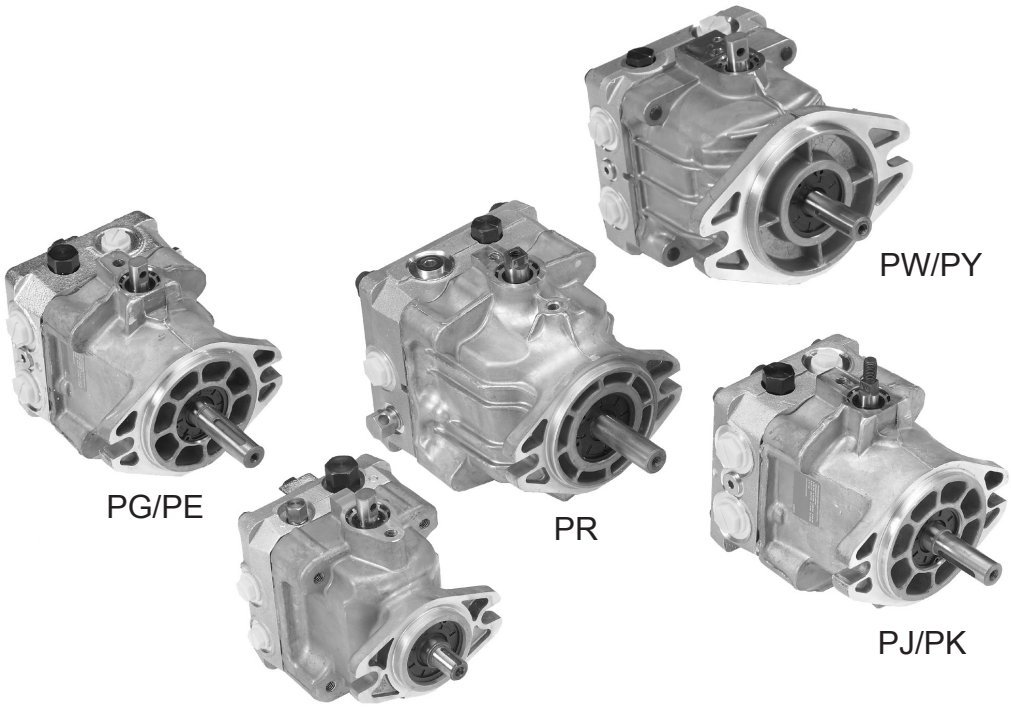
HYDRO-GEAR®

FORWARD MOTION THROUGH FORWARD THINKING



P Series Hydrostatic Pumps Service and Repair Manual

BLN-0093
June, 2018

EXTERNAL FEATURES - PG / PE SERIES

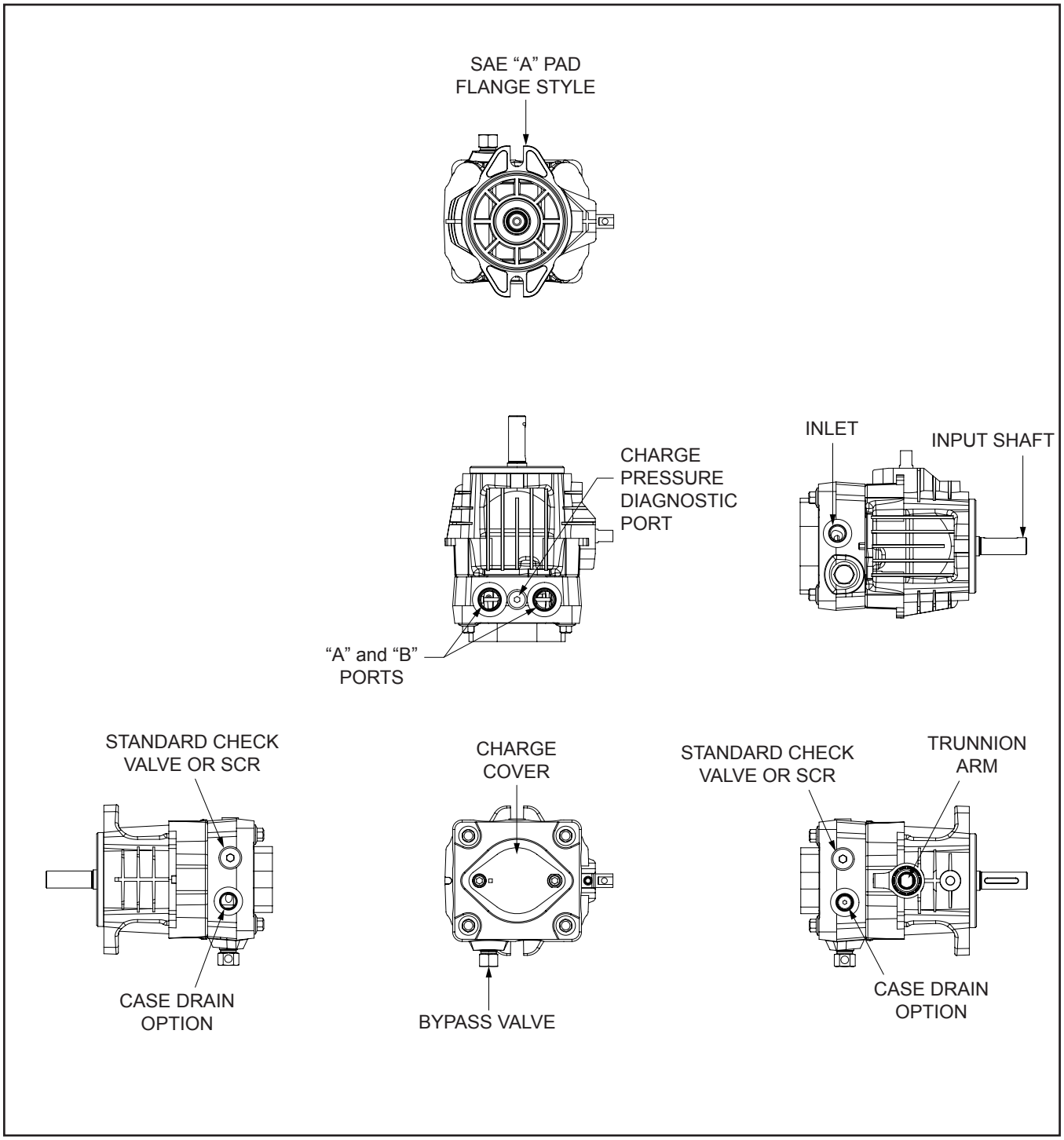


Figure 2. PG Pump With Standard Charge Pump

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.

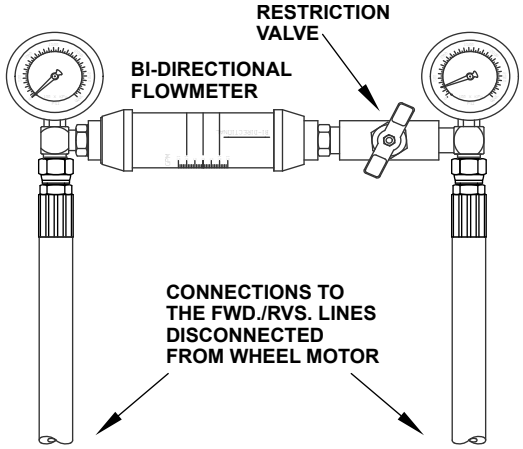
9. Increase the pressure to 1100 PSI (76 bar) for all models (PC, PG, PJ, PE, PK, PL, PR, PW and PY). Record the flow reading on the Bi-Directional Flow Meter.

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

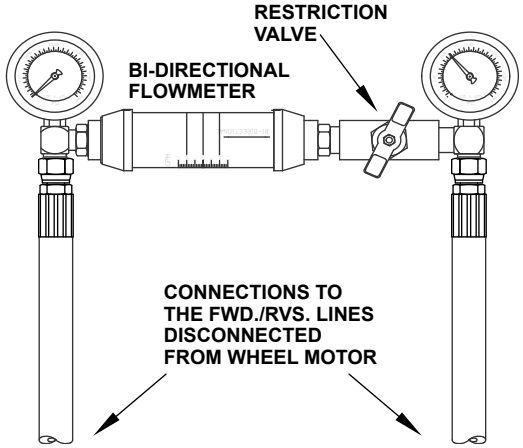
PC	**1.0 gpm (3.7 l/min)**
PG/PL/PE	**1.5 gpm (5.6 l/min)**
PJ/PK	**2.0 gpm (7.6 l/min)**
PR	**2.5 gpm (9.4 l/min)**
PW/PY	**2.5 gpm (9.4 l/min)**

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).

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Rev. P10

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 **Use Auto Xtra SAE 20W50**

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.

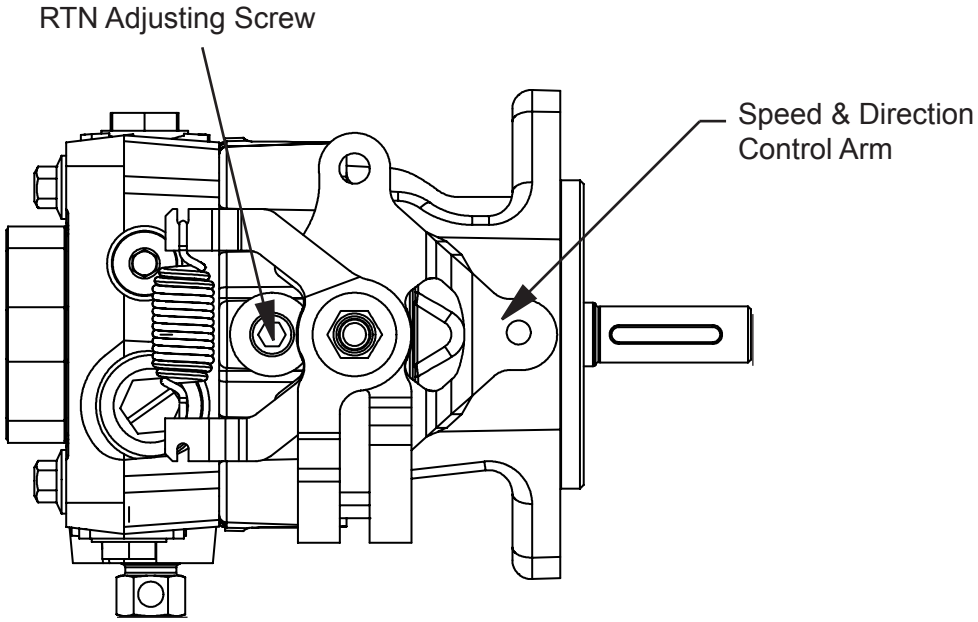

Figure 17. P Series Pump RTN Adjustment

REPAIR - 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).

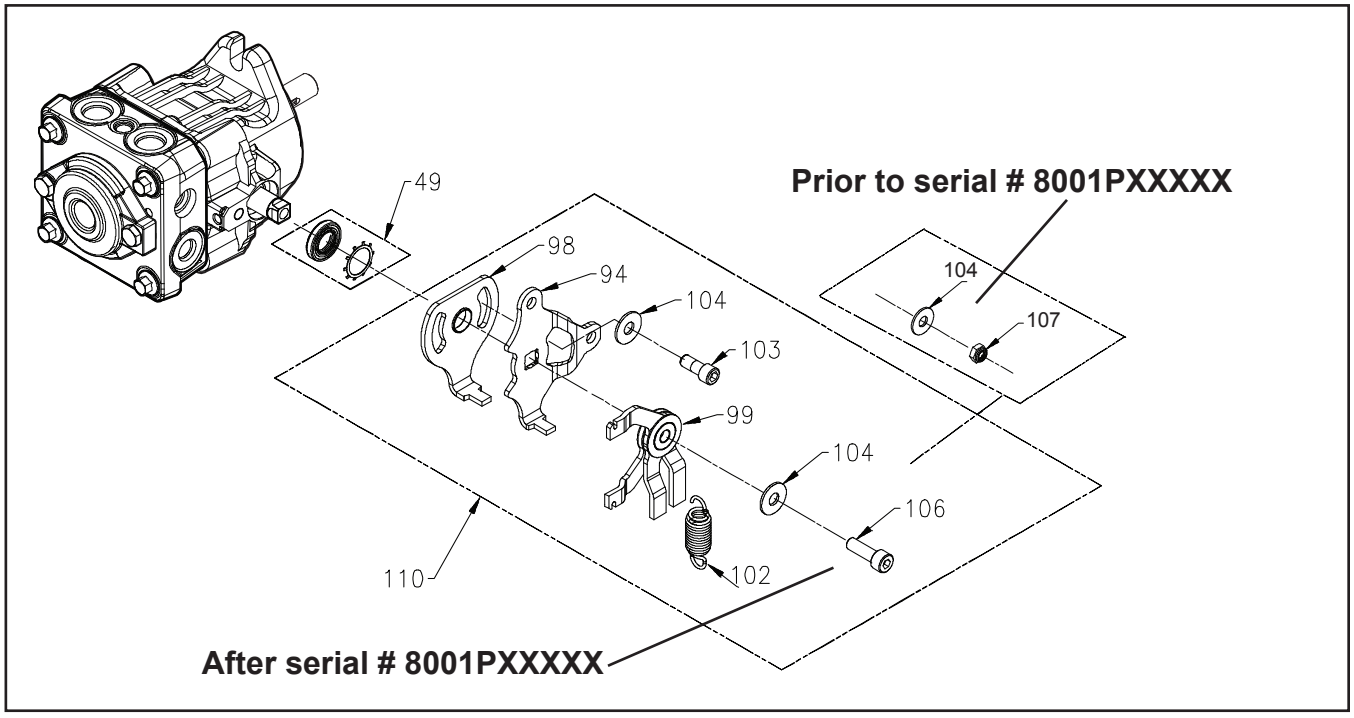

Figure 1. PG / PE Pump Return to Neutral

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.

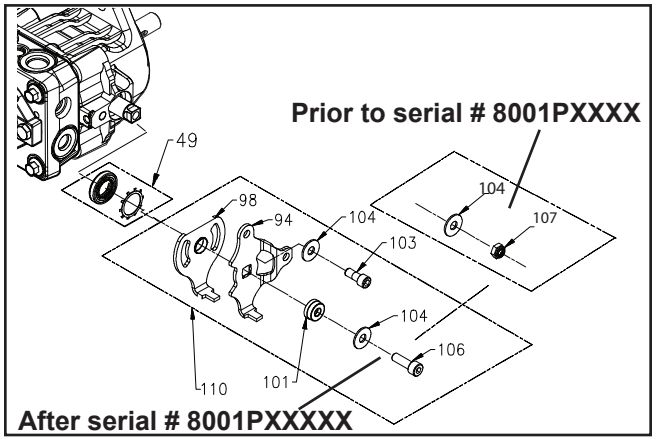

Figure 2. PG / PE Pump Standard Control Arm

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.

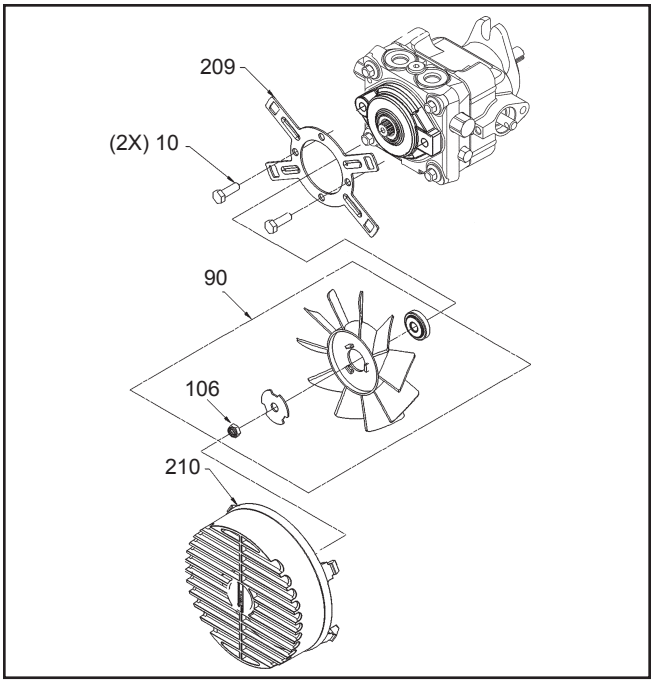

Figure 3. PG / PE Pump Fan Assembly

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.

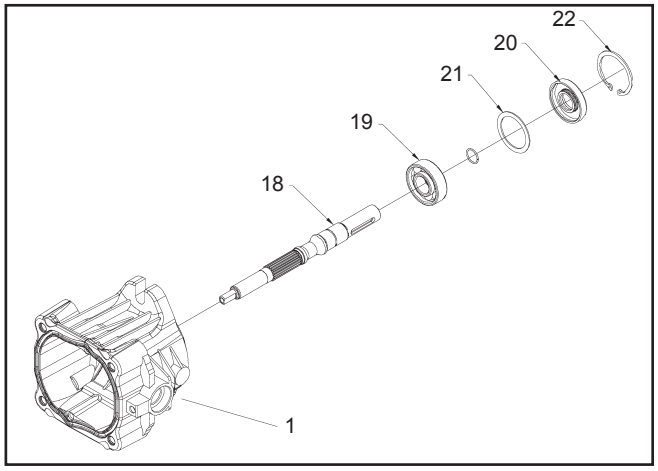

Figure 4. PG / PE Pump Input Shaft Seal

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.

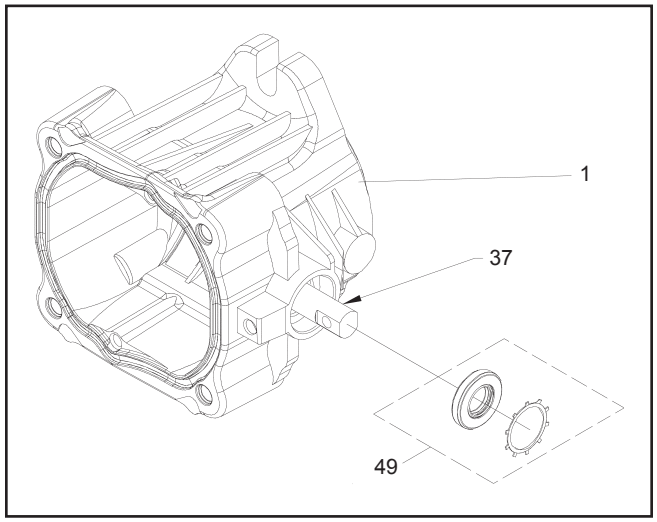

Figure 5. PG / PE Pump Trunnion Arm Seal

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.

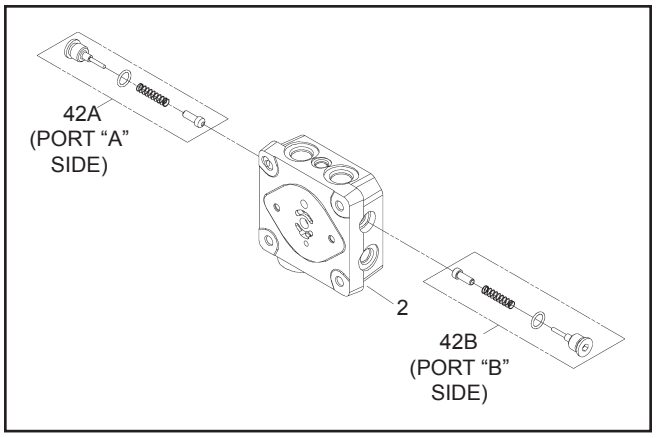

Figure 6. PG / PE Pump Check Valves

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.

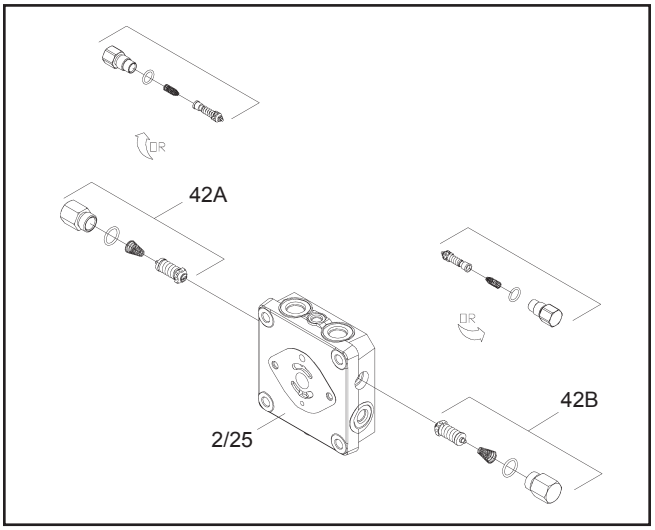

Figure 7. PG / PE Pump Shock Valves

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.

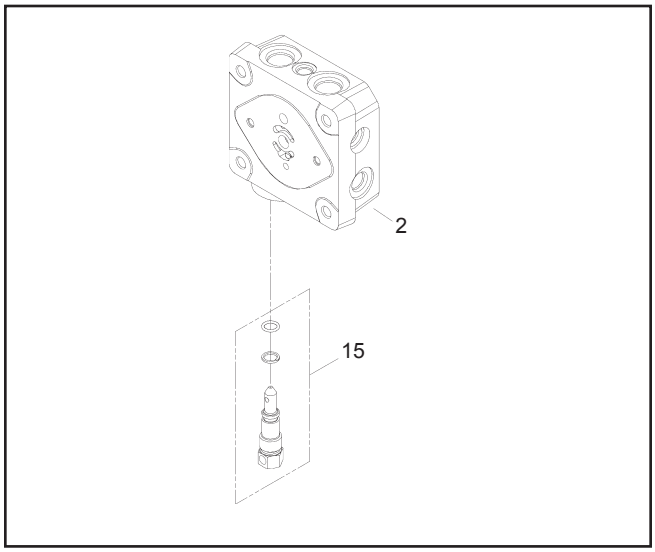

Figure 8. PG / PE Pump Bypass

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.)

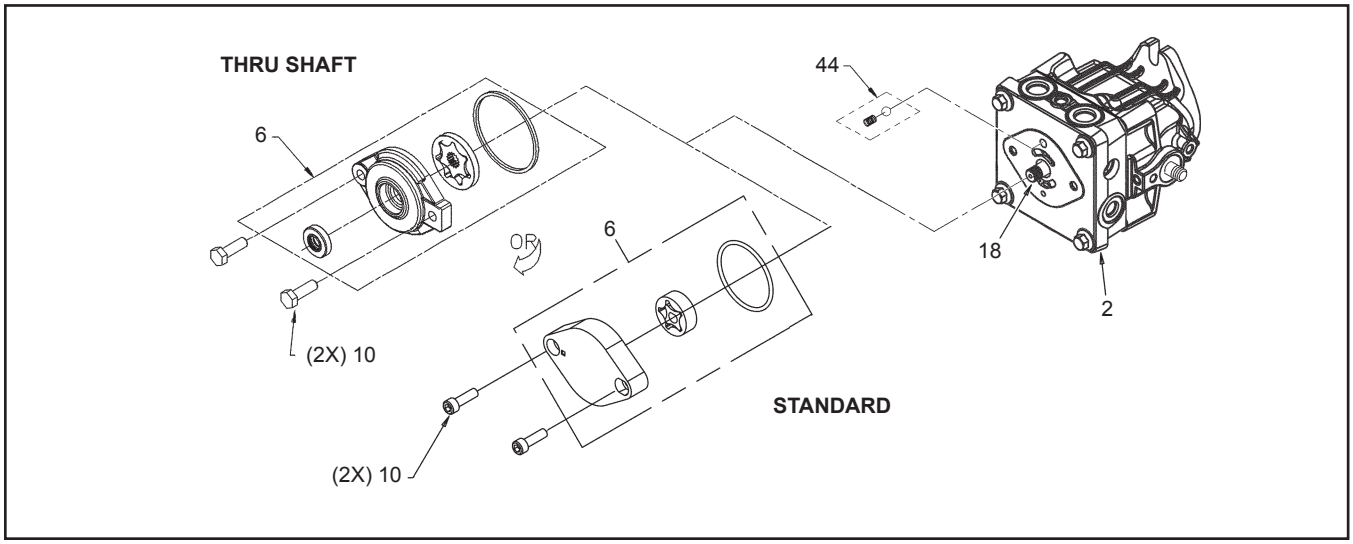

Figure 9. PG / PE Pump Standard or Thru Shaft Charge Pump

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.

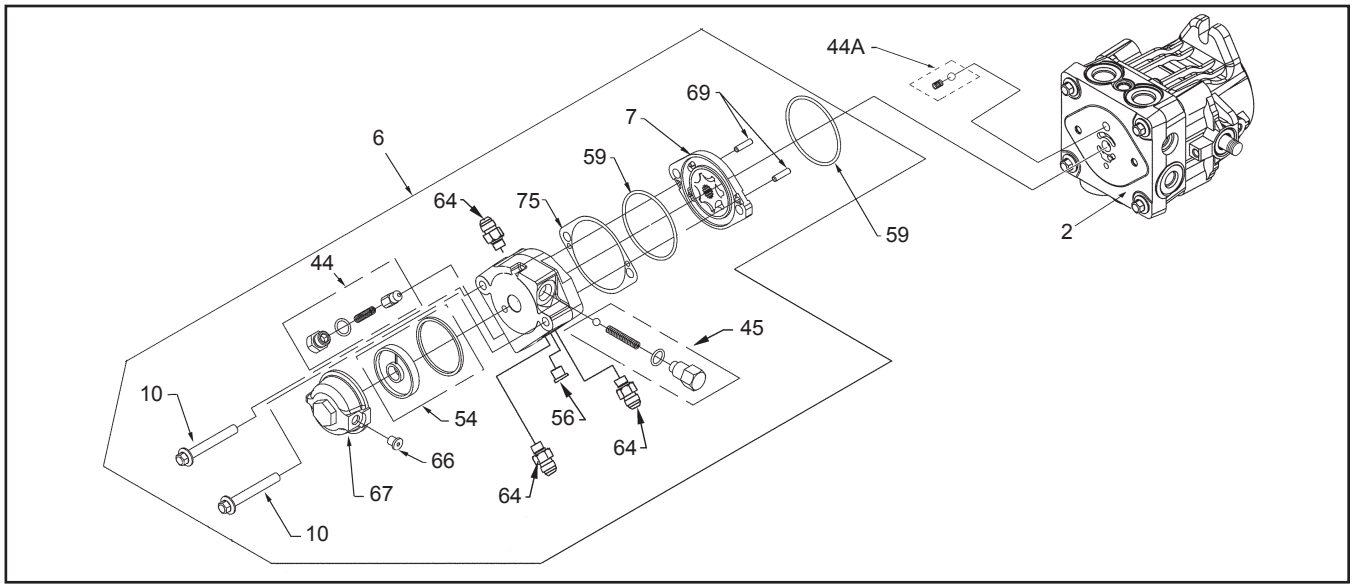

Figure 10. PG / PE Series Auxiliary Pump

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)

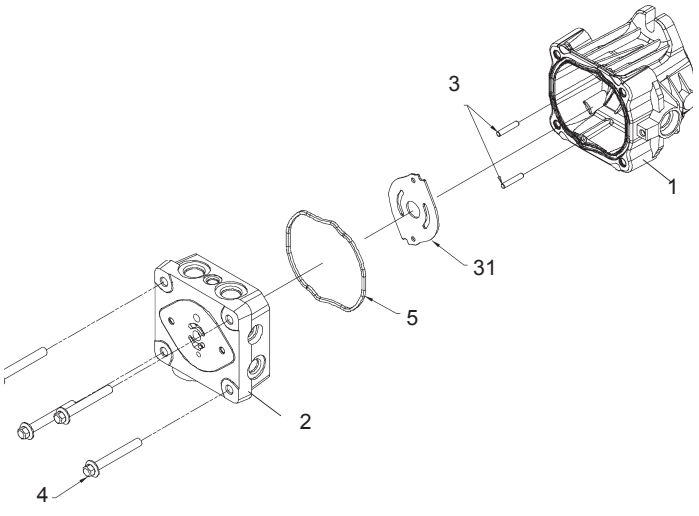

Figure 11a. PG Pump End Cap

PE Series Pumps (No Valve Plate)

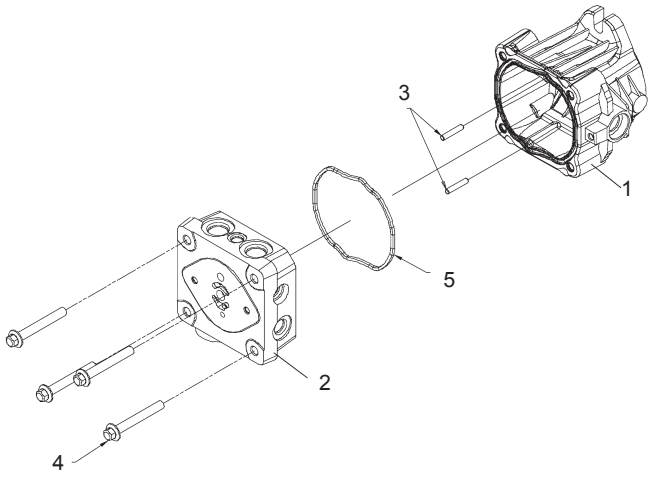

Figure 11b. PE Pump End Cap

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.

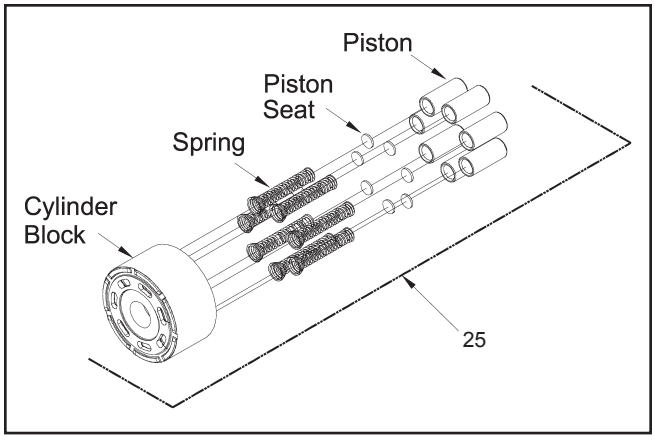

Figure 12. PG / PE Pump Cylinder Block

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).

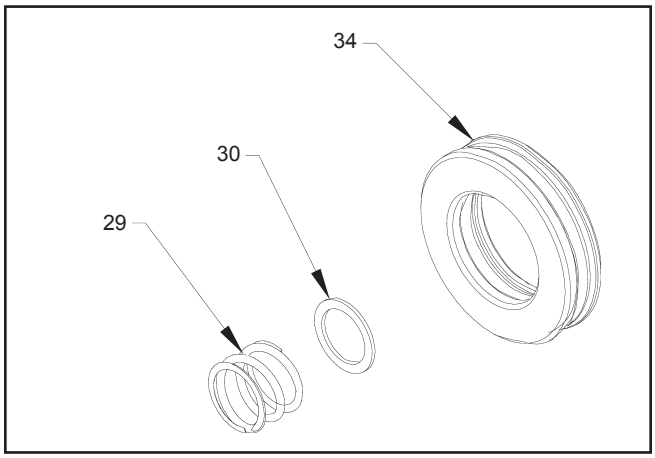

Figure 13. PG / PE Pump Block Spring and Thrust Bearing

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.

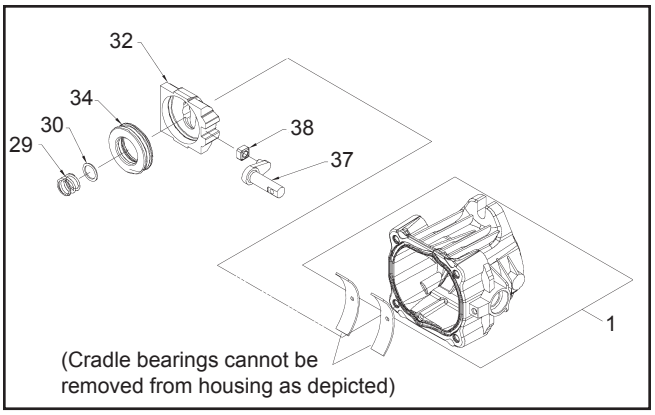

Figure 14. PG / PE Pump Swashplate and Cradle Bearings

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).

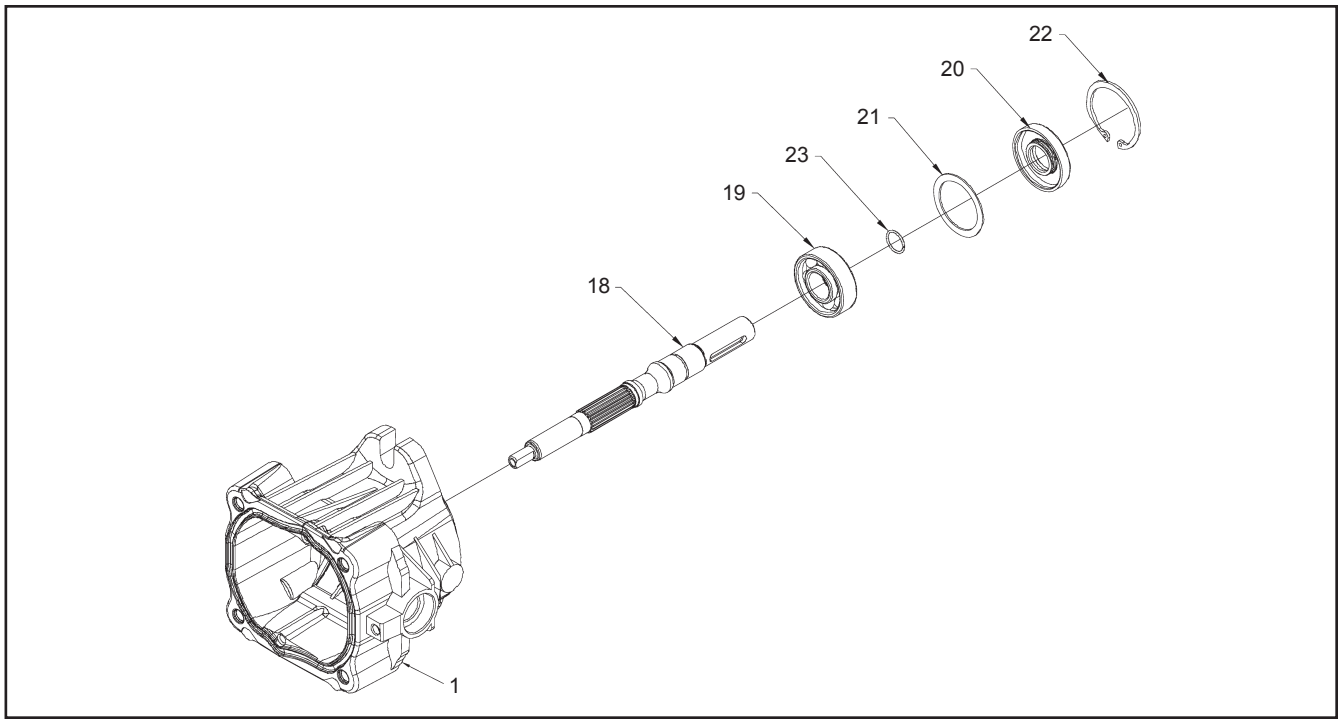

Figure 15. PG / PE Pump Input Shaft

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.

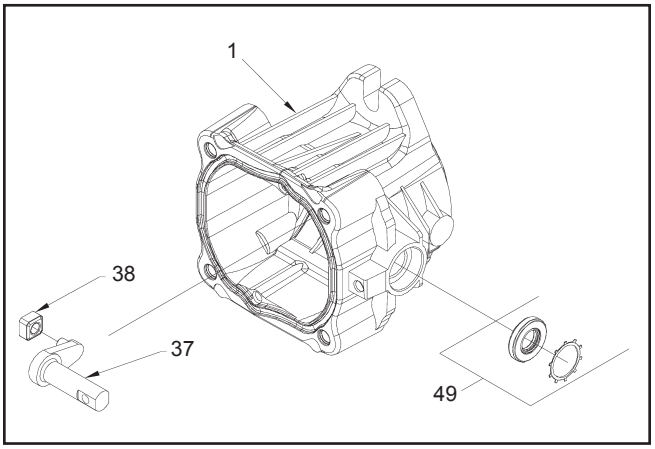

Figure 16. PG / PE Pump Trunnion Arm

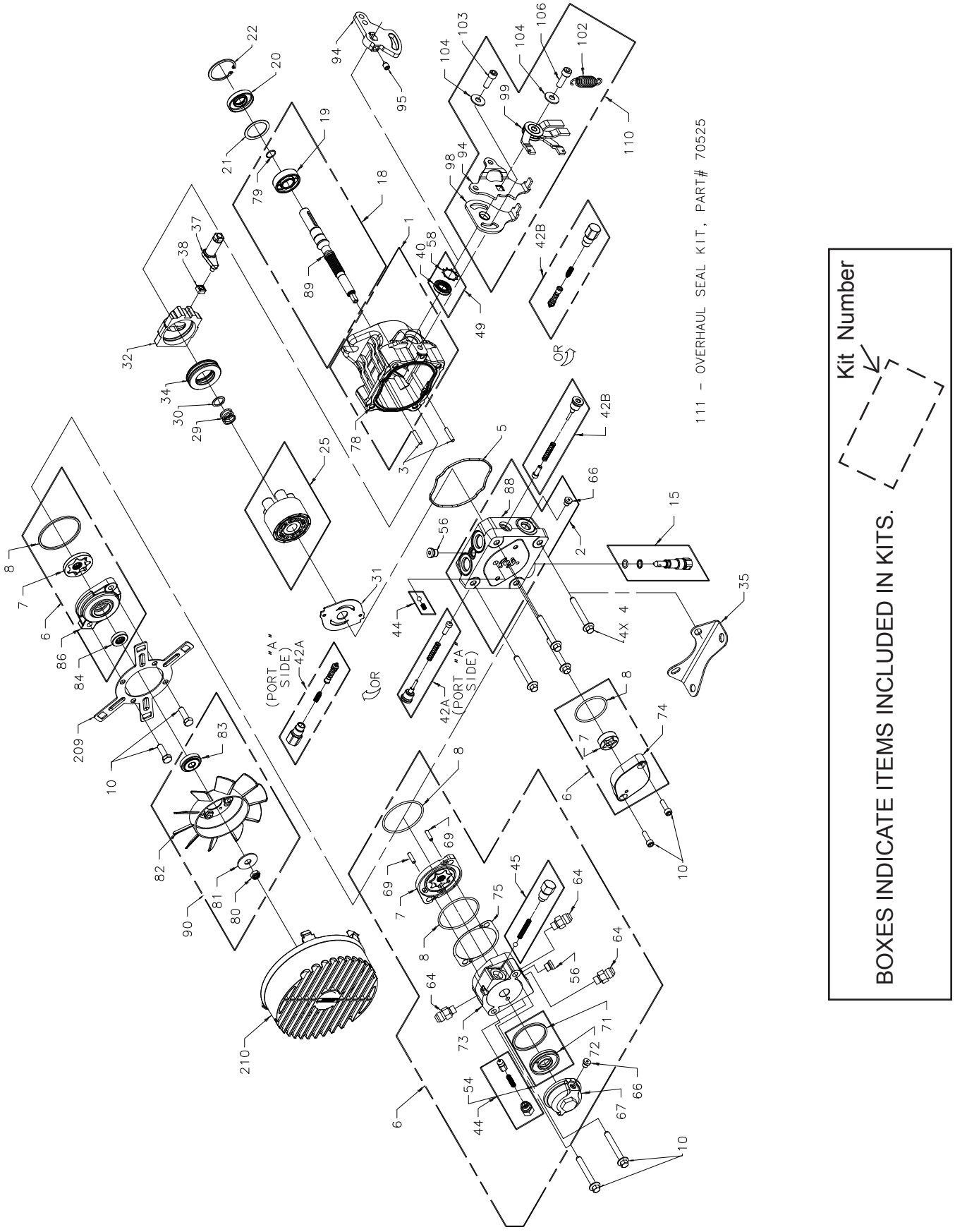

Figure 17. PG / PE Pump

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