2010 BRAKES

Antilock Brake System - HHR

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	Specification	
	Metric	English
Brake Pipe Fitting	21 N.m	15 lb ft
Brake Pressure Modulator Valve (BPMV) Bolt	11 N.m	97 lb in
BPMV Bracket Bolt	25 N.m	18 lb ft
BPMV Mounting Pin	10 N.m	89 lb in
Electronic Brake Control Module (EBCM) Bolt	3 N.m	27 lb in
Inflatable Restraint Indicator Bracket Screw	2 N.m	18 lb in
Yaw Rate Sensor Niut	10 N.m	89 lb in

SCHEMATIC AND ROUTING DIAGRAMS

ANTILOCK BRAKE SYSTEM SCHEMATICS

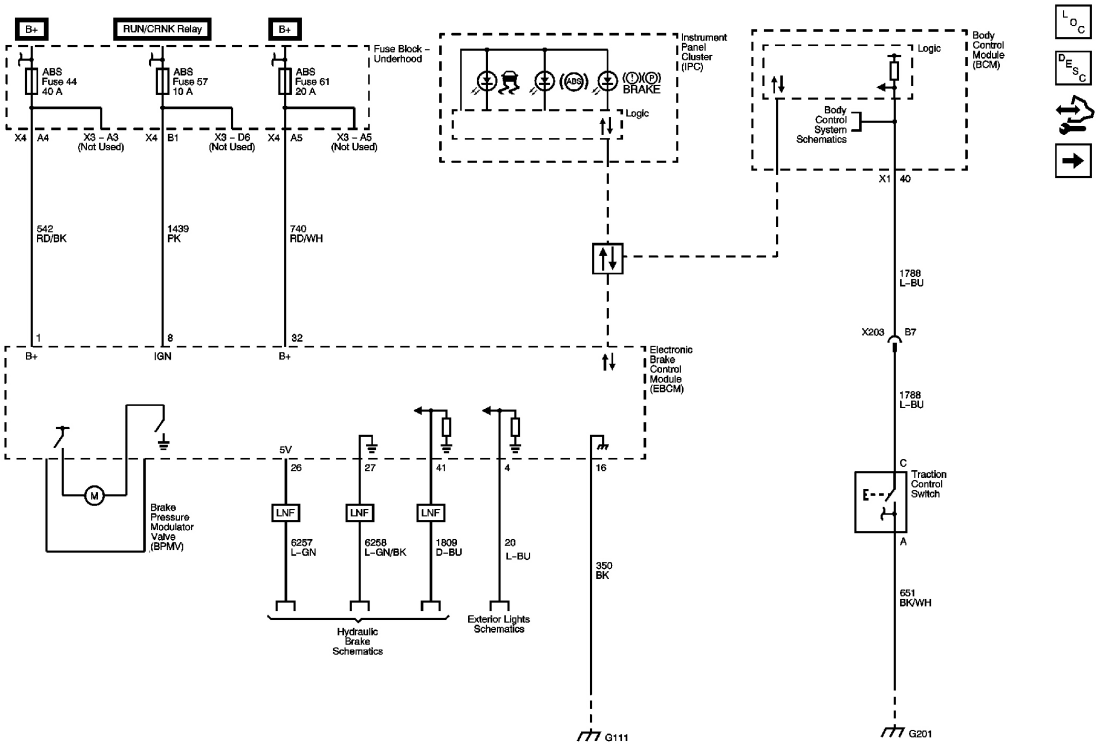

Fig. 1: Power, Ground, Serial Data and Traction Control
Courtesy of GENERAL MOTORS CORP.

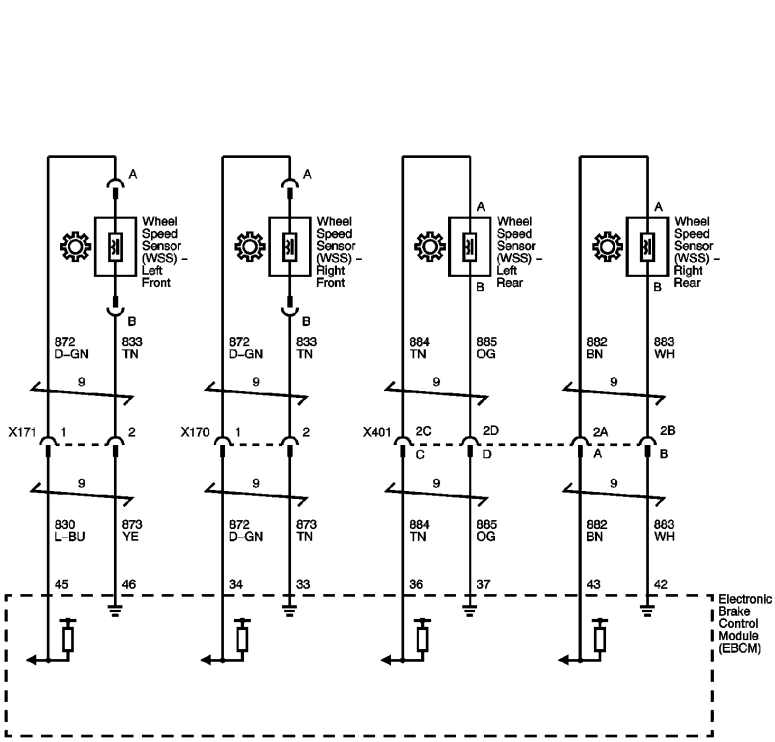

Fig. 2: Wheel Speed Signals
Courtesy of GENERAL MOTORS CORP.

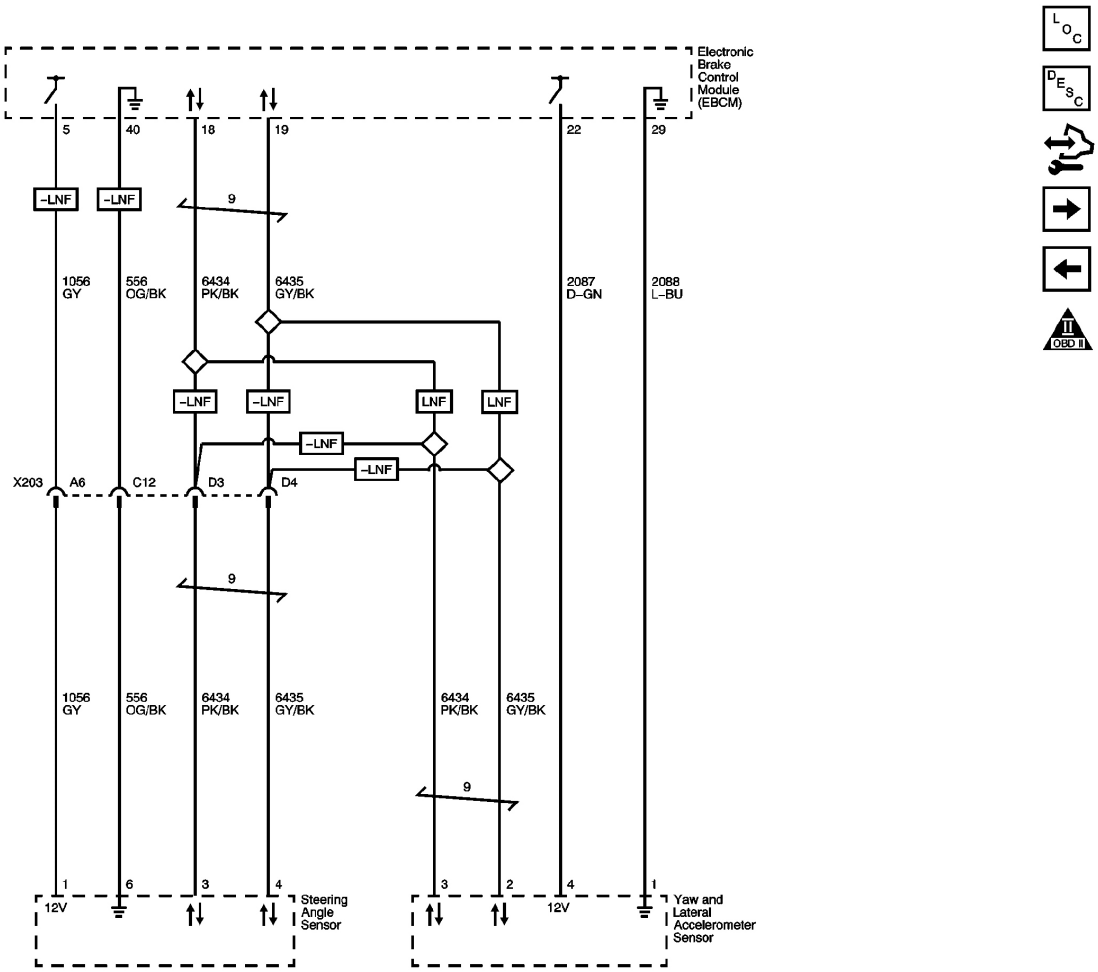

Fig. 3: Vehicle Stability Control
Courtesy of GENERAL MOTORS CORP.

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC C0035-C0050 (With LNF)	C0035 00: Left Front Wheel Speed Sensor Circuit No Additional Information C0035 0F: Left Front Wheel Speed Sensor Circuit Erratic Signal C0035 18: Left Front Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum C0040 00: Right Front Wheel Speed Sensor Circuit No Additional Information C0040 0F: Right Front Wheel Speed Sensor Circuit Erratic Signal C0040 18: Right Front Wheel Speed Sensor Circuit Signal Amplitude

	Less Than Minimum C0045 00: Left Rear Wheel Speed Sensor Circuit No Additional Information C0045 0F: Left Rear Wheel Speed Sensor Circuit Erratic Signal C0045 18: Left Rear Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum C0050 00: Right Rear Wheel Speed Sensor Circuit No Additional Information C0050 0F: Right Rear Wheel Speed Sensor Circuit Erratic Signal C0050 18: Right Rear Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum
DTC C0035-C0050 (Without LNF)	C0035 00: Left Front Wheel Speed Sensor Circuit No Additional Information C0035 0F: Left Front Wheel Speed Sensor Circuit Erratic Signal C0035 18: Left Front Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum C0040 00: Right Front Wheel Speed Sensor Circuit No Additional Information C0040 0F: Right Front Wheel Speed Sensor Circuit Erratic Signal C0040 18: Right Front Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum C0045 00: Left Rear Wheel Speed Sensor Circuit No Additional Information C0045 0F: Left Rear Wheel Speed Sensor Circuit Erratic Signal C0045 18: Left Rear Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum C0050 00: Right Rear Wheel Speed Sensor Circuit No Additional Information C0050 0F: Right Rear Wheel Speed Sensor Circuit Erratic Signal C0050 18: Right Rear Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum
DTC C0110	C0110 04: Pump Motor Circuit Open Circuit C0110 61: Pump Motor Circuit Actuator Stuck
DTC C0131	C0131 00: ABS Pressure Circuit C0131 5A: ABS Pressure Circuit Plausibility Failure
DTC C0161	C0161 00: ABS/TCS Brake Switch Circuit
DTC C0186	C0186 00: Lateral Accelerometer Circuit Electrical Failure C0186 1A: Lateral Accelerometer Circuit Bias Level Out of Range C0186 3B: Lateral Accelerometer Circuit Internal Self Test Failed C0186 5A: Lateral Accelerometer Circuit Plausibility Failure
DTC C0196	C0196 00: Yaw Rate Circuit C0196 1A: Yaw Rate Circuit Bias Level Out of Range C0196 3B: Yaw Rate Circuit Internal Self Test Failed C0196 5A: Yaw Rate Circuit Plausibility Failure
DTC C0201	C0201 04: Antilock Brake System (ABS) Enable Relay Contact Circuit Open
DTC C0252	C0252 4A: Steering Wheel Position Sensor Offset Checksum Failure

DTC C0280	C0280 00: Stability System Active Too Long
DTC C0292	C0292: VSES Combination Sensor Circuits
DTC C0460	C0460 00: Steering Position Signal C0460 42: Steering Position Signal Initialization Not Accomplished C0460 4B: Steering Position Signal Calibration Not Accomplished C0460 5A: Steering Position Signal Not Plausible C0460 71: Steering Position Signal Internal Failure C0460 72: Steering Position Signal Rolling Count Invalid
DTC C0551	C0551 00: Option Configuration Error C0551 41: Option Configuration Error Calibration Set Not Programmed C0551 45: Option Configuration Error Variant Not Programmed C0551 47: Option Configuration Error VIN Not Programmed C0551 4A: Option Configuration Checksum Error
DTC C0561	C0561 71: System Disabled Information Stored
DTC C0569	C0569 00: System Configuration Error
DTC P0856	P0856: Engine Control Module (ECM) Traction Control Torque Request Circuit

DTC C0035-C0050 (WITH LNF)

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 C0035 00

Left Front Wheel Speed Sensor Circuit No Additional Information

DTC C0035 0F

Left Front Wheel Speed Sensor Circuit Erratic Signal

DTC C0035 18

Left Front Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum

DTC C0040 00

Right Front Wheel Speed Sensor Circuit No Additional Information

DTC C0040 0F

Right Front Wheel Speed Sensor Circuit Erratic Signal

DTC C0040 18

Right Front Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum

DTC C0045 00

Left Rear Wheel Speed Sensor Circuit No Additional Information

DTC C0045 0F

Left Rear Wheel Speed Sensor Circuit Erratic Signal

DTC C0045 18

Left Rear Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum

DTC C0050 00

Right Rear Wheel Speed Sensor Circuit No Additional Information

DTC C0050 0F

Right Rear Wheel Speed Sensor Circuit Erratic Signal

DTC C0050 18

Right Rear Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Front Sensor Signal	C0035 00	C0035 00	C0035 00	C0035 0F, C0035 18
Left Front Sensor Low Reference	C0035 00	C0035 00	C0035 00	C0035 0F, C0035 18
Right Front Sensor Signal	C0040 00	C0040 00	C0040 00	C0040 0F, C0040 18
Right Front Sensor Low Reference	C0040 00	C0040 00	C0040 00	C0040 0F, C0040 18
Left Rear Sensor Signal	C0045 00	C0045 00	C0045 00	C0045 0F, C0045 18
Left Rear Sensor Low Reference	C0045 00	C0045 00	C0045 00	C0045 0F, C0045 18

Right Rear Sensor Signal	C0050 00	C0050 00	C0050 00	C0050 0F, C0050 18
Right Rear Sensor Low Reference	C0050 00	C0050 00	C0050 00	C0050 0F, C0050 18

Circuit/System Description

The wheel speed sensor receives ignition voltage from the electronic brake control module (EBCM) and provides an output signal to the EBCM. As the wheel spins, the wheel speed sensor sends a DC square wave signal. The EBCM uses the frequency of the square wave signal to calculate the wheel speed.

Conditions for Running the DTC

C0035-C0050 00

- The ignition is ON.
- Ignition voltage is greater than 9.5 volts.

C0035-C0050 0F

- The ignition is ON.
- Ignition voltage is greater than 9.5 volts.
- The brake pedal is not pressed.
- A DTC is not set for the other wheel speed circuit on the same axle.

C0035-C0050 18

- The ignition is ON.
- Ignition voltage is greater than 9.5 volts.
- The brake pedal is not pressed.
- No other wheel speed circuit DTCs are set.
- At least two other wheel speeds are not 0 km/h.

Conditions for Setting the DTC

C0035-C0050 00

- An open is detected on the wheel speed sensor signal circuit.
- A short to ground is detected on the wheel speed sensor signal circuit.
- A short to voltage is detected on the wheel speed sensor signal circuit.

C0035-C0050 0F

The EBCM detects a rapid variation in the wheel speed. The wheel speed changes by 20 km/h (12 mph) or more in 0.01 second. The change must occur 3 times with no more than 0.2 seconds between occurrences.

C0035-C0050 18

- One wheel speed is 2 km/h (1.2 mph).
- The remaining wheel speeds are greater than 10 km/h (6.2 mph).
- The difference between the remaining wheel speeds is less than 8 km/h (5 mph) from each other for 180 seconds.

OR

- The 2 wheel speed sensor inputs are 0 and DTCs are set.
- The 2 suspect wheel speeds equal zero for 6 seconds.
- The other wheel speeds are greater than 15 km/h (10 mph).
- The other wheel speeds are within 11 km/h (7 mph) of each other.

Action Taken When the DTC Sets

- The EBCM disables the antilock brake system (ABS)/Engine Traction System for the duration of the ignition cycle.
- The dynamic rear proportion does not function optimally with multiple wheel speed faults.
- The ABS indicator turns ON.
- The Engine Traction System indicator turns ON.
- An ECE response may occur. Refer to **ABS Description and Operation** for complete description of ECE 13.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.
- The ABS indicator will remain on until a vehicle speed of 13 km/h (8 mph) or greater is achieved, unless the Scan has cleared codes.

Diagnostic Aids

If 2 or more wheel speed sensors are inoperative diagnose each wheel speed sensor individually.

If the customer comments that the ABS indicator is ON only during moist environmental conditions: rain, snow, vehicle wash, etc., inspect the wheel speed sensor wiring for signs of water intrusion. If the DTC is not current, clear all DTCs and simulate the effects of water intrusion by using the following procedure:

1. Spray the suspected area with a 5 percent saltwater solution. To create a 5 percent saltwater solution, add 2 teaspoons of salt to 8 fl oz of water (10 g of salt to 200 ml of water).
2. Test drive the vehicle over various road surfaces: bumps, turns, etc., above 40 km/h (25 mph) for at least 30 seconds. Also rotate steering wheel from stop to stop for intermittent condition caused from open or chaffing of the front wheel speed sensor harness.

3. Rinse the area thoroughly when completed.

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 Wheel Speed Sensor parameter. The reading should be the same speed on all sensors when driving in a straight line at a speed greater than 15 km/h (10 mph).

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the EBCM.
2. Ignition ON, test for less than 1 V between the ignition voltage circuit terminal of the appropriate sensor listed below and ground.
    - Left Front Sensor circuit terminal 46
    - Right Front Sensor circuit terminal 33
    - Left Rear Sensor circuit terminal 37
    - Right Rear Sensor circuit terminal 42
    - If greater than the specified range, test the ignition voltage circuit for a short to voltage.
3. Test for less than 1 V between the signal circuit terminal of the appropriate sensor listed below and ground.

- Left Front Sensor circuit terminal 45
- Right Front Sensor circuit terminal 34
- Left Rear Sensor circuit terminal 36
- Right Rear Sensor circuit terminal 43
  - If greater than the specified range, test the signal circuit for a short to voltage.

4. Ignition OFF, test for infinite resistance between the appropriate low reference terminal listed below and ground.
   - Left Front Sensor circuit terminal 46
   - Right Front Sensor circuit terminal 33
   - Left Rear Sensor circuit terminal 37
   - Right Rear Sensor circuit terminal 42
     - If not the specified value, test the low reference circuit for a short to ground. If the circuit tests normal, replace the EBCM.
5. Test for infinite resistance between the appropriate signal circuit terminal listed below and ground.
   - Left Front Sensor circuit terminal 45
   - Right Front Sensor circuit terminal 34
   - Left Rear Sensor circuit terminal 36
   - Right Rear Sensor circuit terminal 43
     - If not the specified value, test the signal circuit for a short to ground. If the circuit tests normal, replace the EBCM.
6. Ignition OFF, disconnect the harness connector at the appropriate wheel speed sensor.
7. Ignition OFF, test for less than 2 ohms between the appropriate ignition voltage circuit terminals listed below.
   - Left Front Sensor circuit terminal 45 at the EBCM harness connector and terminal A at the wheel speed sensor harness connector.
   - Right Front Sensor circuit terminal 34 at the EBCM harness connector and terminal A at the wheel speed sensor harness connector.
   - Left Rear Sensor circuit terminal 36 at the EBCM harness connector and terminal A at the wheel speed sensor harness connector.
   - Right Rear Sensor circuit terminal 43 at the EBCM harness connector and terminal A at the wheel speed sensor harness connector.
     - If greater than the specified value, test the ignition voltage circuit for an open or high resistance.
8. Test for less than 2 ohms between the appropriate signal circuit terminals listed below.
   - Left Front Sensor circuit terminal 46 at the EBCM harness connector and terminal B at the wheel speed sensor harness connector.
   - Right Front Sensor circuit terminal 33 at the EBCM harness connector and terminal B at the wheel speed sensor harness connector.
   - Left Rear Sensor circuit terminal 37 at the EBCM harness connector and terminal B at the wheel speed sensor harness connector.
   - Right Rear Sensor circuit terminal 42 at the EBCM harness connector and terminal B at the wheel

speed sensor harness connector.
- If greater than the specified value, test the signal circuit for an open or high resistance.

9. If all circuits test normal, replace the appropriate wheel speed sensor. If the DTC resets, replace the EBCM.

Repair Procedures

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

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

DTC C0035-C0050 (WITHOUT LNF)

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 C0035 00

Left Front Wheel Speed Sensor Circuit No Additional Information

DTC C0035 0F

Left Front Wheel Speed Sensor Circuit Erratic Signal

DTC C0035 18

Left Front Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum

DTC C0040 00

Right Front Wheel Speed Sensor Circuit No Additional Information

DTC C0040 0F

Right Front Wheel Speed Sensor Circuit Erratic Signal

DTC C0040 18

Right Front Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum

DTC C0045 00

Left Rear Wheel Speed Sensor Circuit No Additional Information

DTC C0045 0F

Left Rear Wheel Speed Sensor Circuit Erratic Signal

DTC C0045 18

Left Rear Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum

DTC C0050 00

Right Rear Wheel Speed Sensor Circuit No Additional Information

DTC C0050 0F

Right Rear Wheel Speed Sensor Circuit Erratic Signal

DTC C0050 18

Right Rear Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Front Sensor Signal	C0035 00	C0035 00	C0035 00	C0035 0F, C0035 18
Left Front Sensor Low Reference	C0035 00	C0035 00	C0035 00	C0035 0F, C0035 18
Right Front Sensor Signal	C0040 00	C0040 00	C0040 00	C0040 0F, C0040 18
Right Front Sensor Low Reference	C0040 00	C0040 00	C0040 00	C0040 0F, C0040 18
Left Rear Sensor Signal	C0045 00	C0045 00	C0045 00	C0045 0F, C0045 18
Left Rear Sensor Low Reference	C0045 00	C0045 00	C0045 00	C0045 0F, C0045 18
Right Rear Sensor Signal	C0050 00	C0050 00	C0050 00	C0050 0F, C0050 18
Right Rear Sensor Low Reference	C0050 00	C0050 00	C0050 00	C0050 0F, C0050 18

Circuit/System Description

As the wheel spins, the wheel speed sensor produces an AC signal. The electronic brake control module (EBCM) uses the frequency of the AC signal to calculate the wheel speed.

Conditions for Running the DTC

C0035-C0050 00

- The ignition is ON.
- Ignition voltage is greater than 9.5 V.

C0035-C0050 0F

- The ignition is ON.
- Ignition voltage is greater than 9.5 V.
- The brake pedal is not pressed.
- A DTC is not set for the other wheel speed circuit on the same axle.

C0035-C0050 18

- The ignition is ON.
- Ignition voltage is greater than 9.5 V.
- The brake pedal is not pressed.
- No other wheel speed circuit DTCs are set.
- At least two other wheel speeds are not 0 km/h.

Conditions for Setting the DTC

C0035-C0050 00

- An open is detected on the wheel speed sensor signal circuit.
- A short to ground is detected on the wheel speed sensor signal circuit.
- A short to voltage is detected on the wheel speed sensor signal circuit.

C0035-C0050 0F

The EBCM detects a rapid variation in the wheel speed. The wheel speed changes by 20 km/h (12 mph) or more in 0.01 second. The change must occur 3 times with no more than 0.2 seconds between occurrences.

C0035-C0050 18

- One wheel speed is 2 km/h (1.2 mph).
- The remaining wheel speeds are greater than 10 km/h (6.2 mph).
- The difference between the remaining wheel speeds is less than 8 km/h (5 mph) from each other for 180 seconds.

OR

- The 2 wheel speed sensor inputs are 0 and DTCs are set.
- The 2 suspect wheel speeds equal zero for 6 seconds.
- The other wheel speeds are greater than 15 km/h (10 mph).
- The other wheel speeds are within 11 km/h (7 mph) of each other.

Action Taken When the DTC Sets

- The EBCM disables the antilock brake system (ABS)/engine traction system for the duration of the ignition cycle.
- The dynamic rear proportion does not function optimally with multiple wheel speed faults.
- The ABS indicator turns ON.
- The engine traction system (ETS) indicator turns ON.
- An ECE response may occur. Refer to **ABS Description and Operation** for complete description of ECE 13.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.
- The ABS indicator will remain on until a vehicle speed of 13 Km/h (8 mph) or greater is achieved, unless the Scan has cleared codes.

Diagnostic Aids

If 2 or more wheel speed sensors are inoperative diagnose each wheel speed sensor individually.

If the customer comments that the ABS indicator is ON only during moist environmental conditions: rain, snow, vehicle wash, etc., inspect the wheel speed sensor wiring for signs of water intrusion. If the DTC is not current, clear all DTCs and simulate the effects of water intrusion by using the following procedure:

1. Spray the suspected area with a 5 percent saltwater solution. To create a 5 percent saltwater solution, add 2 teaspoons of salt to 8 FL oz of water (10 g of salt to 200 ml of water).
2. Test drive the vehicle over various road surfaces: bumps, turns, etc., above 40 km/h (25 mph) for at least 30 seconds. Also rotate steering wheel from stop to stop for intermittent condition caused from open or chaffing of the front wheel speed sensor harness.
3. Rinse the area thoroughly when completed.

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 Wheel Speed Sensor parameter. The reading should be the same speed on all sensors when driving in a straight line at a speed greater than 15 km/h (10 mph).

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the EBCM.
2. Ignition ON, test for 0 V between the appropriate low reference circuit terminal listed below and ground:
    - LF Sensor circuit terminal 8 (JM4)
    - LF Sensor circuit terminal 46 (JL4)
    - RF Sensor circuit terminal 6 (JM4)
    - RF Sensor circuit terminal 33 (JL4)
    - LR Sensor circuit terminal 2 (JM4)
    - LR Sensor circuit terminal 37 (JL4)
    - RR Sensor circuit terminal 12 (JM4)
    - RR Sensor circuit terminal 42 (JL4)
    - If not the specified value, test the low reference circuit for a short to voltage. If the circuit tests normal, replace the EBCM.
3. Test for 0 V between the appropriate signal circuit terminal listed below and ground:
    - LF Sensor circuit terminal 9 (JM4)
    - LF Sensor circuit terminal 45 (JL4)
    - RF Sensor circuit terminal 5 (JM4)
    - RF Sensor circuit terminal 34 (JL4)

- LR Sensor circuit terminal 3 (JM4)
- LR Sensor circuit terminal 36 (JL4)
- RR Sensor circuit terminal 11 (JM4)
- RR Sensor circuit terminal 43 (JL4)
  - If not the specified value, test the signal circuit for a short to voltage. If the circuit tests normal, replace the EBCM.

4. Ignition OFF, test for infinite resistance between the appropriate low reference terminal listed below and ground:
   - LF Sensor circuit terminal 8 (JM4)
   - LF Sensor circuit terminal 46 (JL4)
   - RF Sensor circuit terminal 6 (JM4)
   - RF Sensor circuit terminal 33 (JL4)
   - LR Sensor circuit terminal 2 (JM4)
   - LR Sensor circuit terminal 37 (JL4)
   - RR Sensor circuit terminal 12 (JM4)
   - RR Sensor circuit terminal 42 (JL4)
     - If not the specified value, test the low reference circuit for a short to ground. If the circuit tests normal, replace the EBCM.
5. Test for infinite resistance between the appropriate signal circuit terminal listed below and ground:
   - LF Sensor circuit terminal 9 (JM4)
   - LF Sensor circuit terminal 45 (JL4)
   - RF Sensor circuit terminal 5 (JM4)
   - RF Sensor circuit terminal 34 (JL4)
   - LR Sensor circuit terminal 3 (JM4)
   - LR Sensor circuit terminal 36 (JL4)
   - RR Sensor circuit terminal 11 (JM4)
   - RR Sensor circuit terminal 43 (JL4)
     - If not the specified value, test the signal circuit for a short to ground. If the circuit tests normal, replace the EBCM.
6. Test for 1200-2700 ohms between the appropriate wheel speed sensor circuit terminal listed below:
   - LF Sensor circuit terminal 8 and 9 (JM4)
   - LF Sensor circuit terminal 45 and 46 (JL4)
   - RF Sensor circuit terminal 5 and 6 (JM4)
   - RF Sensor circuit terminal 33 and 34 (JL4)
   - LR Sensor circuit terminal 2 and 3 (JM4)
   - LR Sensor circuit terminal 36 and 37 (JL4)
   - RR Sensor circuit terminal 11 and 12 (JM4)
   - RR Sensor circuit terminal 42 and 43 (JL4)

- If not within the specified range, test the low reference and signal circuits for an open/high resistance. If the circuit tests normal, replace the wheel speed sensor.

7. If all circuits test normal, replace the EBCM.

Repair Procedures

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

- **Front Wheel Bearing and Hub Replacement**
- **Rear Wheel Bearing and Hub 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 04

Pump Motor Circuit Open Circuit

DTC C0110 61

Pump Motor Circuit Actuator Stuck

Circuit/System Description

The pump motor is an integral part of the brake pressure modulator valve (BPMV), 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 Antilock Brake System (ABS) or Engine Traction System (ETS) operation is required the EBCM activates the pump motor relay and battery power is provided to the pump motor.

Conditions for Running the DTC

C0110 04

- The ignition switch is in the ON position.
- Initialization is complete.

C0110 61

- The test is initiated once per ignition cycle, when the vehicle speed is greater than 8 km/h (5 mph), and a fault was set on the last ignition cycle.
- The vehicle speed is greater than 20 km/h (13 mph), and the brake is not applied.
- The vehicle speed is greater than 40 km/h (26 mph).

Conditions for Setting the DTC

C0110 04

The EBCM detects a low voltage in the pump motor supply circuit when the feedback voltage is less than 6 volts for more than 1.8 seconds, and the pump motor is not activated. The ground circuit is open, and the feedback voltage is greater than 0.93 volt for 1.8 seconds, the pump is not activated.

C0110 61

The pump motor continues to rotate briefly after activation creating a feedback voltage. The EBCM sets the code if the measured feedback voltage indicates a binding or stalled pump motor.

Action Taken When the DTC Sets

- The EBCM disables the ABS/ETS for the duration of the ignition cycle.
- The ABS indicator turns ON.
- The traction system indicator turns ON.
- An ECE response may occur. Refer to **ABS Description and Operation** for complete description of ECE 13

Conditions for Clearing the DTC

- The condition for the DTC is no longer present.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.
- The ABS indicator will remain on until a vehicle speed of 13 Km/h (8 mph) or greater is achieved, unless the Scan has cleared codes.

Diagnostic Aids

The pump motor is integral to the BPMV. The pump motor is not serviceable. Inspect the power and ground circuits proper connections.

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, command the Pump Motor test with a scan tool. listen/feel the pump motor turn on.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the EBCM.
2. Test for less than 5 ohms between the ground circuit terminal 26 and ground.
    - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Ignition ON, verify that a test lamp illuminates between the B+ circuit terminal 14 and ground.
    - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance. If the circuit tests normal and the B+ circuit fuse is open, test or replace the BPMV.
4. Ignition OFF, remove the EBCM from the BPMV.
5. Inspect the EBCM to BPMV connector for conditions such as damage, corrosion, or presence of brake fluid.
    - If connector corrosion or damage is evident, replace BPMV and/or EBCM as necessary.
    - If brake fluid is present, replace both BPMV and EBCM.
6. Connect the EBCM harness connector with the BPMV still separated.
7. Connect a test lamp between the pump motor circuits terminals.
8. Command the Pump Motor Test with a scan tool, the test lamp should illuminate when commanded.
    - If test lamp does not illuminate, replace the EBCM. If the DTC resets, replace the BPMV.
9. If all circuits test normal, replace the BPMV.

Repair Procedures

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

- **Brake Pressure Modulator Valve Replacement (With JL4)** or **Brake Pressure Modulator Valve Replacement (With JL4, LNF)**
- **Control Module References** for EBCM replacement, setup, and programming

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

ABS Pressure Circuit

DTC C0131 5A

ABS Pressure Circuit Plausibility Failure

Circuit/System Description

The BPMV internal hydraulic brake pressure sensor (BPS) provides brake pressure input to the EBCM. This BPS data is utilized during VSES events. The EBCM also monitors the brake pressure sensor BPS and the body control module (BCM) serial data message of the brake pedal position sensor (BPPS). These readings are compared between the BPS and BPPS and are used to insure the actual braking intent of the driver, during conditions when the brake is applied and when the brake released/decel-accel.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

C0131 00

The EBCM detects an internal pressure sensor fault.

C0131 5A

- The EBCM detects the brake pressure sensor (BPS) input readings does not correlate internally.

  or

- The EBCM detects the brake pressure the brake pressure sensor reading does not correlate with the serial

data message of the brake pedal position(BPP) sensor when the vehicle is stopping, brake pressure is increasing, and the brake pedal is detected as released, or the vehicle is accelerating, brake pressure is not increasing, and the brake pedal is detected as applied.

Action Taken When the DTC Sets

- The EBCM disables the ABS/traction control system (TCS)/vehicle stability enhancement system (VSES) for the duration of the ignition cycle.
- A DIC message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The EBCM clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Diagnostic Aids

- C0131 5A may be set due to a BPPS offset ratio greater than allowed by the EBCM calibrations causing a delay brake applied/released signal from the BCM during EBCM monitoring. If there is a need to relearn the BPPS, then there may be other issues related to the BPPS and circuits.
- The EBCM calibrations for the brake pressure sensors adjusts for minor offset differences between the sensor inputs and can be reset with the scan tool special functions steering angle sensor (SAS) calibration. Under normal vehicle conditions the BPS should not need calibrating unless a BPMV is replaced.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation Reference

ABS Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC C0277, C0278 or C0870 is not set.
   - If any of the DTCs are set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle**
2. Perform the BPPS calibration. Refer to **Brake Pedal Position Sensor Calibration**
3. Perform the SAS calibration to reset the brake pressure sensor offset values. Refer to **Steering Angle Sensor Centering**
4. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset.
   - If DTC is set, replace the BPMV. If DTC reset replace the EBCM.

Repair Procedures

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

- **Brake Pressure Modulator Valve Replacement (With JL4)** or **Brake Pressure Modulator Valve Replacement (With JL4, LNF)**
- **Control Module References** for EBCM replacement, setup, and programming

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 00

ABS/TCS Brake Switch Circuit

Circuit/System Description

The body control module (BCM) illuminates the stop lamps by applying battery positive voltage to the stop lamp supply voltage circuit. The electronic brake control module (EBCM) receives a voltage input from the stop lamp supply voltage circuit to determine if the brake pedal is applied.

Conditions for Running the DTC

- Ignition ON.
- The vehicle speed is greater than 20 km/h (12 mph).

Conditions for Setting the DTC

- The brake pedal is sensed as applied for 6 minutes.
- The vehicle speed is greater than 20 km/h (12 mph).

- The EBCM does not receive a signal change from the stop lamp supply voltage circuit.
- Vehicle speed exceeds 40 km/h (25 mph) in four cycles, and decelerates to under 3 km/h (2 mph).

Action Taken When the DTC Sets

The ABS remains functional.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present.
- The EBCM clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Diagnostic Aids

The DTC C0161 can be set if the vehicle has been driven with the brake applied during acceleration. Also inspect the brake pedal switch and connector for proper operation.

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 Stop Lamp parameter. The reading should be Released and change between Applied and Released when pressing and releasing the brake pedal, the stop lamps should turn on and off.

- If not within the specified value, refer to **Symptoms - Lighting** . If the circuits test normal, replace the EBCM.

Repair Procedures

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

Control Module References for EBCM replacement, setup and programming

DTC C0186

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 00

Lateral Accelerometer Circuit Electrical Failure

DTC C0186 1A

Lateral Accelerometer Circuit Bias Level Out of Range

DTC C0186 3B

Lateral Accelerometer Circuit Internal Self Test Failed

DTC C0186 5A

Lateral Accelerometer Circuit Plausibility Failure

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Voltage	C0186 00	C0186 00	-	C0186 5A, C0186 3B, C0186 1A
				C0186 5A,

Low Reference	C0186 00	C0186 00	C0186 00	C0186 3B, C0186 1A
CAN Bus High Serial Data	C0186 00	C0186 00	C0186 00	C0186 5A, C0186 3B, C0186 1A
CAN Bus Low Serial Data	C0186 00	C0186 00	C0186 00	C0186 5A, C0186 3B, C0186 1A

Circuit/System Description

The lateral accelerometer and the yaw rate sensors are combined into one sensor external to the electronic brake control module (EBCM). The vehicle stability enhancement system (VSES) uses the lateral accelerometer input when calculating the desired yaw rate. The yaw rate/lat sensor communicates with the EBCM via discrete CAN Bus High and CAN Bus Low serial data circuits.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

- The yaw/lateral combination sensor reports an internal failure.
- The yaw/lateral combination sensor learns a wrong offset value.
- Incorrectly mounted yaw/lateral sensor.

Action Taken When the DTC Sets

- The EBCM disables the VSES for the duration of the ignition cycle.
- A DIC message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present.
- The EBCM clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

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 yaw rate/lat sensor.
2. Ignition OFF for 60 seconds, test for less than 5 ohms between the low reference circuit terminal 5 and ground.
    - If greater than the specified range, test the low reference circuit for an open/high resistance.
3. Ignition ON, test for ignition voltage between the ignition voltage circuit terminal 3 and ground.
    - If not within the specified range, test the ignition voltage circuit for a short to ground or open/high resistance.
4. Ignition OFF, disconnect the harness connector at the EBCM.
5. Ignition ON, test for less than 1 volt between the following terminal listed below and ground.
    - CAN Bus High serial data circuit terminal 18
    - CAN Bus Low serial data circuit terminal 19
    - If greater than the specified value, test the appropriate serial data circuit for a short to voltage.
6. Ignition OFF, test for infinite resistance between the following terminal listed below and ground.
    - CAN Bus High serial data circuit terminal 18
    - CAN Bus Low serial data circuit terminal 19
    - If not the specified value, test the appropriate serial data circuit for a short to ground.
7. Test for less than 2 ohms between the appropriate serial data circuit terminals listed below.
    - CAN Bus High serial data circuit terminal 18 at the EBCM harness connector and terminal 2 at the yaw/lat sensor harness connector.
    - CAN Bus Low serial data circuit terminal 19 at the EBCM harness connector and terminal 1 at the yaw/lat sensor harness connector.
    - If greater than the specified range, test the appropriate serial data circuit for an open/high resistance.
8. Test for infinite resistance between the CAN Bus High serial data circuit terminal 18 and the CAN Bus Low serial data circuit terminal 19.

- If not the specified value, repair the serial data circuits for a short together.

9. If all circuits test normal, replace the yaw rate/lat sensor. If the DTC resets, replace the EBCM.

Repair Procedures

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

- **Vehicle Yaw Sensor with Vehicle Lateral Accelerometer Replacement**
- **Control Module References** for EBCM replacement, setup, and programming

DTC C0196

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 C0196 00

Yaw Rate Circuit

DTC C0196 1A

Yaw Rate Circuit Bias Level Out of Range

DTC C0196 3B

Yaw Rate Circuit Internal Self Test Failed

DTC C0196 5A

Yaw Rate Circuit Plausibility Failure

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Voltage	C0196 00	C0196 00	C0196 00	-
Low Reference	C0196 00	C0196 00	C0196 00	C0196 5A, C0196 3B, C0196 1A
CAN Bus High Serial Data	C0196 00	C0196 00	C0196 00	C0196 5A, C0196 3B,

				C0196 1A
CAN Bus Low Serial Data	C0196 00	C0196 00	C0196 00	C0196 5A, C0196 3B, C0196 1A

Circuit/System Description

The yaw rate and the lateral accelerometer sensors are combined into one sensor, external to the electronic brake control module (EBCM). The vehicle stability enhancement system (VSES) uses the lateral accelerometer input when calculating the desired yaw rate. The yaw rate/lat sensor communicates with the EBCM via discrete CAN Bus High and CAN Bus Low serial data circuits.

Conditions for Running the DTC

Ignition ON

Conditions for Setting the DTC

- The yaw/lateral combination sensor reports an internal failure.
- The yaw/lateral combination sensor learns a wrong offset value
- Incorrectly mounted yaw/lateral sensor.

Action Taken When the DTC Sets

- The EBCM disables the VSES for the duration of the ignition cycle.
- A DIC message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present.
- The EBCM clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

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 yaw rate/lat sensor.
2. Ignition OFF for 60 seconds, test for less than 5 ohms between the low reference circuit terminal 5 and ground.
    - If greater than the specified range, test the low reference circuit for an open/high resistance.
3. Ignition ON, test for between the 12 volt reference circuit terminal 3 and ground.
    - If not within the specified range, test the ignition voltage circuit for a short to ground or open/high resistance.
4. Ignition OFF, disconnect the harness connector at the EBCM.
5. Ignition ON, test for less than 1 volt between the following terminal listed below and ground.
    - CAN Bus High serial data circuit terminal 18
    - CAN Bus Low serial data circuit terminal 19
    - If greater than the specified value, test the appropriate serial data circuit for a short to voltage.
6. Ignition OFF, test for infinite resistance between the following terminal listed below and ground.
    - CAN Bus High serial data circuit terminal 18
    - CAN Bus Low serial data circuit terminal 19
    - If not the specified value, test the appropriate serial data circuit for a short to ground.
7. Test for less than 2 ohms between the appropriate serial data circuit terminals listed below.
    - CAN Bus High serial data circuit terminal 18 at the EBCM harness connector and terminal 2 at the yaw/lat sensor harness connector.
    - CAN Bus Low serial data circuit terminal 19 at the EBCM harness connector and terminal 1 at the yaw/lat sensor harness connector.
    - If greater than the specified range, test the appropriate serial data circuit for an open/high resistance.
8. Test for infinite resistance between the CAN Bus High serial data circuit terminal 18 and the CAN Bus Low serial data circuit terminal 19.
    - If not the specified value, repair the serial data circuits for a short together.
9. If all circuits test normal, replace the yaw rate/lat sensor. If the DTC resets, replace the EBCM.

Repair Procedures

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

- **Vehicle Yaw Sensor with Vehicle Lateral Accelerometer Replacement**
- **Control Module References** for EBCM replacement, setup, and programming

DTC C0201

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 C0201 04

Antilock Brake System (ABS) Enable Relay Contact Circuit Open

Circuit/System Description

The solenoid relay, located within the electronic brake control module (EBCM), supplies battery voltage to all of the valve solenoids.

Conditions for Running the DTC

- Ignition voltage is greater than 9.5 volts.
- The solenoid relay is commanded ON.

Conditions for Setting the DTC

The EBCM detects no change in voltage when commanding the solenoid valves ON.

Action Taken When the DTC Sets

- The EBCM disables the ABS for the duration of the ignition cycle.
- The EBCM sends a serial data message to illuminate the appropriate warning indicator/message.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The EBCM clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation Reference

ABS Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Ignition ON, verify that DTC C0201 is not set.

- If DTC is set, replace the EBCM. If the DTC resets, replace the BPMV.

Repair Procedures

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

- **Brake Pressure Modulator Valve Replacement (With JL4)** or **Brake Pressure Modulator Valve Replacement (With JL4, LNF)**
- **Control Module References** for EBCM replacement, setup, and programming

DTC C0252

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 C0252 4A

Steering Wheel Position Sensor Offset Checksum Failure

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Steering Wheel Position Sensor Uncorrelated	-	-	-	C0252 4A

Circuit/System Description

The vehicle stability enhancement system (VSES) is activated by the electronic brake control module (EBCM) and calculates the desired yaw rate and comparing it to the actual yaw rate input. The desired yaw rate is calculated from measured steering wheel position, vehicle speed, and lateral acceleration. The difference between the desired yaw rate and actual yaw rate is the yaw rate error, which is a measurement of over-steer or under-steer. If the yaw rate error becomes to large, the EBCM will attempt to correct the vehicle's yaw motion by applying differential braking to the left or right front wheel.

The amount of differential braking applied to the left or right front wheel is based on both the yaw rate error and side slip rate error. The side slip rate error is a function of the lateral acceleration minus the product of the yaw rate and vehicle speed. The yaw rate error and side slip rate error are combined to produce the total delta velocity error. When the delta velocity error becomes too large and the VSES system activates, the drivers steering inputs combined with the differential braking will attempt to bring the delta velocity error toward zero. The VSES activations generally occur during aggressive driving, in the turns or bumpy roads with out much use of the accelerator pedal. When braking during VSES activation, the brake pedal will feel different than the antilock brake system (ABS) pedal pulsation. The brake pedal pulsates at a higher frequency during VSES activation.

Conditions for Running the DTC

- The ignition is ON.
- Ignition voltage is greater than 9.5 volts.

Conditions for Setting the DTC

One of the following conditions exists:

- The checksum across the sensor offset values stored in the EEPROM are not correct.
- Any of the stored offset values are invalid.

Action Taken When the DTC Sets

One or more of the following actions may occur:

- Vehicle Stability Enhancement System (VSES) are disabled.
- A DIC message and/or a warning message may be displayed.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Diagnostic Aids

The following conditions can cause this concern:

An EBCM internal failure

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation Reference

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

Clear DTC, test drive vehicle under normal driving conditions.

- Verify DTC resets.

Circuit/System Testing

Install the scan tool, perform the steering angle calibration procedure.

- If the calibration procedure was unsuccessful, replace the steering wheel position sensor.
- If the calibration procedure was successful, and the DTC returned as current, replace the EBCM

Repair Procedures

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

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

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 00

Stability System Active Too Long

Circuit/System Description

The electronic brake control module (EBCM) detects a malfunction when VSES brake intervention is active for more than an excessive amount of time.

Conditions for Running the DTC

- Ignition is ON.
- The ignition voltage is above 10 volts.

Conditions for Setting the DTC

The EBCM detects VSES is active for more than 15 seconds.

Action Taken When the DTC Sets

- The VSES functionality is disabled
- A DIC message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present.
- The EBCM clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

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

Verify that DTC C0280 is not set as current.

- If the DTC is set, clear the DTC with a scan tool, and operate the vehicle within the conditions for setting the DTC. If the DTC resets, replace the Yaw Rate/Lateral sensor.

Repair Procedures

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

Vehicle Yaw Sensor with Vehicle Lateral Accelerometer Replacement

DTC C0292

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 C0292

VSES Combination Sensor Circuits

Circuit/System Description

The electronic brake control module (EBCM) supplies a reference voltage of 12 volts to the yaw rate sensor lateral accelerometer and the steering wheel position sensor. The sensor supply voltage is monitored via an internal feedback circuit to the EBCM microprocessor.

Conditions for Running the DTC

- The ignition is ON.
- Ignition voltage is greater than 9.5 volts.

Conditions for Setting the DTC

The yaw/lateral sensor is setting an internal electronic failure.

Action Taken When the DTC Sets

- Vehicle stability enhancement system (VSES) is disabled.
- A DIC message and/or a warning message may be displayed.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present and the DTC is cleared with a scan tool.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Diagnostic Aids

If the yaw and lateral accelerometer sensor is disconnected, DTCs will set and the EBCM will not provide 12-volt reference.

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 Yaw Rate/Lateral Accelerometer.
2. Test for less than 6 ohms between the low reference circuit terminal 5 and ground.
    - If greater than the specified range, test for an open/high resistance in the low reference circuit. If the circuit tests normal, replace the EBCM.
3. Ignition ON, test for 11.8-12.2 volts between the 12-volt reference circuit terminal 3 and ground.
    - If less than the specified range, test the 12-volt reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the EBCM.
    - If greater than the specified range, test the 12-volt reference circuit for a short to voltage. If the circuit tests normal, replace the EBCM.
4. If all circuits test normal, replace the Yaw Rate/Lateral sensor.

Repair Procedures

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

- **Vehicle Yaw Sensor with Vehicle Lateral Accelerometer Replacement**
- **Control Module References** for EBCM replacement, setup, and programming

DTC C0460

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 C0460 00

Steering Position Signal

DTC C0460 42

Steering Position Signal Initialization Not Accomplished

DTC C0460 4B

Steering Position Signal Calibration Not Accomplished

DTC C0460 5A

Steering Position Signal Not Plausible

DTC C0460 71

Steering Position Signal Internal Failure

DTC C0460 72

Steering Position Signal Rolling Count Invalid

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Steering Wheel Position Sensor 12-Volt Reference	C0460 00	C0460 00	C0460 00	-
Low Reference	C0460 00	C0460 00	C0460 00	-
Steering Wheel Position Signal Can HI	C0460 00	C0460 00	C0460 00	C0460 42, C0460 4B, C0460 5A, C0460 71, C0460 72
Steering Wheel Position Signal Can Lo	C0460 00	C0460 00	C0460 00	C0460 42, C0460 4B, C0460 5A, C0460 71, C0460 72

Circuit/System Description

The electronic brake control module (EBCM) provides the steering angle sensor a 12-volt ignition supply

voltage.

The steering angle sensor provides a serial data signal to the EBCM that represents the steering wheel degree of rotation. The EBCM utilizes this signal to calculate the driver intended driving direction.

Conditions for Running the DTC

- Ignition ON.
- Ignition voltage is greater than 10 volts.

Conditions for Setting the DTC

- Steering angle sensor has an internal failure.
- Steering angle sensor has not been initialized.
- Steering angle sensor offset is greater than 15 degrees.

Action Taken When the DTC Sets

- Vehicle stability enhancement system (VSES) is disabled.
- A DIC message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present.
- The EBCM clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

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. Verify that DTC C0460 is not set in the PSCM. If DTC is set refer to **DTC C0460** .
2. With the scan tool perform the steering position sensor calibration.
3. Clear DTC and operate the vehicle within the conditions for running the DTC. Verify the DTC does not reset.
    - If the DTC resets, refer to circuit testing.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the EBCM.
2. Ignition ON, test for less than 1 volt between the following circuit terminals listed below and ground.
    - Reference voltage circuit terminal 5
    - Low Reference circuit terminal 40
    - CAN Bus High Serial Data circuit terminal 18
    - CAN Bus Low Serial Data circuit terminal 19
    - If greater than the specified range, test the appropriate circuit for a short to voltage.
3. Ignition OFF, test for infinite resistance between the following circuit terminals listed below and ground.
    - Reference voltage circuit terminal 5
    - Low Reference circuit terminal 40
    - CAN Bus High Serial Data circuit terminal 18
    - CAN Bus Low Serial Data circuit terminal 19
    - If less than the specified value, test the appropriate circuit for a short to ground.
4. Ignition OFF, disconnect the harness connector at the Steering Angle Sensor.
5. Test for less than 2 ohms between the following circuit terminals listed below.
    - Reference voltage circuit terminal 5 at the EBCM harness connector and terminal 1 at the steering angle sensor harness connector.
    - Low Reference circuit terminal 40 at the EBCM harness connector and terminal 6 at the steering angle sensor harness connector
    - CAN Bus High Serial Data circuit terminal 18 at the EBCM harness connector and terminal 3 at the steering angle sensor harness connector.
    - CAN Bus Low Serial Data circuit terminal 19 at the EBCM harness connector and terminal 4 at the steering angle sensor harness connector.
    - If greater than the specified value, test the appropriate circuit for an open/high resistance.
6. If all circuits test normal, replace the Steering Angle Sensor. If the DTC resets replace the EBCM.

Repair Procedures

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

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

DTC C0551

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 C0551 00

Option Configuration Error

DTC C0551 41

Option Configuration Error Calibration Set Not Programmed

DTC C0551 45

Option Configuration Error Variant Not Programmed

DTC C0551 47

Option Configuration Error VIN Not Programmed

DTC C0551 4A

Option Configuration Checksum Error

Circuit/System Description

When the electronic brake control module (EBCM) is replaced, software and calibrations are flash programmed into the EBCM.

Conditions for Running the DTC

The ignition switch is in the ON position.

Conditions for Setting the DTC

The incorrect EBCM has been installed in the vehicle or the option configuration has not been programmed.

Action Taken When the DTC Sets

One or more of the following actions may occur:

- The antilock brake system (ABS)/Engine Traction System are disabled.
- The ABS/Engine Traction System indicators illuminate.

Conditions for Clearing the DTC

The correct calibration must be programmed into the EBCM.

Diagnostic Aids

If the DTC was set after EBCM replacement, verify that the replacement EBCM and software are correct for the vehicle.

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

Verify that DTC C0551 programming is not set.

- If DTC C0551 is set, program the EBCM. If the DTC resets after programming, replace the EBCM.

Repair Procedures

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

Control Module References for EBCM replacement, setup, and programming

DTC C0561

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 C0561 71

System Disabled Information Stored

Circuit/System Description

The electronic brake control module (EBCM) communicates with the engine control module (ECM) and body control module (BCM) during a traction control or stability control event.

Conditions for Running the DTC

Ignition voltage is greater than 8 volts.

Conditions for Setting the DTC

The EBCM detects and invalid serial data message when communicating with the ECM and BCM during a traction control or stability control event.

Action Taken When the DTC Sets

One or more of the following actions may occur:

- The EBCM disables the vehicle stability enhancement system (VSES) or traction control systems (TCS)
- The traction control Indicator turns ON or the stability control Indicator turns ON.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive

drive cycles.

Diagnostic Aids

This DTC is an aid to the technician, this DTC indicates that there are no problems in the ABS/TCS/VSES. The ECM and BCM should be checked for a possible fault.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation Reference

ABS Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Verify that no DTCs are set in the BCM and ECM.

- If DTCs are set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

DTC C0569

Diagnostic Instructions

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

DTC Descriptor

DTC C0569 00

System Configuration Error

Circuit/System Description

The electronic brake module (EBCM) receives a serial data message from each of the network modules. Each module contains its own unique identification (ID) code that must be programmed into a new the EBCM.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The EBCM has not undergone the programming procedure.

Action Taken When the DTC Sets

- The EBCM disables the ABS/ traction control system (TCS)/ vehicle stability enhancement system (VSES) for the duration of the ignition cycle.
- The ABS indicator illuminates.
- The Red brake indicator illuminates.
- The Stability Control indicator illuminates.
- The driver information center (DIC) displays All Wheel Drive OFF, Service Stabilitrak and Service Traction Control messages.

Conditions for Clearing the DTC

A current DTC will clear when the EBCM is programmed.

Diagnostic Aids

A newly replaced EBCM will set DTC C0569 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 Verification

Verify that C0569 is not set.

- If the DTC is set, program the EBCM. If the DTC resets, replace the EBCM.

Repair Procedures

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

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

Engine Control Module (ECM) Traction Control Torque Request Circuit

Circuit/System Description

The electronic brake control module (EBCM) and the engine control module (ECM) simultaneously control the traction control. The EBCM sends a serial data message to the 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 diagnoses a condition preventing the engine control portion of the 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 Traction Off indicator turns ON.
- The message center displays the Service Traction System message.
- The antilock brake system (ABS) remains functional.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present.
- The EBCM clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Diagnostic Aids

This DTC is for information only. As an aid to the technician, this DTC indicates that there are no problems in the ABS/traction control system (TCS).

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

Verify that there are no DTCs set in the ECM.

- If there are any DTCs set in the ECM, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

SYMPTOMS - ANTILOCK BRAKE SYSTEM

IMPORTANT: 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 **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**
- **StabiliTrak 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 panel cluster (IPC) momentarily illuminates the antilock brake system (ABS) indicator during the bulb check when the ignition is cycled ON. When the electronic brake control module (EBCM) detects a fault requiring ABS indicator ON, it sends a serial data message to the IPC to illuminate the ABS indicator.

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. With a scan tool command the IPC display test ON and OFF. The ABS indicator should turn ON and OFF.
    - If the ABS indicator does not turn ON and OFF when commanded, replace the IPC.
2. Replace the EBCM.

Repair Procedures

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

Control Module References for EBCM or IPC replacement, setup, and programming

STABILITRAK 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 Description

The instrument panel cluster (IPC) momentarily illuminates the stabilitrak indicator during the IPC bulb check when the ignition is turned ON. When the traction control switch is pressed, the BCM sends a serial data message to the IPC to illuminate indicating traction is disabled. When the EBCM detects a fault, a serial data message is sent to the IPC to illuminate the indicator.

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 Verification

1. With a scan tool command the IPC display test ON and OFF. The stabilitrak indicator should turn ON and OFF.

- If the stabilitrak indicator does not turn ON and OFF, replace the IPC.

2. 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 traction control switch.
2. Test for less than 1 ohm between the ground circuit terminal A and ground.
   - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Ignition ON, verify the scan tool Traction Control Switch parameter is Inactive.
   - If not the specified value, test the signal circuit terminal C for a short to ground. If the circuit tests normal, replace the BCM.
4. Install a 3A fused jumper wire between the signal circuit terminal C and the ground circuit terminal A. Verify the scan tool Traction Control Switch parameter is Active.
   - If not the specified value, test the signal circuit for an open/high resistance. If the circuit tests normal, replace the BCM.
5. If all circuits test normal, test or replace the traction control switch.

Component Testing

1. Ignition OFF, disconnect the harness connector at the traction control switch.
2. Test for infinite resistance between the signal terminal C and the ground terminal A with the switch in the open position.
   - If not the specified value, replace the traction control switch.
3. Test for less than 3 ohms between the signal terminal C and the ground terminal A with the switch in the closed position.
   - If greater than the specified range, replace the traction control switch.

Repair Procedures

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

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

REPAIR INSTRUCTIONS

ANTILOCK BRAKE SYSTEM AUTOMATED BLEED PROCEDURE

WARNING: Refer to Brake Fluid Irritant Warning .

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

NOTE: **Before performing the 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.

Performing the 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 four 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 centering often. Centering of the steering angle sensor might be required after certain service procedures are performed. Some of these procedures are as follows:

- Steering gear replacement
- Steering column replacement
- Steering angle sensor replacement
- Intermediate shaft replacement
- Electronic Brake Control Module (EBCM) programming or replacement
- Brake Pressure Modulator Valve Replacement
- Collision or other physical damage

1. Center the steering wheel with the wheels facing forward.
2. With a scan tool, perform the special functions steering position sensor calibration and follow the on screen instructions.

ELECTRONIC BRAKE CONTROL MODULE REPLACEMENT (WITH JL4)

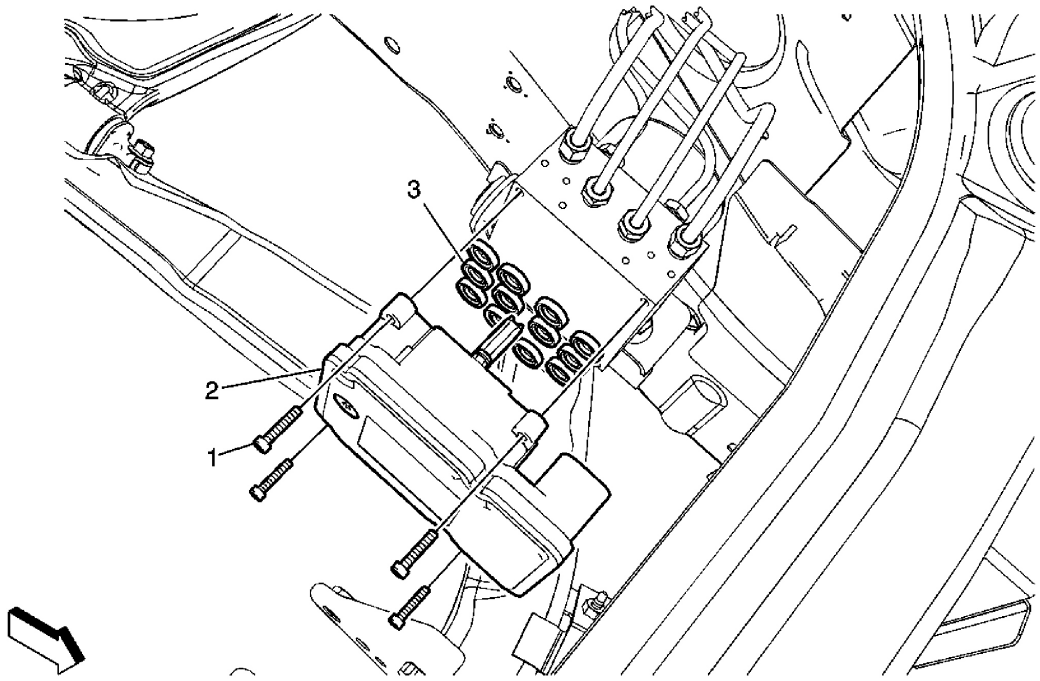

Fig. 4: Electronic Brake Control Module (With JL4)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
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.** **Preliminary Procedures** 1. Turn the ignition switch to the OFF position. 2. If equipped with RPO LNF, release the charge air cooler inlet pipe from the bracket and position aside without removing the charge air cooler inlet pipe. 3. Remove the cover from the engine control module (ECM) and transmission control module (TCM), if equipped. 4. Clean the electronic brake control module (EBCM) to brake pressure modulator valve (BPMV) area of any accumulated dirt and foreign material. 5. Disconnect the electrical connector from the EBCM.	
	Electronic Brake Control Module (EBCM) Bolts (Qty: 4)

1	**CAUTION:** **Refer to Fastener Caution .** **Tighten:** 3 N.m (27 lb in)
2	EBCM **Procedure** 1. Separate the EBCM from the BPMV by carefully pulling apart. Do not pry the components apart. 2. If a new EBCM is being installed, program the EBCM. Refer to **Control Module References** .
3	EBCM O-Ring Seal (Qty: 12) **Procedure** 1. If installing a new EBCM, install new O-ring seals. 2. Clean the sealing surfaces of the BPMV with denatured alcohol and a clean shop cloth.

BRAKE PRESSURE MODULATOR VALVE REPLACEMENT (WITH JL4)

WARNING: Refer to Brake Fluid Irritant Warning .

Removal Procedure

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 cover from the engine control module (ECM) and the transmission control module (TCM).
3. Clean the electronic brake control module (EBCM) to brake pressure modulator valve (BPMV) area and the brake pipe fittings of any accumulated dirt and foreign material.
4. Disconnect the EBCM electrical connector.

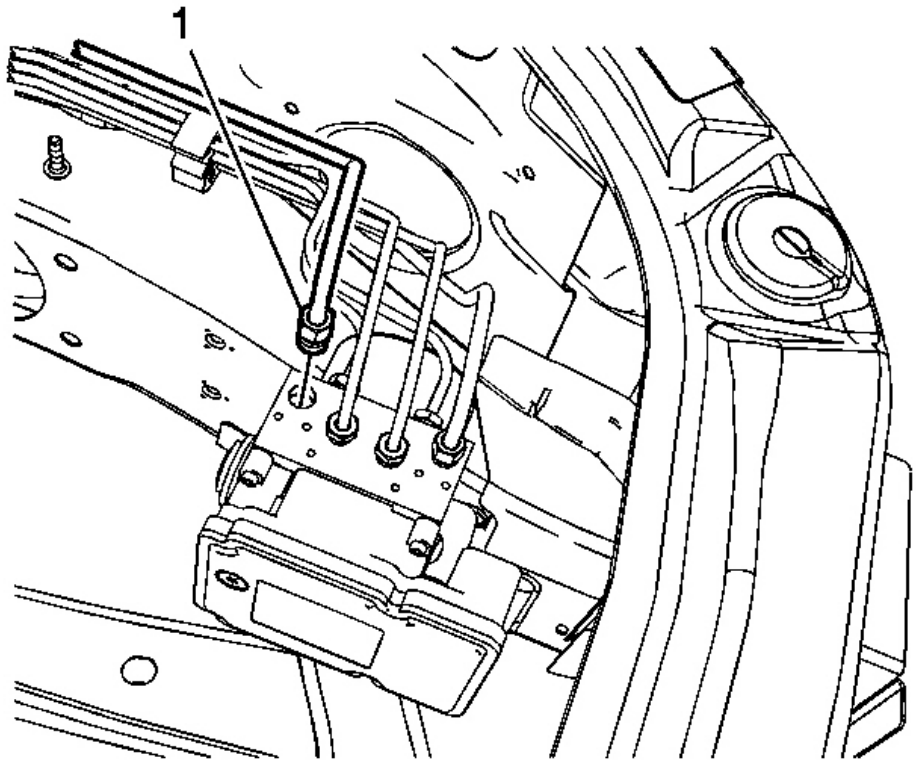

Fig. 5: Master Cylinder Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the master cylinder primary brake pipe fitting (1).

   Cap the fitting and plug the BPMV inlet port to prevent brake fluid loss and contamination.

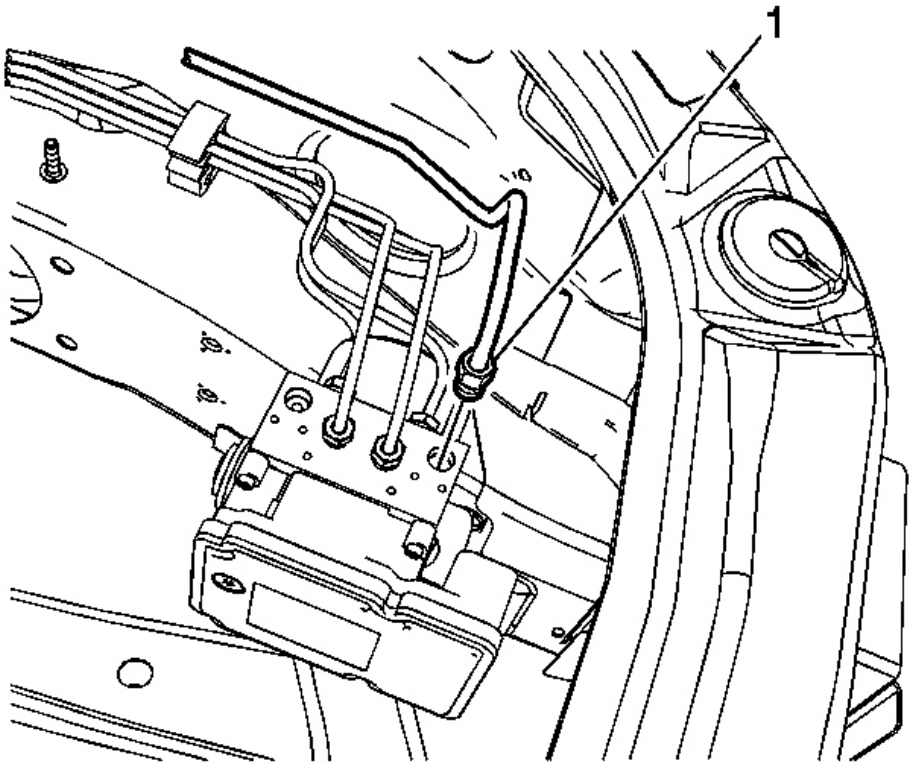

Fig. 6: Master Cylinder Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the master cylinder secondary brake pipe fitting (1).

   Cap the fitting and plug the BPMV inlet port to prevent brake fluid loss and contamination.

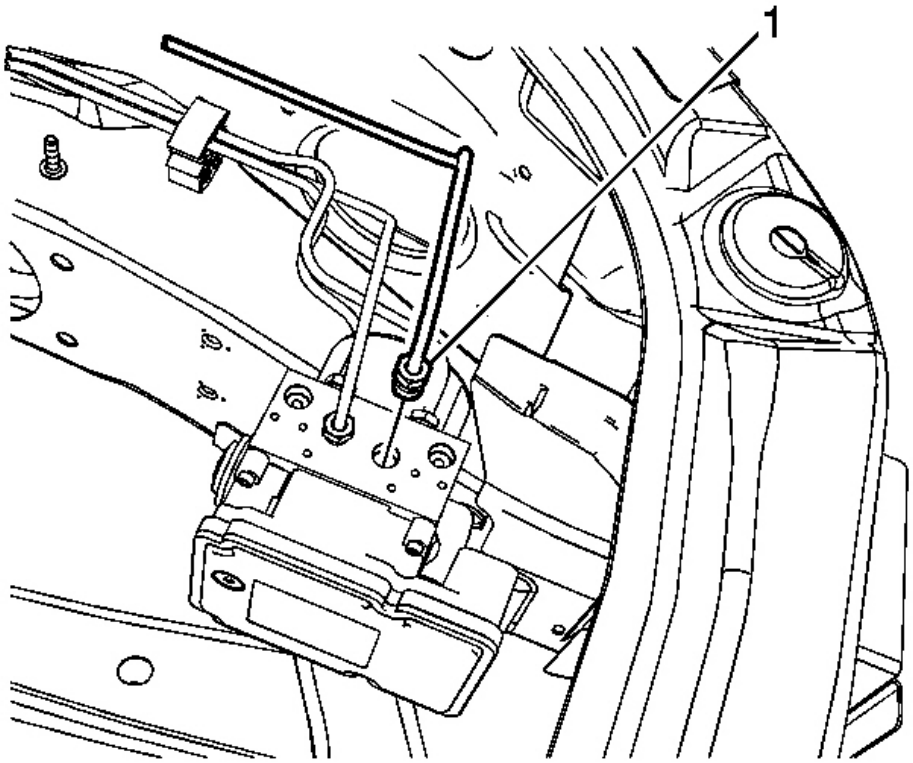

Fig. 7: LF Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the LF brake pipe fitting (1).

   Cap the fitting and plug the BPMV outlet port to prevent brake fluid loss and contamination.

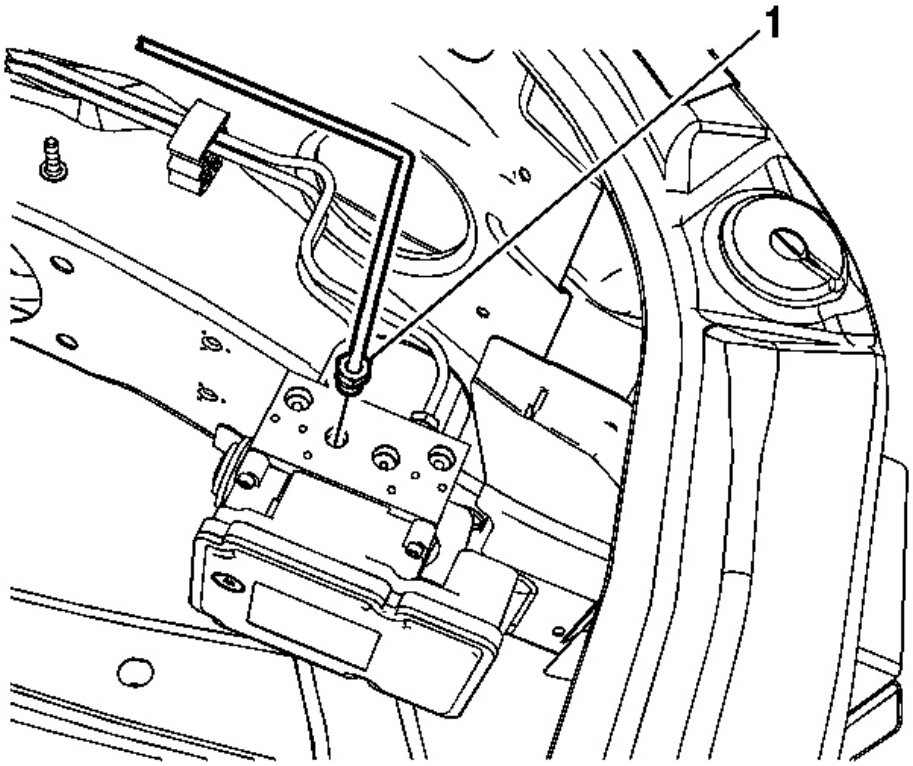

Fig. 8: RF Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

8. Disconnect the RF brake pipe fitting (1).

   Cap the fitting and plug the BPMV outlet port to prevent brake fluid loss and contamination.

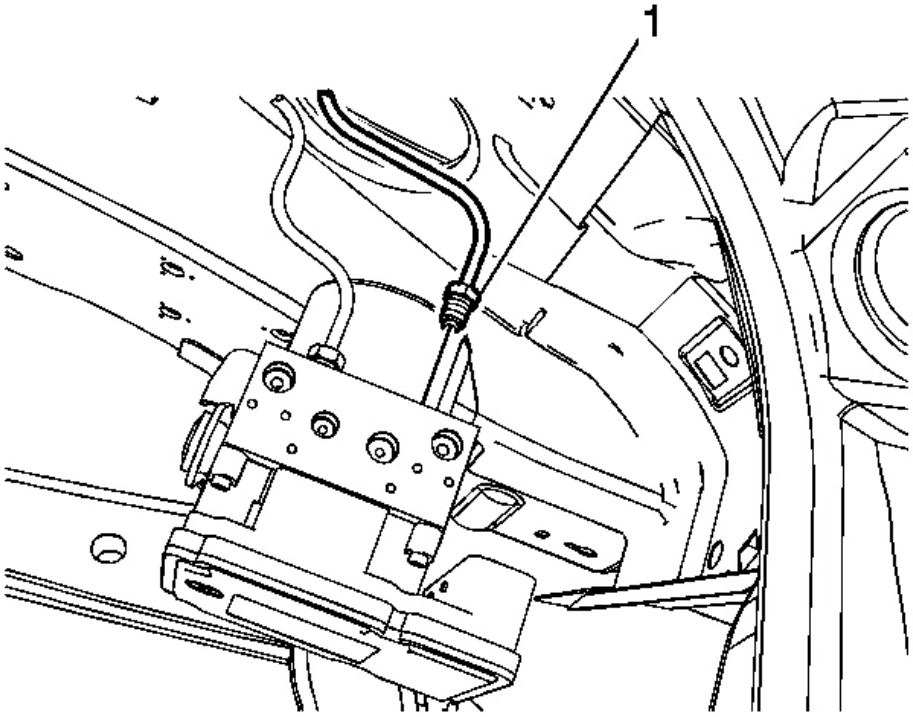

Fig. 9: RR Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

9. Disconnect the RR brake pipe fitting (1).

   Cap the fitting and plug the BPMV outlet port to prevent brake fluid loss and contamination.

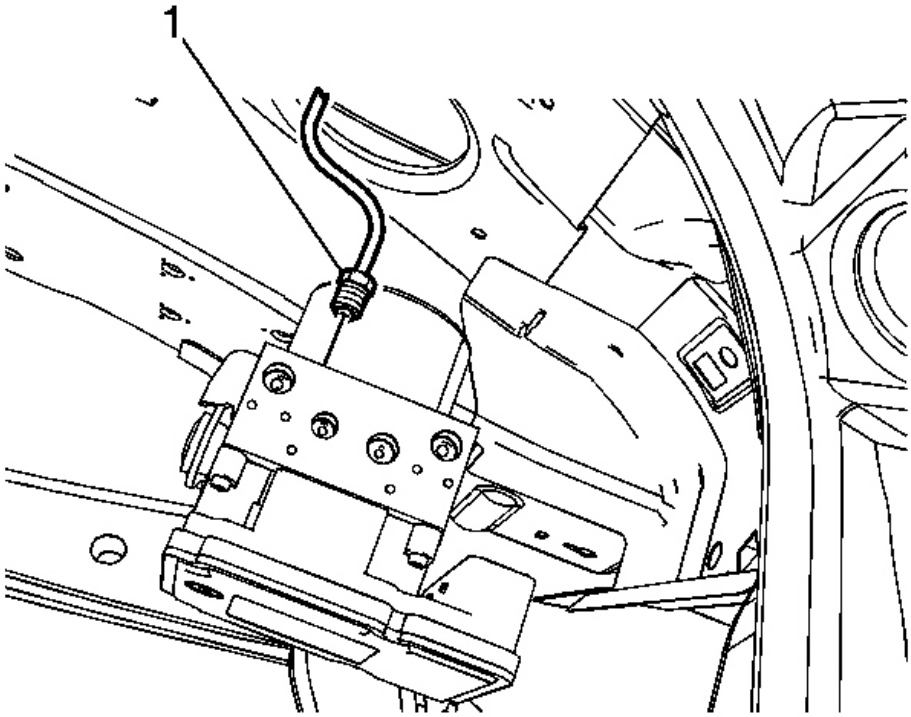

Fig. 10: LR Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

10. Disconnect the LR brake pipe fitting (1).

    Cap the fitting and plug the BPMV outlet port to prevent brake fluid loss and contamination.

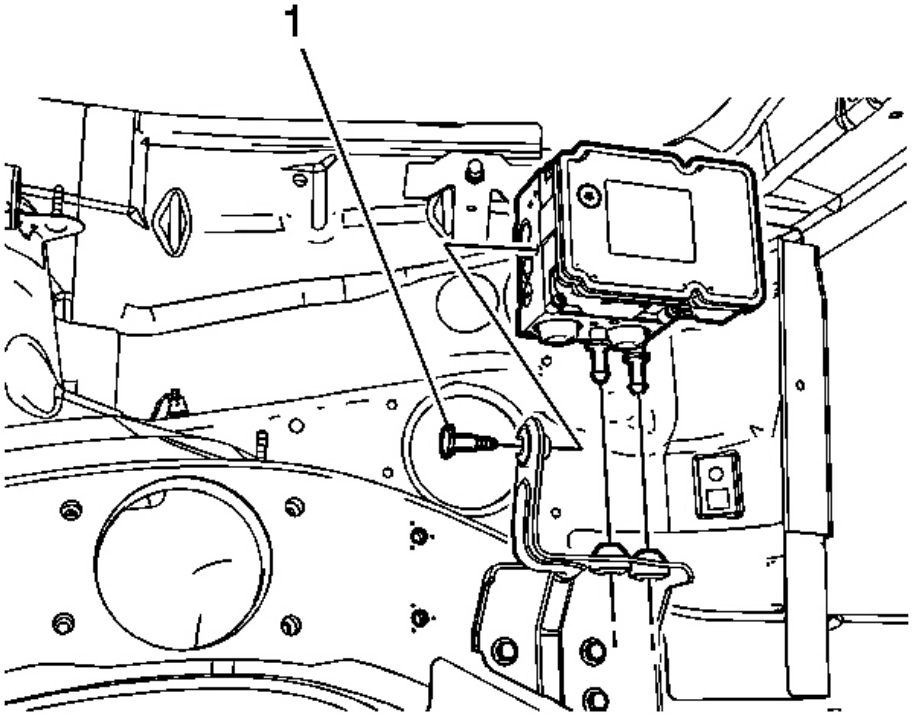

Fig. 11: BPMV Bolt
Courtesy of GENERAL MOTORS CORP.

11. Remove the BPMV bolt (1).

NOTE: Do not remove the mounting pins unless it is necessary to aid in releasing the modulator assembly from the bracket.

12. Carefully remove the brake control module assembly from the BPMV bracket insulators by pulling straight upward.

    Do not pry against the accumulator covers on the underside of the brake modulator assembly to release the mounting pins from the bracket insulators.

13. If installing a new BPMV, remove the EBCM. Refer to **Electronic Brake Control Module**

Replacement (With JL4).

Installation Procedure

1. If installing a new BPMV, install the EBCM. Refer to **Electronic Brake Control Module Replacement (With JL4)**.

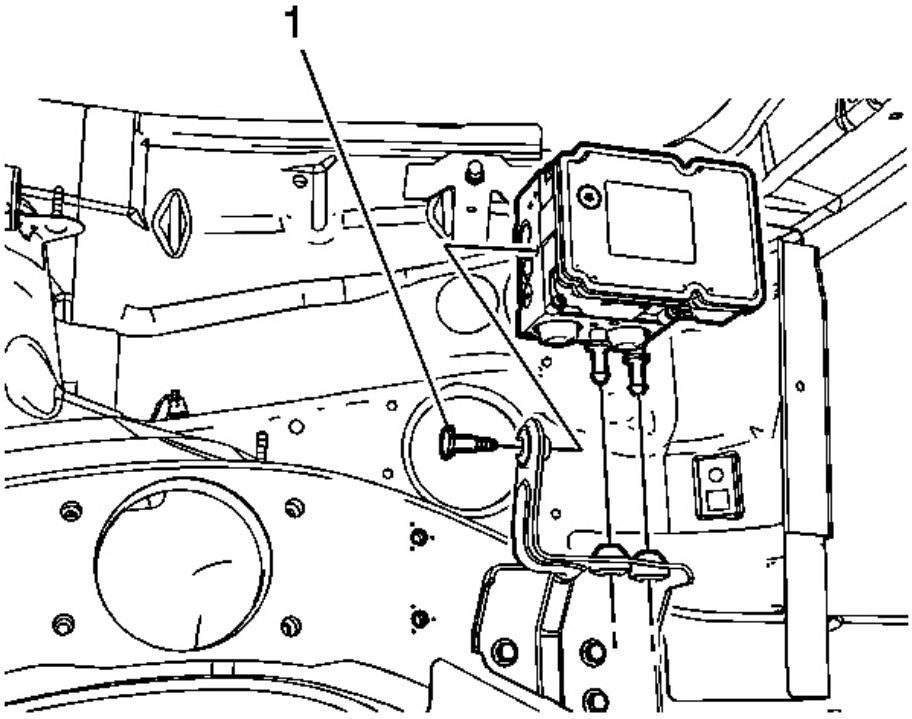

Fig. 12: BPMV Bolt
Courtesy of GENERAL MOTORS CORP.

2. Install the brake control module assembly to the BPMV bracket until the mounting pins are fully inserted in the bracket insulators.

CAUTION: Refer to Fastener Caution .

3. Install the BPMV bolt (1).

   Tighten: Tighten the bolt to 11 N.m (97 lb in).

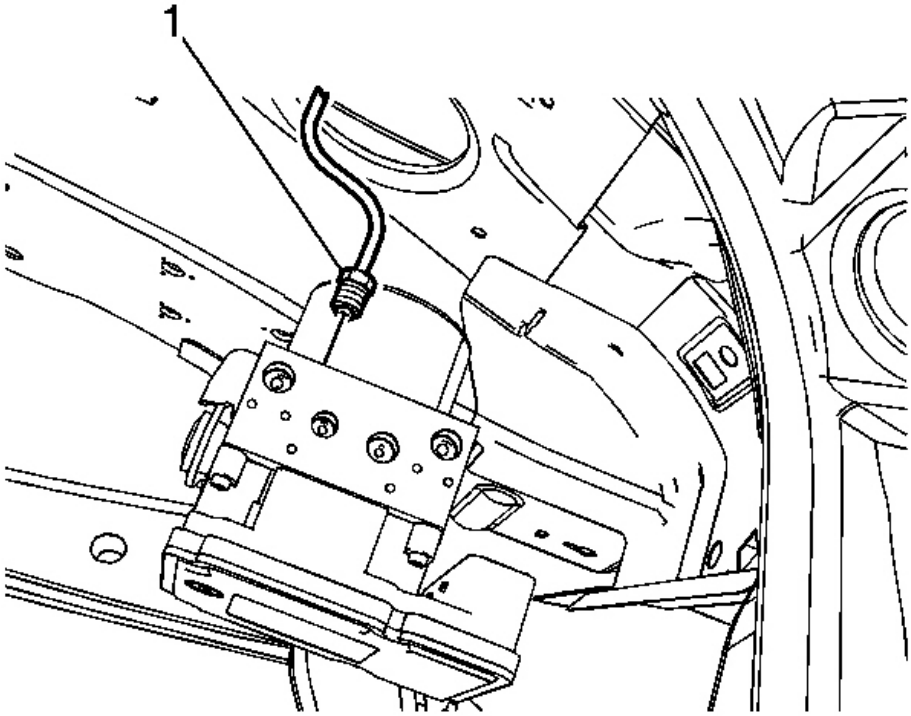

Fig. 13: LR Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

4. Connect the LR brake pipe fitting (1).

   Tighten: Tighten the fitting to 21 N.m (15 lb ft).

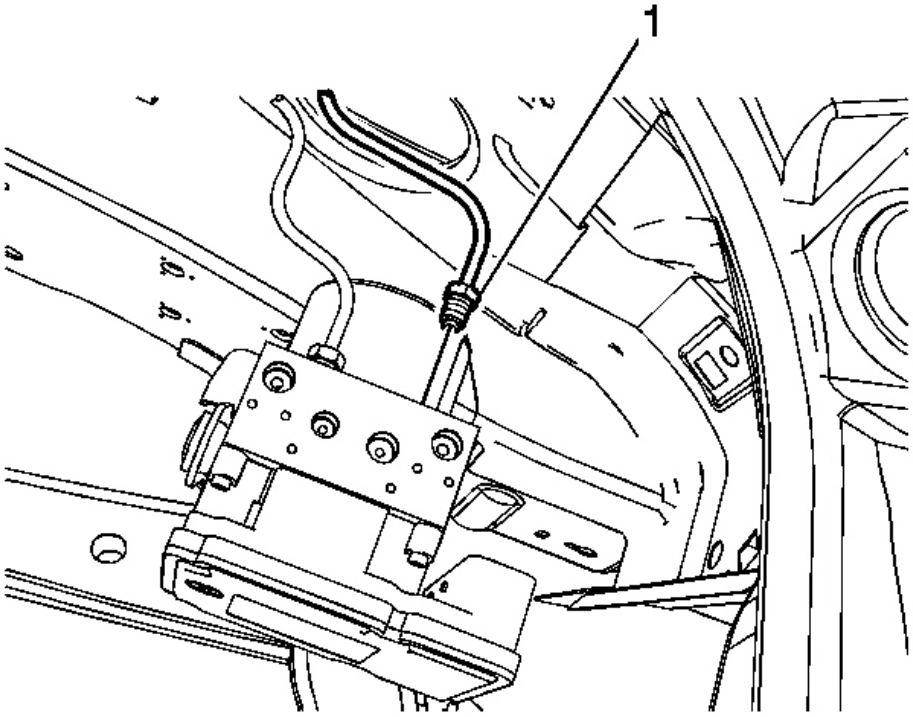

Fig. 14: RR Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

5. Connect the RR brake pipe fitting (1).

   Tighten: Tighten the fitting to 21 N.m (15 lb ft).

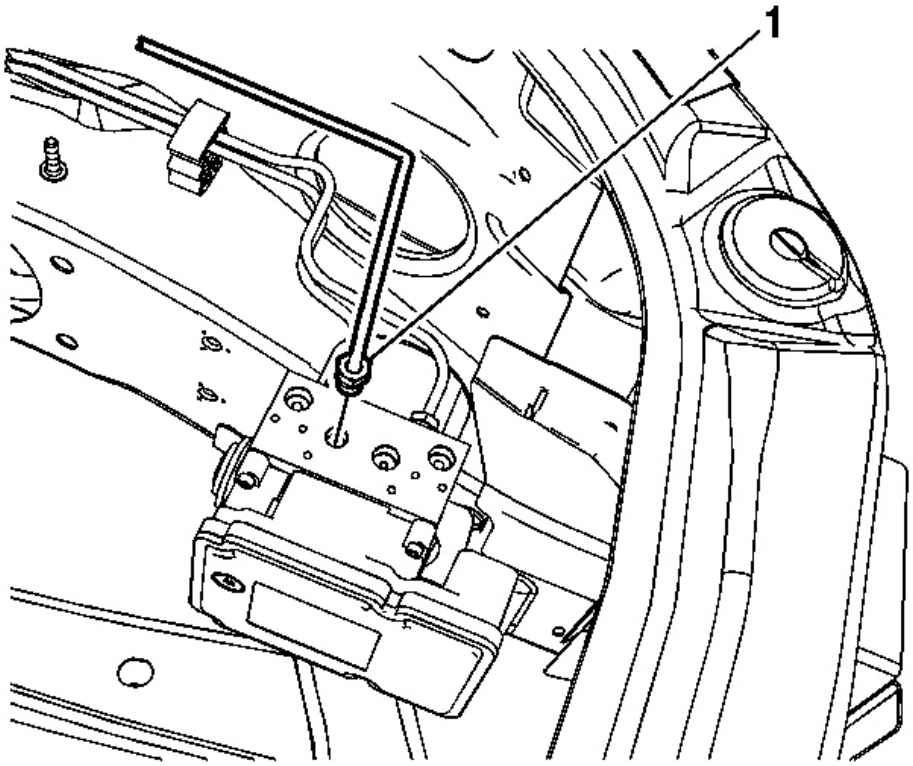

Fig. 15: RF Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

6. Connect the RF brake pipe fitting (1).

   Tighten: Tighten the fitting to 21 N.m (15 lb ft).

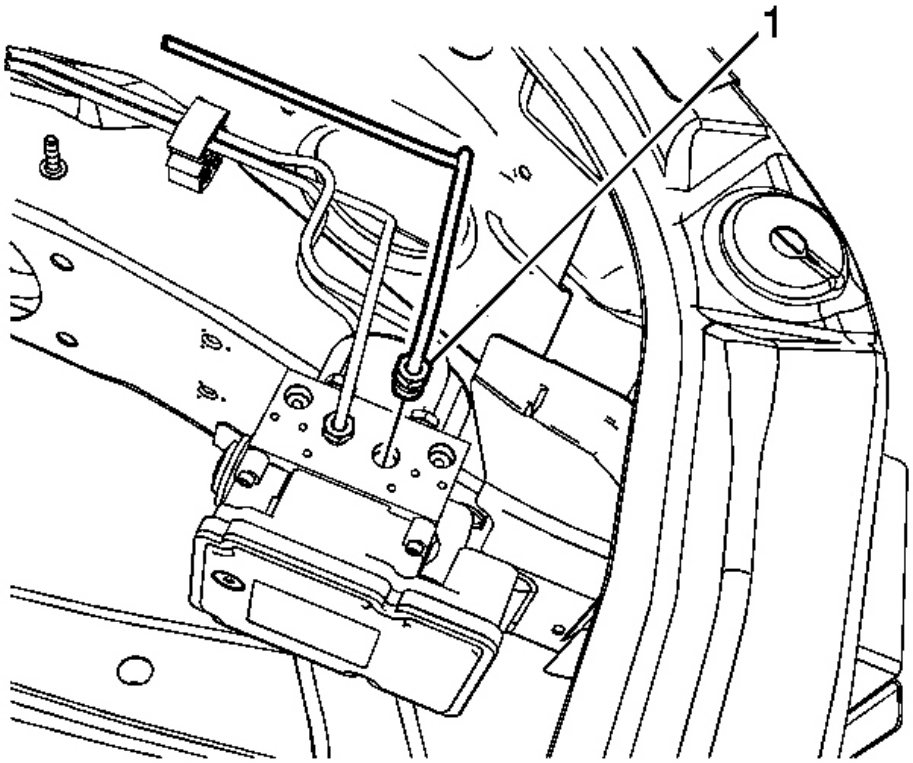

Fig. 16: LF Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

7. Connect the LF brake pipe fitting (1).

   Tighten: Tighten the fitting to 21 N.m (15 lb ft).

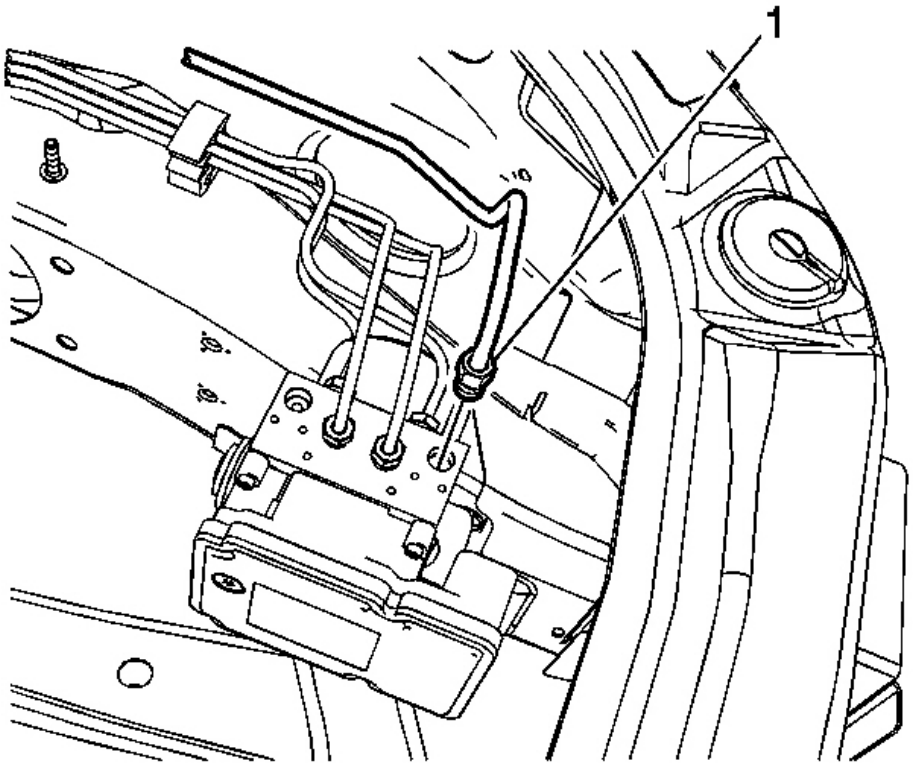

Fig. 17: Master Cylinder Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

8. Connect the master cylinder secondary brake pipe fitting (1).

   Tighten: Tighten the fitting to 21 N.m (15 lb ft).

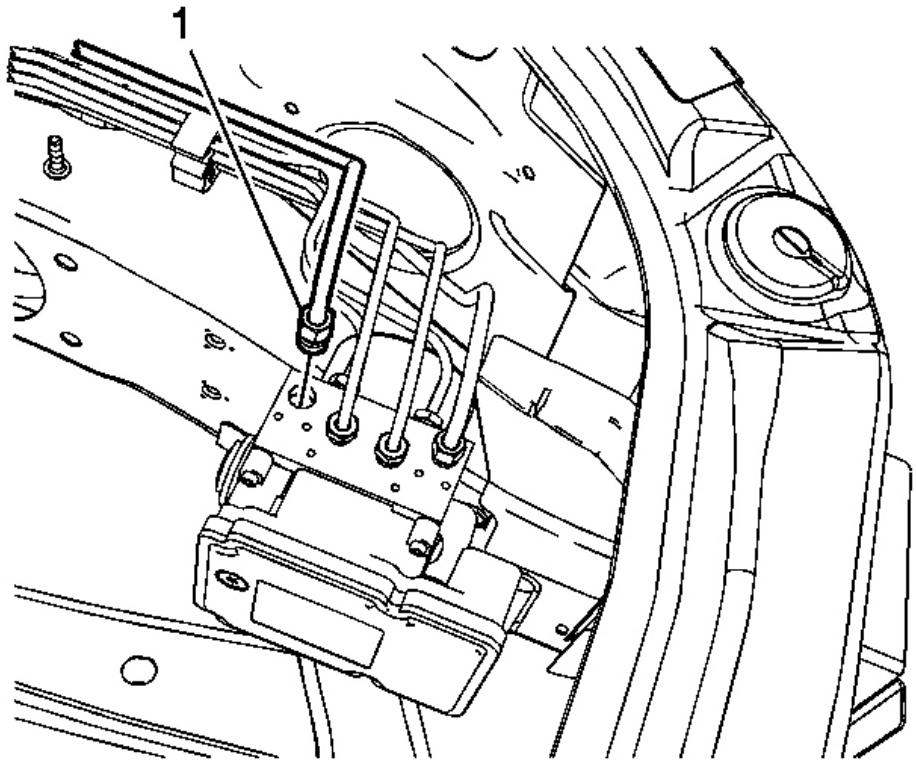

Fig. 18: Master Cylinder Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

9. Connect the master cylinder primary brake pipe fitting (1).

   Tighten: Tighten the fitting to 21 N.m (15 lb ft).

10. Connect the EBCM electrical connector.
11. Install the cover to the ECM and the TCM.
12. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** .
13. Program the EBCM. Refer to **Service Programming System (SPS)** .
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 the secondary hydraulic circuit of the brake modulator which may have been introduced into the primary circuit. If the pedal feels spongy, perform the **Antilock Brake System Automated Bleed Procedure**.

BRAKE PRESSURE MODULATOR VALVE REPLACEMENT (WITH JL4, LNF)

WARNING: Refer to Brake Fluid Irritant Warning .

Removal Procedure

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. Release the charge air cooler inlet pipe from the bracket and position aside without removing the charge air cooler inlet pipe.
3. Remove the transmission control module (TCM) from the bracket and position aside.
4. Clean the brake pressure modulator valve (BPMV) brake pipe fitting area of any accumulated dirt and foreign material.
5. Disconnect the electronic brake control module (EBCM) electrical connector.

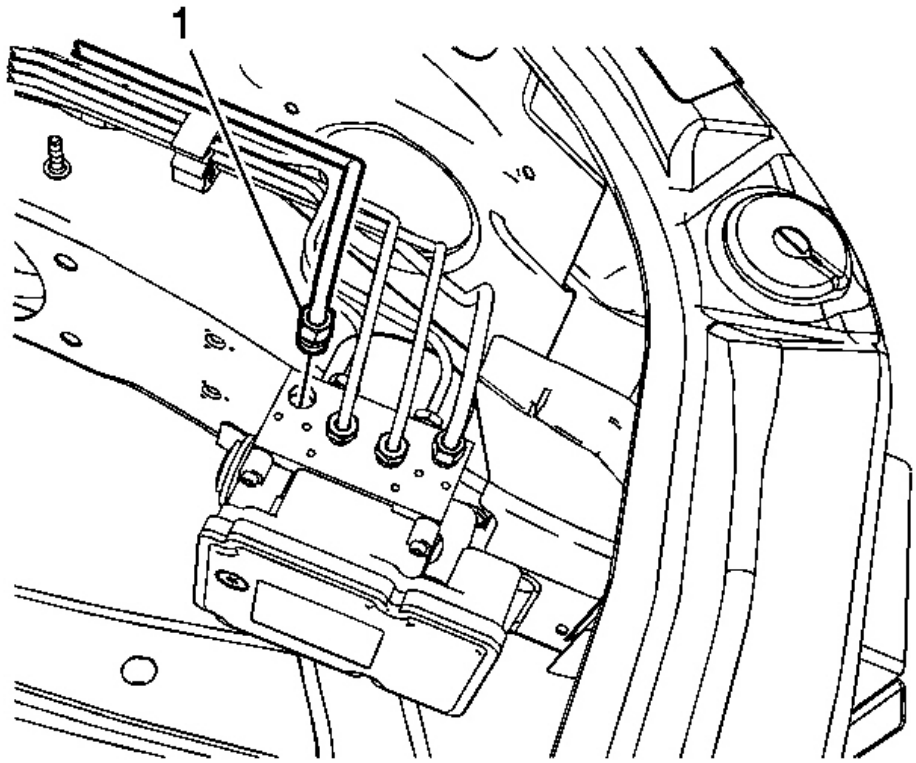

Fig. 19: Master Cylinder Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the master cylinder primary brake pipe fitting (1).

   Cap the fitting and plug the BPMV inlet port to prevent brake fluid loss and contamination.

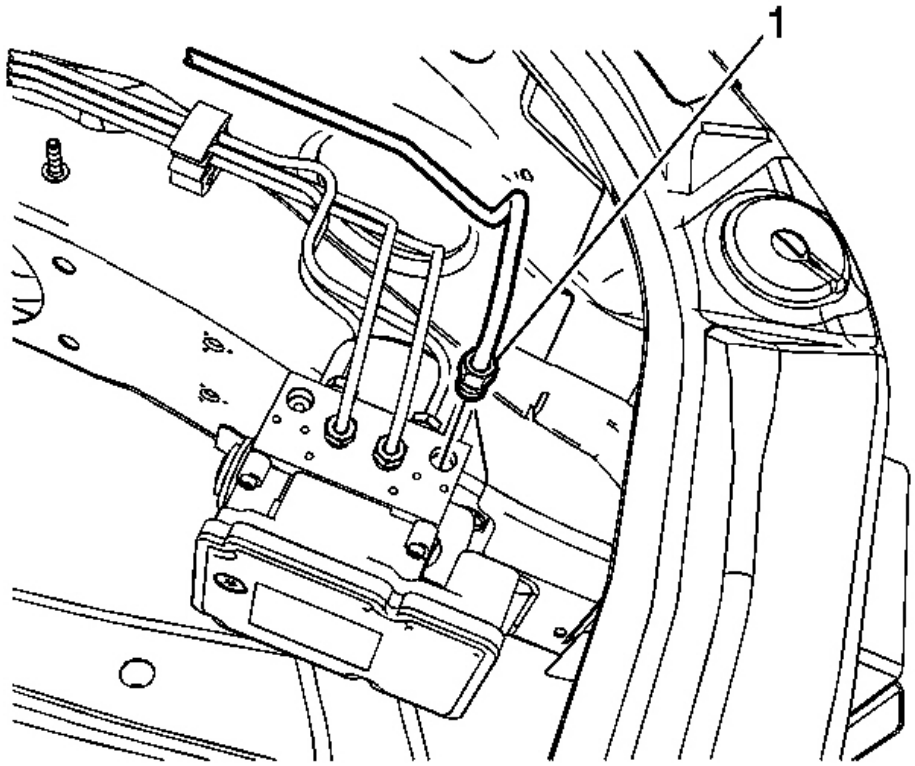

Fig. 20: Master Cylinder Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the master cylinder secondary brake pipe fitting (1).

   Cap the fitting and plug the BPMV inlet port to prevent brake fluid loss and contamination.

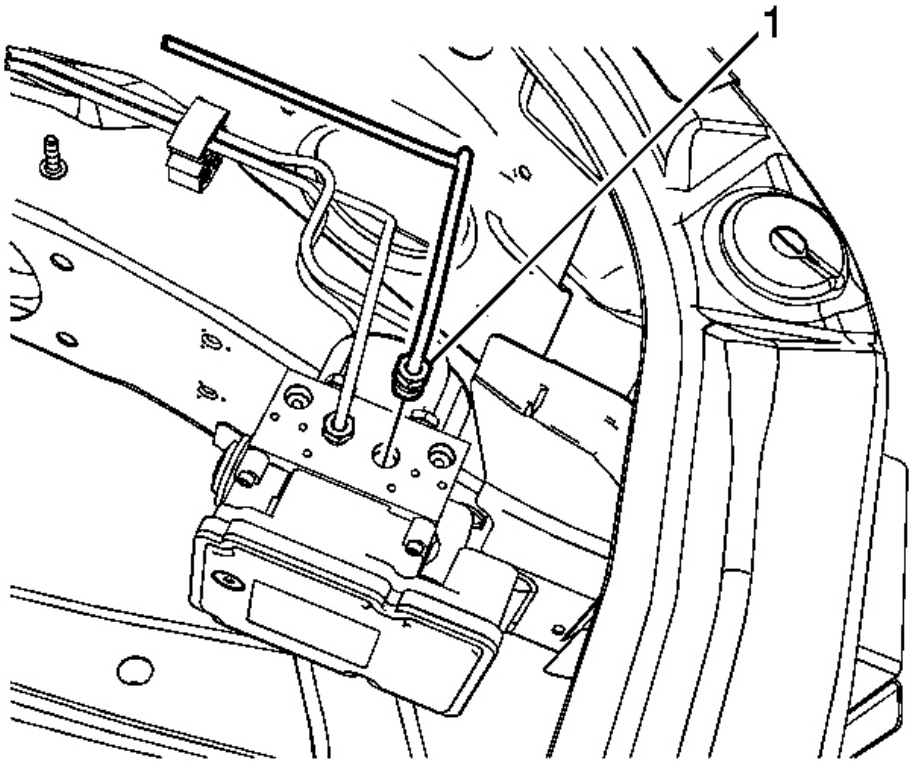

Fig. 21: LF Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

8. Disconnect the LF brake pipe fitting (1).

   Cap the fitting and plug the BPMV outlet port to prevent brake fluid loss and contamination.

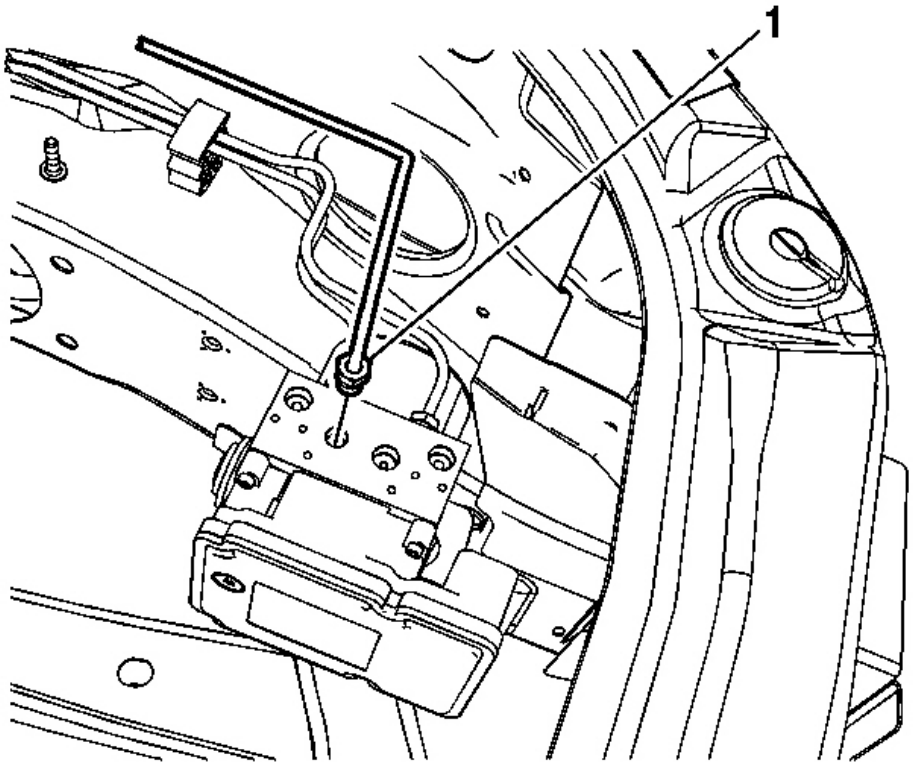

Fig. 22: RF Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

9. Disconnect the RF brake pipe fitting (1).

   Cap the fitting and plug the BPMV outlet port to prevent brake fluid loss and contamination.

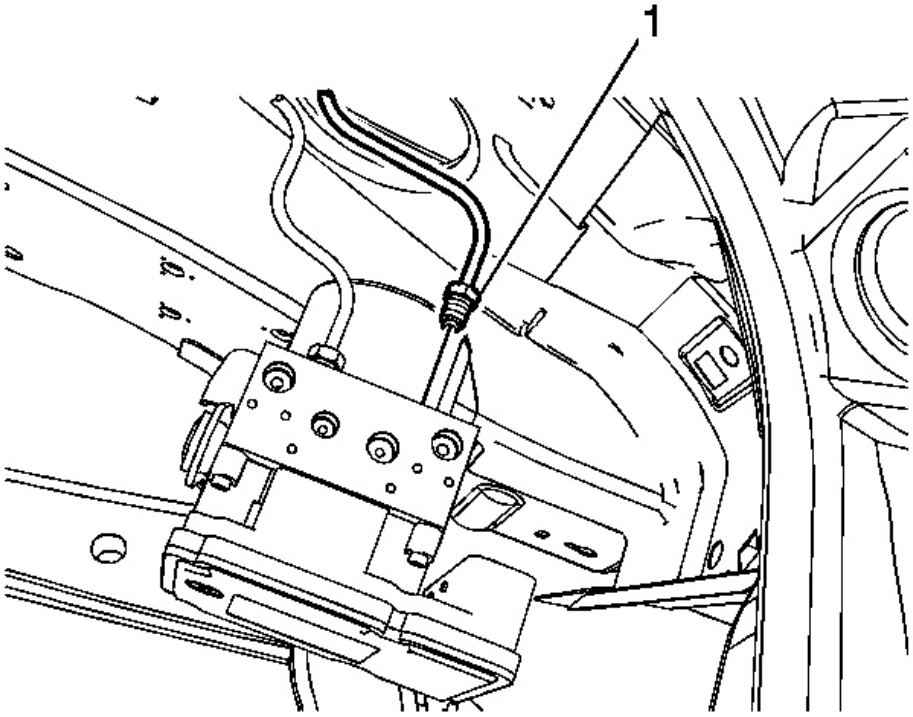

Fig. 23: RR Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

10. Disconnect the RR brake pipe fitting (1).

    Cap the fitting and plug the BPMV outlet port to prevent brake fluid loss and contamination.

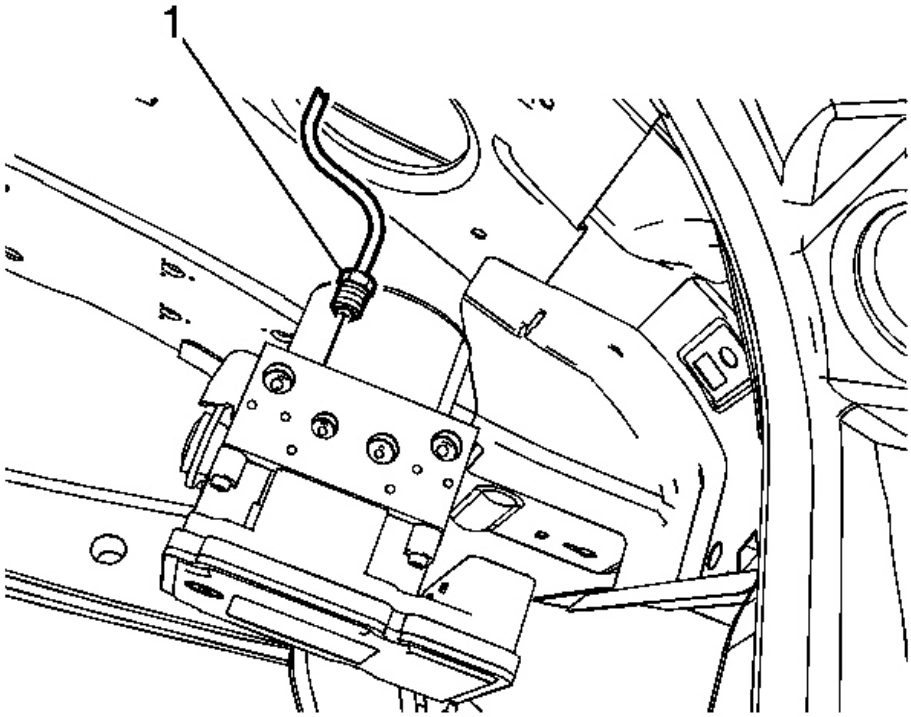

Fig. 24: LR Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

11. Disconnect the LR brake pipe fitting (1).

    Cap the fitting and plug the BPMV outlet port to prevent brake fluid loss and contamination.

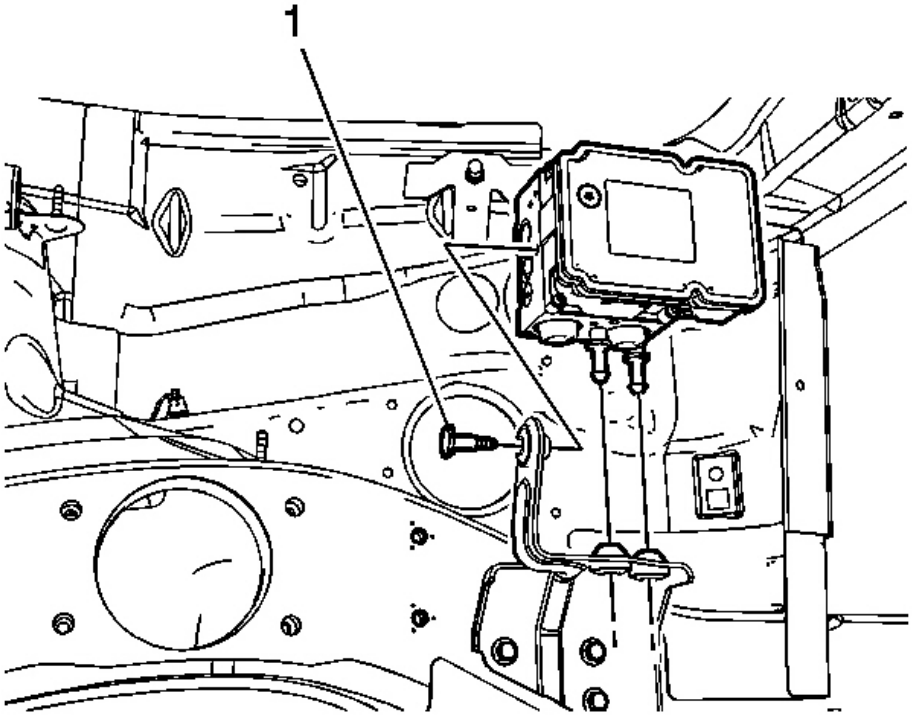

Fig. 25: BPMV Bolt
Courtesy of GENERAL MOTORS CORP.

12. Remove the BPMV bolt (1).

NOTE: Do not remove the mounting pins unless it is necessary to aid in releasing the modulator assembly from the bracket.

13. Carefully remove the brake control module assembly from the BPMV bracket insulators by pulling straight upward.

    Do not pry against the accumulator covers on the underside of the brake modulator assembly to release the mounting pins from the bracket insulators.

14. If installing a new BPMV, remove the EBCM. Refer to **Electronic Brake Control Module**

Replacement (With JL4).

Installation Procedure

1. If installing a new BPMV, install the EBCM. Refer to **Electronic Brake Control Module Replacement (With JL4)**.

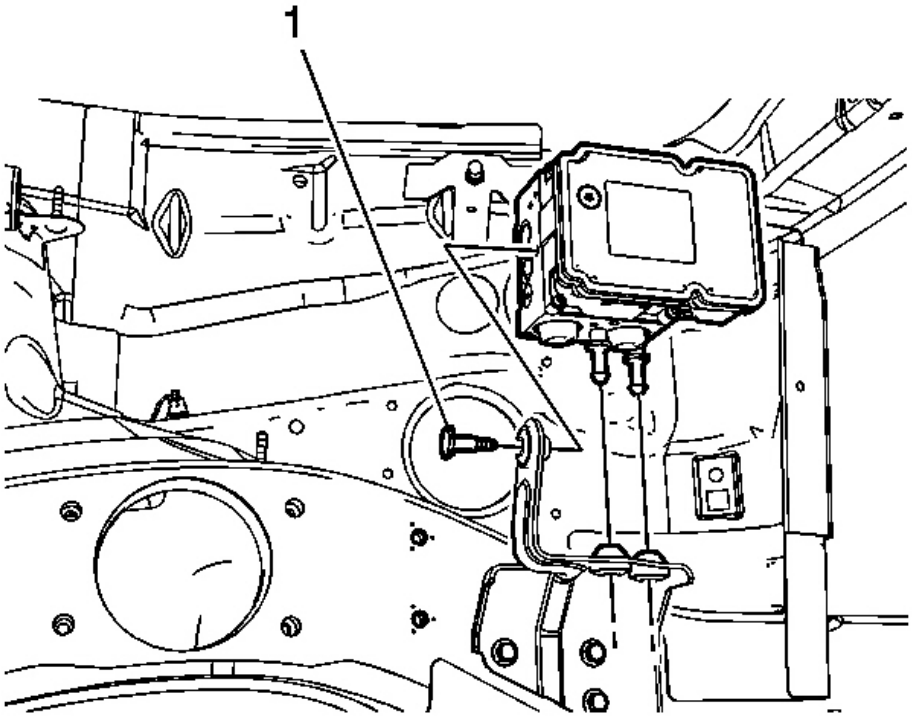

Fig. 26: BPMV Bolt
Courtesy of GENERAL MOTORS CORP.

2. Install the brake control module assembly to the BPMV bracket until the mounting pins are fully inserted in the bracket insulators.

CAUTION: Refer to Fastener Caution .

3. Install the BPMV bolt (1).

   Tighten: Tighten the bolt to 11 N.m (97 lb in).

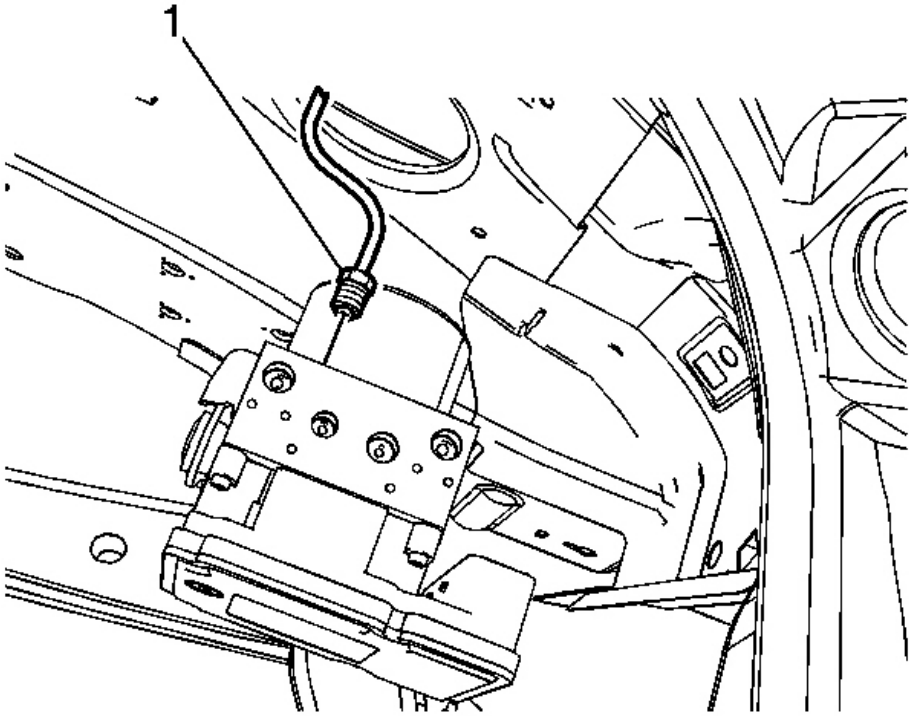

Fig. 27: LR Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

4. Connect the LR brake pipe fitting (1).

   Tighten: Tighten the fitting to 21 N.m (15 lb ft).

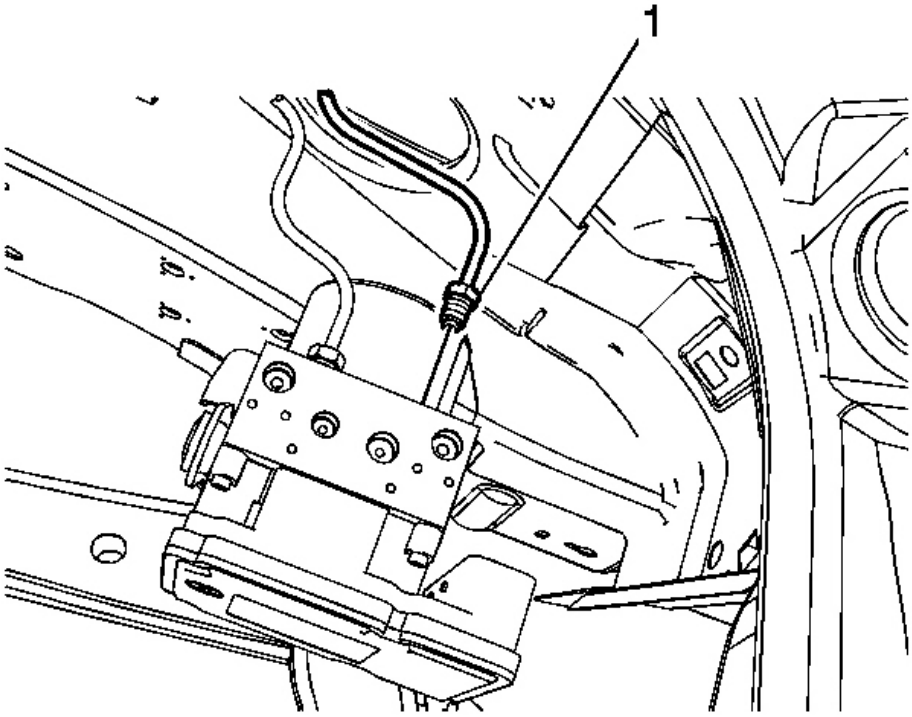

Fig. 28: RR Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

5. Connect the RR brake pipe fitting (1).

   Tighten: Tighten the fitting to 21 N.m (15 lb ft).

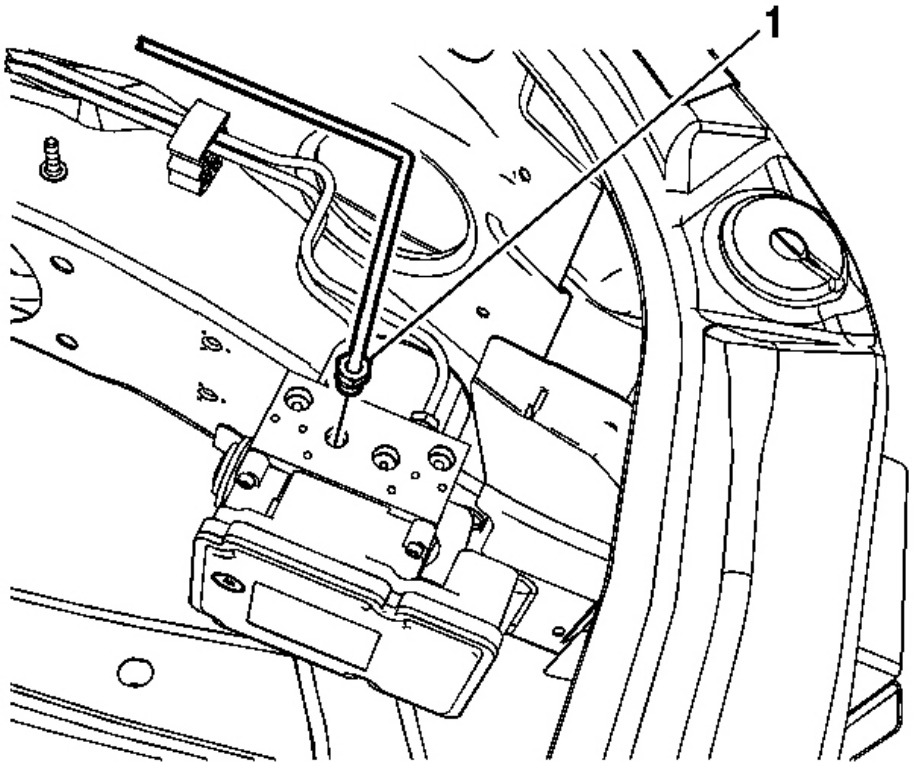

Fig. 29: RF Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

6. Connect the RF brake pipe fitting (1).

   Tighten: Tighten the fitting to 21 N.m (15 lb ft).

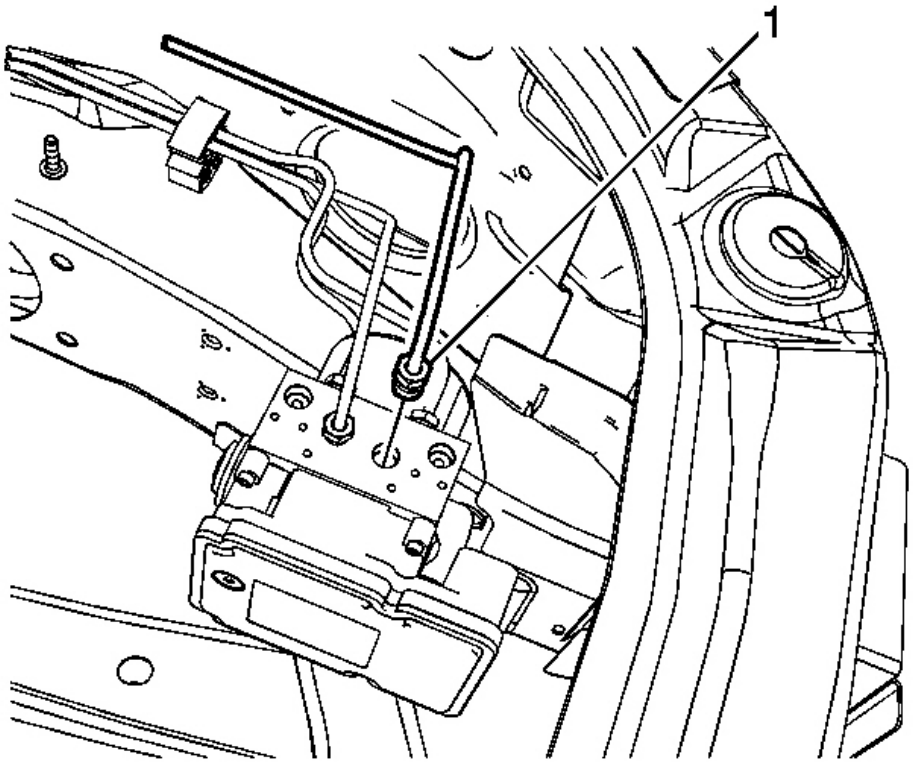

Fig. 30: LF Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

7. Connect the LF brake pipe fitting (1).

   Tighten: Tighten the fitting to 21 N.m (15 lb ft).

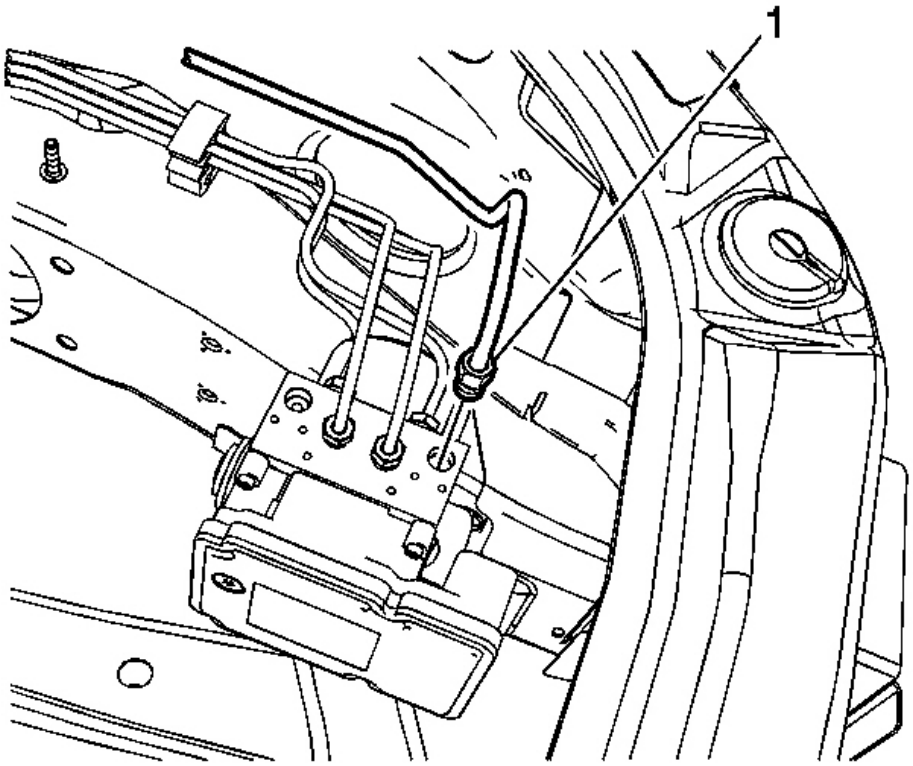

Fig. 31: Master Cylinder Secondary Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

8. Connect the master cylinder secondary brake pipe fitting (1).

   Tighten: Tighten the fitting to 21 N.m (15 lb ft).

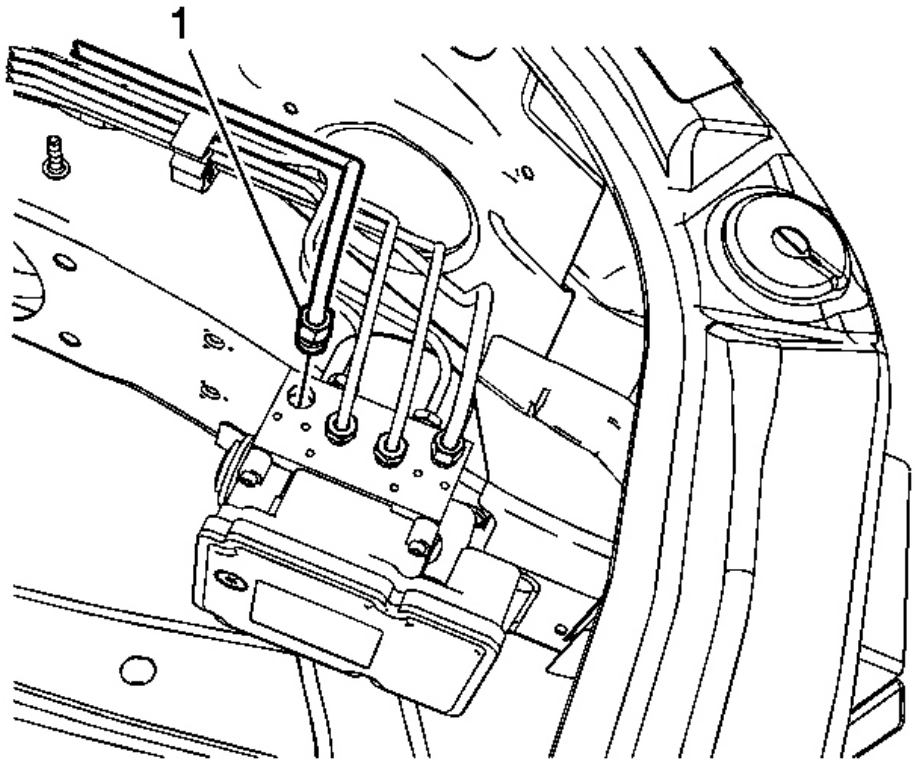

Fig. 32: Master Cylinder Primary Brake Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

9. Connect the master cylinder primary brake pipe fitting (1).

   Tighten: Tighten the fitting to 21 N.m (15 lb ft).

10. Connect the EBCM electrical connector.
11. Install the TCM to the bracket.
12. Position the charge air cooler inlet pipe to the bracket.
13. Program the EBCM. Refer to **Electronic Brake Control Module Programming and Setup** .
14. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** .

15. Perform the **Diagnostic System Check - Vehicle** .
16. Observe the brake pedal feel after performing the diagnostic system check. If the pedal now feels spongy, air may have been in the secondary hydraulic circuit of the brake modulator which may have been introduced into the primary circuit. If the pedal feels spongy, perform the **Antilock Brake System Automated Bleed Procedure**.

BRAKE PRESSURE MODULATOR VALVE BRACKET REPLACEMENT (WITH JL4)

Removal Procedure

1. Turn the ignition switch to the OFF position.
2. Remove the underhood electrical center junction block bracket. Refer to **Underhood Electrical Center or Junction Block Bracket Replacement** .
3. Release the brake pipes from the retainer on the wheelhouse panel.

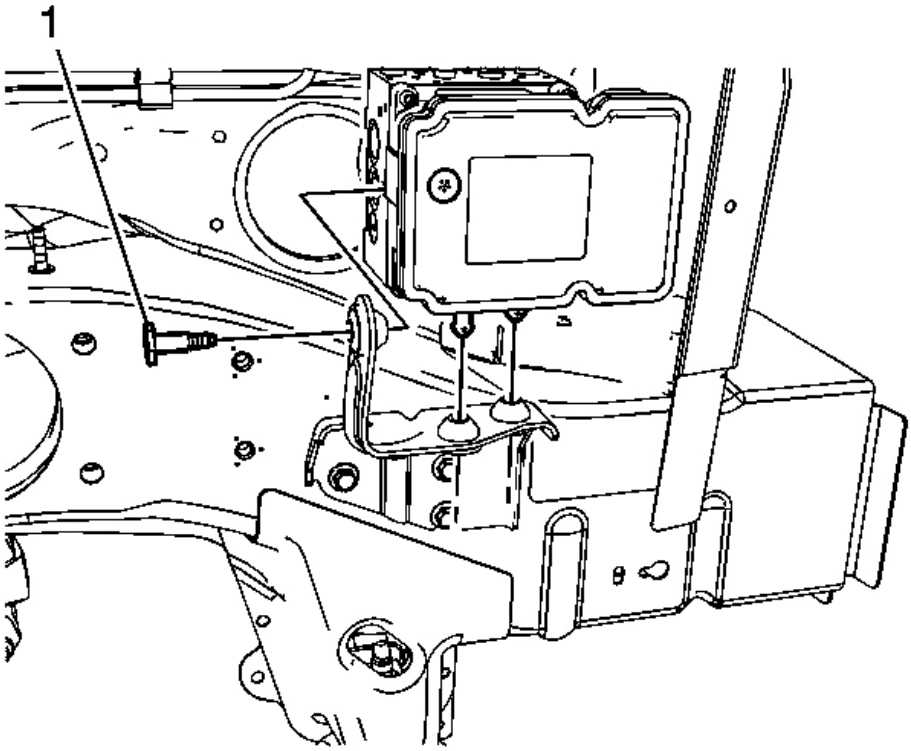

Fig. 33: Brake Pressure Modulator Valve (BPMV) Bolt
Courtesy of GENERAL MOTORS CORP.

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

NOTE: Do not remove the mounting pins unless it is necessary to aid in releasing the modulator assembly from the bracket.

5. Remove the BPMV from the bracket by pulling straight upward.

   Do not pry against the accumulator covers on the underside of the brake modulator assembly to release the mounting pins from the bracket insulators.

6. Support the BPMV with heavy mechanics wire or equivalent.

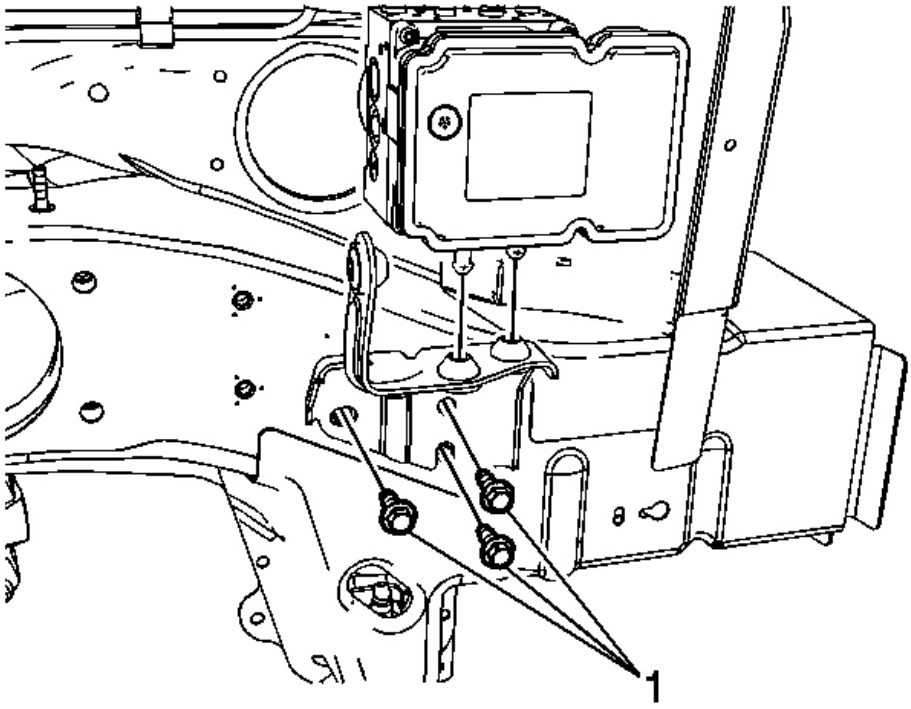

Fig. 34: Upper BPMV Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

7. Loosen the BPMV bracket bolts (1).
8. Remove the 2 upper BPMV bracket bolts.

   It is not necessary to remove the lower BPMV bracket bolt.

9. Remove the BPMV bracket.
10. Inspect the bracket insulators for damage and replace if necessary.

Installation Procedure

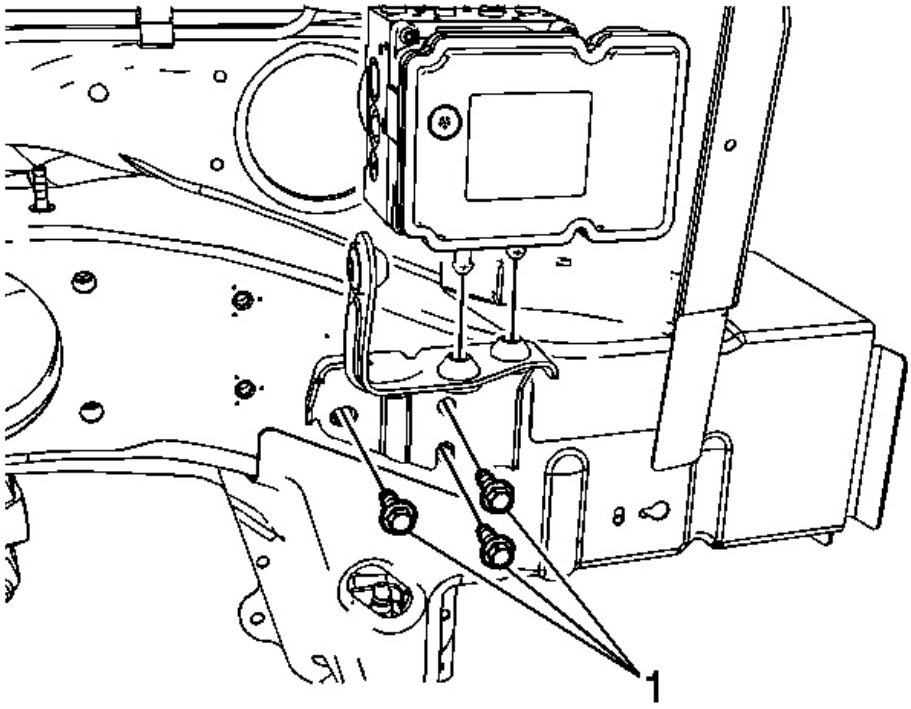

Fig. 35: Upper BPMV Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the BPMV bracket.
2. Install the 2 upper BPMV bracket bolts (1).

CAUTION: Refer to Fastener Caution .

3. Tighten the BPMV bracket bolts.

Tighten: Tighten the bolts to 25 N.m (18 lb ft).

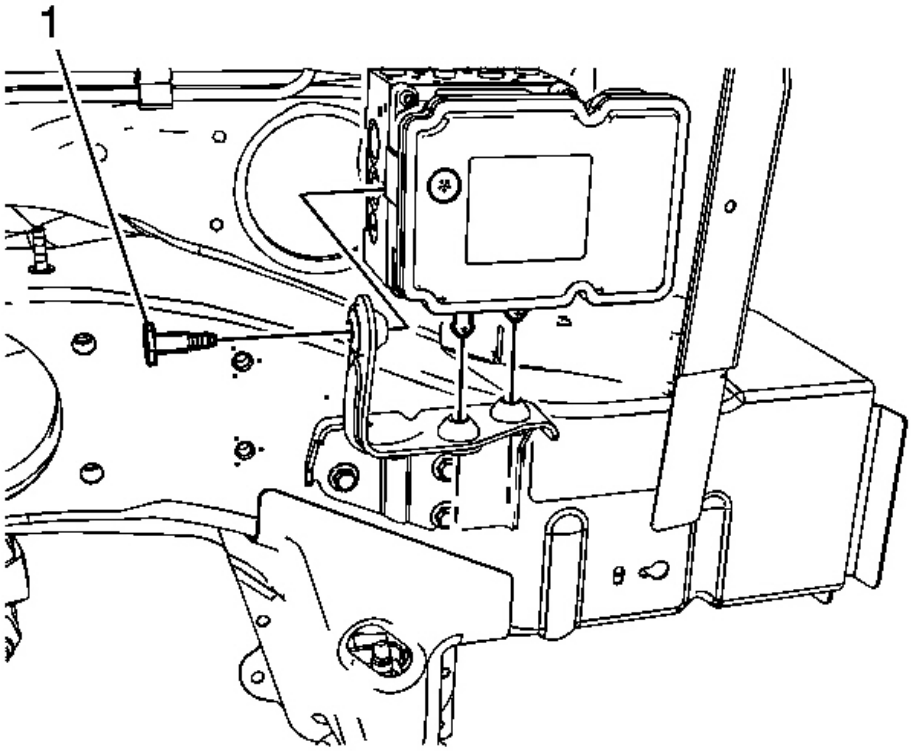

Fig. 36: Brake Pressure Modulator Valve (BPMV) Bolt
Courtesy of GENERAL MOTORS CORP.

4. Install the BPMV to the bracket by pressing the BPMV mounting pins into the bracket insulators until fully seated.
5. Install the BPMV bolt (1).

   Tighten: Tighten the bolt to 11 N.m (97 lb in).

6. Install the brake pipes to the retainer on the wheelhouse panel.
7. Install the underhood electrical center junction block bracket. Refer to **Underhood Electrical Center or Junction Block Bracket Replacement** .

ELECTRONIC TRACTION CONTROL SWITCH REPLACEMENT

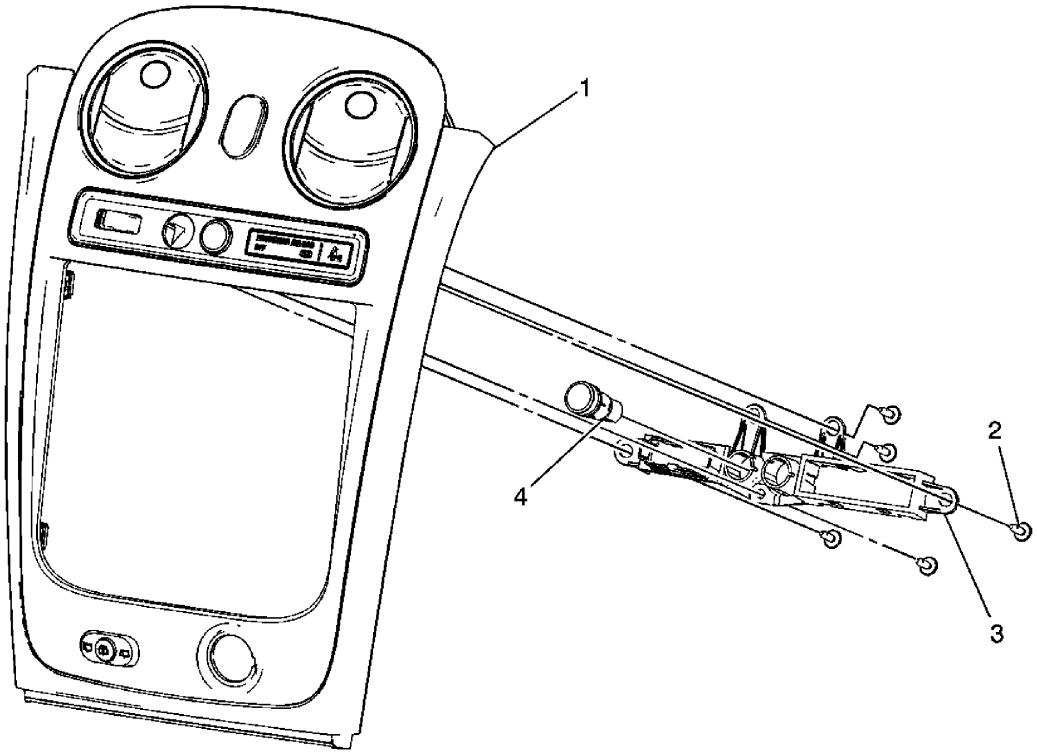

Fig. 37: Electronic Traction Control Switch
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	Instrument Panel Accessory Trim Plate Refer to **Instrument Panel Accessory Trim Plate Replacement** .
2	Inflatable Restraint Indicator Bracket Screw (Qty: 5) **CAUTION:** **Refer to Fastener Caution .** **Tighten:** 2 N.m (18 lb in)
3	Inflatable Restraint Indicator Bracket
4	Electronic Traction Control Switch Assembly

VEHICLE YAW SENSOR WITH VEHICLE LATERAL ACCELEROMETER REPLACEMENT

Removal Procedure

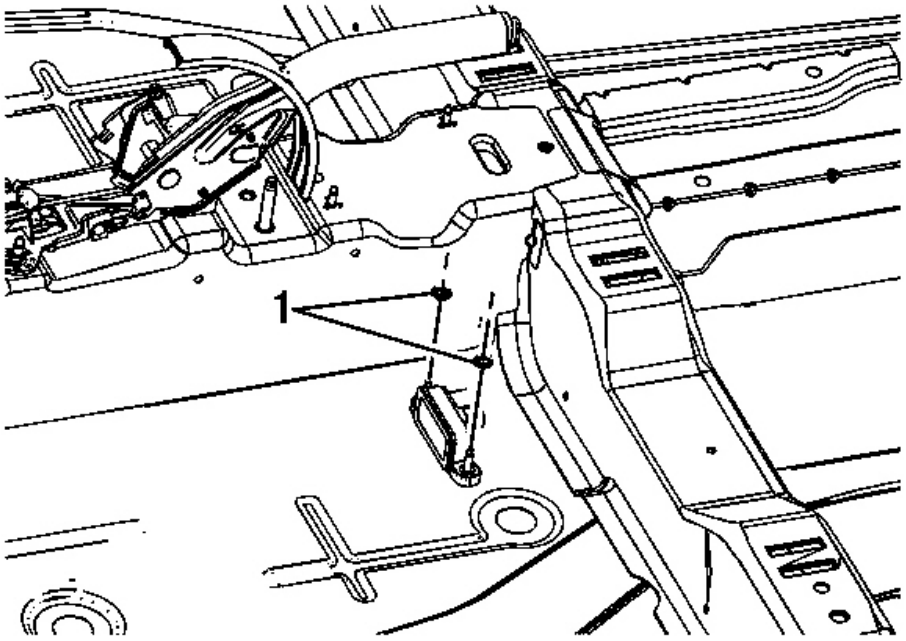

Fig. 38: View Of Yaw Rate Sensor & Nuts
Courtesy of GENERAL MOTORS CORP.

1. Turn OFF the ignition.
2. Remove the right front seat. Refer to **Front Seat Replacement - Bucket** .
3. Remove the right side body hinge pillar trim panel. Refer to **Body Hinge Pillar Trim Panel Replacement - Right Side** .
4. Carefully lift the floor carpet to access the yaw rate sensor.

   To ease access to the yaw rate sensor, it may be necessary to carefully cut a small section of the floor carpeting neat the yaw rate sensor.

5. Disconnect the yaw rate sensor electrical connector.
6. Remove the yaw rate sensor nuts (1).

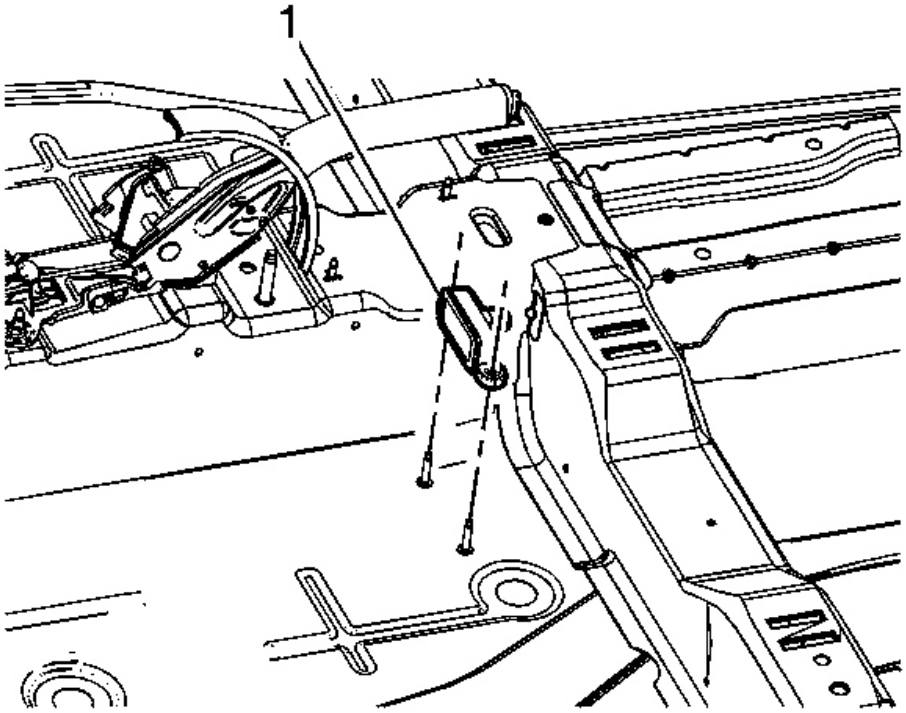

Fig. 39: View Of Yaw Rate Sensor
Courtesy of GENERAL MOTORS CORP.

7. Remove the yaw rate sensor (1).

Installation Procedure

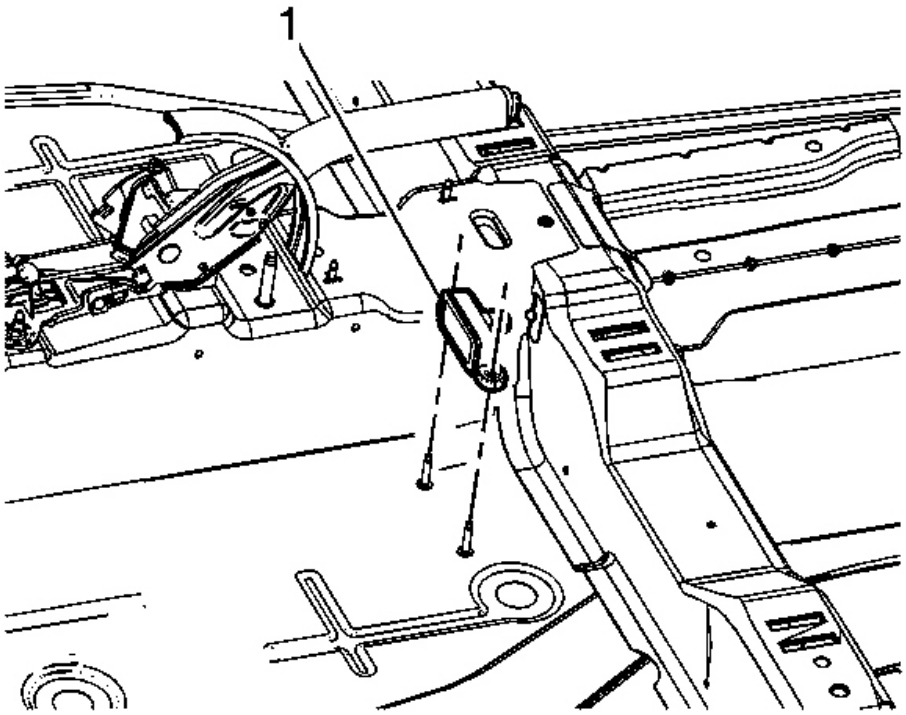

Fig. 40: View Of Yaw Rate Sensor
Courtesy of GENERAL MOTORS CORP.

1. Install the yaw rate sensor (1).

CAUTION: Refer to Fastener Caution .

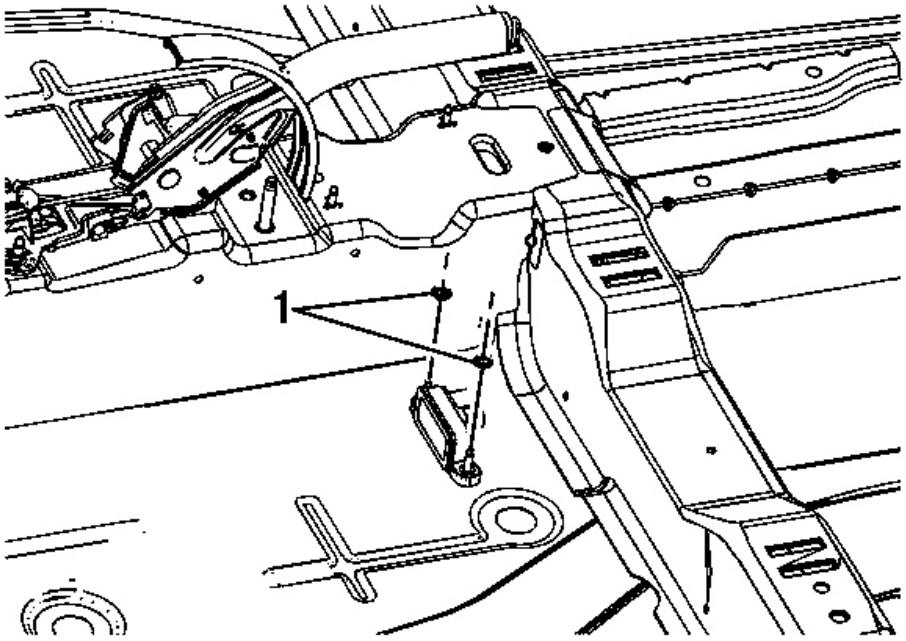

Fig. 41: View Of Yaw Rate Sensor & Nuts
Courtesy of GENERAL MOTORS CORP.

2. Install the yaw rate sensor nuts (1).

   Tighten: Tighten the nuts to 10 N.m (89 lb in).

3. Connect the yaw rate sensor electrical connector.
4. Carefully position the floor carpet to the vehicle floor.
5. Install the right side body hinge pillar trim panel. Refer to **Body Hinge Pillar Trim Panel Replacement - Right Side** .
6. Install the right front seat. Refer to **Front Seat Replacement - Bucket** .
7. Install a scan tool.
8. Using the special functions menu on the scan tool, perform the steering angle sensor calibration. Refer to **Control Module References** .

9. Perform the **Diagnostic System Check - Vehicle** .

DESCRIPTION AND OPERATION

ABS DESCRIPTION AND OPERATION

This vehicle is equipped with the MK 25 E Continental Teves antilock braking system.

The vehicle is equipped with the following braking systems:

- Antilock Brake System (ABS)
- Engine Drag Control
- Electronic Brake Distribution
- Electronic Brake Control Module (EBCM)
- Hydraulic Brake Booster
- Traction Control System
- Vehicle Stability Enhancement System (w/JL4)
- Optimized Hydraulic Braking System

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

- Electronic Brake Control Module (EBCM)-The EBCM controls the system functions and detects failures.

  The EBCM contains the following components:

- Brake Pressure Modulator Valve -The brake pressure modulator valve contains the hydraulic valves and pump motor that are controlled electrically by the EBCM. The BPMV uses a 4 circuit configuration with a diagonal split. The brake pressure modulator valve directs fluid from the reservoir of the master cylinder to the left front and right rear wheels and fluid from the other reservoir to the right front and left rear wheels. The diagonal circuits are hydraulically isolated so that a leak or malfunction in one circuit will allow continued braking ability on the other.

  IMPORTANT: There is a rubber isolator located under the brake pressure modulator valve and on the mounting studs. The rubber isolators protect the brake pressure modulator valve and the EBCM from vehicle vibrations.

  The Brake Pressure Modulator Valve contains the following components:

  - Pump Motor
  - Inlet Valves (one per wheel)
  - Outlet Valves (one per wheel)
  - Master Cylinder Isolation Valves (one per drive wheel)
- The wheel speed sensor receives a 12-volt power supply voltage from the electronic brake control module (EBCM) and provides an output signal to the EBCM. As the wheel spins, the wheel speed sensor sends

the EBCM a DC square wave signal. The EBCM uses the frequency of the square wave signal to calculate the wheel speed.

- Traction Control Switch-The TCS is manually disabled or enabled using the traction control switch.
- Brake Pedal Position-The EBCM uses the BPP sensor as an indication that the brake pedal is applied.
- Lateral Accelerometer Sensor (w/JL4)-The EBCM uses the lateral accelerometer sensor as an indication of the lateral acceleration of the vehicle.
- Yaw Rate Sensor (w/JL4)-The EBCM uses the yaw rate sensor as an indication of the yaw rate of the vehicle.
- Steering Wheel Position Sensor (SWPS) (w/JL4)-The EBCM uses the SWPS as an indication of the position and rotation of the steering wheel.

Initialization Sequence

The EBCM performs 1 initialization test each ignition cycle. The initialization of the EBCM occurs when 1 set of the following conditions occur:

- The EBCM detects that there is a minimum of 500 RPM from the ECM via a serial data message.
- The brake pedal position sensor is not applied.

OR

Both of the following conditions occur:

- The vehicle speed is greater than 16 km/h (10 mph).
- The stop lamp switch is applied.

The initialization sequence cycles each solenoid valve and the pump motor, as well as the necessary relays, for approximately 1.5 seconds to check component operation. The EBCM sets a DTC if any error is detected. The initialization sequence may be heard and felt while it is taking place, and is considered part of normal system operation.

The EBCM defines a drive cycle as the completion of the initialization sequence.

Antilock Brake System

When wheel slip is detected during a brake application, the ABS enters antilock mode. During antilock 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 brake. The ABS cannot, however, increase hydraulic pressure above the amount which is transmitted by the master cylinder during braking.

During antilock 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 antilock 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 antilock braking on dry pavement, intermittent chirping

noises may be heard as the tires approach slipping. These noises and pedal pulsations are considered normal during antilock 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.

Pressure Hold

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

Pressure Decrease

The EBCM decreases the pressure to individual wheels during a deceleration when wheel slip occurs. The inlet valve is closed and the outlet valve is opened. The excess fluid is stored in the accumulator until the return pump can return the fluid to the master cylinder.

Pressure Increase

The EBCM increases the pressure to individual wheels during a deceleration in order to reduce the speed of the wheel. The inlet valve is opened and the outlet valve is closed. The increased pressure is delivered from the master cylinder.

Engine Drag Control

When the driver releases the throttle, and the drag from the engine overcomes the frictional force between the tire and the road, engine drag control becomes active.

The EBCM sends a torque request signal to the ECM, which increases the torque at the wheels. This stabilizes the wheels by reducing the slip at the driven wheels.

When engine drag control is active, the driven wheels are controlled to a target below the non-driven wheels.

Electronic Brake Distribution

The Electronic Brake Distribution is a control system that replaces the hydraulic proportioning function of the mechanical proportioning valve in the base brake system. The electronic brake distribution control system is part of the operation software in the EBCM. The electronic brake distribution uses active control with existing ABS in order to regulate the vehicle's rear brake pressure.

The red brake warning indicator is illuminated when the dynamic rear proportioning function is disabled.

Hydraulic Brake Boost System

If your vehicle is equipped with Electronic Stability Control and the optional 2.0L turbocharged engine, it also has a hydraulic brake boost feature which supplements the power 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. When hydraulic brake boost is active, you might feel minor brake pulsation or movement in the pedal but this is normal.

The Hydraulic Brake Boost system activates (only) during a brake apply when the brake module detects low vacuum from the vacuum sensor mounted in the booster. The boost function in this case will be provided by the electronic stability control system to provide metered brake pressure to the wheels. When the system activates to build pressure, the electronic control unit will run the pump motor, opens the electronic shuttle valve, and closes the isolation valves at the same time. The electronic control unit runs the pump in pulsed cycles and builds pressure in the wheels that exceeds the tandem main cylinder (with low vacuum in the booster). As the brake fluid is drained from the tandem main cylinder, the brakes pedal will move accordingly (pulsing feel in pedal). Pump speed and duration are controlled by computed volume models in the electronic control unit (information includes low vacuum sensed, tandem main cylinder pressure, and pedal travel through the brake apply sensor). If the pressure is reduced or vacuum restored while a low hydraulic boost is required the wheel pressure can thus be continuously adjusted to the tandem main cylinder pressure by selectively lowering the current on the isolation valve.

Traction Control System

When drive wheel slip is noted while the brake is not applied, the electronic brake control module (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 the serial data. The ECM reduces torque to the drive wheels by retarding spark timing and turning off fuel injectors. The ECM reports the amount torque delivered to the drive wheels via the serial data circuit.

If the engine torque reduction does not eliminate drive wheel slip, the EBCM will actively apply the drive wheel brakes. During traction control braking, hydraulic pressure in each drive wheel circuit is controlled to prevent the drive wheels from slipping. The master cylinder isolation valve closes in order to isolate the master cylinder from the rest of the hydraulic system. The prime valve then opens in order to allow the pump to accumulate brake fluid in order to build hydraulic pressure for braking. The drive wheel inlet and outlet solenoid valves then open and close in order to perform the following functions:

- Pressure hold
- Pressure increase
- Pressure decrease

Traction Control Switch

Traction Control Switch Off, or Competitive Mode:

The Traction switch has multiple functions depending on the switch sequence applied. The Traction will be re-enabled by default when an ignition cycle is performed. When the Traction switch is pushed once, only the Traction control will be disabled. When the Traction switch is pressed twice within a 5 second time frame the EBCM will disable Traction and put the vehicle stability enhancement system into a competitive mode which will limit the Vehicle Stability Enhancement System control. When the Traction switch is pressed and held for 5 seconds the Traction and Vehicle Stability Enhancement System will be disabled

ABS Indicator

The instrument panel cluster illuminates the Antilock Brake System (ABS) indicator when the following occurs:

- The electronic brake control module (EBCM) detects a malfunction with the antilock brake system. The instrument panel cluster receives a serial data message from the EBCM requesting illumination.
- The instrument panel cluster performs the displays test at the start of each ignition cycle. The indicator illuminates for approximately 5 seconds.
- The instrument panel cluster detects a loss of serial data communications with the EBCM.

ECE 13 Response

The EBCM illuminates the ABS indicator when a malfunction which disables ABS is detected. Usually, the ABS indicator is turned OFF during the following ignition cycle unless the fault is detected during that ignition cycle. However, the setting of a wheel speed sensor or pump motor related DTC causes the ABS indicator to remain illuminated during the following ignition cycle until the vehicle is operated at a speed greater than 13 km/h (8 mph). This allows the EBCM to verify that no malfunction exists, before turning OFF the ABS indicator. When repairing these vehicles, it is important to ensure that the ECE 13 response has occurred and that the ABS indicator does not illuminate after returning the vehicle to the customer. It is also important to verify that ECE 13 is not the cause of an ABS indicator which is illuminated when no DTCs are set, before attempting to diagnose other possible causes.

Traction Control System Indicator

TRAC OFF

The instrument panel cluster illuminates the TRAC OFF indicator when the following occurs:

- The electronic brake control module (EBCM) inhibits the traction control system due to a malfunction in the traction control system. The instrument panel cluster receives a serial data message from the EBCM requesting illumination.
- The body control module (BCM) detects that the traction control switch has been pressed (signal circuit is low). The BCM sends a serial data message to the EBCM in order to disable traction control. The instrument panel cluster receives a serial data message from the BCM requesting illumination. The BCM sends a serial data message to the radio in order to activate an audible warning.

Vehicle Stability Enhancement System

The Vehicle Stability Enhancement System adds an additional level of vehicle control to the EBCM.

Yaw rate is the rate of rotation about the vehicle's vertical axis. The vehicle stability enhancement system 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 from the following parameters:

- The position of the steering wheel

- The speed of the vehicle
- The lateral, or sideways acceleration of the vehicle

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. If the yaw rate error becomes too large, the EBCM attempts to correct the vehicle's yaw motion by applying differential braking to the appropriate wheel. The amount of differential braking applied to the left or right front wheel is based on both the yaw rate error and side slip rate error.

The vehicle stability enhancement system activations generally occur during aggressive driving, in turns or on bumpy roads without much use of the accelerator pedal. When braking during vehicle stability enhancement system activation, the pedal pulsations feel different than the ABS pedal pulsations. The brake pedal pulsates at a higher frequency during vehicle stability enhancement system activation.

Optimized Hydraulic Braking System

If your vehicle is equipped with Electronic Stability Control and the optional 2.0L turbocharged engine, it also has a optimized hydraulic brake boost feature which supplements the power 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. When hydraulic brake boost is active, you might feel a minor brake pulsation or movement in the pedal but this is normal.

The Optimized Hydraulic Brake Boost system activates (only) during a brake apply when the brake module detects low vacuum from the vacuum sensor mounted in the booster. The boost function in this case will be provided by the Electronic Stability Control system to provide metered brake pressure to the wheels. When the system activates to build pressure, the electronic control unit will run the pump motor, opens the electronic shuttle valve, and closes the isolation valves at the same time. The electronic control unit runs the pump in pulsed cycles and builds pressure in the wheels that exceeds the tandem main cylinder (with low vacuum in the booster). As the brake fluid is drained from the tandem main cylinder, the brakes pedal will move accordingly (pulsing feel in pedal). Pump speed and duration are controlled by computed volume models in the electronic control unit (information includes low vacuum sensed, tandem main cylinder pressure, and pedal travel through the brake apply sensor). If the pressure is reduced or vacuum restored while a low hydraulic boost is required the wheel pressure can then be continuously adjusted to the tandem main cylinder pressure by selectively lowering the current on the isolation valve.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
	J 46079 Tire Pressure Monitor Diagnostic tool