

**T2<sup>®</sup>**  
**Integrated Hydrostatic Transaxle**  
**Service and Repair Manual**

BLN-52749  
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## FOREWORD

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

This Service and Repair Manual is designed to provide information useful in servicing and troubleshooting the Hydro-Gear T2® Integrated Hydrostatic Transaxle.

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

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

Internal repair procedures require that the transaxle 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 the EETC (Equipment and Engine Training Council) at (262) 367-6700 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® T2® Integrated Hydrostatic Transaxle. This manual includes the T2's general description, hydraulic schematic, technical specifications, servicing and troubleshooting procedures.

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

### GENERAL DESCRIPTION

The T2 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.

This transaxle uses a variable displacement pump with a maximum displacement of 8cc per revolution, and motor with a fixed displacement of 10.2cc 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 T2 has a self contained fluid supply and an internal filter. 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 makeup flow of the fluid to the low pressure side of the loop.

A block lifting bypass is utilized in the T2 to permit moving the vehicle for a short distance at a maximum of 2 m.p.h. (3.2 Km/h) without starting the engine. The T2 utilizes an in-line floating disc brake controlled by a "cam" style actuating arm.

## DESCRIPTION AND OPERATION (CONTINUED)

### HYDRAULIC SCHEMATIC

Figure 1 is a schematic of the hydraulic oil circuit. The oil supply for the hydraulic system of the T2<sup>®</sup> is also utilized for lubricating the components of the final drive assembly.

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 swashplate will reverse the direction of oil flow.

During the operation of the transaxle, 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 transaxle housing, then is pulled back into one of the check valves depending upon the direction of vehicle operation. All of this oil must pass through an internal filter.

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

The bypass feature in the T2 has a mechanical lever which lifts the motor block off the center section running surface. This allows oil flow from the cylinder blocks to be discharged.

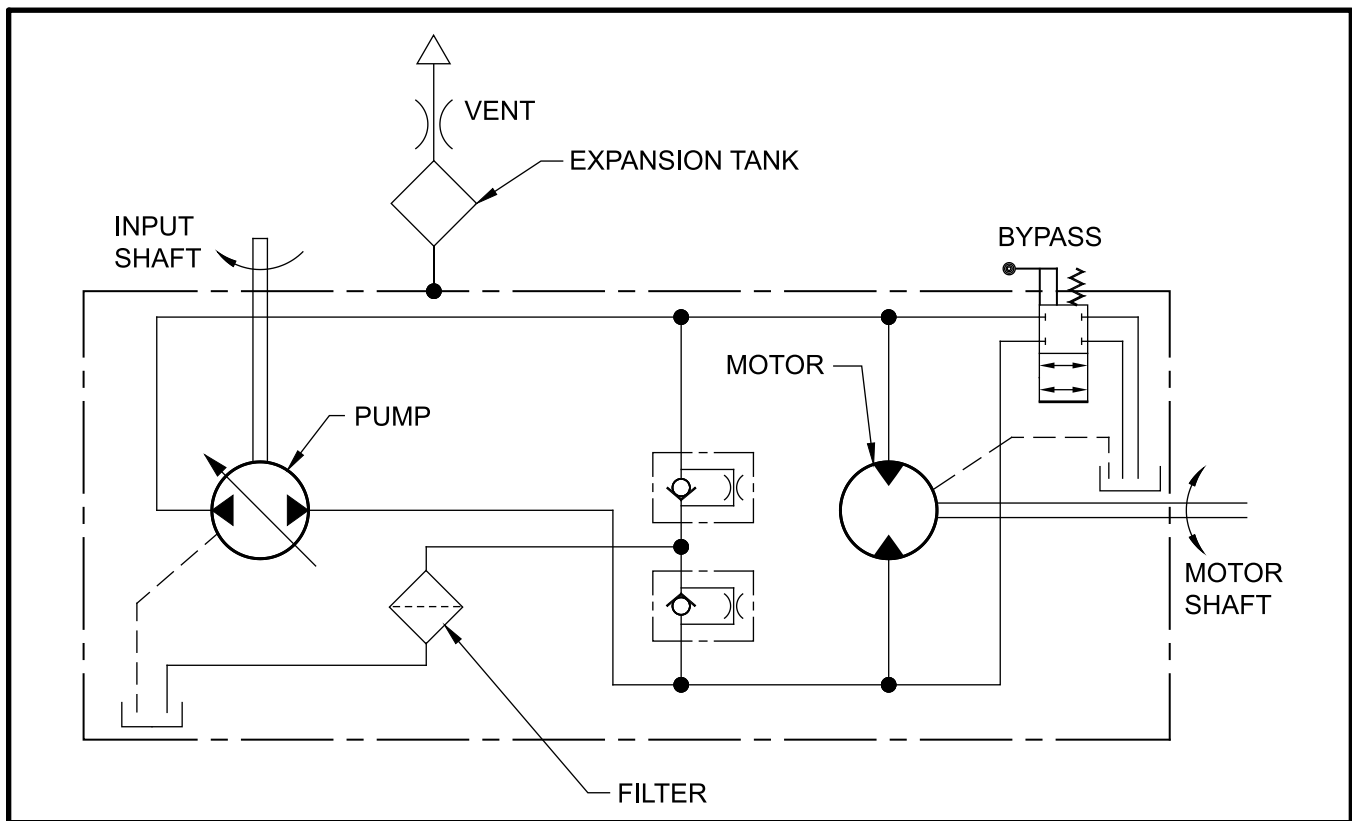
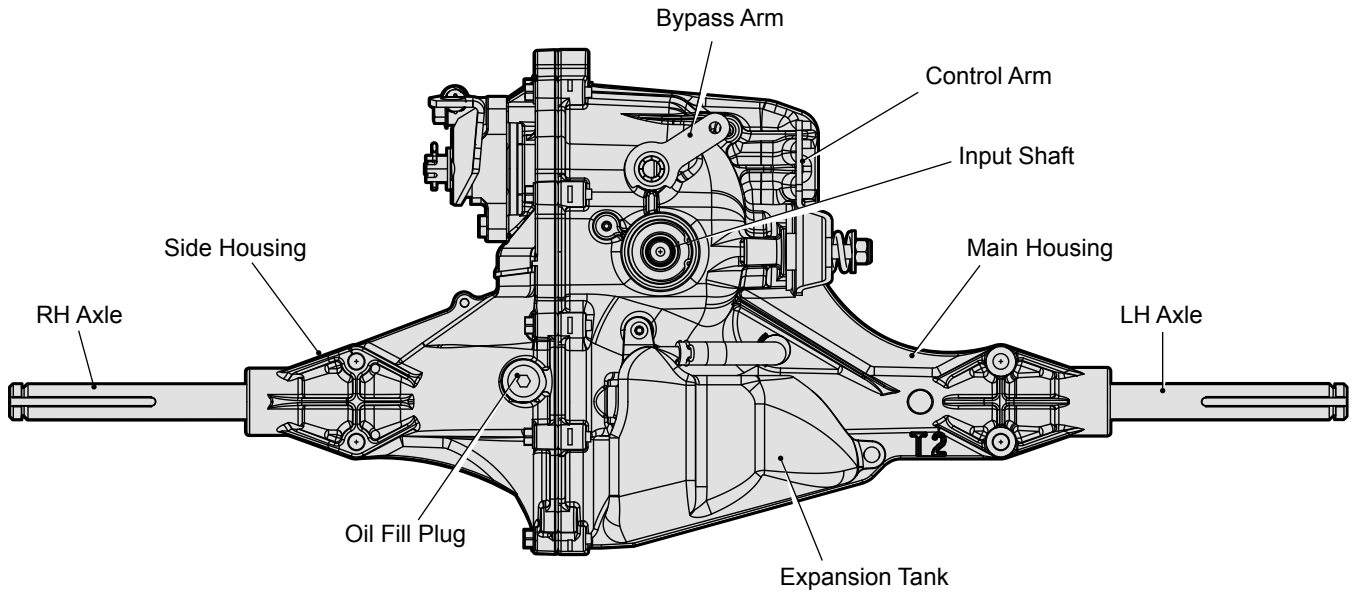
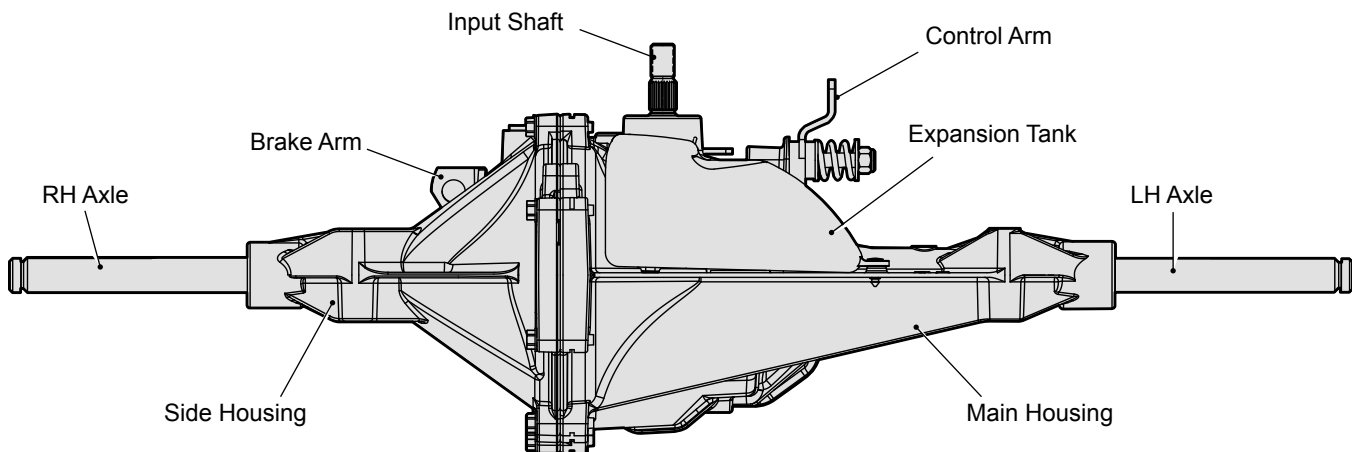


Figure 1, T2 Hydraulic Schematic

## EXTERNAL FEATURES T2®

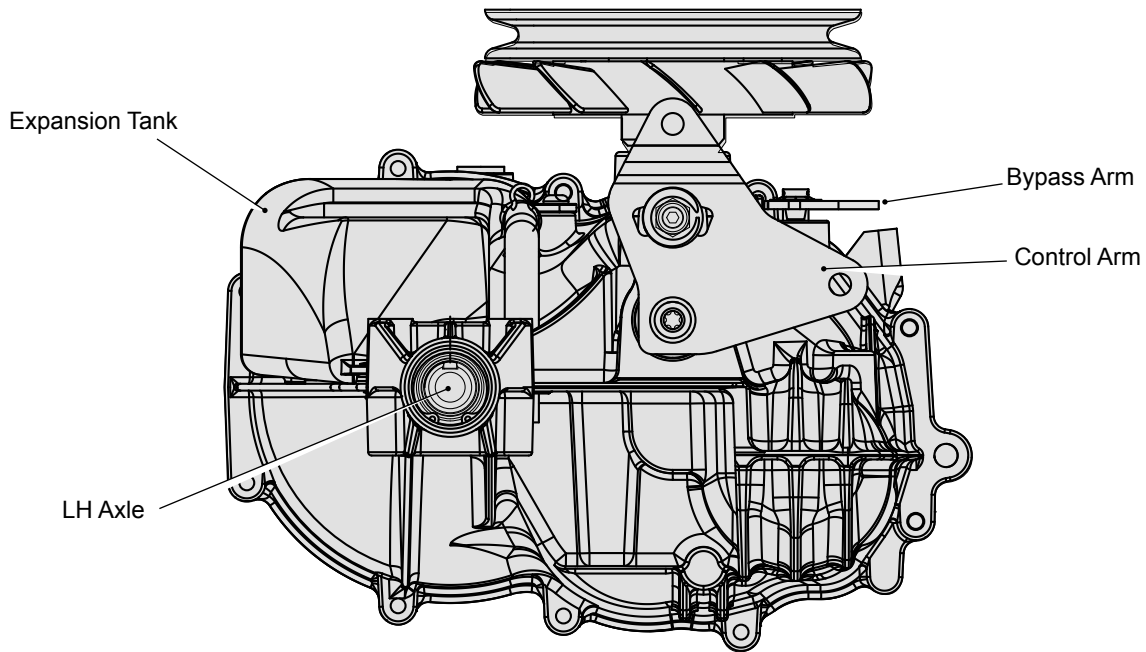


— Top View —

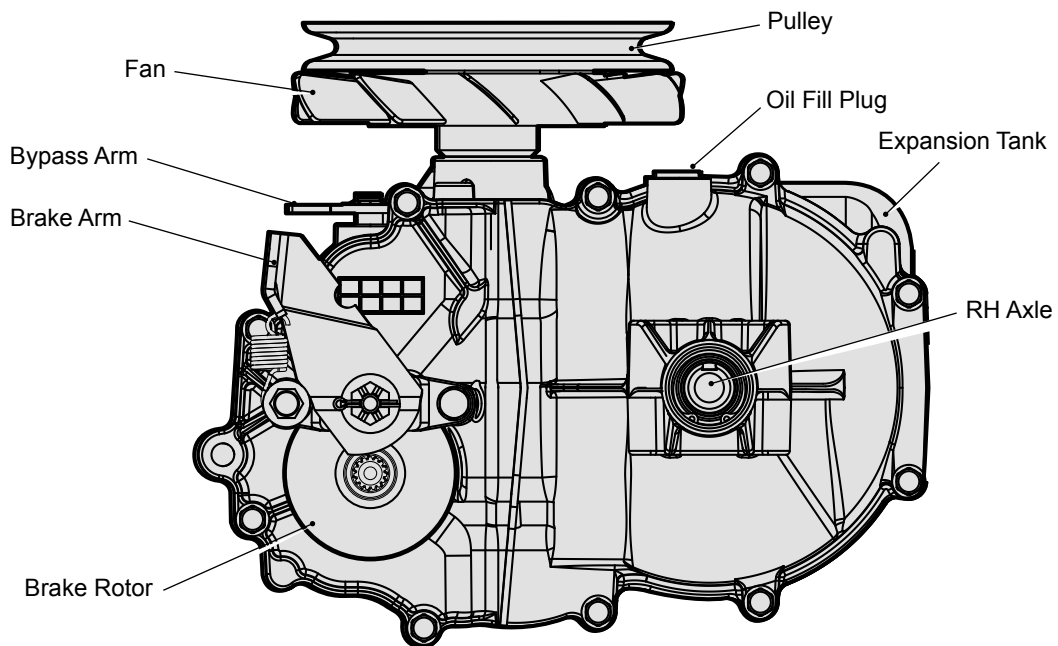


— Inboard View —

## EXTERNAL FEATURES T2®



— Outboard View—Left —



— Outboard View—Right —

## TECHNICAL SPECIFICATIONS

<b>T2® TECHNICAL SPECIFICATIONS</b>		
<b>Overall Transaxle Reduction</b>	20.6	22.7
<b>Input Speeds</b>		
Maximum Hi-Idle (No Load)	3000 rpm	
Minimum	1800 rpm	
<b>Output Torque</b>		
Peak	395 lb-ft (536 N-m)	425 lb-ft (576 N-m)
Continuous	105 lb-ft (142 N-m)	115 lb-ft (156 N-m)
<b>Weight on Tires (per unit)</b>		
Maximum with 16" tires	540 lb (245 kg)	—
Maximum with 18" tires	—	500 lb (227 kg)
<b>Axle Shaft Diameter</b>	.75 in (19.05 mm)	
<b>Axle Shaft End Options</b>	Keyed or Two Flats	
<b>Parking Brake Type</b>	Disc	
<b>Weight of Unit</b>	28 lb (12.7) kg	
<b>Maximum Tire Diameter</b>	16 in (406 mm)	18 in (457 mm)

## PRODUCT IDENTIFICATION

The model and configuration of the T2 can be determined from the label shown below.

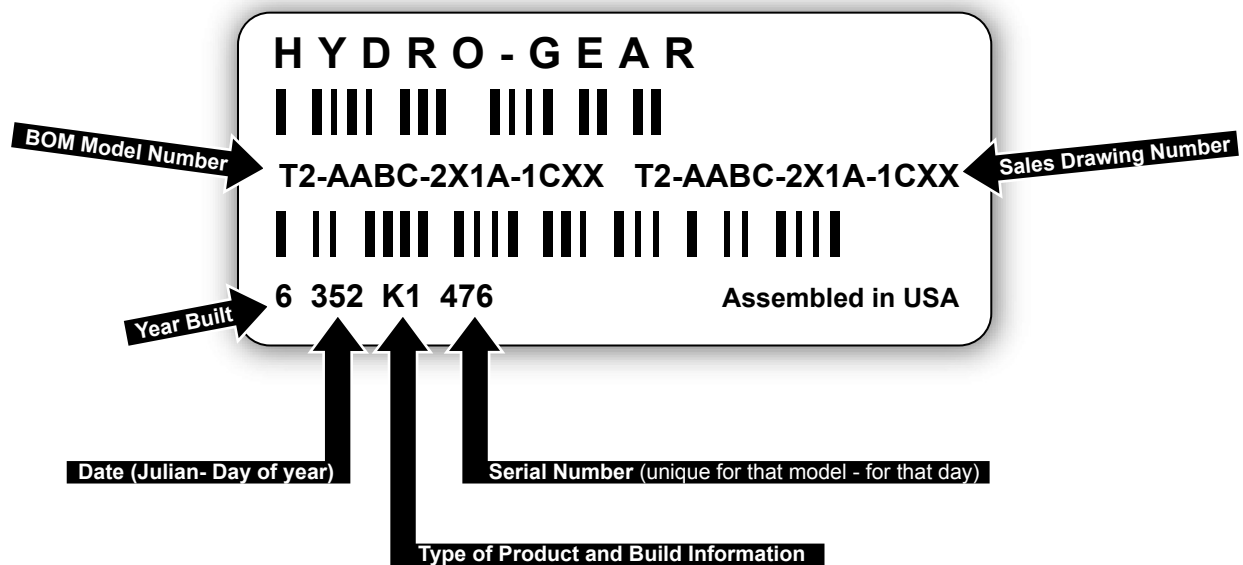


Figure 2, Configuration Label



## 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 transaxle. 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 T2® transaxle, fully read and understand the safety precautions described in this section.**

## PERSONAL SAFETY

Certain safety precautions must be observed while servicing or repairing the T2. 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.

## 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 T2® are not related to a defective transaxle, but are caused by slipping drive belts, partially engaged bypass valves, and loose or damaged control linkages. Be sure to perform all operational checks and adjustments outlined in Service and Maintenance, before assuming the transaxle is malfunctioning. The table below provides a troubleshooting checklist to help determine the cause of operational problems.

### TROUBLESHOOTING CHECKLIST

Possible Cause	Corrective Action
<b>Unit Operates In One Direction Only</b>	
Control linkage bent or out of adjustment	Repair or replace linkage, Page 9
Drive belt slipping or pulley damaged	Repair or replace drive belt or pulley, Page 9
<b>Vehicle Does Not Drive/Track Straight</b>	
Vehicle tires improperly inflated	Refer to vehicle manufacturer suggested pressure
Control linkage bent or out of adjustment	Repair or replace linkage, Pages 9 and 12
Bypass assembly sticking	Repair or replace bypass, Page 29
Brake Partially Engage	Disengage Brake, Replace Broken or Missing Brake Return Spring
<b>Unit Is Noisy</b>	
Oil level low or contaminated oil	Fill to proper level or change oil, Page 10
Excessive loading	Reduce vehicle loading, Page 9
Loose parts	Repair or replace loose parts
Bypass assembly sticking	Repair or replace linkage, Page 9
Air trapped in hydraulic system	Purge hydraulic system, Page 11
Brake Partially Engage	Disengage Brake, Replace Broken or Missing Brake Return Spring
<b>Unit Has No/Low Power</b>	
Engine speed low	Adjust to correct setting
Control linkage bent or out of adjustment	Repair or replace linkage, Page 9
Drive belt slipping or pulley damaged	Repair or replace drive belt or pulley, Page 9
Oil level low or contaminated oil	Fill to proper level or change oil, Page 10
Excessive loading	Reduce vehicle loading, Page 9
Bypass assembly sticking	Repair or replace linkage, Page 9
Air trapped in hydraulic system	Purge hydraulic system, Page 11
Brake Partially Engage	Disengage Brake, Replace Broken or Missing Brake Return Spring
<b>Unit Is Operating Hot</b>	
Debris buildup around transaxle	Clean off debris, Page 9
Cooling fan damaged	Repair or replace cooling fan, Pages 17
Oil level low or contaminated oil	Fill to proper level or change oil, Page 10
Excessive loading	Reduce vehicle loading, Page 9
Air trapped in hydraulic system	Purge hydraulic system, Page 11
Brake Partially Engage	Disengage Brake, Replace Broken or Missing Brake Return Spring
<b>Transaxle Leaks Oil</b>	
Damaged seals, housing, or gaskets	Replace damaged components
Air trapped in hydraulic system	Purge hydraulic system, Page 11

## 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 T2® 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 oil level in accordance with Figure 3 Page 10.
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 transmission cooling fan for broken or distorted blades and remove any obstructions (grass clippings, leaves, dirt, etc.).
5. Inspect the axle parking brake and vehicle linkage to insure proper actuation and adjustment of the parking brake.
6. Inspect the vehicle control linkage to the directional control arm on transaxle. Also, insure the control arm is securely fastened to the trunnion arm of the transaxle.
7. Inspect the bypass mechanism on the transaxle and vehicle linkage to insure it actuates and releases fully.

## SERVICE AND MAINTENANCE PROCEDURES

All the service and maintenance procedures presented on the following pages can be performed while the T2 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.

### 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 20W-50 engine oil has been selected for use by the factory and is recommended for normal operating temperatures.

### FLUID VOLUME AND LEVEL

Fluid volume information is provided in the Table below.

Certain situations may require additional fluid to be added or even replaced. Refer to Page 10, Figure 3 and pages 4 and 5 for the proper fill port location.

Fill the T2 to the bottom of the oil fill port threads.

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

Purging may be required. Refer to the purging procedures on page 11.

Fluid Description
Type: 20W50 motor oil
Fluid Volume (per transaxle)
10 Bolt Housing: 69.3 - 65.9 fl.oz. (2050 - 1950 ml)
14 Bolt Housing: 72.8 - 69.4 fl. oz. (2155 - 2055 ml)

## FLUID CHANGE PROCEDURE

This transaxle is factory filled, sealed and does not require oil maintenance. However, in the event of oil contamination or degradation, oil addition or change may alleviate certain performance problems.

1. Remove the transaxle from the vehicle.
2. Clean the expansion tank and oil fill port areas of any debris.
3. Remove the oil fill port fitting.
4. Position the transaxle so the oil will drain completely out of the housing.
5. After all the oil is drained from the transaxle, remove the expansion tank by removing the self tapping bolt (10-32 x 1/2) and ratchet fastner that holds the tank to the housing.
6. Remove the tank and drain the oil from the tank. DO NOT remove the vent cap from the tank. DO NOT remove the tank hose or o-ring unless a replacement is needed.
7. Install the tank by first inserting the hose into the opening in the expansion tank. Push the tank opening over the o-ring to ensure a proper seal.
8. Install the tank and self tapping bolt making sure not to cross thread the bolt. Torque the bolt to the lower value of the torque specification listed in the Table on page 15.
9. Fill the transaxle at the oil fill port according to Figure 3.
10. Install the oil fill port fitting.

## EXPANSION TANK FUNCTION

The expansion tank allows the T2™ to operate free of air entrainment and provides maximum lubrication to the mechanical and hydraulic components in the transaxle.

As the T2 transaxle is operated, oil in the transaxle housing heats up which causes the oil to expand. The oil flows through an internal hose to the bottom of the vented expansion tank. As the oil cools, the oil in the transaxle housing contracts, causing the oil level to go down in the housing. This creates a negative pressure in the housing causing the oil to be drawn back into the case. This keeps the transaxle housing full of oil at specified operating temperatures.

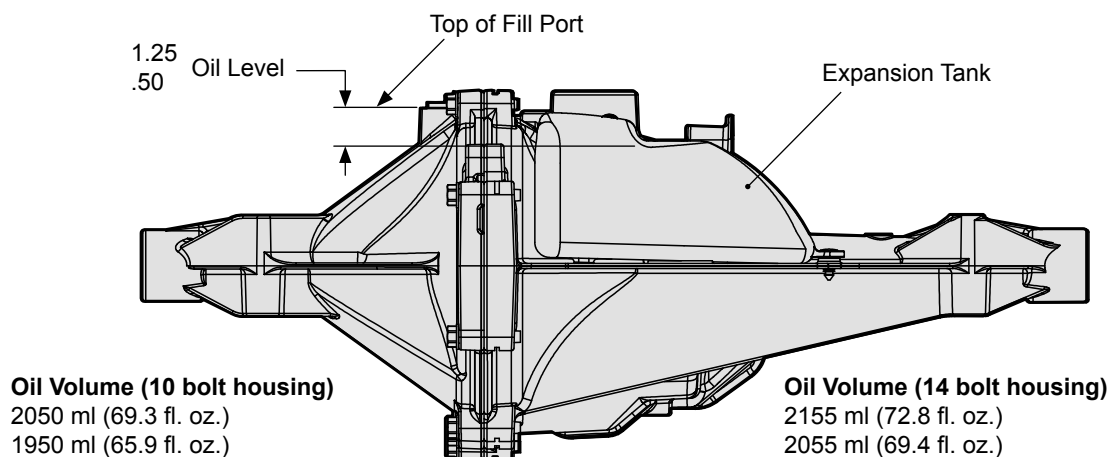


Figure 3, Expansion Tank

## PURGING PROCEDURES

Due to the effects air has on efficiency in hydrostatic drive applications, it is critical that it be 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 transaxle/transmission is at the proper oil level. If it is not, fill to the specifications outlined on page 9.

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 to 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 engine.
3. It may be necessary to repeat Steps 1 and 2 until all the air is completely purged from the system. When the transaxle moves forward and reverse at normal speed purging is complete.

## RETURN TO NEUTRAL SETTING



### WARNING

#### POTENTIAL FOR SERIOUS INJURY

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



### WARNING

Do not attempt any adjustments with the engine running. Use extreme caution while inspecting 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 removes their foot from the foot control. Follow the procedures below to properly adjust the return to neutral mechanism on the transaxle:

1. Confirm the transaxle is in the operating mode (bypass disengaged). Raise the vehicle's drive tires off the ground to allow free rotation.

**NOTE:** *It may be necessary to remove the drive tire from the axle hub to access the linkage control and the transaxle return arm.*

2. Remove the Original Equipment Manufacturer's (OEM's) control linkage at the control arm. Refer to Figure 4.

3. Start the engine and increase the throttle to full engine speed.
4. Check for axle rotation. If the axles do not rotate, go to Step 5. If the axles rotate, go to Step 6.
5. Stop the vehicle's engine. Reattach and adjust the OEM linkage according to the OEM manual. Recheck according to Step 3 and 4. Stop the vehicle engine. Refer to Figure 4.
6. Note the axle directional movement. Stop the vehicle engine. Loosen the lock down screw (168) until the control arm (160) can be rotated. Rotate the control arm in the same direction of the wheel rotation in small increments. Tighten the lock down screw. Recheck according to steps 3 and 4. Refer to Figure 4.

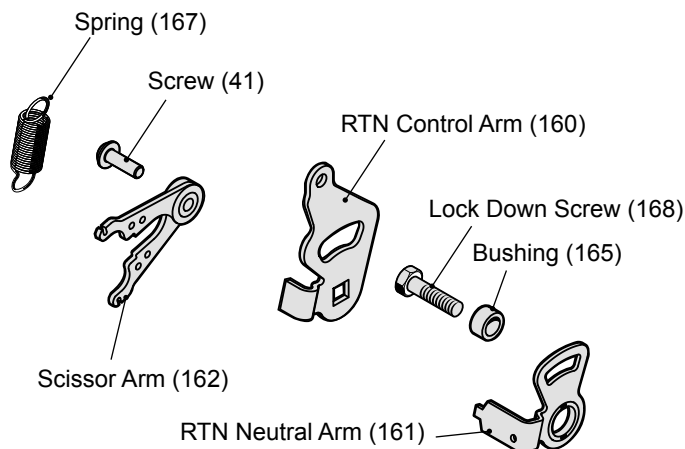


Figure 4, Return to Neutral

## BRAKE MAINTENANCE

### BRAKE SETTING

1. Remove the brake arm bias spring(134), and then the cotter pin (133) securing the brake castle nut (132).
2. Insert a 0.020" feeler gage between the brake rotor (121) and top brake puck, and then set the brake by finger tightening or loosening the castle nut.
3. Install a new cotter pin to secure the castle nut, and then install the brake arm bias spring.

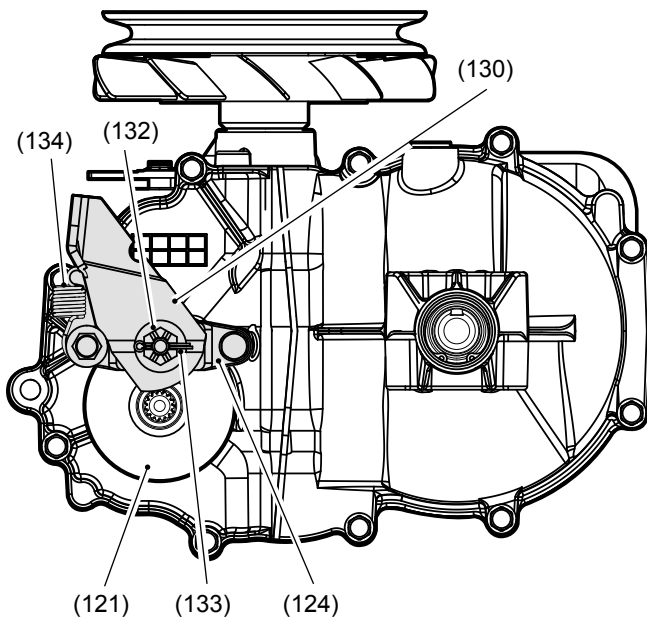


Figure 5, Brake Setting

### FRICITION PACK ADJUSTMENT

The friction pack dampens or holds the operator control lever in its desired position.

Adjustment for the amount of drag or holding force can be made by turning the friction pack nut in or out.

Adjustments should be made in no more than 1/4 turn increments.

Over-tightening will result in difficulty or inability of the operator to move the control lever.

**NOTE:** The factory setting for the friction pack is tightening of the friction pack nut to 100 in-lbs (11 Nm) torque. The friction pack nut is then backed off per the vehicle manufacturer's specifications.

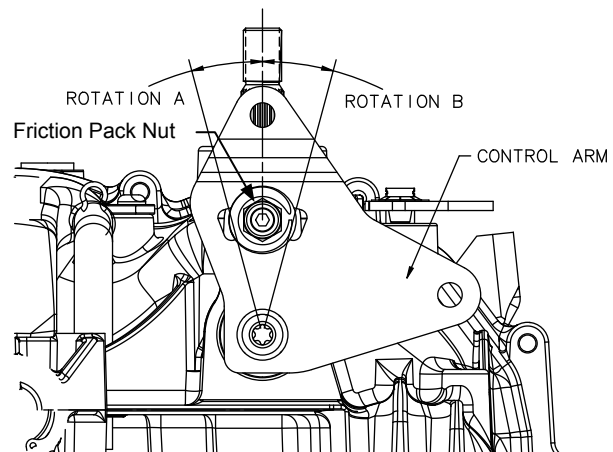


Figure 6, Friction Pack Adjustment

## TEAR DOWN AND REASSEMBLY

### HOW TO USE THIS MANUAL

Each subassembly illustrated in this section is illustrated by an exploded view showing the parts involved. **The item reference numbers in each illustration are for assembly instructions only.** See page 37 for part names and descriptions. A complete exploded view and item list of the transaxle is provided on pages 36 and 37.

Many of the parts and subassemblies of this transaxle can be removed and serviced independently of other components. Where some components and assemblies must be removed before a given assembly can be serviced, that information is given at the beginning of the disassembly instructions.

### 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, 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. Be sure all remnants of this covering are removed after servicing.

Parts requiring replacement must be replaced from the appropriate kits identified in the Items Listing, found on page 37. Use only original

Hydro-Gear® replacement parts found listed in BLN-51427 (CD).

**IMPORTANT:** When internal repair is performed on the T2®, the filter assembly must be replaced.

### TRANSAXLE REMOVAL

It is necessary to remove the T2 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 34.



## TOOLS

REQUIRED TOOLS	
Miscellaneous	Sockets
Flat Blade Screw Driver (2)	1/2"-3/8" Adapter
Torque Wrench	1/2" Deep
Air Impact Wrench	7/16" Deep
Rubber or Neoprene Mallet	3/4" Deep
Breaker Bar	7/8" Deep
Side Cutters/Snips	9/16" Deep
Needle Nose Pliers	T-40 Torx Head
Large External Snap Ring Pliers	10 mm
Small Internal Snap Ring Pliers	

## TORQUES

REQUIRED TORQUE VALUES			
Item	Description	Torque	Operation
8	HFHCS 1/4-20 x 1.25	105-155 in-lbs [11.8-17.5 Nm]	Housing screw
13	Plug 9/16-18 (Metal)	180-240 in-lbs [20.3-27.1 Nm]	Fill plug
22	Bolt, Hex Flange, 3/8-16, CS	525-700 in-lbs [59.3-79.1 Nm]	Center section bolt
24	Check plug	280-400 in-lbs [31.6-45.2 Nm]	Check plugs
25	Check plug	280-400 in-lbs [31.6-45.2 Nm]	Check plugs
41	TWHCS 5/16-18 x 1	230-310 in-lbs [25.9-35.0 Nm]	Trunnion arm screw
43	Screw, set 5/16-24 x 2.50	135-155 in-lbs [15.2-17.5 Nm]	Control arm stud
49	Nut, hex 5/16-24 nylon insert	85-120 in-lbs [9.6-13.5 Nm]	Friction Pack Nut
127	HFHCS 1/4-20 x 2.0 w/ patch	80-120 in-lbs [9.0-13.5 Nm]	Brake yoke screw
128	HHCS 1/4-20 x 1 (patch)	80-120 in-lbs [9.0-13.5 Nm]	Brake yoke screw
140	5/16 SAE, 5/32 tube	96-120 in-lbs [10.8-13.5 Nm]	Expansion tank fitting
144	Bolt, self-tapping 10-32 x 0.5	25-40 in-lbs [2.8-4.5 Nm]	Expansion tank screw
152	Nut, Hex Lock 1/2-20	360-520 in-lbs [40.7-58.8 Nm]	Fan Nut
153	HFHCS 1/4-20 x 0.75	50-80 in-lbs [5.7-9.0 Nm]	Fan Screws
162	Screw, Hex Flange Head	85-120 in-lbs [9.6-13.5 Nm]	Neutral Assy Arm Screw

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

## TRANSAXLE REMOVAL

**NOTE:** *It is necessary to remove the T2® from the vehicle before performing the repair procedures presented in this section.*

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

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

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

*Reassembly is accomplished by performing the “Assembly” portions of the procedures. If the unit has been completely disassembled, a summary of the assembly procedures, in the order in which they should occur, is given on page 34.*

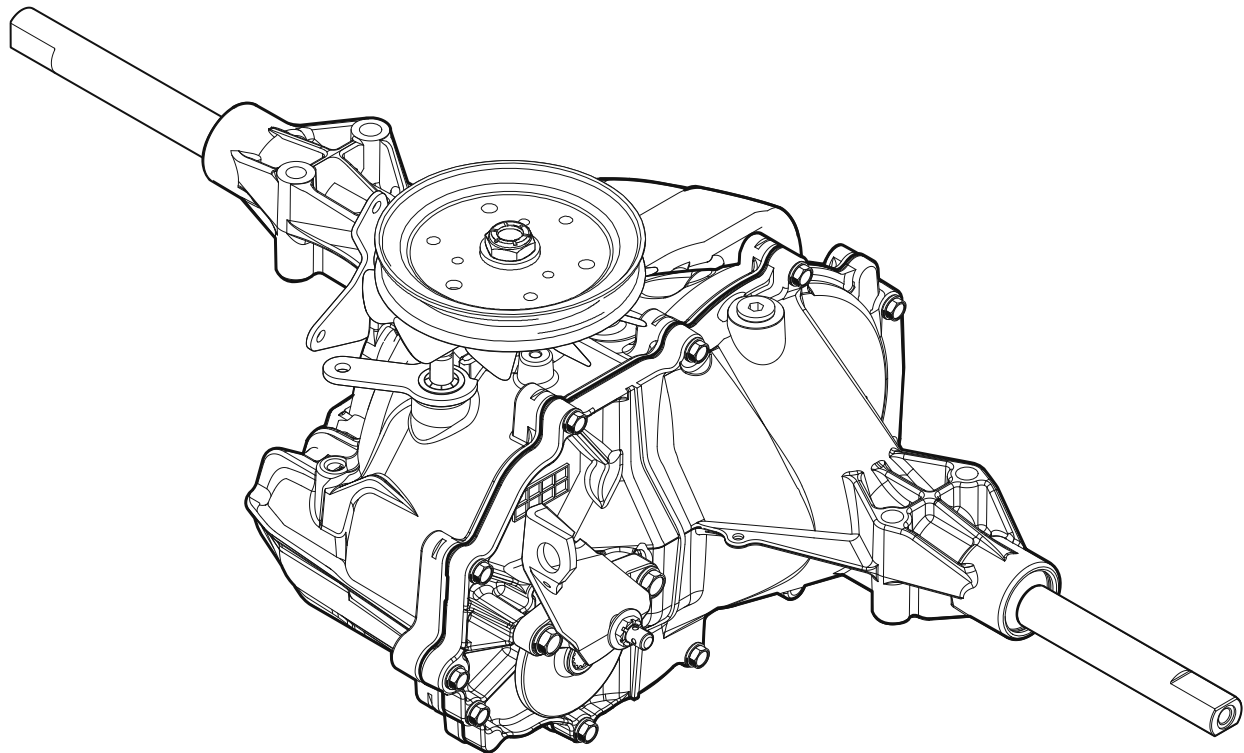


Figure 7, T2 Transaxle

## FAN AND PULLEY

Refer to Figure 8

### PULLEY AND FAN CONFIGURATION

1. Remove the locknut (152), and detach the fan and pulley assembly from the input shaft.
2. Separate the assembly by removing the screws (153), fan (150) and the pulley (151).

### Inspection

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

### Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. When tightening the fasteners, refer to the table on page 15 for the required torque values.

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

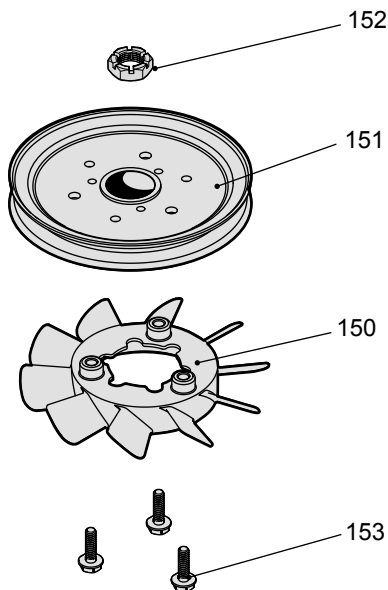


Figure 8, Fan on bottom configuration

Refer to Figure 9

### FAN AND PULLEY CONFIGURATION

1. Remove the locknut (152) and washer (153).
2. Remove the fan (150) and the pulley (151).

### Inspection

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

### Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. When tightening the fasteners, refer to the table on page 15 for the required torque values.

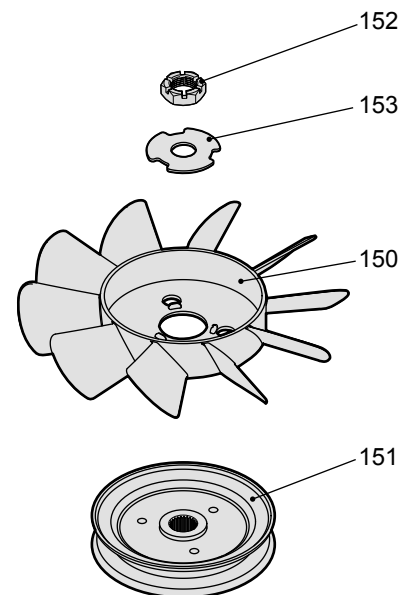


Figure 9, Fan on top configuration

## EXPANSION TANK

Refer to Figure 10

### Disassembly

1. Remove all items previously discussed in their recommended order.
2. Remove the ratchet fastener (147) and discard.
3. Detach the tube (145) from the tank fitting (146). The fitting (146) does not need to be removed – unless, replacing.
4. Remove the screw (144) from the expansion tank.
5. Remove the tank (143). Do not remove the hose (141) at this time.

### Inspection

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

### Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. When tightening the fasteners, refer to the table on page 15 for the required torque values.

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

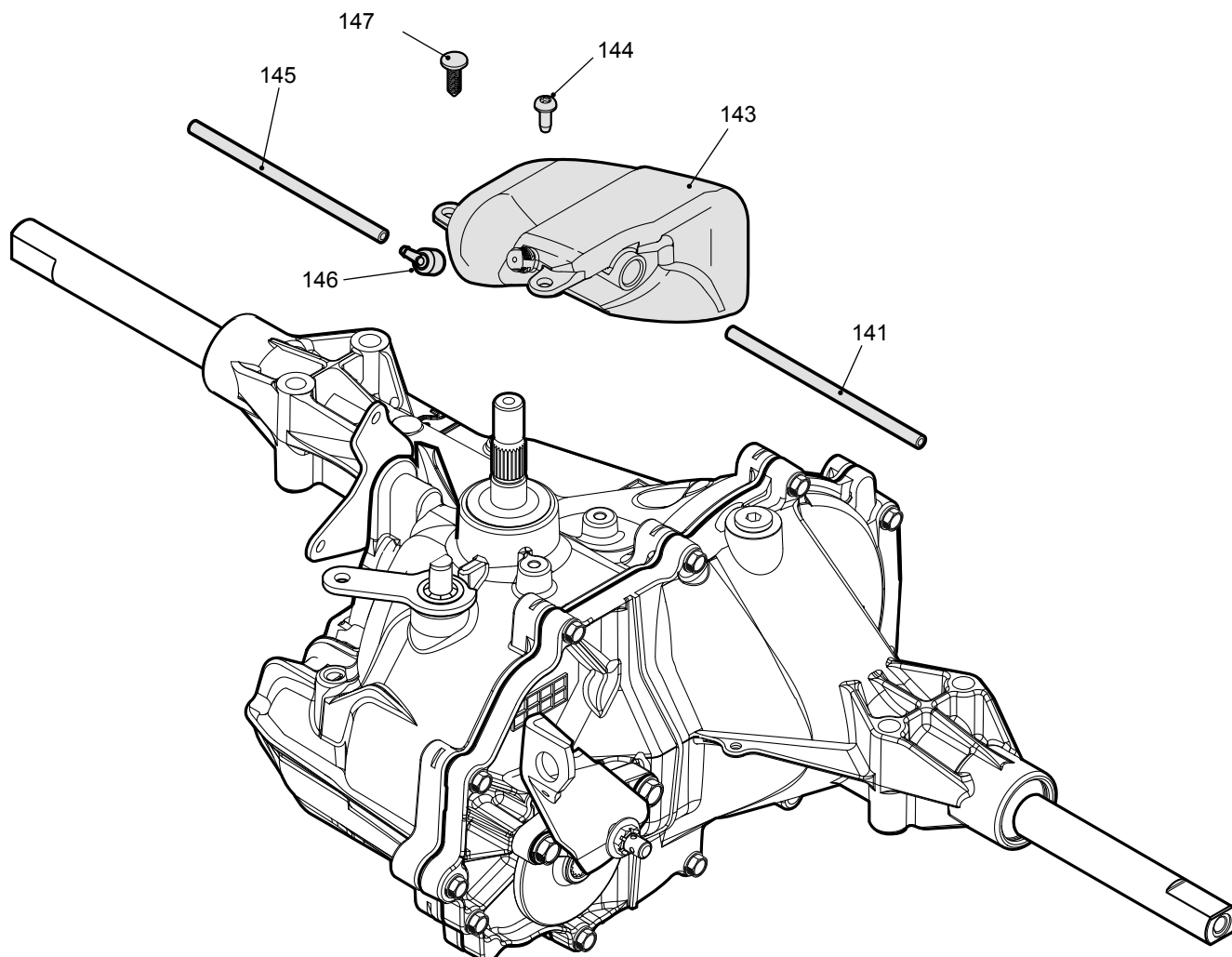


Figure 10, Expansion Tank

## CONTROL ARM ASSEMBLY

Refer to Figure 11

### Disassembly

1. Remove all items previously discussed in their recommended order.
2. If opening the housing or replacing seals, remove the oil port plug (13), then; drain oil from transaxle.
3. Remove the lock nut (49), the washer (46), the helical comp spring (48), the spacer (47), the (second) washer (46), and the plastic washer (45).
4. Remove the Torx head screw (41) and discard.
5. Remove the control arm (42), the (second) washer (45), the belleville washer (44), and the set screw (43).

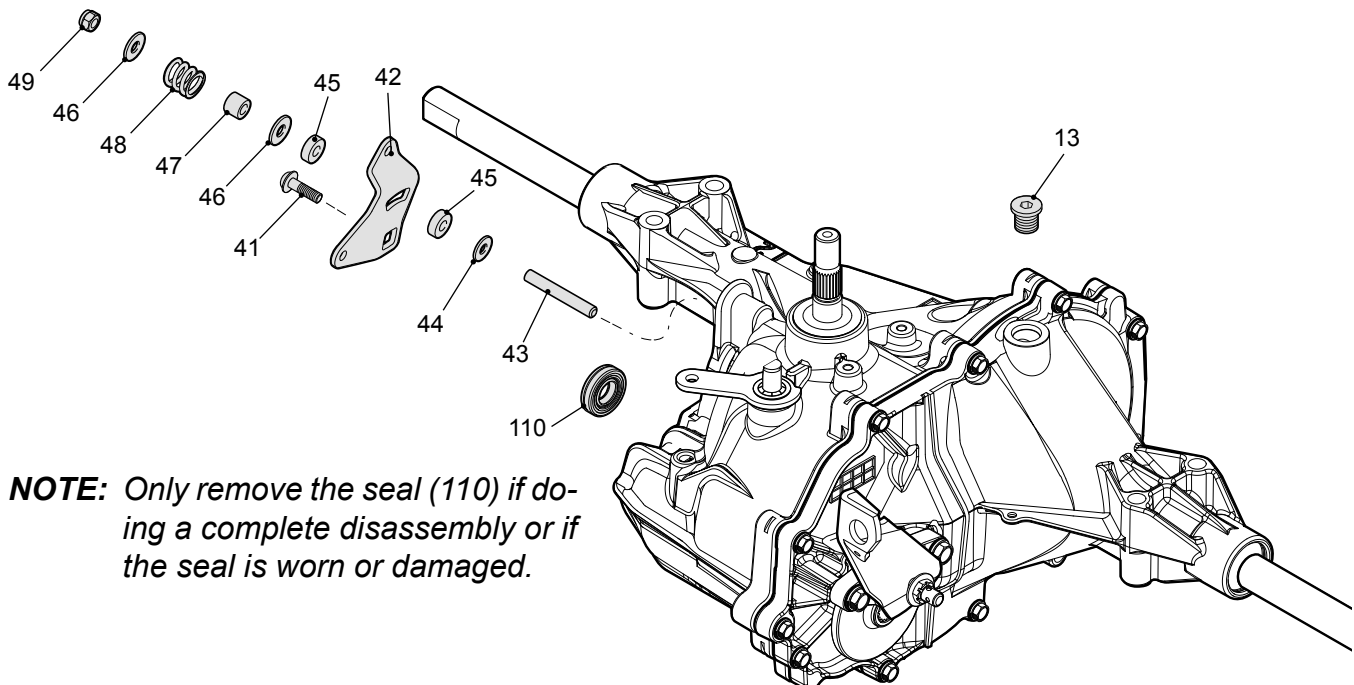
### Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. When tightening the fasteners, refer to the table on page 15 for the required torque values.
3. Install new Torx head screw (41) and lip seal (110) from seal kit, if removed.

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

### Inspection

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



**NOTE:** Only remove the seal (110) if doing a complete disassembly or if the seal is worn or damaged.

Figure 11, Control Arm

## RETURN TO NEUTRAL ASSEMBLY OPTION

Refer to Figure 12

### Disassembly

1. Remove all items previously discussed in their recommended order.
2. Remove the spring (167).
3. Remove the Torx head screw (41) and discard.
4. Remove the scissor arm (164), and the RTN control arm (161).
5. Remove the Hex flange head screw (162), the bushing (166) and the RTN neutral arm (165).

**NOTE:** Only remove the seal (110) if damaged or worn, or if doing a complete disassembly. Refer to "Seal Kit" in the Items List on page 37.

### Inspection

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

### Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. When tightening the fasteners, refer to the table on page 15 for the required torque values.
3. Install new Torx head screw (41) and lip seal (110) from seal kit.

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

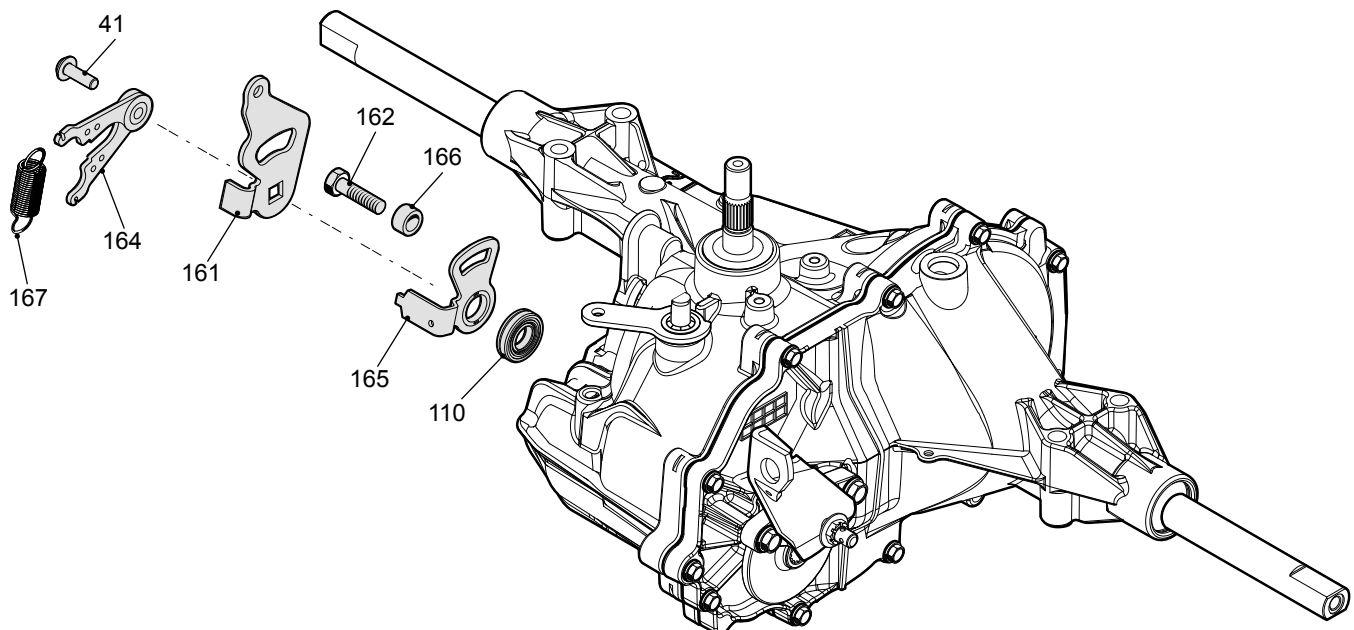


Figure 12, Return to Neutral Assembly

## RETURN TO NEUTRAL/ROS ASSEMBLY OPTION

Refer to Figure 13

### Disassembly

1. Remove all items previously discussed in their recommended order.
2. Remove the spring (167).
3. Remove the Torx head screw (41), discard, and the washer (163).
4. Remove the scissor arm (164), and the RTN control arm (160).
5. Remove the Hex flange head screw (162), the bushing (166) and the RTN neutral arm (165).

### Inspection

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

### Assembly

1. Install the neutral arm (165).
2. Install the bushing (166) and the hex head screw (162).

3. Install the control arm (160).
4. Install the RTN scissor arm (164), washer (163) and Torx head screw (41). Refer to torque chart on page 15.
5. Install the switch retainer over the neutral arm tab. Place the rivet through the switch retainer and neutral arm.
6. Install the RTN spring (167).
7. Press down on the switch retainer tab to bias it. Ensure that the rivet is seated. Then set the rivet using a rivet gun.
8. Refer to page 12 for adjusting the RTN assembly.

**NOTE:** After installing the transaxle on the vehicle be sure the operator presence system and the reverse operation system (ROS) are working properly. Refer to the operations and maintenance sections in the vehicle owner's manual.

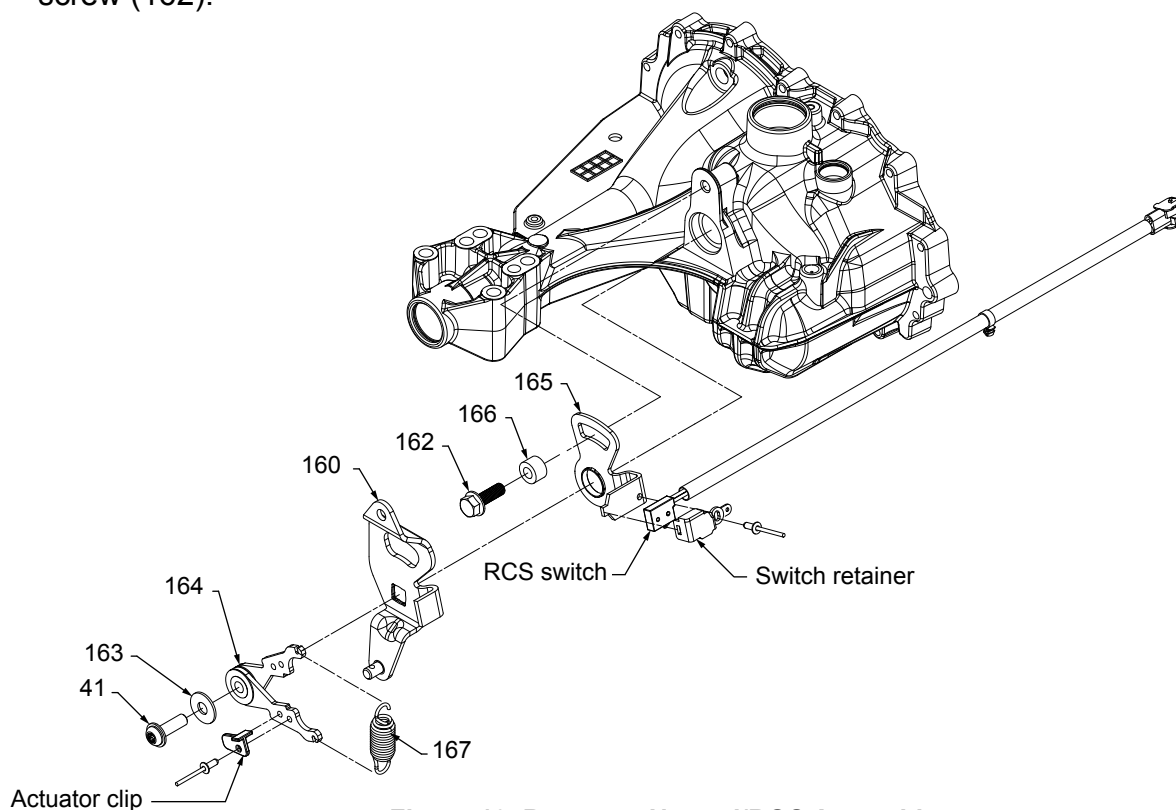


Figure 13, Return to Neutral/ROS Assembly

## BRAKE ARM & BRAKE ASSEMBLY

Refer to Figure 14

### Disassembly

1. Remove all items previously discussed in their recommended order.
2. Remove the cotter pin (133) and discard. Mark the orientation of the bias spring (134), and long screw (127). Remove the brake arm spring (134), the castle nut (132), and the washer (131).
3. Remove the brake arm (130), and the brake compression spring (129).
4. Remove the bolt (128), the bolt (127), and the spacer (126).
5. Remove the brake yoke (124), the puck plate (122), and the brake puck (120).
6. Remove the two brake pins (125) from the brake yoke (124).
7. Remove the brake rotor (121), the inner puck (120) and the seal (7) and discard.

**NOTE:** Only remove the seal (7) if damaged or worn, or if doing a complete disassembly. Refer to "Seal Kit" in the Items List on page 37.

### Inspection

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

### Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. When tightening the fasteners, refer to the table on page 15 for the required torque values.
3. Install new cotter pin (133) and lip seal (7) from seal kit.

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

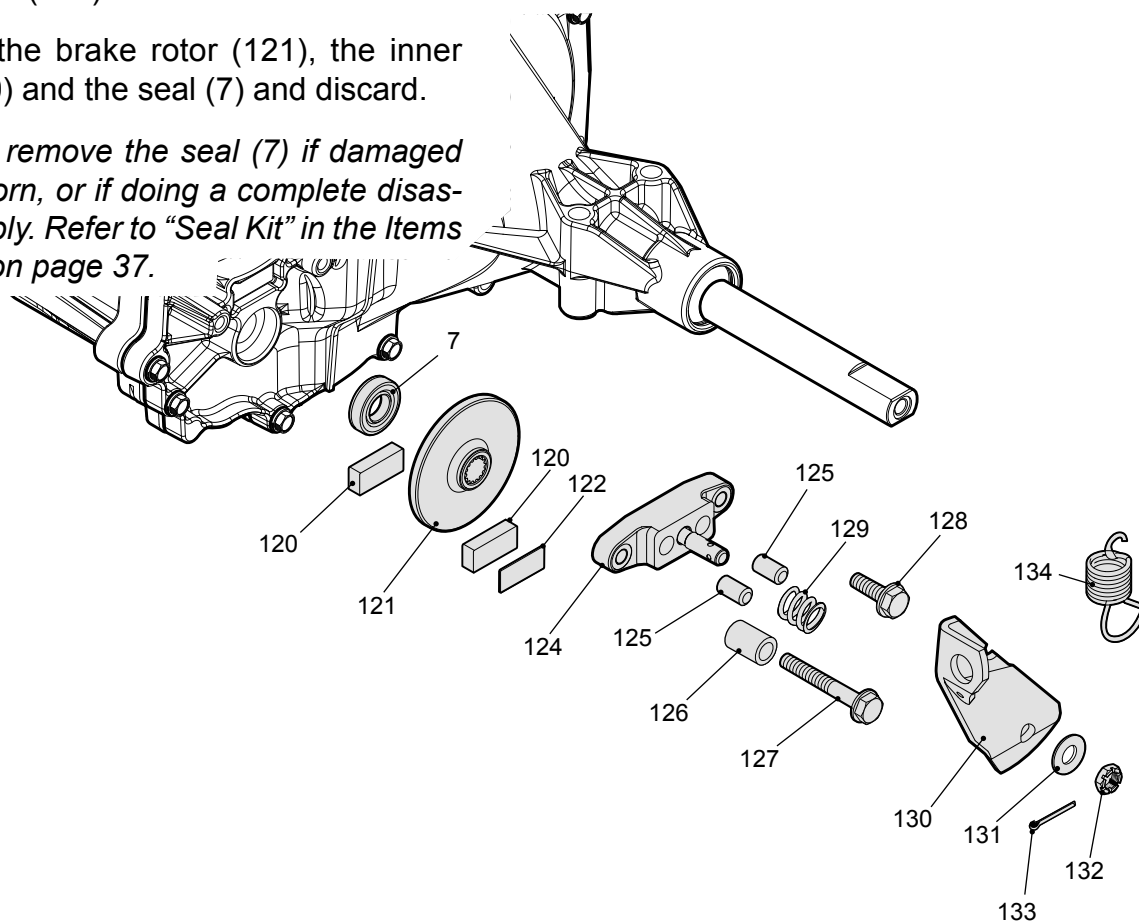


Figure 14, Brake Assembly



## SIDE HOUSING

Refer to Figure 15

### Disassembly

1. Remove all external items previously discussed in their recommended order.
2. Remove the screws (8), separate side housing (2) from main housing (1).

### Inspection

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

### Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. Apply a bead of sealant around the perimeter of the main housing face. See "Sealant Application Diagram" on page 34.
3. Align the side housing (2) with the main housing (1). Use care not to smear the sealant bead.
4. Install the housing screws (8). Refer to the screw tightening pattern on page 35.
5. When tightening the fasteners, refer to the table on page 15 for the required torque values.

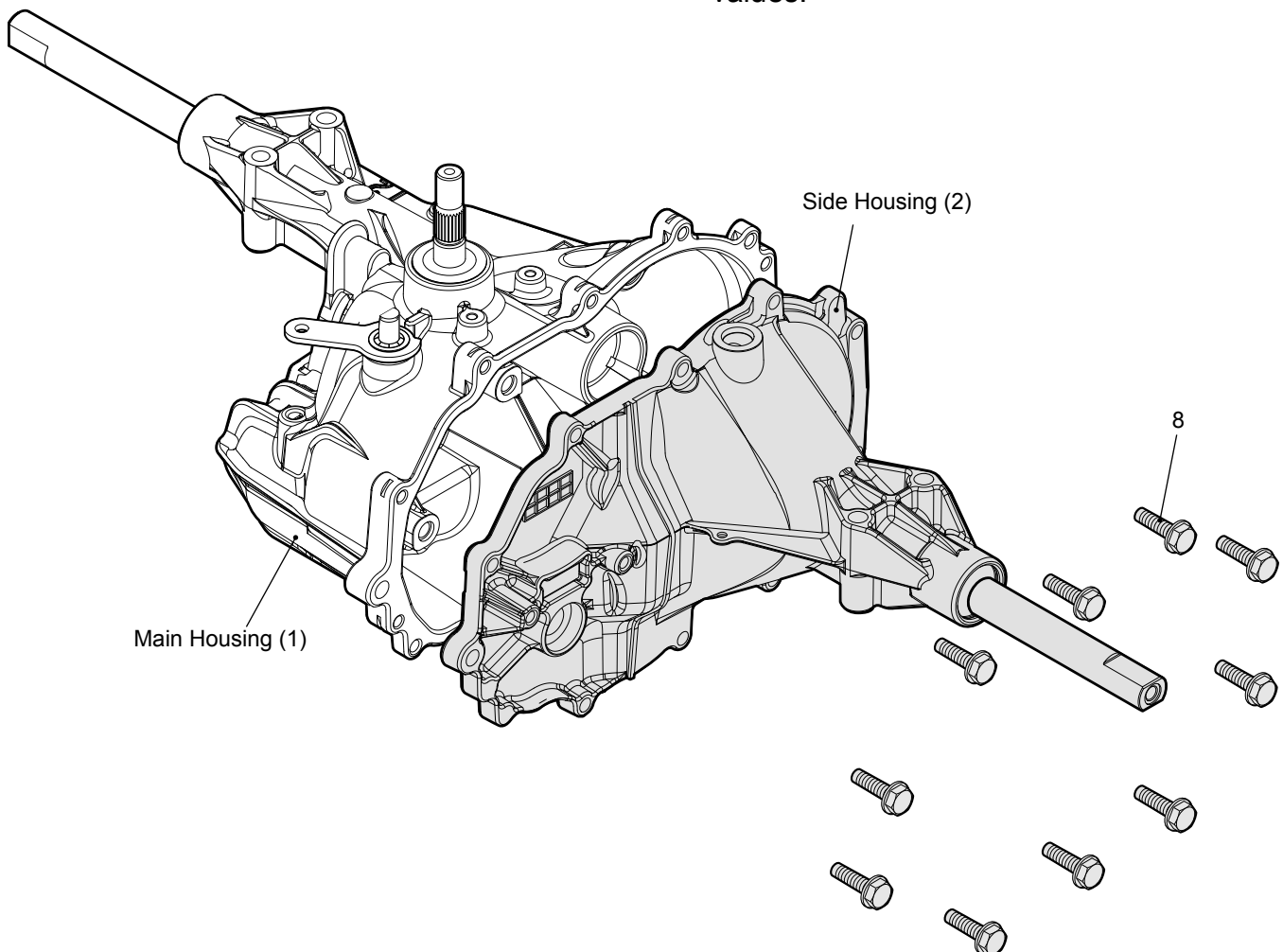


Figure 15, Side Housing Removal

## RH AXLE SHAFT

Refer to Figure 16

### Disassembly

1. Remove all items previously discussed, in their recommended order.
2. Remove the retaining ring (109) and discard.
3. Remove the lip seal (110) and discard.
4. Remove the outboard bushing (106).
5. Remove the axle shaft (103) in the direction of arrow.
6. Remove the inner bushing (105).

### Assembly

1. Assemble items in reverse order of disassembly.

**NOTE:** To protect the lip seal from possible damage when installing into the bore and over the axle shaft, apply a protective covering over the splines, sharp corners and/or keyway of the axle shaft (e.g., cellophane, tape, etc.). Remove protective covering after installation.

### Inspection

1. Inspect the axle shaft for wear or damage. Replace if necessary.

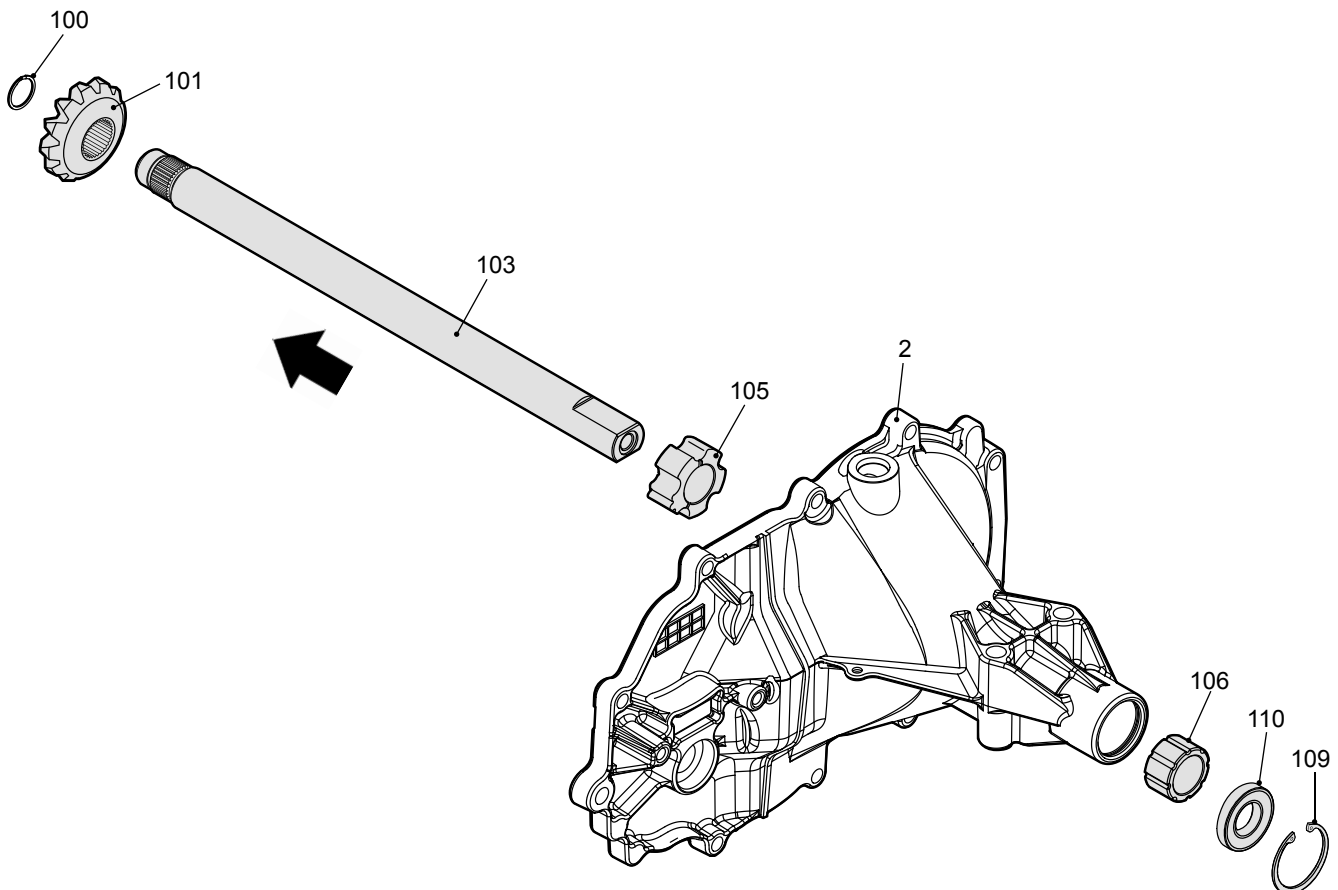


Figure 16, Axle Assembly

## BULL GEAR SET

Refer to Figure 17

### Disassembly

1. Remove all external items previously discussed in their recommended order.
2. Remove the bull gear set — two miter gears (102) with two differential pins (108), and bull gear (107).

### Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. Install the bull gear (107).
3. Install the miter gears (102) with the differential pins (108).

### Inspection

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

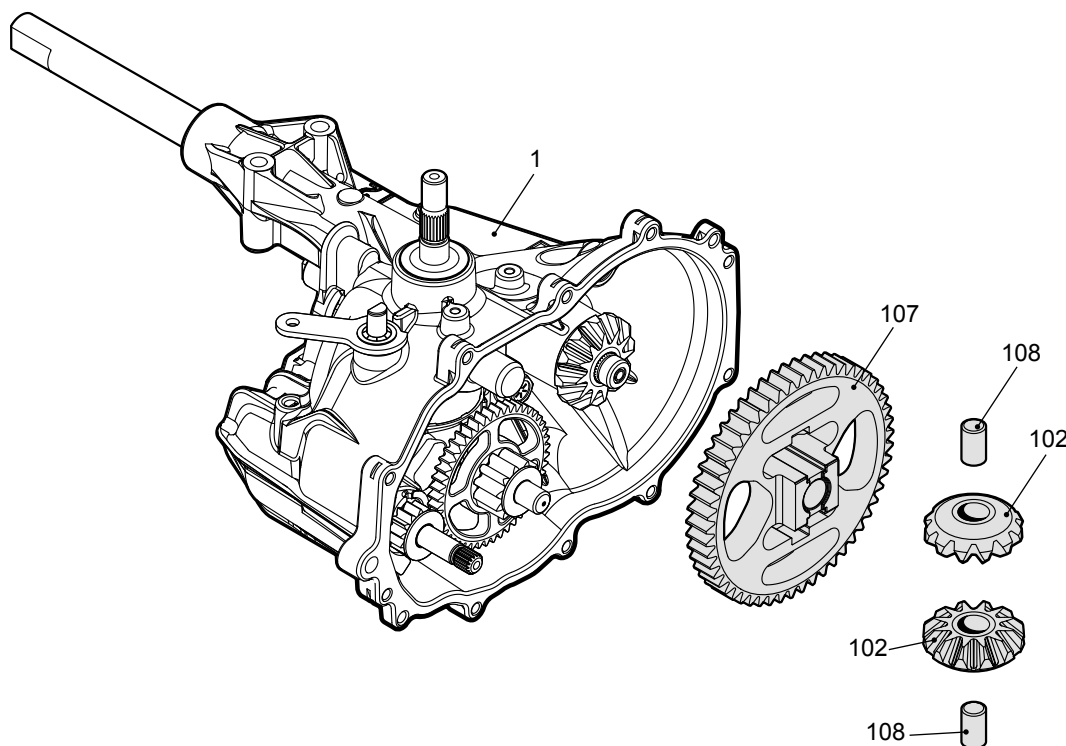


Figure 17, Bull Gear Set

## REDUCTION GEAR SET

Refer to Figure 18

### Disassembly

#### Reduction Gear Set:

1. Remove all external items previously discussed in their recommended order.
2. Remove the washer (93), jack shaft gear (91) and reduction gear (90).
3. Remove the jack shaft (92) and second washer (93).

### Inspection

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

### Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. Install the washer (93) and jack shaft (92).
3. Install the jack shaft gear (91) into the reduction gear (90). Insert onto the jack shaft (92).
4. Place the washer (93) onto the jack shaft (92).

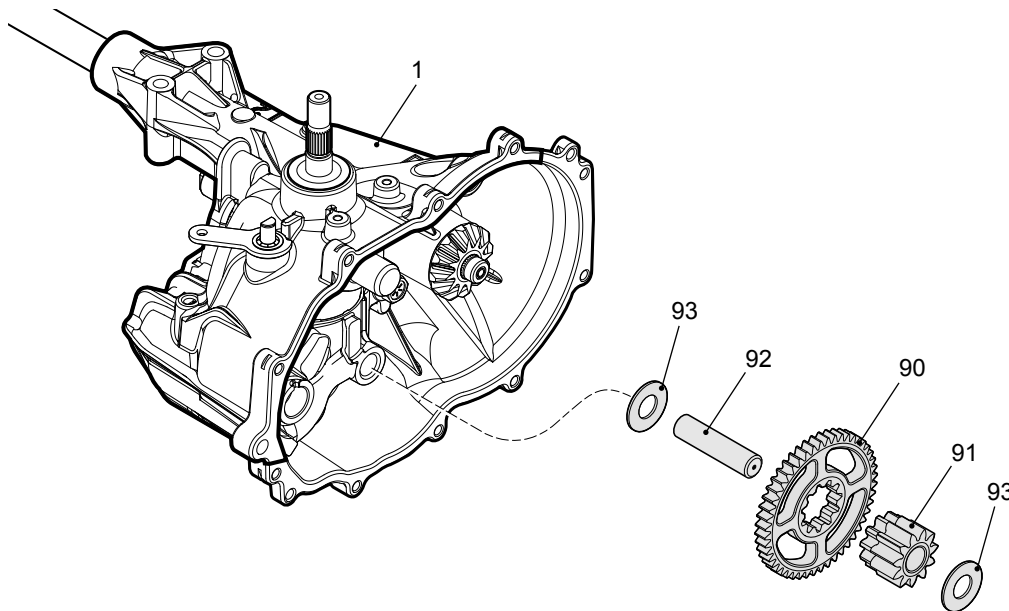


Figure 18, Reduction Gear Set

## INPUT SHAFT

Refer to Figure 19

### Disassembly

1. Remove all external items previously discussed in their recommended order.
2. Remove the retaining ring (66) and discard.
3. Remove the lip seal (65) and discard.
4. Remove the washer (64).
5. Remove the pump shaft (61) with pressed on bearing (62), and the helical spring (67).

**NOTE:** Remove the bearing from pump shaft only if worn or damaged.

6. Remove the wire ring retainer (63) and discard. Remove the bearing (62) from the pump shaft (61).

### Inspection

1. Inspect the bearing and input shaft for wear or damage. Inspect the splines on the shaft for possible damage. Replace if necessary.

### Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. Install the bearing (62), a new retaining wire (63), and spring (67) onto the input shaft.

**NOTE:** Apply a light coating of grease to new seal (65) before installing. Refer to "Seal Kit" in the Items List on page 37.

3. Install the input shaft assembly into the main housing.
4. Install the washer (64), seal (65) and retaining ring (66) into the main housing.

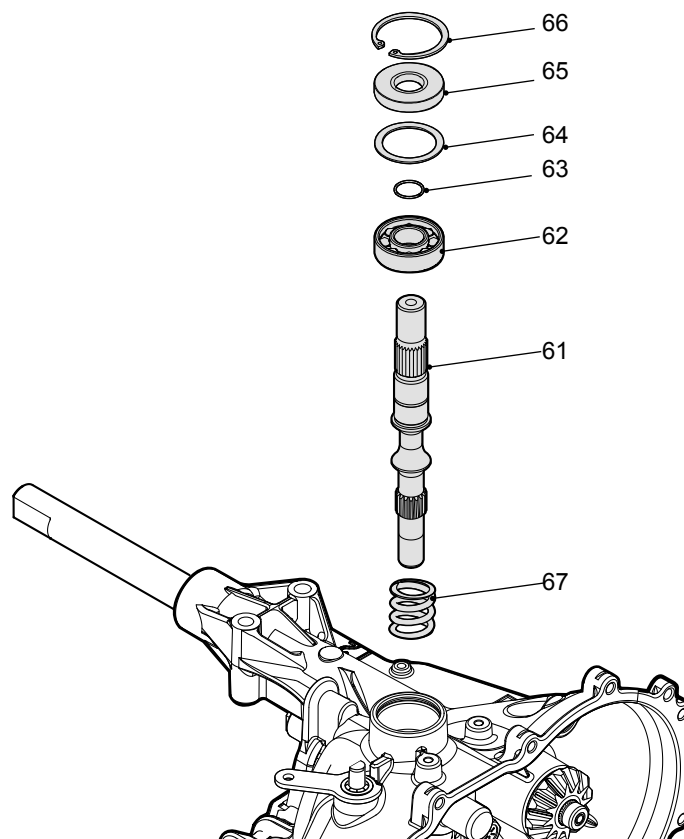


Figure 19, Input Shaft

## SWASHPLATE

Refer to Figures 20-21

### Disassembly

1. Requires removal of all items beginning on page 17.
2. Remove the swashplate (40) and pump cylinder block assembly (70) as a single item.

**NOTE:** Removal will be aided by applying a small amount of pressure on the trunion mounted swashplate towards the center section. While **CAREFULLY** removing the swashplate and block assembly, keep the block face flush with the center section to minimize damage to the running surface.

3. Separate the pump cylinder block assembly (70) and the thrust bearing (74) from the swashplate (40) and set aside.

### Inspection

1. Inspect the swashplate (40) and thrust bearing assembly (74) for wear or damage. Replace if necessary.
2. Inspect pump block per detail on page 31.

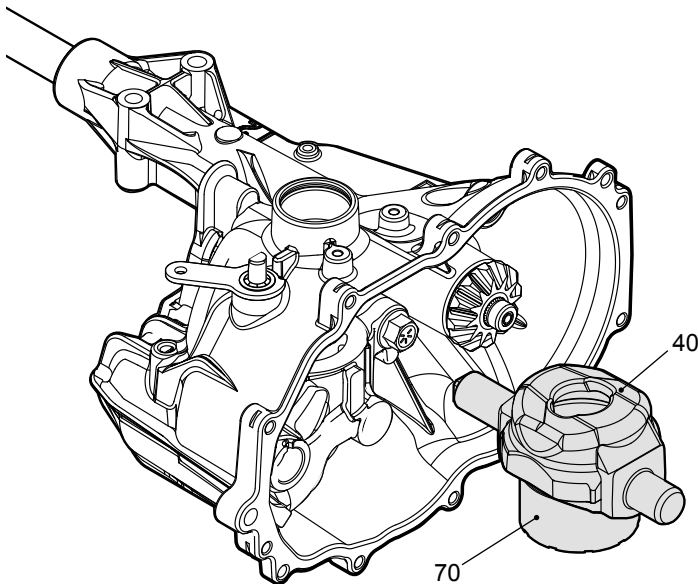


Figure 20, Swash Plate

### Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. Apply a light coating of oil to running surfaces on center section, swashplate bearing races, thrust bearing assembly and pump block assembly.
3. Place the thrust bearing assembly (74) into swashplate (40).
4. With the pistons facing the thrust bearing, place the pump block assembly (70) into the swashplate.
5. While pressing the pump block assembly (thrust bearing – pump cylinder block) and swashplate together, align to center section in main housing.

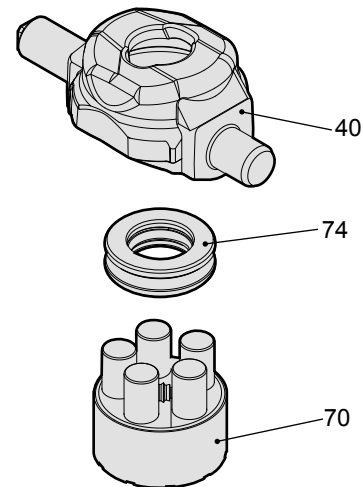


Figure 21, Hydraulic Pump Components

## BYPASS ARM

Refer to Figure 22

### Disassembly

1. Remove all external items previously discussed in their recommended order.
2. Remove the retaining ring (35) and discard. Remove the bypass arm (34).
3. Remove the retaining ring (33) and discard.
4. Remove the bypass rod (32) and the clip retaining ring (31) as a single item.

**NOTE:** It is not necessary to remove the clip retaining ring (31) from the bypass rod (32) unless it is damaged or worn.

5. Remove the lip seal (30) and discard.

### Inspection

1. Inspect the bypass rod (32) for wear or damage. Replace if necessary.

**NOTE:** Take care to insure that the bypass rod is free of burrs that may cut the rubber lip seal.

2. Inspect the housing bore.

### Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. Install a new lip seal (30).
3. Install the bypass rod (32) with new clip retaining ring (31), if removed.
4. Install the new retaining ring (33).
5. Install the bypass arm (34).
6. Install the retaining ring (35).

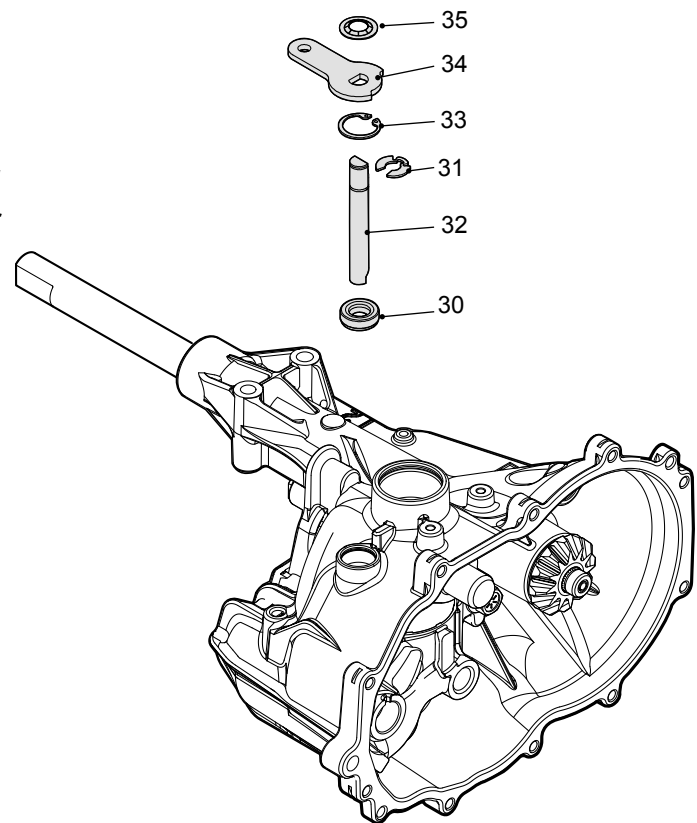


Figure 22, Bypass Arm and Rod

## CENTER SECTION, MOTOR SHAFT & MOTOR BLOCK

Refer to Figure 23

### Disassembly

1. Requires removal of all items beginning on page 17.
2. Remove the center section mounting screws (22).
3. Remove the center section, the motor shaft (82) and the bypass plate (23).
4. Remove the motor cylinder block assembly (75).
5. Remove the motor thrust bearing (79).

### Inspection

1. Inspect the races of the thrust bearing (79) for wear or damage.
2. Inspect the motor shaft for wear or damage. Replace if necessary.
3. Inspect for scratches on the machined surfaces of the center section.
4. Inspect motor cylinder block assembly (75) per detail on page 30.
5. Inspect the bearing surfaces in the main housing.

### Assembly

1. Reassemble all parts in the reverse order of disassembly.
2. Apply a light coating of oil to all running surfaces.
3. Place the thrust bearing assembly (79) into the main housing. Position so the thick race will contact the motor block pistons.
4. Insert the motor shaft assembly (82) into the center section (20).
5. Insert the bypass plate (23) into the center section.
6. Place the motor cylinder block assembly (75) onto the motor shaft (82).
7. Insert the center section (20), the motor shaft (82), the bypass plate (23) and the motor cylinder block (75) into the main housing as one assembly.
8. Install the center section screws (22). Refer to torque chart on page 15.

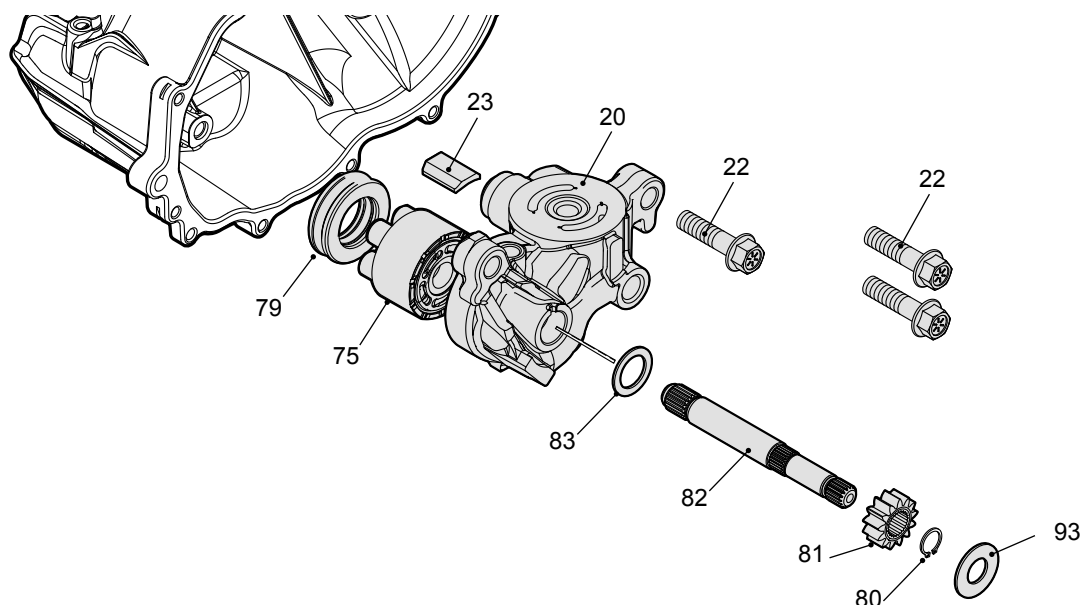


Figure 23, Center Section, Motor Shaft & Motor Block



## FILTER ASSEMBLY

Refer to Figure 24

### Disassembly

1. Remove the magnet (28) and the filter (27). The filter can be removed without damaging the filter base.
2. Remove the deflector (29).
3. Inspect the check plugs (24, 25). Remove if necessary.
4. Inspect the filter base (26). Remove/replace if necessary.

### Inspection

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

### Assembly

1. Install the filter base, if removed.
2. Install the check plugs, if removed. Refer to torque chart on page 15.
3. Install the deflector (29).
4. Install a new filter (27) and the magnet (28).

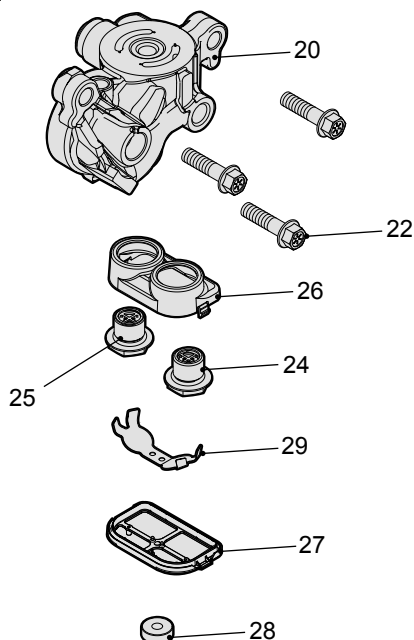


Figure 24, Filter Assembly

## CYLINDER BLOCKS

Refer to Figure 25

Inspect each component of the cylinder block assemblies for wear or damage. Inspect the cylinder blocks' running surface for scratches. Replace if necessary.

**NOTE:** During separation of the cylinder blocks, take care not to damage the surfaces of the pistons and block.

Apply a thin coating of oil to all components of the cylinder block assemblies before reassembly.

After reassembling the cylinder block components, set aside until ready for installation of the center section and swashplate. Refer to pages 28 and 30.

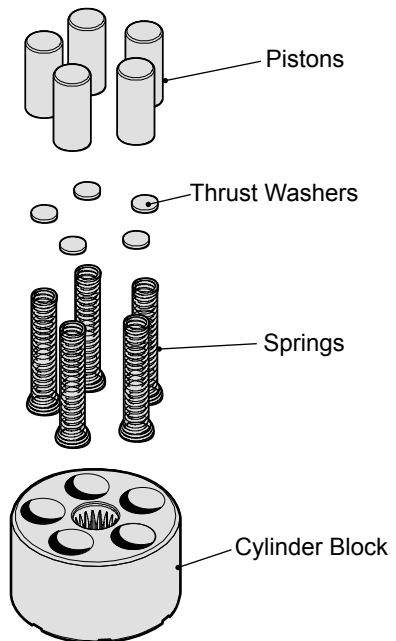


Figure 25, Pump/Motor Cylinder Block Assembly

## LH AXLE SHAFT

Refer to Figure 26

### Disassembly

1. Remove all items previously discussed, in their recommended order.
2. Remove the retaining ring (109) and discard.
3. Remove the lip seal (110) and discard.
4. Remove the outboard bushing (106).
5. Remove the axle shaft (104) in the direction of arrow.
6. Remove the inner bushing (105).

### Assembly

1. Assemble items in reverse order of disassembly.

**NOTE:** To protect the lip seal from possible damage when installing into the bore and over the axle shaft, apply a protective covering over the splines, sharp corners and/or keyway of the axle shaft (e.g., cellophane, tape, etc.). Remove protective covering after installation.

### Inspection

1. Inspect the axle shaft for wear or damage. Replace if necessary.

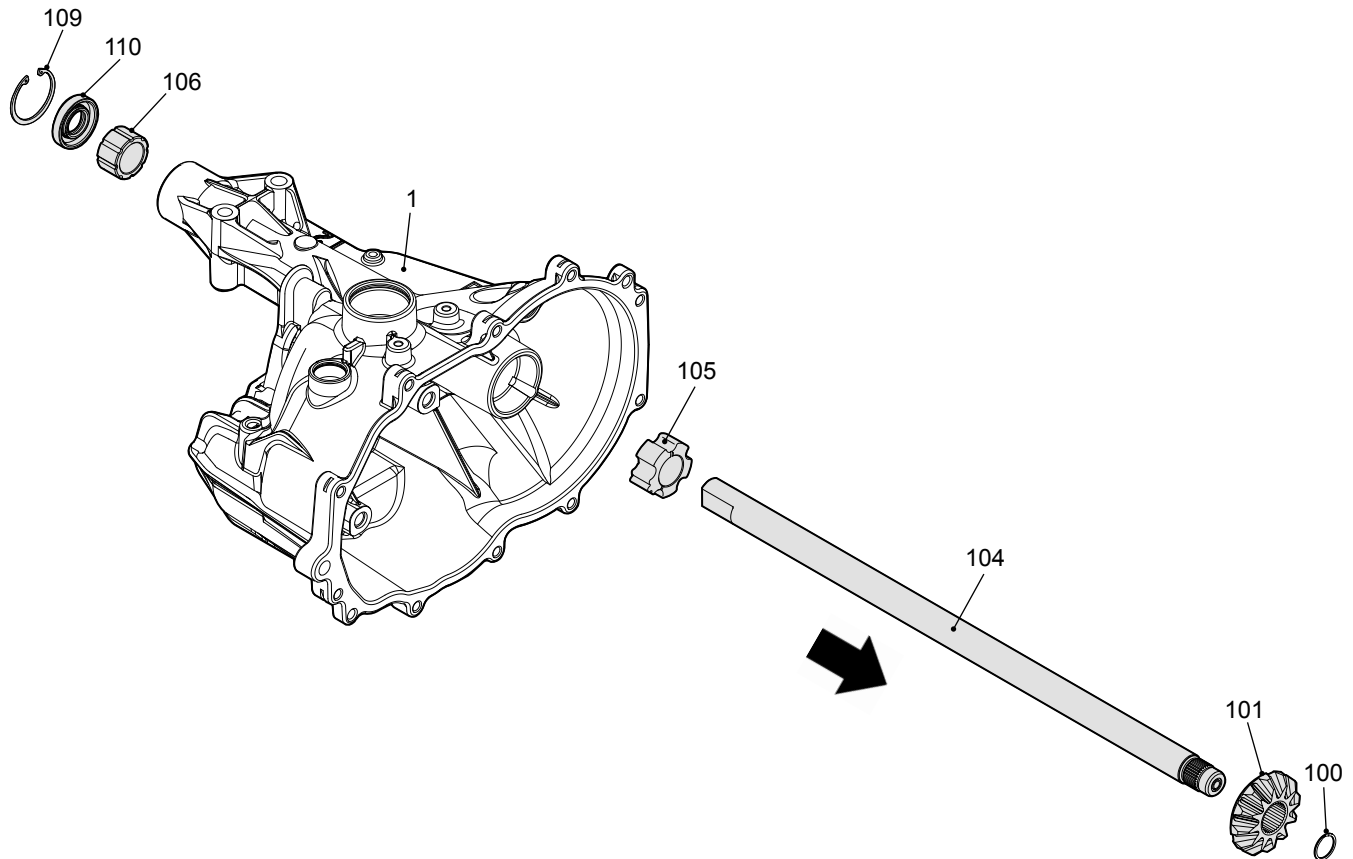


Figure 26, Axle Assembly

## EXPANSION TANK HOSE AND FITTING

Refer to Figure 27

### Disassembly

1. Remove the expansion tank hose (141).
2. Remove the O-ring (142) from the expansion tank fitting (140) and discard.
3. Remove the expansion tank fitting (140).

### Assembly

1. Install the fitting into the main housing. Refer to torque chart on page 15.
2. Install a new O-ring (142) onto the fitting.
3. Place the expansion tank hose (141) onto the fitting (140).

### Inspection

1. Inspect the fitting for damage and replace if necessary.

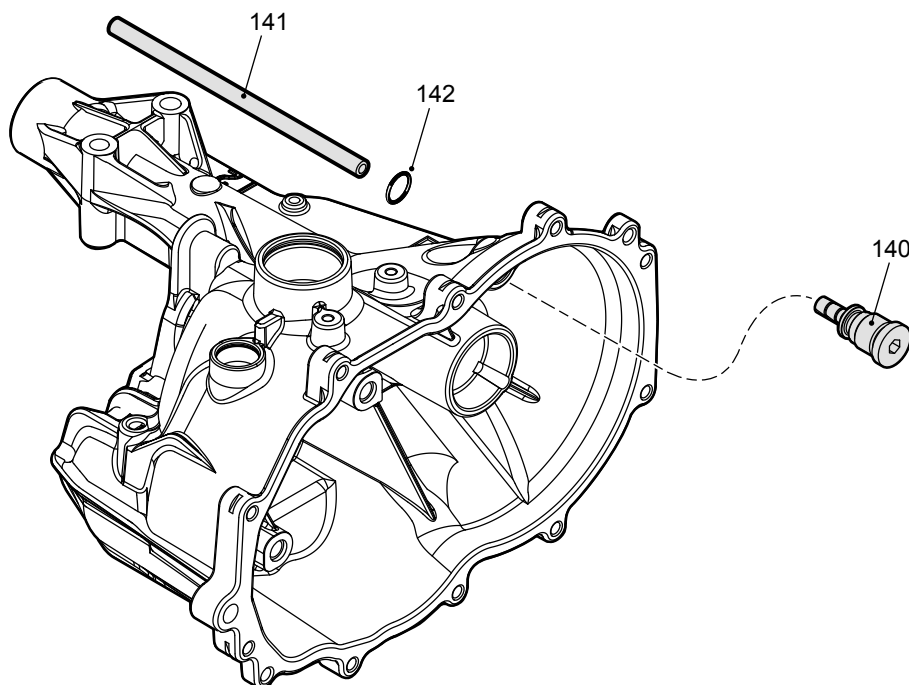


Figure 27, Expansion Tank Hose and Fitting

## 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 procedure illustrations, and are also keyed to the complete unit exploded view on page 36.

1. Install the expansion tank hose and fitting. See page 33.
2. Install the LH axle assembly. See page 32.
3. Install the filter assembly, cylinder block and motor shaft. See pages 30-31.
4. Install the bypass arm. See page 29.
5. Install the pump block and swash plate. See page 28.
6. Install the input shaft. See page 27.
7. Install the reduction gear set. See page 26.
8. Install the bull gear set. See page 25.
9. Install the RH axle assembly. See page 24.

10. Apply sealant to the main housing prior to assembly with the side housing. See page 34.

**NOTE:** *Prior to applying the new sealant, the old sealant must be removed from all surfaces.*

*A small consistent bead (approx. 1/16 – 1/8 inch) of the sealant around the housing face will be sufficient. Use sparingly.*

*The illustration below indicates the correct sealant path.*

11. Install the brake assembly. See page 22.
12. Install the control arm (RTN) assembly. See pages 19-21.
13. Install the expansion tank. See page 18.
14. Fill transaxle with clean oil.
15. Install the fan and pulley assembly. See page 17.
16. Install the transaxle into the vehicle.
17. Perform the purge procedures listed on page 11.

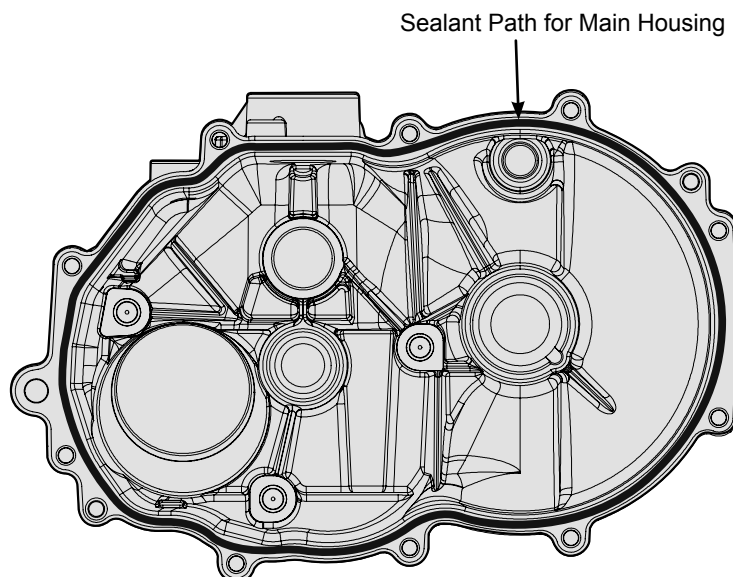


Figure 28, Sealant Application Diagram

## SIDE HOUSING – SCREW TIGHTENING SEQUENCE

Starting with the number “1” screw location, tighten sequentially through to “10.”

Torque each screw to 105 – 155 lb-in (11.8 – 17.5 Nm).

**NOTE:** As a general rule, use the low end of the torque specification.

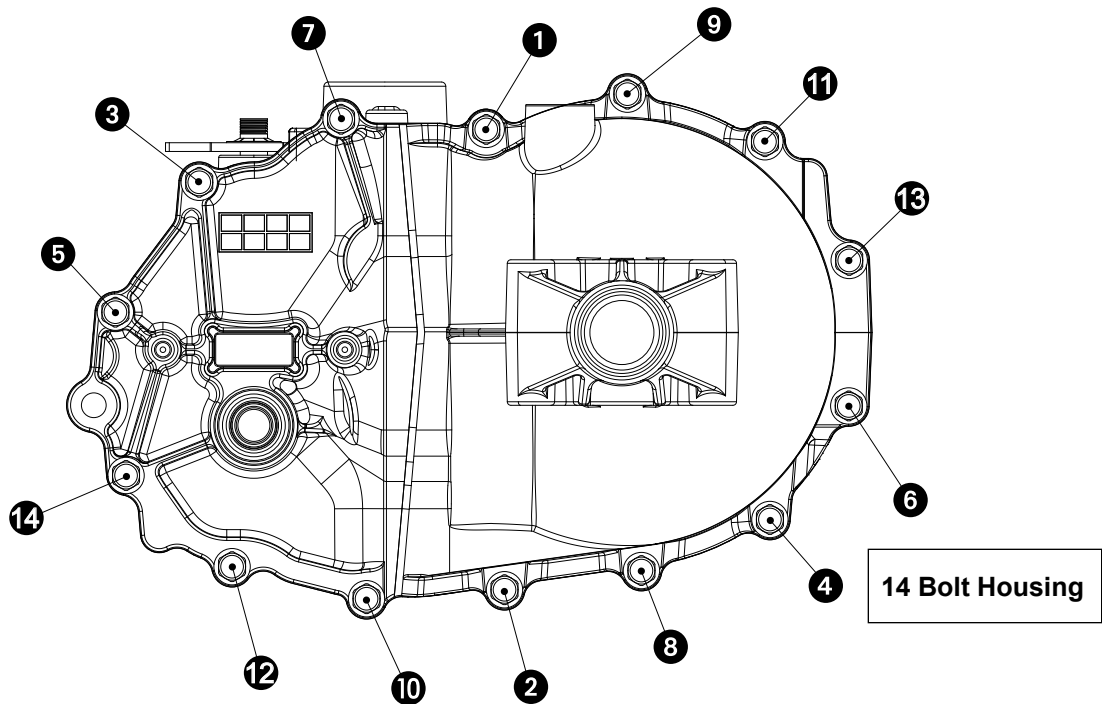
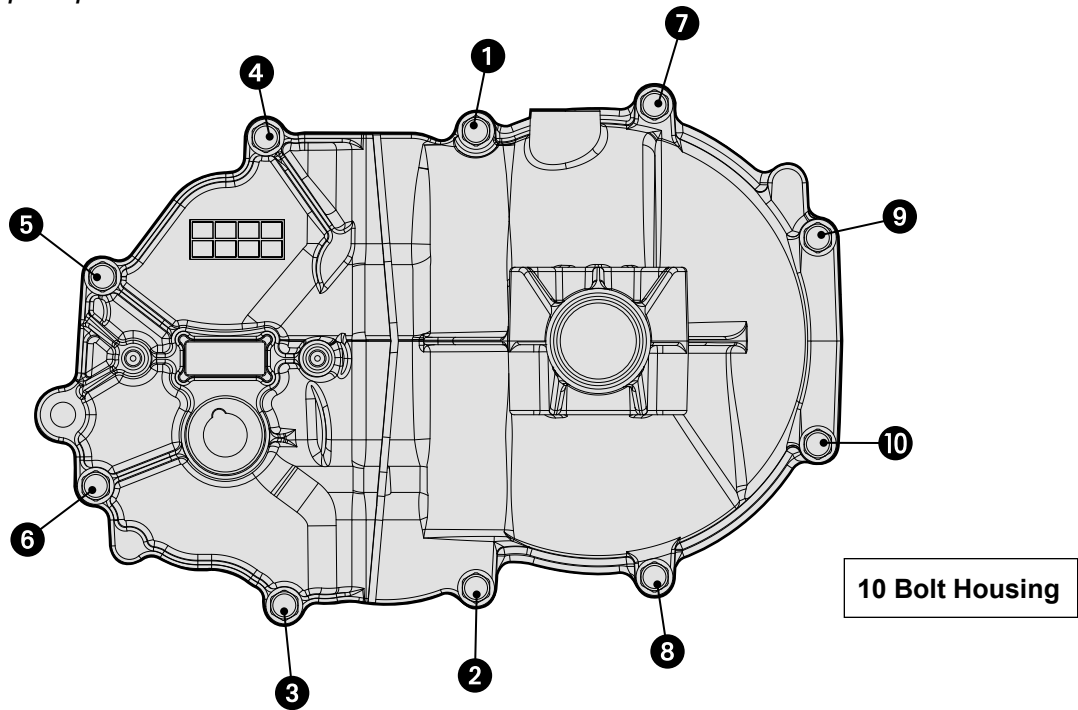
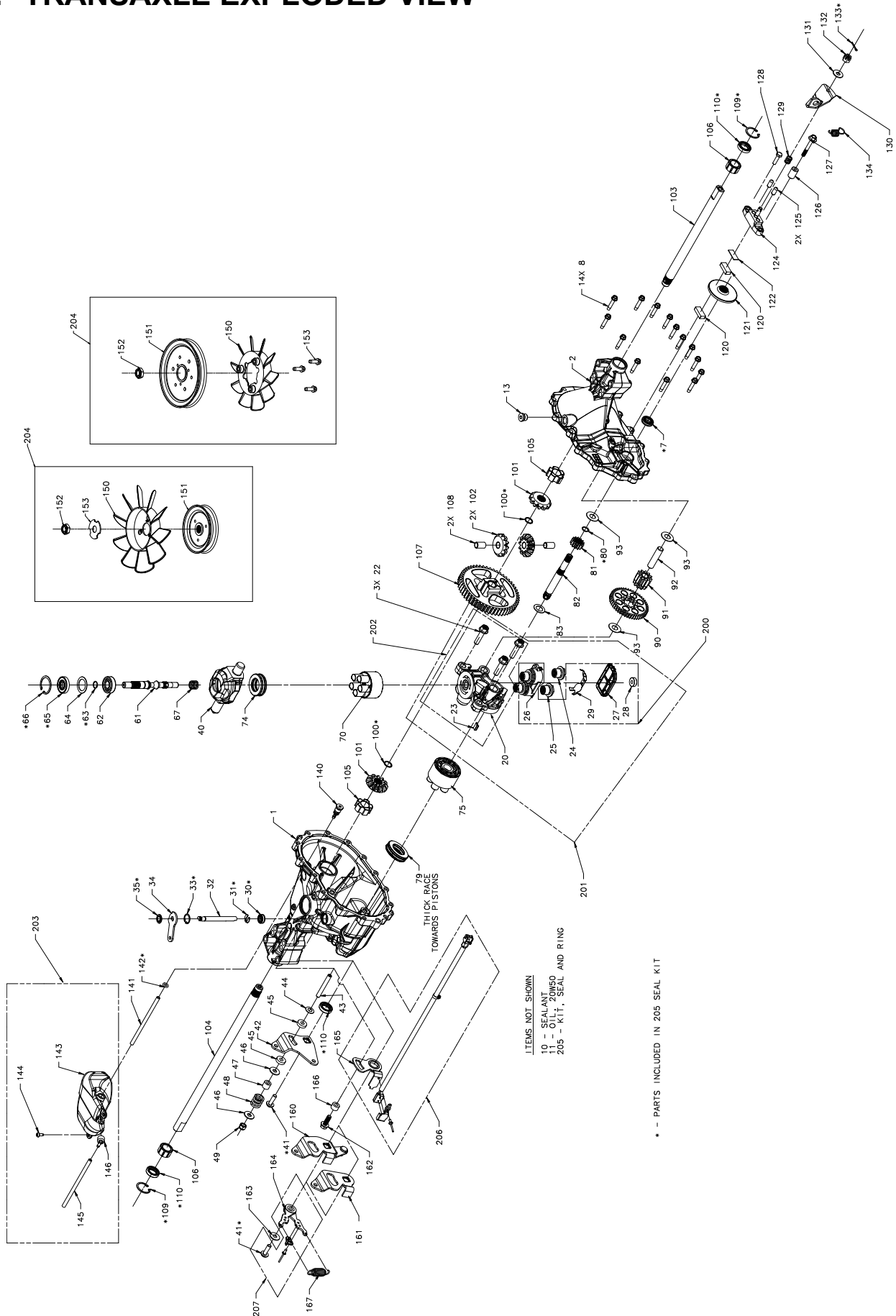


Figure 29, Screw tightening sequence

# T2® TRANSAXLE EXPLODED VIEW



**T2® TRANSAXLE PARTS LIST**

1	Housing, Main	103	Axle .75 dia. RH
2	Housing, Side	104	Axle .75 dia. LH
7	Seal, Lip (included in Center Section Kit 202)	105	Bushing, Inboard
8	HFHCS 1/4-20 x 1.25	106	Bushing, Outboard
10	Sealant, Loctite 5900	107	Gear 53T Bull
11	Oil, 20W50	108	Pin, Differential
13	Plug	109	Ring, Retaining Internal Axle (part of 202)
20	Center Section	110	Seal, Lip .75 x 1.125 x .25 TC (part of 202)
22	Bolt, Hex Flange	120	Puck, Brake
23	Plate, Bypass	121	Rotor, Brake
24	Check Plug Assembly w/Washer	122	Plate, Puck
25	Check Plug/w Assembly w/Washer, .027, Spring	124	Yoke, Brake
26	Bottom, Filter	125	Pin, Brake
27	Cover, Filter	126	Spacer
28	Ring, Magnet	127	Screw 1/4-20 x 2.0 w/Patch
29	Deflector	128	Screw 1/4-20 x 1.0 w/Patch
30	Seal, Lip (included in Center Section Kit 202)	129	Spring
31	Ring, Retaining (included in Center Section Kit 202)	130	Arm, Brake
32	Rod, Actuator	131	Washer
33	Ring, Retaining (included in Center Section Kit 202)	132	Nut, Castle 5/16-24 PL
34	Arm, Bypass	133	Pin, Cotter 3/32 x .75
35	Ring, Retaining (included in Center Section Kit 202)	134	Spring, Brake arm
40	Trunnion, Swashplate	140	5/16 SAE, 5/32 Tube
41	TWHCS 5/16-18 x 1.00	141	Hose
42	Arm, Control	142	O-Ring .103 x .299 ID (part of 202)
43	Screw, Set 5/16-24 x 2.50	143	Tank, Expansion
44	Washer , Belleville	144	Bolt, Self Tapping 10-32 x 1/2, patch
45	Washer, Plastic .32 x .80 x .21	145	Tube
46	Washer .34 x .88 x .06	146	Cap, Barbed Vent
47	Spacer .32 x .59 x .50	150	Fan
48	Spring, Helical Comp	151	Pulley
49	Nut, Hex 5/16-24 nylon insert	152	Nut
61	Input Shaft	153	Washer
62	Bearing, Ball 15 x 35 x 11	153	Screw 1/4-20 x 0.75
63	Ring, Retaining (included in Center Section Kit 202)	160	Arm, Control RTN
64	Washer 1.23 x 1.56 x .04	161	Arm, Control RTN
65	Seal, Lip (included in Center Section Kit 202)	162	Bolt, Hex Flange Head
66	Ring, Retaining (included in Center Section Kit 202)	163	Bushing
67	Spring, Helical	164	Assembly, RTN Bi-Directional
70	Block, Cylinder 8cc	165	Arm, Neutral Assembly
74	Bearing, Thrust 27 x 47 x 14	166	Bushing
75	Block, Cylinder 10cc	167	Spring
79	Bearing, Thrust Ball 30 x 52 x 13	200	Kit, Filter
80	Ring, Retaining .50 External Motor Shaft (part of 202)	201	Center Section w/Filter
81	Gear, 13T Pinion	202	Center Section Kit
82	Shaft, Motor	205	Seal Kit
83	Washer .60 x 1.00 x .03	206	Kit, T2® ROS
90	Gear	207	Kit, T2® ROS
91	Gear, Jack Shaft 11T		
92	Jack Shaft (Pin)		
93	Washer .50 x 1.00 x .03		
100	Ring, Retainer (included in Center Section Kit 202)		
101	Gear, Bevel 12T Spline ID		
102	Gear, Bevel 12T .50 ID		

## 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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