

2017 STEERING

Power Steering - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

Application
NOTE: <i>All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.</i>
Steering Gear Boot Inner Clamp

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: <i>All fasteners listed in this table can be reused after removal.</i>	
Steering Gear Bolt	
• First Pass:	100 N.m (74 lb ft)
• Final Pass:	45 - 60 Degrees
Steering Linkage Inner Tie Rod	80 N.m (59 lb ft)
Steering Linkage Inner Tie Rod Nut	75 N.m (55 lb ft)
Steering Linkage Outer Tie Rod Nut	
• First Pass:	30 N.m (22 lb ft)
• Final Pass:	120 - 130 Degrees

SCHEMATIC WIRING DIAGRAMS

POWER STEERING WIRING SCHEMATICS

Power Steering

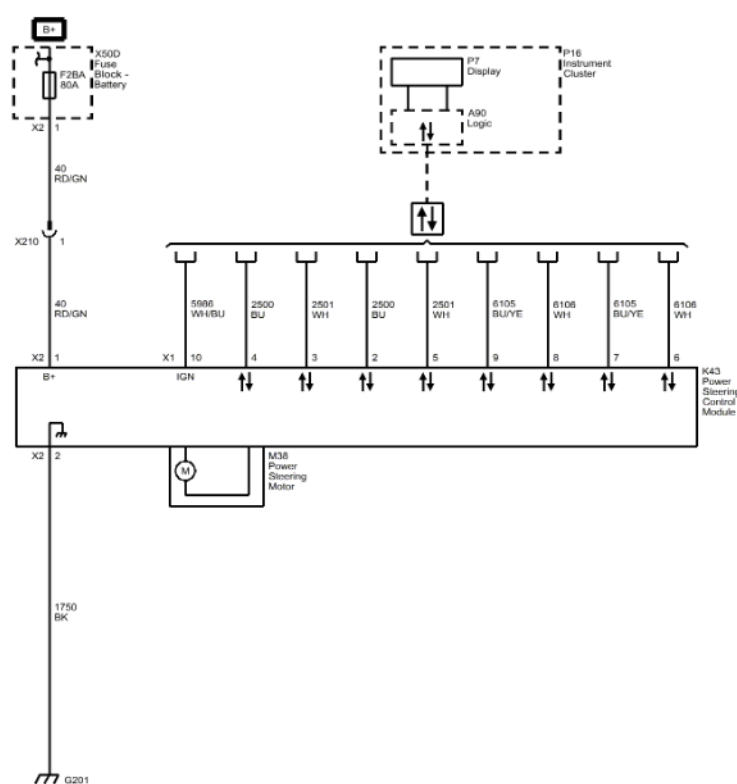


Fig. 1: Power Steering

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC C0176: CONTROL MODULE TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C0176

Control Module Temperature Sensor

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

For an overview of the component/system, refer to: [Power Steering System Description and Operation](#)

Conditions for Running the DTC

- Ignition = On/Vehicle = Service Mode
- Engine = Running
- System Voltage = 9 to 16 V

Conditions for Setting the DTC

Power Steering Control Module Temperature = 115 to 125Â°C (240 to 257Â°F)

Actions Taken When the DTC Sets

Conditions for Clearing the DTC

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

Diagnostic Aids

This DTC does not indicate any system malfunction. To avoid thermal damage, the power steering control module limits the current to the power steering motor. Aggressive steering may cause reduced steering assist. Discuss with the customer about the driving conditions when the concern occurred.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References

Circuit/System Verification

NOTE: A DTC may set depending on certain driving conditions and would not require a component replacement. Aggressive steering may cause reduced steering assist. Discuss with the customer about the driving conditions when the concern occurred.

1. Operate the vehicle within the Conditions for Running the DTC. Verify the DTC does not set.
 - **If the DTC sets**
 1. Ignition/Vehicle - Off
 2. Verify the following conditions do not exist: Steering = Binding or Sticking
 - If a condition exists - Refer to: [Steering Effort Hard or Too Easy in One or Both Directions](#)
 - If no condition exists - Replace the component: K43 Power Steering Control Module
 - **If the DTC is not set**
2. All OK.

Repair Instructions

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

- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC C0460: STEERING WHEEL ANGLE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C0460

Steering Wheel Angle Sensor

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

For an overview of the component/system, refer to: [ABS Description and Operation](#)

Conditions for Running the DTC

- K17 Electronic Brake Control Module = During control module power up
- Ignition Voltage = Greater than 8 V
- Vehicle Speed = Greater than 20 km/h (12 MPH)

Conditions for Setting the DTC

C0460 4B

Steering Wheel Angle Sensor = Calibration Not Learned

C0460 58

Steering Wheel Angle Sensor = Performance

C0460 5A

Steering Wheel Angle Sensor Signal = Not Plausible

Action Taken When the DTC Sets

Active Return and Software Endstops = Not Available

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Circuit/System Verification

C0460 4B

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC C0460 is not set.
 - **If the DTC is set**
 1. Perform the following procedure/test: [Power Steering Control Module Calibration](#)
 2. Verify the DTC does not set.
 - If the DTC sets - Replace the component: Steering Column
 - If the DTC is not set
 3. All OK.
 - **If the DTC is not set**
3. All OK.

C0460 58

NOTE: Inspect the electrical connectors and the ground circuits of the component for poor connections.

- 1.
2. Ignition - On / Vehicle - In Service Mode
3. Verify DTC C0460 58 is not set.
 - **If the DTC is set**

Replace the component: Steering Gear
 - **If the DTC is not set**
4. Ignition/Vehicle - On
5. Rotate the steering wheel from left to right. Verify the scan tool parameter: Steering Wheel Angle - Increase or Decrease
 - If the parameter value does not change

Replace the component: Steering Gear
 - If the parameter value changes
6. All OK.

C0460 5A

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC C0460 5A is not set.
 - **If the DTC is set**
 1. Verify the following conditions do not exist: Front wheel alignment - Incorrect adjustment - Refer to: [Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment](#)
 2. Verify the scan tool parameter: Steering Wheel Angle = 0 degrees
 - **If not 0°**
 3. Perform the following procedure/test: [Power Steering Control Module Calibration](#)
 4. Verify the DTC does not set.
 - If the DTC sets - Replace the component: Steering Gear
 - If the DTC does not set
 5. All OK.
 - **If 0°**
3. All OK.

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

[Steering Column Replacement](#)

For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC C0545: STEERING WHEEL TORQUE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C0545

Steering Wheel Torque Sensor

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

For an overview of the component/system, refer to: [Power Steering System Description and Operation](#)

Conditions for Running the DTC

Ignition = On

Conditions for Setting the DTC

- Steering Wheel Torque Sensor = Short to Ground
- Steering Wheel Torque Sensor = Short to Voltage
- Steering Wheel Torque Sensor = Open/High Resistance

Action Taken When the DTC Sets

Power Steering Output Torque = Disabled

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

[Power Steering Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

NOTE: **Inspect the electrical connectors and the ground circuits of the component for poor connections.**

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC C0545 is not set.
 - **If the DTC is set**
 1. Rotate the steering wheel from left to right. Verify the scan tool parameter: Steering Input Torque - Increase
 - If the parameter value does not change

Replace the component: Steering Column
 - If the parameter value changes
 2. All OK.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

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

- [Steering Column Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC C056E: ELECTRONIC CONTROL UNIT SOFTWARE

Diagnostic Instructions

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

DTC Descriptors

DTC C056E

Electronic Control Unit Software

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

Circuit/System Description

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

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

Conditions for Running the DTC

Ignition OFF, ACCESSORY, or RUN mode.

Conditions for Setting the DTC

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

Actions Taken When DTC Sets

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

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Steering System Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

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

Repair Instructions

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

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

SYMPTOMS - POWER STEERING SYSTEM

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

Operation.

Visual/Physical Inspection

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

Symptoms List

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

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

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

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

WHINE OR GROWL NOISE FROM THE POWER STEERING SYSTEM

Step	Action	Yes	No
1	Did you review the Power Steering System Symptoms and perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Power Steering System</u> .
2	Verify that a whine or a growl noise is present. Is a whine or a growl noise present?	Go to Step 3	System OK

Step	Action	Yes	No
3	Inspect the power steering gear for the proper installation. Refer to Steering Gear Replacement . Is the power steering gear installation incorrect?	Go to Step 6	Go to Step 4
4	Inspect the intermediate shaft. Is the intermediate shaft worn?	Go to Step 8	Go to Step 5
5	Inspect the suspension. Is the suspension worn?	Go to Step 7	Go to Noise Diagnosis - Front Suspension .
6	Install the power steering gear correctly. Refer to Steering Gear Replacement . Did you complete the repair?	Go to Step 9	-
7	Replace the worn suspension components. Did you complete the repair?	Go to Step 9	-
8	Replace the intermediate 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

INCREASE IN EFFORT WHILE TURNING STEERING WHEEL

Step	Action	Yes	No
1	Did you review the Power Steering System Description and Operation and perform the necessary inspections?	Go to Step 2	Go to Power Steering System Description and Operation
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 conditions: • Incorrect tire inflation - Refer to Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label . • 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 Lifting and Jacking the Vehicle . 2. Check for a binding or worn steering linkage outer tie rod. Is the tie rod binding or worn?	Go to Step 7	Go to Step 5
5	Check for a worn or binding intermediate steering shaft. Is the intermediate steering 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 steering linkage outer tie rod. Refer to Steering Linkage Outer Tie Rod Replacement . Did you complete the repair?	Go to Step 10	-
8	Replace the intermediate steering shaft. Refer to Intermediate Steering Shaft Replacement . Did you complete the repair?	Go to Step 10	-

Step	Action	Yes	No
9	Replace the steering gear. Refer to Steering Gear Replacement . 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	Go to Step 3

POOR RETURN OF STEERING WHEEL

Step	Action	Yes	No
DEFINITION: After completing a turn, extra steering input is required for the steering wheel to return to center.			
1	Did you review the General Description and perform the necessary inspections?	Go to Step 2	Go to Power Steering System Description and Operation
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 Lifting and Jacking the Vehicle. 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. Refer to Intermediate Steering Shaft Replacement . Did you find and complete the repair?	Go to Step 12	Go to Step 7

Step	Action	Yes	No
7	1. Remove the front tire and wheel assemblies. Refer to Tire and Wheel Removal and Installation. 2. Disconnect both outer tie rod ends from the steering knuckles. 3. Use your hands in order to move the tie rod end studs. 4. If abnormally difficult to move, replace the tie rod end. Refer to Steering Linkage Outer Tie Rod Replacement. 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. Refer to Steering Gear Replacement. 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. Refer to Steering Column Replacement. Did you find and complete the repair?	Go to Step 12	-
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	-

STEERING WHEEL SURGES/JERKS WHILE TURNING

Step	Action	Yes	No
1	Did you perform the Diagnostic Starting Point - Power Steering System?	Go to Step 2	Go to Symptoms - Power Steering System
2	Verify that the steering wheel surges/jerks while turning. Does the system operate normally?	System OK	Go to Step 3
3	Check for worn or binding front suspension components. Did you find and correct the condition?	Go to Step 14	Go to Step 4
4	1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle. 2. Check for a binding or worn rack and pinion outer tie rod end. Is the rack and pinion outer tie rod end binding or worn?	Go to Step 10	Go to Step 5

Step	Action	Yes	No
5	Check for a worn or binding intermediate steering shaft. Is the intermediate steering shaft worn or binding?	Go to Step 11	Go to Step 6
6	Check for a worn or binding steering gear. Is the steering gear worn or binding?	Go to Step 12	Go to Step 7
7	Check for a worn or binding steering column. Is the steering column worn or binding?	Go to Step 13	Go to Step 8
8	Check for excessive heat in the electric power steering (EPS) motor. Does the EPS motor appear to be overheated?	Go to Step 9	Go to Step 13
9	NOTE: Do not perform excessive parking lot maneuvers during testing, that can cause the EPS motor to heat up. Allow the EPS motor to cool and retest the system. Did you correct the condition?	Go to Step 14	Go to Step 13
10	Replace the steering linkage outer tie rod end. Refer to Steering Linkage Outer Tie Rod Replacement . Did you complete the repair?	Go to Step 14	-
11	Replace the intermediate steering shaft. Refer to Intermediate Steering Shaft Replacement . Did you complete the repair?	Go to Step 14	-
12	Replace the steering gear. Refer to Steering Gear Replacement . Did you complete the repair?	Go to Step 14	-
13	Replace the steering column. Refer to Steering Column Replacement . Did you complete the repair?	Go to Step 14	-
14	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

STEERING EFFORT HARD OR TOO EASY IN ONE OR BOTH DIRECTIONS

Condition	Action
The battery power is low.	Ensure proper battery voltage.
One or both of the intermediate steering shaft boots are binding.	Adjust or replace the intermediate steering shaft boots and/or intermediate steering shaft. Refer to Intermediate Steering Shaft Inner Boot Replacement , and Intermediate Steering Shaft Replacement .
The intermediate steering shaft joints and/or fasteners are worn or binding.	Tighten or replace the intermediate steering shaft joints and/or fasteners. Refer to Intermediate Steering Shaft Replacement .
The steering gear is binding.	Replace the steering gear. Refer to Steering Gear Replacement .
The upper steering shaft is bent.	Replace the steering column. Refer to Steering Column Replacement .
The connectors to the power steering 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 power steering control module is malfunctioning.	Confirm the DTC. Replace the steering column. Refer to Steering Column Replacement .
The power steering assist motor shaft is binding.	Confirm the DTC. Replace the steering column. Refer to Steering Column Replacement .

REPAIR INSTRUCTIONS

STEERING LINKAGE OUTER TIE ROD REPLACEMENT

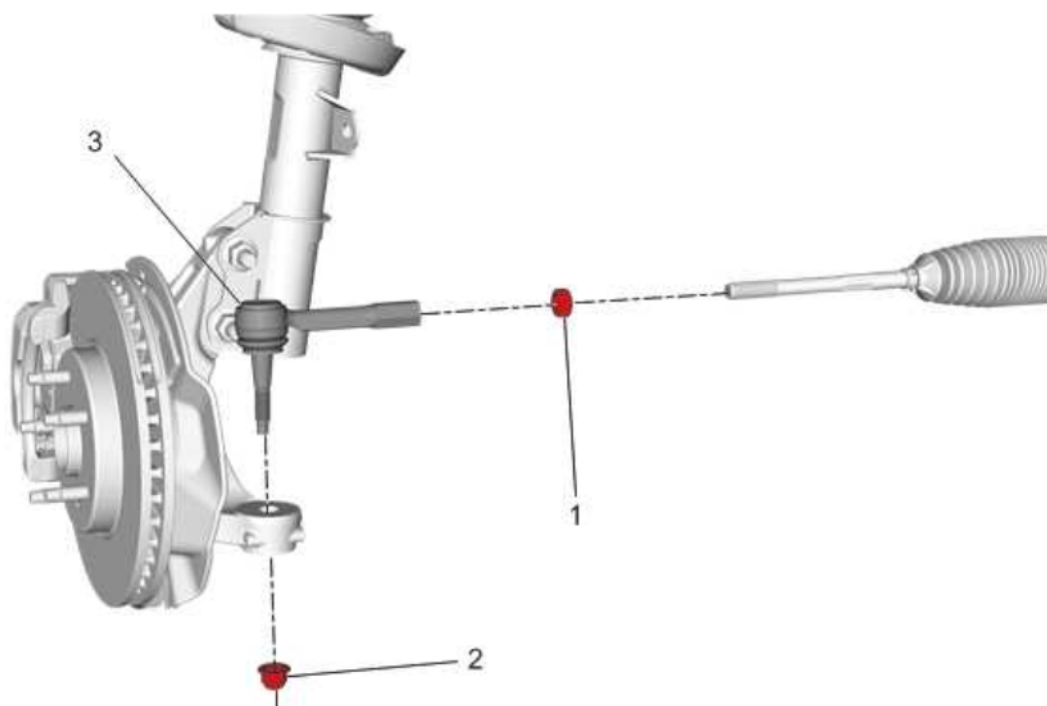


Fig. 2: Steering Linkage Outer Tie Rod

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Lifting and Jacking the Vehicle 2. Remove the front tire and wheel assembly. Tire and Wheel Removal and Installation	
1	Steering Linkage Inner Tie Rod Nut CAUTION: Refer to Fastener Caution . NOTE: Mark the position of the steering linkage inner tie rod nut before removing to aid in installation. Tighten 75 N.m (55 lb ft)
2	Steering Linkage Outer Tie Rod Nut Tighten 1. First Pass: 30 N.m (22 lb ft) 2. Final Pass: 120 - 130 Degrees

Callout	Component Name
3	Steering Linkage Outer Tie Rod Procedure NOTE: The CH-42188-B tie rod end joint / ball joint remover works by putting the nut back on. 1. Use CH-42188-B tie rod end joint / ball joint remover to separate the steering linkage outer tie rod from the steering knuckle. 2. Clean the tapered surface of the steering knuckle. 3. Inspect the steering linkage inner tie rod for bent or damaged threads. If necessary, replace the steering linkage inner tie rod. Steering Linkage Inner Tie Rod Replacement 4. Measure and adjust the front toe. Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment 5. Calibrate the steering angle sensor. Steering Wheel Angle Sensor Centering Special Tools CH-42188-B Tie Rod End Joint / Ball Joint Remover Equivalent regional tools: Special Tools

STEERING GEAR BOOT REPLACEMENT

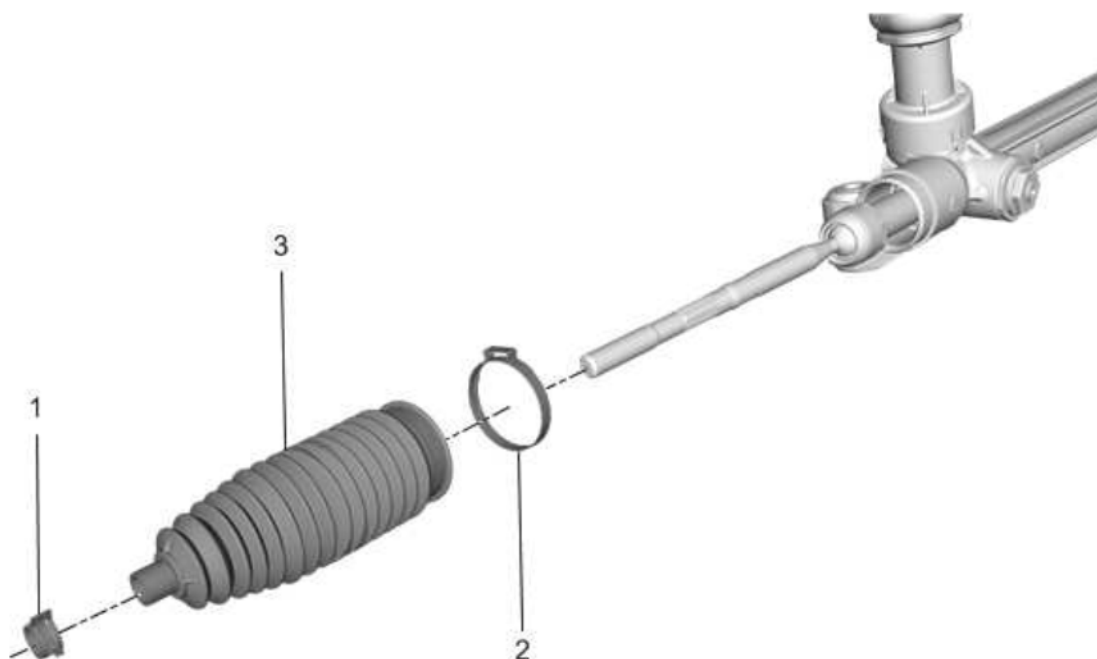


Fig. 3: Steering Gear Boot

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
	1. Automatic Transmission and Drivetrain and Front Suspension Frame Assembly - Remove - Drivetrain and Front Suspension Frame Removal and Installation 2. Steering Linkage Outer Tie Rod Replacement

Callout	Component Name
1	Steering Gear Boot Outer Clamp
2	Steering Gear Boot Inner Clamp Procedure 1. Cut the steering gear boot inner clamp and discard the clamp. 2. Use the CH-804 boot clamp plier to install a NEW steering gear boot inner clamp. Special Tools CH-804 Boot Clamp Plier Equivalent regional tools: Special Tools
3	Steering Gear Boot Procedure 1. Inspect the steering linkage inner tie rod for evidence of corrosion or contamination. If corrosion or contamination is evident, replace the steering linkage inner tie rod. Steering Linkage Inner Tie Rod Replacement 2. Install the inner boot clamp loosely onto the boot prior to installation. 3. Ensure the steering gear boot is seated in the appropriate groove on the steering gear before installing the steering gear boot clamp.

STEERING GEAR REPLACEMENT

Removal Procedure

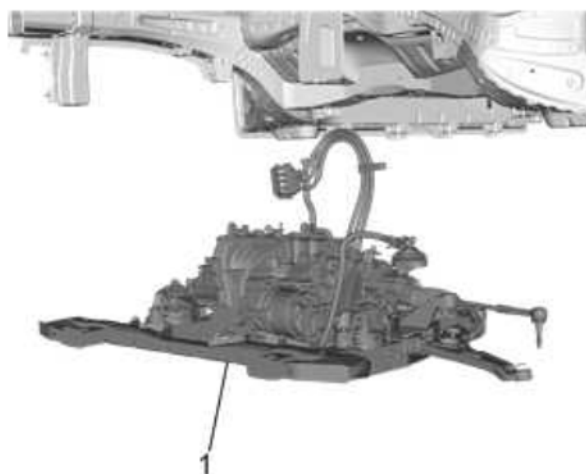


Fig. 4: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
 Courtesy of GENERAL MOTORS COMPANY

1. Automatic Transmission and Drivetrain and Front Suspension Frame Assembly - Remove - **Drivetrain and Front Suspension Frame Removal and Installation**

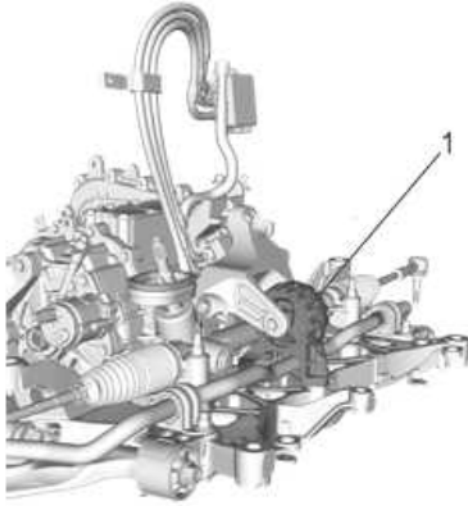


Fig. 5: Drive Motor Rear Mount

Courtesy of GENERAL MOTORS COMPANY

2. Drive Motor Rear Mount - Remove - [**Drive Motor Rear Mount Replacement**](#)

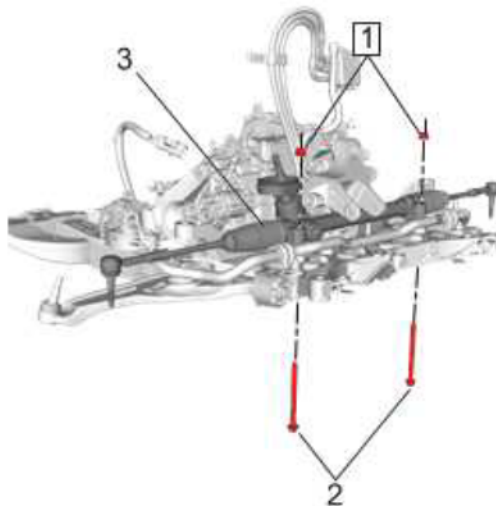


Fig. 6: Steering Gear Nut

Courtesy of GENERAL MOTORS COMPANY

3. Steering Gear Nut - Remove
4. Steering Gear Bolt - Remove
5. Rack and Pinion Steering Gear at Drivetrain and Front Suspension Crossmember - Remove

Installation Procedure

1. Transfer components as necessary.

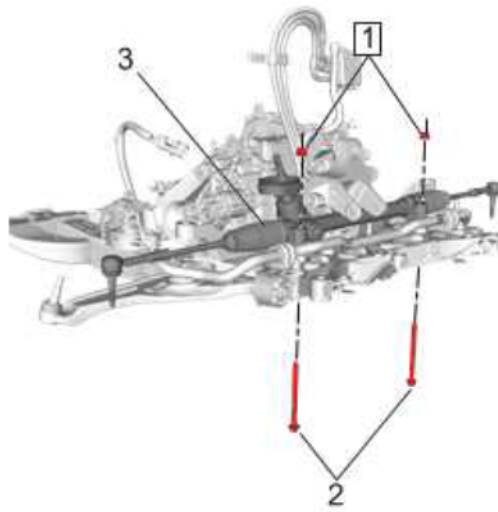


Fig. 7: Steering Gear Nut

Courtesy of GENERAL MOTORS COMPANY

2. Rack and Pinion Steering Gear at Drivetrain and Front Suspension Crossmember - Install
3. Steering Gear Bolt - Install
4. Steering Gear Nut - Install

CAUTION: Fastener Caution

5. Steering Gear Bolt - Tighten
 1. First Pass: 100 N.m (74 lb ft)
 2. Final Pass: 45 - 60 Degrees

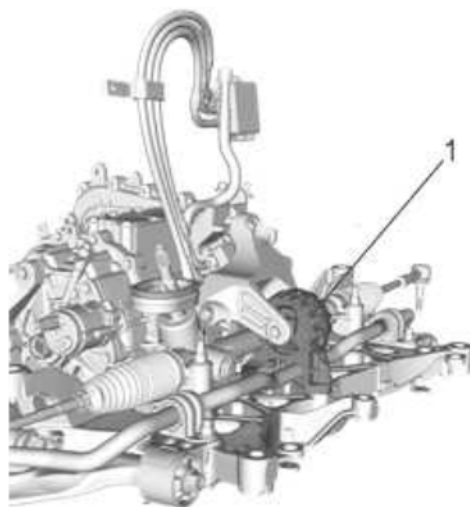


Fig. 8: Drive Motor Rear Mount

Courtesy of GENERAL MOTORS COMPANY

6. Drive Motor Rear Mount - Install - Drive Motor Rear Mount Replacement

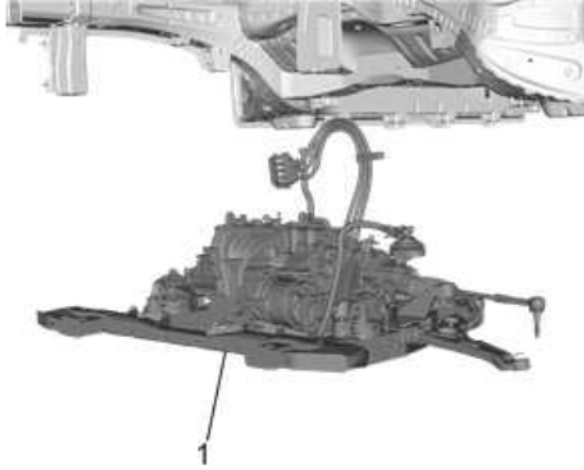


Fig. 9: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
 Courtesy of GENERAL MOTORS COMPANY

7. Automatic Transmission and Drivetrain and Front Suspension Frame Assembly - Install - [**Drivetrain and Front Suspension Frame Removal and Installation**](#)
8. Measure and adjust the front toe. [**Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment**](#)
9. Calibrate the steering angle sensor. [**Steering Wheel Angle Sensor Centering**](#)

STEERING LINKAGE INNER TIE ROD REPLACEMENT

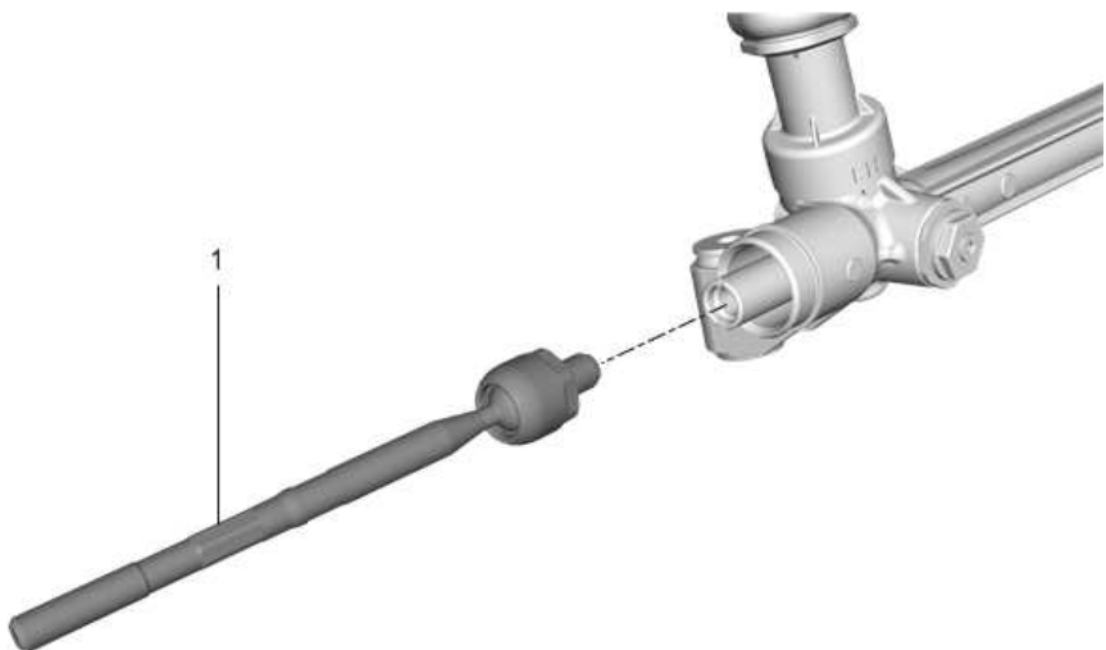


Fig. 10: Steering Linkage Inner Tie Rod
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

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Preliminary Procedures - Automatic Transmission and Drivetrain and Front Suspension Frame Assembly - Remove - Drivetrain and Front Suspension Frame Removal and Installation Steering Linkage Outer Tie Rod Replacement Steering Gear Boot Replacement	
1	Steering Linkage Inner Tie Rod CAUTION: Refer to Fastener Caution . Procedure - Place a wrench on the flats of the steering linkage inner tie rod housing. - Rotate the steering linkage inner tie rod housing counterclockwise to remove the steering linkage inner tie rod from the steering gear rack. - Rotate the steering linkage inner tie rod housing clockwise to install the steering linkage inner tie rod to the steering gear rack. - Use the CH-41240-2 wrench and a torque wrench to tighten the steering linkage inner tie rod to specification. - Measure and adjust the front toe. Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment Tighten 80 N.m (59 lb ft) Special Tools CH-41240-2 Wrench Equivalent regional tools: Special Tools

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 and may 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.

Internal Steering Angle Sensor Centering

NOTE: Ensure the front wheels are facing straight ahead before turning the engine off.

The centering procedure of the internal steering angle sensor can be completed with the following steps: cardiagn.com

Conditions: Front axle measured and set, engine off, 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. Rotate the steering wheel to the left until the endstop is reached and hold position for 2 seconds.
3. Rotate the steering wheel to the right until the endstop is reached and hold position for 2 seconds.
4. Return the steering wheel to the center position.
5. Software endstop learning procedure is completed.

DESCRIPTION AND OPERATION

POWER STEERING SYSTEM DESCRIPTION AND OPERATION

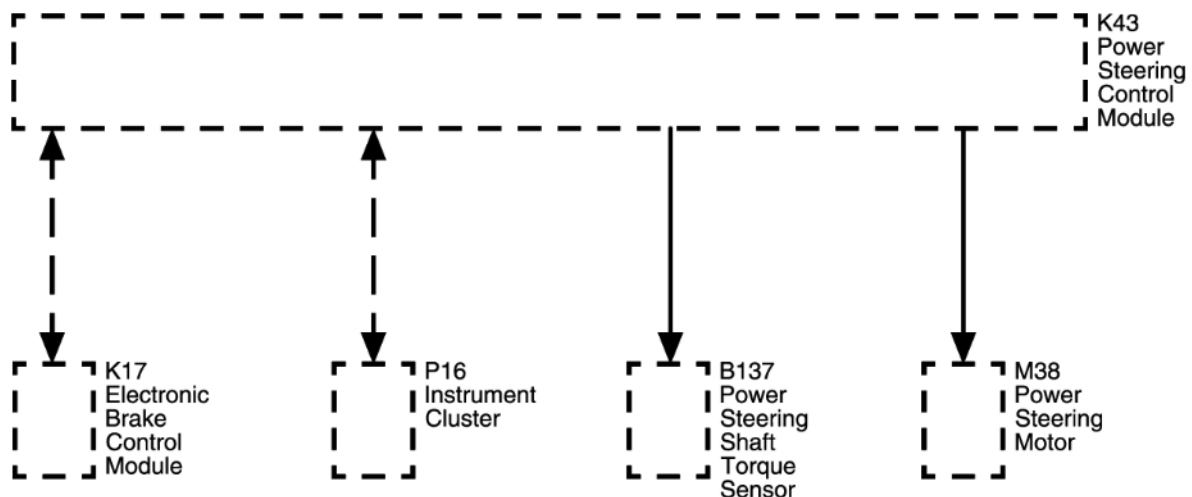


Fig. 11: Power Steering System Diagram

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
K43	K43 Power Steering Control Module
K17	K17 Electronic Brake Control Module
P16	P16 Instrument Cluster
B137	B137 Power Steering Shaft Torque Sensor
M38	M38 Power Steering Motor

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

supply circuit, electric power steering motor, serial data bus, and the instrument panel cluster message center to perform the system functions. Any electric power steering components diagnosed to be malfunctioning requires replacement of the steering column assembly, also known as the electric power steering assembly.

Torque Sensor

The power steering control module uses a torque sensor as it's main input for determining the amount of steering assist. 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 top 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 power steering control module 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 the electrical current and voltage levels as well as ambient temperatures for accurate torque detection.

EPS Motor

The electric power steering motor is a 12-volt brushed DC reversible motor. The motor assists steering through a worm shaft and reduction gear located in the steering column housing.

Power Steering Control Module

The power steering control module 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 power steering control module 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 electric power steering motor. The power steering control module receives serial data from the engine control module 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. In this mode the power steering control module will limit the amount of current commanded to the electric power steering motor which reduces steering assist levels. The power steering control module also chooses which steering calibration to use when the ignition is turned ON, based on the production map number stored in the body control module. The power steering control module contains all 8 of the steering calibrations which are different in relation to the vehicles RPOs. The power steering control module has the ability to detect malfunctions within the electric power steering system. Any malfunction detected will cause the instrument panel cluster message center to display a warning message.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description

Illustration	Tool Number/ Description
	CH 41240-2 J 41240-2 Wrench

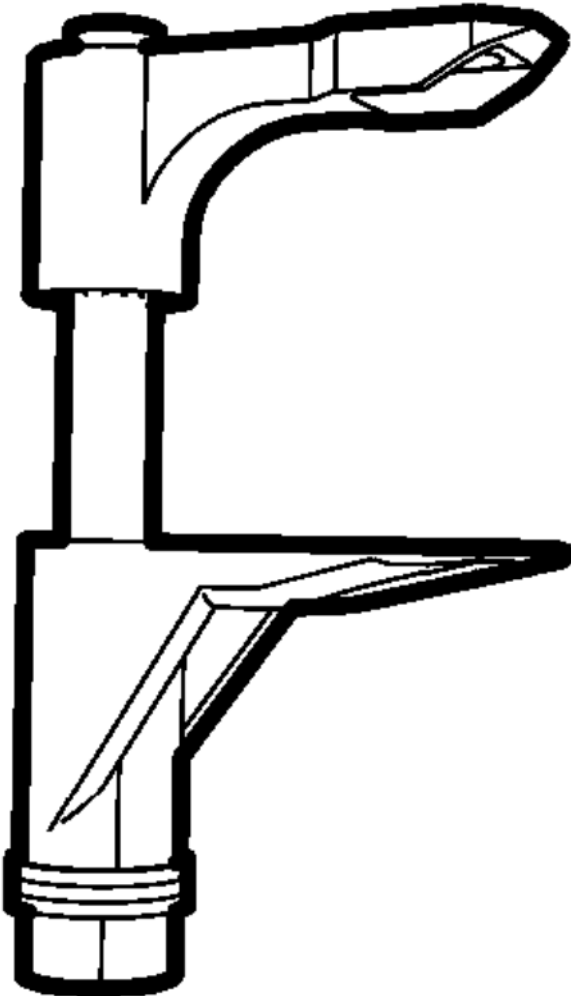
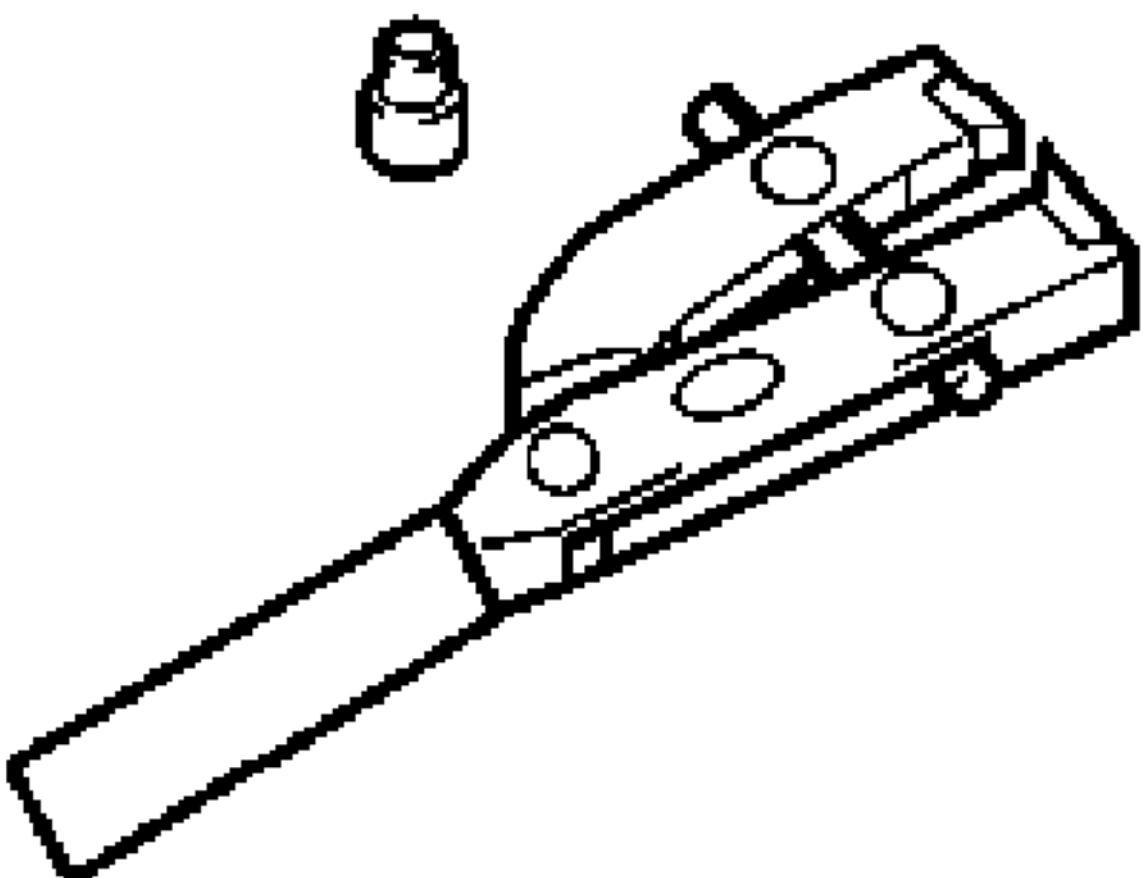
Illustration	Tool Number/ Description
	CH 42188-B J 42188-B CH 24319-B J 24319-B Tie Rod End Joint / Ball Joint Remover

Illustration	Tool Number/ Description
	CH 804 MKM 804 DT 35910 J 35910 Boot Clamp Plier