

2010 BRAKES

Antilock Brake System - Equinox & Terrain

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	Specification	
	Metric	English
Brake Pipe Fitting	21 N.m	16 lb ft
Brake Pressure Modulator Valve (BPMV) Bolt	10 N.m	89 lb in
BPMV Bracket Bolt	10 N.m	89 lb in
BPMV Bracket Nut	10 N.m	89 lb in
Electronic Brake Control Module (EBCM) Bolt	3 N.m	27 lb in
Wheel Speed Sensor Bolt - Front and Rear	10 N.m	89 lb in
Yaw Rate Sensor Nut	6 N.m	53 lb in

SCHEMATIC AND ROUTING DIAGRAMS

ANTILOCK BRAKE SYSTEM SCHEMATICS

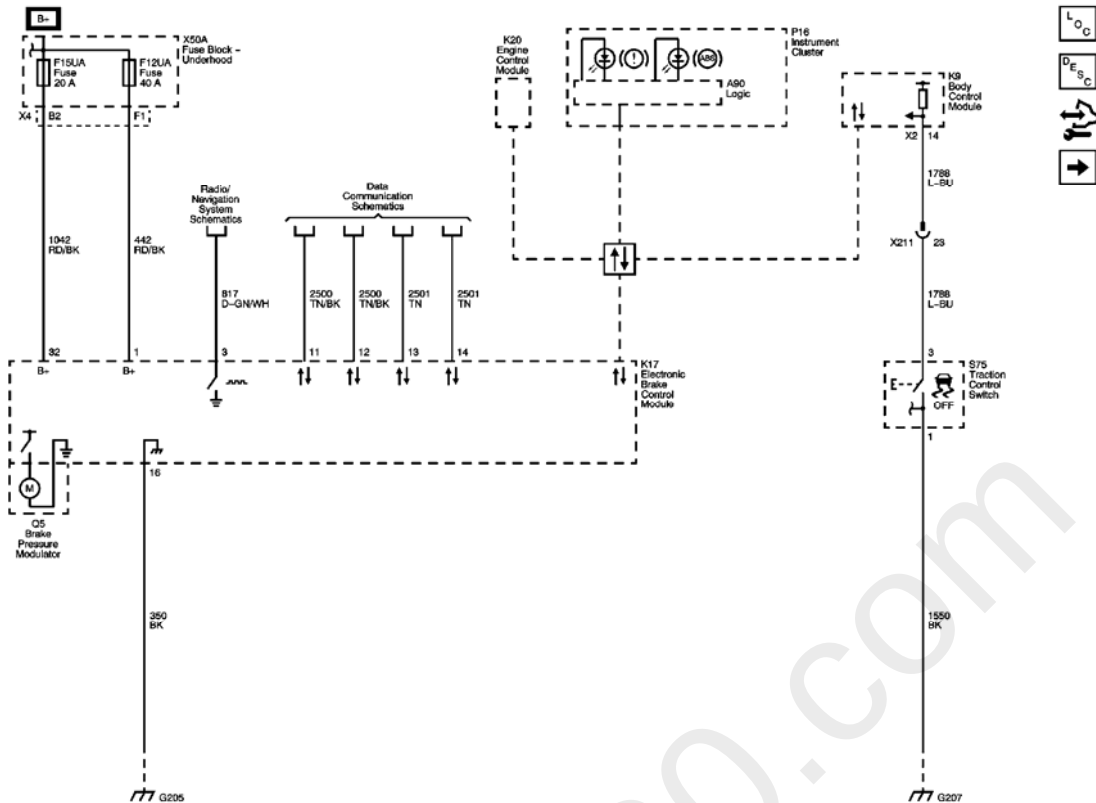


Fig. 1: Power, Ground, Serial Data, and Traction Control
 Courtesy of GENERAL MOTORS CORP.

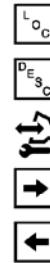
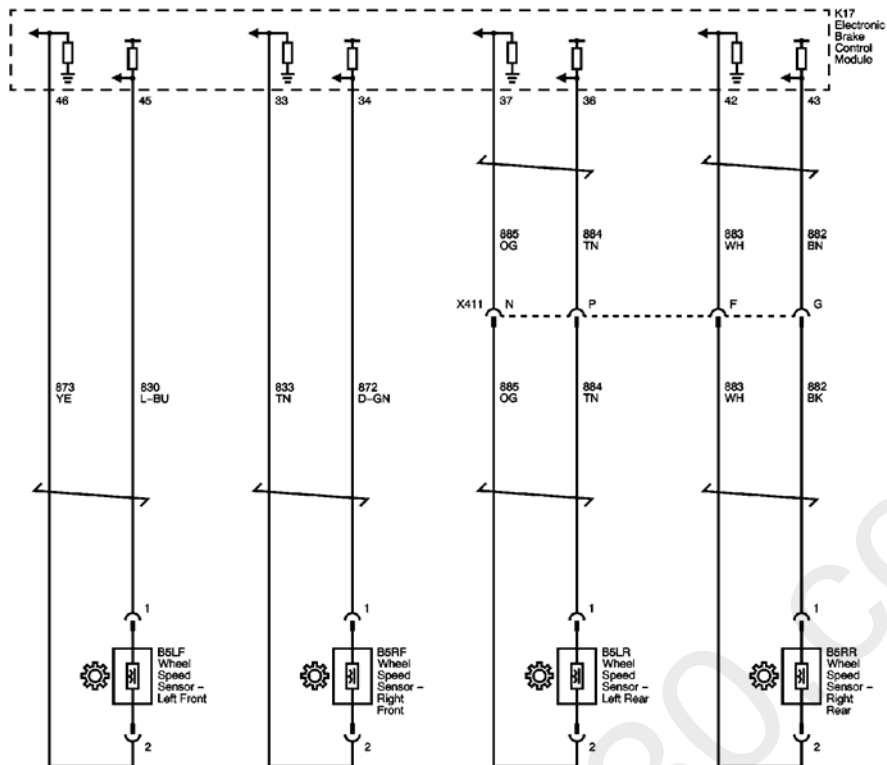


Fig. 2: Wheel Speed Sensors
 Courtesy of GENERAL MOTORS CORP.

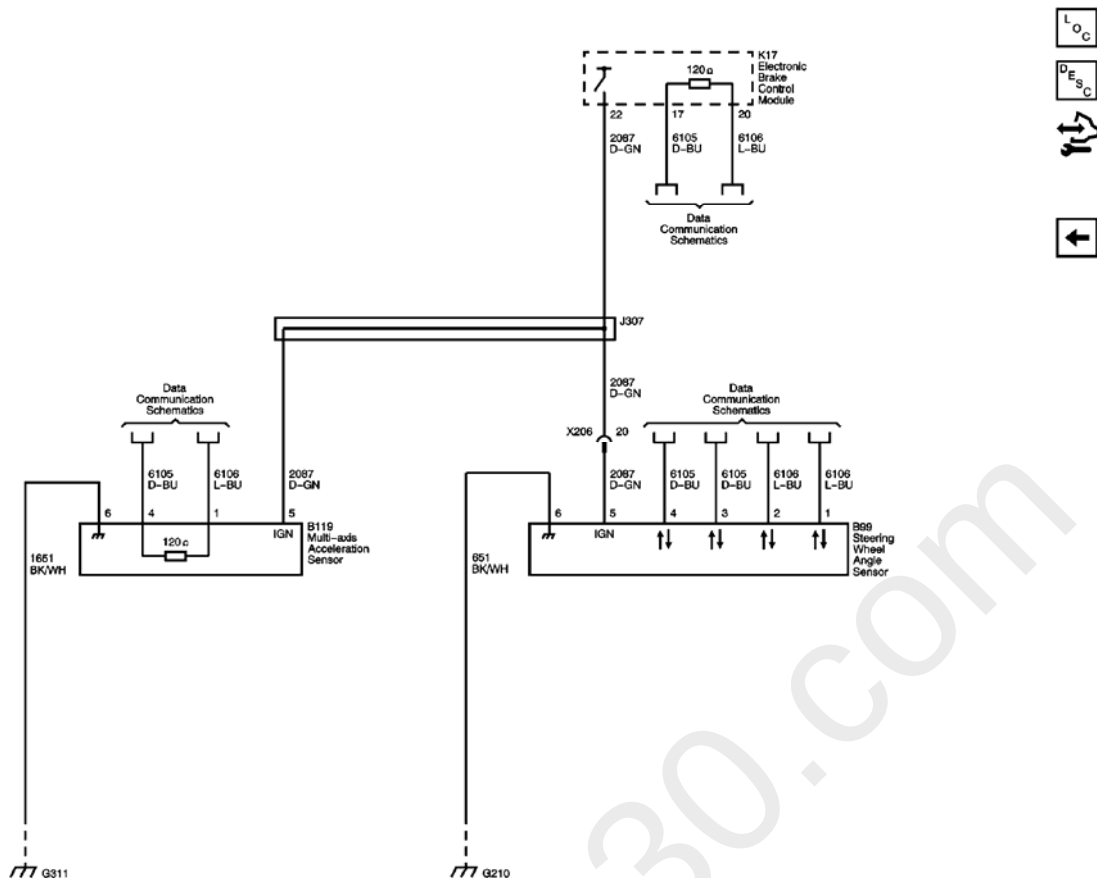


Fig. 3: Stability Controls

Courtesy of GENERAL MOTORS CORP.

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC B2745	B2745 02: Traction Control Switch Circuit Short to Ground
DTC C0000	C0000 71: Vehicle Speed Information Circuit Invalid Data
DTC C0035, C0040, C0045, or C0050	C0035 06: Left Front Wheel Speed Sensor Circuit Low Voltage/Open C0035 0F: Left Front Wheel Speed Sensor Circuit Signal Erratic C0035 18: Left Front Wheel Speed Sensor Circuit Low Signal Amplitude C0035 5A: Left Front Wheel Speed Sensor Circuit Not Plausible C0040 06: Right Front Wheel Speed Sensor Circuit Low Voltage/Open C0040 0F: Right Front Wheel Speed Sensor Circuit Signal Erratic C0040 18: Right Front Wheel Speed Sensor Circuit Low Signal Amplitude

	C0040 5A: Right Front Wheel Speed Sensor Circuit Not Plausible C0045 06: Left Rear Wheel Speed Sensor Circuit Low Voltage/Open C0045 0F: Rear Wheel Speed Sensor Circuit Signal Erratic C0045 18: Left Rear Wheel Speed Sensor Circuit Low Signal Amplitude C0045 5A: Left Rear Wheel Speed Sensor Circuit Not Plausible C0050 06: Right Rear Wheel Speed Sensor Circuit Low Voltage/Open C0050 0F: Right Rear Wheel Speed Sensor Circuit Signal Erratic C0050 18: Right Rear Wheel Speed Sensor Circuit Low Signal Amplitude C0050 5A: Right Rear Wheel Speed Sensor Circuit Not Plausible
<u>DTC C0110</u>	C0110 00: Pump Motor Circuit Malfunction C0110 04: Pump Motor Circuit Open C0110 61: Pump Motor Circuit Stuck
<u>DTC C0131</u>	C0131 00: Traction Control System Pressure Circuit Malfunction C0131 5A: Traction Control System Pressure Circuit Not Plausible
<u>DTC C0161</u>	C0161 5A: Antilock Braking System Brake Switch Circuit Not Plausible
<u>DTC C0186, C0196, C019B, or C0287</u>	C0186 5A: Lateral Acceleration Sensor Circuit Not Plausible C0186 71: Lateral Acceleration Sensor Circuit Invalid Data C0196 00: Yaw Rate Circuit Malfunction C0196 5A: Yaw Rate Signal Not Plausible C019B 5A: Yaw Rate Signal Not Plausible C0287 4B: Longitudinal Acceleration Sensor Circuit Calibration Not Learned C0287 5A: Longitudinal Acceleration Sensor Circuit Not Plausible C0287 71: Longitudinal Acceleration Sensor Circuit Invalid Data
<u>DTC C0280</u>	C0280 54: Stability System Active Too Long High Temperature
<u>DTC C056D</u>	C056D 00: Electronic Control Unit Hardware Malfunction C056D 39: Electronic Control Unit Hardware Internal Malfunction C056D 3B: Electronic Control Unit Hardware Self-Test Malfunction
<u>DTC C056E</u>	C056E 45: Electronic Control Unit Software Variant Not Programmed C056E 4A: Electronic Control Unit Software Programming Checksum Error C056E 5A: Electronic Control Unit Software Not Plausible
<u>DTC C0710</u>	C0710 42: Steering Position Signal Calibration Not Programmed C0710 5A: Steering Position Signal Not Plausible C0710 71: Steering Position Signal Invalid Data
<u>DTC P0856</u>	P0856 00: Traction Control Torque Request Circuit Malfunction

DTC B2745

Diagnostic Instructions

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

DTC Descriptor

DTC B2745 02

Traction Control Switch Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Traction Control Switch Signal	B2745 02	1	1	-
Traction Control Switch Ground	-	1	-	-
1. Traction Control Switch Malfunction				

Circuit/System Description

The body control module (BCM) monitors the traction control switch. When the traction control switch is pressed once, the BCM will request the electronic brake control module (EBCM) via serial data to disable the traction control. When the traction control switch is pressed for 5 seconds, the BCM will request the EBCM to disable the stability control. The EBCM will request the instrument cluster via serial data to turn the traction control off and stability control off indicator ON to notify the driver of the deactivation.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The BCM detects a short to ground on the signal circuit.

Action Taken When the DTC Sets

The BCM ignores the traction control switch signal input.

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS 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

Observe the scan tool BCM Traction Control Switch parameter while pressing and releasing the traction control switch. The reading should change between Active and Inactive.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the S48C Multi-Function Switch - Instrument Panel 1.
2. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Test for less than 10 ohms between the ground circuit terminal 1 and ground.
 - If greater than the specified value, test the ground circuit for an open/high resistance.
3. Ignition ON, verify the scan tool BCM Traction Control Switch parameter is Inactive.
 - If not the specified value, test the signal circuit for a short to ground. If the circuit tests normal, replace the K9 Body Control Module.
4. Install a 3 A fused jumper wire between the signal circuit terminal 3 and ground.
5. Verify the scan tool BCM Traction Control Switch parameter is Active.
 - If not the specified value, test the signal circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the K9 Body Control Module.
6. If all circuits test normal, test or replace the S48C Multi-Function Switch - Instrument Panel 1.

Component Testing

Static Test

1. Ignition OFF, disconnect the harness connector at the S48C Multi-Function Switch - Instrument Panel 1.
2. Test for infinite resistance between the signal circuit terminal 3 and the ground circuit terminal 1 with the switch in the released position.
 - If less than the specified value, replace the S48C Multi-Function Switch - Instrument Panel 1.
3. Test for less than 5 ohms between the signal circuit terminal 3 and the ground circuit terminal 1 with the

switch in the pressed position.

- If greater than the specified value, replace the S48C Multi-Function Switch - Instrument Panel 1.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Electronic Traction Control and Vehicle Stability Control Switch Replacement**
- **Control Module References** for BCM replacement, programming and setup

DTC C0000

Diagnostic Instructions

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

DTC Descriptor

DTC C0000 71

Vehicle Speed Information Circuit Invalid Data

Circuit/System Description

The wheel speeds are detected by active wheel speed sensors. Each wheel speed sensor receives a 12 V reference voltage from the electronic brake control module (EBCM) and provides an alternating current square wave signal to the EBCM. As the wheel spins, the EBCM uses the frequency of the square wave signal to calculate the wheel speed. The EBCM sends the wheel speed information as a high speed controller area network (CAN) serial data message. Modules connected to the high speed CAN circuit monitor for the vehicle speed information.

Conditions for Running the DTC

System voltage is between 9-16 V

Conditions for Setting the DTC

A supervised periodic message that includes the wheel speed serial data has not been received.

Action Taken When the DTC Sets

The electronic suspension control is disabled for the duration of the ignition cycle.

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS 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

Ignition ON, observe the scan tool EBCM Wheel Speed Sensor parameters. The reading should be the same speed on all sensors when driving in a straight line at a speed greater than 20 km/h (13 MPH).

Circuit/System Testing

1. Ignition ON, verify that DTC C0035, C0040, C0045, or C0050 are not present in the EBCM.
 - If any listed DTC is present, refer to **Diagnostic Trouble Code (DTC) List - Vehicle**
2. Replace the K19 Suspension Control Module and verify the DTC does not reset.
 - If the DTC resets, replace the K17 Electronic Brake Control Module (EBCM).

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

Control Module References for control module replacement, setup and programming

DTC C0035, C0040, C0045, OR C0050

Diagnostic Instructions

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

DTC Descriptor

DTC C0035 06

Left Front Wheel Speed Sensor Circuit Low Voltage/Open

DTC C0035 0F

Left Front Wheel Speed Sensor Circuit Signal Erratic

DTC C0035 18

Left Front Wheel Speed Sensor Circuit Low Signal Amplitude

DTC C0035 5A

Left Front Wheel Speed Sensor Circuit Not Plausible

DTC C0040 06

Right Front Wheel Speed Sensor Circuit Low Voltage/Open

DTC C0040 0F

Right Front Wheel Speed Sensor Circuit Signal Erratic

DTC C0040 18

Right Front Wheel Speed Sensor Circuit Low Signal Amplitude

DTC C0040 5A

Right Front Wheel Speed Sensor Circuit Not Plausible

DTC C0045 06

Left Rear Wheel Speed Sensor Circuit Low Voltage/Open

DTC C0045 0F

Rear Wheel Speed Sensor Circuit Signal Erratic

DTC C0045 18

Left Rear Wheel Speed Sensor Circuit Low Signal Amplitude

DTC C0045 5A

Left Rear Wheel Speed Sensor Circuit Not Plausible

DTC C0050 06

Right Rear Wheel Speed Sensor Circuit Low Voltage/Open

DTC C0050 0F

Right Rear Wheel Speed Sensor Circuit Signal Erratic

DTC C0050 18

Right Rear Wheel Speed Sensor Circuit Low Signal Amplitude

DTC C0050 5A

Right Rear Wheel Speed Sensor Circuit Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Front Wheel Speed Sensor 12 V Reference	C0035 06	C0035 06	C0035 06	C0035 0F, C0035 18, C0035 5A
Right Front Wheel Speed Sensor 12 V Reference	C0040 06	C0040 06	C0040 06	C0040 0F, C0040 18, C0040 5A
Left Rear Wheel Speed Sensor 12 V Reference	C0045 06	C0045 06	C0045 06	C0045 0F, C0045 18, C0045 5A
Right Rear Wheel Speed Sensor 12 V Reference	C0050 06	C0050 06	C0050 06	C0050 0F, C0050 18, C0050 5A
Left Front Wheel Speed Sensor Low Reference	C0035 06	C0035 06	C0035 06	C0035 0F, C0035 18, C0035 5A
Right Front Wheel Speed Sensor Low Reference	C0040 06	C0040 06	C0040 06	C0040 0F, C0040 18, C0040 5A
Left Rear Wheel Speed Sensor Low Reference	C0045 06	C0045 06	C0045 06	C0045 0F, C0045 18, C0045 5A
Right Rear Wheel Speed Sensor Low Reference	C0050 06	C0050 06	C0050 06	C0050 0F, C0050 18, C0050 5A

Component	Condition	DTCs
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Wheel Speed Sensor	• Physical damage • Debris on the wheel speed sensor or the encoder ring • Looseness • Air gap between the wheel speed sensor and the encoder ring too large • Water intrusion in the wiring harness	06, 0F, 18, 5A
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Circuit/System Description

The wheel speeds are detected by active wheel speed sensors and encoder rings. The encoder ring consists of permanent magnets. Each wheel speed sensor receives 12 V reference voltages from the electronic brake control module (EBCM). The wheel speed sensor produces changing current between 7-14 mA on the EBCM signal circuit. As the wheel spins, the EBCM uses the frequency of the square wave signal to calculate the actual wheel speed.

Conditions for Running the DTC

C0035 06 - C0050 06

Ignition ON

C0035 0F - C0050 0F

- Ignition ON
- Vehicle speed is greater than 35 km/h (22 mph)

C0035 18 - C0050 18

- Ignition ON
- Vehicle speed is greater than 10 km/h (6 mph)

C0035 5A - C0050 5A

- Ignition ON
- Vehicle speed is greater than 20 km/h (13 mph)

Conditions for Setting the DTC

C0035 06 - C0050 06

A short to voltage, short to ground or open/high resistance on the wheel speed sensor 12 V reference or low reference circuit is detected for 0.14 second.

C0035 0F - C0050 0F

An erratic wheel speed sensor signal is detected for 0.17 second.

C0035 18 - C0050 18

A missing wheel speed sensor signal is detected for 180 seconds.

C0035 5A - C0050 5A

Difference between fastest and slowest wheel speed is greater than 50% for 30 seconds.

Action Taken When the DTC Sets

- The EBCM disables the ABS, traction control, and stability control for the duration of the ignition cycle.
- The ABS indicator turns ON.
- The traction control/stability control-active indicator turns ON.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The EBCM will turn OFF the indicator in the next ignition cycle.

Diagnostic Aids

- Do not use a magnet to clean the encoder ring.
- If 2 or more wheel speed sensors are inoperative, diagnose each wheel speed sensor individually.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS 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

Ignition ON, driving in a straight line at a speed greater than 20 km/h (13 mph), observes the scan tool Wheel Speed Sensor parameters. The readings should be within 1 mph of each other.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the appropriate B5 wheel speed sensor.
2. Ignition ON, test for greater than 11 V between the signal circuit terminal 1 and ground.
 - If less than the specified range, test the signal circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the K17 EBCM.
3. Install a 3 A fused jumper wire at the signal circuit terminal 1. Verify the scan tool Wheel Speed Sensor parameter changes while rapidly tapping the fused jumper wire to the low reference circuit terminal 2.
 - If no change is observed, disconnect the harness connector at the K17 EBCM and test for the following conditions below. If all circuits test normal, replace the K17 EBCM.
 - Signal circuit for short to voltage.
 - Low reference circuit for a short to voltage, short to ground, or an open/high resistance.
4. If all circuits test normal, test or replace the B5 wheel speed sensor.

Component Testing

NOTE: **The following wheel speed sensor test is polarity sensitive. The wheel speed sensor can be permanently damaged if the polarity is reversed during the test.**

1. Ignition OFF, disconnect the harness connector at the appropriate B5 wheel speed sensor.
2. Connect a 3 A fused jumper wire between the signal terminal 1 and 12 V.
3. Connect a DMM set to read DC amperage between the low reference terminal 2 and ground.
4. Spin the wheel very slowly, test for a DC current switching between a low value of 4-8 mA and a high value of 11-16 mA.
 - If not within the specified range, replace the B5 wheel speed sensor.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Front Wheel Speed Sensor Replacement**
- **Rear Wheel Speed Sensor Replacement**
- **Control Module References** for EBCM replacement, setup and programming

DTC C0110

Diagnostic Instructions

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

DTC Descriptors

DTC C0110 00

Pump Motor Circuit Malfunction

DTC C0110 04

Pump Motor Circuit Open

DTC C0110 61

Pump Motor Circuit Stuck

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	C0110 00, C0110 61	C0110 00, C0110 61	-	-
Ground	-	C0110 00, C0110 61	-	-

Component	Condition	DTCs
Pump Motor	• Wear • Damage • Lock	C0110 61

Circuit/System Description

The pump motor is an integral part of the brake pressure modulator valve assembly, while the pump motor relay is integral to the electronic brake control module (EBCM). The pump motor relay is not engaged during normal system operation. When the ABS, traction control or stability control operation is required, the EBCM activates the pump motor relay and turns the pump motor ON.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

C0110 00

- An unintentional pump motor activation is detected for 1.785 s.
- An open/high resistance is detected on the pump motor B+ circuit for 1.8 s.

C0110 04

An unintentional pump motor activation is detected for 1.785 s.

C0110 61

- A short to ground or an open/high resistance is detected on the pump motor B+ circuit for 1.8 s.
- A faulty pump motor is detected.

Action Taken When the DTC Sets

- The EBCM disables the ABS, traction control and stability control for the duration of the ignition cycle.
- The ABS indicator turns ON.
- The traction control/stability control-active indicator turns ON.
- The brake warning indicator turns ON.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The EBCM will turn OFF the indicators in the next ignition cycle.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module (EBCM).
2. Test for less than 1 ohms between the ground circuit terminal 16 and ground.
 - If greater than the specified value, test the ground circuit for an open/high resistance.
3. Verify that a test lamp illuminates between the B+ circuit terminal 1 and ground.
 - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance.
4. Ignition OFF, remove the K17 Electronic Brake Control Module (EBCM) from the Q5 brake pressure modulator valve assembly.
5. Inspect the K17 Electronic Brake Control Module (EBCM) to Q5 brake pressure modulator valve assembly connector for damage, corrosion, or presence of brake fluid.
 - If connector corrosion or damage is diagnosed, replace the Q5 brake pressure modulator valve assembly and/or K17 Electronic Brake Control Module (EBCM) as necessary.
 - If brake fluid is present, replace the Q5 brake pressure modulator valve assembly and the K17 Electronic Brake Control Module (EBCM).
6. Connect the K17 Electronic Brake Control Module (EBCM) harness connector with the Q5 brake pressure modulator valve assembly still separated.
7. Connect a test lamp between the pump motor circuits terminals.
8. Ignition ON, command the ABS Pump Motor Increase and Decrease with a scan tool, verify the test lamp illuminates when commanded.
 - If test lamp does not illuminate, replace the K17 Electronic Brake Control Module (EBCM).
9. If all circuits test normal, replace the Q5 brake pressure modulator valve assembly and verify the DTC does not reset.
 - If the DTC resets, replace the K17 Electronic Brake Control Module (EBCM).

Repair Procedures

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Brake Pressure Modulator Valve Replacement
- Control Module References for EBCM replacement, programming and setup

DTC C0131

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.

- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C0131 00

Traction Control System Pressure Circuit Malfunction

DTC C0131 5A

Traction Control System Pressure Circuit Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	C0131 00	C0131 00	C0131 00	-
Signal	C0131 00	C0131 00	-	C0131 5A

Circuit/System Description

The brake pressure sensor is integral to the brake pressure modulator valve assembly. The electronic brake control module (EBCM) monitors the brake pressure sensor supply voltage and the signal voltage. The body control module (BCM) sends a serial data message when the brake pedal is applied.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

C0131 00

The brake pressure sensor signal is out of the specified range.

C0131 5A

- The EBCM detected an invalid or erratic brake pressure sensor signal.
- The brake pressure sensor signal is not plausible.
- The brake pressure sensor signal offset is out of specified range.

Action Taken When the DTC Sets

- The EBCM disables the traction control and stability control for the duration of the ignition cycle.
- The traction control/stability control-active indicator turns ON.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The EBCM will turn OFF the indicator in the next ignition cycle.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS 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

Ignition ON, observe the scan tool Brake Pressure Sensor parameter. The reading should be 0 V, when the brake pedal is released and greater than 1 V, when the brake pedal is applied.

Circuit/System Testing

1. Verify that DTC C0131 5A is not present.
 - If DTC C0131 5A is present, perform the **Brake Pressure Modulator Valve Pressure Sensor Calibration**.
2. Replace the Q5 brake pressure modulator valve assembly and verify the DTC does not reset.
 - If the DTC resets replace the K17 Electronic Brake Control Module (EBCM).

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Brake Pressure Modulator Valve Replacement**

- **Control Module References** for EBCM replacement, programming and setup

DTC C0161

Diagnostic Instructions

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

DTC Descriptor

DTC C0161 5A

Antilock Braking System Brake Switch Circuit Not Plausible

Circuit/System Description

The body control module (BCM) monitors the brake pedal position sensor and sends a serial data message when the brake pedal is applied. When the vehicle is stopping, the electronic brake control module (EBCM) monitors for the brake pedal applied serial data message from the BCM, with the brake pressure increasing and the vehicle slowing down, or when the vehicle is accelerating, the brake pedal is not applied and brake pressure is not increasing.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

- The EBCM detects 4 accelerations from standstill to a vehicle speed greater 40 km/h (26 MPH) without any brake light switch signal changes.
- The EBCM detects the vehicle speed is greater than 20 km/h (13 MPH), the brake pedal is applied for 360 s, and brake pressure is less than 15 bar (218 PSI).

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Action Taken When the DTC Sets

No actions were taken.

Diagnostic Aids

The DTC C0161 5A can be set if the brake pedal is applied while accelerating or the brake pedal position sensor is out of adjustment.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS 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

Ignition ON, observe the stop lamps while applying and releasing the brake pedal. Verify the stop lamps operate properly.

- If the stop lamps do not operate properly, refer to Symptoms - Lighting .

Circuit/System Testing

1. Ignition OFF, inspect the B22 Brake Pedal Position Sensor for correct installation.
 - If loose or incorrect installation is diagnosed, correct the installation of the component.
2. Ignition ON, perform the Brake Pedal Position Sensor Calibration and verify the DTC does not reset.
 - If the DTC resets, replace the K17 Electronic Brake Control Module (EBCM).

Repair Procedures

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Brake Pedal Position Sensor Replacement
- Control Module References for control module replacement, setup and programming

DTC C0186, C0196, C019B, OR C0287

Diagnostic Instructions

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

DTC Descriptors

DTC C0186 5A

Lateral Acceleration Sensor Circuit Not Plausible

DTC C0186 71

Lateral Acceleration Sensor Circuit Invalid Data

DTC C0196 00

Yaw Rate Circuit Malfunction

DTC C0196 5A

Yaw Rate Signal Not Plausible

DTC C019B 5A

Yaw Rate Signal Not Plausible

DTC C0287 4B

Longitudinal Acceleration Sensor Circuit Calibration Not Learned

DTC C0287 5A

Longitudinal Acceleration Sensor Circuit Not Plausible

DTC C0287 71

Longitudinal Acceleration Sensor Circuit Invalid Data

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance

12 V Reference	U0125	U0125	-	-
CAN Bus High Serial Data	U0073, U0100, U0101, U0125, U0126, U0140	U0073, U0100, U0101, U0125, U0126, U0140	U0073, U0100, U0101, U0125, U0126, U0140	C0186 5A, C0186 71, C0196 00, C0196 5A, C0287 5A, C0287 71,
CAN Bus Low Serial Data	U0073, U0100, U0101, U0125, U0126, U0140	U0073, U0100, U0101, U0125, U0126, U0140	U0073, U0100, U0101, U0125, U0126, U0140	C0186 5A, C0186 71, C0196 00, C0196 5A, C0287 5A, C0287 71,
Ground	-	U0125	-	-

Circuit/System Description

The yaw rate, lateral acceleration and longitudinal acceleration sensors are combined into one multi-axis acceleration sensor, external to the electronic brake control module (EBCM). The EBCM supplies a 12 V reference voltage to the multi-axis acceleration sensor. The multi-axis acceleration sensor communicates with the EBCM via the high speed controller area network (CAN) serial data circuit. The EBCM activates the stability control function depending on multi-axis acceleration sensor input.

Conditions for Running the DTC

Ignition ON

Conditions for Setting the DTC

C0186 5A

- The lateral acceleration sensor signal offset is out of specified range.
- The lateral acceleration sensor signal is not plausible with the yaw rate sensor signal, steering angle sensor signal and vehicle speed.

C0186 71

The EBCM received an invalid lateral acceleration sensor signal.

C0196 00

The yaw rate sensor signal is not plausible.

C0196 5A

- The yaw rate sensor offset is out of specified range.
- The yaw rate sensor signal is not plausible with the lateral acceleration sensor signal, steering angle sensor signal and vehicle speed.

C019B 5A

The yaw rate sensor signal is out of specified range.

C0287 4B

The longitudinal acceleration sensor signal offset is out of specified range.

C0287 5A

The longitudinal acceleration sensor signal is not plausible with the vehicle speed.

C0287 71

The EBCM received an invalid longitudinal acceleration sensor signal.

Action Taken When the DTC Sets

C0186 5A, C0186 71, C0196 00, C0196 5A, and C019B 5A

- The EBCM disables the stability control for the duration of the ignition cycle.
- The traction control/stability control-active indicator turns ON.

C0287 4B, C0287 5A, and C0287 71

The EBCM disables the hill start assist for the duration of the ignition cycle.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The EBCM will turn OFF the indicator in the next ignition cycle.

Diagnostic Aids

DTC C0186 and C0287 may set after replacing the Multi-Axis Acceleration Sensor if the sensor is not configured and setup. Perform the **Multi-Axis Acceleration Sensor Module Programming and Setup** and the **Vehicle Yaw Sensor Learn** procedures to complete the configuration and setup.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition ON, verify that DTC C0800 is not set.
 - If DTC is set, refer to Diagnostic Trouble Code (DTC) List - Vehicle.
2. Verify that DTC C0186 5A, C0196 00, C0196 5A, C019B 5A, C0287 4B, and C0287 5A is not set.
 - If DTC is set, perform the Multi-Axis Acceleration Sensor Module Programming and Setup and the Vehicle Yaw Sensor Learn prior to this diagnostic.
3. Inspect the B119 Multi-axis Acceleration Sensor for correct installation.
 - If loose or incorrect installation is diagnosed, correct the installation of the component and perform the Vehicle Yaw Sensor Learn.
4. Ignition OFF, disconnect the harness connector at the B119 Multi-axis Acceleration Sensor.
5. Test for less than 5 ohms between the ground circuit terminal 6 and ground.
 - If greater than the specified value, test the ground circuit for an open/high resistance.
6. Ignition ON, test for greater than 10 V between the 12 V reference circuit terminal 5 and ground.
 - If less than the specified value, test the 12 V reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the K17 Electronic Brake Control Module (EBCM).
7. If all circuits test normal, replace the B119 Multi-axis Acceleration Sensor and verify the DTC does not reset.
 - If the DTC resets, replace the K17 Electronic Brake Control Module (EBCM).

Repair Procedures

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Vehicle Yaw Sensor Replacement
- Control Module References for EBCM replacement, programming and setup

DTC C0280

Diagnostic Instructions

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

DTC Descriptor

DTC C0280 54

Stability System Active Too Long High Temperature

Circuit/System Description

The solenoid valves are integral parts of the brake pressure modulator valve assembly. The brake pressure modulator valve assembly contains an isolation solenoid valve and a dump solenoid valve for each wheel and a traction control/stability control supply solenoid valve and isolation solenoid valve for each brake circuit. The solenoid valves are not engaged during normal system operation. When the ABS, traction control or stability control operation is required the electronic brake control module (EBCM) turns the required solenoid valves ON.

Conditions for Running the DTC

Ignition ON

Conditions for Setting the DTC

Stability control is active for more than 15 s.

Action Taken When the DTC Sets

- The EBCM disables the stability control for the duration of the ignition cycle.
- The traction control/stability control-active indicator turns ON.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Diagnostic Aids

DTC can set because of extended operation of ABS, traction control or stability control.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition ON, verify that DTC C0186, C0196, C019B, or C0710 is not set as a present DTC.
 - If any listed DTC is present, refer to Diagnostic Trouble Code (DTC) List - Vehicle to diagnose that DTC prior to this diagnostic.
2. Ignition OFF, inspect the B99 Steering Wheel Angle Sensor and B119 Multi-axis Acceleration Sensor for correct installation.
 - If loose or incorrect installation is diagnosed, correct the installation of the component.
3. Ignition ON, verify that DTC C0280 54 is not set as a present DTC.
 - If DTC C0280 54 is present, replace the K17 Electronic Brake Control Module (EBCM) and verify DTC does not reset. If the DTC resets, replace the Q5 brake pressure modulator valve assembly.

Repair Procedures

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Brake Pressure Modulator Valve Replacement
- Control Module References for EBCM replacement, programming and setup

DTC C056D

Diagnostic Instructions

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

DTC Descriptor

DTC C056D 00

Electronic Control Unit Hardware Malfunction

DTC C056D 39

Electronic Control Unit Hardware Internal Malfunction

DTC C056D 3B

Electronic Control Unit Hardware Self-Test Malfunction

Circuit/System Description

The internal fault detection is handled inside the control module. No external circuits are involved.

Conditions for Running the DTC

Ignition ON

Conditions for Setting the DTC

In internal hardware failure is detected.

Action Taken When the DTC Sets

- The electronic brake control module (EBCM) disables the ABS, traction control, and stability control for the duration of the ignition cycle.
- The ABS indicator turns ON.
- The traction control/stability control-active indicator turns ON.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The EBCM will turn OFF the indicators and enable the system functions in the next ignition cycle.

Diagnostic Aids

A newly replaced EBCM can set one or more DTC on its initial ignition ON cycle.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition ON, perform the following calibration procedures. Refer to:
 - Steering Angle Sensor Centering
 - Vehicle Yaw Sensor Learn
 - Brake Pressure Modulator Valve Pressure Sensor Calibration
2. Verify that DTC C056D is not present.
 - If DTC C056D is present, replace the module that set the DTC.

Repair Procedures

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Steering Angle Sensor Replacement
- Vehicle Yaw Sensor Replacement
- Control Module References for module replacement, setup and programming

DTC C056E

Diagnostic Instructions

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

DTC Descriptors

DTC C056E 45

Electronic Control Unit Software Variant Not Programmed

DTC C056E 4A

Electronic Control Unit Software Programming Checksum Error

DTC C056E 5A

Electronic Control Unit Software Not Plausible

Circuit/System Description

The electronic brake control module (EBCM) must be configured with the security code, CAN configuration data and vehicle options. If not properly configured after installation, the EBCM may set a DTC.

The internal fault detection is handled inside the control module. No external circuits are involved.

Conditions for Running the DTC

Ignition ON

Conditions for Setting the DTC

The control module is not properly programmed.

Action Taken When the DTC Sets

- The EBCM disables the traction control and stability control for the duration of the ignition cycle.
- The ABS indicator turns ON.
- The traction control/stability control-active indicator turns ON.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The EBCM will turn OFF the indicators and enable the system functions in the next ignition cycle.

Diagnostic Aids

A newly replaced EBCM can set one or more DTC on its initial ignition ON cycle.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Verify that DTC C056E is not present.
 - If DTC C056E is present, program the module that set the DTC and verify the DTC does not reset.
2. If the DTC resets, replace the module that set the DTC.

Repair Procedures

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for module replacement, setup and programming

DTC C0710

Diagnostic Instructions

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

DTC Descriptor

DTC C0710 42

Steering Position Signal Calibration Not Programmed

DTC C0710 5A

Steering Position Signal Not Plausible

DTC C0710 71

Steering Position Signal Invalid Data

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
12 V Reference	U0125, U0126	U0125, U0126	-	-
CAN Bus High Serial Data	U0073, U0100, U0101, U0125, U0126, U0140	U0073, U0100, U0101, U0125, U0126, U0140	U0073, U0100, U0101, U0125, U0126, U0140	C0710 5A, C0710 71
CAN Bus Low Serial Data	U0073, U0100, U0101, U0125, U0126, U0140	U0073, U0100, U0101, U0125, U0126, U0140	U0073, U0100, U0101, U0125, U0126, U0140	C0710 5A, C0710 71
Ground	-	U0126	-	-

Circuit/System Description

The steering angle sensor receives a 12 V reference voltage from the electronic brake control module (EBCM). The EBCM receives high speed controller area network (CAN) message inputs from the steering angle sensor identifying the position and direction of the steering wheel rotation. The EBCM utilizes this signal to calculate the driver intended driving direction.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

C0710 42

The steering angle sensor is not calibrated.

C0710 5A

- The steering angle sensor signal is out of specified range.
- The steering angle sensor signal is not plausible with the yaw rate sensor and lateral acceleration sensor signal.
- The steering angle sensor offset is out of specified range.

C0710 71

The steering angle sensor signal is invalid.

Action Taken When the DTC Sets

- The EBCM disables the stability control for the duration of the ignition cycle.
- The traction control/stability control-active indicator turns ON.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The EBCM will turn OFF the indicator in the next ignition cycle.

Diagnostic Aids

The car should not pull in either direction causing the steering wheel to be OFF center while driving in a straight line on a level surface.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS 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

Ignition ON, observe the scan tool Steering Column Position parameter. As the steering wheel is turned, the reading should travel between -550 and 550°.

Circuit/System Testing

1. Ignition ON, verify that DTC C0710 42 or C0710 5A is not present.
 - If either DTC is present, perform the **Steering Angle Sensor Centering**.
2. Inspect the B99 Steering Wheel Angle Sensor for correct installation.
 - If loose or incorrect installation is diagnosed, correct the installation of the component.
3. Ignition OFF, disconnect the harness connector at the B99 Steering Wheel Angle Sensor.
4. Test for less than 5 ohms between the ground circuit terminal 6 and ground.
 - If greater than the specified value, test the ground circuit for an open/high resistance.
5. Ignition ON, test for greater than 11 V between the 12 V reference circuit terminal 5 and ground.
 - If less than the specified range, test the 12 V reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the K17 Electronic Brake Control Module (EBCM).
6. If all circuits test normal, replace the B99 Steering Wheel Angle Sensor and verify the DTC does not reset.
 - If the DTC resets, replace the K17 Electronic Brake Control Module (EBCM).

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Steering Angle Sensor Replacement**
- **Control Module References** for EBCM replacement, setup and programming

DTC P0856

Diagnostic Instructions

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

DTC Descriptor

DTC P0856 00

Traction Control Torque Request Circuit Malfunction

Circuit/System Description

When traction control is active, the electronic brake control module (EBCM) sends a serial data message to the engine control module (ECM) requesting torque reduction. When certain ECM DTCs are set, the ECM will not be able to perform the torque reduction for traction control. A serial data message is sent to the EBCM indicating that traction control is not allowed.

Conditions for Running the DTC

Engine running

Conditions for Setting the DTC

The ECM detects a fault that prevents it from performing a traction control function and sends a serial data message to the EBCM indicating that torque reduction is not allowed.

Action Taken When the DTC Sets

- The EBCM disables the traction control and stability control for the duration of the ignition cycle.
- The traction control/stability control-active indicator turns ON.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The EBCM will turn OFF the indicator in the next ignition cycle.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Verify that no DTCs except P0856 00 are present in the ECM.
 - If any DTC is present, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

2. Replace the K20 Engine Control Module (ECM) and verify the DTC does not reset.
 - If the DTC resets, replace the K17 Electronic Brake Control Module (EBCM).

Repair Procedures

- Perform the **Diagnostic Repair Verification**
- **Control Module References** for EBCM or ECM replacement, programming and setup

SYMPTOMS - ANTILOCK BRAKE SYSTEM

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

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the system description and operation in order to familiarize yourself with the system functions. Refer to **ABS Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the ABS. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components, for obvious damage or conditions, which could cause the symptom.

Intermittent

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

Symptom List

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

- **ABS Indicator Malfunction**
- **Traction Control/Stability Control Indicator Malfunction**
- **Brake Warning Indicator Malfunction**

ABS INDICATOR MALFUNCTION

Diagnostic Instructions

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

- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The instrument cluster turns ON the ABS indicator for 5 s after ignition ON or when the electronic brake control module (EBCM) detects a fault and sends a serial data message to the instrument cluster commanding the indicator ON.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS 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

Ignition ON, the ABS indicator should turn ON. After 5 s the ABS indicator should turn OFF.

Circuit/System Testing

1. Ignition ON, with a scan tool command the instrument cluster All Indicators test ON and OFF. Verify the ABS indicator turns ON and OFF.
 - If the ABS indicator does not turn ON and OFF, replace the P16 Instrument Cluster.
2. Verify the ABS indicator turns OFF 5 s after ignition ON.
 - If the ABS indicator does not turn OFF, replace the K17 Electronic Brake Control Module (EBCM).

Repair Procedures

- Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.
- **Control Module References** for instrument cluster or EBCM replacement, setup and programming

TRACTION CONTROL/STABILITY CONTROL INDICATOR MALFUNCTION

Diagnostic Instructions

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

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Stability Control Switch Signal	B2745 02	1	1	-
Stability Control Switch Ground	-	1	-	-
1. Stability Control Switch Inoperative				

Circuit/System Description

The instrument cluster illuminates the traction control/stability control-active indicator, winter indicator and stability control off indicator for 5 s after ignition ON. The electronic brake control module (EBCM) will request the instrument cluster via serial data to turn the traction control/stability control-active indicator ON (flashing) when the system is in traction control or stability control mode. When the EBCM detects a fault it sends a serial data message to the instrument cluster commanding the traction control/stability control-active indicator ON.

The body control module (BCM) monitors the stability control switch. When the stability control switch is pressed once, the BCM will request the EBCM via serial data to disable the traction control. When the stability control switch is pressed for 5 s, the BCM will request the EBCM to disable the stability control. The EBCM will request the instrument cluster via serial data to turn the winter indicator and stability control off indicator ON to notify the driver of the deactivation.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS 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, with a scan tool command the Instrument Cluster All Indicators test ON and OFF. Verify the traction control/stability control-active indicator, traction control off indicator and stability control off indicator turn ON and OFF.
 - If either indicator does not turn ON and OFF, replace the P16 Instrument Cluster.
2. Observe the scan tool BCM Traction Control Switch parameter while pressing and releasing the traction control switch. Verify the reading changes between Active and Inactive.
 - If the parameter does not change between the specified values, refer to Circuit/System Testing.
3. Observe the scan tool EBCM Traction Control System parameter while pressing and releasing the traction control switch. Verify the reading changes between On and Off.
 - If the parameter does not change between the specified values, replace the K9 Body Control Module.
4. Observe the scan tool EBCM Vehicle Stability System parameter while pressing the traction control switch for 5 s and releasing. Verify the reading changes between On and Off.
 - If the parameter does not change between the specified values, replace the K9 Body Control Module.
5. Observe the traction control off indicator while pressing and releasing the traction control switch. Verify the traction control off indicator turns ON and OFF.
 - If the traction control off indicator does not turn ON and OFF, replace the K17 Electronic Brake Control Module (EBCM)
6. Observe the stability control off indicator while pressing the traction control switch for 5 s and releasing. Verify the stability control off indicator turns ON and OFF.
 - If the stability control off indicator does not turn ON and OFF, replace the K17 Electronic Brake Control Module (EBCM)

Circuit/System Testing

NOTE: **Circuit/System Verification must be performed before Circuit/System Testing.**

1. Ignition OFF, disconnect the harness connector at the S48C Multi-Function Switch - Instrument Panel 1.
2. Test for less than 5 ohms between the ground circuit terminal 1 and ground.
 - If greater than the specified value, test the ground circuit for an open/high resistance.
3. Ignition ON, verify the scan tool BCM Traction Control Switch parameter is Inactive.
 - If not the specified value, test the signal circuit for a short to ground. If the circuit tests normal, replace the K9 Body Control Module.
4. Install a 3A fused jumper wire between the signal circuit terminal 3 and ground.
5. Verify the scan tool BCM Traction Control Switch parameter is Active.
 - If not the specified value, test the signal circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the K9 Body Control Module.
6. If all circuits test normal, test or replace the S48C Multi-Function Switch - Instrument Panel 1.

Component Testing

Static Test

1. Ignition OFF, disconnect the harness connector at the S48C Multi-Function Switch - Instrument Panel 1.
2. Test for infinite resistance between the signal circuit terminal 3 and the ground circuit terminal 1 with the switch in the released position.
 - If not within the specified range, replace the S48C Multi-Function Switch - Instrument Panel 1.
3. Test for less than 5 ohms between the signal circuit terminal 3 and the ground circuit terminal 1 with the switch in the pressed position.
 - If not within the specified range, replace the S48C Multi-Function Switch - Instrument Panel 1.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Electronic Traction Control and Vehicle Stability Control Switch Replacement**
- **Control Module References** for BCM replacement, setup and programming

REPAIR INSTRUCTIONS

ANTILOCK BRAKE SYSTEM AUTOMATED BLEED

WARNING: Refer to **Brake Fluid Irritant Warning** .

CAUTION: Refer to **Brake Fluid Effects on Paint and Electrical Components Caution** .

NOTE: Before performing the antilock brake system (ABS) Automated Bleed

Procedure, first perform a manual or pressure bleed of the base brake system. Refer to Hydraulic Brake System Bleeding (Manual) or Hydraulic Brake System Bleeding (Pressure) . The automated bleed procedure is recommended when one of the following conditions exist:

- **Base brake system bleeding does not achieve the desired pedal height or feel**
- **Extreme loss of brake fluid has occurred**
- **Air ingestion is suspected in the secondary circuits of the brake modulator assembly**

The ABS Automated Bleed Procedure uses a scan tool to cycle the system solenoid valves and run the pump in order to purge any air from the secondary circuits. These circuits are normally closed off, and are only opened during system initialization at vehicle start up and during ABS operation. The automated bleed procedure opens these secondary circuits and allows any air trapped in these circuits to flow out toward the brake corners.

Automated Bleed Procedure

CAUTION: The Auto Bleed Procedure may be terminated at any time during the process by pressing the EXIT button. No further Scan Tool prompts pertaining to the Auto Bleed procedure will be given. After exiting the bleed procedure, relieve bleed pressure and disconnect bleed equipment per manufacturers instructions. Failure to properly relieve pressure may result in spilled brake fluid causing damage to components and painted surfaces.

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Remove all 4 tire and wheel assemblies. Refer to Tire and Wheel Removal and Installation .
3. Inspect the brake system for leaks and visual damage. Refer to Symptoms - Hydraulic Brakes . Repair or replace components as needed.
4. Lower the vehicle.
5. Inspect the battery state of charge. Refer to Battery Inspection/Test .
6. Install a scan tool.
7. Turn the ignition ON, with the engine OFF.
8. With the scan tool, establish communications with the ABS system. Select Special Functions. Select Automated Bleed from the Special Functions menu.
9. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
10. Following the directions given on the scan tool, pressure bleed the base brake system. Refer to Hydraulic Brake System Bleeding (Manual) or Hydraulic Brake System Bleeding (Pressure) .
11. Follow the scan tool directions until the desired brake pedal height is achieved.
12. If the bleed procedure is aborted, a malfunction exists. Perform the following steps before resuming the bleed procedure:
 - If a DTC is detected, refer to Diagnostic Trouble Code (DTC) List - Vehicle and diagnose the

appropriate DTC.

- If the brake pedal feels spongy, perform the conventional brake bleed procedure again. Refer to **Hydraulic Brake System Bleeding (Manual)** **Hydraulic Brake System Bleeding (Pressure)** .

13. When the desired pedal height is achieved, press the brake pedal to inspect for firmness.
14. Lower the vehicle.
15. Remove the scan tool.
16. Install the tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .
17. Inspect the brake fluid level. Refer to **Master Cylinder Reservoir Filling** .
18. Road test the vehicle while inspecting that the pedal remains high and firm.

STEERING ANGLE SENSOR CENTERING

The steering angle sensor does not require a centering often. Centering of the steering angle sensor might be required after certain service procedures are performed. Some of these procedures are as follows:

- Electronic brake control module (EBCM) replacement
- Steering angle sensor replacement
- Steering gear replacement
- Steering column replacement
- Collision or other physical damage

The steering angle sensor centering procedure can be completed with a scan tool using the following steps:

1. Using the steering wheel, align the front wheels forward.
2. Apply the parking brake, or set the transmission in the P position.
3. Install the scan tool to the data link connector.
4. Ignition ON, engine OFF
5. Select Steering Wheel Angle Sensor Reset in the Steering Wheel Angle Sensor Module Configuration/Reset Functions list.
6. Follow the scan tool directions to complete the learn procedure.
7. Select Steering Wheel Angle Sensor Learn in the Steering Wheel Angle Sensor Module Configuration/Reset Functions list.
8. Follow the scan tool directions to complete the learn procedure.
9. Select Steering Wheel Angle Sensor Learn in the EBCM Configuration/Reset Functions list.
10. Follow the scan tool directions to complete the learn procedure.
11. Clear any DTCs that may be set.

ELECTRONIC BRAKE CONTROL MODULE REPLACEMENT

Removal Procedure

WARNING: Refer to **Brake Fluid Irritant Warning** .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

CAUTION: Always connect or disconnect the wiring harness connector from the EBCM/EBTCM with the ignition switch in the OFF position. Failure to observe this precaution could result in damage to the EBCM/EBTCM.

1. Place the ignition switch in the OFF position.
2. Remove the accessory wiring junction block. Refer to Accessory Wiring Junction Block Replacement .
3. Clean the electronic brake control module (EBCM) to brake pressure modulator valve (BPMV) area of any dirt or debris.
4. Disconnect the EBCM electrical connector by lifting the locking lever upward.

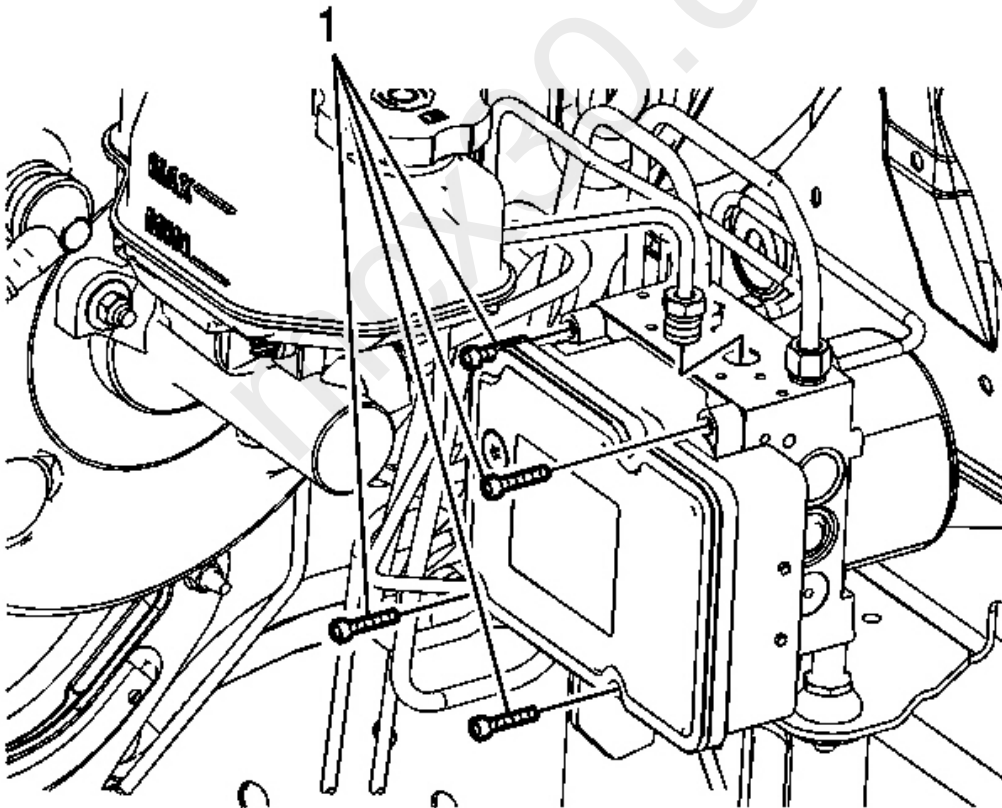


Fig. 4: EBCM Bolts

Courtesy of GENERAL MOTORS CORP.

5. Remove the 4 EBCM bolts (1).

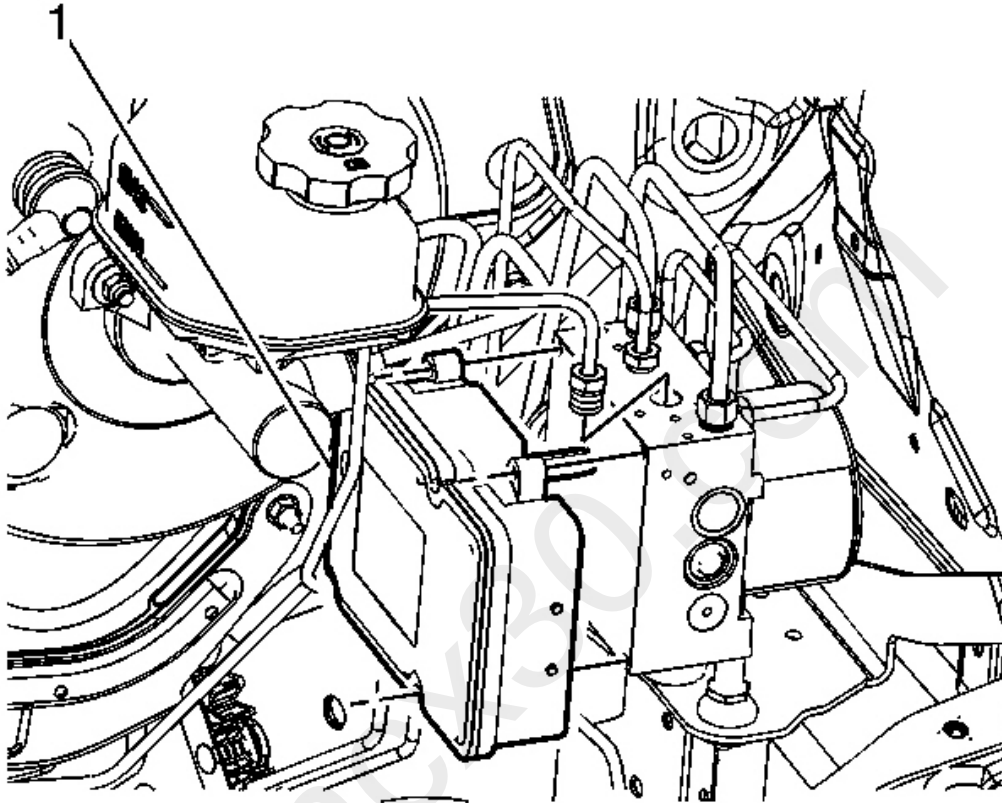


Fig. 5: EBCM

Courtesy of GENERAL MOTORS CORP.

NOTE: Do not pry the components apart.

6. Carefully pull the EBCM (1) from the BPMV.
7. Remove the 12 EBCM seals, if necessary.

Installation Procedure

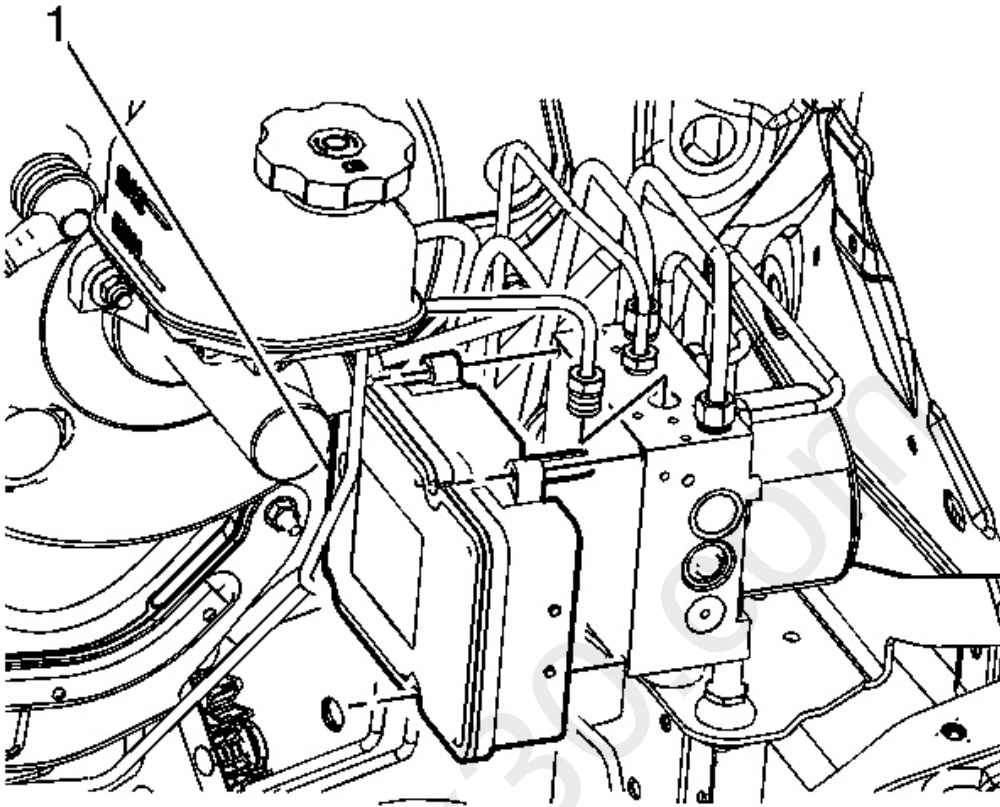


Fig. 6: EBCM

Courtesy of GENERAL MOTORS CORP.

1. Install the EBCM seals, if removed.
2. Install the EBCM (1) to the BPMV.

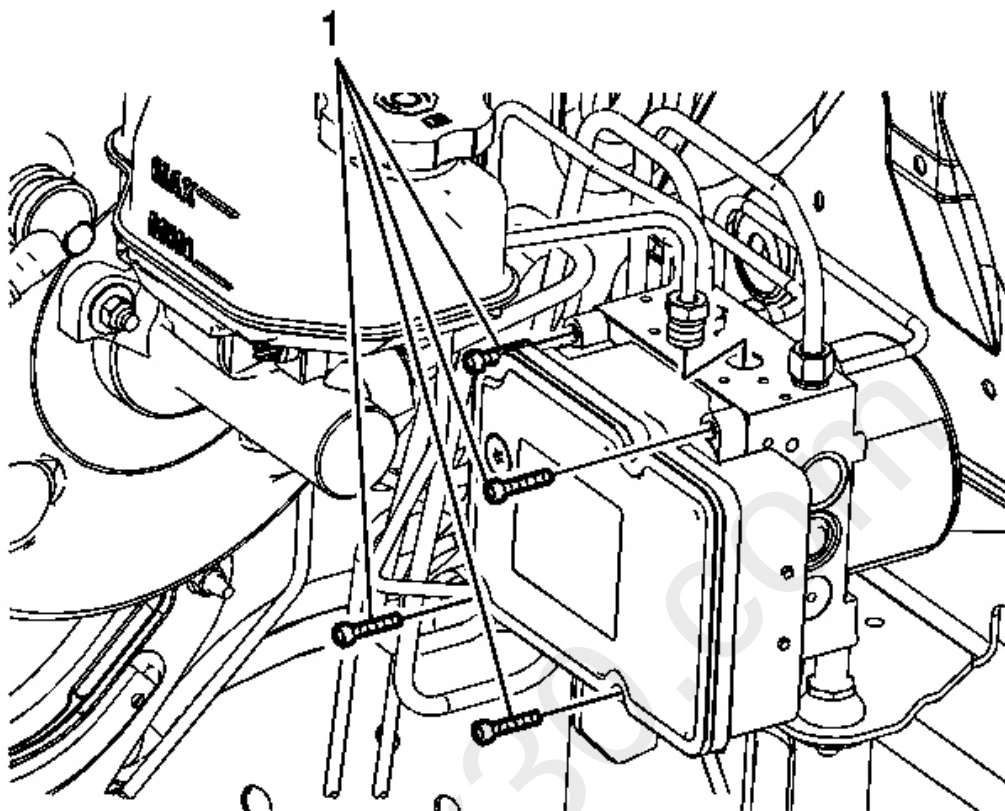


Fig. 7: EBCM Bolts

Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

3. Install the 4 EBCM bolts (1) and tighten the bolts in a cross pattern to 3 N.m (27 lb in).
4. Install the accessory wiring junction block. Refer to Accessory Wiring Junction Block Replacement .
5. If installing a new EBCM, program the EBCM. Refer to Control Module References .
6. Without starting the engine, place the ignition switch in the ON position.
7. Perform the Diagnostic System Check - Vehicle .

BRAKE PRESSURE MODULATOR VALVE REPLACEMENT

Removal Procedure

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

CAUTION: Always connect or disconnect the wiring harness connector from the EBCM/EBTCM with the ignition switch in the OFF position. Failure to observe this precaution could result in damage to the EBCM/EBTCM.

1. Turn the ignition switch to the OFF position.
2. Remove the accessory wiring junction block. Refer to Accessory Wiring Junction Block Replacement .

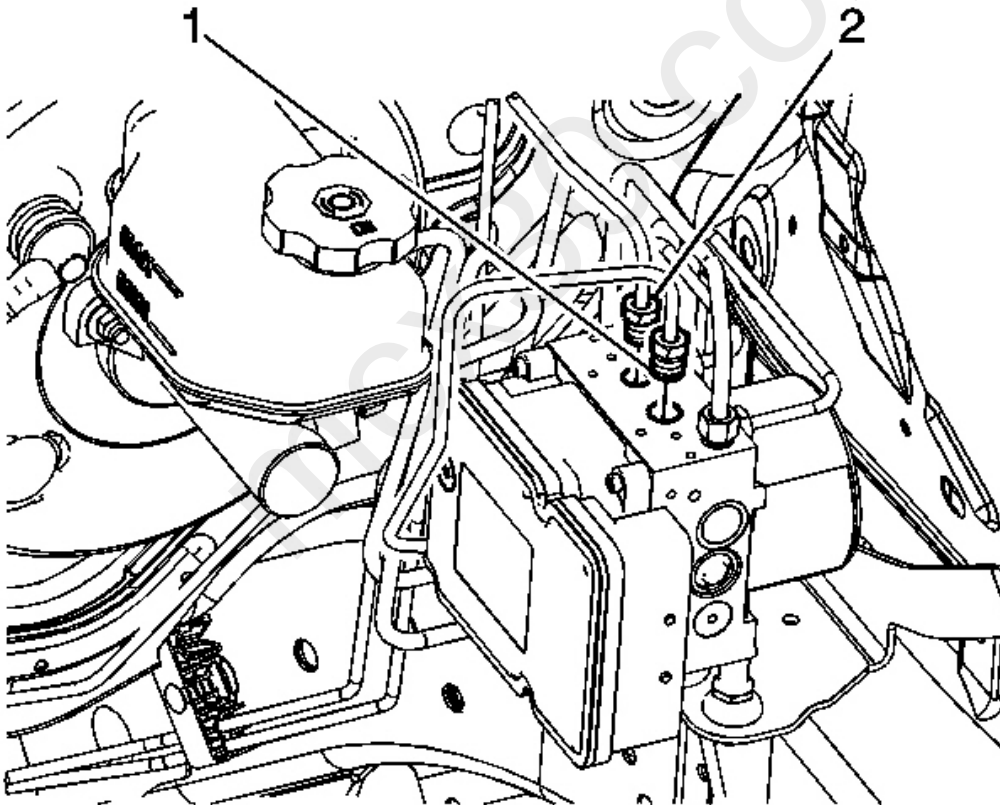


Fig. 8: Brake Pipe Fittings
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the electronic brake control module (EBCM) electrical connector by lifting the locking tabs.
4. Disconnect the left front brake pipe fitting (1) at the brake pressure modulator valve (BPMV).
5. Cap the brake pipe fitting and plug the BPMV outlet port to prevent brake fluid loss and contamination.
6. Disconnect the right front brake pipe fitting (2) from the BPMV.
7. Cap the brake pipe fitting and plug the BPMV outlet port to prevent brake fluid loss and contamination.

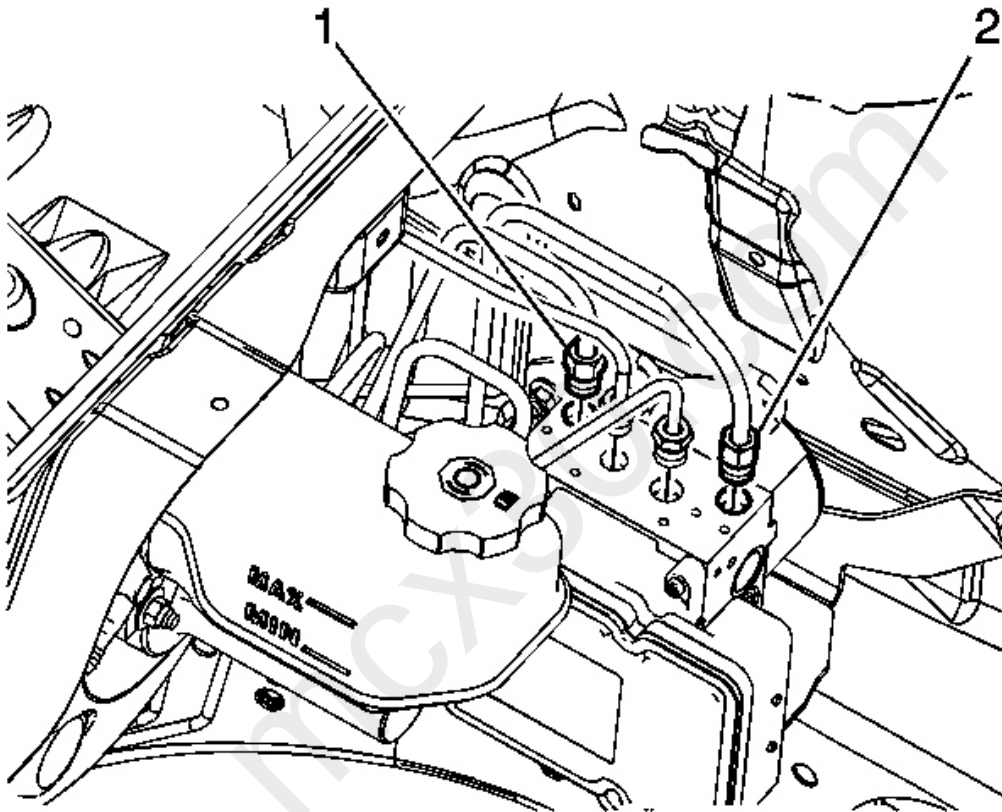


Fig. 9: Master Cylinder Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

8. Disconnect the master cylinder primary brake pipe fitting (1) from the BPMV.
9. Cap the brake pipe fitting and plug the BPMV inlet port to prevent brake fluid loss and contamination.
10. Disconnect the master cylinder secondary brake pipe fitting (2) from the BPMV.
11. Cap the brake pipe fitting and plug the BPMV inlet port to prevent brake fluid loss and contamination.

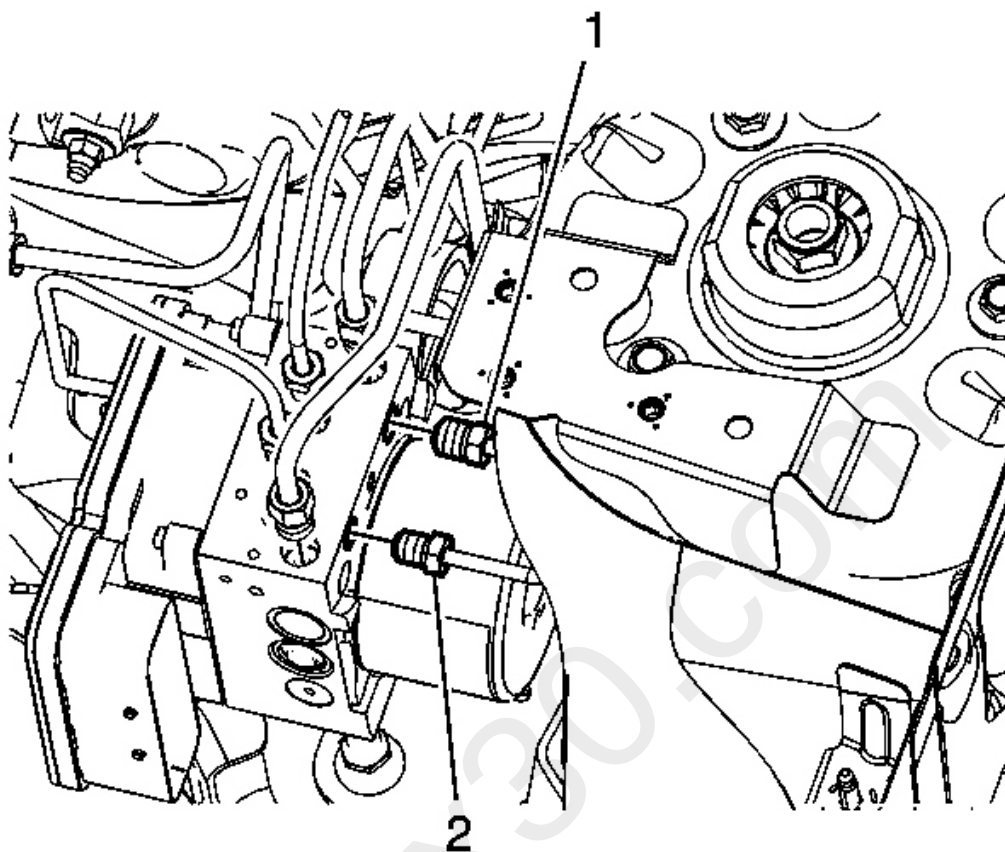


Fig. 10: Brake Pipe Fittings

Courtesy of GENERAL MOTORS CORP.

12. Disconnect the left rear brake pipe fitting (1) from the BPMV.
13. Cap the brake pipe fitting and plug the BPMV outlet port to prevent brake fluid loss and contamination.
14. Disconnect the right rear brake pipe fitting (2) from the BPMV.
15. Cap the brake pipe fitting and plug the BPMV outlet port to prevent brake fluid loss and contamination.

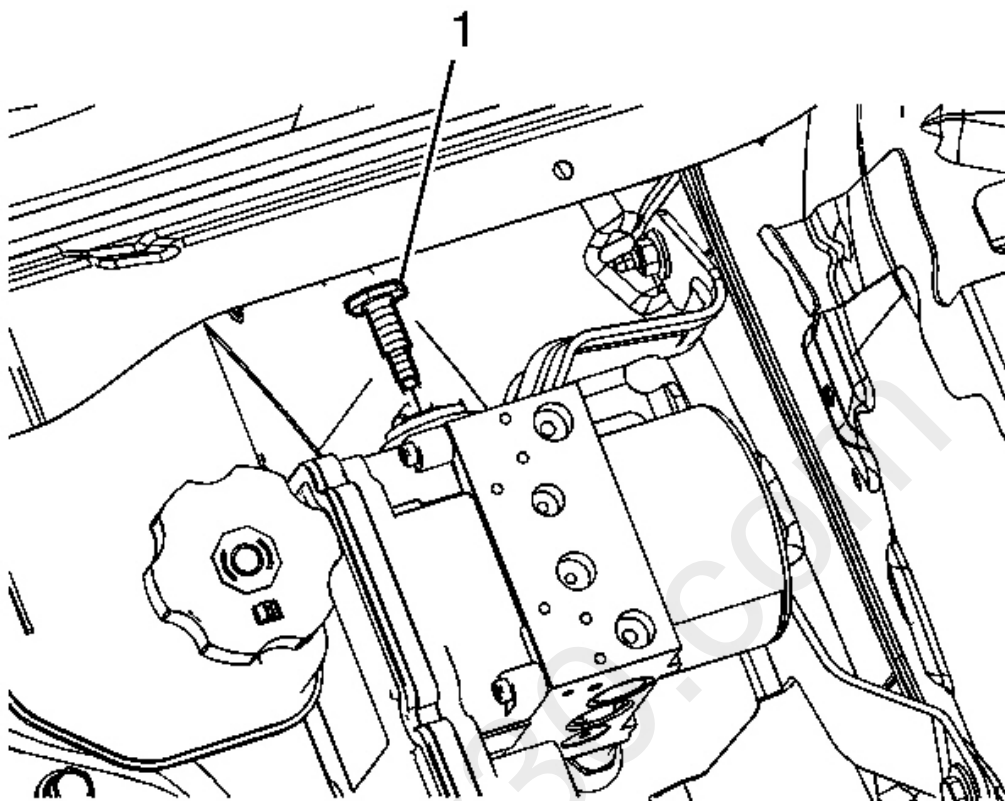


Fig. 11: BPMV Bolt
Courtesy of GENERAL MOTORS CORP.

16. Remove the BPMV bolt (1).

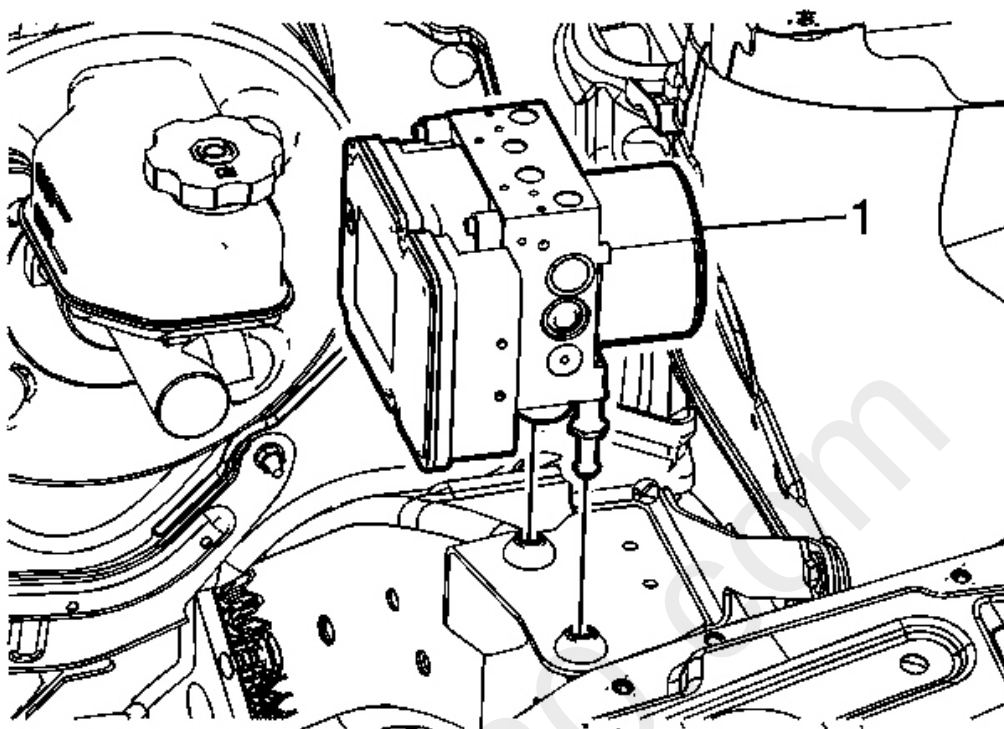


Fig. 12: BPMV Assembly
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not pry on the accumulator caps on the underside of the BPMV.

17. Carefully remove the BPMV assembly (1) by pulling straight upward.
18. Inspect the insulators for damage and replace, if necessary.
19. If replacing the BPMV, remove the EBCM. Refer to **Electronic Brake Control Module Replacement**.

Installation Procedure

1. Install the EBCM, if removed. Refer to **Electronic Brake Control Module Replacement**.

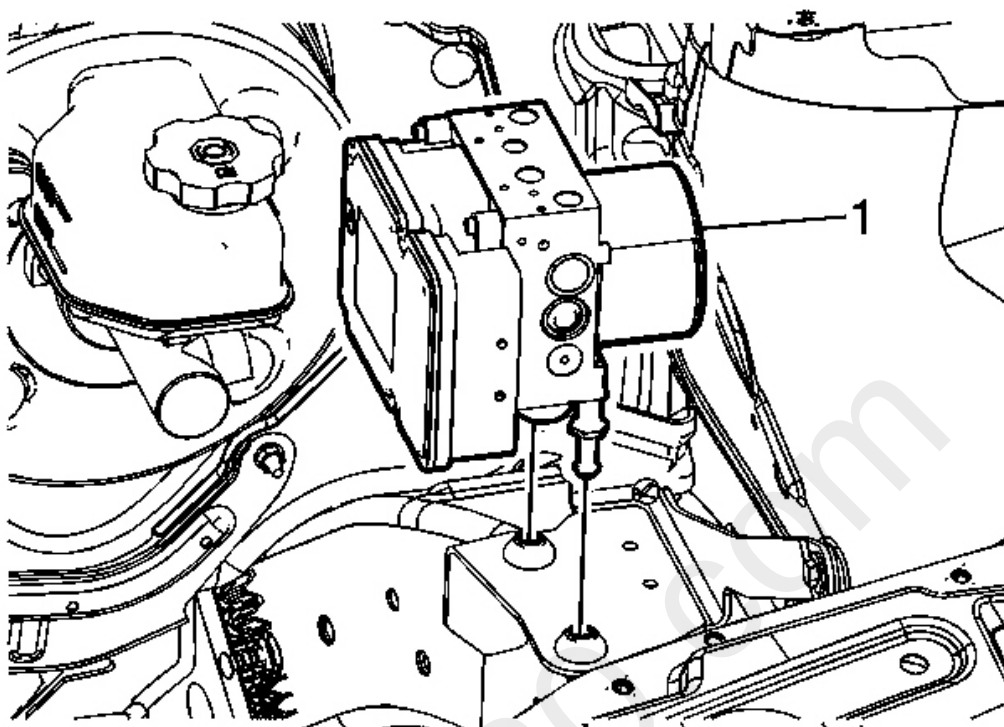


Fig. 13: BPMV Assembly
Courtesy of GENERAL MOTORS CORP.

2. Install the BPMV assembly (1) to the bracket.

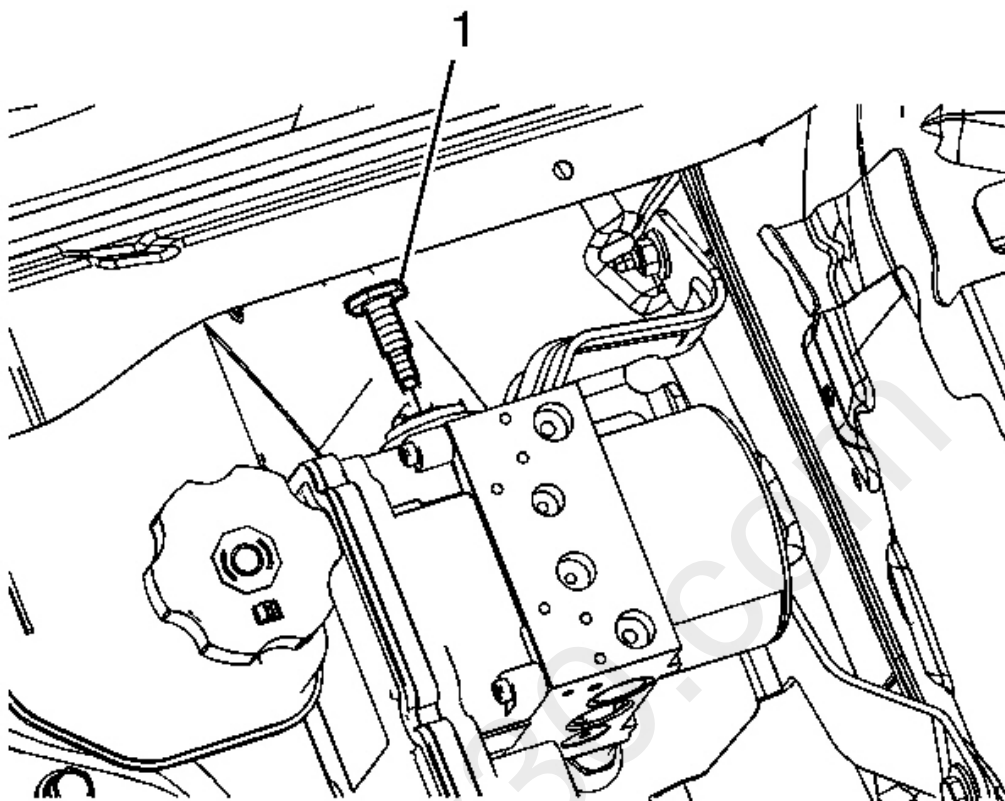


Fig. 14: BPMV Bolt
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

3. Install the BPMV bolt (1) and tighten to 10 N.m (89 lb in).

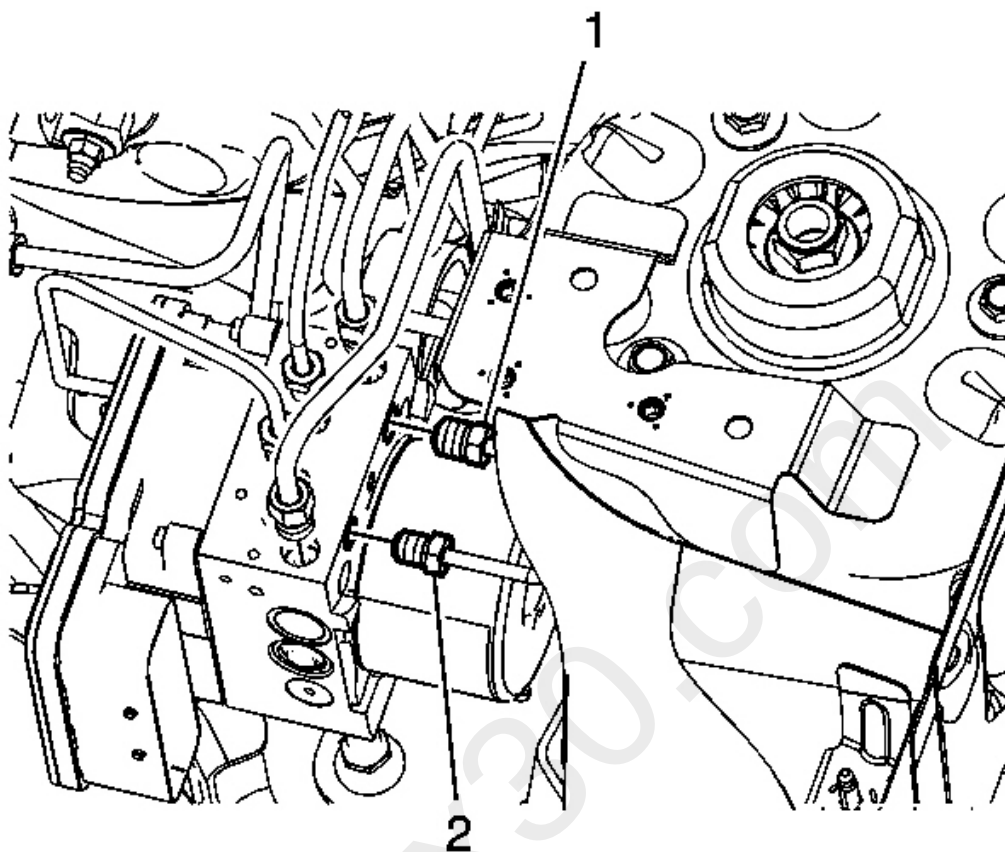


Fig. 15: Brake Pipe Fittings

Courtesy of GENERAL MOTORS CORP.

4. Connect the left rear brake pipe fitting (1) to the BPMV and tighten to 21 N.m (16 lb ft).
5. Connect the right rear brake pipe fitting (2) to the BPMV and tighten to 21 N.m (16 lb ft).

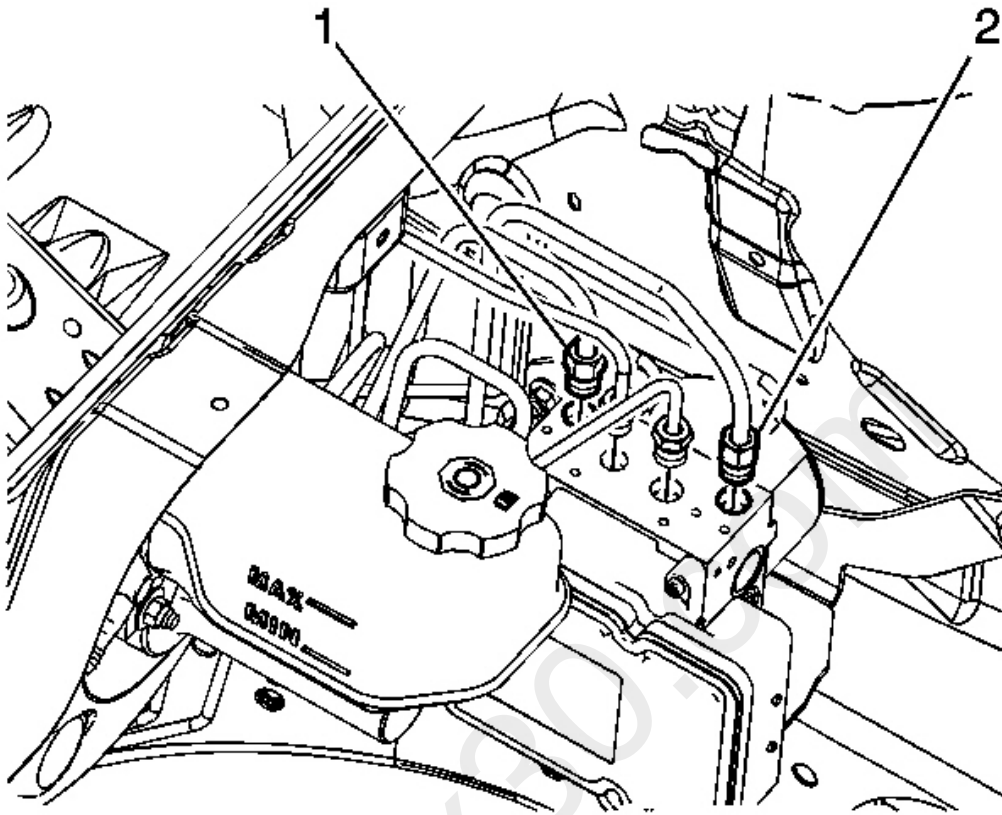


Fig. 16: Master Cylinder Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

6. Connect the master cylinder primary brake pipe fitting (1) to the BPMV and tighten to 21 N.m (16 lb ft).
7. Connect the master cylinder secondary brake pipe fitting (2) to the BPMV and tighten to 21 N.m (16 lb ft).

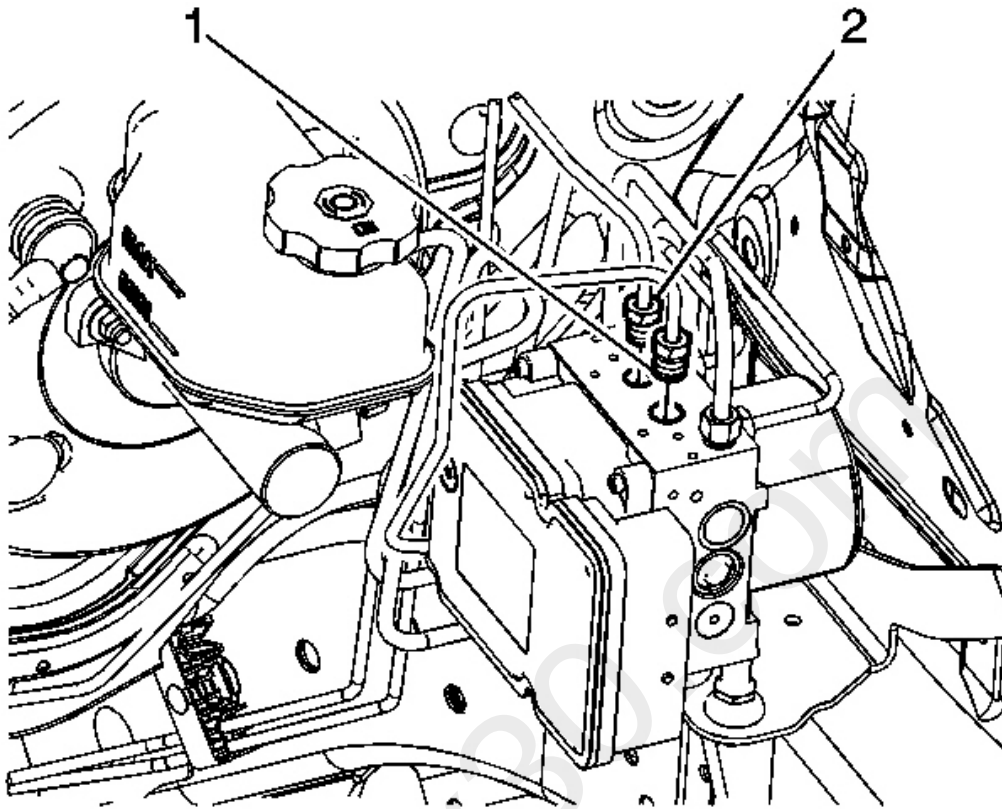


Fig. 17: Brake Pipe Fittings
Courtesy of GENERAL MOTORS CORP.

8. Connect the left front brake pipe fitting (1) to the BPMV and tighten to 21 N.m (16 lb ft).
9. Connect the right front brake pipe fitting (2) to the BPMV and tighten to 21 N.m (16 lb ft).
10. Connect the EBCM electrical connector.
11. Install the accessory wiring junction block. Refer to **Accessory Wiring Junction Block Replacement** .
12. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** .
13. Turn the ignition switch to the ON position.
14. Perform the **Diagnostic System Check - Vehicle** .
15. Observe the brake pedal feel after performing the diagnostic system check. If the pedal now feels spongy, air may have been in, or may have been introduced into the primary circuit.
16. If the pedal feels spongy, perform the **Antilock Brake System Automated Bleed**.

The brake pressure sensor does not require calibration often. Calibration of the brake pressure sensor might be required after certain service procedures are performed. Some of these procedures are as follows:

- Electronic brake control module (EBCM) replacement
- Brake pressure modulator valve assembly replacement

The Brake Pressure Sensor Calibration procedure can be completed with a scan tool using the following steps:

1. Apply the parking brake, or set the transmission in the P position.
2. Release the brake pedal.
3. Install the scan tool to the data link connector.
4. Ignition ON, engine OFF
5. Select Brake Pressure Sensor Calibration in the EBCM Configuration/Reset Functions list.
6. Follow the scan tool directions to complete the calibration procedure.
7. Clear any DTCs that may be set.

BRAKE PRESSURE MODULATOR VALVE BRACKET REPLACEMENT

Removal Procedure

1. Place the ignition switch in the OFF position.
2. Remove the accessory wiring junction block. Refer to **Accessory Wiring Junction Block Replacement** .

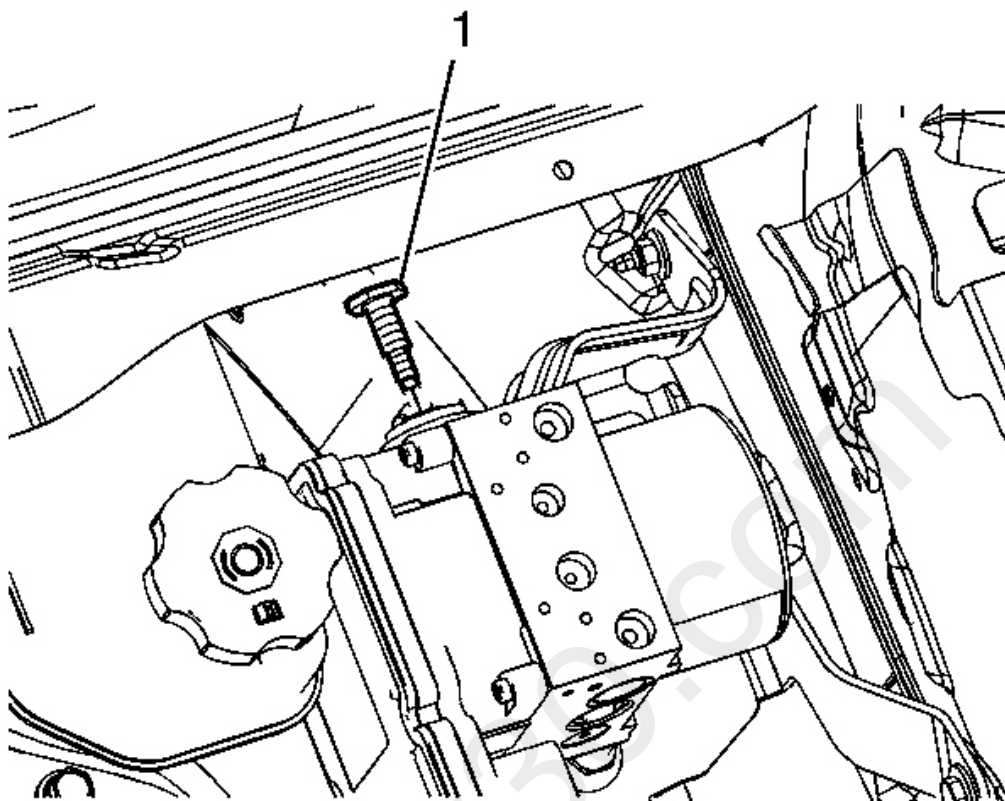


Fig. 18: BPMV Bolt

Courtesy of GENERAL MOTORS CORP.

3. Remove the brake pressure modulator valve (BPMV) bolt (1).

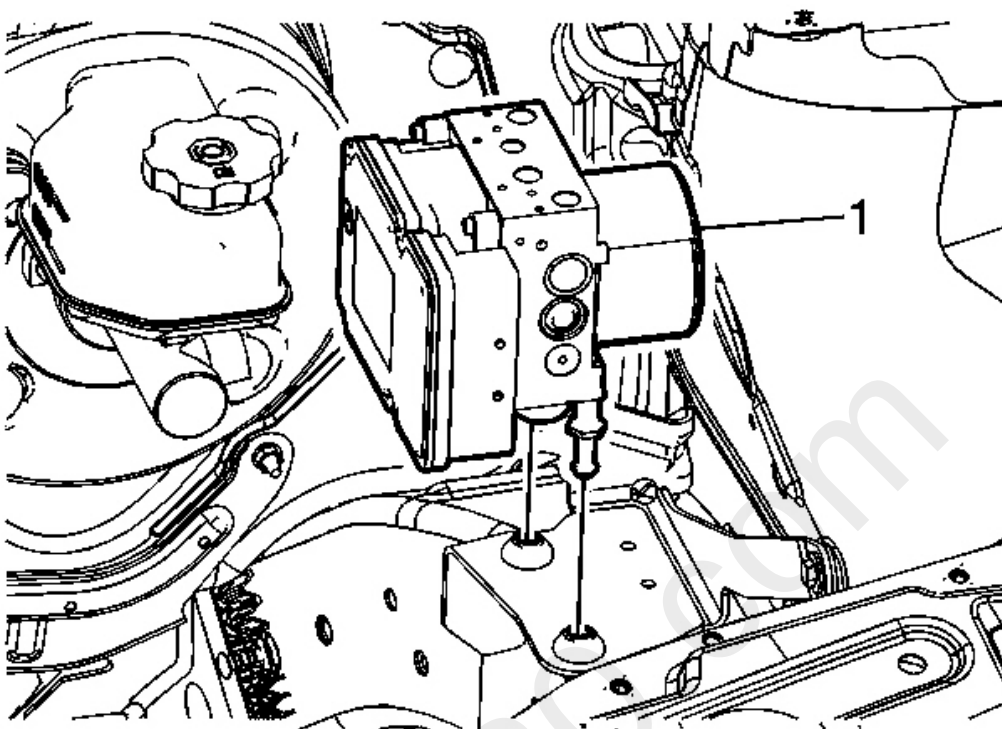


Fig. 19: BPMV Assembly
Courtesy of GENERAL MOTORS CORP.

NOTE: **Do not pry on the accumulator caps on the underside of the BPMV.**

4. Without disconnecting the brake pipe fittings, carefully lift the BPMV assembly (1) upward to release the mounting pins from the BPMV bracket insulators.
5. Position the BPMV assembly aside and secure with heavy mechanics wire or equivalent.

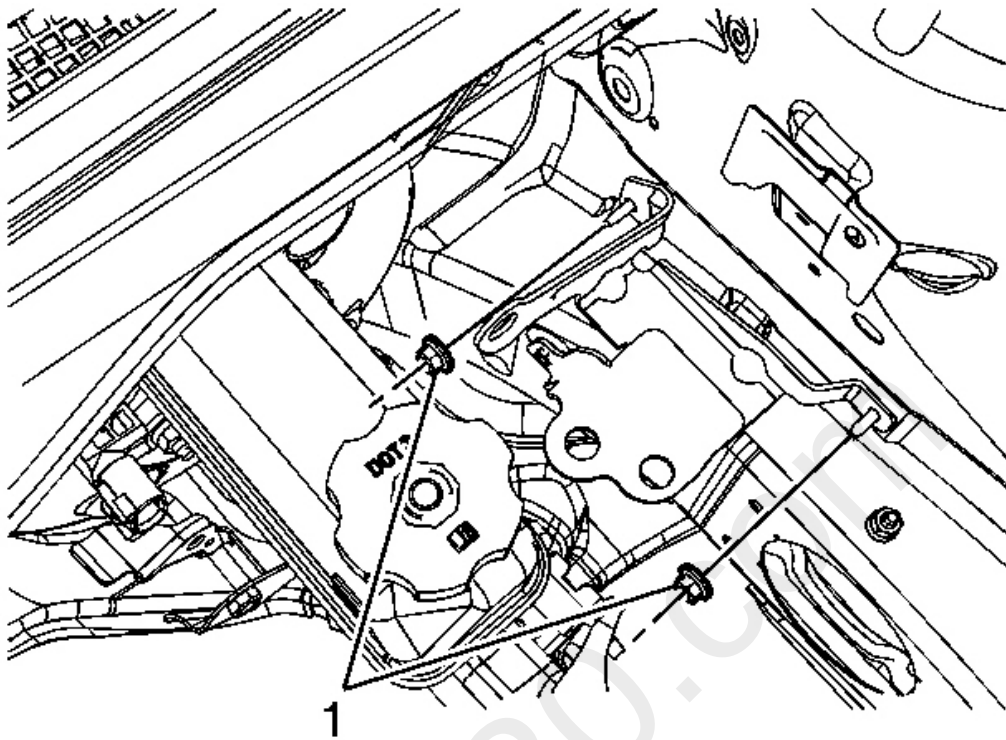


Fig. 20: BPMV Bracket Nuts
Courtesy of GENERAL MOTORS CORP.

6. Remove the 2 BPMV bracket nuts (1).

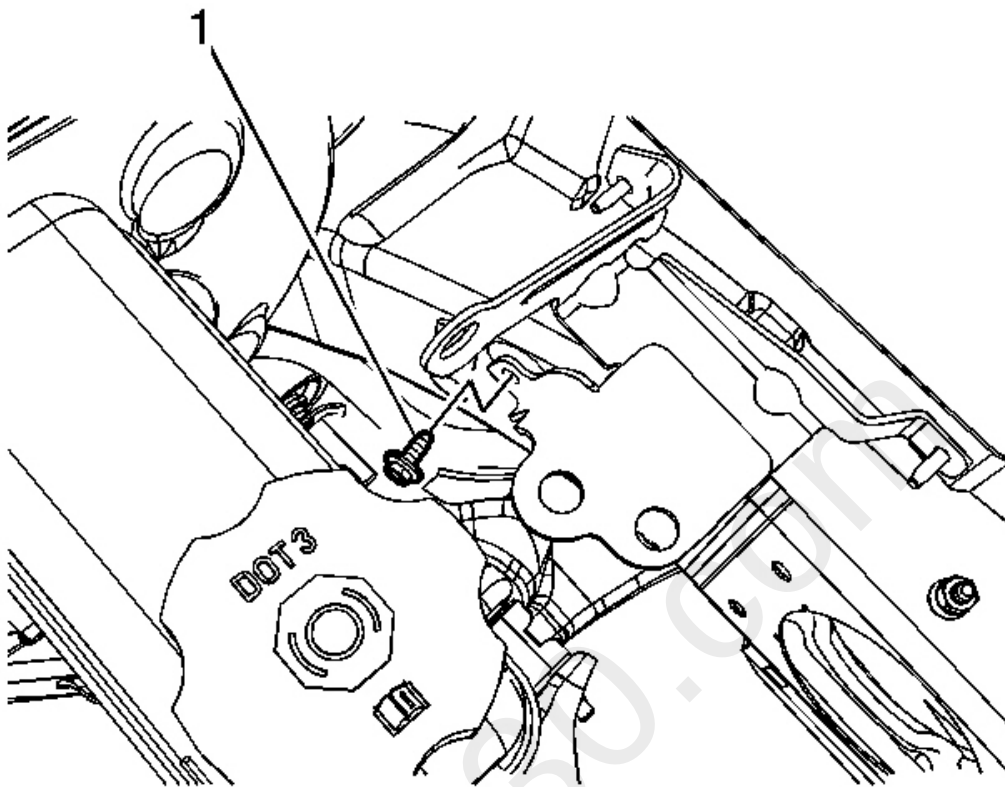


Fig. 21: BPMV Bracket Bolt
Courtesy of GENERAL MOTORS CORP.

7. Remove the BPMV bracket bolt (1).

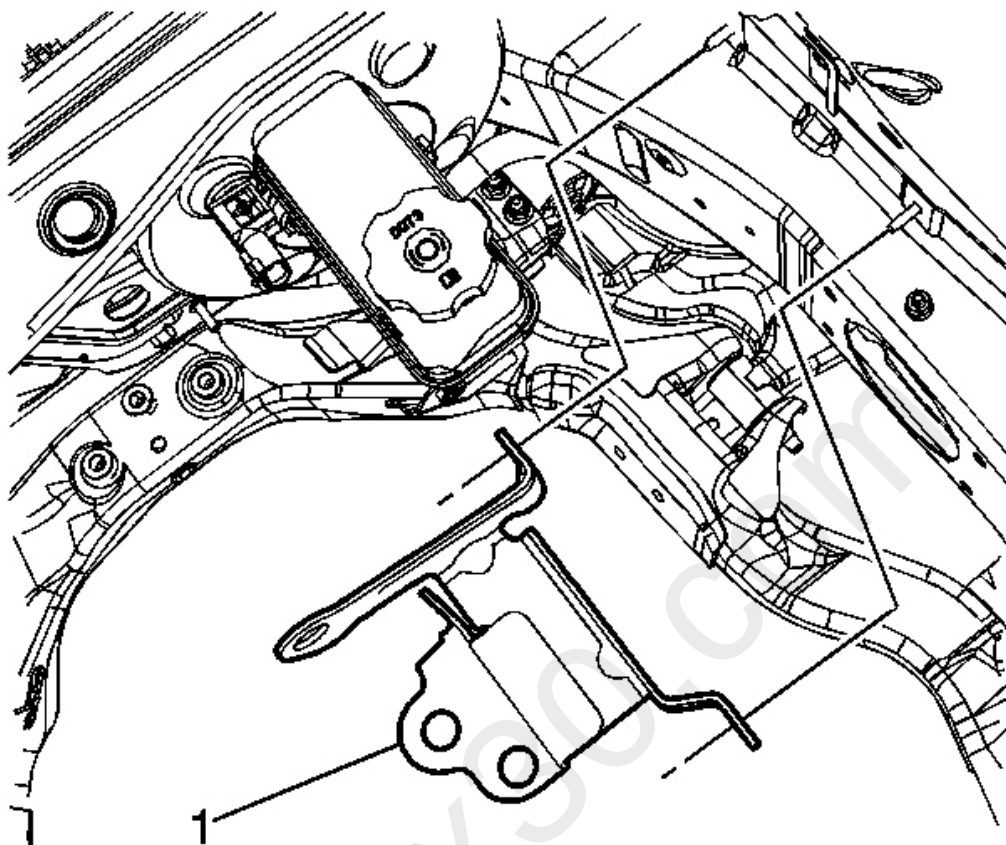


Fig. 22: BPMV Bracket
Courtesy of GENERAL MOTORS CORP.

8. Remove the BPMV bracket (1).
9. Inspect the insulators for damage and replace, if necessary.

Installation Procedure

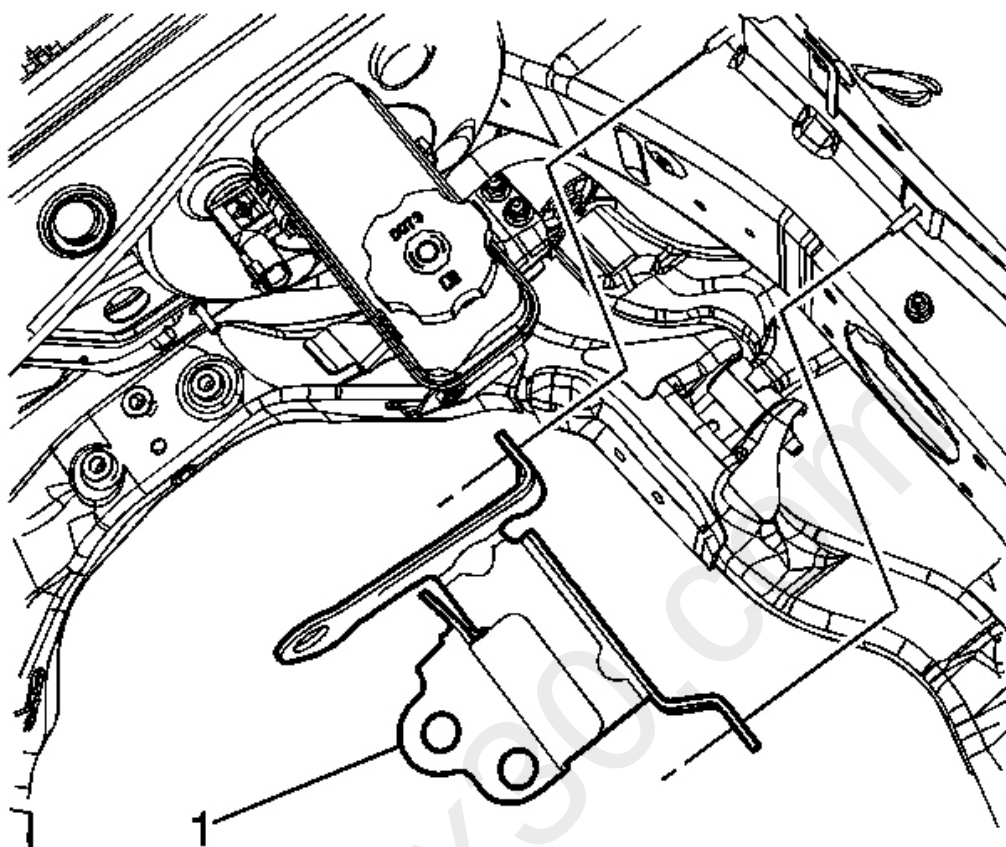


Fig. 23: BPMV Bracket

Courtesy of GENERAL MOTORS CORP.

1. Install the BPMV bracket (1).

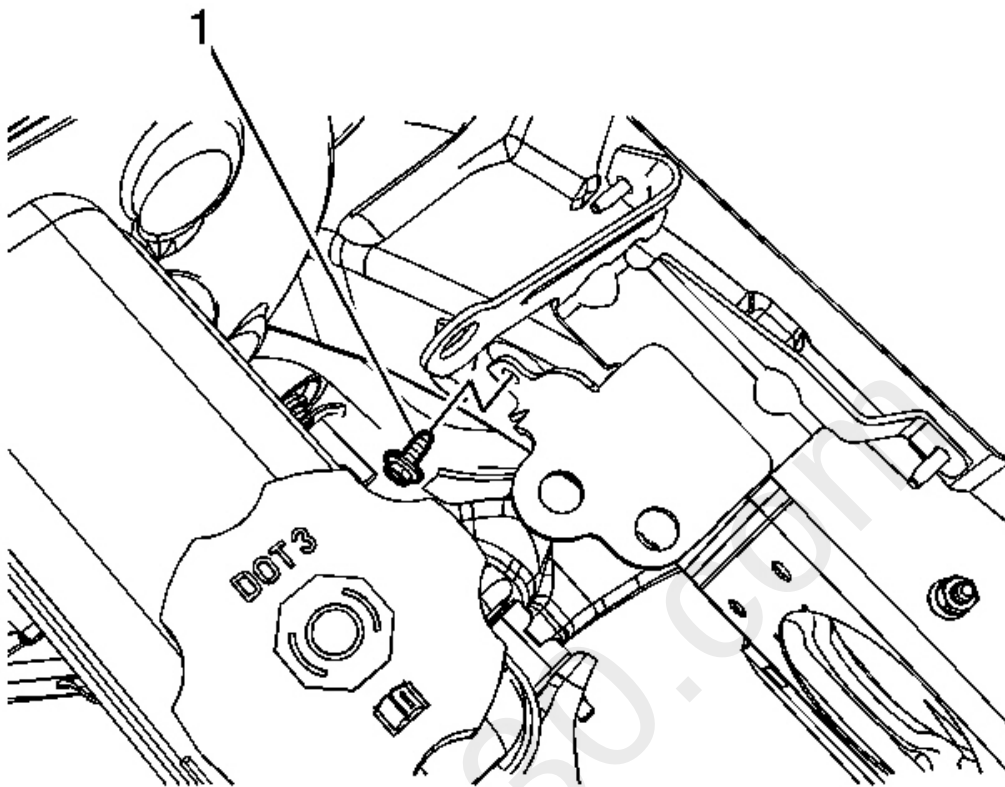


Fig. 24: BPMV Bracket Bolt
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

2. Install the BPMV bracket bolt (1) and tighten to 10 N.m (89 lb in).

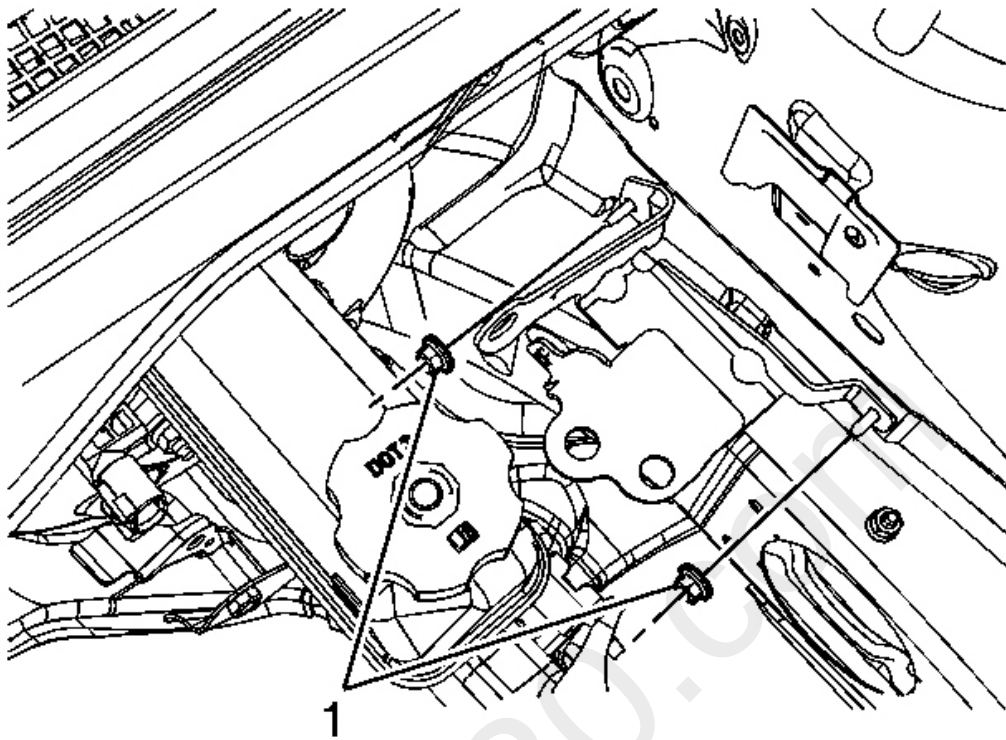


Fig. 25: BPMV Bracket Nuts
Courtesy of GENERAL MOTORS CORP.

3. Install the BPMV bracket nuts (1) and tighten to 10 N.m (89 lb in).

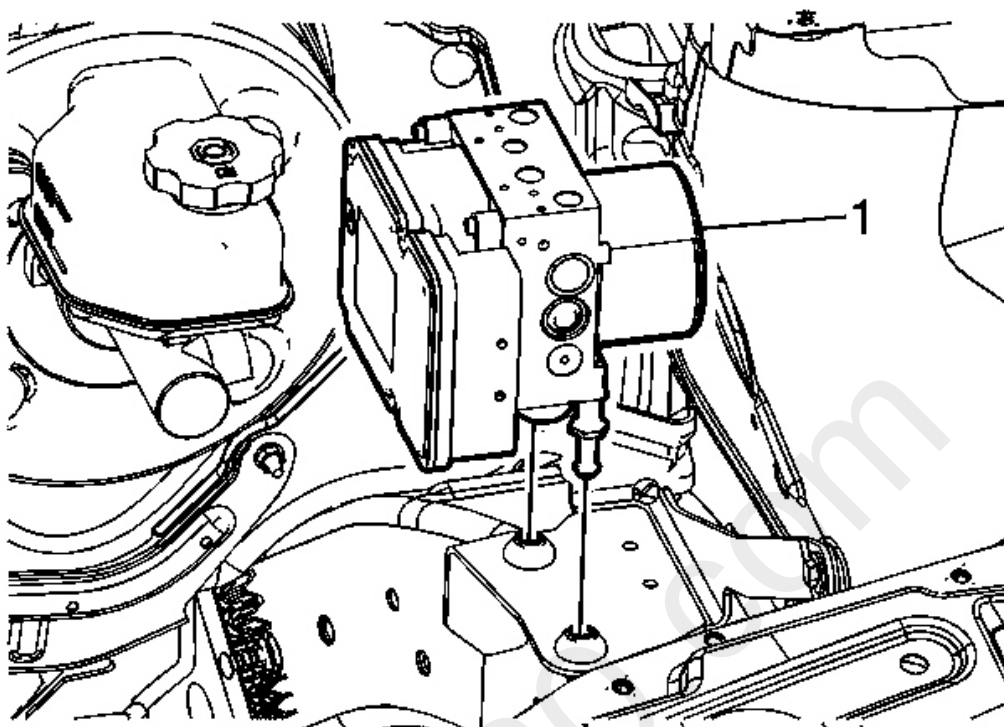


Fig. 26: BPMV Assembly
Courtesy of GENERAL MOTORS CORP.

4. Carefully position the BPMV assembly (1) to the BPMV bracket insulators.

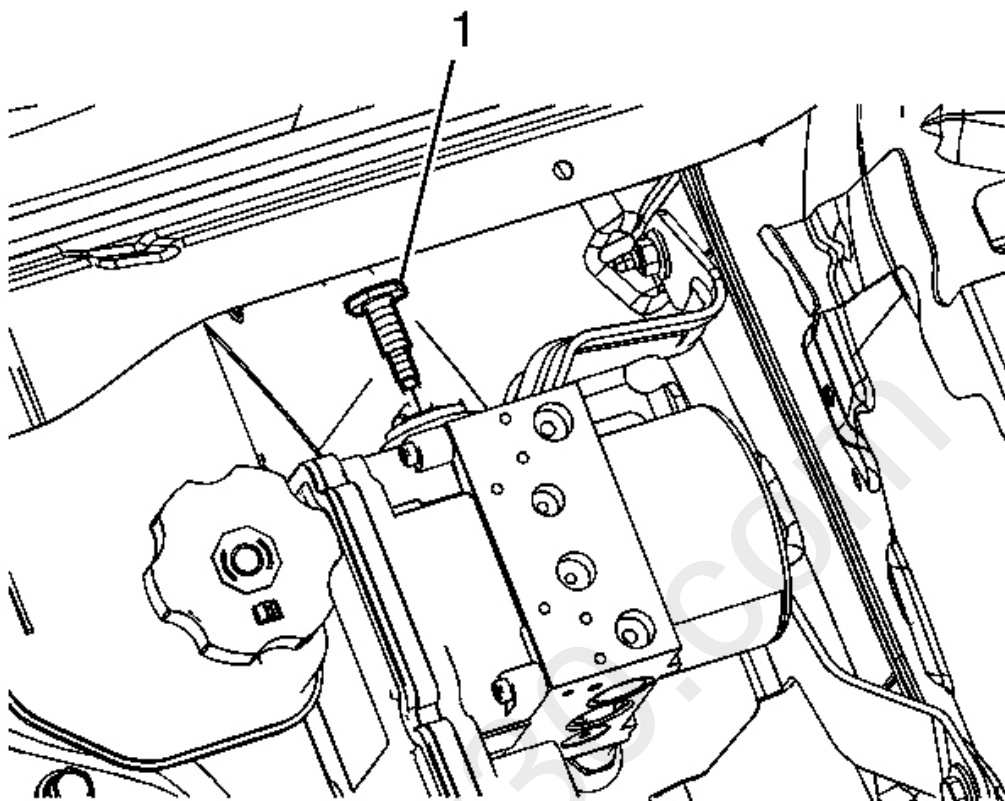


Fig. 27: BPMV Bolt
Courtesy of GENERAL MOTORS CORP.

5. Install the BPMV bolt (1) and tighten to 10 N.m (89 lb in).
6. Install the accessory wiring junction block. Refer to **Accessory Wiring Junction Block Replacement** .

FRONT WHEEL SPEED SENSOR REPLACEMENT

Removal Procedure

WARNING: Refer to **Brake Dust Warning** .

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
3. Disconnect the wheel speed sensor electrical connector.

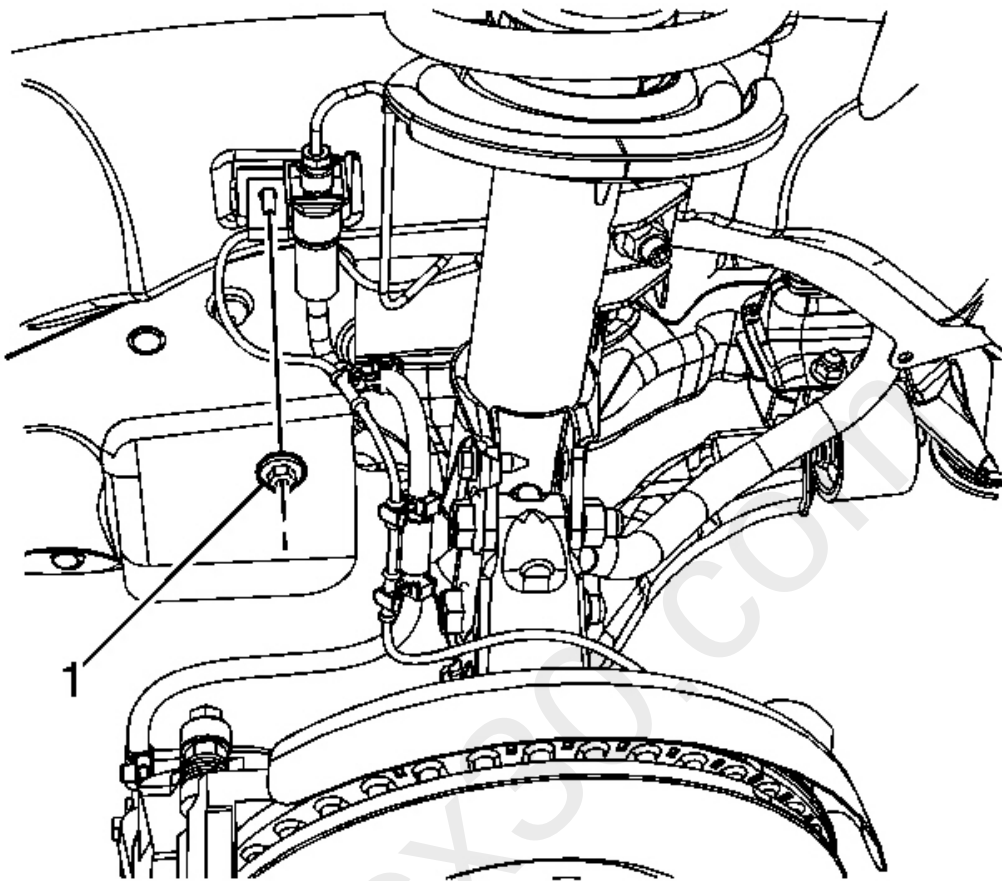


Fig. 28: Front Brake Hose Bracket Nut
Courtesy of GENERAL MOTORS CORP.

4. Remove the front brake hose bracket nut (1).
5. Release the front wheel speed sensor harness from the retainers on the front brake hose.

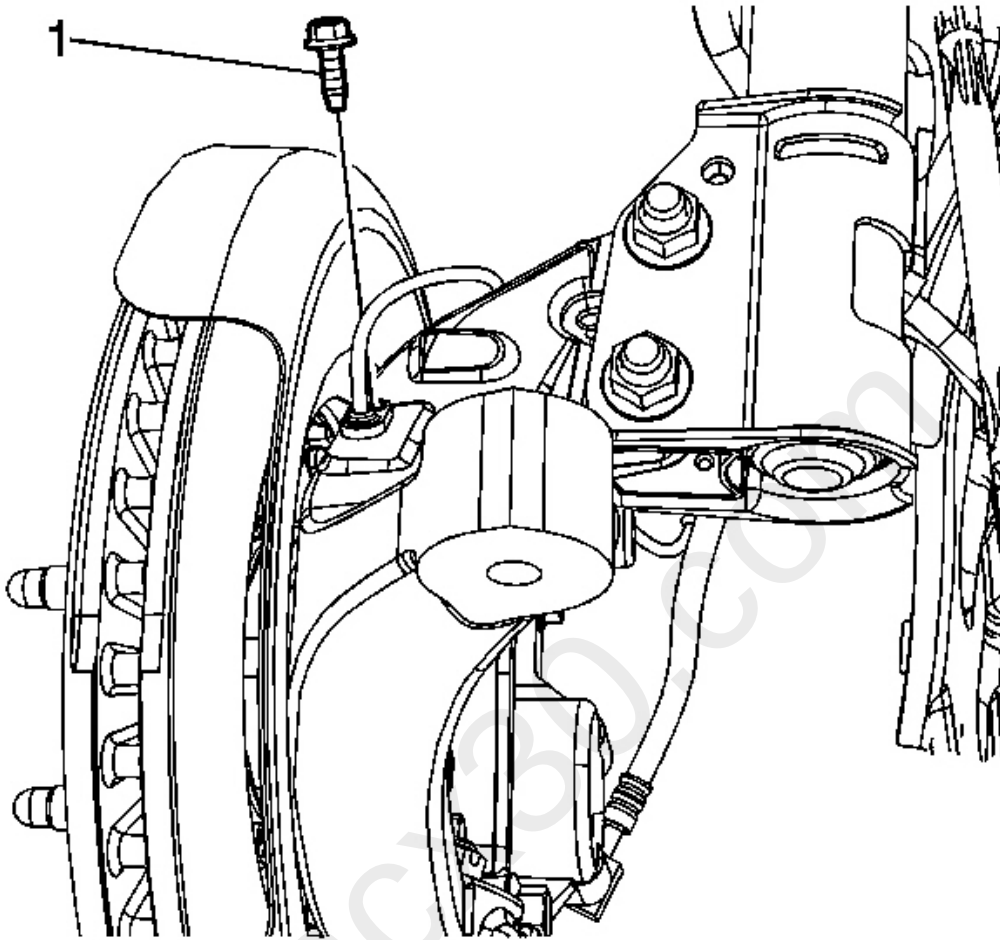


Fig. 29: Wheel Speed Sensor Bolt
Courtesy of GENERAL MOTORS CORP.

6. Remove the wheel speed sensor bolt (1).

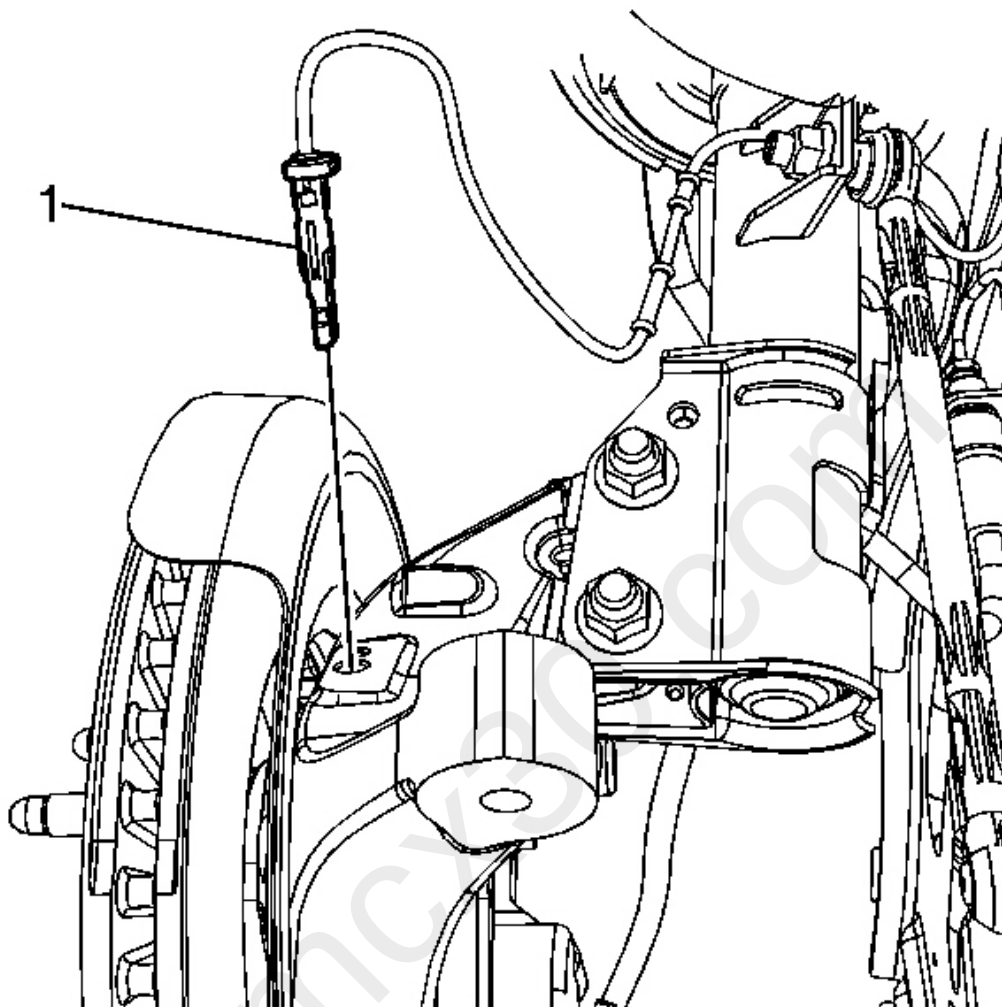


Fig. 30: Wheel Speed Sensor
Courtesy of GENERAL MOTORS CORP.

7. Remove the wheel speed sensor (1) by pulling the sensor straight upward from the steering knuckle.

Installation Procedure

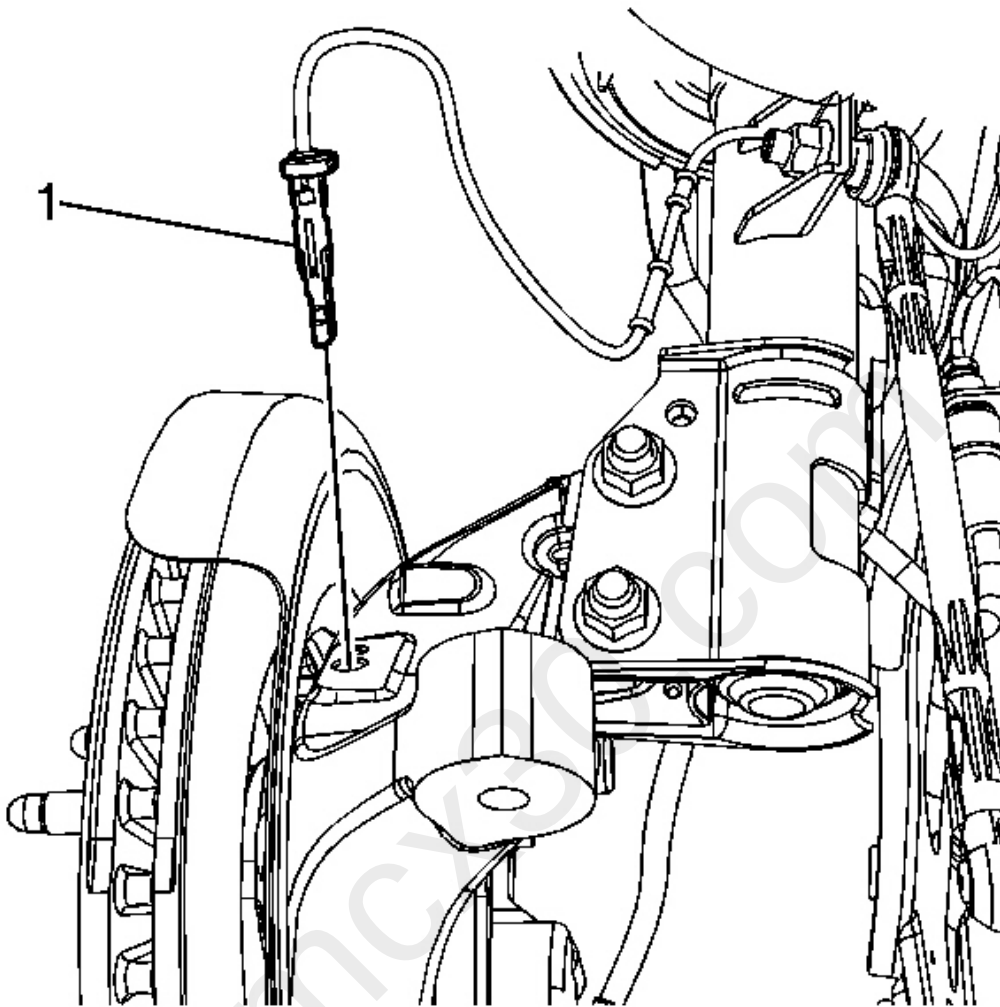


Fig. 31: Wheel Speed Sensor
Courtesy of GENERAL MOTORS CORP.

1. Install the wheel speed sensor (1) to the steering knuckle.

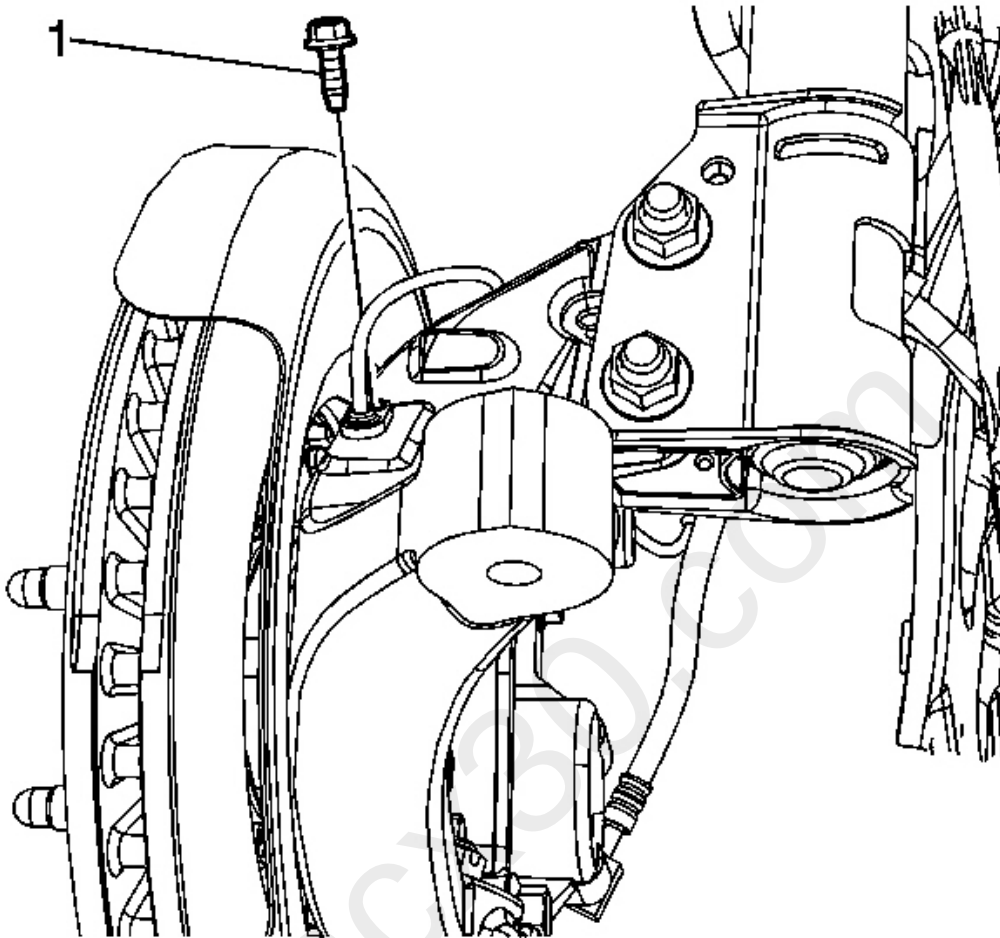


Fig. 32: Wheel Speed Sensor Bolt
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

2. Install the wheel speed sensor bolt (1) and tighten to 10 N.m (89 lb in).

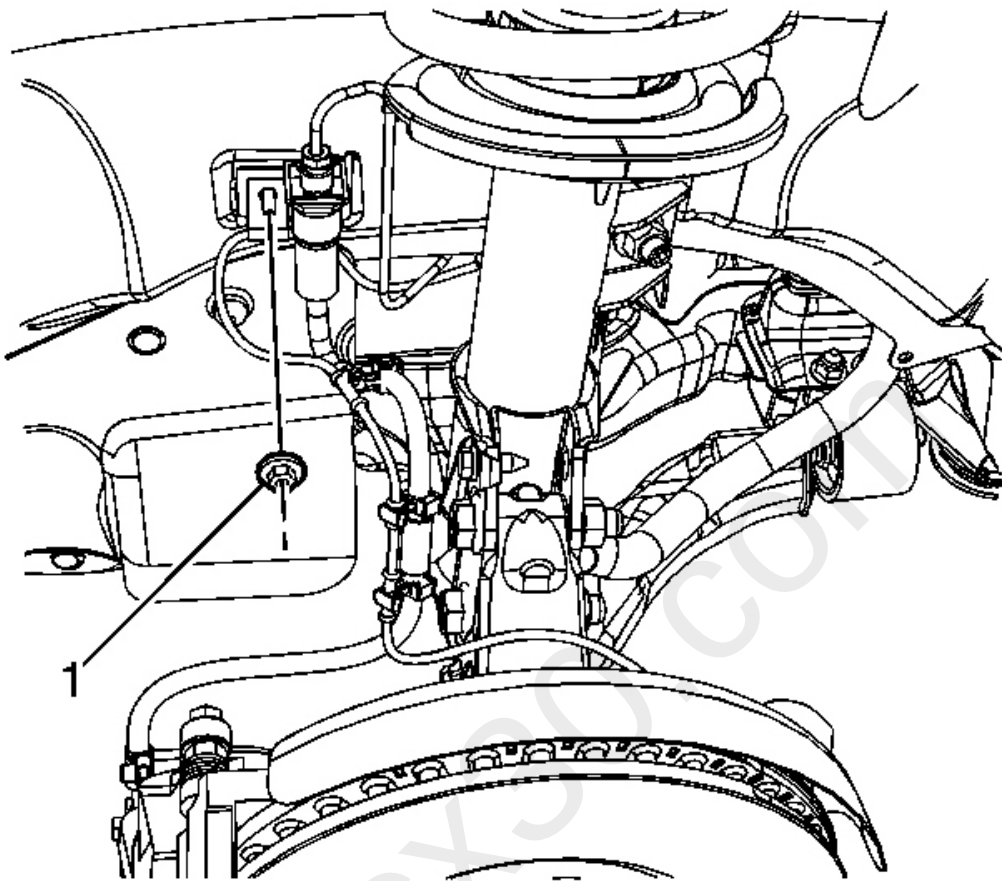


Fig. 33: Front Brake Hose Bracket Nut
Courtesy of GENERAL MOTORS CORP.

3. Install the front brake hose bracket nut (1) and tighten to 10 N.m (89 lb in).
4. Connect the wheel speed sensor electrical connector.
5. Install the front wheel speed sensor harness to the retainers on the front brake hose.
6. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .

REAR WHEEL SPEED SENSOR REPLACEMENT

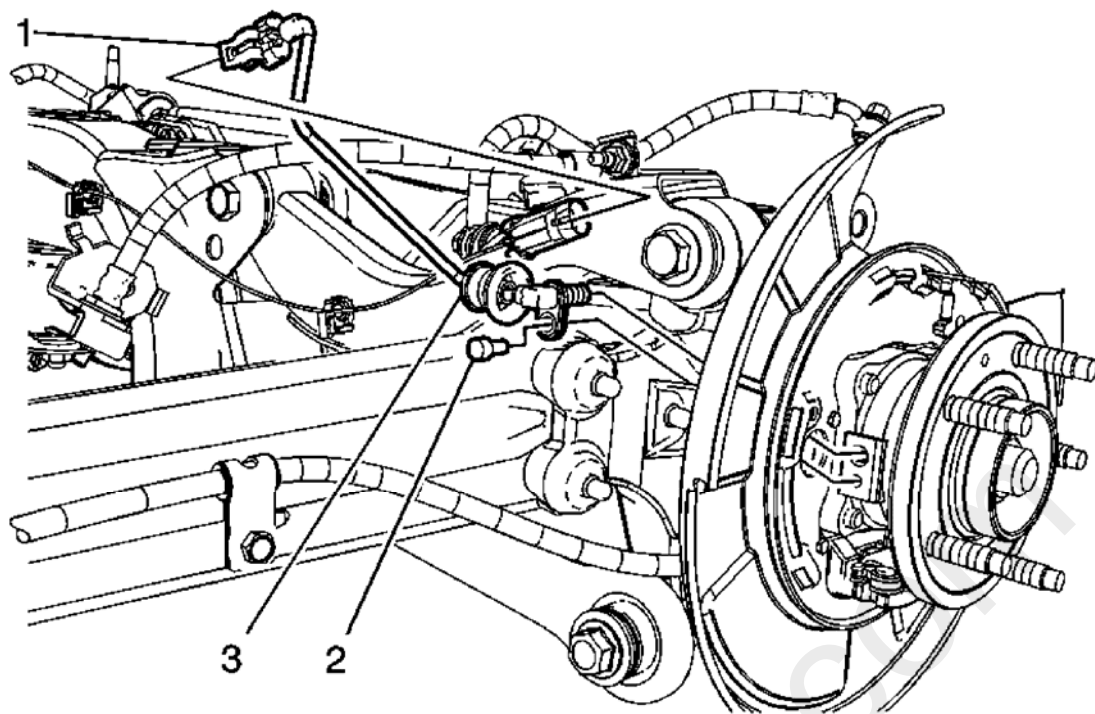


Fig. 34: Rear Wheel Speed Sensor
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
WARNING: Refer to <u>Brake Dust Warning</u> .	
Preliminary Procedures 1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Remove the tire and wheel. Refer to <u>Tire and Wheel Removal and Installation</u> . 3. Remove the park brake shoes. Refer to <u>Parking Brake Shoe Replacement</u> .	
1	Wheel Speed Sensor Electrical Connector
2	Wheel Speed Sensor Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten: 10 N.m (89 lb in)
3	Wheel Speed Sensor Procedure

1. Release the wheel speed sensor electrical harness grommet from the backing plate.
2. Route the wheel speed sensor electrical harness through the backing plate.

ELECTRONIC TRACTION CONTROL AND VEHICLE STABILITY CONTROL SWITCH REPLACEMENT

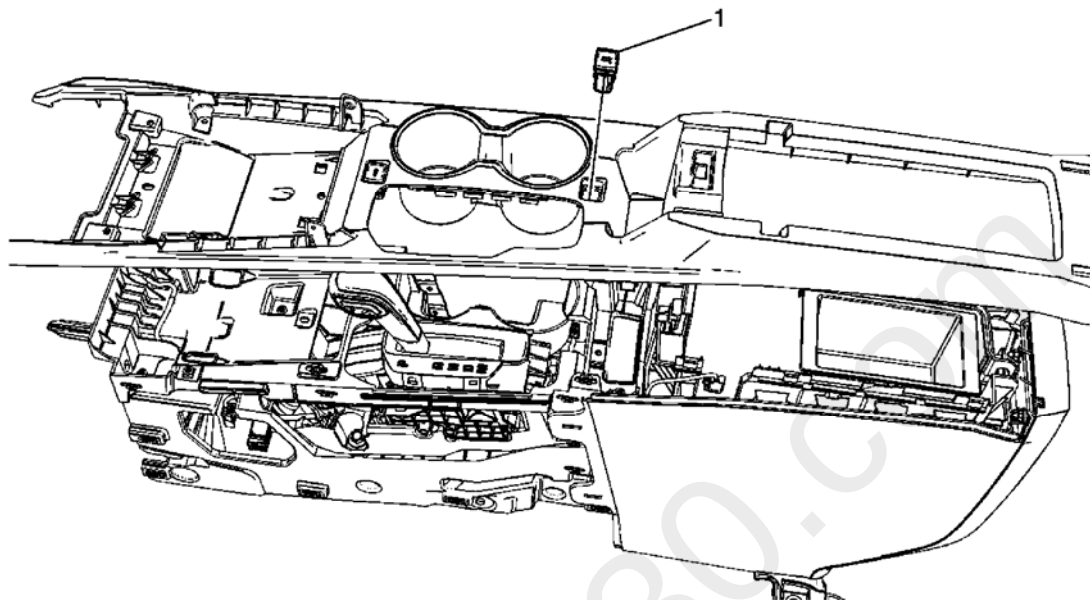


Fig. 35: Electronic Traction Control & Vehicle Stability Control Switch
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Remove the front floor console transmission shift opening trim plate. Refer to <u>Front Floor Console Transmission Shift Opening Trim Plate Replacement</u>	
1	Electronic Traction Control and Vehicle Stability Control Switch 1. Insert your fingers or the appropriate tool into the seam around the shifter assembly and push upward on the traction control switch from below to release the fastening tabs. 2. Disconnect the electrical connector.

VEHICLE YAW SENSOR LEARN

NOTE: The Multi-axis Acceleration Sensor is also known as the Inertia Sensor Module (IMU) in SPS and the Yaw Rate Sensor in the scan tool. The sensor must be configured using SPS before the vehicle yaw sensor learn is performed.

The multi-axis acceleration sensor requires a SPS configuration and a yaw rate sensor learn. This is required after certain service procedures are performed. Some of these procedures are as follows:

- Electronic brake control module (EBCM) replacement
- Multi-axis acceleration sensor replacement
- Vehicle yaw sensor replacement
- Vehicle yaw sensor with lateral and longitudinal accelerometer sensor replacement

The yaw rate sensor learn procedure can be completed with a scan tool using the following steps:

1. Place vehicle on a level surface.
2. Apply the parking brake, or set the transmission in the P position.
3. Install the scan tool to the data link connector.
4. Ignition ON, engine OFF
5. Select Yaw Rate Sensor Reset in the Multi-axis Acceleration Sensor Module Configuration/Reset Functions list.
6. Follow the scan tool directions to complete the calibration procedure.
7. Select Yaw Rate Sensor Learn in the Multi-axis Acceleration Sensor Module Configuration/Reset Functions list.
8. Follow the scan tool directions to complete the calibration procedure.
9. Select Yaw Rate Sensor Learn in the EBCM Configuration/Reset Functions list.
10. Follow the scan tool directions to complete the calibration procedure.
11. Clear any DTCs that may be set.

VEHICLE YAW SENSOR REPLACEMENT

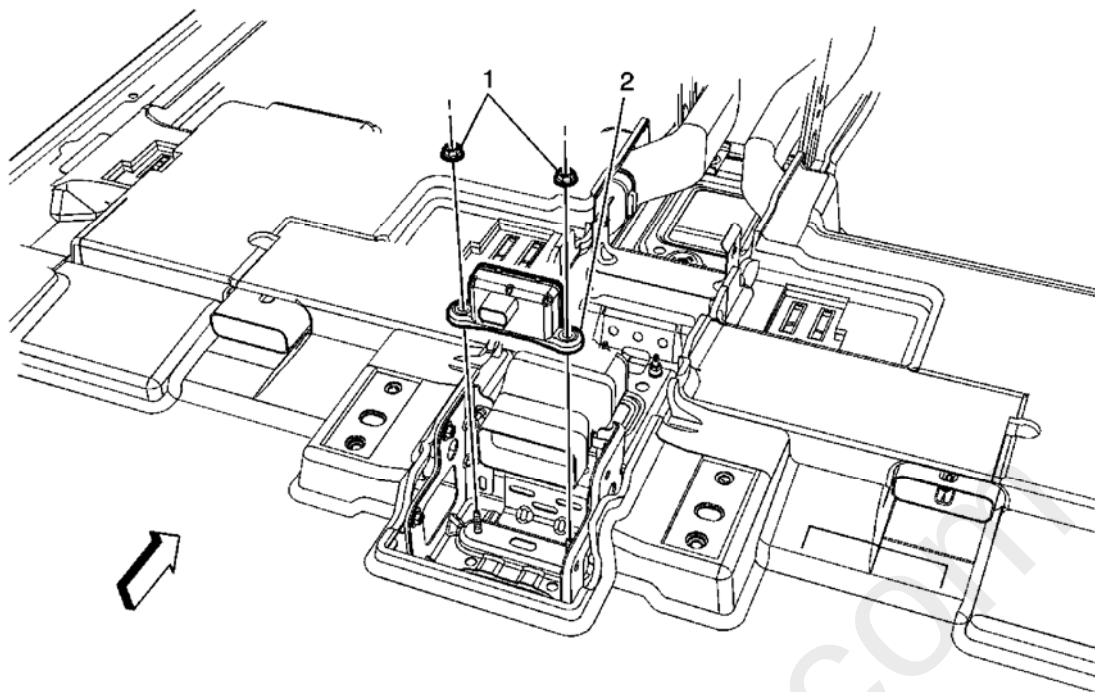


Fig. 36: Vehicle Yaw Sensor
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures 1. Turn the ignition OFF. 2. Remove the front floor console. Refer to <u>Front Floor Console Replacement</u> .	
1	Yaw Rate Sensor Nut CAUTION: Refer to <u>Fastener Caution</u> . Tighten: 6 N.m (53 lb in)
2	Yaw Sensor Procedure 1. After the installation is complete, configure the yaw sensor. Refer to Multi-Axis Acceleration Sensor in <u>Electronic Brake Control Module Programming and Setup</u> . 2. After the installation is complete, perform the <u>Vehicle Yaw Sensor Learn</u>.

DESCRIPTION AND OPERATION

ABS DESCRIPTION AND OPERATION

This vehicle is equipped with a Continental Teves Mk25 brake system. The electronic brake control module (EBCM) and the brake pressure modulator valve assembly are serviced separately. The brake pressure modulator valve assembly uses a 4 circuit configuration to control hydraulic pressure to each wheel independently.

Depending on options, the following vehicle performance enhancement systems are provided.

- Antilock brake system (ABS)
- Traction control
- Stability control
- Dynamic rear proportioning
- Hill start assist
- Hydraulic brake assist
- Trailer stability assist
- Optimized hydraulic braking system

The following components are involved in the operation of the above systems:

- EBCM-The EBCM controls the system functions and detects failures. It supplies voltage to the solenoid valves and pump motor.
- Brake pressure modulator valve assembly-The brake pressure modulator valve assembly contains the following components:
 - Hydraulic pump with pump motor
 - Four isolation valves
 - Four dump valves
 - Two traction control/stability control supply valves
 - Two traction control/stability control isolation valves
 - Pressure sensor
 - High pressure attenuators
 - Low pressure accumulator
- Multi-axis acceleration sensor-The yaw rate, lateral acceleration and longitudinal acceleration sensors are combined into one multi-axis acceleration sensor, external to the EBCM. The EBCM receives serial data message inputs from the yaw rate, lateral acceleration and longitudinal acceleration sensor and activates stability control and hill start assist function depending on multi-axis acceleration sensor input.
- Steering angle sensor-The EBCM receives serial data message inputs from the steering angle sensor. The steering angle sensor signal is used to calculate the desired yaw rate.
- Traction control switch-Traction control and stability control are manually disabled or enabled by pressing the traction control switch.
- Wheel speed sensors-The EBCM sends a 12V reference voltage to each wheel speed sensor. As the wheel spins, the wheel speed sensor produces an alternating current square wave signal. The EBCM uses the

frequency of the square wave signal to calculate the wheel speed.

ABS

When wheel slip is detected during a brake application, an ABS event occurs. During ABS braking, hydraulic pressure in the individual wheel circuits is controlled to prevent any wheel from slipping. A separate hydraulic line and specific solenoid valves are provided for each wheel. The ABS can decrease, hold, or increase hydraulic pressure to each wheel. The ABS does not, however, increase hydraulic pressure above the amount which is transmitted by the master cylinder during braking.

During ABS braking, a series of rapid pulsations is felt in the brake pedal. These pulsations are caused by the rapid changes in position of the individual solenoid valves as the EBCM responds to wheel speed sensor inputs and attempts to prevent wheel slip. These pedal pulsations are present only during ABS braking and stop when normal braking is resumed or when the vehicle comes to a stop. A ticking or popping noise may also be heard as the solenoid valves cycle rapidly. During ABS braking on dry pavement, intermittent chirping noises may be heard as the tires approach slipping. These noises and pedal pulsations are considered normal during ABS operation.

Vehicles equipped with ABS may be stopped by applying normal force to the brake pedal. Brake pedal operation during normal braking is no different than that of previous non ABS systems. Maintaining a constant force on the brake pedal provides the shortest stopping distance while maintaining vehicle stability. The typical ABS activation sequence is as follows.

Pressure Hold

The EBCM closes the isolation valve and keeps the dump valve closed in order to isolate the slipping wheel when wheel slip occurs. This holds the pressure steady on the brake so that the hydraulic pressure does not increase or decrease.

Pressure Decrease

If a pressure hold does not correct the wheel slip condition, a pressure decrease occurs. The EBCM decreases the pressure to individual wheels during deceleration when wheel slip occurs. The isolation valve is closed and the dump valve is opened. The excess fluid is stored in the accumulator until the pump can return the fluid to the master cylinder or fluid reservoir.

Pressure Increase

After the wheel slip is corrected, a pressure increase occurs. The EBCM increases the pressure to individual wheels during deceleration in order to reduce the speed of the wheel. The isolation valve is opened and the dump valve is closed. The increased pressure is delivered from the master cylinder.

Traction Control

When drive wheel slip is noted, the EBCM will enter traction control mode.

First, the EBCM requests the engine control module (ECM) to reduce the amount of torque to the drive wheels via a serial data message. The ECM reduces torque to the drive wheels and reports the amount of delivered

torque.

If the engine torque reduction does not reduce drive wheel slip, the EBCM will actively apply the brakes on the slipping drive wheel. During traction control braking, hydraulic pressure in each drive wheel circuit is controlled to prevent the drive wheels from slipping. The EBCM commands the pump motor and appropriate solenoid valves ON and OFF to apply brake pressure to the slipping wheel.

Traction control can be manually disabled or enabled by pressing the traction control switch.

Stability Control

Stability control provides added stability during aggressive maneuvers. Yaw rate is the rate of rotation about the vehicle's vertical axis. The stability control is activated when the EBCM determines that the desired yaw rate does not match the actual yaw rate as measured by the yaw rate sensor.

The desired yaw rate is calculated by the EBCM using the following inputs:

- Steering wheel position
- Vehicle speed
- Lateral acceleration

The difference between the desired yaw rate and the actual yaw rate is the yaw rate error, which is a measurement of oversteer or understeer. When a yaw rate error is detected, the EBCM attempts to correct the vehicle's yaw motion by applying brake pressure to one or more of the wheels. The amount of brake pressure which is applied varies, depending on the correction required. The engine torque may be reduced also, if it is necessary to slow the vehicle while maintaining stability.

Stability control activations generally occur in turns during aggressive driving. When braking during stability control activation, the brake pedal may pulsate.

Stability control can be manually disabled or enabled by pressing the traction control switch for 5 s.

Dynamic Rear Proportioning

The dynamic rear proportioning is a control system that replaces the mechanical proportioning valve. Under certain driving conditions the EBCM will reduce the rear wheel brake pressure by commanding the appropriate solenoid valves ON and OFF.

Hill Start Assist

The hill start assist allows the driver to launch his vehicle without a roll back while he is moving his foot from the brake pedal to the accelerator pedal. The EBCM calculates the brake pressure, which is needed to hold the vehicle on an incline and locks that pressure for a certain time by commanding the appropriate solenoid valves ON and OFF when the brake pedal is released. Hill start assist is activated when the EBCM determines that the driver wishes to move his vehicle up-hill, either backwards or forwards.

The following inputs are used for hill start assist feature:

- Brake switch
- Brake pressure
- Longitudinal acceleration
- Engine torque
- Reverse gear information
- Clutch switch
- Accelerator pedal position
- Vehicle speed

Hydraulic Brake Assist

The hydraulic brake assist function is designed to support the driver in emergency braking situations.

The EBCM receives inputs from the brake pressure sensor. When the EBCM senses an emergency braking situation, it will actively increase the hydraulic brake pressure to a specific maximum by turning the pump motor ON.

Trailer Stability Assist

The trailer stability assist will detect any vehicle yaw instability, caused by an attached trailer. When instability is detected, the EBCM attempts to correct the vehicle's yaw motion by applying brake pressure to one or more of the wheels. The engine torque may be reduced also, if it is necessary to slow down the vehicle.

Optimized Hydraulic Braking System

With some engines the EBCM monitors the vacuum in the brake booster with a vacuum sensor and controls a brake booster vacuum pump depending on vacuum sensor input. It also has a hydraulic brake boost feature which supplements the brake system to maintain consistent brake performance under conditions of low brake booster vacuum. Low brake booster vacuum conditions can include initial start up after the vehicle has been parked for several hours, very frequent brake stops, or high altitude driving. The hydraulic brake boost system activates only during a brake apply under low vacuum conditions. In this case the EBCM will actively increase and control the hydraulic brake pressure by turning the pump motor ON and the appropriate solenoid valves ON and OFF. When hydraulic brake boost is active, a series of rapid pulsations is felt in the brake pedal.

Driver Information Indicators

Brake Warning Indicator

The instrument cluster turns the brake warning indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The EBCM detects a fault and sends a serial data message to the instrument cluster requesting illumination.
- The body control module (BCM) detects that the park brake is engaged. The instrument cluster receives a serial data message from the BCM requesting illumination.

ABS Indicator

The instrument cluster turns the ABS indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The EBCM detects a malfunction which disables the ABS and sends a serial data message to the instrument cluster requesting illumination.

Traction Control/Stability Control Active Indicator

The instrument cluster turns the traction control/stability control-active indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The ABS system is in traction control or stability control mode.
- The EBCM detects a malfunction which disables the traction control or stability control and sends a serial data message to the instrument cluster requesting illumination.

Traction Control Off Indicator

The instrument cluster turns the traction control off indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The driver manually disables the traction control by pressing the traction control switch. The EBCM sends a serial data message to the instrument cluster requesting illumination.

Stability Control Off Indicator

The instrument cluster turns the stability control off indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The driver manually disables the stability control by pressing the traction control switch. The EBCM sends a serial data message to the instrument cluster requesting illumination.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

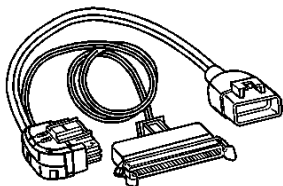
Illustration	Tool Number/ Description
	J 35616 GM-Approved Terminal Test Kit



J 39700
100-Pin Breakout Box



J 39700-300
ABS Breakout Box Adapter



J 39700-530
Breakout Box Adapter