2004 STEERING

Power Steering System - C/K SUV

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Adjuster Lock Nut	49 N.m	36 lb ft
Adjuster Nut Assembly	28 N.m	20 lb ft
Ball Guide Screws	6 N.m	53 lb in
Coupler Shield Retainer and Lock Nut	109 N.m	80 lb ft
Oil Pan Skid Plate Bolts to the Frame	20 N.m	15 lb ft
Pitman Arm to the Relay Rod Nut	62 N.m	46 lb ft
Pitman Arm Nut to the Steering Gear	250 N.m	184 lb ft
Pitman Shaft Cover Bolts (670 Gear)	62 N.m	46 lb ft
Pitman Shaft Cover Bolts (700 Gear)	60 N.m	45 lb ft
Power Steering Cooler Mounting Bolts	5 N.m	44 lb in
Power Steering Gear To Frame Bolts (Non-Rack and Pinion)	150 N.m	110 lb ft
Power Steering Hose Fitting Connections	28 N.m	20 lb ft
Power Steering Pump Filler Neck Retaining Bolts	25 N.m	18 lb ft
Power Steering Pump Front Mounting Bolts	50 N.m	37 lb ft
Power Steering Pump Rear Bracket Mounting Bolt to the Engine	50 N.m	37 lb ft
Power Steering Pump Rear Bracket Mounting Nuts	50 N.m	37 lb ft
Power Steering Pump Rear Mounting Stud	58 N.m	43 lb ft
Power Steering Rear Fitting Assembly	75 N.m	55 lb ft
Rack Piston Plug	150 N.m	111 lb ft
Side Cover Bolts to the Steering Gear	60 N.m	45 lb ft
Steering Gear Side Cover Bolts	62 N.m	46 lb ft
Stub Shaft Housing Bolts	63 N.m	46 lb ft

POWER STEERING PUMP SPECIFICATIONS

Power Steering Pump Specifications

Vehicle	Engine Code	Engine Size	High Flow (Liters per Minute)	High Flow (Gallons per Minute)	Pressure Relief (kPa)	Pressure Relief (PSI)

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C/K 15/25 Utility	LR4 LM7 LQ4 L18	4.8L 5.3L 6.0L 8.1L	13.2/14.7	3.5/3.9	9825/10514	1425/1525

COMPONENT LOCATOR

POWER STEERING GEAR DISASSEMBLED VIEW (670 GEAR)

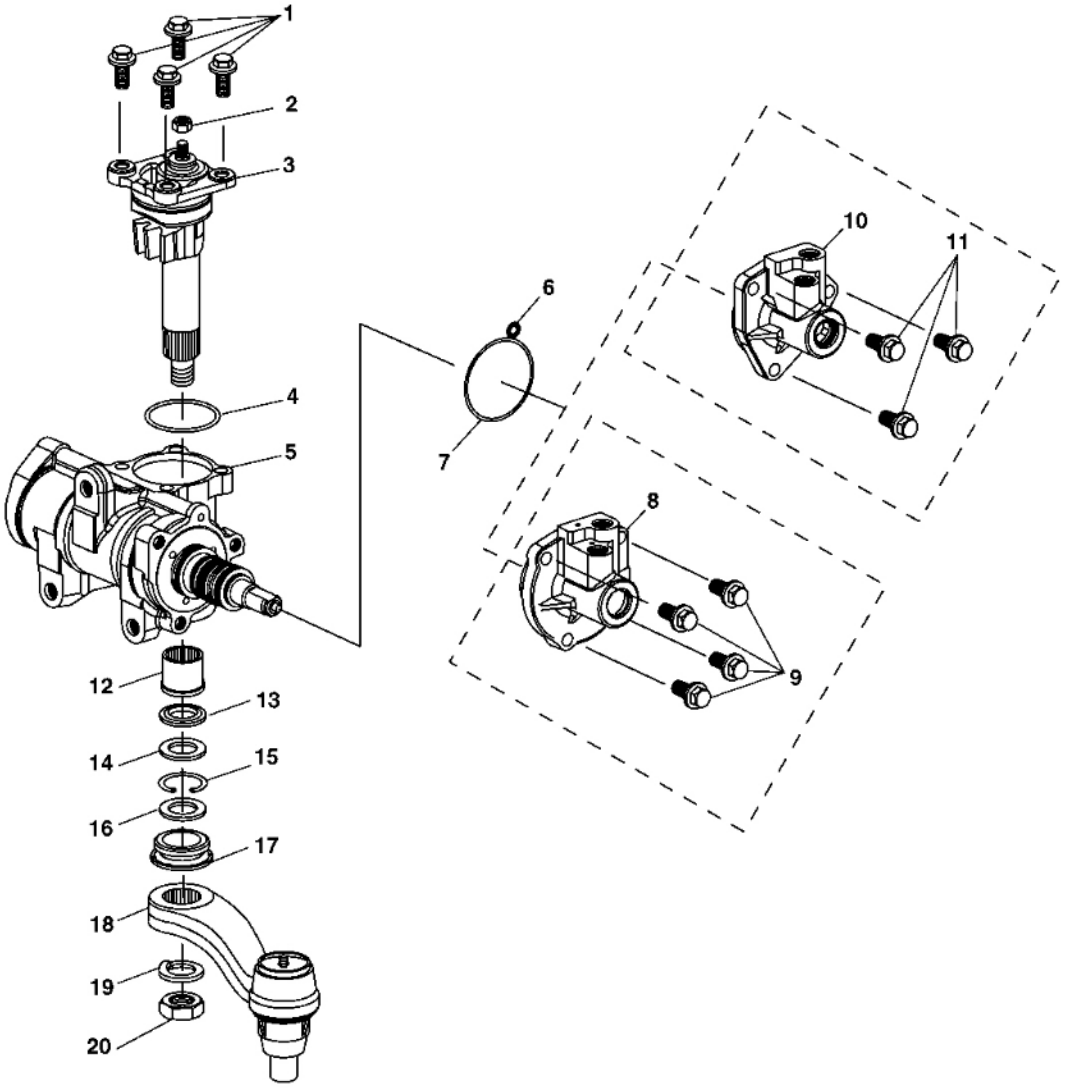


Fig. 1: Right Hand Power Steering Gear Disassembled View (670 Gear)
Courtesy of GENERAL MOTORS CORP.

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Callouts For Fig. 1

Callout	Component Name
1	Hexagon Bolt
2	Lash Adjuster Nut
3	Pitman Shaft and Cover Assembly
4	O-Ring Seal
5	Steering Gear Housing Assembly
6	O-Ring Seal
7	O-ring Seal
8	Stub Shaft Housing (680 Gear)
9	Hexagon Bolt
10	Stub Shaft Housing (670 Gear)
11	Hexagon Bolt
12	Needle Bearing Assembly
13	Pitman Shaft Seal
14	Backup Washer
15	Retaining Ring
16	Dust Seal
17	Pitman Shaft Boot
18	Pitman Arm Assembly
19	Lock Washer
20	Pitman Arm Nut

POWER STEERING PUMP DISASSEMBLED VIEW (REGULAR)

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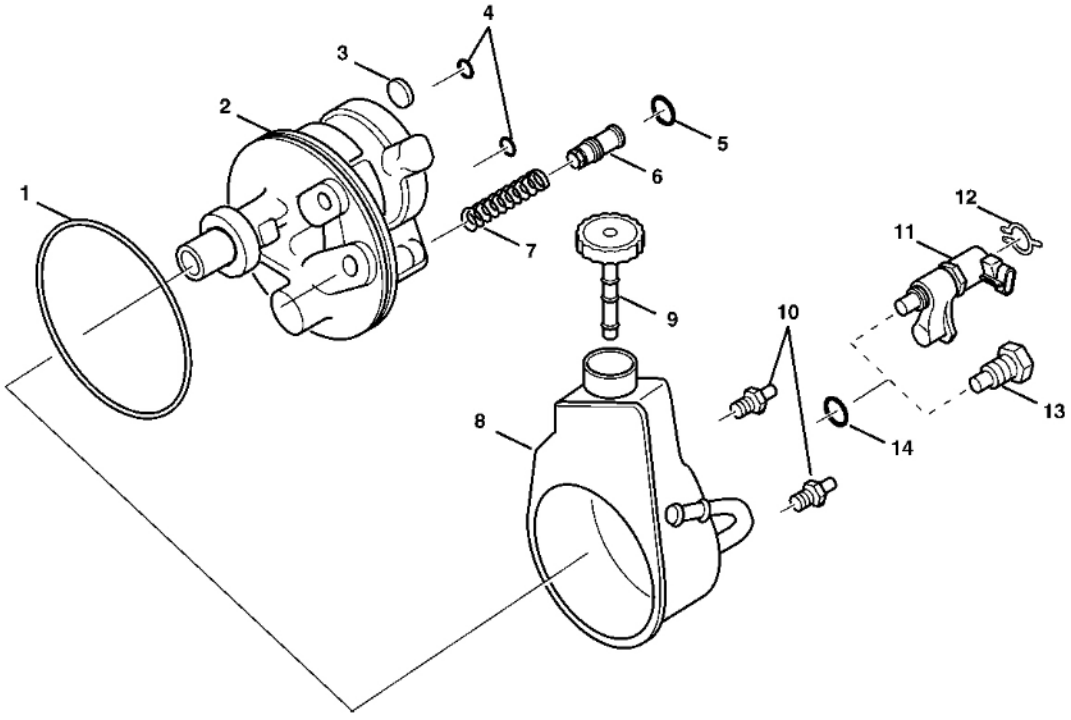


Fig. 2: Power Steering Pump Disassembled View (Regular)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 2

Callout	Component Name
1	O-ring Seal
2	Hydraulic Pump Housing Assembly
3	Magnet
4	O-ring Seals
5	Rectangular Section Seal
6	Control Valve
7	Flow Control Spring
8	Reservoir Assembly
9	Reservoir Capstick
10	Pump Mounting Studs
11	Variable Assist Steering Actuator
12	Retaining Ring
13	Connector and Fitting Assembly
14	O-ring Seal

DIAGNOSTIC INFORMATION AND PROCEDURES

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DIAGNOSTIC STARTING POINT - POWER STEERING SYSTEM (W/O ELECTRO-HYDRAULIC STEERING)

Begin the system diagnosis by reviewing the system Description and Operation. Reviewing the Description and Operation information will help you determine the correct symptom diagnostic procedure when a malfunction exists. Reviewing the Description and Operation information will also help you determine if the condition described by the customer is normal operation. Refer to **Symptoms - Power Steering System** in order to identify the correct procedure for diagnosing the system and where the procedure is located.

SYMPTOMS - POWER STEERING SYSTEM

IMPORTANT: Review the system description and operation in order to familiarize yourself with the system functions. Refer to Power Steering System Description and Operation (w/o Electro-Hydraulic Steering).

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the power steering system.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect the power steering reservoir for the proper power steering fluid level and condition.

Symptoms List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Power Steering Fluid Leaks**
- **Rattle, Clunk, or Shudder Noise from the Power Steering System**
- **Whine or Growl Noise from the Power Steering System (Without Hydraulic Brake Booster)** or **Whine or Growl Noise from the Power Steering System (With Hydraulic Brake Booster)**
- **Steering Effort Hard in One or Both Directions**
- **Steering Effort Too Easy in One or Both Directions**

POWER STEERING SYSTEM TEST PROCEDURE

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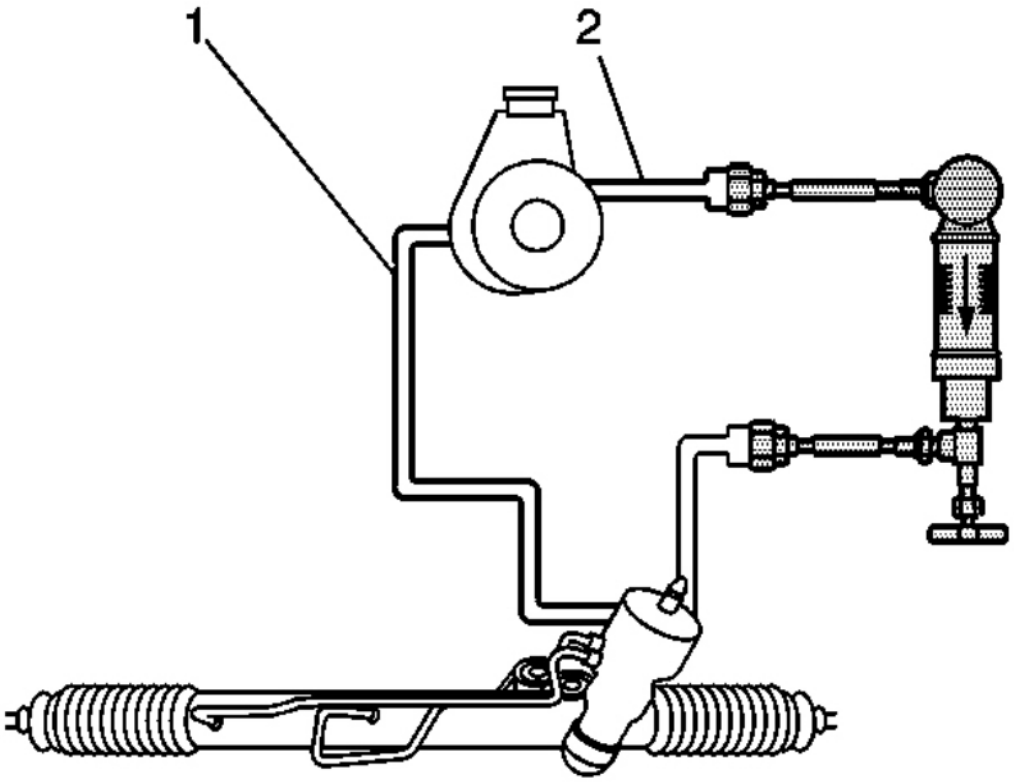


Fig. 3: Testing Rack and Pinion System Pressures
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 3

Callout	Component Name
1	Power Steering Return Hose
2	Power Steering Pressure Hose

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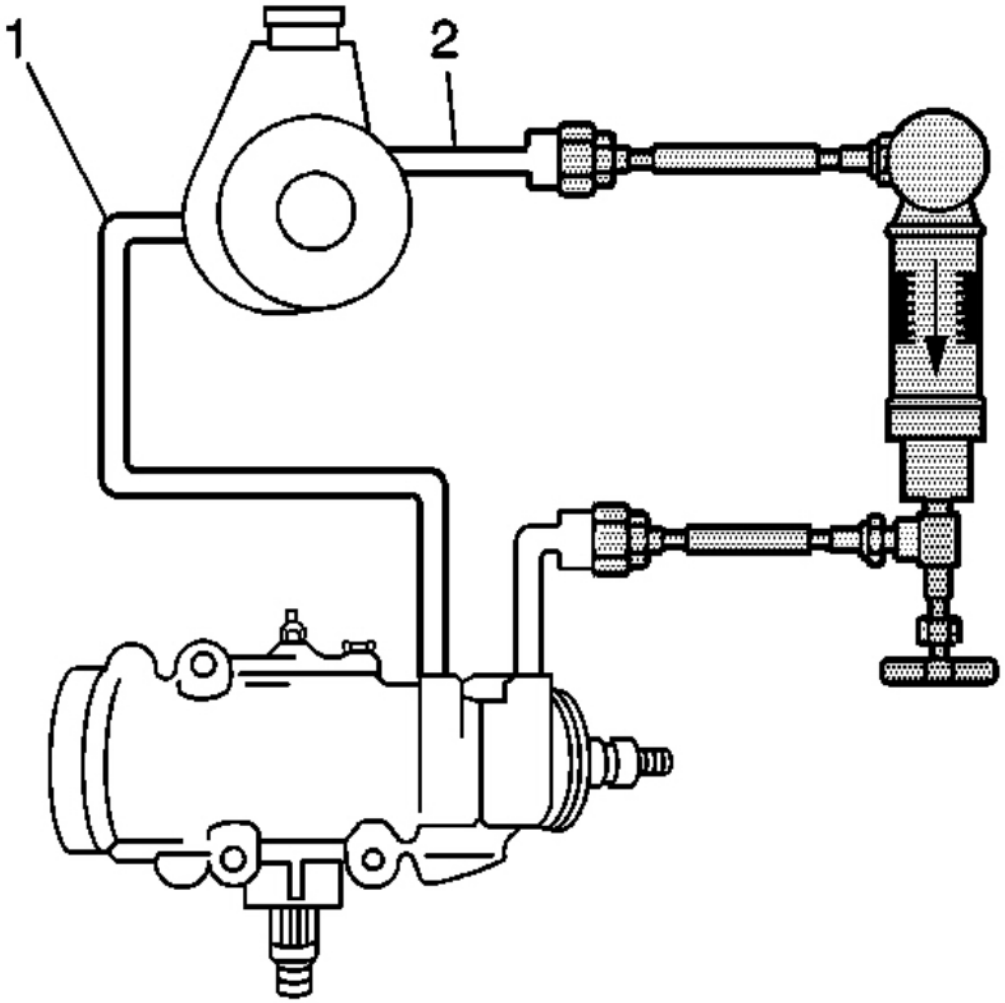


Fig. 4: Testing Recirculating Ball System Pressures
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 4

Callout	Component Name
1	Power Steering Return Hose
2	Power Steering Pressure Hose

Test Description

The numbers below refer to the step numbers on the diagnostic table.

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5: This step tests the system for restrictions.

7: This step tests the following components for the following conditions:

- The pump for internal leaks
- The power steering pipes for kinks

8: This step tests the ability of the pump to regulate flow at maximum pressure.

10: This step tests the ability of the pump to regulate flow under normal operating conditions.

12: This step tests the internal components of the pump and the gear.

Power Steering System Test Procedure

Step	Action	Value(s)	Yes	No
DEFINITION: The Power Steering System Test Procedure will perform the following functions: • Test the operation of the hydraulic power steering system. • Test the operation of the power steering pump and power steering gear. • Identify restrictions in the system.				
1	Inspect the power steering fluid for the following indications of contamination: • Milky fluid - water • Brown fluid - burnt • Debris in fluid - plastic or dirt Is the fluid free of contamination?	-	Go to **Step 3**	Go to **Step 2**
2	Flush the power steering system. Refer to **Flushing the Power Steering System**. Did you complete the procedure?	-	Go to **Step 3**	-
3	**IMPORTANT:** **In order to accurately diagnose the system, the malfunction must be present during the test procedure.** Attempt to duplicate the condition.Is the condition present?	-	Go to **Step 4**	System OK
	1. Turn the ignition switch to the OFF position. 2. Place a drain pan under the vehicle in order to catch any power steering fluid. 3. Disconnect the power steering pressure pipe/hose from the power steering pump or the power steering gear as necessary. 4. Install the **J 44721** Power Steering System			

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4	Analyzer. See **Special Tools and Equipment**. 5. Fill the power steering system. Refer to **Checking and Adding Power Steering Fluid (Without Hydroboost)** or **Checking and Adding Power Steering Fluid (With Hydroboost)**. Did you complete the installation?	-	Go to **Step 5**	-
5	1. Fully open the **J 44721** valve. See **Special Tools and Equipment**. 2. Start the engine. **NOTE:** **Refer to Steering Wheel in the Full Turn Position Notice in Cautions and Notices.** 3. Turn the steering wheel and BRIEFLY hold the steering wheel against the steering stop in order to release any trapped air from the system. 4. Inspect and ensure that all of the power steering pipe/hose connections are not leaking. 5. Make sure the steering wheel is OFF the steering stop, observe the pressure reading. Is the pressure reading greater than the specified value?	1585 kPa (230 psi)	Go to **Step 6**	Go to **Step 7**
6	**IMPORTANT:** **A restriction may be present in the power steering system. Turn off the engine IMMEDIATELY.** Locate and repair the restriction.Did you complete the repair?	-	Go to **Step 18**	-
7	1. Allow the engine to run until the engine reaches full operating temperature. 2. Record the pressure reading and flow reading. 3. Partially close the **J 44721** valve until the system pressure reaches the specified value, then record the FLOW reading. See **Special Tools and Equipment**.	4827 kPa (700 psi)		

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	4. Subtract second flow reading from the first flow reading. Is the flow DECREASE greater than 3.8 L (1 gal) per minute?		Go to **Step 13**	Go to **Step 8**
8	**NOTE:** **Do not leave the valve fully closed for more than 5 seconds, or the pump could be damaged internally.** Fully close then open the **J 44721** valve 3 times. See **Special Tools and Equipment**. Record all of the high pressure readings. Refer to **Power Steering Pump Specifications** for power steering system pressure relief specifications.Are the three high pressure readings within specifications?	-	Go to **Step 9**	Go to **Step 15**
9	Are the three high pressure readings within 245 kPa (50 psi) of each other?	-	Go to **Step 10**	Go to **Step 14**
10	1. Increase the engine speed to approximately 1500 RPM. 2. Record the flow reading. Refer to **Power Steering Pump Specifications** for power steering system pressure specifications. Is the actual flow reading within specifications?	-	Go to **Step 11**	Go to **Step 13**
11	Is the difference between the actual flow reading and the maximum flow specification more than 3.8 L (1 gal) per minute?	-	Go to **Step 16**	Go to **Step 12**
12	**NOTE:** **Refer to Steering Wheel in the Full Turn Position Notice in Cautions and Notices.** Turn the steering wheel from steering stop to steering stop and record the FLOW readings at each stop.Is the flow LOWER than 3.8 L (1 gal) per minute?	-	Go to **Step 18**	Go to **Step 17**
13	Replace the power steering pump. Refer to **Power Steering Pump Replacement (4.8L, 5.3L and 6.0L)** or **Power Steering Pump Replacement (8.1L)**. Did you complete the replacement?	-	Go to **Step 18**	-
	1. Remove the power steering pump flow control valve. Refer to **Power Steering Pump Flow Control Valve Replacement**			

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14	**- Off Vehicle (Regular)**. 2. Inspect the flow control valve. If any burrs or scratches are noticed on the flow control valve, replace the flow control valve. Do NOT attempt to clean the flow control valve. Refer to **Power Steering Pump Flow Control Valve Replacement - Off Vehicle (Regular)**. 3. Inspect the flow control valve bore. If any burrs or scratches are present in the control valve bore, replace the power steering pump. Refer to **Power Steering Pump Replacement (4.8L, 5.3L and 6.0L)** or **Power Steering Pump Replacement (8.1L)**. Did you complete the repair?	-	Go to **Step 18**	-
15	Replace the power steering pump flow control valve. Refer to **Power Steering Pump Flow Control Valve Replacement - Off Vehicle (Regular)**. Did you complete the replacement?	-	Go to **Step 18**	-
16	1. Remove the power steering pump flow control valve and inspect for any wear or damage. Do NOT disassemble the flow control valve. 2. If the flow control valve is worn damaged, replace the flow control valve. Refer to **Power Steering Pump Flow Control Valve Replacement - Off Vehicle (Regular)**. Did you complete the repair?	-	Go to **Step 18**	-
17	The power steering gear is leaking across the piston or bypassing the valve circuit. Replace the power steering gear. Refer to **Power Steering Gear Replacement**. Did you complete the replacement?	-	Go to **Step 18**	-
18	Test the power steering system for the original condition. Does the original condition still exist?	-	Go to **Step 5**	Go to **Step 19**
	1. Disconnect and remove the **J 44721** from			

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19	the vehicle. See **Special Tools and Equipment**. 2. Connect the vehicle power steering pipes/hoses. 3. Bleed the power steering system and add fluid as necessary. Refer to **Bleeding the Power Steering System**. Did you complete the repair?	-	System OK	-

POWER STEERING FLUID LEAKS

Power Steering Fluid Leaks

Step	Action	Yes	No
1	Did you review the Power Steering System General Description and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Power Steering System**
2	Verify that power steering fluid leaks are present. Is the power steering system leaking?	Go to **Step 3**	System OK
3	Inspect the power steering system fittings. Are the fittings leaking?	Go to **Step 9**	Go to **Step 4**
4	Inspect the power steering hoses. Are the hoses leaking?	Go to **Step 10**	Go to **Step 5**
5	Inspect the power steering pump and the reservoir for leaks. Is the power steering pump or reservoir leaking?	Go to **Step 11**	Go to **Step 6**
6	Inspect the power steering gear for leaks. Is the power steering gear leaking?	Go to **Step 12**	Go to **Step 7**
7	Inspect the hydraulic brake booster assembly for leaks. Is the hydraulic brake booster assembly leaking?	Go to Step **13**	Go to **Step 8**
8	Inspect the power steering cooler for leaks. Is the power steering cooler leaking?	Go to **Step 14**	Go to **Step 3**
9	Tighten the fittings. Refer to **Fastener Tightening Specifications**. Did you complete the repair?	Go to **Step 15**	-
10	Replace the power steering hoses. Refer to the appropriate procedure(s): • **Power Steering Cooler Pipe/Hose Replacement (With Hydroboost)** • **Power Steering Gear Inlet Pipe/Hose Replacement (With Hydroboost)** or **Power Steering Gear Inlet Pipe/Hose Replacement (Without Hydroboost)**		

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	• **Power Brake Booster Inlet Hose Replacement** • **Power Brake Booster Outlet Hose Replacement** • **Power Steering Gear Outlet Pipe/Hose Replacement (Recirculating Ball)** Did you complete the repair?	Go to **Step 15**	-
11	Replace the power steering pump or reservoir. Refer to **Power Steering Pump Replacement (4.8L, 5.3L and 6.0L)** or **Power Steering Pump Replacement (8.1L)** or **Power Steering Reservoir Replacement - Off Vehicle**. Did you complete the repair?	Go to **Step 15**	-
12	Replace the power steering gear. Refer to **Power Steering Gear Replacement**. Did you complete the repair?	Go to **Step 15**	-
13	Replace the hydraulic brake booster assembly. Refer to **Hydraulic Brake Booster Replacement** in Hydraulic Brakes. Did you complete the repair?	Go to **Step 15**	-
14	Replace the power steering cooler. Refer to **Power Steering Cooler Pipe/Hose Replacement (With Hydroboost)**. Did you complete the repair?	Go to **Step 15**	-
15	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

RATTLE, CLUNK, OR SHUDDER NOISE FROM THE POWER STEERING SYSTEM

Rattle, Clunk, Or Shudder Noise From The Power Steering System

Step	Action	Yes	No
1	Did you review the Power Steering System General Description and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Power Steering System**
2	Verify that a rattle, clunk or shudder noise is present. Is a rattle, clunk or shudder noise present?	Go to **Step 3**	System OK
3	Inspect the power steering hoses for proper routing and clearance. Is the routing or clearance of the power steering hoses incorrect?	Go to **Step 11**	Go to **Step 4**
4	Inspect the engine drive belt for cracking or excessive wear. Refer to **Drive Belt Excessive Wear Diagnosis** or **Drive Belt Excessive Wear Diagnosis** in Engine Mechanical.		

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	Is the drive belt cracked or excessively worn?	Go to **Step 12**	Go to **Step 5**
5	Inspect the power steering pump pulley for damage. Is the power steering pump pulley damaged?	Go to **Step 13**	Go to **Step 6**
6	Inspect the power steering pump and the power steering mounting bracket/brace for the proper installation. Refer to **Power Steering Pump Replacement (4.8L, 5.3L and 6.0L)** or **Power Steering Pump Replacement (8.1L)**. Is the power steering pump installation incorrect?	Go to **Step 14**	Go to **Step 7**
7	Inspect the power steering gear for the proper installation. Refer to **Power Steering Gear Replacement**. Is the power steering gear installation incorrect?	Go to **Step 15**	Go to **Step 8**
8	Inspect the steering linkage. Refer to **Steering Linkage Inspection (Steering Linkage Inspection)** or **Steering Linkage Inspection (Idler Arm Inspection)** in Steering Linkage. Is the steering linkage worn?	Go to **Step 17**	Go to **Step 9**
9	Inspect the suspension. Is the suspension worn?	Go to **Step 18**	Go to **Step 10**
10	Inspect the intermediate shaft. Is the intermediate shaft worn?	Go to **Step 19**	Go to **Step 3**
11	Adjust or replace the hoses. Refer to the appropriate procedure(s): • **Power Steering Cooler Pipe/Hose Replacement (With Hydroboost)** • **Power Steering Gear Inlet Pipe/Hose Replacement (With Hydroboost)** or **Power Steering Gear Inlet Pipe/Hose Replacement (Without Hydroboost)** • **Power Brake Booster Inlet Hose Replacement** • **Power Brake Booster Outlet Hose Replacement** Did you complete the repair?	Go to **Step 19**	-
12	Replace the engine drive belt. Refer to or **Drive Belt Replacement - Accessory** or **Drive Belt Replacement - Accessory** in Engine Mechanical. Did you complete the repair?	Go to **Step 19**	-
13	Replace the power steering pump pulley. Refer to **Power Steering Pulley Replacement**. Did you complete the repair?	Go to **Step 19**	-
	Install the power steering pump correctly. Refer to		

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14	**Power Steering Pump Replacement (4.8L, 5.3L and 6.0L)** or **Power Steering Pump Replacement (8.1L)**. Did you complete the repair?	Go to **Step 19**	-
15	Install the power steering gear correctly. Refer to **Power Steering Gear Replacement**. Did you complete the repair?	Go to **Step 19**	-
16	Replace the worn steering linkage. Refer to **Steering Linkage Inspection (Steering Linkage Inspection)** or **Steering Linkage Inspection (Idler Arm Inspection)** in Steering Linkage. Did you complete the repair?	Go to **Step 19**	-
17	Replace the worn suspension components. Refer to **Diagnostic Starting Point - Suspension General Diagnosis** in Suspension General Diagnosis. Did you complete the repair?	Go to **Step 19**	-
18	Replace the intermediate shaft. Refer to **Intermediate Steering Shaft Replacement - Upper** or**Intermediate Steering Shaft Replacement - Lower** in Steering Wheel and Column. Did you complete the repair?	Go to **Step 19**	-
19	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

WHINE OR GROWL NOISE FROM THE POWER STEERING SYSTEM (WITHOUT HYDRAULIC BRAKE BOOSTER)

Whine Or Growl Noise From The Power Steering System (Without Hydraulic Brake Booster)

Step	Action	Yes	No
1	Did you review the Power Steering System General Description and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Power Steering System**
2	Verify that a whine or growl noise is present. Is a whine or growl noise present?	Go to **Step 3**	System OK
3	Perform the power steering test procedure in order to diagnose a hydraulic condition and repair or replace a component. Refer to **Power Steering System Test Procedure**. Is there a hydraulic problem in the system?	Go to **Step 10**	Go to **Step 4**
4	Inspect the power steering gear for a whine or growl noise using **J 39570** . Is the noise present at the power steering gear?	Go to **Step 7**	Go to **Step 5**
5	Inspect the power steering pump for a whine or growl noise using **J 39570** . Is the noise present at the power steering pump?	Go to **Step 8**	Go to **Step 6**
	Inspect the power steering hoses for a whine or growl		

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6	noise using **J 39570** . Is the noise present at the power steering hoses?	Go to **Step 9**	Go to **Step 3**
7	Replace the power steering gear. Refer to **Power Steering Gear Replacement**. Did you complete the repair?	Go to **Step 10**	-
8	Replace the power steering pump. Refer to **Power Steering Pump Replacement (4.8L, 5.3L and 6.0L)** or **Power Steering Pump Replacement (8.1L)**. Did you complete the repair?	Go to **Step 10**	-
9	Adjust the routing of the power steering hoses. Did you complete the repair?	Go to **Step 10**	-
10	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

WHINE OR GROWL NOISE FROM THE POWER STEERING SYSTEM (WITH HYDRAULIC BRAKE BOOSTER)

Whine Or Growl Noise From The Power Steering System (With Hydraulic Brake Booster)

Step	Action	Yes	No
1	Did you review the Power Steering System General Description and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Power Steering System**
2	Verify that a whine or growl noise is present. Is a whine or growl noise present?	Go to **Step 3**	System OK
3	Perform the power steering test procedure in order to diagnose a hydraulic condition and repair or replace a component. Refer to **Power Steering System Test Procedure**. Is there a hydraulic problem in the system?	Go to **Step 12**	Go to **Step 4**
4	Inspect the power steering gear for a whine or growl noise using **J 39570** . Is the noise present at the power steering gear?	Go to **Step 8**	Go to **Step 5**
5	Inspect the power steering pump for a whine or growl noise using **J 39570** . Is the noise present at the power steering pump?	Go to **Step 9**	Go to **Step 6**
6	Inspect the power steering hoses for a whine or growl noise using **J 39570** . Is the noise present at the power steering hoses?	Go to **Step 10**	Go to **Step 7**
7	Inspect the hydraulic brake booster for a whine or growl noise using **J 39570** . Is the noise present at the hydro boost?	Go to **Step 11**	Go to **Step 3**
8	Replace the power steering gear. Refer to **Power Steering Gear Replacement**. Did you complete the repair?	Go to **Step 12**	-
	Replace the power steering pump. Refer to **Power**		

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9	**Steering Pump Replacement (4.8L, 5.3L and 6.0L)** or **Power Steering Pump Replacement (8.1L)**. Did you complete the repair?	Go to **Step 12**	-
10	Adjust the routing of the power steering hoses. Did you complete the repair?	Go to **Step 12**	-
11	Diagnose the hydraulic brake booster. Refer to **Diagnostic Starting Point - Hydraulic Brakes** in Hydraulic Brakes. Did you correct the condition?	Go to **Step 12**	-
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

STEERING EFFORT HARD IN ONE OR BOTH DIRECTIONS

Steering Effort Hard In One Or Both Directions

Step	Action	Yes	No
1	Did you review the Power Steering System General Description and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Power Steering System**
2	Verify that the steering effort is hard in one or both directions. Does the system operate normally?	System OK	Go to **Step 3**
3	Perform the power steering test procedure. Refer to **Power Steering System Test Procedure**. Did you complete the procedure?	Go to **Step 4**	-
4	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

STEERING EFFORT TOO EASY IN ONE OR BOTH DIRECTIONS

Steering Effort Too Easy In One Or Both Directions

Step	Action	Yes	No
1	Did you review the Power Steering System Description and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Power Steering System**
2	Verify that the steering effort is too easy in one or both directions. Does the system operate normally?	System OK	Go to **Step 3**
3	Perform the power steering test procedure. Refer to **Power Steering System Test Procedure**. Did you complete the procedure?	Go to **Step 4**	-
4	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

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REPAIR INSTRUCTIONS

BLEEDING THE POWER STEERING SYSTEM

Tools Required

- **J 35555** Metal Mityvac. See **Special Tools and Equipment**.
- **J 43485** Power Steering Bleeder Adapter. See **Special Tools and Equipment**.

IMPORTANT: Hoses touching the frame, body, or engine may cause system noise.

1. Verify that the hoses do not touch any other part of the vehicle.

IMPORTANT: Loose connections may not leak, but could allow air into the steering system.

2. Verify that all hose connections are tight.

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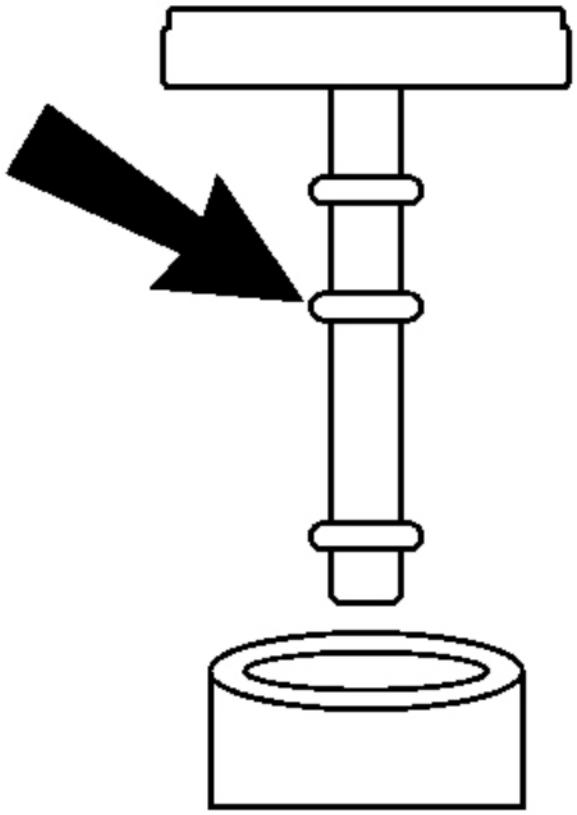


Fig. 5: Identifying FULL COLD Level On Reservoir Cap
Courtesy of GENERAL MOTORS CORP.

NOTE: **If the power steering system has been serviced, an accurate fluid level reading cannot be obtained unless air is bled from the steering system. The air in the fluid may cause pump cavitation noise and may cause pump damage over a period of time.**

IMPORTANT: Maintain the fluid level throughout the bleed procedure.

3. Remove the pump reservoir cap.

IMPORTANT: Use clean, new power steering fluid only.

4. Fill the pump reservoir with fluid to the FULL COLD level.

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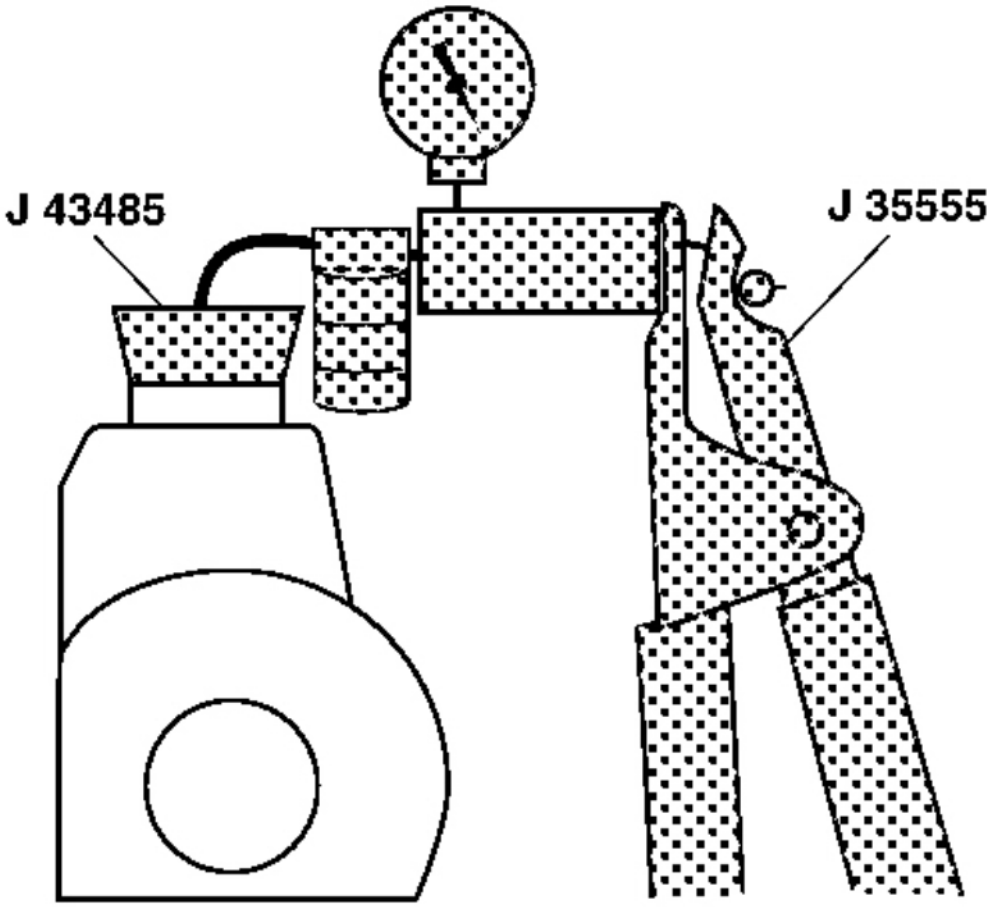


Fig. 6: Bleeding Power Steering System Using J 43485 & J 35555
Courtesy of GENERAL MOTORS CORP.

5. Attach the **J 43485** to the **J 35555** or equivalent. See **Special Tools and Equipment**.
6. Place the **J 43485** on or in the pump reservoir filler neck. See **Special Tools and Equipment**.
7. Apply a vacuum of 68 kPa (20 in Hg) maximum.
8. Wait 5 minutes.

   Typical vacuum drop is 7-10 kPa (2-3 in Hg). If the vacuum does not remain steady, refer to Excessive Vacuum Drop Diagnosis at the end of this procedure.

9. Remove the **J 43485** and the **J 35555** . See **Special Tools and Equipment**.

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10. Reinstall the pump reservoir cap.
11. Start the engine. Allow the engine to idle.
12. Turn off the engine.
13. Verify the fluid level. Repeat steps 11-13 until the fluid stabilizes.

IMPORTANT: Do not turn steering wheel to lock.

14. Start the engine. Allow the engine to idle.
15. Turn the steering wheel 180-360 degrees in both directions 5 times.
16. Switch the ignition off.

NOTE: When adding fluid or making a complete fluid change, always use the proper power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

17. Verify the fluid level.

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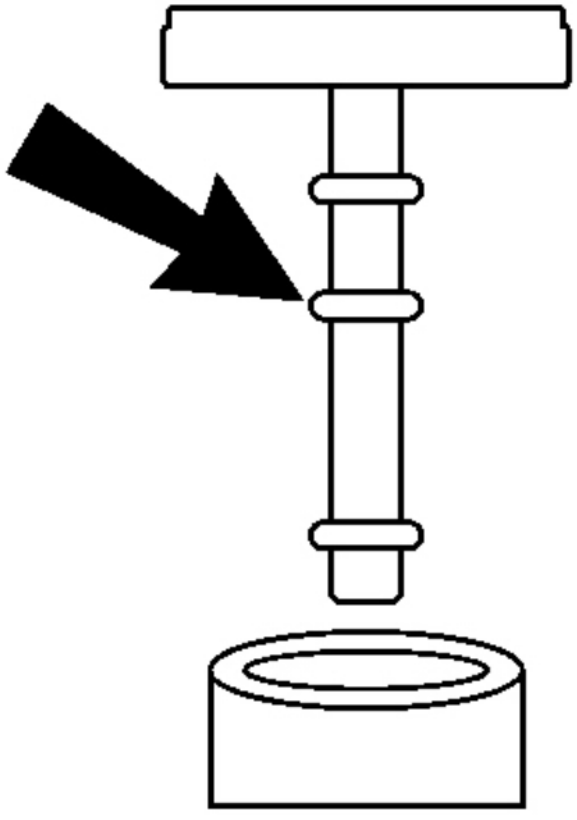


Fig. 7: Identifying FULL COLD Level On Reservoir Cap
Courtesy of GENERAL MOTORS CORP.

18. Remove the pump reservoir cap.

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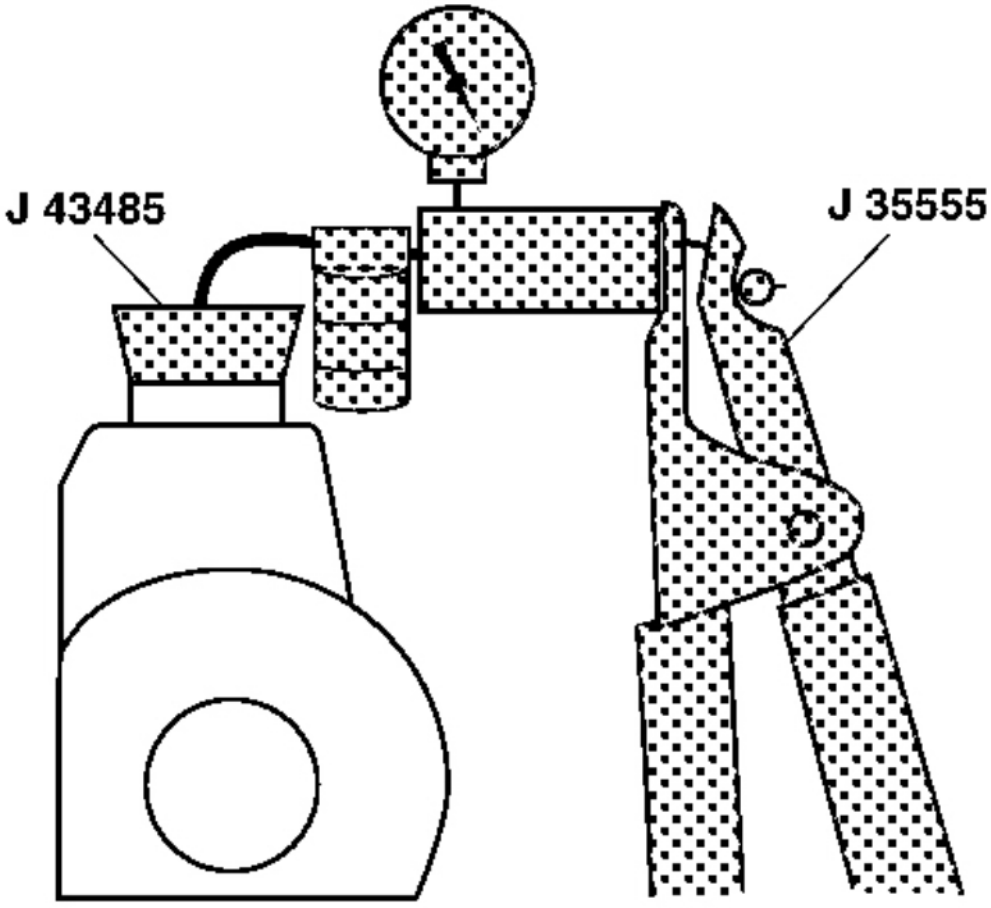


Fig. 8: Bleeding Power Steering System Using J 43485 & J 35555
Courtesy of GENERAL MOTORS CORP.

19. Attach the **J 43485** to the **J 35555** or equivalent. See **Special Tools and Equipment**.
20. Place the **J 43485** on or in the pump reservoir filler neck. See **Special Tools and Equipment**.
21. Apply a vacuum of 68 kPa (20 in Hg) maximum.
22. Wait 5 minutes.
23. Remove the **J 43485** and the **J 35555** . See **Special Tools and Equipment**.
24. Verify the fluid level.

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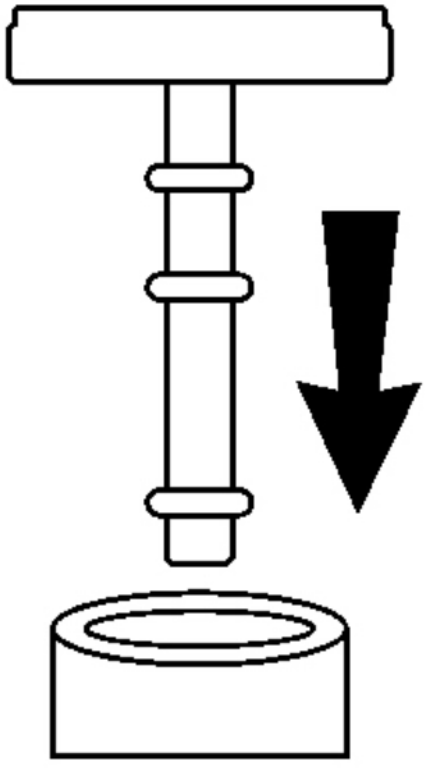


Fig. 9: View Of Pump Reservoir Cap
Courtesy of GENERAL MOTORS CORP.

25. Reinstall the pump reservoir cap.

Excessive Vacuum Drop Diagnosis

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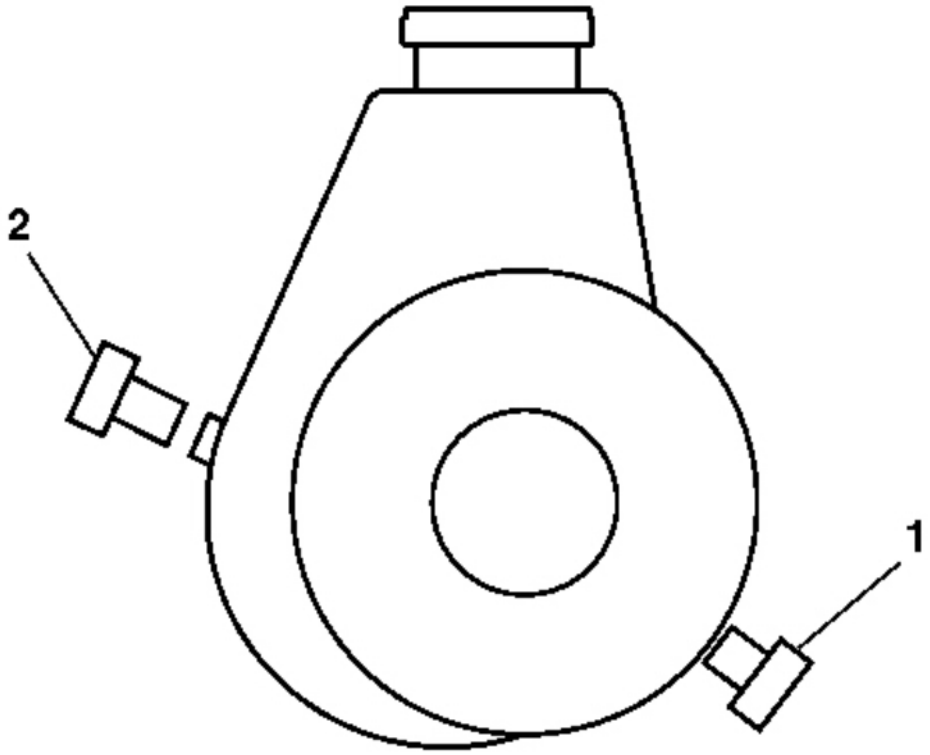


Fig. 10: Installing Plugs Into Power Steering Pump Pressure & Return Ports
Courtesy of GENERAL MOTORS CORP.

1. If the vacuum continues to drop, remove the pressure and return hose from the pump.
2. Install the plugs (1,2) supplied with the **J 43485** into the pressure and return port. See **Special Tools and Equipment**.

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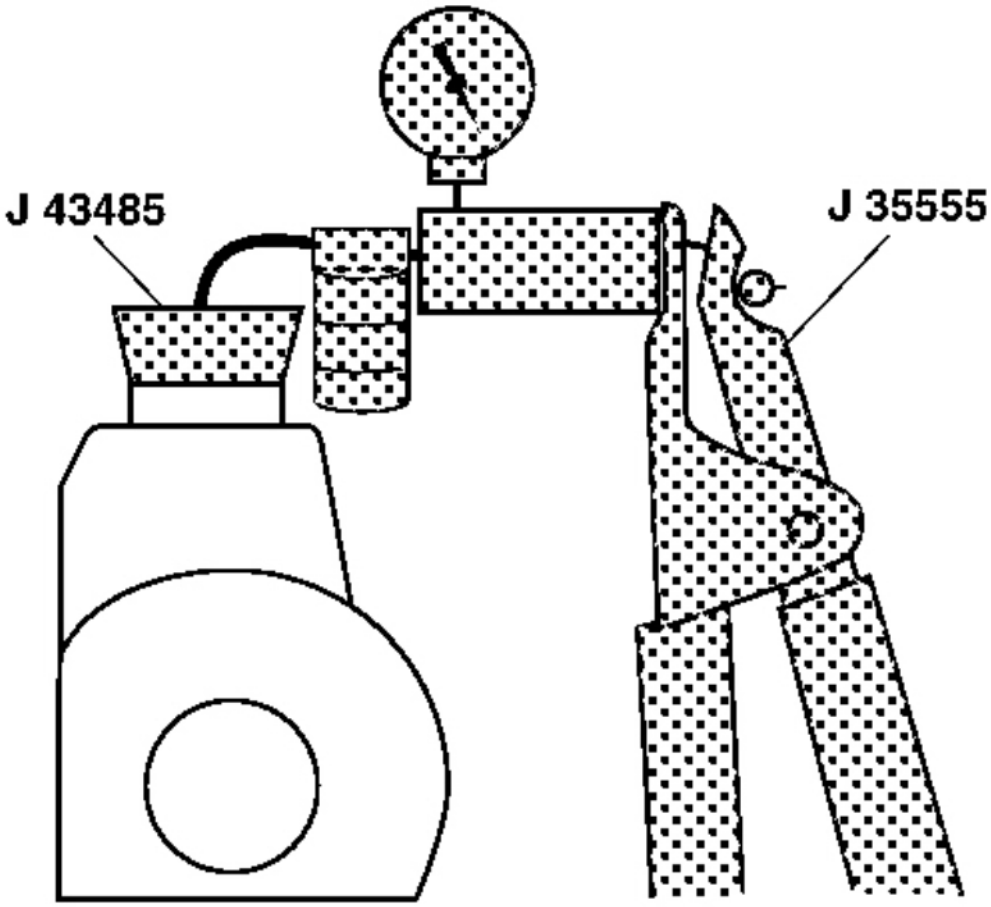


Fig. 11: Bleeding Power Steering System Using J 43485 & J 35555
Courtesy of GENERAL MOTORS CORP.

3. Attach the **J 43485** to the **J 35555** or equivalent. See **Special Tools and Equipment**.
4. Place the **J 43485** on or in the pump reservoir filler neck. See **Special Tools and Equipment**.
5. Apply a vacuum of 68 kPa (20 in Hg) maximum.
6. If the vacuum drops again, repair or replace the pump. If the vacuum holds steady, continue to check the other parts of the steering system.

IMPORTANT: Fluid must be free from bubbles and foam. Be aware of periodic bubbles that indicate a loose connection or leaking O-ring seal in the return hose or the pressure hose.

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Fluid must be free from discoloration.

7. Observe the fluid.
8. If condition persists, replace the following parts:
   - The return hose clamps
   - The return hose O-rings
   - The pressure hose O-rings
   - The gear cylinder line O-rings
   - The reservoir to pump O-ring
9. Repeat the bleed procedure from the beginning.
10. Drive the vehicle approximately 16 km (10 mi) in order to warm the system to operating temperature. Evaluate vehicle on a smooth flat surface.
11. Verify the following conditions:
    - There is smooth power assist.
    - The vehicle operates quietly.
    - The pump maintains the proper fluid level.
    - There is not any leaking in the steering system.
    - The fluid is free of foam or discoloration.

CHECKING AND ADDING POWER STEERING FLUID (WITHOUT HYDROBOOST)

NOTE: When adding fluid or making a complete fluid change, always use the proper power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

1. Clean the area surrounding the reservoir cap.
2. Remove the reservoir cap.
3. Inspect the power steering pump fluid level at regular intervals. Use the appropriate procedure below.

   Add fluid when required. Refer to **Fluid and Lubricant Recommendations** in Maintenance and Lubrication.

   Fluid Is Cold

   1. Remove the reservoir cap.
   2. Inspect the fluid level on the capstick.
   3. Ensure that the fluid level is between the bottom of the COLD/FULL mark and the end of the capstick.

   Fluid Is Hot

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1. Run the engine until the fluid reaches about 80°C (170°F).
2. Turn the engine OFF.
3. Remove the reservoir cap.
4. Inspect the fluid level on the capstick.
5. Ensure that the fluid level is between the HOT/FULL and the COLD/FULL marks on the capstick.

4. If the fluid level is low, add power steering fluid to the proper level.
5. Install the reservoir cap.
6. When checking the fluid level after servicing the steering system, bleed the air from the system. Refer to **Bleeding the Power Steering System**.

CHECKING AND ADDING POWER STEERING FLUID (WITH HYDROBOOST)

NOTE: When adding fluid or making a complete fluid change, always use the proper power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

1. If the power steering system has been serviced, bleed the power steering system to remove any trapped air from the system. Refer to **Bleeding the Power Steering System**.

IMPORTANT: The oil level will appear falsely high if the hydo-boost accumulator is not fully charged. Do not apply the brake pedal with the engine off, this will discharge the hyro-boost accumulator.

2. Fully charge the hydro-boost accumulator using the following procedure:
   1. Start the engine.
   2. Firmly apply the brake pedal 2 to 3 times.
   3. Turn the engine Off.

IMPORTANT: The Add and Cold Full marks on the capstick are calculated for oil at ambient temperature. If the oil is hot, the oil level may appear slightly high.

3. Clean the area surrounding the reservoir cap.
4. Remove the reservoir cap.

IMPORTANT: The ideal oil level is between the Add and the Full Cold marks. Since overfilling is just as undesirable as underfilling, there is no reason to full all the way up to the Full Cold mark.

5. Inspect the power steering pump fluid level at regular intervals.

   Add fluid when required. Refer to **Fluid and Lubricant Recommendations** in Maintenance and

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Lubrication.

6. If the fluid level is low, add power steering fluid to the proper level.
7. Install the reservoir cap.
8. When checking the fluid level after servicing the steering system, bleed the air from the system. Refer to **Bleeding the Power Steering System**.

FLUSHING THE POWER STEERING SYSTEM

IMPORTANT: Do not reuse any drained power steering fluid regardless of appearance or condition.

1. Turn off the engine.
2. Raise the front end of the vehicle off the ground until the tires and wheels turn freely. Refer to **Lifting and Jacking the Vehicle** in General Information.
3. Place a large container under the fluid return hose in order to collect the draining fluid.
4. Remove the fluid return hose at the power steering pump reservoir inlet connection.
5. Plug the reservoir return hose inlet connection on the power steering pump.

IMPORTANT:

- **This step may require 4 L (4 qt) of power steering fluid until the draining fluid appears clear.**
- **Do not run the engine without the power steering fluid level at FULL COLD.**

6. Run the engine at idle while an assistant maintains the fluid level at FULL COLD in the reservoir using new approved power steering fluid.
7. Turn off the engine.
8. Turn the steering wheel fully to the left and to the right.
9. Remove the plug from the pump reservoir inlet connection.
10. Install the fluid return hose to the pump reservoir.
11. Maintain the fluid level at FULL COLD.
12. Operate the engine at idle for approximately 15 minutes.
13. Repeat steps 3-5.
14. Inspect the power steering fluid for the following indications of contamination:
    - Milky fluid - water
    - Brown fluid - burnt
    - Plastic debris or dirt chunks
15. If the fluid is contaminated, repeat steps 6-12 in order to complete a third flush.
16. Remove the plug from the pump reservoir inlet connection.
17. Install the fluid return hose to the pump reservoir.

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18. Clean any spilled fluid.
19. Bleed the power steering system. Refer to **Bleeding the Power Steering System**

POWER STEERING PULLEY REPLACEMENT

Tools Required

- **J 25034-C** Power Steering Pump Pulley Remover. See **Special Tools and Equipment**.
- **J 25033-C** Power Steering Pump Pulley Installer. See **Special Tools and Equipment**.

Removal Procedure

1. Remove the upper fan shroud. Refer to **Fan Shroud Replacement - Upper (W/O M74)** or **Fan Shroud Replacement - Upper (W/M74)** in Engine Cooling.
2. Remove the drive belt. Refer to **Drive Belt Replacement - Accessory** or **Drive Belt Replacement - Accessory** in Engine Mechanical.

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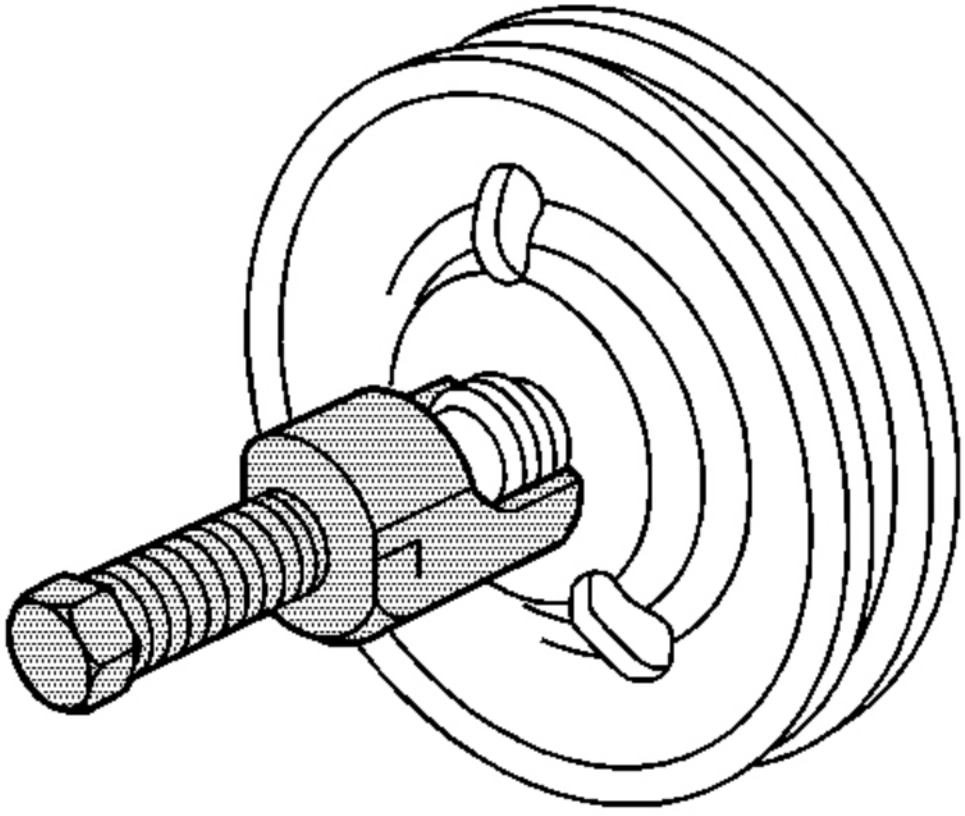


Fig. 12: View Of Power Steering Pump Pulley Remover
Courtesy of GENERAL MOTORS CORP.

3. Remove the power steering pump pulley using the **J 25034-C** . See **Special Tools and Equipment**.

Installation Procedure

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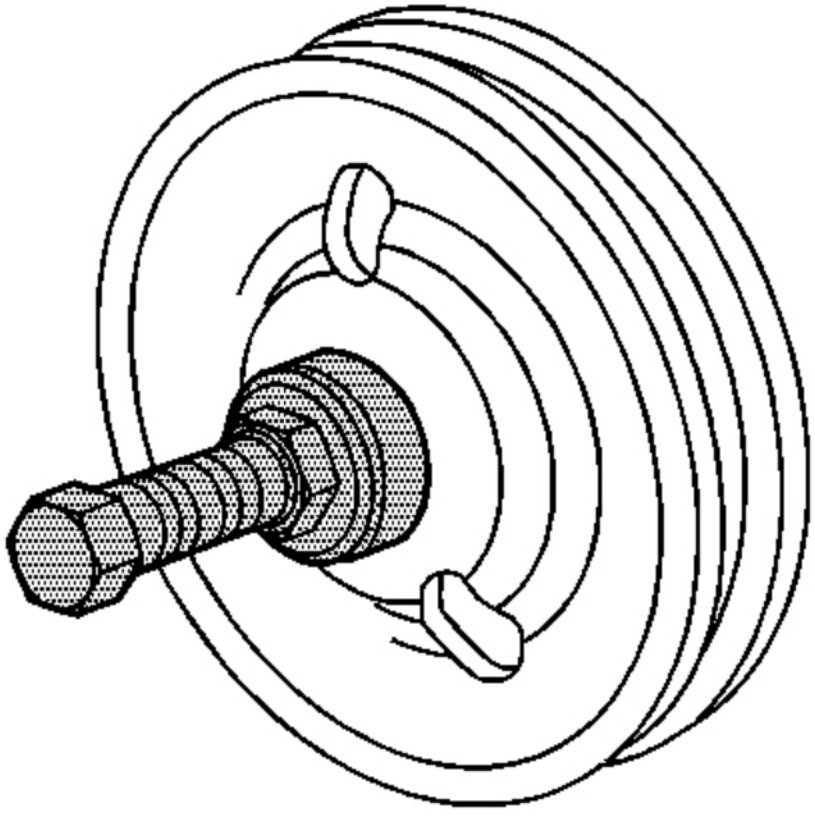


Fig. 13: View Of Power Steering Pump Pulley Installer
Courtesy of GENERAL MOTORS CORP.

1. Place the power steering pump pulley on the end of the power steering pump shaft.
2. Install the power steering pump pulley using **J 25033-C** . See **Special Tools and Equipment**.

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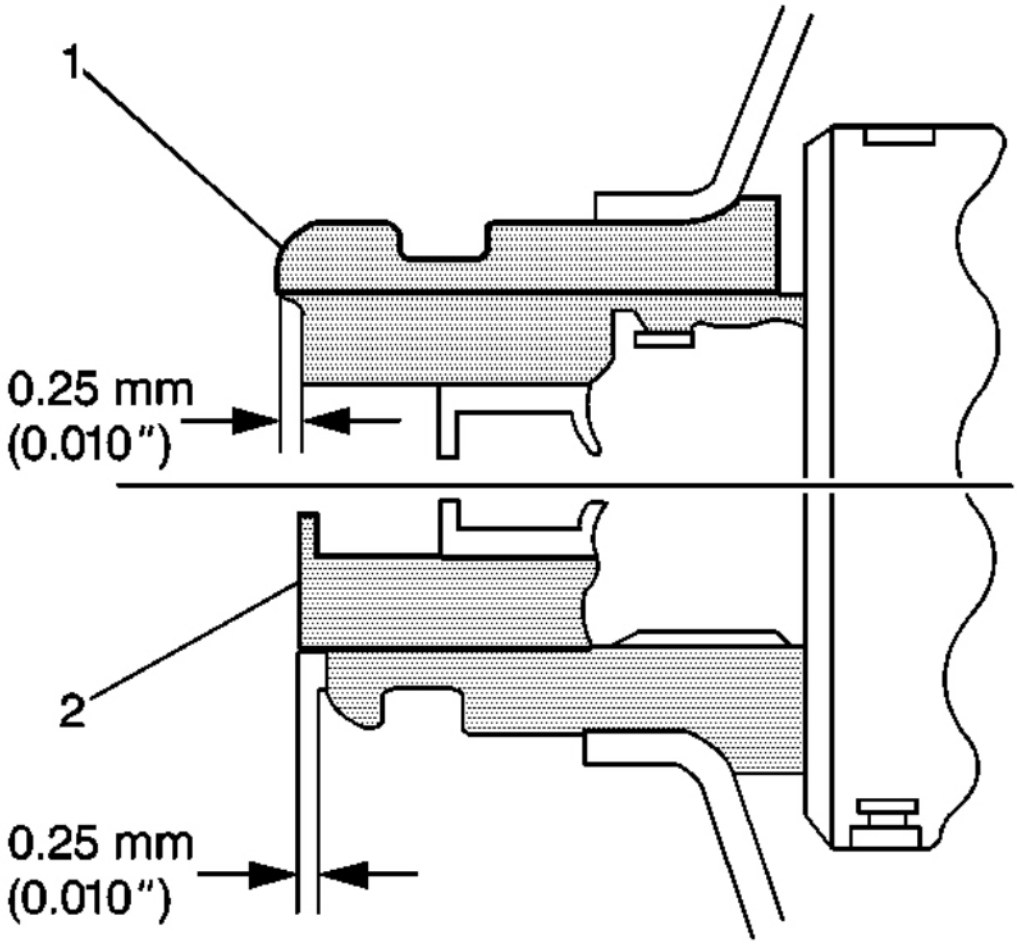


Fig. 14: Checking Power Steering Pump Pulley Installed Depth
Courtesy of GENERAL MOTORS CORP.

3. Ensure that the power steering pump pulley (1) is flush against the power steering pump shaft, with an allowable variance of 0.25 mm (0.010 in).
4. Install the drive belt. Refer to **Drive Belt Replacement - Accessory** or **Drive Belt Replacement - Accessory** in Engine Mechanical.
5. Install the upper fan shroud. Refer to **Fan Shroud Replacement - Upper (W/O M74)** or **Fan Shroud Replacement - Upper (W/M74)** in Engine Cooling.

POWER STEERING PUMP REPLACEMENT (4.8L, 5.3L AND 6.0L)

Removal Procedure

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1. Remove the power steering pulley. Refer to **Power Steering Pulley Replacement**.
2. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

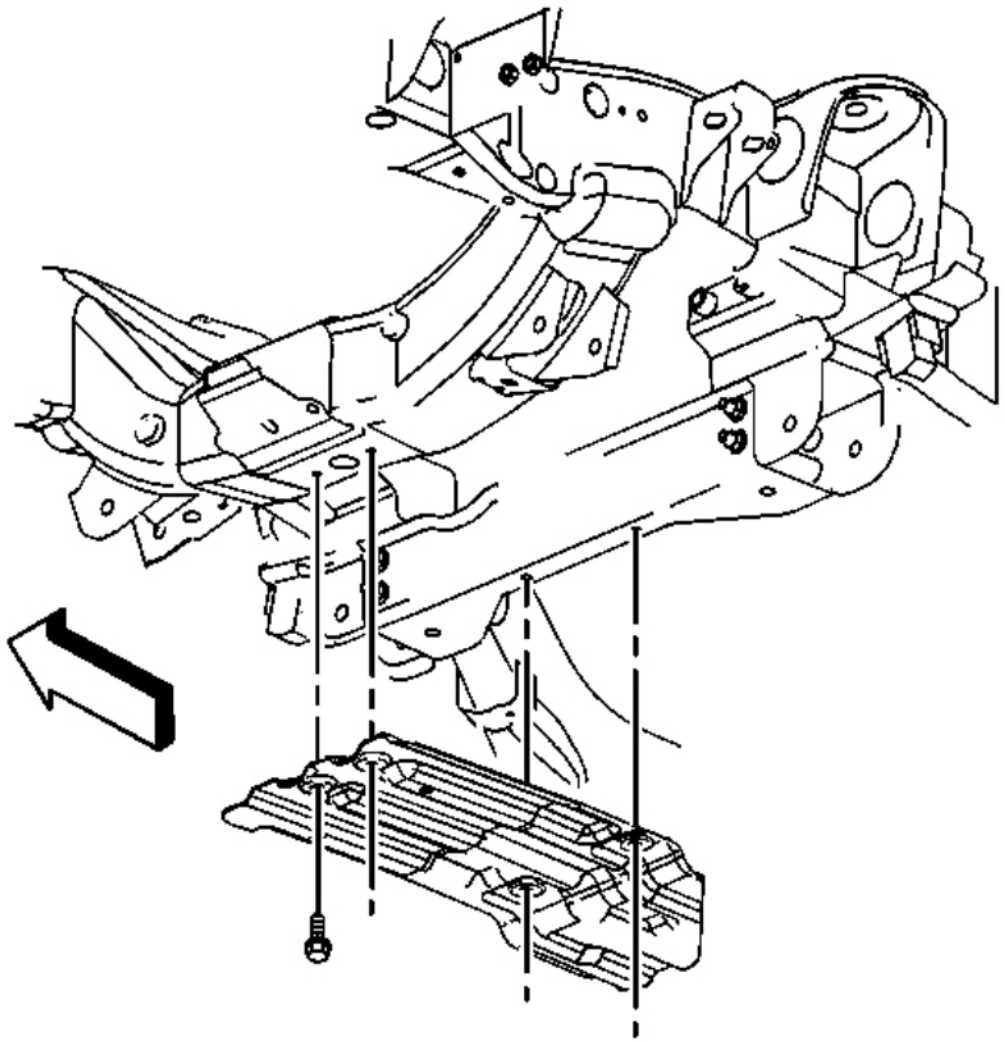


Fig. 15: Identifying Oil Pan Skid Plate
Courtesy of GENERAL MOTORS CORP.

3. Remove the oil pan skid plate bolts.
4. Remove the oil pan skid plate from the vehicle, if equipped.
5. Place a drain pan under the vehicle.

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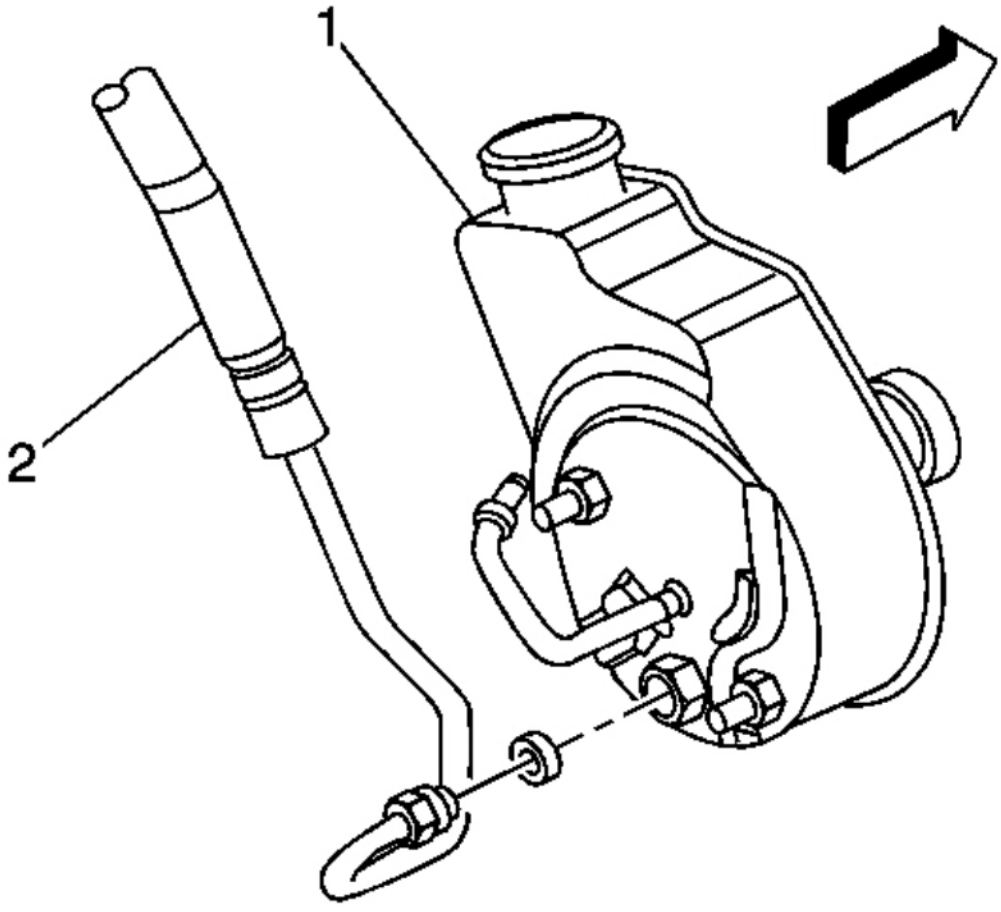


Fig. 16: View Of Power Steering Pressure Hose & Power Steering Pump
Courtesy of GENERAL MOTORS CORP.

6. Remove the power steering pressure hose (2) from the power steering pump from underneath the vehicle.
7. Lower the vehicle.

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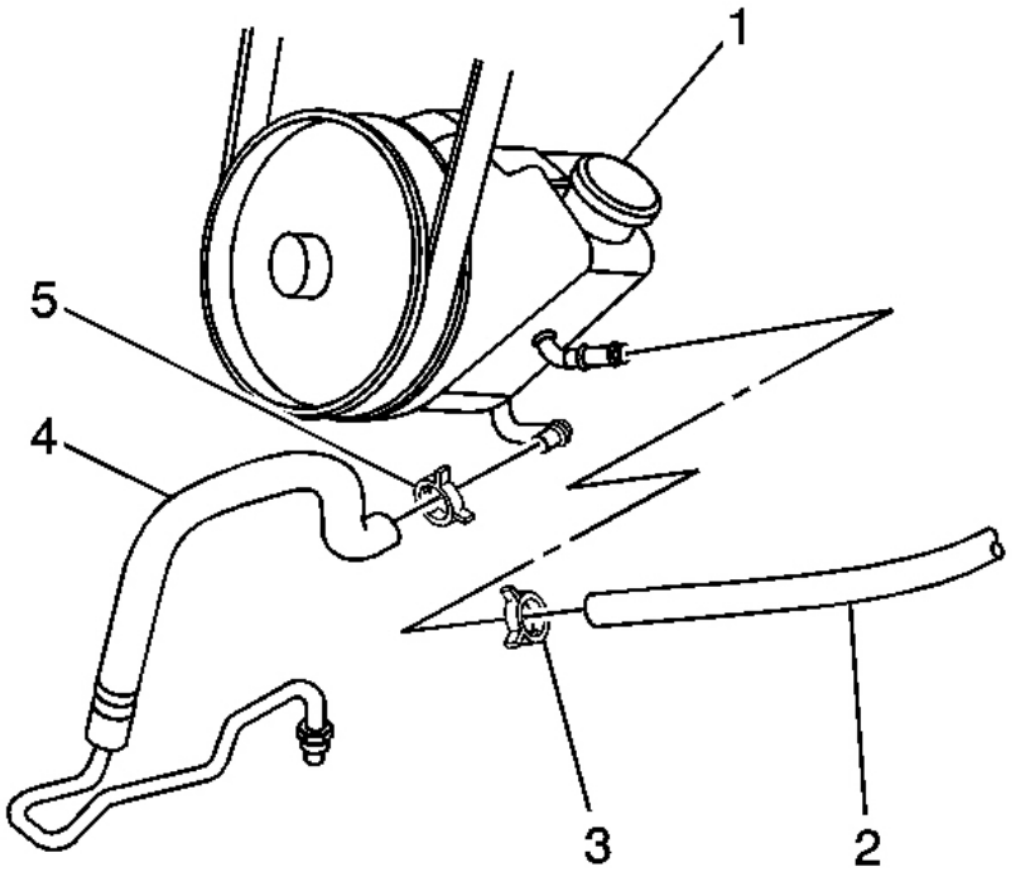


Fig. 17: View Of Power Steering Return Hoses, Clamps & Power Steering Pump
Courtesy of GENERAL MOTORS CORP.

8. Remove the clamps (3,5) retaining the power steering return hoses to the power steering pump and remove the hoses.
9. Remove the lower intermediate shaft from the steering gear. Refer to **Intermediate Steering Shaft Replacement - Lower** in Steering Wheel and Column.

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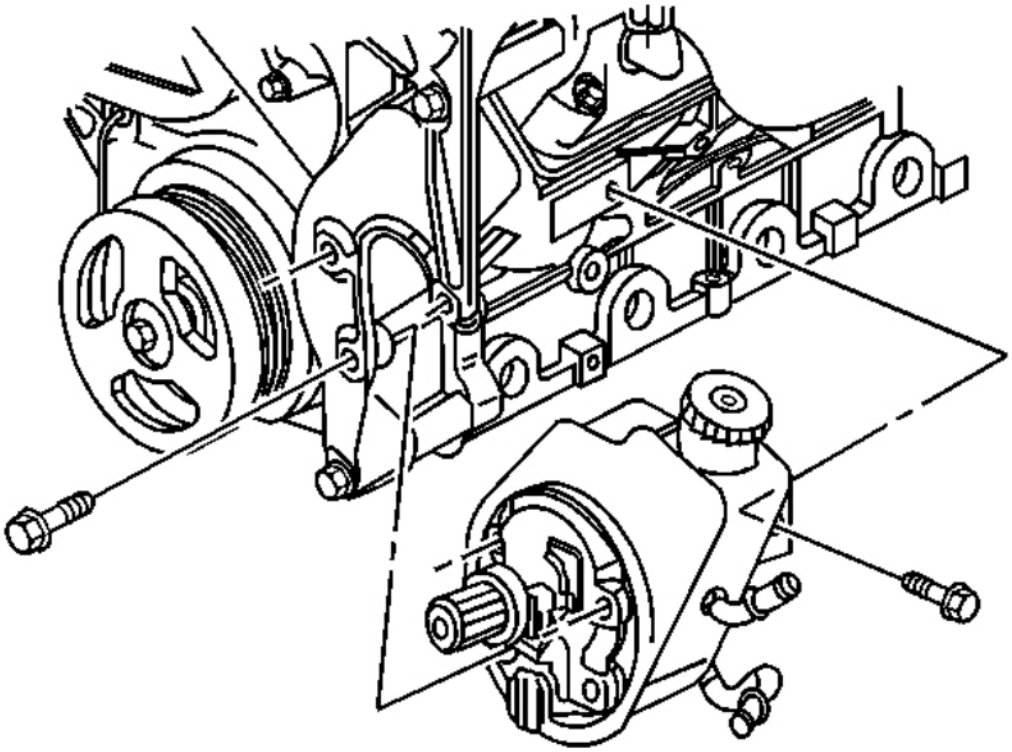


Fig. 18: View Of Power Steering Pump & Bolts (4.8L, 5.3L & 6.0L)
Courtesy of GENERAL MOTORS CORP.

10. Remove the bolt retaining the rear bracket to the engine.
11. Remove the bolts from the front of the pump.
12. Remove the pump from the vehicle.

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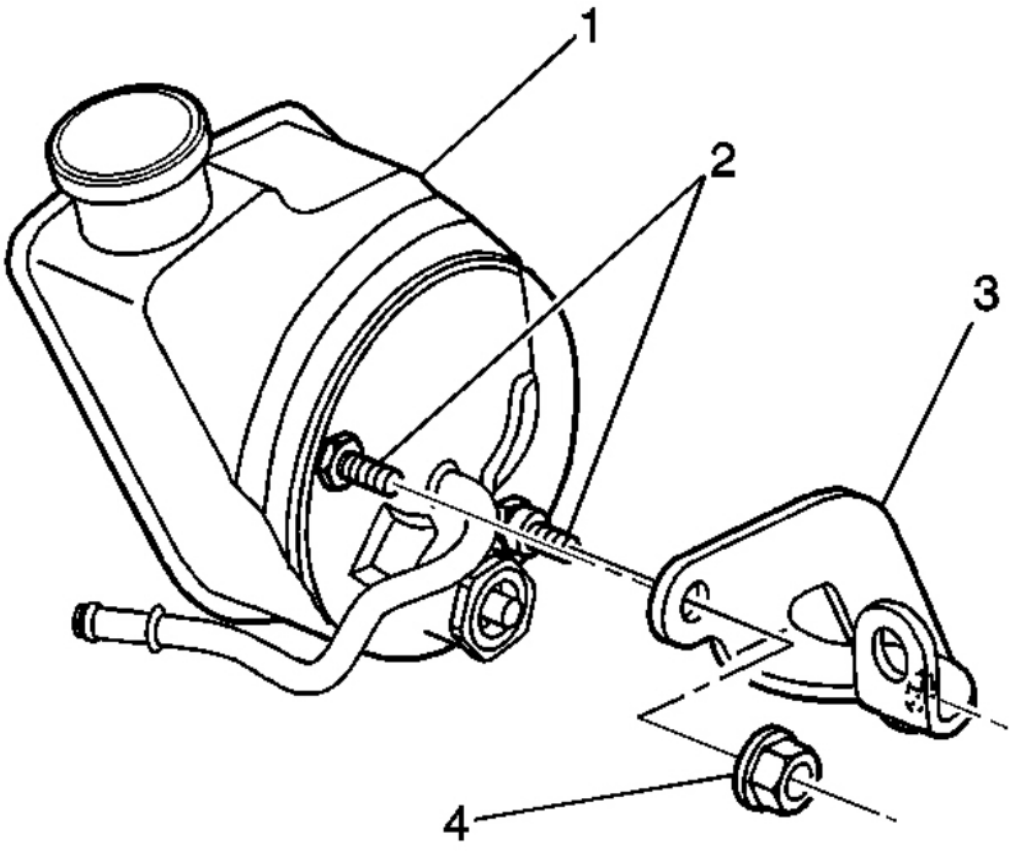


Fig. 19: View Of Bracket At Rear Of Power Steering Pump (4.8L, 5.3L & 6.0L)
Courtesy of GENERAL MOTORS CORP.

13. Remove the bracket (3) from the rear of the pump (1).

Installation Procedure

NOTE: Refer to Fastener Notice in Cautions and Notices.

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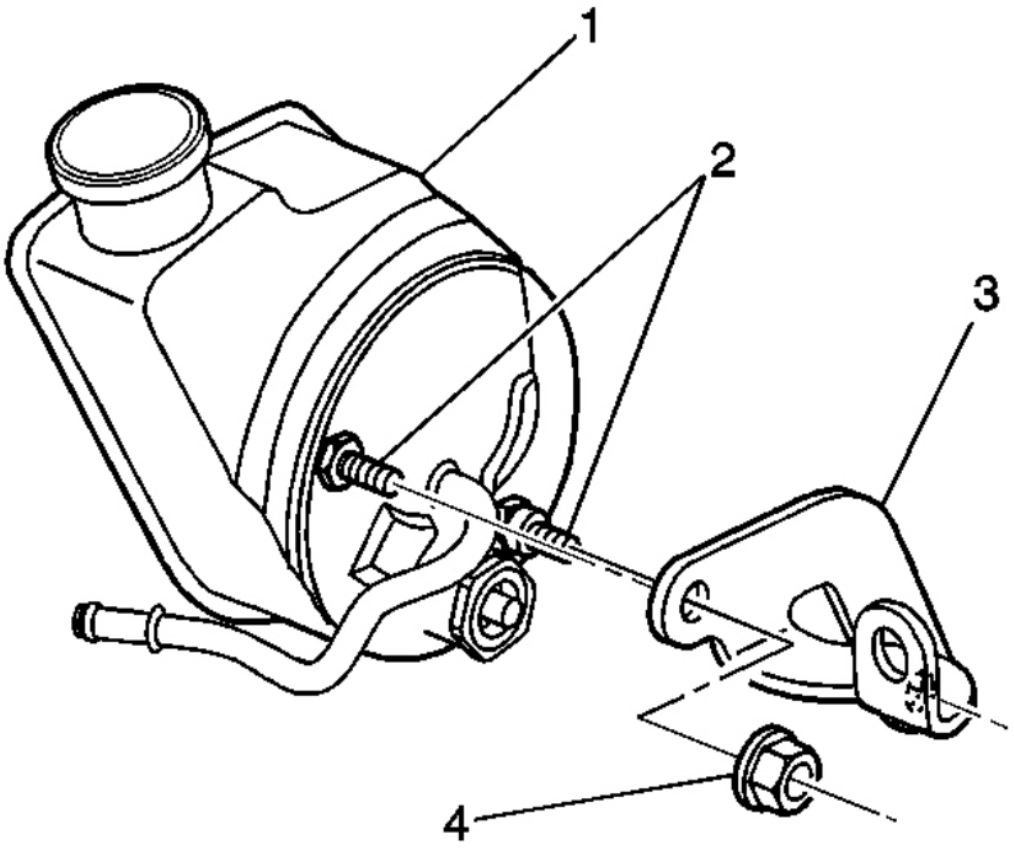


Fig. 20: View Of Bracket At Rear Of Power Steering Pump (4.8L, 5.3L & 6.0L)
Courtesy of GENERAL MOTORS CORP.

1. Install the bracket (3) to the rear of the pump (1).

   Tighten: Tighten the rear bracket retaining nuts to 50 N.m (37 lb ft).

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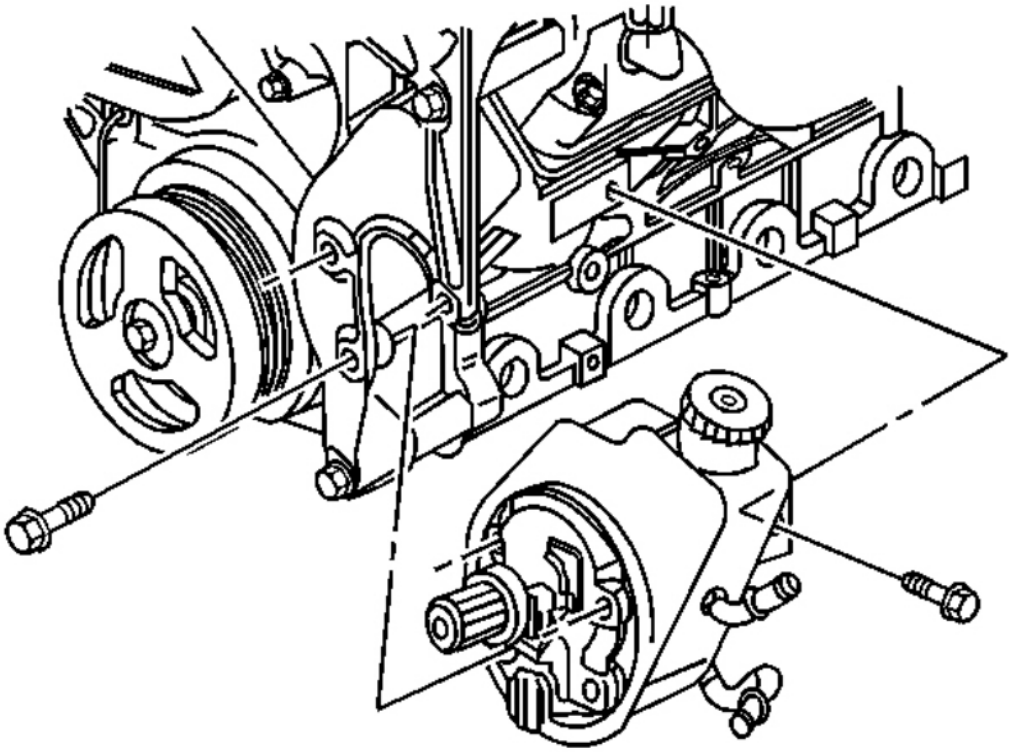


Fig. 21: View Of Power Steering Pump & Bolts (4.8L, 5.3L & 6.0L)
Courtesy of GENERAL MOTORS CORP.

2. Install the power steering pump.
3. Install the bolt retaining the rear bracket to the engine.

   Tighten: Tighten the rear power steering bracket bolt to engine bracket to 50 N.m (37 lb ft).

4. Install the bolts to the front of the pump.

   Tighten: Tighten the bolts to 50 N.m (37 lb ft).

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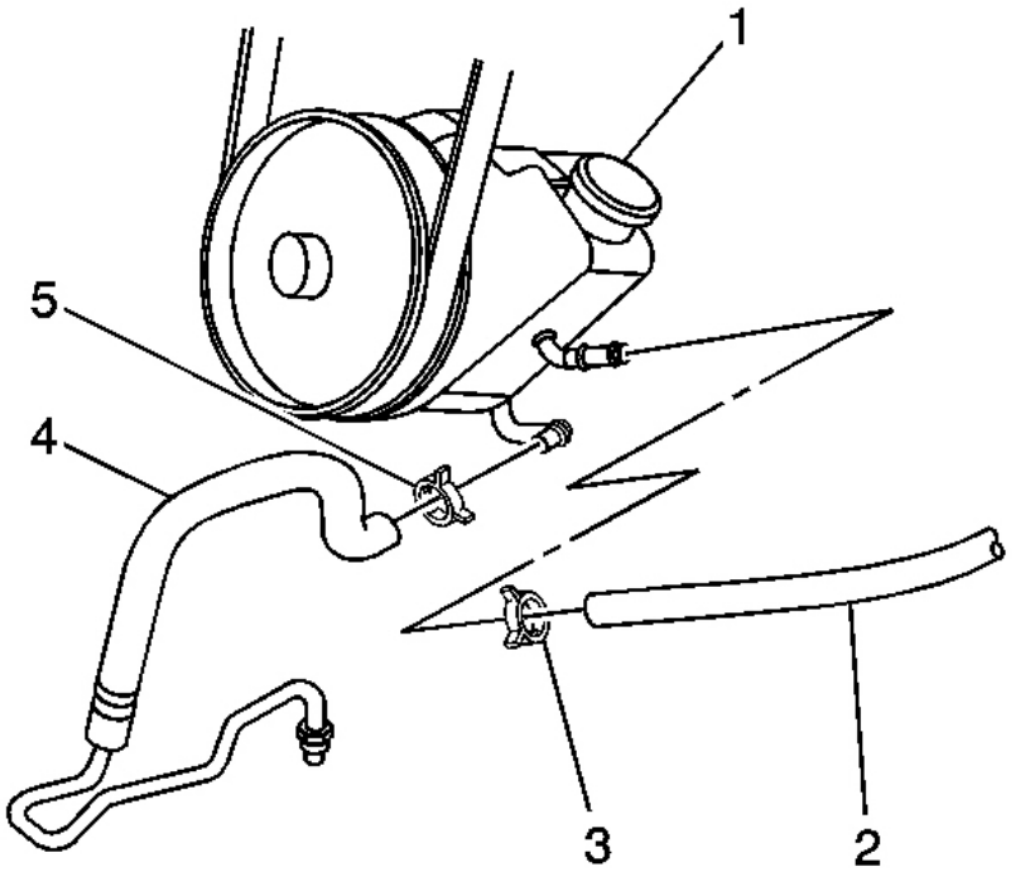


Fig. 22: View Of Power Steering Return Hoses, Clamps & Power Steering Pump
Courtesy of GENERAL MOTORS CORP.

5. Install the power steering pump return hoses (2,4) to the power steering pump and install the retaining clamps.
6. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

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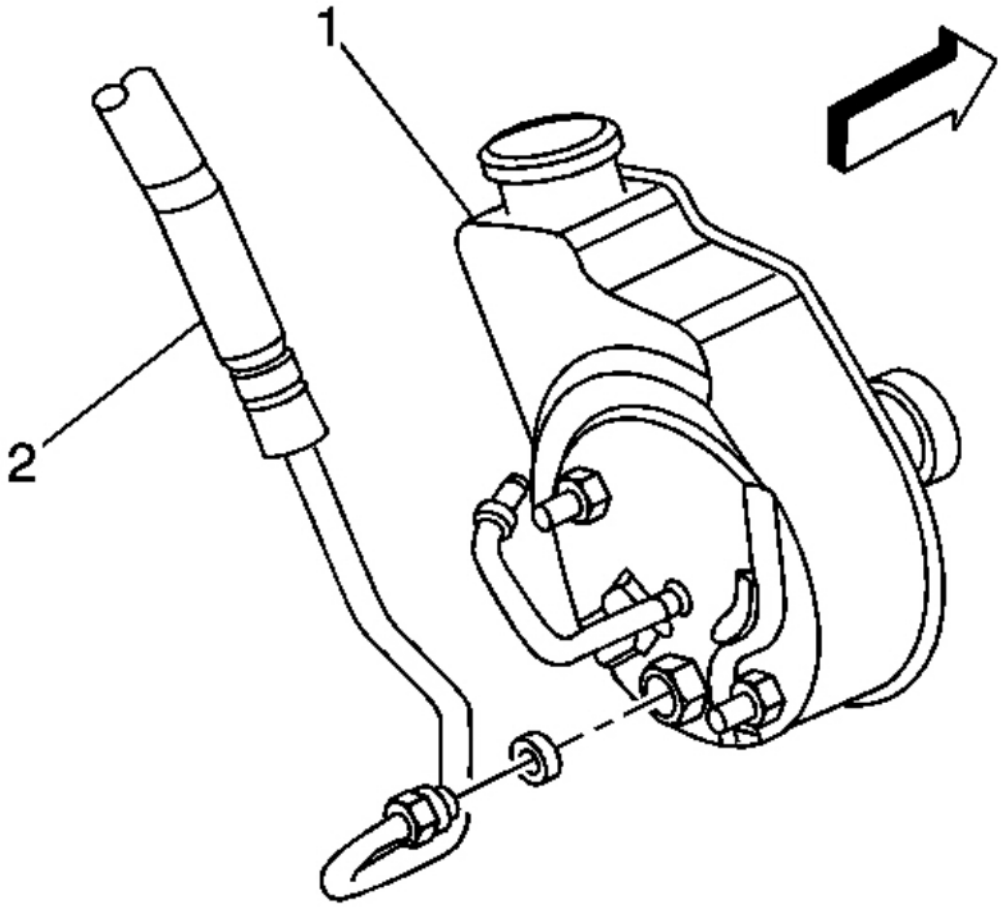


Fig. 23: View Of Power Steering Pressure Hose & Power Steering Pump
Courtesy of GENERAL MOTORS CORP.

7. Install the power steering pressure hose (2) to the power steering pump.

   Tighten: Tighten the fitting to 28 N.m (20 lb ft).

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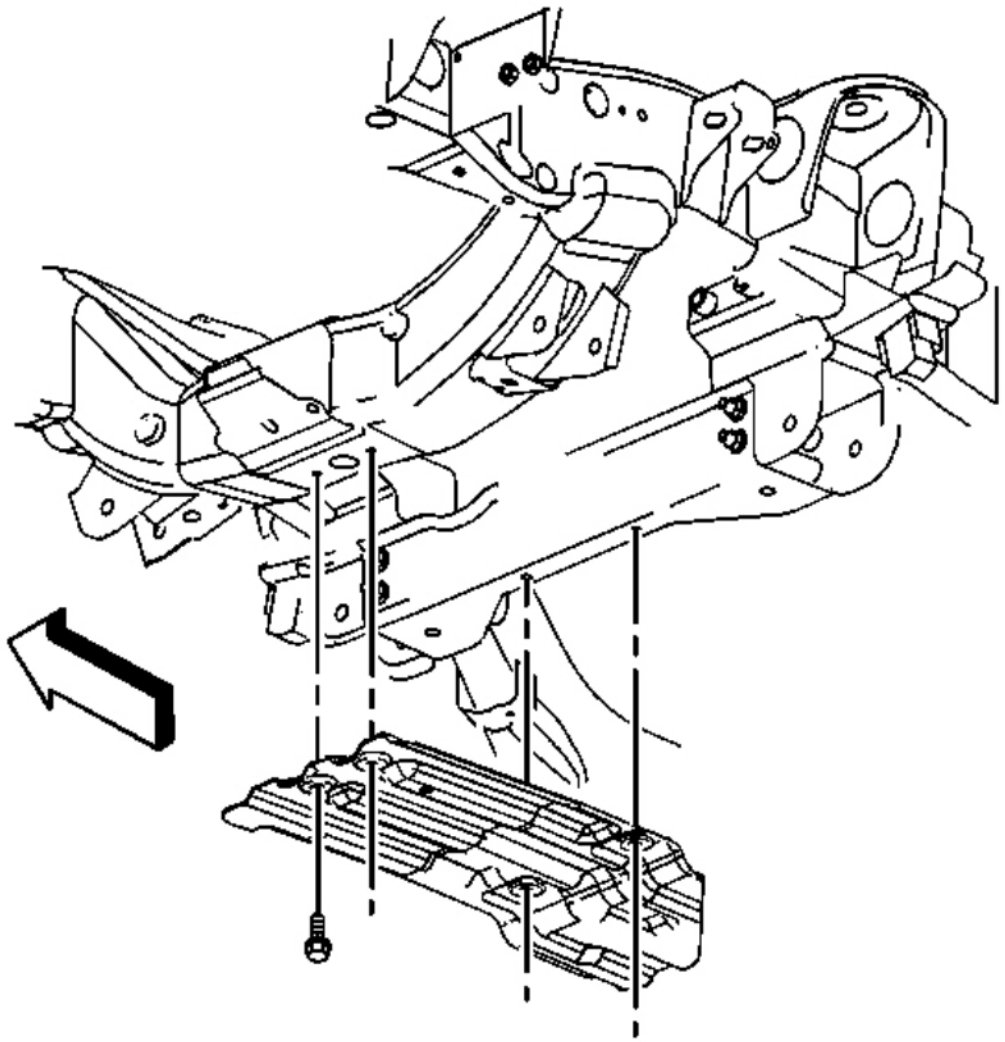


Fig. 24: Identifying Oil Pan Skid Plate
Courtesy of GENERAL MOTORS CORP.

8. Install the oil pan skid plate, if equipped.
9. Install the oil pan skid plate bolts.

   Tighten: Tighten the retaining bolts to 20 N.m (15 lb ft).

10. Lower the vehicle.
11. Install the intermediate shaft. Refer to **Intermediate Steering Shaft Replacement - Lower** .

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12. Install the power steering pulley. Refer to **Power Steering Pulley Replacement**.
13. Fill and bleed the power steering system. Refer to **Bleeding the Power Steering System**.

POWER STEERING PUMP REPLACEMENT (8.1L)

Removal Procedure

1. Place a drain pan under the vehicle.
2. Remove the power steering pulley. Refer to **Power Steering Pulley Replacement**.

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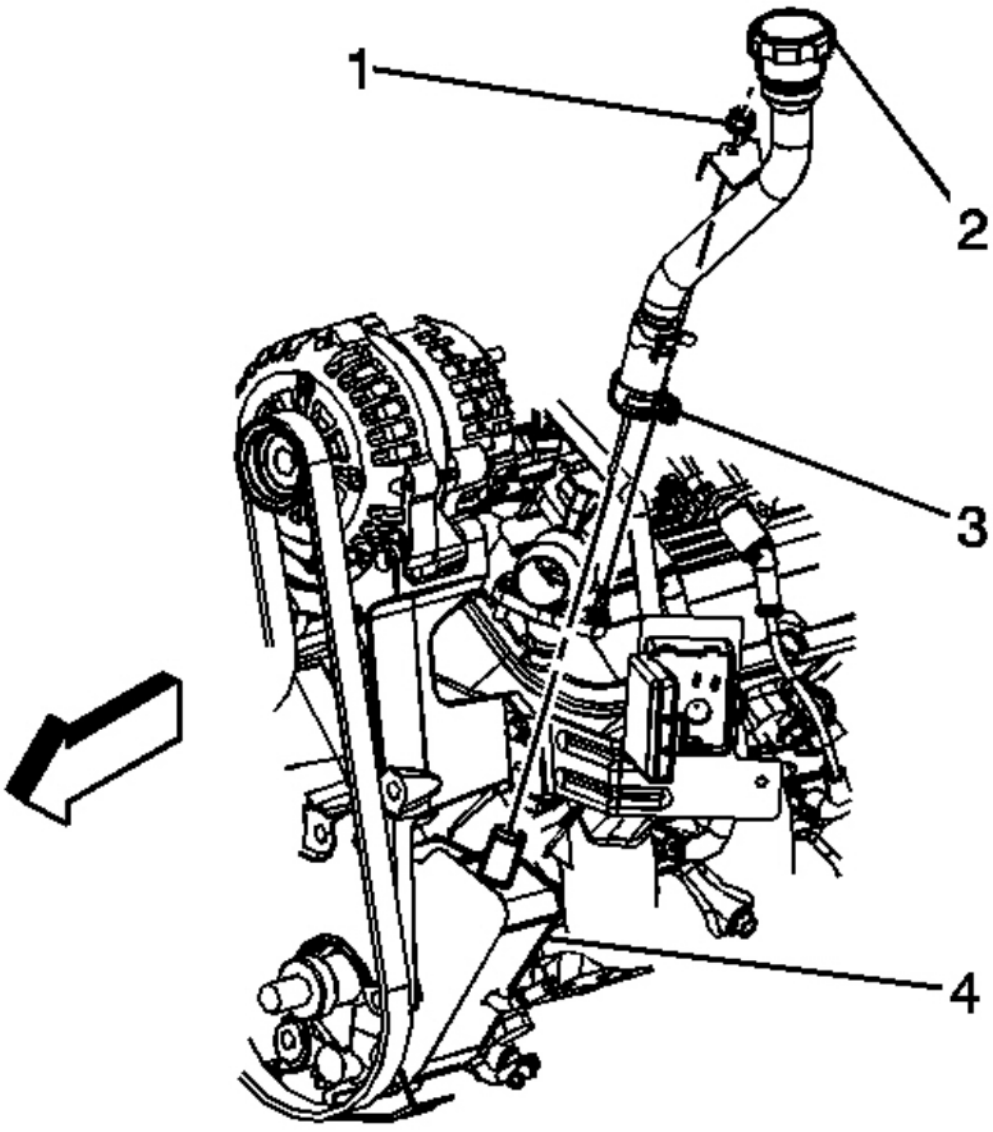


Fig. 25: View Of Filler Neck, Nut & Clamp (8.1L)
Courtesy of GENERAL MOTORS CORP.

3. Remove the nut (1) and clamp (3) retaining the filler neck (1) to the power steering pump, if equipped.

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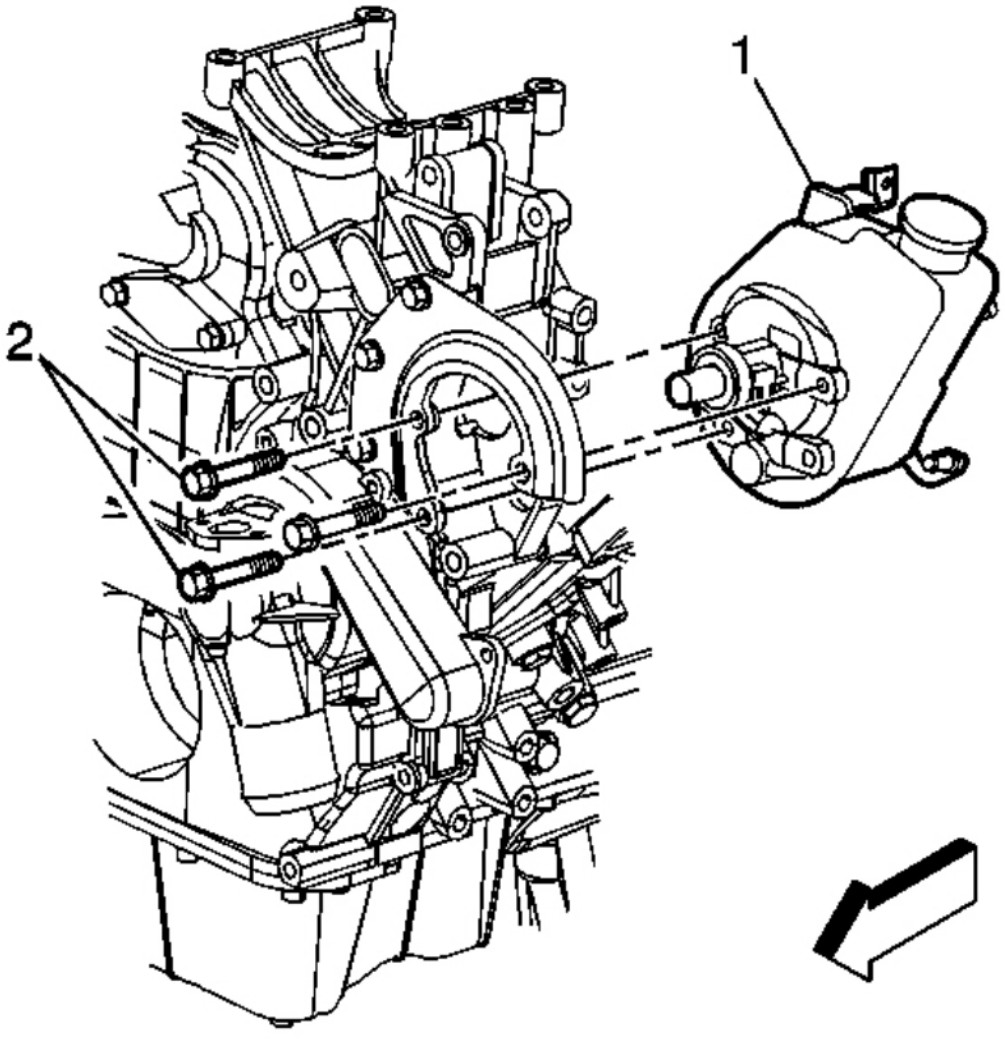


Fig. 26: Bolts At Front Of Power Steering Pump (8.1L)
Courtesy of GENERAL MOTORS CORP.

4. Remove the bolts (2) from the front of the pump.
5. Remove the bolts retaining the power steering mounting bracket.

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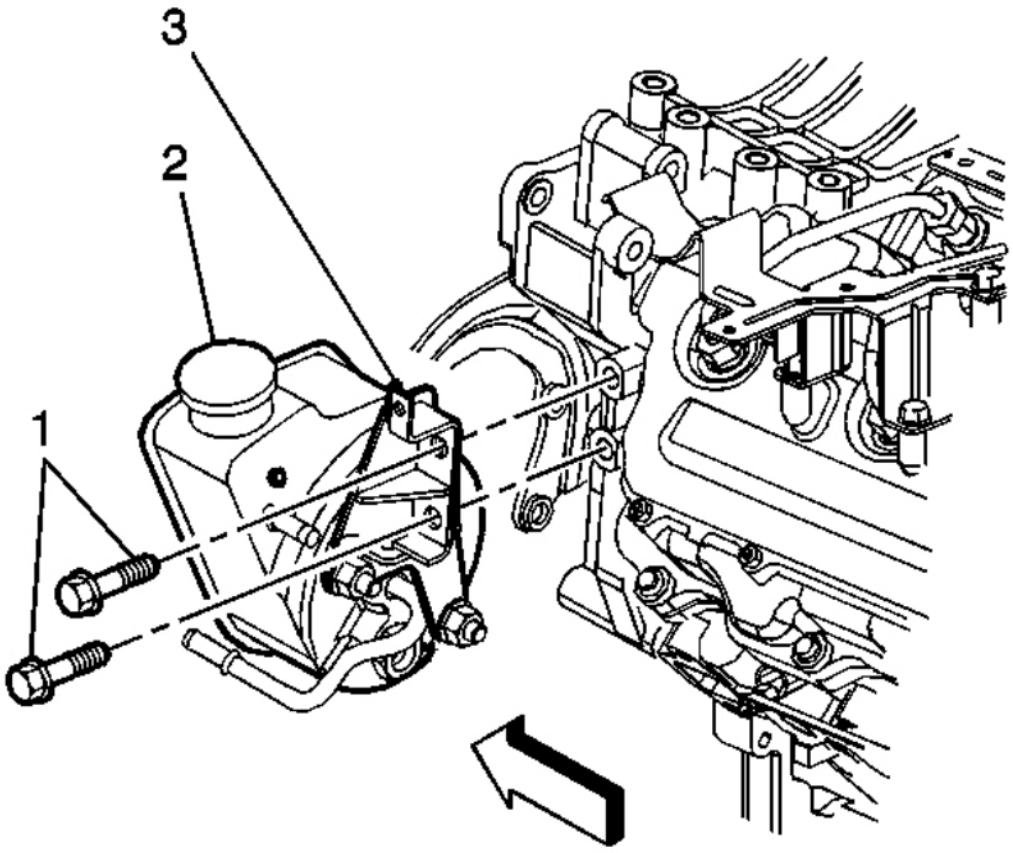


Fig. 27: Bolts At Rear Of Power Steering Pump (8.1L)
Courtesy of GENERAL MOTORS CORP.

6. Remove the bolts (1) from the rear of the pump.

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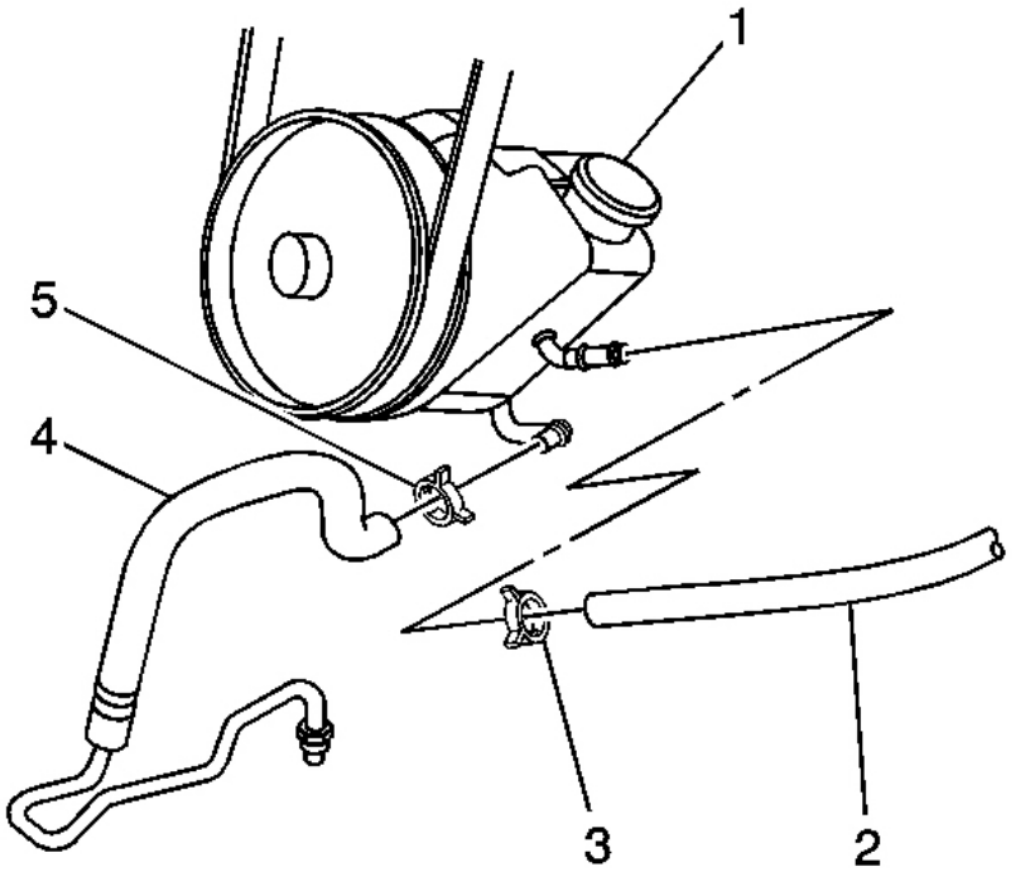


Fig. 28: View Of Power Steering Return Hoses, Clamps & Power Steering Pump
Courtesy of GENERAL MOTORS CORP.

7. Remove the power steering return hoses (2,4) from the power steering pump.

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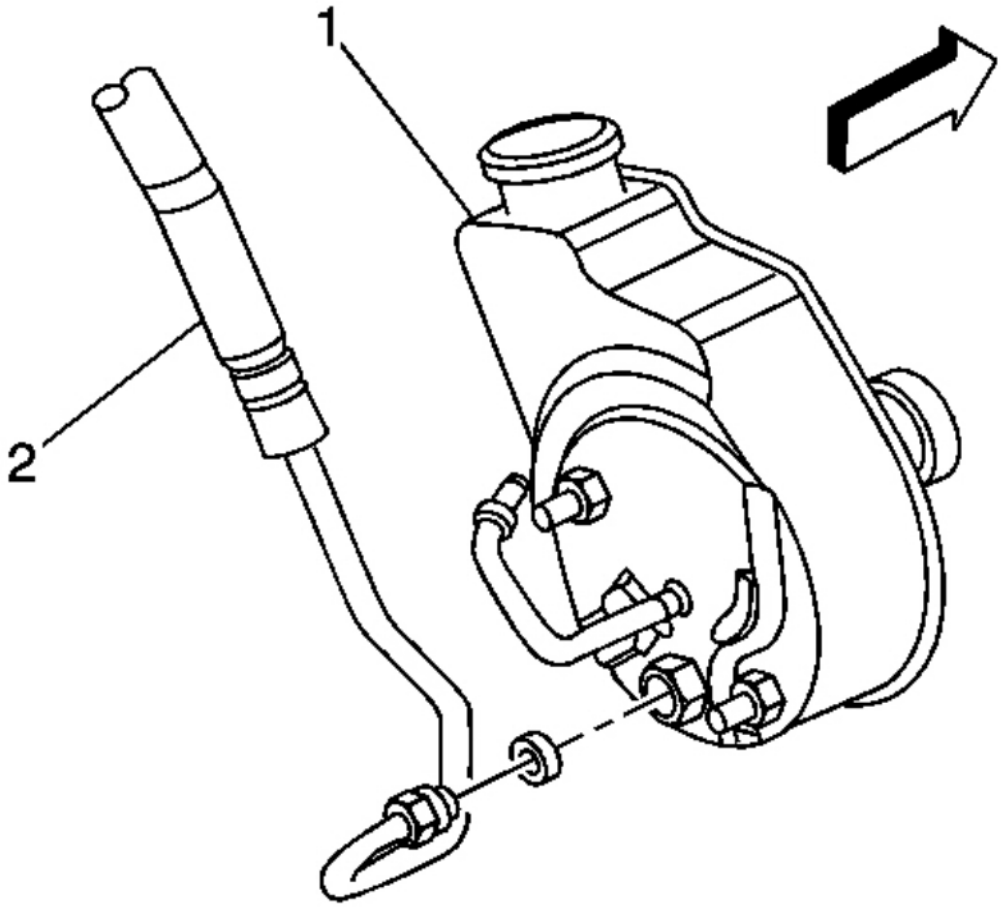


Fig. 29: View Of Power Steering Pressure Hose & Power Steering Pump
Courtesy of GENERAL MOTORS CORP.

8. Remove the power steering pressure hoses (2) from the power steering pump.
9. Remove the pump from the vehicle.
10. Remove the rear bracket from the power steering pump.

Installation Procedure

NOTE: Refer to Fastener Notice in Cautions and Notices.

1. Install the rear bracket to the power steering pump.

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Tighten: Tighten the rear bracket retaining nuts to 50 N.m (37 lb ft).

2. Install the power steering pump to the vehicle.

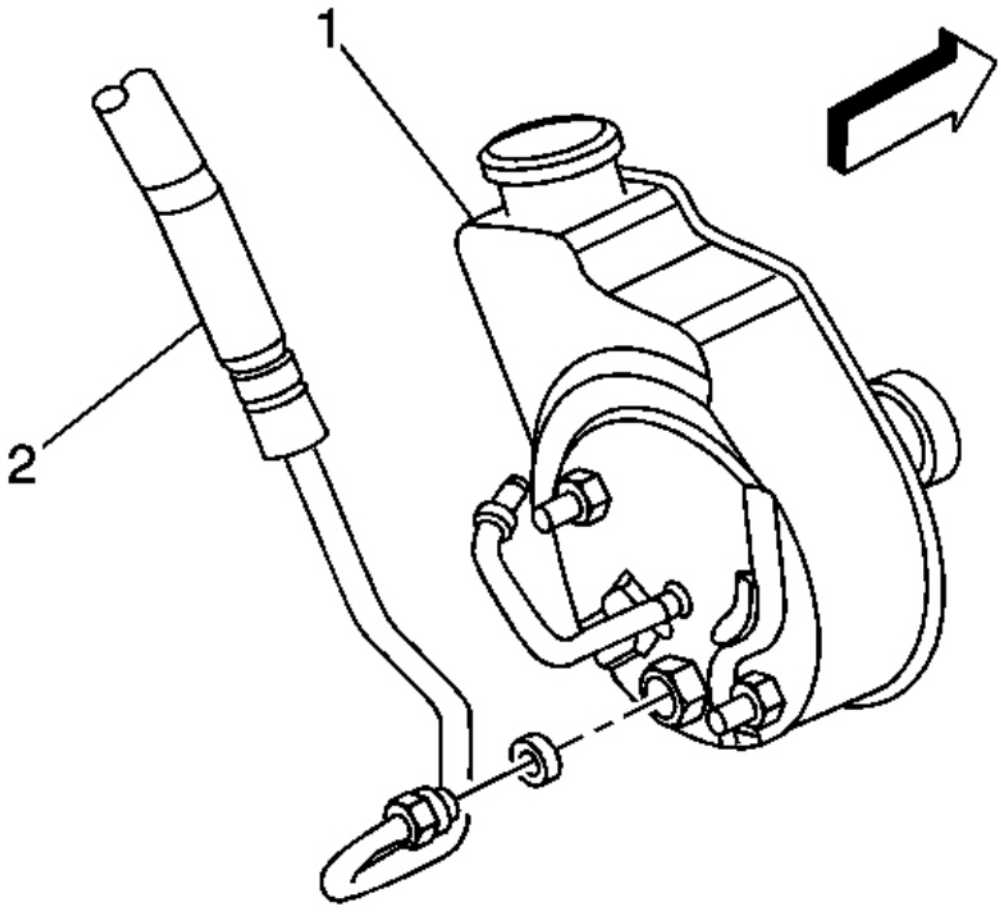


Fig. 30: View Of Power Steering Pressure Hose & Power Steering Pump
Courtesy of GENERAL MOTORS CORP.

3. Install the pressure hose (2) to the power steering pump.

Tighten: Tighten the hose fitting to 28 N.m (20 lb ft).

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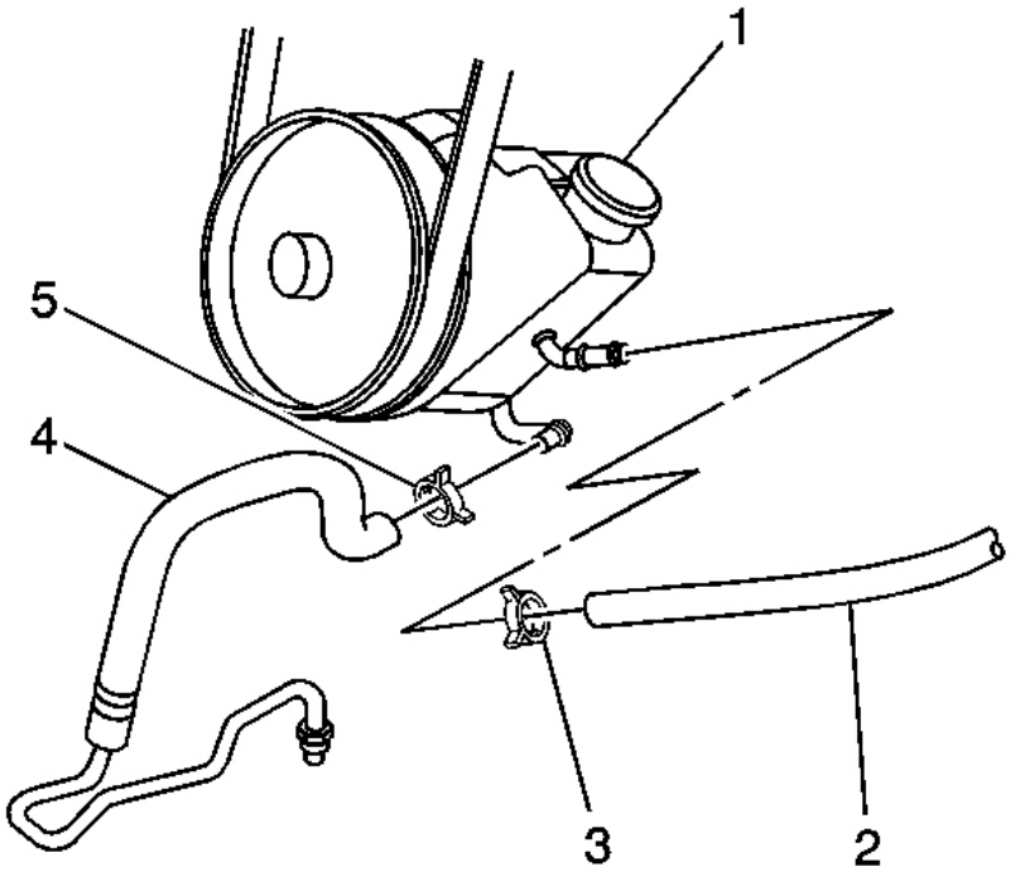


Fig. 31: View Of Power Steering Return Hoses, Clamps & Power Steering Pump
Courtesy of GENERAL MOTORS CORP.

4. Install the power steering return hoses (2,4) and retaining clamps to the power steering pump.

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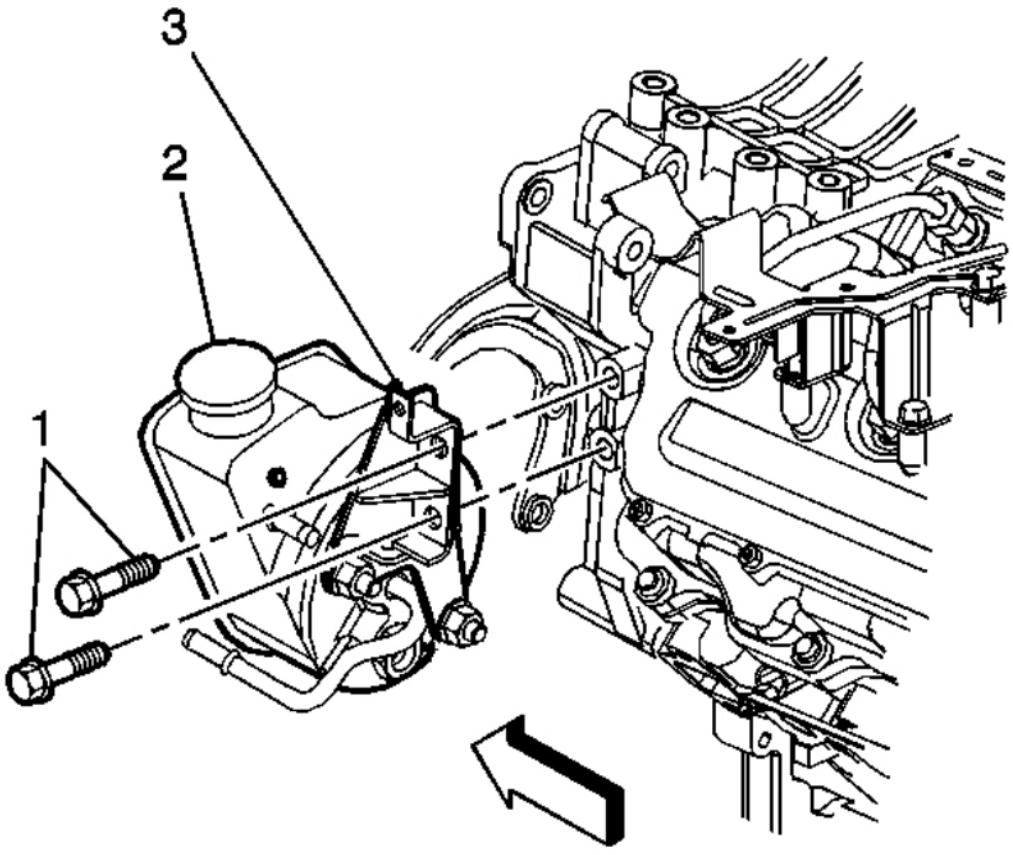


Fig. 32: Bolts At Rear Of Power Steering Pump (8.1L)
Courtesy of GENERAL MOTORS CORP.

5. Install the bolts (1) to the rear of the power steering pump.

   Tighten: Tighten the rear bolts to 50 N.m (37 lb ft).

6. Install the power steering pump mounting bracket bolts.

   Tighten: Tighten the mounting bracket bolts to 50 N.m (37 lb ft).

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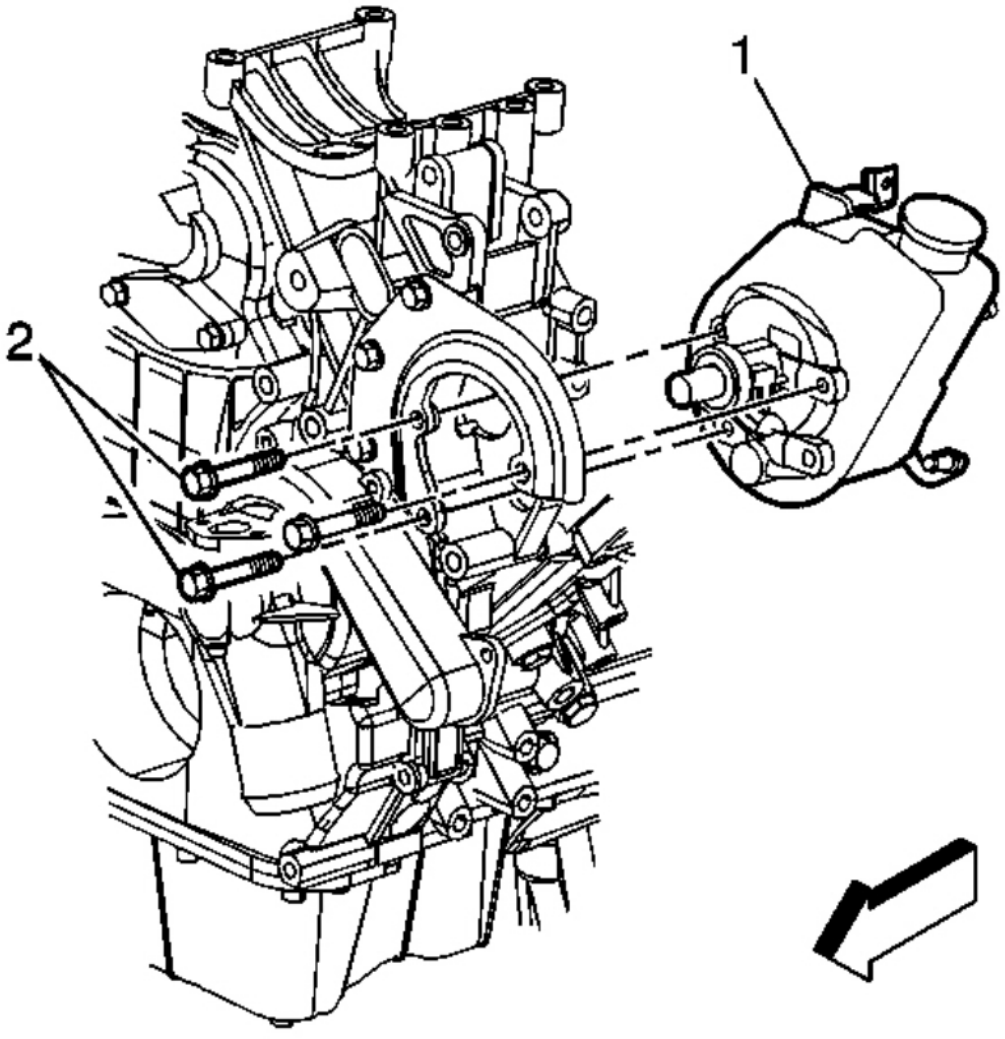


Fig. 33: Bolts At Front Of Power Steering Pump (8.1L)
Courtesy of GENERAL MOTORS CORP.

7. Install the bolts (2) to the front of the pump.

   Tighten: Tighten the power steering pump retaining bolts to 50 N.m (37 lb ft).

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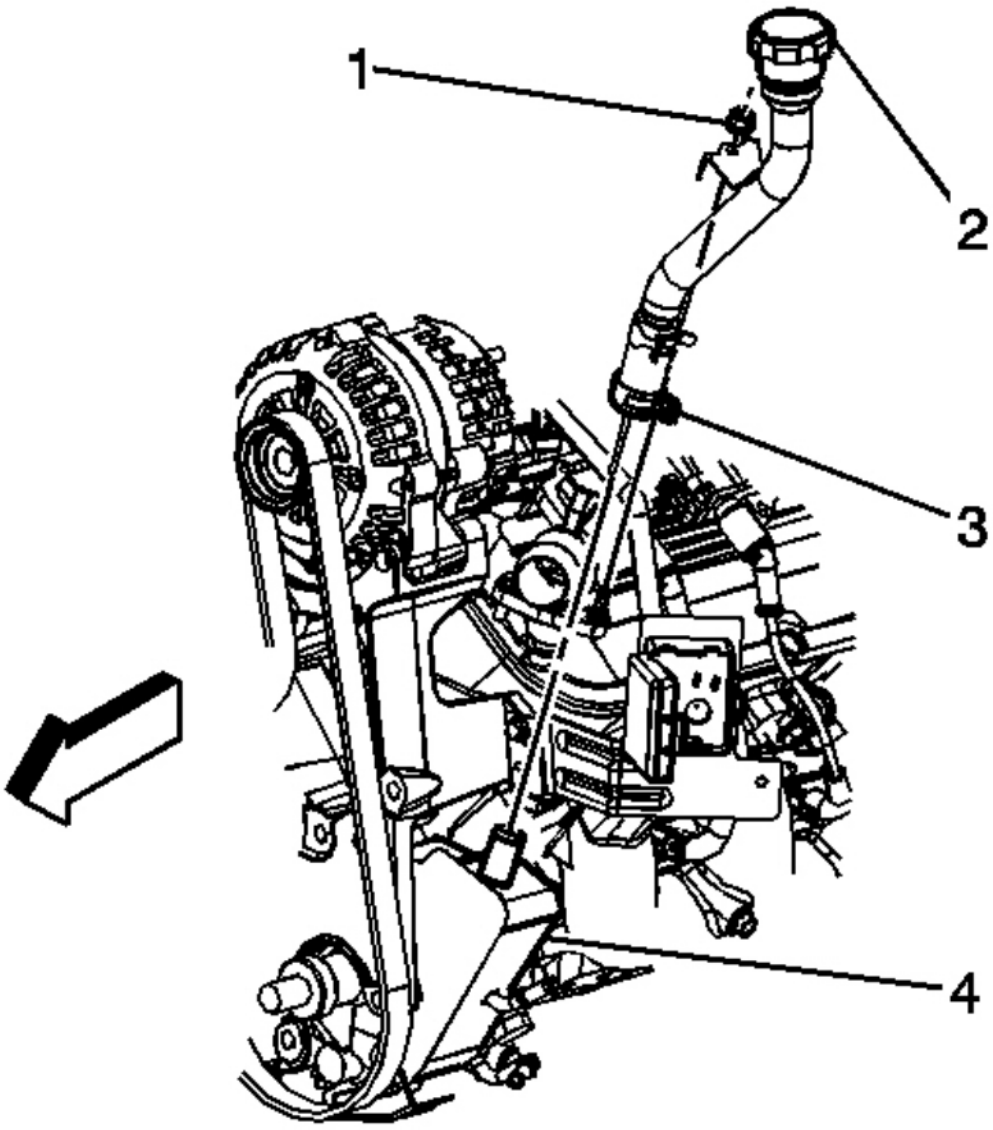


Fig. 34: View Of Filler Neck, Nut & Clamp (8.1L)
Courtesy of GENERAL MOTORS CORP.

8. Install the filler neck to the power steering pump.
9. Install the nut (1) and clamp (3) retaining the filler neck to the power steering pump.

Tighten: Tighten the filler neck retaining nut to 25 N.m (18 lb ft).

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10. Fill and bleed the power steering system. Refer to **Bleeding the Power Steering System**.

POWER STEERING RESERVOIR REPLACEMENT - OFF VEHICLE

Disassembly Procedure

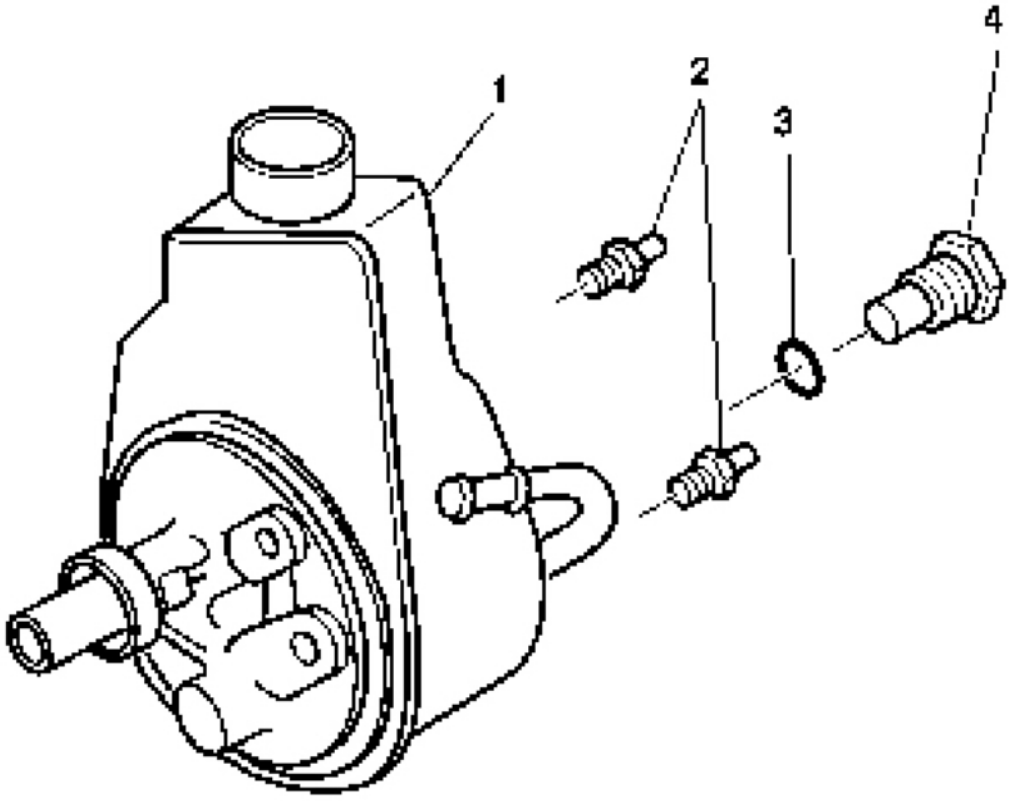


Fig. 35: View Of Pump Housing, Mounting Studs, O-Ring Seal & Connector/Fitting Assembly
Courtesy of GENERAL MOTORS CORP.

1. Drain the power steering fluid from the power steering pump.
2. Remove the pump mounting studs (2).
3. Remove the connector and fitting assembly (4).
4. Remove the O-ring seal (3).

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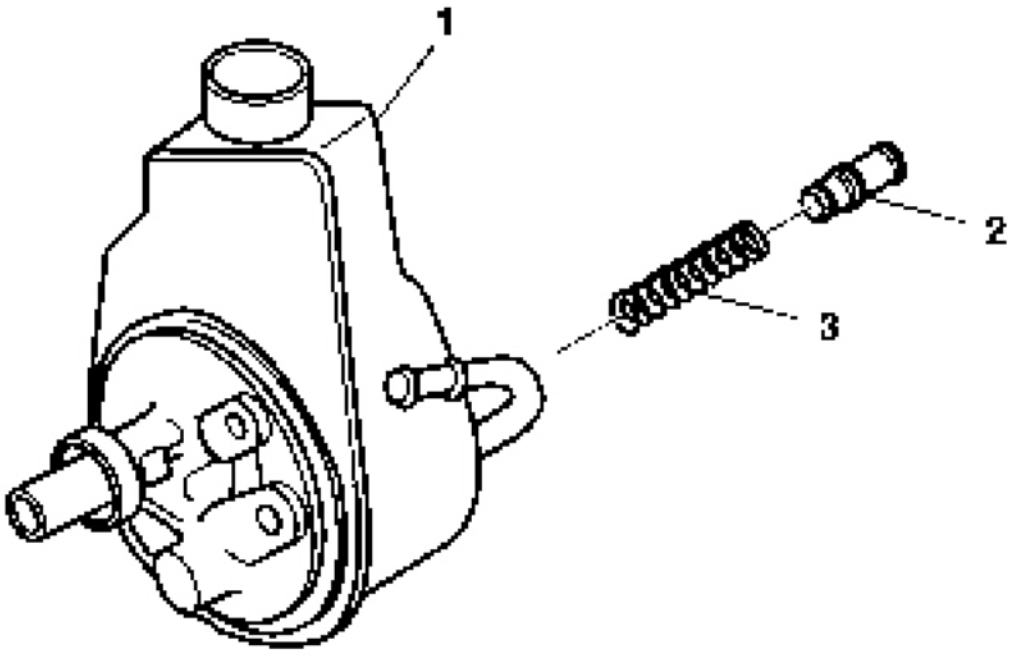


Fig. 36: View Of Pump Housing Assembly, Control Valve Assembly & Flow Control Spring
Courtesy of GENERAL MOTORS CORP.

5. If replacement is required, remove the control valve assembly (2) and the flow control spring (3) from the pump housing assembly (1).

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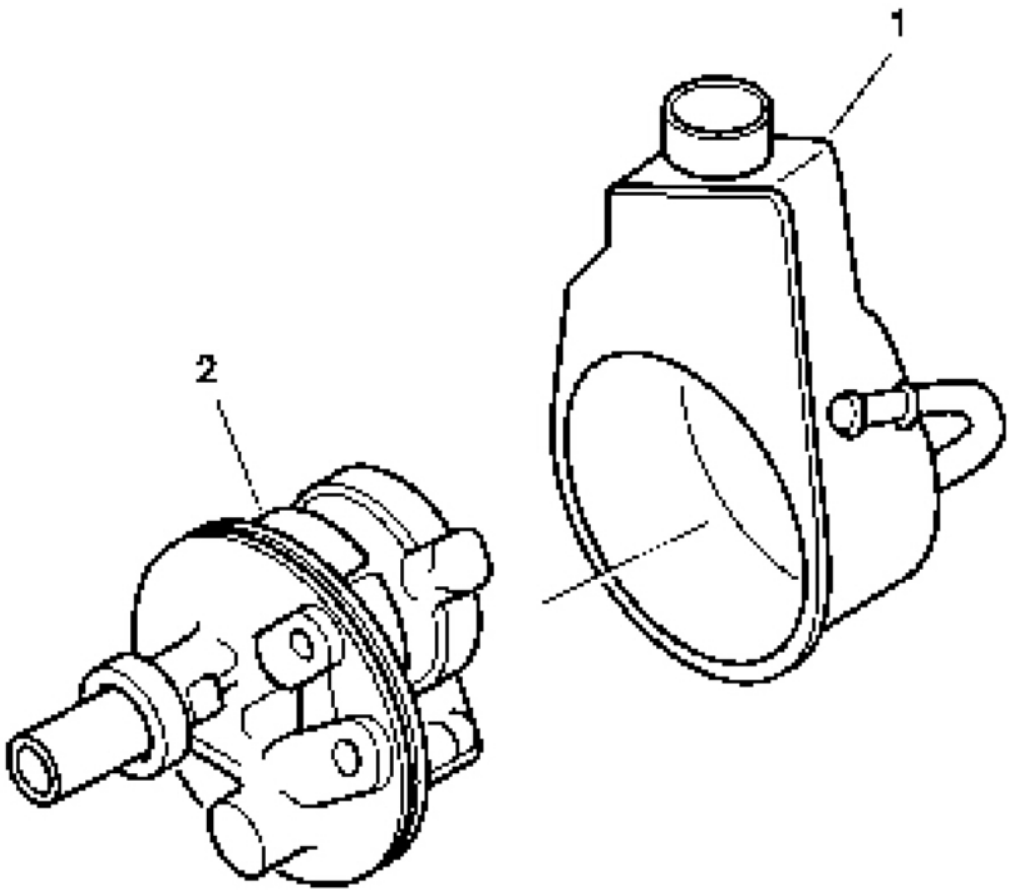


Fig. 37: View Of Reservoir Assembly & Pump Housing Assembly
Courtesy of GENERAL MOTORS CORP.

6. Remove the reservoir assembly (1) from the pump housing assembly (2).

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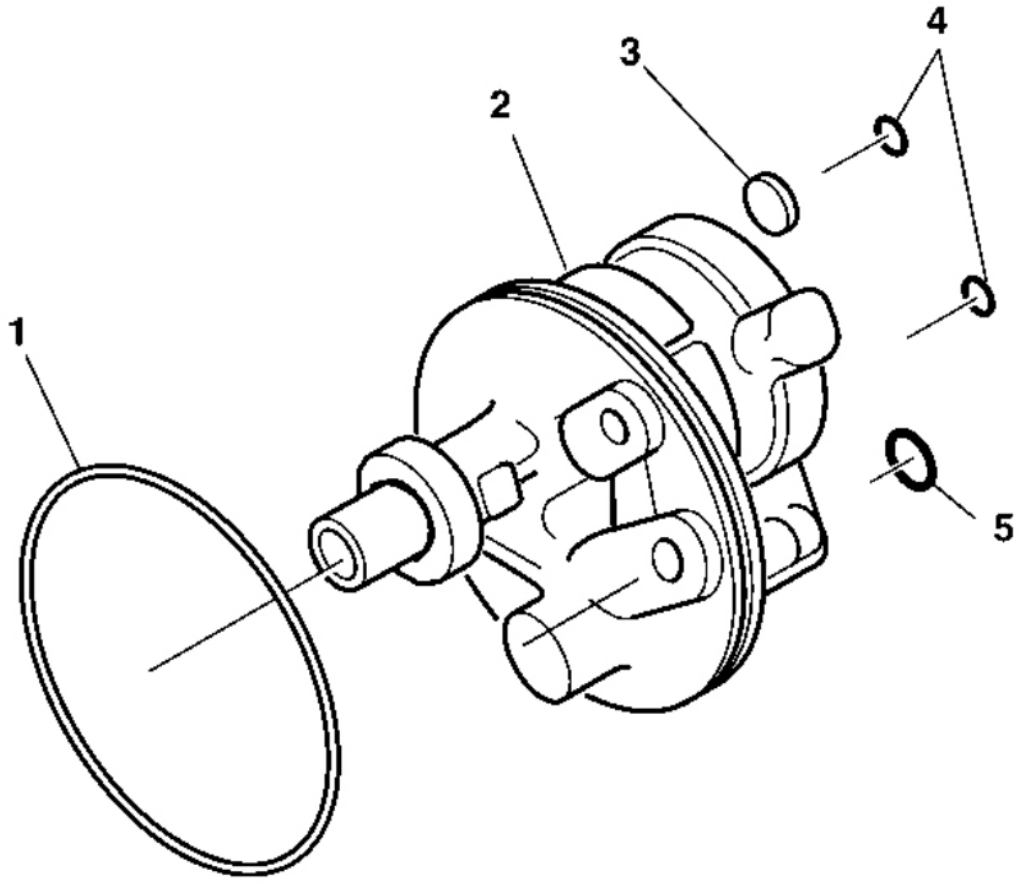


Fig. 38: Reservoir O-Ring Seals, Magnet & Pump Housing
Courtesy of GENERAL MOTORS CORP.

7. Remove the O-ring seals (1) (4) (5).
8. Remove the magnet (3).
9. Clean the magnet (3).
10. Inspect the welch plug in the power steering pump housing (2). Do not remove. If the welch plug is deformed or dislodged, replace the power steering pump housing (2).

Assembly Procedure

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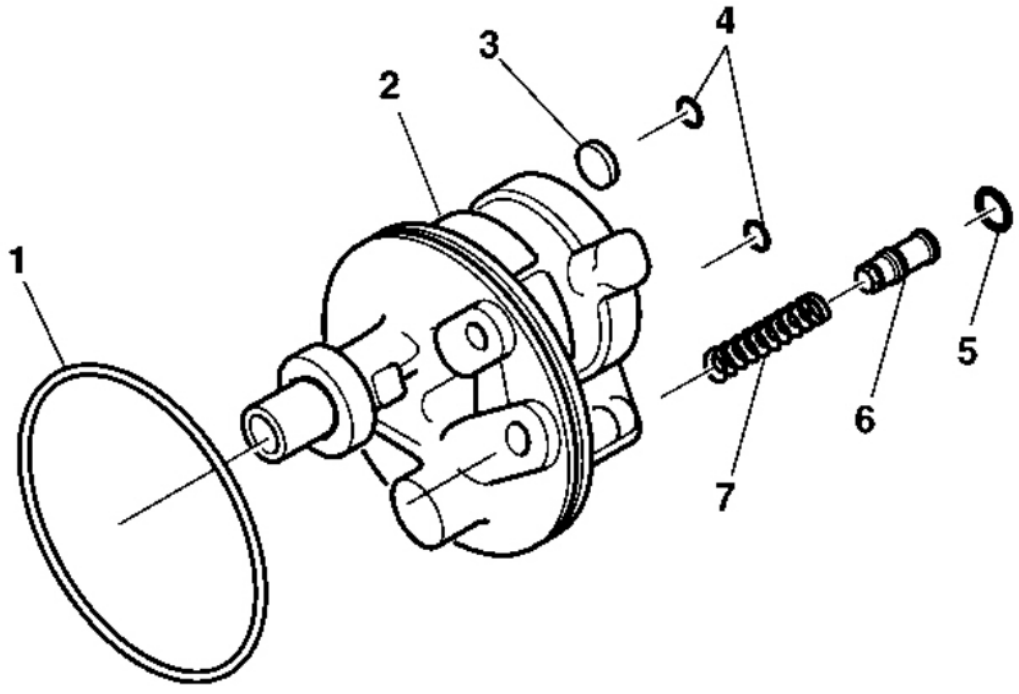


Fig. 39: Disassembled View Of Pump Housing Assembly Components
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Use new O-ring seals when assembling the power steering pump assembly.

1. Lubricate the O-ring seals (1) (4) (5) with power steering fluid.
2. Install the flow control spring (7) to the pump housing assembly (2).
3. Install the control valve assembly (6) to the flow control spring (7).
4. Install the O-ring seals (1) (4) (5) to the pump housing assembly.
5. Install the magnet (3) to the pump housing assembly (2).

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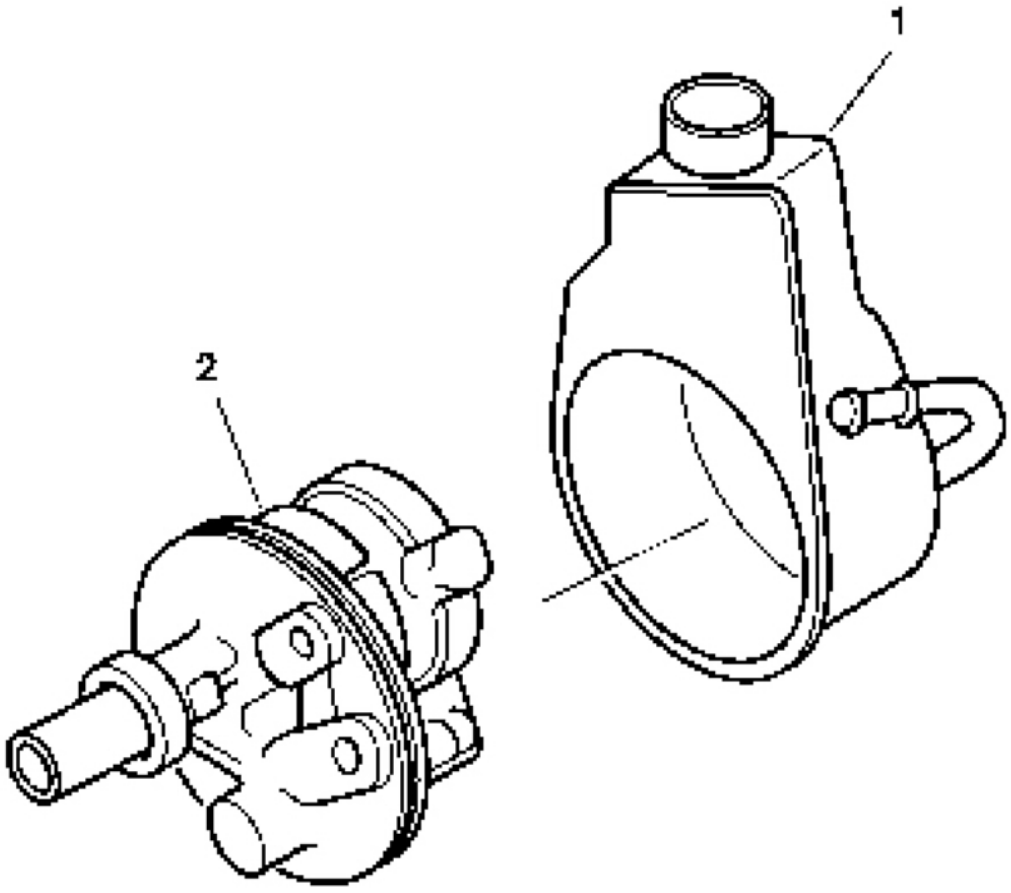


Fig. 40: View Of Reservoir Assembly & Pump Housing Assembly
Courtesy of GENERAL MOTORS CORP.

6. Connect the reservoir assembly (1) to the pump housing assembly (2).
7. Install the O-ring seal.

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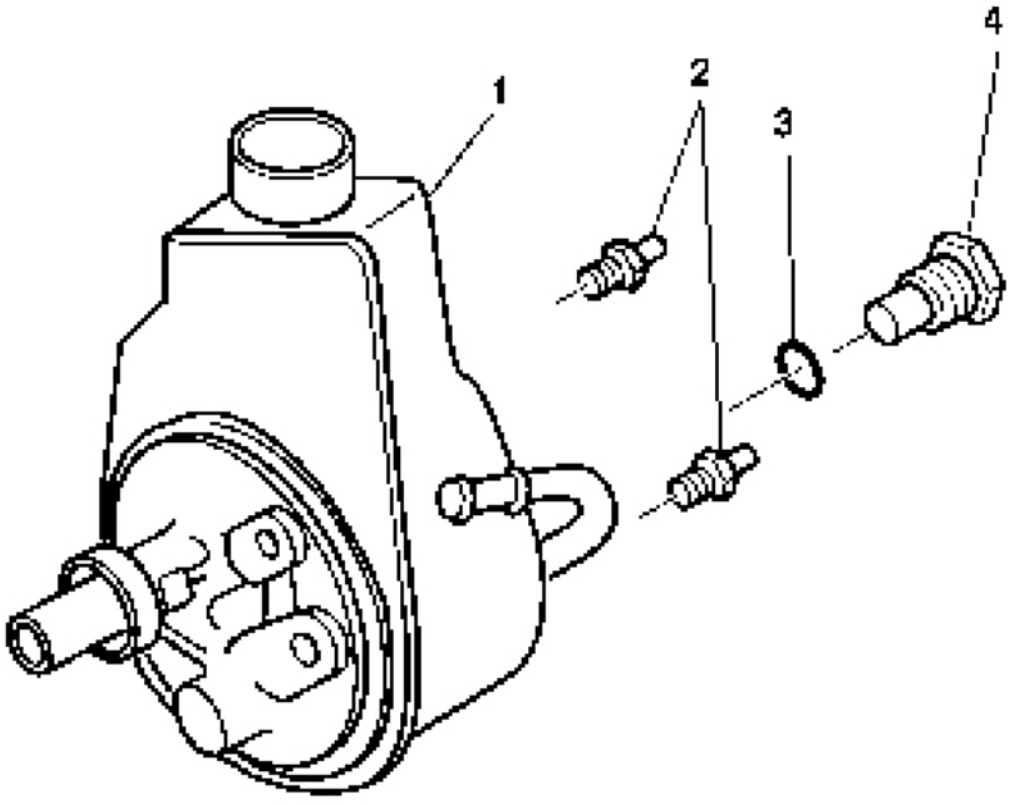


Fig. 41: View Of Pump Housing, Mounting Studs, O-Ring Seal & Connector/Fitting Assembly
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

8. Install the connector and fitting assembly (4) to the pump housing (1).
9. Install the pump mounting studs (2) to the pump housing (1).

   Tighten: Tighten the pump mounting studs to 58 N.m (44 lb ft).

10. Tighten the connector and fitting assembly.

    Tighten: Tighten the connector and fitting assembly to 75 N.m (55 lb ft).

POWER STEERING PUMP FLOW CONTROL VALVE REPLACEMENT - OFF VEHICLE (REGULAR)

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Disassembly Procedure

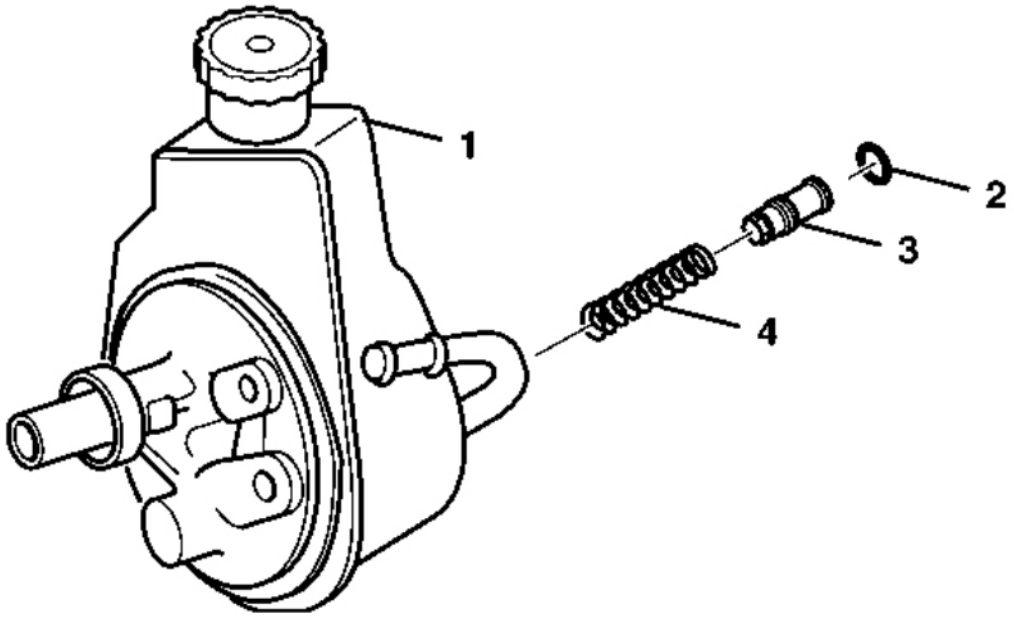


Fig. 42: View Of Reservoir, Control Valve Assembly, Flow Control Spring & Rectangular Section Seal
Courtesy of GENERAL MOTORS CORP.

1. Drain the oil from the reservoir (1).
2. Remove the control valve assembly (3) from the pump housing (1). Make sure the flow control spring (4) does not fall out of the pump housing (1).
3. Remove the rectangular section seal (2) from the control valve assembly (3).

Assembly Procedure

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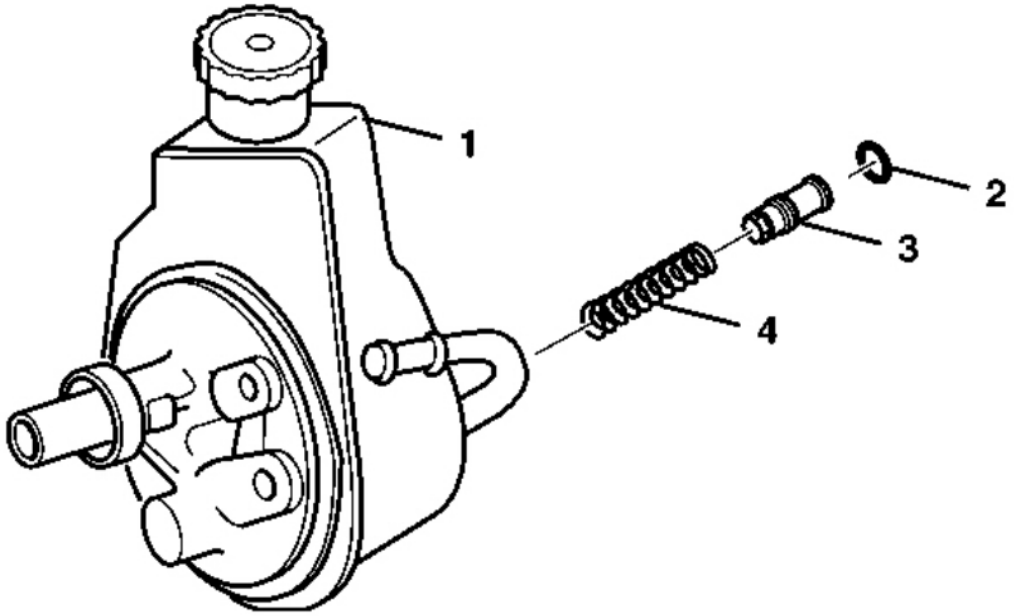


Fig. 43: View Of Reservoir, Control Valve Assembly, Flow Control Spring & Rectangular Section Seal
Courtesy of GENERAL MOTORS CORP.

1. Install the flow control spring (4) if removed from the pump housing (1).
2. Lubricate the new rectangular section seal (2) with power steering fluid.
3. Install the rectangular section seal (2) onto the control valve assembly (3).
4. Install the control valve assembly (3).

POWER STEERING COOLER PIPE/HOSE REPLACEMENT (WITH HYDROBOOST)

Removal Procedure

1. Remove the front grille. Refer to **Grille Replacement (Cadillac)** or **Grille Replacement (Avalanche)** or **Grille Replacement (Chevrolet)** or **Grille Replacement (GMC)** in Exterior Trim.

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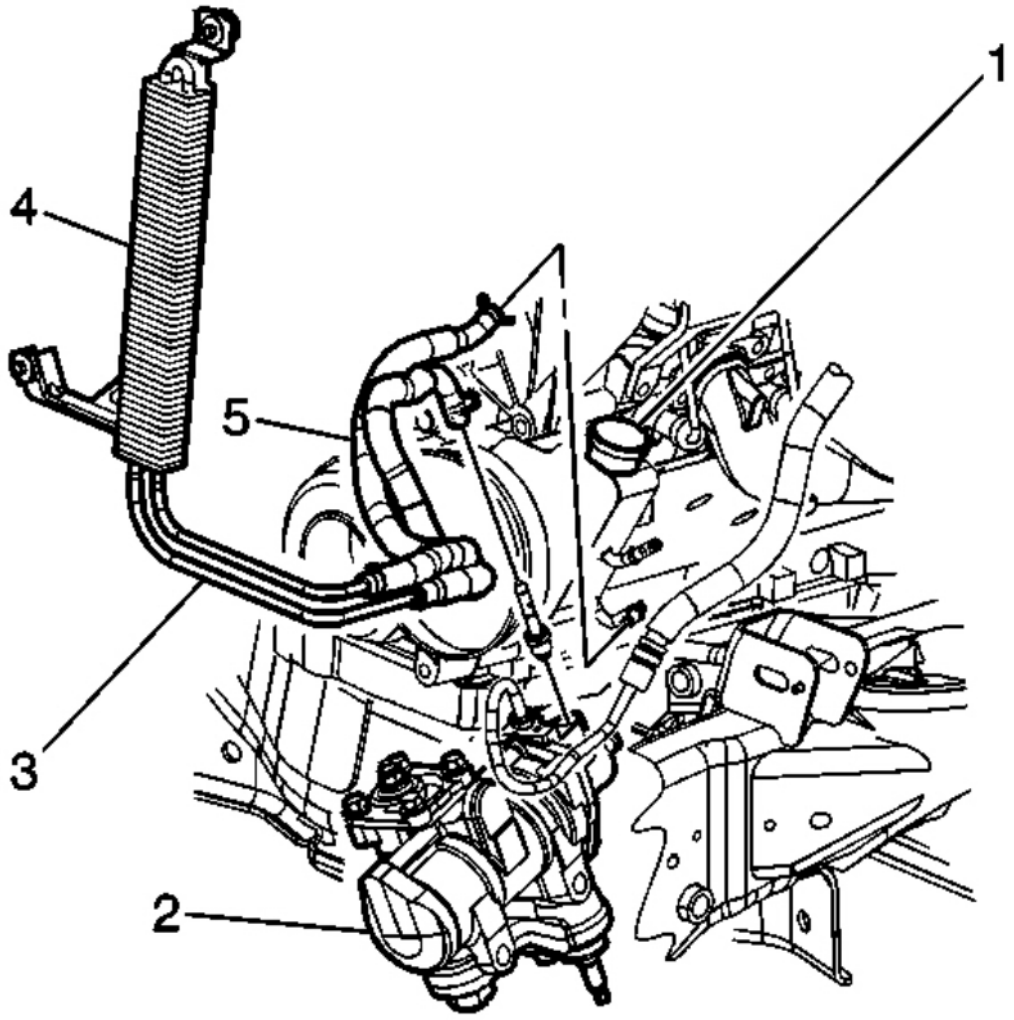


Fig. 44: View Of Power Steering Gear, Pump, Cooler Inlet Hose & Cooler Outlet Hose
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Power Steering Hose Disconnected Notice in Cautions and Notices.

2. Place a drain pan under the vehicle.
3. Siphon the fluid from the reservoir to prevent excess spillage.
4. Remove the clamp retaining the power steering cooler inlet hose (3) to the power steering gear (2).
5. Remove the clamp retaining power steering cooler outlet hose (5) to the power steering pump (1).

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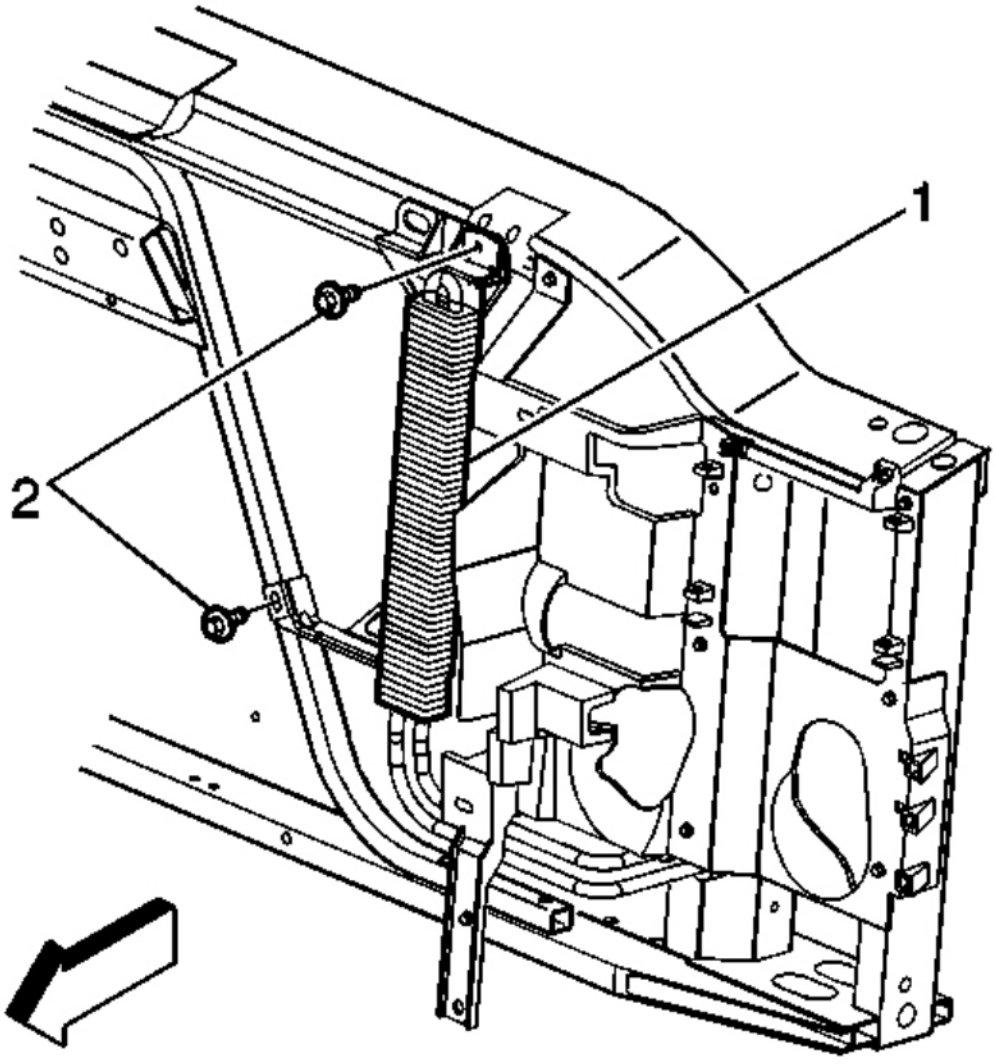


Fig. 45: Power Steering Cooler To Core Support
Courtesy of GENERAL MOTORS CORP.

6. Remove the bolts (2) retaining the power steering cooler from the radiator support.
7. Remove the power steering cooler from the vehicle.

Installation Procedure

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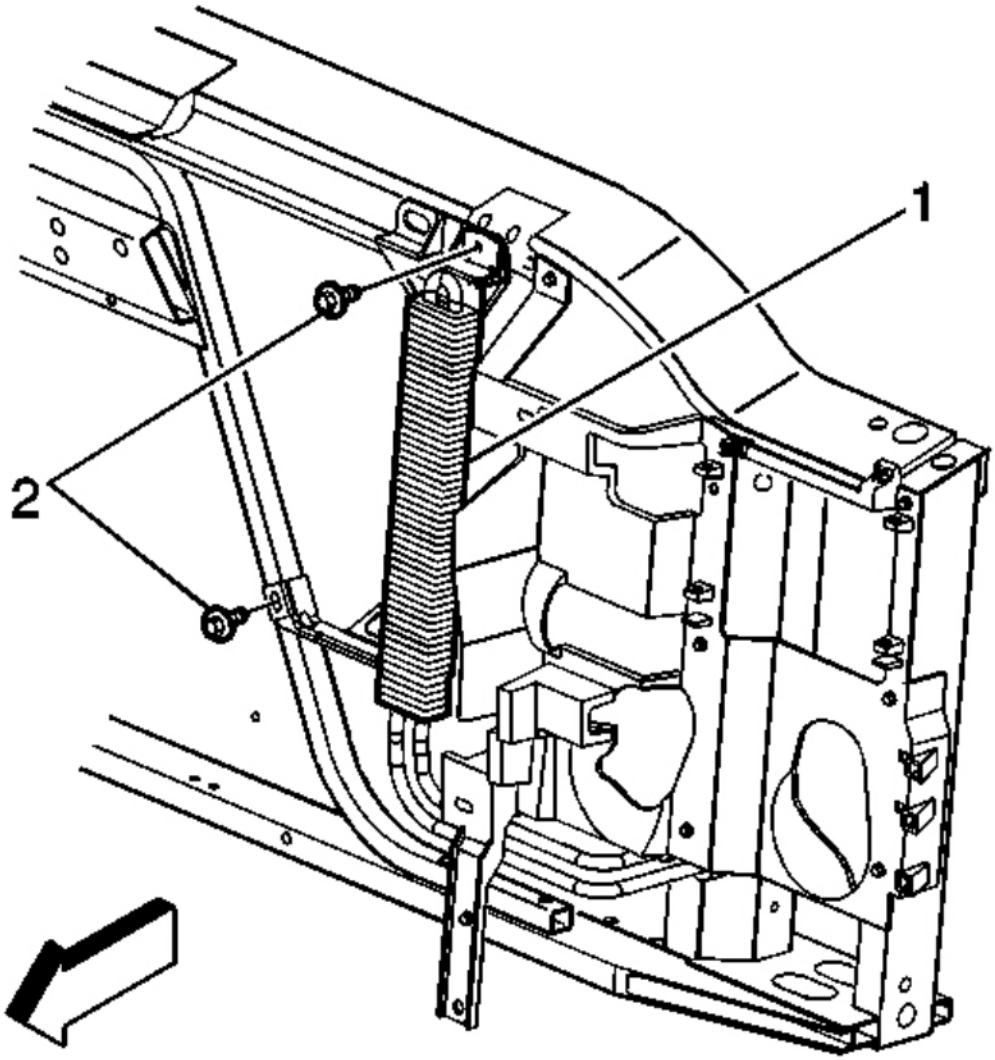


Fig. 46: Power Steering Cooler To Core Support
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

1. Install the power steering cooler (1) to the radiator support.

   Tighten: Tighten the bolts retaining the power steering cooler to 5 N.m (44 lb in).

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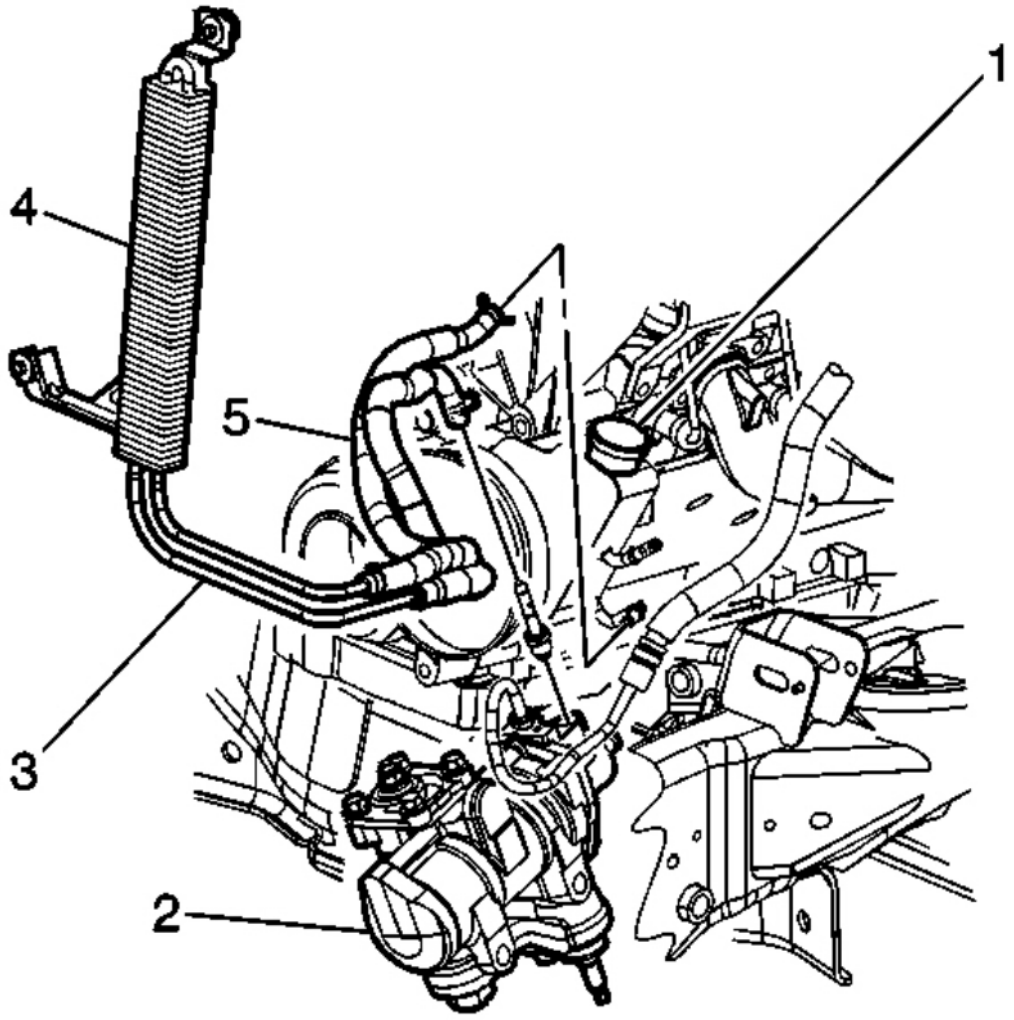


Fig. 47: View Of Power Steering Gear, Pump, Cooler Inlet Hose & Cooler Outlet Hose
Courtesy of GENERAL MOTORS CORP.

2. Install the power steering cooler outlet hose (3) to the power steering pump (2).
3. Install the retaining clamp.
4. Install the power steering inlet hose (5) to the power steering gear (1).
5. Install the retaining clamp.
6. Fill and bleed the power steering system. Refer to **Bleeding the Power Steering System**.
7. Inspect all the hose connections for leaks.
8. Install the front grille. Refer to **Grille Replacement (Cadillac)** or **Grille Replacement (Avalanche)** or

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Grille Replacement (Chevrolet) or **Grille Replacement (GMC)** in Exterior Trim.

POWER STEERING GEAR INLET PIPE/HOSE REPLACEMENT (WITH HYDROBOOST)

Removal Procedure

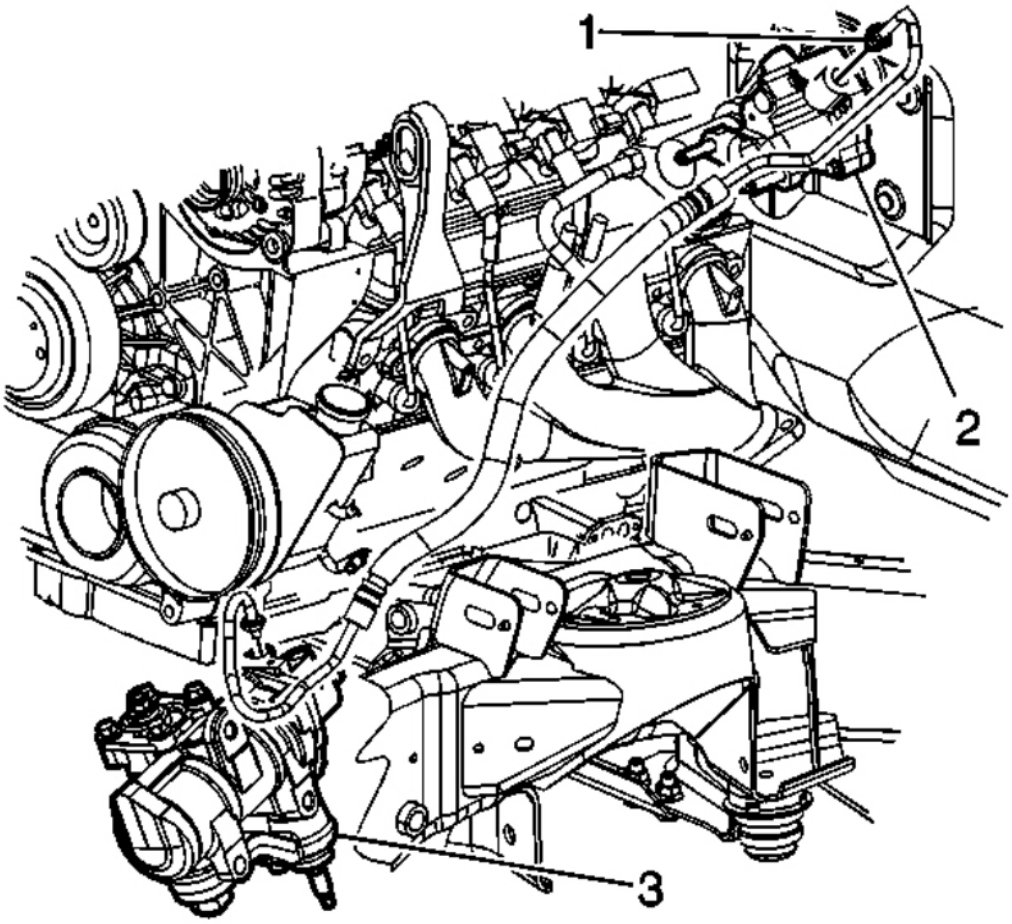


Fig. 48: View Of Power Steering Gear Inlet Hose (With Hydroboost)
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Power Steering Hose Disconnected Notice in Cautions and Notices.

1. Install a drain pan under the vehicle.
2. Remove the power steering gear inlet hose (1) from the brake booster.

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3. Remove the power steering gear inlet hose from the power steering gear.
4. Remove the power steering gear inlet hose from the vehicle.

Installation Procedure

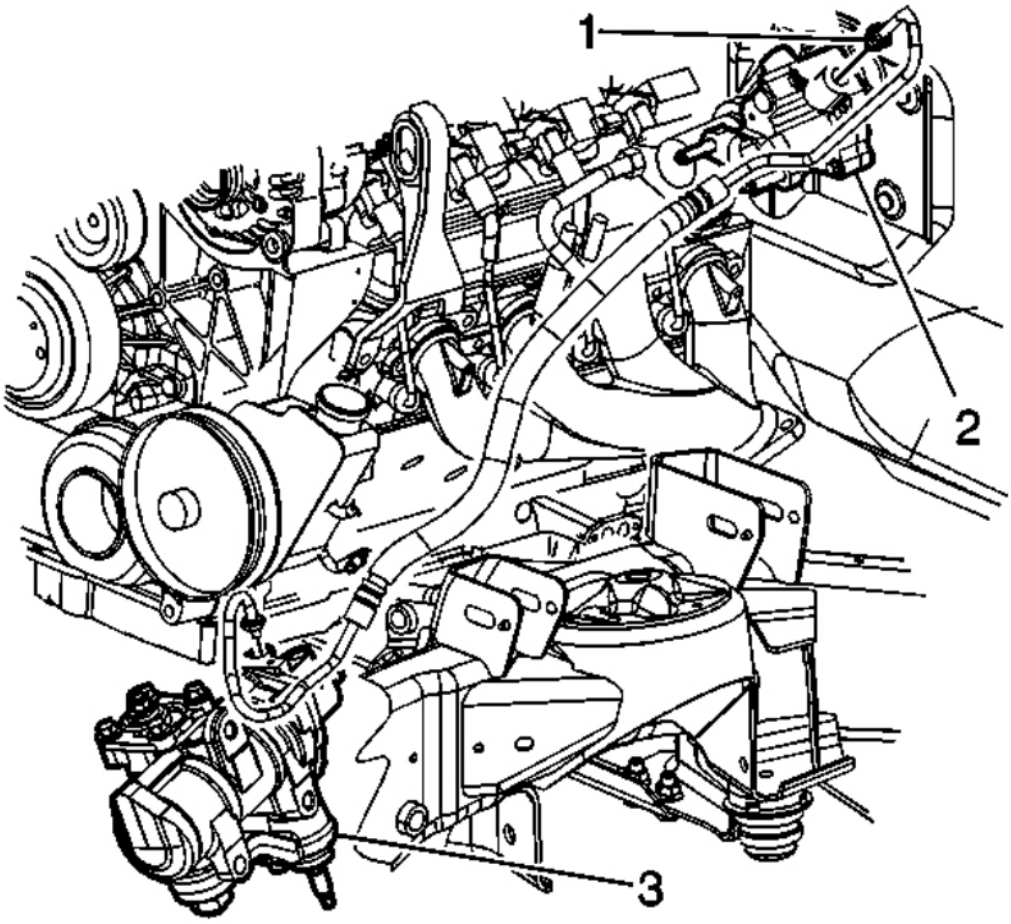


Fig. 49: View Of Power Steering Gear Inlet Hose (With Hydroboost)
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Installing Hoses Without Twists or Bends Notice in Cautions and Notices.

1. Route the hose in the same position the hose occupied prior to removal.
2. Install the power steering gear inlet hose (1) to the brake booster (2). Hand tighten only.

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NOTE: **Refer to Fastener Notice in Cautions and Notices.**

3. Install the power steering gear inlet hose to the power steering gear.

   Tighten: Tighten both power steering gear inlet hose fittings to 28 N.m (20 lb ft).

4. Remove the drain pan from under the vehicle.
5. Bleed the power steering system. Refer to **Bleeding the Power Steering System**.

POWER STEERING GEAR INLET PIPE/HOSE REPLACEMENT (WITHOUT HYDROBOOST)

Removal Procedure

1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the engine protection shield. Refer to **Engine Protection Shield Replacement** in Frame and Underbody.

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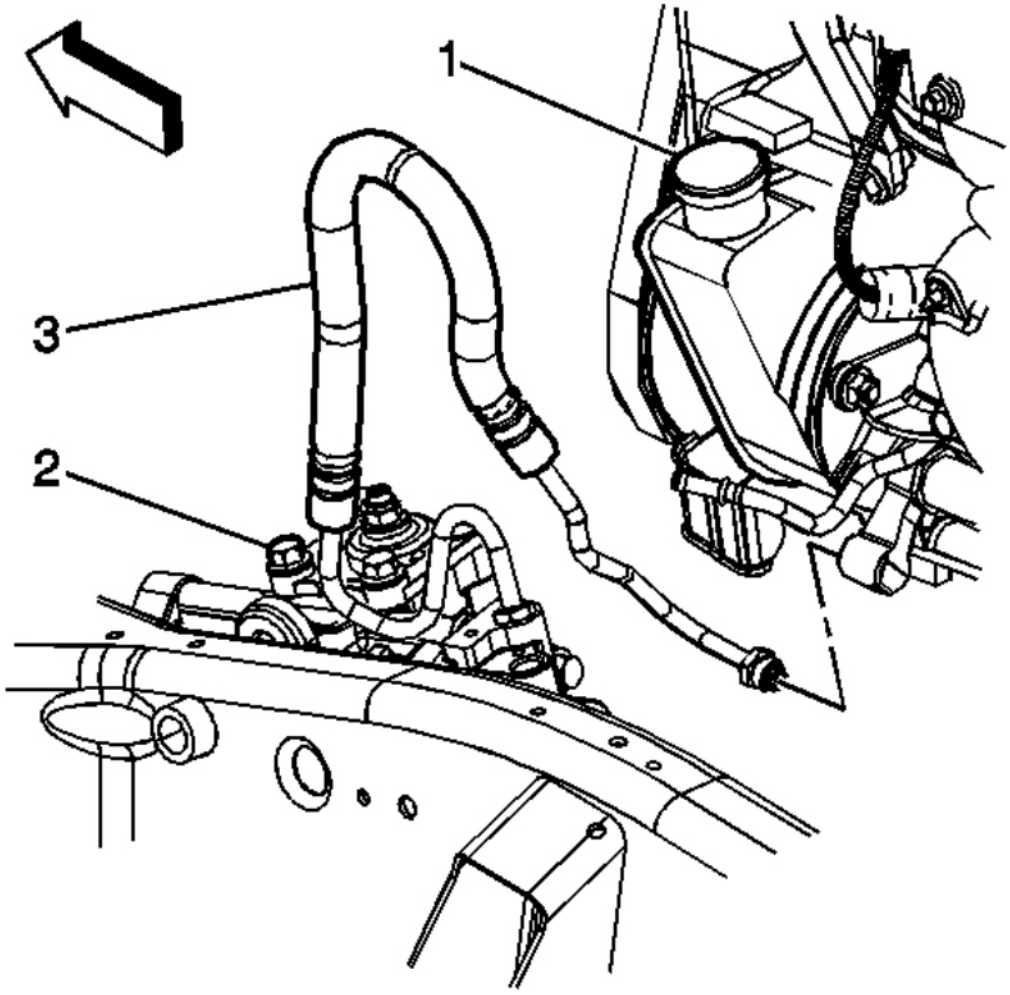


Fig. 50: View Of Power Steering Gear Inlet Hose (Without Hydroboost)
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Power Steering Hose Disconnected Notice in Cautions and Notices.

3. Install a drain pan under the vehicle.
4. Remove the power steering gear inlet hose (3) from the power steering pump (1).
5. Remove the power steering gear inlet hose from the power steering gear.
6. Remove the power steering gear inlet hose from the vehicle.

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Installation Procedure

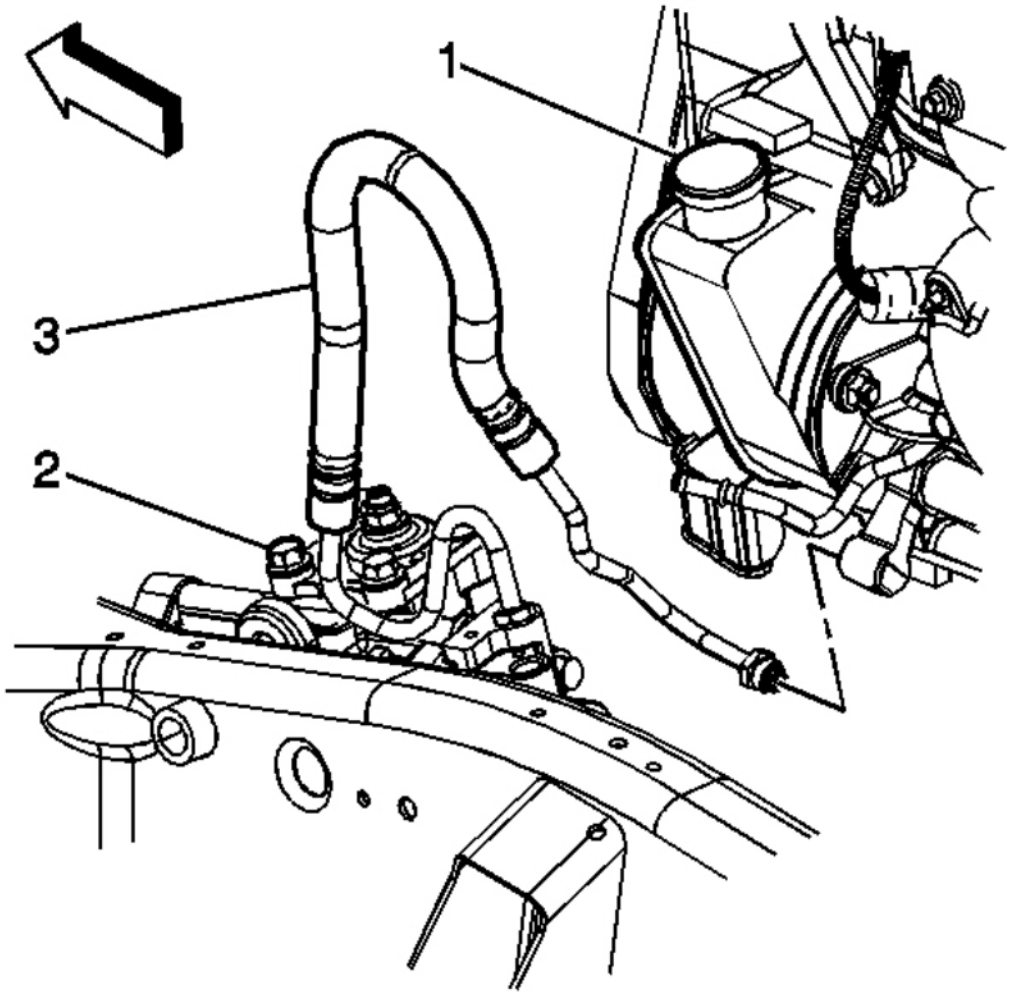


Fig. 51: View Of Power Steering Gear Inlet Hose (Without Hydroboost)
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Installing Hoses Without Twists or Bends Notice in Cautions and Notices.**

1. Route the hose in the same position the hose occupied prior to removal.
2. Install the power steering gear inlet hose (3) to the power steering pump (1). Hand tighten only.

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NOTE: **Refer to Fastener Notice in Cautions and Notices.**

3. Install the power steering gear inlet hose to the power steering gear.

   Tighten: Tighten both power steering gear inlet hose fittings to 28 N.m (20 lb ft).

4. Remove the drain pan from under the vehicle.
5. Install the engine protection shield. Refer to **Engine Protection Shield Replacement** in Frame and Underbody.
6. Lower the vehicle.
7. Bleed the power steering system. Refer to **Bleeding the Power Steering System**.

POWER STEERING GEAR OUTLET PIPE/HOSE REPLACEMENT (RECIRCULATING BALL)

Removal Procedure

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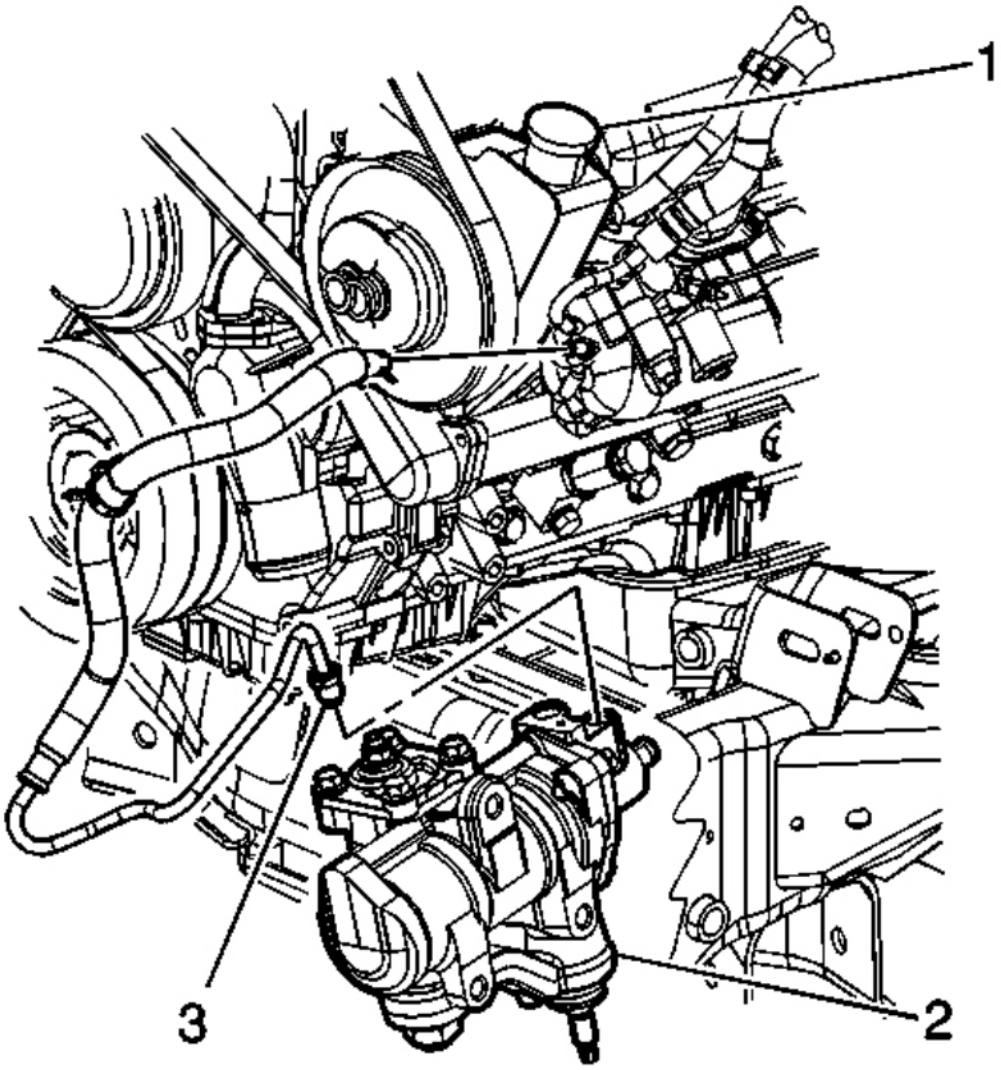


Fig. 52: View Of Power Steering Gear Outlet Hose At Steering Gear & Pump
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Power Steering Hose Disconnected Notice in Cautions and Notices.

1. Install a drain pan under the vehicle.
2. Remove the power steering gear outlet hose (3) from the steering gear (2).
3. Remove the clamp retaining the power steering gear outlet hose (3) to the power steering pump (1).

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Remove the power steering gear outlet hose from the power steering pump.

4. Remove the power steering gear outlet hose from the vehicle.

Installation Procedure

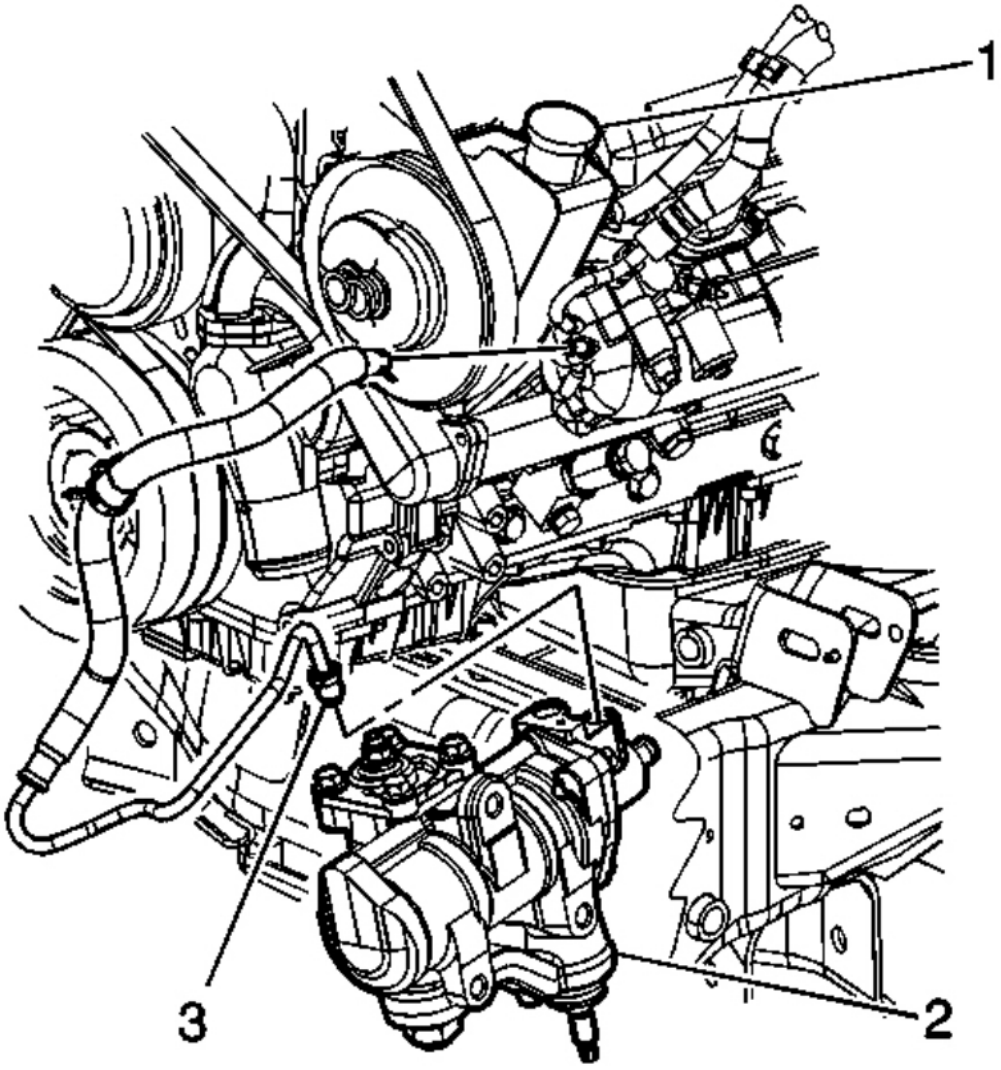


Fig. 53: View Of Power Steering Gear Outlet Hose At Steering Gear & Pump
Courtesy of GENERAL MOTORS CORP.

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NOTE: Refer to Installing Hoses Without Twists or Bends Notice in Cautions and Notices.

1. Route the hose in the same position the hose occupied prior to removal.
2. Install the power steering gear outlet hose (3) to the power steering pump (1).

   Position the clamp at the end of the hose.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the power steering gear outlet hose to the power steering gear.

   Tighten: Tighten the outlet hose fitting to 28 N.m (20 lb ft).

4. Remove the drain pan from under the vehicle.
5. Bleed the power steering system. Refer to **Bleeding the Power Steering System**.

POWER BRAKE BOOSTER INLET HOSE REPLACEMENT

Removal Procedure

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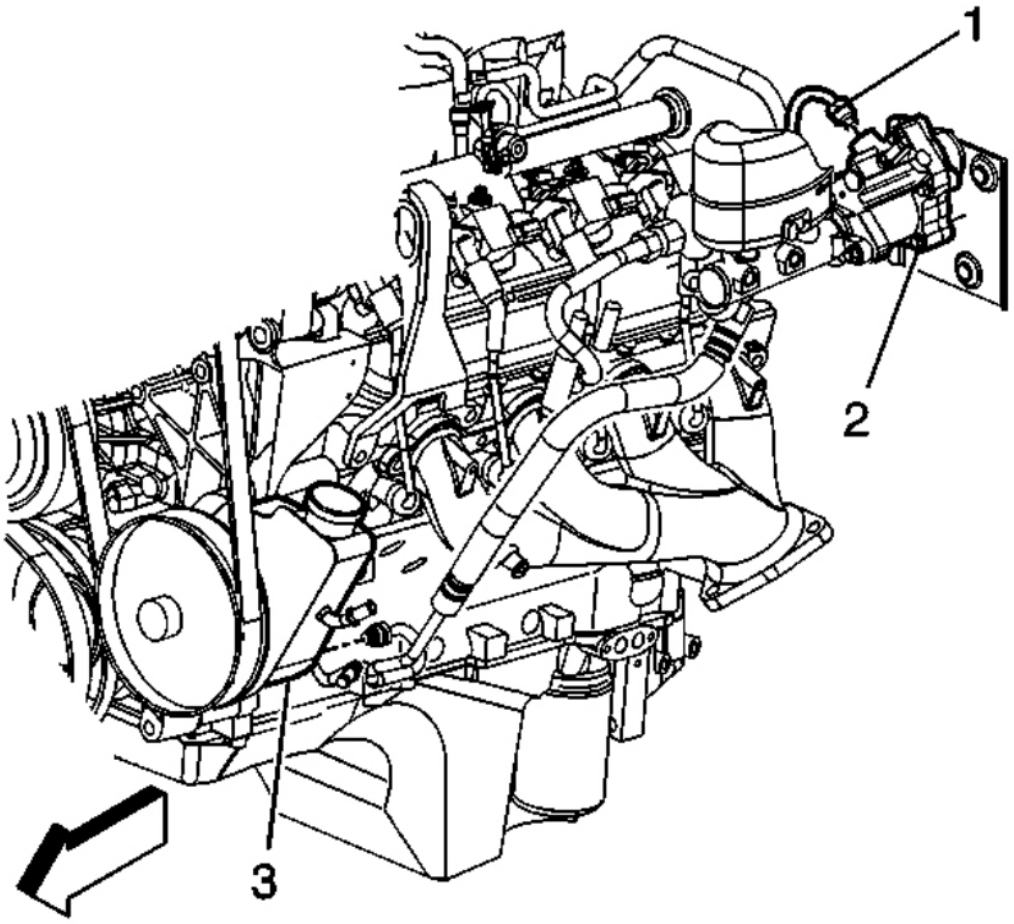


Fig. 54: View Of Power Brake Booster Inlet Hose
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Power Steering Hose Disconnected Notice in Cautions and Notices.

1. Install a drain pan under the vehicle.
2. Remove the brake booster inlet hose (1) from the brake booster (2).
3. Remove the brake booster inlet hose from the power steering pump.
4. Remove the brake booster inlet hose from the vehicle.

Installation Procedure

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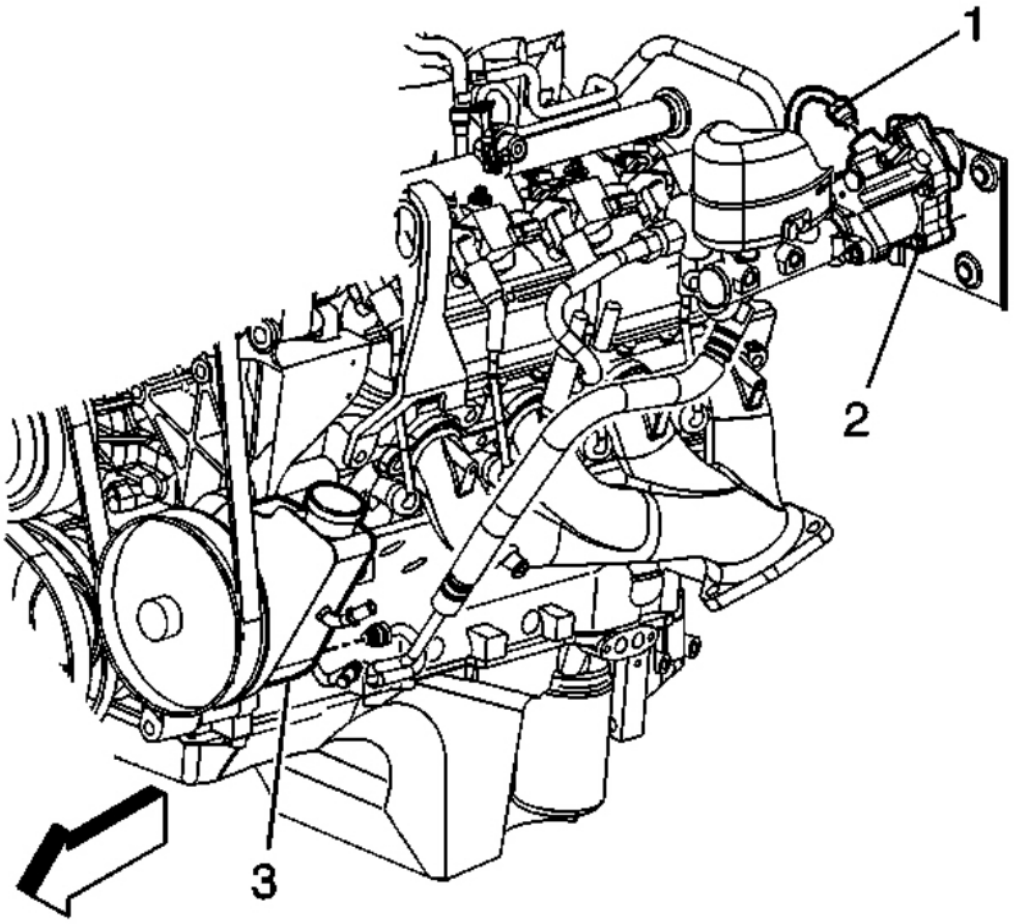


Fig. 55: View Of Power Brake Booster Inlet Hose
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Installing Hoses Without Twists or Bends Notice in Cautions and Notices.

1. Route the hose in the same position the hose occupied prior to removal.
2. Install the brake booster inlet hose (1) to the brake booster (2). Hand tighten only.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the brake booster inlet hose to the power steering pump.

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Tighten: Tighten the brake booster inlet hose fittings to 28 N.m (20 lb ft).

4. Remove the drain pan from under the vehicle.
5. Bleed the power steering system. Refer to **Bleeding the Power Steering System**.

POWER BRAKE BOOSTER OUTLET HOSE REPLACEMENT

Removal Procedure

NOTE: Refer to Power Steering Hose Disconnected Notice in Cautions and Notices.

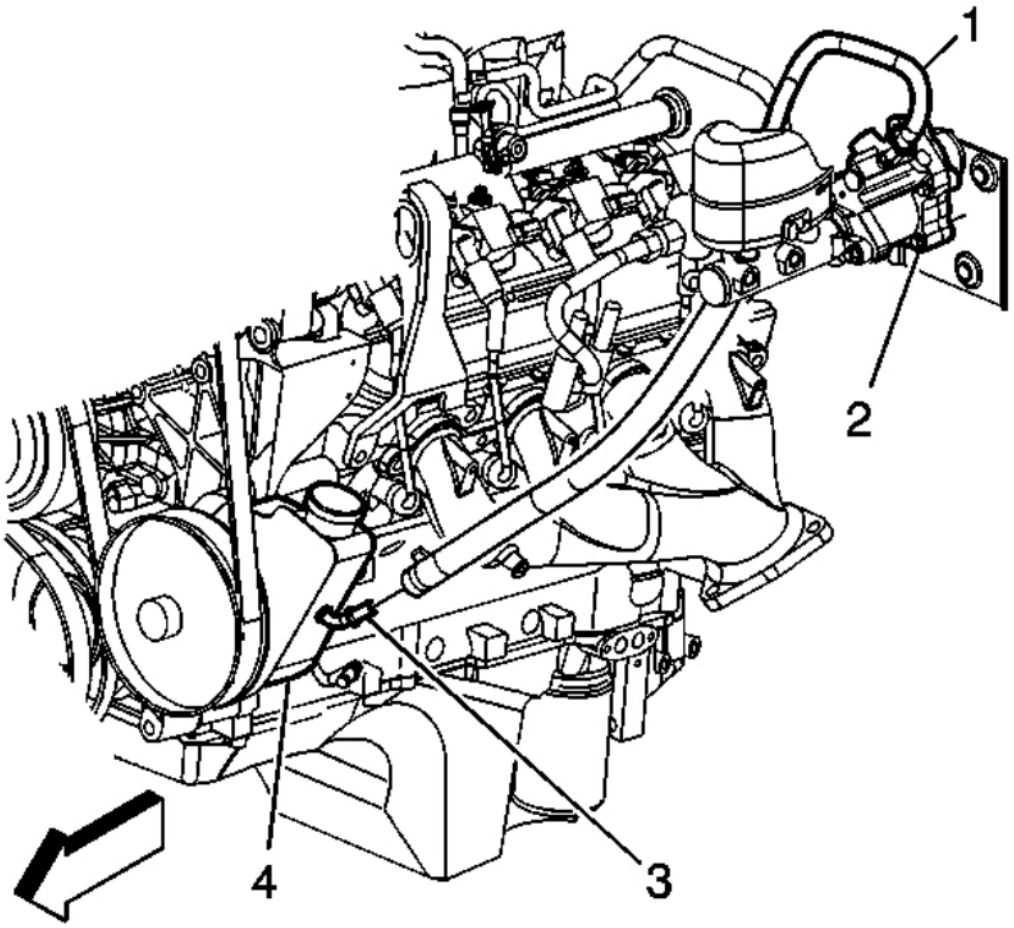


Fig. 56: View Of Power Brake Booster Outlet Hose
Courtesy of GENERAL MOTORS CORP.

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1. Install a drain pan under the vehicle.
2. Remove the brake booster outlet hose (1) from the brake booster (2).
3. Remove the clamp retaining the brake booster outlet hose to the power steering pump.
4. Remove the brake booster outlet hose from the vehicle.

Installation Procedure

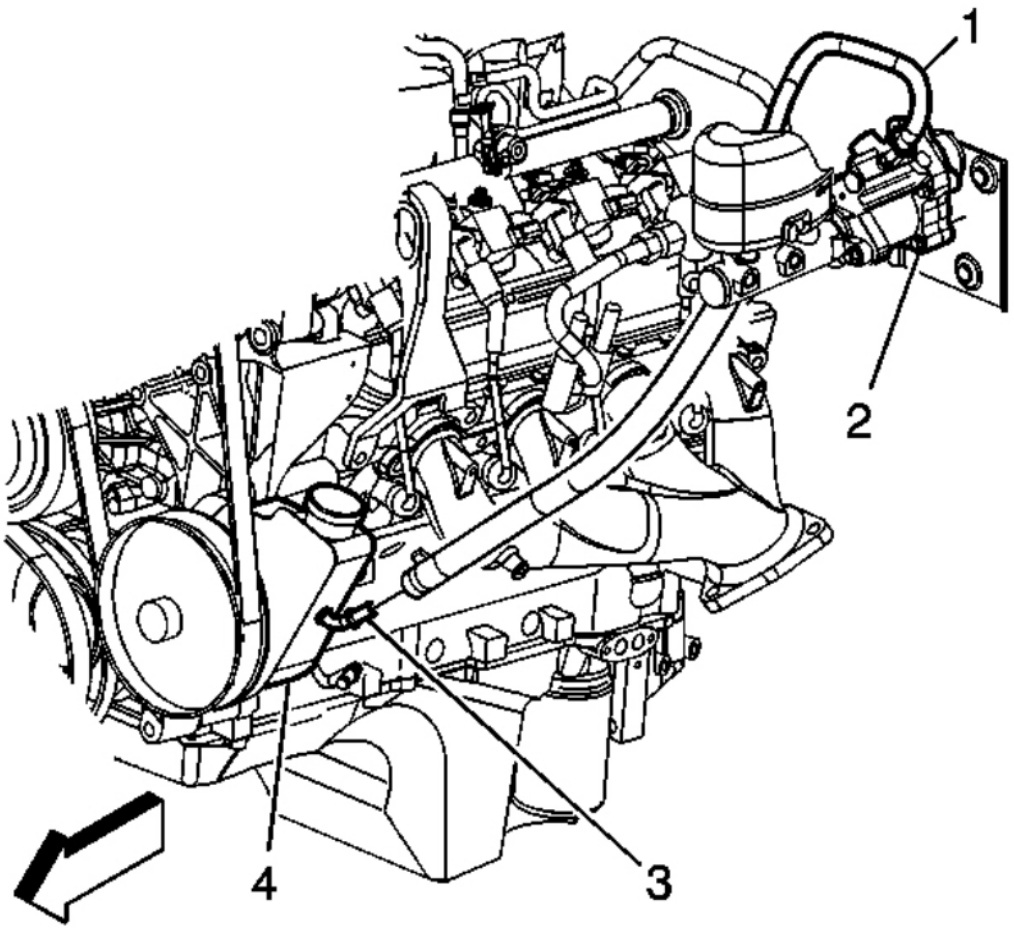


Fig. 57: View Of Power Brake Booster Outlet Hose
Courtesy of GENERAL MOTORS CORP.

NOTE: **The inlet and outlet hoses must not be twisted during installation. Do not bend or distort the inlet or outlet hoses to make installation easier. Failure to follow these procedures could result in component damage.**

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1. Route the hose in the same position the hose occupied prior to removal.
2. Install the brake booster outlet hose (1) to the brake booster (2).

   Position the clamp at the end of the hose.

3. Install the brake booster outlet hose to the power steering pump (4).

   Position the clamp at the end of the hose.

4. Remove the drain pan from under the vehicle.
5. Bleed the power steering system. Refer to **Bleeding the Power Steering System**.

POWER STEERING GEAR REPLACEMENT

Removal Procedure

Tools Required

- **J 6632-01** Pitman Arm Puller. See **Special Tools and Equipment**.
- **J 24319-B** Universal Steering Linkage Puller. See **Special Tools and Equipment**.
- **J 29107-A** Pitman Arm Puller. See **Special Tools and Equipment**.

1. Place a drain pan under the vehicle.
2. Remove the engine protection shield, if equipped. Refer to **Engine Protection Shield Replacement** in Frame and Underbody.

NOTE: Refer to Power Steering Hose Disconnected Notice in Cautions and Notices.

3. Remove the power steering hoses from the steering gear.
4. Cap the ends of the hoses and the power steering gear in order to prevent any entrance of dirt.
5. Disconnect the intermediate shaft from the steering gear. Refer to **Intermediate Steering Shaft Replacement - Lower** in Steering Wheel and Column.

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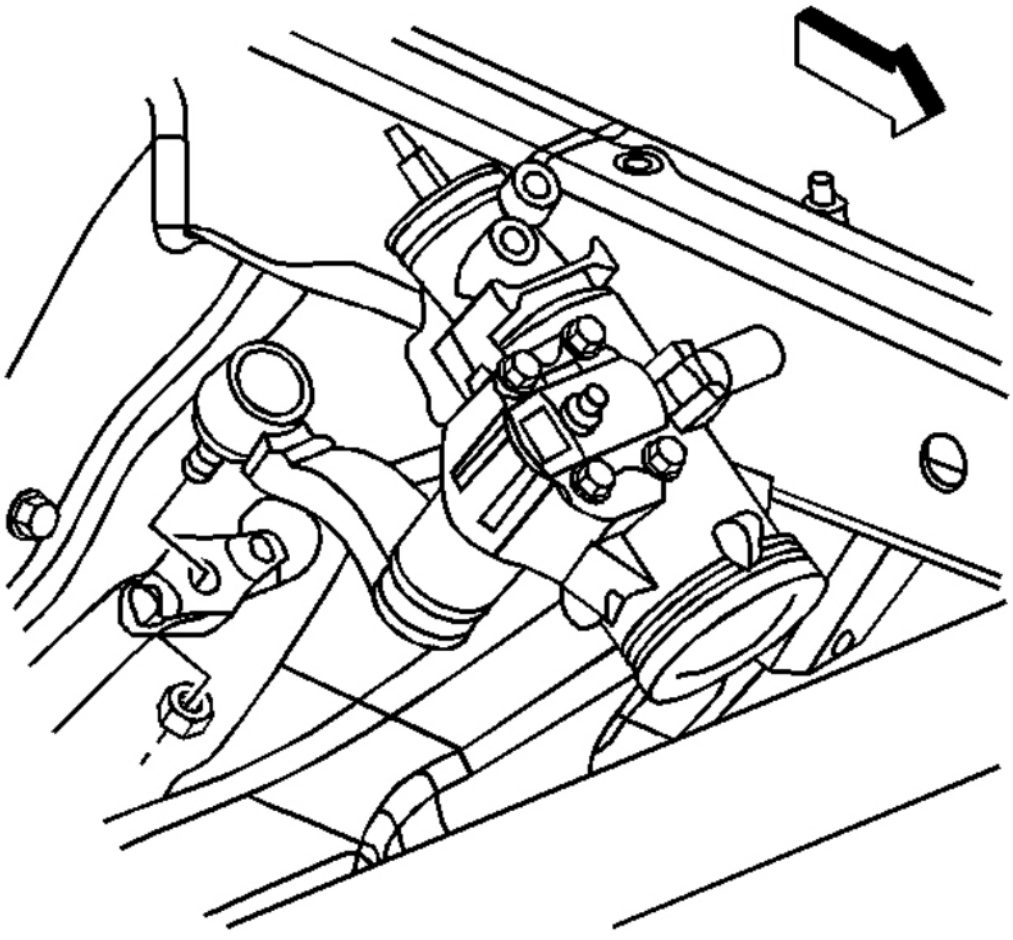


Fig. 58: View Of Pitman Arm At Relay Rod Nut
Courtesy of GENERAL MOTORS CORP.

6. Remove the pitman arm to relay rod nut.

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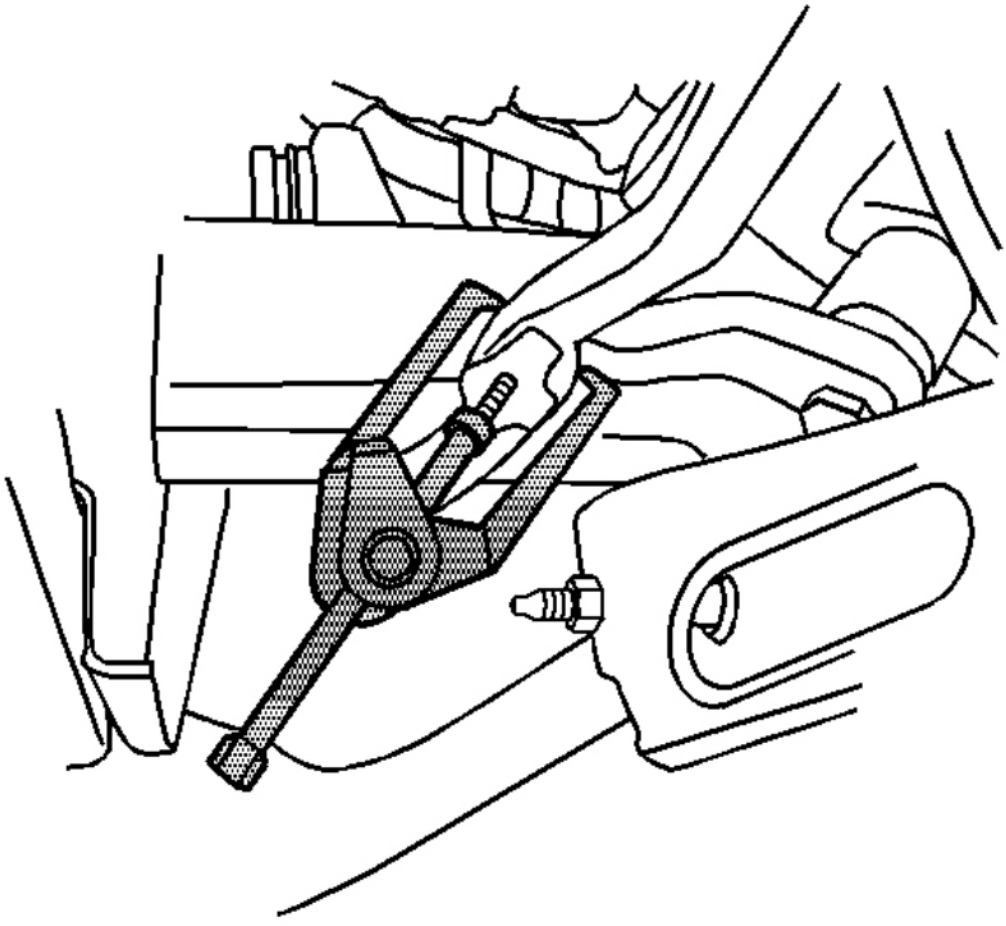


Fig. 59: Disconnecting Pitman Arm From Relay Rod Using J 24319-B
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the pitman arm from the relay rod using **J 24319-B** . See **Special Tools and Equipment**.

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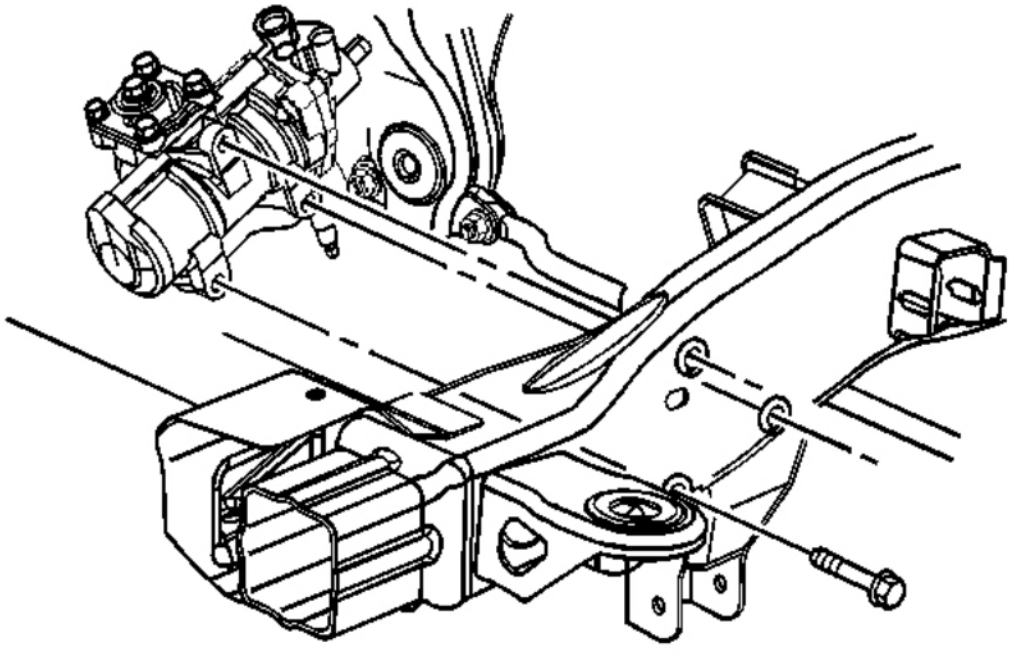


Fig. 60: View Of Power Steering Gear & Bolts
Courtesy of GENERAL MOTORS CORP.

8. Remove the bolts retaining the steering gear to the frame.
9. Remove the steering gear from the vehicle.

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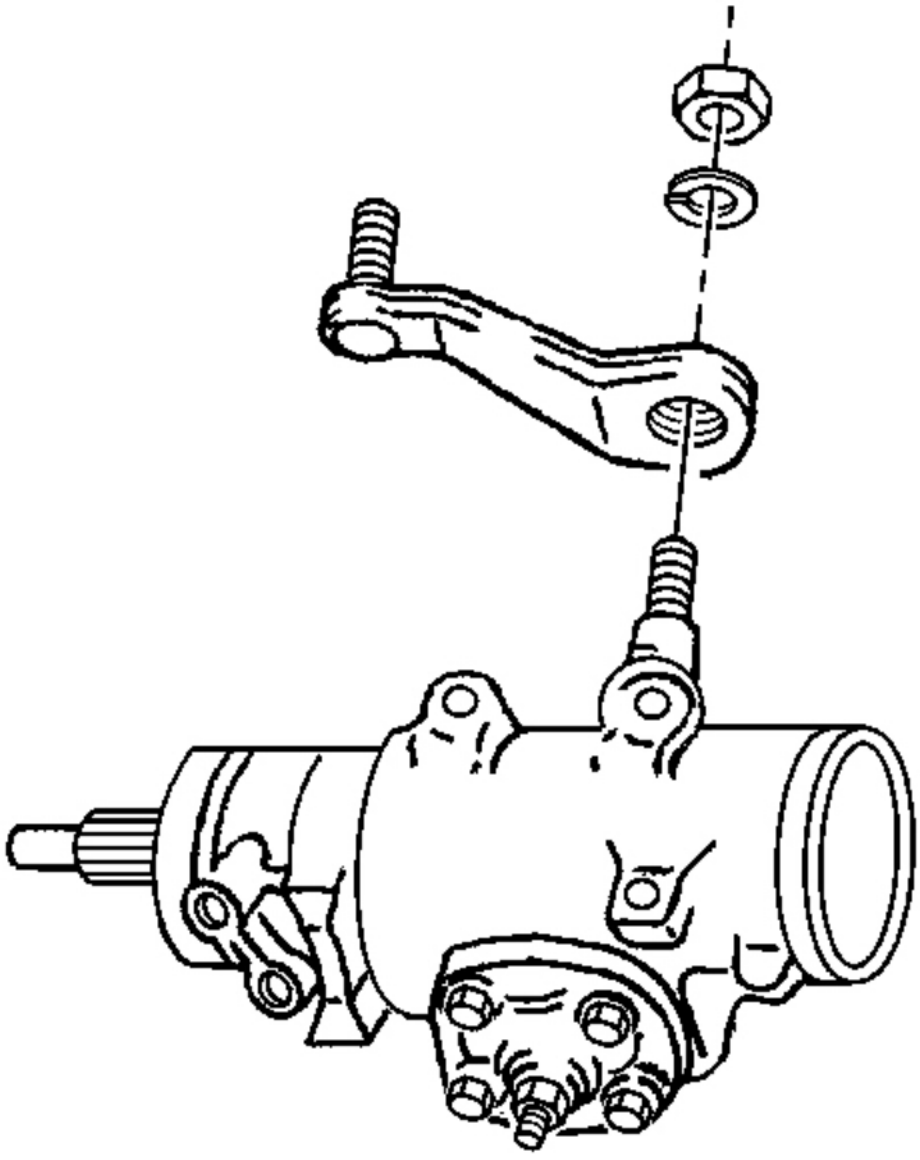


Fig. 61: View Of Pitman Arm, Power Steering Gear, Washer & Nut
Courtesy of GENERAL MOTORS CORP.

10. Remove the pitman arm to the power steering gear retaining nut.

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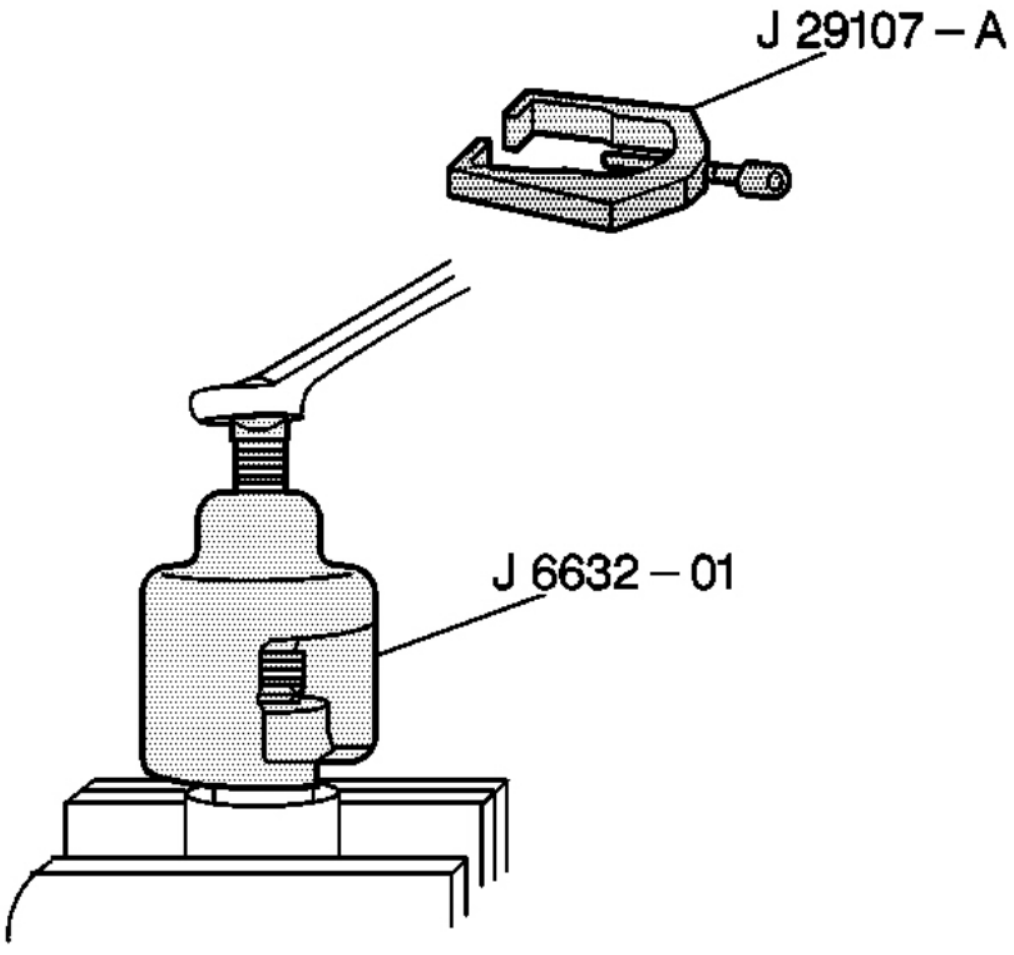


Fig. 62: Removing Pitman Arm From Gear Using J 6632-01 Or J 29107-A
Courtesy of GENERAL MOTORS CORP.

11. Remove the pitman arm from the power steering gear using **J 6632-01** or **J 29107-A** . See **Special Tools and Equipment**.

Installation Procedure

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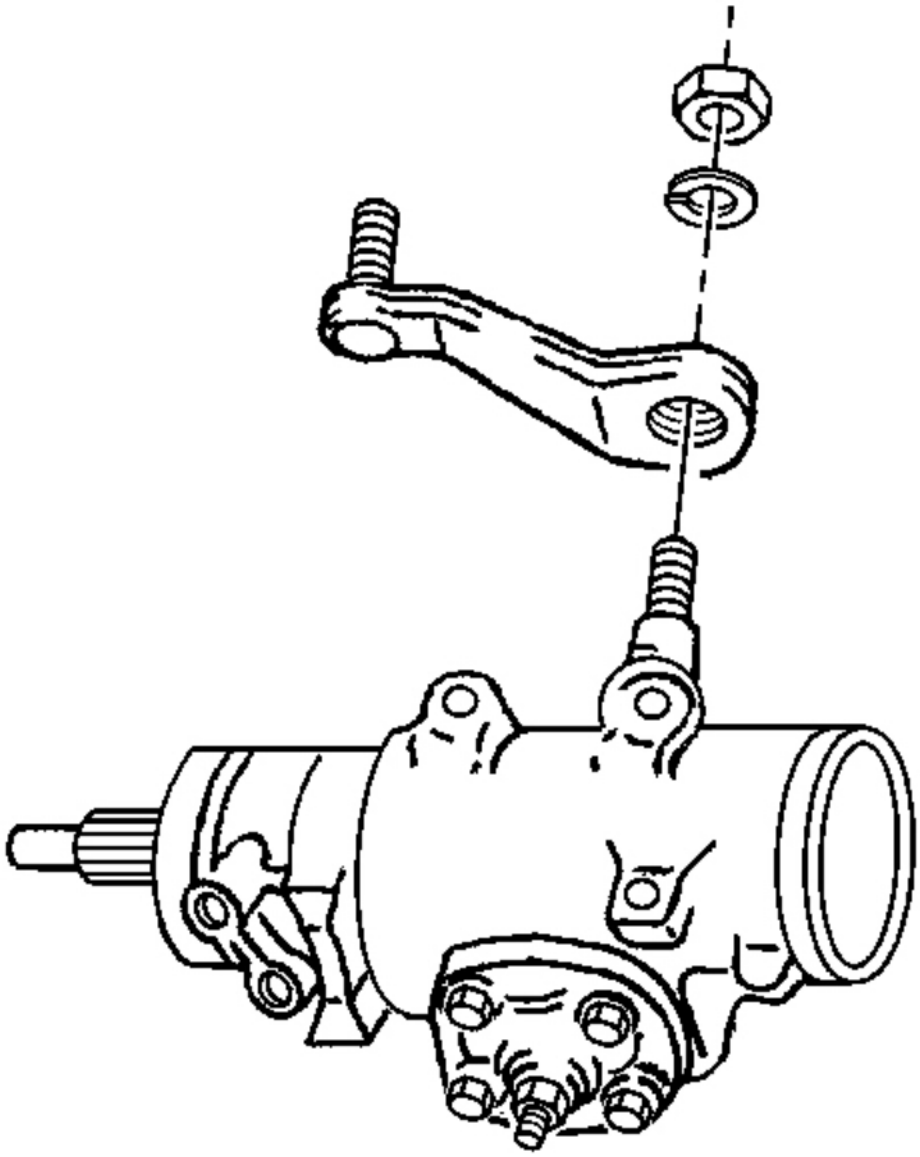


Fig. 63: View Of Pitman Arm, Power Steering Gear, Washer & Nut
Courtesy of GENERAL MOTORS CORP.

1. Install the pitman arm to the power steering gear.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

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2. Install the pitman arm to power steering gear retaining nut and washer.

   Tighten: Tighten the nut to 250 N.m (184 lb ft).

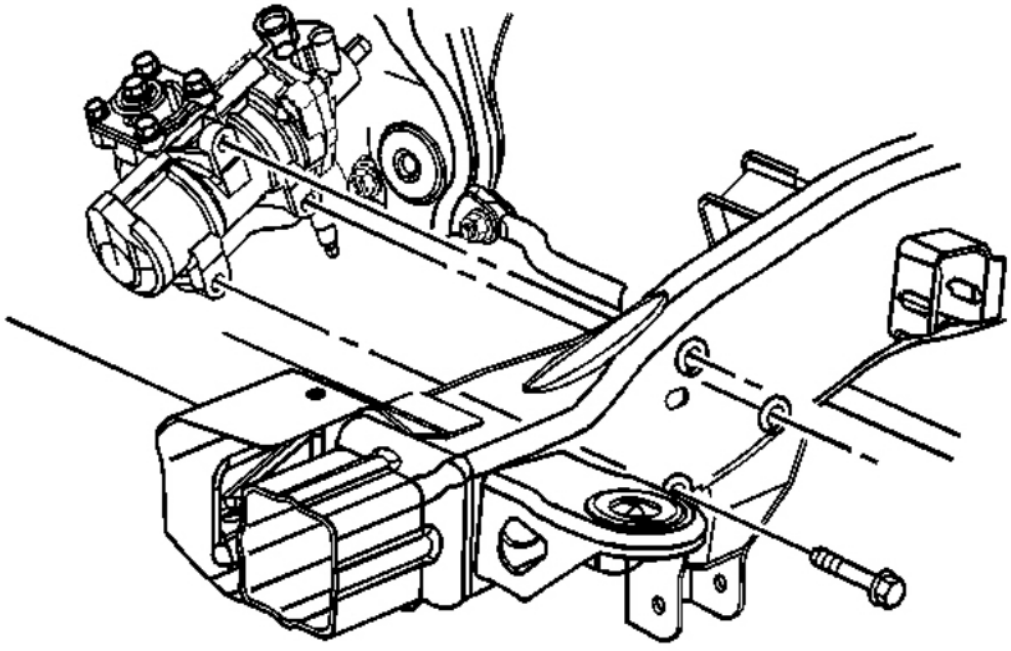


Fig. 64: View Of Power Steering Gear & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the steering gear to the frame and install the retaining bolts.

   Tighten: Tighten the bolts to 150 N.m (110 lb ft).

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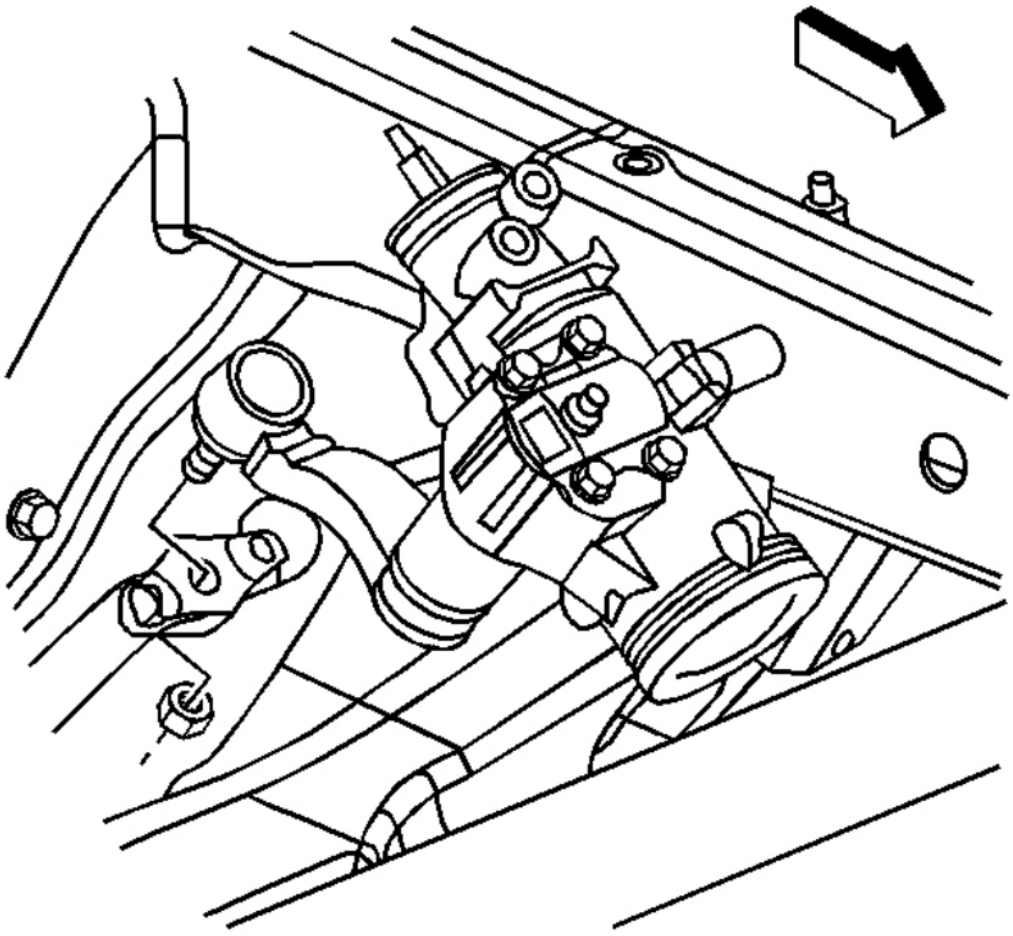


Fig. 65: View Of Pitman Arm At Relay Rod Nut
Courtesy of GENERAL MOTORS CORP.

4. Install the pitman arm to the relay rod.
5. Install the pitman arm to the relay rod nut.

   Tighten: Tighten the nut to 62 N.m (46 lb ft).

6. Install the intermediate shaft to the steering gear. Refer to **Intermediate Steering Shaft Replacement - Lower** in Steering Wheel and Column.
7. Remove the caps or plugs from the steering gear and hoses.
8. Install the hoses to the steering gear.

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Tighten: Tighten the hoses fittings to 28 N.m (20 lb ft).

9. Install the engine protection shield, if equipped. Refer to **Engine Protection Shield Replacement** in Frame and Underbody.
10. Remove the safety stands.
11. Lower the vehicle.
12. Bleed the power steering system. Refer to **Bleeding the Power Steering System**.

WORM THRUST BEARING PRELOAD ADJUSTMENT - OFF VEHICLE

Tools Required

- **J 42882** P/S Adjuster Nut Wrench. See **Special Tools and Equipment**.
- **J 43435** Steering Gear Bearing Protector. See **Special Tools and Equipment**.

Thrust Bearing Preload Adjustment

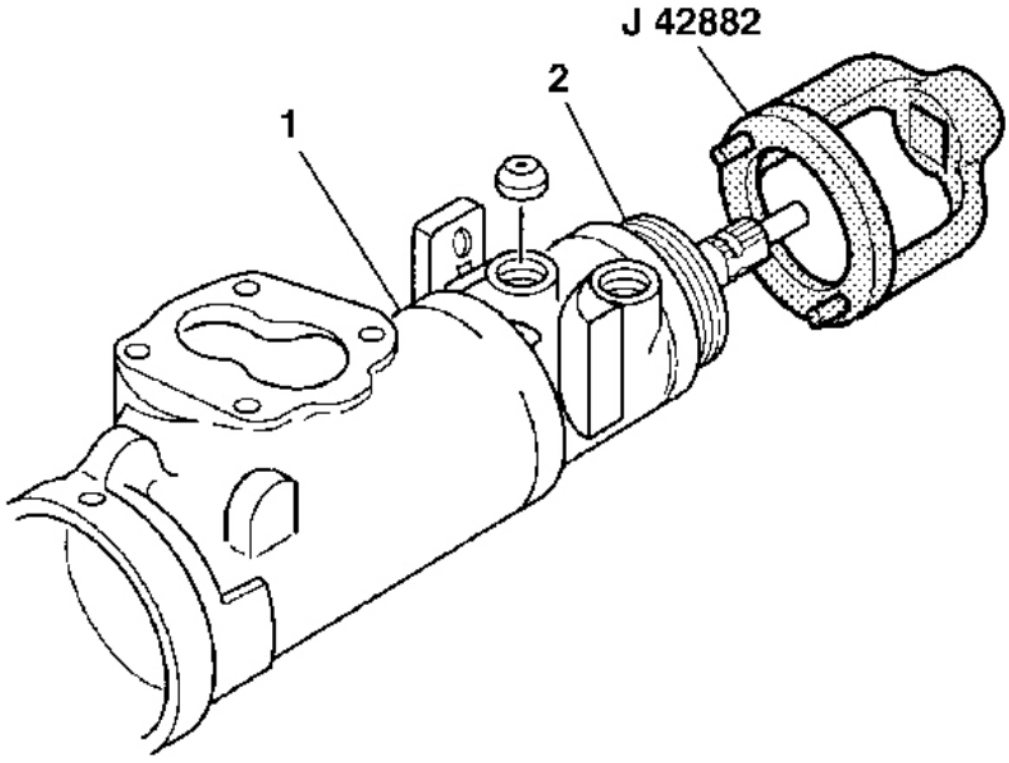


Fig. 66: View Of Adjuster Nut Assembly, Steering Gear Housing & J 42882

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Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

1. Turn the adjuster nut assembly clockwise using **J 42882** until the adjuster nut assembly and the thrust bearing support are firmly bottomed in the steering gear housing. See **Special Tools and Equipment**.

   Tighten: Adjust the adjuster nut assembly to 29.5 N.m (22 lb ft).

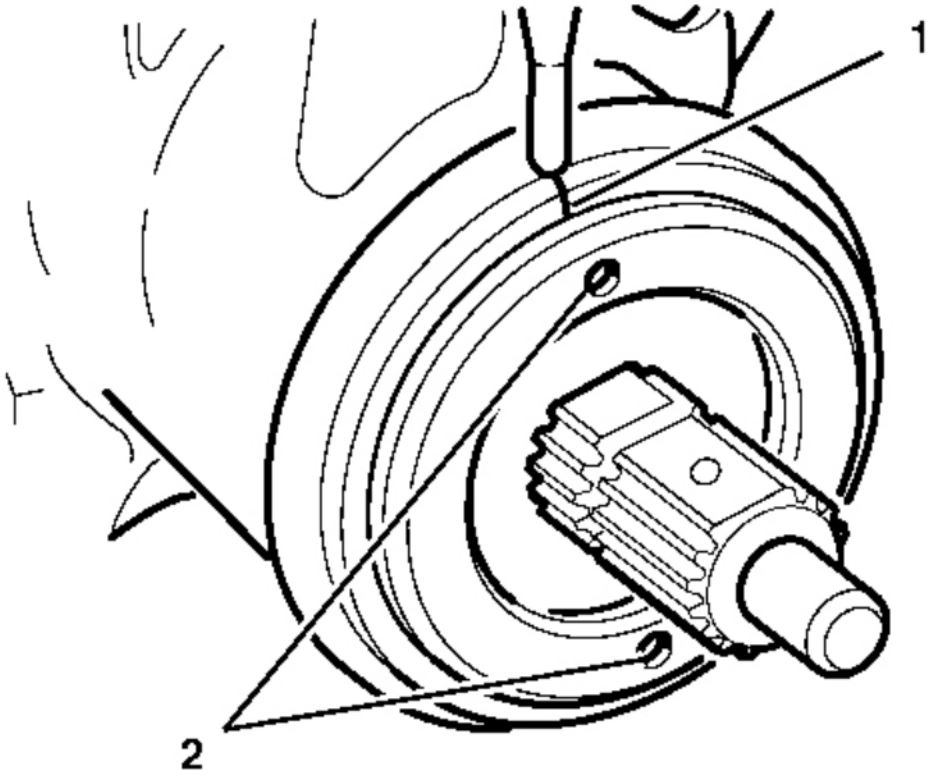


Fig. 67: Placing Index Mark On Steering Gear Housing
Courtesy of GENERAL MOTORS CORP.

2. Place an index mark (1) on the steering gear housing even with one of the holes (2) in the adjuster nut assembly.

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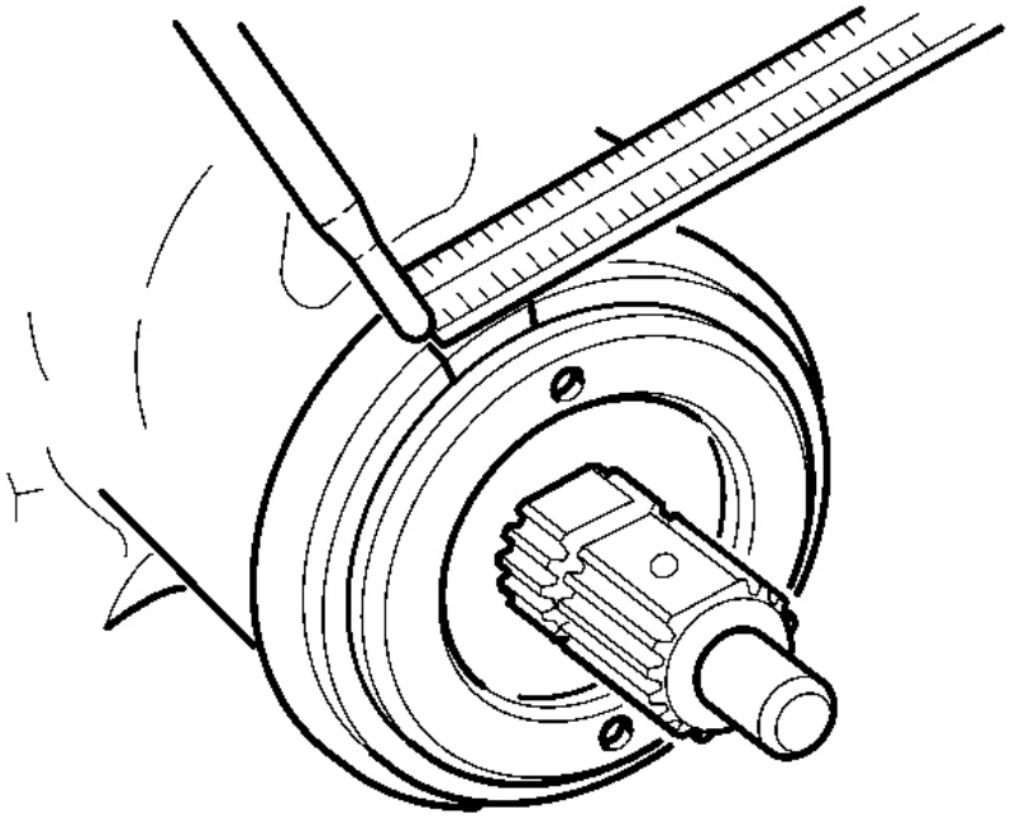


Fig. 68: Measuring & Placing Second Mark On Steering Gear Housing
Courtesy of GENERAL MOTORS CORP.

3. Measure back counterclockwise 13 MM (.5 inch).
4. Place a second mark on the steering gear housing.

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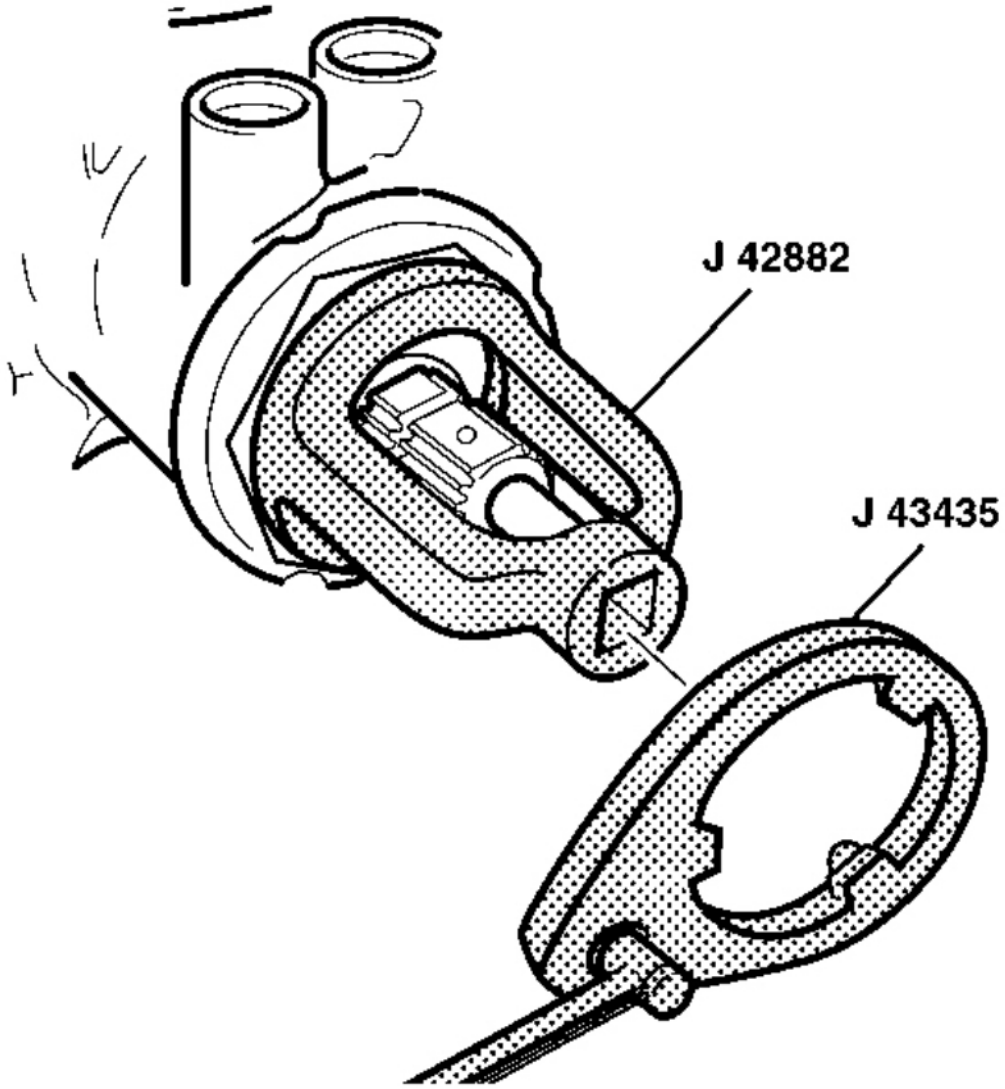


Fig. 69: View Of J 42882 & J 43435 On Adjuster Nut Assembly
Courtesy of GENERAL MOTORS CORP.

5. Using **J 42882** and a torque wrench, turn adjuster nut assembly counterclockwise 22-32 degrees to align the hole in the adjuster nut assembly with the second mark on the steering gear housing. See **Special Tools and Equipment**.
6. Install the lock nut.
7. Hold the adjuster nut assembly in position to maintain alignment of the marks.

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8. Tighten the lock nut using **J 42882** , **J 43435** and a torque wrench. See **Special Tools and Equipment**.

   Tighten: Tighten the lock nut to 109 N.m (80 lb ft).

9. Adjust the pitman shaft over center preload. Refer to **Pitman Shaft Over-Center Preload Adjustment - Off Vehicle**.

PITMAN SHAFT OVER-CENTER PRELOAD ADJUSTMENT - OFF VEHICLE

Pitman Shaft Over Center Preload Adjustment

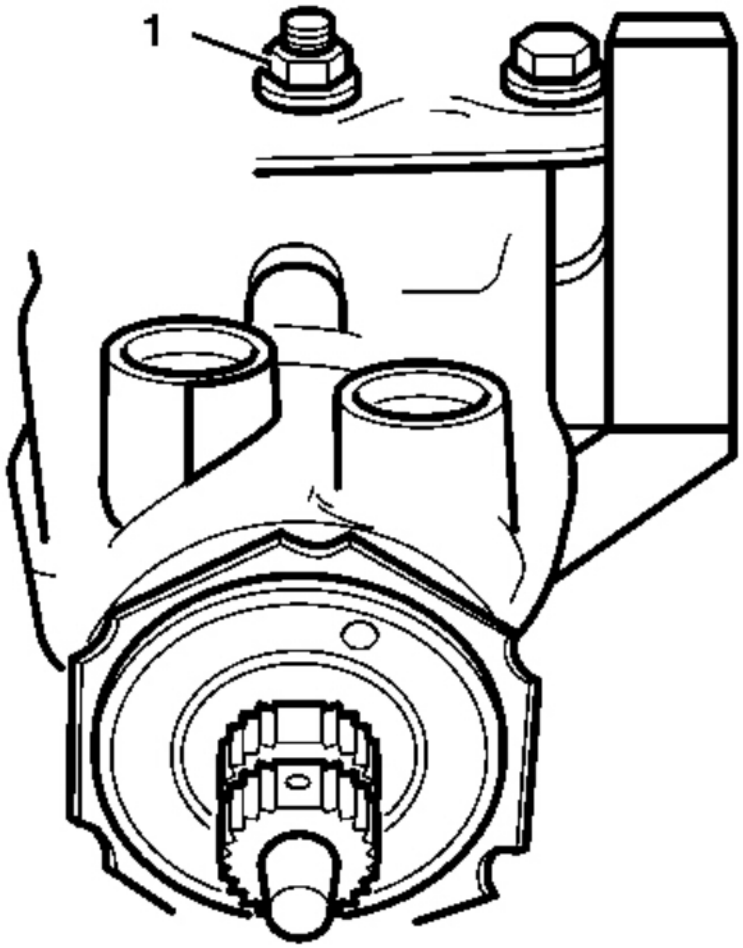


Fig. 70: View Of Lash Adjuster Lock Nut

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Courtesy of GENERAL MOTORS CORP.

1. Loosen the lash adjuster lock nut.
2. Turn the pitman shaft adjuster screw counterclockwise until fully extended.
3. Turn the pitman shaft adjuster screw clockwise 1 full turn.
4. Rotate the stub shaft from stop to stop, using 12-point socket while counting the number of turns.
5. Starting at either stop, turn the stub shaft back half the total number of turns. This is the CENTER of the gear.

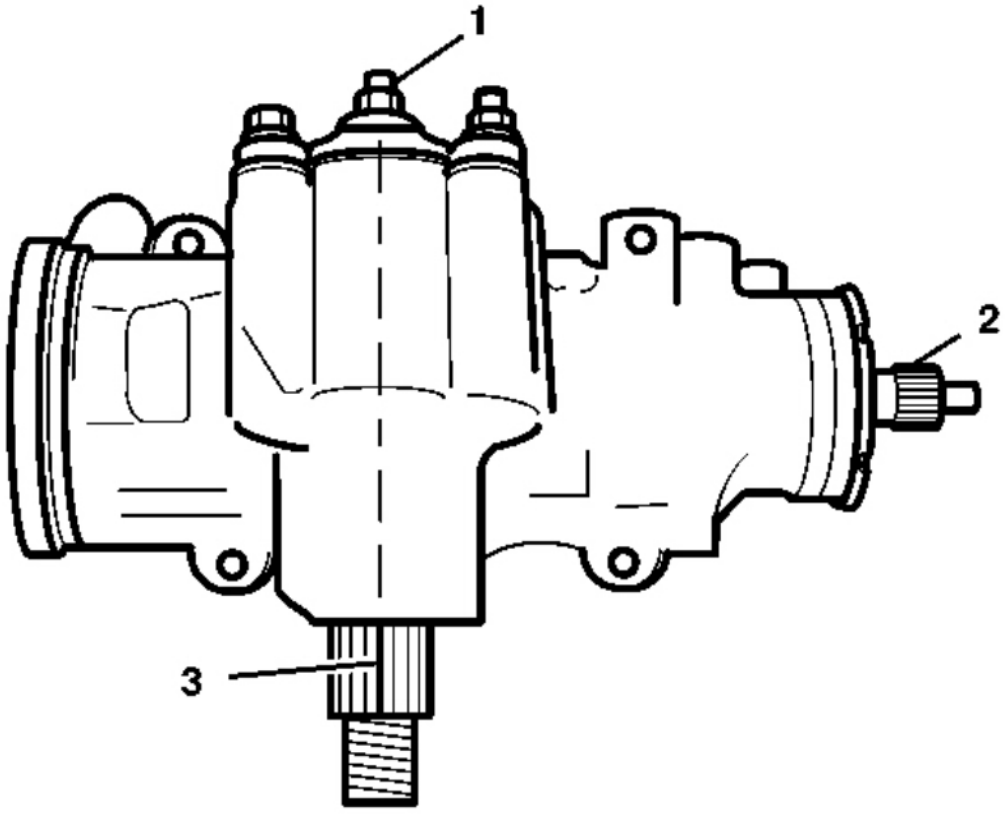


Fig. 71: Ensuring Correct Position Of Stub Shaft & Master Spline
Courtesy of GENERAL MOTORS CORP.

6. Make sure the gear is centered by checking the following items:
   - The flat on the stub shaft (2) faces upward.
   - The flat on the stub shaft is parallel with the side cover.

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- The master spline (3) on the pitman shaft is in line with the adjuster screw (1).

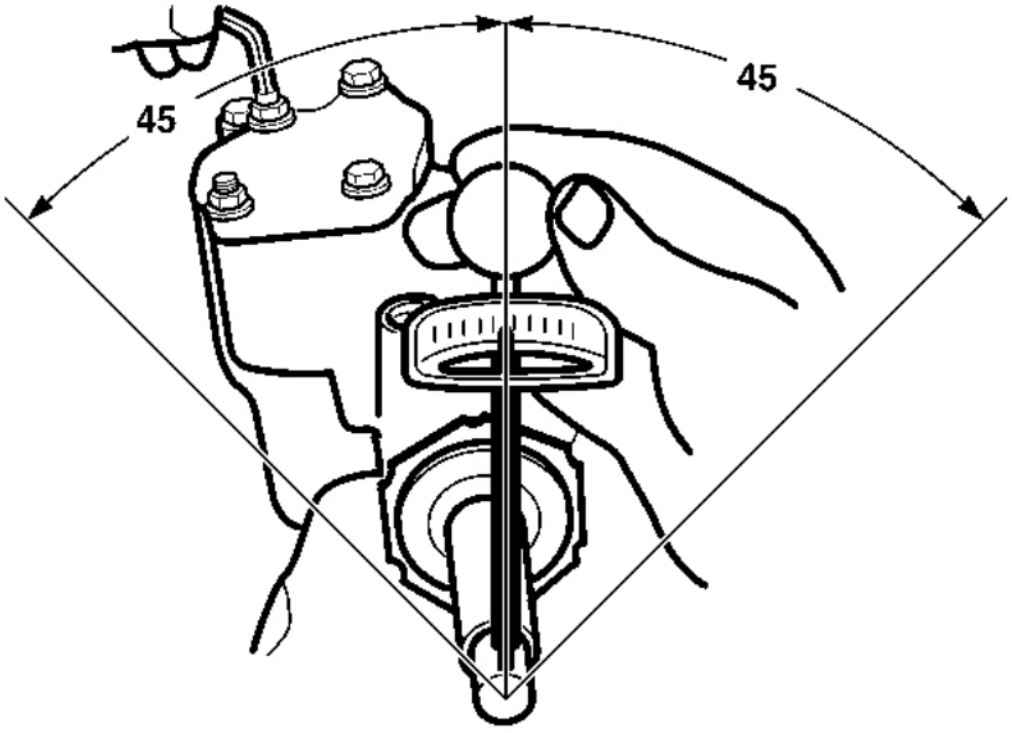


Fig. 72: Obtaining Worm Bearing Preload Torque
Courtesy of GENERAL MOTORS CORP.

7. Place a torque wrench on the stub shaft with the handle in the vertical position.
8. Rotate the stub shaft 45 degrees from each side of the center of the stub shaft. The stub shaft must rotate smoothly and must not stick or bind.
9. Record the worm bearing preload measured on or near the center.
10. Recorded bearing preload must be 0.7-1.7 N.m (6-15 lb in), with the worm and the ball nut installed. If the torque is outside this range, readjust or repair the steering gear assembly as required.
11. To obtain the correct preload torque, adjust the over center torque by turning the pitman shaft adjuster screw clockwise.
12. Add 0.7-1.1 N.m (6-10 lb in) torque to the previously measured worm bearing preload torque.

NOTE: Refer to Fastener Notice in Cautions and Notices.

- **Tighten:** Tighten the lash adjuster lock nut to 49 N.m (36 lb ft).

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- Prevent the adjuster screw from turning while tightening the lash adjuster lock nut.
- Install the steering gear into the vehicle. Refer to **Power Steering Gear Replacement**.
- Bleed the power steering system. Refer to **Bleeding the Power Steering System**.

STEERING GEAR PITMAN SHAFT AND HOUSING COVER REPLACEMENT - OFF VEHICLE (670 GEAR)

Disassembly Procedure

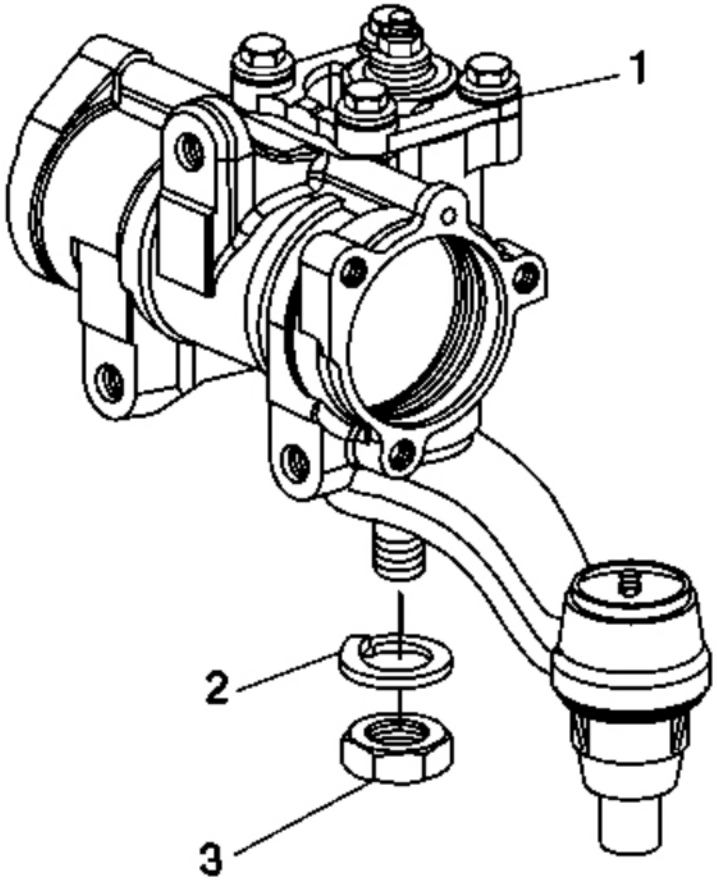


Fig. 73: View Of Steering Gear Housing, Lock Washer & Nut
Courtesy of GENERAL MOTORS CORP.

1. Remove the nut (3).

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2. Remove the lock washer (2).
3. Clean the exposed end of the pitman shaft.
4. Clean the steering gear housing (1).
5. Use a wire brush to clean the pitman shaft splines.

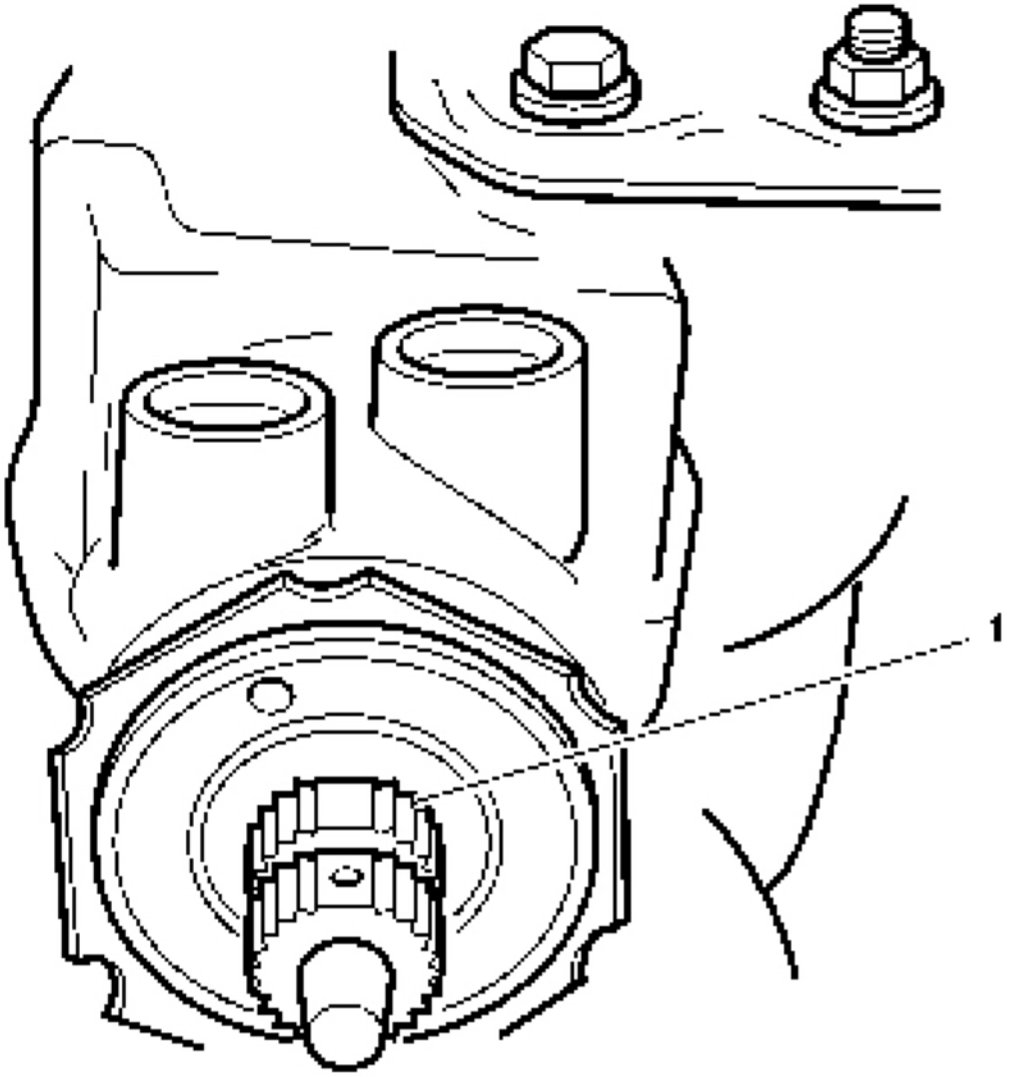


Fig. 74: View Of Stub Shaft
Courtesy of GENERAL MOTORS CORP.

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

6. To center the stub shaft:
    1. Rotate the stub shaft (1) with a wrench from stop to stop.
    2. Count the number of turns.
    3. Rotate the stub shaft back 1/2 of the total amount of turns.

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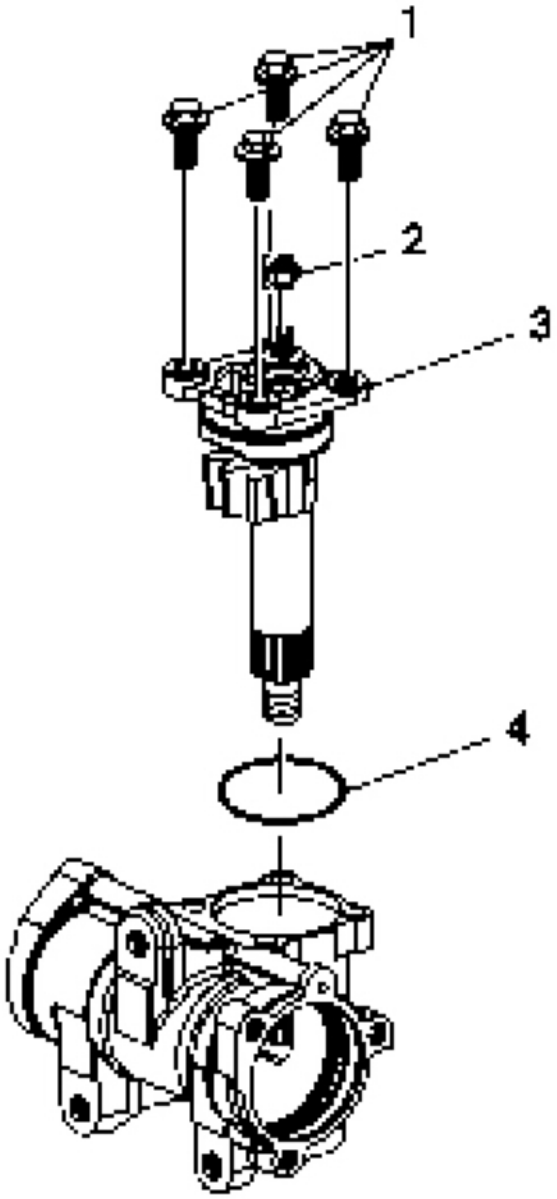


Fig. 75: View Of Pitman Shaft & Cover Assembly
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: When removing the pitman shaft assembly, the pitman arm and its components may fall from the steering gear housing. Support the pitman

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arm and its components while removing the pitman shaft assembly.

7. Remove the pitman shaft cover bolts (1) from the pitman shaft and cover assembly (3).

   Remove the lash adjuster nut (2) from the pitman shaft and cover assembly (3).

8. Remove the pitman shaft and cover assembly (3).
9. Remove the pitman shaft cover O-ring (4) from the steering gear housing assembly.

Assembly Procedure

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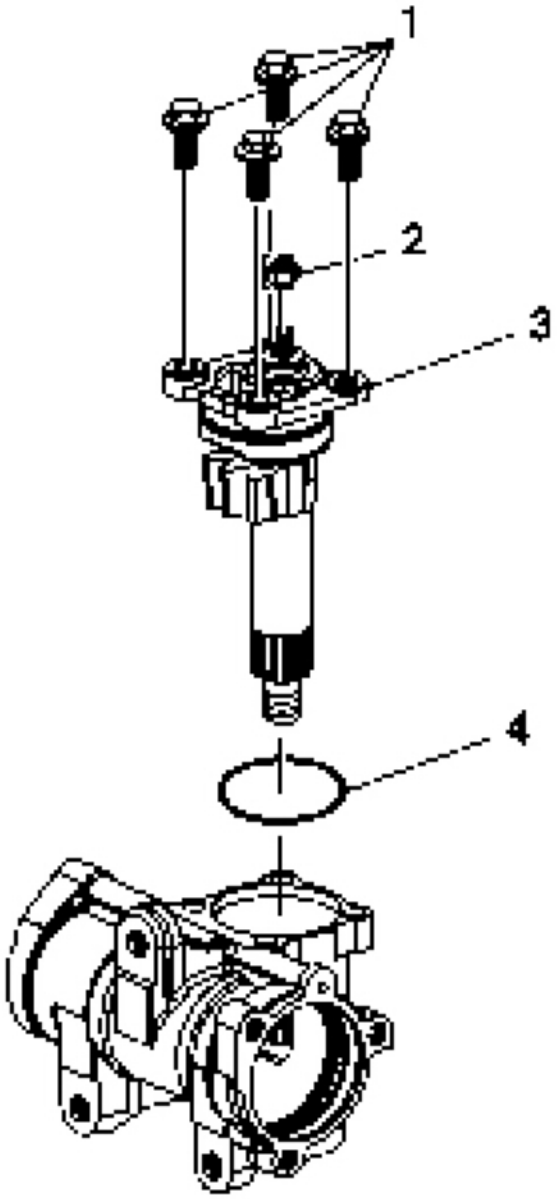


Fig. 76: View Of Pitman Shaft & Cover Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the new pitman shaft cover O-ring (4).
2. Install the pitman shaft and cover assembly (3) onto the steering gear housing assembly.

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3. Install the lash adjuster nut (2) onto the pitman shaft and cover assembly (3)

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

4. Install the pitman shaft cover bolts (1) onto the pitman shaft and cover assembly (3).

Tighten: Tighten the pitman shaft cover bolts to 62 N.m (46 lb ft).

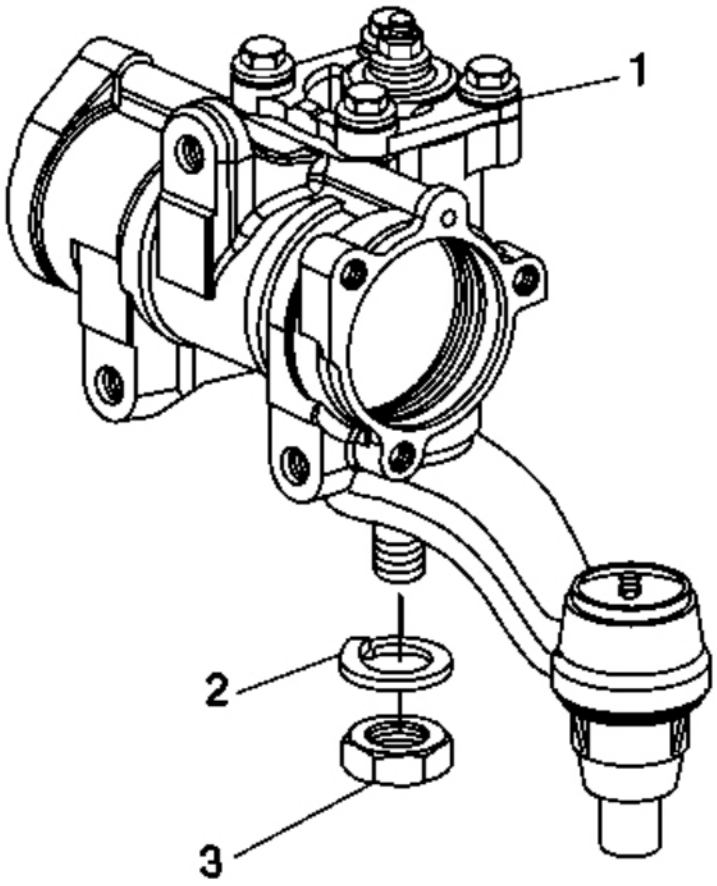


Fig. 77: View Of Steering Gear Housing, Lock Washer & Nut
Courtesy of GENERAL MOTORS CORP.

5. Install the lock washer (2).
6. Install the nut (3).

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7. If necessary adjust the pitman shaft. Refer to **Pitman Shaft Over-Center Preload Adjustment - Off Vehicle**.

STEERING GEAR HOUSING END PLUG REPLACEMENT - OFF VEHICLE

Disassembly Procedure

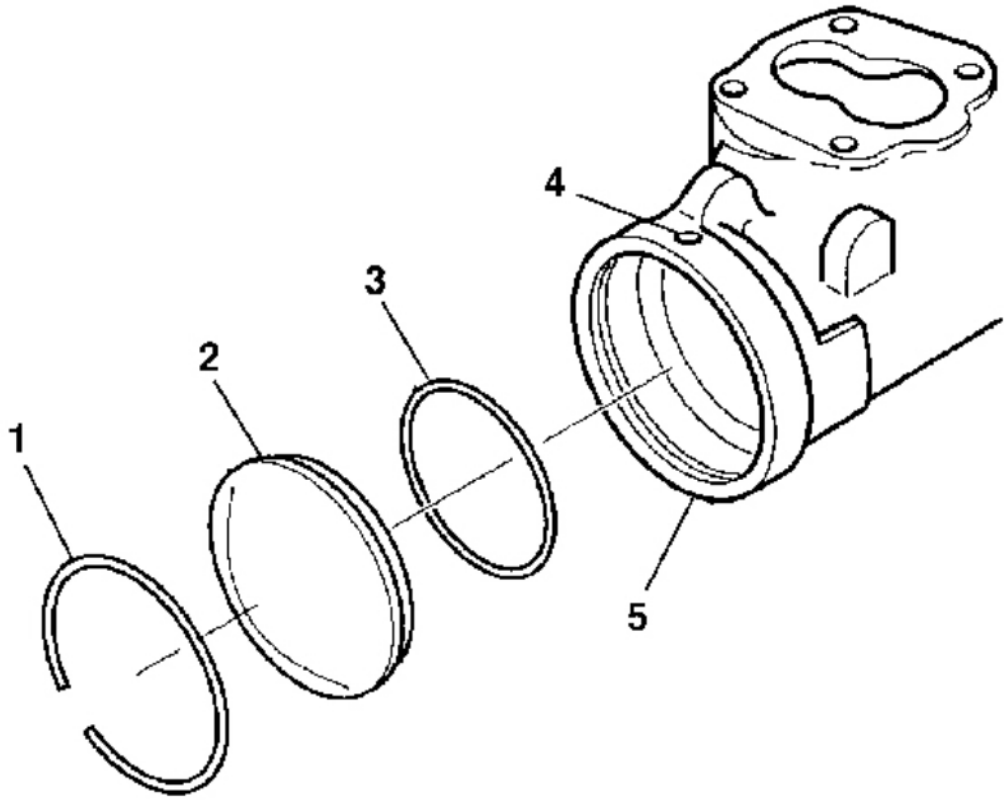


Fig. 78: Steering Gear Housing End Plug Assembly
Courtesy of GENERAL MOTORS CORP.

1. Rotate the stub shaft back and forth to drain the fluid.
2. Insert a punch into the housing access hole to unseat the retaining ring (1).
3. Remove the plug (2).
4. Remove the O-ring seal (3).

Assembly Procedure

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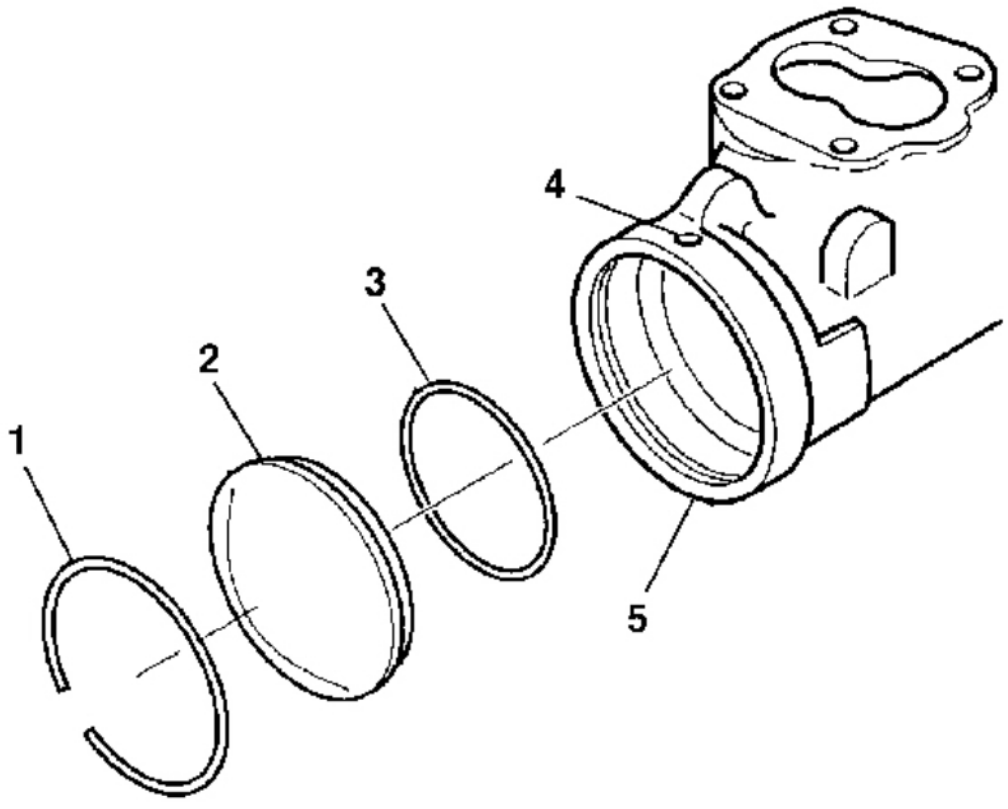


Fig. 79: Steering Gear Housing End Plug Assembly
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the O-ring seal (3) with power steering fluid.
2. Install the O-ring seal (3) into the steering gear housing (5).
3. Install the plug (2).
4. Install the retaining ring (1). Ensure that the retaining ring open end is approximately 25 mm (1 in) from the access hole in the steering gear housing (5).

STEERING GEAR VALVE REPLACEMENT - OFF VEHICLE (700 GEAR)

Disassembly Procedure

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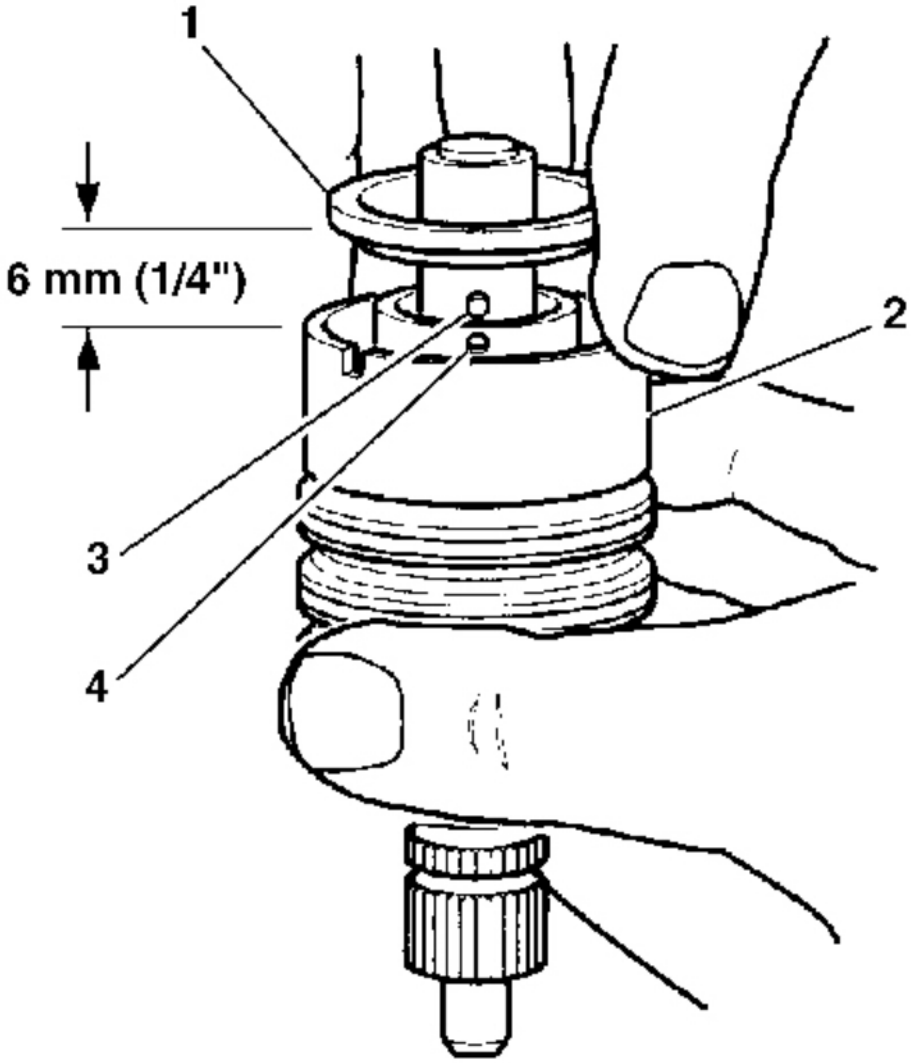


Fig. 80: View Of Stub Shaft, Valve Assembly, Stub Shaft Pin & Valve Spool Hole
Courtesy of GENERAL MOTORS CORP.

1. Remove the thrust support assembly. Refer to **Steering Gear Thrust Support Replacement - Off Vehicle**.
2. Remove the stub shaft (1) and the valve assembly (2) from the steering gear housing.
3. If necessary, remove the stub shaft (1) from the valve assembly (2) in the following manner:
    1. Tap the stub shaft (1) lightly on a wood block in order to loosen the cap.

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2. Pull the cap and the valve spool out from valve body (2) 6 mm (1/4 in).
3. Disengage the stub shaft pin (3) from the hole in the valve spool (4).

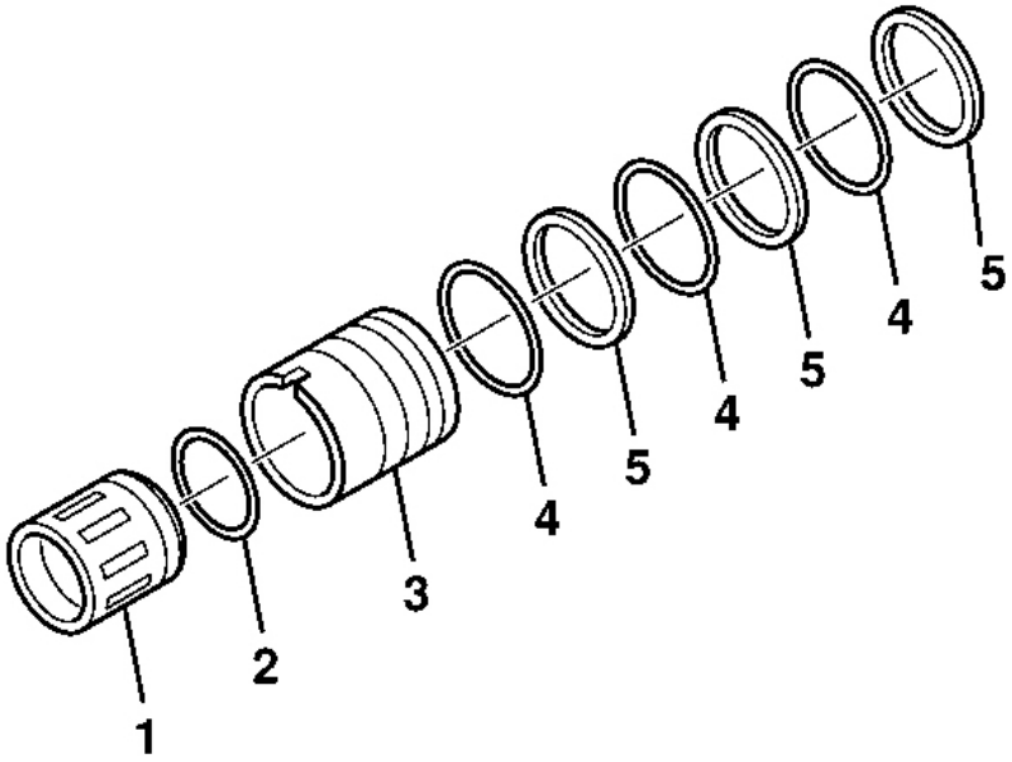


Fig. 81: Exploded View Of Valve Assembly (700 Gear)
Courtesy of GENERAL MOTORS CORP.

4. If the valve assembly needs repair, disassemble the valve in the following manner:
   1. Simultaneously pull and rotate the valve spool (1) from the valve body (3).
   2. Remove the valve spool O-ring seal (2).
   3. Alternately remove the valve body teflon rings (5) and the O-ring seals (4).

Assembly Procedure

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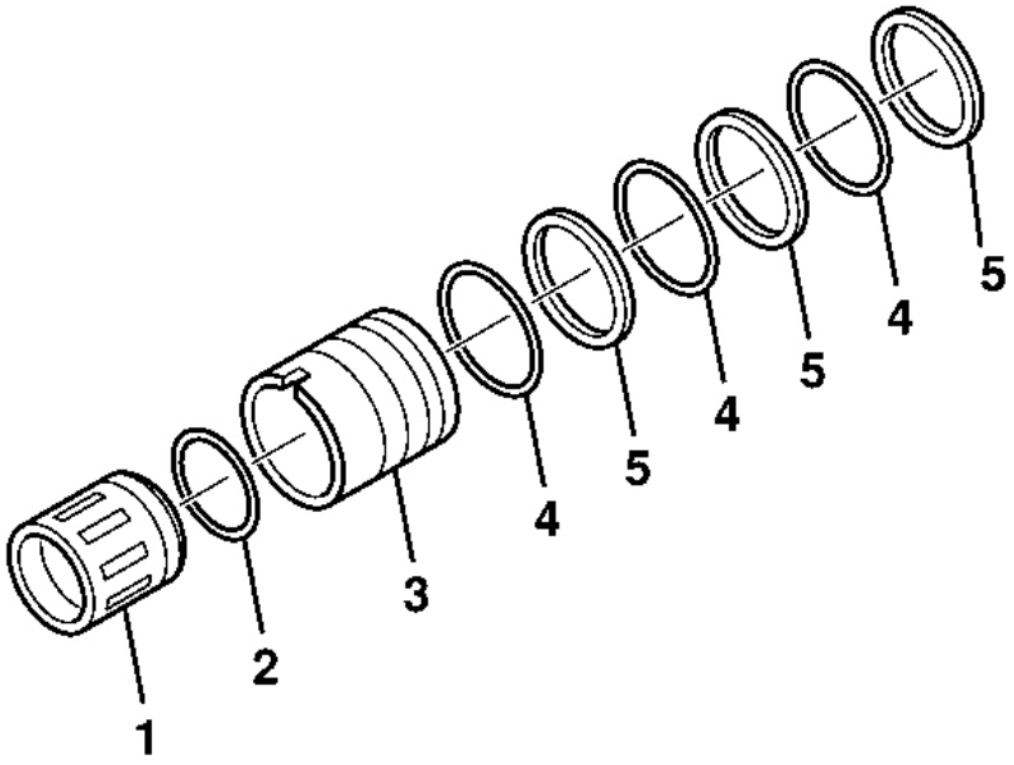


Fig. 82: Exploded View Of Valve Assembly (700 Gear)
Courtesy of GENERAL MOTORS CORP.

1. If disassembled, reassemble the valve assembly in the following manner:
    1. Alternately install the valve body teflon rings (5) and the O-ring seals (4).
    2. Install the valve spool O-ring seal (2) to the valve spool (1).
    3. Lubricate the valve spool (1) and O-ring seal (2) with power steering fluid.

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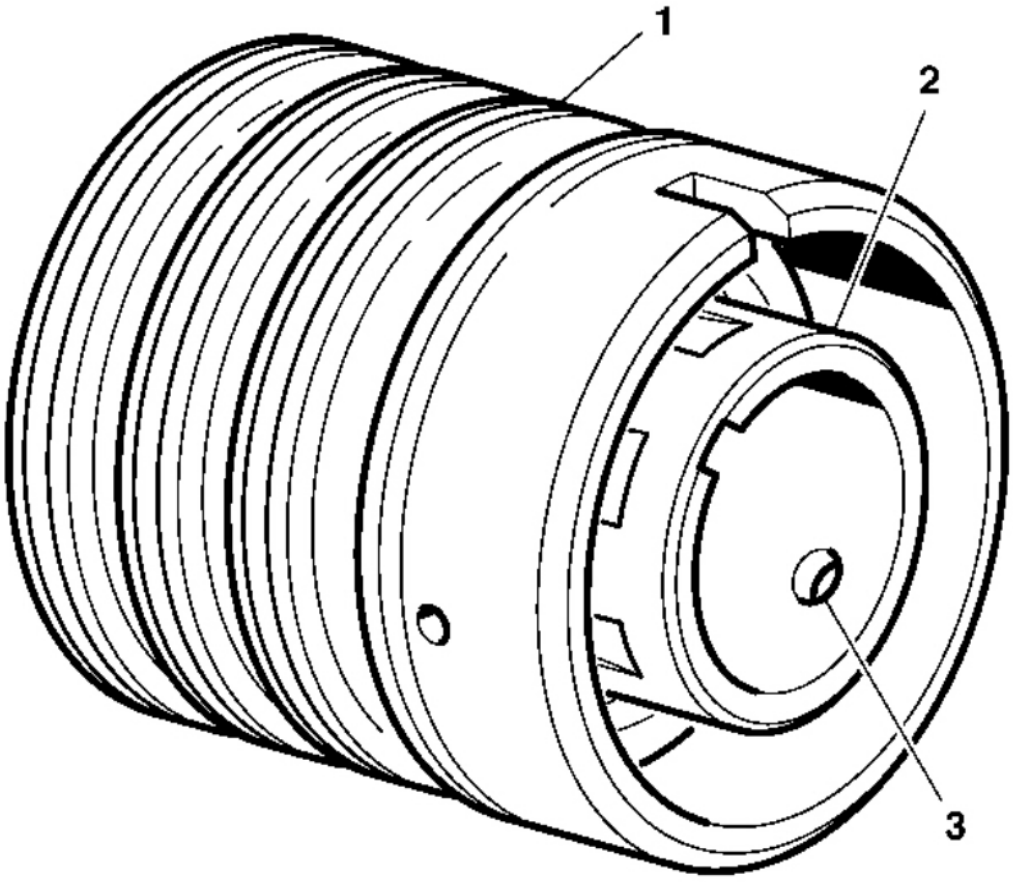


Fig. 83: Valve Spool, Valve Spool Hole & Valve Body
Courtesy of GENERAL MOTORS CORP.

2. Simultaneously push and rotate the valve spool (2) into the valve body (1) until the hole (3) in the valve spool (2) for the stub shaft pin is accessible from the opposite end of the valve body (1).

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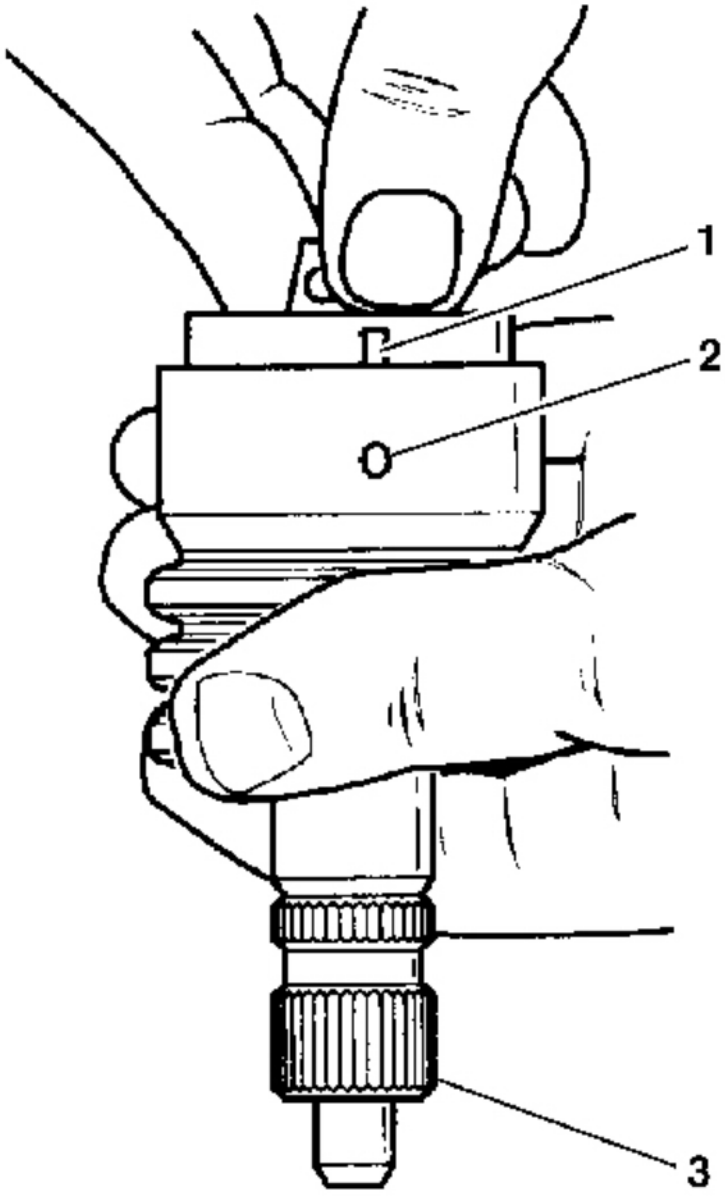


Fig. 84: Aligning Stub Shaft Cap Notch With Valve Body Pin
Courtesy of GENERAL MOTORS CORP.

3. If necessary, install the stub shaft to the valve spool in the following manner:

   Lubricate the stub shaft assembly (3)

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1. Insert the stub shaft (3) into the valve spool.
2. Insert the pin.

IMPORTANT: Make sure that the shaft cap notch (1) is mated with the valve body pin before installing the valve body into the steering gear assembly.

3. The notch in the cap (1) must fully engage the valve body pin (2). Seat the cap against the valve body shoulder.

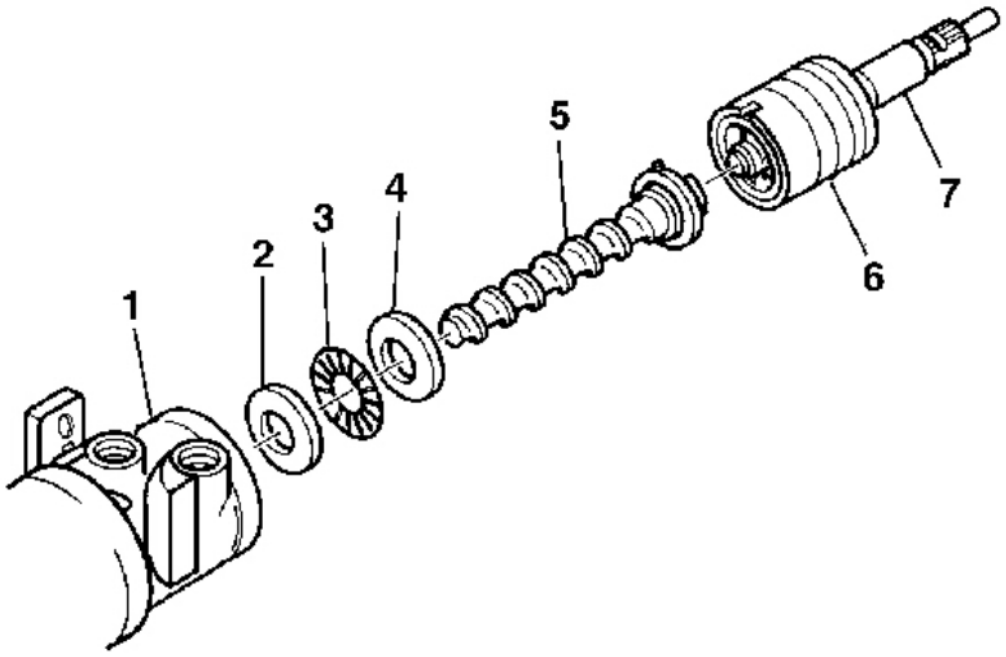


Fig. 85: Disassembled View Of Stub Shaft, Valve Assembly & Worm Shaft
Courtesy of GENERAL MOTORS CORP.

4. Install the stub shaft (7) and valve assembly (6) to the worm shaft (5). Ensure the pin fits in the worm shaft to the slot in the valve assembly.
5. Install the thrust support assembly. Refer to **Steering Gear Thrust Support Replacement - Off Vehicle**.

RACK PISTON AND WORM SHAFT REPLACEMENT - OFF VEHICLE (700 GEAR)

Tools Required

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- **J 21552** Rack Piston Arbor. See **Special Tools and Equipment**.
- **J 8947** Rack Piston Teflon Ring Compressor. See **Special Tools and Equipment**.

Disassembly Procedure

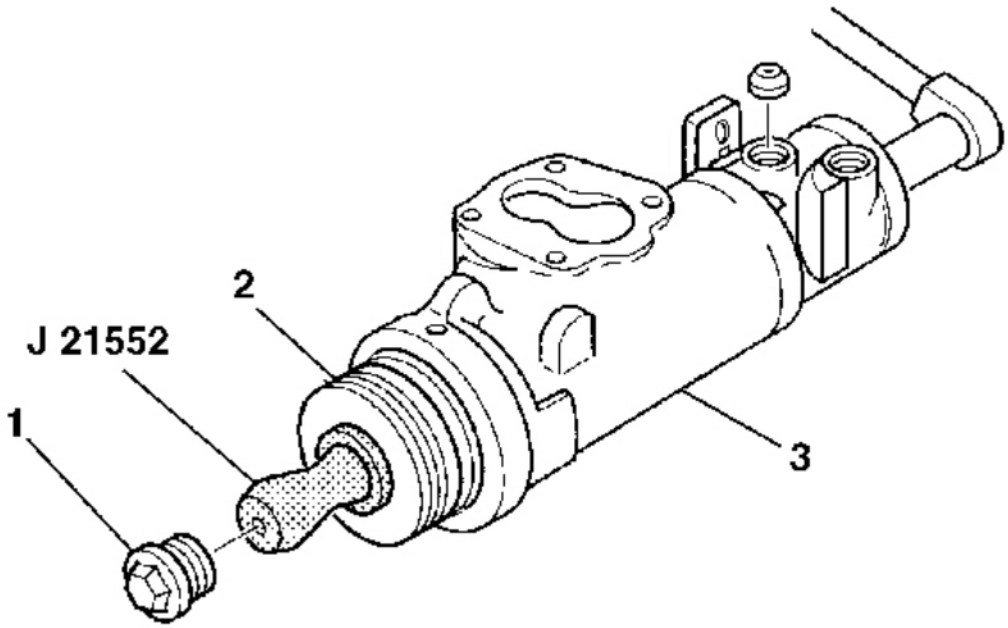


Fig. 86: View Of Rack Piston, Steering Gear Housing, Rack Piston Plug & J 21552
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not remove the needle bearing when removing the pitman shaft arm and its components.

1. Remove the pitman shaft seals and bearing. Refer to **Pitman Shaft Seals and Bearing Replacement - Off Vehicle (670 Gear)**.
2. Remove the housing end plug. Refer to **Steering Gear Housing End Plug Replacement - Off Vehicle**.
3. Turn the stub shaft counterclockwise until the rack piston (2) begins to come out of the steering gear housing (3).
4. Remove the rack piston plug (1).
5. Insert **J 21552** into the bore of the rack piston (2). See **Special Tools and Equipment**.
6. Hold **J 21552** tightly against the worm shaft while turning the stub shaft counterclockwise. Turning the stub shaft forces the rack piston (2) onto **J 21552** . The rack piston balls remain in place. See **Special**

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Tools and Equipment.

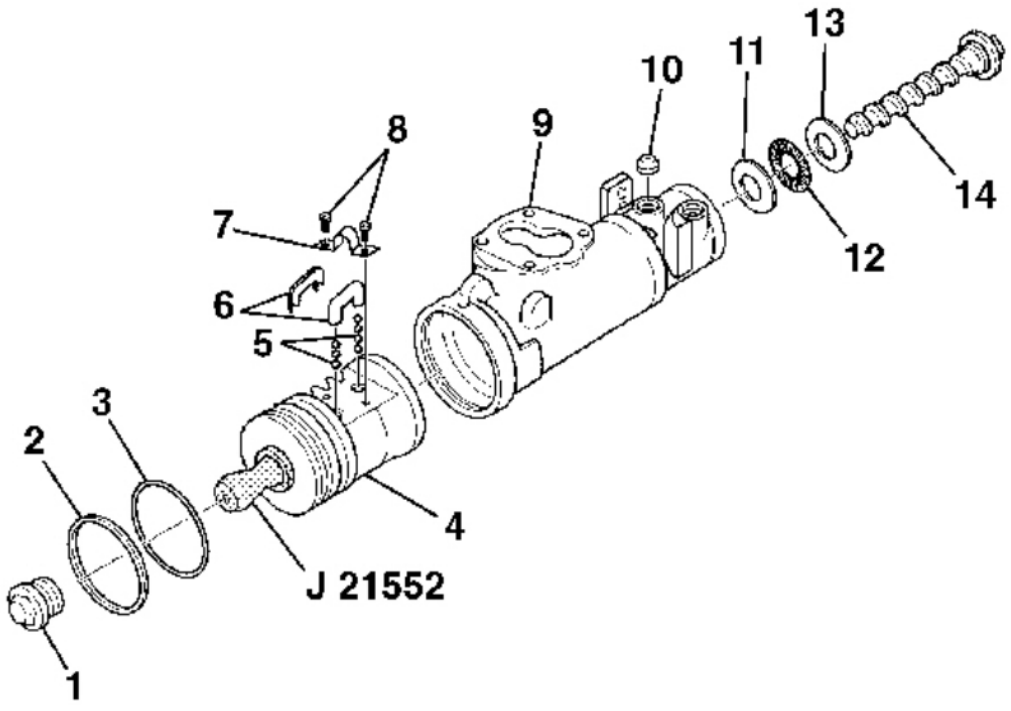


Fig. 87: Disassembled View Of Steering Gear Housing Components
Courtesy of GENERAL MOTORS CORP.

7. Remove the following items as an assembly from the steering gear housing (9):
   - The rack piston (4)
   - The rack piston screws (8), clamp (7), ball guide (6) and balls (5)
   - **J 21552** . See **Special Tools and Equipment**.
8. Remove the spool valve assembly. Refer to **Steering Gear Valve Replacement - Off Vehicle (700 Gear)**.
9. Remove the worm shaft (14).
10. Remove the thrust bearing (12) and the flat races (11, 13).

IMPORTANT: When removing J 21552 , watch for falling piston balls (5) from inside the rack piston (4). See Special Tools and Equipment.

11. Remove **J 21552** from the rack piston (4). See **Special Tools and Equipment**.

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12. Remove the rack piston balls (5).
13. Remove the following items from the rack piston (4):
    1. The screws (8)
    2. The clamp (7)
    3. The ball guide (6)
    4. The remaining rack piston balls (5) in the ball guide (6)
14. Remove the teflon ring (2).
15. Remove the O-ring seal (3).
16. Clean all of the disassembled parts.
17. Inspect all of the disassembled parts for wear.
18. Replace the parts if necessary.

Assembly Procedure

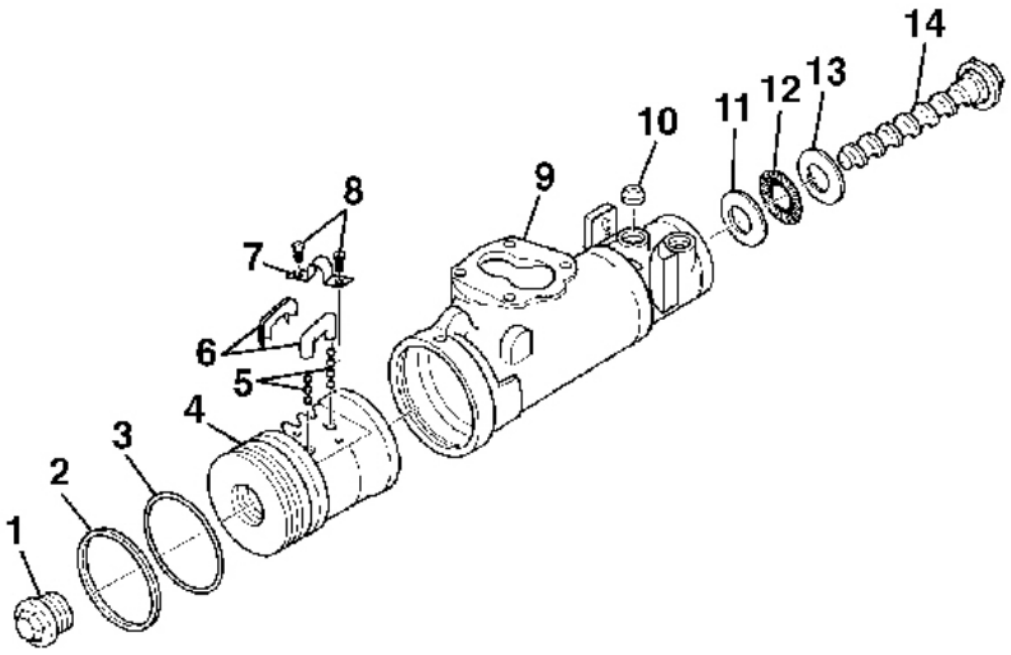


Fig. 88: View Of O-Ring Seal, Teflon Ring, Worm Shaft, Rack Piston & Steering Gear Housing
Courtesy of GENERAL MOTORS CORP.

1. Install the O-ring seal (3) and the teflon ring (2).
2. Lubricate both parts with power steering fluid.

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3. Install the worm shaft (14) to the rack piston (4) outside of the steering gear housing (9).

   Fully seat the worm shaft to the rack piston.

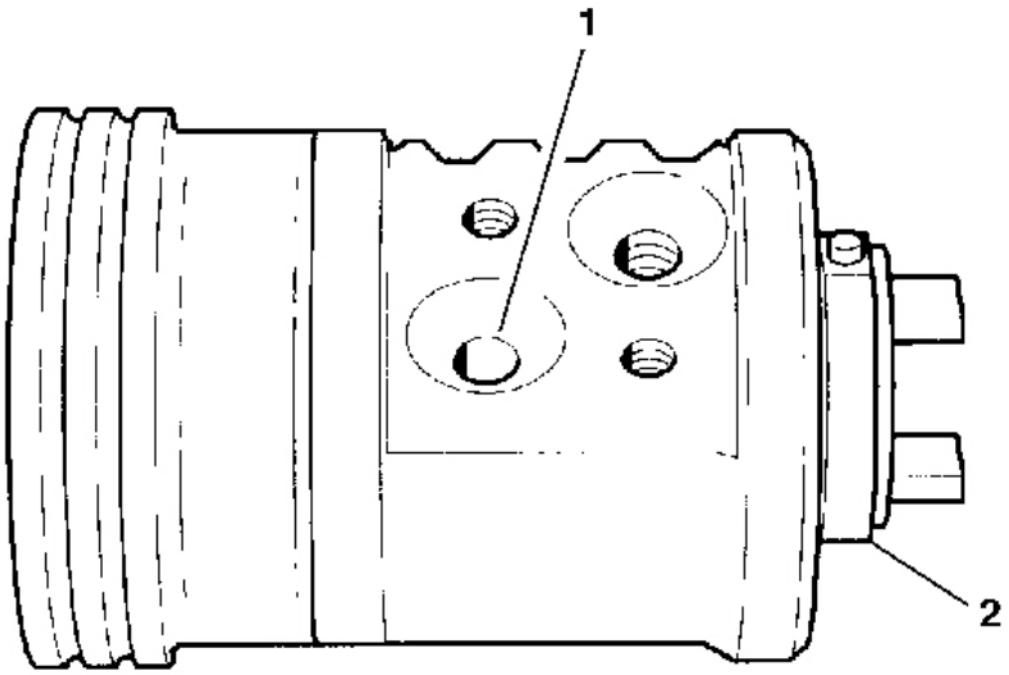


Fig. 89: View Of Worm Shaft & Rack Piston Ball Return Guide Hole
Courtesy of GENERAL MOTORS CORP.

4. Align the worm shaft spiral groove with the rack piston ball return guide hole (1).

CAUTION: In order to avoid injury and/or component damage, install all of the rack piston balls into the rack piston. Install the rack piston balls in the correct order. If you do not correctly install all of the rack piston balls, the steering gear may not operate or may wear out quickly.

5. Lubricate the rack piston balls with power steering fluid.
6. Insert the rack piston balls through the ball return guide hole (1) while turning worm shaft (2) counterclockwise in order to install the rack piston balls into the rack piston. Install the black and the silver rack piston balls alternately into the rack piston and the ball guide to maintain the rack piston to the worm shaft preload.

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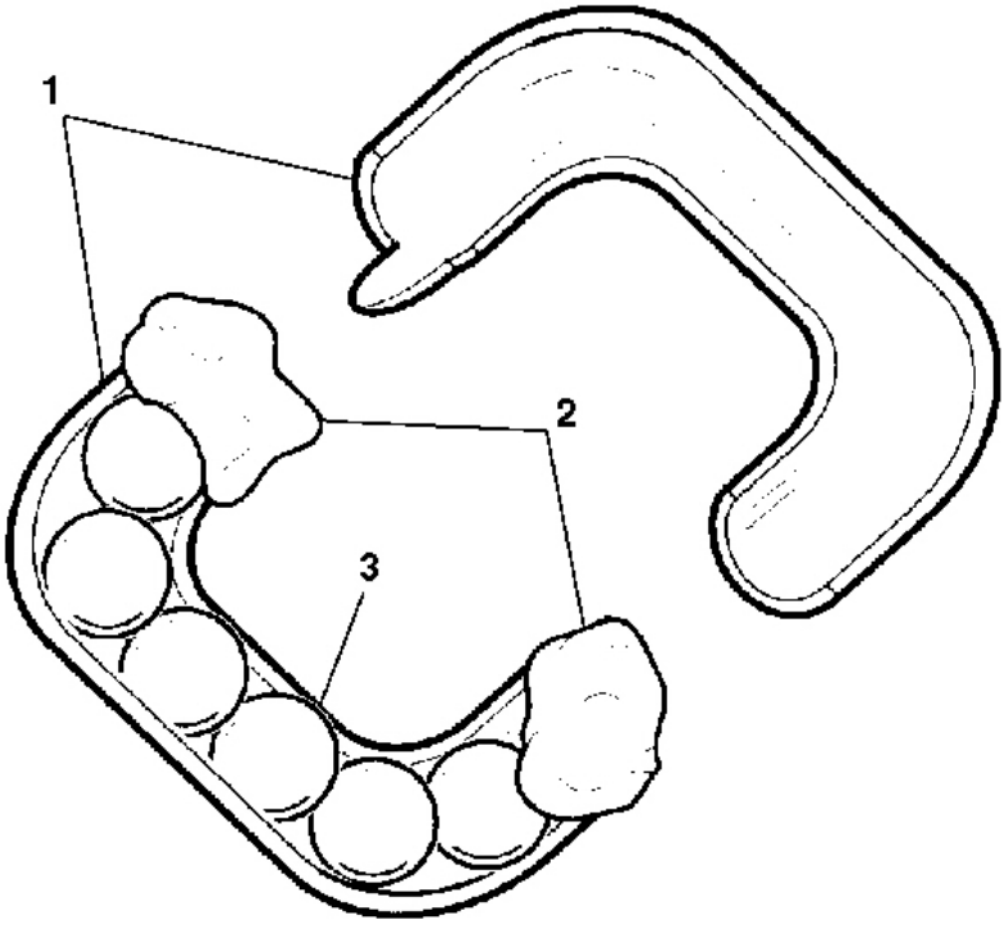


Fig. 90: View Of Rack Piston Balls & Ball Guide
Courtesy of GENERAL MOTORS CORP.

7. Install the remaining rack piston balls (3) into the ball guide (1) using grease at each end (2) to retain the rack piston balls (3).

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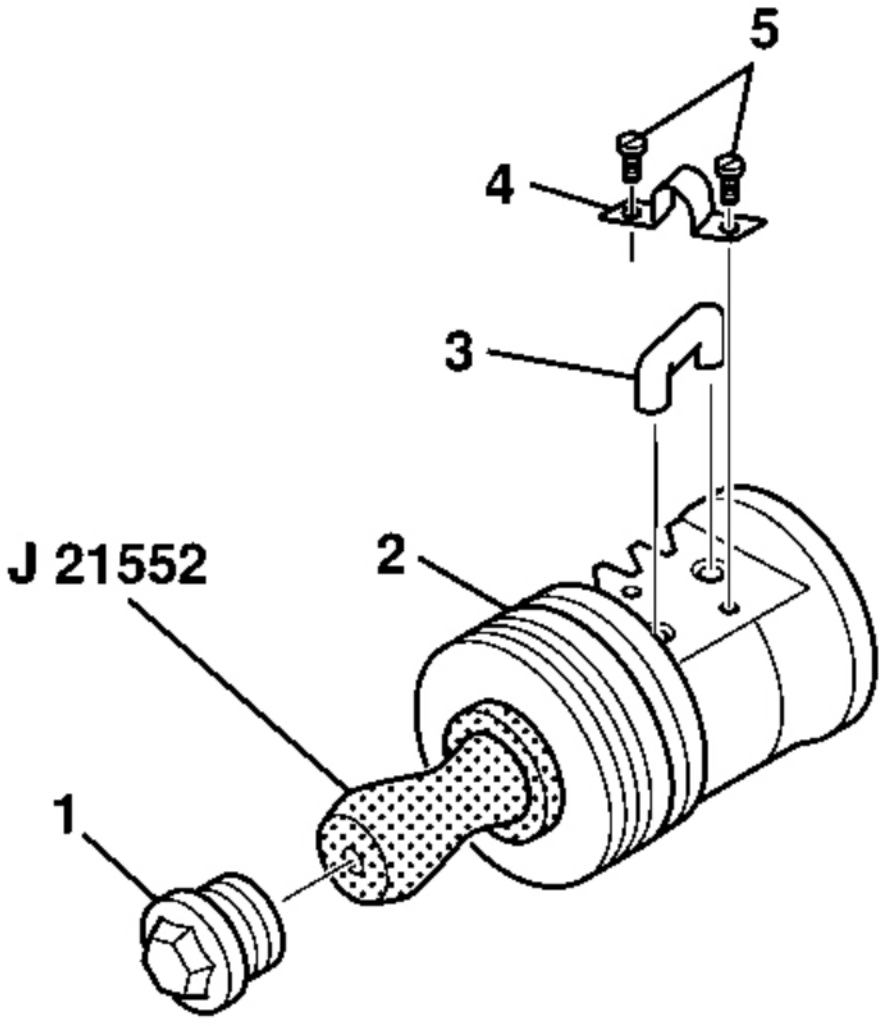


Fig. 91: View Of Ball Guide, Ball Guide Clamp, Rack Piston & Screws
Courtesy of GENERAL MOTORS CORP.

8. Install the ball guide (3) to the rack piston (2).
9. Install the ball guide clamp (4).

NOTE: Refer to Fastener Notice in Cautions and Notices.

10. Install the screws (5).

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Tighten: Tighten the screws (5) to 6 N.m (53 lb in).

11. Insert **J 21552** into the bore of the rack piston while turning the worm shaft counterclockwise. The turning of the worm shaft forces the rack piston onto **J 21552** . The rack piston balls remain in place. See **Special Tools and Equipment**.

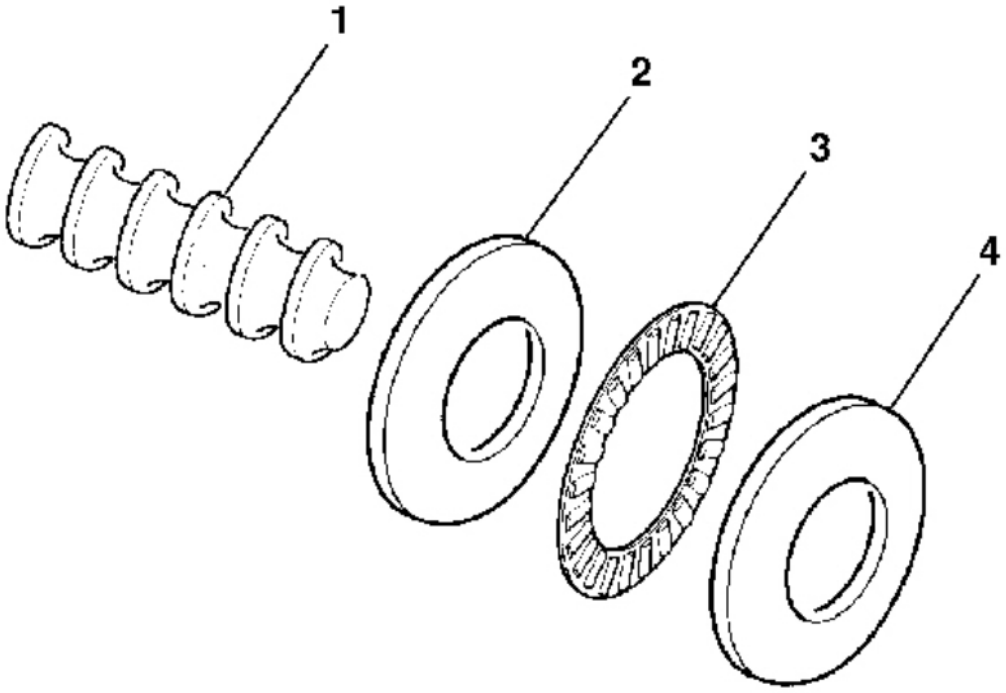


Fig. 92: Installing The Flat Races And The Thrust Bearing Onto The Worm Shaft (700 Gear)
Courtesy of GENERAL MOTORS CORP.

12. Install the flat races (2, 4) and the thrust bearing (3) onto the worm shaft (1).

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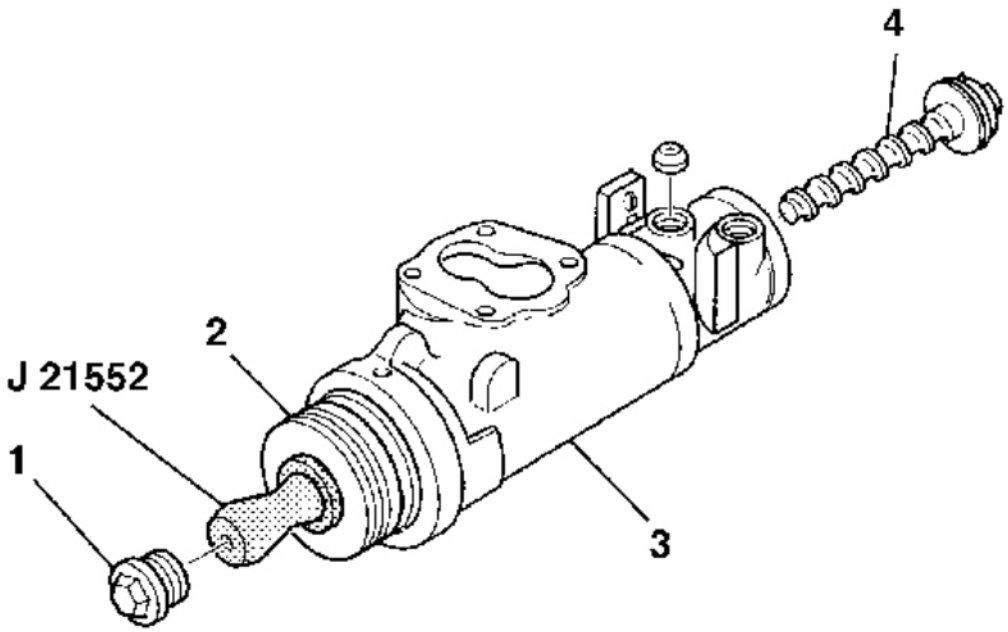


Fig. 93: View Of Worm Shaft, Steering Gear Housing, Rack Piston, Rack Piston Plug & J 21552
Courtesy of GENERAL MOTORS CORP.

13. Install the worm shaft (4) to the steering gear housing (3).

IMPORTANT: Do not adjust the worm shaft until all components are installed onto the steering gear housing.

14. Install the spool valve. Refer to **Steering Gear Valve Replacement - Off Vehicle (700 Gear)**.
15. Install the rack piston (2) to the worm (4) from **J 21552** using **J 8947** to compress the seals. See **Special Tools and Equipment**.
16. Hold **J 21552** tightly against the worm shaft (4). See **Special Tools and Equipment**.
17. Turn the stub shaft clockwise until the rack piston (2) is seated on the worm shaft (4).
18. Remove **J 21552** from the rack piston (1). See **Special Tools and Equipment**.
19. Install the rack piston plug (1).

Tighten: Tighten the rack piston plug to 150 N.m (111 lb ft).

20. Install the housing end plug. Refer to **Steering Gear Housing End Plug Replacement - Off Vehicle**.

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IMPORTANT: Do not adjust the pitman shaft until all components are installed onto the steering gear housing.

21. Install the pitman shaft seals and bearing. Refer to **Pitman Shaft Seals and Bearing Replacement - Off Vehicle (670 Gear)**.
22. To adjust the steering gear; refer to one of the following procedures:
    - **Worm Thrust Bearing Preload Adjustment - Off Vehicle**
    - **Pitman Shaft Over-Center Preload Adjustment - Off Vehicle**

PITMAN SHAFT SEALS AND BEARING REPLACEMENT - OFF VEHICLE (670 GEAR)

Tools Required

- **J 6278** Pitman Shaft Bearing Remover and Installer. See **Special Tools and Equipment**.
- **J 6219** Pitman Shaft Oil Seal Installer. See **Special Tools and Equipment**.
- **J 4245** Internal Snap Ring Pliers. See **Special Tools and Equipment**.

Disassembly Procedure

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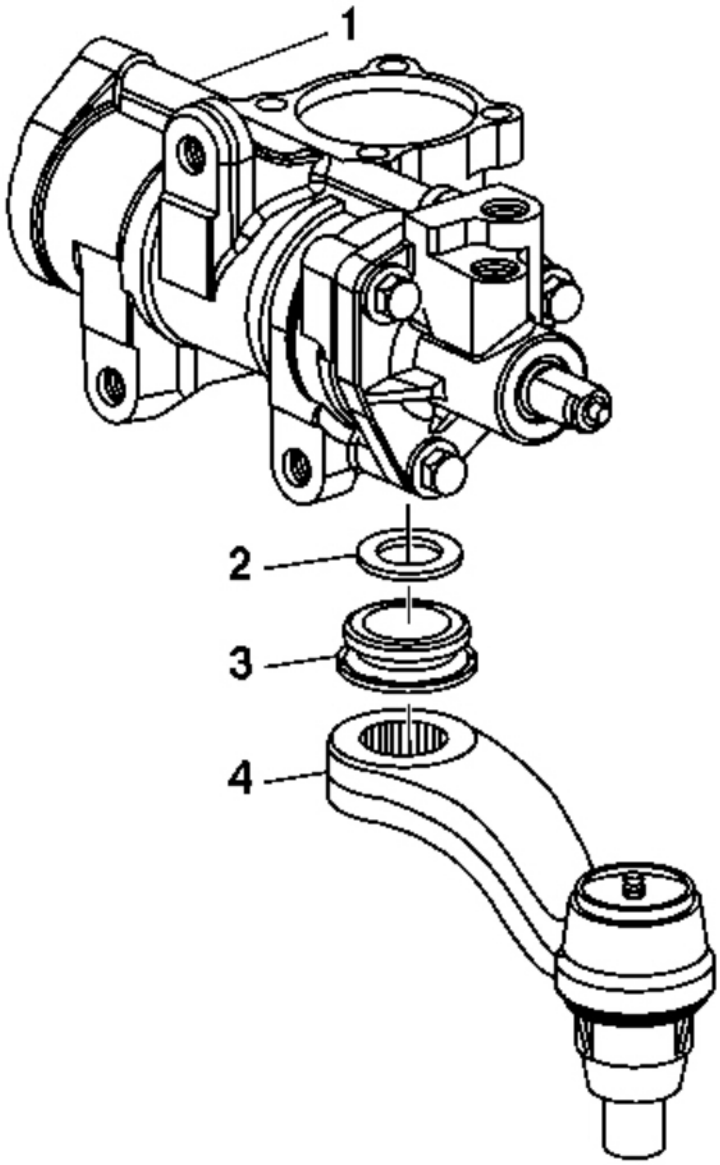


Fig. 94: View Of Pitman Arm, Shaft Boot, Shaft Dust Seal & Steering Gear Housing
Courtesy of GENERAL MOTORS CORP.

1. Remove the steering gear pitman shaft and housing cover. Refer to **Steering Gear Pitman Shaft and Housing Cover Replacement - Off Vehicle (670 Gear)**.
2. Remove the pitman arm (4) from the steering gear.

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3. Remove the pitman shaft boot (3) from the steering gear housing (1).

IMPORTANT: Do not score the housing bore when prying out seals and washers.

4. Remove the pitman shaft dust seal (2) from the steering gear housing (1).

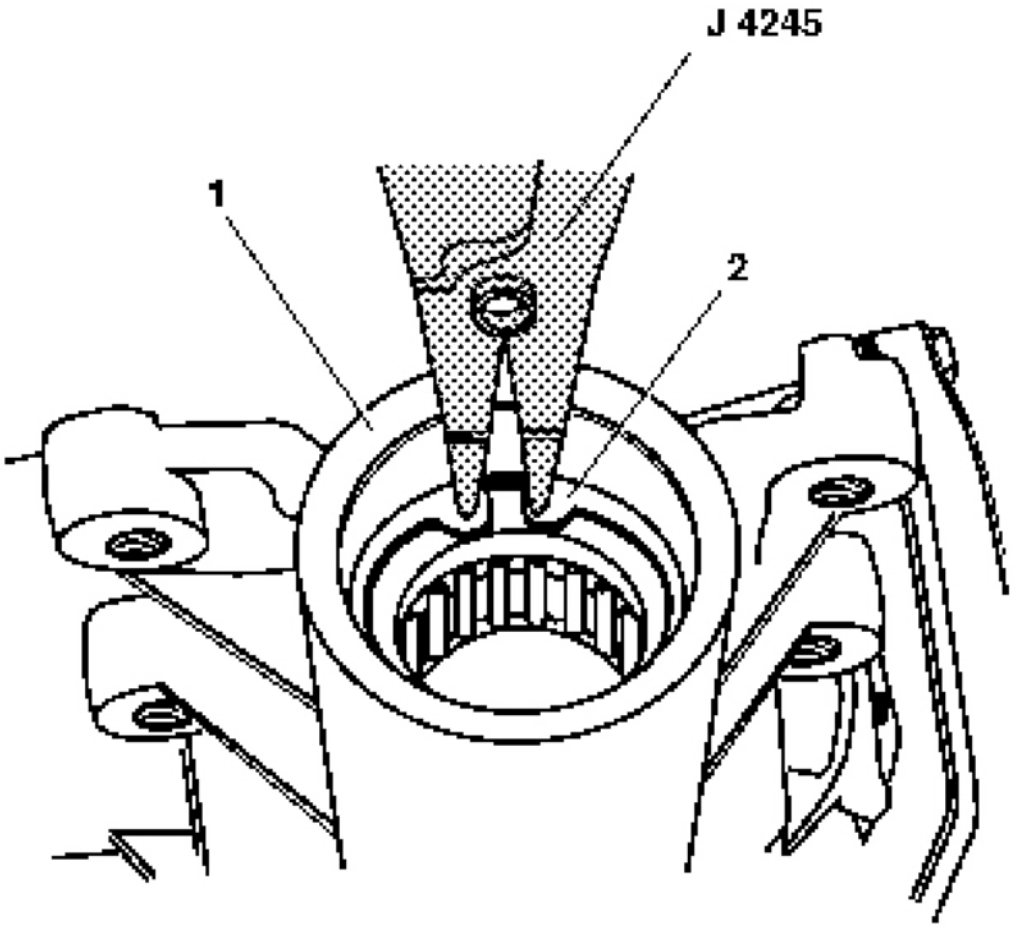


Fig. 95: View Of Pitman Shaft Retaining Ring & J 4245
Courtesy of GENERAL MOTORS CORP.

5. Remove the pitman shaft retaining ring (2) from the steering gear housing (1) using **J 4245** . See **Special Tools and Equipment**.

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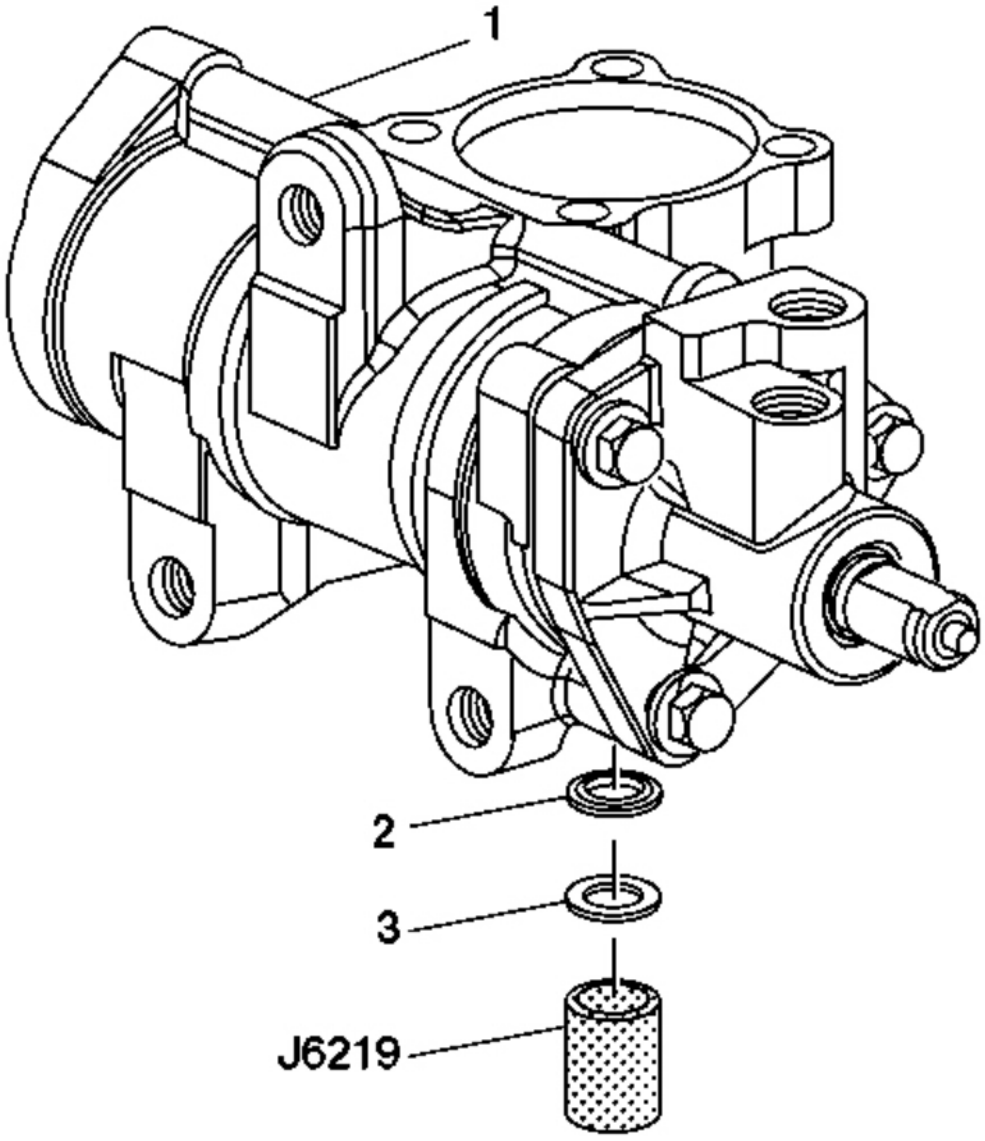


Fig. 96: View Of Backup Washer, Pitman Shaft Seal & J 6219
Courtesy of GENERAL MOTORS CORP.

6. Remove the backup washer (3) from the steering gear housing (1).
7. Pry the pitman shaft seal (2) from the steering gear housing (1) using a screwdriver.
8. Inspect the housing for burrs and replace if necessary.

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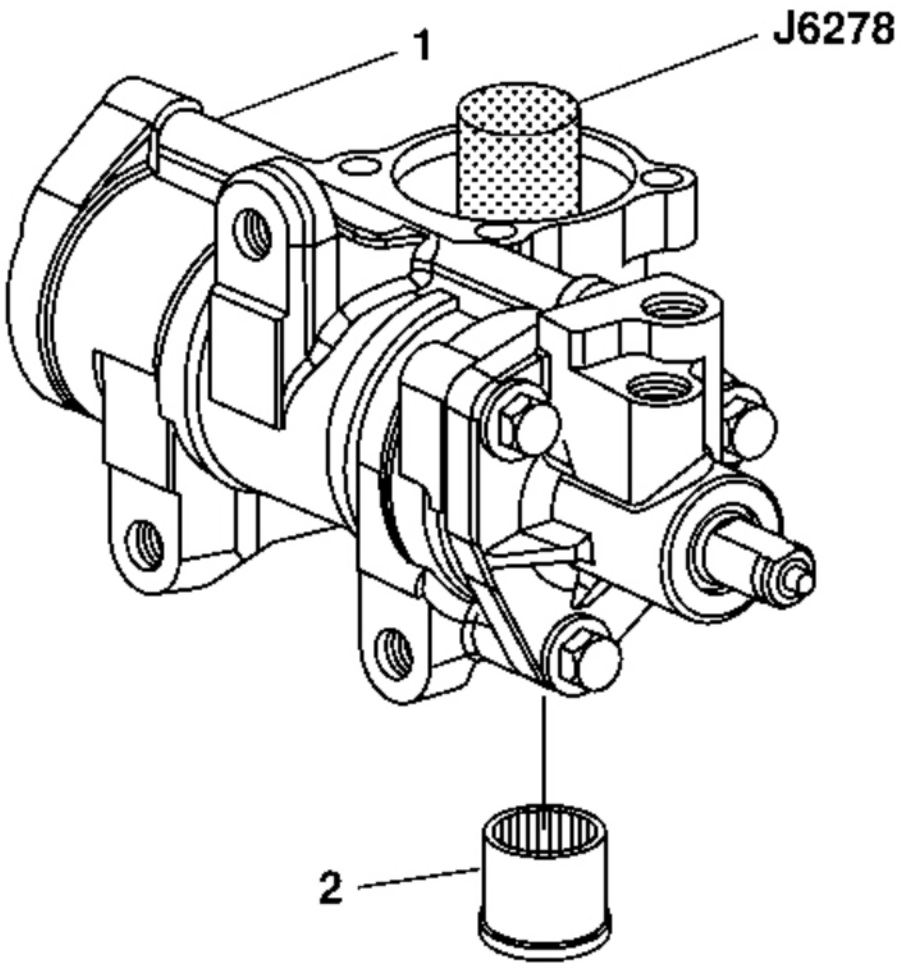


Fig. 97: Removing Needle Bearing Using J 6278
Courtesy of GENERAL MOTORS CORP.

9. Insert **J 6278** through the hole in the top of the steering gear housing (1). See **Special Tools and Equipment**.
10. Drive out the needle bearing (2) from the steering gear housing (1).

Assembly Procedure

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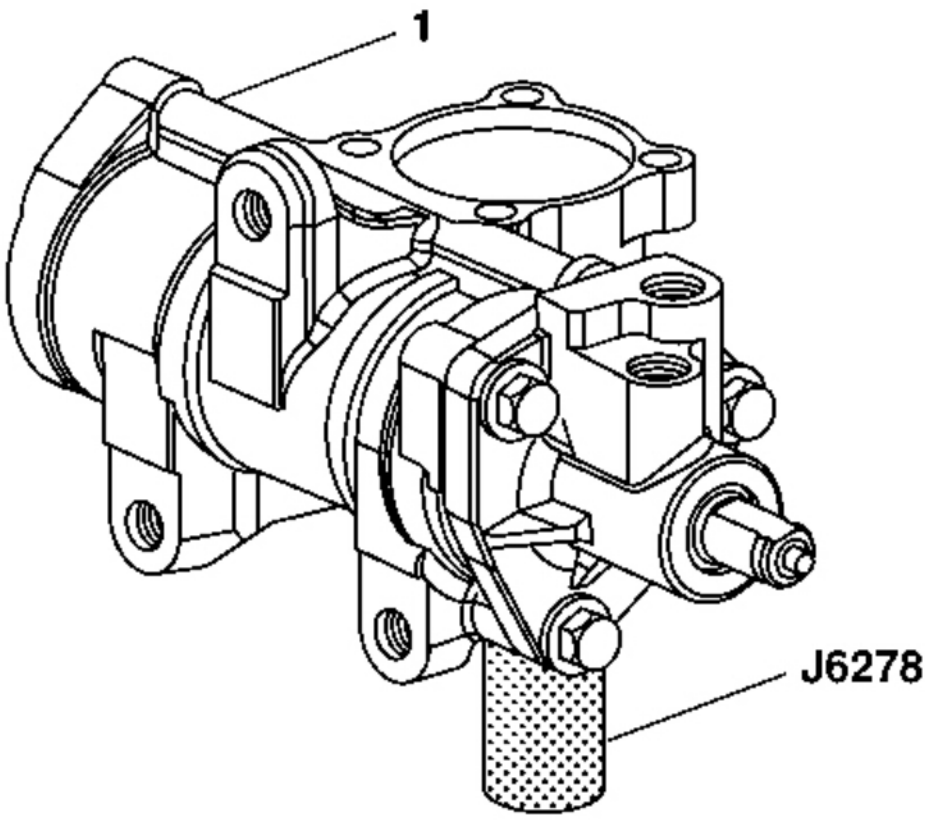


Fig. 98: Installing Needle Bearing Using J 6278
Courtesy of GENERAL MOTORS CORP.

1. Install the needle bearing into the steering gear housing (1) using **J 6278** . See **Special Tools and Equipment**.
2. Drive the bearing into the housing until the needle bearing shoulder seats against the housing.

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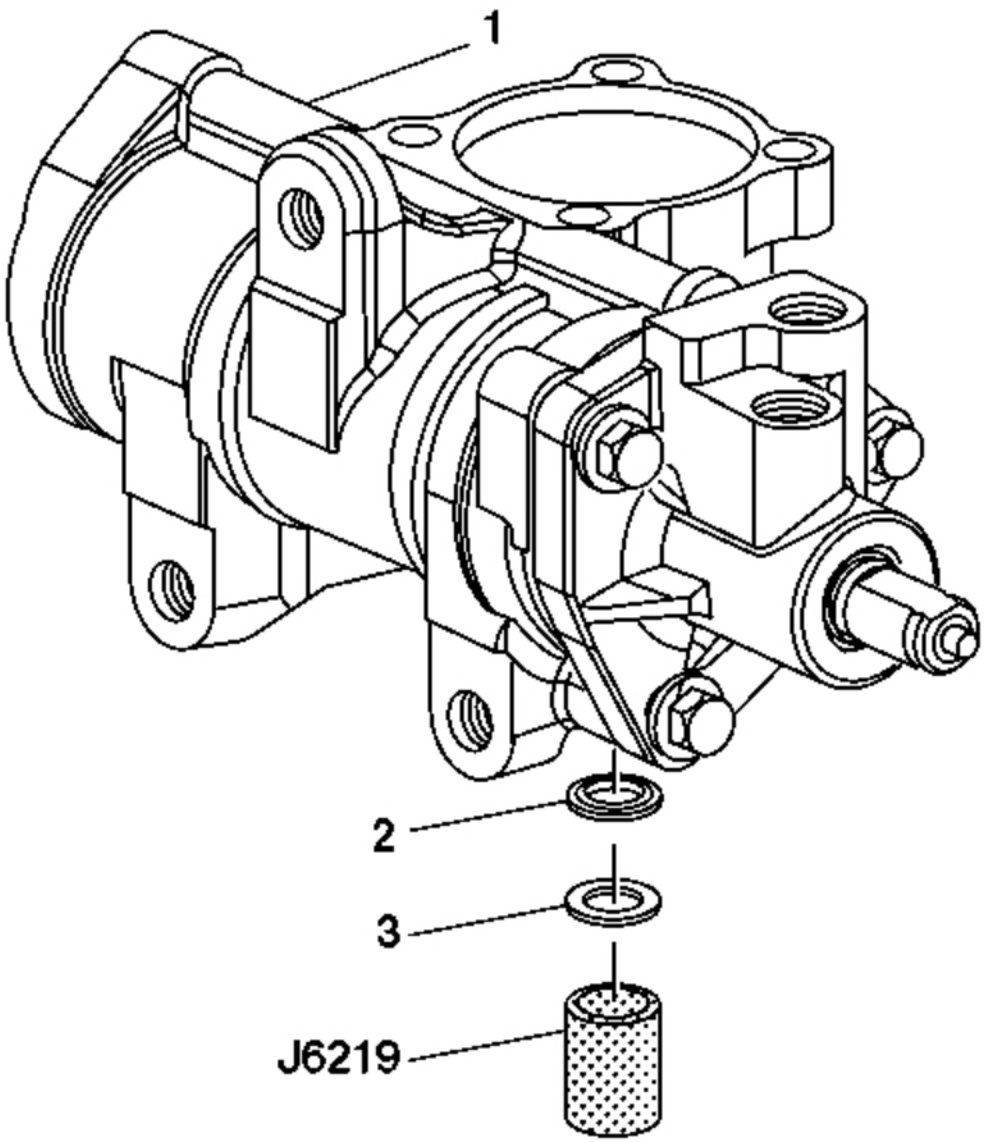


Fig. 99: View Of Backup Washer, Pitman Shaft Seal & J 6219
Courtesy of GENERAL MOTORS CORP.

3. Coat the pitman shaft seal (2) and backup washer (3) with grease.
4. Install the pitman shaft seal (2) onto the steering gear housing (1) using **J 6219** . See **Special Tools and Equipment**.
5. Install the backup washer (3) onto the steering gear housing (1).

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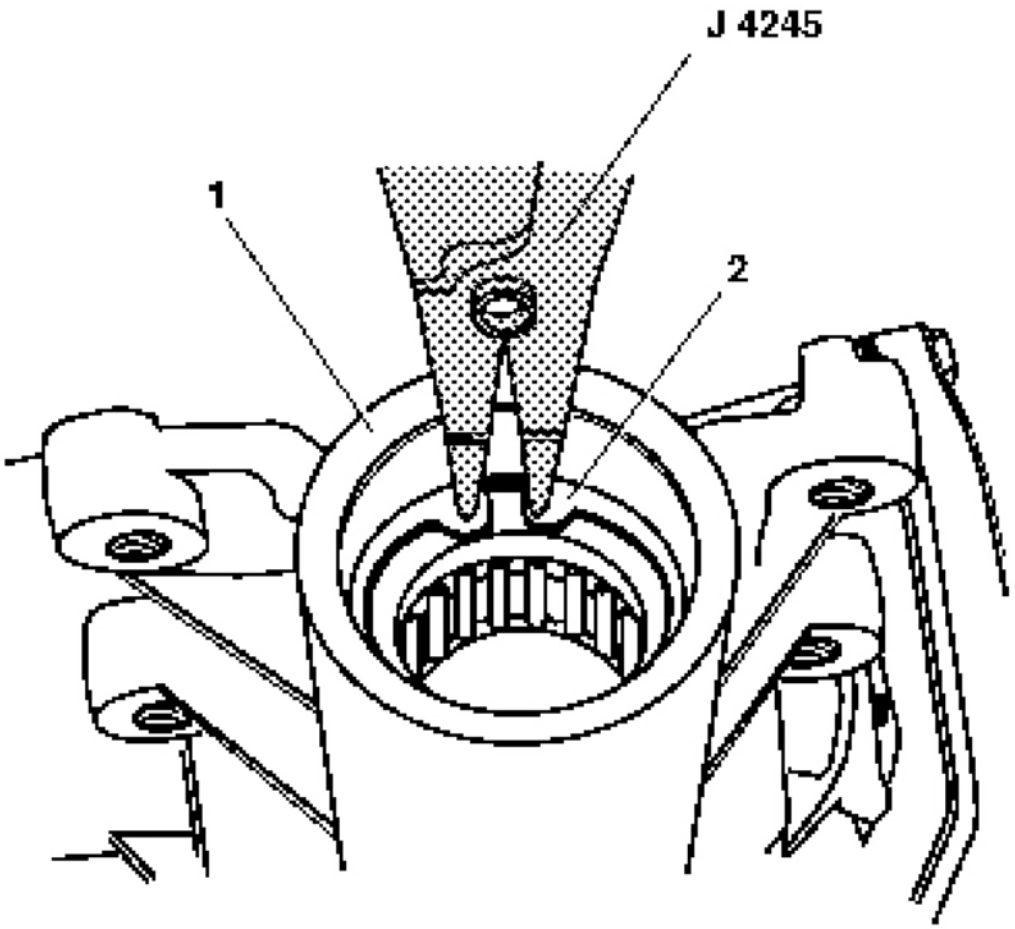


Fig. 100: View Of Pitman Shaft Retaining Ring & J 4245
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The pitman shaft seal must not contact the bearing.

6. Install the pitman shaft retainer ring (2) onto the steering gearing housing (1) using **J 4245** . See **Special Tools and Equipment**.

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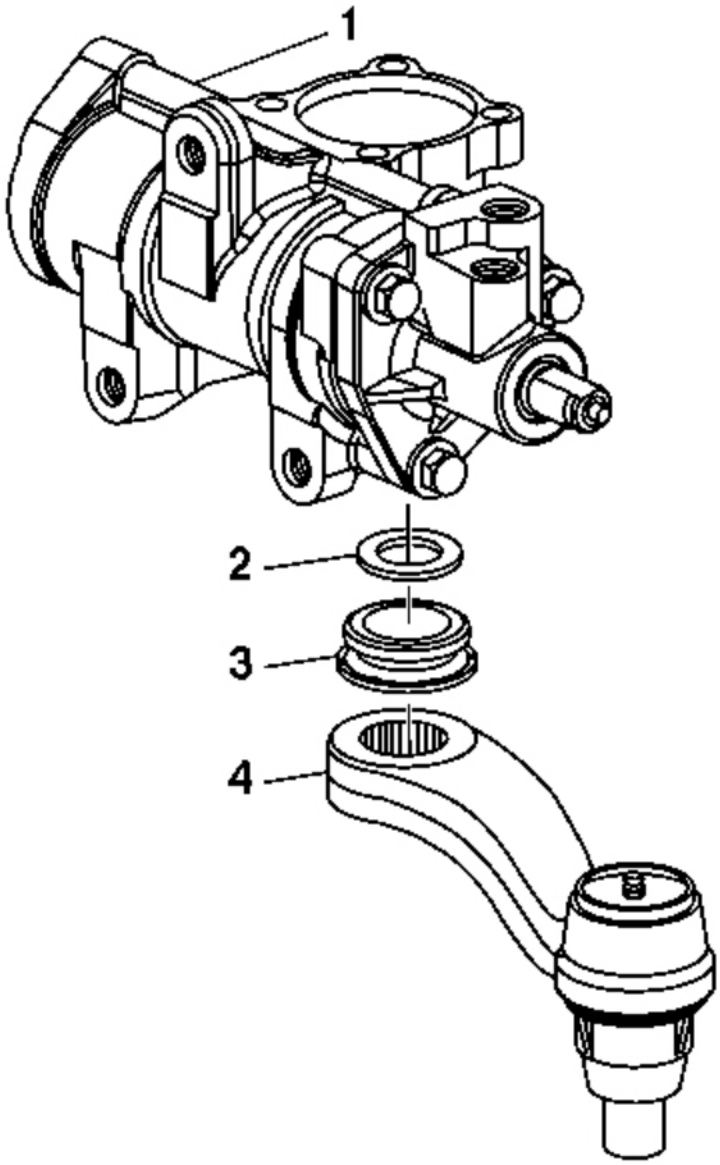


Fig. 101: View Of Pitman Arm, Shaft Boot, Shaft Dust Seal & Steering Gear Housing
Courtesy of GENERAL MOTORS CORP.

7. Coat the dust seal (2) with grease.
8. Install the dust seal (2) onto the steering gear housing (1).
9. Install the pitman shaft boot (3) onto the steering gear housing (1).

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IMPORTANT: Do not install the lock washer and nut until all components have been installed onto the steering gear housing.

10. Install the pitman shaft and the side cover. Refer to **Steering Gear Pitman Shaft and Housing Cover Replacement - Off Vehicle (670 Gear)**.
11. Install the pitman arm (4) to the steering gear.

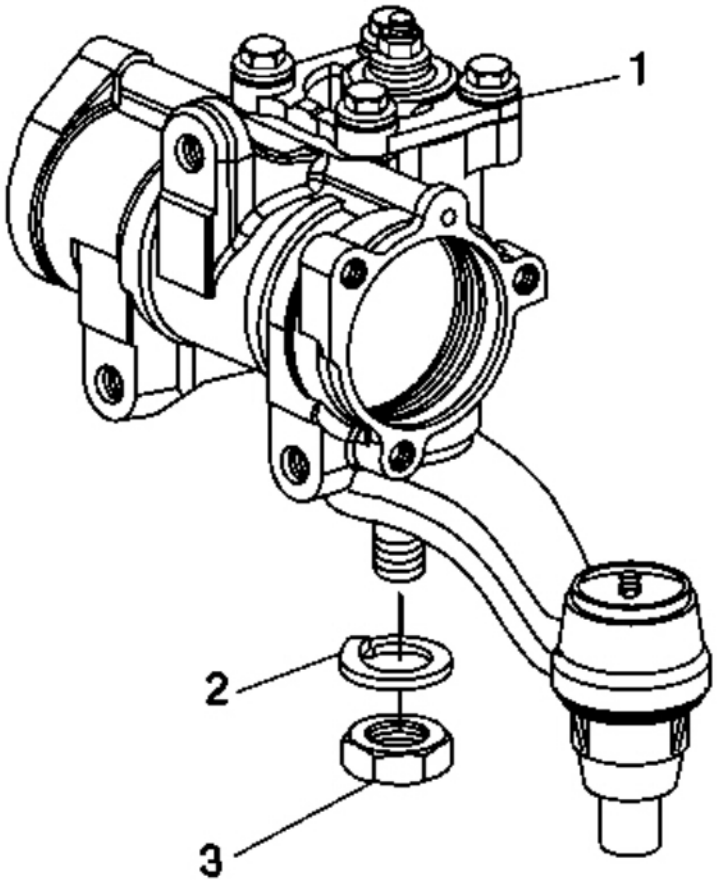


Fig. 102: View Of Steering Gear Housing, Lock Washer & Nut
Courtesy of GENERAL MOTORS CORP.

12. Install the lock washer (2).
13. Install the nut (3).
14. To adjust the pitman shaft, refer to **Pitman Shaft Over-Center Preload Adjustment - Off Vehicle**.

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STEERING GEAR CHECK VALVE REPLACEMENT - OFF VEHICLE

Disassembly Procedure

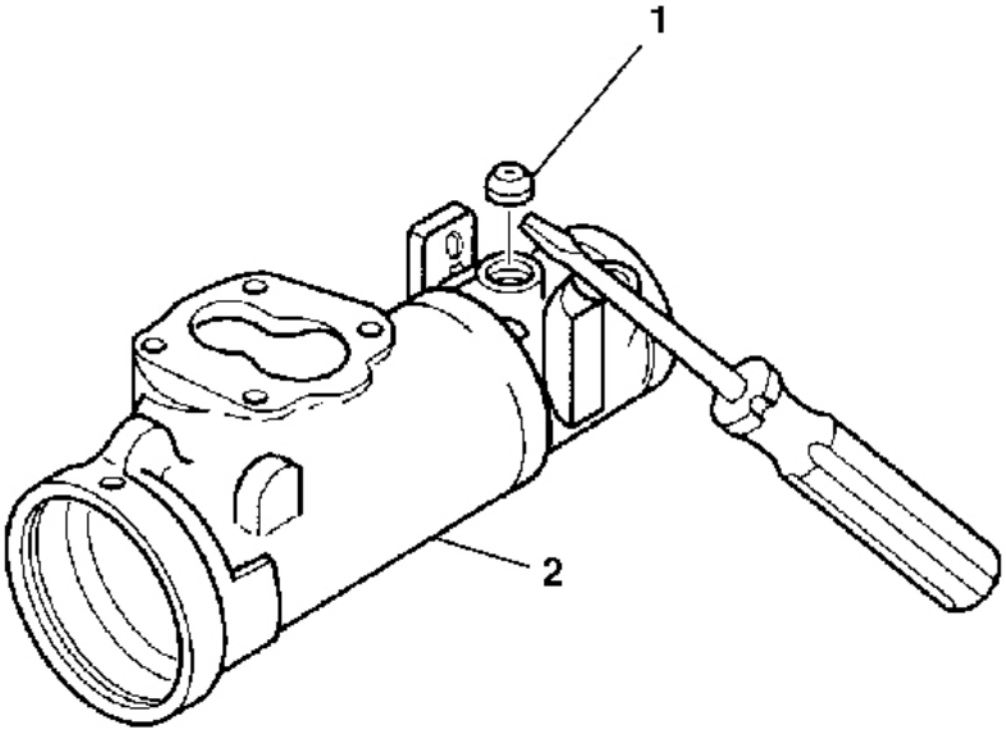


Fig. 103: Removing Check Valve From Steering Gear Housing
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not to damage the threads of the steering gear housing when removing the check valve.

Remove the check valve (1) from the steering gear housing (2) using a small screwdriver.

Assembly Procedure

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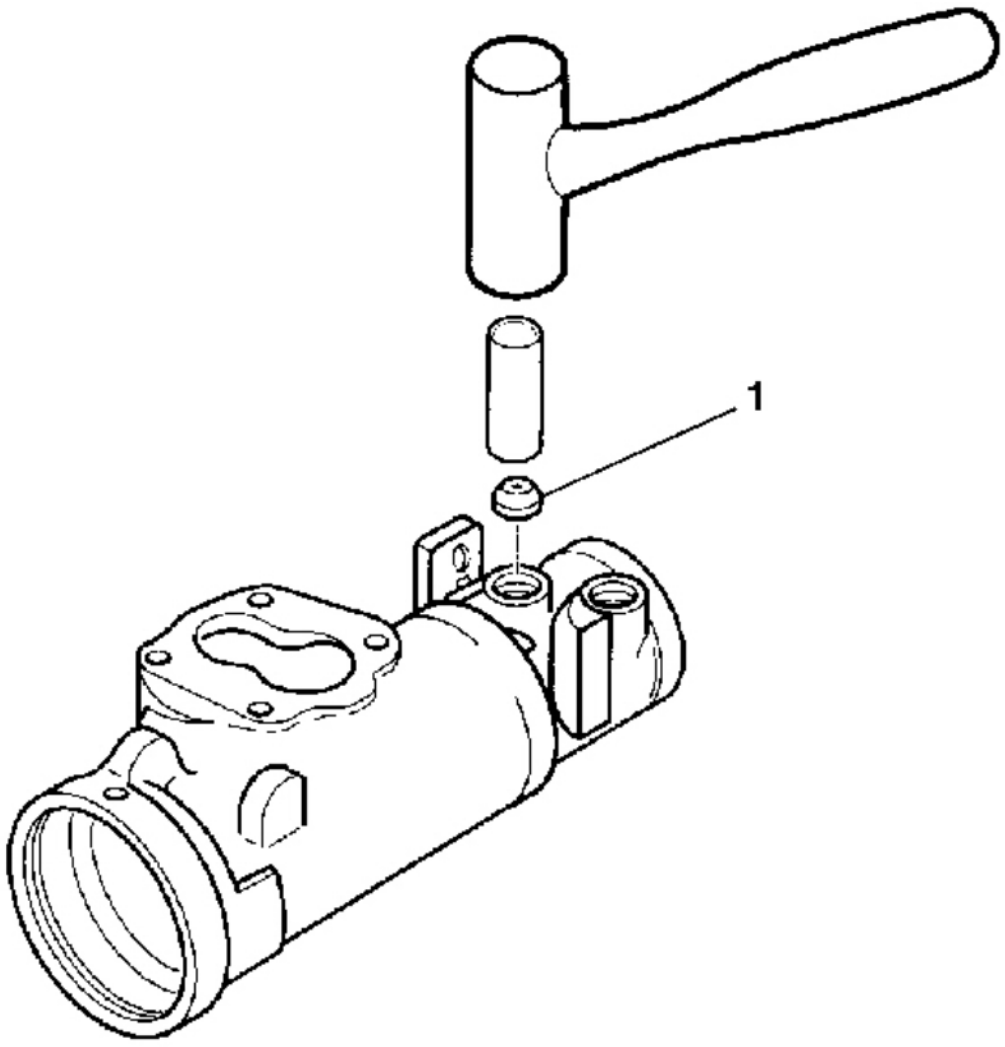


Fig. 104: Installing Check Valve
Courtesy of GENERAL MOTORS CORP.

Install the check valve (1) using a 9.52mm inch diameter piece of tubing 100 mm (4 in) long to drive into the steering gear housing.

STUB SHAFT HOUSING REPLACEMENT (670 GEAR)

Disassembly Procedure

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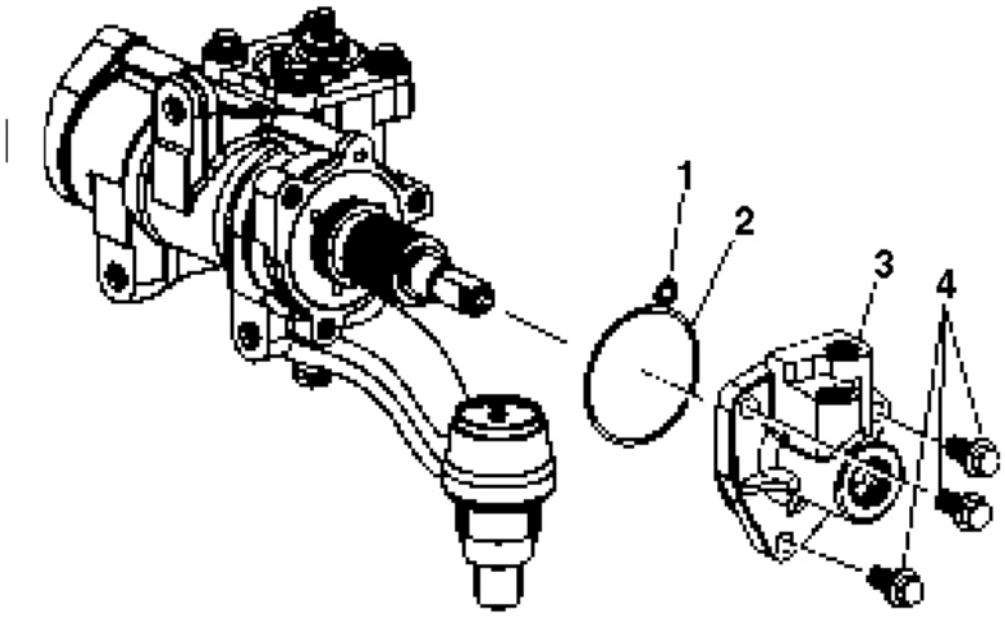


Fig. 105: View Of Stub Shaft Housing, Bolts & O-Rings (670 Gear)
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Replace the housing if the stub shaft housing, seal or bearing are damaged.

1. Remove the stub shaft housing bolts (4) from the stub shaft housing (3).
2. Remove the stub shaft housing (3) from the steering gear.
3. Remove the stub shaft housing O-rings (1) (2) from the steering gear.

Assembly Procedure

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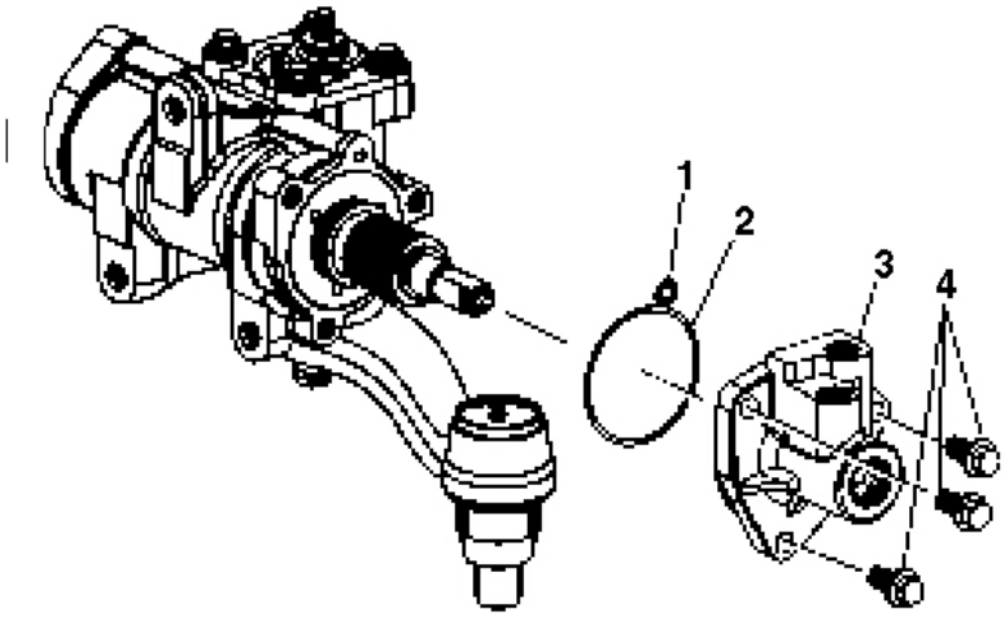


Fig. 106: View Of Stub Shaft Housing, Bolts & O-Rings (670 Gear)
Courtesy of GENERAL MOTORS CORP.

1. Grease the stub shaft seal with the special grease supplied with the new stub shaft housing.
2. Install the new stub shaft housing O-rings (1) (2).
3. Install the stub shaft housing (3) onto the steering gear.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the stub shaft housing bolts (4) into the stub shaft housing (3).

Tighten: Tighten the stub shaft housing bolts to 63 N.m (46 lb ft).

STEERING GEAR THRUST SUPPORT REPLACEMENT - OFF VEHICLE

Tools Required

- **J 42882** P/S Adjuster Nut Wrench. See **Special Tools and Equipment**.
- **J 43435** Power Steering Adjuster Lock Nut Wrench. See **Special Tools and Equipment**.
- J 45798 Steering Gear Bearing Protector

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Removal Procedure

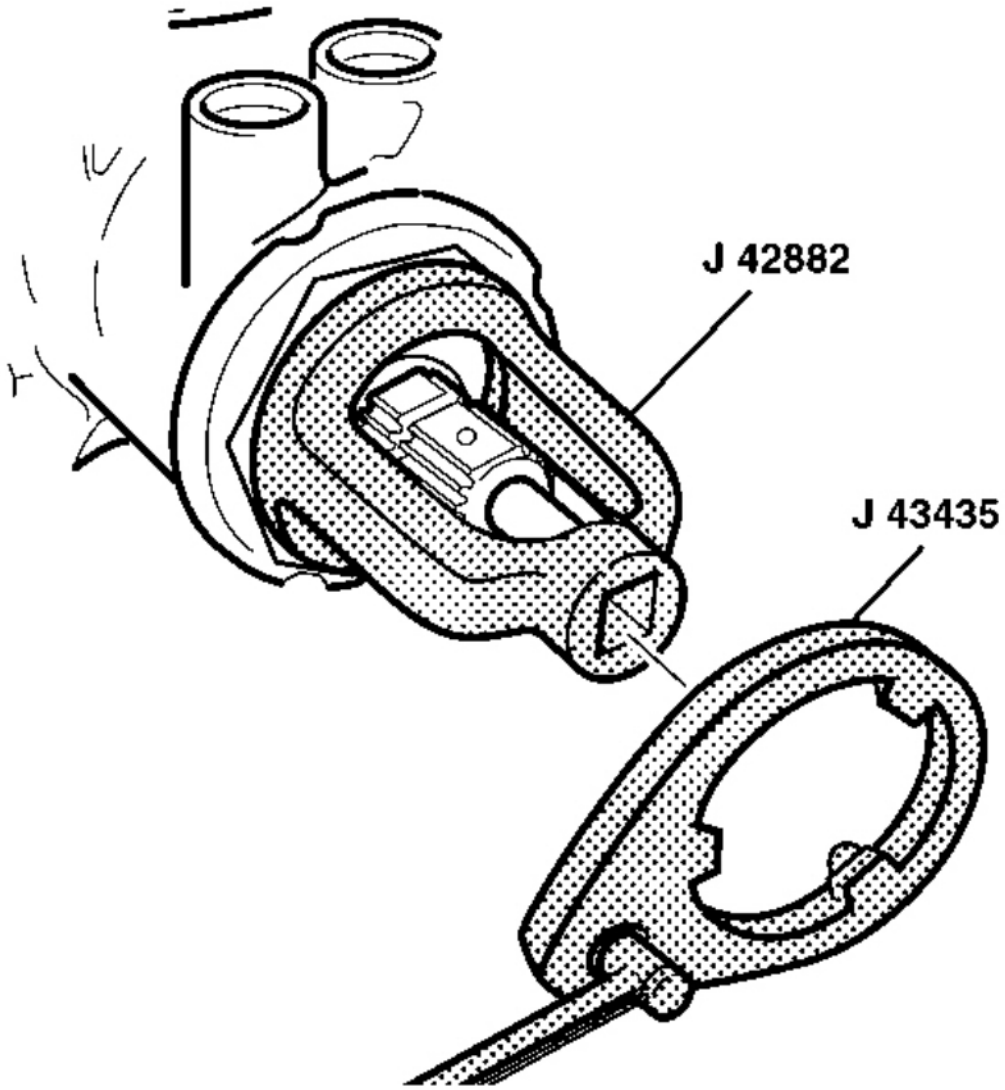


Fig. 107: View Of J 42882 & J 43435 On Adjuster Nut Assembly
Courtesy of GENERAL MOTORS CORP.

1. Remove the steering gear from the vehicle. Refer to **Power Steering Gear Replacement**.
2. Rotate stub shaft back and forth to drain the power steering fluid.
3. Place **J 42882** over the end of the stub shaft. Slide **J 43435** over the top of **J 42882** . Use a torque wrench to remove the lock nut from the steering gear housing.

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J 43435 reverses to work with all available lock nut assemblies.

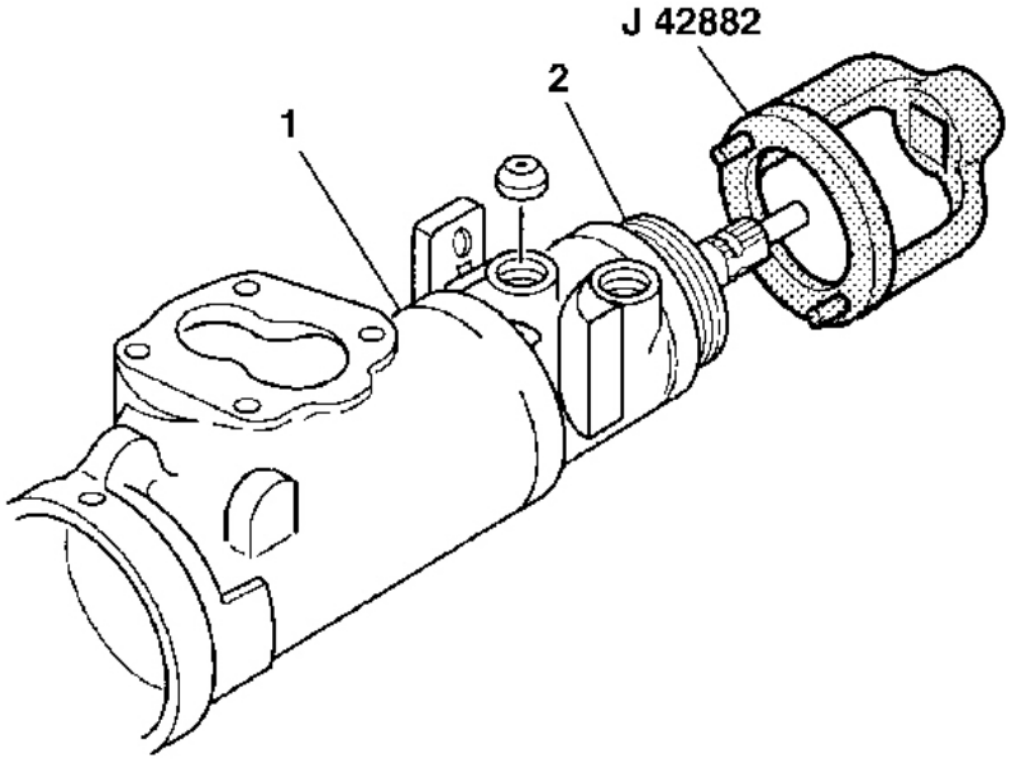


Fig. 108: View Of Adjuster Nut Assembly, Steering Gear Housing & J 42882
Courtesy of GENERAL MOTORS CORP.

4. Using **J 42882** , remove the adjuster nut assembly from the steering gear housing. See **Special Tools and Equipment**.
5. Remove the thrust bearing support from the steering gear housing.

   Discard the thrust bearing support.

Installation Procedure

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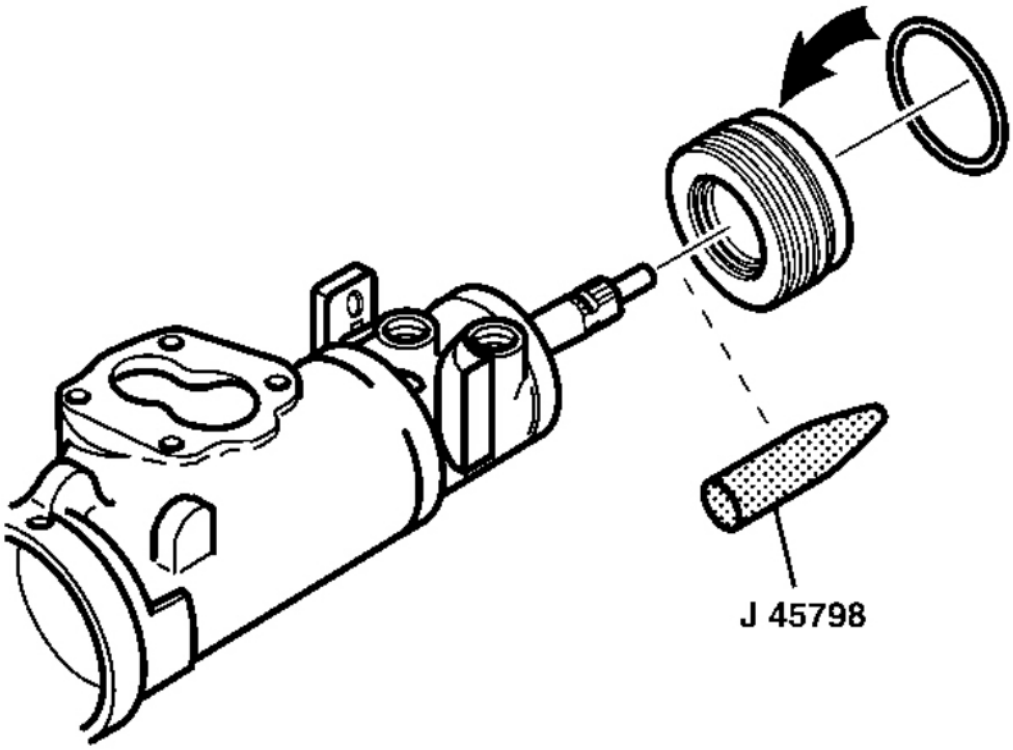


Fig. 109: Installing Thrust Bearing Support Using J 45798
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the new o-ring seal.
2. If necessary, install the new o-ring seal onto the thrust bearing support.
3. Place J 45798 over the stub shaft. This will aid in assembly of the new thrust bearing support.

IMPORTANT: This thrust bearing support is preloaded onto the stub shaft. It will require a large effort to push on. Do not tap thrust bearing support into place with hammer or other object.

4. Press the thrust bearing support onto the stub shaft and into the gear housing. Remove J 45798 from the stub shaft.

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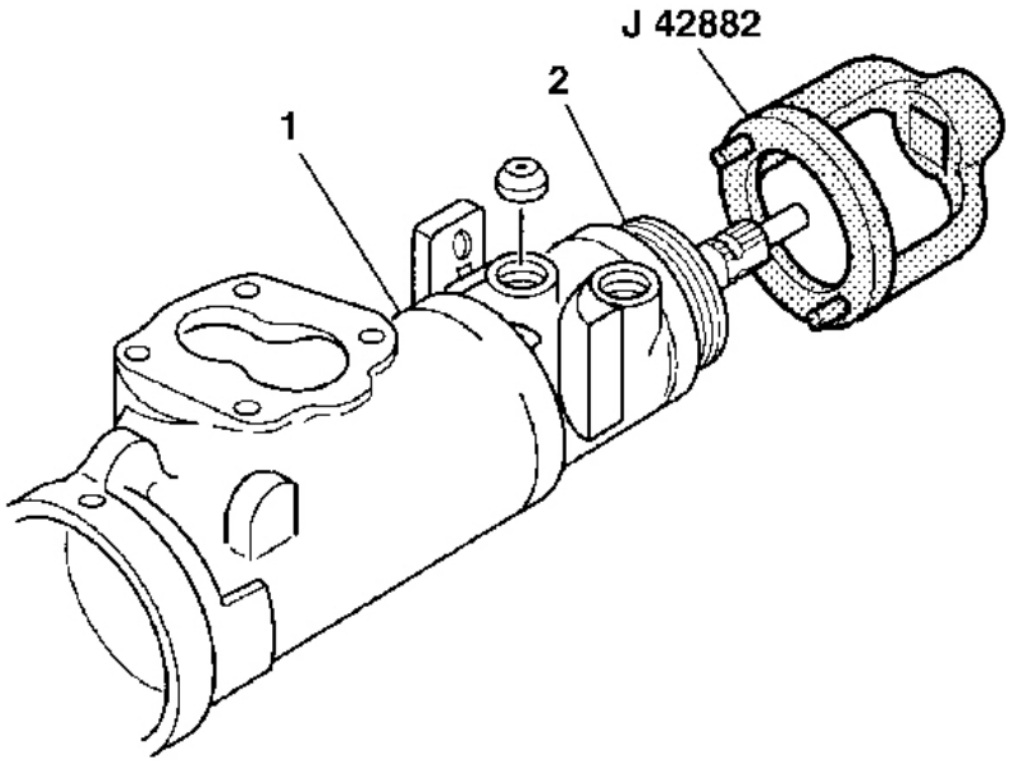


Fig. 110: View Of Adjuster Nut Assembly, Steering Gear Housing & J 42882
Courtesy of GENERAL MOTORS CORP.

5. Connect the adjuster nut assembly to the steering gear housing using **J 42882** . See **Special Tools and Equipment**.
6. Adjust the thrust bearing support preload. Refer to **Worm Thrust Bearing Preload Adjustment - Off Vehicle**.

DESCRIPTION AND OPERATION

POWER STEERING SYSTEM DESCRIPTION AND OPERATION (W/O ELECTRO-HYDRAULIC STEERING)

The hydraulic power steering pump is a constant displacement vane-type pump that provides hydraulic pressure and flow for the power steering gear. The hydraulic power steering pumps are either belt-driven or direct-drive, cam-driven.

The power steering fluid reservoir holds the power steering fluid and may be integral with the power steering

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pump or remotely located. The following locations are typical locations for the remote reservoir:

- Mounted to the front of the dash panel
- Mounted to the inner fender
- Mounted to a bracket on the engine

The 2 basic types of power steering gears are listed below:

- A recirculating ball system
- A rack and pinion system

In the recirculating ball system, a worm gear converts steering wheel movement to movement of a sector shaft. A pitman arm attached to the bottom of the sector shaft actually moves one tie rod and an intermediate rod move the other tie rod.

In the rack and pinion system, the rack and the pinion are the 2 components that convert steering wheel rotation to lateral movement. The steering shaft is attached to the pinion in the steering gear. The pinion rotates with the steering wheel. Gear teeth on the pinion mesh with the gear teeth on the rack. The rotating pinion moves the rack from side to side. The lateral action of the rack pushes and pulls the tie rods in order to change the direction of the vehicle's front wheels.

The power steering pressure hose connects the power steering pump union fitting to the power steering gear and allows pressurized power steering fluid to flow from the pump to the gear.

The power steering return hose returns fluid from the power steering gear back to the power steering fluid reservoir. The power steering return line may contain an integral fin-type or line-type power steering fluid cooler.

In a typical power steering system, a pump generates hydraulic pressure, causing fluid to flow, via the pressure hose, to the steering gear valve assembly. The steering gear valve assembly regulates the incoming fluid to the right and left chambers in order to assist in right and left turns.

Turning the steering wheel activates the valve assembly, which applies greater fluid pressure and flow to 1 side of the steering gear piston, and lower pressure and flow to the other side of the piston. The pressure assists the movement of the gear piston. Tie rods transfer this force to the front wheels, which turn the vehicle right or left.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

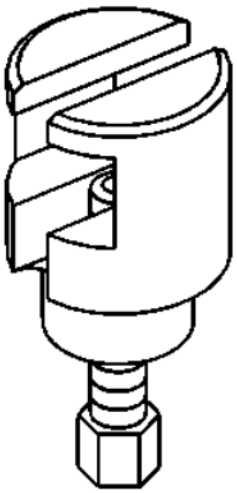
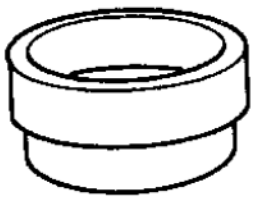
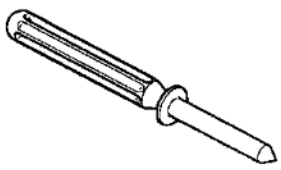
Special Tools

Illustration	Tool Number/ Description

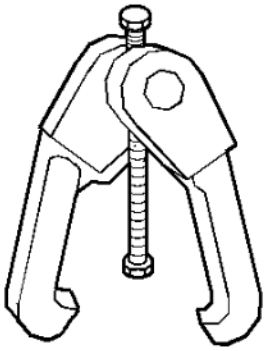
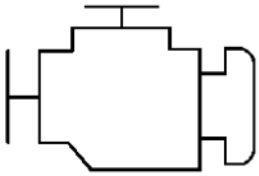
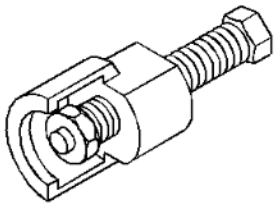
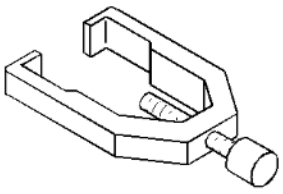
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	J 4245 Internal Snap Ring Pliers
	J 6219 Pitman Shaft Oil Seal Installer
	J 6278 Pitman Shaft Bearing Remover and Installer

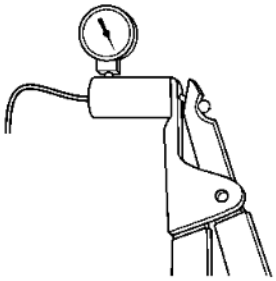
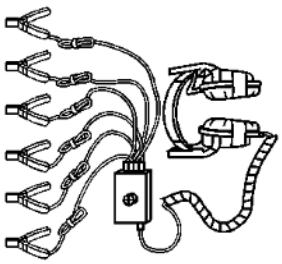
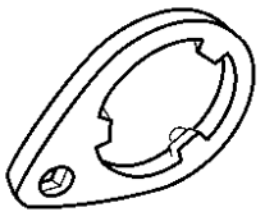
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	J 6632-01 Pitman Arm Puller
	J 8947 Rack Piston Teflon Ring Compressor
	J 21552 Rack Piston Arbor
	J 24319-B

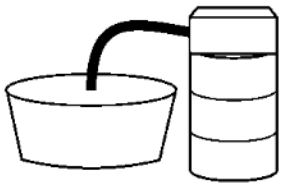
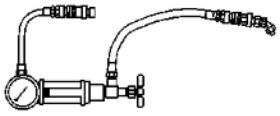
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	Universal Steering Linkage Puller
	J 25033-C Power Steering Pump Pulley Installer
	J 25034-C Power Steering Pump Pulley Remover
	J 29107-A Pitman Arm Puller

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	J 35555 Metal Mityvac
	J 39570 Chassis Ear
	J 42882 Adjuster Nut Socket
	J 43435 Adjuster Lock Nut Wrench

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	J 43485 Power Steering Bleeding Adaptor
	J 44721 Power Steering System Analyzer

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