

# STEERING

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## POWER STEERING

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### GENERAL INFORMATION

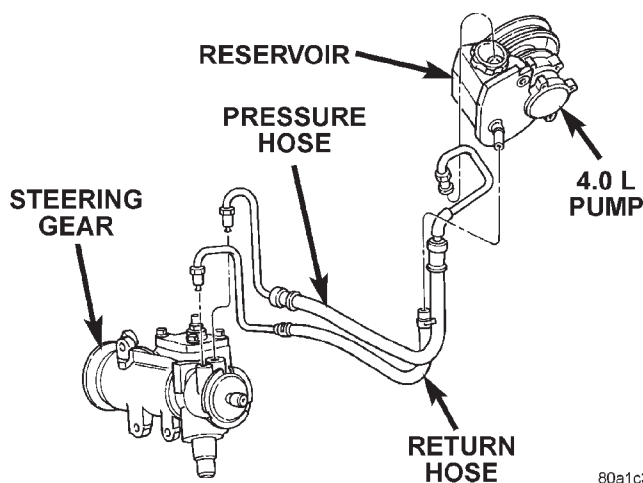
#### STEERING SYSTEM

The power steering system has a hydraulic pump. The pump is a constant flow rate and displacement , vane-type pump. The pump on the 4.0L engine has a reservoir mounted to it (Fig. 1). The 2.5L engine has a remote mounted reservoir.

The steering gear used is a recirculating ball type gear. The gear acts as a rolling thread between the worm shaft and the rack piston. When the steering wheel is turned the worm shaft turns which moves the rack piston. The rack piston movement turns the pitman shaft which is connected to the steering linkage by the pitman arm. This gear is used on all models.

The power steering system consists of:

- Hydraulic pump
- Recirculating ball steering gear
- Steering column
- Steering linkage



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**Fig. 1 Power Steering Gear & Pump - 4.0L**

**NOTE:** Right hand drive (RHD) and left hand drive (LHD) service procedures and torque specifications for steering linkage, gear and column are the same. The power steering pump procedures are different. Refer to appropriate service procedures regarding each component in the system.

## DIAGNOSIS AND TESTING

## POWER STEERING SYSTEM DIAGNOSIS CHARTS

*STEERING NOISE*

There is some noise in all power steering systems. One of the most common is a hissing sound evident at a standstill parking. Or when the steering wheel is at the end of it's travel. Hiss is a high frequency noise similar to that of a water tap being closed slowly. The noise is present in all valves that have a high velocity fluid passing through an orifice. There is no relationship between this noise and steering performance.

CONDITION	POSSIBLE CAUSES	CORRECTION
OBJECTIONAL HISS OR WHISTLE	<ol style="list-style-type: none"> <li>1. Steering intermediate shaft to dash panel seal.</li> <li>2. Noisy valve in power steering gear.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check and repair seal at dash panel.</li> <li>2. Replace steering gear.</li> </ol>
RATTLE OR CLUNK	<ol style="list-style-type: none"> <li>1. Gear mounting bolts loose.</li> <li>2. Loose or damaged suspension components.</li> <li>3. Loose or damaged steering linkage.</li> <li>4. Internal gear noise.</li> <li>5. Pressure hose in contact with other components.</li> </ol>	<ol style="list-style-type: none"> <li>1. Tighten bolts to specification.</li> <li>2. Inspect and repair suspension.</li> <li>3. Inspect and repair steering linkage.</li> <li>4. Replace gear.</li> <li>5. Reposition hose.</li> </ol>
CHIRP OR SQUEAL	<ol style="list-style-type: none"> <li>1. Loose belt.</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjust or replace.</li> </ol>
WHINE OR GROWL	<ol style="list-style-type: none"> <li>1. Low fluid level.</li> <li>2. Pressure hose in contact with other components.</li> <li>3. Internal pump noise.</li> </ol>	<ol style="list-style-type: none"> <li>1. Fill to proper level.</li> <li>2. Reposition hose.</li> <li>3. Replace pump.</li> </ol>
SUCKING AIR SOUND	<ol style="list-style-type: none"> <li>1. Loose return line clamp.</li> <li>2. O-ring missing or damaged on hose fitting.</li> <li>3. Low fluid level.</li> <li>4. Air leak between pump and reservoir.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace clamp.</li> <li>2. Replace o-ring.</li> <li>3. Fill to proper level.</li> <li>4. Repair as necessary.</li> </ol>
SCRUBBING OR KNOCKING	<ol style="list-style-type: none"> <li>1. Wrong tire size.</li> <li>2. Wrong gear.</li> </ol>	<ol style="list-style-type: none"> <li>1. Verify tire size.</li> <li>2. Verify gear.</li> </ol>

DIAGNOSIS AND TESTING (Continued)

*BINDING AND STICKING*

CONDITION	POSSIBLE CAUSE	CORRECTION
DIFFICULT TO TURN WHEEL STICKS OR BINDS	<ol style="list-style-type: none"> <li>1. Low fluid level.</li> <li>2. Tire pressure.</li> <li>3. Steering component.</li> <li>4. Loose belt.</li> <li>5. Low pump pressure.</li> <li>6. Column shaft coupler binding.</li> <li>7. Steering gear worn or out of adjustment.</li> </ol>	<ol style="list-style-type: none"> <li>1. Fill to proper level.</li> <li>2. Adjust tire pressure.</li> <li>3. Inspect and lube.</li> <li>4. Adjust or replace.</li> <li>5. Pressure test and replace if necessary.</li> <li>6. Replace coupler.</li> <li>7. Repair or replace gear.</li> </ol>

*INSUFFICIENT ASST. OR POOR RETURN TO CENTER*

CONDITION	POSSIBLE CAUSE	CORRECTION
HARD TURNING OR MOMENTARY INCREASE IN TURNING EFFORT	<ol style="list-style-type: none"> <li>1. Tire pressure.</li> <li>2. Low fluid level.</li> <li>3. Loose belt.</li> <li>4. Lack of lubrication.</li> <li>5. Low pump pressure.</li> <li>6. Internal gear leak.</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjust tire pressure.</li> <li>2. Fill to proper level.</li> <li>3. Adjust or replace.</li> <li>4. Inspect and lubricate steering and suspension compnents.</li> <li>5. Pressure test and repair as necessary.</li> <li>6. Pressure and flow test, and repair as necessary.</li> </ol>
STEERING WHEEL DOES NOT WANT TO RETURN TO CENTER POSITION	<ol style="list-style-type: none"> <li>1. Tire pressure.</li> <li>2. Wheel alignment.</li> <li>3. Lack of lubrication.</li> <li>4. High friction in steering gear.</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjust tire pressure.</li> <li>2. Align front end.</li> <li>3. Inspect and lubricate steering and suspension compnents.</li> <li>4. Test and adjust as necessary.</li> </ol>

## DIAGNOSIS AND TESTING (Continued)

## LOOSE STEERING AND VEHICLE LEAD

CONDITION	POSSIBLE CAUSE	CORRECTION
EXCESSIVE PLAY IN STEERING WHEEL	<ol style="list-style-type: none"><li>1. Worn or loose suspension or steering components.</li><li>2. Worn or loose wheel bearings.</li><li>3. Steering gear mounting.</li><li>4. Gear out of adjustment.</li><li>5. Worn or loose steering coupler.</li></ol>	<ol style="list-style-type: none"><li>1. Repair as necessary.</li><li>2. Repair as necessary.</li><li>3. Tighten gear mounting bolts to specification.</li><li>4. Adjust gear to specification.</li><li>5. Repair as necessary.</li></ol>
VEHICLE PULLS OR LEADS TO ONE SIDE	<ol style="list-style-type: none"><li>1. Tire Pressure.</li><li>2. Radial tire lead.</li><li>3. Brakes dragging.</li><li>4. Wheel alignment.</li><li>5. Weak or broken spring.</li><li>6. Loose or worn steering or suspension components.</li></ol>	<ol style="list-style-type: none"><li>1. Adjust tire pressure.</li><li>2. Cross front tires.</li><li>3. Repair as necessary.</li><li>4. Align vehicle.</li><li>5. Replace spring.</li><li>6. Repair as necessary.</li></ol>

# POWER STEERING PUMP

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## DESCRIPTION AND OPERATION

### POWER STEERING PUMP

Hydraulic pressure is provided for operation of the power steering gear by a belt driven power steering pump. The power steering pump is a constant flow rate and displacement, vane-type pump. The internal parts in the housing operate submerged in fluid. The flow control orifice is part of the high pressure line fitting. The pressure relief valve inside the flow control valve limits the pump pressure. The reservoir is attached to the pump body with spring clips on the 4.0L engine. On the 2.5L engine the reservoir is separate from the pump.

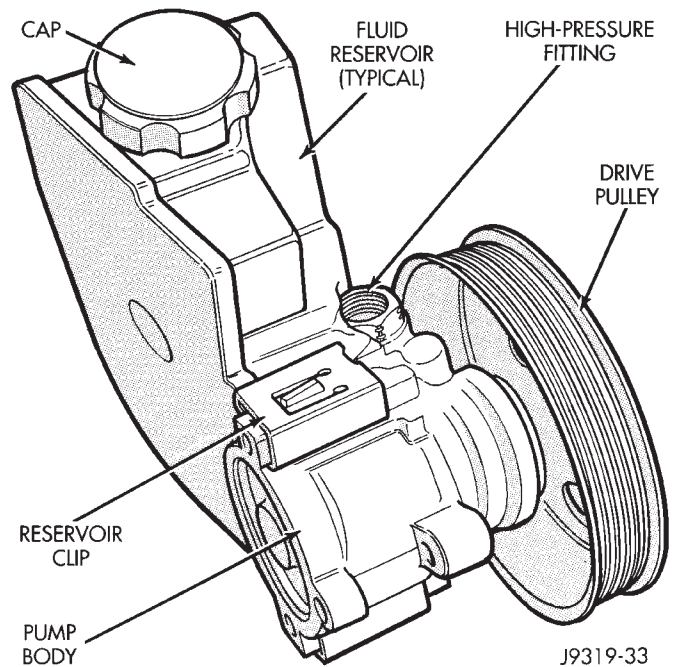
The power steering pump is connected to the steering gear by the pressure and return hoses. The pump shaft has a pressed-on drive pulley that is belt driven by the crankshaft pulley (Fig. 1).

**NOTE: Power steering pumps have different pressure rates and are not interchangeable with other pumps.**

## DIAGNOSIS AND TESTING

### POWER FLOW AND PRESSURE

The following procedure is used to test the operation of the power steering system on the vehicle. This test will provide the gallons per minute (GPM) or flow rate of the power steering pump along with the maximum relief pressure. Perform test any time a power steering system problem is present. This test will determine if the power steering pump or power steering gear is not functioning properly. The following pressure and flow test is performed using Power Steering Analyzer Tool Kit 6815 (Fig. 2) and Adapter Kit 6893.

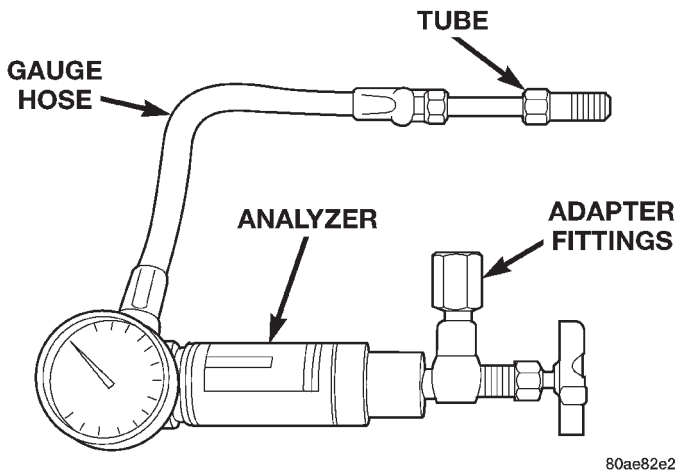


**Fig. 1 Pump With Integral Reservoir**

### FLOW AND PRESSURE TEST

- (1) Check the power steering belt to ensure it is in good condition and adjusted properly.
- (2) Connect pressure gauge hose from the Power Steering Analyzer to Tube 6865.
- (3) Connect Adapter 6826 to Power Steering Analyzer test valve end.
- (4) Disconnect high pressure hose at gear or pump. Use a container for dripping fluid.
- (5) Connect Tube 6865 to the pump hose fitting.
- (6) Connect the power steering hose from the steering gear to Adapter 6826.

## DIAGNOSIS AND TESTING (Continued)



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Fig. 2 Power Steering Analyzer

(7) Open the test valve completely.

(8) Start engine and let idle long enough to circulate power steering fluid through flow/pressure test gauge and to get air out of the fluid. Then shut off engine.

(9) Check fluid level, add fluid as necessary. Start engine again and let idle.

(10) Gauge should read below 862 kPa (125 psi), if above, inspect the hoses for restrictions and repair as necessary. The initial pressure reading should be in the range of 345-552 kPa (50-80 psi).

(11) Increase the engine speed to 1500 RPM and read the flow meter. The reading should be 2.4 - 2.8 GPM, if the reading is below this specification the pump should be replaced.

**CAUTION: The next step involves testing maximum pump pressure output and flow control valve operation. Do not leave valve closed for more than three seconds as the pump could be damaged.**

(12) Close valve fully three times and record highest pressure indicated each time. **All three readings must be above specifications and within 345 kPa (50 psi) of each other.**

- Pressures above specifications but not within 345 kPa (50 psi) of each other, replace pump.

- Pressures within 345 kPa (50 psi) of each other but below specifications, replace pump.

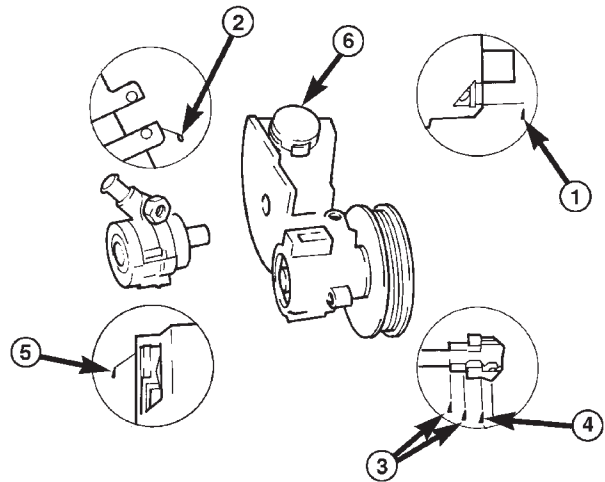
(13) Open the test valve, turn steering wheel extreme left and right positions against the stops. Record the highest indicated pressure at each position. Compare readings to specifications. If highest output pressures are not the same against either stop, the gear is leaking internally and must be repaired.

**CAUTION: Do not force the pump to operate against the stops for more than 2 to 3 seconds at a time because, pump damage will result.**

## PUMP SPECIFICATIONS

ENGINE	RELIEF PRESSURE $\pm$ 50	FLOW RATE (GPM)
2.5L	9653 kPa (1400 psi)	1500 RPM 2.4 - 2.8 GPM
4.0L	9653 kPa (1400 psi)	

## PUMP LEAKAGE DIAGNOSIS



1. BUSHING (BEARING) WORN, SEAL WORN. REPLACE PUMP.
2. REPLACE RESERVOIR O-RING SEAL.
3. TORQUE HOSE FITTING NUT TO SPECIFICATIONS. IF LEAKAGE PERSISTS, REPLACE O-RING SEAL.
4. TORQUE FITTING TO SPECIFICATIONS. IF LEAKAGE PERSISTS, REPLACE O-RING SEAL.
5. REPLACE PUMP.
6. CHECK OIL LEVEL: IF LEAKAGE PERSISTS WITH THE LEVEL CORRECT AND CAP TIGHT, REPLACE THE CAP.

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## SERVICE PROCEDURES

## POWER STEERING PUMP - INITIAL OPERATION

**WARNING: THE FLUID LEVEL SHOULD BE CHECKED WITH ENGINE OFF TO PREVENT INJURY FROM MOVING COMPONENTS.**

**CAUTION: Use MOPAR Power Steering Fluid or equivalent. Do not use automatic transmission fluid and do not overfill.**

## SERVICE PROCEDURES (Continued)

Wipe filler cap clean, then check the fluid level. The dipstick should indicate **COLD** when the fluid is at normal temperature.

(1) Fill the pump fluid reservoir to the proper level and let the fluid settle for at least two minutes.

(2) Start the engine and let run for a few seconds then turn engine off.

(3) Add fluid if necessary. Repeat the above procedure until the fluid level remains constant after running the engine.

(4) Raise the front wheels off the ground.

(5) Slowly turn the steering wheel right and left, lightly contacting the wheel stops at least 20 times.

(6) Check the fluid level add if necessary.

(7) Lower the vehicle, start the engine and turn the steering wheel slowly from lock to lock.

(8) Stop the engine and check the fluid level and refill as required.

(9) If the fluid is extremely foamy or milky looking, allow the vehicle to stand a few minutes and repeat the procedure.

**CAUTION:** Do not run a vehicle with foamy fluid for an extended period. This may cause pump damage.

## REMOVAL AND INSTALLATION

## POWER STEERING PUMP

**NOTE:** The power steering pump is mounted in the same position on LHD and RHD vehicles. On 4.0L RHD vehicles the front bracket is different. The service procedures are the same.

## REMOVAL

(1) Remove serpentine drive belt, refer to Group 7 Cooling.

(2) Remove pressure and return hoses from pump, and drain pump.

(3) Remove 3 pump mounting bolts through pulley access holes .

(4) Loosen the 3 pump bracket bolts (Fig. 3) and (Fig. 4).

(5) Tilt pump downward and remove from engine.

(6) Remove pulley from pump.

## INSTALLATION

(1) Install pulley on pump.

(2) Install pump on engine.

(3) Tighten pump bracket bolts to 47 N-m (35 ft. lbs.).

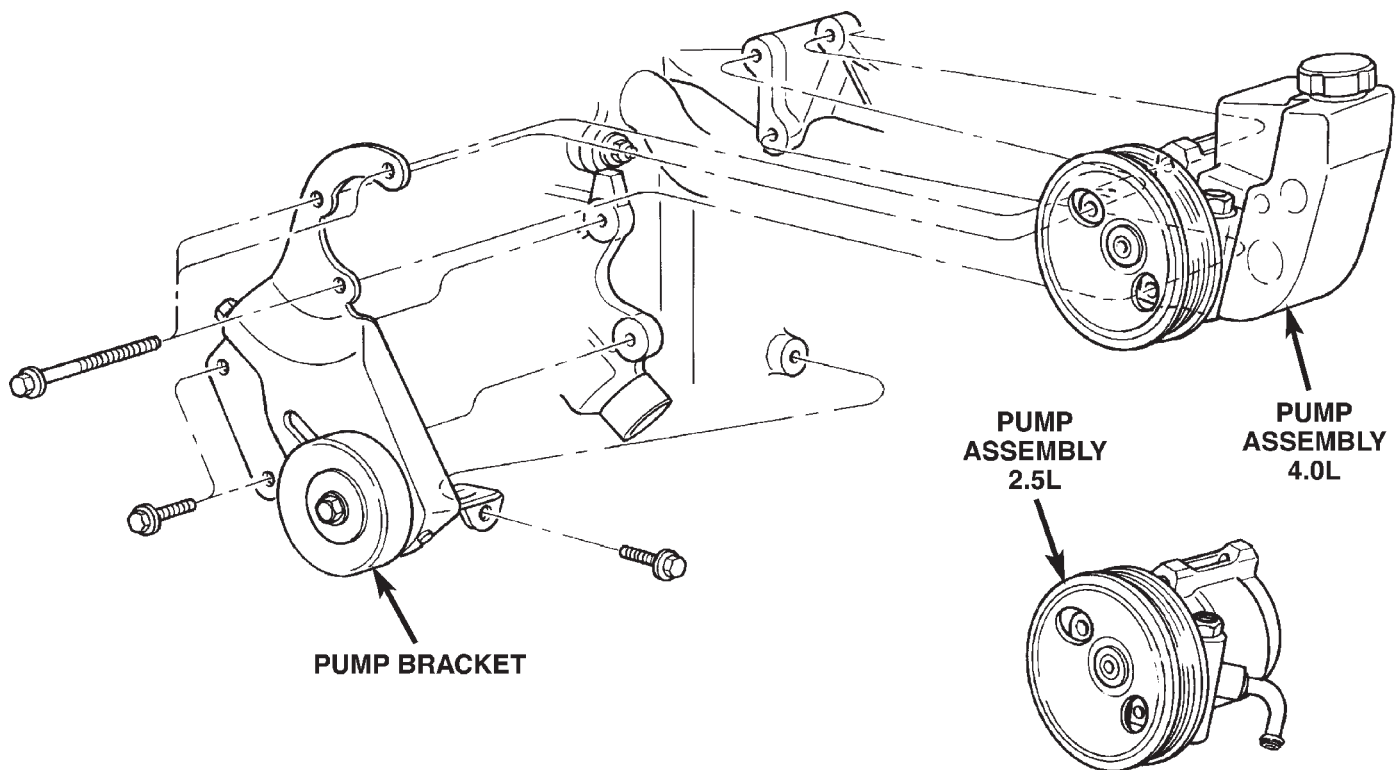
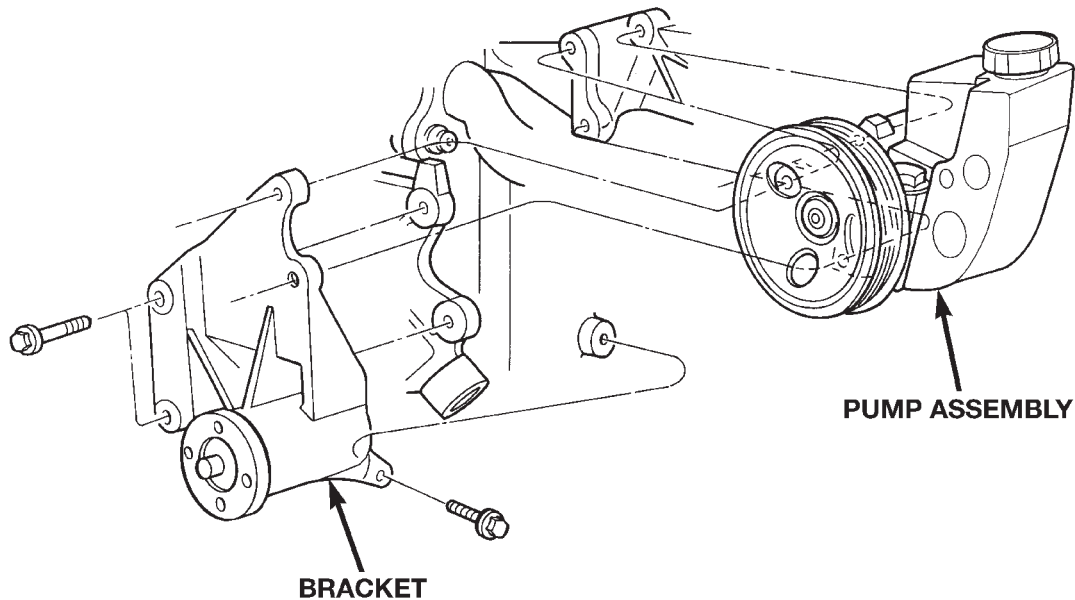


Fig. 3 Pump Mounting

## REMOVAL AND INSTALLATION (Continued)



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Fig. 4 Pump Mounting 4.0L RHD

- (4) Install 3 pump mounting bolts and tighten to 27 N·m (20 ft. lbs.).
- (5) Install the pressure and return hoses to pump.
- (6) Install drive belt, refer to Group 7 Cooling.
- (7) Add power steering fluid and perform Power Steering Pump Initial Operation.

## PUMP RESERVOIR-2.5L

## REMOVAL

- (1) Remove the hoses from the bottom of the reservoir and drain the reservoir.
- (2) Remove the push-in fastener from the top of the fan shroud.
- (3) Slide reservoir up off the fan shroud.

## INSTALLATION

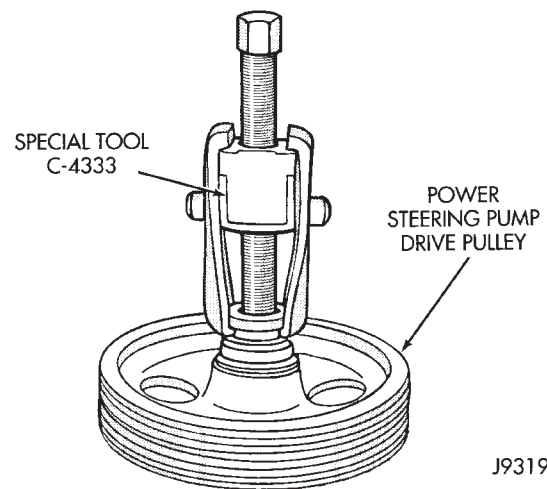
- (1) Slide reservoir down onto fan shroud.
- (2) Install the push-in fastener in the top of fan shroud.
- (3) Install the pump hoses.
- (4) Fill reservoir to proper level. Refer to Power Steering Pump Initial Operation.

## DISASSEMBLY AND ASSEMBLY

## PUMP PULLEY

## DISASSEMBLY

- (1) Remove pump assembly.
- (2) Remove pulley from pump with Puller C-4333 (Fig. 5).



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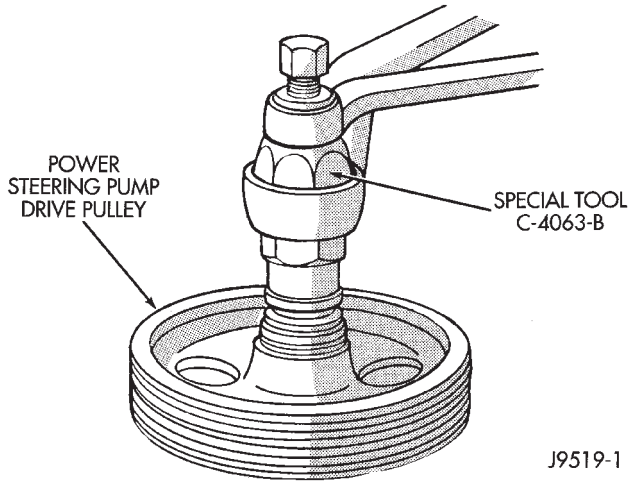
Fig. 5 Pulley Removal

## ASSEMBLY

- (1) Replace pulley if bent, cracked, or loose.
- (2) Install pulley on pump with Installer C-4063-B (Fig. 6) flush with the end of the shaft. Ensure the tool and pulley remain aligned with the pump shaft.
- (3) Install pump assembly.
- (4) With Serpentine Belt, run engine until warm (5 min.) and note any belt chirp. If chirp exists, move pulley outward approximately 0.5 mm (0.020 in.). If noise increases, press on 1.0 mm (0.040 in.). **Be careful that pulley does not contact mounting bolts.**



DISASSEMBLY AND ASSEMBLY (Continued)



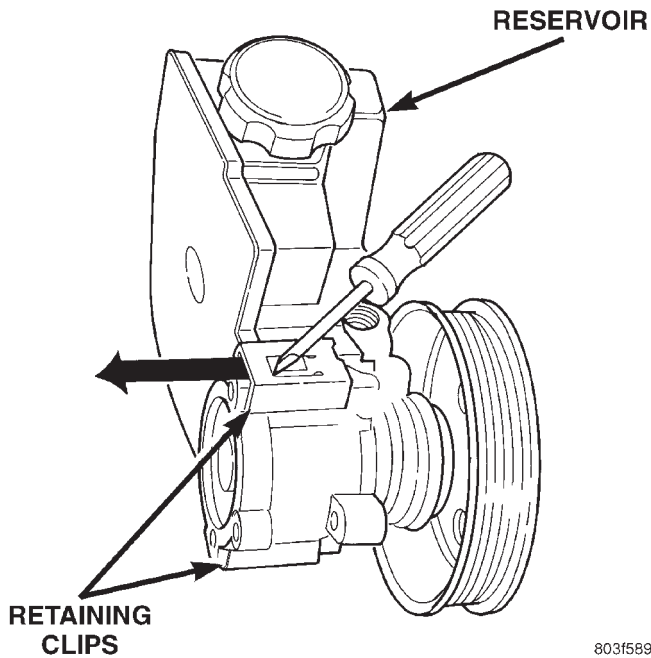
**Fig. 6 Pulley Installation**

**PUMP RESERVOIR**

**DISASSEMBLY**

- (1) Remove power steering pump.
- (2) Clean exterior of pump.
- (3) Clamp the pump body in a soft jaw vice.
- (4) Pry up tab and slide the retaining clips off (Fig. 7).

**NOTE:** Use new retaining clips for installtion.



**Fig. 7 Pump Reservoir Clips**

- (5) Remove fluid reservoir from pump body. Remove and discard O-ring seal.

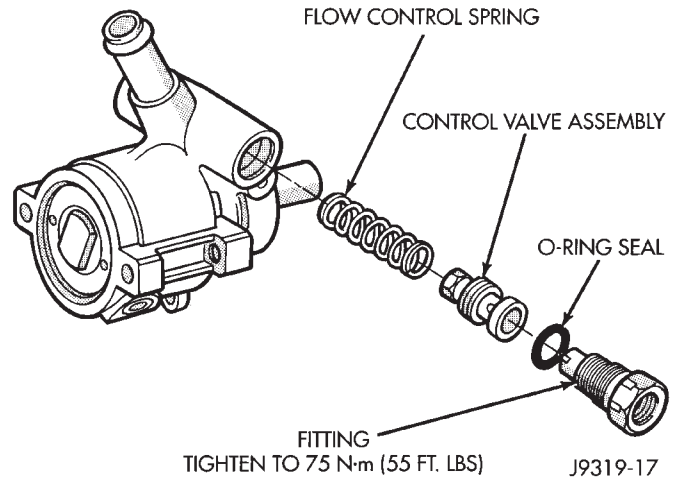
**ASSEMBLY**

- (1) Lubricate new O-ring Seal with Mopar Power Steering Fluid or equivalent.
- (2) Install O-ring seal in housing.
- (3) Install reservoir onto housing.
- (4) Slide and tap in **new** reservoir retainer clips until tab locks to housing.
- (5) Install power steering pump.
- (6) Add power steering fluid, refer to Pump Initial Operation.

**FLOW CONTROL VALVE**

**DISASSEMBLY**

- (1) Clean area around fitting to prevent dirt from entering pump. Remove pressure hose from pump fitting.
- (2) Remove fitting from pump housing (Fig. 8). **Prevent flow control valve and spring from sliding out of housing bore.**



**Fig. 8 Flow Control Valve**

- (3) Remove and discard O-ring seal.

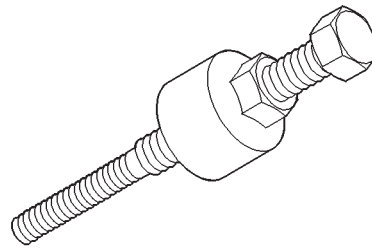
**ASSEMBLY**

- (1) Install spring and flow control valve into pump housing bore. **Be sure the hex nut end of the valve is facing in toward pump.**
- (2) Install O-ring seal onto fitting.
- (3) Install flow control valve in pump housing and tighten to 75 N·m (55 ft. lbs.).
- (4) Install pressure hose to valve.

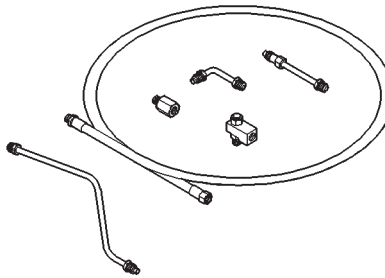
SPECIFICATIONS

TORQUE CHART

<b>DESCRIPTION</b>	<b>TORQUE</b>
<b>Power Steering Pump</b>	
Bracket to Pump .....	28 N·m (21 ft. lbs.)
Bracket to Engine .....	47 N·m (35 ft. lbs.)
Flow Control Valve .....	75 N·m (55 ft. lbs.)
Pressure Line .....	28 N·m (21 ft. lbs.)



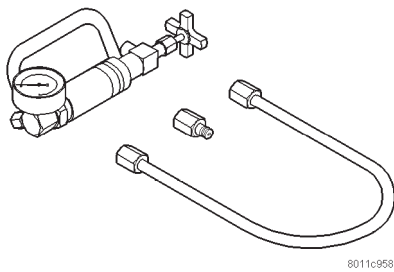
**Installer, Power Steering Pulley C-4063-B**



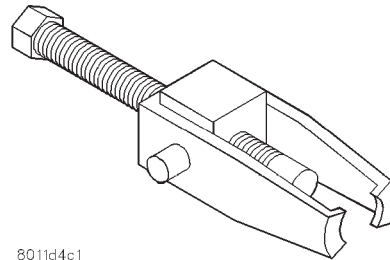
**Adapters, Power Steering Flow/Pressure Tester 6893**

SPECIAL TOOLS

POWER STEERING PUMP



**Analyzer Set, Power Steering Flow/Pressure 6815**



**Puller C-4333**

## POWER STEERING GEAR

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### DESCRIPTION AND OPERATION

#### POWER STEERING GEAR

The power steering gear is a recirculating ball type gear (Fig. 1). The gear acts as a rolling thread between the worm shaft and rack piston. The worm shaft is supported by a thrust bearing at the lower end and a bearing assembly at the upper end. When the worm shaft is turned the rack piston moves. The

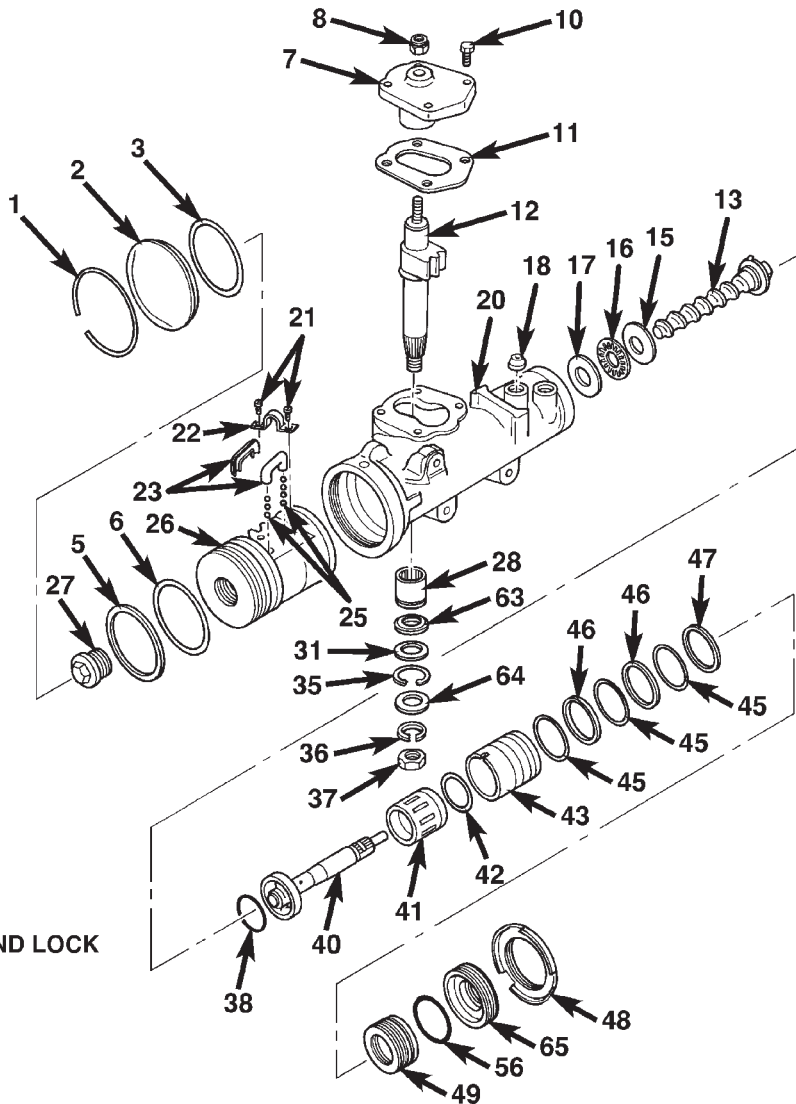
rack piston teeth mesh with the pitman shaft. Turning the worm shaft turns the pitman shaft, which turns the steering linkage.

**CAUTION: Components attached with a nut and cotter pin must be torqued to specification. Then if the slot in the nut does not line up with the cotter pin hole, tighten nut until it is aligned. Never loosen the nut to align the cotter pin hole.**

DESCRIPTION AND OPERATION (Continued)

KEY NO. PART NAME

- 1 - RING, RETAINING
- 2 - PLUG
- 3 - SEAL, O-RING
- 5 - RING, TEFLON
- 6 - SEAL, O-RING
- 7 - COVER, SIDE
- 8 - NUT, ADJUSTER LOCK
- 10 - BOLT
- 11 - GASKET
- 12 - SHAFT, PITMAN
- 13 - SHAFT, WORM
- 15 - RACE, FLAT
- 16 - BEARING, THRUST
- 17 - RACE, FLAT
- 18 - VALVE, CHECK
- 20 - HOUSING
- 21 - SCREW
- 22 - CLAMP
- 23 - GUIDE, BALL
- 25 - BALLS
- 26 - PISTON, RACK
- 27 - PLUG
- 28 - BEARING, NEEDLE
- 31 - WASHER, BACKUP
- 35 - RING, RETAINING
- 36 - WASHER, LOCK
- 37 - NUT
- 38 - SEAL
- 40 - SHAFT, STUB
- 41 - SPOOL, VALVE
- 42 - SEAL
- 43 - BODY, VALVE
- 45 - SEAL, O-RING VALVE BODY
- 46 - RING
- 48 - NUT, COUPLING SHIELD RETAINER AND LOCK
- 49 - THRUST SUPPORT ASSEMBLY
- 56 - SEAL, O-RING
- 63 - SEAL, PITMAN SHAFT
- 64 - SEAL, DUST
- 65 - ADJUSTER NUT ASSEMBLY

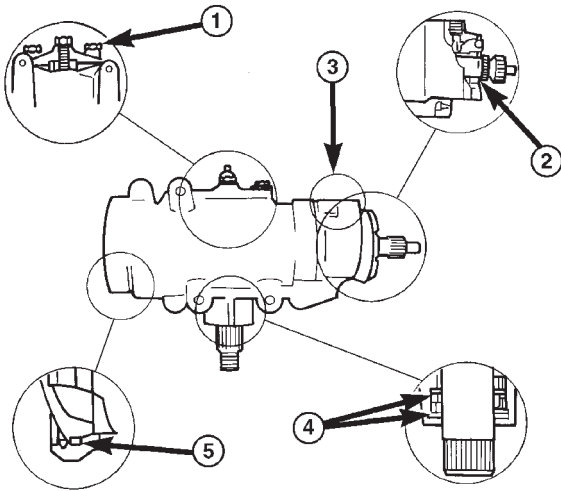


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Fig. 1 Recirculating Ball Type Gear

## DIAGNOSIS AND TESTING

## POWER STEERING GEAR LEAKAGE DIAGNOSIS



1. SIDE COVER LEAK - TORQUE SIDE COVER BOLTS TO SPECIFICATION. REPLACE THE SIDE COVER SEAL IF THE LEAKAGE PERSISTS.
2. ADJUSTER PLUG SEAL - REPLACE THE ADJUSTER PLUG SEALS.
3. PRESSURE LINE FITTING - TORQUE THE HOSE FITTING NUT TO SPECIFICATIONS. IF LEAKAGE PERSISTS, REPLACE THE SEAL.
4. PITMAN SHAFT SEALS - REPLACE THE SEALS.
5. TOP COVER SEAL - REPLACE THE SEAL.

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## REMOVAL AND INSTALLATION

## STEERING GEAR

## REMOVAL

- (1) Place the front wheels in the straight ahead position with the steering wheel centered.
- (2) Disconnect and cap the fluid hoses from steering gear.
- (3) Remove the column coupler shaft from the gear.
- (4) Remove pitman arm from gear.
- (5) Remove the steering gear retaining bolts and remove the gear (Fig. 2) .

## INSTALLATION

- (1) Align the column coupler shaft to steering gear.
- (2) Install steering gear (and bracket) on the frame rail and tighten bolts to 95 N·m (70 ft. lbs.)
- (3) Align and install the pitman arm and tighten nut to 251 N·m (185 ft. lbs.).
- (4) Connect fluid hoses to steering gear and tighten to 28 N·m (21 ft. lbs.).
- (5) Fill power steering system to proper level.

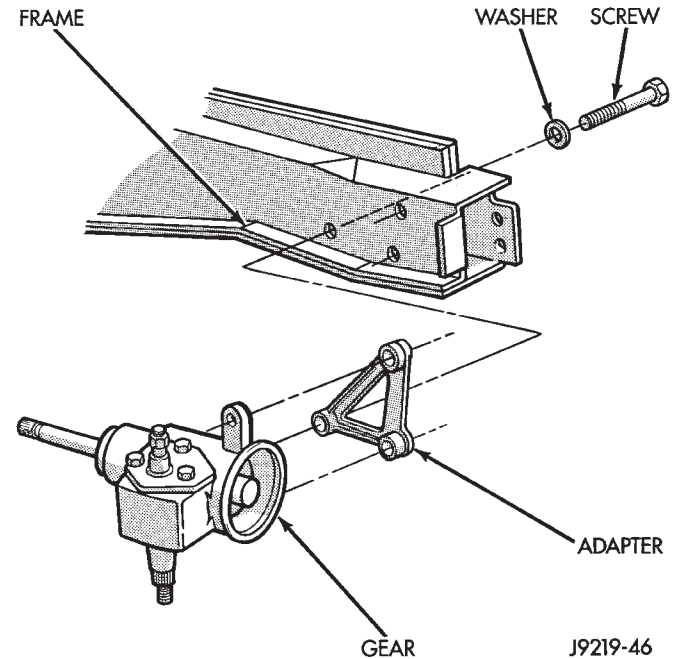


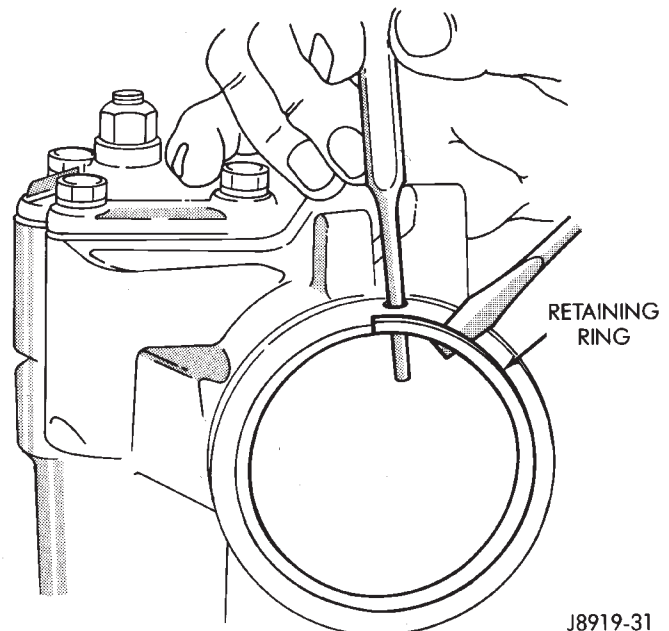
Fig. 2 Steering Gear Mounting (LHD)

## DISASSEMBLY AND ASSEMBLY

## HOUSING END PLUG

## DISASSEMBLY

- (1) Unseat and remove retaining ring from groove with a punch through the hole in the end of the housing (Fig. 3).



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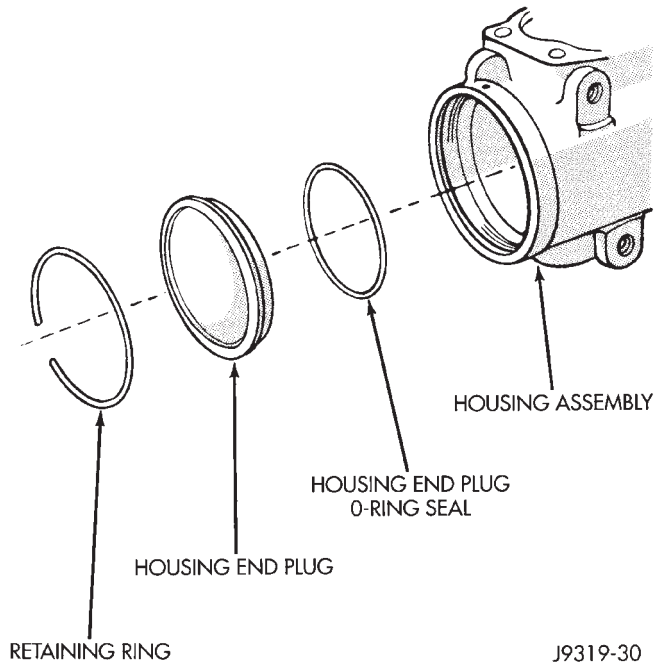
Fig. 3 End Plug Retaining Ring

- (2) Slowly rotate stub shaft with 12 point socket COUNTER-CLOCKWISE to force the end plug out from housing.

## DISASSEMBLY AND ASSEMBLY (Continued)

**CAUTION:** Do not turn stub shaft any further than necessary. The rack piston balls will drop out of the rack piston circuit if the stub shaft is turned too far.

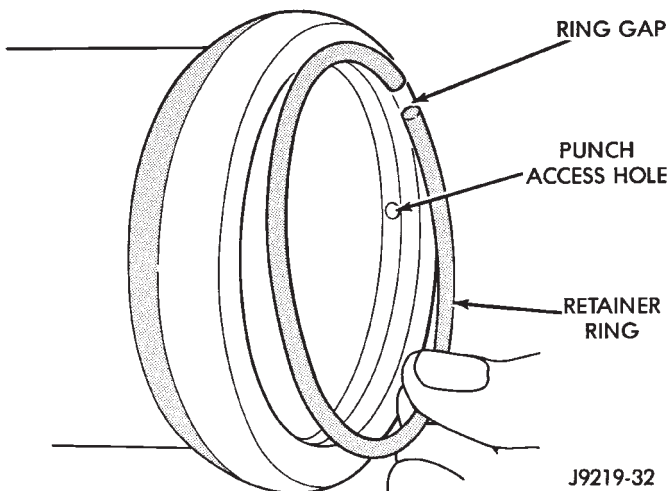
- (3) Remove O-ring from the housing (Fig. 4).



**Fig. 4 End Plug Components**

## ASSEMBLY

- (1) Lubricate O-ring with power steering fluid and install into the housing.
- (2) Install end plug by tapping the plug lightly with a plastic mallet into the housing.
- (3) Install retaining ring so one end of the ring covers the housing access hole (Fig. 5).



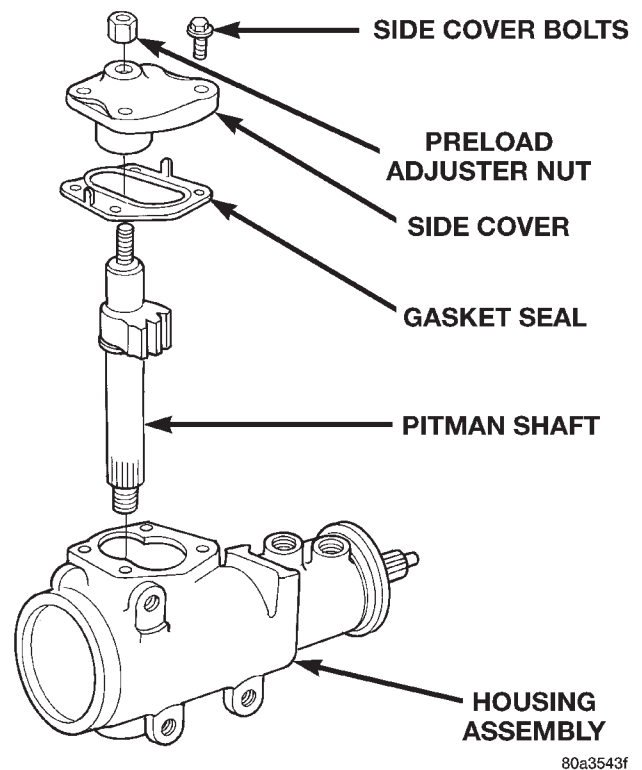
**Fig. 5 Installing The Retaining Ring**

## PITMAN SHAFT/SEALS/BEARING

## DISASSEMBLY

- (1) Clean exposed end of pitman shaft and housing with a wire brush.
- (2) Remove preload adjuster nut (Fig. 6).
- (3) Rotate the stub shaft with a 12 point socket from stop to stop and count the number of turns.
- (4) Center the stub shaft by rotating it from the stop 1/2 of the total amount of turns.
- (5) Remove side cover bolts and remove side cover, gasket and pitman shaft as an assembly (Fig. 6).

**NOTE:** The pitman shaft will not clear the housing if it is not centered.



**Fig. 6 Side Cover and Pitman Shaft**

- (6) Remove pitman shaft from the side cover.
- (7) Remove dust seal from the housing with a seal pick (Fig. 7).

**CAUTION:** Use care not to score the housing bore when prying out seals and washer.

- (8) Remove retaining ring with snap ring pliers.
- (9) Remove washer from the housing.
- (10) Remove oil seal from the housing with a seal pick.
- (11) Remove pitman shaft bearing from housing with a bearing driver and handle (Fig. 8).

DISASSEMBLY AND ASSEMBLY (Continued)

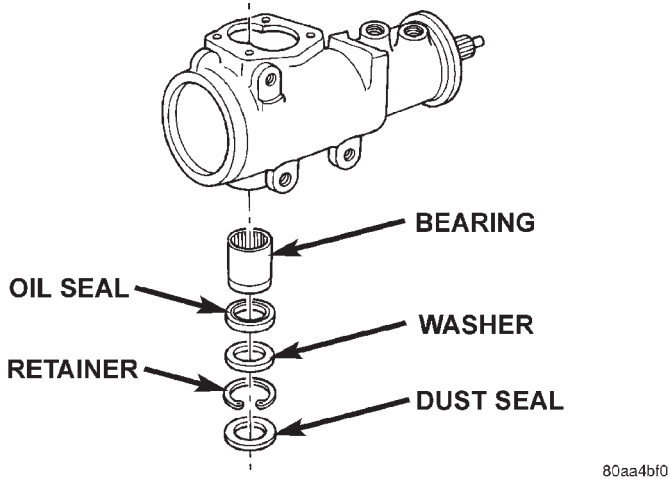


Fig. 7 Pitman Shaft Seals & Bearing

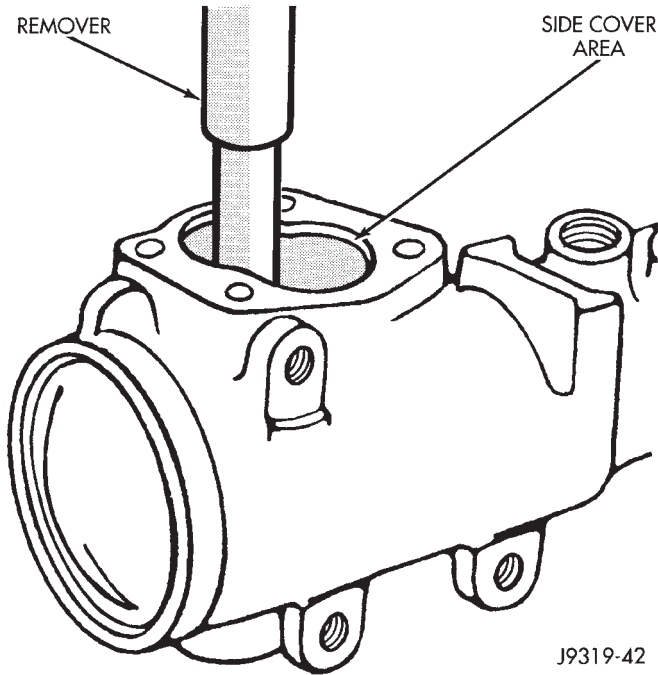


Fig. 8 Needle Bearing Removal

ASSEMBLY

- (1) Install pitman shaft bearing into housing with a bearing driver and handle.
- (2) Coat the oil seal and washer with **special grease** supplied with the new seal.
- (3) Install the oil seal with a driver and handle.
- (4) Install backup washer.
- (5) Install the retainer ring with snap ring pliers.
- (6) Coat the dust seal with **special grease** supplied with the new seal.
- (7) Install dust seal with a driver and handle.
- (8) Install pitman shaft to side cover by screwing shaft in until it fully seats to side cover.

(9) Install preload adjuster nut. **Do not tighten nut until after Over-Center Rotation Torque adjustment has been made.**

(10) Install gasket to side cover and bend tabs around edges of side cover (Fig. 6).

(11) Install pitman shaft assembly and side cover to housing.

(12) Install side cover bolts and tighten to 60 N-m (44 ft. lbs.).

(13) Perform over-center rotation torque adjustment.

SPOOL VALVE

DISASSEMBLY

- (1) Remove lock nut (Fig. 9).
- (2) Remove adjuster nut with Spanner Wrench C-4381.
- (3) Remove thrust support assembly out of the housing (Fig. 10).
- (4) Pull stub shaft and valve assembly from the housing (Fig. 11).

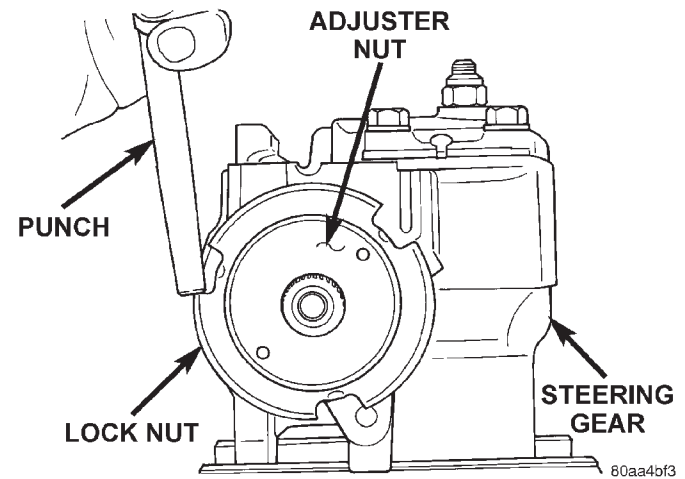


Fig. 9 Lock Nut and Adjuster Nut

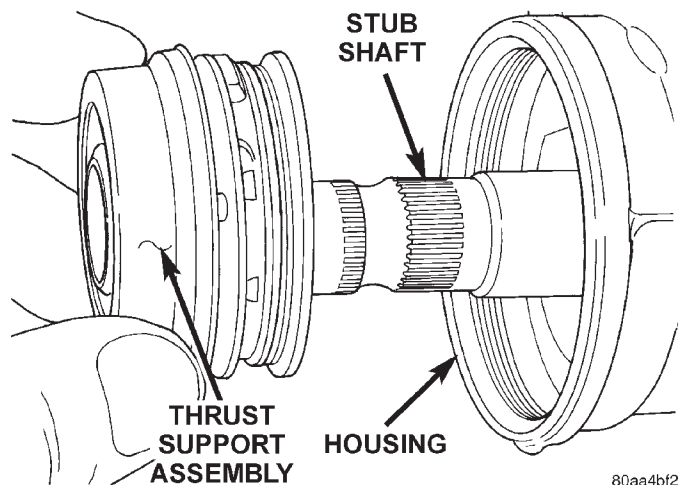
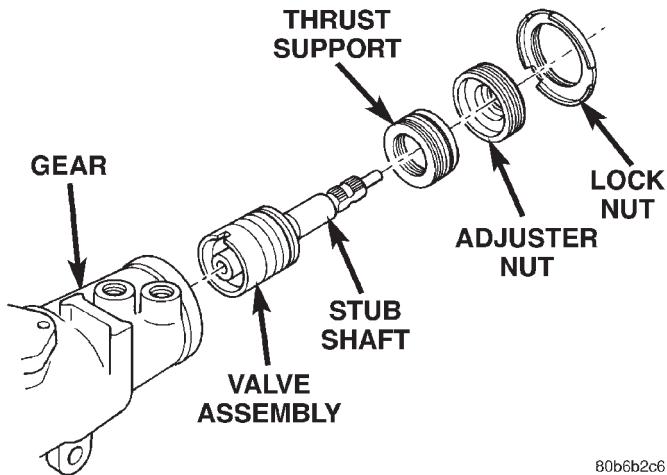


Fig. 10 Thrust Support Assembly

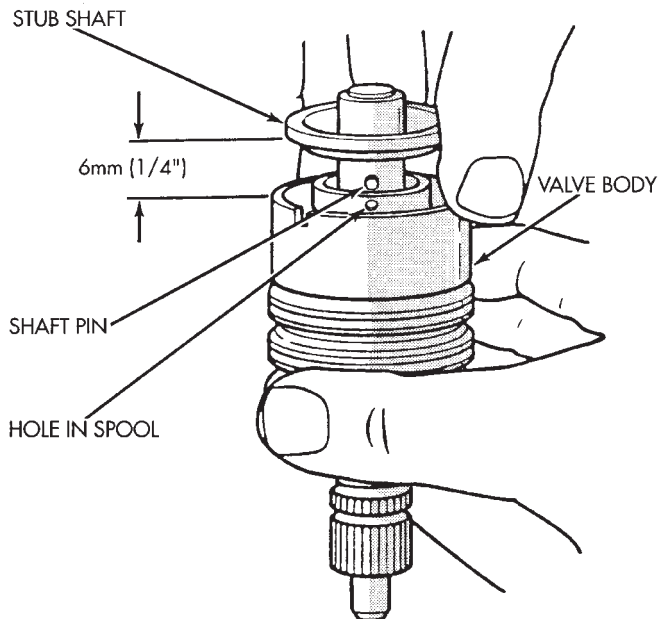
## DISASSEMBLY AND ASSEMBLY (Continued)



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**Fig. 11 Valve Assembly With Stub Shaft**

(5) Remove stub shaft from valve assembly by lightly tapping shaft on a block of wood to loosen shaft. Then disengage stub shaft pin from hole in spool valve and separate the valve assembly from stub shaft (Fig. 12).



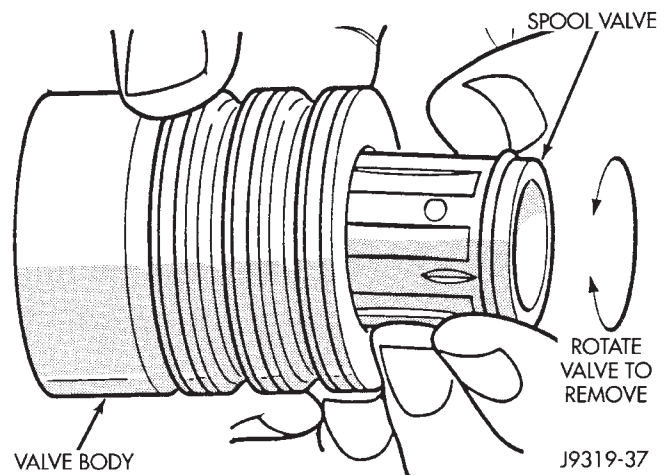
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**Fig. 12 Stub Shaft**

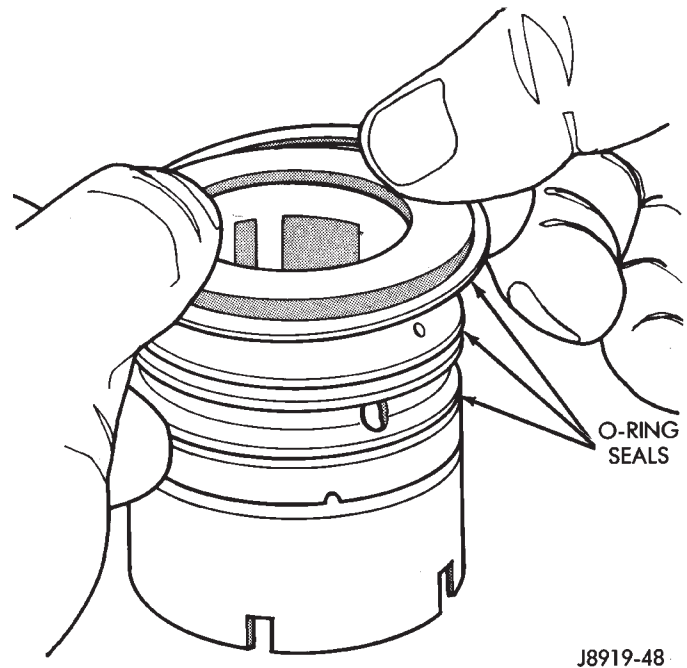
(6) Remove spool valve from valve body by pulling and rotating the spool valve from the valve body (Fig. 13).

(7) Remove spool valve O-ring and valve body teflon rings and O-rings underneath the teflon rings (Fig. 14).

(8) Remove the O-ring between the worm shaft and the stub shaft.



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**Fig. 13 Spool Valve**

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**Fig. 14 Valve Seals****ASSEMBLY**

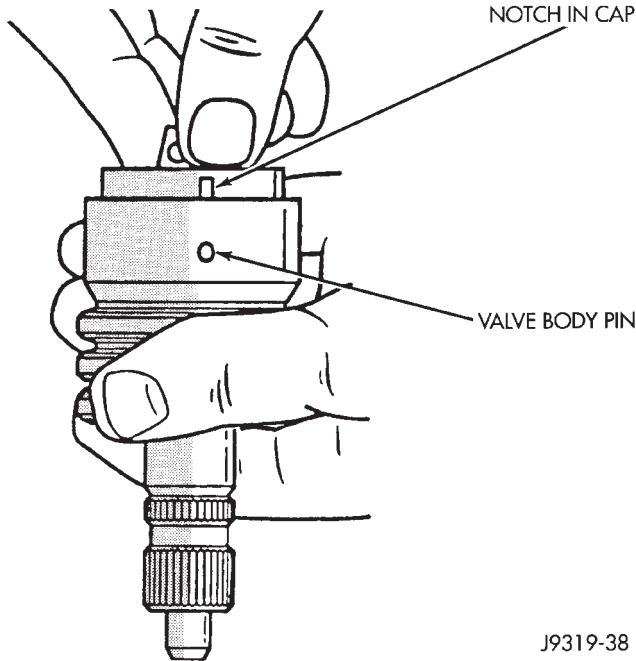
**NOTE:** Clean and dry all components, then lubricate with power steering fluid.

- (1) Install spool valve spool O-ring.
- (2) Install spool valve in valve body by pushing and rotating. Hole in spool valve for stub shaft pin must be accessible from opposite end of valve body.
- (3) Install stub shaft in valve spool and engage locating pin on stub shaft into spool valve hole (Fig. 15).

**NOTE:** Notch in stub shaft cap must fully engage valve body pin and seat against valve body shoulder.

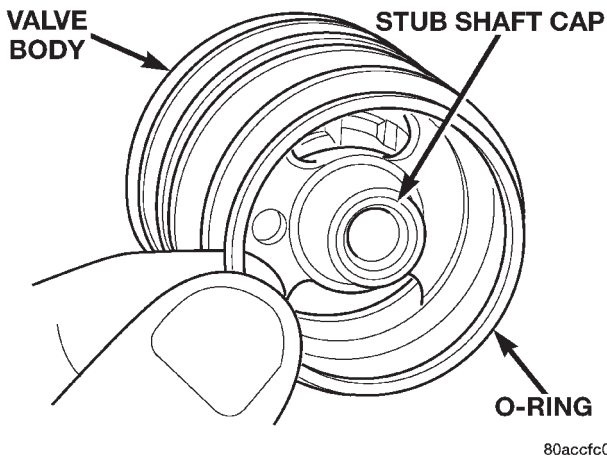


DISASSEMBLY AND ASSEMBLY (Continued)



**Fig. 15 Stub Shaft Installation**

- (4) Install O-rings and teflon rings over the O-rings on valve body.
- (5) Install O-ring into the back of the stub shaft cap (Fig. 16).



**Fig. 16 Stub Shaft Cap O-Ring**

- (6) Install stub shaft and valve assembly in the housing. Line up worm shaft to slots in the valve assembly.
- (7) Install thrust support assembly.

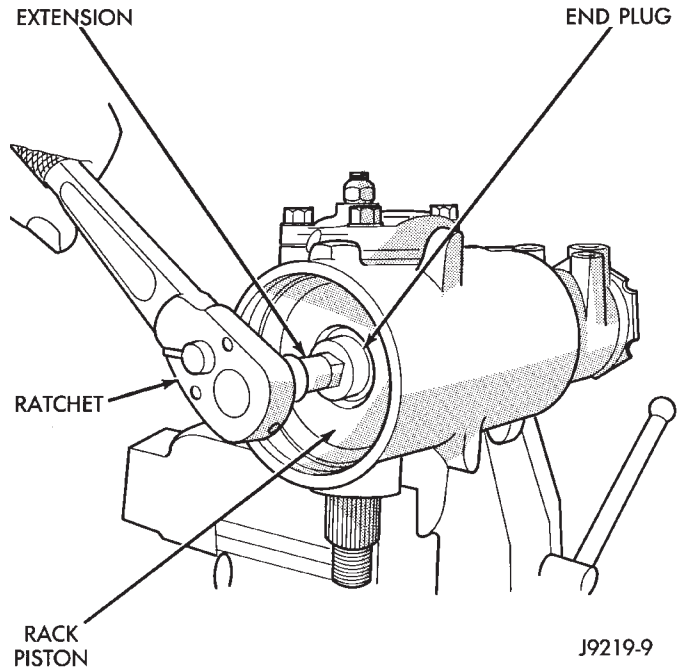
**NOTE:** The thrust support is serviced as an assembly. If any component of the thrust support is damaged the assembly must be replaced.

- (8) Install adjuster nut and lock nut.
- (9) Adjust Thrust Bearing Preload and Over-Center Rotating Torque.

**RACK PISTON AND WORM SHAFT**

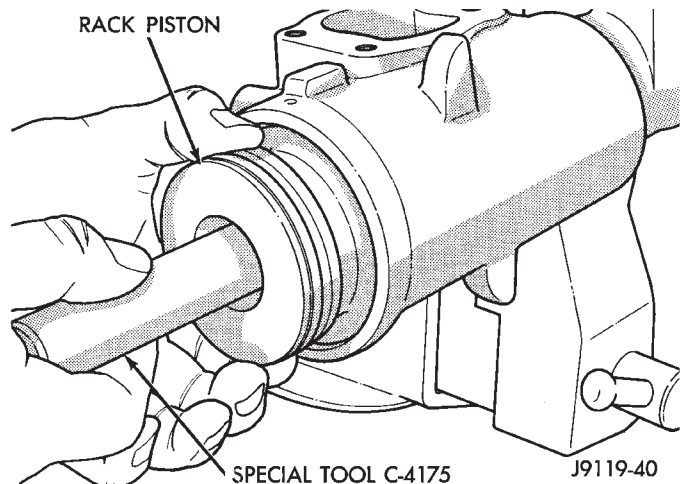
**DISASSEMBLY**

- (1) Remove housing end plug.
- (2) Remove rack piston plug (Fig. 17).
- (3) Remove side cover and pitman shaft.



**Fig. 17 Rack Piston End Plug**

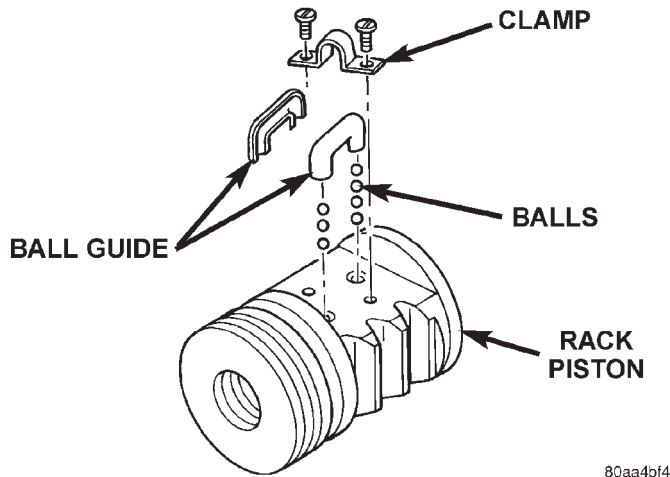
- (4) Turn stub shaft COUNTERCLOCKWISE until the rack piston begins to come out of the housing.
- (5) Insert Arbor C-4175 into bore of rack piston (Fig. 18) and hold tool tightly against worm shaft.
- (6) Turn the stub shaft with a 12 point socket COUNTERCLOCKWISE, this will force the rack piston onto the tool and hold the rack piston balls in place.



**Fig. 18 Rack Piston with Arbor**

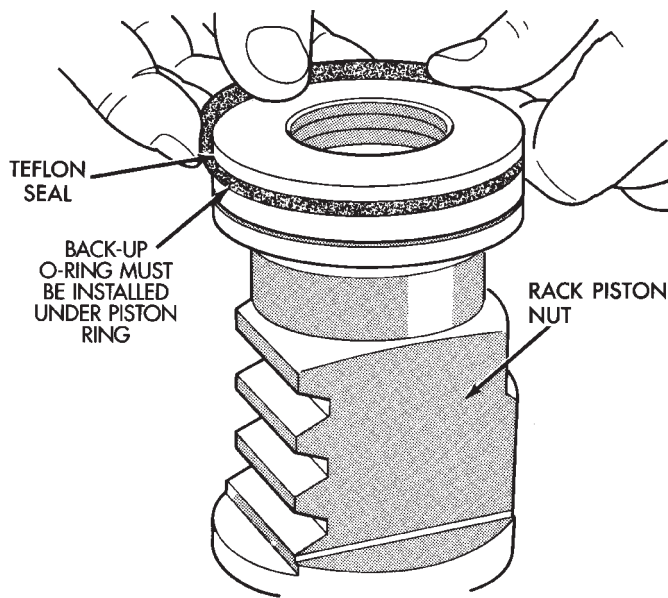
DISASSEMBLY AND ASSEMBLY (Continued)

- (7) Remove the rack piston and tool together from housing.
- (8) Remove tool from rack piston.
- (9) Remove rack piston balls.
- (10) Remove clamp bolts, clamp and ball guide (Fig. 19).
- (11) Remove teflon ring and O-ring from the rack piston (Fig. 20).



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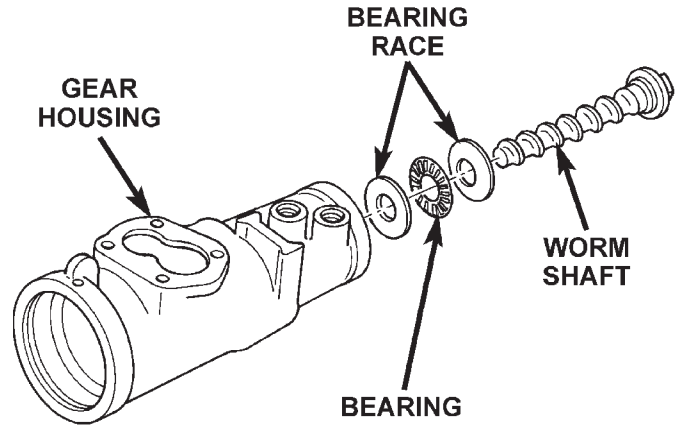
Fig. 19 Rack Piston



J9219-12

Fig. 20 Rack Piston Teflon Ring and O-Ring

- (12) Remove the adjuster lock nut and adjuster nut from the stub shaft.
- (13) Pull the stub shaft with the spool valve and thrust support assembly out of the housing.
- (14) Remove the worm shaft from the housing (Fig. 21).



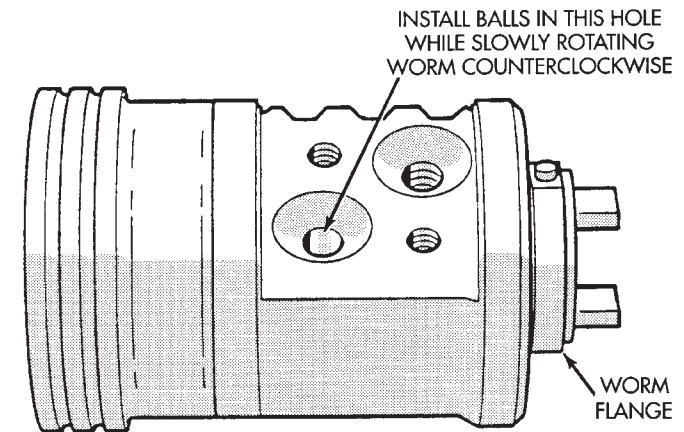
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Fig. 21 Worm Shaft

ASSEMBLY

**NOTE:** Clean and dry all components and lubricate with power steering fluid.

- (1) Check for scores, nicks or burrs on the rack piston finished surface. Slight wear is normal on the worm gear surfaces.
- (2) Install O-ring and teflon ring on the rack piston.
- (3) Install worm shaft in the rack piston and align worm shaft spiral groove with rack piston ball guide hole (Fig. 22).



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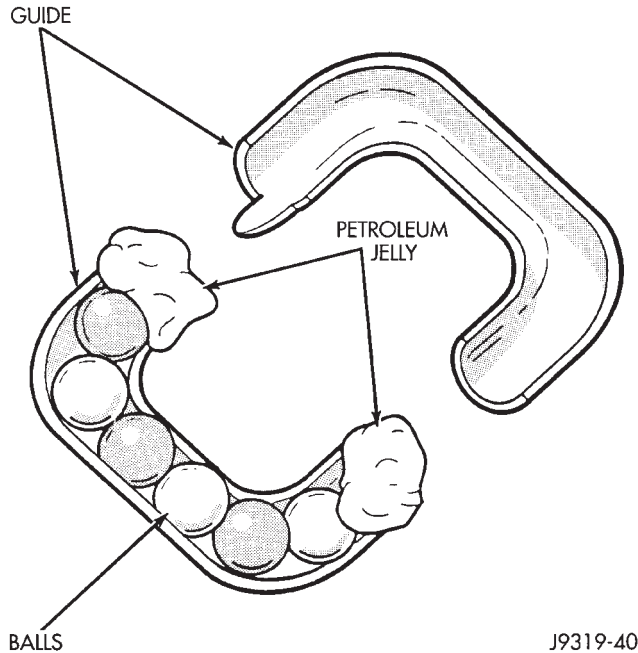
Fig. 22 Installing Balls in Rack Piston

**CAUTION:** The rack piston balls must be installed alternately into the rack piston and ball guide. This maintains worm shaft preload. There are 12 black balls and 12 silver (Chrome) balls. The black balls are smaller than the silver balls.

## DISASSEMBLY AND ASSEMBLY (Continued)

(4) Lubricate and install rack piston balls through return guide hole while turning worm shaft COUNTERCLOCKWISE (Fig. 22).

(5) Install remaining balls in guide using grease to hold the balls in place (Fig. 23).



**Fig. 23 Balls in the Return Guide**

(6) Install the guide onto rack piston and install clamp and clamp bolts. Tighten bolts to 58 N·m (43 ft. lbs.).

(7) Insert Arbor C-4175 into bore of rack piston and hold tool tightly against worm shaft.

(8) Turn the worm shaft COUNTERCLOCKWISE while pushing on the arbor. This will force the rack piston onto the arbor and hold the rack piston balls in place.

(9) Install the races and thrust bearing on the worm shaft and install shaft in the housing (Fig. 21).

(10) Install the stub shaft with spool valve, thrust support assembly and adjuster nut in the housing.

(11) Install the rack piston and arbor tool into the housing.

(12) Hold arbor tightly against worm shaft and turn stub shaft CLOCKWISE until rack piston is seated on worm shaft.

(13) Install pitman shaft and side cover in the housing.

(14) Install rack piston plug and tighten to 150 N·m (111 ft. lbs.).

(15) Install housing end plug.

(16) Adjust worm shaft thrust bearing preload and over-center rotating torque.

## ADJUSTMENTS

## STEERING GEAR

**CAUTION:** Steering gear must be adjusted in the proper order. If adjustments are not performed in order, gear damage and improper steering response may result.

**NOTE:** Adjusting the steering gear in the vehicle is not recommended. Remove gear from the vehicle and drain the fluid. Then mount gear in a vise to perform adjustments.

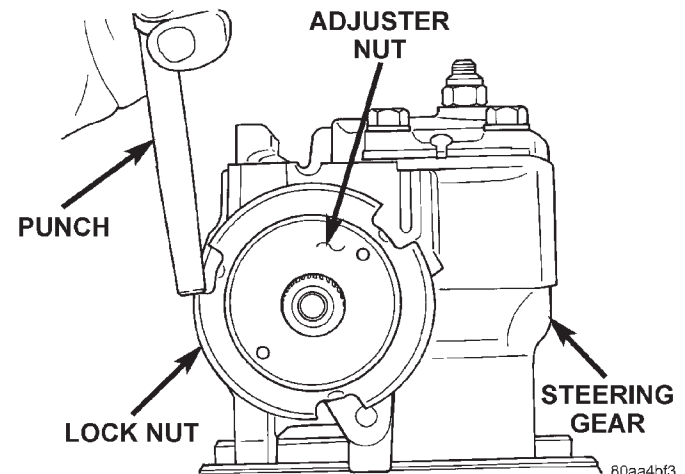
## WORM THRUST BEARING PRELOAD

(1) Mount the gear carefully into a vise.

**CAUTION:** Do not overtighten the vise on the gear case. This may affect the adjustment

(2) Remove adjuster plug locknut (Fig. 24).

(3) Rotate the stub shaft back and forth with a 12 point socket to drain the remaining fluid.



**Fig. 24 Adjuster Lock Nut**

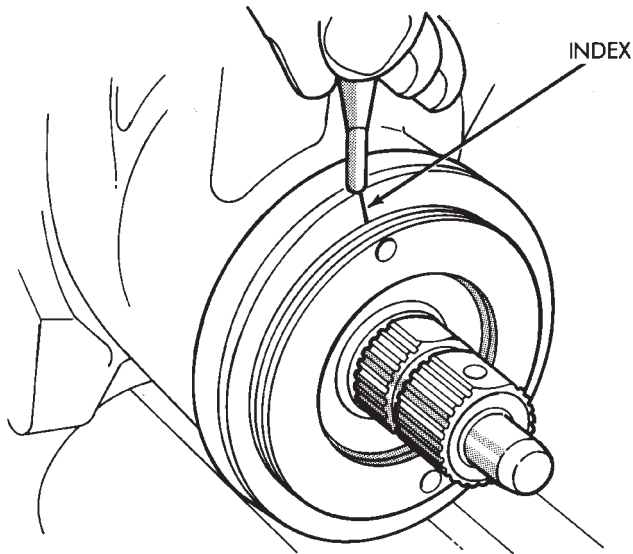
(4) Turn the adjuster in with Spanner Wrench C-4381. Tighten the plug and thrust bearing in the housing until firmly bottomed in the housing about 34 N·m (25 ft. lbs.).

(5) Place an index mark on the housing even with one of the holes in adjuster plug (Fig. 25).

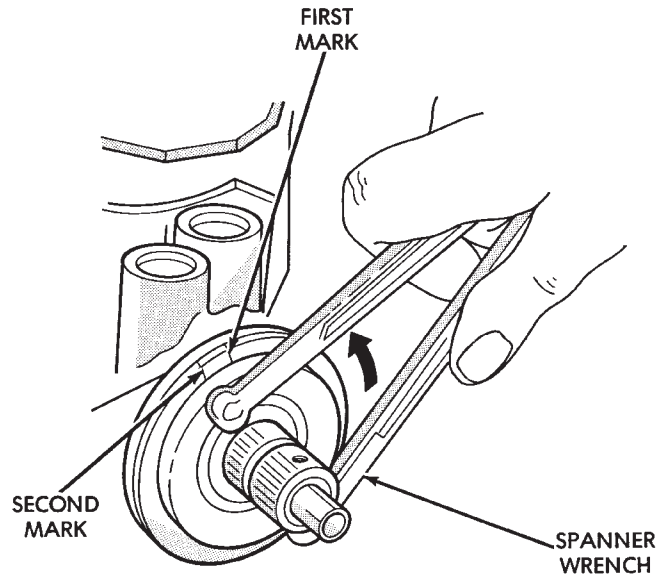
(6) Measure back (counterclockwise) 5.08 mm (0.20 in) and mark housing (Fig. 26).

(7) Rotate adjustment cap back (counterclockwise) with spanner wrench until hole is aligned with the second mark (Fig. 27).

## ADJUSTMENTS (Continued)



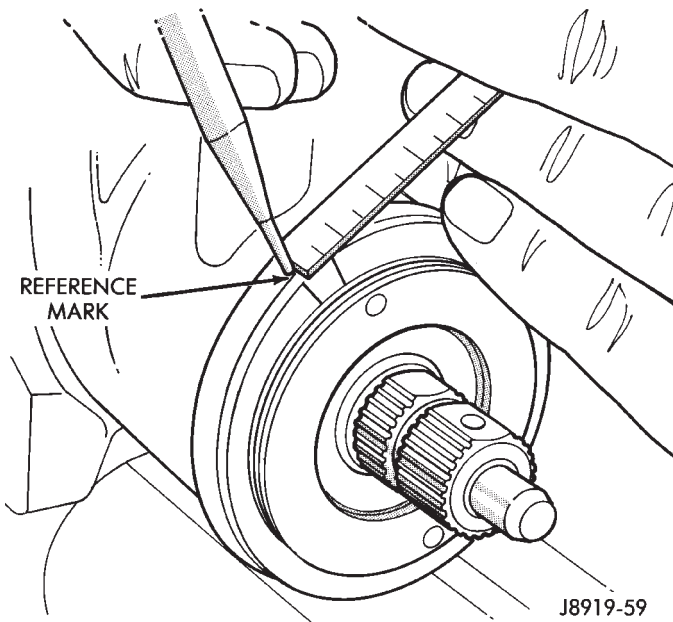
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**Fig. 25 Alignment Marking On Housing**

J9219-30

**Fig. 27 Aligning To The Second Mark**

(2) Starting at either stop, turn the stub shaft back 1/2 the total number of turns. This is the center of the gear travel (Fig. 28).



J8919-59

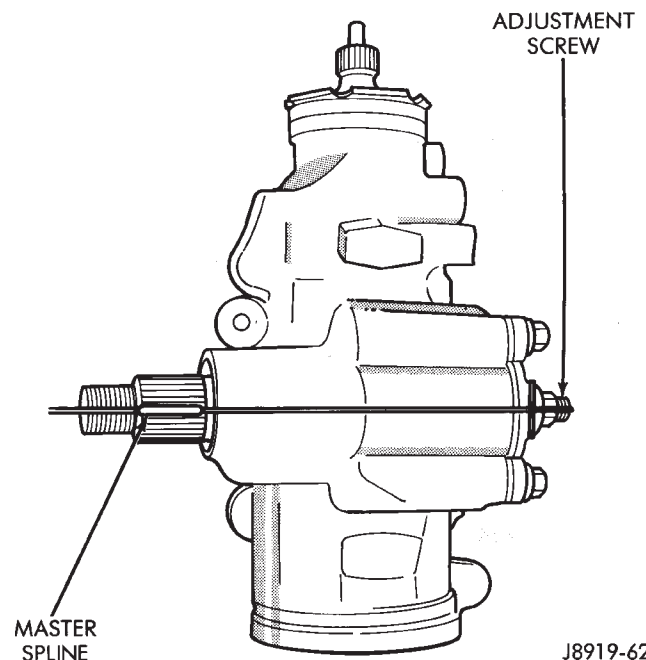
**Fig. 26 Second Marking On Housing**

(8) Install and tighten locknut to 108 N·m (80 ft. lbs.). Be sure adjustment cap does not turn while tightening the locknut.

**OVER-CENTER**

**NOTE:** Before performing this procedure, the worm bearing preload adjustment must be performed.

(1) Rotate the stub shaft with a 12 point socket from stop to stop and count the number of turns.



J8919-62

**Fig. 28 Steering Gear Centered**

(3) Place the torque wrench in the vertical position on the stub shaft. Rotate the wrench 45 degrees each side of the center and record the highest rotational torque in this range (Fig. 29). This is the Over-Center Rotating Torque.

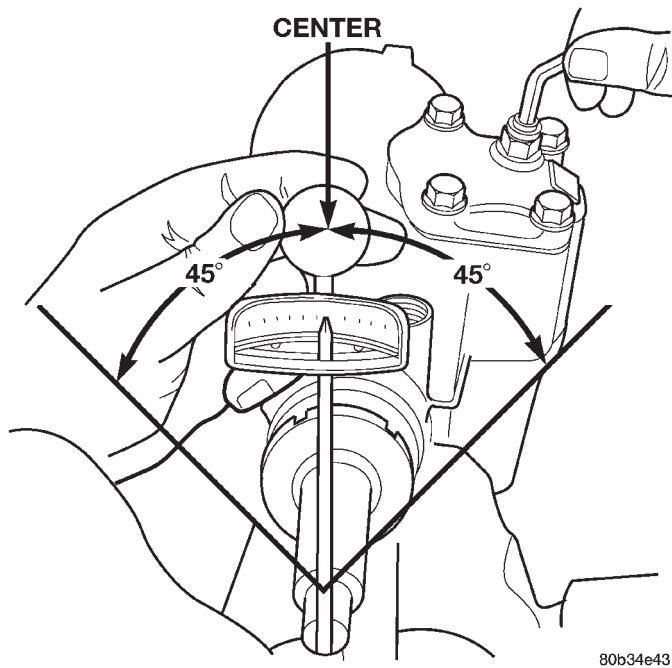
ADJUSTMENTS (Continued)

**NOTE: The stub shaft must rotate smoothly without sticking or binding.**

(4) Rotate the stud shaft between 90° and 180° to the left of center and record the left off-center preload. Repeat this to the right of center and record the right off-center preload. The average of these two recorded readings is the Preload Rotating Torque.

(5) The Over-Center Rotating Torque should be 0.45-0.9 N·m (4-8 in. lbs.) **higher** than the Preload Rotating Torque.

(6) If an adjustment to the Over-Center Rotating Torque is necessary, first loosen the adjuster lock nut. Then turn the pitman shaft adjuster screw back (COUNTERCLOCKWISE) until fully extended, then turn back in (CLOCKWISE) one full turn.



**Fig. 29 Checking Over-center Rotation Torque**

(7) Remeasure Over-Center Rotating Torque. If necessary turn the adjuster screw and repeat measurement until correct Over-Center Rotating Torque is reached.

**NOTE: To increase the Over-Center Rotating Torque turn the screw CLOCKWISE.**

(8) Prevent the adjuster screw from turning while tightening adjuster lock nut. Tighten the adjuster lock nut to 49 N·m (36 ft. lbs.).

SPECIFICATIONS

POWER STEERING GEAR

*Steering Gear*

Type . . . . . Recirculating Ball

**Gear Ratio**

RHD . . . . . 14:1

LHD . . . . . 14:1

**Worm Shaft Bearing**

Preload . . . . . 0.45–1.13 N·m  
(4–10 in. lbs.)

**Pitman Shaft Overcenter Drag**

New Gear (under 400 miles) . . . . . 0.45–0.90 N·m  
(4–8 in. lbs.)

+ Worm Shaft Preload

Used Gear (over 400 miles) . . . . . 0.5–0.6 N·m  
(4–5 in. lbs.)

+ Worm Shaft Preload

TORQUE CHART

**DESCRIPTION**

**TORQUE**

**Power Steering Gear**

Adjustment Cap Locknut . . . . . 108 N·m  
(80 ft. lbs.)

Adjustment Screw Locknut . . . . . 49 N·m  
(36 ft. lbs.)

Gear to Frame Bolts . . . . . 95 N·m  
(70 ft. lbs.)

Pitman Shaft Nut . . . . . 251 N·m  
(185 ft. lbs.)

Rack Piston Plug . . . . . 102 N·m  
(75 ft. lbs.)

Side Cover Bolts . . . . . 60 N·m  
(44 ft. lbs.)

Pressure Line . . . . . 28 N·m  
(21 ft. lbs.)

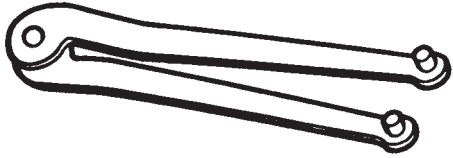
Return Line . . . . . 28 N·m  
(21 ft. lbs.)

Return Guide Clamp Bolt . . . . . 58 N·m  
(43 ft. lbs.)

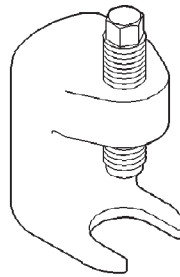
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SPECIAL TOOLS

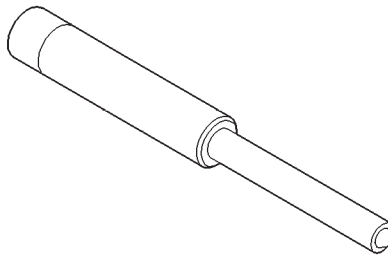
POWER STEERING GEAR



*Remover/Installer, Steering Plug C-4381*



*Remover, Pitman Arm C-4150A*



*Remover/Installer Steering Rack Piston C-4175*

# STEERING LINKAGE

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## GENERAL INFORMATION

### STEERING LINKAGE

The steering linkage consist of a pitman arm, drag link, tie rod, tie rod ends and a steering damper (Fig. 1) and (Fig. 2). The service procedures and torque specifications are the same for LHD and RHD vehicles.

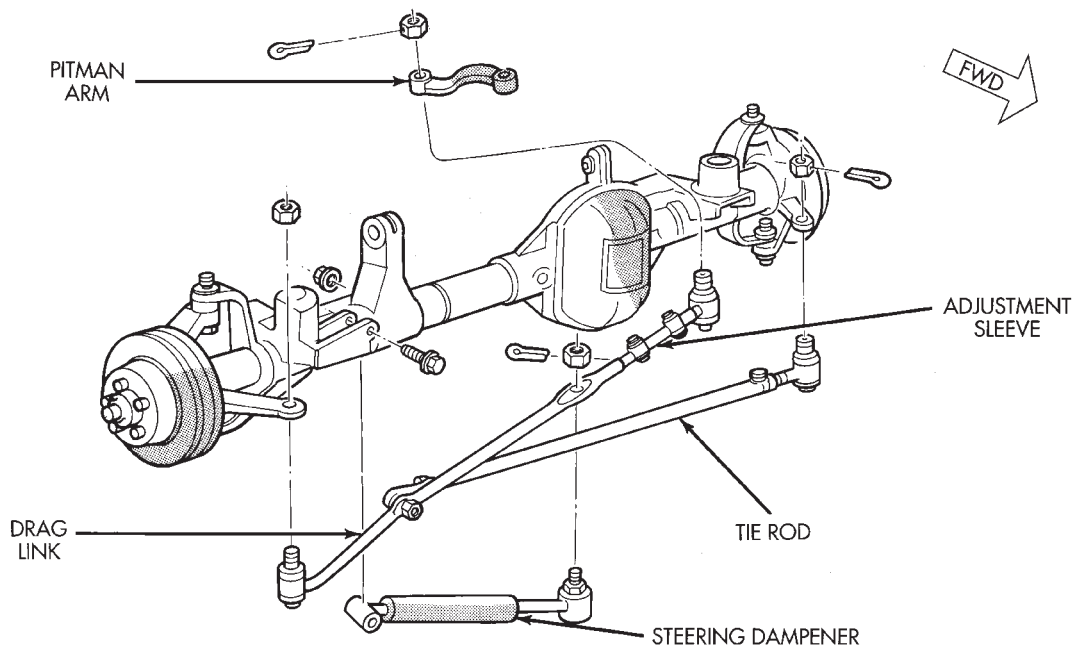
**CAUTION:** Components attached with a nut and cotter pin must be torqued to specification. Then if the slot in the nut does not line up with the cotter pin hole, tighten nut until it is aligned. Never loosen the nut to align the cotter pin hole.

## SERVICE PROCEDURES

### STEERING LINKAGE

The tie rod end and ball stud seals should be inspected during all oil changes. If a seal is damaged, it should be replaced. Before installing a new seal, inspect ball stud at the throat opening. Check for lubricant loss, contamination, ball stud wear or corrosion. If these conditions exist, replace the tie rod. A replacement seal can be installed if lubricant is in good condition. Otherwise, a complete replacement ball stud end should be installed.

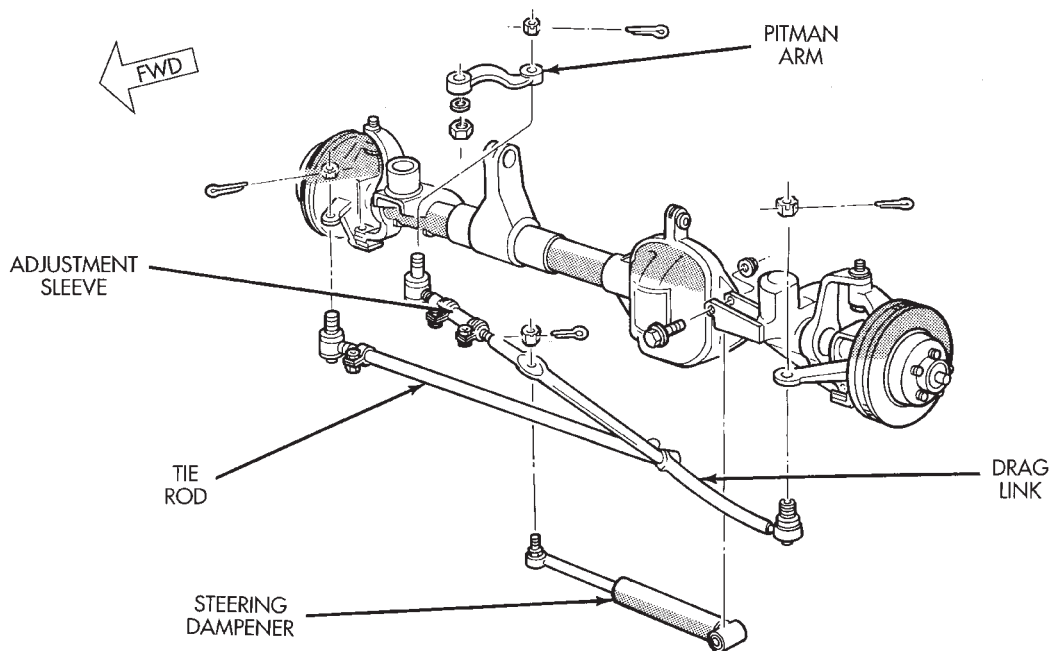
**CAUTION:** If any steering components are replaced or serviced an alignment must be performed, to ensure the vehicle meets all alignment specifications.



J9502-7

Fig. 1 Steering Linkage—LHD

SERVICE PROCEDURES (Continued)



J9502-6

**Fig. 2 Steering Linkage—RHD**

**CAUTION:** Components attached with a nut and cotter pin must be torqued to specification. Then if the slot in the nut does not line up with the cotter pin hole, tighten nut until it is aligned. Never loosen the nut to align the cotter pin hole.

**REMOVAL**

- (1) Remove the cotter pins and nuts at the tie rod ball studs and drag link.
- (2) Loosen the ball studs with a puller tool to remove the tie rod.
- (3) Loosen clamp bolts and unthread the tie rod end from the tube.

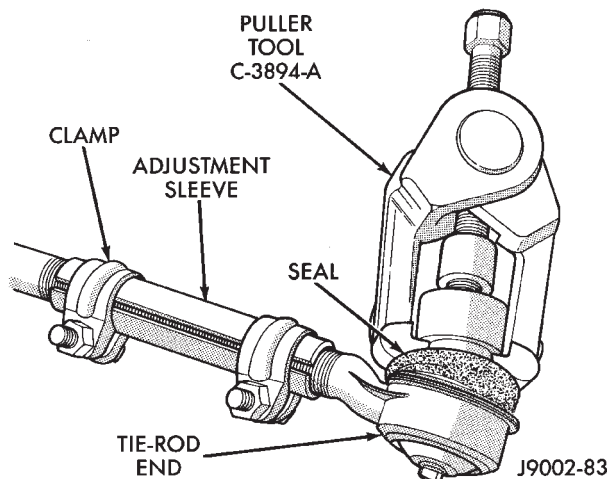
**REMOVAL AND INSTALLATION**

**TIE ROD**

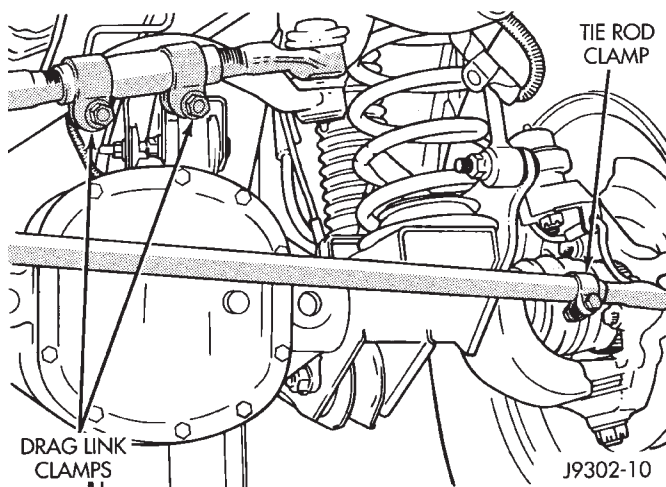
**CAUTION:** Use a Puller tool C-3894-A for tie rod removal. Failure to use this tool could damage the ball stud and seal (Fig. 3).

**INSTALLATION**

- (1) Thread the tie rod end into the tube and position the clamp to its original position (Fig. 4). Tighten the clamp bolts to 27 N·m (20 ft. lbs.).



**Fig. 3 Ball Stud Puller**



**Fig. 4 Tie Rod/Drag Link Clamps**

- (2) Install the tie rod on the drag link and steering knuckle. Install the retaining nuts.



REMOVAL AND INSTALLATION (Continued)

(3) Tighten the ball stud nut on the steering knuckle to 47 N·m (35 ft. lbs.). Tighten the ball stud nut to drag link to 88 N·m (65 ft. lbs.). Install new cotter pins.

**PITMAN ARM**

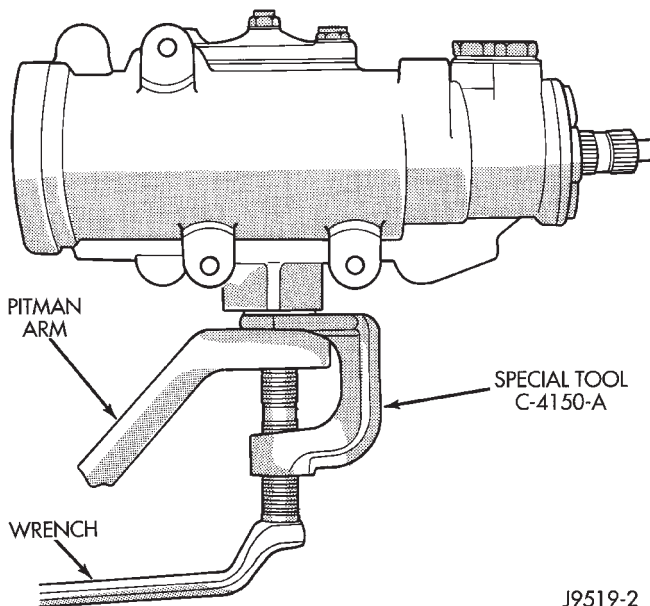
**REMOVAL**

- (1) Remove the cotter pin and nut from the drag link at the pitman arm.
- (2) Remove the drag link ball stud from the pitman arm with a puller.
- (3) Remove the nut and washer from the steering gear shaft. Mark the pitman shaft and pitman arm for installation reference. Remove the pitman arm from steering gear with Puller C-4150-A (Fig. 5).

(4) Remove drag link from the steering knuckle and pitman arm.

**INSTALLATION**

- (1) Install the drag link onto steering knuckle and pitman arm.
- (2) Install nut at steering knuckle and tighten to 47 N·m (35 ft. lbs.). Install new cotter pins.
- (3) Install nut at pitman arm and tighten to 75 N·m (55 ft. lbs.). Install new cotter pins.
- (4) Install tie rod onto drag link and install nut. Tighten nut to 75 N·m (55 ft. lbs.) and install new cotter pins.
- (5) Install steering damper onto drag link and install nut. Tighten nut to 75 N·m (55 ft. lbs.) and install a new cotter pin.



**Fig. 5 Pitman Arm Puller**

**INSTALLATION**

- (1) Align and install the pitman arm on steering gear shaft.
- (2) Install the washer and nut on the shaft and tighten nut to 251 N·m (185 ft. lbs.).
- (3) Install drag link ball stud to pitman arm install nut and tighten to 74 N·m (55 ft. lbs.). Install a new cotter pin.

**DRAG LINK**

**REMOVAL**

- (1) Remove cotter pins and nuts from drag link
- (2) Remove the steering damper ball stud from the drag link.
- (3) Remove tie rod from drag link

**STEERING DAMPER**

**REMOVAL**

- (1) Remove the steering damper retaining bolt from the axle bracket.
- (2) Remove the cotter pin and nut from the ball stud at the drag link.
- (3) Remove the steering damper ball stud from the drag link with Puller C-3894-A.

**INSTALLATION**

- (1) Install steering damper onto the axle bracket and drag link.
- (2) Install steering damper bolt in axle bracket and tighten nut to 75 N·m (55 ft. lbs.).
- (3) Install ball stud nut at the drag link and tighten nut to 75 N·m (55 ft. lbs.). Install a new cotter pin.

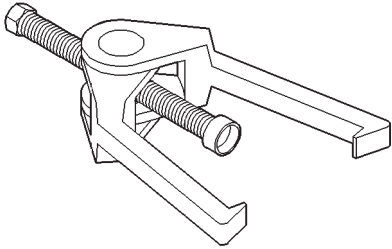
**SPECIFICATIONS**

**TORQUE CHART**

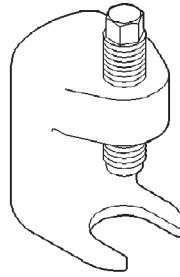
DESCRIPTION	TORQUE
<b>Pitman Arm</b>	
Shaft . . . . .	251 N·m (185 ft. lbs.)
<b>Drag Link</b>	
Ball Studs . . . . .	74 N·m (55 ft. lbs.)
Clamp . . . . .	49 N·m (36 ft. lbs.)
<b>Tie Rod Ends</b>	
Ball Studs . . . . .	74 N·m (55 ft. lbs.)
Clamp . . . . .	27 N·m (20 ft. lbs.)
<b>Tie Rod</b>	
Ball Stud . . . . .	88 N·m (65 ft. lbs.)
<b>Steering Damper</b>	
Frame . . . . .	74 N·m (55 ft. lbs.)
Drag Link . . . . .	74 N·m (55 ft. lbs.)

SPECIAL TOOLS

STEERING LINKAGE



***Puller C-3894-A***



***Remover Pitman C-4150A***

# STEERING COLUMN

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## GENERAL INFORMATION

### STEERING COLUMN

The standard non-tilt and tilt steering column has been designed to be serviced as an assembly. The key cylinder, switches, clock spring, trim shrouds and steering wheel are serviced separately. On the non-tilt column the upper mounting bracket is also serviced separately.

The column is mounted to the column support bracket studs and secured by four nuts. The column is connected to the steering gear by a one piece collapsible shaft with a coupler at each end. The couplers secure the shaft to the steering column and steering gear.

### SERVICE PRECAUTIONS

Safety goggles should be worn at all times when working on steering columns.

To service the steering wheel, switches or airbag, refer to Group 8M and follow all WARNINGS and CAUTIONS.

**WARNING: THE AIRBAG SYSTEM IS A SENSITIVE, COMPLEX ELECTRO-MECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE, REMOVE OR INSTALL THE AIRBAG SYSTEM COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE. FAILURE TO DO SO COULD RESULT IN ACCIDENTAL DEPLOYMENT OF THE AIRBAG AND POSSIBLE PERSONAL INJURY. THE FASTENERS, SCREWS, AND BOLTS, ORIGINALLY USED FOR THE AIRBAG COMPONENTS, HAVE SPECIAL COATINGS AND ARE SPECIFICALLY DESIGNED FOR THE AIRBAG SYSTEM. THEY MUST NEVER BE REPLACED WITH ANY SUBSTITUTES. ANYTIME A NEW FASTENER IS NEEDED, REPLACE WITH THE CORRECT FASTENERS PROVIDED IN THE SERVICE PACKAGE OR FASTENERS LISTED IN THE PARTS BOOKS.**

## REMOVAL AND INSTALLATION

### STEERING COLUMN

**WARNING: BEFORE SERVICING THE STEERING COLUMN THE AIRBAG SYSTEM MUST BE DISARMED. REFER TO GROUP 8M RESTRAINT SYSTEMS FOR SERVICE PROCEDURES. FAILURE TO DO SO MAY RESULT IN ACCIDENTAL DEPLOYMENT OF THE AIRBAG AND POSSIBLE PERSONAL INJURY.**

### REMOVAL

- (1) Position front wheels **straight ahead**.
- (2) Remove and isolate the negative battery ground cable.
- (3) Remove the airbag, refer to Group 8M Restraint Systems for service procedures.

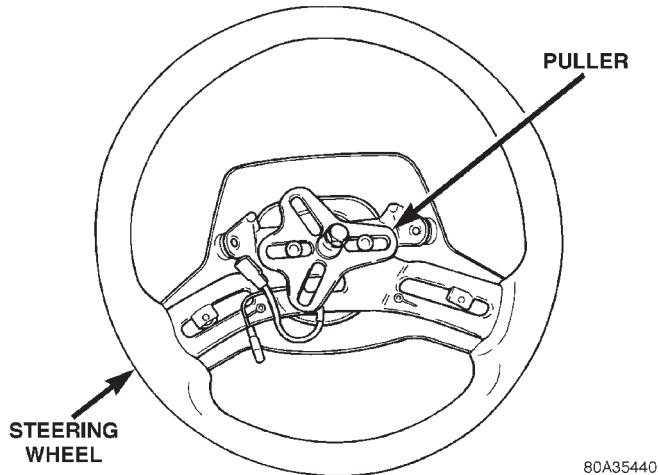
**NOTE: If equipped with cruise control, disconnect clock spring harness from cruise switch harness on the steering wheel.**

- (4) Remove the steering wheel with an appropriate puller (Fig. 1).

**CAUTION: Ensure the puller bolts are fully engaged into the steering wheel and not into the clock-spring, before attempting to remove the wheel. Failure to do so may damage the steering wheel.**

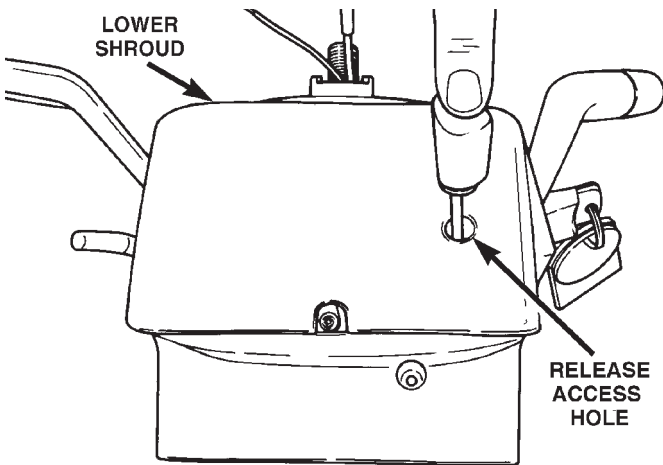
- (5) Turn ignition cylinder to the on position and remove cylinder by pressing release through lower shroud access hole (Fig. 2).
- (6) Remove knee blocker cover and knee blocker, Refer to Group 8E Instrument Panel Systems.
- (7) Remove screws from the lower column shroud (Fig. 3) and remove lower shroud.
- (8) Remove the steering coupler bolt and column mounting nuts (Fig. 4) then lower column off the mounting stud.
- (9) Remove upper column shroud (Fig. 3).

## REMOVAL AND INSTALLATION (Continued)



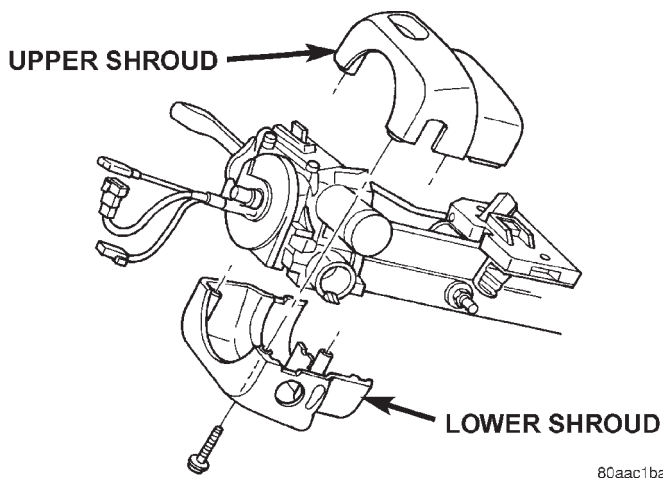
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Fig. 1 Steering Wheel



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Fig. 2 Key Cylinder Release Access Hole

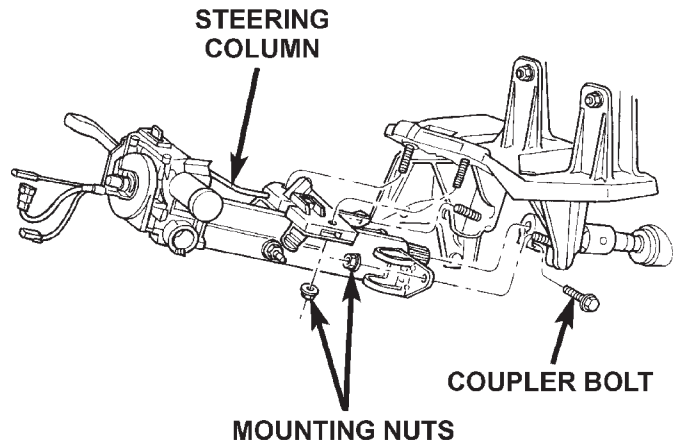


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Fig. 3 Column Shrouds

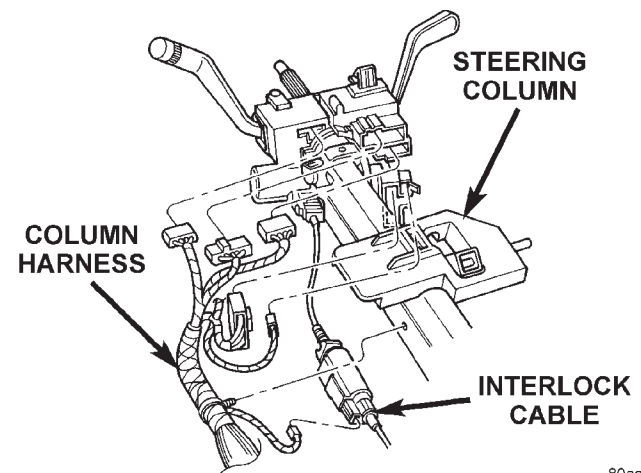
(10) Disconnect and remove the wiring harness from the column (Fig. 5).

**NOTE:** If vehicle is equipped with automatic transmission, remove shifter interlock cable. Refer to



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Fig. 4 Tilt Steering Column Mounting



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Fig. 5 Steering Column Harness

Group 21 Transmission and Transfer Case for procedure.

(11) Remove column.

(12) Remove nut and bolt from the upper column mounting bracket on non-tilt column (Fig. 6). Remove the bracket from the column and **note the mounting location and orientation of the bracket.**

(13) Remove clock spring, switches, (SKIM if equipped) and ignition key cylinder, refer to Group 8 Electrical for service procedures.

### INSTALLATION

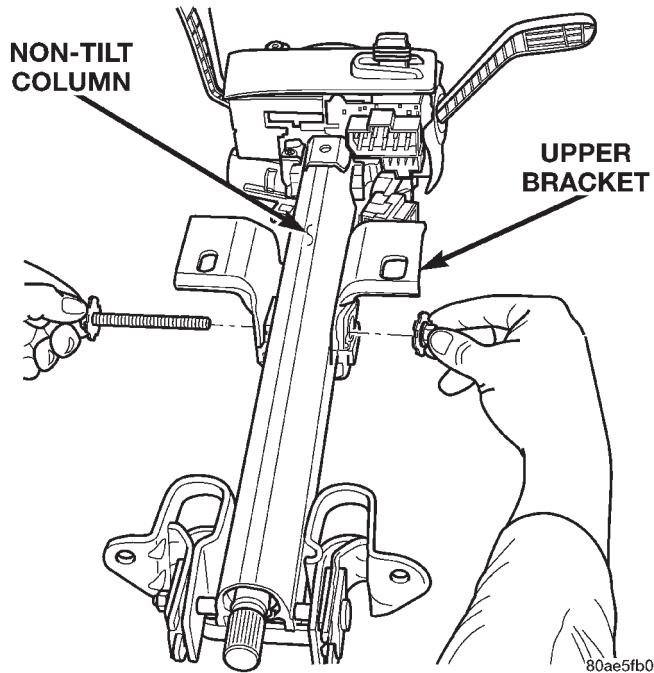
(1) Install upper column mounting bracket on non-tilt column. Install the mounting bolt and tighten the nut to 17 N·m (150 in. lbs.).

(2) Install switches, refer to Group 8 Electrical for service procedures.

(3) Align and install column into the steering coupler.

(4) Install column harness and connect harness to switches.

REMOVAL AND INSTALLATION (Continued)



**Fig. 6 Non-Tilt Column**

**NOTE:** If vehicle is equipped with automatic transmission install shifter interlock cable. Refer to Group 21 Transmission and Transfer Case for procedure.

- (5) Install upper column shrouds.
- (6) Install column onto the mounting studs.
- (7) Install mounting nuts and tighten to 23 N·m (17 ft. lbs.).
- (8) Install steering column coupler bolt and tighten to 49 N·m (36 ft. lbs.).
- (9) Center the clock spring and install it on the column, refer to Group 8 Electrical for service procedures.

- (10) Install lower column shroud and install mounting screws.
- (11) Install ignition cylinder.
- (12) Install knee blocker and knee blocker cover, Refer to Group 8E Instrument Panel Systems.
- (13) Install steering wheel and tighten nut to 54 N·m (40 ft. lbs.).

**NOTE:** If equipped with cruise control, connect clock spring harness to cruise switch harness on the steering wheel.

- (14) Install airbag, refer to Group 8M Restraint Systems for service procedures.
- (15) Install negative battery terminal.

SPECIFICATIONS

TORQUE CHART

DESCRIPTION	TORQUE
<b>Tilt Steering Column</b>	
Steering Wheel Nut . . . . .	54 N·m (40 ft. lbs.)
Mounting Nuts . . . . .	23 N·m (17 ft. lbs.)
Coupler Bolt . . . . .	49 N·m (36 ft. lbs.)
<b>Non-Tilt Steering Column</b>	
Steering Wheel Nut . . . . .	54 N·m (40 ft. lbs.)
Mounting Nuts . . . . .	23 N·m (17 ft. lbs.)
Coupler Bolt . . . . .	49 N·m (36 ft. lbs.)
Upper Bracket Nut . . . . .	17 N·m (150 in. lbs.)

