DIAGNOSIS AND TESTING > CHECKING THE ENGINE MECHANICAL SYSTEM

For a complete wiring diagram, **refer to SYSTEM WIRING DIAGRAMS article** .

DIAGNOSIS AND TESTING > CHECKING THE ENGINE MECHANICAL SYSTEM > DIAGNOSTIC TEST

CHECKING THE ENGINE MECHANICAL SYSTEM

1. Turn the ignition off.
2. Check for any of the following conditions/mechanical problems:
    1. ENGINE VACUUM - must be at least 13 inches in neutral
    2. ENGINE VALVE TIMING - must be within specifications
    3. ENGINE COMPRESSION - must be within specifications
    4. CYLINDER LEAKAGE TEST - must be within specifications
    5. ENGINE EXHAUST SYSTEM - must be free of any restrictions or leaks
    6. ENGINE PCV SYSTEM - must flow freely
    7. TORQUE CONVERTER STALL SPEED - must be within specifications
    8. POWER BRAKE BOOSTER - no internal vacuum leaks
    9. FUEL - must be free of contamination
    10. VALVE SPRINGS - cannot be weak or broken
    11. CAM LOBES - must not be worn excessively
    12. CAM SHAFTS - must not be worn or have excessive end play

    Are there any engine mechanical problems?

    Yes

    1. Repair as necessary in accordance with the Service Information.
    2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

    No

    1. Test Complete.

DIAGNOSIS AND TESTING > CHECKING THE EXHAUST SYSTEM FOR LEAKS > CHECKING THE EXHAUST SYSTEM FOR LEAKS

YouTube	A multimedia supplement to the instructions contained in this article is available. To view the multimedia example of the condition described go to; **http://www.youtube.com/user/Mitchell1Tips then type "A00603031.vid1" into the "Search Channel" box.**

DIAGNOSIS AND TESTING > CHECKING THE EXHAUST SYSTEM FOR LEAKS > DIAGNOSTIC TEST

CHECK THE EXHAUST SYSTEM FOR LEAKS

1. Turn the ignition off.
2. Raise and support the vehicle in accordance with the service information. Refer to HOISTING, STANDARD PROCEDURE .

> *WARNING:*
>
> *The normal operating temperature of the exhaust system is very high. Never work around or attempt to service any part of the exhaust system until it has cooled. Special care should be taken when working near the catalytic converter. The temperature of the converter rises to a high level after a short period of engine operating time.*

3. Connect Exhaust Cone (special tool #8404-ECT, Exhaust Cone, Truck) to Air Pressure Regulator (with hose) W-18-MIL-1146AS.

> *CAUTION:*
>
> *The air pressure must not exceed 27.6 kPa (4 psi), otherwise engine damage can occur.*

4. Attach shop air to the air pressure regulator.
5. Adjust the Air Pressure Regulator to 27.6 kPa (4 psi)
6. Insert the exhaust cone into the vehicle tail pipe.
7. If the vehicle is equipped with dual exhaust, use a second Exhaust Cone (special tool #8404-ECT, Exhaust Cone, Truck) equipped with the attached plug and plug one side of the dual exhaust pipe. Pressurize the other as described above.

8. Apply Mopar® Air Leak Detector PN 05191804AA (or an equivalent leak finder liquid) to the following areas:
    1. All welded joints from the exhaust manifold to 45.72 cm (18 inches) behind the downstream O2 Sensor
    2. O2 Sensor seal points
    3. O2 Sensor boss welds
    4. Flange/joint connection(s)
    5. Exhaust manifold to cylinder head connection(s)
    6. EGR solenoid gasket base and tube seal points (if equipped)
9. Watch for the Mopar® Air Leak Detector PN 05191804AA (or the equivalent leak finder liquid) to bubble.
10. Use the following definitions to help determine if system or component repair/replacement is necessary:
    1. **Type 1 Leak** is defined as a leak where very small foam like bubbles 1 mm (0.04 of an inch) or less appear. Any Type 1 or greater leaks found in welded joints, O2 sensor seal points or O2 sensor boss welds must be repaired or the component must be replaced.
    2. **Type 2 Leak** is defined as a leak where larger bubbles pea size, 8 mm (0.3 of an inch) or greater appear. Any Type 2 or greater leaks found in flange or joint connections, exhaust manifold to cylinder head connections, or EGR gasket and tube seal points must be repaired or the components must be replaced.

Leak Location	Repair as required if results at 27.6 kPa (4 psi) reveal bubble size:
Welded joints	Type 1, 1 mm (0.04 of an inch) or greater
O2 Sensor seal points	Type 1, 1 mm (0.04 of an inch) or greater
O2 Sensor boss welds	Type 1, 1 mm (0.04 of an inch) or greater
Flange / joint connections	Type 2, 8 mm (0.3 of an inch) or greater
Exhaust Manifold to cylinder head connections	Type 2, 8 mm (0.3 of an inch) or greater
EGR gasket and tube seal points	Type 2, 8 mm (0.3 of an inch) or greater

11. If a leak is found that matches the above definition, repair or replace the component as necessary.
12. Once the repair is complete, repeat the procedure to verify that all leaks have been repaired.

    Were any exhaust leaks found?

    Yes

    1. Repair or replace the leaking exhaust parts as necessary.
    2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING &

DIAGNOSTICS article in ENGINE PERFORMANCE .

No

1. Test complete.

DIAGNOSIS AND TESTING > CHECKING THE FUEL DELIVERY SYSTEM (HARD START)

For a complete wiring diagram, **refer to SYSTEM WIRING DIAGRAMS article** .

DIAGNOSIS AND TESTING > CHECKING THE FUEL DELIVERY SYSTEM (HARD START) > POSSIBLE CAUSES

Possible Causes
FUEL DELIVERY SYSTEM LEAKING OR DAMAGED
RESTRICTED FUEL SUPPLY LINE
FUEL PUMP INLET STRAINER PLUGGED
FUEL PUMP CONTROL OUTPUT CIRCUIT OPEN
FUEL INJECTOR(S)
FUEL PUMP MODULE

WARNING:

Follow these safety precautions to reduce the risk of fire and possible serious or fatal injury when performing this test procedure.

- *Fuel or fuel vapors are highly flammable. A fire could occur if an ignition source is present. Do not expose the fuel or the test equipment used in this procedure to open flames or sparks.*
- *Inhalation of fuel vapors could lead to disorientation and personal injury. Keep the service area well ventilated, or perform this test procedure in an area where there is a building exhaust removal system.*
- *Relieve fuel system pressure before servicing fuel system components.*
- *Use extreme caution when connecting and disconnecting fuel lines.*
- *Considerable fuel leakage may occur when servicing the fuel system. Wear protective eye wear and clothing to protect from fuel splash, and take suitable fuel containment measures.*
- *Wrap a shop towel around the fuel pressure gauge connection to absorb fuel leakage that occurs when connecting the test equipment. Place the towel in an approved*

container when complete.

- *Never store fuel in an open container due to the possibility of fire or explosion. Have a dry chemical (Class B) fire extinguisher nearby.*

DIAGNOSIS AND TESTING > CHECKING THE FUEL DELIVERY SYSTEM (HARD START) > DIAGNOSTIC TEST

1. **CHECK THE FUEL DELIVERY SYSTEM FOR LEAKS AND DAMAGE**

> *WARNING:*
>
> *The fuel system is under a constant pressure (even with the engine off). Before testing or servicing any fuel system hose, fitting, or line, the fuel system pressure must be released. Failure to follow these instructions can result in possible serious or fatal injury.*

    1. Visually and physically inspect the fuel delivery system for external leaks and damage.

       Is the system leaking or damaged?

       Yes

        1. Repair or replace as necessary.
        2. Perform the PCM VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

       No

        1. Go To Step 2

2. **CHECK FUEL PUMP OPERATION**

    1. Ignition on, engine not running.
    2. With a scan tool, actuate the Fuel System test.

> *NOTE:*
>
> *It may be necessary to use a mechanics stethoscope in the next step.*

    3. Listen for fuel pump operation at the Fuel Tank.

       Does the Fuel Pump operate?

       Yes

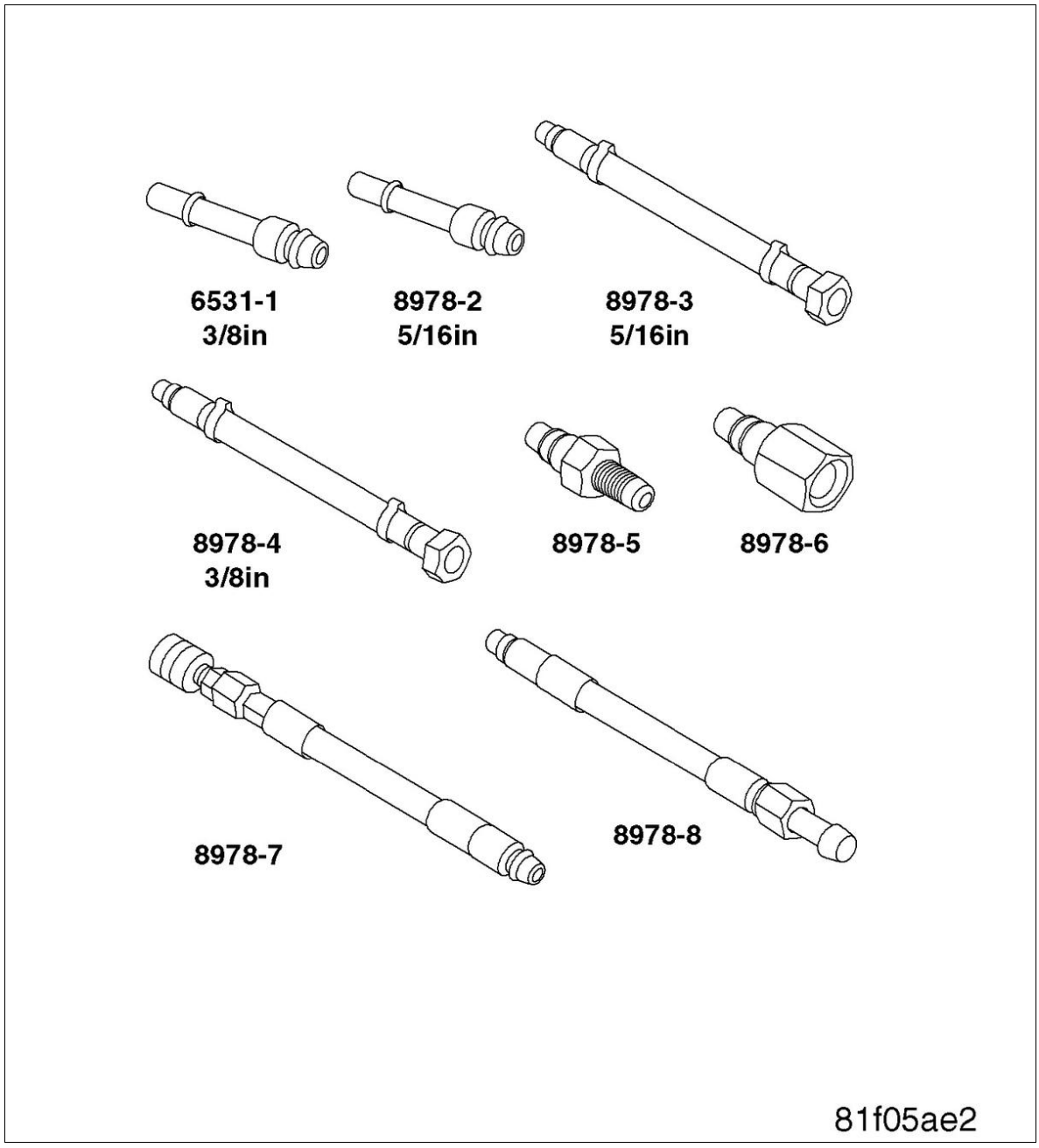
1. Go To Step 3

No

1. Check the power and ground circuits to the Fuel Pump Module assembly. If the circuits test good, replace the Fuel Pump Module assembly.
2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

3. **INSTALL APPROPRIATE FUEL LINE ADAPTERS/FITTING FROM THE GAS AND DIESEL FUEL PRESSURE/DECAY TESTER 8978A**

Fig 1: Fuel Line Adapters/Fitting



Courtesy of CHRYSLER GROUP, LLC

1. Turn the ignition off.

> *WARNING:*
>
> *The fuel system is under a constant pressure (even with the engine off). Before testing or servicing any fuel system hose, fitting, or line, the fuel system pressure must be released. Failure to follow these instructions can result in possible serious or fatal injury.*

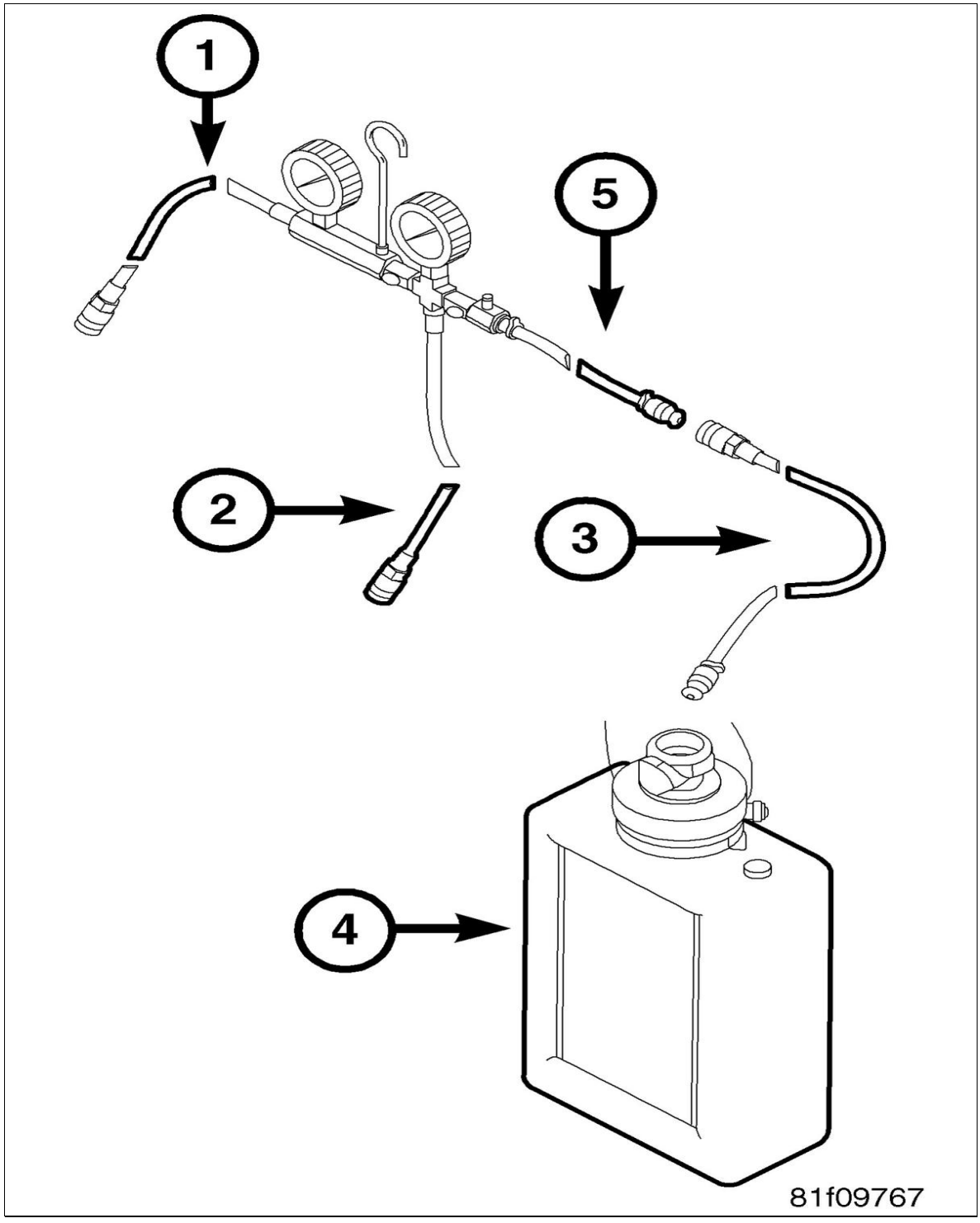
2. Release the fuel system pressure. Refer to FUEL SYSTEM .
3. Disconnect the rail fuel supply line connector between the fuel supply line and the fuel rail. (Refer to LINES, FUEL).
4. Install the appropriate Fuel Line Adapters/Fitting from the Gas and Diesel Fuel Pressure/Decay Tester (special tool #8978A, Decay Tool, Fuel).

   Proceed

   1. Go To Step 4

4. **INSTALL THE FUEL PRESSURE GAUGE ASSEMBLY**

Fig 2: Identifying Fuel Pressure Gauge Assembly



Courtesy of CHRYSLER GROUP, LLC

1. Connect the (special tool #8978A, Decay Tool, Fuel), with the Fuel Inlet Hose (1) toward the Fuel tank side and the Fuel Outlet Hose (2) toward the fuel rail side of the system using the Fuel Line Adapters/Fitting as needed.

2. Connect special tool Drain Extension Hose 535680 (3) to the Fuel Pressure Gauge Assembly Drain Hose (5).

3. Connect Reservoir Assembly 534960 (4) to Drain Extension Hose 535680 (3).

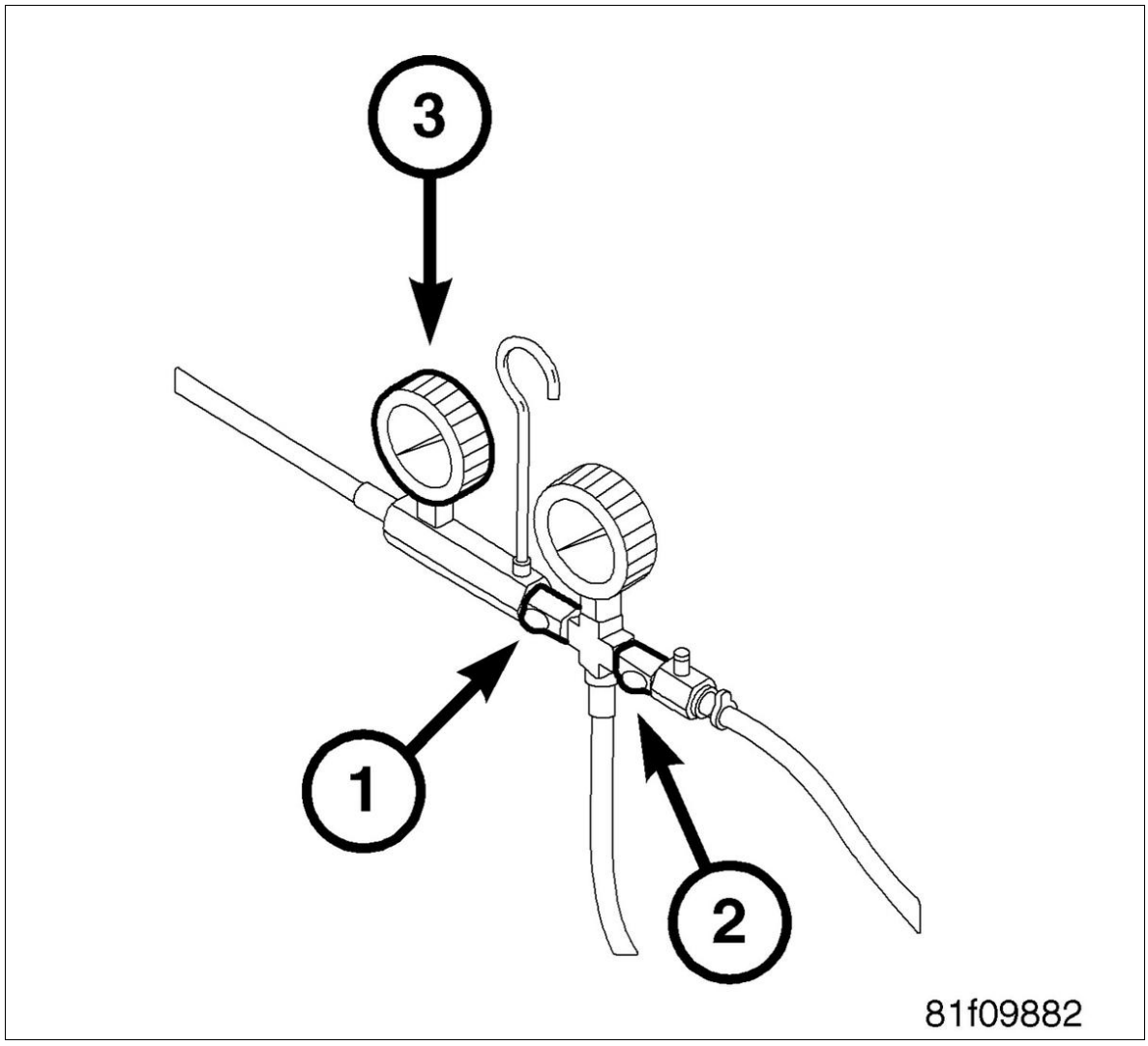
> *WARNING:*
>
> *To reduce the risk of fire and possible serious or fatal injury, place Reservoir Assembly 534960 (4) on the floor and out of the way so that it is not a trip hazard.*

Proceed

1. Go To Step 5

5. **CHECK THE FUEL PRESSURE**

Fig 3: Checking Fuel Pressure



Courtesy of CHRYSLER GROUP, LLC

1. Perform the following procedure to purge air from the system:
    1. Open the Fuel System Isolation Valve (1).

2. Close the Flow Test Valve (2).
3. Ignition on, engine not running.
4. With the scan tool, actuate the Fuel Pump.
5. Open the Flow Test Valve (2) for 10 seconds, then close the Valve.
6. **CAUTION: Stop All Actuations.**
7. Turn the ignition off.
8. Disconnect, empty and then reconnect the Reservoir Assembly.

2. Turn the ignition on.
3. With the scan tool, actuate the Fuel Pump.

> *NOTE:*
>
> *On vehicles equipped with a PWM Fuel Pump, actuate the Fuel Pump at or above 60%.*

4. Read the Fuel Pressure Gauge (3) and record the reading.

> *NOTE:*
>
> *The fuel pressure specification for all engines, including a **Non SRT-4** is 407 kPa +/- 34 kPa (59 psi +/- 5 psi). **SRT-4** fuel pressure specification is 552 kPa +/- 34 kPa (80 psi +/- 5 psi).*

Choose a conclusion that best matches your fuel pressure reading.

Below Specification

1. Go To Step 10

Within Specification

1. Go To Step 6

Above Specification

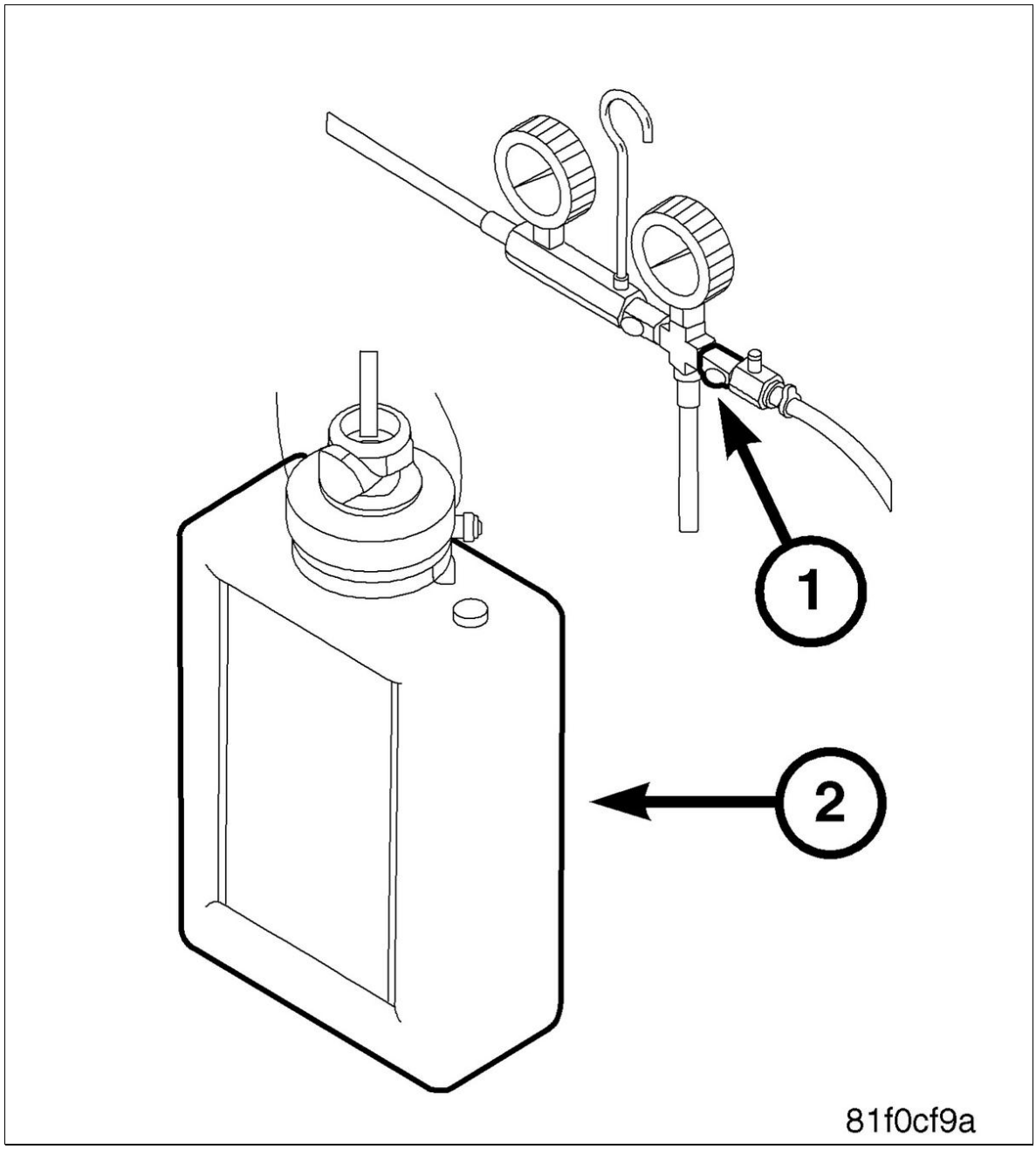
1. Replace the fuel filter/fuel pressure regulator.
2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

CAUTION:

Stop all actuation tests before proceeding.

6. **CHECK THE FUEL DELIVERY SYSTEM OUTPUT**

Fig 4: Checking Fuel Delivery System Output



Courtesy of CHRYSLER GROUP, LLC

WARNING:

The fuel system is under a constant pressure (even with the engine off). Before

testing or servicing any fuel system hose, fitting, or line, the fuel system pressure must be released. Failure to follow these instructions can result in possible serious or fatal injury.

1. With the scan tool, continue to actuate the fuel pump.
2. Open the Flow Test Valve (1) for 20 seconds, then close the Valve.

> ⚠ *CAUTION:*
>
> *Stop all actuation tests before proceeding.*

3. Turn the ignition off.
4. Measure the amount of fuel in the Reservoir Assembly (2). The fuel output specification is ml/s X 20 seconds = fuel flow in ml.

FUEL FLOW		
ENGINE	ml/s	ml per 20 Seconds
4 Cylinder and 6 Cylinder	20.8333	417
8 Cylinder	38.88889	778
SRT-4	50	1000
10 cylinder	55.5	1110

Does the amount of fuel in the reservoir meet or exceed the specification?

Yes

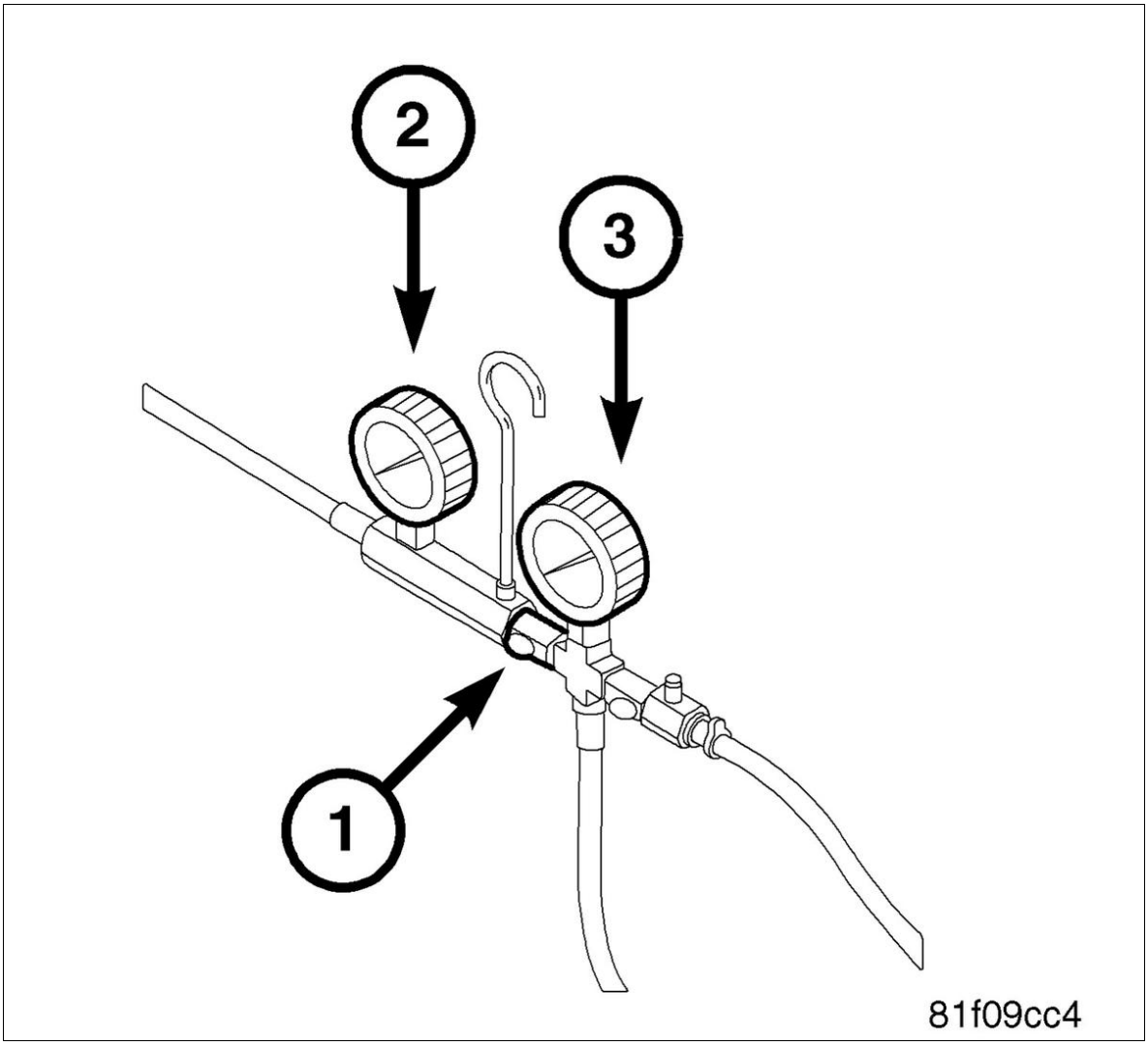
1. Go To Step 7

No

1. Go To Step 8

7. **CHECK THE FUEL DELIVERY SYSTEM FOR LEAK DOWN**

Fig 5: Checking Fuel Delivery System For Leak Down



Courtesy of CHRYSLER GROUP, LLC

WARNING:

The fuel system is under a constant pressure (even with the engine off). Before testing or servicing any fuel system hose, fitting, or line, the fuel system pressure must be released. Failure to follow these instructions can result in possible serious or fatal injury.

1. Ignition on, engine not running.
2. With the scan tool, actuate the fuel pump.
3. Close the Fuel System Isolation Valve (1).

CAUTION:

Stop all actuation tests before proceeding.

4. Turn the ignition off and then wait five minutes before proceeding.
5. Read the Fuel Inlet (2) and Fuel Outlet (3) Pressure Gauges. The pressure should not drop more than 10 psi on either gauge.

   Does the fuel pressure drop more than 10 psi?

   Yes - On Fuel Inlet Gauge (2)

   1. Replace the Fuel Pump Module.
   2. Perform the PCM VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

   Yes - On Fuel Outlet Gauge (3)

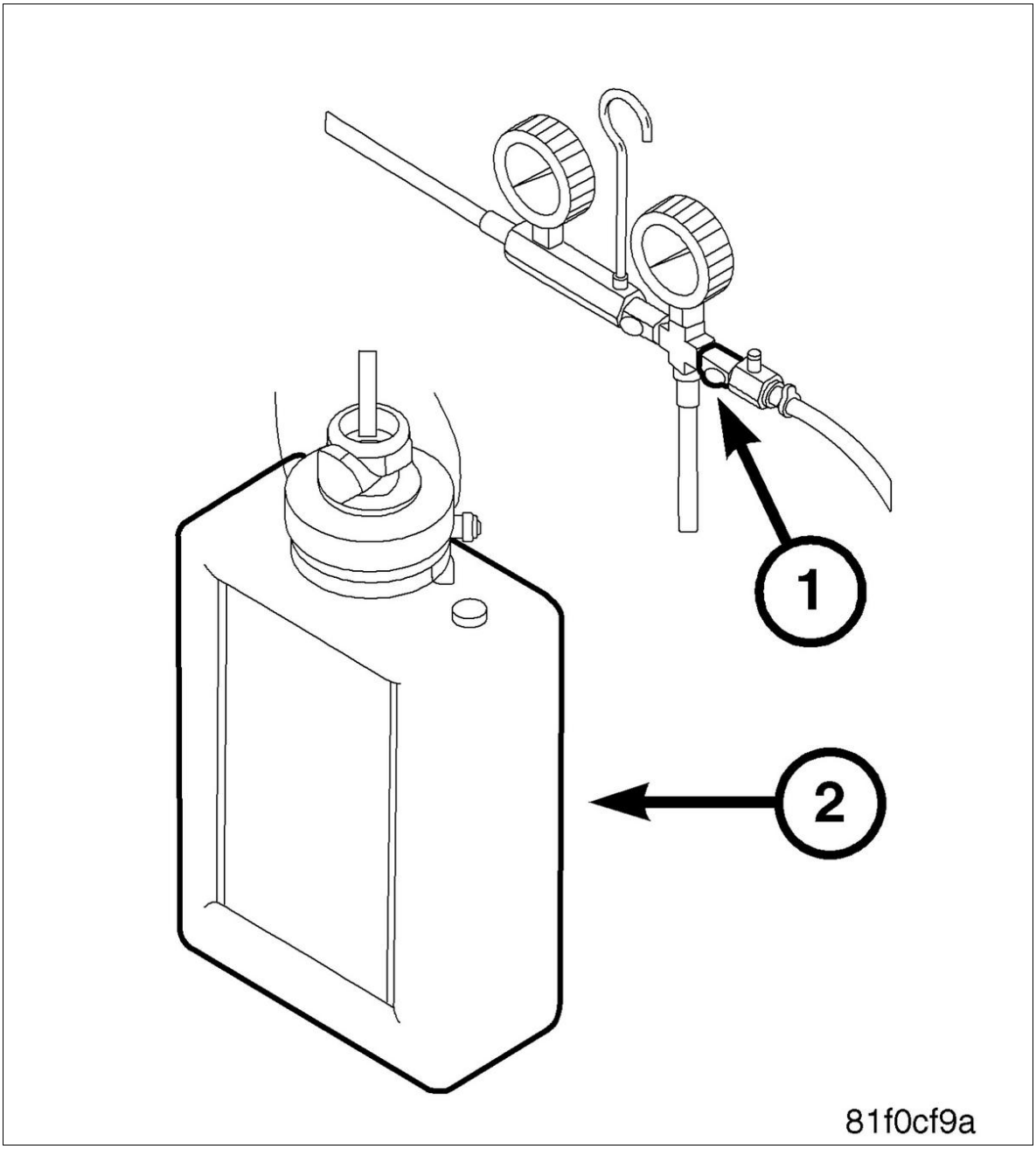
   1. Replace the leaking Fuel Injector(s).
   2. Perform the PCM VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

   No

   1. If directed here by another test, return to that test. Otherwise, test complete.

8. **CHECK FOR RESTRICTED FUEL SUPPLY LINE**

Fig 6: Checking Fuel Delivery System Output



Courtesy of CHRYSLER GROUP, LLC

WARNING:

The fuel system is under a constant pressure even with the engine off. Before testing or servicing any fuel system hose, fitting or line, the fuel system pressure must be released.

1. Turn the ignition off.
2. Disconnect the Fuel Pressure Decay Tester.

3. Raise the vehicle on a hoist, and disconnect the fuel pressure line at the Fuel Pump Module.
4. Install the Fuel Pressure Decay Tester between the fuel supply line and the Fuel Pump Module.
5. Again, purge air from the system.
6. Ignition on, engine not running.
7. With the scan tool, actuate the Fuel Pump.
8. Open the Flow Test Valve (1) for 20 seconds, then close the Valve.

> ⚠ *CAUTION:*
>
> *Stop all actuation tests before proceeding.*

9. Turn the ignition off.
10. Measure the amount of fuel in the Reservoir Assembly (2). The fuel output specification is ml/s X 20 seconds = fuel flow in ml.

FUEL FLOW		
ENGINE	ml/s	ml per 20 Seconds
4 Cylinder and 6 Cylinder	20.8333	417
8 Cylinder	38.88889	778
SRT-4	50	1000
10 cylinder	55.5	1110

Does the amount of fuel in the reservoir meet or exceed the specification?

Yes

1. Repair/replace fuel supply line as necessary.
2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

No

1. Go To Step 9

> ⚠ *CAUTION:*
>
> *Stop all actuation tests before proceeding.*

9. **CHECKING THE FUEL INLET STRAINER**

> *WARNING:*
>
> *The fuel system is under a constant pressure (even with the engine off). Before testing or servicing any fuel system hose, fitting or line, the fuel system pressure must be released. Failure to follow these instructions can result in possible serious or fatal injury.*

1. Turn the ignition off.
2. Remove the Fuel Pump Module and inspect the Fuel Inlet Strainer.

   Is the Fuel Inlet Strainer plugged?

   Yes

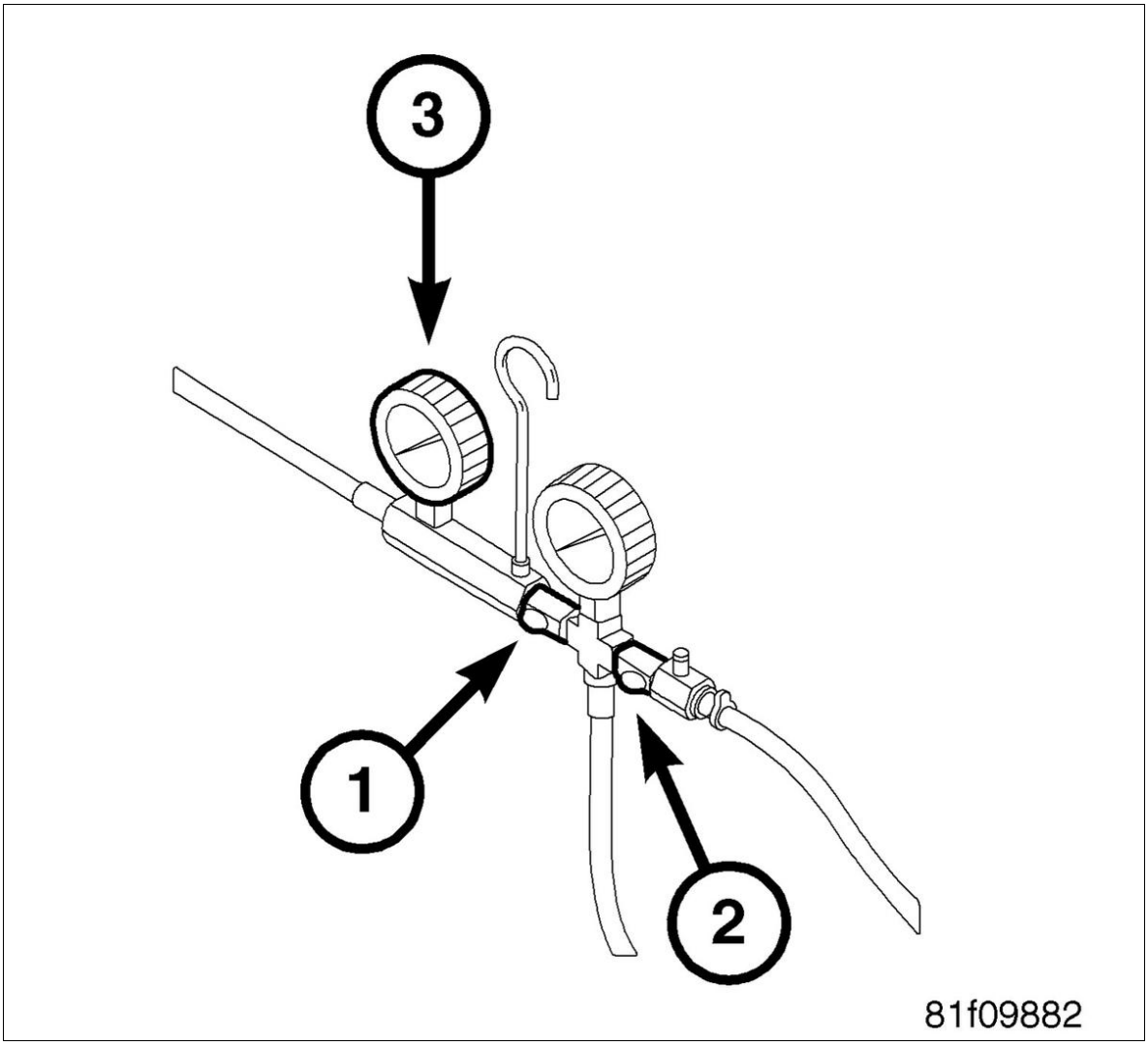
   1. Replace the Fuel Pump Inlet Strainer.
   2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

   No

   1. Replace the Fuel Pump Module.
   2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

10. **CHECK FOR RESTRICTED FUEL SUPPLY LINE**

Fig 7: Checking Fuel Pressure



Courtesy of CHRYSLER GROUP, LLC

WARNING:

The fuel system is under a constant pressure even with the engine off. Before testing or servicing any fuel system hose, fitting or line, the fuel system pressure must be released.

1. Turn the ignition off.
2. Disconnect the Fuel Pressure Decay Tool.
3. Raise the vehicle on a hoist, and disconnect the fuel pressure line at the fuel pump module.
4. Install the Fuel Pressure Decay Tool between the fuel supply line and the fuel pump module.
5. Again, purge air from the system.

6. Turn the ignition on.
7. With the scan tool, actuate the Fuel Pump.

> *NOTE:*
>
> *On vehicles equipped with a PWM Fuel Pump, actuate the Fuel Pump at or above 60%.*

8. Read the Fuel Pressure Gauge (3) and record the reading.

> *NOTE:*
>
> *The fuel pressure specification for all engines, including a **Non SRT-4** is 407 kPa +/- 34 kPa (59 psi +/- 5 psi). **SRT-4** fuel pressure specification is 552 kPa +/- 34 kPa (80 psi +/- 5 psi).*

Is the fuel pressure now within specification?

Yes

1. Repair/replace fuel supply line as necessary.
2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

No

1. Go To Step 11

> *CAUTION:*
>
> *Stop all actuation tests before proceeding.*

11. **CHECKING FUEL INLET STRAINER**

> *WARNING:*
>
> *The fuel system is under a constant pressure (even with the engine off). Before testing or servicing any fuel system hose, fitting or line, the fuel system pressure must be released. Failure to follow these instructions can result in possible serious or fatal injury.*

1. Turn the ignition off.
2. Remove the Fuel Pump Module and inspect the Fuel Inlet Strainer.

Is the Fuel Inlet Strainer plugged?

Yes

1. Replace the Fuel Pump Inlet Strainer.
2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

No

1. Replace the Fuel Pump Module.
2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

DIAGNOSIS AND TESTING > CHECKING THE MAP SENSOR OPERATION

For a complete wiring diagram, **refer to SYSTEM WIRING DIAGRAMS article** .

DIAGNOSIS AND TESTING > CHECKING THE MAP SENSOR OPERATION > DIAGNOSTIC TEST

1. **MAP SENSOR WIRING OR CONNECTORS**

> *NOTE:*
>
> *Diagnose and repair any MAP Sensor circuit DTCs before proceeding with this test.*

> *NOTE:*
>
> *Diagnose and repair any sensor supply or system voltage DTCs before proceeding with this test.*

1. Turn the ignition off.
2. Using the wiring diagram/schematic as a guide, inspect the wiring and connectors between the MAP Sensor and the PCM.
3. Look for any chafed, pierced, pinched, or partially broken wires.
4. Look for broken, bent, pushed out or corroded terminals.
5. Turn the ignition on.
6. Monitor the scan tool data relative to the sensor and wiggle test the wiring and connectors.

7. Look for the data to change or for a DTC to set during the wiggle test. If necessary, check each sensor circuit for high resistance or a shorted condition.

   Were any problems found?

   Yes

   1. Repair as necessary in accordance with the Service Information.
   2. Perform the Powertrain Verification Test. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

   No

   1. Go To Step 2

2. **MAP VACUUM/BAROMETRIC PRESSURE**

   1. With a scan tool, read the Barometric Pressure.

      > *NOTE:*
      >
      > *The Barometric Pressure should be approximately equal to the actual barometric pressure. If necessary, compare the Barometric Pressure value of the tested vehicle to the value of a known good vehicle of a similar make and model.*

   2. Connect a vacuum gauge to a manifold vacuum source.
   3. Start the engine.

      > *NOTE:*
      >
      > *If the engine will not idle, maintain a constant RPM above idle.*

      > *WARNING:*
      >
      > *When the engine is operating, do not stand in direct line with the fan. Do not put your hands near the pulleys, belts, or fan. Do not wear loose clothing. Failure to follow these instructions can result in possible serious or fatal injury.*

   4. With the scan tool, read the MAP Sensor value.

> *NOTE:*
>
> *The scan tool reading for MAP vacuum should be within 1" of the vacuum gauge reading.*

Were any problems found?

Yes

1. Go To Step 4

No

1. Go To Step 3

3. **CHECK THE MAP SENSOR VOLTAGE**

    1. With the scan tool, monitor the MAP Sensor signal voltage.
    2. With the engine idling in neutral or park, snap the throttle.

> *NOTE:*
>
> *The MAP Sensor signal voltage should change from below 2.0 volts at idle to above 3.5 volts at wide open throttle.*

Were any problems found?

Yes

1. Go To Step 4

No

1. Test complete.

4. **CHECK THE 5-VOLT SUPPLY CIRCUIT FOR HIGH RESISTANCE**

    1. Turn the ignition off.
    2. Using a voltmeter, perform a voltage drop test on the MAP Sensor 5-Volt Supply circuit between the MAP Sensor harness connector and the PCM harness connector. Make sure the voltmeter leads are connected so that positive polarity is displayed on the voltmeter.

> *WARNING:*
>
> *When the engine is operating, do not stand in direct line with the fan. Do not put your hands near the pulleys, belts, or fan. Do not wear loose clothing. Failure to follow these instructions can result in possible serious or fatal injury.*

3. Start the engine.

   Is the voltage reading below 0.1 volt?

   Yes

   1. Go To Step 5

   No

   1. Repair the 5-Volt Supply circuit for excessive resistance.
   2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

5. **CHECK THE MAP SENSOR SIGNAL CIRCUIT FOR HIGH RESISTANCE**

   1. Turn the ignition off.
   2. Using a voltmeter, perform a voltage drop test on the MAP Sensor Signal circuit between the MAP Sensor harness connector and the PCM harness connector. Make sure the voltmeter leads are connected so that positive polarity is displayed on the voltmeter.

      > *WARNING:*
      >
      > *When the engine is operating, do not stand in direct line with the fan. Do not put your hands near the pulleys, belts, or fan. Do not wear loose clothing. Failure to follow these instructions can result in possible serious or fatal injury.*

   3. Start the engine.

      Is the voltage reading below 0.1 volt?

      Yes

      1. Go To Step 6

      No

      1. Repair the MAP Sensor Signal circuit for excessive resistance.
      2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

6. **CHECK THE MAP SENSOR GROUND CIRCUIT FOR HIGH RESISTANCE**

    1. Turn the ignition off.
    2. Using a voltmeter, perform a voltage drop test on the MAP Sensor Ground circuit between the MAP Sensor harness connector and the PCM harness connector. Make sure the voltmeter leads are connected so that positive polarity is displayed on the voltmeter.

        > *WARNING:*
        >
        > *When the engine is operating, do not stand in direct line with the fan. Do not put your hands near the pulleys, belts, or fan. Do not wear loose clothing. Failure to follow these instructions can result in possible serious or fatal injury.*

    3. Start the engine.

        Is the voltage below 0.1 volt?

        Yes

        1. Go To Step 7

        No

        1. Repair the MAP Sensor Ground circuit for excessive resistance.
        2. Perform the Powertrain Verification Test. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

7. **MAP SENSOR**

    1. Using the wiring diagram/schematic as a guide, inspect the wiring and connectors between the MAP Sensor and the Powertrain Control Module (PCM).
    2. Look for any chafed, pierced, pinched, or partially broken wires.
    3. Look for broken, bent, pushed out or corroded terminals.
    4. Perform any Service Bulletins that may apply.

        Were any problems found?

        Yes

        1. Repair as necessary.
        2. Perform the Powertrain Verification Test. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

        No

        1. Replace the MAP Sensor in accordance with the Service Information. Refer to SENSOR, MANIFOLD AIR PRESSURE (MAP), REMOVAL AND INSTALLATION

.

2. Perform the Powertrain Verification Test. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

DIAGNOSIS AND TESTING > CHECKING THE OXYGEN SENSOR OPERATION (6 WIRE)

For a complete wiring diagram, **refer to SYSTEM WIRING DIAGRAMS article** .

DIAGNOSIS AND TESTING > CHECKING THE OXYGEN SENSOR OPERATION (6 WIRE) > THEORY OF OPERATION

The wide-band (6-Wire) O2 Sensor operates differently than the traditional 4-Wire O2 Sensor. The wide-band O2 Sensor tip consists of two cells that provide different functions, a measurement chamber and a detection chamber with pumping capabilities. The oxygen pumping function is the ability to pump oxygen into or out of the measurement chamber depending on the level of oxygen in the measurement chamber. This function provides the wide-band sensing capabilities and is critical for proper oxygen measurement. The O2 Sensor Positive Current Control circuit provides a common bias supply to both the O2 Sensor Signal and the O2 Sensor Pump Cell Current circuits.

During normal operation, the O2 Sensor Positive Current Control voltage and O2 Sensor Signal voltage will be a fixed voltage value. The O2 Sensor Pump Cell Current voltage will switch from approximately 0.45 volts above and below the fixed O2 Sensor Return voltage, allowing current to flow in either direction through the pump. This correlates with the pumping of oxygen into and out of the measurement chamber. On a properly operating vehicle, this happens very quickly and the voltage reading will appear as a steady 0.45 volts when taking a voltage measurement between the O2 Sensor Signal circuit and the O2 Sensor Positive Current Control circuit of the O2 Sensor with the engine running and the O2 Sensor operating in closed loop.

When the exhaust stream has a lean air/fuel ratio (high oxygen content) the Pump Cell Current voltage will move toward +0.45 volts pumping oxygen out of the measurement chamber. When the exhaust stream has a rich air/fuel ratio (relatively low oxygen content) the Pump Cell Current voltage will move toward -0.45 volts pumping oxygen into the measurement chamber.

The PCM is able to pinpoint failures to the specific O2 Sensor circuits through a series of steps which include both "cold" and "hot" tests. To ensure that the correct malfunctioning circuit is identified, the diagnostics are performed in three separate test conditions, a **Cold test at startup, Hot test during vehicle operation** and **Cold test during PCM power down** .

A Cold test, performed at startup (before the O2 system enters closed loop operation), can detect a Short Circuit to Battery. Although the diagnostics can detect the failure, it cannot identify the specific circuit which failed and will set the generic fault code P0132.

> *NOTE:*
>
> *The Cold test at startup cannot detect a Short Circuit to Ground or an Open Circuit failure.*

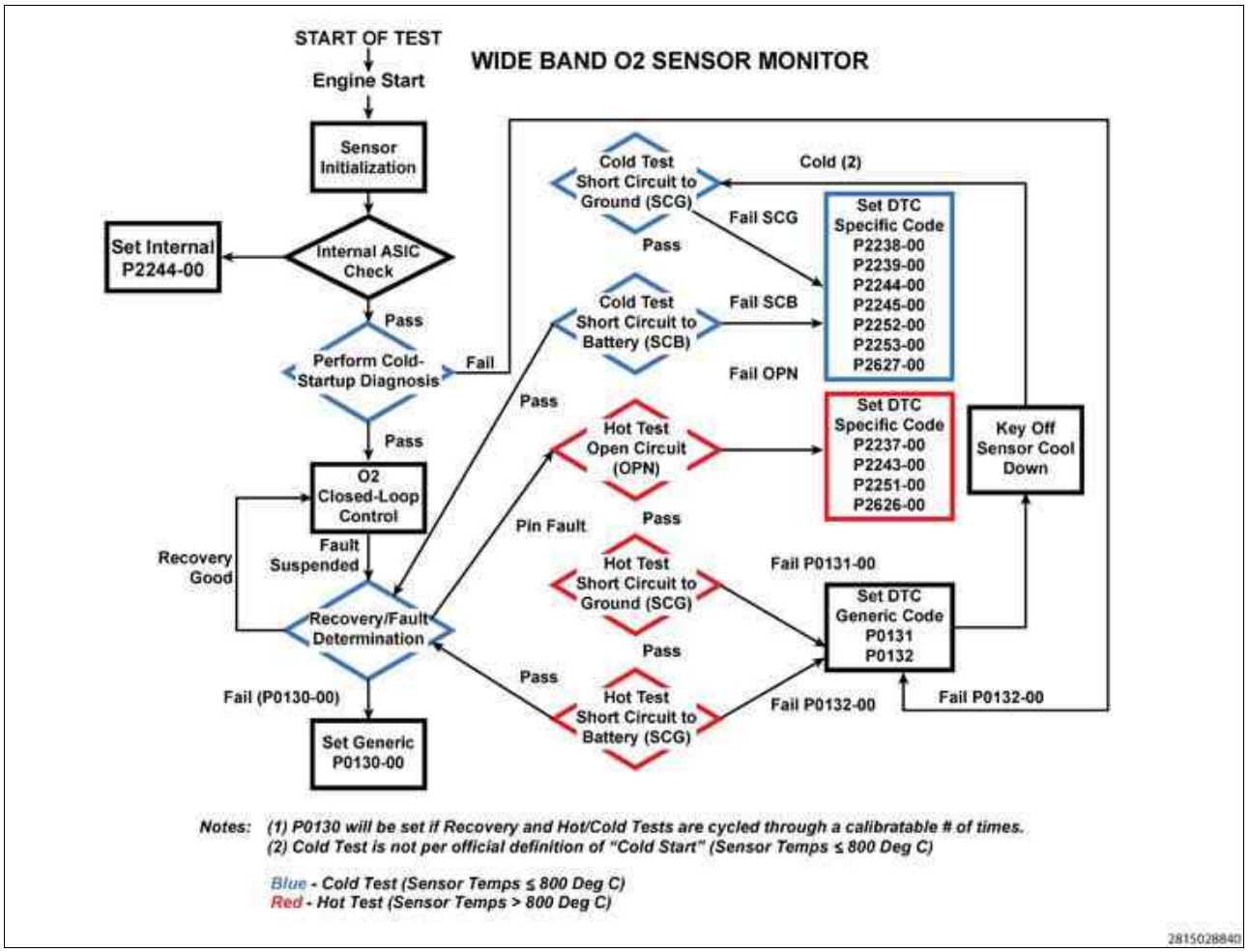
When the PCM detects a circuit that falls outside the allowable range during either the cold startup test or during O2 Sensor closed loop operation, a **Hot test** is initiated. The O2 Sensor is turned off and a 20 second delay timer is started. Once the timer expires, the hot test diagnostic will be performed. It takes approximately 160 ms from the time the hot test is initiated until the fault is set. If an open circuit is detected the specific circuit which failed can be identified during the hot test and the fault code for the related circuit will be set. If a short to ground or short to battery is detected the diagnostics can detect the failure, however it cannot identify the specific circuit which failed and will set the generic fault codes P0131 for short to ground or P0132 for short to battery.

NOTE:

The hot test will be repeated every 20 seconds, as long as the circuit measurements are still out of range. This will continue until the key is switched off or until the measurements are in range.

The Cold test is performed at power down (ignition off) as long as the coolant temperature is at or below 185°F (85°C). This diagnostic will run after a generic short to battery or short to ground fault is set to identify the specific circuit which failed.

Fig 1: Wide Band O2 Sensor Monitor



Courtesy of CHRYSLER GROUP, LLC

If the O2 Sensor is powered up by the PCM and operating normally, the voltage readings should be as follows;

- The voltage at the (K41) O2 Sensor Signal circuit should be approximately 4.3 volts.
- The voltage at the (K902) O2 Sensor Return circuit should be approximately 3.85 volts.
- The voltage at the (K89) O2 Positive Current Control circuit should be switching between approximately 3.4 volts and 4.3 volts.
- The voltage between the (K89) O2 Positive Current Control circuit and the (K902) O2 Sensor Return circuit should switch between +0.45 volts and -0.45 volts.

> *NOTE:*
>
> *The voltage readings may vary up or down slightly depending on the age of the O2 Sensor and operating conditions of the engine. However, if the engine and O2 Sensor are operating normally the voltage reading between the (K89) O2 Positive Current Control circuit and the (K902) O2 Sensor Return circuit should switch between +0.45 volts and -0.45 volts with very little or no change.*

DIAGNOSIS AND TESTING > CHECKING THE OXYGEN SENSOR OPERATION (6 WIRE) > DIAGNOSTIC TEST

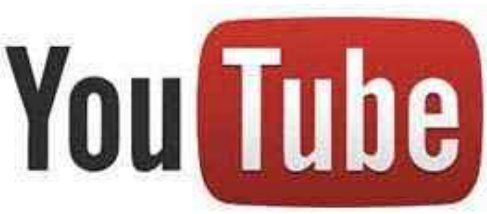
1. **VERIFY O2 SENSOR OPERATION**
    1. Start the engine.
    2. Allow the engine to reach normal operating temperature.
    3. With the scan tool, select and graph the O2 Sensor suspected of not performing correctly.
    4. Review the 3 sample videos of O2 Sensor operation to determine which graph best matches what is displayed on the scan tool for the vehicle.
    5. Which video best matches the graph displayed on the scan tool?

        Video 1 (Normal operation)

YouTube	A multimedia supplement to the instructions contained in this article is available. To view the multimedia example of the condition described go to; **http://www.youtube.com /user/Mitchell1Tips** **then type "A00646310.vid2" into the "Search Channel" box.**

1. Perform the INTERMITTENT CONDITION diagnostic procedure. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

Video 2 (Rich operation)

	A multimedia supplement to the instructions contained in this article is available. To view the multimedia example of the condition described go to; **http://www.youtube.com /user/Mitchell1Tips** **then type "A00646310.vid3" into the "Search Channel" box.**

1. Go To Step 2

Video 3 (Lean operation)

	A multimedia supplement to the instructions contained in this article is available. To view the multimedia example of the condition described go to; **http://www.youtube.com /user/Mitchell1Tips** **then type "A00646310.vid4" into the "Search Channel" box.**

1. Go To Step 3

2. **TESTING FOR RICH O2 SENSOR OPERATION**

    1. Start the engine.
    2. With the scan tool, select and graph the O2 Sensor suspected of not performing correctly.
    3. Disconnect engine vacuum lines to create a lean running condition.
    4. With the engine vacuum lines disconnected monitor the O2 Sensor graph on the scan tool.

       Did the O2 Sensor graph show a change from rich to lean?

       Yes

        1. Check for any of the following conditions/mechanical problems that can cause a O2 Sensor stuck rich condition:
        2. AFTERMARKET equipment or software effecting emissions.
        3. AIR INDUCTION SYSTEM - must be free from blockage.
        4. ENGINE VALVE TIMING - must be within specifications.

5. ENGINE COMPRESSION - must be within specifications.
6. ENGINE EXHAUST SYSTEM - must be free of any restrictions or leaks.
7. ENGINE PCV SYSTEM - must flow freely.
8. FUEL - must be free of contamination.
9. FUEL INJECTOR - plugged, stuck open or restricted injector.

No

1. Replace the Oxygen Sensor in accordance with the Service Information. Refer to SENSOR, OXYGEN, REMOVAL AND INSTALLATION .
2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

3. **TESTING FOR LEAN O2 SENSOR OPERATION**

1. Start the engine.
2. With the scan tool, select and graph the O2 Sensor suspected of not performing correctly.
3. Create a rich running condition.
4. With the rich running condition, monitor the O2 Sensor graph on the scan tool.

   Did the O2 Sensor graph show a change from lean to rich?

   Yes

   1. AFTERMARKET equipment or software effecting emissions.
   2. AIR INDUCTION SYSTEM - must be free from leaks.
   3. ENGINE VACUUM - must be at least 13 inches in neutral.
   4. ENGINE VALVE TIMING - must be within specifications.
   5. ENGINE COMPRESSION - must be within specifications.
   6. ENGINE EXHAUST SYSTEM - must be free of any restrictions or leaks.
   7. ENGINE PCV SYSTEM - must be free of leaks and flow freely.
   8. POWER BRAKE BOOSTER - no internal vacuum leaks.
   9. FUEL - must be free of contamination.
   10. FUEL INJECTOR - plugged or restricted injector; control wire not connected to correct injector.

   No

   1. Replace the Oxygen Sensor in accordance with the Service Information. Refer to SENSOR, OXYGEN, REMOVAL AND INSTALLATION .

2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

DIAGNOSIS AND TESTING > CHECKING THE PCM POWER AND GROUND CIRCUITS

For a complete wiring diagram, **refer to SYSTEM WIRING DIAGRAMS article** .

DIAGNOSIS AND TESTING > CHECKING THE PCM POWER AND GROUND CIRCUITS > DIAGNOSTIC TEST

1. **PCM WIRING OR CONNECTORS**
    1. Turn the ignition off.
    2. Using the wiring diagram/schematic as a guide, inspect the wiring and each connector at the PCM.
    3. Look for any chafed, pierced, pinched or partially broken wires.
    4. Look for broken, bent, pushed out or corroded terminals.

    Were any problems found?

    Yes

    1. Repair as necessary.
    2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

    No

    1. Go To Step 2
2. **CHECK THE PCM GROUND CIRCUITS**
    1. Turn the ignition off.
    2. Using a 12-volt test light connected to 12 volts, probe the PCM ground circuits.
    3. Wiggle test the wiring during the test to check for an intermittent open in the circuit.

    > *NOTE:*
    >
    > *The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.*

    Is the test light illuminated and bright?

    Yes

1. Go To Step 3

No

1. Repair the PCM ground circuit(s) for an open or high resistance.
2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

3. **CHECK THE PCM FUSED B+ CIRCUIT**

1. Using a 12-volt test light connected to ground, probe the PCM Fused B+ circuit.
2. Wiggle test the wiring during the test to check for an intermittent open in the circuit.

> *NOTE:*
>
> *The test light should be illuminated and bright. Compare the brightness to that of a direct connection to the battery.*

Is the test light illuminated and bright?

Yes

1. Go To Step 4

No

1. Repair the PCM Fused B+ circuit for an open or high resistance.
2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

4. **CHECK THE FUSED IGNITION SWITCH CIRCUITS**

1. Turn the ignition on.
2. Using a 12-volt test light connected to ground, probe the Fused Ignition Switch circuit.
3. Check the circuit with the ignition off, ignition on/engine not running position and during cranking.
4. Wiggle test the wiring during the test to check for an intermittent open in the circuit.

> *NOTE:*
>
> *The test light should be illuminated and bright with the ignition on and during cranking. The test light should not be illuminated with the ignition off. Compare the brightness to that of a direct connection to the battery.*

Is the test light illuminated as described above?

Yes

1. Test complete.

No

1. Repair the PCM Fused Ignition Switch circuit for as necessary.
2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

DIAGNOSIS AND TESTING > ENGINE CRANKS BUT DOES NOT START

For a complete wiring diagram, **refer to SYSTEM WIRING DIAGRAMS article** .

DIAGNOSIS AND TESTING > ENGINE CRANKS BUT DOES NOT START > POSSIBLE CAUSES

Possible Causes
5-VOLT SUPPLY CIRCUIT OPEN OR SHORTED
UNDERCHARGED BATTERY
SYSTEM DTCS PRESENT
POWERTRAIN POWER AND GROUND CIRCUIT(S) OPEN OR HIGH RESISTANCE
POWERTRAIN FUSES OPEN
FUEL DELIVERY SYSTEM
FUEL CONTAMINATION
INADEQUATE SPARK
ENGINE MECHANICAL PROBLEM

Always perform the PRE-DIAGNOSTIC TROUBLESHOOTING PROCEDURE before proceeding. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

DIAGNOSIS AND TESTING > ENGINE CRANKS BUT DOES NOT START > DIAGNOSTIC TEST

1. **UNDERCHARGED BATTERY**

NOTE:

Diagnose any 5-Volt Supply DTCs before continuing

NOTE:

The Battery must be fully charged and in good condition. An undercharged Battery may produce invalid test results.

1. Test the battery in accordance with the Service Information.

   Were any problems found?

   Yes

   1. Charge or replace the Battery as necessary and retest.
   2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

   No

   1. Go To Step 2

2. **OPEN FUSE(S)**

   1. Inspect all of the fuses in the Fuse Panel. If any open fuses are found, check the related circuit(s) for a short to ground or high resistance.

      Were any problems found?

      Yes

      1. Repair as necessary.
      2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

      No

      1. Go To Step 3

3. **SYSTEM DTCS PRESENT**

   1. With the scan tool, select System DTCs to read DTCs in all modules. If any DTCs are present, perform the appropriate diagnostic procedure before continuing with this test. If a no response condition is detected in any module, and perform the appropriate NO RESPONSE diagnostic procedure.

      Were any problems found?

      Yes

1. Perform the appropriate diagnostic procedure and repair as necessary. If any pending DTCs are detected, perform the diagnostic procedure as if the DTC is active.
2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

No

1. Go To Step

4. **PCM POWER OR GROUND CIRCUIT OPEN OR HIGH RESISTANCE**

1. Perform the CHECKING THE PCM POWER AND GROUND CIRCUIT test procedure. Refer to CHECKING THE PCM POWER AND GROUND CIRCUITS .

Were any problems found?

Yes

1. Repair as necessary in accordance with the Service Information.
2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

No

1. Go To Step

5. **CHECKING THE FUEL DELIVERY SYSTEM**

> *NOTE:*
>
> *Verify that the fuel tank is not empty before continuing.*

1. Perform the CHECKING THE FUEL DELIVERY SYSTEM test procedure. Refer to CHECKING THE FUEL DELIVERY SYSTEM (HARD START) .

Were any problems found?

Yes

1. Repair as necessary in accordance with the Service Information.
2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

No

1. Go To Step 6

6. **FUEL CONTAMINATION**

1. Check the fuel system for contamination in accordance with the Service Information.

Was any evidence of fuel contamination found?

Yes

1. Clean and repair the fuel system as necessary in accordance with the Service Information.
2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

No

1. Go To Step 7

7. **CHECKING THE IGNITION COIL OPERATION**

1. Perform the diagnostic procedure for CHECKING THE IGNITION COIL OPERATION. Refer to CHECKING THE IGNITION COIL OPERATION .

Were any problems found?

Yes

1. Repair as necessary in accordance with the Service Information.
2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

No

1. Go To Step 8

8. **CHECKING THE ENGINE MECHANICAL SYSTEM**

1. Perform the diagnostic procedure for CHECKING THE ENGINE MECHANICAL SYSTEM. Refer to CHECKING THE ENGINE MECHANICAL SYSTEM .

Were any problems found?

Yes

1. Repair as necessary in accordance with the Service Information.
2. Perform the POWERTRAIN VERIFICATION TEST. Refer to the appropriate TESTING & DIAGNOSTICS article in ENGINE PERFORMANCE .

No

1. Test complete. Perform any Service Bulletins that may apply.