

## 2004 STEERING

### Power Steering System - Vue

## SPECIFICATIONS

### FASTENER TIGHTENING SPECIFICATIONS

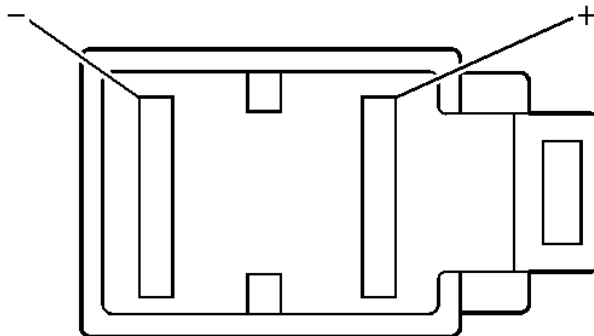
#### Fastener Tightening Specifications

Application	Specification	
	Metric	English
Intermediate Steering Shaft Pinch Bolt	34 N.m	25 lb ft
Outer Tie Rod Retention Nut	60 N.m	44 lb ft
Steering Gear to Cradle Mounting Bolt	110 N.m	81 lb ft

## COMPONENT LOCATOR

### POWER STEERING SYSTEM CONNECTOR END VIEWS

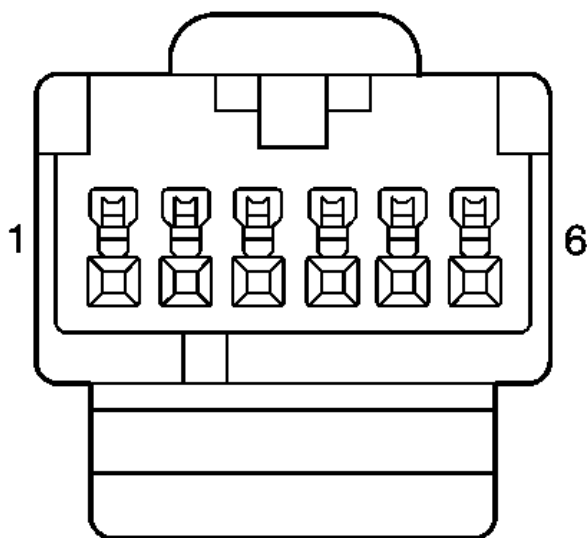
#### Power Steering Control Module (PSCM) C1 (Part of the Steering Column) Terminal Identification



Connector Part Information		<ul style="list-style-type: none"><li>• 7123-4123-30</li><li>• 2-Way F (BK)</li></ul>	
Pin	Wire Color	Circuit No.	Function
1(+)	RD	8040	Battery Positive Voltage
2(-)	BK	350	Ground

#### Power Steering Control Module (PSCM) C2 (Part of the Steering Column) Terminal Identification

Pin	Wire Color	Circuit No.	Function
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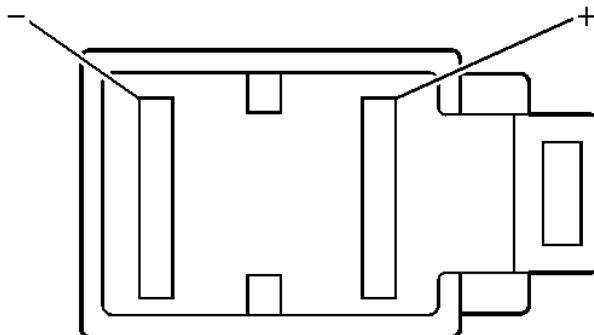


### Connector Part Information

- 776195-6
- 6-Way F (GY)

Pin	Wire Color	Circuit No.	Function
1-3	-	-	Not Used
4	PU	1807	Class 2 Serial Data
5	PU	1807	Class 2 Serial Data
6	PK	739	Ignition 1 Voltage

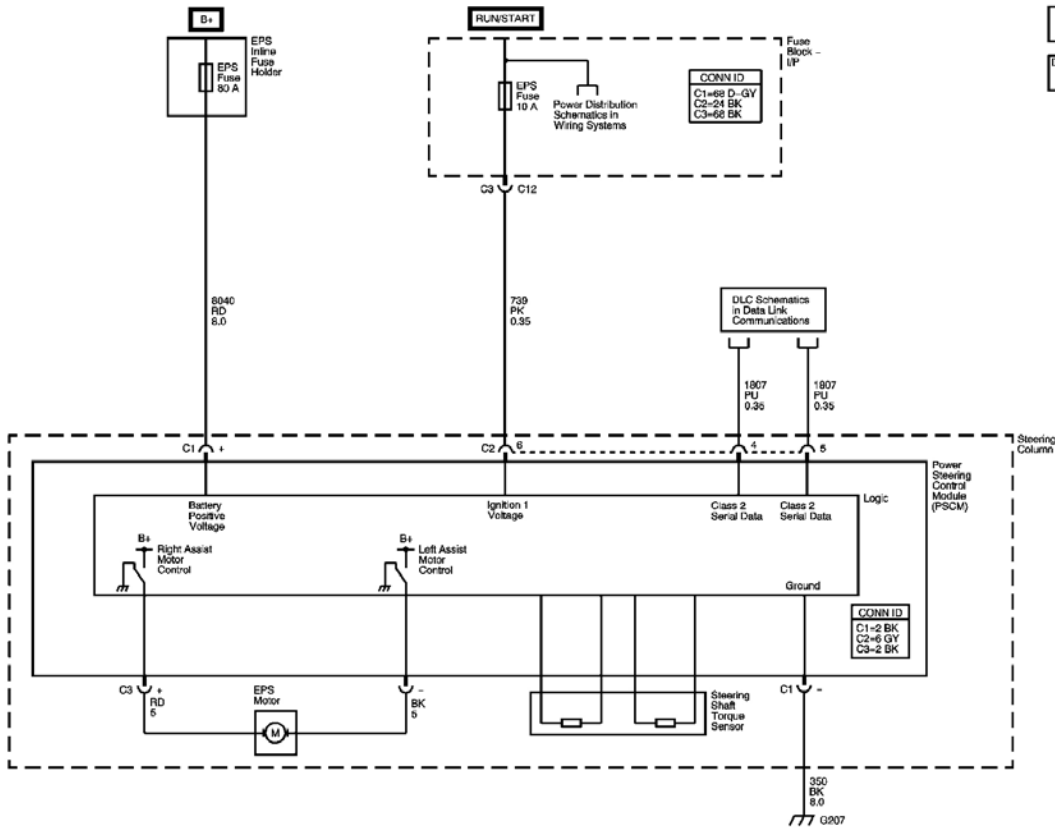
### Power Steering Control Module (PSCM) C3 (Part of the Steering Column) Terminal Identification



Connector Part Information		<ul style="list-style-type: none"> <li>• 7123-4123-30</li> <li>• 2-Way F (BK)</li> </ul>	
Pin	Wire Color	Circuit No.	Function
1(+)	RD	5	Left Assist Motor Control
2(-)	BK	5	Right Assist Motor Control

## SCHEMATIC AND ROUTING DIAGRAMS

### POWER STEERING SYSTEM SCHEMATICS



**Fig. 1: Power Steering System Schematics**  
 Courtesy of GENERAL MOTORS CORP.

## DIAGNOSTIC INFORMATION AND PROCEDURES

### DIAGNOSTIC STARTING POINT - POWER STEERING SYSTEM

**IMPORTANT:** The following steps must be completed before using the symptom tables.

1. Perform the **Diagnostic System Check - Power Steering System** before using the Symptom Tables in order to verify that all of the following are true:
  - There are no DTCs set.
  - The control module can communicate via the serial data link.
  - The EPS assembly has not been damaged from a collision, or air bag deployment.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Power Steering System Description and Operation** .

### Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Electric Power Steering (EPS) System. Refer to **Checking Aftermarket Accessories** in Wiring Systems.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect the vehicles battery and charging system for the proper voltage levels.

### Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems.

### Symptom List

Refer to **Symptoms - Power Steering System** in order to diagnose the symptom:

## DIAGNOSTIC SYSTEM CHECK - POWER STEERING SYSTEM

### Test Description

The numbers below refer to the step numbers on the diagnostic table.

**2:** The lack of communication may be caused by a partial or a total malfunction of the circuit containing the class 2 serial data. The specified procedure will determine the particular condition.

**3:** The presence of DTCs which begin with a U indicate some other module is not communicating. The specified procedure will collect all the available information before tests are performed.

**5:** Tests if a malfunction exists in the EPS system.

**6:** Tests if the steering column shaft is bent, twisted or damaged due to a previous collision and or air bag deployment.

### Diagnostic System Check - Power Steering System

Step	Action	Value (s)	Yes	No
1	Install a scan tool. Does the scan tool turn on?	-		Go to <b><u>Scan Tool Does Not Power Up</u></b> in Data Link

			Go to <b>Step 2</b>	Communications
<b>2</b>	1. Turn ON the ignition, with the engine OFF. 2. Attempt to establish communication with the Power Steering Control Module (PSCM).  Does the scan tool communicate with the PSCM?	-	Go to <b>Step 3</b>	Go to <b>Scan Tool Does Not Communicate with Class 2 Device</b> in Data Link Communications
<b>3</b>	Select the Diagnostic Trouble Codes (DTC) function on the scan tool. Does the scan tool display any DTCs that begin with a U?	-	Go to <b>Diagnostic Trouble Code (DTC) List</b> in Data Link Communications	Go to <b>Step 4</b>
<b>4</b>	Does the scan tool display DTC C0550?	-	Go to <b>Diagnostic Trouble Code (DTC) List</b> in Body Control Systems	Go to <b>Step 5</b>
<b>5</b>	Does the scan tool display any EPS DTCs?	-	Go to <b>Diagnostic Trouble Code (DTC) List</b>	Go to <b>Step 6</b>
<b>6</b>	1. Start the engine. 2. Turn the steering wheel 90° to the left, then 90° to the right, then return the steering wheel to center. 3. remove hands from steering wheel and ensure no force is being applied to the steering wheel. 4. Using the scan tool observe the Torque Sensor Main data parameter in the EPS data list.  Does the scan tool indicate that the Torque Sensor Main data parameter is less than the specified range?	< + or - 1 N.m (0.7 lb ft)	Go to <b>Symptoms - Power Steering System</b>	Go to <b>Steering Column Replacement</b> in Steering Wheel and Column

## SCAN TOOL DATA LIST

### Scan Tool Data List

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Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
<b>Operating Conditions: Ignition ON/ engine ON/ steering wheel centered/ no force applied to steering wheel.</b>			
Actual Motor Current	Data Display	Amps	0.0
Battery Voltage	Data Display	Volts	14.3
Desired Motor Current	Data Display	Amps	0.0
Engine Running	Data Display	Yes/No	Yes
Ignition Voltage	Data Display	Volts	14.3
Limiting Motor Current	Data Display	Amps	58 amps
Motor Voltage +	Data Display	Volts	0.0
Motor Voltage -	Data Display	Volts	0.0
Torque Sensor Amplified	Data Display	N.m/lb ft	0.00
Torque Sensor Main	Data Display	N.m/lb ft	0.00
Torque Sensor Sub	Data Display	N.m/lb ft	0.00
Tuning Profile	Data Display	numeric 1-8	varies
Vehicle Speed	Data Display	kmh/mph	0

## SCAN TOOL DATA DEFINITIONS

### Actual Motor Current

The scan tool displays 0.0 amps to 58.0 amps. The actual amount of current the Power Steering Control Module (PSCM) is commanding to the Electric Power Steering (EPS) motor.

### Battery Voltage

The scan tool displays 8-17 volts. The level of battery voltage available at the PSCM.

### Desired Motor Current

The scan tool displays 0.0 amps to 58.0 amps. The amount of current the PSCM is attempting to command to the EPS motor.

### Engine Running

The scan tool displays Yes or No. Yes indicates the PSCM is receiving it's class 2 message that the engine is running. No indicates the class 2 message is ether missing, invalid, or the engine is not running.

### Ignition Voltage

The scan tool displays 0-17 volts. The level of ignition voltage available at the PSCM.

### Limiting Motor Current

The scan tool displays up to 65 amps. The amount of current last commanded to the EPS motor before the system went into overload protection mode. 65 amps indicates that an overload protection incident has not occurred.

### **Motor Voltage +**

The scan tool displays 7.0-14.0 volts. The amount of voltage being supplied to the EPS motor while turning right.

### **Motor Voltage -**

The scan tool displays 7.0-14.0 volts. The amount of voltage being supplied to the EPS motor while turning left.

### **Torque Sensor Amplified**

The PSCM takes the detection coil voltage and multiplies it. This amplified signal voltage is used by the PSCM to compensate for lag in mechanical steering components.

### **Torque Sensor Main**

The scan tool displays -17.2 N.m to 17.2 N.m (12.6 lb ft). The amount of torque being applied to the steering column shaft when turning the steering wheel. This signal voltage is from the detection coil of the torque sensor which is then converted to N.m by the PSCM. A - value indicates a left turn, a positive value indicates a right turn.

### **Torque Sensor Sub**

The scan tool displays -17.2 N.m to 17.2 N.m (12.6 lb ft). this signal voltage is from the compensation coil of the torque sensor which is then converted to N.m by the PSCM. The Torque Sensor Main and Torque Sensor Sub data parameters should behave the same as each other.

### **Tuning Profile**

The scan tool displays 1-8. The number of the steering calibration the PSCM has been programmed to. After replacement, the PSCM must be programmed with the proper calibration using the Saturn Service Stall.

### **Vehicle Speed**

The scan tool displays 0-255 km/h (0-156 mph). The actual speed of the vehicle.

## **DIAGNOSTIC TROUBLE CODE (DTC) LIST**

### **Diagnostic Trouble Code (DTC) List**

<b>DTC</b>	<b>Diagnostic Procedure</b>	<b>Modules</b>

C0000	<b><u>DTC C0000</u></b>	PSCM
C0475	<b><u>DTC C0475</u></b>	PSCM
C0476	<b><u>DTC C0476</u></b>	PSCM
C0545	<b><u>DTC C0545</u></b>	PSCM
C0551	<b><u>DTC C0551</u></b>	PSCM
C0847	<b><u>DTC C0847</u></b>	PSCM
C0848	<b><u>DTC C0848</u></b>	PSCM
C0896	<b><u>DTC C0896</u></b>	PSCM
C0899	<b><u>DTC C0899</u></b>	PSCM
C0900	<b><u>DTC C0900</u></b>	PSCM

## DTC C0000

### Circuit Description

The power steering control module (PSCM) receives a vehicle speed message from the powertrain control module (PCM) via the serial data circuit. The PSCM uses this vehicle speed message, and other inputs, to determine the desired amount of steering assist.

### Conditions for Running the DTC

- The ignition is ON.
- DTC U1300 or U1301 are not set.

### Conditions for Setting the DTC

The PSCM receives an invalid, or no vehicle speed message from the ECM.

### Action Taken When the DTC Sets

- DTC C0000 is stored in memory.
- The IPC displays the SERVICE VEHICLE SOON warning indicator.
- Steering assist is set to a default level.

### Conditions for Clearing the DTC

- A current DTC will clear on the next consecutive malfunction free ignition cycle.
- A history DTC will clear after 100 consecutive malfunction free ignition cycles.
- Using a scan tool.

### Test Description

**2:** Tests for the presence of vehicle speed related DTCs in the control module where the vehicle speed message originates.



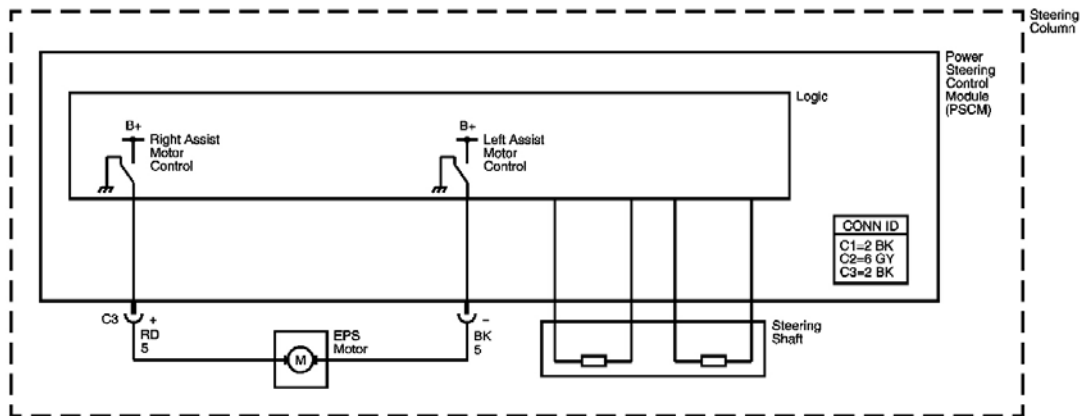
**DTC C0000**

<b>Step</b>	<b>Action</b>	<b>Yes</b>	<b>No</b>
<b>Schematic Reference:Power Steering System Schematics</b> <b>Connector End View Reference:Power Steering System Connector End Views</b>			
1	Did you perform the Power Steering System Diagnostic System Check?	Go to <b>Step 2</b>	Go to <b><u>Diagnostic System Check - Power Steering System</u></b>
2	<ol style="list-style-type: none"><li>1. Install a scan tool.</li><li>2. Turn ON the ignition, with the engine OFF.</li><li>3. With the scan tool, select the Transmission Diagnostic Trouble Codes (DTC) function in Powertrain.</li></ol> Does the scan tool indicate the presents of any vehicle related DTCs?	Go to <b><u>Diagnostic System Check - Automatic Transmission</u></b> in Automatic Transmission - 5AT, or to <b><u>Diagnostic System Check - Automatic Transmission</u></b> in Automatic Transmission VT25-E, or to <b><u>Diagnostic System Check - Manual Transmission</u></b> in Manual Transmission - Getrage 5 Speed	Go to <b>Step 3</b>
3	<ol style="list-style-type: none"><li>1. Use the scan tool in order to clear the EPS DTCs.</li><li>2. Operate the vehicle within the conditions for running the DTC.</li></ol> Does the DTC reset?	Go to <b>Step 2</b>	System OK

**DTC C0475**

LOC

MAIN



**Fig. 2: DTC C0475 Schematics**  
 Courtesy of GENERAL MOTORS CORP.

### Circuit Description

The Power Steering Control Module (PSCM) continuously monitors the voltage and current levels being commanded to the Electric Power Steering (EPS) motor. The PSCM compares the desired and actual current levels to detect malfunctions in the EPS motor, or the circuits to the motor.

### Conditions for Running the DTC

- The ignition is ON.
- No voltage DTCs are present.

### Conditions for Setting the DTC

A short to ground, short to voltage, or an open in the EPS motor, or the circuits to the motor.

### Action Taken When the DTC Sets

- A DTC C0475 is stored in memory.
- The IPC displays the SERVICE VEHICLE SOON warning indicator.
- No steering assist is provided.

### Conditions for Clearing the DTC

- A current DTC will clear on the next malfunction free ignition cycle.
- A history DTC will clear after 100 consecutive malfunction free ignition cycles.
- Using a scan tool

### DTC C0475

Step	Action	Yes	No
<b>Connector End Views Reference: Power Steering System Connector End Views</b>			
1	Did you perform the Power Steering Diagnostic System Check?	Go to <b>Step 2</b>	Go to <b>Diagnostic System Check - Power Steering System</b>
2	Inspect for poor connections at the EPS motor harness connector, refer to <b>Testing for Intermittent Conditions and Poor Connections</b> and <b>Connector Repairs</b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 6</b>	Go to <b>Step 3</b>
3	Test the EPS motor control circuits for a short to ground or an open. Refer to <b>Circuit Testing</b> and <b>Wiring Repairs</b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 6</b>	Go to <b>Step 4</b>
4	Test the EPS motor control circuits for a short to voltage. Refer to <b>Testing for a Short to Voltage</b> and <b>Wiring Repairs</b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 6</b>	Go to <b>Step 5</b>
5	Replace the EPS assembly. Refer to <b>Steering Column Replacement</b> in Steering Wheel and Column. Did you complete the repair?	Go to <b>Step 6</b>	-
6	<ol style="list-style-type: none"> <li>1. Use the scan tool in order to clear the DTCs.</li> <li>2. Operate the vehicle within the Conditions for Running the DTC.</li> </ol> Does the DTC reset?	Go to <b>Step 2</b>	System OK

### DTC C0476

#### Circuit Description

The Power Steering Control Module (PSCM) monitors the temperature of the Electric Power Steering (EPS) system. The PSCM uses voltage and current levels to calculate an estimated system temperature. If the PSCM detects a high system temperature event is occurring the amount of assist is reduced to lower the EPS system temperature to prevent system thermal damage.

#### Condition for Running the DTC

The ignition is ON.

#### Conditions for Setting the DTC

The PSCM detects a high system temperature.

#### Action Taken When the DTC Sets

- A DTC C0476 is stored in memory.
- Steering assist is reduced.

#### Conditions for Clearing the DTC

- A current DTC will clear when the EPS system temperature returns to normal.
- A history DTC will clear after 100 consecutive malfunction free ignition cycles.
- Using a scan tool

#### Diagnostic Aids

- DTC C0476 does not indicate that a malfunction has occurred. Rather that the PSCM had to limit current to the EPS motor to avoid system thermal damage.
- Inspect the under dash area around the EPS assembly. Ensure that no other components have come in contact with the EPS assembly such as under dash insulation or other electrical components.
- Ensure that no steering components down stream of the EPS assembly, such as ball joints, tie rod ends, universal joints, or the steering rack and pinion are mechanically binding.

#### Test Description

The number below refer to the step number on the diagnostic table.

**2:** Tests if the high system temperature is system, or driving condition related.

#### DTC C0476

Step	Action	Yes	No
<b>Schematic Reference:Power Steering System Schematics</b> <b>Connector End View Reference:Power Steering System Connector End Views</b>			
1	Did you perform the Power Steering Diagnostic System Check?	Go to <b>Step 2</b>	Go to <b>Diagnostic System Check - Power Steering System</b>
2	Since most occurrences of the DTC are caused by frequent static steering, such as parking maneuvers and high ambient temperatures, review the EPS system with the customer to determine the conditions under which the DTC set. Did steering conditions, or high ambient temperatures cause the DTC to set?	Go to <b>Step 3</b>	Go to Diagnostic Aids
3	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the		

DTC.		
Does the DTC reset?	Go to <b>Step 2</b>	System OK

## DTC C0545

### Circuit Description

The electric power steering (EPS) system uses a torque sensor to detect the amount of torque being applied to the steering column shaft when the steering wheel is turned. The power steering control module (PSCM) uses this sensor as it's main input in determining the amount of steering assist needed.

### Condition for Running the DTC

The ignition, and the engine are ON.

### Condition for Setting the DTC

- The PSCM's torque sensor input is greater than 17.2 N.m (12.6 lb ft) during a right turn.
- The PSCM's torque sensor input is less than -17.2 N.m (12.6 lb ft) during a left turn.
- The difference between the 2 torque sensor coils is greater than 2.4 N.m (1.7 lb ft).

### Action Taken When the DTC Sets

- A DTC C0545 is stored in memory.
- The IPC displays the SERVICE VEHICLE SOON warning indicator.
- No steering assist is provided.

### Conditions for Clearing the DTC

- A current DTC will clear on the next malfunction free ignition cycle.
- A history DTC will clear after 100 consecutive malfunction free ignition cycles.
- Using a scan tool

### Diagnostic Aids

The torque sensor is hard wired to the PSCM, thus no connector, or circuit testing can be performed. If an intermittent malfunction is suspected with the torque sensor, or the circuits to the torque sensor, replace the EPS assembly. Refer to **Steering Column Replacement** in Steering Wheel and Column. The scan tool can be used to view the torque sensor value.

### Test Description

The number below refers to the step number on the diagnostic table.

2: Tests the torque sensor in its active state.

### DTC C0545

Step	Action	Values	Yes	No
<b>Schematic Reference:Power Steering System Schematics</b>				
<b>Connector End View Reference:Power Steering System Connector End Views</b>				
1	Did you perform the Power Steering Diagnostic System Check?	-	Go to <b>Step 2</b>	Go to <b>Diagnostic System Check - Power Steering System</b>
2	<ol style="list-style-type: none"> <li>1. Install a scan tool</li> <li>2. Start the engine.</li> <li>3. With the scan tool, observe the Torque Sensor Main data parameter in the EPS Data List 2.</li> <li>4. Turn the steering wheel 90 degrees to the right and hold the steering wheel position.</li> </ol> <p>Does the scan tool indicate that the Torque Sensor Main data parameter changes state while turning the steering wheel and is less than the specified value?</p>	17.2 N.m (12.6 lb ft)	Go to Diagnostic Aids	Go to <b>Step 3</b>
3	Replace the EPS assembly. Refer to <b>Steering Column Replacement</b> in Steering Wheel and Column. Did you complete the repair?	-	Go to <b>Step 4</b>	-
4	<ol style="list-style-type: none"> <li>1. Use the scan tool in order to clear the DTCs.</li> <li>2. Operate the vehicle within the Conditions for Running the DTC.</li> </ol> <p>Does the DTC reset?</p>	-	Go to <b>Step 2</b>	System OK

### DTC C0551

#### Circuit Description

After replacement of the Electric Power Steering (EPS) assembly, the Power Steering Control Module (PSCM) must be configured with the proper tuning profile using the Saturn Service Stall.

#### Conditions for Running the DTC

The ignition is ON.

## Conditions for Setting the DTC

The PSCM has not been configured with the proper tuning profile.

## Action Taken When the DTC Sets

- DTC C0551 is stored in memory.
- The IPC displays the SERVICE VEHICLE SOON warning indicator.
- Steering assist is set to a default level.

## Conditions for Clearing the DTC

- A current DTC will clear after the PSCM has been configured with the proper tuning profile.
- A history DTC will clear after 100 consecutive malfunction free ignition cycles from when the PSCM has been configured.
- Using a scan tool

## Diagnostic Aids

A newly replaced EPS assembly will set DTC C0551 on it's initial ignition ON cycle.

## Test Description

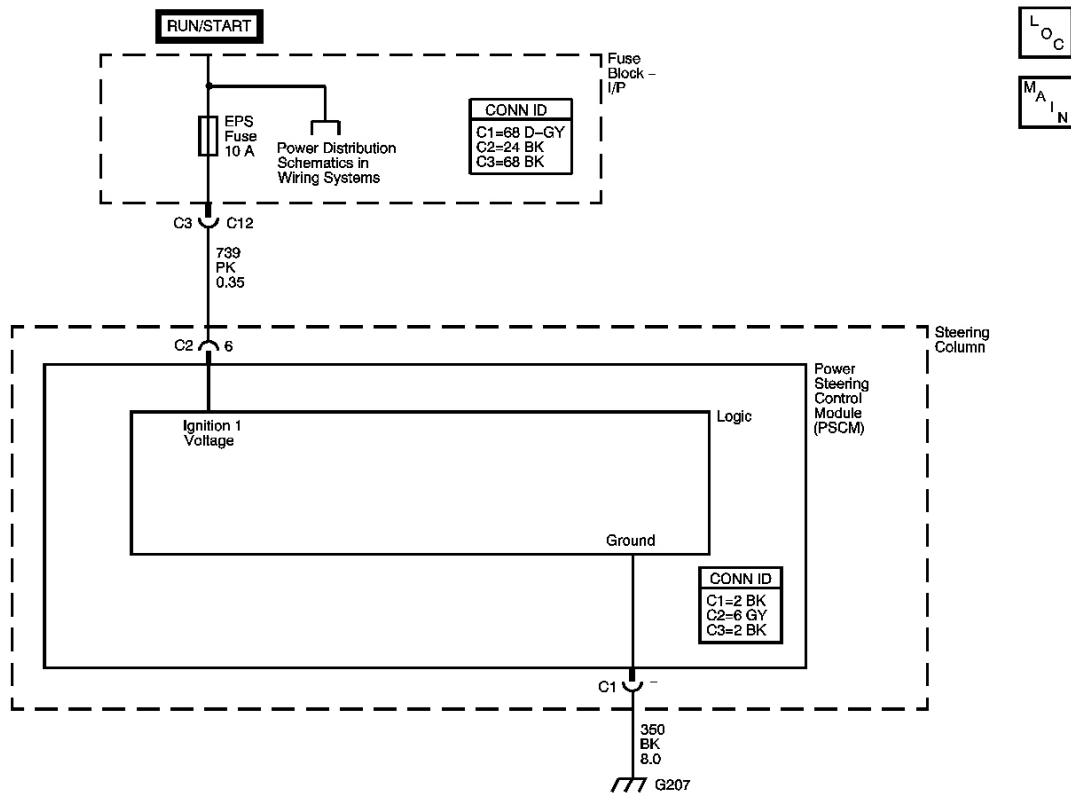
The numbers below refer to the step numbers on the diagnostic table.

**2:** Tests if the condition is current.

## DTC C0551

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Power Steering System?	Go to <b>Step 2</b>	Go to <b>Diagnostic System Check - Power Steering System</b>
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, observe the Tuning Profile parameter in the EPS data list.  Does the scan tool display number 0?	Go to <b>Step 3</b>	Go to <b>Step 4</b>
3	Configure the PSCM. Refer to <b>Service Programming System (SPS)</b> in Vehicle Control Systems. Did you complete the repair?	Go to <b>Step 4</b>	-
4	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC.	Go to	

## DTC C0847



**Fig. 3: DTC C0847 Schematics**  
 Courtesy of GENERAL MOTORS CORP.

### Circuit Description

The instrument panel fuse block (IPFB) contains the 10 amp EPS fuse. This fuse and the ignition 1 voltage circuit supply ignition voltage to the power steering control module (PSCM). This ignition voltage is used to wake up the PSCM.

### Conditions for Running the DTC

The ignition is ON.

### Conditions for Setting the DTC

- The ignition 1 voltage circuit is shorted to ground or open.
- DTCs U1300 and U1301 are not set.



## Action Taken When the DTC Sets

- DTC C0847 is stored in memory.
- The instrument panel cluster (IPC) displays the SERVICE VEHICLE SOON warning indicator.
- The electric power steering (EPS) system is disabled.

## Conditions for Clearing the DTC

- A current DTC will clear when the malfunction is no longer present.
- A history DTC will clear after 100 consecutive malfunction free ignition cycles.
- Using a scan tool

## Diagnostic Aids

The Ignition 1 voltage circuit supplies several other control modules with ignition voltage. Before preceding with the diagnostic table below, ensure no other control modules that use the ignition 1 circuit for their ignition voltage supply have any ignition voltage malfunctions present, such as the sensing and diagnostic module (SDM), or the cruise control module (CCM). Refer to **Power Distribution Schematics** in Wiring Systems. If an intermittent malfunction exists, refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems for further diagnosis.

## Test Description

The numbers below refer to the step numbers on the diagnostic table.

**2:** Tests if the malfunction is intermittent.

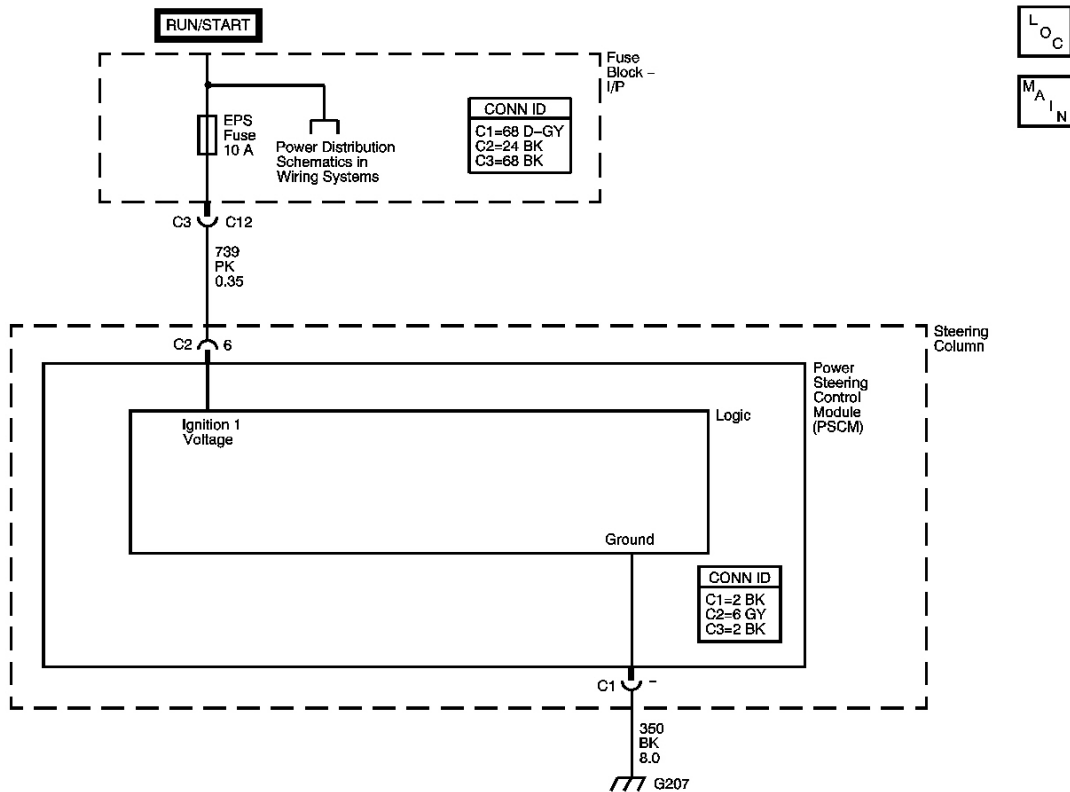
**5:** Tests if a short to ground exists in the ignition 1 voltage circuit, or in the PSCM.

## DTC C0847

Step	Action	Yes	No
<b>Connector End Views Reference: Power Steering System Connector End Views</b>			
1	Did you perform the Power Steering Diagnostic System Check?	Go to <b>Step 2</b>	Go to <b>Diagnostic System Check - Power Steering System</b>
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, attempt to establish communication with the PSCM.  Does the scan tool communicate with the PSCM?	Go to Diagnostic Aids	Go to <b>Step 3</b>
3	1. Turn OFF the ignition. 2. Inspect the 10 A EPS fuse for an open.		

	Is the fuse open?	Go to <b>Step 4</b>	Go to <b>Step 6</b>
4	<ol style="list-style-type: none"> <li>1. Replace the 10 A EPS fuse.</li> <li>2. Turn ON the ignition, with the engine OFF.</li> </ol> <p>Does the fuse open?</p>	Go to <b>Step 5</b>	Go to Diagnostic Aids
5	<p>Test the ignition 1 voltage circuit of the PSCM for a short to ground. Refer to <b>Testing for Short to Ground</b> and <b>Wiring Repairs</b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 10</b>	Go to <b>Step 9</b>
6	<p>Test the ignition 1 voltage circuit of the PSCM for an open. Refer to <b>Circuit Testing</b> and to <b>Wiring Repairs</b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 10</b>	Go to <b>Step 7</b>
7	<p>Inspect for poor connections at the harness connector of the IPFB. Refer to <b>Testing for Intermittent Conditions and Poor Connections</b> and to <b>Connector Repairs</b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 10</b>	Go to <b>Step 8</b>
8	<p>Inspect for poor connections at the harness connector of the PSCM. Refer to <b>Testing for Intermittent Conditions and Poor Connections</b> and to <b>Connector Repairs</b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 10</b>	Go to <b>Step 9</b>
9	<p>Replace the EPS assembly. Refer to <b>Steering Column Replacement</b> in Steering Wheel and Column.</p> <p>Did you complete the replacement?</p>	Go to <b>Step 10</b>	-
10	<ol style="list-style-type: none"> <li>1. Use the scan tool in order to clear the DTCs.</li> <li>2. Operate the vehicle within the Conditions for Running the DTC.</li> </ol> <p>Does the DTC reset?</p>	Go to <b>Step 2</b>	System OK

## DTC C0848



**Fig. 4: DTC C0848 Schematics**  
Courtesy of GENERAL MOTORS CORP.

### Circuit Description

The Power Steering Control Module (PSCM) receives a class 2 power moding message from the Body Control Module (BCM) to determine the position of the ignition switch. After a power mode OFF message is received, the PSCM monitors the ignition 1 voltage circuit to detect if a short to voltage fault exists.

### Conditions for Running the DTC

- The ignition is OFF.
- The class 2 power mode message indicates OFF.

### Conditions for Setting the DTC

- The PSCM ignition 1 voltage circuit is shorted to voltage.
- DTCs U1300 and U1301 are not set.

### Action Taken When the DTC Sets

- DTC C0848 is stored in memory.
- The IPC displays the SERVICE VEHICLE SOON warning indicator.

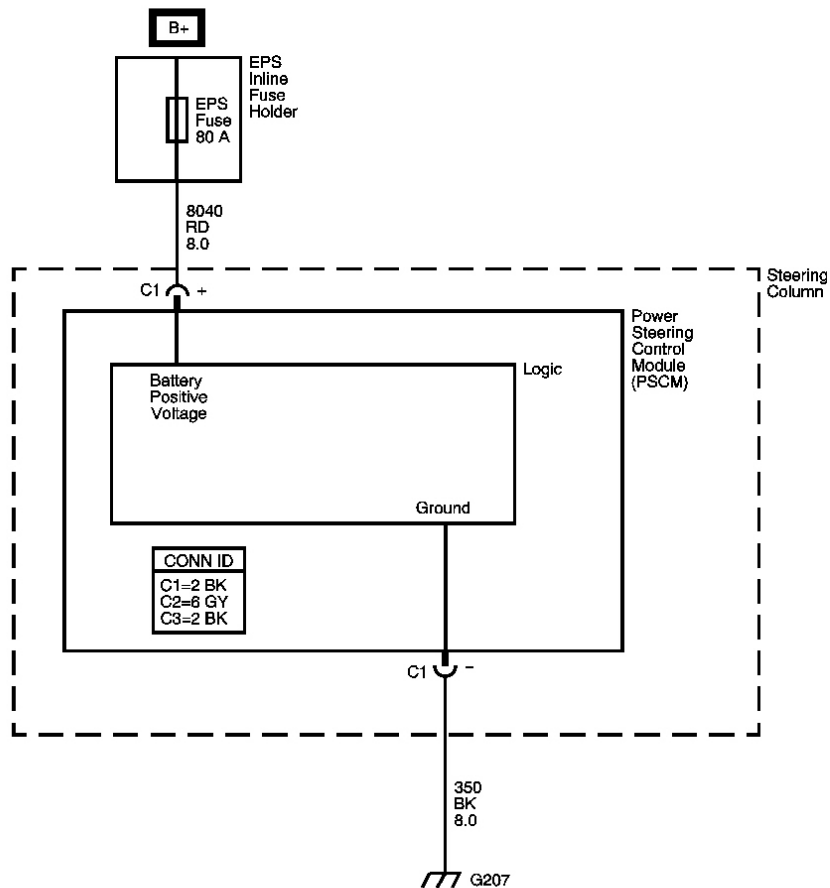
#### Conditions for Clearing the MIL/DTC

- A current DTC will clear on the next consecutive malfunction free ignition cycle.
- A history DTC will clear after 100 consecutive malfunction free ignition cycles.
- Using a scan tool

#### DTC C0848

Step	Action	Yes	No
<b>Connector End Views Reference: Power Steering System Connector End Views</b>			
1	Did you perform the Power Steering Diagnostic System Check?	Go to <b>Step 2</b>	Go to <b>Diagnostic System Check - Power Steering System</b>
2	Test the ignition 1 voltage circuit for a short to voltage. Refer to <b>Testing for a Short to Voltage</b> and <b>Wiring Repairs</b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 3</b>	Go to <b>Testing for Intermittent Conditions and Poor Connections</b> in Wiring Systems
3	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC.  Does the DTC reset?	Go to <b>Step 2</b>	System OK

#### DTC C0896



**Fig. 5: DTC C0896 Schematics**  
**Courtesy of GENERAL MOTORS CORP.**

### Circuit Description

The Power Steering Control Module (PSCM) has a discrete battery positive voltage supply circuit. The PSCM monitors the voltage level on this circuit to ensure the Electric Power Steering (EPS) system has adequate voltage levels to perform the system functions.

### Conditions for Running the DTC

The ignition is ON.

### Conditions for Setting the DTC

EPS system battery voltage is 9-11 volts.

### Action Taken When the DTC Sets

- DTC C0896 is stored in memory.
- The IPC displays the SERVICE VEHICLE SOON warning indicator.
- Steering assist is reduced.

#### Conditions for Clearing the DTC

- A current DTC will clear when EPS system voltage is greater than 11 volts.
- A history DTC will clear after 100 consecutive ignition cycles with EPS system voltage greater than 11 volts.
- Using a scan tool

#### Test Description

The number below refers to the step number on the diagnostic table.

**2:** Tests if the malfunction exists in the vehicles charging system.

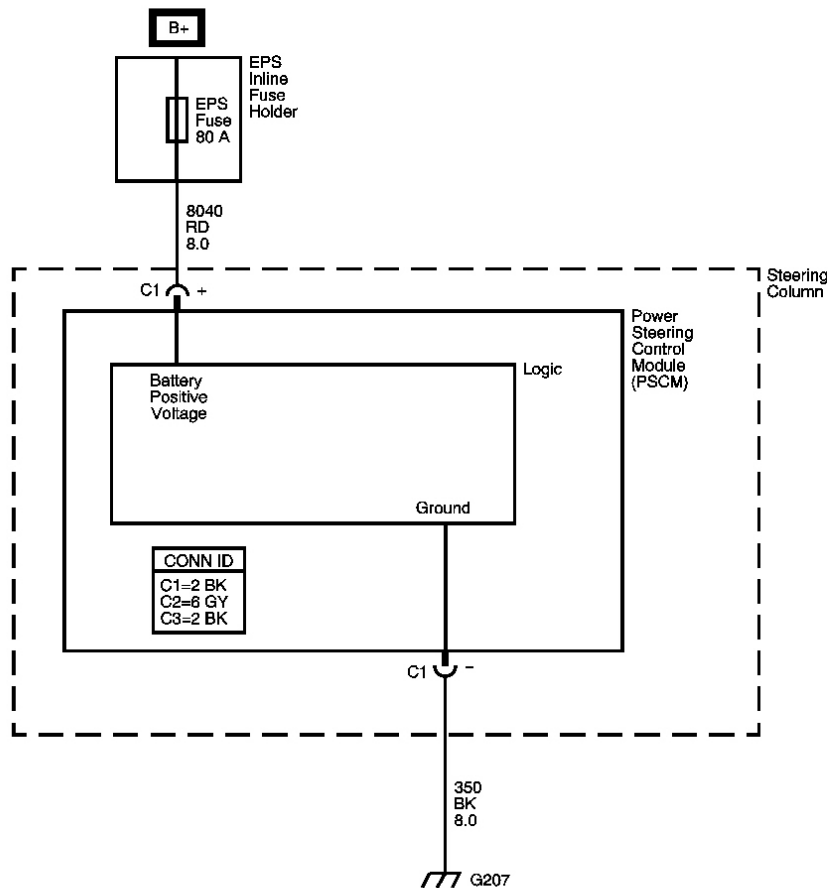
**3:** Tests if the malfunction is intermittent.

#### DTC C0896

Step	Action	Yes	No
<b>Connector End Views Reference: Power Steering System Connector End Views</b>			
1	Did you perform the Power Steering Diagnostic System Check?	Go to <b>Step 2</b>	Go to <b><u>Diagnostic System Check - Power Steering System</u></b>
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, observe the Battery Voltage parameter in the ECM/PCM Data List.  Does the scan tool display greater than 11 volts?	Go to <b>Step 3</b>	Go to <b><u>Diagnostic System Check - Engine Electrical</u></b> in Engine Electrical
3	With a scan tool, observe the Battery Voltage parameter in the EPS Data List. Does the scan tool display greater than 11 volts?	Go to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> in Wiring Systems	Go to <b>Step 4</b>
4	Test the battery positive voltage circuit of the PSCM for a high resistance. Refer to <b><u>Circuit Testing</u></b> and to <b><u>Wiring Repairs</u></b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 10</b>	Go to <b>Step 5</b>
5	Test the ground circuit of the PSCM for a high resistance. Refer to <b><u>Circuit Testing</u></b> and <b><u>Wiring Repairs</u></b> in Wiring Systems.		

	Did you find and correct the condition?	Go to <b>Step 10</b>	Go to <b>Step 6</b>
6	Inspect for poor connections at the harness connector of the underhood fuse block stud terminal. Refer to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> and to <b><u>Connector Repairs</u></b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 10</b>	Go to <b>Step 7</b>
7	Inspect for poor connections at the harness connector of the PSCM. Refer to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> and to <b><u>Connector Repairs</u></b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 10</b>	Go to <b>Step 8</b>
8	Inspect for poor connections at the ground terminal G109. Refer to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> and to <b><u>Connector Repairs</u></b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 10</b>	Go to <b>Step 9</b>
9	Replace the EPS assembly. Refer to <b><u>Steering Column Replacement</u></b> in Steering Wheel and Column. Did you complete the replacement?	Go to <b>Step 10</b>	-
10	<ol style="list-style-type: none"> <li>1. Use the scan tool in order to clear the DTCs.</li> <li>2. Operate the vehicle within the Conditions for Running the DTC.</li> </ol> Does the DTC reset?	Go to <b>Step 2</b>	System OK

## DTC C0899



**Fig. 6: DTC C0899 Schematics**  
**Courtesy of GENERAL MOTORS CORP.**

### Circuit Description

The Power Steering Control Module (PSCM) has a discrete battery positive voltage supply circuit. The PSCM monitors the voltage level on this circuit to ensure the Electric Power Steering (EPS) system has adequate voltage levels to perform the system functions.

### Conditions for Running the DTC

The ignition is ON.

### Conditions for Setting the DTC

EPS system voltage is less than 8 volts

### Action Taken When the DTC Sets



- DTC C0899 is stored in memory.
- The IPC displays the SERVICE VEHICLE SOON warning indicator.
- No steering assist is provided.

#### Conditions for Clearing the DTC

- A current DTC will clear when EPS system voltage is greater than 8.65 volts.
- A history DTC will clear after 100 consecutive ignition cycles with the EPS system voltage greater than 8.65 volts.
- Using a scan tool

#### Test Description

The numbers below refer to the step numbers on the diagnostic table.

**2:** Tests if the malfunction exists in the vehicles charging system.

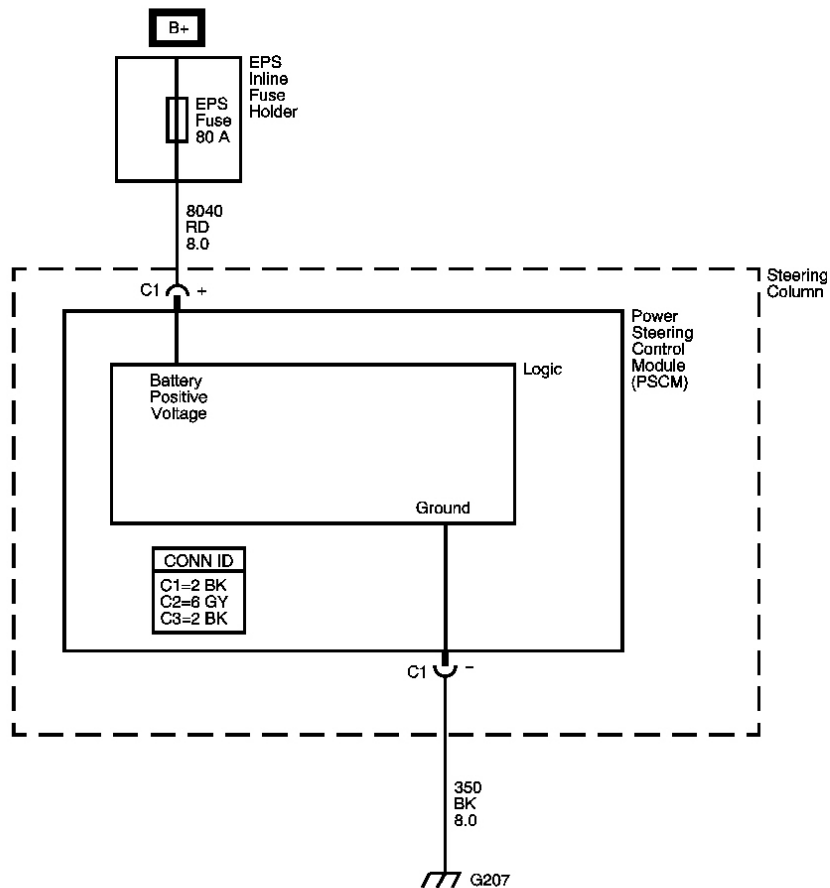
**3:** Tests if the malfunction is in the EPS system.

#### DTC C0899

Step	Action	Yes	No
<b>Connector End Views Reference: Power Steering System Connector End Views</b>			
1	Did you perform the Power Steering Diagnostic System Check?	Go to Step 2	Go to <b><u>Diagnostic System Check - Power Steering System</u></b>
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Turn ON the scan tool  Does the scan tool power up and communicate with the Engine Control Module (ECM)?	Go to Step 3	Go to <b><u>Diagnostic System Check - Engine Electrical</u></b> in Engine Electrical
3	With the scan tool observe the Battery Voltage parameter in the EPS Data List. Does the scan tool display less than 8 Volts?	Go to Step 3	Go to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> in Wiring Systems
4	Test the battery positive voltage circuit of the PSCM for a high resistance. Refer to <b><u>Circuit Testing</u></b> and to <b><u>Wiring Repairs</u></b> in Wiring Systems. Did you find and correct the condition?	Go to Step 10	Go to Step 5
5	Test the ground circuit of the PSCM for a high resistance. Refer to <b><u>Circuit Testing</u></b> and to <b><u>Wiring Repairs</u></b> in Wiring Systems. Did you find and correct the condition?	Go to Step 10	Go to Step 6
	Inspect for poor connections at the harness connector of the		

6	PSCM. Refer to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> and to <b><u>Connector Repairs</u></b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 10</b>	Go to <b>Step 7</b>
7	Inspect for poor connections at the harness connector of the underhood fuse block stud terminal. Refer to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> and to <b><u>Connector Repairs</u></b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 10</b>	Go to <b>Step 8</b>
8	Inspect for poor connections at the ground connector, G207. Refer to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> and to <b><u>Connector Repairs</u></b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 10</b>	Go to <b>Step 9</b>
9	Replace the EPS assembly. Refer to <b><u>Steering Column Replacement</u></b> in Steering Wheel and Column. Did you complete the replacement?	Go to <b>Step 10</b>	-
10	<ol style="list-style-type: none"> <li>1. Use the scan tool in order to clear the DTCs.</li> <li>2. Operate the vehicle within the Conditions for Running the DTC.</li> </ol> Does the DTC reset?	Go to <b>Step 2</b>	System OK

## DTC C0900



**Fig. 7: DTC C0900 Schematics**  
 Courtesy of GENERAL MOTORS CORP.

### Circuit Description

The Power Steering Control Module (PSCM) has a discrete battery voltage supply circuit. The PSCM monitors the voltage level on this circuit to protect itself against high voltage damage.

### Conditions for Running the DTC

The ignition is ON.

### Conditions for Setting the DTC

EPS system voltage is greater than 17 volts.

### Action Taken When the DTC Sets

- DTC C0900 is stored in memory.
- The IPC displays the SERVICE VEHICLE SOON warning indicator.
- The PSCM is disabled to protect itself.

#### Conditions for Clearing the MIL/DTC

- A current DTC will clear when the EPS system voltage returns to less than 15.5 volts.
- A history DTC will clear after 100 consecutive ignition cycles with the EPS system voltage less than 15.5 volts.
- Using a scan tool

#### Diagnostic Aids

Jump starting the vehicle can cause DTC C0900 to set. If an intermittent malfunction exists, refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems for further diagnosis.

#### DTC C0900

Step	Action	Values	Yes	No
<b>Connector End Views Reference: Power Steering System Connector End Views</b>				
1	Did you perform the Power Steering Diagnostic System Check?	-	Go to <b>Step 2</b>	Go to <b><u>Diagnostic System Check - Power Steering System</u></b>
2	<ol style="list-style-type: none"> <li>1. Install a scan tool.</li> <li>2. Turn ON the ignition, with the engine OFF.</li> <li>3. With a scan tool, observe the Battery Voltage parameter in the Engine Control Module (ECM) data list.</li> </ol> Does the scan tool display greater than the specified value?	17 V	Go to <b><u>Diagnostic System Check - Engine Electrical</u></b> in Engine Electrical	Go to <b>Step 3</b>
3	Test the ground circuit of the PSCM for a high resistance. Refer to <b><u>Circuit Testing</u></b> and to <b><u>Wiring Repairs</u></b> in Wiring Systems. Did you find and correct the condition?	-	Go to <b>Step 4</b>	Go to Diagnostic Aids
4	<ol style="list-style-type: none"> <li>1. Use the scan tool in order to clear the DTC.</li> <li>2. Operate the vehicle within the conditions for running the DTC.</li> </ol>	-		

Does the DTC reset?

Go to **Step 2**

System OK

## SYMPTOMS - POWER STEERING SYSTEM

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

### Visual/Physical Inspection

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

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
- Increase in Effort While Turning Steering Wheel
- Poor Return of Steering Wheel
- Steering Wheel Surges/Jerks While Turning

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

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

Step	Action	Yes	No
1	Did you review the Power Steering System General Description and perform the necessary inspections?	Go to <b>Step 2</b>	Go to <u>Symptoms - Steering Wheel and Column</u>
2	Verify that a rattle, clunk or shudder noise is present. Is a rattle, clunk or shudder noise present?	Go to <b>Step 3</b>	System OK
3	Inspect the power steering gear for the proper installation. Refer to <u>Power Steering Gear Replacement</u> . Is the power steering gear installation incorrect?	Go to <b>Step 6</b>	Go to <b>Step 4</b>
4	Inspect the intermediate shaft. Is the intermediate shaft worn?	Go to <b>Step 8</b>	Go to <b>Step 5</b>
5	Inspect the suspension. Is the suspension worn?	Go to <b>Step 7</b>	Go to <u>Noise Diagnosis - Front Suspension</u> In Suspension General Diagnosis
6	Install the power steering gear correctly. Refer to <u>Power Steering Gear Replacement</u> . Did you complete the repair?	Go to <b>Step 9</b>	-
7	Replace the worn suspension components. Did you complete the repair?	Go to <b>Step 9</b>	-

8	Replace the intermediate shaft. Refer to <b><u>Intermediate Steering Shaft Replacement</u></b> in Steering Wheel and Column. Did you complete the repair?	Go to <b>Step 9</b>	-
9	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 3</b>

## INCREASE IN EFFORT WHILE TURNING STEERING WHEEL

### Increase in Effort While Turning Steering Wheel

Step	Action	Yes	No
1	Did you review the Power Steering System Description and Operation and perform the necessary inspections?	Go to <b>Step 2</b>	Go to <b><u>Power Steering System Description and Operation</u></b>
2	Verify that there is an increase in effort while turning is present. Does the system operate normally?	System OK	Go to <b>Step 3</b>
3	Check for the following tire related conditions: <ul style="list-style-type: none"> <li>• Incorrect tire inflation-Refer to <b><u>Tire Inflation Pressure Specifications</u></b> in Maintenance and Lubrication.</li> <li>• Improper tire size</li> </ul> Did you find and correct the condition?	Go to <b>Step 10</b>	Go to <b>Step 4</b>
4	1. Raise and support the vehicle. Refer to <b><u>Lifting and Jacking the Vehicle</u></b> in General Information. 2. Check for a binding or worn tie rod end.  Is the tie rod binding or worn?	Go to <b>Step 7</b>	Go to <b>Step 5</b>
5	Check for a worn or binding intermediate shaft. Is the intermediate shaft worn or binding?	Go to <b>Step 8</b>	Go to <b>Step 6</b>
6	Check for a worn or binding steering gear. Is the steering worn or binding?	Go to <b>Step 9</b>	System OK
7	Replace the outer tie rod end. Refer to <b><u>Rack and Pinion Outer Tie Rod End Replacement</u></b> . Did you complete the repair?	Go to <b>Step 10</b>	-
8	Replace the intermediate shaft. Refer to <b><u>Intermediate Steering Shaft Replacement</u></b> in Steering Wheel and Column. Did you complete the repair?	Go to <b>Step 10</b>	-
9	Replace the steering gear. Refer to <b><u>Power Steering Gear Replacement</u></b> .	Go to	

	Did you complete the repair?	<b>Step 10</b>	-
10	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 3</b>

## POOR RETURN OF STEERING WHEEL

### Poor Return of Steering Wheel

Step	Action	Yes	No
1	Did you review the Power Steering System Description and Operation and perform the necessary inspections?	Go to <b>Step 2</b>	Go to <b>Power Steering System Description and Operation</b>
2	Verify a poor return of the steering wheel is present. Does the system operate normally?	System OK	Go to <b>Step 3</b>
3	Check for incorrect tire inflation. Refer to <b>Tire Inflation Pressure Specifications</b> in Maintenance and Lubrication. Did you find and correct the condition?	Go to <b>Step 11</b>	Go to <b>Step 4</b>
4	1. Raise and support the vehicle. Refer to <b>Lifting and Jacking the Vehicle</b> in General Information. 2. Check for a binding or worn tie rod end.  Is the tie rod binding or worn?	Go to <b>Step 8</b>	Go to <b>Step 5</b>
5	Check for a worn or binding intermediate shaft. Is the intermediate shaft worn or binding?	Go to <b>Step 9</b>	Go to <b>Step 6</b>
6	Check for worn a or binding ball joint. Are the ball joints worn or binding?	Go to <b>Step 10</b>	Go to <b>Step 7</b>
7	Check for proper alignment of the front suspension. Refer to <b>Measuring Wheel Alignment</b> in Wheel Alignment. Did you complete the wheel alignment?	Go to <b>Step 11</b>	-
8	Replace the outer tie rod end. Refer to <b>Rack and Pinion Outer Tie Rod End Replacement</b> . Did you complete the repair?	Go to <b>Step 11</b>	-
9	Replace the intermediate Shaft. Refer to <b>Intermediate Steering Shaft Replacement</b> in Steering Wheel and Column. Did you complete the repair?	Go to <b>Step 11</b>	-
10	Replace the ball joint. Refer to <b>Lower Ball Joint Replacement</b> in Front Suspension. Did you complete the repair?	Go to <b>Step 11</b>	-
11	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 3</b>

## 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 <b>Step 2</b>	Go to <b>Power Steering System Description and Operation</b>
2	Verify that the steering wheel surges/jerks while turning. Does the system operate normally?	System OK	Go to <b>Step 3</b>
3	Check for worn or binding front suspension components. Did you find and correct the condition?	Go to <b>Step 15</b>	Go to <b>Step 4</b>
4	<ol style="list-style-type: none"> <li>1. Raise and support the vehicle. Refer to <b>Lifting and Jacking the Vehicle</b> in General Information.</li> <li>2. Check for a binding or worn tie rod end.</li> </ol> <p>Is the tie rod binding or worn?</p>	Go to <b>Step 11</b>	Go to <b>Step 5</b>
5	Check for a worn or binding intermediate shaft. Is the intermediate shaft worn or binding?	Go to <b>Step 12</b>	Go to <b>Step 6</b>
6	Check for worn a binding steering gear. Is the steering gear worn or binding?	Go to <b>Step 13</b>	Go to <b>Step 7</b>
7	Check for a worn or binding steering column. Is the steering column worn or binding?	Go to <b>Step 14</b>	Go to <b>Step 8</b>
8	Check for excessive heat in the EPS motor. Does the EPS appear to be overheated?	Go to <b>Step 09</b>	Go to <b>Step 10</b>
9	<p><b>IMPORTANT:</b></p> <ul style="list-style-type: none"> <li>• Do not perform excessive parking lot maneuvers during testing.</li> <li>• Excessive parking lot maneuvers can cause the EPS motor to heat up.</li> </ul> <p>Allow the EPS motor to cool and retest the system. Did you find and correct the condition?</p>	Go to <b>Step 15</b>	Go to <b>Step 10</b>
10	Check for low battery voltage. Refer to <b>Diagnostic Starting Point - Engine Electrical</b> in Engine Electrical. Did you find and correct the condition?	Go to <b>Step 15</b>	System OK
11	Replace the outer tie rod end. Refer to <b>Rack and Pinion Outer Tie Rod End Replacement</b> . Did you complete the repair?	Go to <b>Step 15</b>	-
12	Replace the intermediate Shaft. Refer to <b>Intermediate Steering Shaft Replacement</b> in Steering Wheel and Column. Did you complete the repair?	Go to <b>Step 15</b>	-
13	Replace the steering gear. Refer to <b>Power Steering Gear Replacement</b> . Did you complete the repair?	Go to <b>Step 15</b>	-
14	Replace the steering column. Refer to <b>Steering Column Replacement</b> in Steering Wheel and Column.	Go to	



	Did you complete the repair?	<b>Step 15</b>	-
15	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 3</b>

## REPAIR INSTRUCTIONS

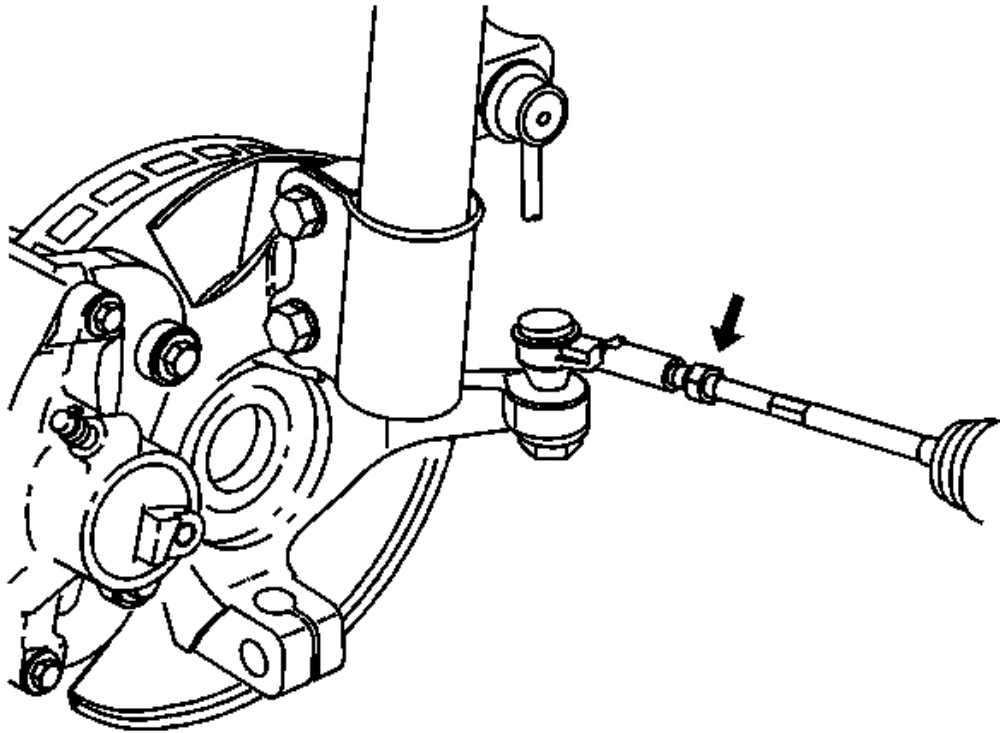
### RACK AND PINION OUTER TIE ROD END REPLACEMENT

#### Tools Required

- **J 44015** Tie Rod Installer
- **SA91100C** Tie Rod Separator

#### Removal Procedure

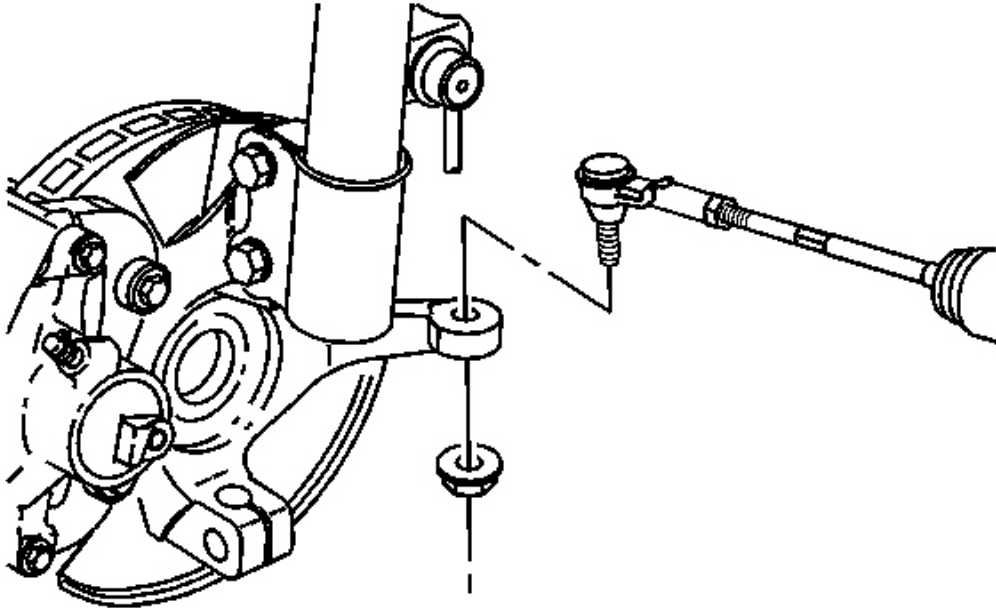
1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the front tire assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.



**Fig. 8: Tie Rod Inner Jam Nut**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT: Mark the location of the jam nut for installation.**

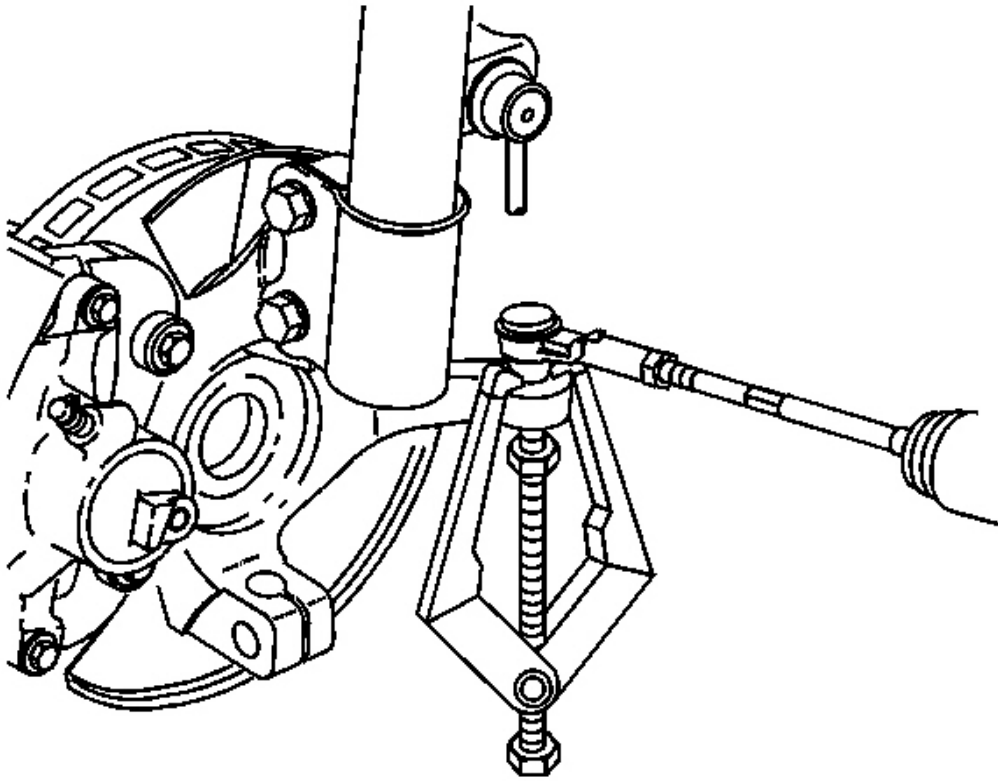
3. Loosen the tie rod inner jam nut.



**Fig. 9: Tie Rod To Knuckle View**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT: Hold the ball stud to prevent turning during removal of the nut.**

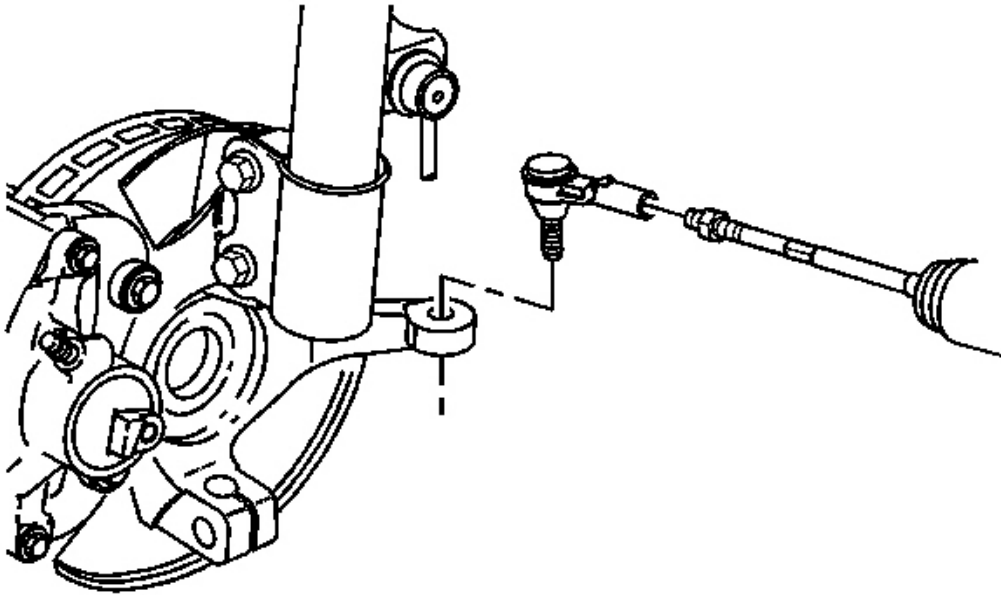
4. Remove the tie rod to knuckle nut. Discard the nut.



**Fig. 10: Tie Rod, Steering Knuckle & SA91100C**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Do not free the ball stud by using a pickle fork or a wedge-type tool.  
Damage to the seal or bushing may result.

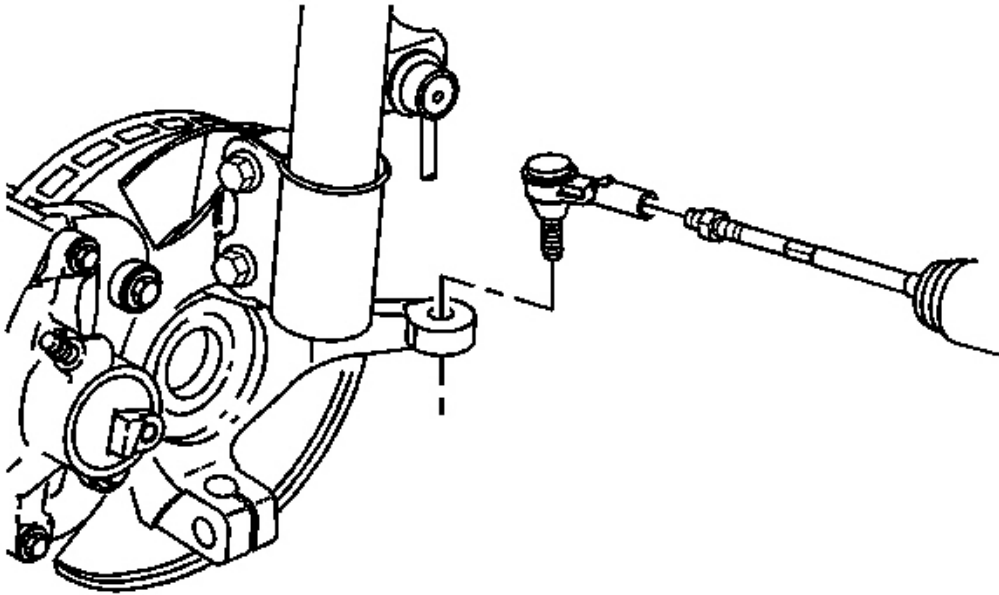
5. Use the SA91100C to separate the tie rod from the steering knuckle.



**Fig. 11: Outer Tie Rod & Inner Tie Rod**  
Courtesy of GENERAL MOTORS CORP.

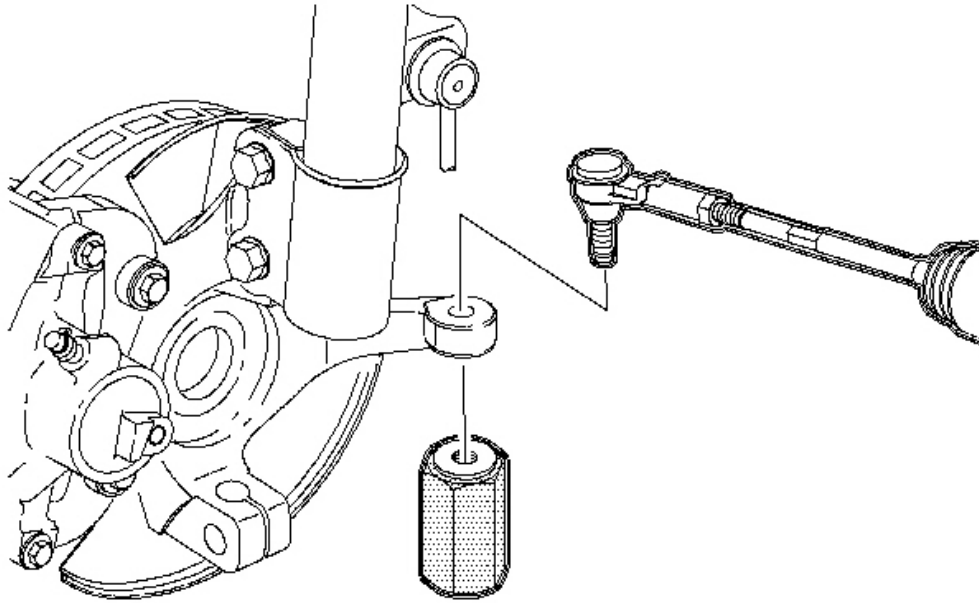
6. Remove the outer tie rod from the inner tie rod.

#### **Installation Procedure**



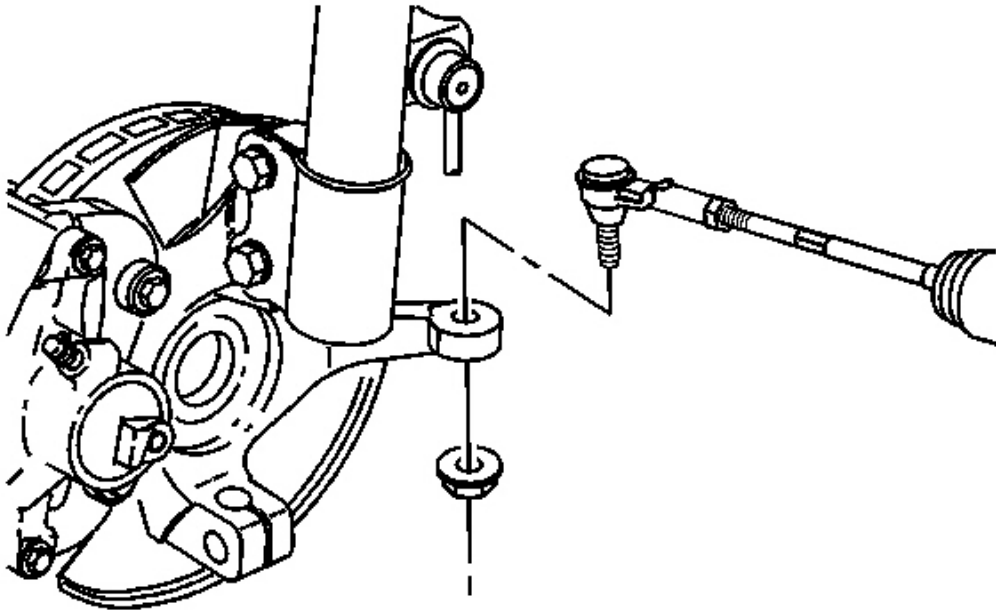
**Fig. 12: Outer Tie Rod & Inner Tie Rod**  
Courtesy of GENERAL MOTORS CORP.

1. Install the outer tie rod to the inner tie rod.



**Fig. 13: Tie Rod, Knuckle & Ball Stud Taper**  
**Courtesy of GENERAL MOTORS CORP.**

2. Connect the tie rod to the knuckle.
3. Use the **J 44015** to seat the ball stud taper to 40 N.m (30 lb ft).
4. Remove the **J 44015** .



**Fig. 14: Tie Rod To Knuckle View**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Refer to Fastener Notice in Cautions and Notices.

5. Install a new tie rod retention nut.

**Tighten:** Tighten the nut to 50 N.m (37 lb ft).

6. Install the front tire assembly. Refer to Tire and Wheel Removal and Installation in Tires and Wheels.
7. Check the wheel alignment. Refer to Measuring Wheel Alignment in Wheel Alignment.

## **RACK AND PINION BOOT REPLACEMENT - ON VEHICLE**

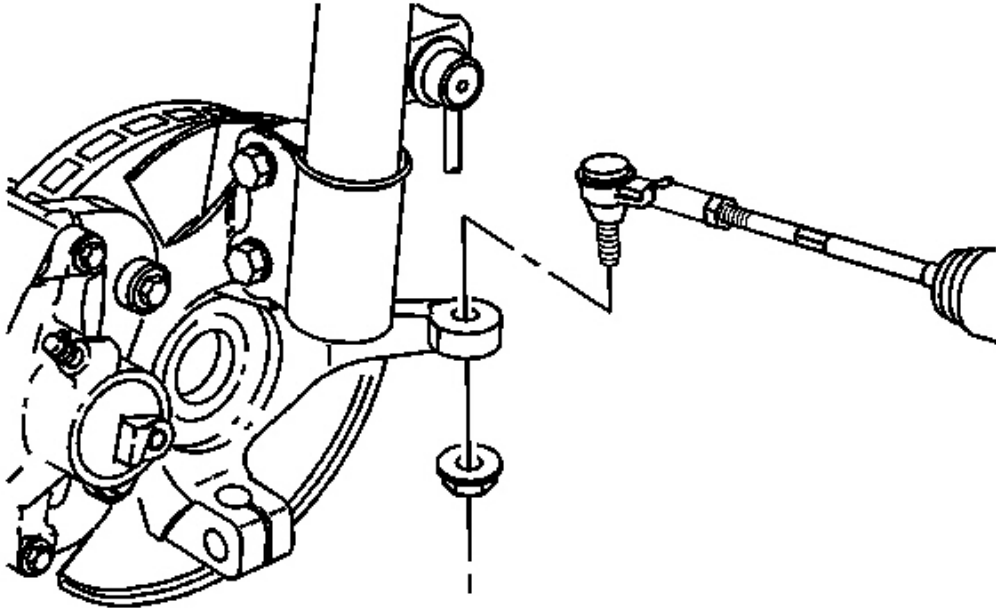
### **Tools Required**

**SA9164C** Clamp Crimper. See Special Tools and Equipment .

### **Removal Procedure**

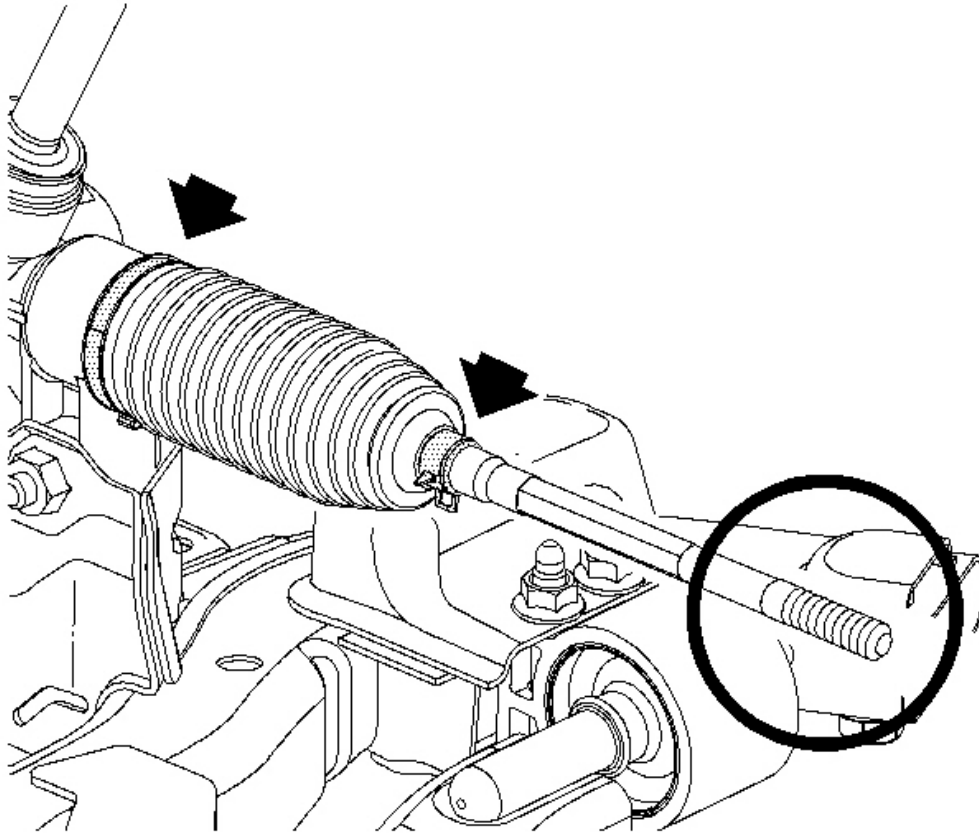
1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle in General Information.
2. Remove the tire assembly. Refer to Tire and Wheel Removal and Installation in Tires and Wheels.





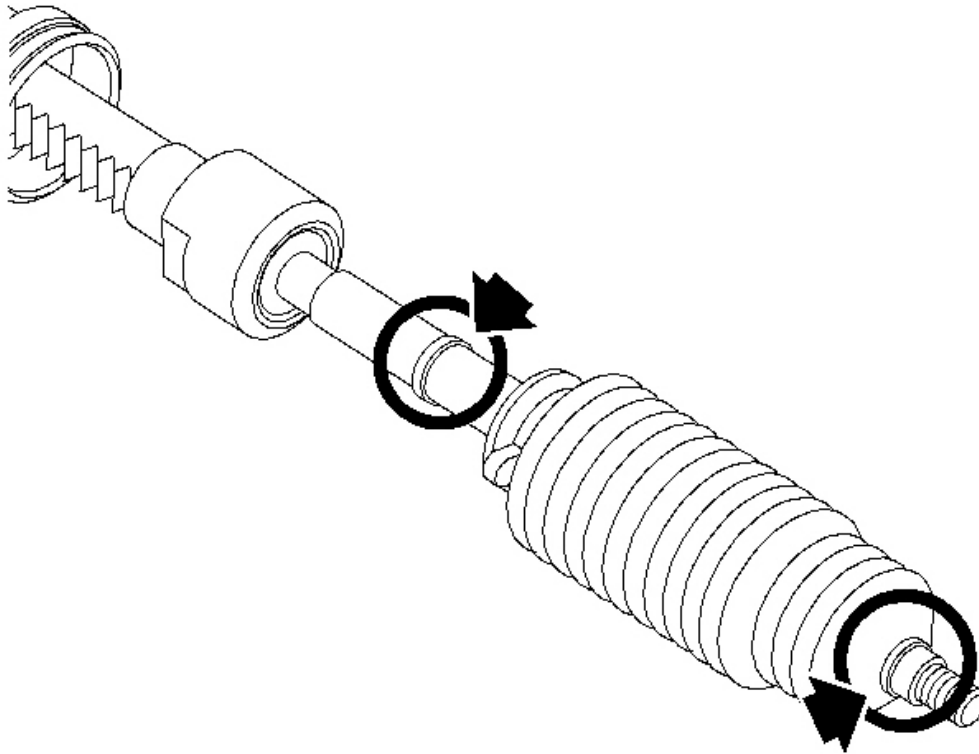
**Fig. 15: Tie Rod To Knuckle View**  
**Courtesy of GENERAL MOTORS CORP.**

3. Remove the outer tie rod. Refer to **Rack and Pinion Outer Tie Rod End Replacement** .
4. Remove the jam nut.



**Fig. 16: Spring, Boot, Outer End & Steering Gear**  
**Courtesy of GENERAL MOTORS CORP.**

5. Remove the spring from the boot, outer end.
6. Cut and remove the crimp clamp, inner end. Discard the clamp.
7. Unseat the boot from the steering gear and remove.



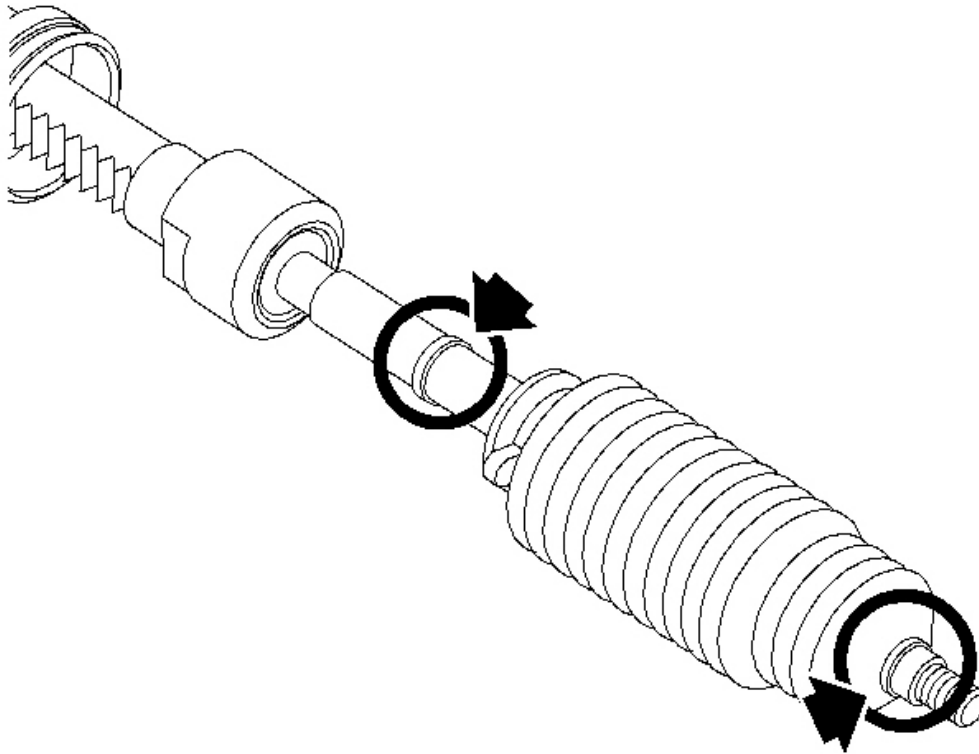
**Fig. 17: Inner Tie Rod & Boot**  
Courtesy of GENERAL MOTORS CORP.

8. Clean the inner tie rod and boot contact area of grease and debris.

#### **Installation Procedure**

**IMPORTANT: The inner tie rod must be free of debris and moisture. The boot sealing are must be clean and dry.**

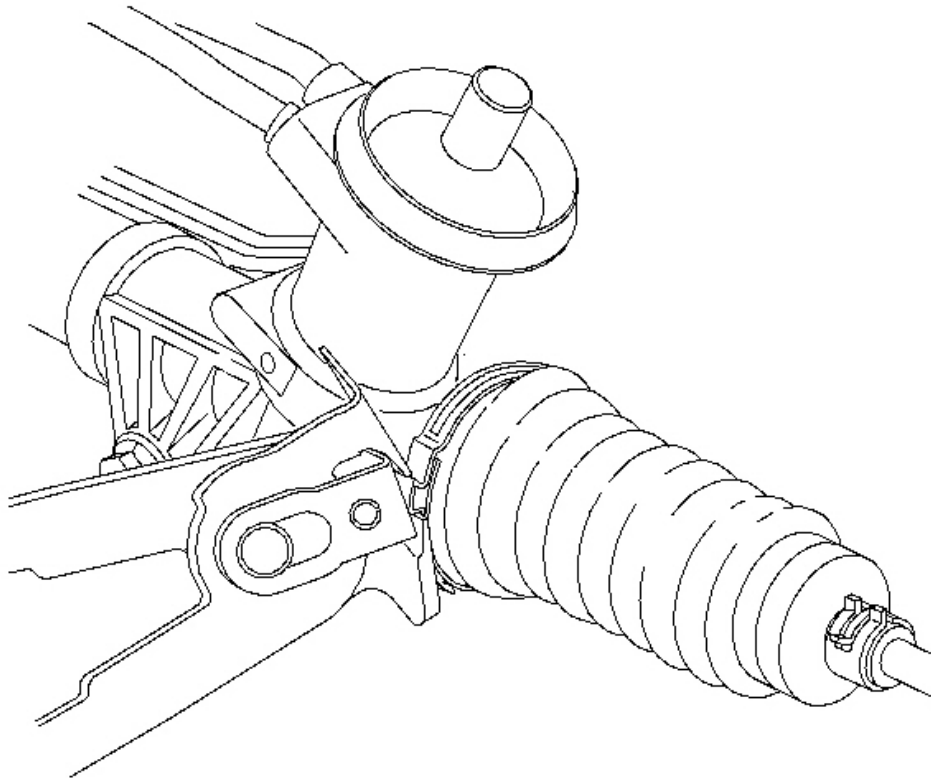
1. Apply approximately 3/4 of the supplied grease packet into the small end of the boot cavity. Apply the remainder of the grease on the shaft where the small end of the boot meets the shaft.



**Fig. 18: Inner Tie Rod & Boot**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT:** Ensure the large end of the boot is firmly seated in the gear housing groove.

2. Install the boot with the large clamp loosely attached, not crimped.

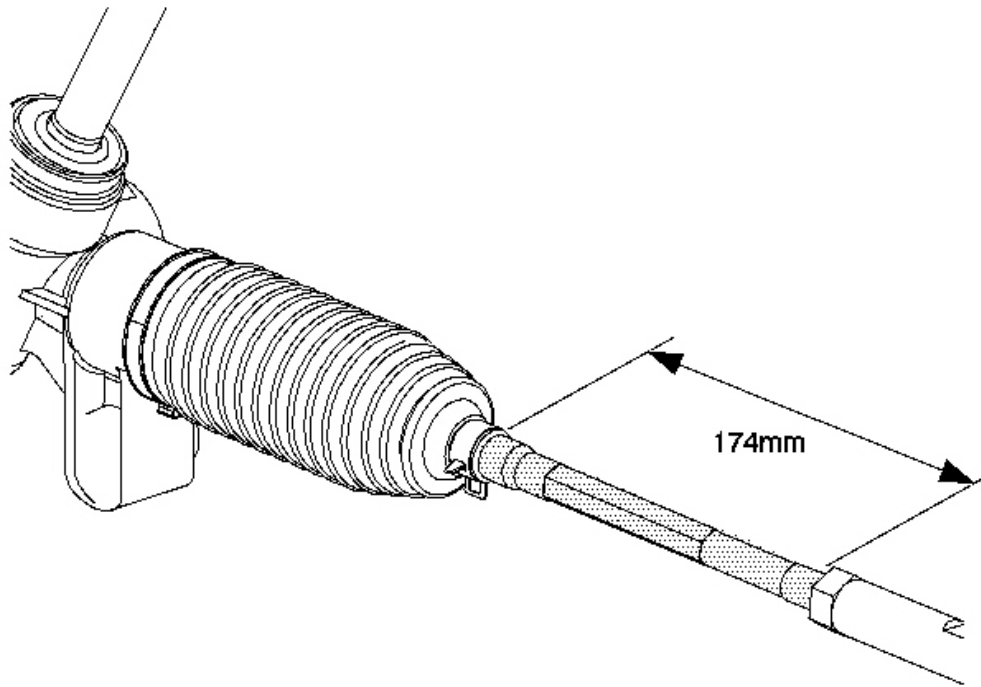


**Fig. 19: Large Clamp**  
Courtesy of GENERAL MOTORS CORP.

3. Using the SA9164C , crimp the large clamp. See Special Tools and Equipment .

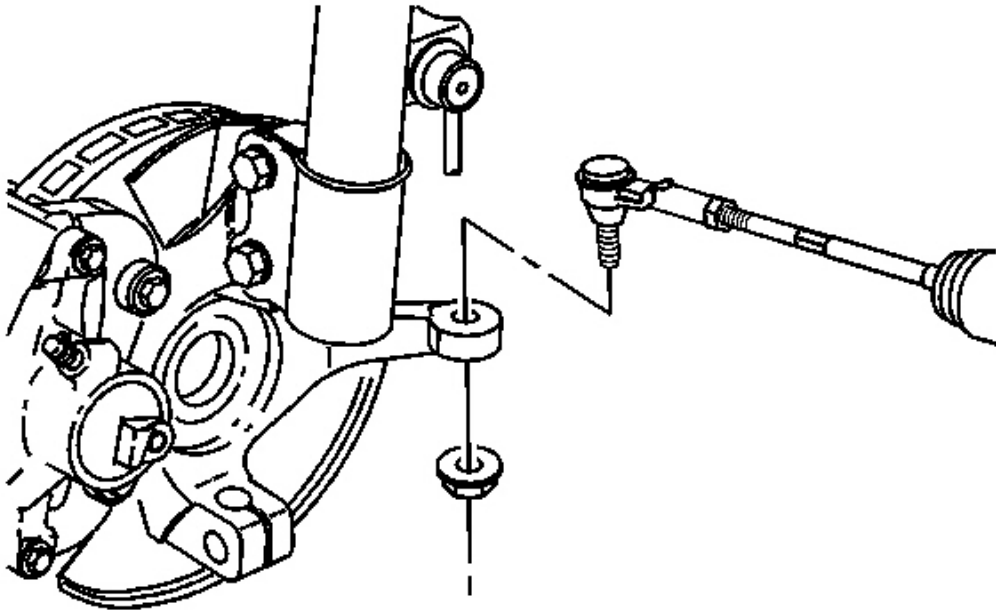
**IMPORTANT:** Ensure the small end of the boot is firmly seated in the inner tie rod end groove.

4. Install the spring clamp to the small end of the boot.



**Fig. 20: Jam Nut & Boot Clamp**  
Courtesy of GENERAL MOTORS CORP.

5. Install the jam nut approximately 174 mm (6.85 in) from the boot clamp.



**Fig. 21: Tie Rod To Knuckle View**  
Courtesy of GENERAL MOTORS CORP.

6. Install the outer tie rod. Refer to **Rack and Pinion Outer Tie Rod End Replacement** .
7. Install the tire assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
8. Check the front wheel alignment and align as necessary. Refer to **Measuring Wheel Alignment** in Wheel Alignment.

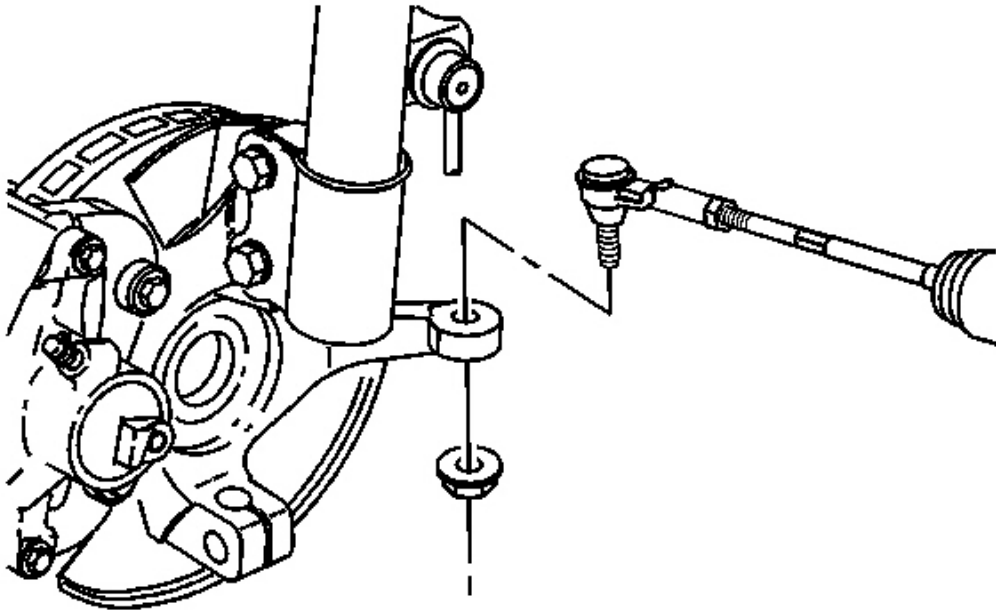
## **POWER STEERING GEAR REPLACEMENT**

### **Tools Required**

- **J 44015** Tie Rod installer
- **SA91100C** Tie Rod Separator

### **Removal Procedure**

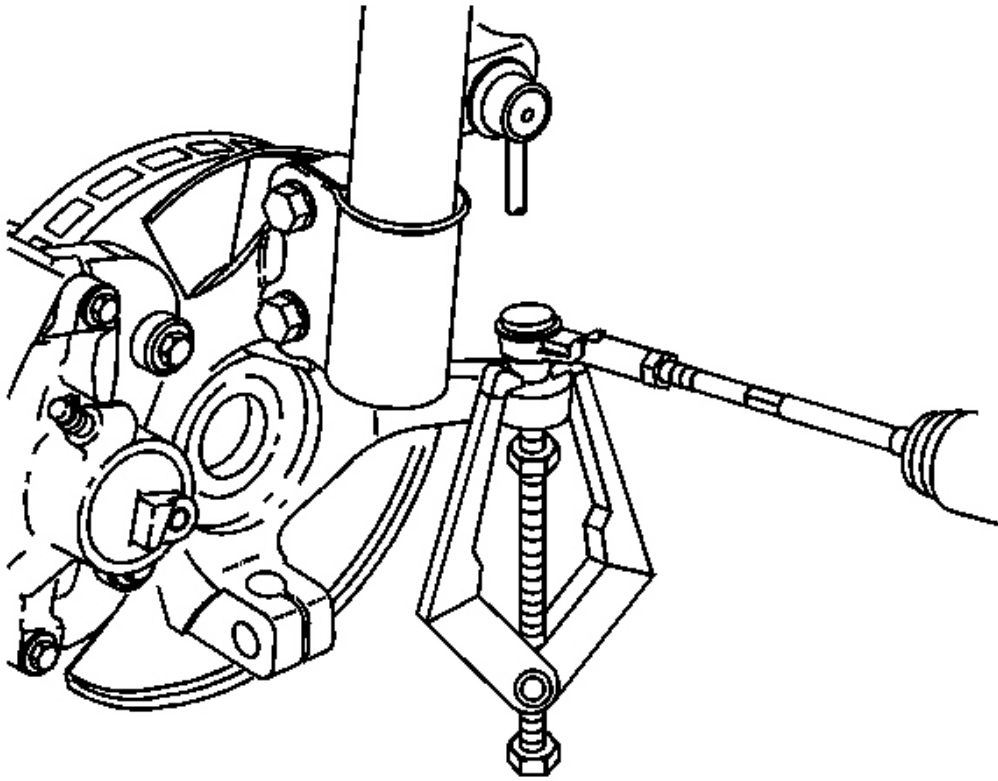
1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the front tires. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.



**Fig. 22: Tie Rod To Knuckle View**  
**Courtesy of GENERAL MOTORS CORP.**

3. Remove both outer tie rod to steering knuckle nuts. Discard the nuts.



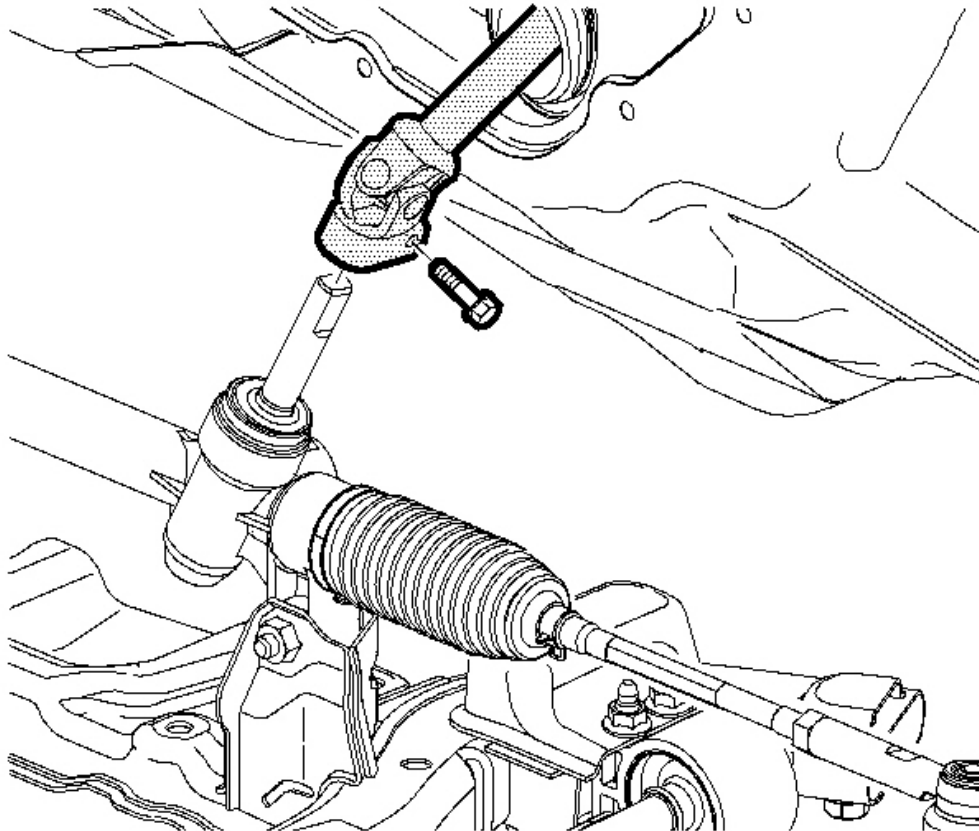


**Fig. 23: Tie Rod, Steering Knuckle & SA91100C**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Do not free the ball stud by using a pickle fork or a wedge-type tool.  
Damage to the seal or bushing may result.

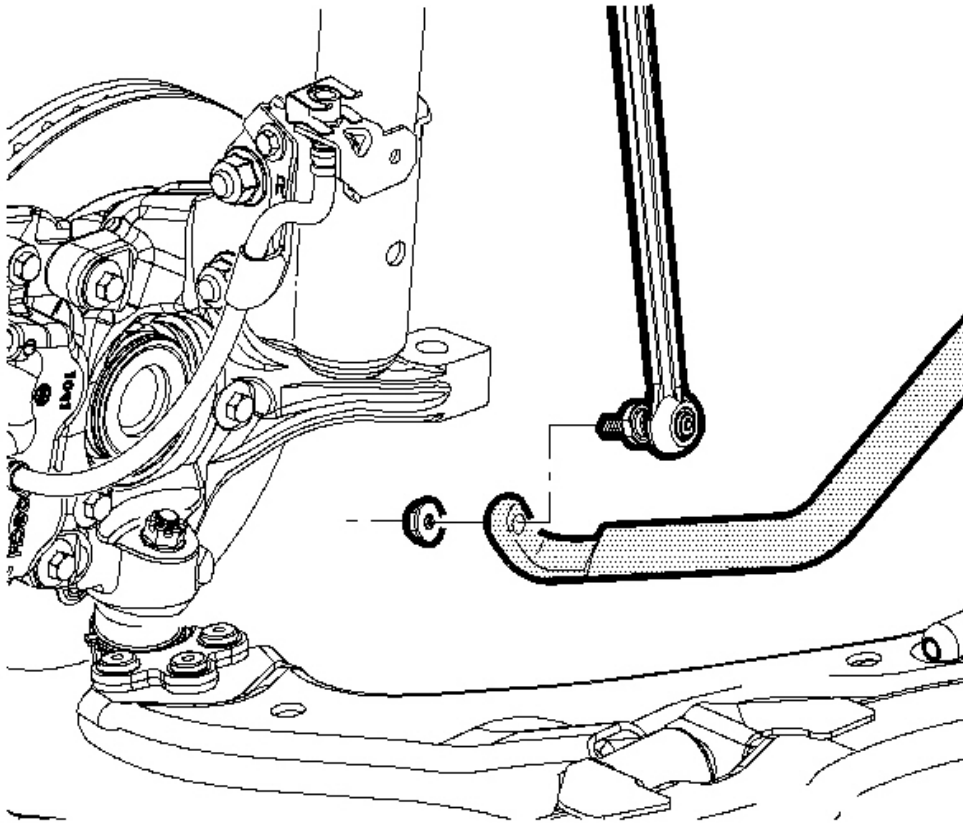
**IMPORTANT:** Hold the ball stud to prevent turning during removal of the nut.

4. Using the SA91100C , separate the tie rods from the steering knuckles.



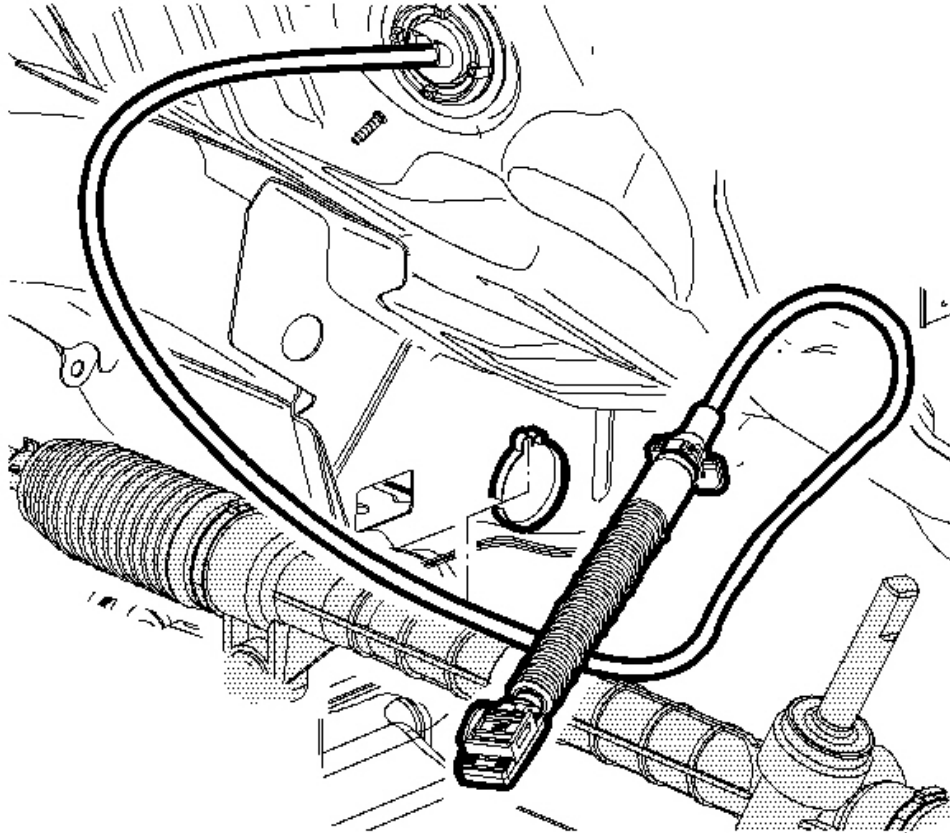
**Fig. 24: Intermediate Shaft, Steering Gear & Bolt**  
Courtesy of GENERAL MOTORS CORP.

5. Rotate the intermediate steering shaft in order to gain access to the intermediate shaft pinch bolt.
6. Remove the intermediate to steering gear pinch bolt. Discard the bolt.
7. Disconnect the intermediate shaft from the steering gear.



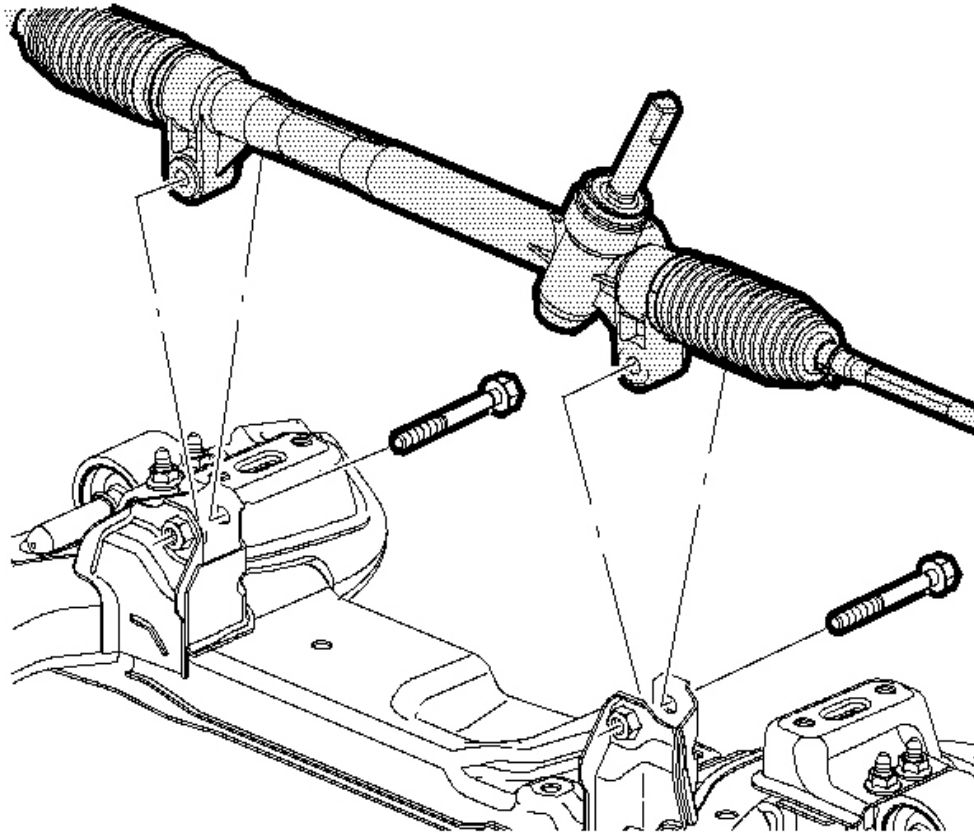
**Fig. 25: Locating Rod & Bar**  
Courtesy of GENERAL MOTORS CORP.

8. Disconnect the stabilizer links from the stabilizer bar. Refer to **Stabilizer Shaft Link Replacement** in Front Suspension.



**Fig. 26: Shift Cable Clip & Steering Gear**  
**Courtesy of GENERAL MOTORS CORP.**

9. On CVT equipped vehicles, remove the shift cable clip from the steering gear.



**Fig. 27: Steering Gear, Cradle & Mounting Bolts**  
Courtesy of GENERAL MOTORS CORP.

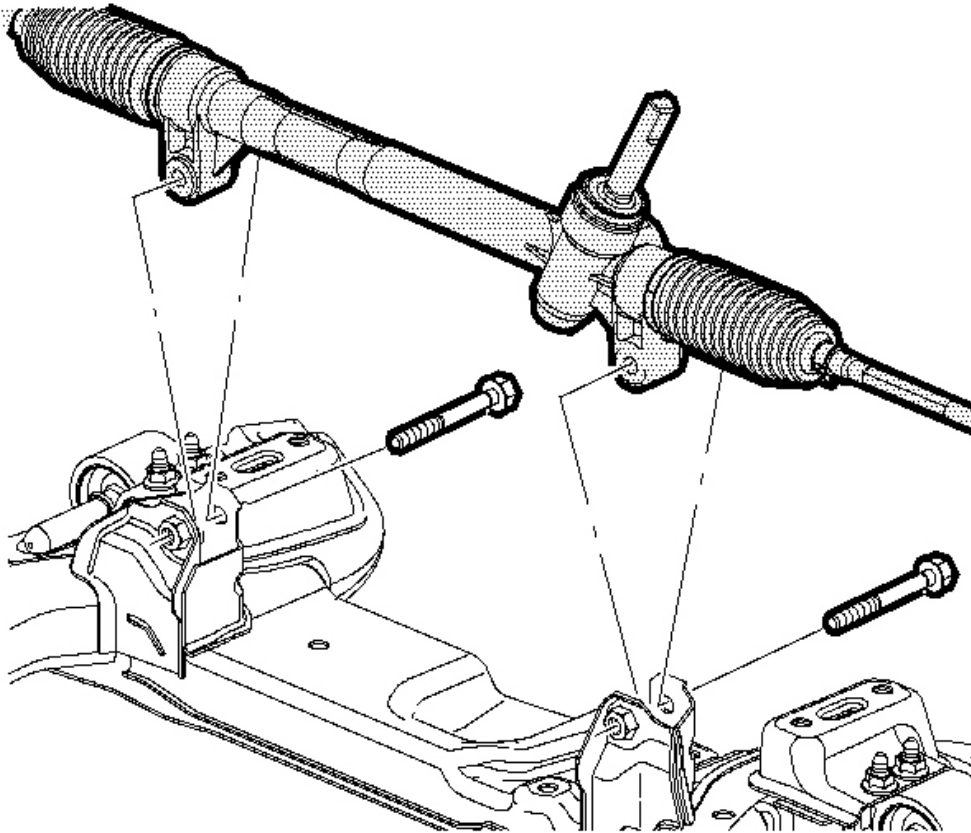
10. Remove the steering gear to cradle mounting bolts.
11. Remove the steering gear through the right side of the vehicle.
12. With heat shield equipped steering gears, remove the heat shield. Save for installation.

#### **Installation Procedure**

1. If applicable, install the heat shield.

**IMPORTANT: Ensure the stabilizer is swung in the upmost position for gear clearance.**

2. Install the steering gear from the right side of the vehicle.



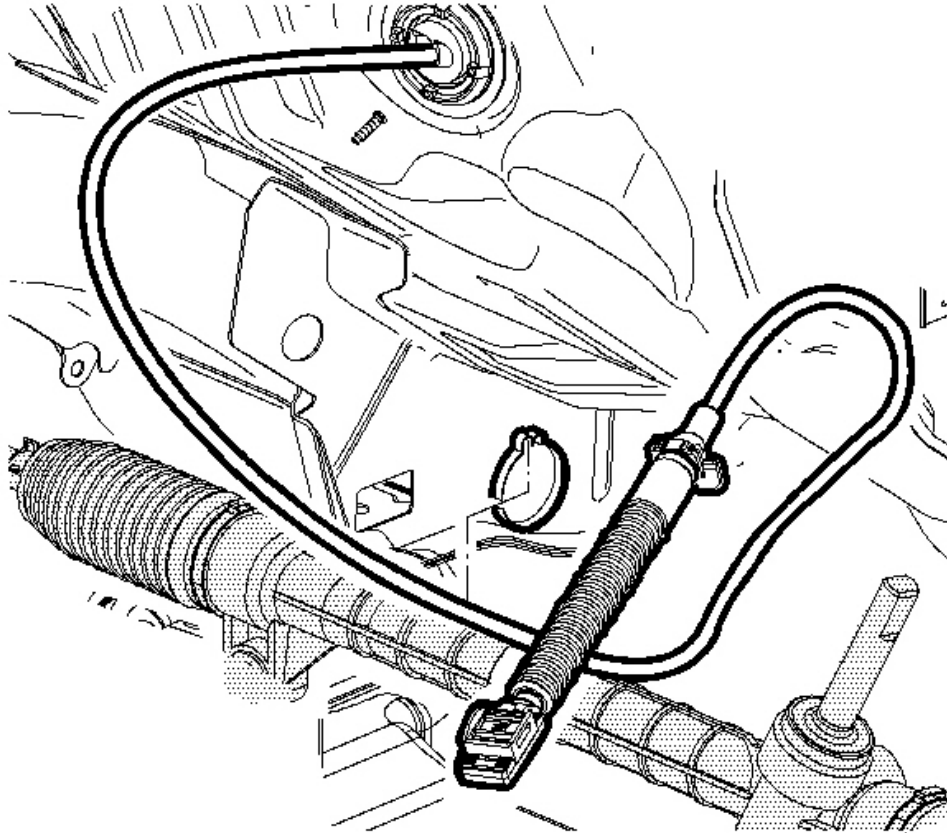
**Fig. 28: Steering Gear, Cradle & Mounting Bolts**  
Courtesy of GENERAL MOTORS CORP.

3. Center the gear mounting bushings into the cradle supports.

**NOTE:** Refer to Fastener Notice in Cautions and Notices.

4. Hand start both steering gear to cradle mounting bolts.

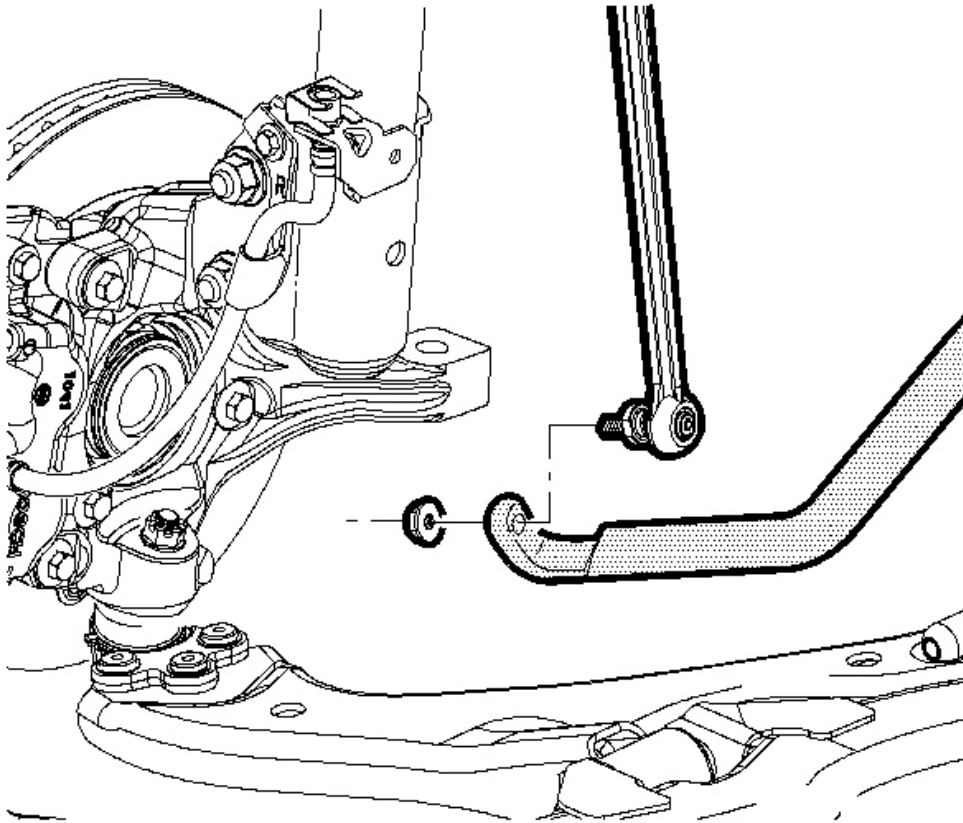
**Tighten:** Tighten the bolts to 110 N.m (81 lb ft).



**Fig. 29: Shift Cable Clip From The Steering Gear**  
Courtesy of GENERAL MOTORS CORP.

5. On CVT equipped vehicles, install the shift cable clip to the steering gear.
6. Connect the intermediate shaft to the steering gear and install a new pinch bolt.

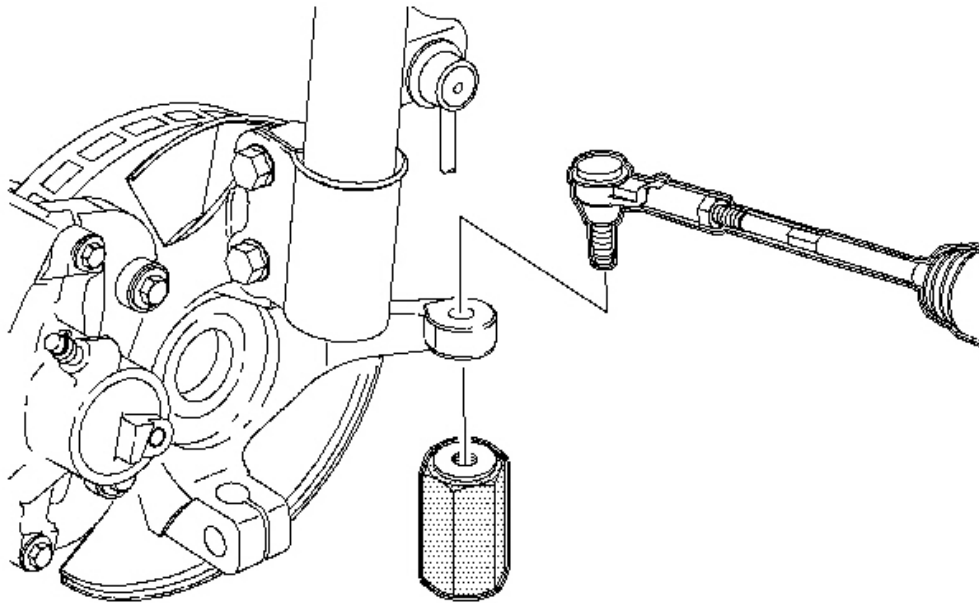
**Tighten:** Tighten the intermediate pinch bolt to 34 N.m (25 lb ft).



**Fig. 30: Locating Rod & Bar**  
Courtesy of GENERAL MOTORS CORP.

7. Connect the stabilizer links to the stabilizer bar. Refer to **Stabilizer Shaft Link Replacement** in Front Suspension.

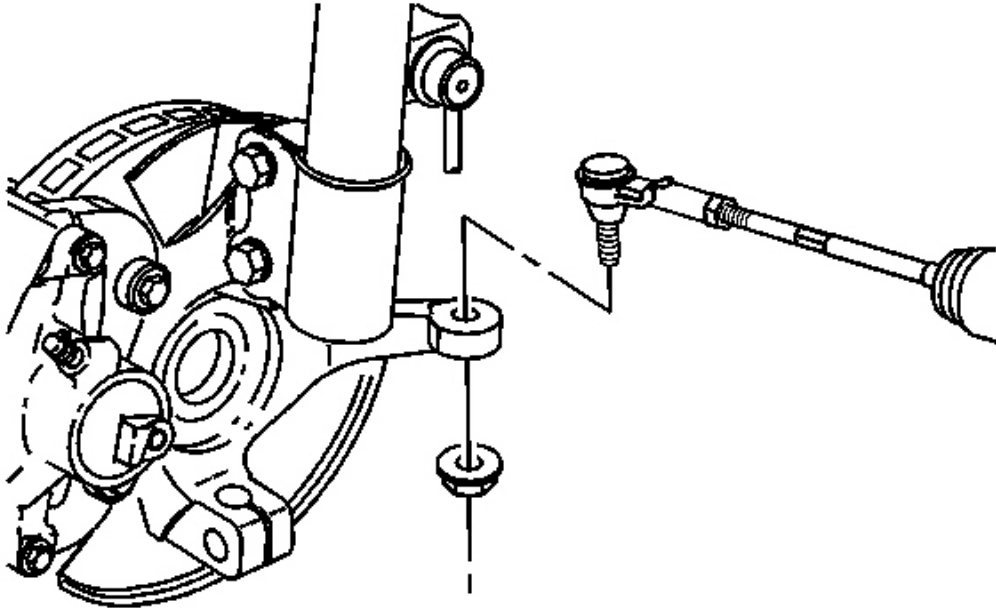




**Fig. 31: Tie Rod, Knuckle & Ball Stud Taper**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT:** Hold the ball stud to prevent turning during installation of the nut.

8. Using the **J 44015** , seat the ball stud taper to 40 N.m (30 lb ft).



**Fig. 32: Tie Rod To Knuckle View**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT:** Hold the ball stud to prevent turning during installation of the nut.

9. Remove the **J 44015** and install a new nuts.

**Tighten:** Tighten the nut to 60 N.m (44 lb ft).

10. Install the front tires and wheels. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
11. Check the front wheel alignment and align as necessary. Refer to **Measuring Wheel Alignment** in Wheel Alignment.
12. Lower the vehicle.

## DESCRIPTION AND OPERATION

### POWER STEERING SYSTEM DESCRIPTION AND OPERATION

The electric power steering (EPS) system reduces the amount of effort needed to steer the vehicle. The system uses the body control module (BCM), power steering control module (PSCM), torque sensor, discrete battery

voltage supply circuit, EPS motor, serial data bus, and the instrument panel cluster (IPC) message center to perform the system functions. The PSCM, torque sensor, nor the EPS motor are serviced separately from each other or from the steering column. Ant EPS components diagnosed to be malfunctioning requires replacement of the steering column assembly, also known as the EPS assembly.

### **Torque Sensor**

The PSCM uses a torque sensor as it's main input for determining the amount of steering assists. The steering column has an input shaft, from the steering wheel to the torque sensor, and an output shaft, from the torque sensor to the steering shaft coupler. The input and output shafts are separated by a torsion bar, where the torque sensor is located. The sensor consists of a compensation coil, detecting coil, and 3 detecting rings. These detecting rings have toothed edges that face each other. Detecting ring 1 is fixed to the output shaft, detecting rings 2 and 3 are fixed to the input shaft. The detecting coil is positioned around the toothed edges of detecting rings 1 and 2. As torque is applied to the steering column shaft the alignment of the teeth between detecting rings 1 and 2 changes, which causes the detecting coil signal voltage to change. The PSCM recognizes this change in signal voltage as steering column shaft torque. The compensation coil is used to compensate for changes in electrical circuit impedance due to circuit temperature changes from electrical current and voltage levels as well as ambient temperatures for accurate torque detection.

### **EPS Motor**

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

### **Power Steering Control Module (PSCM)**

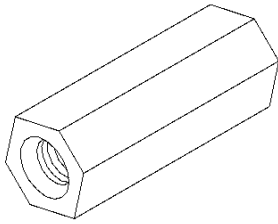
The PSCM uses a combination of torque sensor inputs, vehicle speed, calculated system temperature and the steering calibration to determine the amount of steering assist. When the steering wheel is turned, the PSCM uses signal voltage from the torque sensor to detect the amount of torque being applied to the steering column shaft and the amount of current to command to the EPS motor. The PSCM receives serial data from the engine control module (ECM) to determine vehicle speed. At low speeds more assist is provided for easy turning during parking maneuvers. At high speeds, less assist is provided for improved road feel and directional stability. The PSCM nor the EPS motor are designed to handle 65 amps continuously. The PSCM will go into overload protection mode to avoid system thermal damage. In this mode the PSCM will limit the amount of current commanded to the EPS motor which reduces steering assist levels. The PSCM also chooses which steering calibration to use when the ignition is turned ON, based on the VIN. The PSCM contains all 8 of the steering calibrations which are different in relation to the vehicles RPO's. The PSCM has the ability to detect malfunctions within the EPS system. Any malfunction detected will cause the IPC message center to display the PWR STR (or Power Steering) warning message.

## **SPECIAL TOOLS AND EQUIPMENT**

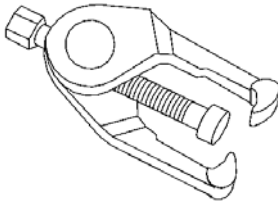
### **SPECIAL TOOLS**

#### **Special Tools**

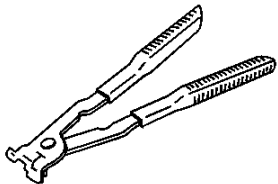
<b>Illustration</b>	<b>Tool Number/ Description</b>



J 44015  
Tie Rod Installer



SA91100C  
Tie Rod Separator



SA9164C  
Clamp Pliers