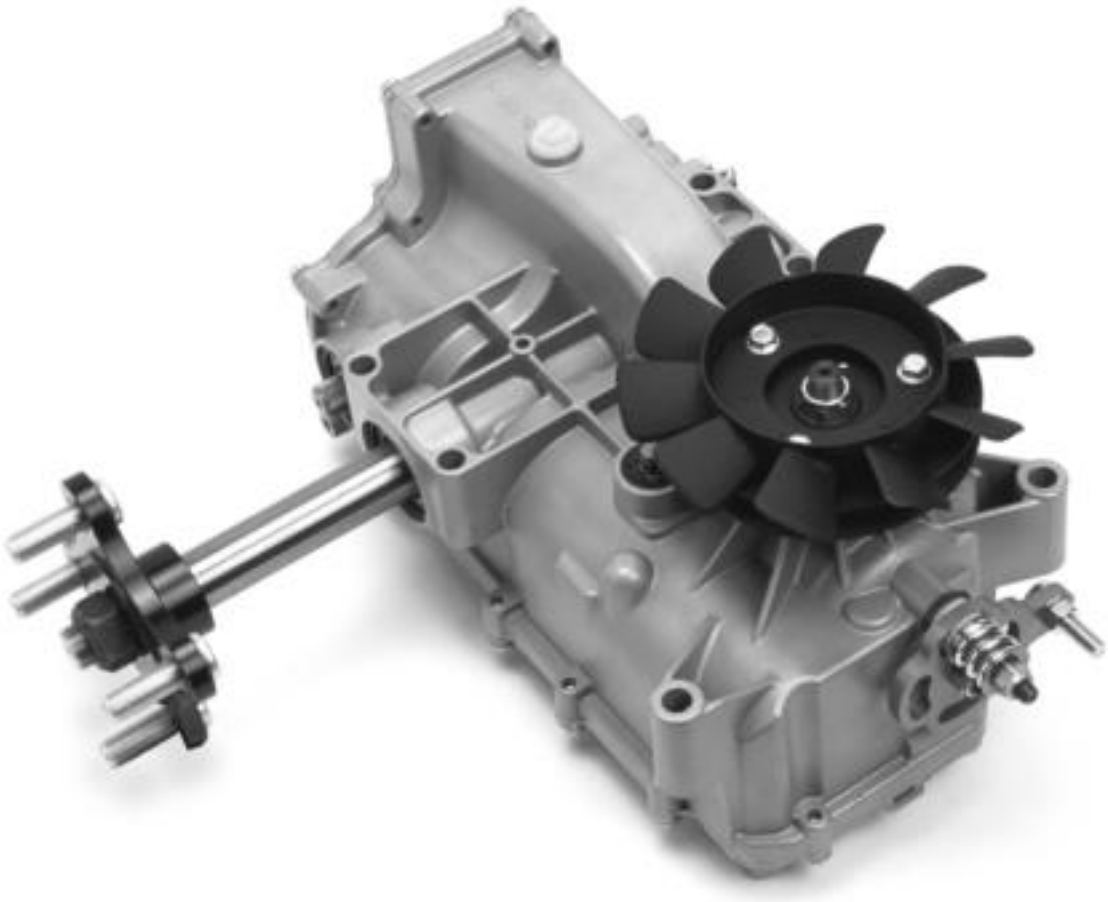
Hydro-Gear®

We set the wheels in motion.



310-2400
Integrated Zero-Turn Transaxle Service and Repair Manual

BLN-51134
March 2001

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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 the Hydro-Gear 310-2400, referred to as the Integrated Zero Turn (IZT).

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

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

Some repair procedures require that the IZT 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 ESA (Engine Service Association) (610) 363-3844 or their Hydro-Gear 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.

SECTION 1. DESCRIPTION AND OPERATION

INTRODUCTION

The purpose of this manual is to provide information useful in servicing the Hydro-Gear Integrated Zero Turn (IZT) transaxle. This manual includes the IZT'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.

GENERAL DESCRIPTION

The 310-2400 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 10cc per revolution, and motor with a fixed displacement of 21cc per revolution. The variable displacement pump features a cradle 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 310-2400 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 bypass is utilized in the 310-2400 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.

The 310-2400 is configured for both floating disc and cog style parking brakes.

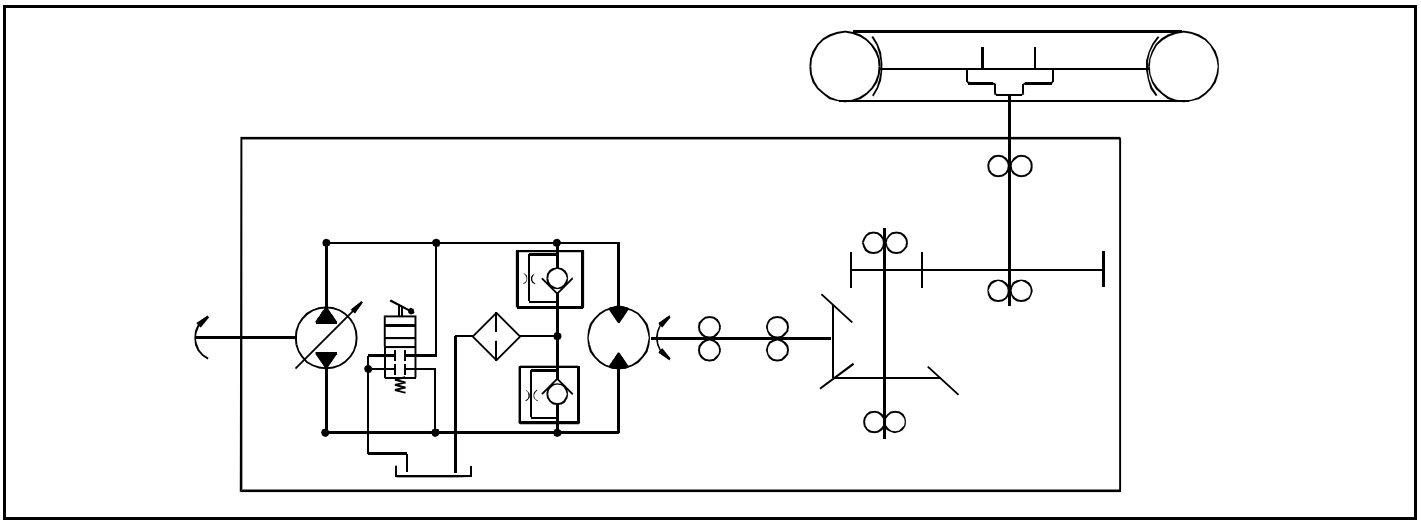


Figure 1. 310-2400 Hydraulic Schematic

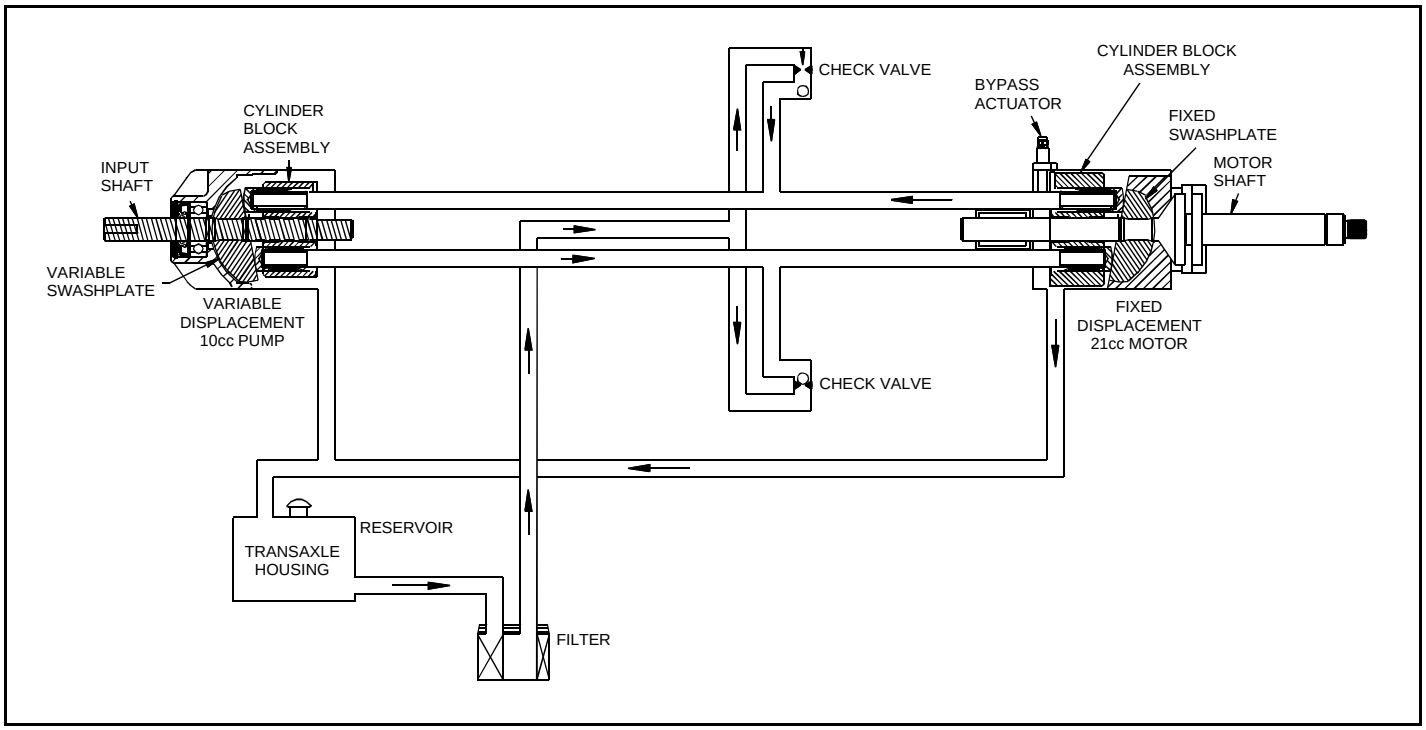


Figure 2. 310-2400 Hydraulic Flow Illustration

HYDRAULIC SCHEMATIC

Figure 2 provides an illustration of the hydraulic oil circuit. The oil supply for the hydraulic system of the 310-2400 IZT is also utilized for lubricating the components of the final drive assembly.

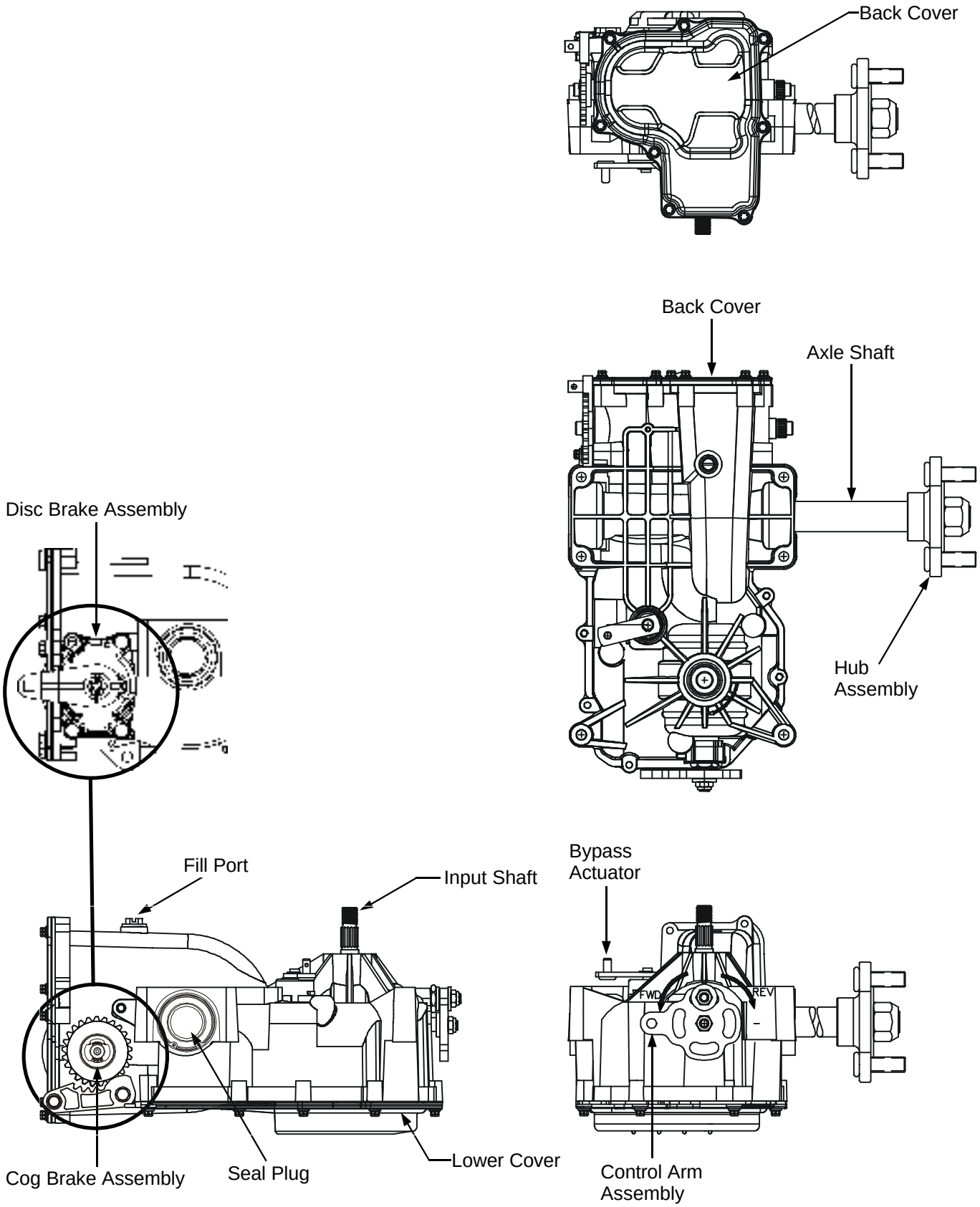
The input shaft and pump cylinder block are turned in one direction only by the engine/drive belt/pulley combination. Output of the oil flow is controlled by the direction and amount that the variable swashplate is angled. As the pump pistons compress they force the oil to flow through one of two passageways (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.

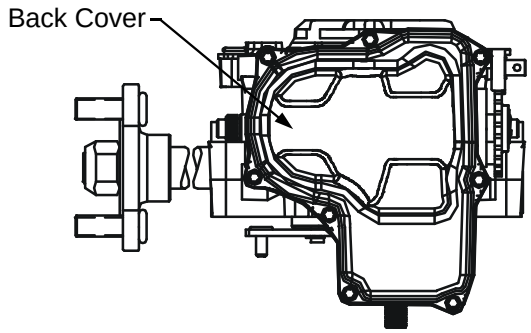
The motor cylinder block mounts onto a splined motor shaft which drives the gear train.

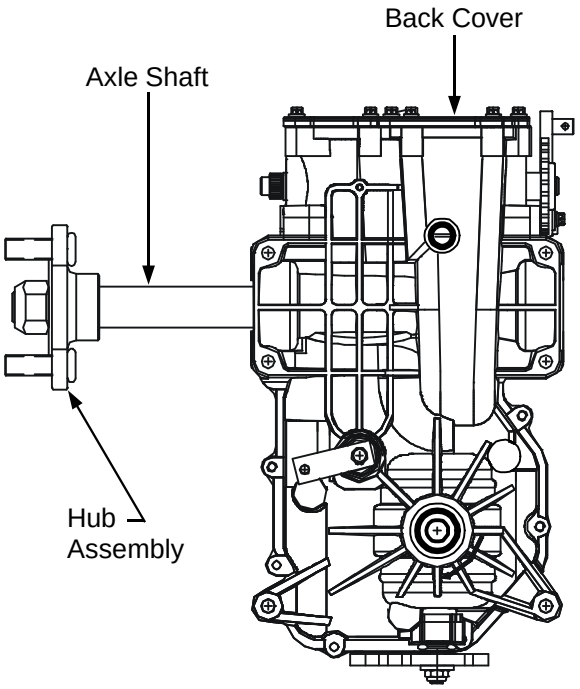
The bypass feature in the 310-2400 has a mechanical lever which lifts the motor block off of the center section running surface, allowing any oil flowing from the pump block to be discharged into the housing without turning the motor.

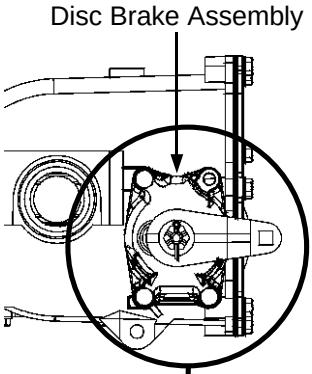
EXTERNAL FEATURES 310-2400L

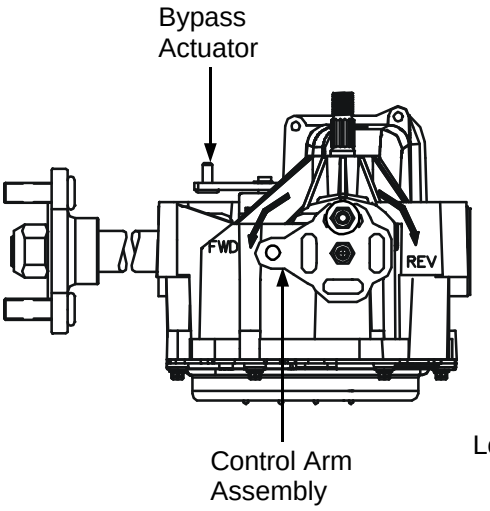


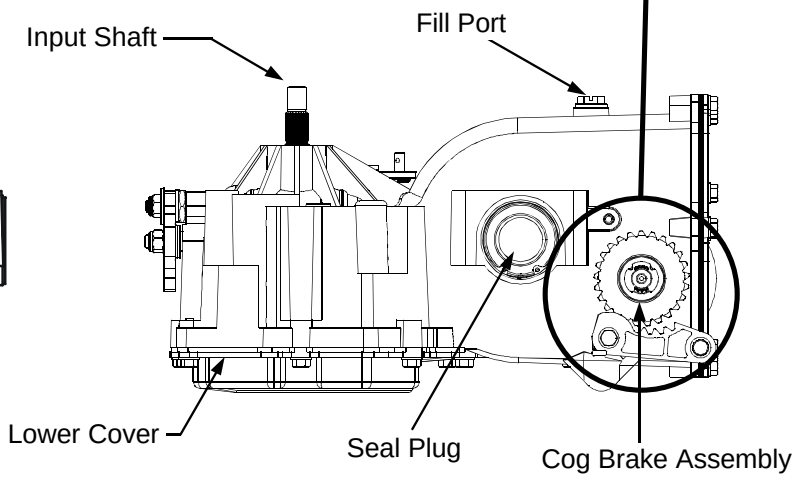
EXTERNAL FEATURES 310-2400R











TECHNICAL SPECIFICATIONS

Technical specifications for the 310-2400 IZT are listed in Table 1.

Overall Transaxle Reduction 19.2:1 **Input Speeds** Maximum: 3000 RPM Minimum: 1800 RPM **Tire Diameter** 18 in; 45.7cm with 325 lbs; 147.4 kg maximum weight on tires	**Axle Shaft Options** Type: Keyed / Double “D” Diameter: 0.984 inch; 25.0 mm Type: Flanged Diameter: Hub **Brake Type** Disc, Parking Cog, Parking **Weight of Unit** 30 lb; 14 kg

Table 1. 310-2400 Technical Specifications

PRODUCT IDENTIFICATION

The model and configuration of the 310-2400 IZT can be determined from the label shown in Figure 3.

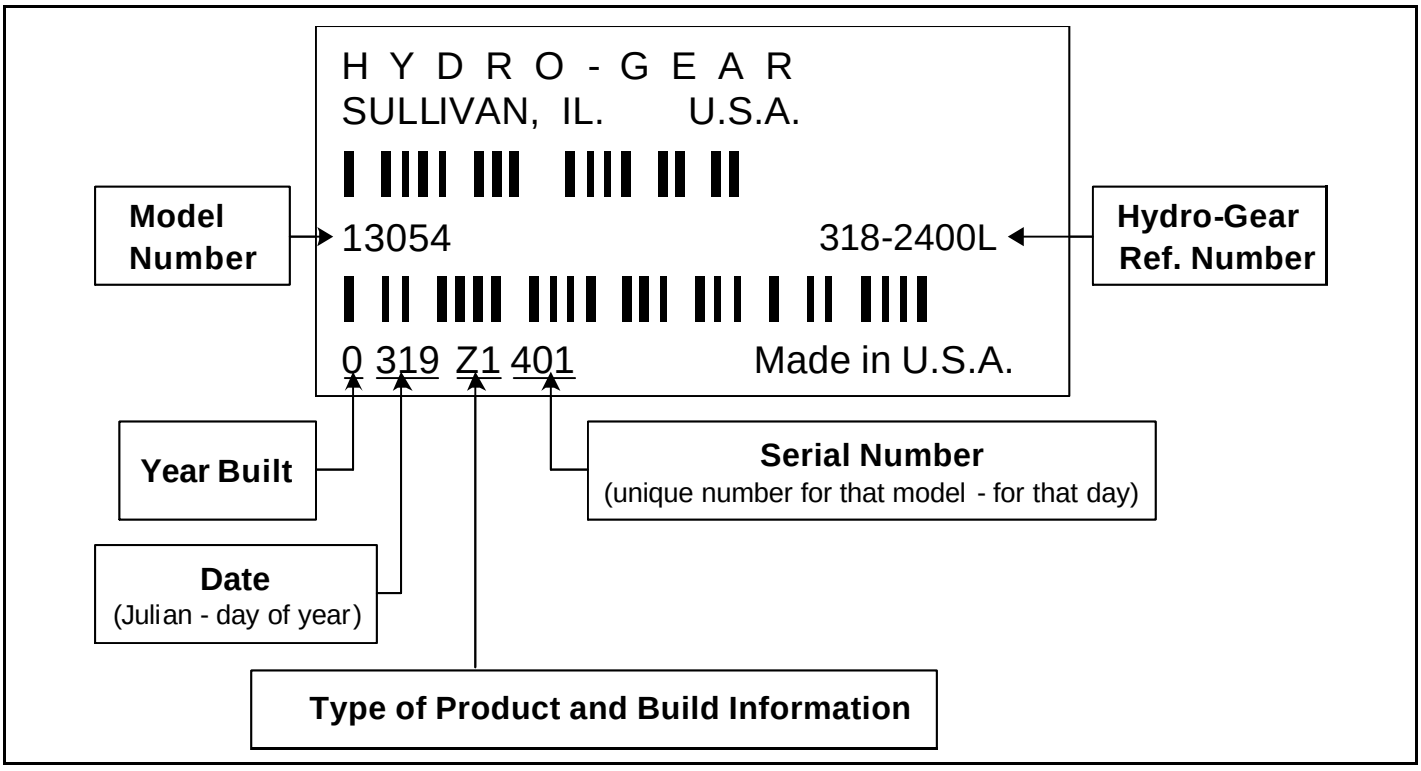


Figure 3. 310-2400 Configuration Label

SECTION 2. SAFETY

 This symbol points out important safety instructions which, if not followed, could endanger the personal safety and/or property of yourself and others. Read and follow all instructions in this manual before attempting maintenance on your 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 310-2400 IZT, fully read and understand the safety precautions described in this section.

PERSONAL SAFETY

Certain safety precautions must be observed while servicing or repairing the 310-2400 IZT. This section addresses some of these precautions but must not be considered an all-inclusive source on safety information. This section is to be used in conjunction with all other safety material which may apply, such as:

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

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

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

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

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

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

TOOL SAFETY

Use the proper tools and equipment for the task.

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

WORK AREA SAFETY

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

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

SERVICING SAFETY

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

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

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

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

Discard used cleaning material in the appropriate containers.

SECTION 3. TROUBLESHOOTING

WARNING

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

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

In many cases problems with the 310-2400 IZT 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 Section 4, Service and Maintenance before assuming the unit is malfunctioning. Table 2 below provides a troubleshooting check list to help determine the cause of operational problems.

Table 2. 310-2400 Troubleshooting Checklist

Possible Cause	Corrective Action
UNIT OPERATES IN ONE DIRECTION ONLY	
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
VEHICLE DOES NOT DRIVE/TRACK STRAIGHT	
Vehicle tires improperly inflated	Refer to vehicle manufacturer suggested pressure
Control linkage bent, loose or out of adjustment	Repair, adjust or replace vehicle linkage
Bypass partially engaged	Adjust bypass linkage
UNIT IS NOISY	
Oil level low or contaminated oil	Fill to proper level or change oil, Page 10
Excessive loading	Reduce vehicle loading, Page 9
Brake setting incorrect	Adjust brake to proper setting, Page 13
Loose parts	Repair or replace loose parts
Bypass assembly sticking	Repair or replace valve or linkage
Air trapped in hydraulic system	Purge hydraulic system, Page 11
UNIT HAS NO/LOW POWER	
Engine speed low	Adjust to correct setting
Control linkage bent or out of adjustment	Repair or replace linkage, Page 9
Brake setting incorrect	Adjust brake to proper setting, Page 13
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 valve or linkage
Air trapped in hydraulic system	Purge hydraulic system, Page 11
UNIT OPERATING HOT	
Debris buildup around transaxle	Clean off debris, Page 9
Brake setting incorrect	Adjust brake to proper setting, Page 13
Cooling fan damaged	Repair or replace cooling fan
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
TRANSAXLE LEAKS OIL	
Damaged seals, housing, or gaskets	Replace damaged component
Air trapped in hydraulic system	Purge hydraulic system, Page 11

SECTION 4. SERVICE AND MAINTENANCE

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

EXTERNAL MAINTENANCE

Regular external maintenance of the 310-2400 IZT 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 4 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 310-2400 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 55 SUS at 212°F (100° 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 Table 3.

Certain situations may require additional fluid to be added or even replaced. Refer to Figure 4 for the proper fill port location.

CAUTION

Do not overfill.

If you overfill the transaxle while the unit is "cold", it may overflow as it reaches normal operating temperatures. The oil level should not be above the manufacturer's suggestions outlined in this manual. This will allow the space needed for the oil to expand as it warms up.

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 CHANGE

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.

It is essential that the unit exterior be free of debris prior to fluid maintenance. The transaxle must be removed from the vehicle for oil drainage from the top.

Table 3. Fluid Volumes for the 310-2400 IZT

Fluid Description	Volume
20W-50 engine oil	79 fl. oz. (2336 ml.)

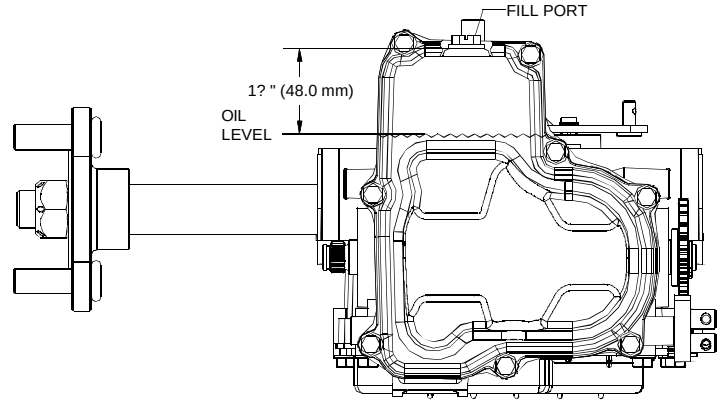


Figure 4. 310-2400 Fluid Level and Fill Port

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 normally 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 10, Figure 4.

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.

The return to neutral mechanism on the transmission is designed to set the directional control into a neutral position when the operator removes their hands from the 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 return arm. Refer to Figure 7.

3. Start the engine and increase the throttle to full engine speed.

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.

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 to the return arm according to the OEM manual. Recheck according to Step 3 and 4. Stop the vehicle engine. Refer to Figure 7.

6. Note the axle directional movement. Stop the vehicle engine. Loosen the lock down screw until the return arm can be rotated. Refer to Figure 7 below to make adjustment. In general, rotate the return arm in the direction opposite of axle rotation. If the axle is rotating in the "B" direction, rotate the return arm in the "A" direction, and vice-versa. Continue until axle rotation stops. Tighten the lock down screw. Refer to Table 3 Required Torque Values, Page 6. 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 7.

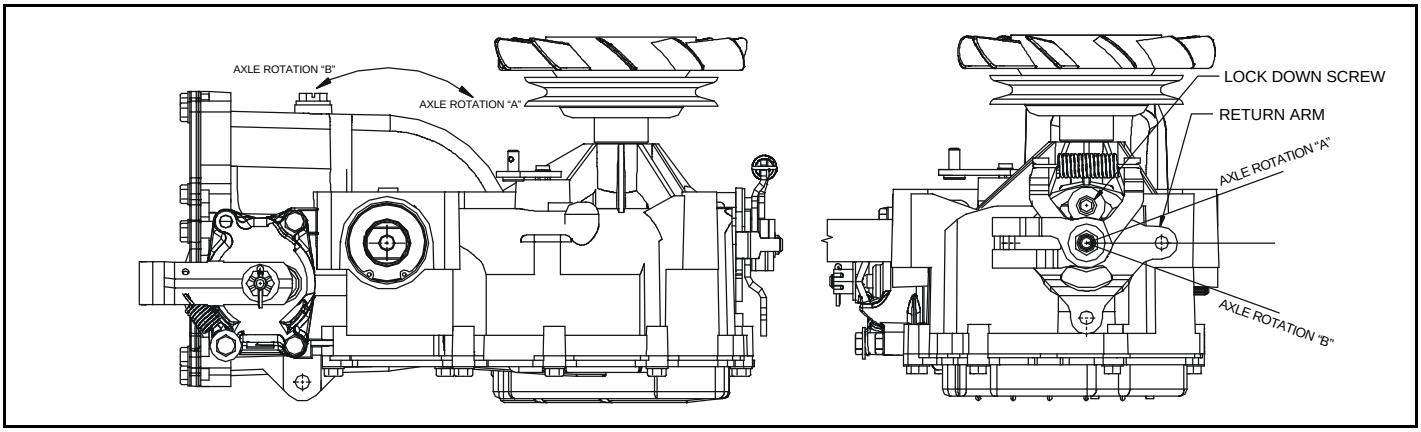


Figure 7. Return to Neutral Control

COG BRAKE MAINTENANCE

1. Check the brake arm teeth for damage or excessive wear. Replace if necessary.
2. Check for excessive looseness at brake arm pivot point.

DISC BRAKE MAINTENANCE

1. Remove the brake return spring, and then the cotter pin securing the brake castle nut.
2. Insert a 0.020" (0.5 mm) feeler gage between the brake rotor and outer brake friction stator, and then set the brake by 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.

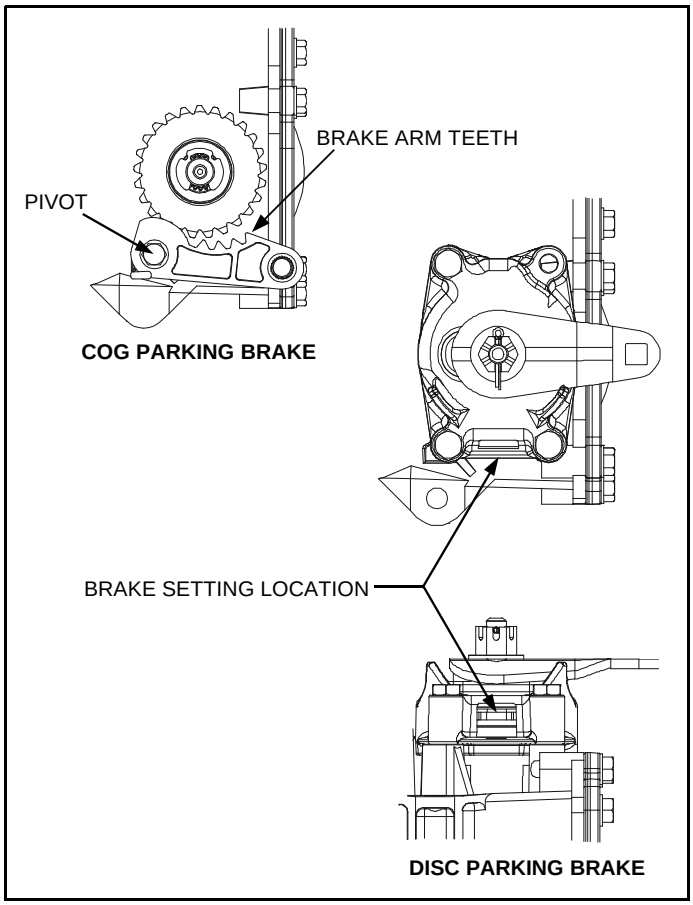


Figure 5. Brake Options

FRICTION 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 assembly of the nut to 100 in-lbs (11 Nm) torque. The friction pack nut is then backed off per vehicle manufacturer's specifications.

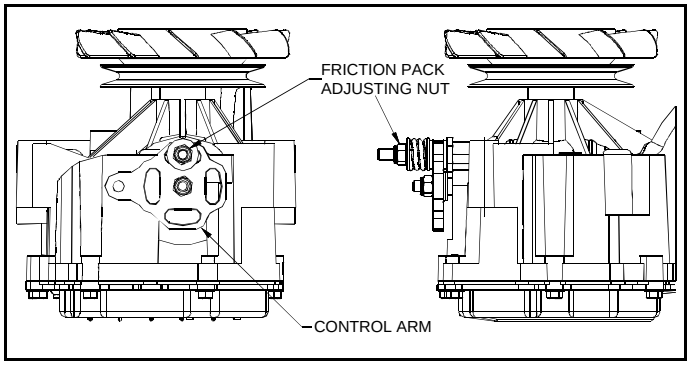


Figure 6. Friction Pack

SECTION 5. REPAIR

HOW TO USE THIS SECTION

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 pages 32 and 33 for part names and descriptions. A complete exploded view and item list of the transaxle is provided at the end of this section.

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.

Parts requiring replacement must be replaced from the appropriate kits identified in the Items Listing, found at the end of this manual. Use only original Hydro-Gear replacement parts found listed in BLN-50937 (microfiche) or BLN-51427 (CD).

TRANSAXLE REMOVAL

It is necessary to remove the 310-2400 from the vehicle before performing the repair procedures presented in this section. Use the following procedure to prepare the unit for removal from the vehicle.

1. With the vehicle wheels on the ground, loosen the ¾-16 hex nut (108, Figure 12) Page 21, if so equipped. Use an air impact wrench and a 1-1/8” socket to loosen the nut.
2. Lift the vehicle wheels off the ground and remove the nut completely.
3. Remove the wheel from the hub.
4. Using a wheel or gear puller, remove the hub from the shaft.

CAUTION

USE CARE IN REMOVING THE HUB TO PREVENT CRACKING.

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.

Table 4. Required Tools

Miscellaneous	**Sockets**
310-2400 Service & Repair Manual	3/8"
Flat Blade Screw Driver	1/2"
Torque Wrench	7/16"
Air Impact Wrench	9/16"
Rubber Mallet	E-8 Torx Head
Pliers	**Wrenches**
Needle Nose	1/2"
Large External Snap Ring	
Small External Snap Ring	
Large Internal Snap Ring	

Table 5. Required Torque Values

Operation	U.S. Torque	Metric Torque	Item	Description
Wheel Hub Nut	200-295 ft-lbs	271-400 Nm	108	Nut, Hex 3/4-16
Fan/Pulley Nut	360-520 in-lbs	41-59 Nm	49	Nut, Hex Lock 1/2-20
Back Cover Screws	110-150 in-lbs	12-17 Nm	50	Screw, 1/4-20
Friction Pack Stud	50-120 in-lbs	6-14 Nm	36	Stud, 5/16-24
Control Arm Nut	180-240 in-lbs	20-27 Nm	35	Nut, 5/16-24
Control Bolt	192-252 in-lbs	22-28 Nm	76/121	Nut/Bolt, 5/16-18
Brake Yolk Screw	80-120 in-lbs	9-14 Nm	123/211	Screw, 1/4-28
Cog Brake Arm Screw	110-150 in-lbs	12-17 Nm	123	Screw, Hex 1/4-20
Check Plug Assembly	200-360 in-lbs	23-41 Nm	45	Check Plug Assembly
Lower Housing Screw	110-150 in-lbs	12-17 Nm	50	Screw, 1/4-20
Center Section Screw	525-700 in-lbs	59-79 Nm	44	Screw, 3/8-24
Lock Down Screw	210-270 in-lbs	24-30 Nm	208	Screw, 5/16-24 (Lock-Down)

BACK COVER

Refer to Figure 8.

DISASSEMBLY

1. Remove the eight screws (50) from the back cover (13), and discard.
2. Remove the back cover (13). Take care not to damage the casting surfaces.
3. Clean off the sealant from the mating surfaces of the back cover (13) and the main housing assembly (1).

INSPECTION

1. Inspect the back cover (13) for excessive wear or damage.

ASSEMBLY

1. Apply sealant to the back cover (1). Refer to page 29.
2. Place the back cover (13) onto the main housing assembly (1).
3. Install the eight replacement screws (50) to secure the back cover (13) to the main housing assembly (1). Tighten the eight screws (50) to the torque value listed in Table 5.

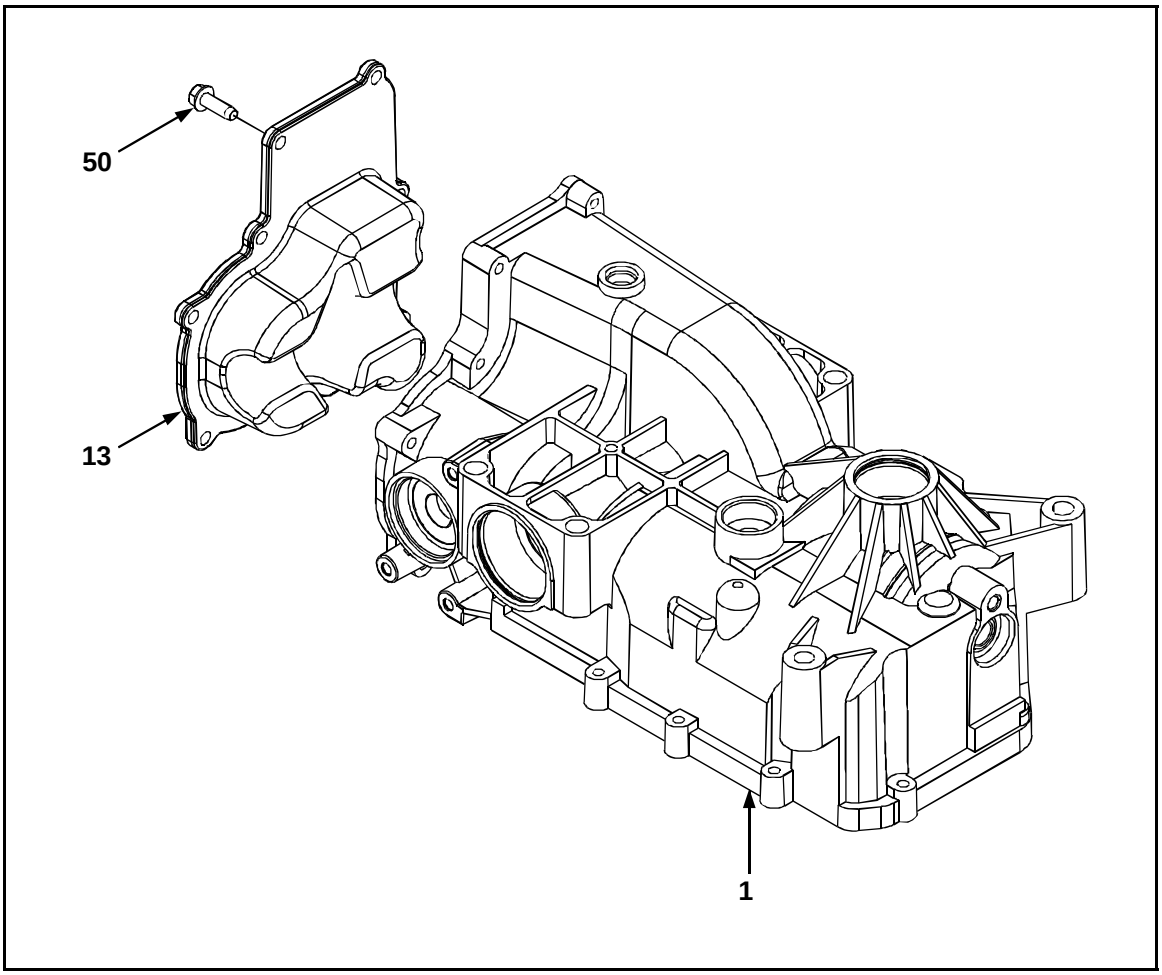


Figure 8. Back Cover Assembly

(Cog Brake)

Refer to Figure 9.

DISASSEMBLY

1. Remove the external retaining ring (63).
2. Remove the brake bolt (123), brake arm (70) and brake disc (73). *Note the orientation of the hub on the brake disc.*

INSPECTION

1. Inspect the brake disc (73) for damaged splines or gear teeth.
2. Inspect the brake arm (70) for damaged teeth.

ASSEMBLY

1. Insert the brake shaft (55) into the main housing (1). Slide the brake disc (73) onto the brake shaft (55). *Note the orientation of the brake disc. The hub on the brake disc should face inward on R.H. units and outward on L.H. units.*
2. Install the brake arm (70) and brake bolt (123) onto the main housing (1). Tighten the brake bolt (123) to the torque value listed in Table 5.
3. Install an external retaining ring (63) onto the brake shaft (55).

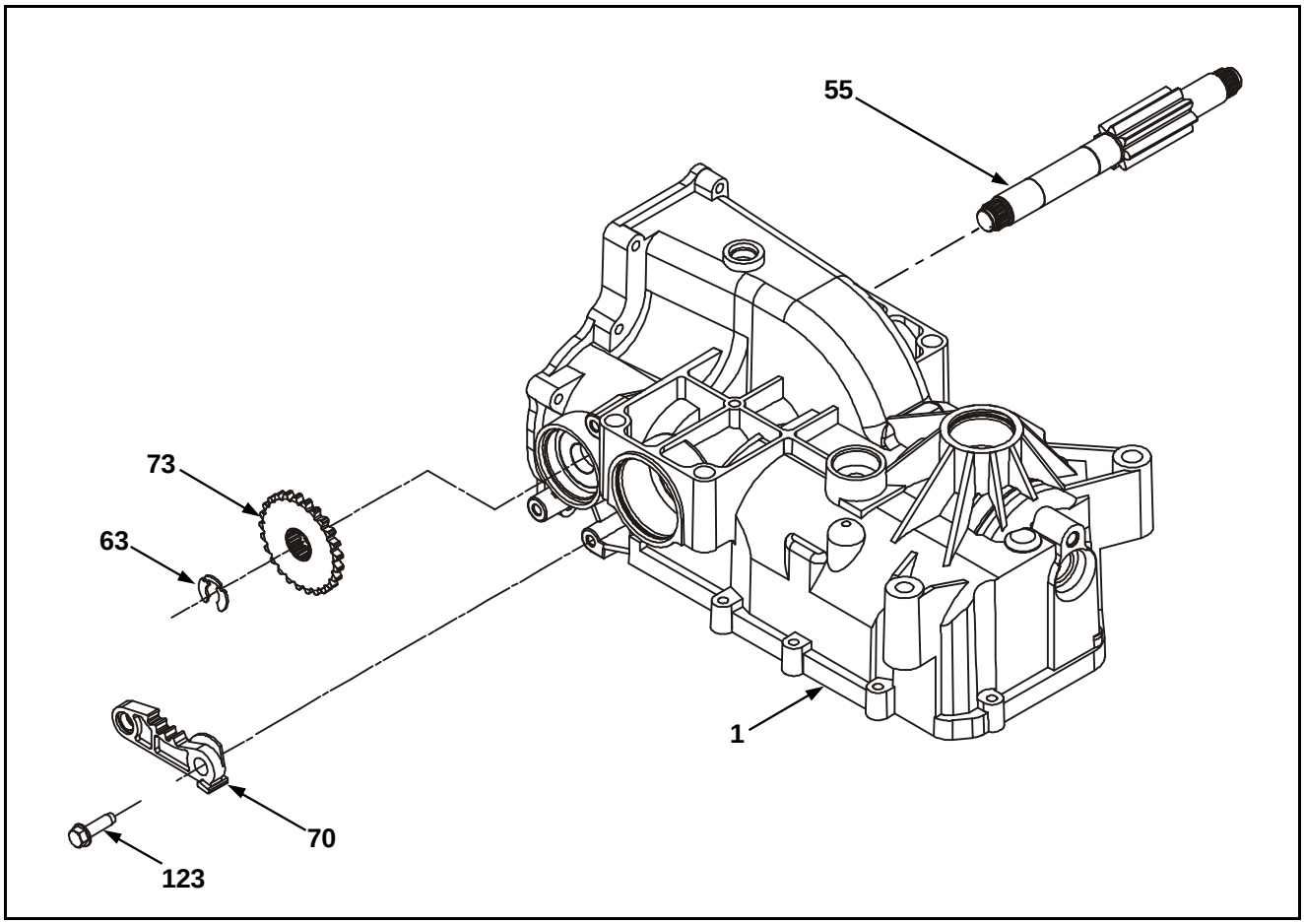


Figure 9. Cog Brake Assembly

BRAKES

(Disc Brake)

Refer to Figure 10.

DISASSEMBLY

1. Remove the cotter pin (128) and slotted hex nut (133). Discard the cotter pin.
2. Remove the washer (19), brake arm (70), compression spring (130) and brake actuating pins (129).
3. Remove the three brake yoke screws (123). Remove the brake yoke (131).
4. Remove the stators (127) and rotor (73).

INSPECTION

1. Inspect the brake components for excessive wear. Replace if necessary.

ASSEMBLY

1. Slide the stators (127) and rotor (73) onto the brake shaft (55, Figure 11). Pay close attention to the stack up of the stators and rotor.
2. Install the brake yoke (131) with the three brake yoke screws (123) onto the main housing (1). Refer to Table 5 for the required torque.
3. Install the brake actuating pins (129) and compression spring (130) onto the brake yoke (131).
4. Install the brake arm (70), washer (19) and slotted hex nut (133) onto the brake yoke (131). Do not tighten the slotted hex nut (133) at this time.
5. Insert a .020" (0.5 mm) feeler gage between the brake rotor (73) and outer stator (127). Adjust the brake by tightening or loosening the slotted hex nut (133).
6. Install a new cotter pin (128) to secure the slotted hex nut (133).

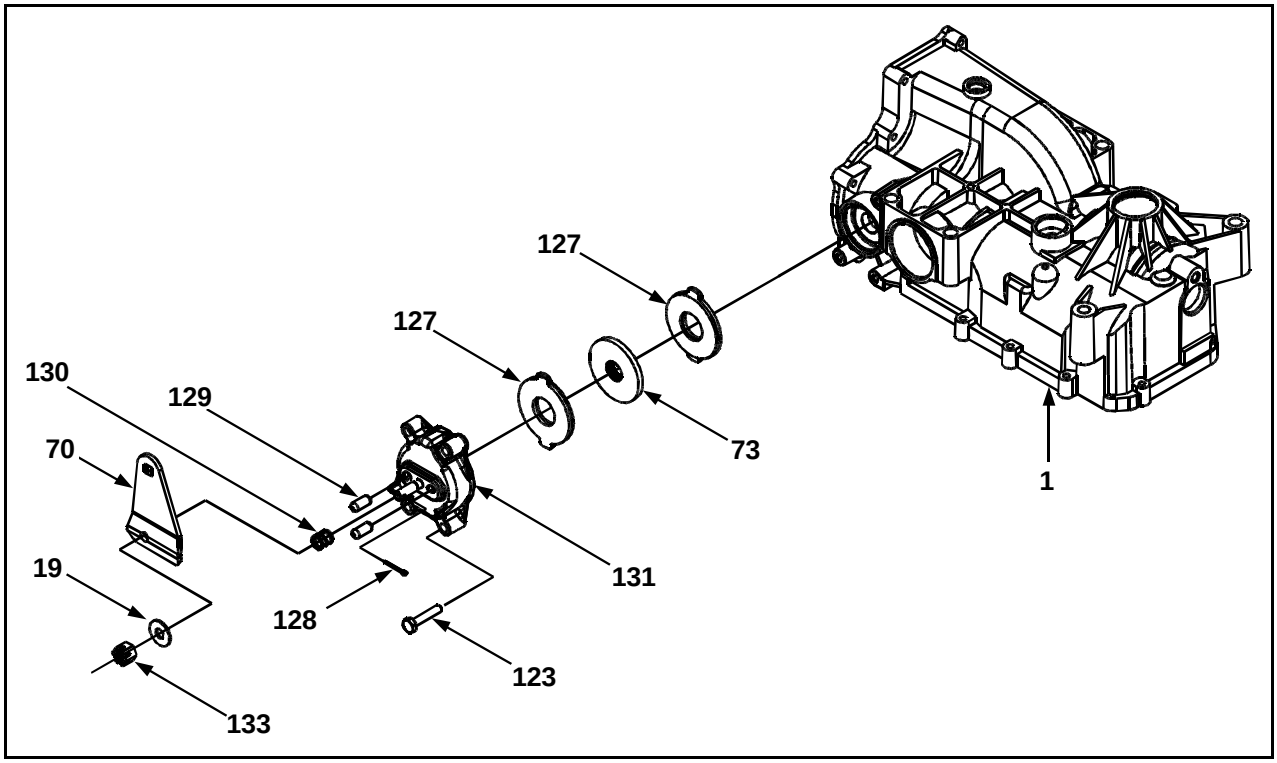


Figure 10. Disc Brake Assembly

BRAKE SHAFT & BEVEL GEAR

Refer to Figure 11.

DISASSEMBLY

1. Remove the back cover. See page 16.
2. Remove the brake. See pages 17-18.
3. Remove the brake shaft lip seals (58) and retaining rings (126). Discard the lip seals (58).
4. Remove the retaining ring (67) from the outside of the ball bearing (26).
5. Remove the brake shaft (55) and ball bearing (26) from the 19 tooth bevel gear (52). *It may be necessary to tap lightly on the brake shaft (55) to remove the bearing (26).*
6. Remove the 19 tooth bevel gear (52).

INSPECTION

1. Inspect the brake shaft (55), ball bearing (26) and bevel gear (52) for wear or damage.

ASSEMBLY

1. Insert the brake shaft (55) and ball bearing (26) into the main housing (1) allowing the brake shaft (55) to pass through the 19 tooth bevel gear (52).
2. Install the retaining ring (67).
3. Install the brake shaft lip seals (58) and retaining rings (126).
4. Install the brake. See pages 17-18.
5. Install the back cover. See page 16.

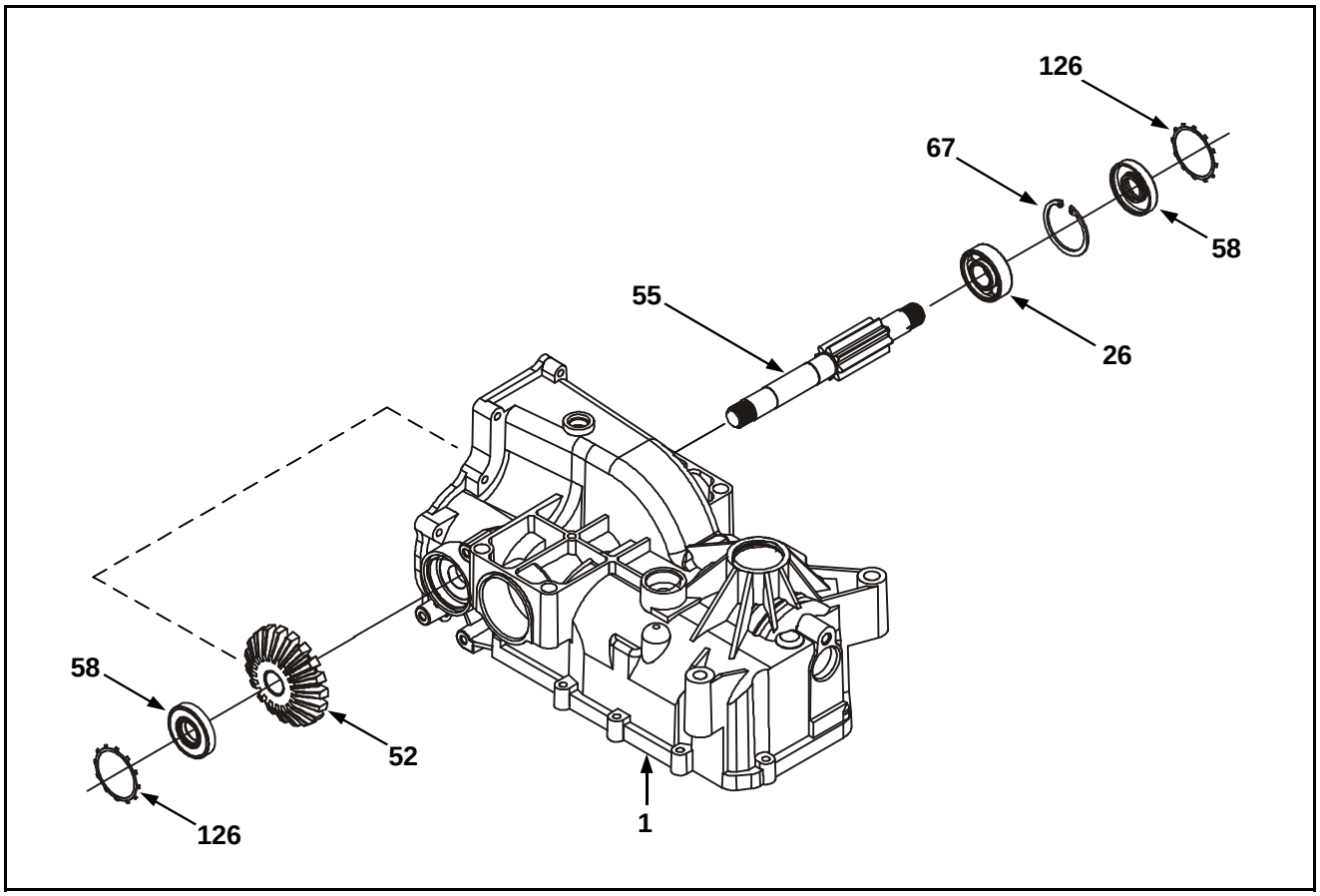


Figure 11. Brake Shaft & Bevel Gear Assembly

AXLE SHAFT & SPUR GEAR

Refer to Figure 12.

DISASSEMBLY

1. Remove the back cover. See page 16.
2. Remove the brake. See page 17-18.
3. Remove the brake shaft and bevel gears. See page 19.
4. Remove the hub assembly (107), if not already removed.

   Note: The orientation of the hub and axle to the main housing is critical in reassembly.

5. Remove the retaining ring (68) from the outside of the axle shaft seal (66).
6. Remove the axle shaft seal (66) and discard.
7. Remove the retaining ring (68) from the outside of the side seal plug (60).
8. Remove the side seal plug (60) by lightly tapping on the end of the axle shaft (56) with a plastic or rubber mallet. Discard the side seal plug (60).
9. Remove the axle shaft retaining ring (62) from the axle shaft (56).
10. Remove the axle shaft (56) from the main housing assembly (1). Remove the ball bearings (64 & 65) from the axle shaft (56). Note the orientation of the axle shaft bushings (81 & 82). This is important for reassembly. Remove the two axle shaft bushings (81 & 82) and spur gear (53) from the inside of the main housing (1).

INSPECTION

1. Inspect the ball bearings (64 & 65) and axle shaft (56) for wear or damage.
2. Inspect the spur gear (53) for wear or damage.

ASSEMBLY

1. Place the spur gear (53) and axle bushings (81&82), per noted orientation, into the main housing (1).
2. Insert the axle shaft bearing (64) and axle shaft (56) into the main housing (1). (A clean screwdriver may be used to help align the gear and bushings during installation).
3. Place the axle retaining ring (62) onto the end of the axle shaft (56).
4. Using a rubber or plastic mallet, lightly tap a new side seal plug (60) into the main housing (1). Install the seal plug retaining ring (68).
5. Slide the axle shaft bearing (65) onto the hub end of the axle shaft (56).
6. Slide the axle seal (66) onto the axle shaft (56). Remember to protect the seal (66) during installation by covering the axle shaft (56) with cellophane. Remove the cellophane once the seal (66) is installed.
7. Install the retaining ring (68).
8. Install the hub assembly (107) and nut (108) with the bolt threads facing away from the transaxle.
9. Install the brake shaft and bevel gear. See page 19.
10. Install the brake. See pages 17-18.
11. Install the back cover. See page 16.

AXLE SHAFT & SPUR GEAR

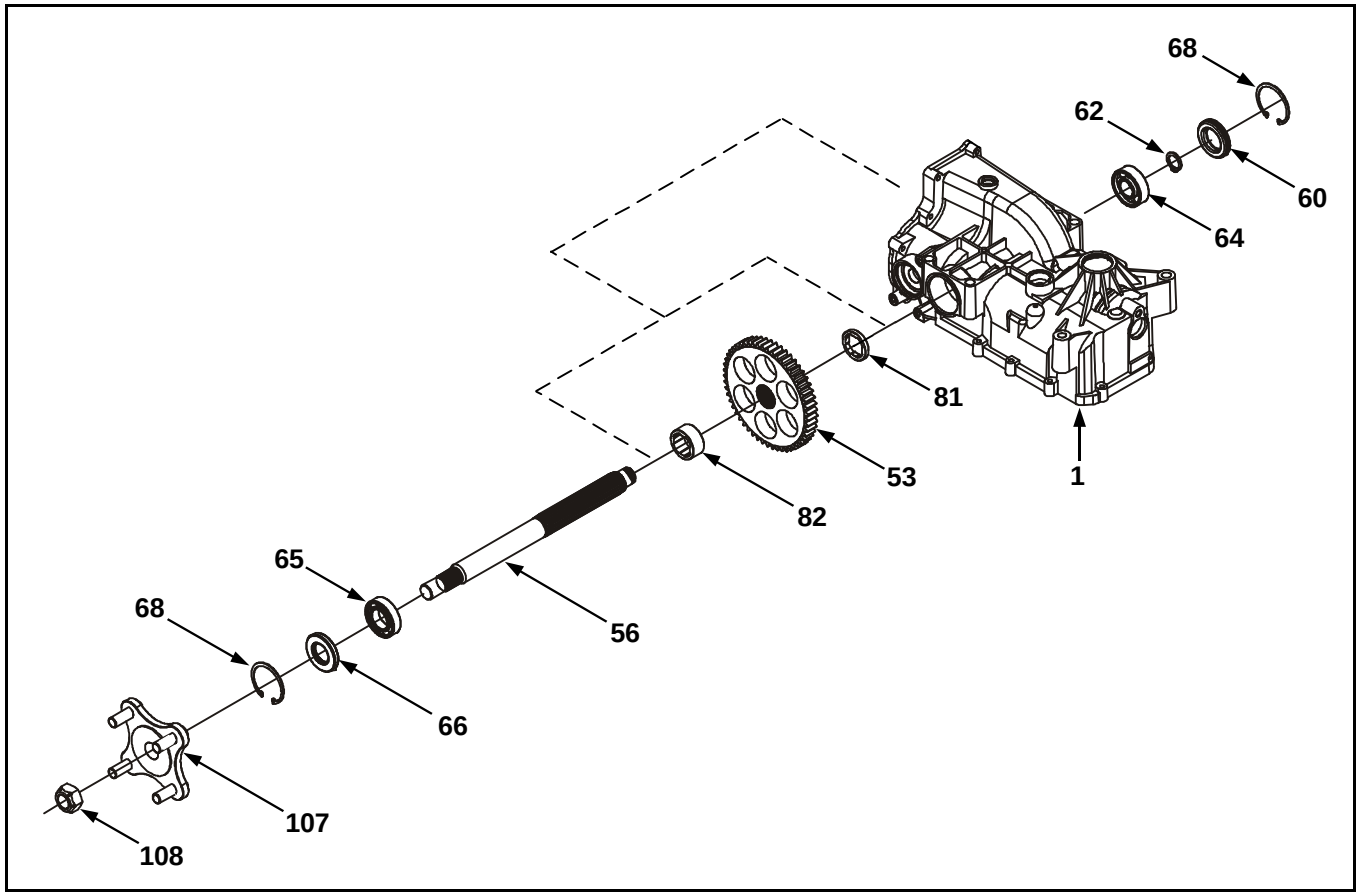


Figure 12. Axle Shaft & Spur Gear Assembly

LOWER HOUSING & FILTER

Refer to Figure 13.

DISASSEMBLY

1. Remove the ten screws (50) holding the lower housing (2) to the main housing (1), and discard.
2. Remove the lower housing (2) and old sealant. Take care not to damage the casting surfaces.
3. Remove and discard the internal filter (46).

INSPECTION

1. Inspect the lower housing (2) for excessive wear or damage.

ASSEMBLY

1. Install a new filter (46).
2. Apply sealant to the lower housing (2) where the lower housing (2) mates with the main housing (1). Refer to page 29.
3. Place the lower housing (2) on the main housing (1).
4. Install the ten replacement screws (50) that hold the lower housing (2) to the main housing (1).
5. Torque the ten screws (50) to the value listed in Table 5.

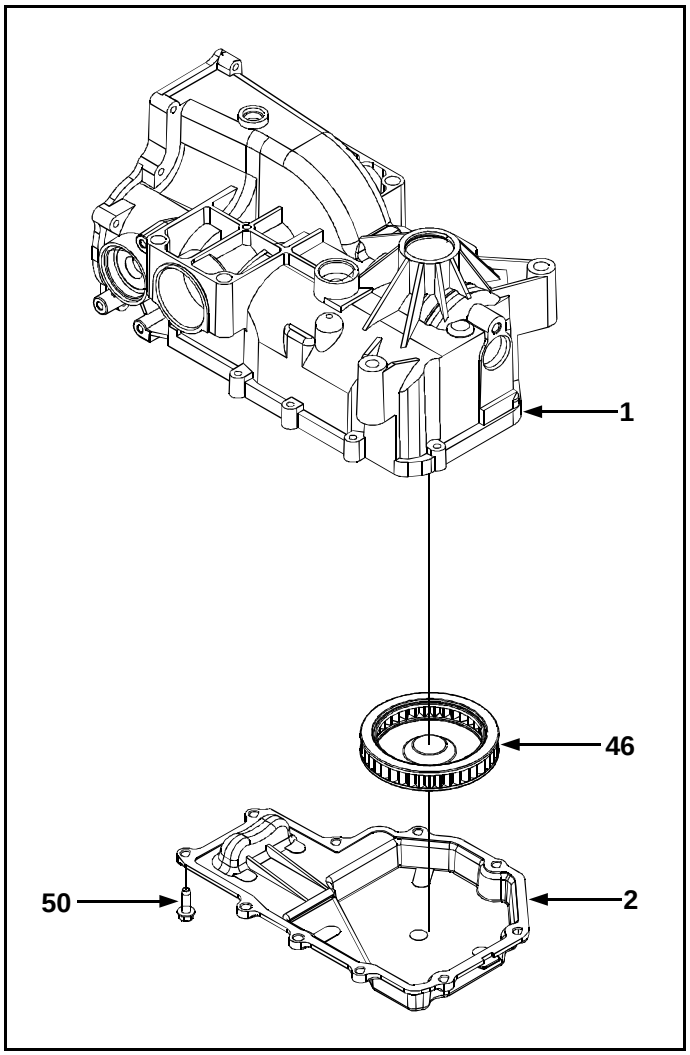


Figure 13. Lower Housing & Filter

MOTOR SHAFT & BEVEL GEAR

Refer to Figure 14.

DISASSEMBLY

1. Remove the back cover. See page 16.
2. Remove the brake. See pages 17 & 18.
3. Remove the brake shaft & bevel gear. See page 19.
4. Remove the axle shaft & spur gear. See pages 20 & 21.
5. Remove the 14 tooth bevel gear (51) from the motor shaft (54).
6. Remove the motor shaft (54), wire retaining ring (27) and bearing assembly (26) from the main housing (1). **Note: The bearing (26) does not fit flush with the housing. This is important for reassembly**.

INSPECTION

1. Inspect the gear (51), shaft (54) and bearing (26) for wear or damage.

ASSEMBLY

1. Install the motor shaft (54), bearing assembly (26) and wire retaining ring (27). **Note: The splines must be aligned when inserting the motor shaft (54)**.
2. Install the 14 tooth bevel gear (51) on the end of the motor shaft (54).
3. Install the axle shaft and spur gear. See pages 20 and 21.
4. Install the brake shaft and bevel gear. See page 19.
5. Install the brake. See pages 17 and 18.
6. Install the back cover. See page 16.

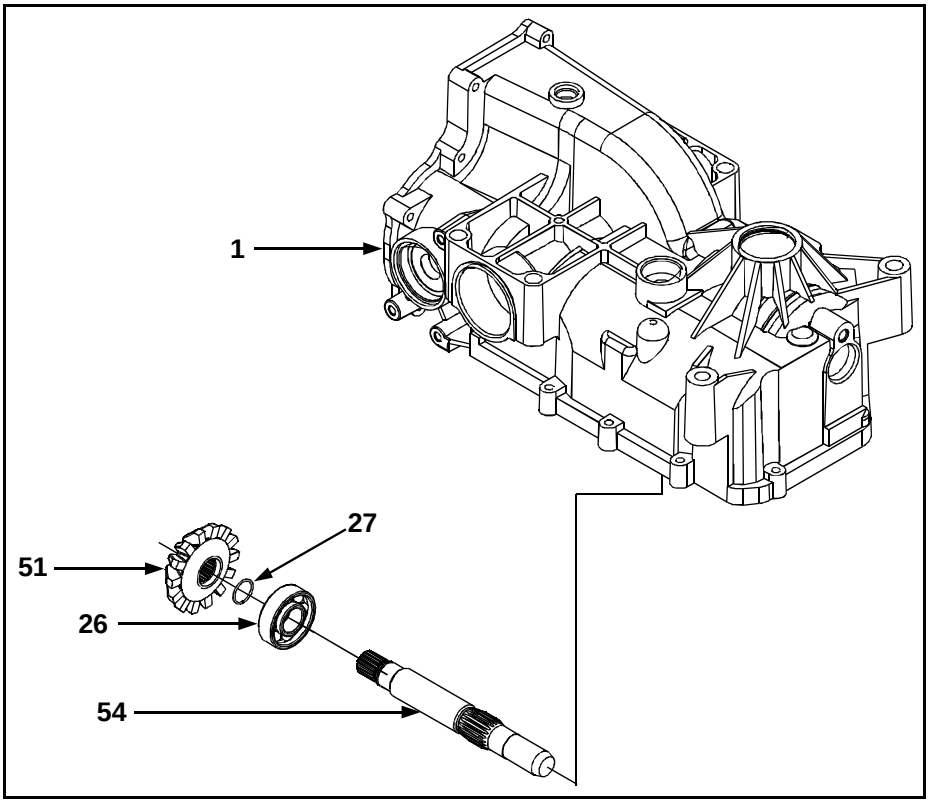


Figure 14. Motor Shaft & Bevel Gear Assembly

CENTER SECTION, CYLINDER BLOCKS AND BYPASS

Refer to Figure 15.

DISASSEMBLY

1. Remove the back cover. See page 16.
2. Remove the brake assembly. See pages 17 and 18.
3. Remove the brake shaft and bevel gear. See page 19.
4. Remove the axle shaft and spur gear. See pages 20 and 21.
5. Remove the lower housing and filter. See page 22.
6. Remove the motor shaft and bevel gear. See page 23.
7. Remove the three screws (44) holding the center section (3) to the upper housing (1). Lift to remove the center section (3) and motor cylinder block assembly (21). Remove the two pins (43).
8. Remove the motor cylinder block assembly (21).
9. Remove the motor block thrust bearing assembly (25). **Note: The thick race is located nearest to the pistons when assembled properly**.
10. Remove the pump block assembly (15).
11. Remove the pump block spring (14), washer (24) and swashplate assembly (10).
12. Remove the thrust bearing assembly (11). **Note: The thick race is located nearest to the pistons when assembled properly**.
13. Remove the slot guide (30, Fig. 16).
14. Remove the bypass arm retaining ring (42), bypass arm (41) and bypass lip seal (40). Discard the lip seal.

INSPECTION

1. Check the pistons in the motor and pump blocks for free movement.
2. Remove and inspect the pistons, springs and seats for wear or damage.
3. Inspect the piston bores in the cylinder blocks for wear or damage.
4. Check the running surface of the motor and pump cylinder blocks for damage. This surface must be smooth in the three sealing areas. Reassemble the motor and pump cylinder block assemblies and set aside.
5. Inspect the bushing in the center section and the by-pass plate (38).
6. Check the motor and pump cylinder block running surfaces on the center section (3). This surface should be smooth. Drag a fingernail across it to detect scratches or smearing.
7. Inspect the thrust bearing assemblies (11 and 25) for wear or damage.

ASSEMBLY

1. Install a new bypass lip seal (40). Install the bypass arm (41) and retaining ring (42) onto the bypass actuator (39).
2. Install the slot guide (30, Fig. 16).
3. Install the swashplate assembly (10) (including the thrust bearing assembly). **Note: Install the thrust bearing assembly (11) with the thick race towards the pistons**.
4. Actuate the trunnion arm (31) and swashplate (10) to verify free movement.
5. Install the pump block washer (24) and spring (14).
6. Install the pump block assembly (15).
7. Center the by-pass actuator (39) in the housing pocket.

8. Install the two pins (43).
9. Install the by-pass plate (38) into the center section (3). Install the center section (3) and motor cylinder block assembly (21).
10. Install the three screws (44) that hold the center section (3) in place.
11. Install the thrust bearing assembly (25). **Note: Install the thrust bearing assembly with the thick race towards the pistons**.
12. Install the motor shaft and bevel gear. See page 23.
13. Install the filter and lower housing. See page 22.
14. Install the axle shaft and spur gear. See pages 20 and 21.
15. Install the brake shaft and bevel gear. See page 19.
16. Install the brake. See pages 17 and 18.
17. Install the back cover. See page 16.

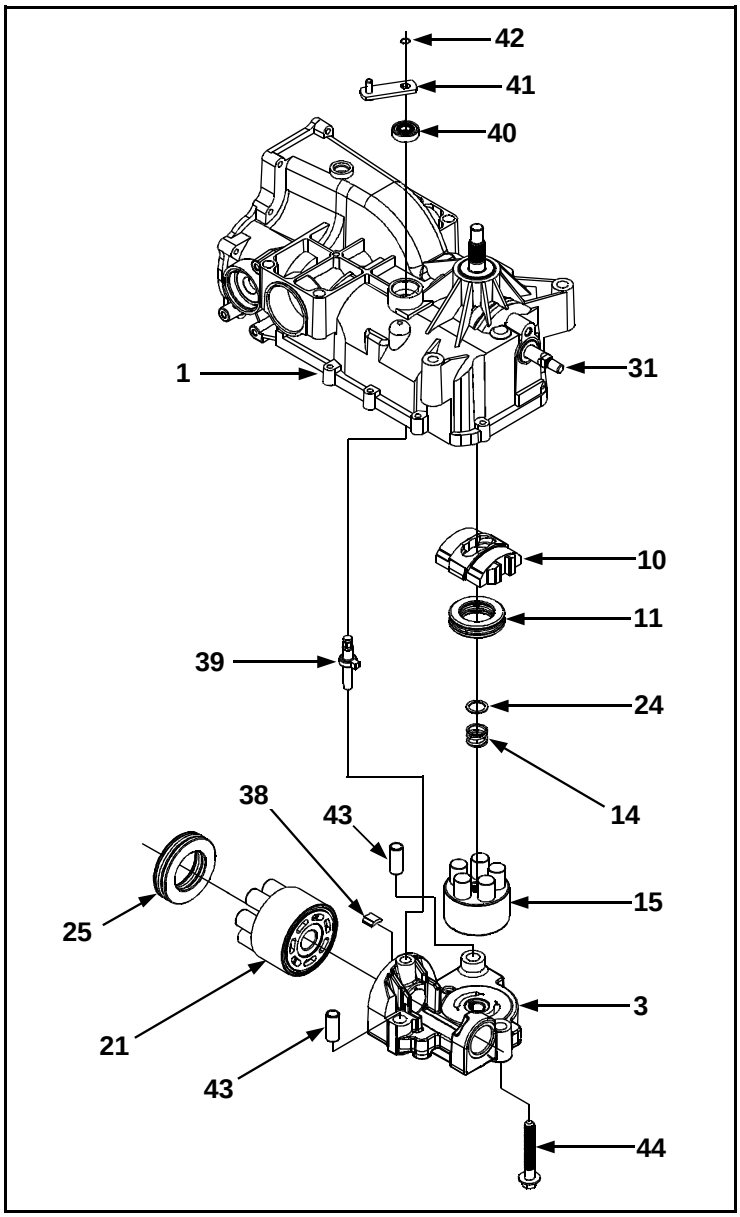


Figure 15. Center Section, Cylinder Blocks and Bypass

INPUT SHAFT & TRUNNION ARM

Refer to Figure 16.

DISASSEMBLY

1. Remove the back cover. See page 16.
2. Remove the brakes. See pages 17 and 18.
3. Remove the brake shaft and bevel gear. See page 19.
4. Remove the axle shaft and spur gear. See pages 20 and 21.
5. Remove the lower housing and filter. See page 22.
6. Remove the motor shaft and bevel gear. See page 23.
7. Remove the center section and cylinder block assemblies. See pages 24 and 25.
8. Remove the input shaft retaining ring (7).
9. Remove and discard the lip seal (4).
10. Remove the spacer (5).
11. Remove the input shaft (12) and bearing (8).
12. Remove the slot guide (30).
13. Rotate the trunnion arm (31) to check for free movement.
14. Remove the trunnion shaft seal (33) if necessary and remove the trunnion arm (31).

INSPECTION

1. Inspect the input shaft (12) and bearing (8) for wear or damage.
2. Inspect the slot guide (30).
3. Inspect the trunnion arm (31) for wear or damage.
4. Inspect the non-removable cradle bearings (9) in the main housing (1) for excessive wear.

ASSEMBLY

1. Install the trunnion arm (31) if removed and install a new trunnion seal (33).
2. Install the slot guide (30).
3. Install the input shaft (12), bearing assembly (8) and wire retaining ring (6), if removed.
4. Install the spacer (5).
5. Install a new input shaft lip seal (4). Remember to protect the seal during installation by covering the shaft with cellophane.
6. Install the input shaft retaining ring (7).
7. Install the center section and cylinder block assemblies. See pages 24 and 25.
8. Install the motor shaft and bevel gear. See page 23.
9. Install the lower housing and filter. See page 22.
10. Install the axle shaft and spur gear. See pages 20 and 21.
11. Install the brake shaft and bevel gear. See page 19.
12. Install the brakes. See pages 17 and 18.
13. Install the back cover. See page 16.

INPUT SHAFT & TRUNNION ARM

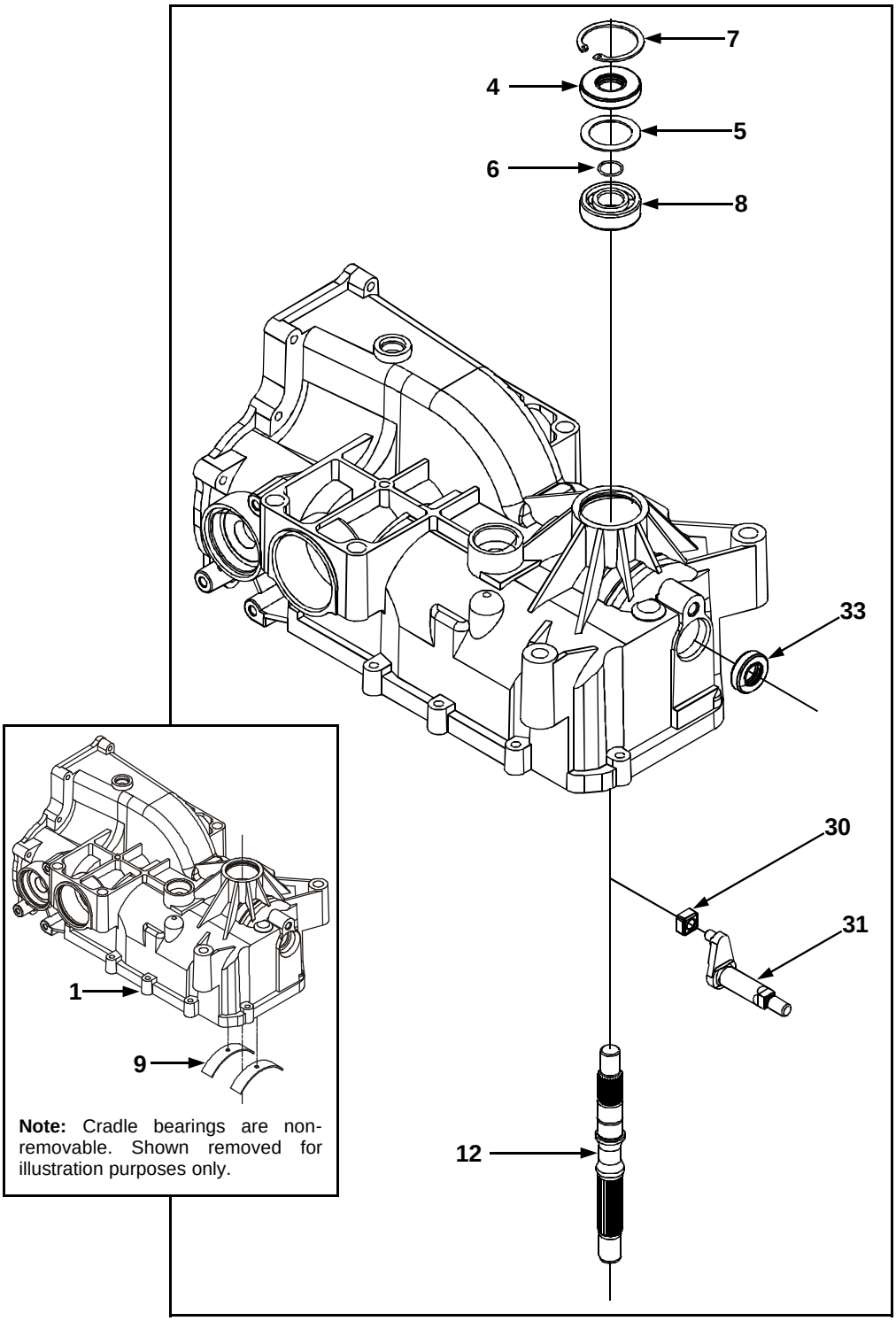


Figure 16. Input Shaft and Trunnion Arm Assembly

TRANSAXLE INSTALLATION

Use the following procedure to complete the installation of the transaxle on the vehicle.

1. Install and secure the transaxle on the vehicle according to the instructions in the vehicle owner's manual.
2. Install the hub assembly (107, page 21) if not already done. Install the ¾-16 hex nut (108, page 21).
3. With the vehicle raised, install the wheel on the hub, and snug the wheel lug nuts.
4. Lower the vehicle wheels to the ground and torque the ¾-16 hex nut to 200-295 ft.-lbs. (271-400 Nm).
5. Tighten the wheel lug nuts per the vehicle owner's manual.

ASSEMBLY AFTER A COMPLETE TEARDOWN

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

The part reference numbers provided in each assembly procedure are keyed to the individual exploded views, and are also keyed to the complete unit exploded view on page 30.

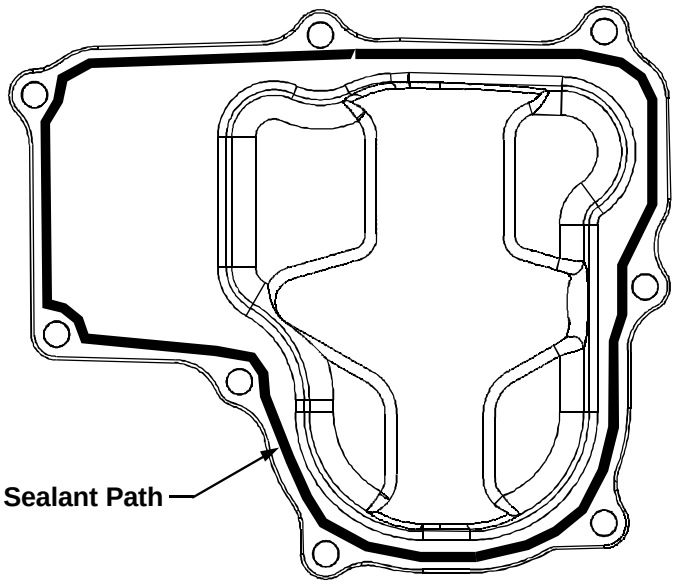
1. Install the input shaft and trunnion arm. See page 26.
2. Install the center section, motor and pump cylinder blocks. See page 24.
3. Install the motor shaft and bevel gear. See page 23.
4. Install the filter and lower housing. See page 22.
5. Install the axle shaft and spur gear. See page 20-21.
6. Install the brake shaft and bevel gear. See page 19.
7. Install the brake. See pages 17 and 18.
8. Install the back cover. See page 16.
9. Fill the transaxle with 79 fluid ounces (2336 ml.) of new 20w50 motor oil. This should put the oil level approximately 1? " (48 mm) from the top of the housing. This should be checked at the fill port.
10. Install the transaxle onto the vehicle.
11. Perform the purge procedures listed on page 11.
12. Perform the return to neutral procedure on page 12.

SEALANT APPLICATION

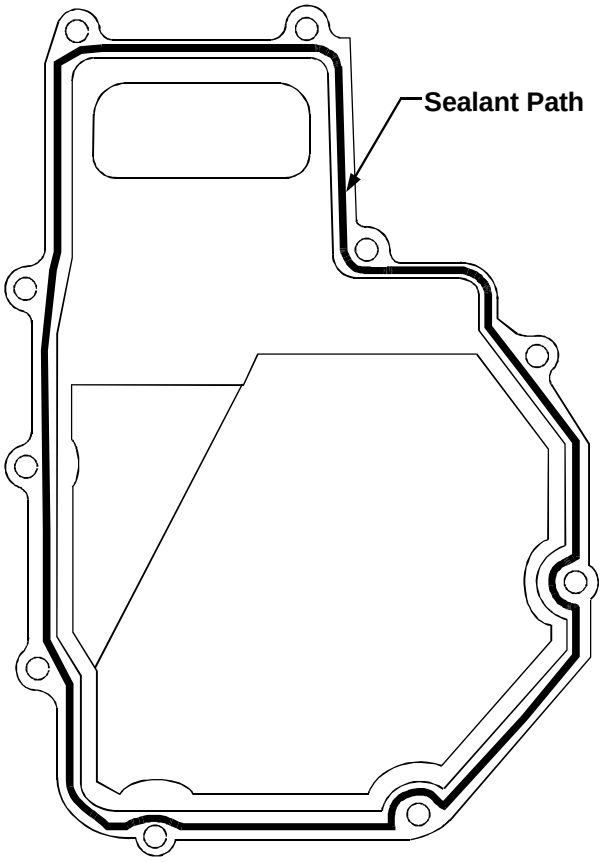
NOTE: Prior to applying the new sealant, the old sealant must be removed from all surfaces.

A small bead of the sealant around the outer part of the housing face will be sufficient. Use sparingly.

The illustrations below indicate the correct areas.

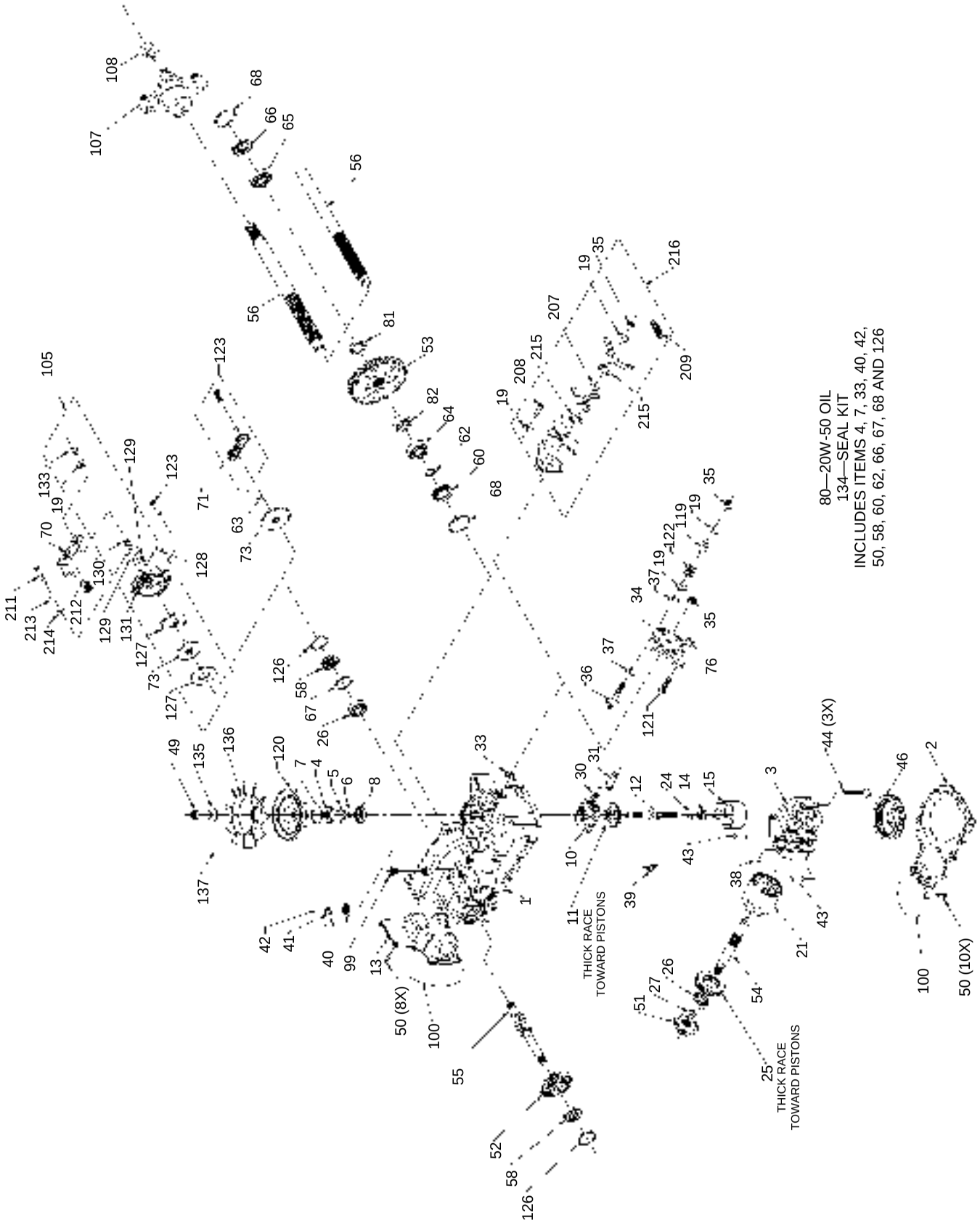


Back Cover Sealant Path



Lower Housing Sealant Path

310-2400 EXPLODED VIEW



ITEMS LIST

No.	DESCRIPTION
1	Kit, Housing-Main
	Housing, Main
	Cradle Bearing
	Lip Seal
	Trunnion Bushing
2	Lower Housing
3	Center Section Assembly Kit
	Bypass Plate
	Check Plug Assembly
	Center Section
	Bushing
	Screw
4	Lip Seal
5	Spacer
6	Wire Retaining Ring
7	Retaining Ring
8	Ball Bearing
9	Cradle Bearing
10	Variable Swashplate
11	Thrust Bearing 30 X 52 X 13
12	Input Shaft
13	Cover-Back
14	Spring, Block
15	10cc Cylinder Block Assy
	10cc Cylinder Block
	10cc Piston Spring
	Piston Seat Washer
	10cc Piston
19	Washer
21	21cc Cylinder Block Assy
	21cc Cylinder Block
	21cc Piston Spring
	Piston Seat Washer
	21cc Piston
24	Washer, Block Thrust
25	Thrust Bearing 42 X 68 X 16
26	Ball Bearing
27	Wire Retaining Ring
30	Slot Guide
31	Trunnion Arm
33	Lip Seal
34	RTN Control Arm
	Standard Control Arm
35	RTN Hex Lock Nut, 5/16-24 UNJF (Nylon Insert)
	Standard Control Arm Nut
36	Stud-Long 5/16-24
37	Friction Puck
38	Bypass Plate
39	Bypass Actuator
40	Lip Seal
41	Bypass Arm
42	Retaining Ring
43	Pin
44	Screw
46	Filter
49	Hex Lock Nut 1/2-20 (Nylon Insert)
50	Screw, 1/4-20 X .75 Long
51	14T Bevel Gear
52	19T Bevel Gear
53	53T Spur Gear
54	Motor Shaft
55	Brake Shaft
56	Shaft, Axle 25mm X 14 (D,D)
	Axle Shaft
58	Seal, Lip 17 X 40 X 7
60	Seal Plug - Side
62	Retaining Ring - Axle
63	Retaining Ring Kit
64	Bearing-Ball 20 X 47 X 14 (6204)
65	Bearing-Ball 20 X 47 X 12 (6205)
66	Seal
67	Retaining Ring
68	Retaining Ring-Axle
70	Arm, Brake
71	RH, Brake Arm Service Assy
	Brake Arm
	Clevis Pin
	Bushing 0.255 X 0.381 X 0.330
	Hex Washer Head Screw, 1/4-20 X 7/8
73	Disc Brake Yoke Brake Rotor
	Cog Brake Arm Brake Disc
76	Hex Nut 5/16-18
80	20W-50 Oil
81	Axle Bushing
82	Axle Bushing
99	Plastic Plug
100	Sealant
105	Kit, Brake
	Washer
	Rotor, Brake
	Stator, Brake Friction
	Cotter Pin 3/32 X 3/4
	Brake Actuating Pin
	Compression Spring Anti Drag
	Kit, Yoke-Brake
107	Hub Assembly
	Hub
	Lug Bolt
108	Nut, Hex 3/4-18
110	Fitting O-Ring Assembly
	Pastic Hose Fitting
	O-Ring
111	Cap Vent Assembly
	Cap-Poppet Valve
	Plastic Vent
119	Spacer
120	Pulley, 4.5
121	Bolt 5/16-18 X 1-1/4
122	Helical Comp. Spring
123	Disc Brake Yoke Screw, 1/4-28 X 1.38 W/Patch
	Cog Brake Arm Hex Washer Head Screw, 1/4-20 X 7/8
126	Ring Retaining
127	Stator, Brake Friction
128	Cotter Pin 3/32 X 3/4
129	Brake Actuating Pin
130	Compression Spring Brake Anti Drag
131	Kit, Yoke-Brake
	Sq Hd Bolt 5/16-24 Ribbed
	Yoke, Brake
133	Slotted Hex Nut 5/16-24
134	Kit, Seal
	Seal, Lip 15 X35 X 7
	Ring, Retaining
	Seal, Lip 12 X 25 X 7
	Seal, Lip 10 X 25 X 7
	Ring, Retaining
	Seal, Lip 17 X 40 X 7
	Seal, Lip 1.85 X 32
	Ring, Retaining
	Ring, Retaining .440 External
	Seal, Lip .98 X 1.85 X .276
	Ring, Retaining
	Ring, Retaining
	Ring, Retaining
	Seal, Lip 17 X 40 X 5
	Screw, 1/4-20 X .75 Long
135	Washer, .531 X 1.250 X .092 (Bellevile)
136	Fan, 6”, 10 Blade
137	Kit, Fan-Pulley
	Washer, .531 X 1.250 X .092 (Belleville)
	Fan, 6”, 10 Blade
	Hex Lock Nut 1/2-20 (Nylon Insert)
	Pulley, 4.5
207	Spacer, RTN
208	Screw, 5/16-24 X .75 (Patch)
209	Spring, Extension
211	Screw, Hex Head 1/4-28 X 1.75 W/Patch
212	Spring, Brake Arm Bias
213	Washer, Flat .28 X .73 X .063
214	Brake Assy. Spacer
215	Washer, Nylon
216	RTN, Kit
	Washer
	Hex Lock Nut, 5/16-24 UNJF (Nylon Insert)
	Spacer, RTN
	Screw, 5/16-24 X .75 (Patch)
	Spring, Extension
	Washer, Nylon
	Control Arm
	Arm, RTN Scissor, Outer
	Arm, RTN Scissor, Inner
	Arm, Return

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).

Bantam Duty: A descriptive term relating to the product capacity (meaning: light duty).

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

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

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

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

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

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

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

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

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

Decay Rate: The ratio of pressure decay over time.

End Cap: See “Center Section”

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

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

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

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

Hydrostatic Pump: See “Hydraulic Pump”

Hydrostatic Transaxle: A 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 transference of power.

Inlet Line: A supply line to the pump.

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

Manifold: A conductor which provides multiple connection ports.

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

Pressure Decay: A falling pressure.

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

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

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

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

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

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

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

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

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

Volumetric Displacement: The volume for one revolution.

Hydro-Gear®

Equipment & Engine Training Council