

2018 STEERING

Power Steering - Equinox & Terrain

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

NOTE: <i>All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.</i>	
Application	
Power Steering Assist Motor Seal	
Steering Gear Boot Inner Clamp	

Single Use Threaded Fastener/Component Tightening Specifications

NOTE: <i>All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.</i>	
Application	Specification
	Metric (English)
Power Steering Assist Motor Bolt	21 N.m (15 lb ft)

Reusable Threaded Fastener Tightening Specifications

NOTE: <i>All fasteners listed in this table can be reused after removal.</i>	
Application	Specification
	Metric (English)
Steering Gear Bolt	
• First Pass:	100 N.m (74 lb ft)
• Final Pass:	45 - 60 degrees
Steering Linkage Inner Tie Rod	105 N.m (77 lb ft)
Steering Linkage Outer Tie Rod Nut	
• First Pass:	35 N.m (26 lb ft)
• Final Pass:	80 - 90 degrees

SCHEMATIC WIRING DIAGRAMS

POWER STEERING WIRING SCHEMATICS

Power Steering

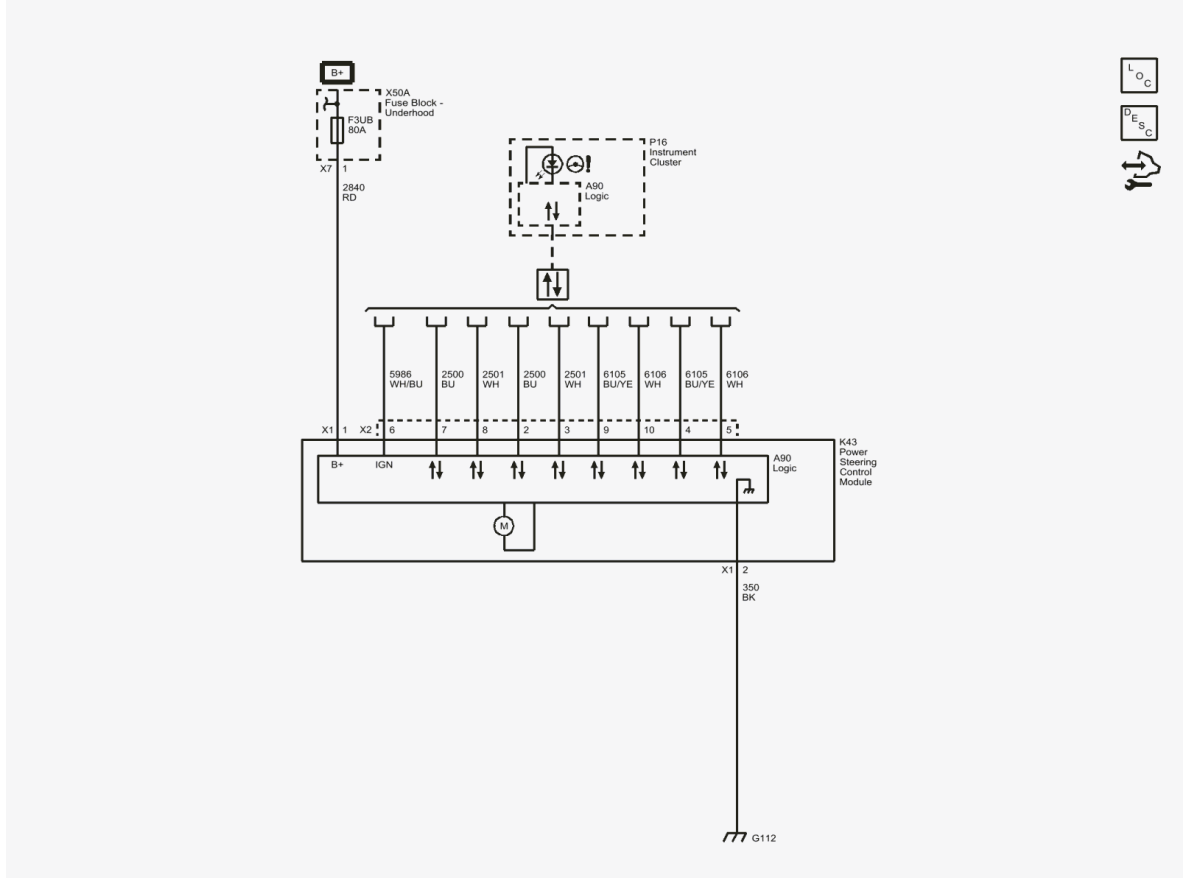


Fig. 1: Power Steering

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC C0176: CONTROL MODULE TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C0176

Control Module Temperature Sensor

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

For an overview of the component/system, refer to: [Power Steering System Description and Operation \(Electronic Power Steering\)](#)

Conditions for Running the DTC

- Ignition = On
- Engine = Running
- System Voltage = 9 to 16 V

Conditions for Setting the DTC

Power Steering Control Module Temperature = 115 to 125Â°C (240 to 257Â°F)

Actions Taken When the DTC Sets

Conditions for Clearing the DTC

- A current DTC will clear on the next malfunction-free ignition cycle.
- A history DTC will clear after 40 consecutive malfunction-free ignition cycles.

Diagnostic Aids

This DTC does not indicate any system malfunction. To avoid thermal damage, the power steering control module limits the current to the power steering motor. Aggressive steering may cause reduced steering assist. Discuss with the customer about the driving conditions when the concern occurred.

Reference Information

Schematic Reference

Power Steering Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References

Circuit/System Verification

NOTE: A DTC may set depending on certain driving conditions and would not require a component replacement. Aggressive steering may cause reduced steering assist. Discuss with the customer about the driving conditions when the concern occurred.

1. Operate the vehicle within the Conditions for Running the DTC. Verify the DTC does not set.
 - **If the DTC sets**
 1. Ignition/Vehicle - Off
 2. Verify the following conditions do not exist: Steering = Binding or Sticking
 - If a condition exists - Refer to: [Steering Effort Hard or Too Easy in One or Both Directions](#)
 - If no condition exists - Replace the component: Steering Gear
 - **Go to next step: If the DTC is not set**
2. All OK.

Repair Instructions

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

- Refer to [Electric Dual Pinion Rack and Pinion Steering Gear Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC C0460: STEERING WHEEL ANGLE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)

- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C0460

Steering Wheel Angle Sensor

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

For an overview of the component/system, refer to: [ABS Description and Operation](#)

Conditions for Running the DTC

- K17 Electronic Brake Control Module = During control module power up
- Ignition Voltage = Greater than 8 V
- Vehicle Speed = Greater than 20 km/h (12 MPH)

Conditions for Setting the DTC

C0460 42

Steering Wheel Angle Sensor = Calibration Not Programmed

C0460 4B

Steering Wheel Angle Sensor = Calibration Not Learned - Zero position not set.

C0460 58

Steering Wheel Angle Sensor = Performance

C0460 5A

Steering Wheel Angle Sensor Signal = Not Plausible

Actions Taken When the DTC Sets

Power Steering Output Torque = Disabled

Conditions for Clearing the DTC

- A current DTC will clear on the next malfunction-free ignition cycle.
- A history DTC will clear after 40 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

Power Steering Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

C0460 42

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC C0460 42 is not set.
 - **If the DTC is set**
 1. Perform the following action: Rotate the steering wheel - To the full stop position - Left & Right
 2. Clear the DTCs.
 3. Verify the DTC does not set.
 - If the DTC sets - Replace the component: K43 Power Steering Control Module
 - If the DTC is not set
 4. All OK.
 - **Go to next step: If the DTC is not set**
3. All OK.

C0460 4B

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC C0460 4B is not set.
 - **If the DTC is set**
 1. Perform the following procedure/test: [Power Steering Control Module Calibration](#)
 2. Verify the DTC does not set.
 - If the DTC sets - Replace the component: K43 Power Steering Control Module
 - If the DTC is not set
 3. All OK.
 - **Go to next step: If the DTC is not set**
3. All OK.

C0460 58

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC C0460 58 is not set.

NOTE: Inspect the electrical connectors and the ground circuits of the component for poor connections.

3.
 - **If the DTC is set**

Replace the component: Steering Gear
 - **Go to next step: If the DTC is not set**
4. All OK.

C0460 5A

1. Ignition - On/Vehicle - In Service Mode
2. Verify there are no other DTCs set, except for DTC C0460 5A.
 - **If any other DTCs are set**

Refer to: [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)
 - **Go to next step: If no other DTCs are set**
3. Verify the following conditions do not exist: Front wheel alignment - Incorrect adjustment
4. Verify the scan tool parameter: Steering Wheel Angle = 0 degrees
 - **If not 0°**

1. Perform the following procedure/test: [Power Steering Control Module Calibration](#)
2. Verify the DTC does not set.
 - If the DTC sets - Replace the component: K43 Power Steering Control Module
 - If the DTC does not set
3. All OK.
 - **Go to next step: If 0**
5. All OK.

Repair Instructions

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

Refer to [Electric Dual Pinion Rack and Pinion Steering Gear Replacement](#)

For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC C0475: POWER STEERING MOTOR CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C0475

Power Steering Motor Circuit

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

For an overview of the component/system, refer to [Power Steering System Description and Operation \(Electronic Power Steering\)](#)

Conditions for Running the DTC

Ignition = On

Conditions for Setting the DTC

Power Steering Motor Circuit = Malfunction

Actions Taken When the DTC Sets

- Power Steering Output Torque = Disabled
- P9 Driver Information Center Display = Service Power Steering

Conditions for Clearing the DTC

- A current DTC will clear on the next malfunction-free ignition cycle.
- A history DTC will clear after 40 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

[Power Steering Wiring Schematics](#)

Connector End View Reference

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC C0475 is not set.
 - **If the DTC is set**
 1. Clear DTCs - DTC C0475
 2. Cycle the ignition from OFF to ON.
 3. Verify the DTC does not set.
 - If the DTC sets - Replace the component: Steering Gear
 - If the DTC does not set
 - **Go to next step: If the DTC is not set**
3. All OK.

Repair Instructions

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

Refer to [Electric Dual Pinion Rack and Pinion Steering Gear Replacement](#)

For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC C047A: POWER STEERING MOTOR POSITION SENSOR CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C047A

Power Steering Motor Position Sensor Circuit

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

For an overview of the component/system, refer to: [Power Steering System Description and Operation \(Electronic Power Steering\)](#)

Conditions for Running the DTC

Ignition = On

Conditions for Setting the DTC

- The control module detects a short to ground. - Power Steering Motor Position Sensor Circuit

- The control module detects a short to voltage. - Power Steering Motor Position Sensor Circuit
- The control module detects an open circuit. - Power Steering Motor Position Sensor Circuit

Actions Taken When the DTC Sets

- Power Steering Output Torque = Disabled
- P9 Driver Information Center Display = Service Power Steering

Conditions for Clearing the DTC

- A current DTC will clear on the next malfunction-free ignition cycle.
- A history DTC will clear after 40 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

Power Steering Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC C047A is not set.

- **If the DTC is set**

Replace the component: K43 Power Steering Control Module

- **Go to next step: If the DTC is not set**

3. All OK.

Repair Instructions

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

For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC C0545: STEERING WHEEL TORQUE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C0545

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

For an overview of the component/system, refer to: [Power Steering System Description and Operation \(Electronic Power Steering\)](#)

Conditions for Running the DTC

Ignition = On

Conditions for Setting the DTC

- Steering Wheel Torque Sensor = Short to Ground
- Steering Wheel Torque Sensor = Short to Voltage
- Steering Wheel Torque Sensor = Open/High Resistance

Actions Taken When the DTC Sets

- Power Steering Output Torque = Disabled
- P9 Driver Information Center Display = Service Power Steering

Conditions for Clearing the DTC

- A current DTC will clear on the next malfunction-free ignition cycle.
- A history DTC will clear after 40 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

[Power Steering Wiring Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#)

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC C0545 is not set.
 - **If the DTC is set**

Replace the component: Steering Gear
 - **Go to next step: If the DTC is not set**
3. All OK.

Repair Instructions

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

- Refer to [Electric Dual Pinion Rack and Pinion Steering Gear Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC C0569: SYSTEM CONFIGURATION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C0569

System Configuration

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

The power steering control module continuously monitors the thermal cycle counter of the steering gear. If the module is replaced, the thermal cycle counter value needs to be transferred from the existing module over to the new module using the SPS Electric Power Steering Setup Procedure.

For an overview of the component/system, refer to: [Power Steering System Description and Operation \(Electronic Power Steering\)](#)

Conditions for Running the DTC

Ignition = On

Conditions for Setting the DTC

The thermal cycle counter value does not meet the system requirement.

Actions Taken When the DTC Sets

- Power Steering Output Torque = Disabled
- P9 Driver Information Center Display = Service Power Steering

Conditions for Clearing the DTC

- A current DTC will clear on the next malfunction-free ignition cycle.
- A history DTC will clear after 40 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

[Power Steering Wiring Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)

- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#)

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC C0569 is not set.
 - **If the DTC is set**
 1. Perform all necessary programming and setup procedures for the control module: K43 Power Steering Control Module
 2. Verify the DTC does not set.
 - If the DTC sets - Replace the component: K43 Power Steering Control Module
 - If the DTC is not set
 3. All OK.
 - **Go to next step: If the DTC is not set**
3. All OK.

Repair Instructions

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

For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC C056D: ELECTRONIC CONTROL UNIT HARDWARE (POWER STEERING CONTROL MODULE)

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C056D

Electronic Control Unit Hardware

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

The internal fault detection is handled inside the control module. No external circuit diagnosis is involved.

Conditions for Running the DTC

Ignition On

Conditions for Setting the DTC

K43 Power Steering Control Module = Malfunction

Actions Taken When the DTC Sets

K43 Power Steering Control Module = Disabled

Conditions for Clearing the DTC

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

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

Diagnostic Aids

- This DTC can be set as a history DTC without affecting the operation of the component: K43 Power Steering Control Module
- If set only as a history DTC, do not replace any component.

Reference Information

Schematic Reference

Power Steering Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC C056D is not set.
 - **If the DTC is set**
 1. Perform all necessary programming and setup procedures for the control module: K43 Power Steering Control Module
 2. Verify the DTC does not set.
 - If the DTC sets - Replace the component: K43 Power Steering Control Module
 - If the DTC is not set
 3. All OK.
 - **Go to next step: If the DTC is not set**
3. All OK.

Repair Instructions

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

For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC C056E: ELECTRONIC CONTROL UNIT SOFTWARE (POWER STEERING CONTROL MODULE)

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C056E

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

For an overview of the component/system, refer to: [Power Steering System Description and Operation \(Electronic Power Steering\)](#)

Conditions for Running the DTC

Ignition = On

Conditions for Setting the DTC

- K43 Power Steering Control Module = Missing Calibration
- Power Steering Control Module SPS Calibration Status = Incomplete
- VIN Not Programmed
- Software Malfunction

Actions Taken When the DTC Sets

Power Steering Output Torque = Default

Conditions for Clearing the DTC

- K43 Power Steering Control Module = Programmed
- K43 Power Steering Control Module = Calibrated

Reference Information

Schematic Reference

[Power Steering Wiring Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#)

Circuit/System Verification

Symptom Byte: 43, 45, 46, 47, 4A, or 5A

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC C056E is not set.
 - **If the DTC is set**
 1. Perform all necessary programming and setup procedures for the control module: K43 Power Steering Control Module
 2. Verify the DTC does not set.

- If the DTC sets - Replace the component: K43 Power Steering Control Module
- If the DTC is not set

3. All OK.

- **Go to next step: If the DTC is not set**

3. All OK.

Symptom Byte: 42

1. Ignition - On/Vehicle - In Service Mode

2. Verify DTC C056E is not set.

- **If the DTC is set**

1. Calibrate the power steering control module. Refer to: [Power Steering Control Module Calibration](#)

2. Verify the DTC does not set.

- If the DTC sets - Replace the component: K43 Power Steering Control Module
- If the DTC is not set

3. All OK.

- **Go to next step: If the DTC is not set**

3. All OK.

Symptom Byte: 37

1. Ignition - On/Vehicle - In Service Mode

2. Verify DTC C056E is not set.

- **If the DTC is set**

Replace the component: Steering Gear

- **Go to next step: If the DTC is not set**

3. All OK.

Repair Instructions

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

Refer to [Electric Dual Pinion Rack and Pinion Steering Gear Replacement](#)

For control module replacement, programming, and setup refer to: [Control Module References](#)

SYMPTOMS - POWER STEERING SYSTEM

NOTE: Review the system description and operation in order to familiarize yourself with the system functions. Refer to [Power Steering System Description and Operation \(Electronic Power Steering\)](#).

Visual/Physical Inspection

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

Symptoms List

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

- [Rattle, Clunk, Pop or Shudder Noise from the Power Steering System](#)
- [Whine or Growl Noise from the Power Steering System](#)
- [Increase in Effort While Turning Steering Wheel](#)
- [Poor Return of Steering Wheel](#)
- [Steering Wheel Surges/Jerks While Turning](#)

- [Steering Wheel Kickback](#)
- [Steering Effort Hard or Too Easy in One or Both Directions](#)

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

Step	Action	Yes	No
1	Did you review the Power Steering System Description and Operation and perform the necessary inspections?	Go to Step 2	Go to 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 Electric Dual Pinion Rack and Pinion Steering Gear Replacement . 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 (Equinox) or Intermediate Steering Shaft Replacement (Terrain) . 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

WHINE OR GROWL NOISE FROM THE POWER STEERING SYSTEM

Special Tools

CH-39570 Chassis Ear

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

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 whine or growl noise is present. Is a whine or growl noise present?	Go to Step 3	System OK
3	Inspect the steering gear for looseness and/or worn bushings. Is the steering gear loose and/or bushings worn?	Go to Step 6	Go to Step 4
4	Inspect the power steering assist motor for a whine or growl noise using the CH-39570 chassis ear. Is the noise present at the power steering assist motor?	Go to Step 7	Go to Step 5
5	Inspect the steering gear for a whine or growl noise using the CH-39570 chassis ear. Is the noise present at the steering gear?	Go to Step 8	Go to Step 3

Step	Action	Yes	No
6	Tighten the steering gear fasteners or replace the steering gear. Refer to Electric Dual Pinion Rack and Pinion Steering Gear Replacement . Did you complete the repair?	Go to Step 9	-
7	Replace the power steering assist motor. Refer to Power Steering Assist Motor Replacement . Did you complete the repair?	Go to Step 9	-
8	Replace the steering gear. Refer to Electric Dual Pinion Rack and Pinion Steering Gear Replacement . 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
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 steering linkage outer tie rod. Is the steering linkage outer tie rod binding or worn?	Go to Step 7	Go to Step 5
5	Check for a worn or binding intermediate steering 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 steering linkage outer tie rod. Refer to Steering Linkage Outer Tie Rod Replacement . Did you complete the repair?	Go to Step 10	-
8	Replace the intermediate steering shaft. Refer to Intermediate Steering Shaft Replacement (Equinox) . Intermediate Steering Shaft Replacement (Terrain) . Did you complete the repair?	Go to Step 10	-
9	Replace the steering gear. Refer to Electric Dual Pinion Rack and Pinion Steering Gear Replacement . 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

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 Power Steering System Description and Operation (Electronic Power Steering) .
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 steering linkage outer tie rods and lower control arm ball joints, if applicable. 3. Inspect the front 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
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 steering 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 steering 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 Tire and Wheel Removal and Installation. 2. Disconnect both steering linkage outer tie rods from the steering knuckles. 3. Use your hands in order to move the steering linkage outer tie rod studs. 4. If abnormally difficult to move, replace the steering linkage outer tie rod(s).		
	Did you find and complete the repair?	Go to Step 12	Go to Step 8

Step	Action	Yes	No
8	1. Use your hands to rotate the steering knuckles inboard and outboard in order to inspect for binding strut bearings, ball joints, or axles. 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 Wheel Alignment Measurement . Did you find and complete the repair?	Go to Step 12	-
11	Inspect the steering column for a binding. If 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 WHEEL SURGES/JERKS WHILE TURNING

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 the steering wheel surges or jerks while turning. Does the steering wheel surge or jerk while turning?	Go to Step 3	System OK
3	Inspect the front suspension for worn or binding components. Did you find and correct the condition?	Go to Step 15	Go to Step 4
4	1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle . 2. Inspect the steering linkage outer tie rods for wear or a binding condition. Is the steering linkage outer tie rod/s worn or binding?	Go to Step 10	Go to Step 5
5	Inspect the intermediate steering shaft for wear or a binding condition. Is the intermediate steering shaft worn or binding?	Go to Step 11	Go to Step 6
6	Inspect the steering gear for wear or a binding condition. Is the steering gear worn or binding?	Go to Step 12	Go to Step 7
7	Inspect the steering column for wear or a binding condition. Is the steering column worn or binding?	Go to Step 13	Go to Step 8
8	Inspect the power steering assist motor for an indication of excessive heat. Does the power steering assist motor appear to be overheated?	Go to Step 9	Go to Step 14

Step	Action	Yes	No
9	NOTE: Do not perform excessive parking lot maneuvers during testing. Excessive parking lot maneuvers can cause the power steering motor to heat up. Allow the power steering motor to cool and retest the system. Did you correct the condition?	Go to Step 15	Go to Step 14
10	Replace the steering linkage outer tie rod/s. Refer to <u>Steering Linkage Outer Tie Rod Replacement</u> . Did you complete the repair?	Go to Step 15	-
11	Replace the intermediate steering shaft. Refer to <u>Intermediate Steering Shaft Replacement (Equinox)</u> . <u>Intermediate Steering Shaft Replacement (Terrain)</u> . Did you complete the repair?	Go to Step 15	-
12	Replace the steering gear. Refer to <u>Electric Dual Pinion Rack and Pinion Steering Gear Replacement</u> . Did you complete the repair?	Go to Step 15	-
13	Replace the steering column. Refer to <u>Steering Column Replacement (Equinox)</u> <u>Steering Column Replacement (Terrain)</u> . Did you complete the repair?	Go to Step 15	-
14	Replace the steering gear. Refer to <u>Electric Dual Pinion Rack and Pinion Steering Gear Replacement</u> . Did you complete the repair?	Go to Step 15	-
15	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

STEERING WHEEL KICKBACK

Condition	Action
The steering column is loosely mounted.	Tighten the steering column fasteners to specification. Refer to <u>Steering Column Replacement (Equinox)</u> . <u>Steering Column Replacement (Terrain)</u> .
The steering gear is loosely mounted.	Tighten the steering gear fasteners to specification. Refer to <u>Electric Dual Pinion Rack and Pinion Steering Gear Replacement</u> .
The steering linkage tie rods are loose or damaged.	Inspect the steering linkage tie rods and replace as necessary. Refer to <u>Steering Linkage Outer Tie Rod Replacement</u> , and <u>Steering Linkage Inner Tie Rod Replacement</u> .

STEERING EFFORT HARD OR TOO EASY IN ONE OR BOTH DIRECTIONS

Condition	Action
The battery power is low.	Ensure proper battery voltage.
The steering column dash seal/s are binding.	Inspect the steering column dash seal/s and adjust or replace as necessary. Refer to <u>Steering Column Dash Inner Seal Replacement (Equinox)</u> <u>Steering Column Dash Inner Seal Replacement (Terrain)</u> , or <u>Steering Column Dash Outer Seal Replacement (Equinox)</u> , <u>Terrain)</u> .
The intermediate steering shaft joints and fasteners are loose or worn.	Inspect the intermediate steering shaft joints and fasteners for looseness or wear and tighten or replace as necessary. Refer to <u>Intermediate Steering Shaft Replacement (Equinox)</u> <u>Intermediate Steering Shaft Replacement (Terrain)</u> .
The steering gear is binding.	Replace the steering gear. Refer to <u>Electric Dual Pinion Rack and Pinion Steering Gear Replacement</u> .

Condition	Action
The upper steering column shaft is bent.	Replace the steering column. Refer to Steering Column Replacement (Equinox) Steering Column Replacement (Terrain) .
The power steering assist motor connectors are damaged or disconnected.	Verify the power steering assist motor connectors are properly connected. Verify the connectors are not damaged. If the connectors are damaged, replace the connectors.
The steering gear torque sensor wiring is damaged.	Replace the steering gear. Refer to Electric Dual Pinion Rack and Pinion Steering Gear Replacement .
The power steering assist motor controller is malfunctioning.	Confirm the DTC. Replace the steering gear. Refer to Electric Dual Pinion Rack and Pinion Steering Gear Replacement .
The power steering assist motor shaft is binding.	Confirm the DTC. Replace the steering gear. Refer to Electric Dual Pinion Rack and Pinion Steering Gear Replacement .

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	

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.

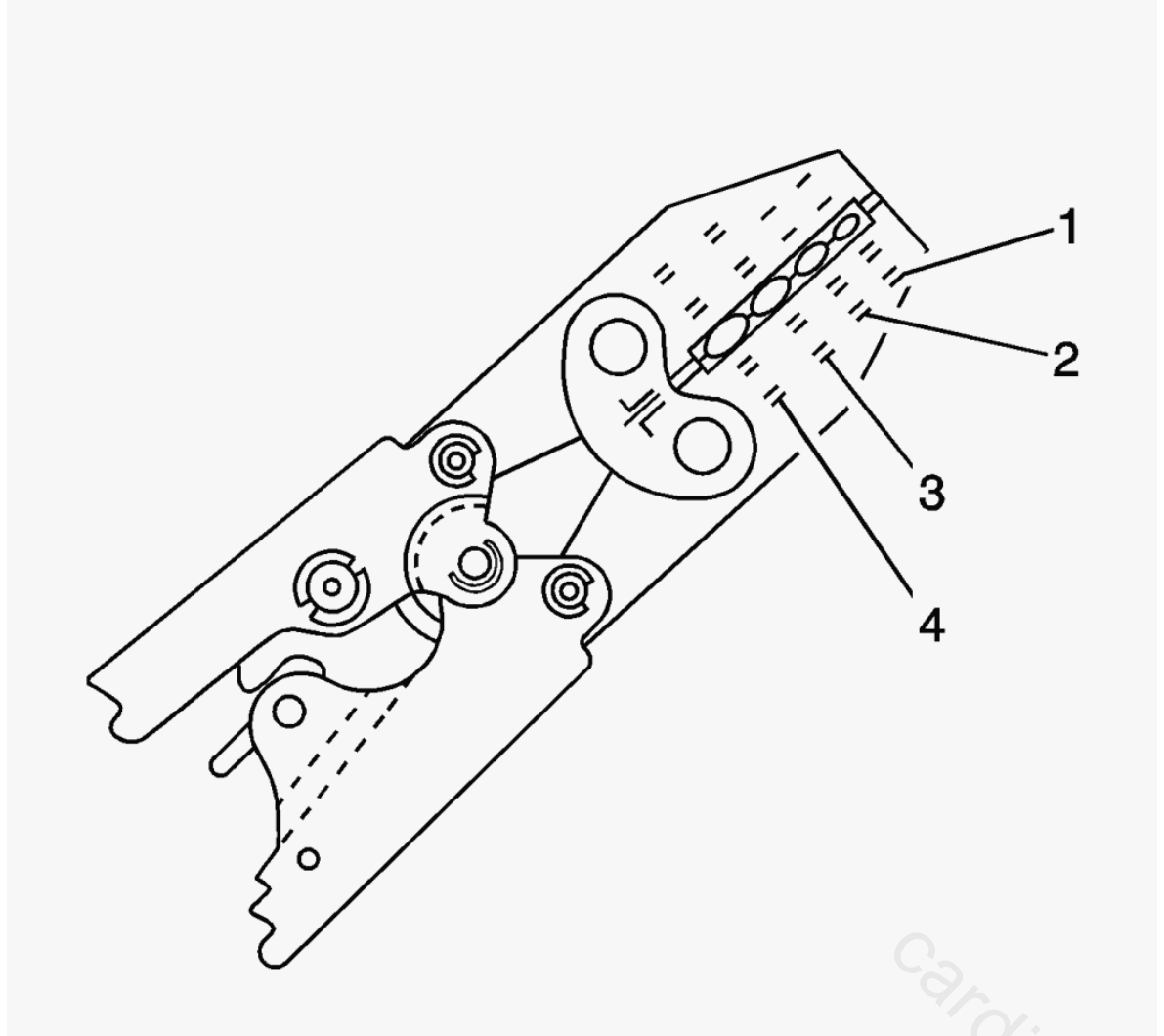


Fig. 2: Splice Sleeve Crimping Tool With 4 Crimp Nests
Courtesy of GENERAL MOTORS COMPANY

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.

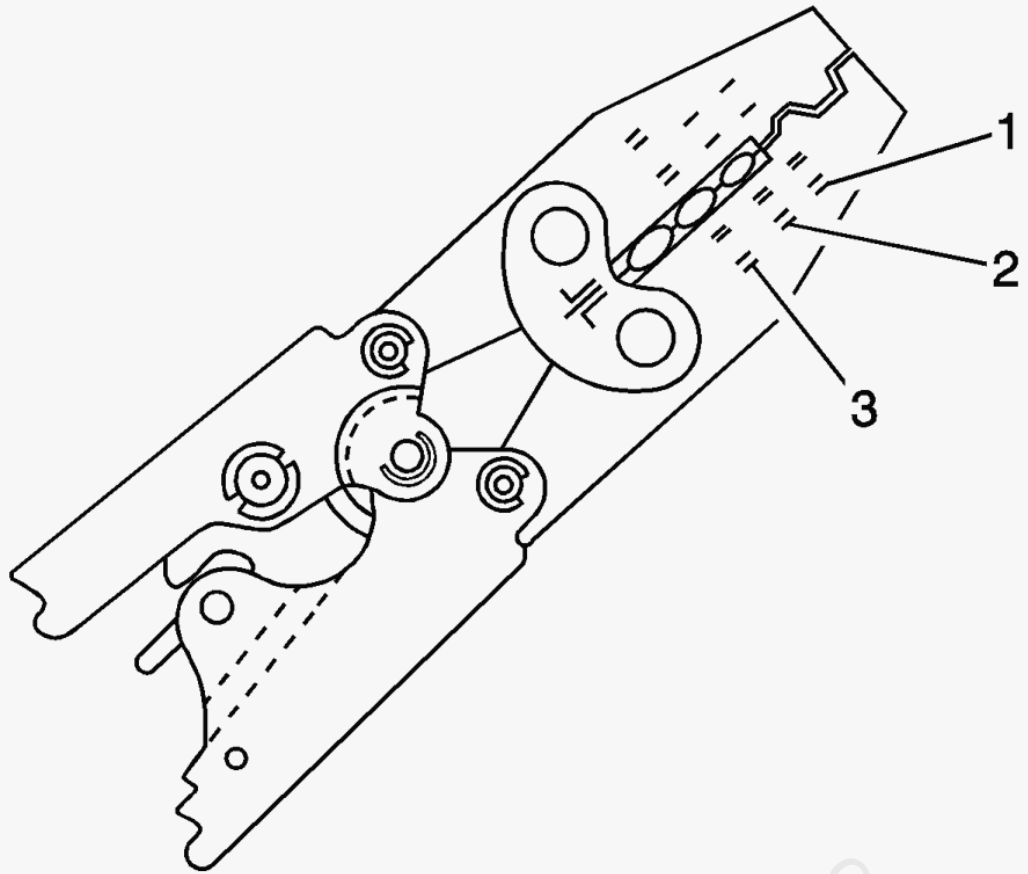


Fig. 3: Splice Sleeve Crimping Tool With 3 Crimp Nests
Courtesy of GENERAL MOTORS COMPANY

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).

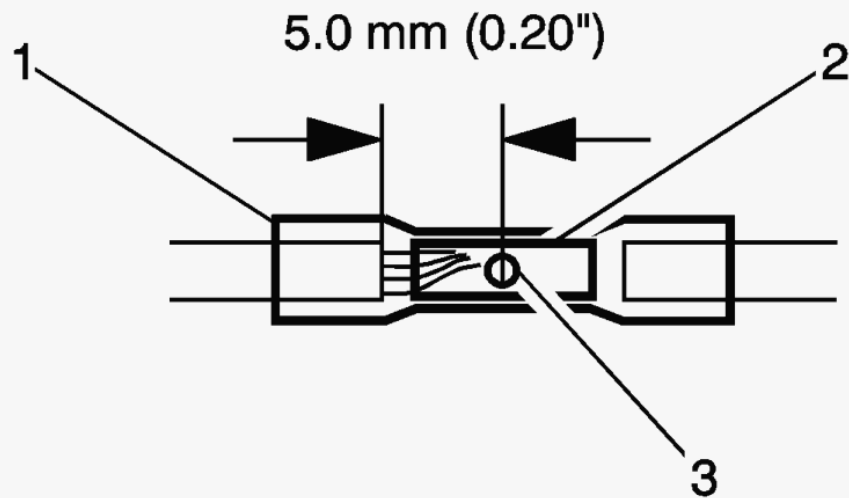


Fig. 4: Identifying DuraSeal Splice Sleeve

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. 5: 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. 6: 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 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.

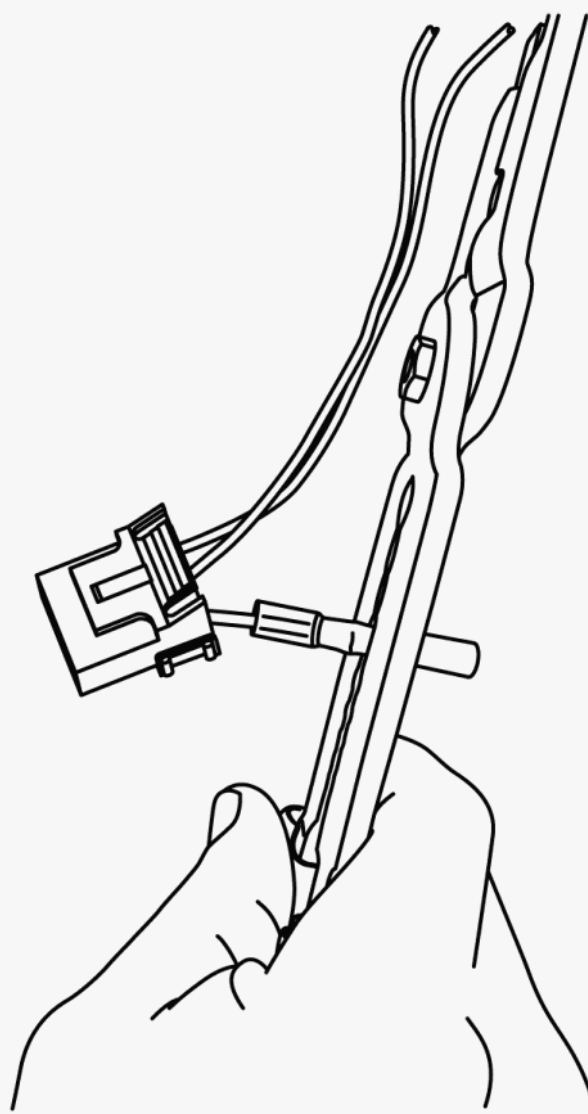


Fig. 7: Tightly Close Handles Of Crimp Tool
Courtesy of GENERAL MOTORS COMPANY

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.

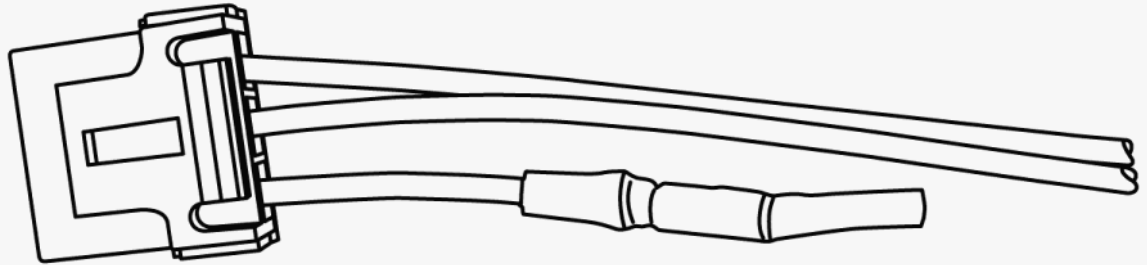


Fig. 8: Heat To Crimped Area Of Barrel

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.

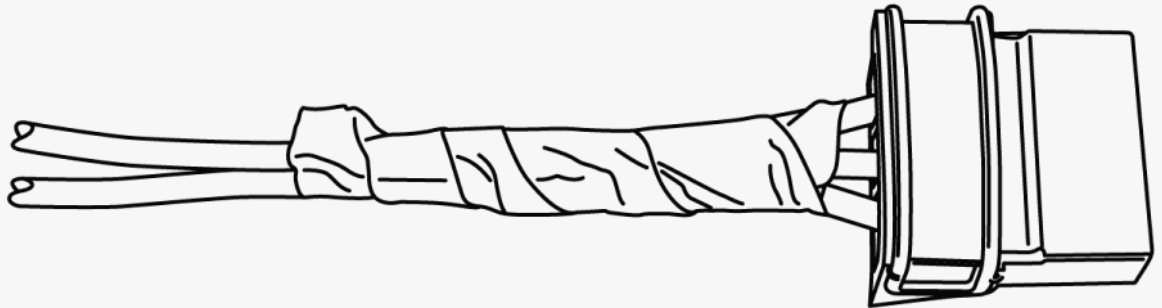


Fig. 9: Taping Extra Terminated Leads Back Into Harness
Courtesy of GENERAL MOTORS COMPANY

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 Wiring Schematics.
- 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 Wiring Schematics.

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.

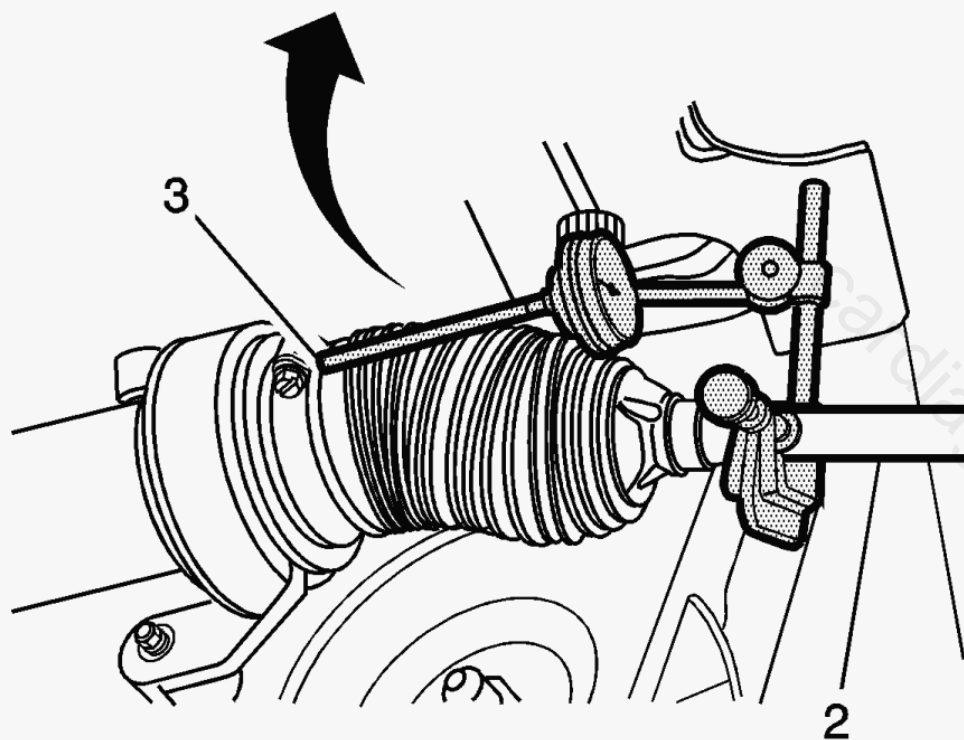
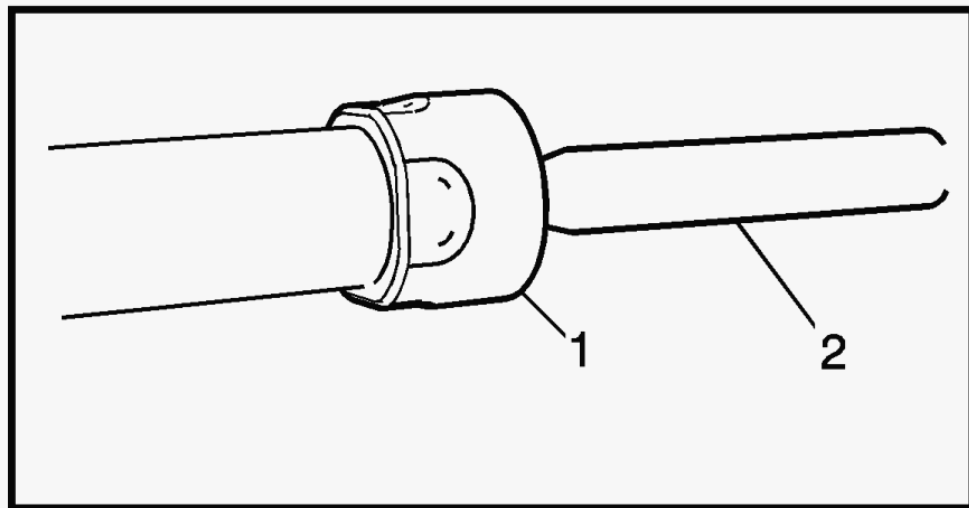


Fig. 10: Measuring Lash Between Inner Tie Rod And Steering Gear Housing
Courtesy of GENERAL MOTORS COMPANY

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.

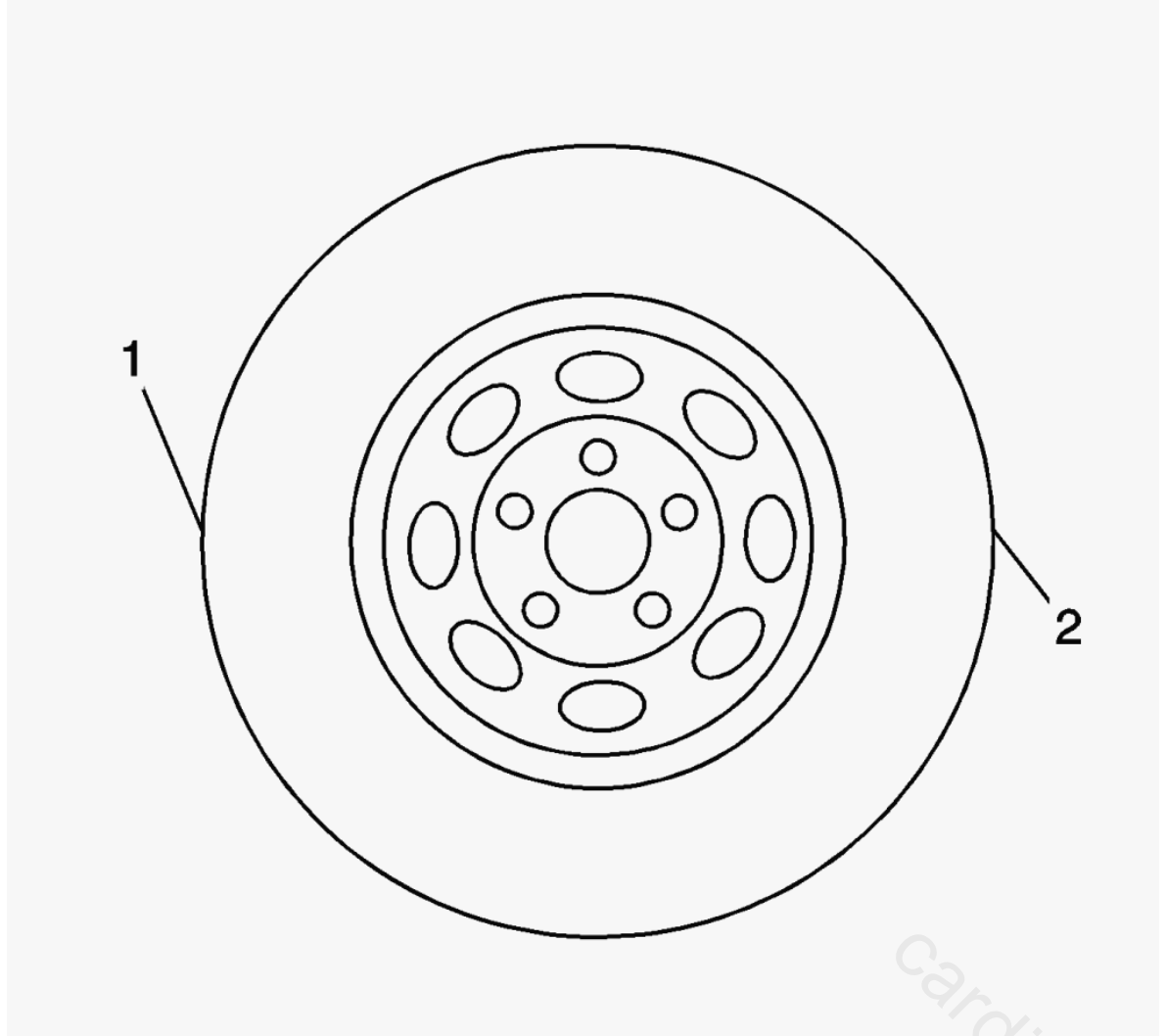


Fig. 11: Tire Grasping Positions

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](#).
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. 12: 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.

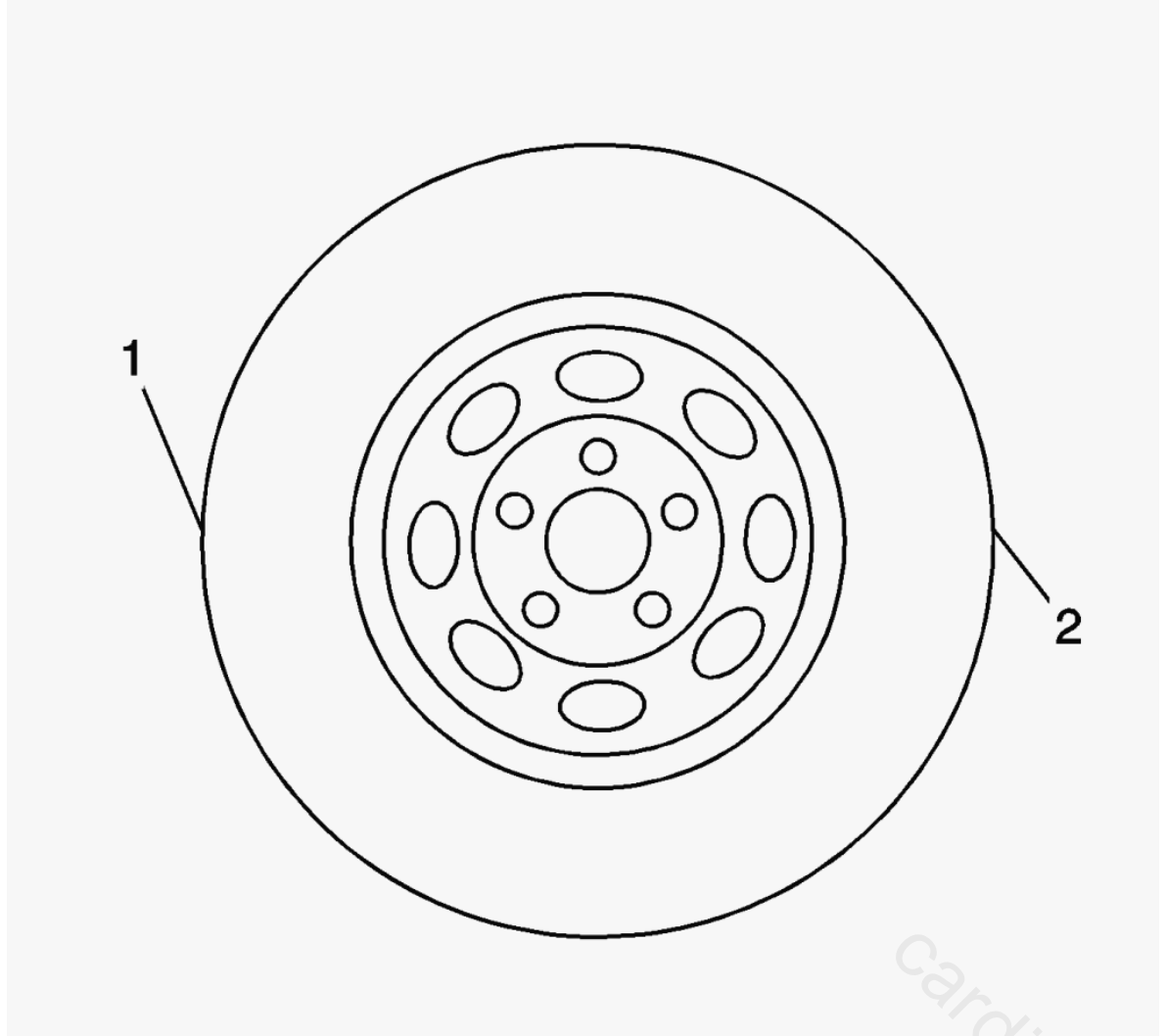


Fig. 13: Tire Grasping Positions

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.

STEERING LINKAGE OUTER TIE ROD REPLACEMENT

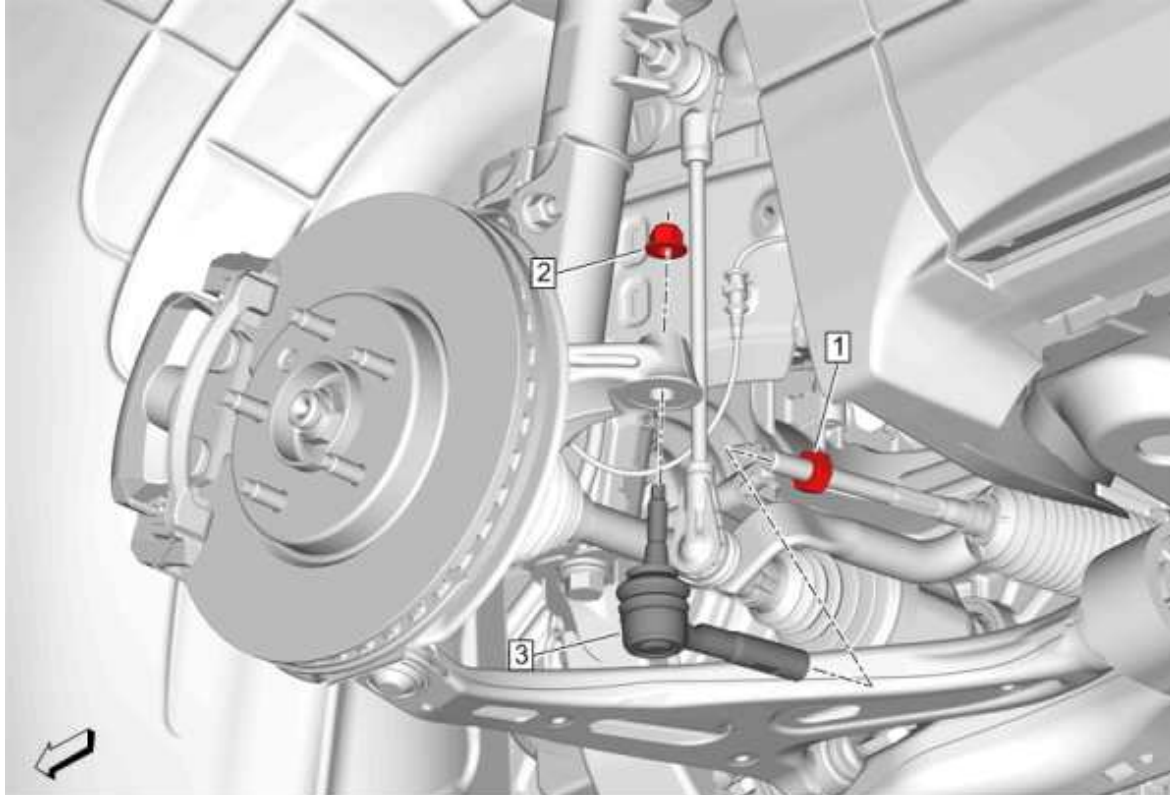


Fig. 14: Steering Linkage Outer Tie Rod
 Courtesy of GENERAL MOTORS COMPANY

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: 35 N.m (26 lb ft) Final Pass: (80 - 90 degrees)

Callout	Component Name
3	Steering Linkage Outer Tie Rod 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 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

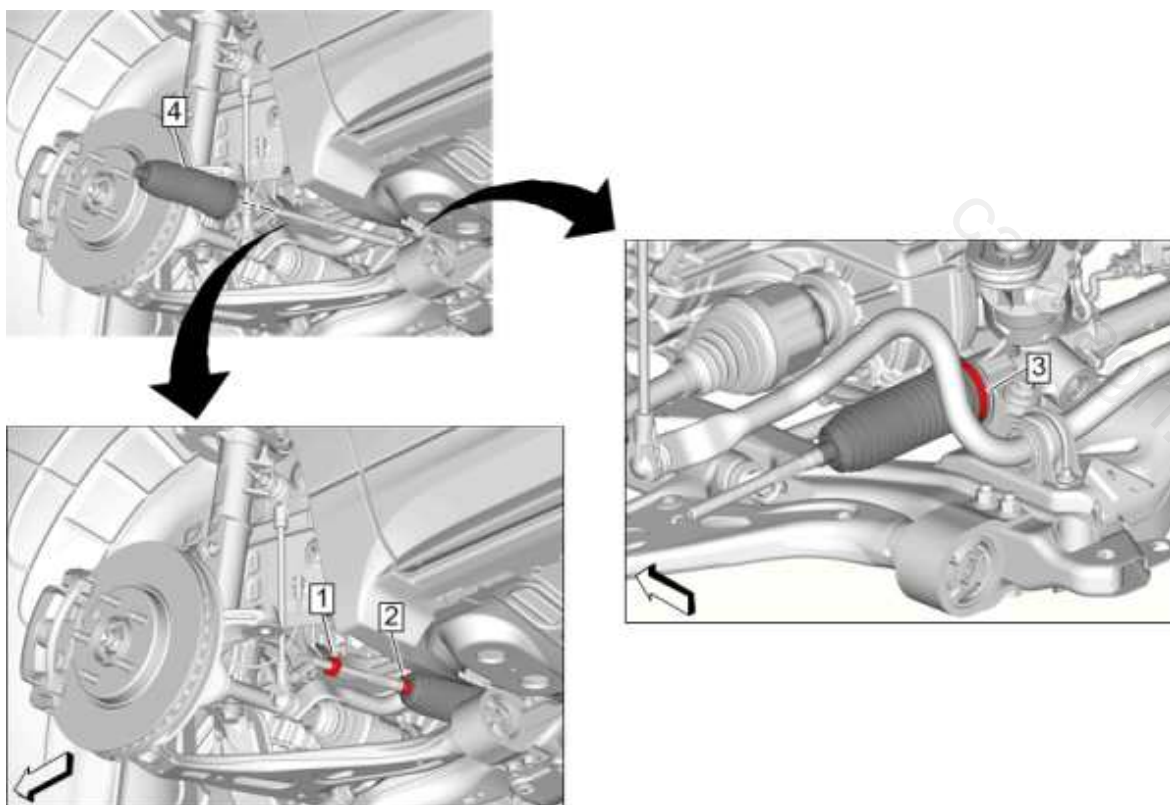


Fig. 15: Steering Gear Boot

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Steering Linkage Outer Tie Rod. Refer to Steering Linkage Outer Tie Rod Replacement	
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.
2	Steering Gear Boot Outer Clamp

Callout	Component Name
3	Steering Gear Boot Inner Clamp Procedure 1. Cut the steering gear boot inner clamp. - DISCARD the clamp. 2. Use the CH-22610 pliers to install the NEW steering gear boot inner clamp. NOTE: Position the NEW steering gear boot inner clamp on the steering gear boot before installing the boot on the steering gear. Special Tools CH-22610 Keystone 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 Electric Dual Pinion Rack and Pinion Steering Gear Replacement 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.

ELECTRIC DUAL PINION RACK AND PINION STEERING GEAR REPLACEMENT

Removal Procedure

CAUTION:

Electrostatic discharge (ESD) can damage many solid-state electrical components. ESD susceptible components may or may not be labeled with the ESD symbol. Handle all electrical components carefully. Use the following precautions in order to avoid ESD damage:

- Touch a metal ground point in order to remove your body's static charge before servicing any electronic component; especially after sliding across the vehicle seat.
- Do not touch exposed terminals. Terminals may connect to circuits susceptible the ESD damage.
- Do not allow tools to contact exposed terminals when servicing connectors.
- Do not remove components from their protective packaging until required to do so.
- Avoid the following actions unless required by the diagnostic procedure:
 - Jumpering or grounding of the components or connectors.
 - Connecting test equipment probes to components or connectors. Connect the ground lead first when using test probes.
- Ground the protective packaging of any component before opening. Do not rest solid-state components on metal workbenches, or on top of TVs, radios, or other electrical devices.

CAUTION:

During removal and installation, all EPS components including mechanical and/or electrical is extremely susceptible to damage. Dropping or prying on any EPS component may cause internal damage. If damage occurs or a part is dropped, the EPS component must be replaced.

CAUTION: Care must be taken during removal and installation of the Electronic Power Steering (EPS) components to not hit or break the EPS motor/controller module or module harness connectors. If the EPS motor/controller module or module connectors are damaged, the complete component must be replaced.

CAUTION: With wheels of the vehicle facing straight ahead, secure the steering wheel utilizing steering column anti-rotation pin, steering column lock, or a strap to prevent rotation. Locking of the steering column will prevent damage and a possible malfunction of the SIR system. The steering wheel must be secured in position before disconnecting the following components:

- The steering column
- The intermediate shaft(s)
- The steering gear

After disconnecting these components, do not rotate the steering wheel or move the front tires and wheels. Failure to follow this procedure may cause the SIR coil assembly to become un-centered and cause possible damage to the SIR coil. If you think the SIR coil has become un-centered, refer to your specific SIR coil's centering procedure to re-center SIR Coil.

1. With the wheels of the vehicle in the straight ahead position, LOCK the steering column.

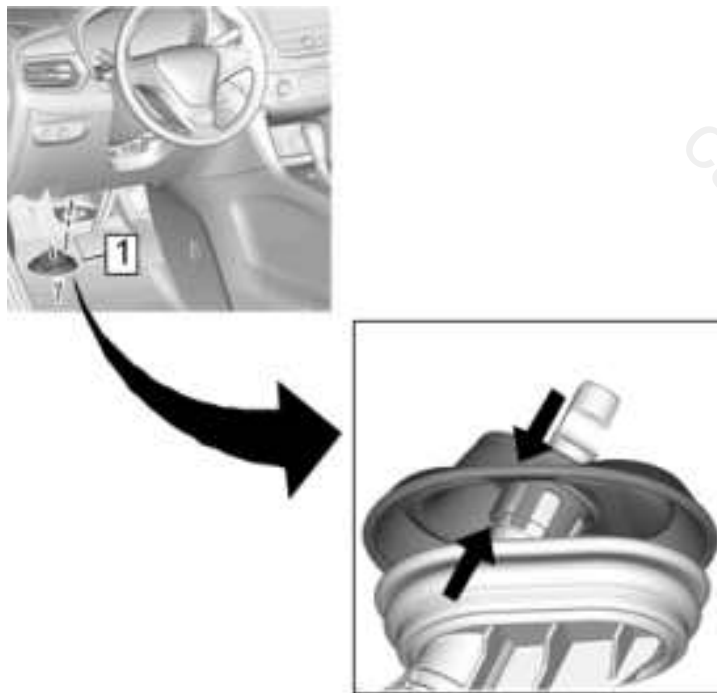


Fig. 16: Steering Column Dash Inner Seal

Courtesy of GENERAL MOTORS COMPANY

2. Remove Steering Column Dash Inner Seal (1). Refer to [Steering Column Dash Inner Seal Replacement \(Equinox\)](#), [Steering Column Dash Inner Seal Replacement \(Terrain\)](#).

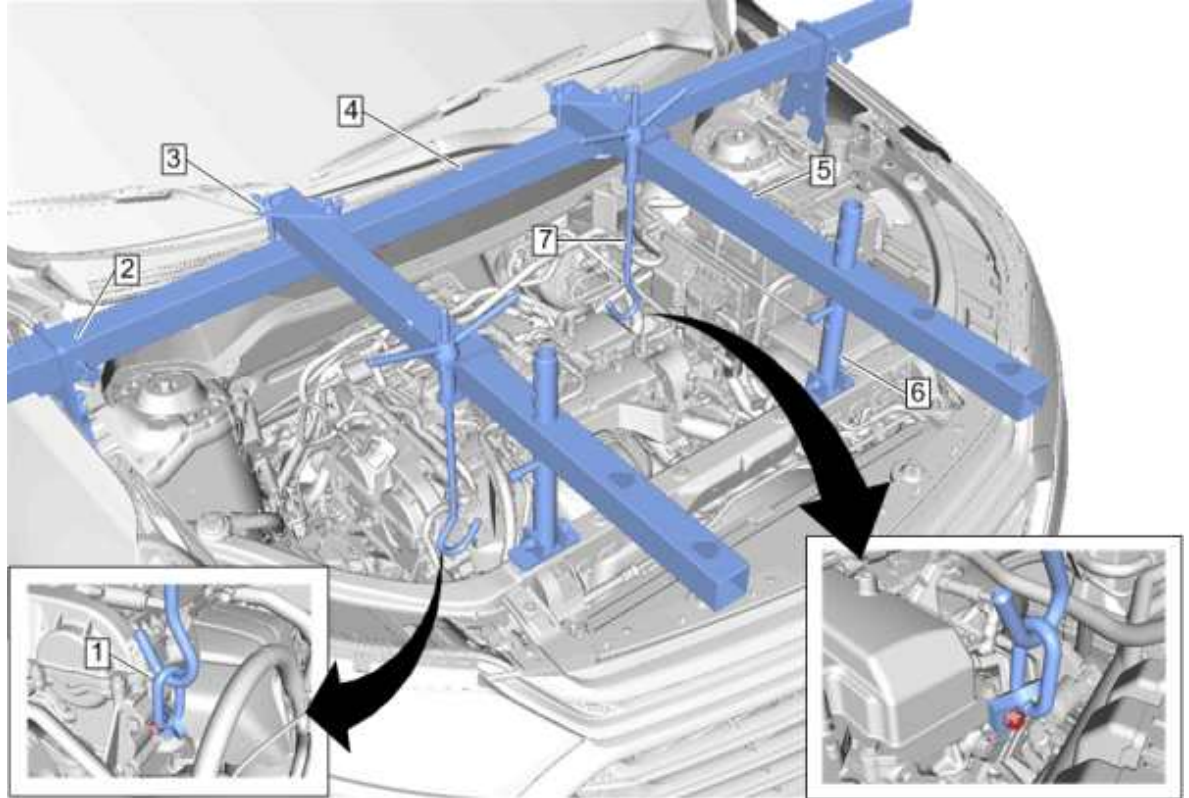


Fig. 17: Engine Support Fixture

Courtesy of GENERAL MOTORS COMPANY

3. Install Engine Support Fixture (2). Refer to [Engine Support Fixture](#)
4. Remove the front tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#)

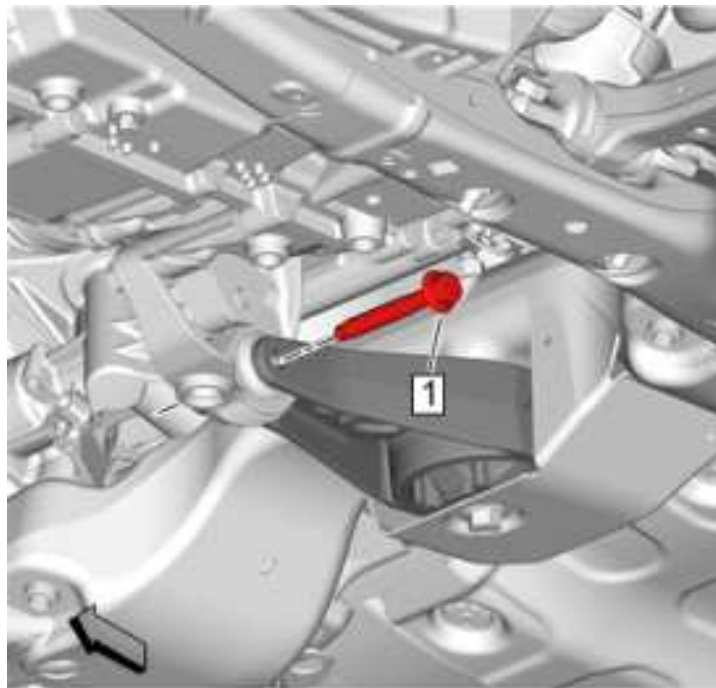


Fig. 18: Rear Transmission Mount Through Bolt

Courtesy of GENERAL MOTORS COMPANY

5. Remove Rear Transmission Mount Through Bolt (1). Refer to [Transmission Mount Strut Bracket Replacement \(All Wheel Drive\)](#) [Transmission Mount Strut Bracket Replacement \(Front Wheel Drive\)](#)

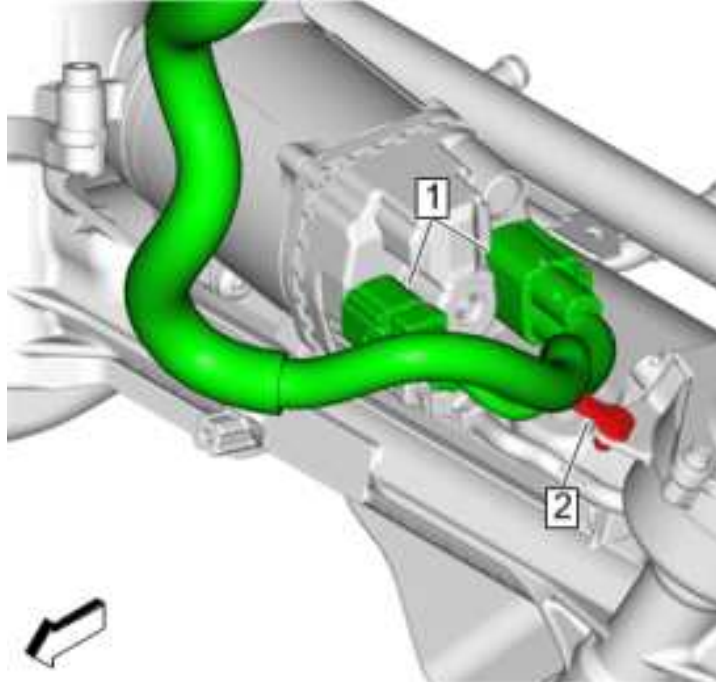


Fig. 19: Steering Gear Electrical Connectors And Wiring Harness Clip
 Courtesy of GENERAL MOTORS COMPANY

6. Disconnect the steering gear electrical connectors (1).
7. Remove the steering gear wiring harness clip (2) from the mounting point on the steering gear.
8. Position adjustable stands underneath the left and right sides of the rear of the drivetrain and front suspension cradle.
9. Loosen the drivetrain and front suspension cradle front bolts. Refer to [Drivetrain and Front Suspension Cradle Replacement \(Front Wheel Drive\)](#), [Drivetrain and Front Suspension Cradle Replacement \(All Wheel Drive\)](#)
10. Remove the drivetrain and front suspension cradle middle bolts and rear bolts. Refer to [Drivetrain and Front Suspension Cradle Replacement \(Front Wheel Drive\)](#), [Drivetrain and Front Suspension Cradle Replacement \(All Wheel Drive\)](#)
11. Partially lower the rear of the drivetrain and front suspension cradle to gain clearance for the front stabilizer shaft. Refer to [Drivetrain and Front Suspension Cradle Replacement \(Front Wheel Drive\)](#), [Drivetrain and Front Suspension Cradle Replacement \(All Wheel Drive\)](#)

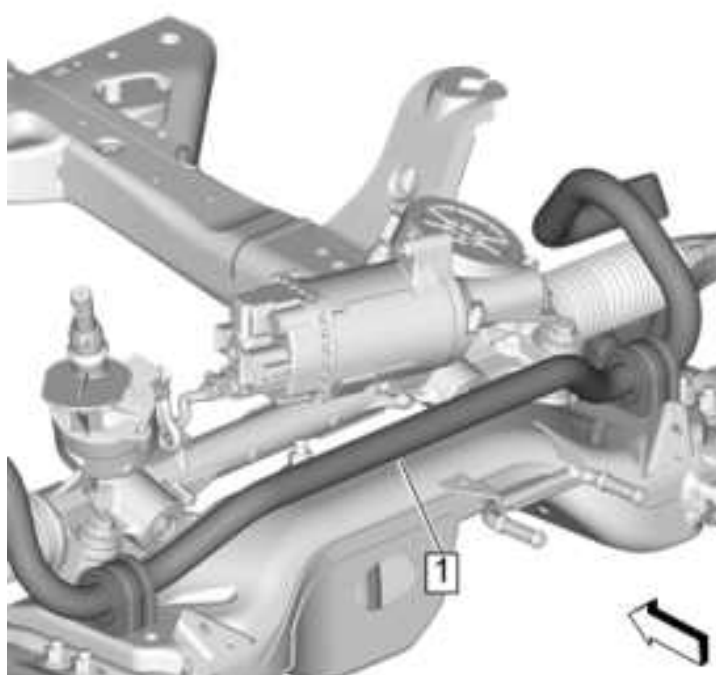


Fig. 20: Front Stabilizer Shaft
 Courtesy of GENERAL MOTORS COMPANY

12. Remove Front Stabilizer Shaft (1). Refer to [Stabilizer Shaft Replacement \(Equinox, Terrain, FWD, LYX\)](#), [Stabilizer Shaft Replacement \(Equinox, Terrain, FWD, LH7\)](#), [Stabilizer Shaft Replacement \(Equinox, Terrain, AWD, LYX\)](#), [Stabilizer Shaft Replacement \(Equinox, Terrain, AWD, LH7\)](#), [Stabilizer Shaft Replacement \(Equinox, Terrain, FWD, LTG\)](#), [Stabilizer Shaft Replacement \(Equinox, Terrain, AWD, LTG\)](#).

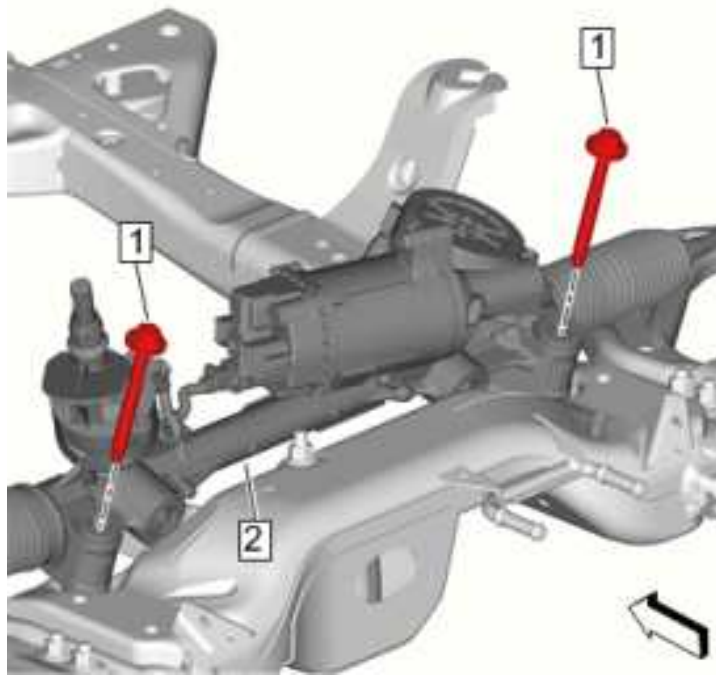


Fig. 21: Steering Gear And Bolts

Courtesy of GENERAL MOTORS COMPANY

13. Remove Steering Gear Bolt (1) - Remove (Qty: 2)
14. Remove the steering gear (2) from the drivetrain and front suspension cradle.
15. Transfer components as necessary.

Installation Procedure

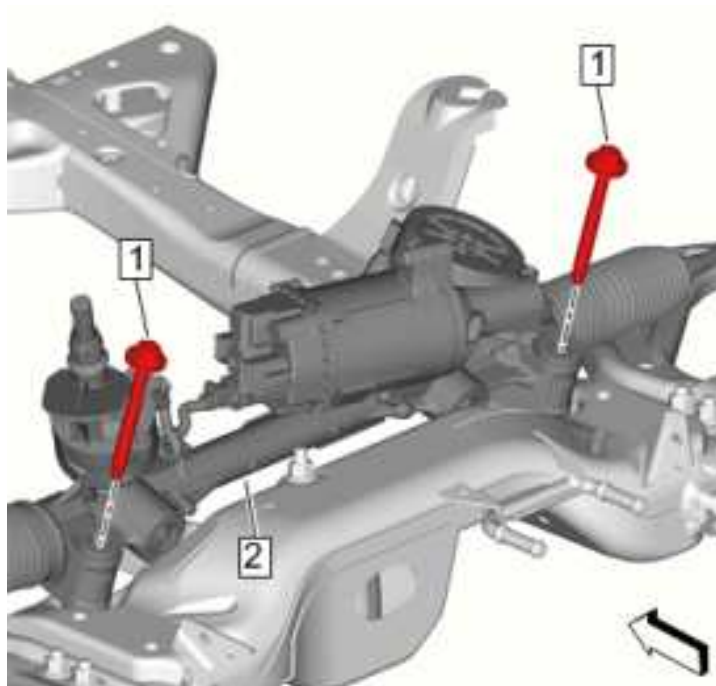


Fig. 22: Steering Gear And Bolts

Courtesy of GENERAL MOTORS COMPANY

1. Position the steering gear (2) on the drivetrain and front suspension cradle.

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

2. Install and tighten Steering Gear Bolts (1) (Qty: 2)

Tighten

1. First Pass: 100 N.m (74 lb ft)
2. Final Pass: (45 - 60 degrees)

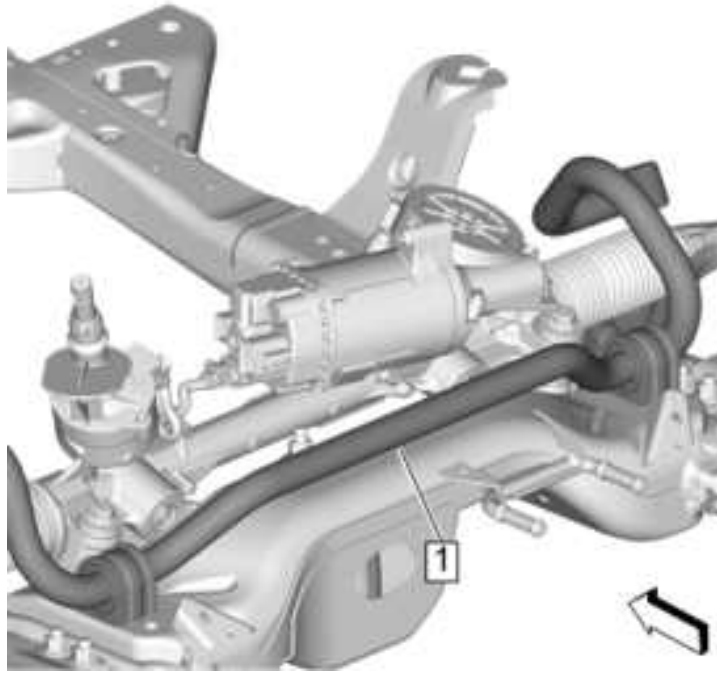


Fig. 23: Front Stabilizer Shaft

Courtesy of GENERAL MOTORS COMPANY

3. Install Front Stabilizer Shaft (1). Refer to [Stabilizer Shaft Replacement \(Equinox, Terrain, FWD, LYX\)](#) [Stabilizer Shaft Replacement \(Equinox, Terrain, AWD, LYX\)](#) [Stabilizer Shaft Replacement \(Equinox, Terrain, FWD, LH7\)](#) [Stabilizer Shaft Replacement \(Equinox, Terrain, AWD, LH7\)](#) [Stabilizer Shaft Replacement \(Equinox, Terrain, FWD, LTG\)](#) [Stabilizer Shaft Replacement \(Equinox, Terrain, AWD, LTG\)](#)
4. Raise the rear of the drivetrain and front suspension cradle. Refer to [Drivetrain and Front Suspension Cradle Replacement \(Front Wheel Drive\)](#) [Drivetrain and Front Suspension Cradle Replacement \(All Wheel Drive\)](#)
5. Install and tighten the drivetrain and front suspension cradle rear bolts and middle bolts. Refer to [Drivetrain and Front Suspension Cradle Replacement \(Front Wheel Drive\)](#) [Drivetrain and Front Suspension Cradle Replacement \(All Wheel Drive\)](#)
6. Tighten the drivetrain and front suspension cradle front bolts. Refer to [Drivetrain and Front Suspension Cradle Replacement \(Front Wheel Drive\)](#) [Drivetrain and Front Suspension Cradle Replacement \(All Wheel Drive\)](#)
7. Remove the adjustable stands from underneath the vehicle.

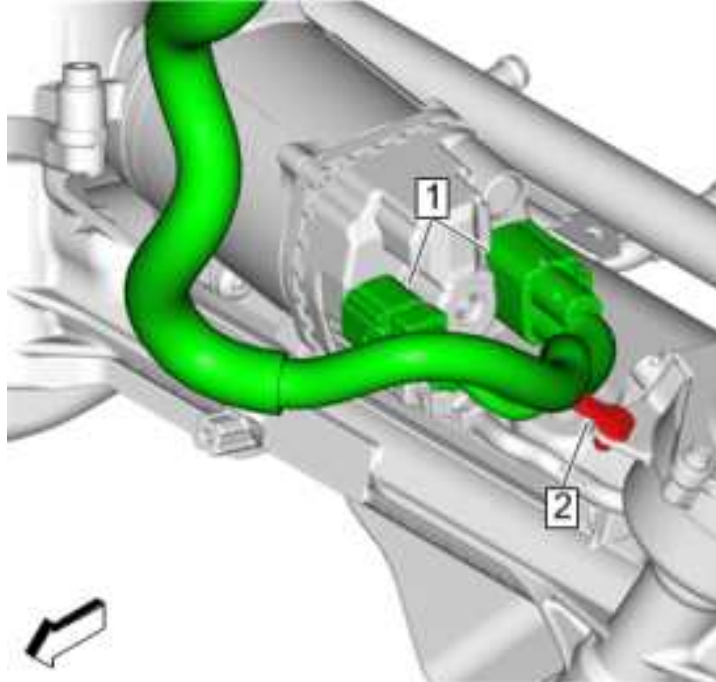


Fig. 24: Steering Gear Electrical Connectors And Wiring Harness Clip
 Courtesy of GENERAL MOTORS COMPANY

8. Connect the steering gear electrical connectors (1).
9. Install the steering gear wiring harness clip (2) in the mounting point on the steering gear.

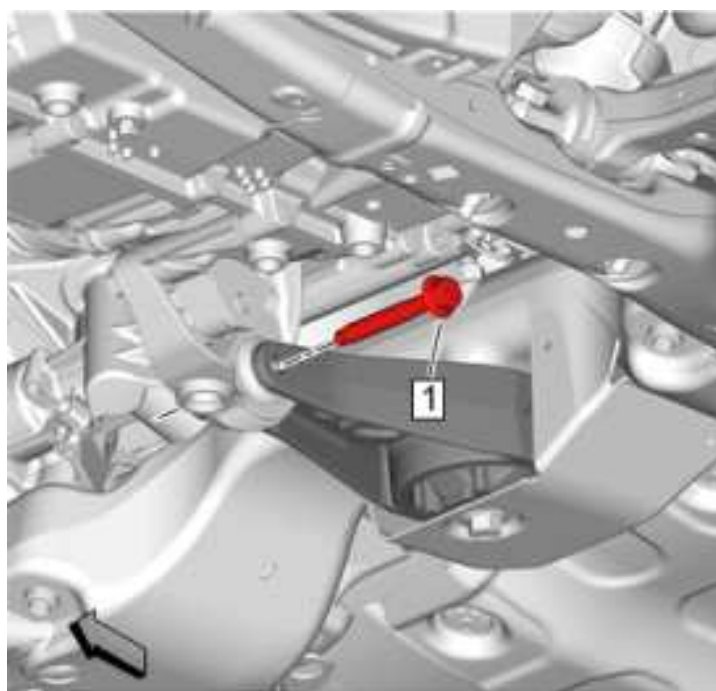


Fig. 25: Rear Transmission Mount Through Bolt
 Courtesy of GENERAL MOTORS COMPANY

10. Install Rear Transmission Mount Through Bolt (1). Refer to [Transmission Mount Strut Bracket Replacement \(All Wheel Drive\)](#). [Transmission Mount Strut Bracket Replacement \(Front Wheel Drive\)](#)
11. Install the front tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#)
12. Lower the vehicle.

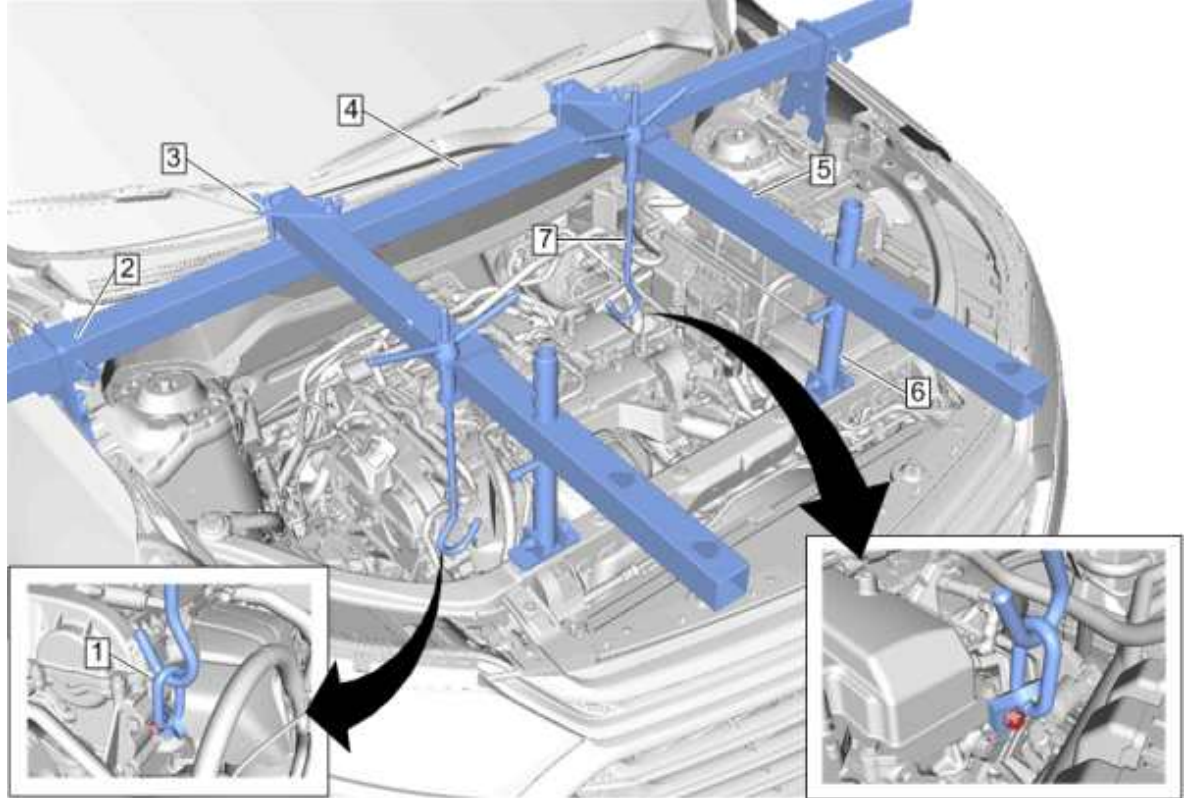


Fig. 26: Engine Support Fixture

Courtesy of GENERAL MOTORS COMPANY

13. Remove Engine Support Fixture (2). Refer to [Engine Support Fixture](#)



Fig. 27: Steering Column Dash Inner Seal

Courtesy of GENERAL MOTORS COMPANY

14. Install Steering Column Dash Inner Seal (1). Refer to [Steering Column Dash Inner Seal Replacement \(Equinox\)](#), [Steering Column Dash Inner Seal Replacement \(Terrain\)](#)
15. Program the power steering control module. Refer to [Control Module References](#)
16. Measure and adjust the wheel alignment. Refer to [Wheel Alignment Measurement](#)

STEERING LINKAGE INNER TIE ROD REPLACEMENT

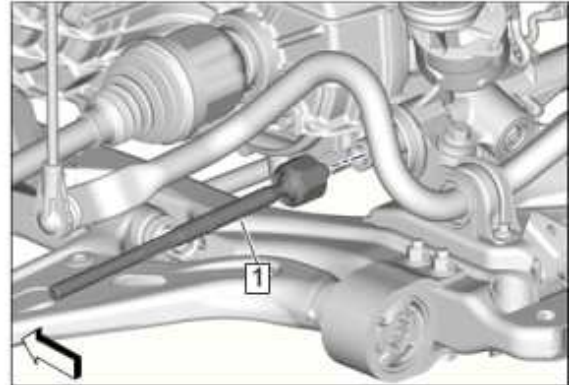


Fig. 28: Steering Linkage Inner Tie Rod
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Steering Gear Boot. Refer to Steering Gear Boot Replacement	
1	Steering Linkage Inner Tie Rod CAUTION: Refer to Component Fastener Tightening Caution . CAUTION: Holding the steering gear rack bar with anything other than a non-serrated adjustable wrench will cause damage to the steering gear 1. Cover the steering gear rack bar with a clean shop towel. 2. Hold the steering gear rack bar with a non-serrated adjustable wrench. 3. Rotate the steering linkage inner tie rod housing counterclockwise to remove the tie rod. 4. Rotate the steering linkage inner tie rod housing clockwise to install the tie rod. 5. Measure and adjust the front toe. Refer to Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment Tighten 105 N.m (77 lb ft)

STEERING GEAR DRIVE COUPLING REPLACEMENT



Fig. 29: Steering Gear Drive Coupling
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Power Steering Assist Motor. Refer to Power Steering Assist Motor Replacement	
1	Steering Gear Drive Coupling NOTE: The steering gear drive coupling connects the power steering assist motor to the steering gear.

POWER STEERING ASSIST MOTOR REPLACEMENT

Removal Procedure

CAUTION: Electrostatic discharge (ESD) can damage many solid-state electrical components. ESD susceptible components may or may not be labeled with the ESD symbol. Handle all electrical components carefully. Use the following precautions in order to avoid ESD damage:

- Touch a metal ground point in order to remove your body's static charge before servicing any electronic component; especially after sliding across the vehicle seat.
- Do not touch exposed terminals. Terminals may connect to circuits susceptible the ESD damage.
- Do not allow tools to contact exposed terminals when servicing connectors.
- Do not remove components from their protective packaging until required to do so.
- Avoid the following actions unless required by the diagnostic procedure:
 - Jumpering or grounding of the components or connectors.
 - Connecting test equipment probes to components or connectors. Connect the ground lead first when using test probes.
- Ground the protective packaging of any component before opening. Do not rest solid-state components on metal workbenches, or on top of TVs, radios, or other electrical devices.

CAUTION:

During removal and installation, all EPS components including mechanical and/or electrical is extremely susceptible to damage. Dropping or prying on any EPS component may cause internal damage. If damage occurs or a part is dropped, the EPS component must be replaced.

CAUTION:

Care must be taken during removal and installation of the Electronic Power Steering (EPS) components to not hit or break the EPS motor/controller module or module harness connectors. If the EPS motor/controller module or module connectors are damaged, the complete component must be replaced.

1. Perform the strategy based diagnosis. Performing the strategy based diagnostics includes reviewing related bulletins, preliminary information and diagnostics. Refer to [Strategy Based Diagnosis](#)

NOTE:

- The power steering control module is part of the power steering assist motor.
- If communication with the OLD power steering control module cannot be established, then replace the entire steering gear as an assembly. Do NOT proceed with replacement of just the power steering assist motor.

2. Capture the key cycle count from the OLD steering gear control module. If the key cycle count from the OLD steering gear control module is NOT captured, it will NOT be possible to flash the NEW steering gear control module. Refer to [Control Module References](#)
3. Remove Steering Gear. Refer to [Electric Dual Pinion Rack and Pinion Steering Gear Replacement](#)

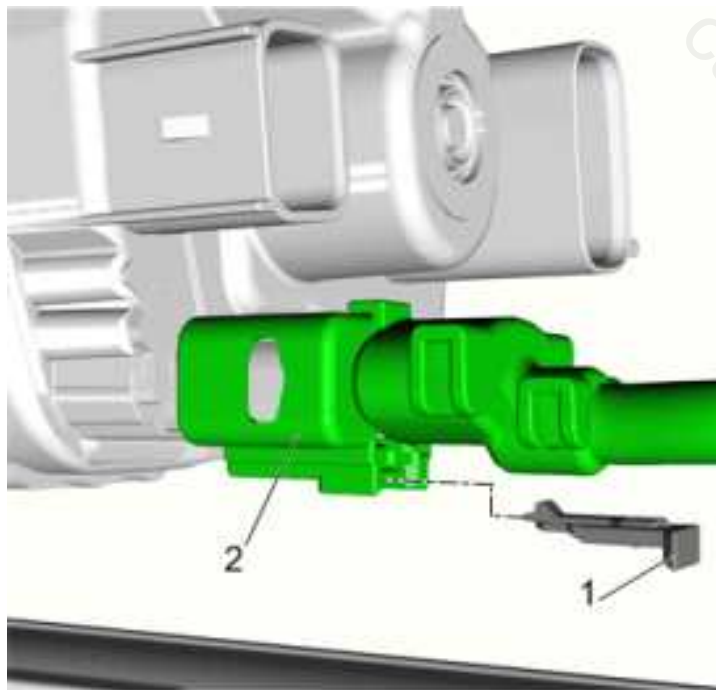


Fig. 30: Connector Position Assurance Lock And Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

CAUTION:

Do NOT pry on the Power Steering Assist Motor electrical connector. Prying on the Power Steering Assist Motor electrical connector could crack the Power Steering Assist Motor housing. If the Power Steering Assist Motor housing is cracked, the motor assembly must be replaced.

4. Remove the connector position assurance lock (1) from the electrical connector. (2)
5. Discard the connector position assurance lock (1) if damaged during removal.

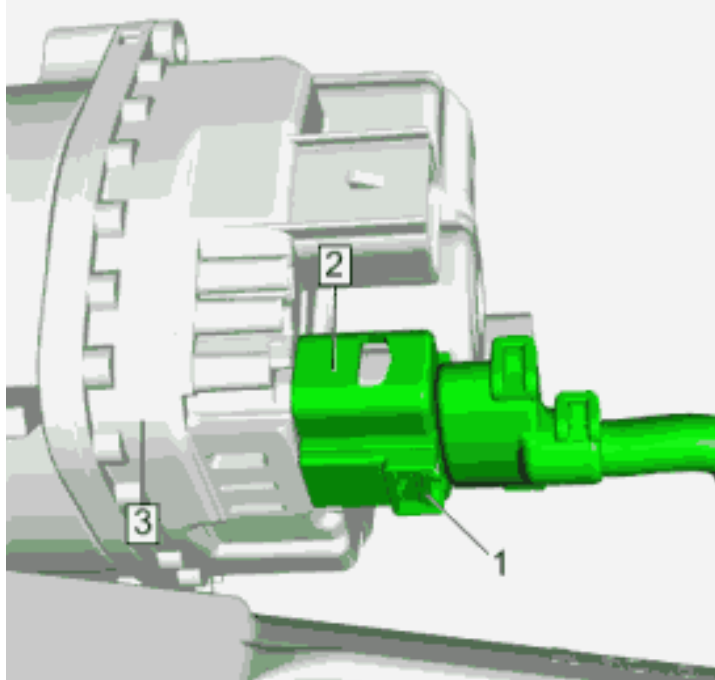


Fig. 31: Connector Tab, Electrical Connector And Power Steering Assist Motor
Courtesy of GENERAL MOTORS COMPANY

6. Depress connector tab (1) and disconnect the electrical connector (2) from the power steering assist motor. (3)

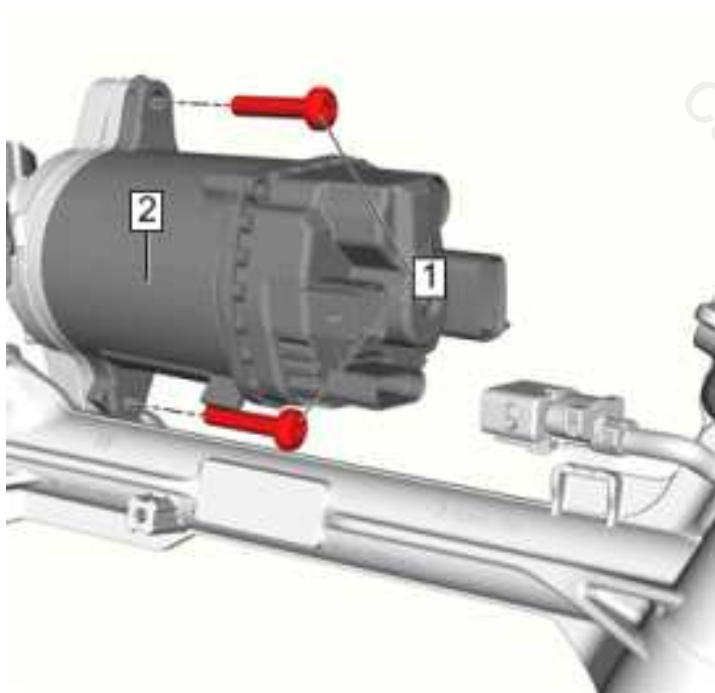


Fig. 32: Power Steering Assist Motor And Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Remove and DISCARD Power Steering Assist Motor Bolts (1) (Qty: 2)
8. Remove Power Steering Assist Motor (2)

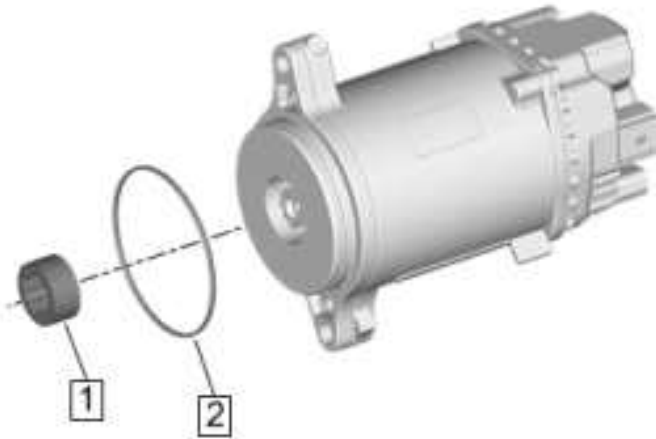


Fig. 33: Steering Gear Drive Coupling And Power Steering Assist Motor Seal
 Courtesy of GENERAL MOTORS COMPANY

9. Remove the Steering Gear Drive Coupling (1)
10. Remove and DISCARD Power Steering Assist Motor Seal (2)

NOTE:

- Inspection of the steering gear motor shaft and the inside of the steering gear housing is **REQUIRED** to ensure that there are **NO** signs of water intrusion or corrosion which **MAY** cause premature motor failure.
 - If signs of water intrusion or corrosion **ARE** present then the steering gear **MUST** be replaced.
11. Inspect the steering gear motor shaft and inside of the steering gear housing for signs of water intrusion or corrosion. If no signs of water intrusion or corrosion are present proceed to the next step. If signs of water intrusion or corrosion are present then replace the steering gear. Refer to [**Electric Dual Pinion Rack and Pinion Steering Gear Replacement**](#)

Installation Procedure

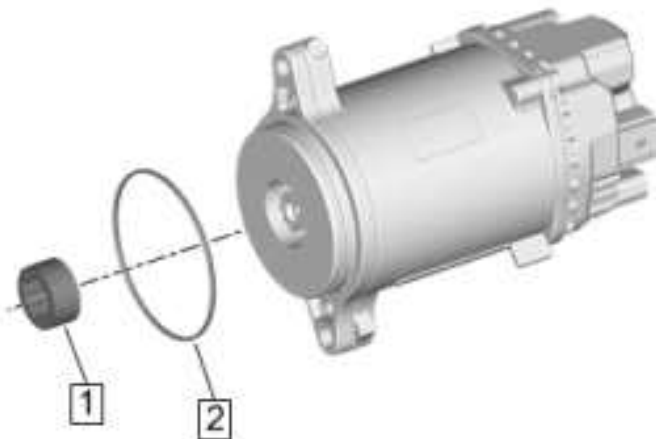


Fig. 34: Steering Gear Drive Coupling And Power Steering Assist Motor Seal
 Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW Power Steering Assist Motor Seal (2).
2. After the seal is in place on the motor, apply a thin layer of grease to the seal. Refer to Adhesives, Fluids, Lubricants, and Sealers
3. Install Steering Gear Drive Coupling (1)

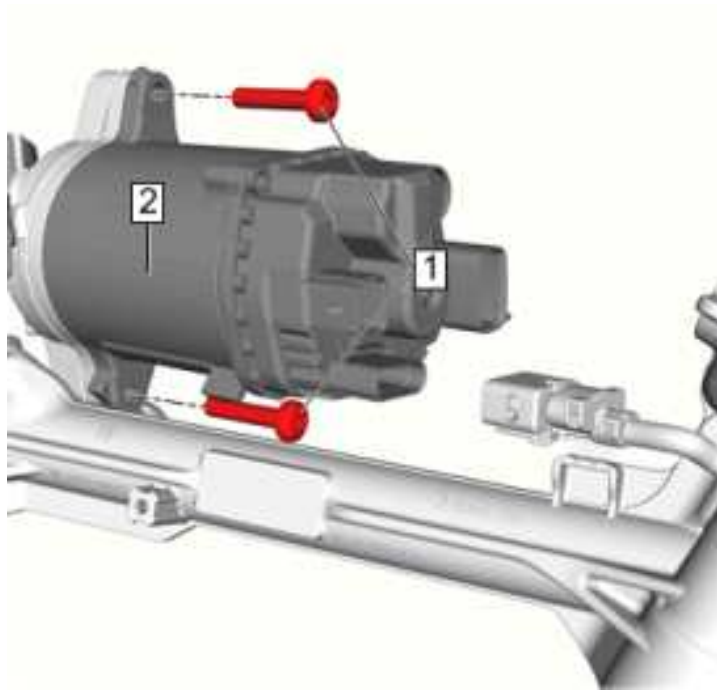


Fig. 35: Power Steering Assist Motor And Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: The steering gear drive coupling and assist motor armature should be aligned with the gear inside of the steering gear housing to aid in installation, otherwise interference MAY occur.

4. Position the power steering assist motor (2) with the steering gear housing and start the power steering assist NEW motor bolts. (1) (Qty: 2)
5. With the power steering assist motor bolt (1) started, completely install the power steering assist motor (2) to the steering gear housing.

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

6. Install and tighten NEW Power steering assist motor bolts (1) (Qty: 2) to 21 N.m (15 lb ft)

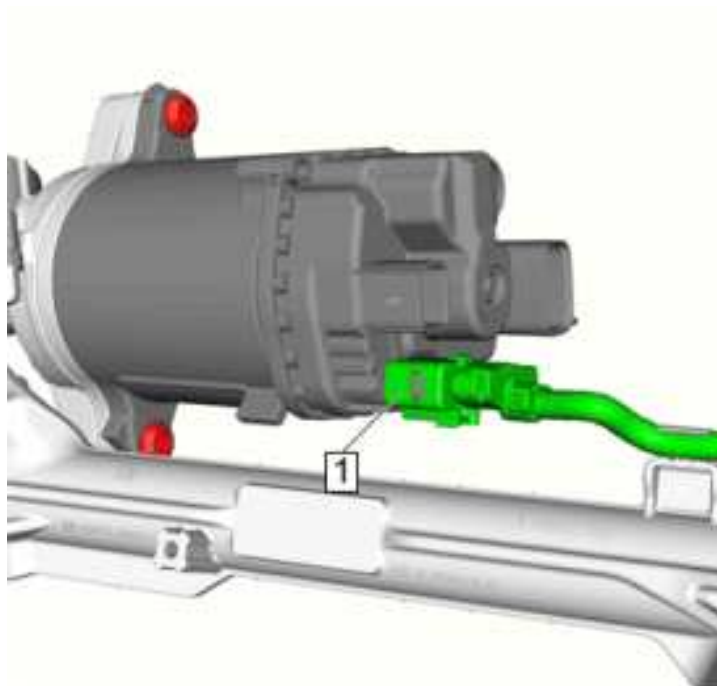


Fig. 36: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

7. Connect the electrical connector (1) to the power steering assist motor.
8. Verify connector (1) is fully seated by lightly pulling on the connector.

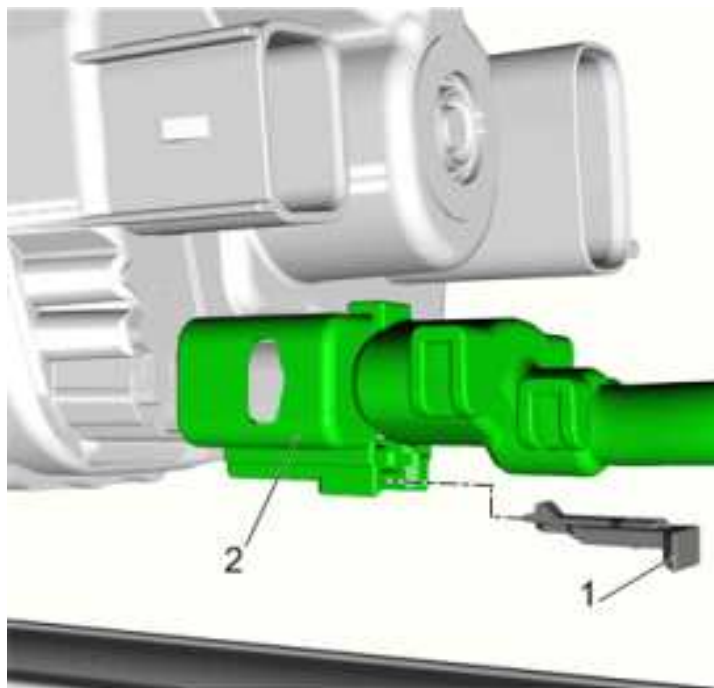


Fig. 37: Connector Position Assurance Lock And Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

9. Install the connector position assurance lock (1) into the electrical connector (2) until fully seated.
10. Install Steering Gear. Refer to [Electric Dual Pinion Rack and Pinion Steering Gear Replacement](#)
11. Transfer the key cycle count from the OLD steering gear control module to the NEW steering gear control module. Refer to [Control Module References](#)

POWER STEERING CONTROL MODULE CALIBRATION

Steering Angle Sensor Centering and Software Endstop Learning

WARNING: An inaccurate or not centered steering angle sensor could limit the operation of the electric power steering and may result in personal injury.

Centering of the steering angle sensor and software endstop learning might be required after certain service procedures are performed. Some of these procedures are as follows:

- Steering angle sensor replacement
- Steering gear replacement
- Power steering assist motor replacement
- Steering column replacement
- Steering linkage inner tie rod replacement
- Steering linkage outer tie rod replacement
- Battery Disconnect

NOTE: It is necessary to perform the steering angle sensor centering BEFORE the software endstop learning.

Steering Angle Sensor Centering

For electronic power steering equipped vehicles WITH electronic stability control program and EXTERNAL Steering Angle Sensor, refer to [Steering Wheel Angle Sensor Centering](#) .

The centering procedure of the internal steering angle sensor (w/o electronic stability program) can be completed with the following steps:

Conditions: Front axle measured and set, engine running, vehicle speed 0 km/h (0 MPH), internal steering angle sensor is activated.

1. Using the steering wheel, align the front wheels in the center forward position.
2. Using a scan tool, perform the Configuration/Reset Functions, Steering Wheel Angle Sensor Centering procedure.
3. Steer from the center position slowly 90° to the left.
4. Steer slowly back to the center position and then slowly 90° to the right.
5. Steer slowly back to the center position.
6. Perform the steering movements again.
7. Centering procedure is completed.

Software Endstop Learning

The software endstop learning procedure can be completed with the following steps:

Conditions: Front axle measured and set, vehicle speed 0 km/h (0 MPH), internal steering angle sensor is calibrated or external steering angle sensor sends a valid CAN signal.

1. Using a scan tool, perform the Configuration/Reset Functions, Power Steering Softstops Reset procedure and follow the on-screen instructions.
2. Using a scan tool, perform the Configuration/Reset Functions, Power Steering Softstops Learn procedure and follow the on-screen instructions.
3. Software endstop learning procedure is completed.

DESCRIPTION AND OPERATION

POWER STEERING SYSTEM DESCRIPTION AND OPERATION (ELECTRONIC POWER STEERING)

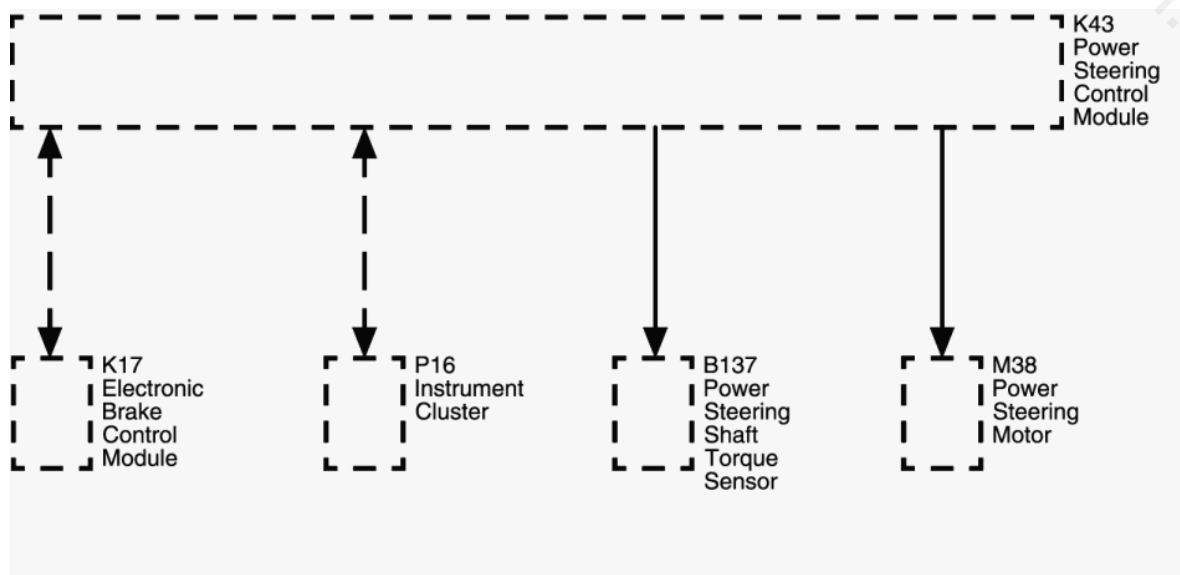


Fig. 38: Electric Power Steering System Block Diagram

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
K43	K43 Power Steering Control Module
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 consists of the following components:

- The power steering control module
- The power steering motor
- The power steering motor rotational sensor
- The torque sensor
- The steering gear (rack and dual pinion)

The rack and dual pinion electric power steering system reduces the amount of effort needed to steer the vehicle utilizing the power steering control module to control the power steering motor to maneuver the steering gear. The power steering control module also uses a combination of the torque sensor, motor rotational sensor, battery voltage circuit and GMLAN serial data circuit to perform the system functions. The power steering control module monitors vehicle speed and engine speed from the engine control module via the GMLAN serial data circuit to determine the amount of steering assist needed to steer the vehicle. At low speeds more assist is provided for easy turning during parking maneuvers. At higher speeds less assist is provided for improved road feel and directional stability.

The power steering control module uses a combination of the torque sensor, motor rotational sensor, vehicle speed, and calculated system temperature inputs to determine the amount of assist needed. The power steering control module continuously monitors the digital torque sensor's torque and index current signals. 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. The voltage signals of the motor position sensor and the digital torque sensor's index current signal are both processed by the power steering control module to detect and calculate the steering wheel angle.

The power steering control module responds to the change in the digital torque sensor signals as well as the motor rotational sensor's voltage signals by commanding current to the power steering motor. The power steering control module controls the pulse width modulated motor drive circuit to drive the 3-phase motor. The power steering control module and motor assembly is attached to the base of the steering gear housing and assists the steering gear pinion to maneuver the rack from left to right according to turning the steering wheel.

The power steering control module has the ability to calculate an internal system temperature to protect the power steering system from damage caused by high temperature. To reduce a high system temperature, the power steering control module will reduce the amount of current commanded to the power steering motor, which reduces the amount of steering assist. The power steering control module has the ability to detect malfunctions within the electric power steering system. Any malfunction detected that disables steering assist will cause the SERVICE POWER STEERING message to be displayed on the driver information center.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description

Illustration	Tool Number/Description
	CH-22610 J-22610 KM-J-22610 SA9164C Keystone Clamp Pliers

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

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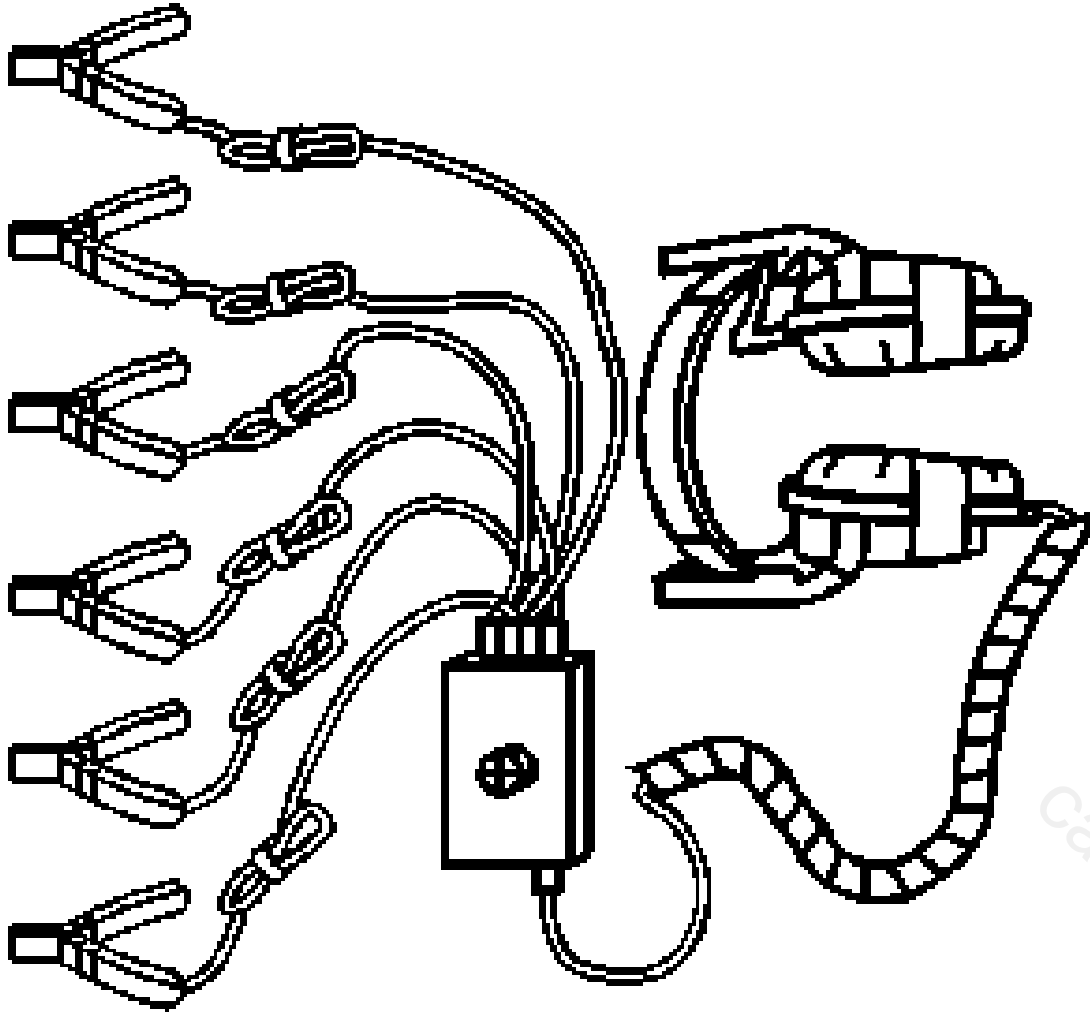
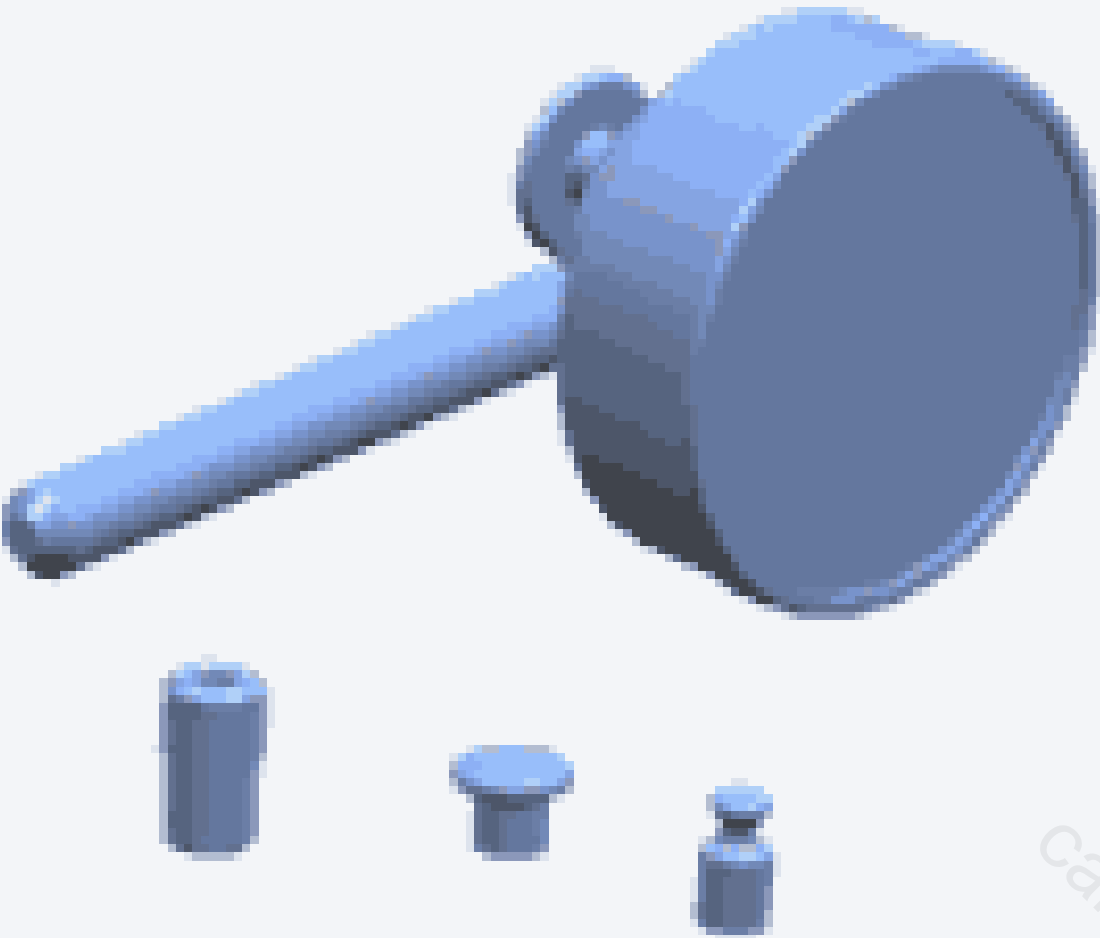
Illustration	Tool Number/Description
	CH-39570 J-39570 Chassis Ear

Illustration	Tool Number/Description
	GE-8001 J-8001 Dial Indicator Set