

2017 STEERING**Power Steering - Encore, Trax****SPECIFICATIONS****FASTENER SPECIFICATIONS****Single Use Non-Threaded Fasteners/Components****NOTE:**

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application
Power Steering Gear Inlet Hose Seal
Power Steering Gear Outlet Hose Seal
Steering Gear Boot Inner Clamp
Steering Linkage Inner Tie Rod Washer

Single Use Threaded Fastener/Component Tightening Specifications**NOTE:**

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application	Specification
	Metric (English)
Steering Gear Bolt	
First Pass:	100 N.m (74 lb ft)
Final Pass:	90-105 degrees

Reusable Threaded Fastener Tightening Specifications**NOTE:**

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Power Steering Fluid Cooler Bracket Nut	9 N.m (80 lb in)
Power Steering Fluid Reservoir Bolt	9 N.m (80 lb in)
Power Steering Gear Inlet and Outlet Hose Bolt	11 N.m (97 lb in)
Power Steering Gear Inlet Hose	34 N.m (25 lb ft)
Power Steering Gear Inlet Hose Bracket Bolt @ Drivetrain and Front Suspension Frame	9 N.m (80 lb in)
Power Steering Gear Inlet Hose Bracket Bolt @ Engine	22 N.m (16 lb ft)
Power Steering Gear Outlet Hose Bracket Bolt @ Drivetrain and Front Suspension Frame	9 N.m (80 lb in)
Power Steering Pump Bolt	22 N.m (16 lb ft)
Power Steering Pump Bracket Bolt	22 N.m (16 lb ft)
Power Steering Pump Rear Brace Nut	22 N.m (16 lb ft)
Steering Gear Pipe	13 N.m (115 lb in)
Steering Linkage Inner Tie Rod (N40)	88 N.m (65 lb ft)

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Steering Linkage Inner Tie Rod (NJ1)	70 N.m (52 lb ft)
Steering Linkage Outer Tie Rod	
• First Pass:	30 N.m (22 lb ft)
• Final Pass:	120-135 degrees

POWER STEERING PUMP SPECIFICATIONS

Engine Code	Engine Size	High Flow		Pressure Relief	
		LPM	GPM	kPa	PSI
LDC LWD	1.2L	6	1.6	10500/11300	1523/1639
LDV LSF	1.3L	6	1.6	10500/11300	1523/1639
LCD LDD LDW L2I L2N	1.4L	6	1.6	10500/11300	1523/1639
LDE LED LFJ	1.6L	6	1.6	10500/11300	1523/1639

APPROXIMATE FLUID CAPACITIES

Application	Specification	
	Metric	US English
Power Steering System	0.9 L	1.9 pt

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number
Steering Fluid	Lubricant	Refer to Electronic Parts Catalog
Locking Agent	Threadlock	Refer to Electronic Parts Catalog

SCHEMATIC WIRING DIAGRAMS**POWER STEERING WIRING SCHEMATICS (ENCORE)**

Power Steering (Encore)

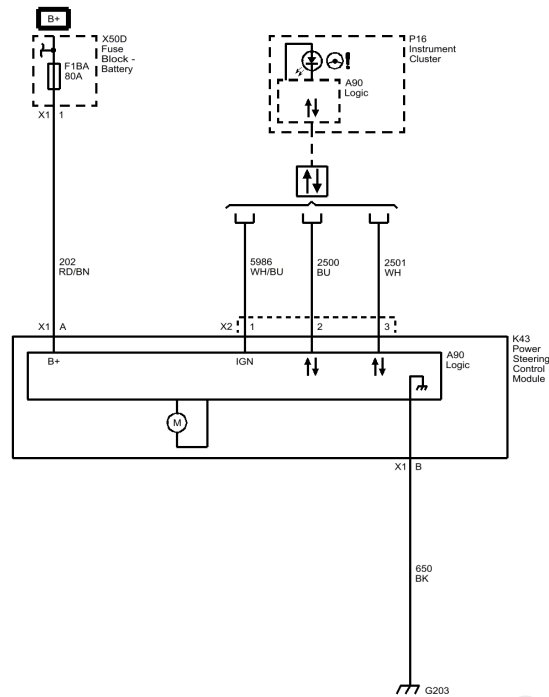


Fig. 1: Power Steering (Encore)

Courtesy of GENERAL MOTORS COMPANY

POWER STEERING WIRING SCHEMATICS (TRAX)

Power Steering (Trax with NJ1)

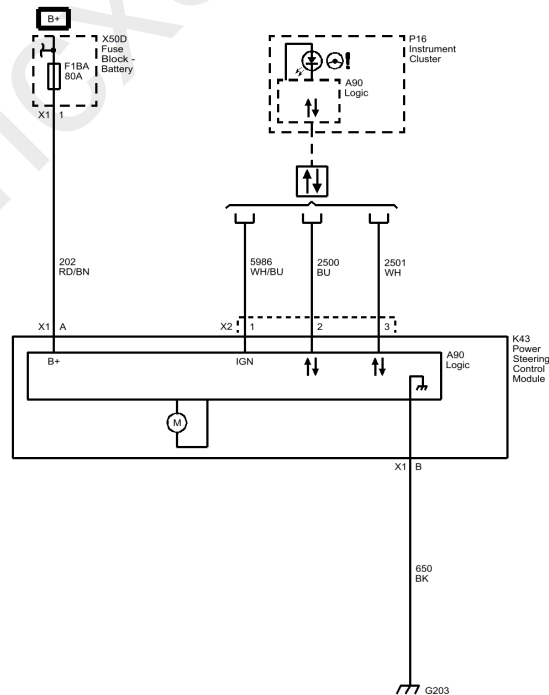


Fig. 2: Power Steering (Trax with NJ1)

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC C0176: CONTROL MODULE TEMPERATURE SENSOR HIGH TEMPERATURE

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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC C0176 54

Control Module Temperature Sensor High Temperature

Circuit/System Description

The power steering control module monitors the temperature of the power steering system. The power steering control module uses voltage, current levels and input from an internal temperature sensor to calculate an estimated system temperature. If the power steering control module detects a high system temperature event is occurring, the amount of assist is decreased to reduce system temperature, in effort to prevent thermal damage to the power steering components.

Conditions for Running the DTC

- Ignition ON, engine running.
- Power steering system voltage is 9-16 V.
- Repetitive steering input applied.

Conditions for Setting the DTC

The power steering control module detects a high system temperature.

Action Taken When the DTC Sets

- DTC C0176 54 is stored in memory.
- Steering assist is reduced.

Conditions for Clearing the DTC

A current DTC will clear on the next malfunction-free ignition cycle.

Diagnostic Aids

- DTC C0176 54 does not indicate that a malfunction has occurred. Rather that the power steering control module had to limit current to the power steering motor to avoid thermal damage to the power steering system components. Discuss with the customer about driving conditions when the steering assist was reduced.
- Ensure that no steering components down stream of the power steering column assembly, such as ball joints, tie rod ends, universal joints, or the steering gear assembly, are mechanically binding.

Reference Information

Schematic Reference

[Power Steering Schematics \(Buick\)](#)[Power Steering Schematics \(Chevrolet\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#) [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

Description and Operation

[Power 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](#) for scan tool information.

Circuit/System Verification

1. Verify that the DTC sets outside of the conditions for running and setting. Since most occurrences of this DTC are caused by excessive driver inputs, review with the customer the conditions under which the DTC set.
 - **If the DTC did not set outside of the conditions for running and setting**
 1. Ignition ON.
 2. Operate the vehicle within the conditions that the customer experienced, avoiding excessive inputs, and verify the DTC does not reset.
 - If the DTC is set
 1. Verify that no steering components down stream of the power steering column assembly are mechanically binding. Refer to [Steering Effort Hard or Too Easy in One or Both Directions \(N40\)Steering Effort Hard or Too Easy in One or Both Directions \(NJ1\)](#)
 - If steering components are mechanically binding, replace the mechanically binding steering components.
 - If no steering components are mechanically binding, replace the steering column assembly.
 - If the DTC is not set
 - 3. All OK.
 - **If the DTC set outside of the conditions for running and setting**
2. All OK. The power steering is operating as designed.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Steering Column Replacement \(Buick, Mexico, NJ1, With BTM, With N06\) Steering Column Replacement \(Buick, Canada/United States, NJ1, With BTM, Without N06\) Steering Column Replacement \(Chevrolet, Mexico, NJ1, With BTM, With N06\) Steering Column Replacement \(Chevrolet, Canada/United States, NJ1, With BTM, Without N06\) Steering Column Replacement \(Chevrolet, Canada/United States, NJ1, Without BTM, Without N06\) Steering Column Replacement \(Chevrolet, Mexico, NJ1, Without BTM, Without N06\) Steering Column Replacement \(Mexico, N40\)](#)
- Refer to [Control Module References](#) for Power Steering Control Module replacement, programming and setup.

DTC C0475: ELECTRIC STEERING MOTOR

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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC C0475 00

Electric Steering Motor Circuit Malfunction

DTC C0475 64

Electric Steering Motor Slip Detected

Circuit/System Description

The power steering control module continuously monitors the voltage and current levels being commanded to the 3-phase steering assist motor. The power steering control module compares the desired and actual current levels to detect malfunctions in the internal power steering assist motor circuits.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The power steering control module detects a short to ground, short to voltage, or an open/high resistance on any of the internal power steering assist motor circuits.

Action Taken When the DTC Sets

- The DTC is stored in memory.
- No steering assist.

Conditions for Clearing the DTC

A history DTC will clear after 40 consecutive malfunction free ignition cycles.

Reference Information

Schematic Reference

Power Steering Schematics (Buick)Power Steering Schematics (Chevrolet)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE) COMPONENT CONNECTOR END VIEWS - INDEX (TRAX)

Description and Operation

Power 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 for scan tool information.

Circuit/System Testing

1. Verify that DTC C0475 is not set.
 - **If the DTC is set**

Replace the K43 Power Steering Control Module.
 - **If the DTC is not set**
2. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Steering Column Replacement (Buick, Mexico, NJ1, With BTM, With N06) Steering Column Replacement (Buick, Canada/United States, NJ1, With BTM, Without N06) Steering Column Replacement (Chevrolet, Mexico, NJ1, With BTM, With N06) Steering Column Replacement

- Refer to [Control Module References](#) for power steering control module replacement, programming and setup.

DTC C0545: STEERING WHEEL TORQUE SENSOR

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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC C0545 00

Steering Wheel Torque Sensor Malfunction

DTC C0545 4B

Steering Wheel Torque Sensor Calibration Not Learned

Circuit/System Description

The power steering control module continuously monitors the digital torque sensor's torque signal. As the steering wheel is turned and torsional twist is applied to the steering shaft, the steering input and output shafts are monitored via the torque signal circuit and then processed by the power steering control module to calculate the steering torque.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The power steering control module detects a short to ground, short to voltage, or an open/high resistance on any of the torque sensor circuits.

Action Taken When the DTC Sets

- DTC C0545 is stored in memory.
- No steering assist.

Conditions for Clearing the DTC

A history DTC will clear after 40 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

[Power Steering Schematics \(Buick\)](#)[Power Steering Schematics \(Chevrolet\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#)[COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

Description and Operation

[Power 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](#) for scan tool information.

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Steering Input Torque parameter changes when turning the steering wheel.
 - **If the parameter does not change**
 1. Program the K43 Power Steering Control Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the Steering Column.
 - If the DTC does not set
 3. All OK.
 - **If the parameter changes**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Steering Column Replacement \(Buick, Mexico, NJ1, With BTM, With N06\)](#) [Steering Column Replacement \(Buick, Canada/United States, NJ1, With BTM, Without N06\)](#) [Steering Column Replacement \(Chevrolet, Mexico, NJ1, With BTM, With N06\)](#) [Steering Column Replacement \(Chevrolet, Canada/United States, NJ1, With BTM, Without N06\)](#) [Steering Column Replacement \(Chevrolet, Canada/United States, NJ1, Without BTM, Without N06\)](#) [Steering Column Replacement \(Chevrolet, Mexico, NJ1, Without BTM, Without N06\)](#) [Steering Column Replacement \(Mexico, N40\)](#)
- Refer to [Control Module References](#) for power steering control module replacement, programming and setup.

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.
- If equipped with hydraulic power steering, inspect for leaking power steering components. If necessary, refer to [Power Steering Fluid Leaks](#).
- If equipped with hydraulic power steering, verify the power steering fluid level is correct. Refer to [Checking and Adding Power Steering Fluid](#).
- If equipped with hydraulic power steering, inspect the power steering fluid for the following indications of contamination:
 - Milky fluid - water
 - Brown fluid - burnt
 - Debris in fluid - plastic or dirt
- If the hydraulic power steering system is contaminated, flush the power steering system. Refer to [Power Steering System Flushing](#).

Symptoms List

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

- Power Steering Fluid Leaks
- Rattle, Clunk, Pop or Shudder Noise from the Power Steering System (NJ1)Rattle, Clunk, Pop or Shudder Noise from the Power Steering System (N40)
- Whine or Growl Noise from the Power Steering System (N40)Whine or Growl Noise from the Power Steering System (NJ1)
- Increase in Effort While Turning Steering Wheel
- Poor Return of Steering Wheel
- Steering Effort Hard or Too Easy in One or Both Directions (N40)Steering Effort Hard or Too Easy in One or Both Directions (NJ1)

POWER STEERING SYSTEM TEST

Special Tools

CH-44721 Power Steering Analyzer

For equivalent regional tools, refer to [Special Tools](#).

Rack and Pinion System

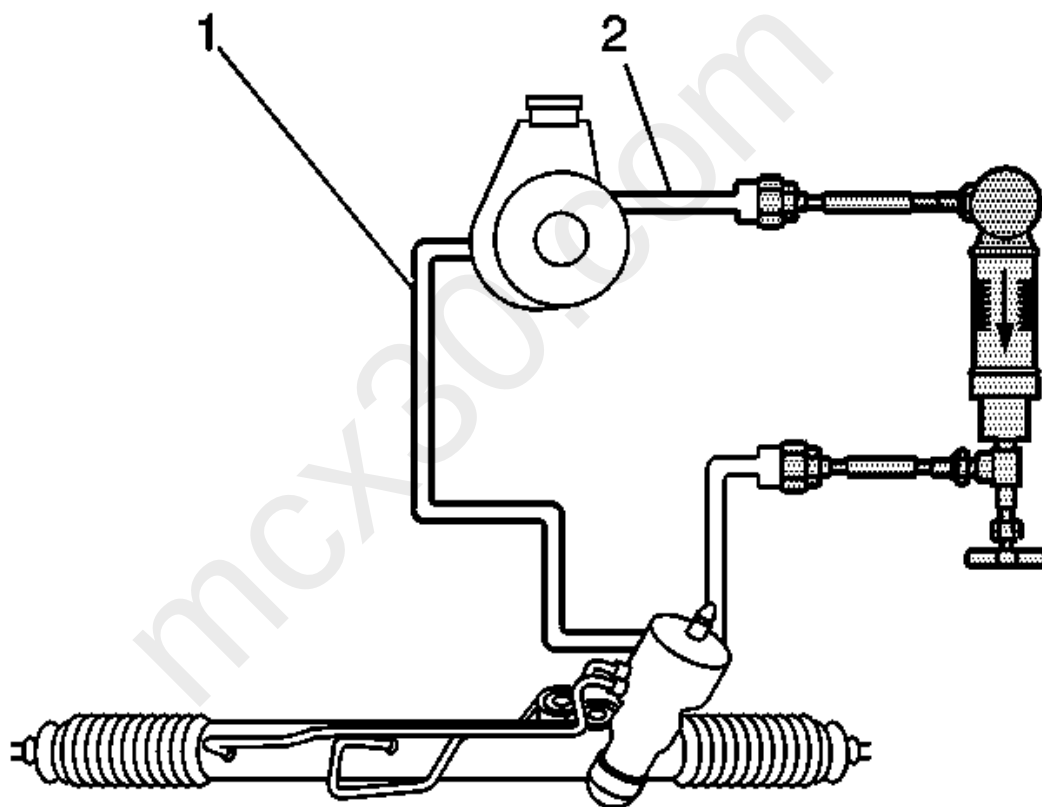


Fig. 3: Testing Rack And Pinion System Pressures
Courtesy of GENERAL MOTORS COMPANY

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.

This step tests the system for restrictions.

7

This step tests the following components for the following conditions:

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

8

This step tests the ability of the power steering pump to regulate flow at maximum pressure.

10

This step tests the ability of the power steering pump to regulate flow under normal operating conditions.

12

This step tests the internal components of the power steering pump and the steering 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 the 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 Power Steering System Flushing . 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 steering gear as necessary. 4. Install the CH-44721 analyzer. 5. Fill the power steering system. Refer to Checking and Adding Power Steering Fluid . Did you complete the installation?	-	Go to Step 5	-

Step	Action	Value(s)	Yes	No
5	1. Fully open the CH-44721 analyzer valve. 2. Start the engine. CAUTION: Do not hold the steering wheel in the full turn position longer than 5 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. With the steering wheel OFF of 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 CH-44721 analyzer valve until the system pressure reaches the specified value, then record the FLOW reading. 4. Subtract the 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
8	NOTE: Do not leave the valve closed for more than 5 seconds, or internal pump damage could accrue. Fully close then open the CH-44721 analyzer valve 3 times. Record all of the high pressure readings. Refer to Power Steering Pump Specifications for the 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

Step	Action	Value(s)	Yes	No
10	1. Increase the engine speed to approximately 1,500 RPM. 2. Record the flow reading. Refer to Power Steering Pump Specifications for the power steering system high flow specifications. Is the actual flow reading within specifications?	-	Go to Step 11	Go to Step 13
11	Is the difference between the actual flow reading and the maximum flow specification more than 3.8 L (1 gal) per minute?	-	Go to Step 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 L (1 gal) per minute?	-	Go to Step 15	Go to Step 14
13	Replace the power steering pump. Refer to Power Steering Pump Replacement . Did you complete the replacement?	-	Go to Step 15	-
14	The steering gear is leaking across the piston or bypassing the valve circuit. Replace the steering gear. Refer to Steering Gear Replacement (N40 With MNK) Steering Gear Replacement (NJ1 With MNH or MNK) Steering Gear Replacement (NJ1 With MR5) Steering Gear Replacement (N40 With M4P) . 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 CH-44721 analyzer from the vehicle. 2. Connect the vehicle power steering pipes/hoses. 3. Fill and bleed the power steering system. Refer to Power Steering System Bleeding . Did you complete the procedure?	-	System OK	-

POWER STEERING FLUID LEAKS

Special Tools

GE-28431-6 Fluorescent Dye

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

NOTE:

- If fluid is found on a manual steering gear or on an electronic power steering gear, do not replace steering gear. Vehicles equipped with these systems do not use hydraulic power steering fluid. The fluid may be assembly fluid or another system fluid.
- Clean the components and identify the sources of the leaks before attempting to repair or replace any power steering components. Clearly mark all locations of leaks with paint, marker, or equivalent for warranty identification and engineering root cause analysis.

Some customers may comment on a fluid LEAK or NOISY power steering pump. Upon inspection, the technician may find power steering fluid leaking from the hydraulic power steering system. Use the following inspection

procedure in order to diagnose the source of the leak and take appropriate action to correct the condition.

1. Inspect the fluid level in the power steering fluid reservoir. Refer to [Checking and Adding Power Steering Fluid](#). If the fluid level is NOT low, a careful analysis of the condition is necessary to confirm that the type of fluid is actually power steering fluid.
2. Visually inspect the power steering system and components where the fluid has accumulated.

CAUTION: Do not clean using brake cleaner or other reactive solvents as these solvents can damage rubber gaskets, seals and bushings.

3. Use a clean towel or a rag in order to completely clean off all residual fluid from the power steering components.
4. Add 30 cc (1 oz) of **GE-28431-6** dye to the power steering fluid.
5. Start the vehicle and warm the steering system by turning to the left steering stop and to the right steering stop 10 times with the weight of the vehicle on the front tires.
6. Turn vehicle engine OFF.
7. Shine a black light on the area where the residual fluid accumulated. Identify the sources of the leaks.
8. Mark all locations of leaks with paint, marker, or equivalent.
9. Repair or replace all affected components.

RATTLE, CLUNK, POP OR SHUDDER NOISE FROM THE POWER STEERING SYSTEM (NJ1)

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 Symptoms - Steering Wheel and Column
2	Verify a rattle noise is present by driving the vehicle on a rough road. Verify a clunk noise is present by turning the steering wheel to the left and to the right several times with the key in the ON position. Is a rattle or a clunk noise present?	Go to Step 3	System OK
3	Inspect the steering gear for the proper installation. Is the steering gear installation incorrect?	Go to Step 6	Go to Step 4
4	Inspect the intermediate steering shaft. Is the intermediate steering shaft worn?	Go to Step 8	Go to Step 5
5	Inspect the front suspension. Refer to Noise Diagnosis - Front Suspension . Is the front suspension worn?	Go to Step 7	Go to Step 3
6	Install the steering gear correctly. Refer to Steering Gear Replacement (NJ1 With MNH or MNK) Steering Gear Replacement (NJ1 With MR5) . Did you complete the repair?	Go to Step 9	-
7	Replace the worn front suspension component that is causing the noise. Did you complete the repair?	Go to Step 9	-
8	Replace the intermediate steering shaft. Refer to Intermediate Steering Shaft Replacement (NJ1) . Did you complete the repair?	Go to Step 9	-
9	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

RATTLE, CLUNK, POP OR SHUDDER NOISE FROM THE POWER STEERING SYSTEM (N40)

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 Symptoms - Power Steering System
2	Verify that a rattle, clunk or shudder noise is present. Is a rattle, clunk or shudder noise present?	Go to Step 3	System OK

Step	Action	Yes	No
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 Falls Off and Excessive Wear Diagnosis</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 and the power steering mounting bracket 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 (N40 With MNK)</u> <u>Steering Gear Replacement (N40 With M4P)</u> . Is the power steering gear installation incorrect?	Go to Step 15	Go to Step 8
8	Inspect for looseness in the inner tie rods or in the outer tie rods. Refer to <u>Steering Linkage Inner Tie Rod Inspection</u> , and to <u>Steering Linkage Outer Tie Rod Inspection</u> . Are the inner tie rods or the outer tie rods worn?	Go to Step 16	Go to Step 9
9	Inspect the suspension. Refer to <u>Noise Diagnosis - Front Suspension</u> . 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
11	Adjust or replace the hoses. Refer to the appropriate procedures: • <u>Power Steering Fluid Reservoir Inlet Pipe Replacement</u> • <u>Power Steering Fluid Reservoir Outlet Hose Replacement</u> • <u>Power Steering Gear Inlet Pipe/Hose Replacement</u> • <u>Power Steering Gear Outlet Pipe/Hose Replacement</u> Did you complete the repair?	Go to Step 19	-
12	Replace the drive belt. Refer to <u>Power Steering Pump 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 (N40 With MNK)</u> <u>Steering Gear Replacement (N40 With M4P)</u> . Did you complete the repair?	Go to Step 19	-

Step	Action	Yes	No
16	Replace either the worn inner tie rod or the worn outer tie rod. Refer to Steering Linkage Inner Tie Rod Replacement (N40) , or to Steering Linkage Outer Tie Rod Replacement . 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 Intermediate Steering Shaft Replacement (N40) . 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 (N40)

Step	Action	Yes	No
Special Tools CH-39570 Chassis Ear For equivalent regional tools, refer to Special Tools .			
1	Did you review the Power Steering System Description and Operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Power Steering System
2	Verify that a whine or growl noise is present. Is a whine or growl noise present?	Go to Step 3	System OK
3	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 5	Go to Step 4
4	Flush the power steering system. Refer to Power Steering System Flushing . Did you complete the procedure?	Go to Step 11	Go to Step 5
5	Using the CH-39570 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 CH-39570 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 CH-39570 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 Steering Gear Replacement (N40 With MNK) Steering Gear Replacement (N40 With M4P) . Did you complete the repair?	Go to Step 11	-
9	Replace the power steering pump. Refer to Power Steering Pump Replacement . 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

WHINE OR GROWL NOISE FROM THE POWER STEERING SYSTEM (NJ1)

Step	Action	Yes	No
Special Tools CH-39570 Chassis Ear For equivalent regional tools, refer to Special Tools .			
1	Did you review the Power Steering System Description and Operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Power Steering System
2	Verify that a whine or growl noise is present. Is a whine or growl noise present?	Go to Step 3	System OK
3	Inspect the power steering gear for looseness and/or worn bushings. Is the steering gear loose or are the bushings worn?	Go to Step 6	Go to Step 4
4	Inspect the power steering motor for a whine or growl noise using the CH-39570 ear. Is the noise present at the power steering motor?	Go to Step 7	Go to Step 5
5	Inspect the power steering gear for a whine or growl noise using the CH-39570 ear. Is the noise present at the power steering gear?	Go to Step 8	Go to Step 3
6	Tighten the power steering gear fasteners or replace the power steering gear due to worn bushings. Refer to Steering Gear Replacement (NJ1 With MNH or MNK) Steering Gear Replacement (NJ1 With MR5) . Did you complete the repair?	Go to Step 9	-
7	Replace the steering column, which includes the electronic power steering assist motor control unit. Refer to Steering Column Replacement (Buick, Mexico, NJ1, With BTM, With N06) Steering Column Replacement (Buick, Canada/United States, NJ1, With BTM, Without N06) Steering Column Replacement (Chevrolet, Mexico, NJ1, With BTM, With N06) Steering Column Replacement (Chevrolet, Canada/United States, NJ1, With BTM, Without N06) Steering Column Replacement (Chevrolet, Canada/United States, NJ1, Without BTM, Without N06) Steering Column Replacement (Chevrolet, Mexico, NJ1, Without BTM, Without N06) . Did you complete the repair?	Go to Step 9	-
8	Replace the power steering gear. Refer to Steering Gear Replacement (NJ1 With MNH or MNK) Steering Gear Replacement (NJ1 With MR5) . Did you complete the repair?	Go to Step 9	-
9	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

INCREASE IN EFFORT WHILE TURNING STEERING WHEEL

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 Symptoms - Power Steering System
2	Verify that there is an increase in effort while turning is present. Does the system operate normally?	System OK	Go to Step 3

Step	Action	Yes	No
3	Check for the following tire related conditions: • Incorrect tire inflation - Refer to Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label . • Improper tire size Did you find and correct the condition?	Go to Step 10	Go to Step 4
4	1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle . 2. Check for a binding or worn tie rod end. Is the tie rod binding or worn?	Go to Step 7	Go to Step 5
5	Check for a worn or binding intermediate shaft. Is the intermediate shaft worn or binding?	Go to Step 8	Go to Step 6
6	Check for a worn or binding steering gear. Is the steering gear worn or binding?	Go to Step 9	System OK
7	Replace the outer tie rod. Refer to Steering Linkage Outer Tie Rod Replacement . Did you complete the repair?	Go to Step 10	-
8	Replace the intermediate shaft. Refer to Intermediate Steering Shaft Replacement (N40) Intermediate Steering Shaft Replacement (NJ1) . Did you complete the repair?	Go to Step 10	-
9	Replace the steering gear. Refer to Steering Gear Replacement (N40 With MNK) Steering Gear Replacement (NJ1 With MNH or MNK) Steering Gear Replacement (NJ1 With MR5) Steering Gear Replacement (N40 With M4P) . Did you complete the repair?	Go to Step 10	-
10	Operate the system in order to verify the repair. Did you correct the condition?	System OK	-

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 Symptoms - Power Steering System
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 Lifting and Jacking the Vehicle . 2. Lubricate the tie rod ends and ball joints, if applicable. 3. Inspect the suspension system for worn or damaged components. 4. Repair as necessary. Did you find and correct the condition?	Go to Step 12	Go to Step 4

Step	Action	Yes	No
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
8	1. Use your hands to rotate the steering knuckle inboard and outboard in order to inspect for a 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 HARD OR TOO EASY IN ONE OR BOTH DIRECTIONS (N40)

Step	Action	Yes	No
1	Did you review the Power Steering System General Description and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Power Steering System
2	Verify that the steering effort is hard or too easy in one or both directions. Does the system operate normally?	System OK	Go to Step 3
3	Perform the power steering test procedure. Refer to Power Steering System Test . 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 OR TOO EASY IN ONE OR BOTH DIRECTIONS (NJ1)

Condition	Action
The battery power is low.	Confirm proper battery voltage.
The intermediate shaft dash seal is binding.	Adjust the dash seal, or replace the intermediate shaft assembly if necessary. Refer to Intermediate Steering Shaft Replacement (NJ1) .
The intermediate shaft joints are loose or worn.	Inspect the joints and the pinch bolts for damage, and replace the intermediate shaft if necessary. Refer to Intermediate Steering Shaft Replacement (NJ1) .
The steering gear is binding.	If necessary, inspect and replace the steering gear. Refer to Steering Gear Replacement (NJ1 With MNH or MNK) Steering Gear Replacement (NJ1 With MR5) .
The upper steering shaft is bent.	If necessary, replace the steering column. Refer to Steering Column Replacement (Buick, Mexico, NJ1, With BTM, With N06) Steering Column Replacement (Buick, Canada/United States, NJ1, With BTM, Without N06) Steering Column Replacement (Chevrolet, Mexico, NJ1, With BTM, With N06) Steering Column Replacement (Chevrolet, Canada/United States, NJ1, With BTM, Without N06) Steering Column Replacement (Chevrolet, Canada/United States, NJ1, Without BTM, Without N06) Steering Column Replacement (Chevrolet, Mexico, NJ1, Without BTM, Without N06) .
The assist mechanism hub gear is misaligned or damaged.	Replace the steering column. Refer to Steering Column Replacement (Buick, Mexico, NJ1, With BTM, With N06) Steering Column Replacement (Buick, Canada/United States, NJ1, With BTM, Without N06) Steering Column Replacement (Chevrolet, Mexico, NJ1, With BTM, With N06) Steering Column Replacement (Chevrolet, Canada/United States, NJ1, With BTM, Without N06) Steering Column Replacement (Chevrolet, Canada/United States, NJ1, Without BTM, Without N06) Steering Column Replacement (Chevrolet, Mexico, NJ1, Without BTM, Without N06) .

Condition	Action
The sensor wire is damaged.	Replace the steering column. Refer to Steering Column Replacement (Buick, Mexico, NJ1, With BTM, With N06) Steering Column Replacement (Buick, Canada/United States, NJ1, With BTM, Without N06) Steering Column Replacement (Chevrolet, Mexico, NJ1, With BTM, With N06) Steering Column Replacement (Chevrolet, Canada/United States, NJ1, With BTM, Without N06) Steering Column Replacement (Chevrolet, Canada/United States, NJ1, Without BTM, Without N06) Steering Column Replacement (Chevrolet, Mexico, NJ1, Without BTM, Without N06) .
The controller is malfunctioning.	Confirm the DTC. If necessary, replace the steering column, which includes the motor and module assembly. Refer to Steering Column Replacement (Buick, Mexico, NJ1, With BTM, With N06) Steering Column Replacement (Buick, Canada/United States, NJ1, With BTM, Without N06) Steering Column Replacement (Chevrolet, Mexico, NJ1, With BTM, With N06) Steering Column Replacement (Chevrolet, Canada/United States, NJ1, With BTM, Without N06) Steering Column Replacement (Chevrolet, Canada/United States, NJ1, Without BTM, Without N06) Steering Column Replacement (Chevrolet, Mexico, NJ1, Without BTM, Without N06) .
The motor shaft is binding.	Confirm the DTC. If necessary, replace the steering column, which includes the motor and module assembly. Refer to Steering Column Replacement (Buick, Mexico, NJ1, With BTM, With N06) Steering Column Replacement (Buick, Canada/United States, NJ1, With BTM, Without N06) Steering Column Replacement (Chevrolet, Mexico, NJ1, With BTM, With N06) Steering Column Replacement (Chevrolet, Canada/United States, NJ1, With BTM, Without N06) Steering Column Replacement (Chevrolet, Canada/United States, NJ1, Without BTM, Without N06) Steering Column Replacement (Chevrolet, Mexico, NJ1, Without BTM, Without N06) .

REPAIR INSTRUCTIONS

WIRE TO WIRE REPAIR - STEERING

Special Tools

- EL-38125-10 Splice Sleeve Crimping Tool (non GMNA)
- J-38125-5A Ultra Torch Special Tool
- J-38125-8 Splice Sleeve Crimping Tool (GMNA)

For equivalent regional tools, refer to [Special Tools](#) .

WARNING:

In order to reduce the risk of personal injury, loss of high voltage isolation to ground and higher system impedance, do not attempt to repair any HV wiring, connector, or terminal that is damaged. High voltage coaxial type cables are not repairable. Never attempt to repair a coaxial type cable. The entire cable/harness or component must be replaced. In order to maintain system integrity and personal safety, never attempt to repair any high voltage wiring, cables, or terminals. Performing this procedure on high voltage circuits may result in serious injury or death.

NOTE: If the wiring harness internal to the transmission is damaged, the wiring harness must be replaced. The use of splice sleeves in an attempt to repair the internal transmission wires, connectors, or terminals could result in performance issues.

NOTE: Do not splice wires in Door Harness Grommets.

NOTE: The DuraSeal splice sleeves have the following 2 critical features:

- A special heat shrink sleeve environmentally seals the splice. The heat shrink sleeve contains a sealing adhesive inside.
- A cross hatched (knurled) core crimp provides the necessary low resistance contact integrity for these sensitive, low energy circuits.

Use only DuraSeal splice sleeves to form a one-to-one splice on all types of insulation except high voltage and specialty cables. Use DuraSeal splice sleeves where there are special requirements such as moisture sealing. Follow the instructions below in order to splice copper wire using DuraSeal splice sleeves.

Splice Sleeve Selection

Splice Sleeve Color	Crimp Tool Nest Color		Wire Gauge mm ² / (AWG)
	3 Crimp Nests	4 Crimp Nests	
Salmon (Yellow-Pink) 19300089	Red (1) or Red/Green (1)	Red (2)	0.22-0.8/(18-26)
Blue 19168447	Blue (2)	Blue (3)	1.0-2.0/(14-16)
Yellow 19168448	Yellow (3)	Yellow (4)	3.0-5.0/(10-12)

NOTE: You must perform the following procedures in the listed order. Repeat the procedure if any wire strands are damaged. You must obtain a clean strip with all of the wire strands intact.

1. Open the harness by removing any tape:
 - Use a sewing seam ripper, available from sewing supply stores, in order to cut open the harness in order to avoid wire insulation damage.
 - Use the DuraSeal splice sleeves on all types of insulation except Tefzel and coaxial.
 - Do not use the crimp and DuraSeal splice sleeve to form a splice with more than 2 wires coming together.
2. Cut as little wire off the harness as possible. You may need the extra length of wire in order to change the location of a splice.

Adjust splice locations so that each splice is at least 40 mm (1.5 in) away from the other splices, harness branches, or connectors.

3. Strip the insulation:
 - When adding a length of wire to the existing harness, use the same size wire as the original wire.
 - Perform one of the following items in order to find the correct wire size:
 - Find the wire on the schematic and convert to regional wiring gauge size.
 - If you are unsure of the wire size, begin with the largest opening in the wire stripper and work down until achieving a clean strip of the insulation.
 - Strip approximately 5.0 mm (0.20 in) of insulation from each wire to be spliced.
 - Do not nick or cut any of the strands. Inspect the stripped wire for nicks or cut strands.
 - If the wire is damaged, repeat this procedure after removing the damaged section.
4. For high temperature wiring, slide a section of high temperature SCT1 shrink tubing down the length of wire to be spliced. Ensure that the shrink tubing will not interfere with the splice procedure.
5. Select the proper DuraSeal splice sleeve according to the wire size. Refer to the above table at the beginning of the repair procedure for the color coding of the DuraSeal splice sleeves and the crimp tool nests.

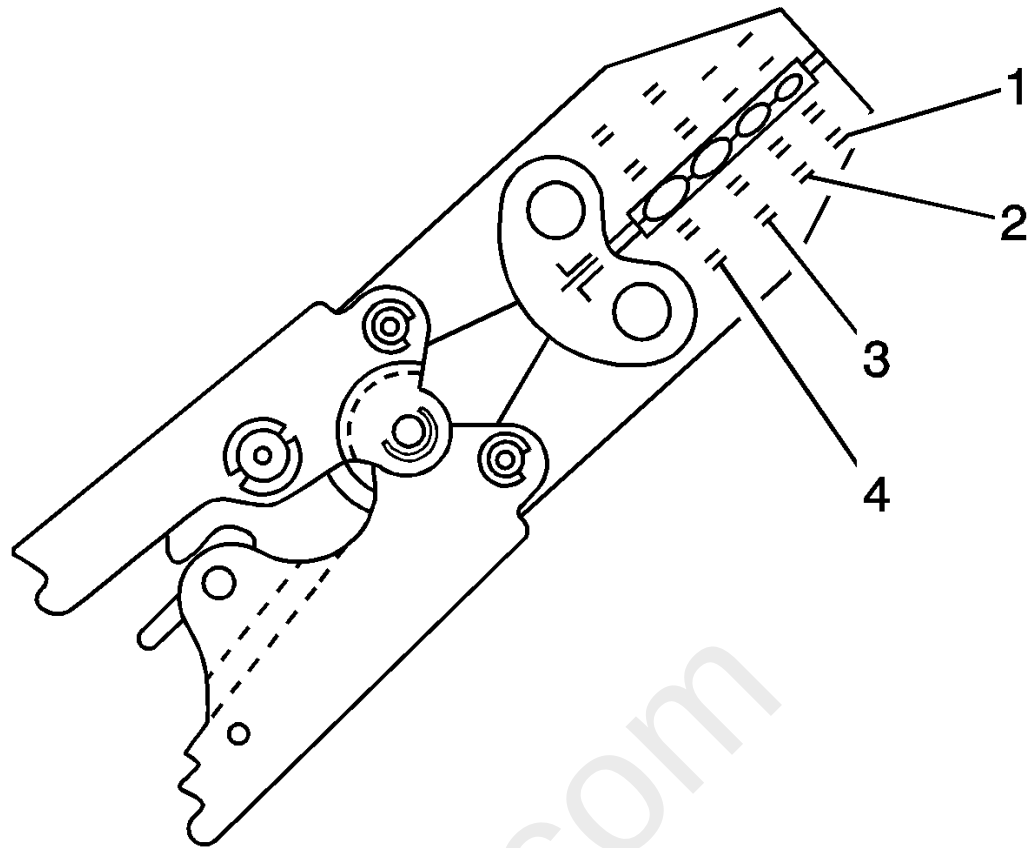


Fig. 4: Splice Sleeve Crimping Tool With 4 Crimp Nests
Courtesy of GENERAL MOTORS COMPANY

6. The **EL-38125-10** splice sleeve crimping tool has four crimp nests. The largest crimp nest (4) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (3) is used for crimping 14 and 16 gauge wires. The third largest crimp nest (2) is used for crimping 18 and 20 gauge wires. The smallest crimp nest (1) is used for crimping 22 to 26 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.

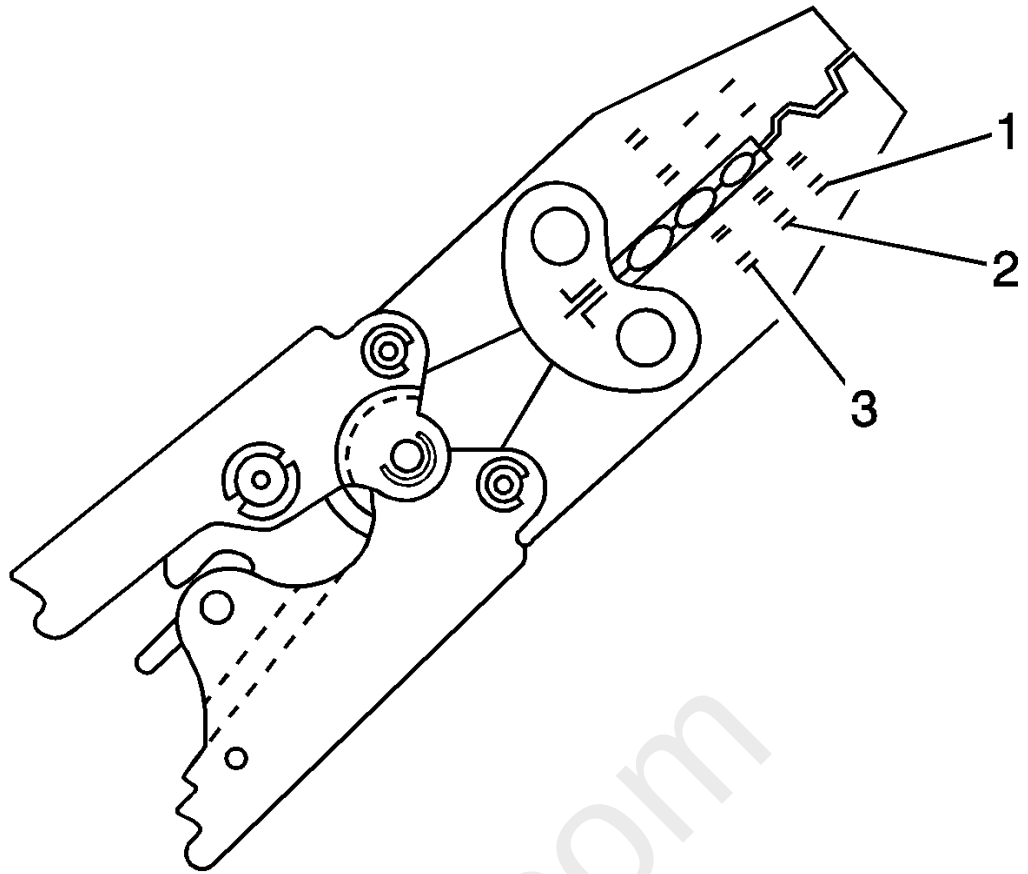


Fig. 5: Splice Sleeve Crimping Tool With 3 Crimp Nests
Courtesy of GENERAL MOTORS COMPANY

7. The **J-38125-8** splice sleeve crimping tool has three crimp nests. The largest crimp nest (3) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (2) is used for crimping 14 and 16 gauge wires. The smallest crimp nest (1) is used for crimping 18 to 20 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.
8. Use the splice sleeve crimp tool in order to position the DuraSeal splice sleeve in the proper color nest of the splice sleeve crimp tool. For the four crimp nest tool, use the three largest crimp nests to crimp the splice sleeves. For the three crimp nest tool, use all three crimp nests to crimp the splice sleeves. Use the four and three crimp tool diagrams (above) and the table (farther above) to match the splice sleeve with the correct crimp nest. The crimp tool diagram callout numbers match the numbers in the table (under crimp tool nest color).

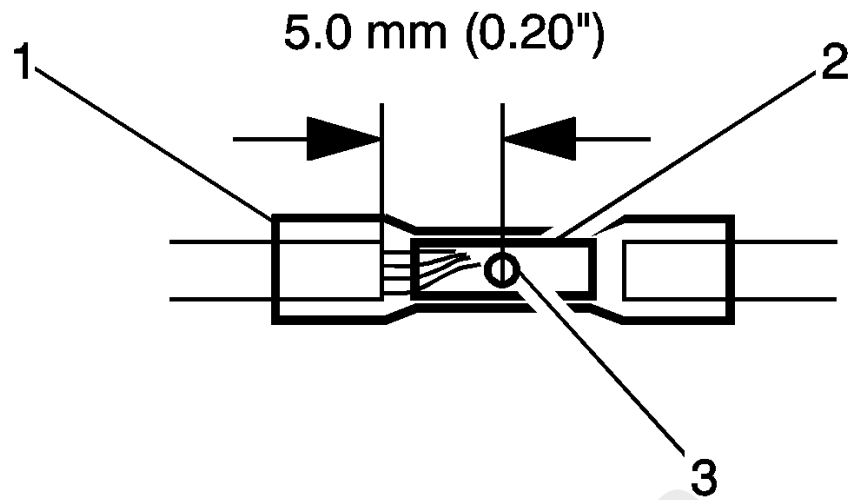


Fig. 6: Identifying DuraSeal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

9. Place the DuraSeal splice sleeve in the nest. Ensure that the crimp falls midway between the end of the barrel and the stop. The sleeve has a stop (3) in the middle of the barrel (2) in order to prevent the wire (1) from going further. Close the hand crimper handles slightly in order to firmly hold the DuraSeal splice sleeve in the proper nest.



Fig. 7: Crimped DuraSeal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

10. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to **Folded-Over Wire Repair** for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.
11. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Repeat steps 4 and 6 for the opposite end of the splice.



Fig. 8: Heated Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

12. Using the heat torch, apply heat to the crimped area of the barrel.
13. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

Weatherpack™ Wiring Repair

NOTE: Some replacement pigtail connectors may be delivered without the terminated leads installed into the connector. For Weatherpack™ connectors, all terminated leads included in the package should to be installed into the connector. If the connector end view shows that a terminal is not occupied, the extra terminated lead(s) need to be installed and the end(s) sealed using a DuraSeal splice sleeve and taped back into the harness.

1. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to **Folded-Over Wire Repair** for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.

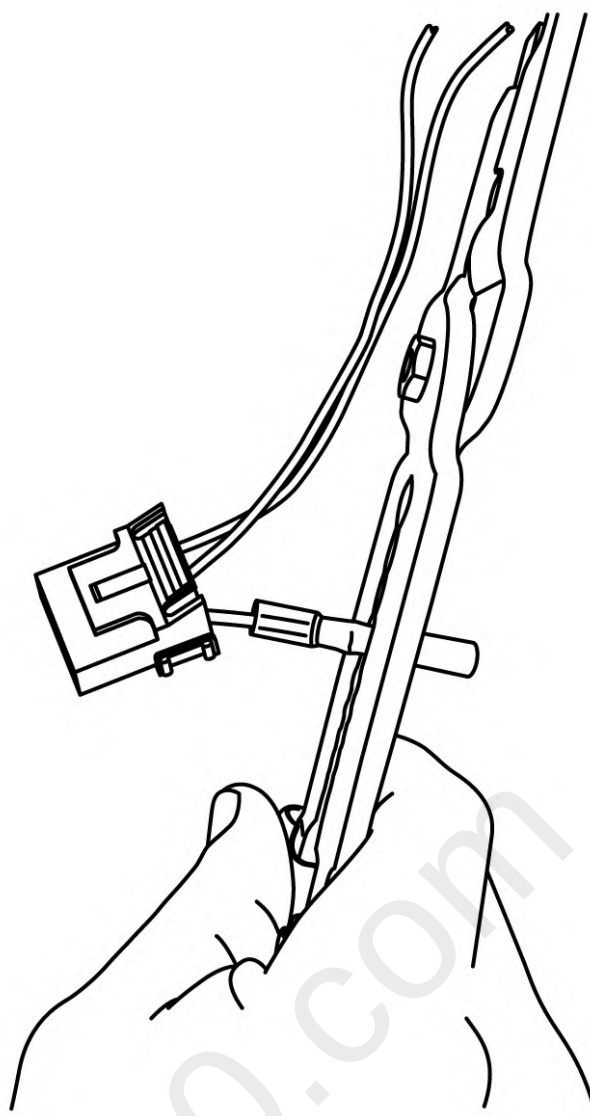


Fig. 9: Tightly Close Handles Of Crimp Tool
Courtesy of GENERAL MOTORS COMPANY

2. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Holding the DuraSeal with one hand gently tug on the wire to ensure it is crimped in the DuraSeal.

3. Using the heat torch, apply heat to the crimped area of the barrel.

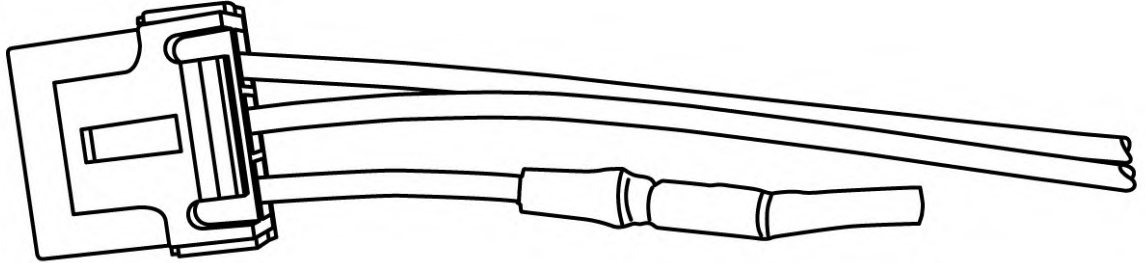


Fig. 10: Heat To Crimped Area Of Barrel

Courtesy of GENERAL MOTORS COMPANY

4. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

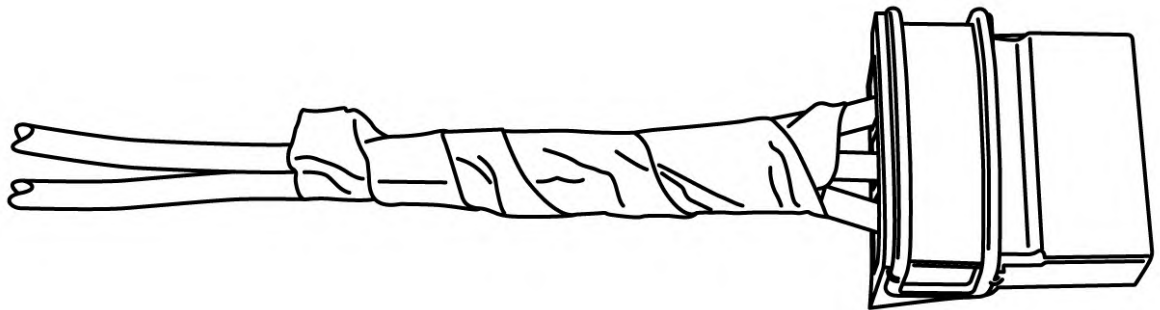


Fig. 11: Taping Extra Terminated Leads Back Into Harness
Courtesy of GENERAL MOTORS COMPANY

5. Tape the extra terminated lead(s) back into the harness.

High Temperature Wiring Repairs

Use the following procedures to perform high temperature wiring repairs:

1. Center the high temperature SCT1 shrink tube over the DuraSeal splice sleeve.
2. Using the heat torch, apply heat to the high temperature heat shrink tubing.
3. Gradually move the heat from the center to the open end of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.
4. Replace any reflective tape and clips that may have been removed during the repair.

CONNECTOR RECONNECTION - STEERING

Special Tools

EL-35616 Terminal Test Probe Kit

For equivalent regional tools, refer to [Special Tools](#) .

When the condition is not currently present, but is indicated in DTC history, the cause may be intermittent. An intermittent may also be the cause when there is a customer complaint, but the symptom cannot be duplicated. Refer to the Symptom Table of the system that is suspect of causing the condition before trying to locate an intermittent condition.

Most intermittent conditions are caused by faulty electrical connections or wiring. Inspect for the following items:

- Loose, corroded, or painted terminal stud/fastener
- Wiring broken inside the insulation
- Poor connection between the male and female terminal at a connector
- A terminal not seated all the way into the connector body
- Poor terminal to wire connection - Some conditions which fall under this description are poor crimps, poor solder joints, crimping over the wire insulation rather than the wire itself, and corrosion in the wire to terminal contact area, etc.
- Pierced or damaged insulation can allow moisture to enter the wiring causing corrosion. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits.
- Wiring which has been pinched, cut, or its insulation rubbed through may cause an intermittent open or short as the bare area touches other wiring or parts of the vehicle.
- Wiring that comes in contact with hot or exhaust components
- Refer to **Inducing Intermittent Fault Conditions** in order to duplicate the conditions required, in order to verify the customer concern.
- Refer to **Testing for Electrical Intermittents** for test procedures to detect intermittent open, high resistance, short to ground, and short to voltage conditions.
- Refer to **Scan Tool Snapshot Procedure** for advanced intermittent diagnosis and Vehicle Data Recorder operation.

Testing for Terminal Fretting

Some intermittent conditions can be caused by wire terminal fretting corrosion. Fretting corrosion is a build-up of insulating, oxidized wear debris that can form when there is a small motion between electrical contacts. The oxidized wear debris can pile up enough at the electrical contact spots that the electrical resistance across the connection increases. Movement between the contacting surfaces as small as 10 to 100 microns can cause fretting. To put this in perspective, a sheet of paper is about 100 microns thick, so fretting motion is small and hard to see. Vibration and thermal expansion/contraction are the main sources that create fretting motion. Since vehicles vibrate and can experience large temperature swings, they are a good source for fretting motion. Tin, copper, nickel, and iron surfaces are all susceptible to fretting corrosion. Fretting corrosion can be difficult to see but it looks like small, dark smudges on the terminals contact surface.

To correct a fretting condition disconnect the suspect connector and add dielectric grease/lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to both sides of the connector terminals. Then reconnect the connector and wipe away any excess lubricant. This will correct the additional terminal contact resistance due to the terminal fretting corrosion.

Testing for Proper Terminal Contact

It is important to test terminal contact at the component and any inline connectors before replacing a suspect component. Mating terminals must be inspected to ensure good terminal contact. A poor connection between the male and female terminal at a connector may be the result of contamination or deformation.

Contamination may be caused by the connector halves being improperly connected. A missing or damaged connector seal, damage to the connector itself, or exposing the terminals to moisture and dirt can also cause contamination. Contamination, usually in the underhood or underbody connectors, leads to terminal corrosion, causing an open circuit or intermittently open circuit.

Deformation is caused by probing the mating side of a connector terminal without the proper adapter. Always use the **EL-35616** kit when probing connectors. Other causes of terminal deformation are improperly joining the connector halves, or repeatedly separating and joining the connector halves. Deformation, usually to the female terminal contact tang, can result in poor terminal contact causing an open or intermittently open circuit.

Testing for Proper Terminal Contact in Bussed Electrical Centers

It is very important to use the correct test adapter when testing for proper terminal contact of fuses and relays in a bussed electrical center. Use the **EL-35616** kit to test for proper terminal contact. Failure to use the **EL-35616** kit can result in improper diagnosis of the bussed electrical center.

Follow the procedure below in order to test terminal contact:

1. Separate the connector halves.

2. Visually inspect the connector halves for contamination. Contamination may result in a white or green build-up within the connector body or between terminals. This causes high terminal resistance, intermittent contact, or an open circuit. An underhood or underbody connector that shows signs of contamination should be replaced in its entirety: terminals, seals, and connector body.
3. Using an equivalent male terminal/terminated lead, verify that the retention force is significantly different between a known good terminal and the suspect terminal. Replace the female terminal in question.

Flat Wire Connectors

There are no serviceable parts for flat wire connectors on the harness side or the component side.

Follow the procedure below in order to test terminal contact:

1. Remove the component in question.
2. Visually inspect each side of the connector for signs of contamination. Avoid touching either side of the connector as oil from your skin may be a source of contamination as well.
3. Visually inspect the terminal bearing surfaces of the flat wire circuits for splits, cracks, or other imperfections that could cause poor terminal contact. Visually inspect the component side connector to ensure that all of the terminals are uniform and free of damage or deformation.
4. Insert the appropriate adapter into the flat wire harness connector in order to test the circuit in question.

Control Module/Component Voltage and Grounds

Poor voltage or ground connections can cause widely varying symptoms.

- Test all control module voltage supply circuits. Many vehicles have multiple circuits supplying voltage to a control module. Other components in the system may have separate voltage supply circuits that may also need to be tested. Inspect connections at the module/component connectors, fuses, and any intermediate connections between the voltage source and the module/component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Power Distribution Schematics \(Buick\)](#) [Power Distribution Schematics \(Chevrolet\)](#) .
- Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point (screw or stud). Inspect the connections at the component and in splice packs, where applicable. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Ground Distribution Schematics \(Buick\)](#) [Ground Distribution Schematics \(Chevrolet\)](#) .

Temperature Sensitivity

- An intermittent condition may occur when a component/connection reaches normal operating temperature. The condition may occur only when the component/connection is cold, or only when the component/connection is hot.
- Freeze Frame, Failure Records, Snapshot, or Vehicle Data Recorder data may help with this type of intermittent condition, where applicable.
- If the intermittent is related to heat, review the data for a relationship with the following:
 - High ambient temperatures
 - Underhood/engine generated heat
 - Circuit generated heat due to a poor connection, or high electrical load
 - Higher than normal load conditions, towing, etc.
- If the intermittent is related to cold, review the data for the following:
 - Low ambient temperatures - In extremely low temperatures, ice may form in a connection or component. Inspect for water intrusion.
 - The condition only occurs on a cold start.
 - The condition goes away when the vehicle warms up.
- Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
- If temperature is suspected of causing an intermittent fault condition, attempt to duplicate the condition. Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required.

Some electrical components/circuits are sensitive to electromagnetic interference or other types of electrical noise. Inspect for the following conditions:

- A mis-routed harness that is too close to high voltage/high current devices such as secondary ignition components, motors, generator etc. - These components may induce electrical noise on a circuit that could interfere with normal circuit operation.
- Electrical system interference caused by a malfunctioning relay, or a control module driven solenoid or switch - These conditions can cause a sharp electrical surge. Normally, the condition will occur when the malfunctioning component is operating.
- Installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. - These accessories may create interference in other circuits while operating and the interference would disappear when the accessory is not operating. Refer to [Checking Aftermarket Accessories](#) .
- Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a clamping diode.
- The generator may be allowing AC noise into the electrical system.

Incorrect Control Module

- There are only a few situations where reprogramming a control module is appropriate:
 - A new service control module is installed.
 - A control module from another vehicle is installed.
 - Revised software/calibration files have been released for this vehicle.

NOTE: **DO NOT re-program the control module with the SAME software/calibration files that are already present in the control module. This is not an effective repair for any type of concern.**

- Verify that the control module contains the correct software/calibration. If incorrect programming is found, reprogram the control module with the most current software/calibration. Refer to [Control Module References](#) for replacement, setup, and programming.

STEERING LINKAGE INNER TIE ROD INSPECTION

Special Tools

GE-8001 Dial Indicator Set

For equivalent regional tools, refer to [Special Tools](#).

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.

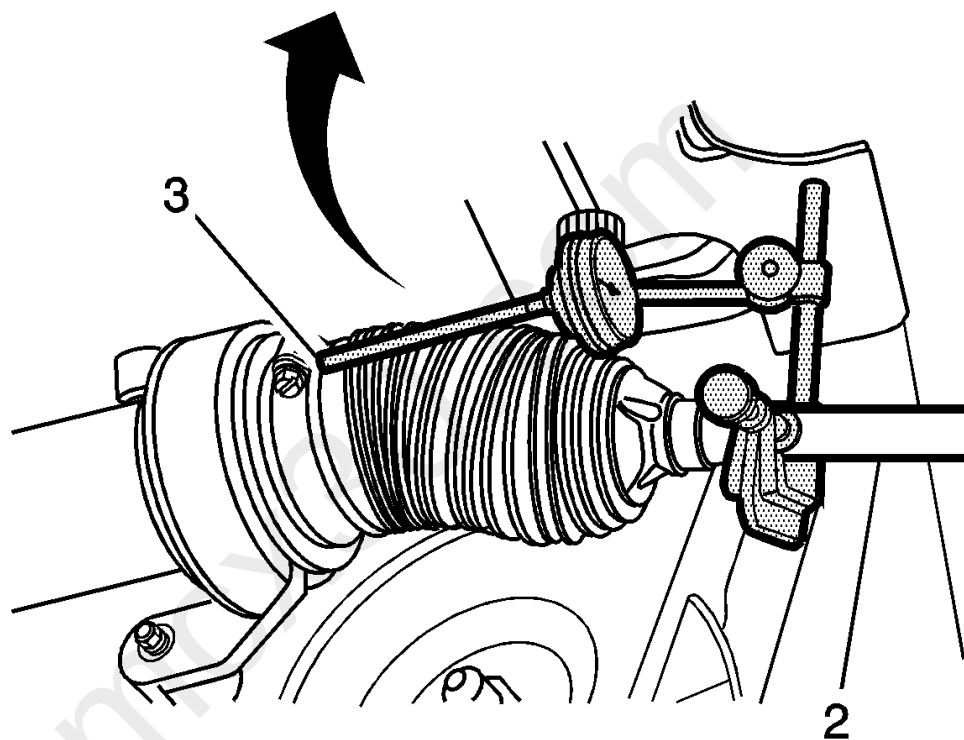
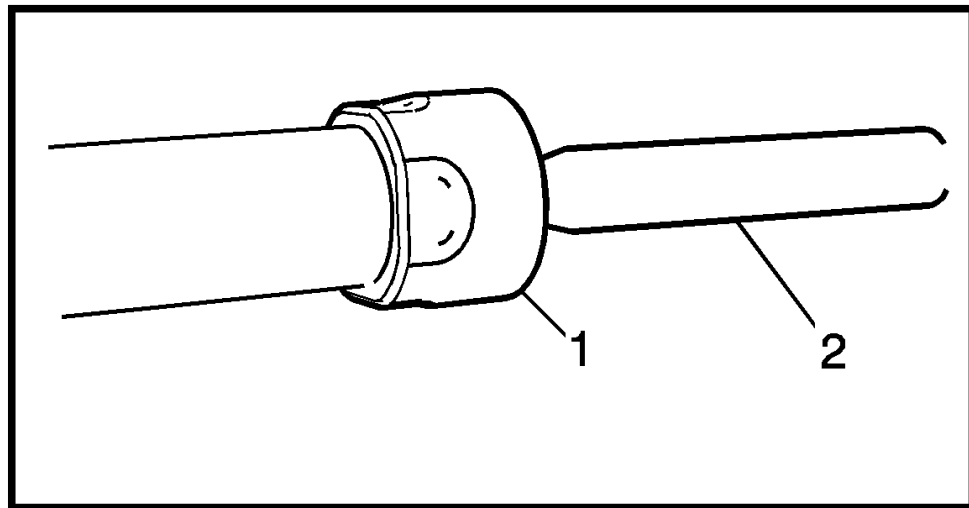


Fig. 12: Measuring Lash Between Inner Tie Rod And Steering Gear Housing
Courtesy of GENERAL MOTORS COMPANY

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. Part of the steering linkage inner tie rod (2) being tested should be inside the steering gear housing. The inner tie rod housing (1) being tested should be inside the steering gear housing and 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 **GE-8001** dial indicator pointer at the steering gear housing, install a large worm gear hose clamp (3) 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 **GE-8001** dial indicator pointer.
5. Install the **GE-8001** dial indicator between the inner tie rod 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. The lash between the inner tie rod and the steering gear housing is equal to the lash between the inner tie rod and the inner tie rod housing because the inner tie rod housing is inside the steering gear housing during this procedure.

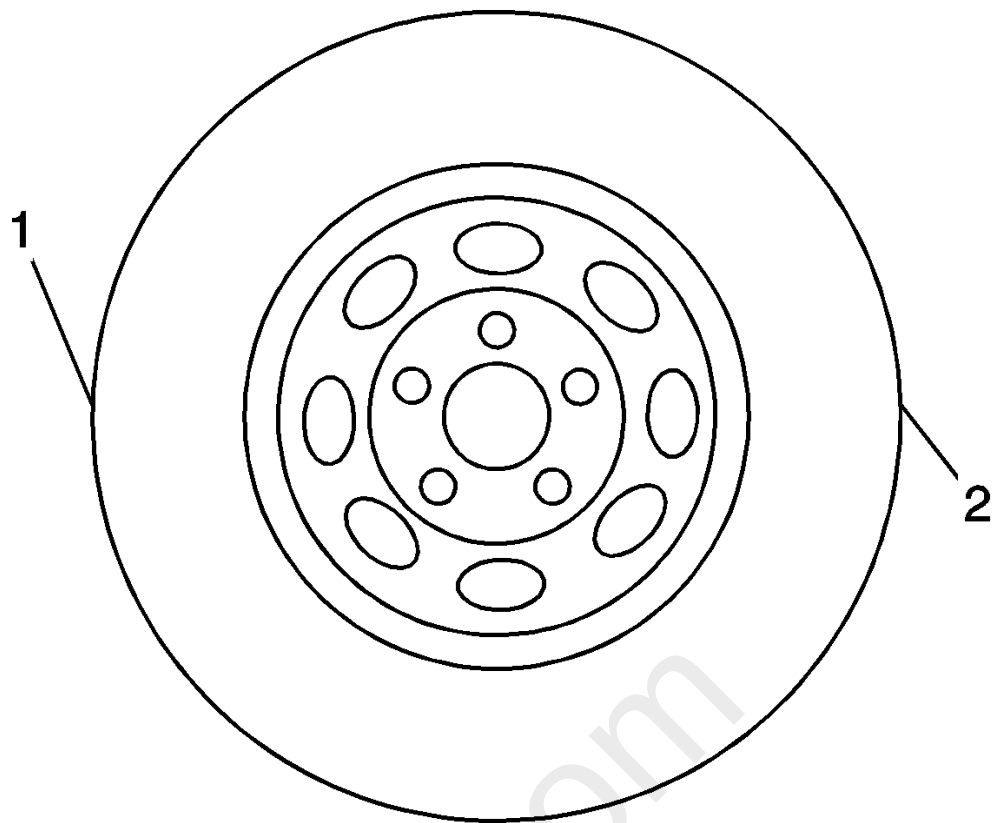


Fig. 13: Tire Grasping Positions

Courtesy of GENERAL MOTORS COMPANY

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 **GE-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 shown on the **GE-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 \(N40\)](#)[Steering Linkage Inner Tie Rod Replacement \(NJ1\)](#).
11. Repeat the procedure for the other side.

STEERING LINKAGE OUTER TIE ROD INSPECTION

Special Tools

GE-8001 Dial Indicator Set

For equivalent regional tools, refer to [Special Tools](#).

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

1. Inspect the outer tie rod seal. If the outer tie rod seal is torn, replace the outer tie rod. 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](#).

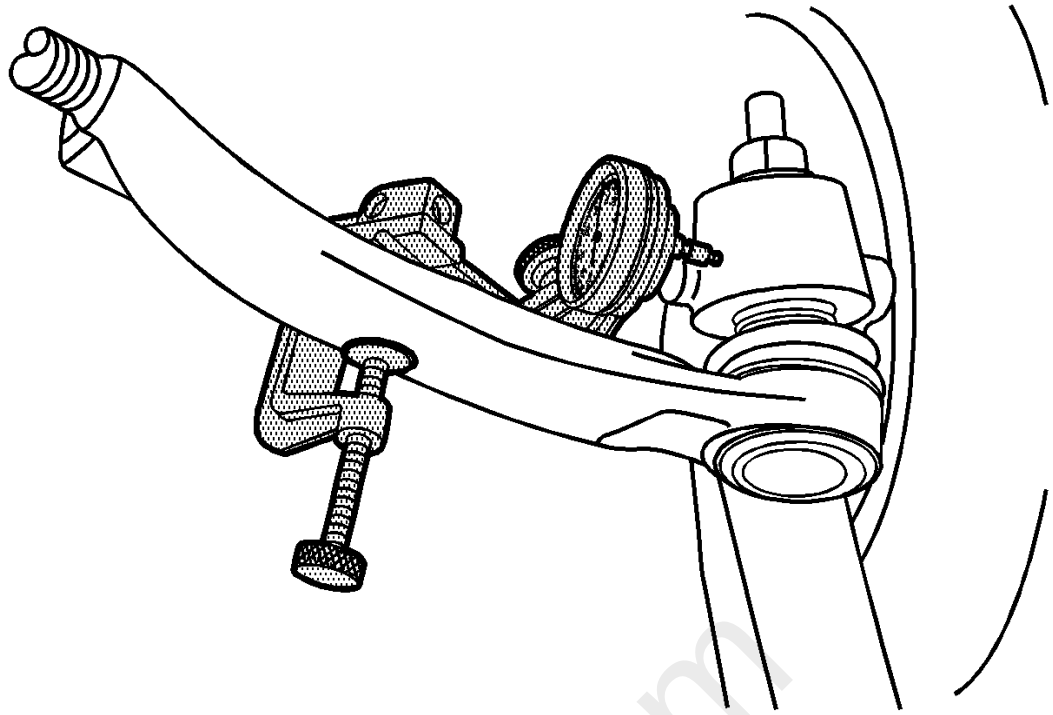


Fig. 14: Measuring Outer Tie Rod Lash
Courtesy of GENERAL MOTORS COMPANY

3. Install the **GE-8001** dial indicator between the outer tie rod and the steering knuckle as shown in the graphic. Note that the tire and wheel assembly is shown removed only for clarification of the **GE-8001** dial indicator position.

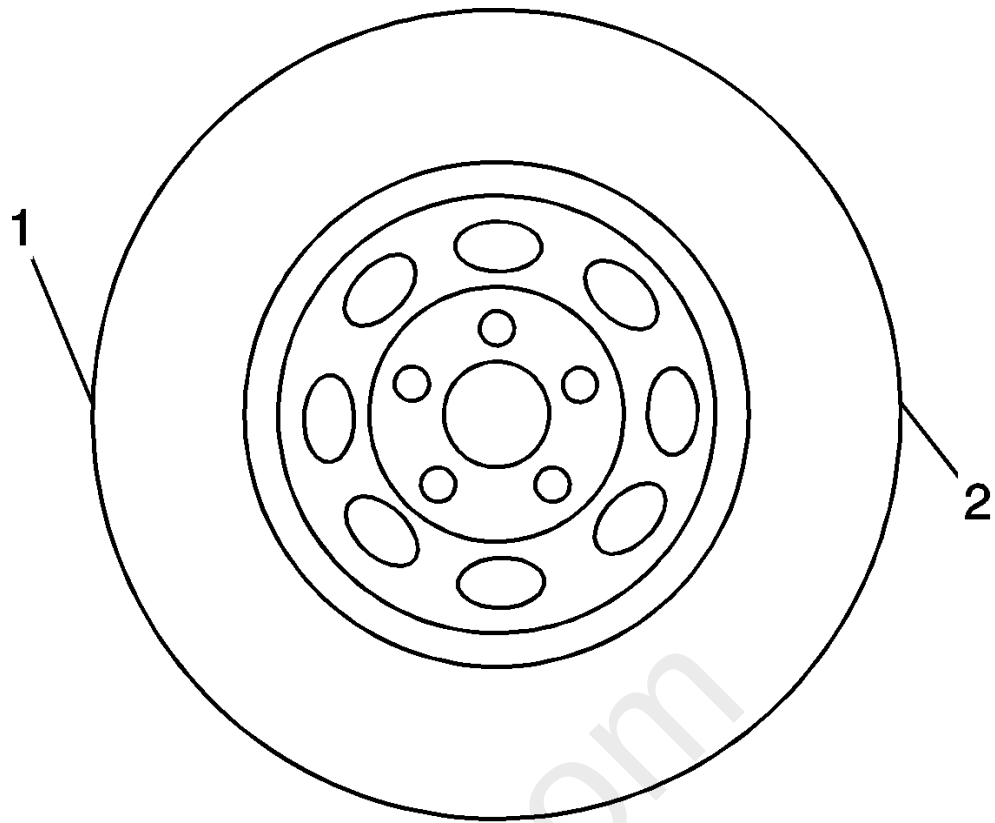


Fig. 15: Tire Grasping Positions

Courtesy of GENERAL MOTORS COMPANY

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. Zero the **GE-8001** dial indicator.
6. On the same side of the tire previously pushed inwards, gently pull outwards and measure the lash.
7. Record the measurement shown on the **GE-8001** dial indicator.
8. If the measured value exceeds 0.5 mm (0.02 in), 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 COLD 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 (170°F).
2. Turn the engine OFF.
3. If the power steering fluid reservoir is covered by a shield or a cover, remove the shield or the cover, as applicable.
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 in the reservoir or on the cap stick, as applicable. Ensure that the fluid level is at the HOT/FULL/MAX mark on the cap stick or on the reservoir, as applicable.

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.

7. Add power steering fluid if necessary. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).
8. Install the reservoir cap.
9. If you removed a shield or a cover, install the shield or the cover, as applicable.

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.
7. 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

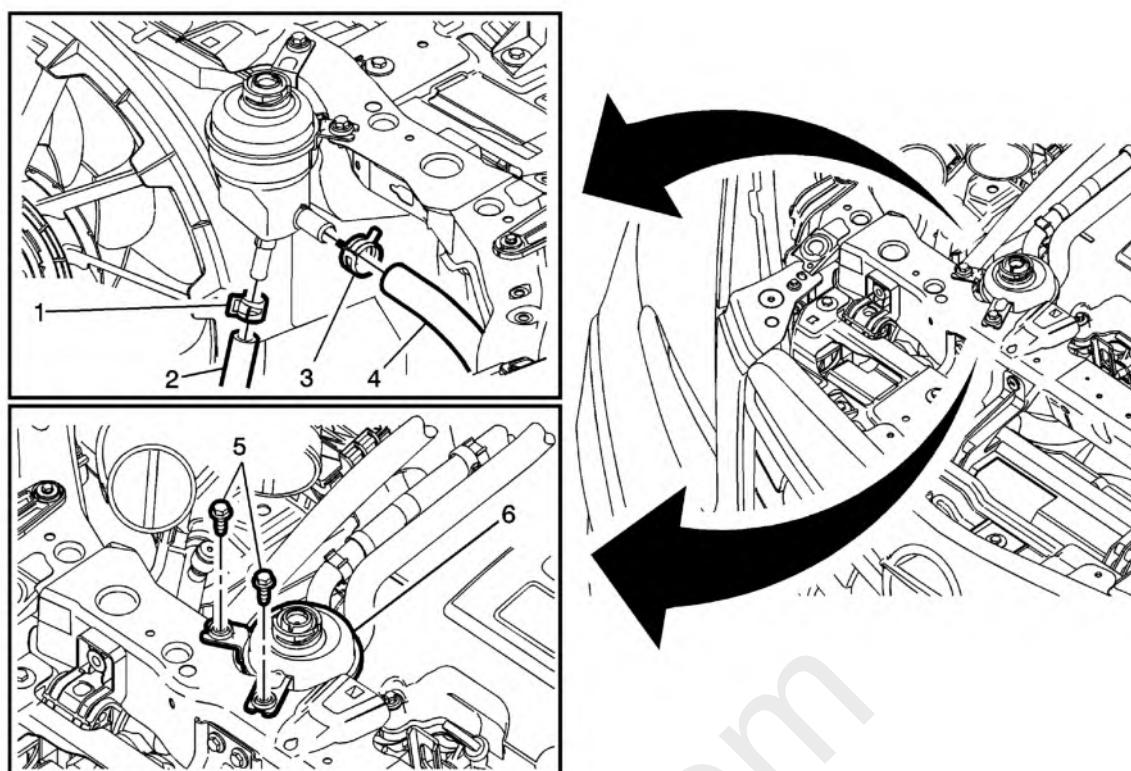


Fig. 16: Power Steering Fluid Reservoir

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1. Remove Front Bumper Fascia Opening Upper Cover. Refer to Front Bumper Fascia Opening Upper Cover Replacement	
2. Remove as much power steering fluid from the power steering fluid reservoir as possible.	
1	Power Steering Fluid Reservoir Inlet Hose Clamp
2	Power Steering Fluid Reservoir Inlet Hose
3	Power Steering Fluid Reservoir Outlet Hose Clamp
4	Power Steering Fluid Reservoir Outlet Hose
5	Power Steering Fluid Reservoir Bolt (Qty: 2)
	CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
6	Power Steering Fluid Reservoir Procedure Fill and bleed the power steering system. Refer to Power Steering System Bleeding

POWER STEERING PUMP PULLEY REPLACEMENT

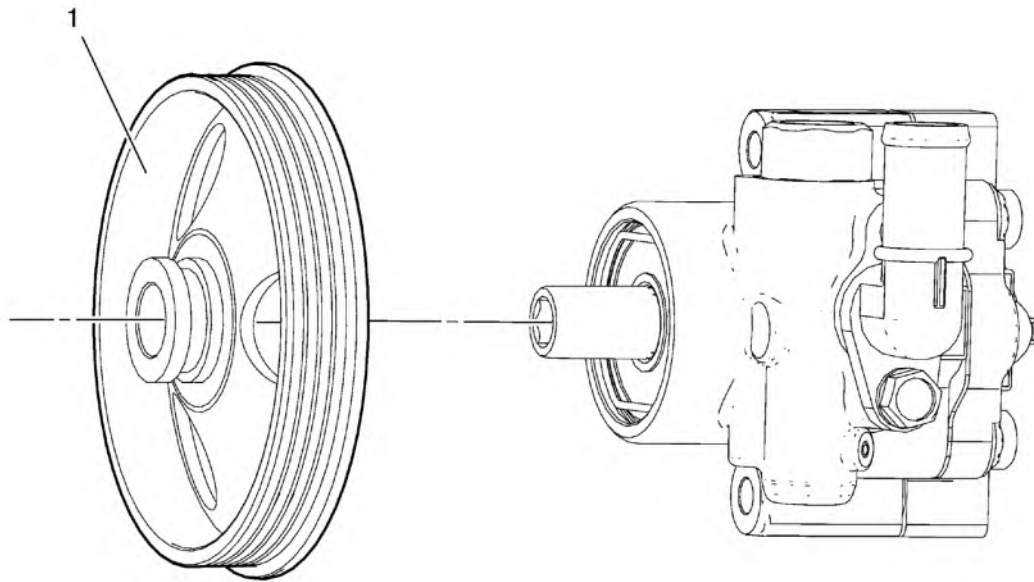


Fig. 17: Power Steering Pump Pulley
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Power Steering Pump. Refer to Power Steering Pump Replacement	
1	Power Steering Pump Pulley Procedure 1. Use the CH-25034-C pulley remover to remove the power steering pump pulley. 2. Use the CH-25033-C pulley installer to install the power steering pump pulley. Special Tools • CH-25033-C Pulley Installer • CH-25034-C Pulley Remover Equivalent regional tools: Special Tools

POWER STEERING PUMP REPLACEMENT

Removal Procedure

1. Remove as much power steering fluid from the power steering fluid reservoir as possible.
2. Remove Air Cleaner Assembly. Refer to [Air Cleaner Assembly Replacement \(2H0\)](#).
3. Remove Power Steering Pump Belt. Refer to [Power Steering Pump Belt Replacement](#)

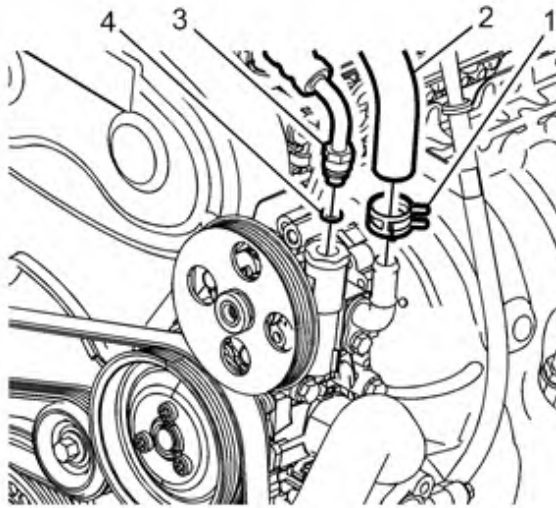
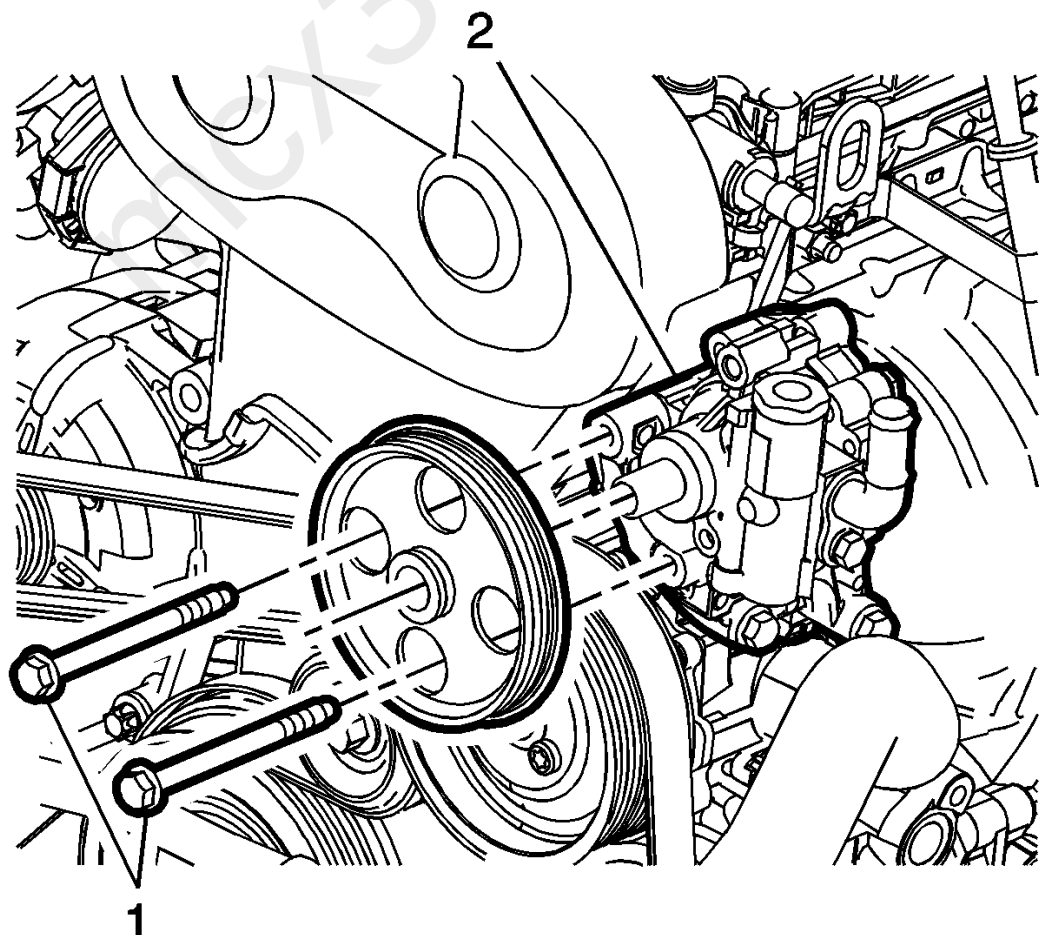


Fig. 18: Power Steering Fluid Reservoir Outlet Hose, Clamp, Power Steering Gear Inlet Hose And Seal
Courtesy of GENERAL MOTORS COMPANY

4. Disengage Power Steering Fluid Reservoir Outlet Hose Clamp (1)
5. Remove Power Steering Fluid Reservoir Outlet Hose (2) @ Power Steering Pump
6. Remove Power Steering Gear Inlet Hose (3) @ Power Steering Pump
7. Remove Power Steering Gear Inlet Hose Seal (4)

DISCARD the seal.

8. Remove Air Conditioning Evaporator Hose Assembly. Refer to [Air Conditioning Evaporator Hose Assembly Replacement \(2H0\)](#) [Air Conditioning Evaporator Hose Assembly Replacement \(LUV\)](#) [Air Conditioning Evaporator Hose Assembly Replacement \(LE2\)](#)



NOTE:

- The power steering pump pulley does NOT need to be removed on vehicle. The pulley is shown off for clarity.
- Remove the power steering pump bolts through the holes in the pulley.

9. Remove Power Steering Pump Bolts (1) (Qty: 2)
10. Remove the power steering pump (2) from the vehicle.
11. Transfer components as necessary.

Installation Procedure

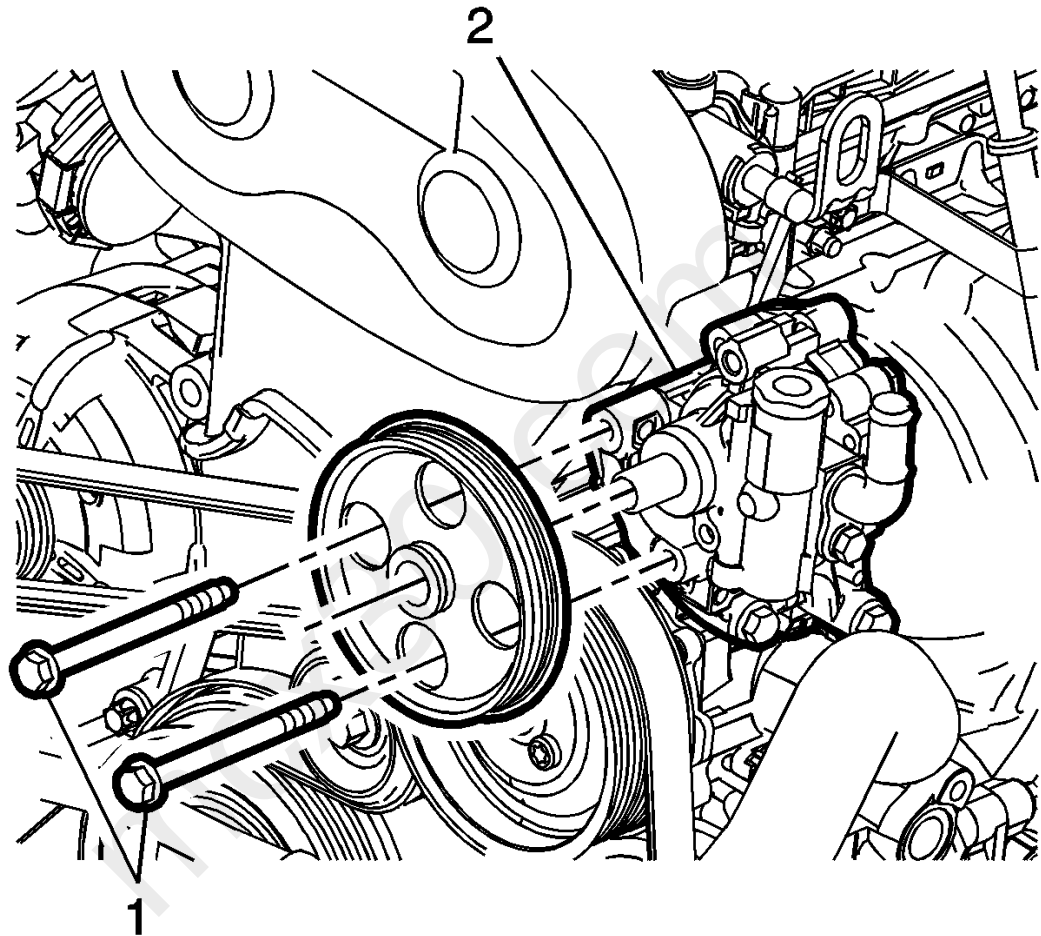


Fig. 20: Power Steering Pump And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Position the power steering pump (2) on the vehicle.

CAUTION: Refer to **Fastener Caution** .

2. Install and tighten Power Steering Pump Bolts (1) (Qty: 2) to 22 N.m (16 lb ft)
3. Install Air Conditioning Evaporator Hose Assembly. Refer to **[Air Conditioning Evaporator Hose Assembly Replacement \(2H0\)](#)**, **[Air Conditioning Evaporator Hose Assembly Replacement \(LUV\)](#)**, **[Air Conditioning Evaporator Hose Assembly Replacement \(LE2\)](#)**.

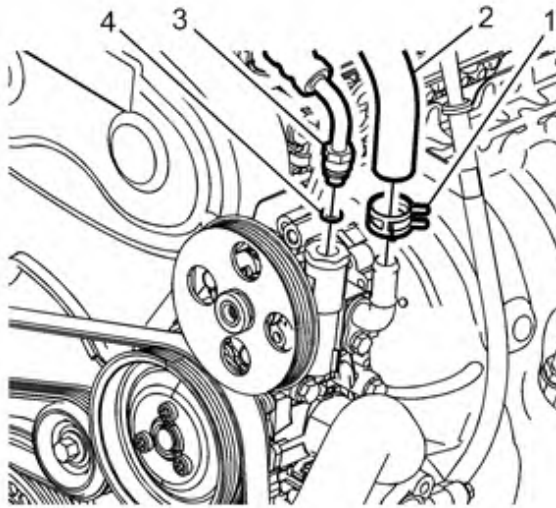


Fig. 21: Power Steering Fluid Reservoir Outlet Hose, Clamp, Power Steering Gear Inlet Hose And Seal
 Courtesy of GENERAL MOTORS COMPANY

4. Install Power Steering Gear Inlet Hose Seal (4)

Install a NEW seal.

CAUTION: Refer to [Component Fastener Tightening Caution](#) .

5. Install and tighten Power Steering Gear Inlet Hose (3) @ Power Steering Pump to 34 N.m (25 lb ft)
6. Install Power Steering Fluid Reservoir Outlet Hose (2) @ Power Steering Pump
7. Engage Power Steering Fluid Reservoir Outlet Hose Clamp (1)
8. Install Power Steering Pump Belt. Refer to [Power Steering Pump Belt Replacement](#)
9. Install Air Cleaner Assembly. Refer to [Air Cleaner Assembly Replacement \(2H0\)](#)
10. Fill and bleed the power steering system. Refer to [Power Steering System Bleeding](#)

POWER STEERING PUMP BRACKET REPLACEMENT

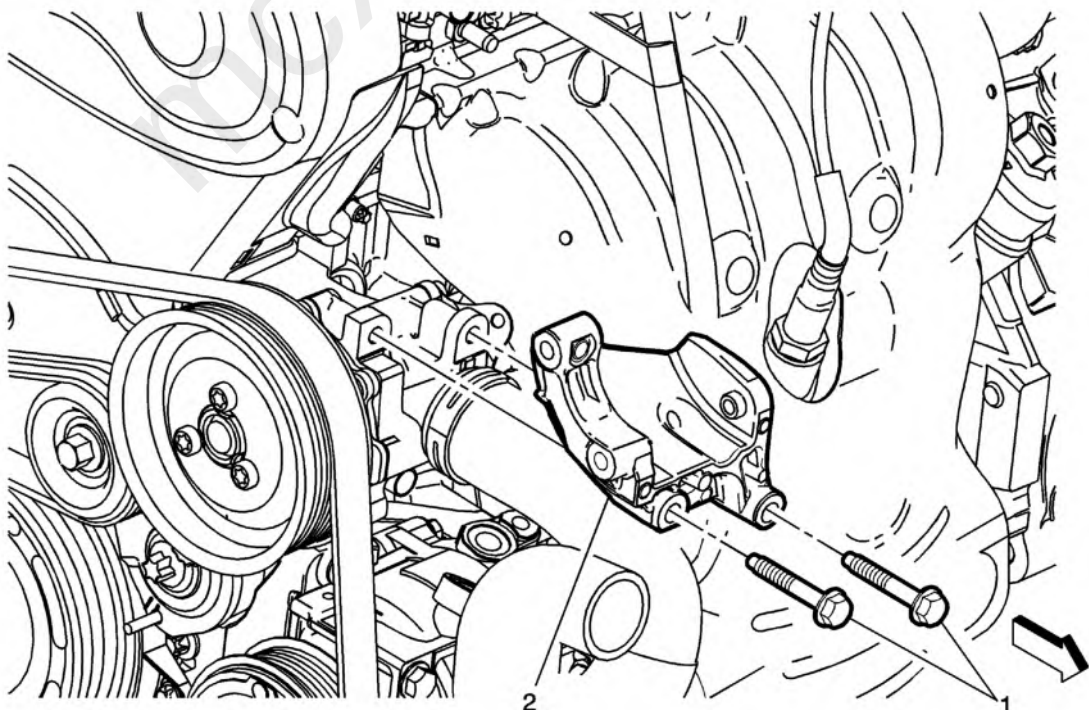


Fig. 22: Power Steering Pump Bracket
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Power Steering Pump. Refer to Power Steering Pump Replacement	
1	Power Steering Pump Bracket Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 22 N.m (16 lb ft)
2	Power Steering Pump Bracket

POWER STEERING PUMP REAR BRACE REPLACEMENT

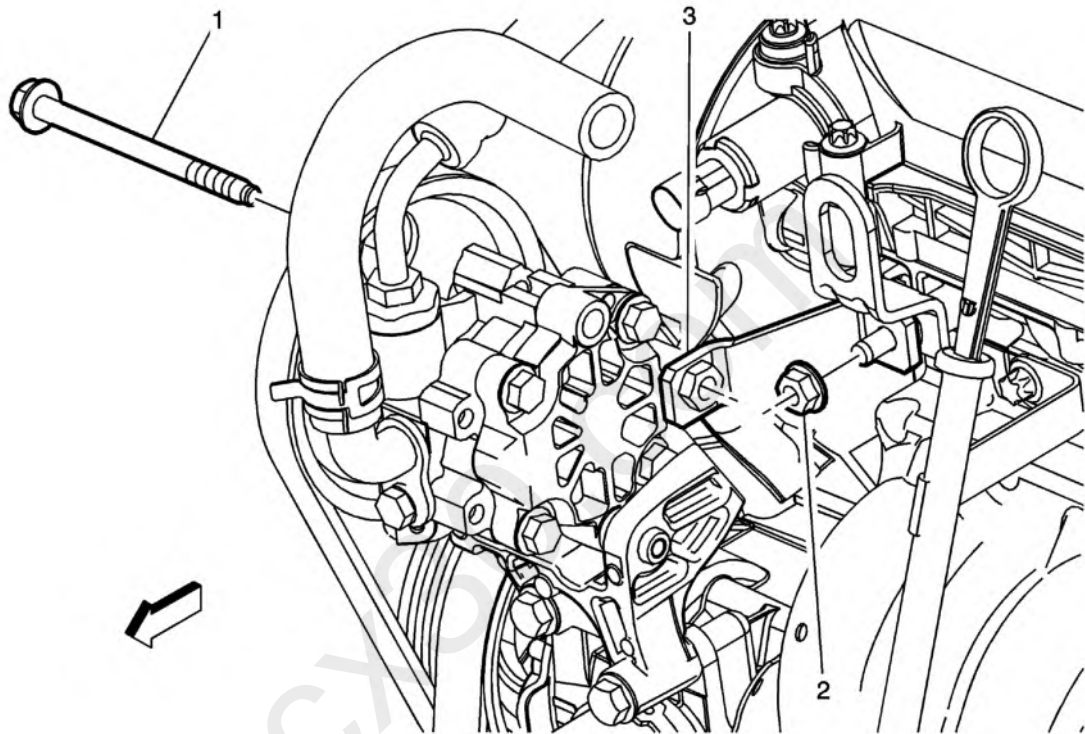


Fig. 23: Power Steering Pump Rear Brace
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Power Steering Fluid Reservoir. Refer to Power Steering Fluid Reservoir Replacement	
1	Power Steering Pump Bolt CAUTION: Refer to Fastener Caution . Tighten 22 N.m (16 lb ft)
2	Power Steering Pump Rear Brace Nut Tighten 22 N.m (16 lb ft)
3	Power Steering Pump Rear Brace

STEERING LINKAGE OUTER TIE ROD REPLACEMENT

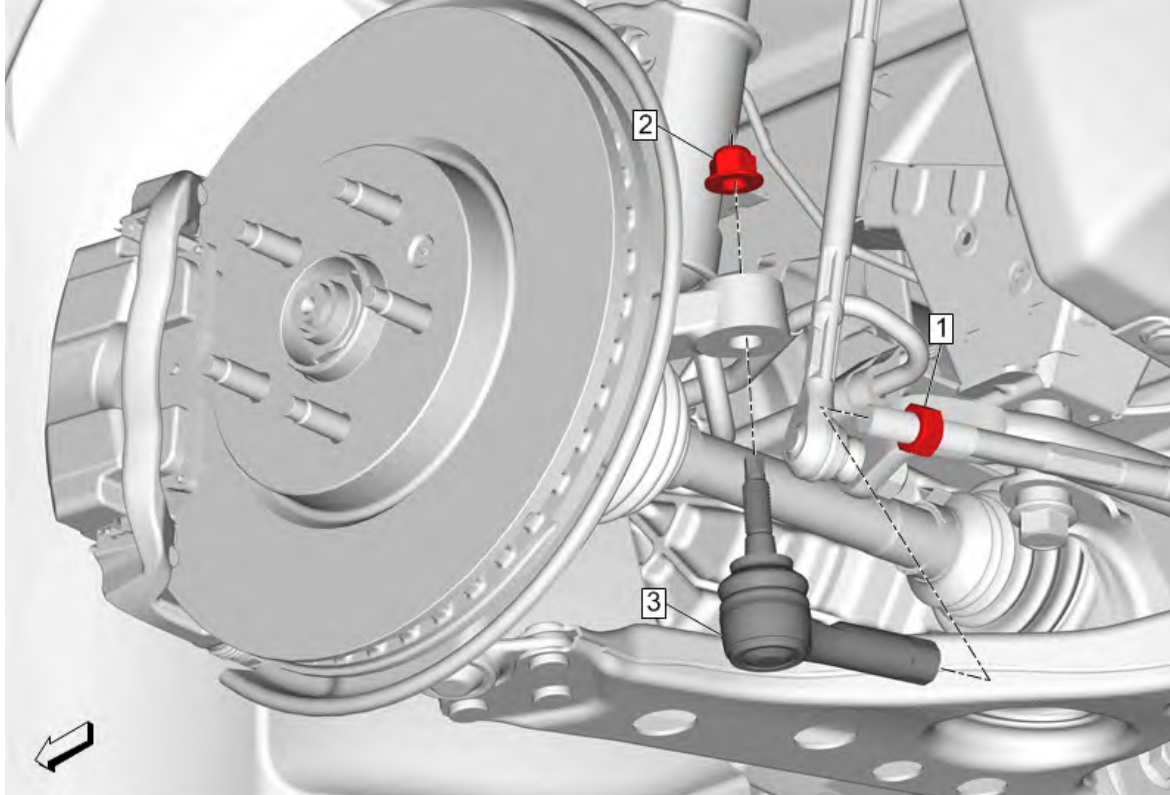


Fig. 24: Steering Linkage Outer Tie Rod
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the front tire and wheel assembly. Refer to Tire and Wheel Removal and Installation	
1	Steering Linkage Inner Tie Rod Nut Procedure Place match marks on the steering linkage inner tie rod nut and the steering linkage inner tie rod. NOTE: Do NOT tighten the steering linkage inner tie rod nut during installation. Tighten the nut after adjusting the front toe.
2	Steering Linkage Outer Tie Rod Nut CAUTION: Refer to Fastener Caution . Tighten First Pass: 30 N.m (22 lb ft) Final Pass: (120-135 degrees)

Callout	Component Name
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 CH-24319-B puller to separate the steering linkage outer tie rod from the steering knuckle. 2. Clean the tapered surface of the steering knuckle. 3. Inspect the steering linkage inner tie rod for bent or damaged threads. If necessary, replace the steering linkage inner tie rod. Refer to Steering Linkage Inner Tie Rod Replacement (N40)Steering Linkage Inner Tie Rod Replacement (NJ1) 4. Measure and adjust the front toe. Refer to Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment Special Tools CH-24319-B Universal Steering Linkage and Tie Rod Puller Equivalent regional tools: Special Tools

STEERING GEAR BOOT REPLACEMENT

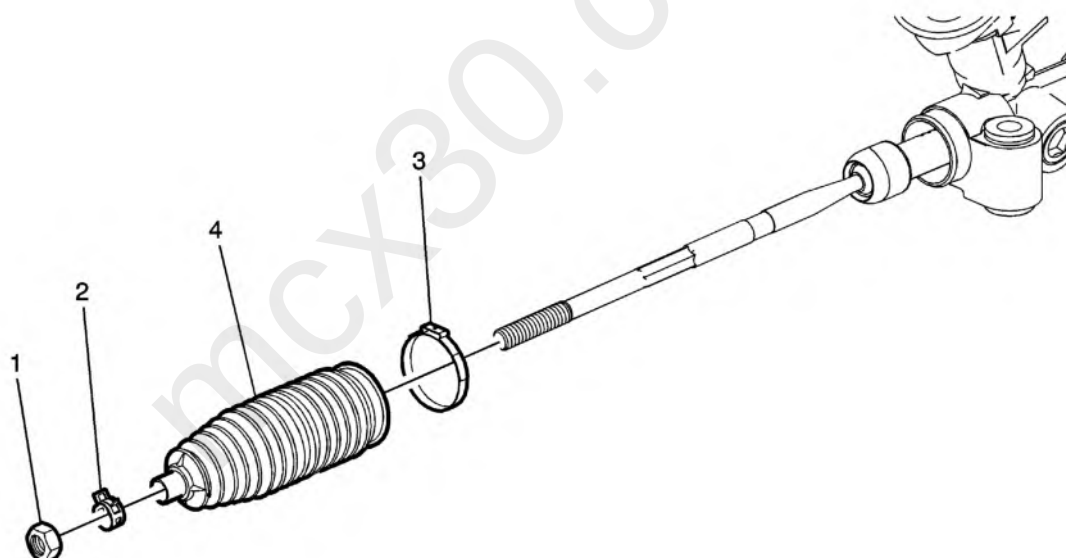


Fig. 25: Steering Gear Boot

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
	1. Remove Steering Gear. Refer to Steering Gear Replacement (N40 With MNK)Steering Gear Replacement (NJ1 With MNH or MNK)Steering Gear Replacement (NJ1 With MR5)Steering Gear Replacement (N40 With M4P) 2. Remove Steering Linkage Outer Tie Rod. Refer to Steering Linkage Outer Tie Rod Replacement

Callout	Component Name
1	Steering Linkage Inner Tie Rod Nut CAUTION: Refer to Fastener Caution . Procedure Place match marks on the steering linkage inner tie rod nut and the steering linkage inner tie rod.
2	Steering Gear Boot Outer Clamp
3	Steering Gear Boot Inner Clamp Procedure 1. Cut the steering gear boot inner clamp. DISCARD the clamp. 2. Use the CH-804 pliers to install a NEW steering gear boot inner clamp. Special Tools CH-804 Boot Clamp Pliers Equivalent regional tools: Special Tools
4	Steering Gear Boot Procedure 1. After removing the steering gear boot, inspect the steering linkage inner tie rod for evidence of corrosion or contamination. If corrosion or contamination is evident, replace the steering gear. Refer to Steering Gear Replacement (N40 With MNK)Steering Gear Replacement (NJ1 With MNH or MNK)Steering Gear Replacement (NJ1 With MR5)Steering Gear Replacement (N40 With M4P). 2. Install the steering gear boot and ensure the boot is seated in the assembly groove of the steering gear before installing the steering gear boot clamps.

POWER STEERING FLUID COOLER REPLACEMENT

Removal Procedure

1. Remove as much power steering fluid from the power steering fluid reservoir as possible.
2. Remove Front Bumper Fascia. Refer to **Front Bumper Fascia Replacement (Chevrolet) Front Bumper Fascia Replacement (Buick)**.

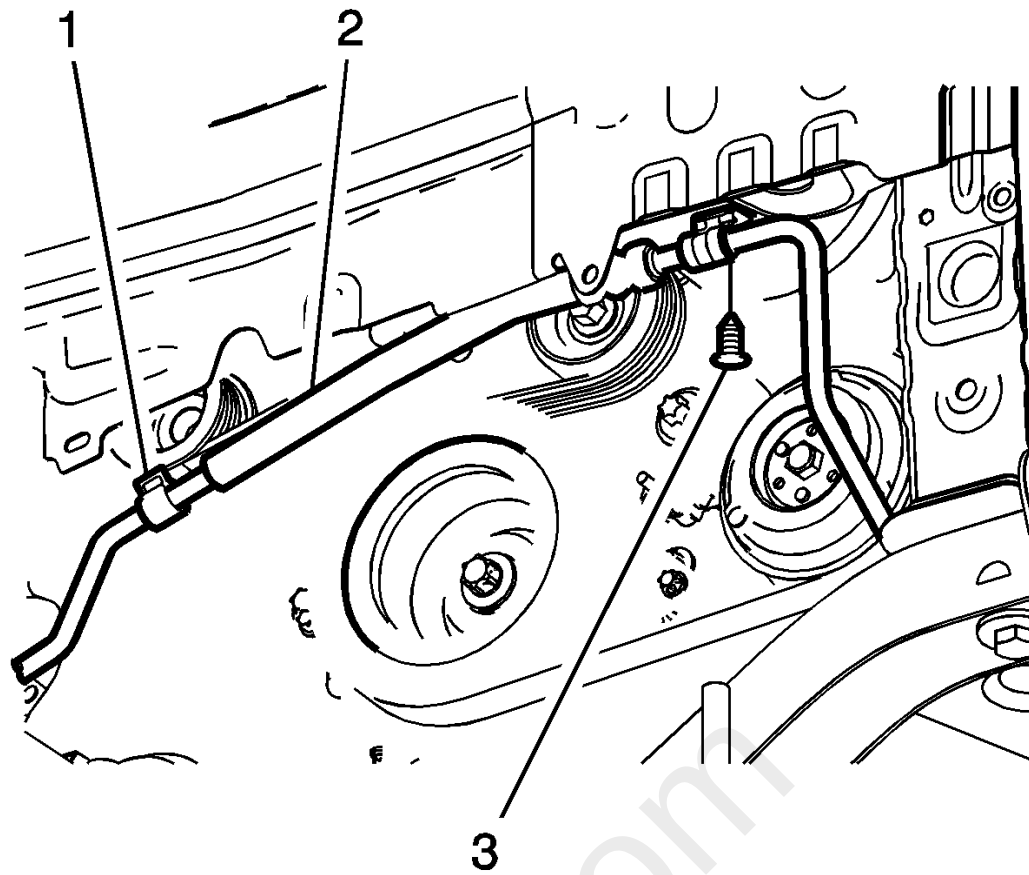


Fig. 26: Power Steering Gear Outlet Hose, Clamp And Push Pin
Courtesy of GENERAL MOTORS COMPANY

3. Disengage Power Steering Gear Outlet Hose Clamp (1)
4. Remove Power Steering Gear Outlet Hose (2) @ Power Steering Fluid Cooler
5. Remove the plastic push pin (3) from the power steering fluid cooler bracket.

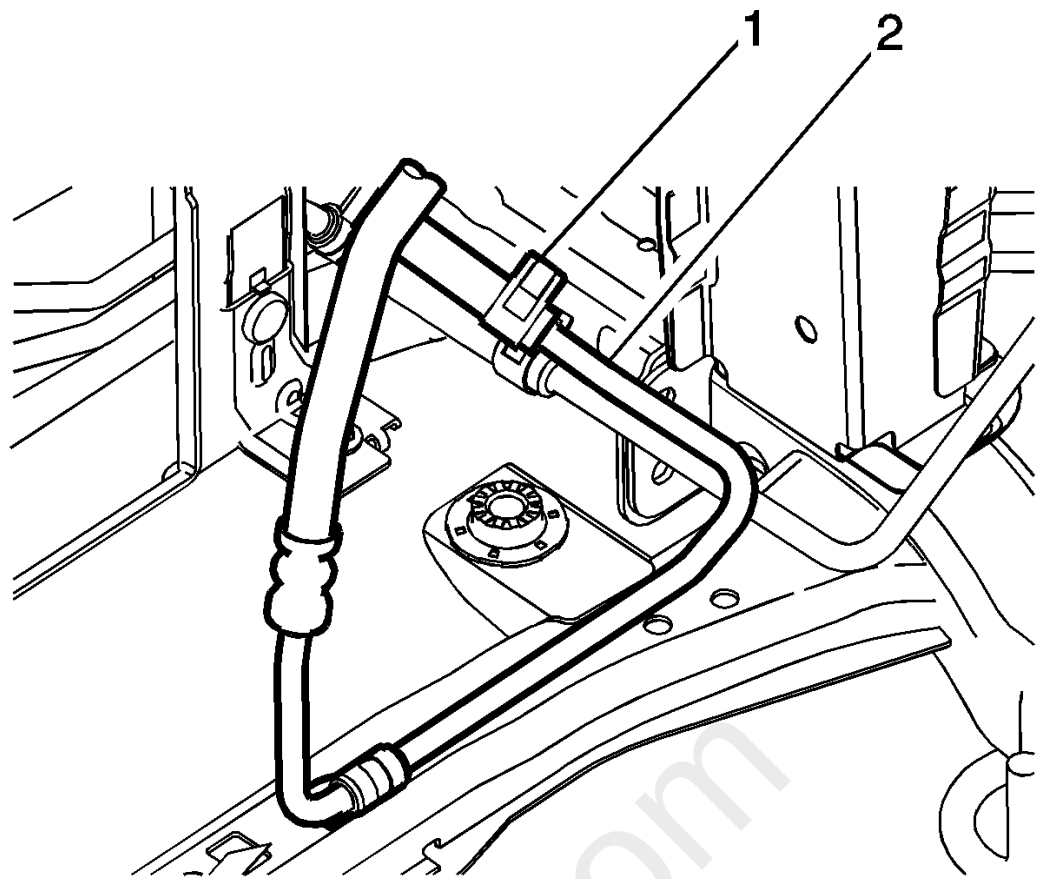


Fig. 27: Power Steering Fluid Reservoir Inlet Pipe And Clamp

Courtesy of GENERAL MOTORS COMPANY

6. Disengage Power Steering Fluid Reservoir Inlet Pipe Clamp (1)
7. Remove Power Steering Fluid Reservoir Inlet Pipe (2) @ Power Steering Fluid Cooler

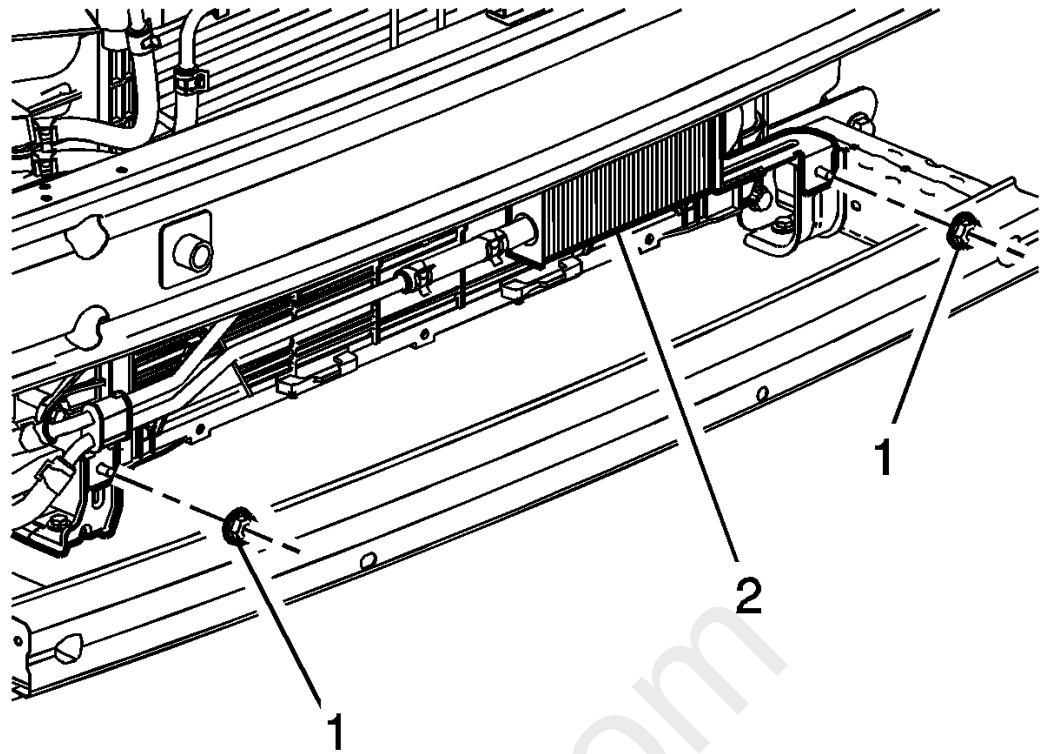


Fig. 28: Power Steering Fluid Cooler And Bracket Nuts
Courtesy of GENERAL MOTORS COMPANY

8. Remove Power Steering Fluid Cooler Bracket Nuts (1) (Qty: 2)
9. Remove the power steering fluid cooler (2) from the vehicle.

Installation Procedure

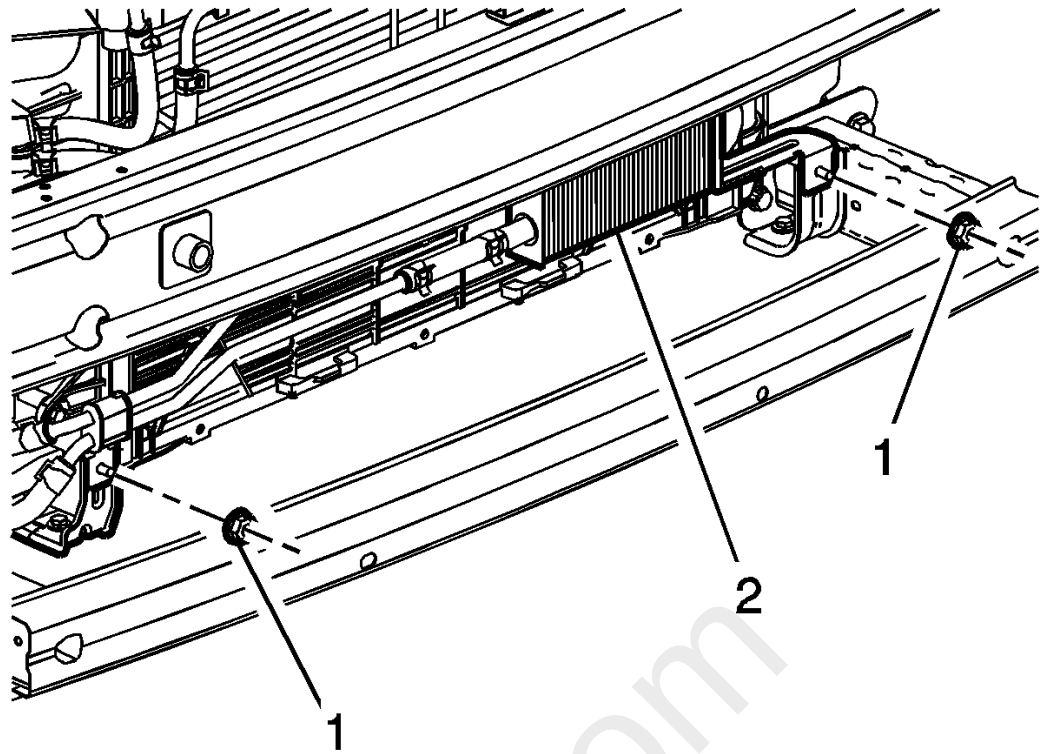


Fig. 29: Power Steering Fluid Cooler And Bracket Nuts
Courtesy of GENERAL MOTORS COMPANY

1. Position the power steering fluid cooler (2) on the vehicle.

CAUTION: Refer to **Fastener Caution** .

2. Install and tighten Power Steering Fluid Cooler Bracket Nuts (1) (Qty: 2) to 9 N.m (80 lb in)

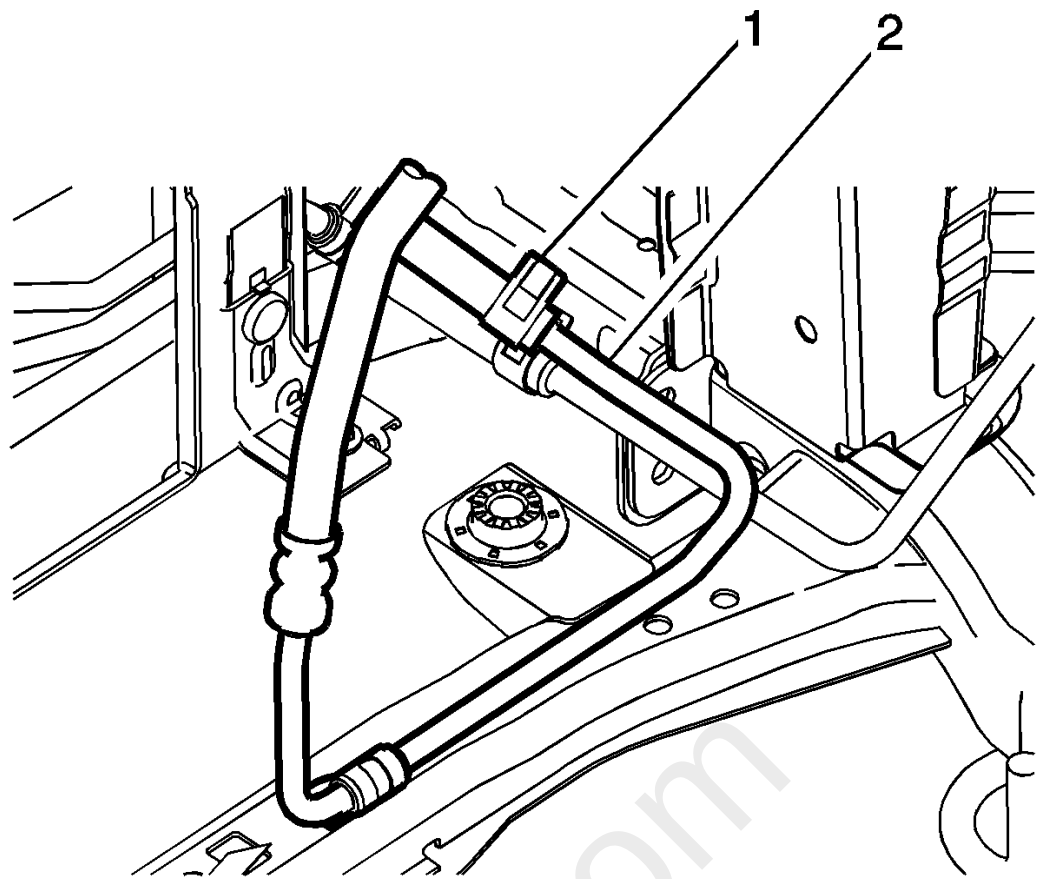


Fig. 30: Power Steering Fluid Reservoir Inlet Pipe And Clamp

Courtesy of GENERAL MOTORS COMPANY

3. Install Power Steering Fluid Reservoir Inlet Pipe (2) @ Power Steering Fluid Cooler
4. Engage Power Steering Fluid Reservoir Inlet Pipe Clamp (1)

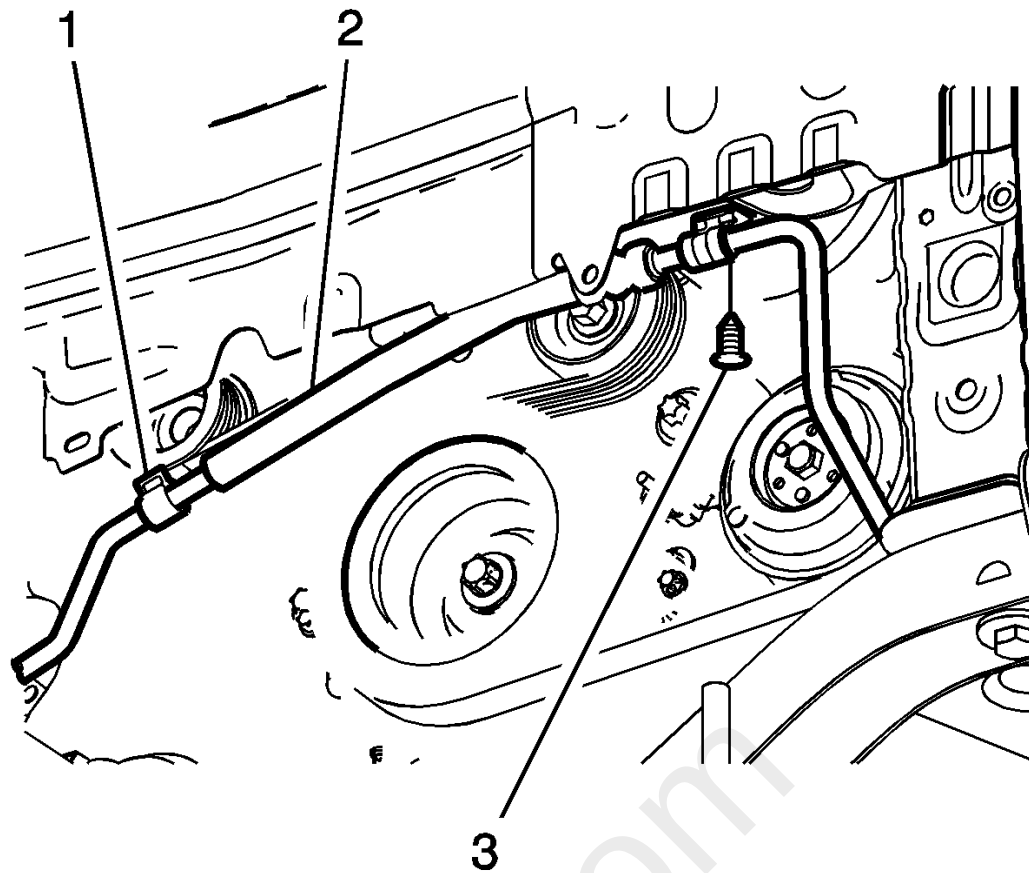


Fig. 31: Power Steering Gear Outlet Hose, Clamp And Push Pin
Courtesy of GENERAL MOTORS COMPANY

5. Install Power Steering Gear Outlet Hose (2) @ Power Steering Fluid Cooler
6. Engage Power Steering Gear Outlet Hose Clamp (1)
7. Install the plastic push pin (3) in the power steering fluid cooler bracket.
8. Install Front Bumper Fascia. Refer to [Front Bumper Fascia Replacement \(Chevrolet\)](#) [Front Bumper Fascia Replacement \(Buick\)](#)
9. Fill and bleed the power steering system. Refer to [Power Steering System Bleeding](#)

POWER STEERING FLUID RESERVOIR OUTLET HOSE REPLACEMENT

Removal Procedure

1. Remove as much power steering fluid from the power steering fluid reservoir as possible.

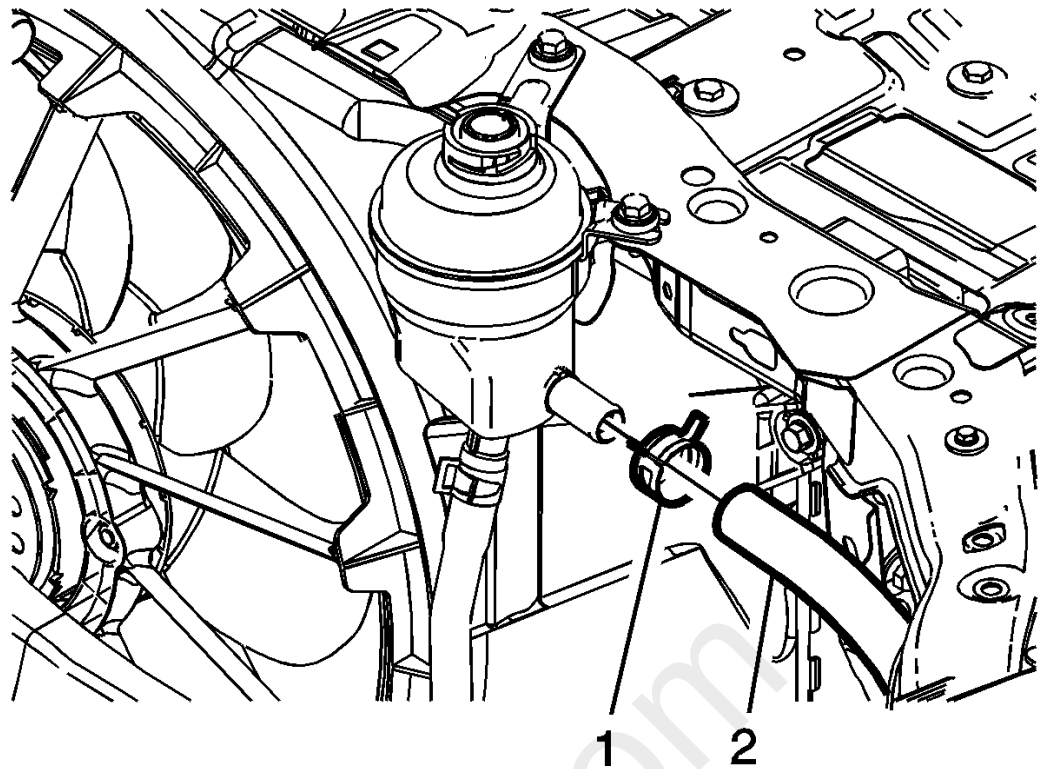


Fig. 32: Steering Fluid Reservoir Outlet Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

2. Disengage Power Steering Fluid Reservoir Outlet Hose Clamp (1)
3. Remove Power Steering Fluid Reservoir Outlet Hose (2) @ Power Steering Fluid Reservoir

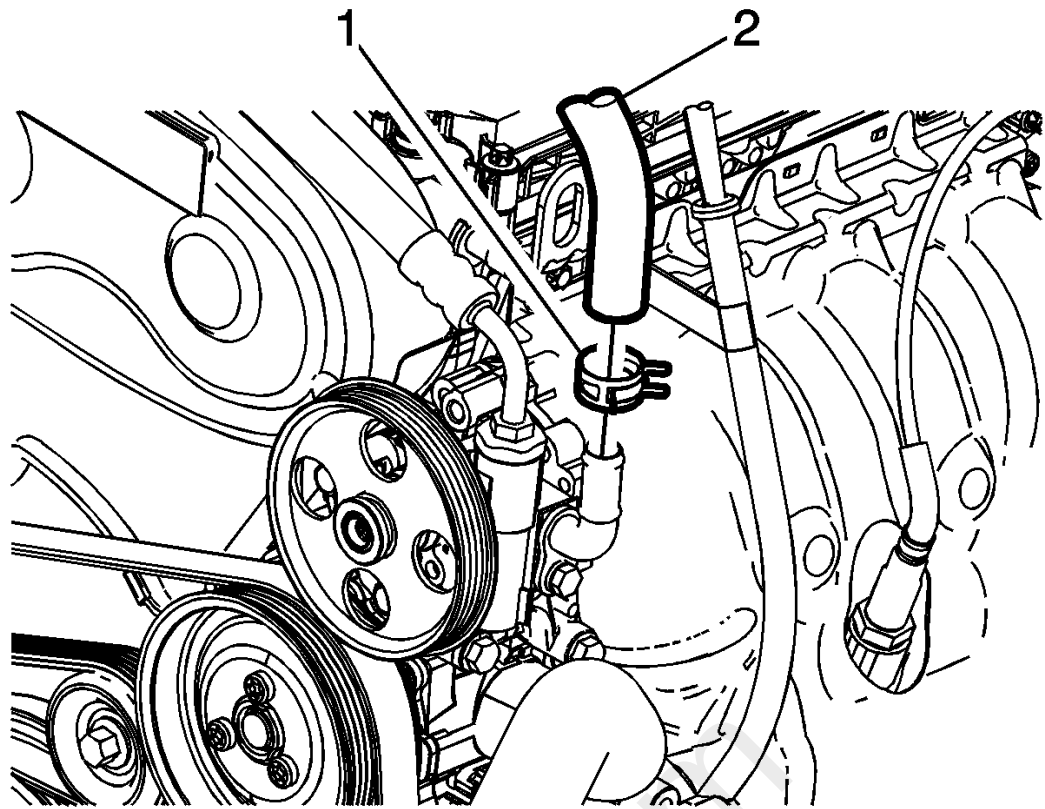


Fig. 33: Power Steering Fluid Reservoir Outlet Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

4. Disengage Power Steering Fluid Reservoir Outlet Hose Clamp (1)
5. Remove Power Steering Fluid Reservoir Outlet Hose (2) @ Power Steering Pump
6. Remove the power steering fluid reservoir outlet hose (2) from the vehicle.

Installation Procedure

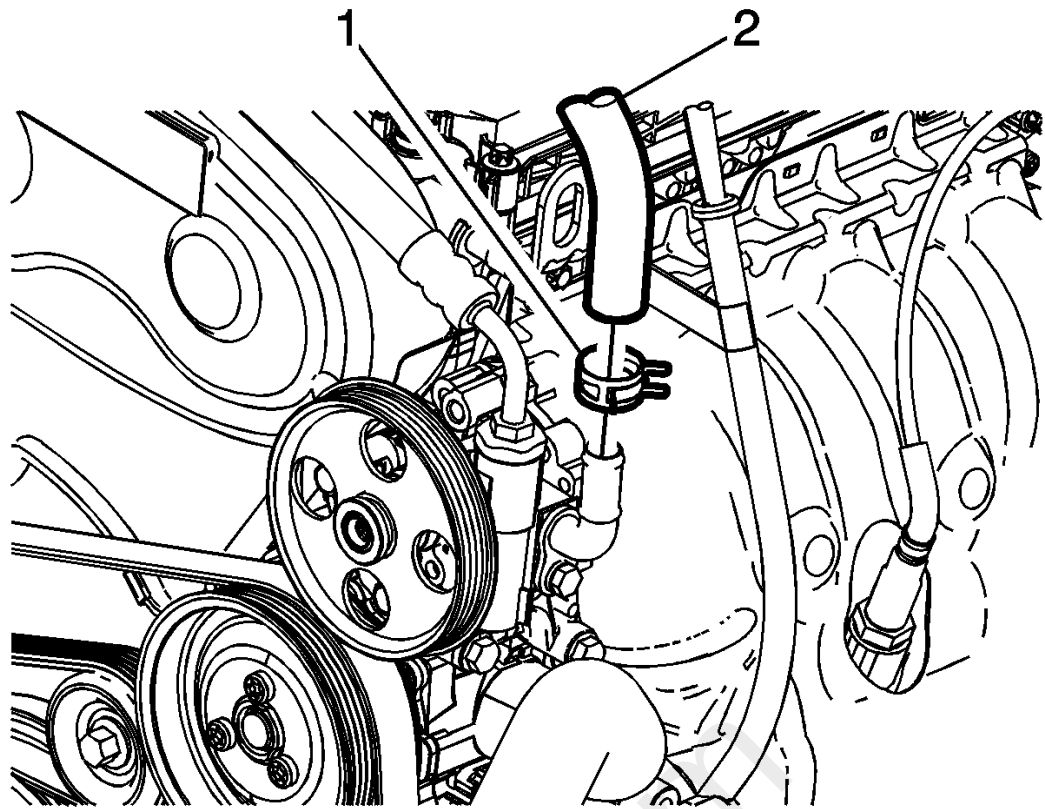


Fig. 34: Power Steering Fluid Reservoir Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Position the power steering fluid reservoir outlet hose (2) on the vehicle.
2. Install Power Steering Fluid Reservoir Outlet Hose (2) @ Power Steering Pump
3. Engage Power Steering Fluid Reservoir Outlet Hose Clamp (1)

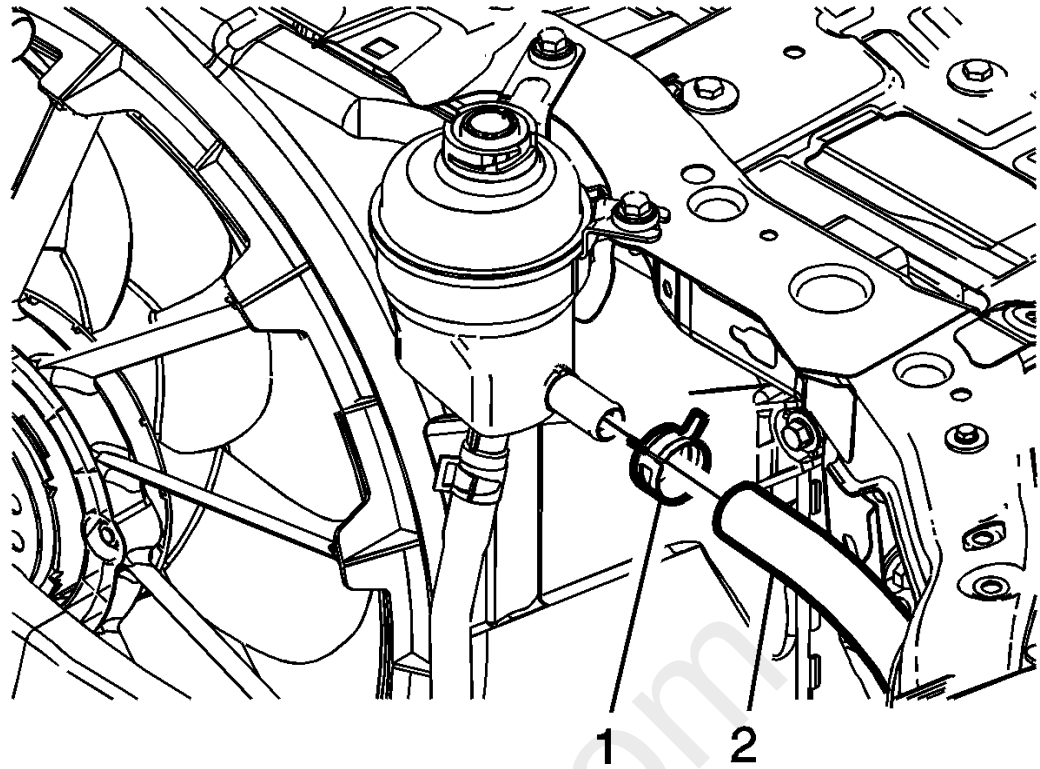


Fig. 35: Steering Fluid Reservoir Outlet Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

4. Install Power Steering Fluid Reservoir Outlet Hose (2) @ Power Steering Fluid Reservoir
5. Engage Power Steering Fluid Reservoir Outlet Hose Clamp (1)
6. Fill and bleed the power steering system. Refer to [**Power Steering System Bleeding**](#)

POWER STEERING FLUID RESERVOIR INLET PIPE REPLACEMENT

Removal Procedure

1. Remove as much power steering fluid from the power steering fluid reservoir as possible.

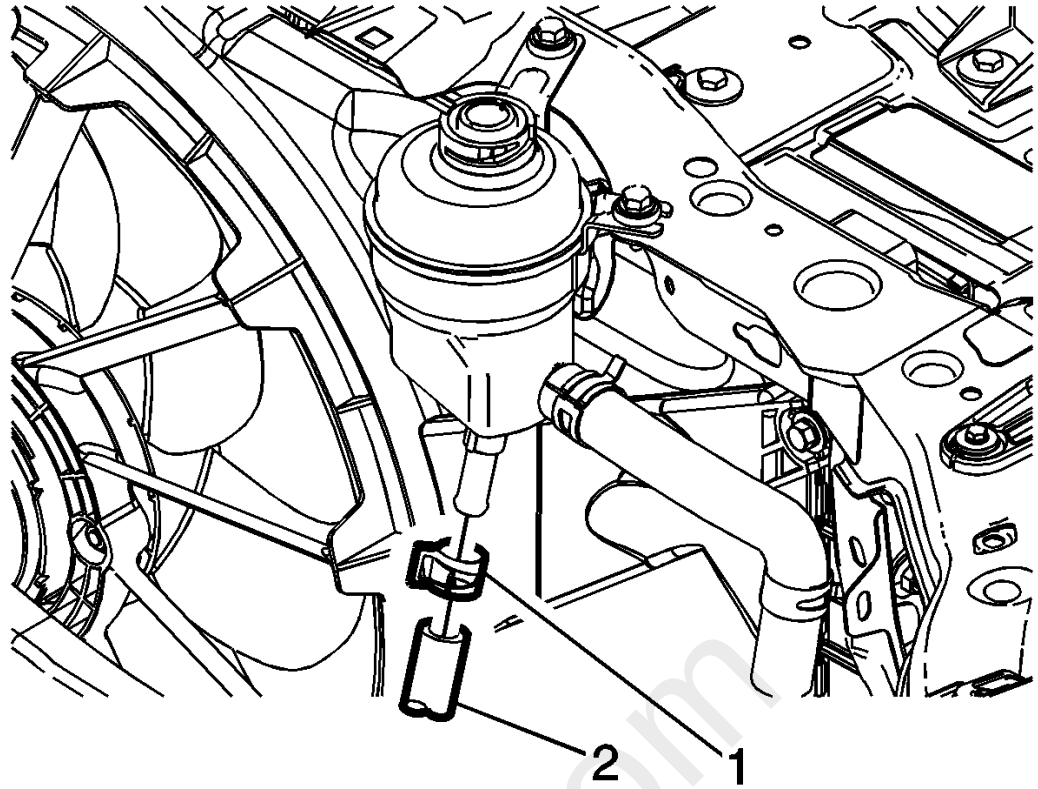


Fig. 36: Power Steering Fluid Reservoir Inlet Pipe And Clamp
Courtesy of GENERAL MOTORS COMPANY

2. Disengage Power Steering Fluid Reservoir Inlet Pipe Clamp (1)
3. Remove Power Steering Fluid Reservoir Inlet Pipe (2) @ Power Steering Fluid Reservoir

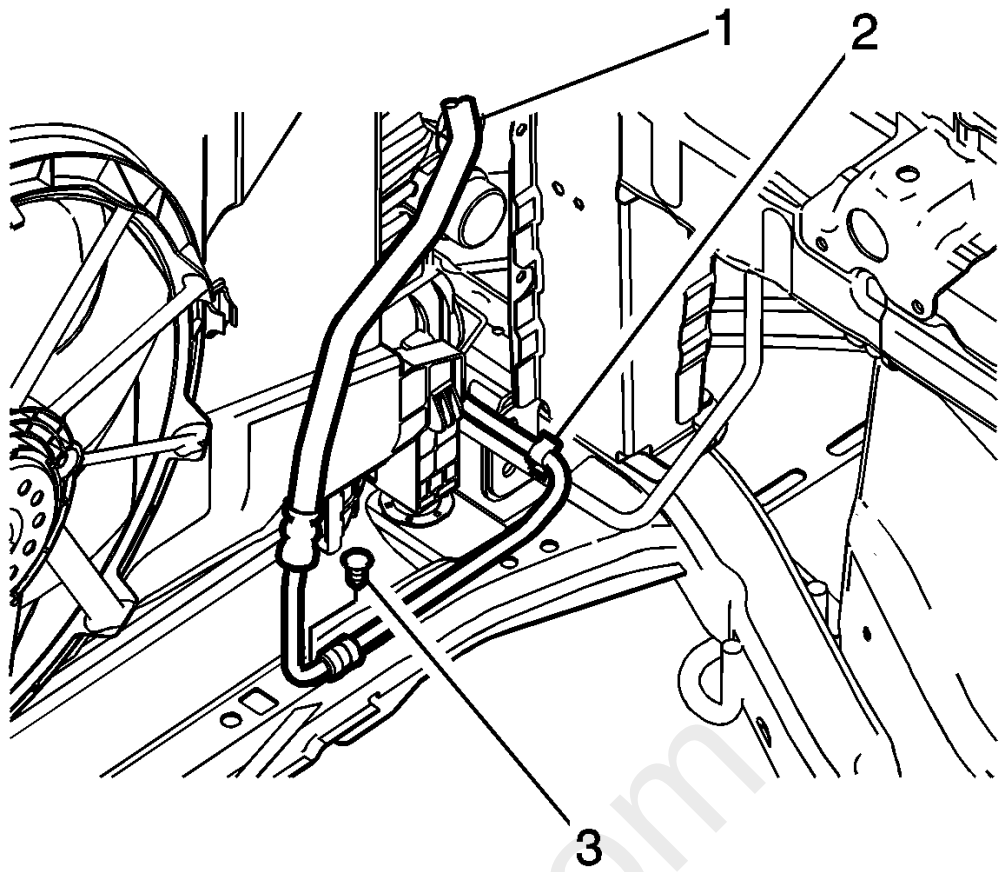


Fig. 37: Power Steering Fluid Reservoir Inlet Hose, Plastic Clip And Push Pin Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Release the power steering fluid reservoir inlet hose (1) from the plastic clip (2) and remove the plastic push pin retainer (3).

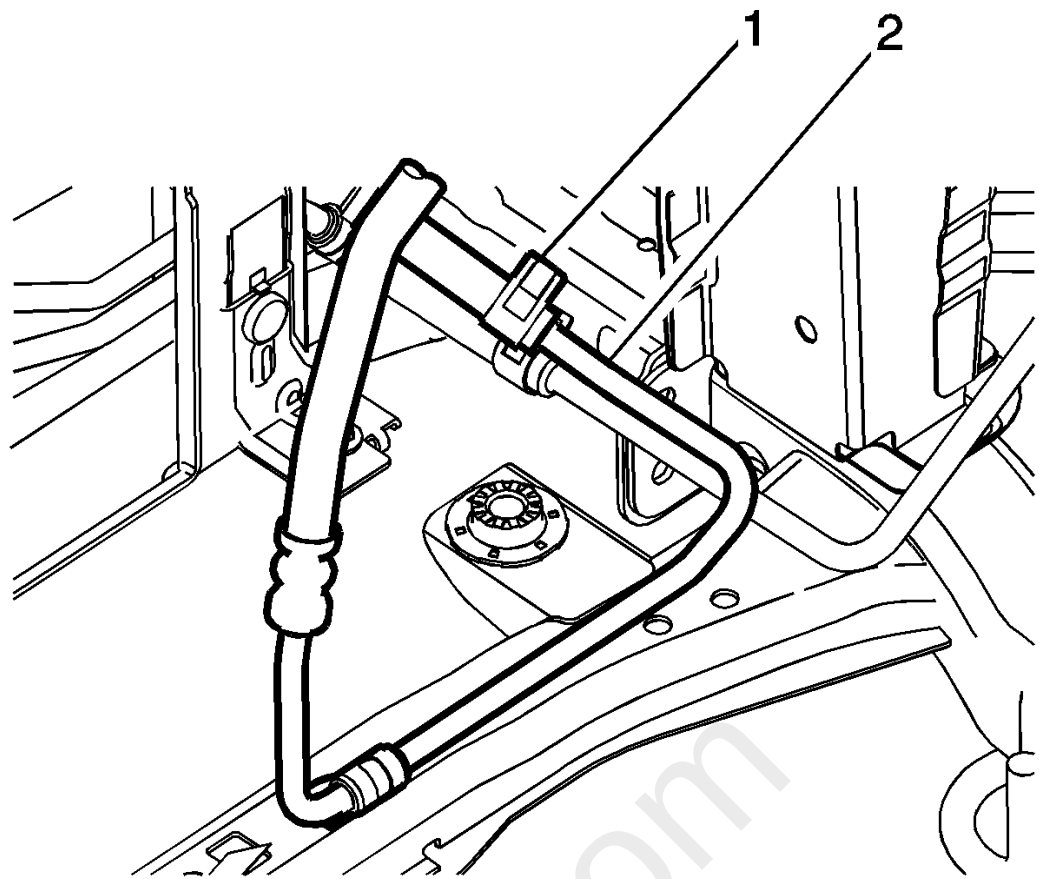


Fig. 38: Power Steering Fluid Reservoir Inlet Pipe And Clamp

Courtesy of GENERAL MOTORS COMPANY

5. Disengage Power Steering Fluid Reservoir Inlet Pipe Clamp (1)
6. Remove Power Steering Fluid Reservoir Inlet Pipe (2) @ Power Steering Fluid Cooler
7. Remove the power steering fluid reservoir inlet pipe (2) from the vehicle.

Installation Procedure

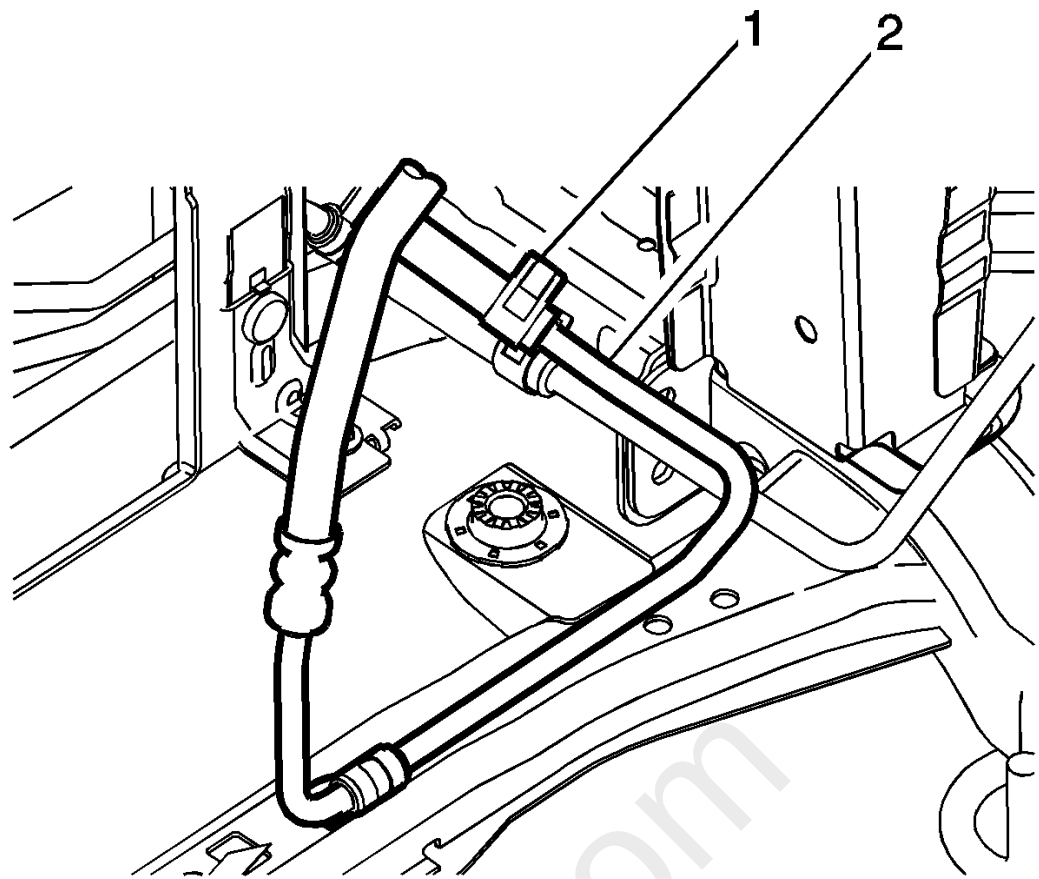


Fig. 39: Power Steering Fluid Reservoir Inlet Pipe And Clamp

Courtesy of GENERAL MOTORS COMPANY

1. Position the power steering fluid reservoir inlet pipe (2) on the vehicle.
2. Install Power Steering Fluid Reservoir Inlet Pipe (2) @ Power Steering Fluid Cooler
3. Engage Power Steering Fluid Reservoir Inlet Pipe Clamp (1)

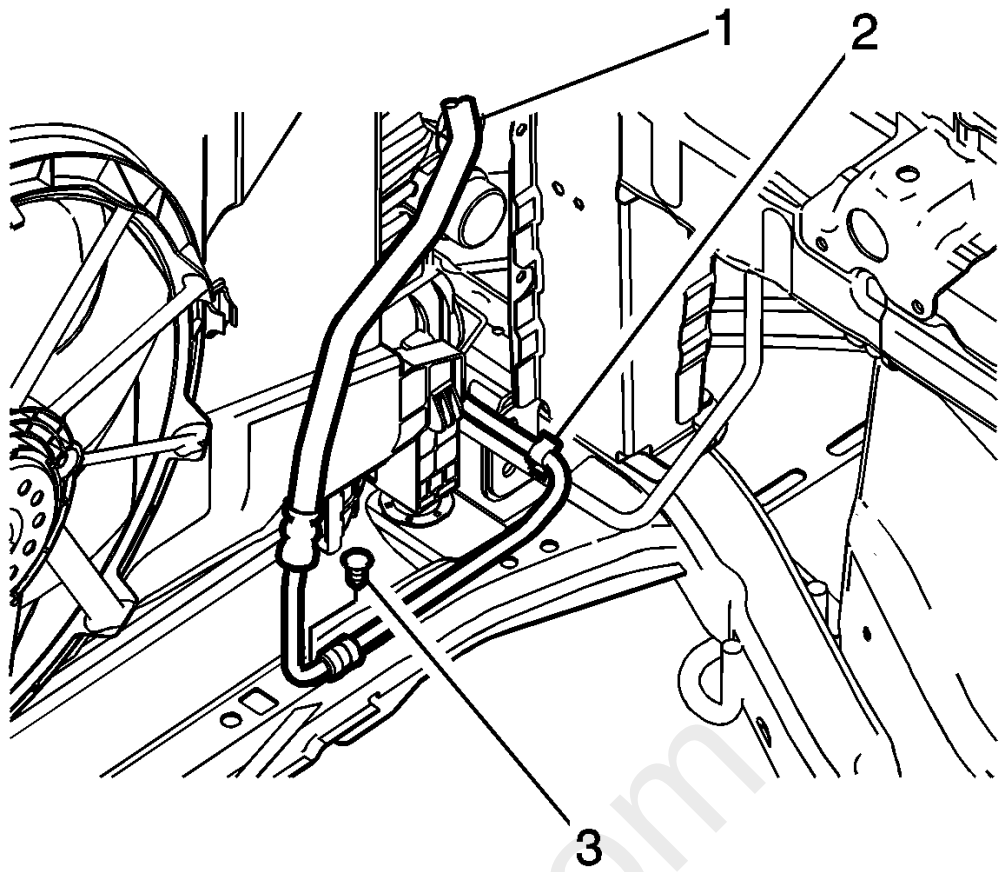


Fig. 40: Power Steering Fluid Reservoir Inlet Hose, Plastic Clip And Push Pin Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Install the plastic push pin retainer (3) and secure the power steering fluid reservoir inlet pipe clamp (1) in the plastic clip (2).

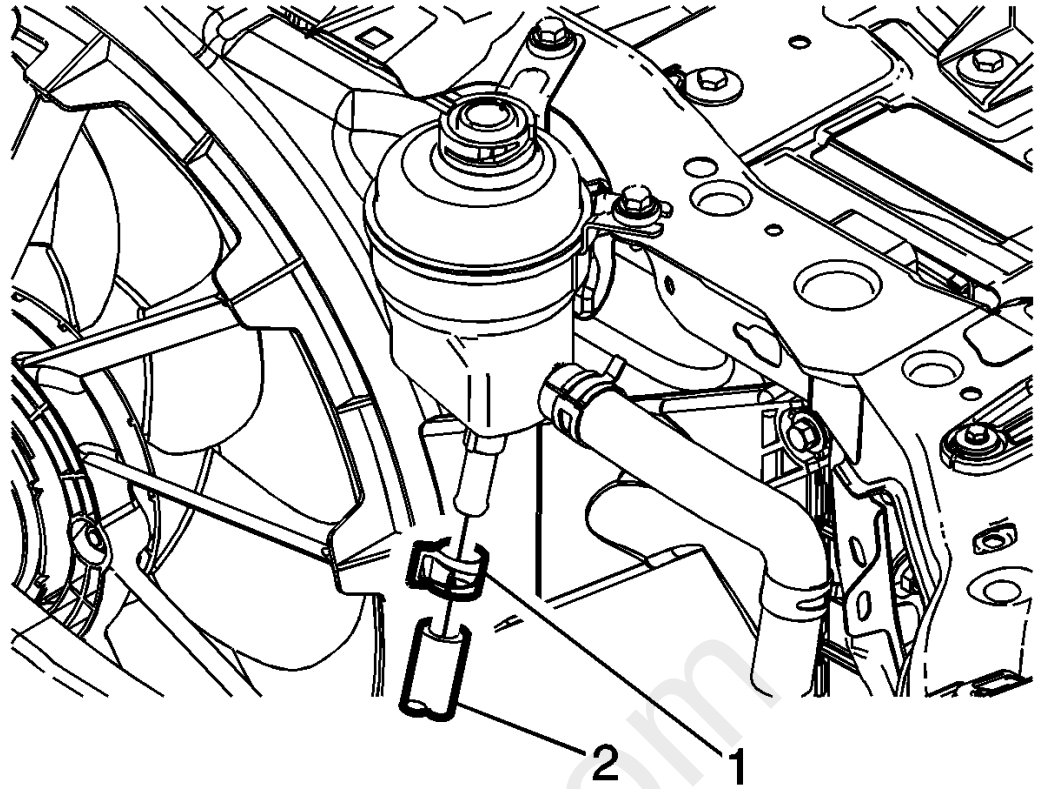


Fig. 41: Power Steering Fluid Reservoir Inlet Pipe And Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Install Power Steering Fluid Reservoir Inlet Pipe (2) @ Power Steering Fluid Reservoir
6. Engage Power Steering Fluid Reservoir Inlet Pipe Clamp (1)
7. Fill and bleed the power steering system. Refer to [Power Steering System Bleeding](#)

POWER STEERING GEAR INLET PIPE/HOSE REPLACEMENT

Removal Procedure

1. Remove as much power steering fluid from the power steering fluid reservoir as possible.

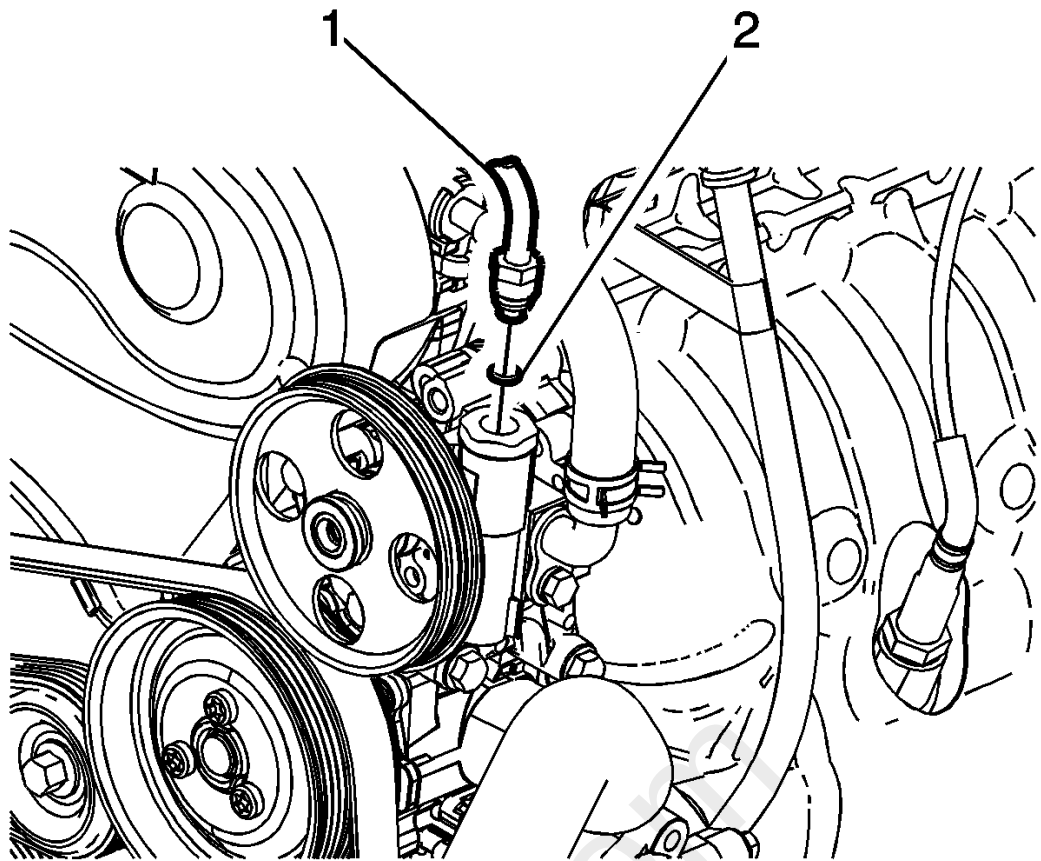


Fig. 42: Power Steering Gear Inlet Hose And Seal
Courtesy of GENERAL MOTORS COMPANY

2. Remove Power Steering Gear Inlet Hose (1) @ Power Steering Pump
3. Remove Power Steering Gear Inlet Hose Seal (2)

DISCARD the seal.

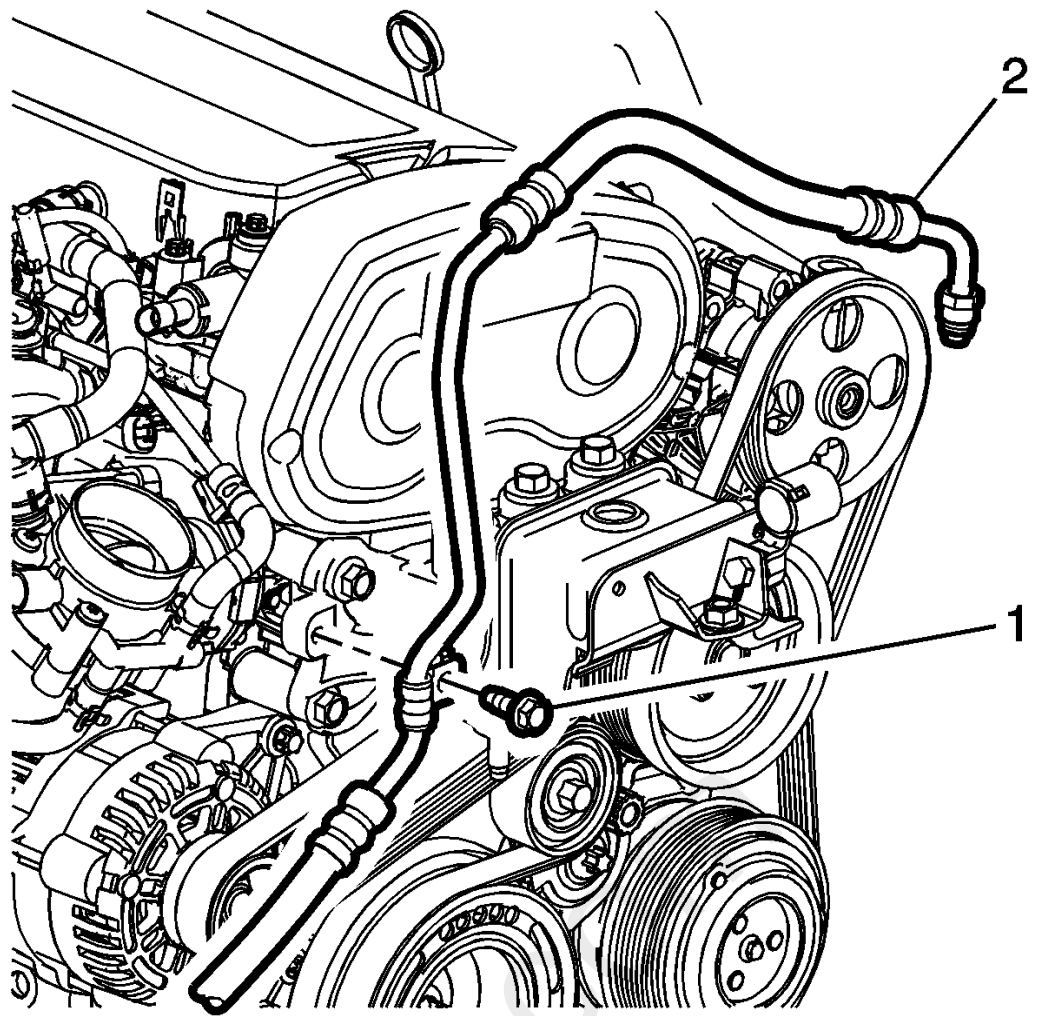


Fig. 43: Power Steering Gear Inlet Hose And Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Remove the power steering gear inlet hose bracket bolt (1) and separate the power steering gear inlet hose (2) from the engine.
5. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)

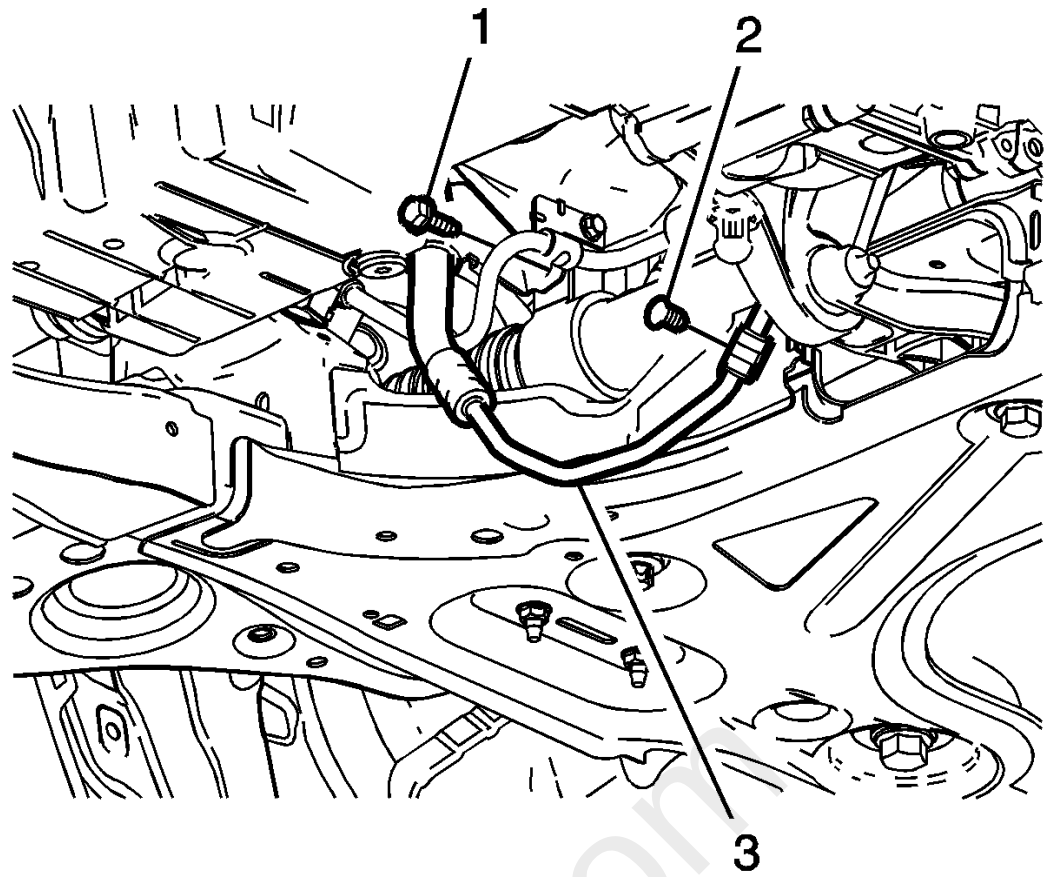


Fig. 44: Power Steering Gear Inlet Hose, Bracket Bolt And Push Pin

Courtesy of GENERAL MOTORS COMPANY

6. Remove the power steering gear inlet hose bracket bolt (1) and the plastic push pin (2) and separate the power steering gear inlet hose (3) from the drivetrain and front suspension frame.

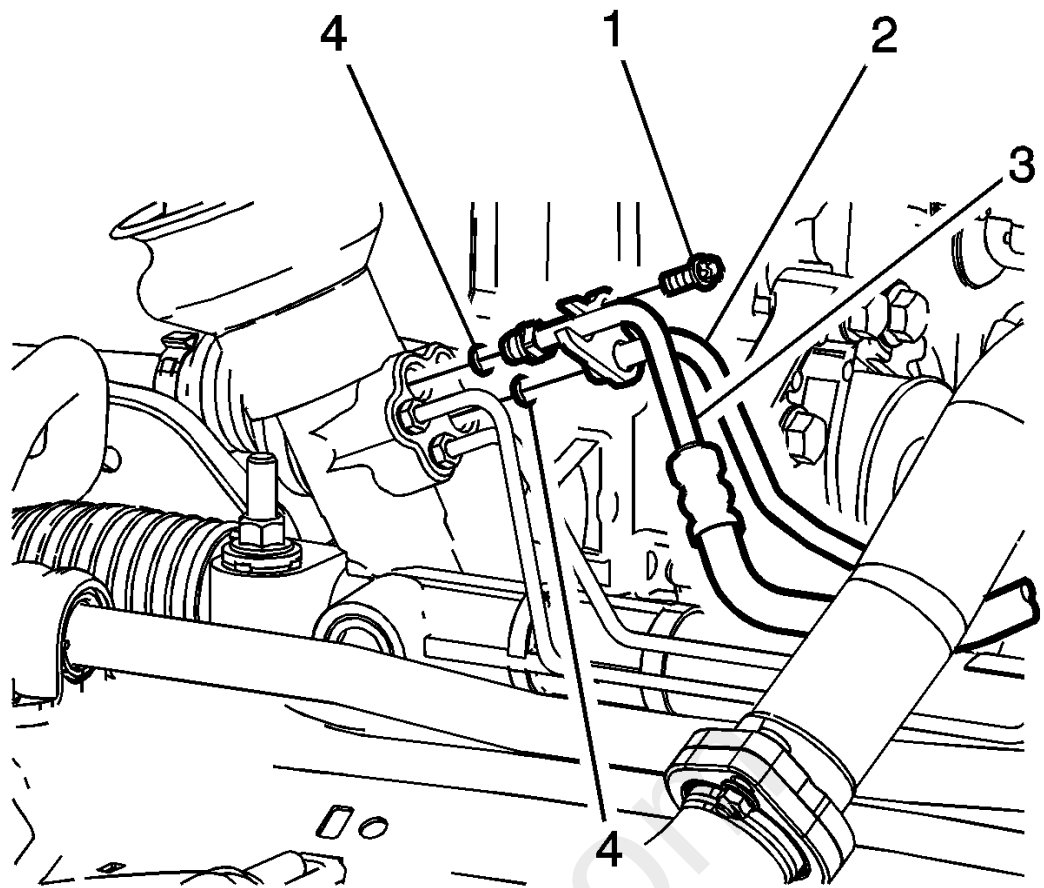


Fig. 45: Power Steering Gear Inlet And Outlet Hoses, Bolt And Seals
Courtesy of GENERAL MOTORS COMPANY

7. Remove Power Steering Gear Inlet and Outlet Hose Bolt (1)
8. Remove Power Steering Gear Inlet Hose (2) @ Steering Gear
9. Remove Power Steering Gear Outlet Hose (3) @ Steering Gear
10. Remove Power Steering Gear Inlet Hose Seal (4)

DISCARD the seal.

11. Remove Power Steering Gear Outlet Hose Seal (4)

DISCARD the seal.

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

Installation Procedure

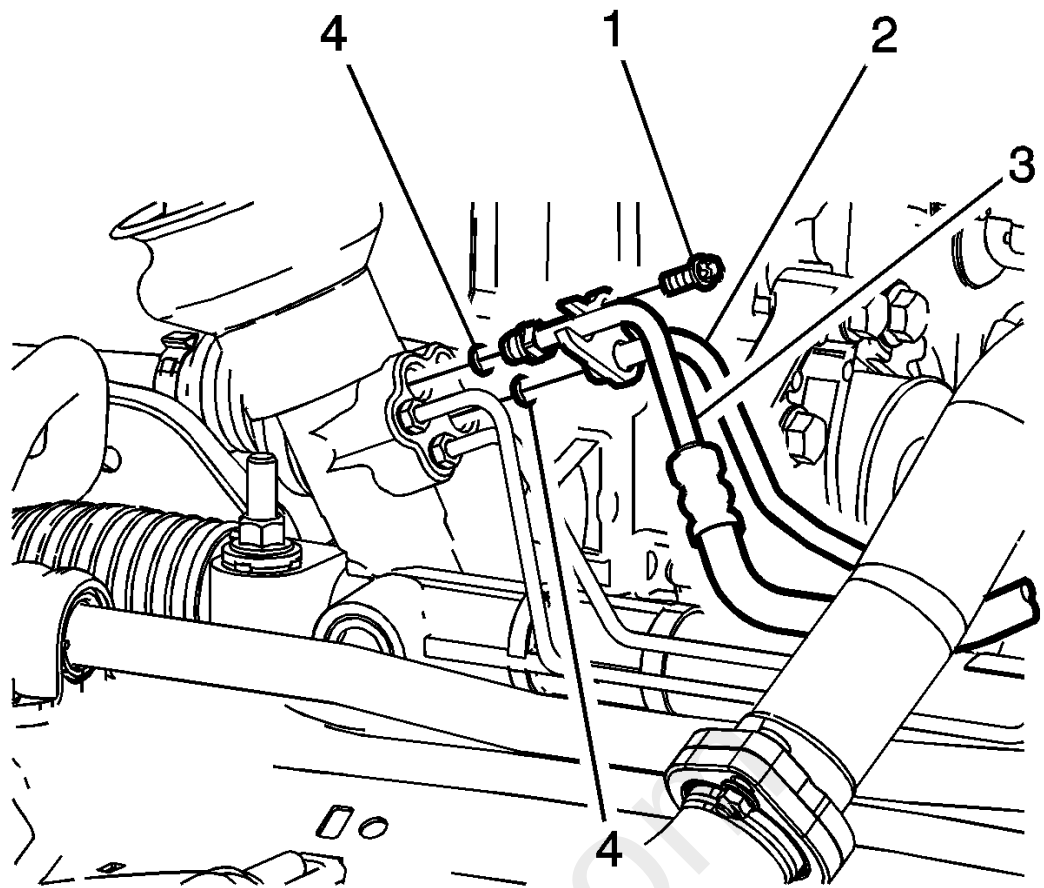


Fig. 46: Power Steering Gear Inlet And Outlet Hoses, Bolt And Seals
Courtesy of GENERAL MOTORS COMPANY

1. Position the power steering gear inlet hose (2) on the vehicle.
2. Install Power Steering Gear Outlet Hose Seal (4)

Install a NEW seal.

3. Install Power Steering Gear Inlet Hose Seal (4)

Install a NEW seal.

4. Install Power Steering Gear Outlet Hose (3) @ Steering Gear
5. Install Power Steering Gear Inlet Hose (2) @ Steering Gear

CAUTION: Refer to **Fastener Caution** .

6. Install and tighten Power Steering Gear Inlet and Outlet Hose Bolt (1) to 11 N.m (97 lb in)

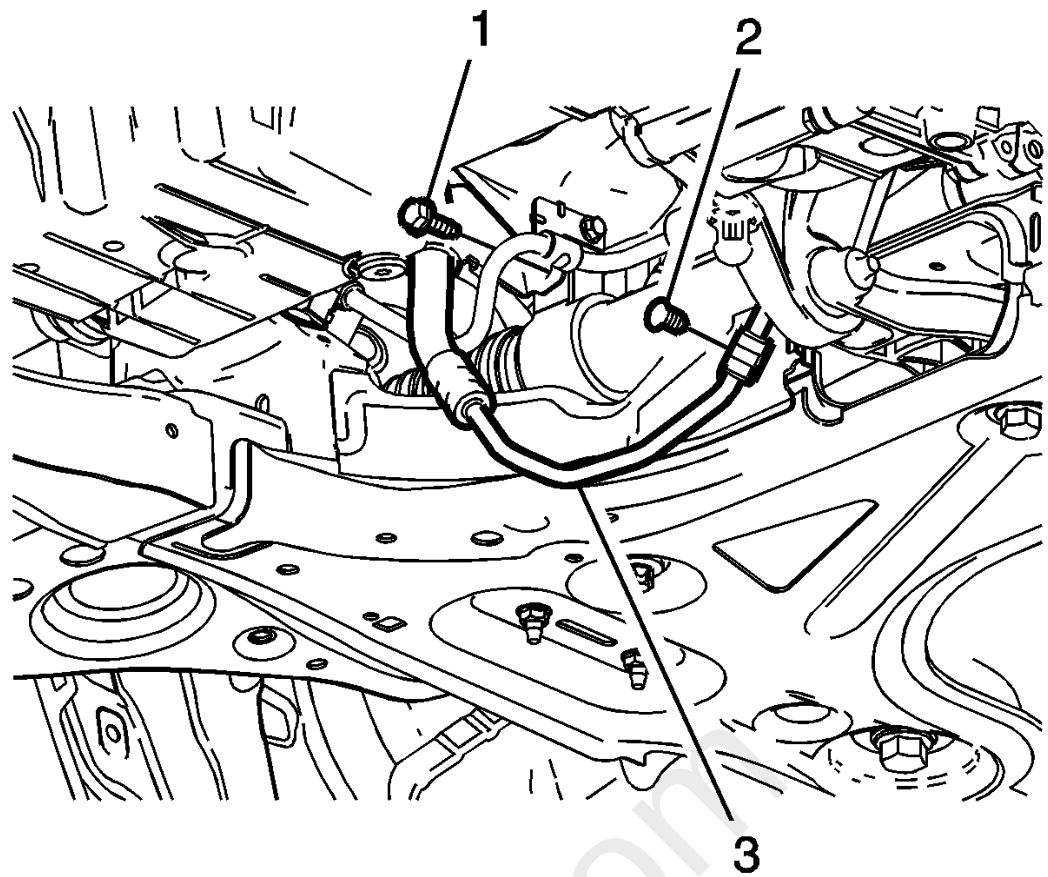


Fig. 47: Power Steering Gear Inlet Hose, Bracket Bolt And Push Pin

Courtesy of GENERAL MOTORS COMPANY

7. Secure the power steering gear inlet hose (3) to the drivetrain and front suspension frame using the plastic push pin (2) and the power steering gear inlet hose bracket bolt (1).
8. Install and tighten Power Steering Gear Inlet Hose Bracket Bolt (1) to 9 N.m (80 lb in)

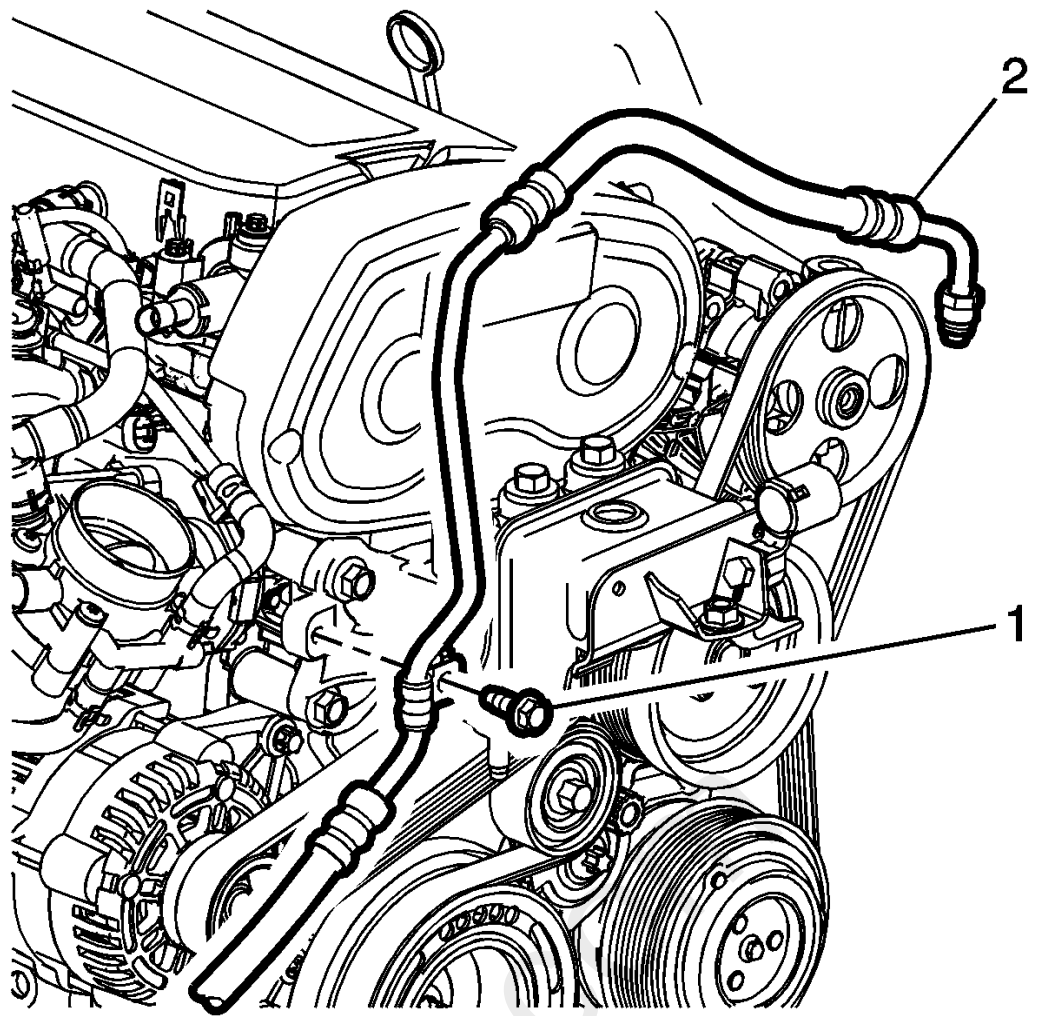


Fig. 48: Power Steering Gear Inlet Hose And Bracket Bolt

Courtesy of GENERAL MOTORS COMPANY

9. Secure the power steering gear inlet hose (2) to the engine using the power steering gear inlet hose bracket bolt (1).
10. Install and tighten Power Steering Gear Inlet Hose Bracket Bolt (1) to 22 N.m (16 lb ft)

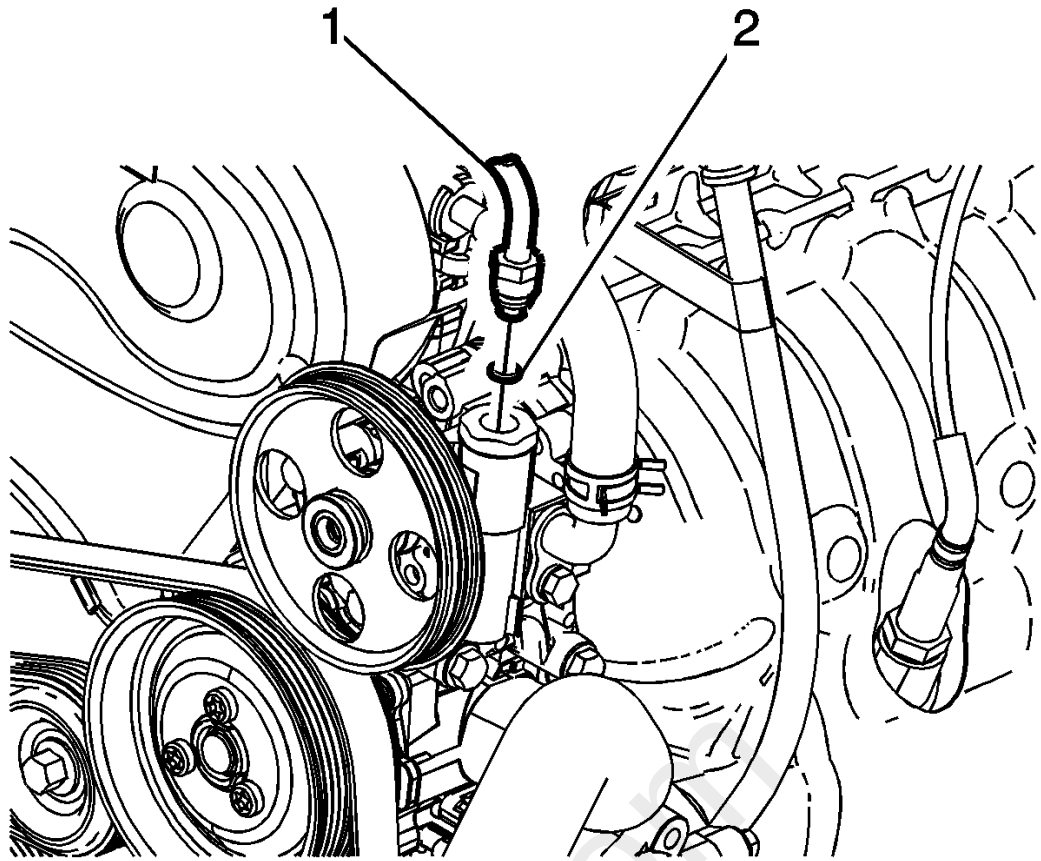


Fig. 49: Power Steering Gear Inlet Hose And Seal
Courtesy of GENERAL MOTORS COMPANY

11. Install Power Steering Gear Inlet Hose Seal (2)

Install a NEW seal.

CAUTION: Refer to [Component Fastener Tightening Caution](#) .

12. Install and tighten Power Steering Gear Inlet Hose (1) @ Power Steering Pump to 34 N.m (25 lb ft)
13. Fill and bleed the power steering system. Refer to [Power Steering System Bleeding](#)

POWER STEERING GEAR OUTLET PIPE/HOSE REPLACEMENT

Removal Procedure

1. Remove as much power steering fluid from the power steering fluid reservoir as possible.
2. Remove the right front tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#)

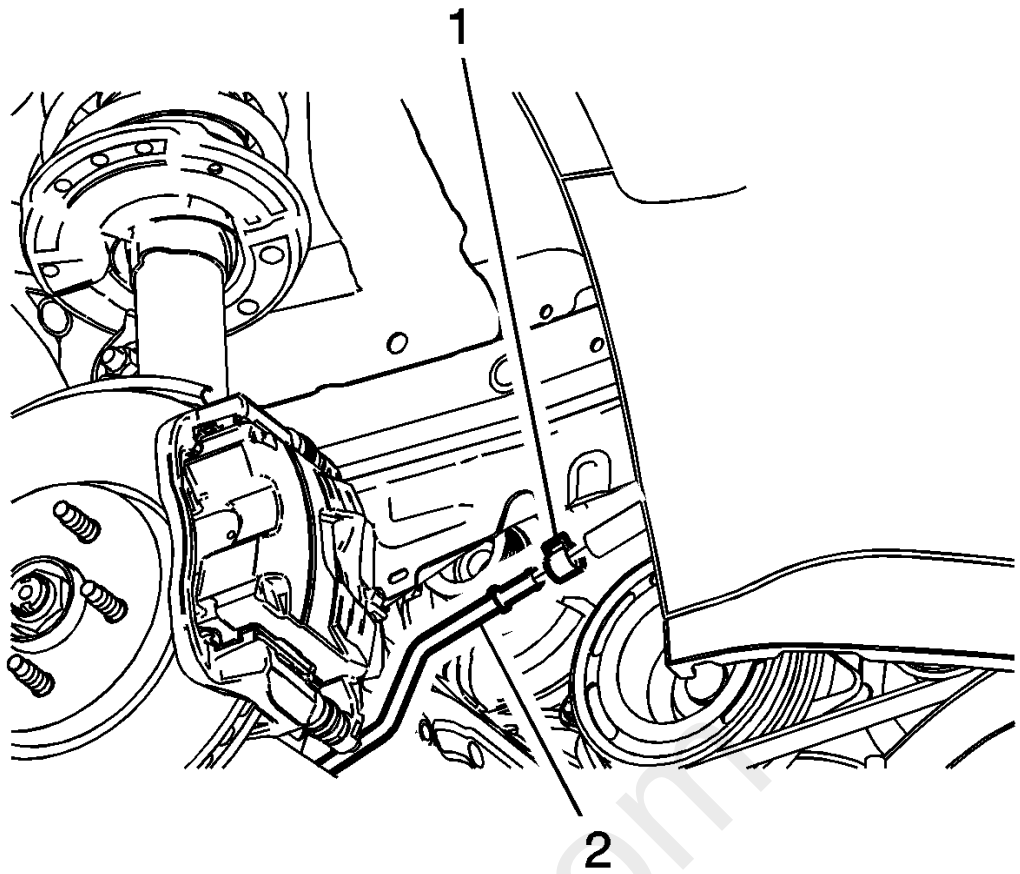


Fig. 50: Power Steering Gear Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

3. Disengage Power Steering Gear Outlet Hose Clamp (1)
4. Remove Power Steering Gear Outlet Hose (2) @ Power Steering Fluid Cooler

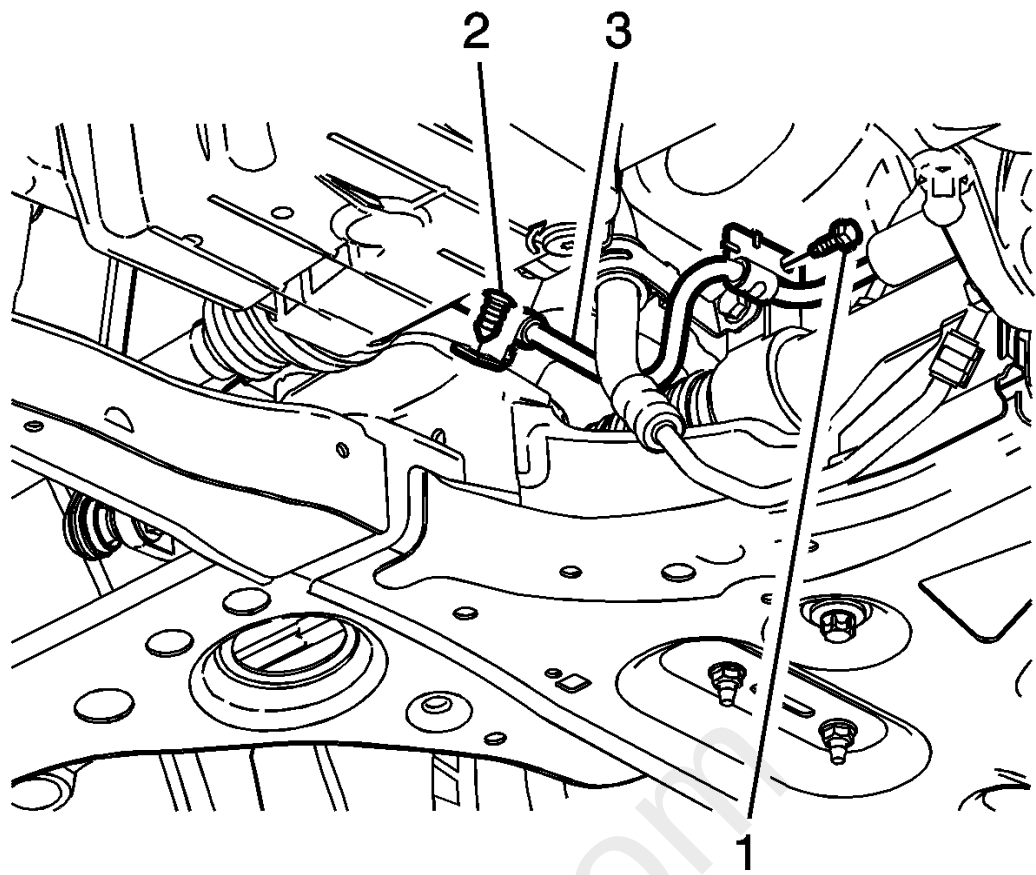


Fig. 51: Power Steering Gear Outlet Hose Bracket Bolt, Push Pin And Power Steering Gear Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

5. Remove the power steering gear outlet hose bracket bolt (1) and the plastic push pin (2) and separate the power steering gear inlet hose (3) from the drivetrain and front suspension frame.

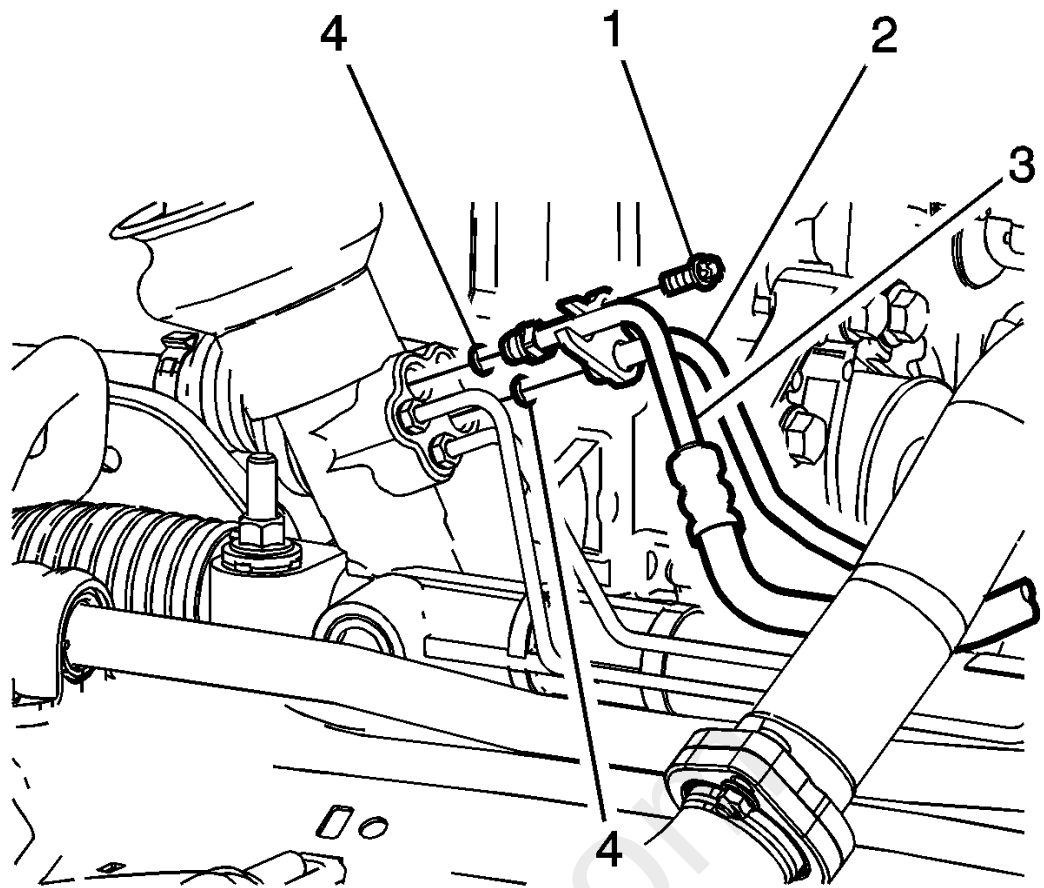


Fig. 52: Power Steering Gear Inlet And Outlet Hoses, Bolt And Seals
Courtesy of GENERAL MOTORS COMPANY

6. Remove Power Steering Gear Inlet and Outlet Hose Bolt (1)
7. Remove Power Steering Gear Inlet Hose (2) @ Steering Gear
8. Remove Power Steering Gear Outlet Hose (3) @ Steering Gear
9. Remove Power Steering Gear Inlet Hose Seal (4)

DISCARD the seal.

10. Remove Power Steering Gear Outlet Hose Seal (4)

DISCARD the seal.

11. Remove the power steering gear inlet hose (2) from the vehicle.

Installation Procedure

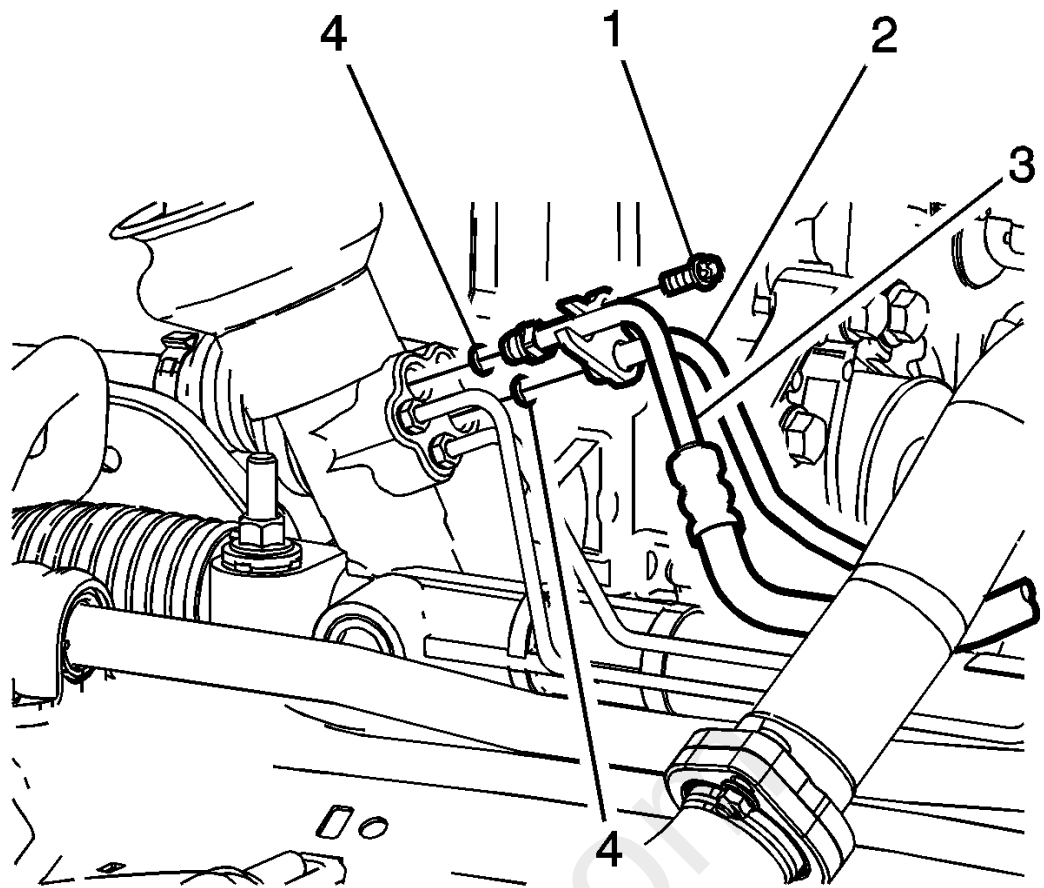


Fig. 53: Power Steering Gear Inlet And Outlet Hoses, Bolt And Seals
Courtesy of GENERAL MOTORS COMPANY

1. Position the power steering gear inlet hose (2) on the vehicle.
2. Install Power Steering Gear Outlet Hose Seal (4)

Install a NEW seal.

3. Install Power Steering Gear Inlet Hose Seal (4)

Install a NEW seal.

4. Install Power Steering Gear Outlet Hose (3) @ Steering Gear
5. Install Power Steering Gear Inlet Hose (2) @ Steering Gear

CAUTION: Refer to **Fastener Caution** .

6. Install and tighten Power Steering Gear Inlet and Outlet Hose Bolt (1) to 11 N.m (97 lb in)

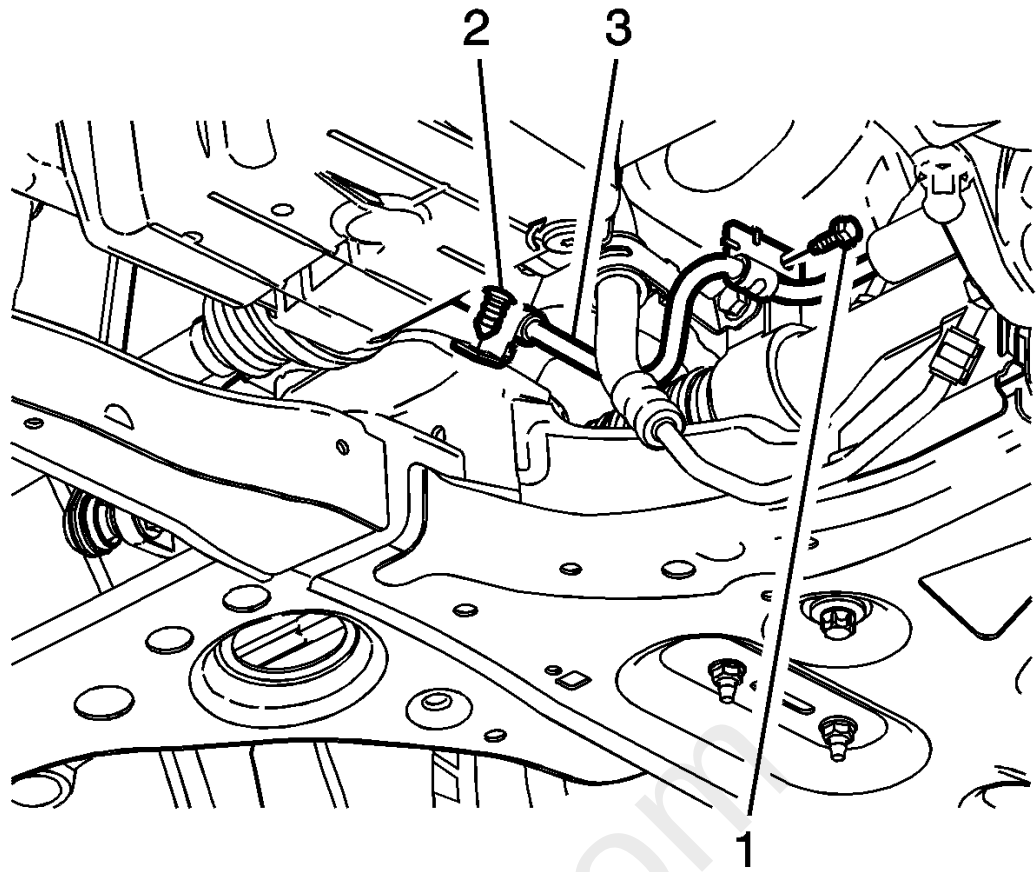


Fig. 54: Power Steering Gear Outlet Hose Bracket Bolt, Push Pin And Power Steering Gear Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

7. Secure the power steering gear outlet hose (3) to the drivetrain and front suspension frame using the plastic push pin (2) and the power steering gear inlet hose bracket bolt (1).
8. Install and tighten Power Steering Gear Outlet Hose Bracket Bolt (1) to 9 N.m (80 lb in)

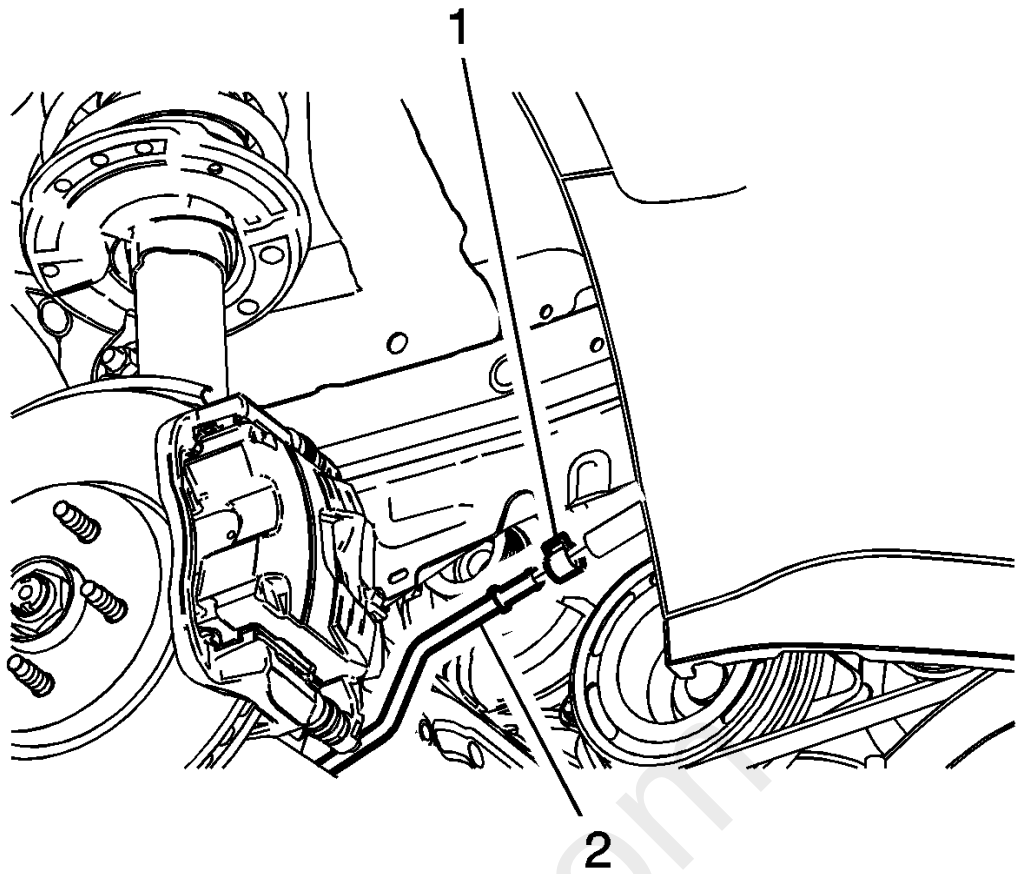


Fig. 55: Power Steering Gear Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

9. Install Power Steering Gear Outlet Hose (2) @ Power Steering Fluid Cooler
10. Engage Power Steering Gear Outlet Hose Clamp (1)
11. Install the right front tire and wheel assembly. Refer to [**Tire and Wheel Removal and Installation**](#)
12. Fill and bleed the power steering system. Refer to [**Power Steering System Bleeding**](#)

STEERING GEAR PIPE REPLACEMENT

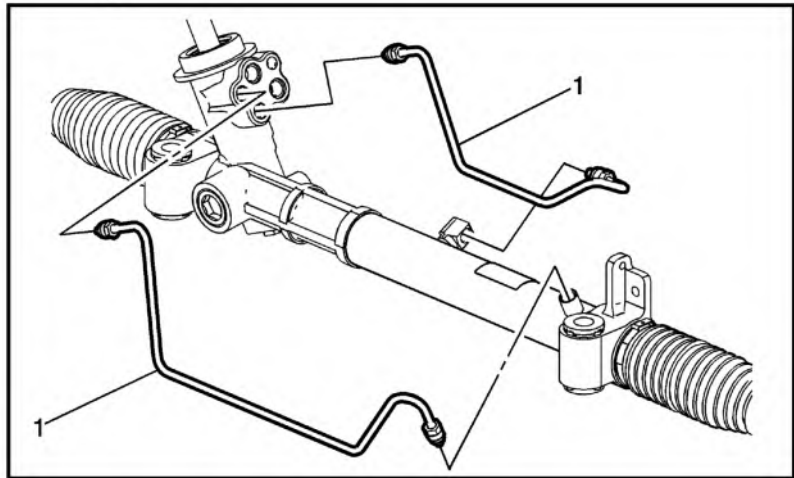
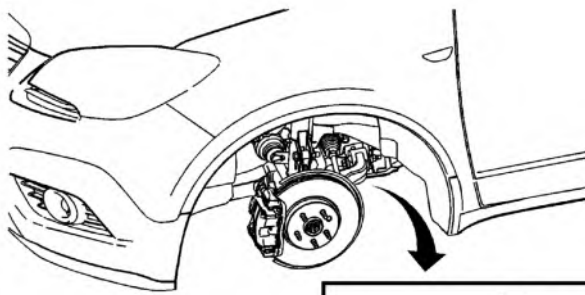


Fig. 56: Steering Gear Pipe

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle	
1	Steering Gear Pipe (Qty: 2) CAUTION: Refer to Component Fastener Tightening Caution . Tighten 13 N.m (115 lb in)

STEERING GEAR REPLACEMENT (N40 WITH MNK)

Removal Procedure

1. Remove the intermediate steering shaft lower universal joint. Refer to [Intermediate Steering Shaft Replacement \(N40\)](#)
2. Remove as much power steering fluid from the power steering fluid reservoir as possible.
3. Remove the front tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#)
4. Separate Steering Linkage Outer Tie Rod (Qty: 2) @ Steering Knuckle. Refer to [Steering Linkage Outer Tie Rod Replacement](#)
5. Separate Front Stabilizer Shaft Link (Qty: 2) @ Front Stabilizer Shaft. Refer to [Stabilizer Shaft Link Replacement](#)
6. Separate Front Lower Control Arm (Qty: 2) @ Steering Knuckle. Refer to [Lower Control Arm Replacement](#)
7. Separate Exhaust Isolator (Qty: 2) @ Drivetrain and Front Suspension Frame. Refer to [Exhaust Front Pipe Replacement \(LUV\)](#) [Exhaust Front Pipe Replacement \(2H0\)](#) [Exhaust Front Pipe Replacement \(LE2\)](#)
8. Remove Rear Transmission Mount Through Bolt. Refer to [Transmission Mount Bracket Replacement - Rear \(All Wheel Drive\)](#) [Transmission Mount Bracket Replacement - Rear \(Front Wheel Drive\)](#)

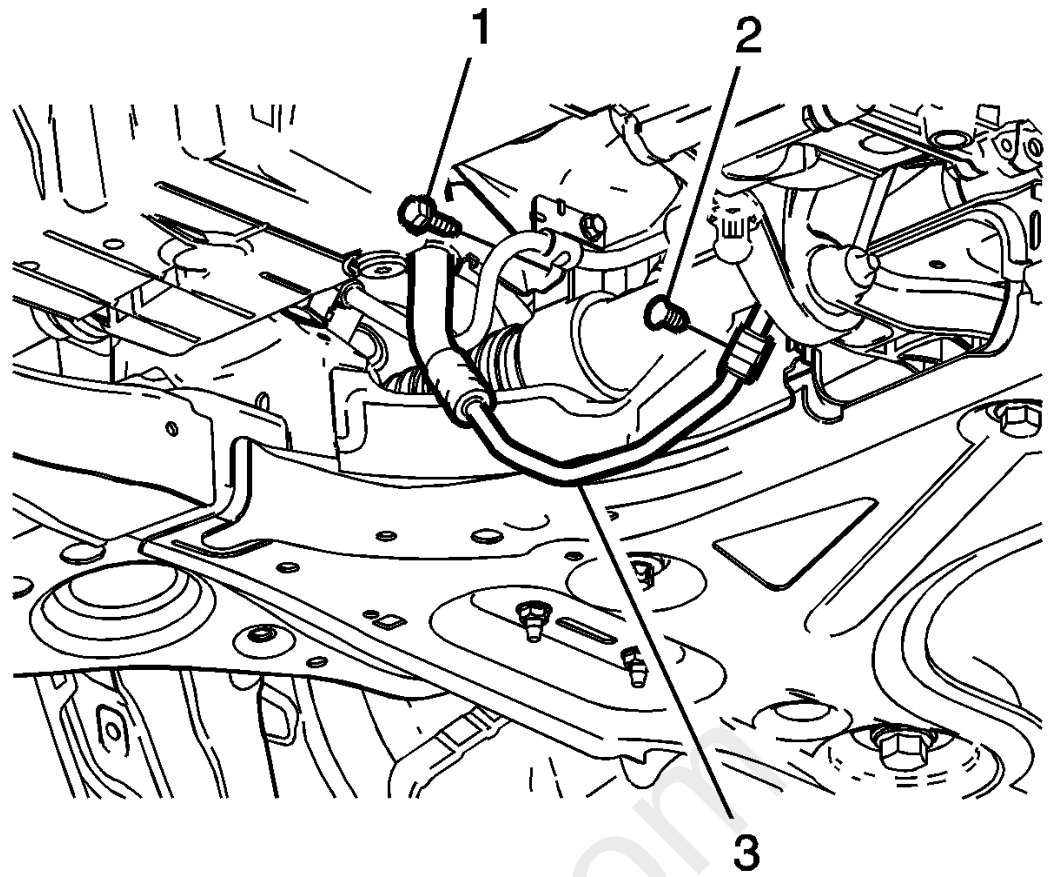


Fig. 57: Power Steering Gear Inlet Hose, Bracket Bolt And Push Pin

Courtesy of GENERAL MOTORS COMPANY

9. Remove the power steering gear inlet hose bracket bolt (1) and the plastic push pin (2) and separate the power steering gear inlet hose (3) from the vehicle frame.

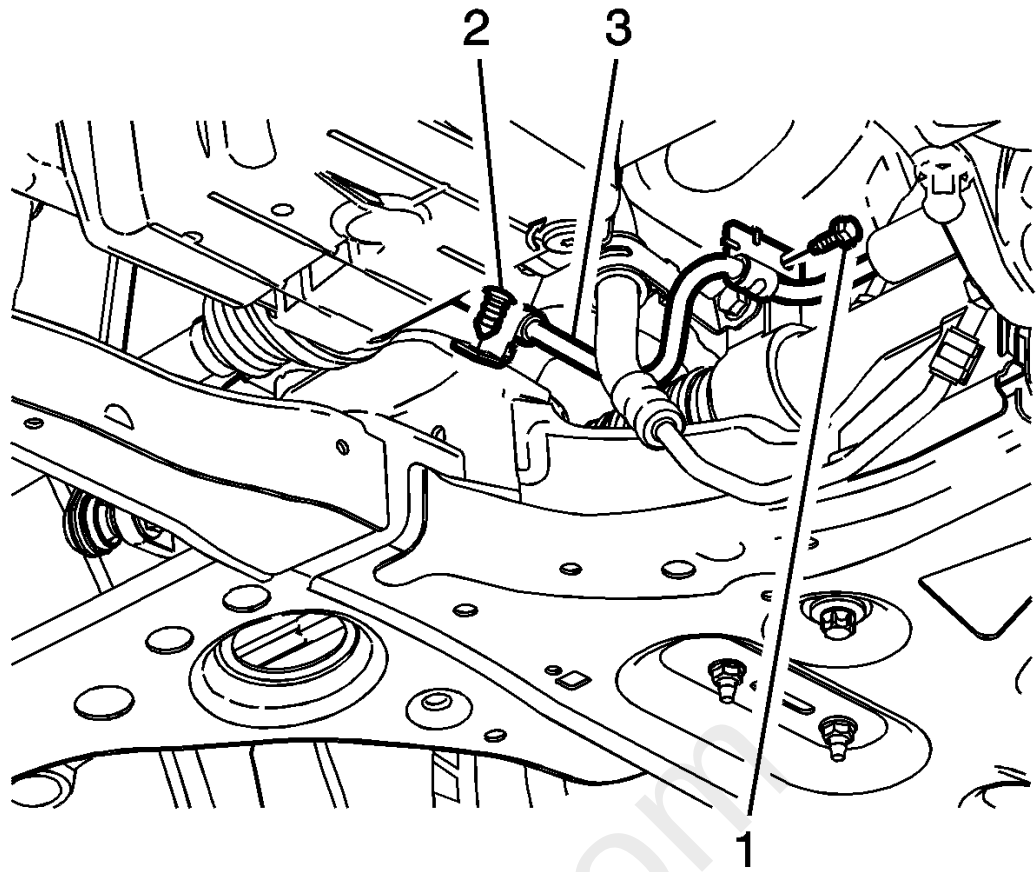


Fig. 58: Power Steering Gear Outlet Hose Bracket Bolt, Push Pin And Power Steering Gear Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

10. Remove the power steering gear outlet hose bracket bolt (1) and the plastic push pin (2) and separate the power steering gear inlet hose (3) from the steering gear.

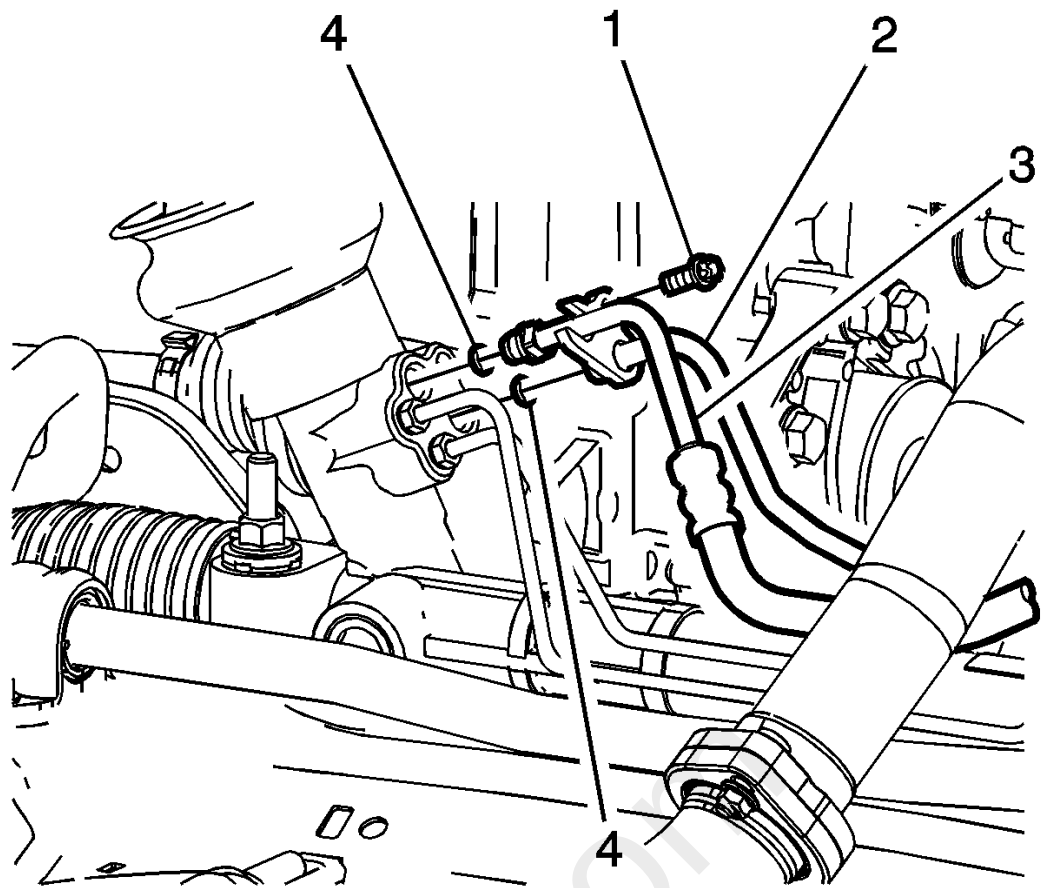


Fig. 59: Power Steering Gear Inlet And Outlet Hoses, Bolt And Seals
Courtesy of GENERAL MOTORS COMPANY

11. Remove the power steering gear inlet and outlet hose bolt (1).
 12. Remove the power steering gear inlet hose (2), power steering gear outlet hose (3), and power steering gear inlet and outlet hose seals (4) from the steering gear.
- DISCARD the seals.
13. Position adjustable stands underneath the left and right sides of the rear of the drivetrain and front suspension frame.
 14. Loosen, but do NOT remove, the drivetrain and front suspension frame front bolts. Refer to [Drivetrain and Front Suspension Frame Replacement \(Long Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Short Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Long Cradle - V50\)](#)
 15. Remove the drivetrain and front suspension frame upper and rear bolts. Refer to [Drivetrain and Front Suspension Frame Replacement \(Long Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Short Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Long Cradle - V50\)](#)
 16. Partially lower the rear of the drivetrain and front suspension frame to gain clearance for the steering gear.
 17. Finish removing the front stabilizer shaft. Refer to [Stabilizer Shaft Replacement](#)

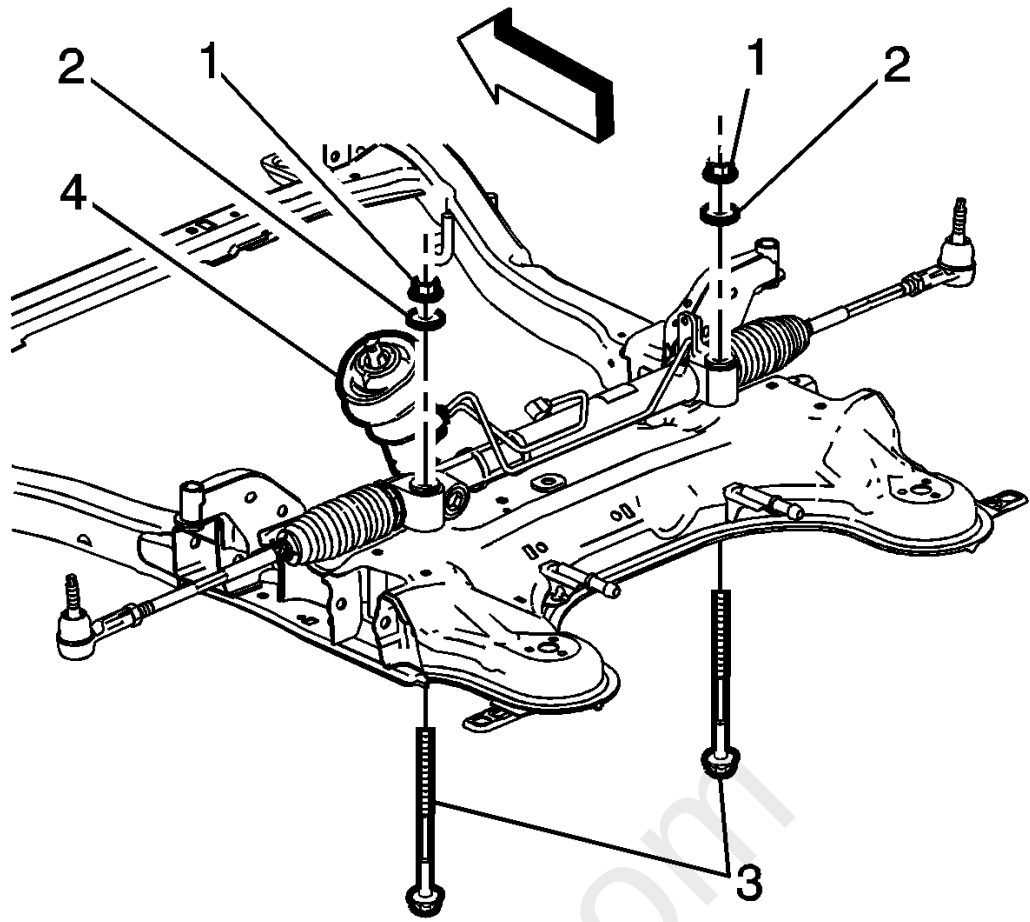


Fig. 60: Steering Gear, Nuts, Washers And Bolts
Courtesy of GENERAL MOTORS COMPANY

18. Remove the steering gear nuts (1), washers (2), and steering gear bolts (3).

DISCARD the bolts.

19. Remove the steering gear (4) from the drivetrain and front suspension frame.

20. Transfer components as necessary.

Installation Procedure

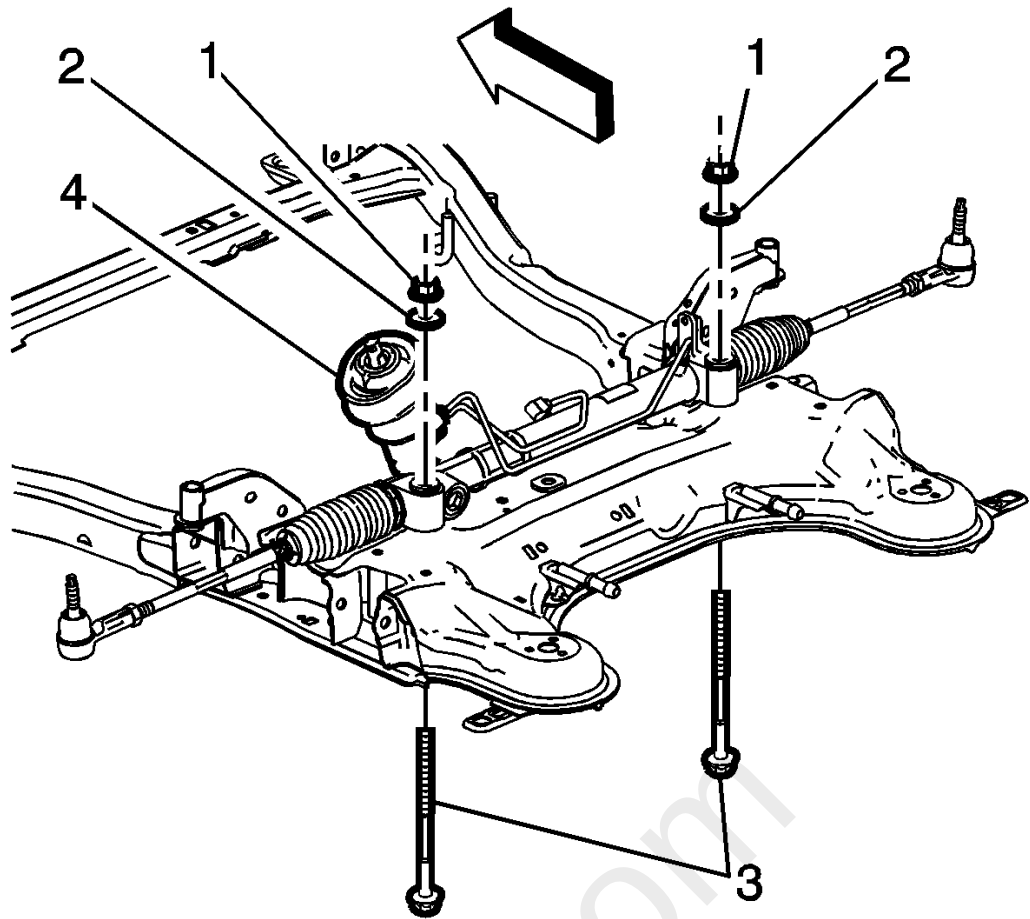


Fig. 61: Steering Gear, Nuts, Washers And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Position the steering gear (4) on the drivetrain and front suspension frame.

CAUTION: This vehicle is equipped with torque-to-yield or single use fasteners. Install a **NEW** torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component.

NOTE: Start ALL fasteners by hand before tightening.

2. Install the steering gear bolts (3), washers (2), and nuts (1).

Install NEW bolts.

CAUTION: Refer to [Fastener Caution](#) .

3. Tighten the NEW steering gear bolts (3).

Tighten

1. First Pass: 100 N.m (74 lb ft)
2. Final Pass: (90-105 degrees)
4. Install the front stabilizer shaft on the drivetrain and front suspension frame. Refer to [Stabilizer Shaft Replacement](#)
5. Raise the rear of the drivetrain and front suspension frame.
6. Install ALL drivetrain and front suspension frame bolts. Refer to [Drivetrain and Front Suspension Frame Replacement \(Long Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Short Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Long Cradle - V50\)](#)
7. Remove the adjustable stands from underneath the vehicle.

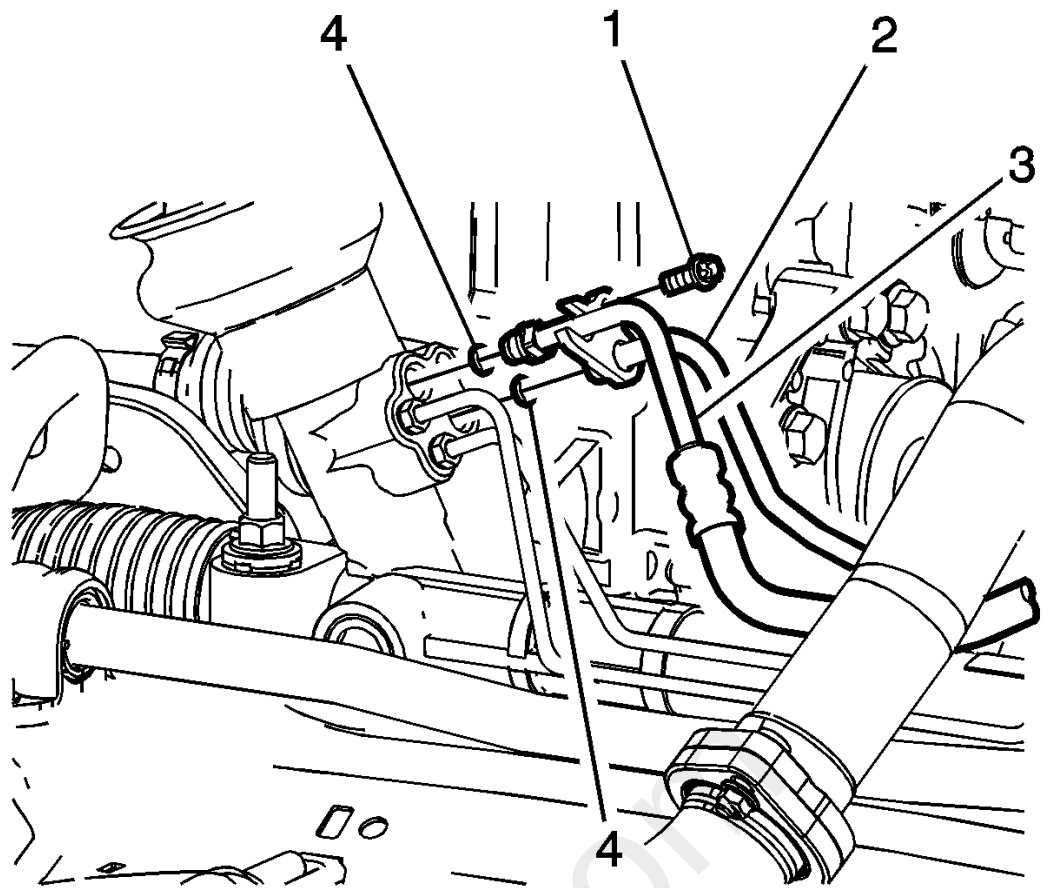


Fig. 62: Power Steering Gear Inlet And Outlet Hoses, Bolt And Seals
Courtesy of GENERAL MOTORS COMPANY

8. Install the power steering gear inlet hose seals (4), power steering gear outlet hose (3), and power steering gear inlet hose (2) in the steering gear.

Install NEW seals.

9. Install the power steering gear inlet and outlet hose bolt (1) and tighten to 11 N.m (97 lb in).

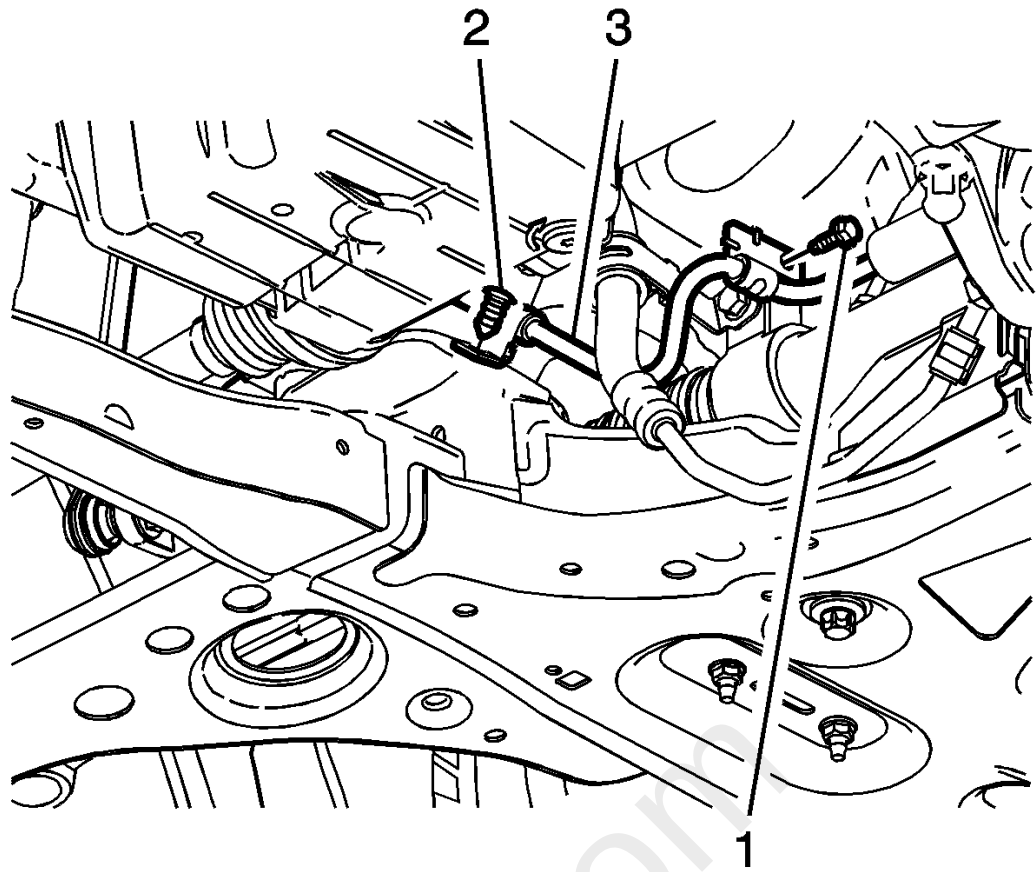


Fig. 63: Power Steering Gear Outlet Hose Bracket Bolt, Push Pin And Power Steering Gear Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

10. Secure the power steering gear outlet hose (3) to the steering gear using the power steering gear inlet hose bracket bolt (1) and the plastic push pin (2).
11. Tighten the power steering gear outlet hose bracket bolt (1) to 9 N.m (80 lb in).

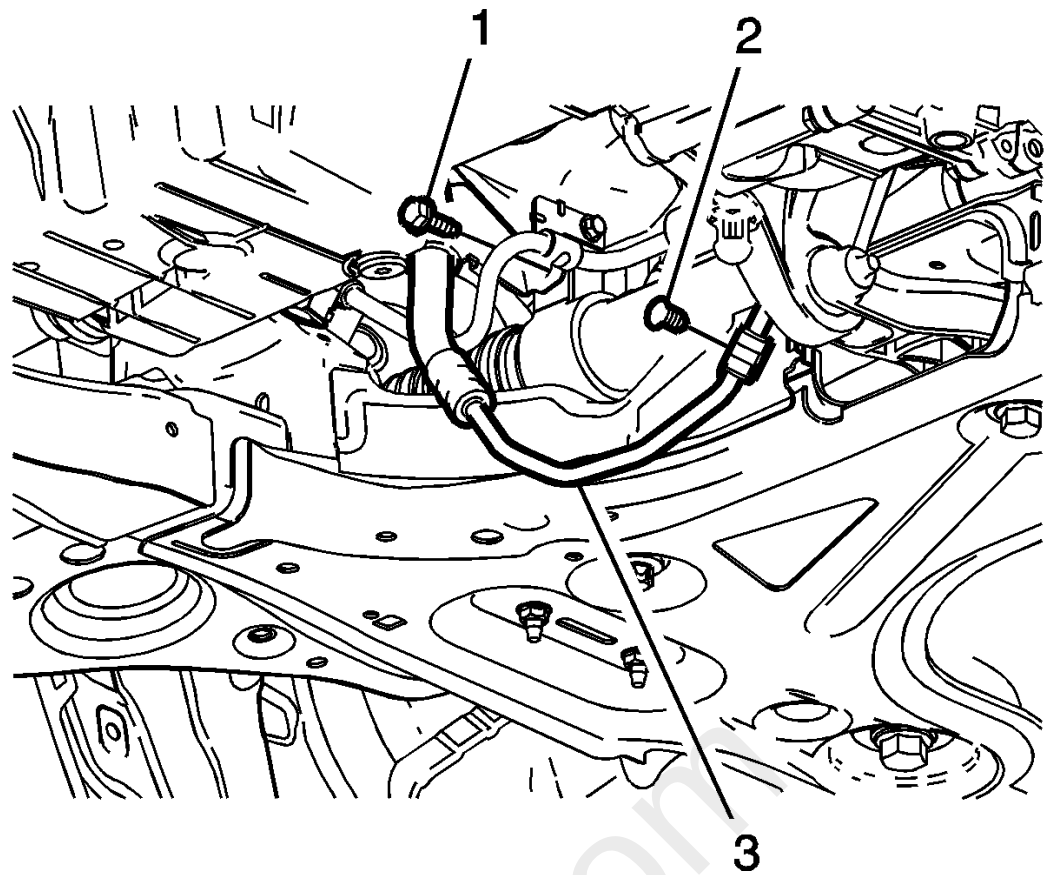


Fig. 64: Power Steering Gear Inlet Hose, Bracket Bolt And Push Pin
Courtesy of GENERAL MOTORS COMPANY

12. Secure the power steering gear inlet hose (3) to the vehicle frame using the power steering gear inlet hose bracket bolt (1) and the plastic push pin (2).
13. Tighten the power steering gear inlet hose bracket bolt (1) to 9 N.m (80 lb in).
14. Install Rear Transmission Mount Through Bolt. Refer to [Transmission Mount Bracket Replacement - Rear \(All Wheel Drive\)](#) [Transmission Mount Bracket Replacement - Rear \(Front Wheel Drive\)](#)
15. Install Exhaust Isolator (Qty: 2) @ Drivetrain and Front Suspension Frame. Refer to [Exhaust Front Pipe Replacement \(LUV\)](#) [Exhaust Front Pipe Replacement \(2H0\)](#) [Exhaust Front Pipe Replacement \(LE2\)](#)
16. Install Front Lower Control Arm (Qty: 2) @ Steering Knuckle. Refer to [Lower Control Arm Replacement](#)
17. Install Front Stabilizer Shaft Link (Qty: 2) @ Front Stabilizer Shaft. Refer to [Stabilizer Shaft Link Replacement](#)
18. Install Steering Linkage Outer Tie Rod (Qty: 2) @ Steering Knuckle. Refer to [Steering Linkage Outer Tie Rod Replacement](#)
19. Install the front tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#)
20. Install the intermediate steering shaft lower universal joint. Refer to [Intermediate Steering Shaft Replacement \(N40\)](#)
21. Fill and bleed the power steering system. Refer to [Power Steering System Bleeding](#)
22. Measure and adjust the wheel alignment. Refer to [Wheel Alignment Measurement](#)

STEERING GEAR REPLACEMENT (NJ1 WITH MNH OR MNK)

Removal Procedure

1. Remove the intermediate steering shaft lower universal joint. Refer to [Intermediate Steering Shaft Replacement \(NJ1\)](#)
2. Remove the front tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#)
3. Separate Steering Linkage Outer Tie Rod (Qty: 2) @ Steering Knuckle. Refer to [Steering Linkage Outer Tie Rod Replacement](#)

4. Separate Front Stabilizer Shaft Link (Qty: 2) @ Front Stabilizer Shaft. Refer to [Stabilizer Shaft Link Replacement](#)
5. Separate Front Lower Control Arm (Qty: 2) @ Steering Knuckle. Refer to [Lower Control Arm Replacement](#)
6. Separate Exhaust Isolator (Qty: 2) @ Drivetrain and Front Suspension Frame. Refer to [Exhaust Front Pipe Replacement \(LUV\)](#) [Exhaust Front Pipe Replacement \(2H0\)](#) [Exhaust Front Pipe Replacement \(LE2\)](#)
7. Remove Rear Transmission Mount Through Bolt. Refer to [Transmission Mount Bracket Replacement - Rear \(All Wheel Drive\)](#) [Transmission Mount Bracket Replacement - Rear \(Front Wheel Drive\)](#)
8. Position adjustable stands underneath the left and right sides of the rear of the drivetrain and front suspension frame.
9. Loosen, but do NOT remove, the drivetrain and front suspension frame front bolts. Refer to [Drivetrain and Front Suspension Frame Replacement \(Long Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Short Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Long Cradle - V50\)](#)
10. Remove the drivetrain and front suspension frame upper and rear bolts. Refer to [Drivetrain and Front Suspension Frame Replacement \(Long Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Short Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Long Cradle - V50\)](#)
11. Partially lower the rear of the drivetrain and front suspension frame to gain clearance for the steering gear.
12. Finish removing the front stabilizer shaft. Refer to [Stabilizer Shaft Replacement](#)

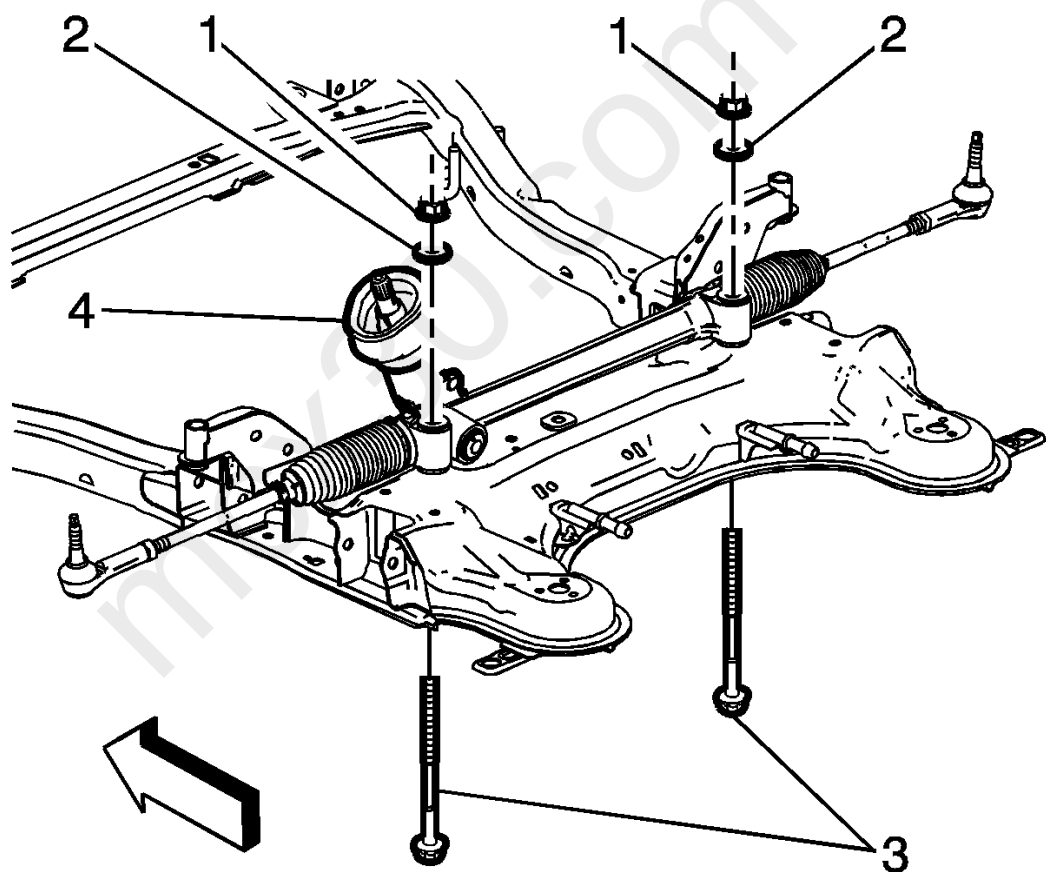


Fig. 65: Steering Gear, Nuts, Washers And Bolts
Courtesy of GENERAL MOTORS COMPANY

13. Remove the steering gear nuts (1), washers (2), and steering gear bolts (3).

DISCARD the bolts.
14. Remove the steering gear (4) from the drivetrain and front suspension frame.
15. Transfer components as necessary.

Installation Procedure

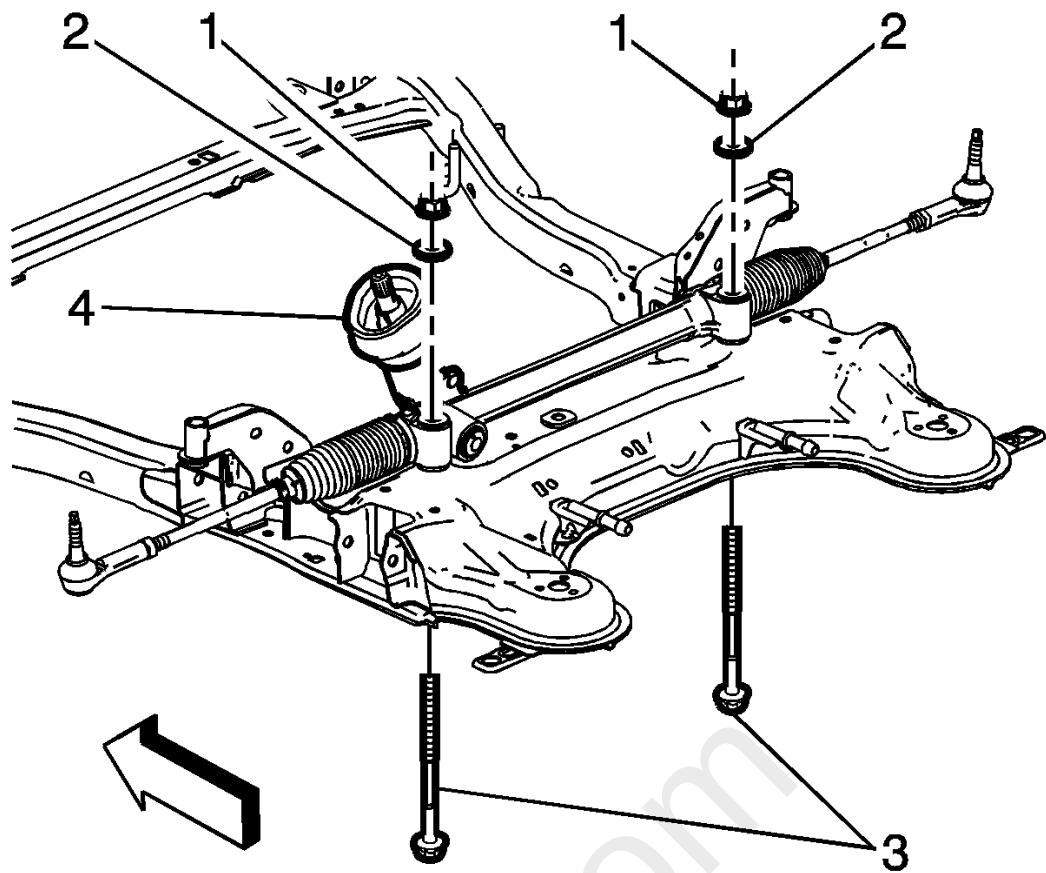


Fig. 66: Steering Gear, Nuts, Washers And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Position the steering gear (4) on the drivetrain and front suspension frame.

CAUTION: This vehicle is equipped with torque-to-yield or single use fasteners. Install a **NEW** torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component.

NOTE: Start ALL fasteners by hand before tightening.

2. Install the steering gear bolts (3), washers (2), and nuts (1).

Install NEW bolts.

CAUTION: Refer to [Fastener Caution](#) .

3. Tighten the NEW steering gear bolts (3).

Tighten

1. First Pass: 100 N.m (74 lb ft)
2. Final Pass: (90-105 degrees)
4. Install the front stabilizer shaft on the drivetrain and front suspension frame. Refer to [Stabilizer Shaft Replacement](#)
5. Raise the rear of the drivetrain and front suspension frame.
6. Install ALL drivetrain and front suspension frame bolts. Refer to [Drivetrain and Front Suspension Frame Replacement \(Long Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Short Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Long Cradle - V50\)](#)
7. Remove the adjustable stands from underneath the vehicle.

8. Install Rear Transmission Mount Through Bolt. Refer to [Transmission Mount Bracket Replacement - Rear \(All Wheel Drive\)](#) [Transmission Mount Bracket Replacement - Rear \(Front Wheel Drive\)](#).
9. Install Exhaust Isolator (Qty: 2) @ Drivetrain and Front Suspension Frame. Refer to [Exhaust Front Pipe Replacement \(LUV\)](#) [Exhaust Front Pipe Replacement \(2H0\)](#) [Exhaust Front Pipe Replacement \(LE2\)](#).
10. Install Front Lower Control Arm (Qty: 2) @ Steering Knuckle. Refer to [Lower Control Arm Replacement](#).
11. Install Front Stabilizer Shaft Link (Qty: 2) @ Front Stabilizer Shaft. Refer to [Stabilizer Shaft Link Replacement](#).
12. Install Steering Linkage Outer Tie Rod (Qty: 2) @ Steering Knuckle. Refer to [Steering Linkage Outer Tie Rod Replacement](#).
13. Install the front tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#).
14. Install the intermediate steering shaft lower universal joint. Refer to [Intermediate Steering Shaft Replacement \(NJ1\)](#).
15. Measure and adjust the wheel alignment. Refer to [Wheel Alignment Measurement](#).

STEERING GEAR REPLACEMENT (NJ1 WITH MR5)

Removal Procedure

1. Remove the intermediate steering shaft lower universal joint. Refer to [Intermediate Steering Shaft Replacement \(NJ1\)](#).
2. Remove the front tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#).
3. Separate Steering Linkage Outer Tie Rod (Qty: 2) @ Steering Knuckle. Refer to [Steering Linkage Outer Tie Rod Replacement](#).
4. Separate Front Stabilizer Shaft Link (Qty: 2) @ Front Stabilizer Shaft. Refer to [Stabilizer Shaft Link Replacement](#).
5. Separate Front Lower Control Arm (Qty: 2) @ Steering Knuckle. Refer to [Lower Control Arm Replacement](#).
6. Separate Exhaust Isolator (Qty: 2) @ Drivetrain and Front Suspension Frame. Refer to [Exhaust Front Pipe Replacement \(LUV\)](#) [Exhaust Front Pipe Replacement \(2H0\)](#) [Exhaust Front Pipe Replacement \(LE2\)](#).
7. Remove Rear Transmission Mount Through Bolt. Refer to [Transmission Rear Mount Replacement \(FWD\)](#) [Transmission Rear Mount Replacement \(AWD\)](#).
8. Position adjustable stands underneath the left and right sides of the rear of the drivetrain and front suspension frame.
9. Loosen, but do NOT remove, the drivetrain and front suspension frame front bolts. Refer to [Drivetrain and Front Suspension Frame Replacement \(Long Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Short Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Long Cradle - V50\)](#).
10. Remove the drivetrain and front suspension frame upper and rear bolts. Refer to [Drivetrain and Front Suspension Frame Replacement \(Long Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Short Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Long Cradle - V50\)](#).
11. Partially lower the rear of the drivetrain and front suspension frame to gain clearance for the steering gear.
12. Finish removing the front stabilizer shaft. Refer to [Stabilizer Shaft Replacement](#).

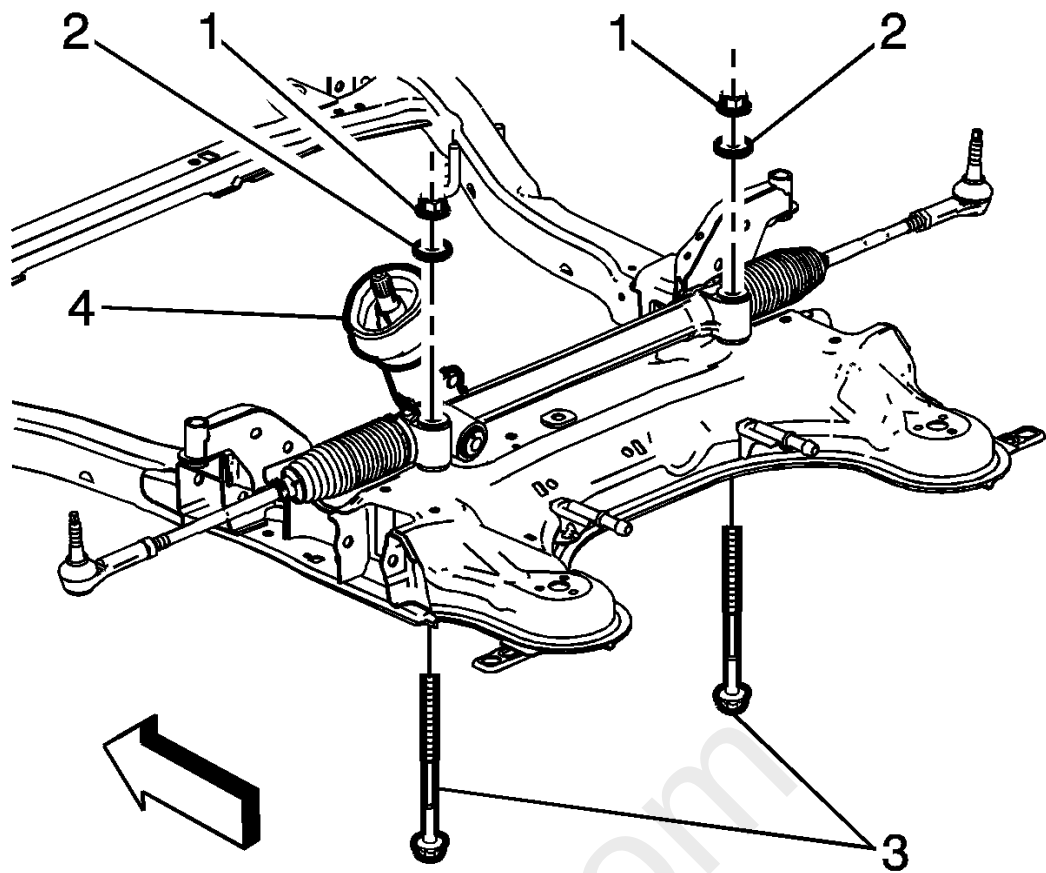


Fig. 67: Steering Gear, Nuts, Washers And Bolts
Courtesy of GENERAL MOTORS COMPANY

13. Remove the steering gear nuts (1), washers (2), and steering gear bolts (3).

DISCARD the bolts.

14. Remove the steering gear (4) from the drivetrain and front suspension frame.

15. Transfer components as necessary.

Installation Procedure

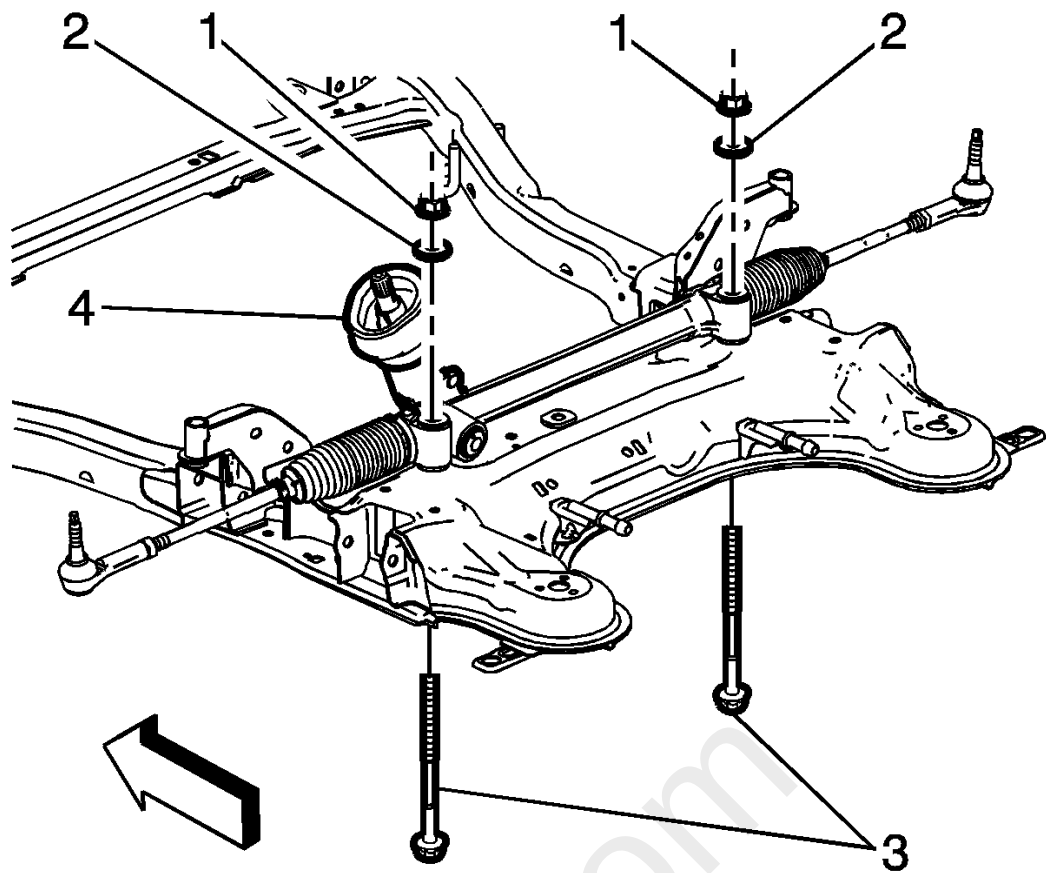


Fig. 68: Steering Gear, Nuts, Washers And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Position the steering gear (4) on the drivetrain and front suspension frame.

CAUTION: This vehicle is equipped with torque-to-yield or single use fasteners. Install a **NEW** torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component.

NOTE: Start **ALL** fasteners by hand before tightening.

2. Install the steering gear bolts (3), washers (2), and nuts (1).

Install NEW bolts.

CAUTION: Refer to [Fastener Caution](#) .

3. Tighten the NEW steering gear bolts (3).

Tighten

1. First Pass: 100 N.m (74 lb ft)
2. Final Pass: (90-105 degrees)
4. Install the front stabilizer shaft on the drivetrain and front suspension frame. Refer to [Stabilizer Shaft Replacement](#)
5. Raise the rear of the drivetrain and front suspension frame.
6. Install ALL drivetrain and front suspension frame bolts. Refer to [Drivetrain and Front Suspension Frame Replacement \(Long Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Short Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Long Cradle - V50\)](#).
7. Remove the adjustable stands from underneath the vehicle.

8. Install Rear Transmission Mount Through Bolt. Refer to [Transmission Rear Mount Replacement \(FWD\)](#), [Transmission Rear Mount Replacement \(AWD\)](#).
9. Install Exhaust Isolator (Qty: 2) @ Drivetrain and Front Suspension Frame. Refer to [Exhaust Front Pipe Replacement \(LUV\)](#), [Exhaust Front Pipe Replacement \(2H0\)](#), [Exhaust Front Pipe Replacement \(LE2\)](#).
10. Install Front Lower Control Arm (Qty: 2) @ Steering Knuckle. Refer to [Lower Control Arm Replacement](#).
11. Install Front Stabilizer Shaft Link (Qty: 2) @ Front Stabilizer Shaft. Refer to [Stabilizer Shaft Link Replacement](#).
12. Install Steering Linkage Outer Tie Rod (Qty: 2) @ Steering Knuckle. Refer to [Steering Linkage Outer Tie Rod Replacement](#).
13. Install the front tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#).
14. Install the intermediate steering shaft lower universal joint. Refer to [Intermediate Steering Shaft Replacement \(NJ1\)](#).
15. Measure and adjust the wheel alignment. Refer to [Wheel Alignment Measurement](#).

STEERING GEAR REPLACEMENT (N40 WITH M4P)

Removal Procedure

1. Remove the intermediate steering shaft lower universal joint. Refer to [Intermediate Steering Shaft Replacement \(N40\)](#).
2. Remove as much power steering fluid from the power steering fluid reservoir as possible.
3. Remove the front tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#).
4. Separate Steering Linkage Outer Tie Rod (Qty: 2) @ Steering Knuckle. Refer to [Steering Linkage Outer Tie Rod Replacement](#).
5. Separate Front Stabilizer Shaft Link (Qty: 2) @ Front Stabilizer Shaft. Refer to [Stabilizer Shaft Link Replacement](#).
6. Separate Front Lower Control Arm (Qty: 2) @ Steering Knuckle. Refer to [Lower Control Arm Replacement](#).
7. Separate Exhaust Isolator (Qty: 2) @ Drivetrain and Front Suspension Frame. Refer to [Exhaust Front Pipe Replacement \(LUV\)](#), [Exhaust Front Pipe Replacement \(2H0\)](#), [Exhaust Front Pipe Replacement \(LE2\)](#).
8. Remove Rear Transmission Mount Through Bolt. Refer to [Transmission Rear Mount Bracket Replacement](#).

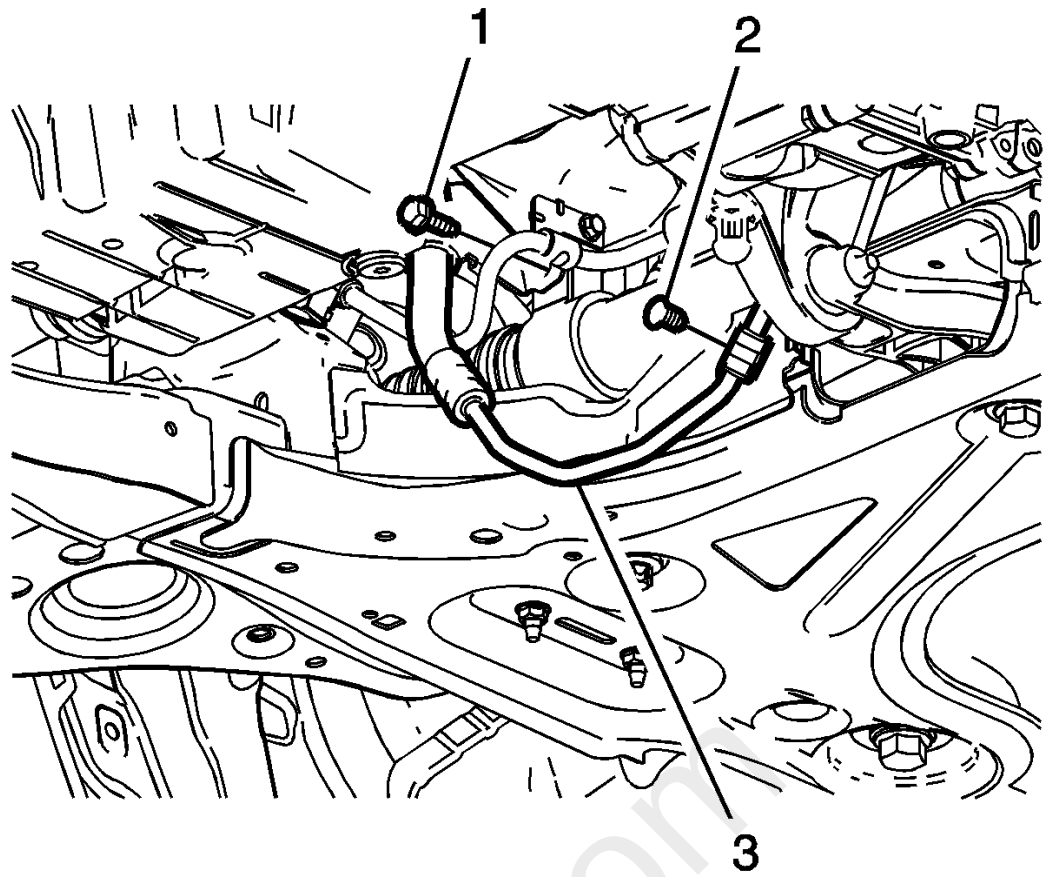


Fig. 69: Power Steering Gear Inlet Hose, Bracket Bolt And Push Pin

Courtesy of GENERAL MOTORS COMPANY

9. Remove the power steering gear inlet hose bracket bolt (1) and the plastic push pin (2) and separate the power steering gear inlet hose (3) from the vehicle frame.

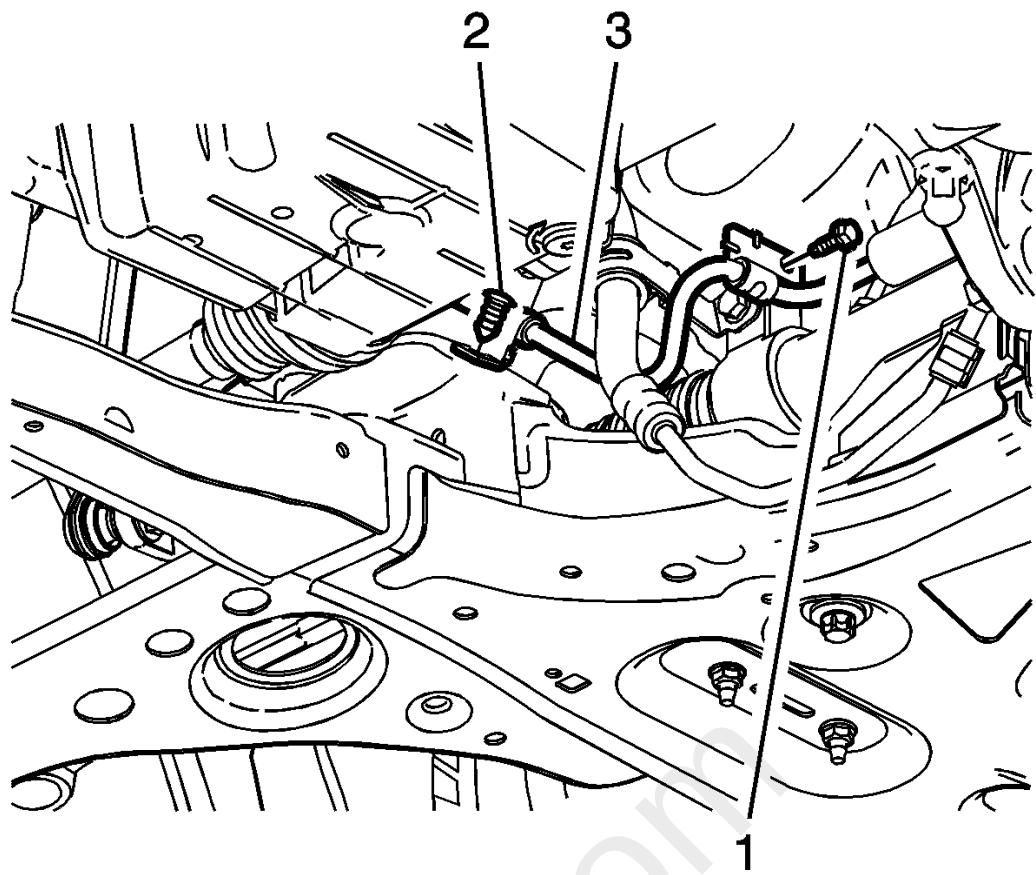


Fig. 70: Power Steering Gear Outlet Hose Bracket Bolt, Push Pin And Power Steering Gear Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

10. Remove the power steering gear outlet hose bracket bolt (1) and the plastic push pin (2) and separate the power steering gear inlet hose (3) from the steering gear.

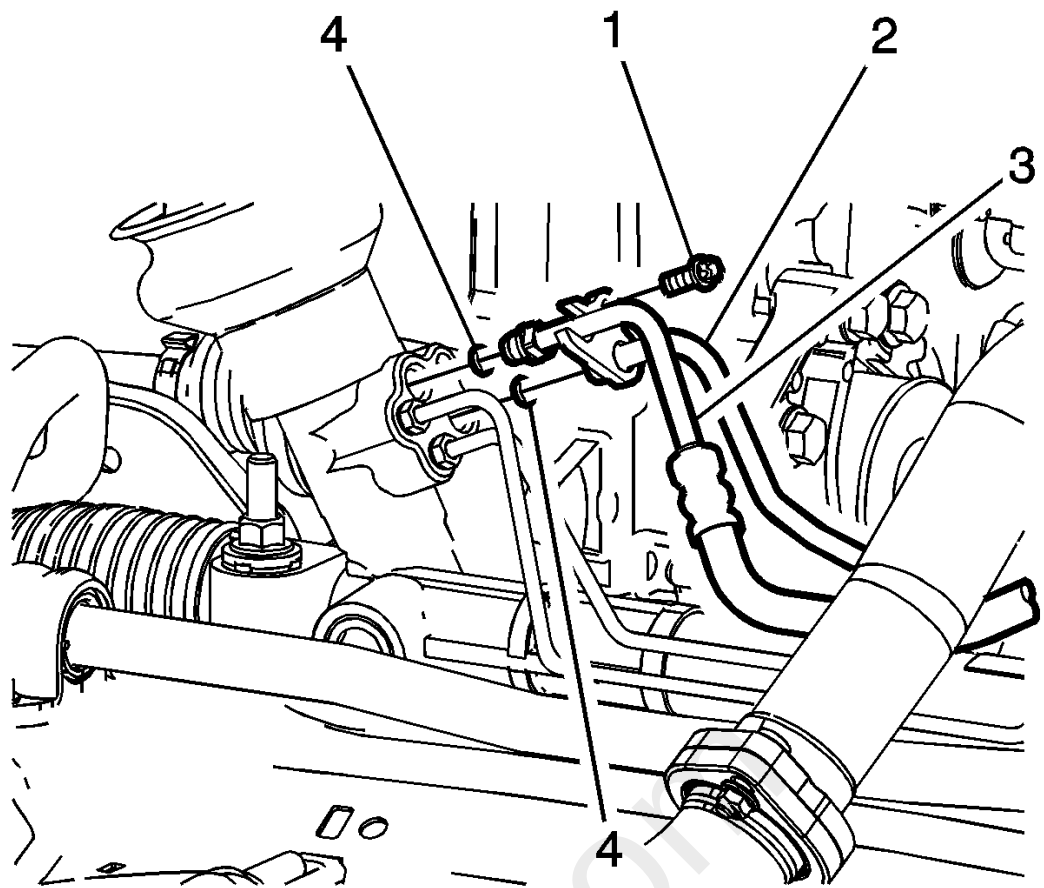


Fig. 71: Power Steering Gear Inlet And Outlet Hoses, Bolt And Seals
Courtesy of GENERAL MOTORS COMPANY

11. Remove the power steering gear inlet and outlet hose bolt (1).
 12. Remove the power steering gear inlet hose (2), power steering gear outlet hose (3), and power steering gear inlet and outlet hose seals (4) from the steering gear.
- DISCARD the seals.
13. Position adjustable stands underneath the left and right sides of the rear of the drivetrain and front suspension frame.
 14. Loosen, but do NOT remove, the drivetrain and front suspension frame front bolts. Refer to [Drivetrain and Front Suspension Frame Replacement \(Long Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Short Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Long Cradle - V50\)](#)
 15. Remove the drivetrain and front suspension frame upper and rear bolts. Refer to [Drivetrain and Front Suspension Frame Replacement \(Long Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Short Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Long Cradle - V50\)](#)
 16. Partially lower the rear of the drivetrain and front suspension frame to gain clearance for the steering gear.
 17. Finish removing the front stabilizer shaft. Refer to [Stabilizer Shaft Replacement](#)

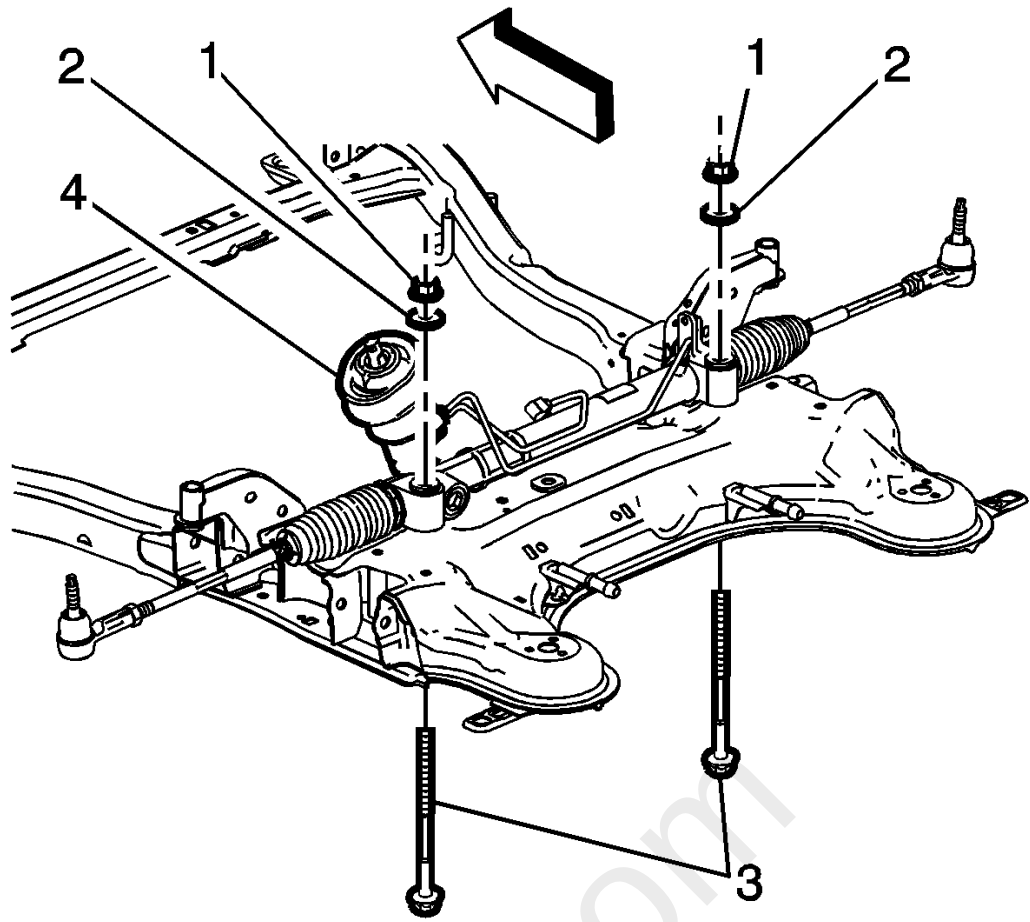


Fig. 72: Steering Gear, Nuts, Washers And Bolts
Courtesy of GENERAL MOTORS COMPANY

18. Remove the steering gear nuts (1), washers (2), and steering gear bolts (3).

DISCARD the bolts.

19. Remove the steering gear (4) from the drivetrain and front suspension frame.

20. Transfer components as necessary.

Installation Procedure

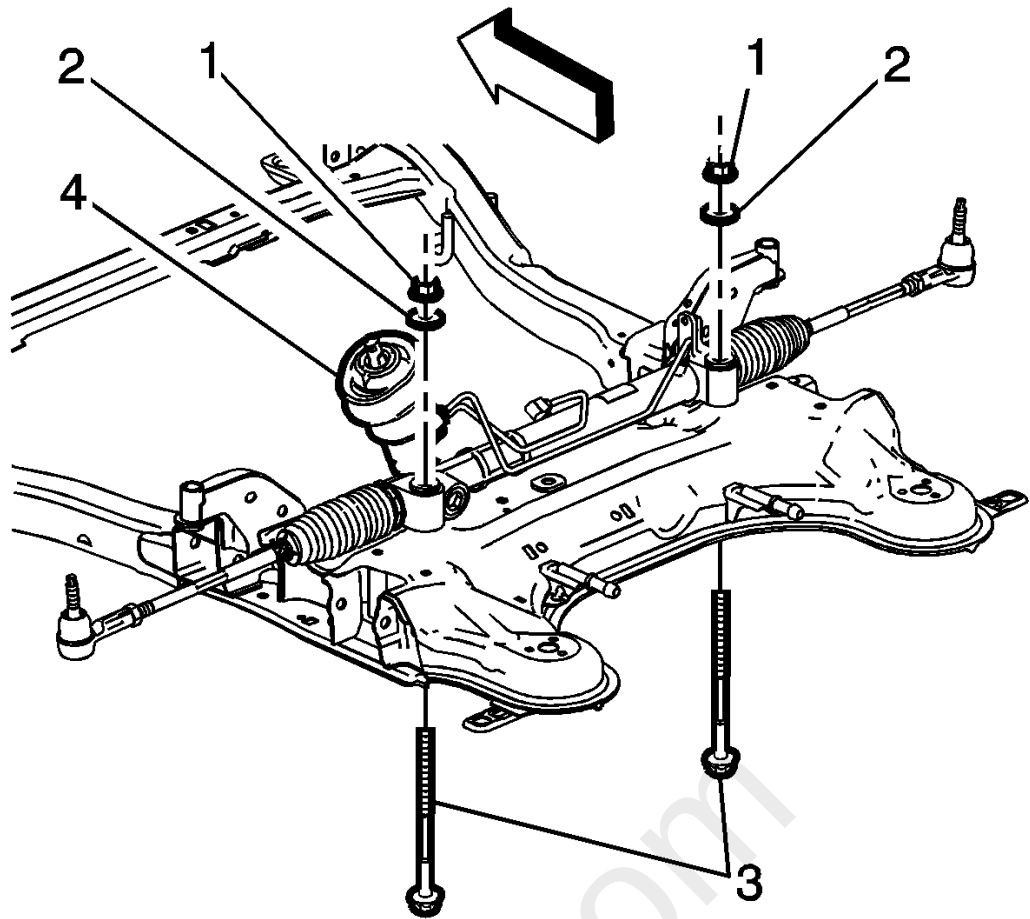


Fig. 73: Steering Gear, Nuts, Washers And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Position the steering gear (4) on the drivetrain and front suspension frame.

CAUTION: This vehicle is equipped with torque-to-yield or single use fasteners. Install a **NEW** torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component.

NOTE: Start ALL fasteners by hand before tightening.

2. Install the steering gear bolts (3), washers (2), and nuts (1).

Install NEW bolts.

CAUTION: Refer to [Fastener Caution](#) .

3. Tighten the NEW steering gear bolts (3).

Tighten

1. First Pass: 100 N.m (74 lb ft)
2. Final Pass: (90-105 degrees)
4. Install the front stabilizer shaft on the drivetrain and front suspension frame. Refer to [Stabilizer Shaft Replacement](#)
5. Raise the rear of the drivetrain and front suspension frame.
6. Install ALL drivetrain and front suspension frame bolts. Refer to [Drivetrain and Front Suspension Frame Replacement \(Long Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Short Cradle\)](#) [Drivetrain and Front Suspension Frame Replacement \(Long Cradle - V50\)](#)
7. Remove the adjustable stands from underneath the vehicle.

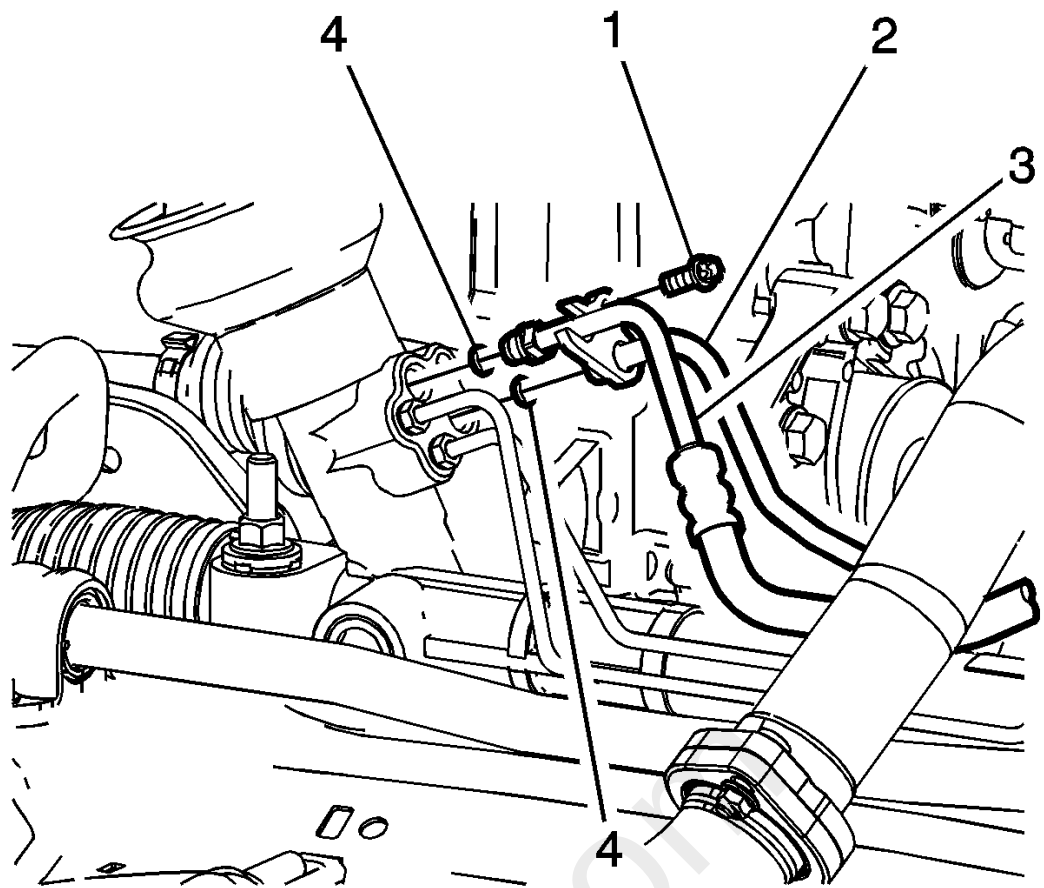


Fig. 74: Power Steering Gear Inlet And Outlet Hoses, Bolt And Seals
Courtesy of GENERAL MOTORS COMPANY

8. Install the power steering gear inlet hose seals (4), power steering gear outlet hose (3), and power steering gear inlet hose (2) in the steering gear.

Install NEW seals.

9. Install the power steering gear inlet and outlet hose bolt (1) and tighten to 11 N.m (97 lb in).

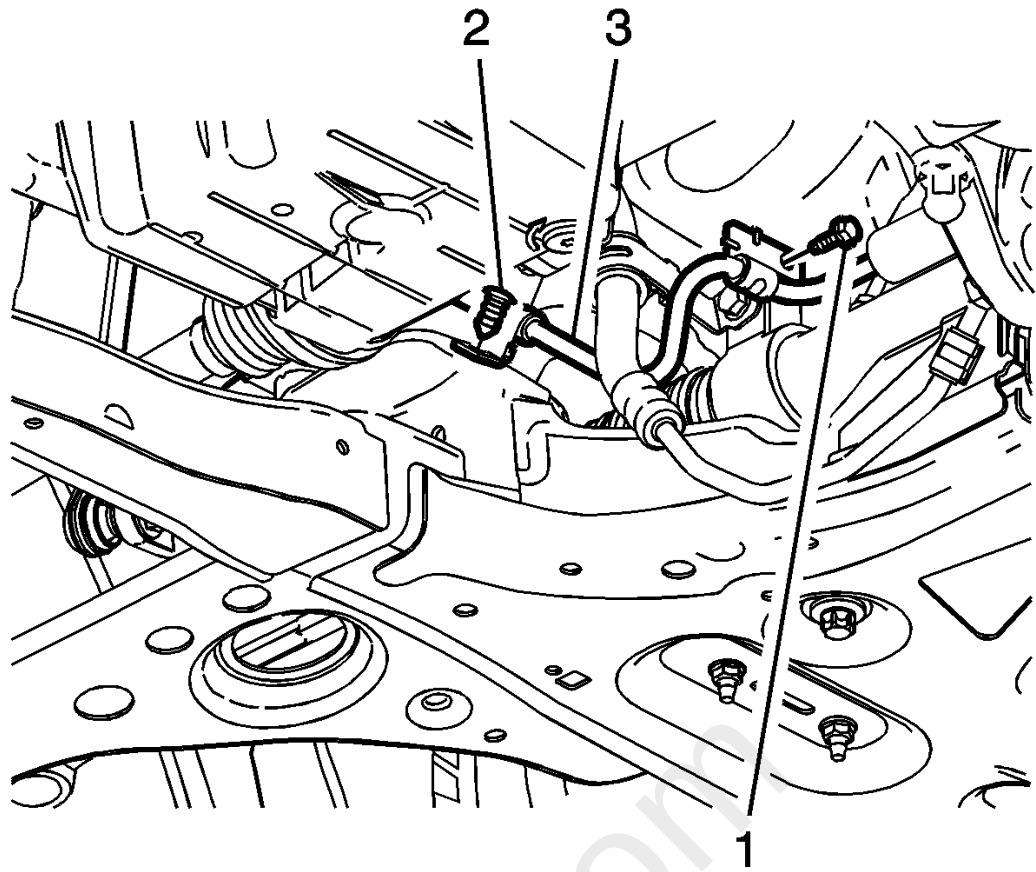


Fig. 75: Power Steering Gear Outlet Hose Bracket Bolt, Push Pin And Power Steering Gear Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

10. Secure the power steering gear outlet hose (3) to the steering gear using the power steering gear inlet hose bracket bolt (1) and the plastic push pin (2).
11. Tighten the power steering gear outlet hose bracket bolt (1) to 9 N.m (80 lb in).

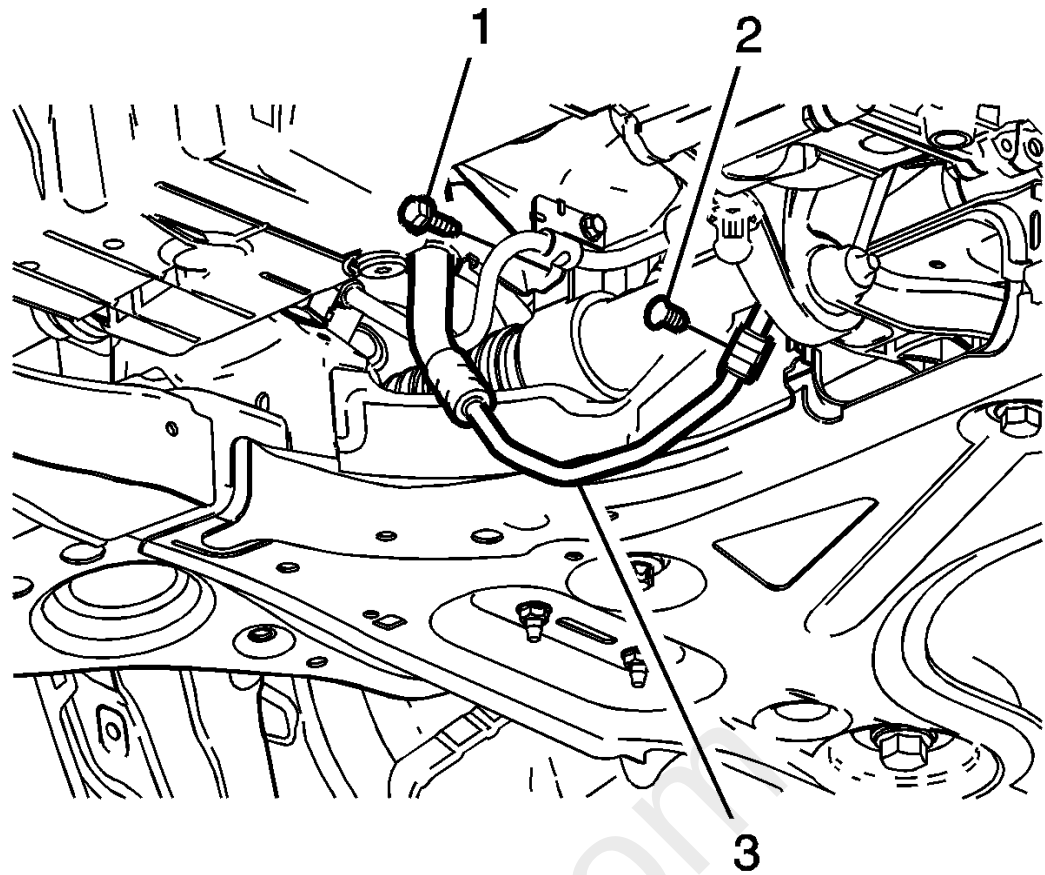


Fig. 76: Power Steering Gear Inlet Hose, Bracket Bolt And Push Pin
Courtesy of GENERAL MOTORS COMPANY

12. Secure the power steering gear inlet hose (3) to the vehicle frame using the power steering gear inlet hose bracket bolt (1) and the plastic push pin (2).
13. Tighten the power steering gear inlet hose bracket bolt (1) to 9 N.m (80 lb in).
14. Install Rear Transmission Mount Through Bolt. Refer to [Transmission Rear Mount Bracket Replacement](#)
15. Install Exhaust Isolator (Qty: 2) @ Drivetrain and Front Suspension Frame. Refer to [Exhaust Front Pipe Replacement \(LUV\)](#) [Exhaust Front Pipe Replacement \(2H0\)](#) [Exhaust Front Pipe Replacement \(LE2\)](#)
16. Install Front Lower Control Arm (Qty: 2) @ Steering Knuckle. Refer to [Lower Control Arm Replacement](#)
17. Install Front Stabilizer Shaft Link (Qty: 2) @ Front Stabilizer Shaft. Refer to [Stabilizer Shaft Link Replacement](#)
18. Install Steering Linkage Outer Tie Rod (Qty: 2) @ Steering Knuckle. Refer to [Steering Linkage Outer Tie Rod Replacement](#)
19. Install the front tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#)
20. Install the intermediate steering shaft lower universal joint. Refer to [Intermediate Steering Shaft Replacement \(N40\)](#)
21. Fill and bleed the power steering system. Refer to [Power Steering System Bleeding](#)
22. Measure and adjust the wheel alignment. Refer to [Wheel Alignment Measurement](#)

STEERING LINKAGE INNER TIE ROD REPLACEMENT (N40)



Callout	Component Name
Preliminary Procedures	
1. Remove Steering Gear. Refer to <u>Steering Gear Replacement (N40 With MNK)Steering Gear Replacement (N40 With M4P)</u> 2. Remove Steering Gear Boot. Refer to <u>Steering Gear Boot Replacement</u>	

Callout	Component Name
1	Steering Linkage Inner Tie Rod CAUTION: Refer to Component Fastener Tightening Caution . CAUTION: 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. Procedure 1. Bend the tabs on the steering linkage inner tie rod washer to release the steering linkage inner tie rod. 2. Place a pipe wrench on the flats of the steering gear rack. Position the pipe wrench between the steering gear housing and the steering linkage inner tie rod housing. 3. Place a wrench on the flats of the steering linkage inner tie rod housing. 4. Rotate the steering linkage inner tie rod housing counterclockwise to remove the steering linkage inner tie rod from the steering gear rack. 5. Remove the steering linkage inner tie rod washer from the steering gear rack. DISCARD the washer. 6. Install the NEW steering linkage inner tie rod washer on the steering gear rack. 7. Rotate the steering linkage inner tie rod housing clockwise to install the steering linkage inner tie rod to the steering gear rack. 8. Bend the tabs on the steering linkage inner tie rod washer to secure the steering linkage inner tie rod. Tighten 88 N.m (65 lb ft)

STEERING LINKAGE INNER TIE ROD REPLACEMENT (NJ1)

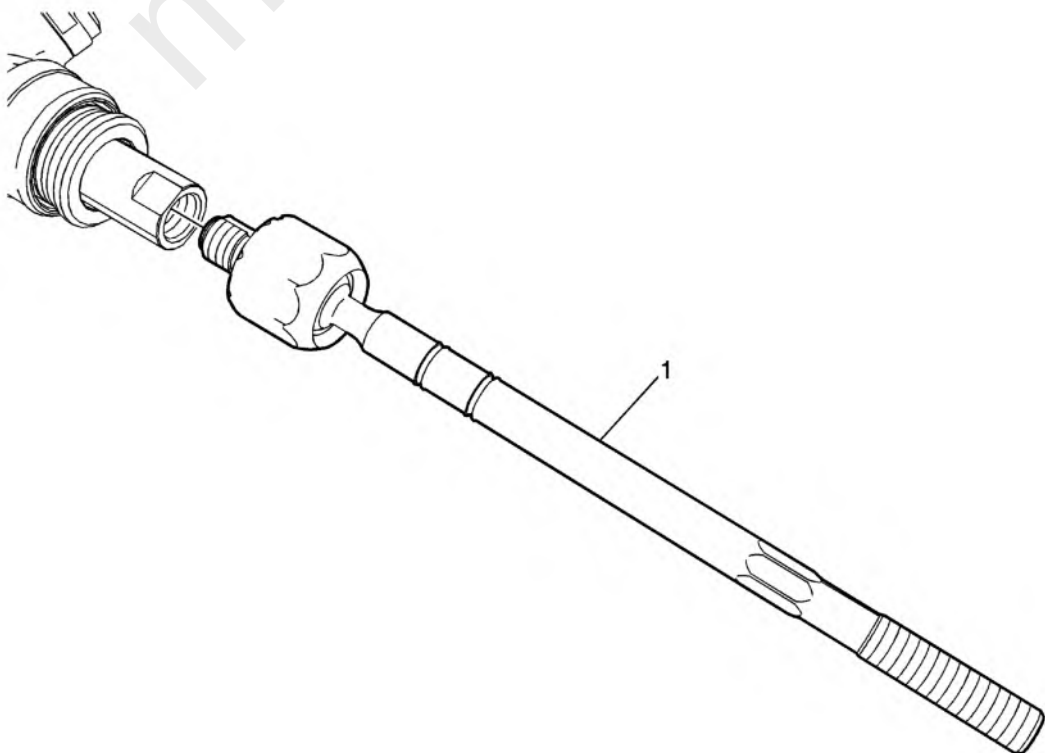


Fig. 78: Steering Linkage Inner Tie Rod (NJ1)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Steering Gear. Refer to Steering Gear Replacement (NJ1 With MNH or MNK)Steering Gear Replacement (NJ1 With MR5) 2. Remove Steering Gear Boot. Refer to Steering Gear Boot Replacement	
1	Steering Linkage Inner Tie Rod CAUTION: Refer to Component Fastener Tightening Caution . CAUTION: 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. Procedure 1. Place a pipe wrench on the flats of the steering gear rack. Position the pipe wrench between the steering gear housing and the steering linkage inner tie rod housing. 2. Place a wrench on the flats of the steering linkage inner tie rod housing. 3. Rotate the steering linkage inner tie rod housing counterclockwise to remove the steering linkage inner tie rod from the steering gear rack. 4. Rotate the steering linkage inner tie rod housing clockwise to install the steering linkage inner tie rod to the steering gear rack. Tighten 70 N.m (52 lb ft)

DESCRIPTION AND OPERATION

POWER STEERING SYSTEM DESCRIPTION AND OPERATION

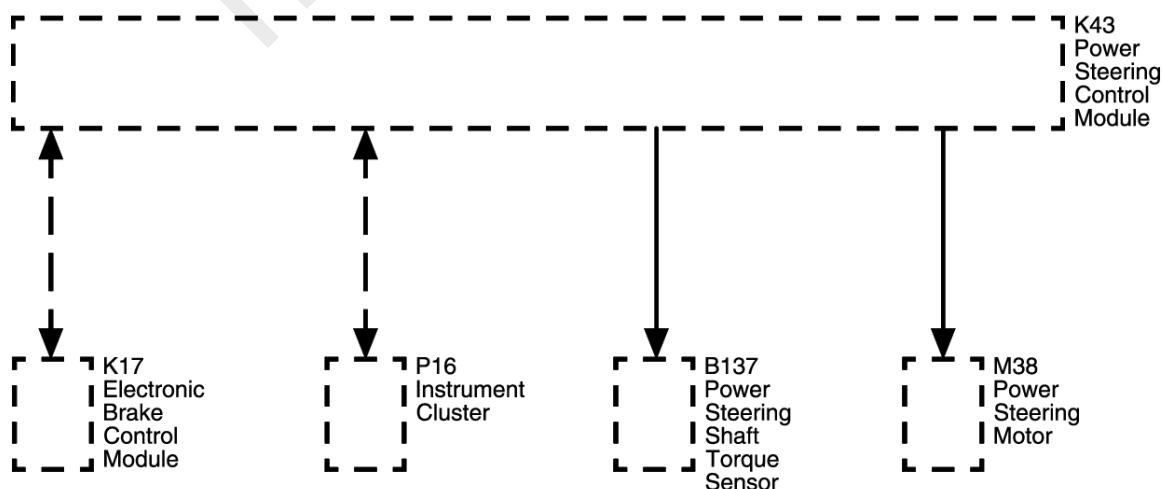


Fig. 79: Electric Power Steering System Block Diagram
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
K43	K43 Power Steering Control Module

Callout	Component Name
K17	K17 Electronic Brake Control Module
P16	P16 Instrument Cluster
B137	B137 Power Steering Shaft Torque Sensor
M38	M38 Power Steering Motor

The power steering system reduces the amount of effort needed to steer the vehicle. The system uses the powertrain control module, body control module, power steering control module, discrete battery voltage supply circuit, steering shaft torque sensor, steering wheel position sensor, power steering motor and the serial data circuit to perform the system functions. The power steering control module and the power steering motor are serviced with the steering column assembly. The steering shaft torque sensor and the steering wheel position sensor are not serviced separately from each other or from the steering column assembly.

Steering Shaft Torque Sensor

The power steering control module uses the steering shaft torque sensor as it's main input for determining steering direction and the amount of assists needed. The steering column has an input shaft, from the steering wheel to the torque sensor, and an output shaft, from the torque sensor to the steering shaft coupler. The input and output shafts are separated by a section of torsion bar, where the torque sensor is located. The sensor is a 5-volt dual analog inverse signal device with a valid signal voltage range of 0.25-4.75 volts. When applying torque to the steering column shaft during a right turn, the sensor's signal 1 voltage increases, while the signal 2 voltage decreases within the valid signal voltage range. When applying torque to the steering column shaft during a left turn, the signal 1 voltage decreases, while the signal 2 voltage increases within the valid signal voltage range. The power steering control module recognizes this change in signal voltage as steering direction and steering column shaft torque.

Steering Wheel Position Sensor

The power steering control module uses the steering position sensor to determine the steering system on center position. Since the power steering motor provides a slight amount of return to center assist, the power steering control module will command the power steering motor to the steering system center position and not beyond. The sensor is a 5-volt dual analog triangle signal device with a valid signal voltage range of 0-5 volts. The sensors signal 1 and signal 2 voltage values will increase and decrease within the valid voltage range, and stay within 2.5-2.8 volts of each other as the steering wheel is turned.

Power Steering Motor

The power steering motor is a 12-volt brushless DC reversible motor with a 65-amp rating. The motor assists steering through a worm gear and reduction gear located in the steering column housing.

Power Steering Control Module

The power steering control module uses a combination of steering shaft torque sensor input, vehicle speed, calculated system temperature and steering tuning to determine the amount of steering assist. When the steering wheel is turned, the power steering control module uses signal voltage from the steering shaft torque sensor to detect the amount of torque and steering direction being applied to the steering column shaft and then command the proper amount of current to the power steering motor. The power steering control module receives a vehicle speed message from the powertrain control module via the serial data circuit. At low speeds more assist is provided for easy turning during parking maneuvers. At high speeds, less assist is provided for improved road feel and directional stability. The power steering control module nor the power steering motor are designed to handle 65 amps continuously. If the power steering system is exposed to excessive amounts of static steering conditions, the power steering control module will go into a protection mode to avoid thermal damage to the power steering components. In this mode the power steering control module will limit the amount of current commanded to the power steering motor which reduces system temperature and steering assist levels. The power steering control module must also be setup with the correct steering tuning which are different in relation to the vehicles powertrain configuration, sedan, coupe, tire and wheel size etc. The power steering control module has the ability to detect malfunctions within the power steering system. Any malfunction detected will cause the driver information center (DIC) to turn ON a warning indicator.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description

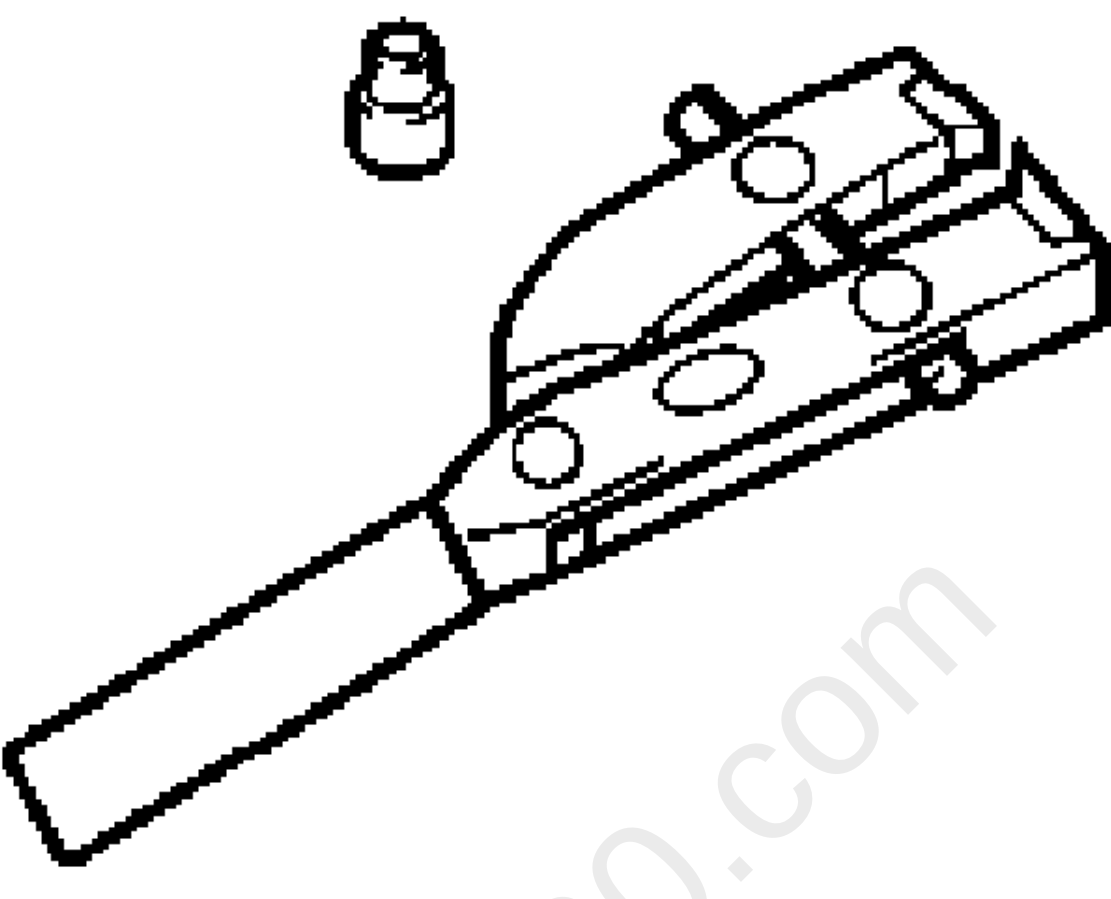
Illustration	Tool Number/Description
	CH-804 MKM-804 V-9306171 Boot Clamp Plier

Illustration	Tool Number/Description
	CH-24319-B J-24319-B SA91100C 7503 Steering Linkage and Tie Rod Puller

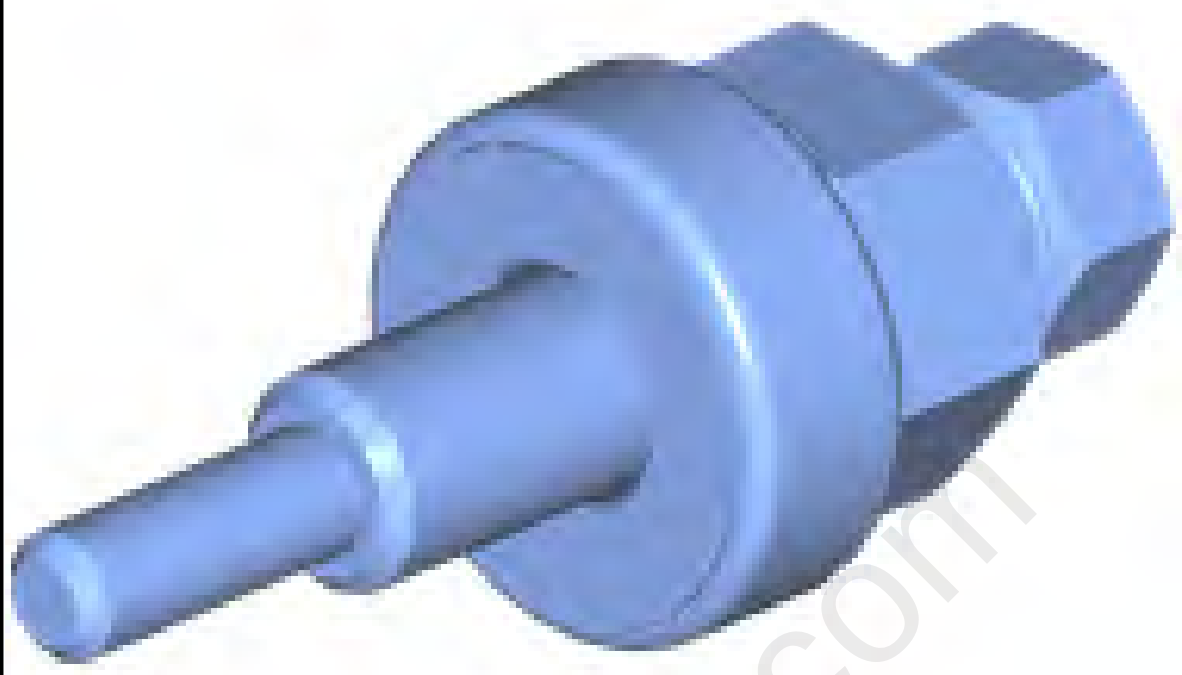
Illustration	Tool Number/Description
	CH-25033-C J-25033-C KM-J-25033-C 8996415 Pulley Installer

Illustration	Tool Number/Description
	CH-25034-C J-25034-C KM-J-25034-C T-9909729 Pulley Remover

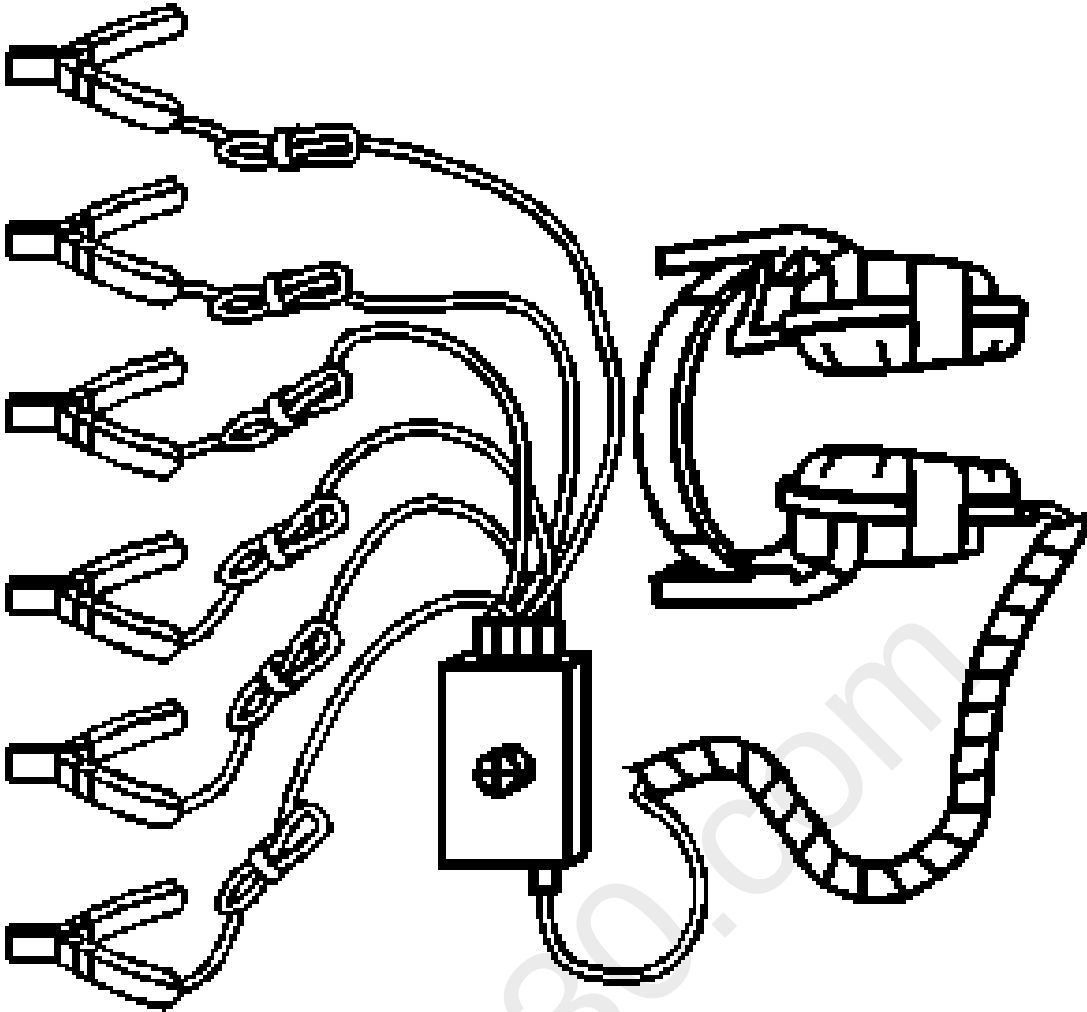
Illustration	Tool Number/Description
	CH-39570 J-39570 Chassis Ear

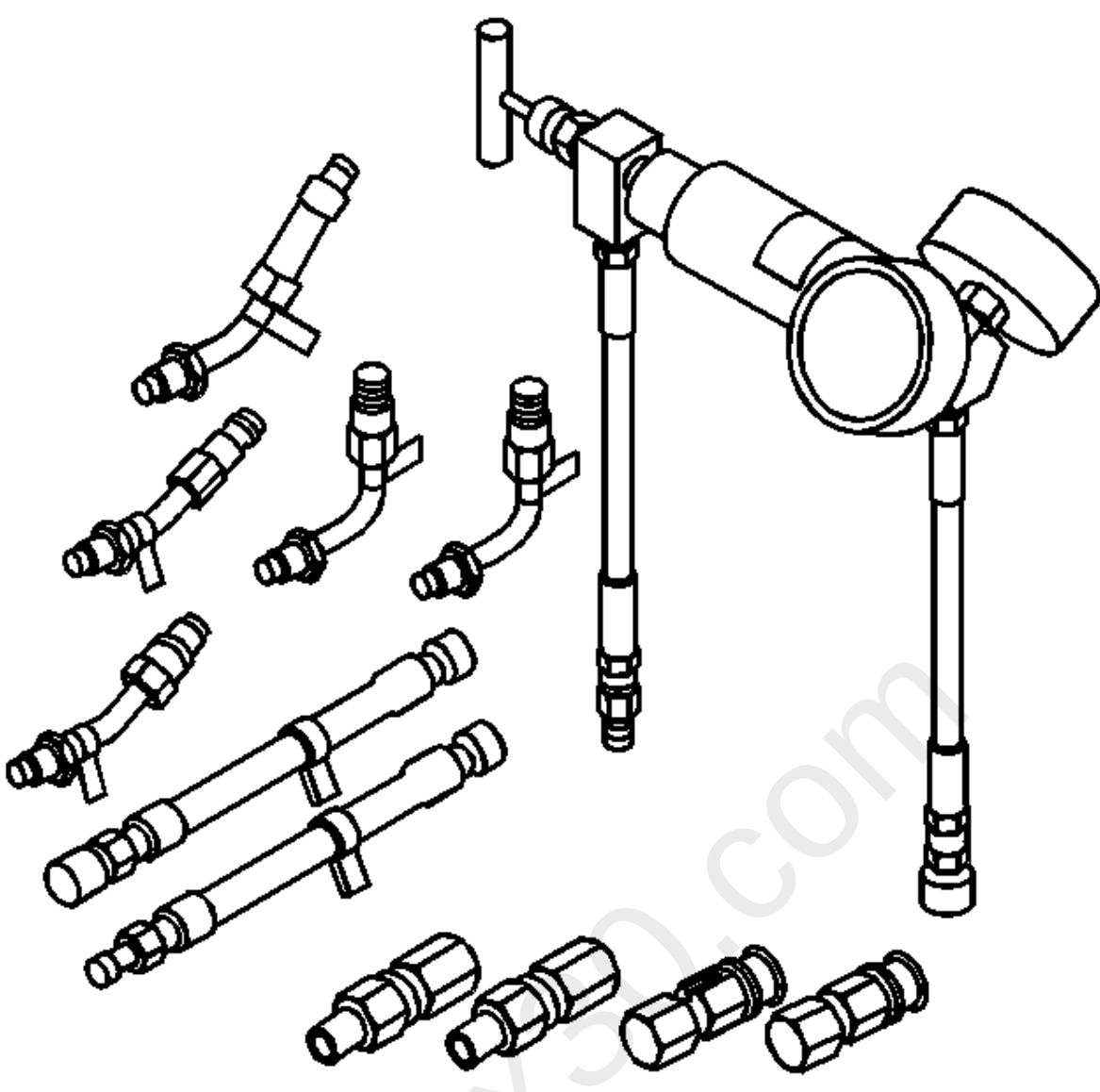
Illustration	Tool Number/Description
	CH-25323-D CH-44721 J-25323-D J-44721 Power Steering Analyzer

Illustration	Tool Number/Description
	GE-8001 J-8001 Dial Indicator Set
	GE-28431-6 J-28431-6 Fluorescent Dye

Illustration	Tool Number/Description
