

Power Steering

Specifications

Fastener Tightening Specifications

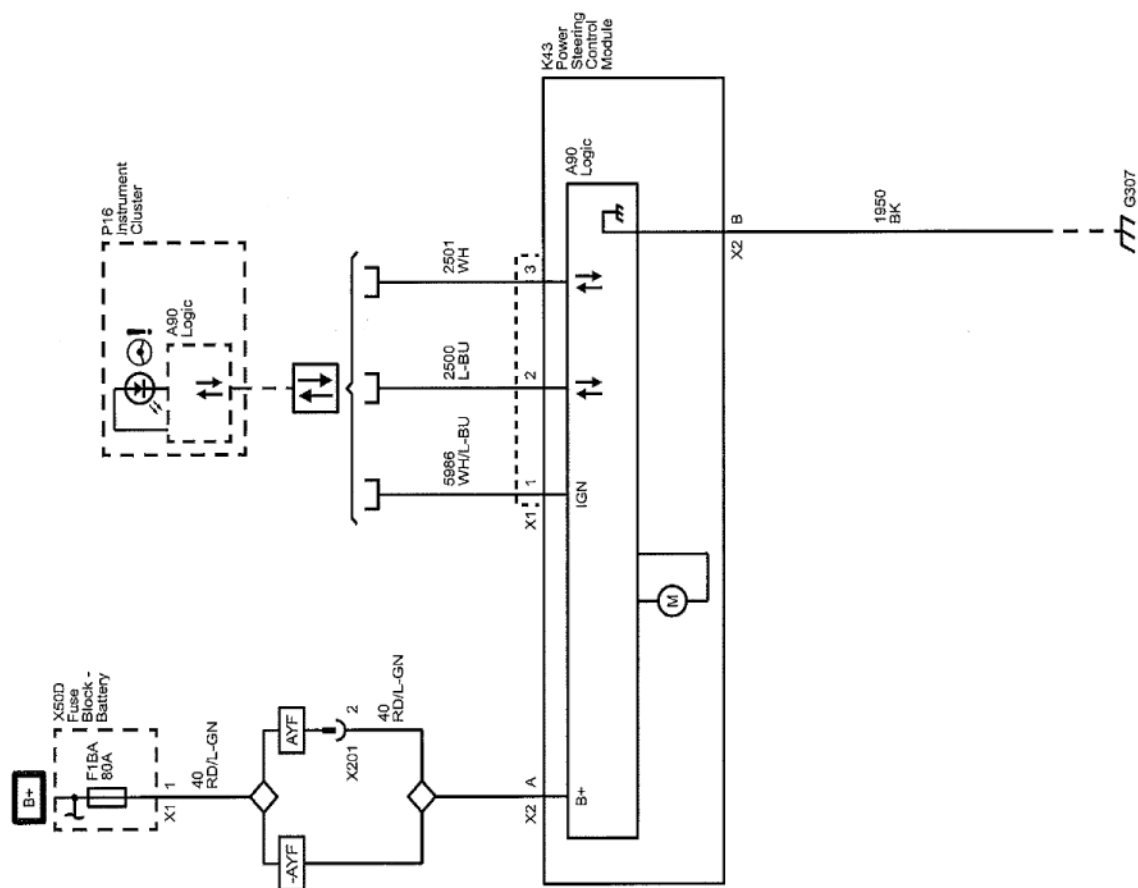
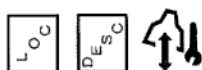
Application	Specification	
	Metric	English
Steering Gear Bolt		
First Pass	100 N•m	74 lb ft
Final Pass	97 degrees	
Steering Linkage Inner Tie Rod	100 N•m	74 lb ft
Steering Linkage Outer Tie Rod Nut		
First Pass	30 N•m	22 lb ft
Final Pass	128 degrees	

Adhesives, Fluids, Lubricants, and Sealers

Application	Type of Material	GM Part Number	
		United States	Canada
Steering Linkage Inner Tie Rod	High Strength Threadlocker - Red Loctite® 262	89021297	10953488

Schematic and Routing Diagrams

Power Steering Schematics (Electric Power Steering)



Diagnostic Information and Procedures

DTC C0176

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle* on page 6-66 prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis* on page 6-58 for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions* on page 6-59 provides an overview of each diagnostic category.

DTC Descriptor

DTC C0176: Control Module Temperature Sensor

For symptom byte information, refer to *Symptom Byte List* on page 6-85.

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 reduced to lower system temperature to prevent thermal damage to the power steering components.

Conditions for Running the DTC

- The ignition is ON, with the engine ON.
- Power steering system voltage is 9–16 volts.
- Repetitive steering input is present.

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

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 on page 15-4

Connector End View Reference

Component Connector End Views on page 11-269

Description and Operation

Power Steering System Description and Operation on page 15-23

Electrical Information Reference

- *Circuit Testing* on page 11-526
- *Connector Repairs* on page 11-548
- *Testing for Intermittent Conditions and Poor Connections* on page 11-531
- *Wiring Repairs* on page 11-537

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

Note: Since most occurrences of this DTC are caused by excessive driver inputs, review the conditions under which the DTC sets with the customer.

1. Verify the DTC sets outside the conditions for running and setting the DTC.

⇒ If the DTC sets within the conditions for running and setting the DTC

The power steering system is operating as designed

↓ If the DTC sets outside the conditions for running and setting the DTC

2. Operate the vehicle within the conditions that the customer experienced.

3. Verify that the DTC does not set.

⇒ **If the DTC sets**

Replace the K43 Power Steering Control Module

⇓ **If the DTC does not set**

4. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification* on page 6-92 after completing the repair.

- *Steering Gear Replacement* on page 15-20
- *Control Module References* on page 6-3 for power steering control module replacement, programming and setup.

DTC C0475

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle* on page 6-66 prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis* on page 6-58 for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions* on page 6-59 provides an overview of each diagnostic category.

DTC Descriptor

DTC C0475: Electric Steering Motor Circuit

For symptom byte information, refer to *Symptom Byte List* on page 6-85.

Circuit/System Description

C0475 00

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

C0475 59

The power steering control module continuously monitors the thermal cycle counter of the steering gear. If the thermal cycle counter exceeds the maximum allowable limit, the steering gear has reached its end of life and must be replaced.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

C0475 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 circuits.

C0475 59

The power steering control module detects the thermal cycle counter has exceeded the maximum allowable limit and the whole steering gear system must be replaced.

Action Taken When the DTC Sets

- The DTC is stored in memory.
- The driver information center displays a message and/or a warning indicator will be displayed on the instrument cluster.
- No steering assist.

Conditions for Clearing the DTC

C0475 00

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

C0475 59

This DTC cannot be cleared.

Reference Information

Schematic Reference

Power Steering Schematics on page 15-4

Connector End View Reference

Component Connector End Views on page 11-269

Description and Operation

Power Steering System Description and Operation on page 15-23

Electrical Information Reference

- *Circuit Testing* on page 11-526
- *Connector Repairs* on page 11-548
- *Testing for Intermittent Conditions and Poor Connections* on page 11-531
- *Wiring Repairs* on page 11-537

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Ignition ON
2. Verify with a scan tool that DTC C0475 57 is not set.

⇒ **If the DTC is set**

Replace the steering column.

⇓ **If the DTC is not set**

3. All OK.

Circuit/System Testing

Note: Please perform the Circuit/System Verification before performing the Circuit/System Testing.

1. Ignition OFF and all vehicle systems OFF. It may take up to 2 min for all vehicle systems to power down.
2. Disconnect the harness connector X2 at the K43 Power Steering Control Module.

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3. Test for less than 5 Ω between the ground circuit terminal B and ground.

⇒ **If 5 Ω or greater**

- 3.1. Ignition OFF, disconnect the harness connector X2 at the K43 Power Steering Control Module.
- 3.2. Test for less than 2 Ω in the ground circuit end to end.
 - ⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.
 - ⇒ If less than 2 Ω , repair the open/high resistance in the ground connection.

↓ **If less than 5 Ω**

4. Ignition ON.
5. Verify a test lamp illuminates between the B+ circuit terminal A and ground.
 - ⇒ **If the test lamp does not illuminate and the circuit fuse is good**
 - 5.1. Ignition OFF.
 - 5.2. Test for less than 2 Ω in the B+ circuit end to end.
 - ⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

- ⇒ If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

- 5.1. Ignition OFF.
- 5.2. Test for infinite resistance between the B+ circuit and ground.
 - ⇒ If less than infinite resistance, repair the short to ground on the circuit.
 - ⇒ If infinite resistance, replace the steering column.

↓ **If the test lamp illuminates**

6. Replace the steering column.

Repair Instructions

Perform the *Diagnostic Repair Verification* on page 6-92 after completing the repair.

- *Steering Column Replacement* on page 15-33
- *Control Module References* on page 6-3 for power steering control module replacement, programming and setup.

DTC C0545

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle* on page 6-66 prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis* on page 6-58 for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions* on page 6-59 provides an overview of each diagnostic category.

DTC Descriptor

DTC C0545: Steering Wheel Torque Sensor

For symptom byte information, refer to *Symptom Byte List* on page 6-85.

Circuit/System Description

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

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 internal motor position sensor circuits.

Action Taken When the DTC Sets

- DTC C0545 is stored in memory.
- The driver information center displays a message and/or a warning indicator will be displayed on the instrument cluster.
- No steering assist.

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

Power Steering Schematics on page 15-4

Connector End View Reference

Component Connector End Views on page 11-269

Description and Operation

Power Steering System Description and Operation on page 15-23

Electrical Information Reference

- *Circuit Testing* on page 11-526
- *Connector Repairs* on page 11-548
- *Testing for Intermittent Conditions and Poor Connections* on page 11-531
- *Wiring Repairs* on page 11-537

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify with a scan tool that DTC C0545 is not set.
⇒ **If the DTC is set**
Replace the steering column.
- ⇓ **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification* on page 6-92 after completing the repair.

- *Steering Column Replacement* on page 15-33
- *Control Module References* on page 6-3 for power steering control module replacement, programming and setup.

DTC C056D

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle* on page 6-66 prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis* on page 6-58 for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions* on page 6-59 provides an overview of each diagnostic category.

DTC Descriptor

DTC C056D: Electronic Control Unit Hardware

For symptom byte information, refer to *Symptom Byte List* on page 6-85.

Circuit/System Description

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

Conditions for Running the DTC

The device 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 device has detected an internal malfunction.

Action Taken When the DTC Sets

The device 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 device 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 device.
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.
- If this DTC is retrieved as both a current and history DTC, replace the device that set the DTC.

Reference Information

Schematic Reference

- *Data Communication Schematics* on page 11-4
- *Control Module References* on page 6-3

Connector End View Reference

Component Connector End Views on page 11-269

Description and Operation

Data Link Communications Description and Operation on page 11-68

Electrical Information Reference

- *Circuit Testing* on page 11-526
- *Connector Repairs* on page 11-548
- *Testing for Intermittent Conditions and Poor Connections* on page 11-531
- *Wiring Repairs* on page 11-537

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC C056D is not set.
 - ⇒ **If DTC C056D is set in a device that can be programmed**
 - 2.1. Program the device that set the DTC.
 - 2.2. Verify the DTC does not set.
 - ⇒ If the DTC sets, replace the device that set the DTC.
 - ⇓ If the DTC does not set
 - 2.3. All OK.
 - ⇒ **If DTC C056D is set in a device that cannot be programmed**
 - Replace the device that set the DTC.
 - ⇓ **If DTC C056D is not set**
3. All OK

Repair Instructions

Perform the *Diagnostic Repair Verification* on page 6-92 after completing the repair.

Control Module References on page 6-3 for device 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* on page 15-23.

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.

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* on page 15-11
- Whine or Growl Noise from the Power Steering System* on page 15-11
- Increase in Effort While Turning Steering Wheel* on page 15-12
- Poor Return of Steering Wheel* on page 15-13
- Steering Wheel Surges/Jerks While Turning* on page 15-14
- Steering Wheel Kickback* on page 15-14
- Steering Effort Hard or Too Easy in One or Both Directions* on page 15-15

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 <i>Power Steering System Description and Operation</i> on page 15-23
2	Verify that a rattle, clunk or shudder noise is present. Is a rattle, clunk or shudder noise present?	Go to Step 3	System OK
3	Inspect the power steering gear for the proper installation. Refer to <i>Steering Gear Replacement</i> on page 15-20. Is the power steering gear installation correct?	Go to Step 4	Go to Step 6
4	Inspect the intermediate shaft. Is the intermediate shaft worn?	Go to Step 7	Go to Step 5
5	Inspect the suspension. Is the suspension worn?	Go to <i>Noise Diagnosis - Front Suspension</i> on page 16-39	Go to Step 2
6	Install the power steering gear correctly. Refer to <i>Steering Gear Replacement</i> on page 15-20. Did you complete the repair?	Go to Step 8	—
7	Replace the intermediate shaft. Refer to <i>Intermediate Steering Shaft Replacement</i> on page 15-27. 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

Whine or Growl Noise from the Power Steering System

Step	Action	Yes	No
Special Tools CH-39570 Chassis Ear For equivalent regional tools, refer to <i>Special Tools</i> on page 15-23.			
1	Did you review the Power Steering System Description and Operation and perform the necessary inspections?	Go to Step 2	Go to <i>Symptoms - Power Steering System</i> on page 15-11
2	Verify that a whine or growl noise is present. Is a whine or growl noise present?	Go to Step 3	System OK
3	Inspect the power steering gear for looseness and/or worn bushings. Is the steering gear loose or are the bushings worn?	Go to Step 6	Go to Step 4
4	Inspect the power steering motor for a whine or growl noise using the CH-39570 ear. Is the noise present at the power steering motor?	Go to Step 7	Go to Step 5

Whine or Growl Noise from the Power Steering System (cont'd)

Step	Action	Yes	No
5	Inspect the power steering gear for a whine or growl noise using the CH-39570 ear. Is the noise present at the power steering gear?	Go to Step 8	Go to Step 3
6	Tighten the power steering gear fasteners or replace the power steering gear due to worn bushings. Refer to <i>Steering Gear Replacement</i> on page 15-20. Did you complete the repair?	Go to Step 9	—
7	Replace the steering column, which includes the electronic power steering assist motor control unit. Refer to <i>Steering Column Replacement</i> on page 15-33. Did you complete the repair?	Go to Step 9	—
8	Replace the power steering gear. Refer to <i>Steering Gear Replacement</i> on page 15-20. Did you complete the repair?	Go to Step 9	—
9	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

Increase in Effort While Turning Steering Wheel

Step	Action	Yes	No
1	Did you review the Power Steering System Description and Operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Power Steering System on page 15-11
2	Verify that there is an increase in effort while turning is present. Does the system operate normally?	System OK	Go to Step 3
3	Check for the following tire related conditions: • Incorrect tire inflation—Refer to <i>Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label</i> on page 1-13. • Improper tire size Did you find and correct the condition?	Go to Step 10	Go to Step 4
4	1. Raise and support the vehicle. Refer to <i>Lifting and Jacking the Vehicle</i> on page 1-31. 2. Check for a binding or worn tie rod end. Is the tie rod binding or worn?	Go to Step 7	Go to Step 5
5	Check for a worn or binding intermediate shaft. Is the intermediate shaft worn or binding?	Go to Step 8	Go to Step 6
6	Check for a worn or binding steering gear. Is the steering gear worn or binding?	Go to Step 9	System OK
7	Replace the outer tie rod. Refer to <i>Steering Linkage Outer Tie Rod Replacement</i> on page 15-17. Did you complete the repair?	Go to Step 10	—
8	Replace the intermediate shaft. Refer to <i>Intermediate Steering Shaft Replacement</i> on page 15-27. Did you complete the repair?	Go to Step 10	—
9	Replace the steering gear. Refer to <i>Steering Gear Replacement</i> on page 15-20. Did you complete the repair?	Go to Step 10	—
10	Operate the system in order to verify the repair. Did you correct the condition?	System OK	—

Poor Return of Steering Wheel

Step	Action	Yes	No
DEFINITION: After completing a turn, extra steering input is required for the steering wheel to return to center.			
1	Did you review the Power Steering System Description and Operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Power Steering System on page 15-11
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 <i>Lifting and Jacking the Vehicle</i> on page 1-31. 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
4	1. Rotate the steering wheel ONE revolution in both directions. 2. Rotate the steering wheel back to the original position. Was the steering wheel abnormally difficult to rotate in either direction?	Go to Step 5	Go to Step 10
5	Note: Position the wheels straight ahead. Do NOT rotate the steering wheel more than one complete revolution from center. 1. Disconnect the intermediate shaft from the steering column. 2. Note the position of the steering wheel and rotate the steering wheel ONE revolution in both directions. 3. Rotate the steering wheel back to the original position. Was the steering wheel abnormally difficult to rotate in either direction?	Go to Step 11	Go to Step 6
6	Inspect the intermediate shaft for stiff or loose joints. Repair or replace as necessary. Did you find and complete the repair?	Go to Step 12	Go to Step 7
7	1. Remove the front tire and wheel assemblies. Refer to <i>Tire and Wheel Removal and Installation</i> on page 16-60. 2. Disconnect both outer tie rod ends from the steering knuckles. 3. Use your hands in order to move the tie rod end studs. 4. If abnormally difficult to move, replace the tie rod end. If equipped with recirculating ball steering, ensure that idler and pitman arm joints are not too stiff. Repair as necessary. Did you find and complete the repair?	Go to Step 12	Go to Step 8
8	1. Use your hands to rotate the steering knuckle inboard and outboard in order to inspect for a binding strut bearings, ball joints, or axle. 2. Repair or replace any abnormally stiff or loose components. Did you find and complete the repair?	Go to Step 12	Go to Step 9
9	Inspect for binding in the steering gear. If a binding is present, repair or replace the steering gear. Did you find and complete the repair?	Go to Step 12	Go to Step 10
10	Inspect the wheel alignment and adjust as necessary. Refer to <i>Wheel Alignment Measurement</i> on page 16-69. 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

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 on page 15-11
2	Verify that the steering wheel surges or jerks while turning. Does the system operate normally?	System OK	Go to Step 3
3	Inspect the front suspension for worn or binding 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 <i>Lifting and Jacking the Vehicle</i> on page 1-31. 2. Inspect the steering linkage outer tie rod for wear or a binding condition. Is the steering linkage outer tie rod worn or binding?	Go to Step 10	Go to Step 5
5	Inspect the intermediate steering shaft for wear or a binding condition. Is the intermediate steering shaft worn or binding?	Go to Step 11	Go to Step 6
6	Inspect the steering gear for wear or a binding condition. Is the steering gear worn or binding?	Go to Step 12	Go to Step 7
7	Inspect the steering column for wear or a binding condition. Is the steering column worn or binding?	Go to Step 13	Go to Step 8
8	Inspect the power steering assist motor for an indication of excessive heat. Does the power steering assist motor appear to be overheated?	Go to Step 9	Go to Step 13
9	Note: 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 13
10	Replace the steering linkage outer tie rod. Refer to <i>Steering Linkage Outer Tie Rod Replacement</i> on page 15-17. Did you complete the repair?	Go to Step 14	—
11	Replace the intermediate steering shaft. Refer to <i>Intermediate Steering Shaft Replacement</i> on page 15-27. Did you complete the repair?	Go to Step 14	—
12	Replace the steering gear. Refer to <i>Steering Gear Replacement</i> on page 15-20. Did you complete the repair?	Go to Step 14	—
13	Replace the steering column. Refer to <i>Steering Column Replacement</i> on page 15-33. 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 Kickback

Condition	Action
The steering column mounting bolts are loose.	Tighten the pivot bolt and the mounting bolts to specification.
The steering gear is loosely mounted.	Tighten the steering gear mounting bolts to specification.
The steering linkage tie rods are loose or damaged.	Inspect the steering linkage tie rods. If necessary, replace the steering linkage tie rods. Refer to <i>Steering Linkage Outer Tie Rod Replacement</i> on page 15-17 or to <i>Steering Linkage Inner Tie Rod Replacement</i> on page 15-22.

Steering Effort Hard or Too Easy in One or Both Directions

Condition	Action
The battery power is low.	Confirm proper battery voltage.
The intermediate shaft dash seal is binding.	Adjust the dash seal, or replace the intermediate shaft assembly if necessary. Refer to <i>Intermediate Steering Shaft Replacement</i> on page 15-27.
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 <i>Intermediate Steering Shaft Replacement</i> on page 15-27.
The steering gear is binding.	If necessary, inspect and replace the steering gear. Refer to <i>Steering Gear Replacement</i> on page 15-20.
The upper steering shaft is bent.	If necessary, replace the steering column. Refer to <i>Steering Column Replacement</i> on page 15-33.
The assist mechanism hub gear is misaligned or damaged.	Replace the steering column. Refer to <i>Steering Column Replacement</i> on page 15-33.
The sensor wire is damaged.	Replace the steering column. Refer to <i>Steering Column Replacement</i> on page 15-33.
The controller is malfunctioning.	Confirm the DTC. If necessary, replace the steering column, which includes the motor and module assembly. Refer to <i>Steering Column Replacement</i> on page 15-33.
The motor shaft is binding.	Confirm the DTC. If necessary, replace the steering column, which includes the motor and module assembly. Refer to <i>Steering Column Replacement</i> on page 15-33.

Repair Instructions

Steering Linkage Inner Tie Rod Inspection

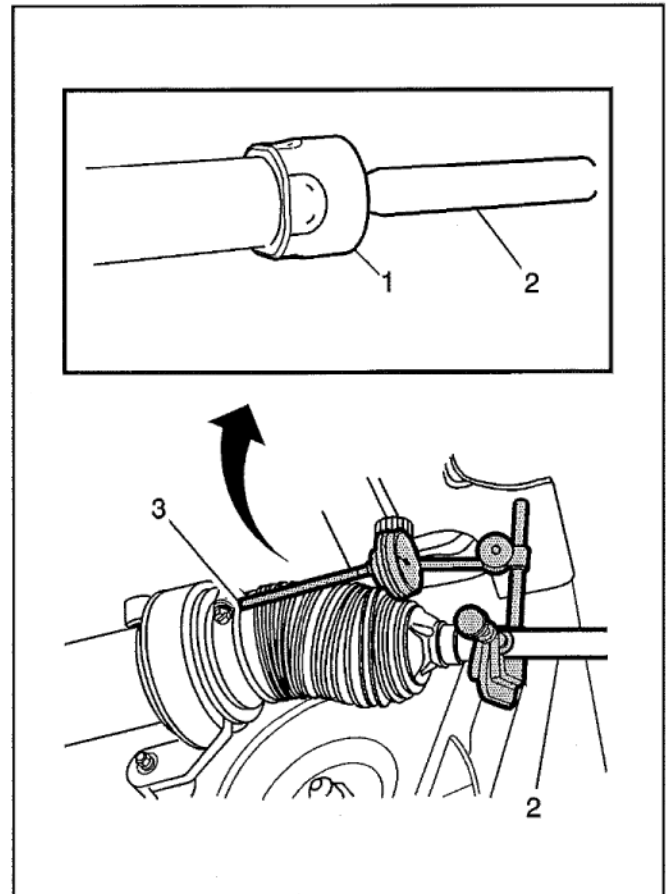
Special Tools

GE-8001 Dial Indicator Set

For equivalent regional tools, refer to *Special Tools* on page 15-23.

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.

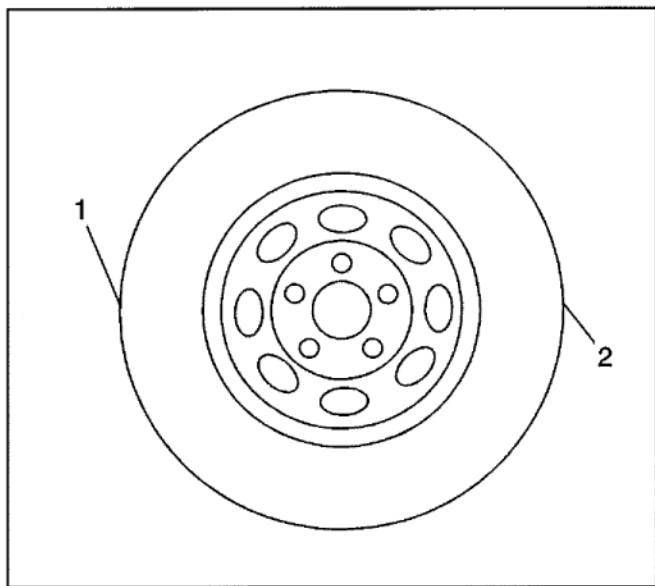


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2. With the aid of an assistant, turn the steering wheel to the full stop position and hold the steering wheel in that position until the test is complete. Part of the steering linkage inner tie rod (2) being tested should be inside the steering gear 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* on page 1-31.
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.



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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* on page 15-22.
11. Repeat the procedure for the other side.

Steering Linkage Outer Tie Rod Inspection

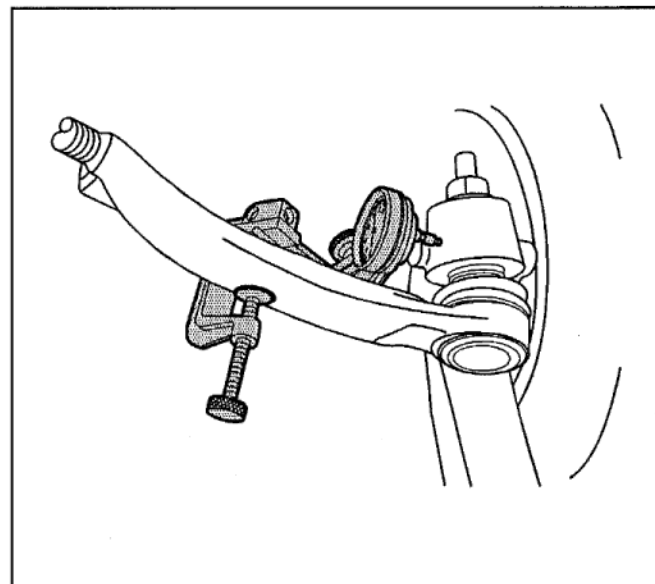
Special Tools

GE-8001 Dial Indicator Set

For equivalent regional tools, refer to *Special Tools* on page 15-23.

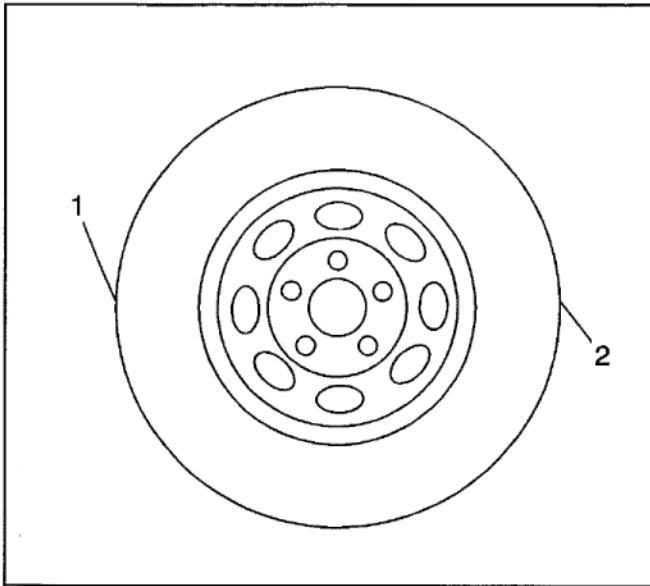
Note: This inspection procedure does not supersede local government required inspections that have more stringent requirements.

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* on page 15-17.
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* on page 1-31.



1855622

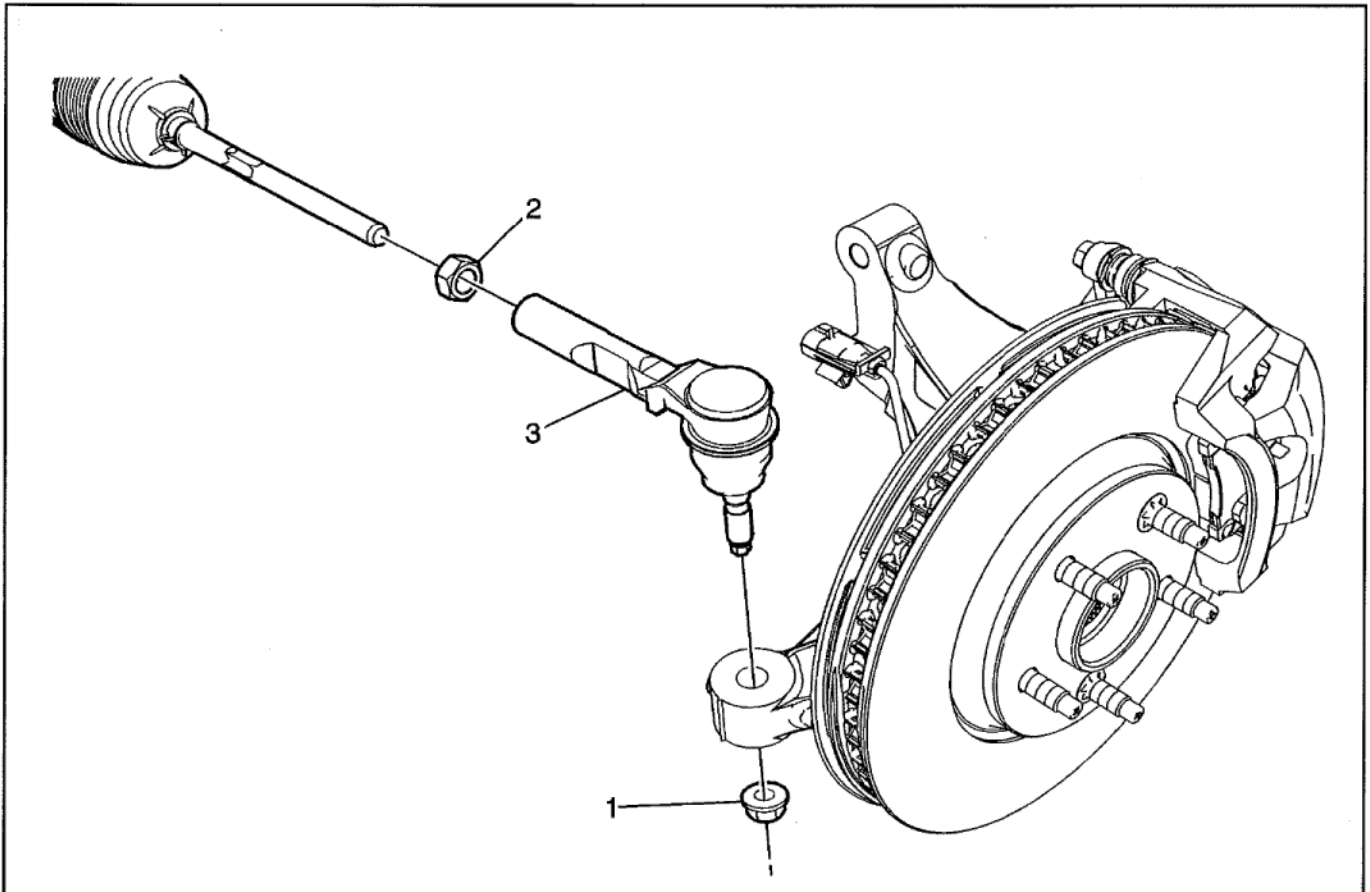
3. Install the GE-8001 dial indicator between the outer tie rod and the steering knuckle as shown in the graphic. Note that the tire and wheel assembly is shown removed only for clarification of the GE-8001 dial indicator position.



2211822

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* on page 15-17.
9. Repeat the procedure for the other side.

Steering Linkage Outer Tie Rod Replacement



1779542

Steering Linkage Outer Tie Rod Replacement

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Refer to <i>Lifting and Jacking the Vehicle</i> on page 1-31. 2. Remove the front tire and wheel assembly. Refer to <i>Tire and Wheel Removal and Installation</i> on page 16-60.	
1	Steering Linkage Outer Tie Rod Nut Warning: This component is equipped with torque-to-yield fasteners. Install a NEW torque-to-yield fastener when installing this component. Failure to replace the torque-to-yield fastener could cause bodily injury and damage to the vehicle or component. Caution: Refer to <i>Fastener Caution</i> on page 0-8. Procedure 1. Remove the steering linkage outer tie rod nut. DISCARD the nut. 2. Install a NEW outer tie rod nut. 3. Use the EN-45059 meter in order to tighten the outer tie rod nut to the specification. Tighten 1. 30 N•m (22 lb ft) 2. 128 degrees Special Tools EN-45059 Angle Meter For equivalent regional tools, refer to <i>Special Tools</i> on page 15-23.
2	Steering Linkage Inner Tie Rod Nut Procedure 1. Use paint in order to place match marks on the steering linkage inner tie rod nut and on the steering linkage inner tie rod. 2. During installation, align the match marks. 3. Do not tighten the nut during installation. Tighten the nut after adjusting the front toe. Refer to <i>Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment</i> on page 16-70.
3	Steering Linkage Outer Tie Rod Caution: Do not free the ball stud by using a pickle fork or a wedge-type tool. Damage to the seal or bushing may result. Procedure 1. Use the CH-161-B puller in order to separate the steering linkage outer tie rod from the steering knuckle. 2. Inspect the steering linkage inner tie rod for bent or damaged threads. 3. Clean the tapered surface of the steering knuckle. 4. After the installation is complete, measure and adjust the front toe. Refer to <i>Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment</i> on page 16-70. Special Tools CH-161-B Bearing Puller For equivalent regional tools, refer to <i>Special Tools</i> on page 15-23.

Steering Gear Boot Replacement

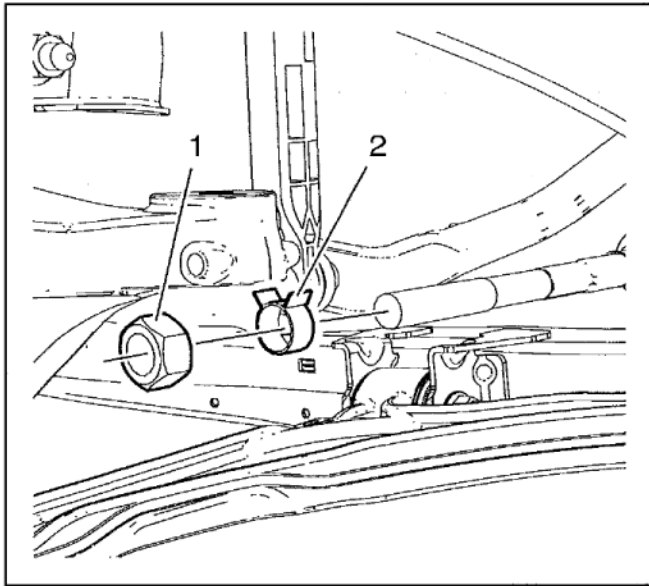
Special Tools

CH-804 Tensioner

For equivalent regional tools, refer to *Special Tools* on page 15-23.

Removal Procedure

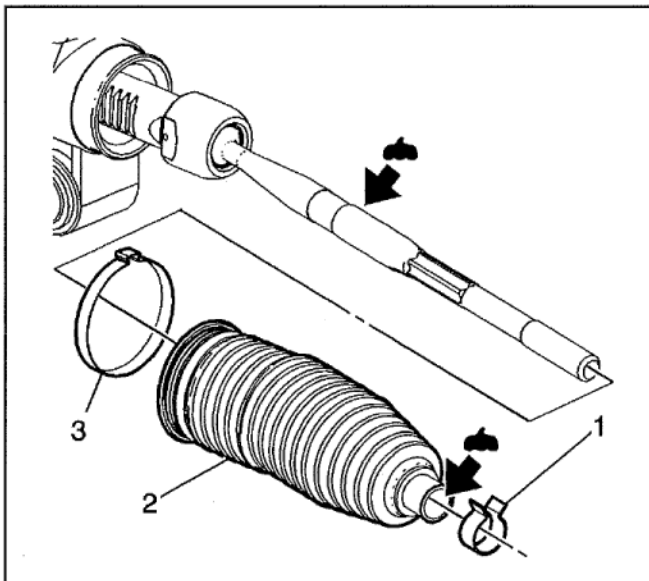
1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle* on page 1-31.
2. Remove the steering linkage outer tie rod. Refer to *Steering Linkage Outer Tie Rod Replacement* on page 15-17.



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Note: Place match marks on the steering linkage inner tie rod nut and the steering linkage inner tie rod before removing. During installation of the nut, align the match marks.

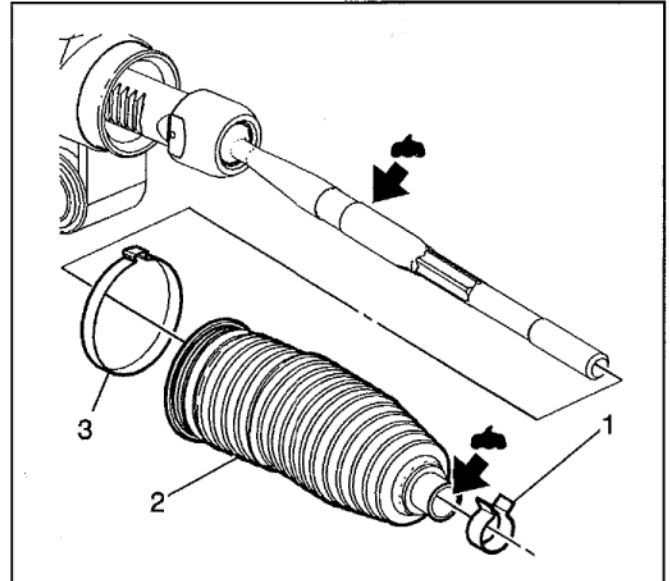
3. Remove the steering linkage inner tie rod nut (1).
4. Remove the steering gear boot outer clamp (2).



2375391

5. Remove the steering gear boot inner clamp (3). Discard the clamp.
6. Remove the steering gear boot (2).
7. Clean the steering linkage inner tie rod and the steering gear boot contact area of any lubricant or debris.

Installation Procedure

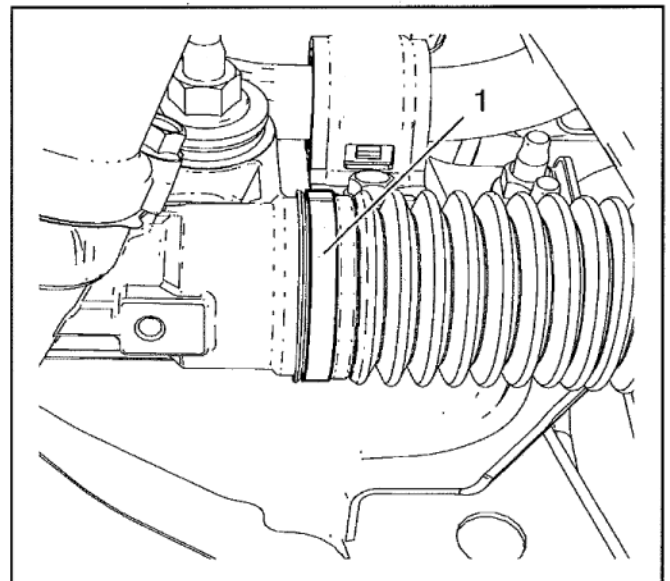


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1. Install a new steering gear boot inner clamp (3) loosely on the steering gear boot (2).
2. Apply the lubricant from the service kit to the steering linkage inner tie rod and to the steering gear boot (2).

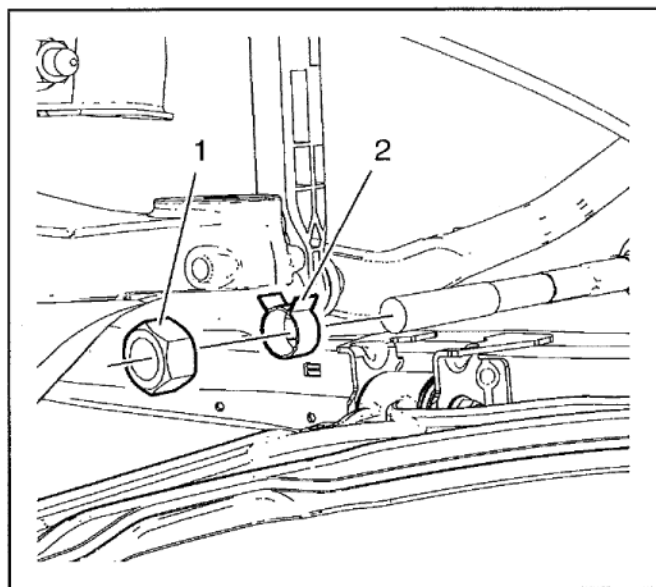
Note: The steering gear boot must seat in the appropriate groove on the steering gear.

3. Install the steering gear boot (2) over the steering linkage inner tie rod and onto the steering gear.



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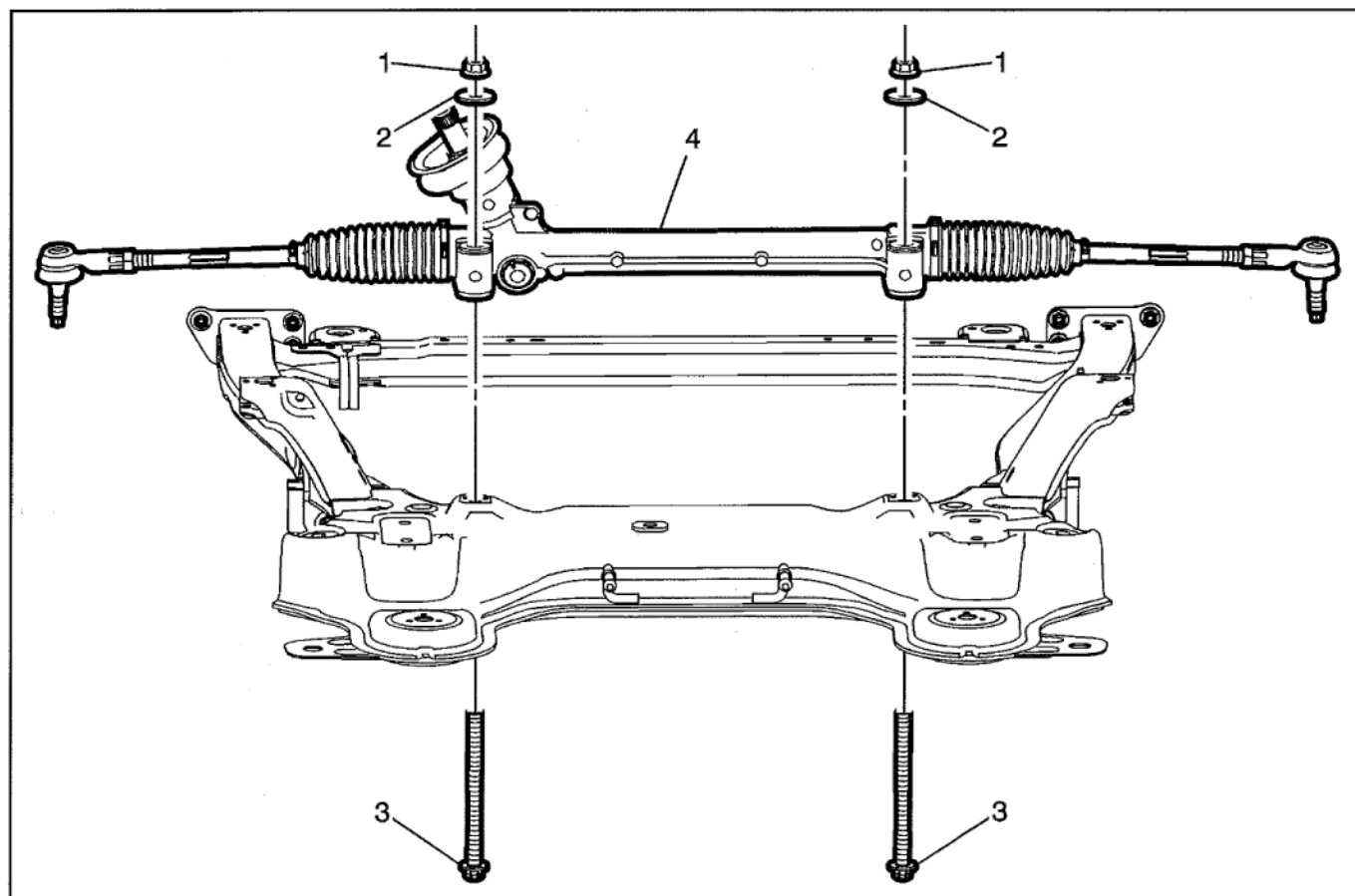
4. Use the CH-804 tensioner in order to crimp the inner steering gear boot clamp (1).



2028056

5. Install the steering gear outer boot clamp (2).
6. Install the steering linkage inner tie rod nut (1).
7. Install the steering linkage outer tie rod. Refer to *Steering Linkage Outer Tie Rod Replacement* on page 15-17.
8. After installation is complete, measure and adjust the front toe. Refer to *Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment* on page 16-70.

Steering Gear Replacement

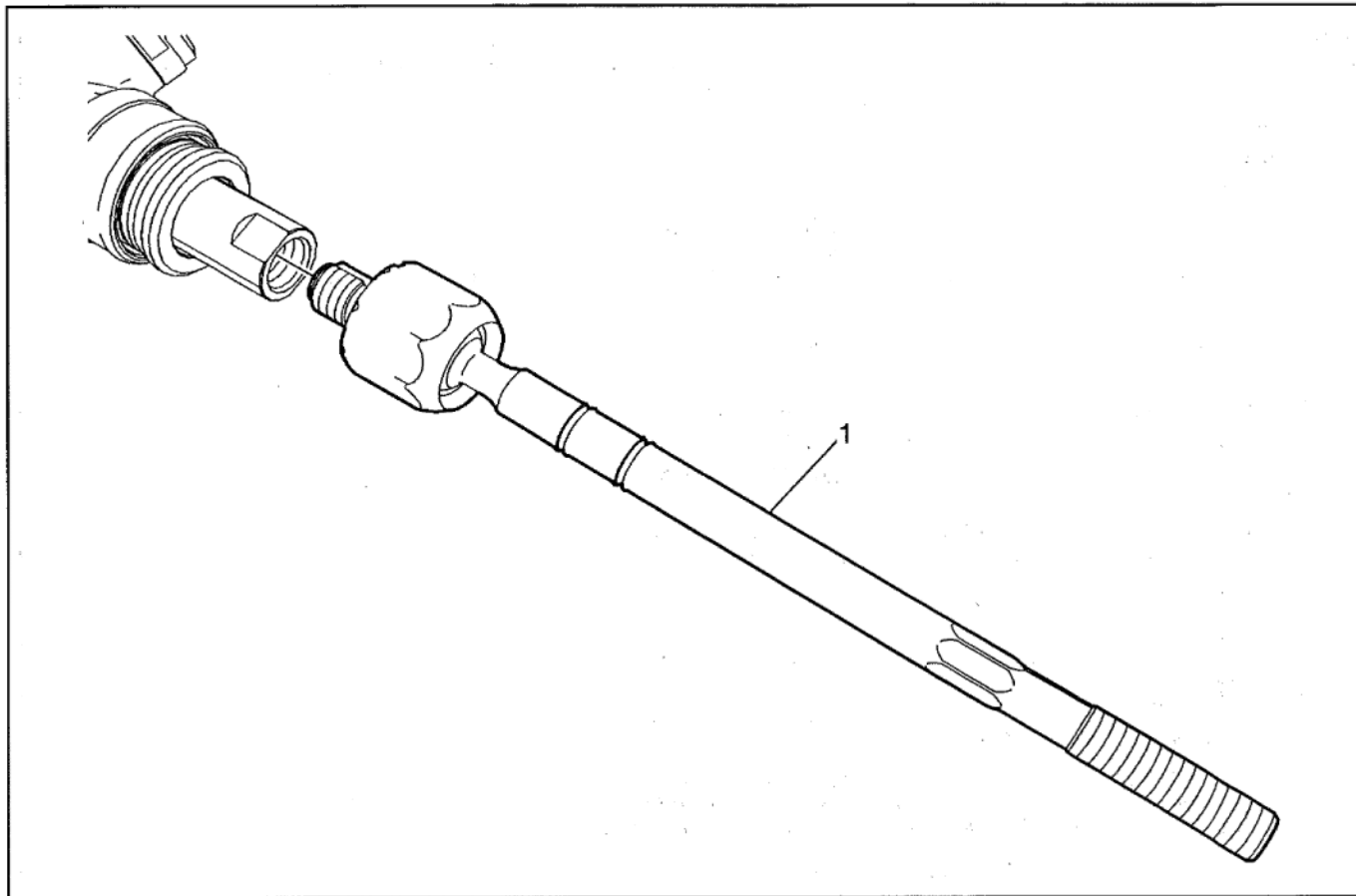


2511581

Steering Gear Replacement

Callout	Component Name
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. Preliminary Procedure 1. With the steering wheel in the straight ahead position, LOCK the steering column. 2. Disconnect the intermediate steering shaft from the steering gear. Refer to <i>Steering Column Replacement</i> on page 15-33. 3. Disconnect the steering column dash seal from the dash panel. 4. Raise and support the vehicle. Refer to <i>Lifting and Jacking the Vehicle</i> on page 1-31. 5. Disconnect the outer tie rods from the steering knuckles. Refer to <i>Steering Linkage Outer Tie Rod Replacement</i> on page 15-17. 6. Partially lower the rear of the drivetrain and front suspension frame in order to gain clearance for the steering gear. Refer to <i>Drivetrain and Front Suspension Frame Replacement</i> on page 3-144.	
1	Steering Gear Nut (Qty: 2) Procedure During installation, hold the steering gear nuts while tightening the steering gear bolts.
2	Steering Gear Washer (Qty: 2)
3	Steering Gear Bolt (Qty: 2) Warning: This component is equipped with torque-to-yield fasteners. Install a NEW torque-to-yield fastener when installing this component. Failure to replace the torque-to-yield fastener could cause bodily injury and damage to the vehicle or component. Caution: Refer to <i>Fastener Caution</i> on page 0-8 Procedure 1. Remove the 2 steering gear bolts. Discard the bolts. 2. Install 2 NEW steering gear bolts. 3. Hold the steering gear nuts while tightening the steering gear bolts. Use the EN-45059 meter in order to tighten the steering gear bolts to the specification. Tighten 1. 100 N•m (74 lb ft) 2. 97 degrees Special Tools EN-45059 Angle Meter For equivalent regional tools, refer to <i>Special Tools</i> on page 15-23.
4	Steering Gear Procedure 1. Carefully remove the steering gear through the left front wheel opening. 2. Transfer parts if necessary. 3. After the installation is complete, measure and adjust the front toe. Refer to <i>Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment</i> on page 16-70.

Steering Linkage Inner Tie Rod Replacement



2264216

Steering Linkage Inner Tie Rod Replacement

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Refer to <i>Lifting and Jacking the Vehicle</i> on page 1-31. 2. Remove the steering gear boot. Refer to <i>Steering Gear Boot Replacement</i> on page 15-18.	
1	Steering Linkage Inner Tie Rod Caution: Do not change the steering gear preload adjustment before moving the inner tie rod from the steering gear. Changing the steering gear preload adjustment before moving the inner tie rod could result in damage to the pinion and the steering gear. Caution: Refer to <i>Fastener Caution</i> on page 0-8. Procedure 1. Place a pipe wrench on the flats of the steering gear rack. Position the pipe wrench between the steering gear housing and the steering linkage inner tie rod housing. 2. Place a wrench on the flats of the steering linkage inner tie rod housing. 3. Rotate the steering linkage inner tie rod housing counterclockwise in order to remove the steering linkage inner tie rod from the steering gear rack. 4. Apply thread locking adhesive to the steering linkage inner tie rod threads prior to installing it to the steering gear rack. Refer to <i>Adhesives, Fluids, Lubricants, and Sealers</i> on page 15-3. 5. Rotate the steering linkage inner tie rod housing clockwise in order to install the steering linkage inner tie rod to the steering gear rack. Tighten 100 N•m (74 lb ft)

Description and Operation

Power Steering System Description and Operation

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

Steering Shaft Torque Sensor

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

Steering Wheel Position Sensor

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

Power Steering Motor

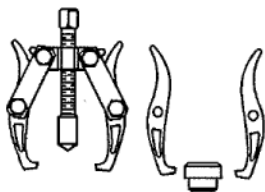
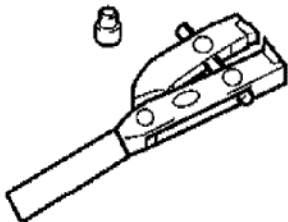
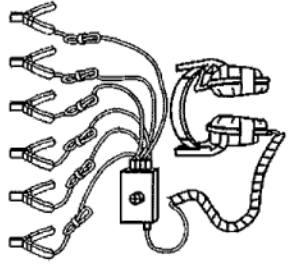
The power steering motor is a 12-volt brushless DC reversible motor with a 65-amp rating. The motor assists steering through a worm gear and reduction gear located in the steering column housing.

Power Steering Control Module (PSCM)

The power steering control module (PSCM) uses a combination of steering shaft torque sensor input, vehicle speed, calculated system temperature and steering tuning to determine the amount of steering

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

Special Tools and Equipment

Illustration	Tool Number/ Description
 1936794	CH-161-B DT-161-B KM-161-B J-22888-20A Bearing Puller
 1938587	CH-804 CH-49692 MKM-804 Tensioner
 643842	CH-39570 J-39570 Chassis Ear

15-24 Power Steering

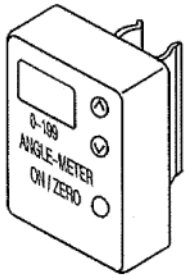
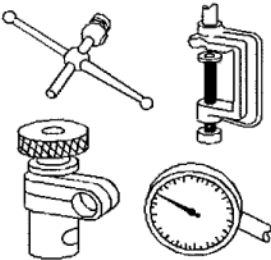
Illustration	Tool Number/ Description
 1197696	EN-45059 J-45059 Angle Meter

Illustration	Tool Number/ Description
 2014	GE-8001 J-8001 Dial Indicator Set