HYDRO-GEAR®

FORWARD MOTION THROUGH FORWARD THINKING

HEM™ Series Motor Service and Repair Manual

BLN-0083 Rev. P1

Revision July 2017

TABLE OF CONTENTS

FOREWORD

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

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

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

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

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

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

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

DESCRIPTION AND OPERATION

INTRODUCTION

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

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

GENERAL DESCRIPTION

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

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

EXTERNAL FEATURES

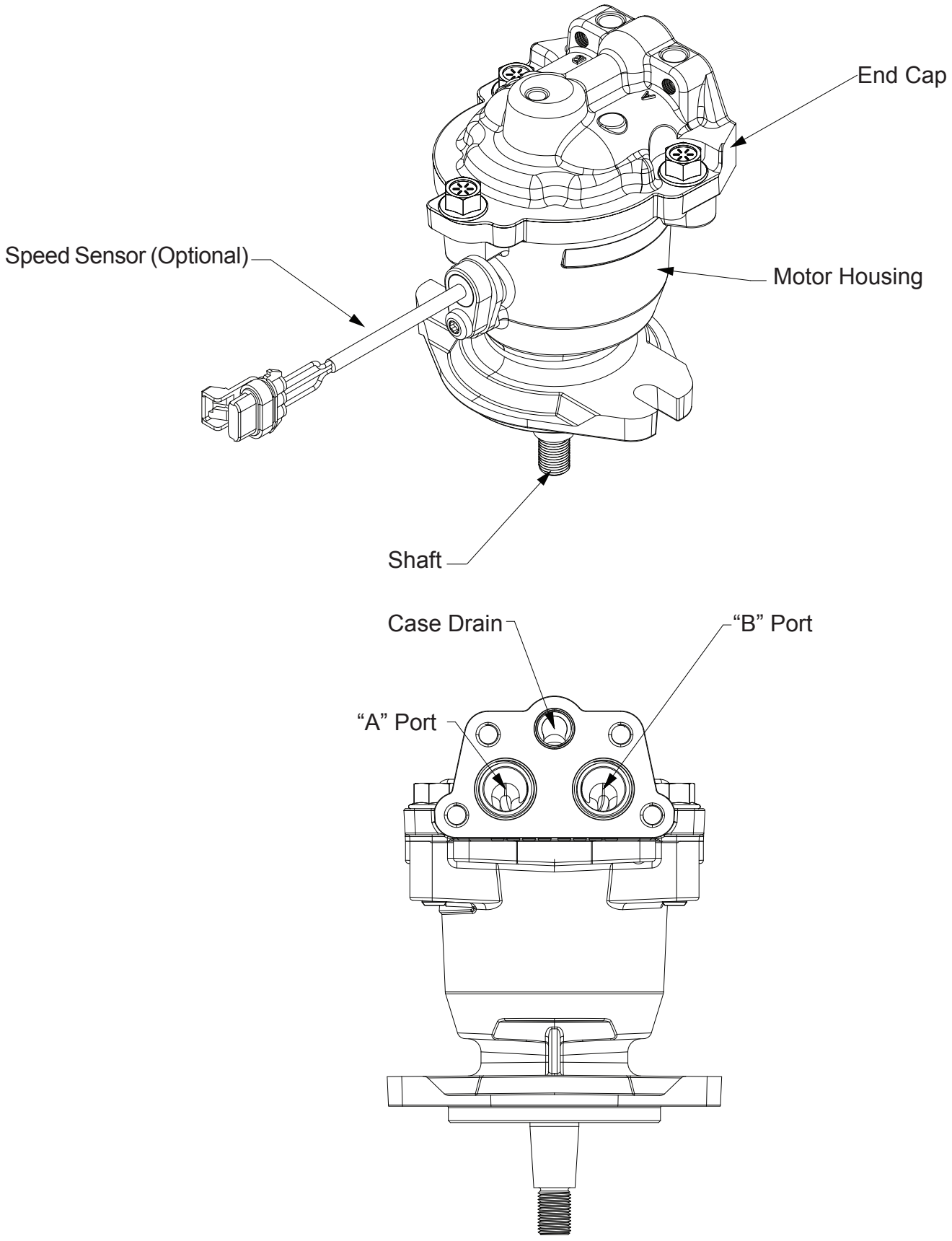


Figure 1, External Features

TECHNICAL SPECIFICATIONS

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

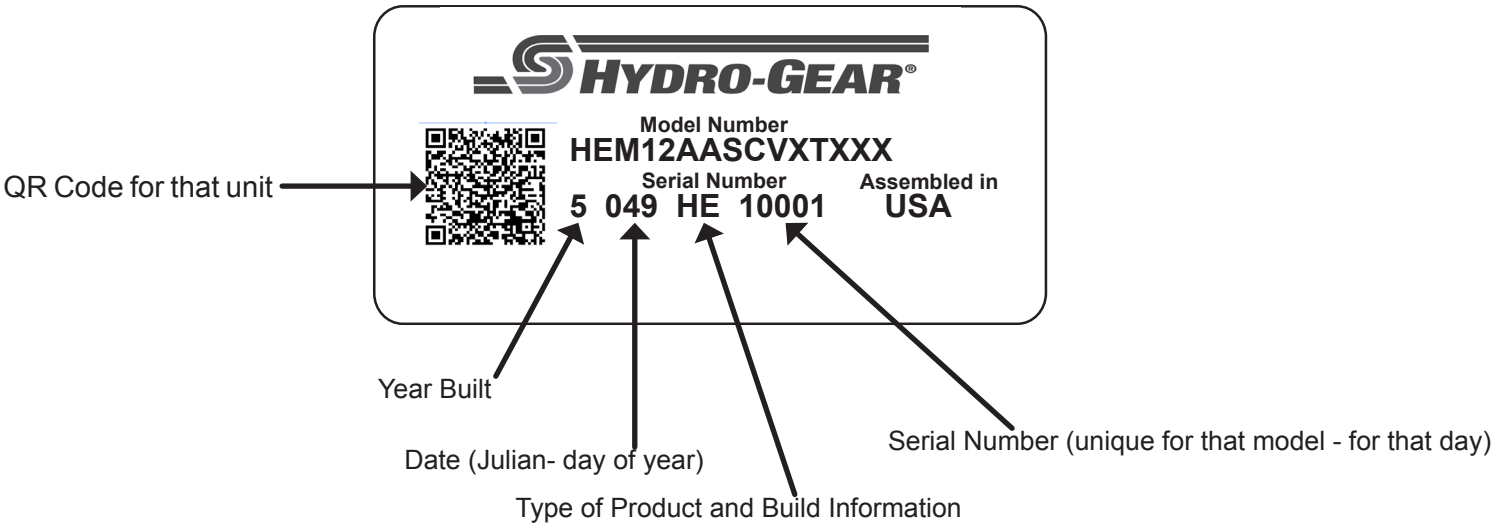


Figure 2, Product Label

SAFETY

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

WARNING

POTENTIAL FOR SERIOUS INJURY

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

PERSONAL SAFETY

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

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

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

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

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

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

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

TOOL SAFETY

Use the proper tools and equipment for the task.

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

WORK AREA SAFETY

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

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

SERVICING SAFETY

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

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

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

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

Discard used cleaning material in the appropriate containers.

TROUBLESHOOTING

WARNING

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

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

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

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

SERVICE AND MAINTENANCE

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

EXTERNAL MAINTENANCE

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

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

SERVICE AND MAINTENANCE PROCEDURES

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

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

FLUIDS

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

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

FLUID VOLUME AND LEVEL

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

FLUID CHANGE

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

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

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

SERVICE AND MAINTENANCE

PURGING PROCEDURES

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

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

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

The resulting symptoms in hydrostatic systems may be:

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

TEAR DOWN AND REASSEMBLY

HOW TO USE THIS MANUAL

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

GENERAL INSTRUCTIONS

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

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

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

Parts requiring replacement must be replaced from the appropriate kits identified in the Items Listing, found at the end of this manual. Use only original Hydro-Gear replacement parts found at www.hydro-gear.com or at your Hydro-Gear Central Service Distributor.

TOOLS

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

TORQUES

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

REMOVAL

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

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

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

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

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

SPEED SENSOR ASSEMBLY (OPTIONAL)

Refer to Figure 3

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

Inspection

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

Assembly

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

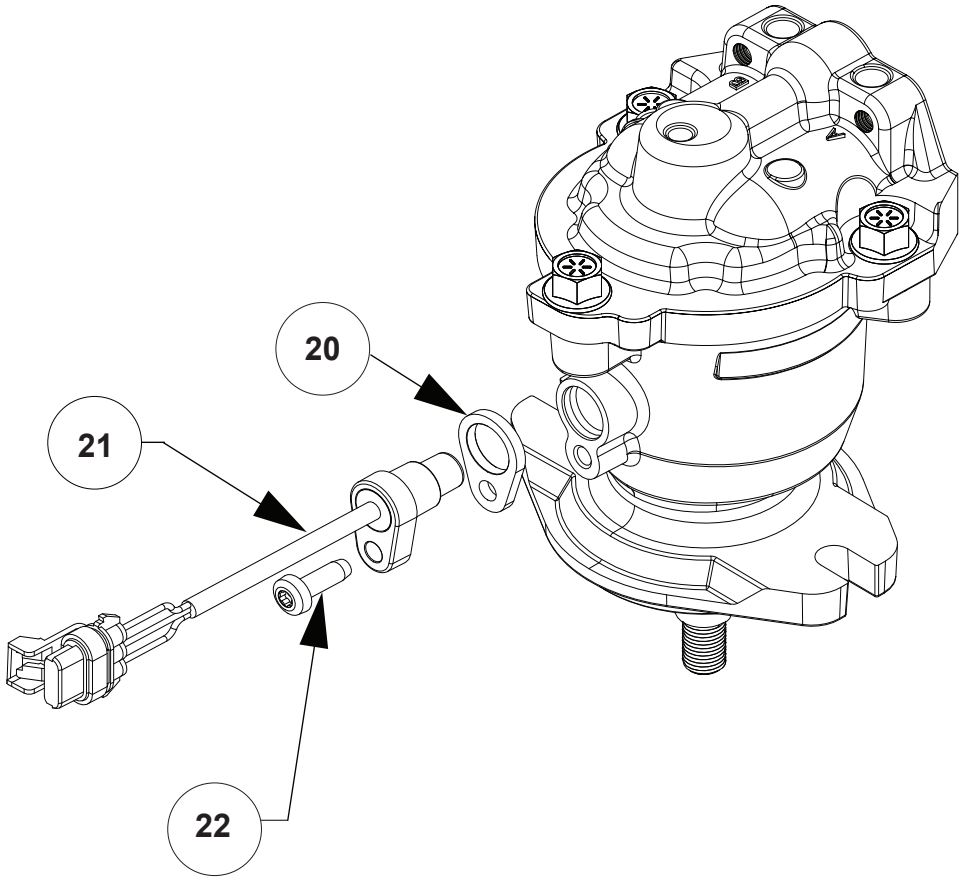


Figure 3, Speed Sensor Assembly

END CAP ASSEMBLY

Refer to Figure 4

Disassembly

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

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

Inspection

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

Assembly

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

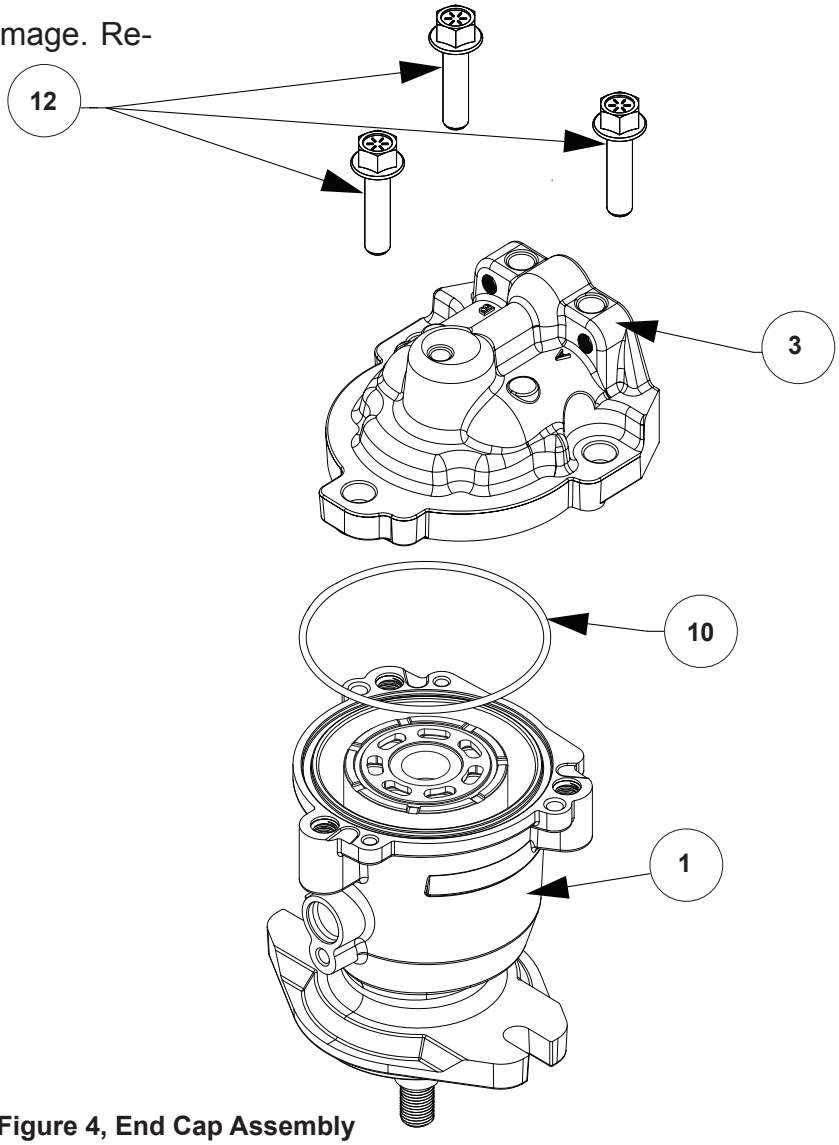


Figure 4, End Cap Assembly

CYLINDER BLOCK ASSEMBLY

Refer to Figure 5

Disassembly

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

Inspection

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

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

Assembly

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

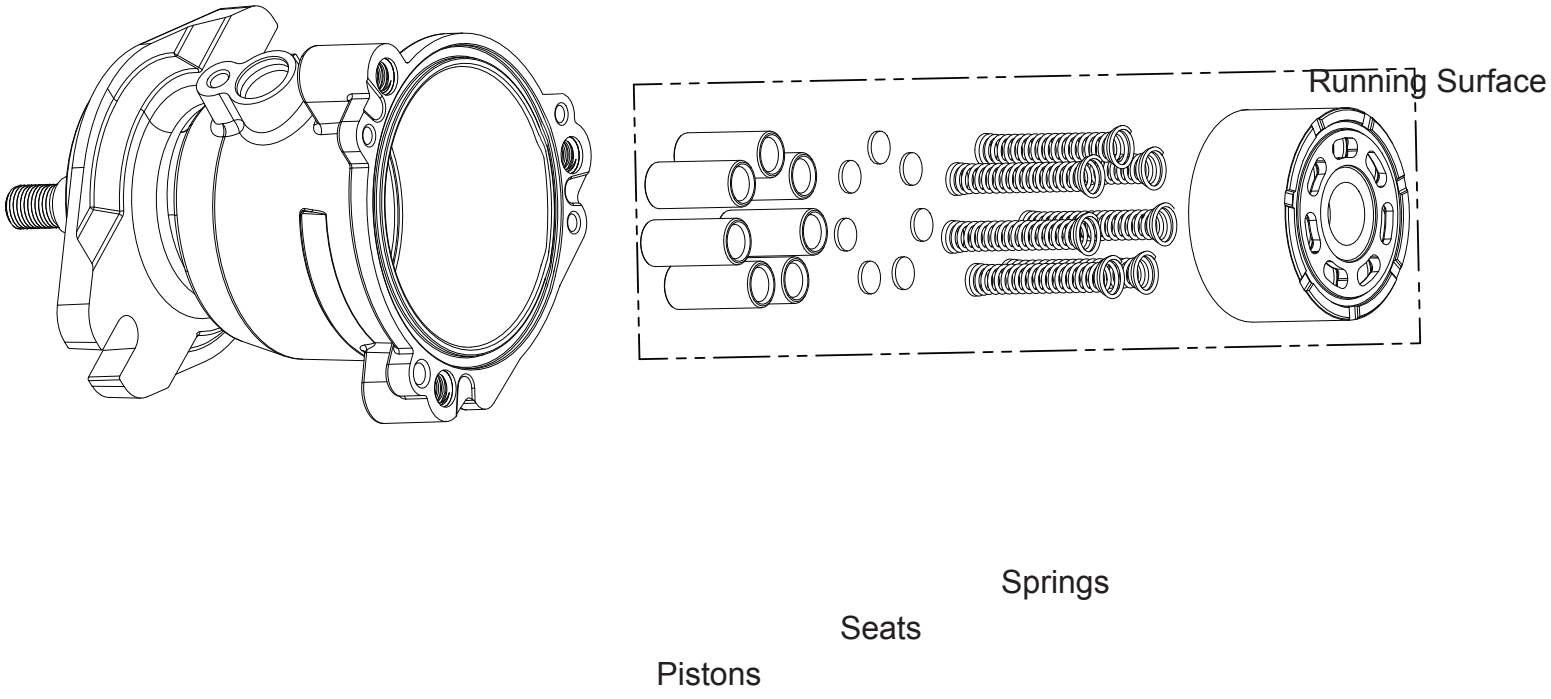


Figure 5, Cylinder Block Assembly

SWASH PLATE AND THRUST BEARING ASSEMBLY

Refer to Figure 6

Disassembly

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

Inspection

1. Inspect all components for wear or damage.

Assembly

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

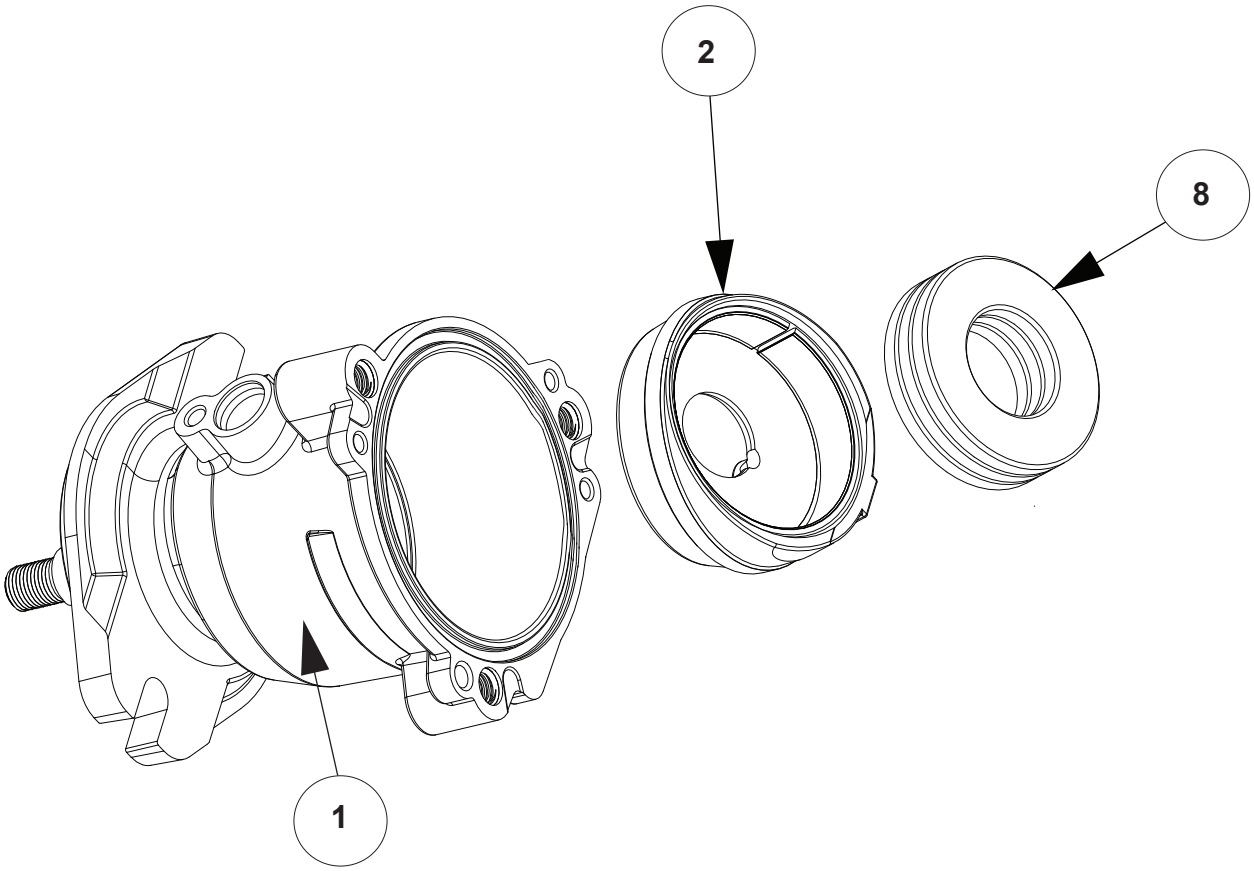


Figure 6, Swash Plate And Thrust Bearing Assembly

SHAFT ASSEMBLY

Refer to Figure 7

Disassembly

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

Inspection

1. Inspect all components for wear or damage.

Assembly

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

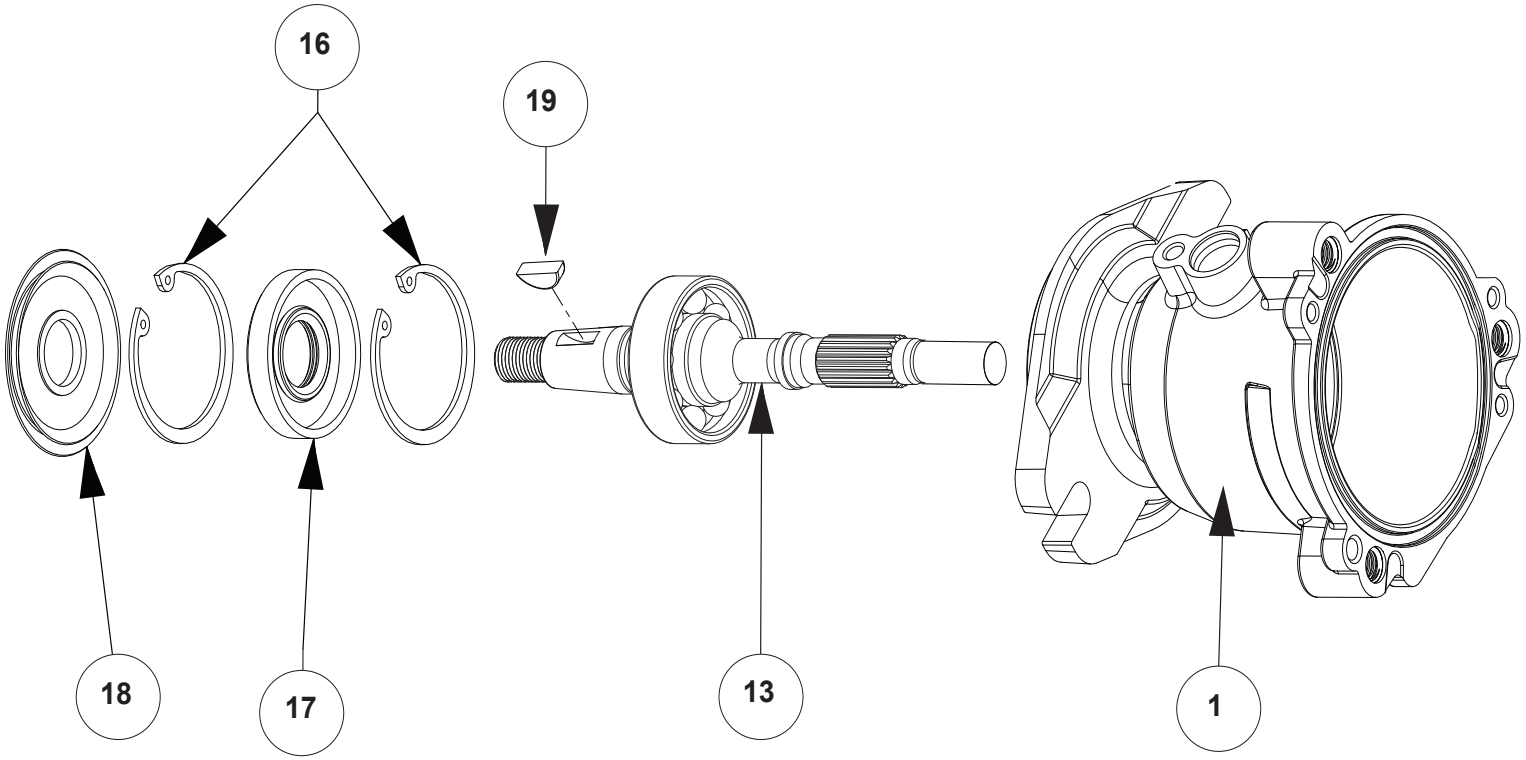


Figure 7, Shaft Assembly

ASSEMBLY AFTER A COMPLETE TEAR DOWN

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

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

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

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

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

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

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

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

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

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

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

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

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

11. Install the endcap. See page 13.

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

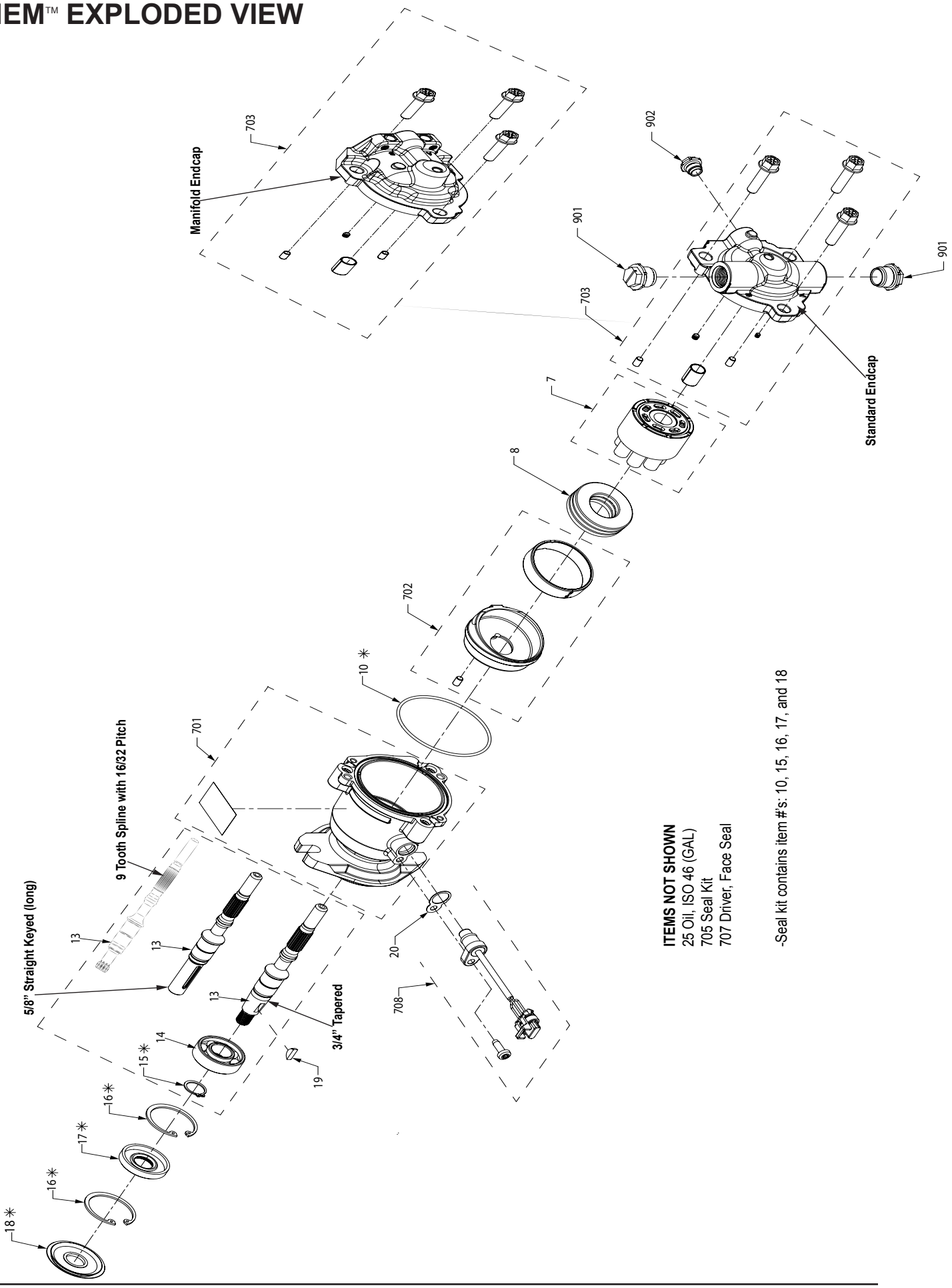
Install the three end cap screws (12). Tighten to the correct torque value. See page 10 for torque specifications.

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

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

Important Pages:

HEM™ EXPLODED VIEW



HEM™ PARTS LIST

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

GLOSSARY OF TERMS

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

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

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

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

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

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

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

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

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

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

Decay Rate: The ratio of pressure decay over time.

End Cap: See “Center Section.”

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

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

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

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

Hydrostatic Pump: See “Hydraulic Pump.”

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

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

Inlet Line: A supply line to the pump.

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

Manifold: A conductor which provides multiple connection ports.

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

Pressure Decay: A falling pressure.

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

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

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

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

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

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

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

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

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

Volumetric Displacement: The volume for one revolution.

NOTES