

2013 STEERING

Power Steering - Malibu

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Drivetrain and Front Suspension Frame Rear Bolt	160 N.m	118 lb ft
Drivetrain and Front Suspension Frame Reinforcement Bolt	60 N.m	44 lb ft
Power Steering Assist Motor Bolt (1)	8 N.m	71 lb in
Power Steering Gear Heat Shield Fastener	9 N.m	80 lb in
Steering Gear Bolt (1)		
• First Pass	110 N.m	81 lb ft
• Final Pass	150 degrees	
Steering Gear Wiring Harness Bracket Bolt	9 N.m	80 lb in
Steering Linkage Inner Tie Rod	100 N.m	74 lb ft
Steering Linkage Outer Tie Rod Nut (1)		
• First Pass	35 N.m	26 lb ft
• Final Pass	30 degrees	
1. Use NEW fastener.		

SCHEMATIC WIRING DIAGRAMS

POWER STEERING WIRING SCHEMATICS

NJ1 Wiring Schematics

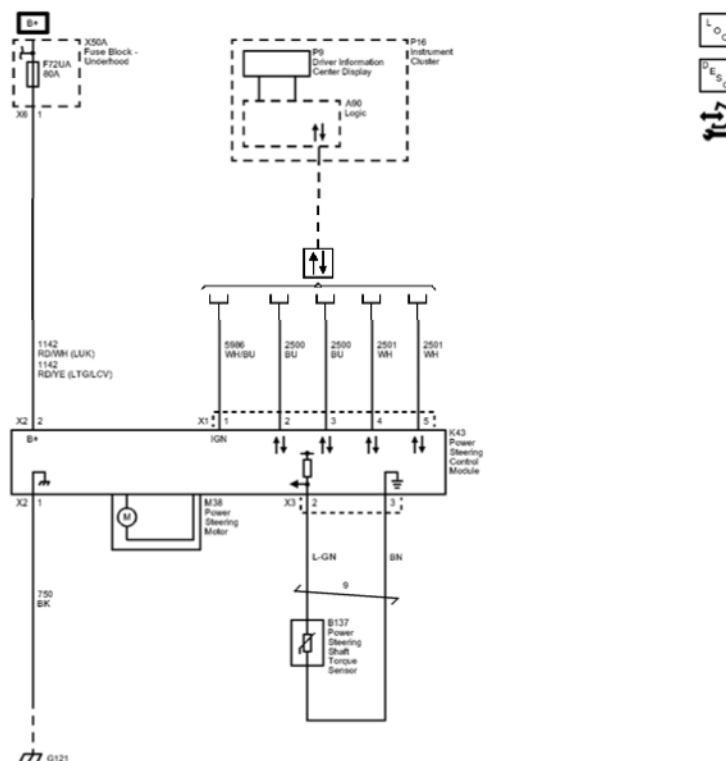


Fig. 1: NJ1 Wiring Schematics
 Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC C005B</u>	DTC C005B 00 Power Steering Softstops Learn
<u>DTC C0176</u>	DTC C0176 54 Control Module Temperature Sensor High Temperature
<u>DTC C044A</u>	DTC C044A 71 Steering System Engine Speed Signal Circuit Invalid Data
<u>DTC C0456</u>	DTC C0456 4B Steering Position Sensor Calibration not Learned
<u>DTC C0475</u>	DTC C0475 00 Electric Steering Motor Circuit Malfunction DTC C0475 59 Electric Steering Motor Circuit Protection Time-Out
<u>DTC C047A</u>	DTC C047A Electric Steering Motor Position Sensor Circuit

<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.
<u>DTC C055C</u>	DTC C055C 00 Steering Gear Performance Malfunction DTC C055C 64 Steering Gear Performance Slip Detected
<u>DTC C0565</u>	DTC C0565 5A Vehicle Identification Number Not Plausible
<u>DTC C0569</u>	DTC C0569 3A System Configuration Incorrect Component Installed

DTC C005B

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 C005B 00

Power Steering Softstops Learn

Circuit/System Description

If the power steering power pack is replaced, the calibration needs to be learned to the new power steering power pack. The power steering control module will set a DTC, if the required parameters are not learned.

Conditions for Running the DTC

Ignition Switch in OFF, ACCESSORY or ON position, power steering control module in communication mode.

Conditions for Setting the DTC

The soft endstop is not learned by the new power steering control module.

Action Taken When the DTC Sets

DTC C005B is stored in memory.

Conditions for Clearing the DTC

The software endstops need to be learned to the new power steering control module using a scan tool, performing the Configuration/Reset functions Power Steering Softstops Reset and Power Steering Softstops Learn.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Steering System Description and Operation (Electronic Power Steering)

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 C005B is not set.
 - **If DTC C005B is set**

Program the K43 Power Steering Control Module.
 - **If DTC C005B is not set**
3. All OK.

Repair Instructions

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

- **Steering Gear Replacement (LUK, MHH), Steering Gear Replacement (LCV, MH8), Steering Gear Replacement (LTG, M7W)**

- **Power Steering Assist Motor Replacement**
- **Control Module References** for Power Steering Control Module programming and setup.

DTC C0176

Diagnostic Instructions

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

DTC Descriptor

DTC C0176 54

Control Module Temperature Sensor High Temperature

Circuit/System Description

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

Conditions for Running the DTC

- 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

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Power Steering Schematics

Connector End View Reference

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- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

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

- If steering components are mechanically binding, replace the mechanically binding steering components.
 - If no steering components are mechanically binding, replace the steering column assembly.
 - If the DTC is not set
3. All OK.
- **If the DTC set outside of the conditions for running and setting**
2. All OK. The power steering is operating as designed.

Repair Instructions

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

- **Steering Column Replacement**
- **Control Module References** for Power Steering Control Module replacement, programming and setup.

DTC C044A

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 C044A 71

Steering System Engine Speed Signal Circuit Invalid Data

Circuit/System Description

The power steering control module receives the engine speed signal from the engine control module.

Conditions for Running the DTC

Engine running.

Conditions for Setting the DTC

The power steering control module detects a invalid engine speed signal on serial data.

Action Taken When the DTC Sets

DTC C044A is stored in memory.

Conditions for Clearing the DTC

- The DTC clears when the diagnostic runs and passes
- 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

Description and Operation

Power Steering System Description and Operation (Electronic Power Steering)

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 C044A.
 - If any other DTCs are set

Refer to Diagnostic Trouble Code (DTC) List - Vehicle

- If no other DTCs are set
3. Replace the K43 Power Steering Control Module.
 4. Verify that DTC C044A does not set while operating the vehicle within the Conditions for Running the DTC.
 - If DTC C044A sets

Replace the K20 Engine Control Module.

- If the DTC C044A does not set
5. All OK.

Repair Instructions

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

- **Steering Gear Replacement (LUK, MHH), Steering Gear Replacement (LCV, MH8), Steering Gear Replacement (LTG, M7W)**
- **Power Steering Assist Motor Replacement**
- **Control Module References** for Power Steering Control Module or Engine Control Module replacement, programming and setup.

DTC C0456

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 C0456 4B

Steering Position Sensor Calibration not Learned

Circuit/System Description

If the power steering control module is replaced, the calibration needs to be learned to the new power steering control module.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The calibration is not learned to the new power steering control module.

Action Taken When the DTC Sets

- DTC C0456 is stored in memory.
- No steering assist.

Conditions for Clearing the DTC

The scan tool function Steering Angle Sensor Centering procedure must be completed successfully.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Steering System Description and Operation (Electronic Power Steering)

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 C0456 4B is not set.
 - **If DTC C0456 4B is set**
 1. Calibrate the B137 Power Steering Shaft Torque Sensor.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the K43 Power Steering Control Module.
 - If the DTC does not set
 - 3. All OK.
 - **If DTC C0456 4B is not set**
3. All OK.

Repair Instructions

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

- Steering Gear Replacement (LUK, MHH), Steering Gear Replacement (LCV, MH8), Steering Gear Replacement (LTG, M7W)
- Power Steering Assist Motor Replacement
- Control Module References for Power Steering Control Module programming and setup.

DTC C0475

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

DTC C0475 59

Electric Steering Motor Circuit Protection Time-Out

Circuit/System Description

C0475 00

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.

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 the end of its predetermined lifecycle and must be replaced.

Conditions for Running the DTC

Ignition 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 power steering assist motor circuits.

C0475 59

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

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

C0475 00

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

C0475 59

This DTC cannot be cleared. The power steering system must be replaced.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

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Power Steering System Description and Operation (Electronic Power Steering)

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

C0475 00

1. Ignition OFF and all vehicle systems OFF, disconnect the X2 harness connector at the K43 Power Steering Control Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Verify a test lamp illuminates between the B+ circuit terminal 2 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 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 K43 Power Steering Control Module.
 - **If the test lamp illuminates**
4. Replace K43 Power Steering Control Module.

C0475 59

1. Ignition ON.
2. Verify that DTC C0475 59 is not set.
 - **If the DTC C0457 59 is set**

Replace the steering gear.
 - **If the DTC C0457 59 is not set**
3. All OK.

Repair Instructions

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

- **Steering Gear Replacement (LUK, MHH), Steering Gear Replacement (LCV, MH8), Steering Gear**

Replacement (LTG, M7W)

- **Power Steering Assist Motor Replacement**
- **Control Module References** for Power Steering Control Module programming and setup.

DTC C047A

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

Electric Steering Motor Position Sensor Circuit

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

The vehicle is ON or in SERVICE MODE.

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, or a plausibility error as a result of a mismatch between the steering angle data from the internal steering angle sensor in the gear versus the external steering angle sensor data on the steering column.

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

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

Diagnostics Aids

A communication error between the Electronic Brake Control Module and Power Steering Control Module can cause DTC C047A to set in history and display Service Power Steering warning message. Do not replace the steering gear or power steering control module if DTC C047A is set in history. If DTC C047A is current, follow the Circuit/System Testing for proper diagnosis.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Steering System Description and Operation (Electronic Power Steering)

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. With a scan tool, verify that DTC C0710 71 is not set.
 - **If DTC C0710 71 is set**

Refer to **DTC C0710** in Anitlock Brake System Diagnostic Information and Procedures.

- **If DTC C0710 71 is not set**

3. With a scan tool verify that DTC C047A is not set.
 - If the DTC is set

Refer to Circuit/System Testing below.

- If the DTC is not set

4. All OK.

Circuit/System Testing

1. Verify that the connector at the B137 Power Steering Shaft Torque Sensor is not damaged or have water intrusion/corrosion.
 - **The B137 Power Steering Shaft Torque Sensor connector is not OK**

Replace the steering gear.

- **The B137 Power Steering Shaft Torque Sensor connector is OK**
2. With a scan tool perform the Power Steering Control Module Calibration procedure Steering Angle Sensor Centering and Software Endstop Learning. Refer to **Power Steering Control Module Calibration**.
 3. Verify that DTC C047A does not set.
 - If the DTC does set

Replace the K43 Power Steering Control Module.

- If the DTC does not set
4. All OK.

Repair Instructions

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

- **Steering Gear Replacement (LUK, MHH), Steering Gear Replacement (LCV, MH8), Steering Gear Replacement (LTG, M7W)**
- **Control Module References** for power steering control module replacement, programming and setup

DTC C0544

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.

The power steering control module has a center detection algorithm that compares the reading of the steering angle sensor to the direction based on other vehicle sensors that the vehicle is travelling to determine if the steering angle reading is plausible.

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.

The power steering control module detected that the steering angle sensor reading and the direction of the vehicle exceeds 329 degrees.

Action Taken When the DTC Sets

- DTC C0544 is stored in memory.
- The driver information center displays the SERVICE POWER STEERING warning message.

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

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Description and Operation

Power Steering System Description and Operation (Electronic Power Steering)

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. With a scan tool, verify that the Steering Wheel Angle parameter is zero degrees or near zero degrees with the front tire/wheels in the straight ahead position.
 - The Steering Wheel Angle parameter is not zero degrees or near zero degrees

Perform the Power Steering Control Module Calibration. Refer to **Power Steering Control Module Calibration**

- The Steering Wheel Angle parameter is zero degrees or near zero degrees
- 4. Verify that DTC C0544 is not set.
 - If the DTC is set

Replace the K43 power steering control module.

- If the DTC is not set
- 5. All OK.

Repair Instructions

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

- **Power Steering Assist Motor Replacement** for power steering control module replacement
- **Control Module References** for power steering control module replacement, programming and setup.

DTC C0545

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.

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

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Description and Operation

Power Steering System Description and Operation (Electronic Power Steering)

Electrical Information Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Torque Sensor parameter changes when turning the steering wheel.
 - **If the parameter does not change**

Refer to Circuit/System Testing below

- **If the parameter changes**
3. All OK.

Circuit/System Testing

1. Ignition ON.
2. Verify that DTC C0545 is not set.
 - **If the DTC is set**

Replace the steering gear.

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

Repair Instructions

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

- **Steering Gear Replacement (LUK, MHH), Steering Gear Replacement (LCV, MH8), Steering Gear Replacement (LTG, M7W)**
- **Control Module References** for Power Steering Control Module replacement, programming and setup.

DTC C055C

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

DTC C055C 64

Steering Gear Performance Slip Detected

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

If the mechanical friction in the steering system is too high, the steering gear has to be checked if the friction is too high and if the tie rod boots are defect. Possible reason for water ingress.

Reference Information

Schematic Reference

Power Steering Schematics

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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**

Replace the steering gear.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

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

- **Steering Gear Replacement (LUK, MHH), Steering Gear Replacement (LCV, MH8), Steering Gear Replacement (LTG, M7W)**
- **Control Module References** for Power Steering Control Module replacement, programming and setup.

DTC C0565

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

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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 K43 Power Steering Control Module.
 - 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.

- **Power Steering Assist Motor Replacement**
- **Control Module References** for Power Steering Control Module replacement, programming and setup.

DTC C0569

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 C0569 3A

System Configuration Incorrect Component Installed

Circuit/System Description

The power steering control module continuously monitors the parameters of the steering gear. If the power steering

control module is replaced, it needs to be calibrated to become fully operational.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

Electronic power steering control module calibration value does not meet the system requirement.

Action Taken When the DTC Sets

- DTC C0569 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

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Description and Operation

Power Steering System Description and Operation (Electronic Power Steering)

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 C0569 is not set.

○ **If the DTC C0569 is set**

1. Program the K43 Power Steering Control Module.
2. Verify the DTC does not set.
 - If the DTC sets, replace the K43 Power Steering Control Module.
 - If the DTC does not set

3. All OK.

○ **If the DTC C0569 is not set**

3. All OK.

Repair Instructions

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

- **Steering Gear Replacement (LUK, MHH), Steering Gear Replacement (LCV, MH8), Steering Gear Replacement (LTG, M7W)**
- **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 (Electronic Power Steering)**.

Visual/Physical Inspection

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

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**
- **Increase in Effort While Turning Steering Wheel**
- **Poor Return of Steering Wheel**
- **Steering Wheel Surges/Jerks While Turning**
- **Steering Wheel Kickback**
- **Steering Effort Hard or Too Easy in One or Both Directions**

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

Rattle, Clunk, or Shudder Noise from the Power Steering System

Step	Action	Yes	No
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1	Did you review the Power Steering System Description and Operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Steering Wheel and Column
2	Verify a rattle noise is present by driving the vehicle on a rough road. Verify a clunk noise is present by turning the steering wheel to the left and to the right several times with the key in the ON position. Is a rattle or a clunk noise present?	Go to Step 3	System OK
3	Inspect the steering gear for the proper installation. Is the steering gear installation incorrect?	Go to Step 6	Go to Step 4
4	Inspect the intermediate steering shaft. Is the intermediate steering shaft worn?	Go to Step 8	Go to Step 5
5	Inspect the front suspension. Refer to Noise Diagnosis - Front Suspension . Is the front suspension worn?	Go to Step 7	Go to Step 3
6	Install the steering gear correctly. Refer to Steering Gear Replacement (LUK, MHH), Steering Gear Replacement (LCV, MH8), Steering Gear Replacement (LTG, M7W) . Did you complete the repair?	Go to Step 9	-
7	Replace the worn front suspension component that is causing the noise. Did you complete the repair?	Go to Step 9	-
8	Replace the intermediate steering shaft. Refer to Intermediate Steering Shaft Replacement . 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
	Did you review the Power Steering		

1	System Description and Operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Power Steering System
2	Verify that a whine or growl noise is present. Is a whine or growl noise present?	Go to Step 3	System OK
3	Inspect the power steering gear for looseness and/or worn bushings. Is the steering gear loose or are the bushings worn?	Go to Step 6	Go to Step 4
4	Inspect the power steering motor for a whine or growl noise using the CH-39570 ear. Is the noise present at the power steering motor?	Go to Step 7	Go to Step 5
5	Inspect the power steering gear for a whine or growl noise using the CH-39570 ear. Is the noise present at the power steering gear?	Go to Step 8	Go to Step 3
6	Tighten the power steering gear fasteners or replace the power steering gear due to worn bushings. Refer to Steering Gear Replacement (LUK, MHH) , Steering Gear Replacement (LCV, MH8) , Steering Gear Replacement (LTG, M7W) . Did you complete the repair?	Go to Step 9	-
7	Replace the electronic power steering assist motor control. Refer to Power Steering Assist Motor Replacement . Did you complete the repair?	Go to Step 9	-
8	Replace the power steering gear. Refer to Steering Gear Replacement (LUK, MHH) , Steering Gear Replacement (LCV, MH8) , Steering Gear Replacement (LTG, M7W) . 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

Increase in Effort While Turning Steering Wheel

Step	Action	Yes	No
	Did you review the Power Steering System		

1	Description and Operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Power Steering System
2	Verify that there is an increase in effort while turning is present. Does the system operate normally?	System OK	Go to Step 3
3	Check for the following tire related conditions: • Incorrect tire inflation-Refer to <u>Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label</u> . • 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 <u>Lifting and Jacking the Vehicle</u> . 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 <u>Steering Linkage Outer Tie Rod Replacement</u> . Did you complete the repair?	Go to Step 10	-
8	Replace the intermediate shaft. Refer to <u>Intermediate Steering Shaft Replacement</u> . Did you complete the repair?	Go to Step 10	-
9	Replace the steering gear. Refer to <u>Steering Gear Replacement (LUK, MHH)</u> , <u>Steering Gear Replacement (LCV, MH8)</u> , <u>Steering Gear Replacement (LTG, M7W)</u> . 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

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.			
	Did you review the General Description and perform the necessary inspections?		Go to <u>Power Steering System Description and</u>

1		Go to Step 2	<u>Operation (Electronic Power Steering)</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
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
	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.		

7	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 <u>Wheel Alignment Measurement</u> . Did you find and complete the repair?	Go to Step 12	-
11	Inspect the steering column for a binding. If a binding is present, repair or replace the steering column as necessary. Did you find and complete the repair?	Go to Step 12	-
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	-

STEERING 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 <u>Symptoms - Power Steering System</u>
2	Verify that the steering wheel surges or jerks while turning. Does the steering wheel surge or jerk while turning?	Go to Step 3	System OK
3	Inspect the front suspension for worn or binding components. Did you find and correct the condition?	Go to Step 15	Go to Step 4

4	1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 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 shaft for wear or a binding condition. Is the intermediate shaft worn or binding?	Go to Step 11	Go to Step 6
6	Inspect the steering gear for wear or a binding condition. Is the steering gear worn or binding?	Go to Step 12	Go to Step 7
7	Inspect the steering column for wear or a binding condition. Is the steering column worn or binding?	Go to Step 13	Go to Step 8
8	Inspect the power steering assist motor for an indication of excessive heat. Does the power steering assist motor appear to be overheated?	Go to Step 9	Go to Step 14
9	NOTE: Do not perform excessive parking lot maneuvers during testing. Excessive parking lot maneuvers can cause the power steering motor to heat up. Allow the power steering motor to cool and retest the system. Did you correct the condition?	Go to Step 15	Go to Step 14
10	Replace the steering linkage outer tie rod. Refer to <u>Steering Linkage Outer Tie Rod Replacement</u>. Did you complete the repair?	Go to Step 15	-
11	Replace the intermediate shaft. Refer to <u>Intermediate Steering Shaft Replacement</u> . Did you complete the repair?	Go to Step 15	-
12	Replace the steering gear. Refer to <u>Steering Gear Replacement (LUK, MHH), Steering Gear Replacement (LCV, MH8), Steering Gear Replacement (LTG, M7W)</u>. Did you complete the repair?	Go to Step 15	-
13	Replace the steering column. Refer to <u>Steering Column Replacement</u> .		-

	Did you complete the repair?	Go to Step 15	
14	Replace the power steering assist motor. Refer to <u>Power Steering Assist Motor Replacement</u> . Did you complete the repair?	Go to Step 15	-
15	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

STEERING WHEEL KICKBACK

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 tie rod ends are loose or damaged.	If necessary, inspect for damage and replace the tie rod ends. Refer to <u>Steering Linkage Outer Tie Rod Replacement</u> .

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</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</u> .
The steering gear is binding.	If necessary, inspect and replace the steering gear. Refer to <u>Steering Gear Replacement (LUK, MHH)</u> , <u>Steering Gear Replacement (LCV, MH8)</u> , <u>Steering Gear Replacement (LTG, M7W)</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>Steering Gear Replacement (LUK, MHH)</u> , <u>Steering Gear Replacement (LCV, MH8)</u> , <u>Steering Gear Replacement (LTG, M7W)</u> .

The controller is malfunctioning.	Confirm the DTC. If necessary, replace the motor/module assembly. Refer to <u>Power Steering Assist Motor Replacement</u> .
The motor shaft is binding.	Confirm the DTC. If necessary, replace the motor/module assembly. Refer to <u>Power Steering Assist Motor Replacement</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.

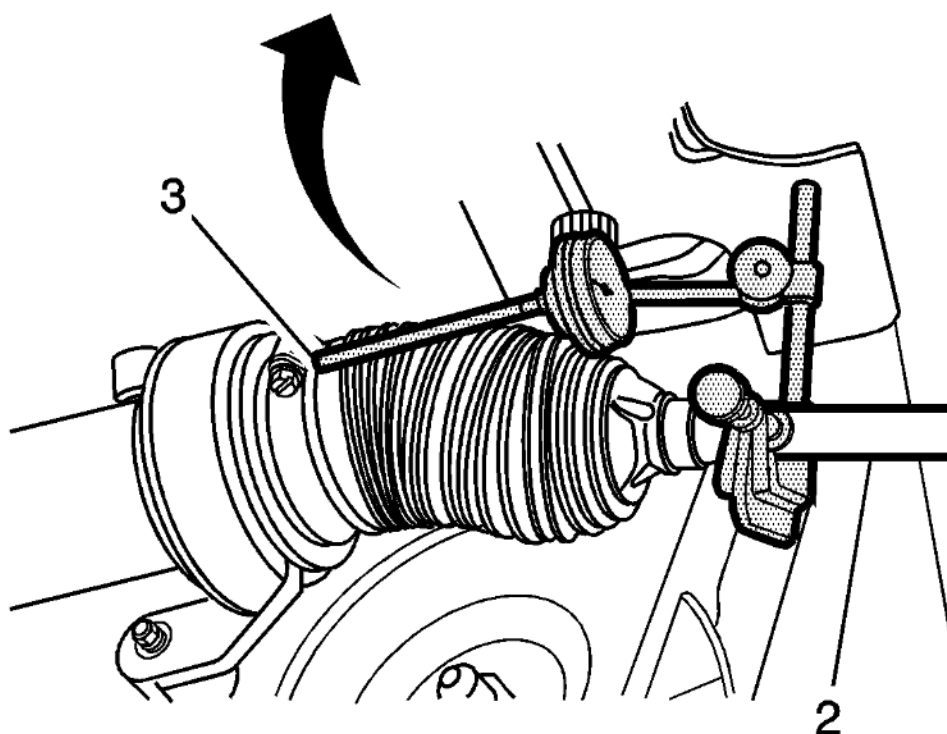
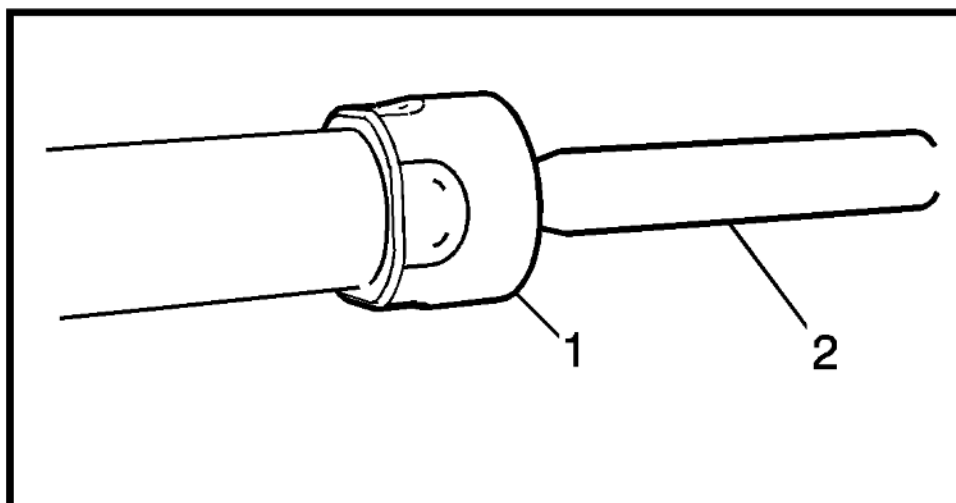


Fig. 2: Inner Tie Rod & Steering Gear Housing
Courtesy of GENERAL MOTORS COMPANY

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.

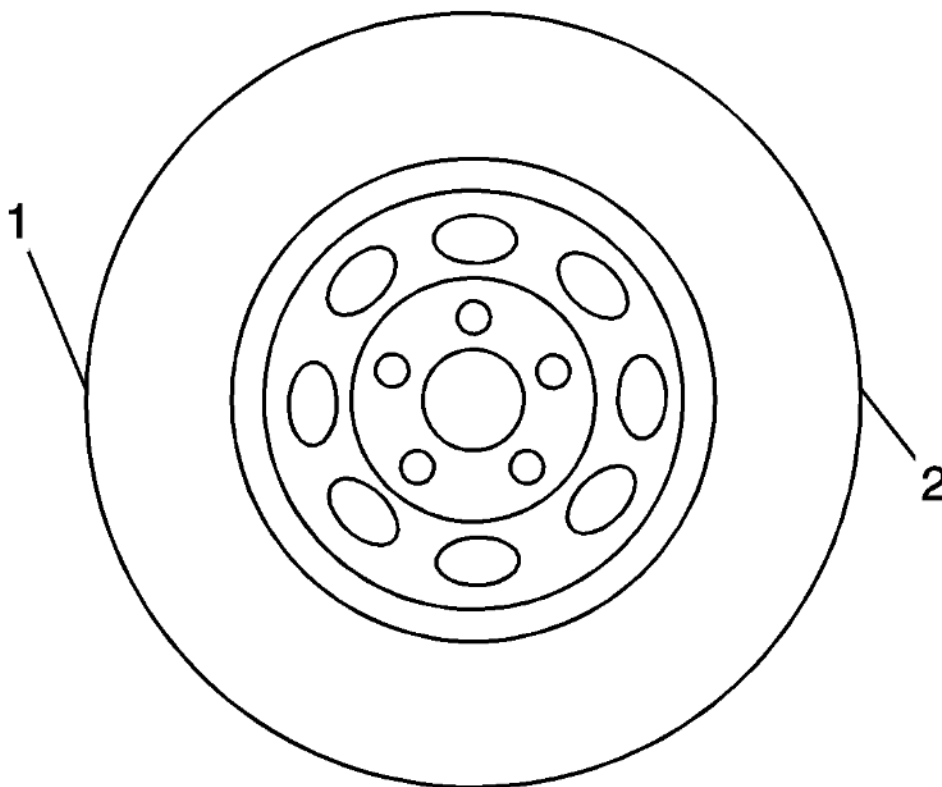


Fig. 3: Identifying Tire Grasping Positions
Courtesy of GENERAL MOTORS COMPANY

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**.
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**.

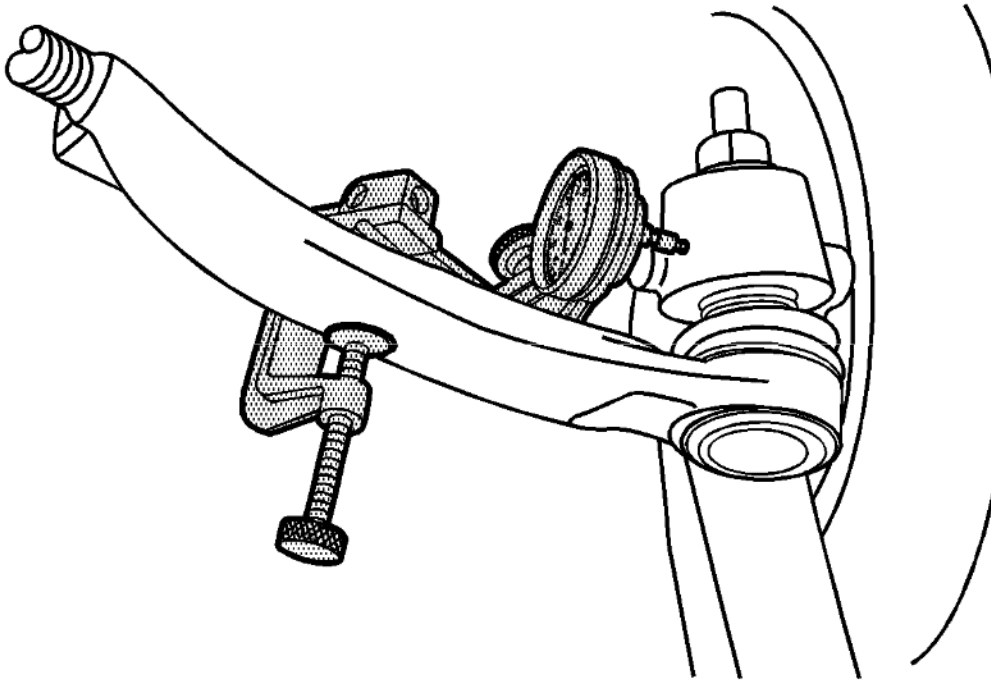


Fig. 4: Measuring Outer Tie Rod Lash
Courtesy of GENERAL MOTORS COMPANY

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.

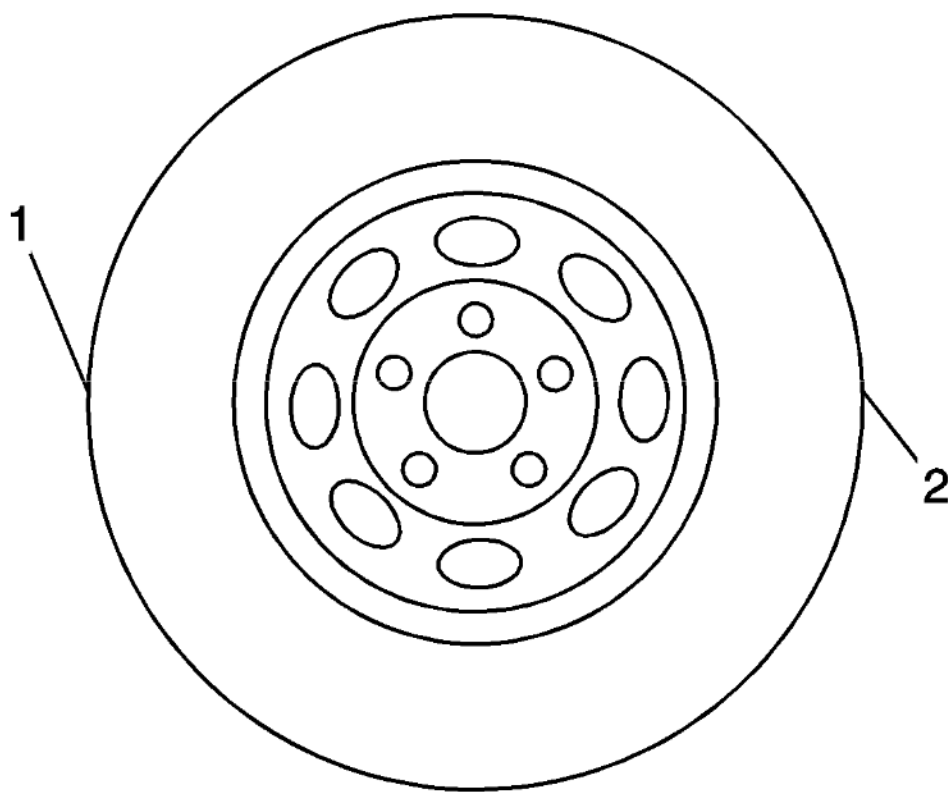


Fig. 5: Identifying Tire Grasping Positions
Courtesy of GENERAL MOTORS COMPANY

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

STEERING LINKAGE OUTER TIE ROD REPLACEMENT

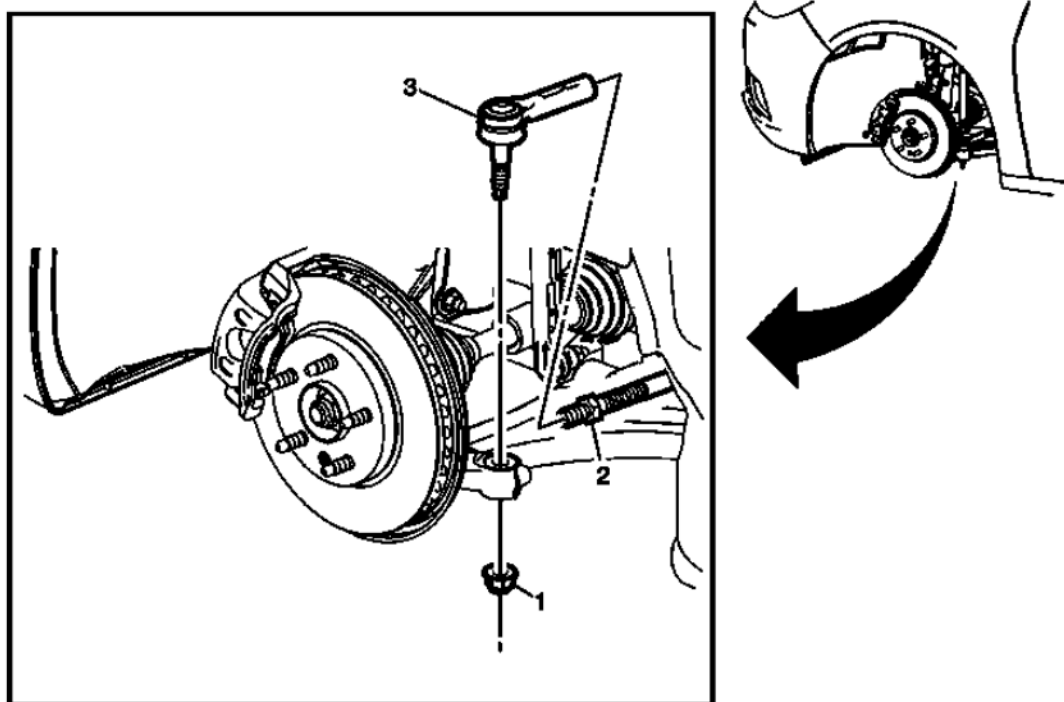


Fig. 6: Steering Linkage Outer Tie Rod And Nuts
Courtesy of GENERAL MOTORS COMPANY

Steering Linkage Outer 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 front tire and wheel assembly. Refer to <u>Tire and Wheel Removal and Installation</u> .	
1	Steering Linkage Outer Tie Rod Nut CAUTION: Refer to <u>Fastener Caution</u> . 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 linkage outer tie rod nut. Discard the nut. 2. Install a NEW steering linkage outer tie rod nut.

	Tighten 35 N.m (26 lb ft) + 30 degrees
2	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.
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 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. After the installation is complete, measure and adjust the front toe. Refer to <u>Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment</u>. 5. If equipped with electronic power steering, perform the software end stop learning procedure. Refer to <u>Power Steering Control Module Calibration</u>. Special Tools CH-161-B Steering Linkage and Tie Rod Puller For equivalent regional tools, refer to <u>Special Tools</u> .

STEERING GEAR BOOT REPLACEMENT

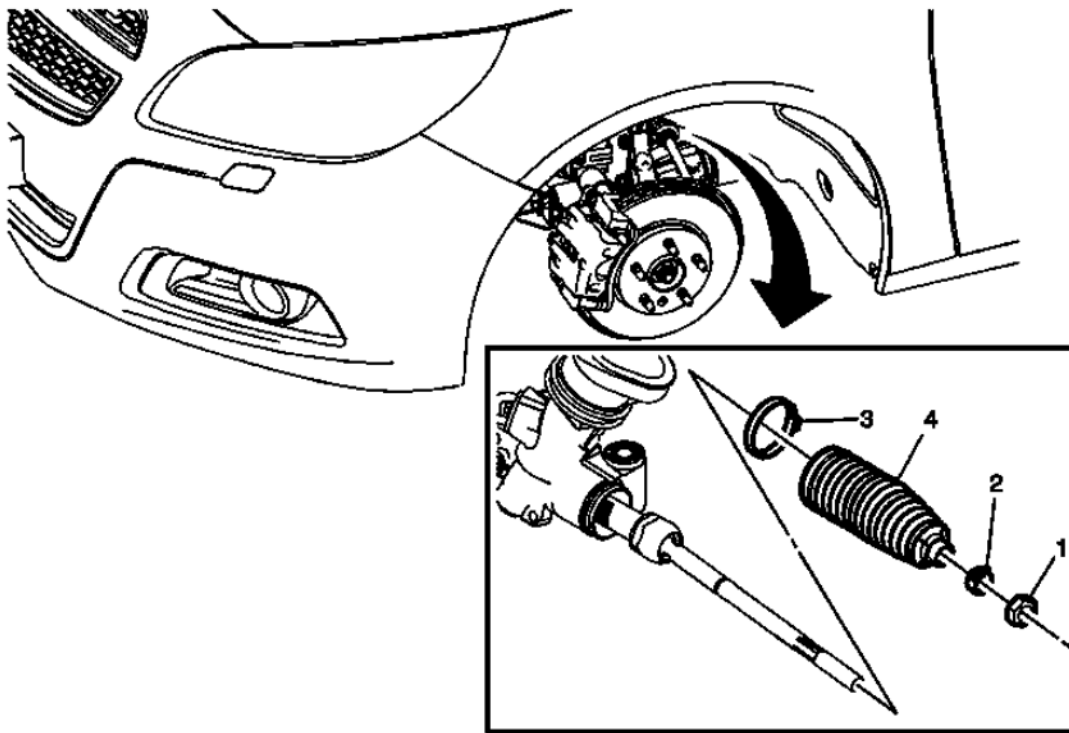


Fig. 7: Steering Gear Boot
Courtesy of GENERAL MOTORS COMPANY

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 steering linkage outer tie rod. Refer to <u>Steering Linkage Outer Tie Rod Replacement</u>. 3. If necessary, remove the steering gear heat shield. Refer to <u>Steering Gear Heat Shield Replacement</u>. 4. 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 steering gear. Refer to <u>Steering Gear Replacement (LUK, MHH)</u>, <u>Steering Gear Replacement (LCV, MH8)</u>, <u>Steering Gear Replacement (LTG, M7W)</u>.	
1	Steering Linkage Inner Tie Rod Nut CAUTION: Refer to <u>Fastener Caution</u> . NOTE: Mark the position of the steering linkage inner tie rod nut before removing to aid in installation.

2	Steering Gear Boot Outer Clamp
3	Steering Gear Boot Inner Clamp Procedure 1. Cut the steering gear boot inner clamp. Discard the clamp. 2. Use the DT-35910 pliers to install a NEW steering gear boot inner clamp. Special Tools DT-35910 Drive Axle Seal Clamp Pliers For equivalent regional tools, refer to <u>Special Tools</u> .
4	Steering Gear Boot Procedure 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.

STEERING GEAR HEAT SHIELD REPLACEMENT

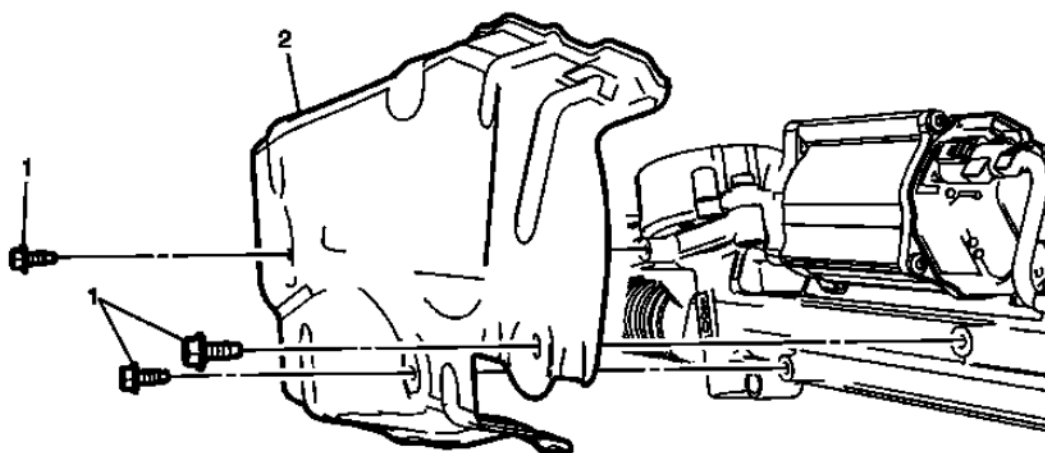


Fig. 8: Steering Gear Heat Shield And Bolts (NJ1)
 Courtesy of GENERAL MOTORS COMPANY

Steering Gear Heat Shield Replacement

Callout	Component Name
Preliminary Procedure Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> .	
1	Steering Gear Heat Shield Fastener (Qty: 3) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 9 N.m (80 lb in)
2	Steering Gear Heat Shield

STEERING GEAR REPLACEMENT (LUK, MHH)

Removal Procedure

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

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

CAUTION: With wheels of the vehicle facing straight ahead, secure the steering

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

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

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

1. Lock the steering column in the straight-ahead position.
2. Disconnect the intermediate steering shaft from the steering gear and remove the front dash seal from the steering gear input shaft. Refer to **Intermediate Steering Shaft Replacement** .
3. Install the universal engine support fixture. Refer to **Engine Support Fixture** .
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
5. Disconnect the steering linkage outer tie rods from the steering knuckles. Refer to **Steering Linkage Outer Tie Rod Replacement**.
6. Disconnect the stabilizer shaft links from the stabilizer shaft. Refer to **Stabilizer Shaft Link Replacement** .
7. Disconnect the lower control arms from the steering knuckles. Refer to **Lower Control Arm Replacement** .
8. Remove the steering gear heat shield. Refer to **Steering Gear Heat Shield Replacement**.
9. Disconnect the electrical connector on the steering gear and disconnect the wiring harness clip from the steering gear housing.

NOTE: **Wiring harness routing is critical. Note the exact routing of the steering gear wiring harness before repositioning it.**

10. Remove the wiring harness bracket bolts from the steering gear. Leave the bracket attached to the wiring harness and position it out of the way.
11. Remove the through bolts for the front and rear transmission mounts. Refer to **Transmission Front Mount Replacement** , and **Transmission Rear Mount Replacement** .
12. Position adjustable jackstands underneath the left and right sides of the rear of the drivetrain and front suspension frame.
13. Lower the vehicle until the drivetrain and front suspension frame is resting lightly on the jackstands.
14. Remove the exhaust front pipe. Refer to **Exhaust Front Pipe Replacement (LUK)** , **Exhaust Front**

Pipe Replacement (LCV) , Exhaust Front Pipe Replacement (LTG) .

15. Loosen the drivetrain and front suspension frame front bolts. Refer to **Drivetrain and Front Suspension Frame Replacement** .
16. Raise the vehicle while the drivetrain and front suspension frame rests on the jackstands. Do not allow the gap between the body and rear of the frame to exceed a maximum of 50 mm (2 in).
17. Finish removing the stabilizer shaft. Refer to **Stabilizer Shaft Replacement** .

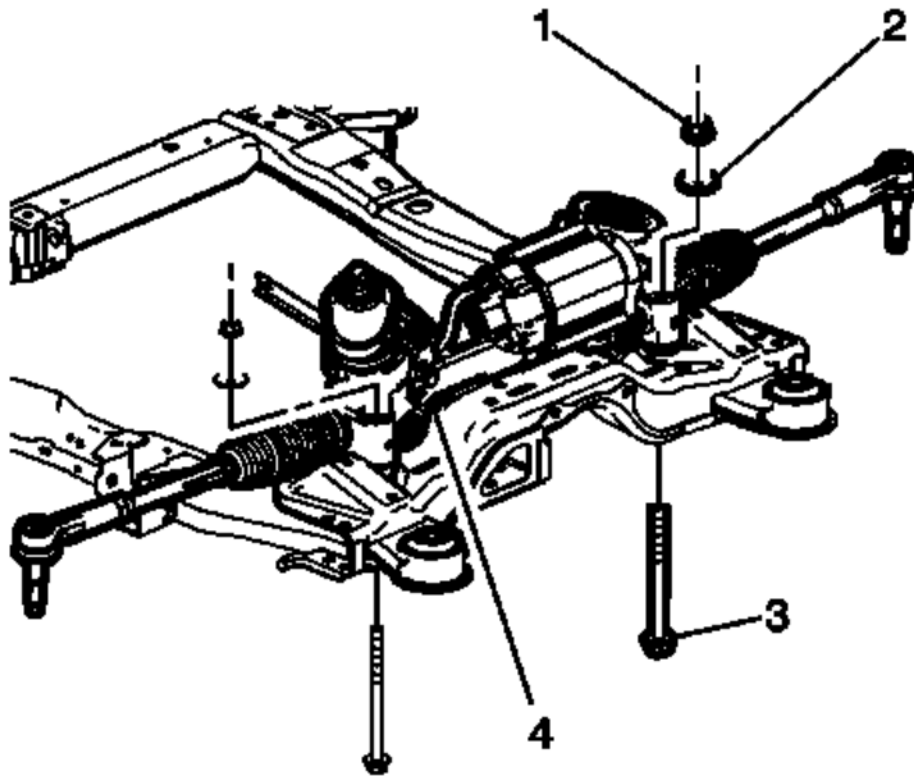


Fig. 9: Power Steering Gear Components
Courtesy of GENERAL MOTORS COMPANY

18. Remove the steering gear nuts (1), washers (2) and bolts (3) from the steering gear (4). Discard the nuts and bolts.
19. Remove the steering gear (4) from the left side of the vehicle.
20. Transfer components as necessary.

Installation Procedure

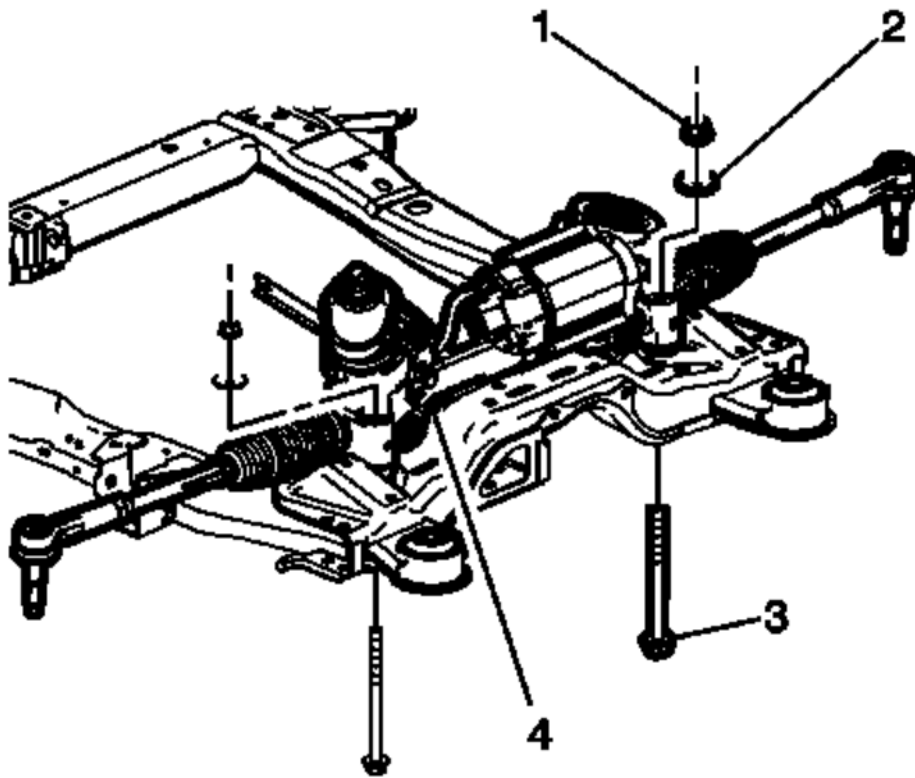


Fig. 10: Power Steering Gear Components
Courtesy of GENERAL MOTORS COMPANY

1. Position the steering gear (4) on the front suspension frame through the left side of the vehicle.

CAUTION: Refer to Fastener Caution .

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

NOTE: Start all bolts by hand before tightening.

2. Install the NEW steering gear bolts (3), washers (2) and NEW nuts (1) and tighten the bolts (3) to 110 N.m (81 lb ft) + 150 degrees.
3. Install the stabilizer shaft onto the drivetrain and front suspension frame. Refer to Stabilizer Shaft Replacement .
4. Lower the vehicle until the gap between the drivetrain and front suspension frame and body is

approximately 12 mm (0.5 in).

5. Install the exhaust front pipe. Refer to [Exhaust Front Pipe Replacement \(LUK\)](#) , [Exhaust Front Pipe Replacement \(LCV\)](#) , [Exhaust Front Pipe Replacement \(LTG\)](#) .
6. Tighten the drivetrain and front suspension frame front bolts. Refer to [Drivetrain and Front Suspension Frame Replacement](#) .
7. Remove the jackstands from underneath the vehicle.
8. Install the through bolts for the front and rear transmission mounts. Refer to [Transmission Front Mount Replacement](#) , and [Transmission Rear Mount Replacement](#) .

NOTE: **Wiring harness routing is critical. When installing, route the wiring harness in the exact same location it was moved from during the removal procedure.**

9. Route the steering gear wiring harness in the position it was in before removal.
10. Tighten the steering gear wiring harness bracket bolts to 9 N.m (80 lb in).
11. Connect the electrical connector on the steering gear and connect the wiring harness clip on the steering gear housing.
12. Install the steering gear heat shield. Refer to [Steering Gear Heat Shield Replacement](#).
13. Connect the lower control arms to the steering knuckles. Refer to [Lower Control Arm Replacement](#) .
14. Connect the stabilizer shaft links to the stabilizer shaft. Refer to [Stabilizer Shaft Link Replacement](#) .
15. Connect the steering linkage outer tie rods to the steering knuckles. Refer to [Steering Linkage Outer Tie Rod Replacement](#).
16. Remove the universal engine support fixture. Refer to [Engine Support Fixture](#) .
17. Install the front dash seal on the steering gear input shaft and connect the intermediate steering shaft to the steering gear. Refer to [Intermediate Steering Shaft Replacement](#) .
18. Program the power steering control module. Refer to [Power Steering Control Module Programming and Setup](#) .
19. Measure and adjust the front toe. Refer to [Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment](#) .

STEERING GEAR REPLACEMENT (LCV, MH8)

Removal Procedure

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

- Touch a metal ground point in order to remove your body's static charge before servicing any electronic component; especially after sliding across the vehicle seat.

- Do not touch exposed terminals. Terminals may connect to circuits susceptible the ESD damage.
- Do not allow tools to contact exposed terminals when servicing connectors.
- Do not remove components from their protective packaging until required to do so.
- Avoid the following actions unless required by the diagnostic procedure:
 - Jumpering or grounding of the components or connectors.
 - Connecting test equipment probes to components or connectors. Connect the ground lead first when using test probes.
- Ground the protective packaging of any component before opening. Do not rest solid-state components on metal workbenches, or on top of TVs, radios, or other electrical devices.

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

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

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

1. Lock the steering column in the straight-ahead position.
2. Disconnect the intermediate steering shaft from the steering gear and remove the front dash seal from the steering gear input shaft. Refer to **Intermediate Steering Shaft Replacement** .
3. Install the engine support fixture. Refer to **Engine Support Fixture** .
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
5. Disconnect the steering linkage outer tie rods from the steering knuckles. Refer to **Steering Linkage Outer Tie Rod Replacement**.
6. Disconnect the stabilizer shaft links from the stabilizer shaft. Refer to **Stabilizer Shaft Link**

Replacement .

7. Disconnect the lower control arms from the steering knuckles. Refer to **Lower Control Arm Replacement** .
8. Remove the steering gear heat shield. Refer to **Steering Gear Heat Shield Replacement**.
9. Disconnect the electrical connector on the steering gear and disconnect the wiring harness clip from the steering gear housing.

NOTE: **Wiring harness routing is critical. Note the exact routing of the steering gear wiring harness before repositioning it.**

10. Remove the wiring harness bracket bolts from the steering gear. Leave the bracket attached to the wiring harness and position it out of the way.
11. Remove the through bolts for the front and rear transmission mounts. Refer to **Transmission Front Mount Replacement** , and **Transmission Rear Mount Replacement** .
12. Position adjustable jackstands underneath the left and right sides of the rear of the drivetrain and front suspension frame.
13. Lower the vehicle until the drivetrain and front suspension frame is resting lightly on the jackstands.
14. Remove the exhaust front pipe. Refer to **Exhaust Front Pipe Replacement (LUK)** , **Exhaust Front Pipe Replacement (LCV)** , **Exhaust Front Pipe Replacement (LTG)** .
15. Loosen the drivetrain and front suspension frame front bolts. Refer to **Drivetrain and Front Suspension Frame Replacement** .
16. Raise the vehicle while the drivetrain and front suspension frame rests on the jackstands. Do not allow the gap between the body and rear of the frame to exceed a maximum of 50 mm (2 in).
17. Finish removing the stabilizer shaft. Refer to **Stabilizer Shaft Replacement** .

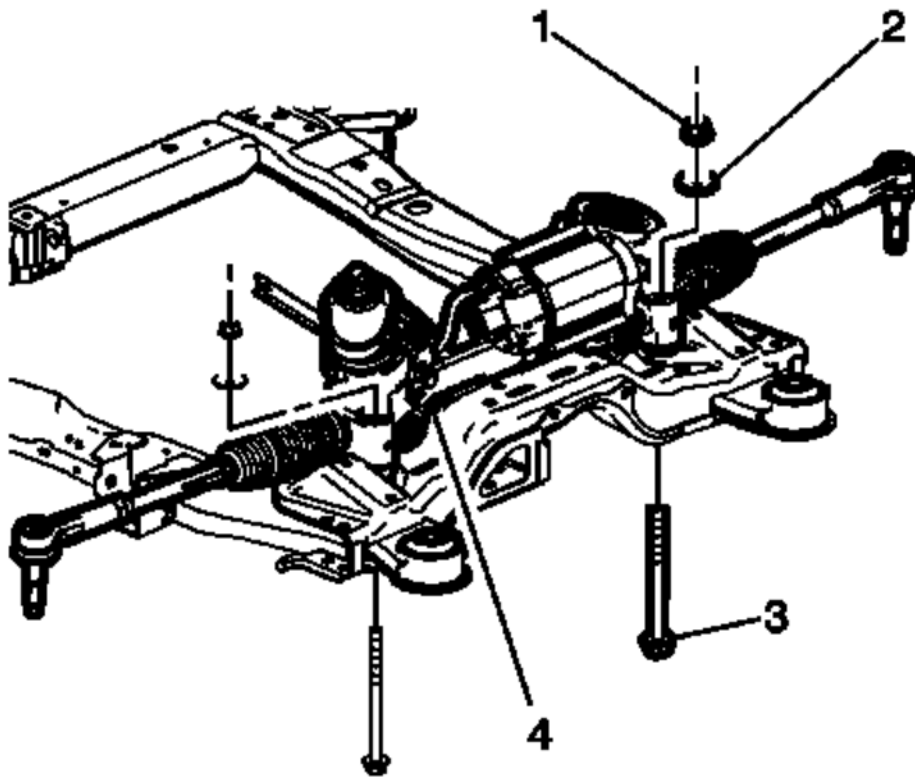


Fig. 11: Power Steering Gear Components
Courtesy of GENERAL MOTORS COMPANY

18. Remove the steering gear nuts (1), washers (2) and bolts (3) from the steering gear (4). Discard the nuts and bolts.
19. Remove the steering gear (4) from the left side of the vehicle.
20. Transfer components as necessary.

Installation Procedure

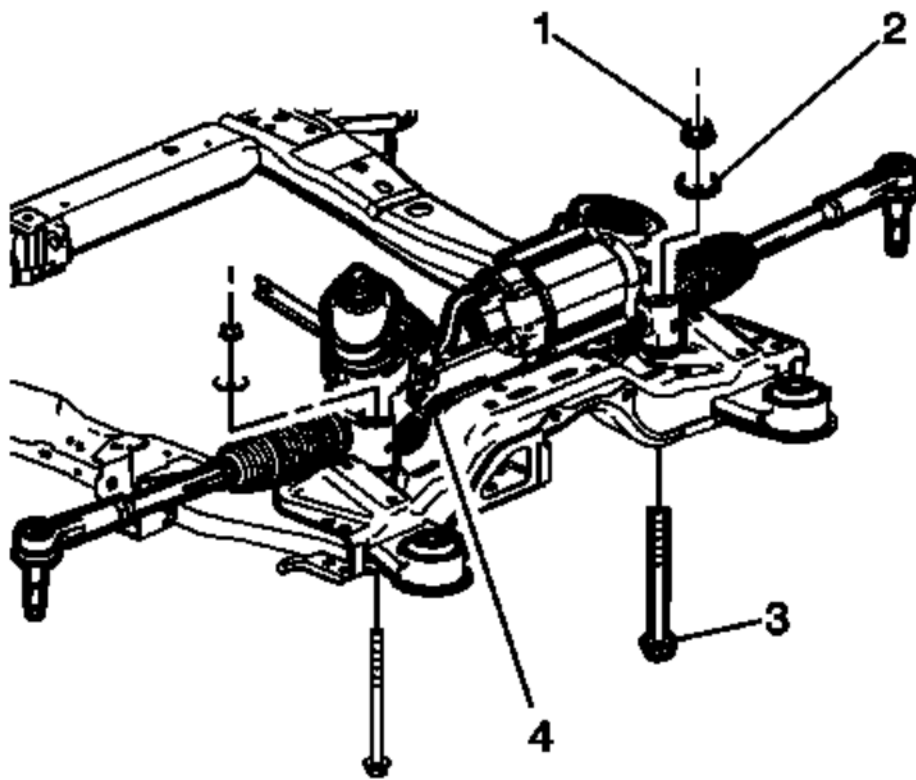


Fig. 12: Power Steering Gear Components
 Courtesy of GENERAL MOTORS COMPANY

1. Position the steering gear (4) on the front suspension frame through the left side of the vehicle.

CAUTION: Refer to Fastener Caution .

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

NOTE: Start all bolts by hand before tightening.

2. Install the NEW steering gear bolts (3), washers (2) and NEW nuts (1) and tighten the bolts (3) to 110 N.m (81 lb ft) + 150 degrees.
3. Install the stabilizer shaft onto the drivetrain and front suspension frame. Refer to Stabilizer Shaft Replacement .
4. Lower the vehicle until the gap between the drivetrain and front suspension frame and body is

approximately 12 mm (0.5 in).

5. Install the exhaust front pipe. Refer to [Exhaust Front Pipe Replacement \(LUK\)](#) , [Exhaust Front Pipe Replacement \(LCV\)](#) , [Exhaust Front Pipe Replacement \(LTG\)](#) .
6. Tighten the drivetrain and front suspension frame front bolts. Refer to [Drivetrain and Front Suspension Frame Replacement](#) .
7. Remove the jackstands from underneath the vehicle.
8. Install the through bolts for the front and rear transmission mounts. Refer to [Transmission Front Mount Replacement](#) , and [Transmission Rear Mount Replacement](#) .

NOTE: **Wiring harness routing is critical. When installing, route the wiring harness in the exact same location it was moved from during the removal procedure.**

9. Route the steering gear wiring harness in the position it was in before removal.
10. Tighten the steering gear wiring harness bracket bolts to 9 N.m (80 lb in).
11. Connect the electrical connector on the steering gear and connect the wiring harness clip on the steering gear housing.
12. Install the steering gear heat shield. Refer to [Steering Gear Heat Shield Replacement](#).
13. Connect the lower control arms to the steering knuckles. Refer to [Lower Control Arm Replacement](#) .
14. Connect the stabilizer shaft links to the stabilizer shaft. Refer to [Stabilizer Shaft Link Replacement](#) .
15. Connect the steering linkage outer tie rods to the steering knuckles. Refer to [Steering Linkage Outer Tie Rod Replacement](#).
16. Remove the engine support fixture. Refer to [Engine Support Fixture](#) .
17. Install the front dash seal on the steering gear input shaft and connect the intermediate steering shaft to the steering gear. Refer to [Intermediate Steering Shaft Replacement](#) .
18. Program the power steering control module. Refer to [Power Steering Control Module Programming and Setup](#) .
19. Measure and adjust the front toe. Refer to [Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment](#) .

STEERING GEAR REPLACEMENT (LTG, M7W)

Removal Procedure

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

- Touch a metal ground point in order to remove your body's static charge before servicing any electronic component; especially after sliding across the vehicle seat.

- Do not touch exposed terminals. Terminals may connect to circuits susceptible the ESD damage.
- Do not allow tools to contact exposed terminals when servicing connectors.
- Do not remove components from their protective packaging until required to do so.
- Avoid the following actions unless required by the diagnostic procedure:
 - Jumpering or grounding of the components or connectors.
 - Connecting test equipment probes to components or connectors. Connect the ground lead first when using test probes.
- Ground the protective packaging of any component before opening. Do not rest solid-state components on metal workbenches, or on top of TVs, radios, or other electrical devices.

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

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

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

1. Lock the steering column in the straight-ahead position.
2. Disconnect the intermediate steering shaft from the steering gear and remove the front dash seal from the steering gear input shaft. Refer to **Intermediate Steering Shaft Replacement** .
3. Install the engine support fixture. Refer to **Engine Support Fixture** .
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
5. Disconnect the steering linkage outer tie rods from the steering knuckles. Refer to **Steering Linkage Outer Tie Rod Replacement**.
6. Disconnect the stabilizer shaft links from the stabilizer shaft. Refer to **Stabilizer Shaft Link**

Replacement .

7. Disconnect the lower control arms from the steering knuckles. Refer to **Lower Control Arm Replacement** .
8. Remove the steering gear heat shield. Refer to **Steering Gear Heat Shield Replacement**.
9. Disconnect the electrical connector on the steering gear and disconnect the wiring harness clip from the steering gear housing.

NOTE: **Wiring harness routing is critical. Note the exact routing of the steering gear wiring harness before repositioning it.**

10. Remove the wiring harness bracket bolts from the steering gear. Leave the bracket attached to the wiring harness and position it out of the way.
11. Remove the through bolts for the front and rear transmission mounts. Refer to **Transmission Front Mount Replacement** , and **Transmission Rear Mount Replacement** .
12. Position adjustable jackstands underneath the left and right sides of the rear of the drivetrain and front suspension frame.
13. Lower the vehicle until the drivetrain and front suspension frame is resting lightly on the jackstands.
14. Remove the exhaust front pipe. Refer to **Exhaust Front Pipe Replacement (LUK)** , **Exhaust Front Pipe Replacement (LCV)** , **Exhaust Front Pipe Replacement (LTG)** .
15. Loosen the drivetrain and front suspension frame front bolts. Refer to **Drivetrain and Front Suspension Frame Replacement** .
16. Raise the vehicle while the drivetrain and front suspension frame rests on the jackstands. Do not allow the gap between the body and rear of the frame to exceed a maximum of 50 mm (2 in).
17. Finish removing the stabilizer shaft. Refer to **Stabilizer Shaft Replacement** .

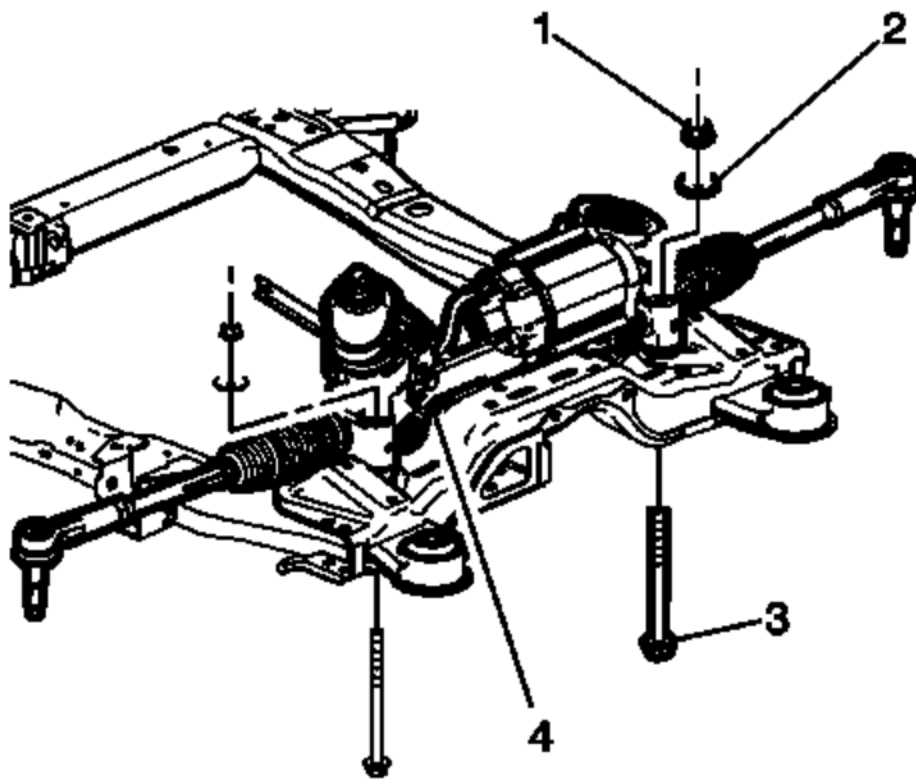


Fig. 13: Power Steering Gear Components
Courtesy of GENERAL MOTORS COMPANY

18. Remove the steering gear nuts (1), washers (2) and bolts (3) from the steering gear (4). Discard the nuts and bolts.
19. Remove the steering gear (4) from the left side of the vehicle.
20. Transfer components as necessary.

Installation Procedure

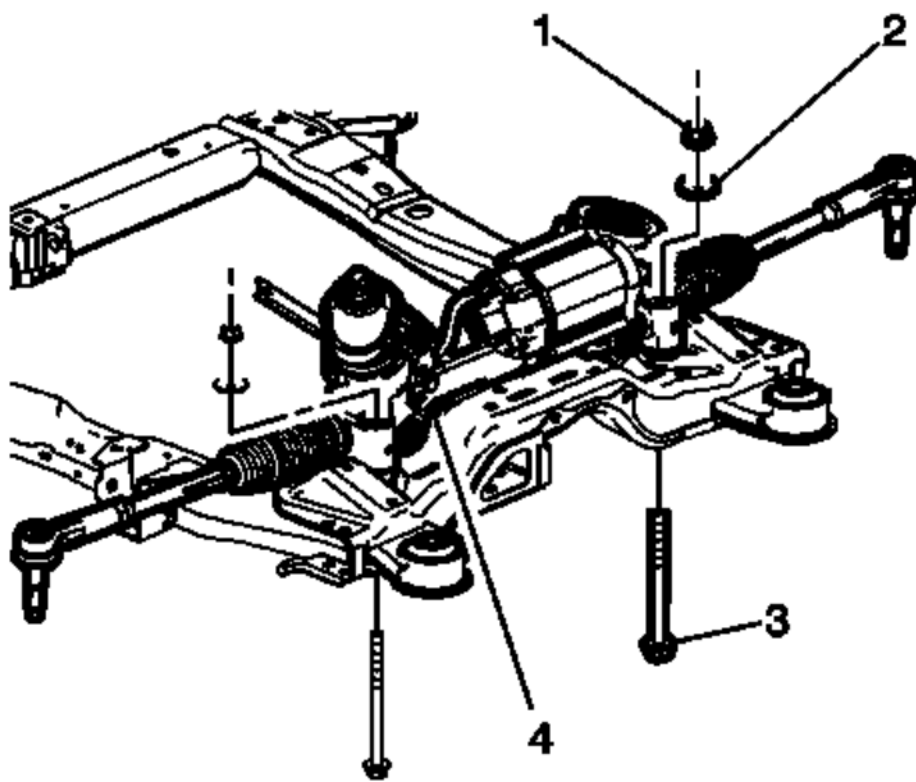


Fig. 14: Power Steering Gear Components
 Courtesy of GENERAL MOTORS COMPANY

1. Position the steering gear (4) on the front suspension frame through the left side of the vehicle.

CAUTION: Refer to Fastener Caution .

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

NOTE: Start all bolts by hand before tightening.

2. Install the NEW steering gear bolts (3), washers (2) and NEW nuts (1) and tighten the bolts (3) to 110 N.m (81 lb ft) + 150 degrees.
3. Install the stabilizer shaft onto the drivetrain and front suspension frame. Refer to Stabilizer Shaft Replacement .
4. Lower the vehicle until the gap between the drivetrain and front suspension frame and body is

approximately 12 mm (0.5 in).

5. Install the exhaust front pipe. Refer to [Exhaust Front Pipe Replacement \(LUK\)](#) , [Exhaust Front Pipe Replacement \(LCV\)](#) , [Exhaust Front Pipe Replacement \(LTG\)](#) .
6. Tighten the drivetrain and front suspension frame front bolts. Refer to [Drivetrain and Front Suspension Frame Replacement](#) .
7. Remove the jackstands from underneath the vehicle.
8. Install the through bolts for the front and rear transmission mounts. Refer to [Transmission Front Mount Replacement](#) , and [Transmission Rear Mount Replacement](#) .

NOTE: **Wiring harness routing is critical. When installing, route the wiring harness in the exact same location it was moved from during the removal procedure.**

9. Route the steering gear wiring harness in the position it was in before removal.
10. Tighten the steering gear wiring harness bracket bolts to 9 N.m (80 lb in).
11. Connect the electrical connector on the steering gear and connect the wiring harness clip on the steering gear housing.
12. Install the steering gear heat shield. Refer to [Steering Gear Heat Shield Replacement](#).
13. Connect the lower control arms to the steering knuckles. Refer to [Lower Control Arm Replacement](#) .
14. Connect the stabilizer shaft links to the stabilizer shaft. Refer to [Stabilizer Shaft Link Replacement](#) .
15. Connect the steering linkage outer tie rods to the steering knuckles. Refer to [Steering Linkage Outer Tie Rod Replacement](#).
16. Remove the engine support fixture. Refer to [Engine Support Fixture](#) .
17. Install the front dash seal on the steering gear input shaft and connect the intermediate steering shaft to the steering gear. Refer to [Intermediate Steering Shaft Replacement](#) .
18. Program the power steering control module. Refer to [Power Steering Control Module Programming and Setup](#) .
19. Measure and adjust the front toe. Refer to [Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment](#) .

STEERING LINKAGE INNER TIE ROD REPLACEMENT

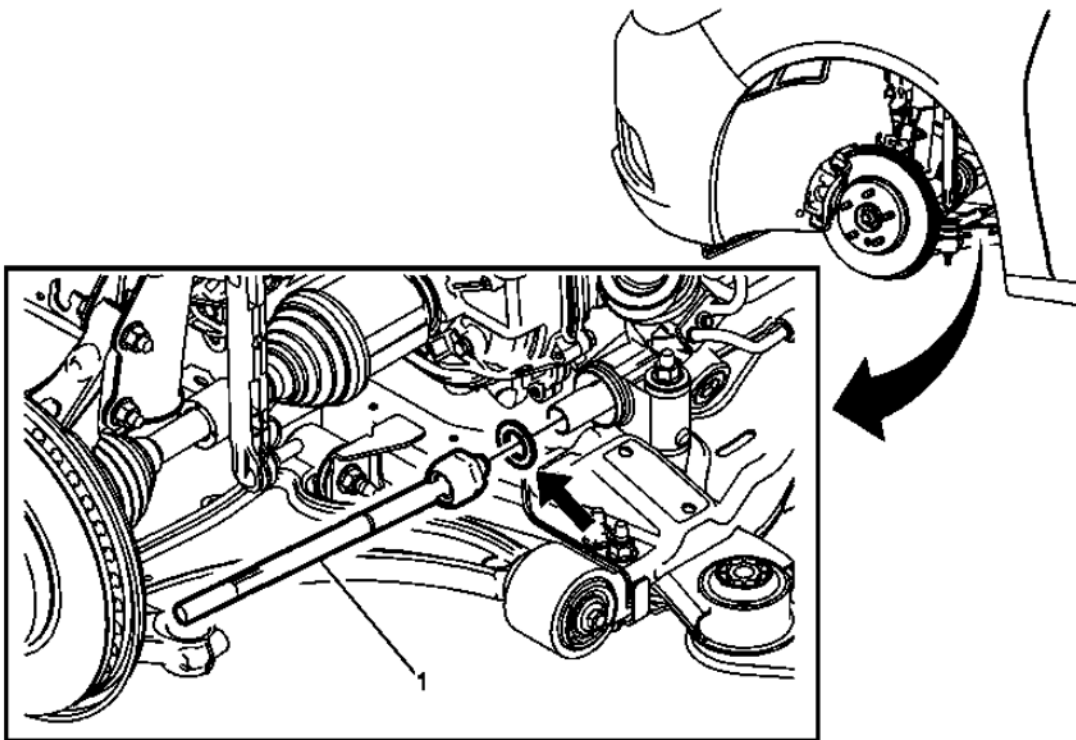


Fig. 15: Steering Linkage Inner Tie Rod
 Courtesy of GENERAL MOTORS COMPANY

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>. 3. After removing the steering gear boot, inspect the steering linkage 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 steering gear. Refer to <u>Steering Gear Replacement (LUK, MHH)</u>, <u>Steering Gear Replacement (LCV, MH8)</u>, <u>Steering Gear Replacement (LTG, M7W)</u>.	
	Steering Linkage Inner Tie Rod CAUTION: Refer to <u>Fastener Caution</u> . Procedure 1. Place a wrench on the flats of the steering linkage inner tie rod housing. 2. Rotate the steering linkage inner tie rod housing counterclockwise to remove the steering linkage inner tie rod from the steering gear rack. 3. Rotate the steering linkage inner tie rod housing clockwise to install the

1	steering linkage inner tie rod to the steering gear rack. Use the CH-6321 wrench and a torque wrench to tighten the steering linkage inner tie rod to specification. 4. After the installation is complete, measure and adjust the front toe. Refer to <u>Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment</u> . NOTE: A 2.5 mm shim is used for vehicles with wheels up to 18 inches and a 5.6 mm shim is used for vehicles with 19 inch and 20 inch wheels. Tighten 100 N.m (74 lb ft) Special Tools CH-6321 Inner Tie Rod Wrench For equivalent regional tools, refer to <u>Special Tools</u>.
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STEERING GEAR DRIVE COUPLING REPLACEMENT

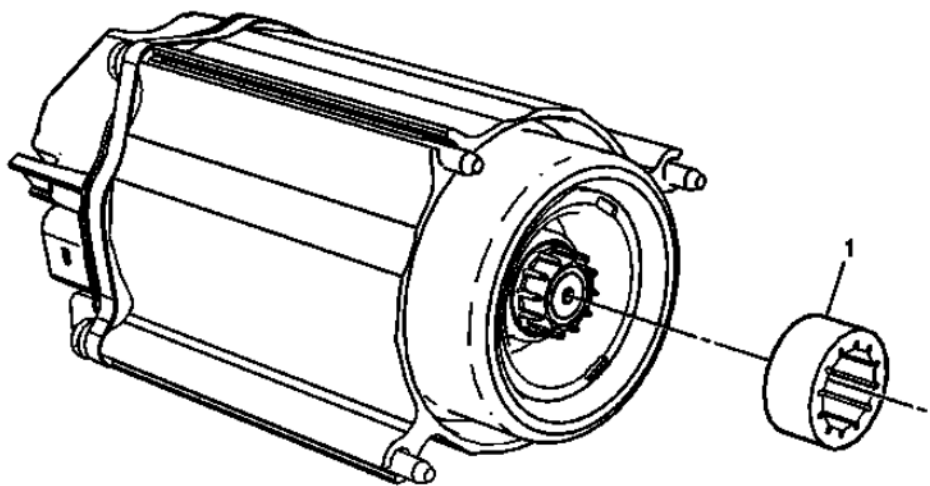


Fig. 16: Steering Gear Drive Coupling
Courtesy of GENERAL MOTORS COMPANY

Steering Gear Drive Coupling Replacement

Callout	Component Name
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Preliminary Procedure

Remove the power steering assist motor. Refer to **Power Steering Assist Motor Replacement**.

1	Steering Gear Coupling NOTE: The steering gear coupling connects the power steering assist motor to the steering gear.
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POWER STEERING ASSIST MOTOR REPLACEMENT

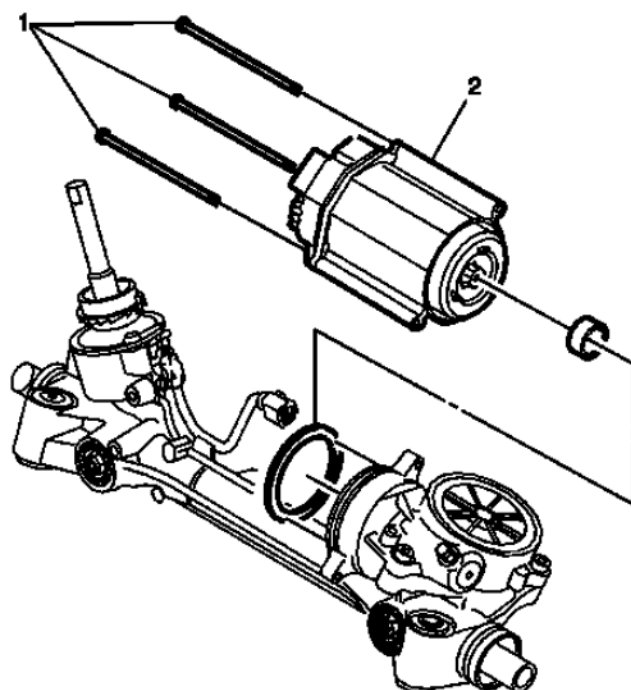


Fig. 17: Power Steering Assist Motor & Bolts
Courtesy of GENERAL MOTORS COMPANY

Power Steering Assist Motor Replacement

Callout	Component Name
CAUTION: Electrostatic discharge (ESD) can damage many solid-state electrical components. ESD susceptible components may or may not be labeled with the ESD symbol. Handle all electrical components carefully. Use the following precautions in order to avoid ESD damage: • Touch a metal ground point in order to remove your body's static charge before servicing any electronic component; especially after sliding across the vehicle seat. • Do not touch exposed terminals. Terminals may connect to circuits susceptible the ESD damage. • Do not allow tools to contact exposed terminals when servicing connectors.	

- Do not remove components from their protective packaging until required to do so.
- Avoid the following actions unless required by the diagnostic procedure:
 - Jumpering or grounding of the components or connectors.
 - Connecting test equipment probes to components or connectors. Connect the ground lead first when using test probes.
- Ground the protective packaging of any component before opening. Do not rest solid-state components on metal workbenches, or on top of TVs, radios, or other electrical devices.

Preliminary Procedures

1. Perform the strategy based diagnosis. Performing the strategy based diagnostics includes reviewing related bulletins, preliminary information and diagnostics. Refer to **Strategy Based Diagnosis**.
2. Capture the key cycle count from the old steering gear control module. If the key cycle count from the old steering gear control module is not captured, it will not be possible to flash the new steering gear control module. Refer to **Power Steering Control Module Programming and Setup**.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**.
4. Remove the steering gear. Refer to **Steering Gear Replacement (LUK, MHH)**, **Steering Gear Replacement (LCV, MH8)**, **Steering Gear Replacement (LTG, M7W)**.

1	Power Steering Assist Motor Bolt (Qty: 3) 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 <u>Fastener Caution</u>. Procedure 1. Remove the power steering assist motor bolts. Discard the bolts. 2. Install the NEW power steering assist motor bolts. Tighten 8 (71 lb in)
	Power Steering Assist Motor Procedure 1. Remove the O-ring from the steering gear housing. Discard the O-ring. 2. Inspect the steering gear motor shaft and inside of the steering gear

2

housing for signs of water intrusion or corrosion. If no signs of water intrusion or corrosion are present proceed to the next step. If signs of water intrusion or corrosion are present then replace the steering gear. Refer to **Steering Gear Replacement (LUK, MHH)**, **Steering Gear Replacement (LCV, MH8)**, **Steering Gear Replacement (LTG, M7W)**.

3. Install a NEW O-ring around the steering gear housing.
4. Install the steering gear coupling to the assist motor armature.
5. Align the steering gear coupling on the assist motor armature to the steering gear.
6. Align the power steering assist motor bolts to the steering gear while pressing the motor over the gear housing O-ring.
7. After installation is complete, transfer the key cycle count from the old steering gear control module to the new steering gear control module. Refer to **Power Steering Control Module Programming and Setup**.

NOTE:

Inspection of the steering gear motor shaft and the inside of the steering gear housing is required to ensure there are no signs of water intrusion or corrosion which may cause premature motor failure. If signs of water intrusion or corrosion are present the steering gear must be replaced.

POWER STEERING CONTROL MODULE CALIBRATION

Steering Angle Sensor Centering and Software Endstop Learning

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

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

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

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

Steering Angle Sensor Centering

For electronic power steering equipped vehicles WITH electronic stability control program and EXTERNAL Steering Angle Sensor, refer to **Steering Angle Sensor Centering**.

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

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

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

Software Endstop Learning

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

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

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

DESCRIPTION AND OPERATION

POWER STEERING SYSTEM DESCRIPTION AND OPERATION (ELECTRONIC POWER STEERING)

The power steering system consists of the following components:

- The power steering control module
- The power steering motor
- The power steering motor rotational sensor
- The torque sensor

- The steering gear (rack and dual pinion)

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

The power steering control module uses a combination of the torque sensor, motor rotational sensor, vehicle speed, and calculated system temperature inputs to determine the amount of assist needed. The power steering control module continuously monitors the digital torque sensor's torque and index current signals. As the steering wheel is turned and torsional twist is applied to the steering shaft, the steering input and output shafts are monitored via the torque signal circuit and then processed by the power steering control module to calculate the steering torque. The voltage signals of the motor position sensor and the digital torque sensor's index current signal are both processed by the power steering control module to detect and calculate the steering wheel angle.

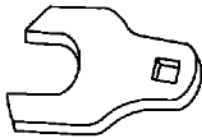
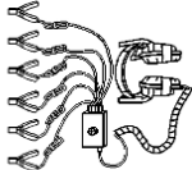
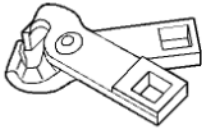
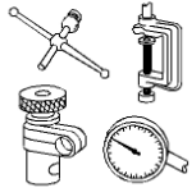
The power steering control module responds to the change in the digital torque sensor signals as well as the motor rotational sensor's voltage signals by commanding current to the power steering motor. The power steering control module controls the pulse width modulated motor drive circuit to drive the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

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

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
	CH-161-B J-22888-20A J-24319-B KM-161-B SA91100C 7503 Steering Linkage and Tie Rod Puller
	CH-6321 J-34028

	KM-6247 KM-6321 Inner Tie Rod Wrench
	CH-39570 J-39570 SA9217NE Chassis Ear
	DT-35910 J-35910 MKM-804 Drive Axle Seal Clamp Pliers
	GE-8001 J-8001 Dial Indicator Set

2013 STEERING

Power Steering - Malibu

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Drivetrain and Front Suspension Frame Rear Bolt	160 N.m	118 lb ft
Drivetrain and Front Suspension Frame Reinforcement Bolt	60 N.m	44 lb ft
Power Steering Assist Motor Bolt (1)	8 N.m	71 lb in
Power Steering Gear Heat Shield Fastener	9 N.m	80 lb in
Steering Gear Bolt (1)		
• First Pass	110 N.m	81 lb ft
• Final Pass	150 degrees	
Steering Gear Wiring Harness Bracket Bolt	9 N.m	80 lb in
Steering Linkage Inner Tie Rod	100 N.m	74 lb ft
Steering Linkage Outer Tie Rod Nut (1)		
• First Pass	35 N.m	26 lb ft
• Final Pass	30 degrees	
1. Use NEW fastener.		

SCHEMATIC WIRING DIAGRAMS

POWER STEERING WIRING SCHEMATICS

NJ1 Wiring Schematics

<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.
<u>DTC C055C</u>	DTC C055C 00 Steering Gear Performance Malfunction DTC C055C 64 Steering Gear Performance Slip Detected
<u>DTC C0565</u>	DTC C0565 5A Vehicle Identification Number Not Plausible
<u>DTC C0569</u>	DTC C0569 3A System Configuration Incorrect Component Installed

DTC C005B

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 C005B 00

Power Steering Softstops Learn

Circuit/System Description

If the power steering power pack is replaced, the calibration needs to be learned to the new power steering power pack. The power steering control module will set a DTC, if the required parameters are not learned.

Conditions for Running the DTC

Ignition Switch in OFF, ACCESSORY or ON position, power steering control module in communication mode.

Conditions for Setting the DTC

The soft endstop is not learned by the new power steering control module.

Action Taken When the DTC Sets

DTC C005B is stored in memory.

Conditions for Clearing the DTC

The software endstops need to be learned to the new power steering control module using a scan tool, performing the Configuration/Reset functions Power Steering Softstops Reset and Power Steering Softstops Learn.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Steering System Description and Operation (Electronic Power Steering)

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 C005B is not set.
 - If DTC C005B is set
Program the K43 Power Steering Control Module.
 - If DTC C005B is not set
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Steering Gear Replacement (LUK, MHH), Steering Gear Replacement (LCV, MH8), Steering Gear Replacement (LTG, M7W)

- **Power Steering Assist Motor Replacement**
- **Control Module References** for Power Steering Control Module programming and setup.

DTC C0176

Diagnostic Instructions

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

DTC Descriptor

DTC C0176 54

Control Module Temperature Sensor High Temperature

Circuit/System Description

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

Conditions for Running the DTC

- 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

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Description and Operation

Power Steering System Description and Operation (Electronic Power Steering)

Electrical Information Reference

- Circuit Testing
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- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

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

- If steering components are mechanically binding, replace the mechanically binding steering components.
 - If no steering components are mechanically binding, replace the steering column assembly.
 - If the DTC is not set
3. All OK.
- **If the DTC set outside of the conditions for running and setting**
2. All OK. The power steering is operating as designed.

Repair Instructions

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

- **Steering Column Replacement**
- **Control Module References** for Power Steering Control Module replacement, programming and setup.

DTC C044A

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 C044A 71

Steering System Engine Speed Signal Circuit Invalid Data

Circuit/System Description

The power steering control module receives the engine speed signal from the engine control module.

Conditions for Running the DTC

Engine running.

Conditions for Setting the DTC

The power steering control module detects a invalid engine speed signal on serial data.

Action Taken When the DTC Sets

DTC C044A is stored in memory.

Conditions for Clearing the DTC

- The DTC clears when the diagnostic runs and passes
- 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

Description and Operation

Power Steering System Description and Operation (Electronic Power Steering)

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 C044A.
 - If any other DTCs are set

Refer to Diagnostic Trouble Code (DTC) List - Vehicle

- If no other DTCs are set
3. Replace the K43 Power Steering Control Module.
 4. Verify that DTC C044A does not set while operating the vehicle within the Conditions for Running the DTC.
 - If DTC C044A sets

Replace the K20 Engine Control Module.

- If the DTC C044A does not set
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Steering Gear Replacement (LUK, MHH), Steering Gear Replacement (LCV, MH8), Steering Gear Replacement (LTG, M7W)
- Power Steering Assist Motor Replacement
- Control Module References for Power Steering Control Module or Engine Control Module replacement, programming and setup.

DTC C0456

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 C0456 4B

Steering Position Sensor Calibration not Learned

Circuit/System Description

If the power steering control module is replaced, the calibration needs to be learned to the new power steering control module.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The calibration is not learned to the new power steering control module.

Action Taken When the DTC Sets

- DTC C0456 is stored in memory.
- No steering assist.

Conditions for Clearing the DTC

The scan tool function Steering Angle Sensor Centering procedure must be completed successfully.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Steering System Description and Operation (Electronic Power Steering)

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 C0456 4B is not set.
 - **If DTC C0456 4B is set**
 1. Calibrate the B137 Power Steering Shaft Torque Sensor.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the K43 Power Steering Control Module.
 - If the DTC does not set
 3. All OK.
 - **If DTC C0456 4B is not set**
3. All OK.

Repair Instructions

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

- Steering Gear Replacement (LUK, MHH), Steering Gear Replacement (LCV, MH8), Steering Gear Replacement (LTG, M7W)
- Power Steering Assist Motor Replacement
- Control Module References for Power Steering Control Module programming and setup.

DTC C0475

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

DTC C0475 59

Electric Steering Motor Circuit Protection Time-Out

Circuit/System Description

C0475 00

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.

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 the end of its predetermined lifecycle and must be replaced.

Conditions for Running the DTC

Ignition 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 power steering assist motor circuits.

C0475 59

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

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

C0475 00

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

C0475 59

This DTC cannot be cleared. The power steering system must be replaced.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Steering System Description and Operation (Electronic Power Steering)

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

C0475 00

1. Ignition OFF and all vehicle systems OFF, disconnect the X2 harness connector at the K43 Power Steering Control Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Verify a test lamp illuminates between the B+ circuit terminal 2 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 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 K43 Power Steering Control Module.
 - **If the test lamp illuminates**
4. Replace K43 Power Steering Control Module.

C0475 59

1. Ignition ON.
2. Verify that DTC C0475 59 is not set.
 - **If the DTC C0457 59 is set**

Replace the steering gear.
 - **If the DTC C0457 59 is not set**
3. All OK.

Repair Instructions

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

- **Steering Gear Replacement (LUK, MHH), Steering Gear Replacement (LCV, MH8), Steering Gear**

Replacement (LTG, M7W)

- **Power Steering Assist Motor Replacement**
- **Control Module References** for Power Steering Control Module programming and setup.

DTC C047A

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

Electric Steering Motor Position Sensor Circuit

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

The vehicle is ON or in SERVICE MODE.

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, or a plausibility error as a result of a mismatch between the steering angle data from the internal steering angle sensor in the gear versus the external steering angle sensor data on the steering column.

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

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

Diagnostics Aids

A communication error between the Electronic Brake Control Module and Power Steering Control Module can cause DTC C047A to set in history and display Service Power Steering warning message. Do not replace the steering gear or power steering control module if DTC C047A is set in history. If DTC C047A is current, follow the Circuit/System Testing for proper diagnosis.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Steering System Description and Operation (Electronic Power Steering)

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. With a scan tool, verify that DTC C0710 71 is not set.
 - **If DTC C0710 71 is set**

Refer to **DTC C0710** in Anitlock Brake System Diagnostic Information and Procedures.

- **If DTC C0710 71 is not set**

3. With a scan tool verify that DTC C047A is not set.
 - If the DTC is set

Refer to Circuit/System Testing below.

- If the DTC is not set

4. All OK.

Circuit/System Testing

1. Verify that the connector at the B137 Power Steering Shaft Torque Sensor is not damaged or have water intrusion/corrosion.
 - o **The B137 Power Steering Shaft Torque Sensor connector is not OK**

Replace the steering gear.

- o **The B137 Power Steering Shaft Torque Sensor connector is OK**
2. With a scan tool perform the Power Steering Control Module Calibration procedure Steering Angle Sensor Centering and Software Endstop Learning. Refer to **Power Steering Control Module Calibration**.
 3. Verify that DTC C047A does not set.
 - o If the DTC does set

Replace the K43 Power Steering Control Module.

- o If the DTC does not set
4. All OK.

Repair Instructions

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

- **Steering Gear Replacement (LUK, MHH), Steering Gear Replacement (LCV, MH8), Steering Gear Replacement (LTG, M7W)**
- **Control Module References** for power steering control module replacement, programming and setup

DTC C0544

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.

The power steering control module has a center detection algorithm that compares the reading of the steering angle sensor to the direction based on other vehicle sensors that the vehicle is travelling to determine if the steering angle reading is plausible.

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.

The power steering control module detected that the steering angle sensor reading and the direction of the vehicle exceeds 329 degrees.

Action Taken When the DTC Sets

- DTC C0544 is stored in memory.
- The driver information center displays the SERVICE POWER STEERING warning message.

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

Description and Operation

Power Steering System Description and Operation (Electronic Power Steering)

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. With a scan tool, verify that the Steering Wheel Angle parameter is zero degrees or near zero degrees with the front tire/wheels in the straight ahead position.
 - The Steering Wheel Angle parameter is not zero degrees or near zero degrees

Perform the Power Steering Control Module Calibration. Refer to **Power Steering Control Module Calibration**

- The Steering Wheel Angle parameter is zero degrees or near zero degrees
- 4. Verify that DTC C0544 is not set.
 - If the DTC is set

Replace the K43 power steering control module.

- If the DTC is not set
- 5. All OK.

Repair Instructions

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

- **Power Steering Assist Motor Replacement** for power steering control module replacement
- **Control Module References** for power steering control module replacement, programming and setup.

DTC C0545

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.

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

Description and Operation

Power Steering System Description and Operation (Electronic Power Steering)

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Torque Sensor parameter changes when turning the steering wheel.
 - **If the parameter does not change**
Refer to Circuit/System Testing below
 - **If the parameter changes**
3. All OK.

Circuit/System Testing

1. Ignition ON.
2. Verify that DTC C0545 is not set.
 - **If the DTC is set**
Replace the steering gear.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

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

- **Steering Gear Replacement (LUK, MHH)**, **Steering Gear Replacement (LCV, MH8)**, **Steering Gear Replacement (LTG, M7W)**
- **Control Module References** for Power Steering Control Module replacement, programming and setup.

DTC C055C

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

DTC C055C 64

Steering Gear Performance Slip Detected

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

If the mechanical friction in the steering system is too high, the steering gear has to be checked if the friction is too high and if the tie rod boots are defect. Possible reason for water ingress.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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Power Steering System Description and Operation (Electronic Power Steering)

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**

Replace the steering gear.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

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

- **Steering Gear Replacement (LUK, MHH), Steering Gear Replacement (LCV, MH8), Steering Gear Replacement (LTG, M7W)**
- **Control Module References** for Power Steering Control Module replacement, programming and setup.

DTC C0565

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

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- 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 K43 Power Steering Control Module.
 - 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.

- **Power Steering Assist Motor Replacement**
- **Control Module References** for Power Steering Control Module replacement, programming and setup.

DTC C0569

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 C0569 3A

System Configuration Incorrect Component Installed

Circuit/System Description

The power steering control module continuously monitors the parameters of the steering gear. If the power steering

control module is replaced, it needs to be calibrated to become fully operational.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

Electronic power steering control module calibration value does not meet the system requirement.

Action Taken When the DTC Sets

- DTC C0569 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

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Power Steering System Description and Operation (Electronic Power Steering)

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- **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 C0569 is not set.

○ **If the DTC C0569 is set**

1. Program the K43 Power Steering Control Module.
2. Verify the DTC does not set.
 - If the DTC sets, replace the K43 Power Steering Control Module.
 - If the DTC does not set

3. All OK.

○ **If the DTC C0569 is not set**

3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Steering Gear Replacement (LUK, MHH), Steering Gear Replacement (LCV, MH8), Steering Gear Replacement (LTG, M7W)
- 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 (Electronic Power Steering).

Visual/Physical Inspection

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

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
- Increase in Effort While Turning Steering Wheel
- Poor Return of Steering Wheel
- Steering Wheel Surges/Jerks While Turning
- Steering Wheel Kickback
- Steering Effort Hard or Too Easy in One or Both Directions

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

Rattle, Clunk, or Shudder Noise from the Power Steering System

Step	Action	Yes	No
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1	Did you review the Power Steering System Description and Operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Steering Wheel and Column
2	Verify a rattle noise is present by driving the vehicle on a rough road. Verify a clunk noise is present by turning the steering wheel to the left and to the right several times with the key in the ON position. Is a rattle or a clunk noise present?	Go to Step 3	System OK
3	Inspect the steering gear for the proper installation. Is the steering gear installation incorrect?	Go to Step 6	Go to Step 4
4	Inspect the intermediate steering shaft. Is the intermediate steering shaft worn?	Go to Step 8	Go to Step 5
5	Inspect the front suspension. Refer to Noise Diagnosis - Front Suspension . Is the front suspension worn?	Go to Step 7	Go to Step 3
6	Install the steering gear correctly. Refer to Steering Gear Replacement (LUK, MHH) , Steering Gear Replacement (LCV, MH8) , Steering Gear Replacement (LTG, M7W) . Did you complete the repair?	Go to Step 9	-
7	Replace the worn front suspension component that is causing the noise. Did you complete the repair?	Go to Step 9	-
8	Replace the intermediate steering shaft. Refer to Intermediate Steering Shaft Replacement . 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
	Did you review the Power Steering		

1	System Description and Operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Power Steering System
2	Verify that a whine or growl noise is present. Is a whine or growl noise present?	Go to Step 3	System OK
3	Inspect the power steering gear for looseness and/or worn bushings. Is the steering gear loose or are the bushings worn?	Go to Step 6	Go to Step 4
4	Inspect the power steering motor for a whine or growl noise using the CH-39570 ear. Is the noise present at the power steering motor?	Go to Step 7	Go to Step 5
5	Inspect the power steering gear for a whine or growl noise using the CH-39570 ear. Is the noise present at the power steering gear?	Go to Step 8	Go to Step 3
6	Tighten the power steering gear fasteners or replace the power steering gear due to worn bushings. Refer to Steering Gear Replacement (LUK, MHH) , Steering Gear Replacement (LCV, MH8) , Steering Gear Replacement (LTG, M7W) . Did you complete the repair?	Go to Step 9	-
7	Replace the electronic power steering assist motor control. Refer to Power Steering Assist Motor Replacement . Did you complete the repair?	Go to Step 9	-
8	Replace the power steering gear. Refer to Steering Gear Replacement (LUK, MHH) , Steering Gear Replacement (LCV, MH8) , Steering Gear Replacement (LTG, M7W) . 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

Increase in Effort While Turning Steering Wheel

Step	Action	Yes	No
	Did you review the Power Steering System		

1	Description and Operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Power Steering System
2	Verify that there is an increase in effort while turning is present. Does the system operate normally?	System OK	Go to Step 3
3	Check for the following tire related conditions: • Incorrect tire inflation-Refer to <u>Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label</u> . • 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 <u>Lifting and Jacking the Vehicle</u> . 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 <u>Steering Linkage Outer Tie Rod Replacement</u> . Did you complete the repair?	Go to Step 10	-
8	Replace the intermediate shaft. Refer to <u>Intermediate Steering Shaft Replacement</u> . Did you complete the repair?	Go to Step 10	-
9	Replace the steering gear. Refer to <u>Steering Gear Replacement (LUK, MHH)</u> , <u>Steering Gear Replacement (LCV, MH8)</u> , <u>Steering Gear Replacement (LTG, M7W)</u> . 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

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.			
	Did you review the General Description and perform the necessary inspections?		Go to <u>Power Steering System Description and</u>

1		Go to Step 2	<u>Operation (Electronic Power Steering)</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
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
	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.		

7	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 or jerks while turning. Does the steering wheel surge or jerk while turning?	Go to Step 3	System OK
3	Inspect the front suspension for worn or binding components. Did you find and correct the condition?	Go to Step 15	Go to Step 4

4	1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 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 shaft for wear or a binding condition. Is the intermediate shaft worn or binding?	Go to Step 11	Go to Step 6
6	Inspect the steering gear for wear or a binding condition. Is the steering gear worn or binding?	Go to Step 12	Go to Step 7
7	Inspect the steering column for wear or a binding condition. Is the steering column worn or binding?	Go to Step 13	Go to Step 8
8	Inspect the power steering assist motor for an indication of excessive heat. Does the power steering assist motor appear to be overheated?	Go to Step 9	Go to Step 14
9	NOTE: Do not perform excessive parking lot maneuvers during testing. Excessive parking lot maneuvers can cause the power steering motor to heat up. Allow the power steering motor to cool and retest the system. Did you correct the condition?	Go to Step 15	Go to Step 14
10	Replace the steering linkage outer tie rod. Refer to <u>Steering Linkage Outer Tie Rod Replacement</u>. Did you complete the repair?	Go to Step 15	-
11	Replace the intermediate shaft. Refer to <u>Intermediate Steering Shaft Replacement</u> . Did you complete the repair?	Go to Step 15	-
12	Replace the steering gear. Refer to <u>Steering Gear Replacement (LUK, MHH), Steering Gear Replacement (LCV, MH8), Steering Gear Replacement (LTG, M7W)</u>. Did you complete the repair?	Go to Step 15	-
13	Replace the steering column. Refer to <u>Steering Column Replacement</u> .		-

	Did you complete the repair?	Go to Step 15	
14	Replace the power steering assist motor. Refer to <u>Power Steering Assist Motor Replacement</u> . Did you complete the repair?	Go to Step 15	-
15	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

STEERING WHEEL KICKBACK

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 tie rod ends are loose or damaged.	If necessary, inspect for damage and replace the tie rod ends. Refer to <u>Steering Linkage Outer Tie Rod Replacement</u> .

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</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</u> .
The steering gear is binding.	If necessary, inspect and replace the steering gear. Refer to <u>Steering Gear Replacement (LUK, MHH)</u> , <u>Steering Gear Replacement (LCV, MH8)</u> , <u>Steering Gear Replacement (LTG, M7W)</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>Steering Gear Replacement (LUK, MHH)</u> , <u>Steering Gear Replacement (LCV, MH8)</u> , <u>Steering Gear Replacement (LTG, M7W)</u> .

The controller is malfunctioning.	Confirm the DTC. If necessary, replace the motor/module assembly. Refer to <u>Power Steering Assist Motor Replacement</u> .
The motor shaft is binding.	Confirm the DTC. If necessary, replace the motor/module assembly. Refer to <u>Power Steering Assist Motor Replacement</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.

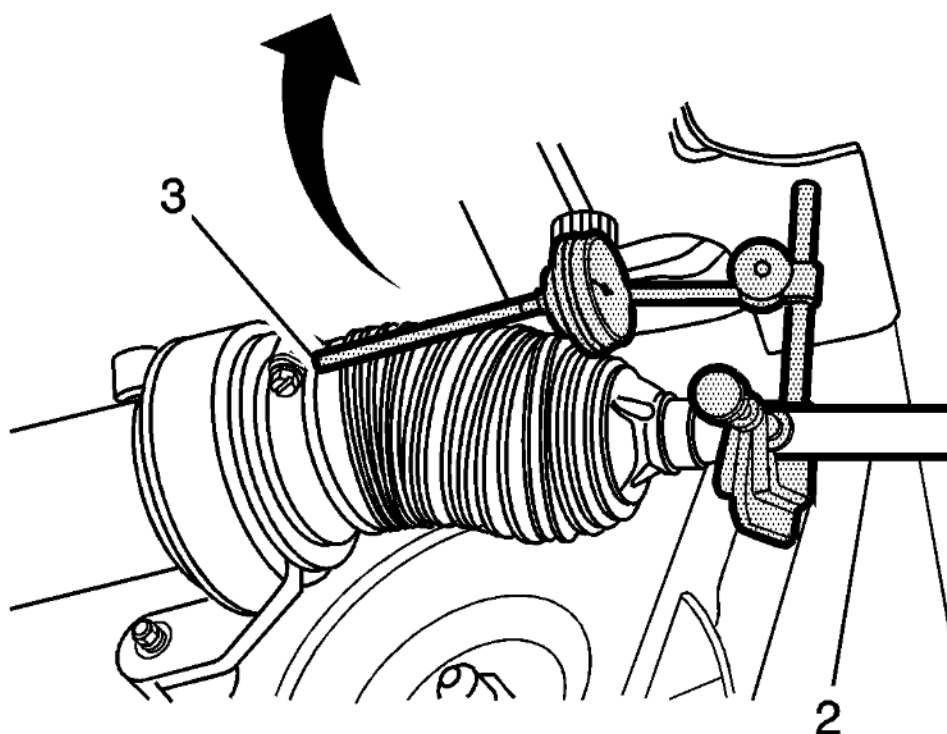
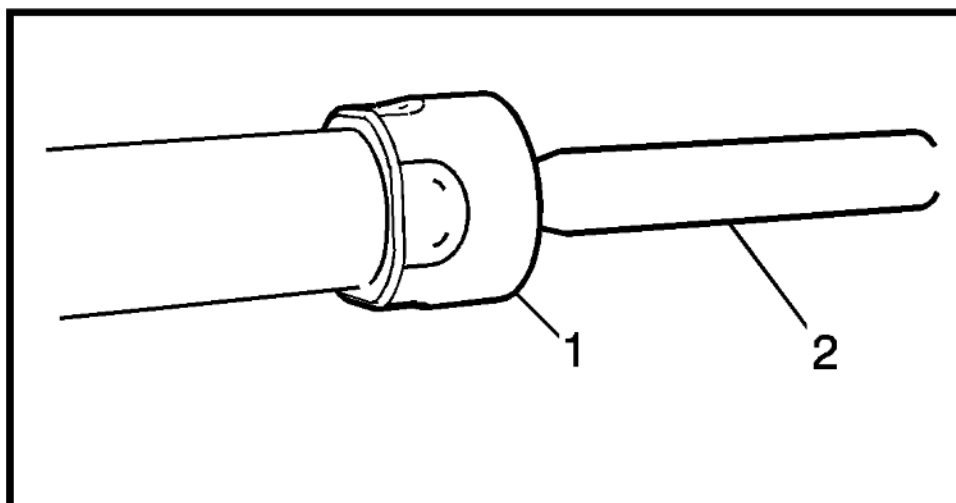


Fig. 2: Inner Tie Rod & Steering Gear Housing
Courtesy of GENERAL MOTORS COMPANY

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.

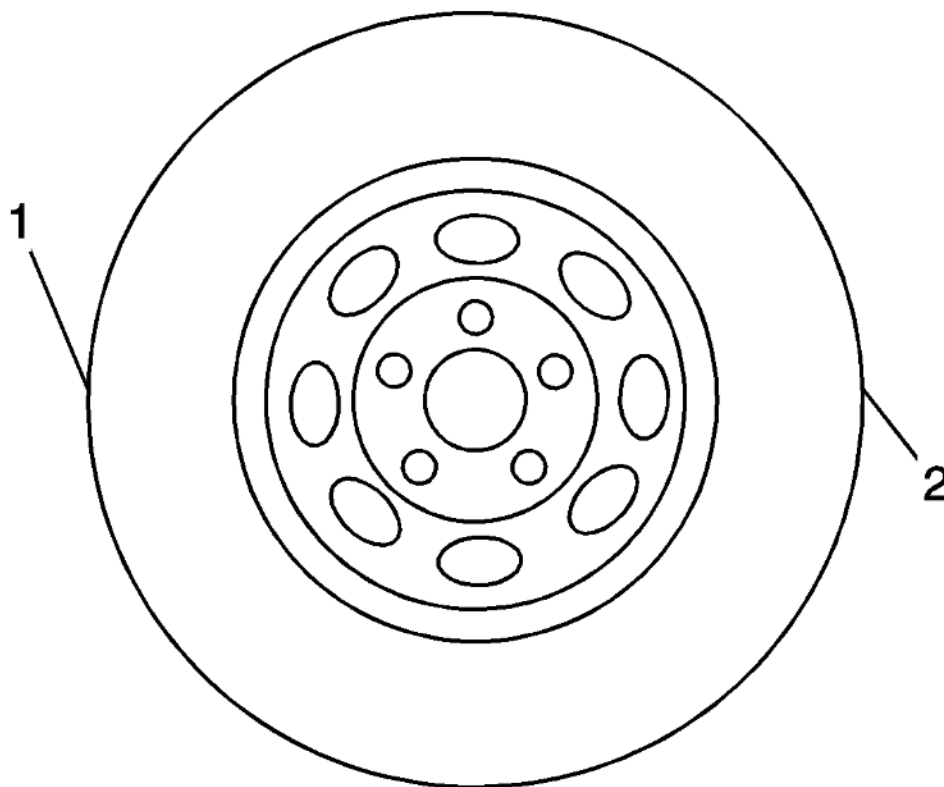


Fig. 3: Identifying Tire Grasping Positions
Courtesy of GENERAL MOTORS COMPANY

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**.
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**.

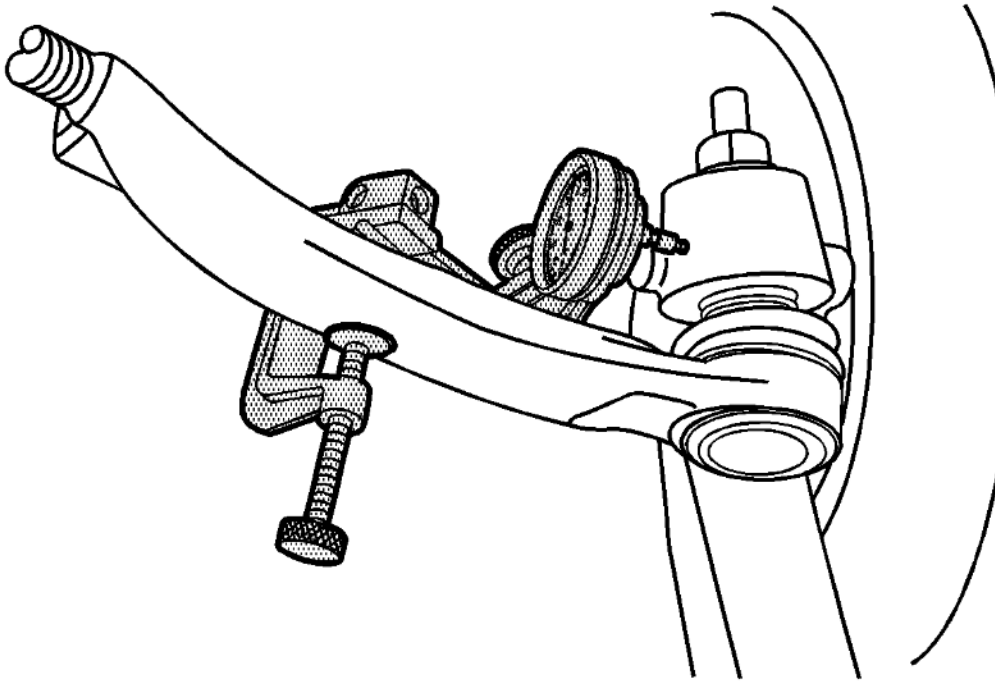


Fig. 4: Measuring Outer Tie Rod Lash
Courtesy of GENERAL MOTORS COMPANY

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.

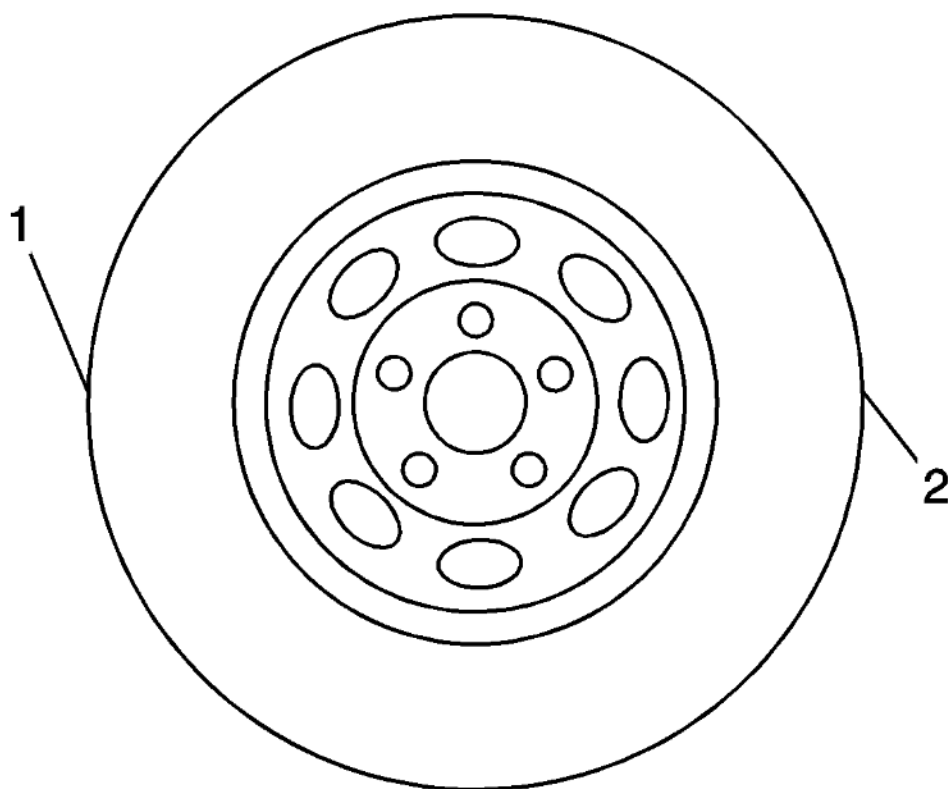


Fig. 5: Identifying Tire Grasping Positions
Courtesy of GENERAL MOTORS COMPANY

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

STEERING LINKAGE OUTER TIE ROD REPLACEMENT

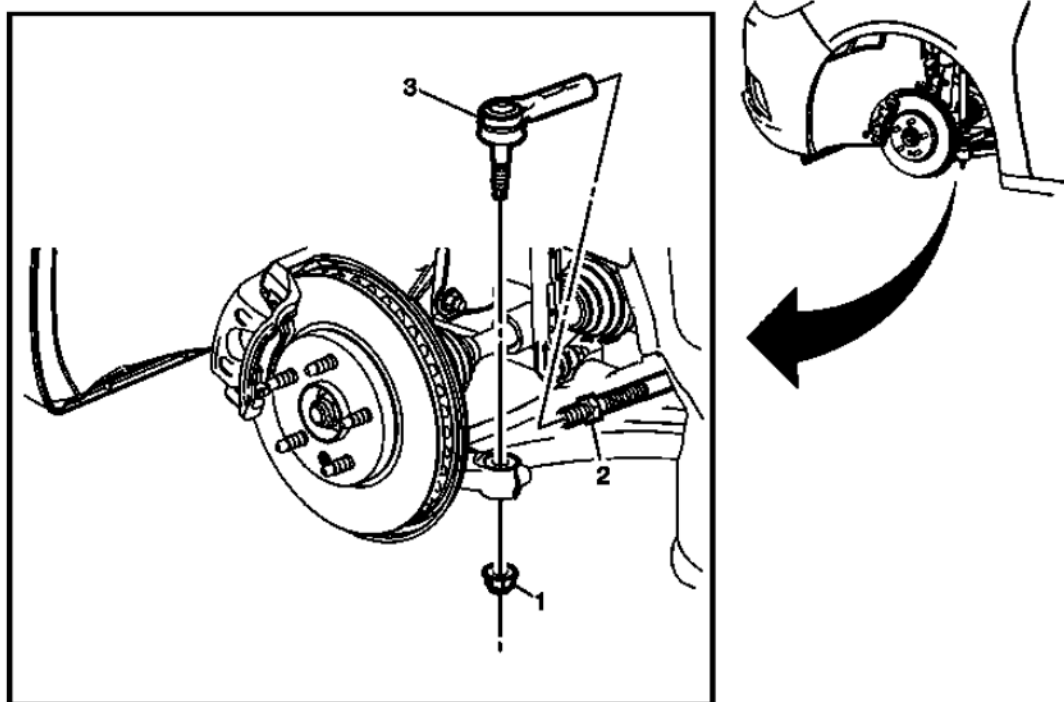


Fig. 6: Steering Linkage Outer Tie Rod And Nuts
 Courtesy of GENERAL MOTORS COMPANY

Steering Linkage Outer 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 front tire and wheel assembly. Refer to <u>Tire and Wheel Removal and Installation</u> .	
1	Steering Linkage Outer Tie Rod Nut CAUTION: Refer to <u>Fastener Caution</u> . 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 linkage outer tie rod nut. Discard the nut. 2. Install a NEW steering linkage outer tie rod nut.

	Tighten 35 N.m (26 lb ft) + 30 degrees
2	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.
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 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. After the installation is complete, measure and adjust the front toe. Refer to <u>Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment</u>. 5. If equipped with electronic power steering, perform the software end stop learning procedure. Refer to <u>Power Steering Control Module Calibration</u>. Special Tools CH-161-B Steering Linkage and Tie Rod Puller For equivalent regional tools, refer to <u>Special Tools</u>.

STEERING GEAR BOOT REPLACEMENT

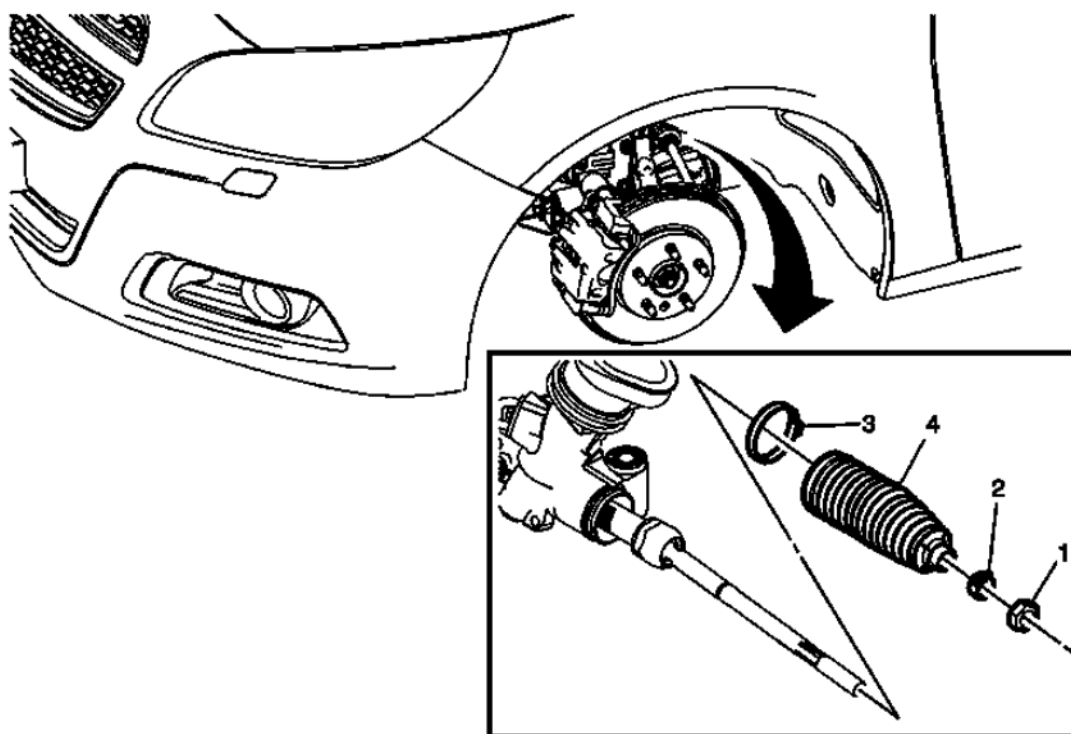


Fig. 7: Steering Gear Boot
Courtesy of GENERAL MOTORS COMPANY

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 steering linkage outer tie rod. Refer to <u>Steering Linkage Outer Tie Rod Replacement</u>. 3. If necessary, remove the steering gear heat shield. Refer to <u>Steering Gear Heat Shield Replacement</u>. 4. 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 steering gear. Refer to <u>Steering Gear Replacement (LUK, MHH)</u>, <u>Steering Gear Replacement (LCV, MH8)</u>, <u>Steering Gear Replacement (LTG, M7W)</u>.	
1	Steering Linkage Inner Tie Rod Nut CAUTION: Refer to <u>Fastener Caution</u> . NOTE: Mark the position of the steering linkage inner tie rod nut before removing to aid in installation.

2	Steering Gear Boot Outer Clamp
3	Steering Gear Boot Inner Clamp Procedure 1. Cut the steering gear boot inner clamp. Discard the clamp. 2. Use the DT-35910 pliers to install a NEW steering gear boot inner clamp. Special Tools DT-35910 Drive Axle Seal Clamp Pliers For equivalent regional tools, refer to Special Tools .
4	Steering Gear Boot Procedure 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.

STEERING GEAR HEAT SHIELD REPLACEMENT

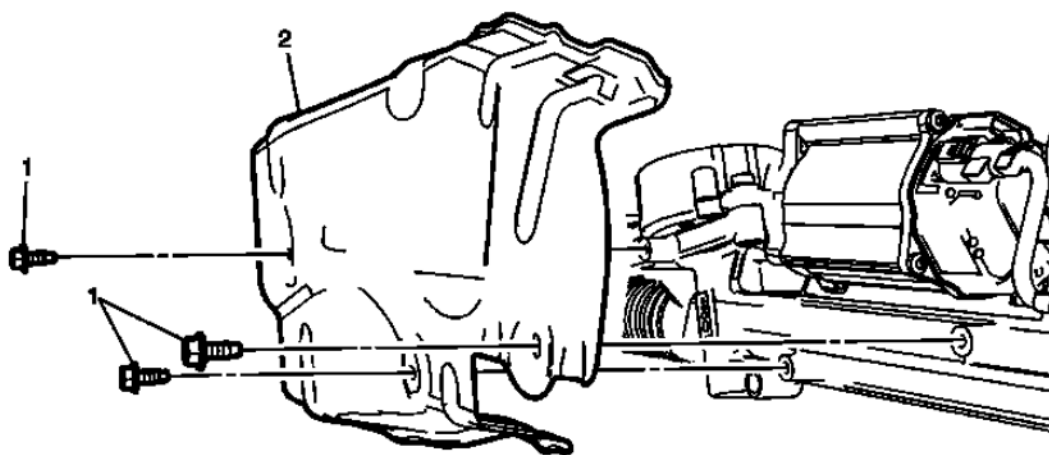


Fig. 8: Steering Gear Heat Shield And Bolts (NJ1)
Courtesy of GENERAL MOTORS COMPANY

Steering Gear Heat Shield Replacement

Callout	Component Name
Preliminary Procedure Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> .	
1	Steering Gear Heat Shield Fastener (Qty: 3) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 9 N.m (80 lb in)
2	Steering Gear Heat Shield

STEERING GEAR REPLACEMENT (LUK, MHH)

Removal Procedure

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

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

CAUTION: With wheels of the vehicle facing straight ahead, secure the steering

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

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

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

1. Lock the steering column in the straight-ahead position.
2. Disconnect the intermediate steering shaft from the steering gear and remove the front dash seal from the steering gear input shaft. Refer to **Intermediate Steering Shaft Replacement** .
3. Install the universal engine support fixture. Refer to **Engine Support Fixture** .
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
5. Disconnect the steering linkage outer tie rods from the steering knuckles. Refer to **Steering Linkage Outer Tie Rod Replacement**.
6. Disconnect the stabilizer shaft links from the stabilizer shaft. Refer to **Stabilizer Shaft Link Replacement** .
7. Disconnect the lower control arms from the steering knuckles. Refer to **Lower Control Arm Replacement** .
8. Remove the steering gear heat shield. Refer to **Steering Gear Heat Shield Replacement**.
9. Disconnect the electrical connector on the steering gear and disconnect the wiring harness clip from the steering gear housing.

NOTE: **Wiring harness routing is critical. Note the exact routing of the steering gear wiring harness before repositioning it.**

10. Remove the wiring harness bracket bolts from the steering gear. Leave the bracket attached to the wiring harness and position it out of the way.
11. Remove the through bolts for the front and rear transmission mounts. Refer to **Transmission Front Mount Replacement** , and **Transmission Rear Mount Replacement** .
12. Position adjustable jackstands underneath the left and right sides of the rear of the drivetrain and front suspension frame.
13. Lower the vehicle until the drivetrain and front suspension frame is resting lightly on the jackstands.
14. Remove the exhaust front pipe. Refer to **Exhaust Front Pipe Replacement (LUK)** , **Exhaust Front**

Pipe Replacement (LCV) , Exhaust Front Pipe Replacement (LTG) .

15. Loosen the drivetrain and front suspension frame front bolts. Refer to **Drivetrain and Front Suspension Frame Replacement** .
16. Raise the vehicle while the drivetrain and front suspension frame rests on the jackstands. Do not allow the gap between the body and rear of the frame to exceed a maximum of 50 mm (2 in).
17. Finish removing the stabilizer shaft. Refer to **Stabilizer Shaft Replacement** .

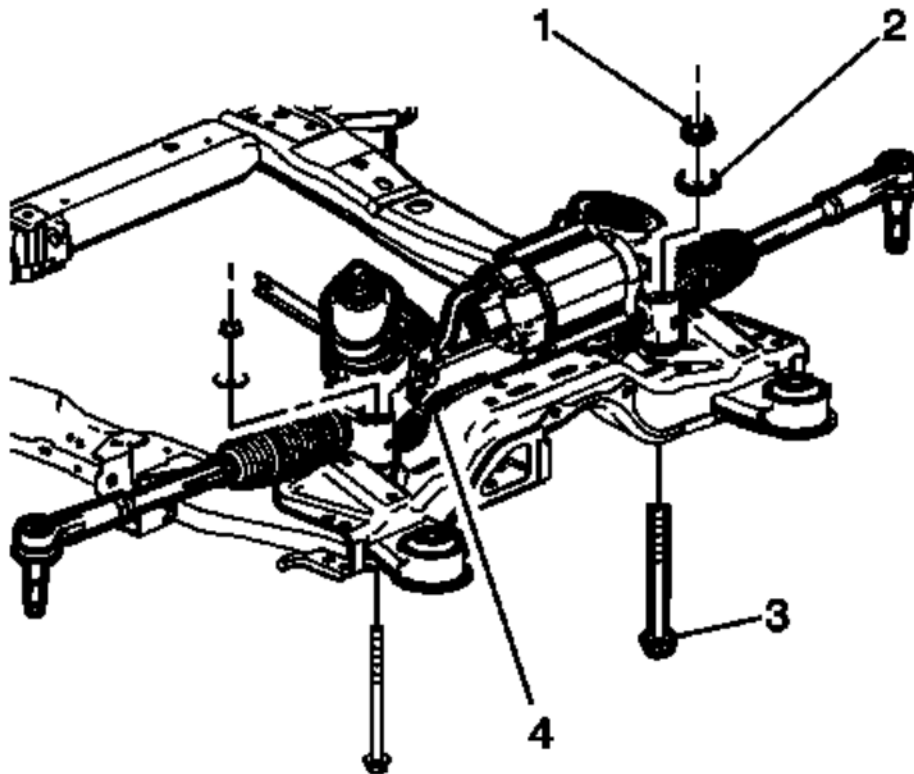


Fig. 9: Power Steering Gear Components
Courtesy of GENERAL MOTORS COMPANY

18. Remove the steering gear nuts (1), washers (2) and bolts (3) from the steering gear (4). Discard the nuts and bolts.
19. Remove the steering gear (4) from the left side of the vehicle.
20. Transfer components as necessary.

Installation Procedure

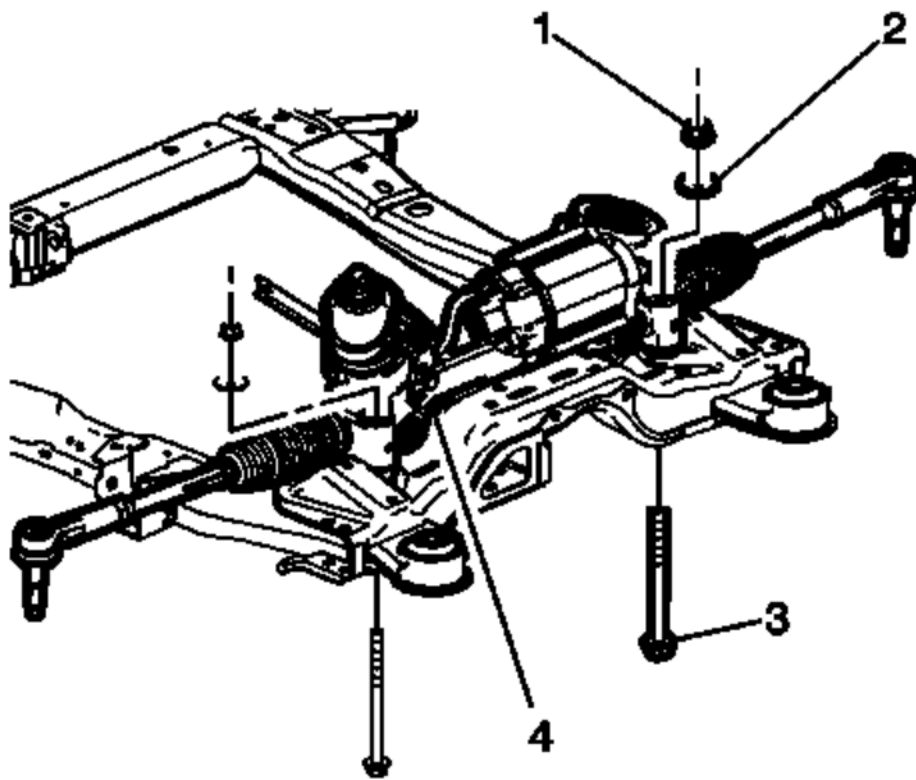


Fig. 10: Power Steering Gear Components
 Courtesy of GENERAL MOTORS COMPANY

1. Position the steering gear (4) on the front suspension frame through the left side of the vehicle.

CAUTION: Refer to Fastener Caution .

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

NOTE: Start all bolts by hand before tightening.

2. Install the NEW steering gear bolts (3), washers (2) and NEW nuts (1) and tighten the bolts (3) to 110 N.m (81 lb ft) + 150 degrees.
3. Install the stabilizer shaft onto the drivetrain and front suspension frame. Refer to Stabilizer Shaft Replacement .
4. Lower the vehicle until the gap between the drivetrain and front suspension frame and body is

approximately 12 mm (0.5 in).

5. Install the exhaust front pipe. Refer to [Exhaust Front Pipe Replacement \(LUK\)](#) , [Exhaust Front Pipe Replacement \(LCV\)](#) , [Exhaust Front Pipe Replacement \(LTG\)](#) .
6. Tighten the drivetrain and front suspension frame front bolts. Refer to [Drivetrain and Front Suspension Frame Replacement](#) .
7. Remove the jackstands from underneath the vehicle.
8. Install the through bolts for the front and rear transmission mounts. Refer to [Transmission Front Mount Replacement](#) , and [Transmission Rear Mount Replacement](#) .

NOTE: **Wiring harness routing is critical. When installing, route the wiring harness in the exact same location it was moved from during the removal procedure.**

9. Route the steering gear wiring harness in the position it was in before removal.
10. Tighten the steering gear wiring harness bracket bolts to 9 N.m (80 lb in).
11. Connect the electrical connector on the steering gear and connect the wiring harness clip on the steering gear housing.
12. Install the steering gear heat shield. Refer to [Steering Gear Heat Shield Replacement](#).
13. Connect the lower control arms to the steering knuckles. Refer to [Lower Control Arm Replacement](#) .
14. Connect the stabilizer shaft links to the stabilizer shaft. Refer to [Stabilizer Shaft Link Replacement](#) .
15. Connect the steering linkage outer tie rods to the steering knuckles. Refer to [Steering Linkage Outer Tie Rod Replacement](#).
16. Remove the universal engine support fixture. Refer to [Engine Support Fixture](#) .
17. Install the front dash seal on the steering gear input shaft and connect the intermediate steering shaft to the steering gear. Refer to [Intermediate Steering Shaft Replacement](#) .
18. Program the power steering control module. Refer to [Power Steering Control Module Programming and Setup](#) .
19. Measure and adjust the front toe. Refer to [Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment](#) .

STEERING GEAR REPLACEMENT (LCV, MH8)

Removal Procedure

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

- Touch a metal ground point in order to remove your body's static charge before servicing any electronic component; especially after sliding across the vehicle seat.

- Do not touch exposed terminals. Terminals may connect to circuits susceptible the ESD damage.
- Do not allow tools to contact exposed terminals when servicing connectors.
- Do not remove components from their protective packaging until required to do so.
- Avoid the following actions unless required by the diagnostic procedure:
 - Jumpering or grounding of the components or connectors.
 - Connecting test equipment probes to components or connectors. Connect the ground lead first when using test probes.
- Ground the protective packaging of any component before opening. Do not rest solid-state components on metal workbenches, or on top of TVs, radios, or other electrical devices.

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

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

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

1. Lock the steering column in the straight-ahead position.
2. Disconnect the intermediate steering shaft from the steering gear and remove the front dash seal from the steering gear input shaft. Refer to **Intermediate Steering Shaft Replacement** .
3. Install the engine support fixture. Refer to **Engine Support Fixture** .
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
5. Disconnect the steering linkage outer tie rods from the steering knuckles. Refer to **Steering Linkage Outer Tie Rod Replacement**.
6. Disconnect the stabilizer shaft links from the stabilizer shaft. Refer to **Stabilizer Shaft Link**

Replacement .

7. Disconnect the lower control arms from the steering knuckles. Refer to **Lower Control Arm Replacement** .
8. Remove the steering gear heat shield. Refer to **Steering Gear Heat Shield Replacement**.
9. Disconnect the electrical connector on the steering gear and disconnect the wiring harness clip from the steering gear housing.

NOTE: **Wiring harness routing is critical. Note the exact routing of the steering gear wiring harness before repositioning it.**

10. Remove the wiring harness bracket bolts from the steering gear. Leave the bracket attached to the wiring harness and position it out of the way.
11. Remove the through bolts for the front and rear transmission mounts. Refer to **Transmission Front Mount Replacement** , and **Transmission Rear Mount Replacement** .
12. Position adjustable jackstands underneath the left and right sides of the rear of the drivetrain and front suspension frame.
13. Lower the vehicle until the drivetrain and front suspension frame is resting lightly on the jackstands.
14. Remove the exhaust front pipe. Refer to **Exhaust Front Pipe Replacement (LUK)** , **Exhaust Front Pipe Replacement (LCV)** , **Exhaust Front Pipe Replacement (LTG)** .
15. Loosen the drivetrain and front suspension frame front bolts. Refer to **Drivetrain and Front Suspension Frame Replacement** .
16. Raise the vehicle while the drivetrain and front suspension frame rests on the jackstands. Do not allow the gap between the body and rear of the frame to exceed a maximum of 50 mm (2 in).
17. Finish removing the stabilizer shaft. Refer to **Stabilizer Shaft Replacement** .

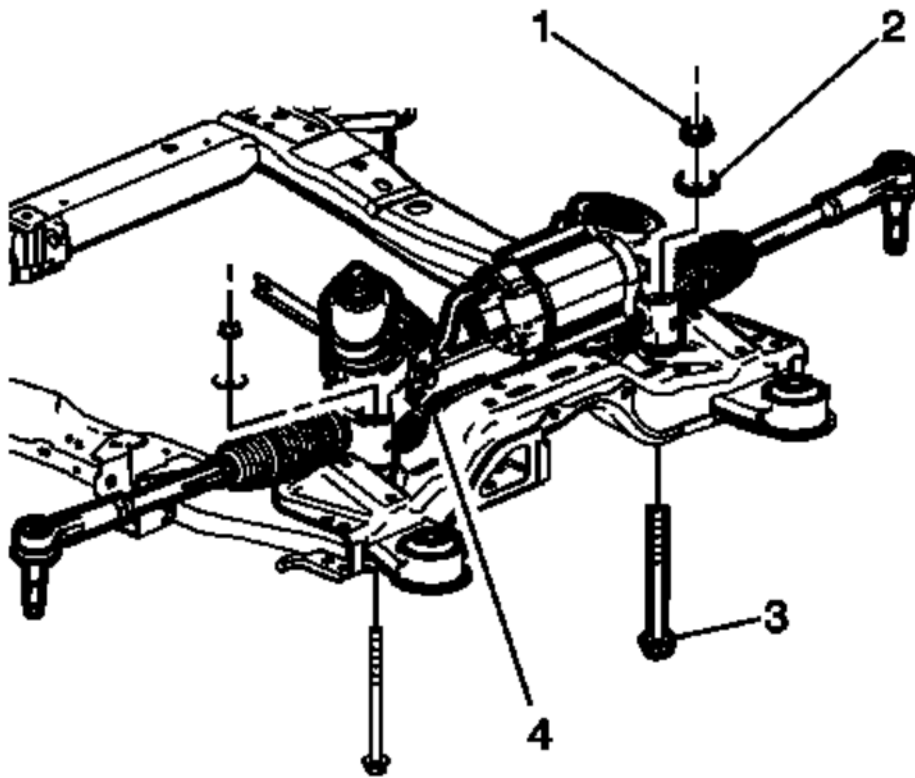


Fig. 11: Power Steering Gear Components
Courtesy of GENERAL MOTORS COMPANY

18. Remove the steering gear nuts (1), washers (2) and bolts (3) from the steering gear (4). Discard the nuts and bolts.
19. Remove the steering gear (4) from the left side of the vehicle.
20. Transfer components as necessary.

Installation Procedure

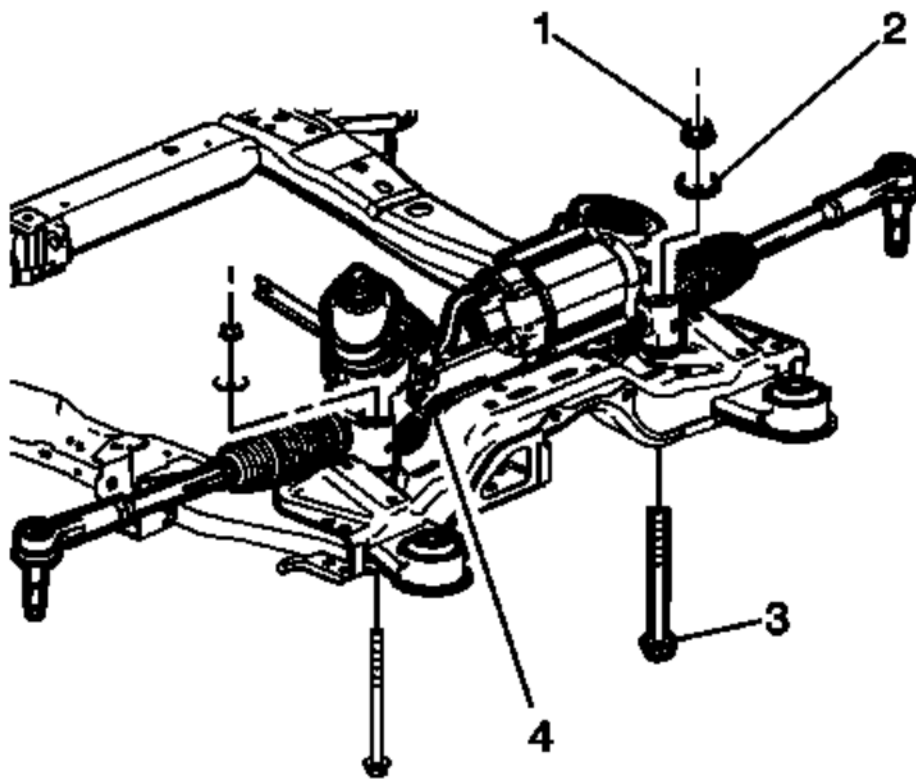


Fig. 12: Power Steering Gear Components
 Courtesy of GENERAL MOTORS COMPANY

1. Position the steering gear (4) on the front suspension frame through the left side of the vehicle.

CAUTION: Refer to Fastener Caution .

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

NOTE: Start all bolts by hand before tightening.

2. Install the NEW steering gear bolts (3), washers (2) and NEW nuts (1) and tighten the bolts (3) to 110 N.m (81 lb ft) + 150 degrees.
3. Install the stabilizer shaft onto the drivetrain and front suspension frame. Refer to Stabilizer Shaft Replacement .
4. Lower the vehicle until the gap between the drivetrain and front suspension frame and body is

approximately 12 mm (0.5 in).

5. Install the exhaust front pipe. Refer to [Exhaust Front Pipe Replacement \(LUK\)](#) , [Exhaust Front Pipe Replacement \(LCV\)](#) , [Exhaust Front Pipe Replacement \(LTG\)](#) .
6. Tighten the drivetrain and front suspension frame front bolts. Refer to [Drivetrain and Front Suspension Frame Replacement](#) .
7. Remove the jackstands from underneath the vehicle.
8. Install the through bolts for the front and rear transmission mounts. Refer to [Transmission Front Mount Replacement](#) , and [Transmission Rear Mount Replacement](#) .

NOTE: **Wiring harness routing is critical. When installing, route the wiring harness in the exact same location it was moved from during the removal procedure.**

9. Route the steering gear wiring harness in the position it was in before removal.
10. Tighten the steering gear wiring harness bracket bolts to 9 N.m (80 lb in).
11. Connect the electrical connector on the steering gear and connect the wiring harness clip on the steering gear housing.
12. Install the steering gear heat shield. Refer to [Steering Gear Heat Shield Replacement](#).
13. Connect the lower control arms to the steering knuckles. Refer to [Lower Control Arm Replacement](#) .
14. Connect the stabilizer shaft links to the stabilizer shaft. Refer to [Stabilizer Shaft Link Replacement](#) .
15. Connect the steering linkage outer tie rods to the steering knuckles. Refer to [Steering Linkage Outer Tie Rod Replacement](#).
16. Remove the engine support fixture. Refer to [Engine Support Fixture](#) .
17. Install the front dash seal on the steering gear input shaft and connect the intermediate steering shaft to the steering gear. Refer to [Intermediate Steering Shaft Replacement](#) .
18. Program the power steering control module. Refer to [Power Steering Control Module Programming and Setup](#) .
19. Measure and adjust the front toe. Refer to [Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment](#) .

STEERING GEAR REPLACEMENT (LTG, M7W)

Removal Procedure

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

- Touch a metal ground point in order to remove your body's static charge before servicing any electronic component; especially after sliding across the vehicle seat.

- Do not touch exposed terminals. Terminals may connect to circuits susceptible the ESD damage.
- Do not allow tools to contact exposed terminals when servicing connectors.
- Do not remove components from their protective packaging until required to do so.
- Avoid the following actions unless required by the diagnostic procedure:
 - Jumpering or grounding of the components or connectors.
 - Connecting test equipment probes to components or connectors. Connect the ground lead first when using test probes.
- Ground the protective packaging of any component before opening. Do not rest solid-state components on metal workbenches, or on top of TVs, radios, or other electrical devices.

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

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

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

1. Lock the steering column in the straight-ahead position.
2. Disconnect the intermediate steering shaft from the steering gear and remove the front dash seal from the steering gear input shaft. Refer to **Intermediate Steering Shaft Replacement** .
3. Install the engine support fixture. Refer to **Engine Support Fixture** .
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
5. Disconnect the steering linkage outer tie rods from the steering knuckles. Refer to **Steering Linkage Outer Tie Rod Replacement**.
6. Disconnect the stabilizer shaft links from the stabilizer shaft. Refer to **Stabilizer Shaft Link**

Replacement .

7. Disconnect the lower control arms from the steering knuckles. Refer to **Lower Control Arm Replacement** .
8. Remove the steering gear heat shield. Refer to **Steering Gear Heat Shield Replacement**.
9. Disconnect the electrical connector on the steering gear and disconnect the wiring harness clip from the steering gear housing.

NOTE: **Wiring harness routing is critical. Note the exact routing of the steering gear wiring harness before repositioning it.**

10. Remove the wiring harness bracket bolts from the steering gear. Leave the bracket attached to the wiring harness and position it out of the way.
11. Remove the through bolts for the front and rear transmission mounts. Refer to **Transmission Front Mount Replacement** , and **Transmission Rear Mount Replacement** .
12. Position adjustable jackstands underneath the left and right sides of the rear of the drivetrain and front suspension frame.
13. Lower the vehicle until the drivetrain and front suspension frame is resting lightly on the jackstands.
14. Remove the exhaust front pipe. Refer to **Exhaust Front Pipe Replacement (LUK)** , **Exhaust Front Pipe Replacement (LCV)** , **Exhaust Front Pipe Replacement (LTG)** .
15. Loosen the drivetrain and front suspension frame front bolts. Refer to **Drivetrain and Front Suspension Frame Replacement** .
16. Raise the vehicle while the drivetrain and front suspension frame rests on the jackstands. Do not allow the gap between the body and rear of the frame to exceed a maximum of 50 mm (2 in).
17. Finish removing the stabilizer shaft. Refer to **Stabilizer Shaft Replacement** .

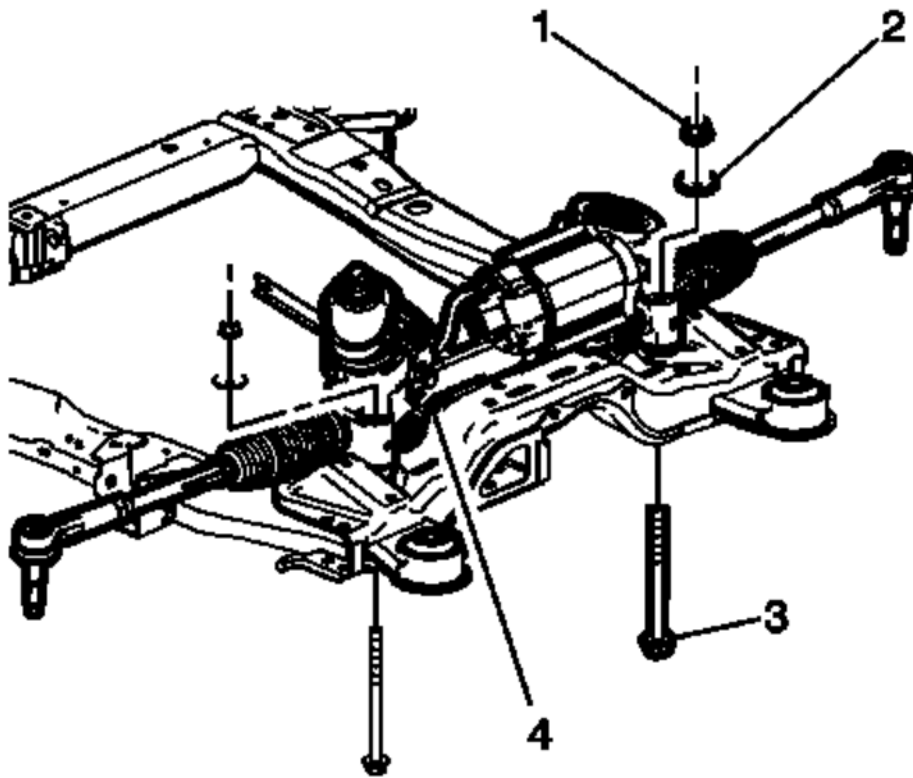


Fig. 13: Power Steering Gear Components
Courtesy of GENERAL MOTORS COMPANY

18. Remove the steering gear nuts (1), washers (2) and bolts (3) from the steering gear (4). Discard the nuts and bolts.
19. Remove the steering gear (4) from the left side of the vehicle.
20. Transfer components as necessary.

Installation Procedure

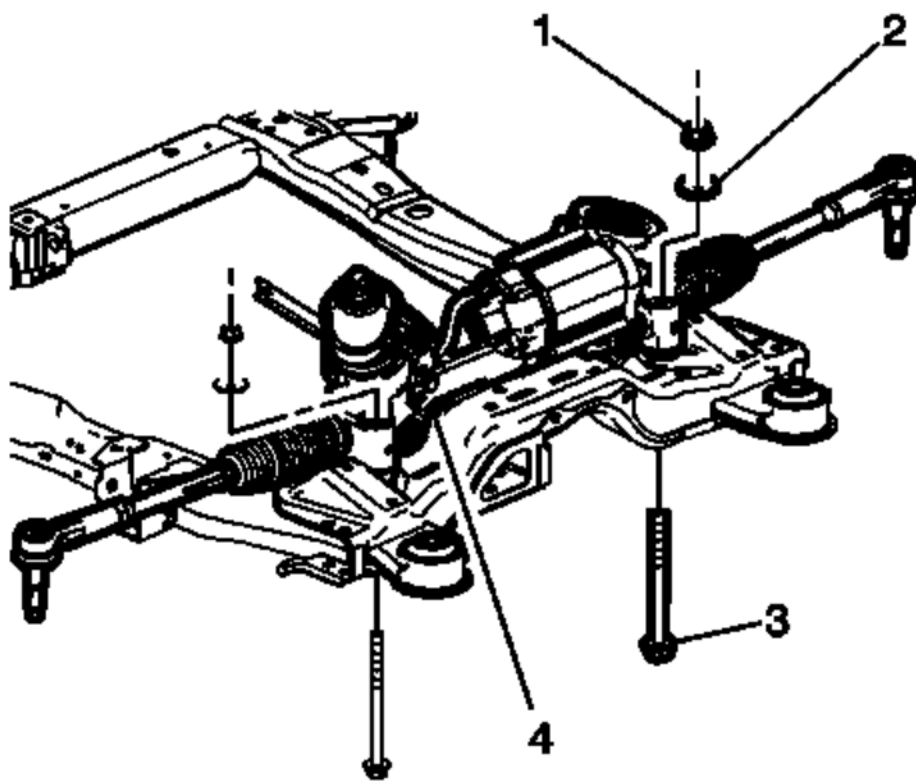


Fig. 14: Power Steering Gear Components
 Courtesy of GENERAL MOTORS COMPANY

1. Position the steering gear (4) on the front suspension frame through the left side of the vehicle.

CAUTION: Refer to Fastener Caution .

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

NOTE: Start all bolts by hand before tightening.

2. Install the NEW steering gear bolts (3), washers (2) and NEW nuts (1) and tighten the bolts (3) to 110 N.m (81 lb ft) + 150 degrees.
3. Install the stabilizer shaft onto the drivetrain and front suspension frame. Refer to Stabilizer Shaft Replacement .
4. Lower the vehicle until the gap between the drivetrain and front suspension frame and body is

approximately 12 mm (0.5 in).

5. Install the exhaust front pipe. Refer to [Exhaust Front Pipe Replacement \(LUK\)](#) , [Exhaust Front Pipe Replacement \(LCV\)](#) , [Exhaust Front Pipe Replacement \(LTG\)](#) .
6. Tighten the drivetrain and front suspension frame front bolts. Refer to [Drivetrain and Front Suspension Frame Replacement](#) .
7. Remove the jackstands from underneath the vehicle.
8. Install the through bolts for the front and rear transmission mounts. Refer to [Transmission Front Mount Replacement](#) , and [Transmission Rear Mount Replacement](#) .

NOTE: **Wiring harness routing is critical. When installing, route the wiring harness in the exact same location it was moved from during the removal procedure.**

9. Route the steering gear wiring harness in the position it was in before removal.
10. Tighten the steering gear wiring harness bracket bolts to 9 N.m (80 lb in).
11. Connect the electrical connector on the steering gear and connect the wiring harness clip on the steering gear housing.
12. Install the steering gear heat shield. Refer to [Steering Gear Heat Shield Replacement](#).
13. Connect the lower control arms to the steering knuckles. Refer to [Lower Control Arm Replacement](#) .
14. Connect the stabilizer shaft links to the stabilizer shaft. Refer to [Stabilizer Shaft Link Replacement](#) .
15. Connect the steering linkage outer tie rods to the steering knuckles. Refer to [Steering Linkage Outer Tie Rod Replacement](#).
16. Remove the engine support fixture. Refer to [Engine Support Fixture](#) .
17. Install the front dash seal on the steering gear input shaft and connect the intermediate steering shaft to the steering gear. Refer to [Intermediate Steering Shaft Replacement](#) .
18. Program the power steering control module. Refer to [Power Steering Control Module Programming and Setup](#) .
19. Measure and adjust the front toe. Refer to [Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment](#) .

STEERING LINKAGE INNER TIE ROD REPLACEMENT

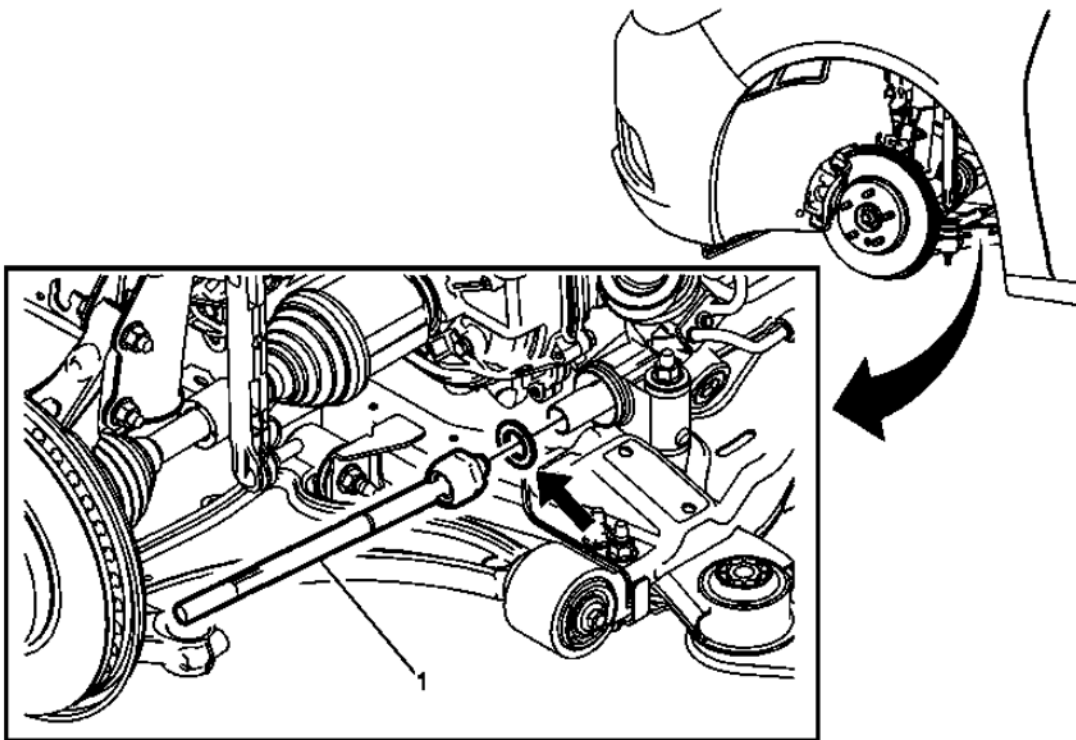


Fig. 15: Steering Linkage Inner Tie Rod
 Courtesy of GENERAL MOTORS COMPANY

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>. 3. After removing the steering gear boot, inspect the steering linkage 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 steering gear. Refer to <u>Steering Gear Replacement (LUK, MHH)</u>, <u>Steering Gear Replacement (LCV, MH8)</u>, <u>Steering Gear Replacement (LTG, M7W)</u>.	
	Steering Linkage Inner Tie Rod CAUTION: Refer to <u>Fastener Caution</u> . Procedure 1. Place a wrench on the flats of the steering linkage inner tie rod housing. 2. Rotate the steering linkage inner tie rod housing counterclockwise to remove the steering linkage inner tie rod from the steering gear rack. 3. Rotate the steering linkage inner tie rod housing clockwise to install the

1	steering linkage inner tie rod to the steering gear rack. Use the CH-6321 wrench and a torque wrench to tighten the steering linkage inner tie rod to specification. 4. After the installation is complete, measure and adjust the front toe. Refer to <u>Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment</u> . NOTE: A 2.5 mm shim is used for vehicles with wheels up to 18 inches and a 5.6 mm shim is used for vehicles with 19 inch and 20 inch wheels. Tighten 100 N.m (74 lb ft) Special Tools CH-6321 Inner Tie Rod Wrench For equivalent regional tools, refer to <u>Special Tools</u>.
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STEERING GEAR DRIVE COUPLING REPLACEMENT

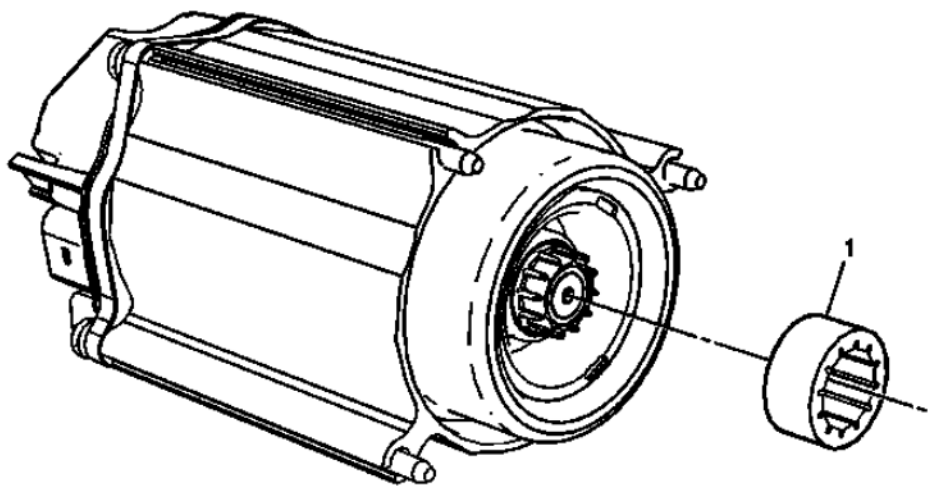


Fig. 16: Steering Gear Drive Coupling
Courtesy of GENERAL MOTORS COMPANY

Steering Gear Drive Coupling Replacement

Callout	Component Name
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Preliminary Procedure

Remove the power steering assist motor. Refer to **Power Steering Assist Motor Replacement**.

1	Steering Gear Coupling NOTE: The steering gear coupling connects the power steering assist motor to the steering gear.
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POWER STEERING ASSIST MOTOR REPLACEMENT

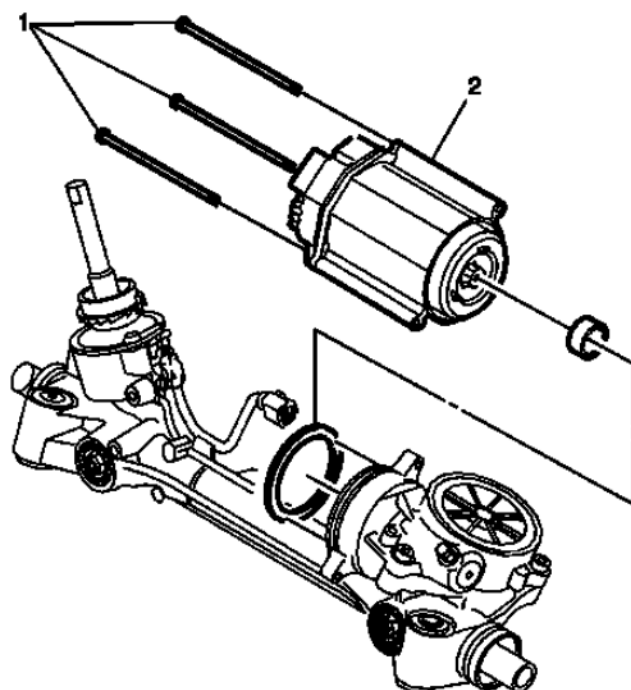


Fig. 17: Power Steering Assist Motor & Bolts
Courtesy of GENERAL MOTORS COMPANY

Power Steering Assist Motor Replacement

Callout	Component Name
CAUTION: Electrostatic discharge (ESD) can damage many solid-state electrical components. ESD susceptible components may or may not be labeled with the ESD symbol. Handle all electrical components carefully. Use the following precautions in order to avoid ESD damage: • Touch a metal ground point in order to remove your body's static charge before servicing any electronic component; especially after sliding across the vehicle seat. • Do not touch exposed terminals. Terminals may connect to circuits susceptible the ESD damage. • Do not allow tools to contact exposed terminals when servicing connectors.	

- Do not remove components from their protective packaging until required to do so.
- Avoid the following actions unless required by the diagnostic procedure:
 - Jumpering or grounding of the components or connectors.
 - Connecting test equipment probes to components or connectors. Connect the ground lead first when using test probes.
- Ground the protective packaging of any component before opening. Do not rest solid-state components on metal workbenches, or on top of TVs, radios, or other electrical devices.

Preliminary Procedures

1. Perform the strategy based diagnosis. Performing the strategy based diagnostics includes reviewing related bulletins, preliminary information and diagnostics. Refer to **Strategy Based Diagnosis**.
2. Capture the key cycle count from the old steering gear control module. If the key cycle count from the old steering gear control module is not captured, it will not be possible to flash the new steering gear control module. Refer to **Power Steering Control Module Programming and Setup**.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**.
4. Remove the steering gear. Refer to **Steering Gear Replacement (LUK, MHH)**, **Steering Gear Replacement (LCV, MH8)**, **Steering Gear Replacement (LTG, M7W)**.

1	Power Steering Assist Motor Bolt (Qty: 3) 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 <u>Fastener Caution</u>. Procedure 1. Remove the power steering assist motor bolts. Discard the bolts. 2. Install the NEW power steering assist motor bolts. Tighten 8 (71 lb in)
	Power Steering Assist Motor Procedure 1. Remove the O-ring from the steering gear housing. Discard the O-ring. 2. Inspect the steering gear motor shaft and inside of the steering gear

2

housing for signs of water intrusion or corrosion. If no signs of water intrusion or corrosion are present proceed to the next step. If signs of water intrusion or corrosion are present then replace the steering gear. Refer to **Steering Gear Replacement (LUK, MHH)**, **Steering Gear Replacement (LCV, MH8)**, **Steering Gear Replacement (LTG, M7W)**.

3. Install a NEW O-ring around the steering gear housing.
4. Install the steering gear coupling to the assist motor armature.
5. Align the steering gear coupling on the assist motor armature to the steering gear.
6. Align the power steering assist motor bolts to the steering gear while pressing the motor over the gear housing O-ring.
7. After installation is complete, transfer the key cycle count from the old steering gear control module to the new steering gear control module. Refer to **Power Steering Control Module Programming and Setup**.

NOTE:

Inspection of the steering gear motor shaft and the inside of the steering gear housing is required to ensure there are no signs of water intrusion or corrosion which may cause premature motor failure. If signs of water intrusion or corrosion are present the steering gear must be replaced.

POWER STEERING CONTROL MODULE CALIBRATION

Steering Angle Sensor Centering and Software Endstop Learning

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

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

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

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

Steering Angle Sensor Centering

For electronic power steering equipped vehicles WITH electronic stability control program and EXTERNAL Steering Angle Sensor, refer to **Steering Angle Sensor Centering**.

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

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

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

Software Endstop Learning

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

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

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

DESCRIPTION AND OPERATION

POWER STEERING SYSTEM DESCRIPTION AND OPERATION (ELECTRONIC POWER STEERING)

The power steering system consists of the following components:

- The power steering control module
- The power steering motor
- The power steering motor rotational sensor
- The torque sensor

- The steering gear (rack and dual pinion)

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

The power steering control module uses a combination of the torque sensor, motor rotational sensor, vehicle speed, and calculated system temperature inputs to determine the amount of assist needed. The power steering control module continuously monitors the digital torque sensor's torque and index current signals. As the steering wheel is turned and torsional twist is applied to the steering shaft, the steering input and output shafts are monitored via the torque signal circuit and then processed by the power steering control module to calculate the steering torque. The voltage signals of the motor position sensor and the digital torque sensor's index current signal are both processed by the power steering control module to detect and calculate the steering wheel angle.

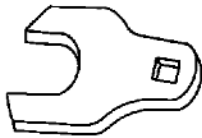
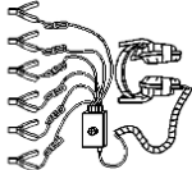
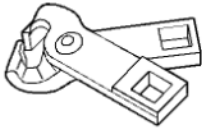
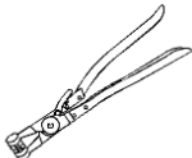
The power steering control module responds to the change in the digital torque sensor signals as well as the motor rotational sensor's voltage signals by commanding current to the power steering motor. The power steering control module controls the pulse width modulated motor drive circuit to drive the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

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

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
	CH-161-B J-22888-20A J-24319-B KM-161-B SA91100C 7503 Steering Linkage and Tie Rod Puller
	CH-6321 J-34028

	KM-6247 KM-6321 Inner Tie Rod Wrench
	CH-39570 J-39570 SA9217NE Chassis Ear
	DT-35910 J-35910 MKM-804 Drive Axle Seal Clamp Pliers
	GE-8001 J-8001 Dial Indicator Set

