TRW Automotive

Commercial Steering Systems

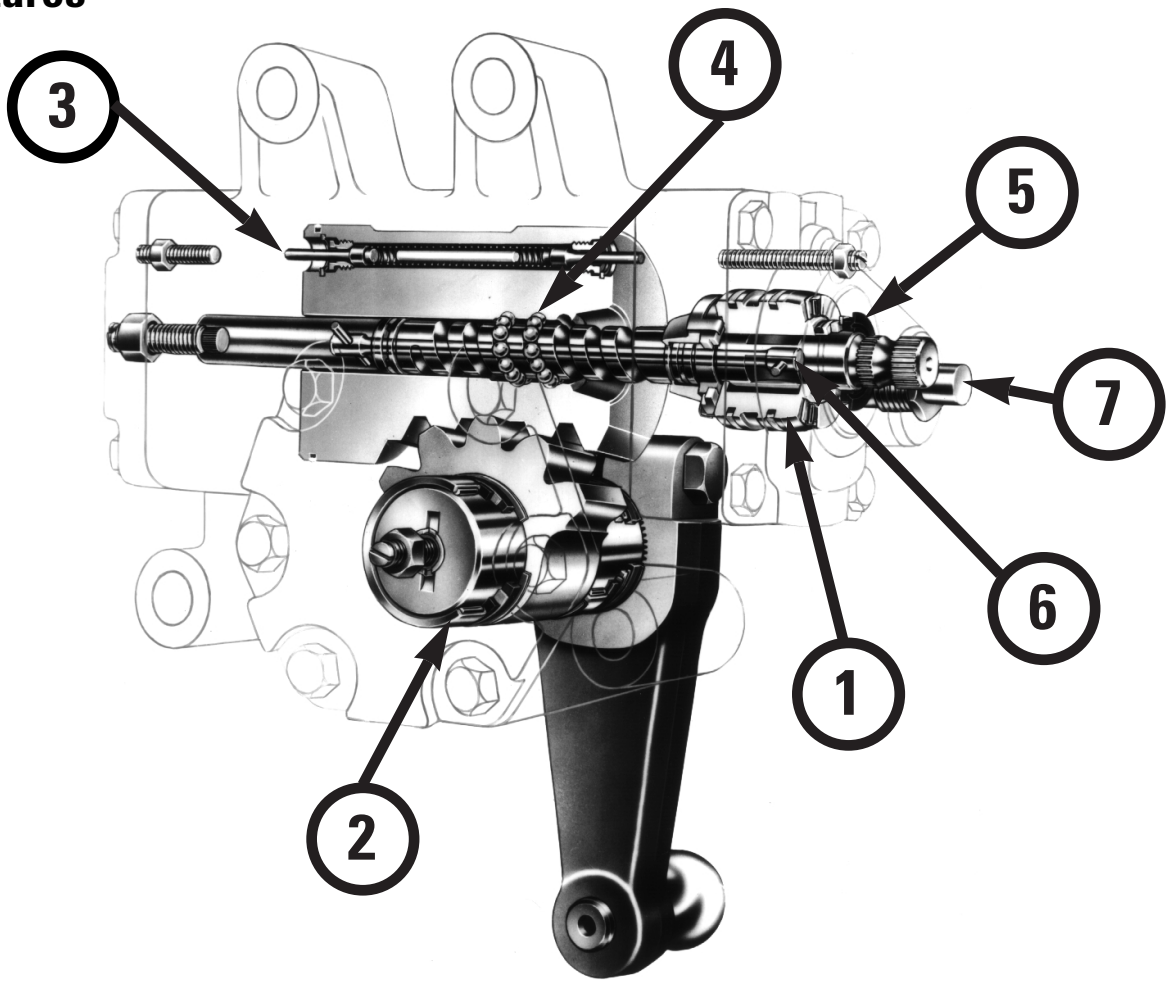
HFB Steering Gear Service Manual

HFB64 SERIES

HFB64 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. ***DU bushing and or 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 (optional)
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"
7. **Relief Valves** - Furnish pump protection by limiting maximum pressure (optional)

- 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

***** DU is a registered trademark of Glacier Metal Co. Ltd.

Definitions

NOTE: **A NOTE gives key information to make a procedure easier or quicker to follow.**

CAUTION: **A CAUTION refers to those procedures that must be followed to avoid damage to a steering component or the gear.**

WARNING: **A WARNING REFERS TO THOSE PROCEDURES THAT 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 HFB64 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 HFB64 steering gear, or (b) any repairs or service of a particular HFB64 steering gear will result in a properly functioning steering gear.

If inspection or testing reveals evidence of abnormal wear or damage to the HFB64 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 A HFB64 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 HFB64 STEERING GEAR.

It is the responsibility of the mechanic performing the maintenance, repairs or service on a particular HFB64 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 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.

Patents

This TRW Ross Gear Division vehicle power steering gear is covered by one or more of the following 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 or issued.

Table of Contents Page

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 HFB64

This service manual has one purpose: to guide you in maintaining, troubleshooting and servicing the HFB64 Hydrapower [a] integral power steering gear.

Material in this manual is organized so you can work on the HFB64 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 HFB64.

The section of this manual on General Design and Operation, treats the major parts of the HFB64 and explains how they function together. The knowledge you acquire from reviewing this section should assist you in solving your steering problem.

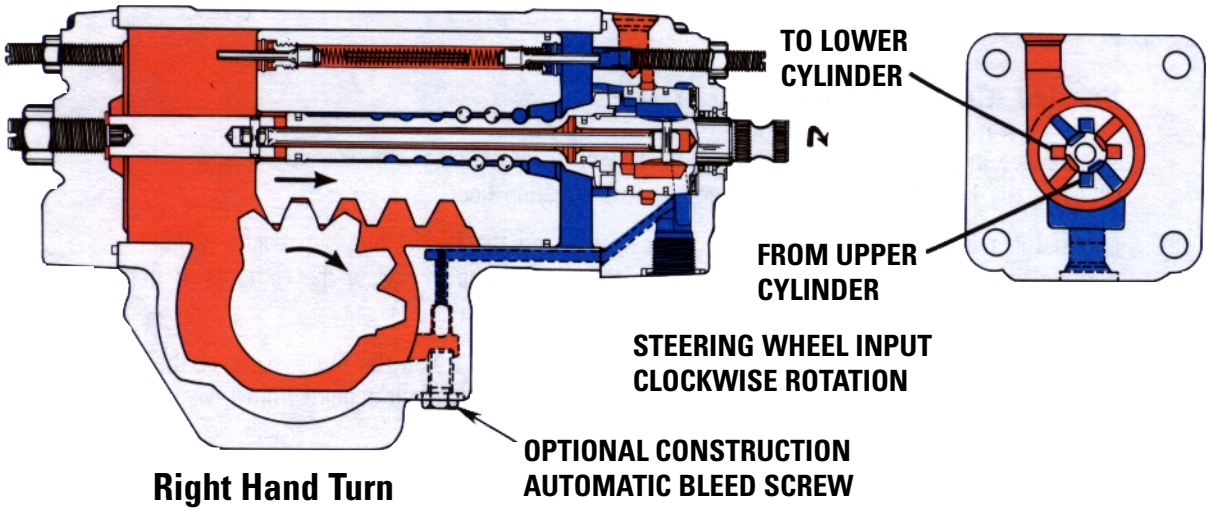
This manual also contains troubleshooting information and checklists. With them, you can diagnose a steering problem without removing the HFB64 from the vehicle. If you must service the HFB64 the checklists will help you to determine where the problem may be.

The three-column format of the Repairs, Adjustments, Disassembly, Inspection and Assembly sections will make it easier for you to service the HFB64. 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.

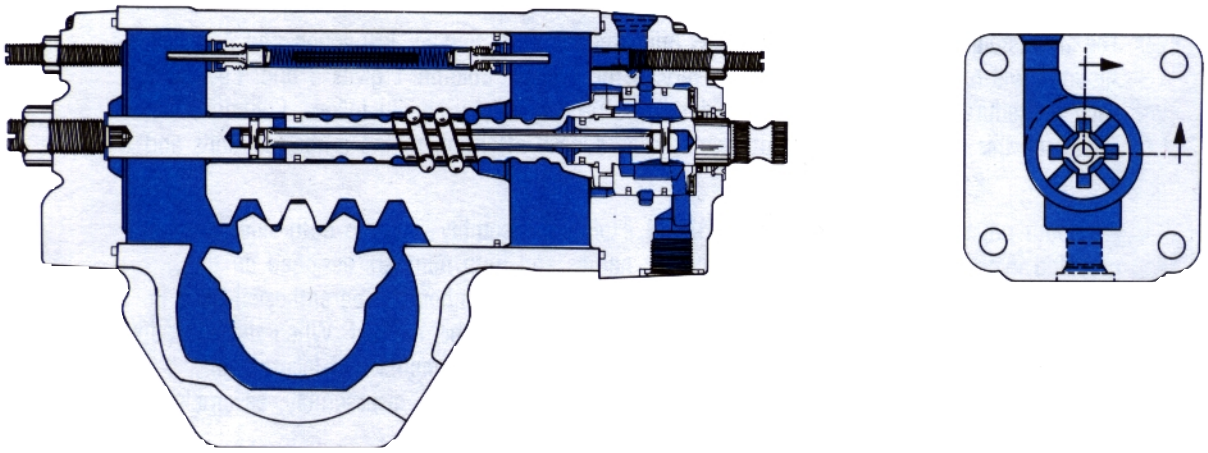
A foldout page with the same typical HFB64 exploded assembly view on both sides is provided in this manual. The component part names and item numbers assigned on this exploded assembly view correspond with names and item numbers (in parentheses) used in the disassembly, assembly and other procedures 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 HFB64, 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 HFB64 should be a safe and productive procedure.

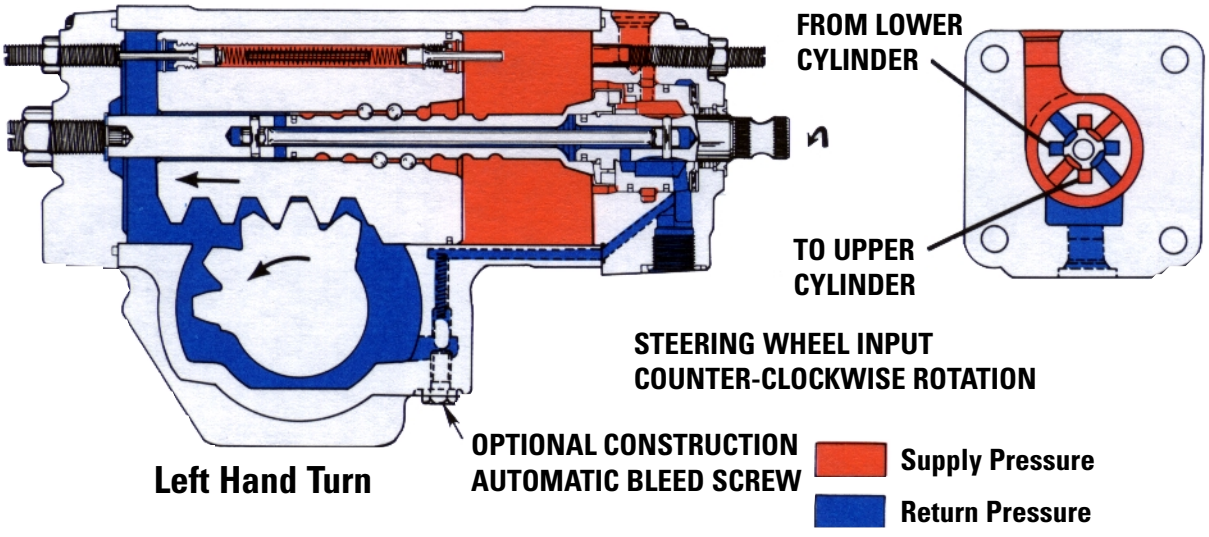
HFB64 Oil Flow Illustration



Right Hand Turn



Neutral - No Steering Action



Left Hand Turn

HFB64: General Design and Operation

Design

Integral Power Steering

The HFB64 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 HFB64 can steer a vehicle with a front-end weight rating of about 12,000 pounds (5443 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 HFB64, maximum operating pressure is 2000 psi (137.9 bar), maximum flow rate 6 gpm (22.7 Liters/Min.). NOTE: The recommended minimum flow at 1 1/2 hand wheel turns/second must be no less than 2.9 gpm (11.0 Liters/Min.). If the HFB64 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

Some HFB64 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.

Relief Valve

Some HFB64 gears, whether equipped with or without poppets, are also supplied with a relief valve. The relief valve limits maximum supply pressure to protect the power steering pump, but it does not reduce pressure as the steered wheels approach the axle stops.

Bleed Systems

Some HFB64 gears which are mounted with the output shaft above the rack piston bore are equipped with either an automatic bleed system or a manual bleed screw.

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

If the unit has an automatic bleed system, illustrated as optional on the oil flow diagram, no servicing is required on the vehicle.

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 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 to 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 In gel 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.

Typical Steering System

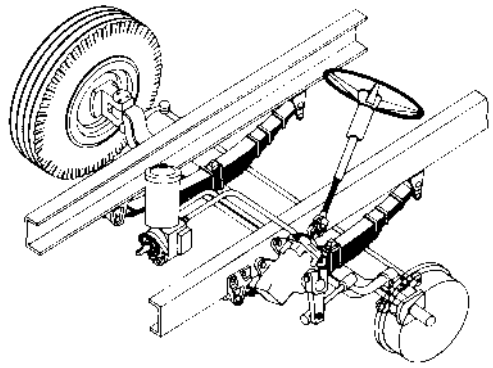


Figure 1

Typical Steering System (with Auxiliary Cylinder)

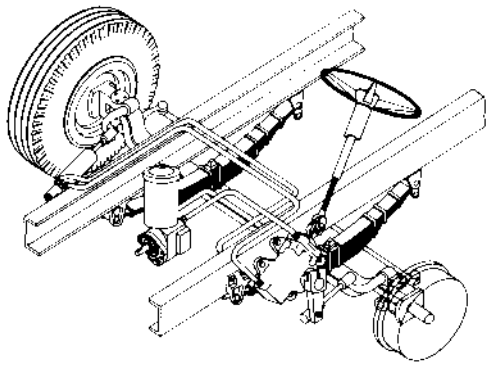


Figure 1A

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 steering 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 through 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.

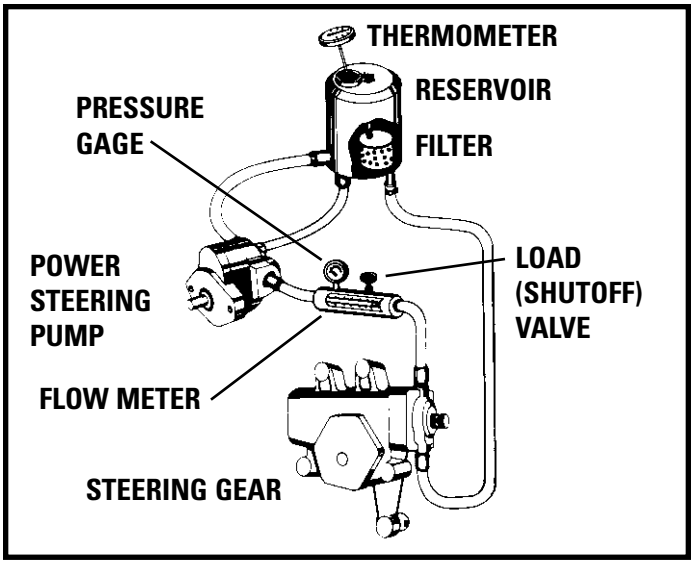


Figure 2

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 HFB64 STEERING GEAR IS 6 GPM (22.7 LITER/MIN). FLOW RATE SHOULD NOT EXCEED 6 GPM (22.7 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 or relief valve (or both, in some gears) 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). To prevent operation of the relief valve, remove the relief valve by following disassembly step 18. Install the relief valve plug, special tool J29059, in its place.

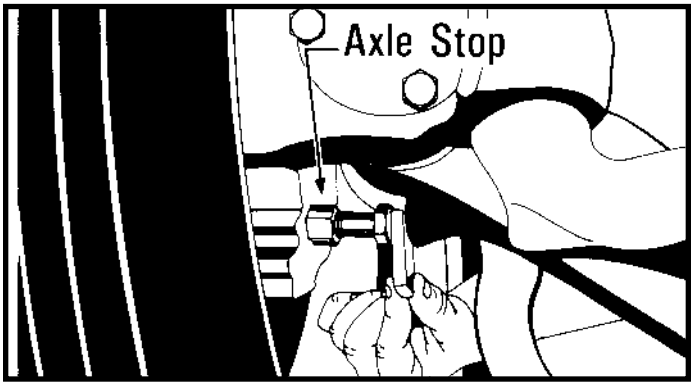


Figure 3

NOTE: Be sure you reinstall the relief valve, with new seals and O rings, back onto the gear. Follow assembly step 29.

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 HFB64 gear, isolate the auxiliary cylinder from the system by disconnecting the auxiliary cylinder hydraulic lines at the HFB64 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 HFB64 gear. See internal leakage diagram (FIG. 4).

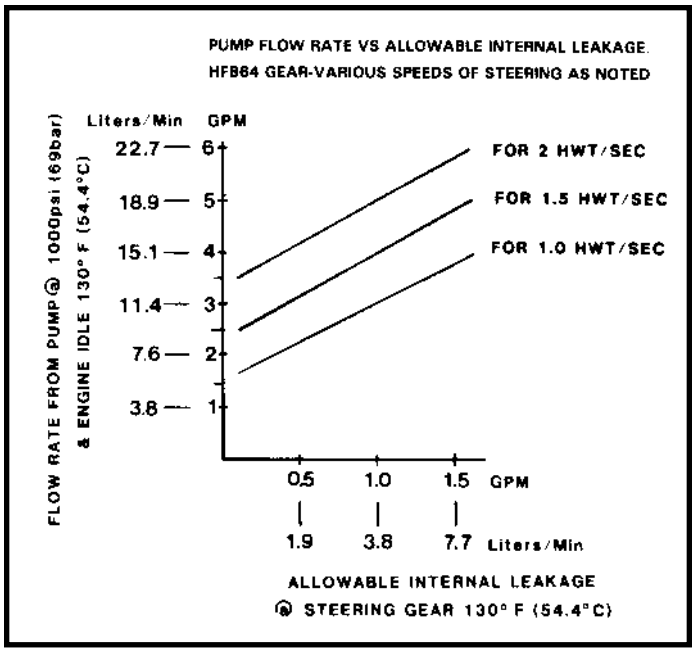


Figure 4

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

NOTE: If all seals as included in the complete seal kit have been correctly replaced, and the HFB64 steering gear cannot pass the internal leakage test, or if intermittent lose 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, . 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.
- 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 HFB64 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 (50). 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.

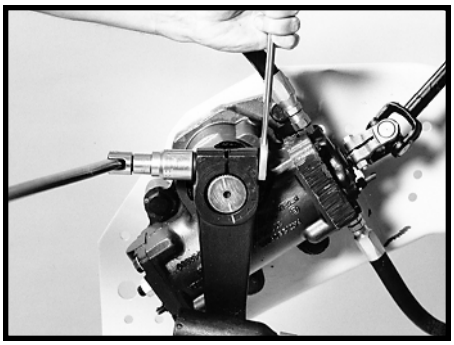


Figure 5

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.

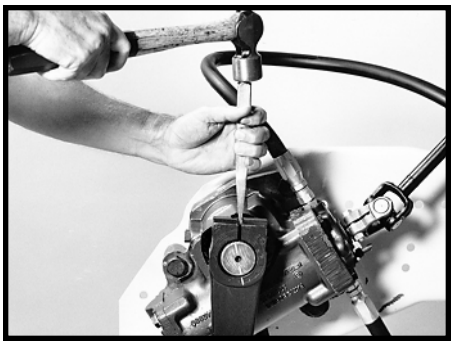


Figure 6

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 (63), grease fitting (64), if included, and dirt and water seal (27). SEE FIGURE 7. Discard protector boot and dirt and water seal.

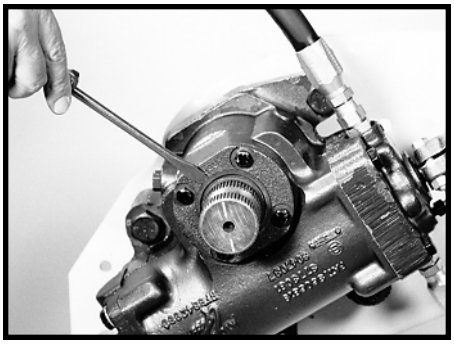


Figure 7

clean sector shaft

1.3 Clean the sector shaft (50) with a fine grade of emery paper. Be sure to remove any paint. SEE FIGURE 8.

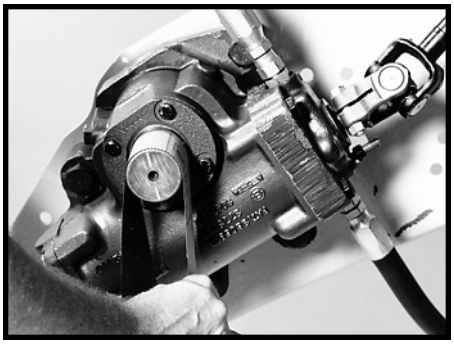


Figure 8

remove trunnion cover and seal package

1.4 Next, remove the four trunnion cover bolts (28), and trunnion cover (26). SEE FIGURE 9. 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 (25). SEE FIGURE 10.

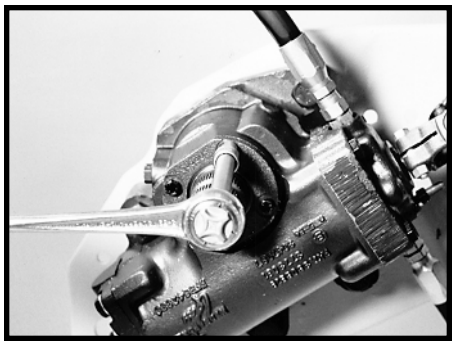


Figure 9

clean and inspect trunnion cover

1.5 Clean the trunnion cover (26) with petroleum based solvent and inspect the seal cavity and sealing face for nicks or corrosion. Replace the trunnion cover with a new one if these conditions exist.

WARNING

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

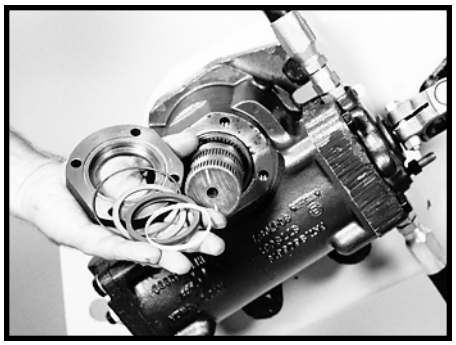


Figure 10

install new washer

1.6 Place the trunnion cover (26) on a bench to install the new seal package. Start with the Teflon backup washer (24).

install new seal

1.7 Install the two-piece sector shaft seal (23), so that the words "oil side" are visible after seal is in place. SEE FIGURE 11.

WARNING

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

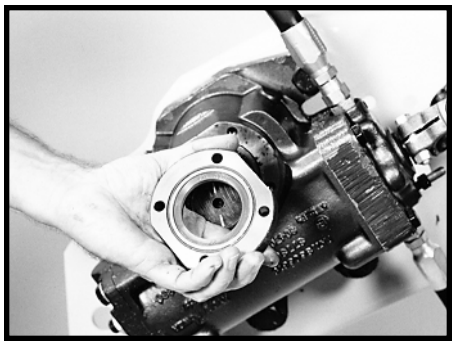


Figure 11

install new seal ring

1.8 Grease the new trunnion cover seal ring (25) and install it into the cover groove.

tape sector shaft

1.9 Cover the serrations of the sector shaft (50) with tape to avoid damaging the seals during installation. SEE FIGURE 12.

NOTE

NOTE: Use only one layer of tape.

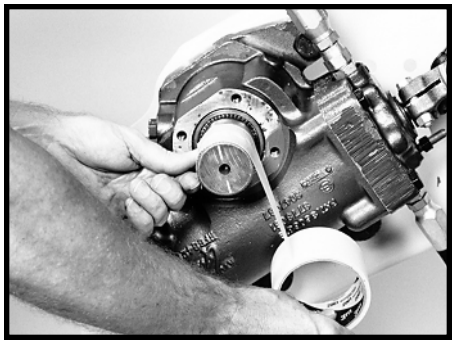


Figure 12

install trunnion cover & bolts

1.10 Install the trunnion cover (26) and four trunnion 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. One-half inch socket required. SEE FIGURES 13, 14.

*Teflon is a registered trademark of DuPont Corporation

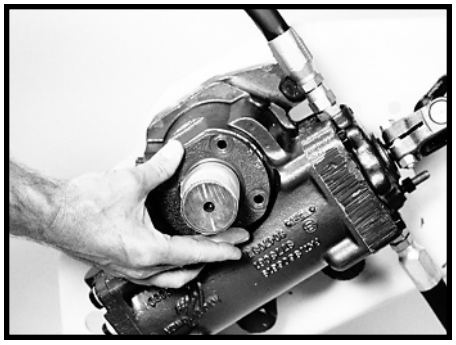


Figure 13

install new dirt and 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 (50). Install a new dirt and water seal (27) using a suitable blunt end drift. SEE FIGURE 15.

assemble protector boot & fitting

1.12 Apply a generous amount of the same grease to protector boot (63) in the area inside of the smaller diameter ring. Assemble protector boot onto sector shaft (50) and trunnion cover (26), locating the grease fitting hole toward the input shaft end of gear assembly. Insert grease fitting (64) into protector boot, if included. Remove tape from sector shaft serrations. SEE FIGURE 16.

NOTE

NOTE: The current protector boot does not have a grease fitting (64).

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 17.

WARNING

WARNING: WHEN USING A CHISEL TO SPREAD THE PITMAN ARM BOSS FOR ASSEMBLY ONTO THE SECTOR SHAFT (50), 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.

install and torque pitman arm bolt

1.14 Insert the pitman arm clamp bolt and nut assembly, using a 3/4-16 grade 8 bolt. SEE FIGURE 18. If the bolt is lubricated or plated, torque it to 300-320 ft. lbs. (407-434 N m). If dry and unplated, torque to 380-420 ft. lbs. (515-569 N m).

CAUTION

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

fill and bleed system

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

*Mobil Temp is a registered trademark of Mobil Oil Co.

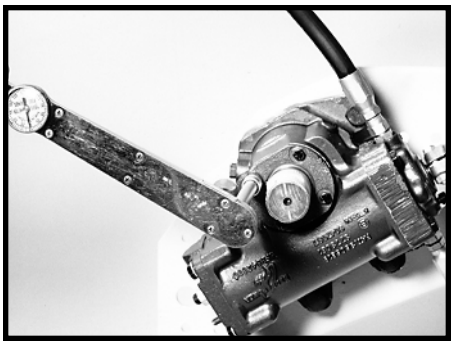


Figure 14

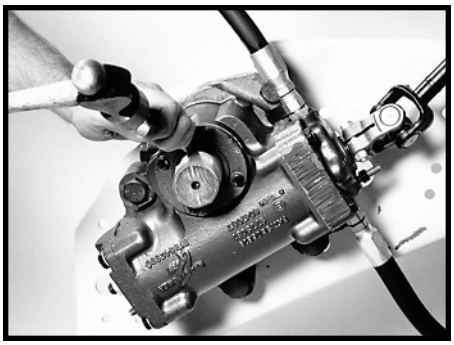


Figure 15

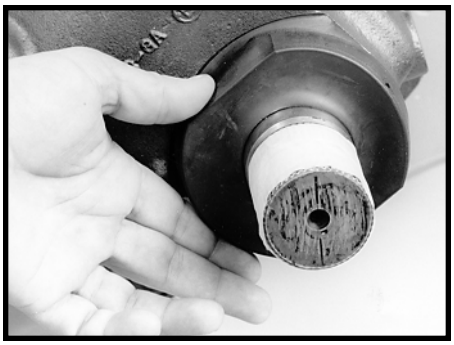


Figure 16

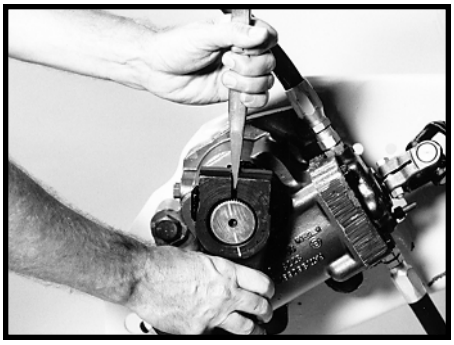


Figure 17

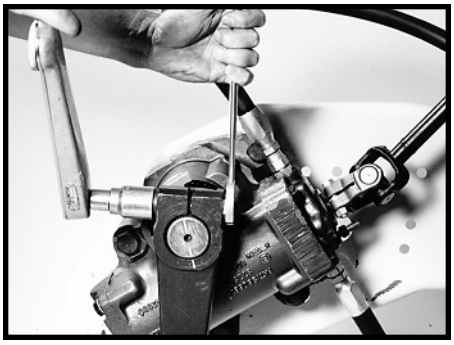


Figure 18

2 The Worm Shaft/Input Shaft Seal

remove input coupling; clean input shaft

2.1 If there is a leak in the shaft seal, you can usually replace the input shaft seal assembly (7 and 8) with the gear on the vehicle. Start by removing the input coupling per the vehicle manufacturers instructions. SEE FIGURE 19. Remove seal protector (62) and clean the area around the input shaft with a fine grade of emery paper. SEE FIGURE 20.

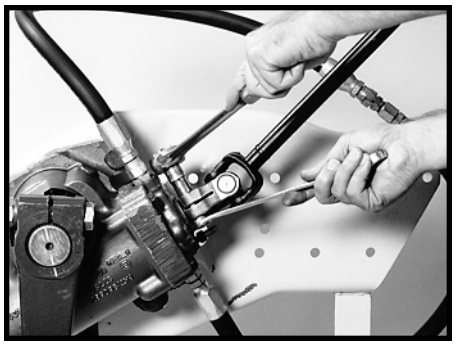


Figure 19

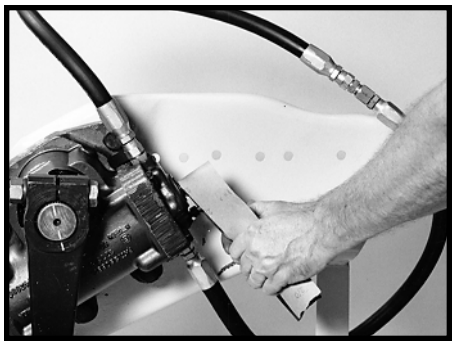


Figure 20

WARNING

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

remove and plug the return line

2.2 Remove and plug the return line. SEE FIGURE 21.

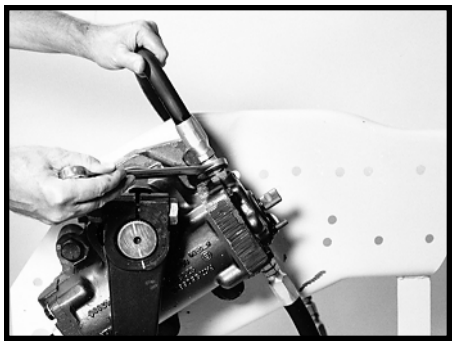


Figure 21

remove seal

2.3 Remove and discard the dirt and water seal (4). SEE FIGURE 22.

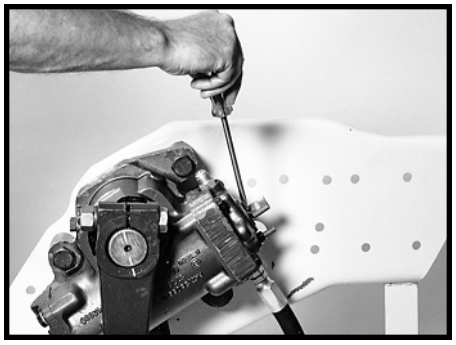


Figure 22

remove retaining ring

2.4 Remove the seal retaining ring (5) from the valve housing (9). SEE FIGURE 23.

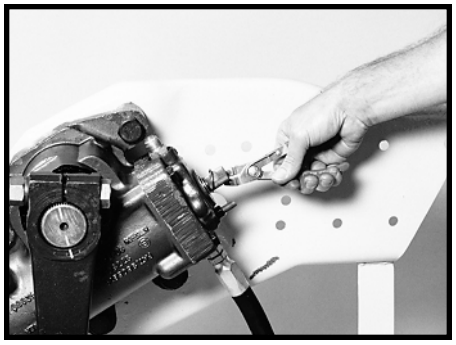


Figure 23

apply air pressure to port

2.5 Hold a shop rag over the worm shaft/input shaft (17) and apply shop air pressure to the valve housing return port. SEE FIGURE 24.

WARNING

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

Figure 24

remove seal and washer

2.6 The air pressure will force the two-piece input shaft seal (7 and 8) and the steel backup washer (6) to pop out of the gear, and some fluid will leak from the gear. Discard the two-piece seal. Disconnect the shop air as soon as the seal assembly is out. SEE FIGURE 25.

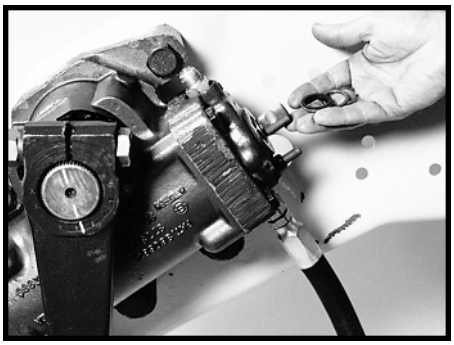


Figure 25

install seal package

2.7 Apply clean grease to the new input shaft seal assembly (7 and 8), the washer (6) and to the input shaft. Install the new two-piece seal (7 and 8) flat side up and the steel backup washer (6), using seal driving tool J26653. SEE FIGURE 26. Install the retaining ring (5).

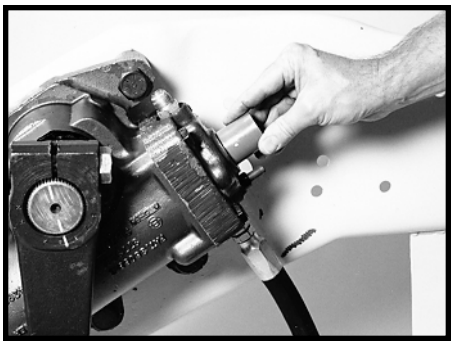


Figure 26

grease input shaft

2.8 Pack the area around the input shaft with high temperature industrial grease per Ross specification 045231, *Mobil Temp 1 or 2 equivalent. SEE FIGURE 27.

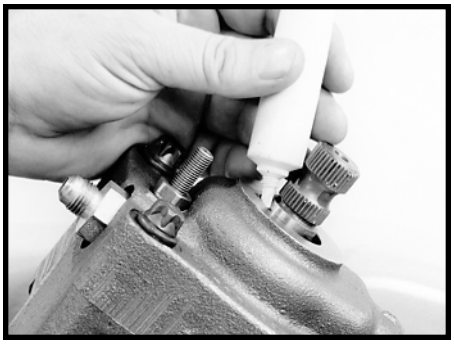


Figure 27

install dirt and water seal

2.9 Install the new dirt and water seal (4) onto the input shaft (17) with the part number facing out. Use tool J26654 or a suitable blunt-ended drift to press the seal into its counter bore. SEE FIGURE 28. If the new seal has a sealing lip on the O.D., it must be against the valve housing (9) face. If the new seal does not have a lip on the O.D., the outer end of the seal must be flush with valve housing face.

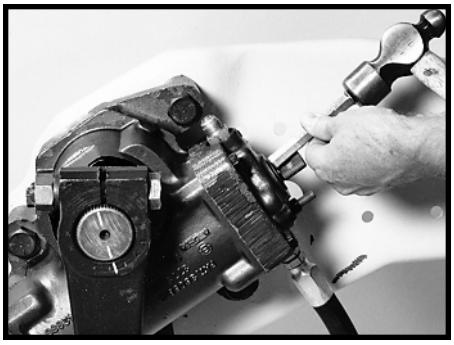


Figure 28

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

assemble seal protector

2.10 Add more grease to seal area and assemble seal protector (63) onto worm shaft/input shaft (17), seating it in the relief groove just beyond the input sift serrations, with cup side toward the gear. SEE FIGURE 29.

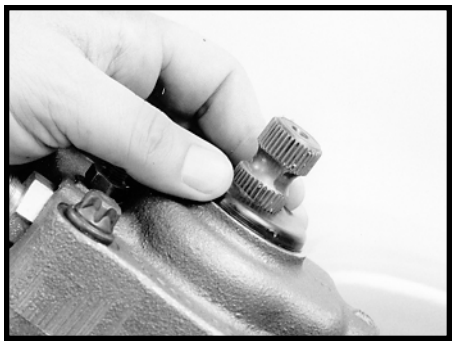


Figure 29

reconnect line

2.11 Remove the plug and reconnect the return line.

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 manufacturer for recommended 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 and bleed air from the system by following the Filling and Air 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 if your gear is equipped with poppets, and the sector shaft adjustment.

3 Worm Shaft Preload Adjustment

(With vehicle engine off)

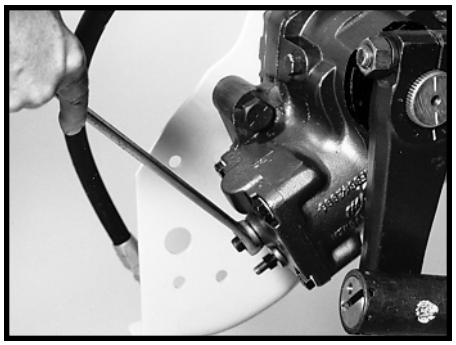


Figure 30

loosen sealing nut and adjusting screw

3.1 Back off the worm shaft adjusting screw sealing nut (38) three turns. SEE FIGURE 30. Back off the worm shaft preload adjusting screw (39) one turn. SEE FIGURE 31. Inspect the threads between the sealing nut and housing end (or end cover, 37, if equipped) for foreign matter. Clean the threads and replace the sealing nut if necessary. SEE FIGURE 32. One and 1/16 inch socket required.

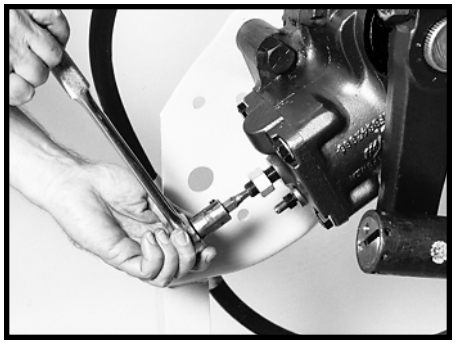


Figure 31

NOTE

NOTE: HFB64 gears are equipped with a housing that has either a closed, nonremovable end or a removable end cover (37). The worm shaft preload adjustment described here applies in either case, and you should make the adjustment according to the instructions in this manual.

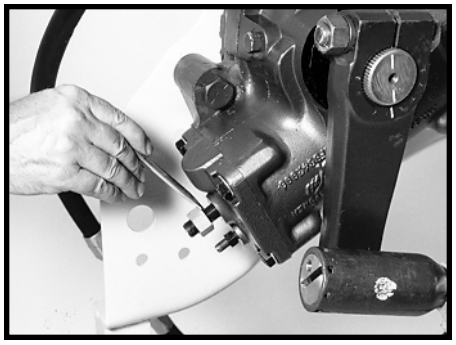


Figure 32

torque adjusting screw

3.2 While someone lightly rotates the steering wheel back and forth about one inch total, torque the worm shaft preload adjusting screw (39) to 60-70 in. lbs. (4.13-4.33 N m). SEE FIGURE 33. 5/16 inch allen or screwdriver socket required.

NOTE

NOTE: While torquing the adjusting screw, make sure that the worm shaft adjusting screw sealing nut (38) does not tighten against housing or cover.

torque sealing nut

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

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. Then, assemble and adjust the assembly as described.

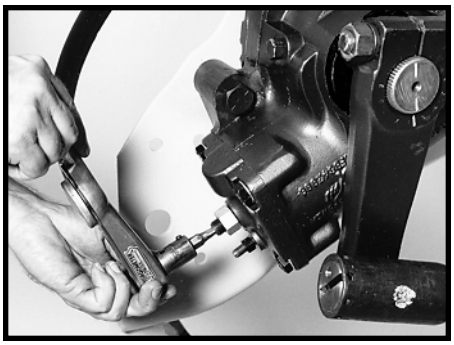


Figure 33

4 Poppet Valve Adjustment

(With vehicle engine on)

NOTE

NOTE: This adjustment is for all HFB64 gears equipped with poppet (unloading) valves, whether they are also equipped with a relief valve or not.

set axle stops

4.1 Before you adjust the poppets, set the axle stops according to the manufacturer's specifications.

install flow meter

4.2 Install a pressure gage or a flow meter/pressure gage package into the supply line from the pump to the gear. Make sure that the flow meter can be pressurized. Bring the fluid temperature to between 125¡F and 135¡F (51.7¡C and 57.2¡C), using the method to warm the system up described in the troubleshooting section, page 7.

rotate sector shaft

4.3 With the engine at idle, have someone turn the steering wheel to full lock (axle against axle stop), while you observe the rotation of the sector shaft (50) SEE FIGURE 34. If the sector shaft rotates counter-clockwise as shown, adjust the poppet adjusting screw identified in FIGURE 34. If the sector shaft rotates clockwise, adjust the other poppet adjusting screw.

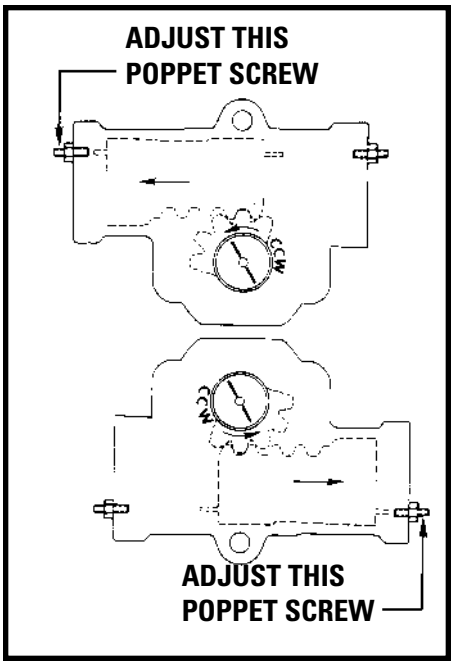


Figure 34

CAUTION

CAUTION: If relief pressure is reached while the steering wheel is at full lock (axle against axle stop), release the steering wheel from this position. At no time should relief pressure be maintained for longer than 5 seconds as damage to the pump may result.

NOTE

NOTE: You must maintain enough force on the steering wheel to assure that the steering gear control valve is completely closed when reading pressure gage.

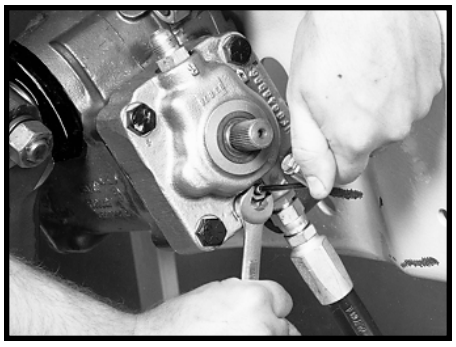


Figure 35

loosen sealing nut and adjusting screw

4.4 Once you have determined which poppet to adjust, loosen the poppet adjusting screw sealing nut (3 or 3A) and the poppet adjusting screw (2, 2A or 40) until the pressure gage reads maximum system (pump) pressure with steering wheel at full lock. SEE FIGURE 35.

CAUTION

CAUTION: If the HFB64 steering gear assembly has a 5/16-24 UNF-2A poppet adjusting screw (2A) in the valve housing (9), the screw cannot be removed from the assembled valve housing because the screw end inside of gear is enlarged. SEE FIGURE 36. This screw, found only in the valve housing, can only be removed, if required, by following the valve housing disassembly procedures.

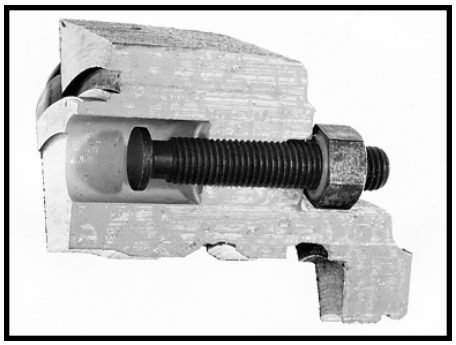


Figure 36

set adjusting screw & tighten sealing nut

4.5 Manually (no power tool) and carefully screw in the poppet adjusting screw (2, 2A or 40) until the pressure gage shows 2 significant drop in pressure, 200-400 psi (13.8-27.6 BAR) with the steering gear against the axle stops. Tighten the poppet adjusting screw sealing nut (3) which has 3/8-24 threads to 12-18 ft. lbs. (16-24 N m). 11/16 inch socket required. Tighten the poppet adjusting screw sealing nut (3A) which has 5/16-24 threads to 8-11 ft. lbs. (11-15 N m). 9/16 inch socket required.

adjust other poppet

4.6 To adjust the other poppet, repeat these instructions for full lock in the other direction. SEE FIGURE 37.

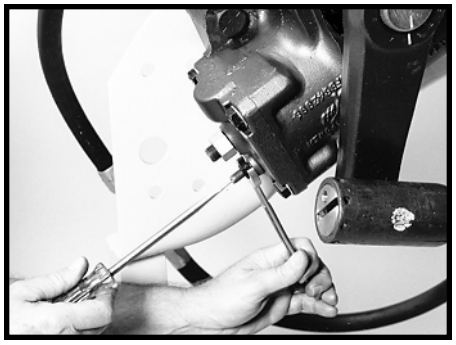


Figure 37

5 Cross-shaft or Sector-shaft Adjustment

(With vehicle engine off)

locate adjusting nut

5.1 If the sector-shaft adjusting screw jam nut (59), located on the side cover, is not accessible, the steering gear must be removed prior to adjustment.

remove the drag link

5.2 If the sector shaft adjusting screw (51) is accessible, remove the drag link from the pitman arm.

CAUTION

CAUTION: This adjustment must be performed with the sector shaft on its center of travel.

NOTE

NOTE: Because of pitman arm or internal stops or poppet adjustment the "center of travel" for this adjustment may not be the center of sector shaft or handwheel rotation.

center the sector shaft

5.3 To position the sector shaft (50) on center of travel for this adjustment rotate steering wheel (worm shaft/input shaft) until the timing mark across the end of the sector shaft is perpendicular to the worm shaft/input shaft 117). SEE FIGURE 38, page 20.

check for lash

5.4 With the sector shaft (50) in the center position, grasp the pitman arm and gently try to move this arm back and forth in the direction of travel. Finger-tip force is adequate to detect lash of a loose sector shaft. There must be no movement of the input shaft or sector shaft. If no lash is detected, do not adjust.

position adjusting screw

5.5 If lash is detected, loosen jam nut (59) with a 3/4 inch socket and move the adjusting screw (51) clockwise until the sector shaft and rack piston (31) are in contact. [Use no more than 10 ft. lbs. (14 N m) of torque]. Then, turn the adjusting screw counterclockwise one turn.

check for lash

5.6 At this point, there should be lash at the pitman arm.

eliminate lash

5.7 To adjust, slowly turn the adjusting screw (51) clockwise until no lash is felt at the pitman arm. Hold the adjusting screw in place, and tighten the jam nut (59). Final torque 40-45 ft. lbs. (54-61 N m).

recheck for lash

5.8 Recheck the pitman arm for lash. Turn the steering wheel 1/4 turn each side of center. No lash should be felt. If lash exists, repeat adjustments 5.3-5.8.

connect drag link

5.9 Re-connect drag link to pitman arm.

HFB64 Exploded Assembly View-Typical (Identical to page 19 C)

ITEM NO.

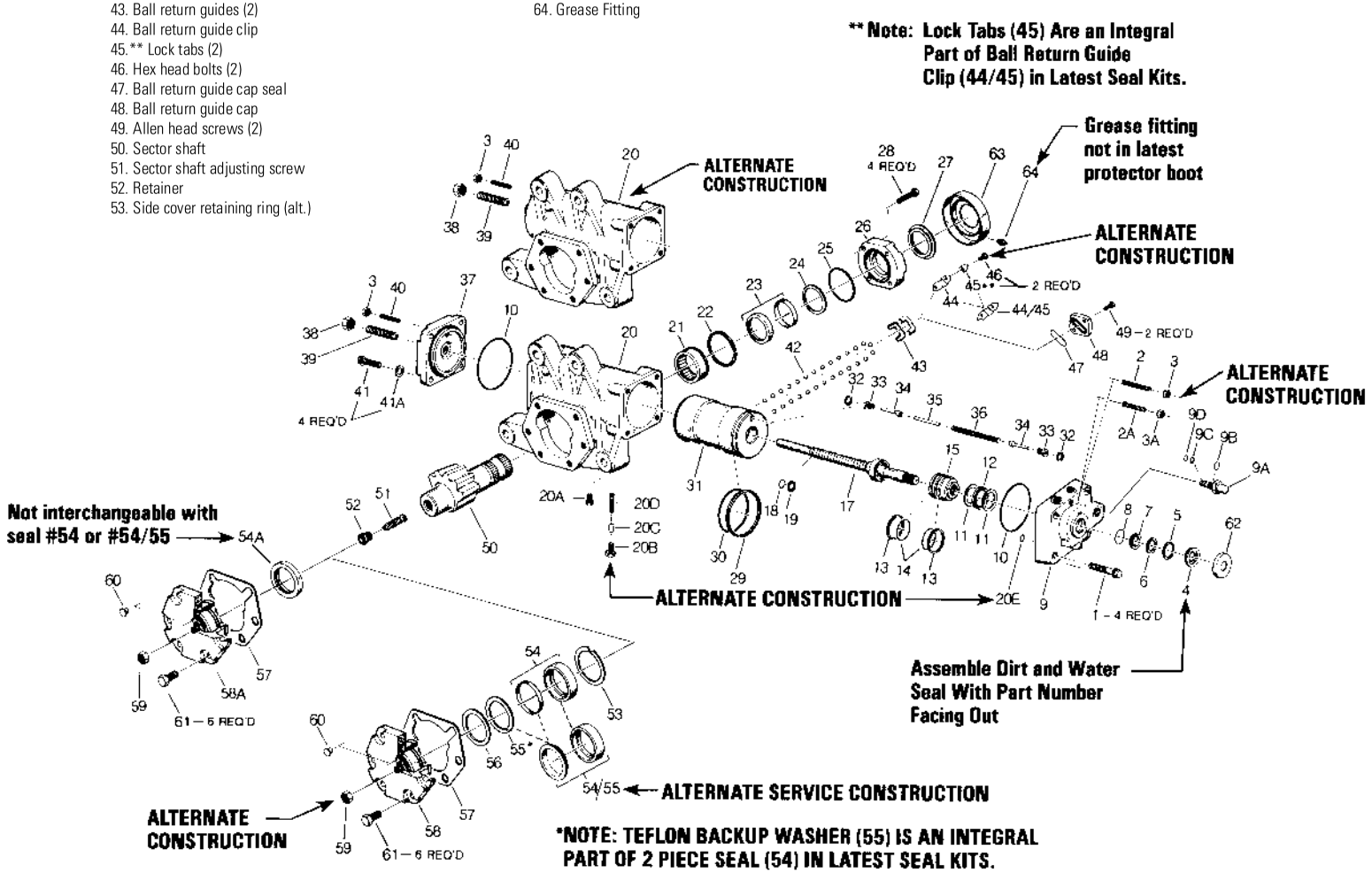
1. Valve housing bolts (4)
2. Poppet adjusting screw
2A. Allen Head Hex Poppet Adjusting Screw
3. Poppet adjusting screw sealing nut
3A. Poppet adjusting screw sealing nut
4. Dirt and water seal
5. Retaining ring
6. Steel backup washer
7. Input shaft seal
8. Input shaft O-ring
9. Valve housing
9A. Relief valve
9B. Large O-ring
9C. Teflon seal ring
9D. Small O-ring
10. Seal rings (2)
11. Thrust washers (21
12. Thrust bearing
13. Teflon seal rings (2)
14. Backup O rings (2)
15. Valve sleeve
17. Worm shaft/input shaft
18. Worm shaft backup O-ring
19. Teflon worm shaft seal ring
20. Gear housing
20A. Manual bleed screw
20B. Automatic bleed screw
20C. Special pin
20D. Spring
20E. Automatic Bleed Passage Way Seal
21. Housing bearing
22. Retaining ring
23. Two-piece sector shaft seal
24 Teflon backup washer
25. Trunnion cover seal ring
26. Trunnion cover
27. Dirt and water seal
28. Trunnion cover bolts (4)
29. Teflon rack piston seal ring
30. Rack piston backup O-ring
31. Rack piston

ITEM NO.

32. Poppet retaining rings (2)
33. Poppet seats (2)
34. Poppets (2)
35. Nylon spacer rod
36. Poppet spring
37. End cover
38. Worm shaft adjusting screw Sealing nut
39. Worm shaft adjusting screw
40. Poppet adjusting screw
41. End cover bolts (4)
41A Washers (4)
42. Steel balls (27)
43. Ball return guides (2)
44. Ball return guide clip
45.** Lock tabs (2)
46. Hex head bolts (2)
47. Ball return guide cap seal
48. Ball return guide cap
49. Allen head screws (2)
50. Sector shaft
51. Sector shaft adjusting screw
52. Retainer
53. Side cover retaining ring (alt.)

ITEM NO.

54. Two-piece side cover seal (alt.)
54A. Seal
55.* Teflon backup washer (alt.)
56. Steel backup washer (alt.)
57. Side cover gasket
58. Side cover (alt.)
58A. Side cover
59. Sector shaft adjusting screw jam nut
60. Vent plug
61. Special bolts (6)
62. Seal Protector
63. Seal Protector Boot
64. Grease Fitting



HFB64 Exploded Assembly View-Typical (Identical to page 19 B)

ITEM NO.

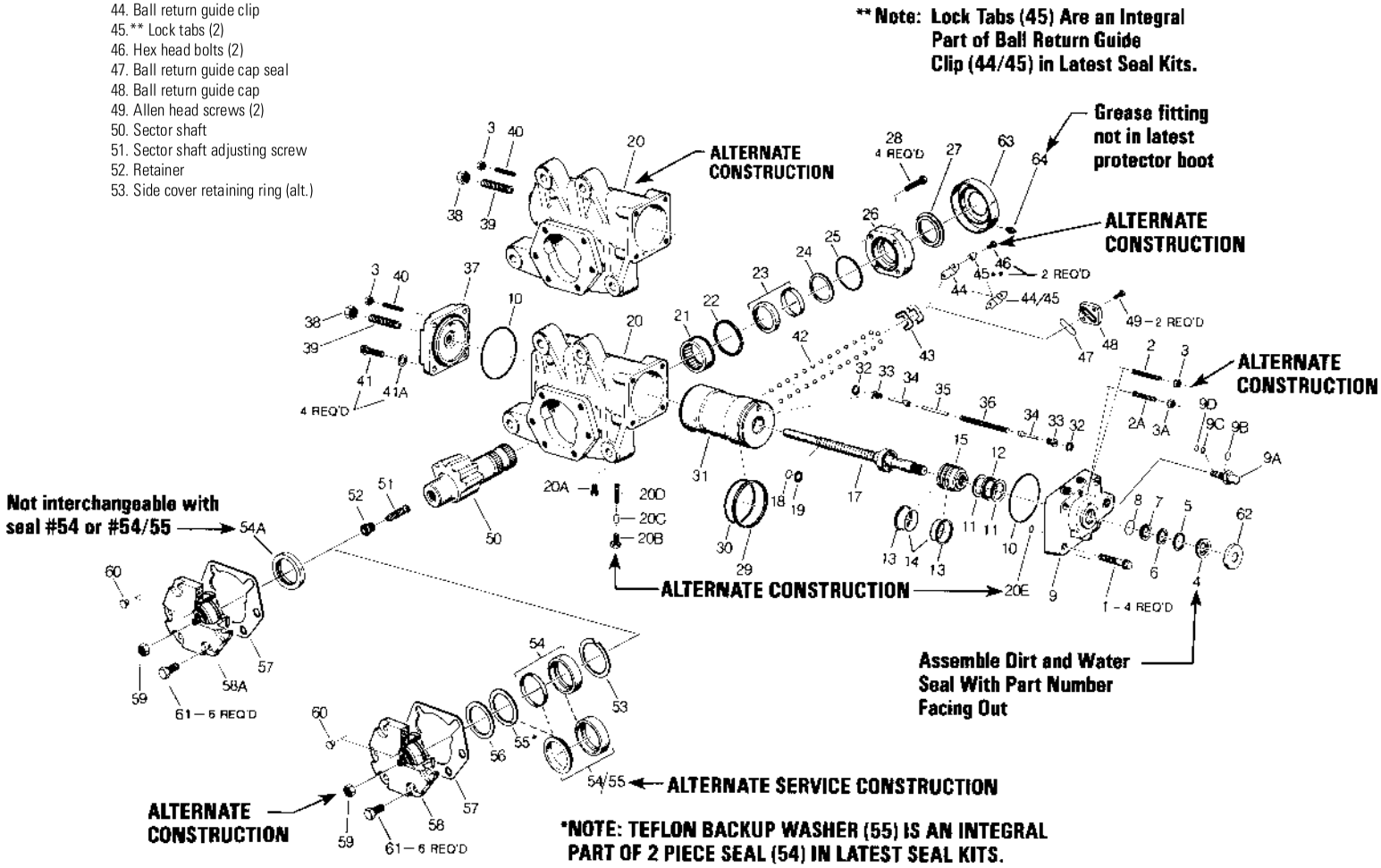
1. Valve housing bolts (4)
2. Poppet adjusting screw
2A. Allen Head Hex Poppet Adjusting Screw
3. Poppet adjusting screw sealing nut
3A. Poppet adjusting screw sealing nut
4. Dirt and water seal
5. Retaining ring
6. Steel backup washer
7. Input shaft seal
8. Input shaft O-ring
9. Valve housing
9A. Relief valve
9B. Large O-ring
9C. Teflon seal ring
9D. Small O-ring
10. Seal rings (2)
11. Thrust washers (21
12. Thrust bearing
13. Teflon seal rings (2)
14. Backup O rings (2)
15. Valve sleeve
17. Worm shaft/input shaft
18. Worm shaft backup O-ring
19. Teflon worm shaft seal ring
20. Gear housing
20A. Manual bleed screw
20B. Automatic bleed screw
20C. Special pin
20D. Spring
20E. Automatic Bleed Passage Way Seal
21. Housing bearing
22. Retaining ring
23. Two-piece sector shaft seal
24 Teflon backup washer
25. Trunnion cover seal ring
26. Trunnion cover
27. Dirt and water seal
28. Trunnion cover bolts (4)
29. Teflon rack piston seal ring
30. Rack piston backup O-ring
31. Rack piston

ITEM NO.

32. Poppet retaining rings (2)
33. Poppet seats (2)
34. Poppets (2)
35. Nylon spacer rod
36. Poppet spring
37. End cover
38. Worm shaft adjusting screw Sealing nut
39. Worm shaft adjusting screw
40. Poppet adjusting screw
41. End cover bolts (4)
41A Washers (4)
42. Steel balls (27)
43. Ball return guides (2)
44. Ball return guide clip
45.** Lock tabs (2)
46. Hex head bolts (2)
47. Ball return guide cap seal
48. Ball return guide cap
49. Allen head screws (2)
50. Sector shaft
51. Sector shaft adjusting screw
52. Retainer
53. Side cover retaining ring (alt.)

ITEM NO.

54. Two-piece side cover seal (alt.)
54A. Seal
55.* Teflon backup washer (alt.)
56. Steel backup washer (alt.)
57. Side cover gasket
58. Side cover (alt.)
58A. Side cover
59. Sector shaft adjusting screw jam nut
60. Vent plug
61. Special bolts (6)
62. Seal Protector
63. Seal Protector Boot
64. Grease Fitting



Torque Chart

Part Name	Item Number	Torque
Valve housing bolts (4)	1	105-115 ft. lbs. (142-156 Nm)
Valve housing bolts (4)	1 if lubricated	75-85 ft. lbs. (102-115 Nm)
Poppet adjusting screw sealing nut		
-3/8-24	3	12-18 ft. lbs. (16-24 Nm)
-5/16-24	3A	8-11 ft. lbs. (11-15 N m)
Relief valve	9A	25-35 ft. lbs. (34-48 N m)
Manual bleed screw	20A	27-33 in lbs. (3.1-3.7 N m)
Automatic bleed screw	20B	16-20 ft. lbs. (22-27 N m)
Auxiliary cylinder fittings	-	25-35 ft. lbs. (34-48 N m)
Trunnion cover bolts (4)	28	15-22 ft. lbs. (20-30 N m)
Trunnion cover bolts (4)	28 if lubricated	11-16 ft. lbs. (15-22 N m)
Poppet seat	33	20-25 ft. lbs. (27-34 N m)
Worm shaft adjusting screw sealing nut	38	70-8- ft. lbs. (95-108 N m)
Worm shaft preload adjusting screw	39	60-7- in. lbs. (6.8-7.9 N m)
End cover bolts (4)	41	105-115 ft. lbs. (142-156 N m)
End cover bolts (4)	41if lubricated	75-85 ft. lbs. (102-115 N m)
Hex head bolts (2)	46	14-22 ft. lbs. (19-30 N m)
Allen or Torx head screws (2)	49	14-22 ft. lbs. (19-30 N m)
Sector shaft adjusting screw	59	40-45 ft. lbs. (54-61 N m)
Special bolts (6)	61	220-240 ft. lbs. (298-325 N m)
Special bolts (6)	61 if lubricated	160-180 ft. lbs. (217-244 N m)
Pitman arm clamp bolt	lubed or plated	300-320 ft. lbs. (407-434 N m)
Pitman arm clamp bolt	dry/unplated	380-420 ft. lbs. (515-569 N m)

Universal joint bolts - torque to vehicle manufacturer's specifications.

All torque values in this manual are for dry/unplated parts unless otherwise specified.

Tools and Materials Required for Servicing

Service manual
Masking tape
Grease - **Mobil Temp 1 or 2 or equivalent
Wheel bearing grease
Adjustable wrench
Pocket knife
Torque wrench - in. lbs. (N m)
Torque wrench 0 ft. lbs. (N m)
Soft punch
Rubber mallet
Allen wrench set
Vise
Retaining pliers
Breaker bar
Ratchet
Sockets: 5/16, 1/2, 9/16, 11/16, 3/4
15/16, 1 and 1 1/16 inch
Allen sockets: 5/32, 3/16, 5/16 inch
12-point sockets: 11/16 and 3/4 inch
Torx sockets: T-30, E-10, E-16
Pitman arm puller
Screwdriver
Slot type screwdriver socket
Chisel
Box end wrenches: 9/16, 11/16, 1 1/16 inch
Rolling head prybar (ladyfoot)
1/2-20 UNF 2A x 3 inch bolt

Special Tools*

Complete Tool Kit	J26872	Seal Driving Tool	J26653
Seal Installation Tool	J26650-01	Seal Driving Tool	J26654
Seal Compression Tool	J26649	Relief Valve Plug	J29059
Seal Installation Tool	J26647	Bearing & Seal Tool	J37071
Seal Compression Tool	J26648		

*Special Tools Available From:
Kent-Moore Tool Division
29784 Little Mack
Roseville, MI 48066
Phone: 313-774-9500
TELEX: 23-5377

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