

## 2006 Buick Rainier

2006 STEERING Power Steering System - Ascender, Envoy, Rainier & TrailBlazer

### 2006 STEERING

#### Power Steering System - Ascender, Envoy, Rainier & TrailBlazer

## SPECIFICATIONS

### FASTENER TIGHTENING SPECIFICATIONS

#### Fastener Tightening Specifications

Application	Specification	
	Metric	English
Adjuster Plug Lock Nut	68 N.m	50 lb ft
Cylinder End Fitting	27 N.m	20 lb ft
Cylinder Valve End Fitting	17 N.m	13 lb ft
Flow Control Valve Fitting	75 N.m	55 lb ft
Inner Tie Rod Housing	100 N.m	74 lb ft
Lower Intermediate Shaft to Power Steering Gear Input Shaft Pinch Bolt	40 N.m	30 lb ft
Outer Tie Rod Retaining Nut	60 N.m	44 lb ft
Outer Tie Rod To the Inner Tie Rod Jam Nut	75 N.m	55 lb ft
Power Steering Cooler Mounting Bolts	20 N.m	15 lb ft
Power Steering Gear to the Frame Mounting Bolts	110 N.m	81 lb ft
Power Steering Hose Assembly to the Frame Brackets Mounting Bolts	10 N.m	89 lb in
Power Steering Hose Assembly to the Front Crossmember Bracket Mounting Bolt	10 N.m	89 lb in
Power Steering Hose Assembly to the Power Steering Gear Retaining bolt	12 N.m	106 lb in
Power Steering Hose Assembly (Pressure Hose) to the Power Steering Pump	30 N.m	22 lb ft
Power Steering Hose Assembly to the Wheel Well Bracket Mounting Bolt	10 N.m	89 lb in
Power Steering Pump Bracket Mounting Bolts	50 N.m	37 lb ft
Power Steering Pump Mounting Bolts	25 N.m	18 lb ft

### POWER STEERING PUMP SPECIFICATIONS

#### Power Steering Pump Specifications

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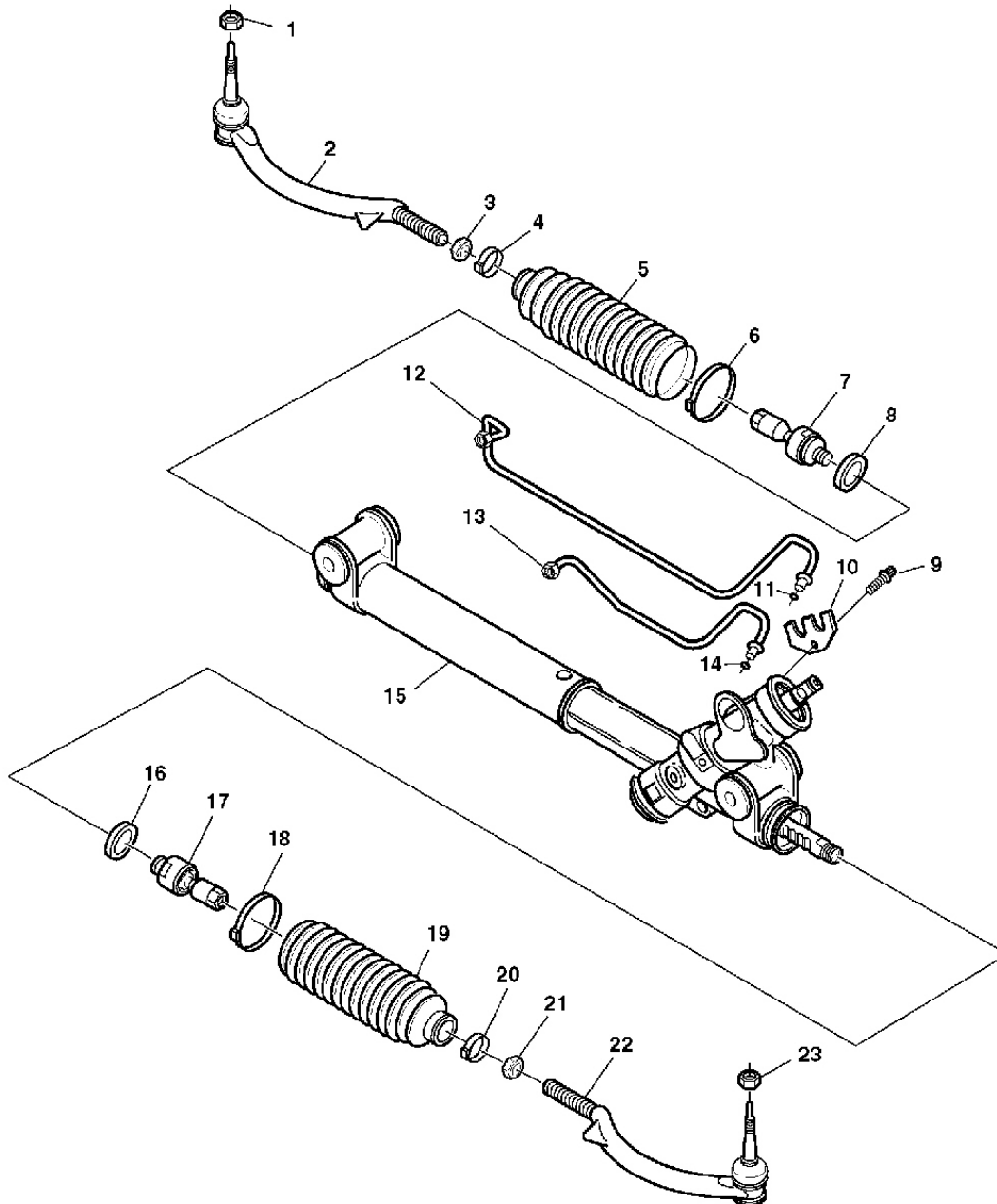
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<b>Vehicle</b>	<b>Engine Code</b>	<b>Engine Size</b>	<b>High Flow (Liters per Minute)</b>	<b>High Flow (Gallons per Minute)</b>	<b>Pressure Relief (kPa)</b>	<b>Pressure Relief (PSI)</b>
TrailBlazer, Envoy,	LL8	4.2L	10.2/11.7	2.7/3.1	10342/11032	1500/1600
TrailBlazer Ext, Envoy Ext	LL8	4.2L	11.7/13.2	3.1/3.5	10342/11032	1500/1600
TrailBlazer Ext, Envoy Ext	LM4	5.3L	11.7/13.2	3.1/3.5	10342/11032	1500/1600
Rainier	LM4	5.3L	10.2/11.7	2.7/3.1	10342/11032	1500/1600

**COMPONENT LOCATOR****POWER STEERING GEAR DISASSEMBLED VIEW**

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**Fig. 1: Identifying Power Steering Gear Components**  
 Courtesy of GENERAL MOTORS CORP.

### Callouts For Fig. 1

Callout	Component Name
1	Torque Prevailing Nut

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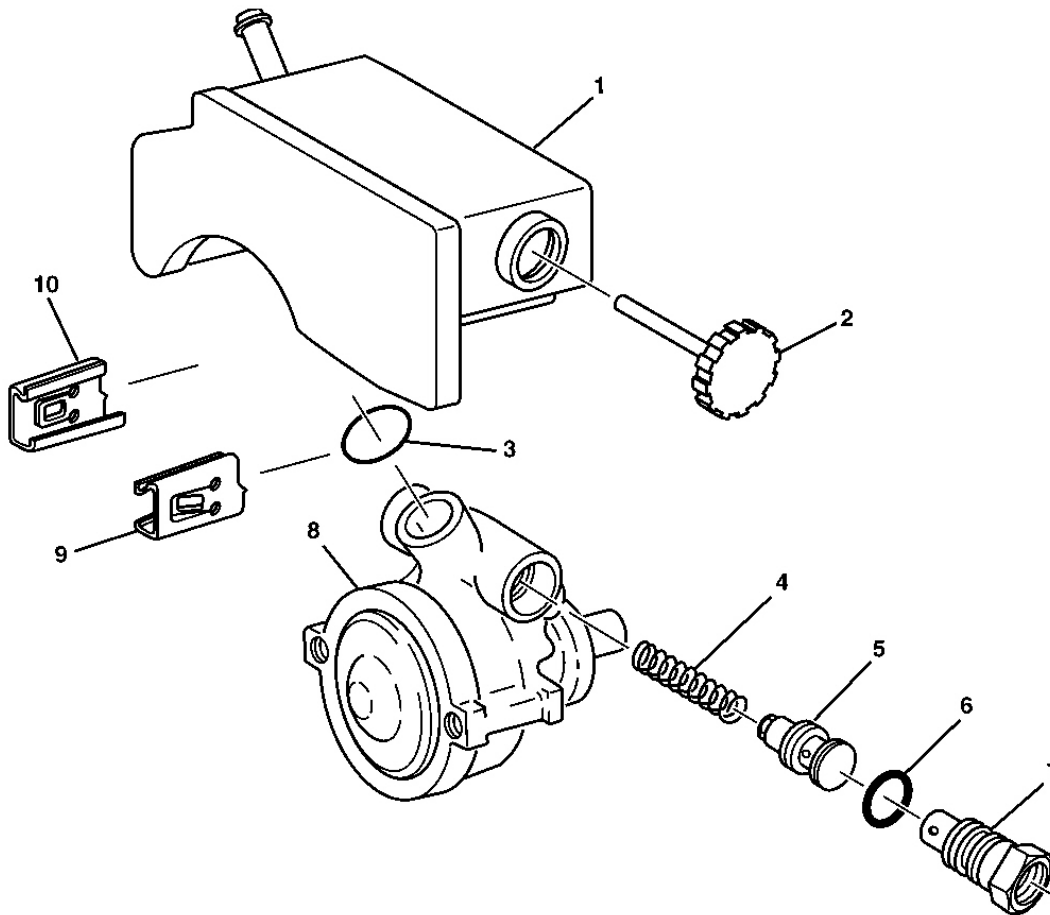
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2	Outer Tie Rod Assembly
3	Hexagon Jam Nut
4	Tie Rod End Clamp
5	Rack and Pinion Boot
6	Boot Clamp
7	Inner Tie Rod Assembly
8	Shock Dampener Ring
9	External TORX® Screw
10	Cylinder Line Retaining Plate
11	O-ring Seal
12	Cylinder (RH) Line
13	Cylinder (LH) Line
14	O-ring Seal
15	Rack and Pinion Gear (Partial)
16	Shock Dampener Ring
17	Inner Tie Rod Assembly
18	Boot Clamp
19	Rack and Pinion Boot
20	Tie Rod End Clamp
21	Hexagon Jam Nut
22	Outer Tie Rod Assembly
23	Torque Prevailing Nut

**POWER STEERING PUMP DISASSEMBLED VIEW (CB SERIES PUMP)**

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**Fig. 2: Exploded View Of Power Steering Pump Components (CB Series)**  
Courtesy of GENERAL MOTORS CORP.

### Callouts For Fig. 2

Callout	Component Name
1	Hydraulic Pump Reservoir Assembly (Typical)
2	Reservoir Capstick Assembly
3	O-Ring Seal
4	Flow Control Spring
5	Control Valve Assembly
6	O-Ring Seal
7	O-Ring Union Fitting
8	Hydraulic Pump Housing Assembly

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9	Reservoir Retaining Clip (RH)
10	Reservoir Retaining Clip (LH)

## DIAGNOSTIC INFORMATION AND PROCEDURES

### 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

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

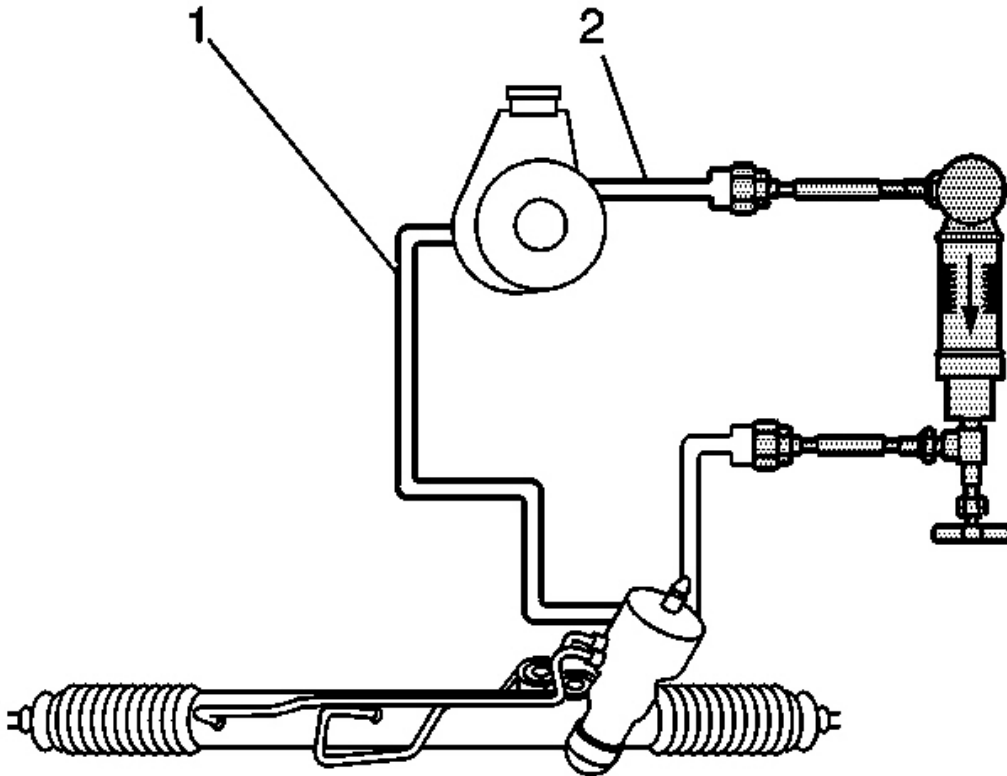
- Inspect for aftermarket devices which could affect the operation of the power steering system.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect the power steering reservoir for the proper power steering fluid level 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 (4.2L)** or **Rattle, Clunk, or Shudder Noise from the Power Steering System (5.3L)**
- **Whine or Growl Noise from the Power Steering System**
- **Steering Effort Hard in One or Both Directions**
- **Steering Effort Too Easy in One or Both Directions**

**POWER STEERING SYSTEM TEST PROCEDURE**



**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

**Test Description**

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

**5:** This step tests the system for restrictions.

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

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- 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
<p>DEFINITION: The Power Steering System Test Procedure will perform the following functions:</p> <ul style="list-style-type: none"> <li>• Test the operation of the hydraulic power steering system.</li> <li>• Test the operation of the power steering pump and power steering gear.</li> <li>• Identify restrictions in the system.</li> </ul>				
1	<p>Inspect the power steering fluid for the following indications of contamination:</p> <ul style="list-style-type: none"> <li>• Milky fluid - water</li> <li>• Brown fluid - burnt</li> <li>• Debris in fluid - plastic or dirt</li> </ul> <p>Is the fluid free of contamination?</p>	-	Go to <b>Step 3</b>	Go to <b>Step 2</b>
2	<p>Flush the power steering system. Refer to <b>Flushing the Power Steering System</b>.</p> <p>Did you complete the procedure?</p>	-	Go to <b>Step 3</b>	-
3	<p><b>IMPORTANT:</b> In order to accurately diagnose the system, the malfunction must be present during the test procedure.</p> <p>Attempt to duplicate the condition. Is the condition present?</p>	-	Go to <b>Step 4</b>	System OK
	<ol style="list-style-type: none"> <li>1. Turn the ignition switch to the OFF position.</li> <li>2. Place a drain pan under the vehicle in</li> </ol>			



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4	<p>order to catch any power steering fluid.</p> <ol style="list-style-type: none"> <li>3. Disconnect the power steering pressure pipe/hose from the power steering pump or the power steering gear as necessary.</li> <li>4. Install the <b>J 44721</b> Power Steering System Analyzer. See <b><u>Special Tools</u></b>.</li> <li>5. Fill the power steering system. Refer to <b><u>Checking and Adding Power Steering Fluid</u></b>.</li> </ol> <p>Did you complete the installation?</p>	-	Go to <b>Step 5</b>	-
5	<ol style="list-style-type: none"> <li>1. Fully open the <b>J 44721</b> valve. See <b><u>Special Tools</u></b>.</li> <li>2. Start the engine.</li> </ol> <p><b>NOTE:</b> Refer to <b>Steering Wheel in the Full Turn Position Notice in Cautions and Notices</b>.</p> <ol style="list-style-type: none"> <li>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.</li> <li>4. Inspect and ensure that all of the power steering pipe/hose connections are not leaking.</li> <li>5. Ensure that the steering wheel is OFF the steering stop. Observe the pressure reading.</li> </ol> <p>Is the pressure reading greater than the specified value?</p>	1379 kPa (200 psi)	Go to <b>Step 6</b>	Go to <b>Step 7</b>
	<p><b>IMPORTANT:</b> A restriction may be present in the power steering system. Turn off the engine</p>			

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6	<p><b>IMMEDIATELY.</b></p> <p>Locate and repair the restriction. Did you complete the repair?</p>	-	Go to <b>Step 18</b>	-
7	<ol style="list-style-type: none"> <li>1. Allow the engine to run until the engine reaches full operating temperature.</li> <li>2. Record the pressure reading and flow reading.</li> <li>3. Partially close the <b>J 44721</b> valve until the system pressure reaches the specified value, then record the FLOW reading. See <b>Special Tools</b>.</li> <li>4. Subtract second flow reading from the first flow reading.</li> </ol> <p>Is the flow DECREASE greater than 3.8 L (1 gal) per minute?</p>	4827 kPa (700 psi)	Go to <b>Step 13</b>	Go to <b>Step 8</b>
8	<p><b>NOTE:</b> Do not leave the valve fully closed for more than 5 seconds, or the pump could be damaged internally.</p> <p>Fully close then open the <b>J 44721</b> valve 3 times. See <b>Special Tools</b>. Record all of the high pressure readings. Refer to <b>Power Steering Pump Specifications</b> for power steering system pressure relief specifications. Are the three high pressure readings within specifications?</p>	-	Go to <b>Step 9</b>	Go to <b>Step 15</b>
9	Are the three high pressure readings within 245 kPa (50 psi) of each other?	-	Go to <b>Step 10</b>	Go to <b>Step 14</b>
10	<ol style="list-style-type: none"> <li>1. Increase the engine speed to approximately 1500 RPM.</li> <li>2. Record the flow reading. Refer to <b>Power Steering Pump Specifications</b> for power steering system pressure specifications.</li> </ol>	-		

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	Is the actual flow reading within specifications?		Go to <b>Step 11</b>	Go to <b>Step 13</b>
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 <b>Step 16</b>	Go to <b>Step 12</b>
12	<p><b>NOTE:</b> Refer to <b>Steering Wheel in the Full Turn Position Notice in Cautions and Notices.</b></p> <p>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?</p>	-	Go to <b>Step 18</b>	Go to <b>Step 17</b>
13	<p>Replace the power steering pump. Refer to <b><u>Power Steering Pump Replacement (4.2L)</u></b> or <b><u>Power Steering Pump Replacement (5.3L)</u></b>. Did you complete the replacement?</p>	-	Go to <b>Step 18</b>	-
14	<ol style="list-style-type: none"> <li>Remove the power steering pump flow control valve. Refer to <b><u>Power Steering Pump Flow Control Valve Replacement - Off Vehicle (CB Series)</u></b>.</li> <li>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 <b><u>Power Steering Pump Flow Control Valve Replacement - Off Vehicle (CB Series)</u></b>.</li> <li>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</li> </ol>	-		

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	<p><b><u>Power Steering Pump Replacement (4.2L) or Power Steering Pump Replacement (5.3L).</u></b></p> <p>Did you complete the repair?</p>		<p align="center"><b>Go to Step 18</b></p>	-
15	<p>Replace the power steering pump flow control valve. Refer to <b><u>Power Steering Pump Flow Control Valve Replacement - Off Vehicle (CB Series).</u></b></p> <p>Did you complete the replacement?</p>	-	<p align="center"><b>Go to Step 18</b></p>	-
16	<ol style="list-style-type: none"> <li>1. Remove the power steering pump flow control valve and inspect for any wear or damage. Do NOT disassemble the flow control valve.</li> <li>2. If the flow control valve is worn damaged, replace the flow control valve. Refer to <b><u>Power Steering Pump Flow Control Valve Replacement - Off Vehicle (CB Series).</u></b></li> </ol> <p>Did you complete the repair?</p>	-	<p align="center"><b>Go to Step 18</b></p>	-
17	<p>The power steering gear is leaking across the piston or bypassing the valve circuit. Replace the power steering gear. Refer to <b><u>Power Steering Gear Replacement.</u></b></p> <p>Did you complete the replacement?</p>	-	<p align="center"><b>Go to Step 18</b></p>	-
18	<p>Test the power steering system for the original condition.</p> <p>Does the original condition still exist?</p>	-	<p align="center"><b>Go to Step 5</b></p>	<b>Go to Step 19</b>
19	<ol style="list-style-type: none"> <li>1. Disconnect and remove the <b>J 44721</b> from the vehicle. See <b><u>Special Tools.</u></b></li> <li>2. Connect the vehicle power steering pipes/hoses.</li> <li>3. Bleed the power steering system and add fluid as necessary. Refer to <b><u>Bleeding the Power Steering</u></b></li> </ol>	-		

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<u><b>System.</b></u>		
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 <b>Step 2</b>	Go to <b><u>Symptoms - Power Steering System</u></b>
2	Verify that power steering fluid leaks are present. Is the power steering system leaking?	Go to <b>Step 3</b>	System OK
3	Inspect the power steering system fittings. Are the fittings leaking?	Go to <b>Step 8</b>	Go to <b>Step 4</b>
4	Inspect the power steering hoses. Are the hoses leaking?	Go to <b>Step 9</b>	Go to <b>Step 5</b>
5	Inspect the power steering pump, shaft seal, and the reservoir for leaks. Is the power steering pump, shaft seal, or reservoir leaking?	Go to <b>Step 10</b>	Go to <b>Step 6</b>
6	Inspect the power steering gear for leaks. Is the power steering gear leaking?	Go to <b>Step 11</b>	Go to <b>Step 7</b>
7	Inspect the power steering cooler for leaks. Is the power steering cooler leaking?	Go to <b>Step 12</b>	Go to <b>Step 3</b>
8	Tighten the fittings. Refer to <b><u>Fastener Tightening Specifications</u></b> . Did you complete the repair?	Go to <b>Step 13</b>	-
9	Replace the power steering hoses. Refer to <b><u>Power Steering Gear Inlet and Outlet Hose Replacement (4.2L)</u></b> or <b><u>Power Steering Gear Inlet and Outlet Hose Replacement (5.3L)</u></b> . Did you complete the repair?	Go to <b>Step 13</b>	-
10	Replace the power steering pump or shaft seal. Refer to <b><u>Power Steering Pump Replacement (4.2L)</u></b> or <b><u>Power Steering Pump Replacement (5.3L)</u></b> or <b><u>Power Steering</u></b>		

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	<b><u>Pump Drive Shaft Seal Replacement (CB).</u></b> Did you complete the repair?	Go to <b>Step 13</b>	-
11	Replace the power steering gear. Refer to <b><u>Power Steering Gear Replacement.</u></b> Did you complete the repair?	Go to <b>Step 13</b>	-
12	Replace the power steering cooler. Refer to <b><u>Power Steering Cooler Replacement (4.2L)</u></b> or <b><u>Power Steering Cooler Replacement (5.3L).</u></b> Did you complete the repair?	Go to <b>Step 13</b>	-
13	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 3</b>

**RATTLE, CLUNK, OR SHUDDER NOISE FROM THE POWER STEERING SYSTEM (4.2L)**

**Rattle, Clunk, or Shudder Noise from the Power Steering System (4.2L)**

<b>Step</b>	<b>Action</b>	<b>Yes</b>	<b>No</b>
1	Did you review the Power Steering System Description and perform the necessary inspections?	Go to <b>Step 2</b>	Go to <b><u>Symptoms - Power Steering System</u></b>
2	Verify that a rattle, clunk or shudder noise is present. Is a rattle, clunk or shudder noise present?	Go to <b>Step 3</b>	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 <b>Step 11</b>	Go to <b>Step 4</b>
4	Inspect the engine drive belt for cracking or excessive wear. Refer to <b><u>Drive Belt Excessive Wear Diagnosis</u></b> in Engine Mechanical - 4.2L. Is the drive belt cracked or excessively worn?	Go to <b>Step 12</b>	Go to <b>Step 5</b>
5	Inspect the power steering pump pulley for damage. Is the power steering pump pulley damaged?	Go to <b>Step 13</b>	Go to <b>Step 6</b>
6	Inspect the power steering pump and the power steering mounting bracket/brace for the proper installation. Refer to <b><u>Power Steering Pump Replacement (4.2L)</u></b> or <b><u>Power Steering</u></b>		

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	<p><b><u>Pump Replacement (5.3L).</u></b> Is the power steering pump installation incorrect?</p>	Go to <b>Step 14</b>	Go to <b>Step 7</b>
7	<p>Inspect the power steering gear for the proper installation. Refer to <b><u>Power Steering Gear Replacement.</u></b> Is the power steering gear installation incorrect?</p>	Go to <b>Step 15</b>	Go to <b>Step 8</b>
8	<p>Inspect the power steering gear rack bearing preload for the proper adjustment. Is the power steering gear rack bearing preload adjustment incorrect?</p>	Go to <b>Step 16</b>	Go to <b>Step 9</b>
9	<p>Inspect the suspension. Is the suspension worn?</p>	Go to <b>Step 17</b>	Go to <b>Step 10</b>
10	<p>Inspect the intermediate shaft. Is the intermediate shaft worn?</p>	Go to <b>Step 18</b>	Go to <b>Step 3</b>
11	<p>Adjust or replace the power steering hoses. Refer to <b><u>Power Steering Gear Inlet and Outlet Hose Replacement (4.2L)</u></b> or <b><u>Power Steering Gear Inlet and Outlet Hose Replacement (5.3L).</u></b> Did you complete the repair?</p>	Go to <b>Step 19</b>	-
12	<p>Replace the engine drive belt. Refer to <b><u>Drive Belt Tensioner Replacement</u></b> in Engine Mechanical - 4.2L. Did you complete the repair?</p>	Go to <b>Step 19</b>	-
13	<p>Replace the power steering pump pulley. Refer to <b><u>Power Steering Pulley Replacement (5.3L)</u></b> or <b><u>Power Steering Pulley Replacement (4.2L).</u></b> Did you complete the repair?</p>	Go to <b>Step 19</b>	-
14	<p>Install the power steering pump correctly. Refer to <b><u>Power Steering Pump Replacement (4.2L)</u></b> or <b><u>Power Steering Pump Replacement (5.3L).</u></b> Did you complete the repair?</p>	Go to <b>Step 19</b>	-
15	<p>Install the power steering gear correctly. Refer to <b><u>Power Steering Gear Replacement.</u></b> Did you complete the repair?</p>	Go to <b>Step 19</b>	-

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16	Adjust the power steering gear rack bearing preload. Did you complete the repair?	Go to <b>Step 19</b>	-
17	Replace the worn suspension components. Refer to <b><u>Diagnostic Starting Point - Suspension General Diagnosis</u></b> in Suspension General Diagnosis. Did you complete the repair?	Go to <b>Step 19</b>	-
18	Replace the intermediate shaft. Refer to <b><u>Intermediate Steering Shaft Replacement - Upper</u></b> or <b><u>Intermediate Steering Shaft Replacement - Lower</u></b> in Steering Wheel and Column. Did you complete the repair?	Go to <b>Step 19</b>	-
19	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 3</b>

### RATTLE, CLUNK, OR SHUDDER NOISE FROM THE POWER STEERING SYSTEM (5.3L)

#### Rattle, Clunk, or Shudder Noise from the Power Steering System (5.3L)

Step	Action	Yes	No
1	Did you review the Power Steering System Description and perform the necessary inspections?	Go to <b>Step 2</b>	Go to <b><u>Symptoms - Power Steering System</u></b>
2	Verify that a rattle, clunk or shudder noise is present. Is a rattle, clunk or shudder noise present?	Go to <b>Step 3</b>	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 <b>Step 11</b>	Go to <b>Step 4</b>
4	Inspect the engine drive belt for cracking or excessive wear. Refer to <b><u>Drive Belt Excessive Wear Diagnosis</u></b> in Engine Mechanical - 5.3L. Is the drive belt cracked or excessively worn?	Go to <b>Step 12</b>	Go to <b>Step 5</b>
5	Inspect the power steering pump pulley for damage. Is the power steering pump pulley damaged?	Go to <b>Step 13</b>	Go to <b>Step 6</b>



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6	<p>Inspect the power steering pump and the power steering mounting bracket/brace for the proper installation. Refer to <b><u>Power Steering Pump Replacement (4.2L)</u></b> or <b><u>Power Steering Pump Replacement (5.3L)</u></b>.</p> <p>Is the power steering pump installation incorrect?</p>	Go to <b>Step 14</b>	Go to <b>Step 7</b>
7	<p>Inspect the power steering gear for the proper installation. Refer to <b><u>Power Steering Gear Replacement</u></b>.</p> <p>Is the power steering gear installation incorrect?</p>	Go to <b>Step 15</b>	Go to <b>Step 8</b>
8	<p>Inspect the power steering gear rack bearing preload for the proper adjustment.</p> <p>Is the power steering gear rack bearing preload adjustment incorrect?</p>	Go to <b>Step 16</b>	Go to <b>Step 9</b>
9	<p>Inspect the suspension.</p> <p>Is the suspension worn?</p>	Go to <b>Step 17</b>	Go to <b>Step 10</b>
10	<p>Inspect the intermediate shaft.</p> <p>Is the intermediate shaft worn?</p>	Go to <b>Step 18</b>	Go to <b>Step 3</b>
11	<p>Adjust or replace the power steering hoses. Refer to <b><u>Power Steering Gear Inlet and Outlet Hose Replacement (4.2L)</u></b> or <b><u>Power Steering Gear Inlet and Outlet Hose Replacement (5.3L)</u></b>.</p> <p>Did you complete the repair?</p>	Go to <b>Step 19</b>	-
12	<p>Replace the engine drive belt. Refer to <b><u>Drive Belt Replacement - Accessory</u></b> in Engine Mechanical - 5.3L.</p> <p>Did you complete the repair?</p>	Go to <b>Step 19</b>	-
13	<p>Replace the power steering pump pulley. Refer to <b><u>Power Steering Pulley Replacement (5.3L)</u></b> or <b><u>Power Steering Pulley Replacement (4.2L)</u></b>.</p> <p>Did you complete the repair?</p>	Go to <b>Step 19</b>	-
14	<p>Install the power steering pump correctly. Refer to <b><u>Power Steering Pump Replacement (4.2L)</u></b> or <b><u>Power Steering Pump Replacement (5.3L)</u></b>.</p>		

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	Did you complete the repair?	Go to <b>Step 19</b>	-
15	Install the power steering gear correctly. Refer to <b><u>Power Steering Gear Replacement</u></b> . Did you complete the repair?	Go to <b>Step 19</b>	-
16	Adjust the power steering gear rack bearing preload. Did you complete the repair?	Go to <b>Step 19</b>	-
17	Replace the worn suspension components. Refer to <b><u>Diagnostic Starting Point - Suspension General Diagnosis</u></b> in Suspension General Diagnosis. Did you complete the repair?	Go to <b>Step 19</b>	-
18	Replace the intermediate shaft. Refer to <b><u>Intermediate Steering Shaft Replacement - Upper</u></b> or <b><u>Intermediate Steering Shaft Replacement - Lower</u></b> in Steering Wheel and Column. Did you complete the repair?	Go to <b>Step 19</b>	-
19	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 3</b>

**WHINE OR GROWL NOISE FROM THE POWER STEERING SYSTEM**

**Whine or Growl Noise from the Power Steering System**

Step	Action	Yes	No
1	Did you review the Power Steering System Description and perform the necessary inspections?	Go to <b>Step 2</b>	Go to <b><u>Symptoms - Power Steering System</u></b>
2	Verify that a whine or growl noise is present. Is a whine or growl noise present?	Go to <b>Step 3</b>	System OK
3	Perform the power steering test procedure in order to diagnose a hydraulic condition and repair or replace a component. Refer to <b><u>Power Steering System Test Procedure</u></b> . Did you repair or replace a power steering system component?	Go to <b>Step 10</b>	Go to <b>Step 4</b>
4	Using the <b>J 39570</b> Chassis Ear, inspect the power steering gear for a whine or growl noise.		

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	Is the noise present at the power steering gear?	Go to <b>Step 7</b>	Go to <b>Step 5</b>
5	Using the <b>J 39570</b> , inspect the power steering pump for a whine or growl noise. Is the noise present at the power steering pump?	Go to <b>Step 8</b>	Go to <b>Step 6</b>
6	Using the <b>J 39570</b> , inspect the power steering hoses for a whine or growl noise. Is the noise present at the power steering hoses?	Go to <b>Step 9</b>	Go to <b>Step 2</b>
7	Replace the power steering gear. Refer to <b><u>Power Steering Gear Replacement</u></b> . Did you complete the repair?	Go to <b>Step 10</b>	-
8	Replace the power steering pump. Refer to <b><u>Power Steering Pump Replacement (4.2L)</u></b> or <b><u>Power Steering Pump Replacement (5.3L)</u></b> . Did you complete the repair?	Go to <b>Step 10</b>	-
9	Adjust the routing of the power steering hoses. Did you complete the repair?	Go to <b>Step 10</b>	-
10	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 3</b>

### 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 <b>Step 2</b>	Go to <b><u>Symptoms - Power Steering System</u></b>
2	Verify that the steering effort is hard in one or both directions. Does the system operate normally?	System OK	Go to <b>Step 3</b>
3	Perform the power steering test procedure. Refer to <b><u>Power Steering System Test Procedure</u></b> . Did you complete the procedure?	Go to <b>Step 4</b>	-
4	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 3</b>

### STEERING EFFORT TOO EASY IN ONE OR BOTH DIRECTIONS

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### 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 <b>Step 2</b>	Go to <b>Symptoms - Power Steering System</b>
2	Verify that the steering effort is too easy in one or both directions. Does the system operate normally?	System OK	Go to <b>Step 3</b>
3	Perform the power steering test procedure. Refer to <b>Power Steering System Test Procedure</b> . Did you complete the procedure?	Go to <b>Step 4</b>	-
4	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 3</b>

## REPAIR INSTRUCTIONS

### BLEEDING THE POWER STEERING SYSTEM

#### Tools Required

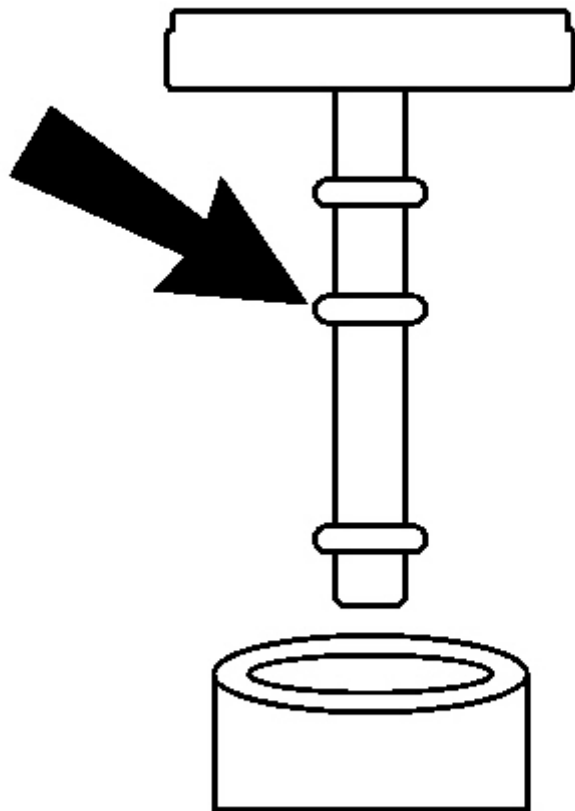
- **J 35555** Metal Mityvac. See **Special Tools**.
- **J 43485** Power Steering Bleeder Adapter. See **Special Tools**.

**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.



**Fig. 4: Identifying FULL COLD Level On Reservoir Cap**  
Courtesy of GENERAL MOTORS CORP.

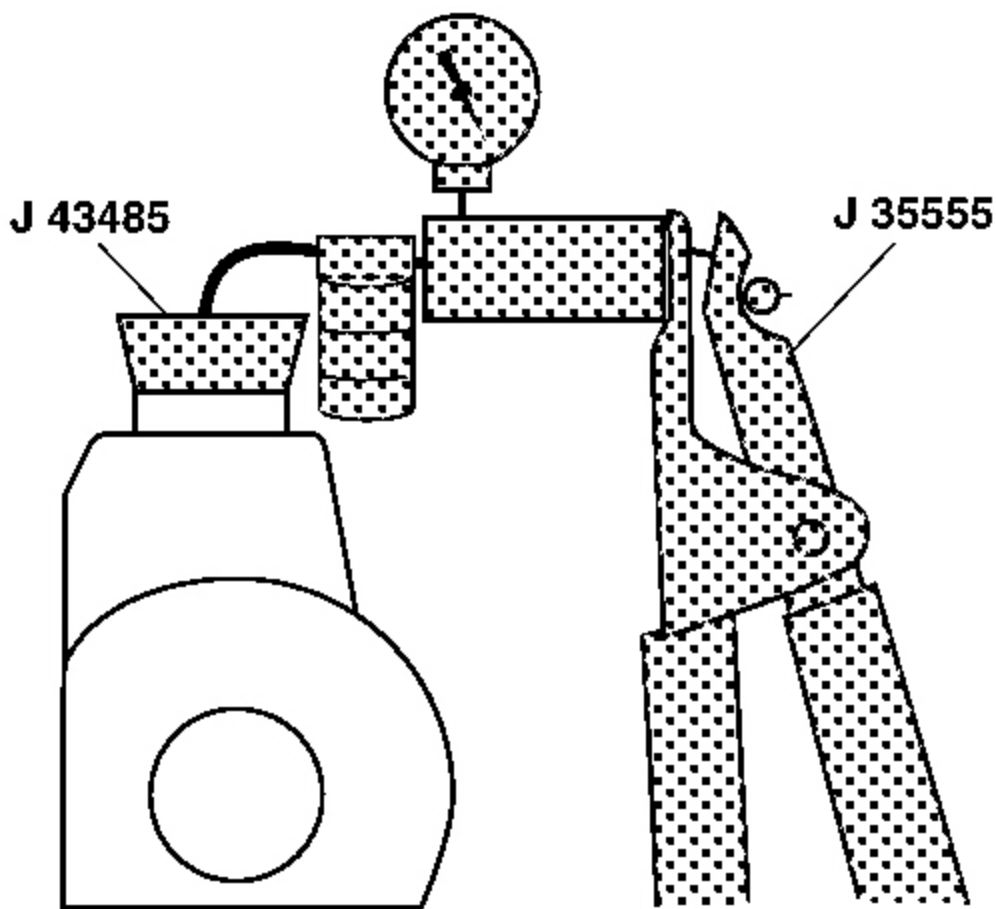
**NOTE:** If the power steering system has been serviced, an accurate fluid level reading cannot be obtained unless air is bled from the steering system. The air in the fluid may cause pump cavitation noise and may cause pump damage over a period of time.

**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.



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

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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.

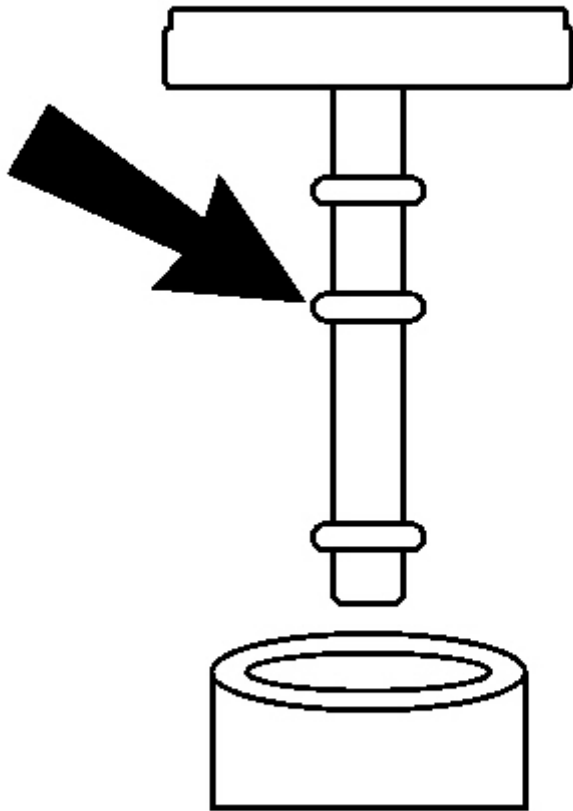
9. Remove the **J 43485** and the **J 35555** . See **Special Tools**.
10. Reinstall the pump reservoir cap.
11. Start the engine. Allow the engine to idle.
12. Turn off the engine.
13. Verify the fluid level. Repeat steps 11-13 until the fluid stabilizes.

**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.**

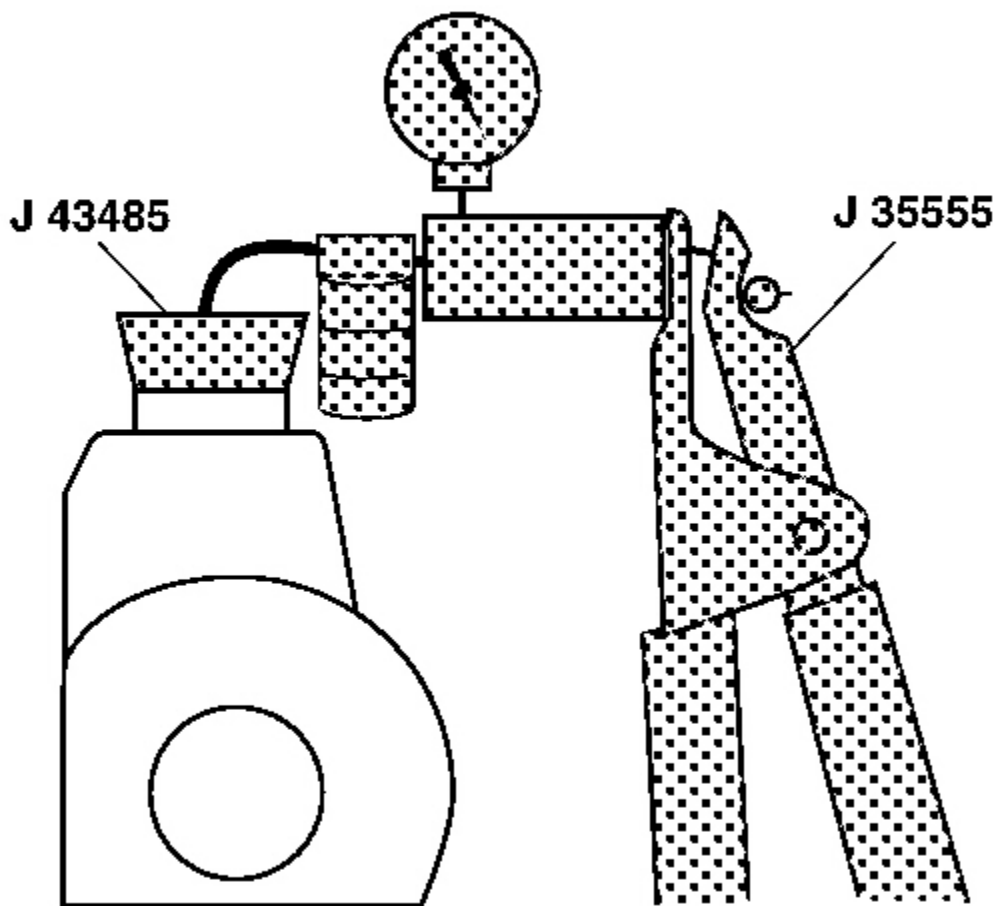
17. Verify the fluid level.



**Fig. 6: Identifying FULL COLD Level On Reservoir Cap**  
Courtesy of GENERAL MOTORS CORP.

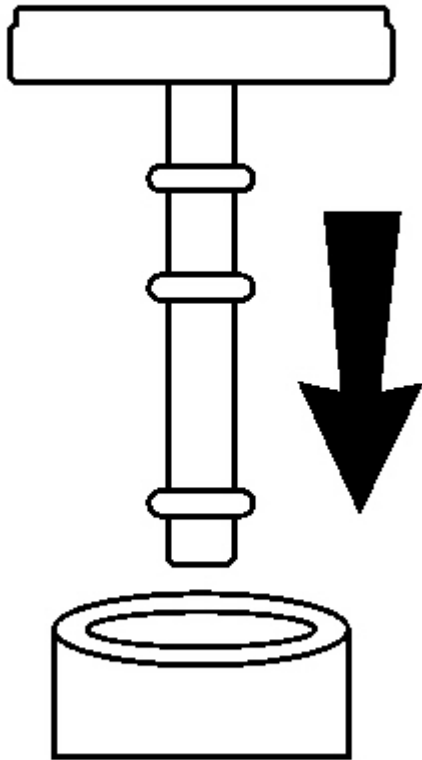
18. Remove the pump reservoir cap.





**Fig. 7: Bleeding Power Steering System Using J 43485 & J 35555**  
Courtesy of GENERAL MOTORS CORP.

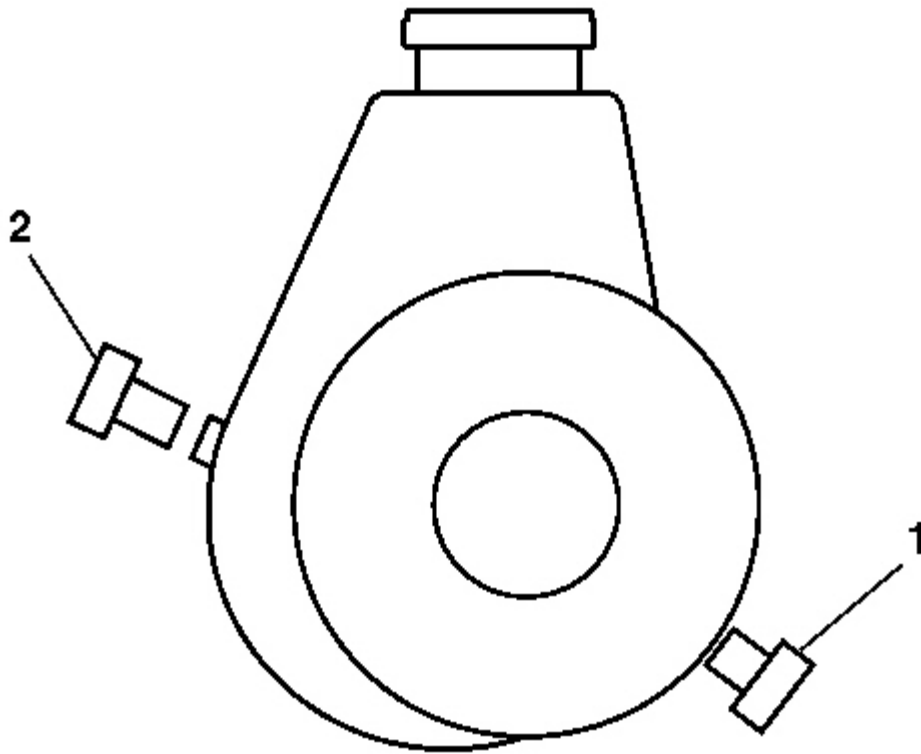
19. Attach the **J 43485** to the **J 35555** or equivalent. See **Special Tools**.
20. Place the **J 43485** on or in the pump reservoir filler neck. See **Special Tools**.
21. Apply a vacuum of 68 kPa (20 in Hg) maximum.
22. Wait 5 minutes.
23. Remove the **J 43485** and the **J 35555** . See **Special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



**Fig. 8: View Of Pump Reservoir Cap**  
**Courtesy of GENERAL MOTORS CORP.**

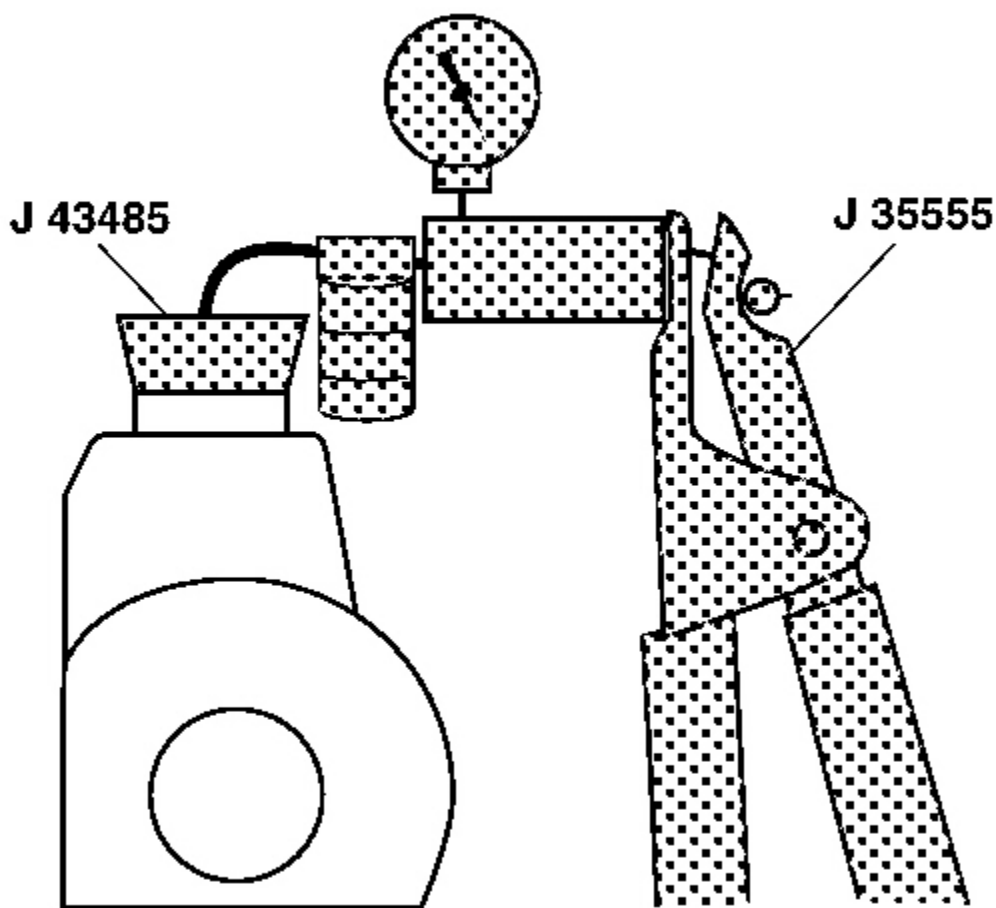
25. Reinstall the pump reservoir cap.

Excessive Vacuum Drop Diagnosis



**Fig. 9: 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**.



**Fig. 10: 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**.
4. Place the **J 43485** on or in the pump reservoir filler neck. See **Special Tools**.
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.  
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**

**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 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 at the HOT/FULL mark 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**.

### 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.

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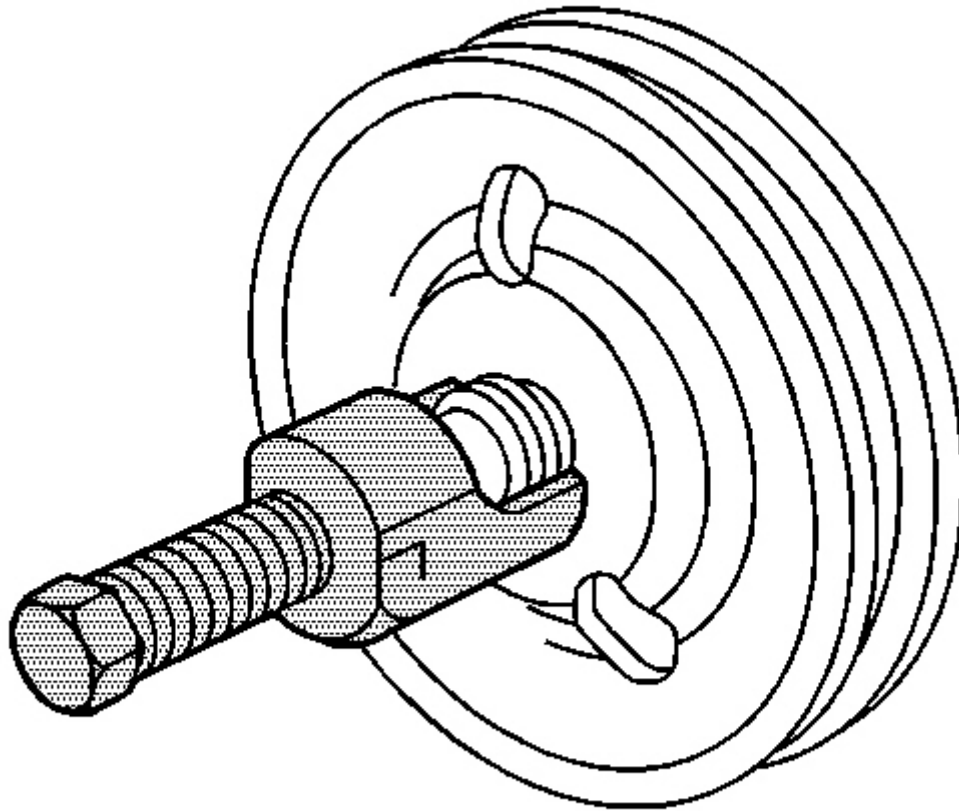
13. Repeat steps 3-5.
14. Inspect the power steering fluid for the following indications of contamination:
  - Milky fluid - water
  - Brown fluid - burnt
  - Plastic debris or dirt chunks
15. If the fluid is contaminated, repeat steps 6-12 in order to complete a third flush.
16. Remove the plug from the pump reservoir inlet connection.
17. Install the fluid return hose to the pump reservoir.
18. Clean any spilled fluid.
19. Bleed the power steering system. Refer to **Bleeding the Power Steering System**

### **POWER STEERING PULLEY REPLACEMENT (5.3L)**

#### **Tools Required**

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

#### **Removal Procedure**

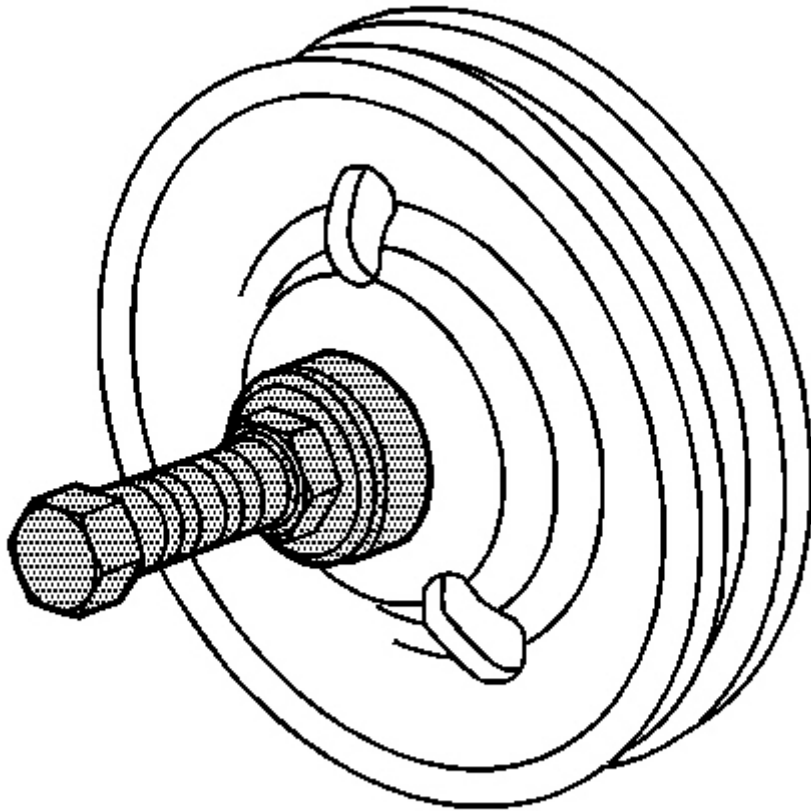


**Fig. 11: View Of Power Steering Pump Pulley Remover**  
Courtesy of GENERAL MOTORS CORP.

1. Remove the power steering pump. Refer to **Power Steering Pump Replacement (4.2L)** or **Power Steering Pump Replacement (5.3L)**.
2. Secure the power steering pump in a vise, taking care not to damage the power steering reservoir.
3. Using the **J 25034-C** , remove the power steering pump pulley. See **Special Tools**.

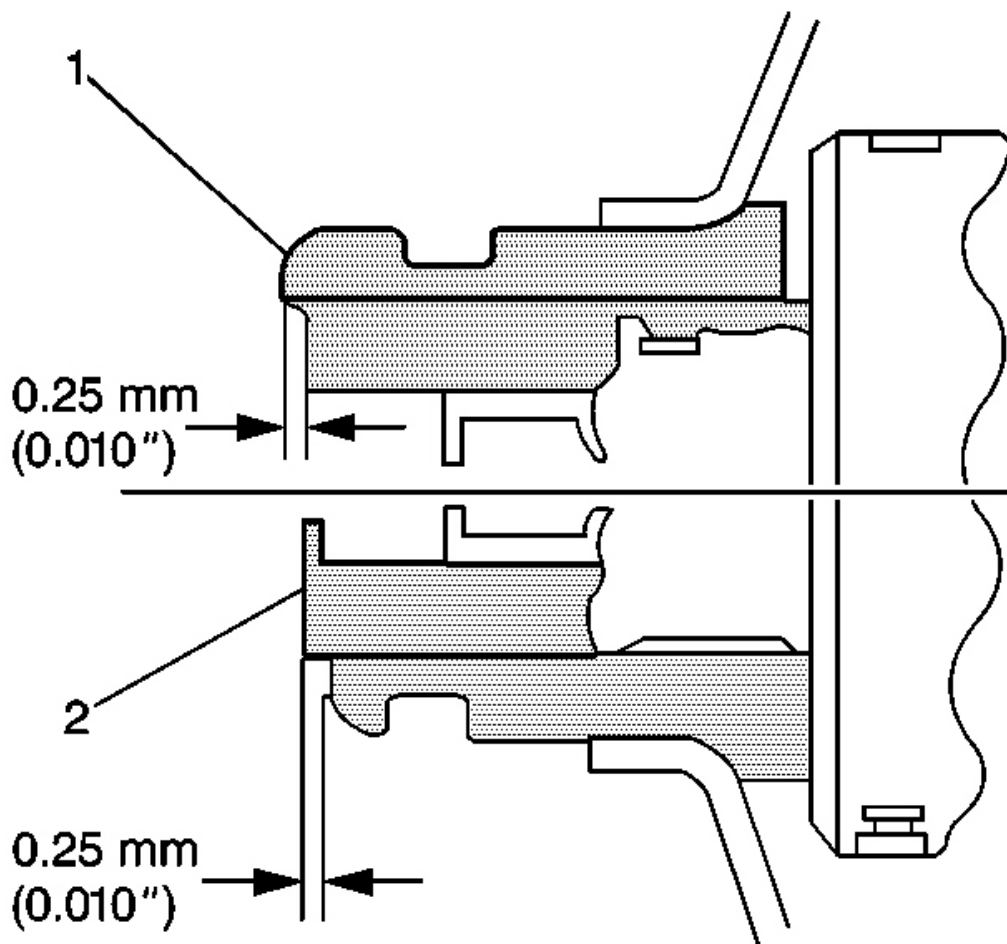
Installation Procedure





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

1. Position the power steering pump pulley to the end of the power steering pump shaft.
2. Using the **J 25033-C** , install the power steering pump pulley to the power steering pump.  
See **Special Tools**.



**Fig. 13: Checking Power Steering Pump Pulley Installed Depth**  
Courtesy of GENERAL MOTORS CORP.

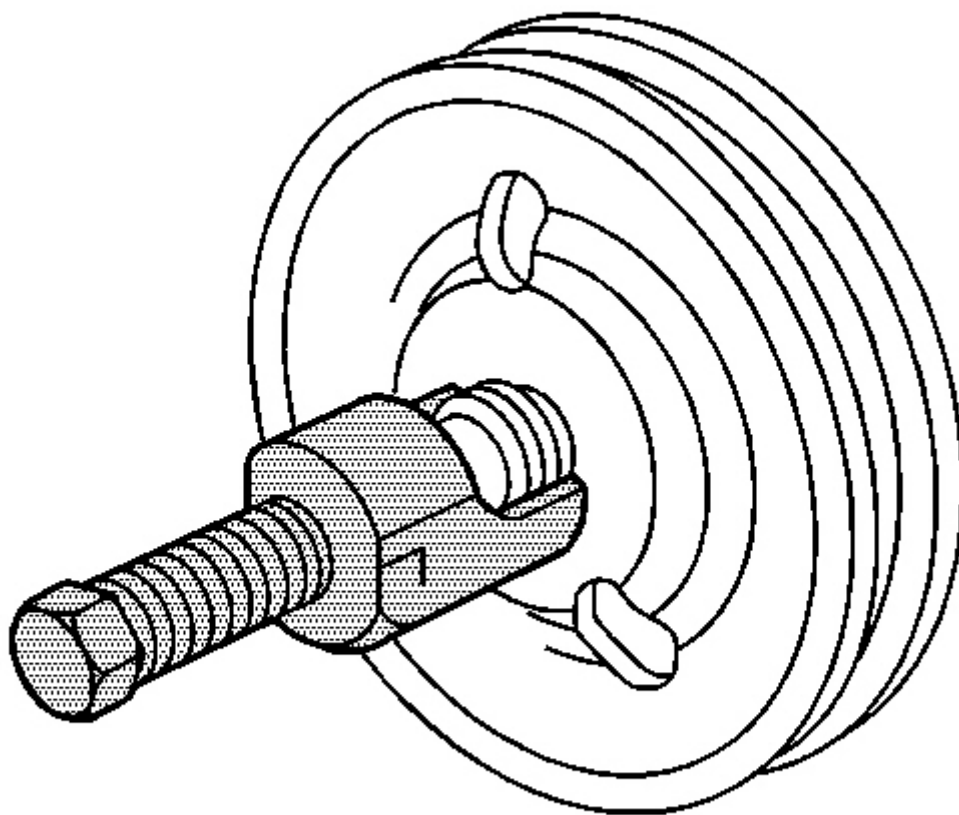
3. Install the power steering pump pulley (1) flush against the end of the power steering pump shaft (2), with an allowable variance of 0.25 mm (0.010 in).
4. Install the power steering pump. Refer to **Power Steering Pump Replacement (4.2L)** or **Power Steering Pump Replacement (5.3L)**.

#### POWER STEERING PULLEY REPLACEMENT (4.2L)

#### Tools Required

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

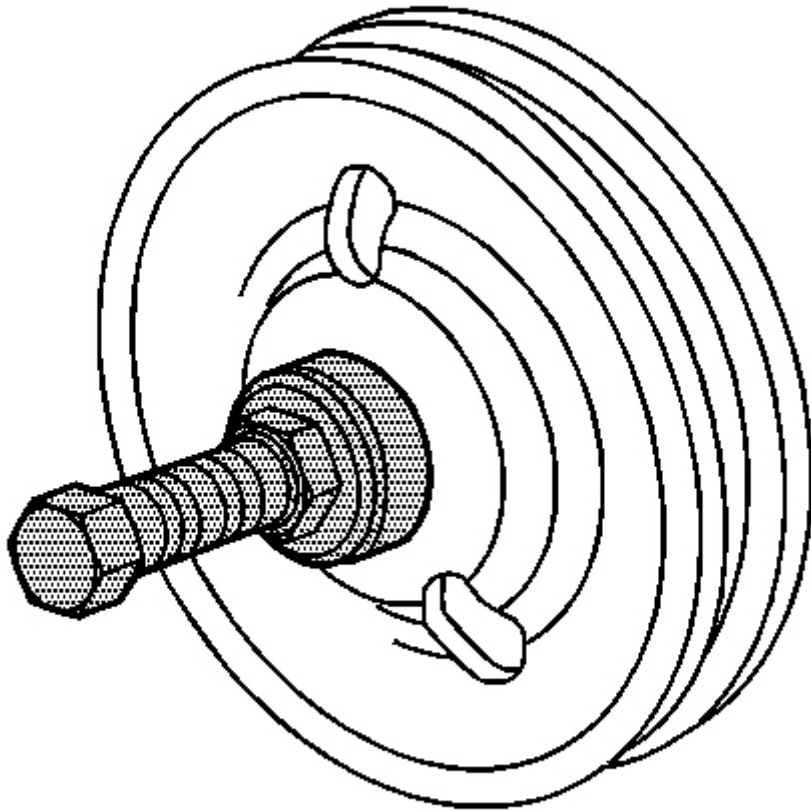
#### Removal Procedure



**Fig. 14: View Of Power Steering Pump Pulley Remover**  
Courtesy of GENERAL MOTORS CORP.

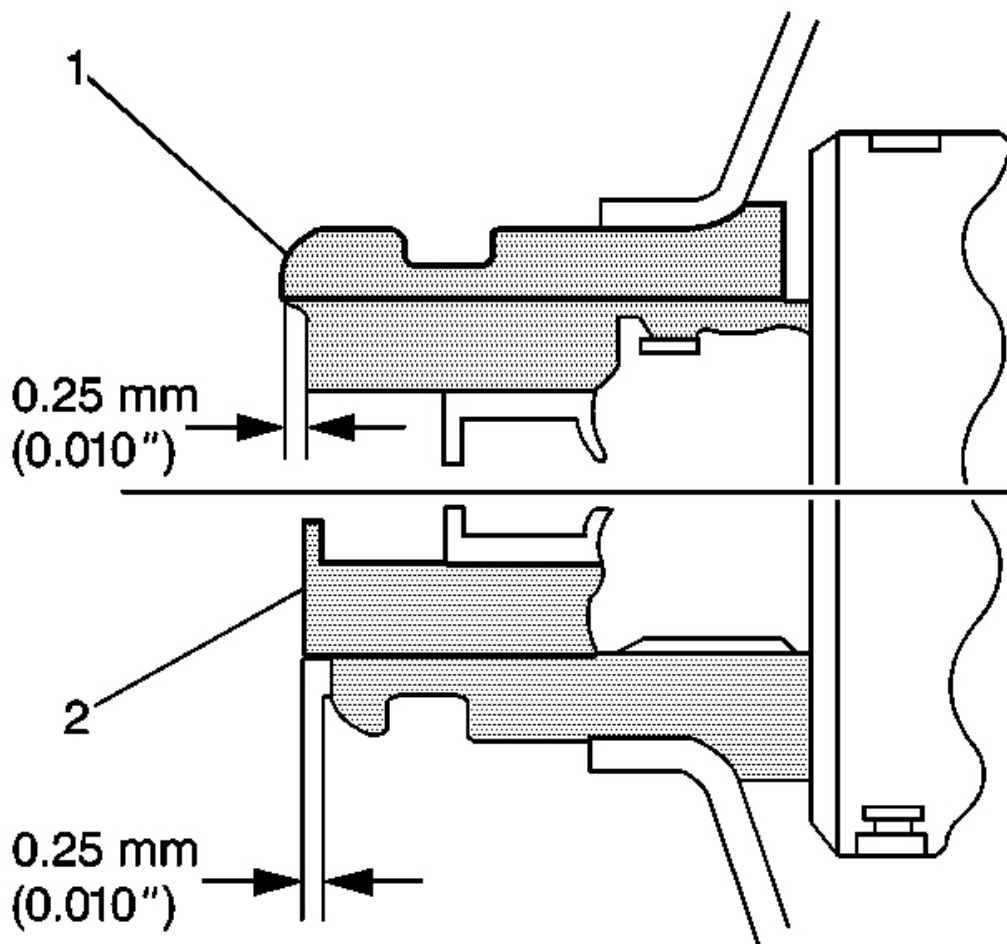
1. Remove the drive belt. Refer to **Drive Belt Replacement** in Engine Mechanical - 4.2L.
2. Remove the power steering pump pulley using **J 25034-C** . See **Special Tools**.

#### Installation Procedure



**Fig. 15: View Of Power Steering Pump Pulley Installer**  
Courtesy of GENERAL MOTORS CORP.

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

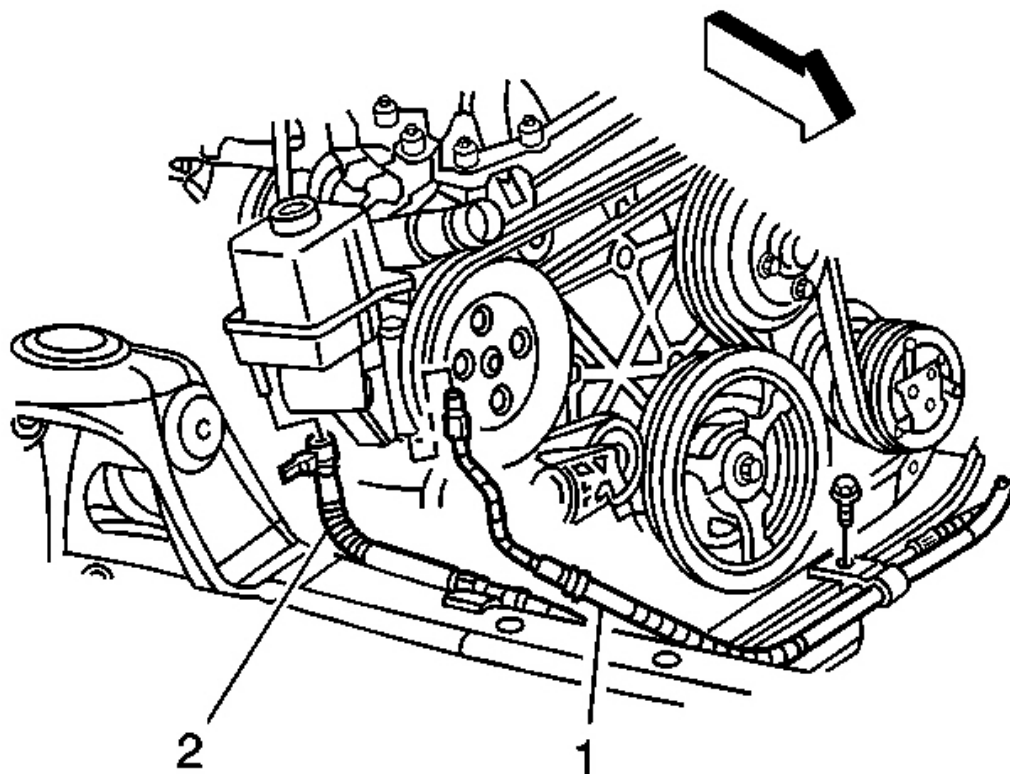


**Fig. 16: Checking Power Steering Pump Pulley Installed Depth**  
Courtesy of GENERAL MOTORS CORP.

3. Install the power steering pump pulley (1) flush against the end of the power steering pump shaft (2), with an allowable variance of 0.25 mm (0.010 in).
4. Install the drive belt. Refer to **Drive Belt Replacement** in Engine Mechanical - 4.2L.

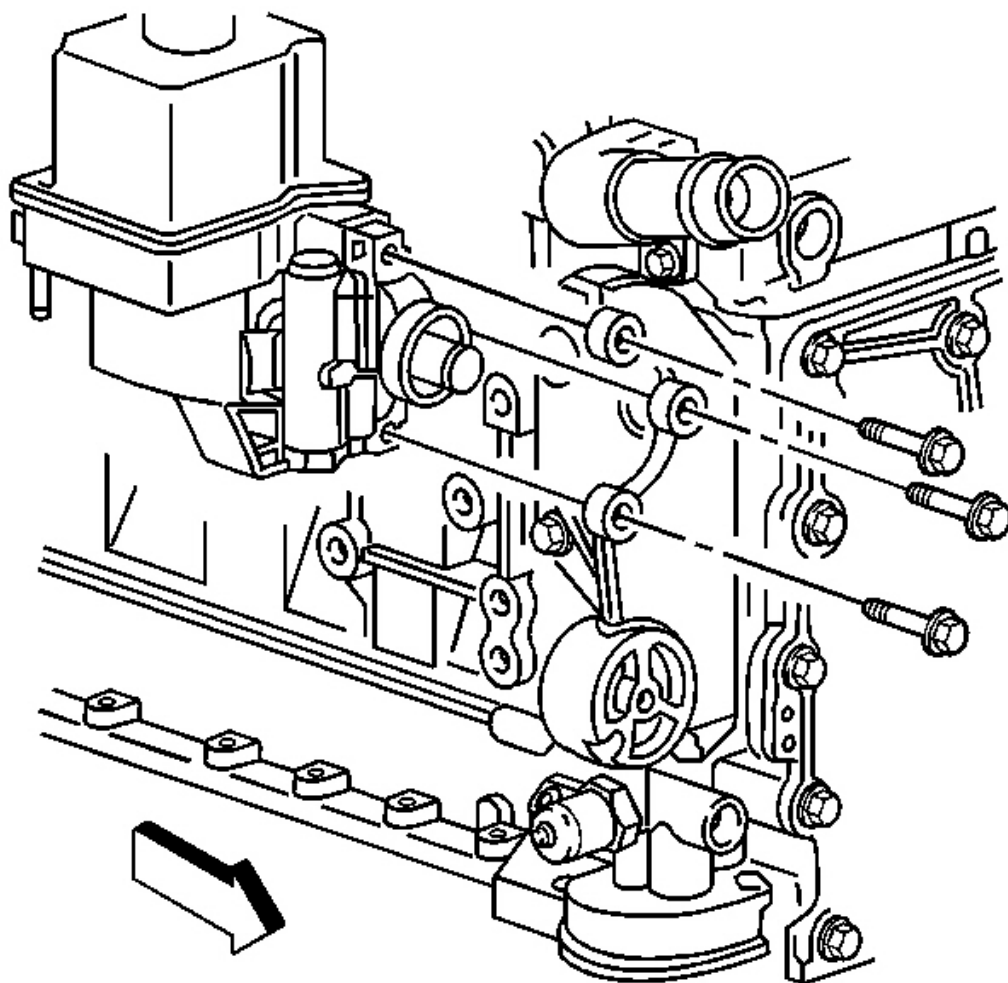
## POWER STEERING PUMP REPLACEMENT (4.2L)

### Removal Procedure



**Fig. 17: Removing/Installing Power Steering Hoses**  
Courtesy of GENERAL MOTORS CORP.

1. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** in Engine Controls - 4.2L.
2. Remove the drive belt. Refer to **Drive Belt Replacement** in Engine Mechanical - 4.2L.
3. Install a drain pan under the vehicle.
4. Disconnect the power steering pressure hose (1) from the power steering pump.
5. Disconnect the power steering cooler hose (2) from the power steering pump.
6. Disconnect the wiring harness from the wiring loom on the power steering pump.



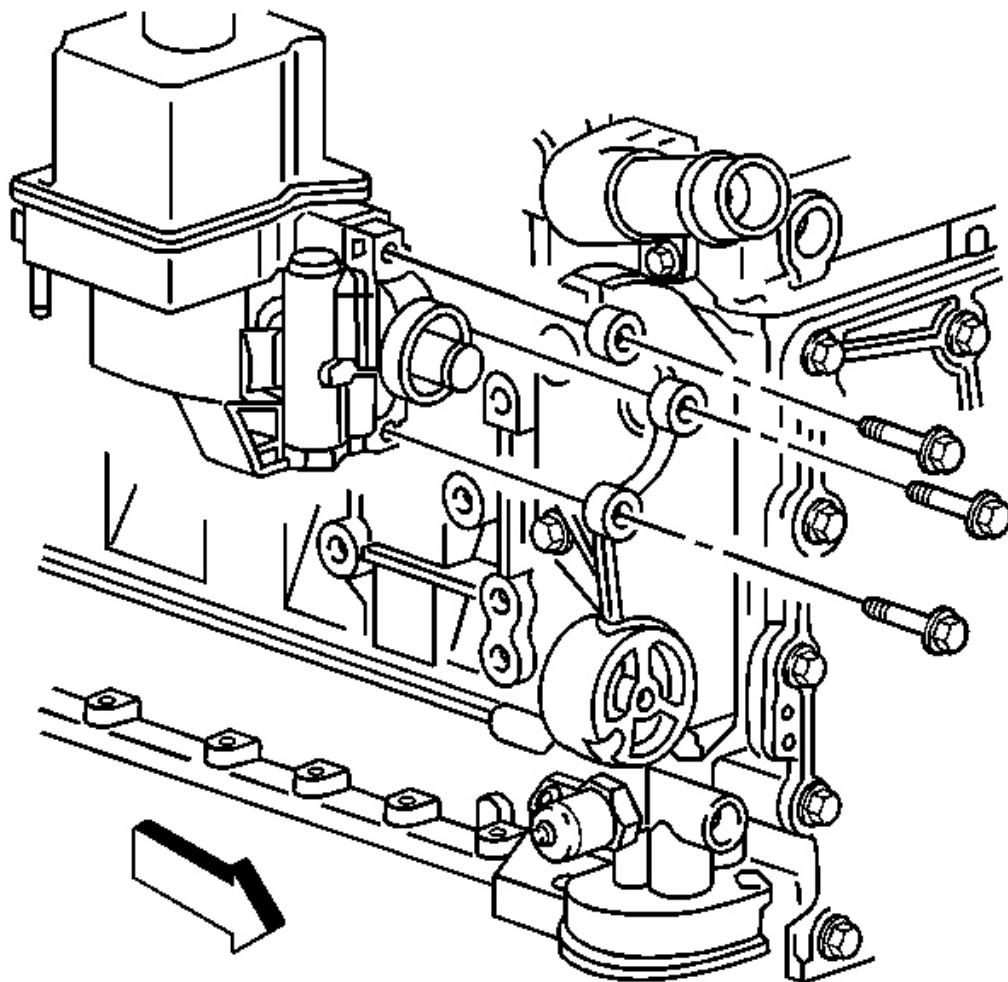
**Fig. 18: View Of Power Steering Pump Bolts**  
Courtesy of GENERAL MOTORS CORP.

7. Remove the power steering pump mounting bolts.
8. Remove the power steering pump.
9. Remove the power steering pump pulley. Refer to **Power Steering Pulley Replacement (5.3L)** or **Power Steering Pulley Replacement (4.2L)**.

**Installation Procedure**

1. Install the power steering pump pulley. Refer to **Power Steering Pulley Replacement**

(5.3L) or Power Steering Pulley Replacement (4.2L).



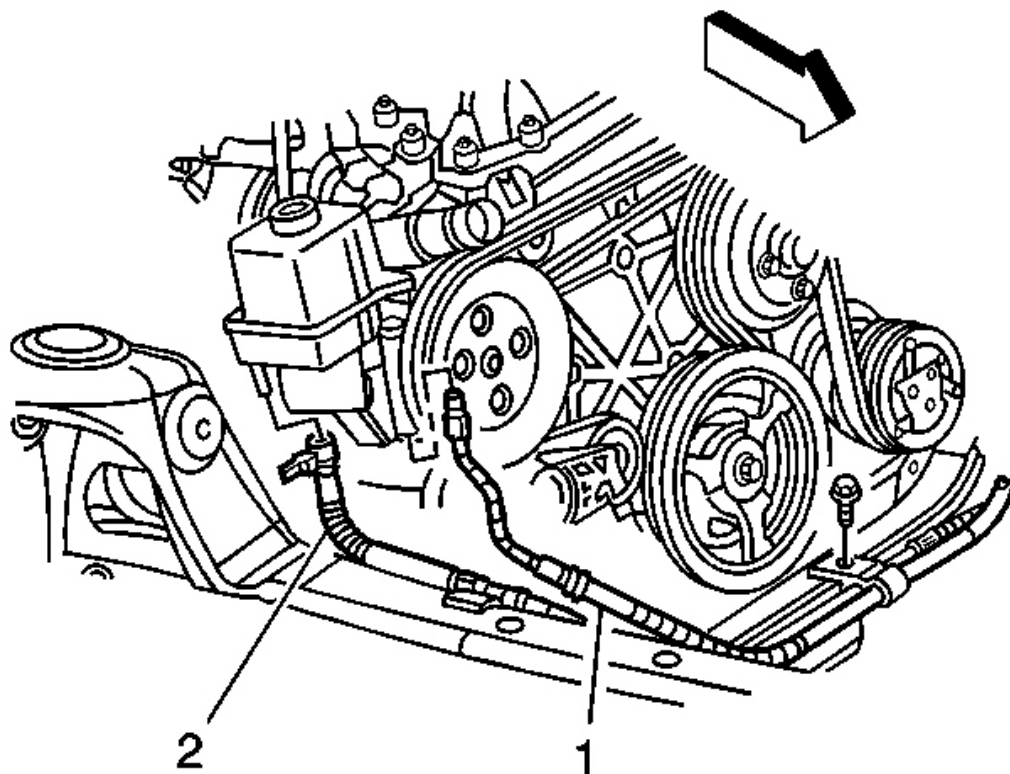
**Fig. 19: View Of Power Steering Pump Bolts**  
Courtesy of GENERAL MOTORS CORP.

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

2. Install the power steering pump.
3. Install the power steering pump mounting bolts.

**Tighten:** Tighten the power steering pump mounting bolts to 25 N.m (18 lb ft).





**Fig. 20: Removing/Installing Power Steering Hoses**  
Courtesy of GENERAL MOTORS CORP.

4. Install the power steering cooler hose (2) to the power steering pump.
5. Install the power steering pressure hose (1) to the power steering pump.

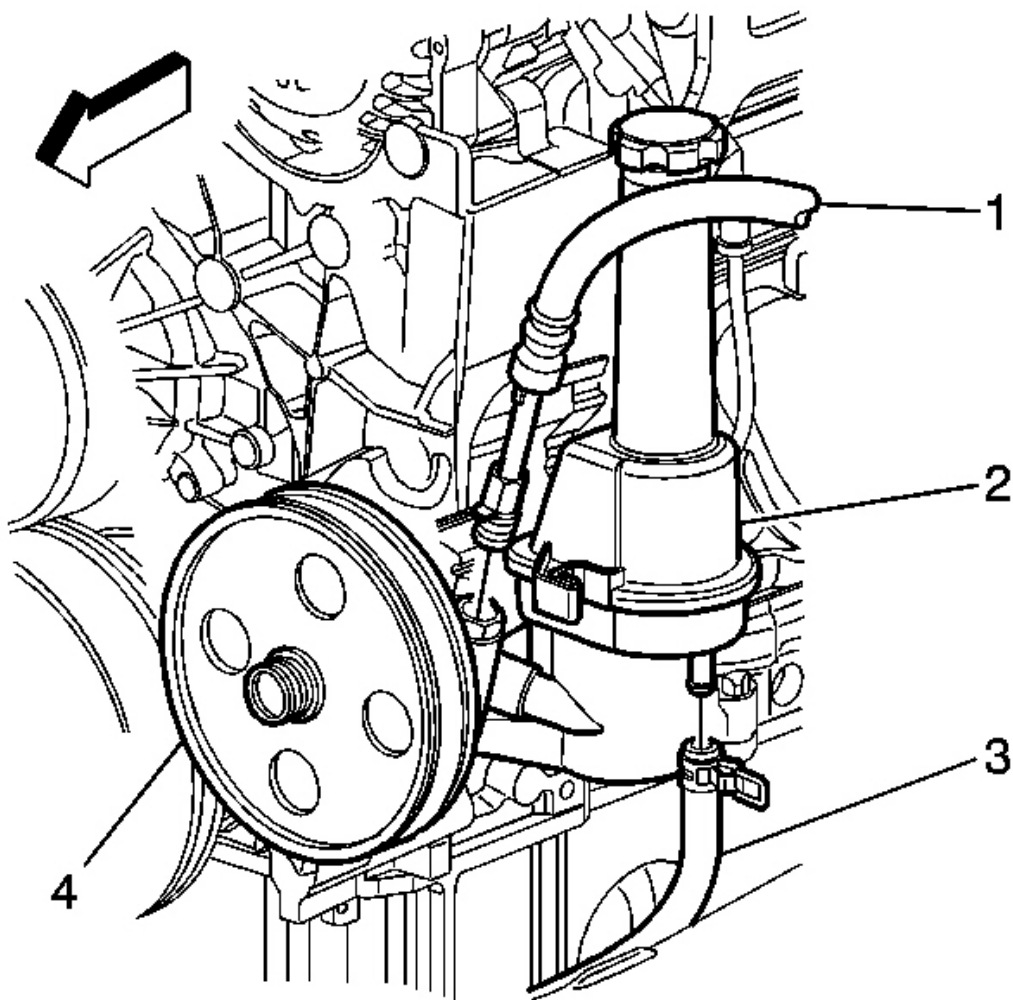
**Tighten:** Tighten the power steering pressure hose to 25 N.m (18 lb ft).

6. Remove the drain pan from under the vehicle.
7. Install the drive belt. Refer to **Drive Belt Replacement** in Engine Mechanical - 4.2L.
8. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** in Engine Controls - 4.2L
9. Bleed the power steering system. Refer to **Bleeding the Power Steering System**.
10. Inspect the power steering system for leaks and the hoses for clearance away from the frame and other components.

## POWER STEERING PUMP REPLACEMENT (5.3L)

### Removal Procedure

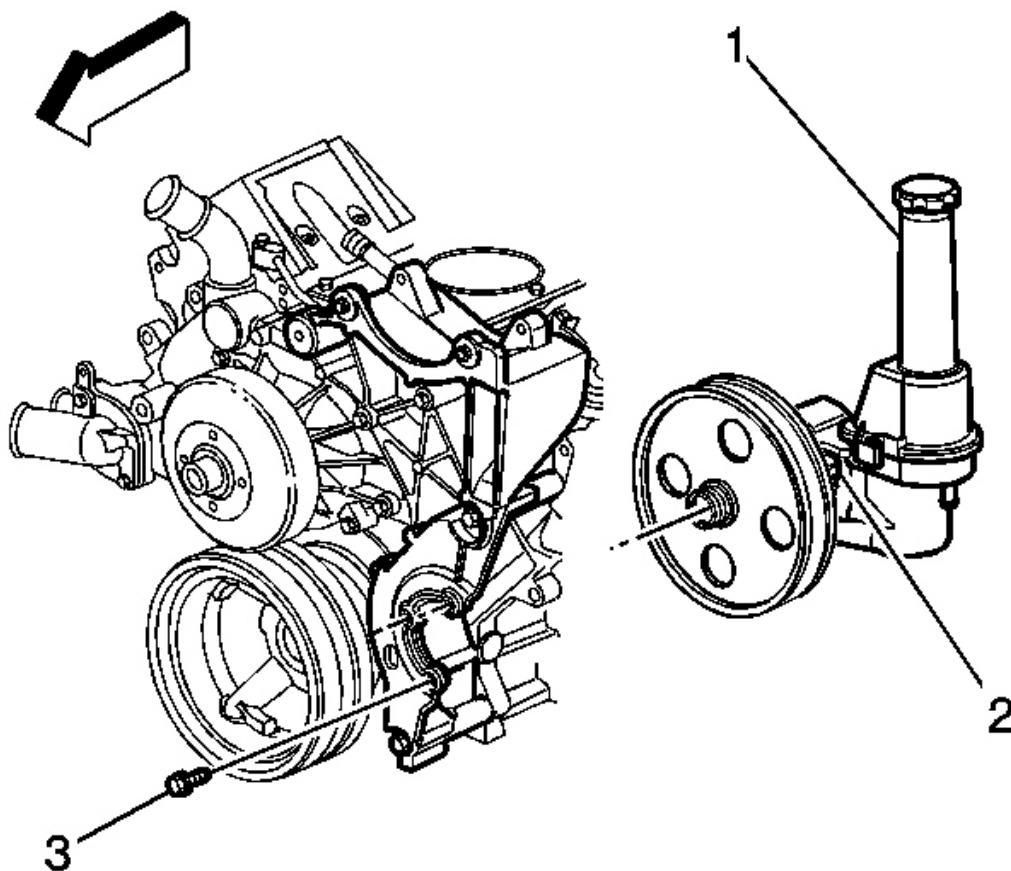
1. Remove the drive belt. Refer to **Drive Belt Replacement - Accessory** in Engine Mechanical - 5.3L.
2. Remove the engine control module (ECM) from the ECM mounting bracket and move to the side. Refer to **Engine Control Module (ECM) Replacement** in Engine Controls - 5.3L.



**Fig. 21: View Of Power Steering Pressure Hose, Return Hose & Pump**

**Courtesy of GENERAL MOTORS CORP.**

3. Remove the power steering pressure hose (1) from power steering pump (2).
4. Remove the power steering pump return hose (3) from power steering pump (2).



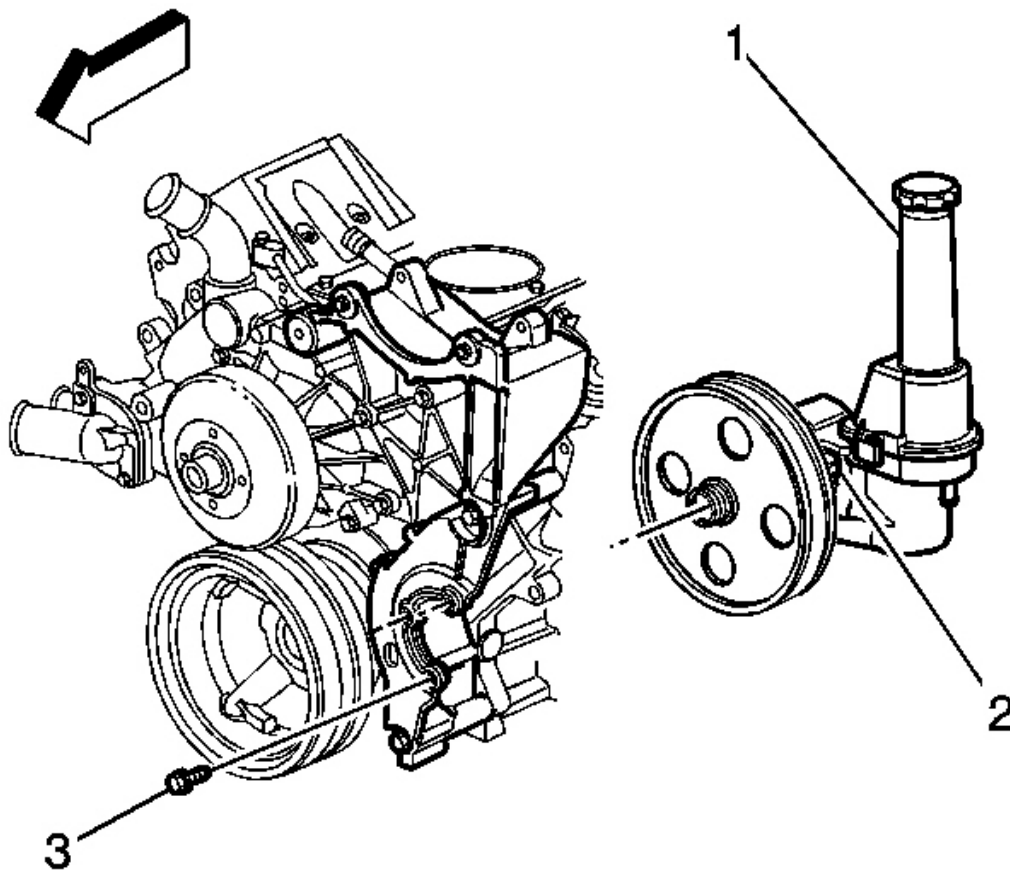
**Fig. 22: Removing/Installing Power Steering Pump**  
**Courtesy of GENERAL MOTORS CORP.**

5. Remove the power steering pump mounting bolts (3).
6. Remove the power steering pump (1).
7. Remove the power steering pump pulley. Refer to **Power Steering Pulley Replacement (5.3L)** or **Power Steering Pulley Replacement (4.2L)**.
8. If applicable, remove the power steering pump reservoir. Refer to **Power Steering**

**Reservoir Replacement - Off Vehicle (CB Series).**

**Installation Procedure**

1. If applicable, install the power steering pump reservoir. Refer to **Power Steering Reservoir Replacement - Off Vehicle (CB Series).**
2. Install the power steering pump pulley. Refer to **Power Steering Pulley Replacement (5.3L)** or **Power Steering Pulley Replacement (4.2L).**



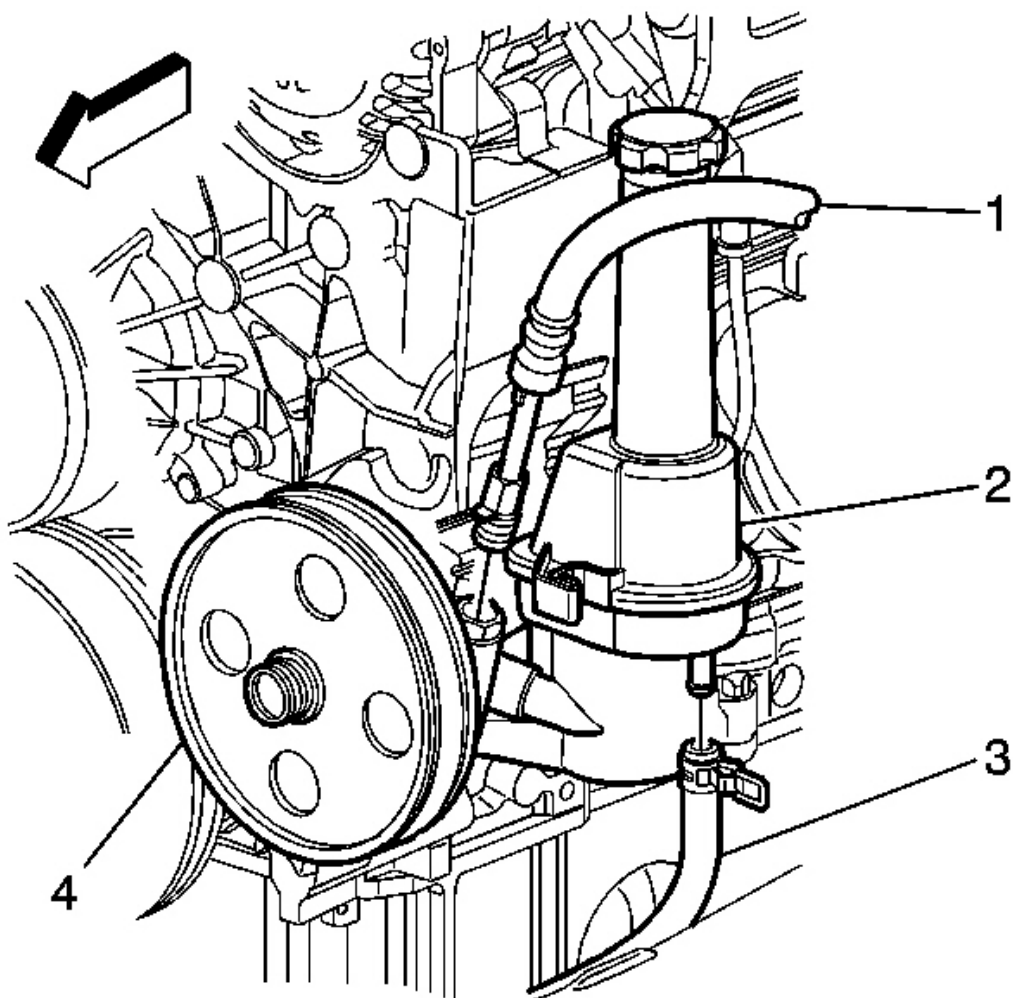
**Fig. 23: Removing/Installing Power Steering Pump**  
Courtesy of GENERAL MOTORS CORP.

3. Align the power steering pump (1) with mounting bolt holes on engine block (2).

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

4. Install the power steering pump mounting bolts (3).

**Tighten:** Tighten the bolts to 25 N.m (18 lb ft).



**Fig. 24: View Of Power Steering Pressure Hose, Return Hose & Pump**  
Courtesy of GENERAL MOTORS CORP.

5. Attach the power steering pump return hose (3) to power steering pump (2).

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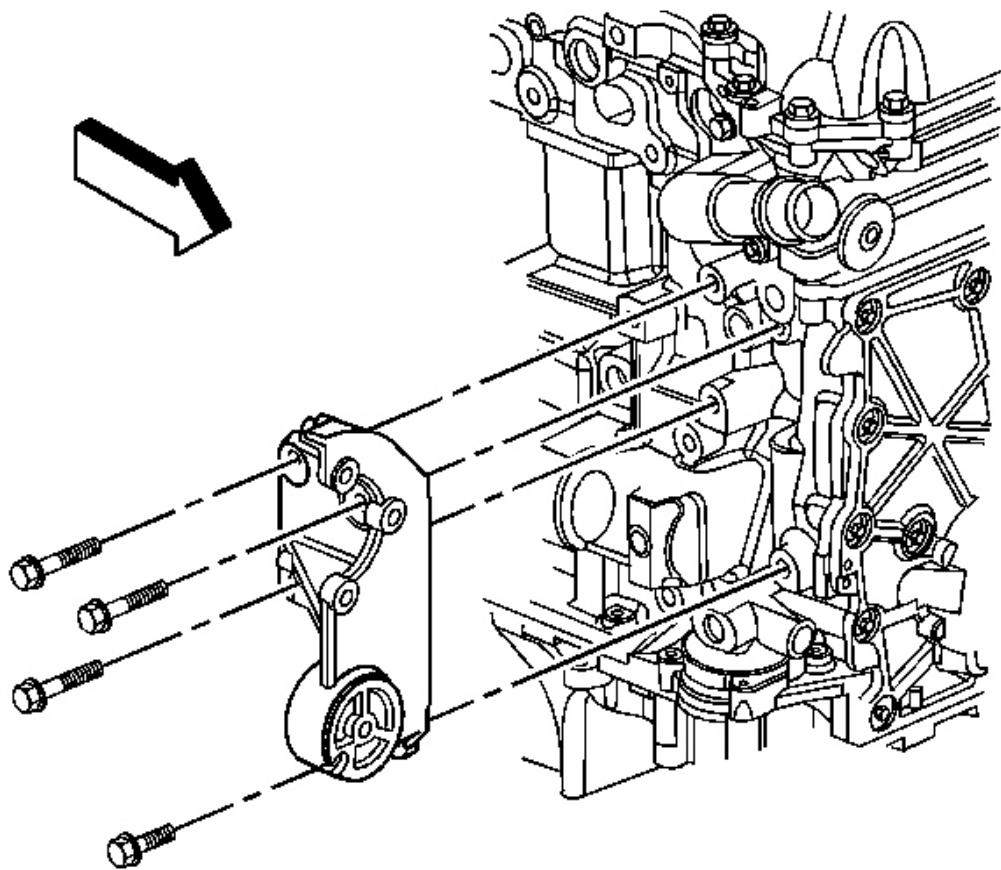
6. Attach the power steering pump pressure hose (1) to power steering pump (2).

**Tighten:** Tighten the fittings to 25 N.m (18 lb in).

7. Install the ECM to the ECM mounting bracket. Refer to **Engine Control Module (ECM) Replacement** in Engine Controls - 5.3L.
8. Install the drive belt. Refer to **Drive Belt Replacement - Accessory** in Engine Mechanical - 5.3L.
9. Bleed the power steering system. Refer to **Bleeding the Power Steering System**.

### POWER STEERING PUMP BRACKET REPLACEMENT

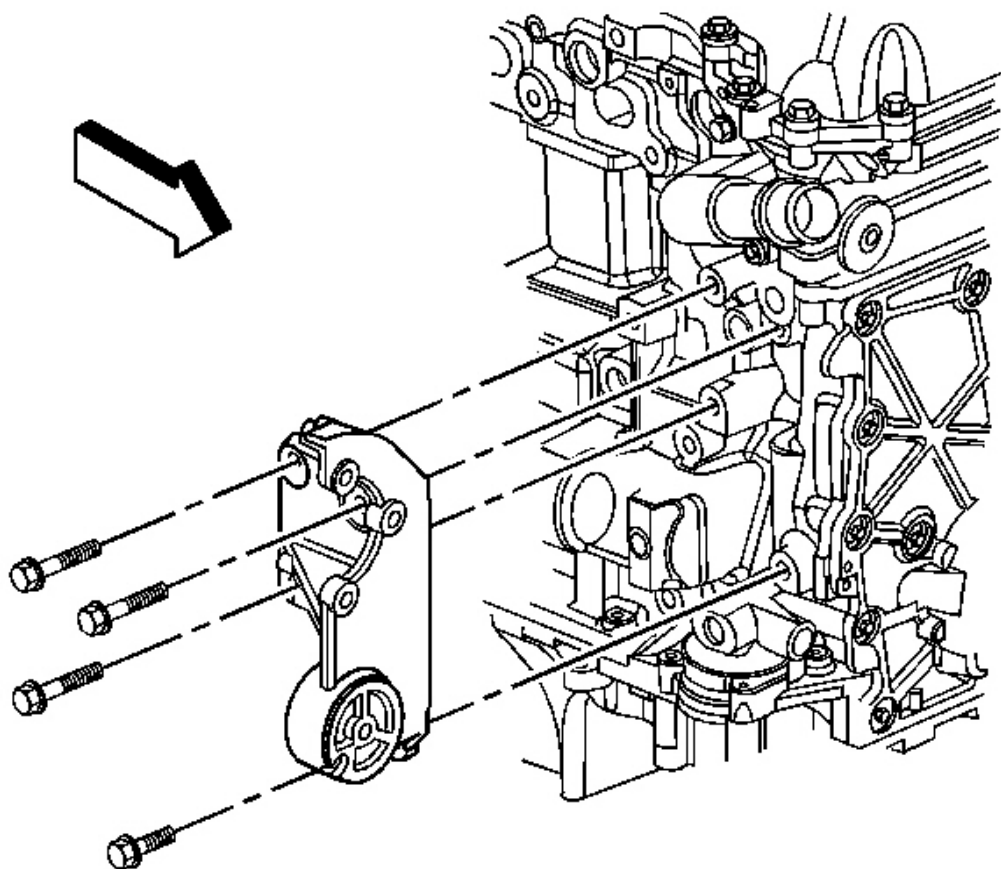
#### Removal Procedure



**Fig. 25: Removing/Installing Power Steering Pump Bracket**  
Courtesy of GENERAL MOTORS CORP.

1. Remove the power steering pump. Refer to **Power Steering Pump Replacement (4.2L)** or **Power Steering Pump Replacement (5.3L)**.
2. Remove the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement** in Engine Mechanical-4.2L.
3. Remove the power steering pump bracket mounting bolts.
4. Remove the power steering pump bracket.

**Installation Procedure**



**Fig. 26: Removing/Installing Power Steering Pump Bracket**

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### Courtesy of GENERAL MOTORS CORP.

1. Install the power steering pump bracket.

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

2. Install the power steering pump bracket mounting bolts.

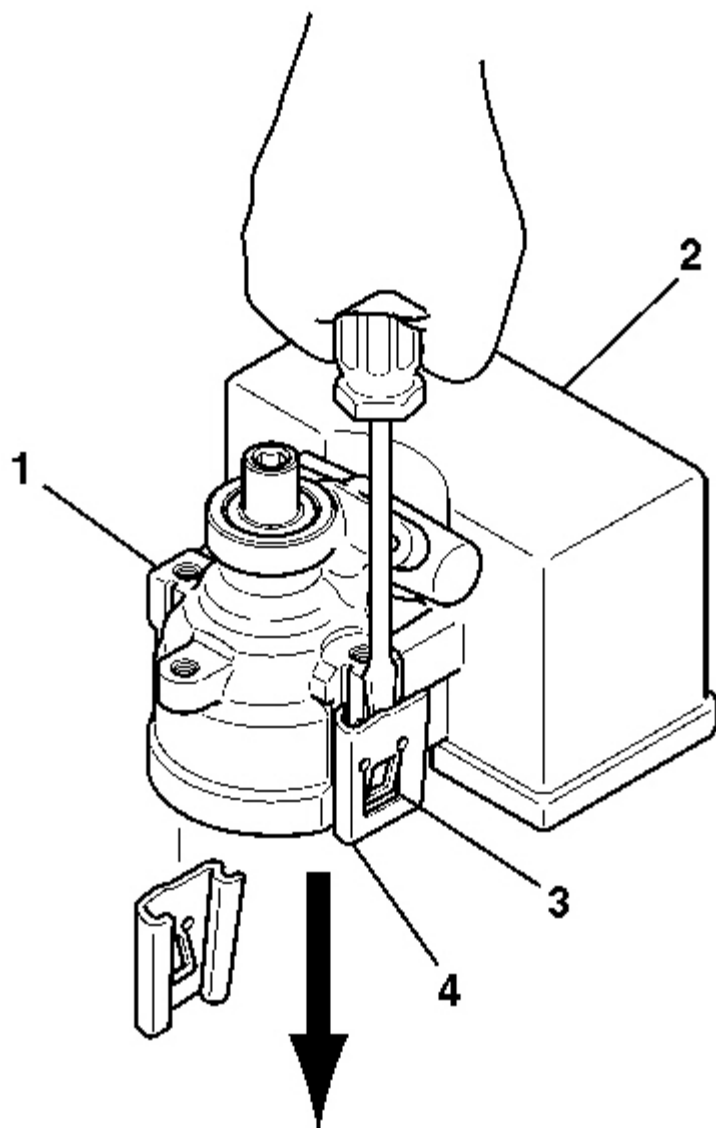
**Tighten:** Tighten the power steering pump mounting bolts to 50 N.m (37 lb ft).

3. Install the drive belt tensioner. Refer to Drive Belt Tensioner Replacement in Engine Mechanical-4.2L.
4. Install the power steering pump. Refer to Power Steering Pump Replacement (4.2L) or Power Steering Pump Replacement (5.3L).

### POWER STEERING RESERVOIR REPLACEMENT - OFF VEHICLE (CB SERIES)

#### Disassembly Procedure





**Fig. 27: Removing Power Steering Reservoir (CB Series)**  
**Courtesy of GENERAL MOTORS CORP.**

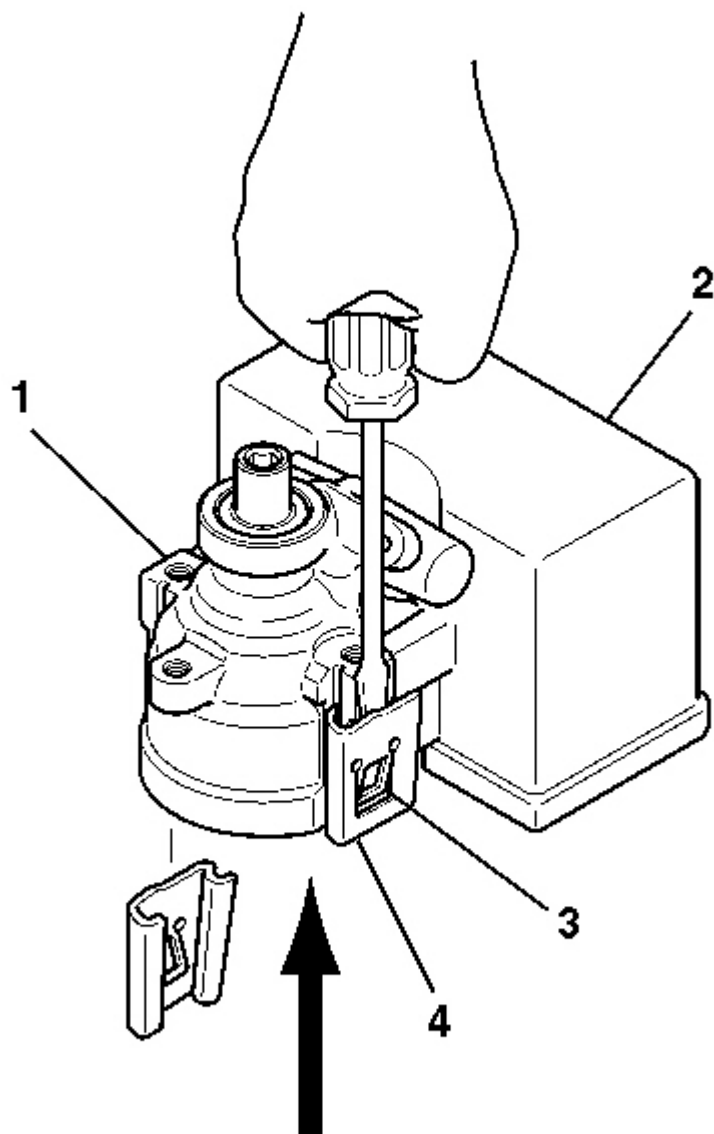
1. Place the hydraulic pump (1) on a fixed, flat surface, with the shaft facing upward.
2. Insert a screwdriver into the retaining clip tab (3).
3. Using the screwdriver, force the retaining clip tab (3) outward.

## 2006 Buick Rainier

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4. Slide the reservoir clip (4) away from the hydraulic pump assembly (1).
5. Repeat the above steps to remove the second reservoir clip (4).
6. Remove the reservoir (2) from the hydraulic pump housing (1).
7. Remove the O-ring seal from the neck of the reservoir (2) or inside the hydraulic pump housing (1). Discard the O-ring seal.

### Assembly Procedure



**Fig. 28: View Of Power Steering Pump And Reservoir (CB Series)**  
**Courtesy of GENERAL MOTORS CORP.**

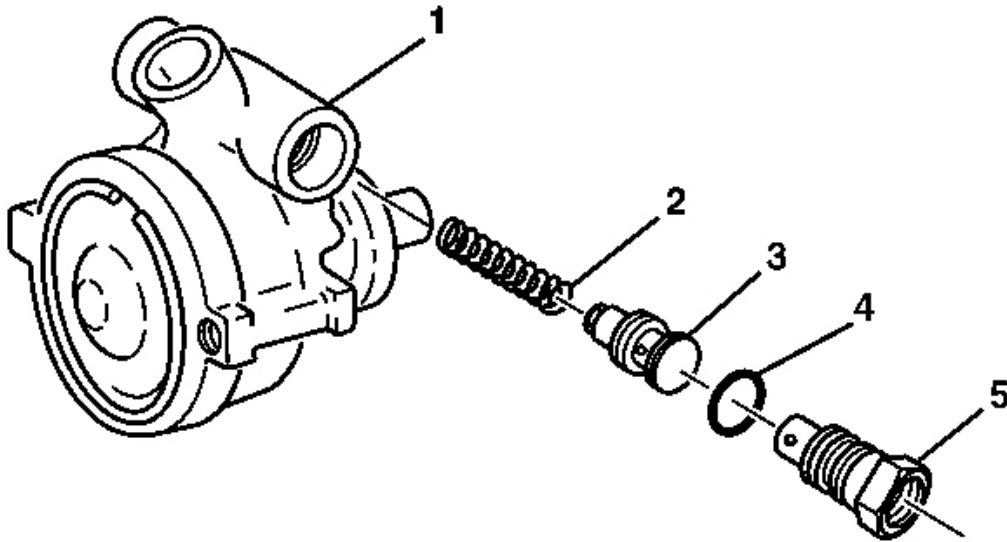
1. Lubricate the new O-ring seal with power steering fluid.
2. Install the new O-ring seal onto the neck of the reservoir (2).
3. Install the reservoir (2) onto the hydraulic pump assembly (1). Ensure the reservoir neck is

completely engaged onto the hydraulic pump assembly (1).

4. Align the feet of the reservoir with the sides of the hydraulic pump housing.
5. Install the new reservoir retaining clips (4) (supplied with the pump). Ensure the retaining clip tabs (3) fully engage with the hydraulic pump housing (1).

## POWER STEERING PUMP FLOW CONTROL VALVE REPLACEMENT - OFF VEHICLE (CB SERIES)

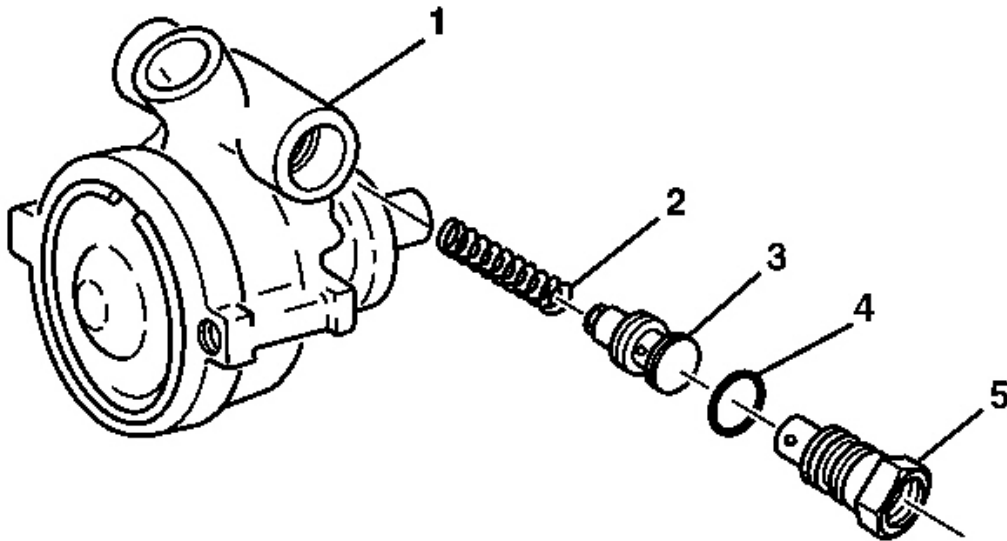
### Disassembly Procedure



**Fig. 29: Exploded View Of Power Steering Pump Flow Control Valve (CB Series)**  
Courtesy of GENERAL MOTORS CORP.

1. Remove the O-ring union fitting (5) from the hydraulic pump housing assembly (1).
2. Remove the O-ring seal (4) from the O-ring union fitting (5).
3. Remove the control valve assembly (3).
4. Remove the flow control spring (2).

### Assembly Procedure



**Fig. 30: Exploded View Of Power Steering Pump Flow Control Valve (CB Series)**  
 Courtesy of GENERAL MOTORS CORP.

1. Install the flow control spring (2) to the hydraulic pump housing assembly (1).
2. Install the control valve assembly (3).
3. Lubricate the O-ring seal (4) with power steering fluid.
4. Install the O-ring seal (4) onto the O-ring union fitting (5).

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

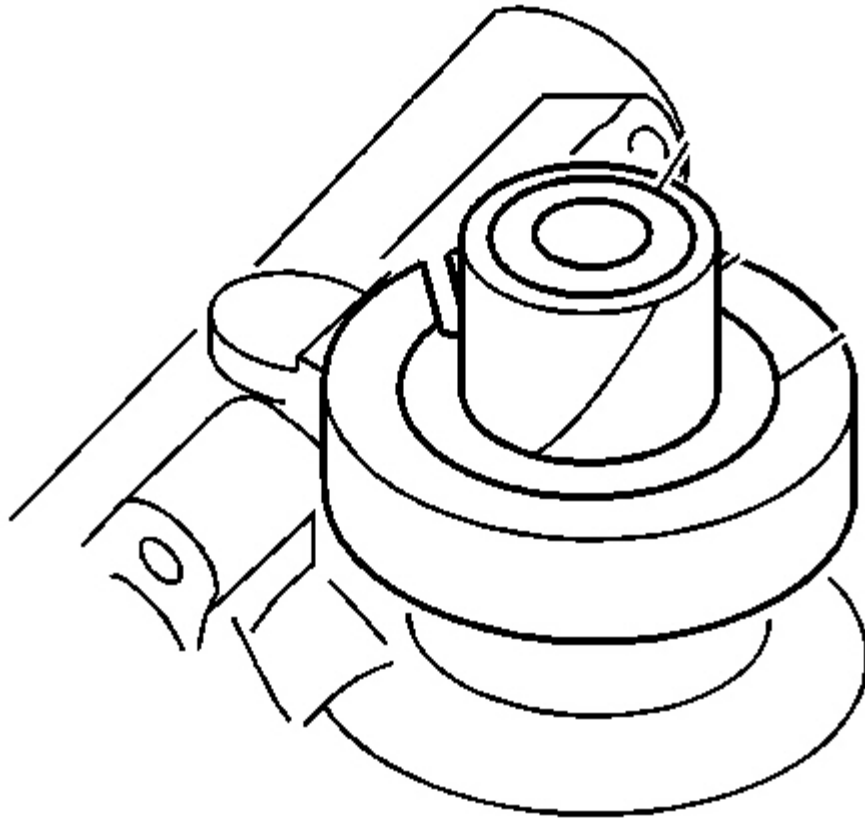
5. Install the O-ring union fitting (5) into the hydraulic pump housing assembly (1).

**Tighten:** Tighten the fitting (5) to 75 N.m (55 lb ft).

#### POWER STEERING PUMP DRIVE SHAFT SEAL REPLACEMENT (CB)

##### Removal Procedure

1. Remove the power steering pump from the vehicle, if necessary. Refer to Power Steering Pump Replacement (4.2L) or Power Steering Pump Replacement (5.3L).



**Fig. 31: Power Steering Pump Drive Shaft Seal**  
Courtesy of GENERAL MOTORS CORP.

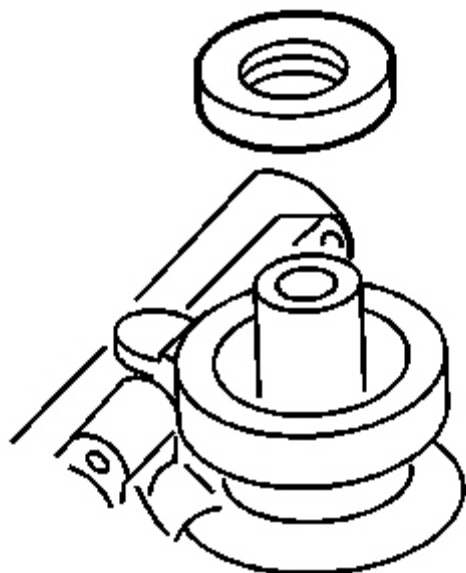
**IMPORTANT: Protect the drive shaft with the shim stock.**

2. Use a small chisel in order to remove the seal.

Discard the seal.

**Installation Procedure**

1. Lubricate the new drive shaft seal using power steering fluid.



**Fig. 32: Power Steering Pump Drive Shaft Seal**  
Courtesy of GENERAL MOTORS CORP.

2. Use a deep socket in order to install the new drive shaft seal.
3. Install the power steering pump, if removed. Refer to **Power Steering Pump Replacement (4.2L)** or **Power Steering Pump Replacement (5.3L)**.

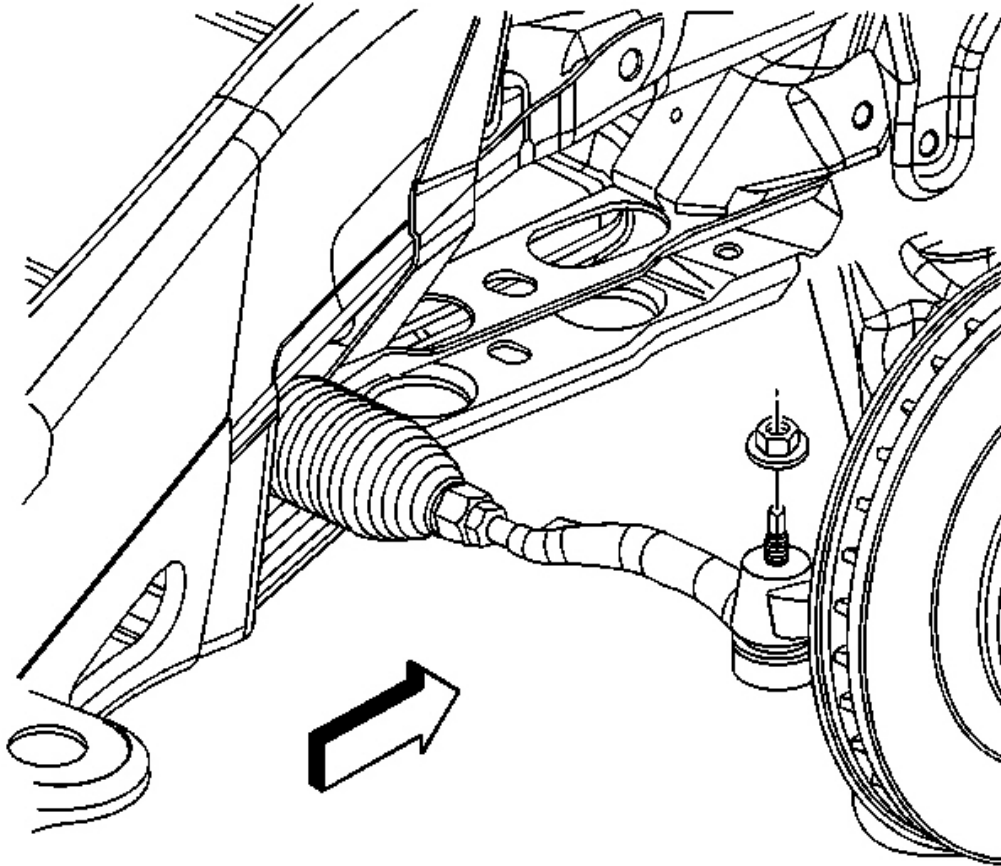
## **RACK AND PINION OUTER TIE ROD END REPLACEMENT**

### **Tools Required**

**J 24319-B** Steering Linkage and Tie Rod Puller. See **Special Tools**.

### **Removal Procedure**

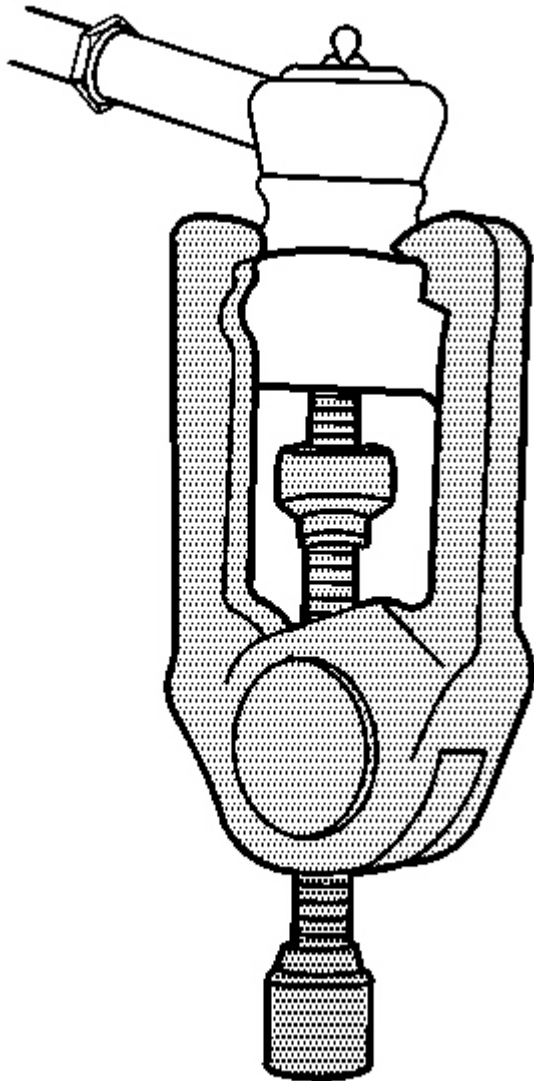
1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.



**Fig. 33: View Of Tie Rod Retaining Nut**  
**Courtesy of GENERAL MOTORS CORP.**

3. Remove the outer tie rod retaining nut.

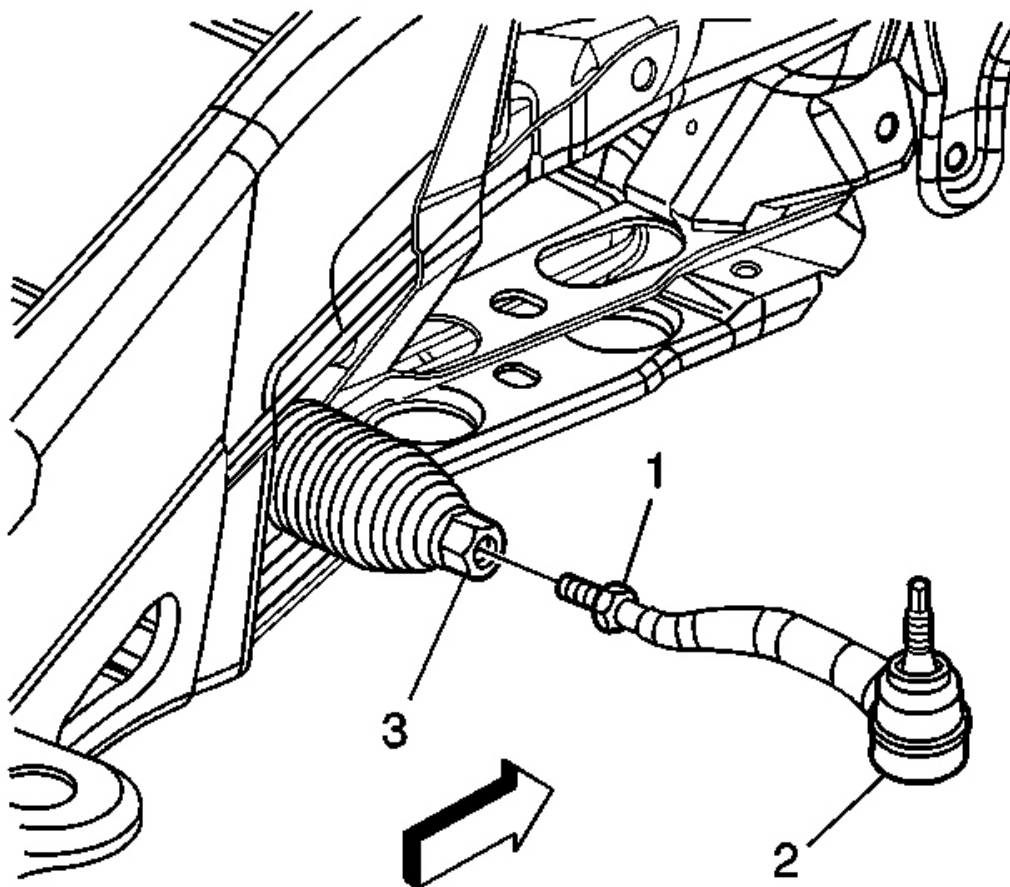




**Fig. 34: Removing Outer Tie Rod Assembly From Steering Knuckle**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Do not attempt to disconnect a steering linkage joint by driving a wedge between the joint and the attached part. Seal damage may result which will cause premature failure of the joint.

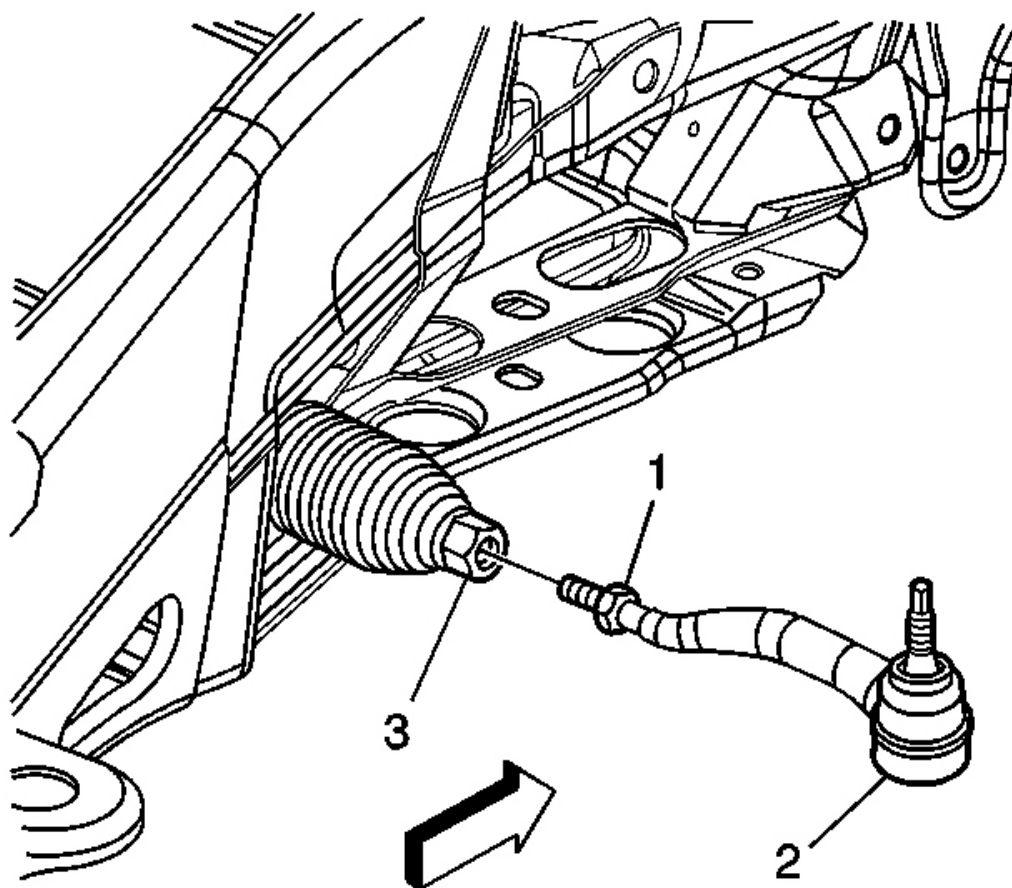
4. Disconnect the outer tie rod from the steering knuckle using **J 24319-B** . See **Special Tools**.



**Fig. 35: Removing/Installing Outer Tie Rod**  
Courtesy of GENERAL MOTORS CORP.

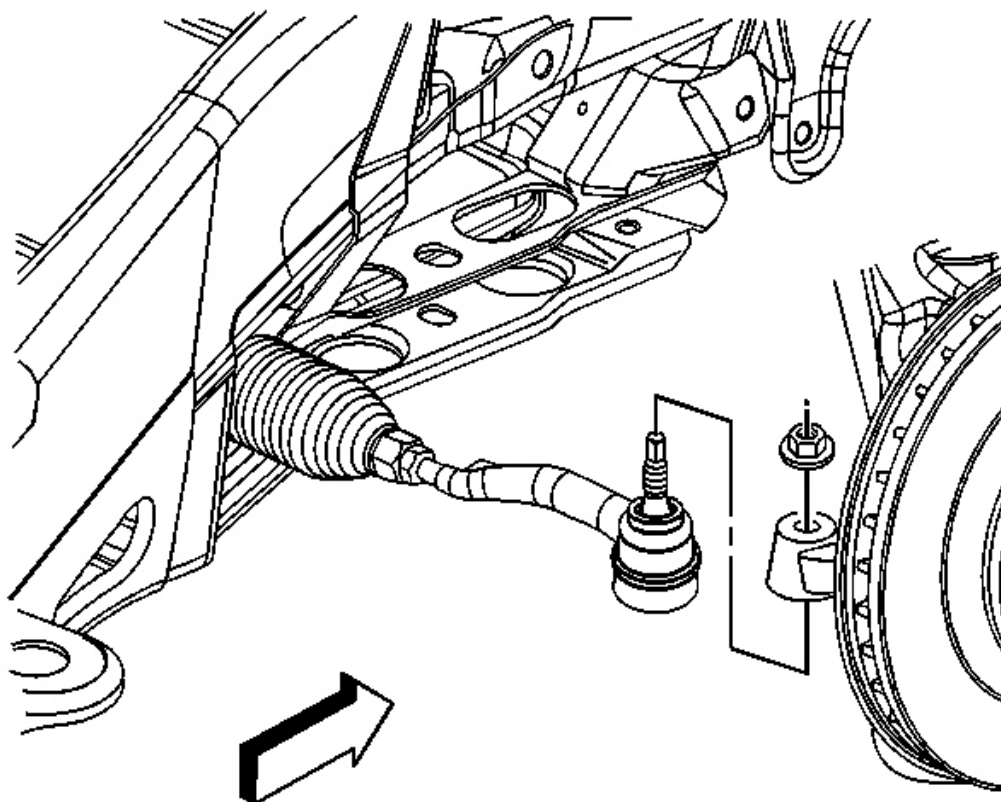
5. Loosen the jam nut (1) and remove the outer tie rod (2) from the inner tie rod (3).  
Do not reuse the jam nut.
6. Inspect the shaft for bent or damaged threads.
7. Clean the tapered surface of the steering knuckle.

Installation Procedure



**Fig. 36: Removing/Installing Outer Tie Rod**  
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the inner tie rod (3) threads with a suitable chassis lubricant before installing the outer tie rod (2).
2. Install the new jam nut (1) to the outer tie rod (2).
3. Install the outer tie rod (2) to the inner tie rod (3).



**Fig. 37: Removing/Installing Tie Rod**  
Courtesy of GENERAL MOTORS CORP.

4. Install the outer tie rod to the steering knuckle.

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

5. Install the new outer tie rod retaining nut.

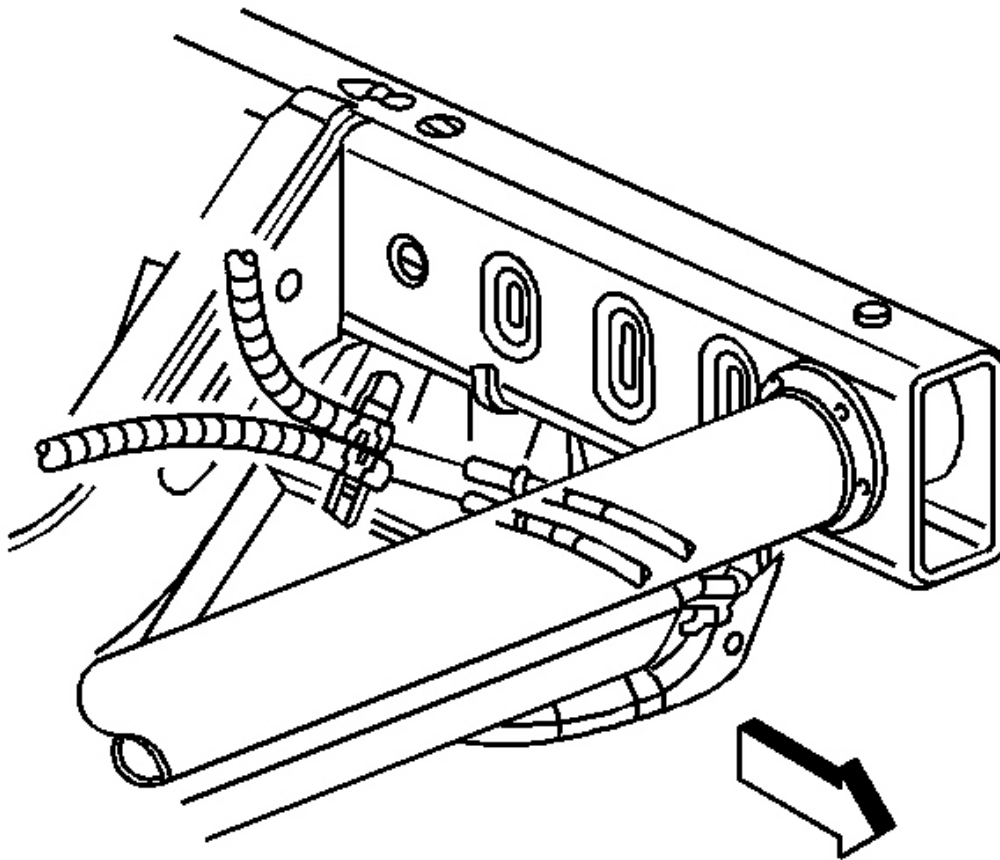
**Tighten:** Tighten the outer tie rod retaining nut to 60 N.m (44 lb ft).

6. Install the tire and wheel. Refer to Tire and Wheel Removal and Installation in Tires and Wheels.
7. Lower the vehicle.
8. Adjust the front toe. Refer to **Front Toe Adjustment** in Wheel Alignment.

## POWER STEERING COOLER REPLACEMENT (4.2L)

### Removal Procedure

1. Remove the front air dam deflector. Refer to [Air Deflector Replacement - Front Bumper Fascia](#) .

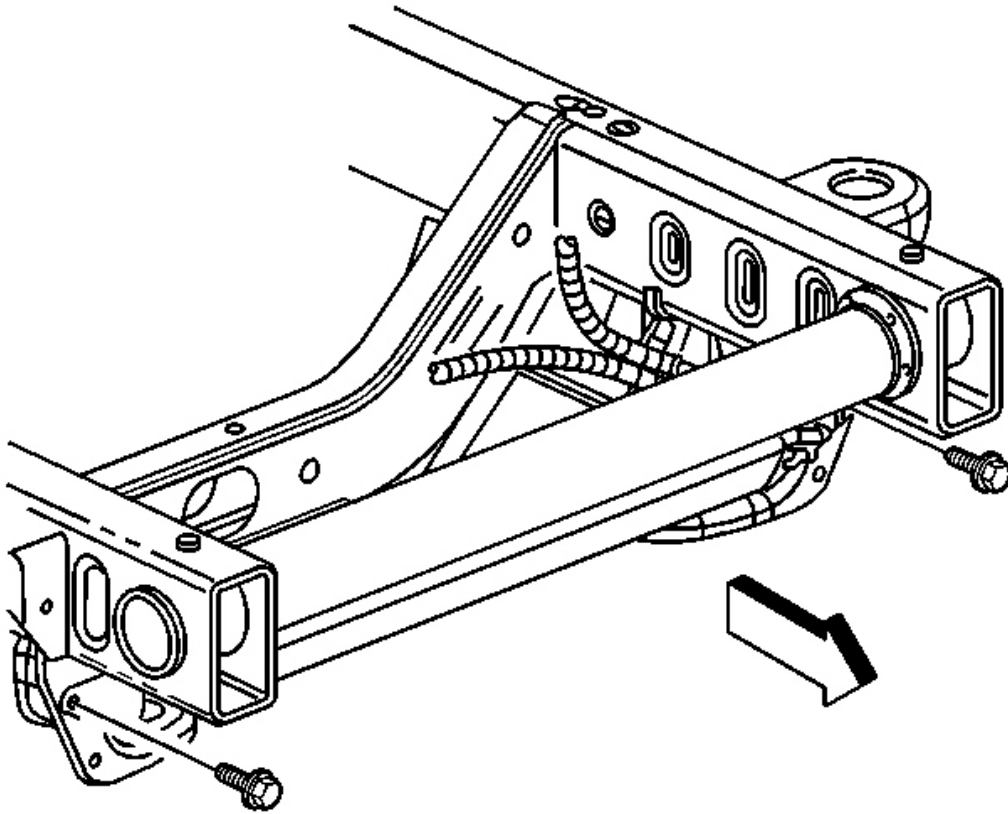


**Fig. 38: View Of Power Steering Hose Assembly At Power Steering Cooler**  
Courtesy of GENERAL MOTORS CORP.

2. Install a drain pan under the vehicle.
3. Disconnect the power steering hose assembly from the power steering cooler.

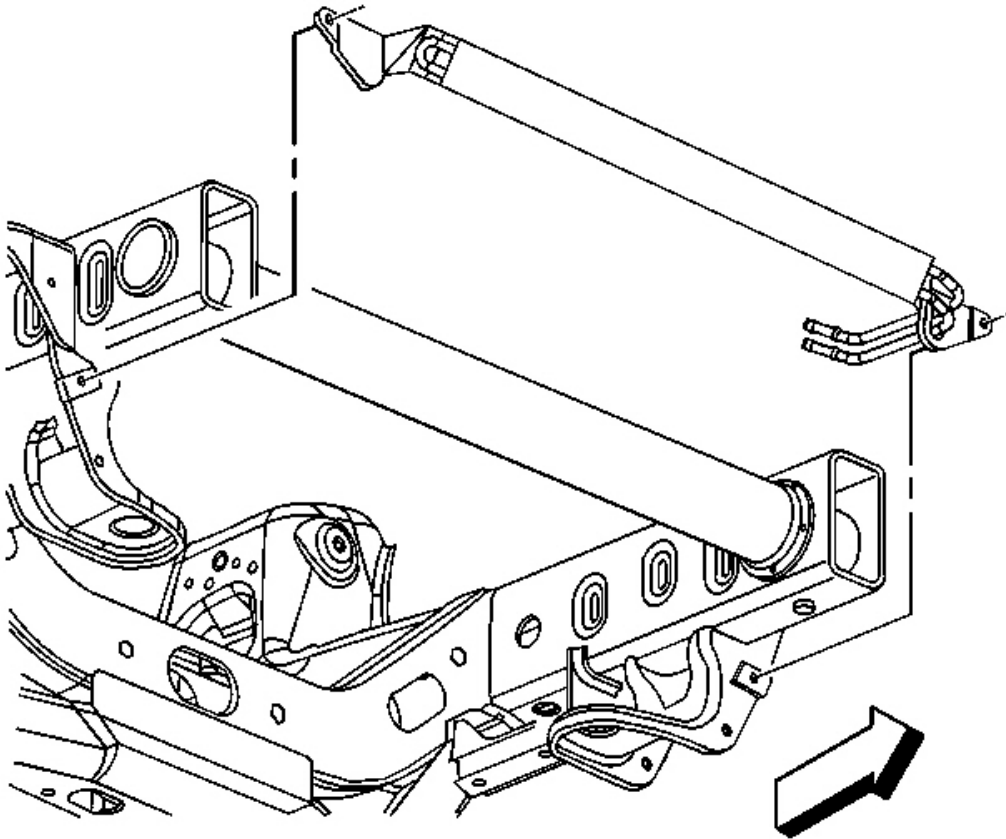
**2006 Buick Rainier**

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**Fig. 39: Removing/Installing Power Steering Cooler Mounting Bolts**  
Courtesy of GENERAL MOTORS CORP.

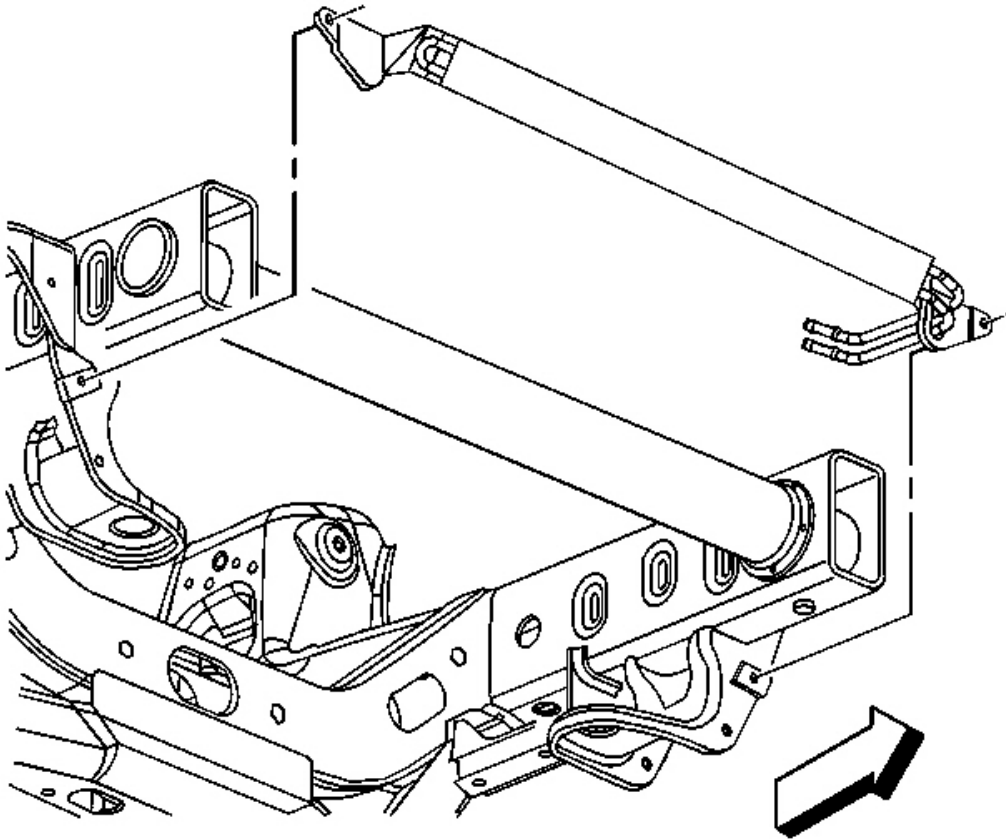
4. Remove the power steering cooler mounting bolts.



**Fig. 40: Removing/Installing Power Steering Cooler**  
Courtesy of GENERAL MOTORS CORP.

5. Remove the power steering cooler from the radiator support.

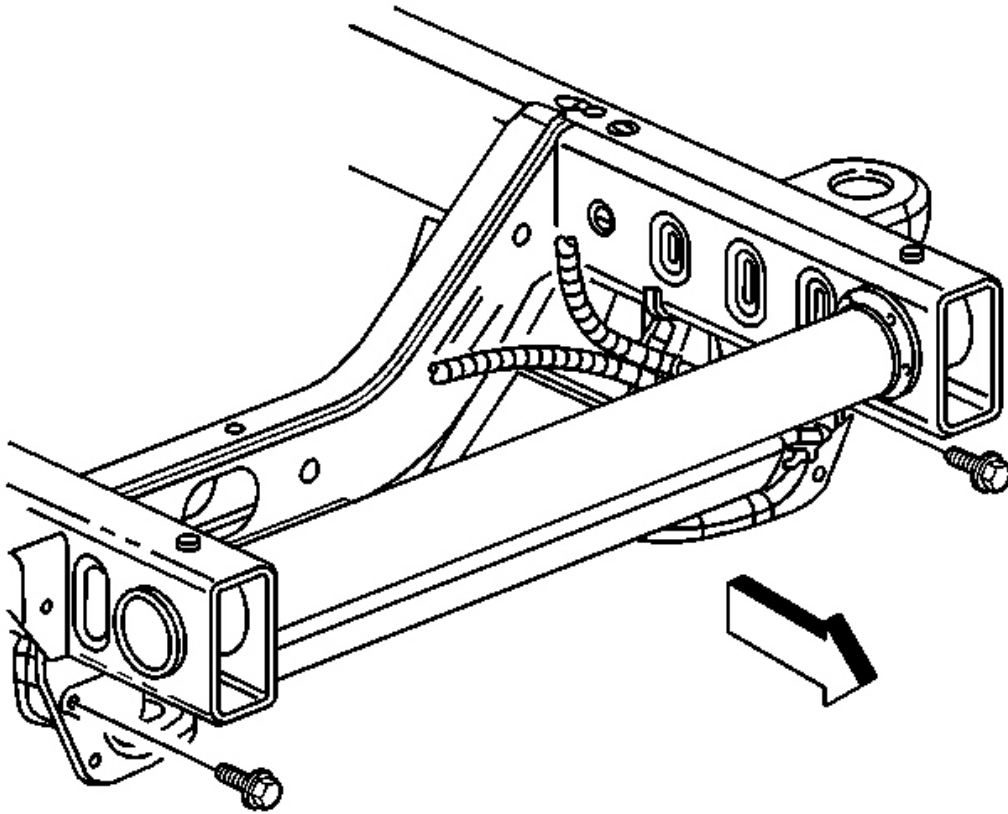
**Installation Procedure**



**Fig. 41: Removing/Installing Power Steering Cooler**  
Courtesy of GENERAL MOTORS CORP.

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



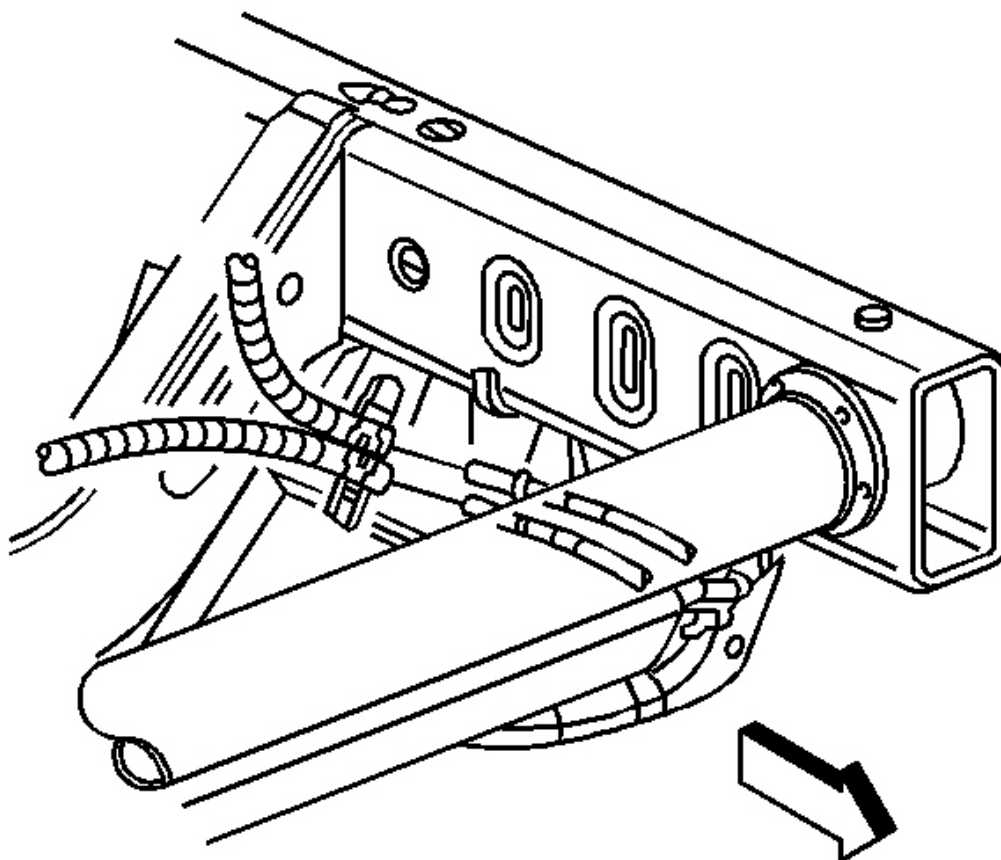


**Fig. 42: Removing/Installing Power Steering Cooler Mounting Bolts**  
Courtesy of GENERAL MOTORS CORP.

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

2. Install the power steering cooler mounting bolts.

**Tighten:** Tighten the power steering cooler mounting bolts to 20 N.m (15 lb ft).



**Fig. 43: View Of Power Steering Hose Assembly At Power Steering Cooler**  
**Courtesy of GENERAL MOTORS CORP.**

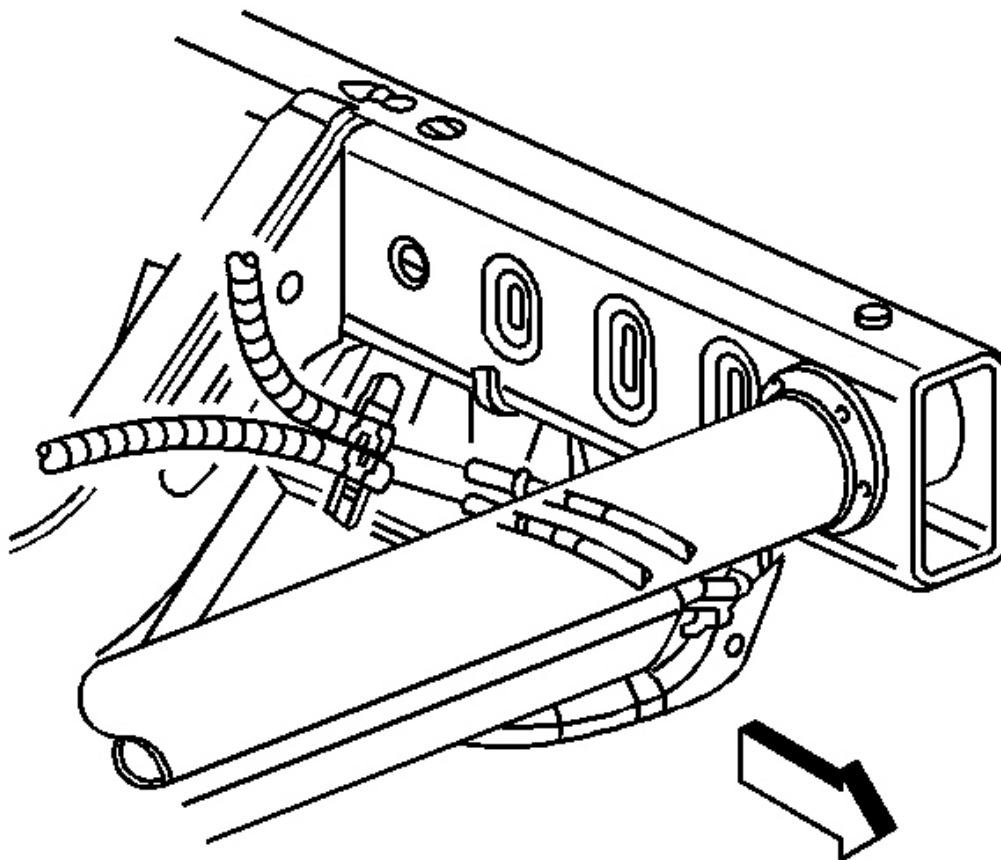
3. Connect the power steering hoses assembly to the power steering cooler.
4. Remove drain pan from under the vehicle.
5. Install the front air deflector. Refer to **Air Deflector Replacement - Front Bumper Fascia** .

#### **POWER STEERING COOLER REPLACEMENT (5.3L)**

##### **Removal**

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

2. Place drain pan under vehicle.
3. Remove the front fascia. Refer to **Fascia Replacement - Front Bumper (Rainier)** or **Fascia Replacement - Front Bumper (TrailBlazer)** or **Fascia Replacement - Front Bumper (Envoy)** in Bumpers.

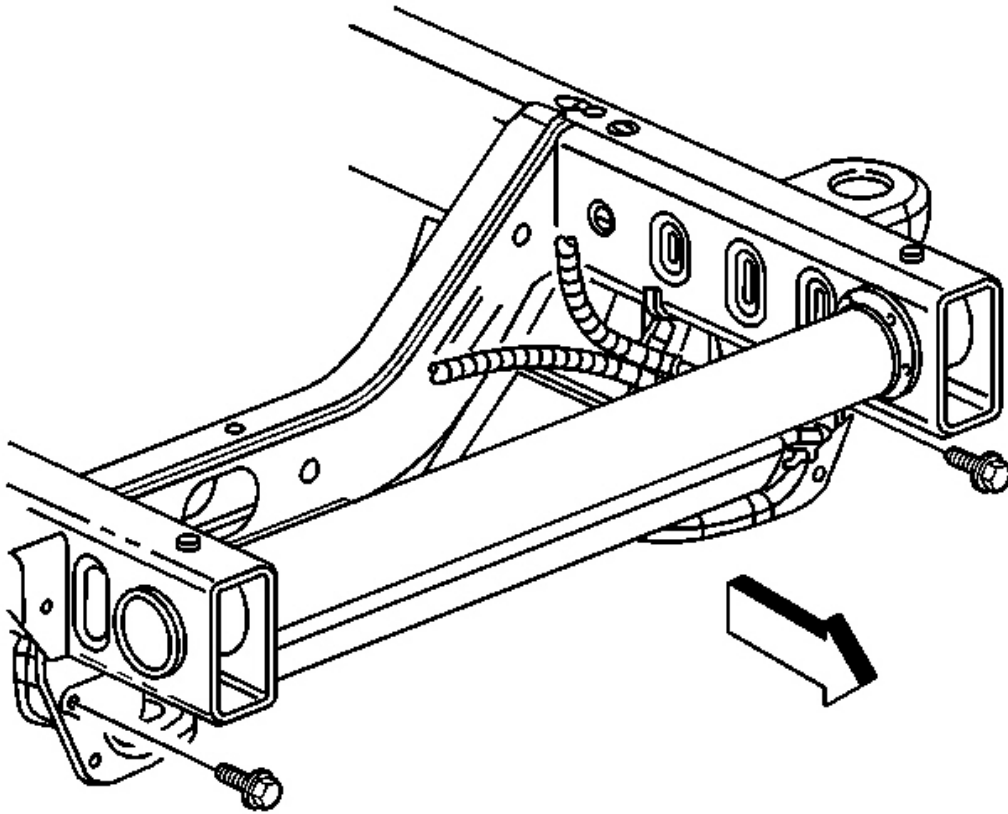


**Fig. 44: View Of Power Steering Hose Assembly At Power Steering Cooler**  
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the power steering cooler hoses from the power steering cooler.

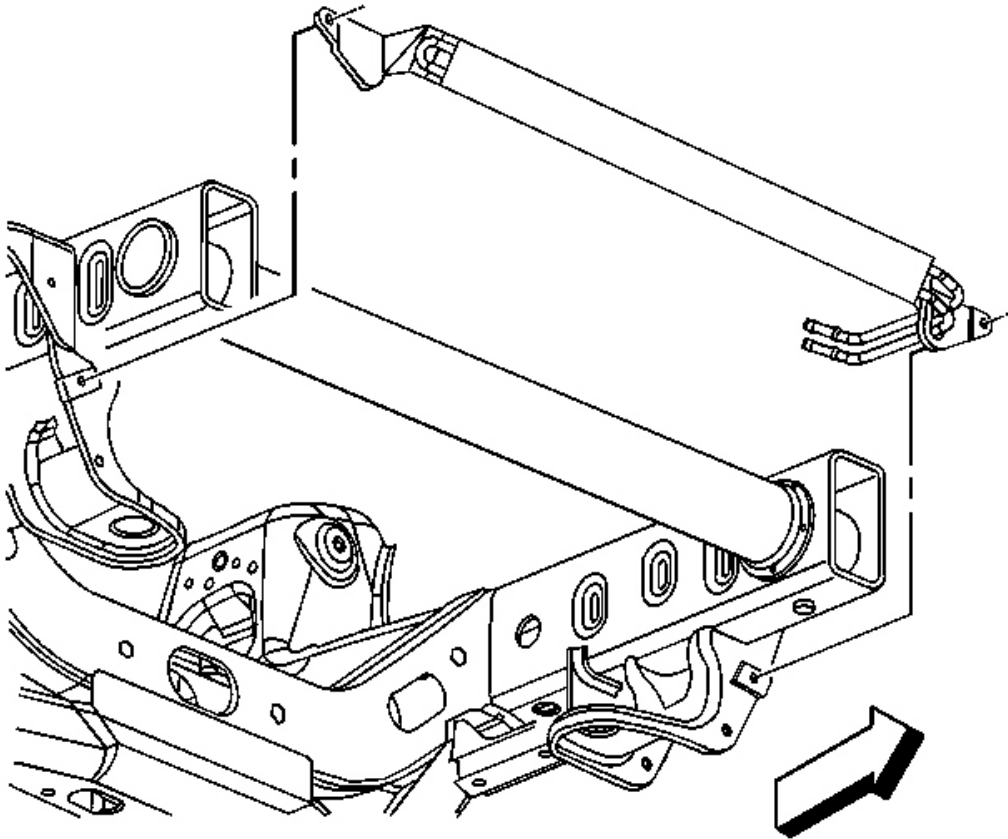
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**Fig. 45: Removing/Installing Power Steering Cooler Mounting Bolts**  
Courtesy of GENERAL MOTORS CORP.

5. Remove the power steering cooler mounting bolts.



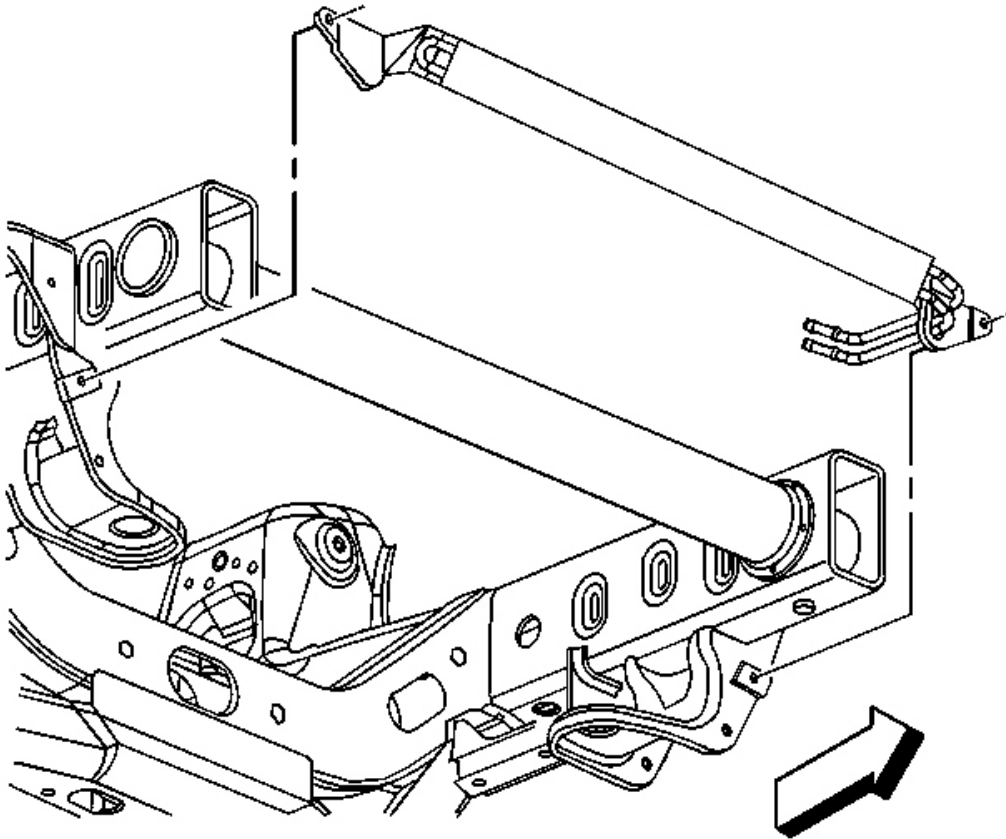
**Fig. 46: Removing/Installing Power Steering Cooler**  
**Courtesy of GENERAL MOTORS CORP.**

6. Remove the power steering cooler from the radiator support.

**Installation**

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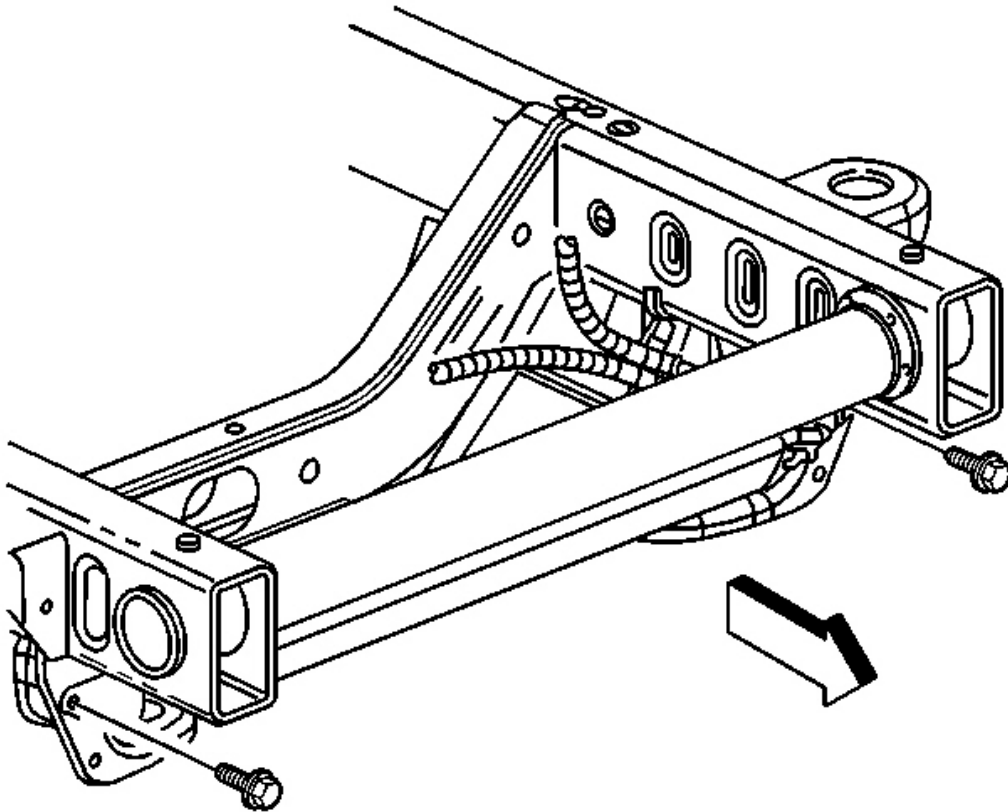
2006 STEERING Power Steering System - Ascender, Envoy, Rainier & TrailBlazer



**Fig. 47: Removing/Installing Power Steering Cooler**  
Courtesy of GENERAL MOTORS CORP.

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

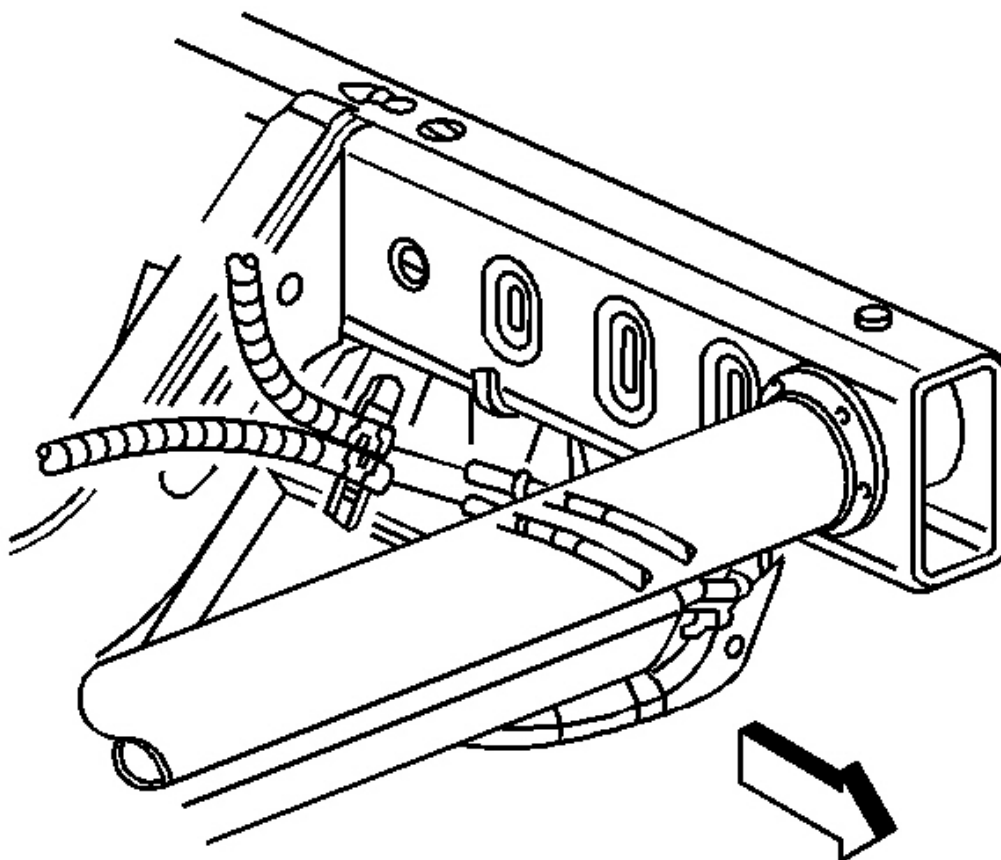
**NOTE:** Refer to Fastener Notice in Cautions and Notices.



**Fig. 48: Removing/Installing Power Steering Cooler Mounting Bolts**  
Courtesy of GENERAL MOTORS CORP.

2. Install the power steering cooler mounting bolts.

**Tighten:** Tighten the power steering cooler mounting to 20 N.m(15 lb ft).



**Fig. 49: View Of Power Steering Hose Assembly At Power Steering Cooler**  
**Courtesy of GENERAL MOTORS CORP.**

3. Connect the power steering cooler hoses to the power steering cooler.
4. Install the front fascia. Refer to **Fascia Replacement - Front Bumper (Rainier)** or **Fascia Replacement - Front Bumper (TrailBlazer)** or **Fascia Replacement - Front Bumper (Envoy)** in Bumpers.
5. Remove the drain pan from under the vehicle.
6. Lower the vehicle.
7. Start vehicle and inspect power steering fluid level.
8. Add power steering fluid in needed.



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### POWER STEERING GEAR INLET AND OUTLET HOSE REPLACEMENT (4.2L)

#### Tools Required

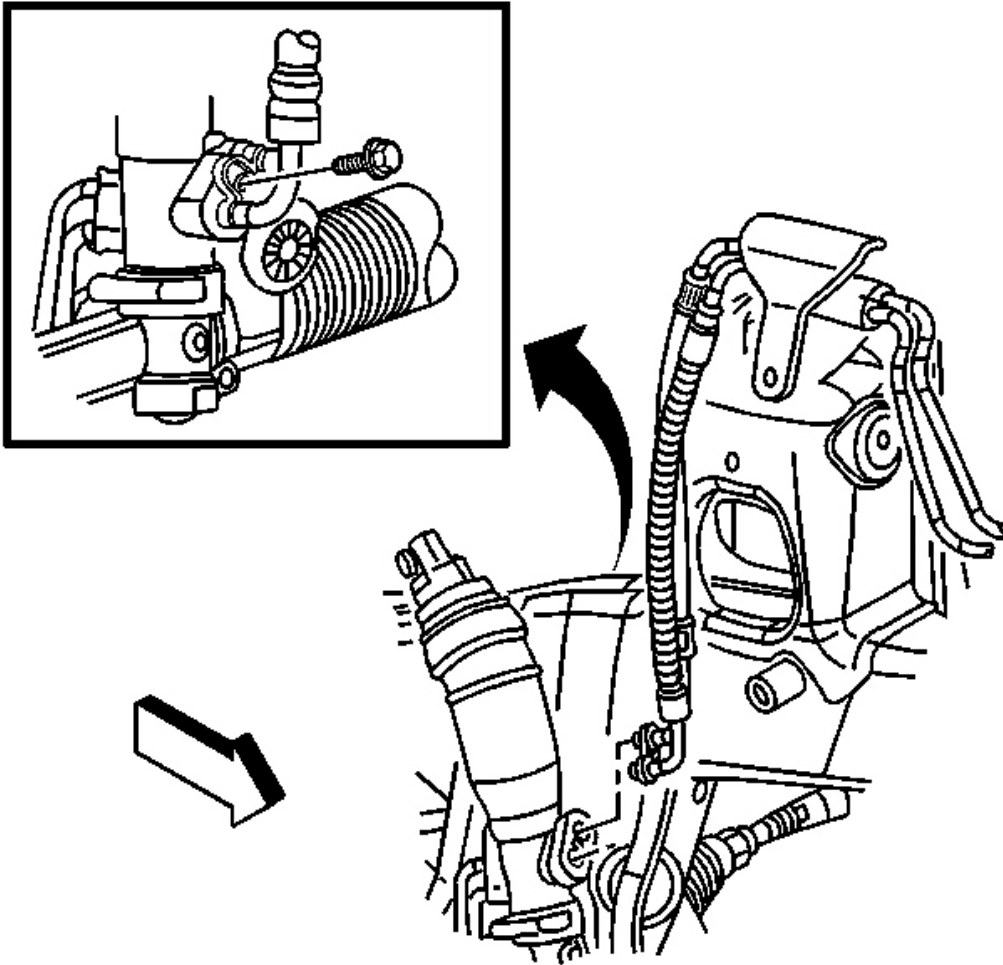
**J 44586** Power Steering Gear Oil Seal Remover/Installer. See **Special Tools**.

#### Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

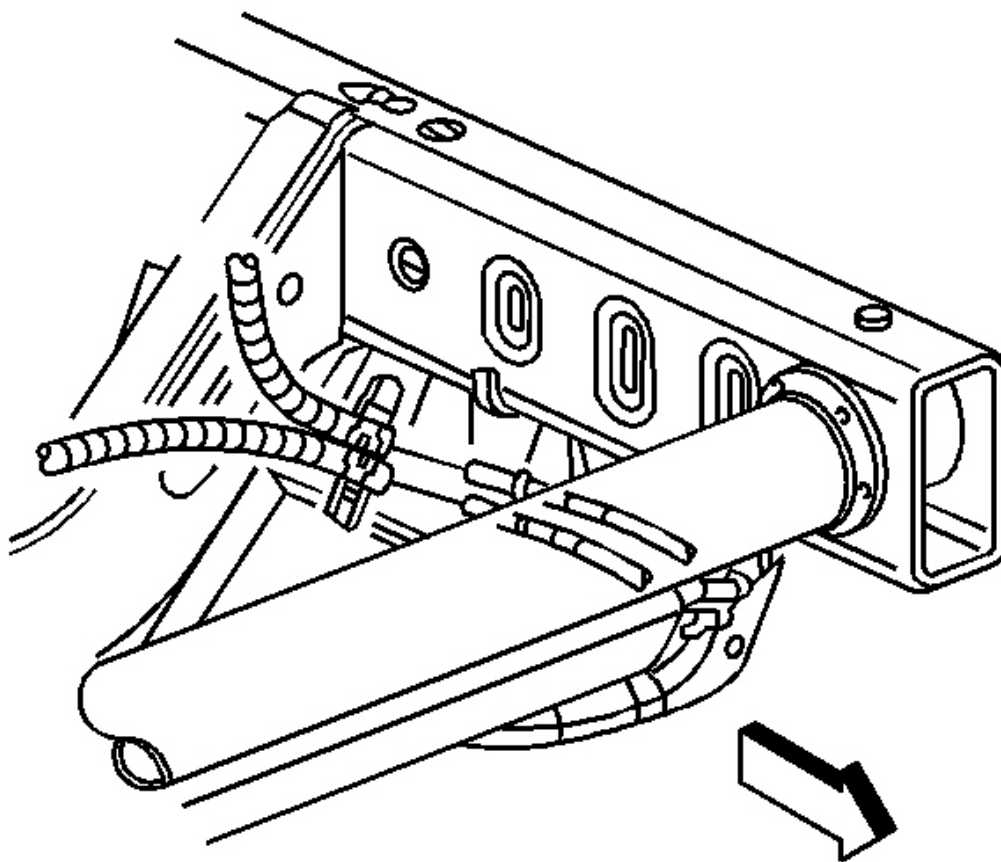
**NOTE:** Refer to **POWER STEERING HOSE DISCONNECTED NOTICE** in **Cautions and Notices**.

2. Install the drain pan under the vehicle.



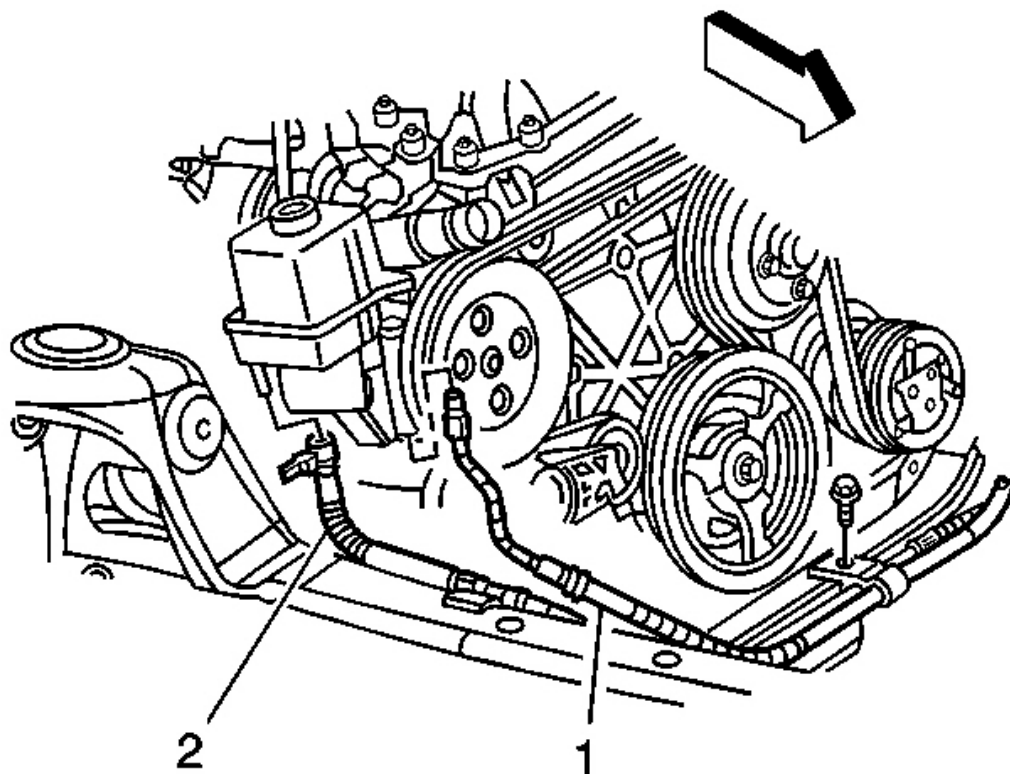
**Fig. 50: View Of Power Steering Hose Assembly To Gear Retaining Bolt**  
Courtesy of GENERAL MOTORS CORP.

3. Remove the power steering hose assembly to the power steering gear retaining bolt.
4. Disconnect the power steering hose assembly from the power steering gear.



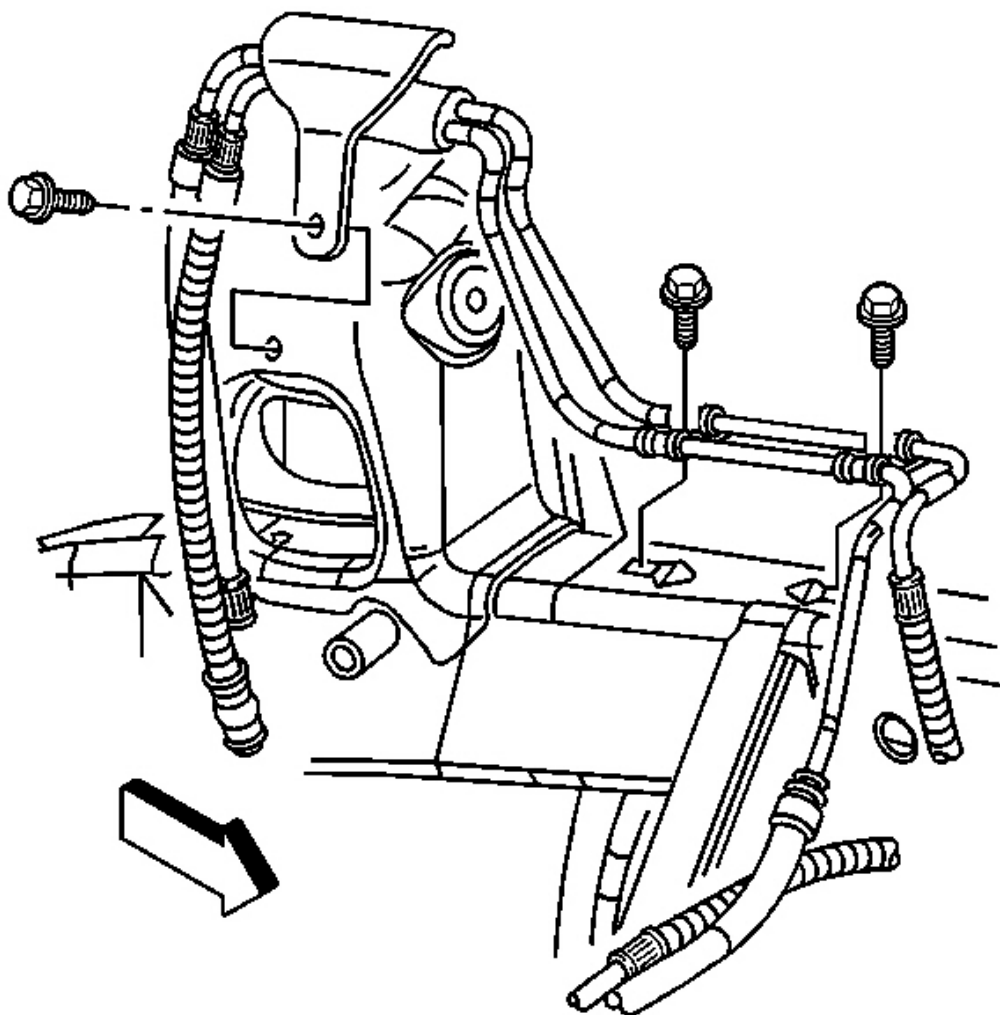
**Fig. 51: View Of Power Steering Hose Assembly At Power Steering Cooler**  
**Courtesy of GENERAL MOTORS CORP.**

5. Disconnect the power steering return hose and power steering cooler hose from the power steering cooler.
6. Lower the vehicle.



**Fig. 52: Removing/Installing Power Steering Hoses**  
Courtesy of GENERAL MOTORS CORP.

7. Remove the power steering hose assembly to front crossmember bracket mounting bolt.
8. Disconnect the power steering pressure hose (1) and power steering cooler hose (2) from the power steering pump.
9. Disconnect the fuse block wiring harnesses from the wiring loops.
10. Remove the fuse block.
11. Remove the battery tray. Refer to **Battery Tray Replacement** in Engine Electrical.

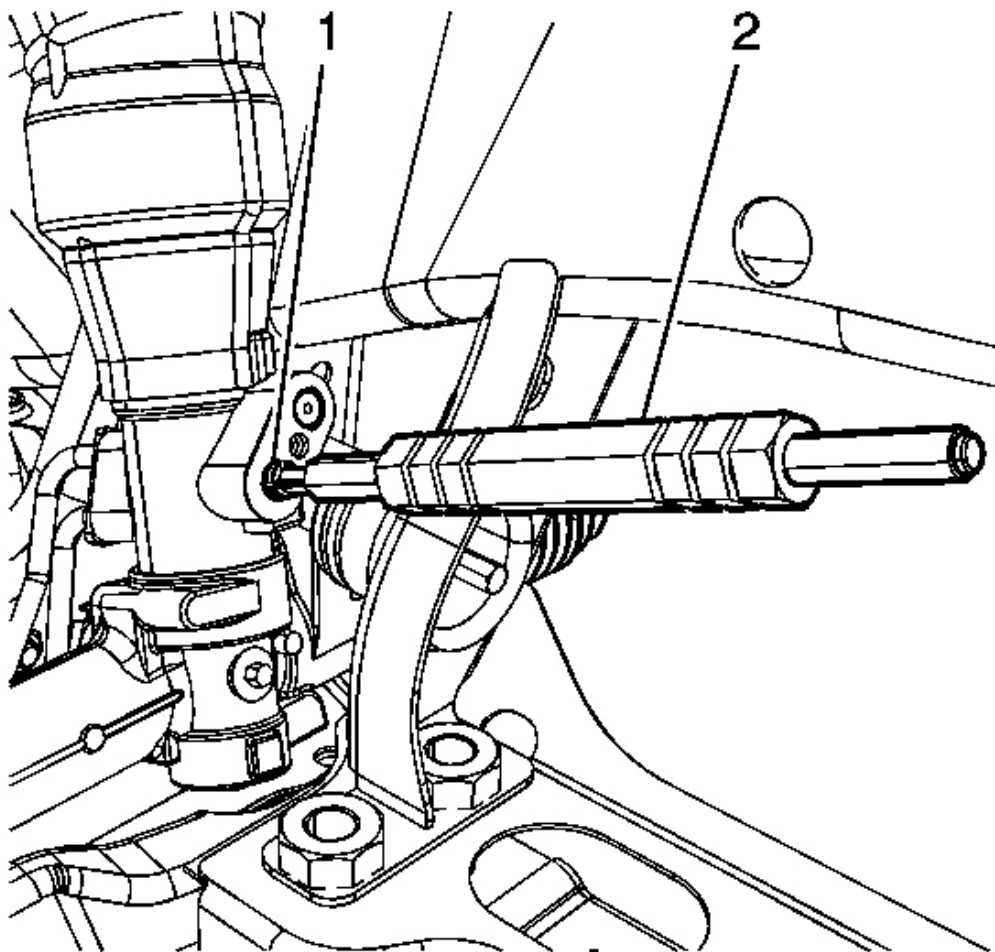


**Fig. 53: Removing/Installing Power Steering Hose Assembly From Bracket At Wheel Well**

Courtesy of GENERAL MOTORS CORP.

12. Remove the power steering hose assembly bracket retaining bolt at the wheel well.
13. Remove the power steering hose assembly bracket from the wheel well.
14. Remove the power steering hose assembly to frame brackets retaining bolts.
15. Remove the power steering hose assembly from the vehicle.
16. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General

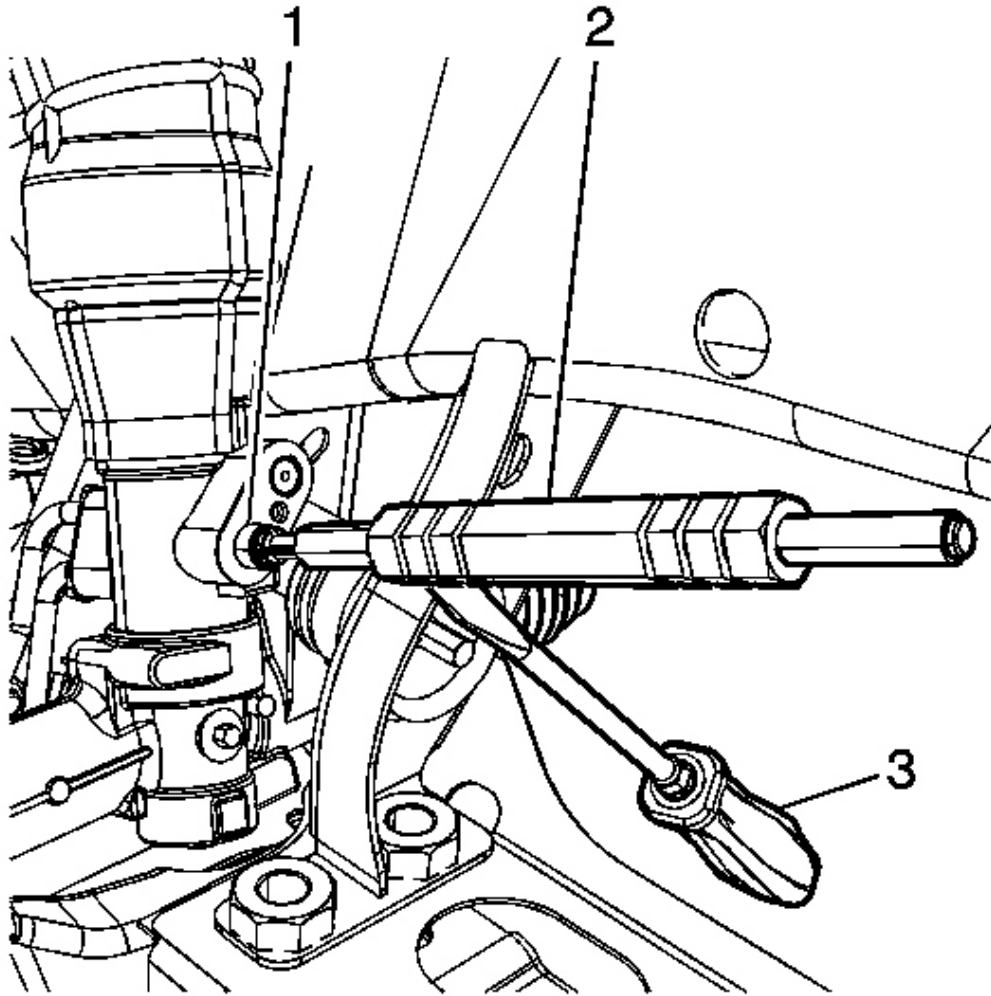
Information.



**Fig. 54: Installing Seal Extractor J 44586**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Clean the power steering gear inlet and outlet ports thoroughly of any debris. Failure to do so could result in contamination and damage to the power steering system components.

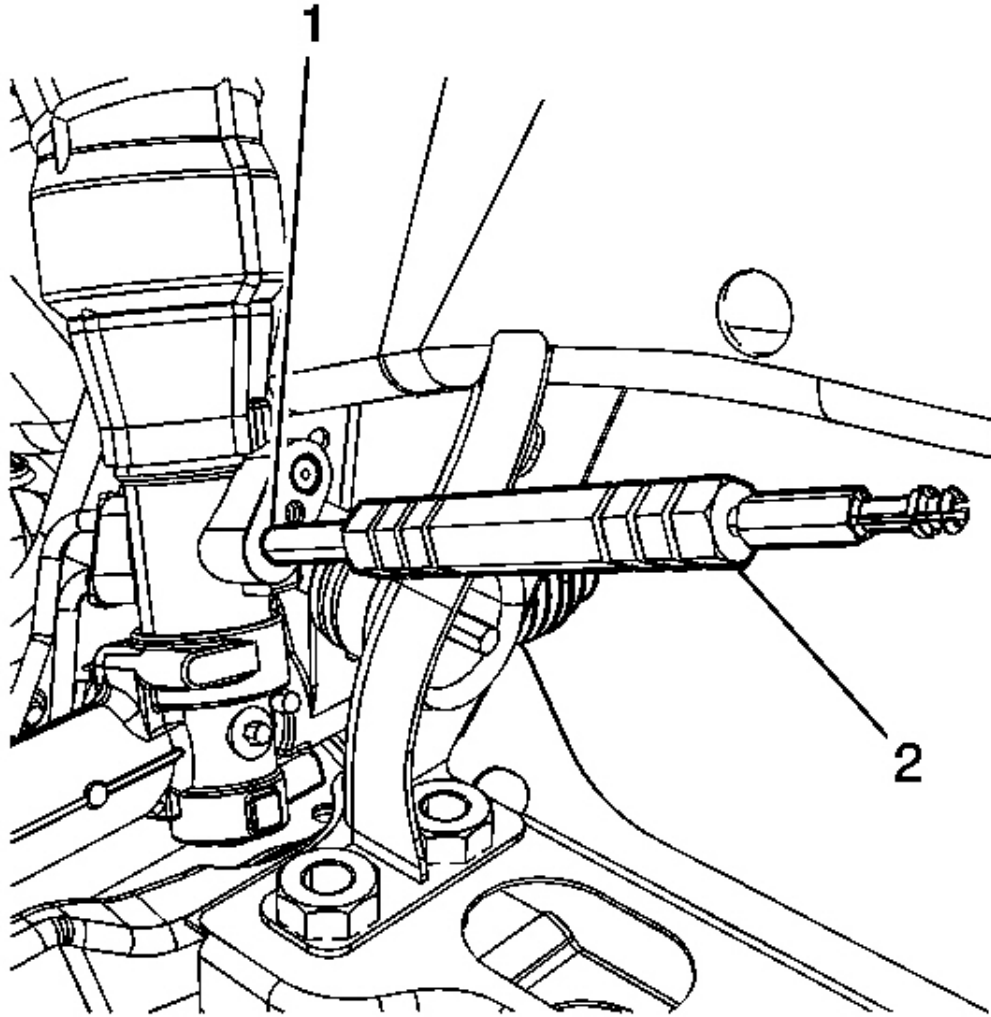
17. Install the seal extraction end of the **J 44586** (2) to the power steering gear oil seal (1). See **Special Tools**.



**Fig. 55: Removing Steering Gear Oil Seal**  
Courtesy of GENERAL MOTORS CORP.

18. Extract the power steering gear oil seal (1) from the power steering gear using the **J 44586** (2) with the aid of a flat bladed tool (3) for additional leverage. See **Special Tools**.

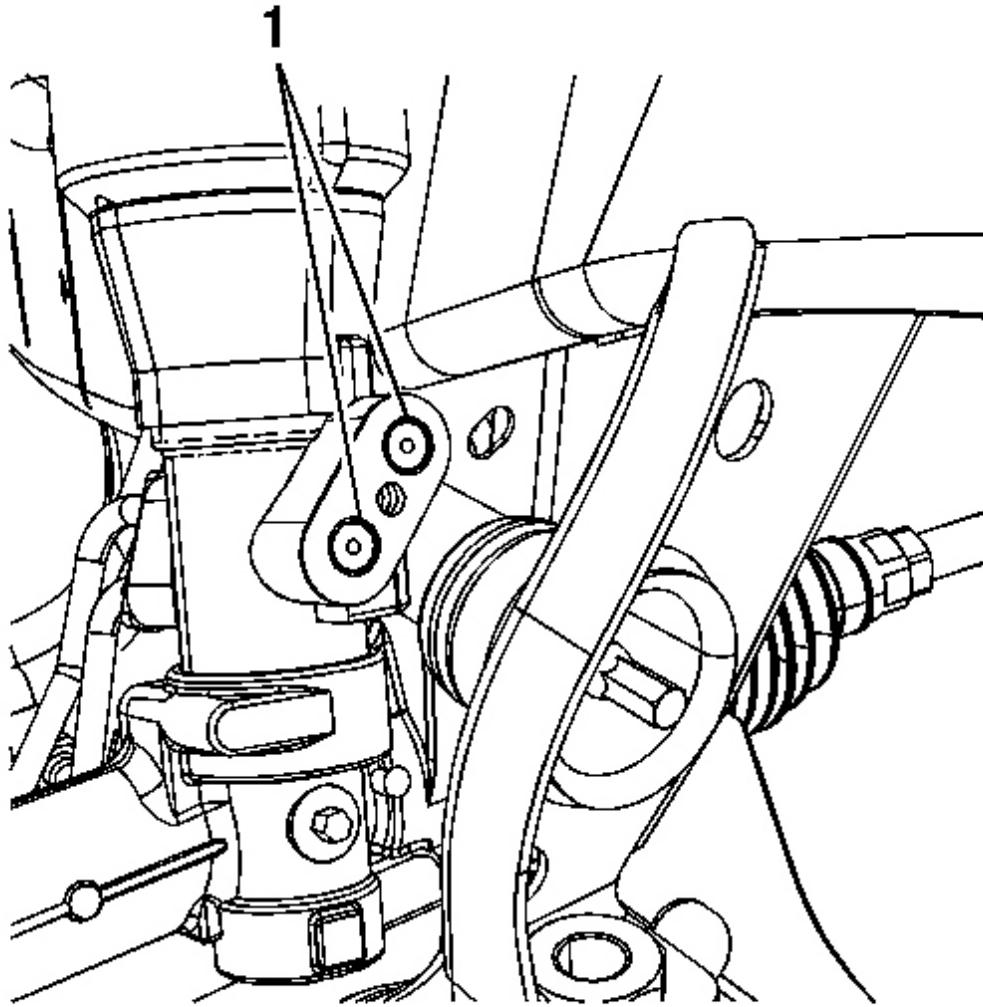
**Installation Procedure**



**Fig. 56: Installing Replacement Steering Gear Oil Seal**  
Courtesy of GENERAL MOTORS CORP.

1. Install the NEW power steering gear oil seal (1) to the power steering gear using the seal installation end of the **J 44586** (2). See **Special Tools**.

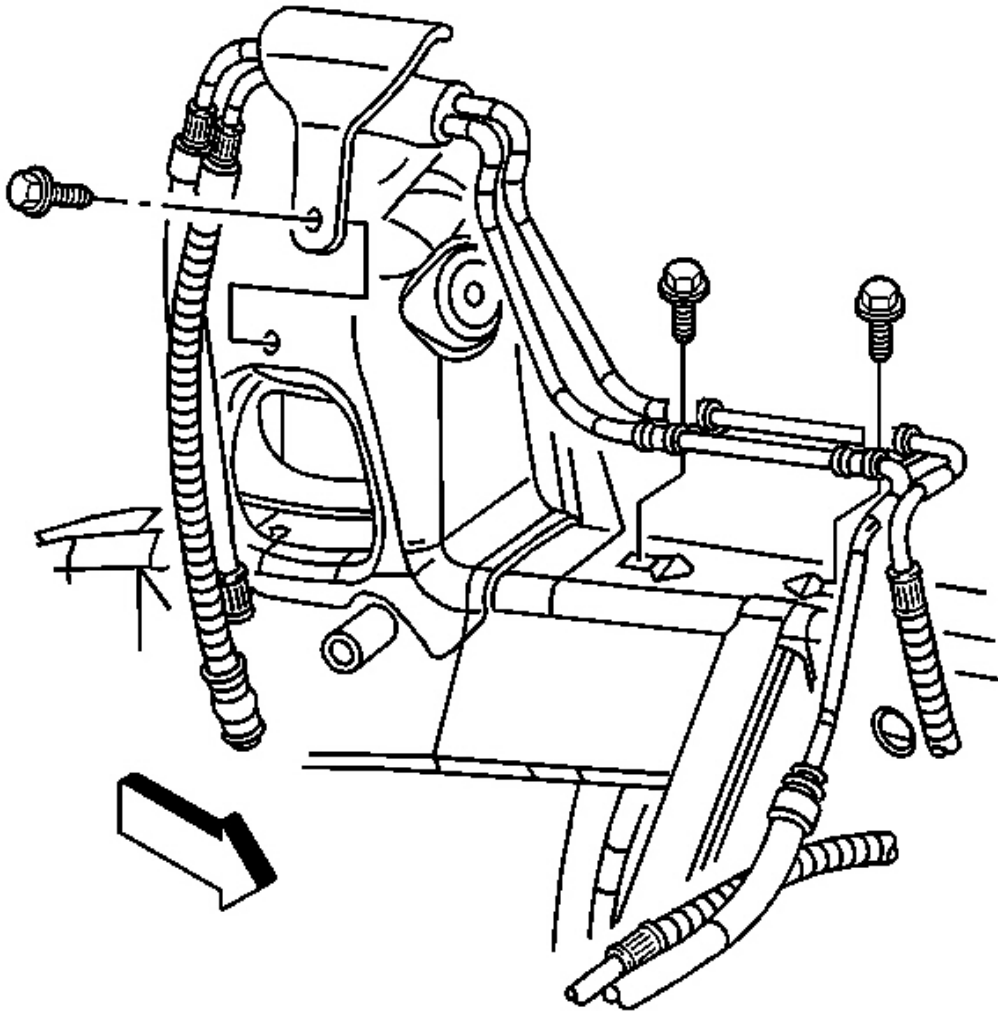




**Fig. 57: Ensuring Power Steering Gear Oil Seals (Are Fully Seated In Power Steering Gear**

**Courtesy of GENERAL MOTORS CORP.**

2. Ensure the power steering gear oil seals (1) are fully seated in the power steering gear.
3. Lower the vehicle.
4. Install the power steering hose assembly to the vehicle.



**Fig. 58: Removing/Installing Power Steering Hose Assembly From Bracket At Wheel Well**

Courtesy of GENERAL MOTORS CORP.

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

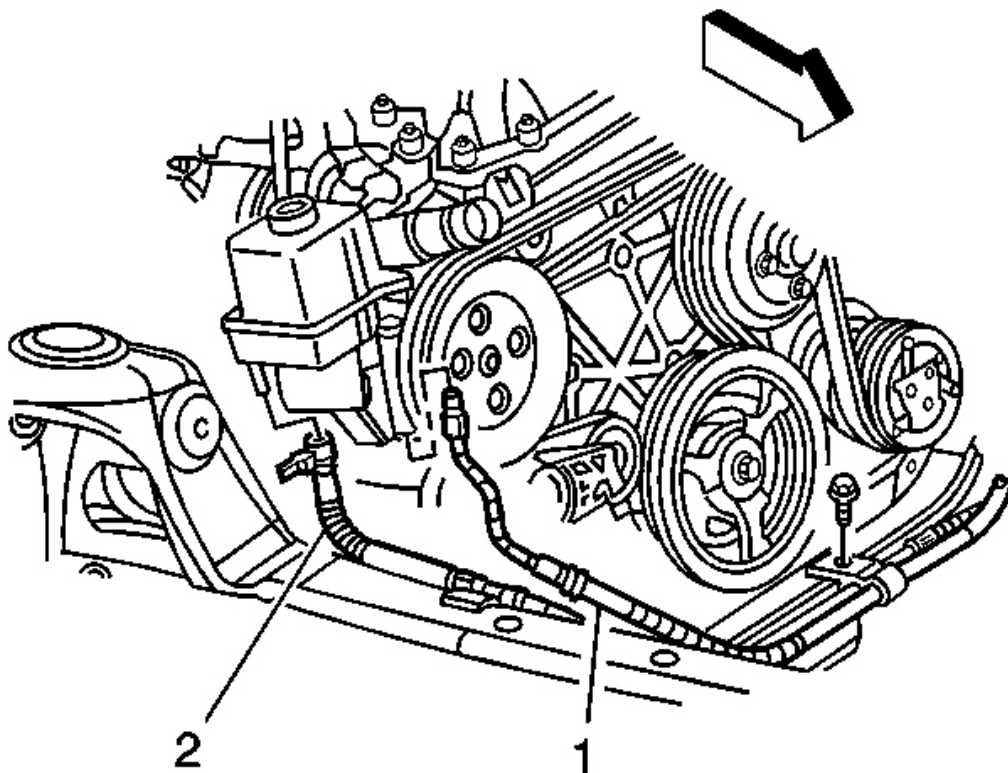
5. Install the power steering hose assembly to frame brackets retaining bolts.

**Tighten:** Tighten the bolts to 10 N.m (89 lb in).

6. Install the power steering hose assembly bracket to the wheel well.
7. Install the power steering hose assembly bracket retaining bolt at the wheel well.

**Tighten:** Tighten the bolt to 10 N.m (89 lb in).

8. Install the fuse block.
9. Install the battery tray. Refer to **Battery Tray Replacement** in Engine Electrical.
10. Connect the fuse block harnesses to the wiring loops.



**Fig. 59: Removing/Installing Power Steering Hoses**  
Courtesy of GENERAL MOTORS CORP.

11. Install the power steering cooler hose (2) the power steering pump.

**NOTE:** Refer to **Component Fastener Tightening Notice** in Cautions

**and Notices.**

12. Install the power steering pressure hose (1) to the power steering pump.

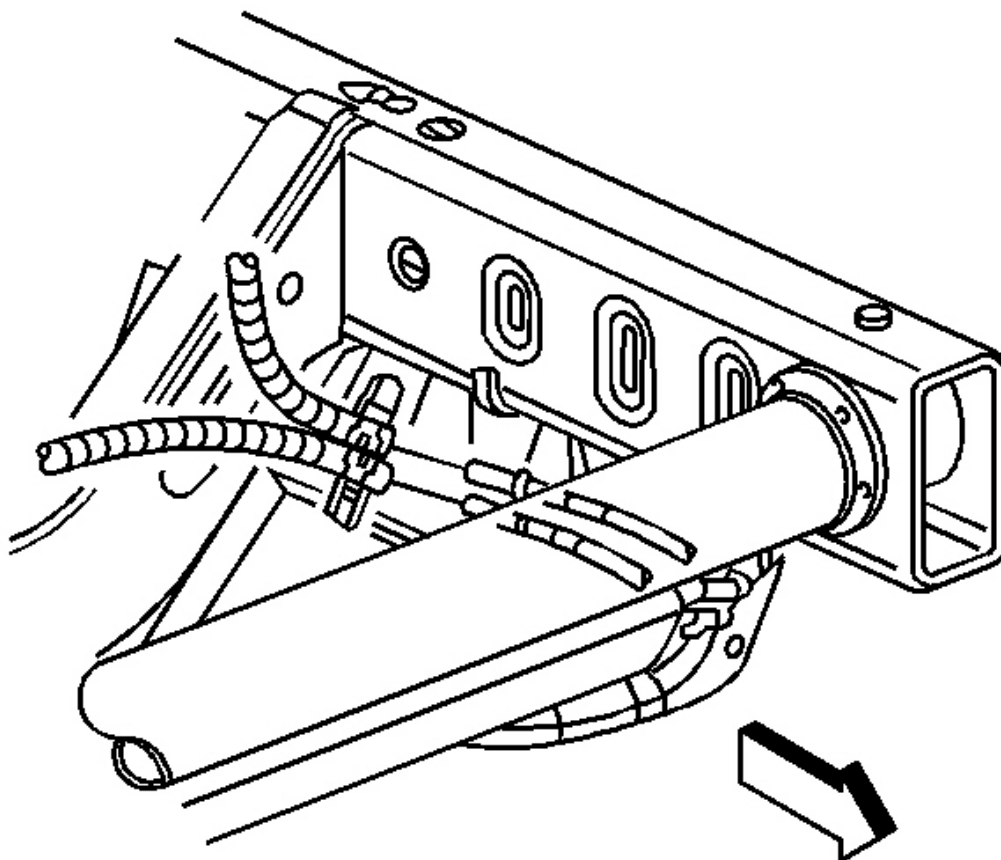
**Tighten:** Tighten the power steering pressure hose fitting to 25 N.m (18 lb ft).

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

13. Install the power steering hose assembly to front crossmember bracket mounting bolt.

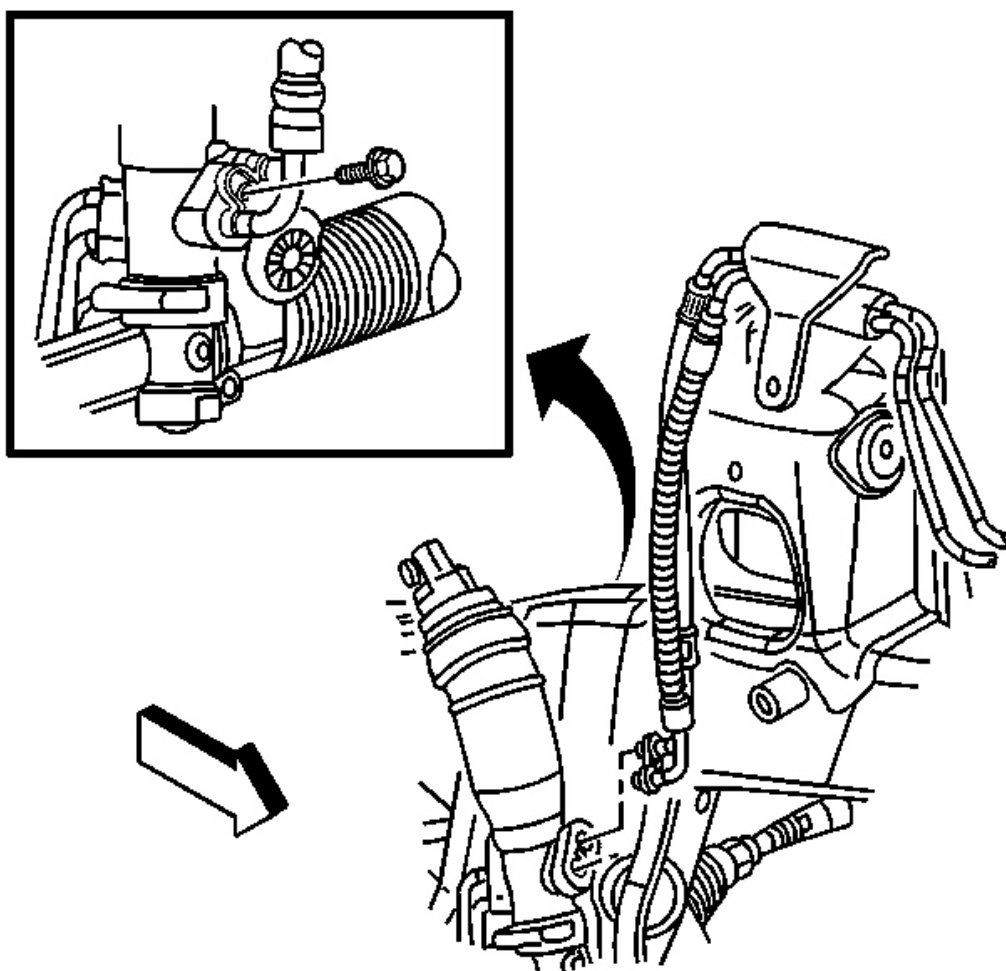
**Tighten:** Tighten the bolt to 10 N.m (89 lb in).

14. Raise the vehicle. Refer to Lifting and Jacking the Vehicle in General Information.



**Fig. 60: View Of Power Steering Hose Assembly At Power Steering Cooler**  
Courtesy of GENERAL MOTORS CORP.

15. Install the power steering return hose and the power steering cooler hose to the power steering cooler.
16. Remove the power steering gear oil seals from the power steering gear using **J 44586** . See **Special Tools**.



**Fig. 61: View Of Power Steering Hose Assembly To Gear Retaining Bolt**  
Courtesy of GENERAL MOTORS CORP.

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17. Connect the power steering hose assembly to the power steering gear.
18. Install the power steering hose assembly to power steering gear retaining bolt.

**Tighten:** Tighten the bolt to 12 N.m (106 lb in).

19. Remove the drain pan from under the vehicle.
20. Lower the vehicle.
21. Bleed the power steering system. Refer to **Bleeding the Power Steering System**.

### POWER STEERING GEAR INLET AND OUTLET HOSE REPLACEMENT (5.3L)

#### Tools Required

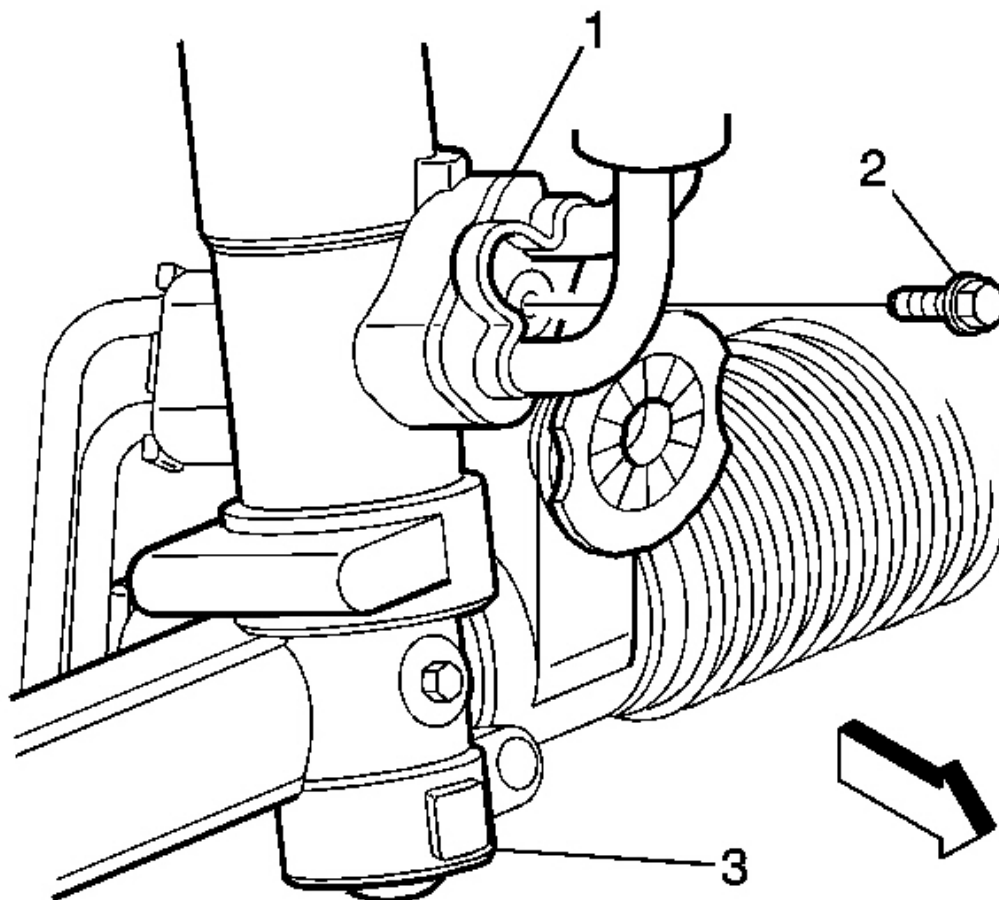
**J 44586** Power Steering Gear Oil Seal Remover/Installer. See **Special Tools**.

#### Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

**NOTE:** Refer to **POWER STEERING HOSE DISCONNECTED NOTICE** in **Cautions and Notices**.

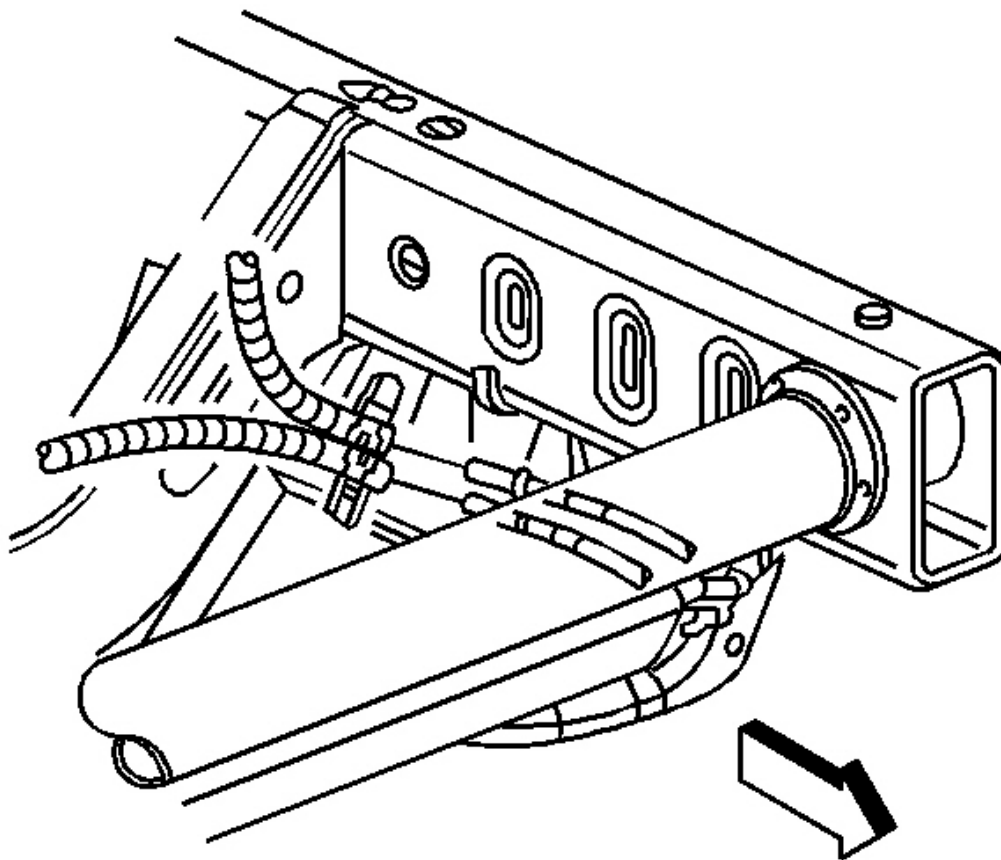
2. Install the drain pan under the vehicle.



**Fig. 62: Disconnecting/Reconnecting Power Steering Hose Assembly To Power Steering Gear**

Courtesy of GENERAL MOTORS CORP.

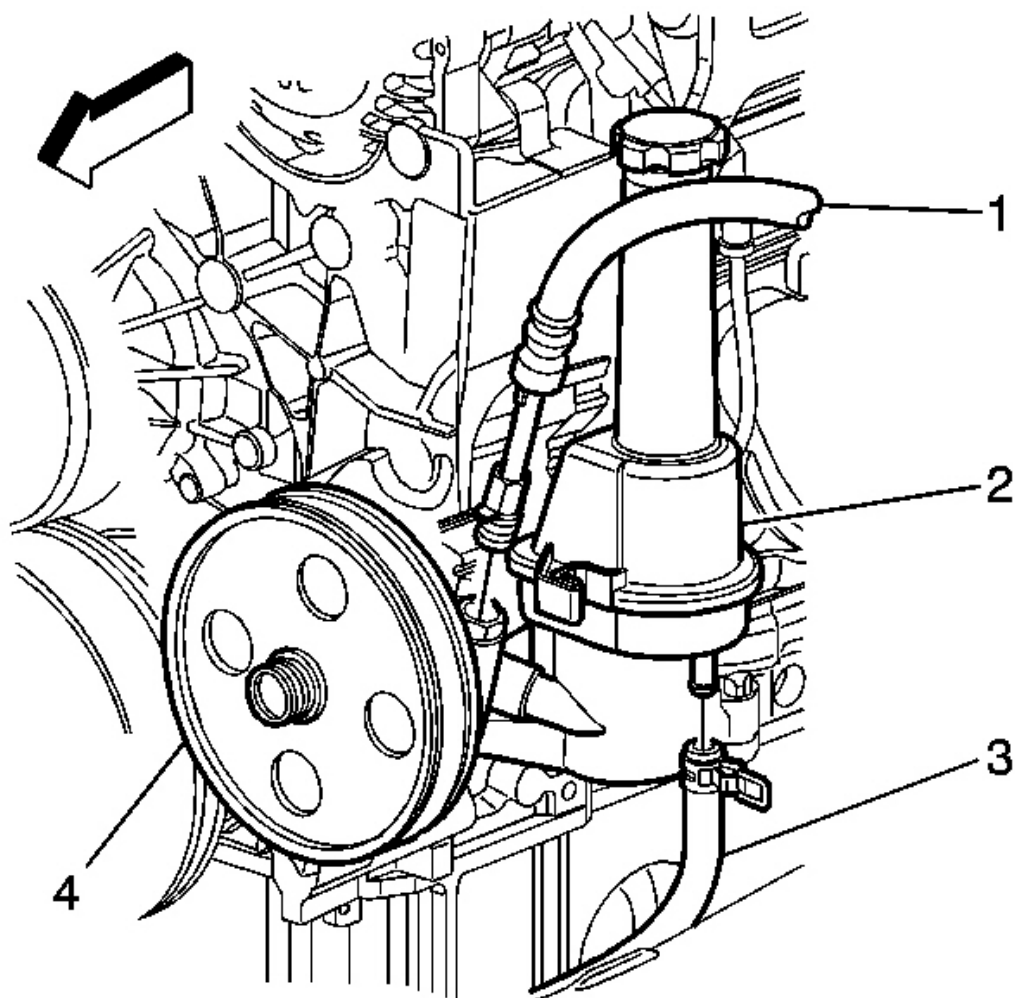
3. Remove power steering hose assembly to power steering gear mounting bolt (2).
4. Disconnect the power steering hose assembly (1) from the power steering gear (3).



**Fig. 63: View Of Power Steering Hose Assembly At Power Steering Cooler**  
**Courtesy of GENERAL MOTORS CORP.**

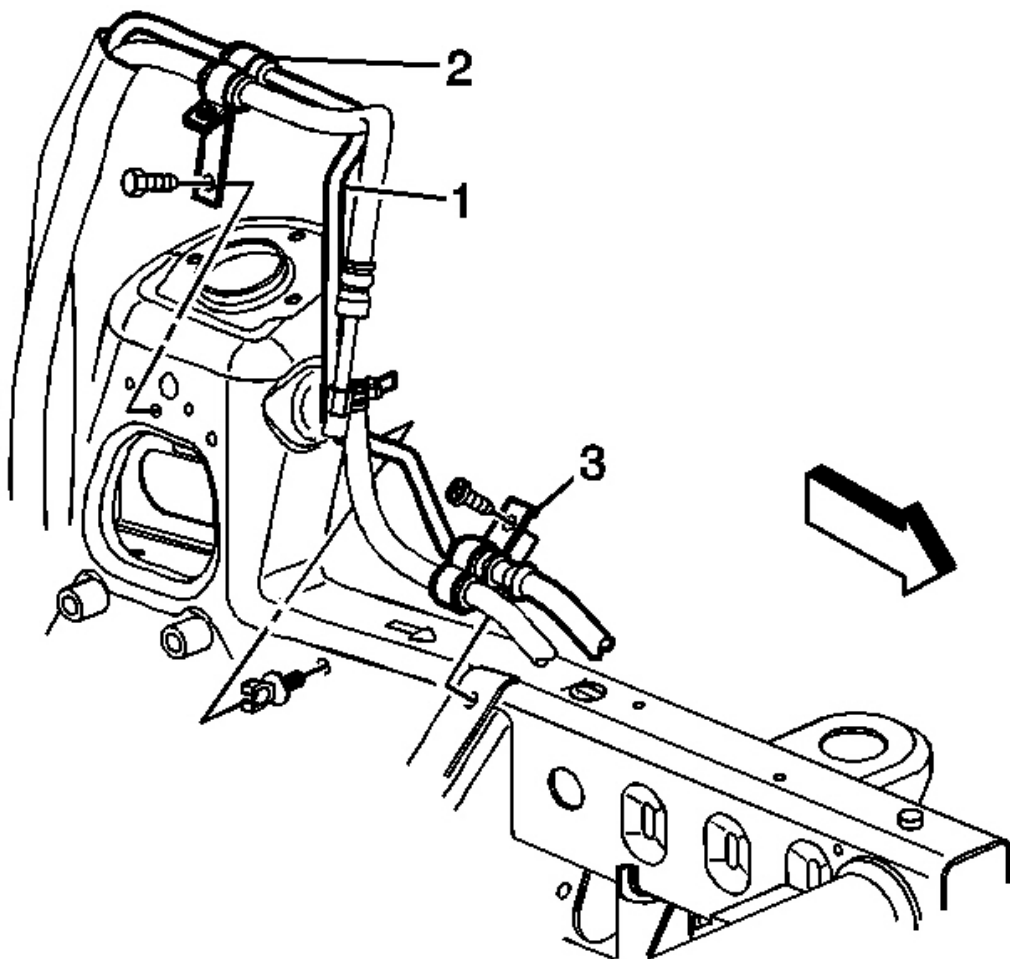
5. Disconnect the power steering return hose and power steering cooler hose from the power steering cooler.
6. Lower the vehicle.





**Fig. 64: View Of Power Steering Pressure Hose, Return Hose & Pump**  
Courtesy of GENERAL MOTORS CORP.

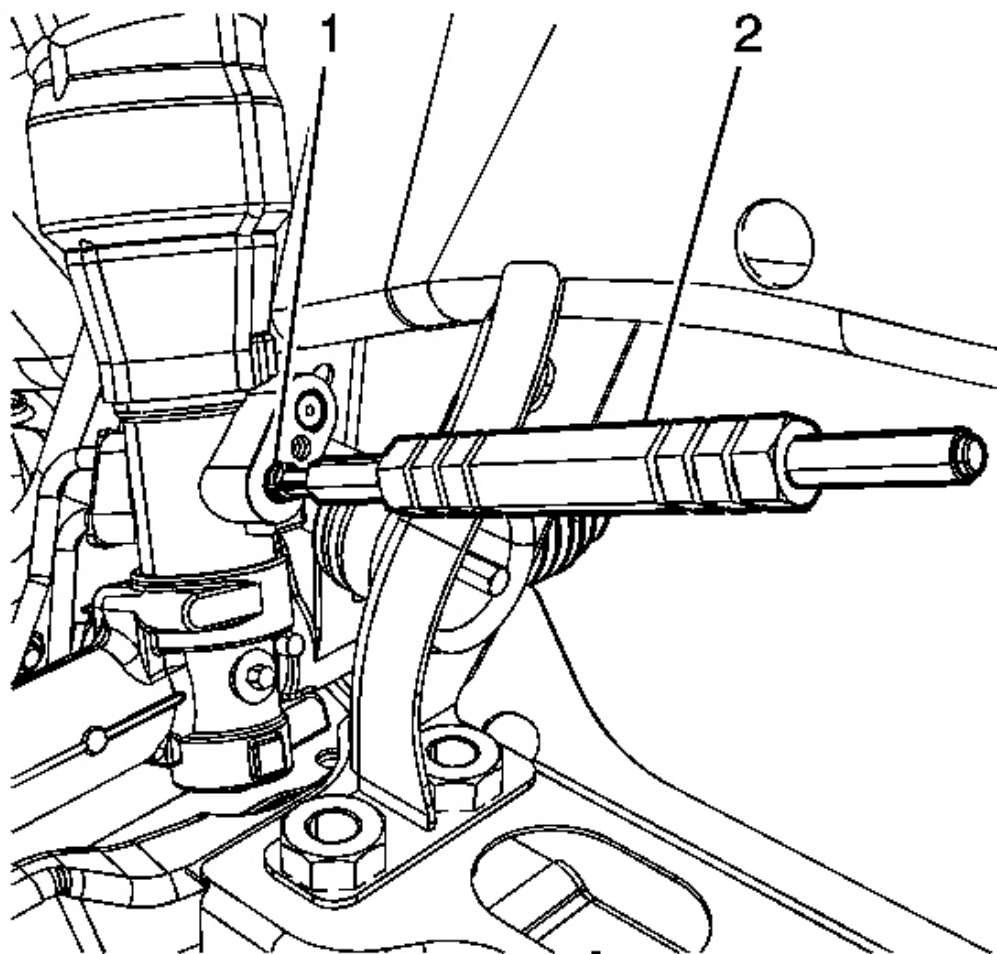
7. Disconnect the power steering pressure (1) and return hose (3) from the power steering pump (2).
8. Remove the engine control module (ECM) from the ECM mounting bracket and position the ECM out of the way. Refer to **Engine Control Module (ECM) Replacement** in Engine Controls - 5.3L.



**Fig. 65: Removing/Installing Power Steering Hoses Assembly Front Bracket Mounting Bolt At frame**  
Courtesy of GENERAL MOTORS CORP.

9. Remove the power steering hose assembly (1) front bracket mounting bolt (3) from the frame.
10. Remove the power steering pressure hose from the retaining clip.
11. Remove the power steering hose assembly rear bracket mounting bolt (2).
12. Remove the power steering hose assembly from the vehicle.
13. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General

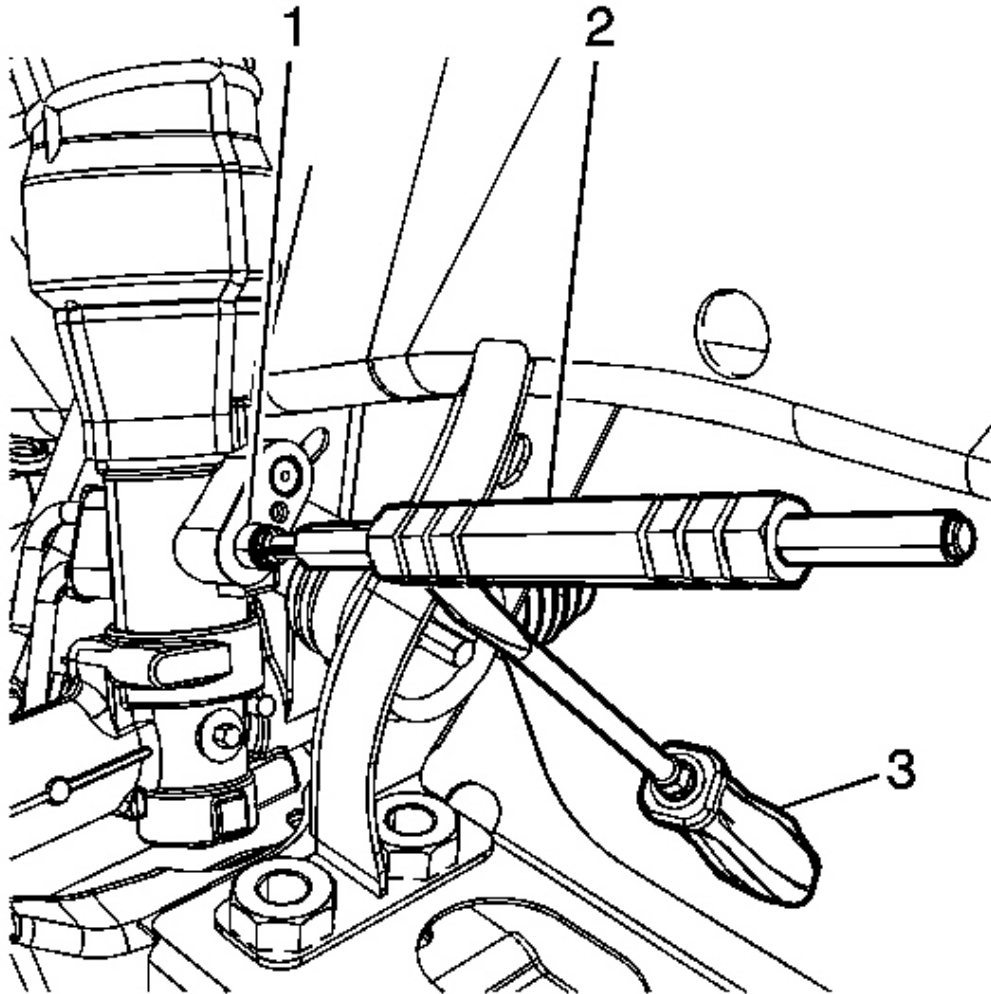
Information.



**Fig. 66: Installing Seal Extractor J 44586**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Clean the power steering gear inlet and outlet ports thoroughly of any debris. Failure to do so could result in contamination and damage to the power steering system components.

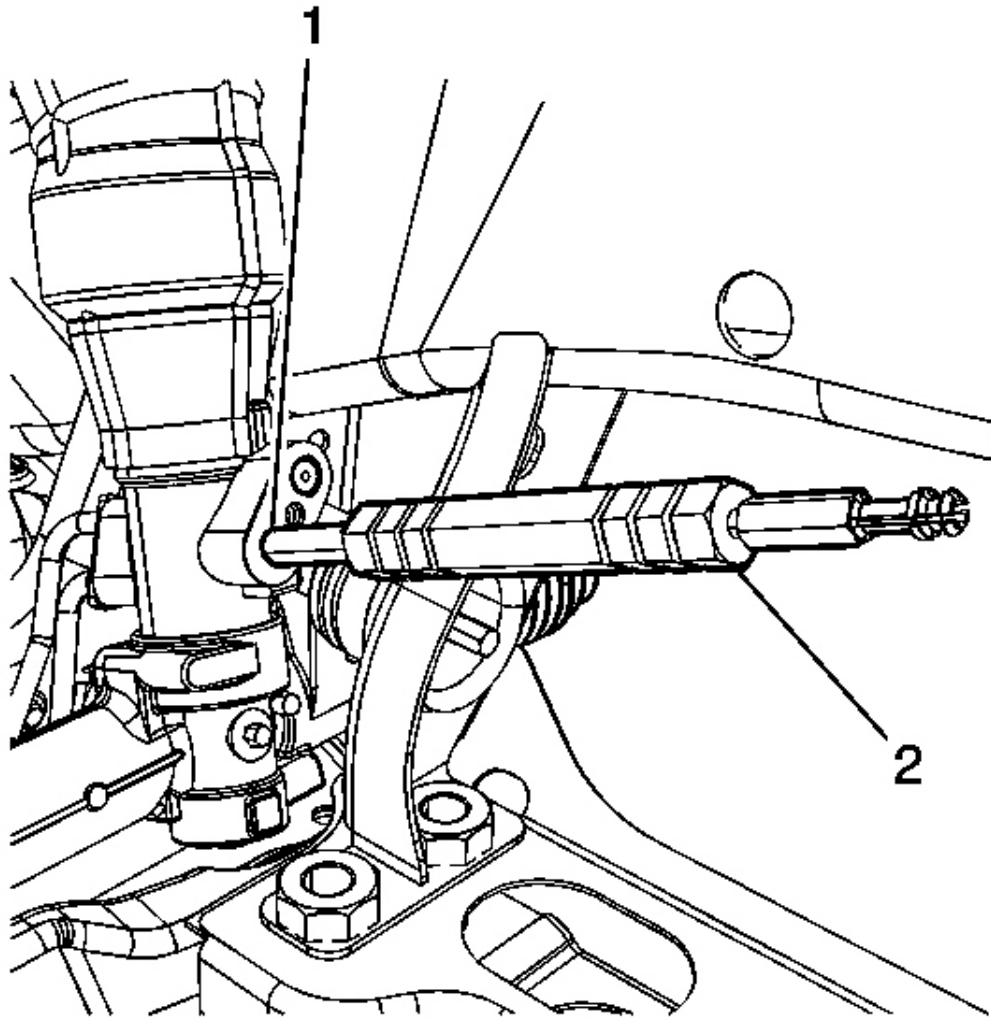
14. Install the seal extraction end of the **J 44586** (2) to the power steering gear oil seal (1). See **Special Tools**.



**Fig. 67: Removing Steering Gear Oil Seal**  
Courtesy of GENERAL MOTORS CORP.

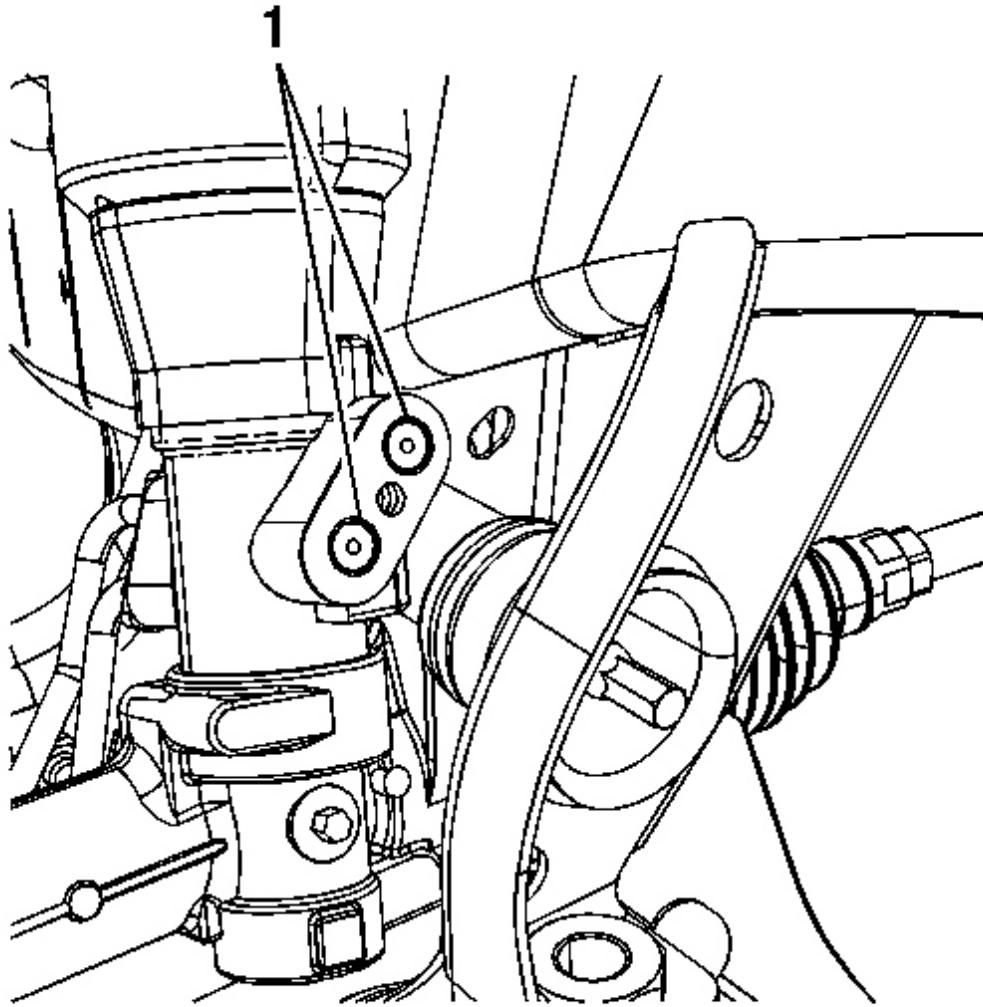
15. Extract the power steering gear oil seal (1) from the power steering gear using the **J 44586** (2) with the aid of a flat bladed tool (3) for additional leverage. See **Special Tools**.

**Installation Procedure**



**Fig. 68: Installing Replacement Steering Gear Oil Seal**  
Courtesy of GENERAL MOTORS CORP.

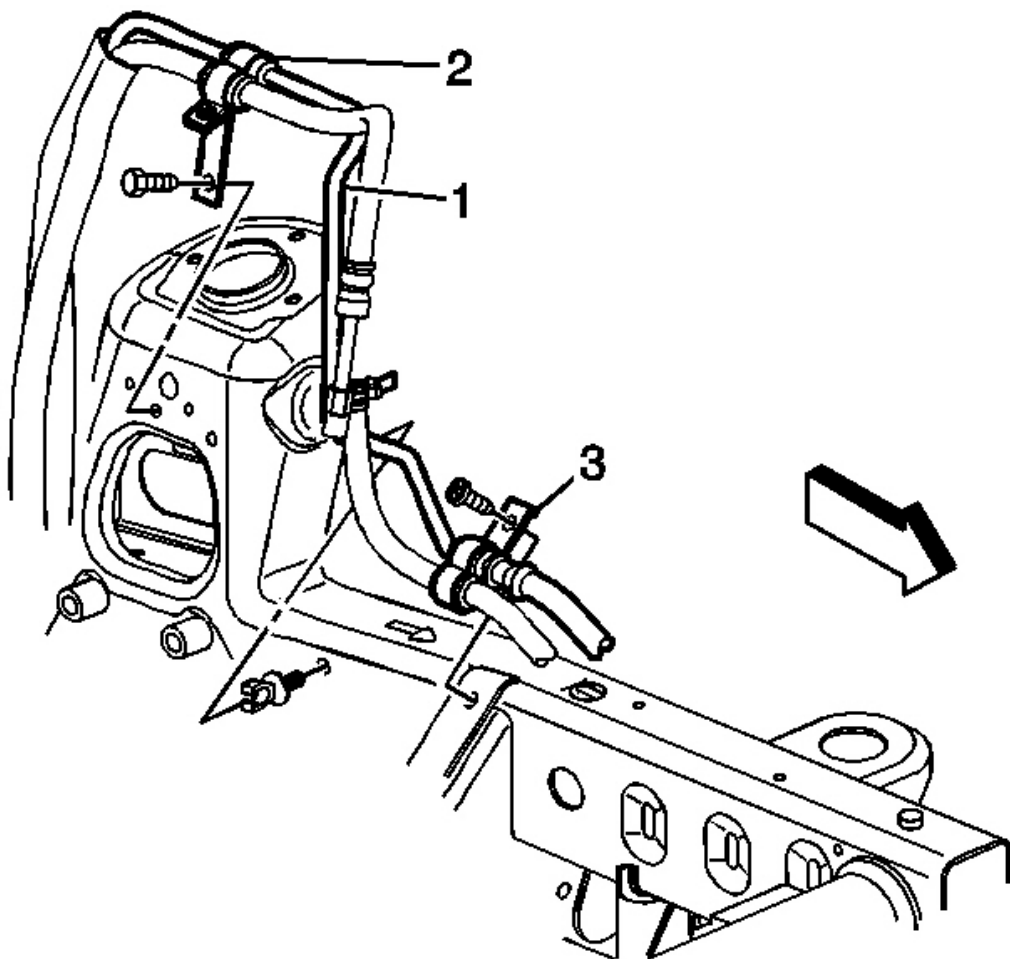
1. Install the NEW power steering gear oil seal (1) to the power steering gear using the seal installation end of the **J 44586** (2). See **Special Tools**.



**Fig. 69: Ensuring Power Steering Gear Oil Seals (Are Fully Seated In Power Steering Gear**

**Courtesy of GENERAL MOTORS CORP.**

2. Ensure the power steering gear oil seals (1) are fully seated in the power steering gear.
3. Lower the vehicle.



**Fig. 70: Removing/Installing Power Steering Hoses Assembly Front Bracket Mounting Bolt At frame**  
Courtesy of GENERAL MOTORS CORP.

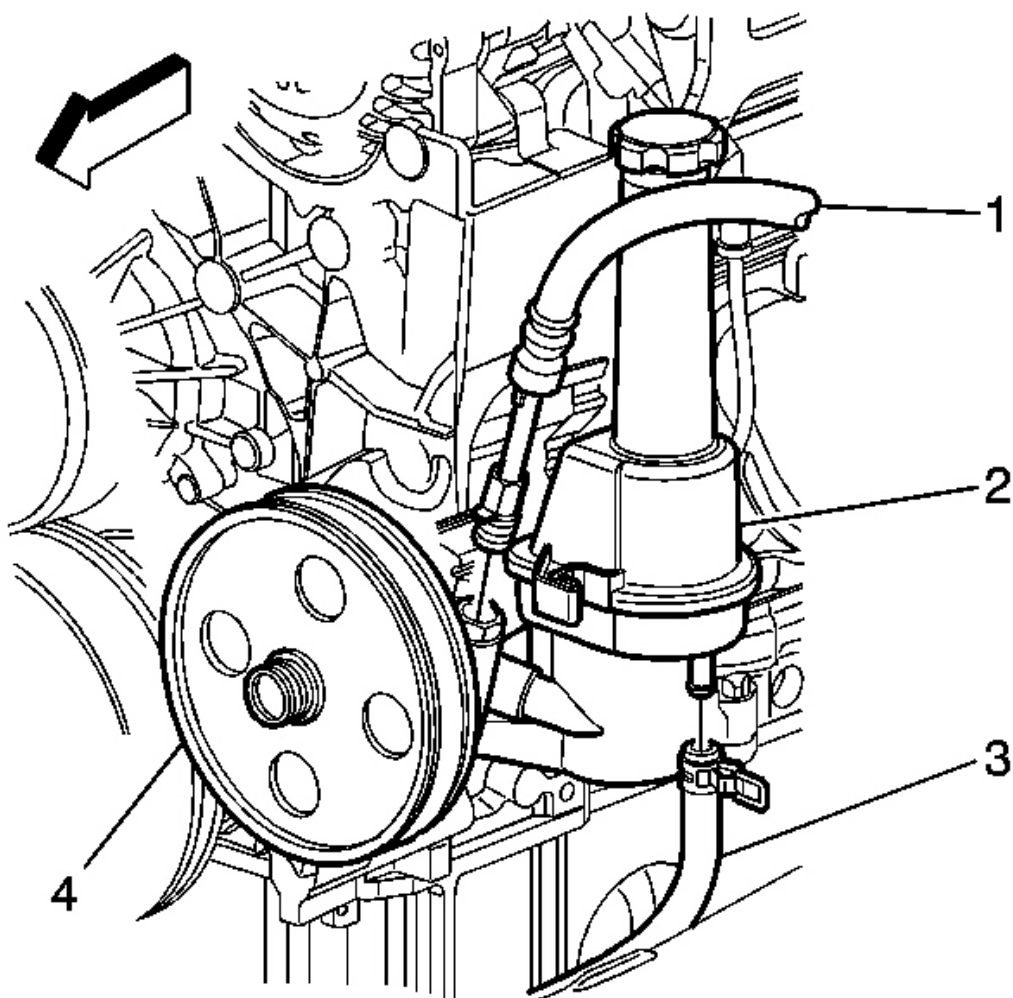
4. Install the power steering hose assembly (1) to the vehicle.

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

5. Install the power steering hose assembly rear bracket (2) mounting bolt.

**Tighten:** Tighten the bolt to 10 N.m (89 lb in).

6. Install the power steering pressure hose retaining clip.
7. Install the power steering hose assembly front bracket mounting bolt (3).



**Fig. 71: View Of Power Steering Pressure Hose, Return Hose & Pump**  
Courtesy of GENERAL MOTORS CORP.

8. Install the power steering cooler hose (3) the power steering pump (2).

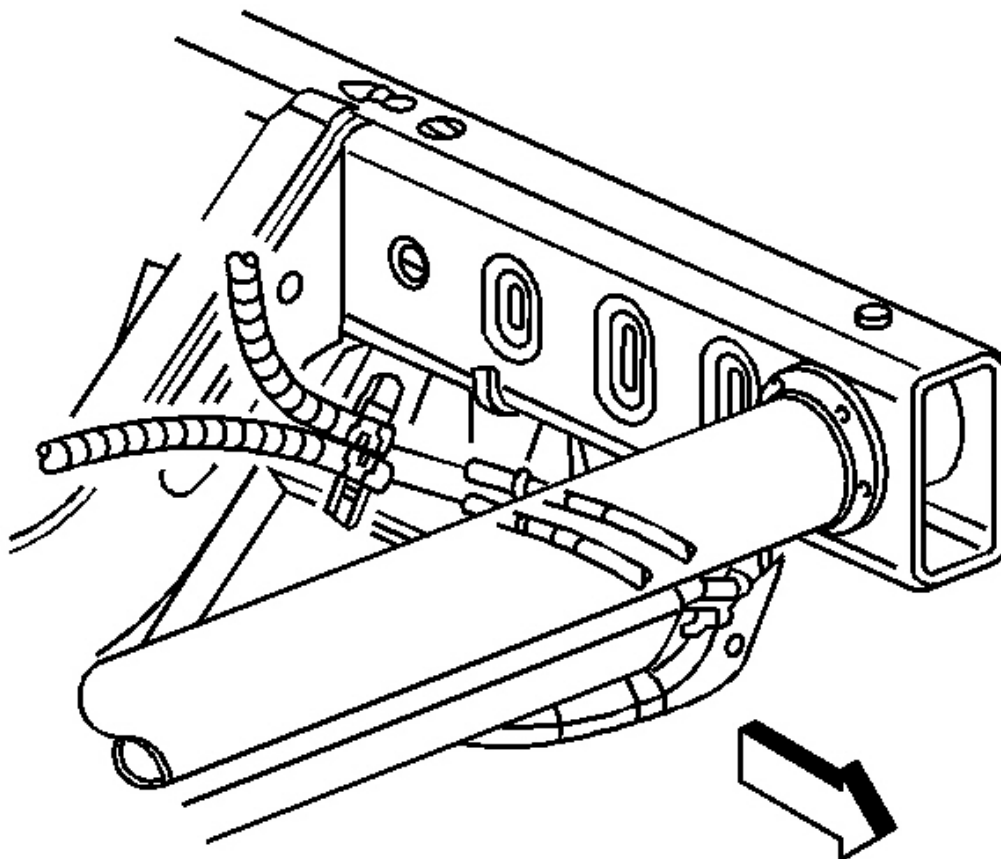
**NOTE:** Refer to Component Fastener Tightening Notice in Cautions and Notices.



9. Connect the power steering pressure (1) to the power steering pump (2).

**Tighten:** Tighten the power steering pressure hose fitting to 25 N.m (18 lb in).

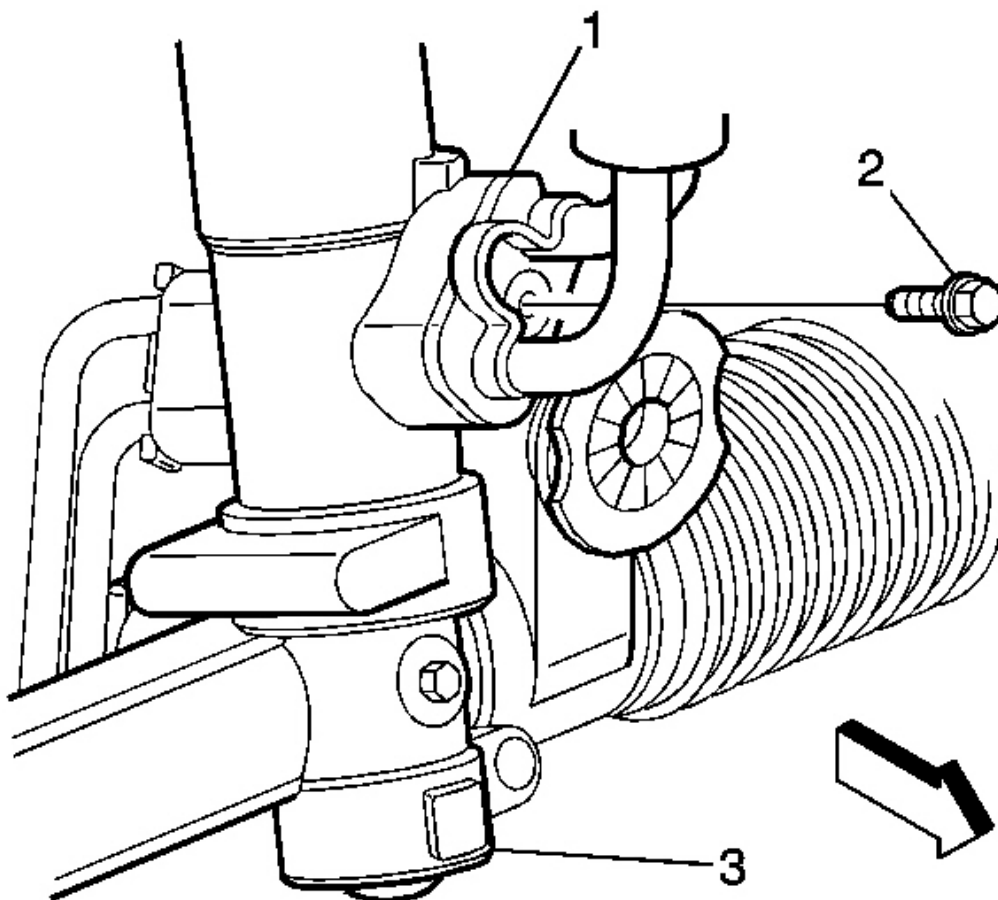
10. Install the ECM to the ECM mounting bracket. Refer to **Engine Control Module (ECM) Replacement** in Engine Controls - 5.3L.
11. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.



**Fig. 72: View Of Power Steering Hose Assembly At Power Steering Cooler**  
Courtesy of GENERAL MOTORS CORP.

12. Install the power steering return hose and the power steering cooler hose to the power

steering cooler.



**Fig. 73: Disconnecting/Reconnecting Power Steering Hose Assembly To Power Steering Gear**

Courtesy of GENERAL MOTORS CORP.

13. Connect the power steering hose assembly (1) to the power steering gear (3).

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

14. Install the power steering hose assembly to the power steering gear with the mounting bolt (2).

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**Tighten:** Tighten the bolt to 12 N.m (106 lb in).

15. Remove the drain pan from under the vehicle.
16. Lower the vehicle.
17. Bleed the power steering system. Refer to **Bleeding the Power Steering System**.

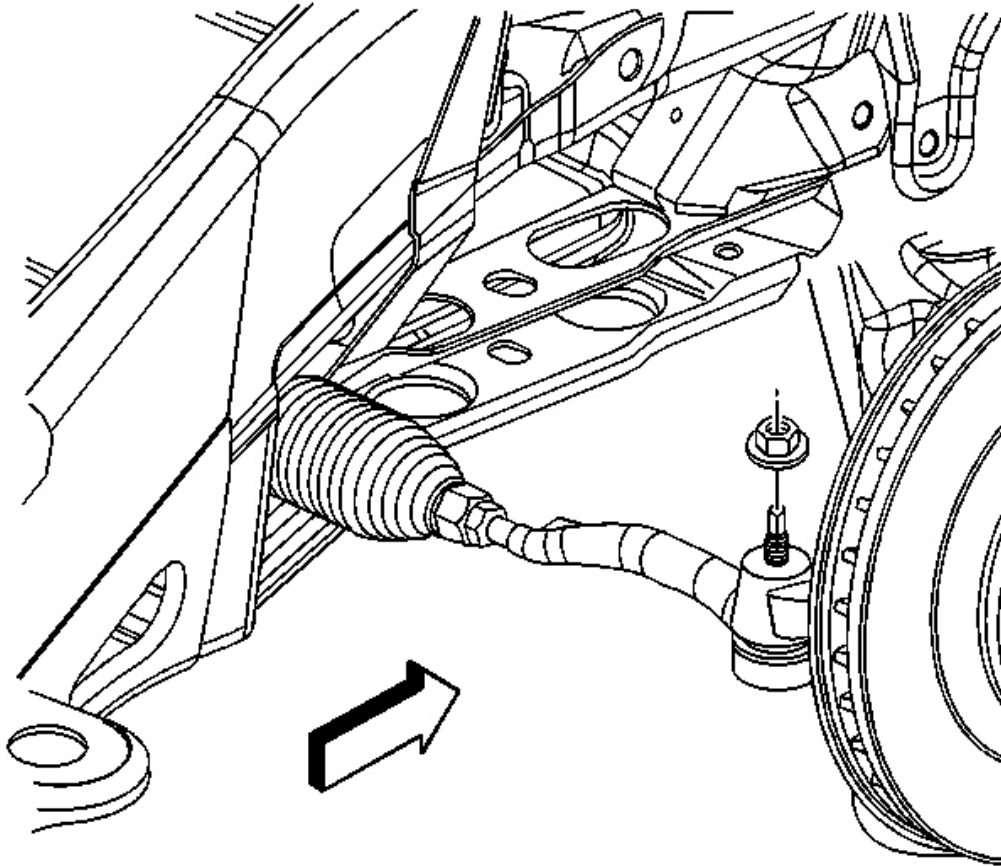
### POWER STEERING GEAR REPLACEMENT

#### Tools Required

**J 24319-B** Steering Linkage and Tie Rod Puller. See **Special Tools**.

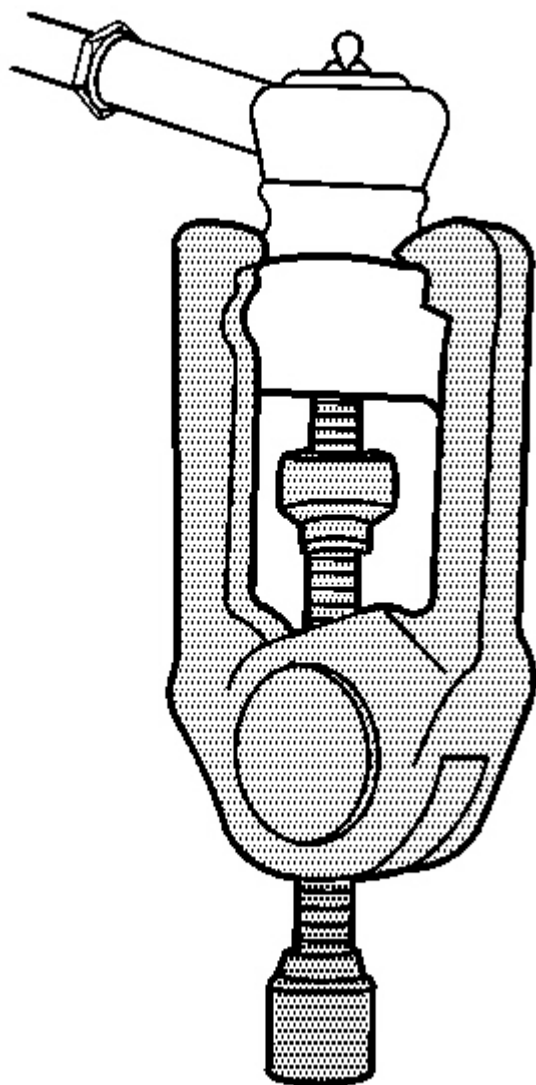
#### Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Install a drain pan under the vehicle.
3. Remove the tires and wheels. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.



**Fig. 74: View Of Tie Rod Retaining Nut**  
**Courtesy of GENERAL MOTORS CORP.**

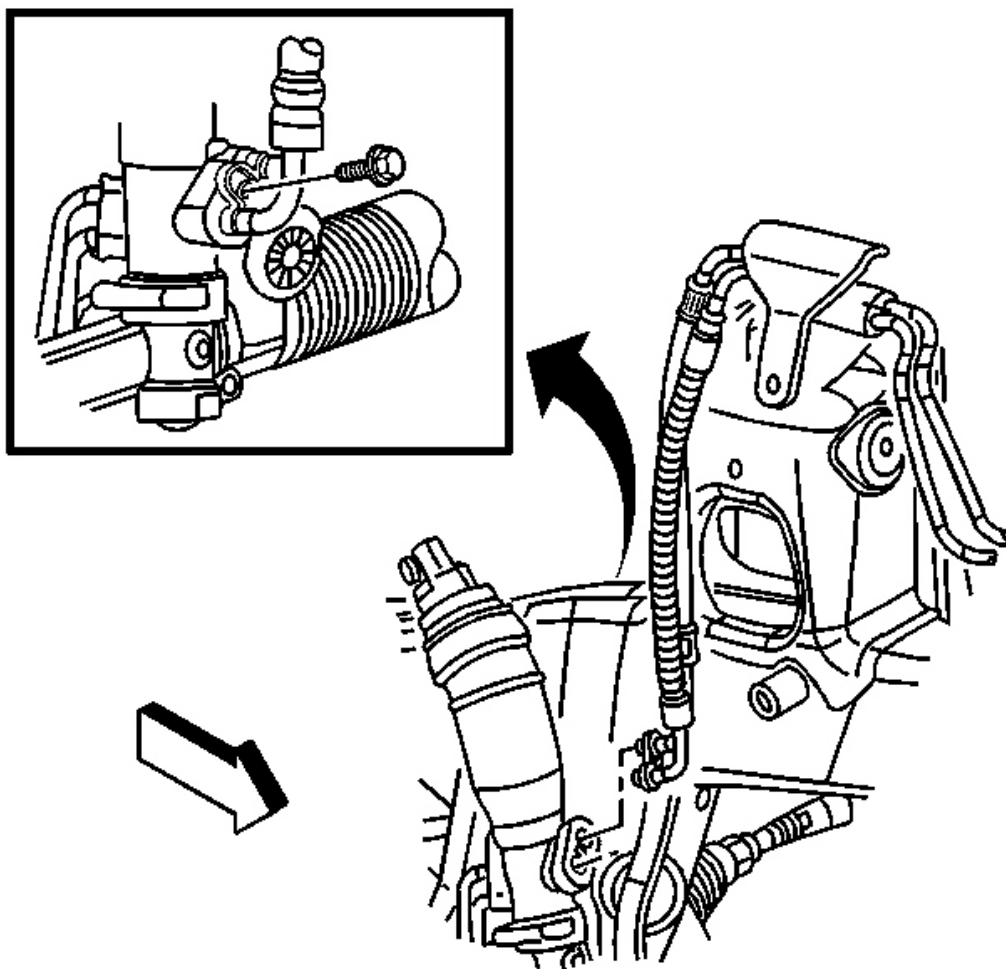
4. Remove the outer tie rods retaining nuts.



**Fig. 75: Removing Outer Tie Rod Assembly From Steering Knuckle**  
Courtesy of GENERAL MOTORS CORP.

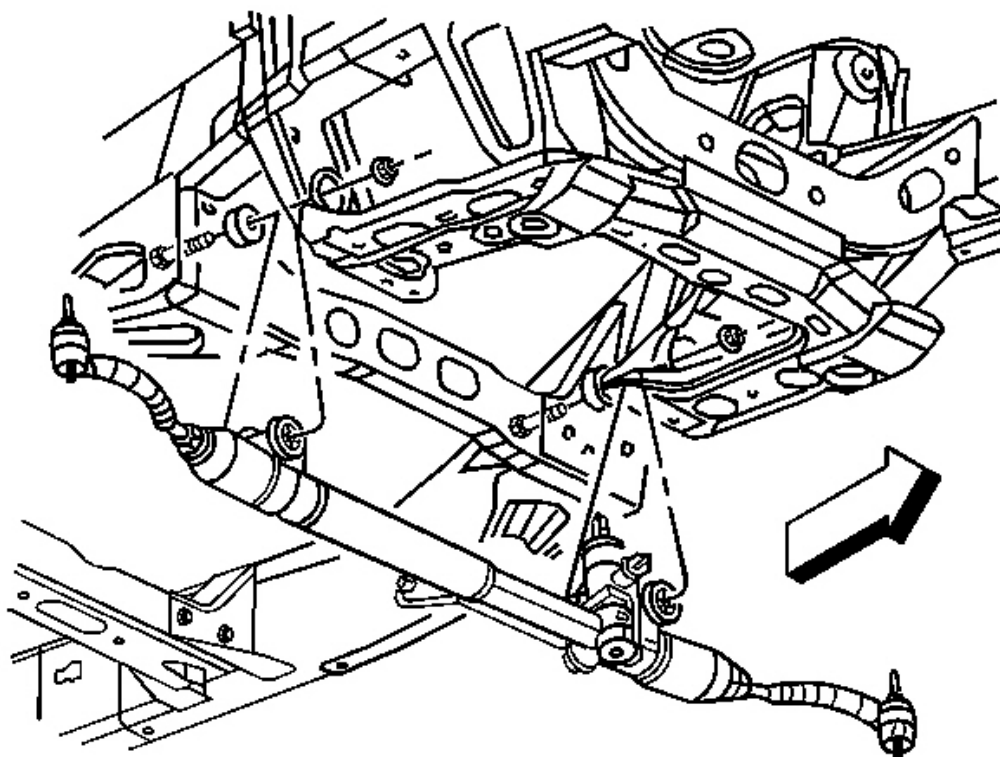
**NOTE:** Do not attempt to disconnect a steering linkage joint by driving a wedge between the joint and the attached part. Seal damage may result which will cause premature failure of the joint.

5. Disconnect the outer tie rods from the steering knuckles using **J 24319-B** . See **Special Tools**.
6. Remove the steering gear crossmember. Refer to **Crossmember Replacement - Front Steering Gear** in Frame and Underbody.
7. Disconnect the lower intermediate shaft from the power steering gear. Refer to **Intermediate Steering Shaft Replacement - Lower** in Steering Wheel and Column.



**Fig. 76: View Of Power Steering Hose Assembly To Gear Retaining Bolt**  
Courtesy of GENERAL MOTORS CORP.

8. Remove the power steering hose assembly to the power steering gear retaining bolt.
9. Remove the power steering hose assembly from the power steering gear.
10. Support the power steering gear.

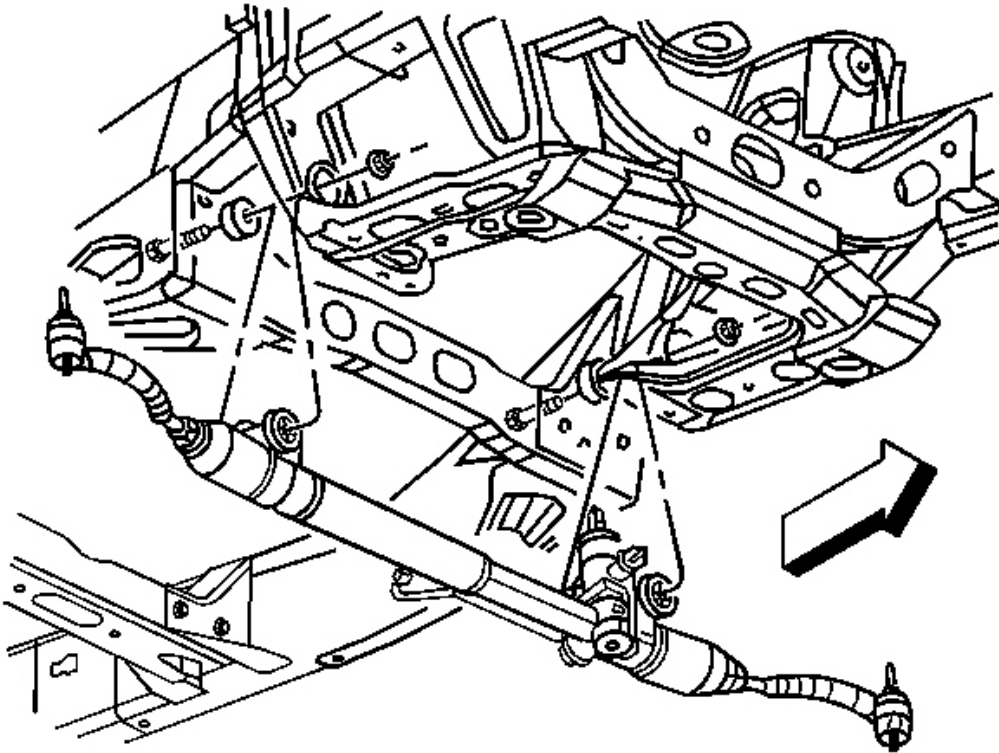


**Fig. 77: View Of Power Steering Gear & Bolts**  
Courtesy of GENERAL MOTORS CORP.

11. Remove the power steering gear mounting bolts.
12. Remove the power steering gear from the vehicle.
13. Remove the outer tie rods from the inner tie rods. Refer to **Rack and Pinion Outer Tie Rod End Replacement**.

#### Installation Procedure

1. Install the outer tie rods. Refer to **Rack and Pinion Outer Tie Rod End Replacement**.



**Fig. 78: View Of Power Steering Gear & Bolts**  
Courtesy of GENERAL MOTORS CORP.

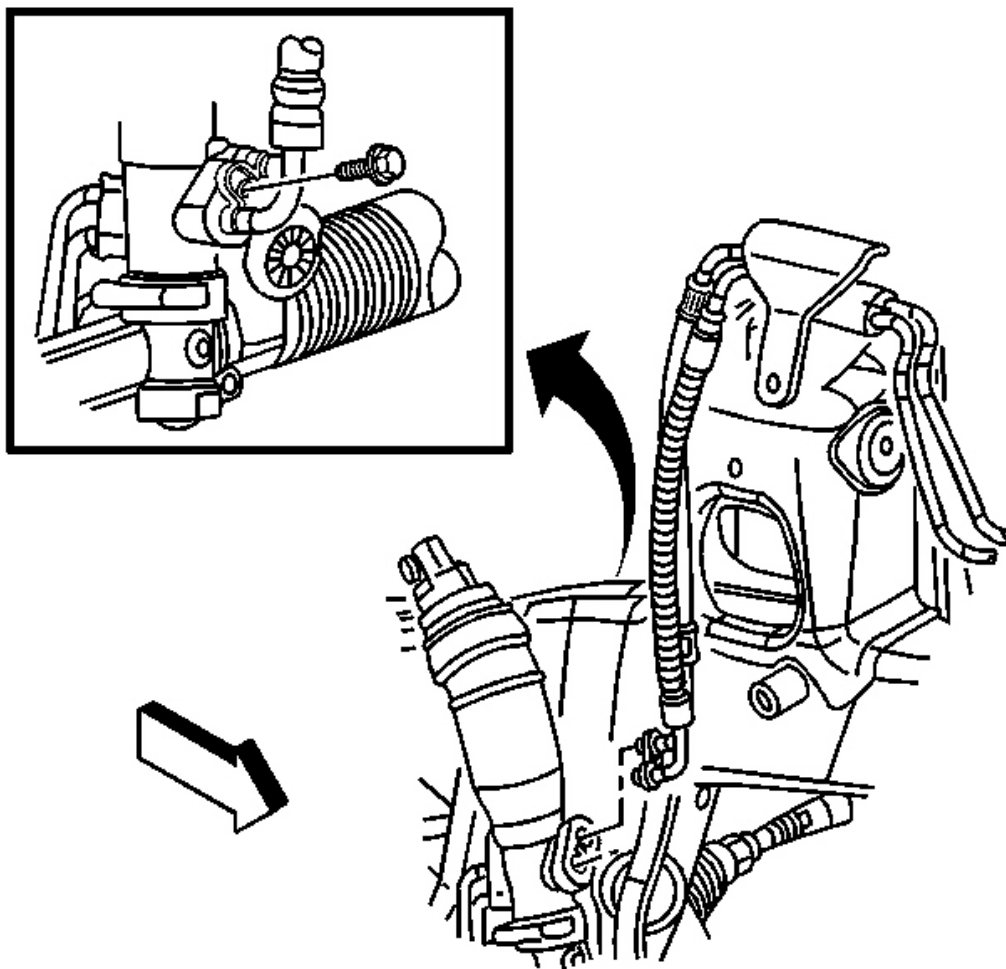
2. Install the power steering gear to the vehicle.

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

3. Install the power steering gear mounting bolts.

**Tighten:** Tighten the power steering gear mounting bolts to 110 N.m (81 lb ft).





**Fig. 79: View Of Power Steering Hose Assembly To Gear Retaining Bolt**  
Courtesy of GENERAL MOTORS CORP.

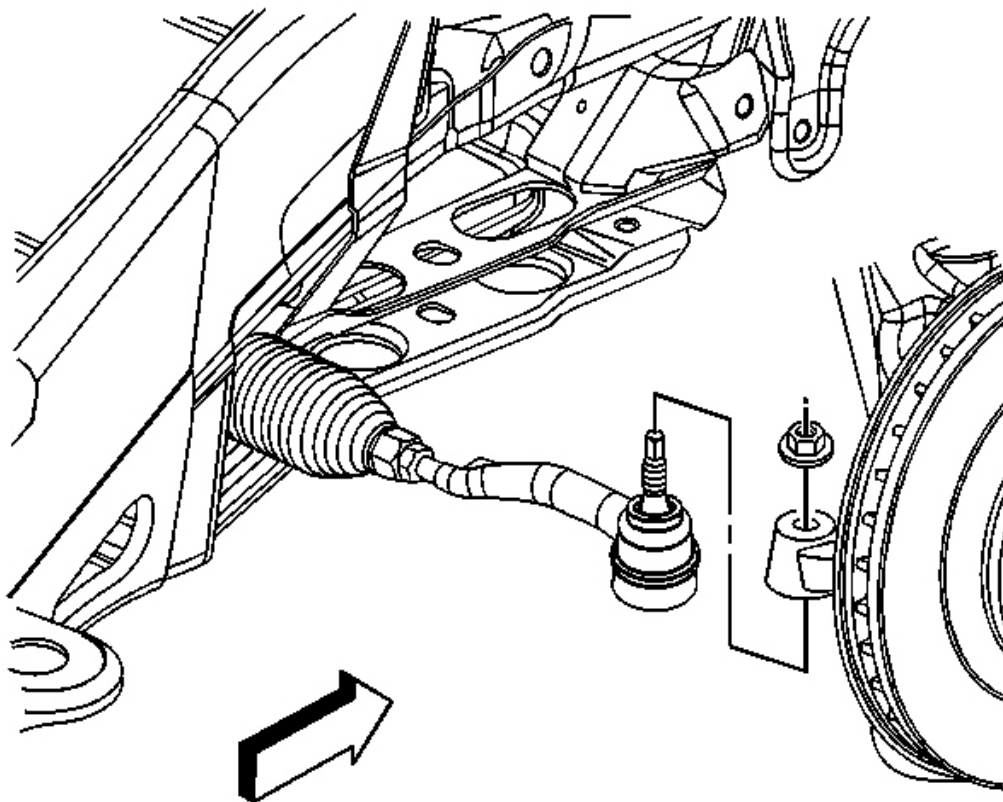
4. Remove the support from the power steering gear.
5. Install the power steering hose assembly to the power steering gear.
6. Install the power steering hose assembly to the power steering gear retaining bolt.

**Tighten:** Tighten the power steering hose assembly to power steering gear retaining bolt to 12 N.m (106 lb in).

7. Connect the lower intermediate shaft to the power steering gear. Refer to **Intermediate**

**Steering Shaft Replacement - Lower** in Steering Wheel and Column.

8. Install the steering gear crossmember. Refer to **Crossmember Replacement - Front Steering Gear** in Frame and Underbody.



**Fig. 80: Removing/Installing Tie Rod**  
Courtesy of GENERAL MOTORS CORP.

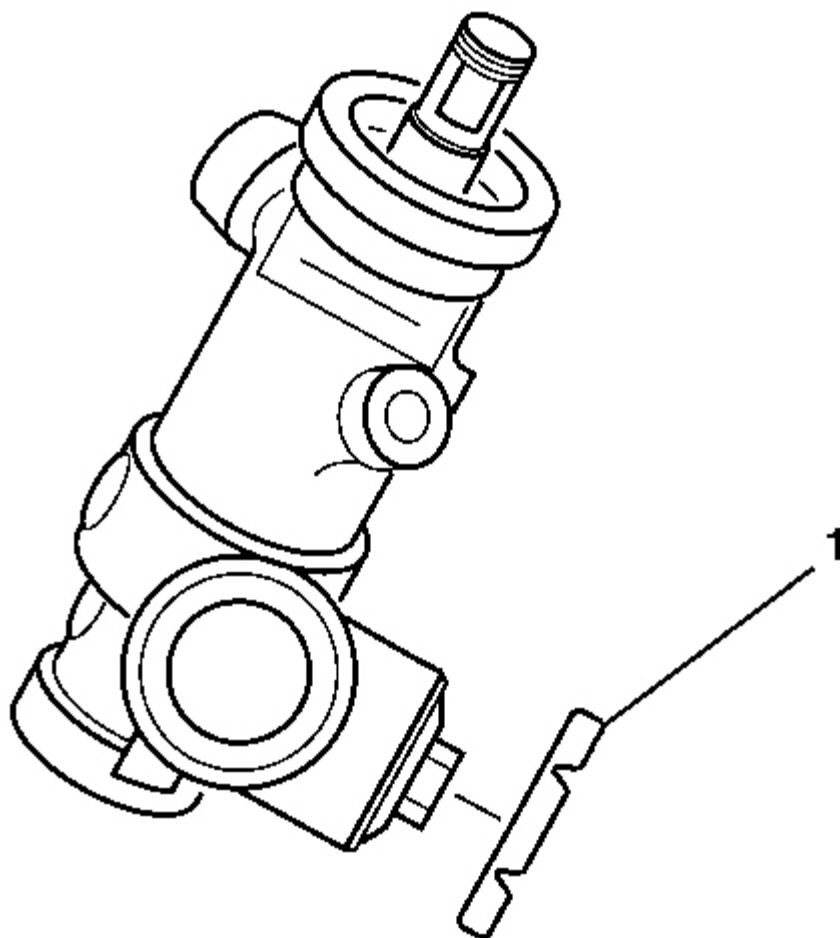
9. Connect the outer tie rods to the steering knuckles.
10. Install the outer tie rods to steering knuckles retaining nuts.

**Tighten:** Tighten the outer tie rods to steering knuckles retaining nuts to 60 N.m (44 lb ft).

11. Install the tires and wheels. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
12. Remove the drain pan from under the vehicle.

13. Lower the vehicle.
14. Bleed the power steering system. Refer to **Bleeding the Power Steering System**.
15. Adjust the front toe. Refer to **Front Toe Adjustment** in Wheel Alignment.

**RACK AND PINION GEAR RACK BEARING PRELOAD ADJUSTMENT - OFF VEHICLE (RACK AND PINION)**



**Fig. 81: View Of Adjuster Plug Lock Nut (Rack & Pinion)**  
Courtesy of GENERAL MOTORS CORP.

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1. Loosen the adjuster plug lock nut (1).
2. Turn the adjuster plug clockwise until the adjuster plug bottoms in the gear assembly.
3. Turn the adjuster plug back 50 degrees to 70 degrees (approximately one flat).

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

4. Install the adjuster plug lock nut (1) to the adjuster plug.

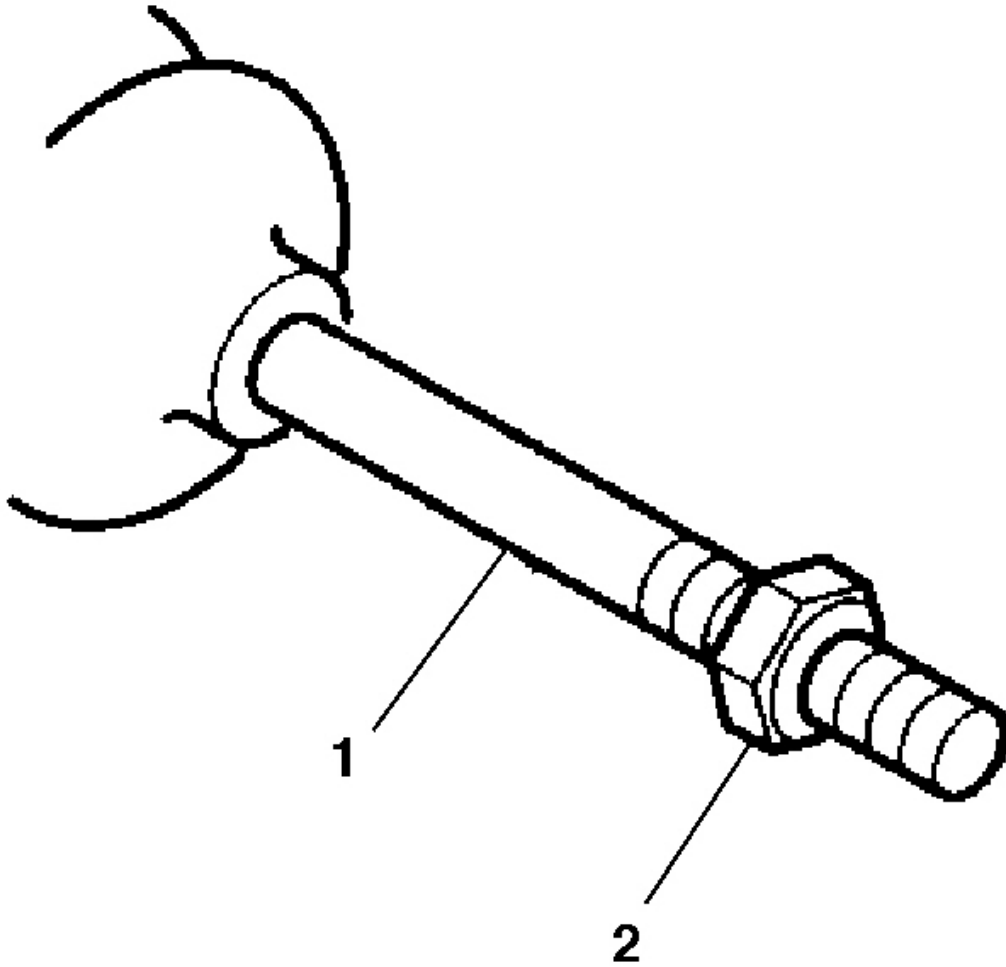
**Tighten:** Hold the adjuster plug stationary while tightening the adjuster plug lock nut (1) to 68 N.m (50 lb ft).

### RACK AND PINION BOOT REPLACEMENT - OFF VEHICLE

#### Tools Required

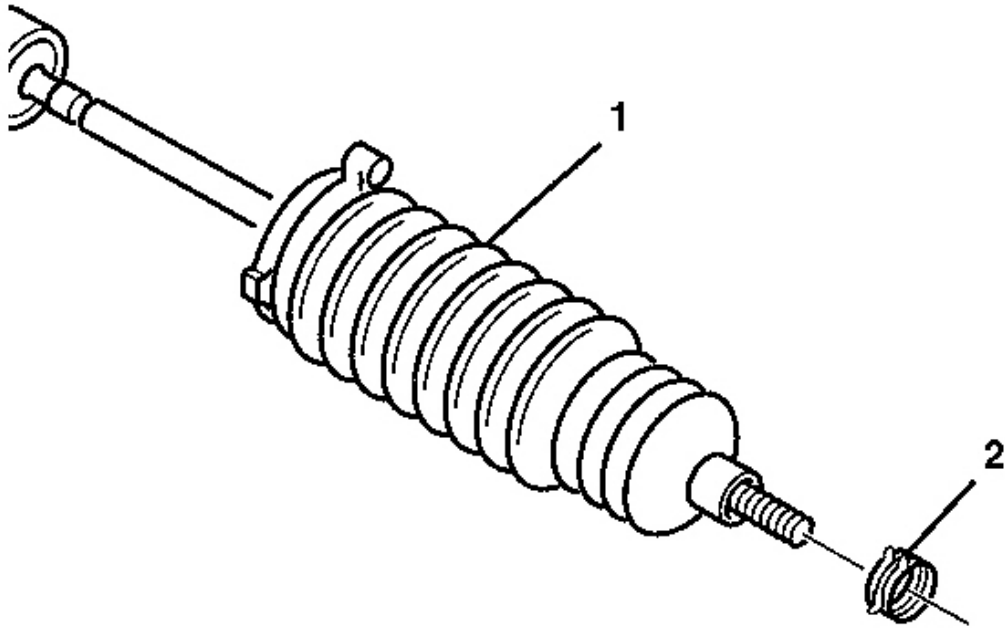
**J 22610** Keystone Clamp Pliers. See Special Tools.

#### Disassembly Procedure



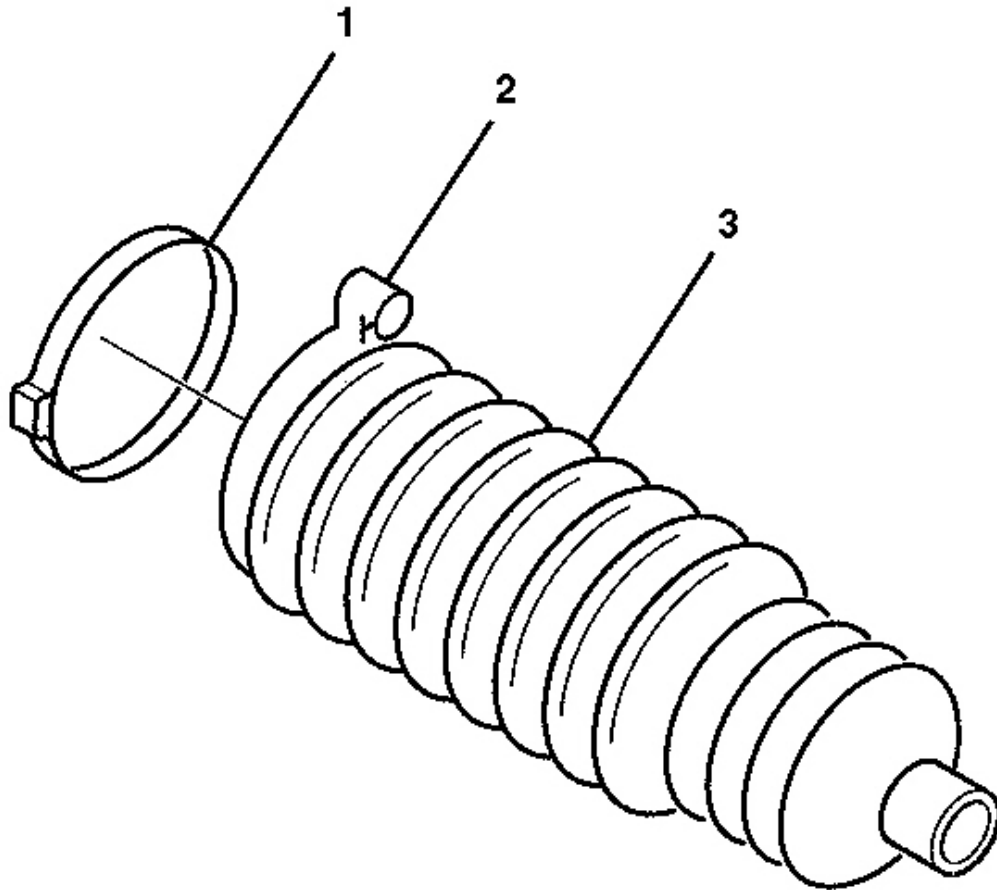
**Fig. 82: Identifying Inner Tie Rod Assembly Jam Nut**  
Courtesy of GENERAL MOTORS CORP.

1. To remove the outer tie rod; refer to **Rack and Pinion Outer Tie Rod End Replacement.**
2. Remove the hex jam nut (2) from the inner tie rod assembly (1).



**Fig. 83: View Of Tie Rod End Clamp, Rack & Pinion Boot**  
Courtesy of GENERAL MOTORS CORP.

3. Remove the tie rod end clamp (2) from the rack and pinion boot (1).

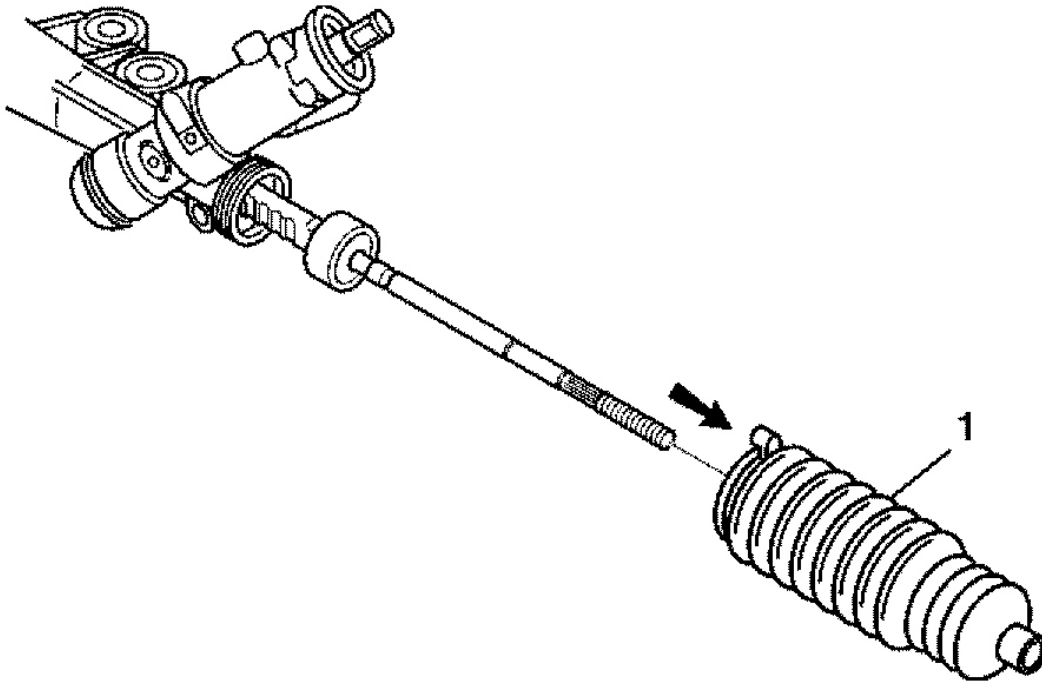


**Fig. 84: View Of Inner Tie Rod Boot Clamp**  
**Courtesy of GENERAL MOTORS CORP.**

4. Remove the boot clamp (1) from the rack and pinion boot with side cutters.
5. Discard the boot clamp (1).

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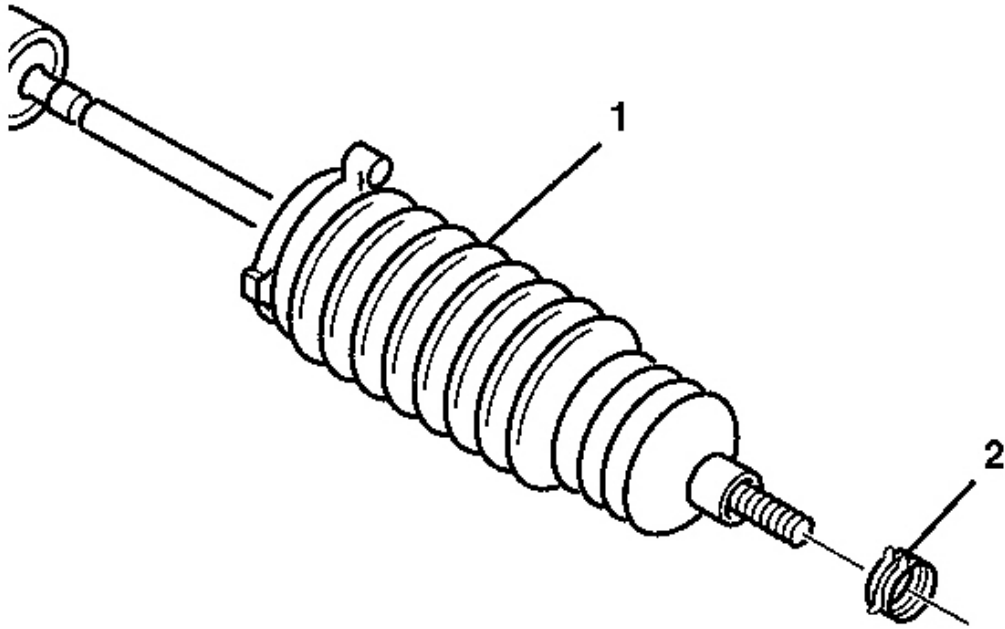


**Fig. 85: Removing Rack & Pinion Boot**  
**Courtesy of GENERAL MOTORS CORP.**

6. Remove the rack and pinion boot (1) from the rack and pinion gear assembly.

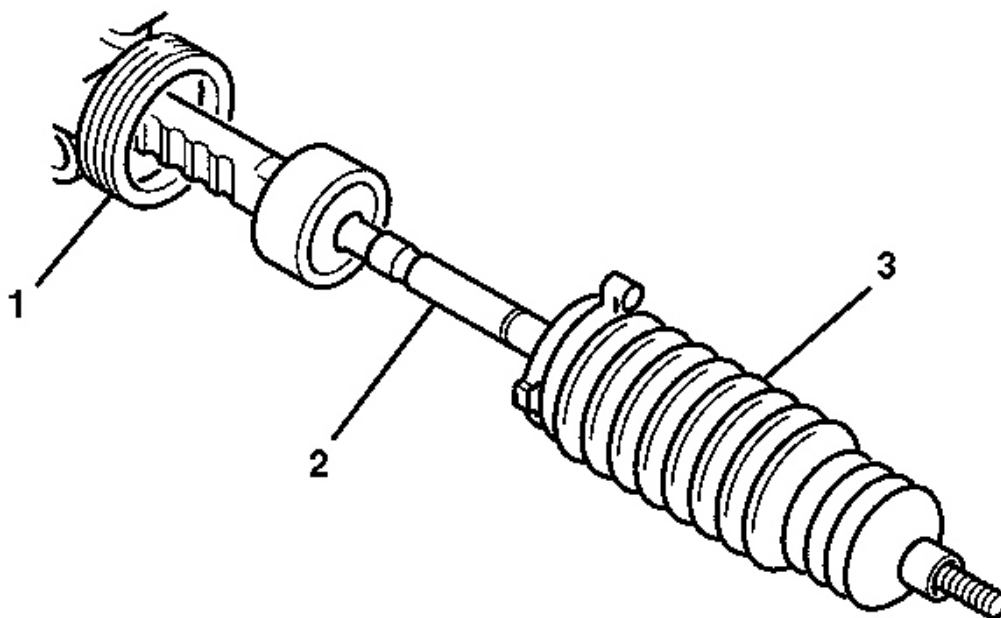
**Assembly Procedure**





**Fig. 86: View Of Tie Rod End Clamp, Rack & Pinion Boot**  
Courtesy of GENERAL MOTORS CORP.

1. Install the new boot clamp (2) onto the rack and pinion boot (1).

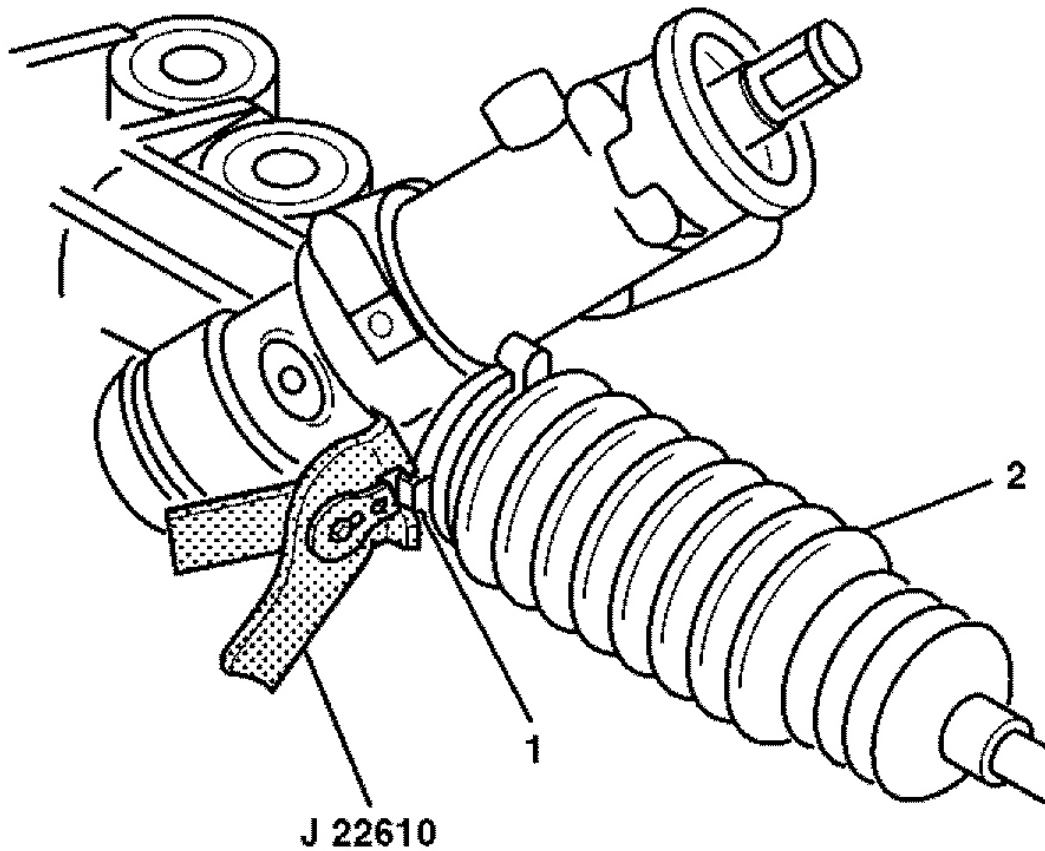


**Fig. 87: Inner Tie Rod, Rack And Pinion Gear & Rack And Pinion Boot**  
Courtesy of GENERAL MOTORS CORP.

2. Prior to rack and pinion boot installation, apply grease to the inner tie rod assembly (2) and the rack and pinion gear assembly (1).
3. Install the rack and pinion boot (3) onto the inner tie rod assembly (2).

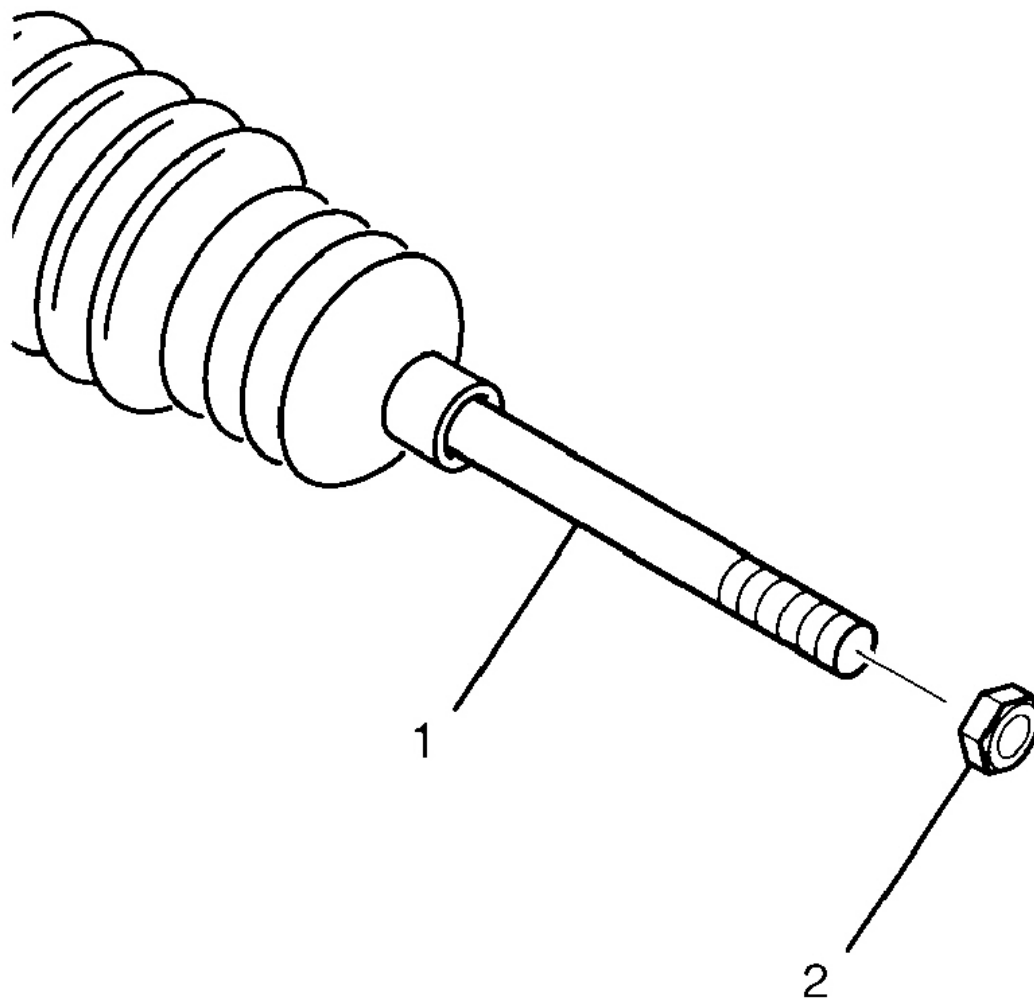
**IMPORTANT:** The rack and pinion boot (3) must not be twisted, puckered or out of shape in any way. If the rack and pinion boot (3) is not shaped properly, adjust the rack and pinion boot (3) by hand before installing the boot clamp.

4. Install the rack and pinion boot onto the gear assembly (1) until the rack and pinion boot (3) is seated in the gear assembly groove.



**Fig. 88: Installing Inner Tie Rod Boot Clamp**  
**Courtesy of GENERAL MOTORS CORP.**

5. Install the boot clamp (1) on the rack and pinion boot (2) with **J 22610** .
6. Crimp the boot clamp (1).
7. Pinch the pliers together on the rack and pinion boot (2) in order to install the tie rod end clamp.



**Fig. 89: View Of Inner Tie Rod & Hex Jam Nut**  
Courtesy of GENERAL MOTORS CORP.

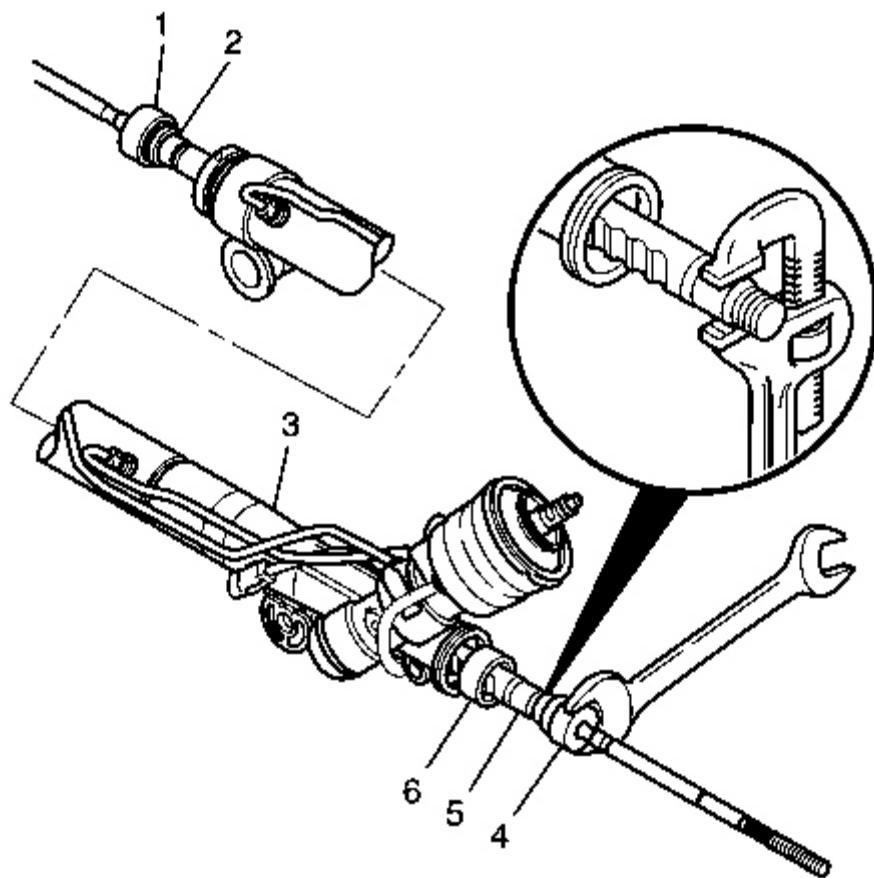
8. Install the hex jam nut (2) to the inner tie rod assembly (1).
9. To assemble the outer tie rod assembly; refer to **Rack and Pinion Outer Tie Rod End Replacement**.

#### RACK AND PINION INNER TIE ROD REPLACEMENT - OFF VEHICLE (MAGNASTEER)

##### Tools Required

**J 34028** Inner Tie Rod Wrench. See **Special Tools**.

Disassembly Procedure



**Fig. 90: View of Shock Dampener, Inner Tie Rod Housing, and Rack**  
Courtesy of GENERAL MOTORS CORP.

1. To remove the rack and pinion boot. Refer to [Rack and Pinion Boot Replacement - Off Vehicle](#).
2. Place the gear in a vise.

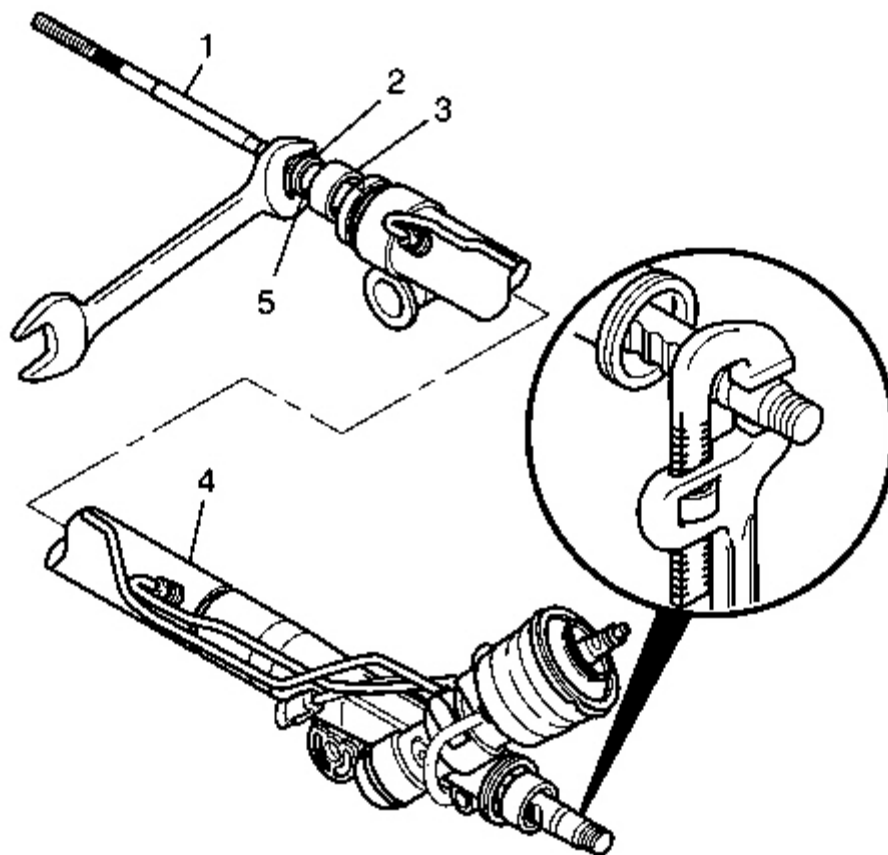
**NOTE:** Do not change the steering gear preload adjustment before moving the inner tie rod from the steering gear. Changing the steering gear preload adjustment before moving the inner tie

**rod could result in damage to the pinion and the steering gear.**

3. Remove the shock dampener (6) from the inner tie rod housing (4).
4. Slide the shock dampener (6) back on the rack (5).

**NOTE: The pipe wrench must be placed at the valve end of the steering gear and positioned up against the inner tie rod housing. Placing the pipe wrench in any other location will cause damage to the steering gear.**

5. Place a pipe wrench on the rack (5) next to the inner tie rod housing (4).
6. Place a wrench on the flats of the inner tie rod housing (4).
7. Rotate the inner tie rod housing (4) counterclockwise, while holding the rack stationary, until the inner tie rod separates from the rack (5).



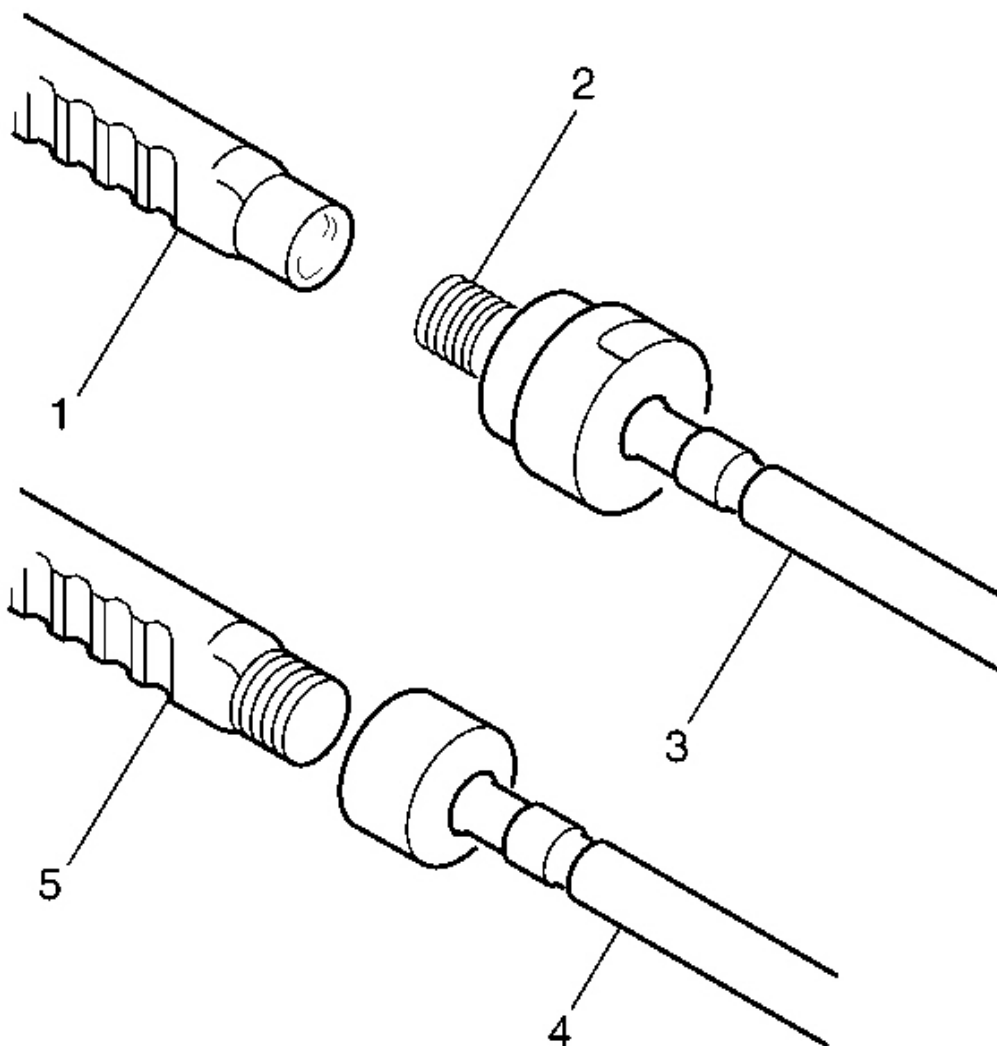
**Fig. 91: View of Shock Dampener, Inner Tie Rod Housing, Rack and Inner Tie Rod**  
Courtesy of GENERAL MOTORS CORP.

8. Remove the shock dampener (3) from the inner tie rod housing (2).
9. Slide the shock dampener (3) back on the rack (5).

**NOTE:** Refer to PIPE WRENCH POSITIONING NOTICE in Cautions and Notices.

10. Place a pipe wrench on the rack.
11. Place a wrench on the flats of the inner tie rod housing (2).
12. Rotate the inner tie rod housing (2) counterclockwise, while holding the rack stationary,

until the inner tie rod (1) separates from the rack (5).



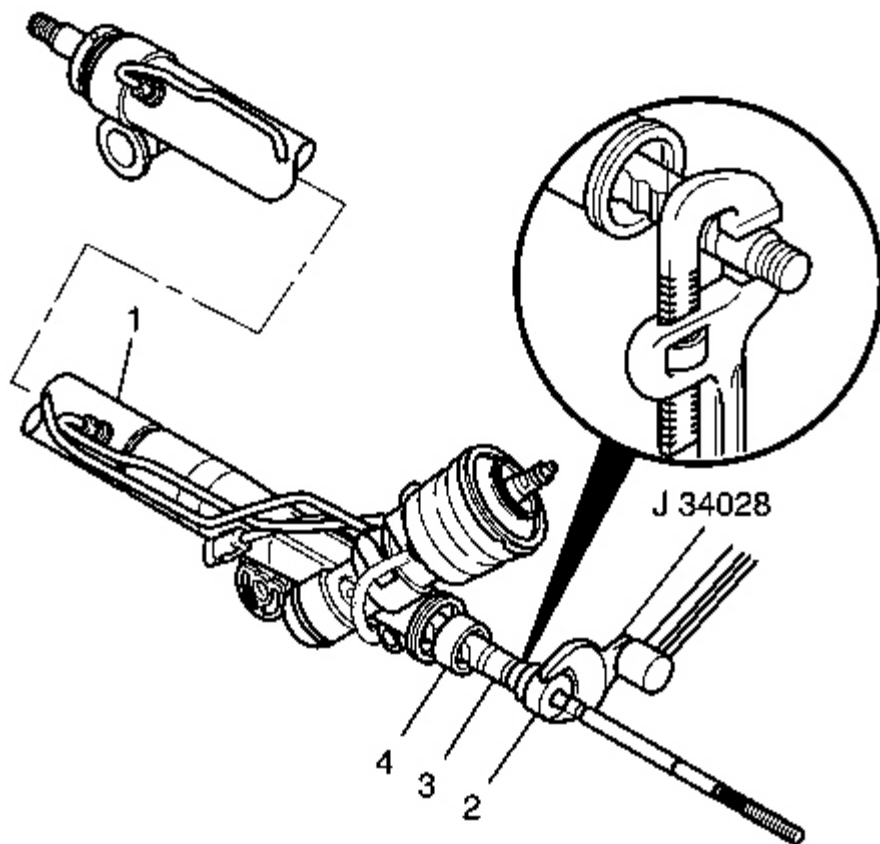
**Fig. 92: Identifying Tie Rod Male & Female Ends**  
Courtesy of GENERAL MOTORS CORP.

13. If female rack (1) and male inner tie rod (3), remove the old LOCTITE® from the threads (2) of the inner tie rod (3) and the rack (1).

If male rack (5) and female inner tie rod (4) LOCTITE® will not be present.



## Assembly Procedure



**Fig. 93: View of Shock Dampener, Rack, Female/Male Inner Tie Rod with J 34028**  
Courtesy of GENERAL MOTORS CORP.

1. Slide the shock dampener (4) forward onto the rack (3).

**IMPORTANT:** Threads must be clean prior to LOCTITE® application. Check LOCTITE®, or equivalent, container for expiration date. Use only enough LOCTITE® to evenly coat threads. If male rack (3) and female inner tie rod (2) do not apply LOCTITE®.

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2. If female rack (3) and male inner tie rod (2), apply LOCTITE® 262, or equivalent, to the inner tie rod threads.
3. Attach the inner tie rod onto the rack (3).

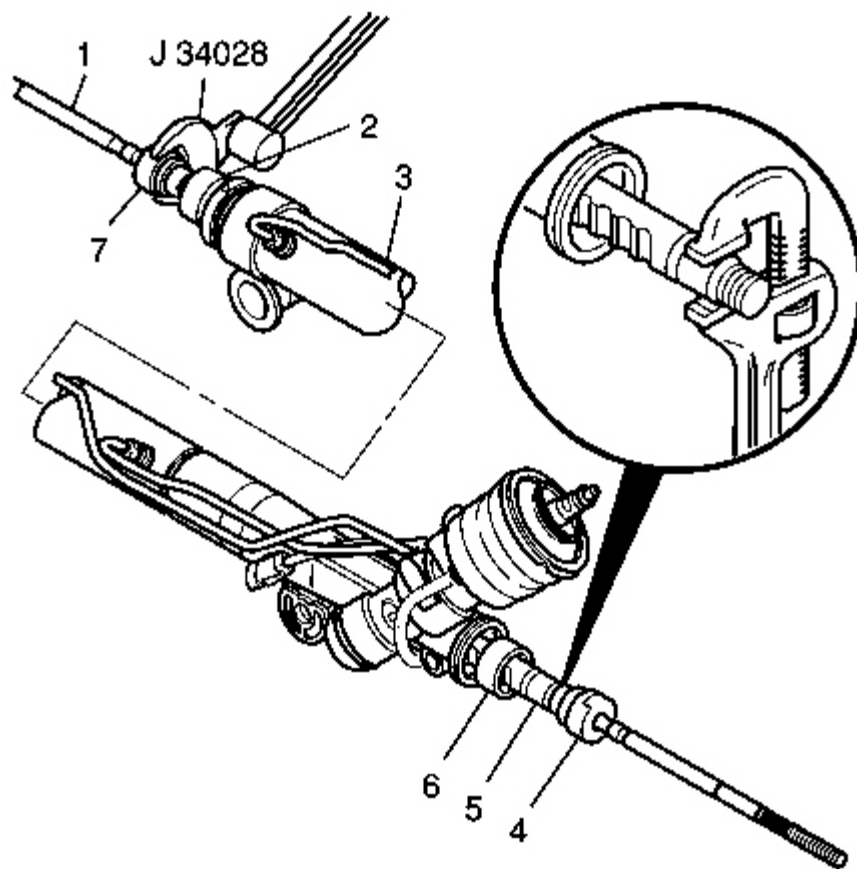
**NOTE:** Refer to PIPE WRENCH POSITIONING NOTICE in Cautions and Notices.

4. Place a pipe wrench on the rack (3) next to the inner tie rod housing (2).

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

5. Place a torque wrench and **J 34028** on the flats of the inner tie rod housing (2). See Special Tools.

**Tighten:** Tighten the inner tie rod to 100 N.m (74 lb ft).



**Fig. 94: View of Shock Dampener, Female/Male Inner Tie Rod and Inner Tie Rod Housing with J 34028**

Courtesy of GENERAL MOTORS CORP.

6. Slide the shock dampener (2) forward onto the rack.

**IMPORTANT:** Threads must be clean prior to LOCTITE® application. Check LOCTITE®, or equivalent, container for expiration date. Use only enough LOCTITE® to evenly coat threads. If male rack and female inner tie rod (1) do not apply LOCTITE®.

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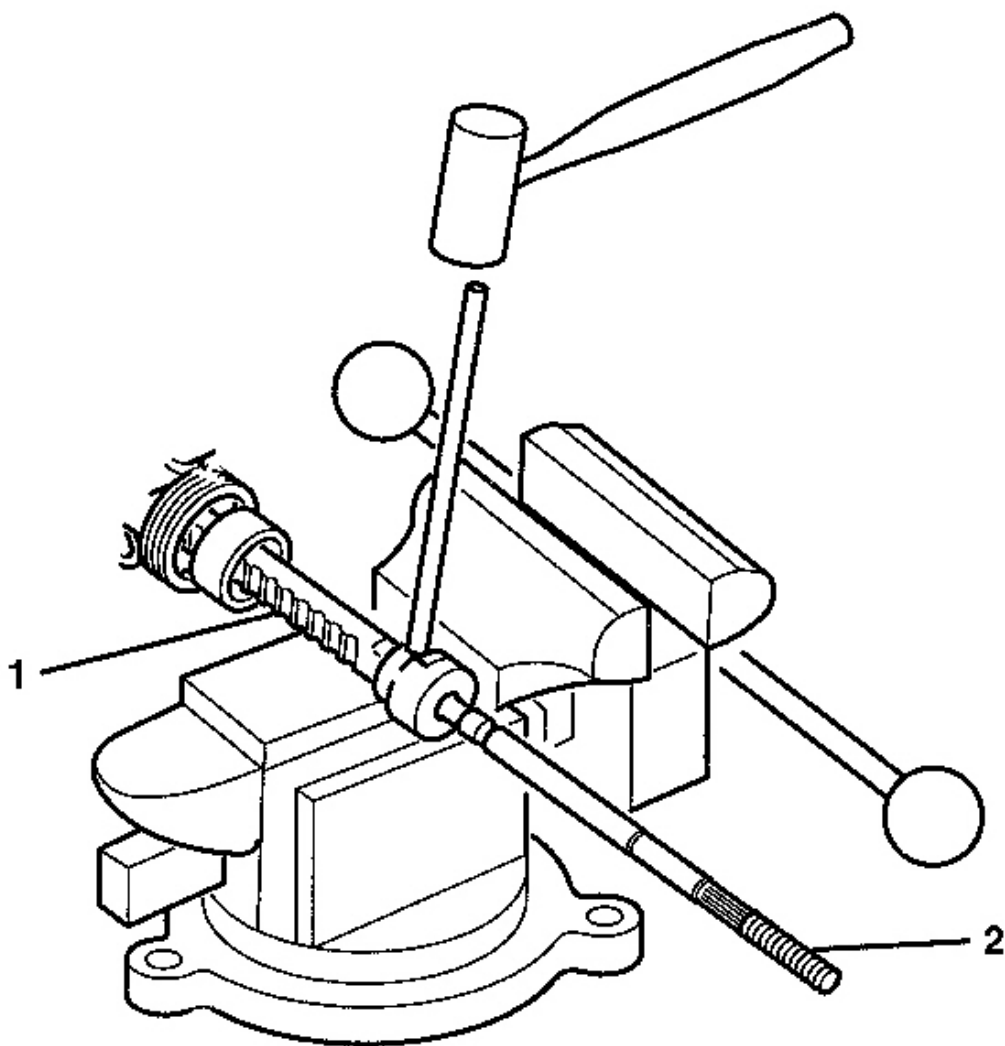
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7. If female rack and male inner tie rod (1), apply LOCTITE® 262, or equivalent, to the inner tie rod threads.
8. Attach the inner tie rod (1) onto the rack.

**NOTE:** Refer to PIPE WRENCH POSITIONING NOTICE in Cautions and Notices.

9. Place a pipe wrench on the rack next to the inner tie rod housing (4).
10. Place a torque wrench and **J 34028** on the flats of the inner tie rod housing (7). See Special Tools.

**Tighten:** Tighten the inner tie rod to 100 N.m (74 lb ft).



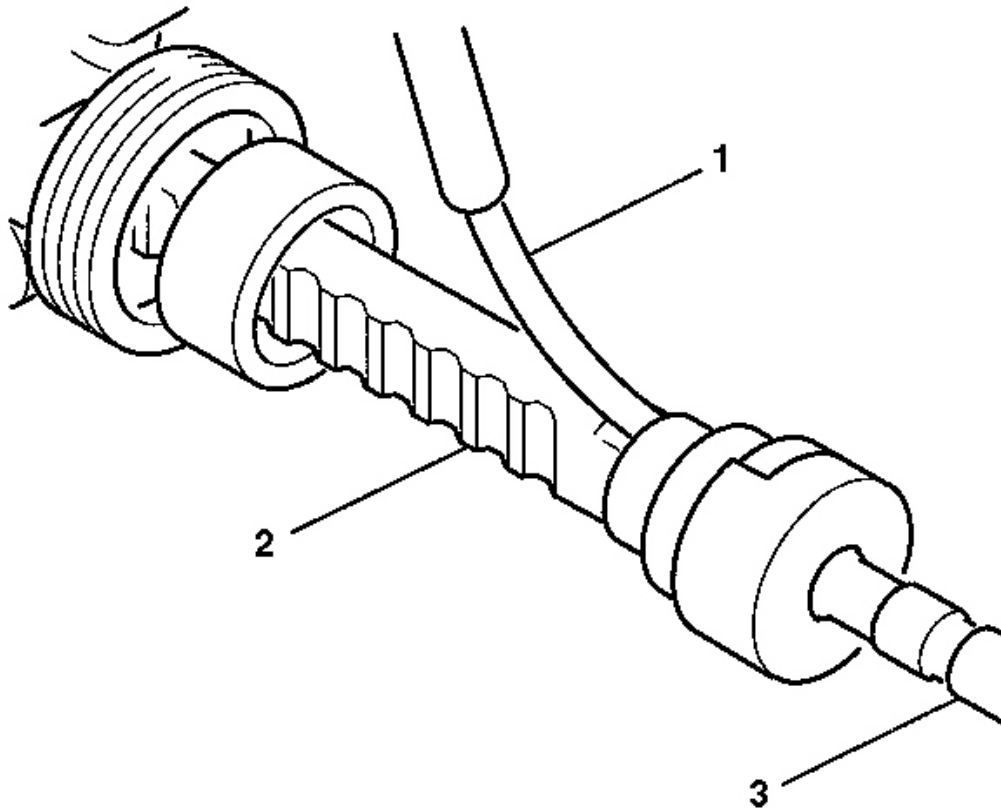
**Fig. 95: Staking Both Sides Of Female Inner Tie Rod Assembly Housing To The Male Rack**

**Courtesy of GENERAL MOTORS CORP.**

11. Place the inner tie rod assembly (2) in a vise.

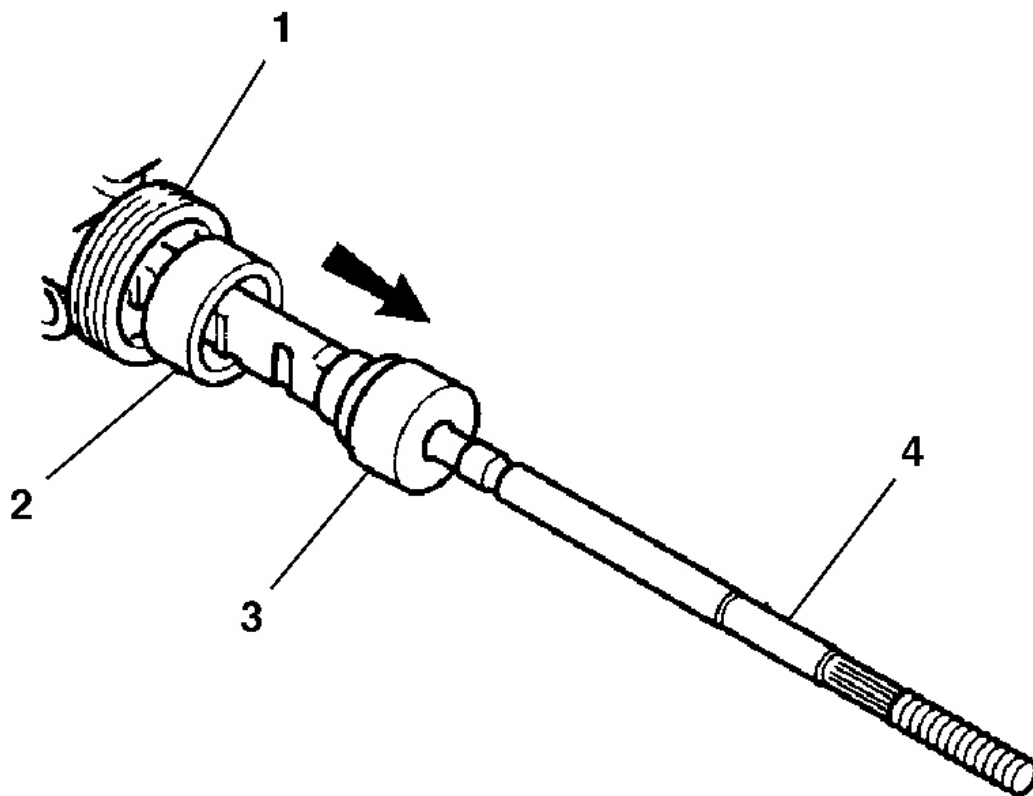
**IMPORTANT:** If female rack (1) and male inner tie rod (2) do not stake. If male rack (1) and female inner tie rod (2) you must stake.

12. Stake both sides of the female inner tie rod assembly housing to the male rack (1).



**Fig. 96: Inserting Gage Between Rack & Inner Tie Rod Housing**  
Courtesy of GENERAL MOTORS CORP.

13. Insert a 0.25 mm gauge (1) between the rack (2) and the inner tie rod housing in order to check both stakes. The feeler gauge (1) must not pass between the rack and the housing stake.

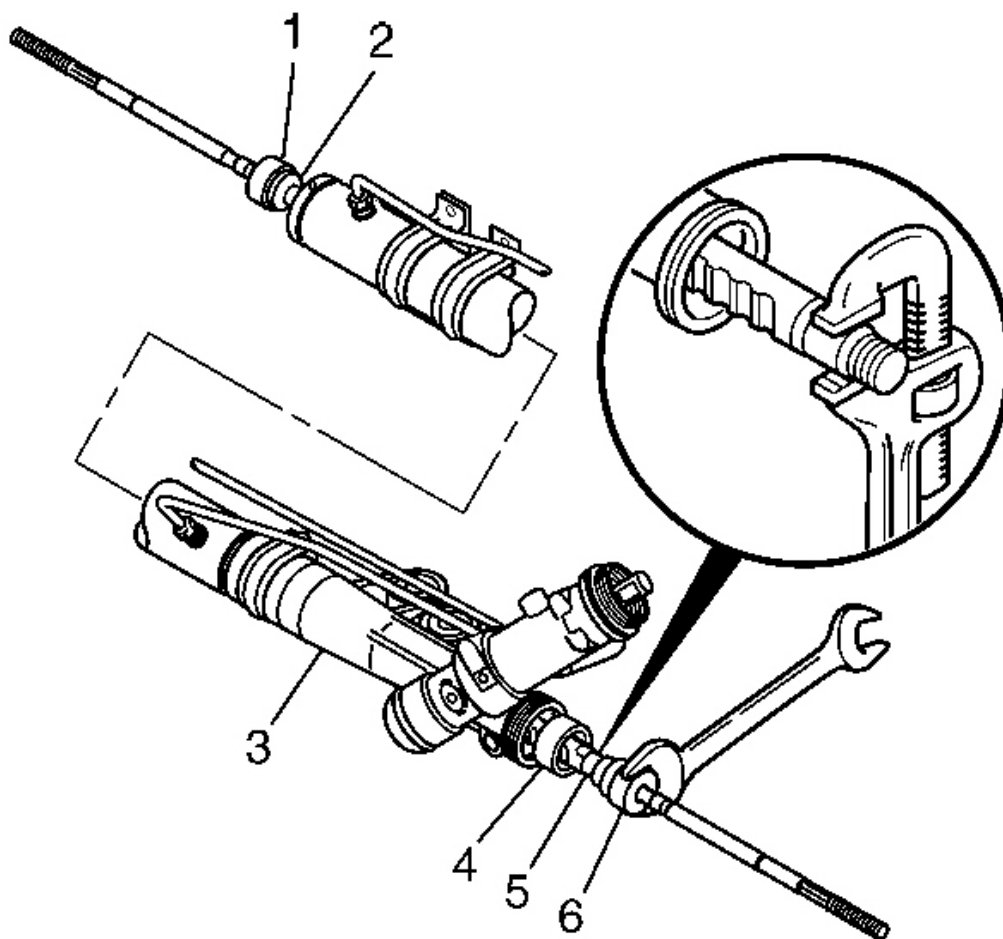


**Fig. 97: Identifying Shock Dampener & Inner Tie Rod Housing**  
Courtesy of GENERAL MOTORS CORP.

14. Slide the shock dampener (2) over the inner tie rod housing (3) until the front lip of the shock dampener (2) bottoms against the inner tie rod housing (3).
15. To assemble the rack and pinion boot. Refer to **Rack and Pinion Boot Replacement - Off Vehicle**.

#### **RACK AND PINION INNER TIE ROD REPLACEMENT - OFF VEHICLE (QUIET VALVE)**

##### **Disassembly Procedure**



**Fig. 98: Identifying Inner Tie Rod Components**  
Courtesy of GENERAL MOTORS CORP.

1. Remove the rack and pinion boot. Refer to **Rack and Pinion Boot Replacement - Off Vehicle**.
2. Place the gear in a vise.

**NOTE:** Do not change the steering gear preload adjustment before moving the inner tie rod from the steering gear. Changing the steering gear preload adjustment before moving the inner tie rod could result in damage to the pinion and the steering gear.



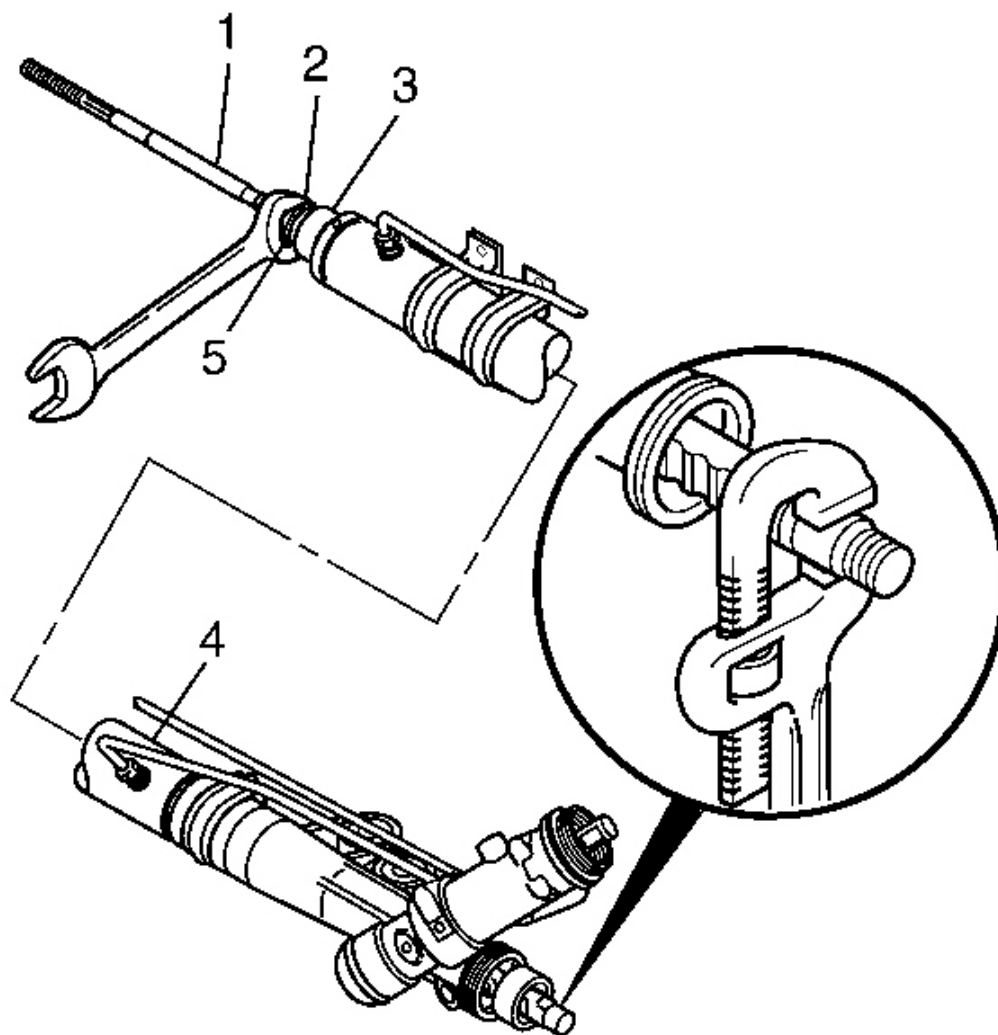
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3. Remove the shock dampener (4) from the inner tie rod assembly (6).
4. Slide the shock dampener (4) back on the rack (5).

**NOTE:** Refer to **PIPE WRENCH POSITIONING NOTICE** in **Cautions and Notices.**

5. Place a pipe wrench on the rack (5) next to the inner tie rod housing (6).
6. Place a wrench on the flats of the inner tie rod housing (6).
7. Rotate the inner tie rod housing (6) counterclockwise, while holding the rack stationary, until the inner tie rod separates from the rack (5).



**Fig. 99: Separating Inner Tie Rod From Rack**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Do not change the steering gear preload adjustment before moving the inner tie rod from the steering gear. Changing the steering gear preload adjustment before moving the inner tie rod could result in damage to the pinion and the steering gear.

8. Remove the shock dampener (3) from the inner tie rod housing (2).

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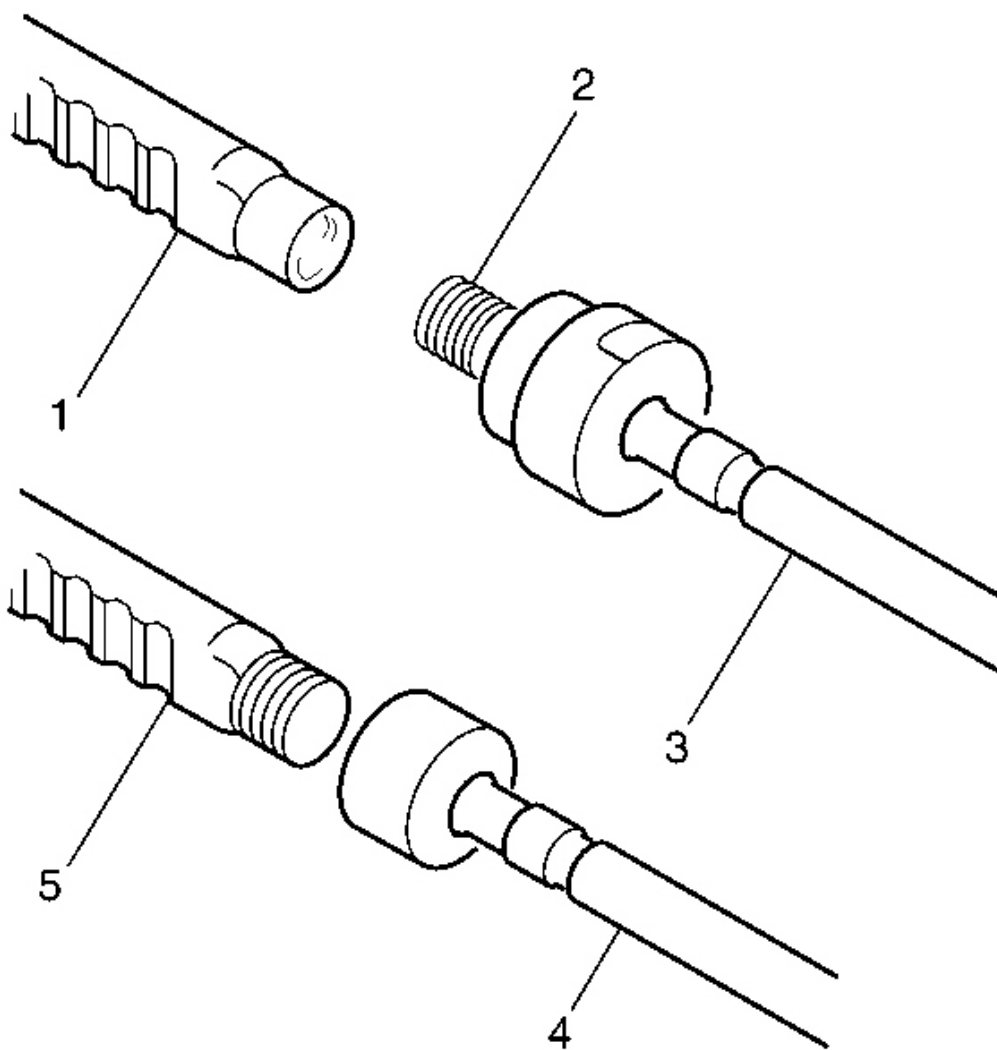
9. Slide the shock dampener (3) back on the rack (5).

**NOTE: Refer to PIPE WRENCH POSITIONING NOTICE in Cautions and Notices.**

10. Place a pipe wrench on the rack.

11. Place a wrench on the flats of the inner tie rod housing (2).

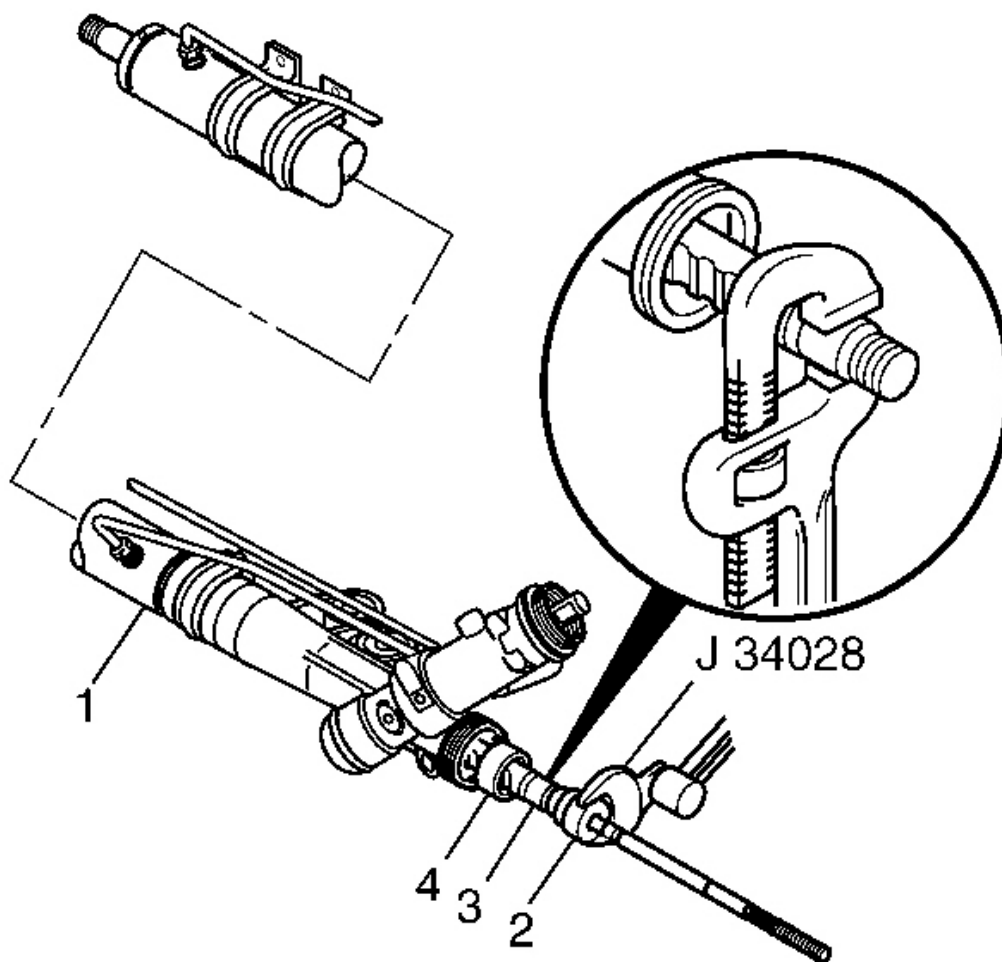
12. Rotate the inner tie rod housing (2) counterclockwise, while holding the rack stationary, until the inner tie rod (1) separates from the rack (5).



**Fig. 100: Identifying Tie Rod Male & Female Ends**  
Courtesy of GENERAL MOTORS CORP.

13. If female rack (1) and male inner tie rod (3), remove the old LOCTITE® from the threads (2) of the inner tie rod and the rack.

If male rack (5) and female inner tie rod (4) LOCTITE® will not be present.



**Fig. 101: Connecting Inner Tie Rod To Rack**  
Courtesy of GENERAL MOTORS CORP.

1. Slide the shock dampener (4) forward onto the rack (3).

**IMPORTANT:** Threads must be clean prior to LOCTITE® application. Check LOCTITE® or equivalent container for expiration date. Use only enough LOCTITE® to evenly coat threads. If male rack (3) and female inner tie rod (2) do not apply LOCTITE®.

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2. If female rack (3) and male inner tie rod (2), apply LOCTITE® 262 or equivalent to the inner tie rod threads.
3. Attach the inner tie rod onto the rack (3).

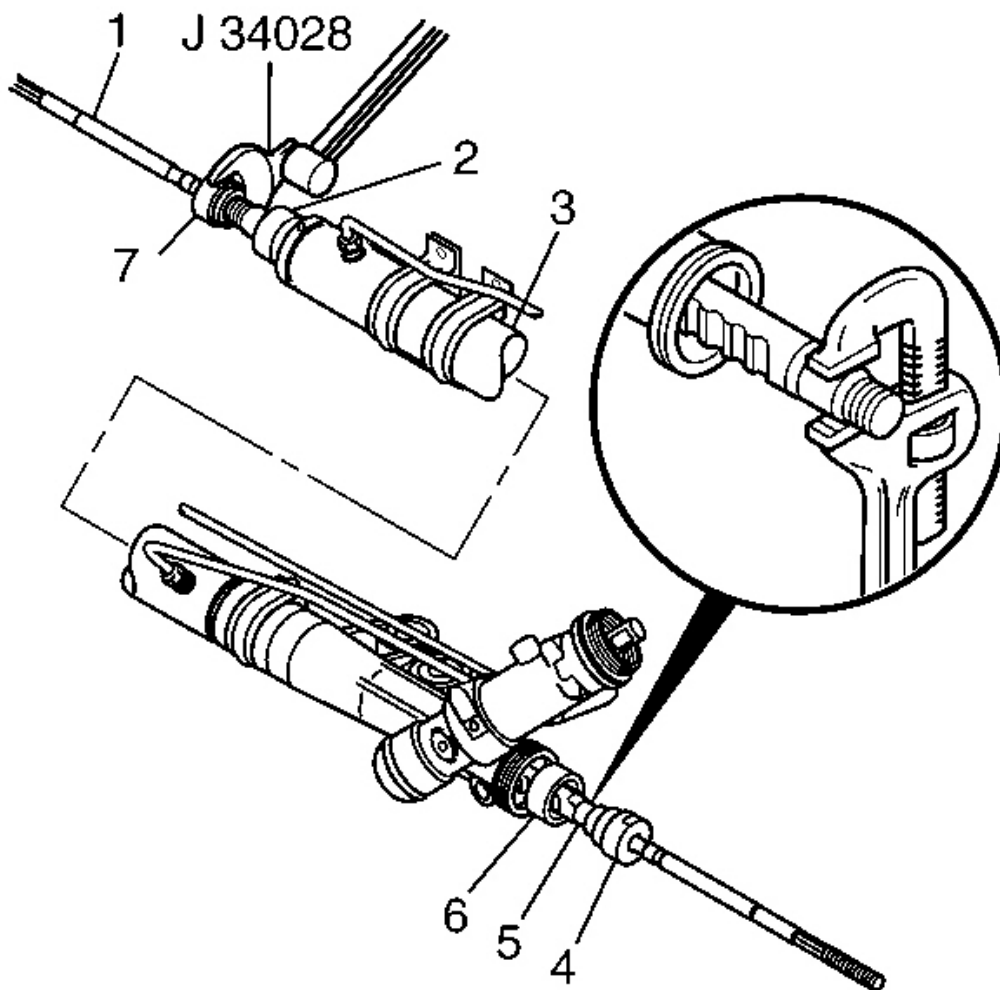
**NOTE:** Refer to PIPE WRENCH POSITIONING NOTICE in Cautions and Notices.

4. Place a pipe wrench on the rack (3) next to the inner tie rod housing (2).

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

5. Place a torque wrench and **J 34028** on the flats of the inner tie rod housing (2). See Special Tools.

**Tighten:** Tighten the inner tie rod to 100 N.m (74 lb ft).



**Fig. 102: Tighten The Inner Tie Rod To Rack**  
Courtesy of GENERAL MOTORS CORP.

6. Slide the shock dampener (2) forward onto the rack.

**IMPORTANT:** Threads must be clean prior to LOCTITE® application. Check LOCTITE® or equivalent container for expiration date. Use only enough LOCTITE® to evenly coat threads. If male rack and female inner tie rod (1) do not apply LOCTITE®.

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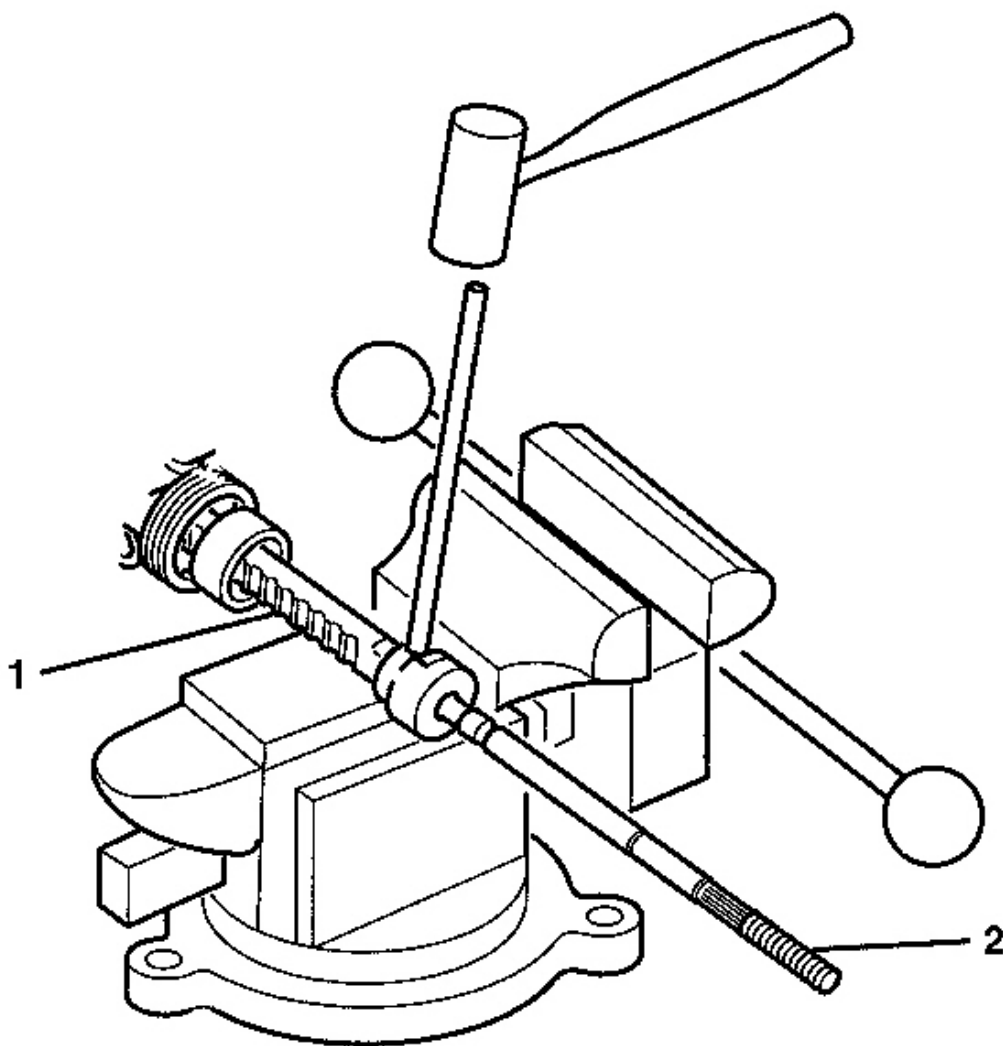
7. If female rack and male inner tie rod (1), apply LOCTITE® 262 or equivalent to the inner tie rod threads.
8. Attach the inner tie rod (1) onto the rack.

**NOTE:** Refer to PIPE WRENCH POSITIONING NOTICE in Cautions and Notices.

9. Place a pipe wrench on the rack next to the inner tie rod housing (4).
10. Place a torque wrench and **J 34028** on the flats of the inner tie rod housing (7). See Special Tools.

**Tighten:** Tighten the inner tie rod to 100 N.m (74 lb ft).





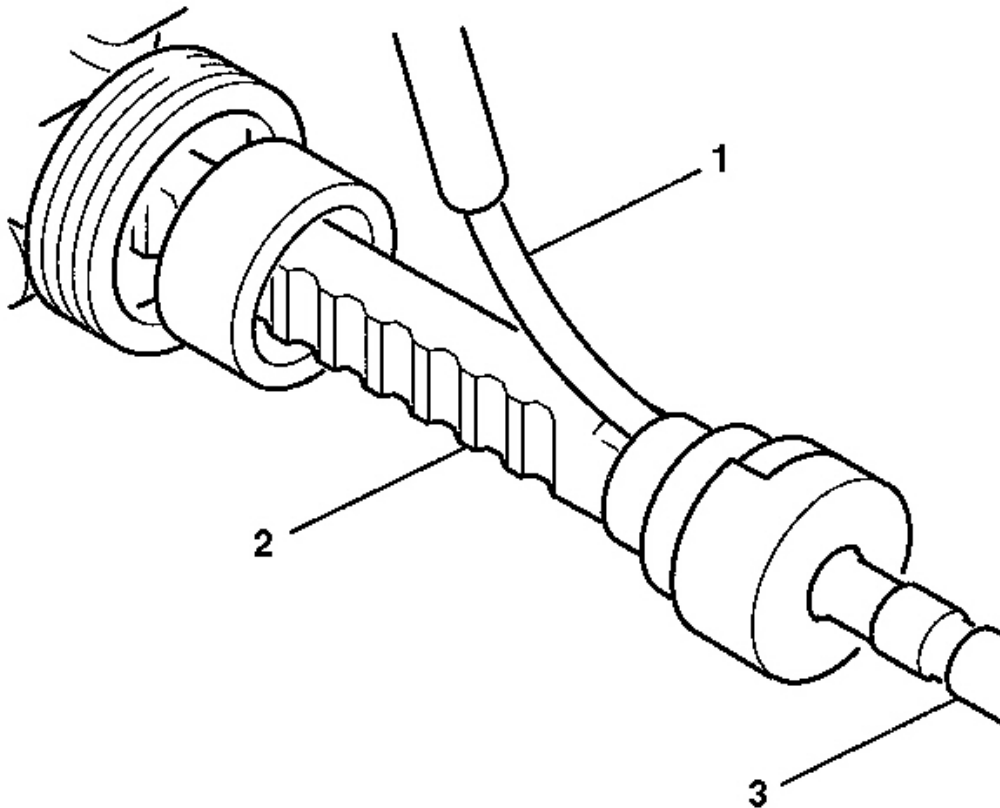
**Fig. 103: Staking Both Sides Of Female Inner Tie Rod Assembly Housing To The Male Rack**

**Courtesy of GENERAL MOTORS CORP.**

11. Place the inner tie rod assembly (2) in a vise.

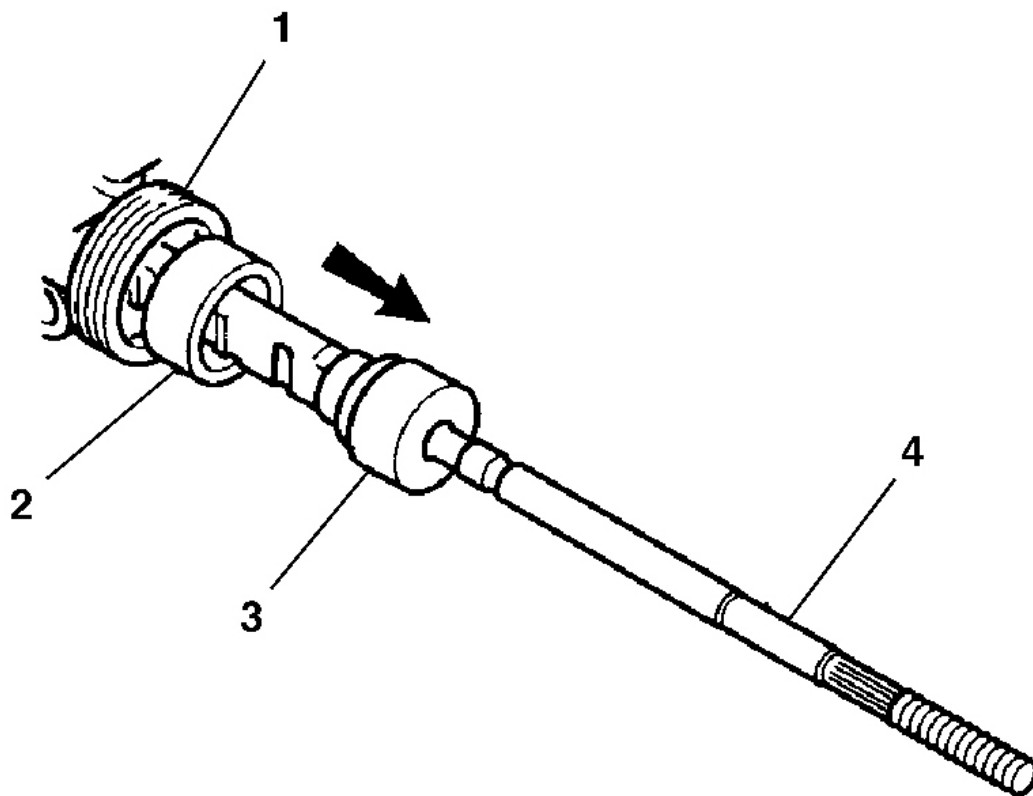
**IMPORTANT:** If female rack (1) and male inner tie rod (2) do not stake. If male rack (1) and female inner tie rod (2) you must stake.

12. Stake both sides of the female inner tie rod assembly housing to the male rack.



**Fig. 104: Inserting Gage Between Rack & Inner Tie Rod Housing**  
Courtesy of GENERAL MOTORS CORP.

13. Insert a 0.25 mm gauge (1) between the rack (2) and the inner tie rod housing in order to check both stakes. The feeler gauge (1) must not pass between the rack and the housing stake.

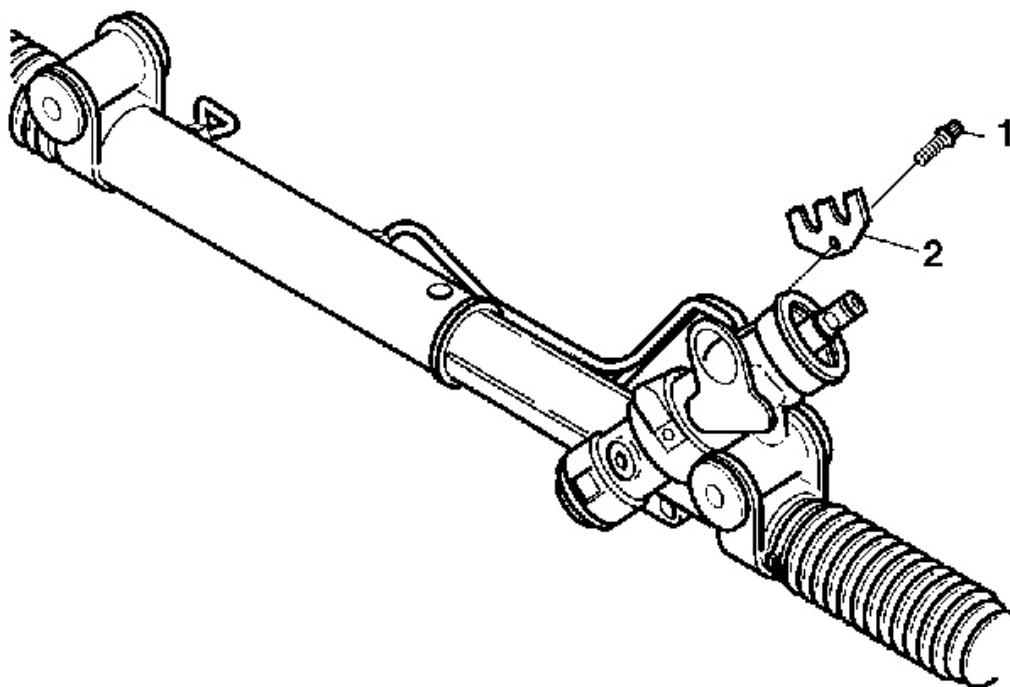


**Fig. 105: Identifying Shock Dampener & Inner Tie Rod Housing**  
Courtesy of GENERAL MOTORS CORP.

14. Slide the shock dampener (2) over the inner tie rod housing (3) until the front lip of the shock dampener (2) bottoms against the inner tie rod housing (3).
15. To assemble the rack and pinion boot. Refer to **Rack and Pinion Boot Replacement - Off Vehicle**.

#### **STEERING GEAR CYLINDER PIPE ASSEMBLIES/O-RING SEALS REPLACEMENT - OFF VEHICLE**

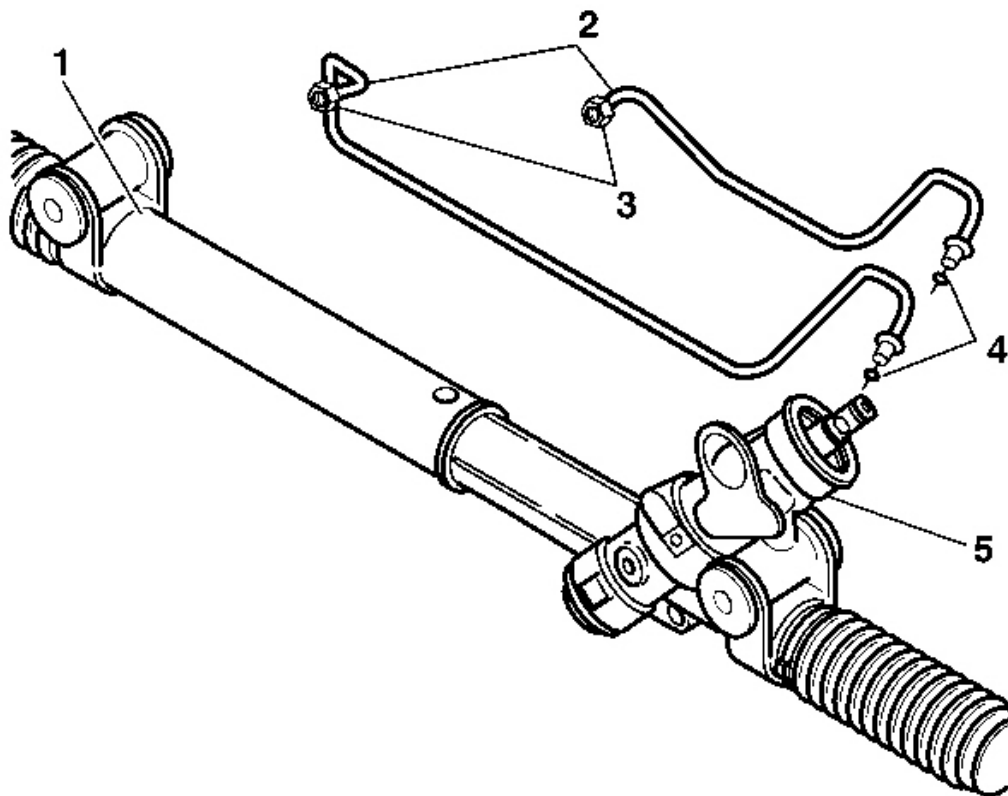
##### **Removal Procedure**



**Fig. 106: Removing Cylinder Line Retaining Plate**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT:** Protect the boots from sharp tools and from the sharp edges of surrounding components.

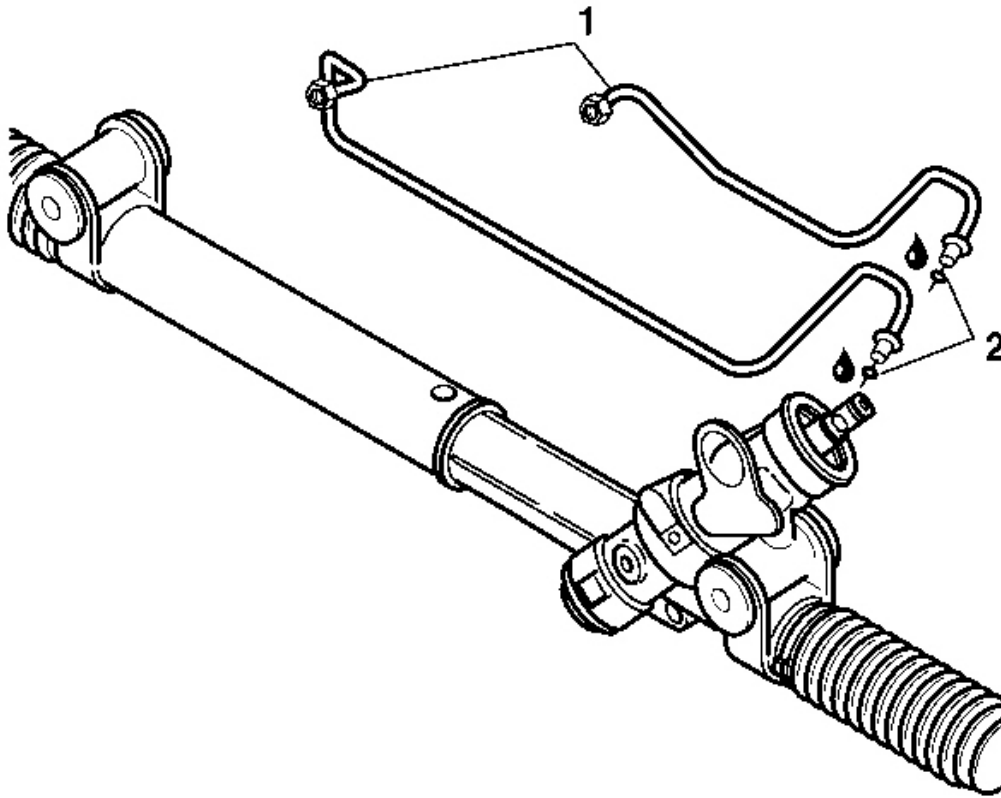
1. Remove the TORX® screw (1) from the cylinder line retaining plate (2) at the valve end.
2. Remove the cylinder line retaining plate (2).



**Fig. 107: Removing Both Cylinder Line Assemblies From Gear Assembly**  
**Courtesy of GENERAL MOTORS CORP.**

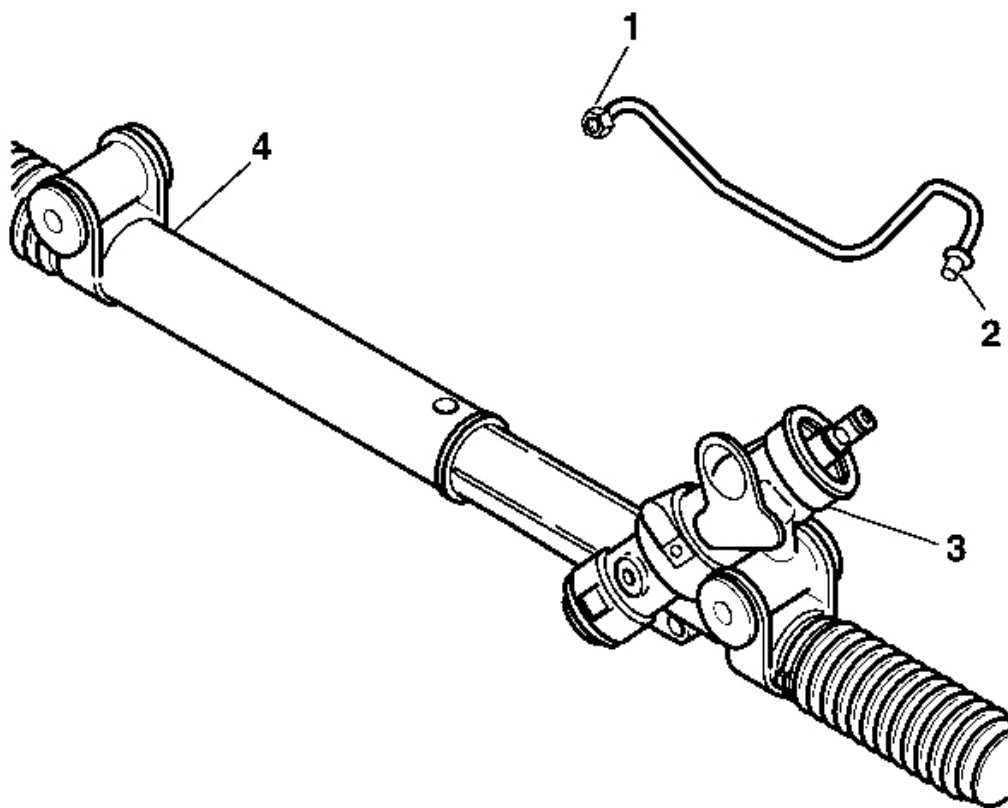
3. Loosen both cylinder line nuts (3) on cylinder end of the gear assembly (1).
4. Remove both cylinder line assemblies (2) from the rack and pinion gear assembly (1).
5. Remove and discard the O-rings seals (4) from the valve end (5).

**Installation Procedure**



**Fig. 108: Inspecting Cylinder Lines**  
**Courtesy of GENERAL MOTORS CORP.**

1. Inspect the cylinder lines (1) for the following items:
  - Cracks
  - Dents
  - Damage to the threads
2. Replace the parts as needed.
3. Lubricate and install the O-rings seals (2) onto the cylinder lines (1).



**Fig. 109: Installing Smaller Cylinder Line Into Valve Housing**  
Courtesy of GENERAL MOTORS CORP.

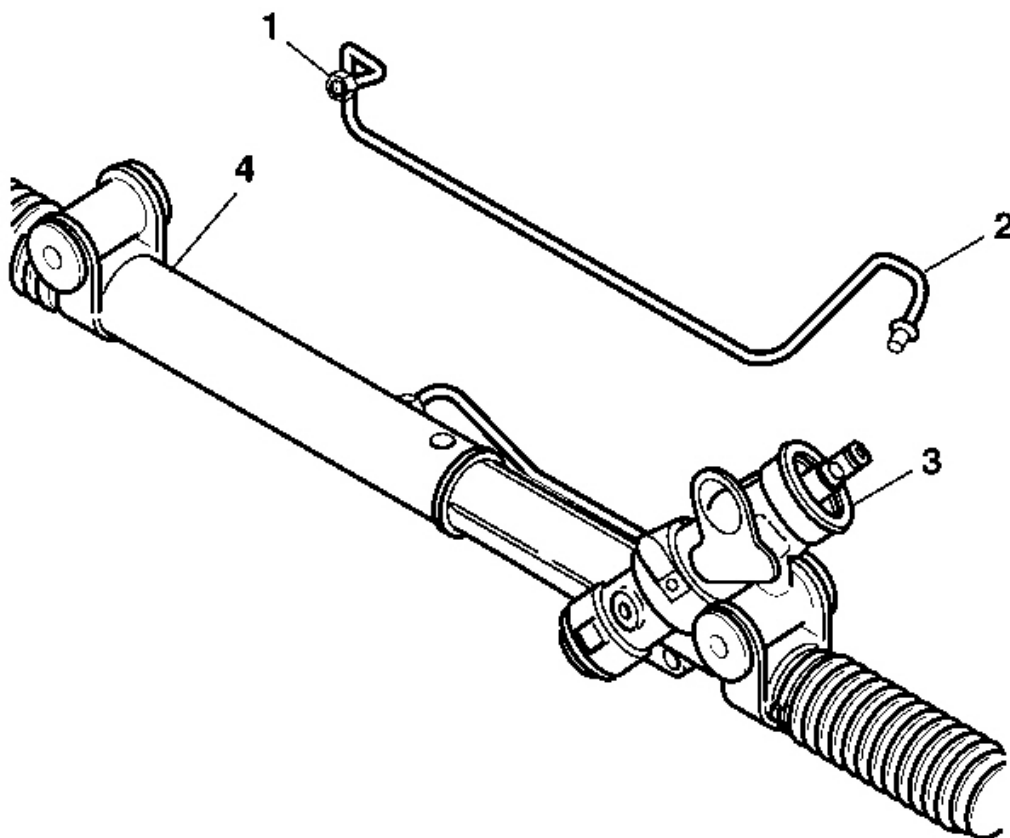
**IMPORTANT:** You must install the smaller cylinder line into the valve housing (3) first.

4. Place the smaller cylinder line (2) into the valve housing (3).

**IMPORTANT:** Hold the smaller cylinder line (2) in place. Do not torque the cylinder line nut (1).

5. Place the other end of the cylinder line at the gear tube end (4).

Finger tighten the cylinder line nut (1) on the smaller cylinder line.



**Fig. 110: Installing Larger Cylinder Line Into Valve Housing**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT:** You must install the larger cylinder line into the valve housing (3) first.

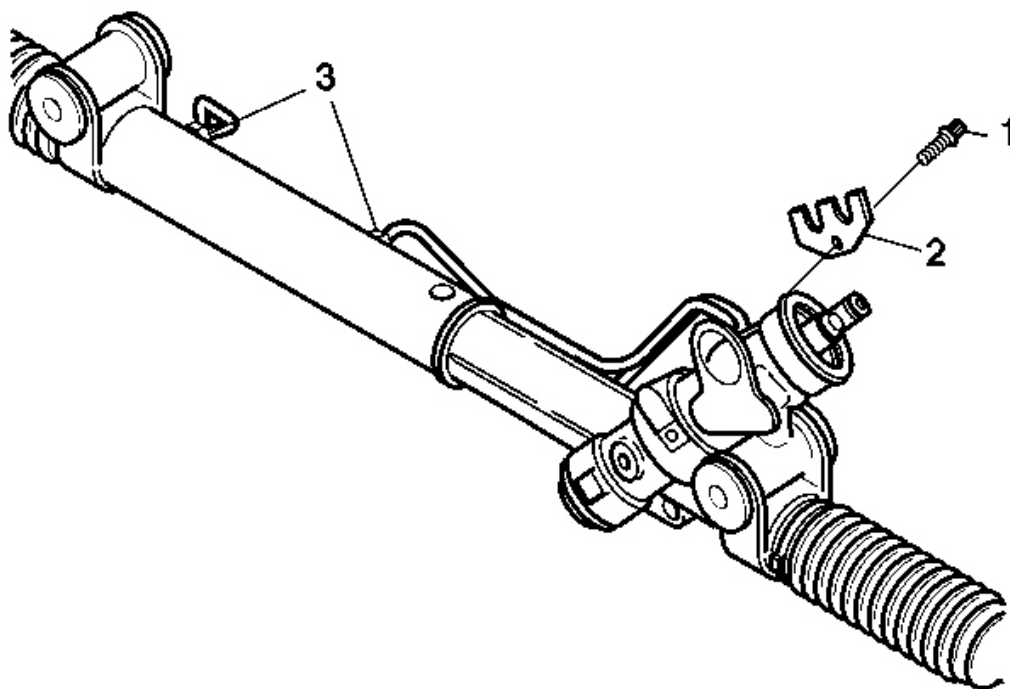
6. Place the larger cylinder line (2) into the valve housing (3).

**IMPORTANT:** Hold the larger cylinder line (2) in place. Do not torque the cylinder line nut (1).

7. Place the other end of the cylinder line at the gear tube end (4).

Finger tighten the cylinder line nut (1) on the larger cylinder line.





**Fig. 111: Installing Cylinder Line Retaining Plate**  
Courtesy of GENERAL MOTORS CORP.

8. Place the cylinder line retaining plate (2) over the cylinder line beads at the valve end.

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

9. Install the TORX® screw (1) into the cylinder line retaining plate (2) and tighten using an E 8 socket.

**Tighten:** Tighten the screw to 15 N.m (12 lb ft).

10. Tighten both cylinder line nuts (3) at the cylinder end.

**Tighten:** Tighten the nuts to 31 N.m (23 lb ft).

## 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 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.

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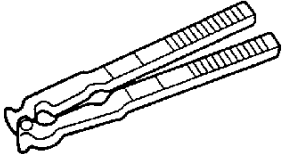
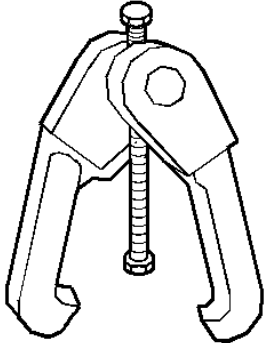
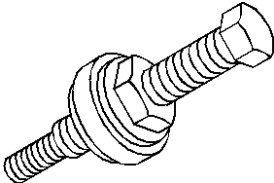
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Turning the steering wheel activates the valve assembly, which applies greater fluid pressure and flow to 1 side of the steering gear piston, and lower pressure and flow to the other side of the piston. The pressure assists the movement of the gear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

### SPECIAL TOOLS AND EQUIPMENT

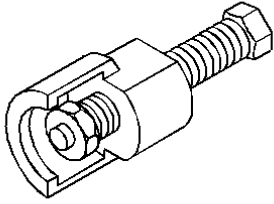
#### SPECIAL TOOLS

##### Special Tools

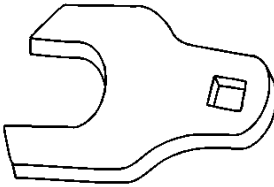
Illustration	Tool Number/ Description
	J 22610 Keystone Clamp Plier
	J 24319-B Steering Linkage and Tie Rod Puller
	J 25033-C Pulley Installer

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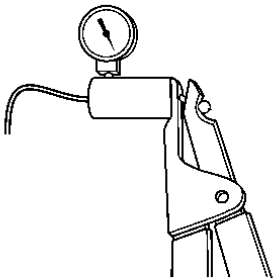
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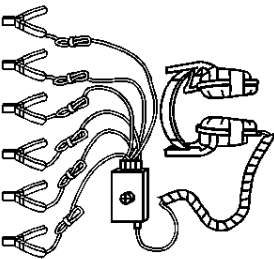
J 25034-C  
Pulley Remover



J 34028  
Inner Tie Rod Wrench



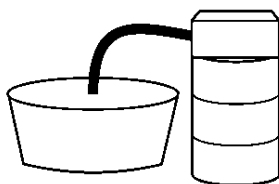
J 35555  
Metal Mityvac



J 39570  
Chassis Ear

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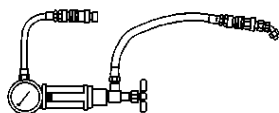
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J 43485  
Power Steering Bleeding Adapter



J 44586  
Power Steering Gear Oil Seal  
Remover/Installer



J 44721  
Power Steering Analyzer