

BDR

Service and Repair Manual

BLN-0079
January 2018

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FOREWORD

Headquartered in Sullivan, Illinois, Hydro-Gear® is a world leader in the design, manufacture, and service of quality hydrostatic transmissions 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 BDR.

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 transmission unit be removed from the vehicle.

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 OPEESA (Outdoor Power Equipment and Engine Service Association) at (860) 767-1770 or their Hydro-Gear Central Service Distributor. 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, or call our Customer Service Department at (217) 728-2581.

DESCRIPTION AND OPERATION

INTRODUCTION

The purpose of this manual is to provide information useful in servicing the Hydro-Gear® BDR. This manual includes the general descriptions, hydraulic schematics, technical specifications, servicing and troubleshooting procedures.

The transmission 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 transmission will need to be thoroughly cleaned before beginning most procedures. Do not wash the transmission while it is hot. **Do not use a pressure washer to clean the unit.**

GENERAL DESCRIPTION

The BDR is a self contained unit designed for the transfer and control of power. It provides an infinitely variable speed range between zero and maximum in both forward and reverse modes of operation.

The BDR uses a variable displacement pump with a maximum displacement of 10cc per revolution, and motor with a fixed displacement of 21cc per revolution. The variable displacement pump features a trunnion mounted swashplate with a direct-proportional displacement control.

Reversing the direction of the swashplate reverses the flow of oil from the pump and thus reverses the direction of the motor output rotation. The pump and motor are of the axial piston design and utilize spherical nosed pistons which are held against a thrust race by internal compression springs.

The BDR has a self contained fluid supply. The fluid is forced through the filter by a positive “head” on the fluid in the housing/expansion tank with an assist by the negative pressure created in the pump pistons as they operate.

The check valves in the center section are used to control the make-up flow of the fluid to the low pressure side of the loop.

A cam style, block lifting bypass is utilized in the BDR 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.



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.

HYDRAULIC FLOW SCHEMATIC

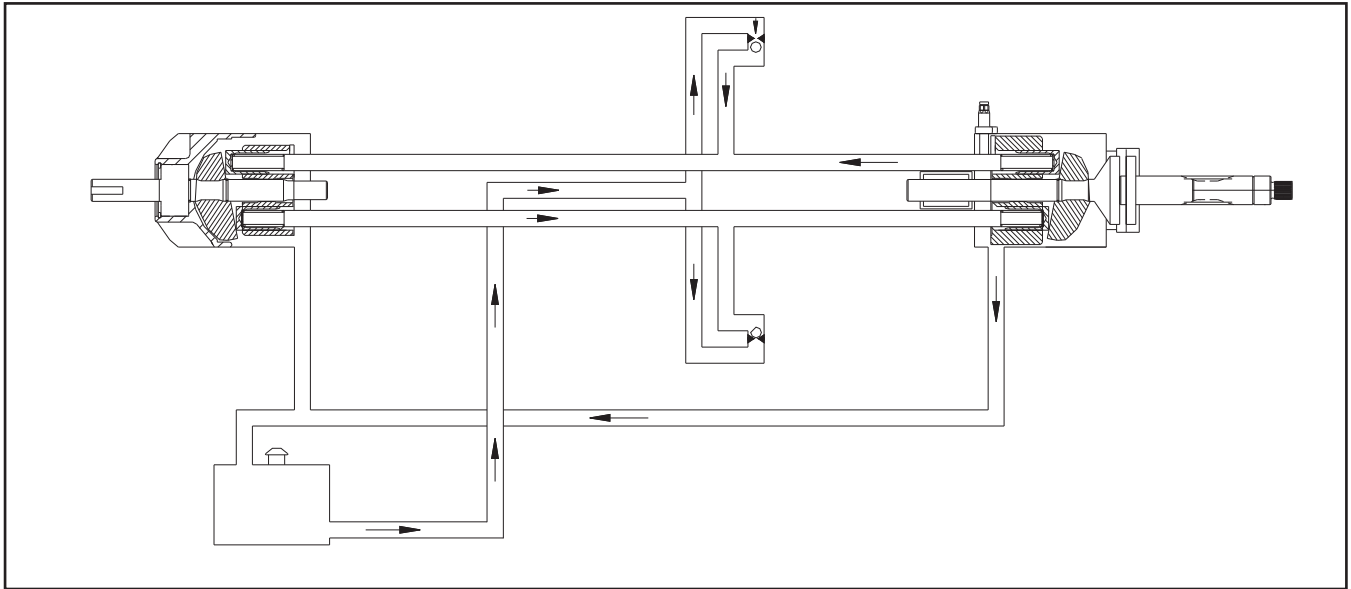


Figure 1. Hydraulic Flow Illustration

HYDRAULIC SCHEMATIC

Figure 1 provides an 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. Output of the oil flow is controlled by the direction and amount that the variable swashplate is angled. As the pump pistons compress they force the oil to flow through one of two passageways (forward or reverse) in the center section to the motor cylinder block and motor shaft. Since the motor has a fixed displacement angle it is forced to turn with the flow of oil. 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 motor. Reversing the angle of the pump swashplate will reverse the direction of oil flow.

During the operation of the transmission, fluid is “lost” from the hydraulic loop through leak paths designed into the product for lubrication purposes (around pistons, under the rotating cylinder blocks, etc.). This “lost” fluid returns to the transmission housing, then is pulled back into one of the check valves depending upon the direction of vehicle operation.

The motor cylinder block mounts onto a splined motor shaft which drives the gear train.

The bypass feature in the BDR has a mechanical lever which lifts the motor block off of the center section running surface. This allows oil flow from the cylinder blocks to be discharged.

EXTERNAL FEATURES BDR

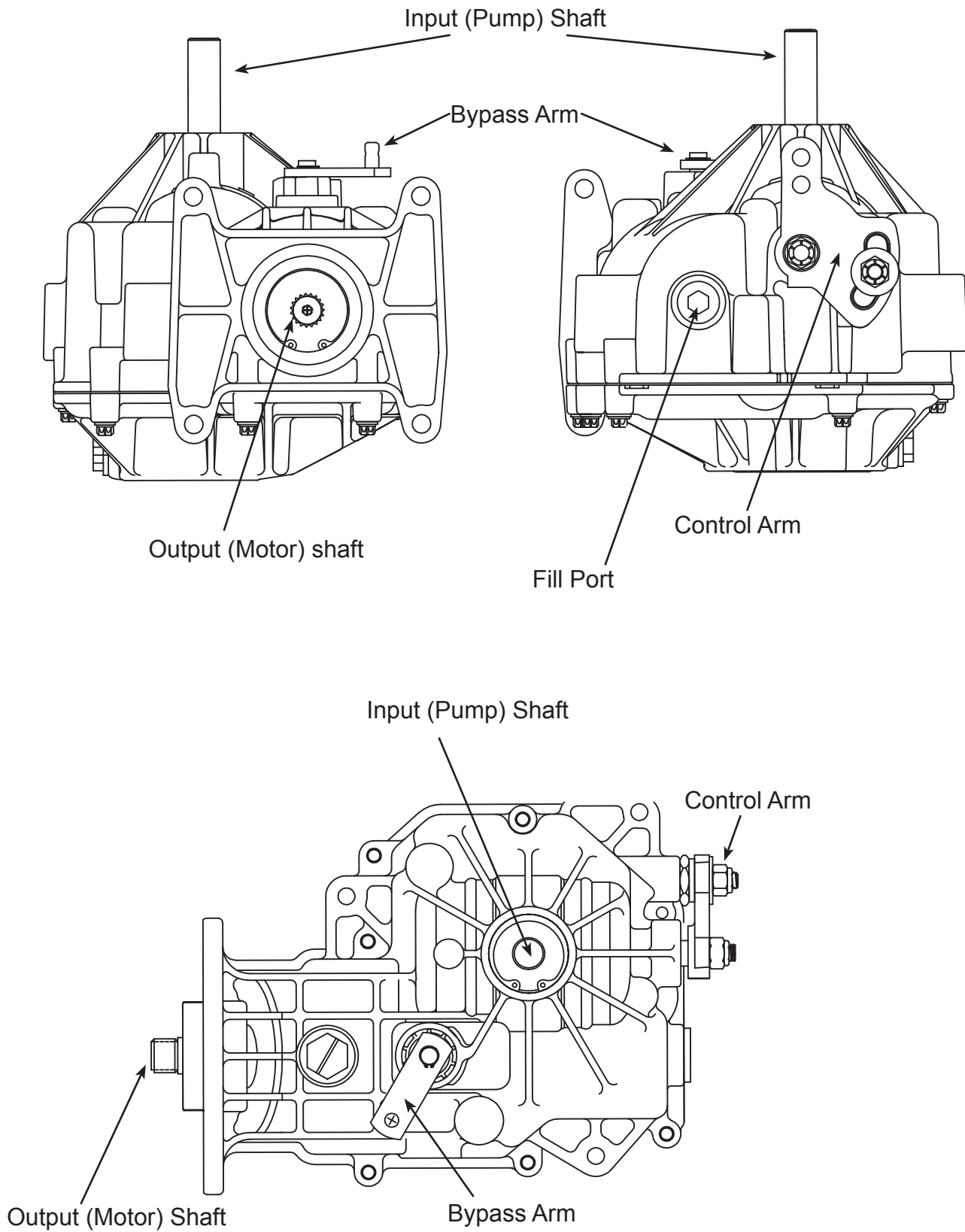


Figure 2. External Features

EXTERNAL FEATURES BDR

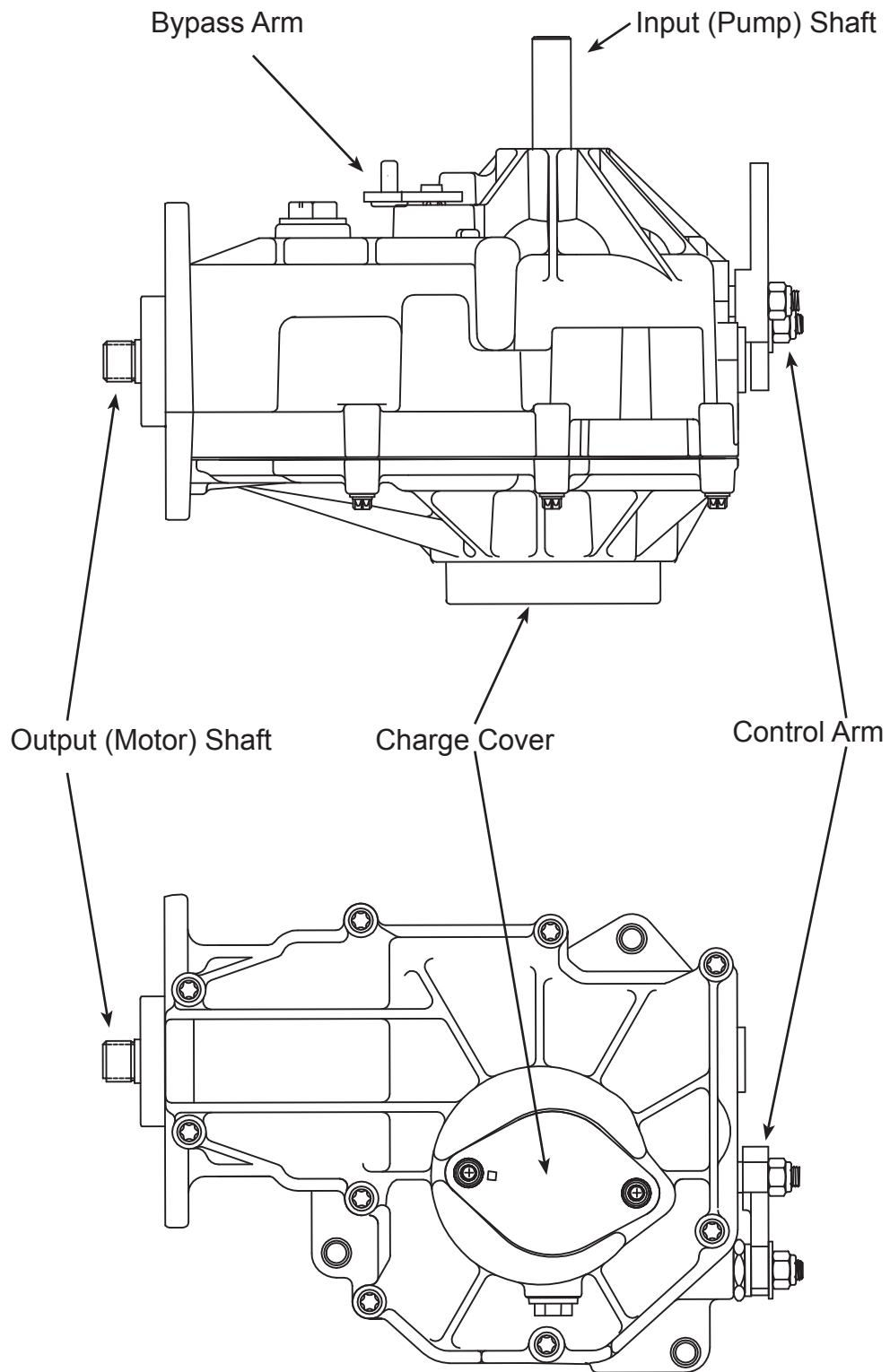


Figure 3. External Features

TECHNICAL SPECIFICATIONS

	Charged	Non Charged
Displacement Variable Pump (Maximum)	10.2 cc/rev .62 in³/rev	
Fixed Motor	21.8 cc/rev 1.33 in³/rev	
Input Speeds Maximum Unloaded Minimum Loaded	3600 rpm 1800 rpm	3000 rpm 1800 rpm
System Operating Pressure Intermittent	2100 psi 145 bar	2100 psi 145 bar
Continuous	1000 psi 70 bar	850 psi 60 bar
Case Pressure Continuous	8 psi 0.6 bar	
Maximum at Cold Start	15 psi 1.0 bar	
Weight	15 lbs 6.8 kg	
Motor Output Torque (Approximate)	180 in-lb / 1000 psi 20.3 N-m / 70 bar	
Charge Pump Displacements	1.9 cc/rev .11 in³/rev	--- ---

Table 1. Technical Specifications

PRODUCT IDENTIFICATION

The model and configuration of the BDR can be determined from the label shown in Figure 3.

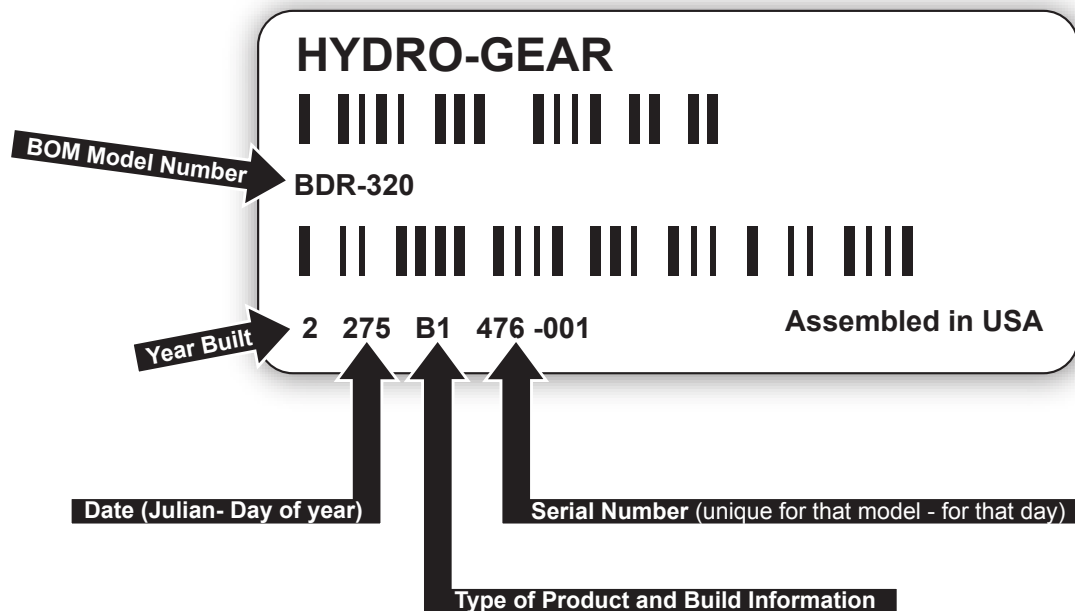


Figure 4. Configuration Label

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 transmission. 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 BDR, fully read and understand the safety precautions described in this section.

PERSONAL SAFETY

Certain safety precautions must be observed while servicing or repairing the BDR. 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 the BDR are not related to a defective transmission, 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 the Service and Maintenance section before assuming the transmission is malfunctioning. Table 5 below provides a troubleshooting checklist to help determine the cause of operational problems.

Possible Cause	Corrective Action
UNIT OPERATES IN ONE DIRECTION ONLY	
Control linkage bent or out of adjustment Drive belt slipping or pulley damaged	Repair or replace linkage Repair or replace drive belt or pulley
VEHICLE DOES NOT DRIVE/TRACK STRAIGHT	
Vehicle tires improperly inflated Control linkage bent or out of adjustment Bypass assembly sticking	Refer to vehicle manufacturer suggested pressure Repair or replace linkage Repair or replace bypass
UNIT IS NOISY	
Oil level low or contaminated oil Excessive loading Loose parts Bypass assembly sticking Air trapped in hydraulic system	Fill to proper level or change oil Reduce vehicle loading Repair or replace loose parts Repair or replace linkage Purge hydraulic system
UNIT HAS NO/LOW POWER	
Engine speed low Control linkage bent or out of adjustment Drive belt slipping or pulley damaged Oil level low or contaminated oil Excessive loading Bypass assembly sticking Air trapped in hydraulic system	Adjust to correct setting Repair or replace linkage Repair or replace drive belt or pulley Fill to proper level or change oil Reduce vehicle loading Repair or replace linkage Purge hydraulic system
UNIT IS OPERATING HOT	
Debris buildup around transmission Cooling fan damaged Oil level low or contaminated oil Excessive loading Air trapped in hydraulic system	Clean off debris Repair or replace cooling fan Fill to proper level or change oil Reduce vehicle loading Purge hydraulic system
TRANSMISSION LEAKS OIL	
Damaged seals, housing, or gaskets Air trapped in hydraulic system	Replace damaged component Purge hydraulic system

Table 4. BDR Troubleshooting Guide

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 BDR 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 oil level in accordance with Figure 4 Page 11.
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 transmission.
4. Inspect the vehicle control linkage to the directional control arm on the transmission. Also insure that the control arm is securely fastened to the trunnion arm of the transmission.
5. Inspect the bypass mechanism on the transmission and the vehicle linkage to insure that both actuate and release fully.

SERVICE AND MAINTENANCE PROCEDURES

Some of the service procedures presented on the following pages can be performed while the transmission 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. The unit 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.

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. A 20W50 engine oil has been selected for use by the factory and is recommended for normal operating procedures.

FLUID VOLUME AND LEVEL

Fluid volume information is provided in Table 6, page 11.

Certain situations may require additional fluid to be added or even replaced. Refer to page 5 for the proper fill port location.

A volume of 37.87 fluid ounces should bring the fluid to the correct level in the transmission.

Recheck the fluid level once the unit has been operated for approximately 1 minute.

Purging will be required. Refer to the purging procedures on Page 12.

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

FLUID CHANGE

FLUID CHANGE PROCEDURE

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.

1. Remove the transmission from the vehicle.
2. Clean the oil fill port area of any debris.
3. Remove the oil fill port fitting.
4. Position the transmission so the oil will drain completely out of the housing.
5. Fill the transmission at the oil fill port according to Figure 5.
6. Install the oil fill port fitting.
7. Purging will be required. Refer to the purging procedures on Page 12.
8. Recheck the fluid level once the unit has been operated for approximately 1 minute.

Fluid Description	Volume
20W50	37.87 fluid ounces

Table 6. Fluid Volumes for the BDR

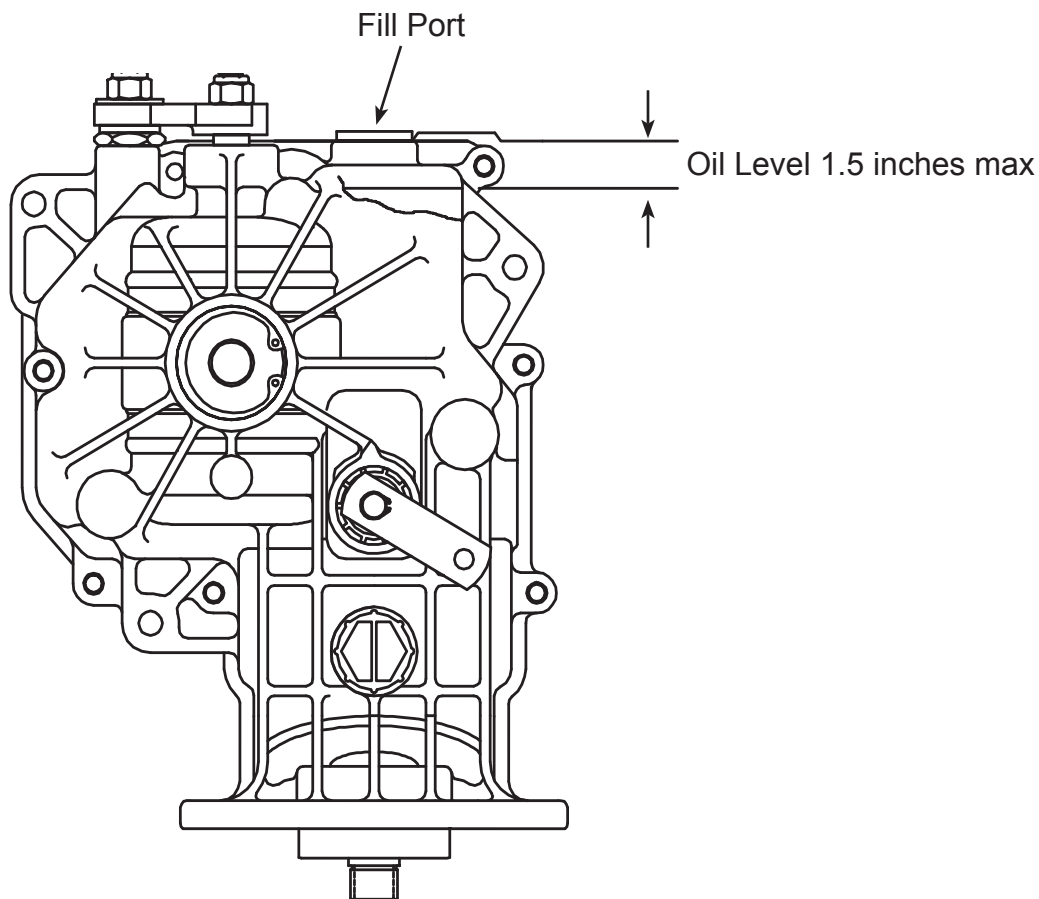


Figure 5. Oil Level

PURGING PROCEDURES

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

These purge procedures should be implemented any time a hydrostatic system has been opened to facilitate maintenance or any additional oil has been added to the system.

Air creates inefficiency because its compression and expansion rate is higher than that of the oil approved for use in hydrostatic drive systems.

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.

Before starting, make sure the transmission is at the proper oil level. If it is not, fill to the specifications outlined on Page 11, Table 6.

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

1. With the bypass valve open and the engine running, slowly move the directional control in both forward and reverse directions (5 or 6 times), as air is purged from the unit, the oil level 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 the engine.
3. It may be necessary to repeat Steps 1 and 2 until all the air is completely purged from the system. When the transmission moves forward and reverse at normal speed purging is complete.

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 BDR, fully read and understand the safety precautions described in this section.



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 transmission 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 transmission:

1. Confirm the transmission 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. Refer to Figure 6.
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 OEM linkage according to Step 3 and Step 4. Stop the vehicle engine. Refer to Figure 6.

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 opposite direction of the wheel rotation in 5 degree increments. Tighten the RTN adjustment screw. Refer to Table 8, Required Torque Values, page 15. Recheck according to steps 3 and 4. Stop the vehicle engine. Reattach and adjust the OEM linkage according to the OEM manual. Recheck according to steps 3 and 4. Refer to Figure 6.

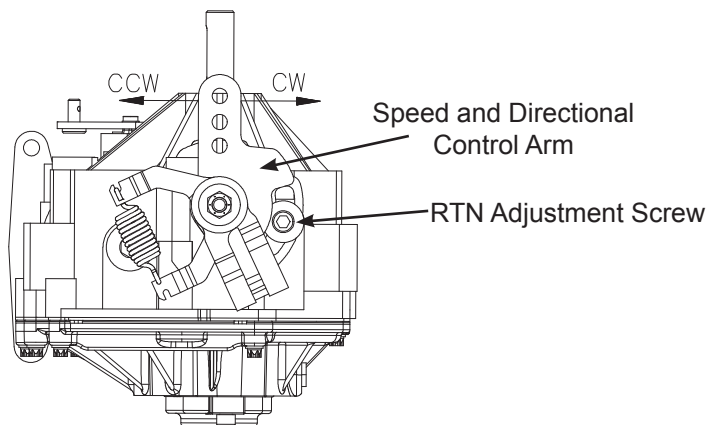


Figure 6. Return to Neutral Setting

BDR REPAIR

HOW TO USE THIS MANUAL

Each subassembly illustrated in this section is illustrated with an exploded view showing the parts involved. The **item reference numbers in each illustration are for assembly instructions only**. See page 30 for part names and descriptions. A complete exploded view and item list of the transmission 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.

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 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 at the Hydro-Gear website (www.hydro-gear.com).

TRANSMISSION REMOVAL

It is necessary to remove the transmission from the vehicle before performing the repair procedures presented in this section.

LIMITED DISASSEMBLY

The following procedures are presented in the order in which they must be performed to completely disassemble the unit. Do not disassemble the unit any farther than is necessary to accomplish the required repairs. Each disassembly procedure is followed by a corresponding assembly procedure.

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 28.

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

TOOLS AND TORQUES

Miscellaneous

Service & Repair Manual
 Flat Blade Screw Driver (2)
 Torque Wrench
 Air Impact Wrench
 Rubber Mallet
 Breaker Bar
 Plastic Putty Knife
 Large External Snap Ring
 Small Internal Snap Ring

Sockets

1/2"-3/8" Adapter
 3/8" Deep
 1/2" Deep
 7/16" Deep
 9/16" Deep
 13/16" Deep
 7/8"
 E8 Torx
 T-25 Torx

Table 7. Required Tools

Operation	Torque	Item	Description
Control Arm	See Page 16-17	35	Nut
Center Section Screws	525-700 in-lbs (60-79 Nm)	44	Screw
Housing Screws	135-185 in-lbs (16-20 Nm)	50	Screw, Self Tapping
Plug	180-240 in-lbs (21-27 Nm)	51	Plug
Charge Cover Screws	87-108 in-lbs (10-12 Nm)	55	Screw
Charge Relief	42-62 in-lbs (5-7 Nm)	57	Bolt, Self Tapping
Charge Cover Plug	6-24 in-lbs (.67-2.7 Nm)	60	Plug
Control Arm	210-270 in-lbs (24-30 Nm)	76	Screw
Plug	6-24 in-lbs (.67-2.7 Nm)	202	Plug

Table 8. Required Torque Values

SEAL KIT REPLACEMENT

Before disassembly, wipe the unit free of any debris to avoid contamination.

Trunnion Seal (page 17 & 18)

1. Remove the control arm and any attachments to the control arm. See page 18.
2. Remove retaining ring (58) and discard.
3. The seal (33) can be replaced by following steps 2-5 of the procedure used to replace the input shaft.
4. Install new retaining ring (58).
5. Install the control arm and any attachments to the control arm.

Input (Pump) Seal (page 19)

1. Remove the seal retaining ring (7).
2. Carefully pull the input seal (4) out of the housing bore with a “hook” type tool and discard. Care must be taken to avoid damage to the housing bore or shaft sealing area.
3. Lubricate the new seal with petroleum jelly prior to installation.
4. Wrap the shaft keyway (splines) with cellophane to prevent damage to the seal lip during installation.
5. Slide the seal over the shaft and press it into the housing bore.
6. The seal should seat against the spacer.
7. Install the seal retaining ring (7) and make sure it is fully seated in its groove.

Output (Motor) Seal (page 20)

1. The seal (66) can be replaced by following steps 1-7 of the procedure used to replace the input seal.

Bypass Seal (page 21)

1. Remove the bypass arm and any attachments to the bypass arm. See page 21.
2. Remove the seal retaining ring (58). Remove the bypass rod seal (40) out of the housing bore with a “hook” type tool. Care must be taken to avoid damage to the housing bore or the bypass actuator.
3. The seal (40) can be replaced by following steps 3-5 of the procedure used to replace the input shaft.
4. Install the bypass arm (41).
5. Install the seal retaining ring (42).

Charge Cover O-Ring (page 22)

1. Mark the orientation of the charge cover (54). It is very important that the charge cover is reinstalled the same way it was taken off.
2. Replace the o-ring (53)
5. Install the charge cover (54) and bolts (55) see page 15 for torque value.

Lower Housing Gasket (page 23)

1. Mark the orientation of the charge cover (54) and remove. It is very important that the charge cover is reinstalled the same way it was taken off.
2. Remove o-ring (53) and geroter (52) and set aside.
3. Remove lower housing (2).
4. Remove gasket (49) discard and install new gasket.
5. Install lower housing (2) reference page 15 for torque values for the housing bolts (9).
6. Install o-ring (53) and geroter set (52).
7. Install charge cover (54) and bolts (55).

TRUNNION SEAL (RETURN TO NEUTRAL)

Refer to Figure 7.

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 car and properly protection turning disassembly and assembly of the return to neutral linkage.*

1. Loosen (but do not remove) the nut (35).
2. To relieve spring tension, carefully pry up on the out scissor control arm until it releases from the tab on the control arm (34).
3. Remove the spring (81), the nut (35) and washer (104).
4. Remove the scissors arm assembly (80).
5. Remove control arm (34).
6. Remove the bolt (76) and washer (59).
7. Remove the return arm (74).
8. Remove and discard the retaining ring (58) and seal (33) only if replacing the seal or doing a complete rebuild.

Inspection

1. Inspect all parts of damage, corrosion, or wear.

Assembly

1. Install seal (33) and retaining ring (58).
2. Install return arm (74).
3. Install washer (59) and bolt (76) see torque value below.
4. Install control arm (34).
5. Install scissors arm kit (80).
6. Install washer (59) and nut (35) see torque value below.
7. Install spring (81).
8. See page 13 to adjust neutral setting.

Item	Torque
76	210-270 in-lbs (24-30 Nm)
35	180-240 in-lbs (21-27 Nm)
See page 15 for full torque value chart.	

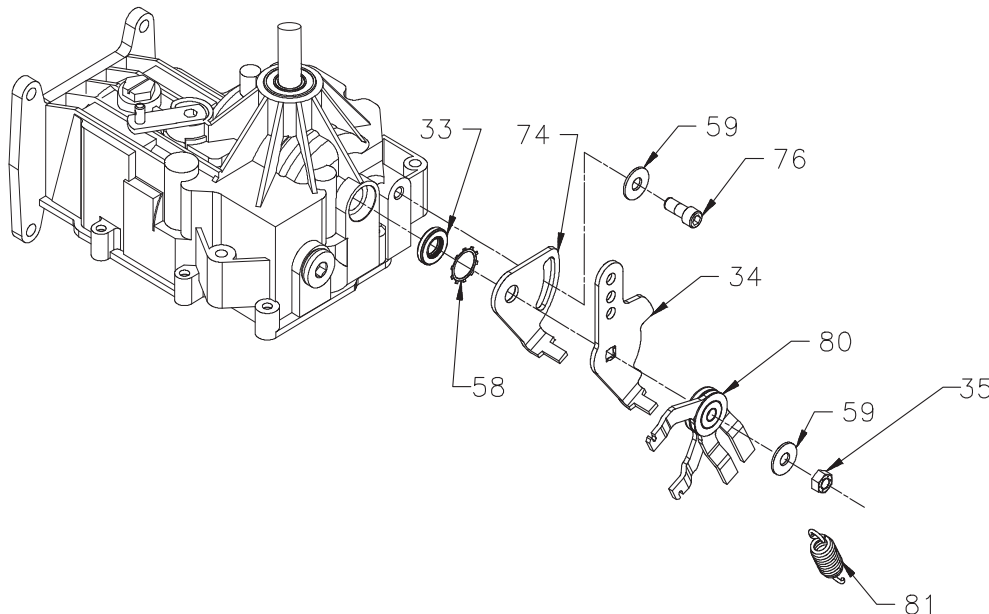


Figure 7. Control Arm and Return to Neutral

TRUNNION SEAL (CONTROL ARM)

Refer to Figure 8.

Disassembly

1. Remove nut (35).
2. Remove washer (59).
3. Remove nut (35B) / set screw (72).
4. Remove control arm (34).
5. Remove washer (37).
6. Remove stud (36) only if damaged or doing a complete rebuild.
7. Remove and discard the retaining ring (58) and seal (33) only if replacing the seal or doing a complete rebuild.

Assembly

1. Install seal (33) and retaining ring (58).
2. Instal stud (36) see torque value below and washer (37).
3. Install control arm (34).
4. Instal nut (35B) / set screw (72) see torque values below.
5. Install washer (59).
6. Install nut (35) after setting neutral. See torque values below.

Item	Torque
76	210-270 in-lbs (24-30 Nm)
35	85-120 in-lbs (10-13.5 Nm)
35B	180-240 in-lbs (21-27 Nm)
72	100-185 in-lbs (12-20 Nm)
36	50-120 in-lbs (6-13.5 Nm)
See page 15 for full torque value chart.	

Inspection

1. Inspect all parts of damage, corrosion, or wear.

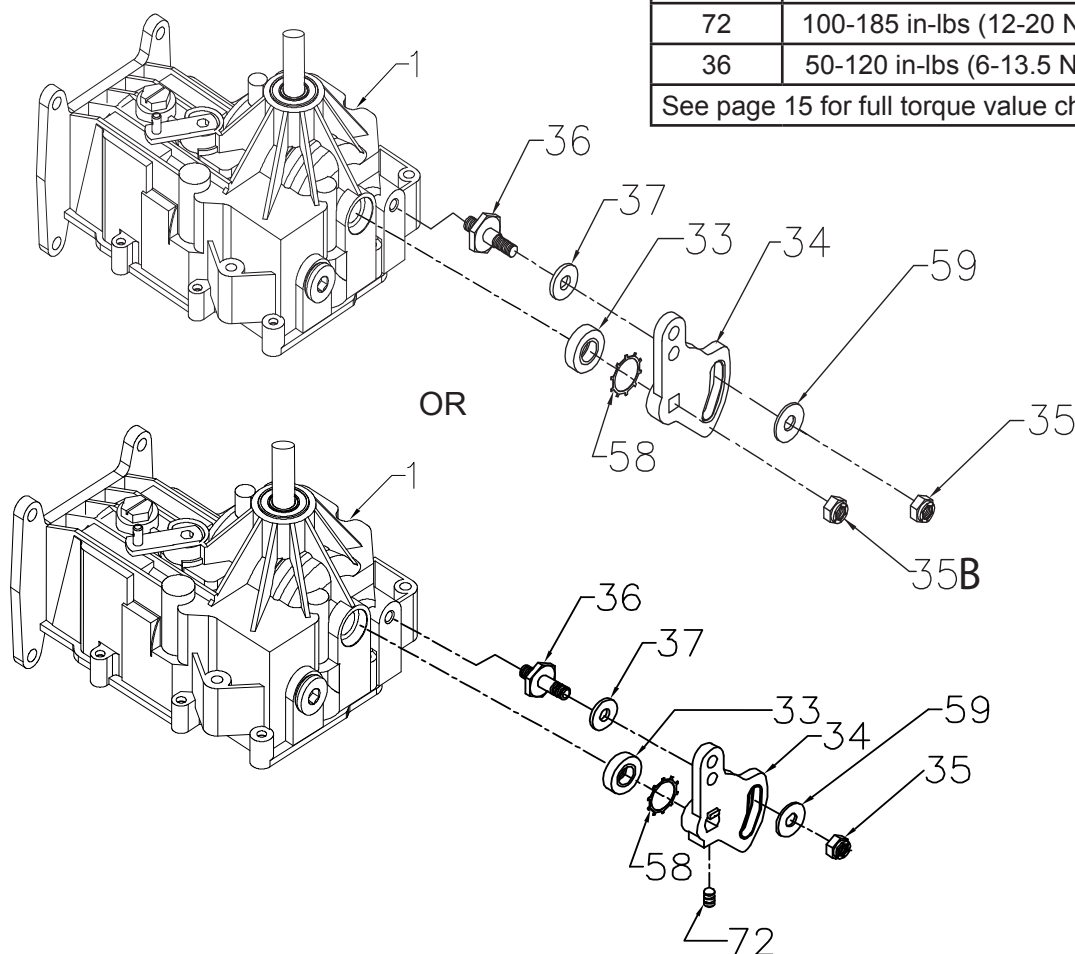


Figure 8. Control Arm

INPUT (PUMP) SHAFT

Refer to Figure 9.

Disassembly

1. Requires removal of all items beginning on page 16.
2. Remove the retaining ring (7).
3. Remove the lip seal (4) and discard.
4. Remove the washer (5).
5. Remove the pump shaft assembly (12).

Inspection

1. Inspect the components for wear or damage.

Assembly

Note: If the unit is charge mark the orientation of the charge cover and then remove before reinstalling the input shaft. See page 28 for complete rebuild instructions.

1. Install input shaft (12).
2. Install washer (5).
3. Lubricate the new seal (5) with petroleum jelly prior to installation.
4. Wrap the shaft keyway (splines) with cellophane to prevent damage to the seal lip during installation.

5. Slide the seal over the shaft and press it into the housing bore.
6. The seal should seat against the spacer.
7. Install the seal retaining ring (7) and make sure it is fully seated in its groove.

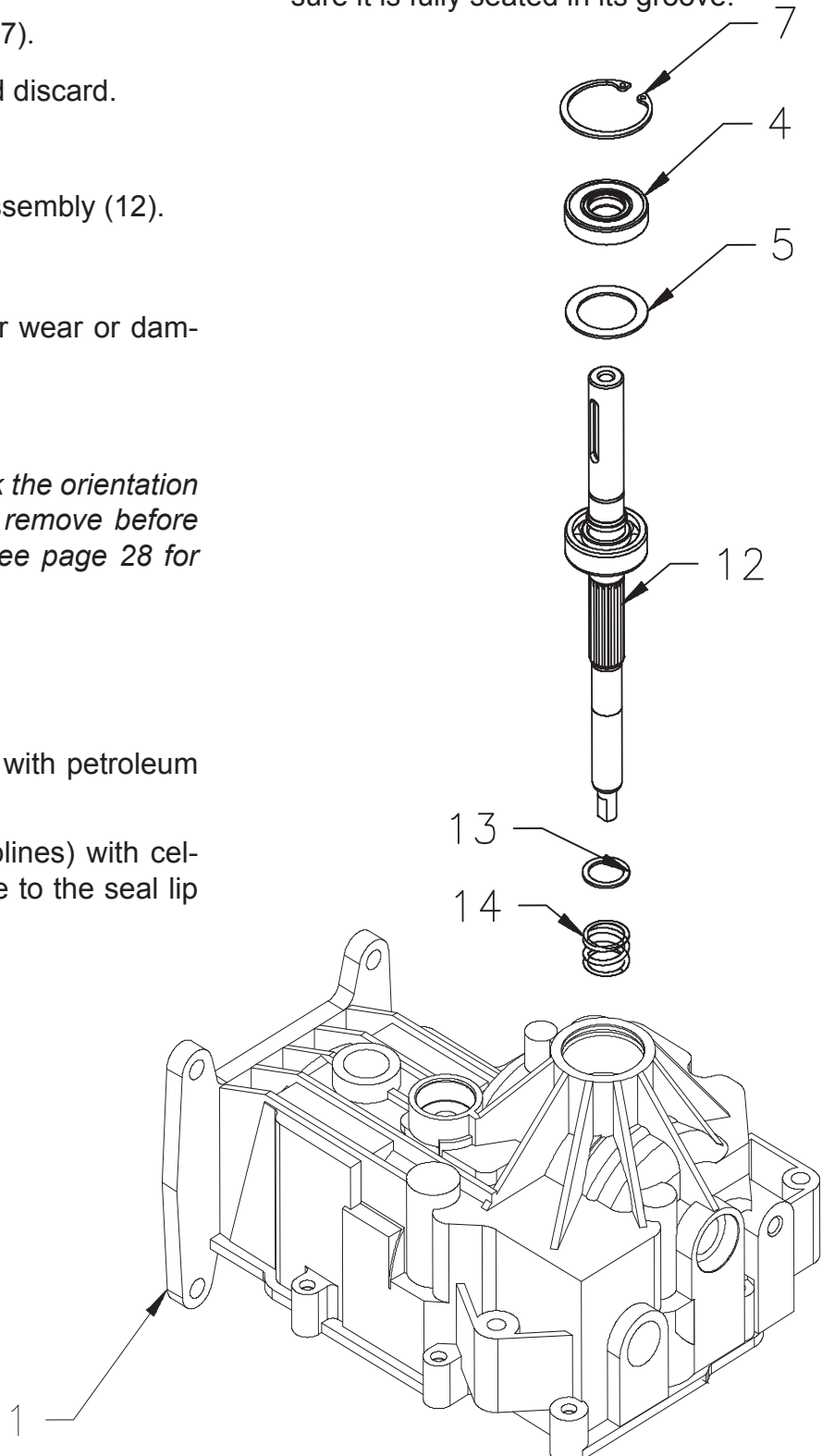


Figure 9. Input (Pump) Shaft

OUTPUT (MOTOR) SHAFT

Refer to Figure 10.

Disassembly

1. Requires removal of all items beginning on page 16.
2. Remove the retaining ring (28).
3. Remove the lip seal (66) and discard.
4. Remove the washer (69).
5. Remove the pump shaft assembly (24).

Inspection

1. Inspect the components for wear or damage.

Assembly

Note: See page 28 for complete rebuild instructions.

1. Install input shaft (24).
2. Install washer (69).
3. Lubricate the new seal (66) with petroleum jelly prior to installation.
4. Wrap the shaft keyway (splines) with cellophane to prevent damage to the seal lip during installation.
5. Slide the seal over the shaft and press it into the housing bore.
6. The seal should seat against the spacer.
7. Install the seal retaining ring (28) and make sure it is fully seated in its groove.

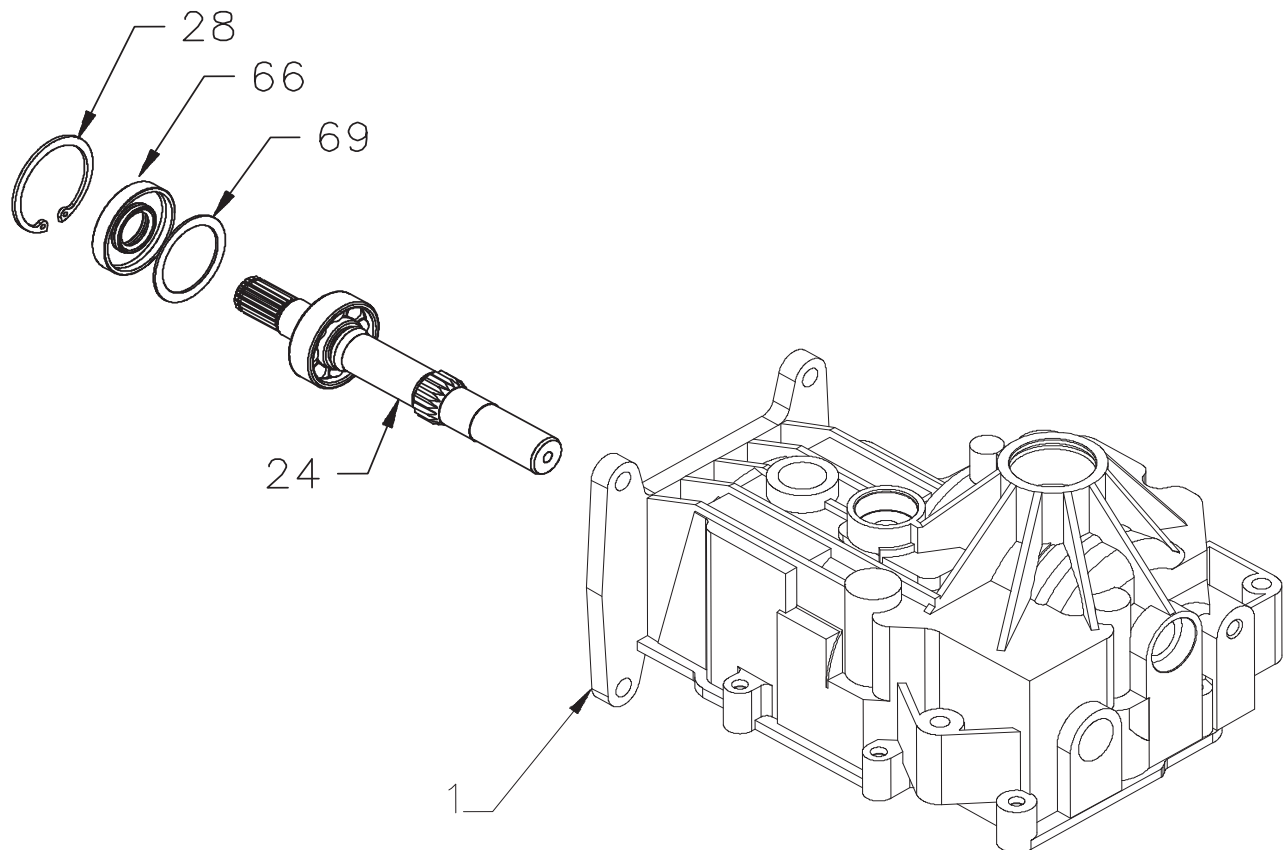


Figure 10. Motor Shaft

BYPASS ARM

Refer to Figure 11.

Disassembly

1. Remove the retaining ring (42).
2. Remove the bypass arm (40).
3. Remove and discard the retaining ring (58) and seal (40) only if replacing the seal or doing a complete rebuild.

Inspection

1. Inspect the components for wear or damage.

Assembly

Note: See page 28 for complete rebuild instructions.

1. Lubricate the new seal (40) with petroleum jelly prior to installation.
2. Wrap the shaft keyway (splines) with cellophane to prevent damage to the seal lip during installation.
3. Slide the seal over the shaft and press it into the housing bore.
4. Install retaining ring (58).
5. Install bypass arm (41).
6. Install retaining ring (42).

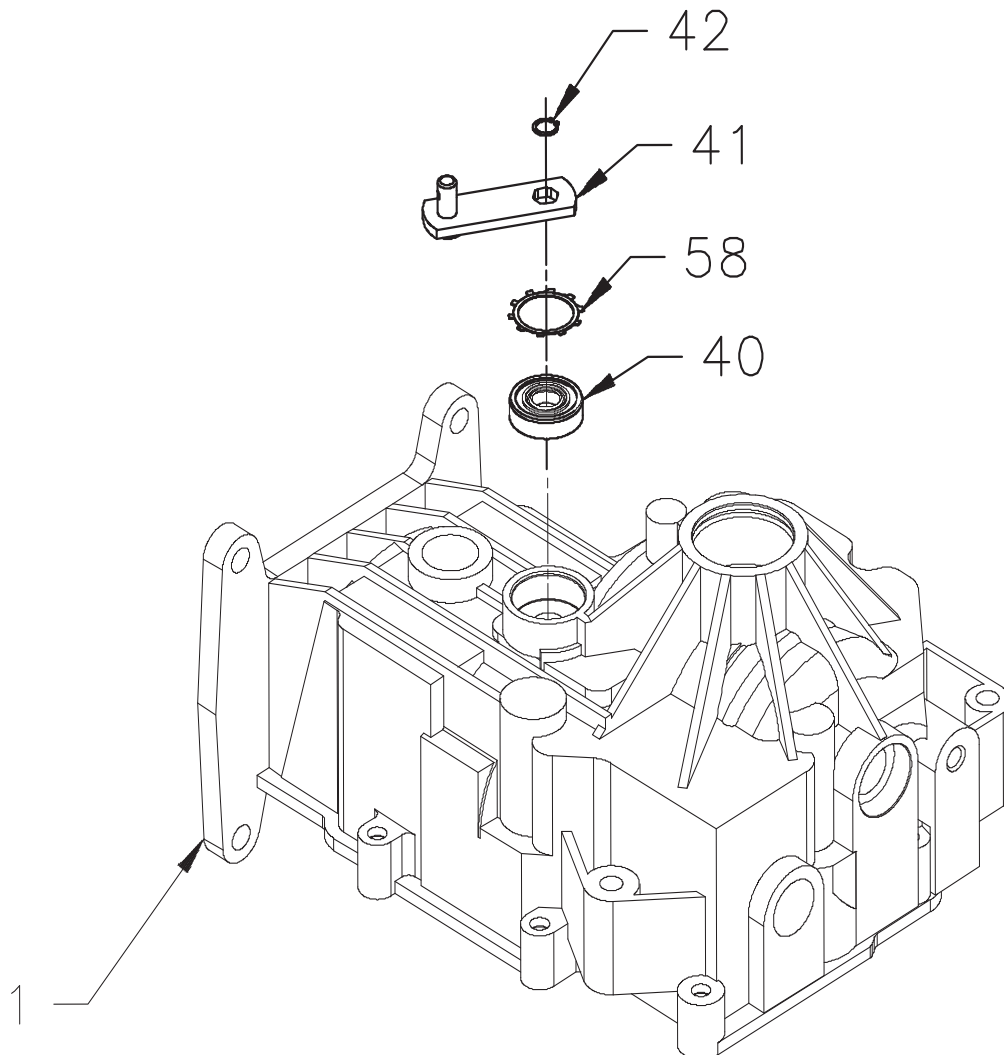


Figure 11. Bypass Arm

CHARGE COVER

Refer to Figure 12.

Disassembly

1. Mark the orientation of the charge cover (54). It is very important that the charge cover is reinstalled the same way it was taken off.
2. Remove the bolts (55).
3. Remove the charge cover (54).
4. Remove gerotor (52).
5. Remove o-ring (53).

Inspection

1. Inspect the charge cover o-ring and running surface for wear or damage.

Assembly

Note: See page 28 for complete rebuild instructions.

1. Install the o-ring (53).
2. Install the gerotor (52).
3. Install the charge cover (54). It is very important that the charge cover is reinstalled the same way it was taken off.
4. Install the bolts (55) see page 15 for torque value.

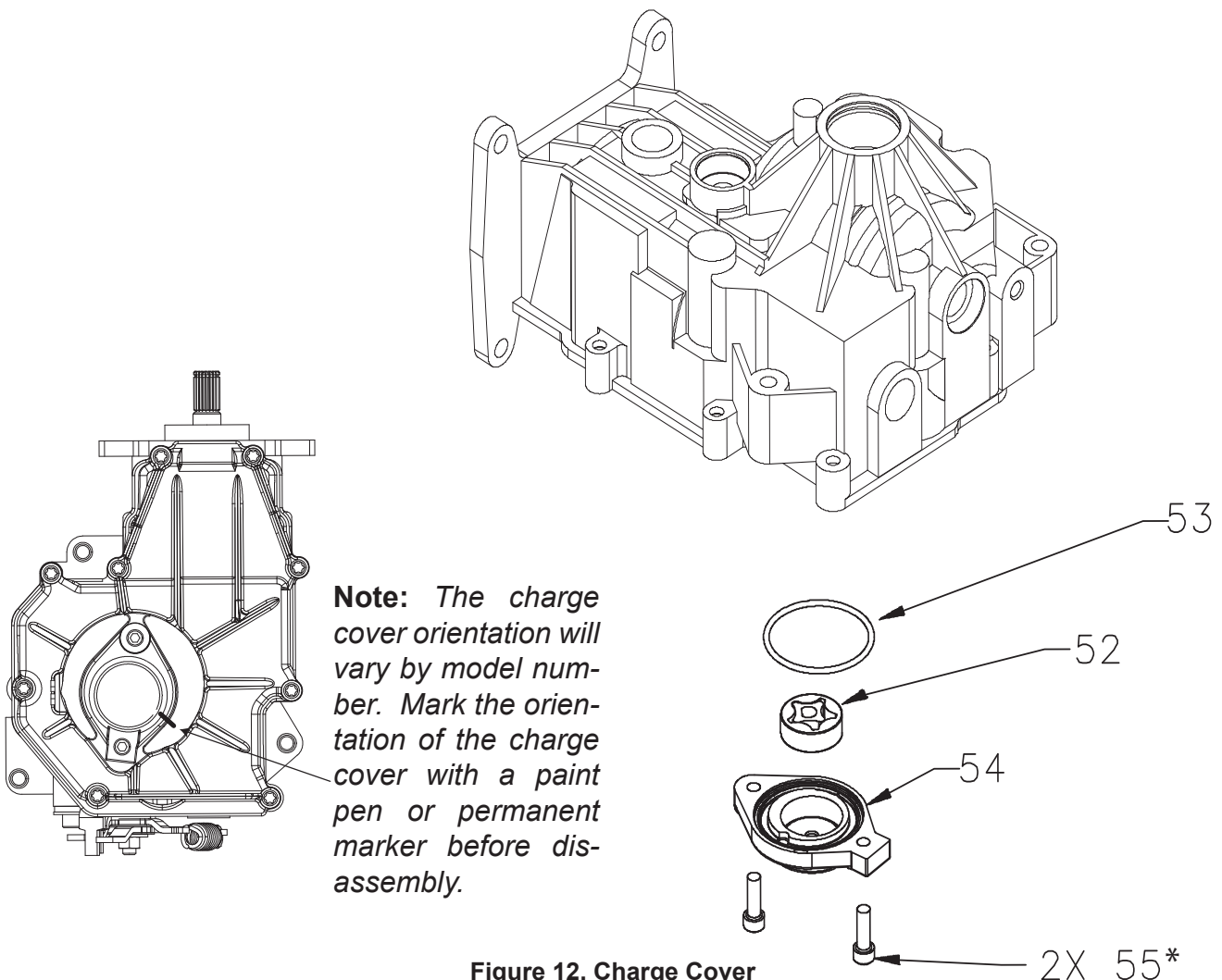


Figure 12. Charge Cover

LOWER HOUSING

Refer to figure 13.

Disassembly

1. Requires removal of all items beginning on page 16.
2. Remove the housing bolts (50).
3. Remove and discard the gasket (49).

Inspection

1. Inspect the bearing and bushing areas of the side cover.

Assembly

Note: See page 28 for complete rebuild instructions.

1. Install new gasket (49).
2. Install lower housing (2).
3. Install bolts (50) see page 15 for torque values.

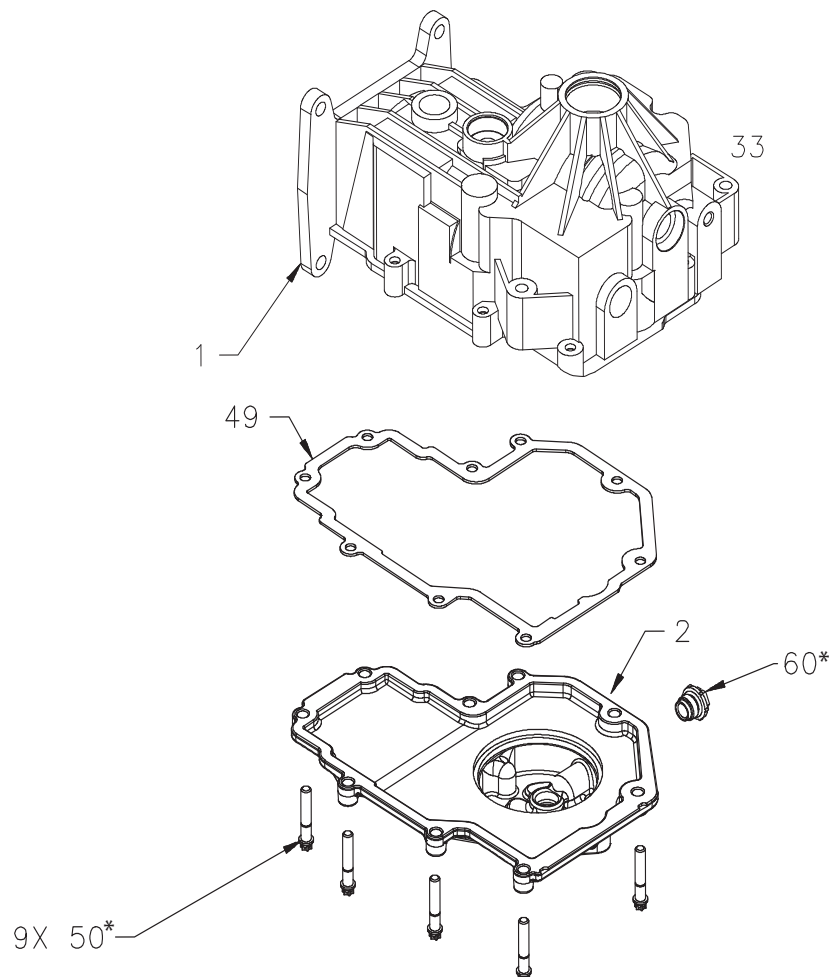


Figure 13. Bottom Cover

MOTOR BLOCK, BEARING RETAINER AND THRUST BEARING

Refer to Figures 14 A and 14 B.

Disassembly

1. Requires removal of all items beginning on page 16.
2. Remove the bearing retainer (29).
3. Remove the thrust bearing (25) and block kit (21) but inserting a plastic putty knife between the housing and the thrust bearing. Use caution to avoid damaging the components.
2. Inspect the block running surfaces. NOTE: These “sealing” surfaces (see Figure 14 B) should be smooth in appearance without scratches, scoring, nicks or abrasions. Drag a fingernail across the surface to detect uneven wear or scratches which may not be visible.

Inspection

1. Disassemble the motor cylinder block assembly (21). Check each piston for proper operation by pressing the pistons in and releasing them in the block bore. Disassemble the motor cylinder block. Check for piston/block wear in the cylinder bore. Inspect the pistons, piston springs and thrust washers for excessive wear or damage. NOTE: Thrust washers may be held in place in the piston by residual oil.

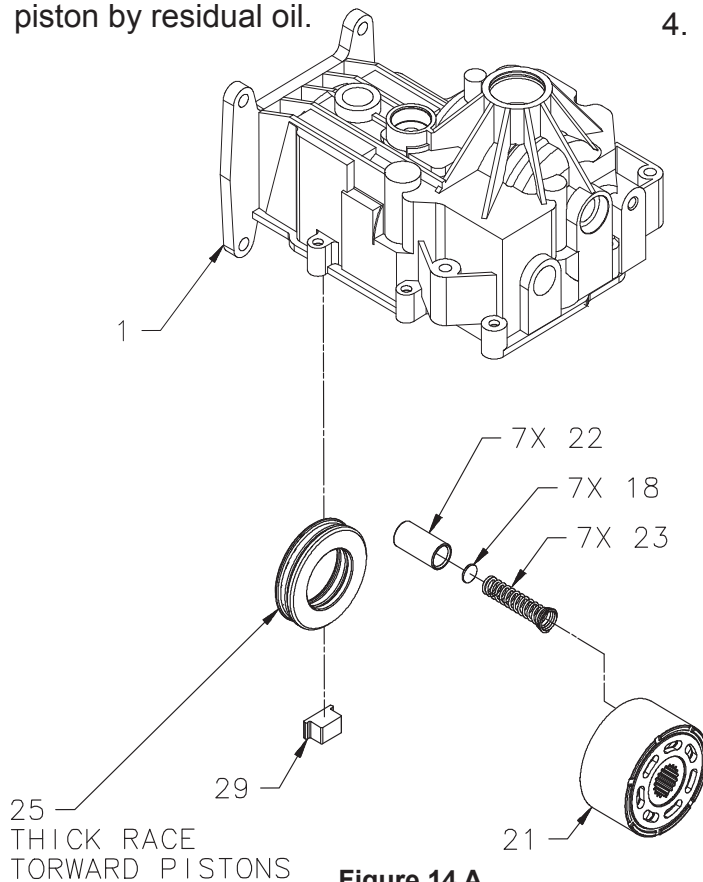


Figure 14 A.

Assembly

Note: See page 28 for complete rebuild instructions.

1. Ensure that the bypass plate (38) is in the center section (3) see page 24.
2. Coat the pump running surface with clean motor oil.
3. Place the thrust bearing (25) on the block kit (21) making sure the thick race is against the pistons.
4. Use a plastic putty knife between the housing (1) and the thrust bearing to depress the pistons allowing the thrust bearing and block kit to slid into position.

Note: Care must be taken to prevent the scaring or scratching of the center section sealing face during this step.

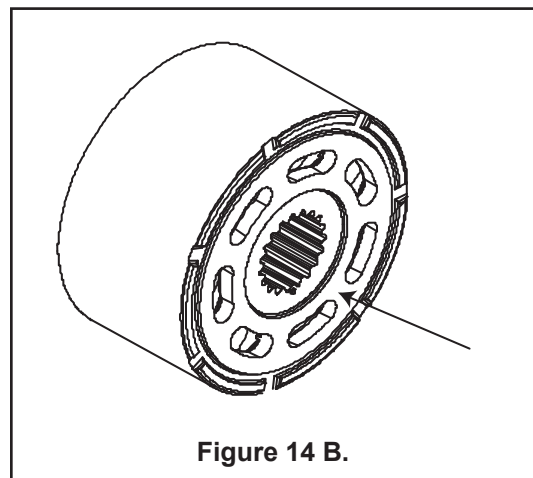


Figure 14 B.

CENTER SECTION

Refer to Figures 15 A and 14 B.

Disassembly

1. Remove the check valves (45). Make a mark to ensure they are installed back into the correct ports during assembly.
2. Remove the bolt (57), the relief plate (56), the charge ball (47) and spring (46).
3. Remove the center section bolts (44).
4. Remove the center section (3).
5. Remove the bypass plate (38).
6. Remove the pins (43).

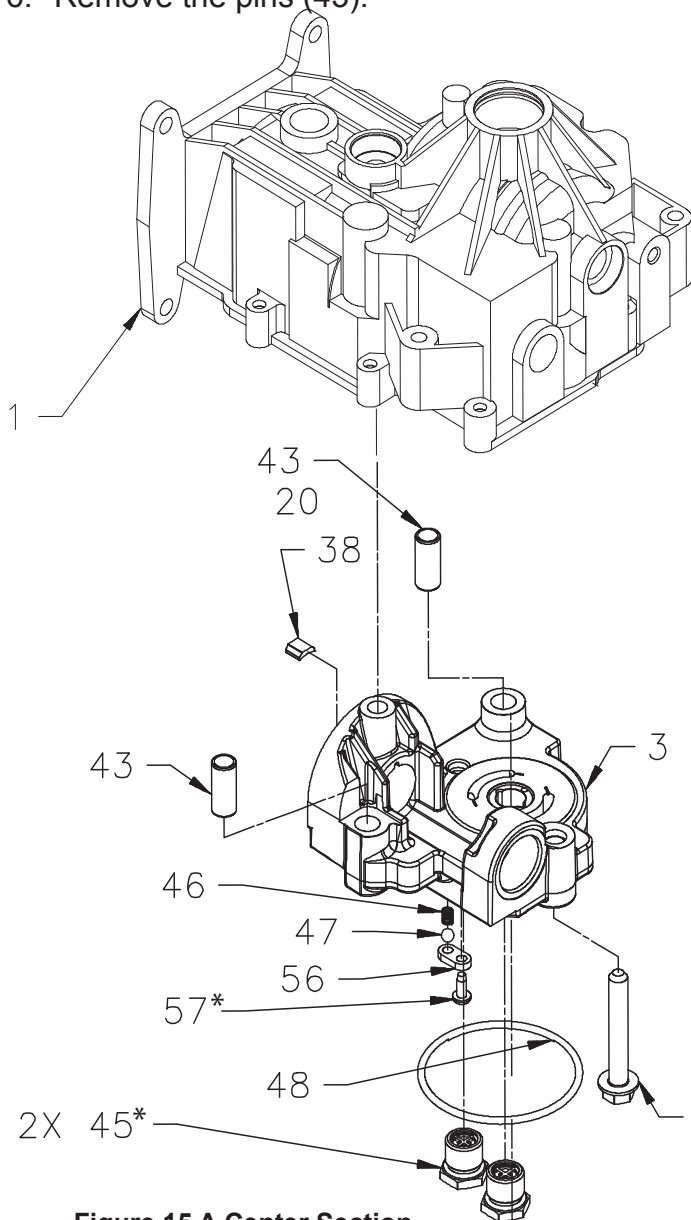


Figure 15 A Center Section

Inspection

1. Inspect the center section block running surfaces. *Note:* These “sealing” surfaces (see Figure 15 B) should be smooth in appearance without scratches, scoring, nicks or abrasions. Drag a fingernail across the surface to detect uneven wear or scratches which may not be visible.
2. Inspect the threaded check plug ports of the center section for debris or damage.

Assembly

Note: See page 28 for complete rebuild instructions.

1. Install the pins (43).
2. Install the bypass plate (38) into the center section (3).
3. Install the bolts (44). See page 15 for torque values.
4. Install the spring (46), the charge relief ball (47), the relief plate (56) and the bolt (57). See page 15 for torque values.
5. Install the check valves (45) referencing the marks to ensure they are installed back into the correct port. See page 15 for torque values.
6. Install o-ring (48).

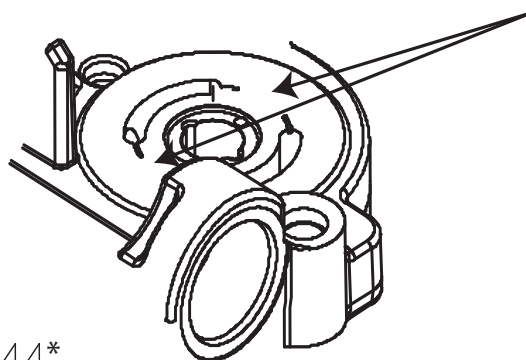


Figure 15 B Running Surface Close Up

PUMP BLOCK AND THRUST BEARING

Refer to Figure 16.

Disassembly

1. Remove the pump block (15).
2. Remove the thrust bearing (11).

Inspection

1. Disassemble the pump cylinder block assembly (4). Check each piston for proper operation by pressing the pistons in and releasing them in the block bore. Disassemble the motor cylinder block. Check for piston/block wear in the cylinder bore. Inspect the pistons, piston springs and thrust washers for excessive wear or damage. *Note:* Thrust washers may be held in place in the piston by residual oil.

2. Inspect the block running surfaces. *Note:* These “sealing” surfaces (see figure 13 B) should be smooth in appearance without scratches, scoring, nicks or abrasions. Drag a fingernail across the surface to detect uneven wear or scratches which may not be visible.

Assembly

Note: See page 28 for complete rebuild instructions.

1. Install pump shaft first see page 18.
2. Install thrust bearing (11) with thick race against the pistons.
3. Install the block kit (15).

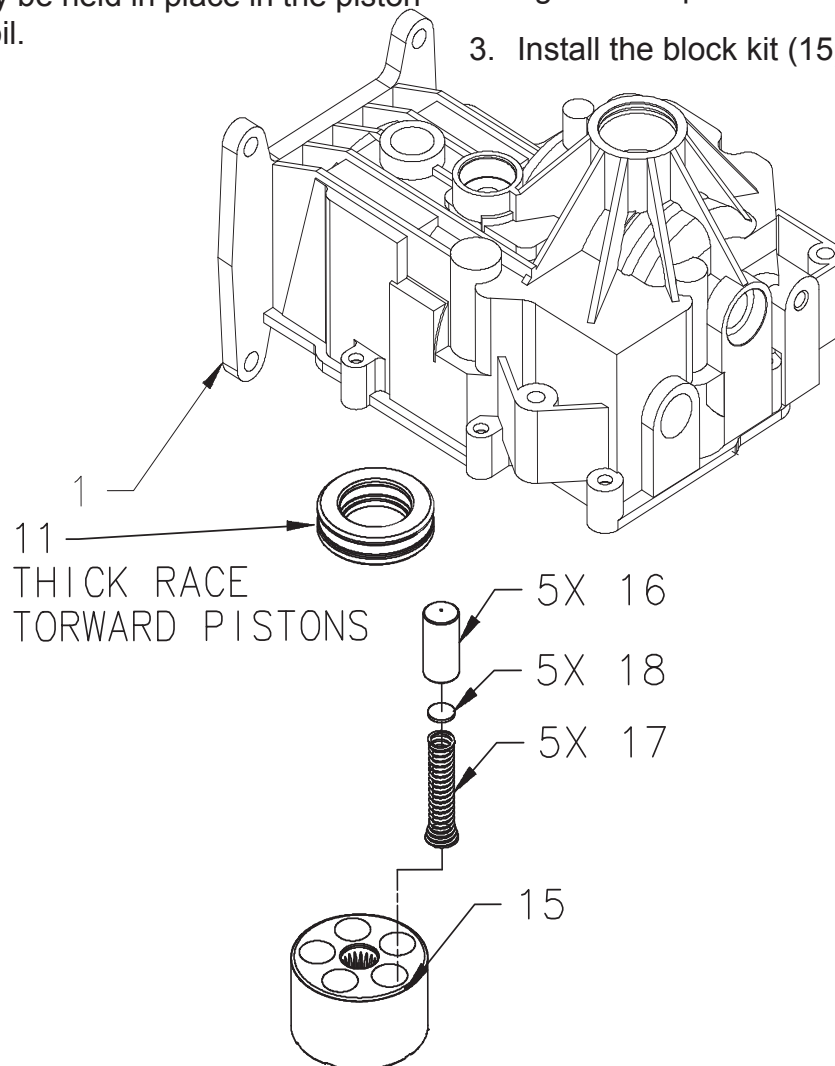


Figure 16. Pump Block and Thrust Bearing

SWASHPLATE, TRUNNION ARM, SLOT GUIDE AND BYPASS

Refer to Figure 17.

Disassembly

1. Remove swashplate (10).
2. Remove slot guide (30).
3. Remove bypass actuator (39).
4. Remove trunnion arm (31).

Inspection

1. Inspect the components, bearing and bushing areas for wear or damage.

Assembly

Note: See page 28 for complete rebuild instructions.

1. Install pump shaft first. See page 18.
2. Install trunnion arm (31).
3. Install slot guide (30).
4. Install bypass actuator (39).
5. Install swashplate (10).

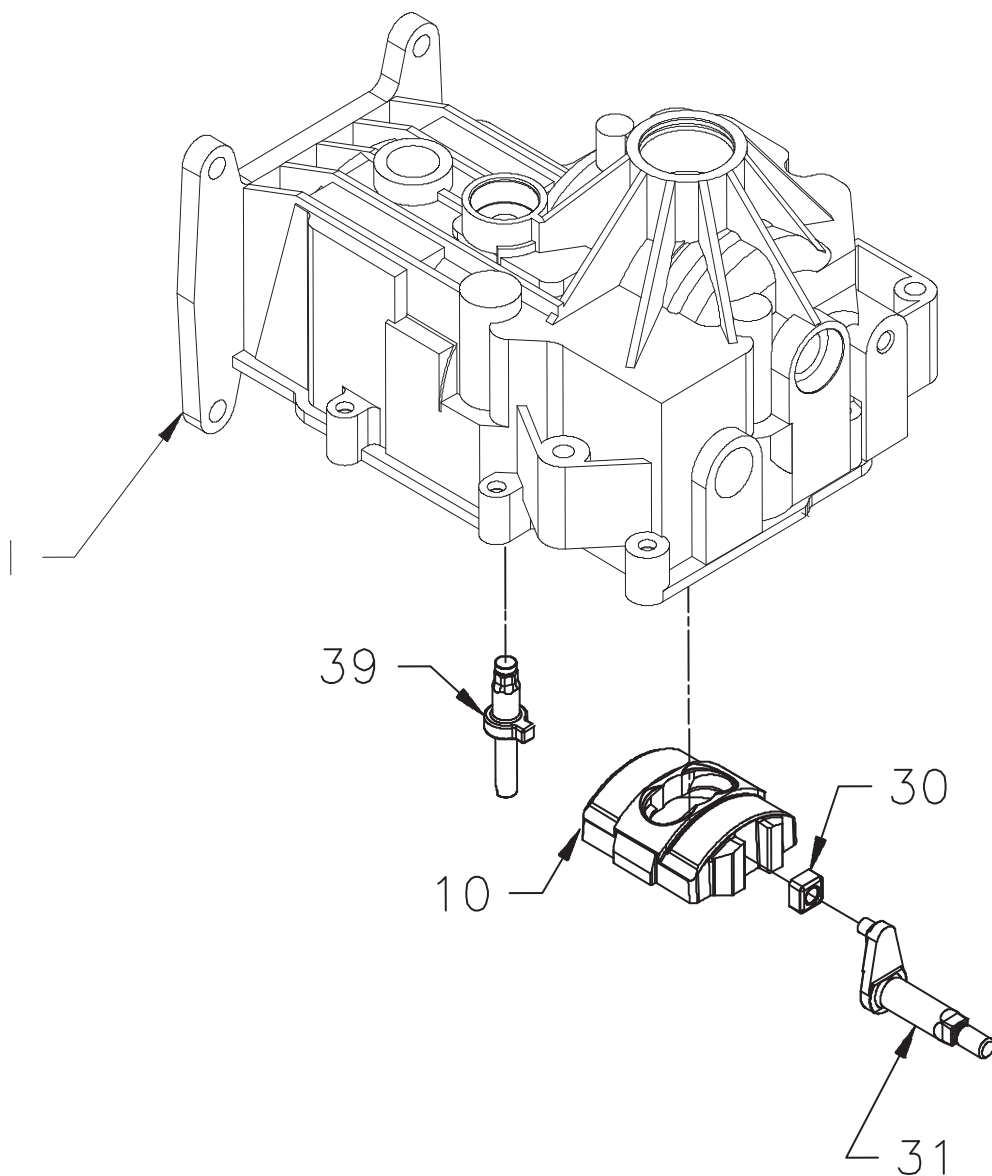


Figure 17. Swashplate, Trunnion Arm, Slot Guide and Bypass

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. 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 29.

1. Install the input shaft (12), washer (5), seal (4) and retaining ring (7). Turn until over and install the thrust washer (13) and spring (14). See page 19.
2. Install the trunnion arm (31), slot guide (30), bypass actuator (39) and swashplate (10). See page 27.
3. Install the thrust bearing (11) with the thick race towards the pistons and the pump block kit (15). See page 26.
4. Install pins (43). Install the bypass plate (38) into the center section (3). Installing the center section (3) and bolts (44). Install the spring (46), charge relief ball (47), relief plate (56) and bolt (57). Install the check valves (45) into the correct ports. Install o-ring (48). See page 15 for torque values and page 25 for detailed assembly procedure.
5. Verify that the bypass plate (38) is correctly positioned in the center section (3). Using a plastic putty knife between the housing (1) and the thrust bearing (25) with the thick race toward the pistons apply pressure to the pistons of the block kit (21) in order to slid both pieces into the house. Care must be taken to avoid damaging the surfaces. Install bearing retainer (29). See page 24.
6. Install the motor shaft (24), washer (69), seal (66) and retaining ring (28). See page 20.
7. Install new housing gasket (49), install lowering housing (2) and bolts (50). See page 15 for torque values and page 23 for detailed assembly procedure.
8. Install o-ring (53) and gerotor (52). Make sure the charge cover (54) is installed the same way it was taken off. Install bolts (55) see page 15 for torque values and page 22 for detailed assembly procedure.
9. Install bypass seal (40), retaining ring (58), bypass arm (41) and retaining ring (42). See page 21.
10. See page 17 and 18 for detailed assembly procedure of the control arm.

BDR EXPLODED VIEW

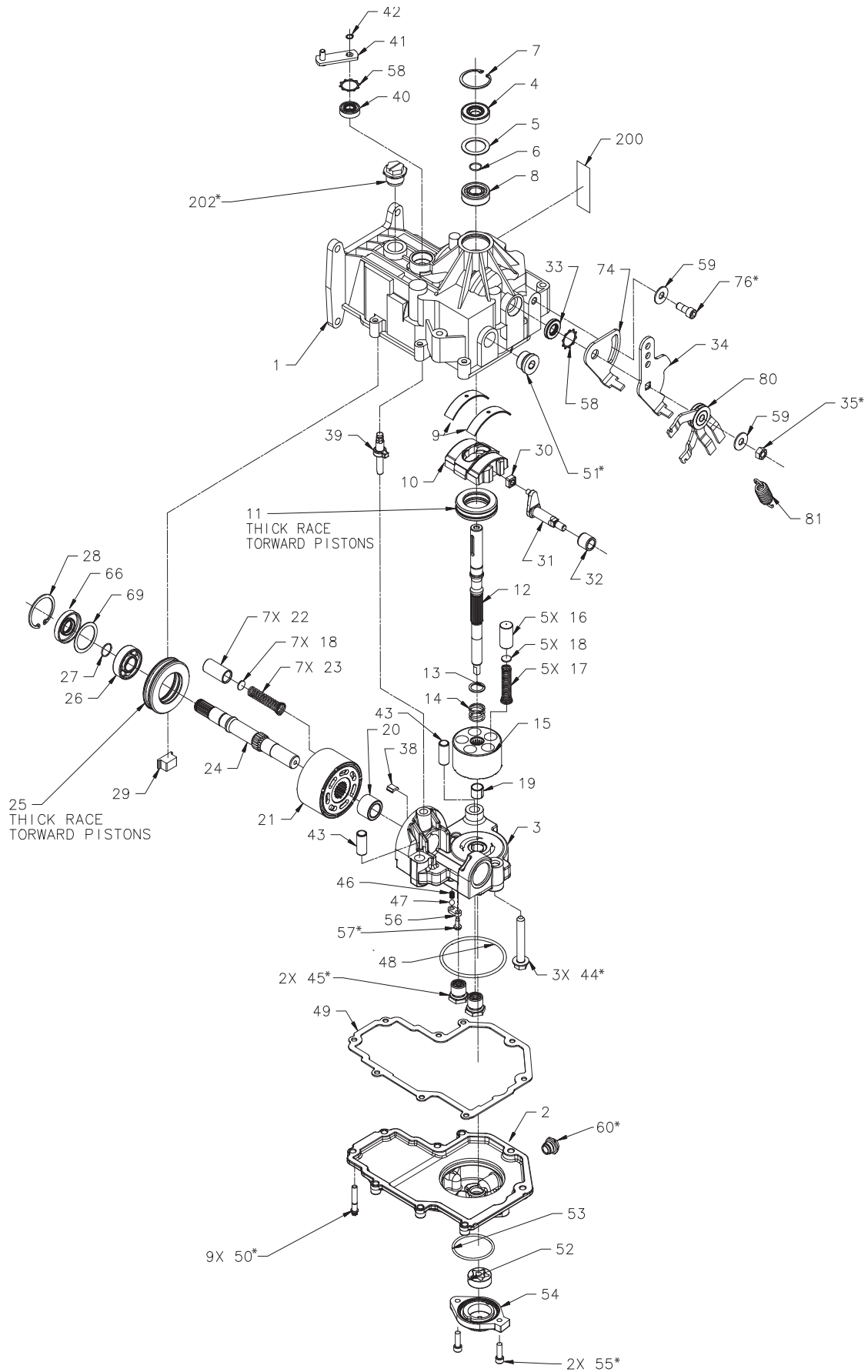


Figure 18. BDR

BDR ITEMS LIST

No.	DESCRIPTION
1	Housing, Upper -Only available in Upper Housing Kit
2	Housing, Lower
3	Center Section - Only available in Center Section Kit
4	Lip Seal
5	Spacer
6	Wire Retaining Ring
7	Retaining Ring
8	Ball Bearing
9	Cradle Bearing -Only available in Upper Housing Kit
10	Swashplate
11	Thrust Bearing
12	Pump Shaft
13	Block Thrust Washer
14	Block Spring
15	Pump Cylinder Block 10cc - Only available in Pump Block Kit
16	Piston 10cc - Only available in Pump Block Kit
17	Piston Spring 10cc- Only available in Pump Block Kit
18	Piston Seat Washers - Only available in Block Kits
19	Bearing Jrnl - Only available in Center Section Kit
20	Bushing - Only available in Center Section Kit
21	Cylinder Block 21cc- Only available in Motor Block Kit
22	Piston 21cc - Only available in Motor Block Kit
23	Piston Springs 21cc - Only available in Motor Block Kit
24	Output (Motor) Shaft
25	Thrust Bearing
26	Ball Bearing
27	Wire Retaining Ring
28	Retaining Ring

No.	DESCRIPTION
29	Retainer, Motor Bearing
30	Slot Guide
31	Trunnion Arm
32	Trunnion Bushing -Only available in Upper Housing Kit
33	Lip Seal
34	Control Arm
35	Nut, Lock
38	Bypass Plate - Only available in Center Section Kit
39	Bypass Actuator
40	Lip Seal
41	Bypass Arm
42	Retaining Ring
43	Pin
44	Screw
45	Check Plug Assembly - Only available in Center Section Kit
46	Spring, Charge Relief
47	Ball
48	O-Ring
49	Gasket
50	Screw, Self Tapping
51	Plug
52	Gerotor
53	O-ring
54	Charge Pump
55	Screw
56	Relief Plate
57	Bolt, Self Tapping
58	Retaining Ring
59	Washer
60	Plug
66	Lip Seal
69	Spacer
74	Return Arm
76	Screw
80	Scissors Arm Assembly
81	Spring, Extension
200	Hydro-Gear Label
202	Plug

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 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 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.



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Printed in U.S.A.
Rev. P3

