SHEPPARD

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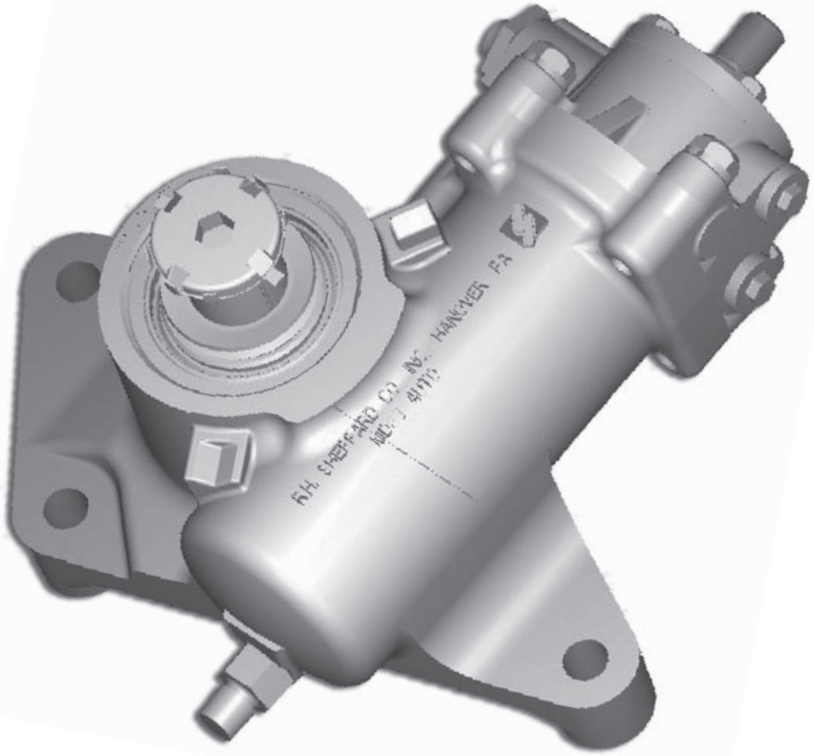
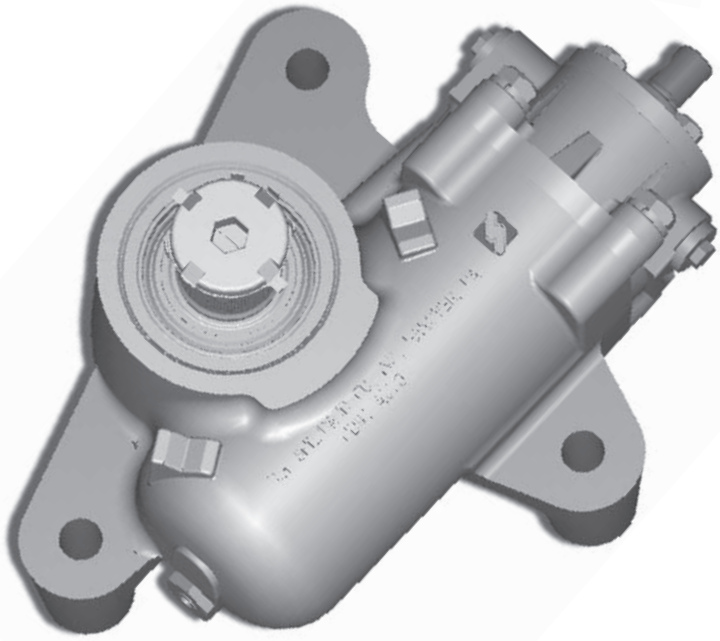
D-SERIES INTEGRAL POWER STEERING GEAR MANUAL





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Questions or Problems?
Call Sheppard Field Service at 800-2RH-SHEP (274-7437)
or refer to the Service Section at www.rhsheppard.com.

Part# 1000205 rev. A

The Sheppard D-Series Integral Power Steering Gear is a full-time hydraulic steering unit. When compared to earlier Sheppard units and to other steering gears on the market, the D-Series gear has a number of competitive advantages.

- **Four Applications** (Figure 1) – For front axle ratings from 6,000 to in excess of 23,000 lbs.

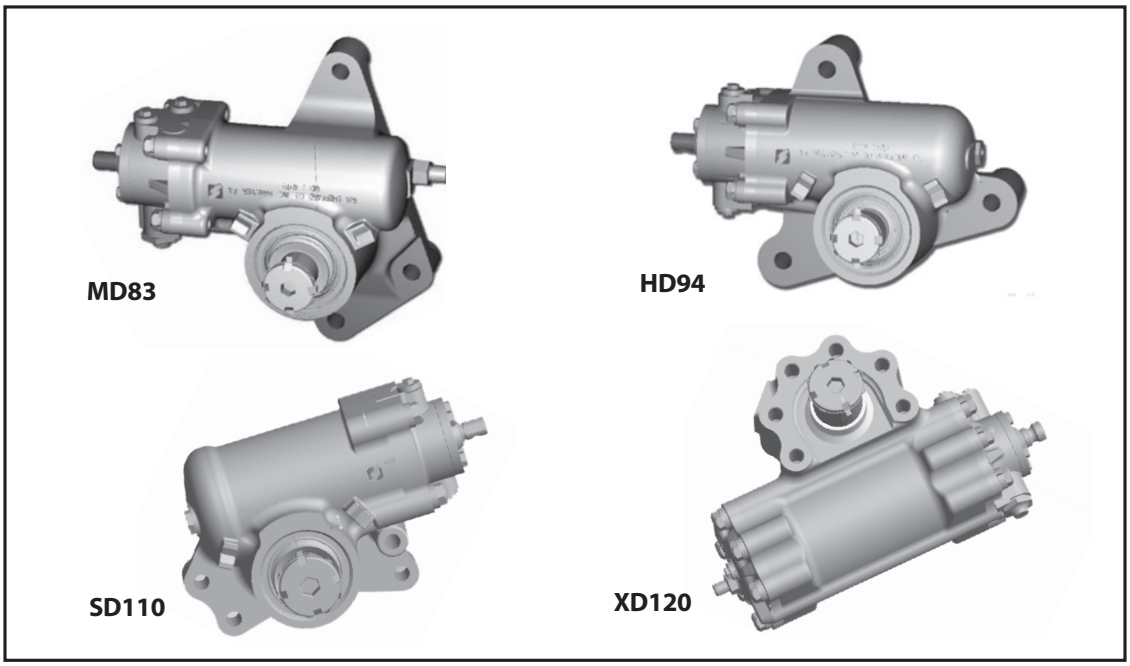


Figure 1. HD and MD Steering Gears.

- **Better Road Feel** – The gear feels stiffer on-center, yet takes no more effort to park than a standard gear. The time lag between steering input and response is greatly reduced.
- **Improved Overall Performance** – The D-Series gear's 16.9 ratio is the fastest on the market for quicker steering response and less driver effort. The HD is 11.4% more responsive than the current M100 gear.
- **Less Vibration** – Hydraulics are smoother to damp shudder and shake.
- **Lighter Weight** -- Stronger ductile iron reduces wall thickness and weight by about 10 pounds.
- **Improved Maneuverability** – The piston and sector shaft mating redesign makes the HD about 1.5 inches shorter than previous Sheppard models for closer mounting to the frame rail, so wheel cut angles can be sharper. The autoplunger is recessed into the cylinder end to shorten overall length.
- **Quieter** – The patent-pending 8-slot valve produces less than 70 decibels, which is below the driver's audible range from within the cab.
- **Longer Life** – The sector cover seals have been redesigned for substantially longer seal life, and the remaining seals utilize the finest material available. The blind bore cylinder head reduces potential leaks and saves space. The piston rack and sector shaft have a new, more robust gear tooth design. The cylinder head autoplunger is inside a removable cartridge for ease of maintenance.

D-Series Specifications – US Standard Units

	MD83	HD94	SD110	XD120
Front Axle Range	6K - 10K	10K - 14.6K	14.6K - 18K	18K - 23K
Output Torque @ Rated Pressure 90% Efficiency	35,058 inch lbs	45,439 inch lbs	59,760 inch lbs	78,825 inch lbs
Rated Pressure	2,683 psi	2,683 psi	2,756 psi	2,176 psi
Min. Pump Flow @ 1.5 H.W.T./S	2.3 GPM	2.9 GPM	3.7 GPM	4.5 GPM
Pump Flow Range Single	2.3 - 3.8 GPM	2.9 - 4.4 GPM	3.7 - 5.2 GPM	4.5 - 6.0 GPM
Ratio	16.9	16.9	16.9	23
Gear Travel	95°	95	95	96
Max. Operating Temperature	200 F	200 F	200 F	200 F
Output Shaft Diameter	2.00 in.	2.00 in.	2.25 in.	2.50 in.
Approx. Dry Weight	60	70	85	~140
Pump Flow Range @ 1.5 HWT/S Dual w/	MD	HD	SD	
HD94	5.2 - 6.7 GPM			
SD110	6 - 7.5	6.6 -8.1 GPM		
XD120	6.8 - 8.2	7.4 -8.9	8.2 - 9.7 GPM	
Output Torque @ Pressure 2,683 PSI 90% efficiency	MD	HD	SD	
HD94	80,497			
SD110	93,246	103,626		
	@ 2,176 psi	@ 2,176 psi	@ 2,176 psi	
XD120	107,251	115,668	126,004	

Operating Principles

When the engine is running, a constant low-pressure oil flow through the steering gear gives instant response and absorbs road shock to help eliminate steering wheel kick. Pressure is equal throughout the steering gear, except in two situations:

- When the engine or supply pump is not running, any towing or moving the vehicle should be done carefully because the steering may be much slower to respond to correction.
- In addition, in the unlikely event of sudden pressure loss, the system reverts to mechanical back-up steering so that the vehicle may be safely steered to the side of the road.

Special Warranty Procedure

Before replacing a Sheppard steering gear for ANY reason, please contact the RH Sheppard Service Hotline at 800-2RH-SHEP (274-7437). RHS experts will provide troubleshooting assistance and, if necessary, an authorization (RGA) number. This RGA should be noted on the warranty claim AND on the steering gear being returned. Claims for steering gears replaced without prior authorization from RHS may be denied.

Warranty and Installation Tips

Sheppard power steering gears are manufactured and tested for proper operation prior to shipment. Every effort has been made to ensure that the product will deliver many miles of trouble-free, safe operation. To protect your customer's investment and comply with the warranty, it is important that these instructions be closely followed.

- Any time a power steering gear or power steering pump is replaced, the oil and oil filter in the power steering system must be changed (see the Maintenance section of this manual on page 31). All lines and fittings must be flushed of any possible contaminants. Use the type of fluid specified by the vehicle manufacturer or 15W40 engine oil if none is specified.

NOTE: Sheppard recommends following the vehicle manufacturer's schedule for changing the power steering system filter and fluids.

- If a power steering pump has been replaced, it should be tested to ensure that its pressure and oil flow are the same as originally specified by the vehicle manufacturer.
- When installing the steering gear on the vehicle, take care to ensure the mounting bracket or steering gear is not distorted when the bolts are tightened. Distortion could cause binding in the gear.
- Transfer the hose fittings from the old steering gear to the new one. Replace the O-rings.
- Attach all hoses to the gear or gears. Ensure they are in good condition and routed with no kinks in the line. Refer to the next section (page 5) for proper routing of dual steer systems. On D-Series gears, the inlet and outlet ports are staggered. The inlet port is always the one closest to the output shaft.
- Install the steering column or intermediate shaft to the steering gear input shaft. Ensure the clamp bolt is torqued to the vehicle manufacturer's specification.
- Install the pitman arm using the guidelines found in this manual. Take care not to move the arm more than 2 inches in either direction until the draglink has been installed. Over-traveling the piston will prematurely set automatic relief plungers.
- Install the draglink on the pitman arm (except slave gears) and torque the fastener to the vehicle manufacturer's specification. Slave gears should not have the draglink installed until the bleeding procedure.

NOTE: The pitman arm may be mistimed if you cannot turn the steering all the way until the stops contact the axle in each direction with the steer tires off the ground.

- Fill the power steering system with an approved fluid. Start the engine and let it idle. DO NOT ALLOW THE RESERVOIR TO RUN DRY!

IMPORTANT! Set the automatic relief plungers to obtain proper wheel cut. Use the procedures on page 18.

- Bleed the gear or gears using the guidelines found in this manual.
- Double-check all fasteners, fittings, and hose routings. Check for leaks. Top off the power steering system and return the vehicle to service.

Routing D-Series Dual Gear Hoses and Lines

Two or more integral steering gears ("master" and "slave" units) are sometimes used where front axle weights exceed 16,000-pounds. Dual steering systems balance the steering gear output across two or more steering arms and conserve under-hood space.

Pressure from the master gear on the vehicle's left side powers the secondary or slave unit (Figure 2) on the vehicle's right side. Hydraulic pressure and flow move the slave gear in the opposite direction of the master gear. Another difference between the two units is that hydraulic relief plungers are not used in the slave gear. Master gear relief plungers will relieve hydraulic pressure for both gears when properly adjusted.

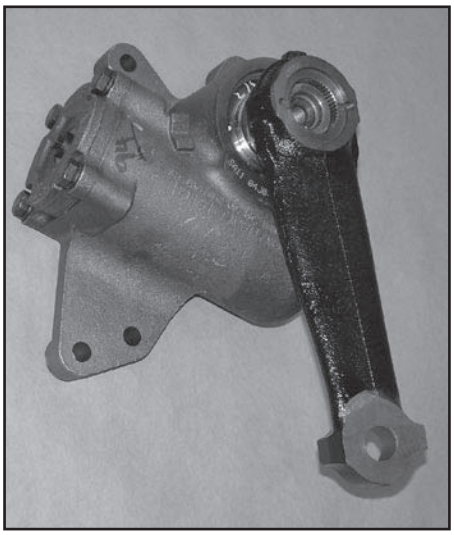


Figure 2. HD94 Slave Gear.

The dual system is mechanically linked to the front-end components by a draglink and steer arm on the right hand spindle on the axle. However, only hydraulic connections, with no physical mechanical components, exist between the master and slave units (Figure 3).

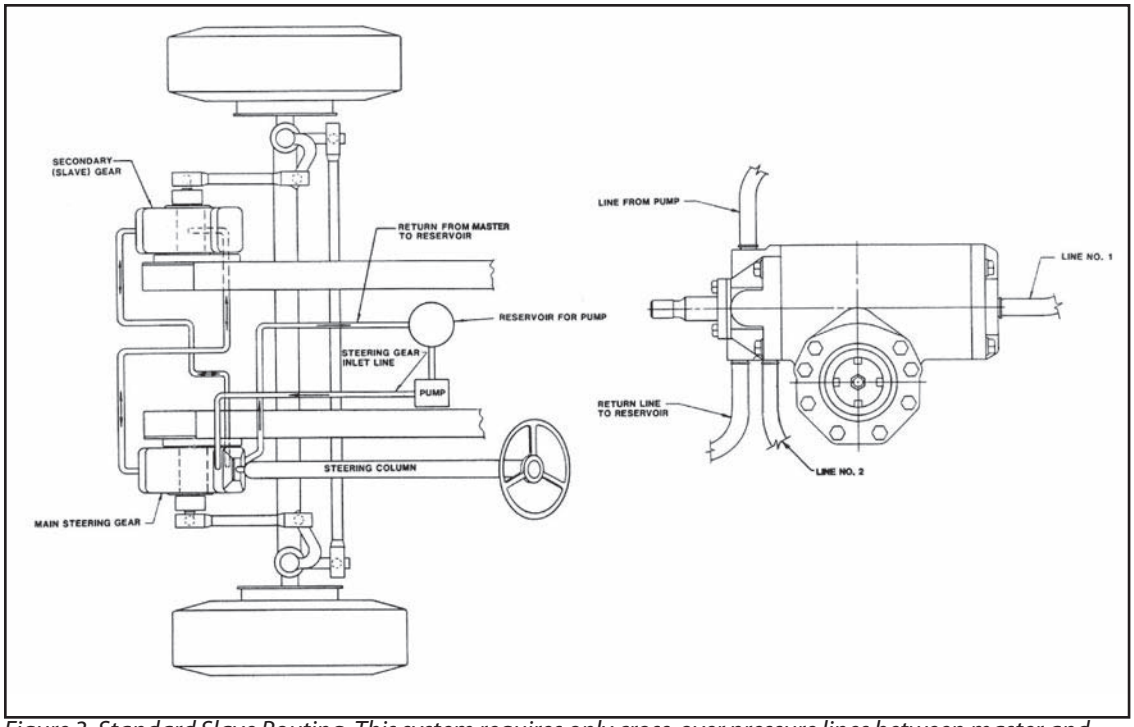


Figure 3. Standard Slave Routing. This system requires only cross-over pressure lines between master and slave, requiring no additional line.

Pitman Arm Installation

WARNING: Proper pitman arm installation is crucial to the safe operation of the vehicle. Correct torque values are very important! Always follow these procedures when installing the pitman arm.

DANGER: If the pitman arm is not applied as specified, it can cause an accident. Any time a pitman arm is found loose, replace the pitman arm and the sector shaft.

Tools Required

- ✓ Appropriate size Allen drive bit
- ✓ Torque wrench
- ✓ Hammer
- ✓ Punch
- ✓ Anti-seize compound

Procedure:

NOTE: Mount the steering gear on the frame to make pitman arm installation easier.

1. To install the pitman arm:
   a. Install the arm onto the sector shaft, taking care to align the timing marks (Figure 4).
   b. Install the pitman arm retainer into the sector shaft, taking care to align the tabs in the notches of the arm (Figure 5).
   c. Apply anti-seize compound:
      i. To the retainer threads.
      ii. To both sides of the friction washer if the retainer is new.

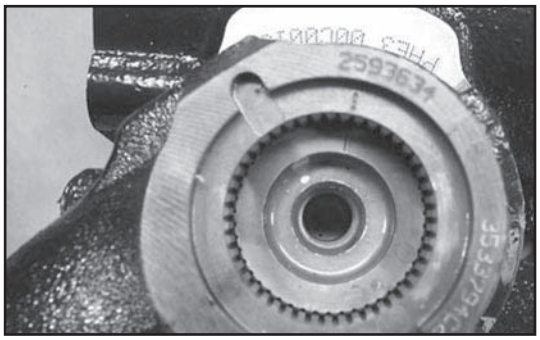


Figure 4. Aligned Timing Marks.

Figure 5. Aligned Tabs.

! ***CAUTION***: In step 2 below, take note of the torque value on the face of the retainer. Always torque the retainer to the specified value.

2. Torque the retainer to the specified value.

! ***DANGER***: Do not back off the torque value to align the tabs! A loose pitman arm or loss of steering control could result.

3. Continue torquing the retainer past the specified value until two of the notches in the retainer align with the tabs of the washer (Figure 6).
4. Use the punch and hammer to bend the restraining tabs of the washer into the notches of the retainer (Figure 7).
5. Apply torque putty to the tabs for future reference.

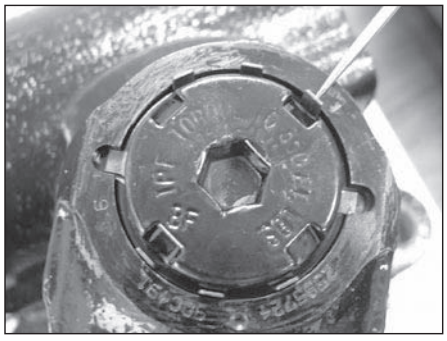


Figure 6. Aligning with Washer Tabs.

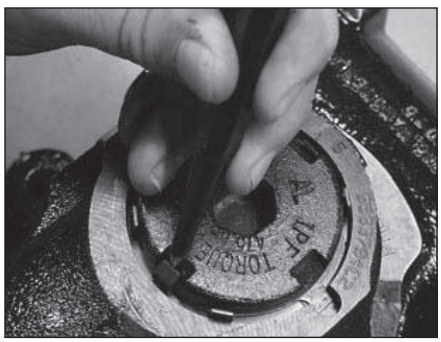


Figure 7. Bending Retainer Tabs.

SHEPPARD STEERING GEAR PITMAN ARM REMOVAL INSTRUCTIONS

CAUTION – The pitman arm removes with great force and a loud bang may occur when the arm breaks free from the sector shaft. Exercise extreme caution when using this removal tool. Always wear safety glasses or a face shield.

TOOLS REQUIRED:
Sheppard Pitman Arm Puller 3589922K
3/4" or 5/8" Allen drive socket
Impact wrench
15/16" Impact socket
Punch
Hammer
Chassis grease

Figure 8.

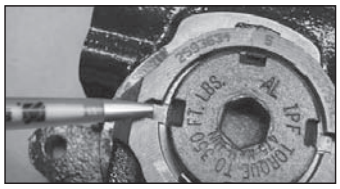


Figure 9.

WARNING – THE PITMAN ARM WILL BE EXTREMELY TIGHT! USE ONLY LIGHT HAMMER BLOWS WHEN TAPPING ON THE ARM TO REMOVE IT! NEVER APPLY HEAT TO THE PITMAN ARM OR STEERING GEAR AS DAMAGE TO THE PITMAN ARM, SECTOR SHAFT, OR SEALS MAY RESULT!

NOTE – The pitman arm is easiest to remove while the steering gear is still mounted to the vehicle, in most applications. The 3/8" bolts and large flat washer are used when pulling smaller arms.

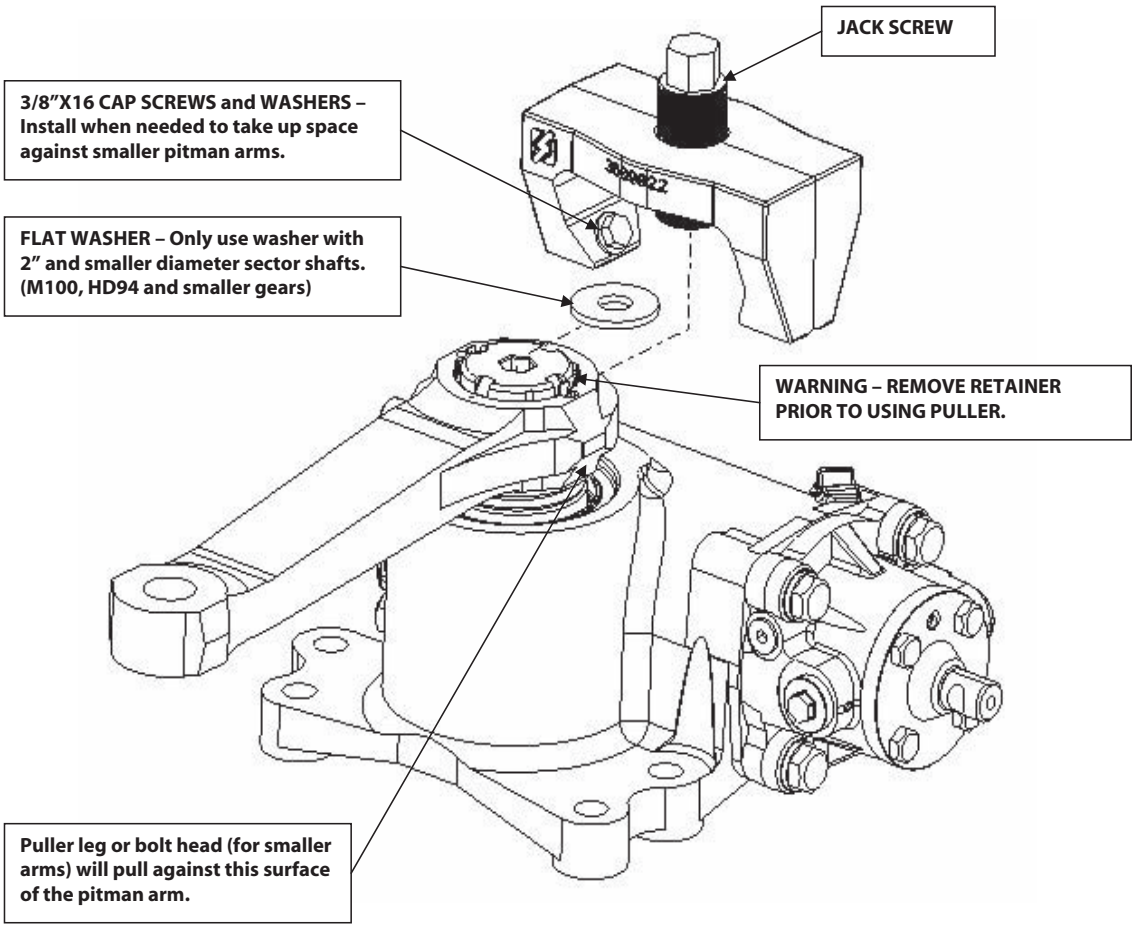
1. Park the vehicle and secure it for service per the manufacturer's directions.
2. Disconnect the drag link from the pitman arm per the manufacturer's directions.
3. Use the punch to bend the restraining tabs out of the notches in the pitman arm retainer. (Figure 8)
4. Do not bend the tabs out of the 2 slots machined into the pitman arm. (Figure 9)
5. Using the appropriate Allen drive socket and impact wrench, remove the retainer. If the retainer is not damaged, it may be reused.
6. Apply a dab of chassis grease to the end of the sector shaft and to the threads of the puller jackscrew.
7. Use the large flat washer on the end of the sector shaft and apply a coat of grease to it if sector shaft is 2" or smaller. Slide the puller over the end of the pitman arm far enough that the jackscrew will be centered on the end of the sector shaft and washer. You may have to tap the puller with the hammer to get it properly positioned on the arm. Ensure the jackscrew is centered and makes contact down in the recess of the sector shaft counter bore.
8. If pulling a narrow arm, screw the 3/8" bolts into the puller legs from the inside, so that the bolt heads make contact with the pitman arm.

NOTE – The jackscrew must be centered squarely on the end of the sector shaft. Damage to the puller will result if it is not aligned properly.

9. Tighten the jackscrew with the impact wrench and remove the pitman arm. Tapping on the arm with a hammer at the same time will aide in loosening the arm.

CONTACT THE SHEPPARD FIELD SERVICE HOTLINE AT 1-800-274-7437 IF YOU HAVE ANY QUESTIONS ON THE USE OF THIS PULLER OR THE REPAIR OF SHEPPARD PRODUCTS.

Sheppard Pitman Arm Puller 3589922K



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INPUT SHAFT SEAL REPLACEMENT

TOOL REQUIRED:

Drain Pan	15/16",½" Drive Socket	¼" Flat Screwdrive	Seal Pick
Rags	1",½" Drive Socket	Small Ball Peen Hammer	
5/8",½" Drive Socket	½" Drive Ratchet Handle	11/16" Combination Wrench	
16mm, ½" Drive Socket	0-100 ft/lb (minimum)	½" Drive Torque Wrench	

1. Remove the steering column lower yoke from the steering gear input shaft using the 5/8" socket and 11/16" wrench. Place the drain pan below the steering gear. Depending on how the gear is mounted, some fluid may be lost.
2. Remove the rubber boot from the input shaft with the screwdriver.
   IMPORTANT! CLEAN THE AREA AROUND THE INPUT SHAFT!
   WARNING! DO NOT TURN THE INPUT SHAFT WITH THE BEARING CAP COVER REMOVED! TURNING THE SHAFT OR MIXING OF COMPONENTS WILL CAUSE DAMAGE TO THE INPUT SHAFT, ROTARY VALVE, THRUST BEARINGS AND BEARING CAP.
3. Remove the four bolts on the bearing cap cover with the 16mm socket and remove the cover by prying it off evenly with the screwdriver.
   CAUTION! THE THRUST WASHER MAY STICK TO THE COVER. IF IT DOES, REINSTALL THE WASHER ON TOP OF THE THRUST BEARING IN THE BEARING CAP. (Figure 10)
4. Pry the outside salt seal from the cover with the screwdriver and discard it. Remove the cover washer (if equipped) with the screwdriver. (Figure 11)
5. Using the 15/16" socket or seal driver, tap the input (high pressure) seal out of the cover and discard it.
6. Remove the o-ring from the bottom of the cover with the seal pick and discard it.
7. Using the 1" socket or a seal driver, tap the new input seal into the cover with the gold spring facing the bottom of the cover, toward the thrust bearings. A press or vice may also be used.
8. Locate the appropriate size salt seal and tap it into the cover with the 1" socket. Ensure the seal lip or silver spring is facing the top of the cover, toward the steering column.

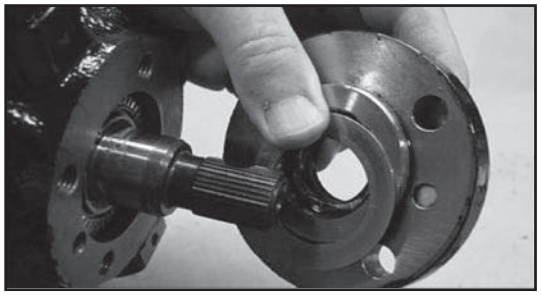


Figure 10. Reinstalling Thrust Washer.

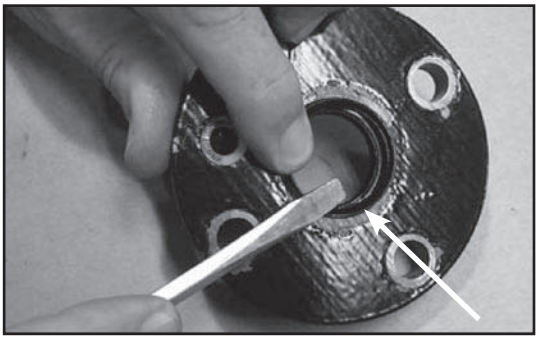


Figure 11. Discarding Salt Seal.

SEAL REPLACEMENT

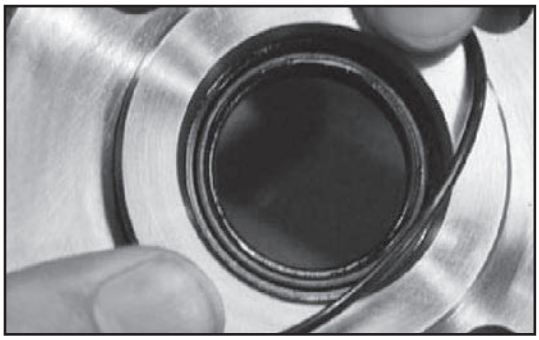


Figure 12. Installing Bearing Cap Cover O-ring.

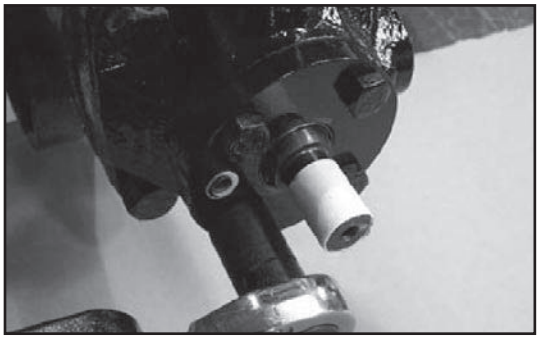


Figure 13. Taped Splines.

9. Install the new o-ring onto the outside of the cover. (Figure 12) Tap the cover washer back in the cover if equipped.
10. Using #2 chassis grease, fill the area between the seals. No further greasing is required or recommended. If the cover has a grease fitting, remove it and fill the hole with silicone sealant.
11. Lube the o-ring and seal lips with a light coat of grease. Wrap the input shaft splines with tape to avoid damaging the new seals and install the cover onto the bearing cap making sure not to roll the lip of the high pressure seal. Ensure the small hole in the cover is aligned with the relief plunger screw hole in the bearing cap. Torque the bolts to 53-64 ft/lbs. (Figure 13)
12. Choose the correct size rubber boot and install it over the input shaft. Ensure it is pushed down below the bottom of the splines and makes good contact with the cover.
13. Remove the tape from the input shaft and reinstall the steering column lower yoke. Torque the pinch bolt to manufacturer's specification.
14. Fill the power steering reservoir to the proper level, start the truck and check for leaks.

NOTE: In step 3 below, lubricate the retainer face. Otherwise, pitman arm removal will be difficult.

3. Lubricate the face of the retainer with clean chassis lube.
4. To remove the pitman arm:
    a. Slide the pitman arm puller over the pitman arm. NOTE: It will be necessary to remove the sector shaft cover bolts to slide the puller over the arm if the gear has a bolt-on cover.
    b. Take care to align the hole in the puller with the Allen socket in the retainer.
    c. Insert the Allen drive socket through the puller and into the retainer socket.
    d. Use an impact wrench to back off the retainer. The retainer will act as a jackscrew to remove the pitman arm.

INPUT SHAFT SEAL REPLACEMENT

TOOL REQUIRED:

Drain Pan	15/16", ½" Drive Socket	¼" Flat Screwdriver	Seal Pick
Rags	1", ½" Drive Socket	Small Ball Peen Hammer	
5/8", ½" Drive Socket	½" Drive Ratchet Handle	11/16" Combination Wrench	
16mm, ½" Drive Socket	0-100 ft/lb (minimum) ½" Drive Torque Wrench		

1. Remove the steering column lower yoke from the steering gear input shaft using the 5/8" socket and 11/16" wrench. Place the drain pan below the steering gear. Depending on how the gear is mounted, some fluid may be lost.
2. Remove the rubber boot from the input shaft with the screwdriver.
   IMPORTANT! CLEAN THE AREA AROUND THE INPUT SHAFT!
   WARNING! DO NOT TURN THE INPUT SHAFT WITH THE BEARING CAP COVER REMOVED! TURNING THE SHAFT OR MIXING OF COMPONENTS WILL CAUSE DAMAGE TO THE INPUT SHAFT, ROTARY VALVE, THRUST BEARINGS AND BEARING CAP.
3. Remove the four bolts on the bearing cap cover with the 16mm socket and remove the cover by prying it off evenly with the screwdriver.

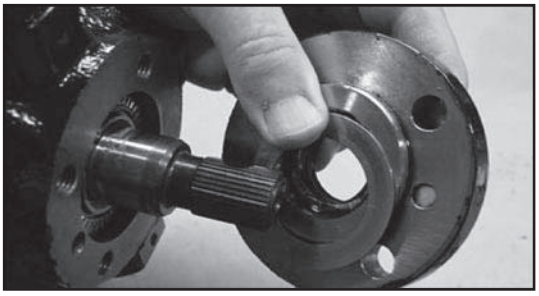


Figure 10. Reinstalling Thrust Washer.

Figure 11. Discarding Salt Seal.

CAUTION! THE THRUST WASHER MAY STICK TO THE COVER. IF IT DOES, REINSTALL THE WASHER ON TOP OF THE THRUST BEARING IN THE BEARING CAP. (Figure 10)

4. Pry the outside salt seal from the cover with the screwdriver and discard it. Remove the cover washer (if equipped) with the screwdriver. (Figure 11)
5. Using the 15/16" socket or seal driver, tap the input (high pressure) seal out of the cover and discard it.
6. Remove the o-ring from the bottom of the cover with the seal pick and discard it.
7. Using the 1" socket or a seal driver, tap the new input seal into the cover with the gold spring facing the bottom of the cover, toward the thrust bearings. A press or vice may also be used.
8. Locate the appropriate size salt seal and tap it into the cover with the 1" socket. Ensure the seal lip or silver spring is facing the top of the cover, toward the steering column.

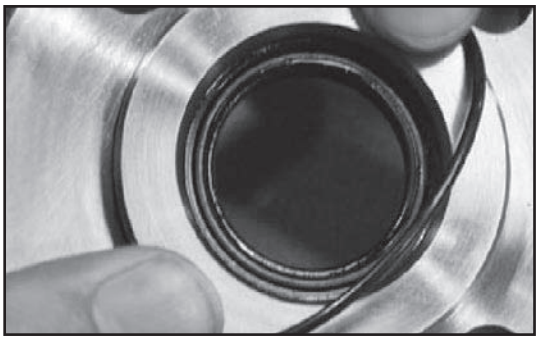


Figure 12. Installing Bearing Cap Cover O-ring.

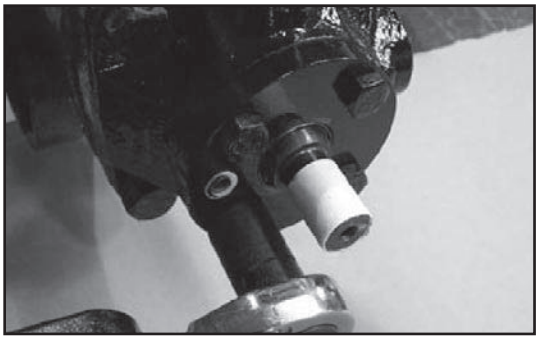


Figure 13. Taped Splines.

9. Install the new o-ring onto the outside of the cover. (Figure 12) Tap the cover washer back in the cover if equipped.
10. Using #2 chassis grease, fill the area between the seals. No further greasing is required or recommended. If the cover has a grease fitting, remove it and fill the hole with silicone sealant.
11. Lube the o-ring and seal lips with a light coat of grease. Wrap the input shaft splines with tape to avoid damaging the new seals and install the cover onto the bearing cap making sure not to roll the lip of the high pressure seal. Ensure the small hole in the cover is aligned with the relief plunger screw hole in the bearing cap. Torque the bolts to 53-64 ft/lbs. (Figure 13)
12. Choose the correct size rubber boot and install it over the input shaft. Ensure it is pushed down below the bottom of the splines and makes good contact with the cover.
13. Remove the tape from the input shaft and reinstall the steering column lower yoke. Torque the pinch bolt to manufacturer's specification.
14. Fill the power steering reservoir to the proper level, start the truck and check for leaks.

SECTOR SHAFT SEAL REPLACEMENT

TOOL REQUIRED:

Drain Pan	5/8" or ¾",½" Drive Allen Socket	15/16" Impact Socket
Rags	Silicone Sealer Impact Wrench½"	Drive Ratchet Handle
1/8" Punch	Very Large Snap Ring Pliers	13mm ½" Drive Socket
Medium sized Hammer	0-600 ft/lb Torque Wrench	18mm ½" Drive Socket
¼" Flat Screwdriver	Sheppard Pitman Arm Puller 3591842K or equivalent	
Seal Pick		

1. Park the vehicle on a clean dry surface, shut off the engine and set the parking brake. Place a drain pan under the steering gear.
   NOTE: FOR STEERING GEAR MODELS MOUNTED INSIDE THE FRAME RAIL OR WHERE THE PITMAN ARM IS BETWEEN THE STEERING GEAR AND THE FRAME RAIL, THE STEERING GEAR MUST BE REMOVED FROM THE VEHICLE FOR SECTOR SEAL REPLACEMENT.
2. Bend the locking tabs away from the pitman arm retainer using the punch and hammer. Remove the retainer using the 5/8" or ¾" Allen Drive Socket. Remove the pitman arm with the puller, using the 15/16" impact socket and impact wrench.
   Only a Sheppard pitman arm puller or a jaw-type puller should be used to remove the pitman arm on snap ring design housings.
   CAUTION! DO NOT ATTEMPT TO REMOVE THE ARM BY USING A WEDGE BETWEEN THE PITMAN ARM AND HOUSING. HOUSING DAMAGE WILL RESULT! DO NOT APPLY HEAT TO THE PITMAN ARM!
3. Remove the V-boot from the sector shaft. Remove the snap ring protective cover, if equipped, by carefully prying the plastic seal from the housing with a screwdriver. Take care to not damage the housing during removal. Clean any RTV sealant from the snap ring area.
4. Remove the stick on plastic dust cover or metal hub cap from the back side of the housing if equipped.
5. Carefully clean any paint or corrosion from the housing to allow the cover to slide freely out of the housing. Remove the snap ring using a suitable size pair of snap ring pliers or "walk it out" with a pair of flat bladed screwdrivers. Remove the retaining clips and bolts (with 13mm socket), if equipped, or the bolt on cover (with 18mm socket) as required.
   DANGER! THE SNAP RING CAN SLIP OFF OF THE PLIERS WHEN REMOVED FROM THE HOUSING. TAKE CARE WHEN REMOVING THE SNAP RING AS PERSONAL INJURY CAN RESULT.
6. Start the truck and allow the circulating pressure of the system to push the sector shaft cover out of the housing. Shut off the engine when the cover exits the housing. You may start two bolts on bolt on covers to ensure the cover does not completely exit the housing. A slide hammer may also be used to remove the sector shaft and cover, or the cover and shaft can be driven out of the housing from the opposite side if the steering gear is removed from the vehicle.
   CAUTION! DO NOT TURN THE STEERING WHEEL WHILE REMOVING THE COVER! INCREASED PRESSURE FROM TURNING CAN CAUSE THE COVER TO BE FORCED OUT CAUSING PERSONAL INJURY.

SEAL REPLACEMENT

7. Remove the sector shaft and cover from the steering gear housing.
8. Remove the sector shaft seals from the housing and cover using the seal pick. Carefully pry the pressed in excluder from the cover with the screwdriver, taking care not to damage the housing surface.
9. Remove the O-ring from the sector shaft cover, or the 2 piece L-seal from the housing. (Figure 14)
10. Install 1 new sector shaft seal in the sector cover and 1 new sector shaft seal in the housing. Install the sector shaft seals so the black side (pressure seal) faces the inside of the steering gear. Lubricate the seals with clean chassis lube after installation.
    CAUTION! THE SECTOR SHAFT OIL SEALS ARE TWO PIECE SEALS. IT WILL BE NECESSARY TO BEND THE SEALS TO INSTALL THEM. SET ONE SIDE OF THE SEAL IN THE GROOVE, AND WALK IT IN USING YOUR FINGERS. WHEN THE SEAL IS IN PLACE IT MAY BE NECESSARY TO WORK THE SEAL WITH YOUR FINGERS OR A BLUNT SEAL PICK TO PROPERLY SEAT THE SEAL. WHEN USING A SEAL PICK TO SEAT THE SEAL, PUSH ONLY ON THE BODY OF THE SEAL AND NOT ON THE SEAL LIP. DAMAGE TO THE SEAL LIP WILL CAUSE AN OIL LEAK. THE SEAL SHOULD LOOK PERFECTLY ROUND WHEN INSTALLED.
    NOTE: ALL SNAP RING STYLE GEARS WILL UTILIZE THE THICKER O-RING SUPPLIED OR THE 2 PIECE L-SEAL.

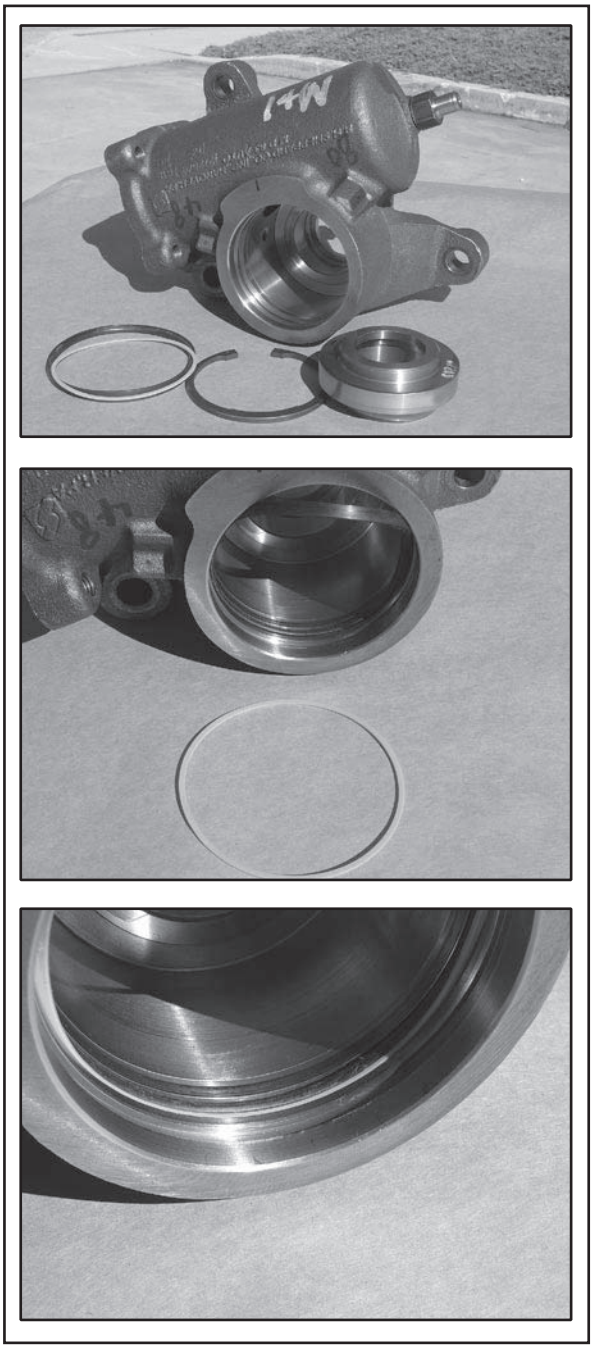


Figure 14. MD83 Showing Housing, L-Seal, New Cover, and Backup Ring.

11. Install the new O-ring on the sector shaft cover taking care not to twist it during installation if so equipped or, install the new 2 piece L-seal into the housing by first inserting the black pressure seal into the housing with the L side facing out. Then insert the flat backup ring into the L side of the pressure seal. When assembled, the backup ring will be on the side of the L-seal facing out. Apply a coat of clean chassis lube to the O-ring or L-seal prior to installing the cover into the housing.
12. Install the new excluder seal into the face of the sector cover by tapping it into place with the hammer.

13. Install the sector shaft into the housing. Take care to align the timing mark on the sector shaft with the timing marks on the piston. Failure to align the timing marks will result in incorrect turn radius.
14. Install the cover over the sector shaft. Light hammer blows will be required to install the cover.
    CAUTION! USE ONLY ENOUGH FORCE TO INSTALL THE COVER. EXCESSIVE FORCE ON THE COVER COULD DAMAGE THE SECTOR SHAFT COVER OR BEARING AND STEERING GEAR DAMAGE WILL RESULT. THE COVER MUST BE INSTALLED TO FLUSH OR BELOW THE SNAP RING GROOVE IN THE HOUSING ON SNAP RING AND CLIP RETAINED COVERS.
15. Install the snap ring or install the cover retaining bolts or retaining clips with bolts in bolt on cover designs. Torque the cover bolts to 72-87 ft/lbs and clip bolts to 31-38 ft/lbs.
    DANGER! THE SNAP RING CAN SLIP OFF THE PLIERS WHEN REMOVED FROM THE HOUSING. TAKE CARE WHEN INSTALLING THE SNAP RING AS PERSONAL INJURY CAN RESULT.
    DANGER! THE SNAP RING MUST BE FULLY SEATED IN THE SNAP RING GROOVE. IMPROPERLY SEATED SNAP RINGS CAN COME OUT WITHOUT WARNING! LOSS OF STEERING CONTROL, AN OIL LEAK OR PERSONAL INJURY MAY RESULT.
16. Install the snap ring protective cover into the housing over the snap ring by lightly tapping on the outside diameter of the cover until it bottoms in the bore. It may be necessary to tap on the body of the cover with the punch and hammer to fully seat the cover.
17. Pack the V-boot with clean chassis lube and slide the V-boot over the sector shaft splines until the lip contacts the sector shaft cover. On models with a groove cut into the sector shaft under the splines using the boot which has one lip larger than the other, the larger lip should be facing the pitman arm. Slide the boot on until it snaps into the groove. Clean all excess grease from the sector shaft splines.
18. Attach the new frame side dust cover by cleaning the housing with a solvent and applying the new disk over the sector shaft bore with a small bead of RTV silicone on the edge of the disk. Apply a bead of silicone inside the edge of the housing before installing the hub cap.
19. Install the pitman arm by aligning the timing mark on the arm to the timing mark on the end of the sector shaft. Ensure the splines of the arm and shaft are clean and dry. Screw the retainer in making sure the tabs on the washer sit into the groves machined into the pitman arm. Torque the retainer to the value stamped on the face of the retainer. Keep applying torque until the locking tabs on the washer align with the slots in the retainer. Bend the lock tabs into the retainer.
    WARNING! PROPER INSTALLATION OF THE PITMAN ARM IS CRITICAL. IMPROPER INSTALLATION OF THE ARM CAN CAUSE AN ACCIDENT AT A LATER DATE. DO NOT BACK OFF WHEN TIGHTENING RETAINER!
20. Fill the system with an approved fluid. Start the engine, check and correct the fluid level. Check for leaks. Bleed the system if necessary. Refer to the Sheppard Power Steering service manual #1000400 for the proper bleeding procedure. Return the vehicle to service.

END CAP SEAL REPLACEMENT

TOOL REQUIRED:

Drain Pan		1/8" and ¼" Flat Screwdriver	Vice Grip Locking Pliers
Rags	Seal Pick	Small Ball Peen Hammer	11/16" Combination Wrench
5/8",½" Drive Socket		½" Drive Ratchet Handle	2-7/8" Combination Wrenches
16,18,21 or 24mm, ½" Drive Socket		0-300 ft/lb (minimum) ½" Drive Torque Wrench	

Place a drain pan under the steering gear.
NOTE: AUTO PLUNGER STEERING GEARS MAY REQUIRE PART NUMBER 18212821K IF THE PLUNGER IS DAMAGED DURING DISASSEMBLY OR REASSEMBLY.

CYLINDER HEAD:

1. Mark the cylinder head and housing for alignment. Remove the four large bolts from the cylinder head using a 16,18,21 or 24mm socket. Remove the cylinder head.
2. Remove the square ring and tetra seal from the cylinder head with the seal pick and discard.
3. Remove the relief plunger and replace the o-ring supplied in the kit. Manual plungers can be unscrewed using a flat bladed screwdriver. AUTO Plungers must be disassembled (flange nut removed from the plunger) and the plunger pushed out of the cylinder head or cartridge. Replace the o-ring, coat with clean chassis lube and install the plunger back into the cylinder head or cartridge. Apply lock-tite to the plunger threads and tighten the flange nut against the spring pin.
   NOTE: YOU WILL NEED TO CHECK AND CORRECT THE RELIEF PLUNGER SETTINGS AFTER REPAIR.
4. Clean the cylinder head using a suitable solvent. Install the square ring or o-ring in the groove of the cylinder head and install the tetra seal in the small gland of the cylinder head. Apply a light coat of clean chassis lube to hold the seals in place during installation.
5. Install the cylinder head onto the housing, taking care to align the marks made during disassembly. Insure that the tetra seal aligns with the tube of the housing.
6. Torque the bolts to the spec listed on the next page of this instruction.

BEARING CAP:

1. Mark the bearing cap and housing for reassembly. Remove the lower u-joint from the steering gear input shaft using the 5/8" socket and 11/16" wrench. Remove the hoses and fittings using the 7/8" wrenches and vice grip pliers (if required for removing clamps).
2. Using the 16,18,21 or 24mm socket remove the four large bolts from the bearing cap. **DO NOT REMOVE THE BEARING CAP COVER AROUND THE INPUT SHAFT**. Turn the input shaft and raise the bearing cap off the housing until it stops so the seal can be accessed.
3. Using a seal pick, remove the square ring or o-ring and tetra seal from the bearing cap and discard.

3. Carefully stretch the square ring or o-ring over the bearing cap assembly. It can be warmed under hot water to allow it to stretch easier. Take care not to over stretch the seal. With the seal over the bearing cap, push the square ring or o-ring into the seal groove of the bearing cap. Use clean chassis lube to hold the seal into the seal groove. Install the tetra seal in the smaller groove of the bearing cap and lightly coat the seal with clean chassis lube.
4. Remove the relief plunger and replace the o-ring supplied in the kit. Manual plungers can be unscrewed using a flat bladed screwdriver. AUTO Plungers must be disassembled (flange nut removed from the plunger) and the plunger pushed out of the cylinder head or cartridge. Replace the o-ring, coat with clean chassis lube and install the plunger back into the cylinder head or cartridge. Apply lock-tite to the plunger threads and tighten the flange nut against the spring pin. **NOTE:** YOU WILL NEED TO CHECK AND CORRECT THE RELIEF PLUNGER SETTINGS AFTER REPAIR.
5. Turn the input shaft into the steering gear taking care to align the marks on the housing and bearing cap. Take care not to pinch the seals during assembly.
6. Install the four attaching bolts and torque to specifications listed in this instruction.
7. Install the u-joint following the vehicle manufacturers' guidelines. Start the vehicle. Check and correct the fluid level in the system.
8. Check and correct relief plunger settings as required.

TORQUE SPECS AND SOCKET SIZES
FOR BOLTS ON ALL D-SERIES AND M-SERIES SHEPPARD STEERING GEARS

APPLICATION	SIZE	GRADE	FT/LBS	(NM)	SOCKET
Bearing Cap Cover Bolts-All D&M Series	M10 X 1.5	10.9	53-64	(72-87)	16mm
Bearing Cap Bolts -					
M80	M10 X 1.5	10.9	53-64	(72-87)	16mm
M90	M12 X 1.75	8.8	72-87	(97-118)	18mm
M100	M14 X 2.0	8.8	114-140	(154-190)	21mm
M110	M16 X 2.0	10.9	230-277	(312-376)	24mm
MD83	M14 X 2.0	9.8/10.9	114-140	(154-190)	21mm
HD94	M14 X 2.0	9.8/10.9	114-140	(154-190)	21mm
SD110	M16 X 2.0	10.9	230-277	(312-376)	24mm
XD120	M16 X 2.0	10.9	230-277	(312-376)	24mm
Cylinder Head Bolts-					
M80	M10 X 1.5	10.9	53-64	(72-87)	16mm
M83	M10 X 1.5	10.9	53-64	(72-87)	16mm
M90	M12 X 1.75	8.8	72-87	(97-118)	18mm
M100	M14 X 2.0	8.8	114-140	(154-190)	21mm
M110	M10 X 1.5	10.9	53-64	(72-87)	16mm
XD120	M16 X 2.0	10.9	230-277	(312-376)	24mm
All M100 Bolt-On Sector Cover Bolts	M12 X 1.75	9.8	72-87	(97-118)	18mm
All Clip-Style M110 Sector Cover Bolts	M8 X 1.25	12.9	31-38	(42-52)	13mm

Relief Plungers

Relief plungers (Figure 15) prevent the power steering pump from operating at maximum relief pressure at the end of steering travel. When properly adjusted, the relief plungers reduce system temperature and excessive stress on the mechanical components of the steering system by preventing the axle stops from contacting the axle under full pump pressure. A relief plunger is placed in each end of all Sheppard steering gears (with the exception of slave gears) to unload steering system pressure prior to the axle stops contacting the axle. One plunger is located in a small hole in the bearing cap cover next to the input shaft. The other plunger is on the opposite end of the steering gear in a cartridge screwed into the housing.

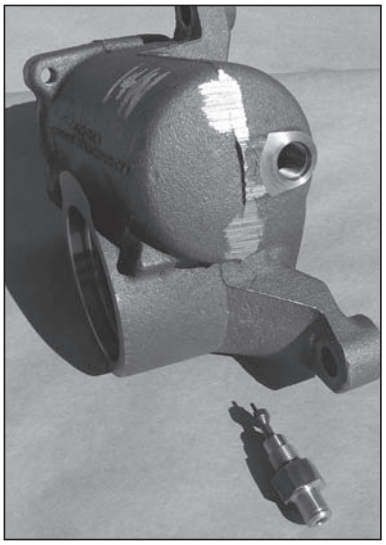


Figure 15. Relief Plunger and Cartridge.

! ***CAUTION***! Failure to set or adjust the relief plungers could result in damage to the steering system. Plungers MUST be set or adjusted whenever a steering gear is replaced.

NOTE: While most D-Series steering gears are equipped with automatic plungers, there are a very limited number of gears equipped with manual plungers.

Automatic Plungers

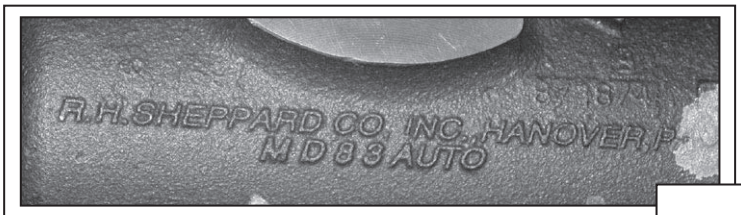
Automatic plunger gears are identified in two ways (Figure 16):

- The word AUTO in raised letters is cast into the side of the steering gear housing.
- Plastic caps on each end of the gear cover the plunger hole.

Procedure:

1. Raise the steer tires off the ground.
2. Start the engine and let it run at idle speed.
3. Ensure the axle stops are set for maximum wheel cut with a minimum of 1" clearance between the tire and any part of the chassis.
4. Set the automatic plungers by turning the steering wheels from side to side until the axle stops contact the axle. This allows the piston in the steering gear to contact the automatic plunger assembly and push it back to its set position. The stops MUST contact the axle.
5. Lower the vehicle so the full weight is on the front tires.
6. Turn the steering wheel completely from stop to stop. The chassis should not flex when the steering reaches the end of travel. If it does, the automatic plungers must be reset. Normally, there is a small gap between the axle stop and the axle.
7. Reset the automatic plungers by tapping them in with a 1/4" punch and hammer until you feel the plunger bottom out in the bore (Figure 17). Be careful not to score the plunger bore. Scoring the bore will cause a leak that cannot be repaired. After the automatic plungers are installed, set them by repeating steps 1 - 6.

RELIEF PLUNGERS AND AXLE STOPS



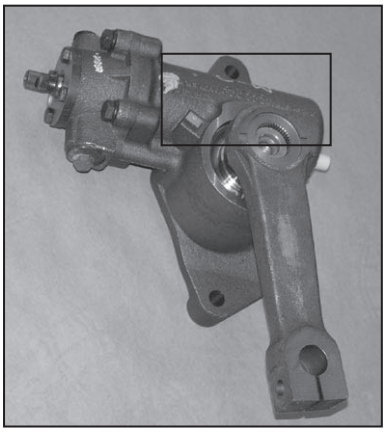


Figure 16. Identifying Automatic Plungers.

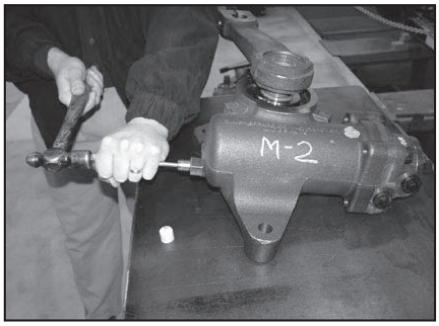


Figure 17. Resetting Automatic Plungers.

Manual Plungers

1. Your steering gear has manual plungers if you can back them out of the plunger hole with a small flat-bladed screwdriver.
2. Manual plungers are turned all the way in from the factory for minimum wheel cut. Adjust the plungers in to decrease wheel cut, adjust out to increase wheel cut. Use a long, flat bladed screwdriver.
3. Start the engine and let it run at idle speed. Ensure the axle stops are set for maximum wheel cut with a minimum of 1" clearance between the tire and any part of the chassis.
4. With the full weight of the vehicle on the ground, have a helper turn the steer tires full left. Check the gap between the axle stop and the axle on the left steer tire. If it is greater than 1/8" adjust the plunger out (counter clockwise). Adjust the plunger in the end of the gear which the piston has moved toward. If the stop is touching the axle try turning the plunger in then recheck it.

NOTE: The plungers are fine thread so it may take several turns to get them properly adjusted. Do not back the head of the plunger out past flush with the end of the hole. The plunger could be ejected from the gear.

5. After making an adjustment, center the steering and recheck the gap at the axle stop.
6. When the steer tires have been turned back and forth about 4 times, rubber will accumulate under the tires and make setting the plungers difficult. Roll the vehicle ahead or back about 1 foot and recheck the gap at the axle stop.
7. Turn the steer tires full right and adjust the opposite plunger for the gap at the right side axle stop using the same procedure.

Once the relief plungers are set, no further adjustment is necessary unless tire size or wheel offset is changed.

If you have questions at any time, our entire Service Manual can be found on our website at www.rhsheppard.com or contact our Field Service Hotline at 1-800-274-7437.

RELIEF PLUNGERS AND AXLE STOPS

SHEPPARD
Quality Engineered Products. Unlimited Capabilities.

Manual Plungers

1. Your steering gear has manual plungers if you can back them out of the plunger hole with a small flat-bladed screwdriver. Some plungers may have a ½" nut welded to the end of the plunger for applications where access to the plunger is restricted. Steering gears using an attached miter box may have the bearing cap plunger protrude from the whole for access.
2. Manual plungers are turned all the way in from the factory for minimum wheel cut. Adjust the plungers in to decrease wheel cut, adjust out to increase wheel cut. Use a long, flat bladed screwdriver (or a ½" wrench if applicable).
3. Start the engine and let it run at idle speed. Ensure the axle stops are set for maximum wheel cut with a minimum of 1" clearance between the tire and any part of the chassis.
4. With the full weight of the vehicle on the ground, have a helper turn the steer tires full left. Check the gap between the axle stop and the axle on the left steer tire. If it is greater than 1/8" adjust the plunger out (counter clockwise). Adjust the plunger in the end of the gear which the piston has moved toward. If the stop is touching the axle try turning the plunger in then recheck it.

NOTE: THE PLUNGERS ARE FINE THREAD SO IT MAY TAKE SEVERAL TURNS TO GET THEM PROPERLY ADJUSTED. DO NOT BACK THE HEAD OF THE PLUNGER OUT PAST FLUSH WITH THE END OF THE HOLE. THE PLUNGER COULD BE EJECTED FROM THE GEAR.

5. After making an adjustment, center the steering and recheck the gap at the axle stop.
6. When the steer tires have been turned back and forth about 4 times, rubber will accumulate under the tires and make setting the plungers difficult. Roll the vehicle ahead or back about 1 foot to give the tires a new bite on the floor and recheck the gap at the axle stop.
7. Turn the steer tires full right and adjust the opposite plunger for the gap at the right side axle stop using the same procedure.

Once the relief plungers are set, no further adjustment is necessary unless tire size or wheel offset is changed.

Repairing Automatic Plungers

Under normal use, Sheppard automatic plungers need no regular maintenance. The automatic plunger is serviceable only as a kit and is only required if a leak is present. Sheppard plunger kit part number 18212821K will fit both the cylinder head and bearing cap end of the steering gear.

Tools Required

- ✓ Drain pan
- ✓ Metric sockets and ratchet
- ✓ Slotted screwdriver bit with suitable socket and ratchet
- ✓ 1/4" drift punch
- ✓ 1/8" pin punch
- ✓ 1/4" pin punch
- ✓ 1/4" center punch
- ✓ 10mm open end wrench
- ✓ Hammer

Repairing Cylinder Head

1. Park the vehicle on a clean, dry, solid surface, preferably concrete.
   a. Set the parking brake.
   b. Block the wheels.
   c. Place the transmission in neutral.
   d. Tilt the hood or cab to access the front tires.
2. Verify that the steering gear has automatic plungers.
   a. Look for the letters "AUTO" cast into the housing.
   b. Look for plastic caps on the plunger hole.
3. Place a drain pan under the steering gear.
4. Remove the auto plunger cartridge.
5. To service the cylinder head auto plunger:
   a. Place the cartridge in a vise.
   b. Remove the plastic plug from the automatic plunger hole.

! ***CAUTION***: In step 5c below, keep the 1/4" punch straight in the bore and do not hit the plunger too hard. Otherwise, the steering gear or automatic plunger assembly will be damaged.

   c. Using a 1/4" punch and hammer, drive the automatic plunger assembly in until it bottoms in the bore. The spring pin, flange, and plunger body should now be accessible for repair.

d. Carefully insert the screwdriver bit into the plunger bore to engage the slotted head of the plunger body (Figure 18).

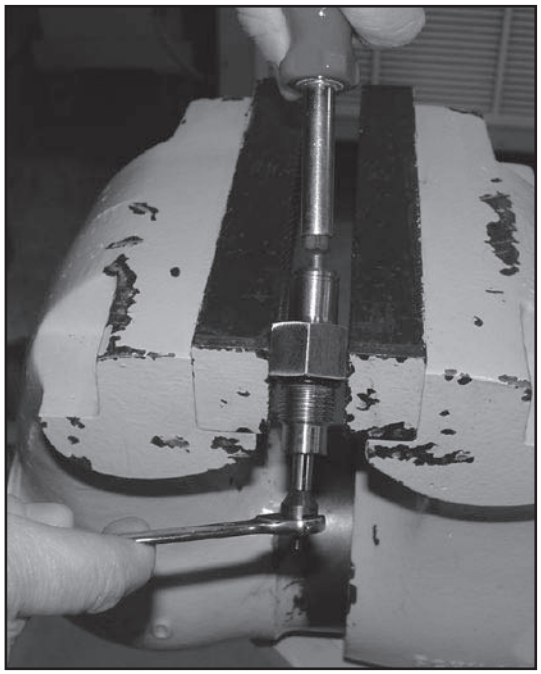


Figure 18. Servicing Plunger Body.

! ***CAUTION***: In step 5e below, do not allow the screwdriver bit to slip off the plunger body. Otherwise, the bore can be damaged.

NOTE: The automatic plunger flange is held in place with thread locking compound installed at the factory. Approximately 15-20 inch/pounds of torque are required to remove the flange.

e. Using the 10mm open-end wrench to hold the flange across the flat sides, carefully turn the flange to remove the flange from the plunger body.

f. Discard the flange.

6. Using a 1/8" pin punch, remove the plunger body from the spring pin and discard. It may be necessary to tap the plunger body to remove it from the spring pin.
7. To install a new plunger assembly:
   a. Coat the plunger assembly O-ring with a light coat of grease.

! ***CAUTION***: Check the plunger bore for nicks or gouges before installing the plunger assembly. Take care not to introduce dirt or contaminants in the plunger bore when reassembling.

   b. Install the plunger body through the spring pin.
   c. Use the screwdriver bit and ratchet to hold the plunger body.

! ***CAUTION***: In step 7d below, the flange must contact the spring pin. Otherwise, steering gear damage or a leak can result.

NOTE: The plunger body has thread-locking compound and will require approximately 15-20 inch/pounds of torque to overcome it.

   d. Screw the flange onto the plunger body using the 10mm open-end wrench until the flange contacts the spring pin.

8. Install the cartridge into the cylinder head and torque to 30-50 ft/lbs.
9. To complete the service:
   a. Fill the reservoir with an approved fluid.
   b. Start the engine.
   c. Check and correct the fluid level.

d. Check for leaks.
e. Set the automatic plungers following the procedure on page 18.
f. Lower and fasten the hood or cab following the procedures in the vehicle manufacturer's service manual.

Repairing Input End Bearing Cap Automatic Plunger

Parts Required

✓ Auto plunger repair kit 18212821K

Tools Required

✓ Drain pan
✓ Metric sockets and ratchet
✓ Slotted screwdriver bit with suitable socket and ratchet
✓ 1/4" drift punch
✓ 1/8" pin punch
✓ 1/4" pin punch
✓ 1/4" center punch
✓ 10mm open end wrench
✓ Hammer

Procedure:

1. Park the vehicle on a clean, dry, solid surface, preferably concrete.
   a. Set the parking brake.
   b. Block the wheels.
   c. Place the transmission in neutral.
   d. Tilt the hood or cab to access the front tires.
2. Place a drain pan under the steering gear.
3. Mark the bearing cap and housing for re-assembly.
4. Remove the universal joint from the input shaft of the steering gear.
5. Remove the plastic plug from the plunger hole.

! ***WARNING***: In step 6 below, failure to keep the 1/4" punch straight in the bore or hitting the plunger too hard can result in damage to the steering gear or automatic plunger assembly.

6. Using the 1/4" punch and hammer, drive the automatic plunger in until it bottoms.
7. Remove the four attaching bolts from the bearing cap using an appropriate size socket and ratchet.

! ***CAUTION***: In step 8 below, do not force the shaft when turning it out of the housing. Binding of the shaft and steering gear damage can result.

8. Separate the bearing cap assembly from the housing by turning the input shaft out of the housing. Turn the shaft until it stops.
9. Carefully insert the screwdriver bit into the plunger bore to engage the slotted head of the plunger body.

! ***CAUTION***: In step 10 below, do not allow the screwdriver bit to slip off the plunger body as damage to the bore can result.

NOTE: The auto plunger flange is held in place with thread locking compound and the threads are staked at the factory. It will require approximately 15-20 inch/pounds of torque to remove the flange.

10. Using the 10mm open-end wrench to hold the flange across the flat sides, carefully turn the flange to remove the flange from the plunger body.
11. Discard the flange.
12. Remove the plunger body from the spring pin and discard. It may be necessary to tap the plunger body to remove it from the spring pin. Use of a 1/8" pin punch is recommended.
13. Coat the O-ring of the plunger assembly with a light coat of grease.
14. Install the plunger body through the spring pin.

! ***CAUTION***: Check the plunger bore for nicks or gouges before installing the plunger assembly. Take care not to introduce dirt or contaminants in the plunger bore when reassembling.

! ***CAUTION***: The flange must contact the spring pin. Otherwise, steering gear damage or a leak can result.

NOTE: The plunger body has locking compound on the threads and will require approximately 15-20 inch/pounds of torque to overcome it.

15. Use the screwdriver bit and ratchet to hold the plunger body. Screw the flange onto the plunger body using the 10mm open-end wrench until the flange contacts the spring pin.
16. Remove the block.
17. Install the bearing cap assembly onto the housing taking care to align the reassembly marks made earlier.
18. Install the plug in the plunger hole. Torque the attaching bolts to specifications.
19. Install the universal joint onto the steering gear input shaft following the procedures in the vehicle manufacturer's service manual.
20. Fill the reservoir with an approved fluid.
21. Start the engine.
22. Check and correct the fluid level.
23. Check for leaks.
24. Set the automatic plungers as described above.
25. Lower and fasten the hood or cab following the procedures in the vehicle manufacturer's service manual.

Axle Stop Adjustment

Axle stop positioning should be checked during pre-delivery because such positioning will determine the vehicle's maximum wheel cut. Stops can be adjusted using the adjustable bolt and lock nut on each spindle.

NOTE: The following procedure is a guide. Refer to the OEM specifications for specific vehicle wheel cuts.

Tools Required

✓ Hydraulic jack

✓ Wrenches to fit stop bolts

Procedure:

1. Park the vehicle on a clean, dry, solid surface, preferably concrete.
   a. Set the parking brake.
   b. Chock the wheels.
   c. Tilt the hood or cab to access the front tires.
2. Raise the front of the vehicle until the tires clear the surface.

! ***WARNING***: In step 3 below, do not exceed the minimum clearance of 1". Never allow the tire to contact the chassis. Otherwise, tire or steering component damage will result.

3. Turn the wheels:
   a. To a full right turn.
      i. Note the position of the tire relative to the steering gear or draglink.
      ii. Adjust the stop bolt on the spindle until a minimum clearance of 1" is maintained between the tire and the chassis. This is the maximum wheel cut available.
   b. To a full left turn. Repeat adjustment.
4. Make sure the jam nuts are tight on both axle stop bolts.
5. To complete the service:
   a. Lower the vehicle.
   b. Lower and fasten the hood or cab following the procedure in the vehicle manufacturer's service manual.
   c. Remove the chocks.

Bleeding Air from Steering Gears

Most single steering gears can be bled simply by turning the steering wheel all the way from stop to stop after the gear has been installed, lines connected, system filled with fluid, and relief plungers set. Some gears, however, require bleeding through a bleeder screw or, in the case of dual gear systems, a special procedure. The following guidelines can be used.

NOTE: Two technicians are needed for this procedure.

Single Gear Systems

CAUTION:
Do not allow the reservoir to run dry at any time.

Procedure:

1. If the gear is mounted with the bulge in the housing for the sector shaft hanging below the piston cylinder:
   a. With the weight of the vehicle on the ground, start the engine and let it run at idle speed.
   b. Turn the steering wheel lock to lock 3 times.
   c. Hold the wheel in pressure for about 5 seconds when you reach the lock position in each direction.
   d. Center the steering.
   e. Bleeding is complete.
2. If the gear is mounted with the bulge in the housing for the sector shaft sitting above the piston cylinder:
   a. Locate the bleeder plug on the sector housing (Figure 19). It resembles a 3/4" bolt head.
      i. Locate a piece of tape covering a 1/8" allen set screw in the center of the head.
      ii. Remove the tape to expose the set screw.

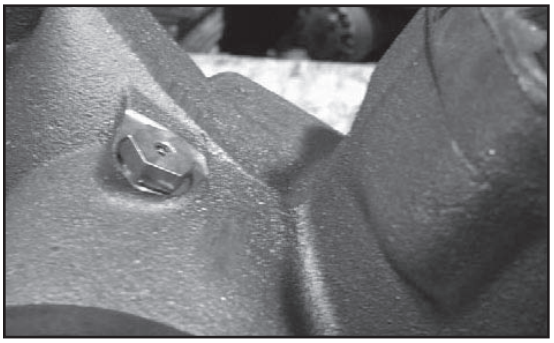


Figure 19. Bleeder Plug with Set Screw.

CAUTION: Do not remove the bleeder screw from the plug. A check ball behind the screw may easily be lost.

CAUTION: The bleeder should only be open when turning the steer tires to the right. If it is open when turning left, air will be forced back into the system.

b. With the weight of the vehicle on the ground, start the engine and let it run at idle speed.
c. Technician #1 turns the steering wheel to full left.
d. Technician #2 opens the set screw in the bleeder plug 4 turns.
e. With the bleeder still open, technician #1 turns the wheels to full right. At the full right turn position, technician #2 shuts the bleeder.
f. Turn the wheels all the way to the left and repeat the procedure 2 more times.

3. Center the steering.
4. Bleeding is complete.

Dual Gear Systems

CAUTION:
Do not allow the reservoir to run dry at any time.

Procedure:

1. With the weight of the vehicle on the ground, start the engine and let it run at idle speed. The draglink should be connected to the pitman arm on the main gear but not connected to the slave gear.
2. Turn the steering wheel all the way to the left until the axle stop contacts the axle and hold it until the pitman arm on the slave gear moves its full travel. It should move in the opposite direction of the pitman arm on the main gear.
3. Turn the steering wheel full right until the axle stop contacts the axle.
4. Hold it until the pitman arm on the slave gear moves its full travel.
5. Repeat the procedure 3 more times or until there is no air in the system and the slave gear moves freely.

NOTE: Do not move the pitman arm on the slave gear by hand. Air may be drawn into the system.

6. Turn the steering wheel until the pitman arm on the slave gear lines up with the draglink and install the draglink.
7. Cycle the steering from stop to stop. If the steering catches or sticks, some air is in the system and additional bleeding is needed. Follow the procedure outlined for bleeding a single gear with the bulge in the housing for the sector shaft sitting above the piston cylinder. If both gears have bleeder plugs, bleed only when turning the steering wheel to the right.

Bleeding is complete when the steering operates smoothly from lock to lock in both directions.

To properly diagnose steering complaints, it is important to understand the complete steering system. Many factors outside of the steering system will affect steering performance: suspension misalignment, looseness in front-end components, mismatched tires, a dry fifth wheel, and more.

General Diagnosis

Often, a steering gear is replaced needlessly because an orderly diagnostic procedure is not followed. Begin your diagnosis using the following outline as a guide.

Step 1: Define the Complaint

- ✓ Interview the driver – Refer to the list of technical terms at the end of this manual to obtain a clear understanding of what the driver is saying.
- ✓ Drive the vehicle – If possible, the driver should show the technician the problem he is experiencing, driving the vehicle together to duplicate the condition.

Step 2: Visually Inspect the Vehicle

- ✓ Check for a dry fifth wheel – The drag from lack of lubrication will tend to steer the vehicle.
- ✓ Check tires for mismatch, improper inflation, or uneven wear patterns.
- ✓ Check for poor loading practices – Special body or equipment installations should be checked for their effect on steering angles and effort.
- ✓ Check for suspension sagging or shifting. Out-of-line rear axles will tend to steer the front end of the vehicle.

Step 3: Inspect Mechanical Components

- ✓ Check all front axle components for wear, looseness, or seizing.
- ✓ Inspect the steering column for drag. More than 10 inch/pounds of drag measured with the column suspended at the angle of operation is excessive.
- ✓ Check the steering gear mounting to be sure that it is tight. A steering gear that is shifting on the frame will cause poor steering performance and may eventually lead to a catastrophic failure of the housing.

Step 4: Check the Hydraulic Supply System

- ✓ Follow the procedures as outlined in the hydraulic diagnosis section below. Oil pressure and flow must be within the vehicle manufacturer's specifications.

Troubleshooting and Testing

Before proceeding with diagnostic tests and repair procedures, check all mechanical and external conditions. **The checklist form on the last page can be photocopied. It follows the troubleshooting outline.**

Testing The Hydraulic System

The Sheppard Heavy Duty Power Steering Test Kit Part #5517641 (Figure 20) is an excellent tool for troubleshooting power steering systems and can be ordered from Sheppard.

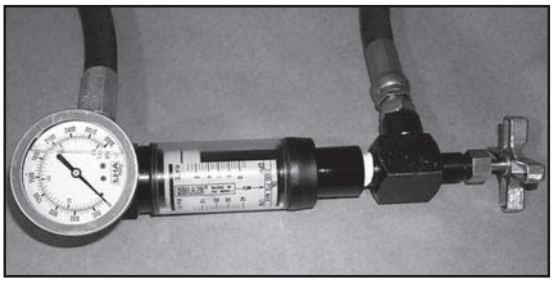


Figure 20. Sheppard Power Steering Tester.

This tester is a self contained, direct reading device to check system flow, pressure, or both at the same time. It can detect worn components, check flow and pressure control settings, or monitor overall system performance.

Low Cost – Easy to Use

Only one hose is disconnected, either at the pump output or at the pressure input to the power steering gear housing. This tester:

- Installs between the pump and steering gear.
- Isolates the pump from the gear with a shutoff valve.
- Reads pressure and flow at the same time.
- Includes a 0-3000 psi pressure gauge.
- Includes a 1-10 gpm flow meter.
- Is complete with hoses and standard swivel fitting.

Hydraulic Diagnosis

Before any steering gear repairs are made, complete the hydraulic supply evaluation and make any repairs. Many times steering gears have been replaced needlessly because a hydraulic supply system evaluation had not been completed.

Vehicle manufacturers specify the maximum operating pressure for their various steering systems. Always refer to the vehicle manufacturer's specifications for the correct pump relief settings. Sheppard D-series steering gears operate at system pressures up to 2790 psi depending on the chassis the gear is installed on. Some applications operate at lower pressures; consult the vehicle OEM for the power steering pump pressure rating. Steering system pump flow should be in the 2.5-6.0 gpm range. Optimum performance will be about 4 gpm for single gear applications and 5.5 gpm for dual gear applications.

NOTE: All tests must be performed with the vehicle parked on a clean, dry, solid surface, with the engine running and the full weight of the vehicle on the front wheels.

Procedure:

1. Make a copy of the troubleshooting test sheet.
2. Connect the pressure and flow tester in series with the pressure line of the pump.
3. Start the engine.
4. Check the system oil level. Make sure the oil is flowing in the proper direction as indicated by the arrow on the flow meter.
5. Place a thermometer in the reservoir.
6. Run the engine at idle speed.
7. Slowly close the shut off valve until you have a pressure reading of 1000 psi.
   a. Maintain this pressure until system temperature reaches 180 degrees Fahrenheit.
   b. Open the shutoff valve all the way when the temperature is 180 degrees.
8. Check system backpressure:
   a. Normal system backpressure will be between 0 and 100 psi with the engine idling and the steering wheel stationary. Dual systems will normally read slightly higher.
   b. Backpressure should be checked at normal operating temperature.

! ***WARNING***: In step 9 below, a bad pressure relief valve may not relieve pump pressure. Closing the shutoff valve may cause severe pump damage or high-pressure hoses to rupture. Watch the pressure gauge closely. If pressure rises rapidly or goes above 2800 psi, stop the test! Do not close the valve all the way.

! ***CAUTION***: After closing the shutoff valve in step 9a below, open the valve as quickly as possible to avoid heat build-up or possible damage to the steering pump.

NOTE: Some steering pumps are not equipped with integral relief valves. Close the shutoff valve slowly.

9. Check the pump maximum relief pressure:
   a. With the engine running at specified idle speed, slowly turn the shutoff valve until it is closed.
   b. Read the pressure at which the pressure relief valve opens. This pressure reading should equal the maximum pump pressure specified by the vehicle manufacturer.

10. Check system flow by measuring oil flow under the following conditions, recording your findings on the troubleshooting checklist.
    a. Flow at idle with back pressure only
    b. Flow at idle under a 1500 psi load applied with the shutoff valve
    c. Flow at full governed rpm with back pressure only
    d. Flow at full governed rpm under a 1500 psi load applied with the shutoff valve
11. Check for aerated oil:
    a. Visually check for air in the steering system oil. The oil should be clear.
    b. Any signs of frothing indicate air in the system and steering performance will be affected.
    c. Carefully check for leakage on the suction side of the steering pump.
    d. Drain, refill, and bleed the system.
    e. Set the relief plungers using the procedure on page 18.
12. Check dry park pressure and input effort:
    a. Measure and record the pressure required to steer the vehicle from full left to full right while parked. Input effort is measured at the steering wheel retaining nut.
    b. Use a dial type inch/pound torque wrench to check static steering input effort. Normal input effort will be less than 100 inch/pounds.

Power Steering Internal Leakage Test Procedure

The following procedure can be used to detect internal problems of the steering gear when there is a complaint of hard steering in one or both directions. All other steering components should be inspected to be free of defects prior to conducting this test. History has shown most steering problems are not the result of a faulty steering gear. A complete pressure and flow test should be completed prior to conducting this test.

Tools Required:

Pressure and Flow Test Kit (Sheppard Part No.5517641 or equivalent)
1 to 1 1/2" Steel Block (minimum thickness)
2 - 7/8" Wrenches
3331812K Test Plug (if applicable)
Drain Pan

Procedure:

1. Park the vehicle on a clean dry surface, preferably concrete, with the transmission in neutral. Set the parking brake and shut off the engine. Place the drain pan under the steering gear.

2. Install the pressure and flow test kit in series in the pressure line of the power steering pump. Ensure all fittings and connections are tight but do not over tighten them. If the steering gear is built with a pressure relief valve (PRV), it must be removed and replaced with the 3331812K Test Plug for testing purposes only. If the PRV is not replaced with the test plug, the PRV will open during the test and show excessive internal leakage. The PRV looks like a 1 ½" nut on the side of the steering gear bearing cap. Simply unscrew it and replace it with the test plug. Do not over tighten the plug.

3. Check and correct the fluid level. Start the engine. Check the flow meter to ensure flow is in the proper direction as indicated by the arrow on the flow gage. Close the hand valve until 1000 psi is reached. Maintain this pressure until a temperature reading of 180 degrees Fahrenheit is reached at the reservoir.

4. Close the tester hand valve all the way and note the maximum pump pressure. Make sure the flow drops to zero. Immediately open the valve all the way.

> **CAUTION**: Keeping the tester hand valve completely closed for longer than 15 seconds at a time can damage the power steering pump.

5. Place the 1" block (minimum thickness) between the axle stop bolt and the axle on the left front wheel. (The block needs to be at least 1" thick to prevent the gear from going into relief.) While holding the block in place have the wheels turned slowly to a full left squeezing the block between the axle stop bolt and the axle. Pull firmly on the steering wheel to ensure the valve in the steering gear is completely open. When properly done, the steering system should achieve maximum pump pressure and flow should be less than one gallon per minute. Note the pressure and flow readings with the 1" block in place.

CAUTION: Take care when squeezing the block between the axle stop and the axle. The block can slip out of place and personal injury could result.

6. Repeat step 5 for a right turn, placing the block between the axle stop bolt and axle on the right side of the vehicle.

7. If excessive internal leakage was noted in one or both directions (flow greater than 1 gpm), the steering gear should be replaced.

NOTE: If this test is being performed on a dual steering gear system (master and slave gear, or assist cylinder) and excessive internal leakage is noted, remove and plug (or cap) the 2 pressure lines coming off the master gear which lead to the slave gear or cylinder. Disconnect the draglink for the slave gear or disconnect one end of the assist cylinder. Repeat steps 5 and 6. If the internal leakage drops below 1 gpm, the problem is in the slave gear or assist cylinder. If the internal leakage is still above 1 gpm, the problem is in the master steering gear.

8. Shut off the engine. Remove the pressure and flow test kit. Replace the test plug (if used) with a PRV. Torque the PRV to 55-65 ft-lbs (75-88Nm). Reconnect all lines and linkages previously disconnected.

9. Check and correct the fluid level. Remove the drain pan and return the vehicle to service.

Contact the RH Sheppard Co. Field Service Hotline at **1-800-274-7437** if you have any questions concerning the diagnosis of a steering complaint or your test results. Refer to the Sheppard website at **www.rhsheppard.com** for additional service information and our online service manual.

Fluid and Filter Change

Fluid and filter change keeps the system fluid clean. The use of high quality fluids (see list below) and filters will assure the removal of contaminants and dissipate heat.

NOTE: Sheppard recommends the power steering system fluid and filter be changed at every engine oil change. Today's systems typically have smaller reservoirs and operate at much higher temperatures than in the past. Regular preventive maintenance is essential to extended steering system life.

Fluid Recommendations

Power steering fluid lubricates moving parts and removes the heat that reduces efficiency and increases wear. Sheppard lists all approved fluids on their website (www.rhsheppard.com) and approves these fluids in the D-Series steering gear:

- Automatic Transmission Fluid Dexron II or Type "E" or "F"
- Chevron 10W40
- Chevron Customer 10W40 Motor Oil
- Cummins Premium Blue 2000 15W40
- Drydene XHD 15W40
- Drydene MP Dexron II/ Mercon ATF
- Exxon Auto H32 Hydraulic Fluid
- Fleetrite PSF (Can #990625C2)
- Ford Spec. M2C138CJ
- Mack EO-K2 Engine Oil
- Mobil 1 15W50 Motor Oil
- Mobil ATF 210
- Mobil Super 10W40 Motor Oil
- Mobil Super 15W40 Motor Oil
- Shell Rotella T30W
- Shell Rotella T SAE 30
- Texaco 10W40
- Texaco Code 1831 Power Steering Fluid 11872
- Texaco Code 1854 Mercon / Dexron III
- Union 10W40
- Union 15W40
- Unocal 46 Power Steering Fluids
- Unocal Guardol 15W40 Motor Oil
- Valvoline All-Climate 10W40 Motor Oil

Tools Required

- ✓ Drain pan
- ✓ Shop towels
- ✓ 10" adjustable wrench
- ✓ Hydraulic jack of a suitable size
- ✓ Screwdriver

Parts Required

- ✓ Specified steering fluid
- ✓ Specified filter

Procedure:

1. Park the vehicle on a clean, dry, solid surface, preferably a concrete pad.
   a. Set the parking brake.
   b. Block the rear wheels.
   c. Place the transmission in neutral.
2. Using the hydraulic jack, raise the front end of the vehicle until the tires have cleared the surface.
3. Tilt the hood or raise the cab using the procedure in the vehicle manufacturer's service manual.
4. Drain the fluid:
   a. Place the drain pan under the steering gear to catch the fluid.
   b. Remove the pressure and return lines from the steering gear to drain fluid.

NOTE: In step 5 below, discard only the filter element. The other parts retain the filter in the reservoir assembly.

5. To remove the filter:
   a. Wipe off the area around the reservoir cap with a clean towel.
   b. Remove the bolt from canister type reservoirs.
   c. Remove the cover.
   d. Remove the filter from the canister and discard. If a spin-on filter is used, remove the filter and discard using the filter wrench.
   e. Wipe the inside of the reservoir canister clean with a clean shop towel.
   f. With the hoses disconnected:
      i. Make sure the drain pan will catch the oil from the steering gear.
      ii. Slowly turn the steering wheel from full left to full right three or more times to purge oil from the steering gear.

6. Attach the pressure and return lines to the steering gear and tighten to specifications.
7. Install a new filter element in the reservoir according to the directions on the filter element and the vehicle manufacturer's service manual.
8. To clean and service the reservoir cap:
   a. Clean the reservoir cap with an approved solvent.
   b. Install a new gasket.
   c. For vehicles with a spin-on filter element, replace the filter using procedures in the vehicle manufacturer's service manual.
9. Fill the reservoir with new steering fluid to within 1" of the top of the reservoir canister.
10. Install the reservoir cover and tighten the bolt to the vehicle manufacturer's specification.

! ***CAUTION***: In steps 11 and 12 below, do not allow the reservoir to empty during start up. Pump damage may result.

11. Start the vehicle.
12. With the engine idling:
    a. Check the fluid level and fill as needed.
    b. Bleed the system following the guidelines contained in this manual.

! ***WARNING***: In step 12c below, do not check for leaks by hand. Hydraulic oil under pressure can penetrate the skin and cause severe injury.

    c. Visually check all fittings and hoses for external leaks.

13. To complete the service:
    a. Shut the engine off.
    b. Remove the drain pan.
    c. Lower the vehicle until the full weight of the tires is on the surface.
    d. Remove the jack.
    e. Lower and fasten the cab or hood using the procedures in the vehicle manufacturer's manual.

Final Adjustments

Sheppard Power Steering gears have no external adjustments for sector shaft or valve shaft pre-load. Make sure all linkages and system components are within the vehicle manufacturer's specifications.

- **TORQUE**: Check all fastener torque values when installing the steering gear (Table 1). Consult the vehicle manufacturer's service manual for torque values from steering gear to frame, pinch bolt, and draglink.

! ***DANGER***: Improper pitman arm installation could lead to an accident or serious personal injury!

- **PITMAN ARM**: Pitman arm application torque is critical. Follow the pitman arm installation instructions in this manual.
- **SET RELIEF PLUNGERS**: Verify the type of relief plungers in your steering gear. Refer to procedures beginning on page 18 to properly set the relief plungers.
- **BLEED THE SYSTEM**: Follow the guidelines on pages 25-26 for proper bleeding of both single and dual gear systems.

Table 1. Torque Values

APPLICATION	SIZE	GRADE	FT/LBS	(N/M)
Bearing Cap Cover: All D-Series	M10 x 1.5	10.9	53-64	(72-87)
Bearing Cap Bolts: MD or HD	M14 x 2.0	9.8	114-140	(154-190)
Cylinder Head: HD Slave	M14 x 2.0	9.8	114-124	(154-190)
Bearing Cap Bolts: SD or XD	M16 x 2.0	10.9	230-277	(312-376)
Cylinder Head: XD	M16 x 2.0	10.9	230-277	(312-376)

TECHNICAL TERMS

The following are terms (in alphabetical order) that technicians should know when discussing heavy vehicle power steering.

Back Pressure – Circulating pressure of the steering system.

Base Mounted Gear – The steering gear is mounted to the frame rail or bracket utilizing the eight mounting holes opposite the sector shaft cover.

Bearing Cap – End cap of the steering gear that houses the actuating shaft and valve.

Bearing Cap Cover – Small cover on the end of the bearing cap of the steering gear. The bearing cap cover houses the input shaft oil and salt seals.

Bleed Screw – 1/8" allen screw located in the sector shaft bore of the steering gear.

Cavitation – Bubbles that form in the oil which keep the pump from supplying pressure and volume.

Contamination – Dirt or other foreign material in a fluid.

Cylinder Bore – Long bore of the steering gear where the steering gear piston is housed.

Cylinder Head – The end cap of the steering gear bolted on the housing opposite the actuating shaft end of the gear.

Displacement – The volume of fluid that can pass through a pump or cylinder in a single revolution or stroke.

Feedback – Transferred energy from the output of a device to its input.

Flow – The amount of fluid that passes a certain point in a unit of time. The volume of flow is usually expressed in gallons per minute for liquids.

Fluid Flow – The stream or movement of a fluid, or the rate of its movement.

Piston – Changes the hydraulic force to mechanical force in the steering gear cylinder bore.

Plunger – Relief valves in the steering gear to limit steering gear piston travel. Plungers are automatic and are adjustable.

Pressure Relief Valve – Optional pressure relief valve integral to the steering gear to limit system operating pressure. Identified by a large hex nut on the side of the bearing cap.

Pump – A device that converts mechanical force and motion into hydraulic fluid power.

Rack Teeth – The area on the piston that engages the sector shaft teeth.

Recirculation Ball Thread – The area of the rotary valve on which the 24 steel balls travel.

Relief Valve – A pressure control valve used to limit system pressure.

Rotary Valve – Internal valve in the bearing cap of the steering gear. It is actuated by the steering wheel through the yoke connection of the steering column.

Sector Shaft – The shaft on which the pitman arm is attached.

Sector Shaft Bore – Area of the steering gear that houses the sector shaft.

Slave Gear – Right hand gear in a dual system application.

Slave Ports – Threaded openings in the cylinder head, bearing cap, and sector shaft bore to install the pressure lines to operate the slave gear.

Tab-Lock Retainer – Bolt assembly used to provide initial torque when installing the pitman arm. Uses alignment tabs that fit into the pitman arm and restraining tabs to be locked into the head of the retainer.

TROUBLESHOOTING

Here are the causes and solutions for the most common steering gear problems.

NOTE: For safety reasons, the R. H. Sheppard Co. no longer recommends that power steering gears be dismantled and repaired. If any problem listed below would require dismantling the gear, instead replace it with a new or remanufactured one.

Possible Causes	*Solutions*
OIL LEAKS	
1. At output shaft 2. At actuating shaft 3. At supply pump driveshaft	1. Replace damaged sector shaft seal and sector shaft if necessary. 2. Replace worn or damaged oil shaft seal. 3. a. Replace damaged seal. b. Check for high operating temperatures that may damage seal. c. Replace pump if shaft bushing is loose or damaged.
LUBRICANT APPEARANCE	
1. Lubricant milky or white, caused by water entry through reservoir venting system 2. Lubrication oil discolored a. Operating temperatures too high b. Change intervals too long c. Incorrect lubricant used	1. Clean vent system or replace cap assembly, then flush system. 2. a. Correct cause of overheating. b. Change oil more often. c. Drain, flush, and refill with recommended fluid.
OIL FORCED OUT OF RESERVOIR OR FOAMING	
1. Clogged oil filter 2. Air in system 3. Relief plungers not adjusted properly, creating high operating temperatures 4. Air leak in suction side of supply pump 5. Pump cavitating 6. Oil overheating	1. Change oil and filter – Change more often. 2. a. Bleed air from system. b. Check for air leak on suction side of supply pump. 3. Adjust relief plungers (see page 18). 4. Refer to pump servicing instructions. 5. Check for restriction in pump supply. 6. Check for restriction in steering gear return.
ENGINE OIL IN POWER STEERING RESERVOIR (GEAR DRIVEN PUMP)	
1. Faulty seal at pump drive shaft 2. Faulty seal at accessory shaft driving supply pump	1. Repair pump. 2. Repair shaft.
HIGH OPERATING TEMPERATURES	
1. Oil flow restriction 2. Oil flow too high (high pump temperature)	1. Check back pressure. 2. Check maximum oil flow.
NO POWER STEERING ON COLD STARTING	
Hydraulic supply pump vanes not extending (vane pump only)	Increase engine speed momentarily to extend vanes and start pump action. Usually does not happen often and does not last long. Not a cause for pump repair or replacement.

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Possible Causes	*Solutions*
EXCESSIVE PUMP PRESSURE WITH STEERING GEAR IN NEUTRAL POSITION	
1. Pinched oil return line – High back pressure 2. Binding steering column	1. Relocate line. 2. Repair steering column.
WHEEL CUTS RESTRICTED	
Relief plungers not adjusted properly	Adjust relief plungers.
ERRATIC STEERING OR MECHANICAL STEERING ONLY	
1. Insufficient volume of oil 2. Sticking pressure relief valve	1. Refer to pump servicing instructions. 2. Replace relief valve as required.
HARD STEERING	
1. Faulty supply pump 2. Steering out of alignment 3. High operating temperature	1. Check pump flow. 2. Align front end. 3. Locate and correct cause of overheating.
WHEEL TURNS HARD IN ONE OR BOTH DIRECTIONS	
1. Bind in steering column 2. Dirt or foreign matter trapped in piston relief 3. Bent or damaged king pins and tie rods 4. Front end load too great 5. Low oil level in steering system 6. Air in system 7. Caster degree incorrect	1. Check column drag. 2. Check piston relief. 3. Replace king pins and tie rods. 4. Lighten load. Notify customer of overloading. 5. Fill oil reservoir as required. Check for leaks. 6. Bleed system and check for cause. 7. Correct to specifications.
NO ATTEMPT TO RETURN TO STRAIGHT AHEAD FROM TURNS (MAY ALSO BE HARD STEERING COMPLAINT)	
1. No positive caster 2. Steering gear mounting distorted 3. Linkage ball sockets seized or binding 4. King pins seized or binding 5. Oil flow rate incorrect	1. Set caster to 3° to 5° positive. 2. Shim mounting pads to eliminate piston-to-bore interference. Use correct bolt length on the base mount gears. 3. Check and repair or replace. 4. Repair or replace. 5. Check and correct supply pump.
DARTING, WANDERING (OVERSTEERING)	
1. Oil flow too high 2. Air trapped in steering gear 3. Looseness, worn front end parts 4. Front end alignment not correct 5. Overloading 6. Rear axle not parallel 7. Tight tie rod ends, draglink sockets	1. Supply pump not to specifications. 2. Bleed system. 3. Check and repair as required. 4. Align front end caster. 5. Reduce loads. Notify customer of overloading. 6. Repair as required. 7. Check rotational torque. Replace if necessary.

Possible Causes	*Solutions*
EXCESSIVE BACKLASH OR FREEPLAY	
1. Worn U-joint or U-joint yoke loose on actuating shaft 2. Pitman arm ball worn "egg-shaped" (if equipped) 3. Worn or damaged pitman arm splines 4. Loose bracket frame to bracket or bracket to gear 5. Rack on piston damaged 6. Damaged sector shaft/splines	1. Replace damaged parts. 2. Replace pitman arm assembly where riveted ball is used. 3. Replace pitman arm and sector shaft. 4. Remove and clean frame and bracket. Assure bracket is not bearing on frame radius or worn by looseness. Reinstall bracket, torqueing bolts to proper rating. If necessary, replace bracket. 5. Replace steering gear. 6. Replace steering gear.
STEERING INPUT NOT SMOOTH	
1. Worn U-joint 2. Lack of lubrication 3. U-joints not phased properly 4. Low oil flow 5. Overload on front axle 6. Pump cavitating 7. Overheating	1. Replace as required. 2. Lubricate per vehicle manufacturer's recommendations. 3. Re-phase columns (see Note). 4. a. Idle speed too low – adjust idle b. Drive belts slipping – tighten belts c. Supply pump not to specifications – replace 5. Verify front axle weight. Notify customer of overloading. 6. Correct pump supply. 7. Correct cause of overheating.

NOTE: U-joint operating angle must be 20° to 25°. Read inch/pound torque differences while steering from lock-to-lock. Variation of more than 15 inch/pound means improper phasing. To correct phasing, rotate the intermediate shaft one spline at a time until torque is the same through 360 degrees.

NOTES

POWER STEERING TROUBLESHOOTING CHECKLIST

Before proceeding with the following tests, check all mechanical and external conditions before hydraulic testing. **Do not remove the steering gear or pump until hydraulic tests are completed and an authorization number has been received from Sheppard.**

Date: _____
Dealer Name & Location: _____
_____
Dealer Contact Name: _____
Contact Phone Number: _____
Servicing Tech Name: _____

Sheppard / LuK Authorization Number:
_____

Description of Steering Complaint:
_____
_____
_____

Vehicle Model _____ Mileage_____VIN_____
Engine Model _____
Steering Gear Model _____ Serial No. _____
Slave Gear Model (if equipped) _____ Serial No. _____
Pump Manufacturer _____ Pump Part # _____
Front Axle Weight Rating _____

Hydraulic Tests: Refer to RH Sheppard Service Manual available on line at: www.rhsheppard.com
Do not remove the steering gear! Install a pressure and flow tester in series with the pressure line of the pump as outlined in the Diagnosis and Troubleshooting Section. Record the following information:

Engine Idle RPM _____
Stabilized Oil Temperature _____
System Backpressure @ Idle _____ Backpressure @ Full RPM _____
Maximum System Pressure (Pump Relief Setting) _____PSI
Flow @ Idle with Backpressure Only _____GPM
Flow @ Full Governed RPM Backpressure Only _____GPM
Flow @ Idle With 1500psi Load Applied _____GPM
Flow @ Full Governed RPM With 1500psi Load Applied _____GPM
Steering Gear Internal Leakage Right Turn _____PSI _____GPM
Steering Gear Internal Leakage Left Turn _____ PSI _____GPM
Static Steer Pressure Right Turn _____PSI Left Turn _____PSI
Static Steer Input Effort Right Turn _____In. Lbs Left Turn _____In. Lbs.

Sheppard Field Service Hotline: 1-800-274-7437.

Call the Hotline for authorization and fax completed checklists to Sheppard at 717-633-4121 for review prior to pump or steering gear replacement authorization. No authorization will be given without a completed checklist.

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