

**STEERING SYSTEM - POWER RECIRCULATING BALL****1997 STEERING Power Recirculating Ball - General Motors Corp.****DESCRIPTION & OPERATION****STEERING GEAR**

Steering gear assembly contains a recirculating ball system which acts as a rolling thread between worm shaft and rack piston. Steering gear housing contains a control valve that directs hydraulic pressure through rotary valve spool and body, to either side of rack piston. Hydraulic pressure exerted on rack piston lessens mechanical force required to turn pitman shaft and steering linkage.

Vehicles are equipped with Variable Effort Steering (VES) system. VES system provides maximum steering assist at low speeds for ease of turning and parking. At higher speeds, increased steering effort provides driver with firmer steering and directional stability. Power steering control module uses vehicle speed input from Electronic Brake Traction Control Module/Brake Pressure Modulator Valve (EBTCM/BPMV). This input causes an appropriate change in fluid flow control valve actuator. Power steering fluid flow control valve actuator, mounted on steering gear, uses a pintle valve to control fluid flow.

**POWER STEERING PUMP**

Power steering pump is a constant displacement vane-type pump with a remote fluid reservoir. When fluid pressure exceeds preset limits, an internal flow control pressure relief valve opens, allowing fluid to return to reservoir and inlet side of pump. See [Fig. 1](#).

**TROUBLE SHOOTING**

**NOTE:** See [TROUBLE SHOOTING - BASIC PROCEDURES](#) article in **GENERAL TROUBLE SHOOTING**.

**TESTING**

**NOTE:** **Incorrect fluid level, belt tension, idle speed or damaged pump pulley can affect test results. Correct such conditions before testing power steering system.**

1. Connect Power Steering Pressure Tester (J-5176-E) and Adapters (J-5176-11A and J-5176-5A) in pressure line. Open valve fully. Start and run engine until fluid reaches normal operating temperature. Bleed power steering system. See [HYDRAULIC SYSTEM BLEEDING](#). Check fluid level. Add fluid as necessary.
2. With engine at operating temperature, pressure reading should be less than 150 psi (10.5 kg/cm<sup>2</sup>). If pressure is more than 150 psi (10.5 kg/cm<sup>2</sup>), inspect system for restrictions. Check for proper installation of check valve in steering gear.

**CAUTION: To prevent pump damage, DO NOT hold valve closed for more than 5 seconds.**

3. Completely close valve for less than 5 seconds and then open it, recording highest pressure obtained when valve is closed. Repeat procedure 2 more times. Each reading should be at least 1600 psi (112.5 kg/cm<sup>2</sup>).
4. If readings are within 50 psi (3.5 kg/cm<sup>2</sup>) of each other, pump is okay. If pressure readings are less than 1600 psi (112.5 kg/cm<sup>2</sup>), replace pump. If pump meets specification, leave valve open. Turn steering wheel from stop to stop, recording highest pressure at each stop. If pressure at both stops is not equal to pressure recorded in step 3), steering gear is leaking internally. Repair or replace steering gear.

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### LUBRICATION

#### CAPACITY

**NOTE:** Information not available from manufacturer at time of publication.

#### FLUID TYPE

When adding or changing fluid, use Dexron III automatic transmission fluid (GM 12346143) or equivalent. Use of improper fluid will cause hose, pump and seal damage, resulting in fluid leaks and/or failure to operate.

#### FLUID LEVEL CHECK

Fluid level is indicated by marks on reservoir dipstick. When fluid is at operating temperature, about 170°F (77°C), fluid level should be at FULL HOT mark. Fluid level should be at FULL COLD mark when fluid is cold, about 70°F (21°C).

#### HYDRAULIC SYSTEM BLEEDING

**CAUTION: If air is introduced into hydraulic system during servicing, bleed complete system. Aerated fluid, which appears Light Tan in color, results in poor steering performance and will cause severe pump damage.**

1. With engine off, raise and support vehicle with front wheels off ground and turned fully to left. Add power steering fluid to FULL COLD mark on dipstick. Leave cap off.
2. Turn wheels from side to side, without touching stops at either end. Add fluid, if necessary, to maintain level at FULL COLD mark. It may be necessary to repeat this step several times.
3. Start engine. With engine idling, recheck fluid level. Add fluid, if necessary, to bring level to FULL COLD mark. Install cap. Ensure wheels are at center, straight-ahead position. Lower vehicle. Continue to run engine for 2-3 minutes to eliminate air in system.
4. Road test vehicle. Check for leaks. Ensure fluid level is at FULL HOT mark when fluid is stabilized at operating temperature.

### ADJUSTMENTS

#### POWER STEERING PUMP BELT

Power steering pump is driven by serpentine belt. Belt tension is maintained by automatic tensioner. No maintenance or adjustment is necessary. Check belt operating range, indicated by marks on tensioner. If belt is not within operating range, check for proper installation before replacing belt.

### REMOVAL & INSTALLATION

**CAUTION: When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle. See COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION before disconnecting battery.**

#### POWER STEERING PUMP

##### Removal & Installation

1. Siphon fluid from power steering reservoir. Disconnect negative battery cable. Remove power steering pump pulley. Disconnect gear inlet hose connection from pump. Disconnect fluid reservoir inlet hose clamp and

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disconnect hose from pump.

2. Raise and support vehicle. Remove AIR injection crossover pipe support bracket bolts and remove support bracket. Remove pump mounting bolts. Remove pump. To install, reverse removal procedure. Fill and bleed hydraulic system. See **HYDRAULIC SYSTEM BLEEDING** under LUBRICATION.

### PUMP PULLEY

#### Removal & Installation

Disconnect negative battery cable. With drive belt still installed, loosen pump pulley bolts. Remove drive belt. Remove power steering pump pulley bolts and remove pulley from pump. To install, reverse removal procedure. Tighten bolts to specification. See **TORQUE SPECIFICATIONS**.

### FLUID FLOW CONTROL VALVE ACTUATOR

#### Removal & Installation

Disconnect negative battery cable. Remove steering gear. See **POWER STEERING GEAR**. Remove fluid flow control valve actuator screws. Remove fluid flow control valve actuator from steering gear. To install, reverse removal procedure. Tighten screws to specification. See **TORQUE SPECIFICATIONS**.

### POWER STEERING GEAR

#### Removal

1. Disconnect negative battery cable. Remove windshield wiper assembly. Disconnect 3 body harness electrical connectors. Remove Engine Control Module (ECM) from electrical box. Drain cooling system. Remove upper radiator hose. Drain A/C refrigerant from A/C system. Remove A/C evaporator line extension bolt.
2. Siphon fluid from power steering reservoir. Remove power steering reservoir bracket bolt. Reposition reservoir aside. Siphon fluid from brake system reservoir. Disconnect brake booster vacuum connection from intake plenum. Disconnect brake lines from master cylinder. Disconnect electrical connector from master cylinder reservoir cap.

**NOTE: To prevent damage to SIR coil inside steering column, DO NOT allow steering wheel to rotate when steering coupler is disconnected.**

3. Remove sound insulator tabs and sound insulator. Remove steering coupler bolts. Mark lower steering coupler-to-steering gear spline alignment for installation reference if steering gear is to be reinstalled. Place steering wheel in straight ahead position and lock into place. Remove ignition key. Carefully separate steering column from steering gear.
4. Disconnect brake pedal from brake power booster link rod. Remove instrument panel knee bolster. Remove fuse/relay panel screws and reposition panel aside for access to upper brake vacuum booster nuts. Remove brake vacuum booster nuts from inward side of cowl. Remove brake vacuum booster with master cylinder attached.
5. Disconnect A/C evaporator line extension quick connect. Disconnect power steering hoses from steering gear and reposition aside for access to EBTCM/BPMV. Remove EBTCM/BPMV assembly. Remove heat shield upper mounting bolt.
6. Raise and support vehicle. Mark pitman arm-to-steering gear spline alignment for installation reference if steering gear is to be reinstalled. Remove pitman arm nut and washer. Using pitman arm puller, separate pitman arm from steering gear. Remove lower heat shield nuts. Remove steering gear lower bolts, nuts and washers.
7. Lower vehicle. Remove heat shield. Disconnect fluid flow control valve actuator electrical connector. Note position of steering gear shim(s) for installation reference. Remove upper steering gear bolt and shim(s). Remove steering gear from vehicle.

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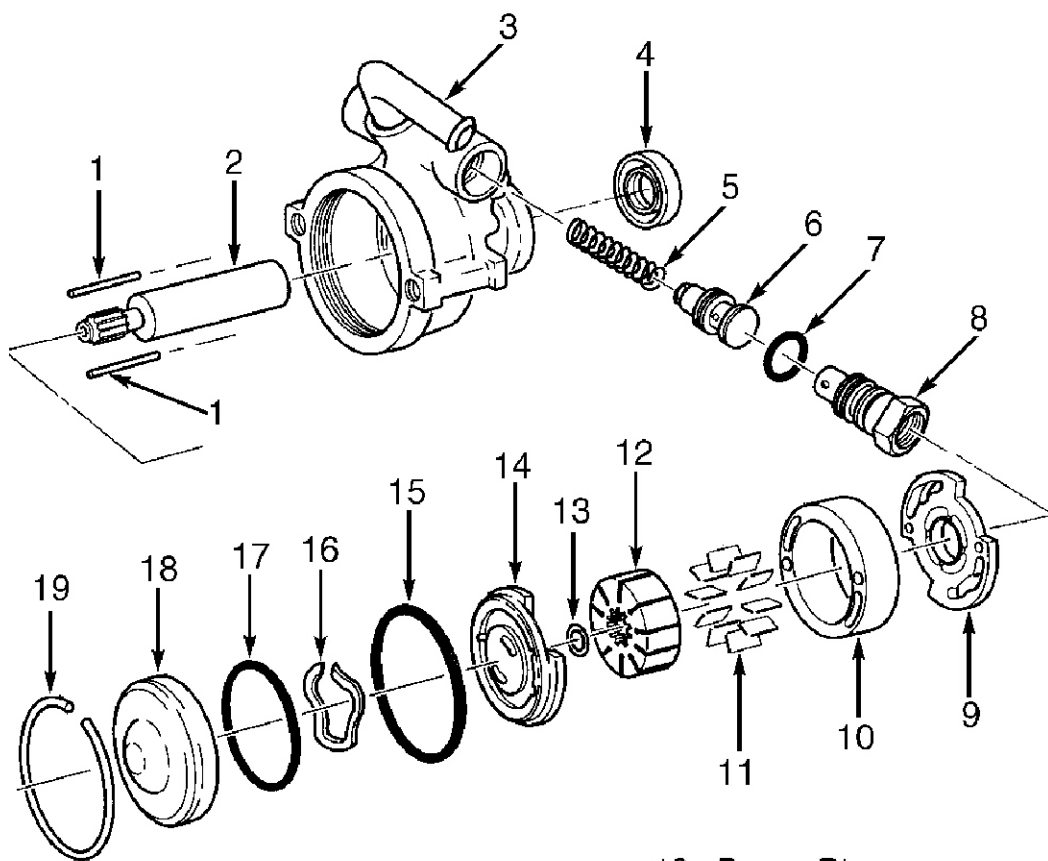
**NOTE:** Center steering gear before installing steering gear into vehicle.

### Installation

1. Using an 5/16" (8 mm) open-end wrench, rotate steering gear stub shaft from stop to stop counting number of turns. beginning from either stop, rotate stub shaft half the number of turns counted. Align mark on stub shaft to "V" mark on steering gear case. Steering gear should be centered. Install shim(s) and upper steering gear bolt. Hand tighten bolt.
2. To complete installation, reverse removal procedure. Ensure rubber steering gear shaft protector is in place prior to installation of pitman arm. Lubricate NEW A/C evaporator line extension "O" rings with mineral oil before installation.
3. Fill and bleed power steering system. See **HYDRAULIC SYSTEM BLEEDING** under LUBRICATION. Fill and bleed cooling system. Recharge and leak test A/C system. Fill and bleed brake system.

### OVERHAUL

**NOTE:** Power steering gear is not serviceable. Power steering gear must be replaced as a complete assembly.



- |                                    |                           |
|------------------------------------|---------------------------|
| 1. Pump Ring Dowel Pin             | 10. Pump Ring             |
| 2. Drive Shaft                     | 11. Vane                  |
| 3. Hydraulic Pump Housing Assembly | 12. Pump Rotor            |
| 4. Drive Shaft Seal                | 13. Shaft Retaining Ring  |
| 5. Flow Control Spring             | 14. Pressure Plate        |
| 6. Control Valve Assembly          | 15. "O" Ring Seal         |
| 7. "O" Ring Seal                   | 16. Pressure Plate Spring |
| 8. "O" Ring Union Fitting          | 17. "O" Ring Seal         |
| 9. Thrust Plate                    | 18. End Cover             |
|                                    | 19. Retaining Ring        |

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**Fig. 1: Exploded View Of Power Steering Pump**

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Courtesy of **GENERAL MOTORS CORP.****TORQUE SPECIFICATIONS****TORQUE SPECIFICATIONS**

<b>Application</b>	<b>Ft. Lbs. (N.m)</b>
A/C Evaporator Line Extension Bolt	15 (20)
AIR Injection Crossover Pipe Support Bracket Bolt	15 (20)
Brake Lines-To-Master Cylinder	12 (16)
Brake Vacuum Booster Nut	15 (20)
Gear Inlet & Outlet Hose Connections	21 (28)
Idler Arm Bolt	44 (60)
Lower Heat Shield Nut	11 (15)
Pitman Arm Nut	118 (160)
Power Steering Pump Mounting Bolt	15 (20)
Power Steering Pump Pulley	15 (20)
Relay Rod Ball Stud	
To-Idler Arm Nut	44 (60)
To-Pitman Arm Nut	44 (60)
Steering Coupler Bolt	16 (22)
Tie Rod Adjuster Clamp Bolt	11 (15)
Tie Rod Ball Stub Nut (Inner & Outer)	44 (60)
Upper & Lower Steering Gear Bolt	30 (40)
	<b>INCH Lbs. (N.m)</b>
Fluid Flow Control Valve Actuator Screw	27 (3)
Power Steering Fluid Reservoir Clamp Bolt	62 (7)
Upper Heat Shield Bolt	71 (8)

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