

2010 Cadillac SRX

2010 STEERING Power Steering - SRX

2010 STEERING**Power Steering - SRX****SPECIFICATIONS****FASTENER TIG TENDING SPECIFICATIONS**

Application	Specification	
	Metric	English
Power Steering Fluid Cooler Bracket Bolt	9 N.m	80 lb in
Power Steering Fluid Cooler Inlet and Outlet Hose Bracket Bolt	9 N.m	80 lb in
Power Steering Fluid Reservoir Bolt	9 N.m	80 lb in
Power Steering Fluid Reservoir Bracket Bolt	9 N.m	80 lb in
Power Steering Gear Inlet Hose Bracket Fastener	9 N.m	80 lb in
Power Steering Gear Inlet Hose Fitting	34 N.m	25 lb ft
Power Steering Gear Outlet and Reservoir Inlet Hose Bracket Fastener	9 N.m	80 lb in
Power Steering Gear Outlet Pipe and Hose Bracket Fastener	9 N.m	80 lb in
Power Steering Gear Outlet Pipe and Hose Fitting	34 N.m	25 lb ft
Power Steering Pump Bolt	22 N.m	16 lb ft
Steering Gear Heat Shield Fastener	9 N.m	80 lb in
Steering Gear Nut		
• First Pass	60 N.m	44 lb ft
• Second Pass	120	
Steering Gear Pipe Retainer Fastener	12 N.m	106 lb in
Steering Gear Valve Solenoid Bolt - Lower		
• First Pass	0.5 N.m	4.4 lb in
• Second Pass	2.9 N.m	25.7 lb in
Steering Gear Valve Solenoid Bolt - Upper		
• First Pass	1.5 N.m	13.3 lb in
• Second Pass	2.9 N.m	25.7 lb in
Steering Linkage Inner Tie Rod	70 N.m	52 lb ft
Steering Linkage Outer Tie Rod Nut		
• First Pass	25 N.m	18 lb ft
• Second Pass	90	

POWER STEERING PUMP SPECIFICATIONS

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High Flow		Pressure Relief	
LPM	GPM	kPa	PSI
8.25/9.75	2.18/2.58	11200/12400	1624/1798

ADDITIVES, FLUIDS, Lubricants, AND SEALERS

Application	Type of Material	GM Part Number	
		United States	Canada
Power Steering Fluid	GM Dexron -VI Automatic Transmission Fluid - red in color	88861003	88861004
Power Steering Fluid	GM Power Steering Fluid - amber in color	89020661	89021186

SCHEMATIC AND ROUTING DIAGRAMS

POWER STEERING SCHEMATICS

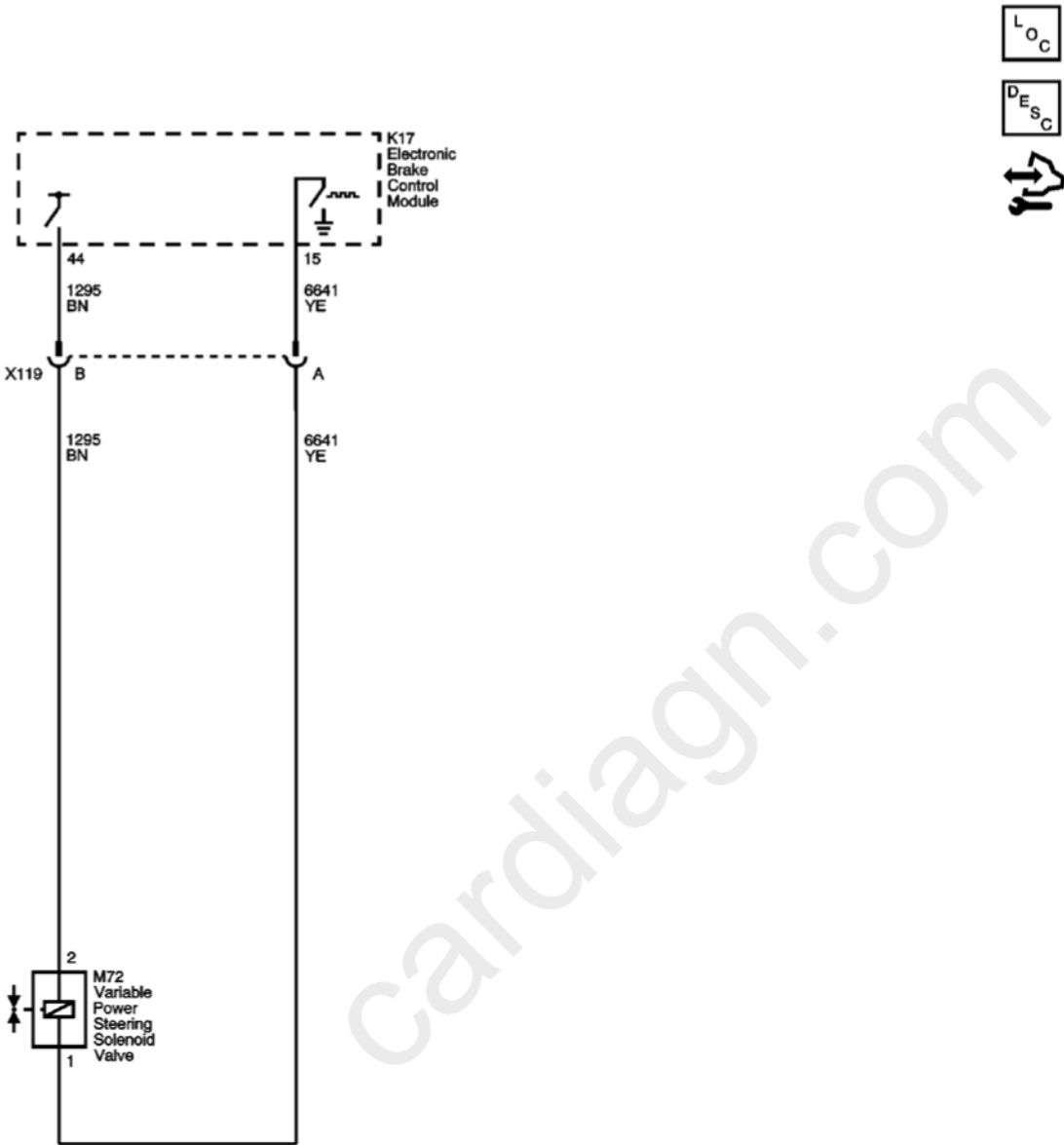


Fig. 1: Power Steering Circuit Schematic
 Courtesy of GENERAL MOTORS CORP.

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDE

DIAGNOSTIC CODE INDE

DTC	Description
DTC C0450	C0450 00: Steering Assist Control Solenoid Valve Circuit Malfunction C0450 04: Steering Assist Control Solenoid Valve Circuit Open C0450 08: Steering Assist Control Solenoid Valve Circuit Performance -

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Signal Invalid
C0450 0B: Steering Assist Control Solenoid Valve Circuit High Current

DTC C0450

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C0450 00

Steering Assist Control Solenoid Valve Circuit Malfunction

DTC C0450 04

Steering Assist Control Solenoid Valve Circuit Open

DTC C0450 08

Steering Assist Control Solenoid Valve Circuit Performance - Signal Invalid

DTC C0450 0B

Steering Assist Control Solenoid Valve Circuit High Current

Diagnostic Fault Information

Circuit	Short to Ground	Open/ igh Resistance	Short to Voltage	Signal Performance
Variable Effort Steering High Control	C0450 00	C0450 04	C0450 00	C0450 08
Variable Effort Steering Low Control	C0450 00	C0450 04	C0450 00	C0450 08

Circuit/System Description

The electronic brake control module (EBCM) controls the current through the variable effort steering actuator located on the steering gear. The current used to control the actuator is between 0-1 A. At low speeds and in parking lot maneuvers the current is applied to the actuator causing the orifice to open increasing fluid flow and reducing the steering effort. At high speeds the orifice is commanded closed by reducing current through the actuator and restricting fluid flow increasing steering effort. The EBCM monitors and compares the commanded and feedback current parameters to detect malfunctions in the variable effort steering system.

Conditions for Running the DTC

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- Ignition ON.
- Ignition voltage is greater than 8 volts.

Conditions for Setting the DTC

A malfunction, open/high resistance, a invalid signal or a high current is detected on the high control or low control circuit.

Action Taken When the DTC Sets

- The driver information center displays SERVICE POWER STEERING SYSTEM.
- The variable effort steering system is disabled for the remainder of the ignition cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present and the DTC is cleared with a scan tool.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Diagnostic Aids

The vehicle may need to be driven to view full actuator commanded and actuator feedback data parameters.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Variable Effort Steering System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References**Circuit/System Testing**

NOTE: It is recommended that Component Testing is performed before Circuit System Testing when diagnosing the actuator because the module will default and does not supply voltage to the sensor when the DTC is set.

1. Ignition OFF, disconnect the harness connector at the M72 Variable Power Steering Solenoid Valve.
2. Ignition ON, verify that a test lamp illuminates between the control circuit terminal A and ground.
 - If the test lamp does not illuminate, test the control circuit for a short to ground or an open/high resistance.
3. Ignition OFF, connect the test lamp between the control circuit terminal A and the control circuit terminal B.
4. Ignition ON, verify the test lamp briefly illuminates for approximately 1 second, then turns OFF.
 - If the test lamp is always ON, test the control circuit terminal B for a short to ground. If the circuit tests normal, replace the K17 Electronic Brake Control Module (EBCM).
 - If the test lamp is always OFF, test the control circuit terminal B for a short to voltage or an open/high resistance. If the circuit tests normal, replace the K17 Electronic Brake Control Module (EBCM).
5. If all circuits test normal, test or replace the M72 Variable Power Steering Solenoid Valve.

Component Testing**Static Test**

1. Ignition OFF, disconnect the harness connector at the M72 Variable Power Steering Solenoid Valve.
2. Test for 2.5-10 ohms between the control terminals A and B.
 - If not within the specified range, replace the M72 Variable Power Steering Solenoid Valve.
3. Test for infinite resistance between each terminal and the M72 Variable Power Steering Solenoid Valve housing/case.
 - If not the specified value, replace the M72 Variable Power Steering Solenoid Valve.

Repair Procedures

Perform the **Diagnostic Repair Verification**

- **Steering Gear Valve Solenoid Replacement**
- **Steering Gear Replacement**
- **Control Module References**

SYMPTOMS - POWER STEERING SYSTEM

NOTE: Review the system description and operation in order to familiarize yourself

with the system functions. Refer to Power Steering System Description and Operation.

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 for leaking power steering components. If necessary, refer to **Power Steering Fluid Leaks**.
- Verify the power steering fluid level per operating specification.
- Inspect the power steering fluid for the following indications of contamination:
 - Milky fluid - water
 - Brown fluid - burnt
 - Debris in fluid - plastic or dirt
- If necessary, flush the power steering system.

Symptoms List

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

- **Power Steering Fluid Leaks**
- **Rattle, Clunk, or Shudder Noise from the Power Steering System**
- **Whine or Growl Noise from the Power Steering System**
- **Steering Effort Too Easy in One or Both Directions**

POWER STEERING SYSTEM TEST

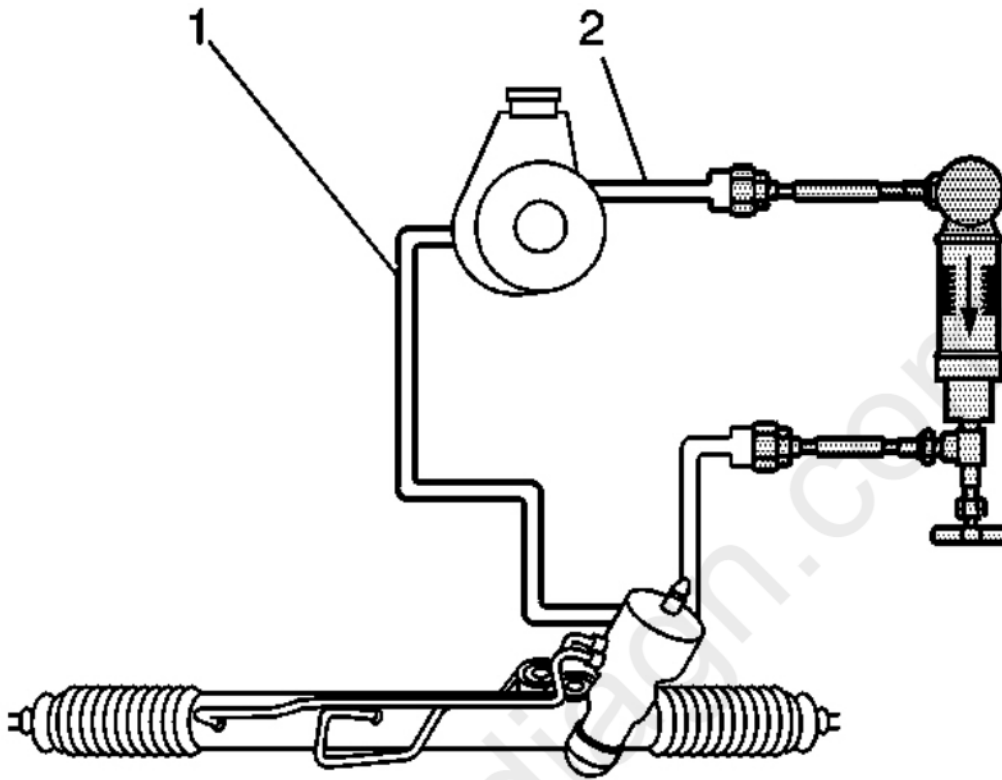


Fig. 2: View of Testing Rack & Pinion System Pressures
Courtesy of GENERAL MOTORS CORP.

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:

- 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.

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

Step	Action	Value(s)	Yes	No
DEFINITION: The Power Steering System Test Procedure will perform the following functions: • Test the operation of the hydraulic power steering system. • Test the operation of the power steering pump and power steering gear. • Identify restrictions in the system.				
1	Inspect the power steering fluid for the following indications of contamination: • Milky fluid - water • Brown fluid - burnt • Debris in fluid - plastic or dirt Is the fluid free of contamination?	-	Go to Step 3	Go to Step 2
2	Flush the power steering system. Refer to <u>Power Steering System Flushing</u> . Did you complete the procedure?	-	Go to Step 3	-
3	NOTE: In order to accurately diagnose the system, the malfunction must be present during the test procedure. Attempt to duplicate the condition. Is the condition present?	-	Go to Step 4	System OK
4	1. Turn the ignition switch to the OFF position. 2. Place a drain pan under the vehicle in order to catch any power steering fluid. 3. Disconnect the power steering pressure pipe/hose from the power steering pump or the power steering gear as necessary. 4. Install the J-44721: Power Steering System Analyzer. 5. Fill the power steering system. Refer to <u>Checking and Adding Power Steering Fluid</u>. Did you complete the installation?	-	Go to Step 5	-
	1. Fully open the J-44721: Power Steering System Analyzer valve.			

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5	2. Start the engine. CAUTION: Do not hold the steering wheel in the full turn position longer than seconds, as damage to the steering pump may result. 3. Turn the steering wheel and BRIEFLY hold the steering wheel against the steering stop in order to release any trapped air from the system. 4. Inspect and ensure that all of the power steering pipe/hose connections are not leaking. 5. Making sure the steering wheel is OFF the steering stop, observe the pressure reading. Is the pressure reading greater than the specified value?	1379 kPa (200 psi)	Go to Step 6	Go to Step 7
6	NOTE: A restriction may be present in the power steering system. Turn OFF the engine IMMEDIATELY. Locate and repair the restriction. Did you complete the repair?	-	Go to Step 15	-
7	1. Allow the engine to run until the engine reaches full operating temperature. 2. Record the pressure reading and flow reading. 3. Partially close the J-44721: Power Steering System Analyzer valve until the system pressure reaches the specified value, then record the FLOW reading. 4. Subtract second flow reading from the first flow reading. Is the flow DECREASE greater than 3.8 L (1 gal) per minute?	4827 kPa (700 psi)	Go to Step 11	Go to Step 8
	NOTE: Do not leave the valve closed for more than seconds, or internal pump damage could accrue. Fully close then open the J-44721: Power			

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8	Steering System analyzer valve 3 times. Record all of the high pressure readings. Refer to <u>Power Steering Pump Specifications</u> for power steering system pressure relief specifications. Are the 3 high pressure readings within specifications?	-	Go to Step 9	Go to Step 13
9	Are the three high pressure readings within 245 kPa (50 psi) of each other?	-	Go to Step 10	Go to Step 13
10	1. Increase the engine speed to approximately 1,500 RPM. 2. Record the flow reading. Refer to <u>Power Steering Pump Specifications</u> for power steering system pressure specifications. Is the actual flow reading within specifications?	-	Go to Step 11	Go to Step 13
11	Is the difference between the actual flow reading and the maximum flow specification more than 3.8 (1 gal) per minute?	-	Go to Step 13	Go to Step 12
12	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 (1 gal) per minute?	-	Go to Step 15	Go to Step 14
13	Replace the power steering pump. Refer to <u>Power Steering Pump Replacement</u> . Did you complete the replacement?	-	Go to Step 15	-
14	The power steering gear is leaking across the piston or bypassing the valve circuit. Replace the power steering gear. Refer to <u>Steering Gear Replacement</u> . Did you complete the replacement?	-	Go to Step 15	-
15	Test the power steering system for the original condition. Does the original condition still exist?	-	Go to Step 5	Go to Step 16
16	1. Disconnect and remove the J-44721: Power Steering System analyzer from the vehicle. 2. Connect the vehicle power steering pipes/hoses. 3. Fill and bleed the power steering system. Refer to <u>Power Steering System Bleeding</u>. Did you complete the procedure?	-	System OK	-

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POWER STEERING FL ID LEAKS

Step	Action	Yes	No
1	Did you review the Power Steering System Description and Operation perform the necessary inspections?	Go to Step 2	Go to Symptoms - Power Steering System
2	Verify that power steering fluid leaks are present. Is the power steering system leaking?	Go to Step 3	System OK
3	Inspect the power steering system fittings. re the fittings leaking?	Go to Step 7	Go to Step 4
4	Inspect the power steering hoses. re the hoses leaking?	Go to Step 8	Go to Step 5
5	Inspect the power steering pump and the reservoir for leaks. Is the power steering pump or reservoir leaking?	Go to Step 9	Go to Step 6
6	Inspect the power steering gear for leaks. Is the power steering gear leaking?	Go to Step 10	Go to Step 8
7	CAUTION: Refer to <u>Fastener Caution</u> . Tighten the fittings. Refer to <u>Fastener Tightening Specifications</u> . Did you complete the repair?	Go to Step 11	-
8	Replace the power steering hoses. Refer to the appropriate procedure(s) • <u>Power Steering Fluid Reservoir Outlet Hose Replacement LA</u> or <u>Power Steering Fluid Reservoir Outlet Hose Replacement LF1</u> • <u>Power Steering Gear Inlet Pipe Hose Replacement LA</u> or <u>Power Steering Gear Inlet Pipe Hose Replacement LF1 LHD</u> • <u>Power Steering Gear Outlet and Fluid Reservoir Inlet Hose Replacement LF1 LHD</u> Did you complete the repair?	Go to Step 11	-
9	Replace the power steering pump, or reservoir. Refer to the appropriate procedure(s) • <u>Power Steering Fluid Reservoir Replacement LA</u> or <u>Power Steering Fluid Reservoir Replacement LF1</u> • <u>Power Steering Pump Replacement</u>		

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	Did you complete the repair?	Go to Step 11	-
10	Replace the power steering gear. Refer to <u>Steering Gear Replacement</u> . Did you complete the repair?	Go to Step 11	-
11	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

RATTLE CL NK OR SH DDER NOISE FROM THE POWER STEERING SYSTEM

Step	Action	Yes	No
1	Did you review the Power Steering System Description and Operation and perform the necessary inspections?	Go to Step 2	Go to <u>Power Steering System Description and Operation</u>
2	Verify that a rattle, clunk or shudder noise is present. Is a rattle, clunk or shudder noise present?	Go to Step 3	System OK
3	Inspect the power steering hoses for proper routing and clearance. Is the routing or clearance of the power steering hoses incorrect?	Go to Step 11	Go to Step 4
4	Inspect the engine drive belt for cracking or excessive wear. Refer to <u>Drive Belt Replacement</u> . Is the drive belt cracked or excessively worn?	Go to Step 12	Go to Step 5
5	Inspect the power steering pump pulley for damage. Is the power steering pump pulley damaged?	Go to Step 13	Go to Step 6
6	Inspect the power steering pump for the proper installation. Refer to <u>Power Steering Pump Replacement</u> . Is the power steering pump installation incorrect?	Go to Step 14	Go to Step 7
7	Inspect the power steering gear for the proper installation. Refer to <u>Steering Gear Replacement</u> . Is the power steering gear installation incorrect?	Go to Step 15	Go to Step 8
8	Inspect for looseness in the inner and outer tie rod ends. Did you find looseness in the tie rod ends?	Go to Step 16	Go to Step 9
9	Inspect the suspension. Is the suspension worn?	Go to Step 17	Go to Step 10
10	Inspect the intermediate shaft. Is the intermediate shaft worn?	Go to Step 18	Go to Step 3
	Adjust or replace the hoses. Refer to the appropriate procedure(s) • <u>Power Steering Fluid Reservoir Outlet Hose Replacement LA</u> or <u>Power Steering Fluid Reservoir Outlet Hose Replacement LF1</u>		

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11	• <u>Power Steering Gear Inlet Pipe Hose Replacement LA</u> or <u>Power Steering Gear Inlet Pipe Hose Replacement LF1 LHD</u> • <u>Power Steering Gear Outlet and Fluid Reservoir Inlet Hose Replacement LF1 LHD</u>		
	Did you complete the repair?	Go to Step 19	-
12	Replace the engine drive belt. Refer to <u>Drive Belt Replacement</u> .		
	Did you complete the repair?	Go to Step 19	-
13	Replace the power steering pump pulley. Refer to <u>Power Steering Pump Pulley Replacement</u> .		
	Did you complete the repair?	Go to Step 19	-
14	Install the power steering pump correctly. Refer to <u>Power Steering Pump Replacement</u> .		
	Did you complete the repair?	Go to Step 19	-
15	Install the power steering gear correctly. Refer to <u>Steering Gear Replacement</u> .		
	Did you complete the repair?	Go to Step 19	-
16	Replace the tie rod. Refer to <u>Steering Linkage Inner Tie Rod Replacement</u> or <u>Power Steering Fluid Reservoir Outlet Hose Replacement LA</u> or <u>Power Steering Fluid Reservoir Outlet Hose Replacement LF1</u> .		
	Did you complete the repair?	Go to Step 19	-
17	Replace the worn suspension components.		
	Did you complete the repair?	Go to Step 19	-
18	Replace the intermediate shaft. Refer to <u>Intermediate Steering Shaft Replacement</u> .		
	Did you complete the repair?	Go to Step 19	-
19	Operate the system in order to verify the repair.		
	Did you correct the condition?	System OK	Go to Step 3

WHINE OR GROWL NOISE FROM THE POWER STEERING SYSTEM

Step	Action	Yes	No
1	Did you review the Power Steering System Description and Operation and perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Power Steering System</u>
2	Verify that a whine or growl noise is present. Is a whine or growl noise present?	Go to Step 3	System OK
	Inspect the power steering fluid for the following indications of contamination		

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3	• ilky fluid - water • rown Fluid - burnt • Debris in fluid - plastic or dirt		
	Is the fluid free of contamination?	Go to Step 5	Go to Step 4
4	Flush the power steering system. Refer to <u>Power Steering System Flushing</u> . Did you complete the procedure?	Go to Step 11	Go to Step 5
5	Using the J-39570: hassis Ear, inspect the power steering gear for a whine or growl noise. Is the noise present at the power steering gear?	Go to Step 8	Go to Step 6
6	Using the J-39570: hassis Ear, inspect the power steering pump for a whine or growl noise. Is the noise present at the power steering pump?	Go to Step 9	Go to Step 7
7	Using the J-39570: hassis Ear, inspect the power steering hoses for a whine or growl noise. Is the noise present at the power steering hoses?	Go to Step 10	Go to Step 2
8	Replace the power steering gear. Refer to <u>Steering Gear Replacement</u> . Did you complete the repair?	Go to Step 11	-
9	Replace the power steering pump. Refer to <u>Power Steering Pump Replacement</u> . Did you complete the repair?	Go to Step 11	-
10	Adjust the routing of the power steering hoses. Did you complete the repair?	Go to Step 11	-
11	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

POOR RETURN OF STEERING WHEEL

Step	Action	Yes	No
DEFINITION After completing a turn, extra steering input is required for the steering wheel to return to center.			
1	Did you review the Power Steering System Description and Operation and perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Power Steering System</u>
2	Verify that poor return of the steering wheel is present. Does the system operate normally?	System OK	Go to Step 3
3	1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u>. 2. Lubricate the tie rod ends and ball joints, if applicable. 3. Inspect the suspension system for worn or		

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	damaged components. 4. Repair as necessary. Did you find and correct the condition?	Go to Step 12	Go to Step 4
4	1. Rotate the steering wheel ONE revolution in both directions. 2. Rotate the steering wheel back to the original position. Was the steering wheel abnormally difficult to rotate in either direction?	Go to Step 5	Go to Step 10
5	NOTE: Position the wheels straight ahead. Do NOT rotate the steering wheel more than one complete revolution from center. 1. Disconnect the intermediate shaft from the steering column. 2. Note the position of the steering wheel and rotate the steering wheel ONE revolution in both directions. 3. Rotate the steering wheel back to the original position. Was the steering wheel abnormally difficult to rotate in either direction?	Go to Step 11	Go to Step 6
6	Inspect the intermediate shaft for stiff or loose joints. Repair or replace as necessary. Did you find and complete the repair?	Go to Step 12	Go to Step 7
7	1. Remove the front tire and wheel assemblies. Refer to <u>Tire and Wheel Removal and Installation</u> . 2. Disconnect both outer tie rod ends from the steering knuckles. 3. Use your hands in order to move the tie rod end studs. 4. If abnormally difficult to move, replace the tie rod end. If equipped with recirculating ball steering, ensure that idler and pitman arm joints are not to stiff. Repair as necessary. Did you find and complete the repair?	Go to Step 12	Go to Step 8
	1. Use your hands to rotate the steering knuckle inboard and outboard in order to inspect for a		

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8	binding strut bearings, ball joints, or axle. 2. Repair or replace any abnormally stiff or loose components. Did you find and complete the repair?	Go to Step 12	Go to Step 9
9	Inspect for binding in the steering gear. If a binding is present, repair or replace the steering gear. Did you find and complete the repair?	Go to Step 12	Go to Step 10
10	Inspect the wheel alignment and adjust as necessary. Refer to <u>Wheel Alignment Measurement</u> . Did you find and complete the repair?	Go to Step 12	-
11	Inspect the steering column for a binding. If a binding is present, repair or replace the steering column as necessary. Did you find and complete the repair?	Go to Step 12	-
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	-

STEERING EFFORT TOO EASY IN ONE OR BOTH DIRECTIONS

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

STEERING EFFORT HARD IN ONE OR BOTH DIRECTIONS

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

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Operate the system in order to verify the repair.
Did you correct the condition?

System OK

Go to **Step 3**

REPAIR INSTRUCTIONS

STEERING LINKAGE INNER TIE ROD INSPECTION

Special Tools

J-8001: Dial Indicator Set

For equivalent regional tools, refer to **Special Tools**.

Inspection Procedure

NOTE: This inspection procedure does not supersede local government required inspections that have more stringent requirements.

1. Turn the ignition key to the ON position with the engine OFF.
2. With the aid of an assistant, turn the steering wheel to the full stop position and hold the steering wheel in that position until the test is complete. The tie rod being tested should be inside the steering gear housing seated against the steering stop.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**.
4. If there is not a good location for the **J-8001:** Dial Indicator pointer at the steering gear housing, install a large worm gear hose clamp to the steering gear housing over the larger steering gear boot clamp and align the clamp so that the screw can be a location for the **J-8001:** Dial Indicator pointer.

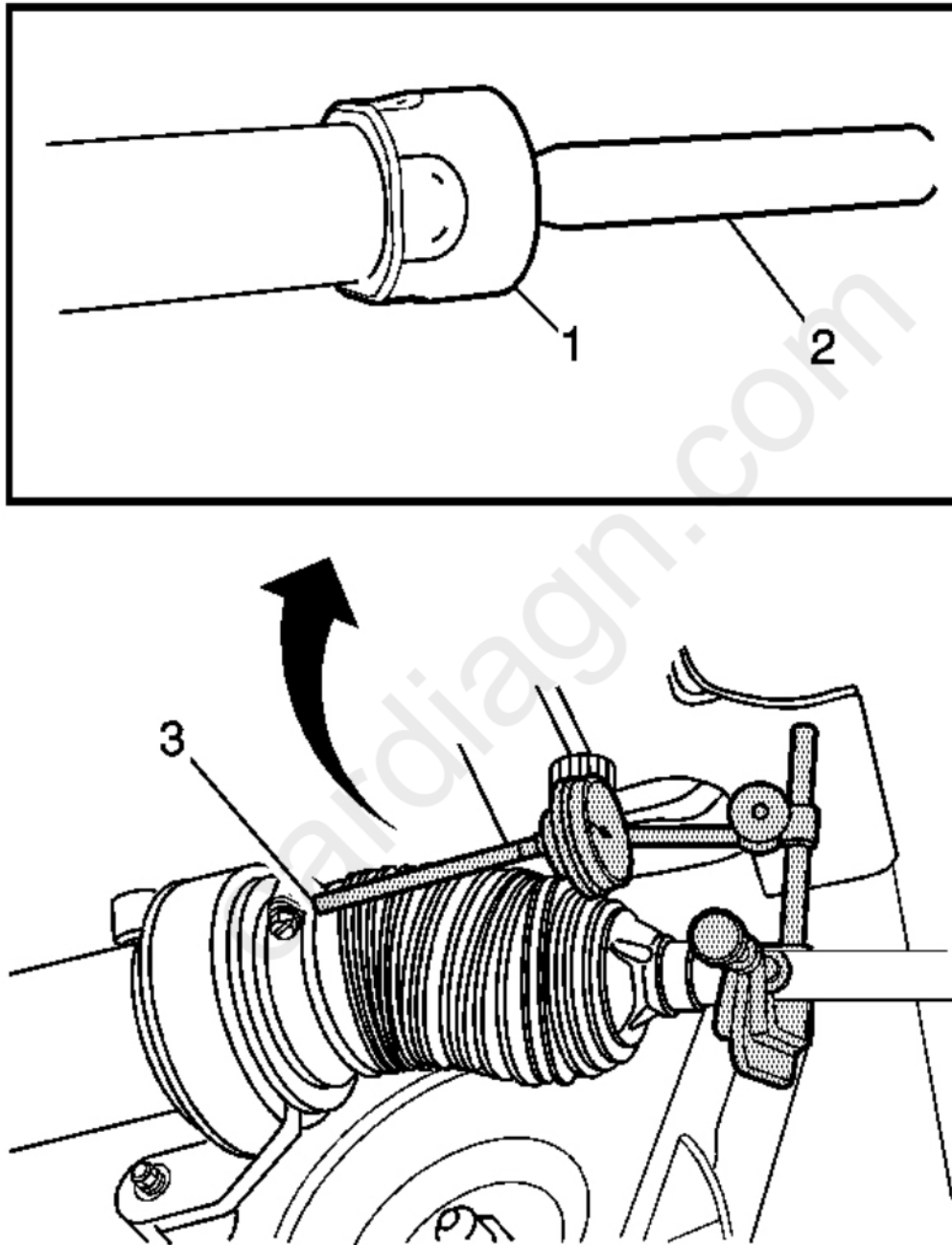


Fig. 3: Measuring Lash Between Inner Tie Rod & Steering Gear Housing
Courtesy of GENERAL MOTORS CORP.

5. Install the **J-8001: Dial Indicator** between the inner tie rod (2) and the steering gear housing or the worm

gear clamp in such a way as to measure the lash between the inner tie rod and the steering gear housing.

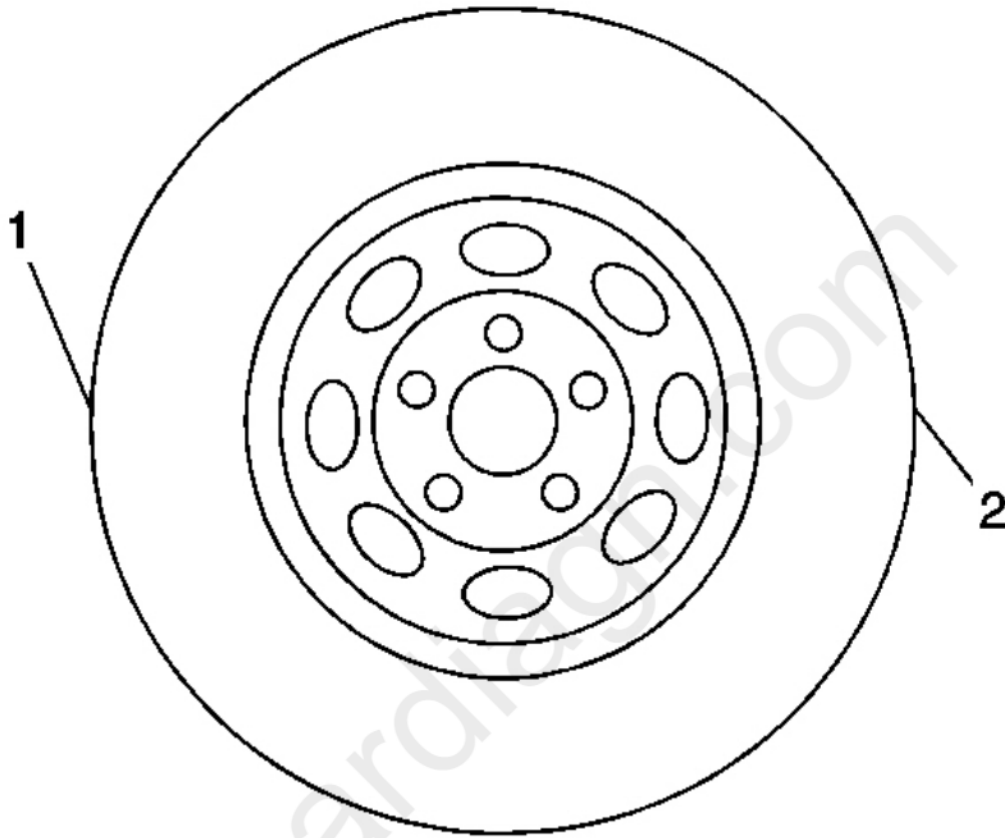


Fig. 4: Identifying Grasping Positions
Courtesy of GENERAL MOTORS CORP.

NOTE: Only move the tire enough to feel any lash between the inner tie rod and the inner tie rod housing without moving the steering gear rack.

6. Grasping the tire at the 3 o'clock (2) and 9 o'clock (1) positions, gently push in on one side of the tire in order to remove any lash.
7. Zero the **J-8001: Dial Indicator**.
8. On the same side of the tire previously pushed in, gently pull out and measure the lash.
9. Record the measurement seen on the **J-8001: Dial Indicator**.
10. If the measured value exceeds 0.5 mm (0.02 in), replace the inner tie rod. Refer to **Steering Linkage Inner Tie Rod Replacement**.

11. Repeat the procedure for the other side.

STEERING LINKAGE OUTER TIE ROD INSPECTION

Special Tools

J-8001: Dial Indicator Set

For equivalent regional tools, refer to **Special Tools**.

Inspection Procedure

NOTE: This inspection procedure does not supersede local government required inspections that have more stringent requirements.

1. Inspect the outer tie rod end seal. If the outer tie rod end seal is torn, replace the outer tie rod end. Refer to **Steering Linkage Outer Tie Rod Replacement**.
2. Raise the side of the vehicle being inspected with a floor jack while maintaining contact between the opposite wheel and the shop floor. Support the lower control arm with a floor jack stand as far outboard as possible and remove the floor jack. Refer to **Lifting and Jacking the Vehicle**.

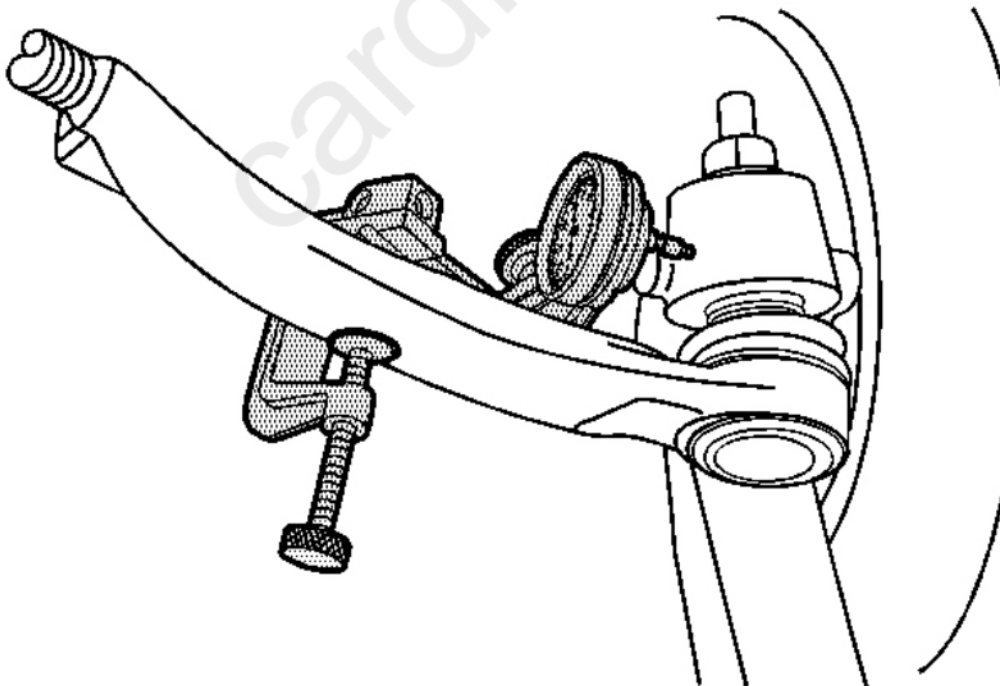


Fig. 5: Measuring Outer Tie Rod Lash
Courtesy of GENERAL MOTORS CORP.

3. Install the **J-8001: Dial Indicator** between the outer tie rod end and the steering knuckle as shown in the graphic. Note that the tire and wheel assembly is shown removed only for clarification of the **J-8001: Dial Indicator** position.

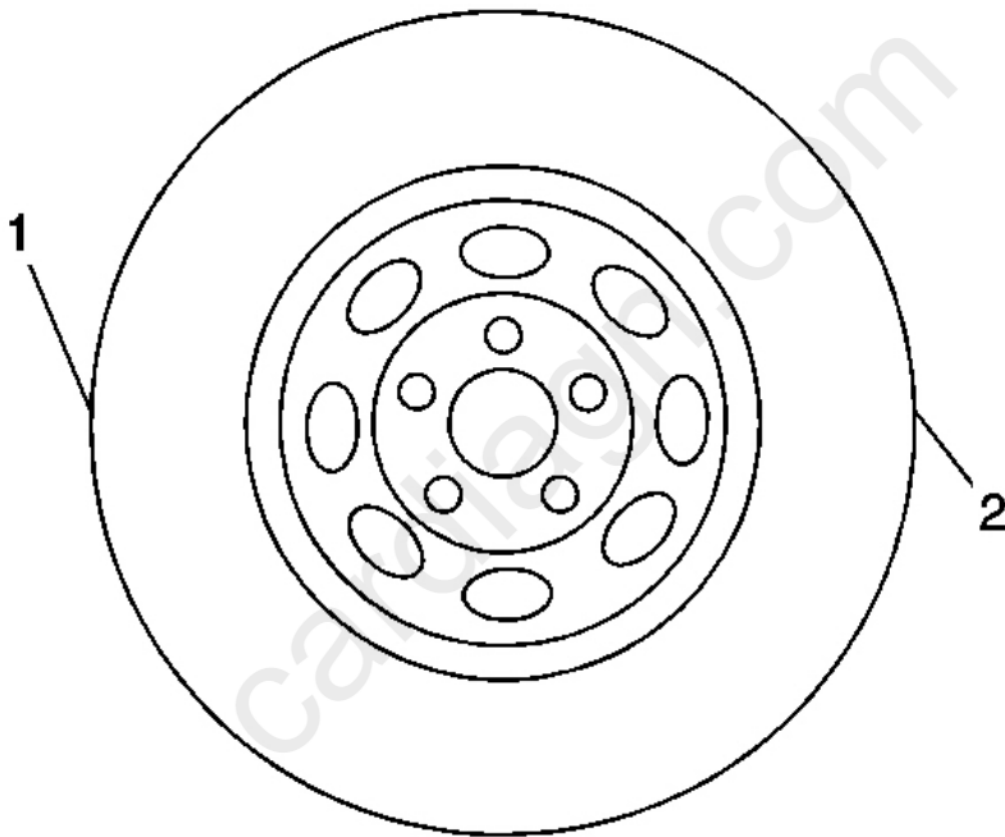


Fig. : Identifying Grasping Positions
Courtesy of GENERAL MOTORS CORP.

4. Grasping the tire at the 3 o'clock (2) and 9 o'clock (1) positions, gently push in on one side of the tire to remove any lash.
5. Insert the **J-8001: Dial Indicator**.
6. On the same side of the tire previously pushed inwards, gently pull outwards and measure the lash.
 - Record the measurement seen on the **J-8001: Dial Indicator**.
8. If the measured value exceeds 0.5 mm (0.02 in) then replace the outer tie rod. Refer to **Steering Linkage**

Outer Tie Rod Replacement.

9. Repeat the procedure for the other side.

POWER STEERING SYSTEM BLEEDING**NOTE:**

- Use clean, new power steering fluid only. Refer to **Adhesives, Fluids, Lubricants, and Sealers.**
- Hoses touching the frame, body or engine may cause system noise. Ensure the hoses do not touch any other part of the vehicle.
- Loose connections may not leak, but could allow air into the steering system. Ensure all hose connections are tight.
- Maintain the power steering fluid level throughout the bleeding procedure.

1. Fill the power steering fluid reservoir with fluid to the minimum system level, the FULL level, or the middle of the hash mark on the cap stick fluid level indicator, as applicable.
2. Raise the vehicle until the front wheels are off the ground. Refer to **Lifting and Jacking the Vehicle**.
3. With the key in the ON position and with the engine OFF, turn the steering wheel from stop to stop 12 times.

If the vehicle is equipped with longer length power steering hoses, turn the steering wheel from stop to stop 15 to 20 times.

4. Verify the power steering fluid level. Refer to **Checking and Adding Power Steering Fluid.**
5. Start the engine. Rotate the steering wheel from left to right. Inspect the power steering system for signs of cavitation or fluid aeration, like pump noise or whining.
6. Verify the fluid level. Repeat the bleed procedure, if necessary.
7. Lower the vehicle.

CHECKING AND ADDING POWER STEERING FLUID

1. Run the engine until the power steering fluid reaches about 80 °C (180 °F).
2. Turn the engine OFF.
3. If equipped with the F1 engine, remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
4. Clean the power steering fluid reservoir and the reservoir cap.
5. Remove the reservoir cap.

NOTE: Inspect the power steering pump fluid level at regular intervals.

6. Inspect the power steering fluid level on the cap stick. Ensure that the fluid level is at the FULL mark on the cap stick.

CAUTION: 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.

NOTE: If the power steering fluid color is red or pink, use GM DEXRON®-VI Automatic Transmission Fluid. If the power steering fluid color is amber or brown, use GM Power Steering Fluid.

- Add the proper fluid to the reservoir, if necessary. Refer to Adhesives Fluids Lubricants and Sealers.
- 8. Install the reservoir cap.
- 9. If equipped with the F1 engine, install the intake manifold cover. Refer to Intake Manifold Cover Replacement.

POWER STEERING SYSTEM FLUSHING

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

- 1. Raise the vehicle until the front wheels are off the ground. Refer to Lifting and Jacking the Vehicle.
- 2. Place a large drain pan under the vehicle in order to collect the draining fluid.
- 3. Remove the fluid return hose at the power steering fluid reservoir or the pump inlet connection, as applicable.
- 4. Plug the reservoir return hose inlet connection on the power steering fluid reservoir or the pump, as applicable.

NOTE: This step may require 4 L (4 qt) of power steering fluid until the draining fluid appears clear.

- 5. Have an assistant maintain the minimum fluid level in the reservoir using clean, new power steering fluid. Refer to Checking and Adding Power Steering Fluid.
- 6. With the key in the ON position and with the engine OFF, turn the steering wheel fully to the left and to the right. Continue until the fluid from the return hose runs clear.
 - Remove the plug and install the fluid return hose to the power steering fluid reservoir or the pump inlet connection, as applicable.
- 8. Bleed the power steering system. Refer to Power Steering System Bleeding.
- 9. Inspect the power steering fluid for the following indications of contamination:
 - Milky fluid - water
 - Brown fluid - burnt
 - Plastic debris or dirt chunks
- 10. If the fluid is contaminated, repeat steps 3-9.
- 11. Remove the drain pan.
- 12. Lower the vehicle.

POWER STEERING FLUID RESERVOIR REPLACEMENT (LAU)

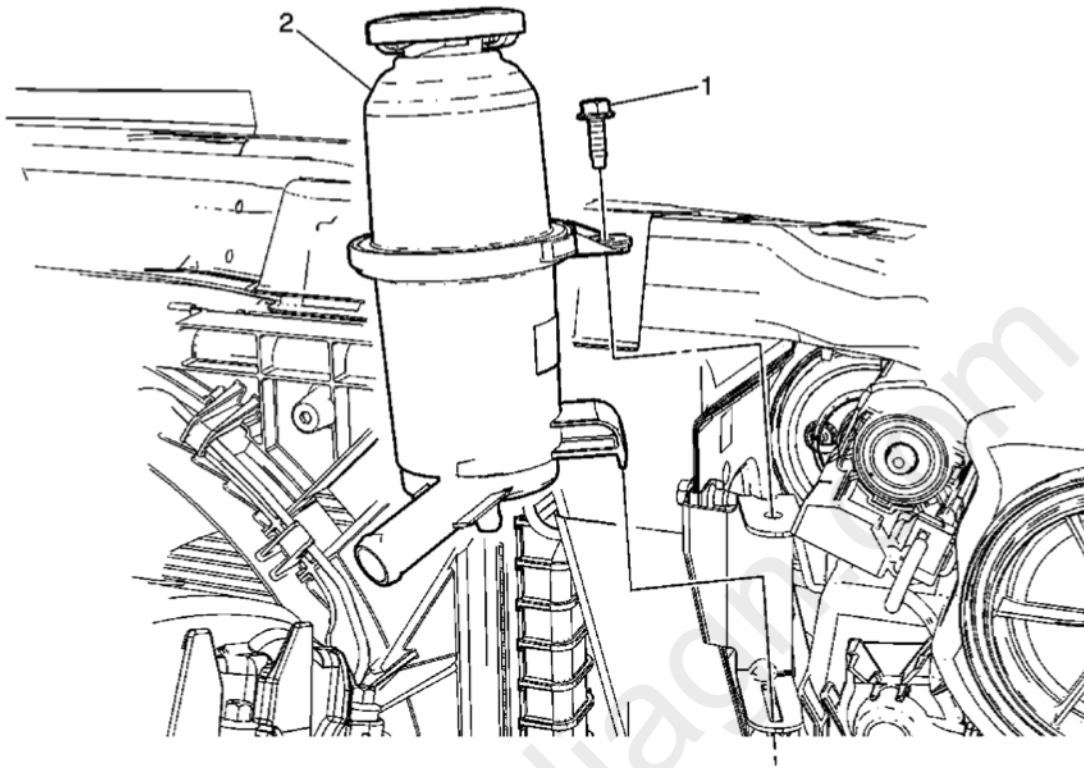


Fig. : View Of Power Steering Fluid Reservoir (LAU)
 Courtesy of GENERAL MOTORS CORP.

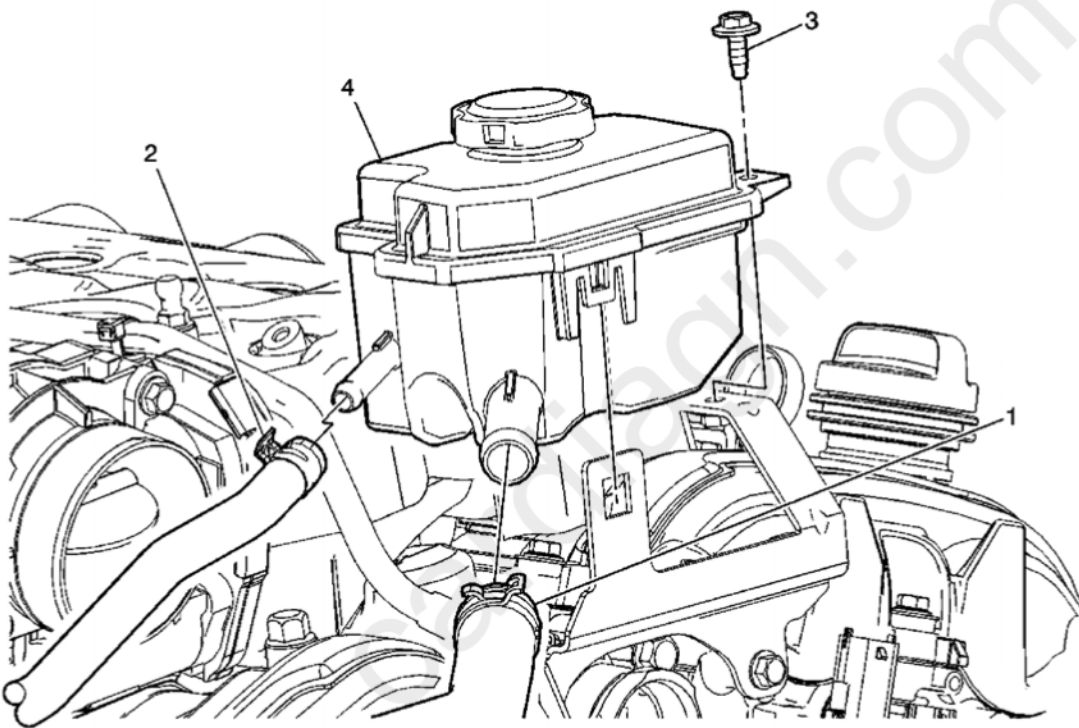
Callout	Component Name
Preliminary Procedure 1. Remove the air cleaner assembly. Refer to <u>Air Cleaner Assembly Replacement (LF1)</u> or <u>Air Cleaner Assembly Replacement (LAU)</u>. 2. Place drain pans under the vehicle. 3. Remove as much power steering fluid from the reservoir as possible. 4. Disconnect the power steering fluid reservoir inlet hose from the reservoir. Refer to <u>Power Steering Fluid Reservoir Inlet Hose Replacement (LAU)</u>. 5. Disconnect the power steering fluid reservoir outlet hose from the reservoir. Refer to <u>Power Steering Fluid Reservoir Outlet Hose Replacement (LAU)</u>.	
1	Power Steering Fluid Reservoir Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten: 9 N.m (80 lb in)

Power Steering Fluid Reservoir

Procedure

2

1. Disconnect the power steering fluid reservoir from the reservoir bracket.
2. Fill and bleed the power steering system. Refer to **Power Steering System Bleeding**.
3. Clean any excess power steering fluid from the vehicle.

POWER STEERING FLUID RESERVOIR REPLACEMENT (LF1)**Fig. 8: View Of Power Steering Fluid Reservoir (LF1)**

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure	
1. Remove the intake manifold cover. Refer to <u>Intake Manifold Cover Replacement</u> 2. Remove the power steering fluid from the reservoir. 3. Place a drain pan under the vehicle.	
1	Power Steering Reservoir Outlet Hose
2	Power Steering Gear Outlet Hose
	Bolt

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3	CAUTION: Refer to Fastener Caution . Tighten: 9 N.m (80 lb in) Power Steering Reservoir
4	Procedure 1. Use a flat bladed tool to disengage the reservoir from the reservoir bracket. 2. Fill and bleed the power steering system. Refer to Power Steering System Bleeding

POWER STEERING FLUID RESERVOIR BRACKET REPLACEMENT (LF1)

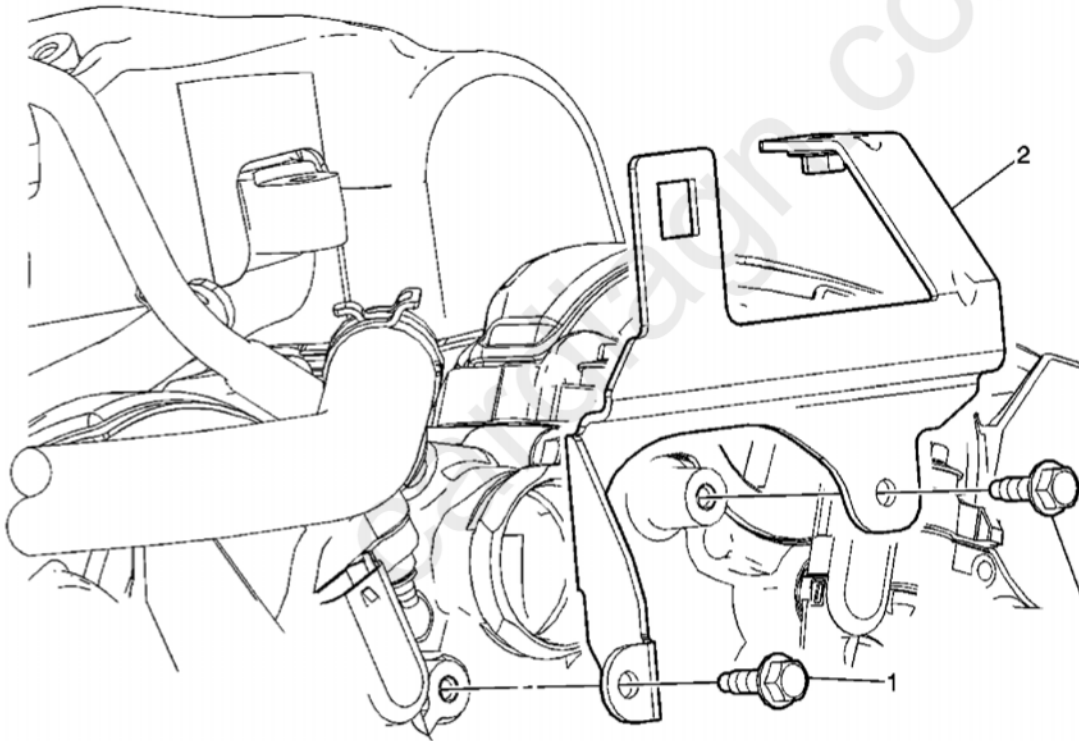


Fig. 9: Identifying Power Steering Fluid Reservoir Bracket (LF1)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure	
1. Remove the intake manifold cover. Refer to Intake Manifold Cover Replacement	
2. Remove the power steering Reservoir from the bracket only. Do not remove the hoses. Refer to Power Steering Fluid Reservoir Replacement (LF1) .	
	Bolt (Qty: 2)

1	CAUTION: Refer to Fastener Caution . Tighten: 9 N.m (80 lb in)
2	Power Steering Reservoir Bracket

POWER STEERING PUMP PULLEY REPLACEMENT

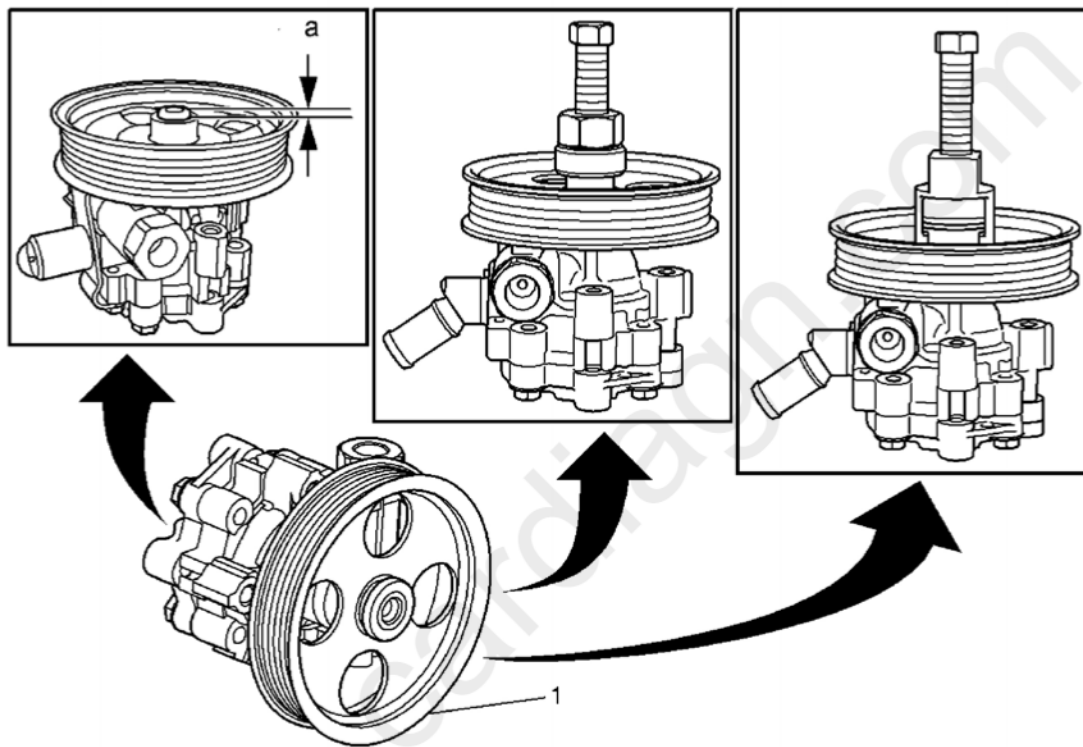


Fig. 10: Identifying Power Steering Pump Pulley
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure:	
Remove the power steering pump. Refer to Power Steering Pump Replacement .	
Power Steering Pump Pulley	
Procedure	
1. Use the J-25034-C: remover in order to remove the power steering pump pulley. 2. Use the J-25033-C: installer in order to install the power steering pump pulley. 3. Ensure the axial tolerance (a) of the power steering pump pulley on the power steering pump shaft is within 0.25 mm (0.010 in).	

Special Tools

1

- **J-25033-C:** Pulley Installer
- **J-25034-C:** Pulley Remover

For equivalent regional tools, refer to **Special Tools**.

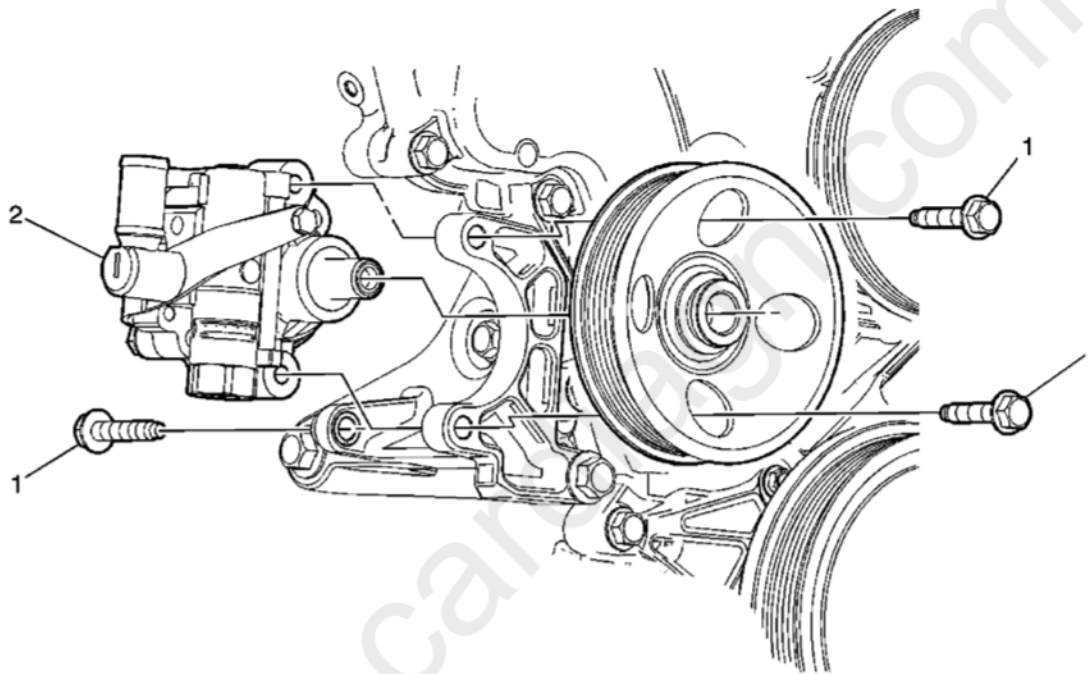
POWER STEERING PUMP REPLACEMENT

Fig. 11: View Of Power Steering Pump & Bolts
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure	
1.	Place drain pans under the vehicle.
2.	Remove as much power steering fluid from the power steering fluid reservoir as possible.
3.	Remove the drive belt from the power steering pump pulley only. Refer to <u>Drive Belt Replacement</u> .
4.	Remove the right front tire and wheel assembly. Refer to <u>Tire and Wheel Removal and Installation</u> .
5.	Disconnect the power steering fluid reservoir outlet hose from the power steering pump. Refer to <u>Power Steering Fluid Reservoir Outlet Hose Replacement (LAU)</u> or <u>Power Steering Fluid</u>

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Reservoir Outlet Hose Replacement (LF1).

6. Disconnect the power steering gear inlet hose from the power steering pump. Refer to **Power Steering Gear Inlet Pipe/Hose Replacement (LAU)** or **Power Steering Gear Inlet Pipe/Hose Replacement (LF1 LHD)**.

1	Power Steering Pump Bolt (Qty: 3) CAUTION: Refer to <u>Fastener Caution</u> . Tip: Note the routing for installation. Tighten: 22 N.m (16 lb ft)
2	Power Steering Pump Procedure 1. Remove the power steering pump through the right front wheel well opening. 2. Transfer the power steering pump pulley. Refer to <u>Power Steering Pump Pulley Replacement</u>. 3. Fill and bleed the power steering system. Refer to <u>Power Steering System Bleeding</u>. 4. Clean any excess power steering fluid from the vehicle.

STEERING LINKAGE OUTER TIE ROD REPLACEMENT

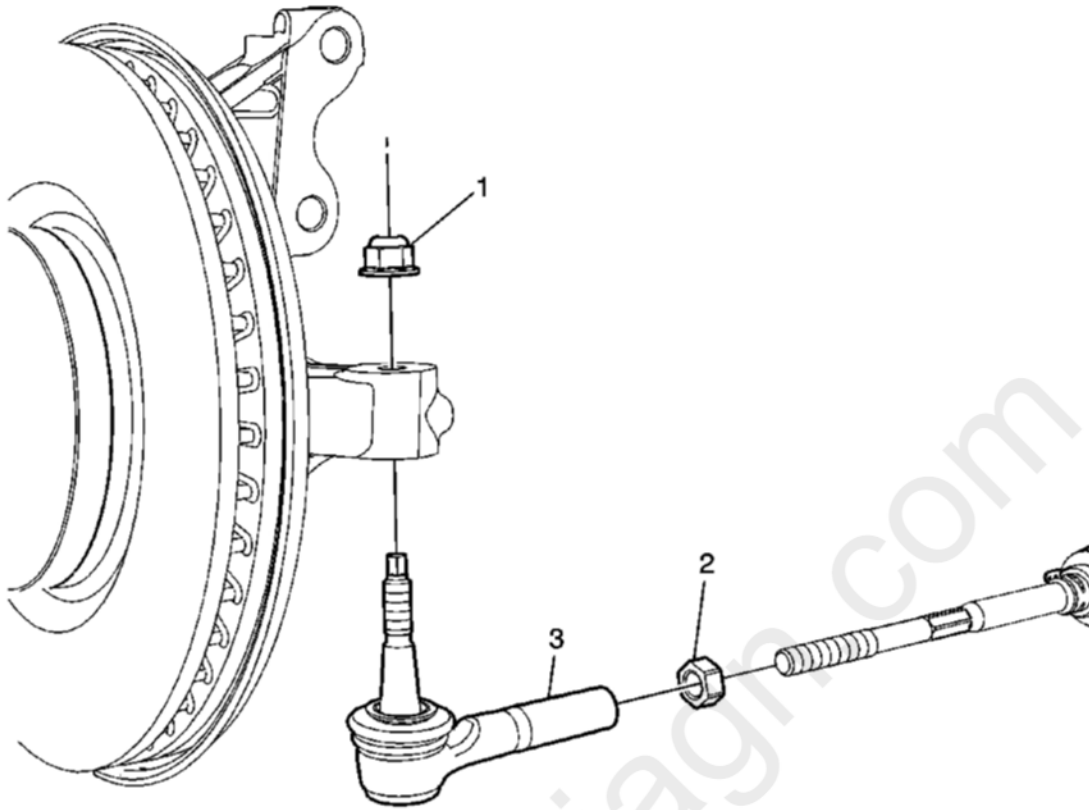


Fig. 1 : View Of Steering Linkage Outer Tie Rod
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Remove the front tire and wheel assembly. Refer to <u>Tire and Wheel Removal and Installation</u> .	
1	Steering Linkage Outer Tie Rod Nut CAUTION: Refer to <u>Fastener Caution</u> . Tighten: 1. 25 N.m (18 lb ft) 2. 90 degrees
2	Steering Linkage Inner Tie Rod Nut Procedure 1. Use paint in order to place match marks on the steering linkage inner tie rod nut and on the steering linkage inner tie rod.

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	2. During installation, align the match marks. 3. Do not tighten the nut during installation. Tighten the nut after adjusting the front toe. Refer to <u>Wheel Alignment Steering Wheel Angle and or Front Toe Adjustment</u>.
3	Steering linkage Outer Tie Rod CAUTION: Do not free the ball stud by using a pickle fork or a wedge-type tool. Damage to the seal or bushing may result. Procedure 1. Use the 19 B: puller in order to separate the steering linkage outer tie rod from the steering knuckle. 2. Inspect the steering linkage inner tie rod for bent or damaged threads. 3. Clean the tapered surface of the steering knuckle. 4. Measure and adjust the front toe. Refer to <u>Wheel Alignment Steering Wheel Angle and or Front Toe Adjustment</u>. Special Tools: 19 B: Steering linkage and Tie Rod Puller For equivalent regional tools, refer to <u>Special Tools</u>.

STEERING GEAR BOOT REPLACEMENT

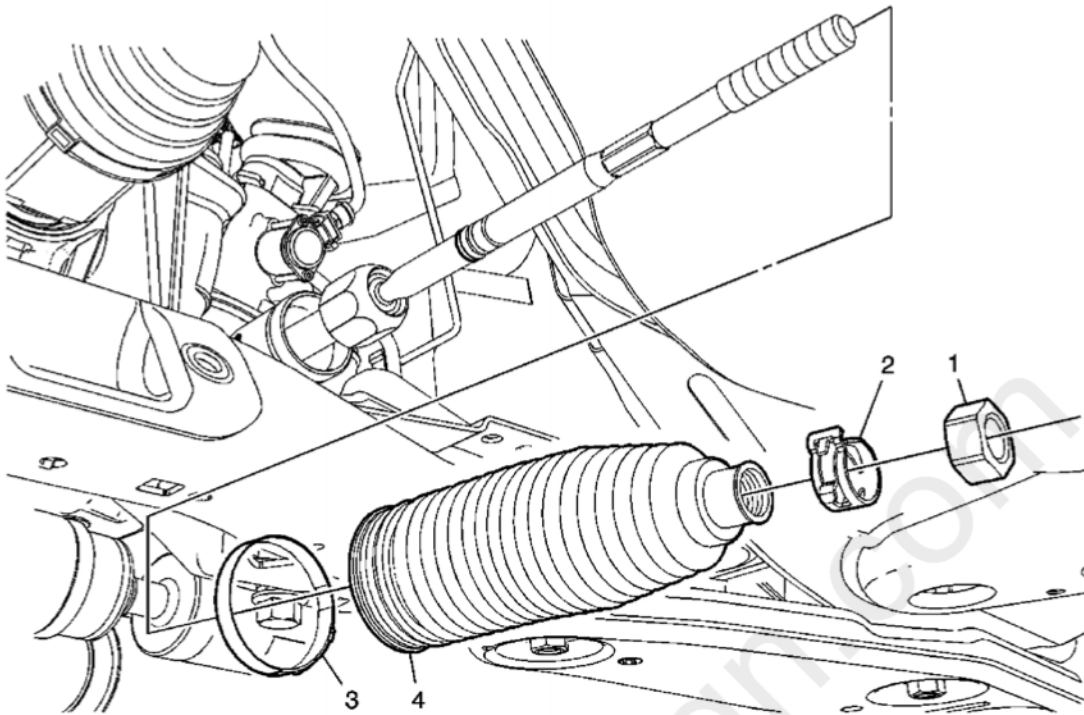


Fig. 1 : Identifying Steering Gear Boot
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures	
1. Remove the steering linkage outer tie rod. Refer to <u>Steering Linkage Outer Tie Rod Replacement</u> . 2. If equipped, remove the steering gear heat shield. Refer to <u>Steering Gear Heat Shield Replacement</u> .	
1	Steering Linkage Inner Tie Rod Nut
2	Steering Gear Boot Outer Clamp
3	Steering Gear Boot Inner Clamp
Procedure	
1. Cut the old steering gear boot inner clamp. Discard the clamp.	
2. Use the 61 : pliers in order to crimp the new steering gear inner boot clamp.	
Special Tools:	

	61 : Keystone lamp Pliers For equivalent regional tools, refer to <u>Special Tools</u> .
4	Steering Gear oot Procedure 1. fter removing the boot, inspect the inner tie rod for evidence of corrosion or contamination. If none is evident, continue with the repair. If corrosion or contamination is evident, replace the steering gear. Refer to <u>Steering Gear Replacement</u> . 2. Ensure the new steering gear boot is seated in the assembly groove of the steering gear.

FL I COOLER INLET AN O TLET HOSE REPLACEMENT

Remo al Procedure

1. Place drain pans under the vehicle.
2. Remove as much power steering fluid from the reservoir as possible.
3. Remove the right front wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement** .
4. Remove the front bumper fascia. Refer to **Front Bumper Fascia Replacement** .

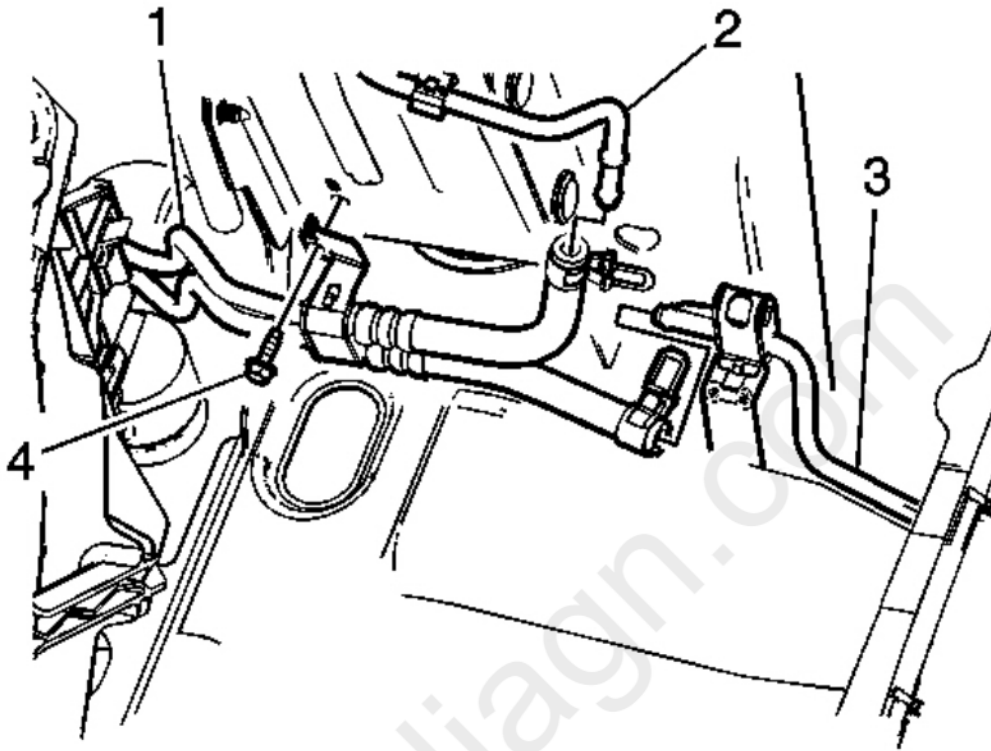


Fig. 1 : Identifying Power Steering Fluid Cooler Inlet & Outlet Hose Bracket
Courtesy of GENERAL MOTORS CORP.

5. Remove the bolt (4) from the power steering fluid cooler inlet and outlet hose bracket.
6. Disconnect the power steering fluid cooler inlet and outlet hose bracket from the body.
7. Compress the hose clamp and disconnect the power steering fluid cooler outlet hose (1) from the power steering fluid reservoir inlet pipe (2).
8. Compress the hose clamp and disconnect the power steering fluid cooler inlet hose from the power steering gear outlet pipe (3).

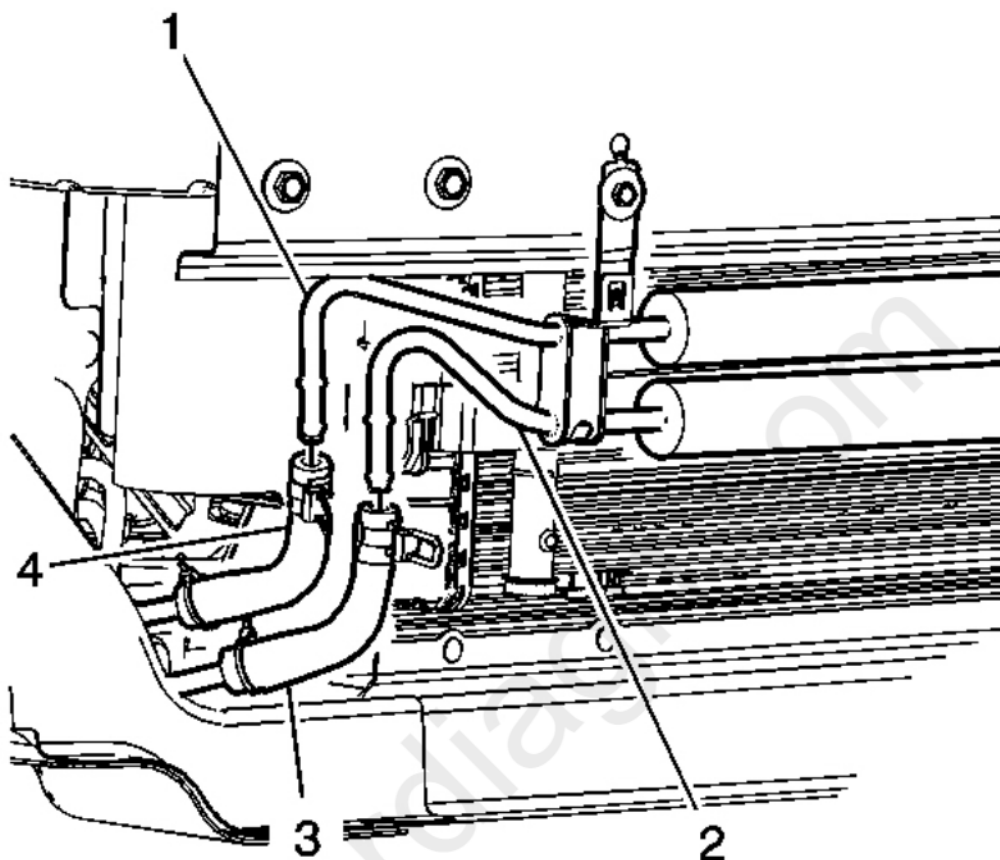


Fig. 15: Locating Fluid Cooler Inlet Hose Power Steering Fluid Cooler Inlet Pipe
Courtesy of GENERAL MOTORS CORP.

9. Compress the hose clamp and disconnect the power steering fluid cooler inlet hose (3) from the power steering fluid cooler inlet pipe (2).
10. Compress the hose clamp and disconnect the power steering fluid cooler outlet hose (4) from the power steering fluid cooler outlet pipe (1).

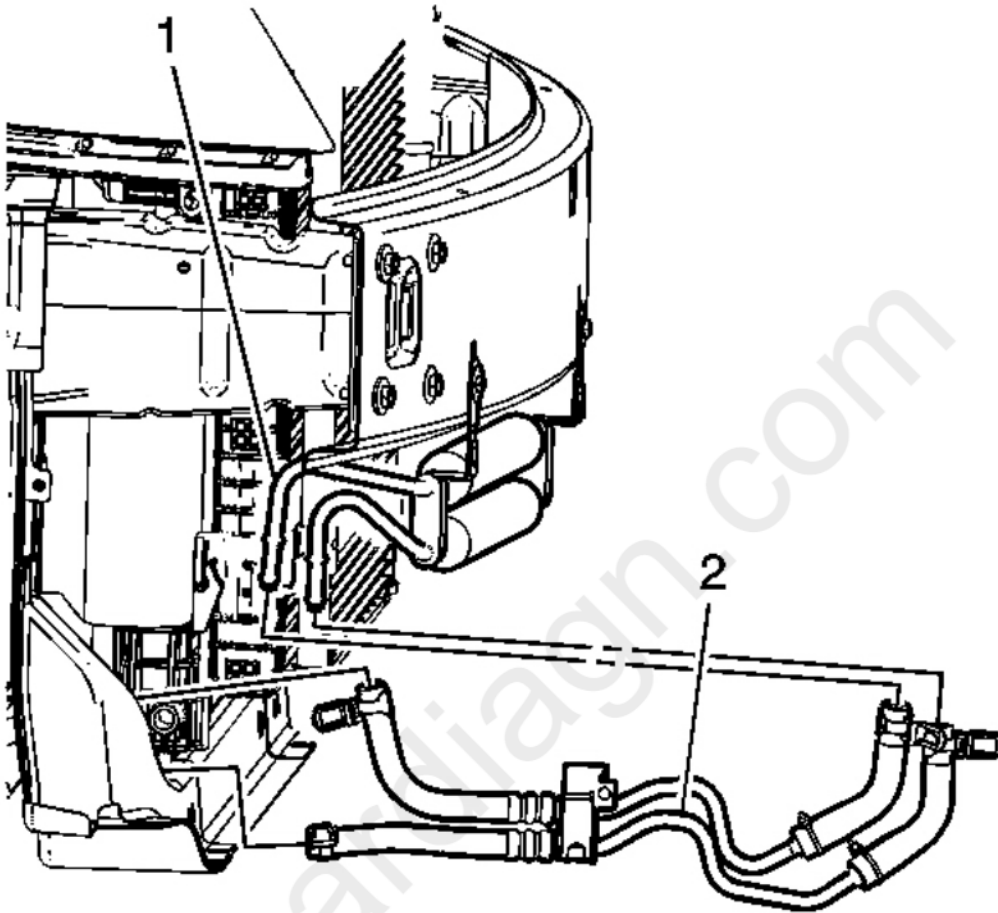


Fig. 16: View Of Fluid Cooler Inlet & Outlet Hose Assembly
Courtesy of GENERAL MOTORS CORP.

11. Remove the power steering fluid cooler inlet and outlet hose assembly (2) from the vehicle.

Installation Procedure

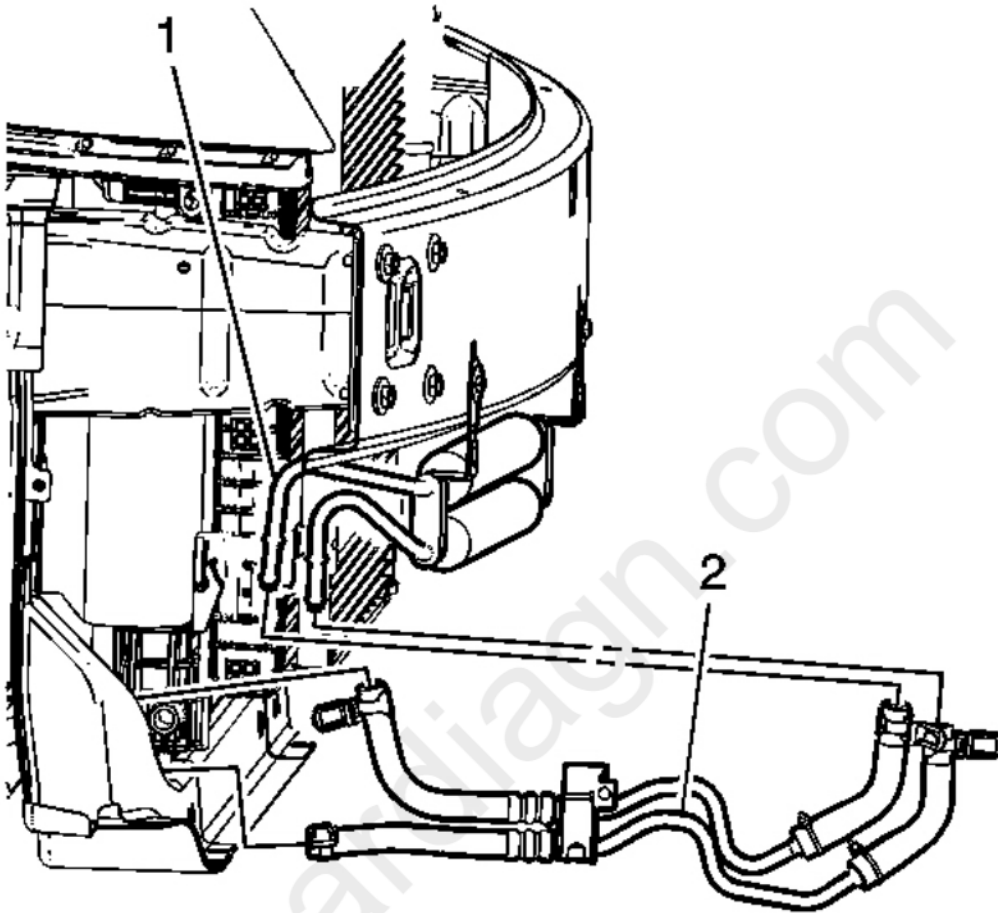


Fig. 17: View Of Fluid Cooler Inlet & Outlet Hose Assembly
Courtesy of GENERAL MOTORS CORP.

1. Position the power steering fluid cooler inlet and outlet hose assembly (2) in the vehicle.

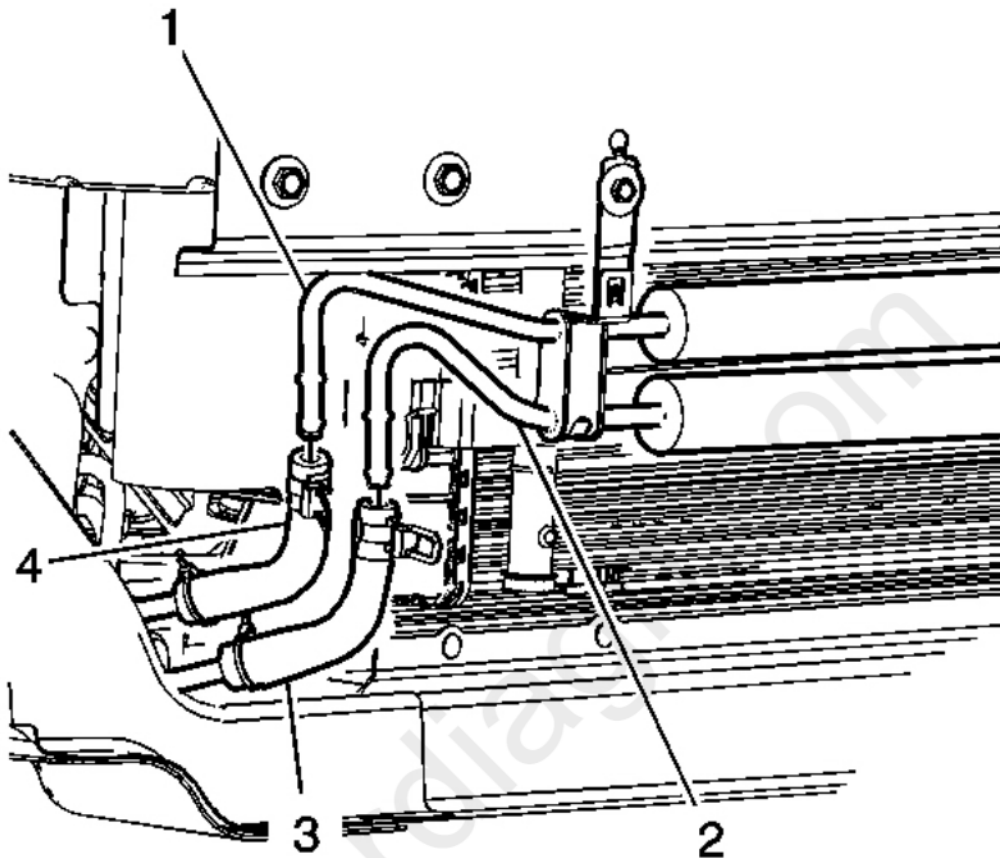


Fig. 18: Locating Fluid Cooler Inlet Hose Power Steering Fluid Cooler Inlet Pipe
Courtesy of GENERAL MOTORS CORP.

2. Compress the hose clamp and connect the power steering fluid cooler outlet hose (4) to the power steering fluid cooler outlet pipe (1).
3. Compress the hose clamp and connect the power steering fluid cooler inlet hose (3) to the power steering fluid cooler inlet pipe (2).

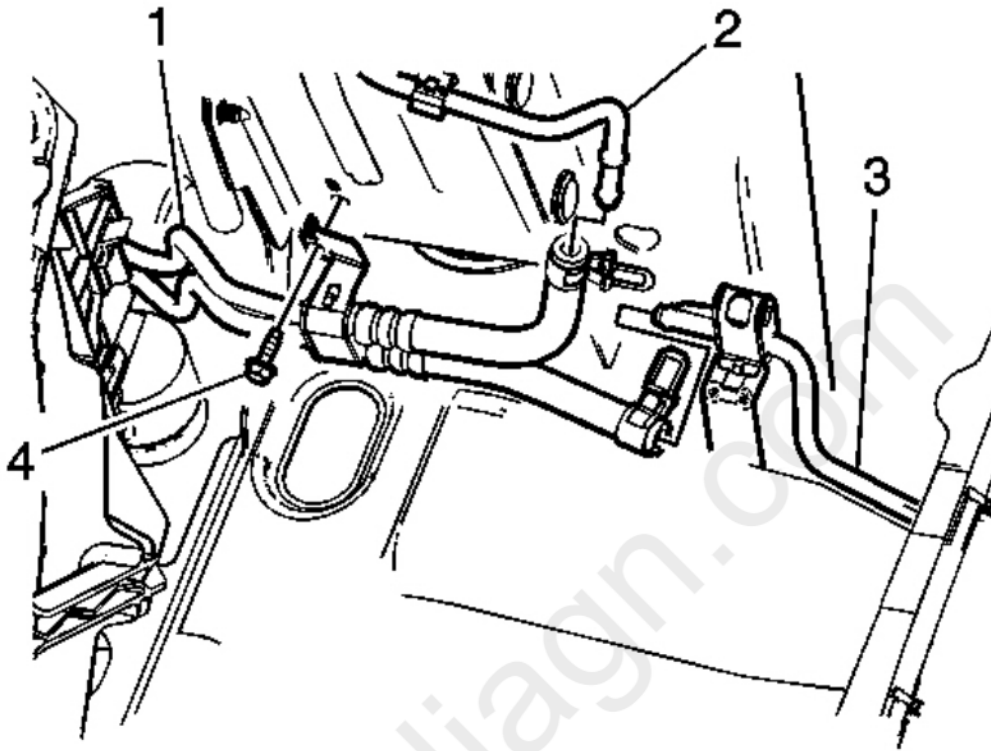


Fig. 19: Identifying Power Steering Fluid Cooler Inlet & Outlet Hose Bracket
 Courtesy of GENERAL MOTORS CORP.

4. Compress the hose clamp and connect the power steering fluid cooler inlet hose to the power steering gear outlet pipe (3).
5. Compress the hose clamp and connect the power steering fluid cooler outlet hose (1) to the power steering fluid reservoir inlet pipe (2).
6. Connect the power steering fluid cooler inlet and outlet hose bracket to the body.

CAUTION: Refer to Fastener Caution .

7. Install the bolt (4) to the power steering fluid cooler inlet and outlet hose bracket and tighten to 9 N.m (80 lb in).
8. Install the front bumper fascia. Refer to **Front Bumper Fascia Replacement** .
9. Install the right front wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement** .
10. Fill and bleed the power steering system. Refer to **Power Steering System Bleeding**.

11. Clean any excess power steering fluid from the vehicle.
12. Remove the drain pans.

POWER STEERING FLUID COOLER REPLACEMENT

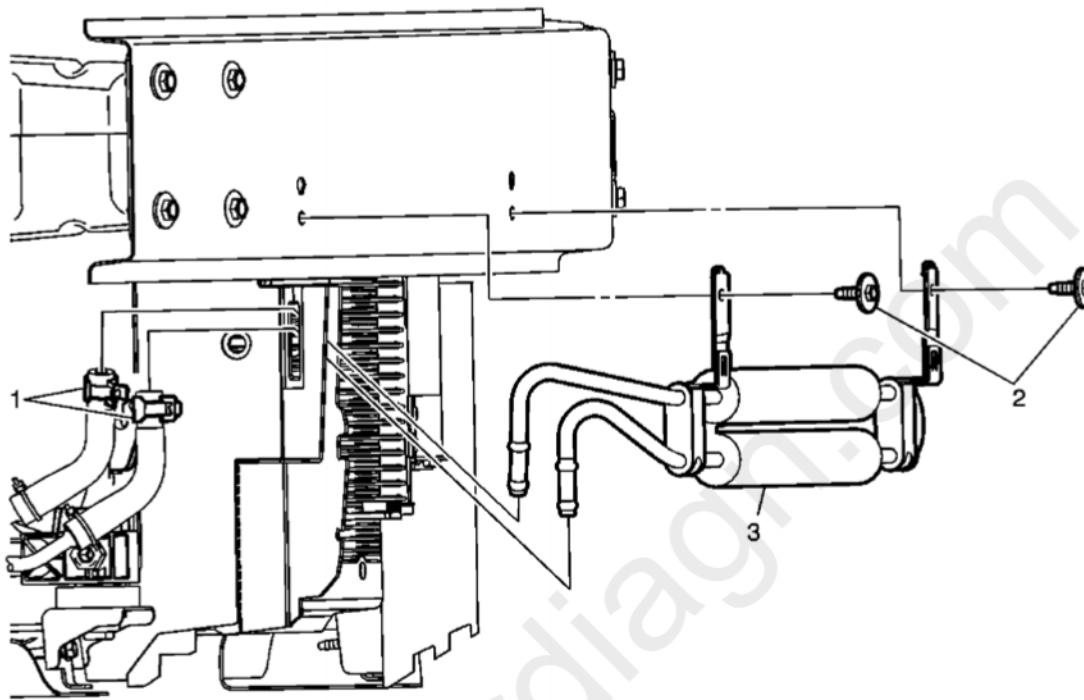


Fig. 2 : View Of Power Steering Fluid Cooler
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure 1. Place drain pans under the vehicle. 2. Remove as much power steering fluid from the reservoir as possible. 3. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 4. Remove the front bumper fascia. Refer to <u>Front Bumper Fascia Replacement</u> .	
1	Power Steering Fluid Cooler Hose Clamp (Qty: 2) Procedure: Loosen the hose clamps and disconnect the power steering fluid cooler inlet and outlet hoses from the power steering fluid cooler.
2	Power Steering Fluid Cooler Bracket Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> .

	Tighten: 9 N.m (80 lb in)
	Power Steering Fluid Cooler
3	Procedure 1. Fill and bleed the power steering system. Refer to <u>Power Steering System Bleeding</u>. 2. Clean any excess power steering fluid from the vehicle.

POWER STEERING FLUID RESERVOIR INLET HOSE REPLACEMENT (LAU)

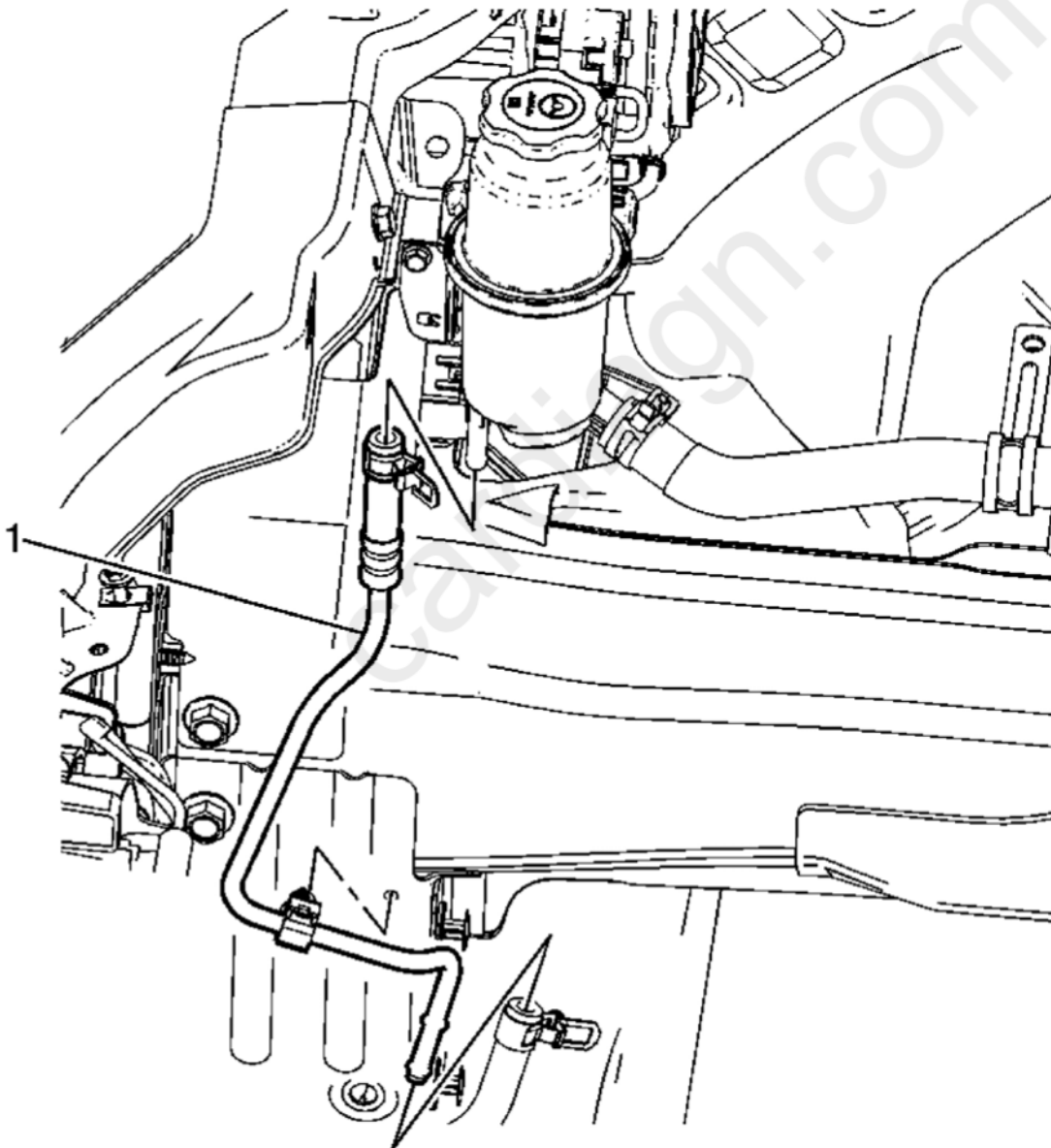


Fig. 21: Identifying Power Steering Fluid Reservoir Inlet Hose (LAU)

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Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure 1. Place drain pans under the vehicle. 2. Remove as much power steering fluid from the reservoir as possible. 3. Remove the power steering fluid reservoir. Refer to <u>Power Steering Fluid Reservoir Replacement (LAU)</u>. 4. Remove the front wheelhouse liner. Refer to <u>Front Wheelhouse Liner Replacement</u>.	
1	Power Steering Fluid Reservoir Inlet Hose Procedure 1. Disconnect the retainer from the body. 2. Compress the hose clamp and disconnect the power steering fluid reservoir inlet hose from the power steering fluid cooler outlet hose. 3. Compress the hose clamp and disconnect the power steering fluid reservoir inlet hose from the power steering fluid reservoir. 4. Fill and bleed the power steering system. Refer to <u>Power Steering System Bleeding</u>. 5. Clean any excess power steering fluid from the vehicle.

POWER STEERING FLUID RESERVOIR OUTLET HOSE REPLACEMENT (LAU)

Removal Procedure

1. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement (LAU)**.
2. Place drain pans under the vehicle.
3. Remove as much power steering fluid from the reservoir as possible.

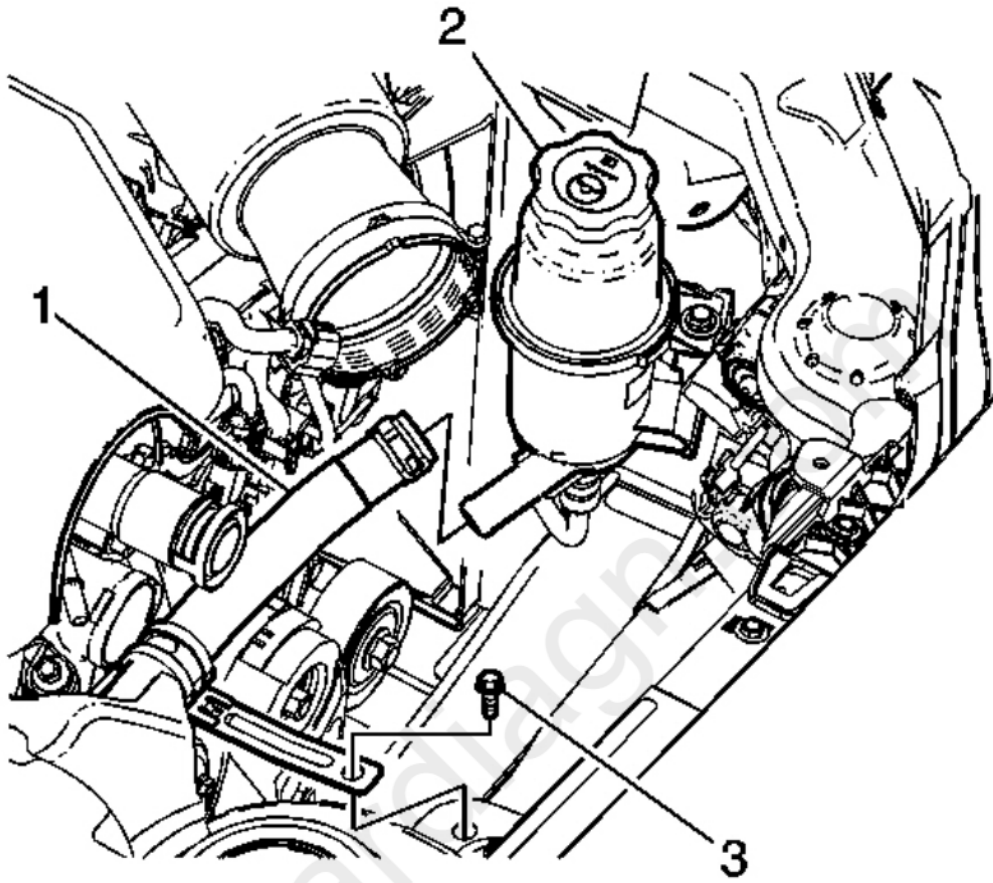


Fig. 22: Identifying Power Steering Fluid Reservoir Outlet Hose Retainer & Bracket
Courtesy of GENERAL MOTORS CORP.

4. Remove the retainer (3) from the power steering fluid reservoir outlet hose bracket.
5. Compress the hose clamp and disconnect the power steering fluid reservoir outlet hose (1) from the power steering fluid reservoir (2).
6. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
7. Position the front wheels as necessary in order to access the power steering fluid reservoir outlet hose connection to the power steering pump.

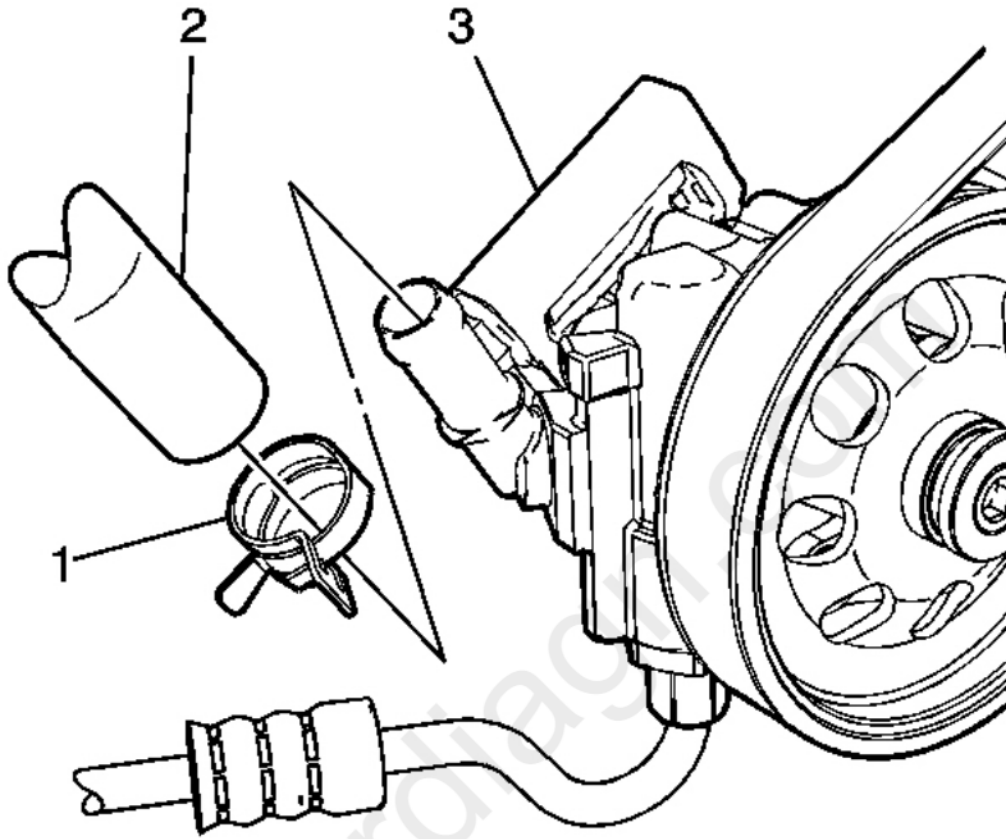


Fig. 2 : Identifying Reservoir Inlet Hose At Pump
Courtesy of GENERAL MOTORS CORP.

8. Compress the hose clamp (1) and disconnect the power steering fluid reservoir outlet hose (2) from the power steering pump (3).
9. Remove the power steering fluid reservoir outlet hose from the vehicle.

Installation Procedure

1. Position the power steering fluid reservoir outlet hose in the vehicle.

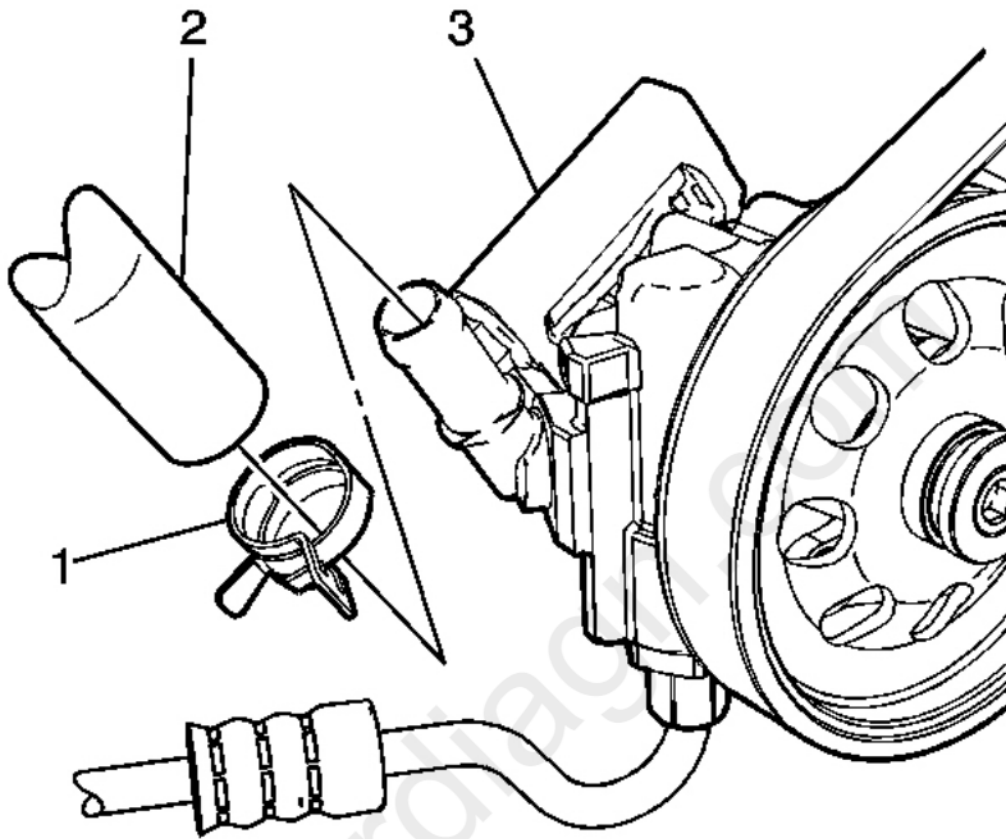


Fig. 24: Identifying Reservoir Inlet Hose At Pump
Courtesy of GENERAL MOTORS CORP.

2. Compress the hose clamp (1) and connect the power steering fluid reservoir outlet hose (2) to the power steering pump (3).
3. Lower the vehicle.

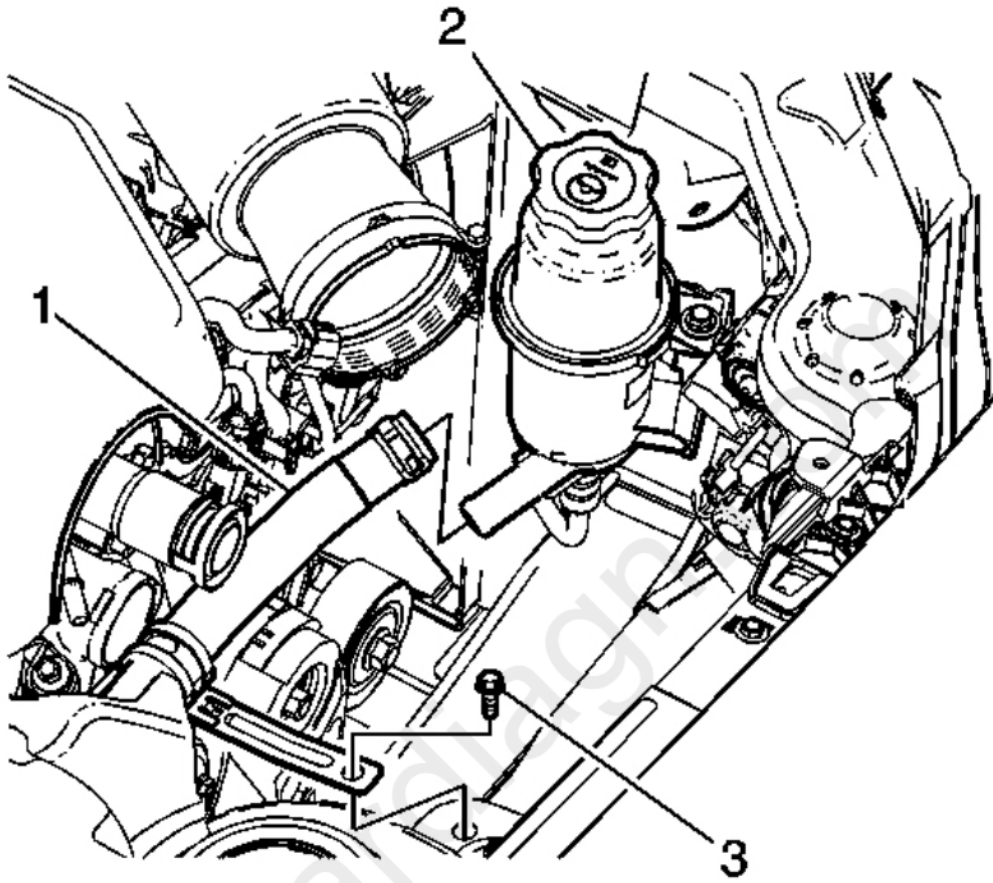


Fig. 25: Identifying Power Steering Fluid Reservoir Outlet Hose Retainer & Bracket
Courtesy of GENERAL MOTORS CORP.

4. Compress the hose clamp and connect the power steering fluid reservoir outlet hose (1) to the power steering fluid reservoir (2).
5. Install the retainer (3) to the power steering fluid reservoir outlet hose bracket.
6. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement (LAU)** .
7. Fill and bleed the power steering system. Refer to **Power Steering System Bleeding**.
8. Clean any excess power steering fluid from the vehicle.
9. Remove the drain pans.

POWER STEERING FLUID RESERVOIR OUTLET HOSE REPLACEMENT (LF1)

Removal Procedure

1. Remove the intake manifold cover. Refer to Intake Manifold Cover Replacement .
2. Place drain pans under the vehicle.

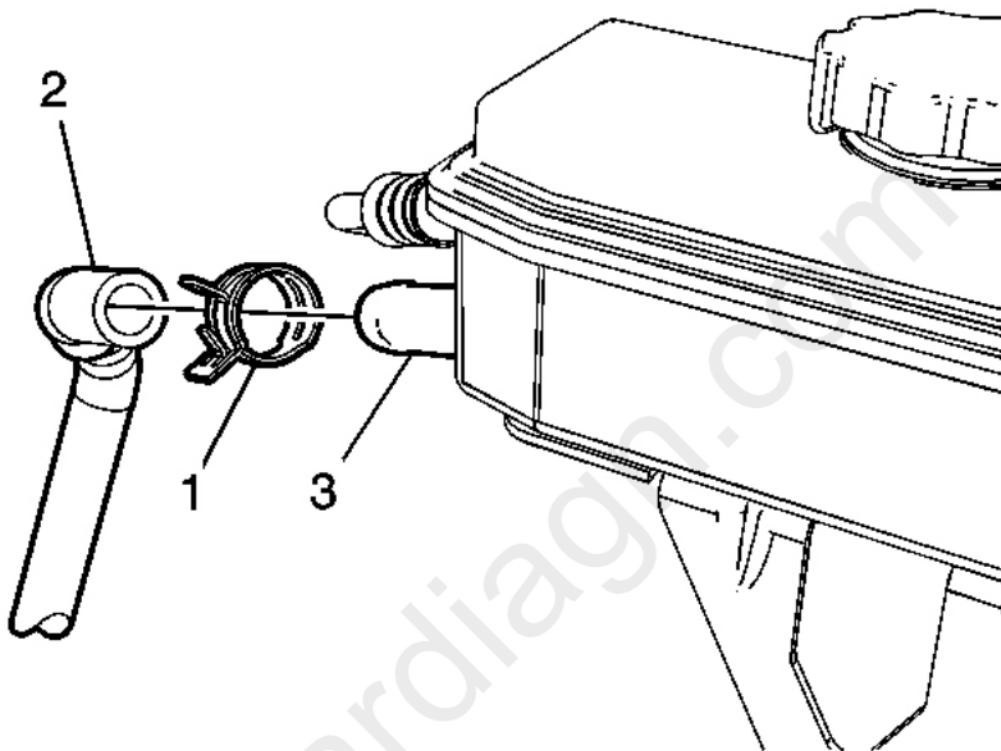


Fig. 26: Identifying Reservoir Inlet Hose At Reservoir
Courtesy of GENERAL MOTORS CORP.

3. Remove as much power steering fluid from the power steering fluid reservoir (3) as possible.
4. Compress the power steering fluid reservoir outlet hose clamp (1) and disconnect the power steering fluid reservoir outlet hose (2) from the power steering fluid reservoir.
5. Remove the right front tire and wheel assembly. Refer to Tire and Wheel Removal and Installation .

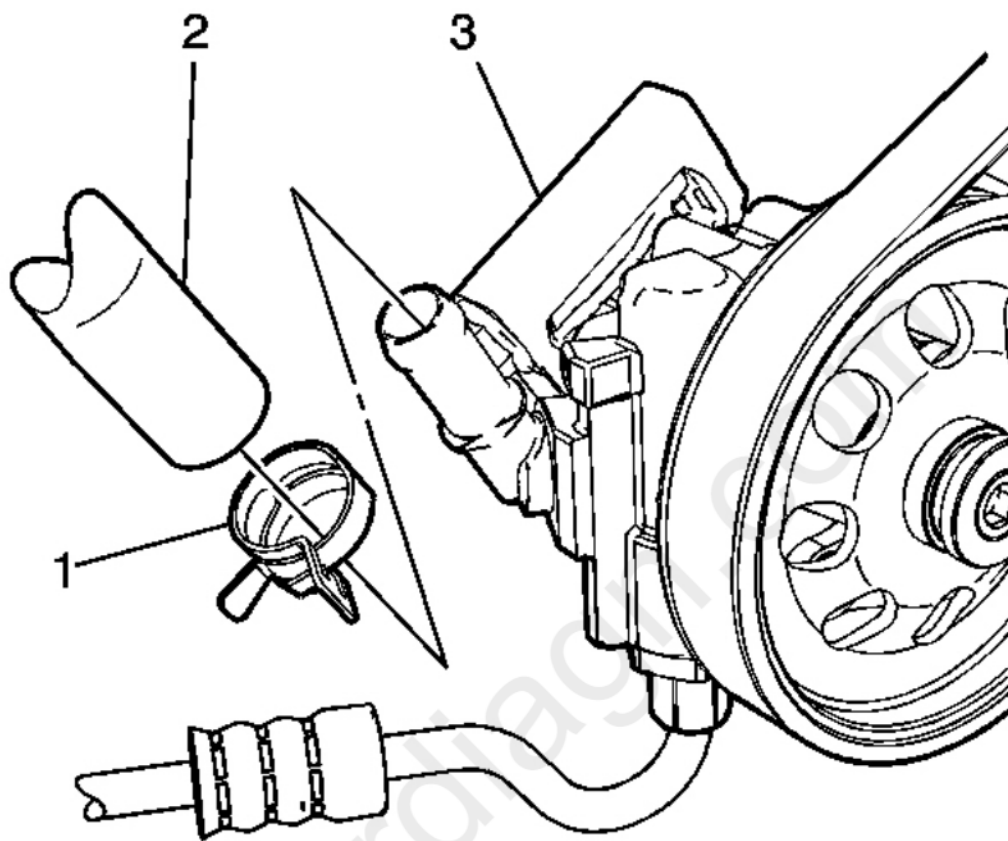


Fig. 27: Identifying Reservoir Inlet Hose At Pump
Courtesy of GENERAL MOTORS CORP.

6. Compress the power steering fluid reservoir outlet hose clamp (1) and disconnect the power steering fluid reservoir outlet hose (2) from the power steering pump (3).
7. Remove the power steering fluid reservoir outlet hose from the vehicle.

Installation Procedure

1. Position the power steering fluid reservoir outlet hose in the vehicle.

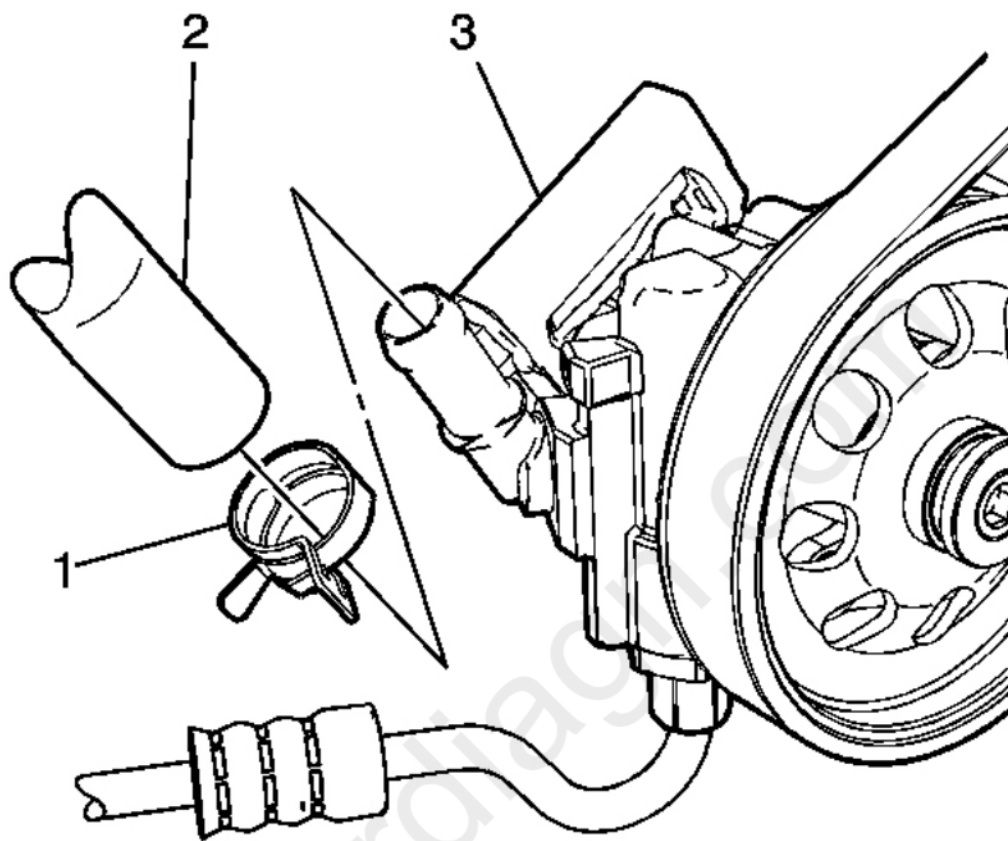


Fig. 28: Identifying Reservoir Inlet Hose At Pump

Courtesy of GENERAL MOTORS CORP.

2. Compress the power steering fluid reservoir outlet hose clamp (1) and connect the power steering fluid reservoir outlet hose (2) to the power steering pump (3).
3. Install the right front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

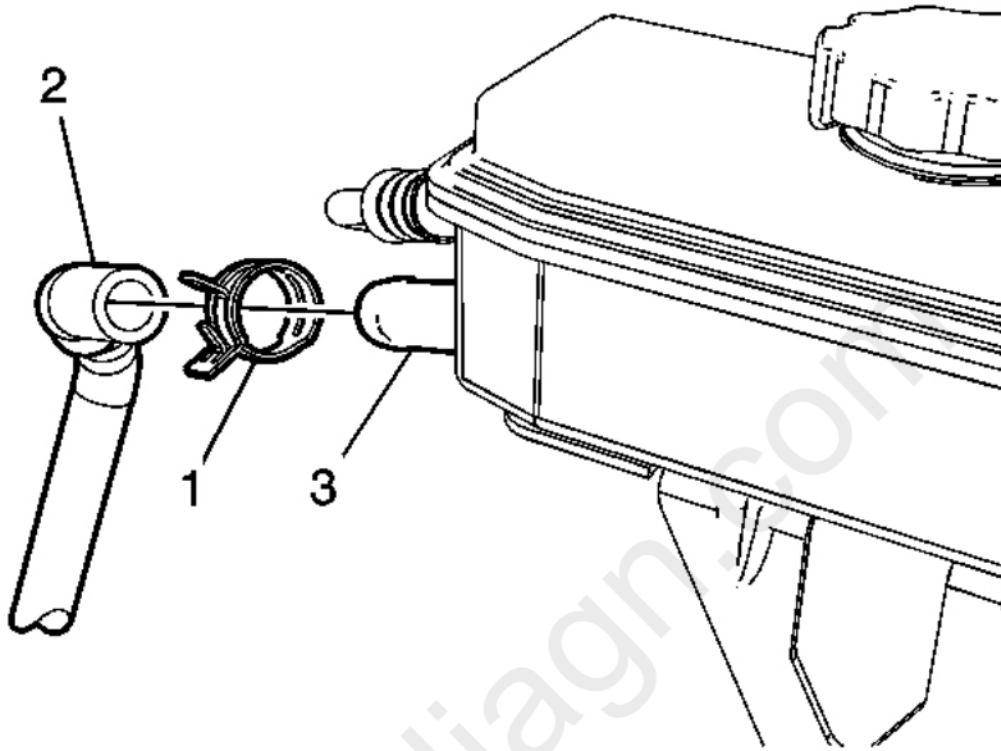


Fig. 29: Identifying Reservoir Inlet Hose At Reservoir
Courtesy of GENERAL MOTORS CORP.

4. Compress the power steering fluid reservoir outlet hose clamp (1) and connect the power steering fluid reservoir outlet hose (2) to the power steering fluid reservoir (3).
5. Fill and bleed the power steering system. Refer to **Power Steering System Bleeding**.
6. Clean any excess power steering fluid from the vehicle.
7. Remove the drain pans
8. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

POWER STEERING GEAR OUTLET AND FLUID RESERVOIR INLET HOSE REPLACEMENT (LF1 LHD)

Removal Procedure

1. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement (LF1)**.
3. Remove as much power steering fluid from the power steering fluid reservoir as possible.

4. Place drain pans under the vehicle.

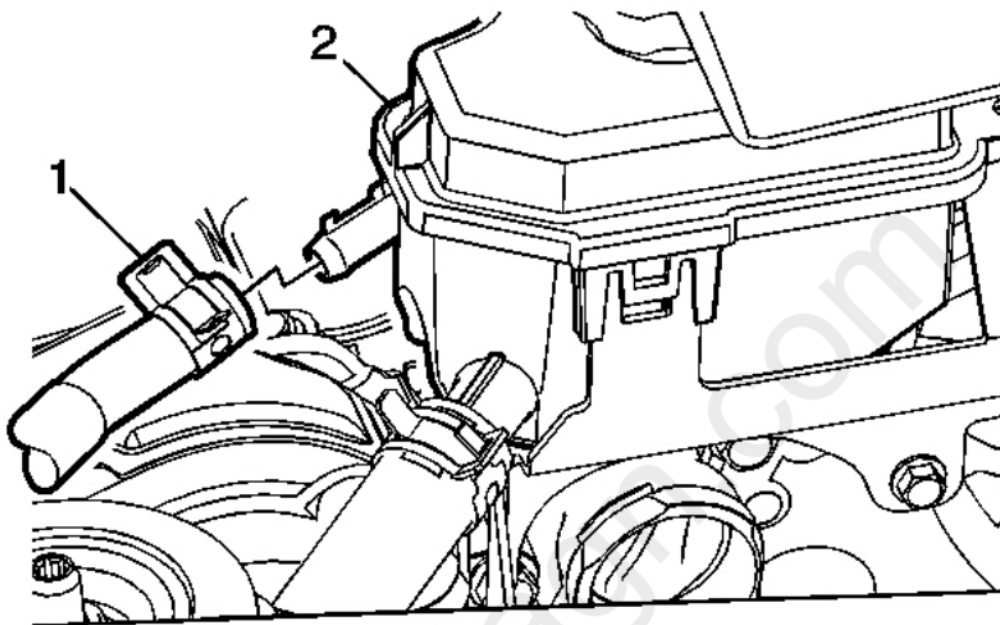


Fig. 30: View Of Power Steering Fluid Reservoir Inlet Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

5. Loosen the hose clamp (1) and disconnect the power steering fluid reservoir inlet hose from the power steering fluid reservoir.
6. Remove the right front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
7. Remove the right front wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement** .

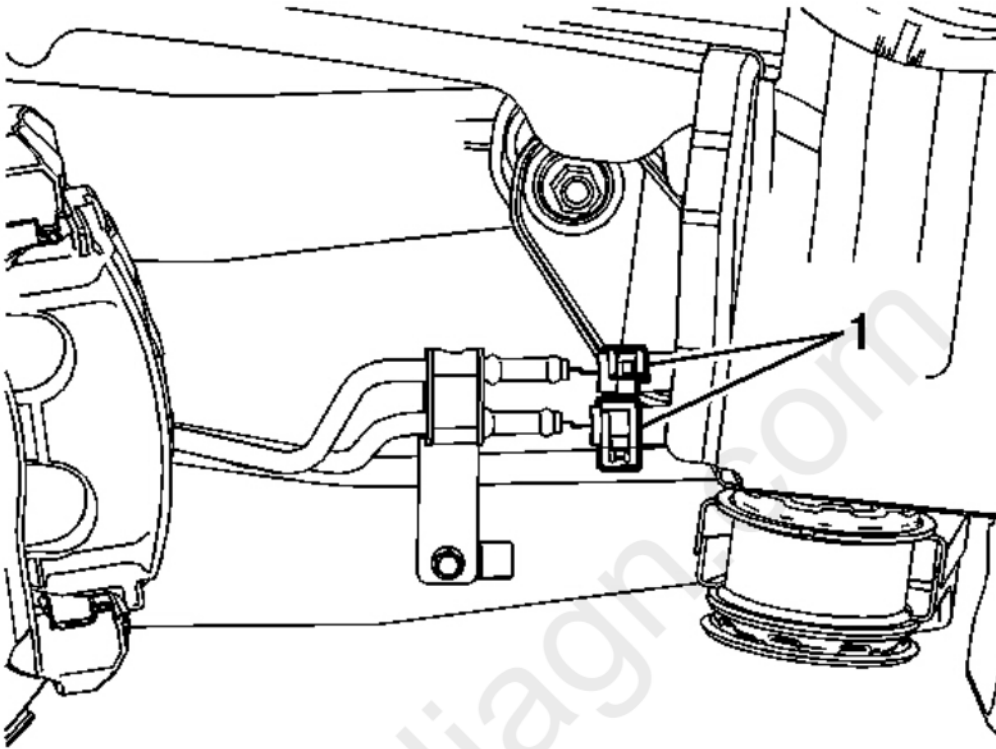


Fig. 31: Identifying Steering Gear Outlet & Fluid Reservoir Inlet Hoses & Clamps
Courtesy of GENERAL MOTORS CORP.

8. Loosen the 2 hose clamps (1) and disconnect the power steering gear outlet and fluid reservoir inlet hoses from the power steering cooler.

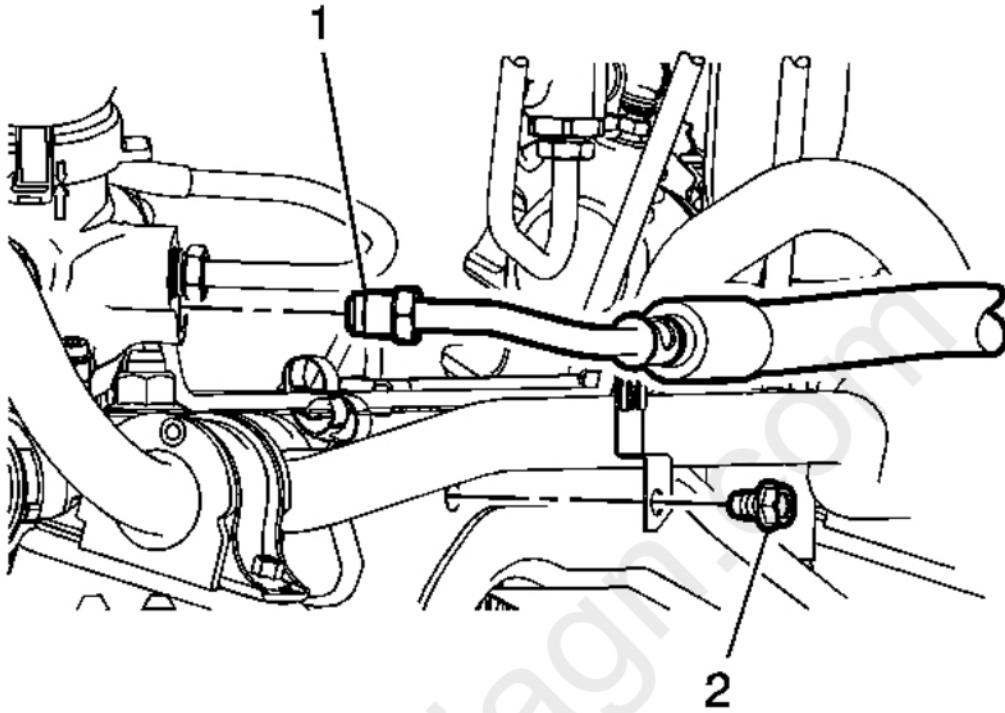


Fig. 32: Identifying Power Steering Gear Outlet Pipe
Courtesy of GENERAL MOTORS CORP.

9. Disconnect the power steering gear outlet pipe (1) from the steering gear.
10. Remove the power steering gear outlet pipe bracket fastener (2) from the power steering gear.

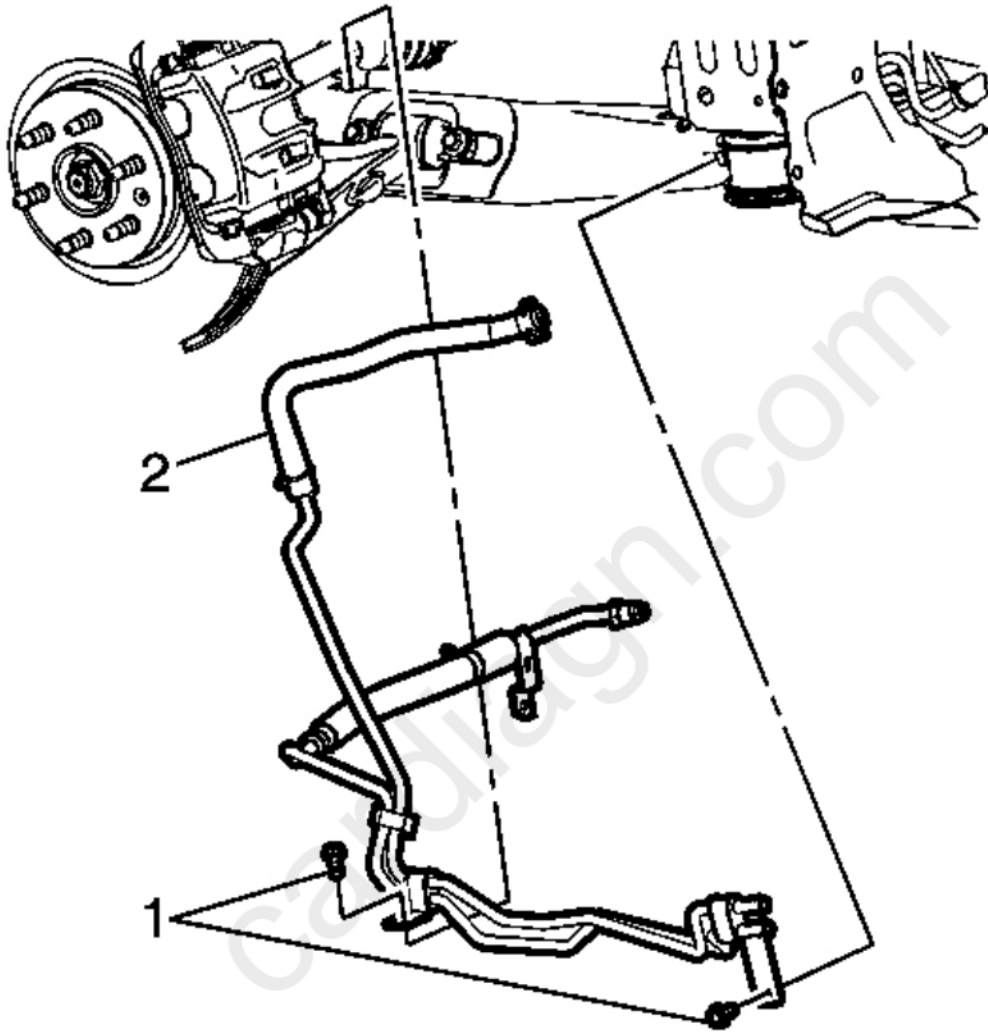


Fig. 33: View Of Steering Gear Outlet & Fluid Reservoir Inlet Hose Bracket & Fasteners
Courtesy of GENERAL MOTORS CORP.

11. Remove the power steering gear outlet and fluid reservoir inlet hose bracket fasteners (1).
12. Remove the power steering gear outlet and fluid reservoir inlet hose as an assembly (2) from the vehicle.

Installation Procedure

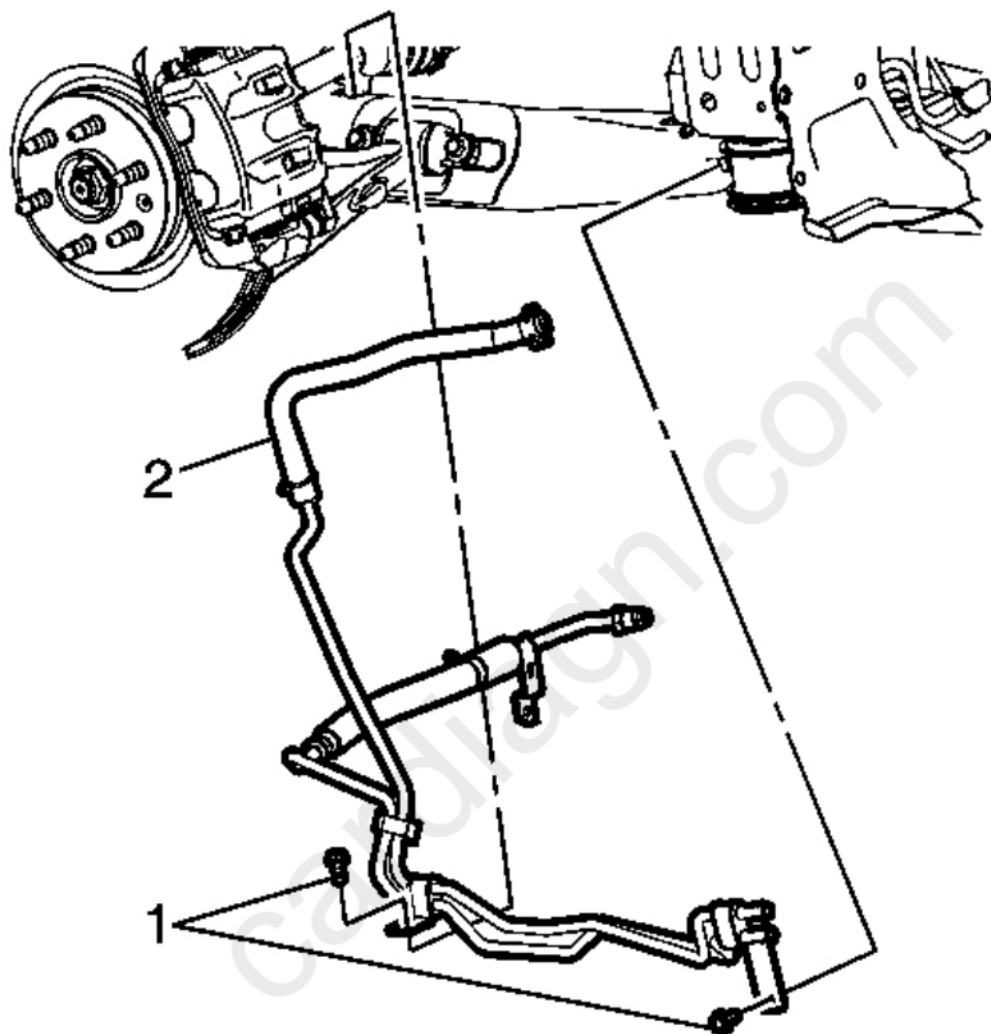


Fig. 4: View Of Steering Gear Outlet & Fluid Reservoir Inlet Hose Bracket & Fasteners
Courtesy of GENERAL MOTORS CORP.

1. Position the power steering gear outlet and fluid reservoir inlet hose as an assembly (2) in the vehicle.

CAUTION: Refer to Fastener Caution .

2. Install the power steering gear outlet and fluid reservoir inlet hose bracket fasteners (1) and tighten to 9 N.m (80 lb in).

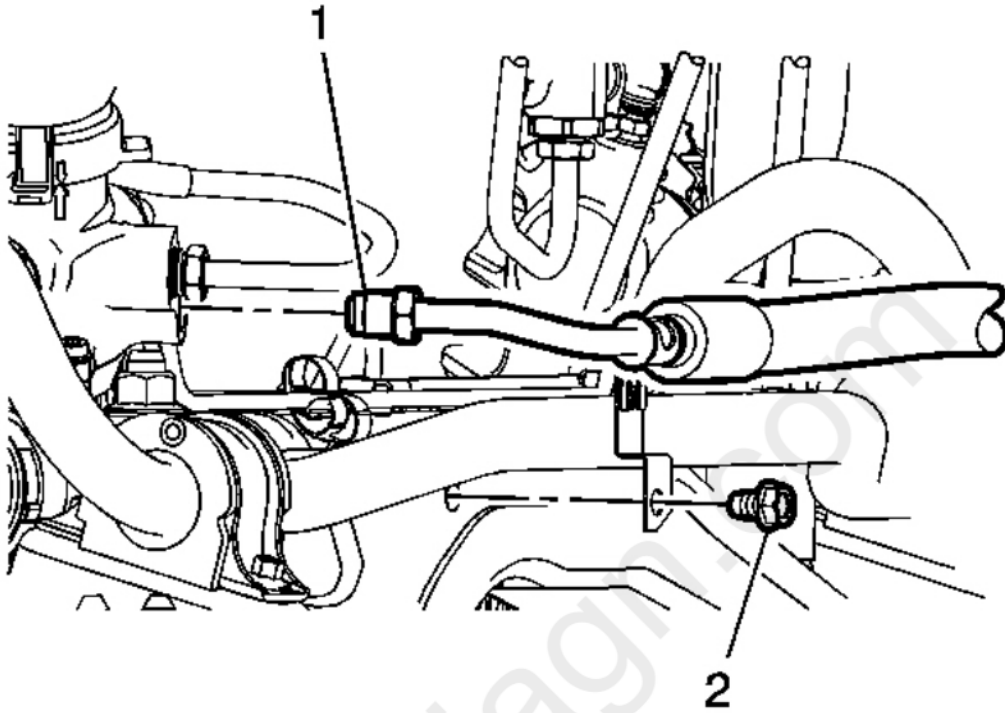


Fig. 5: Identifying Power Steering Gear Outlet Pipe
Courtesy of GENERAL MOTORS CORP.

3. Install the power steering gear outlet pipe bracket fastener (2) to the power steering gear and tighten to 9 N.m (80 lb in).
4. Connect the power steering gear outlet pipe (1) to the steering gear and tighten the fitting to 34 N.m (25 lb ft).

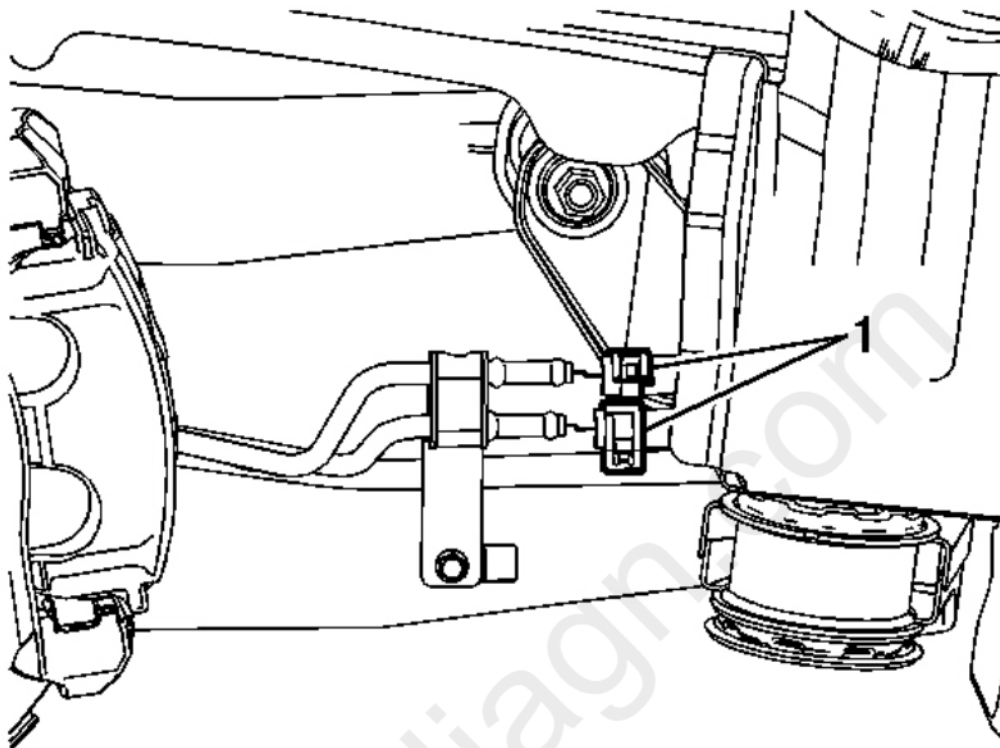


Fig. : Identifying Steering Gear Outlet & Fluid Reservoir Inlet Hoses & Clamps
Courtesy of GENERAL MOTORS CORP.

5. Connect the power steering gear outlet and fluid reservoir inlet hoses to the power steering cooler and secure with the 2 hose clamps (1).
6. Install the right front wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement** .
7. Install the right front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
8. Lower the vehicle.

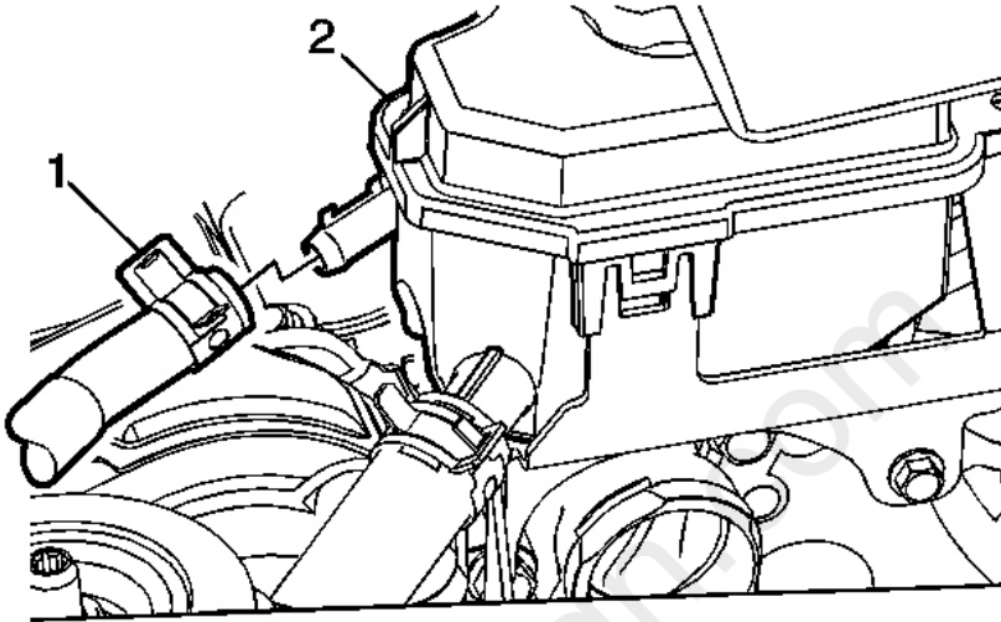


Fig. : View Of Power Steering Fluid Reservoir Inlet Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

9. Connect the power steering fluid reservoir inlet hose to the power steering fluid reservoir and secure with the hose clamp (1).
10. Remove the drain pans.
11. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement (LF1)** .
12. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement** .
13. Fill and bleed the power steering system. Refer to **Power Steering System Bleeding**.
14. Clean any excess power steering fluid from the vehicle.

POWER STEERING GEAR INLET PIPE/HOSE REPLACEMENT (LAU)

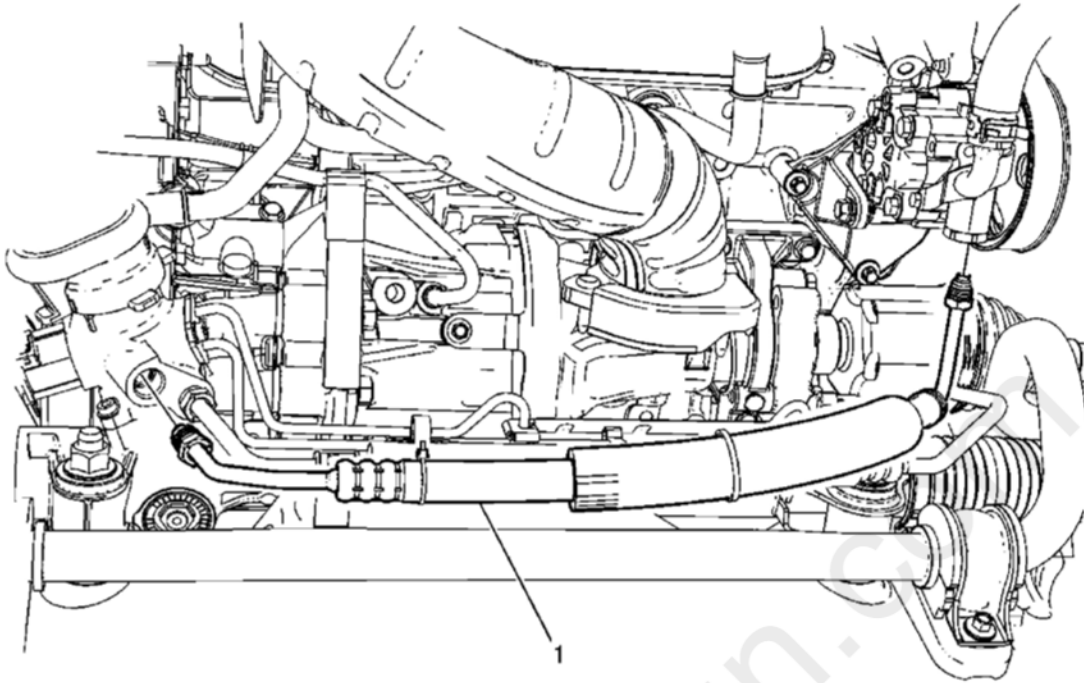


Fig. 8: Identifying Power Steering Gear Inlet Pipe/Hose (LAU)
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure 1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Place drain pans under the vehicle. 3. Remove as much power steering fluid from the power steering fluid reservoir as possible.	
1	Power Steering Gear inlet Hose CAUTION: Refer to <u>Fastener Caution</u> . Procedure 1. Fill and bleed the power steering system. Refer to <u>Power Steering System Bleeding</u>. 2. Clean any excess power steering fluid from the vehicle. Tighten: 34 N.m (25 lb ft)

POWER STEERING GEAR INLET PIPE/HOSE REPLACEMENT (LF1 LHD)

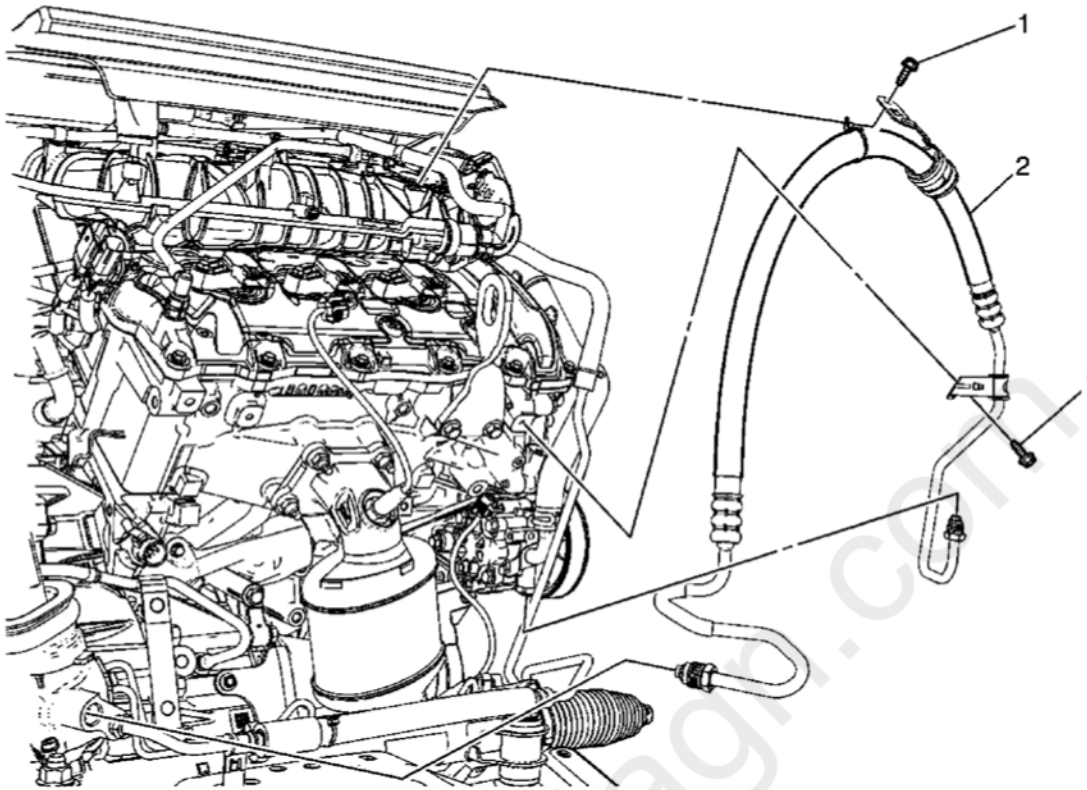


Fig. 39: Identifying Power Steering Gear Inlet Pipe/Hose (LF1 LHD)
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure 1. Remove the intake manifold cover. Refer to <u>Intake Manifold Cover Replacement</u> . 2. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 3. Place drain pans under the vehicle. 4. Remove as much power steering fluid from the power steering fluid reservoir as possible.	
1	Power Steering Gear Inlet Hose Fastener (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten: 9 N.m (80 lb in)
2	Power Steering Gear inlet Hose Procedure 1. Install NEW power steering gear inlet hose seals.

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2. Fill and bleed the power steering system. Refer to **Power Steering System Bleeding**.
3. Clean any excess power steering fluid from the vehicle.

Tighten: 34 N.m (25 lb ft)

POWER STEERING GEAR OUTLET PIPE/HOSE REPLACEMENT (LAU)

Removal Procedure

1. Place drain pans under the vehicle.
2. Remove as much power steering fluid from the reservoir as possible.
3. Complete the following steps. Refer to **Drivetrain and Front Suspension Frame Replacement**.
 1. Install the engine support fixture.
 2. Raise and support the vehicle.
 3. Remove the front tire and wheel assemblies.
 4. Remove the radiator air lower deflector.
 5. Remove the rear transmission mount through bolt.
 6. Use mechanics wire in order to suspend the steering gear from the powertrain.
 7. Remove the steering gear fasteners.
4. Disconnect the lower electronic suspension front vertical accelerometer link, if equipped. Refer to **Electronic Suspension Front Vertical Accelerometer Replacement - Lower**.

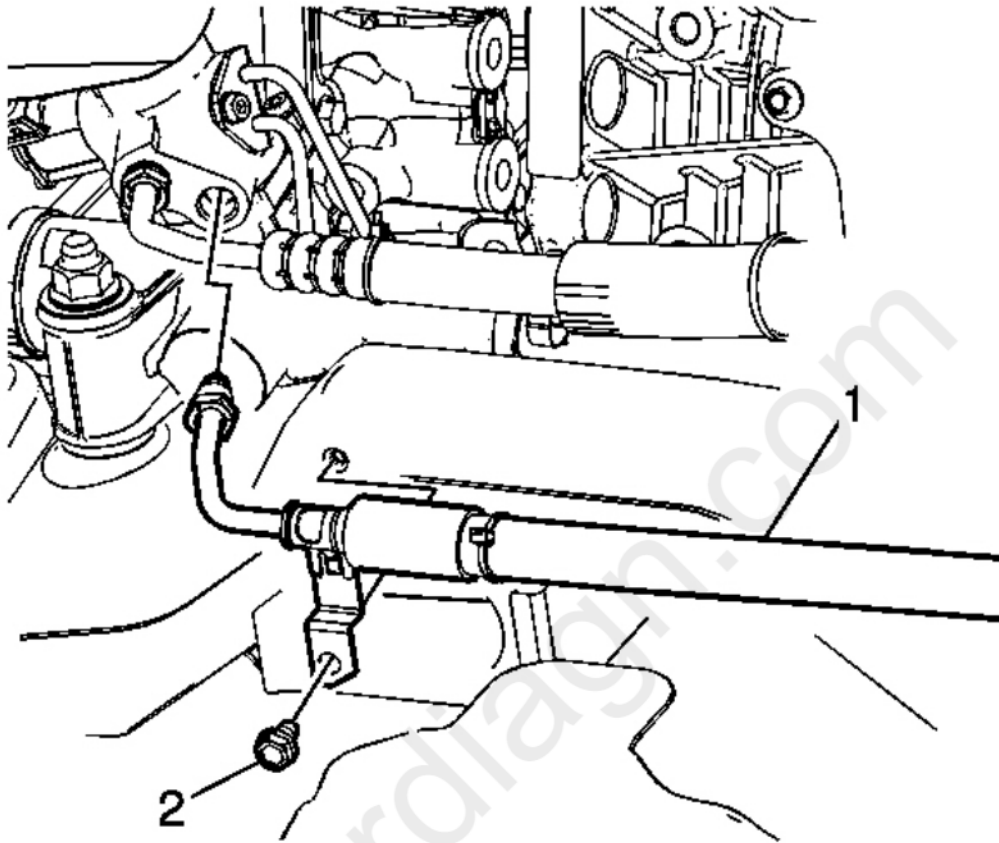


Fig. 40: Identifying Steering Gear Outlet Hose Bracket & Bolt
Courtesy of GENERAL MOTORS CORP.

5. Remove the bolt (2) from the power steering gear outlet hose bracket near the steering gear.

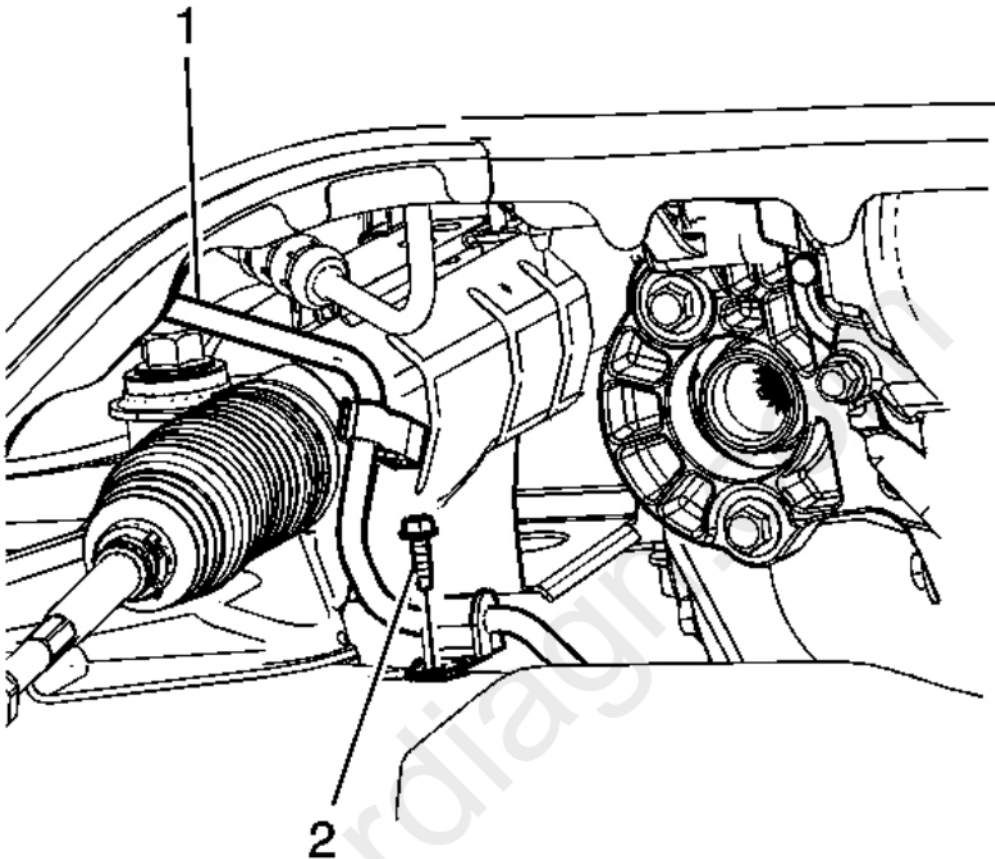


Fig. 41: Identifying Steering Gear Hose Bracket Bolt
Courtesy of GENERAL MOTORS CORP.

6. Remove the bolt (2) from the power steering gear outlet hose bracket near the right steering gear boot.

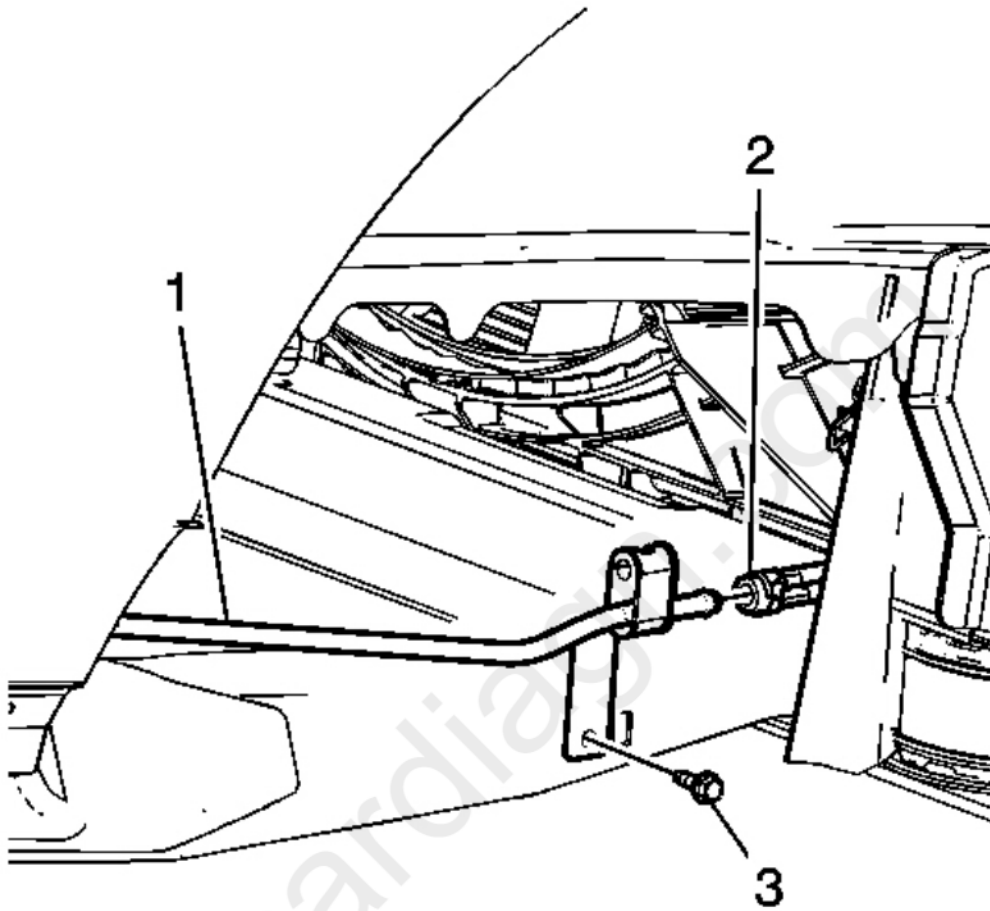


Fig. 42: Locating Power Steering Gear Outlet Hose Bracket At Frame
Courtesy of GENERAL MOTORS CORP.

7. Remove the bolt (3) from the power steering gear outlet hose bracket on the right front corner of the frame.
8. Use a jack in order to support the rear of the drivetrain and front suspension frame.
9. Complete the following steps. Refer to **Drivetrain and Front Suspension Frame Replacement**.
 1. Loosen the front frame-to-body bolts.
 2. Remove the reinforcement bolts.
 3. Remove the rear frame-to-body bolts.
 4. Lower the rear of the frame in order to access the hose on the steering gear.
10. Compress the hose clamp and disconnect the power steering gear outlet hose (1) from the power steering fluid cooler inlet hose (2).

11. Disconnect the power steering gear outlet hose from the steering gear.

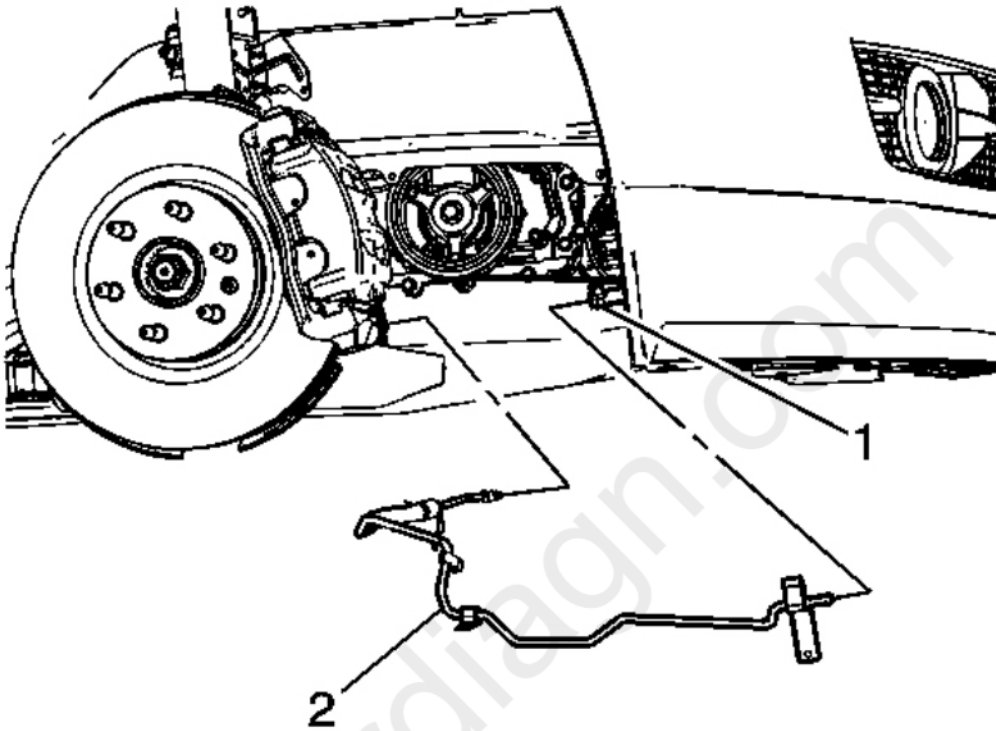


Fig. 43: Identifying Power Steering Gear Outlet Hose
Courtesy of GENERAL MOTORS CORP.

12. Remove the power steering gear outlet hose (2) from the vehicle.

Installation Procedure

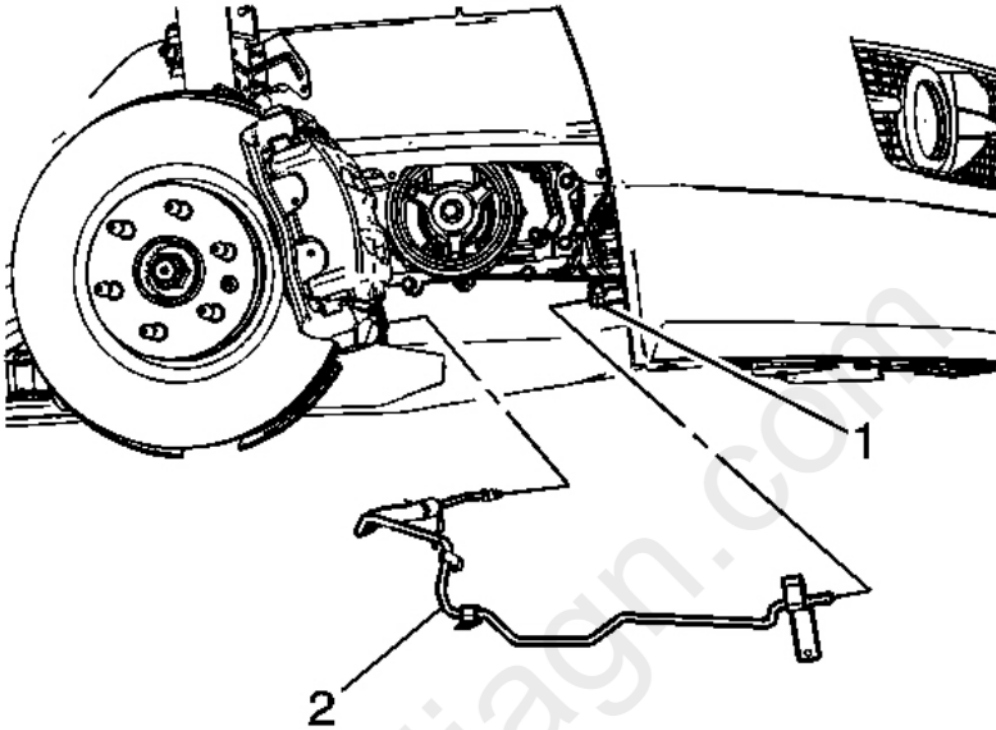


Fig. 44: Identifying Power Steering Gear Outlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Position the power steering gear outlet hose (2) in the vehicle.

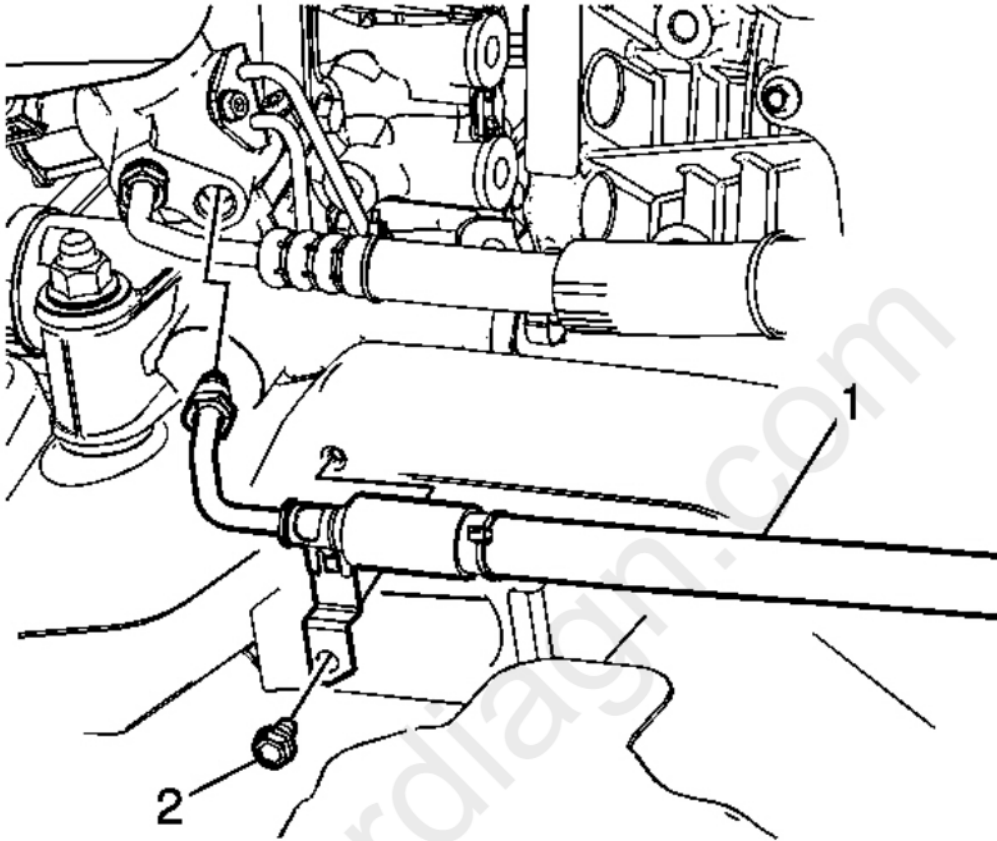


Fig. 45: Identifying Steering Gear Outlet Hose Bracket & Bolt
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

2. Connect the power steering gear outlet hose (1) to the steering gear. Tighten the fitting to 34 N.m (25 lb ft).

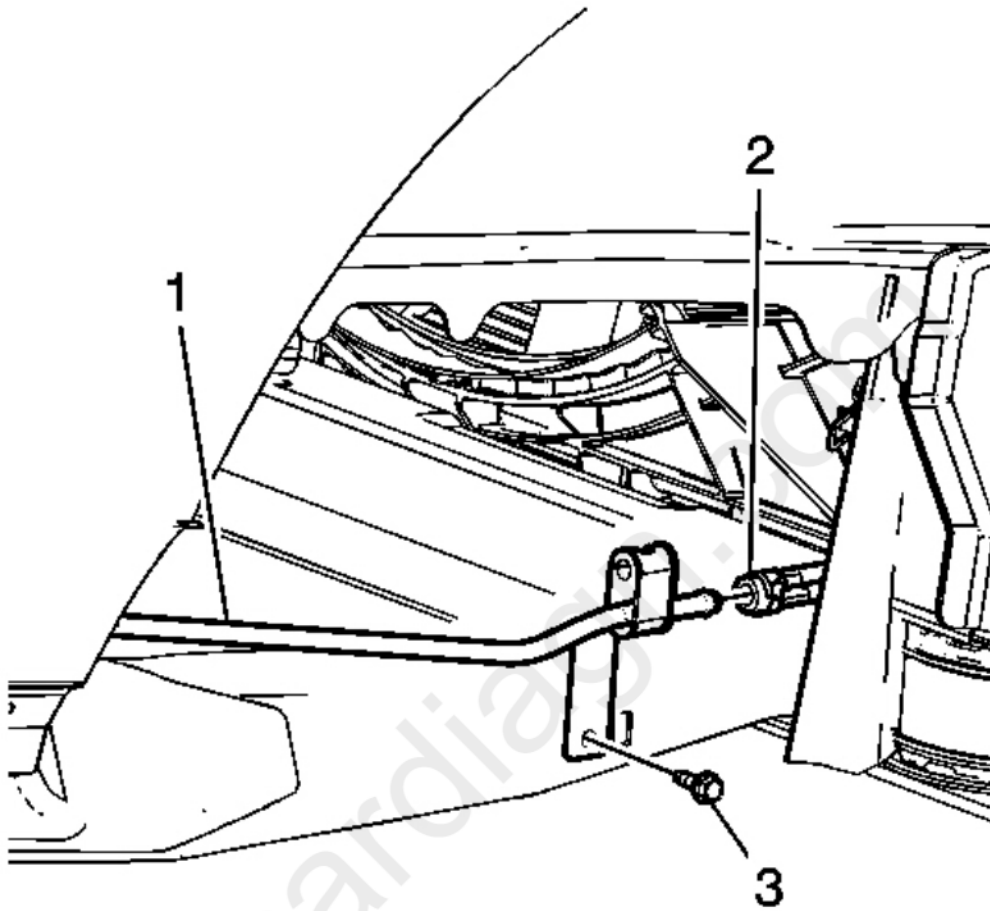


Fig. 46: Locating Power Steering Gear Outlet Hose Bracket At Frame
Courtesy of GENERAL MOTORS CORP.

3. Compress the hose clamp and connect the power steering gear outlet hose (1) to the power steering fluid cooler inlet hose (2).
4. Use the jack in order to raise the rear of the drivetrain and front suspension frame.
5. Complete the following steps. Refer to **Drivetrain and Front Suspension Frame Replacement**.
 1. Install the rear frame-to-body bolts.
 2. Tighten the front frame-to-body bolts.
 3. Install the reinforcement bolts.
 4. Remove the mechanics wire from the steering gear.
6. Install the bolt (3) to the power steering gear outlet hose bracket on the right front corner of the frame and tighten to 9 N.m (80 lb in).

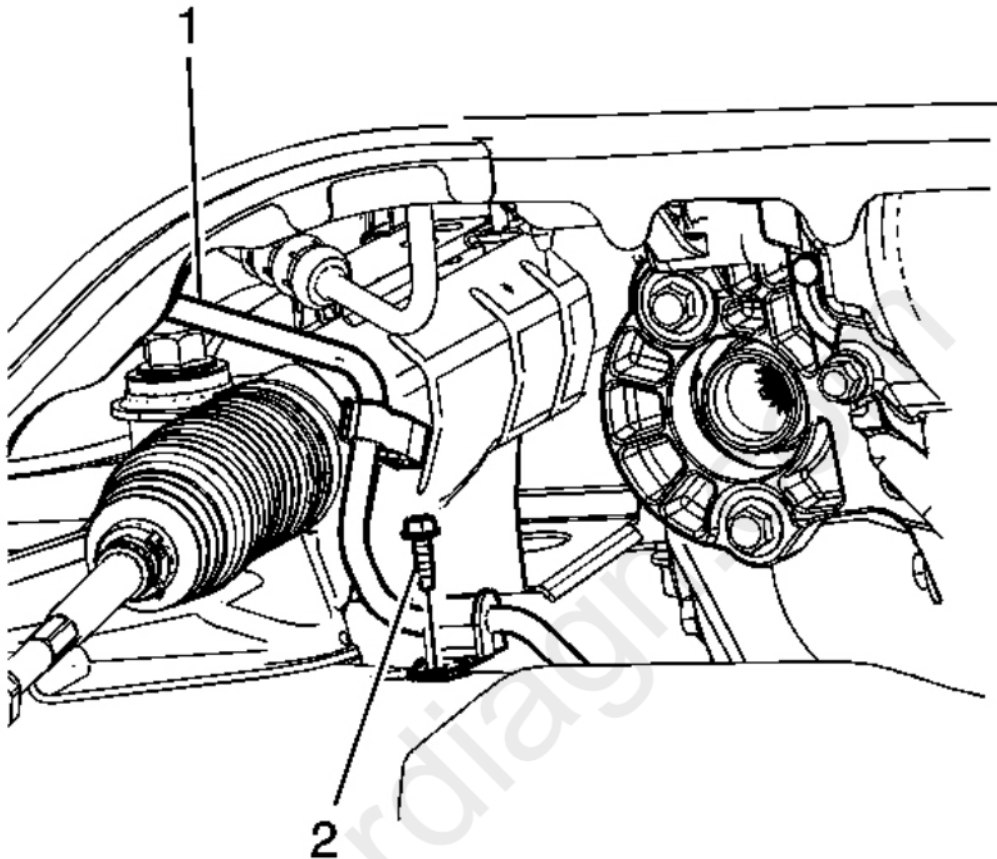


Fig. 47: Identifying Steering Gear Hose Bracket Bolt
Courtesy of GENERAL MOTORS CORP.

7. Install the bolt (2) to the power steering gear outlet hose bracket near the right steering gear boot and tighten to 9 N.m (80 lb in).
8. Install the bolt to the power steering gear outlet hose bracket at the steering gear and tighten to 9 N.m (80 lb in).
9. Install the fasteners to the steering gear. Refer to **Steering Gear Replacement**.
10. Connect the lower electronic suspension front vertical accelerometer link, if equipped. Refer to **Electronic Suspension Front Vertical Accelerometer Replacement - Lower**.
11. Complete the following steps. Refer to **Drivetrain and Front Suspension Frame Replacement**.
 1. Install the rear transmission mount through bolt.
 2. Install the radiator air lower deflector.
 3. Install the tire and wheel assemblies.

4. Lower the vehicle.
5. Remove the engine support fixture.
12. Fill and bleed the power steering system. Refer to **Power Steering System Bleeding**.
13. Clean any excess power steering fluid from the vehicle.
14. Remove the drain pans.

STEERING GEAR PIPE AND SEAL REPLACEMENT

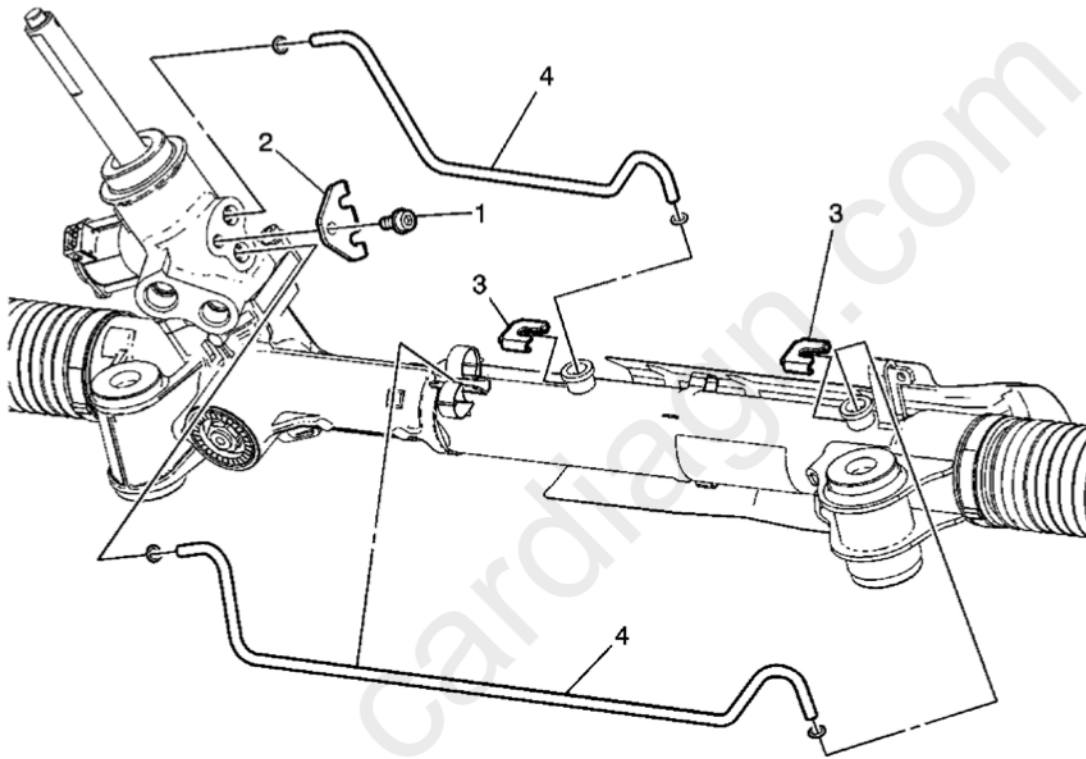


Fig. 48: View Of Steering Gear Pipes & Seals
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Remove the steering gear. Refer to <u>Steering Gear Replacement</u> .	
1	Steering Gear Pipe Retainer Fastener CAUTION: Refer to <u>Fastener Caution</u> . Tighten: 12 N.m (106 lb in)
2	Steering Gear Pipe Retainer
3	Steering Gear Clip (Qty: 2)

4

Steering Gear Pipe (Qty: 2)

Procedure:

Install NEW steering gear pipe seals.

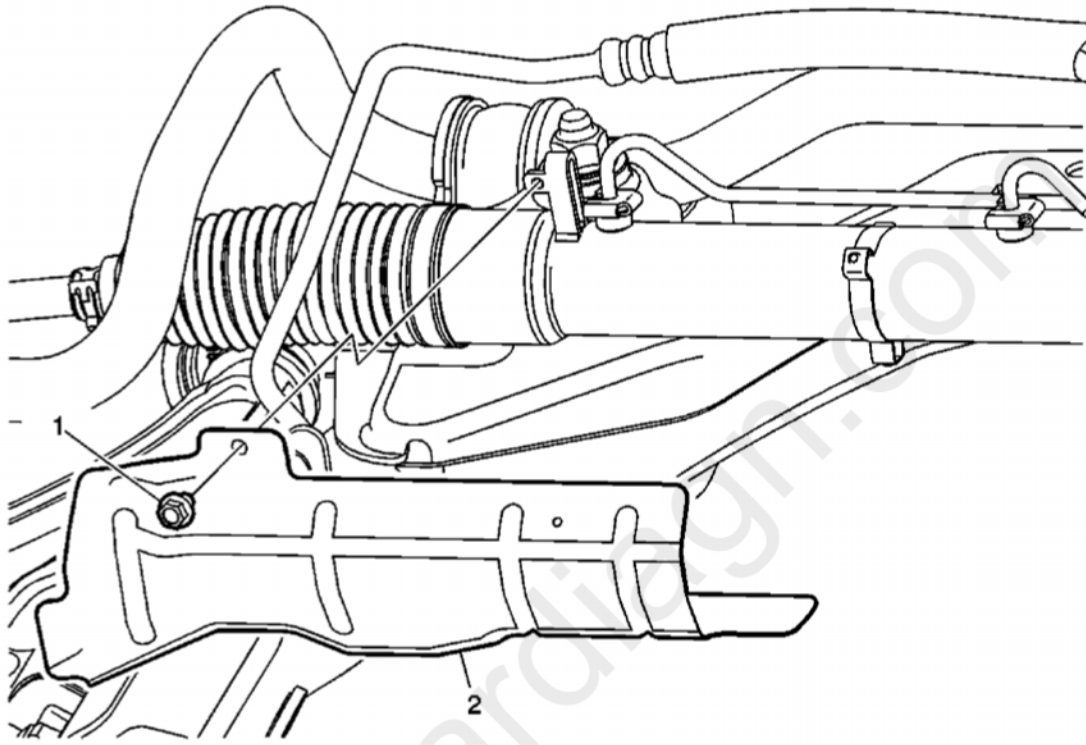
STEERING GEAR HEAT SHIELD REPLACEMENT

Fig. 49: Identifying Steering Gear Heat Shield & Bolt
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> .	
1	Fastener CAUTION: Refer to <u>Fastener Caution</u> . Tighten: 9 N.m (80 lb in)
2	Power Steering Gear Heat Shield

STEERING GEAR REPLACEMENT

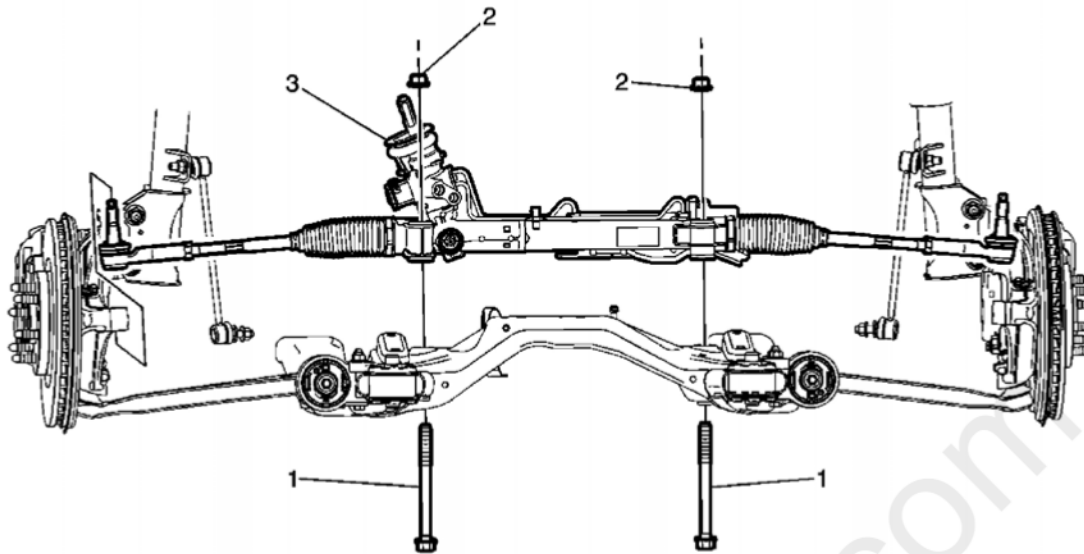


Fig. 50: View Of Steering Gear & Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
CAUTION: It is essential that the vehicle facing straight ahead secure the steering wheel utilized in steering column anti-rotation in steering column lock or a strap to prevent rotation. Locking of the steering column will prevent damage and a possible malfunction of the SIR system. The steering wheel must be secured in position before disconnecting the following components: • The steering column • The steering shaft coupler • The intermediate shafts After disconnecting these components do not rotate the steering wheel or move the front tires and wheels. Failure to follow this procedure may cause the SIR coil assembly to become uncentered and cause possible damage to the SIR coil. If output in the SIR coil assembly is uncentered refer to our specific SIR coil centering procedure to re-center SIR Coil. Preliminary Procedures 1. With the wheels of the vehicle in the straight ahead position, lock the steering column. 2. Disconnect the intermediate steering shaft from the steering gear. Refer to <u>Intermediate Steering Shaft Replacement</u>. 3. Place drain pans under the vehicle. 4. Remove as much power steering fluid from the reservoir as possible. 5. Disconnect the front stabilizer shaft from the 2 stabilizer shaft links. Rotate the front stabilizer shaft as necessary for access. Refer to <u>Stabilizer Shaft Link Replacement</u>.	

6. Disconnect the 2 steering linkage outer tie rods from the steering knuckles. Refer to **Steering Linkage Outer Tie Rod Replacement**.
7. Disconnect the power steering gear inlet hose from the steering gear. Refer to **Power Steering Gear Inlet Pipe/Hose Replacement (LAU)** or **Power Steering Gear Inlet Pipe/Hose Replacement (LF1 LHD)**.
8. Disconnect the power steering gear outlet hose and the outlet hose bracket from the steering gear. Refer to **Power Steering Gear Outlet and Fluid Reservoir Inlet Hose Replacement (LF1 LHD)**.
9. Perform the following steps. Refer to **Drivetrain and Front Suspension Frame Replacement** .
 1. Support the front frame with a jack.
 2. If equipped with all wheel drive, remove the propeller shaft.
 3. Remove the rear transmission mount through bolt.
 4. Remove the rear frame-to-body bolts.
 5. Lower the rear part of the frame a maximum of 51 mm (2 in) in order to gain clearance for the steering gear.

1	Steering Gear Bolt (Qty: 2) Procedure: Hold the steering gear bolt with a wrench and tighten the steering gear nut.
2	Steering Gear Nut (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten: 1. 60 N.m (44 lb ft) 2. 120 degrees
3	Steering Gear Procedure 1. If equipped with variable effort steering, disconnect the electrical connector. 2. Fill and bleed the power steering system. Refer to <u>Power Steering System Bleeding</u>. 3. Measure and adjust the front toe. Refer to <u>Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment</u> .

STEERING LINKAGE INNER TIE ROD REPLACEMENT

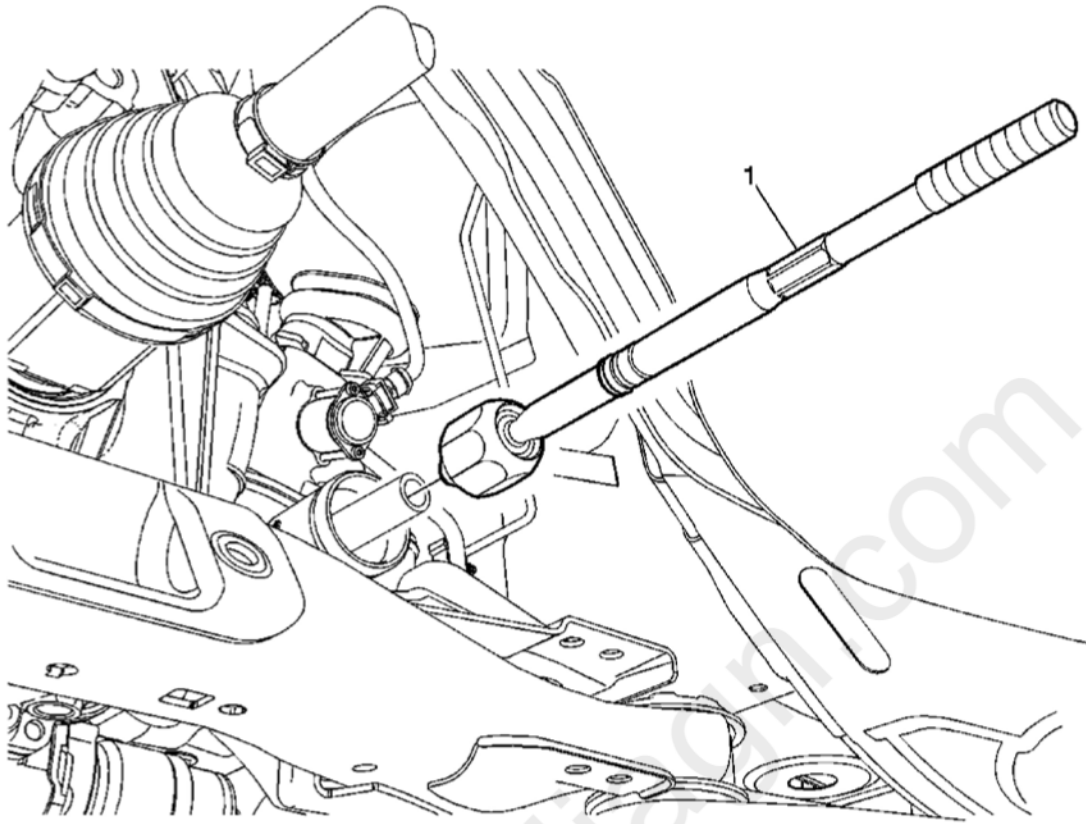


Fig. 51: Identifying Steering Linkage Inner Tie Rod
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Remove the steering gear boot. Refer to <u>Steering Gear Boot Replacement</u> .	
1	Steering Linkage Inner Tie Rod CAUTION: Refer to <u>Fastener Caution</u> . Procedure 1. Place a wrench on the flats of the steering linkage inner tie rod housing. 2. Rotate the steering linkage inner tie rod housing counterclockwise in order to remove the steering linkage inner tie rod from the rack. 3. Rotate the steering linkage inner tie rod housing clockwise in order to install the steering linkage inner tie rod to the rack. Tighten: 70 N.m (52 lb ft)

STEERING GEAR VALVE SOLENOID REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Place drain pans under the vehicle.

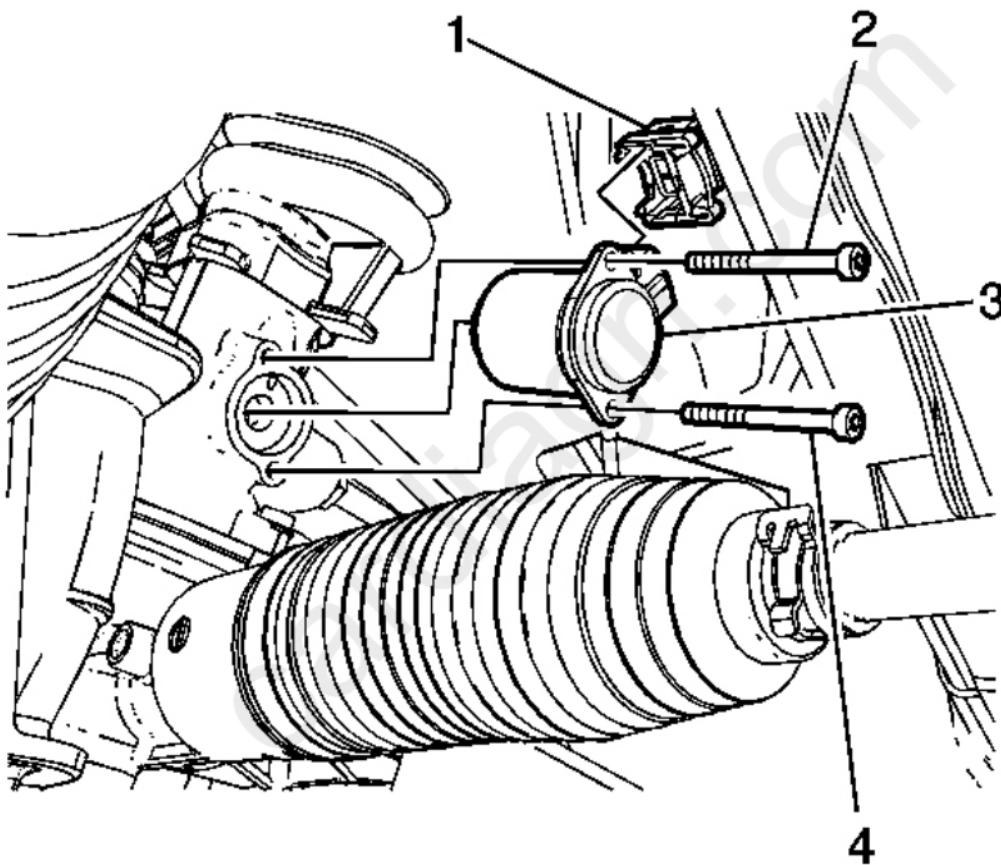


Fig. 52: Identifying Electrical Connector & Steering Gear Valve Solenoid
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the electrical connector (1) from the steering gear valve solenoid (3).
4. Remove the 2 steering gear valve solenoid bolts (2, 4).
5. Remove the steering gear valve solenoid from the steering gear.

Installation Procedure

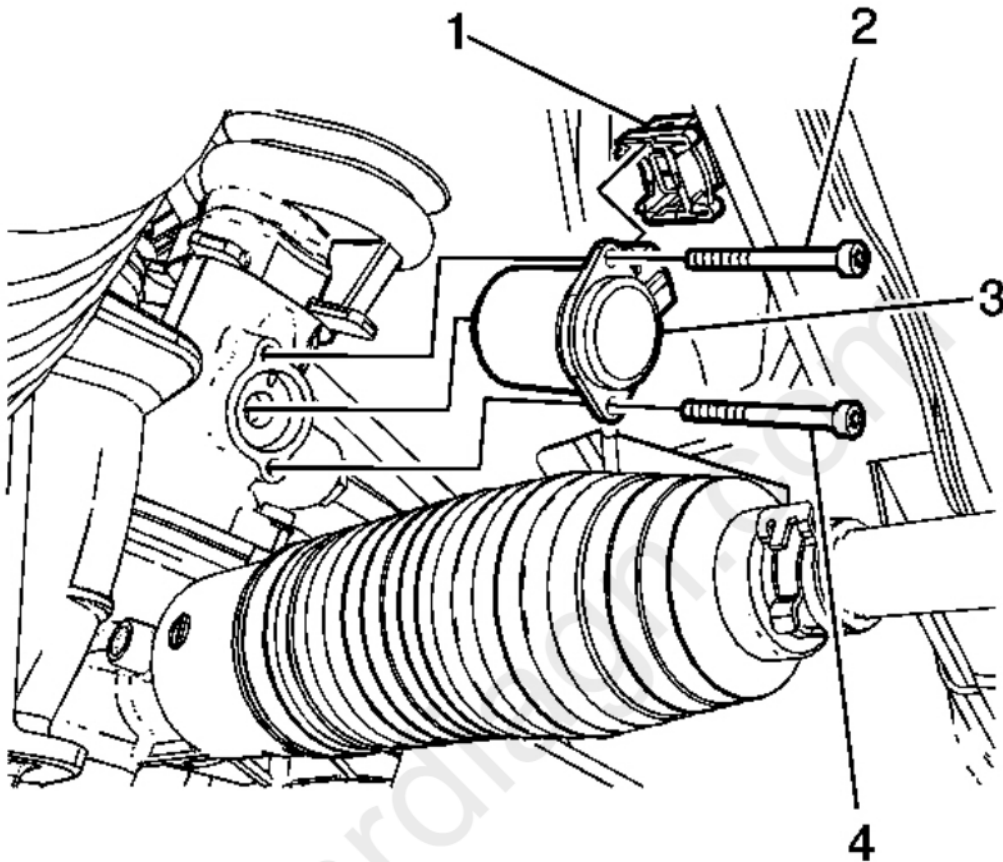


Fig. 53: Identifying Electrical Connector & Steering Gear Valve Solenoid
 Courtesy of GENERAL MOTORS CORP.

1. Install the steering gear valve solenoid (3) to the steering gear.

CAUTION: Refer to Fastener Caution .

2. Install the lower steering gear valve solenoid bolt (4) to the lower bolt hole and tighten to 0.5 N.m (4.4 lb in).
3. Install the upper steering gear valve solenoid bolt (2) to the upper bolt hole and tighten to 1.5 N.m (13.3 lb in).
4. Tighten the lower steering gear valve solenoid bolt to 2.9 N.m (25.7 lb in).
5. Tighten the upper steering gear valve solenoid bolt to 2.9 N.m (25.7 lb in).
6. Connect the electrical connector (1) to the steering gear valve solenoid.

7. Lower the vehicle.
8. Fill and bleed the power steering system. Refer to **Power Steering System Bleeding**.
9. Clean any excess power steering fluid from the vehicle.
10. Remove the drain pans.

DESCRIPTION AND OPERATION

POWER STEERING SYSTEM DESCRIPTION AND OPERATION

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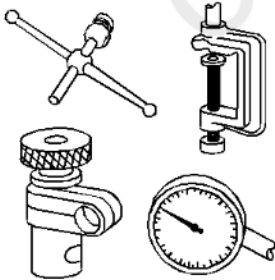
Turning the steering wheel activates the valve assembly, which applies greater fluid pressure and flow to one side of the steering gear piston, and lower pressure and flow to the other side of the piston. The pressure assists the movement of the gear piston. Tie rods transfer this force to the front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

VARIABLE EFFORT STEERING SYSTEM DESCRIPTION AND OPERATION

The variable effort steering system varies the amount of effort to steer the vehicle as wheel speed changes or lateral acceleration occurs. The electronic brake control module (EBCM) controls an actuator located in the steering rack and pinion. The actuator consists of an electromagnetic coil and a normally open pintle valve. The valve regulates an orifice that bleeds inlet pressure through a return passage to regulate the amount of pressure available for steering assist. The EBCM commands current from 0-1 A to the variable effort steering actuator which varies the amount of effort required to steer the vehicle. At high speeds, 1 A of current is commanded to the variable effort steering actuator and the pintle valve is fully closed which provides minimum pressure for a firm steering feel and directional stability. The variable effort steering system uses the steering wheel position sensor input to calculate lateral acceleration during abrupt driving maneuvers. The system also uses the antilock brake system (ABS) wheel speed sensor inputs to determine vehicle speed. The EBCM is constantly monitoring these inputs to achieve the desired current to the variable effort steering actuator. The EBCM has the ability to detect malfunctions in the variable effort steering actuator or the circuits to the actuator. Any malfunctions detected will cause the variable effort steering outputs to be disabled, and the actuator will return to an open state. The EBCM will command the driver information center to display the SERVICE STEERING SYSTEM warning message via a serial data circuit.

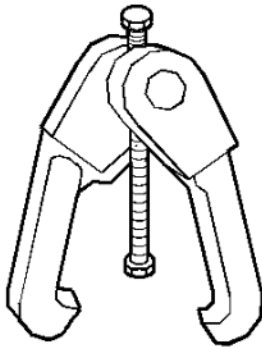
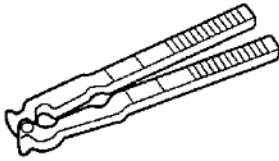
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

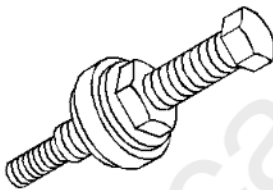
Illustration	Tool Number/Description
	J-8001 Dial Indicator Set
	J-22610 Keystone Clamp Pliers

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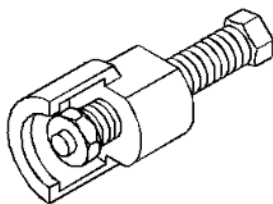
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J-24319-B
Steering Linkage and Tie Rod Puller



J-25033-C
CH-25033
KM-J-25033
8996415
Pulley Installer

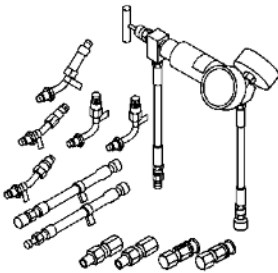
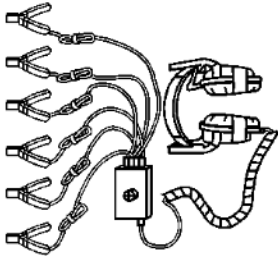


J-25034-C
CH-25034
KM-J-25034
8996423
Pulley Remover

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Chassis Ear



J-44721
CH-354-B
KM-354-B
Power Steering Analyzer

