

STEERING

Power Steering - CTS Sedan

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Steering Gear Nut (AWD) (1)		
• First Pass	70 N.m	52 lb ft
• Final Pass	90-100 Degrees	
Steering Gear Nut (RWD) (1)		
• First Pass	58 N.m	43 lb ft
• Final Pass	90-105 Degrees	
Steering Linkage Inner Tie Rod	105 N.m	77 lb ft
Steering Linkage Outer Tie Rod Nut (AWD)		
• First Pass	35 N.m	26 lb ft
• Final Pass	90-100 Degrees	
Steering Linkage Outer Tie Rod Nut (RWD)		
• First Pass	35 N.m	26 lb ft
• Final Pass	40-50 Degrees	
1. Torque-to-yield fastener in use, requires NEW bolt.		

SCHEMATIC WIRING DIAGRAMS

POWER STEERING WIRING SCHEMATICS

Electric Power Steering System

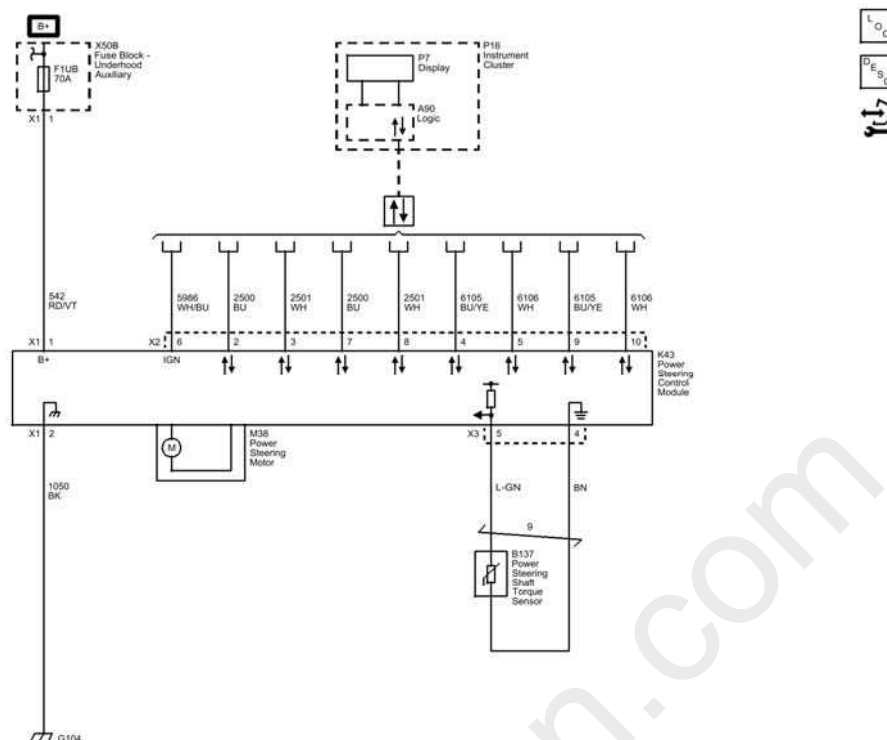


Fig. 1: Electric Power Steering System
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC C0176</u>	DTC C0176 11 Control Module Temperature Sensor High Input DTC C0176 54 Control Module Temperature Sensor High Temperature
<u>DTC C0475</u>	DTC C0475 00 Electric Steering Motor Circuit Malfunction
<u>DTC C047A</u>	DTC C047A 00 Electric Steering Motor Position Sensor Circuit Malfunction. DTC C047A 5A Electric Steering Motor Position Sensor Circuit Not Plausible
<u>DTC C0544</u>	DTC C0544 5A Steering Wheel Angle Sensor Signal Not Plausible
<u>DTC C0545</u>	DTC C0545 00 Steering Wheel Torque Sensor Malfunction. DTC C0545 3A Steering Wheel Torque Sensor Incorrect Component Installed DTC C0545 4B Steering Wheel Torque Sensor Calibration Not Learned.
<u>DTC C0546</u>	DTC C0546 39 Steering System Temperature Sensor Circuit Internal Malfunction
<u>DTC C055C</u>	DTC C055C 00 Steering Gear Performance Malfunction
<u>DTC C0565</u>	DTC C0565 5A Vehicle Identification Number Not Plausible

<u>DTC C056D</u>	DTC C056D 34 Electronic Control Unit Hardware RAM Malfunction DTC C056D 35 Electronic Control Unit Hardware ROM Malfunction DTC C056D 36 Electronic Control Unit Hardware EEPROM Performance/Malfunction DTC C056D 37 Electronic Control Unit Hardware Software Malfunction DTC C056D 39 Electronic Control Unit Hardware Internal Malfunction DTC C056D 3B Electronic Control Unit Hardware Internal Self - Test Malfunction
<u>DTC C056E</u>	DTC C056E 36 Electronic Control Unit Software EEPROM Performance/Malfunction DTC C056E 42 Electronic Control Unit Software Configuration Not Programmed DTC C056E 46 Electronic Control Unit Software Calibration Not Learned

DTC C0176: CONTROL MODULE TEMPERATURE 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 Descriptor

DTC C0176 11

Control Module Temperature Sensor High Input

DTC C0176 54

Control Module Temperature Sensor High Temperature

Circuit/System Description

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

Conditions for Running the DTC

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

Conditions for Setting the DTC

The power steering control module detects a high system temperature.

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

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

Diagnostic Aids

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

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - SEDAN

Description and Operation

Power Steering System Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

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

- **Electric Belt Drive Rack and Pinion Steering Gear Replacement (AWD), Electric Belt Drive Rack and Pinion Steering Gear Replacement (RWD)**
- **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

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

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - SEDAN

Description and Operation

Power Steering System Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Testing

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

Replace the K43 Power Steering Control Module.

- **If the DTC is not set**

2. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Electric Belt Drive Rack and Pinion Steering Gear Replacement (AWD), Electric Belt Drive Rack and Pinion Steering Gear Replacement (RWD)**
- **Control Module References** for power steering control module replacement, programming and setup.

DTC C047A: ELECTRIC STEERING MOTOR POSITION 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 Descriptor

DTC C047A 00

Electric Steering Motor Position Sensor Circuit Malfunction.

DTC C047A 5A

Electric Steering Motor Position Sensor Circuit Not Plausible

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.
- The steering wheel has been rotated greater than 15°.

Conditions for Setting the DTC

C047A 00

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.

C047A 5A

The calculated difference between the internal steering angle and the external steering angle is out of the specified range.

Action Taken When the DTC Sets

- No steering assist.
- A Service Power Steering Drive with Care message may be displayed on the driver information center.

Conditions for Clearing the DTC

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

Diagnostic Aids

Verify the torque sensor harness is properly routed and connected.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - SEDAN

Description and Operation

Power Steering System Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC U0125, U0126, or C0710 is not set.
 - **If any of the DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If none of the DTCs are set**
3. Verify that DTC C047A is not set.
 - **If the DTC is set**

Replace the Steering Gear.

- **If the DTC is not set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Electric Belt Drive Rack and Pinion Steering Gear Replacement (AWD), Electric Belt Drive Rack and Pinion Steering Gear Replacement (RWD)**
- **Control Module References** for power steering control module replacement, programming and setup.

DTC C0544: STEERING WHEEL ANGLE SENSOR SIGNAL NOT PLAUSIBLE

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 C0544 5A

Steering Wheel Angle Sensor Signal Not Plausible

Circuit/System Description

The power steering control module continuously monitors the steering wheel angle sensor. The steering wheel angle sensor indicates the direction in which the driver intends to go.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The power steering control module detects a not plausible signal from the steering wheel angle sensor.

Action Taken When the DTC Sets

- DTC C0544 is stored in memory.
- No steering assist.

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - SEDAN

Description and Operation

Power Steering System Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Ignition ON.
2. Verify that no other DTCs are set except for C0544.
 - **If any other DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**

- **If no other DTCs are set**
- 3. Verify that DTC C0544 is not set.
 - **If the DTC is set**
 1. Program the K43 Power Steering Control Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the B99 Steering Wheel Angle Sensor.
 - If the DTC does not set
 3. All OK.
 - **If the DTC is not set**
- 4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Steering Angle Sensor Replacement**
- **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 Descriptor

DTC C0545 00

Steering Wheel Torque Sensor Malfunction.

DTC C0545 3A

Steering Wheel Torque Sensor Incorrect Component Installed

DTC C0545 4B

Steering Wheel Torque Sensor Calibration Not Learned.

Circuit/System Description

The power steering control module continuously monitors the digital torque sensor's torque. As the steering wheel is turned and torsional twist is applied to the steering shaft, the steering input and output shafts are

monitored via the torque signal circuit and then processed by the power steering control module to calculate the steering torque.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - SEDAN

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

DTC C0545 00 and C0545 3A

1. Verify that the X3 harness connector is installed properly at the K43 Power Steering Control Module.
 - **If the X3 harness connector at the K43 Power Steering Control Module is not installed properly**
 1. Connect the X3 harness connector properly at the K43 Power Steering Control Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the Steering Gear.
 - If the DTC does not set
 3. All OK.
 - **If the X3 harness connector at the K43 Power Steering Control Module is installed properly**
2. Ignition ON.
3. Verify the scan tool Torque Sensor parameter changes when turning the steering wheel.
 - **If the parameter does not change**

Replace the Steering Gear.
 - **If the parameter changes**
4. All OK.

DTC C0545 4B

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

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Electric Belt Drive Rack and Pinion Steering Gear Replacement (AWD), Electric Belt Drive Rack and Pinion Steering Gear Replacement (RWD)**
- **Control Module References** for power steering control module replacement, programming and setup.

DTC C0546: STEERING SYSTEM TEMPERATURE SENSOR CIRCUIT INTERNAL

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 Descriptor

DTC C0546 39

Steering System Temperature Sensor Circuit Internal Malfunction

Circuit/System Description

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

Conditions for Running the DTC

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

Conditions for Setting the DTC

The power steering control module detects a high system temperature.

Action Taken When the DTC Sets

- DTC C0546 39 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

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 - SEDAN

Description and Operation

Power Steering System Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Ignition ON.
2. Verify DTC C0546 is not set.
 - **If DTC C0546 is set**
 1. Verify that no steering components down stream of the power steering column assembly are mechanically binding. Refer to **Steering Effort Hard or Too Easy in One or Both Directions**
 - If steering components are mechanically binding, replace the mechanically binding steering components.
 - If no steering components are mechanically binding
 2. Replace the Steering Gear.
 - **If DTC C0546 is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Electric Belt Drive Rack and Pinion Steering Gear Replacement (AWD), Electric Belt Drive Rack and Pinion Steering Gear Replacement (RWD)**
- **Control Module References** for power steering control module replacement, programming and setup.

DTC C055C: STEERING GEAR PERFORMANCE 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 Descriptor

DTC C055C 00

Steering Gear Performance Malfunction

Circuit/System Description

The power steering control module continuously verifies the mechanical friction of the steering gear. If the friction is too high the clutch between motor and rack slips and the internal angle is not longer valid.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The DTC is set when the mechanical friction of the steering gear is too high.

Action Taken When the DTC Sets

- DTC C055C is stored in memory.
- No steering assist.

Conditions for Clearing the DTC

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

Diagnostic Aids

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 - SEDAN

Description and Operation

Power Steering System Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC C055C is not set.
 - **If the DTC is set**
 1. Verify that no steering components down stream of the power steering column assembly are mechanically binding. Refer to **Steering Effort Hard or Too Easy in One or Both Directions**
 - If steering components are mechanically binding, replace the mechanically binding steering components.
 - If no steering components are mechanically binding, replace the steering gear.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Electric Belt Drive Rack and Pinion Steering Gear Replacement (AWD), Electric Belt Drive Rack and Pinion Steering Gear Replacement (RWD)**
- **Control Module References** for power steering control module replacement, programming and setup.

DTC C0565: VEHICLE IDENTIFICATION NUMBER NOT PLAUSIBLE

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 C0565 5A

Vehicle Identification Number Not Plausible

Circuit/System Description

The vehicle identification number (VIN) is programmed into the power steering control module during initial programming of the module.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The power steering control module is properly not programmed.

Action Taken When the DTC Sets

- DTC C0565 is stored in memory.
- No steering assist.

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - SEDAN

Description and Operation

Power Steering System Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC C0565 is not set.
 - **If the DTC C0565 is set**
 1. Program the K43 Power Steering Control Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the Steering Gear.
 - If the DTC does not set
 3. All OK.
 - **If the DTC C0565 is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Electric Belt Drive Rack and Pinion Steering Gear Replacement (AWD), Electric Belt Drive Rack and Pinion Steering Gear Replacement (RWD)**
- **Control Module References** for power steering control module replacement, programming and setup.

DTC C056D: ELECTRONIC CONTROL UNIT HARDWARE/SOFTWARE

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 C056D 34

Electronic Control Unit Hardware RAM Malfunction

DTC C056D 35

Electronic Control Unit Hardware ROM Malfunction

DTC C056D 36

Electronic Control Unit Hardware EEPROM Performance/Malfunction

DTC C056D 37

Electronic Control Unit Hardware Software Malfunction

DTC C056D 39

Electronic Control Unit Hardware Internal Malfunction

DTC C056D 3B

Electronic Control Unit Hardware Internal Self - Test 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 OFF, ACCESSORY, or RUN mode.

Conditions for Setting the DTC

The power steering control module has detected missing calibration data, calibration procedure not run or completed, missing VIN, or internal software malfunction.

Actions Taken When DTC Sets

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

Conditions for Clearing the DTC

A current or history DTC will clear after the power steering control module has been programmed and calibrated.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - SEDAN

Description and Operation

Power Steering System Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC C056D is not set.
 - **If the DTC C056D is set**
 1. Program the K43 Power Steering Control Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the Steering Gear.
 - If the DTC does not set
 - **If the DTC C056D is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Electric Belt Drive Rack and Pinion Steering Gear Replacement (AWD), Electric Belt Drive Rack and Pinion Steering Gear Replacement (RWD)**
- **Control Module References** for power steering control module replacement, programming and setup.

DTC C056E: ELECTRONIC CONTROL UNIT SOFTWARE

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 36

Electronic Control Unit Software EEPROM Performance/Malfunction

DTC C056E 42

Electronic Control Unit Software Configuration Not Programmed

DTC C056E 46

Electronic Control Unit Software Calibration Not Learned

Circuit/System Description

After replacement 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 OFF, ACCESSORY, or RUN mode.

Conditions for Setting the DTC

The power steering control module has detected missing calibration data, calibration procedure not run or completed, missing VIN, or internal software malfunction.

Actions Taken When DTC Sets

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

Conditions for Clearing the DTC

A current or history DTC will clear after the power steering control module has been programmed and calibrated.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - SEDAN

Description and Operation

Power Steering System Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

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

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Electric Belt Drive Rack and Pinion Steering Gear Replacement (AWD), Electric Belt Drive Rack and Pinion Steering Gear Replacement (RWD)**

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

SYMPTOMS - POWER STEERING SYSTEM

NOTE: Review the system description and operation in order to familiarize yourself with the system functions. Refer to **Power Steering System Description and Operation**.

Visual/Physical Inspection

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

Symptoms List

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

- **Rattle, Clunk, 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 or Too Easy in One or Both Directions**

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

Rattle, Clunk, 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 <u>Symptoms - Steering Wheel and Column</u>
2	Verify a rattle noise is present by driving the vehicle on a rough road. Verify a clunk noise is present by turning the steering wheel to the left and to the right several times with the key in the ON position. Is a rattle or a clunk noise present?	Go to Step 3	System OK
3	Inspect the steering gear for the proper installation. Refer to <u>Electric Belt Drive Rack and Pinion Steering Gear Replacement (AWD)</u> , <u>Electric Belt Drive Rack and Pinion Steering Gear Replacement (RWD)</u> . Is the steering gear installation incorrect?	Go to Step 6	Go to Step 4
4	Inspect the intermediate steering shaft. Is the intermediate steering shaft worn?	Go to Step 8	Go to Step 5
	Inspect the front suspension. Refer to <u>Noise</u>		

5	<u>Diagnosis - Front Suspension .</u> Is the front suspension worn?	Go to Step 7	Go to Step 3
6	Install the steering gear correctly. Refer to <u>Electric Belt Drive Rack and Pinion Steering Gear Replacement (AWD)</u> , <u>Electric Belt Drive Rack and Pinion Steering Gear Replacement (RWD)</u> . Did you complete the repair?	Go to Step 9	-
7	Replace the worn front suspension component that is causing the noise. Did you complete the repair?	Go to Step 9	-
8	Replace the intermediate steering shaft. Refer to <u>Intermediate Steering Shaft Replacement (RWD)</u> , <u>Intermediate Steering Shaft Replacement (AWD)</u> . Did you complete the repair?	Go to Step 9	-
9	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

WHINE OR GROWL NOISE FROM THE POWER STEERING SYSTEM

Special Tools

CH-39570 Chassis Ear

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

Whine or Growl Noise from the Power Steering System

Step	Action	Yes	No
1	Did you review the Power Steering System General Description and perform the necessary inspections?	Go to Step 2	Go to <u>Power Steering System Description and Operation</u>
2	Verify that a whine or growl noise is present. Is a whine or growl noise present?	Go to Step 3	System OK
3	Inspect the power steering gear fasteners for looseness and inspect the steering gear mounting surface for damage. Are the steering gear fasteners loose or the mounting surface damaged?	Go to Step 6	Go to Step 4
4	Inspect the power steering assist motor for a whine or growl noise using the CH-39570 chassis ear. Is the noise present at the steering assist motor?	Go to Step 7	Go to Step 5
5	Inspect the power steering gear for a whine or growl noise using the CH-39570 chassis ear. Is the noise present at the steering gear?	Go to Step 7	Go to Step 3
	If the mounting surface on the steering gear is not		

6	damaged then replace the power steering gear fasteners. If the mounting surface on the steering gear is damaged replace the steering gear and steering gear fasteners. Refer to the appropriate procedure(s): • <u>Fastener Tightening Specifications</u> • <u>Electric Belt Drive Rack and Pinion Steering Gear Replacement (AWD), Electric Belt Drive Rack and Pinion Steering Gear Replacement (RWD)</u> Did you complete the repair?	Go to Step 8	-
7	Replace power steering gear. Refer to <u>Electric Belt Drive Rack and Pinion Steering Gear Replacement (AWD), Electric Belt Drive Rack and Pinion Steering Gear Replacement (RWD)</u>. Did you complete the repair?	Go to Step 8	-
8	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

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 General Description and perform the necessary inspections?	Go to Step 2	Go to <u>Power Steering System Description and Operation</u>
2	Verify that poor return of the steering wheel is present. Does the system operate normally?	System OK	Go to Step 3
3	1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Lubricate the tie rod ends and ball joints, if applicable. 3. Inspect the suspension system for worn or damaged components. 4. Repair as necessary. Did you find and correct the condition?	Go to Step 12	Go to Step 4
	1. Rotate the steering wheel ONE revolution in		

4	both directions. 2. Rotate the steering wheel back to the original position. Was the steering wheel abnormally difficult to rotate in either direction?	Go to Step 5	Go to Step 10
5	NOTE: Position the wheels straight ahead and lock the steering wheel to prevent rotation. Once the intermediate shaft is disconnected, do NOT rotate the steering wheel more than one complete revolution from center. Ensure the steering column is locked before connecting the intermediate shaft. 1. Disconnect the intermediate shaft from the steering column. 2. Note the position of the steering wheel and rotate the steering wheel ONE revolution in both directions. 3. Rotate the steering wheel back to the original position. Was the steering wheel abnormally difficult to rotate in either direction?	Go to Step 11	Go to Step 6
6	Inspect the intermediate shaft for stiff or loose joints. Repair or replace as necessary. Did you find and complete the repair?	Go to Step 12	Go to Step 7
7	1. Remove the front tire and wheel assemblies. Refer to <u>Tire and Wheel Removal and Installation</u>. 2. Disconnect both outer tie rod ends from the steering knuckles. 3. Use your hands in order to move the tie rod end studs. 4. If abnormally difficult to move, replace the tie rod end. Did you find and complete the repair?	Go to Step 12	Go to Step 8
8	1. Use your hands to rotate the steering knuckle inboard and outboard in order to inspect for a binding strut bearings, ball joints, or axle. 2. Repair or replace any abnormally stiff or loose components.		

	Did you find and complete the repair?	Go to Step 12	Go to Step 9
9	Inspect for binding in the steering gear. If a binding is present repair or replace the steering gear. Did you find and complete the repair?	Go to Step 12	Go to Step 10
10	Inspect the wheel alignment and adjust as necessary. Refer to Wheel Alignment Measurement . Did you find and complete the repair?	Go to Step 12	-
11	Inspect the steering column for a binding. If a binding is present, repair or replace the steering column as necessary. Did you find and complete the repair?	Go to Step 12	-
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	-

STEERING WHEEL SURGES/JERKS WHILE TURNING

Steering Wheel Surges/Jerks While Turning

Step	Action	Yes	No
1	Did you review the Power Steering System Description and Operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Power Steering System
2	Verify that the steering wheel surges/jerks while turning. Does the system operate normally?	System OK	Go to Step 3
3	Check for worn or binding front suspension components. Did you find and correct the condition?	Go to Step 14	Go to Step 4
4	1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle . 2. Check for a binding or worn tie rod end. Is the tie rod end binding or worn?	Go to Step 10	Go to Step 5
5	Check for a worn or binding intermediate steering shaft(s). Is the intermediate steering shaft(s) worn or binding?	Go to Step 11	Go to Step 6
6	Check for worn a binding power steering gear. Is the power steering gear worn or binding?	Go to Step 12	Go to Step 7
7	Check for a worn or binding steering column. Is the steering column worn or binding?	Go to Step 13	Go to Step 8
8	Check for excessive heat in the power steering assist motor. Does the power steering assist motor appear to be overheated?	Go to Step 09	Go to Step 12
	NOTE:		

9	• Do not perform excessive parking lot maneuvers during testing. • Excessive parking lot maneuvers can cause the power steering assist motor to heat up. Allow the power steering assist motor to cool and retest the system. Did you correct the condition?	Go to Step 14	Go to Step 12
10	Replace the outer tie rod end. Refer to <u>Steering Linkage Outer Tie Rod Replacement (AWD)</u>, <u>Steering Linkage Outer Tie Rod Replacement (RWD)</u>. Did you complete the repair?	Go to Step 14	-
11	Replace the intermediate steering shaft(s). Refer to <u>Intermediate Steering Shaft Replacement (RWD)</u>, <u>Intermediate Steering Shaft Replacement (AWD)</u>. Did you complete the repair?	Go to Step 14	-
12	Replace the power steering gear. Refer to <u>Electric Belt Drive Rack and Pinion Steering Gear Replacement (AWD)</u>, <u>Electric Belt Drive Rack and Pinion Steering Gear Replacement (RWD)</u>. Did you complete the repair?	Go to Step 14	-
13	Replace the steering column. Refer to <u>Steering Column Replacement</u>. 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 EFFORT HARD OR TOO EASY IN ONE OR BOTH DIRECTIONS

Steering Effort Hard or Too Easy in One or Both Directions

Condition	Action
The battery power is low.	Ensure proper battery voltage.
The intermediate shaft dash seal is binding.	Adjust the dash seal or replace the intermediate shaft if necessary. Refer to <u>Intermediate Steering Shaft Replacement (RWD)</u> , <u>Intermediate Steering Shaft Replacement (AWD)</u> .
The intermediate shaft joints are loose or worn.	Inspect the joints and the pinch bolts for damage, and replace the intermediate shaft if necessary. Refer to <u>Intermediate Steering Shaft Replacement (RWD)</u> , <u>Intermediate Steering Shaft Replacement (AWD)</u> .
The steering gear is binding.	If necessary, inspect and replace the steering gear. Refer to <u>Electric Belt Drive Rack and Pinion Steering Gear Replacement (AWD)</u> , <u>Electric Belt Drive Rack and Pinion Steering Gear Replacement (RWD)</u> .

The upper steering shaft is bent.	If necessary, replace the steering column. Refer to <u>Steering Column Replacement</u> .
The connectors to the assist motor are damaged or disconnected.	Verify the connectors are properly connected. Verify the connectors are not damaged. If the connectors are damaged, replace the connectors.
The sensor wire is damaged.	Replace the steering gear. Refer to <u>Electric Belt Drive Rack and Pinion Steering Gear Replacement (AWD)</u> , <u>Electric Belt Drive Rack and Pinion Steering Gear Replacement (RWD)</u> .
The controller is malfunctioning.	Confirm the DTC. If necessary, replace the motor/module assembly. Refer to <u>Electric Belt Drive Rack and Pinion Steering Gear Replacement (AWD)</u> , <u>Electric Belt Drive Rack and Pinion Steering Gear Replacement (RWD)</u> .
The motor shaft is binding.	Confirm the DTC. If necessary, replace the motor/module assembly. Refer to <u>Electric Belt Drive Rack and Pinion Steering Gear Replacement (AWD)</u> , <u>Electric Belt Drive Rack and Pinion Steering Gear Replacement (RWD)</u> .

REPAIR INSTRUCTIONS

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.

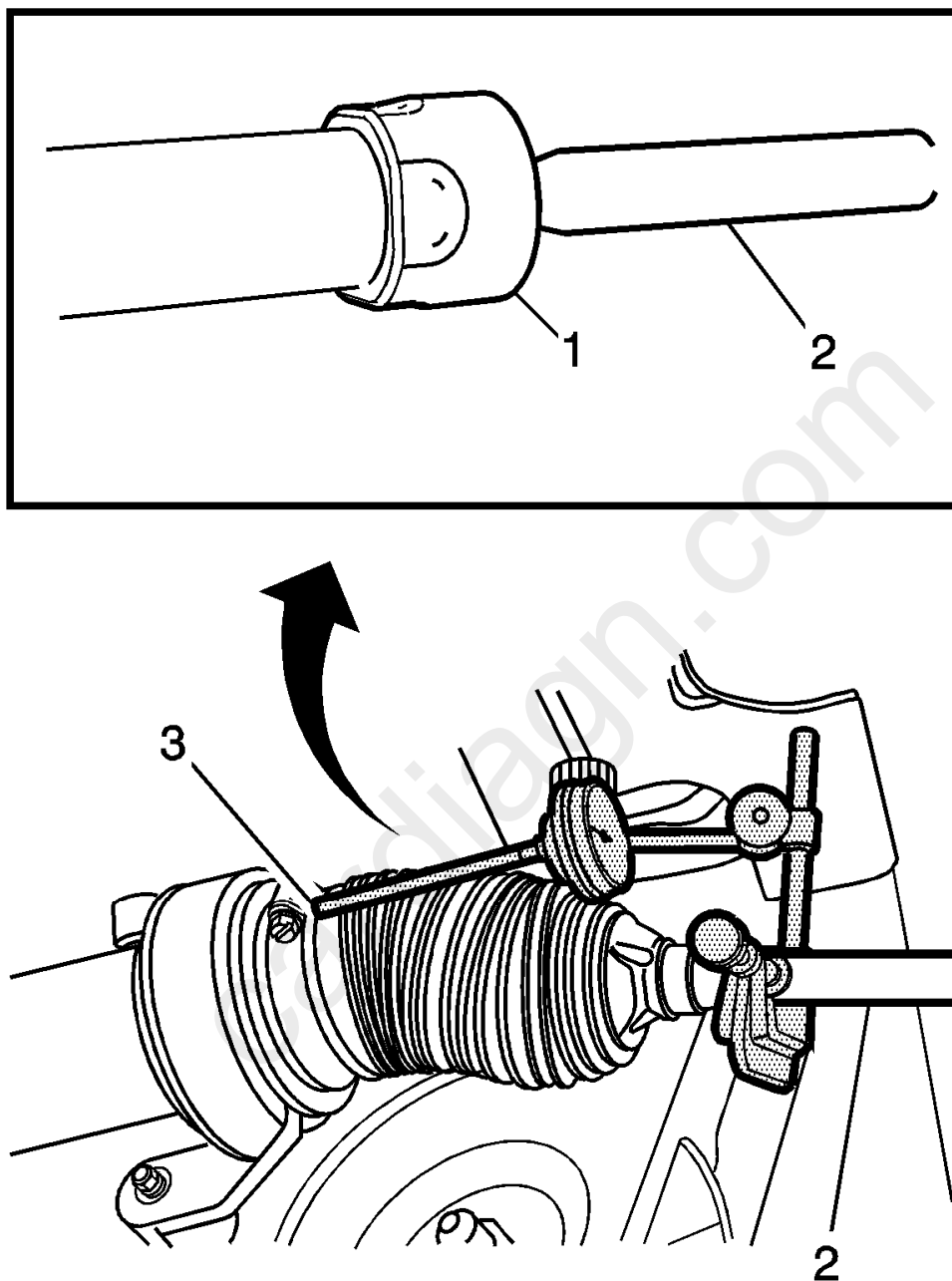


Fig. 2: Measuring Lash Between Inner Tie Rod & Steering Gear Housing
Courtesy of GENERAL MOTORS COMPANY

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** .
4. If there is not a good location for the **GE-8001** dial indicator pointer at the steering gear housing, install a large worm gear hose clamp (3) to the steering gear housing over the larger steering gear boot clamp and align the clamp so that the screw can be a location for the **GE-8001** dial indicator pointer.
5. Install the **GE-8001** dial indicator between the inner tie rod and the steering gear housing or the worm gear clamp in such a way as to measure the lash between the inner tie rod and the steering gear housing. The lash between the inner tie rod and the steering gear housing is equal to the lash between the inner tie rod and the inner tie rod housing because the inner tie rod housing is inside the steering gear housing during this procedure.

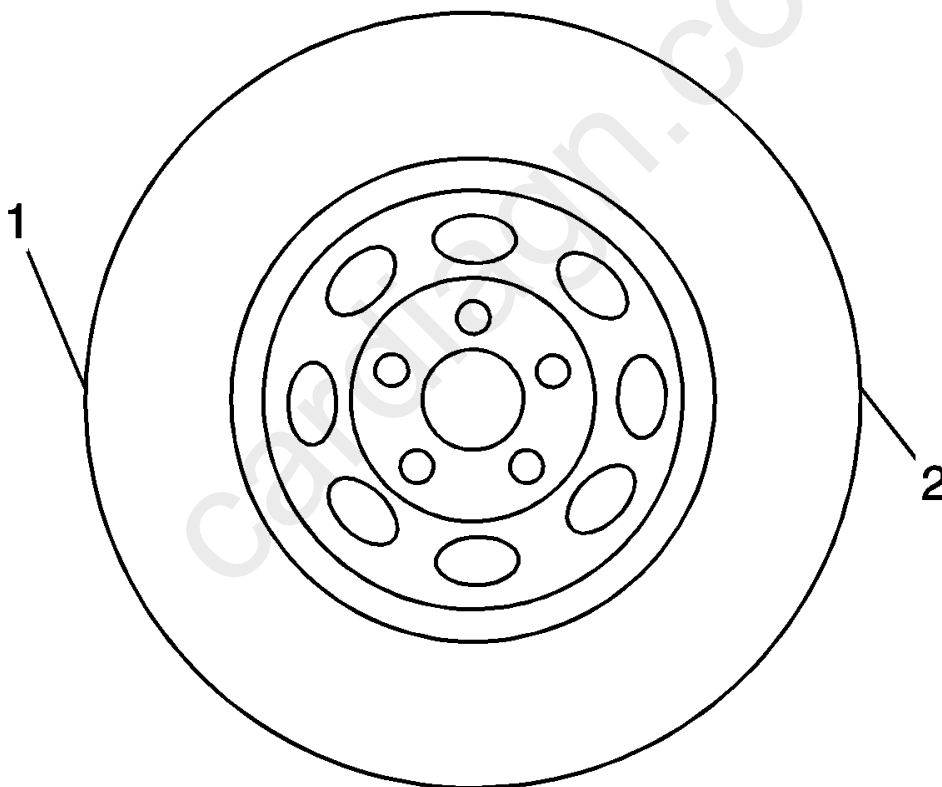


Fig. 3: Identifying Tire Grasping Positions
Courtesy of GENERAL MOTORS COMPANY

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**.
11. Repeat the procedure for the other side.

STEERING LINKAGE OUTER TIE ROD INSPECTION

Special Tools

GE-8001 Dial Indicator Set

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

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

1. Inspect the outer tie rod seal. If the outer tie rod seal is torn, replace the outer tie rod. Refer to **Steering Linkage Outer Tie Rod Replacement (AWD)**, **Steering Linkage Outer Tie Rod Replacement (RWD)**.
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**.

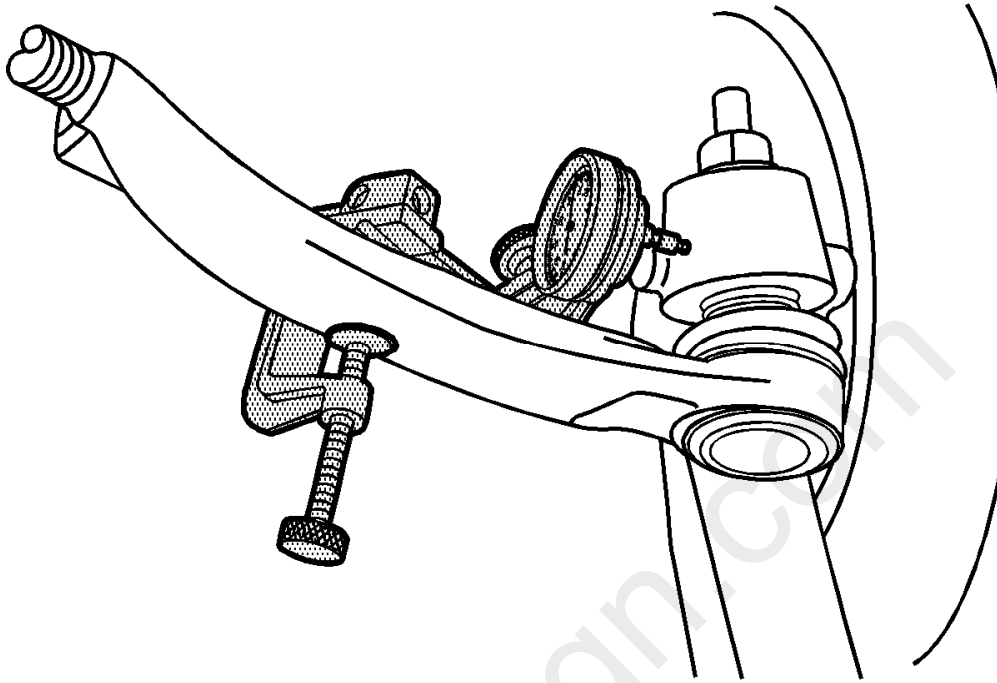


Fig. 4: Measuring Outer Tie Rod Lash
Courtesy of GENERAL MOTORS COMPANY

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

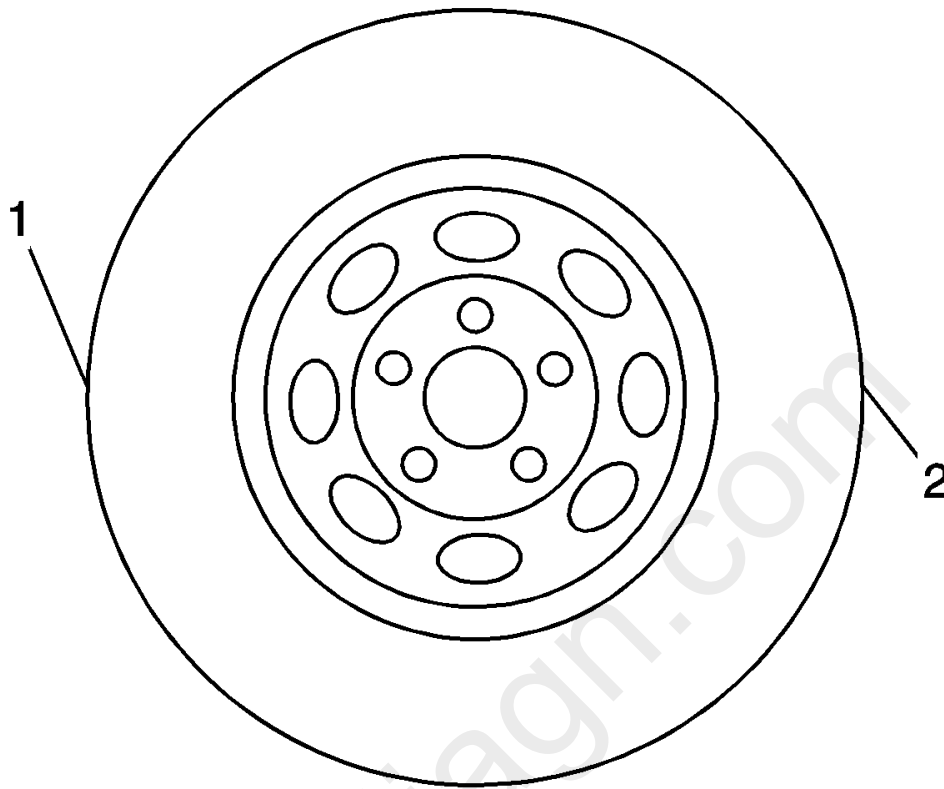


Fig. 5: Identifying Tire Grasping Positions
Courtesy of GENERAL MOTORS COMPANY

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 (AWD)**, **Steering Linkage Outer Tie Rod Replacement (RWD)**.
9. Repeat the procedure for the other side.

STEERING LINKAGE OUTER TIE ROD REPLACEMENT (AWD)

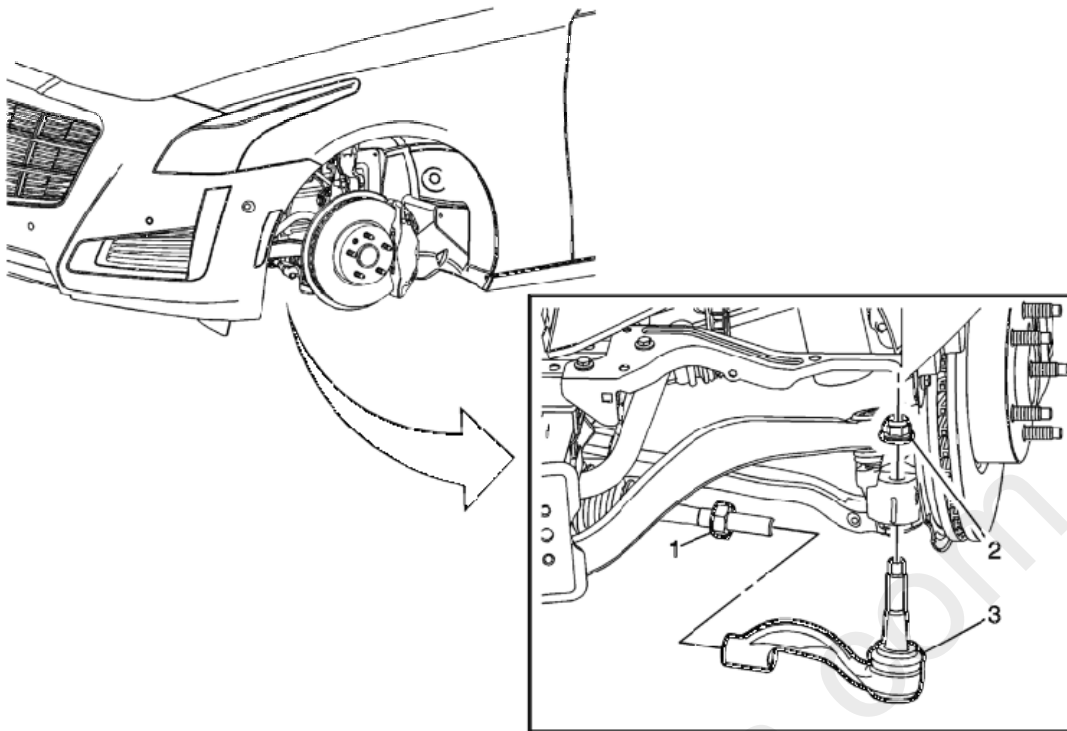


Fig. 6: Steering Linkage Outer Tie Rod (AWD)
 Courtesy of GENERAL MOTORS COMPANY

Steering Linkage Outer Tie Rod Replacement (AWD)

Callout	Component Name
Preliminary Procedures	
1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Remove the front tire and wheel assembly. Refer to <u>Tire and Wheel Removal and Installation</u> .	
1	Steering Linkage Inner Tie Rod Nut Procedure 1. Place match marks on the steering linkage inner tie rod nut and the steering linkage inner tie rod. 2. During installation, align the match marks. 3. Do not tighten the nut during installation. Tighten the nut after adjusting the front toe.
2	Steering Linkage Outer Tie Rod Nut CAUTION: Refer to <u>Fastener Caution</u> . Tighten

	35 N.m (26 lb ft) + (90-100 degrees)
3	Steering Linkage Outer Tie Rod CAUTION: Do not free the ball stud by using a pickle fork or a wedge-type tool. Damage to the seal or bushing may result. Procedure 1. Use the J-24319-B puller to disconnect the steering linkage outer tie rod from the steering knuckle. 2. Inspect the steering linkage inner tie rod for bent or damaged threads. 3. Clean the tapered surface of the steering knuckle. 4. Measure and adjust the front toe. Refer to <u>Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment</u> . Special Tools J-24319-B Steering Linkage and Tie Rod Puller For equivalent regional tools, refer to <u>Special Tools</u>.

STEERING LINKAGE OUTER TIE ROD REPLACEMENT (RWD)

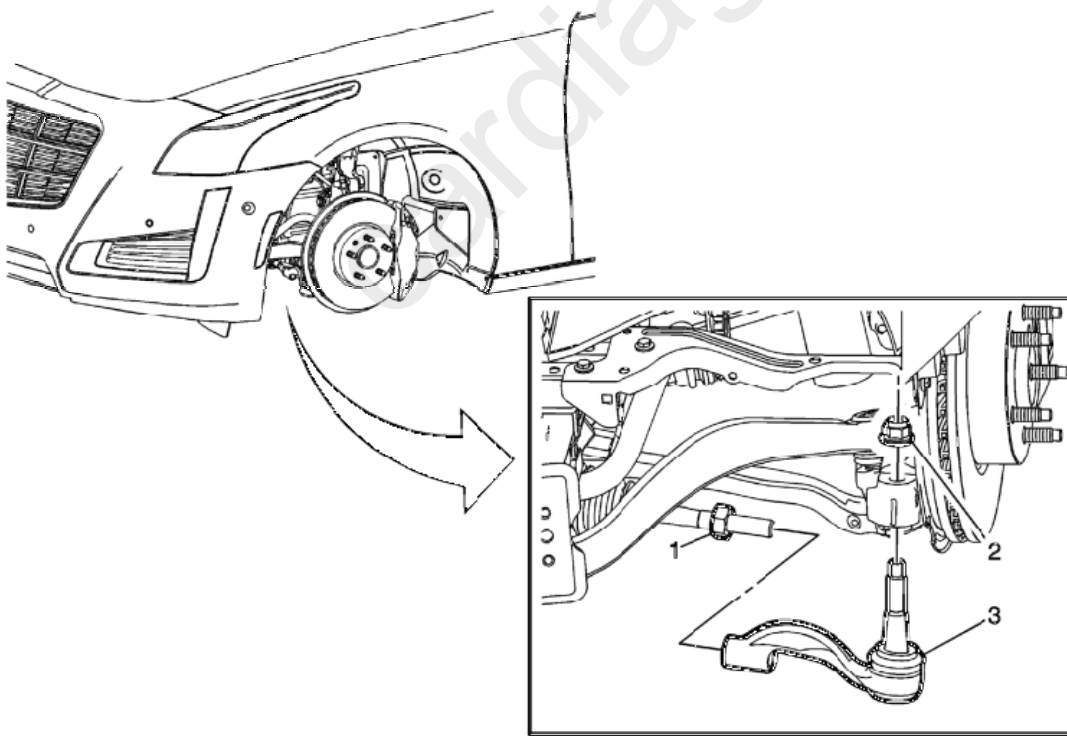


Fig. 7: Steering Linkage Outer Tie Rod (RWD)
Courtesy of GENERAL MOTORS COMPANY

Steering Linkage Outer Tie Rod Replacement (RWD)

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Remove the front tire and wheel assembly. Refer to <u>Tire and Wheel Removal and Installation</u> .	
1	Steering Linkage Inner Tie Rod Nut Procedure 1. Place match marks on the steering linkage inner tie rod nut and the steering linkage inner tie rod. 2. During installation, align the match marks. 3. Do not tighten the nut during installation. Tighten the nut after adjusting the front toe.
2	Steering Linkage Outer Tie Rod Nut CAUTION: Refer to <u>Fastener Caution</u> . Tighten 35 N.m (26 lb ft) + (40-50 degrees)
3	Steering Linkage Outer Tie Rod CAUTION: Do not free the ball stud by using a pickle fork or a wedge-type tool. Damage to the seal or bushing may result. Procedure 1. Use the J-24319-B puller to disconnect the steering linkage outer tie rod from the steering knuckle. 2. Inspect the steering linkage inner tie rod for bent or damaged threads. 3. Clean the tapered surface of the steering knuckle. 4. Measure and adjust the front toe. Refer to <u>Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment</u> . Special Tools J-24319-B Steering Linkage and Tie Rod Puller For equivalent regional tools, refer to <u>Special Tools</u> .

STEERING GEAR BOOT REPLACEMENT

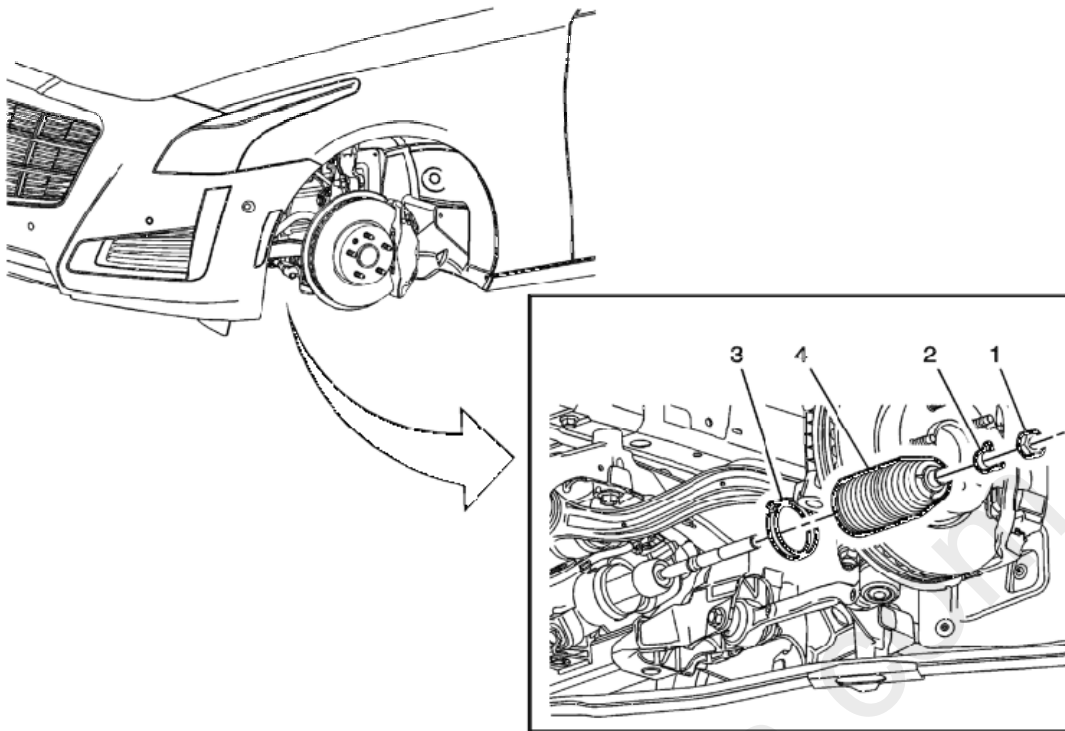


Fig. 8: Steering Gear Boot
Courtesy of GENERAL MOTORS COMPANY

Steering Gear Boot Replacement

Callout	Component Name
Preliminary Procedures	
1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Remove the front compartment lower noise shield. Refer to <u>Front Compartment Lower Noise Shield Replacement (AWD)</u> , <u>Front Compartment Lower Noise Shield Replacement (RWD)</u> . 3. Remove the steering linkage outer tie rod. Refer to <u>Steering Linkage Outer Tie Rod Replacement (AWD)</u>, <u>Steering Linkage Outer Tie Rod Replacement (RWD)</u>.	
1	Steering Linkage Inner Tie Rod Nut Procedure 1. Place match marks on the steering linkage inner tie rod nut and the steering linkage inner tie rod to mark the location of the nut on the tie rod. 2. During installation, align the match marks.
2	Steering Gear Boot Outer Clamp
	Steering Gear Boot Inner Clamp Procedure

3	1. Cut the steering gear boot inner clamp. Discard the clamp. 2. Use the DT-35910 pliers to install a NEW steering gear boot inner clamp. Special Tools DT-35910 Drive Axle Boot Clamp Pliers For equivalent regional tools, refer to Special Tools.
4	Steering Gear Boot Procedure 1. Inspect the inner tie rod for evidence of corrosion or contamination. If none is evident, continue with the repair. If corrosion or contamination is evident, replace the electric drive belt rack and pinion steering gear. Refer to <u>Electric Belt Drive Rack and Pinion Steering Gear Replacement (AWD)</u>, <u>Electric Belt Drive Rack and Pinion Steering Gear Replacement (RWD)</u>. 2. Install the steering gear boot and ensure the boot is seated in the assembly groove of the steering gear before installing the steering gear boot clamps.

ELECTRIC BELT DRIVE RACK AND PINION STEERING GEAR REPLACEMENT (AWD)

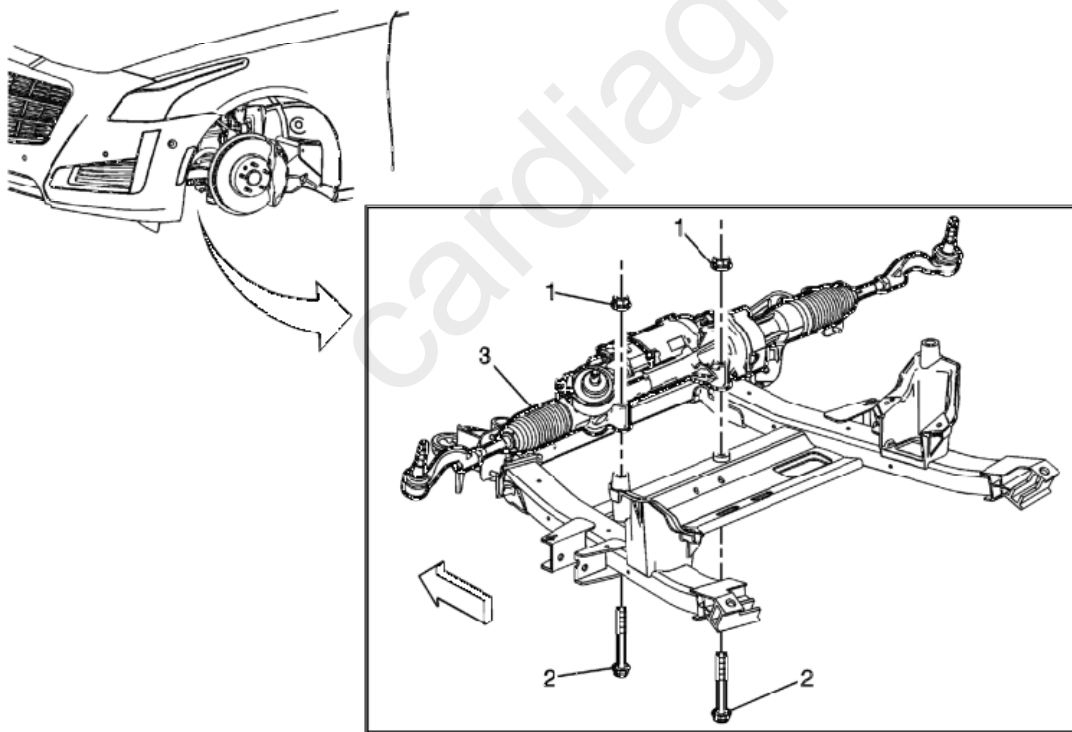


Fig. 9: Electric Belt Drive Rack and Pinion Steering Gear (AWD)
Courtesy of GENERAL MOTORS COMPANY

Electric Belt Drive Rack and Pinion Steering Gear Replacement (AWD)

Callout	Component Name
Preliminary Procedures	
1. Disconnect the steering linkage outer tie rods from the steering knuckles. Refer to <u>Steering Linkage Outer Tie Rod Replacement (AWD)</u>, <u>Steering Linkage Outer Tie Rod Replacement (RWD)</u>. 2. Disconnect the intermediate steering shaft from the steering gear. Refer to <u>Intermediate Steering Shaft Replacement (RWD)</u> , <u>Intermediate Steering Shaft Replacement (AWD)</u> . 3. Remove the front lower control front link. Refer to <u>Front Lower Control Front Link Replacement (RWD)</u> , <u>Front Lower Control Front Link Replacement (AWD)</u> . 4. Disconnect any electrical connectors as necessary.	
1	Steering Gear Nut (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 70 N.m (52 lb ft) + (90-100 degrees)
2	Steering Gear Bolt (Qty: 2) CAUTION: This vehicle is equipped with torque-to-yield or single use fasteners. Install a NEW torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component. Procedure 1. Remove the steering gear bolts. DISCARD the bolts. 2. Install NEW steering gear bolts.
3	Electric Belt Drive Rack and Pinion Steering Gear Procedure 1. Transfer components as necessary. 2. Perform the power steering control module programming and setup. Refer to <u>Power Steering Control Module Programming and Setup</u> . 3. Measure and adjust the front toe. Refer to <u>Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment</u> .

ELECTRIC BELT DRIVE RACK AND PINION STEERING GEAR REPLACEMENT (RWD)

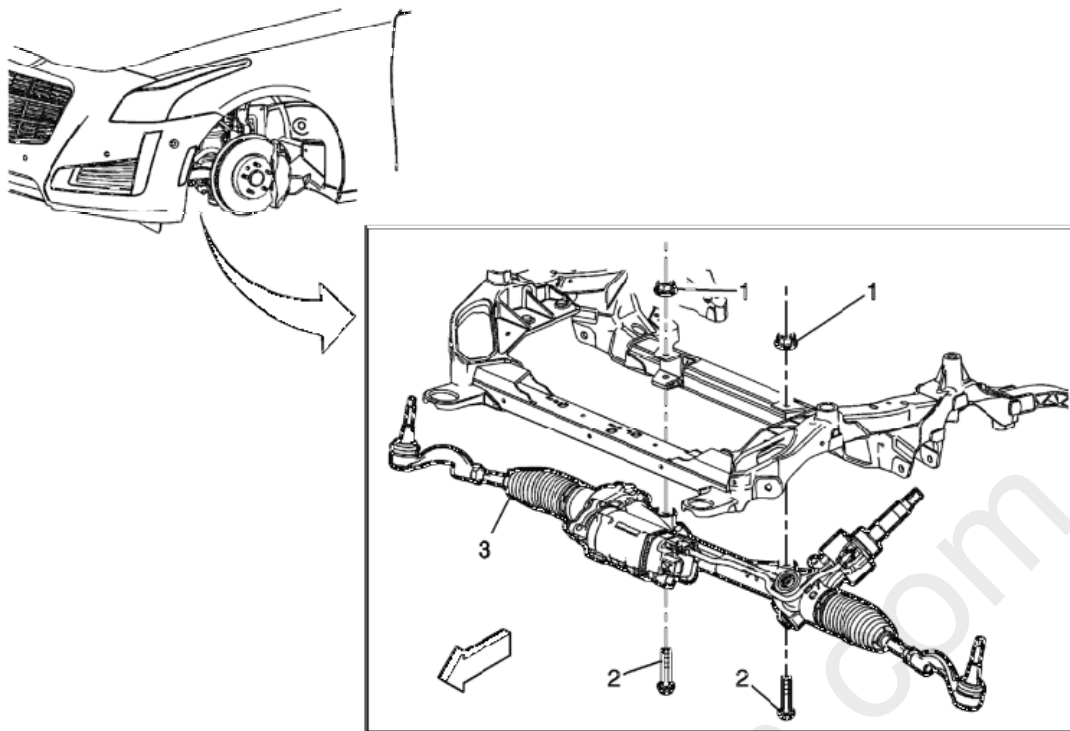


Fig. 10: Electric Belt Drive Rack and Pinion Steering Gear (RWD)
Courtesy of GENERAL MOTORS COMPANY

Electric Belt Drive Rack and Pinion Steering Gear Replacement (RWD)

Callout	Component Name
Preliminary Procedures	
1. Remove the engine compartment lower noise shield. Refer to <u>Front Compartment Lower Noise Shield Replacement (AWD)</u> , <u>Front Compartment Lower Noise Shield Replacement (RWD)</u> . 2. Disconnect the steering linkage outer tie rods from the steering knuckles. Refer to <u>Steering Linkage Outer Tie Rod Replacement (AWD)</u>, <u>Steering Linkage Outer Tie Rod Replacement (RWD)</u>. 3. Disconnect the intermediate steering shaft from the steering gear. Refer to <u>Intermediate Steering Shaft Replacement (RWD)</u> , <u>Intermediate Steering Shaft Replacement (AWD)</u> . 4. Disconnect any electrical connectors as necessary.	
1	Steering Gear Nut (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 58 (43 lb ft) + (90-105 degrees)
	Steering Gear Bolt (Qty: 2)

2	CAUTION: This vehicle is equipped with torque-to-yield or single use fasteners. Install a NEW torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component. Procedure 1. Remove the steering gear bolts. DISCARD the bolts. 2. Install NEW steering gear bolts.
3	Electric Belt Drive Rack and Pinion Steering Gear Procedure 1. Transfer components as necessary. 2. Perform the power steering control module programming and setup. Refer to <u>Power Steering Control Module Programming and Setup</u> . 3. Measure and adjust the front toe. Refer to <u>Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment</u> .

STEERING LINKAGE INNER TIE ROD REPLACEMENT

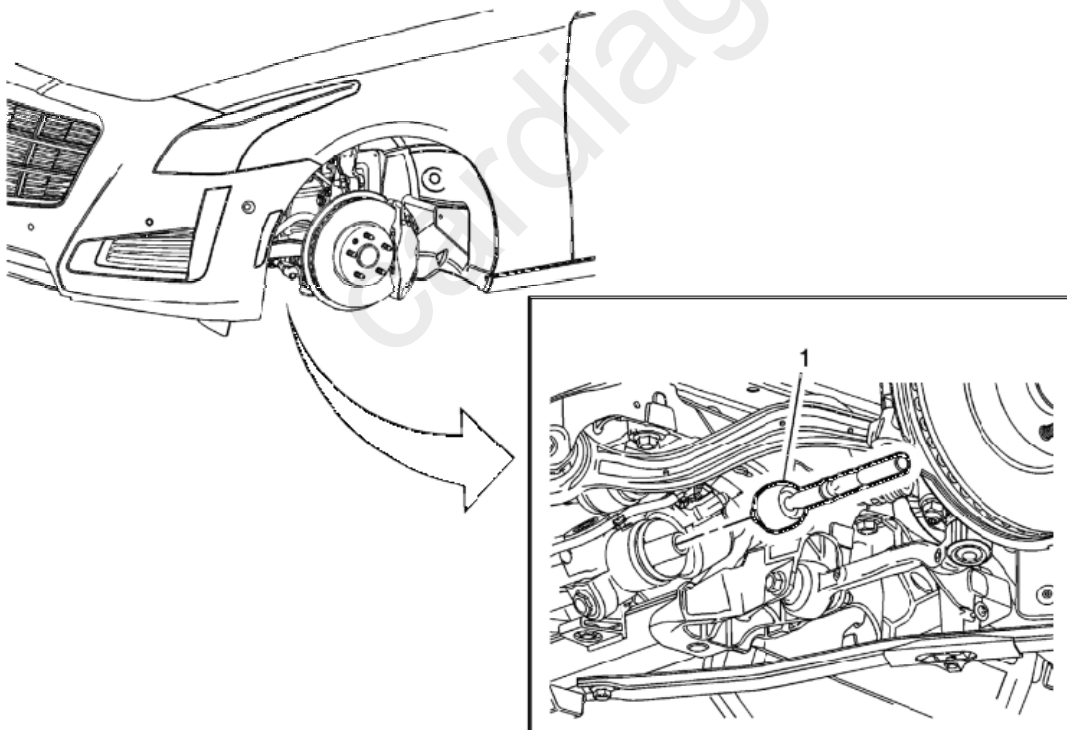


Fig. 11: Steering Linkage Inner Tie Rod
Courtesy of GENERAL MOTORS COMPANY

Steering Linkage Inner Tie Rod Replacement

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Remove the steering gear boot. Refer to <u>Steering Gear Boot Replacement</u>.	
1	Steering Linkage Inner Tie Rod CAUTION: Refer to <u>Component Fastener Tightening Caution</u> . Procedure 1. Place a 42 mm wrench on the flats of the steering linkage inner tie rod and rotate the tie rod counterclockwise to remove it from the steering gear rack. 2. Place a 42 mm wrench on the flats of the steering linkage inner tie rod and rotate the tie rod clockwise to install it to the steering gear rack. 3. Measure and adjust the front toe. Refer to <u>Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment</u> . Tighten 105 N.m (77 lb ft)

DESCRIPTION AND OPERATION

POWER STEERING SYSTEM DESCRIPTION AND OPERATION

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

- A belt drive and a ball nut mechanism
- A power pack; containing the power steering control module, its sensors, the power steering motor
- A torque sensor
- The steering gear (rack and pinion)

The belt driven electric power steering system reduces the amount of effort needed to steer the vehicle by utilizing the power steering control module to control the power steering motor to maneuver the steering rack. The power steering control module uses input from the torque sensor, motor rotational sensor, battery voltage circuit and GMLAN serial data circuit to determine the level of motor assist. Vehicle speed and engine speed from the GMLAN serial data circuit is also used to adjust the amount of steering assist needed to steer the vehicle. At low speeds more assist is provided for easy turning during parking maneuvers. At higher speeds less assist is provided for improved road feel and directional stability

The torque sensor is attached to the steering gear housing near the input shaft, and is critical to proper operation of the electronic power steering system. As the steering wheel is turned and torque is applied to the steering

shaft, the torque sensor monitors the amount of input torque.

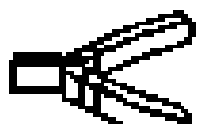
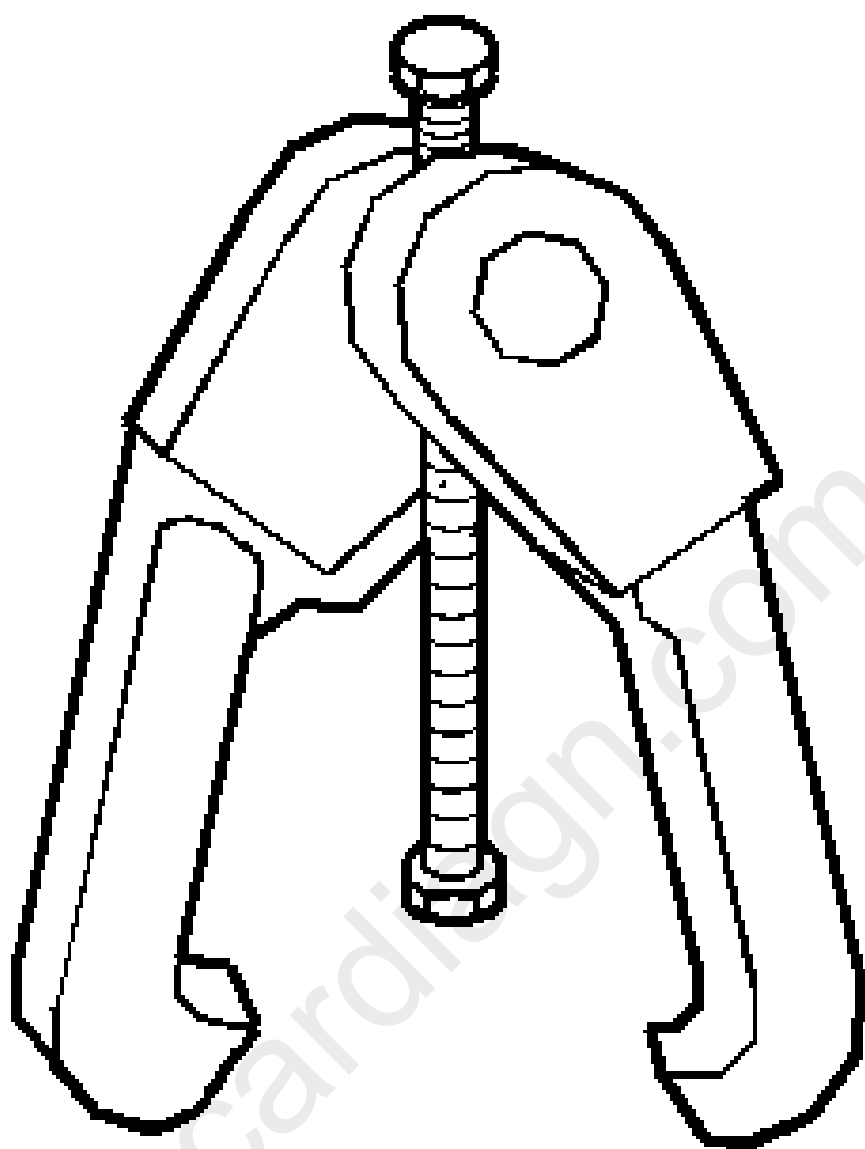
The power steering control module responds to the torque sensor and motor rotational sensor by commanding current to the power steering motor.

The power steering control module and motor are attached to the base of the steering gear housing, and applies power assist through the belt drive and ball nut mechanism to the steering rack. The ball nut mechanism translates the rotational movement of the belt drive system to lateral movement of the steering rack. The power steering control module has the ability to detect malfunctions within the electric power steering system. Any malfunction detected that disables steering assist will cause the SERVICE POWER STEERING message to be displayed on the driver information center. Additionally, the power steering control module calculates an internal system temperature which is used to protect the power steering system from damage caused by high temperature. When the calculated temperature exceeds a pre-determined level the amount of current commanded to the power steering motor is reduced. This will result in a temporary reduced level of assist. Full assist will return once the calculated temperature drops below the pre-determined level.

SPECIAL TOOLS AND EQUIPMENT

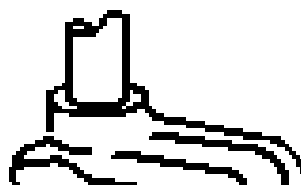
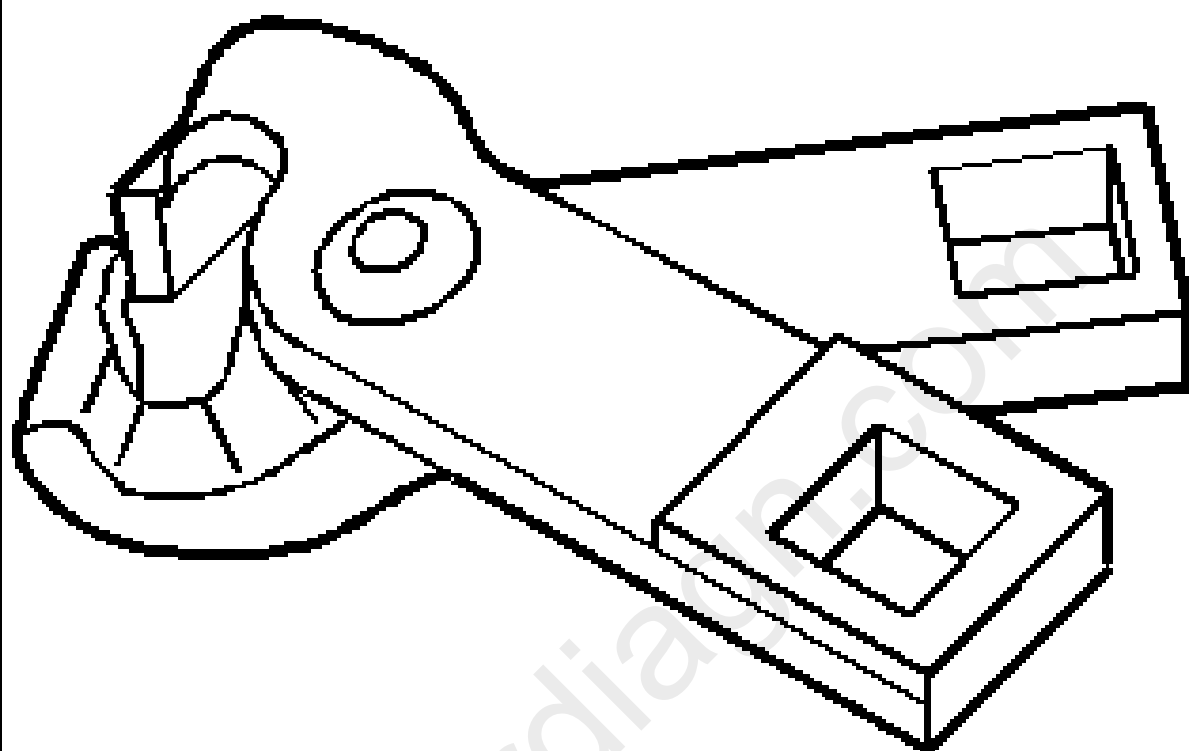
SPECIAL TOOLS

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



CH-39570
J-39570
Chassis Ear

DT-35910
J-35910
Drive Axle
Boot Clamp
Pliers



GE-8001
J-8001
Dial
Indicator
Set