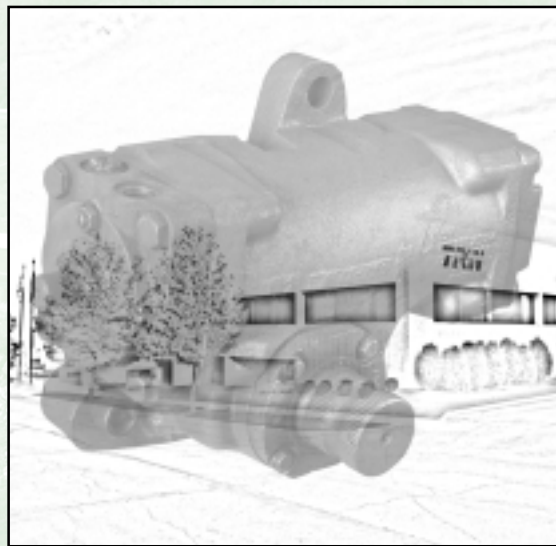


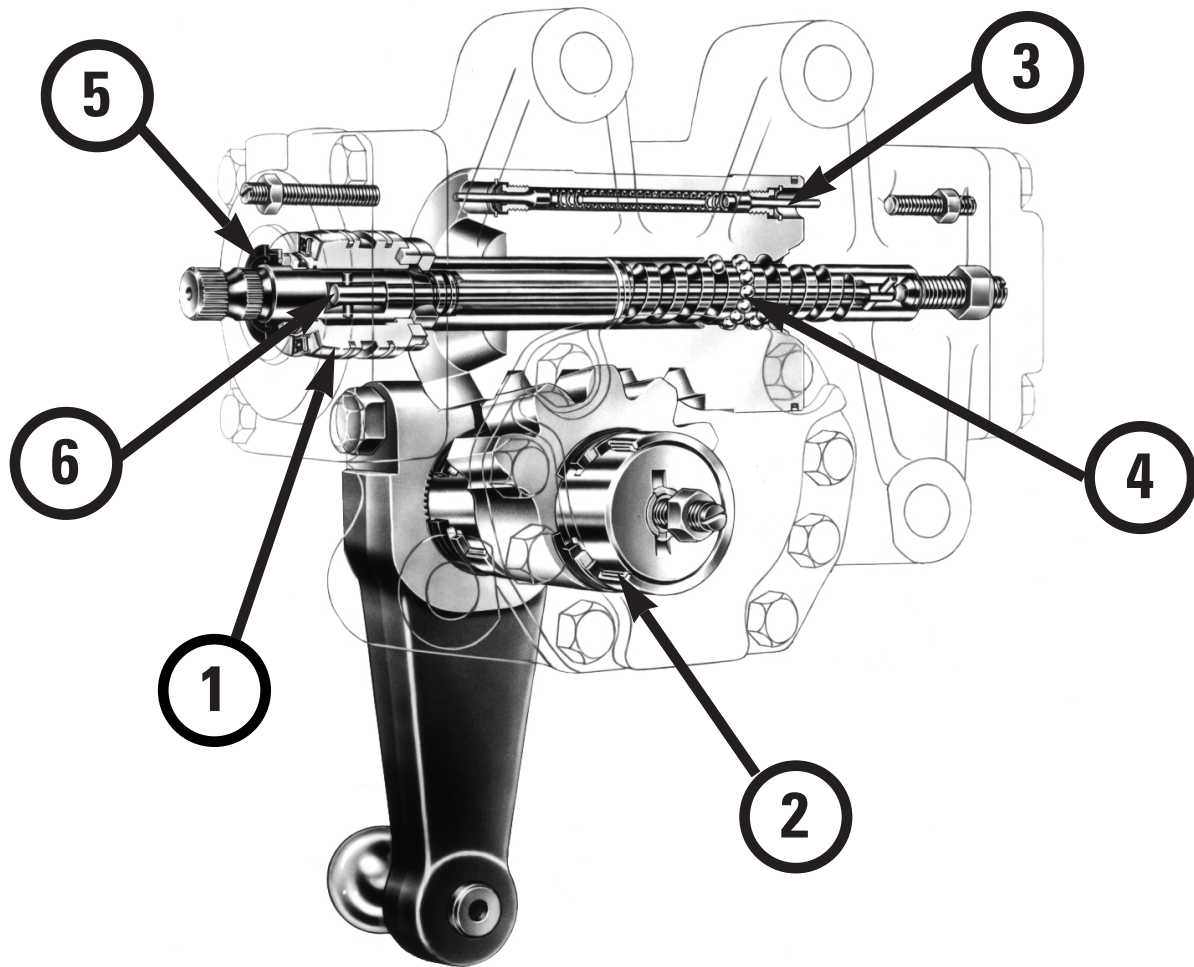
HFB Steering Gear Service Manual

HFB70 SERIES



HFB70 Integral Hydraulic Power Steering Gear

This steering gear was specifically designed for motor trucks; new design features and our design experience with previous models of integral hydraulic power steering gears have been combined into this new product.



Design Features

1. **Rotary Valve** - This device provides responsive steering control
 2. **Precision Roller Bearings** - Allow the steering gear to operate with high efficiency and reversibility
 3. **Unloading Valves** - Furnish power steering pump protection and reduce pressure to unload steering linkage at the ends of steering gear travel
 4. **Recirculating Balls** - Combines high mechanical efficiency with smooth operation
 5. **Dirt and Water Seals** - Lip type seals on both input and output shafts
 6. **Torsion Bar** - Provides positive valve centering with definitive "feel of the road"
- **Balanced Area Cylinder** - Back pressures cannot affect steering stability
 - **High Temperature Seals** - These specially developed seals may be operated intermittently at 300°F (148.9°C)
 - **Manual Steering Capability** - Provides for steering control in the event of hydraulic failure
 - **Compactness** - Lowest weight to output torque ratio in the industry
 - **Auxiliary Porting Available** - For auxiliary cylinder control
 - **Seal Protectors** - Provide protection from harsh environment

Definitions

NOTE: A NOTE gives key information to make procedures easier or clearer.

CAUTION: A CAUTION refers to those procedures which must be followed to avoid damage to the gear.

WARNING: A WARNING REFERS TO THOSE PROCEDURES WHICH MUST BE FOLLOWED FOR THE SAFETY OF THE DRIVER AND THE PERSON INSPECTING OR REPAIRING THE GEAR.

Disclaimer

This Service Manual has been prepared by TRW Ross Gear Division for reference and use by mechanics who have been trained to repair and service steering components and systems on heavy commercial vehicles. TRW Ross Gear Division has exercised reasonable care and diligence to present accurate, clear and complete information and instructions regarding the techniques and tools required for maintaining, repairing and servicing the complete line of TRW Ross Gear HFB70 Integral Power Steering Gears. However, despite the care and effort taken in preparing this general Service Manual, TRW makes no warranties that (a) the Service Manual or any explanations, illustrations, information, techniques or tools described herein are either accurate, complete or correct as applied to a specific HFB70 steering gear, or (b) any repairs or service of a particular HFB70 steering gear will result in a properly functioning steering gear.

If inspection or testing reveals evidence of abnormal wear or damage to the HFB70 steering gear or if you encounter circumstances not covered in the Manual, STOP - CONSULT THE VEHICLE MANUFACTURER'S SERVICE MANUAL AND WARRANTY. DO NOT TRY TO REPAIR OR SERVICE AN HFB70 STEERING GEAR WHICH HAS BEEN DAMAGED OR INCLUDES ANY PART THAT SHOWS EXCESSIVE WEAR UNLESS THE DAMAGED AND WORN PARTS ARE REPLACED WITH ORIGINAL TRW REPLACEMENT AND SERVICE PARTS AND THE UNIT IS RESTORED TO TRW'S SPECIFICATIONS FOR THE HFB70 STEERING GEAR.

It is the responsibility of the mechanic performing the maintenance, repairs or service on a particular HFB70 steering gear to (a) inspect the steering gear for abnormal wear and damage, (b) choose a repair procedure which will not endanger his/her safety, the safety of others, the vehicle, or the safe operation of the vehicle, and (c) fully inspect and test the HFB70 steering gear and the vehicle steering system to insure that the repair or service of the steering gear has been properly performed and that the steering gear and system will function properly.

This TRW Ross Gear Division vehicle power steering gear is covered by one or more of United States patent numbers: 3,896,702; 3,606,819; 3,741,074; 3,773,081; 3,955,473; 3,935,790; and 3,921,669. Other United States patent applications are pending, and corresponding foreign patents are pending and issued.

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Table of Contents

Page

HFB70 Design Features and Phantom View	Inside front cover
Definitions and Patents	1
Introduction	3
HFB70 Oil Flow Illustration	4
HFB70 General Design and Operation	5
Troubleshooting Information	6
Troubleshooting Guide	8
Repairs and Adjustments on Vehicle	11
—The Sector Shaft and Trunnion Cover	11
—The Worm Shaft/Input Shaft Seal	14
—Worm Shaft Preload Adjustment	17
—Poppet Valve Adjustment	18
—Cross Shaft or Sector Shaft Adjustment	19A
HFB70 Exploded Assembly View— Typical	19B
Torque Chart	19D
Tools and Materials Required for Servicing	19D
Disassembly	20
Inspection	31
Assembly	34
Final Adjustment	49
Hydraulic Fluid	50
Filling and Air Bleeding the System	50
WARNINGS for Proper Steering Gear Operation	50
Steering System Maintenance Tips	52

WARNING: ALL STEERING MECHANISMS ARE LIFE AND LIMB ITEMS. AS SUCH, IT IS IMPERATIVE THAT THE INSTRUCTIONS IN THIS BOOKLET ARE FOLLOWED TO THE LETTER. FAILURE TO OBSERVE THE PROCEDURES SET OUT IN THIS PAMPHLET MAY RESULT IN LOSS OF STEERING.

Introduction

Service Manual for Model HFB70

This service manual has one purpose: to guide you in maintaining, troubleshooting and servicing the HFB70 Hydrapower™ integral power steering gear.

Material in this manual is organized so you can work on the HFB70 and get results without wasting time or being confused. To get these results, you should review the contents of this manual before you begin any work on the HFB70.

The section of this manual on General Design and Operation, treats the major parts of the HFB70 and explains how they function together. The knowledge you acquire from reviewing this section should assist you in solving your steering problem.

This manual also contains troubleshooting information and checklists. With them, you can diagnose a steering problem without removing the HFB70 from the vehicle. If you must service the HFB70 the checklists will help you to determine where the problem may be.

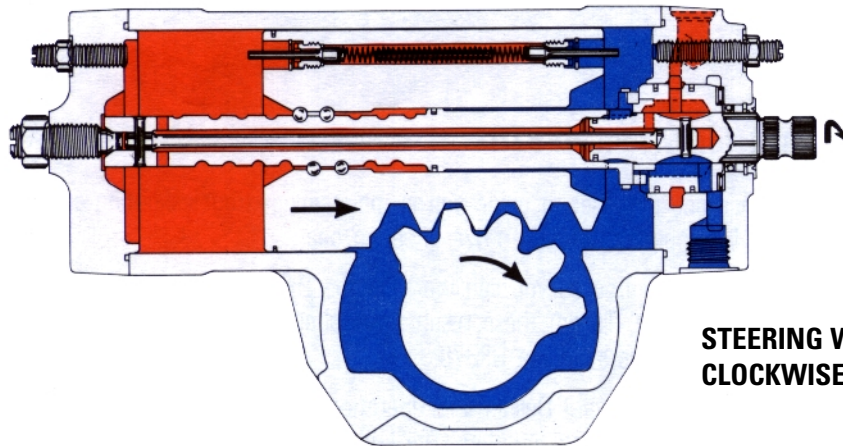
The three-column format of the Repairs, Adjustments, Disassembly, Inspection and Assembly sections will make it easier for you to service the HFB70. Column 1 gives a brief key for each procedure.

Column 2 explains in detail the procedure you should follow. Column 3 illustrates this procedure with photographs. Pay special attention to the notes, cautions, and warnings.

A foldout page with the same typical HFB70 exploded assembly view on both sides is provided in this manual. The component part names and item numbers assigned on this exploded assembly view correspond with names and item numbers (in parentheses) used in the disassembly, assembly and other procedures set forth in this manual. When this exploded assembly view page is folded out, you can easily identify components and locate their relative position on the exploded assembly view as you follow the disassembly, assembly and other procedures.

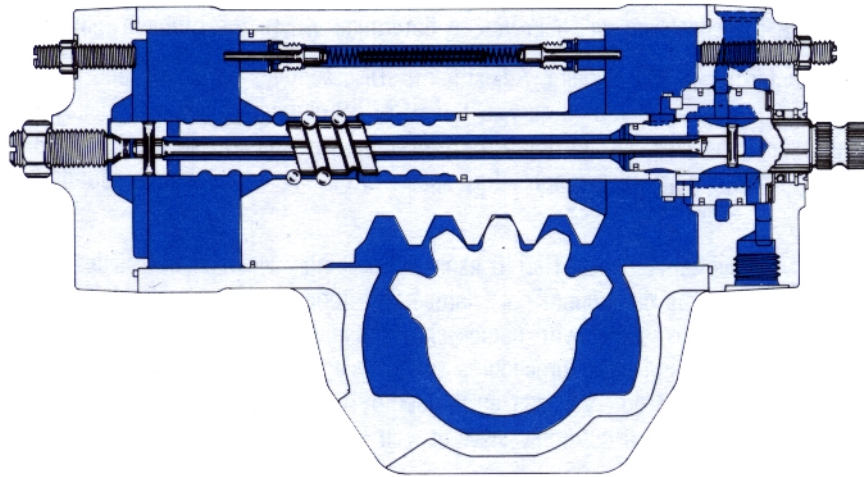
As you gain experience in servicing the HFB70, you may find that some information in this manual could be clearer and more complete. If so, let us know about it. Don't try to second guess the manual; if you are stuck, contact us. Servicing the HFB70 should be a safe and productive procedure.

HFB70 OIL FLOW ILLUSTRATION

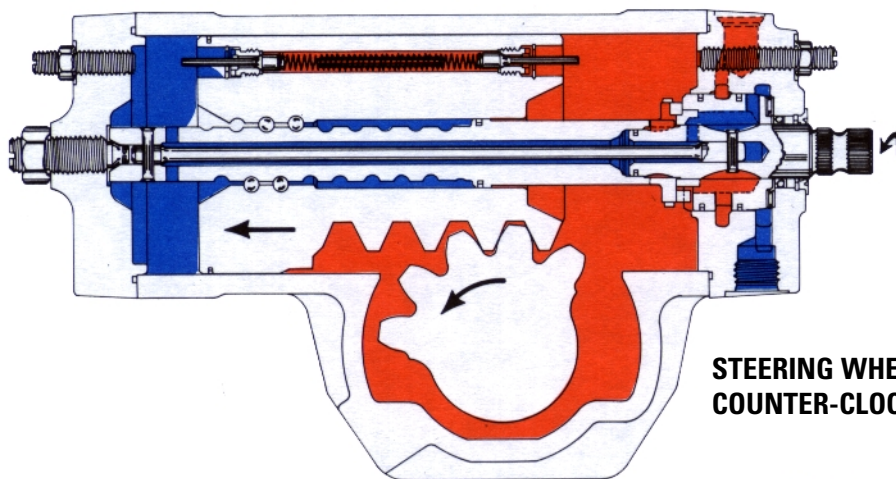


**STEERING WHEEL INPUT
CLOCKWISE ROTATION**

Right Hand Turn



Neutral - No Steering Action



**STEERING WHEEL INPUT
COUNTER-CLOCKWISE ROTATION**

Left Hand Turn

Supply Pressure
Return Pressure

HFB70: General Design and Operation

Design

Integral Power Steering

The HFB70 power steering gear is the latest design in the Ross family of integral hydraulic power steering gears. Integral hydraulic power steering means that the gear box contains a manual steering mechanism, a hydraulic control valve, and a hydraulic power cylinder, all in a single, compact package.

Rotary Control Valve

The rotary control valve combines simplicity of construction with desirable performance characteristics. The speed at which the driver can turn the steering wheel with power assist is dependent upon the pump flow (measured in gallons per minute-gpm or Liters/Min.) directed to a cylinder cavity.

The pressure (measured in pounds per square inch—psi or bar) required for the gear to steer the vehicle is created by the power steering pump to overcome resistance at the steered wheels. The control valve senses these requirements and directs fluid to the cylinder cavity at the proper flow rate and pressure.

Pressure Means Work, Flow Means Speed

The higher pressure a gear can withstand, the more work it can perform. The HFB70 can steer a vehicle with a front end weight rating of about 16,000 pounds (7257 Kg) through a turn at low vehicle speed and engine idle. As the driver turns the steering wheel faster or slower, more or less fluid will be required by the gear in one minute. For the HFB70, maximum operating pressure is 2000 psi (137.9 bar), maximum flow rate 8 gpm (30 Liters/Min). NOTE: The recommended minimum flow at 1 1/2 hand wheel turns/second must be no less than 3.4 gpm (13 Liters/Min.). If the HFB70 steering gear is controlling an auxiliary cylinder, increased minimum flow is required based on the size of the auxiliary cylinder and the vehicle's steering geometry.

Operation

What Happens During a Steering Maneuver

When the driver turns the steering wheel, he transmits force from the wheel to the steering gear input shaft. A torsion bar, pinned at its one end to the input shaft and at its other end to the worm shaft, turns with the input shaft and exerts a rotational force on the worm shaft. In response to this rotational force, the worm shaft, acting through the recirculating ball mechanism, tries to move the rack piston axially through the gear housing cylinder bore.

The rack piston's axial movement is resisted by its engagement to the sector shaft, which is connected by linkage to the steered wheels. Because of this resistance, the torsion bar is twisted by the input shaft, thereby actuating the control valve. Pressurized fluid, directed by the control valve, assists in moving the rack piston axially through the cylinder bore. The rack piston then turns the sector shaft to steer the vehicle.

Shock Loads to the Gear

If the steered wheels receive a shock load, the shock forces are transmitted through the sector shaft, to the rack piston, and onto the worm shaft. The internal geometry of the steering gear causes the control valve to send high pressure fluid to the correct cylinder cavity to resist the shock forces. By absorbing the shock forces hydraulically, the steering gear prevents objectionable kickback at the steering wheel.

Unloading (Poppet) Valves

The HFB70 gears are equipped with two unloading valves, one at each end of the rack piston. One valve or the other, depending on the direction of turn, will trip as the steered wheels approach the axle stops (which must be set according to manufacturer's specification). The tripped valve reduces pressure in the gear and helps to reduce heat generated by the pump. At the same time, the valves also reduce forces on the steering linkage.

Bleed Systems

Some HFB70 gears which are mounted with the output shaft above the rack piston bore are equipped with a manual bleed screw.

The procedure for servicing the manual bleed screw is described under "Filling and Air Bleeding" (page 50) in this manual.

Troubleshooting Information

Preliminary Checks

When a customer comes to you with a problem related to his truck's steering, you can save a lot of time and work if you first verify the problem. Make sure you're both talking the same language about the same problem. If he says the truck's hard to steer, find out exactly what he means. Is it hard steering into a right or left turn? Only when turning the steering wheel while the truck is sitting still? Is there only intermittent power steering? Or is there no power assist at all?

If at all possible, and if it's safe to do so, test drive the truck. If you're not familiar with the rig, let the customer drive it while you sit beside him. Take hold of the wheel while he drives to get a feel for the problem he's talking about. Since most of his driving will be with his truck hauling a load, arrange for a load if one is required to reproduce the steering problem.

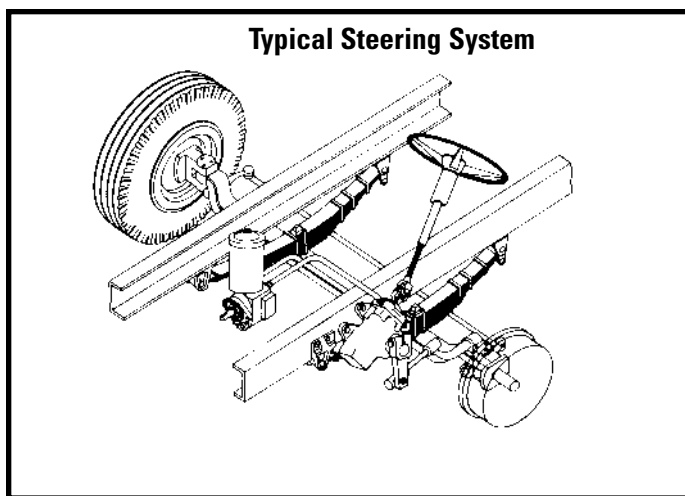


Figure 1

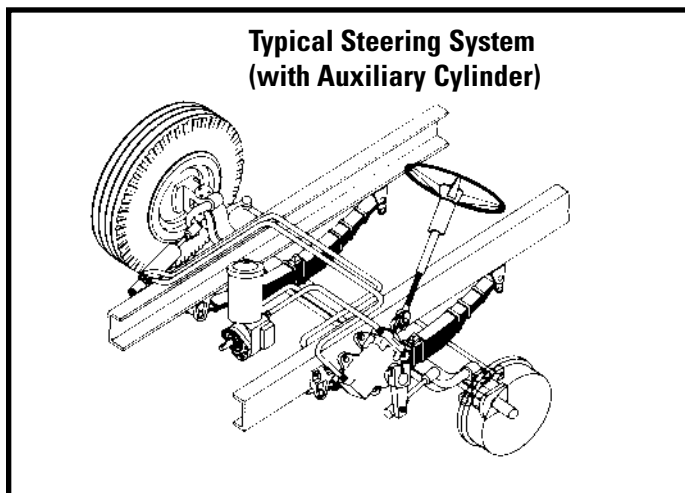


Figure 1A

Once you've determined the problem and its symptoms, don't jump right in to tear the steering gear or pump apart. In most cases, in fact, the gear should be the last component you check. There are many other components in the steering system that could be causing the problem (see FIG. 1 & 1A). These you should check first.

Begin, then, by checking the steered wheels: make sure that the tires are at correct pressure and equal all around, that they are properly sized, and that they are not worn or damaged.

Next, have the front-end alignment checked and look for abnormal looseness or tightness in the steering linkage, ball joints, and king pins.

A service replacement hose or fluid line may be misrouted or may be too small in diameter, or it may be restricted in some other way. Reroute any hose that is kinked or bent sharply. Replace any hoses that are not the same as original equipment.

Continue by checking the power steering fluid reservoir to make sure that oil is up to the correct level. Also, check the pump drive belt, if one is used, to see if it is slipping. The belt may be tight, but it may also be glazed, and a slipping belt doesn't always squeal. If you adjust the belt, check the specifications.

These are just some of the checks you should make before you turn to the steering gear or pump. The Troubleshooting Guide on pages 8 thru 10 explains what to diagnose for a particular steering problem. Match the trouble symptom against the chart and follow the recommended troubleshooting sequence. Doing so will most likely save you time and may prevent unnecessary repairs and costs.

Hydraulic Tests

If the checks described above all prove satisfactory, it is possible that the cause of the steering problem can be traced to a lack of pressure or insufficient flow. In this case, you may have to do more detailed troubleshooting that involves conducting hydraulic tests.

Preparation for Hydraulic Tests

To conduct the following hydraulic tests, first install a flow meter, pressure gage and load (shut off) valve in the fluid supply line to the steering gear, as indicated by the instructions that come with the flow meter. Steering system analyzers are available with the 3 units integral. Place a thermometer in the reservoir (FIG. 2) You must use a flow meter, and it is recommended that you use a thermometer, if you are to troubleshoot the hydraulic system accurately. Start the engine and warm the hydraulic system up by partially closing the load valve until the pressure gage reads 1000 psi (69.0 Bar). When the fluid temperature, as indicated on the thermometer, reaches between 125°F (51.7°C) and 135°F (57.2°C), open the load valve. The system is warmed up, and you can conduct the tests.

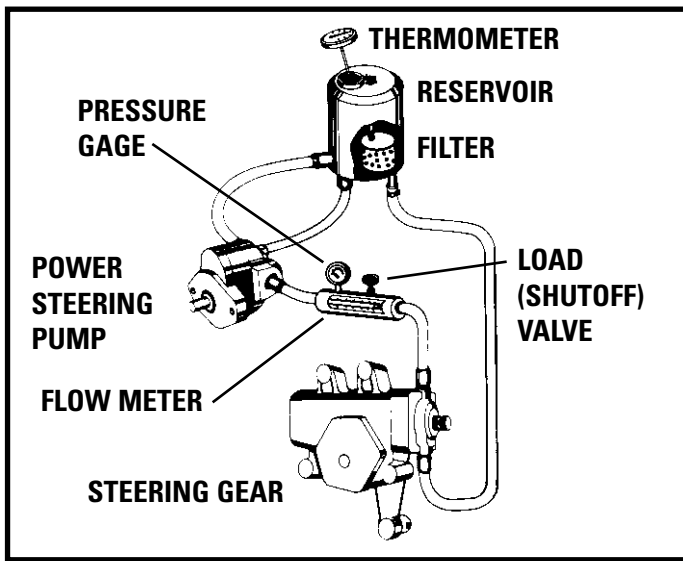


Figure 2

CAUTION: Do not close the load valve completely and leave it closed, or you may damage the pump. At no time allow fluid temperature to exceed 180°F (82.2°C). Run all the tests at the prescribed temperature range of 125°F (51.7°C) 135°F (57.2°C).

Power Steering Pump Pressure Test

With the engine idling, close the load valve and read the pressure gage. If the pressure reads below the minimum specified by the pump manufacturer, repair or replace the pump.

CAUTION: Do not keep the load valve closed for longer than 5 seconds to avoid damaging the pump. Closing the load valve causes the pump to operate at relief pressure and the fluid temperature to increase rapidly. Allow fluid to cool between 125°F (51.7°C) and 135°F (57.2°C) before you resume with the other tests.

Power Steering Pump Flow Test

WARNING: MAXIMUM FLOW RATE FOR THE HFB70 STEERING GEAR IS 8 GPM (30 LITER/MIN). FLOW RATE SHOULD NOT EXCEED 8 GPM (30 LITER/MIN). EXCESSIVE FLOW CAN CAUSE DAMAGE TO INTERNAL PARTS OF THE STEERING GEAR, WHICH COULD RESULT IN A LOSS OF POWER STEERING.

NOTE: If flow specifications and methods of checking flow rate are provided by the vehicle manufacturer, you should follow those instructions rather than the procedure described below.

With the engine idling and the fluid temperature between 125°F (51.7°C) and 135°F (57.2°C), check the pump manufacturer's specifications for flow rate. Compare these specifications with the flow rate on the flow meter.

Now, fully close the load valve until the pressure gage registers the pressure at which the pump is relieving. When pump relief is reached, flow rate must be zero. IMMEDIATELY OPEN THE LOAD VALVE. The flow rate must instantly return to the original reading. If this rate does not return immediately, the pump is malfunctioning, which can result in intermittent power assist.

Now, set the engine at governed rpm, and fully close the load valve again until pump relief is reached. At pump relief, the flow rate must be zero. IMMEDIATELY OPEN THE LOAD VALVE. The flow rate must instantly return to the original reading. If this rate does not return immediately, the pump is malfunctioning, which can result in intermittent power assist.

NOTE: Conduct the pump flow test once at idle rpm and three times at governed rpm.

CAUTION: Do not allow the fluid temperature to exceed 180°F (82.2°C). Run each phase of this test between 125°F (51.7°C) and 135°F (57.2°C).

Steering Gear Internal Leakage Test

To test the steering gear for internal leakage, you must first prevent operation of the gear's internal unloading (poppet) valves. This will allow full pump relief pressure to develop. To prevent operation of the poppets, place an unhardened steel spacer block, about 1 inch thick and long enough to keep your fingers clear, between the axle and stop at one wheel (see FIG. 3)

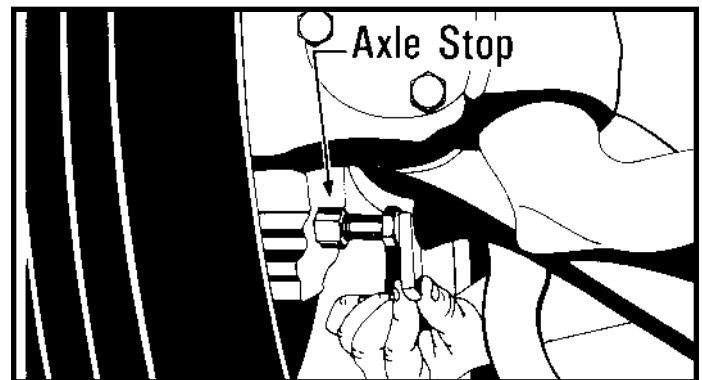


Figure 3

With the fluid temperature between 125°F (51.7°C) and 135°F (57.2°C), turn the steering wheel until the axle stops bottom on the spacer block (FIG. 3).

CAUTION: When running this test, do not hold the steering wheel in the full turn position for longer than 5 to 10 seconds at a time to avoid damaging the pump.

WARNING: KEEP YOUR FINGERS CLEAR OF THE AXLE STOPS AND SPACER BLOCK DURING THIS TEST. MAKE SURE THAT THE SPACER BLOCK CONTACTS THE AXLE STOP SQUARELY. CONTACT THAT IS NOT SQUARE COULD BREAK THE AXLE STOPS OR DANGEROUSLY THROW OR EJECT THE SPACER BLOCK.

Apply 20 lbs. (9.1 KG) to the rim of the steering wheel during this test to be sure that the steering gear control valve is fully closed. The pressure gage should now read pump relief pressure, as noted during the pump pressure test. You can now read steering gear internal leakage on the flow meter.

Acceptable internal leakage can range from 0 to 1.5 gpm. (5.7 Liters/Min.)

Repeat this test for the opposite direction of turn.

If internal leakage is greater than 1.0 gpm (3.8 Liters/ Min.) and there is no auxiliary hydraulic cylinder in the system, repair the gear. If the internal leakage is greater than 1.5 gpm (5.7 Liters/Min.) and there is an auxiliary hydraulic cylinder in the system, controlled by the HFB70 gear, isolate the auxiliary cylinder from the system by disconnecting the auxiliary cylinder hydraulic lines at the HFB70 unit's auxiliary ports. Plug those ports with suitable pressure plugs or caps. Connect the disconnected lines together if a rotary auxiliary cylinder is in the system. Plug the disconnected lines if a linear auxiliary cylinder is in the system and disconnect the linear cylinder from the steering linkage, making sure it will clear the steered axle. Repeat the internal leakage test. If the internal leakage is less than 1.0 gpm (3.8 Liters/Min.), repair the auxiliary cylinder. If the internal leakage is greater than 1.0 gpm (3.8 Liters/Min.), repair the HFB70 gear. See internal leakage diagram, FIGURE 4.

NOTE: When hydraulic tests are completed and fluid lines are reconnected, check fluid level and air bleed the system. Reference page 50.

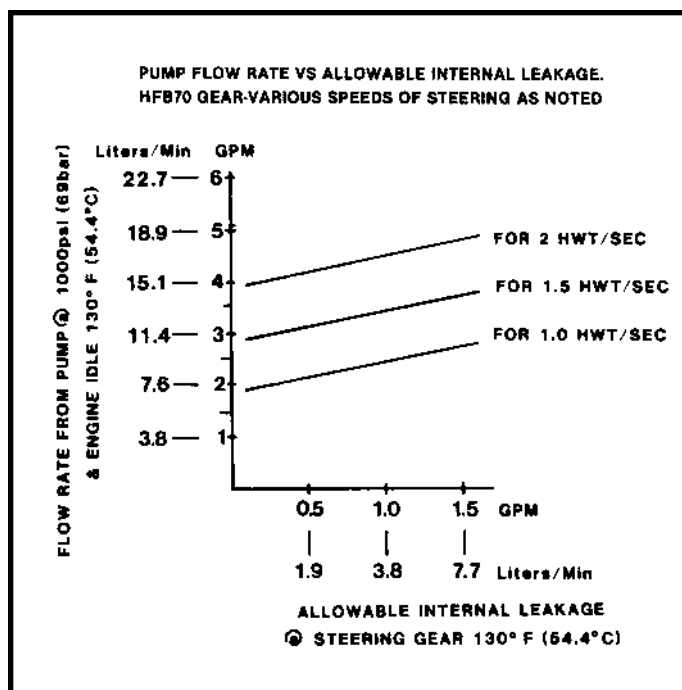


Figure 4

NOTE: If all seals as included in the complete seal kit have been correctly replaced, and the HFB70 steering gear cannot pass the internal leakage test, or if intermittent loss of power steering occurs, a service worm shaft/input shaft, valve sleeve assembly is required.

Troubleshooting Guide

I. Normal Noises

- You or the driver may hear a “hissing” noise from the control valve when it is actuated during a steering maneuver.
- You or the driver may hear a noise as fluid bypasses through the poppets at full turn.
- You or the driver may hear a noise from the system relief valve when it is required to actuate.
- You or the driver may hear pump “growl” from some types of power steering pumps.

II. Abnormal Noises

- If the power steering pump is belt driven, a “squealing” noise may indicate that the belts should be tightened or replaced.
- A “clicking” noise heard during a turn, or when changing directions, may indicate that some component is loose and shifting under load.
- A change in the normal noise of the pump may indicate that air has been induced into the system or that fluid level is low.

III. Possible Steering Problems and Causes

Road Wander

- Tire pressure incorrect or unequal left to right.
- Components in steering linkage loose or worn (Steering wheel to road wheel).
- Wheel bearings improperly adjusted or worn.
- Front end alignment out of specification.
- Dry fifth wheel or poor finish on fifth wheel or trailer plate.
- Steering gear mounting bolts loose on frame.
- Steering gear improperly adjusted.
- Looseness in rear axle assemblies or trailer bogies.

No Recovery

- Tire pressure low.
- Front end components binding.
- Front end alignment incorrect.
- Tight front axle king pins.
- Dry fifth wheel or poor finish on fifth wheel or trailer plate.
- Steering column binding.
- Pump flow insufficient.
- Steering gear improperly adjusted.
- Steering gear control valve sleeve sticking.

Shimmy

- Badly worn or unevenly worn tires.
- Improperly mounted tire or wheel.
- Wheel bearings improperly adjusted or worn.
- Components in steering linkage loose or worn.
- Wheels or brake drums out of balance.
- Front end alignment incorrect.
- Air in the hydraulic system.

External Oil Leakage

- Finding the location of leak may be difficult, since oil may run away from leak source, the fittings, hoses, pump, or gear to a low point on the gear or chassis.
- A leak from the vent plug at the side cover indicates failure of the sector shaft oil seal inside the side cover.

Oversteering or Darting

- Dry fifth wheel or poor finish on fifth wheel or trailer plate.
- Front end components binding or loose.
- Steering column binding.

- Steering gear improperly adjusted.
- Steering gear control valve sleeve sticking.
- Rear axle mounts (rear steer).

High Steering Effort in One Direction

- Unequal tire pressure.
- Vehicle overloaded.
- Inadequate hydraulic system pressure.
- Excessive internal leakage in one direction of turn only (verify with internal leakage test).

High Steering Effort in Both Directions

- Low tire pressure.
- Vehicle overloaded.
- Low hydraulic fluid level.
- Low pressure or flow from pump.
- Components of steering system binding.
- Restriction in return line, or line too small in diameter.
- Excessive internal leakage (verify with internal leakage test).
- Oversize tires (check manufacturer's specifications).

Lost Motion (Lash) at the Steering Wheel

- Steering wheel loose on the shaft.
- Loose connection between the steering gear, intermediate column, and steering column.
- Steering gear loose on frame.
- Pitman arm loose on output shaft.
- Components in steering linkage loose or worn.
- Steering gear improperly adjusted.

Excessive Heat [150°F (65.6°C) Over Ambient]. Not to Exceed 250°F (121°C) Continuously

- Excessive pump flow.
- Vehicle overloaded.
- Undersized replacement hose or line.
- Restricted hose or line that is kinked or severely bent or internally blocked.
- Restricted recentering of gear valve caused by column bind or side load on the input shaft.
- Poppet not adjusted properly (only for gears equipped with poppets).
- Prolonged stationary vehicle operation.

WARNING: IF THE HYDRAULIC SYSTEM FLUID BECOMES OVERHEATED, IT CAN CAUSE THE SEALS IN THE STEERING GEAR AND PUMP TO SHRINK, HARDEN, OR CRACK AND LOSE THEIR SEALING ABILITY.

Repairs and Adjustments on Vehicle

When you have conducted the checks and tests described in the troubleshooting sections, you may find it necessary to repair or adjust the steering gear. Since removing the gear from the vehicle is usually difficult and time-consuming, you will probably find it easier to perform the following repairs and adjustments with the gear on the vehicle. The photographs in this section show a gear mounted on a mock-up frame for clearer illustration.

1 The Sector Shaft And Trunnion Cover

remove pitman arm

- 1.1 If a leak is detected in the trunnion cover area on many HFB70 installations, you can remove the trunnion cover to gain access to the sector shaft seal package while the steering gear is on the vehicle. First remove the pitman arm nut and bolt and then the pitman arm from the sector shaft (48). SEE FIGURES 5 & 6. Check the radial position of the pitman arm to the sector shaft prior to removal of pitman arm. Add timing marks to the arm and shaft if necessary to insure correct alignment at reassembly.

NOTE

NOTE: A chisel will help you loosen the pitman arm. Use only a puller if you cannot remove the pitman arm with your hands.

WARNING

WARNING: WHEN USING A CHISEL TO SPREAD THE PITMAN ARM BOSS IN ORDER TO LOOSEN THE PITMAN ARM FOR REMOVAL FROM THE SHAFT, MAINTAIN A FIRM GRIP ON THE CHISEL AT ALL TIMES. FAILURE TO DO THIS MAY RESULT IN THE CHISEL FLYING LOOSE WHICH COULD CAUSE AN INJURY. NEVER LEAVE THE CHISEL WEDGED IN THE PITMAN ARM BOSS. IF YOU CANNOT REMOVE THE PITMAN ARM FROM THE SHAFT WITH A CHISEL AND YOUR HANDS, REMOVE THE CHISEL FROM THE PITMAN ARM AND USE A PULLER ONLY TO REMOVE THE PITMAN ARM.

remove protector boot, fitting and dirt and water seal

- 1.2 Remove protector boot (60), grease fitting (61) and dirt and water seal (26). SEE FIGURE 7, 8. Discard protector boot and dirt and water seal.

clean sector shaft

- 1.3 Clean the sector shaft (48) with a fine grade of emery paper. Be sure to remove any paint. SEE FIGURE 9.

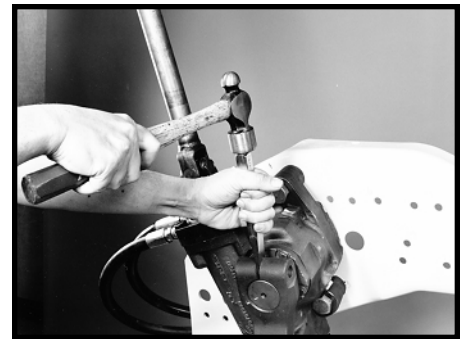


Figure 5

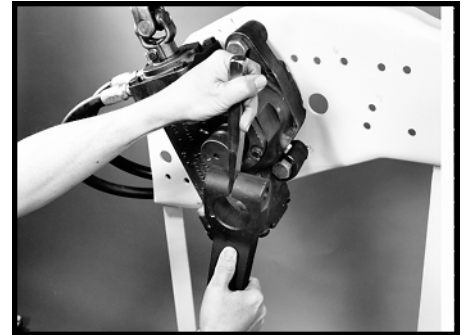


Figure 6



Figure 7

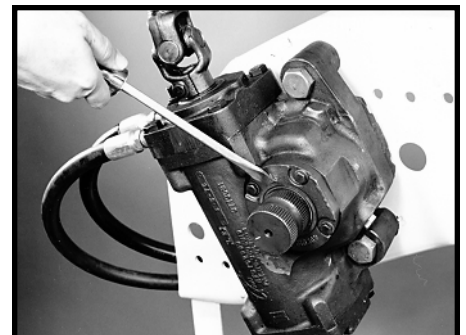


Figure 8



Figure 9

remove trunnion cover & seal package

1.4 Next, remove the four trunnion cover bolts (28) washers (27) and trunnion cover (25). SEE FIGURE 10. A 1/2 inch socket required. Be prepared for fluid loss. Then remove and discard the sector shaft seal package consisting of the two-piece sector shaft seal (23), the Teflon* backup washer (24), and the trunnion cover seal ring (22). SEE FIGURE 11.

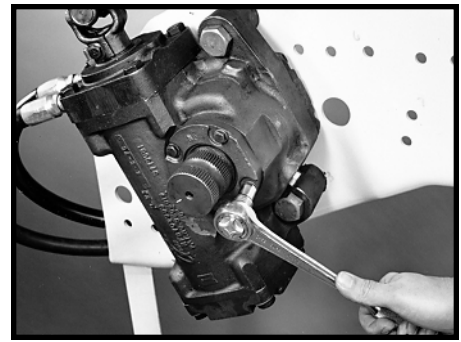


Figure 10

clean and inspect trunnion cover

1.5 Clean the trunnion cover (25) with petroleum based solvent, blow dry and inspect the seal cavity and sealing face for nicks or corrosion. Replace the trunnion cover with a new one if these conditions exist.



Figure 11

WARNING

WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

WARNING

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

install new washer

1.6 Place the trunnion cover (25) on a bench to install the new seal package. Start with the new Teflon backup washer (24).

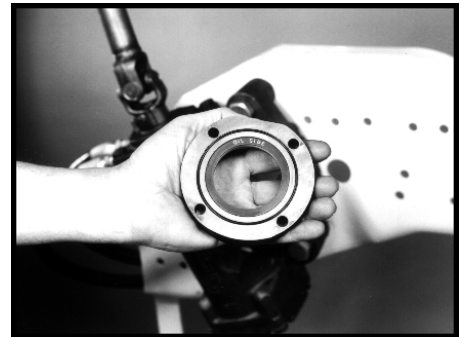


Figure 12

install new seal

1.7 Install the new two-piece sector shaft seal (23), so that the words "oil side" are visible after seal is in place. SEE FIGURE 12.

WARNING

WARNING: THE WORDS "OIL SIDE" MUST BE VISIBLE ON THE SEAL AFTER IT IS IN PLACE. IF NOT, THE SEAL WILL NOT FUNCTION, AND A LOSS OF POWER STEERING ASSIST MAY OCCUR.

install new seal ring

1.8 Grease the new trunnion cover seal ring (22) and install it into the cover groove.

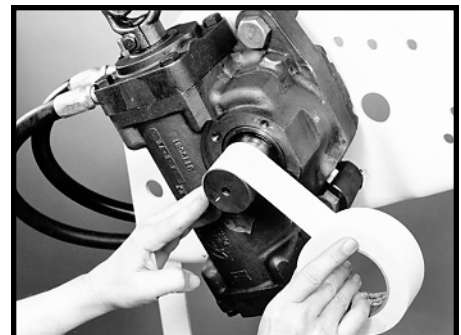


Figure 13

tape sector shaft

1.9 Cover the serrations of the sector shaft (48) with tape to avoid damaging the seals during installation. SEE FIGURE 13.

NOTE

NOTE: Use only one layer of tape.



Figure 14

*Teflon is a registered trademark of DuPont Corporation

install trunnion cover, washers & bolts

1.10 Install the trunnion cover (25) and four trunnion cover washers (27) and bolts (28). Torque bolts to 15-22 ft. lbs. (20-30 N m) if dry or 11-16 ft. lbs. (15-22 N m) if lubricated. 1/2 inch socket required. SEE FIGURES 14, 15, 16.

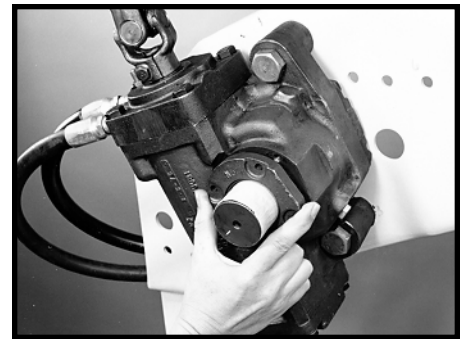


Figure 15

install new dirt & water seal

1.11 Pack clean high temperature industrial grease per Ross specification 045231, *Mobil temp. 1 or 2 or equivalent around seal area of sector shaft (48). Install a new dirt and water seal (26) using a suitable blunt end drift. SEE FIGURE 17.

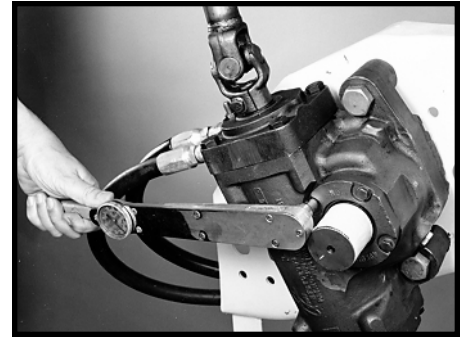


Figure 16

assemble protector boot & fitting

1.12 Apply a generous amount of the same grease to protector boot (60) in the area inside of the smaller diameter ring. Assemble protector boot onto sector shaft (48) and trunnion cover (25), locating the grease fitting hole toward the input shaft end of gear assembly. Insert grease fitting (61) into protector boot. Remove tape from sector shaft serrations. SEE FIGURE 18.



Figure 17

install pitman arm

1.13 Reconnect the pitman arm, making sure the timing mark on the pitman arm aligns with the timing mark on the sector shaft. SEE FIGURE 19.



Figure 18

WARNING

WARNING: WHEN USING A CHISEL TO SPREAD THE PITMAN ARM BOSS FOR ASSEMBLY ONTO THE SECTOR SHAFT (48), MAINTAIN A FIRM GRIP ON THE CHISEL AT ALL TIMES. FAILURE TO DO THIS MAY RESULT IN THE CHISEL FLYING LOOSE WHICH COULD CAUSE AN INJURY. NEVER LEAVE THE CHISEL WEDGED IN THE PITMAN ARM BOSS.



Figure 19

*Mobil Temp is a Registered Trademark of Mobil Oil Co.

install and torque pitman arm bolt

CAUTION

fill and bleed system

remove input coupling & protector, clean input shaft

WARNING

remove and plug the return line

- 1.14 Insert the pitman arm clamp bolt and nut assembly, using a 3/4-16 grade 8 bolt. SEE FIGURE 20. If the bolt is lubricated or plated, torque its to 300-320 ft. lbs. (407-434 N m). If dry and unplated, torque to 380-420 ft. lbs. (515-569 N m).

CAUTION: Be sure there is no spreading wedge left in the pitman arm boss before torquing pitman arm clamp bolt.

- 1.15 Before operating the steering gear, fill the with the recommended fluid and bleed air the system by following the Filling and Air Bleeding instructions on page 50.

2 The Worm Shaft/Input Shaft Seal

- 2.1 If there is a leak in the shaft seal, you can usually replace the input shaft seal assembly with the gear on the vehicle. Start by removing the input coupling per the vehicle manufacturers instructions. SEE FIGURE 21. Remove seal protector (62) and clean the area around the input shaft with a fine grade of emery paper. SEE FIGURE 22 & 23.

WARNING: DO NOT DRIVE OR PRY COUPLING FROM WORM SHAFT/INPUT SHAFT. INTERNAL DAMAGE TO THE STEERING GEAR CAN RESULT. IF COUPLING IS TIGHT, INSERT SCREWDRIVER INTO SLOT TO RELEASE.

- 2.2 Remove and plug the return line. SEE FIGURE 24.

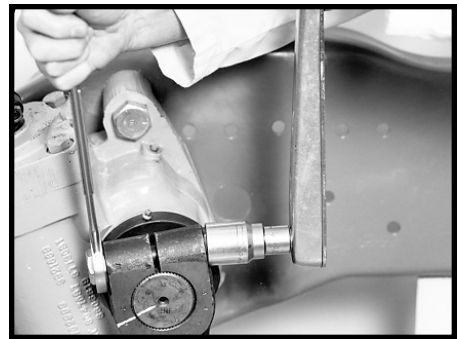


Figure 20



Figure 21



Figure 22

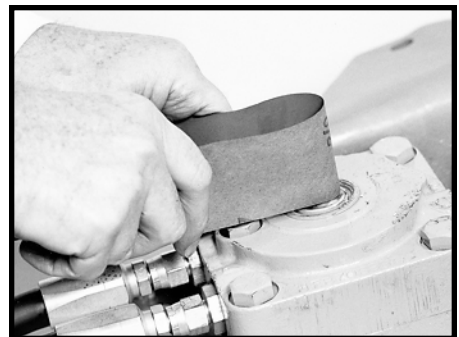


Figure 23



Figure 24

remove seal

2.3 Remove and discard the dirt and water seal (4) SEE FIGURE 25.



Figure 25

remove retaining ring

2.4 Remove the seal retaining ring (5) from the valve housing (8). SEE FIGURE 26.

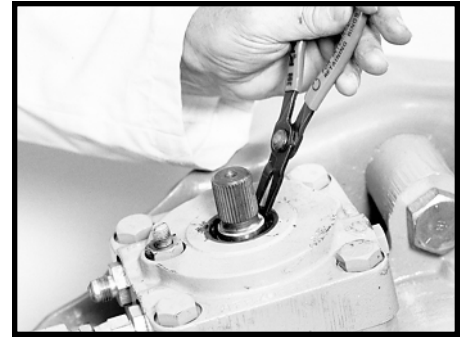


Figure 26

apply air pressure to port

2.5 Hold a shop rag over the worm shaft/input shaft and apply shop air pressure to the valve housing (8) return port. SEE FIGURE 27.

WARNING

WARNING: BE SURE TO WEAR EYE PROTECTION, AND TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.



Figure 27

remove seal & washer

2.6 The air pressure will force the two-piece input shaft seal (7) and the steel backup washer (6) to pop out of the gear, and some fluid will squirt out of the gear. SEE FIGURE 28. Discard the seal. Disconnect the shop air as soon as the seal assembly is out.



Figure 28

install seal package

2.7 Apply clean grease to the new input shaft seal assembly (7), washer (6) and the input shaft. Install the new two piece input shaft seal flat side up and the steel backup washer, using the seal driving tool J28490. SEE FIGURE 29. Install the retaining ring (5).



Figure 29

grease input shaft

2.8 Pack the area around the worm shaft/input shaft (16) and dirt and water seal (4) cavity with high temperature industrial grease per Ross specification 045231, *Mobil Temp 1 or 2 or equivalent. SEE FIGURE 30.

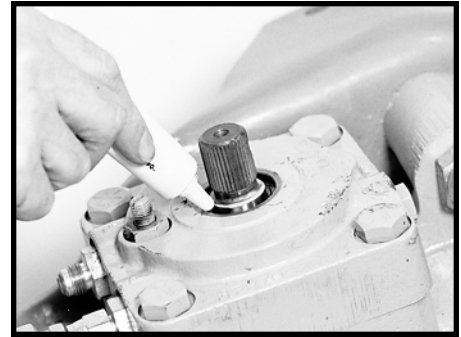


Figure 30

install seal

2.9 Install the new dirt and water seal (4) with tool J28490 or a suitable blunt end drift. SEE FIGURE 31.

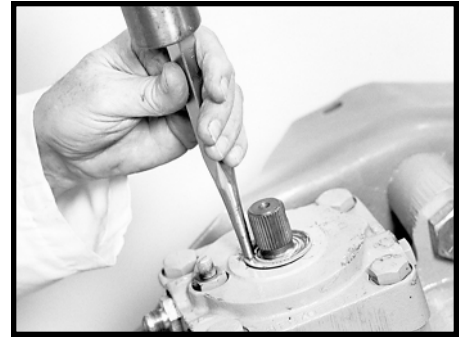


Figure 31

assemble seal protector

2.10 Add more grease to seal area and assemble seal protector (62) onto worm shaft/input shaft (16), seating it in the relief groove just beyond the input shaft serrations with cupped side toward the gear. SEE FIGURE 32.



Figure 32

reconnect line

2.11 Remove the plug and reconnect the return line.

*Mobil Temp is a Registered Trademark of Mobil Oil Co.

reconnect input coupling

- 2.12 Reconnect the input coupling. If the input coupling male assembly slides free of the female end during reassembly, realign the timing marks to insure proper phasing of the U-joints. Refer to Vehicle Service Manual for proper torque.

WARNING

WARNING: MISTIMED U-JOINTS CAN RESULT IN A BUMPY SENSATION AT THE STEERING WHEEL AND POSSIBLY AFFECT STEERING CONTROL.

fill and bleed system

- 2.13 Before operating the steering gear, fill the system with the recommended fluid only and bleed the system following the filling and bleeding instructions on page 50.

Adjustments

You can make three adjustments to the gear while it is mounted on the vehicle: the worm shaft preload adjustment, the poppet valve adjustment and the sector shaft adjustment.

3 Worm Shaft Preload Adjustment

(With vehicle engine off)

loosen sealing nut and adjusting screw

- 3.1 Back off the worm shaft adjusting screw sealing nut (39) three turns. SEE FIGURE 33. Back off the worm shaft preload adjusting screw (38) at least one turn. SEE FIGURE 34. Inspect the threads between the jam nut and end cover (37) for foreign matter. Clean the threads or replace the sealing nut if necessary. SEE FIGURE 35.

torque adjusting screw

- 3.2 While torquing the worm shaft preload adjusting screw (38) to 60-70 in. lbs. (81-95 N m) have someone lightly move the steering wheel back and forth about one inch (25 mm) total.

NOTE

NOTE: While torquing the adjusting screw, make sure that the worm shaft adjusting screw sealing nut (39) does not tighten against end cover.

torque sealing nut

- 3.3 Torque the worm shaft adjusting screw sealing nut (39) to 70-80 ft. lbs. (95-108 N m), making sure that the worm shaft preload adjusting screw (38) does not move. SEE FIGURE 36.

NOTE

NOTE: If the sealing material in the sealing nut has separated, remove the adjusting screw and replace the sealing nut with a new one onto the nonslotted end of the adjusting screw.

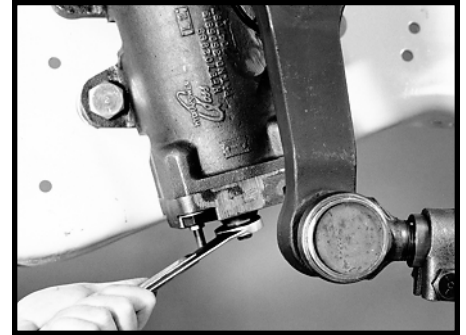


Figure 33

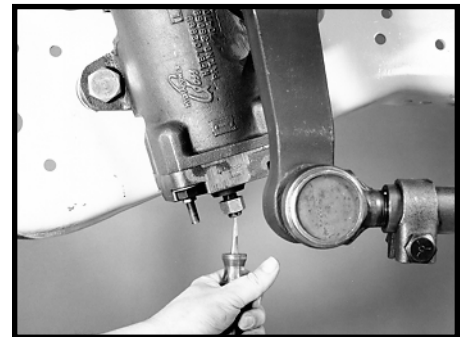


Figure 34

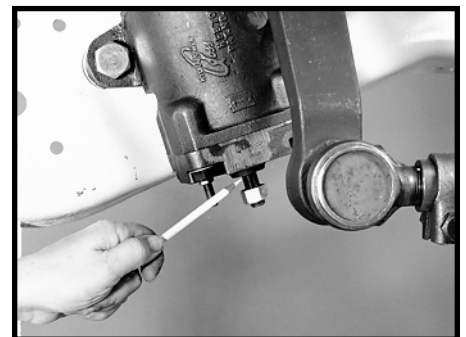


Figure 35



Figure 36

TRW Automotive
Commercial Steering Systems
800 Heath Street
Lafayette, IN 47904
Tel 765.423.5377
Fax 765.429.1868
<http://www.trw.com/commercialsteering>

