the rubber band and remove it from the housing.

5. With the pump housing tilted on its side, install the cylinder block assembly (25) with pistons contacting the thrust bearing.

NOTE: To check if the cylinder block assembly is installed correctly, position the pump housing vertically and support the housing at the mounting flange. Push down on the cylinder block. The cylinder block must move up and down freely. If it does not, remove the cylinder block assembly and

6. Install the end cap. (See page 29).
7. Install the charge pump. (See page 27).

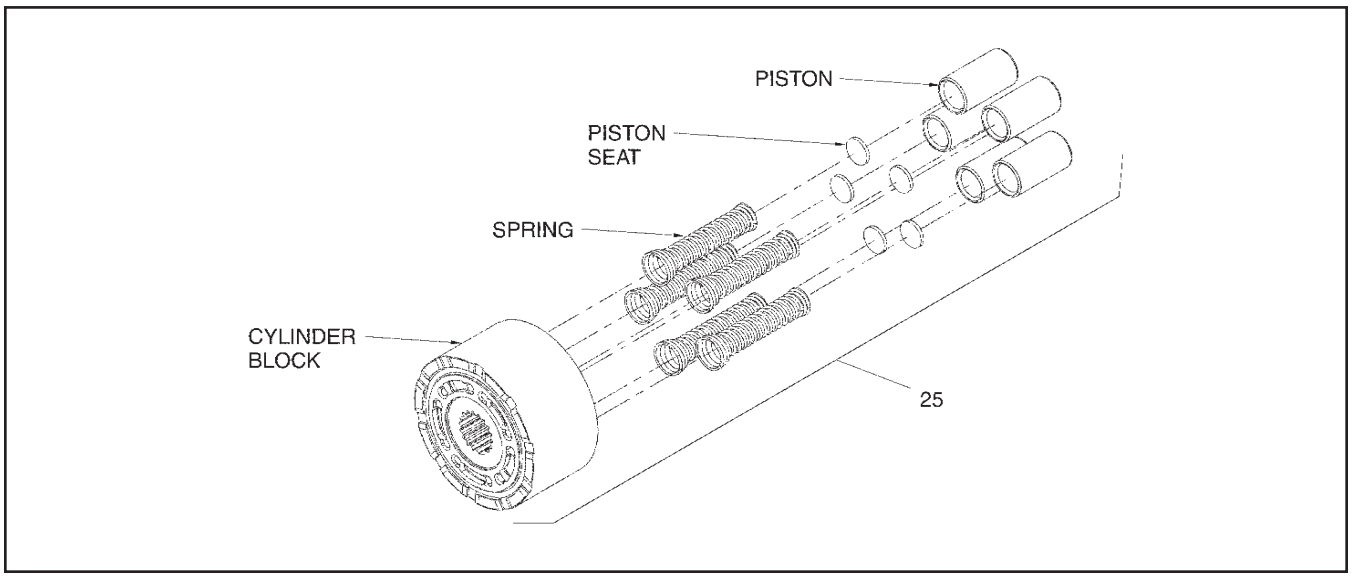


Figure 11. PC Pump Cylinder Block Assembly

REMOVAL, INSPECTION AND ASSEMBLY OF BLOCK SPRING AND THRUST BEARING

Refer to Figure 12.

Disassembly

1. Remove the block spring (29).
2. Remove the thrust bearing and races (34).

Inspection

1. Inspect and replace the block spring (29) if it is distorted or broken.
2. Inspect the running surface of the bearing races for damage, nicks or unusual wear patterns. The running surface may show evidence of minor abrasion. This will be normal wear.

   Inspect the bearings for free movement. Inspect the bearing cage for distortion or damage. Replace if necessary.

Assembly

1. Install thrust bearing and race assembly (34).

2. Install block spring (29).

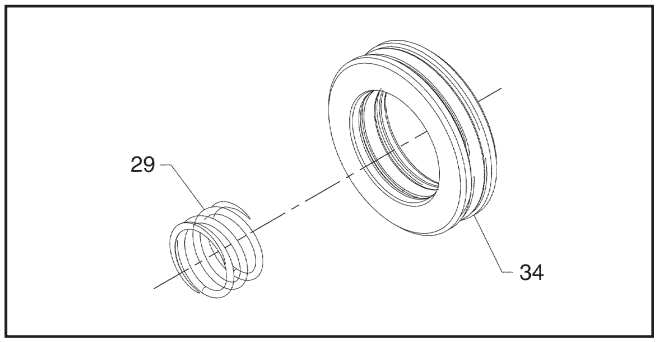


Figure 12. PC Pump Block Spring and Thrust Bearing

REMOVAL, INSPECTION AND ASSEMBLY OF SWASHPLATE AND CRADLE BEARINGS

Refer to Figure 13.

Disassembly

Remove the swashplate (32).

Inspection

1. Inspect the running surface of the bearing pocket of swashplate (32) for damage, nicks or unusual wear patterns. The running surface may show evidence of minor abrasion. This is normal wear. Inspect the cradle bearing side of the swashplate (32) for damage. Replace if necessary.
2. Inspect the cradle bearings attached to the inside of the housing (1) for normal wear patterns and placement, and insure they are staked securely in place. If the bearings are

NOTE: The cradle bearings will have discoloration due to normal wear. Under normal circumstances, this will not warrant replacement.

damaged, replace housing (1).

Assembly

1. Install swashplate (32) by holding trunnion arm's slot guide (38) with a flat tip screwdriver. Use the screwdriver to hold the slot guide in place while positioning the swashplate (32) onto the cradle bearing in the housing (1).
2. Rotate trunnion arm (37) to verify that the

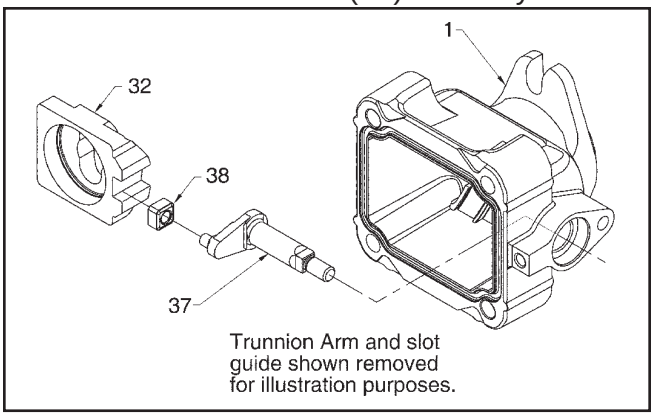


Figure 13. PC Pump Swashplate and Cradle Bearings

REMOVAL, INSPECTION AND ASSEMBLY OF INPUT SHAFT

Refer to Figure 14.

Disassembly

1. Remove the retaining ring (22).
2. Remove the lip seal (20).
3. Remove the spacer (21).
3. Remove the shaft (18) and bearing (19) assembly (18) from the pump.

Inspection

1. Inspect the input shaft (18) for worn splines, surface damage, or keyway damage. Replace shaft assembly if necessary.
2. Inspect the bearing (19) for evidence of scoring, corrosion, or damage. If the bearing must be replaced, remove the retaining ring (23) and use a press or bearing puller to remove the bearing.
3. Inspect and replace the spacer (21) if it is bent or broken.
4. Inspect and replace the retaining ring (22) if it is bent or broken.

NOTE: Upon removal, all seals, O-rings and gaskets should be replaced.

Assembly

NOTE: If trunnion arm is to be removed, do not assemble input shaft until the trunnion arm is installed.

NOTE: During installation, lightly lubricate all seals, O-rings and gaskets with clean petroleum jelly prior to assembly. Also, protect the inner diameter of seals by covering the shaft with plastic wrap.

1. If removed, press bearing (19) onto shaft (18) tight against the shoulder of the shaft. Install retaining ring (23) onto the shaft (18).
2. Install input shaft assembly (18) into the housing (1) bore. Light tapping with a rubber mallet may be necessary on the input shaft (18) once the bearing is aligned with the housing (1) bore. Verify that the shaft rotates smoothly.
3. Install spacer (21).
4. Install new lip seal (20) with the flat side of the seal toward the outside of the pump.
5. Remove the plastic wrap.
6. Install retaining ring (22).

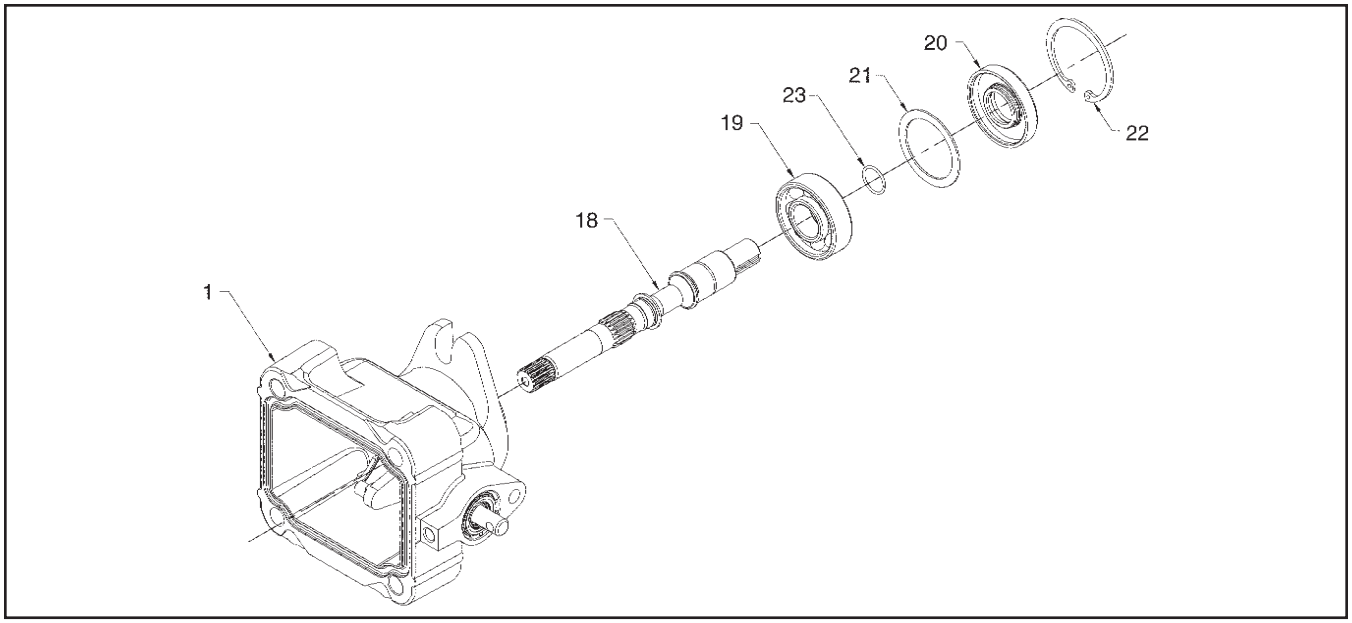


Figure 14. PC Pump Input Shaft

REMOVAL, INSPECTION AND INSTALLATION OF TRUNNION ARM

Refer to Figure 15.

Disassembly

1. Remove the slot guide (38).
2. Remove and discard the trunnion seal retainer and seal (49).
3. Remove the trunnion arm (37).

Inspection

NOTE: Upon removal, all seals, O-rings and gaskets should be replaced.

1. Inspect the trunnion arm (37) for wear or damage. Replace the trunnion arm if necessary.
2. Check for excessive play between trunnion arm (37) and housing (1). Replace housing if necessary.

Assembly

1. Install the trunnion arm (37) into the housing (1) bore. Rotate the trunnion arm to verify free movement.

NOTE: During installation, lightly lubricate all seals, O-rings and gaskets with clean petroleum jelly prior to assembly. Also protect the inner diameter of the seals by covering the shaft with plastic wrap. Remove the plastic wrap after the seal is installed.

2. Install a new seal and seal retainer (49).
3. Install slot guide (38).
4. To completely assemble the pump, refer to the assembly steps on pages 23-33. Begin with the trunnion arm assembly steps listed on page 33 and complete the assembly steps in reverse order working toward the front of the manual.

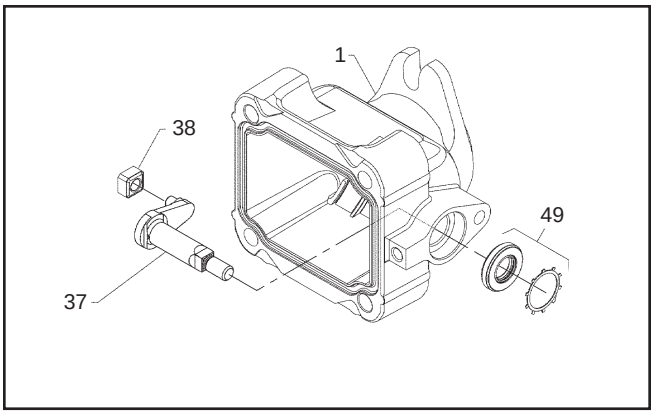


Figure 15. PC Pump Trunnion Arm

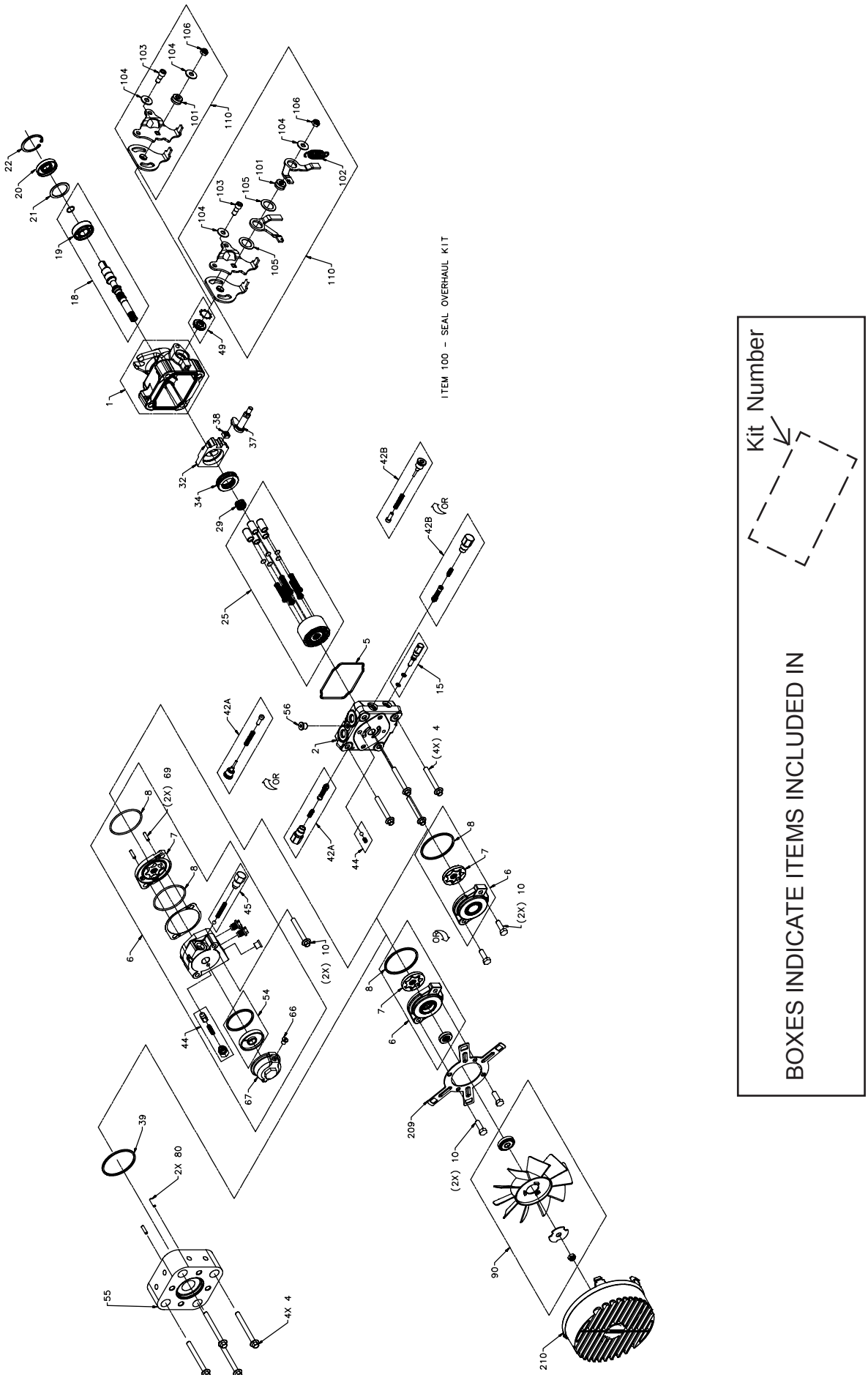


Figure 16. PC Pump

ITEM LIST - PC SERIES

Part numbers are not provided in this manual.

No.	Description
1	Housing Kit
2	End Cap
4	Screw, Hex Flange, M8 x 1.25
5	Housing O-Ring
6	Charge Pump Kit (Std. Charge)
	Charge Pump Kit (Std. Charge) Thru Shaft
7	STD Gerotor Assy (0.11 cu in./rev)
8	O-Ring
10	Cap Screw, Hex, 5/16 - 18 x 1.0
15	Bypass Valve Kit (No Bleed Orifice)
18	Pump Shaft Kit (1/2 in. Keyed w/Std. Charge)
	Pump Shaft Kit (1/2 in. Keyed, Thru Shaft w Std. Charge
	Pump Shaft Kit (9 tooth w/Std. Charge)
19	Ball Bearing, 17 x 40 x 12 mm
20	Lip Seal, 17 x 40 x 7 PTC
21	Spacer
22	Retaining Ring
23	Retaining Ring
25	Cylinder Block Kit
29	Block Spring
32	Swashplate
34	Ball Thrust Bearing
37	Trunnion Arm, Tapered Square Trunnion
	Arm, Double D
38	Slot Guide
42	Shock Valve Kit
	2900 psi, (200 bar), No Orifice
	2900 psi, (200 bar), 0.024 in. Orifice
	2900 psi, (200 bar), 0.031 in. Orifice
	2900 psi, (200 bar), 0.044 in. Orifice
	2320 psi, (160 bar), No Orifice
	2320 psi, (160 bar), 0.024 in. Orifice
	2320 psi, (160 bar), 0.031 in. Orifice
	2320 psi, (160 bar), 0.044 in. Orifice
	1740 psi, (120 bar), No Orifice
	1740 psi, (120 bar), 0.024 in. Orifice
	1740 psi, (120 bar), 0.031 in. Orifice
	1740 psi, (120 bar), 0.044 in. Orifice

No.	Description
44	Charge Relief Valve Kit (1/4 in. Plastic Ball and 50654 Spring)
45	Auxiliary Relief Valve Kit
49	Trunnion Seal/Retainer Kit
54	Filter Kit
55	Plate, Adapter (Gear AA)
56	Plug, 5/16 - 24
66	Plug
67	Filter Cover
69	Pin, Straight Headless
80	Pin, Straight Headless
90	Fan Kit
100	Overhaul Seal Kit
101	Spacer, Return
102	Spring, Extension
103	Screw, 5/16 x 0.875 in. (PATCH)
104	Washer, 0.34 x 0.88 x 0.06 in.
105	Washer, Nylon
106	Nut, Hex Lock, 5/16 - 24 UNF
110	Return-to-Neutral Kit, Std.
	Return-to-Neutral Kit, CW Scissor
	Return-to-Neutral Kit, CCC Scissor
	Return-to-Neutral Kit,
209	Shroud Bracket
210	Shroud

REPAIR - PG AND PE SERIES PUMP

HOW TO USE THIS MANUAL

Each assembly is provided with an exploded view showing the parts involved. **The item reference numbers in each illustration are for assembly instructions only.** See pages 52 and 53 for part names and descriptions. A complete exploded view and item list of the pump is provided at the end of this section.

GENERAL INSTRUCTIONS

Cleanliness is a primary means of ensuring satisfactory life on repaired pumps. Thoroughly clean all exposed surfaces prior to any type of maintenance. Cleaning of all parts by using a solvent wash and air drying is usually adequate. As with any precision equipment, all parts must be kept free of foreign material and chemicals.

Protect all exposed sealing surfaces and open cavities from damage and foreign material. The external surfaces should be cleaned before beginning any repairs.

Lip-type seals (shaft seals) are used on the input shaft and directional control shaft of each pump. These seals can be replaced without major disassembly of the unit. However, replacement of these seals generally requires removal of the pump from the machine. Upon removal, it is recommended that all seals, O-rings and gaskets be replaced.

During installation, lightly lubricate all seals, O-rings and gaskets with clean petroleum jelly prior to assembly. Also protect the inner diameter of the seals by covering the shaft with a cellophane (plastic wrap, etc.) material.

Parts requiring replacement must be replaced from the appropriate kits identified in the Items Listing, found at the end of this manual. Use only original Hydro-Gear replacement parts.

TOOLS AND TORQUES

Miscellaneous	3/8-Inch Drive Ratchet and Sockets
P Series Service & Repair Manual	1/2-inch Socket
Torque Wrench	9/16-inch Socket
Scribe, Paint Pen, or Marker	5/8-inch Socket
Seal Hook with a Magnet	10-mm Socket
Flat Blade Screwdriver	
	Combination Wrenches
Pliers	1/2 inch
Internal Snap Ring	9/16 inch
	5/8 inch
Allen Wrenches	7/8 inch
5mm	10 mm
3/16 inch	
1/4 inch	

Table 1. Required Tools

Item # and/or Description	Torque
Case Drain (fitting torque)	200-250 lb-in (22.6-28.2 Nm)
System Port (fitting torque)	370-470 lb-in (41.8-53.1 Nm)
Inlet (fitting torque)	200-250 lb-in (22.6-28.2 Nm)
Fan Nut, Hex Lock 5/16-24 UNF	180-220 lb-in (20.3-24.9 Nm)
4, End Cap Bolts	180-220 lb-in (20.3-24.9 Nm)
10, Cap Screw (Aux Pump and Shroud Bracket)	180-220 lb-in (20.3-24.9 Nm)
10, Cap Screw (Charge Pump Cover)	87-118 lb-in (9.8-13.3 Nm)
15, Bypass Valve	110-130 lb-in (12.4-14.7 Nm)
42A, 42B, Shock Valves/Check Plugs	180-240 lb-in (20.3-27.1 Nm)
44, System Charge Relief Kit (Aux Chg)	180-240 lb-in (20.3-27.1 Nm)
45, Aux Relief Valve Kit	180-240 lb-in (20.3-27.1 Nm)
56, Diagnostic Plug	84-120 lb-in (9.4-13.5 Nm)
66, Filter Cover Plug	55-85 lb-in (6.2-9.6 Nm)
67, Filter Cover	200-275 lb-in (22.6-31.1 Nm)
95, Screw, Socket Head Set	100-185 lb-in (11.3-20.9 Nm)
103, Screw 5/16 x .875	200-240 lb-in (22.6-27.1 Nm)
106, Bolt	180-220 lb-in (20.3-24.9 Nm)
107, Nut, Hex Lock 5/16-24UNF	180-220 lb-in (20.3-24.9 Nm)

Table 2. PG / PE Pump Torque Values

REMOVAL, INSPECTION AND/OR REPLACEMENT OF RETURN TO NEUTRAL ASSEMBLY

Refer to Figure 1.

Prior to disassembly, note the position of the scissor arm brackets and the tab on the outer control arm bracket.

Disassembly

CAUTION: The spring used on the return to neutral linkage is under tension. To avoid possible injury, use care and proper protection during disassembly and assembly of the return to neutral linkage.

1. Loosen (but do not remove) the bolt (106)/ nut(107).
2. To relieve spring tension, carefully pry up on the outer scissor control arm until it releases from the tab on the outer control arm bracket.
3. Remove the spring (102), bolt (106)/nut (107) and washer (104).
4. Remove the scissor arm (99).
5. Remove the outer control arm bracket(94), bolt (103), washer (104) and the inner return arm bracket(98).

Inspection

1. With the arm control linkage removed, inspect the trunnion arm (37) and trunnion arm seal (49).
2. Inspect scissor arm (99) and all other linkage parts for damage, corrosion or wear.

Assembly

1. Install the inner return arm bracket(98), washer (104) and bolt (103).

NOTE: Do not over tighten the bolt (103). The bracket must move freely.

2. Install the inner scissor control arm(94)
3. Tighten washer (104), and nut (103) to the correct torque value. See page 38.
4. Install the scissor arm(99).
5. Install washer(104) and bolt (106)/nut(107) to the correct torque value. See page 38.
5. Install the spring (102).

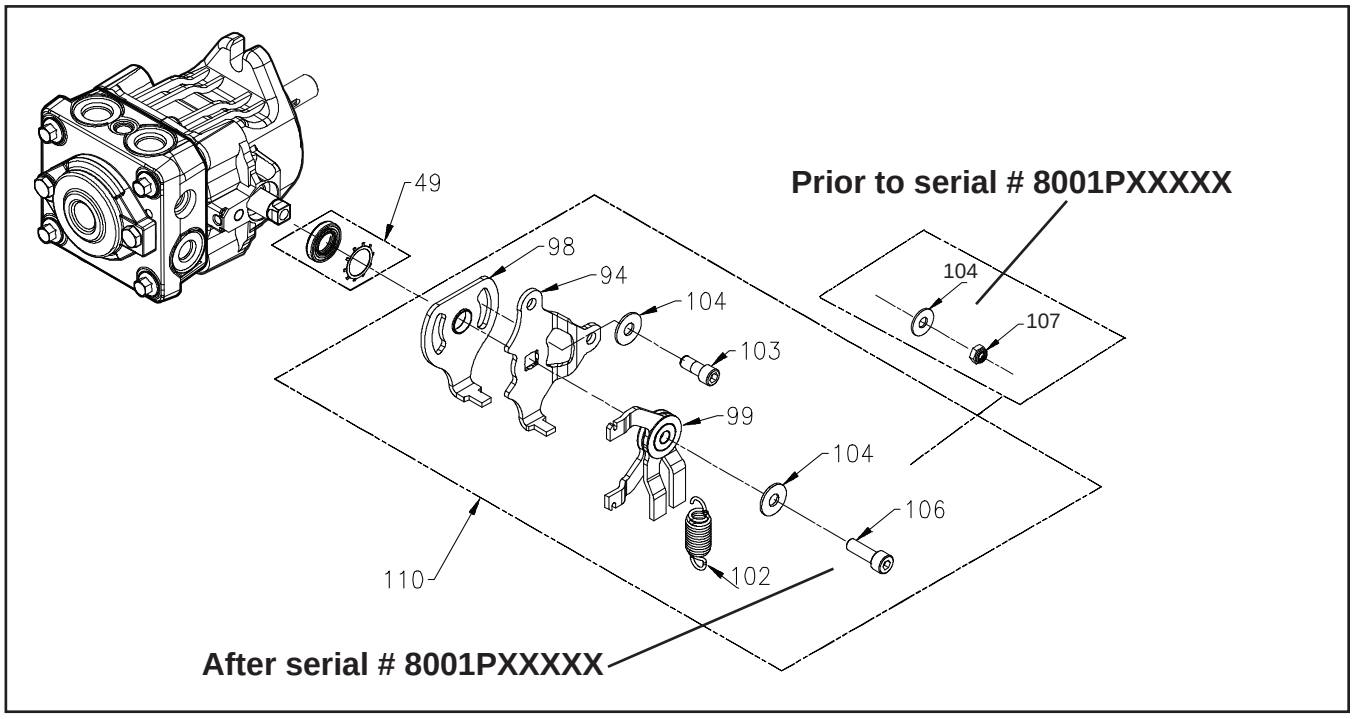


Figure 1. PG / PE Pump Return to Neutral

REMOVAL, INSPECTION AND/OR REPLACEMENT OF CONTROL ARM

Refer to Figure 2.

Disassembly

1. Remove the bolt (106), washer (104) and bushing (101).
2. Remove the outer control arm bracket.
3. Remove bolt (103), washer (104) and the inner control arm bracket.

Inspection

1. With the arm control linkage removed, inspect the trunnion arm (37) and trunnion arm seal (49).
2. Inspect bushing (101) and all other linkage parts for damage, corrosion or wear.

Assembly

1. Install the inner control arm bracket, washer (104) and bolt (103).

NOTE: Do not over tighten the bolt (103). The bracket must move freely.

2. Install the outer control arm bracket, bushing (101), washer (104, and bolt (106). Tighten to the correct torque value. See page 38.

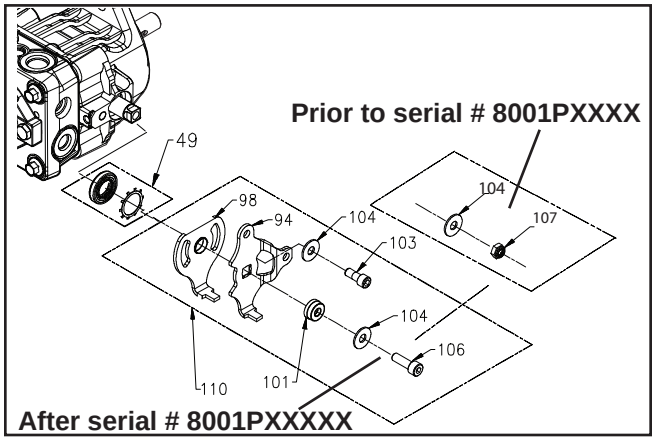


Figure 2. PG / PE Pump Standard Control Arm

REMOVAL, INSPECTION AND/OR REPLACEMENT OF FAN ASSEMBLY

Refer to Figure 3.

Disassembly

1. Remove the fan shroud (210) from the mounting bracket (209) by carefully pushing down on the shroud tabs.
2. Remove the nut (106) and fan assembly (90).
3. Remove the bolts (10) and bracket (209).

Inspection

Inspect the fan shroud (210), fan assembly (90) and mounting bracket (209) for damage.

Assembly

1. To install the mounting bracket (209), align and insert the bolts (10) into the bracket and charge pump cover. While holding the charge cover in place, tighten the bolts (10) per table 2, page 38.
2. Install the fan and washer assembly onto the shaft.
3. Install the nut (106) and tighten per table 2, page 38.
4. Install the fan shroud (210) onto the mounting bracket (209). Make sure that all shroud lock tabs are fully engaged in the mounting bracket slots.

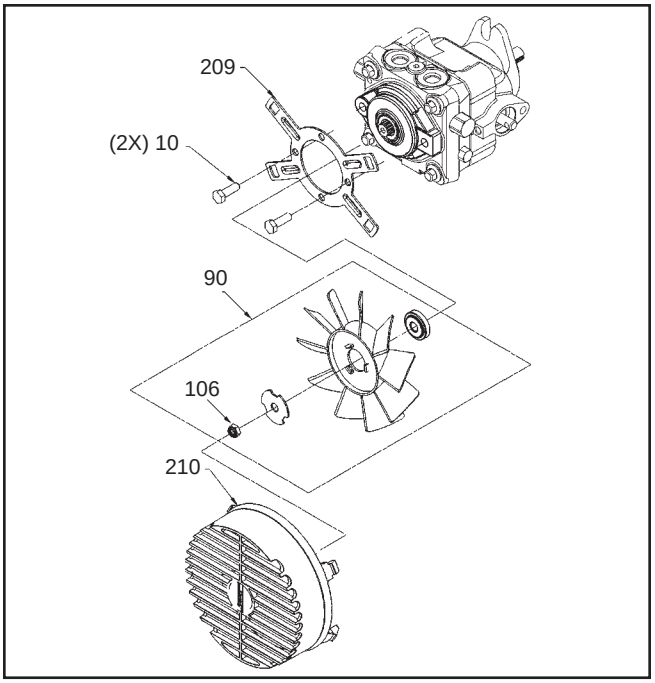


Figure 3. PG / PE Pump Fan Assembly

REMOVAL, INSPECTION AND/OR REPLACEMENT OF INPUT SHAFT SEAL

Refer to Figure 4.

Disassembly

1. Remove retaining ring (22) from housing.
2. Remove lip seal (20). Care must be taken to prevent damage to the housing bore, shaft sealing surface, or bearing. Once removed, the seal is not reusable.

Inspection

1. With seal removed inspect the spacer (21), input shaft bearing (19) and housing (1) bore for damage, corrosion or wear.

Assembly

1. Lubricate the new lip seal (20) inside diameter with petroleum jelly.
2. Wrap the input shaft (18) with plastic wrap to prevent damage to the inner surface of the lip seal (20).
3. Slide seal (20) over shaft (18) so that lettering on the seal faces out.
4. Press the lip seal (20) into the housing bore. Insure the lip seal (20), shaft (18) or housing (1) bore do not become damaged. Remove plastic wrap.
5. Install the retaining ring (22) into the housing (1) bore groove.

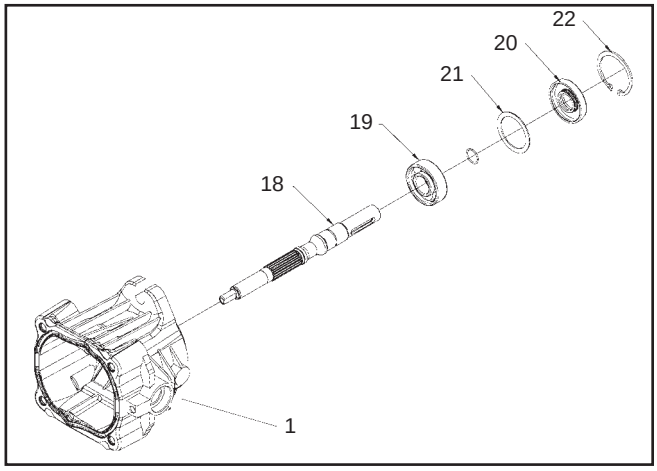


Figure 4. PG / PE Pump Input Shaft Seal

REMOVAL, INSPECTION AND/OR REPLACEMENT OF TRUNNION ARM (CONTROL ARM) SEAL

Refer to Figure 5.

Disassembly

1. Remove the retainer and lip seal (49) from the housing (1). Care must be taken to prevent damage to the housing trunnion bore, trunnion arm (37) and sealing surface. Once removed the retainer and lip seal is not reusable.

Inspection

1. With the lip seal (49) removed, inspect the area for corrosion and wear. Inspect the trunnion bore area sealing surface for damage or wear.

Assembly

1. Lubricate the new lip seal (49) with petroleum jelly.
2. Wrap the trunnion arm (37) with plastic wrap to prevent damage to the inner surface of the lip seal (49).
3. Slide the lip seal (49) over the trunnion arm (37) so that the lettering on the seal (49) faces out.
4. Press the lip seal (49) into the housing bore (1). Insure the seal (49), trunnion arm (37), and housing bore do not become damaged. Remove the plastic wrap.
5. Install the retainer from (49) over the trunnion arm (37) on top of the lip seal (49). Press into the trunnion seal bore in the housing until the retainer mates against the trunnion seal.

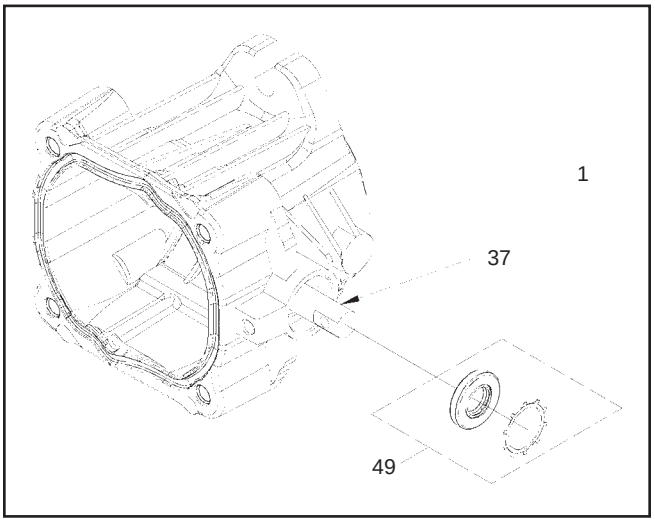


Figure 5. PG / PE Pump Trunnion Arm Seal

REMOVAL, INSPECTION AND/OR REPLACEMENT OF CHECK VALVES

Refer to Figure 6.

Disassembly

Perform disassembly, inspection and assembly on check valves one side at a time. Some units vary in “A” side to “B” side check configuration.

1. Remove the check valve (42) with an 1/4” allen wrench.
2. Remove the valve spring and poppet from the end cap (2).

Inspection

1. Inspect the poppets and mating seats in the end cap (2) for damage or foreign material.

Assembly

1. Lay the pump on its side, so the check plug port is horizontal.
2. Insert the check plug, spring and poppet (42) as one assembly into the check plug port. Tighten, reference Table 2, page 38 for torque values.
3. Repeat disassembly, inspection and assembly for the opposite port side.

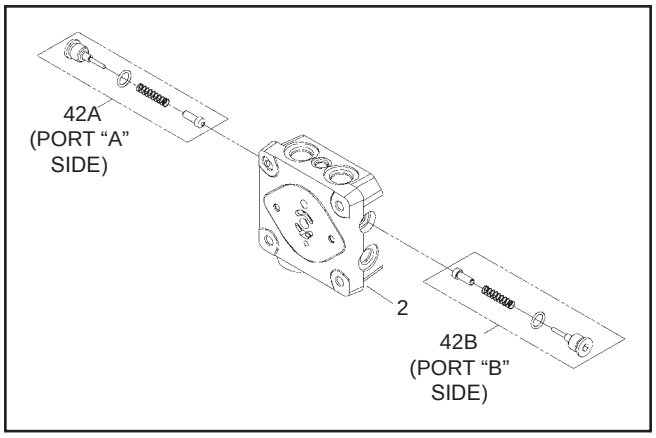


Figure 6. PG / PE Pump Check Valves

REMOVAL, INSPECTION AND/ OR REPLACEMENT OF SYSTEM CHECK RELIEFS (SCR’S) OR SHOCK VALVES

Refer to Figure 7.

Disassembly

Perform disassembly, inspection and assembly on SCR/shock valve one side at a time. Some units vary in “A” side to “B” side configuration.

1. Remove the SCR (42) with a 7/8” wrench or the shock valve (42) with an 11/16” wrench.
2. Remove the check relief/shock valve spring and the check relief/shock valve from the end cap (2).

Inspection

1. Inspect the check relief or shock valve (42) and mating seat in the end cap (2) for damage or foreign material.

Assembly

1. Lay the pump on its side, so the check plug port is horizontal.
2. Insert the system check relief spring and check relief or shock valve spring and shock valve as one assembly into the check plug port. Tighten to the correct torque value. See page 38.
3. Repeat disassembly, inspection and assembly for the opposite port side.

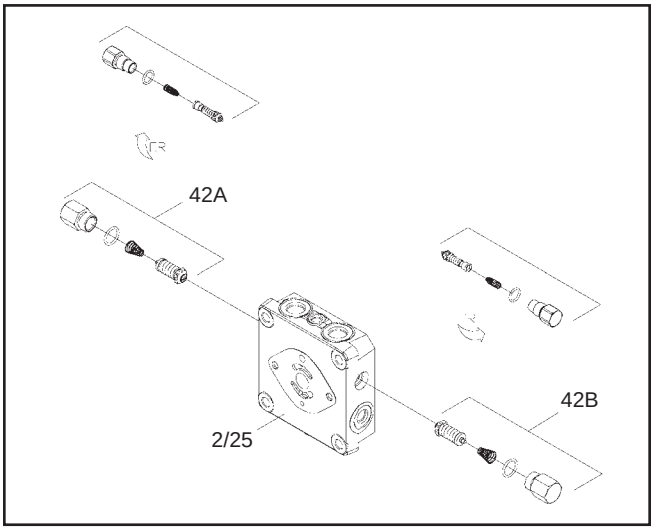


Figure 7. PG / PE Pump Shock Valves

REMOVAL, INSPECTION AND /OR REPLACEMENT OF THE BYPASS

Refer to Figure 8.

Disassembly

1. Loosen the bypass valve (15) using a 5/8” wrench.
2. Remove the bypass (15) from the end cap (2).

Inspection

1. Inspect the bypass O-rings and mating seats in the end cap (2) for damage or foreign materials.
2. If damaged or worn replace bypass (15)

Assembly

1. Lay the pump on its side, so the bypass port is horizontal.
2. Insert the bypass (15) into the bypass port on the end cap (2). Tighten to the proper torque value. See page 38.

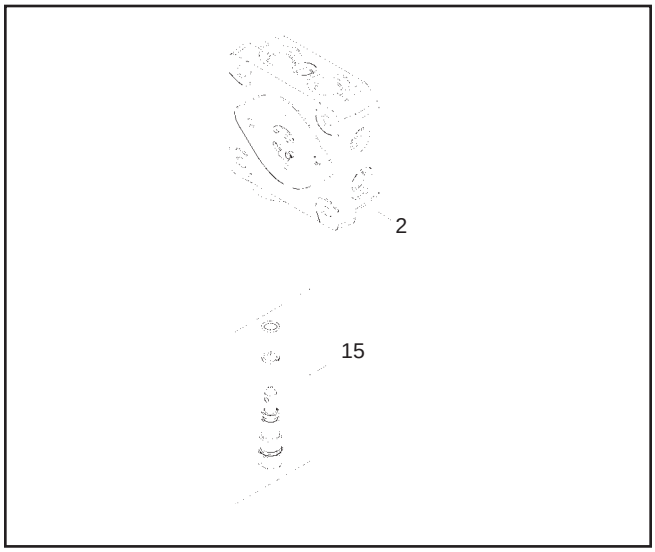


Figure 8. PG / PE Pump Bypass

REMOVAL, INSPECTION AND ASSEMBLY OF STANDARD OR THRU SHAFT CHARGE PUMP

Refer to Figure 9.

Disassembly

1. Prior to removal of the charge pump cover, place a mark on the cover and end cap for alignment at assembly.
2. Using a 1/2 inch wrench, or 5 mm allen wrench, loosen the charge pump cover bolts (10) from the end cap (2). While holding the charge cover in place, remove the charge cover bolts (10).
3. Remove the charge cover, O-ring and gerotor items (6). Carefully check for and remove the charge spring and charge ball (44).
4. For the Thru Shaft charge pump, remove the shaft seal.

Inspection

1. Inspect the charge cover O-ring and running surfaces for damage. Inspect the spring, check ball (44), and mating seat in the end cap (2) for damage or foreign material.

NOTE: If the end cap (2) is to be removed from the housing, do not assemble the charge pump (6) until the end cap is installed on the housing.

2. Inspect the charge cover bore for damage, corrosion or wear.

Assembly

NOTE: For the Thru Shaft charge pump follow steps 1-8. For the Standard charge pump follow steps 3-8.

1. Lubricate the new shaft seal with petroleum jelly.
2. Press the shaft seal into the charge cover. Be careful not to damage the seal or charge cover bore.
3. Position the pump with the input shaft down, and the end cap (2) horizontal. Place the charge ball (44) in the end cap (2) charge passage so the ball mates to the end cap (2) charge ball seat. Place the charge spring, on top of the charge ball.
4. Insert the inner gerotor over input shaft (18).
5. Align the outer gerotor to fit over the inner gerotor.
6. Insert the O-ring into the groove in the charge cover.
7. Position the charge cover and O-ring with the aligning mark on the end cap. Place the charge cover and O-ring with aligning mark on the end cap. Place the charge cover and O-ring as one piece over the charge spring and gerotor assembly. Insure the spring fits into the charge cover spring retaining groove.
8. Align and insert the charge pump cover bolts (10) into the end cap (2). Tighten to the correct torque value. See Table 2, page 38. (Torque Values.)

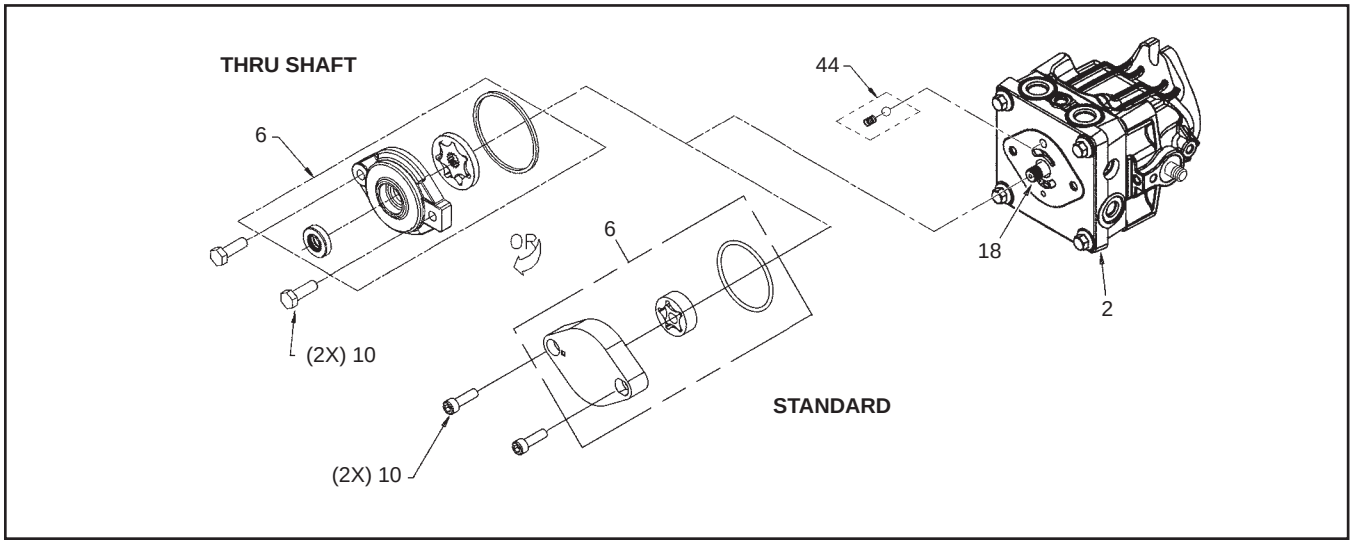


Figure 9. PG / PE Pump Standard or Thru Shaft Charge Pump

REMOVAL, INSPECTION AND/OR REPLACEMENT OF AUXILIARY PUMP (IF EQUIPPED)

Refer to Figure 10.

Disassembly

1. Prior to removal of the auxiliary pump, place a mark on the auxiliary pump, charge pump (7) and end cap (2) for alignment at assembly.
2. Use a 10mm wrench to loosen the auxiliary pump bolts (10) from the end cap (2). While holding the auxiliary pump in place, remove the bolts (10).
3. Remove the auxiliary pump, gasket (75), O-ring (59) and charge pump (7). While removing the charge pump, be sure to retain the spring and ball (44A) housed in the end cap (2).
4. Remove the plug (66) from the filter cover (67).
5. Use a 7/8 inch wrench to remove the filter cover assembly (67) from the auxiliary pump.
6. Remove the O-ring and filter (54).
7. Remove the charge relief valve assembly (44), plug (56) and auxiliary relief valve assembly (45) from the auxiliary pump.

Inspection

1. With the auxiliary pump removed, inspect the pump running surfaces for wear or damage.
2. Inspect all O-rings, gasket and mounting seats.
3. Inspect the filter cover assembly threads and filter for wear, damage or foreign material.

Assembly

1. Install the check ball, spring, and cap as one assembly (45) into the auxiliary relief valve port. Tighten to the correct torque value. See page 38.
2. Install the plug (56). Tighten to the correct torque value. See page 38.
3. Install the poppet, spring and cap as one assembly into the charge relief port. Tighten to the correct torque value. See page 42.
4. Install the filter (54) and O-ring onto the filter cover assembly (67). Install the assembly (67) into the auxiliary pump and tighten. Install plug (66) into the filter cover (67).
5. Lay the PG pump (input shaft down), so the end cap is horizontal. Install the O-ring (59) into the charge pump (7).
6. Install the gasket (75) onto the auxiliary pump.
7. Make sure that the ball and spring (44A) are seated in the end cap (2), then position the auxiliary pump and gasket with the aligning mark on the charge pump (7). Insure that the pump fully engages the alignment pins (69).
8. Align and insert the bolts (10) into the auxiliary pump. While holding the auxiliary pump and charge pump in place, tighten the bolts (10) per table 2, page 38.

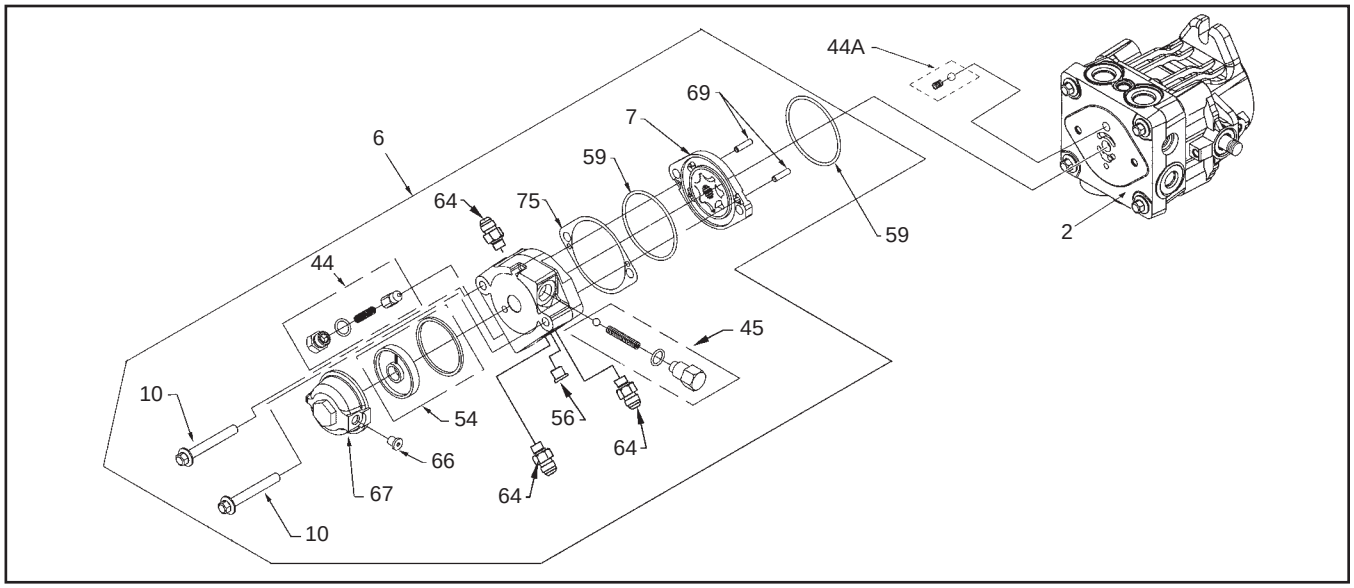


Figure 10. PG / PE Series Auxiliary Pump

REMOVAL, INSPECTION AND ASSEMBLY OF THE END CAP AND VALVE PLATE

Refer to Figure 11a and 11b.

Disassembly

1. Using a 10 mm wrench, loosen the end cap bolts (4) evenly.
2. Keeping the end cap (2) held in place, remove the four end cap bolts (4).
3. Slowly remove the end cap (2).
4. Remove the valve plate (31).

   NOTE: Not applicable in PE-series pumps.
5. Remove housing alignment pins (3).
6. Remove housing gasket (5).

Inspection

1. Inspect the end cap body (2) for damage, nicks or unusual wear patterns. Replace if necessary.
2. Inspect the running surface (side that contacts the cylinder block) of the valve plate (31). The running surface may show evidence of minor abrasive rings, this is normal.

   NOTE: Grooving in the valve plate and or end cap, made evident when the surface is checked by dragging a fingernail across it, would be cause for replacement of the valve plate.
3. Inspect and replace alignment pins (3) if bent or distorted.
4. Replace the housing gasket (5) with a new gasket before reassembly.

Assembly

1. Install housing gasket (5) into housing gasket seat of housing (1).
2. Install alignment pins (3) into housing (1).
3. Lubricate the valve plate prior to installation. Install valve plate (31) so the stamped letters “UP” on the valve plate are facing up toward the end cap.

   NOTE: Not applicable in PE-series pumps.
4. Lubricate the end cap (2) face prior to installation in PE-series pumps.
5. Install end cap (2). Before installing the four end cap bolts (4), push down on the end cap (2) verifying alignment and insuring that the cylinder block pistons spring back and forth. Install end cap bolts (4). Tighten, reference Table 2, page 38 torque values.

PG Series Pumps (With Valve Plate)

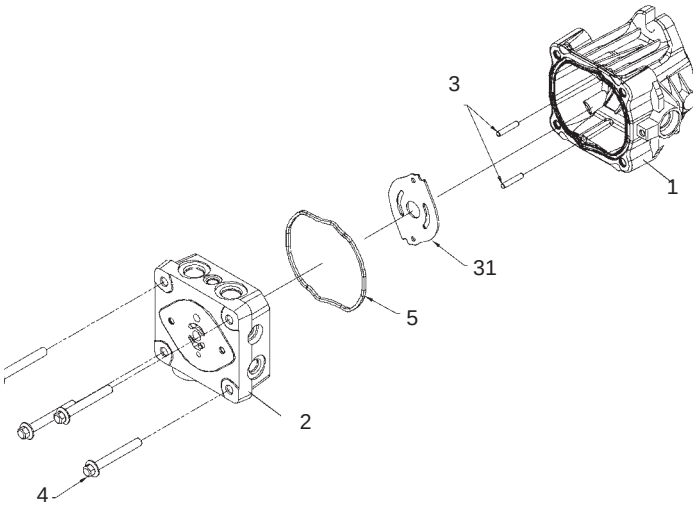


Figure 11a. PG Pump End Cap

PE Series Pumps (No Valve Plate)

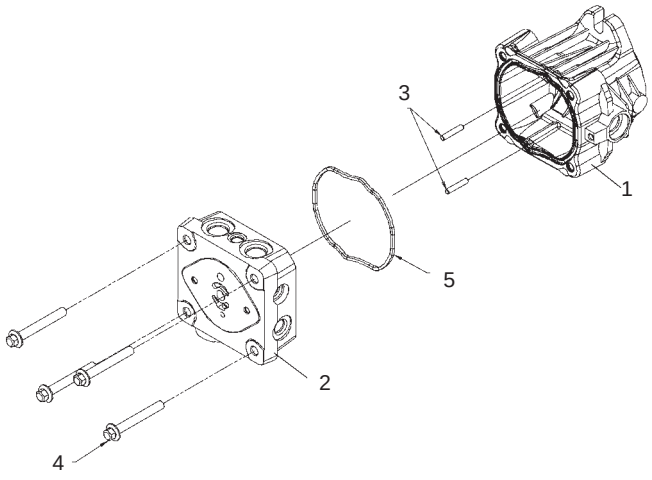


Figure 11b. PE Pump End Cap

REMOVAL, INSPECTION AND ASSEMBLY OF THE CYLINDER BLOCK

Refer to Figure 12.

Disassembly

1. Tilt the pump on its side, drain remaining oil. Lift out the cylinder block assembly (25).
2. Remove the pistons, springs and piston seats.

Inspection

1. Inspect the running surface of the cylinder block and piston ends for damage, nicks or unusual wear patterns. The running surface may show evidence of minor abrasion. This will be normal wear. If grooved or smeared, replace with a new cylinder block assembly.
2. Inspect the piston springs for distortion or breaks. If necessary, replace with a new cylinder block kit.
3. Inspect the piston seats. Residual oil may cause these to remain stuck to the inside of the pistons.

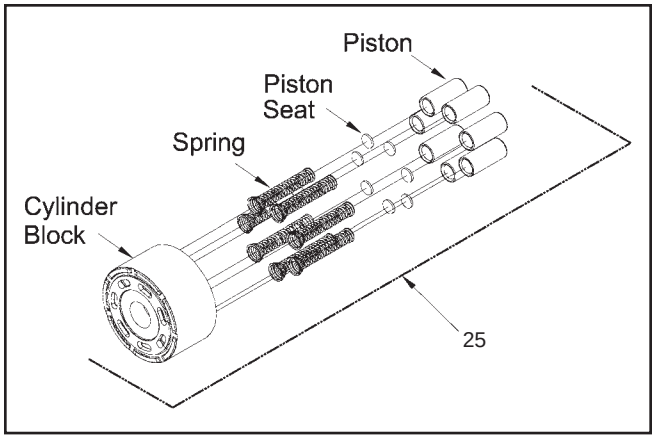


Figure 12. PG / PE Pump Cylinder Block

Assembly

1. Install piston seats into the end of the pistons.
2. Install springs into the pistons.
3. Install one at a time, pistons, springs and seats as one assembly into the cylinder block.
4. With the pump housing tilted on its side, install the cylinder block assembly (25) with pistons contacting the thrust bearing.

NOTE: To check that piston placement is correct, push downward on the cylinder block assembly (25). If this results in a spring action the block assembly has been installed correctly. If this cannot be accomplished, remove and reassemble the block assembly. Place a rubber band around the cylinder block pistons to hold them in position during installation. Then after installation cut the rubber band and remove it. Check cylinder block assembly for spring action.

REMOVAL, INSPECTION AND ASSEMBLY OF BLOCK SPRING, THRUST WASHER, AND THRUST BEARING

Refer to Figure 13.

Disassembly

1. Remove the block spring (29).
2. Remove the block thrust washer (30).
3. Remove the thrust bearing and race (34).

Inspection

1. Inspect and replace the block spring (29) and thrust washer (30) if they are distorted or broken.
2. Inspect the running surface of the bearing race for damage, nicks or unusual wear patterns. The running surface may show evidence of minor abrasion. This will be normal wear.

   Inspect the bearings for free movement. Inspect the bearing cage for distortion or damage. Replace if necessary.

Assembly

1. Install thrust bearing and race assembly (34).

NOTE: The difference in race thicknesses: The thin race seats into the swashplate (32). The thicker race will be installed toward the piston noses.

2. Install thrust washer (30).
3. Install block spring (29).

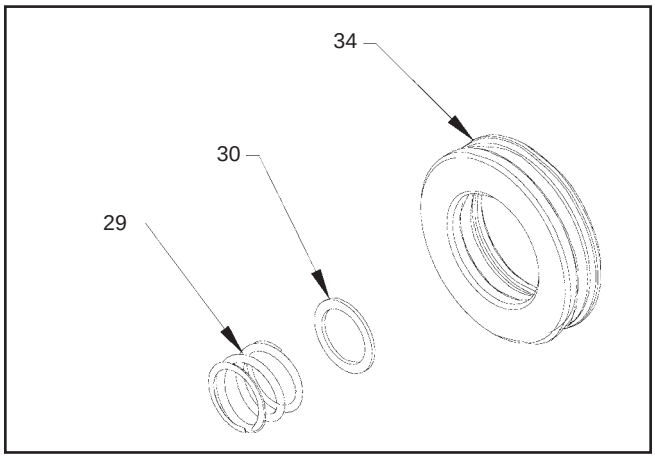


Figure 13. PG / PE Pump Block Spring and Thrust Bearing

REMOVAL, INSPECTION OF SWASHPLATE, INSPECTION OF CRADLE BEARINGS

Refer to Figure 14.

Disassembly

1. Remove the swashplate (32).

Inspection

1. Inspect the running surface of the bearing pocket for damage (32), nicks or unusual wear patterns. The running surface may show evidence of minor abrasion. This is normal wear. Inspect the cradle bearing side of the swashplate (32) for damage. Replace if necessary.
2. Inspect the cradle bearings attached to the inside of the housing (1) for normal wear patterns, placement, and insure they are staked securely in place. If damaged, replace housing (1).

NOTE: The cradle bearings will have discoloration due to normal wear. Under normal circumstances, this will not warrant replacement.

Assembly

1. Install swashplate (32) by holding trunnion arm's (37) slot guide (38) with the aide of a flat tip screwdriver. Use the screwdriver to hold the slot guide (38) in place while positioning the swashplate (32) onto the cradle bearing in the housing (1).
2. Rotate trunnion arm (37) to assure swashplate pivoting action.

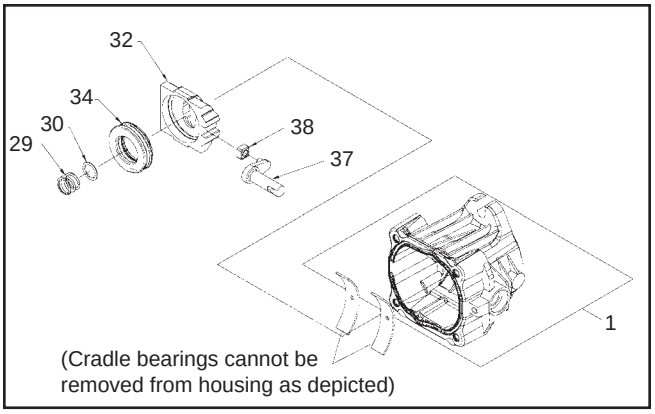


Figure 14. PG / PE Pump Swashplate and Cradle Bearings

REMOVAL, INSPECTION AND ASSEMBLY OF INPUT SHAFT

Refer to Figure 15.

Disassembly

1. Remove the retaining ring (22).
2. Remove the lip seal (20).
3. Remove the spacer (21).
4. Remove the shaft (18) from the pump.

Inspection

1. Inspect the input shaft (18) for worn splines, surface damage, or keyway damage. Replace shaft assembly if necessary.
2. Inspect the bearing (19) for evidence of scoring, corrosion, or damage. Replace shaft assembly if necessary.
3. Inspect and replace the spacer (21) if it is bent or broken.
4. Inspect and replace the retaining ring (22) if it is bent or broken.

NOTE: Replace the input shaft seal (20) after removal.

NOTE: If trunnion arm is to be removed, delay reassembly of input shaft assembly.

Assembly

NOTE: Upon removal, it is recommended that all seals, O-rings and gaskets be replaced. During installation, lightly lubricate all seals, O-rings and gaskets with clean petroleum jelly prior to assembly. Also, protect the inner diameter of seals by covering the shaft with plastic wrap.

1. Install input shaft assembly (18, 19, 23) into the housing (1) bore. Light tapping with a rubber mallet may be necessary on the input shaft (18) once the bearing is aligned with the housing (1) bore. Rotate the input shaft (18) to insure free movement.
2. Install spacer (21).
3. Install new lip seal (20).
4. Remove the plastic wrap.
5. Install retaining ring (22).

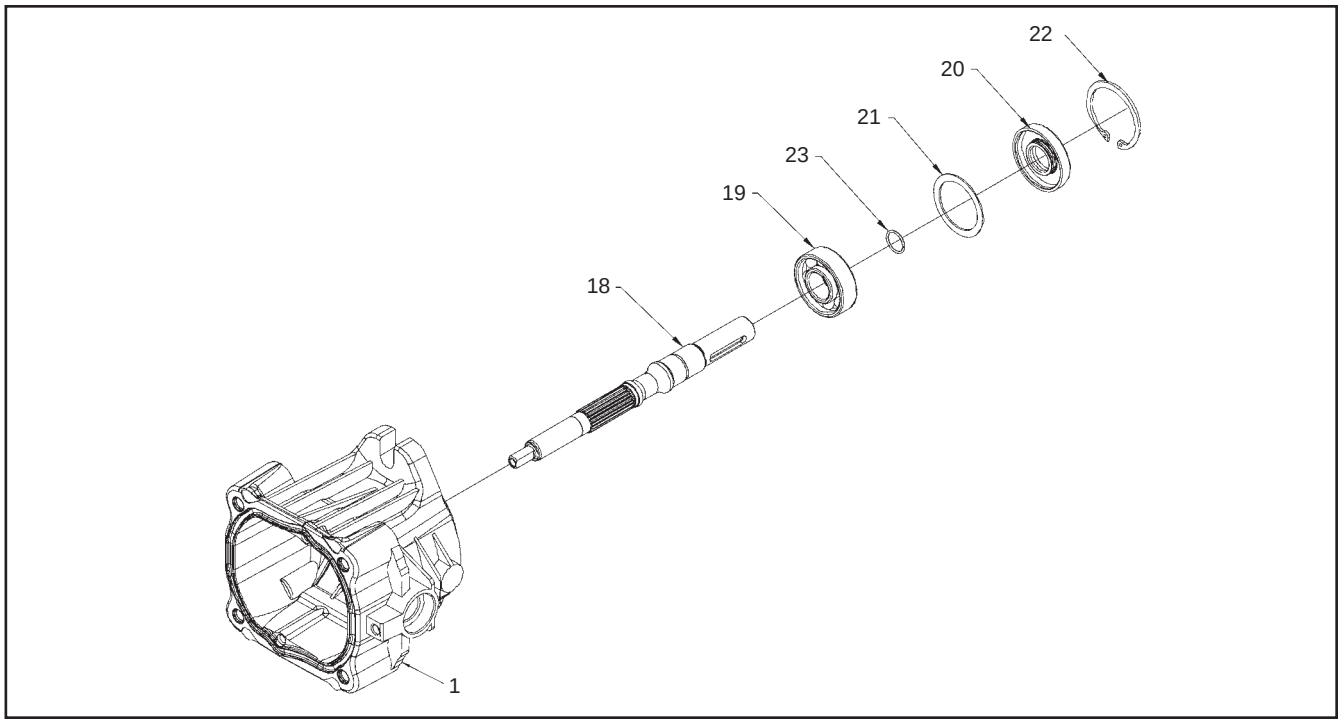


Figure 15. PG / PE Pump Input Shaft

REMOVAL AND INSPECTION OF TRUNNION ARM

Refer to Figure 16.

Disassembly

1. Remove the slot guide (38).
2. Remove and discard the trunnion seal retainer and seal (49).
3. Remove the trunnion arm (37).

Inspection

1. Inspect the trunnion arm (37) for wear or damage. Replace the trunnion arm if necessary.

Assembly

1. Install the trunnion arm (37) into the housing (1) bore. Rotate the trunnion arm to verify free movement.

NOTE: Upon removal, it is recommended that all seals, O-rings, and gaskets be replaced. During installation, lightly lubricate all seals, O-rings and gaskets with clean petroleum jelly prior to assembly. Also protect the inner diameter of seals by covering the shaft with plastic wrap. Remove the plastic wrap after the seal is installed.

2. Install a new seal and seal retainer (49).
3. Install the slot guide (38).
4. To completely reassemble the pump, refer to the assembly steps on pages 39-50. Begin with the trunnion arm assembly steps listed on page 54 and complete the assembly steps in reverse order working towards the front of the manual.

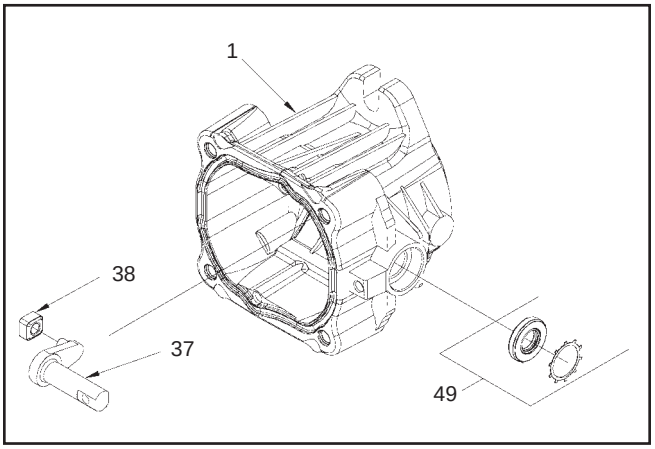


Figure 16. PG / PE Pump Trunnion Arm

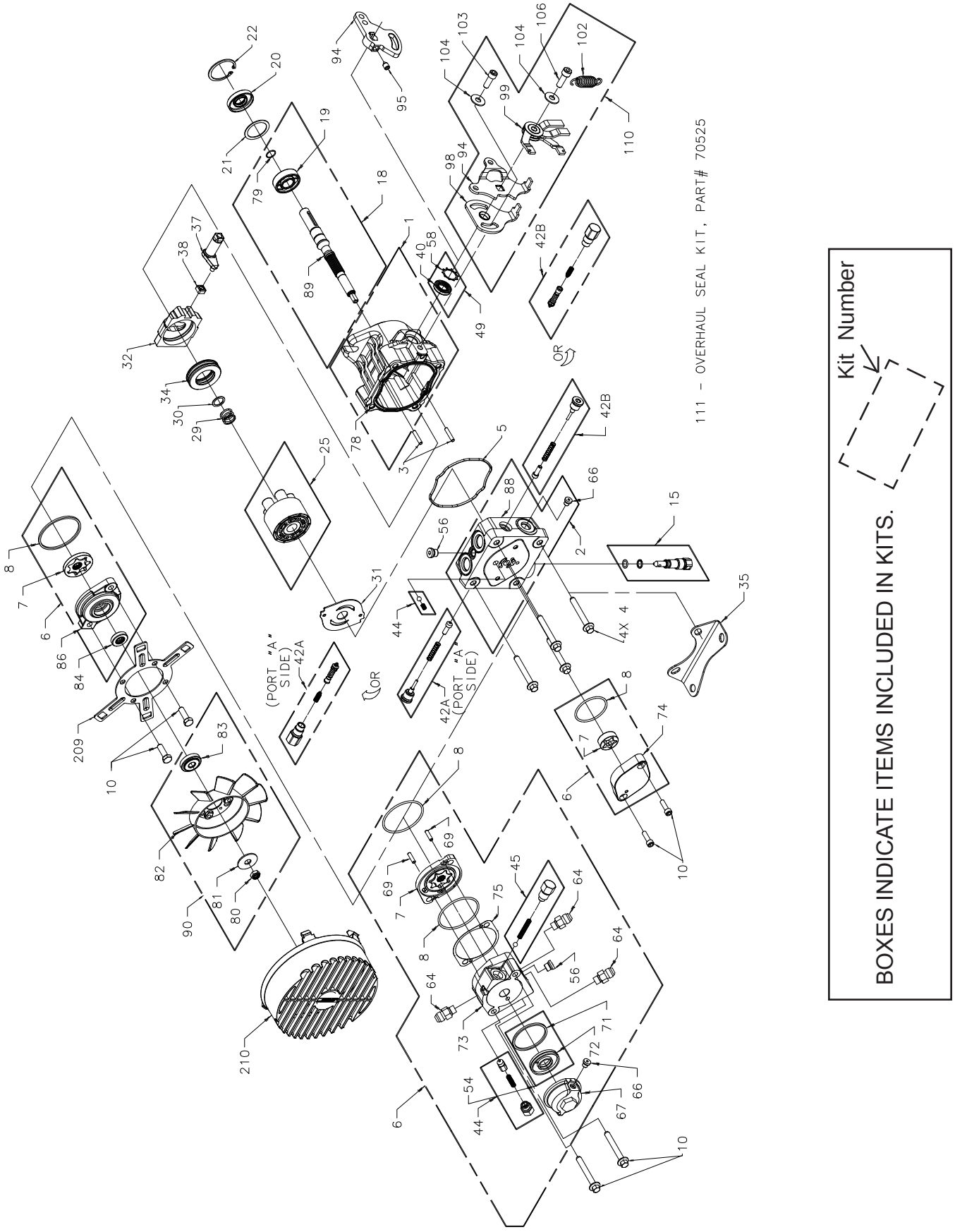


Figure 17. PG / PE Pump

ITEM LIST - PG AND PE SERIES

Part numbers are not provided in this manual.

No.	Description
1	Housing Kit
2	End Cap Kit (W/Poppets, Standard Charge)
	End Cap Kit (W/ SCR'S, Standard Charge)
	End Cap Kit (W/ Poppets, Auxiliary Charge)
	End Cap Kit (W/ SCR'S, Auxiliary Charge)
	End Cap Kit (STD CHG) LH;SCR/HR: Poppet
	End Cap Kit (STD CHG) LH:Poppet/RH:SCR
	End Cap Kit (STD CHG) LH:SCR/RH:SCR
	End Cap Kit (AUX CHG) LH:SCR/RH:Poppet
	End Cap Kit (AUX CHG) LH:Poppet/RH:SCR
	End Cap Kit (AUX CHG) LH:SCR/RHPoppet, Thru
	End Cap Kit (AUX CHG) W/Poppets, Thru
	End Cap Kit (AUX CHG) W/SCR;s, Thru
	End Cap Kit (AUX CHG) LH:Poppet/RH:SCR, Thru
3	Straight Headless Pin
4	Hex Flange Bolt M8-1.25 X 60 mm LG
5	Housing O-Ring
6	Charge Pump Kit (STD)
	Charge Pump Kit (STD CHG), Thru
	Aux Pump Kit (AL., 15T Splined, 2-7/16 SAE Ports)
	Aux Pump Kit (AL., 15T Splined, 3-7/16 SAE Ports)
7	STD Gerotor Assy (.11 cu. In/rev D-Drive)
	Auxiliary Gerotor & Housing Assembly
8	O-Ring
10	Socket Head Screw M6 x 1.0-20 mm Lg (STD Chg)
	Hex Flange Bolt 8M-1.25 x 60 mm (Aux Chg)
	Cap Screw, Hex 5/16-18 x 1.00 (Thru Chg) Supplied with item # 2 only
15	Bypass Valve Kit (Blank)
	Bypass Valve Kit (0.031")
	Bypass Valve Kit (0.043")
18	Pump Shaft Kit (Blind 15mm Keyway W/Std Chg)
	Pump Shaft Kit (Blind 15mm Keyway W/Aux Chg)
	Pump Shaft Kit (9 Tooth W/Std Chg)
	Pump Shaft Kit (9 Tooth W/Aux Chg)
	Pump Shaft Kit (15mm Keyed, Std Chg, Thru)
	Pump Shaft Kit (9 Tooth Thru Chg)
	Pump Shaft Kit (Tapered)
19	Ball Bearing 17 X 40 X 12
20	Lip Seal 17 X 40 X 7 PTC
21	Spacer
22	Retaining Ring
25	Cylinder Block Kit
29	Block Spring
30	Block Thrust Washer
31	Valve Plate
32	Swashplate

No.	Description
34	Ball Thrust Bearing
35	Stud, Torque
37	Trunnion Arm
	Trunnion, RTN
38	Slot Guide
42	Check Valve Kit (blank Orifice)
	Check Valve Kit (0.024" Orifice)
	Check Valve Kit (0.031" Orifice)
	Check Valve Kit (0.044" Orifice)
	System Check / Relief Kit
	System Check Relief Kit (.031" Orifice)
	Shock Valve Kit
44	Charge Relief Valve Kit (1/4" Plastic Ball & 50654 Spring)
	Charge Relief Valve Kit (9/16" SAE Plug & 3101536 Spring)
45	Aux Relief Valve Kit (1/4" Steel Ball)
	Aux Relief Valve Kit (Aux Poppet)
49	Trunnion Seal/Retainer Kit
54	Auxiliary Filter Kit
56	Straight Thread Plug
59	O-Ring
64	Connector
66	5/16" SAE Plug
67	Filter Cover
69	Straight Headless Pin
75	Shim - Charge Pump (.002 - Red)
85	R-Ring - 144
90	Hub / 6" Fan Kit
	Hub / 7" CCW Fan Kit
	Hub / 7" CW Fan Kit
	Hug / 7" Fan Kit
94	Control Arm
95	Screw, Soc Head
98	Return Arm
99	Inner Scissor Arm
100	Outer Scissor Arm
101	Spacer RTN
102	Spring, Extension
103	Screw, 5/16 x .875 (patch)
104	Washer .34 x .88 x .06
105	Washer, Nylon
106	Bolt
107	Nut, Hex
110	Kit, RTN, STD
	Kit, RTN, CW
	Kit, RTN, CCW
111	Seal Kit
209	Shroud Bracket
210	Shroud

REPAIR - PJ SERIES PUMP

HOW TO USE THIS MANUAL

Each assembly is provided with an exploded view showing the parts involved. **The item reference numbers in each illustration are for assembly instructions only.** See pages 70 and 71 for part names and descriptions. A complete exploded view and item list of the pump is provided at the end of this section.

GENERAL INSTRUCTIONS

Cleanliness is a primary means of ensuring satisfactory life on repaired pumps. Thoroughly clean all exposed surfaces prior to any type of maintenance. Cleaning of all parts by using a solvent wash and air drying is usually adequate. As with any precision equipment, all parts must be kept free of foreign material and chemicals.

Protect all exposed sealing surfaces and open cavities from damage and foreign material. The external surfaces should be cleaned before beginning any repairs.

Lip-type seals (shaft seals) are used on the input shaft and directional control shaft of each pump. These seals can be replaced without major disassembly of the unit. However, replacement of these seals generally requires removal of the pump from the machine. Upon removal, it is recommended that all seals, O-rings and gaskets be replaced.

During installation, lightly lubricate all seals, O-rings and gaskets with clean petroleum jelly prior to assembly. Also protect the inner diameter of the seals by covering the shaft with a cellophane (plastic wrap, etc.) material.

Parts requiring replacement must be replaced from the appropriate kits identified in the Items Listing, found at the end of this manual. Use only original Hydro-Gear replacement parts found listed in BLN-51427 (CD).

TOOLS AND TORQUES

Miscellaneous	3/8-Inch Drive Ratchet and Sockets
P Series Service & Repair Manual	7/16-inch Socket
Torque Wrench	1/2-inch Socket
Scribe, Paint Pen, or Marker	9/16-inch Socket
Seal Hook with a Magnet	5/8-inch Socket
Flat Blade Screwdriver	11/16-inch Socket
	10-mm Socket
Pliers	
Internal Snap Ring	**Combination Wrenches**
	7/16 inch
Allen Wrenches	1/2 inch
5mm	9/16 inch
1/8 inch	5/8 inch
3/16 inch	11/16 inch
1/4 inch	7/8 inch
	10 mm

Table 1. Required Tools

Item # and/or Description	Torque
Case Drain (fitting torque)	200-250 lb-in (22.6-28.2 Nm)
System Port (fitting torque)	370-470 lb-in (41.8-53.1 Nm)
Inlet (fitting torque)	200-250 lb-in (22.6-28.2 Nm)
4, End Cap/Adapter Plate Bolts	180-220 lb-in (20.3-24.9 Nm)
10, Cap Screw	180-220 lb-in (20.3-24.9 Nm)
15, Bypass Valve	110-130 lb-in (12.4-14.6 Nm)
42A, 42B, Shock Valves/Check Plugs	180-240 lb-in (20.3-27.1 Nm)
44, System Charge Relief Kit (Aux Chg)	180-240 lb-in (20.3-27.1 Nm)
45, Aux Relief Valve Kit	180-240 lb-in (20.3-27.1 Nm)
56, Diagnostic Plug	84-120 lb-in (9.4-13.5 Nm)
66, Filter Cover Plug	55-85 lb-in (6.2-9.6 Nm)
67, Filter Cover	200-275 lb-in (22.6-31.1 Nm)
103, Screw 5/16 x .875	200-240 lb-in (22.6-27.1 Nm)
106, Bolt	180-220 lb-in (20.3-24.9 Nm)
107, Nut, Hex Lock 5/16-24UNF	180-220 lb-in (20.3-24.9 Nm)

Table 2. PJ Pump Torque Values

REMOVAL, INSPECTION AND/OR REPLACEMENT OF RETURN TO NEUTRAL ASSEMBLY

Refer to Figure 1.

Prior to disassembly, note the position of the scissor arm brackets and the tab on the outer control arm bracket.

Disassembly

CAUTION: The spring used on the return to neutral linkage is under tension. To avoid possible injury, use care and proper protection during disassembly and assembly of the return to neutral linkage.

1. Loosen (but do not remove) the bolt (106)/nut (107).
2. To relieve spring tension, carefully pry up on the outer scissor control arm until it releases from the tab on the outer control arm bracket.
3. Remove the spring (102), bolt (106)/nut (107) and washer (104).
4. Remove the scissor arm (99).
5. Remove the outer control arm bracket(94), bolt (103), washer (104) and the inner return arm bracket(98).

Inspection

1. With the arm control linkage removed, inspect the trunnion arm (37) and trunnion arm seal (49).
2. Inspect scissor arm (99) and all other linkage parts for damage, corrosion or wear.

Assembly

1. Install the inner return arm bracket(98), washer (104) and bolt (103).

NOTE: Do not over tighten the bolt (103). The bracket must move freely.

2. Install the inner scissor control arm(94)
3. Tighten washer (104), and nut (103) to the correct torque value. See page 74.
4. Install the scissor arm(99).
5. Install washer(104) and bolt (106)/nut (107) to the correct torque value. See page 74.
5. Install the spring (102).

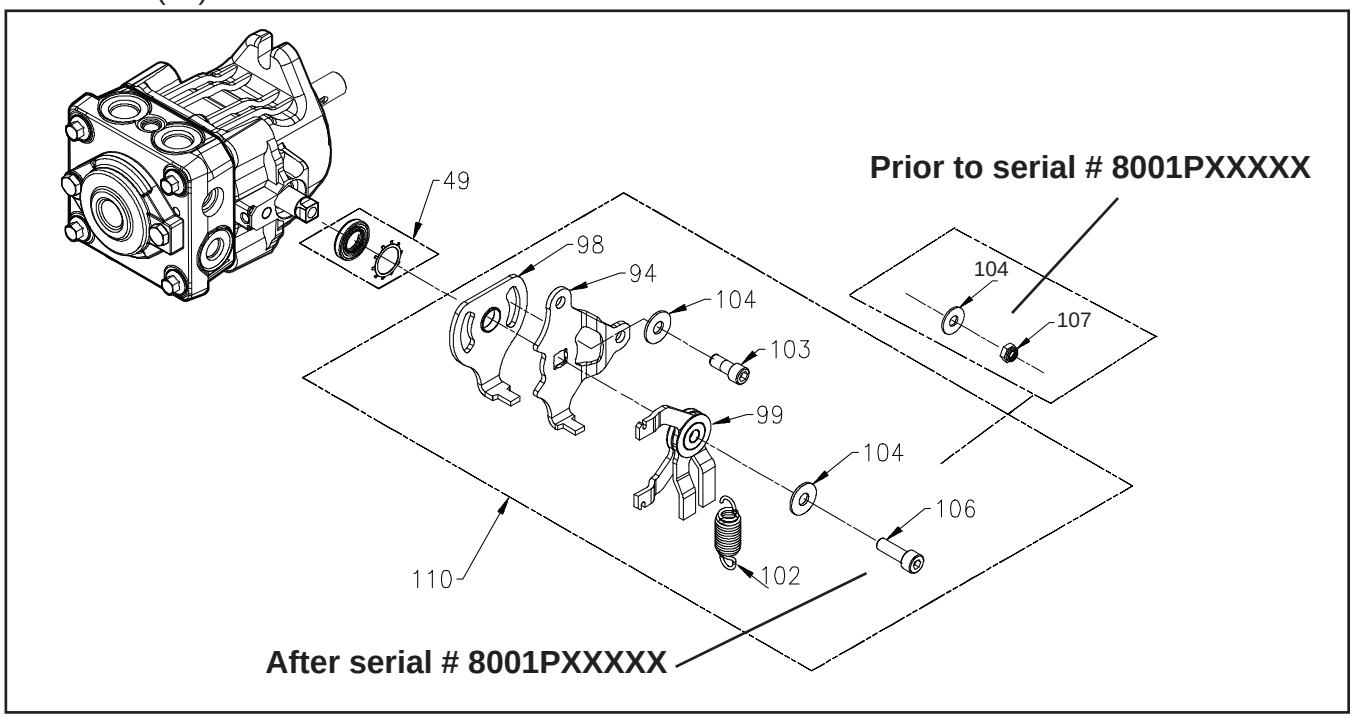


Figure 1. PJ Pump Return to Neutral

REMOVAL, INSPECTION AND/OR REPLACEMENT OF CONTROL ARM

Refer to Figure 2.

Disassembly

1. Remove the bolt (106)/nut (107), washer (104) and bushing (101).
2. Remove the outer control arm bracket.
3. Remove bolt (103), washer (104) and the inner control arm bracket.

Inspection

1. With the arm control linkage removed, inspect the trunnion arm (37) and trunnion arm seal (49).
2. Inspect bushing (101) and all other linkage parts for damage, corrosion or wear.

Assembly

1. Install the inner control arm bracket, washer (104) and bolt (103).

NOTE: Do not over tighten the bolt (103). The bracket must move freely.

2. Install the outer control arm bracket, bushing (101), washer (104, and bolt (106)/nut(107). Tighten to the correct torque value. See page 56.

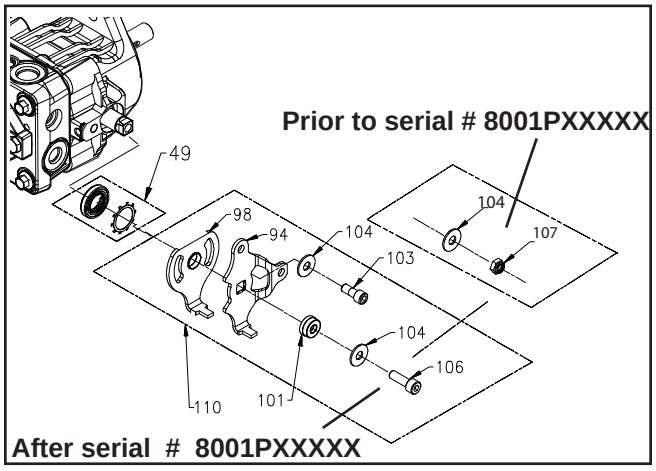


Figure 2. PJ Pump Standard Control Arm

REMOVAL, INSPECTION AND/OR REPLACEMENT OF FAN ASSEMBLY

Refer to Figure 3.

Disassembly

1. Remove the fan shroud (210) from the mounting bracket (209) by carefully pushing down on the shroud tabs.
2. Remove the nut (106) and fan assembly (90).
3. Remove the bolts (10) and bracket (209).

Inspection

Inspect the fan shroud (210), fan assembly (90) and mounting bracket (209) for damage.

Assembly

1. To install the mounting bracket (209), align and insert the bolts (10) into the bracket and charge pump cover. While holding the charge cover in place, tighten the bolts (10) per table 2, page 56.
2. Install the fan and washer assembly onto the shaft.
3. Install the nut (106) and tighten per table 2, page 56.
4. Install the fan shroud (210) onto the mounting bracket (209). Make sure that all shroud lock tabs are fully engaged in the mounting bracket slots.

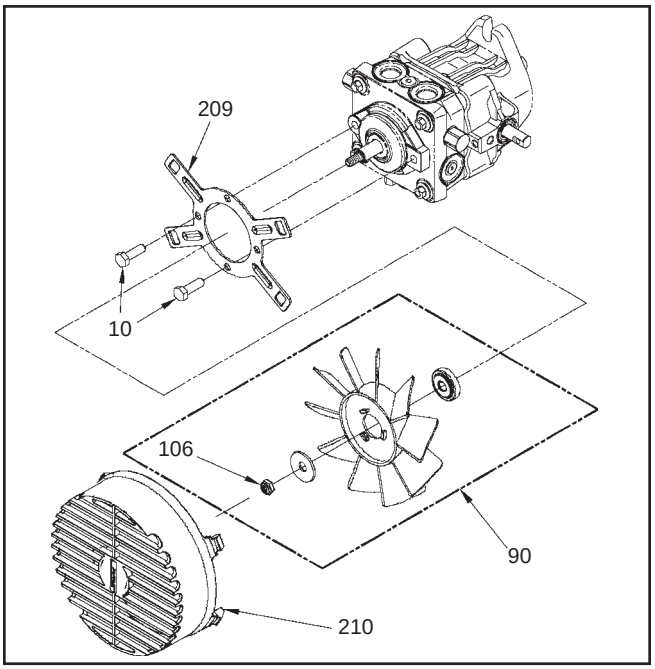


Figure 3. PJ Pump Fan Assembly

REMOVAL, INSPECTION AND/OR REPLACEMENT OF INPUT SHAFT SEAL

Refer to Figure 4.

Disassembly

1. Remove retaining ring (22) from housing.
2. Remove lip seal (20). Care must be taken to prevent damage to the housing bore, shaft sealing surface, or bearing. Once removed, the seal is not reusable.

Inspection

With seal removed inspect the spacer (21) and housing (1) bore for damage, corrosion or wear.

Assembly

1. Lubricate the new lip seal (20) inside diameter with petroleum jelly.
2. Wrap the input shaft with plastic wrap to prevent damage to the inner surface of the lip seal (20).
3. Slide spacer (21) and seal (20) over the input shaft so that lettering on the seal faces out.
4. Press the lip seal (20) into the housing bore. Insure the lip seal (20), input shaft or housing (1) bore does not become damaged.
5. Install the retaining ring (22) into the housing bore groove.

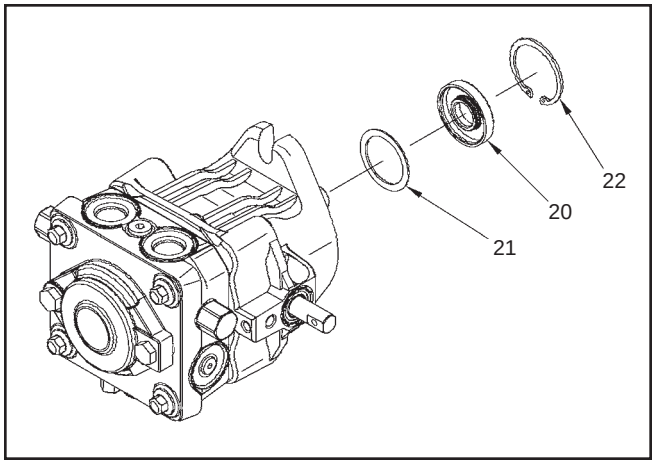


Figure 4. PJ Pump Input Shaft Seal

REMOVAL, INSPECTION AND/OR REPLACEMENT OF TRUNNION ARM SEAL

Refer to Figure 5.

Disassembly

1. Remove the RTN assembly or control arm.
2. Remove the retainer and lip seal (49) from the housing. Care must be taken to prevent damage to the housing trunnion bore, trunnion arm and sealing surface. Once removed the retainer and lip seal are not reusable.

Inspection

With the lip seal (49) removed, inspect the area for corrosion and wear. Inspect the trunnion bore area sealing surface for damage or wear.

Assembly

1. Lubricate the new lip seal (49) inside diameter with petroleum jelly.
2. Wrap the trunnion arm with plastic wrap to prevent damage to the inner surface of the lip seal (49).
3. Slide the lip seal (49) over the trunnion arm so that the lettering on the seal (49) faces out.
4. Press the lip seal (49) into the housing bore. Insure the seal (49), trunnion arm, and housing bore do not become damaged. Remove the plastic wrap.
5. Install the retainer from (49) over the trunnion arm on top of the lip seal. Press into the trunnion seal bore in the housing until the retainer mates against the trunnion seal.
6. Install the RTN assembly or control arm.

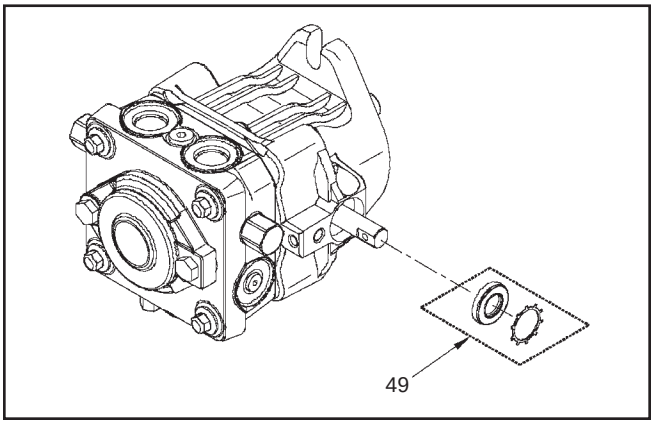


Figure 5. PJ Pump Trunnion Arm Seal

REMOVAL, INSPECTION AND/OR REPLACEMENT OF CHECK VALVES

Refer to Figure 6.

Perform disassembly, inspection and assembly on check valves one side at a time. Some units vary in “A” side to “B” side check configuration.

Disassembly

1. Remove the check valve (42) with an 1/4” allen wrench.
2. Remove the valve spring and poppet from the end cap.

Inspection

1. Inspect the poppets and mating seats in the end cap for damage or foreign material.

Assembly

1. Lay the pump on its side, so the check plug port is horizontal.
2. Insert the check plug, spring and poppet (42) as one assembly into the check plug port. Tighten, reference Table 2, page 56 for torque values.
3. Repeat disassembly, inspection and assembly for the opposite port side.

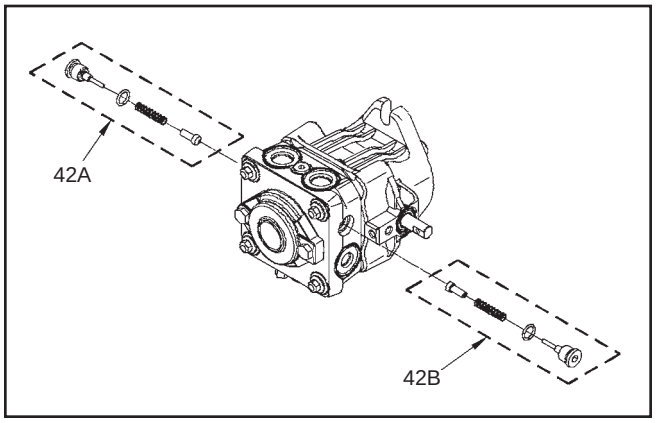


Figure 6. PJ Pump Check Valves

REMOVAL, INSPECTION AND/ OR REPLACEMENT OF SYSTEM CHECK RELIEFS (SCR’S) OR SHOCK VALVES

Refer to Figure 7.

Disassembly

Perform disassembly, inspection and assembly on SCR/shock valve one side at a time. Some units vary in “A” side to “B” side configuration.

1. Remove the SCR (42) with a 7/8” wrench or the shock valve (42) with an 11/16” wrench.
2. Remove the check relief/shock valve spring and the check relief/shock valve from the end cap.

Inspection

1. Inspect the check relief or shock valve (42) and mating seat in the end cap for damage or foreign material.

Assembly

1. Lay the pump on its side, so the check plug port is horizontal.
2. Insert the system check relief spring and check relief or shock valve spring and shock valve as one assembly into the check plug port. Tighten to the correct torque value. See page 56.
3. Repeat disassembly, inspection and assembly for the opposite port side.

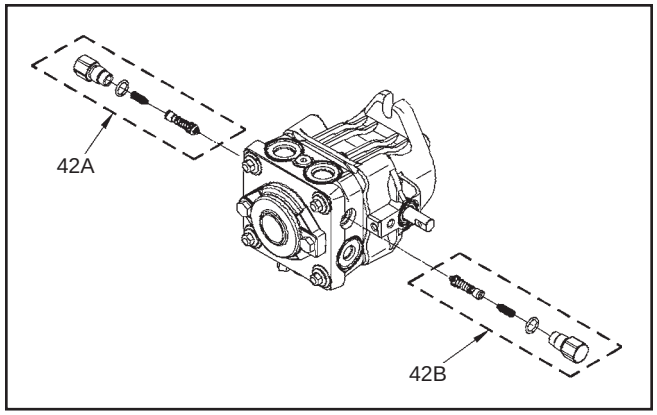


Figure 7. PJ Pump Shock Valves

REMOVAL, INSPECTION AND /OR REPLACEMENT OF THE BYPASS

Refer to Figure 8.

Disassembly

1. Loosen the bypass valve (15) using a 5/8” wrench.
2. Remove the bypass (15) from the end cap (2).

Inspection

1. Inspect the bypass O-rings and mating seats in the end cap (2) for damage or foreign materials.
2. If damaged or worn replace bypass (15)

Assembly

1. Lay the pump on its side, so the bypass port is horizontal.
2. Insert the bypass (15) into the bypass port on the end cap (2). Tighten to the proper torque value. See page 56.

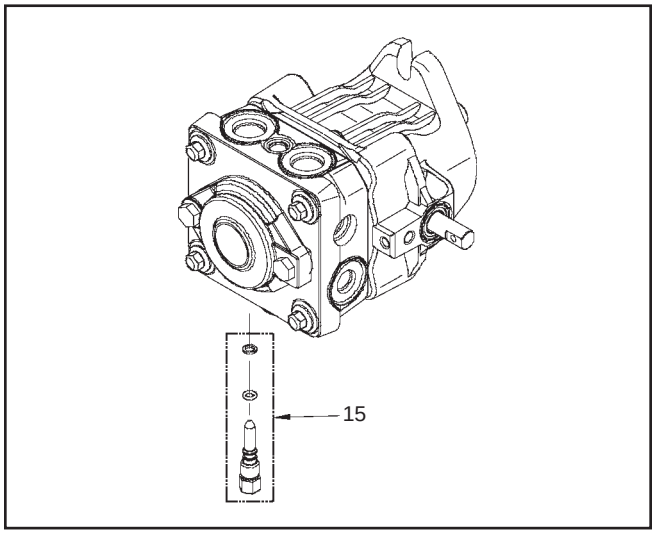


Figure 8. PJ Pump Bypass

REMOVAL, INSPECTION AND ASSEMBLY OF STANDARD OR THRU SHAFT CHARGE PUMP

Refer to Figure 9.

Disassembly

1. Prior to removal of the charge pump cover, place a mark on the cover and end cap for alignment at assembly.
2. Using a 1/2 inch wrench, or 5 mm allen wrench, loosen the charge pump cover bolts (10) from the end cap (2). While holding the charge cover in place, remove the charge cover bolts (10).
3. Remove the charge cover, O-ring and gerotor items (6). Carefully check for and remove the charge spring and charge ball (44).
4. For the Thru Shaft charge pump, remove the shaft seal.

Inspection

1. Inspect the charge cover O-ring and running surfaces for damage. Inspect the spring, check ball (44), and mating seat in the end cap (2) for damage or foreign material.

NOTE: If the end cap (2) is to be removed from the housing, do not assemble the charge pump (6) until the end cap is installed on the housing.

2. Inspect the charge cover bore for damage, corrosion or wear.

Assembly

NOTE: For the Thru Shaft charge pump follow steps 1-8. For the Standard charge pump follow steps 3-8.

1. Lubricate the new shaft seal with petroleum jelly.
2. Press the shaft seal into the charge cover. Be careful not to damage the seal or charge cover bore.
3. Position the pump with the input shaft down, and the end cap (2) horizontal. Place the charge ball (44) in the end cap (2) charge passage so the ball mates to the end cap (2) charge ball seat. Place the charge spring, on top of the charge ball.
4. Insert the inner gerotor over input shaft (18).
5. Align the outer gerotor to fit over the inner gerotor.
6. Insert the O-ring (8) into the groove in the charge cover.
7. Position the charge cover and O-ring with the aligning mark on the end cap. Place the charge cover and O-ring with aligning mark on the end cap. Place the charge cover and O-ring as one piece over the charge spring and gerotor assembly. Insure the spring fits into the charge cover spring retaining groove.
8. Align and insert the charge pump cover bolts (10) into the end cap (2). Tighten to the correct torque value. See Table 2, page 56. (Torque Values.)

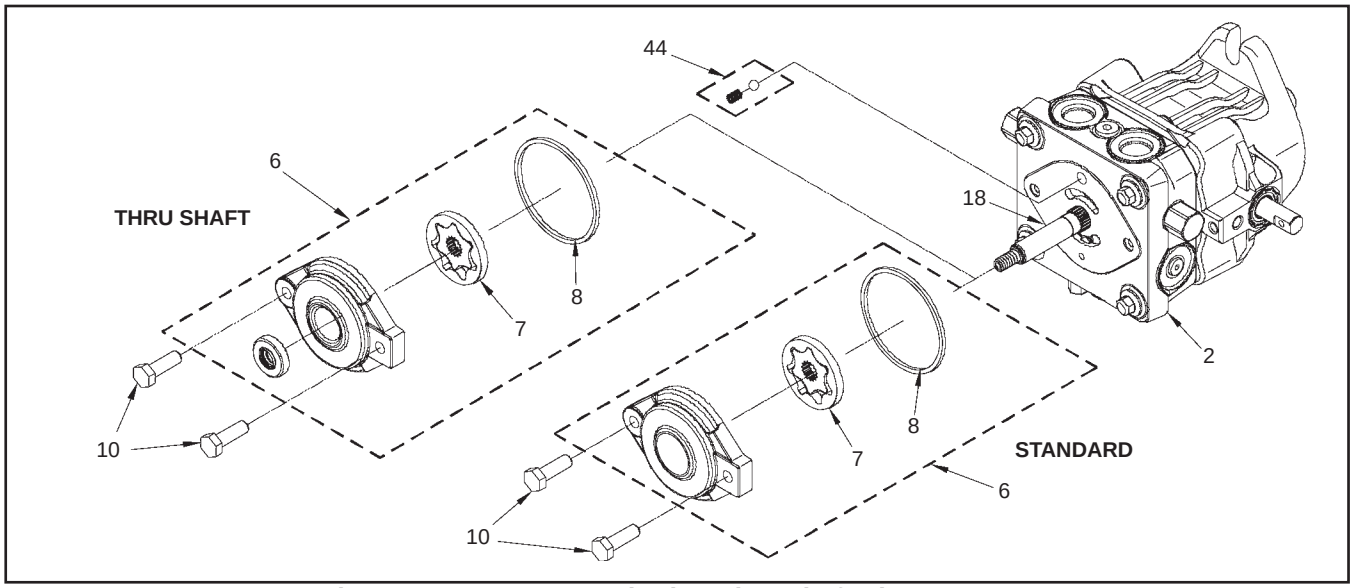


Figure 9. PJ Pump Standard or Thru Shaft Charge Pump

REMOVAL, INSPECTION AND/OR REPLACEMENT OF AUXILIARY PUMP (IF EQUIPPED)

Refer to Figure 10.

Disassembly

1. Prior to removal of the auxiliary pump, place a mark on the auxiliary pump, charge pump (7) and end cap (2) for alignment at assembly.
2. Use a 10mm wrench to loosen the auxiliary pump bolts (10) from the end cap (2). While holding the auxiliary pump in place, remove the bolts (10).
3. Remove the auxiliary pump, gasket (75), O-ring (8) and charge pump (7). While removing the charge pump, be sure to retain the spring and ball (44A) housed in the end cap (2).
4. Remove the plug (66) from the filter cover (67).
5. Use a 7/8 inch wrench to remove the filter cover assembly (67) from the auxiliary pump.
6. Remove the O-ring and filter (54).
7. Remove the charge relief valve assembly (44) and auxiliary relief valve assembly (45) from the auxiliary pump.

Inspection

1. With the auxiliary pump removed, inspect the pump running surfaces for wear or damage.
2. Inspect all O-rings, gasket and mounting seats.
3. Inspect the filter cover assembly threads and filter for wear, damage or foreign material.

Assembly

1. Install the check ball, spring, and cap as one assembly (45) into the auxiliary relief valve port. Tighten to the correct torque value. See page 56.
2. Install the poppet, spring and cap (44) as one assembly into the charge relief port. Tighten to the correct torque value. See page 56.
3. Install the filter (54) and O-ring onto the filter cover assembly (67). Install the assembly (67) into the auxiliary pump and tighten. Install plug (66) into the filter cover (67).
4. Lay the PJ Pump (input shaft down), so the end cap is horizontal. Install the O-ring (8) into the charge pump (7).
5. Install the gasket (75) onto the auxiliary pump.
6. Make sure that the ball and spring (44A) are seated in the end cap (2), then position the auxiliary pump and gasket with the aligning mark on the charge pump (7). Insure that the pump fully engages the alignment pins (69).
7. Align and insert the bolts (10) into the auxiliary pump. While holding the auxiliary pump and charge pump in place, tighten the bolts (10) per table 2, page 56.

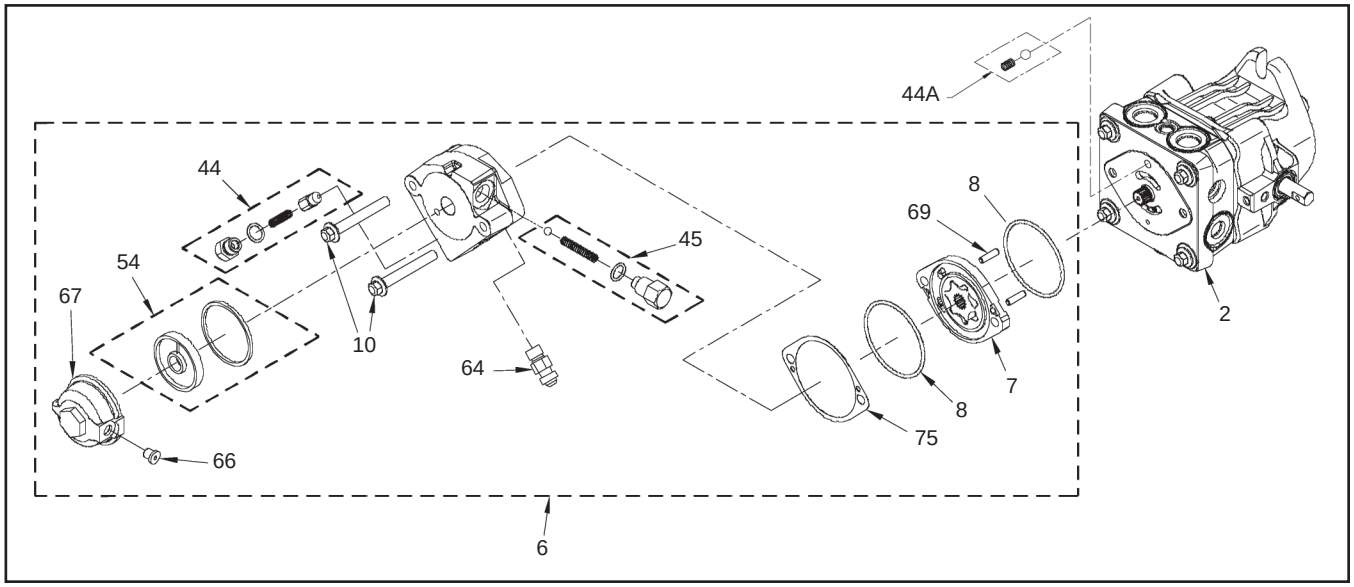


Figure 10. Auxiliary Pump

REMOVAL, INSPECTION AND ASSEMBLY OF THE END CAP

Refer to Figure 11.

Disassembly

1. Remove charge pump. (See page 62).
2. Using a 10 mm wrench, loosen the end cap bolts (4) evenly.
3. Hold the end cap (2) in place and remove the four end cap bolts (4).
4. Slowly remove the end cap (2).
5. Remove housing gasket (5).

Inspection

1. Inspect the end cap (2) body for damage, nicks or unusual wear patterns. Replace if necessary.
2. Inspect the running surface (side that contacts the cylinder block) of the end cap (2). The running surface may show evidence of minor abrasive rings, this is normal.

   Grooving in the end cap, or material transfer that is evident when the surface is checked by dragging a fingernail across it, would be cause for replacement of the end cap (2).
3. Replace the housing gasket (5) with a new gasket before assembly.

Assembly

1. Install housing gasket (5) into gasket seat of housing (1).
2. Lubricate the cylinder block (25) to end cap (2) mating surface with clean oil prior to installation.
3. Install end cap (2). Before installing the four end cap bolts (4), push down on end cap (92) verifying alignment and insuring that the cylinder block pistons spring back and forth. Install end cap bolts (4). Tighten to the correct torque value. See Table 2, page 56 (Torque Values).
4. Install the charge pump. (See page 62.)

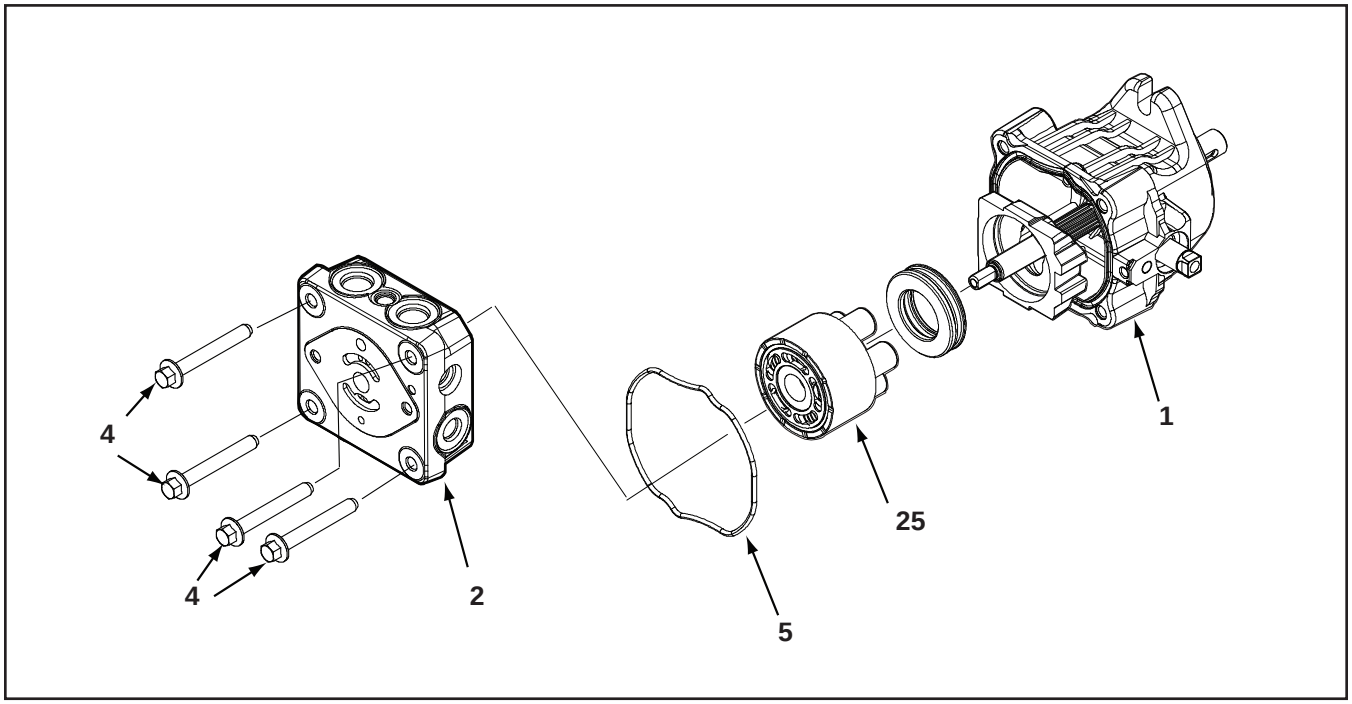


Figure 11. PJ Pump End Cap

REMOVAL, INSPECTION AND ASSEMBLY OF THE CYLINDER BLOCK

Refer to Figure 12.

Disassembly

1. Remove charge pump. (See page 62).
2. Remove end cap. (See page 64).
3. Tilt the pump on its side and drain remaining oil. Lift out the cylinder block assembly (25).
4. Remove the pistons, springs and piston seats.

Inspection

1. Inspect the running surface of the cylinder block and piston ends for damage, nicks or unusual wear patterns. The running surface may show evidence of minor abrasion. This will be normal wear. If grooved or smeared, replace with a new cylinder block assembly.
2. Inspect the piston springs for distortion or breaks. If necessary, replace with a new cylinder block kit.
3. Inspect the piston seats. Residual oil may cause these to remain stuck to the inside of the pistons.

Assembly

1. Apply a thin layer of clean oil to the pistons and springs.
2. Install piston seats into the end of the pistons.
3. Install springs into the pistons.
4. Install each piston, spring and seat assembly into the cylinder block.
5. With the pump housing tilted on its side, install the cylinder block assembly (25) with pistons contacting the thrust bearing.

NOTE: To check if the cylinder block assembly is installed correctly, position the pump housing vertically and support housing at the mounting flange. Push down on the cylinder block. The cylinder block must move up and down freely. If it does not, remove the cylinder block assembly. Place a rubber band around the cylinder block pistons to hold them in position during installation. Then after installation cut the rubber band and remove it. Check cylinder block assembly for spring action.

6. Install the end cap. (See page 64)
7. Install the charge pump. (See page 62)

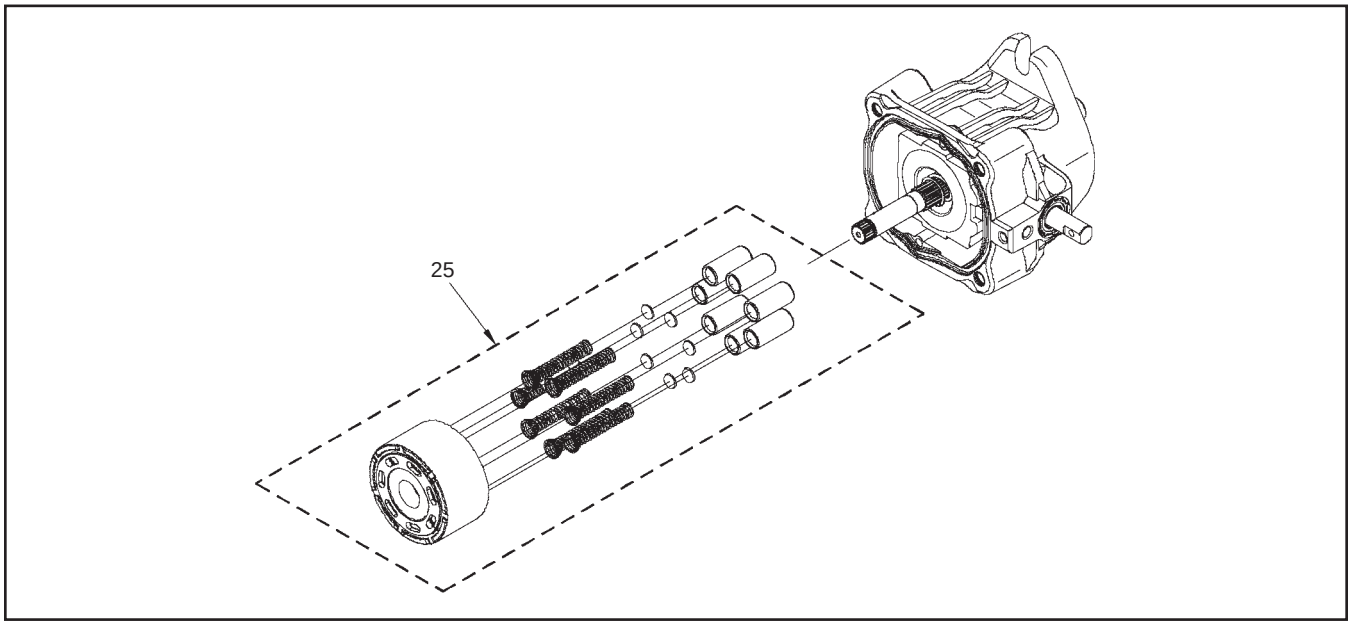


Figure 12. PJ Pump Cylinder Block

REMOVAL, INSPECTION AND ASSEMBLY OF BLOCK SPRING AND THRUST BEARING

Refer to Figure 13.

Disassembly

1. Remove the block spring (29).
2. Remove the block thrust washer (30) and thrust bearing (34).

Inspection

1. Inspect and replace the block spring (29) if it is distorted or broken.
2. Inspect the running surface of the bearing races for damage, nicks or unusual wear patterns. The running surface may show evidence of minor abrasion. This will be normal wear.

   Inspect the bearings for free movement. Inspect the bearing cage for distortion or damage. Replace if necessary.

Assembly

1. Install thrust bearing and race assembly (34).
2. Install the block thrust washer (30).

NOTE: The difference in race thicknesses: The thin race seats into the swashplate (32). The thicker race will be installed toward the piston noses.

3. Install block spring (29).

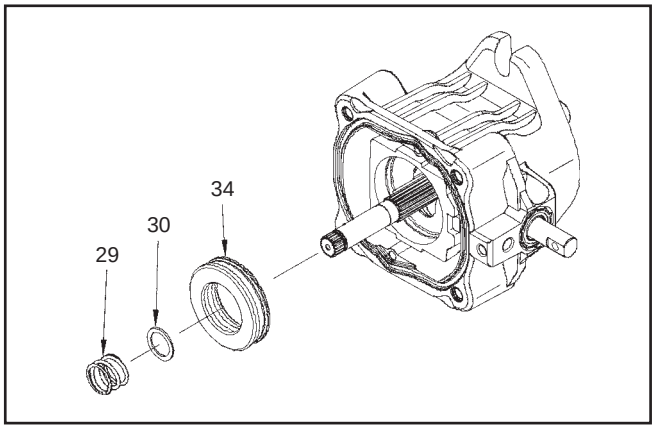


Figure 13. Pump Block Spring and Thrust Bearing

REMOVAL, INSPECTION AND ASSEMBLY OF SWASHPLATE AND CRADLE BEARINGS

Refer to Figure 14.

Disassembly

1. Remove the swashplate (32).

Inspection

1. Inspect the running surface of the bearing pocket of swashplate (32) for damage, nicks or unusual wear patterns. The running surface may show evidence of minor abrasion. This is normal wear. Inspect the cradle bearing side of the swashplate (32) for damage. Replace if necessary.
2. Inspect the cradle bearings attached to the inside of the housing (1) for normal wear patterns and placement, and insure they are staked securely in place. If the bearings are damaged, replace housing (1).

NOTE: The cradle bearings will have discoloration due to normal wear. Under normal circumstances, this will not warrant replacement.

Assembly

1. Install swashplate (32) by holding trunnion arm's slot guide (38) with a flat tip screwdriver. Use the screwdriver to hold the slot guide in place while positioning the swashplate (32) onto the cradle bearing in the housing (1).
2. Rotate trunnion arm (37) to verify that the swashplate moves freely.

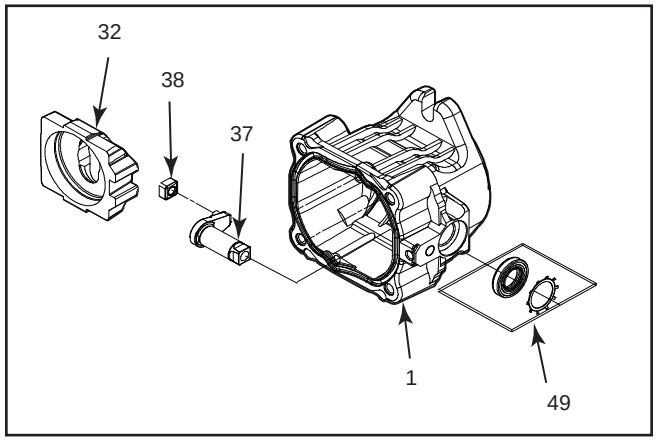


Figure 14. PJ Pump Swashplate and Cradle Bearings

REMOVAL, INSPECTION AND ASSEMBLY OF INPUT SHAFT

Refer to Figure 15.

Disassembly

1. Remove the retaining ring (22).
2. Remove the lip seal (20).
3. Remove the spacer (21).
4. Remove the shaft (18) and bearing (19) assembly from the pump.

Inspection

1. Inspect the input shaft (18) for worn splines, surface damage, or keyway damage. Replace shaft assembly if necessary.
2. Inspect the bearing (19) for evidence of scoring, corrosion, or damage. If the bearing must be replaced, remove the retaining ring and use a press or bearing puller to remove the bearing.
3. Inspect and replace the spacer (21) if it is bent or broken.
4. Inspect and replace the retaining ring (22) if it is bent or broken.

NOTE: Upon removal, all seals, O-rings and gaskets should be replaced.

Assembly

NOTE: If trunnion arm is to be removed, do not assemble input shaft until the trunnion arm is installed.

NOTE: During installation, lightly lubricate all seals, O-rings and gaskets with clean petroleum jelly prior to assembly. Also, protect the inner diameter of seals by covering the shaft with plastic wrap.

1. If removed, press bearing (19) onto shaft (18) tight against the shoulder of the shaft. Install retaining ring onto the shaft (18).
2. Install input shaft assembly (18) into the housing (1) bore. Light tapping with a rubber mallet may be necessary on the input shaft (18) once the bearing is aligned with the housing (1) bore. Verify that the shaft rotates smoothly.
3. Install spacer (21).
4. Install new lip seal (20) with the flat side of the seal toward the outside of the pump.
5. Remove the plastic wrap.
6. Install retaining ring (22).

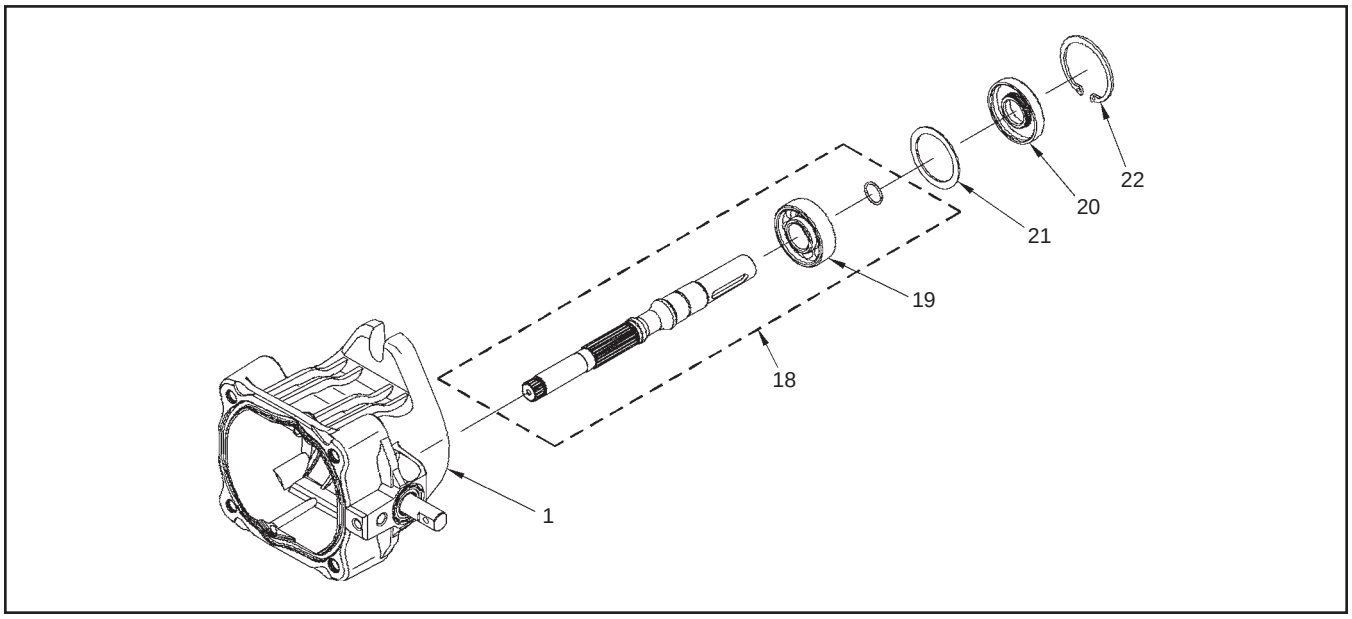


Figure 15. PJ Pump Input Shaft

REMOVAL, INSPECTION AND INSTALLATION OF TRUNNION ARM

Refer to Figure 16.

Disassembly

1. Remove the slot guide (38).
2. Remove and discard the trunnion seal retainer and seal (49).
3. Remove the trunnion arm (37).

Inspection

1. Inspect the trunnion arm (37) for wear or damage. Replace the trunnion arm if necessary.
2. Check for excessive play between trunnion arm (37) and housing (1). Replace housing if necessary.

Assembly

1. Install the trunnion arm (37) into the housing (1) bore. Rotate the trunnion arm to verify free movement.
2. Install a new seal and seal retainer (49).
3. Install slot guide (38).
4. To completely assembly the pump, refer to the assembly steps on pages 57-68. Begin with the trunnion arm assembly steps listed on page 68 and complete the assembly steps in reverse order working toward the front of the manual.

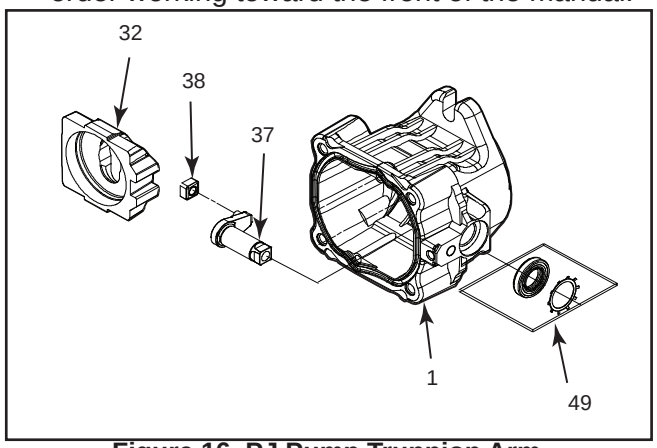


Figure 16. PJ Pump Trunnion Arm

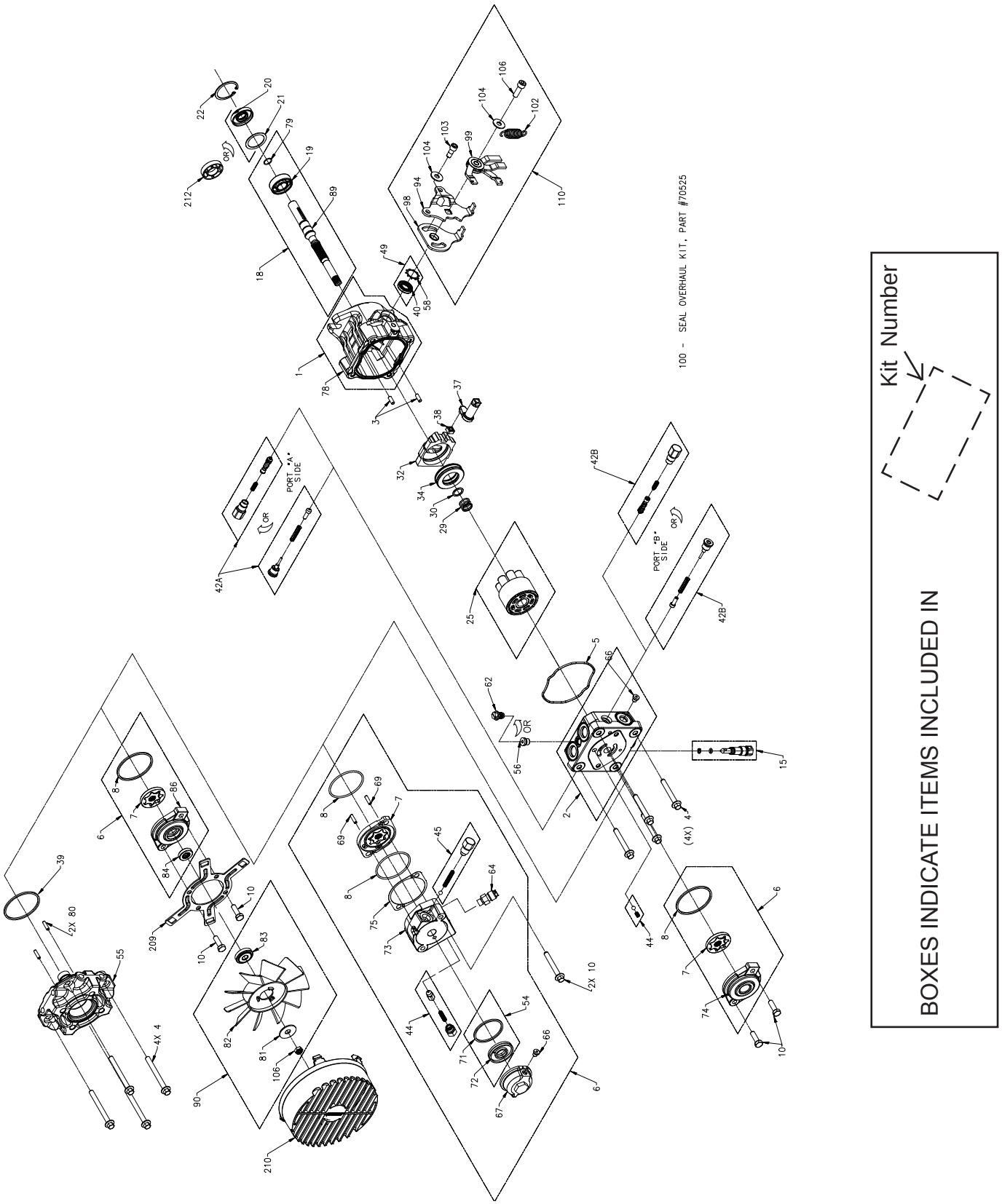


Figure 17. PJ Pump

ITEM LIST - PJ SERIES

Part numbers are not provided in this manual.

No.	Description
1	Housing Kit
2	End Cap Kit (W/Poppets, Standard Charge)
	End Cap Kit (W/ SCR'S, Standard Charge)
	End Cap Kit (W/ Poppets, Auxiliary Charge)
	End Cap Kit (W/ SCR'S, Auxiliary Charge)
	End Cap Kit (STD CHG) LH;SCR/HR: Poppet
	End Cap Kit (STD CHG) LH:Poppet/RH:SCR
	End Cap Kit (STD CHG) LH:SCR/RH:SCR
	End Cap Kit (AUX CHG) LH:SCR/RH:Poppet
	End Cap Kit (AUX CHG) LH:Poppet/RH:SCR
	End Cap Kit (AUX CHG) LH:SCR/RHPoppet, Thru
	End Cap Kit (AUX CHG) W/Poppets, Thru
	End Cap Kit (AUX CHG) W/SCR;s, Thru
	End Cap Kit (AUX CHG) LH:Poppet/RH:SCR, Thru
3	Straight Headless Pin
4	Hex Flange Bolt M8-1.25 X 60 mm LG
5	Housing O-Ring
6	Charge Pump Kit (STD)
	Charge Pump Kit (STD CHG), Thru
	Aux Pump Kit (AL., 15T Splined, 2-7/16 SAE Ports)
	Aux Pump Kit (AL., 15T Splined, 3-7/16 SAE Ports)
7	STD Gerotor Assy (.11 cu. In/rev D-Drive)
	Auxiliary Gerotor & Housing Assembly
8	O-Ring
10	Socket Head Screw M6 x 1.0-20 mm Lg (STD CHg)
	Hex Flange Bolt 8M-1.25 x 60 mm (Aux Chg)
	Cap Screw, Hex 5/16-18 x 1.00 (Thru Chg)
	Supplied with item # 2 only
15	Bypass Valve Kit (Blank)
	Bypass Valve Kit (0.031")
	Bypass Valve Kit (0.043")
18	Pump Shaft Kit (Blind 15mm Keyway W/Std Chg)
	Pump Shaft Kit (Blind 15mm Keyway W/Aux Chg)
	Pump Shaft Kit (9 Tooth W/Std Chg)
	Pump Shaft Kit (9 Tooth W/Aux Chg)
	Pump Shaft Kit (15mm Keyed, Std Chg, Thru)
	Pump Shaft Kit (9 Tooth Thru Chg)
	Pump Shaft Kit (Tapered)
19	Ball Bearing 17 X 40 X 12
20	Lip Seal 17 X 40 X 7 PTC
21	Spacer
22	Retaining Ring
25	Cylinder Block Kit
29	Block Spring

No.	Description
34	Ball Thrust Bearing
35	Stud, Torque
37	Trunnion Arm
	Trunnion, RTN
38	Slot Guide
42	Check Valve Kit (blank Orifice)
	Check Valve Kit (0.024" Orifice)
	Check Valve Kit (0.031" Orifice)
	Check Valve Kit (0.044" Orifice)
	System Check / Relief Kit
	System Check Relief Kit (.031" Orifice)
	Shock Valve Kit
44	Charge Relief Valve Kit (1/4" Plastic Ball & 50654 Spring)
	Charge Relief Valve Kit (9/16" SAE Plug & 3101536 Spring)
45	Aux Relief Valve Kit (1/4" Steel Ball)
	Aux Relief Valve Kit (Aux Poppet)
49	Trunnion Seal/Retainer Kit
54	Auxiliary Filter Kit
55	Plate, Adapter (Gear A)
56	Straight Thread Plug
59	O-Ring
64	Connector
66	5/16" SAE Plug
67	Filter Cover
69	Straight Headless Pin
75	Shim - Charge Pump (.002 - Red)
80	Pin, Straight Headless
85	R-Ring - 144
90	Hub / 6" Fan Kit
	Hub / 7" CCW Fan Kit
	Hub / 7" CW Fan Kit
	Hug / 7" Fan Kit
98	Return Arm
99	Inner Scissor Arm
100	Seal Kit
101	Spacer RTN
102	Spring, Extension
103	Screw, 5/16 x .875 (patch)
104	Washer .34 x .88 x .06
105	Washer, Nylon
106	Bolt
107	Nut, Hex Lock 5/16 - 24 UNF
110	Kit, RTN, STD
	Kit, RTN, CW
	Kit, RTN, CCW
209	Shroud Bracket
210	Shroud

REPAIR - PK SERIES PUMP

HOW TO USE THIS MANUAL

Each assembly is provided with an exploded view showing the parts involved. **The item reference numbers in each illustration are for assembly instructions only.** See pages 88 and 89 for part names and descriptions. A complete exploded view and item list of the pump is provided at the end of this section.

GENERAL INSTRUCTIONS

Cleanliness is a primary means of ensuring satisfactory life on repaired pumps. Thoroughly clean all exposed surfaces prior to any type of maintenance. Cleaning of all parts by using a solvent wash and air drying is usually adequate. As with any precision equipment, all parts must be kept free of foreign material and chemicals.

Protect all exposed sealing surfaces and open cavities from damage and foreign material. The external surfaces should be cleaned before beginning any repairs.

Lip-type seals (shaft seals) are used on the input shaft and directional control shaft of each pump. These seals can be replaced without major disassembly of the unit. However, replacement of these seals generally requires removal of the pump from the machine. Upon removal, it is recommended that all seals, O-rings and gaskets be replaced.

During installation, lightly lubricate all seals, O-rings and gaskets with clean petroleum jelly prior to assembly. Also protect the inner diameter of the seals by covering the shaft with a cellophane (plastic wrap, etc.) material.

Parts requiring replacement must be replaced from the appropriate kits identified in the Items Listing, found at the end of this manual. Use only original Hydro-Gear replacement parts found listed in BLN-51427 (CD).

TOOLS AND TORQUES

Miscellaneous	3/8-Inch Drive Ratchet and Sockets
P Series Service & Repair Manual	7/16-inch Socket
Torque Wrench	1/2-inch Socket
Scribe, Paint Pen, or Marker	9/16-inch Socket
Seal Hook with a Magnet	5/8-inch Socket
Flat Blade Screwdriver	11/16-inch Socket
	10-mm Socket
Pliers	
Internal Snap Ring	**Combination Wrenches**
	7/16 inch
Allen Wrenches	1/2 inch
5mm	9/16 inch
1/8 inch	5/8 inch
3/16 inch	11/16 inch
1/4 inch	7/8 inch
	10 mm

Table 1. Required Tools

Item # and/or Description	Torque
Case Drain (fitting torque)	200-250 lb-in (22.6-28.2 Nm)
System Port (fitting torque)	370-470 lb-in (41.8-53.1 Nm)
Inlet (fitting torque)	200-250 lb-in (22.6-28.2 Nm)
4, End Cap/Adapter Plate Bolts	180-220 lb-in (20.3-24.9 Nm)
10, Cap Screw	180-220 lb-in (20.3-24.9 Nm)
15, Bypass Valve	110-130 lb-in (12.4-14.6 Nm)
42A, 42B, Shock Valves/Check Plugs	180-240 lb-in (20.3-27.1 Nm)
44, System Charge Relief Kit (Aux Chg)	180-240 lb-in (20.3-27.1 Nm)
45, Aux Relief Valve Kit	180-240 lb-in (20.3-27.1 Nm)
56, Diagnostic Plug	84-120 lb-in (9.4-13.5 Nm)
66, Filter Cover Plug	55-85 lb-in (6.2-9.6 Nm)
67, Filter Cover	200-275 lb-in (22.6-31.1 Nm)
103, Screw 5/16 x .875	200-240 lb-in (22.6-27.1 Nm)
106, Bolt	180-220 lb-in (20.3-24.9 Nm)

Table 2. PK Pump Torque Values

REMOVAL, INSPECTION AND/OR REPLACEMENT OF RETURN TO NEUTRAL ASSEMBLY

Refer to Figure 1.

Prior to disassembly, note the position of the scissor arm brackets and the tab on the outer control arm bracket.

Disassembly

CAUTION: The spring used on the return to neutral linkage is under tension. To avoid possible injury, use care and proper protection during disassembly and assembly of the return to neutral linkage.

1. Loosen (but do not remove) the bolt (106).
2. To relieve spring tension, carefully pry up on the outer scissor control arm until it releases from the tab on the outer control arm bracket.
3. Remove the spring (102), bolt(106) washer (104).
4. Remove the scissor arm (99).
5. Remove the outer control arm bracket(94), bolt (103), washer (104) and the inner return arm bracket(98).

Inspection

1. With the arm control linkage removed, inspect the trunnion arm (37) and trunnion arm seal (49).
2. Inspect scissor arm (99) and all other linkage parts for damage, corrosion or wear.

Assembly

1. Install the inner return arm bracket(98), washer (104) and bolt (103).

NOTE: Do not over tighten the bolt (103). The bracket must move freely.

2. Install the inner scissor control arm(94)
3. Tighten washer (104), and nut (103) to the correct torque value. See page 74.
4. Install the scissor arm(99).
5. Install washer(104) and bolt (106) to the correct torque value. See page 74.
5. Install the spring (102).

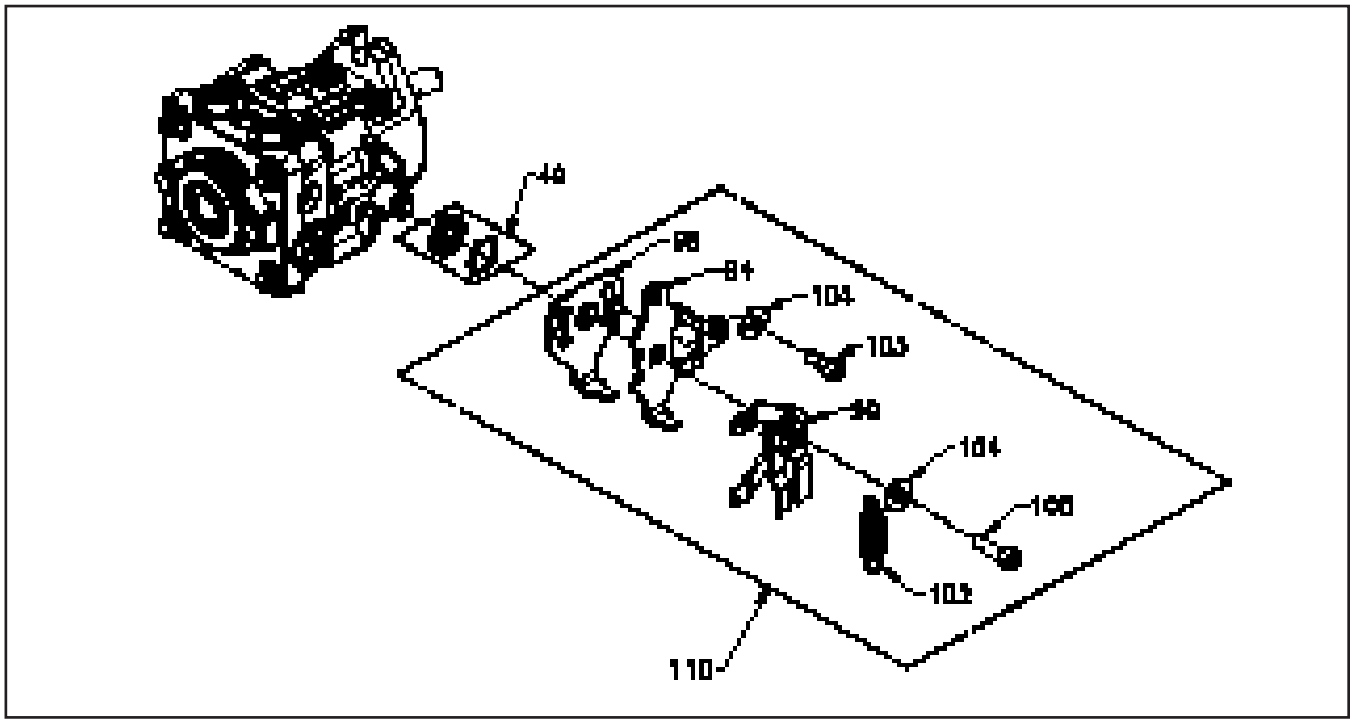


Figure 1. PK Pump Return to Neutral

REMOVAL, INSPECTION AND/OR REPLACEMENT OF CONTROL ARM

Refer to Figure 2.

Disassembly

1. Remove the bolt (106), washer (104) and bushing (101).
2. Remove the outer control arm bracket.
3. Remove bolt (103), washer (104) and the inner control arm bracket.

Inspection

1. With the arm control linkage removed, inspect the trunnion arm (37) and trunnion arm seal (49).
2. Inspect bushing (101) and all other linkage parts for damage, corrosion or wear.

Assembly

1. Install the inner control arm bracket, washer (104) and bolt (103).

NOTE: Do not over tighten the bolt (103). The bracket must move freely.

2. Install the outer control arm bracket, bushing (101), washer (104, and bolt (106). Tighten to the correct torque value. See page 74.

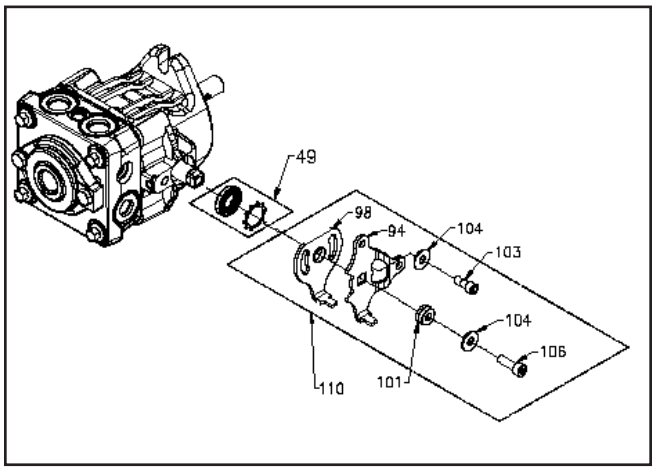


Figure 2. PK Pump Standard Control Arm

REMOVAL, INSPECTION AND/OR REPLACEMENT OF FAN ASSEMBLY

Refer to Figure 3.

Disassembly

1. Remove the fan shroud (210) from the mounting bracket (209) by carefully pushing down on the shroud tabs.
2. Remove the nut (106) and fan assembly (90).
3. Remove the bolts (10) and bracket (209).

Inspection

Inspect the fan shroud (210), fan assembly (90) and mounting bracket (209) for damage.

Assembly

1. To install the mounting bracket (209), align and insert the bolts (10) into the bracket and charge pump cover. While holding the charge cover in place, tighten the bolts (10) per table 2, page 74.
2. Install the fan and washer assembly onto the shaft.
3. Install the nut (106) and tighten per table 2, page 74.
4. Install the fan shroud (210) onto the mounting bracket (209). Make sure that all shroud lock tabs are fully engaged in the mounting bracket slots.

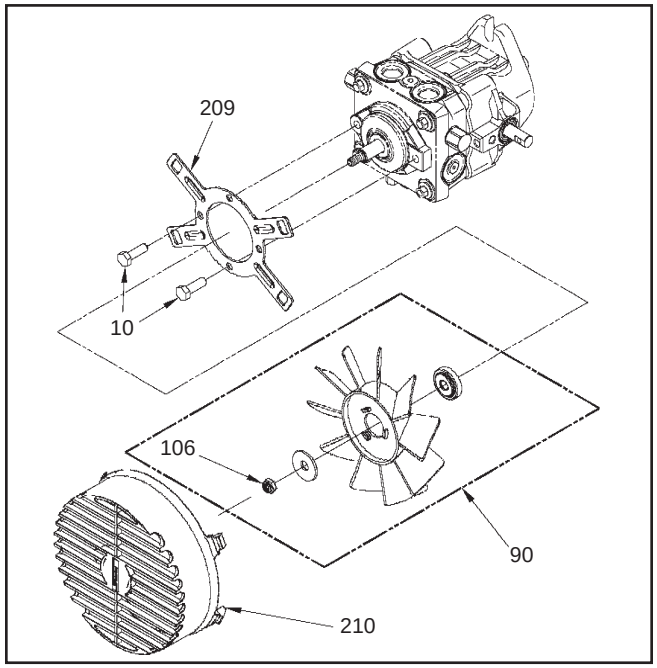


Figure 3. PK Pump Fan Assembly

REMOVAL, INSPECTION AND/OR REPLACEMENT OF INPUT SHAFT SEAL

Refer to Figure 4.

Disassembly

1. Remove retaining ring (22) from housing.
2. Remove lip seal (20). Care must be taken to prevent damage to the housing bore, shaft sealing surface, or bearing. Once removed, the seal is not reusable.

Inspection

With seal removed inspect the spacer (21) and housing (1) bore for damage, corrosion or wear.

Assembly

1. Lubricate the new lip seal (20) inside diameter with petroleum jelly.
2. Wrap the input shaft with plastic wrap to prevent damage to the inner surface of the lip seal (20).
3. Slide spacer (21) and seal (20) over the input shaft so that lettering on the seal faces out.
4. Press the lip seal (20) into the housing bore. Insure the lip seal (20), input shaft or housing (1) bore does not become damaged.
5. Install the retaining ring (22) into the housing bore groove.

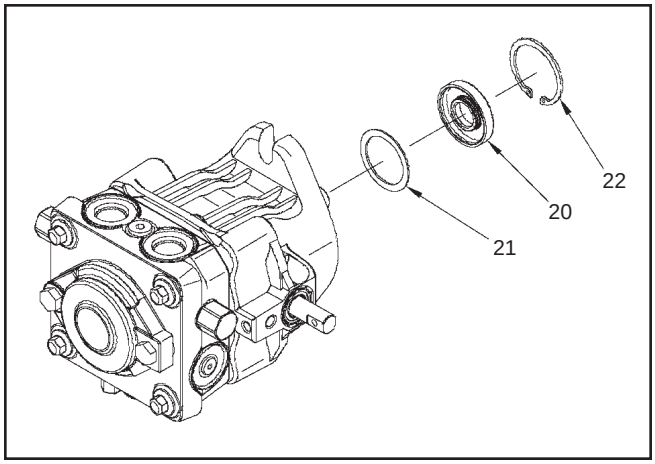


Figure 4. PK Pump Input Shaft Seal

REMOVAL, INSPECTION AND/OR REPLACEMENT OF TRUNNION ARM SEAL

Refer to Figure 5.

Disassembly

1. Remove the RTN assembly or control arm.
2. Remove the retainer and lip seal (49) from the housing. Care must be taken to prevent damage to the housing trunnion bore, trunnion arm and sealing surface. Once removed the retainer and lip seal are not reusable.

Inspection

With the lip seal (49) removed, inspect the area for corrosion and wear. Inspect the trunnion bore area sealing surface for damage or wear.

Assembly

1. Lubricate the new lip seal (49) inside diameter with petroleum jelly.
2. Wrap the trunnion arm with plastic wrap to prevent damage to the inner surface of the lip seal (49).
3. Slide the lip seal (49) over the trunnion arm so that the lettering on the seal (49) faces out.
4. Press the lip seal (49) into the housing bore. Insure the seal (49), trunnion arm, and housing bore do not become damaged. Remove the plastic wrap.
5. Install the retainer from (49) over the trunnion arm on top of the lip seal. Press into the trunnion seal bore in the housing until the retainer mates against the trunnion seal.
6. Install the RTN assembly or control arm.

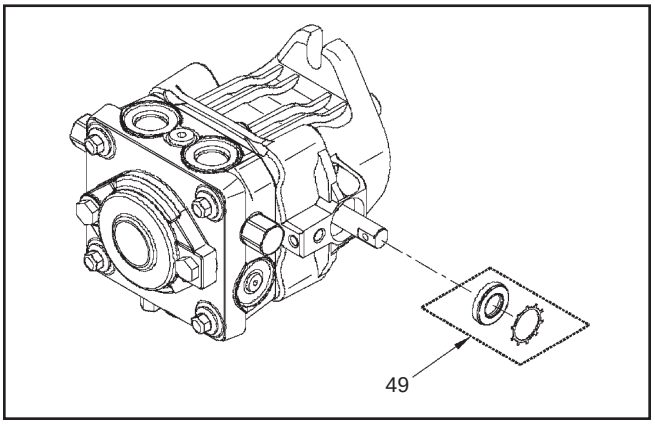


Figure 5. PK Pump Trunnion Arm Seal

REMOVAL, INSPECTION AND/OR REPLACEMENT OF CHECK VALVES

Refer to Figure 6.

Perform disassembly, inspection and assembly on check valves one side at a time. Some units vary in “A” side to “B” side check configuration.

Disassembly

1. Remove the check valve (42) with an 1/4” allen wrench.
2. Remove the valve spring and poppet from the end cap.

Inspection

1. Inspect the poppets and mating seats in the end cap for damage or foreign material.

Assembly

1. Lay the pump on its side, so the check plug port is horizontal.
2. Insert the check plug, spring and poppet (42) as one assembly into the check plug port. Tighten, reference Table 2, page 74 for torque values.
3. Repeat disassembly, inspection and assembly for the opposite port side.

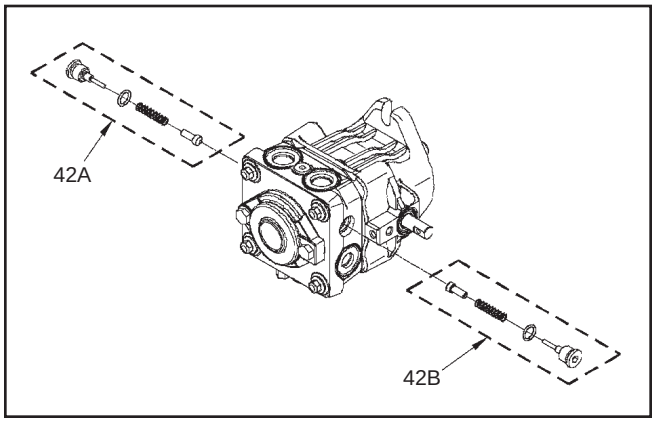


Figure 6. PK Pump Check Valves

REMOVAL, INSPECTION AND/ OR REPLACEMENT OF SYSTEM CHECK RELIEFS (SCR’S) OR SHOCK VALVES

Refer to Figure 7.

Disassembly

Perform disassembly, inspection and assembly on SCR/shock valve one side at a time. Some units vary in “A” side to “B” side configuration.

1. Remove the SCR (42) with a 7/8” wrench or the shock valve (42) with an 11/16” wrench.
2. Remove the check relief/shock valve spring and the check relief/shock valve from the end cap.

Inspection

1. Inspect the check relief or shock valve (42) and mating seat in the end cap for damage or foreign material.

Assembly

1. Lay the pump on its side, so the check plug port is horizontal.
2. Insert the system check relief spring and check relief or shock valve spring and shock valve as one assembly into the check plug port. Tighten to the correct torque value. See page 74.
3. Repeat disassembly, inspection and assembly for the opposite port side.

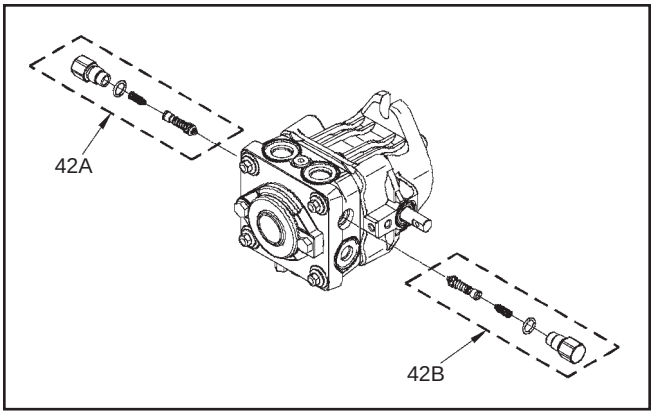


Figure 7. PK Pump Shock Valves

REMOVAL, INSPECTION AND /OR REPLACEMENT OF THE BYPASS

Refer to Figure 8.

Disassembly

1. Loosen the bypass valve (15) using a 5/8” wrench.
2. Remove the bypass (15) from the end cap (2).

Inspection

1. Inspect the bypass O-rings and mating seats in the end cap (2) for damage or foreign materials.
2. If damaged or worn replace bypass (15)

Assembly

1. Lay the pump on its side, so the bypass port is horizontal.
2. Insert the bypass (15) into the bypass port on the end cap (2). Tighten to the proper torque value. See page 74.

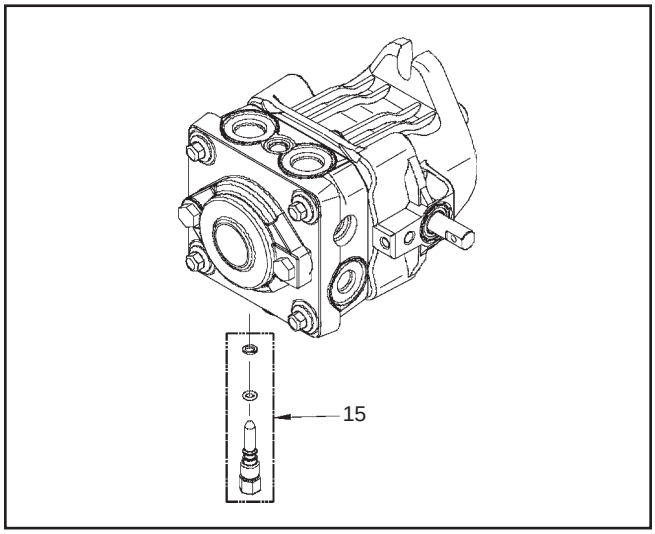


Figure 8. PK Pump Bypass

REMOVAL, INSPECTION AND ASSEMBLY OF STANDARD OR THRU SHAFT CHARGE PUMP

Refer to Figure 9.

Disassembly

1. Prior to removal of the charge pump cover, place a mark on the cover and end cap for alignment at assembly.
2. Using a 1/2 inch wrench, or 5 mm allen wrench, loosen the charge pump cover bolts (10) from the end cap (2). While holding the charge cover in place, remove the charge cover bolts (10).
3. Remove the charge cover, O-ring and gerotor items (6). Carefully check for and remove the charge spring and charge ball (44).
4. For the Thru Shaft charge pump, remove the shaft seal.

Inspection

1. Inspect the charge cover O-ring and running surfaces for damage. Inspect the spring, check ball (44), and mating seat in the end cap (2) for damage or foreign material.

NOTE: If the end cap (2) is to be removed from the housing, do not assemble the charge pump (6) until the end cap is installed on the housing.

2. Inspect the charge cover bore for damage, corrosion or wear.

Assembly

NOTE: For the Thru Shaft charge pump follow steps 1-8. For the Standard charge pump follow steps 3-8.

1. Lubricate the new shaft seal with petroleum jelly.
2. Press the shaft seal into the charge cover. Be careful not to damage the seal or charge cover bore.
3. Position the pump with the input shaft down, and the end cap (2) horizontal. Place the charge ball (44) in the end cap (2) charge passage so the ball mates to the end cap (2) charge ball seat. Place the charge spring, on top of the charge ball.
4. Insert the inner gerotor over input shaft (18).
5. Align the outer gerotor to fit over the inner gerotor.
6. Insert the O-ring (8) into the groove in the charge cover.
7. Position the charge cover and O-ring with the aligning mark on the end cap. Place the charge cover and O-ring with aligning mark on the end cap. Place the charge cover and O-ring as one piece over the charge spring and gerotor assembly. Insure the spring fits into the charge cover spring retaining groove.
8. Align and insert the charge pump cover bolts (10) into the end cap (2). Tighten to the correct torque value. See Table 2, page 74. (Torque Values.)

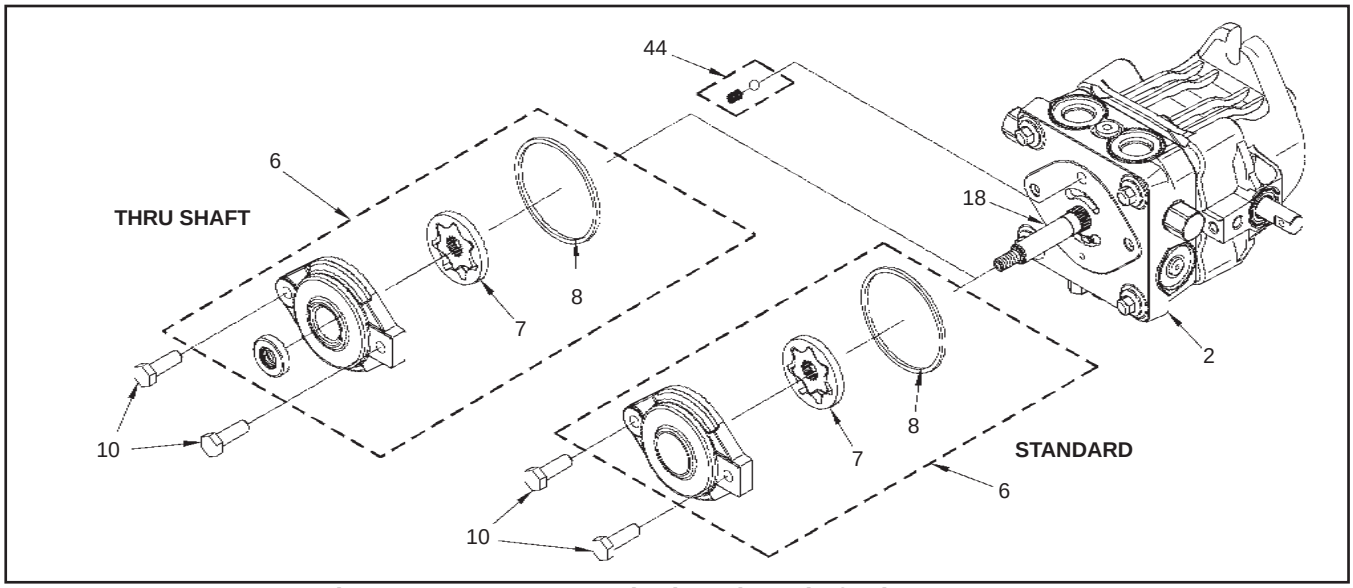


Figure 9. PK Pump Standard or Thru Shaft Charge Pump

REMOVAL, INSPECTION AND/OR REPLACEMENT OF AUXILIARY PUMP (IF EQUIPPED)

Refer to Figure 10.

Disassembly

1. Prior to removal of the auxiliary pump, place a mark on the auxiliary pump, charge pump (7) and end cap (2) for alignment at assembly.
2. Use a 10mm wrench to loosen the auxiliary pump bolts (10) from the end cap (2). While holding the auxiliary pump in place, remove the bolts (10).
3. Remove the auxiliary pump, gasket (75), O-ring (8) and charge pump (7). While removing the charge pump, be sure to retain the spring and ball (44A) housed in the end cap (2).
4. Remove the plug (66) from the filter cover (67).
5. Use a 7/8 inch wrench to remove the filter cover assembly (67) from the auxiliary pump.
6. Remove the O-ring and filter (54).
7. Remove the charge relief valve assembly (44) and auxiliary relief valve assembly (45) from the auxiliary pump.

Inspection

1. With the auxiliary pump removed, inspect the pump running surfaces for wear or damage.
2. Inspect all O-rings, gasket and mounting seats.
3. Inspect the filter cover assembly threads and filter for wear, damage or foreign material.

Assembly

1. Install the check ball, spring, and cap as one assembly (45) into the auxiliary relief valve port. Tighten to the correct torque value. See page 74.
2. Install the poppet, spring and cap (44) as one assembly into the charge relief port. Tighten to the correct torque value. See page 74.
3. Install the filter (54) and O-ring onto the filter cover assembly (67). Install the assembly (67) into the auxiliary pump and tighten. Install plug (66) into the filter cover (67).
4. Lay the PJ Pump (input shaft down), so the end cap is horizontal. Install the O-ring (8) into the charge pump (7).
5. Install the gasket (75) onto the auxiliary pump.
6. Make sure that the ball and spring (44A) are seated in the end cap (2), then position the auxiliary pump and gasket with the aligning mark on the charge pump (7). Insure that the pump fully engages the alignment pins (69).
7. Align and insert the bolts (10) into the auxiliary pump. While holding the auxiliary pump and charge pump in place, tighten the bolts (10) per table 2, page 74.

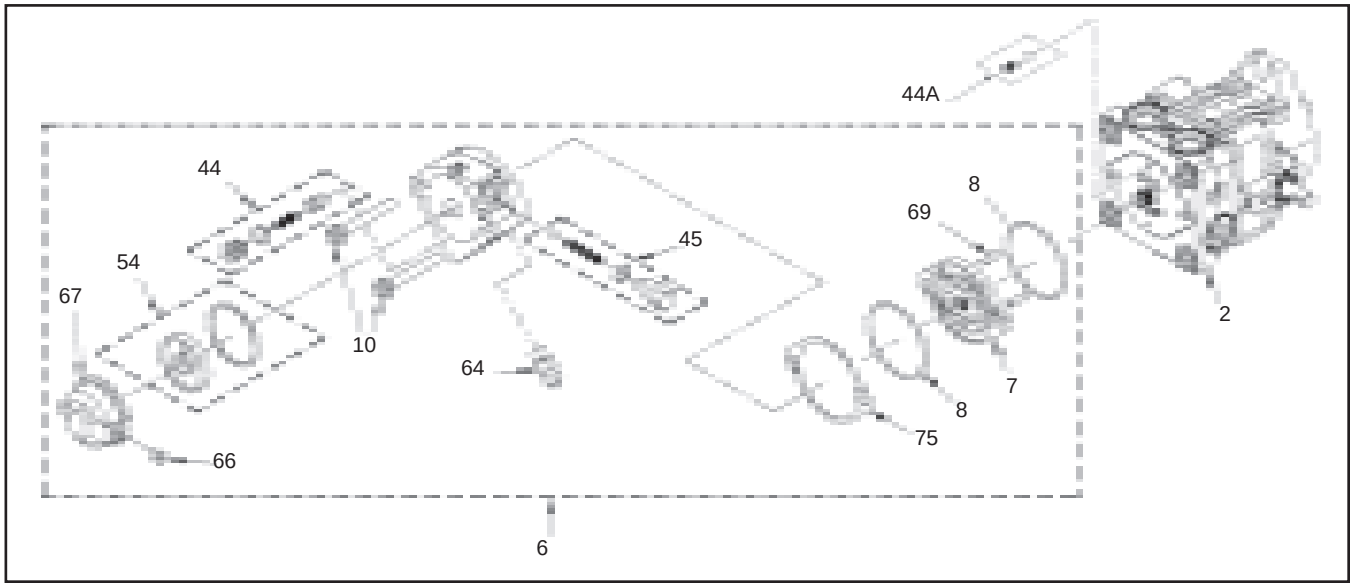


Figure 10. Auxiliary Pump

REMOVAL, INSPECTION AND ASSEMBLY OF THE END CAP

Refer to Figure 11.

Disassembly

1. Remove charge pump. (See page 62).
2. Using a 10 mm wrench, loosen the end cap bolts (4) evenly.
3. Hold the end cap (2) in place and remove the four end cap bolts (4).
4. Slowly remove the end cap (2).
5. Remove housing gasket (5).

Inspection

1. Inspect the end cap (2) body for damage, nicks or unusual wear patterns. Replace if necessary.
2. Inspect the running surface (side that contacts the cylinder block) of the end cap (2). The running surface may show evidence of minor abrasive rings, this is normal.

   Grooving in the end cap, or material transfer that is evident when the surface is checked by dragging a fingernail across it, would be cause for replacement of the end cap (2).
3. Replace the housing gasket (5) with a new gasket before assembly.

Assembly

1. Install housing gasket (5) into gasket seat of housing (1).
2. Lubricate the cylinder block (25) to end cap (2) mating surface with clean oil prior to installation.
3. Install end cap (2). Before installing the four end cap bolts (4), push down on end cap (92) verifying alignment and insuring that the cylinder block pistons spring back and forth. Install end cap bolts (4). Tighten to the correct torque value. See Table 2, page 74 (Torque Values).
4. Install the charge pump. (See page 80.)

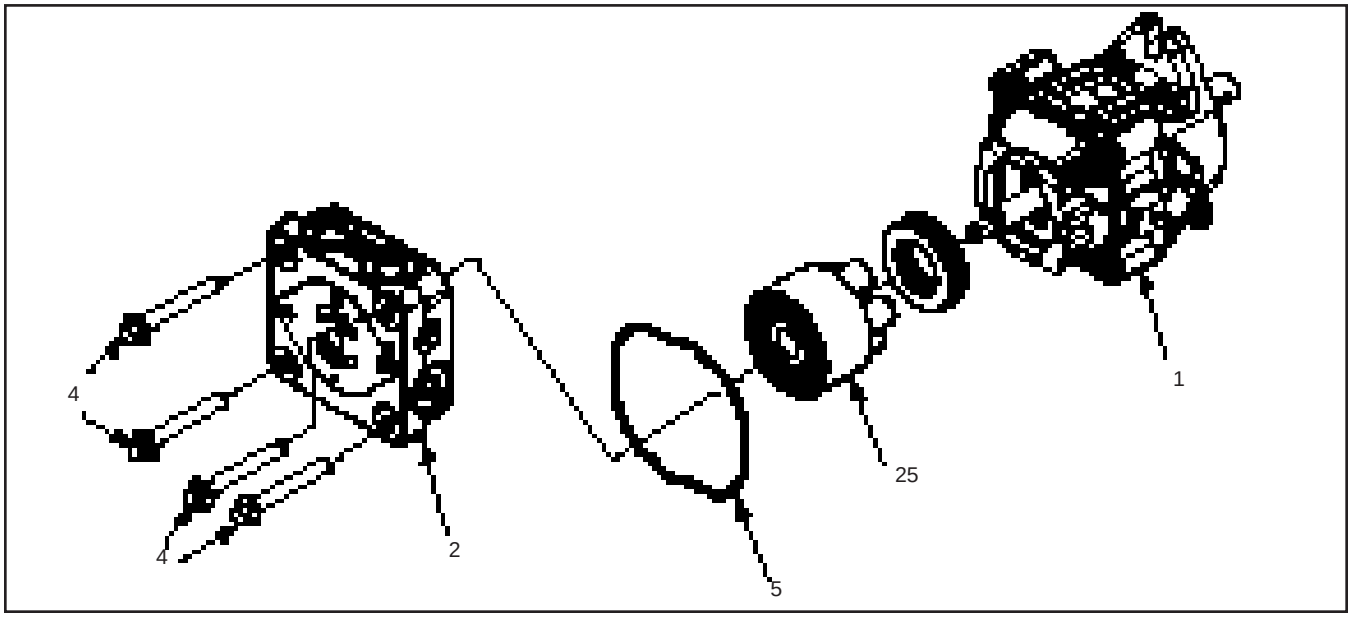


Figure 11. PK Pump End Cap

REMOVAL, INSPECTION AND ASSEMBLY OF THE CYLINDER BLOCK

Refer to Figure 12.

Disassembly

1. Remove charge pump. (See page 80.
2. Remove end cap. (See page 82).
3. Tilt the pump on its side and drain remaining oil. Lift out the cylinder block assembly (25).
4. Remove the pistons, springs and piston seats.

Inspection

1. Inspect the running surface of the cylinder block and piston ends for damage, nicks or unusual wear patterns. The running surface may show evidence of minor abrasion. This will be normal wear. If grooved or smeared, replace with a new cylinder block assembly.
2. Inspect the piston springs for distortion or breaks. If necessary, replace with a new cylinder block kit.
3. Inspect the piston seats. Residual oil may cause these to remain stuck to the inside of the pistons.

Assembly

1. Apply a thin layer of clean oil to the pistons and springs.
2. Install piston seats into the end of the pistons.
3. Install springs into the pistons.
4. Install each piston, spring and seat assembly into the cylinder block.
5. With the pump housing tilted on its side, install the cylinder block assembly (25) with pistons contacting the thrust bearing.

NOTE: To check if the cylinder block assembly is installed correctly, position the pump housing vertically and support housing at the mounting flange. Push down on the cylinder block. The cylinder block must move up and down freely. If it does not, remove the cylinder block assembly. Place a rubber band around the cylinder block pistons to hold them in position during installation. Then after installation cut the rubber band and remove it. Check cylinder block assembly for spring action.

6. Install the end cap. (See page 82)
7. Install the charge pump. (See page 80)

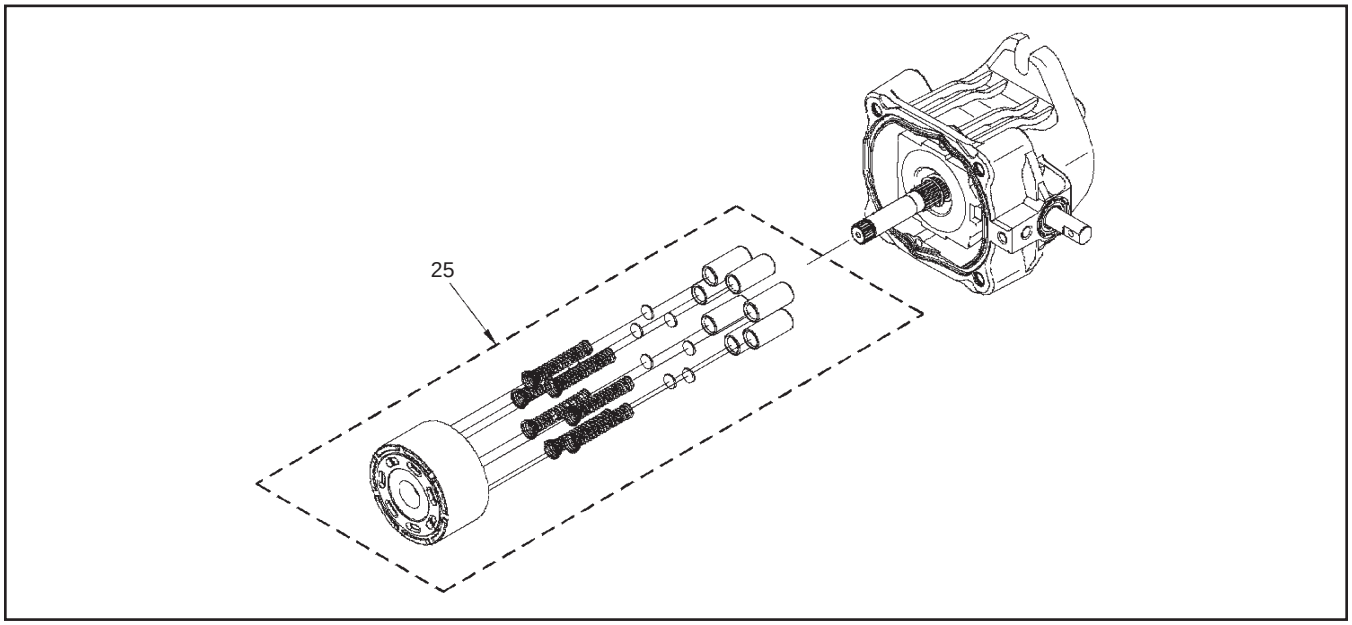


Figure 12. PK Pump Cylinder Block

REMOVAL, INSPECTION AND ASSEMBLY OF BLOCK SPRING AND THRUST BEARING

Refer to Figure 13.

Disassembly

1. Remove the block spring (29).
2. Remove the block thrust washer (30) and thrust bearing (34).

Inspection

1. Inspect and replace the block spring (29) if it is distorted or broken.
2. Inspect the running surface of the bearing races for damage, nicks or unusual wear patterns. The running surface may show evidence of minor abrasion. This will be normal wear.

   Inspect the bearings for free movement. Inspect the bearing cage for distortion or damage. Replace if necessary.

Assembly

1. Install thrust bearing and race assembly (34).
2. Install the block thrust washer (30).

NOTE: The difference in race thicknesses: The thin race seats into the swashplate (32). The thicker race will be installed toward the piston noses.

3. Install block spring (29).

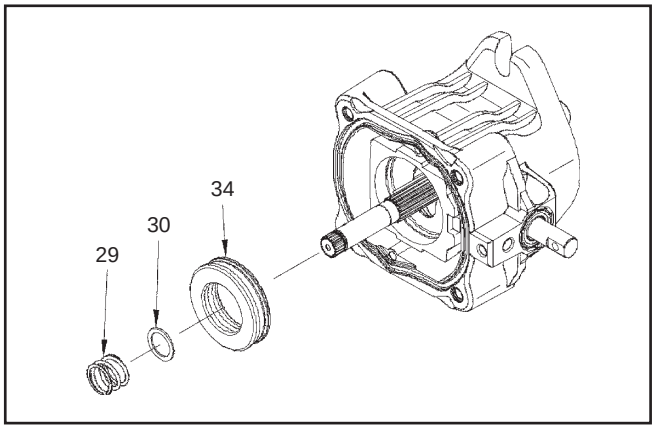


Figure 13. Pump Block Spring and Thrust Bearing

REMOVAL, INSPECTION AND ASSEMBLY OF SWASHPLATE AND CRADLE BEARINGS

Refer to Figure 14.

Disassembly

1. Remove the swashplate (32).

Inspection

1. Inspect the running surface of the bearing pocket of swashplate (32) for damage, nicks or unusual wear patterns. The running surface may show evidence of minor abrasion. This is normal wear. Inspect the cradle bearing side of the swashplate (32) for damage. Replace if necessary.
2. Inspect the cradle bearings attached to the inside of the housing (1) for normal wear patterns and placement, and insure they are staked securely in place. If the bearings are damaged, replace housing (1).

NOTE: The cradle bearings will have discoloration due to normal wear. Under normal circumstances, this will not warrant replacement.

Assembly

1. Install swashplate (32) by holding trunnion arm's slot guide (38) with a flat tip screwdriver. Use the screwdriver to hold the slot guide in place while positioning the swashplate (32) onto the cradle bearing in the housing (1).
2. Rotate trunnion arm (37) to verify that the swashplate moves freely.

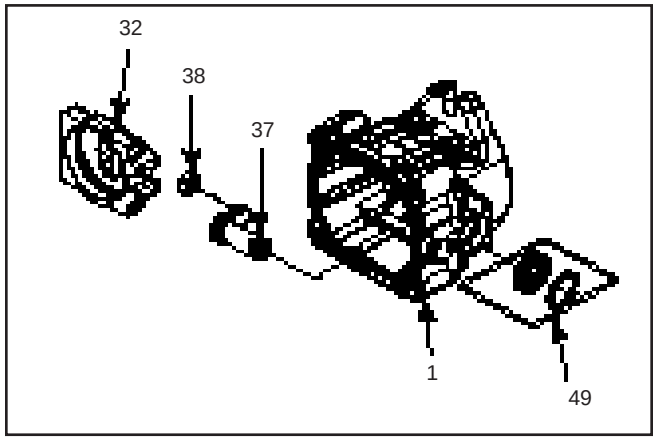


Figure 14. PK Pump Swashplate and Cradle Bearings

REMOVAL, INSPECTION AND ASSEMBLY OF INPUT SHAFT

Refer to Figure 15.

Disassembly

1. Remove the retaining ring (22).
2. Remove the lip seal (20).
3. Remove the spacer (21).
4. Remove the shaft (18) and bearing (19) assembly from the pump.

Inspection

1. Inspect the input shaft (18) for worn splines, surface damage, or keyway damage. Replace shaft assembly if necessary.
2. Inspect the bearing (19) for evidence of scoring, corrosion, or damage. If the bearing must be replaced, remove the retaining ring and use a press or bearing puller to remove the bearing.
3. Inspect and replace the spacer (21) if it is bent or broken.
4. Inspect and replace the retaining ring (22) if it is bent or broken.

NOTE: Upon removal, all seals, O-rings and gaskets should be replaced.

Assembly

NOTE: If trunnion arm is to be removed, do not assemble input shaft until the trunnion arm is installed.

NOTE: During installation, lightly lubricate all seals, O-rings and gaskets with clean petroleum jelly prior to assembly. Also, protect the inner diameter of seals by covering the shaft with plastic wrap.

1. If removed, press bearing (19) onto shaft (18) tight against the shoulder of the shaft. Install retaining ring onto the shaft (18).
2. Install input shaft assembly (18) into the housing (1) bore. Light tapping with a rubber mallet may be necessary on the input shaft (18) once the bearing is aligned with the housing (1) bore. Verify that the shaft rotates smoothly.
3. Install spacer (21).
4. Install new lip seal (20) with the flat side of the seal toward the outside of the pump.
5. Remove the plastic wrap.
6. Install retaining ring (22).

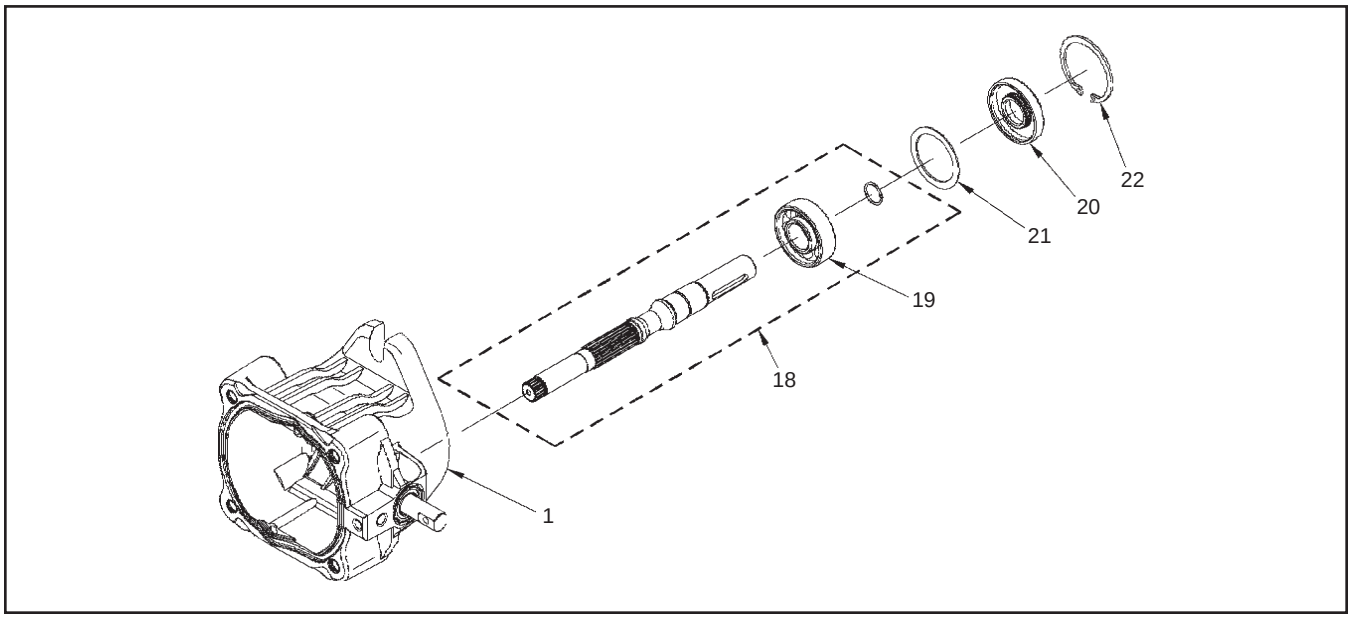


Figure 15. PK Pump Input Shaft

REMOVAL, INSPECTION AND INSTALLATION OF TRUNNION ARM

Refer to Figure 16.

Disassembly

1. Remove the slot guide (38).
2. Remove and discard the trunnion seal retainer and seal (49).
3. Remove the trunnion arm (37).

Inspection

1. Inspect the trunnion arm (37) for wear or damage. Replace the trunnion arm if necessary.
2. Check for excessive play between trunnion arm (37) and housing (1). Replace housing if necessary.

Assembly

1. Install the trunnion arm (37) into the housing (1) bore. Rotate the trunnion arm to verify free movement.
2. Install a new seal and seal retainer (49).
3. Install slot guide (38).
4. To completely assembly the pump, refer to the assembly steps on pages 75-86. Begin with the trunnion arm assembly steps listed on page 86 and complete the assembly steps in reverse order working toward the front of the manual.

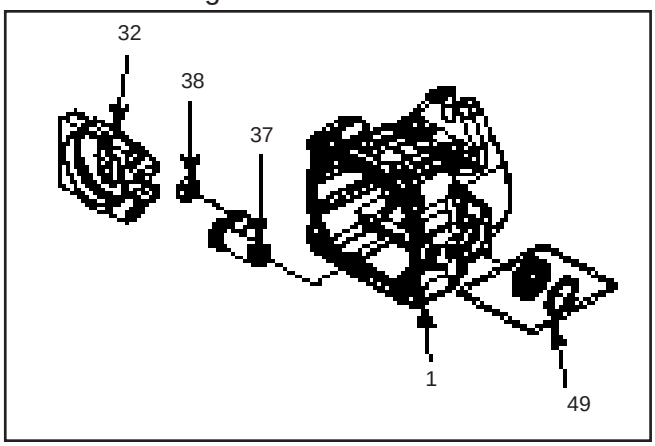


Figure 16. PK Pump Trunnion Arm

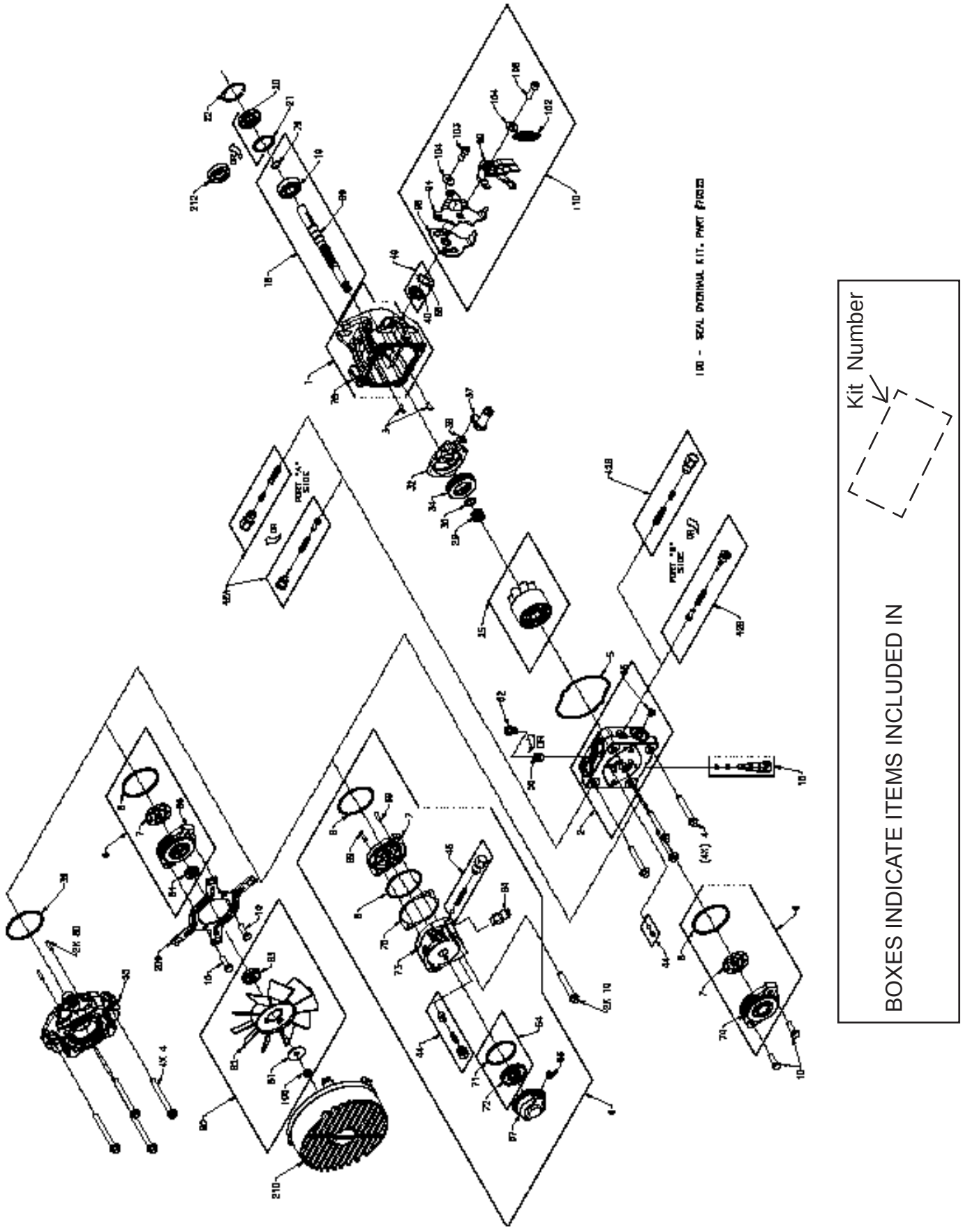


Figure 17. PK Pump

ITEM LIST - PK SERIES

Part numbers are not provided in this manual.

No.	Description
1	Housing Kit
2	End Cap Kit (W/Poppets, Standard Charge)
	End Cap Kit (W/ SCR'S, Standard Charge)
	End Cap Kit (W/ Poppets, Auxiliary Charge)
	End Cap Kit (W/ SCR'S, Auxiliary Charge)
	End Cap Kit (STD CHG) LH;SCR/HR: Poppet
	End Cap Kit (STD CHG) LH:Poppet/RH:SCR
	End Cap Kit (STD CHG) LH:SCR/RH:SCR
	End Cap Kit (AUX CHG) LH:SCR/RH:Poppet
	End Cap Kit (AUX CHG) LH:Poppet/RH:SCR
	End Cap Kit (AUX CHG) LH:SCR/RHPoppet, Thru
	End Cap Kit (AUX CHG) W/Poppets, Thru
	End Cap Kit (AUX CHG) W/SCR;s, Thru
	End Cap Kit (AUX CHG) LH:Poppet/RH:SCR, Thru
3	Straight Headless Pin
4	Hex Flange Bolt M8-1.25 X 60 mm LG
5	Housing O-Ring
6	Charge Pump Kit (STD)
	Charge Pump Kit (STD CHG), Thru
	Aux Pump Kit (AL., 15T Splined, 2-7/16 SAE Ports)
	Aux Pump Kit (AL., 15T Splined, 3-7/16 SAE Ports)
7	STD Gerotor Assy (.11 cu. In/rev D-Drive) Auxiliary Gerotor & Housing Assembly
8	O-Ring
10	Socket Head Screw M6 x 1.0-20 mm Lg (STD CHg)
	Hex Flange Bolt 8M-1.25 x 60 mm (Aux Chg)
	Cap Screw, Hex 5/16-18 x 1.00 (Thru Chg) Supplied with item # 2 only
15	Bypass Valve Kit (Blank)
	Bypass Valve Kit (0.031")
	Bypass Valve Kit (0.043")
18	Pump Shaft Kit (Blind 15mm Keyway W/Std Chg)
	Pump Shaft Kit (Blind 15mm Keyway W/Aux Chg)
	Pump Shaft Kit (9 Tooth W/Std Chg)
	Pump Shaft Kit (9 Tooth W/Aux Chg)
	Pump Shaft Kit (15mm Keyed, Std Chg, Thru)
	Pump Shaft Kit (9 Tooth Thru Chg)
	Pump Shaft Kit (Tapered)
19	Ball Bearing 17 X 40 X 12
20	Lip Seal 17 X 40 X 7 PTC
21	Spacer
22	Retaining Ring
25	Cylinder Block Kit
29	Block Spring

No.	Description
34	Ball Thrust Bearing
35	Stud, Torque
37	Trunnion Arm
	Trunnion, RTN
38	Slot Guide
42	Check Valve Kit (blank Orifice)
	Check Valve Kit (0.024" Orifice)
	Check Valve Kit (0.031" Orifice)
	Check Valve Kit (0.044" Orifice)
	System Check / Relief Kit
	System Check Relief Kit (.031" Orifice)
	Shock Valve Kit
44	Charge Relief Valve Kit (1/4" Plastic Ball & 50654 Spring)
	Charge Relief Valve Kit (9/16" SAE Plug & 3101536 Spring)
45	Aux Relief Valve Kit (1/4" Steel Ball)
	Aux Relief Valve Kit (Aux Poppet)
49	Trunnion Seal/Retainer Kit
54	Auxiliary Filter Kit
55	Plate, Adapter (Gear A)
56	Straight Thread Plug
59	O-Ring
64	Connector
66	5/16" SAE Plug
67	Filter Cover
69	Straight Headless Pin
75	Shim - Charge Pump (.002 - Red)
80	Pin, Straight Headless
85	R-Ring - 144
90	Hub / 6" Fan Kit
	Hub / 7" CCW Fan Kit
	Hub / 7" CW Fan Kit
	Hug / 7" Fan Kit
98	Return Arm
99	Scissor Arm
100	Seal Kit
101	Spacer RTN
102	Spring, Extension
103	Screw, 5/16 x .875 (patch)
104	Washer .34 x .88 x .06
105	Washer, Nylon
106	Bolt
110	Kit, RTN, STD
	Kit, RTN, CW
	Kit, RTN, CCW
209	Shroud Bracket
210	Shroud

REPAIR - PR SERIES PUMP

HOW TO USE THIS MANUAL

Each assembly is provided with an exploded view showing the parts involved. **The item reference numbers in each illustration are for assembly instructions only.** See pages 106 and 107 for part names and descriptions. A complete exploded view and item list of the pump is provided at the end of this section.

GENERAL INSTRUCTIONS

Cleanliness is a primary means of ensuring satisfactory life on repaired pumps. Thoroughly clean all exposed surfaces prior to any type of maintenance. Cleaning of all parts by using a solvent wash and air drying is usually adequate. As with any precision equipment, all parts must be kept free of foreign material and chemicals.

Protect all exposed sealing surfaces and open cavities from damage and foreign material. The external surfaces should be cleaned before beginning any repairs.

Lip-type seals (shaft seals) are used on the input shaft and directional control shaft of each pump. These seals can be replaced without major disassembly of the unit. However, replacement of these seals generally requires removal of the pump from the machine. Upon removal, it is recommended that all seals, O-rings and gaskets be replaced.

During installation, lightly lubricate all seals, O-rings and gaskets with clean petroleum jelly prior to assembly. Also protect the inner diameter of the seals by covering the shaft with a cellophane (plastic wrap, etc.) material.

Parts requiring replacement must be replaced from the appropriate kits identified in the Items Listing, found at the end of this manual. Use only original Hydro-Gear replacement parts found listed in BLN-51427 (CD).

TOOLS AND TORQUES

Miscellaneous	3/8-Inch Drive Ratchet and Sockets
P Series Service & Repair Manual	1/2-inch Socket
Torque Wrench	9/16-inch Socket
Scribe, Paint Pen, or Marker	5/8-inch Socket
Seal Hook with a Magnet	10-mm Socket
Flat Blade Screwdriver	
	Combination Wrenches
Pliers	1/2 inch
Internal Snap Ring	9/16 inch
	5/8 inch
Allen Wrenches	7/8 inch
5mm	10 mm
3/16 inch	
1/4 inch	

Table 1. Required Tools

Item # and/or Description	Torque
Case Drain (fitting torque)	200-250 lb-in (22.6-28.2 Nm)
System Port (fitting torque)	370-470 lb-in (41.8-53.1 Nm)
Inlet (fitting torque)	200-250 lb-in (22.6-28.2 Nm)
Fan Nut, Hex Lock 5/16-24 UNF	160-220 lb-in (18.1-24.9 Nm)
42A, 42B, Shock Valves/Check Plugs	180-240 lb-in (20.3-27.1 Nm)
45, Aux Relief Valve Kit	180-240 lb-in (20.3-27.1 Nm)
49, Aux Bypass/Check Kit	180-240 lb-in (20.3-27.1 Nm)
50, Bypass Valve	110-130 lb-in (12.4-14.7 Nm)
56, Screw	180-220 lb-in (20.3-24.9 Nm)
58, Hex Screw	255-300 lb-in (28.8-33.9 Nm)
67, Filter Cover	200-275 lb-in (22.6-31.1 Nm)
102, Cap Screw, Socket Head M8 x 1.25 x 25	180-220 lb-in (20.3-24.9 Nm)
107, Screw, 5/16-24 x .75	200-240 lb-in (22.6-27.1 Nm)
151, Diagnostic Plug	85-120 lb-in (9.6-13.5 Nm)
156, Filter Cover Plug	55-85 lb-in (6.2-9.6 Nm)

Table 2. PR Pump Torque Values

REMOVAL, INSPECTION AND/OR REPLACEMENT OF RETURN TO NEUTRAL ASSEMBLY

Prior to disassembly, note the position of the scissor arm brackets and the tab on the outer control arm bracket.

See Figure 1.

Disassembly

CAUTION: The spring used on the return to neutral linkage is under tension. To avoid possible injury, use care and proper protection during disassembly and assembly of the return to neutral linkage.

1. Loosen (but do not remove) the bolt (102).
2. To relieve spring tension, carefully pry up on the outer scissor control arm until it releases from the tab on the outer control arm bracket.
3. Remove the spring (108), bolt (102), washer (99) and outer scissor arm bracket (103).
4. Remove bushing (106), washers (109), and the inner scissor arm bracket (104).
5. Remove the outer control arm bracket (101), bolt (107), washer (99), and inner control arm bracket (105).

Inspection

1. With the arm control linkage removed, inspect the trunnion arm (13) and trunnion arm seal (12).
2. Inspect bushing (106) and all other linkage parts for damage, corrosion or wear.

Assembly

1. Install the inner return arm bracket (105), washer (99) and bolt (107).

NOTE: Do not over tighten the bolt (107). The bracket must move freely.

2. Install the outer control arm bracket (101), washer (109) and bushing (106).
3. Install the inner scissor control arm bracket (104), washer (109), and outer scissor control arm bracket (103).
4. Install washer (99), and bolt (102). Tighten to the correct torque value. See page 92
5. Install the spring (108).

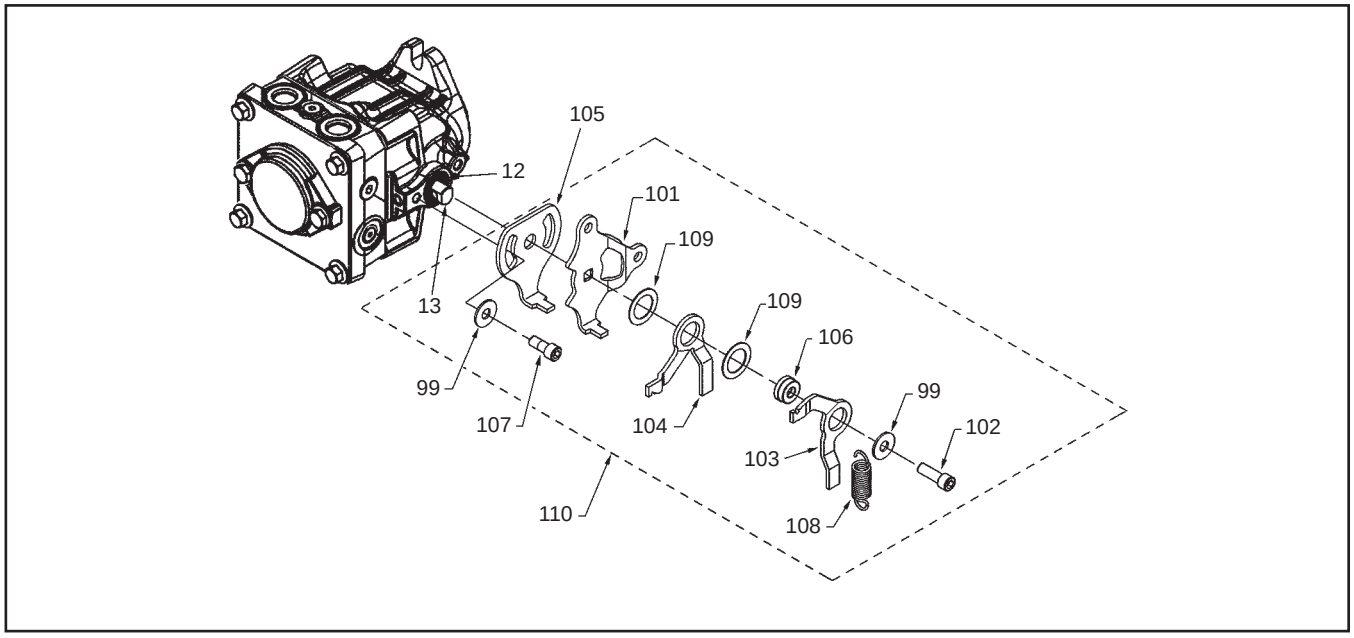


Figure 1. PR Pump Return to Neutral

REMOVAL, INSPECTION AND/OR REPLACEMENT OF CONTROL ARM

Refer to Figure 2.

Disassembly

1. Remove the bolt (102), washer (99) and bushing (106).
2. Remove the outer control arm bracket (101).
3. Remove bolt (107), washer (99) and the inner control arm bracket (105).

Inspection

1. With the arm control linkage removed, inspect the trunnion arm (13) and trunnion arm seal (12).
2. Inspect bushing (106) and all other linkage parts for damage, corrosion or wear.

Assembly

1. Install the inner return arm bracket (105), washer (99) and bolt (107).

NOTE: Do not over tighten the bolt (107). The bracket must move freely.

2. Install the outer control arm bracket (101), bushing (106), washer (99), and bolt (102). Tighten to the correct torque value. See page 92.

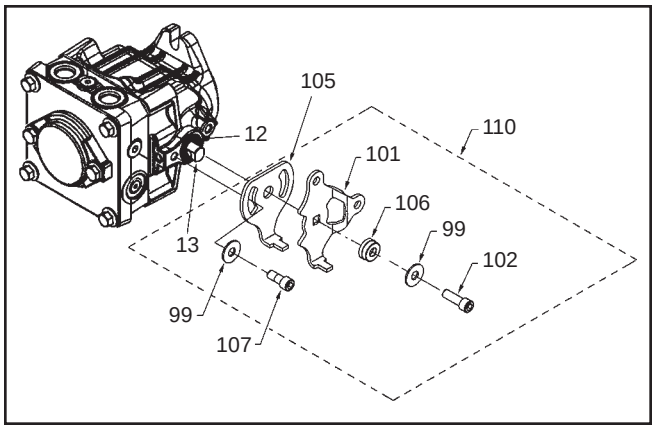


Figure 2. PR Pump Standard Control Arm

REMOVAL, INSPECTION AND/OR REPLACEMENT OF FAN ASSEMBLY

Refer to Figure 3.

Disassembly

1. Remove the fan shroud (210) from the mounting bracket (209) by carefully pushing down on the shroud tabs.
2. Remove the fan nut and fan assembly (90).
3. Remove the bolts (56) and bracket (209).

Inspection

Inspect the fan shroud (210), fan assembly (90) and mounting bracket (209) for damage.

Assembly

1. To install the mounting bracket (209), align and insert the bolts (56) into the bracket and charge pump cover. While holding the charge cover in place, tighten the bolts (56) per table 2, page 92.
2. Install the fan and washer assembly onto the shaft.
3. Install the fan nut and tighten per table 2, page 92.
4. Install the fan shroud (210) onto the mounting bracket (209). Make sure that all shroud lock tabs are fully engaged in the mounting bracket slots.

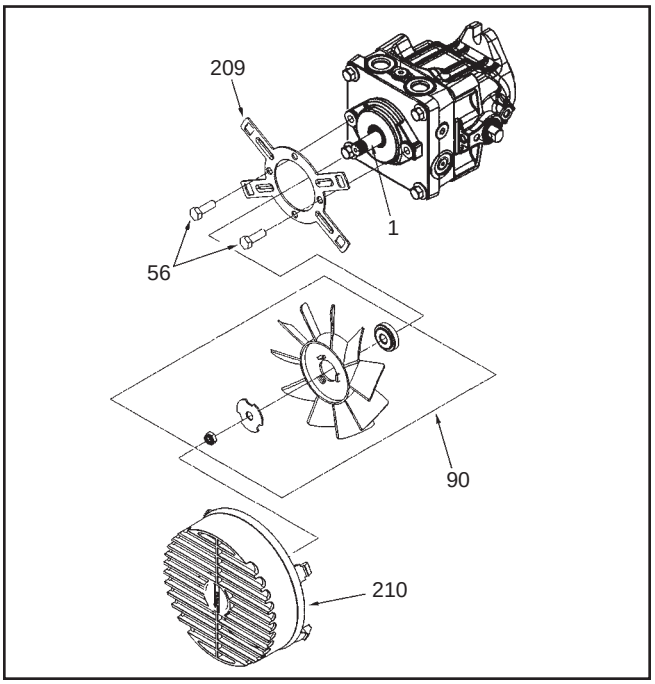


Figure 3. PR Pump Fan Assembly

REMOVAL, INSPECTION AND/OR REPLACEMENT OF INPUT SHAFT SEAL

Refer to Figure 4.

Disassembly

1. Remove retaining ring (3) from housing (15).
2. Remove lip seal (6). Care must be taken to prevent damage to the housing bore, shaft sealing surface, or bearing. Once removed, the seal is not reusable.

Inspection

1. With the lip seal (6) removed, inspect the spacer (4), shaft bearing (5) and housing (15) bore.

Assembly

1. Lubricate the new lip seal (6) with petroleum jelly.
2. Wrap the input shaft (1) with plastic wrap to prevent damage to the inner surface of the lip seal (6).
3. Slide the seal (6) over shaft (1) so that lettering on the seal (6) faces out.
4. Press the lip seal (6) into the housing (15) bore. Insure seal (6), shaft (1) or housing (15) bore do not become damaged.
5. Remove the plastic wrap.
6. Install the retaining ring (3) into the housing (15) bore groove.

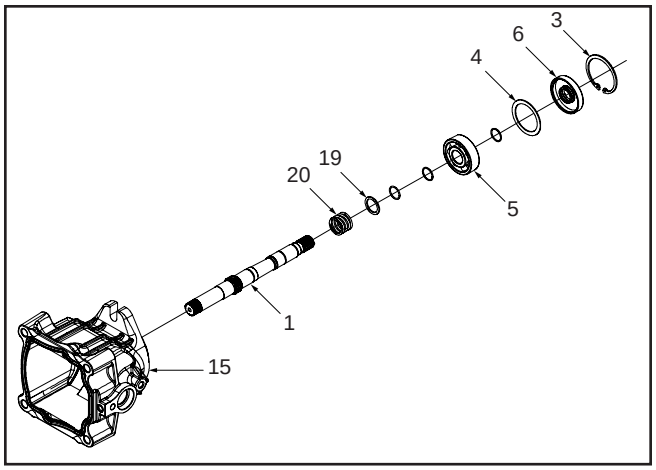


Figure 4. PR Pump Input Shaft Seal

REMOVAL, INSPECTION AND/OR REPLACEMENT OF TRUNNION ARM (CONTROL ARM) SEAL

Refer to Figure 5.

Disassembly

1. Remove the retainer and lip seal (12) from the housing (15). Care must be taken to prevent damage to the housing trunnion bore, trunnion arm (13) and sealing surface. Once removed the retainer and lip seal is not reusable.

Inspection

1. With the lip seal (12) removed, inspect the area for corrosion and wear. Inspect the trunnion bore area sealing surface for damage or wear.

Assembly

1. Lubricate the new lip seal (12) with petroleum jelly.
2. Wrap the trunnion arm (13) with plastic wrap to prevent damage to the inner surface of the lip seal (12).
3. Slide the lip seal (12) over the trunnion arm (13) so that the lettering on the seal (12) faces out.
4. Press the lip seal (12) into the housing bore (15). Insure the seal (12), trunnion arm (13), and housing bore do not become damaged. Remove the plastic wrap.
5. Install the retainer from (12) over the trunnion arm (13) on top of the lip seal (12). Press into the trunnion seal bore in the housing until the retainer mates against the trunnion seal.

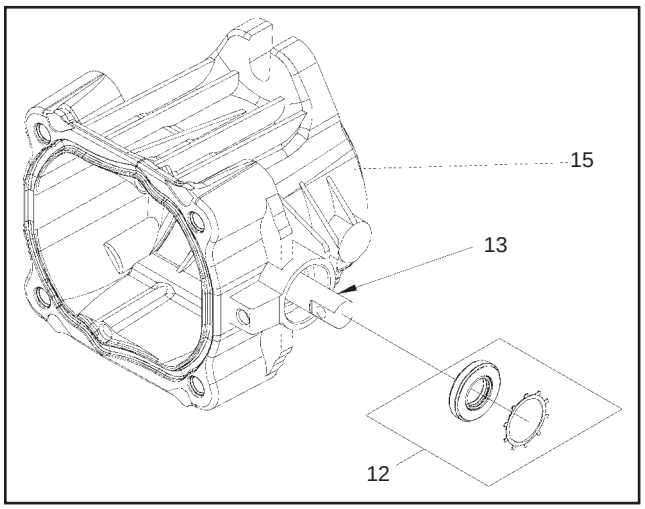


Figure 5. PR Pump Trunnion Arm Seal

REMOVAL, INSPECTION AND/OR REPLACEMENT OF CHECK VALVES

Refer to Figure 6.

Disassembly

Perform disassembly, inspection and assembly on check valves one side at a time. Some units vary in “A” side to “B” side check configuration.

1. Remove the check valve (42) with an 1/4” allen wrench.
2. Remove the valve spring and poppet from the end cap (25).

Inspection

1. Inspect the poppets and mating seats in the end cap (25) for damage or foreign material.

Assembly

1. Lay the pump on its side, so the check plug port is horizontal.
2. Insert the check plug, spring and poppet (42) as one assembly into the check plug port. Tighten, reference Table 2, page 92 for torque values.
3. Repeat disassembly, inspection and assembly for the opposite port side.

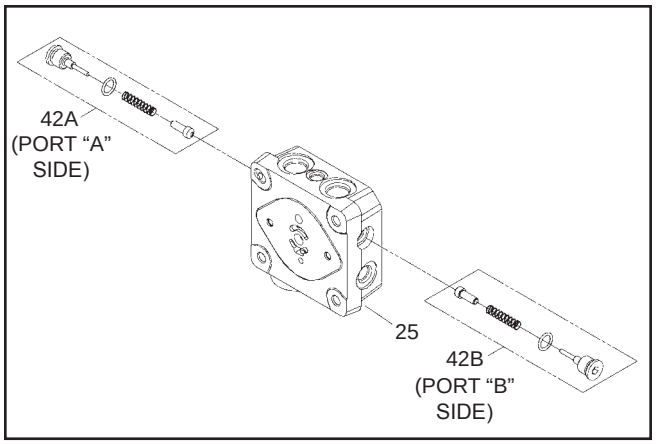


Figure 6. PR Pump Check Valves

REMOVAL, INSPECTION AND/ OR REPLACEMENT OF SYSTEM CHECK RELIEFS (SCR’S) OR SHOCK VALVES

Refer to Figure 7.

Disassembly

Perform disassembly, inspection and assembly on SCR/shock valve one side at a time. Some units vary in “A” side to “B” side configuration.

1. Remove the SCR (42) with a 7/8” wrench or the shock valve (42) with an 11/16” wrench.
2. Remove the check relief/shock valve spring and the check relief/shock valve from the end cap (25).

Inspection

1. Inspect the check relief or shock valve (42) and mating seat in the end cap (25) for damage or foreign material.

Assembly

1. Lay the pump on its side, so the check plug port is horizontal.
2. Insert the system check relief spring and check relief or shock valve spring and shock valve as one assembly into the check plug port. Tighten to the correct torque value. See page 92.
3. Repeat disassembly, inspection and assembly for the opposite port side.

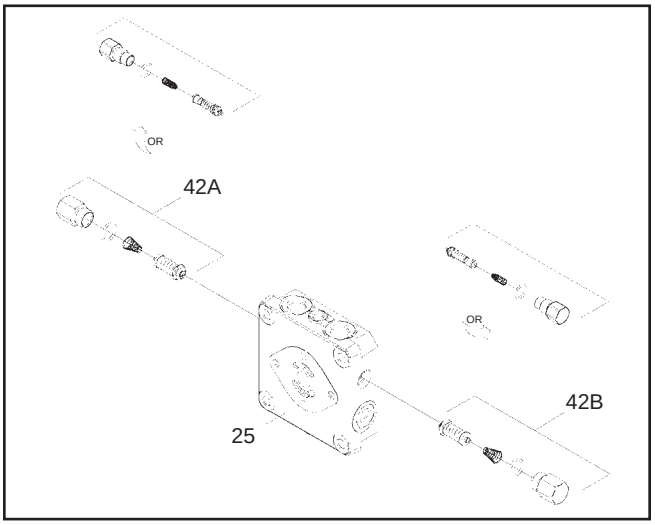


Figure 7. PR Pump Shock Valves

REMOVAL, INSPECTION AND /OR REPLACEMENT OF THE BYPASS

Refer to Figure 8.

Disassembly

1. Loosen the bypass valve (50) using a 5/8” wrench.
2. Remove the bypass (50) from the end cap (25).

Inspection

1. Inspect the bypass O-rings and mating seats in the end cap (25) for damage or foreign materials.
2. If damaged or worn replace bypass (50).

Assembly

1. Lay the pump on its side, so the bypass port is horizontal.
2. Insert the bypass (50) into the bypass port on the end cap (25). Tighten to the proper torque value. See page 92.

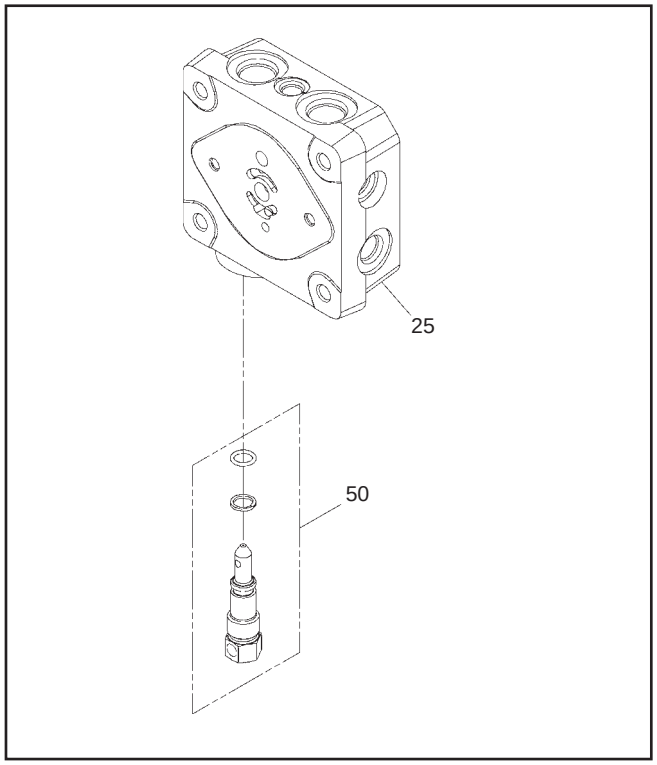


Figure 8. PR Pump Bypass

REMOVAL, INSPECTION AND ASSEMBLY OF STANDARD OR THRU SHAFT CHARGE PUMP

Refer to Figure 9.

Disassembly

1. Prior to removal of the charge pump cover, place a mark on the cover and end cap for alignment at assembly.
2. Using a 1/2 inch wrench loosen the charge pump cover bolts (56) from the end cap (2). While holding the charge cover in place, remove the charge cover bolts (56).
3. Remove the charge cover, O-ring (39) and gerotor items (41). Carefully check for and remove the charge spring and charge ball (44).
4. For the Thru Shaft charge pump, remove the shaft seal.

Inspection

1. Inspect the charge cover O-ring and running surfaces for damage. Inspect the spring, check ball (44), and mating seat in the end cap for damage or foreign material.

NOTE: If the end cap (2) is to be removed from the housing, do not assemble the charge pump (40) until the end cap is installed on the housing.

2. Inspect the charge cover bore for damage, corrosion or wear.

Assembly

NOTE: For the Thru Shaft charge pump follow steps 1-8. For the Standard charge pump follow steps 3-8.

1. Lubricate the new shaft seal with petroleum jelly.
2. Press the shaft seal into the charge cover. Be careful not to damage the seal or charge cover bore.
3. Position the pump with the input shaft down, and the end cap (25) horizontal. Place the charge ball (44) in the end cap (25) charge passage so the ball mates to the end cap (25) charge ball seat. Place the charge spring, on top of the charge ball.
4. Insert the outer gerotor over input shaft.
5. Align the outer gerotor to fit over the inner gerotor.
6. Insert the O-ring (39) into the groove in the charge cover.
7. Position the charge cover and O-ring (39) with the aligning mark on the end cap (25). Place the charge cover and O-ring with aligning mark on the end cap. Place the charge cover and O-ring as one piece over the charge spring and gerotor assembly. Insure the spring fits into the charge cover spring retaining groove.
8. Align and insert the charge pump cover bolts (56) into the end cap (25). Tighten to the correct torque value. See Table 2, page 92. (Torque Values.)

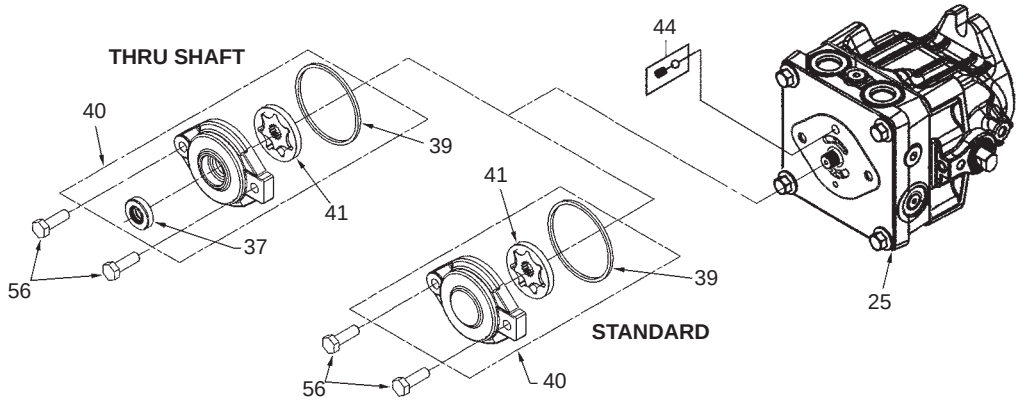


Figure 9. PR Pump Standard or Thru Shaft Charge Pump

REMOVAL, INSPECTION AND/OR REPLACEMENT OF AUXILIARY PUMP (IF EQUIPPED)

Refer to Figure 10.

Disassembly

1. Prior to removal of the auxiliary pump, place a mark on the auxiliary pump, charge pump (41) and end cap (25) for alignment at assembly.
2. Use a 10mm wrench to loosen the auxiliary pump bolts (56) from the end cap (25). While holding the auxiliary pump in place, remove the bolts (56).
3. Remove the auxiliary pump, gasket, O-ring (39) and charge pump (41). While removing the charge pump, be sure to retain the spring and ball (44) housed in the end cap (25).
4. Remove the plug (156) from the filter cover (67).
5. Use a 7/8 inch wrench to remove the filter cover assembly (67) from the auxiliary pump.
6. Remove the O-ring and filter (54).
7. Remove the charge relief valve assembly (49) and auxiliary relief valve assembly (45) from the auxiliary pump.

Inspection

1. With the auxiliary pump removed, inspect the pump running surfaces for wear or damage.
2. Inspect all O-rings, gasket and mounting seats.
3. Inspect the filter cover assembly threads and filter for wear, damage or foreign material.

Assembly

1. Install the check ball, spring, and cap as one assembly (45) into the auxiliary relief valve port. Tighten to the correct torque value. See page 92.
2. Install the poppet, spring and cap as one assembly (49) into the charge relief port. Tighten to the correct torque value. See page 92.
3. Install the filter (54) and O-ring onto the filter cover assembly (67). Install the assembly (67) into the auxiliary pump and tighten. Install plug (156) into the filter cover (67). See page 92 for the correct torque value.
4. Lay the PR pump (input shaft down), so the end cap is horizontal. Install the O-ring (39) into the charge pump (41).
5. Install the gasket onto the auxiliary pump.
6. Make sure that the ball and spring (44) are seated in the end cap (25), then position the auxiliary pump and gasket with the aligning mark on the charge pump (41). Insure that the pump fully engages the alignment pins (69).
7. Align and insert the bolts (56) into the auxiliary pump. While holding the auxiliary pump and charge pump in place, tighten the bolts (56) per table 2, page 92.

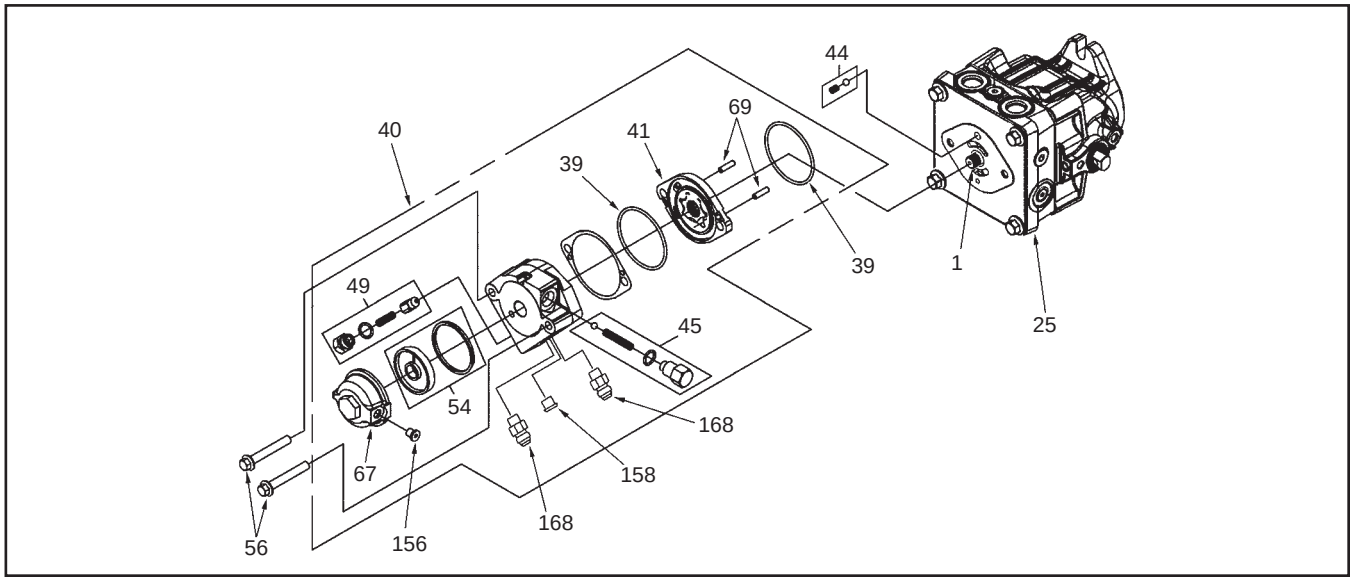


Figure 10. PR Series Auxiliary Pump

REMOVAL, INSPECTION AND ASSEMBLY OF THE END CAP AND VALVE PLATE

Refer to Figure 11.

Disassembly

1. Using any combination of two, 9/16” wrenches or 9/16” socket and ratchet drive, loosen the end cap bolts (58) evenly.
2. Keeping the end cap (25) held in place, remove the four end cap bolts (58).
3. Slowly remove the end cap (25).
4. Remove the valve plate (29).

   NOTE: This step is only applicable on PR series pumps built prior to 0216Pxxxxx.
5. Remove housing alignment pins (26).
6. Remove housing gasket (28).

Inspection

1. Inspect the end cap (25) body for damage, nicks or unusual wear patterns. Replace if necessary.
2. Inspect the running surface (side that contacts the cylinder block) of the valve plate (29) and/or end cap (25). The running surface may show evidence of minor abrasive rings, this is normal.

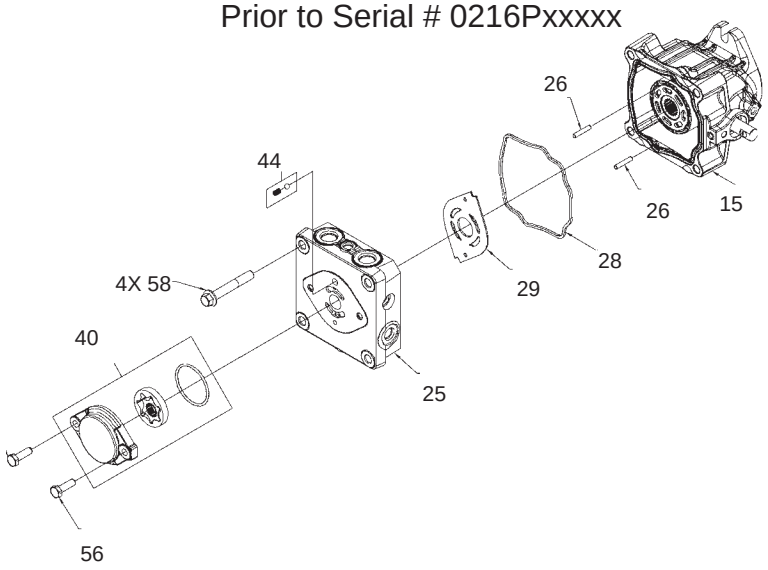
   NOTE: Grooving in the valve plate and/or end cap, made evident when the surface is checked by dragging a fingernail across it, would be cause for replacement of the valve plate.
3. Inspect and replace alignment pins (26) if bent or distorted.
4. Replace the housing O-ring (28) with a new O-ring before reassembly.

Assembly

1. Install O-ring (28) into the O-ring seat of housing (15).
2. Install alignment pins (26) into housing (15).
3. Lubricate the valve plate prior to installation. Install valve plate (29) so the bronze side of the valve plate is facing down toward the cylinder block.

   NOTE: This step is only applicable on PR series pumps built prior to 0216Pxxxxx.
4. On pumps built without a valve plate, lubricate the end cap (25) prior to installation.
5. Install end cap (25). Before installing the four end cap bolts (58), push down on the end cap (25) verifying alignment and insuring that the cylinder block pistons spring back and forth. Install and torque end cap bolts (58). Reference Table 2, page 92 (torque values).

Prior to Serial # 0216Pxxxxx



On or After Serial # 0216Pxxxxx

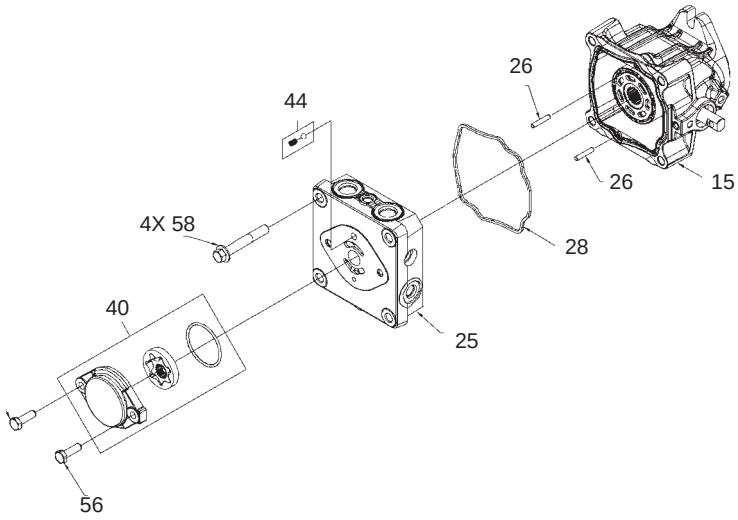


Figure 11. PR Pump End Cap

REMOVAL, INSPECTION AND ASSEMBLY OF THE CYLINDER BLOCK

Refer to Figure 12.

Disassembly

1. Tilt the pump on its side, drain remaining oil. Lift out the cylinder block assembly (38).
2. Remove the pistons, springs and piston seats.

Inspection

1. Inspect the running surface of the cylinder block and piston ends for damage, nicks or unusual wear patterns.

   The running surface may show evidence of minor abrasion. This will be normal wear. If grooved or smeared, replace with a new cylinder block assembly.
2. Inspect the piston springs for distortion or breaks. If necessary, replace with a new cylinder block kit.
3. Inspect the piston seats. Residual oil may cause these to remain stuck to the inside of the pistons.

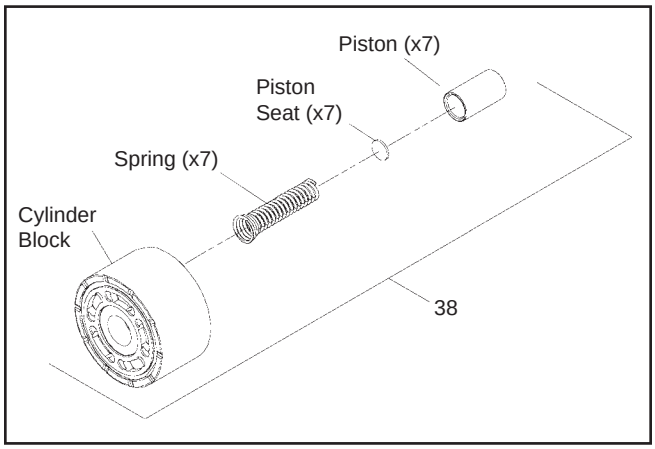


Figure 12. PR Pump Cylinder Block

Assembly

1. Install piston seats into the end of the pistons.
2. Install springs into the pistons.
3. Install one at a time, pistons, springs and seats as one assembly into the cylinder block.
4. With the pump housing tilted on its side, install the cylinder block assembly (38) with pistons contacting the thrust bearing.

NOTE: To check that piston placement is correct, push downward on the cylinder block assembly (38). If this results in a spring action the block assembly has been installed correctly. If this cannot be accomplished, remove and reassemble the block assembly. Place a rubber band around the cylinder block pistons to hold them in position during installation. Then after installation cut the rubber band and remove it. Check cylinder block assembly for spring action.

REMOVAL, INSPECTION AND ASSEMBLY OF BLOCK SPRING, THRUST WASHER, AND THRUST BEARING

Refer to Figure 13.

Disassembly

1. Remove the block spring (20).
2. Remove the thrust washer (19).
3. Remove the thrust bearing and race (17).

Inspection

1. Inspect and replace the block spring (20) and thrust washer (19) if they are distorted or broken.
2. Inspect the running surface of the bearing race for damage, nicks or unusual wear patterns. The running surface may show evidence of minor abrasion. This will be normal wear.

   Inspect the bearings for free movement. Inspect the bearing cage for distortion or damage. Replace if necessary.

Assembly

1. Install thrust bearing and race assembly (17).

NOTE: The difference in race thicknesses: The thin race seats into the swashplate. The thicker race will be installed toward the piston noses.

2. Install thrust washer (19).
3. Install block spring (20).

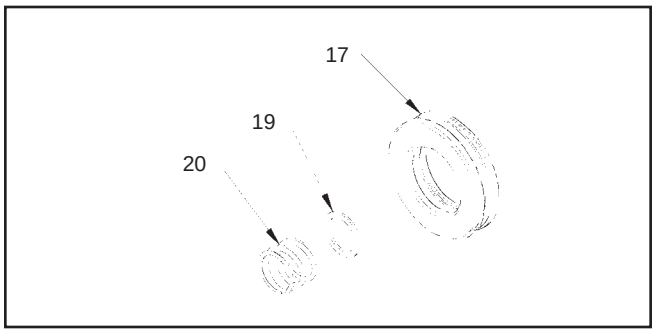


Figure 13. PR Pump Block Spring and Thrust Bearing

REMOVAL, INSPECTION OF SWASHPLATE, INSPECTION OF CRADLE BEARINGS

Refer to Figure 14.

Disassembly

1. Remove the swashplate (31).

Inspection

1. Inspect the running surface of the bearing pocket for damage (31), nicks or unusual wear patterns. The running surface may show evidence of minor abrasion. This is normal wear. Inspect the cradle bearing side of the swashplate (31) for damage. Replace if necessary.
2. Inspect the cradle bearings attached to the inside of the housing (15) for normal wear patterns, placement, and insure they are staked securely in place. If damaged, replace housing (15).

NOTE: The cradle bearings will have discoloration due to normal wear. Under normal circumstances, this will not warrant replacement.

Assembly

1. Install swashplate (31) by holding trunnion arm's (13) slot guide (14) with a flat tip screwdriver. Use the screwdriver to hold the slot guide (14) in place while positioning the swashplate (31) onto the cradle bearing in the housing (15).
2. Rotate trunnion arm (13) to assure swashplate pivoting action.

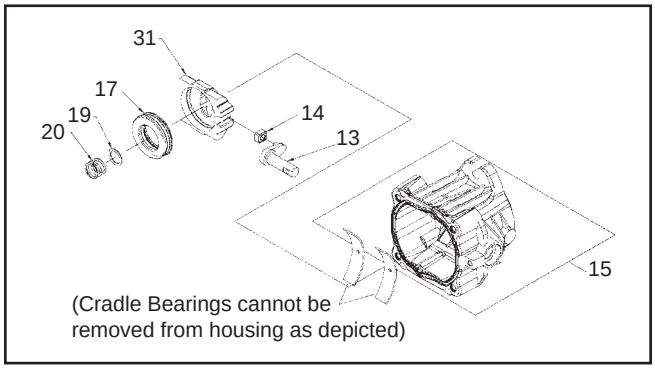


Figure 14. PR Pump Swashplate and Cradle Bearings

REMOVAL, INSPECTION AND ASSEMBLY OF INPUT SHAFT

Refer to Figure 15.

Disassembly

1. Remove the retaining ring (3).
2. Remove the lip seal (6).
3. Remove the spacer (4).
4. Remove the shaft assembly (1).

Inspection

1. Inspect the input shaft (1) for worn splines, damage, or keyway damage. Replace shaft assembly if necessary.
2. Inspect the bearing (5) for evidence of scoring, corrosion, or damage. Replace shaft assembly if necessary.
3. Inspect and replace the spacer (4) if it is bent or broken.

NOTE: Replace the input shaft seal (6) after removal.

4. Inspect and replace the retaining ring (3) if it is bent or broken.

NOTE: If trunnion arm is to be removed, delay reassembly of input shaft assembly.

5. Inspect and replace the thrust spring (20) and thrust washer (19) if they are distorted or broken.

Assembly

NOTE: Upon removal, it is recommended that all seals, O-rings and gaskets be replaced. During installation, lightly lubricate all seals, O-rings and gaskets with clean petroleum jelly prior to assembly. Also, protect the inner diameter of seals by covering the shaft with plastic wrap.

1. Install input shaft assembly (1) into the housing (15) bore. Light tapping with a rubber mallet may be necessary on the input shaft (1) once the bearing is aligned with the housing bore (15). Rotate the input shaft (1) to insure free movement.
2. Install spacer (4).
3. Install new lip seal (6).
4. Install retaining ring (3).

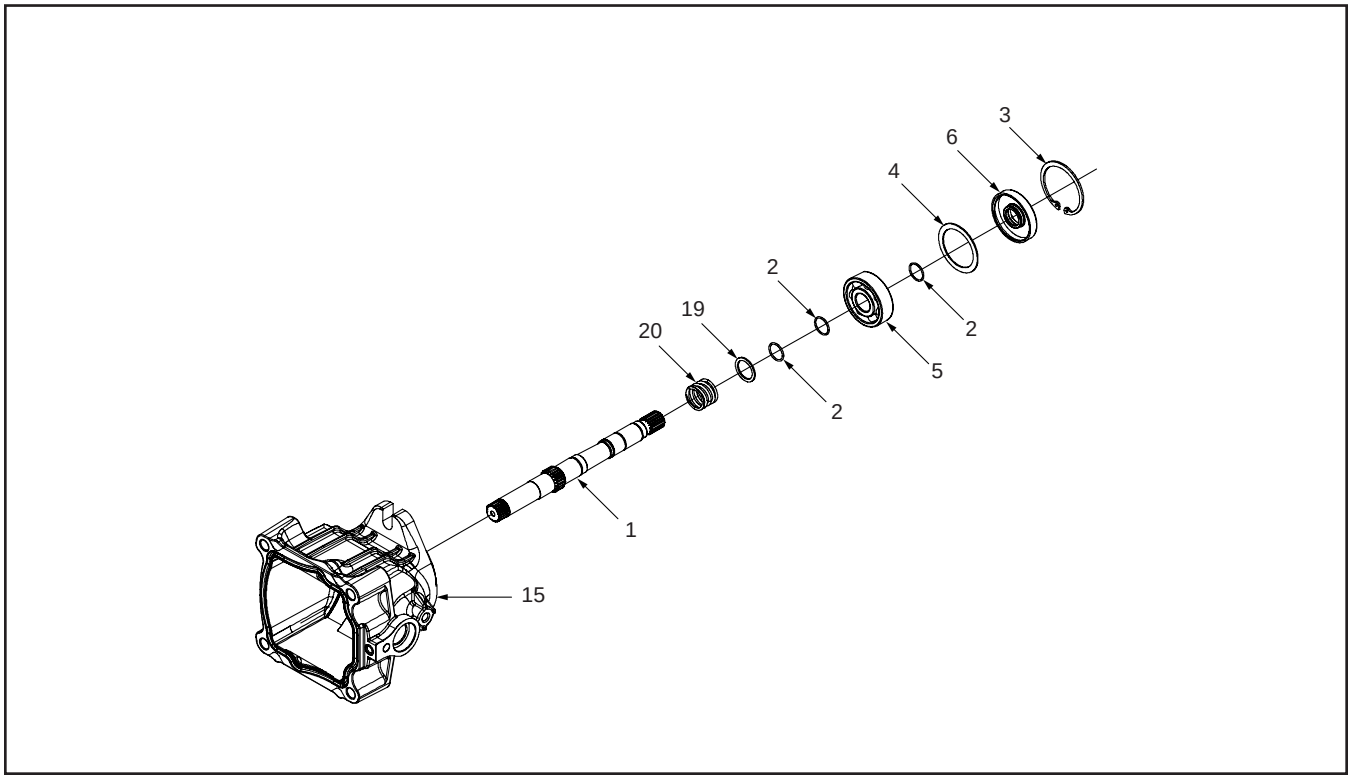


Figure 15. PR Pump Input Shaft

REMOVAL AND INSPECTION OF TRUNNION ARM

Refer to Figure 16.

Disassembly

1. Remove and discard the trunnion seal retainer and seal (12).
2. Remove the slot guide (14).
3. Remove the trunnion arm (13).

Inspection

1. Inspect the trunnion arm (13) for wear or damage. Replace the trunnion arm if necessary.

Assembly

1. Install the trunnion arm (13) into the housing (15) bore. Rotate the trunnion arm to verify free movement.
2. Install a new seal and seal retainer (12).
3. Install the slot guide (14).
4. To completely reassemble the pump, refer to the assembly steps on pages 93-104. Begin with the trunnion arm assembly steps listed on page 90 and complete the assembly steps in reverse order working towards the front of the manual.

NOTE: Upon removal, it is recommended that all seals, O-rings, and gaskets be replaced. During installation, lightly lubricate all seals, O-rings and gaskets with clean petroleum jelly prior to assembly. Also protect the inner diameter of seals by covering the shaft with plastic wrap. Remove the plastic wrap after the seal is installed.

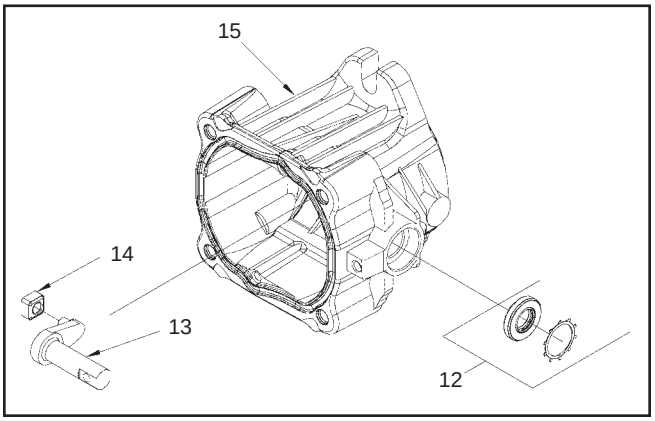


Figure 16. PR Pump Trunnion Arm

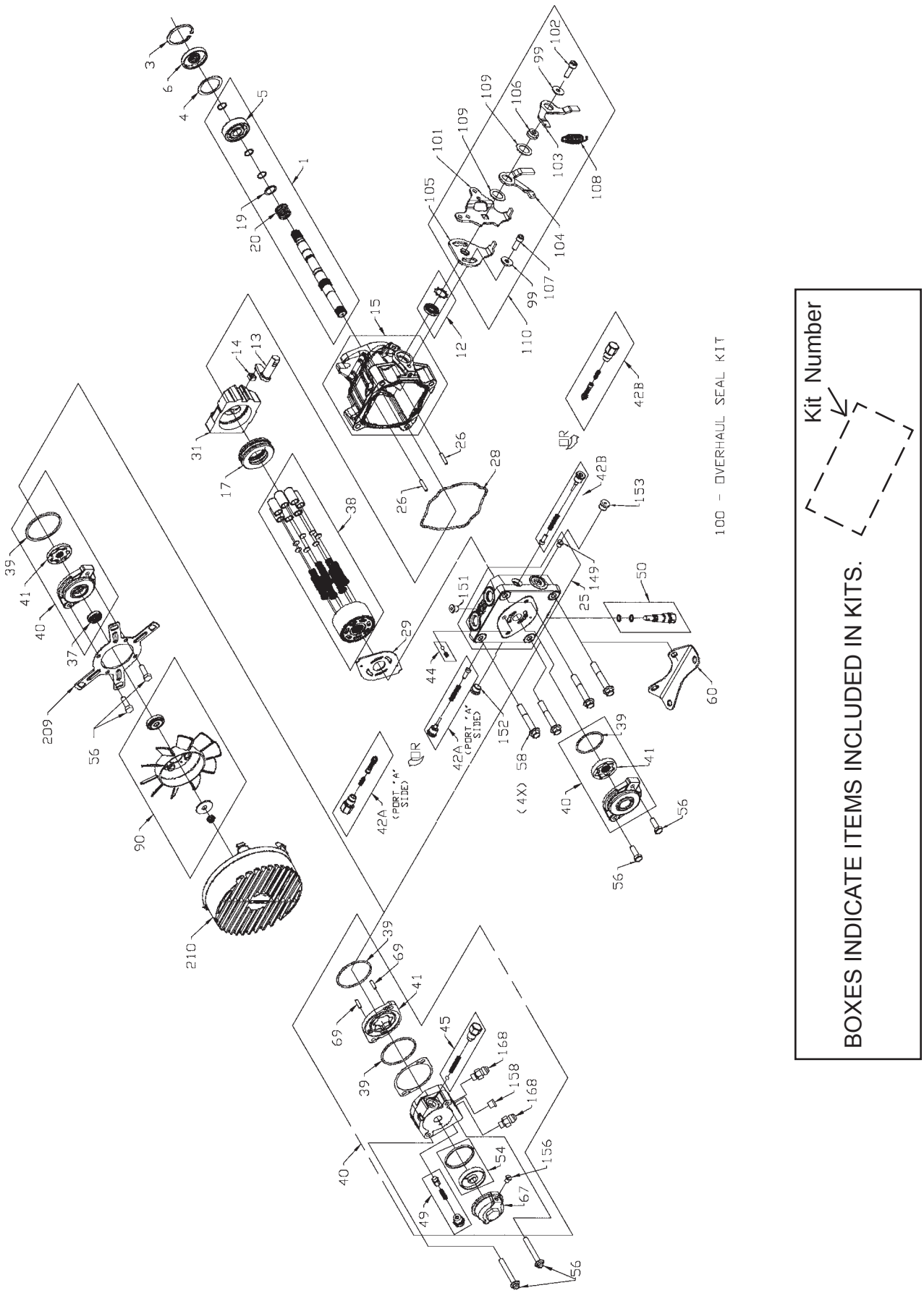


Figure 17. PR Pump

ITEM LIST - PR SERIES

Part numbers are not provided in this manual.

No.	Description
1	Pump Shaft Kit (19T spline)
	Pump Shaft Kit (17 mm keyed)
	Pump Shaft Kit (17 mm keyed thru taper)
	Pump Shaft Kit (double tapered thru shaft)
3	Retaining Ring
4	Spacer
5	Shaft Ball Bearing
6	Lip Seal 17 X 47 X 8 PTCN1
12	Trunnion Seal Kit
13	Trunnion Arm
14	Slot Guide
15	Housing Kit
17	Thrust Ball Bearing Assembly
19	Block Thrust Washer
20	Block Spring
25	End Cap Kit (w/poppets & std chg)
	End Cap Kit (w/poppets & aux chg)
26	Pin
28	O-Ring
29	Valve Plate
31	Variable Swashplate
38	Cylinder Block Kit (16cc)
39	O-Ring
	R-Ring (-144)
40	Charge Pump Kit (.19 std splined)
	Charge Pump Kit (.13 std thru shaft)
	Charge Pump Kit (CW-Iron Aux, 40-70 psi, .001” shim)
	Charge Pump Kit (CW-Iron Aux, 135-165 psi, .001” shim)
	Charge Pump Kit (CCW-Iron Aux, 70-70 psi, .001” shim)
	Charge Pump Kit (Al Aux, 7/16 SAE port, 40-70 psi, .001” shim)
	Charge Pump Kit (Al Aux 7/16 SAE port, 75-105 psi, .001” shim)
41	Gerotor Assembly (.13 cu.in./rev)
	Gerotor Assembly (.19 cu.in./rev)
	Aux Gerotor & Hsg Assembly (0.19 cu.in./rev)
42	Check Valve Kit (blank orifice)
	Check Valve Kit (0.24” orifice)
	Check Valve Kit (.031” orifice)
	Check Valve Kit (.044” orifice)
	Shock Valve Kit (blank orifice)
	Shock Valve Kit (.024” orifice)
	Shock Valve Kit (.031” orifice)
	Shock Valve Kit (.044” orifice)
44	Charge Relief Kit (1/4” plastic ball & spring)
	Charge Relief Kit (1/4” plastic ball & spring)
	Charge Relief Kit (w/ 9/16” SAE valve plug 40-70 psi)
	Charge Relief Kit (w/ 9/16” SAE valve plug 75-105 psi)
	Charge Relief Kit (w/ 1/2” SAE valve plug 40-70 psi)
	Charge Relief Kit (w/ 1/2” SAE valve plug 135-1650 psi)
45	Aux Relief Valve Kit
49	Aux Bypass/Check Kit
50	Bypass Valve Kit (blank orifice)
	Bypass Valve Kit (.031” orifice)
	Bypass Valve Kit (.043” orifice)
54	Auxiliary Filter Kit
56	Socket Hd Cap Screw (M8 x 1.25-25mm
	Flange Hd Screw (5/16-18 x 2.5)
58	Hex Screw, Flanged Hd (M10 x 1.50-65 mm)
60	Mounting Bracket
67	Filter Cover
69	Dowel Pin
90	Fan Kit
99	Washer
100	Seal Kit
101	Control Arm
102	Screw
103	Outer Scissor Arm
104	Inner Scissor Arm
105	Return Arm
106	Spacer
197	Screw
108	Spring
109	Washer
110	Return Kit
149	Plug
150	Plug
151	Plug
152	Plug
153	Plug
156	Plug
158	Plug
168	Connector
209	Shroud Bracket
210	Shroud

REPAIR - PW / PY SERIES PUMP

HOW TO USE THIS MANUAL

Each assembly is provided with an exploded view showing the parts involved. **The item reference numbers in each illustration are for assembly instructions only.** See pages 124 and 125 for part names and descriptions. A complete exploded view and item list of the pump is provided at the end of this section.

GENERAL INSTRUCTIONS

Cleanliness is a primary means of ensuring satisfactory life on repaired pumps. Thoroughly clean all exposed surfaces prior to any type of maintenance. Cleaning of all parts by using a solvent wash and air drying is usually adequate. As with any precision equipment, all parts must be kept free of foreign material and chemicals.

Protect all exposed sealing surfaces and open cavities from damage and foreign material. The external surfaces should be cleaned before beginning any repairs.

Lip-type seals (shaft seals) are used on the input shaft and directional control shaft of each Pump. These seals can be replaced without major disassembly of the unit. However, replacement of these seals generally requires removal of the pump from the machine. Upon removal, it is recommended that all seals, O-rings and gaskets be replaced.

During installation, lightly lubricate all seals, O-rings and gaskets with clean petroleum jelly prior to assembly. Also protect the inner diameter of the seals by covering the shaft with a cellophane (plastic wrap, etc.) material.

Parts requiring replacement must be replaced from the appropriate kits identified in the Items Listing, found at the end of this manual. Use only original Hydro-Gear replacement parts found listed in BLN-51427 (CD).

TOOLS AND TORQUES

Miscellaneous

P Series Service & Repair Manual

Torque Wrench

Scribe, Paint Pen, or Marker

Seal Hook with a Magnet

Flat Blade Screwdriver

Pliers

Internal Snap Ring

Allen Wrenches

5mm

3/16 inch

1/4 inch

3/8-Inch Drive Ratchet and Sockets

1/2-inch Socket

9/16-inch Socket

5/8-inch Socket

10-mm Socket

Combination Wrenches

1/2 inch

9/16 inch

5/8 inch

7/8 inch

10 mm

Table 1. Required Tools

Item # and/or Description	Torque
Case Drain (fitting torque)	370-470 lb-in (41.8-53.1 Nm)
System Port (fitting torque)	370-470 lb-in (41.8-53.1 Nm)
Inlet (fitting torque)	370-470 lb-in (41.8-53.1 Nm)
Fan Nut, Hex Lock 3/8-24 UNF	180-220 lb-in (20.3-24.9 Nm)
42A, 42B, Shock Valves/Check Plugs	180-240 lb-in (20.3-27.1 Nm)
44, Charge Relief Kit	180-240 lb-in (20.3-27.1 Nm)
45, Aux Relief Valve Kit	180-240 lb-in (20.3-27.1 Nm)
49, Aux Bypass/Check Kit	180-240 lb-in (20.3-27.1 Nm)
50, Bypass Valve	110-130 lb-in (12.4-14.7 Nm)
56, Screw	180-220 lb-in (20.3-24.9 Nm)
58, Housing Bolt	255-300 lb-in (28.8-38.9 Nm)
66, Steel Plug	55-85 lb-in (6.2-9.6 Nm)
67, Filter Cover	200-275 lb-in (22.6-31.1 Nm)
70, Relief Valve	180-240 lb-in (20.3-27.1 Nm)
79, Pan Head Screw	100-130 lb-in (11.2-14.6 Nm)
158, Plug 9/16	110-150 lb-in (12.4-16.9 Nm)
166, Plug	6-12 lb-in (.6-1.3 Nm)
167, Plug	6-12 lb-in (.6-1.3 Nm)
Screw, Socket Hd.Control Arm 5/16-24 x .75	200-240 lb-in (22.6-27.1 Nm)
Screw, Socket Hd. RTN M8 x 1.25 x 25	180-220 lb-in (20.3-24.9 Nm)

Table 2. PW / PY Pump Torque Values

REMOVAL, INSPECTION AND/OR REPLACEMENT OF RETURN TO NEUTRAL ASSEMBLY

Prior to disassembly, note the position of the scissor arm brackets and the tab on the outer control arm bracket.

See Figure 1.

Disassembly

CAUTION: The spring used on the return to neutral linkage is under tension. To avoid possible injury, use care and proper protection during disassembly and assembly of the return to neutral linkage.

1. Loosen (but do not remove) the bolt (112).
2. To relieve spring tension, carefully pry up on the outer scissor control arm until it releases from the tab on the outer control arm bracket.
3. Remove the spring (18), bolt (112) washer (109) and outer scissor arm bracket (113).
4. Remove bushing (116), washer (119), and the inner scissor control arm bracket (114).
5. Remove the outer control arm bracket (111), bolt (117), washer (109), and inner control arm bracket (115).

Inspection

1. With the arm control linkage removed, inspect the trunnion arm and trunnion arm seal.
2. Inspect bushing (116) and all other linkage parts for damage, corrosion or wear.

Assembly

1. Install the inner control arm bracket (115), washer (109) and bolt (117).

NOTE: Do not over tighten the bolt (117). The bracket must move freely.

2. Install the outer control arm bracket (111), washer (119) and bushing (116).
3. Install the inner scissor arm bracket (114), washer (119), and outer scissor arm bracket (113).
4. Install washer (109), and bolt (112). Tighten to the correct torque value. See page 110.
5. Install the spring (18).

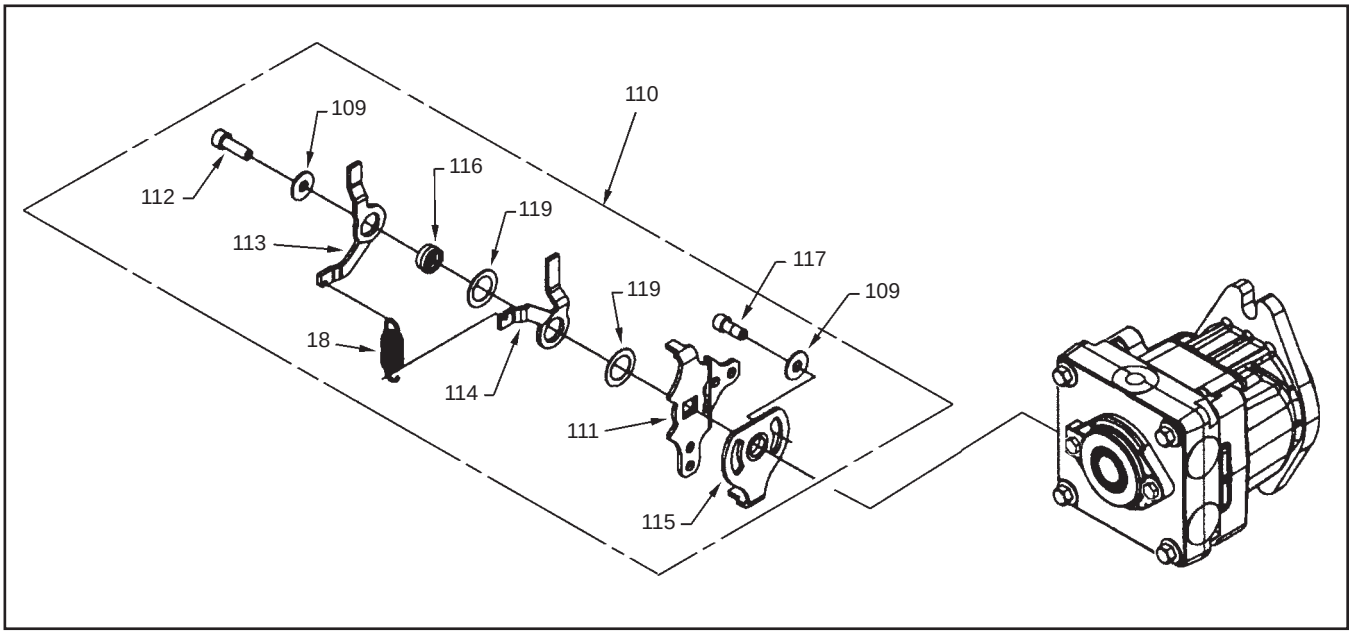


Figure 1. PW / PY Pump Return to Neutral

REMOVAL, INSPECTION AND/OR REPLACEMENT OF CONTROL ARM

Refer to Figure 2.

Disassembly

1. Remove the bolt (112), washer (109) and bushing (116).
2. Remove the outer control arm bracket (111).
3. Remove bolt (117), washer (109) and the inner control arm bracket (115).

Inspection

1. With the arm control linkage removed, inspect the trunnion arm and trunnion arm seal.
2. Inspect bushing (116) and all other linkage parts for damage, corrosion or wear.

Assembly

1. Install the inner return arm bracket (115), washer (109) and bolt (117).

NOTE: Do not over tighten the bolt (117). The bracket must move freely.

2. Install the outer control arm bracket (111), bushing (116), washer (109) and bolt (112). Tighten to the correct torque value. See page 110.

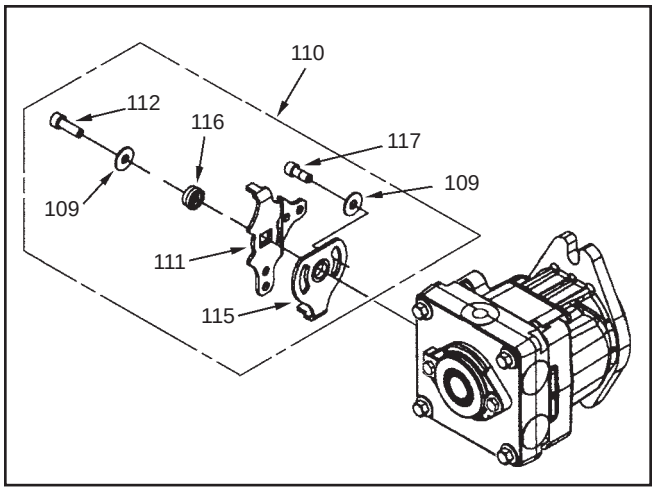


Figure 2. PW / PY Pump Standard Control Arm

REMOVAL, INSPECTION AND/OR REPLACEMENT OF FAN ASSEMBLY

Refer to Figure 3.

Disassembly

1. Remove the fan shroud (210) from the mounting bracket (209) by carefully pushing down on the shroud tabs.
2. Remove the fan nut and fan assembly (90).
3. Remove the bolts (56) and bracket (209).

Inspection

Inspect the fan shroud (210), fan assembly (90) and mounting bracket (209) for damage.

Assembly

1. To install the mounting bracket (209), align and insert the bolts (56) into the bracket and charge pump cover. While holding the charge cover in place, tighten the bolts (56) per table 2, page 110.
2. Install the fan and washer assembly onto the shaft.
3. Install the fan nut and tighten per table 2, page 110.
4. Install the fan shroud (210) onto the mounting bracket (209). Make sure that all shroud lock tabs are fully engaged in the mounting bracket slots.

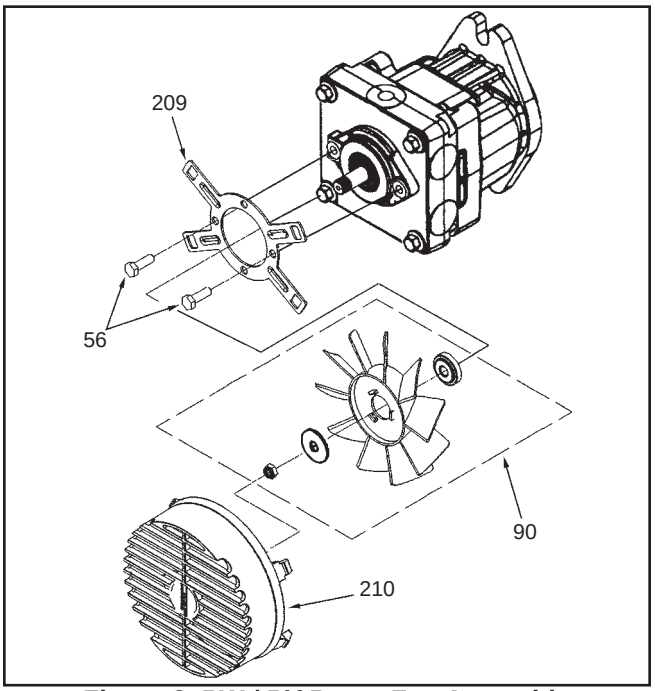


Figure 3. PW / PY Pump Fan Assembly

REMOVAL, INSPECTION AND/OR REPLACEMENT OF INPUT SHAFT SEAL

Refer to Figure 4.

Disassembly

1. Remove retaining ring (3) from housing (15).
2. Remove lip seal (6). Care must be taken to prevent damage to the housing bore, shaft, sealing surface, or bearing. Once removed, the seal is not reusable.

Inspection

1. With the lip seal (6) removed, inspect the spacer (4), shaft bearing (5) and housing (15) bore.

Assembly

1. Lubricate the new lip seal (6) with petroleum jelly.
2. Wrap the input shaft (1) with plastic wrap to prevent damage to the inner surface of the lip seal (6).
3. Slide the seal (6) over shaft (1) so that lettering on the seal (6) faces out.
4. Press the lip seal (6) into the housing (15) bore. Insure seal (6), shaft (1) or housing (15) bore do not become damaged. Remove the plastic wrap.
5. Install the retaining ring (3) into the housing (15) bore groove.

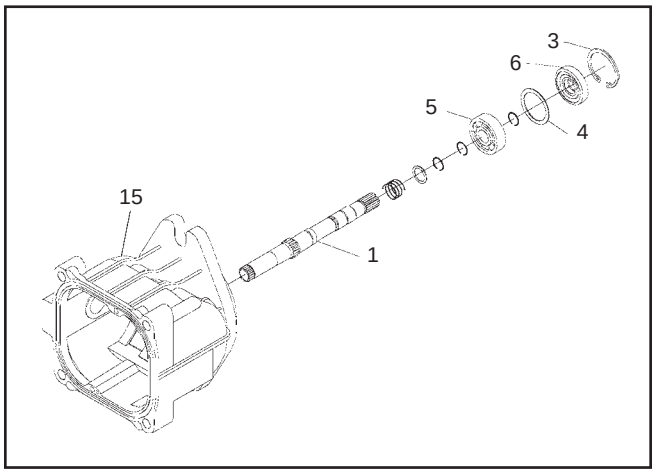


Figure 4. PW / PY Pump Input Shaft Seal

REMOVAL, INSPECTION AND/OR REPLACEMENT OF TRUNNION ARM (CONTROL ARM) SEAL

Refer to Figure 5.

Disassembly

1. Remove the retainer and lip seal (12). Care must be taken to prevent damage to the housing trunnion bore, trunnion arm (13) and sealing surface. Once removed the retainer and lip seal (12) is not reusable.

Inspection

1. With the lip seal (12) removed, inspect the area for corrosion and wear. Inspect the trunnion bore area sealing surface for damage or wear.

Assembly

1. Lubricate the new lip seal (12) with petroleum jelly.
2. Wrap the trunnion arm (13) with plastic wrap to prevent damage to the inner surface of the lip seal (12).
3. Slide the lip seal (12) over the trunnion arm (13) so that the lettering on the seal (12) faces out.
4. Press the lip seal (12) into the housing bore (15). Insure the seal (12), trunnion arm (13), and housing bore do not become damaged. Remove the plastic wrap.
5. Install the retainer over the trunnion arm (13) on top of the lip seal (12). Press into the trunnion seal bore in the housing (15).

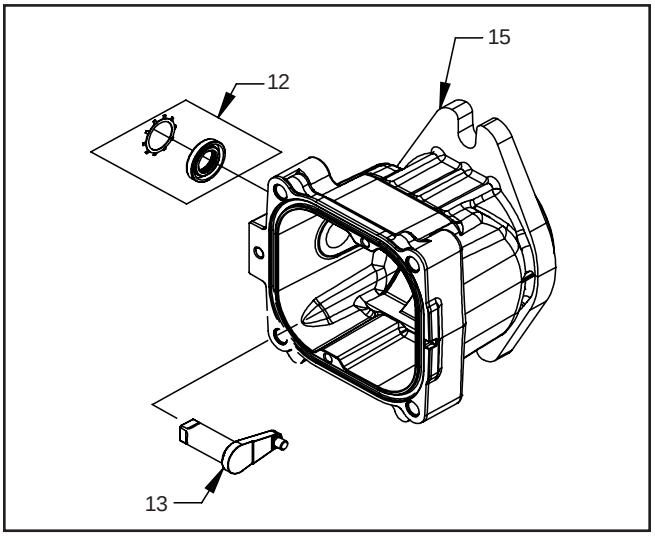


Figure 5. PW / PY Pump Trunnion Arm Seal

REMOVAL, INSPECTION AND/OR REPLACEMENT OF CHECK VALVES

Refer to Figure 6.

Disassembly

Perform disassembly, inspection and assembly on check valves one side at a time. Some units vary in “A” side to “B” side check configuration.

1. Remove the check valve (42) with an 1/4” allen wrench.
2. Remove the valve spring and poppet from the end cap (25).

Inspection

1. Inspect the poppets and mating seats in the end cap (25) for damage or foreign material.

Assembly

1. Lay the pump on its side, so the check plug port is horizontal.
2. Insert the check plug, spring and poppet (42) as one assembly into the check plug port. Tighten, reference Table 2, page 110 for torque values.
3. Repeat disassembly, inspection and assembly for the opposite port side.

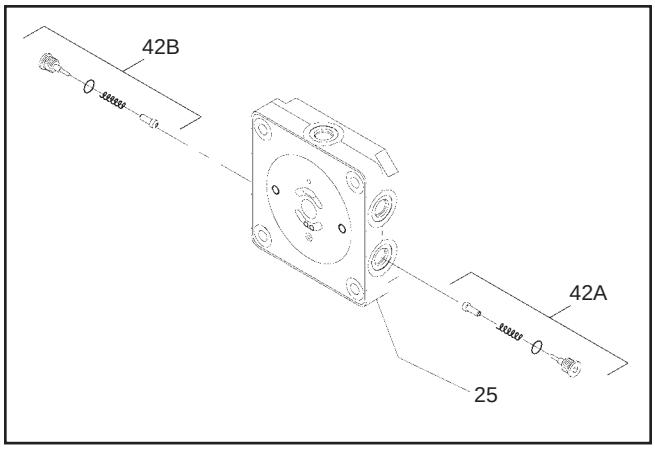


Figure 6. PW / PY Pump Check Valves

REMOVAL, INSPECTION AND/ OR REPLACEMENT OF SYSTEM CHECK RELIEFS (SCR’S) OR SHOCK VALVES

Refer to Figure 7.

Disassembly

Perform disassembly, inspection and assembly on SCR/shock valve one side at a time. Some units vary in “A” side to “B” side configuration.

1. Remove the SCR (42) with a 7/8” wrench or the shock valve (42) with an 11/16” wrench.
2. Remove the check relief/shock valve spring and the check relief/shock valve from the end cap (25).

Inspection

1. Inspect the check relief or shock valve (42) and mating seat in the end cap (25) for damage or foreign material.

Assembly

1. Lay the pump on its side, so the check plug port is horizontal.
2. Insert the system check relief spring and check relief or shock valve spring and shock valve as one assembly into the check plug port. Tighten, reference Table 2, page 110, for torque values.
3. Repeat disassembly, inspection and assembly for the opposite port side.

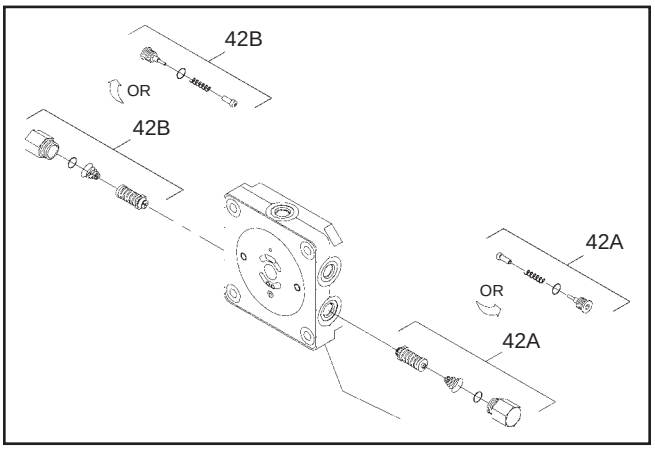


Figure 7. PW / PY Pump Shock Valves

REMOVAL, INSPECTION AND /OR REPLACEMENT OF THE BYPASS

Refer to Figure 8.

Disassembly

1. Loosen the bypass valve (50) using a 5/8” wrench.
2. Remove the bypass (50) from the end cap (25).

Inspection

1. Inspect the bypass O-rings and mating seats in the end cap (25) for damage or foreign materials.
2. If damaged or worn replace bypass (50)

Assembly

1. Lay the pump on its side, so the bypass port is horizontal.
2. Insert the bypass (50) into the bypass port on the end cap (25). Tighten, reference Table 2, page 110, torque values.

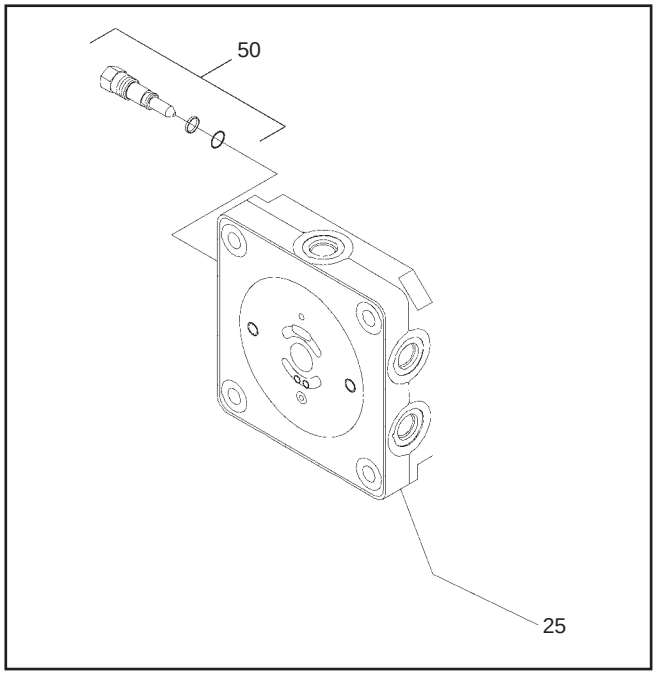


Figure 8. PW / PY Pump Bypass

REMOVAL, INSPECTION AND ASSEMBLY OF STANDARD OR THRU SHAFT CHARGE PUMP

Refer to Figure 9.

Disassembly

1. Prior to removal of the charge pump cover, place a mark on the cover and end cap for alignment at assembly.
2. Using a 1/2 inch wrench loosen the charge pump cover bolts (56) from the end cap (25). While holding the charge cover in place, remove the charge cover bolts (56).
3. Remove the charge cover, O-ring (39) and gerotor items (41). Carefully check for and remove the charge spring and charge ball (44).
4. For the thru shaft charge pump, remove the shaft seal (37). After serial date code 3076PXXXX all thru shaft charge covers will have a retaining ring (327) holding the shaft seal (37) in place.

Inspection

1. Inspect the charge cover O-ring and running surfaces for damage. Inspect the spring, check ball (44), and mating seat in the end cap (25) for damage or foreign material.
2. Inspect the charge cover bore for damage, corrosion or wear.

NOTE: If the end cap (25) is to be removed from the housing, do not assemble the charge pump (40) until the end cap is installed on the housing.

Assembly

For the Thru Shaft charge pump follow steps 1-8. For the Standard charge pump follow steps 3-8.

1. Lubricate the new shaft seal with petroleum jelly.
2. Press the shaft seal into the charge cover. Be careful not to damage the seal or charge cover bore.
3. Position the pump with the input shaft down, and the end cap (25) horizontal. Place the charge ball (44) in the end cap (25) charge passage so the ball mates to the end cap (25) charge ball seat. Place the charge spring (44), on top of the charge ball.
4. Insert the inner gerotor over input shaft.
5. Align the outer gerotor to fit over the inner gerotor.
6. Insert the O-ring (39) into the groove in the charge cover.
7. Position the charge cover and O-ring (39) with the aligning mark on the end cap (25). Place the charge cover and O-ring with aligning mark on the end cap. Place the charge cover and O-ring as one piece over the charge spring (44) and gerotor assembly. Insure the spring fits into the charge cover spring retaining groove.
8. Align and insert the charge pump cover bolts (56) into the end cap (25). Tighten to the correct torque value. See Table 2, page 110. (Torque Values.)

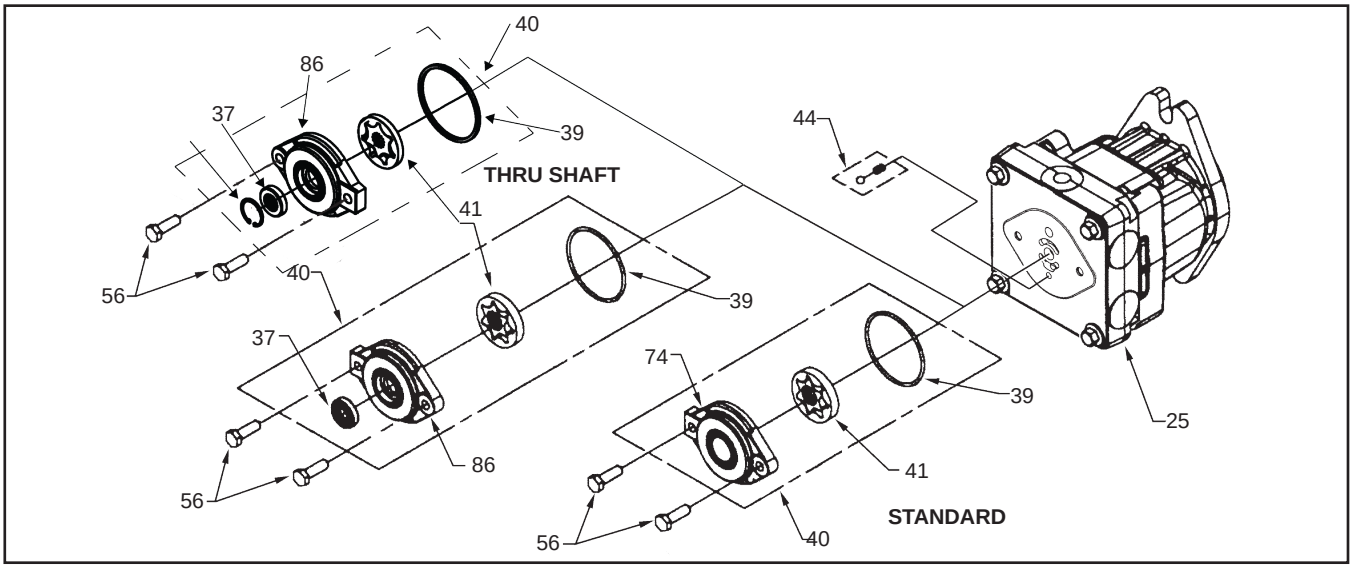


Figure 9. PW / PY Pump Standard or Thru Shaft Charge Pump

REMOVAL, INSPECTION AND/OR REPLACEMENT OF AUXILIARY PUMP (IF EQUIPPED)

Refer to Figure 10.

Disassembly

1. Prior to removal of the auxiliary pump, place a mark on the auxiliary pump, charge pump (41) and end cap (25) for alignment at assembly.
2. Use a 10mm wrench to loosen the auxiliary pump bolts (56) from the end cap (25). While holding the auxiliary pump in place, remove the bolts (56).
3. Remove the auxiliary pump, gasket, O-ring (39) and charge pump (41). While removing the charge pump, be sure to retain the spring and ball (44A) housed in the end cap (25).
4. Remove the plug (66) from the filter cover (67).
5. Use a 7/8 inch wrench to remove the filter cover assembly (67) from the pump.
6. Remove the O-ring and filter (54).
7. Remove the charge relief valve assembly (44) and auxiliary relief valve assembly (45) from the auxiliary pump.

Inspection

1. With the auxiliary pump removed, inspect the pump running surfaces for wear or damage.
2. Inspect all O-rings, gasket and mounting seats.
3. Inspect the filter cover assembly threads and filter for wear, damage or foreign material.

Assembly

1. Install the check ball, spring, and cap as one assembly (45) into the auxiliary relief valve port. Tighten to the correct torque value. See page 110.
2. Install the poppet, spring and cap as one assembly (44) into the charge relief port. Tighten to the correct torque value. See page 110.
3. Install the filter (54) and O-ring into the filter cover assembly (67). Install the assembly (67) into the auxiliary pump and tighten. Install the plug (66) into the filter cover (67).
4. Lay the PW pump (input shaft down), so the end cap is horizontal. Install the O-ring (39) into the charge pump (41).
5. Install the gasket onto the auxiliary pump.
6. Make sure that the ball and spring (44A) are seated in the end cap (25), then position the auxiliary pump and gasket with the aligning mark on the charge pump (7). Insure that the pump fully engages the alignment pins (69).
7. Align and insert the bolts (56) into the auxiliary pump. While holding the auxiliary pump and charge pump in place, tighten the bolts (56) per table 2, page 110.

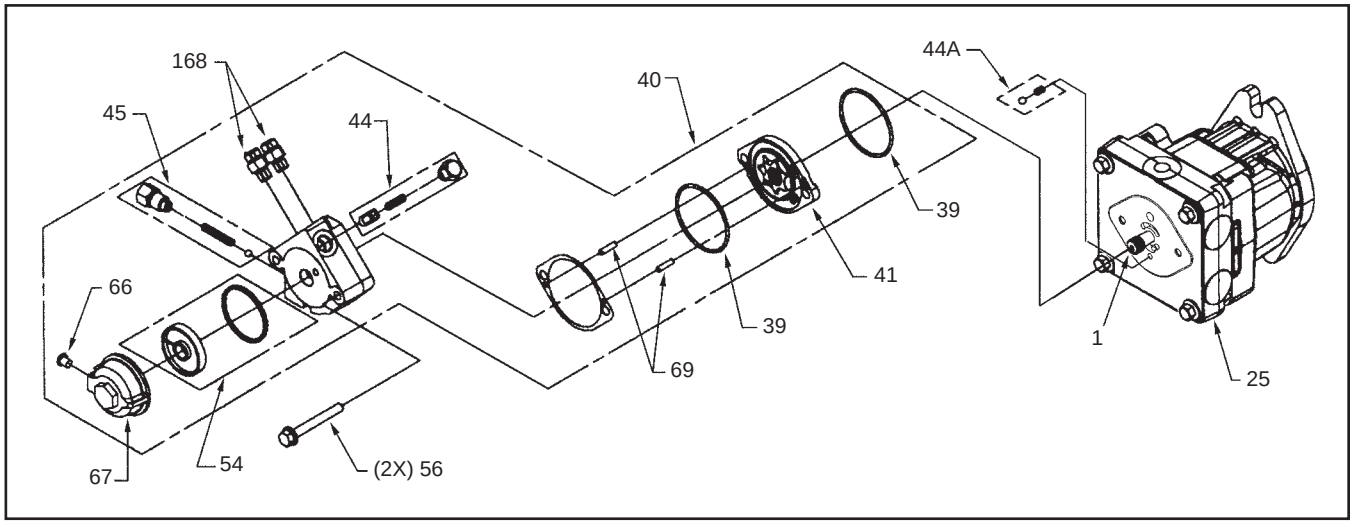


Figure 10. PW / PY Series Auxiliary Pump

REMOVAL, INSPECTION AND/OR REPLACEMENT OF 6CC PISTON AUXILIARY PUMP (IF EQUIPPED)

Refer to Figure 11.

Disassembly

1. Prior to removal of the 6cc piston auxiliary pump (40), *mark the auxiliary pump, charge pump (41) and end cap (25) for correct alignment at assembly.*
2. Remove the rotating cap (78) and O-ring (77).
3. Remove the thrust bearing (76).
4. Remove the cylinder block assembly (72-75).
5. Remove the portblock (40).
6. Remove the gerotor (41),O-ring (39), charge ball and spring (44A).
7. Remove the relief valve (70) from port block (40).

Inspection

1. Inspect bearing areas on (78) and O-ring.
2. Inspect thrust bearing (76) see page 121 figure 14.
3. Inspect cylinder block assembly (72-75) see page 120 figure 13.
4. Inspect running face on portblock (40). Grooving in the portblock, made evident when the surface is checked by dragging a fingernail across the surface, would be cause for replacement.
5. Inspect gerotor (41), O-ring (39) and end cap(25).

Assembly

1. After the endcap (25) has been installed on the pump housing (15). Position the pump with the input shaft down, and the end cap (25) horizontal. Place the charge ball (44) in the end cap (25) charge passage so the ball mates to the end cap (25) charge ball seat. Place the charge spring (44), on top of the charge ball.
2. Insert the gerotor (41) over input shaft.
3. Install the portblock (40) *paying attention to the orientation marks made before disassembly.* Tighten to the correct torque value. See Table 2, page 110. (Torque Values.)
4. Install cylinder block.
5. Install the rotating cap (78). Tighten to the correct torque value. See Table 2, page 110. (Torque Values.)

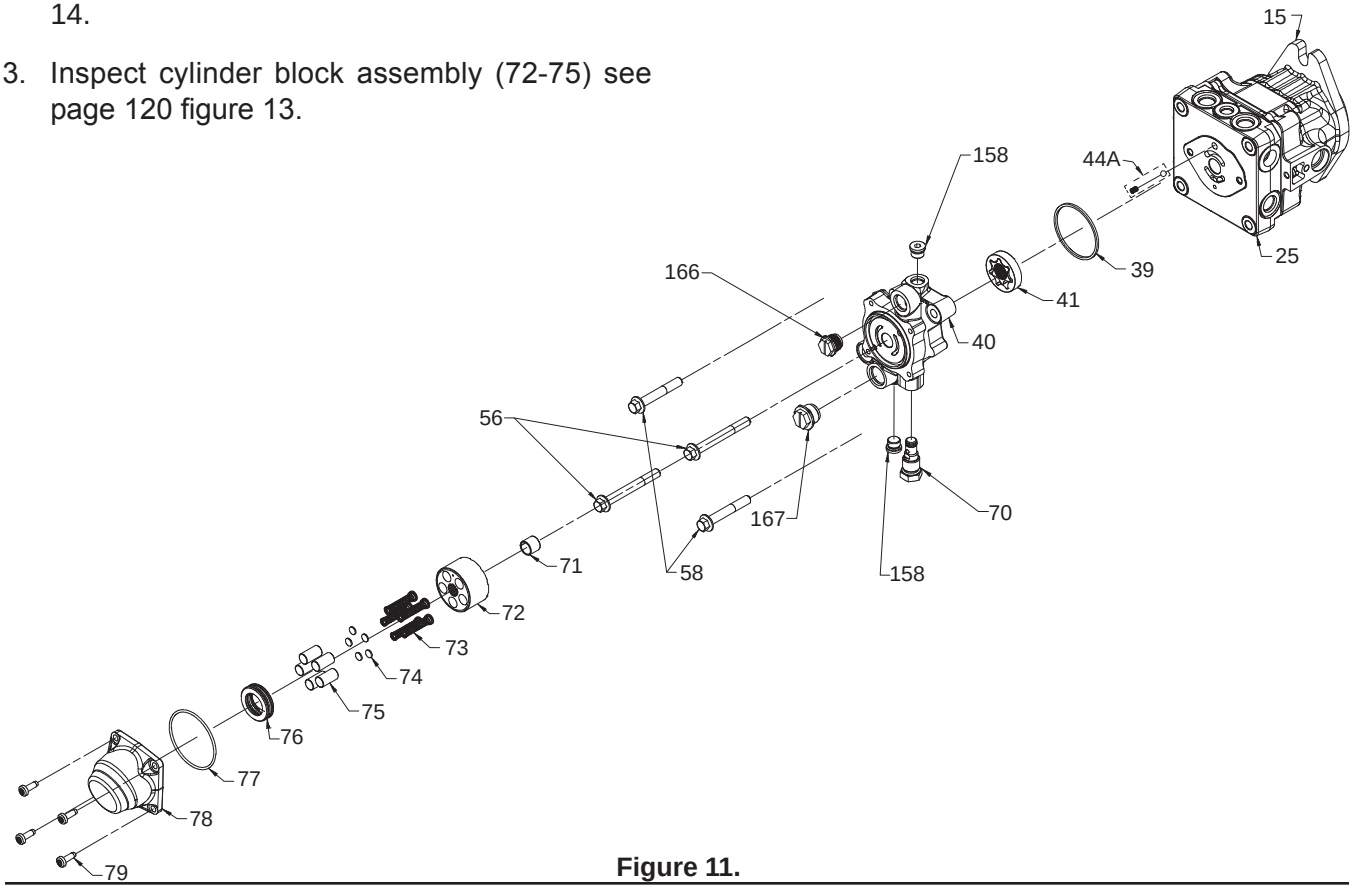


Figure 11.

REMOVAL, INSPECTION AND ASSEMBLY OF THE END CAP AND VALVE PLATE

Refer to Figure 12.

Disassembly

1. Using any combination of two, 9/16” wrenches or 9/16” socket and ratchet drive, loosen the end cap bolts (58) evenly.
2. Keeping the end cap (25) held in place, remove the four end cap bolts (58).
3. Slowly remove the end cap (25).
4. Remove the valve plate (29).

   NOTE: This step is only applicable on PW series pumps built prior to 0216Pxxxxx.
5. Remove housing alignment pins (26).
6. Remove housing gasket (28).

Inspection

1. Inspect the end cap (25) and/or valve plate (29) for damage, nicks or unusual wear patterns.

   NOTE: Grooving in the valve plate and/or end cap, made evident when the surface is checked by dragging a fingernail across the surface, would be cause for replacement of the valve plate and/or end cap.
2. Inspect and replace alignment pins (26) if bent or distorted.
3. Replace the housing O-ring (28) with a new O-ring before reassembly.

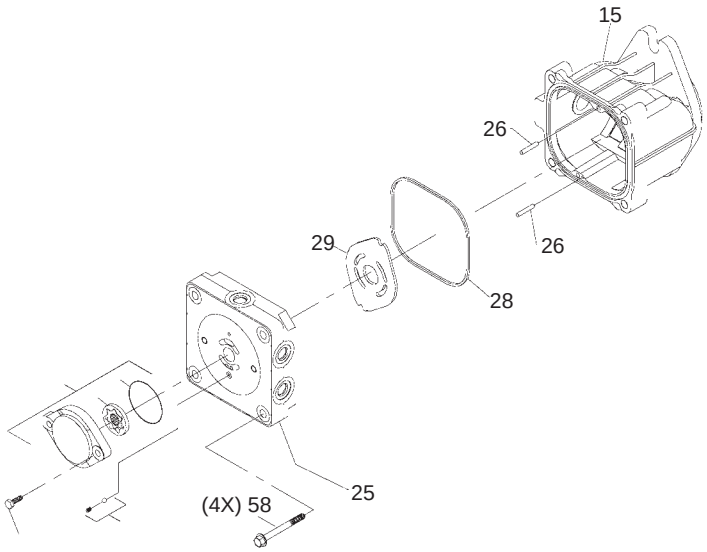
Assembly

1. Install housing O-ring (28) into O-ring seat of housing (15).
2. Install alignment pins (26) into housing (15).
3. Lubricate the valve plate prior to installation. Install valve plate (29) with the bronze side down, contacting the cylinder block.

   NOTE: This step is only applicable on PW series pumps built prior to 0216Pxxxxx.
4. On pumps built without a valve plate, lubricate the end cap prior to installation.

5 Install end cap (25). Before installing the four end cap bolts (58), push down on the end cap (25) verifying alignment and insuring that the cylinder block pistons spring back and forth. Install end cap bolts. Tighten, per Table 2, page 110, torque values.

Prior to Serial # 0216Pxxxxx



On or After Serial # 0216Pxxxxx

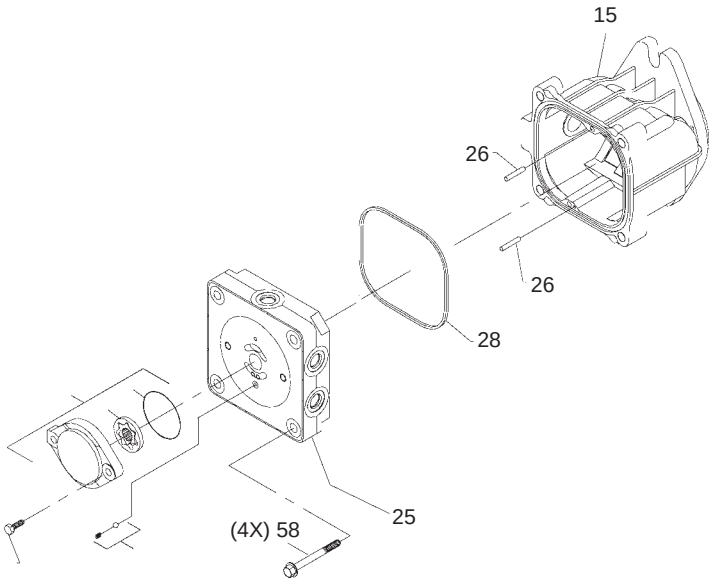


Figure 12. PW / PY Pump End Cap

REMOVAL, INSPECTION AND ASSEMBLY OF THE CYLINDER BLOCK

Refer to Figure 13.

Disassembly

1. Tilt the pump on its side, drain remaining oil. Lift out the cylinder block assembly (38).
2. Remove the pistons, springs and piston seats.

Inspection

1. Inspect the running surface of the cylinder block and piston ends for damage, nicks or unusual wear patterns.

   The running surface may show evidence of minor abrasion. This will be normal wear. If grooved or smeared, replace with a new cylinder block assembly.
2. Inspect the piston springs for distortion or breakage. If necessary, replace with a new cylinder block kit.
3. Inspect the piston seats. Residual oil may cause these to remain stuck to the inside of the pistons.

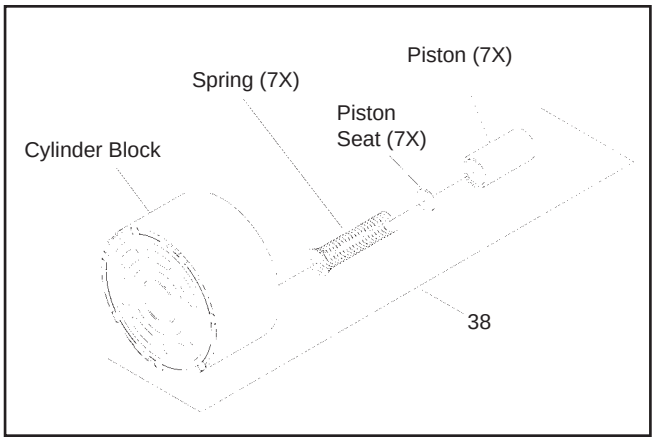


Figure 13. PW / PY Pump Cylinder Block

Assembly

1. Install piston seats into the end of the pistons.
2. Install springs into the pistons.
3. Install one at a time, pistons, springs and seats as one assembly into the cylinder block.
4. With the pump housing tilted on its side, install the cylinder block assembly (38) with pistons contacting the thrust bearing.

NOTE: To check that piston placement is correct, push downward on the cylinder block assembly (38). If this results in a spring action the block assembly has been installed correctly. If this cannot be accomplished, remove and reassemble the block assembly. Place a rubber band around the cylinder block pistons to hold them in position during installation. Then after installation cut the rubber band and remove it. Check for cylinder block assembly for spring action.

REMOVAL, INSPECTION AND ASSEMBLY OF THRUST BEARING

Refer to Figure 14.

Disassembly

1. Remove the thrust bearing and race (17).

Inspection

1. Inspect the running surface of the bearing race for damage (17), nicks or unusual wear patterns. The running surface may show evidence of minor abrasion. This will be normal wear. Inspect the bearings for free movement. Inspect the bearing cage for distortion or damage. Replace if necessary.

Assembly

1. Install thrust bearing and race assembly (17).

NOTE: The difference in race thicknesses: The thin race seats into the swashplate. The thicker race will be installed toward the piston noses.

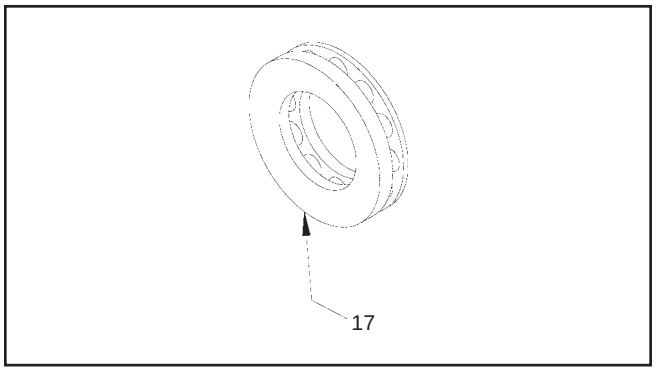


Figure 14. PW / PY Pump Thrust Bearing

REMOVAL, INSPECTION AND ASSEMBLY OF SWASHPLATE AND CRADLE BEARINGS

Refer to Figure 15.

Disassembly

1. Remove the swashplate (31).

Inspection

1. Inspect the running surface of the bearing pocket for damage (31), nicks or unusual wear patterns. The running surface may show evidence of minor abrasion. This is normal wear. Inspect the cradle bearing side of the swashplate (31) for damage. Replace if necessary.

2. Inspect the cradle bearings attached to the inside of the housing (15) for normal wear patterns, placement, and insure they are staked in place. If damaged, replace housing (15).

NOTE: The cradle bearings will have discoloration due to normal wear. Under normal circumstances, this will not warrant replacement.

Assembly

1. Install swashplate (31) by holding trunnion arm's (13) slot guide (14) with a flat tip screwdriver. Use the screwdriver to hold the slot guide (14) in place while positioning the swashplate (31) onto the cradle bearing in the housing (15).

2. Rotate trunnion arm (13) to assure swashplate pivoting action.

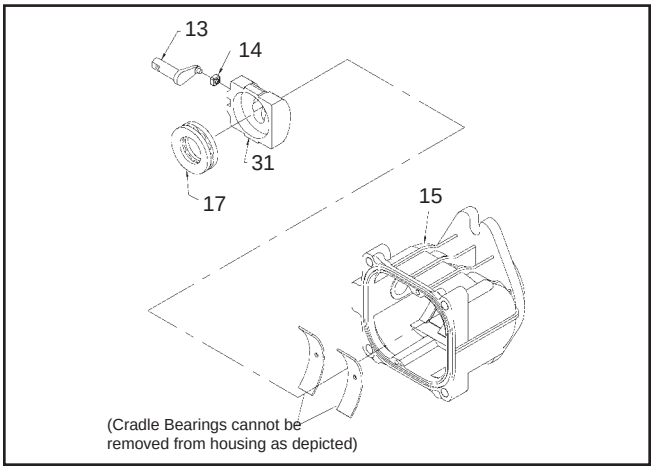


Figure 15. PW / PY Pump Swashplate and Cradle Bearings

REMOVAL, INSPECTION AND ASSEMBLY OF INPUT SHAFT

Refer to Figure 16.

Disassembly

1. Remove the retaining ring (3).
2. Remove the lip seal (6).
3. Remove the spacer (4).
4. Remove the shaft assembly (1).

Inspection

1. Inspect the input shaft (1) for worn splines, damage, or keyway damage. Replace shaft assembly if necessary.
2. Inspect the bearing (5) for evidence of scoring, corrosion, or damage. Replace shaft assembly if necessary.
3. Inspect and replace the spacer (4) if it is bent or broken.

NOTE: Replace the input shaft seal (6) after removal.

4. Inspect and replace the retaining ring (3) if it is bent or broken.

NOTE: If trunnion arm is to be removed, delay reassembly of input shaft assembly.

5. Inspect and replace the thrust spring (20) and thrust washer (19) if they are distorted or broken.

Assembly

NOTE: Upon removal, it is recommended that all seals, O-rings and gaskets be replaced. During installation, lightly lubricate all seals, O-rings and gaskets with clean petroleum jelly prior to assembly. Also, protect the inner diameter of seals by covering the shaft with plastic wrap.

1. Install input shaft (1) assembly into the housing (15) bore. Light tapping with a rubber mallet may be necessary on the input shaft (1) once the bearing is aligned with the housing bore (15). Rotate the input shaft (1) to insure free movement.
2. Install spacer (4).
3. Install new lip seal (6). Remove the plastic wrap.
4. Install retaining ring (3).

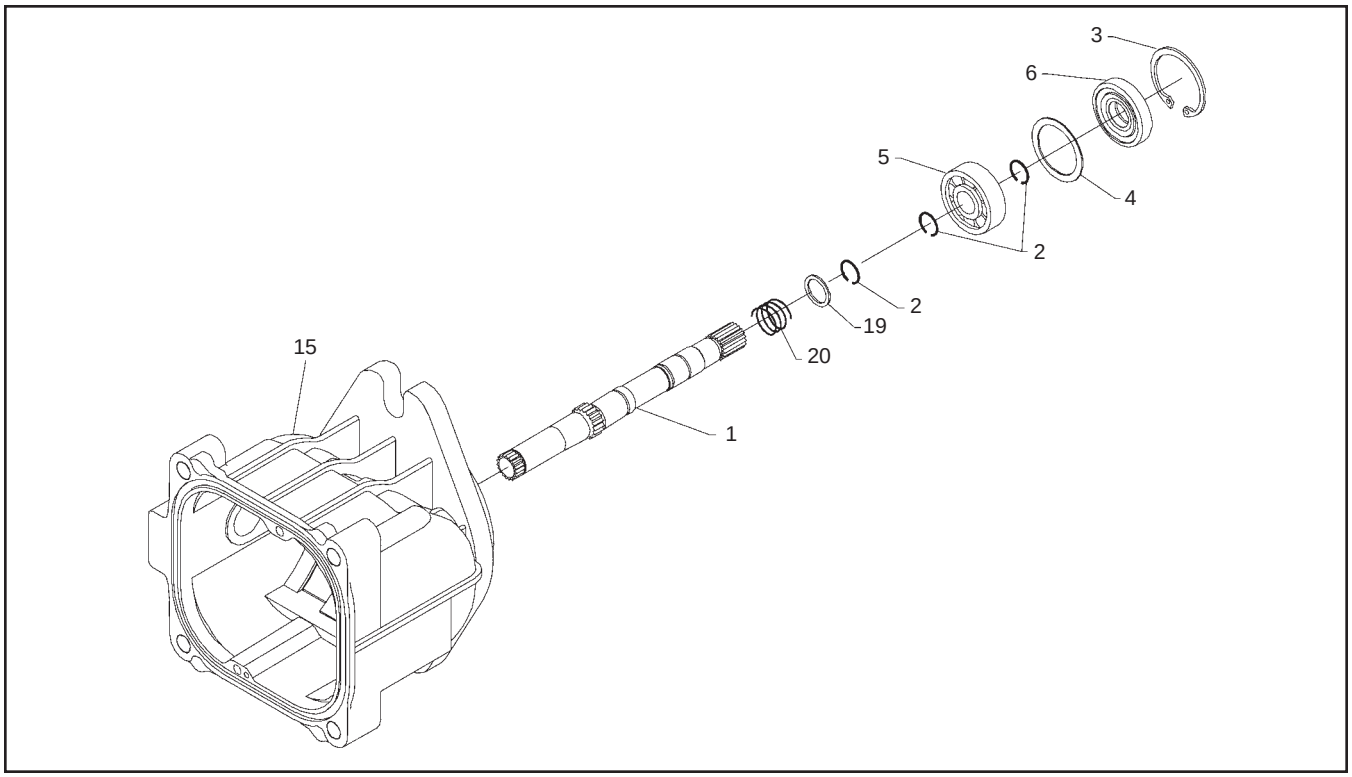


Figure 16. PW / PY Pump Input Shaft

REMOVAL AND INSPECTION OF TRUNNION ARM

Refer to Figure 17.

Disassembly

1. Remove trunnion seal retainer and seal (12).
2. Remove the slot guide (14).
3. Remove the trunnion arm (13).

Inspection

1. Inspect the trunnion arm (13) for wear or damage. Replace the trunnion arm if necessary.

Assembly

1. Install the trunnion arm (13) into the housing (15) bore. Rotate the trunnion arm to verify free movement.

NOTE: Upon removal, it is recommended that all seals, O-rings, and gaskets be replaced. During installation, lightly lubricate all seals, O-rings and gaskets with clean petroleum jelly prior to assembly. Also protect the inner diameter of seals by covering the shaft with plastic wrap. Remove the plastic wrap after the seal is installed.

2. Install a new seal and seal retainer.
3. Install the slot guide (14).
4. To completely reassemble the pump, refer to the assembly steps on pages 111-122. Begin with the trunnion arm assembly steps listed on page 122 and complete the assembly steps in reverse order working towards the front of the manual.

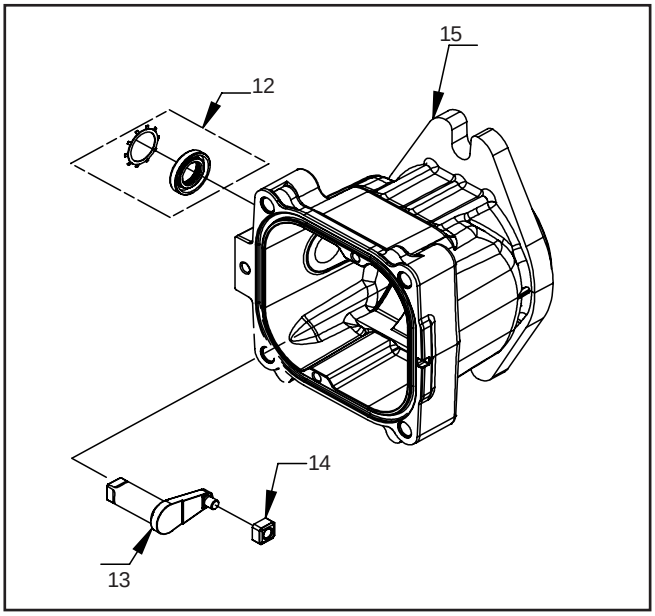


Figure 17. PW / PY Pump Trunnion Arm

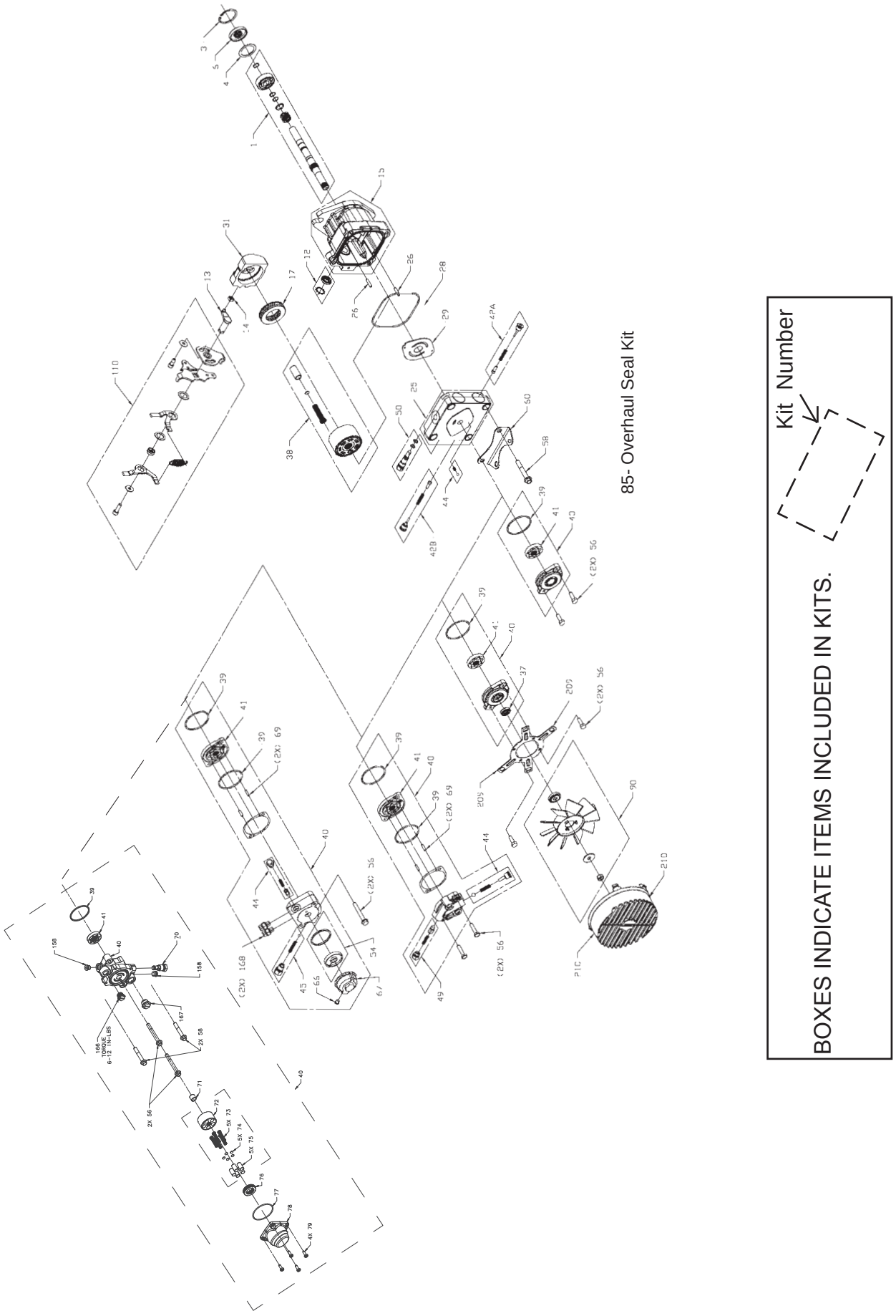


Figure 17. PW / PY Pump

ITEM LIST - PW / PY SERIES

Part numbers are not provided in this manual.

No.	Description
1	Pump Shaft Kit (19T spline)
	Pump Shaft Kit (closed key)
	Pump Shaft Kit (thru shaft spline)
	Pump Shaft Kit (tapered thru shaft)
	Pump Shaft Kit (shaft - thru pump)
	Retaining Ring
4	Spacer
5	Shaft Ball Bearing
6	Lip Seal 17 X 47 X 8 PTCN1
10	Trunnion Seal Retaining Ring
12	Lip Seal 15 X 27 X 7
13	Trunnion Arm
14	Slot Guide
15	Housing Kit
17	Thrust Ball Bearing Assembly
19	Block Thrust Washer
20	Block Spring
25	End Cap Kit (w/poppets)
	End Cap Kit (w/poppets , .078” cooling ori fice)
	End Cap Kit (w SCR’S)
	End Cap Kit (Aux w/ poppets)
	End Cap Kit (Aux w/ SCR’s)
	End Cap Kit (Aux w/ LH:SCR and RH:poppet)
	End Cap Kit (w/LH:poppet and RH:SCR)
26	Pin
28	O-Ring
29	Valve Plate
31	Variable Swashplate
38	Cylinder Block Kit
39	O-Ring
	R-Ring (-144)
40	Charge Pump Kit (0.19 std splined)
	Charge Pump Kit (0.13 std splined)
	Charge Pump Kit (0.13 std thru shaft)
	Charge Pump Kit (0.13 std spline, clear zinc cover)
	Charge Pump Kit (CW - splined Aux, 40-70 psi)
	Charge Pump Kit (CW - splined Aux, 135-165 psi)
	Charge Pump Kit (CCW - splined Aux, 40-70 psi)
	Charge Pump Kit (AL Aux, 7/16 SAE port, 40-70 psi)
	Charge Pump Kit (AL Aux, 7/16 SAE port, 75-105 psi)
	Charge Pump Kit (6cc Aux)
41	Gerotor Assembly (0.19 in^3/rev)
	Aux Gerotor & HSG Assembly (0.19 in^3/rev)
	Gerotor Assembly (0.13 in^3/rev)
42	Check Valve Kit (.031”)
	Check Valve Kit (.044”)
	Shock Valve Kit (blank)
	System Check/Relief Kit
44	Charge Relief Kit (w 1/2” SAE valve plug, 40-70 psi)
	Charge Relief Kit (w 1/2” SAE valve plug, 135-165 psi)
	Charge Relief Kit (w/ 9/16” SAE valve plug)
	Charge Relief Kit (w/ 9/16” SAE valve plug 75-105 psi)
	Charge Relief Kit (w/ 7/32” plastic ball & spring)
	Charge Relief Kit (w/ 1/4” plastic ball & spring)
45	Aux Relief Valve Kit
49	Aux Bypass/Check Kit
50	Bypass Valve Kit (blank)
	Bypass Valve Kit (.031”)
54	Auxiliary Filter Kit
56	Hex Screw, 5/16 - 18 X 1.0
	Hex Hd Cap Screw, 5/16 - 18 X 2.5
58	Hex Screw, Flanged Head
59	Hex Flange Nut
60	Mounting Bracket
66	Plug
67	Filter Cover
69	Pin
85	Overhaul Seal Kit
110	Return Kit
168	Connector
209	Shroud Bracket
210	Shroud

GLOSSARY OF TERMS

Axial Piston: Type of design for hydraulic motors and pumps in which the pistons are arranged parallel with the spindle (input or output shaft).

Bypass Valve: A valve whose primary function is to open a path for the fluid to bypass the motor or pump. Also referred to occasionally as the freewheel valve or dump valve.

Case Drain Line (Return Line): A line returning fluid from the component housing to the reservoir.

Cavitation: A phenomenon of boiling in a flowing liquid at normal temperatures, as a result of low pressure condition. The gas liberated from the fluid implodes rapidly and damages pump components.

Center Section: A device which acts as the valve body and manifold of the transmission.

Charge Pump: A device which supplies replenishing fluid to the fluid power system (closed loop).

Charge Pressure: The pressure at which replenishing fluid is forced into a fluid power system.

Charge Relief Valve: A pressure control valve whose primary function is to limit pressure in the charge circuit.

Check Valve: A valve whose primary function is to restrict flow in one direction.

Closed Loop: A sealed and uninterrupted circulating path for fluid flow from the pump to the motor and back.

Decay Rate: The ratio of pressure decay over time.

End Cap: See “Center Section.”

Entrained Air: A mechanically generated mixture of air bubbles having a tendency to separate from the liquid phase.

Gerotor: A fixed displacement pump frequently used as a charge pump.

Hydraulic Motor: A device which converts hydraulic fluid pressure and flow into mechanical force and motion.

Hydraulic Pump: A device which converts mechanical force and motion into hydraulic fluid pressure and flow.

Hydrostatic Motor: See “Hydraulic Motor.”

Hydrostatic Pump: See “Hydraulic Pump.”

Hydrostatic Transaxle: A multicomponent assembly including a gear case and a hydrostatic transmission.

Hydrostatic Transmission: The combination of a hydraulic pump and motor in one housing to form a device for the control and transfer of power.

Inlet Line: A supply line to the pump.

Integrated Hydrostatic Transaxle (IHT): The combination of a hydrostatic transmission and gear case in one housing to form a complete transaxle.

Manifold: A conductor which provides multiple connection ports.

Neutral: Typically described as a condition in which fluid flow and system pressure are below that which is required to turn the output shaft of the motor.

Pressure Decay: A falling pressure.

Priming: The filling of the charge circuit and closed loop of the fluid power system during start-up, frequently achieved by pressurizing the fluid in the inlet line.

Purging: The act of replacing air with fluid in a fluid power system.

Rated Flow: The maximum flow that the pump is capable of supplying.

Scoring: Scratches in the direction of motion of mechanical parts caused by abrasive contaminants.

Shock Valve: A relief valve in the closed loop of the hydrostatic circuit that provides makeup oil, as well as protecting the circuit from high pressure shocks or spikes.

Swashplate: A mechanical device used to control the displacement of the pump pistons in a fluid power system.

System Charge Check Valve: A valve controlling the replenishing flow of fluid from a charge circuit to the closed loop in a fluid power system.

System Pressure: The pressure which overcomes the total resistance in a system, including all efficiency losses.

Valve: A device which controls fluid flow direction, pressure, or flow rate.

Variable Displacement Pump: A pump in which the displacement per revolution can be varied.

Volumetric Displacement: The fluid volume for one revolution.

HYDRO-GEAR®

FORWARD MOTION THROUGH FORWARD THINKING

HGM-C
LSHT Wheel Motor
Service and Repair Manual

BLN-52690
January 2018

Table of Contents

Forward

Headquartered in Sullivan, Illinois, Hydro-Gear® is a world leader in the design, manufacture, and service of quality hydrostatic transaxles for the lawn and garden industry. The mission of our company is to be recognized by our customers and the industry as a world-class supplier and the quality leader in everything we do.

This Service and Repair Manual is designed to provide information useful in servicing and troubleshooting the Hydro-Gear HGM - C motor.

It is necessary, and a good shop practice, that your service area be equipped with the proper tools and the mechanics be supplied the latest information available. All repair procedures illustrated in this guide are suggested, but preferred methods of repair.

Internal repair procedures require that the motor be removed from the vehicle.

How to Use This Manual

How to Use This Manual

Each subassembly illustrated in this manual is illustrated with an exploded view showing the parts involved. The **item reference numbers in each illustration are for assembly instructions only.** See page 18 for part names and descriptions. A complete exploded view and item number list of the HGM - C motor is on page 18.

General Instructions

Cleanliness is a primary means of assuring satisfactory life on repaired units. Thoroughly clean all exposed surfaces prior to any type of maintenance. Clean all parts carefully with low aromatic kerosene.

As with any precision equipment, all parts must be kept free of foreign material and chemicals.

Protect all exposed sealing surfaces and open cavities from damage and foreign material. The external surfaces should be cleaned before beginning any repairs.

Upon removal, it is recommended that seal and O-rings be replaced. Before assembly, lubricate all metal parts with hydraulic oil and lightly grease rubber parts with petroleum jelly.

Parts requiring replacement must be replaced from the appropriate kits identified in the Items Listing, found at the end of this manual. Use only original Hydro-Gear® replacement parts found in BLN-51427 (CD).

General Description

Hydro-Gear HGM-C wheel motors convert hydraulic energy (pressure and oil flow) into mechanical energy (torque and speed). Hydro-Gear wheel motors are of a fixed displacement LSHT design. For a given displacement (size of motor) the speed is determined by the oil flow rate and the torque is determined by the pressure differential.

The operating principle of the motor is based on an internal gearwheel that moves about an eccentric, while rotating and advancing on the rollers in the external gearwheel.

As oil flow enters the working port it is directed through internal cavities to ports in the bore of the housing to valving slots on the output shaft through the distributor plate to drive the gearwheel set. The cardan shaft rotates and transfers mechanical energy from the gearwheel to the output shaft.

“All fluids and cleaning materials should be handled and disposed of according to local, state, and federal regulations.”

Note: “Any and all Hydro-Gear components removed and replaced during service are recyclable.”

TOOLS

REQUIRED TOOLS
Flat Blade Screw Driver (2)
Torque Wrench
Rubber or Neoprene Mallet
13mm Wrench
Snap Ring Removal Tool
3.5mm Screw tap
Hydraulic Press

TORQUES

REQUIRED TORQUE VALUES			
Item	**Description**	**Torque**	**Operation**
1	Castellated nut	160 - 210 ft-lbs [217 - 284 Nm]	Brake Drum Assembly
22	Screw, Hex head 1/4-20 x 1.25”	354 in-lbs [40 Nm]	End Cover
29	Bolt, 5/16-18 x .75 SHCS	180 - 240 in-lbs [20.3 - 27.1 Nm]	Brake Assembly

As a general rule, use the low end of the torque specification on fasteners when reassembling the unit.

DRUM & BRAKE ASSEMBLY

Disassembly

1. Remove the cotter pin. *See figure 1.*
2. Remove the castellated nut (1). *See figure 1.*

NOTE: *If the drum assembly or hub assembly is removed from the axle shaft, the drum/hub assembly must be discarded and replaced with a new assembly.*

3. Remove the drum assembly. *See figure 1.*
4. Remove the four bolts (29) securing the brake assembly to the HGM motor. *See figure 2.*
5. Remove the brake assembly. *See figure 2.*

Inspection

1. Inspect the studs on drum for wear and/or damage. Replace if necessary.
2. Inspect the brake assembly, i.e., the brake shoes for wear and/or damage.

Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. When tightening the fasteners, refer to the table on page 3 for the required torque values.

NOTE: *As a general rule, use the low end of the torque specification on fasteners when reassembling the unit.*

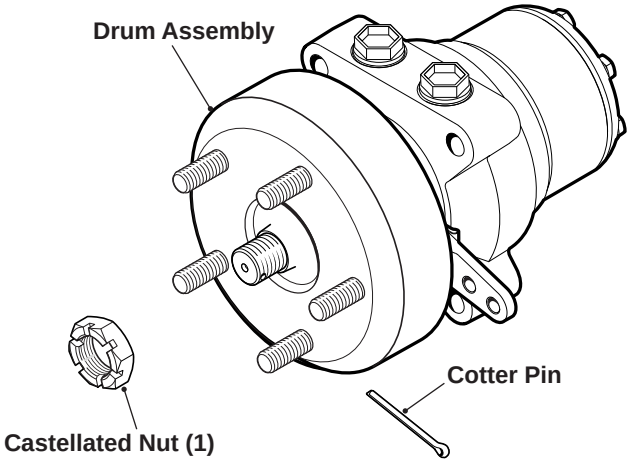


Figure 1, Drum Assembly

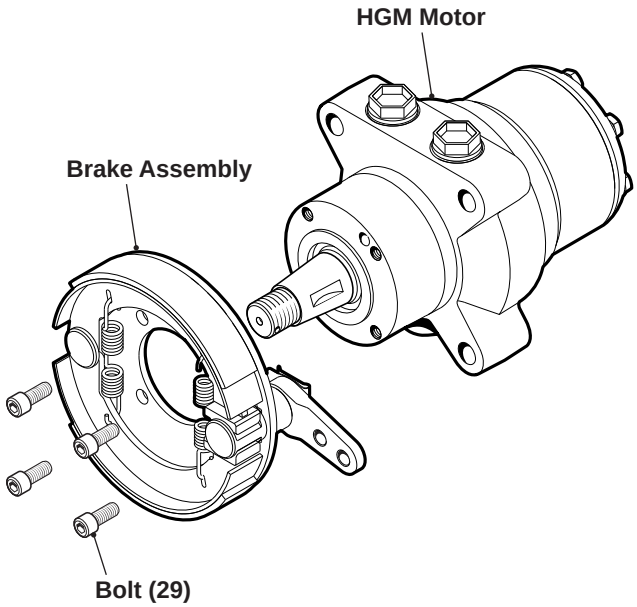


Figure 2, Brake Assembly

SERVICE PREPARATION

1. To ensure correct alignment and location during reassembly of motor parts, provide a “V” shaped identification mark. *See figure 3.*
2. Remove the castellated nut (1). *See figure 4.*
3. Remove the woodruff key (6) and the plastic plugs or fittings (8), if installed. *See figure 4.* Drain oil from the motor.
4. Remove the retaining ring (2). *See figure 5.*
5. Place the HGM-C motor into a holding tool. *See figure 6.*

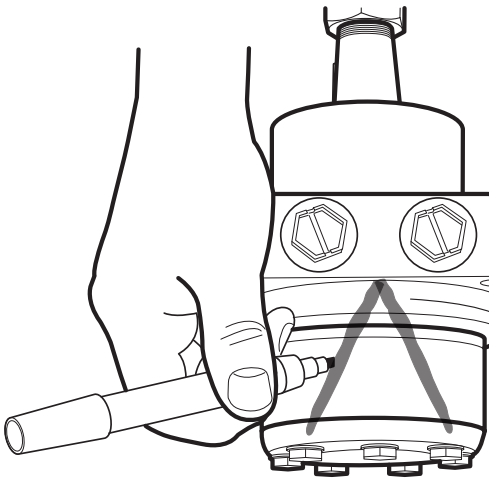


Figure 3, Identification Mark

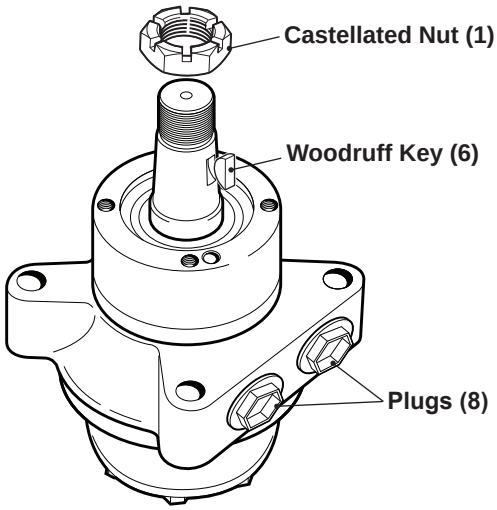


Figure 4, Nut, Woodruff Key and Plugs

Inspection

1. Inspect woodruff key (6) for wear or damage.

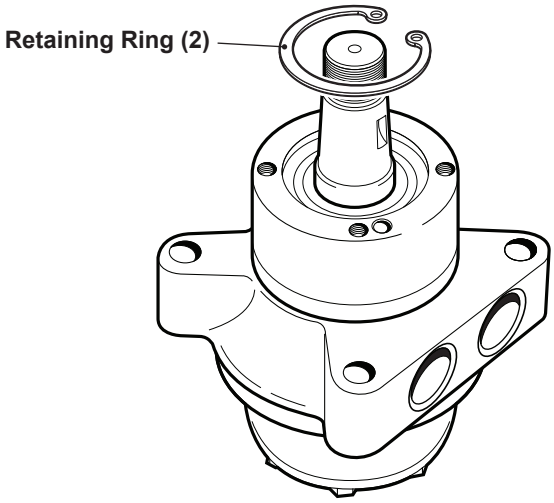


Figure 5, Retaining Ring

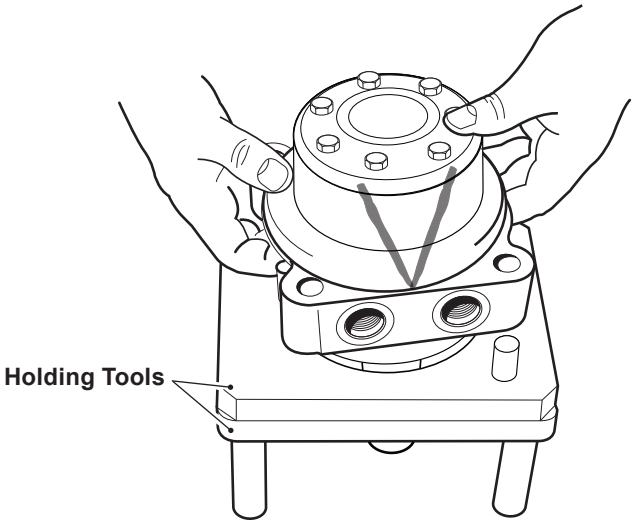


Figure 6, Service position

END COVER

Disassembly

1. Remove castellated nut (1), woodruff key (6), plastic plugs (8), and retaining ring (2). *See page 5.*
2. Using a 13mm wrench — remove the seven screws (22). *See figure 7.*
3. Remove the seven washers (23) and discard.
4. Remove the end cover (19) by sliding the end cover sideways, off the gearwheel set. *See figure 8.*

Inspection

1. Inspect for wear or damage.
2. Inspect screws (22) – threads, for wear or damage.

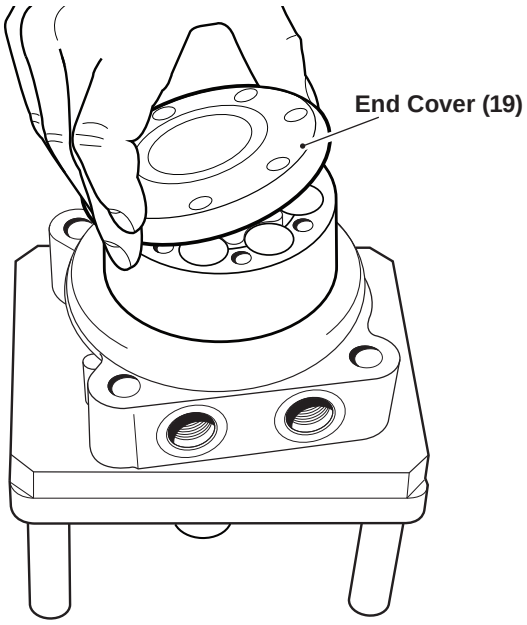


Figure 8, End Cover

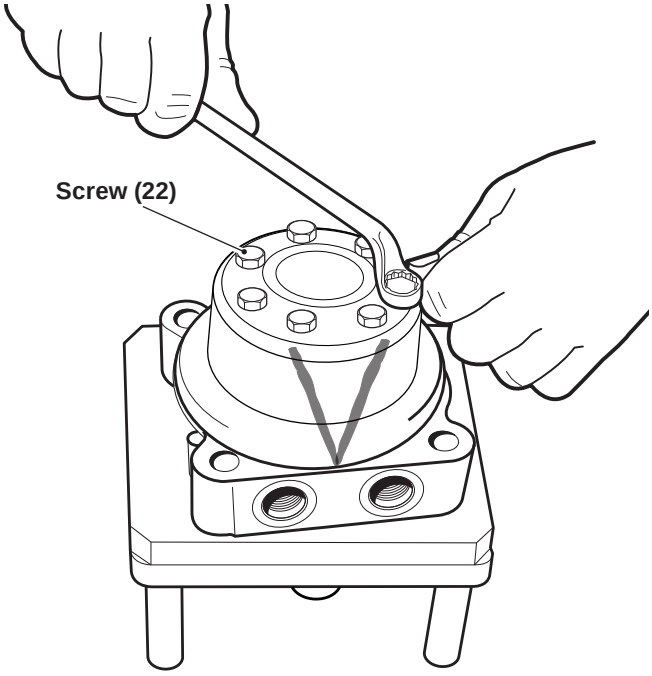


Figure 7, Screws

GEARWHEEL SET

Disassembly

1. Remove castellated nut (1), woodruff key (6), plastic plugs (8), retaining ring (2), seven screws (22), seven washers (23), and the end cover (19). *See pages 5 and 6*.
2. Remove the O-ring (18) and gearwheel set (17). Discard O-ring (18). *See figure 9.*

Note: *Placing fingers underneath gearwheel set will help keep parts from falling out.*

3. Remove second O-ring (16), under gearwheel set, and discard.
4. Dismantle the gearwheel set for inspection if contamination or damage is suspected.

Inspection

1. Inspect for wear or damage.

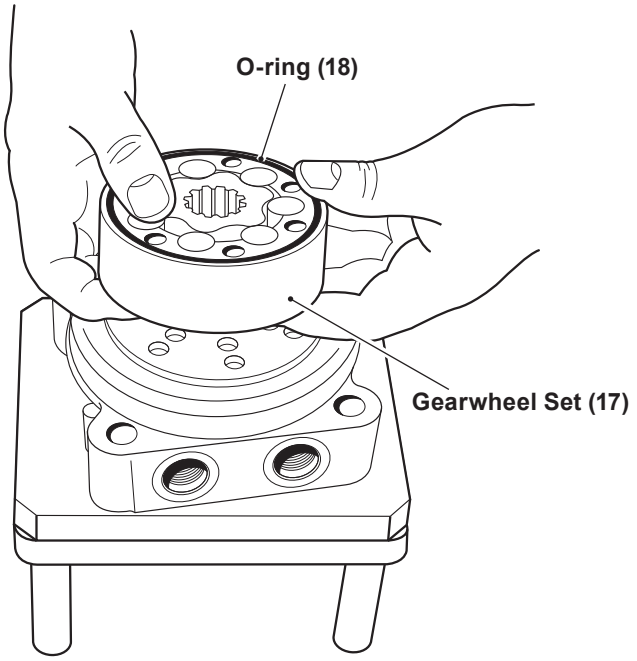


Figure 9, Gearwheel Set

CARDAN SHAFT

Disassembly

1. Remove castellated nut (1), woodruff key (6), plastic plugs (8), retaining ring (2), seven screws (22), seven washers (23), end cover (19), and the gearwheel set (17) with O-rings (16, 18). *See figure 4 - 7*.
2. Remove the cardan shaft (15). *See figure 10.*

Inspection

1. Check for wear and/or damage to the individual splines on the cardan shaft (15).

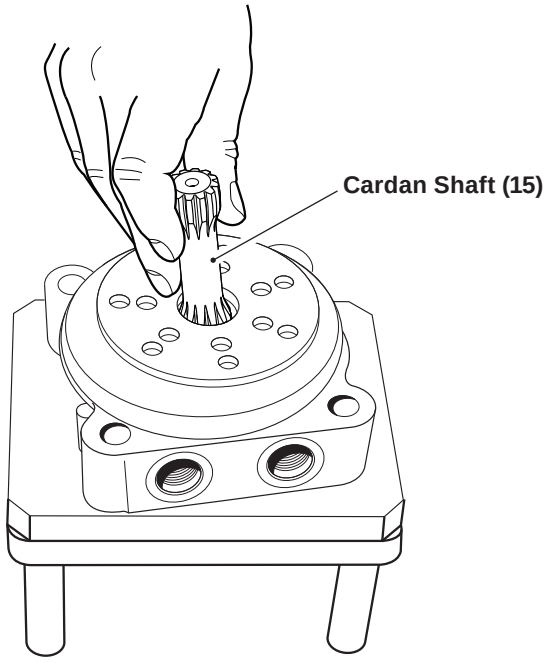


Figure 10, Cardan Shaft

DISTRIBUTOR PLATE

Disassembly

1. Remove castellated nut (1), woodruff key (6), plastic plugs (8), retaining ring (2), seven screws (22), seven washers (23), end cover (19), the gearwheel set (17) with O-rings (16, 18), and cardan shaft (15). *See pages 4 - 7.*
2. Remove the distributor plate (14).
3. Remove and discard the O-ring (13). *See figure 11.*

Inspection

1. Inspect for wear or damage.

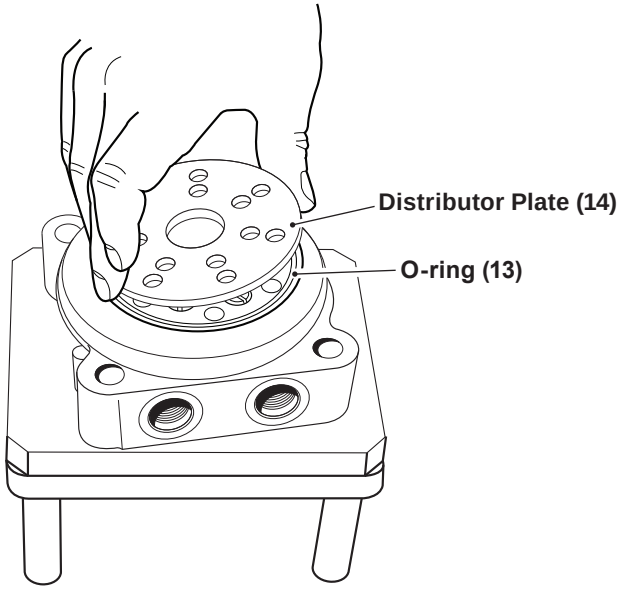


Figure 11, Distributor Plate

OUTPUT SHAFT

Disassembly

1. Remove castellated nut (1), woodruff key (6), plastic plugs (8), retaining ring (2), seven screws (22), seven washers (23), end cover (19), the gearwheel set (17) with O-rings (16, 18), cardan shaft (15), distributor plate (14), and O-ring (13). *See pages 4 - 8.*
2. Place the motor in a hydraulic press — replace the cardan shaft (15) and press out the output shaft (7). *See figure 12.*

Inspection

1. Inspect for wear or damage.

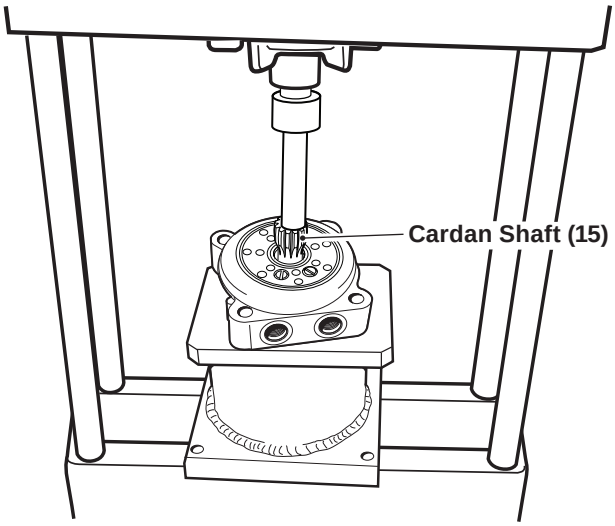


Figure 12, Output Shaft

SHAFT SEAL

Disassembly

1. Remove castellated nut (1), woodruff key (6), plastic plugs (8), retaining ring (2), seven screws (22), seven washers (23), end cover (19), gearwheel set (17) with O-rings (16, 18), cardan shaft (15), distributor plate (14), O-ring (13), and the output shaft (7). *See pages 4 - 8.*

2. Using a holding tool, press ball bearing (3), washer (4), and shaft seal (5) off the output shaft (7). *See figure 13.*

Inspection

1. Inspect for wear or damage.

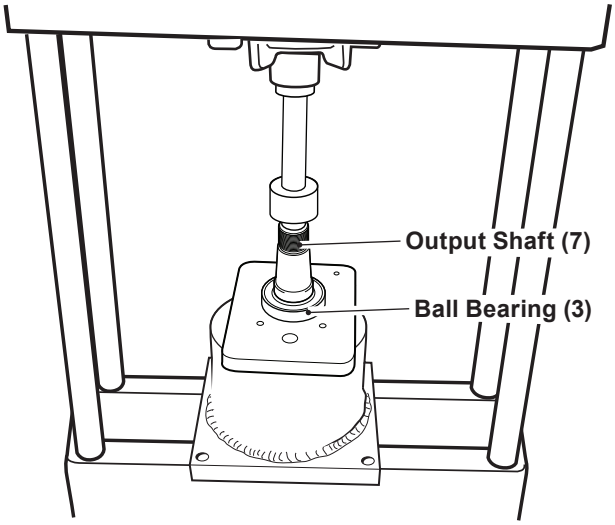


Figure 13, Output Shaft Seal

NEEDLE BEARING

Disassembly

1. Remove castellated nut (1), woodruff key (6), plastic plugs (8), retaining ring (2), seven screws (22), seven washers (23), end cover (19), gearwheel set (17) with O-rings (16, 18), cardan shaft (15), distributor plate (14), O-ring (13), output shaft (7) and the shaft seal. *See pages 4 - 9.*

2. Remove the needle bearing (12) with a pressing tool. *See figure 14.*

Note: *The needles may fall out of the needle bearing (12) during dismantling and can be retrieved for re-use.*

Inspection

1. Inspect for wear or damage.

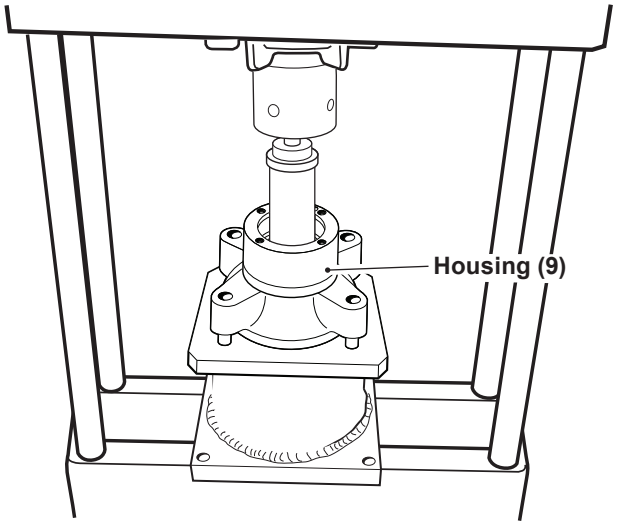


Figure 14, Needle Bearing

CHECK VALVES

Disassembly

1. Remove castellated nut (1), woodruff key (6), plastic plugs (8), retaining ring (2), seven screws (22), seven washers (23), end cover (19), gearwheel set (17) with O-rings (16, 18), cardan shaft (15), distributor plate (14), O-ring (13), output shaft (7) needle bearing (12), And, from the output shaft — remove ball bearing (3), washer (4), and output shaft seal (5). *See pages 4 - 9.*

2. Remove the check valves (11) with a ground 3.5mm screw tap. *See figure 15.* The check valves are pressed in and can be removed by pulling on the tap.

Inspection

1. Inspect for wear or damage.

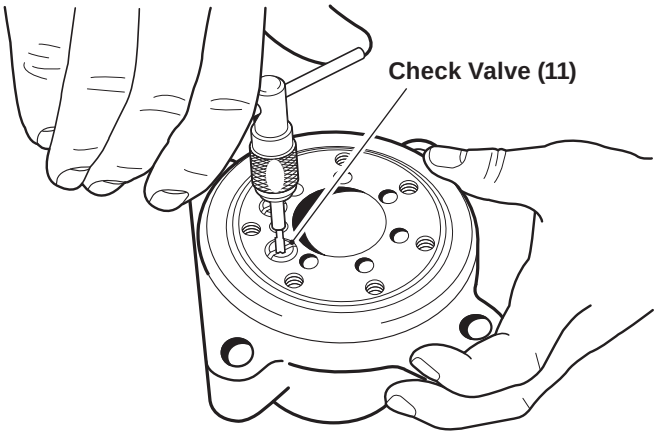


Figure 15, Check Valves

BALL BEARING

Assembly

Note: *Before assembly, lubricate all parts with hydraulic oil and grease rubber parts with clean petroleum jelly.*

1. Place the bullet on the output shaft (7) and mount the output shaft seal (5). *See figure 1.*
2. Remove the bullet and mount the washer (4). *See figure 2.*
3. Place the ball bearing (3) onto output shaft (7) and press into position. *See figure 3.*

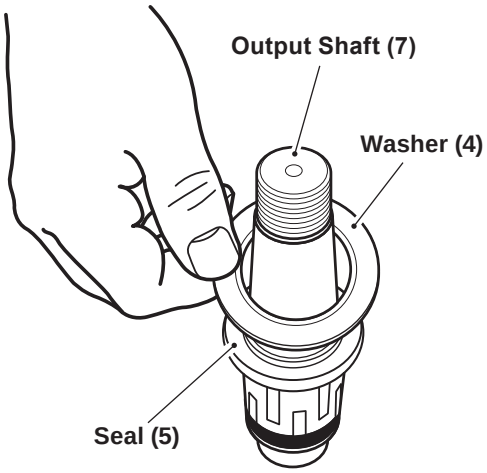


Figure 2, Washer

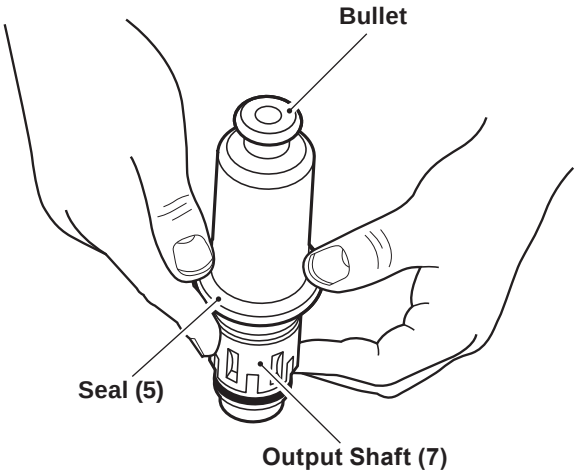


Figure 1, Bullet/Output Shaft Seal

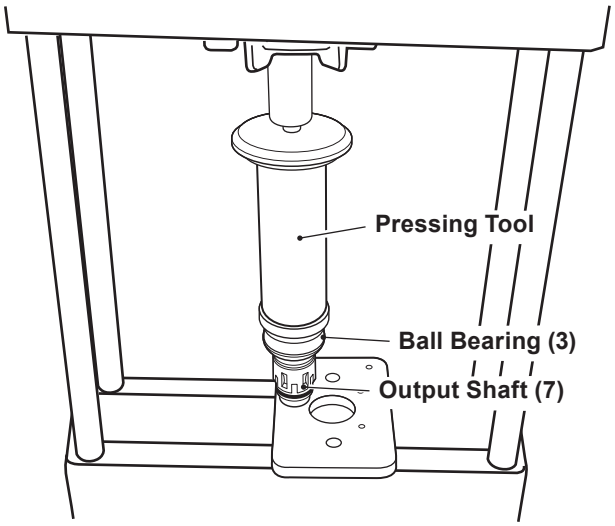


Figure 3, Ball Bearing/Press Tool

CHECK VALVES

Assembly

1. Mount seal (5), washer (4), and ball bearing (3) onto output shaft (7). *See page 11.*
2. Place the motor housing (9), with holding fixture into hydraulic press. *See figure 4.*
3. Install the two check valves (11) into their bores. *See figure 5.*
4. Seat the check valves (11) by lighty tapping with a rubber hammer. *See figure 5.*

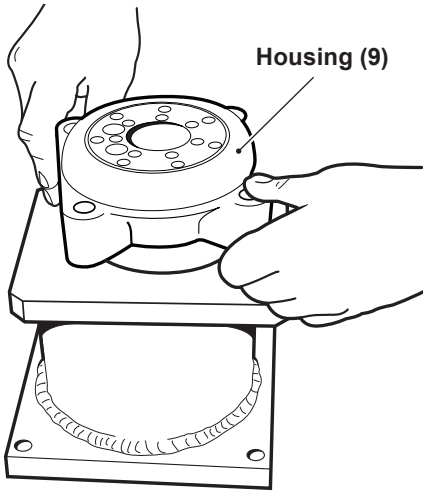


Figure 4, Service Position

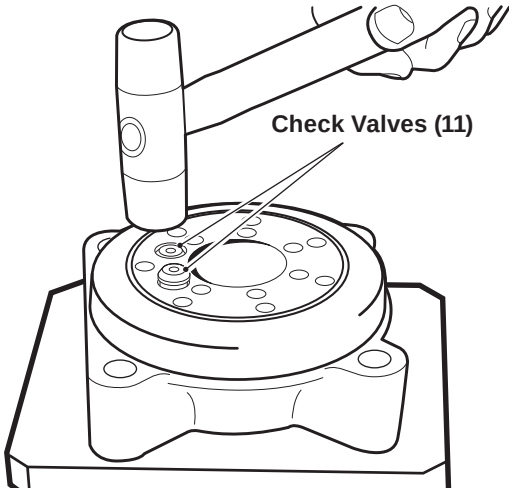


Figure 5, Check Valve

NEEDLE BEARING

Assembly

1. Mount seal (5), washer (4), and ball bearing (3) onto output shaft (7). *See page 11.*
2. Install the check valves (11).
3. Place the needle bearing (12) into motor housing (9), then; press into position. *See figure 6.*

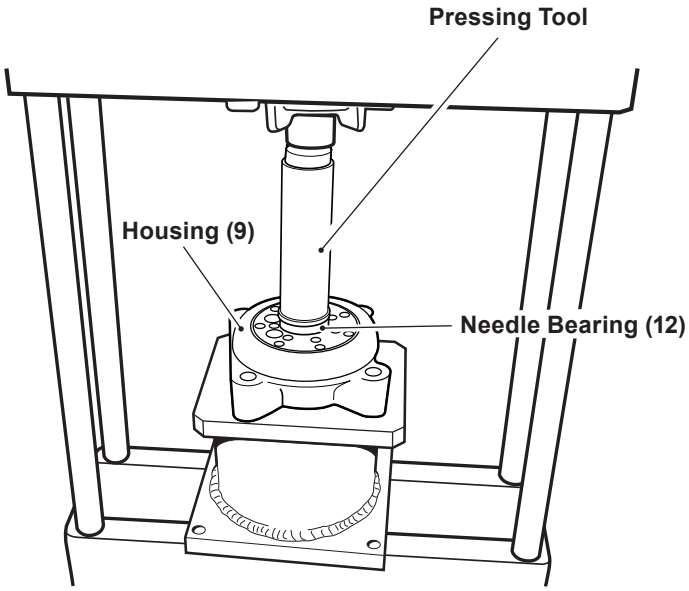


Figure 6, Needle Bearing

OUTPUT SHAFT

Assembly

1. Mount seal (5), washer (4), and ball bearing (3) onto output shaft (7). *See page 11.*
2. Install check valves (11), and needle bearing (12). *See page 12.*
3. Rotate the motor housing (9) so that the front (output shaft end) is pointing upward . *See figure 7.*
4. The rear of the output shaft (7) must be marked before fitted into motor housing (9). The mark must be positioned vertically above a commutation slot leading up to the front annular channel. *See figure 8.*
5. Grease the journals with hydraulic oil.
6. Position output shaft (7) over motor housing (9) and carefully lower into the motor housing (9). Press the output shaft with ball bearing, washer and seal into motor housing. *See figure 9.*

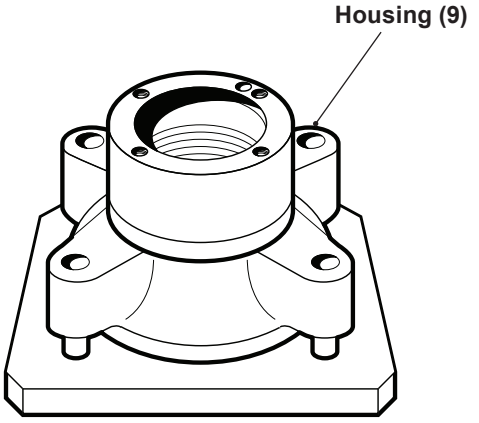


Figure 7, Motor Housing

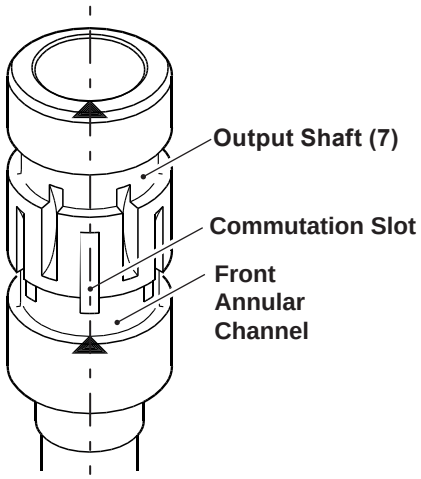


Figure 8, Output Shaft

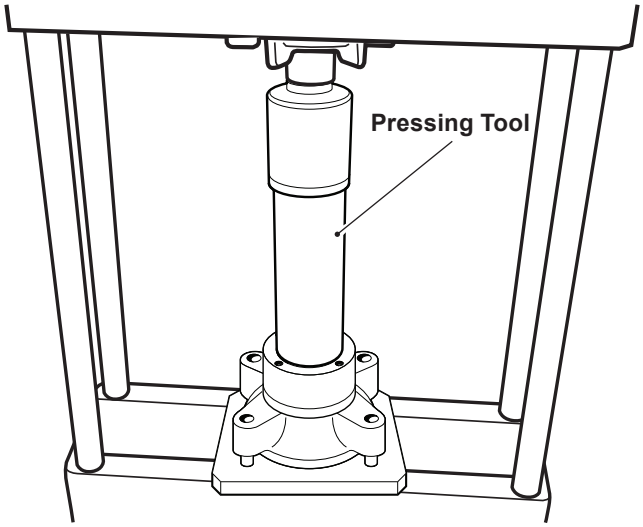


Figure 9, Output Shaft/Press Tool

RETAINING RING

Assembly

1. Mount seal (5), washer (4), and ball bearing (3) onto output shaft (7). *See page 11.*
2. Install check valves (11), needle bearing (12) and output shaft assembly. *See pages 12 - 13.*
3. Mount the retaining ring (2). *See figure 10.*

Note: *Make sure that the retaining ring is fully engaged in motor housing groove.*

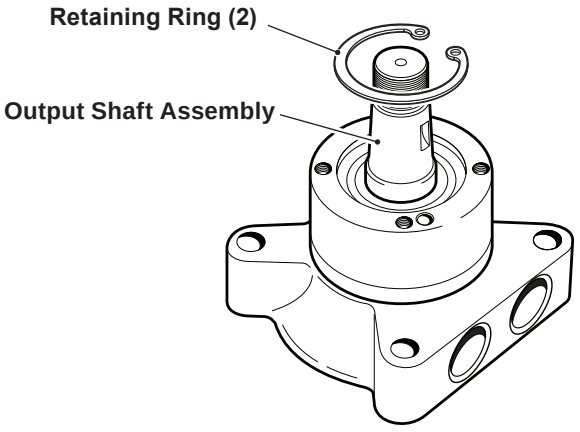


Figure 10, Retaining Ring

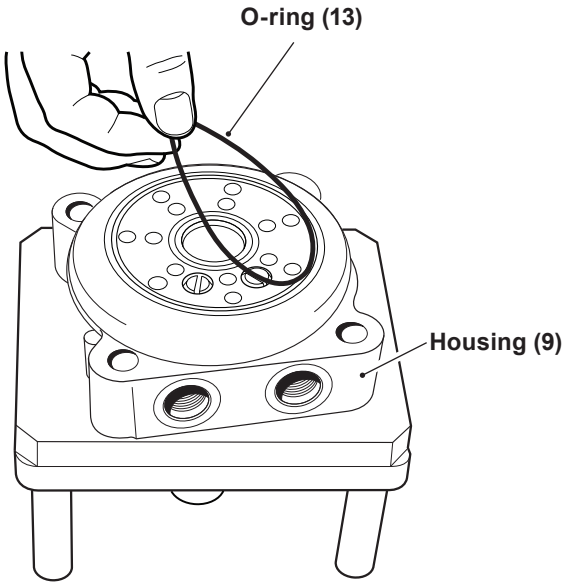


Figure 11, O-ring/Cardan Shaft

CARDAN SHAFT

Assembly

1. Mount seal (5), washer (4), and ball bearing (3) onto output shaft (7). *See page11.*
2. Install check valves (11), needle bearing (12), output shaft assembly and retaining ring (2). *See pages 12 - 14.*
3 Turn motor housing (9) so that its rear end is upwards and install a *new* O-ring (13). *See figure 11.*
4. Guide the cardan shaft (15) down into the motor housing and into the output shaft assembly. *See figure 12*. In case of different spline lengths turn the cardan shaft to ensure the long spline end is fitted in the output shaft.
5. Transfer marking from output shaft to cardan shaft. *See figure 12.*

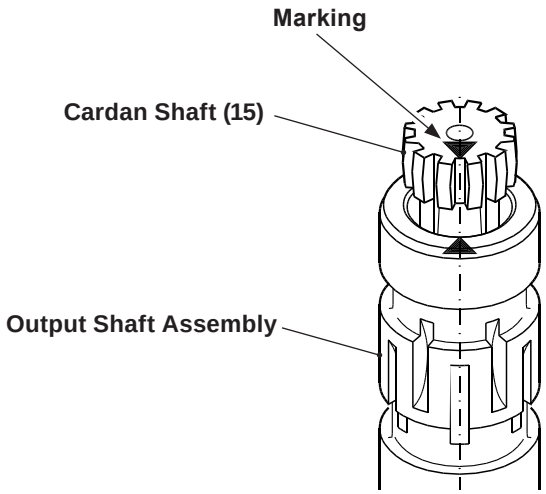


Figure 12, Cardan Shaft Marks
(Motor housing not shown)

DISTRIBUTOR PLATE

Assembly

1. Mount seal (5), washer (4), and ball bearing (3) onto output shaft (7). *See page 11.*
2. Install check valves (11), needle bearing (12), output shaft assembly, retaining ring (2), and O-ring (13). *See pages 12 - 14.*
3. Turn the distributor plate (14) so that the slots are against the motor housing (9) and indentation in the distributor plate is pointing to port surface. *See figure 13.*

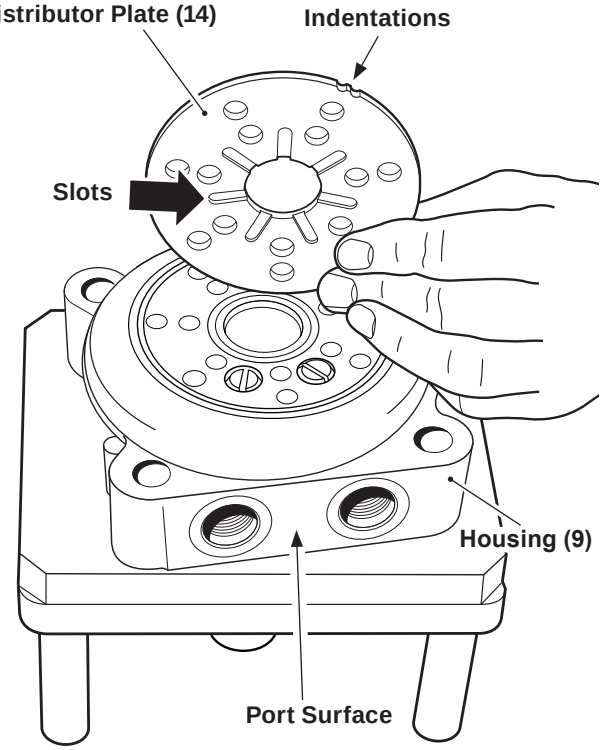


Figure 13, Distributor Plate

GEARWHEEL SET

Assembly

1. Mount seal (5), washer (4), and ball bearing (3) onto output shaft (7). *See page 11.*
2. Install check valves (11), needle bearing (12), output shaft assembly, retaining ring (2), O-ring (13), and distributor plate (14). *See pages 12 - 15.*
3. Place *new* O-rings (16, 18) in the O-ring grooves of the gearwheel set (17). *See figure 14.*

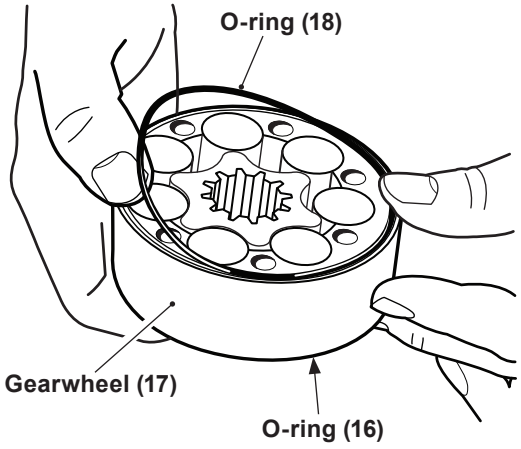


Figure 14, Gearwheel Set/O-ring

GEARWHEEL SET *(continued)*

Assembly

4. In gearwheel set (17) with non-through splines place the gearwheel set (17) with the recess in the spline hole facing down towards the motor housing (9).

5. Fit the gearwheel set (17) on the cardan shaft (15) so that the top of the tooth in the external teeth of the gearwheel is vertically over the mark on the cardan shaft.

6. Turn the gearwheel set (17) counter clockwise until the cardan shaft (15) and the internal gearwheel slips over and engages the splines.

7. Turn the gearwheel rim to line up the screw holes. *See figure 15.* Alignment marks made before disassembly should line up.

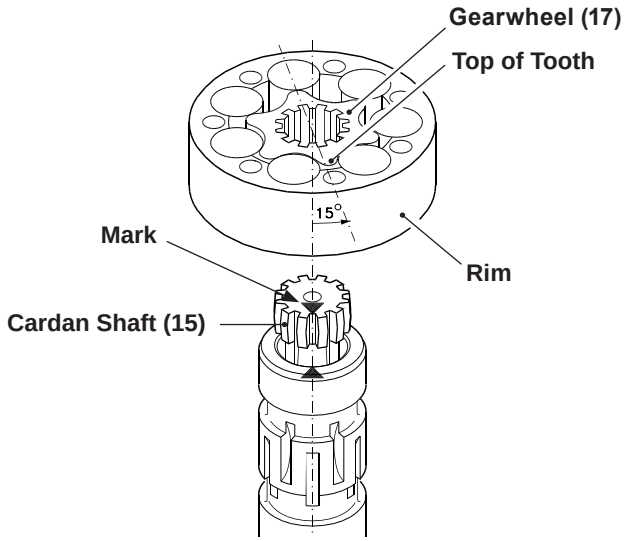


Figure 15, Gearwheel Set

END COVER

Assembly

1. Install the end cover (19). *See figure 16.* Align markings.

2. Install *new* washers (23) onto the end cover screws (22). *See figure 17.*

Note: *When tightening the screws, refer to the table on page 3 for the required torque values. Also refer to figure 18 for the proper torque sequence.*

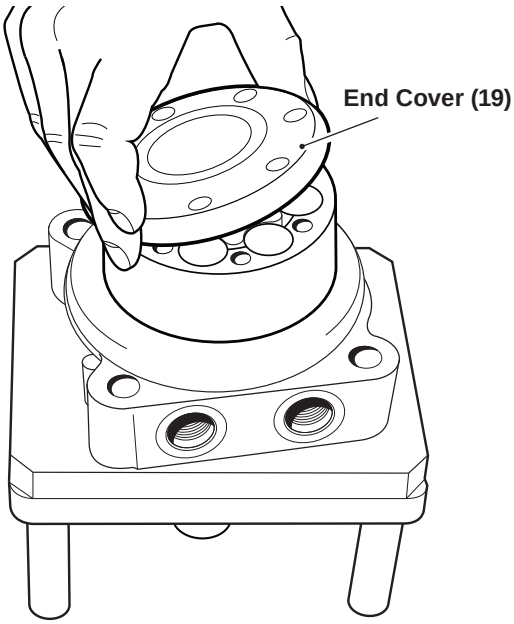


Figure 16, End Cover

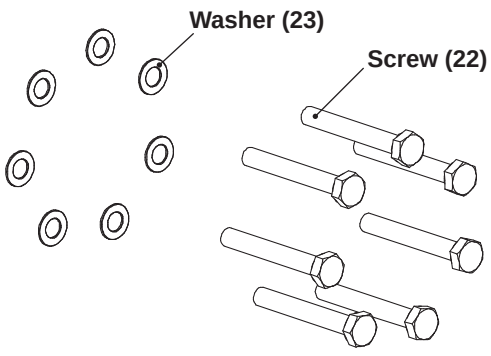


Figure 17, Washers & Screws

END COVER *(continued)*

Assembly

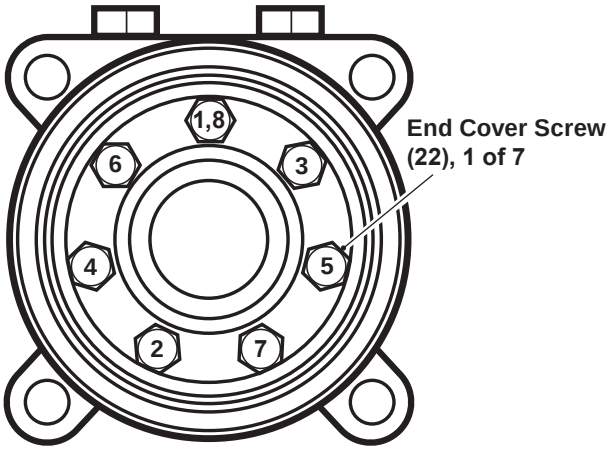


Figure 18, Torque Sequence

Assembly

3. Install the woodruff key (6), nut (1) and plastic plugs or fittings (8). *See figure 19.*

NOTE: *If the drum assembly or hub assembly is removed from the axle shaft, the drum/hub assembly must be discarded and replaced with a new assembly.*

4. Refer to page 4 for brake/hub installation instructions.

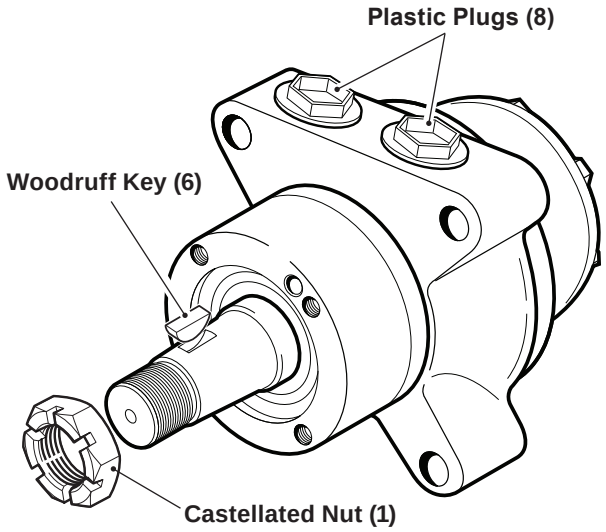
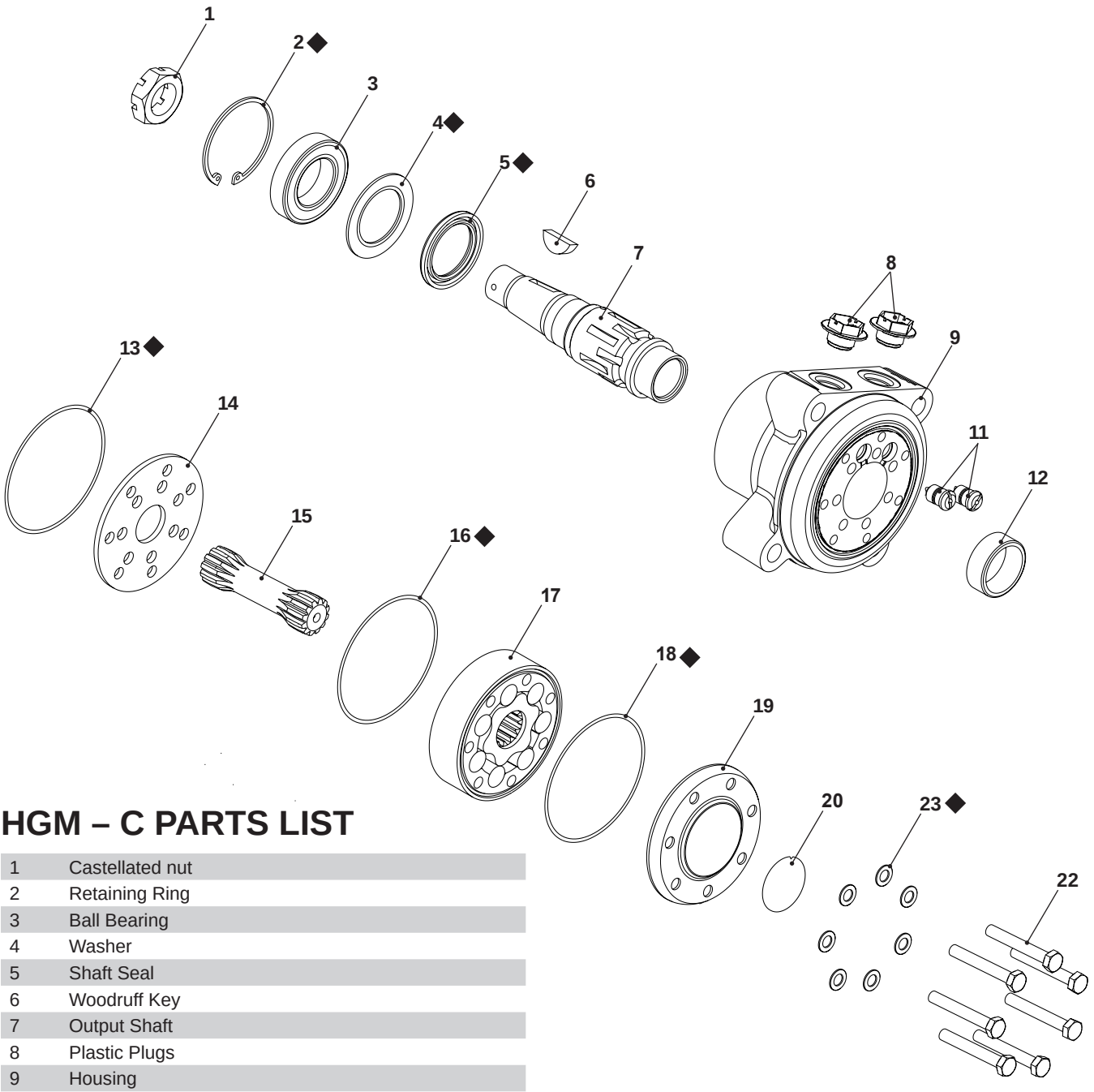


Figure 19, Final Assembly

Exploded View



HGM – C PARTS LIST

1	Castellated nut
2	Retaining Ring
3	Ball Bearing
4	Washer
5	Shaft Seal
6	Woodruff Key
7	Output Shaft
8	Plastic Plugs
9	Housing
11	Check Valve
12	Needle Bearing
13	O-ring
14	Distributor plate
15	Cardan Shaft
16	O-ring
17	Gearwheel set
18	O-ring
19	End Cover
20	Label
22	Screw
23	Washer
200	Seal Kit

200 Seal Kit

◆ Contained in seal kit