

STEERING SYSTEM - POWER RACK & PINION

1994 Volvo 960

1994 STEERING
Volvo - Power Rack & Pinion

960

DESCRIPTION

960 may be equipped with either a ZF gear with an integral housing or a cam gear steering rack.

TROUBLE SHOOTING

Refer to TROUBLE SHOOTING - BASIC PROCEDURES article in the GENERAL TROUBLE SHOOTING section.

LUBRICATION

CAPACITY

Fluid capacity is 1 qt. (1L) for 960.

FLUID TYPE

Power steering system uses automatic transmission fluid (ATF).

FLUID LEVEL CHECK

Check fluid level when fluid is cold with engine off. To check and fill, remove fluid level gauge from reservoir and check fluid level. Fluid level should be between MIN and MAX marks on gauge dipstick. Add fluid through dipstick opening as needed, and recheck fluid level. DO NOT overfill.

HYDRAULIC SYSTEM BLEEDING

1) Fill reservoir with fluid. Start engine and let idle. Add fluid as level drops. Turn steering wheel from lock to lock in a slow, even motion to allow pump to operate at low pressure.

2) Continue turning steering wheel until fluid in reservoir is free of air bubbles. Ensure fluid is at level mark. Install reservoir cap.

ADJUSTMENTS

POWER STEERING PUMP PRESSURE

NOTE: On 960, maximum power steering pump pressure is 1320-1420 psi (93.0-99.9 kg/cm²). Pump volume at 500 RPM is 5.3 qts. (5L) per minute.

POWER STEERING PUMP BELT

BELT ADJUSTMENT SPECIFICATIONS TABLE

Application

(1) Deflection - In. (mm)

Power Steering Belt2-.4 (5-10)

- (1) - Deflection is measured with moderate thumb pressure applied midway on longest belt run.

TESTING

HYDRAULIC SYSTEM PRESSURE TEST

- 1) Connect pressure gauge between steering pump and steering gear. See Fig. 1. Ensure gauge can be seen from driving position. Ensure reservoir is full. Start engine.

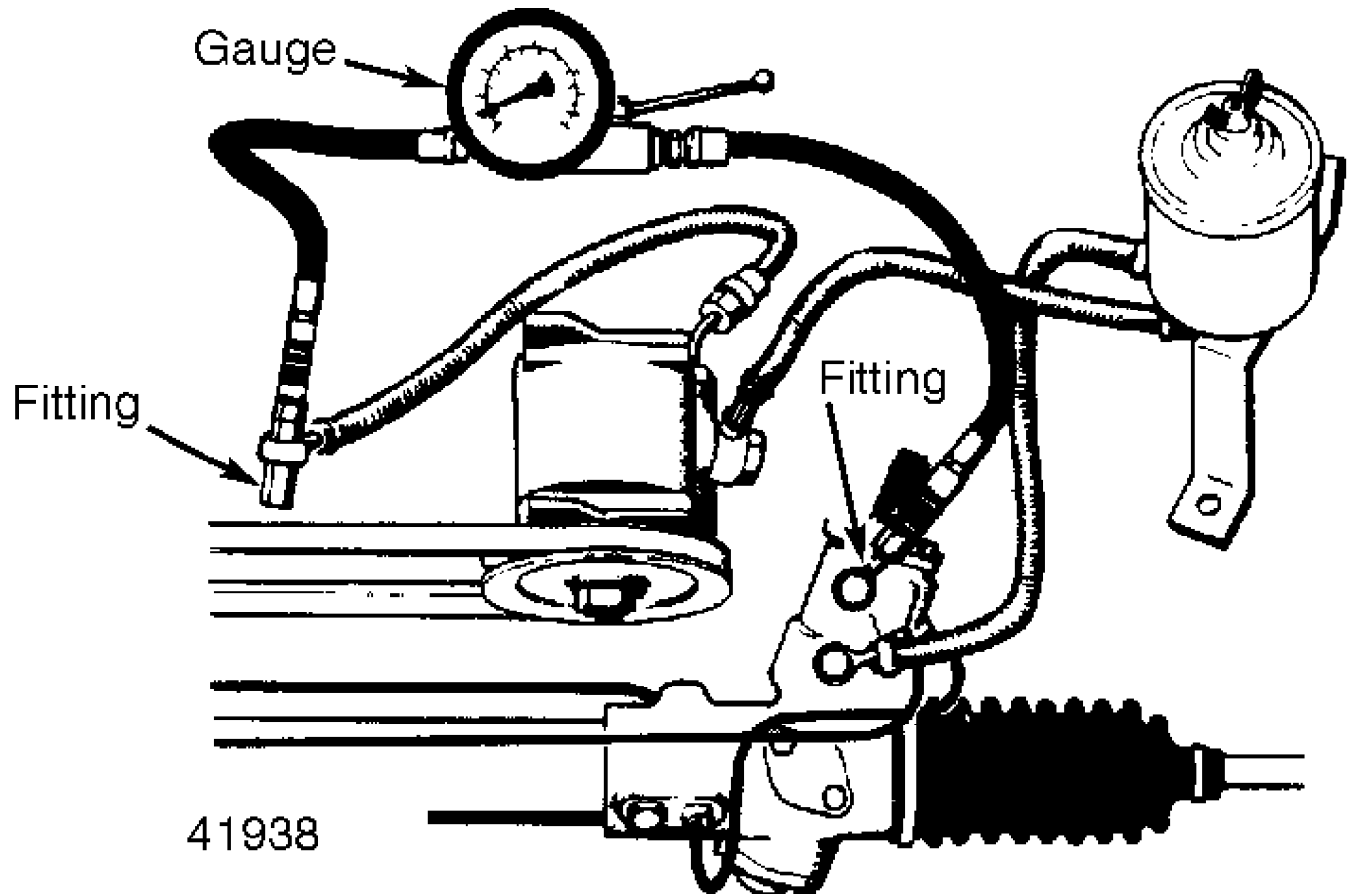


Fig. 1: Installing Pressure Gauge
Courtesy of Volvo Cars of North America

- 2) Turn steering wheel to full left and hold for less than 10 seconds, then turn steering wheel to full right and hold for less than 10 seconds. On cam gear type pump, pressure should be 1102-1204 psi (77.4-84.6 kg/cm²). On ZF type pump, pressure should be 1349-1450 psi (94.8-101.9 kg/cm²).

STEERING WHEEL TURNING FORCE

- 1) Raise front wheel off ground. Connect pressure gauge between steering pump and steering gear. See Fig. 2. Ensure gauge can be seen from driving position. Ensure reservoir is full.

2) Remove air bag module from steering wheel. See STEERING WHEEL & AIR BAG MODULE under REMOVAL & INSTALLATION in appropriate STEERING COLUMN article in the in the ENGINE PERFORMANCE section section. Place torque wrench on steering wheel nut.

3) With engine at idle, turn steering wheel slowly to right. Read torque when pressure reaches 171 psi (12 kg/cm²) on cam gear type, or 285 psi (20 kg/cm²) for ZF type.

4) Turn wheel to left. Torque should be 31-40 INCH lbs. (3.5-4.5 N.m) as gear approaches specified pressure. Turn steering wheel to right and read torque. Difference between both sides must not exceed 9 INCH lbs. (1 N.m) on cam gear-type. Difference must not exceed 4.4 INCH lbs. (.5 N.m) on ZF steering gear. If difference exceeds specification, repair or replace steering gear.

NOTE: For remaining steering gear adjustments, see OVERHAUL.

REMOVAL & INSTALLATION

POWER STEERING PUMP

Removal

Remove pump bracket-to-pump retaining bolts. Place a drain pan below pump. Disconnect hydraulic connections at pump. Remove pump.

Installation

To install, reverse removal procedure. Fill and bleed system. Check for leaks.

POWER RACK & PINION

Removal

1) Disconnect lower steering gear shaft by removing snap ring and lower clamp bolt. Loosen upper clamp bolt. Slide joint up on shaft.

2) Raise and support vehicle. Remove wheel assemblies. Remove tie rod ends from knuckles. Remove splash guard.

3) Disconnect hoses at steering gear. Plug hose connections. Remove sway bar mounting brackets and move them aside. Remove steering gear attaching bolts. Lower steering gear.

Installation

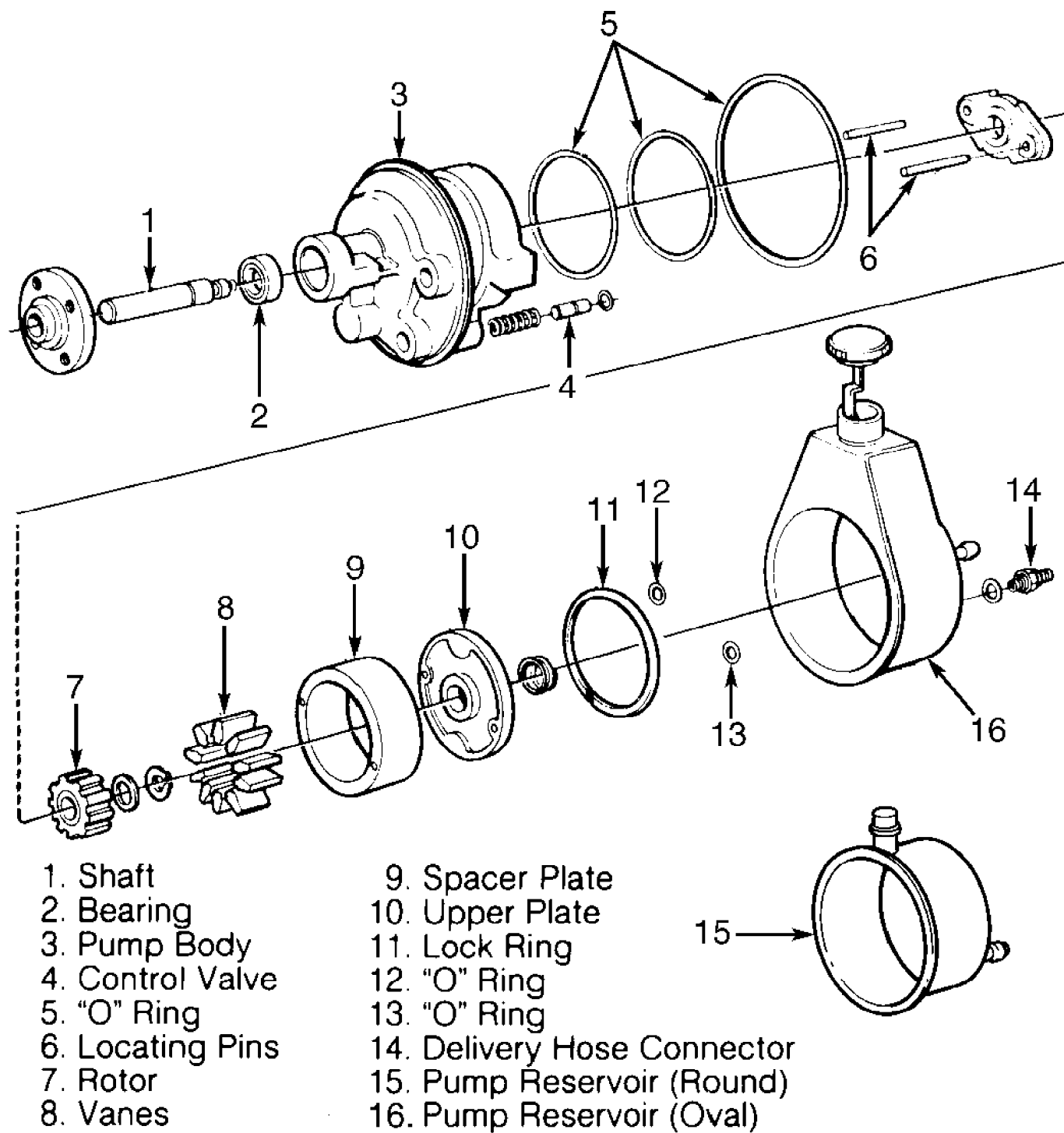
1) To install, reverse removal procedure. Ensure recess on pinion shaft is aligned with lock bolt opening in flange. Install right side "U" bolt and flange, but do not tighten. Install and tighten left side bolts.

2) Tighten right side "U" bolt. Connect tie rods to steering gear. Ensure rods are same length. Difference should not exceed .063" (1.6 mm). Install lock bolt on flange. Reconnect hoses. Install splash shield and wheels.

OVERHAUL

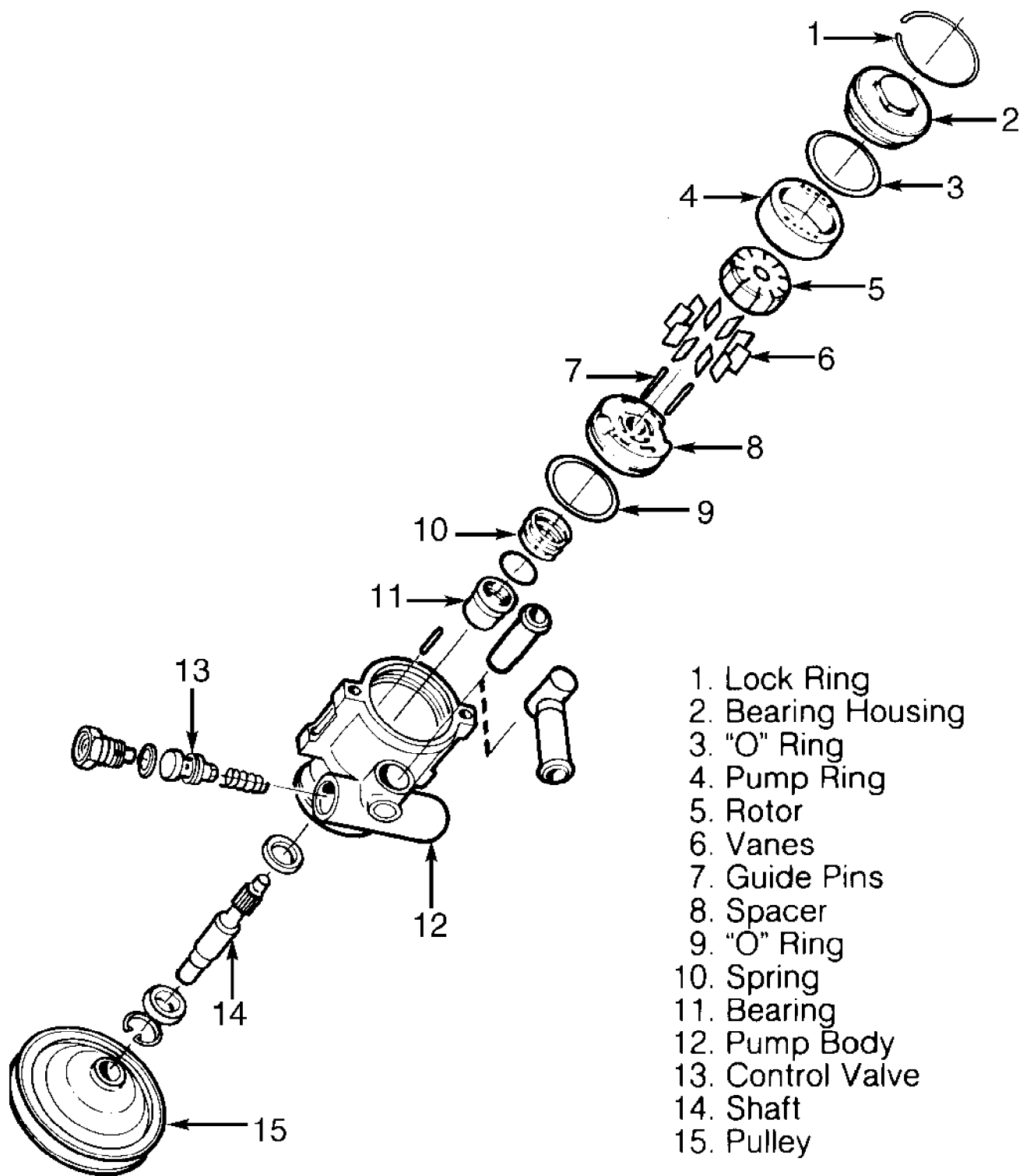
POWER STEERING PUMP

NOTE: For power steering pump overhaul, see Figs. 2-4.



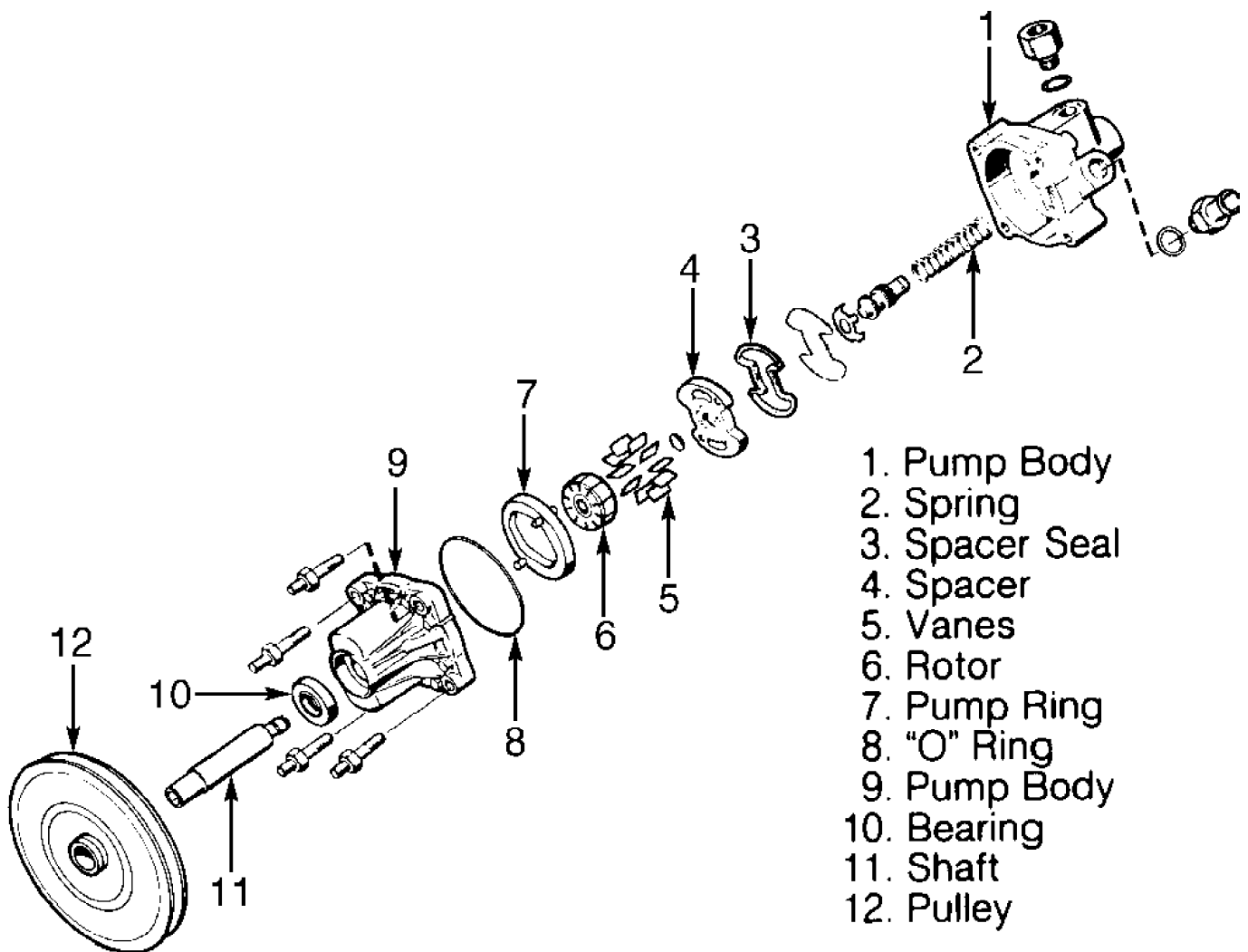
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Fig. 2: Exploded View Of Saginaw "P" Power Steering Pump
 Courtesy of Volvo Cars of North America



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Fig. 3: Exploded View Of Saginaw TC Power Steering Pump
 Courtesy of Volvo Cars of North America



92E01780

Fig. 4: Exploded View Of ZF Power Steering Pump
 Courtesy of Volvo Cars of North America

STEERING GEAR

Disassembly (Cam Gear Type)

1) Clean housing and remove oil pipes. Turn pinion back and forth to pump oil out of gear. Place rack in center position.

2) Remove clamps and boots. To prevent pinion damage, hold rack with adjustable wrench. Unscrew left steering rod completely. Loosen, but do not remove, right side steering rod. Remove right side locking wire.

3) Remove steering rod. Remove lock sleeve, plastic ring and bushing. Remove adjusting nut, rack preload piston and spring. See Fig. 7.

4) From top of pinion, remove dust cover and lock ring. Remove lower pinion cover and pinion nut. Lift out pinion and spool valve. Remove rack from housing.

5) Remove lock ring from lower pinion bearing, and drive out bearing. From center of pinion housing, drive out pinion lower seal.

6) Tap rack seal and spacer from inside of tube. DO NOT score inside of housing when removing seal. Replace piston seal if damaged

or with more than 25,000 miles on vehicle.

7) Remove dust cover, lock ring, seal and upper bearing from spool valve assembly. See Fig. 5.

CAUTION: DO NOT remove 4 Teflon rings from spool valve assembly. Replacement rings are not available. If rings are worn, replace entire steering gear.

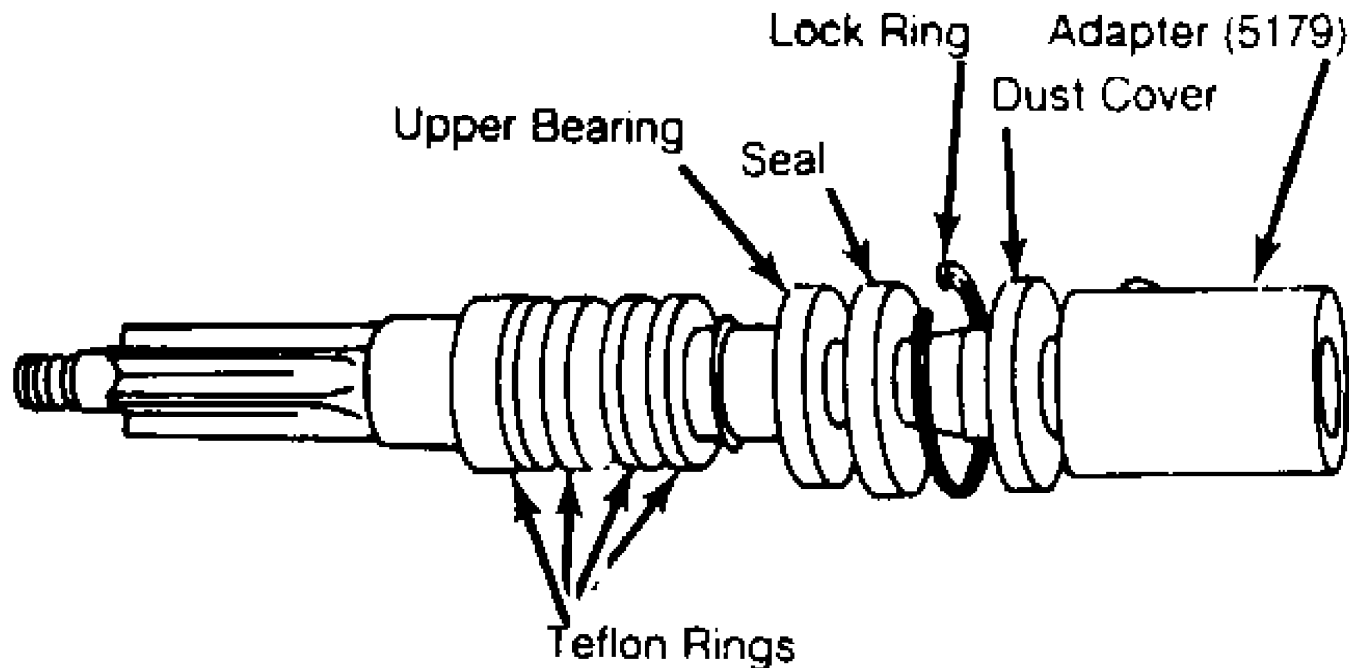


Fig. 5: Cam Gear Spool Valve Assembly (960)

Cleaning & Inspection

Replace all seals except 4 Teflon rings on spool valve. If pinion or spool valve is damaged, replace entire steering gear. Clean and inspect rubber boots and replace if necessary.

Reassembly

1) Coat all parts with ATF before assembly. Install NEW "O" ring and Teflon ring on rack piston. If difficult to install, heat Teflon ring in water to about 100°F (40°C).

2) Using Seal Drive (5277) and Handle (1801), install lower pinion seal and guide sleeve in housing. Seal ring lip must face up. If seal is not centered properly, pinion will not turn easily.

3) Install lower bearing and lock ring. Wrap rack teeth using tape. Install seal with lip facing piston seal. Install tapered spacer with tapered side facing seal. Install flat spacer.

4) Press 2 spacers together. Remove tape from rack. Lube rack teeth. Install rack in housing. As rack seats, lightly push on rack to seat seal and spacers.

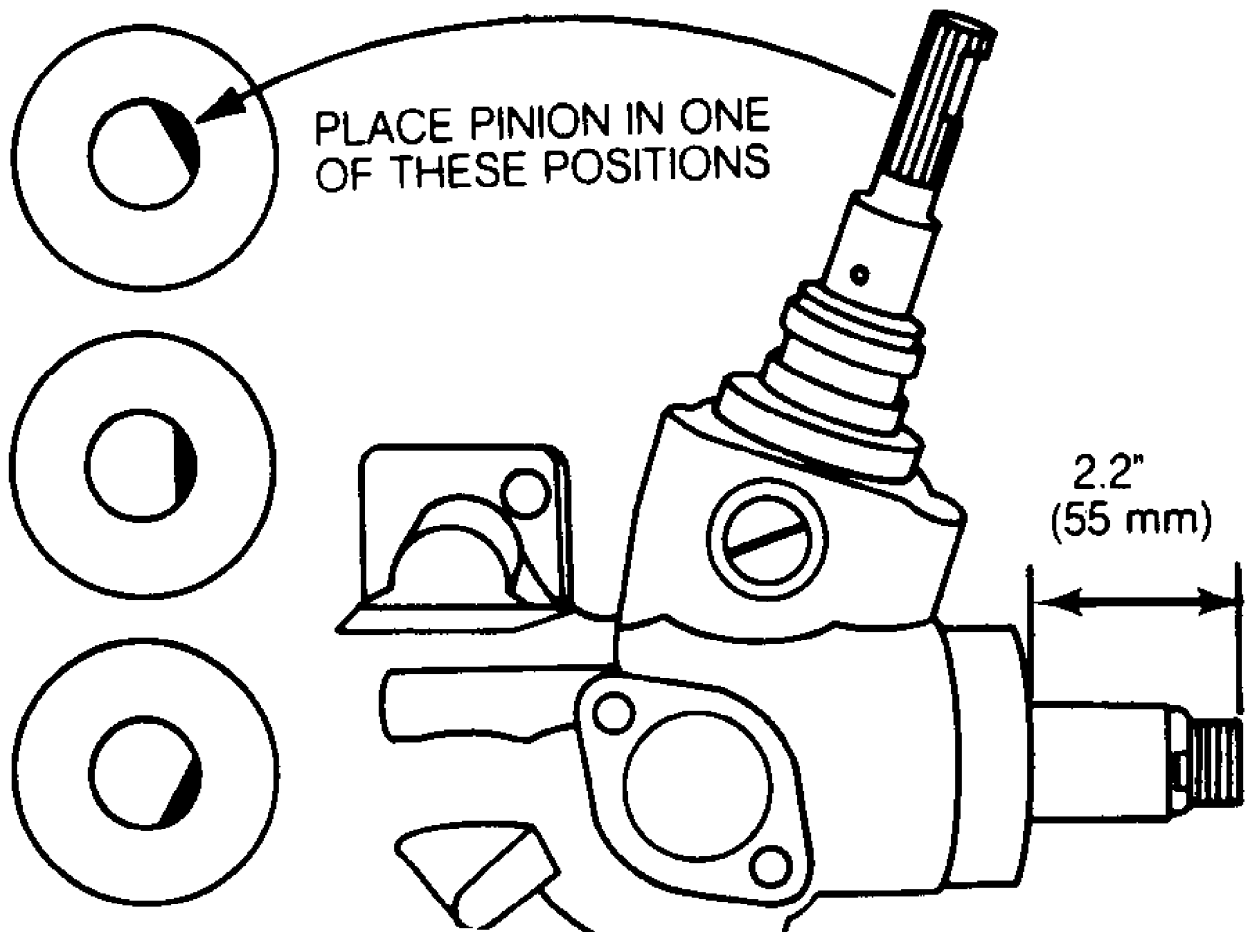
5) To ensure seal is correctly positioned, look through pressure tube opening to ensure at least half of piston seal retainer has passed center of opening. Position rack so end protrudes about .750" (19 mm) from end of housing next to pinion housing.

6) Clean end of rack with wet fine-grit sandpaper. Clean rack and wrap one turn of tape around rack edge. Lubricate rack and tape.

7) Install plastic spacer with beveled side facing toward seal. Install lock sleeve and bushing onto rack. Use small screwdriver to lift edge of seal on end of rack.

8) Position end of lock sleeve so cut-out sections face end of rack. Ensure rack locking wire opening is in line with elongated hole in tube. Install locking wire. Turn bushing until wire is positioned correctly.

9) Center rack in housing and lubricate teeth with grease. Place pinion in housing with flat side in any one of 3 correct positions. See Fig. 6. End of rack should protrude 2.2" (55 mm).



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Fig. 6: Positioning Cam Gear Pinion (960)
Courtesy of Volvo Cars of North America

10) Wrap pinion splines using tape. Install lower pinion lock nut. Install upper bearing on pinion with bevelled side down. Lubricate and install upper seal with lip facing down. Install snap ring and dust cover.

11) Install lower pinion lock nut. Tighten lock nut to 27 ft. lbs. (37 N.m). Pack lower pinion cover with Lubricant (11 61 001-1). Install preload piston assembly in housing.

Preload Adjustment

1) Install preload piston spring and adjusting nut in housing. Place steering rack in center position. Tighten nut to 3.7-4.1 ft. lbs. (5.0-5.6 N.m) using Adapter (5296) and Torque Gauge (9177). Loosen adjusting nut 50-55 degrees.

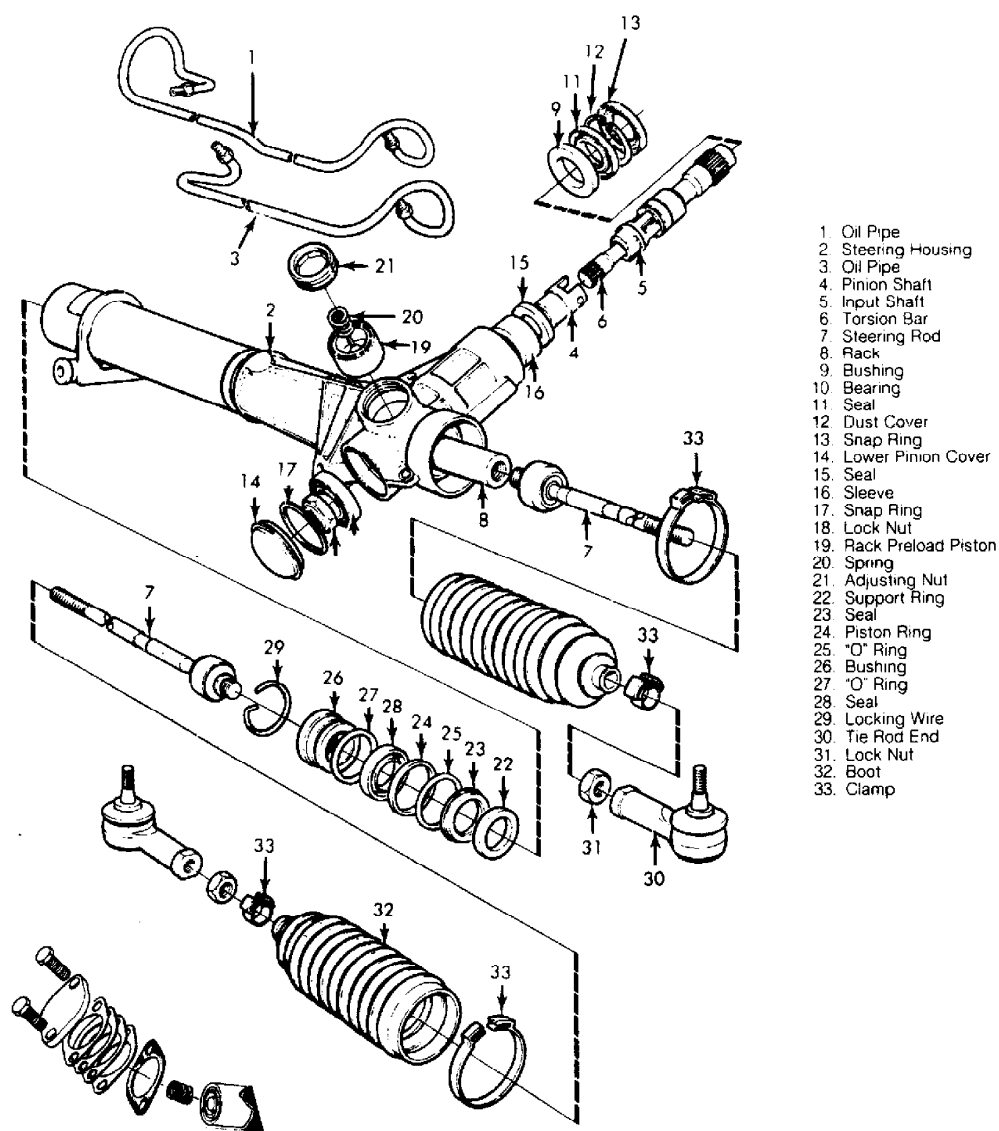
2) Ensure turning torque of pinion shaft is 9-18 INCH lbs.

(1-2 N.m) using Adapter (5179) and Torque Gauge (9177). If torque exceeds specification in any position, stop rack in that position. Readjust rack in high position.

3) If turning torque is still more than specification, install new steering gear. If turning torque is okay, use a punch to stake lock nut to valve housing.

Final Reassembly

Install and tighten steering rods. Hold rack with adjustable wrench while tightening. Use narrow punch to lock ball joints to rack recesses. Fill boots with about an ounce of grease and install on rack.



1. Oil Pipe
2. Steering Housing
3. Oil Pipe
4. Pinion Shaft
5. Input Shaft
6. Torsion Bar
7. Steering Rod
8. Rack
9. Bushing
10. Bearing
11. Seal
12. Dust Cover
13. Snap Ring
14. Lower Pinion Cover
15. Seal
16. Sleeve
17. Snap Ring
18. Lock Nut
19. Rack Preload Piston
20. Spring
21. Adjusting Nut
22. Support Ring
23. Seal
24. Piston Ring
25. "O" Ring
26. Bushing
27. "O" Ring
28. Seal
29. Locking Wire
30. Tie Rod End
31. Lock Nut
32. Boot
33. Clamp

RACK PRELOAD PISTON
(EARLY VERSION)

Fig. 7: Exploded View Of Cam Gear-Type Power Steering Assembly (1960)
Courtesy of Volvo Cars of North America

Disassembly (ZF Steering Gear)

1) Clean exterior of steering gear. Mount steering gear in

vise. Remove oil tubes. Turn steering gear back and forth to pump out oil.

2) Remove clamps and boots. To prevent pinion damage, hold rack with adjustable wrench. Unscrew left and right side steering rods.

3) Remove preload piston cover, shim, spring and preload piston. See Fig. 8. Remove dust shield, lock ring and washer from upper part of pinion assembly. Remove lower pinion housing cover.

4) Secure upper pinion shaft. Remove lock nut, washer and snap ring. Withdraw pinion and spool valve assembly from housing. Remove end sleeve lock wire.

5) Slide rack and sleeve assembly from rack housing. Drive lower pinion bearing and seal out of pinion housing. DO NOT scratch inside of pinion housing surface.

6) Tap out rack seal and spacer ring from inside of steering housing. Remove "O" ring, seal, washer and bushing from rack end sleeve. Remove upper bearing housing from pinion and spool valve. Remove "O" ring and seal from upper bearing housing.

CAUTION: Remove 4 Teflon rings from spool valve only if damaged. Replace rack piston seal only if damaged or after 25,000 miles.

Cleaning & Inspection

Replace rubber boots if defective. Check all parts for wear, corrosion or damage. Replace as necessary. Replace entire steering gear if spool valve assembly is damaged.

Reassembly

1) Lubricate all parts with ATF before reassembly. Install "O" ring and Teflon ring on rack piston. If difficult to install, heat Teflon ring in water to 104-122°F (40-50°C).

2) Install seal over rack teeth with lip facing piston. Lubricate rack piston teeth. Place spacer ring next to seal.

3) Install rack with seal and spacer ring into housing. When rack seats, gently push it in farther to seat seal and spacer ring. Rack is positioned correctly when rack seal is visible in center of outlet tube hole.

4) Position rack so end protrudes about .750" (19 mm) from pinion housing end of rack housing. DO NOT push rack farther into housing or seal may be damaged.

5) Install bushing, spacer washer and seal in end sleeve. Seal lips face outward from end of sleeve. Drive end sleeve in housing and secure with snap ring.

6) Install "O" rings and Teflon rings (if removed) on spool valve. If necessary, heat Teflon rings in water to 104-122°F (40-50°C) to ease installation.

7) Install bearing and "O" ring in upper bearing housing. Install seal with lip facing bearing. Install lower pinion seal in pinion housing with lip facing upward. Install lower pinion bearing and lock ring.

8) Install pinion and spool valve assembly in pinion housing. Install upper bearing housing, spacer washer, snap ring and dust shield. Pack bottom of dust shield with grease.

9) On bottom of pinion and spool valve assembly, install spacer washer and tighten lock nut to 11 ft. lbs. (15 N.m). Fill pinion housing lower cover with grease and install.

10) Center steering rack in housing. Install preload spring WITHOUT "O" ring. Install spring in piston.

11) Install Counterhold (2985) on steering rack. See Fig. 9. Install dial indicator with stem on rack housing. Zero dial indicator.

12) Turn dial indicator so tip rests on face of preload piston. Note reading.

13) Move rack from lock to lock and note maximum indicator reading. Subtract .004" (.10 mm) from maximum indicator reading to achieve total thickness of shim to be installed.

14) Remove dial indicator and counterhold. Install "O" ring on preload piston. Install preload piston with spring, shim and cover. Tighten bolts to 79 INCH lbs. (9 N.m).

15) Install boot "O" ring and steering rods. Stake steering rods to rack to secure in position. Install boots and clamps.

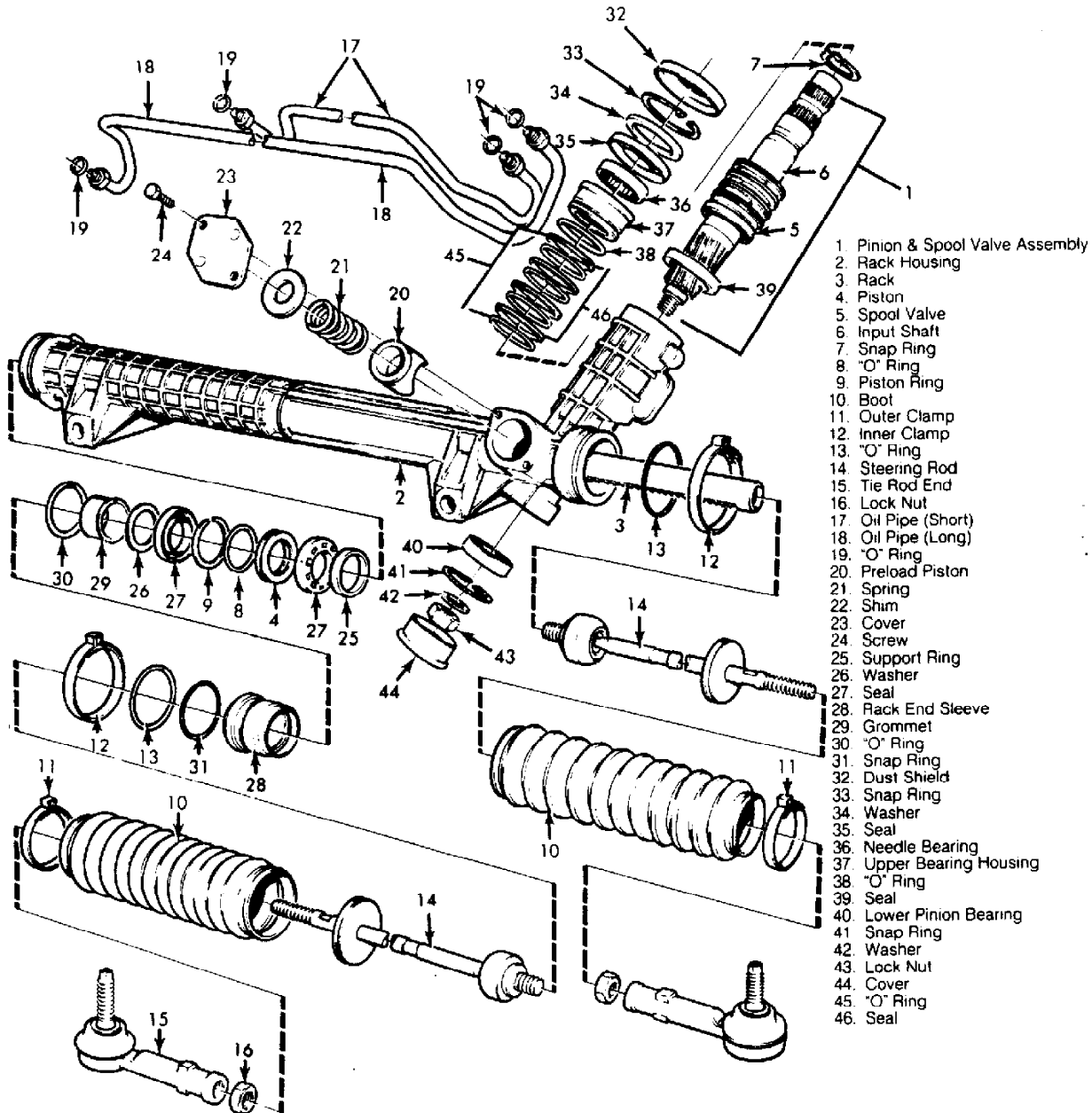


Fig. 8: Exploded View Of ZF Steering Gear (960)
 Courtesy of Volvo Cars of North America

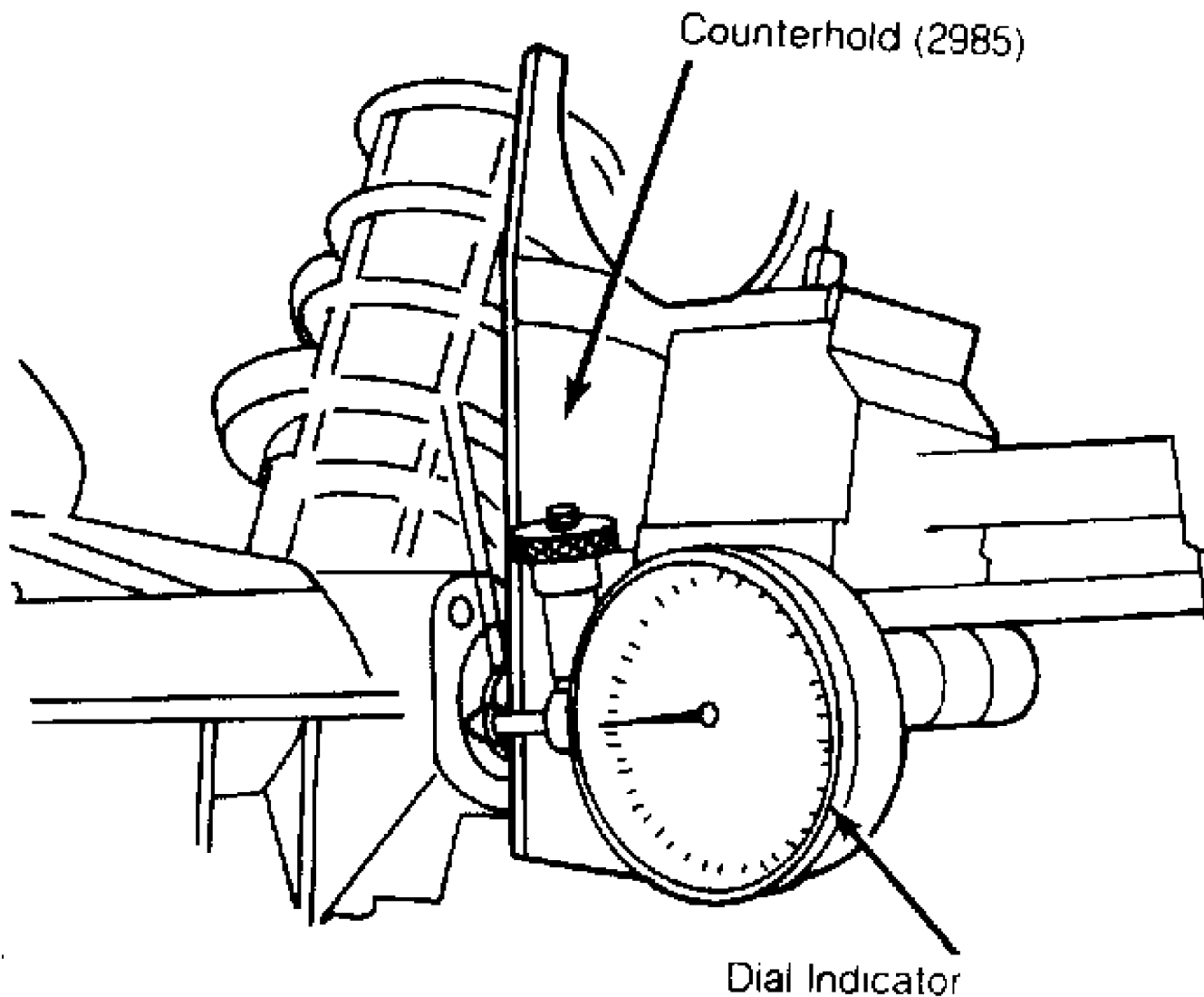


Fig. 9: Checking Rack Preload On ZF Steering Gear (960)

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS TABLE

Application	Ft. Lbs. (N.m)
Cam Gear	
Pinion Cover Bolts	12 (17)
Pinion Lower Lock Nut	27 (37)
Rack Mounting Bolts	32 (44)
ZF Steering Gear	
Rack Mounting Bolts	32 (44)
	INCH Lbs. (N.m)
ZF Steering Gear	
Rack Preload Adjusting Cover Bolts	79 (9)

(1) - Tighten an additional 120 degrees.
