## Steering System

Refer to Wiring Diagrams Cell 41 , Rear Air Suspension for schematic and connector information.

Refer to Wiring Diagrams Cell 43 , Electric Variable Assist Power Steering (EVO) for schematic and connector information.

**Special Tool(s)**

| | |
|---|---|
|  ST1619-A | Super Star II Tester or equivalent<br>007-0041-B |
|  ST1477-A | Power Steering Analyzer or equivalent<br>014-00207 |
|  ST1396-A | Dial Thermometer 0-220° F or equivalent<br>023-R0007 |
|  ST1137-A | 73 Digital Multimeter or equivalent<br>105-R0051 |
|  ST1177-A | 88 Digital Multimeter or equivalent<br>105-R0053 |

### Principles of Operation

**NOTE:** The electronic variable orifice (EVO) steering system is not available on police vehicles.

The EVO steering system controls the level of power steering assistance based on vehicle speed and the rate of change in the steering position. Greater power assistance is provided at lower speeds to lessen steering effort and increase maneuverability. Less power assistance is provided at higher speeds to raise the steering effort for increased directional stability and greater "road feel."

Steering effort increases with vehicle speed in a smooth and continuous manner in the mid-range speed, reaching a constant level at high rates of speed. A high rate of change in the steering wheel position, which might indicate an evasive maneuver, will result in an increase in the power assistance.

Vehicles with air suspension use the air suspension control module to monitor steering control for the electronic variable orifice steering (EVO) system. Vehicles with base suspension use the EVO control module to monitor the steering system. Both systems on a panic or aggressive turn will provide additional power assist. If there is any electrical system failure in the EVO system the system will default to full power assist.

**Inspection and Verification**

1. Verify the customer's concern by operating the vehicle to duplicate the condition.

2. Visually inspect for obvious signs of mechanical and electrical damage. Refer to the following chart:

**Visual Inspection Chart**

| Mechanical | Electrical |
|---|---|
| • Tire pressure, loose wheels<br>• Loose outer or inner tie rod ends<br>• Loose suspension struts or ball joints<br>• Loose universal joints<br>• Loose connecting bolts on column intermediate shaft<br>• Loose steering gear assembly<br>• Drive belt<br>• Binding or misaligned steering column<br>• Power steering pump, fluid level, hose leak | • Central junction box (CJB) Fuse 5 (15A)<br>• Battery junction box (BJB) Fuse 8 (30A)<br>• Wiring harness<br>• Loose or corroded connector(s)<br>• Steering wheel rotation sensor<br>• Vehicle speed sensor<br>• EVO actuator<br>• EVO control module-controlled<br>• Computer controlled air suspension. Refer to Section 204-05 . |

3. If the inspection reveals obvious concerns that can be readily identified, repair as required.

4. If the concern(s) remains after the inspection, run the Auto Test. Go to EVO Steering Diagnosis — Without Air Suspension if not equipped with air suspension, or refer to Section 204-05 if equipped with air suspension. If any DTCs are retrieved, refer to EVO Control Module Diagnostic Trouble Code (DTC) Index (for vehicles without air suspension) or refer to Air Suspension Control Module Diagnostic Trouble Code (DTC) Index (for vehicles with air suspension).

**EVO Steering Diagnosis — Without Air Suspension**

When the engine is started and the HOLD/TEST button is latched down, the EVO control module will respond by sending a code 20 to the Super Star II Tester which represents "Diagnostics mode entered." If diagnostic trouble (DTC) 20 is not displayed, go to Pinpoint Test A.

Once this mode is entered, the EVO module will continuously cycle through a menu of five tests. The EVO control module will scroll through these tests, waiting eight seconds before proceeding to the next test. If at any time in the eight-second period the Super Star II Tester line is toggled high by unlatching the HOLD/TEST button for at least one second but less than eight, then toggled back low by relatching the HOLD/TEST button, the EVO control module will enter and run that selected test. If the HOLD/TEST button is unlatched for the entire eight seconds in between any of the tests, the EVO control module will exit diagnostic mode and resume operation in its normal operating state.

If power is removed at any time while the EVO control module is in diagnostic mode, the EVO control module will exit diagnostic mode and resume operation in its normal operating state when power is reapplied.

The sequence and definition of the five tests that the technician can carry out are as follows:

5. Reading the fault codes. The first item on the menu the EVO control module will output to the Super Star II Tester is DTC 21. This represents asking the technician whether he/she would like to "Read fault codes?" stored in memory. If the technician releases the HOLD/ TEST button for one second, then latches the HOLD/TEST down again within eight seconds after receiving DTC 21, the EVO control module will enter this test, output the fault DTCs stored in memory and complete this test by outputting DTC 22 to the Super Star II Tester which signals end of test.

6. Clearing the fault codes. The second item on the menu the EVO will output to the Super Star II Tester is DTC 23. This represents asking the technician whether he/she would like to "Clear fault codes?" stored in memory. If the technician releases the HOLD/TEST button for one second, then latches the HOLD/TEST button down again within eight seconds after receiving DTC 23, the EVO control module will enter this test, clear the fault DTCs and complete this test by outputting DTC 24 to the Super Star II Tester which means DTCs cleared.

7. Actuator Output Test. The third item on the menu the EVO control module will output to the Super Star II Tester is DTC 25. This represents asking the technician whether he/she would like to "Carry out actuator test?" If the technician releases the HOLD/TEST button for one second, then latches the HOLD/TEST button down again within eight seconds after receiving DTC 25, the EVO control module will enter this auto test and automatically test for the actuator faults. If faults exist, the control module will store the appropriate codes in memory, output these codes to the Super Star II Tester and complete this test by outputting DTC 22 to the Super Star II Tester which signals end of test. If no faults exist, the control module will complete this test by outputting DTC 26 to the Super Star II Tester which represents "Test passed."

8. Steering Wheel Sensor Test. The fourth item on the menu the EVO control module will output to the Star Tester is DTC 32. This represents asking the technician whether they would like to "Carry out steering wheel sensor test?" If the technician releases the HOLD/TEST button for one second, then latches the HOLD/TEST button down again within eight seconds after receiving DTC 32, the EVO control module will enter this test. Once this test has been entered and with vehicle speed = 0, the control module will wait 30 seconds for the technician to rotate the steering wheel at least 40 degrees in one direction only. If the steering wheel rotation is not detected within this time, the control module will store DTC 33 in memory and complete this test by outputting DTC 33 to the Super Star II Tester which represents "Steering wheel rotation not detected." If the steering wheel sensor hardware is operating properly, the control module will complete this test by outputting DTC 26 to the Super Star II Tester which means " Test passed." If DTC 33 is received, go to Pinpoint Test K.

**NOTE:** Before entering this test, the vehicle drive wheels must be raised off the floor.

9. Vehicle Speed Sensor Test. The final item on the menu the EVO control module will output to the Super Star II Tester is DTC 34. This represents asking the technician whether he/she would like to "Carry out vehicle speed sensor test?" If the technician releases the HOLD/TEST button for one second, then latches the HOLD/TEST button down again within eight seconds after receiving DTC 34, the EVO control module will enter this test. Once this test has been entered and with steering wheel rotation rate = 0, the control module will wait 30 seconds for the technician to make the vehicle speed go above 24 km/h (15mph). If a vehicle speed of greater than 24km/h (15mph) is not detected within this time, the control module will store DTC 35 in memory and complete this test by outputting DTC 35 to the Super Star II Tester which represents "Vehicle speed greater than 15 mph not detected." If the vehicle speed sensor hardware is operating properly, the control module will complete this test by outputting DTC 26 to the Super Star II Tester which means "Test passed." If DTC 35 is received, go to Pinpoint Test L.

10. After completion of this test, the EVO module will go back to test No. 1 and continuously cycle through the menu of tests until the technician either unlatches the HOLD/TEST button until the control module exits this mode or removes power to the EVO control module by turning the ignition switch OFF.

**EVO Steering Diagnosis-With Air Suspension**

1. Run the Auto Test; refer to Section 204-05.

2. Carry out the manual input test as follows:

3. A DTC 12 will be displayed at the end of the Auto Test only if everything checked to this point is functional.

4. After DTC 12 (or DTC 13) is displayed, the air suspension control module is ready to check for manual inputs. The manual inputs check the steering sensor and door courtesy lamp switch circuits. During the manual test, the air suspension control module continually monitors the door and steering sensor circuits for activity. To pass the manual test, the air suspension control module must detect that four doors have been opened and closed, and the steering wheel has been turned at least one quarter turn in each direction. After the manual test, the Super Star II Tester button must be toggled or the air suspension control module will continue to monitor the manual input tests indefinitely. Either a DTC 11 (air suspension OK) or other DTCs will be displayed at this time.

5. After the auto and manual input tests, the DTCs will be displayed automatically. Each DTC detected will be displayed for about 15 seconds. The code display will continue until all DTCs have been displayed. The display will repeat the DTC until Super Star II Tester button is released (up). Document all DTCs.

**EVO Control Module Diagnostic Trouble Code (DTC) Index**

**EVO Control Module Diagnostic Trouble Code (DTC) Index**

| DTC | Description | Source | Action |
|---|---|---|---|
| 20 | Diagnostics mode entered | EVO control module | — |
| 21 | Read trouble codes | EVO control module | — |
| 22 | End of test | EVO control module | — |
| 23 | Clear trouble codes | EVO control module | — |
| 24 | Diagnostic trouble codes cleared | EVO control module | — |
| 25 | Carry out actuator tests | EVO control module | — |
| 26 | Test passed | EVO control module | — |
| 27 | Actuator circuit open | EVO control module | GO to Pinpoint Test F. |
| 28 | Actuator circuit shorted | EVO control module | GO to Pinpoint Test G. |
| 29 | Actuator circuit high side shorted to ground | EVO control module | GO to Pinpoint Test H. |
| 30 | Actuator circuit shorted to battery | EVO control module | GO to Pinpoint Test I. |
| 31 | Actuator circuit low side shorted to ground | EVO control module | GO to Pinpoint Test J. |
| 33 | Steering wheel rotation not detected | EVO control module | GO to Pinpoint Test K. |
| 34 | Carry out vehicle speed sensor test. | EVO control module | — |
| 35 | Vehicle speed greater than 24 km/h (15 mph) not detected | EVO control module | GO to Pinpoint Test L. |

**Air Suspension Control Module Diagnostic Trouble Code (DTC) Index**

**Air Suspension Control Module Diagnostic Trouble Code (DTC) Index**

| DTC | Description | Source | Action |
|---|---|---|---|
| 10 | Diagnostic auto test in progress | Air suspension control module | — |
| 11 | Vehicle system passes | Air suspension control module | — |
| 12 | Auto test passed | Air suspension control module | CARRY OUT manual inputs. |
| 13 | Auto test failed | Air suspension control module | CARRY OUT manual inputs. |
| 15 | No drive cycle errors detected | Air suspension control module | — |
| 16 | EVO diagnostic trouble code | Air suspension control module | GO to Pinpoint Test E. |
| 17 | EVO diagnostic trouble code | Air suspension control module | GO to Pinpoint Test E. |
| 18 | EVO diagnostic trouble code | Air suspension control module | GO to Pinpoint Test E. |
| 23 | Vent rear function test | Air suspension control module | REFER to Section 204-05. |
| 26 | Compress rear function test | Air suspension control module | REFER to Section 204-05. |
| 31 | Air compressor relay toggle function test | Air suspension control module | REFER to Section 204-05. |

| | | | |
|---|---|---|---|
| 32 | Vent solenoid toggle function test | Air suspension control module | REFER to Section 204-05 . |
| 33 | Air spring solenoid function test | Air suspension control module | REFER to Section 204-05 . |
| 35 | DCycle error codes erased ok | Air suspension control module | — |
| 39 | Compressor relay control circuit short to power | Air suspension control module | REFER to Section 204-05 . |
| 40 | Compressor relay control circuit short to ground | Air suspension control module | REFER to Section 204-05 . |
| 42 | Air spring solenoid circuit short to ground | Air suspension control module | REFER to Section 204-05 . |
| 43 | Air spring solenoid circuit short to power | Air suspension control module | REFER to Section 204-05 . |
| 44 | Vent solenoid circuit short to power | Air suspension control module | REFER to Section 204-05 . |
| 45 | Vent solenoid circuit failure | Air suspension control module | REFER to Section 204-05 . |
| 46 | Air suspension height sensor supply circuit failure | Air suspension control module | REFER to Section 204-05 . |
| 51 | Unable to detect lowering of rear | Air suspension control module | REFER to Section 204-05 . |
| 54 | Unable to detect raising of rear | Air suspension control module | REFER to Section 204-05 . |
| 55 | Unable to detect vehicle speed greater than 24 km/h (15 mph) | Air suspension control module | REFER to Section 204-05 . |
| 60 | Air suspension switch short to power | Air suspension control module | REFER to Section 204-05 . |
| 61 | Air suspension switch circuit failure | Air suspension control module | REFER to Section 204-05 . |
| 68 | Air suspension height sensor circuit failure | Air suspension control module | REFER to Section 204-05 . |
| 70 | ECU defective | Air suspension control module | INSTALL a new air suspension control module; REFER to Section 204-05 . |
| 71 | Air suspension height sensor circuit open | Air suspension control module | REFER to Section 204-05 . |
| 72 | Did not detect four open or closed door signals | Air suspension control module | REFER to Section 204-05 . |
| 74 | Steering wheel rotation not detected | Air suspension control module | GO to Pinpoint Test M . |
| 80 | Battery voltage high or low | Air suspension control module | REFER to Section 204-05 . |

**Symptom Chart**

**Symptom Chart**

**NOTE: Refer to the Wiring Diagrams for connector numbers stated in the Pinpoint Tests.**

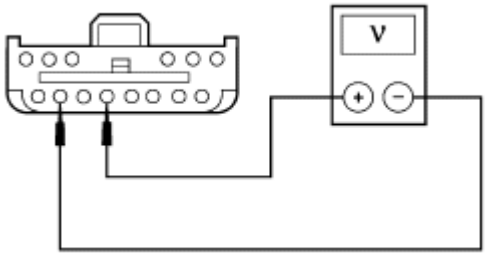
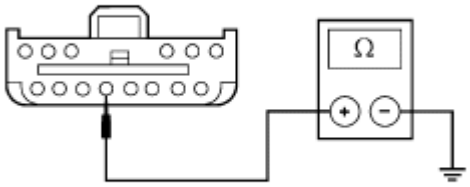
| Condition | Possible Sources | Action |
|---|---|---|
| • No communication with the EVO control | • CJB Fuse:<br>▪ 5 (15A). | • GO to Pinpoint Test A . |

| | | |
|---|---|---|
| module | • Battery junction box (BJB) Fuse:<br>▪ 8 (30A).<br>• Circuitry.<br>• EVO control module. | |
| • No communication with the air suspension control module | • CJB Fuse:<br>▪ 5 (15A).<br>• BJB Fuse:<br>▪ 8 (30A).<br>• Circuitry.<br>• Air suspension control module. | • GO to Pinpoint Test B . |
| • Unable to enter auto test — EVO control module | • CJB Fuse:<br>▪ 5 (15A).<br>• BJB Fuse:<br>▪ 8 (30A).<br>• Circuitry.<br>• EVO control module. | • GO to Pinpoint Test C . |
| • Unable to enter auto test — air suspension control module | • CJB Fuse:<br>▪ 5 (15A).<br>• BJB Fuse:<br>▪ 8 (30A).<br>• Circuitry.<br>• Air suspension control module. | • GO to Pinpoint Test D . |
| • Steering very difficult/very easy | • Power steering pump actuator valve.<br>• Circuitry open/shorted.<br>• EVO control module.<br>• Air suspension module. | • GO to EVO Steering Diagnosis — Without Air Suspension. CARRY OUT actuator output test and steering wheel sensor test. CARRY OUT Pinpoint Test E (with air suspension). |
| • Steering does not vary with increased wheel rotation | • Steering wheel rotation sensor inoperative.<br>• Open/shorted circuitry. | • GO to EVO Steering Diagnosis — Without Air Suspension. CARRY OUT Steering Wheel Sensor Test. CARRY OUT Pinpoint Test E (with air suspension). |

**Pinpoint Tests**

**PINPOINT TEST A: NO COMMUNICATION WITH THE EVO CONTROL MODULE**

| CONDITIONS | DETAILS/RESULTS/ACTIONS |
|---|---|
| **A1** CHECK POWER FEED | |
| 1<br>  <br>2<br>  | |

| | |
|---|---|
| EVO Control Module C2131c<br>3<br>  <br><br>GG1217-A | 3 Measure the voltage between EVO control module C2131c Pin 7, Circuit 298 (VT/OG), harness side and EVO control module C2131c Pin 5, Circuit 57 (BK), harness side.<br>• **Is the voltage greater than 10 volts?**<br>→ **Yes**<br>INSTALL a new EVO control module, REFER to Section 211-02 . CLEAR the DTCs. REPEAT the Auto Test.<br>→ **No**<br>GO to A2 . |
| **A2** CHECK FOR GROUND | |
| 1<br>  <br><br>GG1218-A | 1 Measure the resistance between EVO control module C2131c Pin 5, Circuit 57 (BK), harness side and ground.<br>• **Is the resistance less than 5 ohms?**<br>→ **Yes**<br>REPAIR Circuit 298 (VT/OG). CLEAR the DTCs. REPEAT the Auto Test.<br>→ **No**<br>REPAIR Circuit 57 (BK). CLEAR the DTCs. REPEAT the Auto Test. |

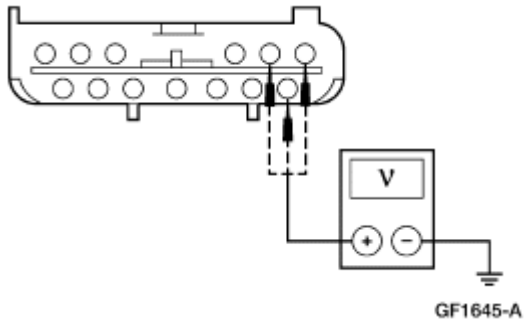
**PINPOINT TEST B: NO COMMUNICATION WITH THE AIR SUSPENSION CONTROL MODULE**

| CONDITIONS | DETAILS/RESULTS/ACTIONS |
|---|---|
| **B1** CHECK CIRCUIT 1053 (LB/PK) AND CIRCUIT 298 (VT/OG) FOR AN OPEN | |
| 1<br>  <br>2 | |

Air Suspension Control Module

3

4




4 Measure the voltage between air suspension control module C2131b, harness side and ground as follows:

| Air Suspension Control Module C2131b | Circuit |
|---|---|
| Pin 16 | 298 (VT/OG) |
| Pin 1 | 1053 (LB/PK) |
| Pin 15 | 1053 (LB/PK) |

- **Are the voltages greater than 10 volts?**

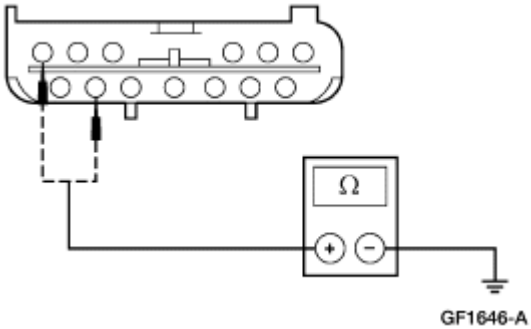
→ **Yes**
GO to B2 .

→ **No**
REPAIR the circuit in question. CLEAR the DTCs. REPEAT the Auto Test.

**B2** CHECK CIRCUIT 57 (BK) AND CIRCUIT 676 (PK/OG) FOR AN OPEN

1

2




2 Measure the resistance between air suspension control module C2131b pin 6, circuit 57 (BK), harness side and ground; and between air suspension control module C2131b pin 20, circuit 676 (PK/OG), harness side and ground.

- **Are the resistances less than 5 ohms?**

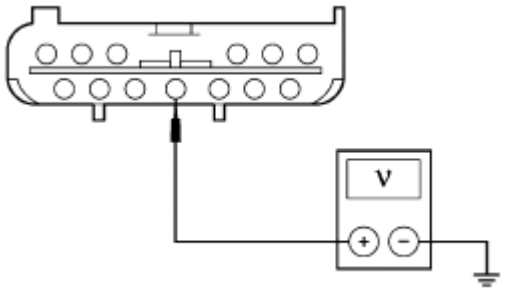
→ **Yes**
GO to B3 .

→ **No**
REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the Auto Test.

**B3** CHECK CIRCUIT 419 (DG/LG) FOR VOLTAGE AT THE AIR SUSPENSION CONTROL MODULE

1

2




2 Measure the voltage between air suspension control module C2131a Pin 11, Circuit 419 (DG/LG), harness side and ground.

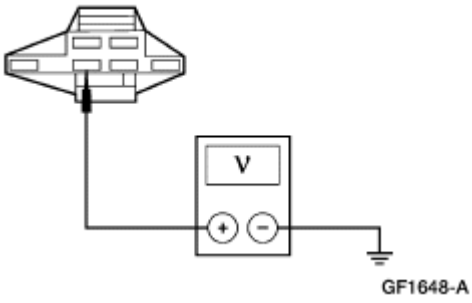
- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to B4 .

→ **No**
REFER to Section 413-01A (conventional cluster) or REFER to Section 413-01B (electronic cluster), or REFER to Section 413-01C (natural gas cluster).

**B4** CHECK CIRCUIT 419 (DG/LG) FOR VOLTAGE AT THE AIR SUSPENSION TEST CONNECTOR

1




1 Measure the voltage between air suspension test connector C4146 Pin 4, Circuit 419 (DG/LG), harness side and ground.

- **Is the voltage greater than 10 volts?**

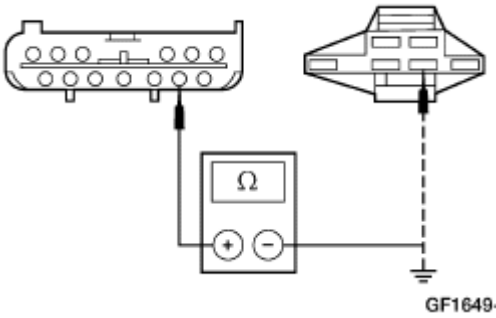
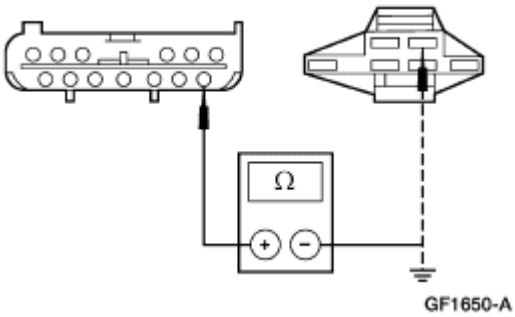
→ **Yes**
GO to B5 .

→ **No**
REPAIR the circuit. CLEAR the DTCs. REPEAT the Auto Test.

**B5** CHECK CIRCUIT 844 (GY/RD)

1

1 Measure the resistance between air suspension control module C2131a Pin 9, Circuit 844 (GY/RD), harness side and air suspension test connector C4146 Pin 5, Circuit 844 (GY/RD), harness side; and between air suspension control module C2131a Pin 9, Circuit 844 (GY/RD), harness side and ground.

| | |
|---|---|
|  | • **Is the resistance less than 5 ohms between air suspension control module and air suspension test connector; and greater than 10,000 ohms between air suspension control module and ground?**<br><br>→ **Yes**<br>GO to B6 .<br><br>→ **No**<br>REPAIR the circuit. CLEAR the DTCs. REPEAT the Auto Test. |
| **B6** CHECK CIRCUIT 432 (BK/PK) | |
| 1<br>  | 1 Measure the resistance between air suspension control module C2131a Pin 8, Circuit 432 (BK/PK), harness side and air suspension test connector C4146 Pin 2, Circuit 432 (BK/PK), harness side; and between air suspension control module C2131a Pin 9, Circuit 432 (BK/PK), harness side and ground.<br><br>• **Is the resistance less than 5 ohms between air suspension control module and air suspension test connector; and greater than 10,000 ohms between air suspension control module and ground?**<br><br>→ **Yes**<br>INSTALL a new air suspension control module; REFER to Section 204-05 . REPEAT the Auto Test.<br><br>→ **No**<br>REPAIR the circuit. CLEAR the DTCs. REPEAT the Auto Test. |

**PINPOINT TEST C: UNABLE TO ENTER AUTO TEST — EVO CONTROL MODULE**

| CONDITIONS | DETAILS/RESULTS/ACTIONS |
|---|---|
| **C1** CHECK COMMUNICATION TO THE EVO CONTROL MODULE | |
| | 1 Check communication between the Super Star II Tester and the EVO control module. |

| | |
|---|---|
| | • **Does the Super Star II Tester communicate?**<br><br>→ **Yes**<br>INSTALL a new EVO control module; REFER to Section 211-02 . REPEAT the Auto Test.<br><br>→ **No**<br>GO to Pinpoint Test A . |

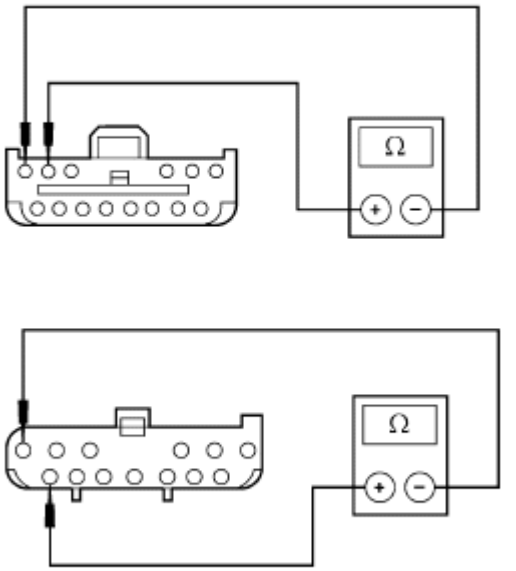
**PINPOINT TEST D: UNABLE TO ENTER AUTO TEST-AIR SUSPENSION CONTROL MODULE**

| CONDITIONS | DETAILS/RESULTS/ACTIONS |
|---|---|
| **D1** CHECK COMMUNICATION TO THE AIR SUSPENSION CONTROL MODULE | |
| | 1 Check communication between the Super Star II Tester and the air suspension control module.<br><br>• **Does the Super Star II Tester communicate?**<br><br>→ **Yes**<br>INSTALL a new air suspension control module; REFER to Section 204-05 . REPEAT the Auto Test.<br><br>→ **No**<br>GO to Pinpoint Test B . |

**PINPOINT TEST E: DTC 16 — EVO ACTUATOR SHORTED, DTC 17 — EVO ACTUATOR SHORTED OR OPEN, OR DTC 18 — EVO ACTUATOR RESISTANCE OUT OF RANGE**

| CONDITIONS | DETAILS/RESULTS/ACTIONS |
|---|---|
| **E1** EVO ACTUATOR VALVE CHECK (DTC 16) | |
| 1<br>  | 2 Retrieve and document continuous DTCs.<br><br>• **Is DTC 16 displayed?**<br><br>→ **Yes**<br>GO to E4 .<br><br>→ **No**<br>If DTC 17 is displayed, GO to E2 .<br><br>If DTC 18 is displayed, INSTALL a new EVO actuator. REFER to Section 211-02 . CLEAR the DTCs. REPEAT the Self-Test. |
| **E2** CHECK EVO ACTUATOR AND CIRCUIT RESISTANCE | |
| 1<br>  | |

3




GG1219-A

2 If not equipped with air suspension, disconnect EVO control module C2131c. If equipped with air suspension, disconnect air suspension control module C2131a.

3 If not equipped with air suspension, measure the resistance between EVO control module C2131c Pin 14, Circuit 87 (TN/YE), harness side and EVO control module C2131c Pin 13, Circuit 86 (GY/OG), harness side. If equipped with air suspension, measure the resistance between air suspension control module C2131a Pin 14, Circuit 86 (GY/OG), harness side and air suspension control module C2131a Pin 26, Circuit 87 (TN/YE), harness side.

- **Is the resistance between 5 and 20 ohms?**

→ **Yes**
GO to E3 .

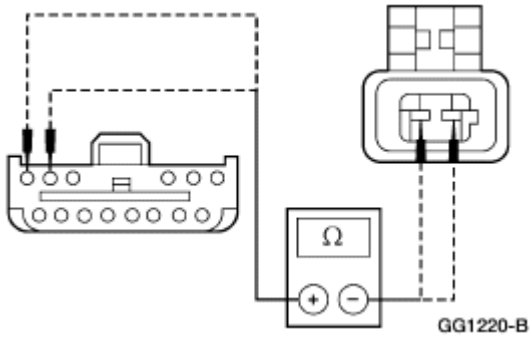
→ **No**
GO to E4 .

**E3** CHECK CIRCUITS 86 (GY/OG) AND 87 (TN/YE)

1

EVO Actuator C1169

2



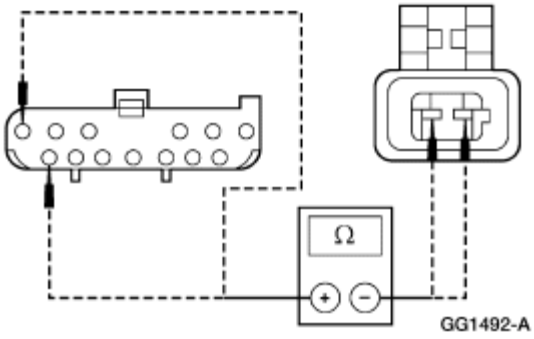

GG1220-B

3

2 If not equipped with an air suspension, measure the resistance between the EVO control module C2131c, harness side and EVO actuator C1169, harness side.

| EVO Control Module C2131c | EVO Actuator C1169 | Circuit |
|---|---|---|
| Pin 14 | Pin 1 | 87 (TN/YE) |
| Pin 13 | Pin 2 | 86 (GY/OG) |

3 If equipped with an air suspension, measure the resistance between the air suspension control module C2131a, harness side and EVO actuator C1169, harness side.




| Air Suspension Control Module C2131a | EVO Actuator C1169 | Circuit |
|---|---|---|
| Pin 26 | Pin 1 | 87 (TN/YE) |
| Pin 14 | Pin 2 | 86 (GY/OG) |

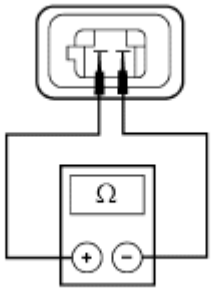
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to E4 .

→ **No**
REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the Auto Test.

**E4** CHECK EVO ACTUATOR RESISTANCE

1




1 Measure the resistance between EVO actuator pins (component side).

- **Is the resistance between 5 and 20 ohms?**

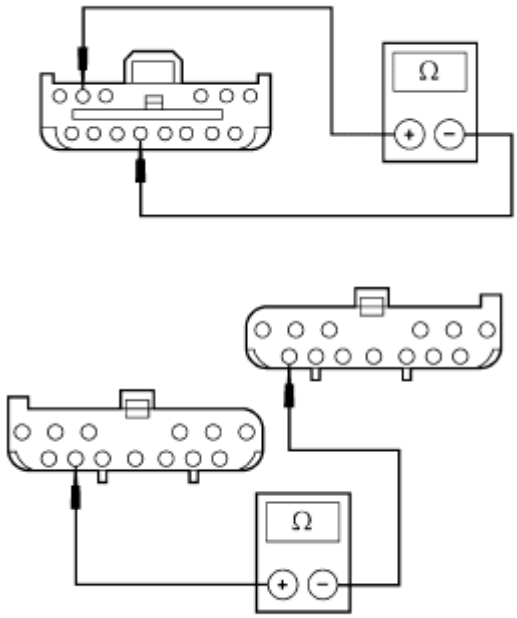
→ **Yes**
GO to E5 .

→ **No**
INSTALL a new EVO Actuator. CLEAR the DTCs. REPEAT the Auto Test.

**E5** CHECK CIRCUIT 86 (GY/OG) FOR SHORT TO GROUND

1

1 If not equipped with air suspension, measure the resistance between EVO control module C2131c Pin 13, Circuit 86 (GY/OG), harness side and EVO control module C2131c Pin 5, Circuit 57 (BK), harness side. If equipped with air suspension, measure the resistance between air suspension control module C2131a Pin 14, Circuit 86 (GY/OG), harness side and air suspension control module C2131b Pin 6, Circuit 57 (BK), harness side.




GG1222-A

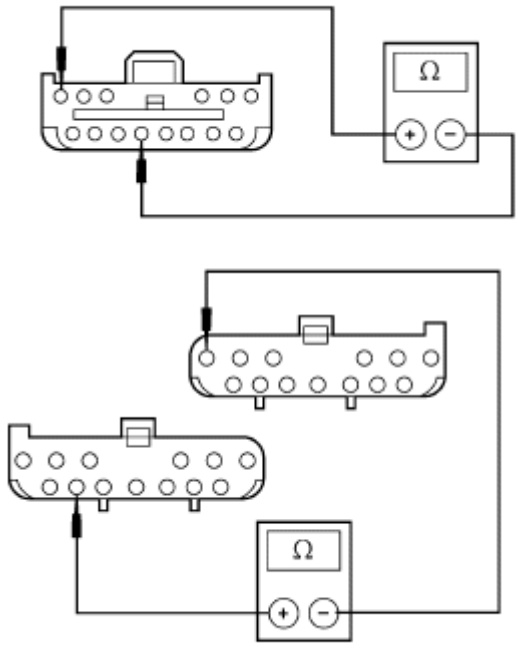
- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
GO to E6 .

→ **No**
REPAIR the circuit. CLEAR the DTCs. REPEAT the Auto Test.

**E6** CHECK CIRCUIT 87 (TN/YE) FOR SHORT TO GROUND

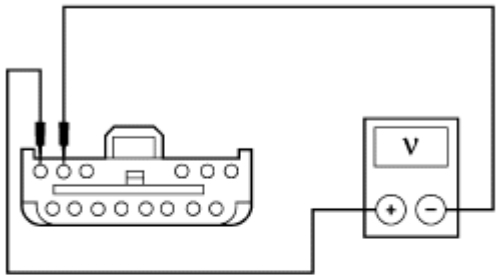
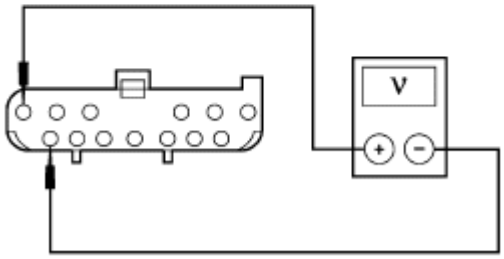
1




GG1223-A

1 If not equipped with air suspension, measure the resistance between EVO control module C2131c Pin 14, Circuit 87 (TN/YE), harness side and EVO control module C2131c Pin 5, Circuit 57 (BK), harness side. If equipped with air suspension, measure the resistance between air suspension control module C2131a Pin 26, Circuit 87 (TN/YE), harness side and air suspension control module C2131b Pin 6, Circuit 57 (BK), harness side.

- **Is the resistance greater than 10,000 ohms?**

| | |
|---|---|
| | → **Yes**<br>GO to E7 .<br><br>→ **No**<br>REPAIR the circuit. CLEAR the DTCs. REPEAT the Auto Test. |
| **E7** CHECK FOR SHORT TO BATTERY | |
| 1<br>  <br>2<br>  <br>  <br>GG1224-A | 2 If not equipped with air suspension, measure the voltage between EVO control module C2131c Pin 13, Circuit 86 (GY/OG), harness side and ground; and between EVO control module C2131c Pin 14, Circuit 87 (TN/YE), harness side and ground. If equipped with air suspension, measure the voltage between air suspension control module C2131a Pin 14, Circuit 86 (GY/OG), harness side and ground; and between air suspension control module C2131a Pin 26, Circuit 87 (TN/YE), harness side and ground.<br><br>• **Are the resistances greater than 10,000 ohms?**<br><br>→ **Yes**<br>If not equipped with air suspension, INSTALL a new EVO control module. REFER to Section 211-02 . CLEAR the DTCs. REPEAT the Auto Test. If equipped with air suspension, INSTALL a new air suspension module. REFER to Section 204-05 . CLEAR the DTCs. REPEAT the Auto Test.<br><br>→ **No**<br>REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the Auto Test. |

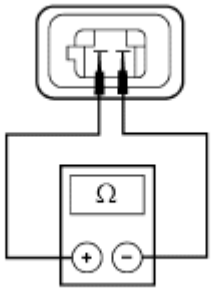
**PINPOINT TEST F: DTC 27 — EVO ACTUATOR CIRCUIT OPEN**

| CONDITIONS | DETAILS/RESULTS/ACTIONS |
|---|---|
| **F1** CHECK EVO ACTUATOR FOR AN OPEN | |
| 1 | |

2

EVO Actuator C1169

3




GG1137-A

3 Measure the resistance between EVO actuator pins (component side).

- **Is the resistance between 5 and 20 ohms?**

→ **Yes**
GO to F2 .

→ **No**
INSTALL a new EVO actuator. REFER to Section 211-02 . CLEAR the DTCs. REPEAT the Auto Test.

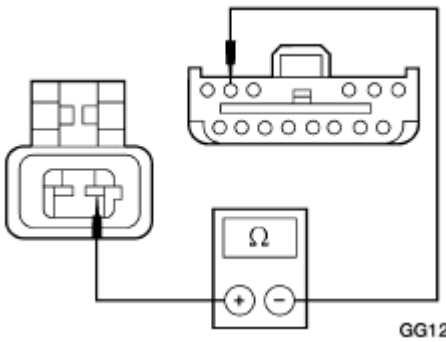
**F2** CHECK CIRCUIT 86 (GY/OG) FOR AN OPEN

1

2

EVO Control Module C2131c

3

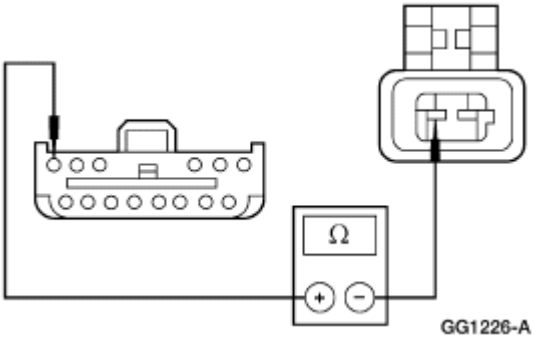



GG1225-A

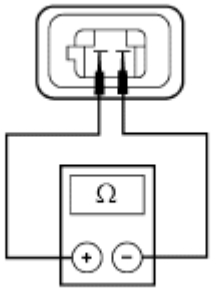
3 Measure the resistance between EVO control module C2131c Pin 13, Circuit 86 (GY/OG), harness side and EVO actuator C1169 Pin 2, Circuit 86 (GY/OG), harness side.

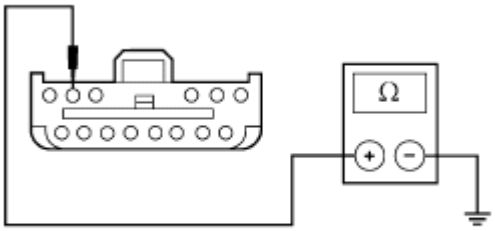
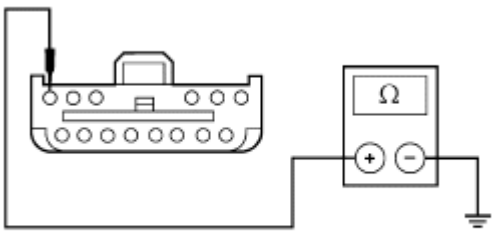
- **Is the resistance less than 5 ohms?**

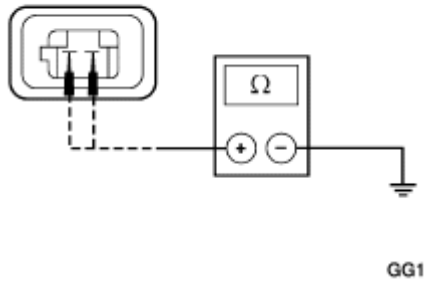
→ **Yes**
GO to F3 .

| | |
|---|---|
| | → **No**<br>REPAIR the circuit. CLEAR the DTCs. REPEAT the Auto Test. |
| **F3** CHECK CIRCUIT 87 (TN/YE) FOR AN OPEN | |
| 1<br>  <br><br>GG1226-A | 1 Measure the resistance between EVO control module C2131c Pin 14, Circuit 87 (TN/YE), harness side and EVO actuator C1169 Pin 1, Circuit 87 (TN/YE), harness side.<br>• **Is the resistance less than 5 ohms?**<br>→ **Yes**<br>INSTALL a new EVO control module. CLEAR the DTCs. REPEAT the Auto Test.<br>→ **No**<br>REPAIR the circuit. CLEAR the DTCs. REPEAT the Auto Test. |

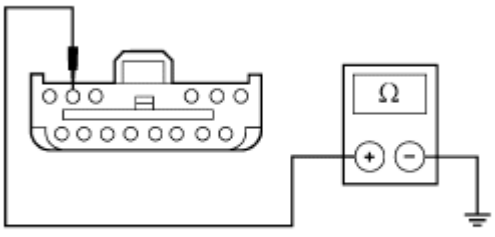
**PINPOINT TEST G: DTC 28 — EVO ACTUATOR CIRCUIT SHORTED**

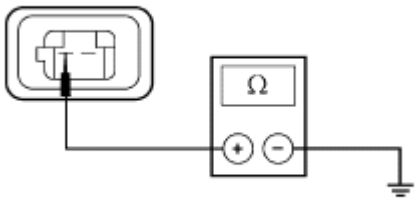
| CONDITIONS | DETAILS/RESULTS/ACTIONS |
|---|---|
| **G1** CHECK EVO ACTUATOR FOR A SHORT | |
| 1<br>  <br>2<br>  <br>EVO Actuator C1169<br>3<br>  <br><br>GG1137-A | 3 Measure the resistance between EVO actuator pins (component side).<br>• **Is the resistance between 5 and 20 ohms?** |

| | |
|---|---|
| | → **Yes**<br>GO to G2 .<br><br>→ **No**<br>INSTALL a new EVO actuator. REFER to Section 211-02 . CLEAR the DTCs. REPEAT the Auto Test. |
| **G2** CHECK CIRCUIT 86 (GY/OG) FOR A SHORT TO GROUND | |
| 1<br>  <br>EVO Control Module C2131c<br>2<br>  <br><br>GG1230-A | 2 Measure the resistance between EVO control module C2131c Pin 13, Circuit 86 (GY/OG), harness side and ground.<br><br>• **Is the resistance greater than 10,000 ohms?**<br><br>→ **Yes**<br>GO to G3 .<br><br>→ **No**<br>REPAIR the circuit. CLEAR the DTCs. REPEAT the Auto Test. |
| **G3** CHECK CIRCUIT 87 (TN/YE) FOR A SHORT TO GROUND | |
| 1<br>  <br><br>GG1228-A | 1 Measure the resistance between EVO control module C2131c Pin 14, Circuit 87 (TN/YE), harness side and ground.<br><br>• **Is the resistance greater than 10,000 ohms?**<br><br>→ **Yes**<br>GO to G4 .<br><br>→ **No**<br>REPAIR the circuit. CLEAR the DTCs. REPEAT the Auto Test. |
| **G4** CHECK CIRCUIT RESISTANCE | |
| 1 | 1 Measure the resistance between EVO actuator |

| | |
|---|---|
|  <br>GG1229-A | Pin 1, (component side) and ground; and between EVO actuator Pin 2, (component side) and ground.<br><br>• **Are the resistances greater than 10,000 ohms?**<br><br>→ **Yes**<br>INSTALL a new EVO control module. REFER to Section 211-02 . CLEAR the DTCs. REPEAT the Auto Test.<br><br>→ **No**<br>INSTALL a new EVO actuator. REFER to Section 211-02 . CLEAR the DTCs. REPEAT the Auto Test. |

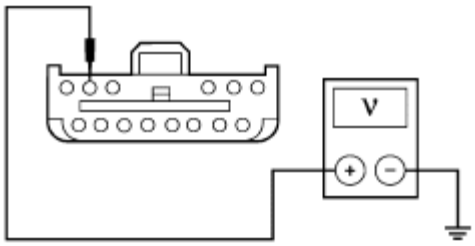
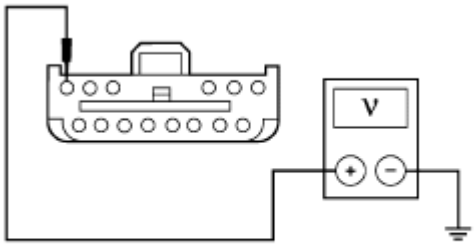
**PINPOINT TEST H: DTC 29 — EVO ACTUATOR CIRCUIT HIGH SIDE SHORTED TO GROUND**

| CONDITIONS | DETAILS/RESULTS/ACTIONS |
|---|---|
| **H1** CHECK CIRCUIT 86 (GY/OG) FOR SHORT TO GROUND | |
| 1<br>  <br>2<br>  <br>EVO Actuator C1169<br>3<br>  <br>EVO Control Module C2131c<br>4<br>  <br>GG1230-A | 4 Measure the resistance between EVO control module C2131c Pin 13, Circuit 86 (GY/OG), harness side and ground.<br><br>• **Is the resistance less than 10,000 ohms?** |

| | |
|---|---|
| | → **Yes**<br>REPAIR the circuit. CLEAR the DTCs. REPEAT the Auto Test.<br><br>→ **No**<br>GO to H2 . |
| **H2** CHECK EVO ACTUATOR FOR SHORT TO GROUND | |
| 1<br>  <br><br>GG1132-A | 1 Measure the resistance between EVO actuator Pin 2, circuit 86 (component side) and ground.<br><br>• **Is the resistance greater than 10,000 ohms?**<br><br>→ **Yes**<br>INSTALL a new EVO control module. REFER to Section 211-02 . CLEAR the DTCs. REPEAT the Auto Test.<br><br>→ **No**<br>REPAIR the circuit. CLEAR the DTCs. REPEAT the Auto Test. |

**PINPOINT TEST I: DTC 30 — EVO ACTUATOR CIRCUIT SHORTED TO BATTERY**

| CONDITIONS | DETAILS/RESULTS/ACTIONS |
|---|---|
| **I1** CHECK CIRCUIT 86 (GY/OG) FOR SHORT TO BATTERY | |
| 1<br>  <br>2<br>  <br>EVO Actuator C1169<br>3<br>  <br>EVO Control Module C2131c<br>4 | 4 Measure the voltage between EVO control module C2131c Pin 13, Circuit 86 (GY/OG), harness side and ground. |

| | |
|---|---|
|  <br>GG1231-A | • **Is voltage present?**<br><br>→ **Yes**<br>REPAIR the circuit. CLEAR the DTCs. REPEAT the Auto Test.<br><br>→ **No**<br>GO to I2 . |
| **I2** CHECK CIRCUIT 87 (TN/YE) FOR SHORT TO BATTERY | |
| 1<br>  <br>GG1227-A | 1 Measure the voltage between EVO control module C2131c Pin 14, Circuit 87 (TN/YE), harness side and ground.<br><br>• **Is voltage present?**<br><br>→ **Yes**<br>REPAIR the circuit. CLEAR the DTCs. REPEAT the Auto Test.<br><br>→ **No**<br>INSTALL a new EVO control module. REFER to Section 211-02 . CLEAR the DTCs. REPEAT the Auto Test. |

**PINPOINT TEST J: DTC 31 — EVO ACTUATOR CIRCUIT LOW SIDE SHORTED TO GROUND**

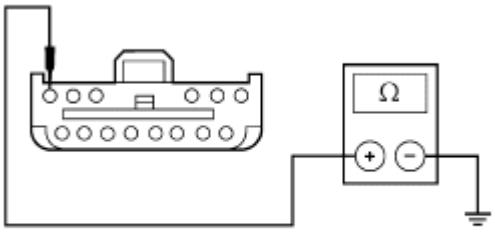
| CONDITIONS | DETAILS/RESULTS/ACTIONS |
|---|---|
| **J1** CHECK CIRCUIT 87 (TN/YE) FOR SHORT TO GROUND | |
| 1<br>  <br>2 | |

EVO Actuator C1169

3

EVO Control Module C2131c

4




GG1228-A

4 Measure the resistance between EVO control module C2131c Pin 14, Circuit 87 (TN/YE), harness side and ground.

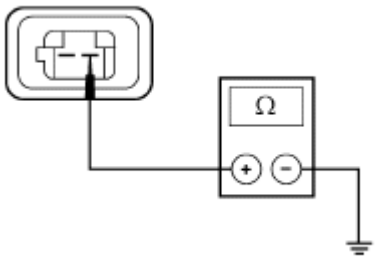
- **Is the resistance less than 10,000 ohms?**

→ **Yes**
REPAIR the circuit. CLEAR the DTCs. REPEAT the Auto Test.

→ **No**
GO to J2 .

**J2** CHECK EVO ACTUATOR FOR SHORT TO GROUND

1




GG1403-A

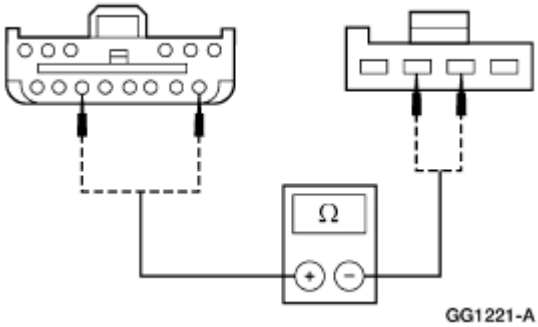
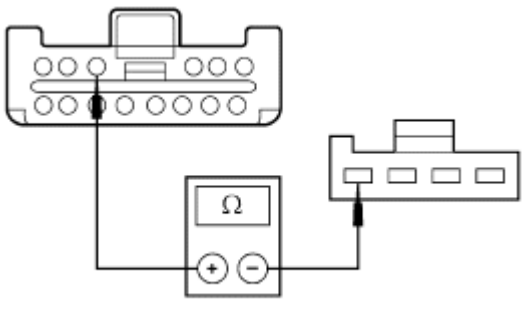
1 Measure the resistance between EVO actuator Pin 1, (component side) and ground.

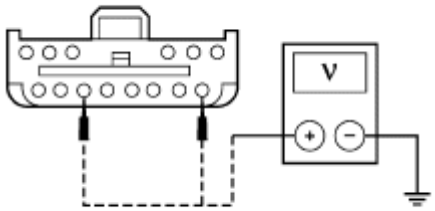
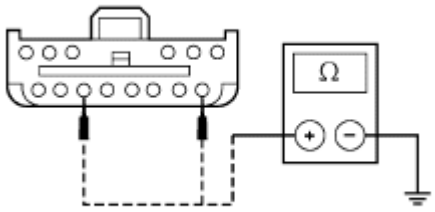
- **Is the resistance greater than 10,000 ohms?**

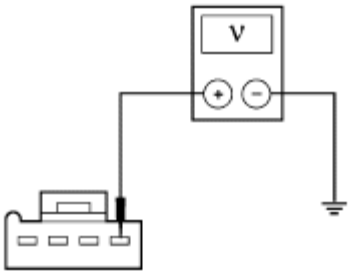
→ **Yes**
INSTALL a new EVO control module. REFER to Section 211-02 . CLEAR the DTCs. REPEAT the Auto Test.

→ **No**
REPAIR the circuit. CLEAR the DTCs. REPEAT the Auto Test.

**PINPOINT TEST K: DTC 33 — STEERING ROTATION NOT DETECTED**

| CONDITIONS | DETAILS/RESULTS/ACTIONS |
|---|---|
| **K1** CHECK CIRCUITS 633 (RD) AND 634 (BN) FOR CONTINUITY | |
| 1<br>  <br>2<br>  <br>Steering Wheel Rotation Sensor C226<br>3<br>  <br>EVO Control Module C2131c<br>4<br>  <br>GG1221-A | 4 Measure the resistance between EVO control module C2131c Pin 1, Circuit 633 (RD), harness side and steering wheel rotation sensor C226 Pin 3, Circuit 633 (RD), harness side; and between EVO control module C2131c Pin 6, Circuit 634 (BN), harness side and steering wheel rotation sensor C226 Pin 2, Circuit 634 (BN), harness side.<br>• **Are the resistances less than 5 ohms?**<br>→ **Yes**<br>GO to K2 .<br>→ **No**<br>REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the Auto Test. |
| **K2** CHECK CIRCUIT 837 (YE/BK) FOR CONTINUITY | |
| 1<br>  <br>GG1245-A | 1 Measure the resistance between EVO control module C2131c Pin 12, Circuit 837 (YE/BK), harness side and steering wheel rotation sensor C226 Pin 1, Circuit 837 (YE/BK), harness side.<br>• **Is the resistance less than 5 ohms?**<br>→ **Yes**<br>GO to K3 . |

| | |
|---|---|
| | → **No**<br>REPAIR the circuit. CLEAR the DTCs. REPEAT the Auto Test. |
| **K3** CHECK CIRCUITS 633 (RD) AND 634 (BN) FOR SHORT TO BATTERY | |
| 1<br>  <br><br>GG1232-A | 1 Measure the voltage between EVO control module C2131c Pin 1, Circuit 633 (RD), harness side and ground; and between EVO control module C2131c Pin 6, Circuit 634 (BN), harness side and ground.<br>• **Is voltage present?**<br>→ **Yes**<br>REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the Auto Test.<br>→ **No**<br>GO to K4 . |
| **K4** CHECK CIRCUITS 633 (RD) AND 634 (BN) FOR SHORT TO GROUND | |
| 1<br>  <br><br>GG1233-A | 1 Measure the resistance between EVO control module C2131c Pin 1, Circuit 633 (RD), harness side and ground; and between EVO control module C2131c Pin 6, Circuit 634 (BN), harness side and ground.<br>• **Are the resistances greater than 10,000 ohms?**<br>→ **Yes**<br>GO to K5 .<br>→ **No**<br>REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the Auto Test. |
| **K5** CHECK CIRCUIT 298 (VT/OG) FOR VOLTAGE | |
| 1<br>  <br>2 | 2 Measure the voltage between steering wheel rotation sensor C226 Pin 4, Circuit 298 (VT/OG), harness side and ground. |




GG0714-A

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to K6 .

→ **No**
REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the Auto Test.

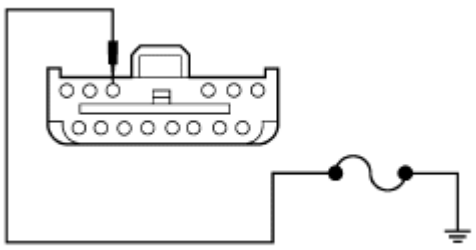
**K6** CHECK STEERING WHEEL ROTATION SENSOR

1

2

Steering Wheel Rotation Sensor C226

3

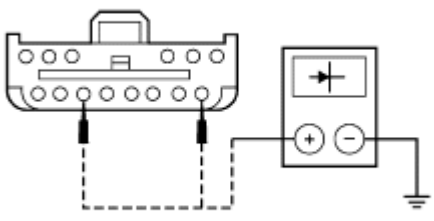


GG1234-A

3 Connect a (5A) amp fused jumper wire between EVO control module C2131c Pin 12, Circuit 837 (YE/BK), harness side and ground.

4 Place the 73 Digital Multimeter in the diode check position.

5



GG1235-A

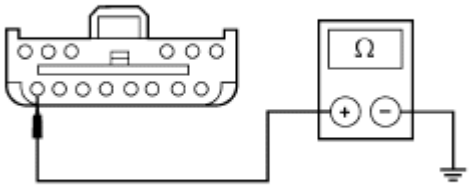
5 **NOTE:** Touch 73 Digital Multimeter leads together to be sure the audio (beep) function is operational.

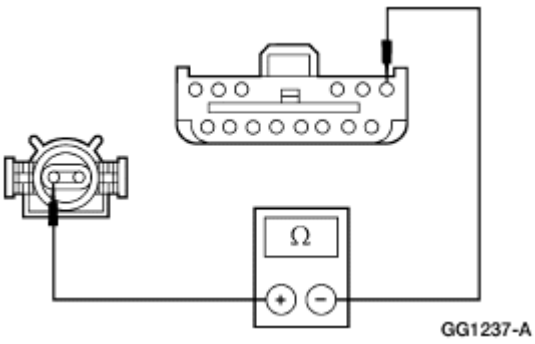
**NOTE:** The 73 Digital Multimeter should beep several times while rotating the steering wheel.

Connect 73 Digital Multimeter leads between EVO control module C2131c Pin 1, Circuit 633 (RD), harness side and ground; and between EVO control module C2131c Pin 6, Circuit 634 (BN), harness side and ground. Listen for an audible beep while turning the steering wheel one quarter turn in each direction.

| | |
|---|---|
| | • **Does 73 Digital Multimeter beep multiple times in each direction?**<br><br>→ **Yes**<br>INSTALL a new EVO control module. REFER to Section 211-02 . CLEAR the DTCs. REPEAT the Auto Test.<br><br>→ **No**<br>INSTALL a new steering wheel rotation sensor. REFER to Section 211-02 . CLEAR the DTCs. REPEAT the Auto Test. |

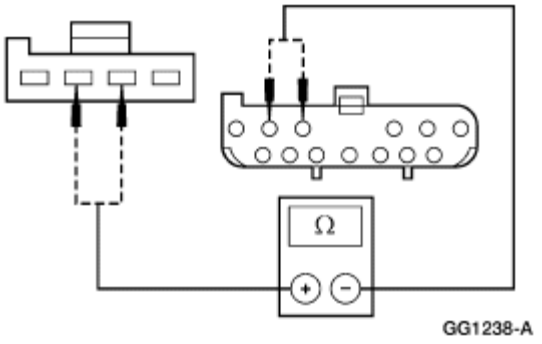
**PINPOINT TEST L: DTC 35 — VEHICLE SPEED ABOVE 24 KM/H (15 MPH) NOT DETECTED**

| CONDITIONS | DETAILS/RESULTS/ACTIONS |
|---|---|
| **L1** CHECK SPEEDOMETER OPERATION | |
| | 1 Drive the vehicle and check for correct speedometer operation.<br><br>• **Does the speedometer indicate vehicle speeds above 24 km/h (15 mph)?**<br><br>→ **Yes**<br>GO to L2 .<br><br>→ **No**<br>REFER to Section 413-01A (Instrument Cluster — Conventional), Section 413-01B (Instrument Cluster — Electronic), or Section 413-01C (Instrument Cluster — Natural Gas). CLEAR the DTCs. REPEAT the Auto Test. |
| **L2** CHECK CIRCUIT 676 (PK/OG) FOR AN OPEN | |
| 1<br>  <br>EVO Control Module C2131c<br>2<br>  <br>GG1236-A | 2 Measure the resistance between EVO control module C2131c Pin 8, Circuit 676 (PK/OG), harness side and ground.<br><br>• **Is the resistance greater than 10,000 ohms?**<br><br>→ **Yes**<br>GO to L3 . |

| | |
|---|---|
| | → **No**<br>REPAIR the circuit. CLEAR the DTCs. REPEAT the Auto Test. |
| **L3** CHECK CIRCUIT 679 (GY/BK) FOR AN OPEN | |
| 1<br>  <br>Vehicle Speed Sensor C1088<br>2<br>  <br> | 2 Measure the resistance between EVO control module C2131c Pin 9, Circuit 679 (GY/BK), harness side and vehicle speed sensor C1088 Pin 1, Circuit 679 (GY/BK), harness side.<br>• **Is the resistance less than 5 ohms?**<br>→ **Yes**<br>INSTALL a new EVO control module. REFER to Section 211-02 . CLEAR the DTCs. REPEAT the Auto Test.<br>→ **No**<br>REPAIR the circuit. CLEAR the DTCs. REPEAT the Auto Test. |

**PINPOINT TEST M: DTC 74 — STEERING ROTATION NOT DETECTED**

| CONDITIONS | DETAILS/RESULTS/ACTIONS |
|---|---|
| **M1** CHECK CIRCUITS 633 (RD) AND 634 (BN) FOR CONTINUITY | |
| 1<br>  <br>2<br>  <br>Steering Wheel Rotation Sensor C226<br>3<br>  <br>Air Suspension Control Module C2131b<br>4 | 4 Measure the resistance between air suspension control module C2131b Pin 18, Circuit 633 (RD), harness side and steering wheel rotation sensor |




C226 Pin 3, Circuit 633 (RD), harness side; and between air suspension control module C2131b Pin 19, Circuit 634 (BN), harness side and steering wheel rotation sensor C226 Pin 2, Circuit 634 (BN), harness side.

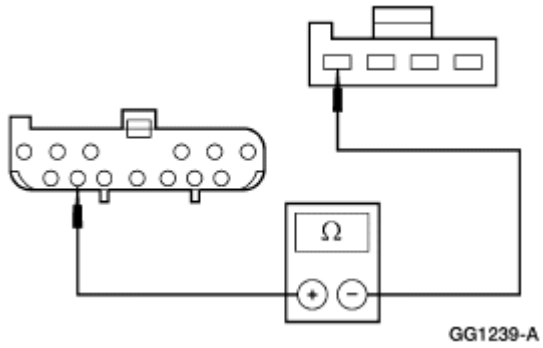
- **Are the resistances less than 5 ohms?**

→ **Yes**
GO to M2 .

→ **No**
REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the Auto Test.

**M2** CHECK CIRCUIT 837 (YE/BK) FOR CONTINUITY

1




1 Measure the resistance between air suspension control module C2131b Pin 6, Circuit 57 (BK), harness side and steering wheel rotation sensor C226 Pin 1, Circuit 837 (YE/BK), harness side.

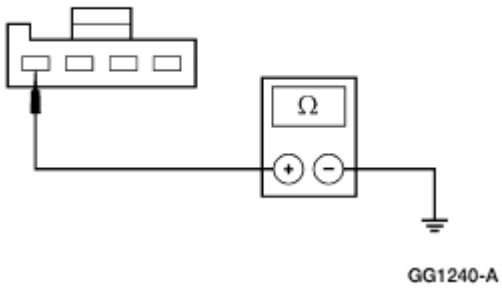
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to M3 .

→ **No**
REPAIR the circuit. CLEAR the DTCs. REPEAT the Auto Test.

**M3** CHECK CIRCUIT 837 (YE/BK) FOR GROUND

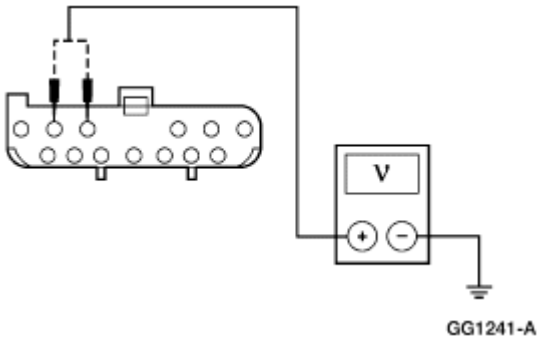
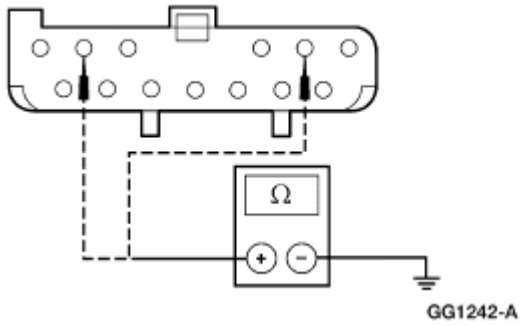
1

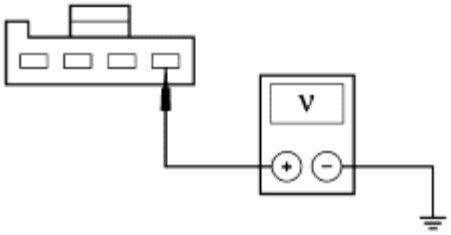



1 Measure the resistance between steering wheel rotation sensor C226 Pin 1, Circuit 837 (YE/BK), harness side and ground.

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**

| | |
|---|---|
| | GO to M4 .<br><br>→ **No**<br>REPAIR the circuit. CLEAR the DTCs. REPEAT the Auto Test. |
| **M4** CHECK CIRCUITS 633 (RD) AND 634 (BN) FOR SHORT TO BATTERY | |
| 1<br>  <br><br>GG1241-A | 1 Measure the voltage between air suspension control module C2131b Pin 18, Circuit 633 (RD), harness side and ground; and between air suspension control module C2131b pin 19, circuit 634 (BN), harness side and ground.<br><br>• **Is voltage present?**<br><br>→ **Yes**<br>REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the Auto Test.<br><br>→ **No**<br>GO to M5 . |
| **M5** CHECK CIRCUITS 633 (RD) AND 634 (BN) FOR SHORT TO GROUND | |
| 1<br>  <br><br>GG1242-A | 1 Measure the resistance between air suspension control module C2131b Pin 18, Circuit 633 (RD), harness side and ground; and between air suspension control module C2131b Pin 19, Circuit 634 (BN), harness side and ground.<br><br>• **Are the resistances greater than 10,000 ohms?**<br><br>→ **Yes**<br>GO to M6 .<br><br>→ **No**<br>REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the Auto Test. |
| **M6** CHECK CIRCUIT 298 (VT/OG) FOR VOLTAGE | |
| 1<br>  <br>2 | 2 Measure the voltage between steering wheel rotation sensor C226 Pin 4, Circuit 298 (VT/OG), harness side and ground. |




GG1243-A

- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to M7 .

→ **No**
REPAIR the circuit(s) in question. CLEAR the DTCs. REPEAT the Auto Test.

**M7** CHECK STEERING WHEEL ROTATION SENSOR

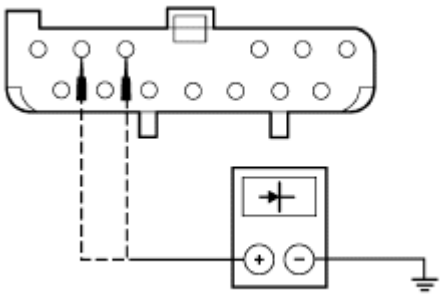
1

2

Steering Wheel Rotation Sensor C226

3 Place the 73 Digital Multimeter in the diode check position.

4



GG1244-A

4 **NOTE:** Touch 73 Digital Multimeter leads together to be sure the audio (beep) function is operational.

**NOTE:** The 73 Digital Multimeter should beep several times while rotating the steering wheel.

Connect 73 Digital Multimeter leads between air suspension control module C2131b Pin 18, Circuit 633 (RD), harness side and ground; and between air suspension control module C2131b Pin 19, Circuit 634 (BN), harness side ground. Listen for an audible beep while turning the steering wheel one quarter turn in each direction.

- **Does 73 Digital Multimeter beep multiple times in each direction?**

→ **Yes**
INSTALL a new EVO control module. REFER to Section 211-02 . CLEAR the DTCs. REPEAT the Auto Test.

→ **No**
INSTALL a new steering wheel rotation sensor. REFER to Section 211-02 . CLEAR the DTCs.

| | |
|---|---|
| | REPEAT the Auto Test. |

**Component Tests**

**Steering Linkage**

1. With the parking brake applied, carry out the following:
   - **NOTE:** Excessive vertical or horizontal motion of the stud relative to the steering linkage ball sockets may indicate excessive wear.

     Have an assistant rotate the steering wheel back and forth 360 degrees and watch for relative motion of the studs in the steering linkage ball sockets.
   - Watch for a loose steering gear attachment to the frame.

2. **NOTE:** Improper separation of the tapered stud from its seat will cause premature failure of the ball socket.

   Steel greaseable joints can be checked for excessive wear by measuring the torque it takes to turn the stud.
   - Separate the tapered stud from its seat and thread the attaching nut back onto the stud.
   - Turn the stud with an inch-pound torque wrench and note the torque required to turn the stud.

| Torque Required to Turn Stud in Socket | Nm | Lb-In |
|---|---|---|
| New Steel Joints | 2.0-5.3 | 17.8-47.3 |
| Used Steel Joints | 0.5-3 | 5-26.5 |
| Steel Joints With Excessive Play | 0-0.5 | 0-5 |

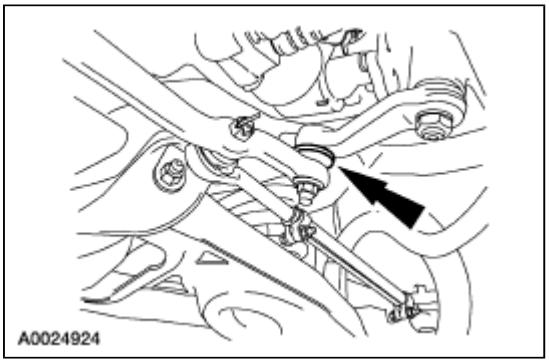
   - **NOTE:** Some joint turning torques will be as little as 0.5 Nm (5 lb-in) within the first 1,600 km (1,000 miles) and will remain there for the life of the joint.

     Only install a new ball joint that requires less than 0.5 Nm (5 lb-in).
   - REPAIR as necessary. For additional information, refer to Section 211-03 .

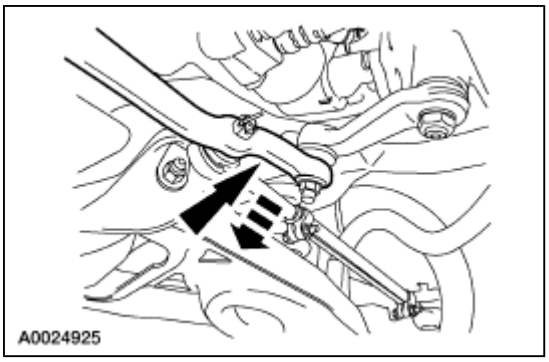
**Sector Shaft Arm Inspection — Backlash**

1. **WARNING: The electrical power to the air suspension must be shut off prior to hoisting jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the luggage compartment. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in the shifting of the vehicle during these operations.**

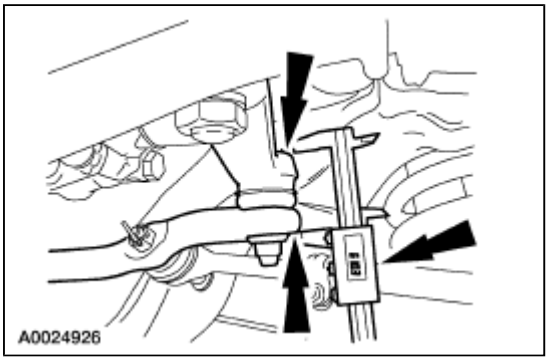
   Raise and support the vehicle. For additional information, refer to Section 100-02 .



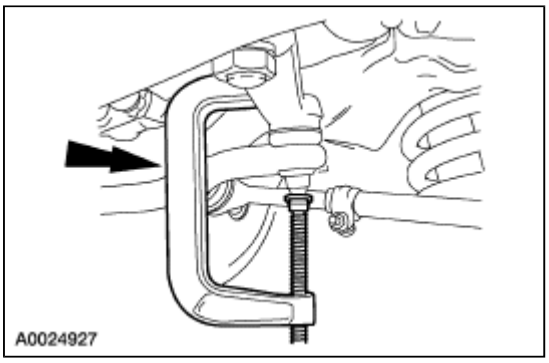
2. Inspect the sector shaft air dust boot for cuts or tears. If it is cut or torn, install a new sector shaft arm. For additional information, refer to Section 204-01 .



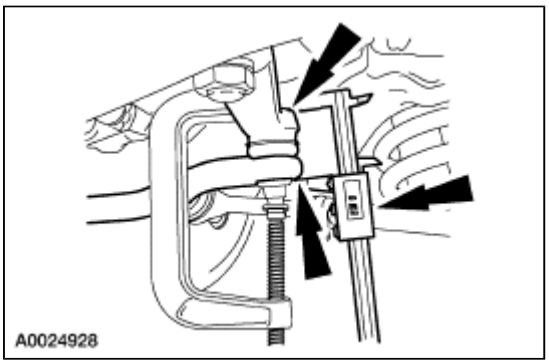

3. Pull downward on the sector shaft arm drag link.




4. Using digital calipers, measure the distance from the top of the sector shaft arm forging to the bottom of the drag link.




5. Using a C-clamp, fully compress the sector shaft arm ball stud.




6. Measure the distance from the top of the sector shaft arm forging to the bottom of the drag link.

7. Subtract the second measurement from the first measurement. If the movement measure is greater than

0.11 in., install a new sector shaft arm. For additional information, refer to Section 211-02 .

**Pump Flow and Pressure Test**

**WARNING: Do not touch the flowmeter during the test procedure or severe burns and serious injury can occur.**

1. **CAUTION: Make sure that the connection point will not interfere with any of the engine accessory drive components or drive belts.**

   **NOTE:** On some vehicles, the power steering pump high-pressure port is not accessible. If so, the Power Steering Analyzer should be installed either at the steering gear or at a point in the high-pressure line between the power steering pump and the steering gear.

   Install Power Steering Analyzer at the high-pressure port of the power steering pump. Make sure the Power Steering Analyzer gate valve is fully open.

2. Place a Dial Thermometer in the power steering pump reservoir.

3. Check the power steering fluid level. If necessary, add power steering fluid.
   - Use Motorcraft MERCON Multi-Purpose (ATF) Transmission Fluid XT-2-QDX meeting Ford specification MERCON or equivalent.

4. Install the digital tachometer.

5. **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump can occur.**

   Start the engine. Place the transmission in NEUTRAL. Set the parking brake. Raise the power steering fluid temperature to 74-80°C (165-175°F) by rotating the steering wheel fully to the left and right several times.

6. Set the engine speed to idle. Record the free flow rate and pressure readings.
   - If the flow rate is not within the specified range, the power steering pump may require repair. Continue with the test procedure.
   - If the back pressure reading is above the maximum pressure specification, check power steering hoses for kinks and restrictions.

7. Partially close the gate valve to obtain 5,102 kPa (740 psi). Set the engine speed at idle. Record the flow rate.
   - If the flow rate is less than the specified flow rate, replace the power steering pump.

8. **CAUTION: Do not allow the gate valve to remain closed for more than five seconds.**

   Completely close and partially open the gate valve three times. Record the relief pressure.
   - If the pressure does not meet the relief pressure specification, replace the power steering pump.

9. Set the engine speed to 1,500 rpm. Record the flow rate.
   - If the flow rate varies more than 3.785 liters/minute (1 gallon/minute) from the initial flow rate reading, replace the power steering pump.

10. **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

    Set the engine speed at idle. Turn (or have an assistant turn) the steering wheel to the left and right stops.

Record the flow rate and pressure readings at the stops.

- The pressure reading at both stops should be nearly the same as the maximum pump relief pressure.
- The flow rate should drop below 1.9 liters/minute (0.5 gallons/minute).
- If the pressure does not reach the maximum pump relief pressure or the flow rate does not drop below the specified value, excessive internal leakage is occurring. Repair or replace the steering gear as necessary. For additional information, refer to Section 211-02 .

11. Turn (or have an assistant turn) the steering wheel slightly in both directions and release quickly while watching the pressure gauge.
    - The pressure reading should move from the normal back-pressure reading and snap back as the steering wheel is released.
    - If the pressure returns slowly or sticks, the rotary valve in the steering column is binding. Check the steering column and linkage before repairing the steering gear.

**Turning Effort Test**

**NOTE:** Make sure the front wheels are correctly aligned and tire pressure is correct before checking turning effort.

1. Park the vehicle on dry concrete and set the parking brake.

2. Idle the engine for two to three minutes. Turn the steering wheel to the left and right several times to warm the power steering fluid to 43-49°C (110-120°F).

3. With the engine running, attach a pull scale to rim of the steering wheel. Measure the pull required to turn the steering wheel one complete revolution in each direction. Refer to Specifications.

**Steering Gear Valve**

With the vehicle in motion, place the transmission in N (neutral) and turn the engine OFF.

- If the vehicle does not pull with the engine OFF, repair or install a new steering gear. For additional information, refer to Section 211-02 .
- If the vehicle pull direction does not change, check the front suspension components and wheel alignment. For additional information, refer to Section 204-00 and Section 204-01 .