

STEERING

Power Steering - Canyon, Colorado

SPECIFICATIONS

FASTENER SPECIFICATIONS

Application	Specification	
	Metric	English
Power Steering Assist Motor Pivot Bolt	12 N.m	106 lb in
Steering Gear Bolt- Lower		
• First Pass:	150 N.m	111 lb ft
• Final Pass:	30-45 degrees	
Steering Gear Bolt- Upper	100 N.m	74 lb ft
Steering Gear Housing Cover Bolt	12 N.m	106 lb in
Steering Linkage Inner Tie Rod	90 N.m	66 lb ft
Steering Linkage Outer Tie Rod Nut		
• First Pass:	35 N.m	26 lb ft
• Final Pass:	85-95 degrees	

SCHEMATIC WIRING DIAGRAMS

POWER STEERING WIRING SCHEMATICS

Electric Power Steering

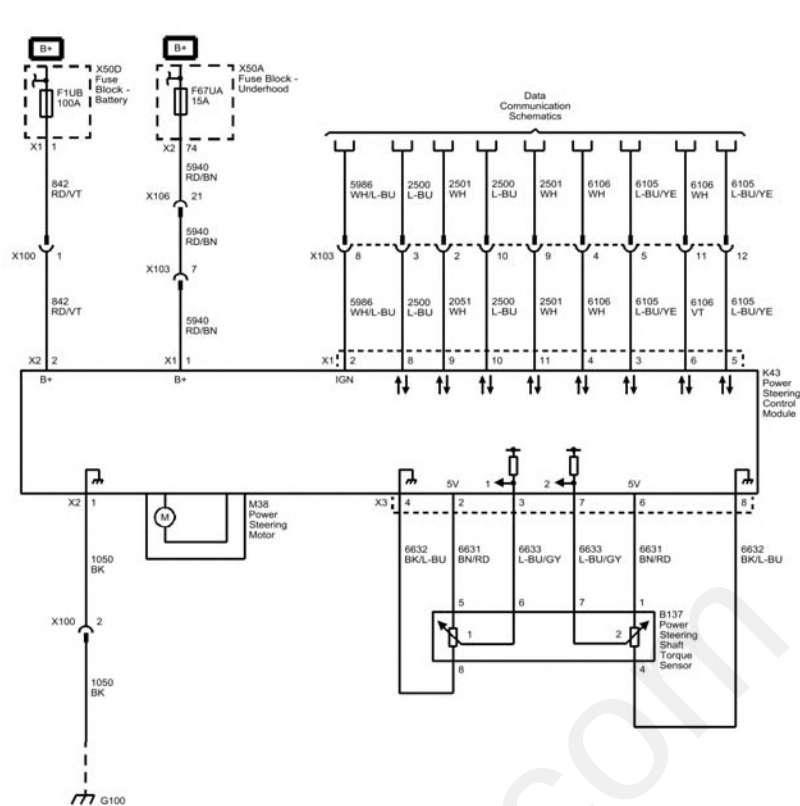


Fig. 1: Electric Power Steering

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.
- [Diagnostic Procedure Instructions](#) provides 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

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

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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

- **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 in One or Both Directions](#)
 - If steering components are mechanically binding, replace the mechanically binding steering components.
 - If no steering components are mechanically binding, replace the power steering motor control module.
 - 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.

- [Power Steering Assist Motor Replacement \(4WD\)](#)[Power Steering Assist Motor Replacement \(2WD\)](#)
- [Control Module References](#) for power steering control module replacement, programming and setup.

DTC C0460: STEERING WHEEL ANGLE 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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C0460 4B

Steering Wheel Angle Sensor Calibration Not Learned

DTC C0460 58

Steering Wheel Angle Sensor Signal Performance

DTC C0460 5A

Steering Wheel Angle Sensor Not Plausible

Circuit/System Description

The power steering control module continuously monitors the parameters of the steering gear. The power steering control module performs a self-test diagnostic during power-up to determine if the steering wheel angle sensor is configured and the signal is plausible.

Running the DTC

Ignition ON.

Conditions for Setting the DTC

C0460 4B

Steering Angle Sensor has not been properly calibrated.

C0460 58

Steering Angle sensor has a hardware failure.

C0460 5A

Steering wheel angle sensor signal is not plausible

Action Taken When the DTC Sets

- DTC C0460 is stored in memory.
- Steering assist is reduced.

Conditions for Clearing the DTC

C0460 4B

Steering Angle Sensor has been properly calibrated.

C0460 58

Steering Angle Sensor has no hardware failure.

C0460 5A

Steering Angle Sensor signal is plausible.

A history DTC will clear after 50 consecutive malfunction free ignition cycles.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Steering System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs

for Intermittent Conditions and Poor Connections

- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

DTC C0460 4B

1. Ignition ON.
2. Verify that DTC C0460 4b is not set.
 - **If the DTC C0460 4B is set**

Perform Steering Angle Sensor Centering with scan tool.

1. Verify that DTC C0460 4B is not set.
 - **If the DTC C0460 4B is set**

Replace the electronic power steering motor control module.

- **If the DTC C0460 4B did not set**

All OK.

- **If the DTC C0460 4B is not set**

3. All OK.

DTC C0460 58

1. Ignition ON.
2. Verify that DTC C0460 58 is not set.
 - **If the DTC C0460 58 is set**

Replace the Electric Belt Drive Rack and Pinion Steering Gear.

- **If the DTC C0460 58 is not set**

3. All OK.

DTC C0460 5A

1. Ignition ON.
2. Verify that DTC C0460 5A is not set.
 - **If the DTC C0460 5A is set**

Perform Steering Angle Sensor Centering with scan tool.

1. Verify that DTC C0460 5A is not set.
 - **If the DTC C0460 5A is set**

Replace the electronic power steering motor control module.

- **If the DTC C0460 5A did not set**

All OK.

2. Verify that DTC C0460 58 did not reset.

- **If the DTC C0460 58 is set**

Replace the Electric Belt Drive Rack and Pinion Steering Gear.

- **If the DTC C0460 58 did not set**

All OK.

- **If the DTC C0460 5A is not set**

3. All OK.

Repair Instructions

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

- [Power Steering Assist Motor Replacement \(4WD\)](#)[Power Steering Assist Motor Replacement \(2WD\)](#)
- [Electric Belt Drive Rack and Pinion Steering Gear Replacement \(4WD\)](#)[Electric Belt Drive Rack and Pinion Steering Gear Replacement \(2WD\)](#)
- [Control Module References](#) for power steering control module replacement, programming and setup.

DTC C0475: ELECTRIC STEERING MOTOR CIRCUIT MALFUNCTION

Diagnostic Instructions

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

DTC Descriptors

DTC C0475 00

Electric Steering Motor Circuit Malfunction

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

C is stored in memory.

- Steering assist is reduced.

Conditions for Clearing the DTC

A history DTC will clear after 50 consecutive malfunction free ignition cycles.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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 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.

- Control Module References for power steering control module programming and setup.

DTC C047A: ELECTRIC STEERING MOTOR POSITION SENSOR CIRCUIT MALFUNCTION

Diagnostic Instructions

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

DTC C047A 00

Electric Steering Motor Position Sensor Circuit Malfunction.

Circuit/System Description

The power steering control module continuously monitors the motor position sensor voltage signals. The voltage signals of the motor position sensor and the digital torque sensor index current signal are both processed by the power steering control module to detect and calculate the steering wheel angle.

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 motor position sensor circuits.

Action Taken When the DTC Sets

- No steering assist.
- The driver information center displays the SERVICE POWER STEERING warning message.

Conditions for Clearing the DTC

A history DTC will clear after 50 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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

ON.

2. Verify that DTC C047A is not set.

- **If the DTC is set**

Replace the K43 Power Steering Control Module.

- **If the DTC is not set**

3. All OK.

Repair Instructions

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

- [Power Steering Assist Motor Replacement \(4WD\)](#)[Power Steering Assist Motor Replacement \(2WD\)](#)
- [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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C0545 00

Steering Wheel Torque Sensor

Circuit/System Description

The power steering control module continuously monitors the digital torque sensors 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 steering wheel torque sensor needs to be calibrated to be fully functional.

Conditions for Running the DTC

The ignition is 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.
- The driver information center displays the SERVICE POWER STEERING warning message.
- No Steering assist.

Conditions for Clearing the DTC

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

ly DTC will clear after 40 consecutive malfunction free ignition cycles.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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 DTC C0545 is not set.

- **If the DTC is set**

NOTE: Check the torque sensor terminal connections for signs of corrosion or damage.

Replace the steering gear.

- **If the DTC is not set**

2. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Electric Belt Drive Rack and Pinion Steering Gear Replacement (4WD)Electric Belt Drive Rack and Pinion Steering Gear Replacement (2WD)
- Control Module References for control module replacement, programming and setup.

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

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.

[stic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC C056D

Electronic Control Unit Hardware

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

The internal fault detection is handled inside the power steering control module. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

The power steering control module runs the program to detect an internal fault when power up is commanded. The only requirements are voltage and ground. This program runs even if the voltage is out of the valid operating range.

Conditions for Setting the DTC

The power steering control module has detected an internal malfunction.

Action Taken When the DTC Sets

The power steering control module refuses all additional inputs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the power steering control module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the power steering control module.
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the power steering control module.
- If this DTC is retrieved as both a current and history DTC, replace the power steering control module.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

Communications 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 DTC C056D is not set.
 - If DTC C056D is set

NOTE: Check power and ground on the engine wiring harness for faulty connections or corrosion before replacing the K43 Power Steering Control Module.

Replace the K43 Power Steering Control Module.

- If DTC C056D is not set
3. All OK

[Repair Instructions](#)

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

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

DTC C056E: ELECTRONIC CONTROL UNIT HARDWARE

[Diagnostic Instructions](#)

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provide an overview of each diagnostic category.

[DTC Descriptors](#)

DTC C056E 41

Electronic Control Unit Hardware Not Programmed

DTC C056E 4B

Electronic Control Unit Hardware Calibration Not Learned

[Circuit/System Description](#)

ment of the power steering control module, the power steering control module must be configured with the proper tuning profile using the service programming system (SPS).

After replacement of the power steering control module, power steering motor, or steering gear, the steering position/torque sensor calibration procedure must be performed.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

DTC C056E 41

This DTC will set if the operational software or calibration code (tuning parameter value) does not save in Flash.

DTC C056E 4B

This DTC will set if the power steering control module, motor or torque sensor has not been calibrated using the steering position / torque sensor calibration procedure.

Actions Taken When DTC Sets

- DTC is stored in memory.
- Steering assist is set to a default level.

Conditions for Clearing the DTC

DTC C056E 41

A current or history DTC will clear after the power steering control module has been configured with the proper tuning profile.

DTC C056E 4B

A current or history DTC will clear after the steering position/torque sensor calibration procedure has been performed.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Steering System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

for Intermittent Conditions and Poor Connections

- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

DTC C056E 41

1. Ignition ON.
2. Verify that DTC C056E 41 is not set.
 - **If the DTC C056E 41 is set**
 1. Program the K43 Power Steering Control Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the K43 Power Steering Control Module.
 - If the DTC does not set
 3. All OK.
 - **If the DTC C056E 41 is not set**
3. All OK.

DTC C056E 4B

1. Ignition ON.
2. Verify that DTC C056E 4B is not set.
 - **If the DTC C056E 4B is set**
 1. Refer to Power Steering Control Module Programming and Setup and follow the steps to perform "Replace and Program Control Module."
 2. Verify the DTC does not set.
 - If the DTC sets, replace the K43 Power Steering Control Module.
 - If the DTC does not set
 3. All OK.
 - **If the DTC C056E 4B is not set**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- 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.

Action	Yes	No
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](#)
- [Poor Return of Steering Wheel](#)
- [Steering Wheel Surges/Jerks While Turning](#)
- [Steering Effort Hard 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 - Power Steering System
2	Road test the vehicle in order to verify the complaint. It may be necessary to compare to a like vehicle. Is a rattle, clunk or shudder noise present?	Go to Step 3	System OK
3	Inspect the power steering gear bushings for wear or damage. Are the power steering gear bushings worn or damaged?	Go to Step 8	Go to Step 4
4	Inspect the power steering gear fasteners for looseness. Are the power steering gear fasteners loose?	Go to Step 9	Go to Step 5
5	Inspect the steering linkage inner and outer tie rods for looseness. Refer to Steering Linkage Inner Tie Rod Inspection , and Steering Linkage Outer Tie Rod Inspection . Did you find and correct the condition?	Go to Step 12	Go to Step 6
6	Inspect the front suspension components for damage or wear. Are the front suspension components damaged or worn?	Go to Step 10	Go to Step 7
7	Inspect the intermediate steering shaft and lower steering shaft assembly for proper installation and loose or missing fasteners. Are the intermediate steering shaft and lower steering shaft assembly installed incorrectly or do they have loose or missing fasteners?	Go to Step 11	Go to Step 2
8	Replace the power steering gear. Refer to Electric Belt Drive Rack and Pinion Steering Gear Replacement (4WD) Electric Belt Drive Rack and Pinion Steering Gear Replacement (2WD) . Did you complete the repair?	Go to Step 12	-
9	Install the power steering gear fasteners correctly. Refer to Fastener Specifications .	Go to Step 12	-

	Action	Yes	No
10	Replace the damaged or worn front suspension components. Did you complete the repair?	Go to Step 12	-
11	Install the intermediate steering shaft, lower steering shaft assembly and/or fasteners correctly. Refer to Intermediate Steering Shaft Replacement , or Lower Steering Shaft Assembly Replacement . Did you complete the repair?	Go to Step 12	-
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

WHINE OR GROWL NOISE FROM THE POWER STEERING SYSTEM

Step	Action	Yes	No
1	Did you review the Power Steering System General Description and Operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Power Steering System
2	Road test the vehicle in order to verify the complaint. Is a whine or growl noise present?	Go to Step 3	System OK
3	Inspect the power steering assist motor for a whine or growl noise using the J-39570 chassis ear. Is the noise present at the power steering assist motor?	Go to Step 5	Go to Step 4
4	Inspect the power steering gear for a whine or growl noise using the J-39570 chassis ear. Is the noise present at the power steering gear?	Go to Step 6	Go to Step 3
5	Replace the power steering assist motor. Refer to Power Steering Assist Motor Replacement (4WD) Power Steering Assist Motor Replacement (2WD) . Did you complete the repair?	Go to Step 7	-
6	Replace the power steering gear. Refer to Electric Belt Drive Rack and Pinion Steering Gear Replacement (4WD) Electric Belt Drive Rack and Pinion Steering Gear Replacement (2WD) . Did you complete the repair?	Go to Step 7	-
7	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

POOR RETURN OF STEERING WHEEL

Step	Action	Yes	No
DEFINITION: After completing a turn, extra steering input is required for the steering wheel to return to center.			
1	Did you review the Power Steering System Description and Operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Power Steering System
2	Road test the vehicle in order to verify the complaint. It may be necessary to compare to a like vehicle. Does the system operate normally?	System OK	Go to Step 3

	Action	Yes	No
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 steering and suspension systems for worn or damaged components. 4. Repair as necessary. Did you find and correct the condition?	Go to Step 14	Go to Step 4
4	NOTE: The effort required to turn the belt driven electric steering gear will be harder than a hydraulic system, but the gear should rotate smoothly. Inspect the steering system for unequal effort. The vehicle must be suspended on a hoist, the engine running, and the transmission in park or neutral. Grasp the tire and wheel assembly and manually simulate a turn from the left of center and the right of center observing whether more force is needed to turn to the left or to the right. Was the tire and wheel assembly abnormally difficult to turn or was there a binding condition while turning in either direction?	Go to Step 5	Go to Step 11
5	NOTE: Position the wheels straight ahead. Do NOT rotate the steering wheel more than one complete revolution from center. 1. Lower the vehicle, but do not allow the tires to contact the ground. 2. Disconnect the intermediate steering shaft from the upper intermediate steering shaft. Refer to Intermediate Steering Shaft Replacement. 3. Note the position of the steering wheel and rotate the steering wheel ONE revolution in both directions. 4. Rotate the steering wheel back to the original position. Was the steering wheel abnormally difficult turn or was there a binding condition while turning in either direction?	Go to Step 12	Go to Step 6

	Action	Yes	No
6	1. Disconnect intermediate steering shaft from the steering gear. Refer to Intermediate Steering Shaft Replacement . 2. Inspect the intermediate steering shaft for stiff or binding joints. Replace as necessary. Did you find and complete the repair?	Go to Step 14	Go to Step 7
7	NOTE: The effort required to turn the belt driven electric steering gear will be harder than a hydraulic system, but the gear should rotate smoothly. Grasp the tire and wheel assembly and manually simulate a turn from the left of center and the right of center observing whether more force is needed or a binding condition exists while turning to the left or to the right. Was the tire and wheel assembly abnormally difficult to turn or was there a binding condition while turning in either direction?	Go to Step 8	Go to Step 2
8	1. Remove the front tire and wheel assemblies. Refer to Tire and Wheel Removal and Installation . 2. Disconnect both steering linkage outer tie rod ends from the steering knuckles. Refer to Steering Linkage Outer Tie Rod Replacement. 3. Use your hands in order to move the tie rod end studs. 4. If abnormally difficult to move, replace the tie rod end. Did you find and complete the repair?	Go to Step 14	Go to Step 9
9	Using hand's, manually simulate a turn from the left of center and the right of center observing whether more force is needed or a binding condition exists to inspect the strut, strut bearings, ball joints, or axle drive shafts for binding. Replace as necessary. Did you find and complete the repair?	Go to Step 14	Go to Step 10

	Action	Yes	No
10	NOTE: The effort required to turn the belt driven electric steering gear will be harder than a hydraulic system, but the gear should rotate smoothly. Using a wrench, turn the steering gear input shaft from the left of center and the right of center observing whether more force is needed or a binding condition exists. Was the steering gear abnormally difficult to turn or binding?	Go to Step 13	Go to Step 2
11	Inspect the wheel alignment and adjust as necessary. Refer to Wheel Alignment Measurement . Did you find and complete the repair?	Go to Step 14	-
12	Inspect the steering column and front of dash seal for a binding. If a binding is present, repair or replace the steering column or front of dash seal as necessary. Did you find and complete the repair?	Go to Step 14	-
13	Replace the steering gear. Refer to Electric Belt Drive Rack and Pinion Steering Gear Replacement (4WD) Electric Belt Drive Rack and Pinion Steering Gear Replacement (2WD) . Did you complete the repair?	Go to Step 14	-
14	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

STEERING WHEEL SURGES/JERKS WHILE TURNING

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	Road test the vehicle in order to verify the complaint. 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 steering and suspension systems for worn or damaged components. 4. Repair as necessary. Did you find and correct the condition?	Go to Step 12	Go to Step 4

Action		Yes	No
4	NOTE: Position the wheels straight ahead. Do NOT rotate the steering wheel more than one complete revolution from center. 1. Lower the vehicle, but do not allow the tires to contact the ground. 2. Disconnect the intermediate steering shaft from the upper intermediate steering shaft. Refer to Intermediate Steering Shaft Replacement . 3. Note the position of the steering wheel and rotate the steering wheel ONE revolution in both directions. 4. Rotate the steering wheel back to the original position. Was the steering wheel abnormally difficult to turn or was there a binding condition while turning in either direction?	Go to Step 10	Go to Step 5
5	1. Disconnect intermediate steering shaft from the steering gear. Refer to Intermediate Steering Shaft Replacement . 2. Inspect the intermediate steering shaft for stiff or binding joints. Replace as necessary. Did you find and complete the repair?	Go to Step 12	Go to Step 6
6	NOTE: The effort required to turn the belt driven electric steering gear will be harder than a hydraulic system, but the gear should rotate smoothly. Grasp the tire and wheel assembly and manually simulate a turn from the left of center and the right of center observing whether more force is needed or a binding condition exists while turning to the left or to the right. Was the tire and wheel assembly abnormally difficult to turn or was there a binding condition while turning in either direction?	Go to Step 7	Go to Step 2

	Action	Yes	No
7	1. Remove the front tire and wheel assemblies. Refer to Tire and Wheel Removal and Installation. 2. Disconnect both steering linkage outer tie rod ends from the steering knuckles. Refer to Steering Linkage Outer Tie Rod Replacement. 3. Use your hands in order to move the tie rod end studs. 4. If abnormally difficult to move, replace the tie rod end. Did you find and complete the repair?	Go to Step 12	Go to Step 8
8	Using hand's, manually simulate a turn from the left of center and the right of center observing whether more force is needed or a binding condition exists to inspect the strut, strut bearings, ball joints, or axle drive shafts for binding. Replace as necessary. Did you find and complete the repair?	Go to Step 12	Go to Step 9
9	NOTE: The effort required to turn the belt driven electric steering gear will be harder than a hydraulic system, but the gear should rotate smoothly. Using a wrench, turn the steering gear input shaft from the left of center and the right of center observing whether more force is needed or a binding condition exists. Was the steering gear abnormally difficult to turn or binding?	Go to Step 11	Go to Step 2
10	Inspect the steering column and front of dash seal for a binding. If a binding is present, repair or replace the steering column or front of dash seal as necessary. Did you find and complete the repair?	Go to Step 12	-
11	Replace the steering gear. Refer to Electric Belt Drive Rack and Pinion Steering Gear Replacement (4WD) Electric Belt Drive Rack and Pinion Steering Gear Replacement (2WD). Did you complete the repair?	Go to Step 12	-
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

STEERING EFFORT HARD IN ONE OR BOTH DIRECTIONS

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

	Action	Yes	No
2	Road test the vehicle in order to verify the complaint. It may be necessary to compare to a like vehicle. Is the steering effort hard in one or both directions?	Go to Step 3	System OK
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 steering and suspension systems 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	NOTE: Position the wheels straight ahead. Do NOT rotate the steering wheel more than one complete revolution from center. 1. Lower the vehicle, but do not allow the tires to contact the ground. 2. Disconnect the intermediate steering shaft from the upper intermediate steering shaft. Refer to Intermediate Steering Shaft Replacement. 3. Note the position of the steering wheel and rotate the steering wheel ONE revolution in both directions. 4. Rotate the steering wheel back to the original position. Was the steering wheel abnormally difficult to turn or was there a binding condition while turning in either direction?	Go to Step 10	Go to Step 5
5	1. Disconnect lower intermediate steering shaft from the steering gear. 2. Inspect the lower intermediate steering shaft for stiff or binding joints. Replace as necessary. Did you find and complete the repair?	Go to Step 12	Go to Step 6

Action		Yes	No
6	NOTE: The effort required to turn the belt driven electric steering gear will be harder than a hydraulic system, but the gear should rotate smoothly. Grasp the tire and wheel assembly and manually simulate a turn from the left of center and the right of center observing whether more force is needed or a binding condition exists while turning to the left or to the right. Was the tire and wheel assembly abnormally difficult turn or was there a binding condition while turning in either direction?	Go to Step 7	Go to Step 2
7	1. Remove the front tire and wheel assemblies. Refer to Tire and Wheel Removal and Installation. 2. Disconnect both steering linkage outer tie rod ends from the steering knuckles. Refer to Steering Linkage Outer Tie Rod Replacement. 3. Use your hands in order to move the tie rod end studs. 4. If abnormally difficult to move, replace the tie rod end. Did you find and complete the repair?	Go to Step 12	Go to Step 8
8	Using hand's, manually simulate a turn from the left of center and the right of center observing whether more force is needed or a binding condition exists to inspect the strut, strut bearings, ball joints, or axle driveshafts for binding. Replace as necessary. Did you find and complete the repair?	Go to Step 12	Go to Step 9
9	NOTE: The effort required to turn the belt driven electric steering gear will be harder than a hydraulic system, but the gear should rotate smoothly. Using a wrench, turn the steering gear input shaft from the left of center and the right of center observing whether more force is needed or a binding condition exists. Was the steering gear abnormally difficult to turn or binding?	Go to Step 11	Go to Step 2
10	Inspect the steering column and front of dash seal for a binding. If a binding is present, repair or replace the steering column or front of dash seal as necessary.	Go to Step 12	-

Splice Sleeve Color	Action	Crimp Tool Nest Color	Yes	No	Wire Gauge mm ² / (AWG)
11	Replace the steering gear. Refert Electric Belt Drive Rack and Pinion Steering Gear Replacement (4WD)Electric Belt Drive Rack and Pinion Steering Gear Replacement (2WD). Did you complete the repair?	3 Crimp Nests	Go to Step 12		-
12	Operate the system in order to verify the repair. Did you correct the condition?		System OK		Go to Step 3

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.

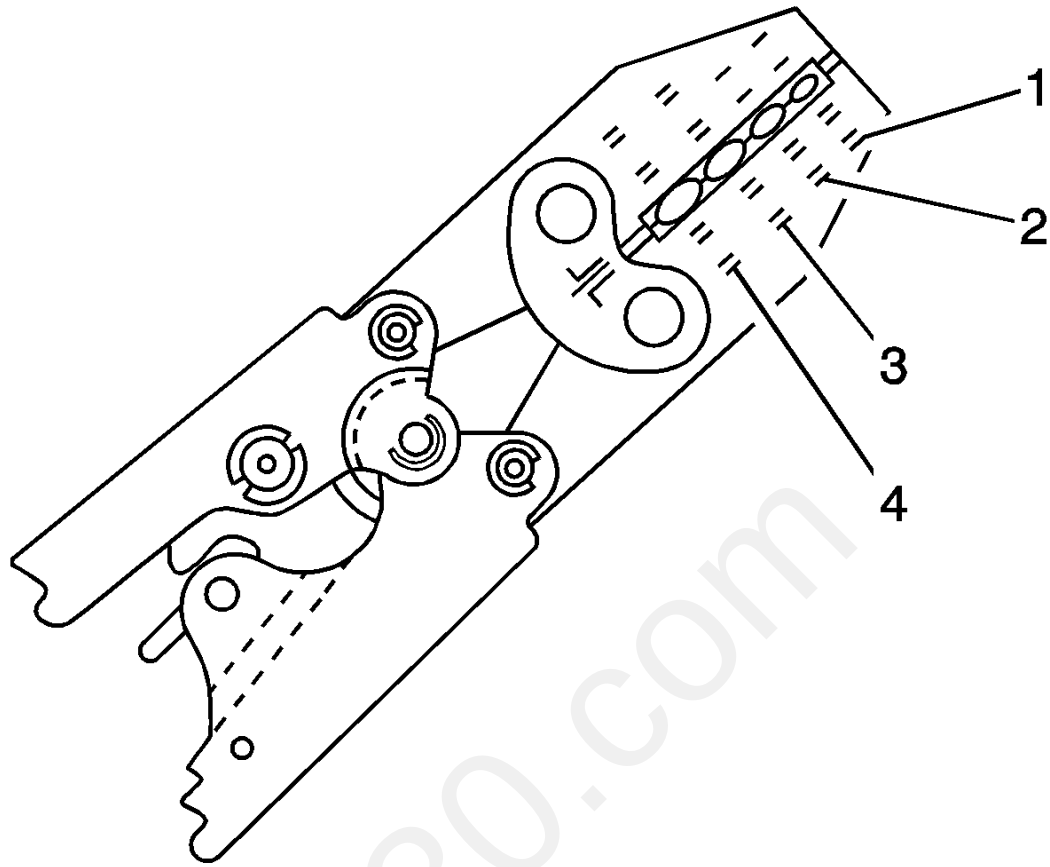


Fig. 2: Crimping Tool

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.

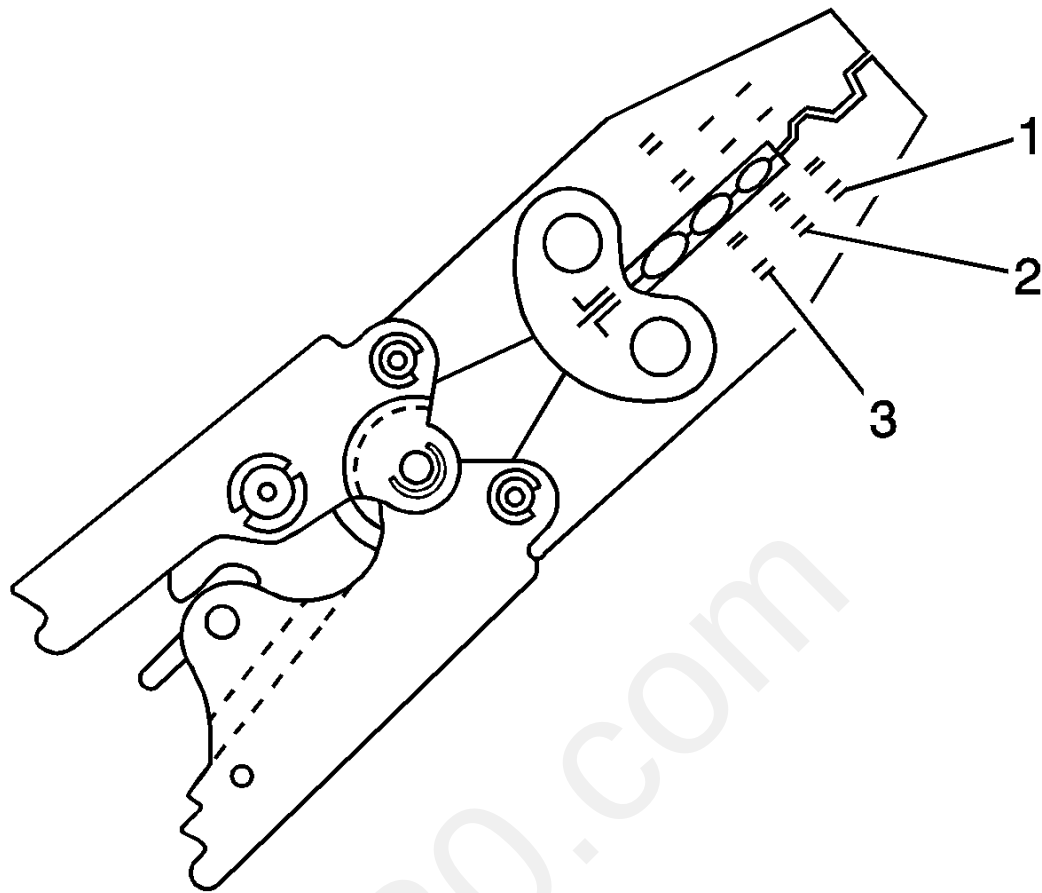


Fig. 3: Identifying Splice Crimp Tool Nests Terminal Identification
 Courtesy of GENERAL MOTORS COMPANY

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).

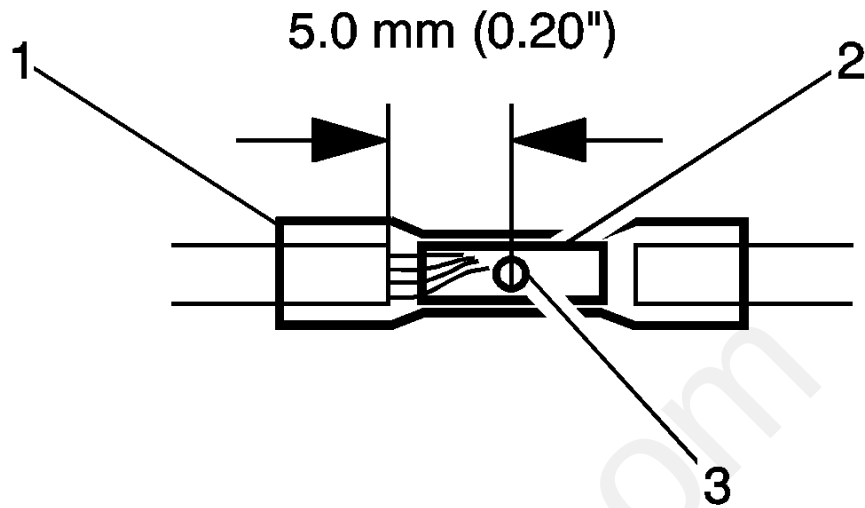


Fig. 4: Identifying Duraseal Splice Sleeve

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: Crimped Duraseal 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.

ie 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.

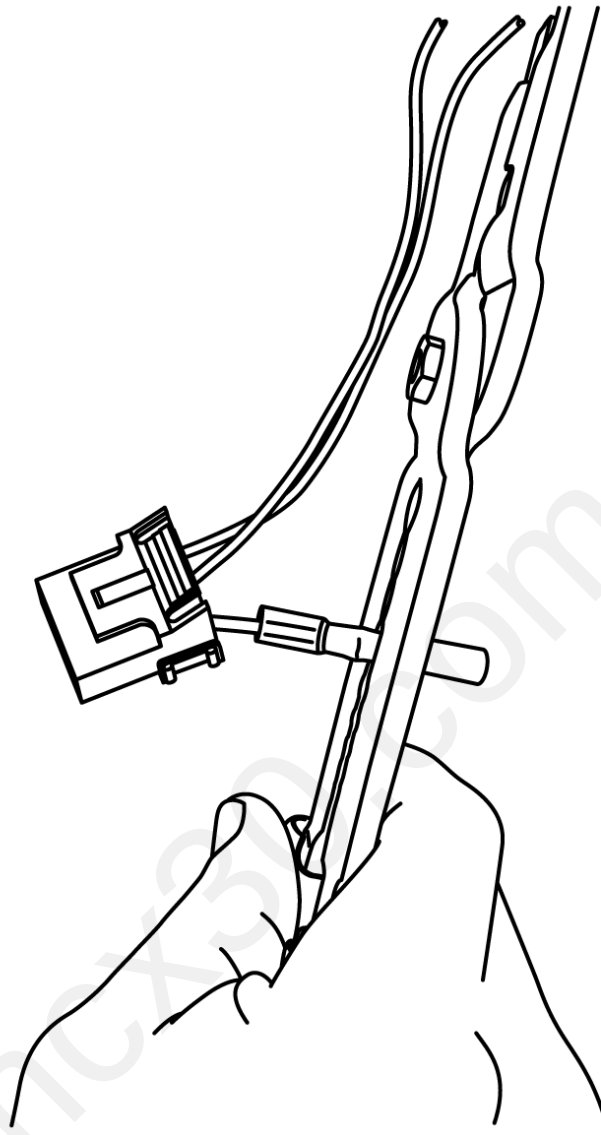


Fig. 7: Tightly Close Handles Of Crimp Tool
Courtesy of GENERAL MOTORS COMPANY

- 2.
3. 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.

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

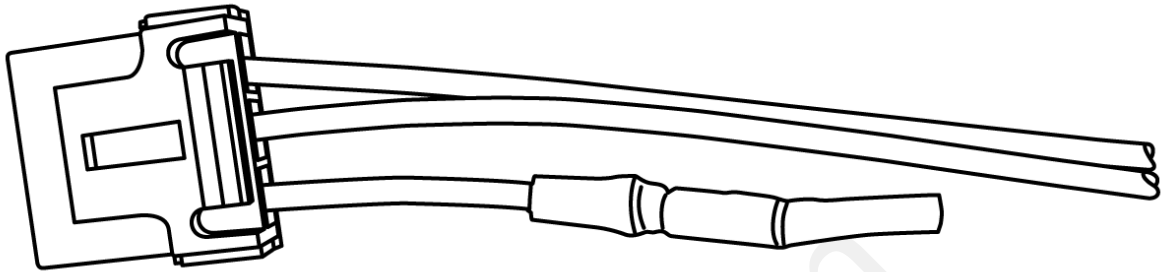


Fig. 8: Applying Heat To Crimped Area Of Barrel
Courtesy of GENERAL MOTORS COMPANY

5. 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.

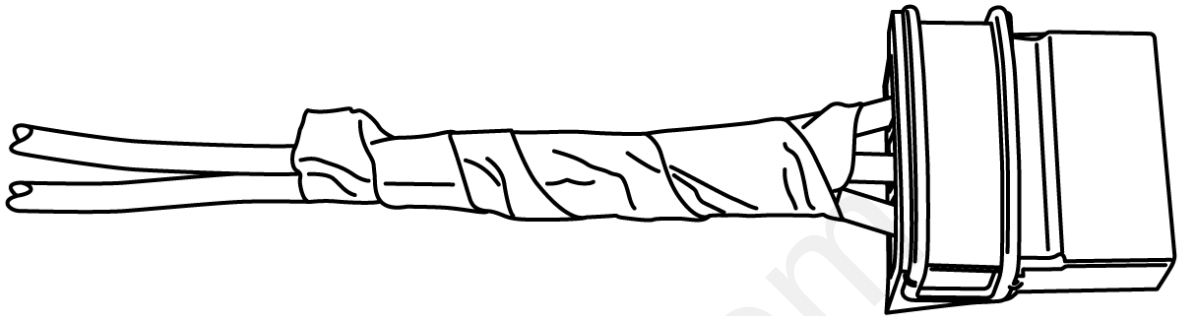


Fig. 9: Taping Extra Terminated Leads Back Into Harness
Courtesy of GENERAL MOTORS COMPANY

6. 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

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:

- Wiring broken inside the insulation
- Poor connection between the male and female terminal at a connector
- 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.

n 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](#) .
- 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. Inspect the connections at the component and

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](#) .

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.

Electromagnetic Interference and Electrical Noise

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.

: **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.

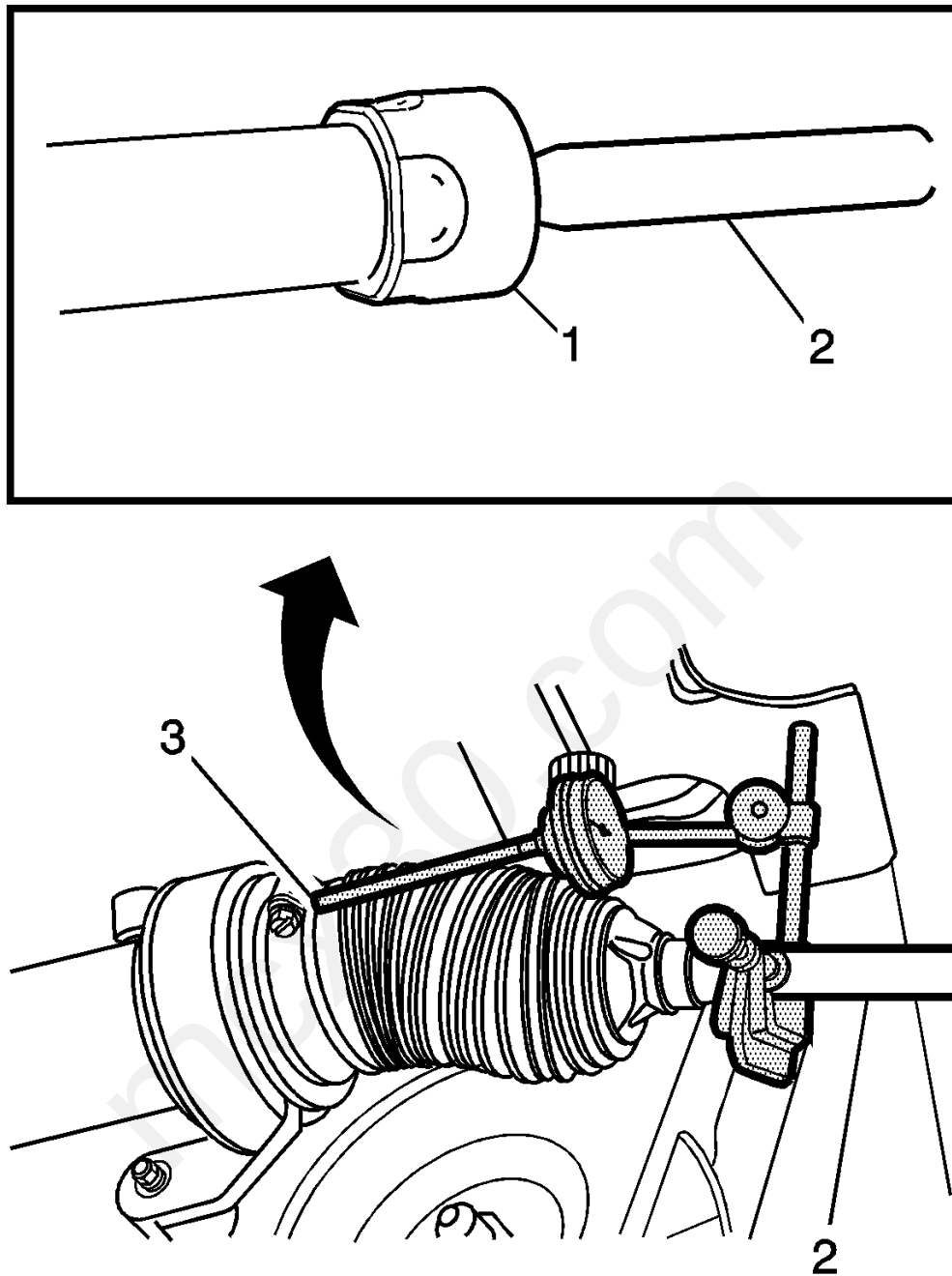


Fig. 10: Measuring Lash Between Inner Tie Rod & Steering Gear Housing
Courtesy of GENERAL MOTORS COMPANY

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](#) .

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.

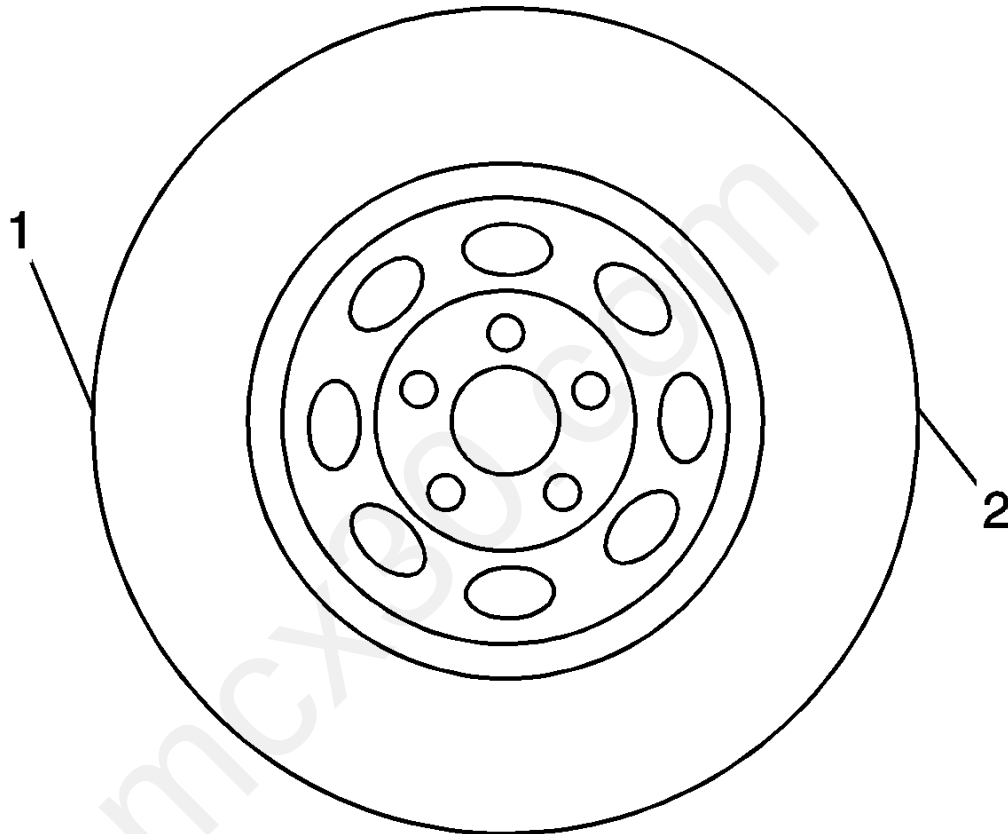


Fig. 11: Identifying Tire Grasping Positions

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**.

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](#).

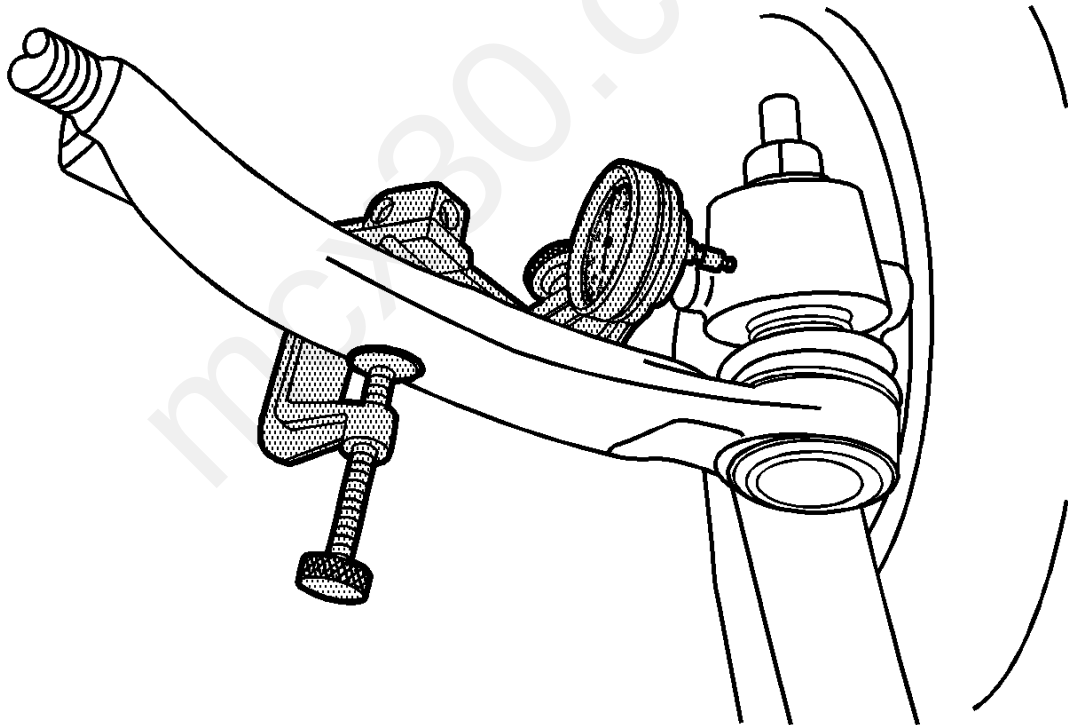


Fig. 12: Measuring Outer Tie Rod Lash
Courtesy of GENERAL MOTORS COMPANY

he **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.

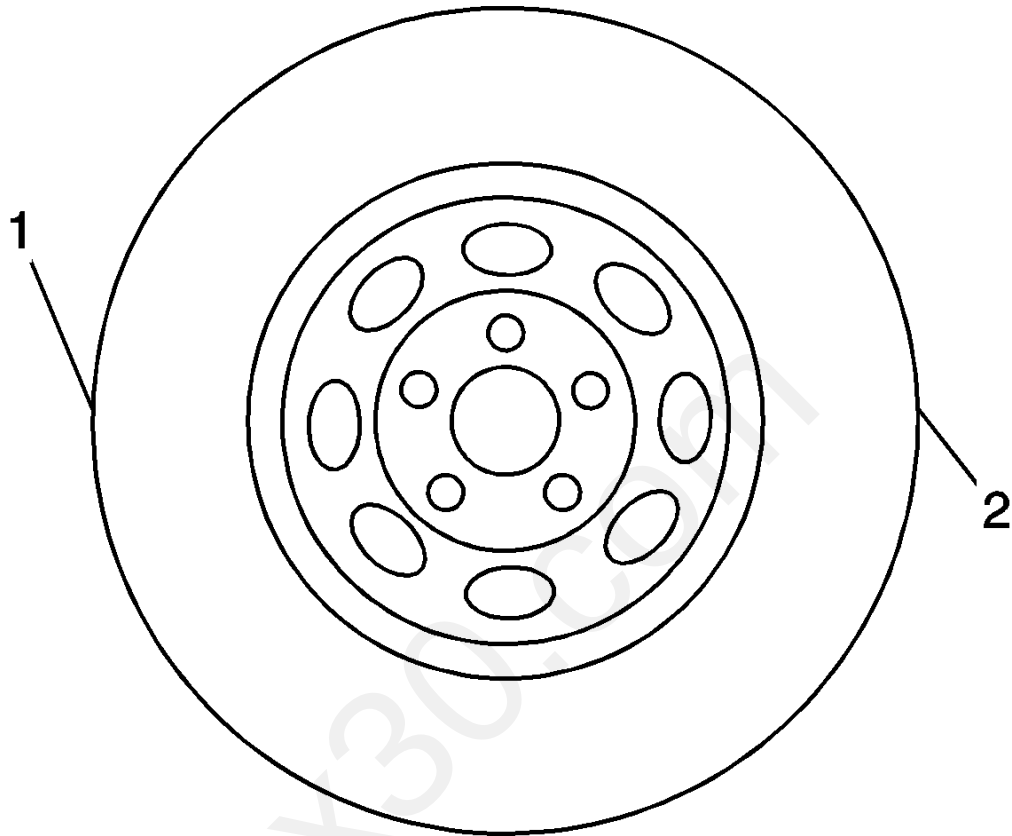


Fig. 13: Identifying Tire Grasping Positions

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

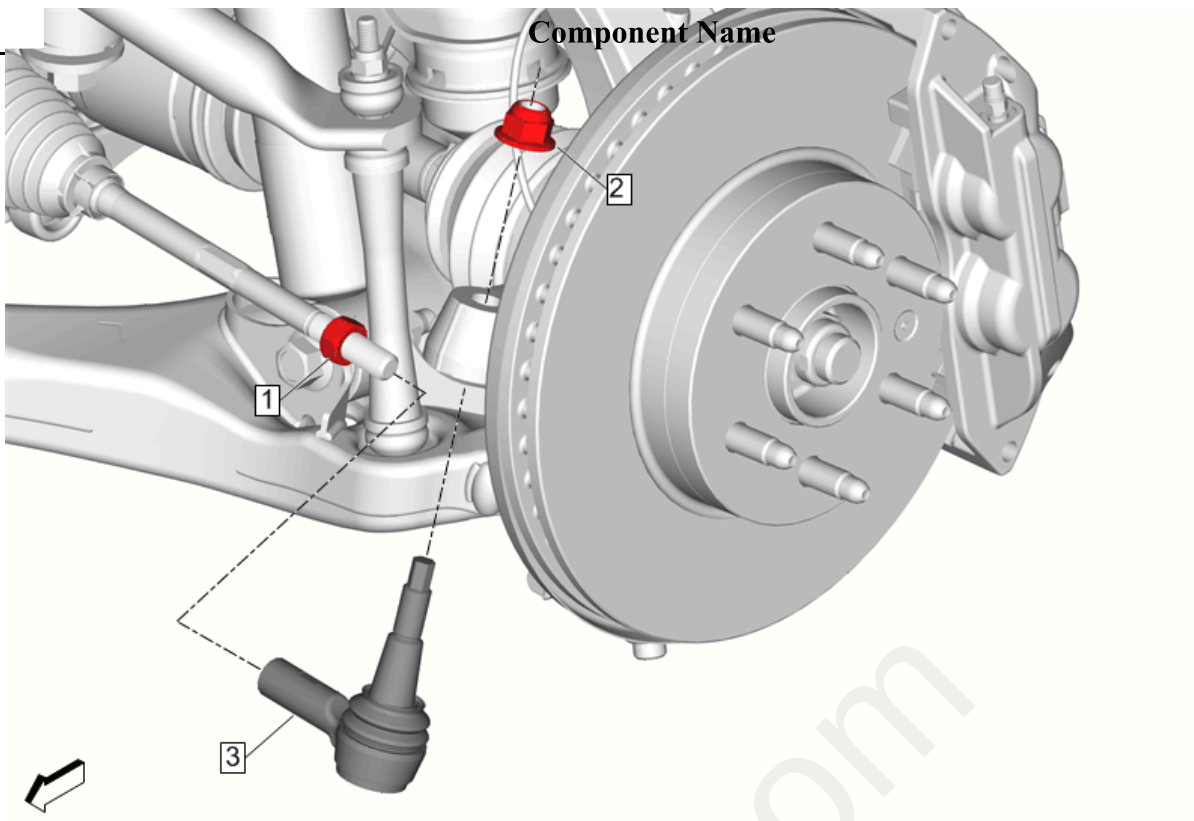


Fig. 14: Steering Linkage Outer Tie Rod
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the front tire and wheel assembly. 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 . Procedure Use the EN-45059 meter to tighten the steering linkage outer tie rod nut. Tighten First Pass: 35 N.m (26 lb ft) Final Pass: (85-95 degrees) Special Tools EN-45059 Torque Angle Meter Equivalent regional tools: Special Tools

Steering Gear Boot Outer Clamp

Courtesy of GENERAL MOTORS COMPANY

NOTE: Place match marks on the steering linkage inner tie rod nut and the steering linkage inner tie rod.

2. Remove Steering Linkage Inner Tie Rod Nut (1)
3. Remove Steering Gear Boot Outer Clamp (2)

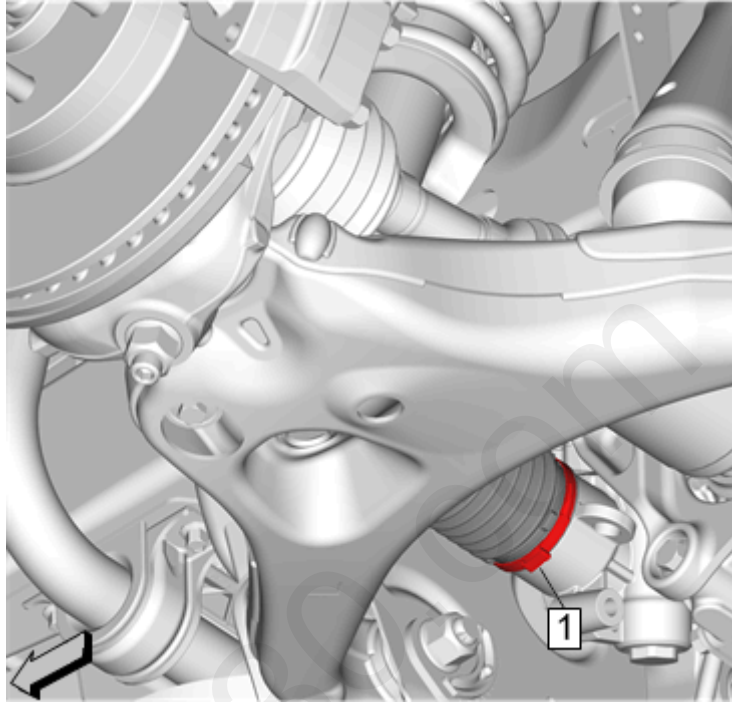


Fig. 16: Steering Gear Boot Inner Clamp

Courtesy of GENERAL MOTORS COMPANY

4. Remove Steering Gear Boot Inner Clamp (1).

DISCARD the clamp.

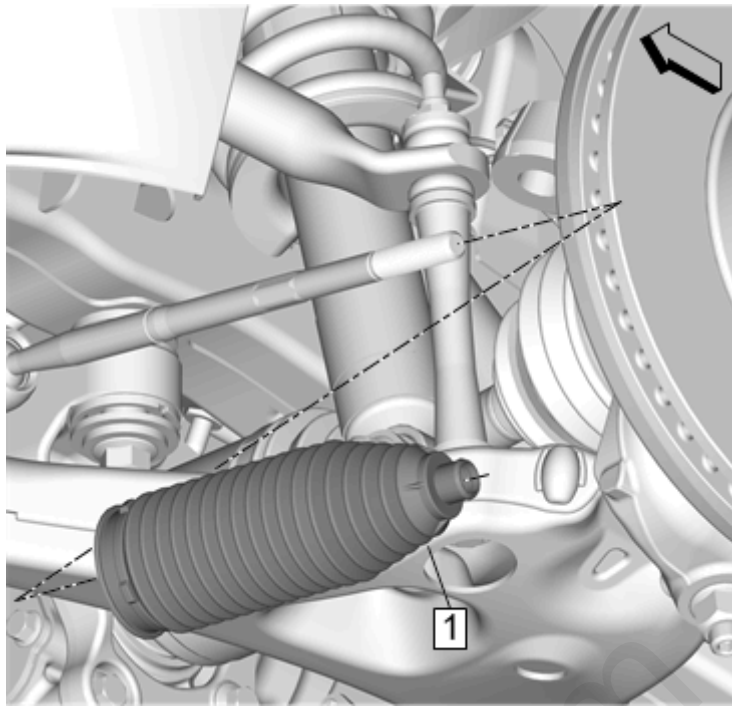


Fig. 17: Steering Gear Boot

Courtesy of GENERAL MOTORS COMPANY

5. Remove the steering gear boot (1) from the steering gear.

Installation Procedure

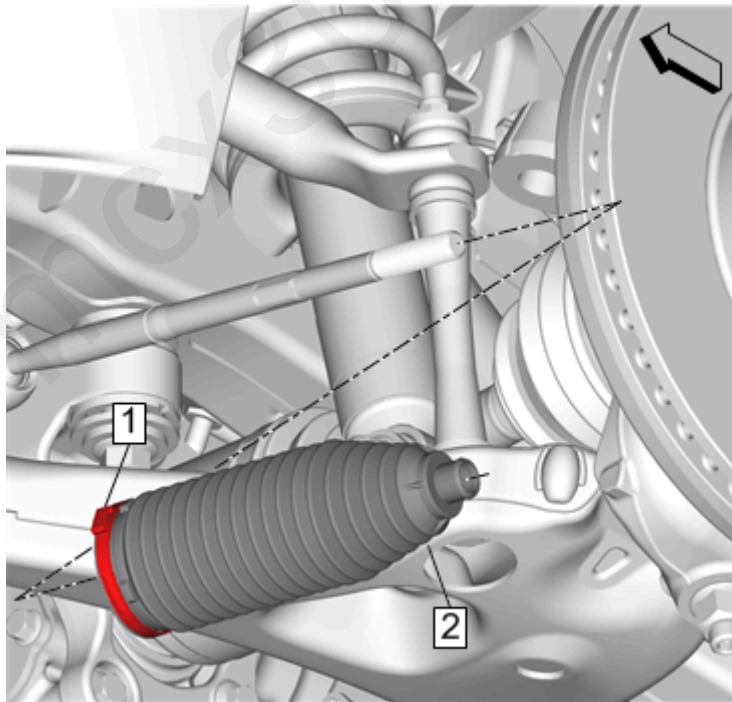


Fig. 18: Steering Gear Boot Inner Clamp

Courtesy of GENERAL MOTORS COMPANY

1. Position a NEW steering gear boot inner clamp (1) on the steering gear boot (2).
2. Position the steering gear boot (2) on the steering gear.

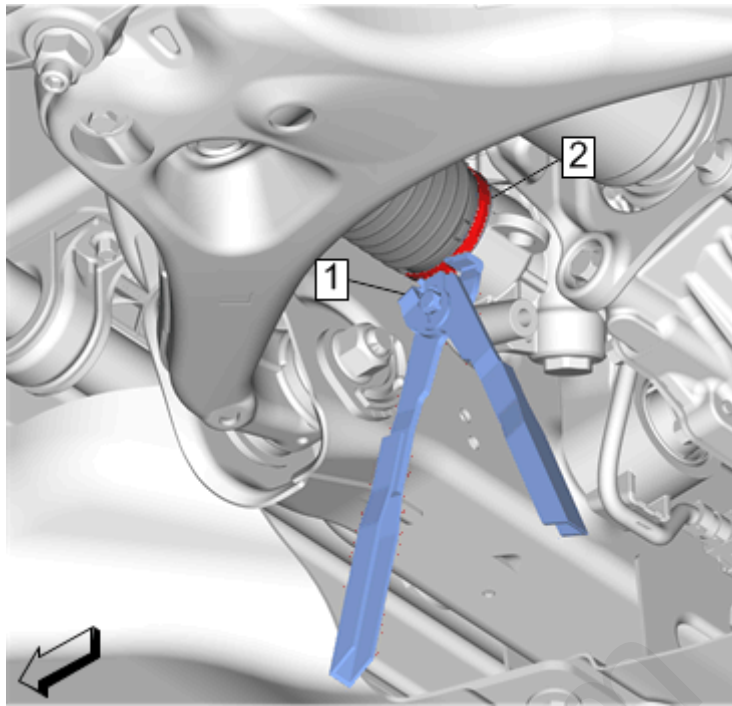


Fig. 19: J-22610 Pliers To Tighten Steering Gear Boot Inner Clamp
 Courtesy of GENERAL MOTORS COMPANY

3. Use the **CH-22610** pliers (1) to tighten the steering gear boot inner clamp (2).

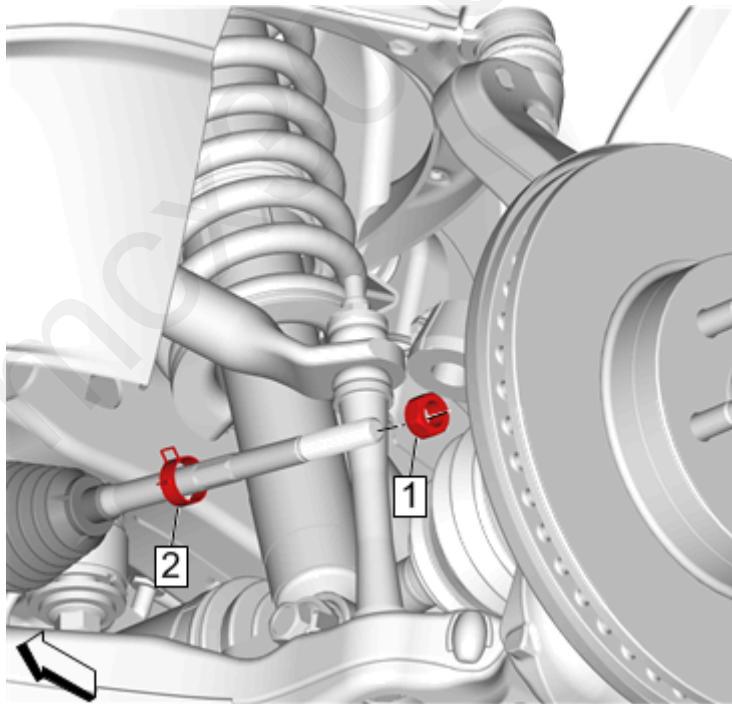


Fig. 20: Steering Gear Boot Outer Clamp
 Courtesy of GENERAL MOTORS COMPANY

4. Install Steering Gear Boot Outer Clamp (2).
5. Install Steering Linkage Inner Tie Rod Nut (1).
6. Install Steering Linkage Outer Tie Rod. **Steering Linkage Outer Tie Rod Replacement**
7. Measure and adjust the front toe. **Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment**

BELT DRIVE RACK AND PINION STEERING GEAR REPLACEMENT (4WD)

Special Tools

EN-45059 Torque Angle Meter

Equivalent regional tools: [Special Tools](#)

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 steering wheel in the straight ahead position, LOCK the steering column.
2. Remove the front tire and wheel assemblies. [Tire and Wheel Removal and Installation](#)

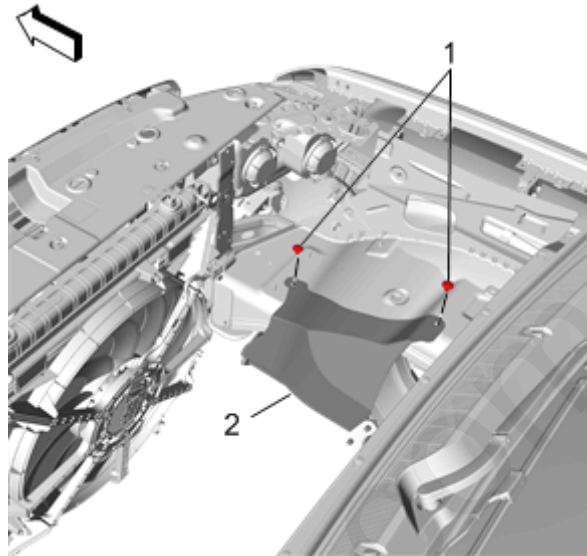


Fig. 21: Engine Front Splash Shield

Courtesy of GENERAL MOTORS COMPANY

3. Remove Engine Front Splash Shield (2). [Engine Front Splash Shield Replacement](#)

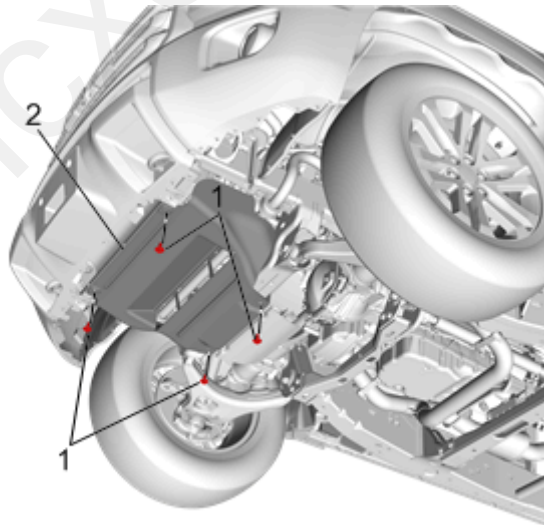


Fig. 22: Underbody Splash Shield

Courtesy of GENERAL MOTORS COMPANY

4. Remove Underbody Splash Shield (2). [Underbody Splash Shield Replacement](#)

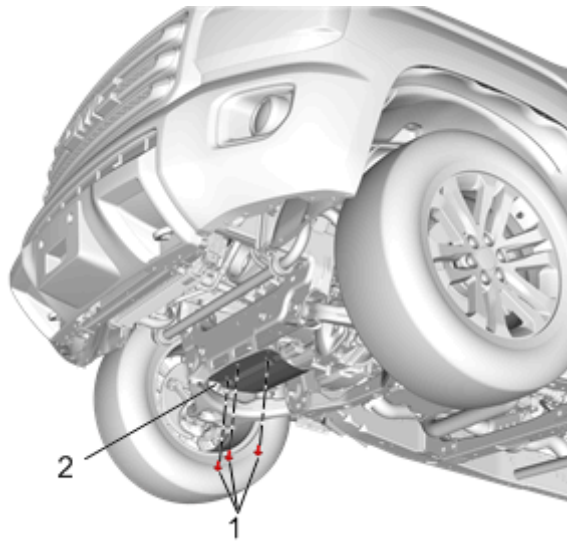


Fig. 23: Steering Gear Skid Shield

Courtesy of GENERAL MOTORS COMPANY

5. Remove Steering Gear Skid Shield (2). **Steering Gear Skid Shield Replacement**

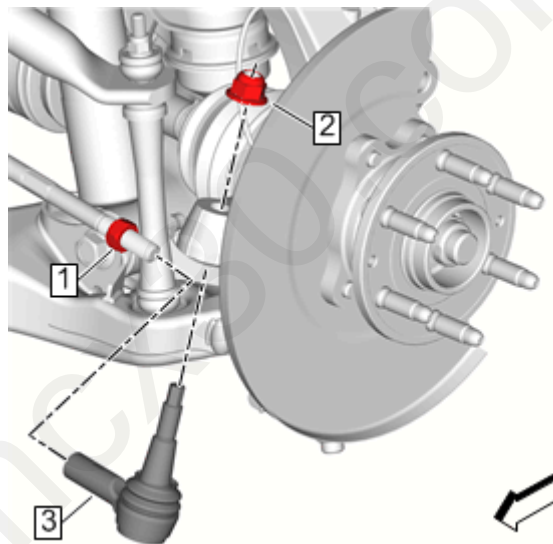


Fig. 24: Steering Linkage Outer Tie Rod

Courtesy of GENERAL MOTORS COMPANY

6. Separate Steering Linkage Outer Tie Rod (3) @Steering Knuckle. **Steering Linkage Outer Tie Rod Replacement**

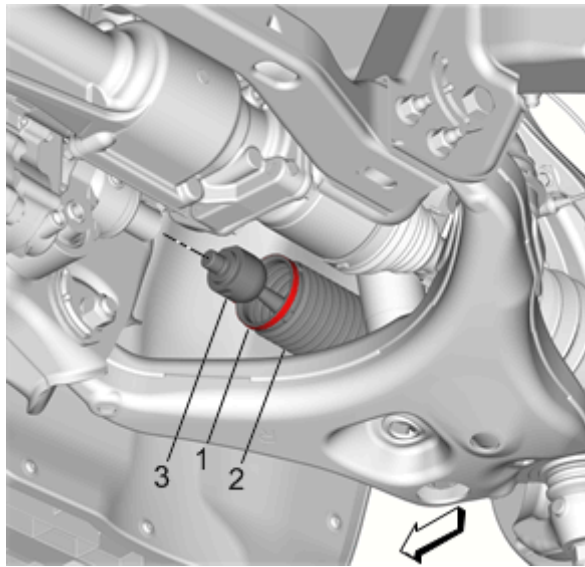


Fig. 25: Steering Gear Boot Inner Clamp

Courtesy of GENERAL MOTORS COMPANY

7. On the right side of the vehicle, remove the steering gear boot inner clamp (1).

DISCARD the clamp.

8. Loosen the steering gear boot outer clamp and move the steering gear boot (2) outward to expose the steering linkage inner tie rod at the steering gear. [Steering Gear Boot Replacement](#)
9. Separate the steering linkage inner tie rod (3) from the steering gear and remove it from the vehicle. [Steering Linkage Inner Tie Rod Replacement](#)
10. Disconnect the vehicle wiring harnesses from the steering gear and the front drive axle and set aside.
11. Place match marks on the intermediate steering shaft and the lower steering shaft assembly to aid in installation.

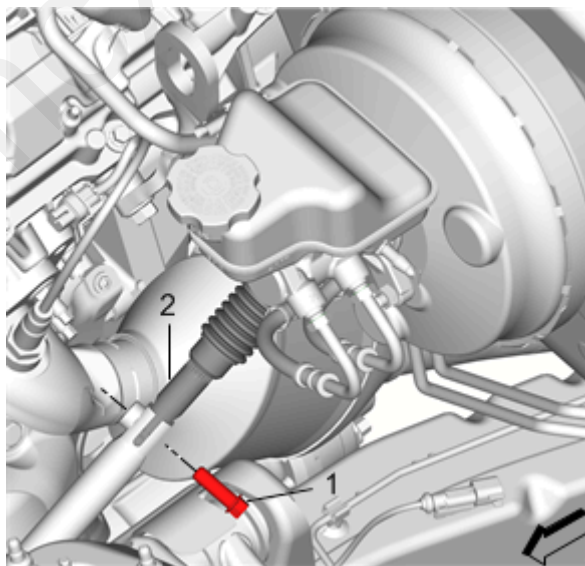


Fig. 26: Intermediate Steering Shaft Lower Bolt

Courtesy of GENERAL MOTORS COMPANY

12. Separate Intermediate Steering Shaft (3) @Lower Steering Shaft Assembly. [Lower Steering Shaft Assembly Replacement](#)

: the steering gear assembly with a suitable support.

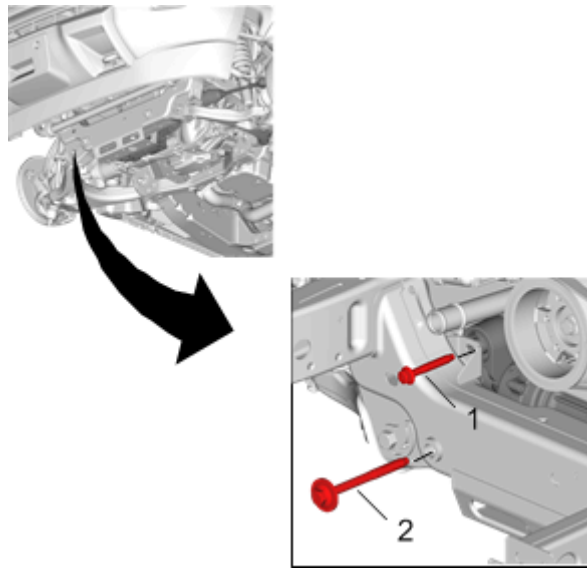


Fig. 27: Upper Steering Gear Bolt
Courtesy of GENERAL MOTORS COMPANY

14. On the right side of the vehicle, remove the upper steering gear bolt (1) and the lower steering gear bolt (2).

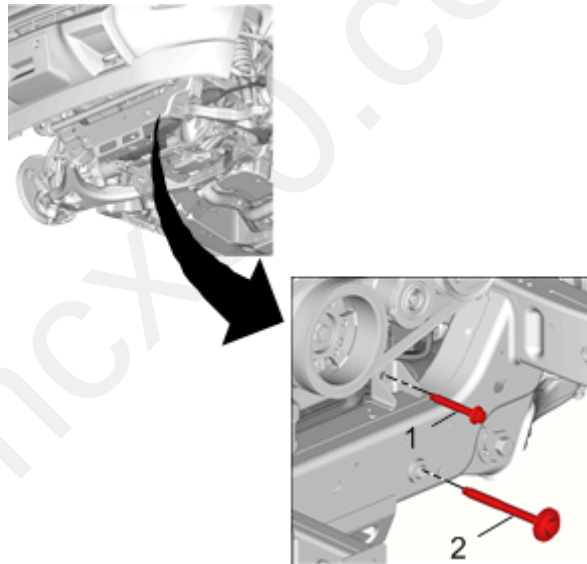


Fig. 28: Upper Steering Gear Bolt
Courtesy of GENERAL MOTORS COMPANY

15. On the left side of the vehicle, remove the upper steering gear bolt (1) and the lower steering gear bolt (2).

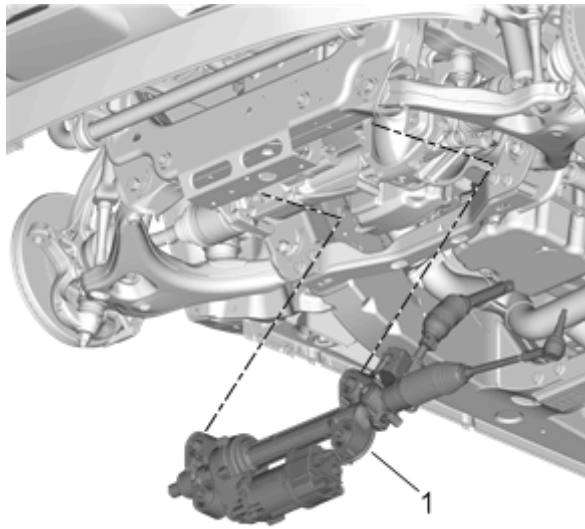


Fig. 29: Steering Gear

Courtesy of GENERAL MOTORS COMPANY

16. With the assistance of a helper, remove the support and rotate the steering gear (1) toward the front of the vehicle until the steering gear shaft and lower steering shaft assembly are vertical.
17. Carefully remove the steering gear (1) from the vehicle.
18. Transfer components as necessary.

Installation Procedure

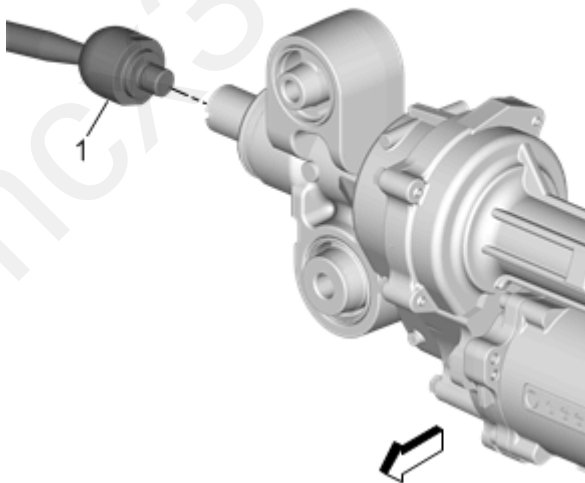


Fig. 30: Right Side Steering Linkage Inner Tie Rod

Courtesy of GENERAL MOTORS COMPANY

1. If replacing the steering gear, remove the right side steering linkage inner tie rod (1). **Steering Linkage Inner Tie Rod Replacement**

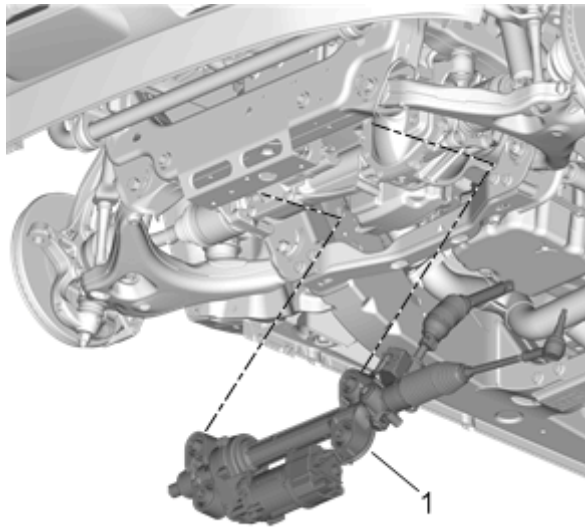


Fig. 31: Steering Gear

Courtesy of GENERAL MOTORS COMPANY

2. With the assistance of a helper, hold the steering gear (1) with the steering gear shaft and lower steering shaft assembly vertical.
3. Carefully position the steering gear (1) on the vehicle and support the assembly with a suitable support.

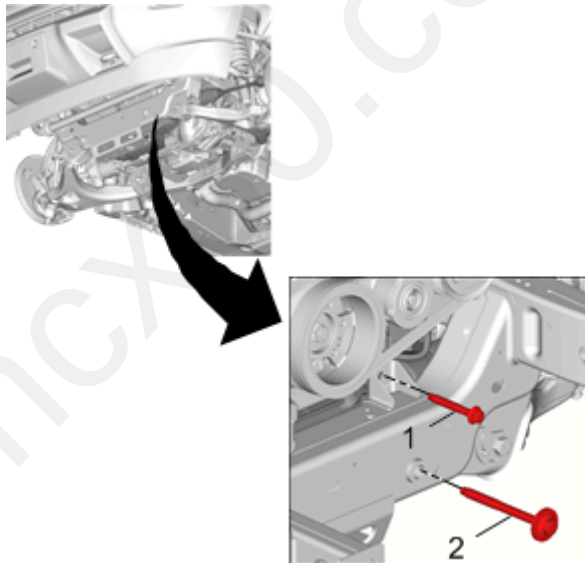


Fig. 32: Upper Steering Gear Bolt

Courtesy of GENERAL MOTORS COMPANY

4. On the left side of the vehicle, loosely install the lower steering gear bolt (2) and the upper steering gear bolt (1).

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

5. After all steering gear bolts are installed, tighten the upper steering gear bolt (1) to 100 N.m (74 lb ft).
6. After all steering gear bolts are installed, use the **EN-45059** meter to tighten the lower steering gear bolt (2).

Tighten

1. First Pass: 150 N.m (111 lb ft)

inal Pass: (30-45 degrees)

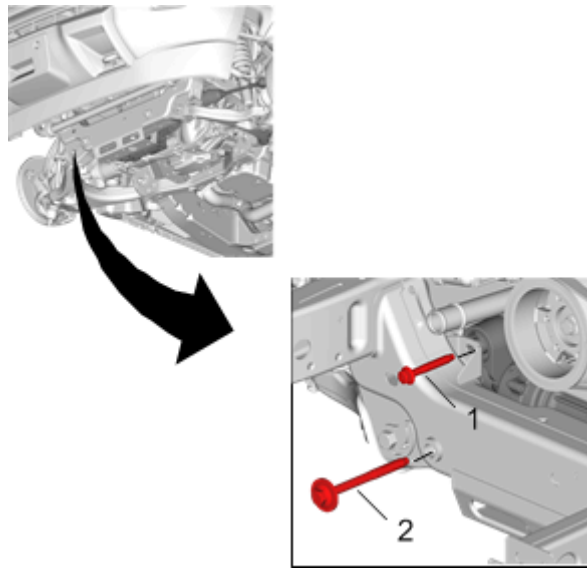


Fig. 33: Upper Steering Gear Bolt

Courtesy of GENERAL MOTORS COMPANY

7. On the right side of the vehicle, loosely install the lower steering gear bolt (2) and the upper steering gear bolt (1).
8. After all steering gear bolts are installed, tighten the upper steering gear bolt (1) to 100 N.m (74 lb ft).
9. After all steering gear bolts are installed, use the **EN-45059** meter to tighten the lower steering gear bolt (2).

Tighten

1. First Pass: 150 N.m (111 lb ft)
 2. Final Pass: (30-45 degrees)
10. Remove the support from underneath the vehicle.
 11. Connect the vehicle wiring harnesses to the steering gear and the front drive axle.

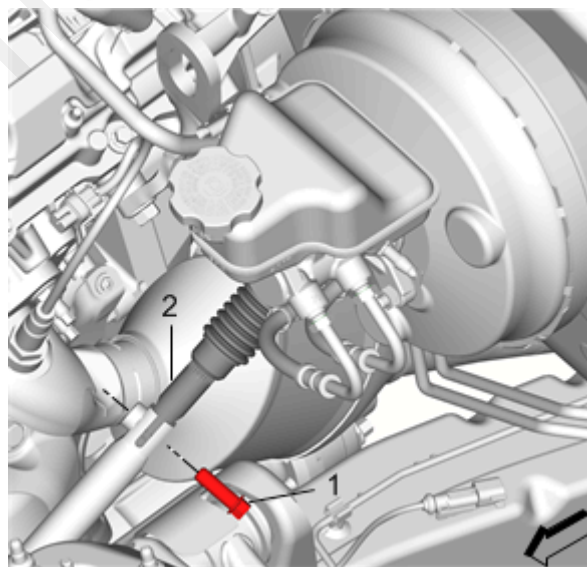


Fig. 34: Intermediate Steering Shaft Lower Bolt

Courtesy of GENERAL MOTORS COMPANY

Intermediate Steering Shaft (2) @Lower Steering Shaft Assembly.[Lower Steering Shaft Assembly Replacement](#)

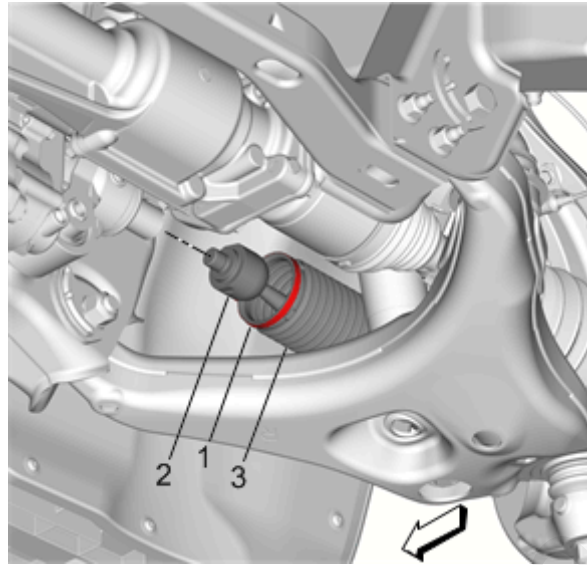


Fig. 35: Steering Gear Boot Inner Clamp
Courtesy of GENERAL MOTORS COMPANY

13. On the right side of the vehicle, position a NEW steering gear boot inner clamp (1) onto the steering gear boot.
14. Install the steering linkage inner tie rod (2). [Steering Linkage Inner Tie Rod Replacement](#)
15. Install the steering gear boot (3) and secure the outer and inner steering gear boot clamps. [Steering Gear Boot Replacement](#)

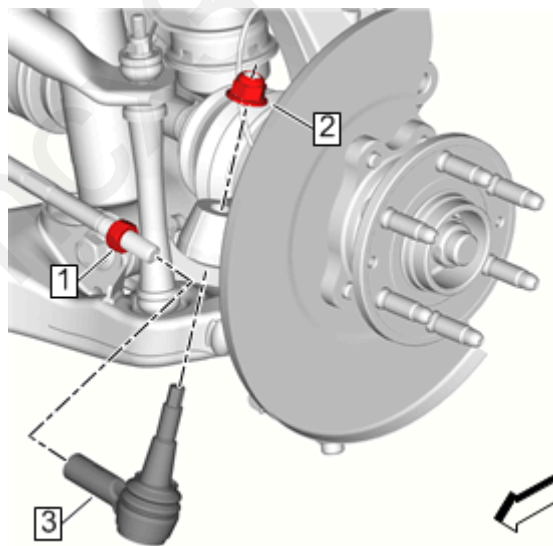


Fig. 36: Steering Linkage Outer Tie Rod
Courtesy of GENERAL MOTORS COMPANY

16. Install Steering Linkage Outer Tie Rod (3) @Steering Knuckle.[Steering Linkage Outer Tie Rod Replacement](#)

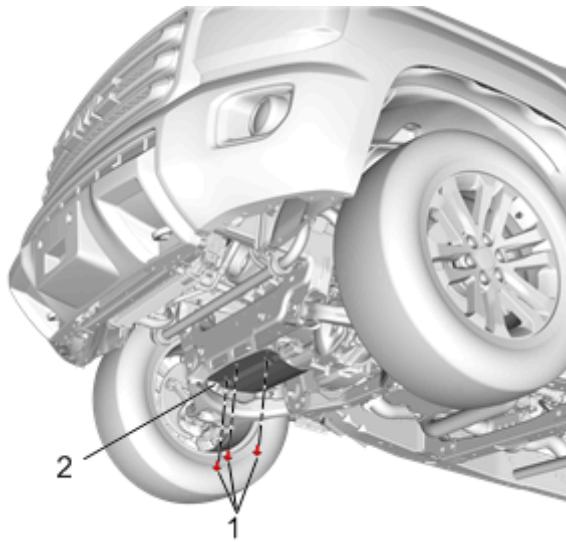


Fig. 37: Steering Gear Skid Shield

Courtesy of GENERAL MOTORS COMPANY

17. Install Steering Gear Skid Shield (2). [Steering Gear Skid Shield Replacement](#)

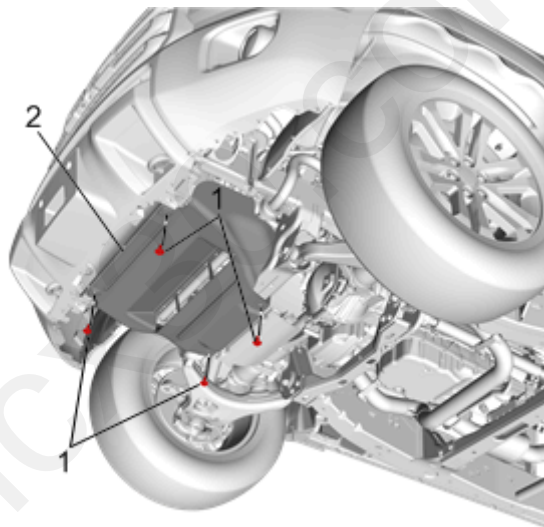


Fig. 38: Underbody Splash Shield

Courtesy of GENERAL MOTORS COMPANY

18. Install Underbody Splash Shield (2). [Underbody Splash Shield Replacement](#)

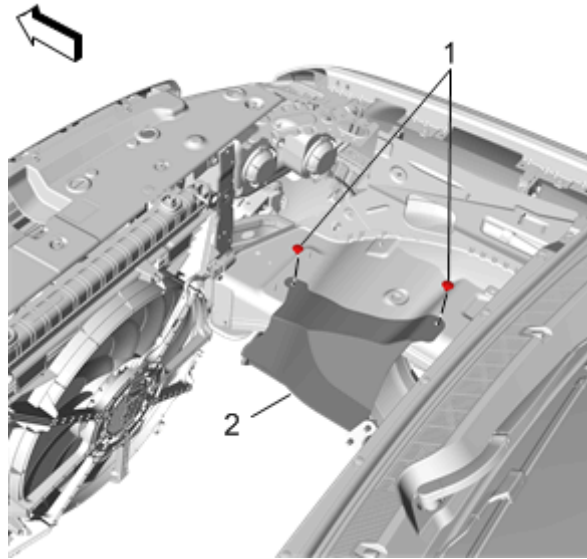


Fig. 39: Engine Front Splash Shield

Courtesy of GENERAL MOTORS COMPANY

19. Install Engine Front Splash Shield (2). [Engine Front Splash Shield Replacement](#)
20. Install the front tire and wheel assemblies. [Tire and Wheel Removal and Installation](#)
21. Program the power steering control module. [Power Steering Control Module Programming and Setup](#)
22. Measure and adjust the front toe. [Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment](#)

ELECTRIC BELT DRIVE RACK AND PINION STEERING GEAR REPLACEMENT (2WD)

Special Tools

EN-45059 Torque Angle Meter

Equivalent regional tools: [Special Tools](#)

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 steering wheel in the straight ahead position, LOCK the steering column.
2. Remove the front tire and wheel assemblies. [Tire and Wheel Removal and Installation](#)

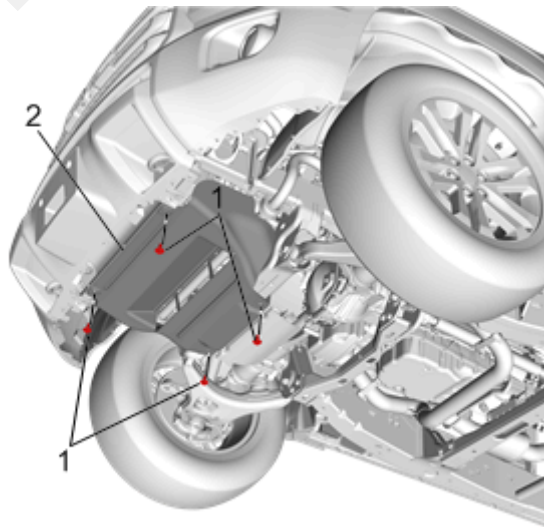


Fig. 40: Underbody Splash Shield

Courtesy of GENERAL MOTORS COMPANY

3 Underbody Splash Shield (2) [Underbody Splash Shield Replacement](#)

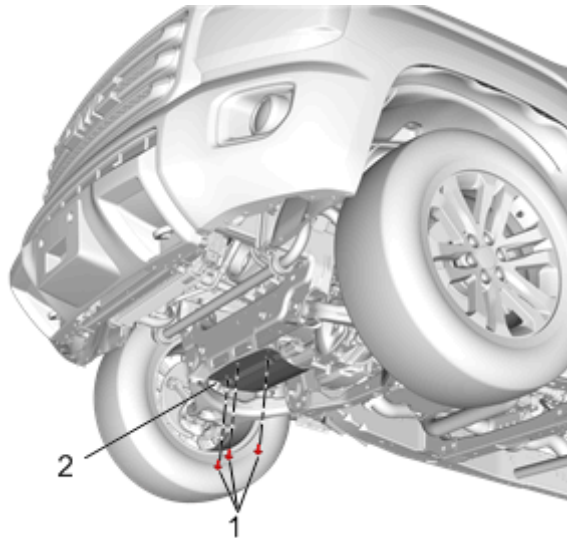


Fig. 41: Steering Gear Skid Shield

Courtesy of GENERAL MOTORS COMPANY

4. Remove Steering Gear Skid Shield (2) [Steering Gear Skid Shield Replacement](#)

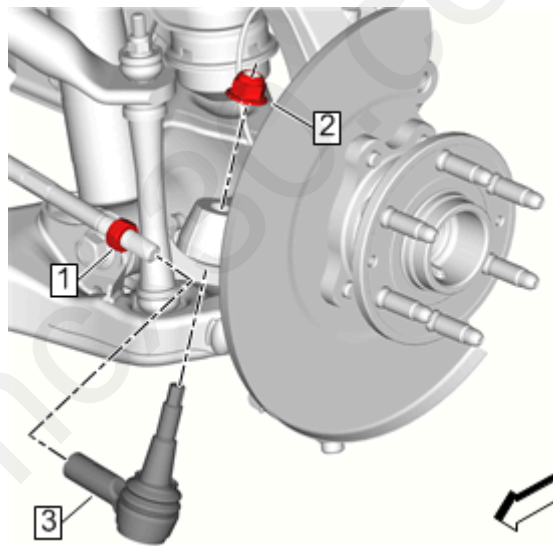


Fig. 42: Steering Linkage Outer Tie Rod

Courtesy of GENERAL MOTORS COMPANY

5. Separate Steering Linkage Outer Tie Rod (3) @Steering Knuckle [Steering Linkage Outer Tie Rod Replacement](#)
6. Disconnect the vehicle wiring harnesses from the steering gear and set aside.
7. Place match marks on the intermediate steering shaft and the lower steering shaft assembly to aid in installation.

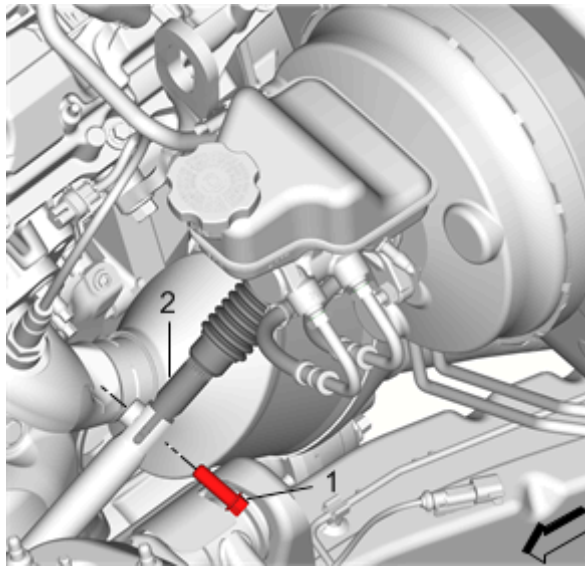


Fig. 43: Intermediate Steering Shaft Lower Bolt
 Courtesy of GENERAL MOTORS COMPANY

8. Separate Intermediate Steering Shaft (2) @Lower Steering Shaft Assembly. **Lower Steering Shaft Assembly Replacement**
9. Support the steering gear assembly with a suitable support.

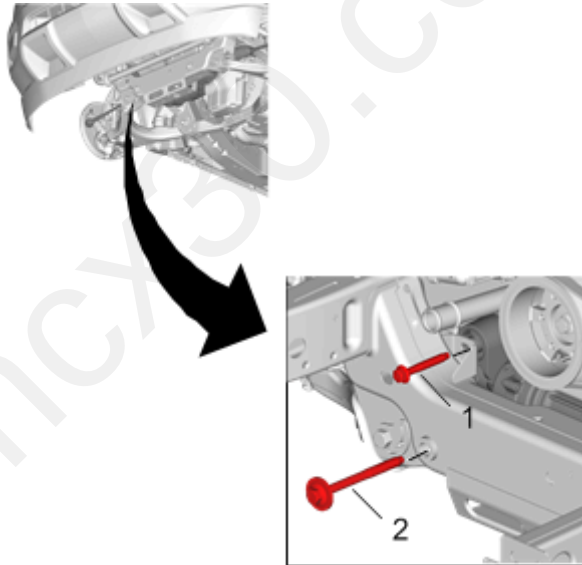


Fig. 44: Upper Steering Gear Bolt
 Courtesy of GENERAL MOTORS COMPANY

10. On the right side of the vehicle, remove the upper steering gear bolt (1) and the lower steering gear bolt (2).

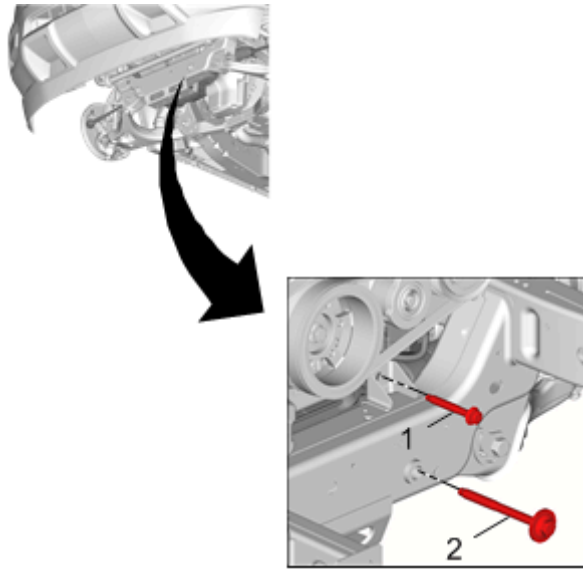


Fig. 45: Upper Steering Gear Bolt

Courtesy of GENERAL MOTORS COMPANY

11. On the left side of the vehicle, remove the upper steering gear bolt (1) and the lower steering gear bolt (2).

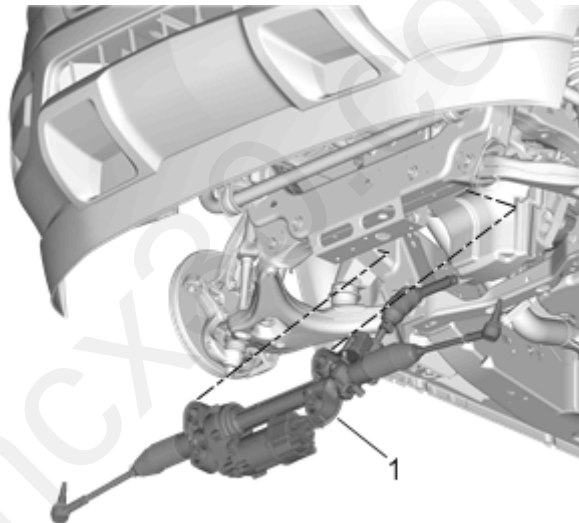


Fig. 46: Steering Gear

Courtesy of GENERAL MOTORS COMPANY

12. With the assistance of a helper, remove the support and rotate the steering gear (1) toward the front of the vehicle until the steering gear shaft and lower steering shaft assembly are vertical.
13. Carefully remove the steering gear (1) from the vehicle.
14. Transfer components as necessary.

Installation Procedure

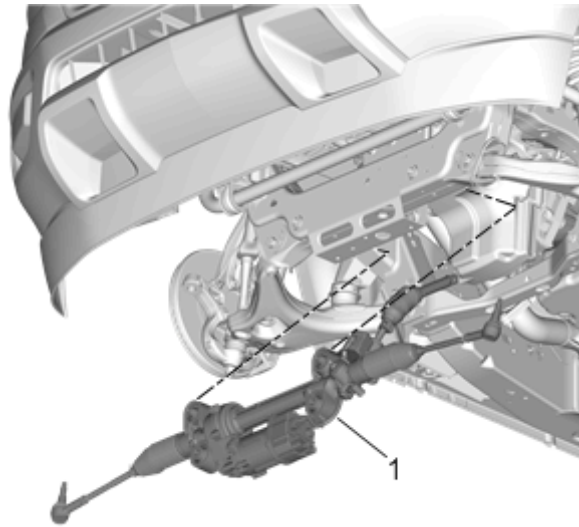


Fig. 47: Steering Gear

Courtesy of GENERAL MOTORS COMPANY

1. With the assistance of a helper, hold the steering gear (1) with the steering gear shaft and lower steering shaft assembly vertical.
2. Carefully position the steering gear (1) on the vehicle and support the assembly with a suitable support.

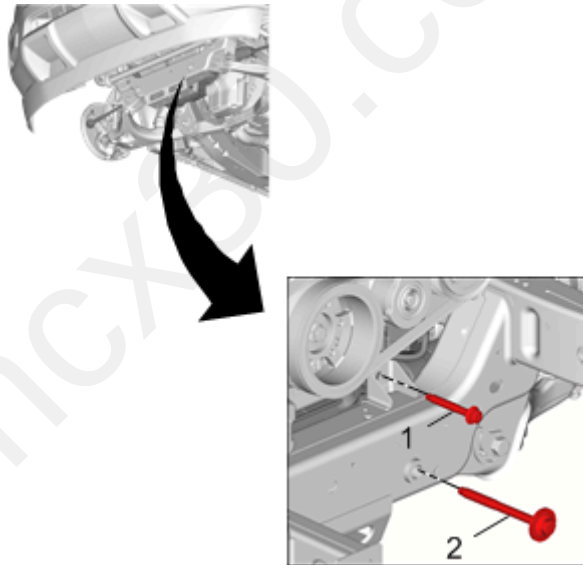


Fig. 48: Upper Steering Gear Bolt

Courtesy of GENERAL MOTORS COMPANY

3. On the left side of the vehicle, loosely install the lower steering gear bolt (2) and the upper steering gear bolt (1).

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

4. After all steering gear bolts are installed, tighten the upper steering gear bolt (1) to 100 N.m (74 lb ft).
5. After all steering gear bolts are installed, use the **EN-45059** meter to tighten the lower steering gear bolt (2).

Tighten

1. First Pass: 150 N.m (111 lb ft)

inal Pass: (30-45 degrees)

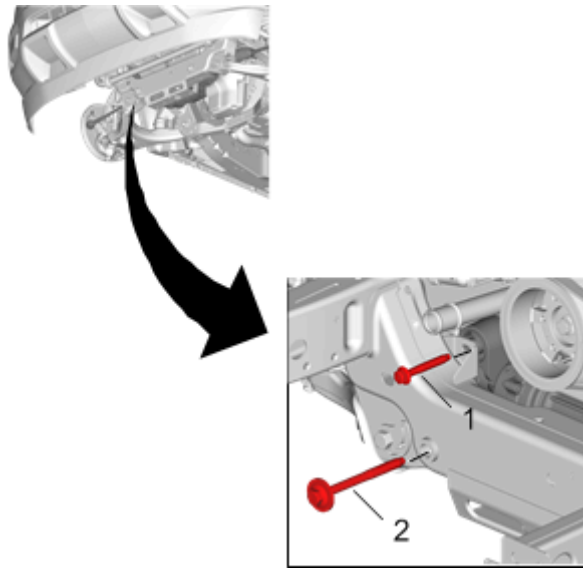


Fig. 49: Upper Steering Gear Bolt

Courtesy of GENERAL MOTORS COMPANY

6. On the right side of the vehicle, loosely install the lower steering gear bolt (2) and the upper steering gear bolt (1).
7. After all steering gear bolts are installed, tighten the upper steering gear bolt (1) to 100 N.m (74 lb ft).
8. After all steering gear bolts are installed, use the **EN-45059** meter to tighten the lower steering gear bolt (2).

Tighten

1. First Pass: 150 N.m (111 lb ft)
2. Final Pass: (30-45 degrees)
9. Remove the support from underneath the vehicle.
10. Connect the vehicle wiring harnesses to the steering gear.

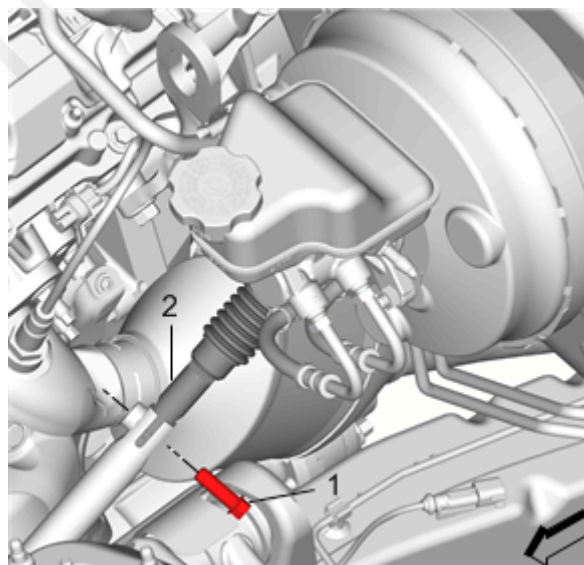


Fig. 50: Intermediate Steering Shaft Lower Bolt

Courtesy of GENERAL MOTORS COMPANY

Intermediate Steering Shaft (2) @Lower Steering Shaft Assembly [Lower Steering Shaft Assembly Replacement](#)

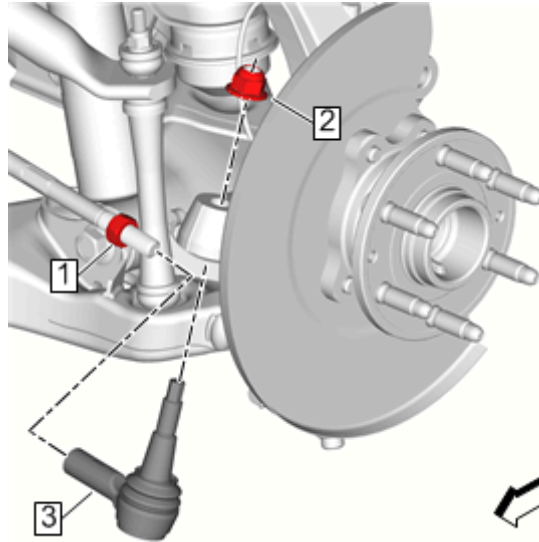


Fig. 51: Steering Linkage Outer Tie Rod
Courtesy of GENERAL MOTORS COMPANY

12. Install Steering Linkage Outer Tie Rod (3) @Steering Knuckle [Steering Linkage Outer Tie Rod Replacement](#)

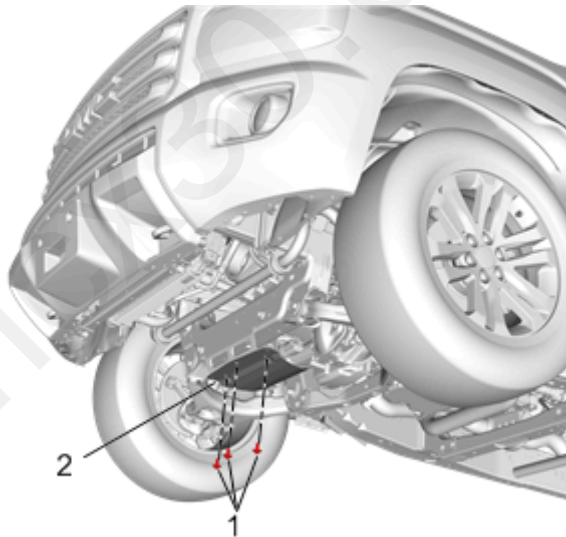


Fig. 52: Steering Gear Skid Shield
Courtesy of GENERAL MOTORS COMPANY

13. Install Steering Gear Skid Shield (2) [Steering Gear Skid Shield Replacement](#)

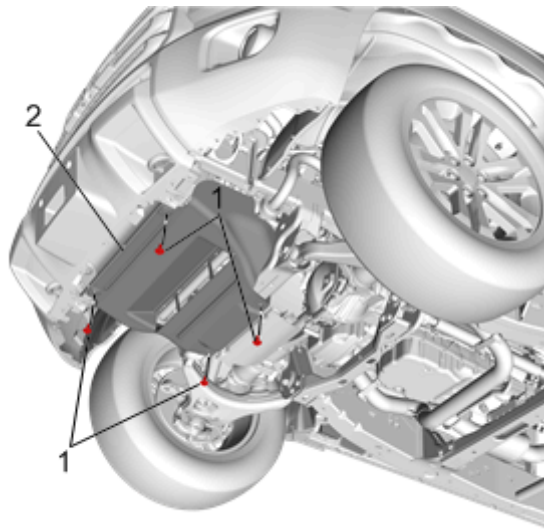


Fig. 53: Underbody Splash Shield

Courtesy of GENERAL MOTORS COMPANY

14. Install Underbody Splash Shield (2) [Underbody Splash Shield Replacement](#)
15. Install the front tire and wheel assemblies. [Tire and Wheel Removal and Installation](#)
16. Program the power steering control module. [Power Steering Control Module Programming and Setup](#)
17. Measure and adjust the front toe. [Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment](#)

STEERING LINKAGE INNER TIE ROD REPLACEMENT

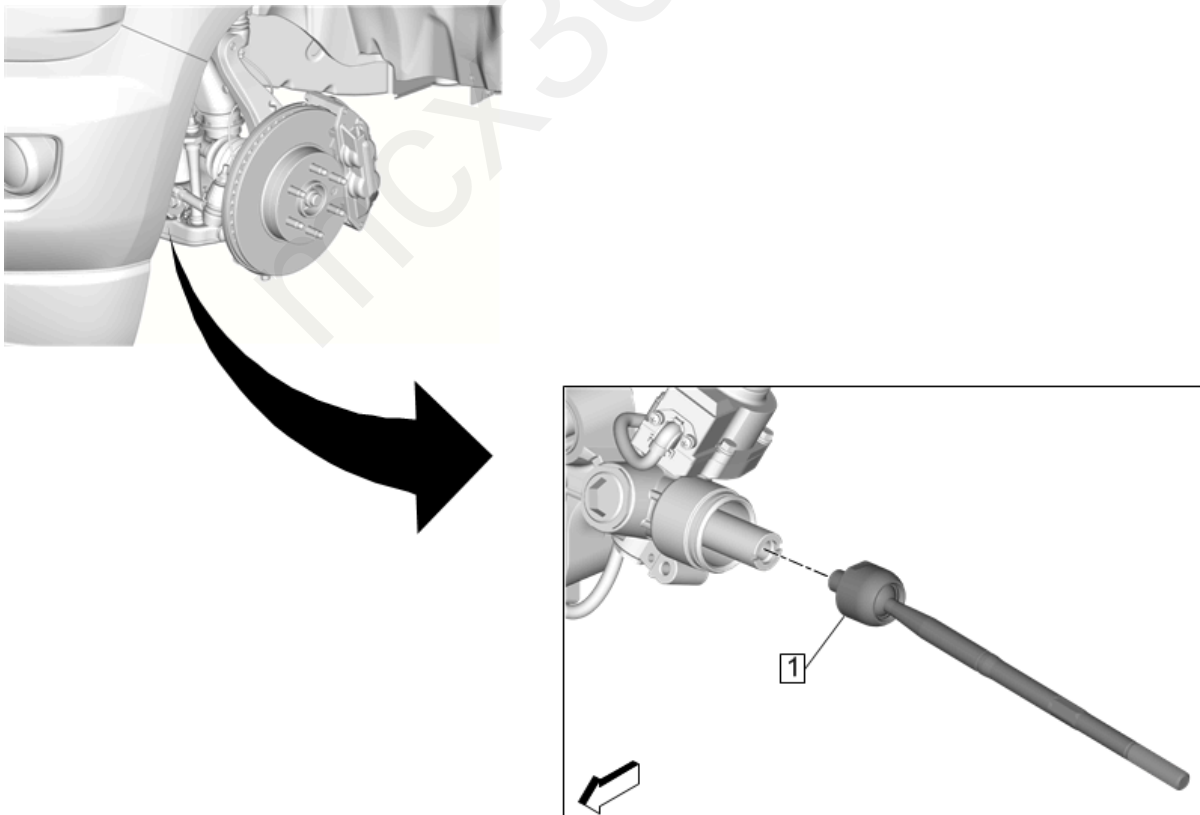


Fig. 54: Steering Linkage Inner Tie Rod

Courtesy of GENERAL MOTORS COMPANY

Component Name

Preliminary Procedures

1. [Steering Gear Boot Replacement](#)
2. 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. [Electric Belt Drive Rack and Pinion Steering Gear Replacement \(4WD\)](#) [Electric Belt Drive Rack and Pinion Steering Gear Replacement \(2WD\)](#)

Steering Linkage Inner Tie Rod

CAUTION:

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

CAUTION:

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

Procedure

1

1. Place a pipe wrench on the input shaft end of the steering gear rack next to the steering linkage inner tie rod housing and an appropriate size wrench on the flats of the inner tie rod housing.
2. Rotate the steering linkage inner tie rod housing counterclockwise while holding the steering gear rack stationary until the inner tie rod separates from the rack.
3. Rotate the steering linkage inner tie rod housing clockwise while holding the steering gear rack stationary until the inner tie rod tightens to the rack.
4. Measure and adjust the front toe. [Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment](#)

Tighten

90 N.m (66 lb ft)

POWER STEERING ASSIST MOTOR REPLACEMENT (4WD)

Special Tools

GE-50576-A Acoustic Belt Tension Tester

Equivalent regional tools: [Special Tools](#)

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.

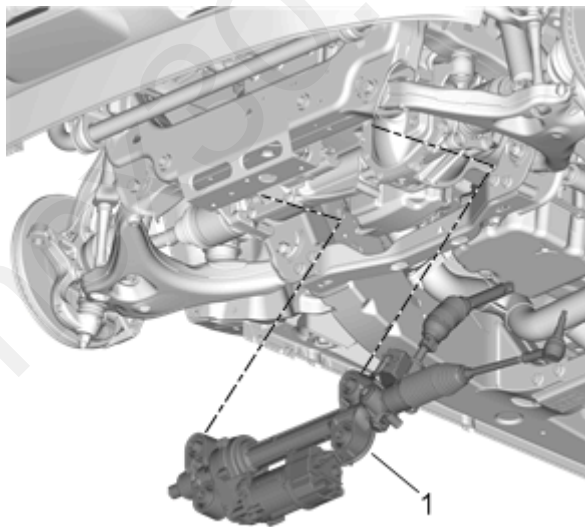


Fig. 55: Steering Gear

Courtesy of GENERAL MOTORS COMPANY

1. Remove Steering Gear (1) [Electric Belt Drive Rack and Pinion Steering Gear Replacement \(4WD\)](#)
2. Remove any dirt or debris from the steering gear. Cleaning the entire area of dirt and debris will ensure no contaminants enter the steering gear.
3. Place the steering gear in a vise or on a clean bench.

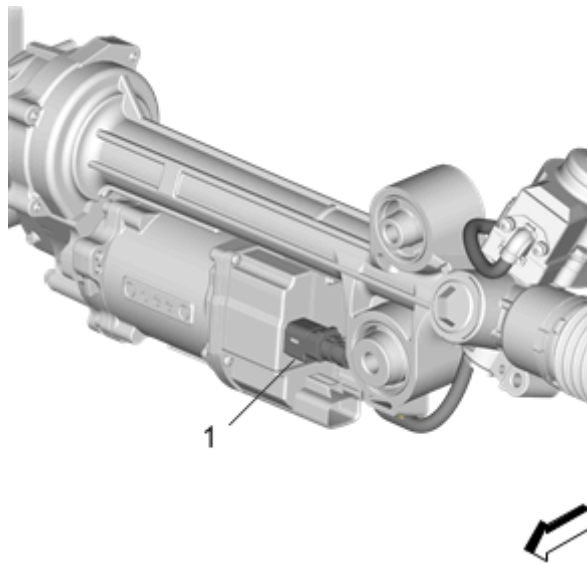


Fig. 56: Torque Sensor Wiring Harness Connector
 Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the torque sensor wiring harness connector (1) from the power steering assist motor. The wiring harness is NOT repairable. Do NOT attempt to repair the harness under any circumstances. If either harness is damaged then the steering gear MUST be replaced.

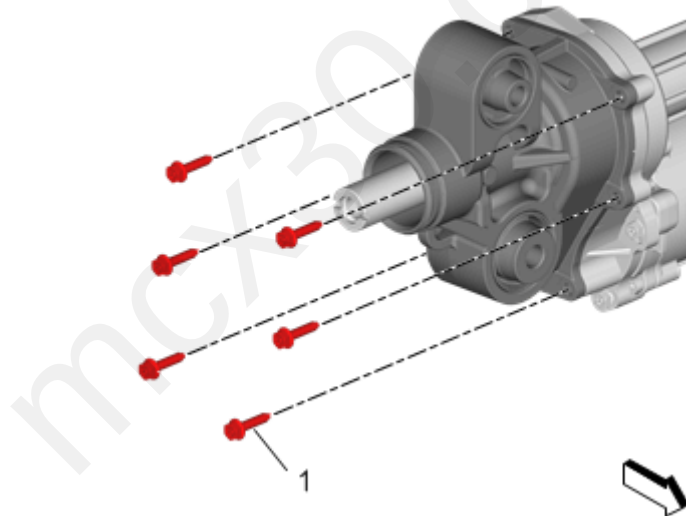


Fig. 57: Steering Gear Housing Cover Bolts
 Courtesy of GENERAL MOTORS COMPANY

5. Remove the steering gear housing cover bolts (1).

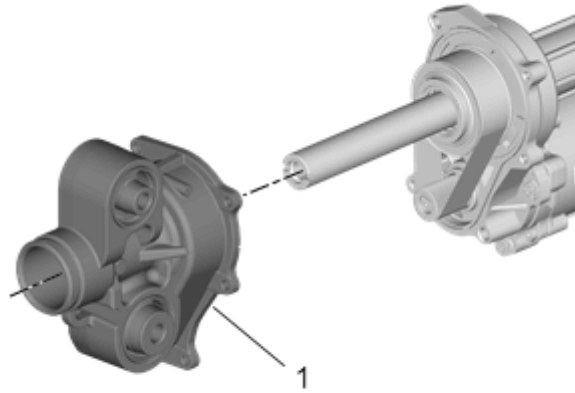


Fig. 58: Steering Gear Housing Cover

Courtesy of GENERAL MOTORS COMPANY

6. Use a rubber mallet to separate the steering gear housing cover (1) from the steering gear housing and remove the cover.

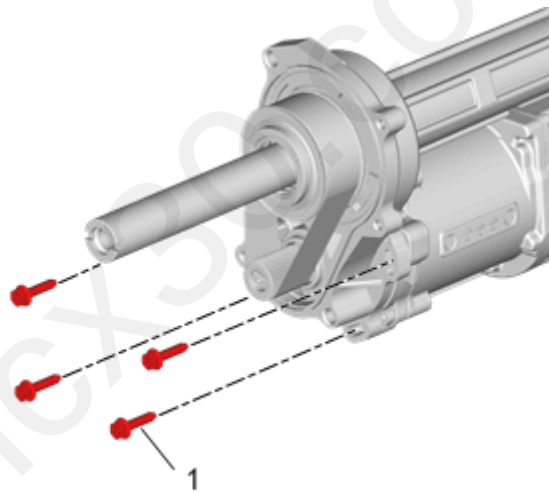


Fig. 59: Power Steering Assist Motor Pivot Bolts

Courtesy of GENERAL MOTORS COMPANY

7. Remove the power steering assist motor pivot bolts (1).

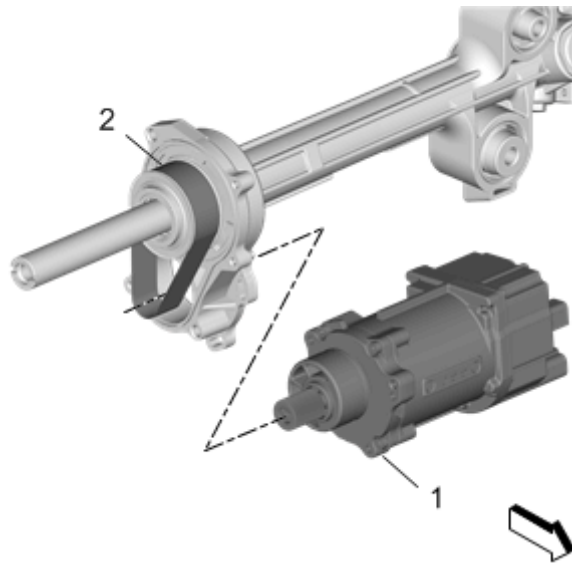


Fig. 60: Power Steering Assist Motor
Courtesy of GENERAL MOTORS COMPANY

8. Rotate the power steering assist motor (1) toward the steering gear and then pull the motor toward the steering gear input shaft until the motor is released from the steering gear housing. Then, lower the nose of the motor to release the steering gear belt (2) from the pulley and remove the motor from the belt. DISCARD the belt.

Installation Procedure

1. Use a clean shop rag to clean the surfaces where the power steering assist motor and the steering gear housing mate of any old grease or loose particles. Also clean the surfaces where the steering gear housing cover and the steering gear housing mate of any old grease or loose particles.

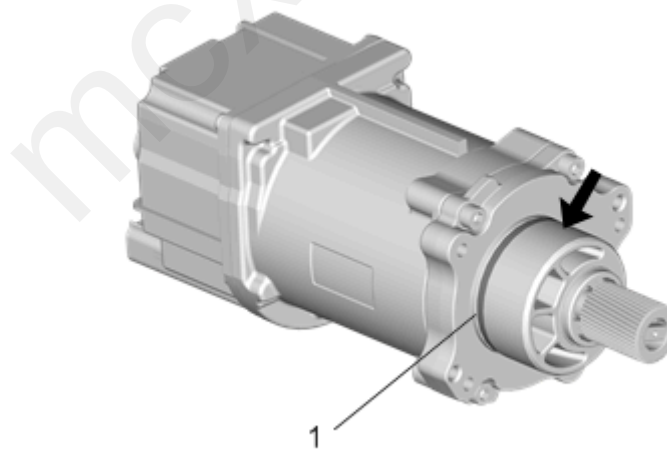


Fig. 61: Power Steering Assist Motor Seal
Courtesy of GENERAL MOTORS COMPANY

2. Install a NEW power steering assist motor seal (1) on the power steering assist motor. Add a light film of lithium grease to the nose of the motor.

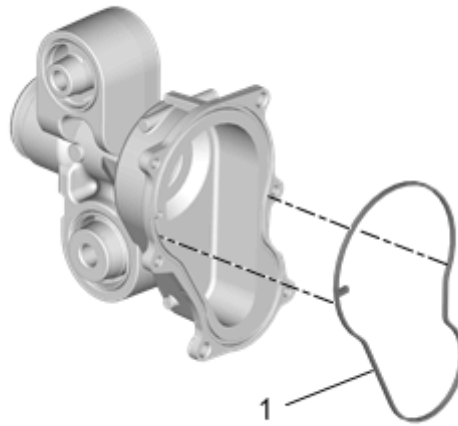


Fig. 62: Steering Gear Housing Cover Seal

Courtesy of GENERAL MOTORS COMPANY

3. Inspect the steering gear housing cover seal (1) and ensure the seal is seated correctly. If the seal is damaged, install a NEW seal.

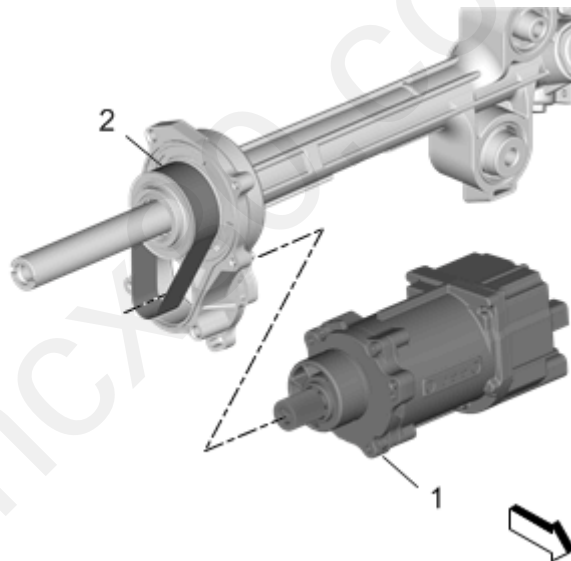


Fig. 63: Power Steering Assist Motor

Courtesy of GENERAL MOTORS COMPANY

4. Hang the NEW steering gear belt (2) on the pulley.
5. Lower the nose of the power steering assist motor (1) and install the nose of the motor into the steering gear belt. Do NOT allow the belt to come into contact with any of the grease in the steering gear housing.

CAUTION: Ensure that the belt is completely installed on to the power steering assist motor pulley. Misalignment of the belt on the pulley will damage the belt and the electric belt drive rack and pinion steering gear will need to be replaced.

6. After the power steering assist motor (1) is installed in the steering gear and steering gear belt, rotate the motor clockwise, while making sure the screw holes in the motor and slotted holes in steering gear housing are aligned properly.

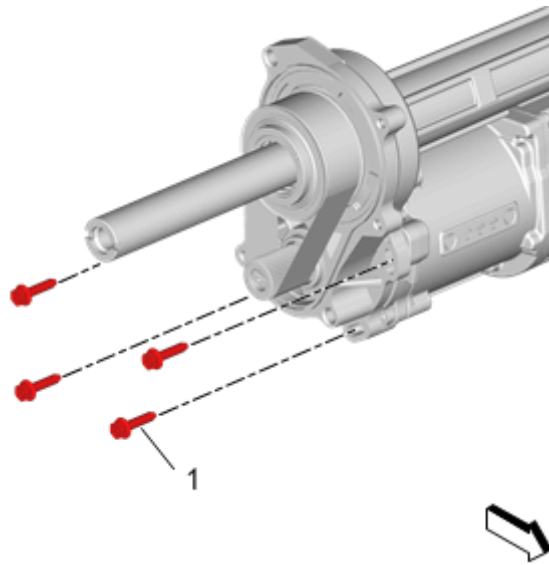


Fig. 64: Power Steering Assist Motor Pivot Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: A suitable clamp may be necessary to help draw the power steering assist motor into the steering gear housing completely. Ensure the motor is flush with the housing before continuing the installation process.

7. Install the power steering assist motor pivot bolts (1) and hand tighten. Ensure the power steering assist motor is snug to the steering gear housing but can still turn.
8. Install a wrench on the steering gear input shaft and rotate the input shaft one half of a full revolution in each direction from the centered position to seat the belt.

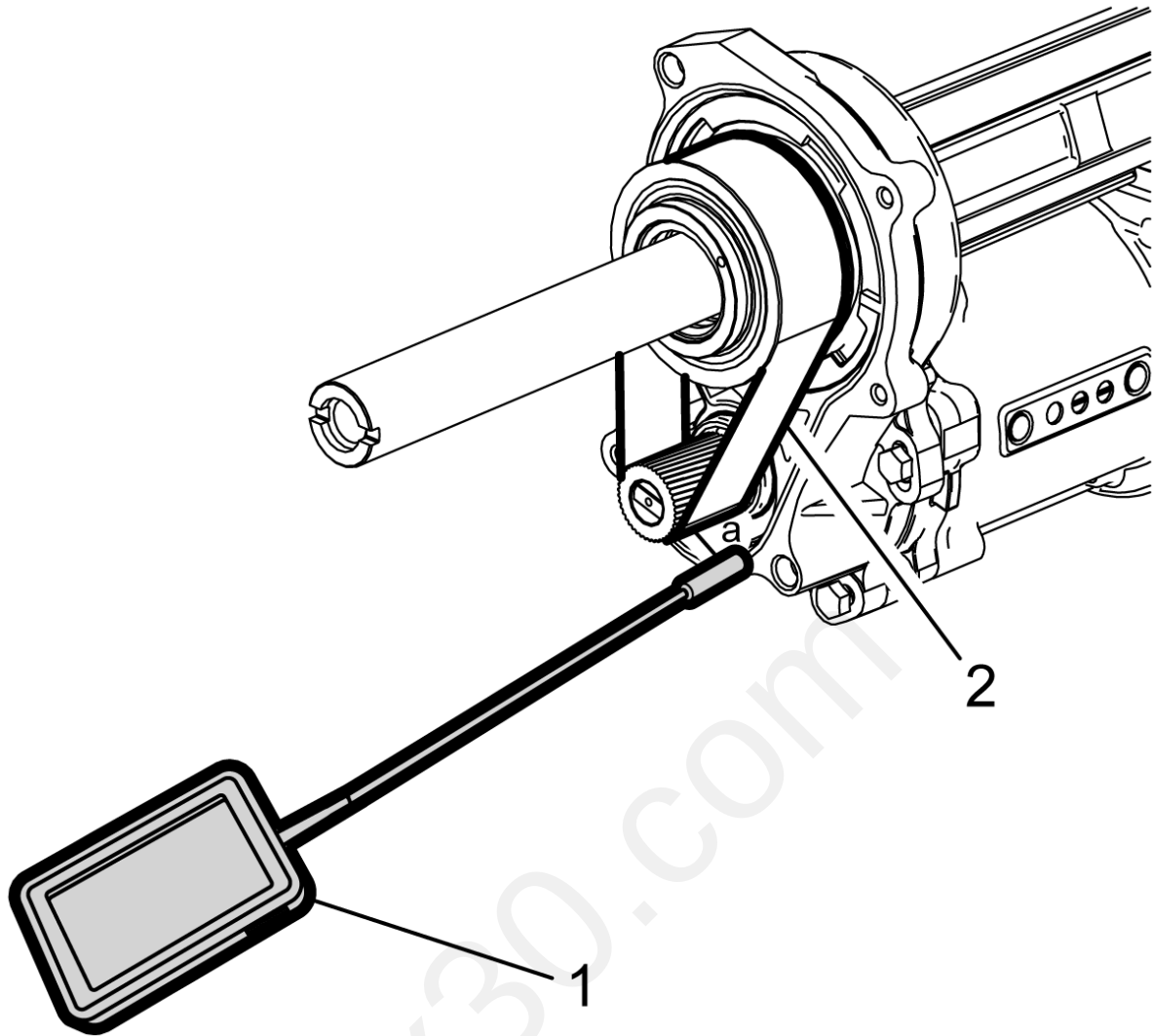


Fig. 65: GE-50576--A tension Tester
Courtesy of GENERAL MOTORS COMPANY

9. Place body of the **GE-50576-A** tension tester (1) on a flat surface or secure it to the steering gear housing. NEVER hold the tester by hand while taking measurements or the reading will be inaccurate.
10. Position the microphone of the **GE-50576-A** tension tester approximately 6 mm (0.25 in) (a) from the steering gear belt (2).

CAUTION: Never use a sharp object to strum the belt as belt damage may occur. If the belt is damaged, the electric belt drive rack and pinion steering gear will need to be replaced.

11. Use an allen wrench or finger to strum the steering gear belt (1) at the center location between the pulleys three times to get an average belt tension measurement.
12. If the average steering gear belt tension measurement is between 260-320 Hz then continue to the next step. If the average of the measurements is lower or higher than the specification, then rotate the motor clockwise to tighten or counterclockwise to loosen and take the average of another set of three measurements. Repeat this step until the average of the measurements is within the range specified.

CAUTION: Refer to **Fastener Caution** .

the power steering assist motor pivot bolts to 12 N.m (106 lb in) and recheck the belt tension using the **GE-50576-A** tension tester. If the average of the measurements is not between 260-320 Hz then loosen the pivot bolts and readjust the belt tension. If the measurement is still within the specified range then continue to the next step.

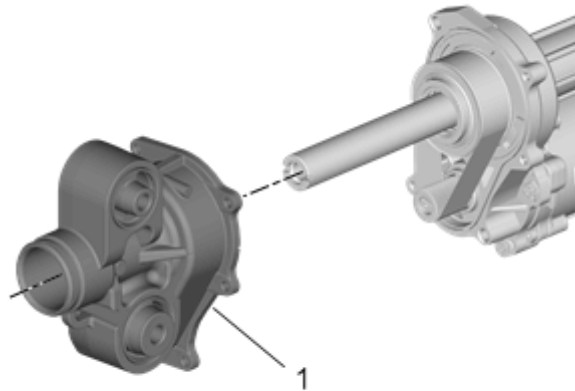


Fig. 66: Steering Gear Housing Cover

Courtesy of GENERAL MOTORS COMPANY

14. Ensure that the steering gear housing cover seal is in position and install the steering gear housing cover (1).

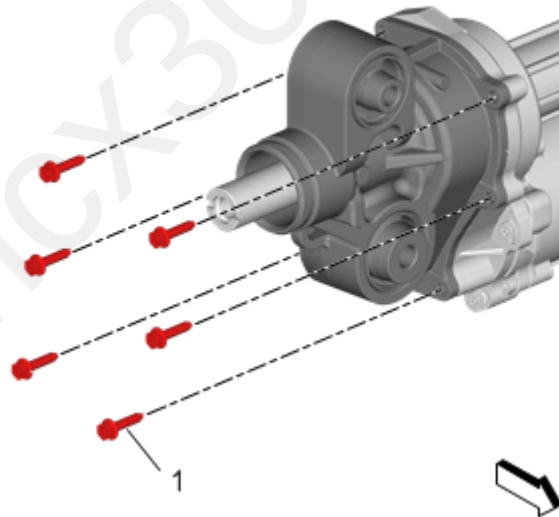


Fig. 67: Steering Gear Housing Cover Bolts

Courtesy of GENERAL MOTORS COMPANY

15. Install the steering gear housing cover bolts (1) and hand tighten.

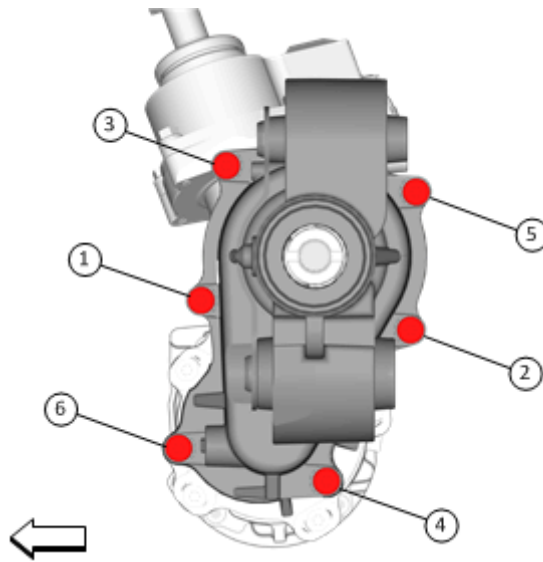


Fig. 68: Tighten Steering Gear Housing Cover Bolts In Sequence
 Courtesy of GENERAL MOTORS COMPANY

16. Tighten the steering gear housing cover bolts in the sequence shown to 12 N.m (106 lb in).

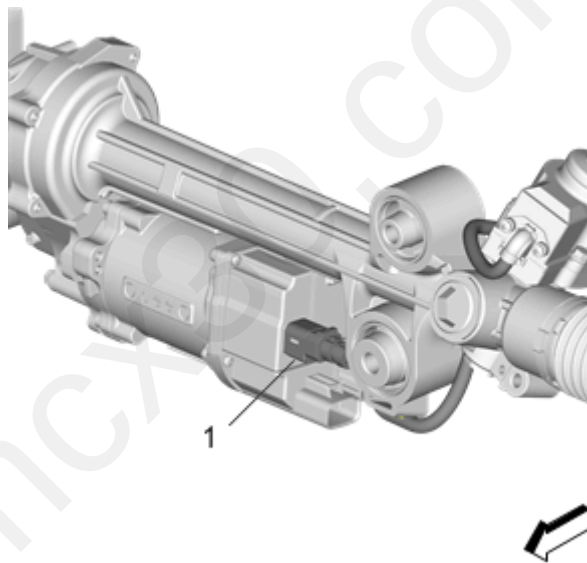


Fig. 69: Torque Sensor Wiring Harness Connector
 Courtesy of GENERAL MOTORS COMPANY

17. Connect the torque sensor wiring harness connector (1) to the power steering assist motor. Ensure the connector lock is engaged.

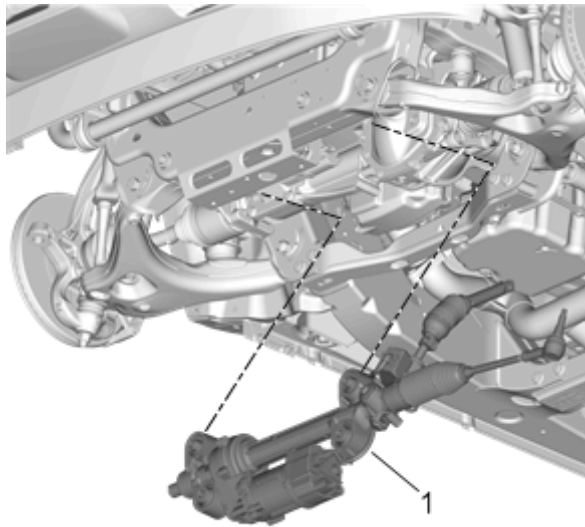


Fig. 70: Steering Gear

Courtesy of GENERAL MOTORS COMPANY

18. Install the steering gear (1) and steering gear fasteners, but leave the steering linkage outer tie rods and intermediate steering shaft disconnected. [Electric Belt Drive Rack and Pinion Steering Gear Replacement \(4WD\)](#)

NOTE:

The steering linkage outer tie rods and the intermediate steering shaft **MUST** be disconnected and able to move freely during the power steering control module programming and setup procedure to properly calibrate the torque sensor in the steering gear.

19. Program the power steering control module. [Power Steering Control Module Programming and Setup](#)

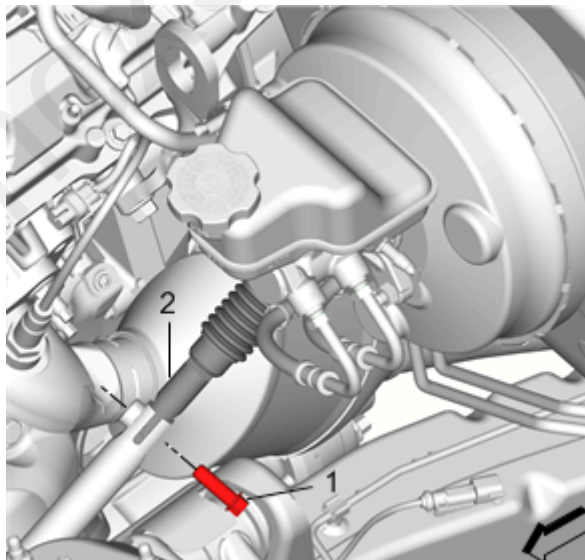


Fig. 71: Intermediate Steering Shaft Lower Bolt

Courtesy of GENERAL MOTORS COMPANY

20. Install Intermediate Steering Shaft (2) @Lower Steering Shaft Assembly [Lower Steering Shaft Assembly Replacement](#)

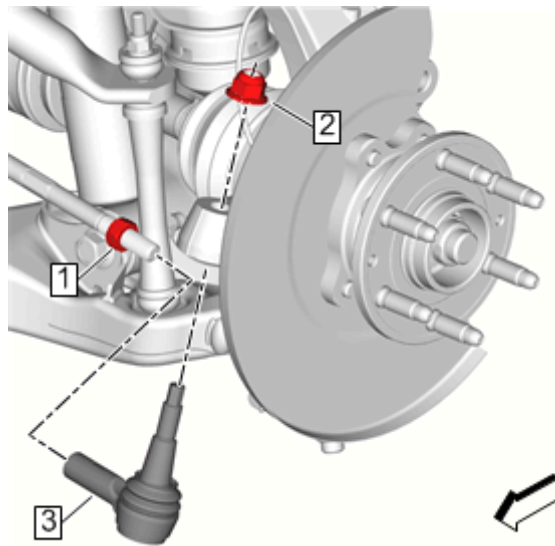


Fig. 72: Steering Linkage Outer Tie Rod

Courtesy of GENERAL MOTORS COMPANY

21. Install Steering Linkage Outer Tie Rod (3) @Steering Knuckle **Steering Linkage Outer Tie Rod Replacement**

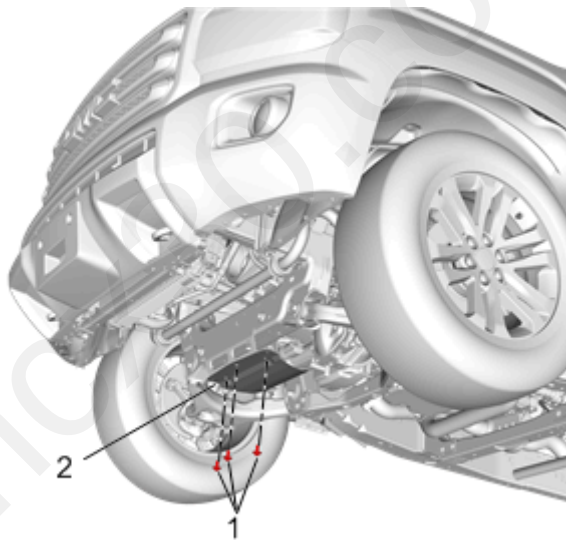


Fig. 73: Steering Gear Skid Shield

Courtesy of GENERAL MOTORS COMPANY

22. Install Steering Gear Skid Shield (2) **Steering Gear Skid Shield Replacement**

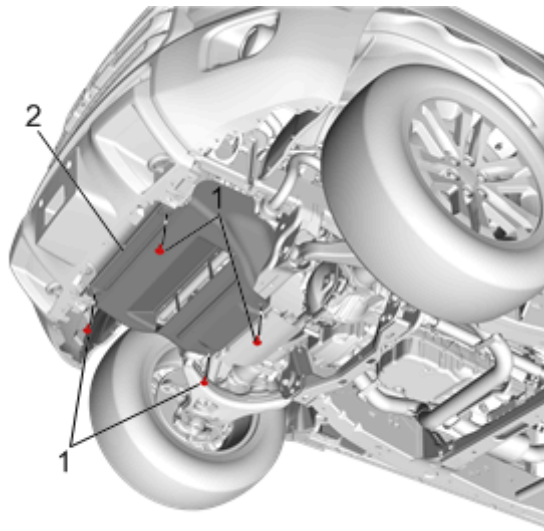


Fig. 74: Underbody Splash Shield

Courtesy of GENERAL MOTORS COMPANY

23. Install Underbody Splash Shield (2) [Underbody Splash Shield Replacement](#)

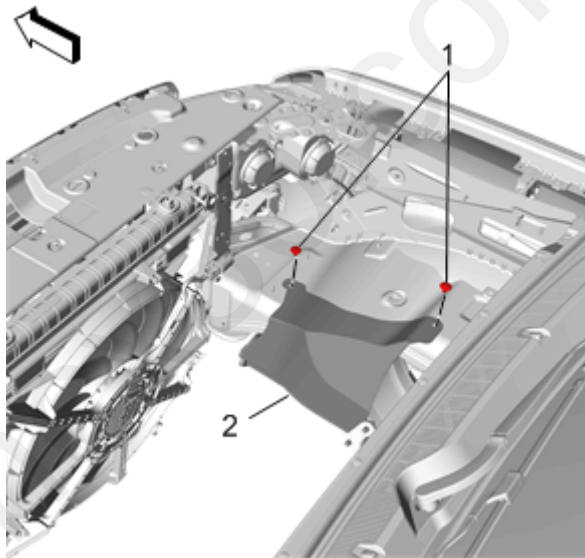


Fig. 75: Engine Front Splash Shield

Courtesy of GENERAL MOTORS COMPANY

24. Install Engine Front Splash Shield (2) [Engine Front Splash Shield Replacement](#)
 25. Install the front tire and wheel assemblies. [Tire and Wheel Removal and Installation](#)
 26. Measure and adjust the front toe. [Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment](#)
 27. Center the steering angle sensor. [Steering Angle Sensor Centering](#)

POWER STEERING ASSIST MOTOR REPLACEMENT (2WD)

Special Tools

GE-50576-A Acoustic Belt Tension Tester

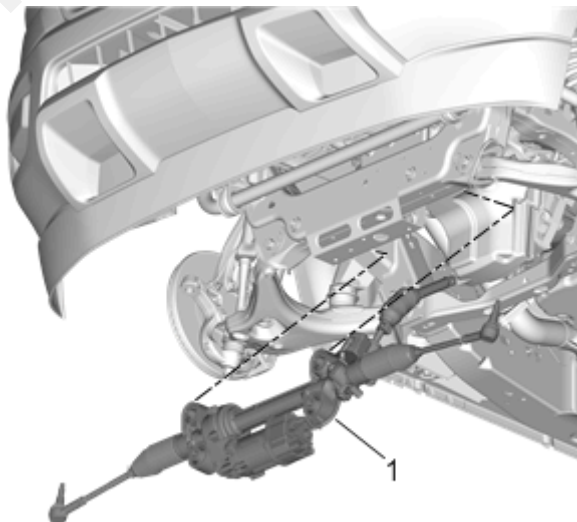
Equivalent regional tools: [Special Tools](#)

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.



Steering Gear

Courtesy of GENERAL MOTORS COMPANY

1. Remove Steering Gear (1) [Electric Belt Drive Rack and Pinion Steering Gear Replacement \(2WD\)](#)
2. Remove any dirt or debris from the steering gear. Cleaning the entire area of dirt and debris will ensure no contaminants enter the steering gear.
3. Place the steering gear in a vise or on a clean bench.

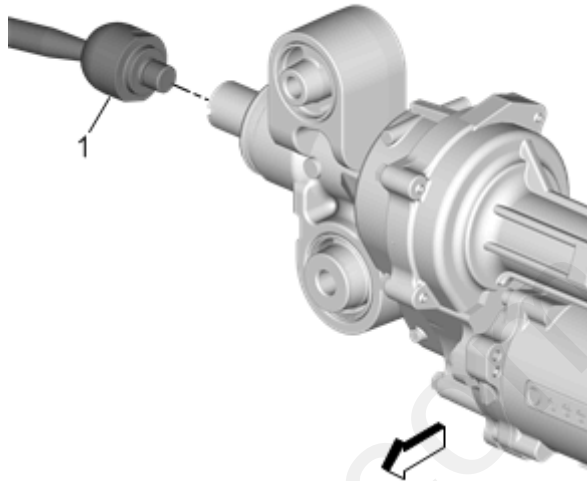


Fig. 77: Right Side Steering Linkage Inner Tie Rod

Courtesy of GENERAL MOTORS COMPANY

4. Remove the right side steering linkage inner tie rod (1). [Steering Linkage Inner Tie Rod Replacement](#)

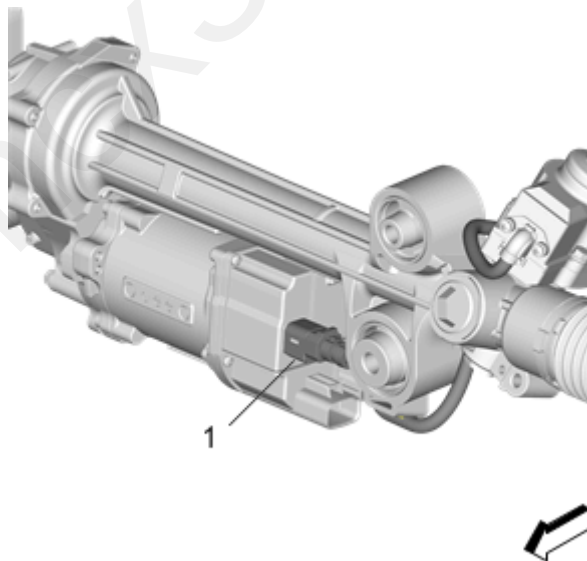


Fig. 78: Torque Sensor Wiring Harness Connector

Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the torque sensor wiring harness connector (1) from the power steering assist motor. The wiring harness is NOT repairable. Do NOT attempt to repair the harness under any circumstances. If either harness is damaged then the steering gear MUST be replaced.

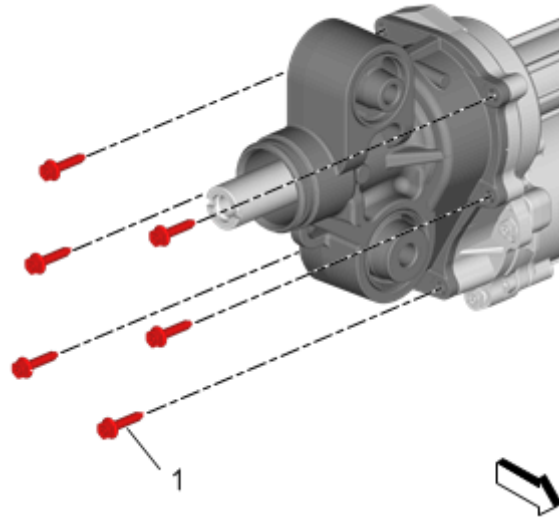


Fig. 79: Steering Gear Housing Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Remove the steering gear housing cover bolts (1).

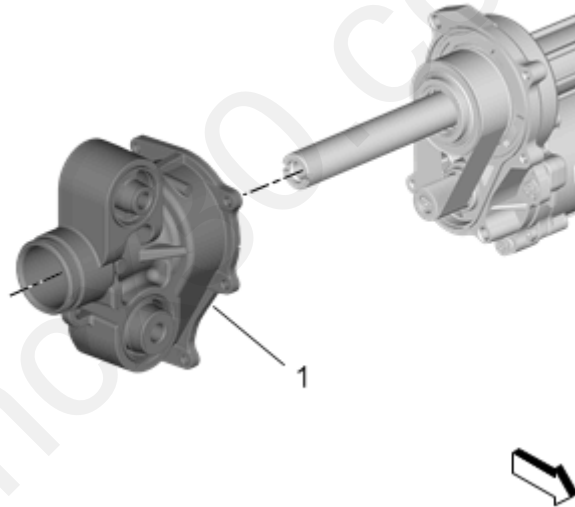


Fig. 80: Steering Gear Housing Cover
Courtesy of GENERAL MOTORS COMPANY

7. Use a rubber mallet to separate the steering gear housing cover (1) from the steering gear housing and remove the cover.

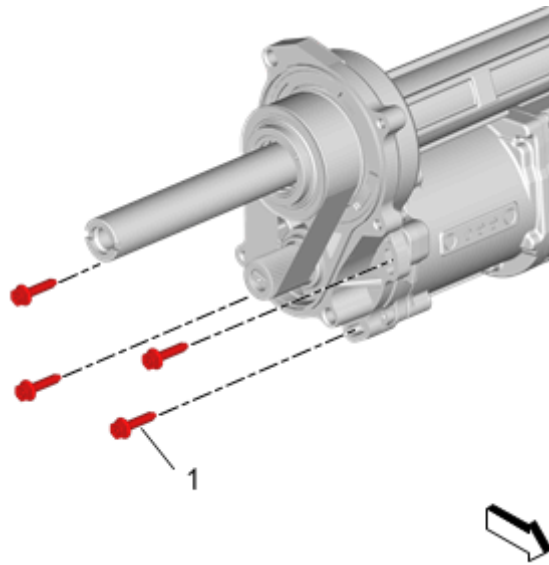


Fig. 81: Power Steering Assist Motor Pivot Bolts
Courtesy of GENERAL MOTORS COMPANY

8. Remove the power steering assist motor pivot bolts (1).

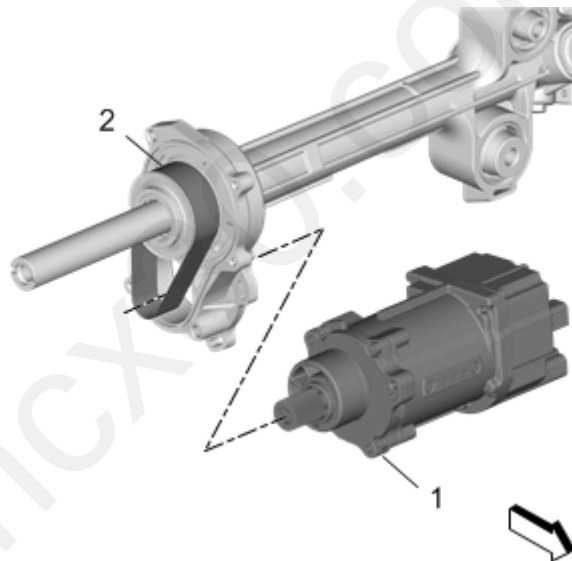


Fig. 82: Power Steering Assist Motor
Courtesy of GENERAL MOTORS COMPANY

9. Rotate the power steering assist motor (1) toward the steering gear and then pull the motor toward the steering gear input shaft until the motor is released from the steering gear housing. Then, lower the nose of the motor to release the steering gear belt (2) from the pulley and remove the motor from the belt. DISCARD the belt.

Installation Procedure

1. Use a clean shop rag to clean the surfaces where the power steering assist motor and the steering gear housing mate of any old grease or loose particles. Also clean the surfaces where the steering gear housing cover and the steering gear housing mate of any old grease or loose particles.

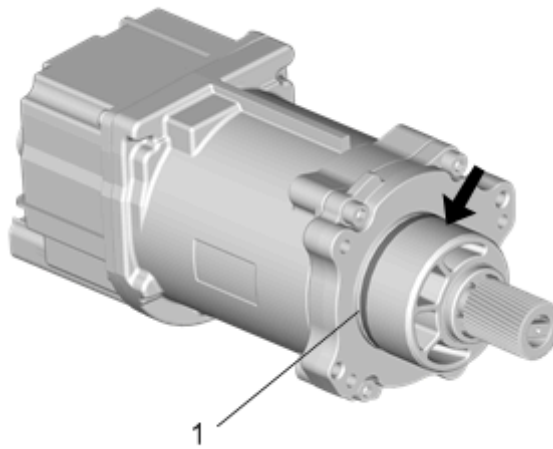


Fig. 83: Power Steering Assist Motor Seal

Courtesy of GENERAL MOTORS COMPANY

2. Install a NEW power steering assist motor seal (1) on the power steering assist motor. Add a light film of lithium grease to the nose of the motor.

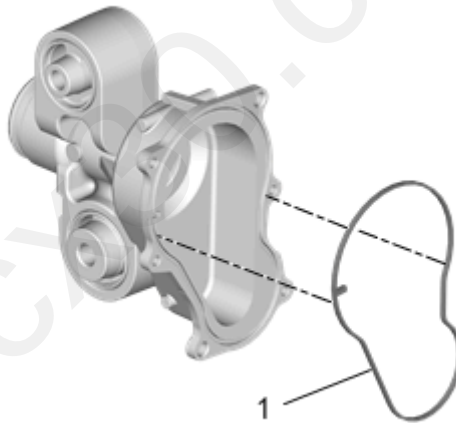


Fig. 84: Steering Gear Housing Cover Seal

Courtesy of GENERAL MOTORS COMPANY

3. Inspect the steering gear housing cover seal (1) and ensure the seal is seated correctly. If the seal is damaged, install a NEW seal.

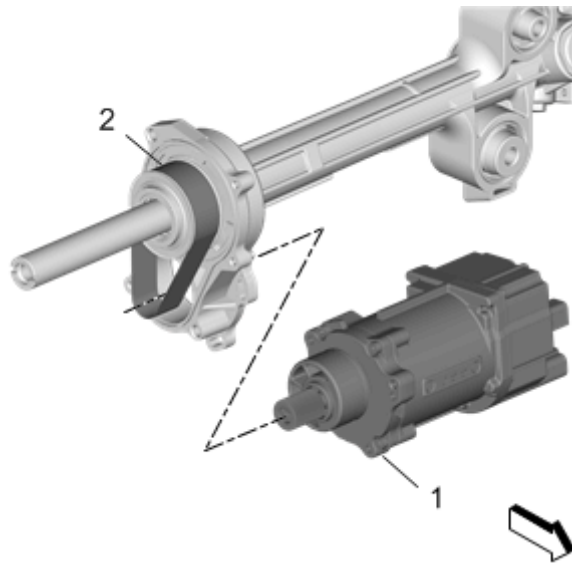


Fig. 85: Power Steering Assist Motor

Courtesy of GENERAL MOTORS COMPANY

4. Hang the NEW steering gear belt (2) on the pulley.
5. Lower the nose of the power steering assist motor (1) and install the nose of the motor into the steering gear belt. Do NOT allow the belt to come into contact with any of the grease in the steering gear housing.

CAUTION: Ensure that the belt is completely installed on to the power steering assist motor pulley. Misalignment of the belt on the pulley will damage the belt and the electric belt drive rack and pinion steering gear will need to be replaced.

6. After the power steering assist motor (1) is installed in the steering gear and steering gear belt, rotate the motor clockwise, while making sure the screw holes in the motor and slotted holes in steering gear housing are aligned properly.

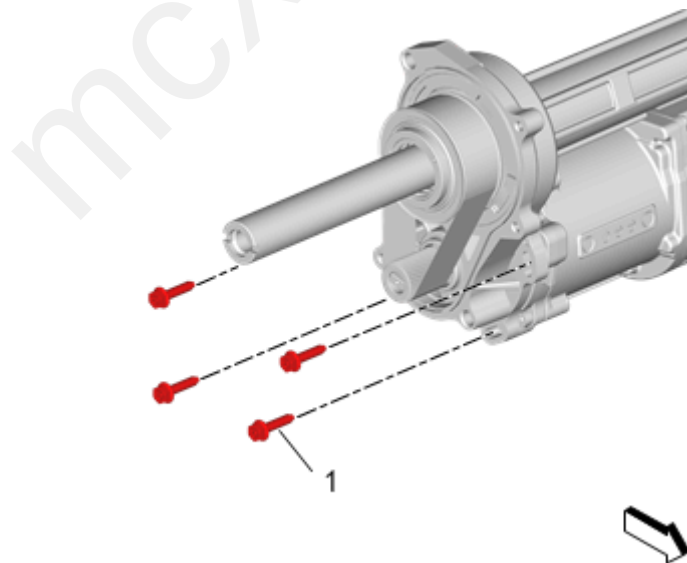


Fig. 86: Power Steering Assist Motor Pivot Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: A suitable clamp may be necessary to help draw the power steering assist motor into the steering gear housing completely. Ensure the motor is flush with the housing before continuing the installation process.

the power steering assist motor pivot bolts (1) and hand tighten. Ensure the power steering assist motor is snug to the steering gear housing but can still turn.

8. Install a wrench on the steering gear input shaft and rotate the input shaft one half of a full revolution in each direction from the centered position to seat the belt.

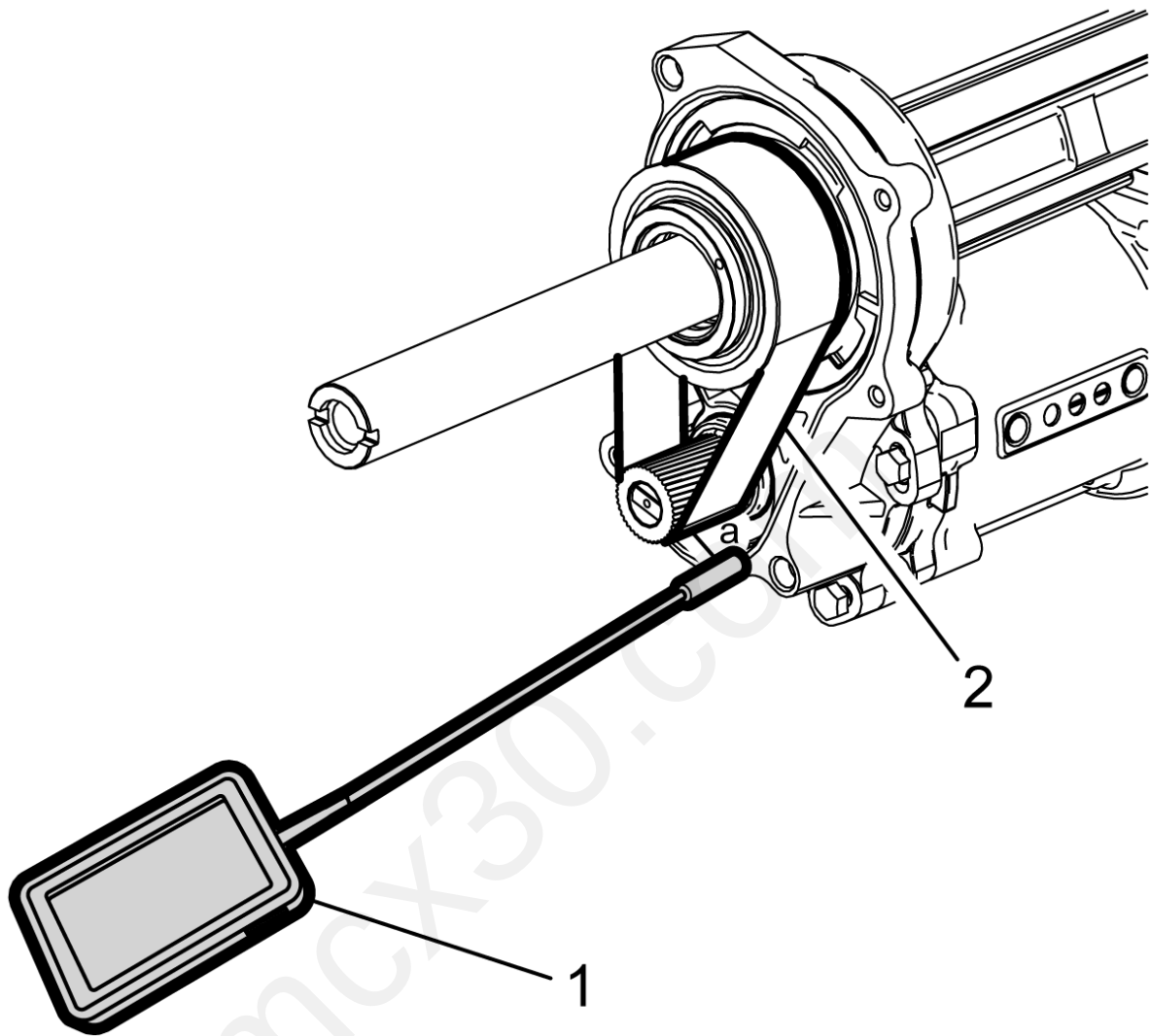


Fig. 87: GE-50576--A tension Tester
Courtesy of GENERAL MOTORS COMPANY

9. Place body of the **GE-50576-A** tension tester (1) on a flat surface or secure it to the steering gear housing. NEVER hold the tester by hand while taking measurements or the reading will be inaccurate.
10. Position the microphone of the **GE-50576-A** tension tester approximately 6 mm (0.25 in) (a) from the steering gear belt (2).

CAUTION: Never use a sharp object to strum the belt as belt damage may occur. If the belt is damaged, the electric belt drive rack and pinion steering gear will need to be replaced.

11. Use an allen wrench or finger to strum the steering gear belt (1) at the center location between the pulleys three times to get an average belt tension measurement.

Average steering gear belt tension measurement is between 260-320 Hz then continue to the next step. If the average of the measurements is lower or higher than the specification, then rotate the motor clockwise to tighten or counterclockwise to loosen and take the average of another set of three measurements. Repeat this step until the average of the measurements is within the range specified.

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

13. Tighten the power steering assist motor pivot bolts to 12 N.m (106 lb in) and recheck the belt tension using the **GE-50576-A** tension tester. If the average of the measurements is not between 260-320 Hz then loosen the pivot bolts and readjust the belt tension. If the measurement is still within the specified range then continue to the next step.

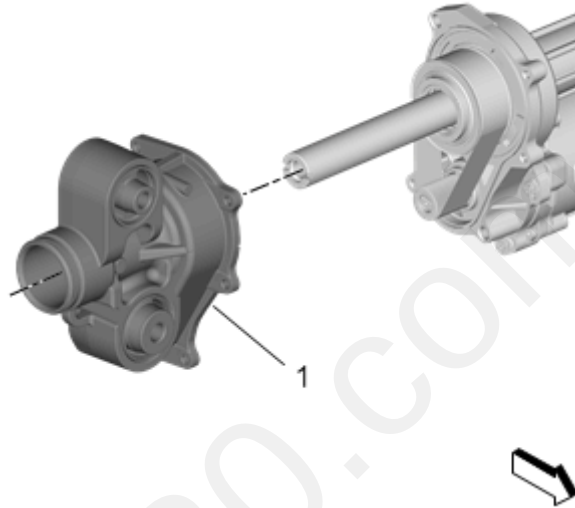


Fig. 88: Steering Gear Housing Cover
Courtesy of GENERAL MOTORS COMPANY

14. Ensure that the steering gear housing cover seal is in position and install the steering gear housing cover (1).

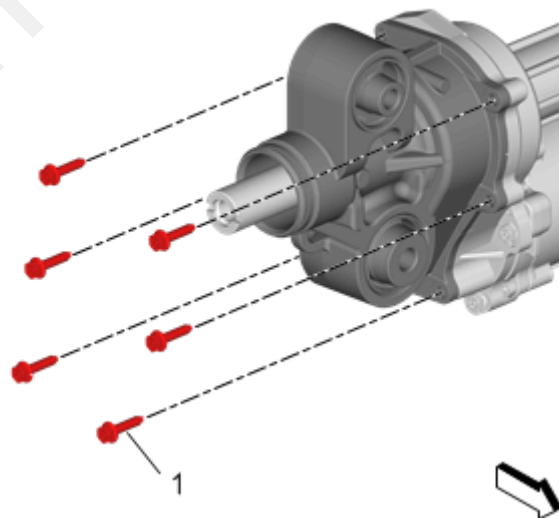


Fig. 89: Steering Gear Housing Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

15. Install the steering gear housing cover bolts (1) and hand tighten.

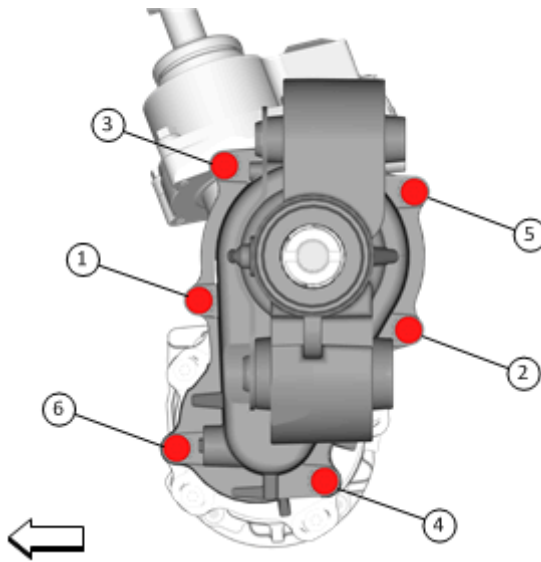


Fig. 90: Tighten Steering Gear Housing Cover Bolts In Sequence
 Courtesy of GENERAL MOTORS COMPANY

16. Tighten the steering gear housing cover bolts in the sequence shown to 12 N.m (106 lb in).

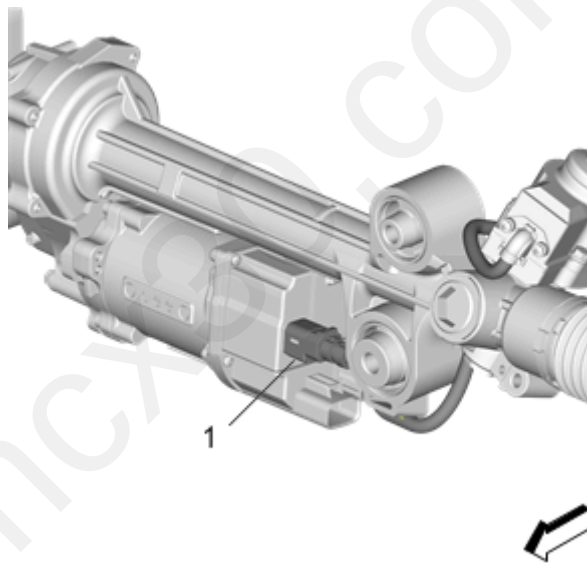


Fig. 91: Torque Sensor Wiring Harness Connector
 Courtesy of GENERAL MOTORS COMPANY

17. Connect the torque sensor wiring harness connector (1) to the power steering assist motor. Ensure the connector lock is engaged.

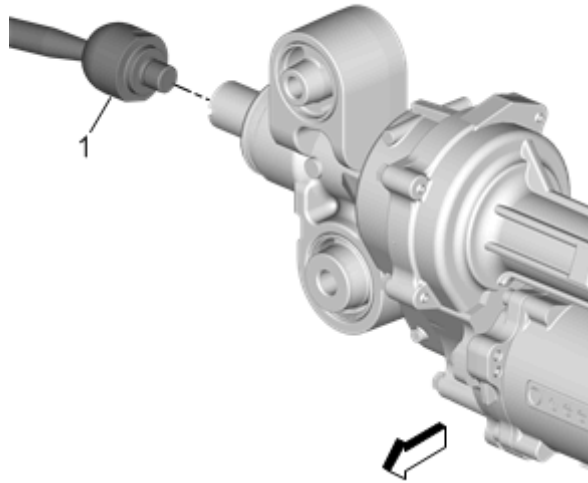


Fig. 92: Right Side Steering Linkage Inner Tie Rod
 Courtesy of GENERAL MOTORS COMPANY

18. Install the right side steering linkage inner tie rod (1). [Steering Linkage Inner Tie Rod Replacement](#)

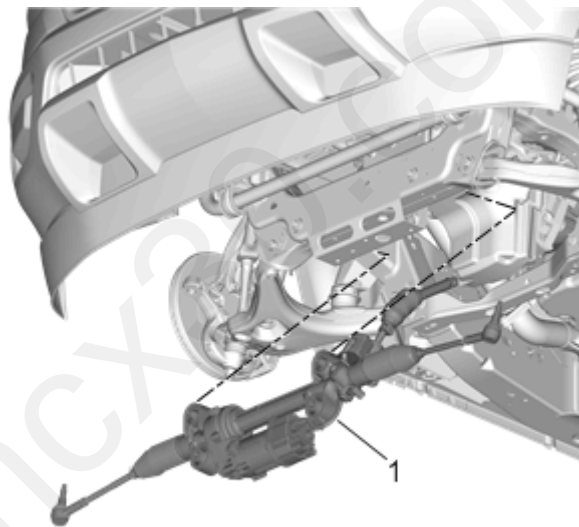


Fig. 93: Steering Gear
 Courtesy of GENERAL MOTORS COMPANY

19. Install the steering gear (1) and steering gear fasteners, but leave the steering linkage outer tie rods and intermediate steering shaft disconnected. [Electric Belt Drive Rack and Pinion Steering Gear Replacement \(2WD\)](#)

NOTE: The steering linkage outer tie rods and the intermediate steering shaft **MUST** be disconnected and able to move freely during the power steering control module programming and setup procedure to properly calibrate the torque sensor in the steering gear.

20. Program the power steering control module. [Power Steering Control Module Programming and Setup](#)

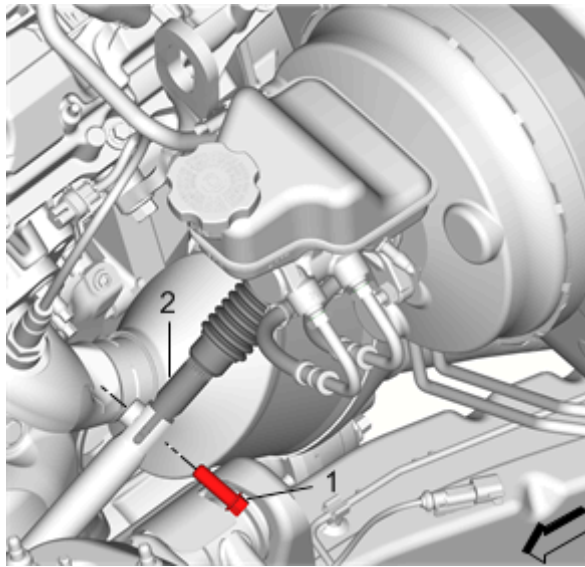


Fig. 94: Intermediate Steering Shaft Lower Bolt
 Courtesy of GENERAL MOTORS COMPANY

21. Install Intermediate Steering Shaft (2) @Lower Steering Shaft Assembly **Lower Steering Shaft Assembly Replacement**

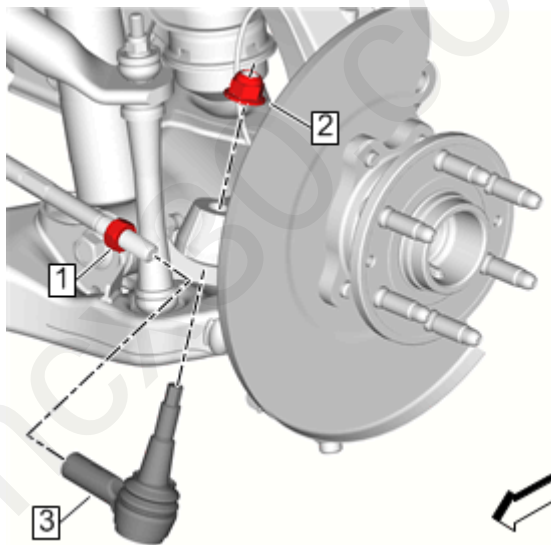


Fig. 95: Steering Linkage Outer Tie Rod
 Courtesy of GENERAL MOTORS COMPANY

22. Install Steering Linkage Outer Tie Rod (3) @Steering Knuckle **Steering Linkage Outer Tie Rod Replacement**

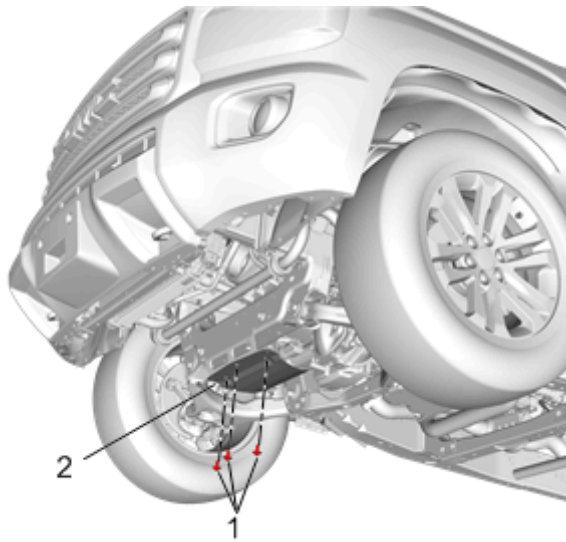


Fig. 96: Steering Gear Skid Shield

Courtesy of GENERAL MOTORS COMPANY

23. Install Steering Gear Skid Shield (2). [Steering Gear Skid Shield Replacement](#)

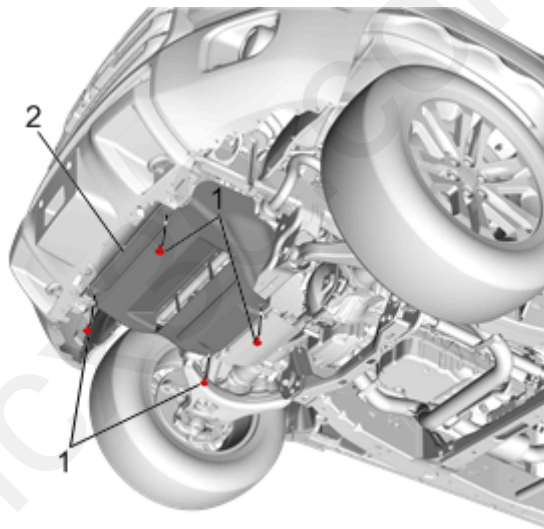


Fig. 97: Underbody Splash Shield

Courtesy of GENERAL MOTORS COMPANY

24. Install Underbody Splash Shield (2) [Underbody Splash Shield Replacement](#)

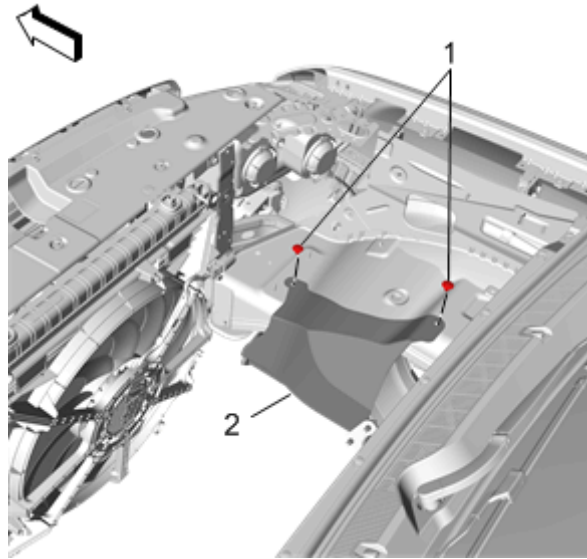


Fig. 98: Engine Front Splash Shield

Courtesy of GENERAL MOTORS COMPANY

25. Install Engine Front Splash Shield (2). [Engine Front Splash Shield Replacement](#)
26. Install the front tire and wheel assemblies. [Tire and Wheel Removal and Installation](#)
27. Measure and adjust the front toe. [Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment](#)
28. Center the steering angle sensor. [Steering Angle Sensor Centering](#)

DESCRIPTION AND OPERATION

POWER STEERING SYSTEM DESCRIPTION AND OPERATION

The belt driven electronic power steering system consists of the following components:

- The integrated electromechanical power steering unit, containing the power steering control module, its sensors, the power steering motor, a belt drive and a ball nut mechanism.
- The steering gear (rack and pinion)

The power steering control module is part of the power steering assist motor assembly and is replaceable as a complete unit independent of the steering gear assembly. The steering wheel torque and angle sensor is integrated with the steering gear pinion and is serviced as part of the steering gear.

The belt driven 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 serial data circuit to perform the system functions. 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 continuously monitors the digital torque sensor's torque and index current signals. As the steering wheel is turned and torque 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.

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 motor drive circuit to drive the alternating current motor. The power steering control module and motor assembly is attached to the base of the steering gear housing and applies power assist directly to the rack with a belt drive and a ball nut mechanism to maneuver the rack laterally depending on the direction the steering wheel is turned.

The power steering control module has advanced software features referred to as Active Pull Compensation and Smooth Road Shake Compensation.

Active Pull Compensation constantly measures steering wheel torque being applied by the driver to maintain the vehicle's path. When the software detects extra effort being used, the steering assist motor adds torque in the proper direction to prevent the driver from having to make corrections to keep the vehicle on course. The torque assistance reduces driver fatigue and effort and makes steering easier. The software automatically resets itself to compensate for changing road conditions or the vehicle turning on curves. This software feature will compensate for a specific range of lead/pull up to its maximum limit within a set of parameters. The feature can be disabled during diagnostics for appropriate root cause of a complaint vehicle.

Smooth Road Shake Compensation reduces steering wheel rotational vibration caused by an imbalance from the front tire/wheel assemblies. The rotational vibration transmitted to the steering wheel is referred to as Smooth Road Shake and is a phenomenon that occurs only at highway speeds and on smooth roads. The power steering control module employs active controls to sense and reduce the periodic torque component applied to the steering wheel caused by the wheel imbalance force. This software feature will compensate for a specific range of imbalance. If the imbalance is above a certain level, the power steering control module will disable the smooth road shake compensation software feature.

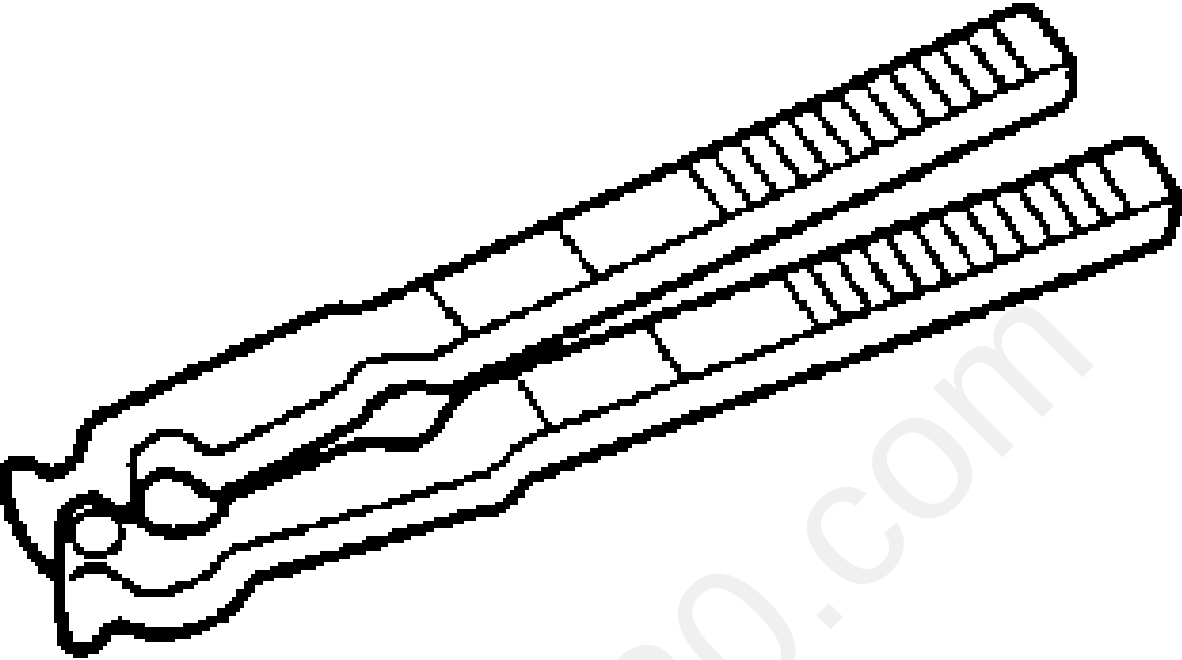
The power steering control module has the ability to calculate an internal system temperature to protect the power steering system from potential damage. To reduce a high system temperature, the power steering control module will reduce the amount of current commanded to the power steering motor, which reduces the amount of steering assist and will set DTC C0176.

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 or STEERING ASSIST IS REDUCED DRIVE WITH CARE message to be displayed on the driver information center.

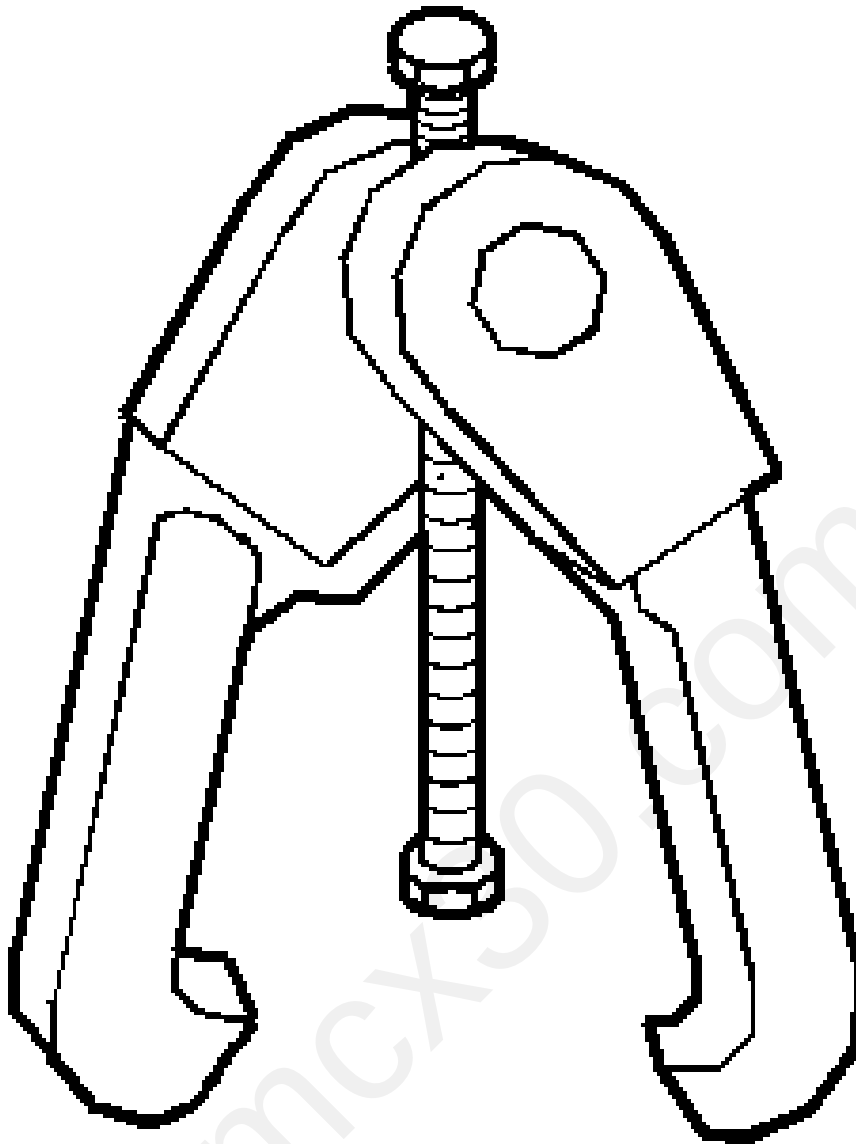
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description

Illustration	Tool Number/ Description
 A line drawing of a pair of pliers. The jaws are long and feature a series of parallel ridges or teeth. The handles are also long and have a similar serrated texture. A locking mechanism is visible at the base of the handles, consisting of a small circular component and a lever. The entire tool is oriented diagonally from the bottom-left towards the top-right.	CH-22610 J-22610 KM-J-22610 SA9164C Keystone Clamp Pliers

Illustration

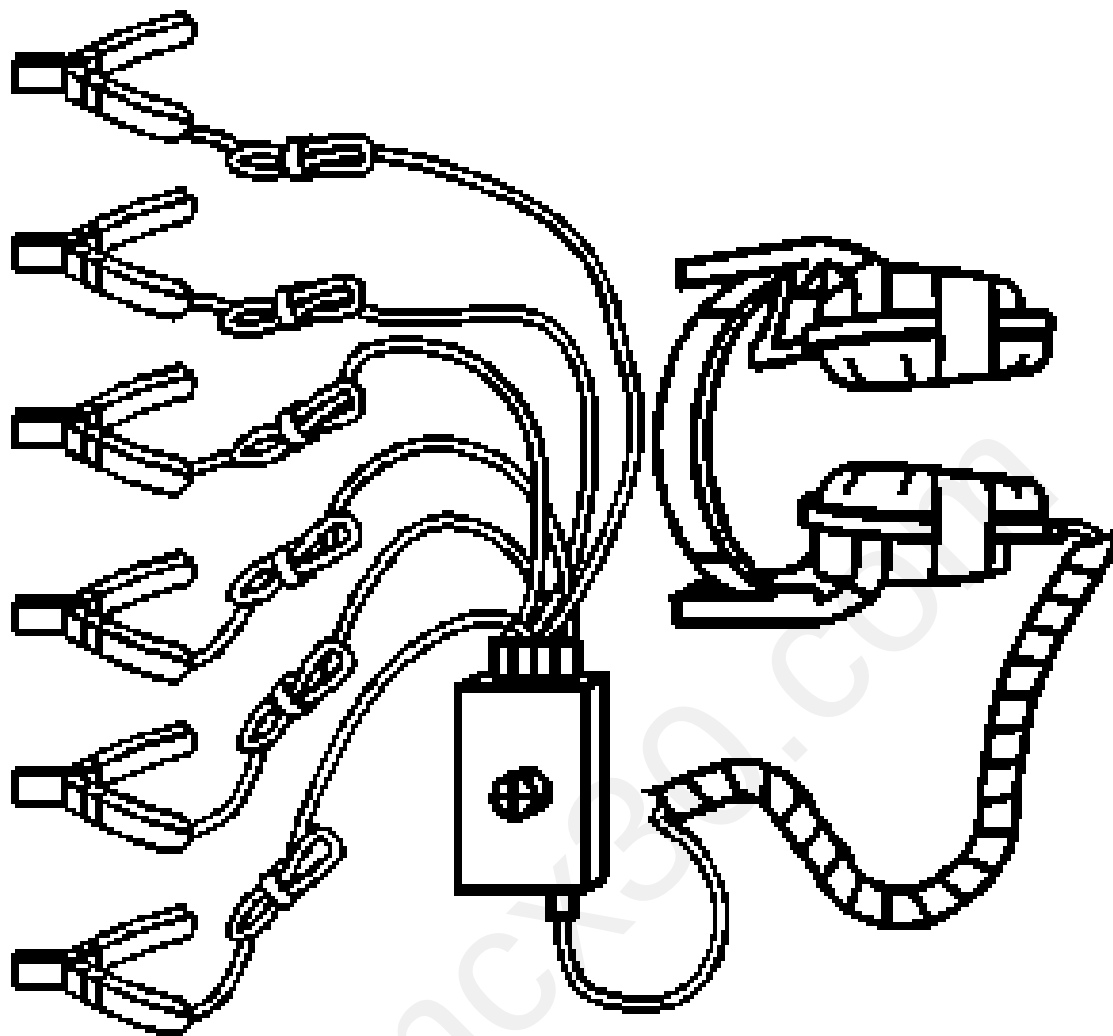


Tool
Number/
Description

CH-24319-B
J-24319-B
SA91100C
7503
Universal
Steering
Linkage and
Tie Rod
Puller

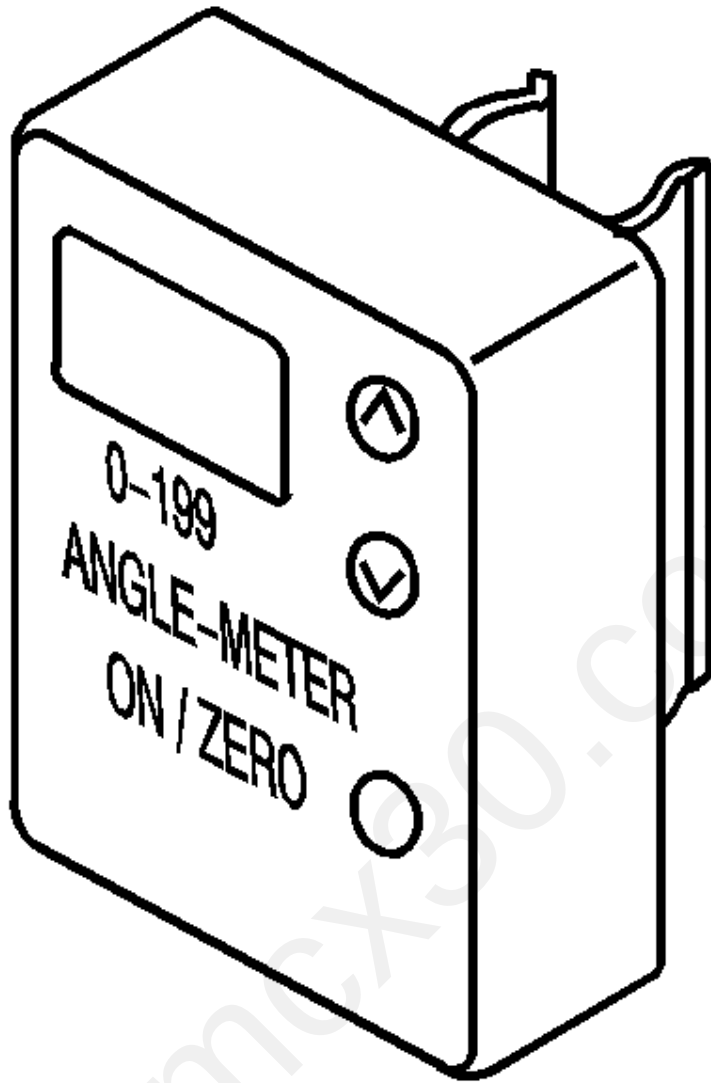
Illustration

Tool
Number/
Description



CH-39570
J-39570
SA9217NE
Electronic
Listening
Chassis Ear

Illustration

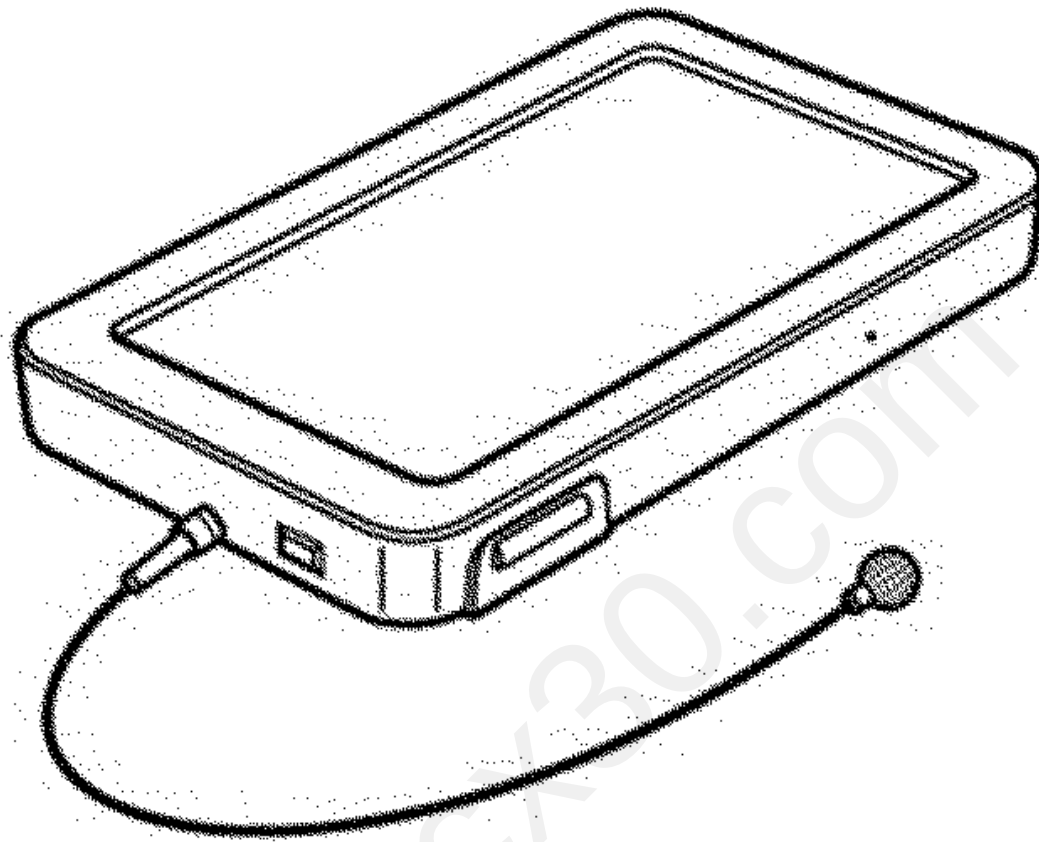


Tool
Number/
Description

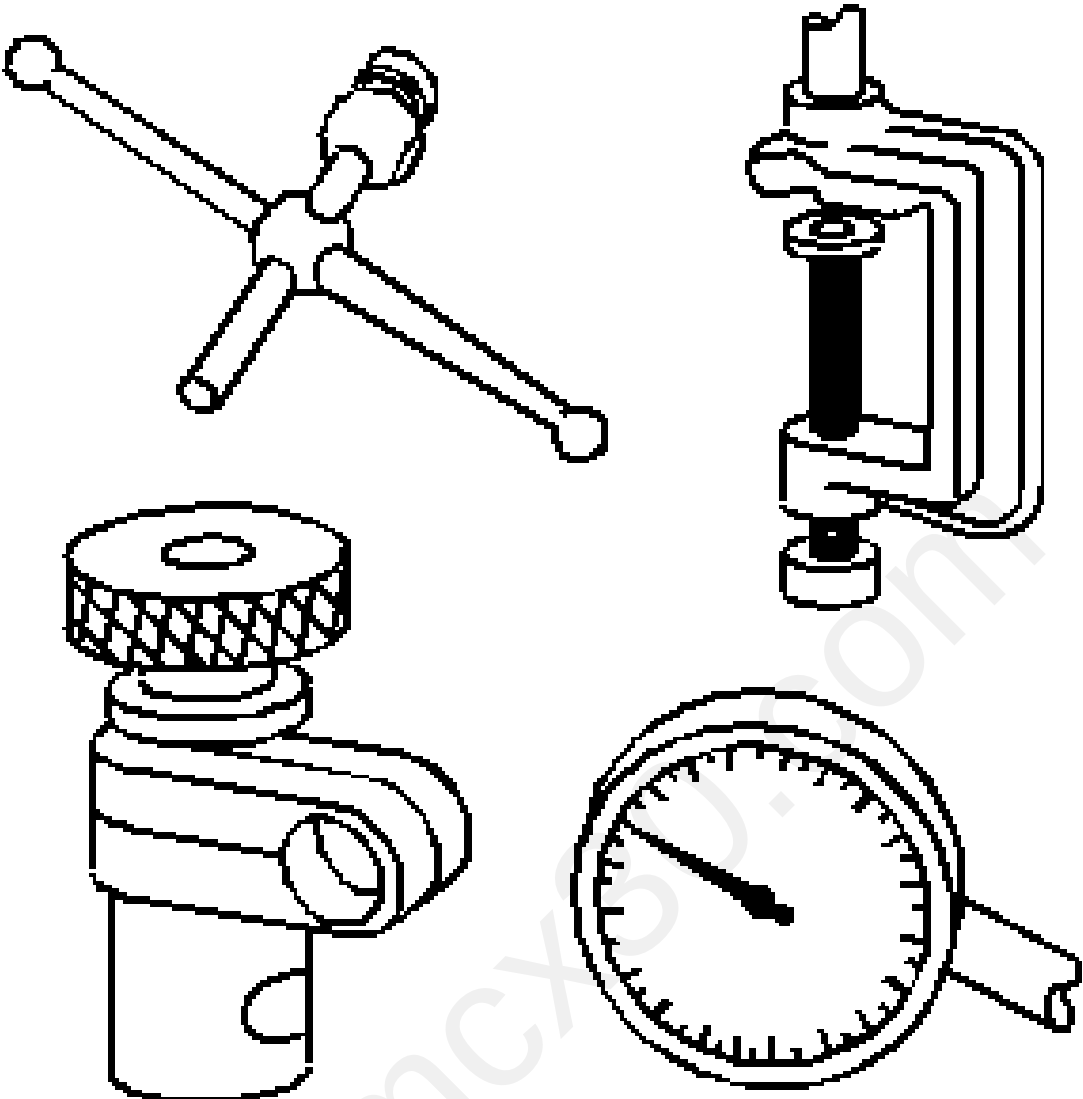
EN-45059
J-45059
Torque Angle
Meter

Illustration

**Tool
Number/
Description**



GE-50576-A
Acoustic Belt
Tension Tool

Illustration	Tool Number/ Description
 The illustration contains four separate line drawings of mechanical components. In the top left is a cross-shaped base with four arms, each ending in a small spherical tip. In the top right is a C-clamp with a threaded rod and a conical foot. In the bottom left is a mounting bracket with a large knurled adjustment wheel on top and a circular dial mount on the side. In the bottom right is a circular dial face with a scale of 100 divisions and a single needle pointing to approximately the 25 mark.	J-8001 GE-8001 Dial Indicator Set