FUEL SYSTEM

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GENERAL INFORMATION

INTRODUCTION

Throughout this group, references may be made to a particular vehicle by letter or number designation. A chart showing the breakdown of these designations is included in the Introduction Section at the front of this service manual.

The Evaporation Control System, is also considered part of the fuel system. The system reduces the emission of fuel vapor into the atmosphere.

The description and function of the Evaporation Control System is found in Group 25 of this manual.

FUEL REQUIREMENTS

Light spark knock at low engine speeds is not harmful to your engine. However, continued heavy spark knock at high speeds can cause damage and should be reported to your dealer immediately. Engine damage resulting from operating with a heavy spark knock may not be covered by the new vehicle warranty.

In addition to using unleaded gasoline with the proper octane rating, gasolines that contain detergents, corrosion and stability additives are recommended. Using gasolines that have these additives will help improve fuel economy, reduce emissions, and maintain vehicle performance. Generally, premium unleaded gasolines contain more additive than regular unleaded.

Poor quality gasoline can cause problems such as hard starting, stalling, and stumble. If you experience these problems, try another brand of gasoline before considering service for the vehicle.

GASOLINE/OXYGENATE BLENDS

Some fuel suppliers blend gasoline with materials that contain oxygen such as alcohol, MTBE (Methyl Tertiary Butyl Ether) and ETBE (Ethyl Tertiary Butyl Ether). Oxygenates are required in some areas of the country during winter months to reduce carbon monoxide emissions. The type and amount of oxygenate used in the blend is important.

The following are generally used in gasoline blends:

Ethanol - (Ethyl or Grain Alcohol) properly blended, is used as a mixture of 10 percent ethanol and 90 percent gasoline. Gasoline blended with ethanol may be used in your vehicle.

Methanol - (Methyl or Wood Alcohol) is used in a variety of concentrations when blended with unleaded gasoline. You may find fuels containing 3 percent or more methanol along with other alcohols called cosolvents.

Do not use gasolines containing Methanol.

Use of methanol/gasoline blends may result in starting and driveability problems and damage critical fuel system components.

Problems that are the result of using methanol/gasoline blends are not the responsibility of Chrysler Motors and may not be covered by the new vehicle warranty.

MTBE/ETBE - Gasoline and MTBE (Methyl Tertiary Butyl Ether) blends are a mixture of unleaded gasoline blended and up to 15 percent MTBE. Gaso-

GENERAL INFORMATION (Continued)

line and ETBE (Ethyl Tertiary Butly Ether) are blends of gasoline and up to 17 percent ETBE. Gasoline blended with MTBE or ETBE may be used in your vehicle.

Many gasolines are now being blended that contribute to cleaner air, especially in those areas of the country where pollution levels are high. These new blends provide a cleaner burning fuel and some are referred to as reformulated gasoline.

Reformulated Gasoline

Many areas of the country are requiring the use of cleaner-burning fuel referred to as **Reformulated Gasoline**. Reformulated gasolines are specially blended to reduce vehicle emissions and improve air quality.

Chrysler Corporation strongly supports the use of reformulated gasolines whenever available. Although your vehicle was designed to provide optimum performance and lowest emissions operating on high quality unleaded gasoline, it will perform equally well and produce even lower emissions when operating on reformulated gasoline.

Materials Added to Fuel

Indiscriminate use of fuel system cleaning agents should be avoided. Many of these materials intended for gum and varnish removal may contain active solvents of similar ingredients that can be harmful to fuel system gasket and diaphragm materials.

FUEL DELIVERY SYSTEM

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DESCRIPTION AND OPERATION

FUEL DELIVERY SYSTEM

The fuel delivery system consists of: the electric fuel pump, a separate fuel filter, fuel pressure regulator, fuel tubes/lines/hoses, fuel rail, fuel injectors, fuel tank, accelerator pedal and throttle cable.

A fuel return system is used on all models (all engines). Fuel is returned through the fuel pump module and back into the fuel tank through the fuel pressure regulator. A separate fuel return line from the engine to the tank is no longer used with any engine.

The fuel tank assembly consists of: the fuel tank, filler tube, fuel gauge sending unit/electric fuel pump module, a pressure relief/rollover valve and a pressure-vacuum filler cap.

Also to be considered part of the fuel system is the evaporation control system. This is designed to reduce the emission of fuel vapors into the atmosphere. The description and function of the Evaporative Control System is found in Group 25, Emission Control Systems.

FUEL PUMP MODULE

The fuel pump module is installed in the top of the fuel tank (Fig. 1) or (Fig. 2). The fuel pressure regulator is a part of the fuel pump module assembly and is no longer mounted to the fuel rail on either engine. The fuel pump module contains the following components:

- Electric fuel pump
- Fuel pressure regulator
- Fuel pump reservoir
- In-tank fuel filter
- Fuel gauge sending unit
- Fuel supply line (tube) connection

FUEL PUMP

The fuel pump used in this system has a permanent magnet electric motor. The pump is part of the fuel pump module. The fuel pump module is suspended in fuel in the fuel tank. Fuel is drawn in through a filter and pushed through the electric motor to the outlet. The pump contains a check valve. This valve is located near the pump outlet. It restricts fuel movement in either direction to maintain fuel supply line pressure when the

DESCRIPTION AND OPERATION (Continued)

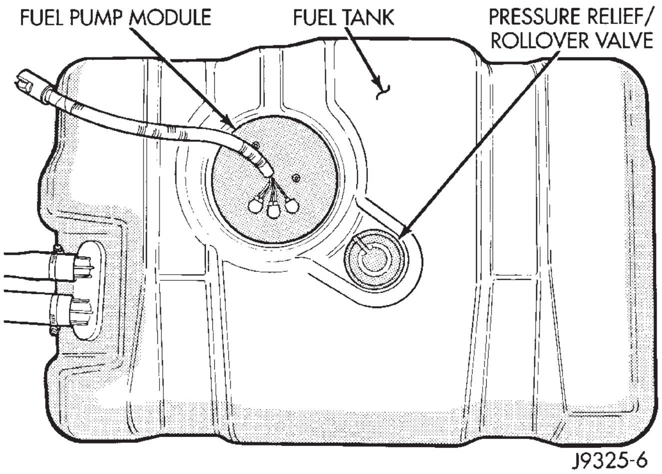


Fig. 1 Fuel Pump Module Location

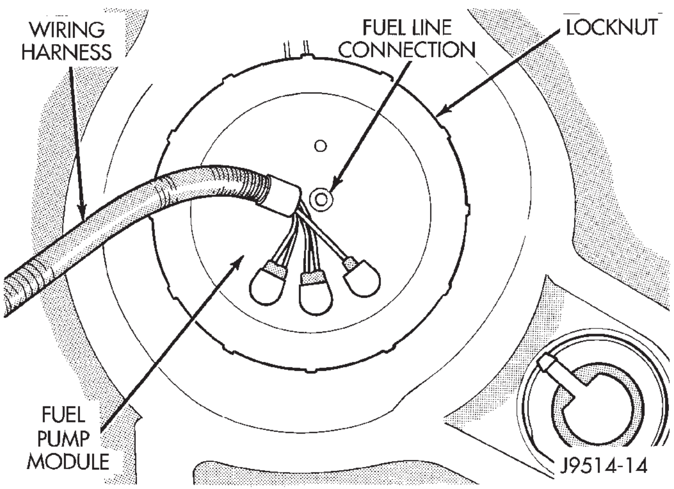


Fig. 2 Top View of Fuel Pump Module—Typical

pump is not operational. Voltage to operate the pump is supplied through the fuel pump relay.

FUEL GAUGE SENDING UNIT

The fuel gauge sending unit is attached to the side of the fuel pump module. The sending unit consists of a float, an arm, and two variable resistors (tracks). These two tracks are used to send two different electrical signals. One is used for fuel gauge operation and the other is for OBD II emission requirements.

Track 1— fuel gauge operation: As the fuel level increases, the float and arm move up. This decreases the sending unit resistance, causing the fuel gauge on the instrument panel to read full. As the fuel level decreases, the float and arm move down. This increases the sending unit resistance, causing the fuel gauge on the instrument panel to read empty.

Track 2—OBD II emission requirements: A variable voltage signal is sent to the PCM to indicate fuel level. The purpose of this feature is to prevent a false setting of misfire and fuel system monitor trouble codes. This is if the fuel level in the tank is either less than 15 percent, or more than 85 percent of its rated capacity.

FUEL FILTER

The fuel filter protects the fuel injectors from dirt, water and other foreign matter. The filter is located under the vehicle near the fuel tank (Fig. 3). Replace fuel filter at intervals specified in the Lubrication and Maintenance Schedule chart found in Group 0, Lubrication and Maintenance.

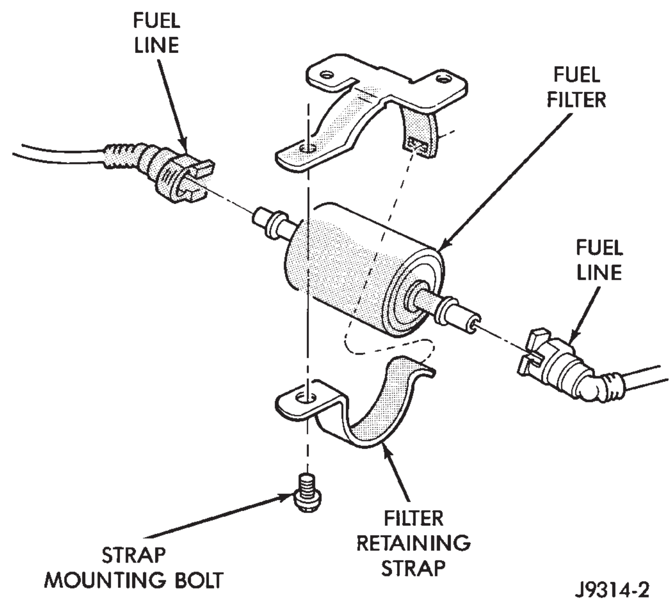


Fig. 3 Fuel Filter Location

FUEL PRESSURE REGULATOR

A fuel pressure regulator is used with all engines. It is mounted inside of the fuel pump module (Fig. 4) and is suspended in fuel.

NOTE: The vacuum assisted fuel pressure regulator located on the fuel rail is no longer used on the 4.0L or 5.2L engine.

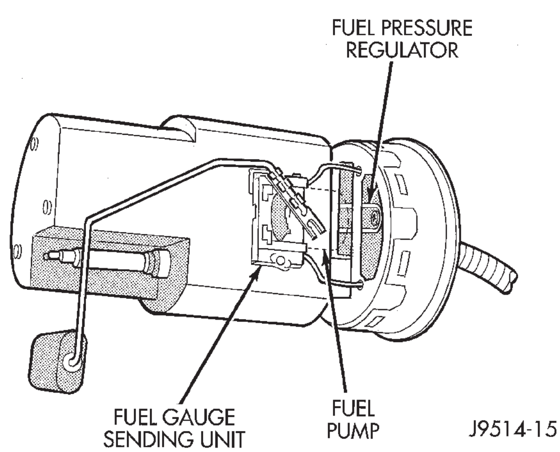


Fig. 4 Fuel Pressure Regulator Location

Fuel Pressure Regulator Operation: The pressure regulator is a mechanical device that is not con-

DESCRIPTION AND OPERATION (Continued)

trolled by engine vacuum or by the powertrain control module (PCM).

The regulator is calibrated to maintain a constant pressure at the fuel pump module outlet fitting of 338 kPa ± 14 kPa (49 psi ± 2 psi). The regulator contains a diaphragm, calibrated springs and a fuel return valve.

Fuel is supplied to the regulator by the electric fuel pump. The fuel pump also contains a check valve to maintain some fuel pressure at the fuel injectors when the engine is not operating. This will help to start the engine.

If fuel pressure at the pressure regulator exceeds 338 kPa ± 14 kPa (49 psi ± 2 psi), an internal diaphragm closes and excess fuel pressure is routed back into the fuel tank through the pressure regulator. A separate fuel return line to the engine is no longer used with any 4.0L or 5.2L engine.

FUEL TANK

All models pass a full 360 degree rollover test without fuel leakage. To accomplish this, fuel and vapor flow controls are required for all fuel tank connections.

All models have a pressure relief/rollover valve mounted in the top of the fuel tank.

An evaporation control system is used to reduce emissions of fuel vapors into atmosphere by evaporation and to reduce unburned hydrocarbons emitted by vehicle engine. When fuel evaporates from fuel tank, vapors pass through vent hoses or tubes to a charcoal canister. The are temporarily held in the canister. When the engine is running, the vapors are drawn into intake manifold. Refer to Group 25, Emission Control System for additional information.

FUEL INJECTORS—5.2L ENGINES

The fuel injectors are attached to the fuel rail (Fig. 5). 5.2L V-8 engines use eight injectors.

The nozzle ends of the injectors are positioned into openings in the intake manifold just above the intake valve ports of the cylinder head. The engine wiring harness connector for each fuel injector is equipped with an attached numerical tag (INJ 1, INJ 2 etc.). This is used to identify each fuel injector with its respective cylinder number.

The injectors are energized individually in a sequential order by the powertrain control module (PCM). The PCM will adjust injector pulse width by switching the ground path to each individual injector on and off. Injector pulse width is the period of time that the injector is energized. The PCM will adjust injector pulse width based on various inputs it receives.

FUEL INJECTORS—4.0L ENGINE

Six individual fuel injectors are used with the 4.0L 6-cylinder engine. The injectors are attached to the fuel rail (Fig. 6).

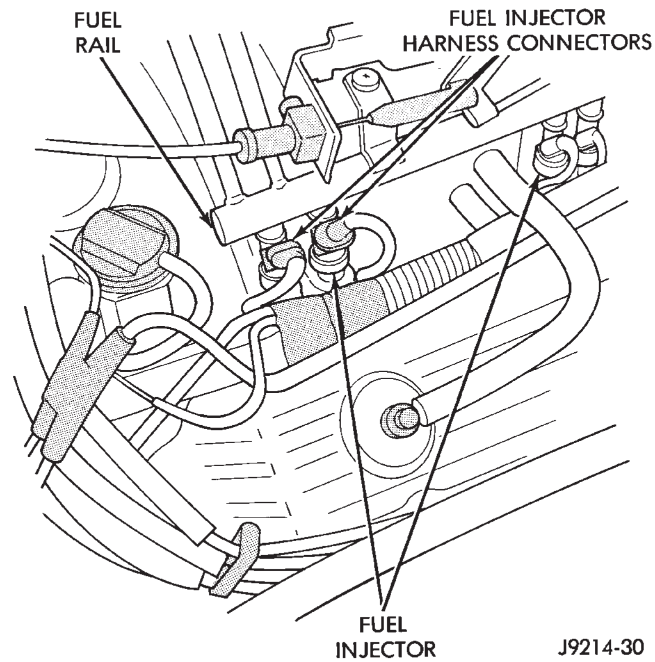


Fig. 5 Fuel Injectors—5.2L Engines—Typical

The nozzle ends of the injectors are positioned into openings in the intake manifold just above the intake valve ports of the cylinder head. The engine wiring harness connector for each fuel injector is equipped with an attached numerical tag (INJ 1, INJ 2 etc.). This is used to identify each fuel injector.

The injectors are energized individually in a sequential order by the powertrain control module (PCM). The PCM will adjust injector pulse width by switching the ground path to each individual injector on and off. Injector pulse width is the period of time that the injector is energized. The PCM will adjust injector pulse width based on various inputs it receives.

During start up, battery voltage is supplied to the injectors through the ASD relay. When the engine is operating, voltage is supplied by the charging system. The PCM determines injector pulse width based on various inputs.

FUEL RAIL

The fuel rail supplies the necessary fuel to each individual fuel injector and is mounted to the intake manifold. The fuel pressure regulator is no longer mounted to the fuel rail on any engine. It is now located on the fuel tank mounted fuel pump module. Refer to Fuel Pressure Regulator in this group for information.

Certain engines are equipped with a fuel pressure test port. **Not all engines are equipped with this test port.**

The fuel rail is not repairable.

DESCRIPTION AND OPERATION (Continued)

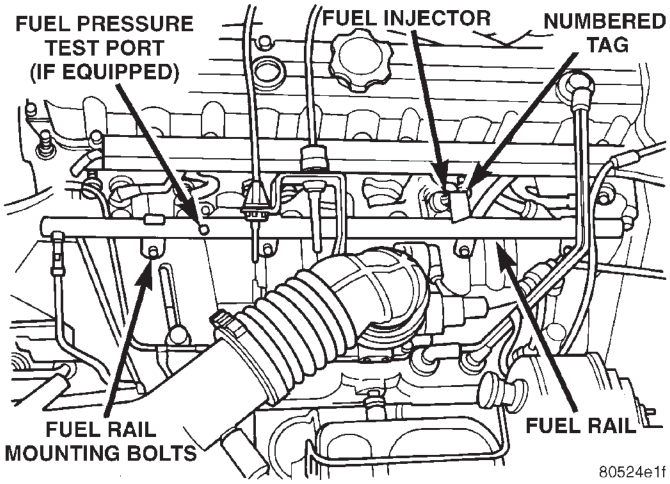


Fig. 6 Fuel Injectors—4.0L Engine

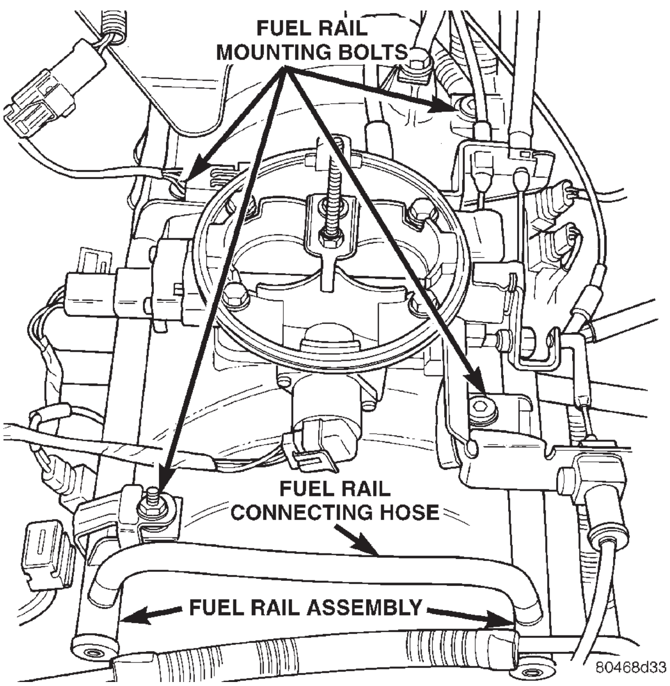


Fig. 7 Fuel Rail—Typical (5.2L Engine Shown)

CAUTION: 5.2L Engines Only: The left and right sections of the fuel rail are connected with a flexible connecting hose. Do not attempt to separate the rail halves at this connecting hose. Due to the design of this connecting hose, it does not use any clamps. Never attempt to install a clamping device of any kind to the hose. When removing the fuel rail assembly for any reason, be careful not to bend or kink the connecting hose.

FUEL TANK FILLER TUBE CAP

The loss of any fuel or vapor out of filler neck is prevented by the use of a pressure-vacuum fuel tank filler tube cap. Relief valves inside cap will release only under significant pressure of 6.58 to 8.44 kPa (1.95 to 2.5 psi). The vacuum release for all gas caps is between .97 and 2.0 kPa (.14 and .29 psi). This cap must be replaced by a similar unit if replacement is necessary. This is in order for the system to remain effective.

CAUTION: Remove fuel tank filler tube cap before servicing any fuel system component. This is done to help relieve tank pressure.

QUICK-CONNECT FITTINGS

Different types of quick-connect fittings are used to attach various fuel system components. These are: a single-tab type, a two-tab type or a plastic retainer ring type. Some are equipped with safety latch clips. Refer to the Removal/Installation section for more information.

CAUTION: The interior components (o-rings, spacers) of quick-connect fitting are not serviced separately, but new pull tabs are available for some types. Do not attempt to repair damaged fittings or fuel lines/tubes. If repair is necessary, replace the complete fuel tube assembly.

DIAGNOSIS AND TESTING

FUEL PUMP PRESSURE TEST–4.0L ENGINE

NOTE: The fuel pressure test port is used on certain engines only. If equipped, the test port will be located on the fuel rail (Fig. 8). A sealing cap is screwed onto the test port.

All fuel systems are equipped with a fuel tank module mounted, fuel pressure regulator. The fuel pressure regulator is not controlled by engine vacuum.

With engine at idle speed, system fuel pressure should be 338 kPa ± 14 kPa (49.0 psi ± 2 psi).

WARNING: DO NOT ALLOW FUEL TO SPILL ONTO THE ENGINE INTAKE OR EXHAUST MANIFOLDS. PLACE SHOP TOWELS UNDER AND AROUND THE PRESSURE PORT TO ABSORB FUEL.

WARNING: WEAR PROPER EYE PROTECTION WHEN TESTING FUEL SYSTEM PRESSURE.

(1) Remove the protective cap at the fuel rail test port. Connect the 0–414 kPa (0-60 psi) fuel pressure gauge (from gauge set 5069) to the test port pressure fitting on the fuel rail.

(2) Start the engine and note pressure gauge reading. Fuel pressure should be 338 kPa ± 14 kPa (49.0 psi ± 2 psi) at idle.

DIAGNOSIS AND TESTING (Continued)

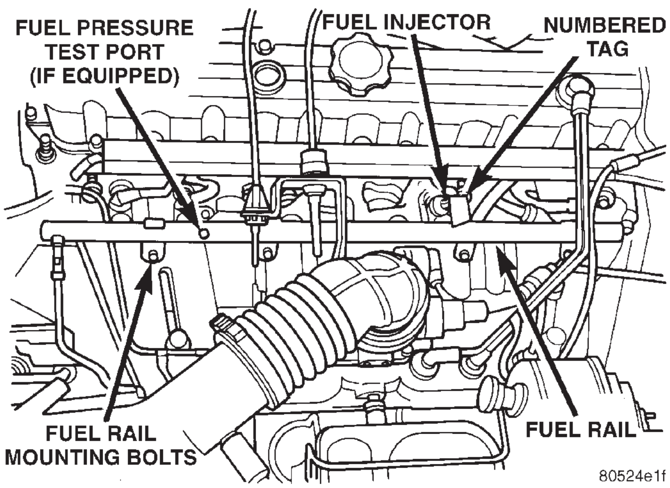


Fig. 8 Fuel Pressure Test Port—4.0L Engine

(3) If pressure is at O psi, connect DRB scan tool and refer to operating instructions in the appropriate Powertrain Diagnostics Procedures service manual.

(4) If operating pressure is above 51.0 psi, fuel pump is OK but pressure regulator is defective. Regulator is not serviced separately. Replace fuel pump module assembly.

FUEL PUMP PRESSURE TEST—5.2L ENGINES WITH PRESSURE TEST PORT

NOTE: The fuel pressure test port is used on certain engines only. On 5.2L engines, and when equipped, the test port will be located on the fuel rail near the throttle position sensor (Fig. 9). A sealing cap is screwed onto the test port.

All fuel systems are equipped with a fuel tank module mounted, fuel pressure regulator. The fuel pressure regulator is not controlled by engine vacuum.

With engine at idle speed, system fuel pressure should be 338 kPa ± 14 kPa (49 psi ± 2 psi).

WARNING: DO NOT ALLOW FUEL TO SPILL ONTO THE ENGINE INTAKE OR EXHAUST MANIFOLDS. PLACE SHOP TOWELS UNDER AND AROUND THE PRESSURE PORT TO ABSORB FUEL.

WARNING: WEAR PROPER EYE PROTECTION WHEN TESTING FUEL SYSTEM PRESSURE.

(1) Remove the protective cap at the fuel rail test port. Connect the 0–414 kPa (0-60 psi) fuel pressure gauge (from gauge set 5069) to the test port pressure fitting on the fuel rail (Fig. 9).

(2) Start the engine and note pressure gauge reading. Fuel pressure should be 338 kPa ± 14 kPa (49 psi ± 2 psi) at idle.

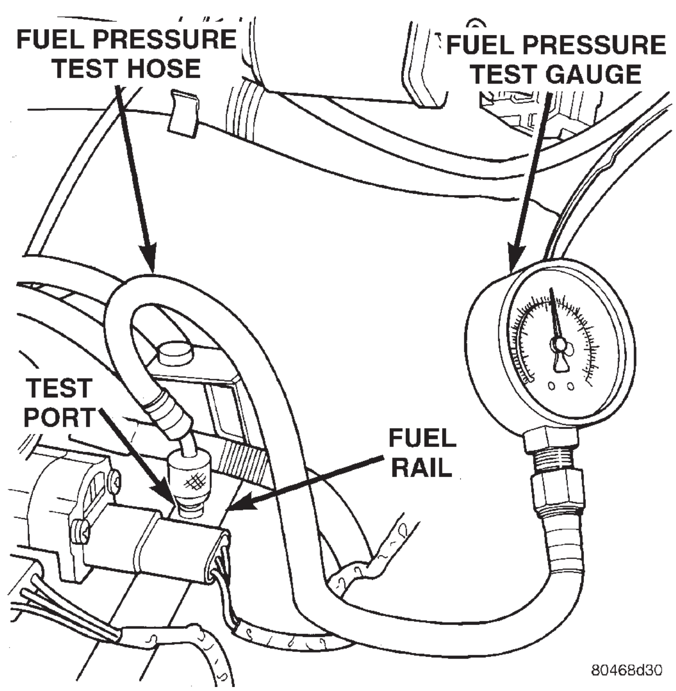


Fig. 9 Fuel Pressure Test Port—5.2L Engine—Typical

(3) If pressure is at O psi, connect DRB scan tool and refer to operating instructions in the appropriate Powertrain Diagnostics Procedures service manual.

(4) If operating pressure is above 51 psi, fuel pump is OK but fuel pressure regulator is defective. Refer to Fuel Pressure Regulator removal/installation.

FUEL PUMP PRESSURE TEST-5.2L ENGINES WITHOUT PRESSURE TEST PORT

NOTE: The fuel pressure test port is used on certain 5.2L engines only. If equipped, the test port will be located on the fuel rail near the throttle position sensor. If not equipped, refer to the following procedure:

All fuel systems are equipped with a fuel tank module mounted, fuel pressure regulator. The fuel pressure regulator is not controlled by engine vacuum.

With engine at idle speed, system fuel pressure should be 338 kPa ± 14 kPa (49 psi ± 2 psi).

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE EVEN WITH THE ENGINE OFF. BEFORE DISCONNECTING FUEL LINE AT FUEL RAIL, THIS PRESSURE MUST BE RELEASED. REFER TO THE FUEL SYSTEM PRESSURE RELEASE PROCEDURE.

(1) Release fuel pressure. Refer to the Fuel System Pressure Release Procedure—Without Pressure Test Port.

(2) Disconnect latch clip and fuel line at fuel rail. Refer to Quick-Connect Fittings for procedures. This can be found in this section of the group.

DIAGNOSIS AND TESTING (Continued)

(3) Connect adapter tool number 6923 into the fuel rail (Fig. 10). **Be sure adapter tool is fully seated into fuel rail.**

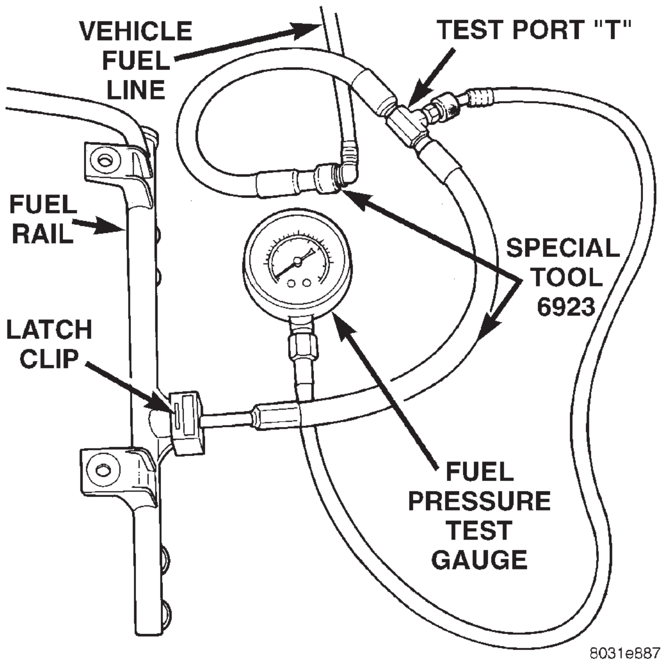


Fig. 10 Installing Adapter Tool and Pressure Gauge

(4) Install latch clip to fuel rail. If latch clip can not be fully seated into fuel rail, check for adapter tool not fully seated to fuel rail.

(5) Connect vehicle fuel line into adapter tool 6923 (Fig. 10). Be sure fuel line is fully seated into adapter tool 6923.

(6) Remove protective cap at test port “T” on adapter tool number 6923.

(7) Connect the 0–414 kPa (0-60 psi) fuel pressure gauge (from gauge set 5069) to the test port “T” (Fig. 10).

(8) Start engine and note pressure gauge reading. Fuel pressure should be 338 kPa ± 14 kPa (49 psi ± 2 psi) at idle.

(9) If pressure is at 0 psi, connect DRB scan tool and refer to operating instructions in the appropriate Powertrain Diagnostics Procedures service manual.

(10) If operating pressure is above 51 psi, fuel pump is OK but fuel pressure regulator is defective. Refer to Fuel Pressure Regulator removal/installation.

(11) After performing pressure test, install fuel line into fuel rail. Install latch clip into fuel rail. Refer to Quick-Connect Fittings for procedures. This can be found in this section of the group.

FUEL PUMP CAPACITY TEST

Before performing this test, verify fuel pump pressure by performing the previous tests.

(1) Release the fuel system pressure from fuel system. Refer to the previous Fuel Pressure Release Procedure in this group.

(2) Disconnect the fuel supply line at the fuel rail. Refer to Fuel Tubes/Lines/Hoses and Clamps in this section of the group for procedures. Some engines may require air cleaner housing removal before line disconnection.

(3) Connect the appropriate Fuel Line Pressure Test Adapter Tool (number 6631, 6923, 6541 or 6539) into the disconnected fuel supply line. Insert the other end of Adaptor Tool into an approved gasoline container.

(4) To activate the fuel pump and pressurize the system, obtain the DRB scan tool. Refer to the appropriate Powertrain Diagnostic Procedures service manual for DRB operation.

(5) A good fuel pump will deliver at least 1 liter of fuel per minute.

FUEL PRESSURE LEAK DOWN TEST

Abnormally long periods of cranking to restart a hot engine that has been shut down for a short period of time may be caused by:

- Fuel pressure bleeding past a fuel injector(s).
- Fuel pressure bleeding past the check valve in the fuel pump module.

(1) Disconnect the fuel inlet line at fuel rail. Refer to Fuel Tubes/Lines/Hoses and Clamps in this section of the group for procedures. On some engines, air cleaner housing removal may be necessary before fuel line disconnection.

(2) Connect the appropriate Fuel Line Pressure Test Adapter Tool (number 6539, 6631, 6541 or 6923) between the disconnected fuel line and fuel rail (Fig. 11) or (Fig. 12).

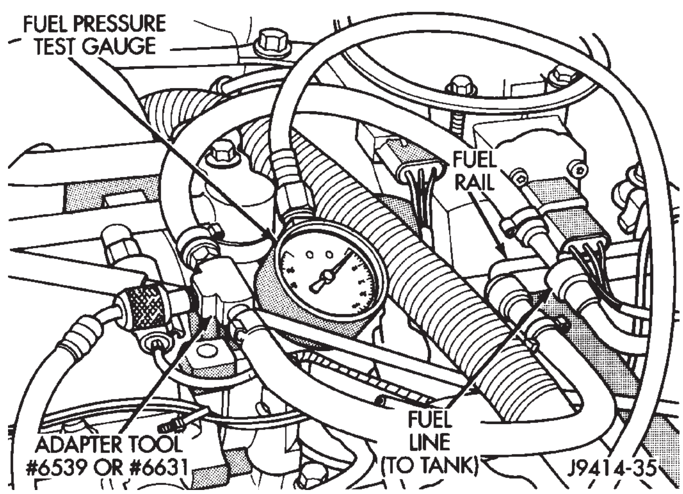


Fig. 11 Connecting Adapter Tool—Typical

(3) Connect the 0-414 kPa (0-60 psi) fuel pressure test gauge (from Gauge Set 5069) to the test port on the appropriate Adaptor Tool. **The fittings on both tools must be in good condition and free from any small leaks before performing the proceeding test.**

DIAGNOSIS AND TESTING (Continued)

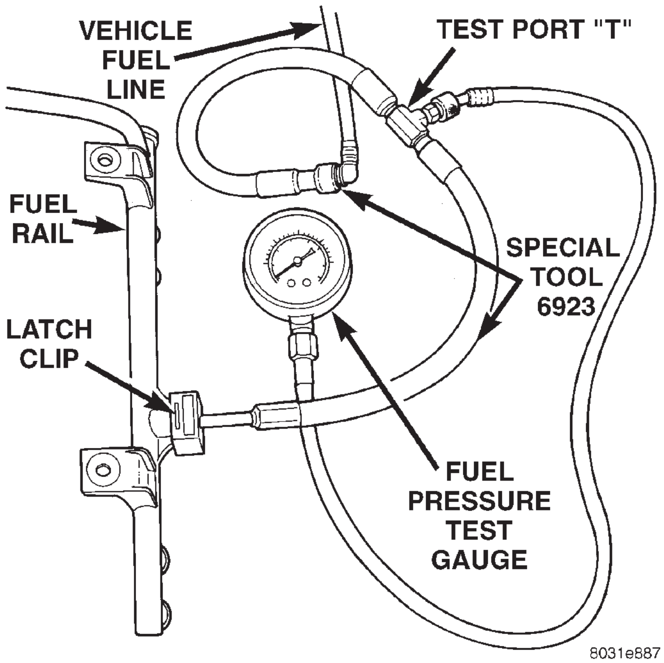


Fig. 12 Connecting Adapter Tool—Typical

(4) Start engine and bring to normal operating temperature.

(5) Observe test gauge. Normal operating pressure should be 338 kPa ± 14 kPa (49 psi ± 2 psi).

(6) Shut engine off.

(7) Pressure should not fall below 24 psi for five minutes.

(8) If pressure falls below 24 psi, it must determined if a fuel injector, the fuel pressure regulator or a fuel tube/line is leaking.

(9) Again, start engine and bring to normal operating temperature.

(10) Shut engine off.

(11) **Checking for fuel injector leakage:** Clamp off the rubber hose portion of Adaptor Tool between the fuel rail and the test port "T" on Adapter Tool. If pressure now holds at or above 24 psi, a fuel injector or the fuel rail is leaking.

(12) **Checking for fuel pump module or fuel tube/line leakage:** Clamp off the rubber hose portion of Adaptor Tool between the vehicle fuel line and test port "T" on Adapter Tool. If pressure now holds at or above 24 psi, a leak can be found at a fuel tube/ line. If no leaks are found at fuel tubes or lines, replace the fuel pump module.

FUEL GAUGE SENDING UNIT

For fuel gauge diagnosis, refer to Group 8E, Instrument Panel and Gauges.

FUEL INJECTORS

To perform a complete test of the fuel injectors and their circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the injector only, refer to the following:

Disconnect the fuel injector wire harness connector from the injector (Fig. 13). Place an ohmmeter across the injector terminals. Resistance reading should be approximately 14.5 ohms ±1.2 ohms at 20°C (68°F). Proceed to following Injector Diagnosis chart. **When performing the following tests from the chart, do not leave electrical current applied to the injector for longer than five seconds. Damage to injector coil or internal injector seals (Fig. 14) could result.**

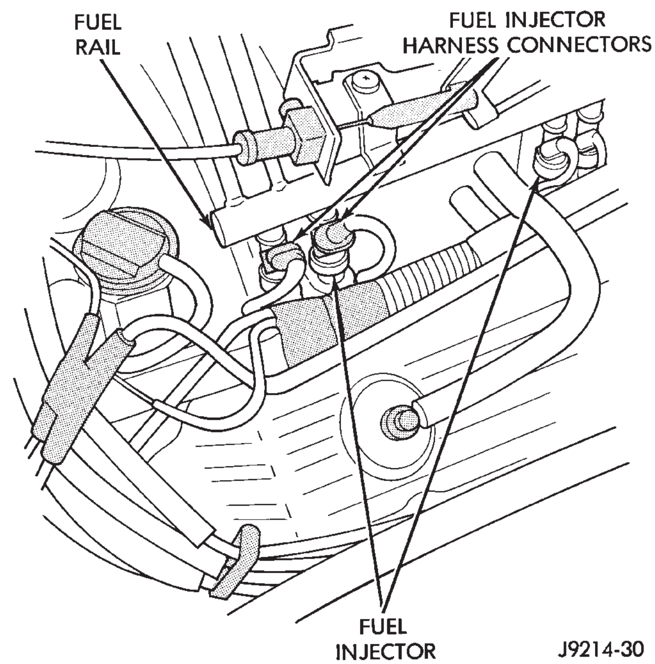


Fig. 13 Fuel Injector Wiring Connector—Typical (5.2L Shown)

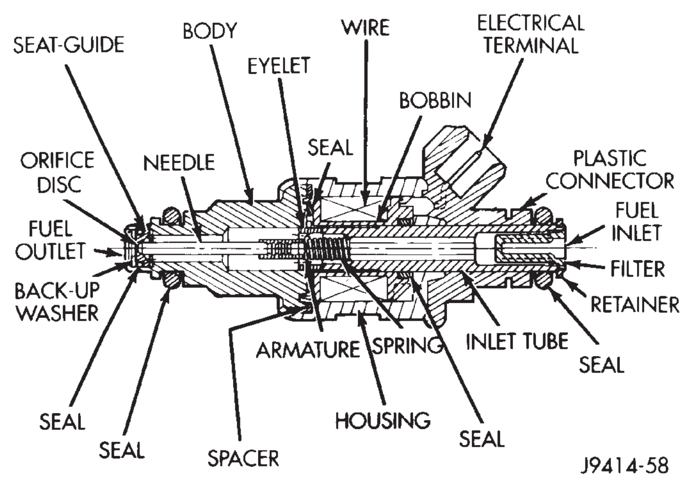
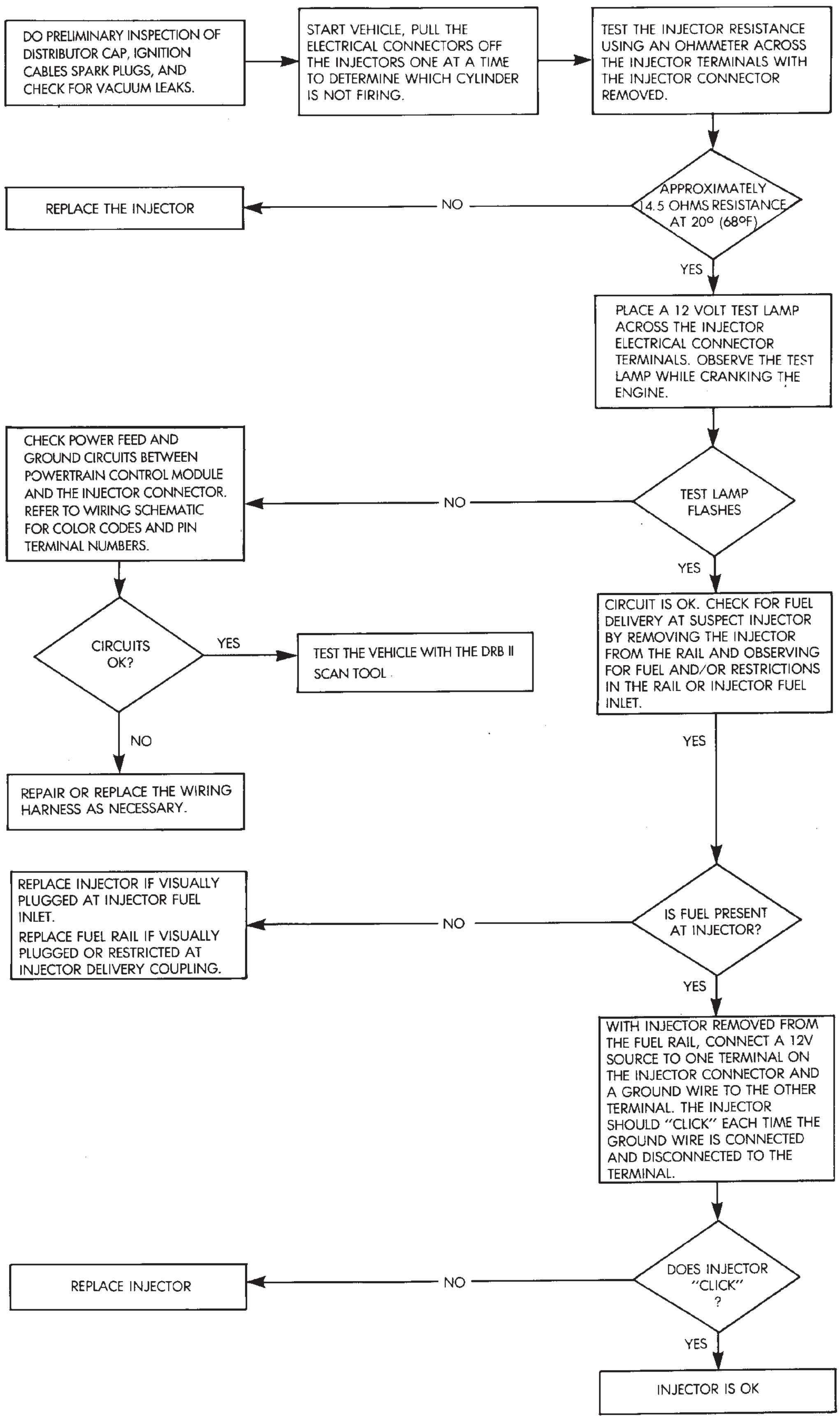


Fig. 14 Fuel Injector Internal Components—Typical



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INJECTOR DIAGNOSIS—VEHICLE RUNS ROUGH AND/OR HAS A MISS

SERVICE PROCEDURES

FUEL SYSTEM PRESSURE RELEASE PROCEDURE–WITH PRESSURE TEST PORT

NOTE: The fuel pressure test port is used on certain engines only. If equipped, the test port will be located on the fuel rail near the throttle position sensor. A sealing cap is screwed onto the test port.

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

WARNING: BECAUSE THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE, THE PRESSURE MUST BE RELEASED BEFORE SERVICING ANY FUEL SYSTEM COMPONENT. THIS DOES NOT APPLY TO THROTTLE BODY REMOVAL.

(1) Disconnect negative battery cable.
(2) Remove the fuel tank filler tube cap to release fuel tank pressure.
(3) Remove protective cap from pressure test port on the fuel rail. This is located on top of fuel rail near the throttle position sensor.

WARNING: DO NOT ALLOW FUEL TO SPILL ONTO THE ENGINE INTAKE OR EXHAUST MANIFOLDS. PLACE SHOP TOWELS UNDER AND AROUND THE PRESSURE PORT TO ABSORB FUEL WHEN THE PRESSURE IS RELEASED FROM THE FUEL RAIL.

WARNING: WEAR PROPER EYE PROTECTION WHEN RELEASING FUEL SYSTEM PRESSURE.

(4) Obtain the fuel pressure gauge/hose assembly from fuel pressure gauge tool set 5069. Remove the gauge from the hose.
(5) Place one end of hose (gauge end) into an approved gasoline container.
(6) Place a shop towel under the test port.
(7) To release fuel pressure, screw the other end of hose onto the fuel pressure test port.
(8) After fuel pressure has been released, remove the hose from the test port.
(9) Install protective cap to fuel test port.

FUEL SYSTEM PRESSURE RELEASE PROCEDURE—WITHOUT PRESSURE TEST PORT

Use the following procedure if the fuel rail is not equipped with a fuel pressure test port.

(1) Remove the Fuel Pump relay from the Power Distribution Center (PDC). For location of the relay, refer to the label on the underside of the PDC cover.
(2) Start and run engine it stalls.
(3) Attempt restarting engine until it will no longer run.
(4) Turn ignition key to OFF position.

CAUTION: Steps 1, 2, 3 and 4 must be performed to relieve high pressure fuel from within the fuel rail. Do not attempt to use the following steps to relieve this pressure as excessive fuel will be forced into a cylinder chamber.

(5) Unplug connector from any injector.
(6) Attach one end of a jumper wire with alligator clips (18 gauge or smaller) to either injector terminal.
(7) Connect the other end of the jumper wire to the positive side of the battery.
(8) Connect one end of a second jumper wire to the remaining injector terminal.

CAUTION: Supplying power to an injector for more than 4 seconds will permanently damage the injector. Do not leave the injector connected to power for more than 4 seconds.

(9) Momentarily touch the other end of this jumper wire to the negative terminal of the battery for no more than 4 seconds.
(10) Place a rag or towel below the fuel line at the quick connect to the rail.
(11) Disconnect the quick connect fitting to the rail. Refer to Quick-Connect Fittings in this section.
(12) Return the fuel pump relay to the PDC.
(13) One or more Diagnostic Trouble Codes (DTC's) may have been stored in the PCM memory due to fuel pump relay removal. The DRB scan tool must be used to erase a DTC. Refer to Group 25, Emission Control System. See On-Board Diagnostics.

FUEL TUBES/LINES/HOSES AND CLAMPS

Also refer to the section on Quick-Connect Fittings.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSES, FITTINGS OR LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL SYSTEM PRESSURE RELEASE PROCEDURE IN THIS GROUP.

Inspect all hose connections such as clamps, couplings and fittings to make sure they are secure and leaks are not present. The component should be replaced immediately if there is any evidence of degradation that could result in failure.

Never attempt to repair a plastic fuel line/tube. Replace as necessary.

Avoid contact of any fuel tubes/hoses with other vehicle components that could cause abrasions or scuffing. Be sure that the plastic fuel lines/tubes are

SERVICE PROCEDURES (Continued)

properly routed to prevent pinching and to avoid heat sources.

The lines/tubes/hoses used on fuel injected vehicles are of a special construction. This is due to the higher fuel pressures and the possibility of contaminated fuel in this system. If it is necessary to replace these lines/tubes/hoses, only those marked EFM/EFI may be used.

The hose clamps used to secure rubber hoses on fuel injected vehicles are of a special rolled edge construction. This construction is used to prevent the edge of the clamp from cutting into the hose. Only these rolled edge type clamps may be used in this system. All other types of clamps may cut into the hoses and cause high-pressure fuel leaks.

Use new original equipment type hose clamps. Tighten hose clamps to 1 N·m (15 in. lbs.) torque.

QUICK-CONNECT FITTINGS

Also refer to the Fuel Tubes/Lines/Hoses and Clamps section.

Different types of quick-connect fittings are used to attach various fuel system components. These are: a single-tab type, a two-tab type, a plastic retainer ring type or a latch clip type. Certain fittings may require the use of a special tool for disconnection.

SINGLE-TAB TYPE

This type of fitting is equipped with a single pull tab (Fig. 15). The tab is removable. After the tab is removed, the quick-connect fitting can be separated from the fuel system component.

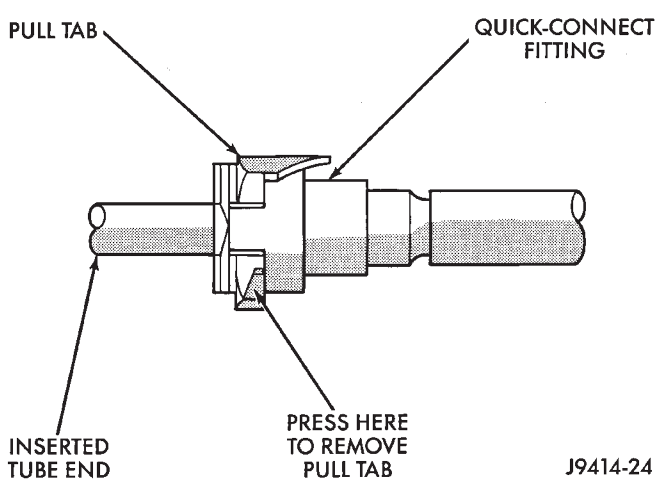


Fig. 15 Single-Tab Type Fitting

CAUTION: The interior components (o-rings, spacers) of this type of quick-connect fitting are not serviced separately, but new pull tabs are available. Do not attempt to repair damaged fittings or fuel lines/tubes. If repair is necessary, replace the complete fuel tube assembly.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSES, FITTINGS OR LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL SYSTEM PRESSURE RELEASE PROCEDURE IN THIS GROUP.

DISCONNECTION/CONNECTION

(1) Disconnect negative battery cable from battery.

(2) Perform the fuel pressure release procedure. Refer to the Fuel Pressure Release Procedure in this section.

(3) Clean the fitting of any foreign material before disassembly.

(4) Press the release tab on the side of fitting to release pull tab (Fig. 16).

CAUTION: If this release tab is not pressed prior to releasing the pull tab, the pull tab will be damaged.

(5) While pressing the release tab on the side of the fitting, use a screwdriver to pry up the pull tab (Fig. 16).

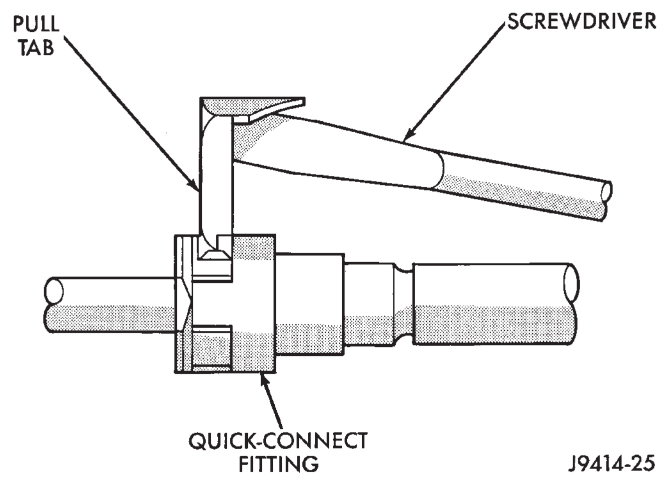


Fig. 16 Disconnecting Single-Tab Type Fitting

(6) Raise the pull tab until it separates from the quick-connect fitting (Fig. 17). Discard the old pull tab.

(7) Disconnect the quick-connect fitting from the fuel system component being serviced.

(8) Inspect the quick-connect fitting body and fuel system component for damage. Replace as necessary.

(9) Prior to connecting the quick-connect fitting to component being serviced, check condition of fitting and component. Clean the parts with a lint-free cloth. Lubricate them with clean engine oil.

(10) Insert the quick-connect fitting into the fuel tube or fuel system component until the built-on stop

SERVICE PROCEDURES (Continued)

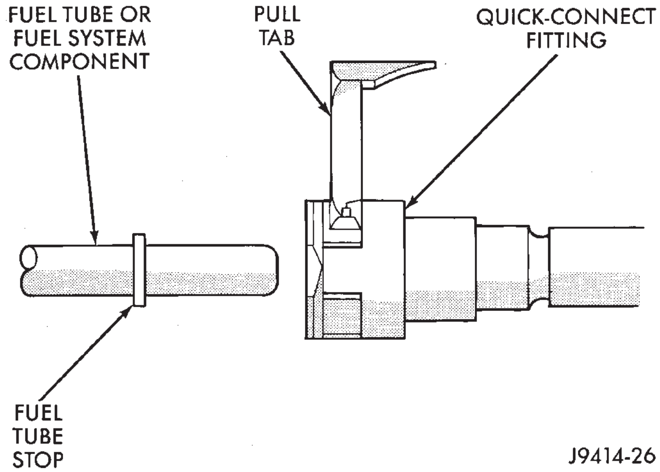


Fig. 17 Removing Pull Tab

on the fuel tube or component rests against back of fitting.

(11) Obtain a new pull tab. Push the new tab down until it locks into place in the quick-connect fitting.

(12) Verify a locked condition by firmly pulling on fuel tube and fitting (15-30 lbs.).

(13) Connect negative cable to battery.

(14) Start engine and check for leaks.

TWO-TAB TYPE FITTING

This type of fitting is equipped with tabs located on both sides of the fitting (Fig. 18). These tabs are supplied for disconnecting the quick-connect fitting from component being serviced.

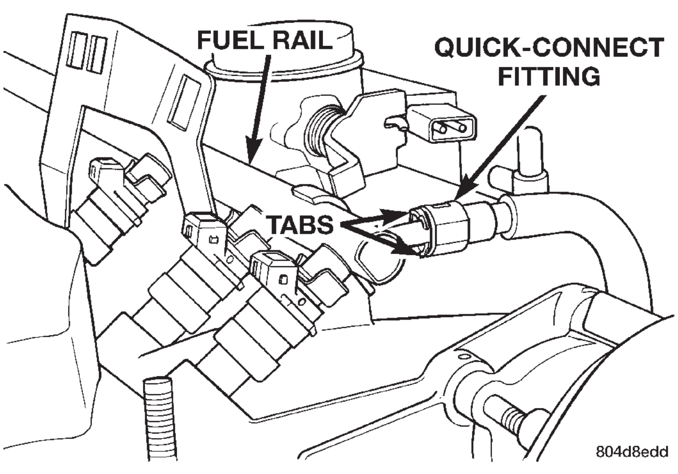


Fig. 18 Typical Two-Tab Type Quick-Connect Fitting

CAUTION: The interior components (o-rings, spacers) of this type of quick-connect fitting are not serviced separately, but new plastic retainers are available. Do not attempt to repair damaged fittings or fuel lines/tubes. If repair is necessary, replace the complete fuel tube assembly.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSES, FITTINGS OR LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL PRESSURE RELEASE PROCEDURE IN THIS GROUP.

DISCONNECTION/CONNECTION

(1) Disconnect negative battery cable from the battery.

(2) Perform the fuel pressure release procedure. Refer to the Fuel Pressure Release Procedure in this section.

(3) Clean the fitting of any foreign material before disassembly.

(4) To disconnect the quick-connect fitting, squeeze the plastic retainer tabs (Fig. 18) against the sides of the quick-connect fitting with your fingers. Tool use is not required for removal and may damage plastic retainer. Pull the fitting from the fuel system component being serviced. The plastic retainer will remain on the component being serviced after fitting is disconnected. The o-rings and spacer will remain in the quick- connect fitting connector body.

(5) Inspect the quick-connect fitting body and component for damage. Replace as necessary.

CAUTION: When the quick-connect fitting was disconnected, the plastic retainer will remain on the component being serviced. If this retainer must be removed, very carefully release the retainer from the component with two small screwdrivers. After removal, inspect the retainer for cracks or any damage.

(6) Prior to connecting the quick-connect fitting to component being serviced, check condition of fitting and component. Clean the parts with a lint-free cloth. Lubricate them with clean engine oil.

(7) Insert the quick-connect fitting to the component being serviced and into the plastic retainer. When a connection is made, a click will be heard.

(8) Verify a locked condition by firmly pulling on fuel tube and fitting (15-30 lbs.).

(9) Connect negative cable to battery.

(10) Start engine and check for leaks.

PLASTIC RETAINER RING TYPE FITTING

This type of fitting can be identified by the use of a full-round plastic retainer ring (Fig. 19) usually black in color.

SERVICE PROCEDURES (Continued)

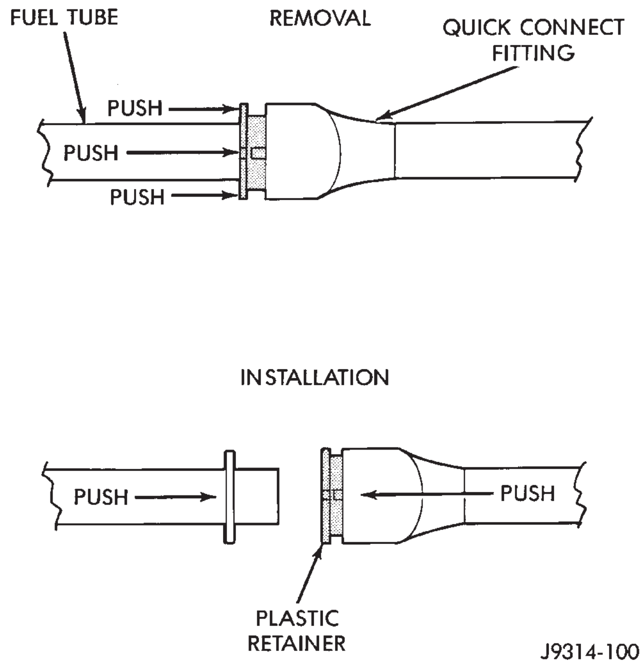


Fig. 19 Plastic Retainer Ring Type Fitting

CAUTION: The interior components (o-rings, spacers, retainers) of this type of quick-connect fitting are not serviced separately. Do not attempt to repair damaged fittings or fuel lines/tubes. If repair is necessary, replace the complete fuel tube assembly.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSES, FITTINGS OR LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL SYSTEM PRESSURE RELEASE PROCEDURE IN THIS GROUP.

DISCONNECTION/CONNECTION

(1) Disconnect negative battery cable from the battery.

(2) Perform the fuel pressure release procedure. Refer to the Fuel Pressure Release Procedure in this section.

(3) Clean the fitting of any foreign material before disassembly.

(4) To release the fuel system component from the quick-connect fitting, firmly push the fitting towards the component being serviced while firmly pushing the plastic retainer ring into the fitting (Fig. 19). With the plastic ring depressed, pull the fitting from the component. **The plastic retainer ring must be pressed squarely into the fitting body. If this retainer is cocked during removal, it may be difficult to disconnect fitting. Use an open-end wrench on the shoulder of the plastic retainer ring to aid in disconnection.**

(5) After disconnection, the plastic retainer ring will remain with the quick-connect fitting connector body.

(6) Inspect fitting connector body, plastic retainer ring and fuel system component for damage. Replace as necessary.

(7) Prior to connecting the quick-connect fitting to component being serviced, check condition of fitting and component. Clean the parts with a lint-free cloth. Lubricate them with clean engine oil.

(8) Insert the quick-connect fitting into the component being serviced until a click is felt.

(9) Verify a locked condition by firmly pulling on fuel tube and fitting (15-30 lbs.).

(10) Connect negative battery cable to battery.

(11) Start engine and check for leaks.

FUEL LINE AT FUEL RAIL

Use the following procedure if the fuel rail is equipped with a fuel pressure test port.

A latch clip is used to secure the fuel line to the fuel rail on certain engines (Fig. 20). A special tool will be necessary to separate the fuel line from the fuel rail after the latch clip is removed.

DISCONNECTION/CONNECTION AT FUEL RAIL

(1) Disconnect the negative battery cable from battery.

(2) Perform the fuel pressure release procedure. Refer to the Fuel Pressure Release Procedure in this section.

(3) Clean the fitting of any foreign material before disassembly.

(4) Pry up on the latch clip with a screwdriver (Fig. 21).

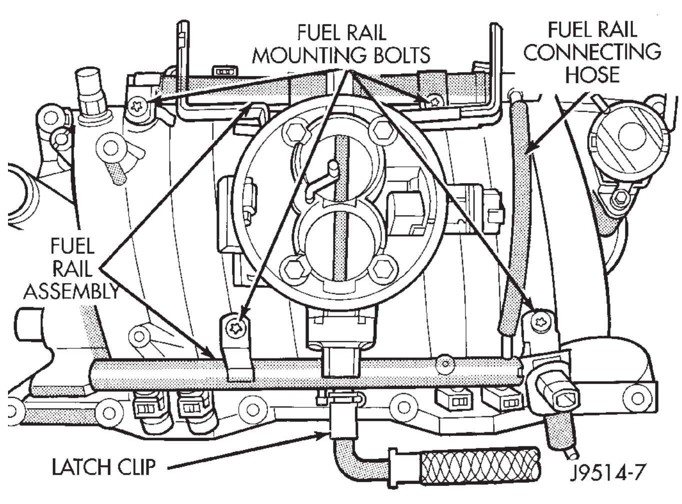


Fig. 20 Latch Clip Location—Typical

(5) Slide the latch clip toward the fuel rail while lifting with the screwdriver.

SERVICE PROCEDURES (Continued)

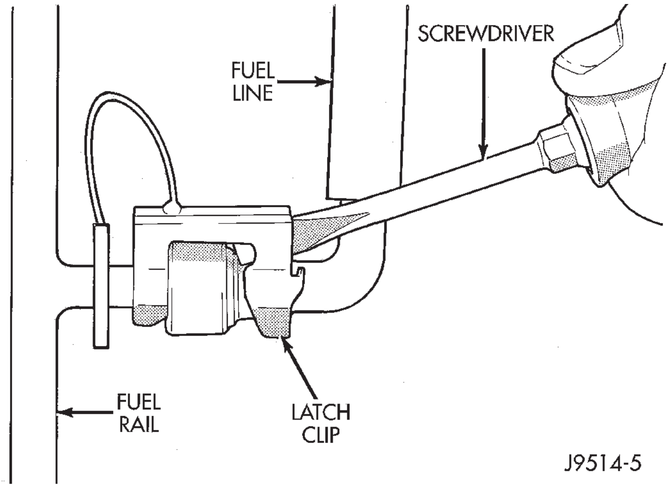


Fig. 21 Latch Clip Removal—Typical

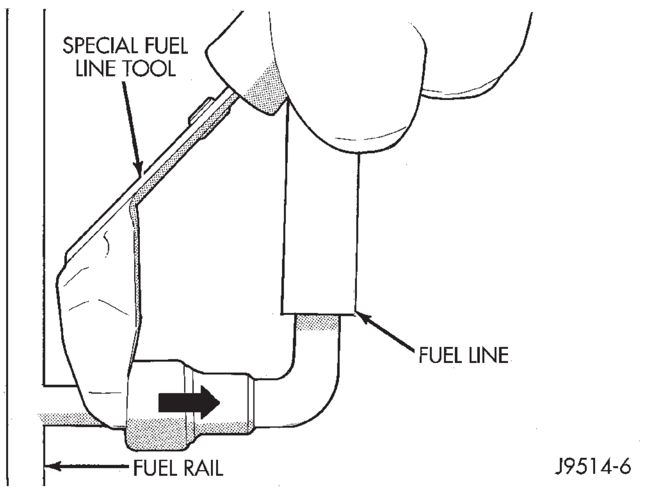


Fig. 22 Fuel Line Disconnection—Typical

(6) Insert special fuel line removal tool (Snap-On number FIH 9055- 1 or equivalent) into the fuel line (Fig. 22). Use this tool to release the locking fingers in the end of the line.

(7) With the special tool still inserted, pull the fuel line from the fuel rail.

(8) After disconnection, the locking fingers will remain within the quick-connect fitting at the end of the fuel line.

(9) Inspect fuel line fitting, locking fingers and fuel rail fitting for damage. Replace as necessary.

(10) Prior to connecting the fuel line to the fuel rail, check condition of both fittings. Clean the parts with a lint-free cloth. Lubricate them with clean engine oil.

(11) Insert the fuel line onto the fuel rail until a click is felt.

(12) Verify a locked condition by firmly pulling on fuel line and fitting (15-30 lbs.).

(13) Install latch clip (snaps into position). **If the latch clip will not fit, this indicates the fuel line is not properly installed to the fuel rail. Recheck the fuel line connection.**

(14) Connect negative battery cable to battery.

(15) Start engine and check for leaks.

FUEL LINE AT FUEL RAIL—5.2L ENGINES

Use the following procedure if the fuel rail is not equipped with a fuel pressure test port.

A special latch clip is used to secure the fuel line to the fuel rail on this particular engine (Fig. 23).

DISCONNECTION/CONNECTION AT FUEL RAIL

(1) Disconnect the negative battery cable from battery.

(2) Perform the fuel pressure release procedure. Refer to the Fuel Pressure Release Procedure in this section.

(3) Clean the fitting of any foreign material before disassembly.

(4) Pry up on the latch clip with two small screwdrivers (Fig. 23).

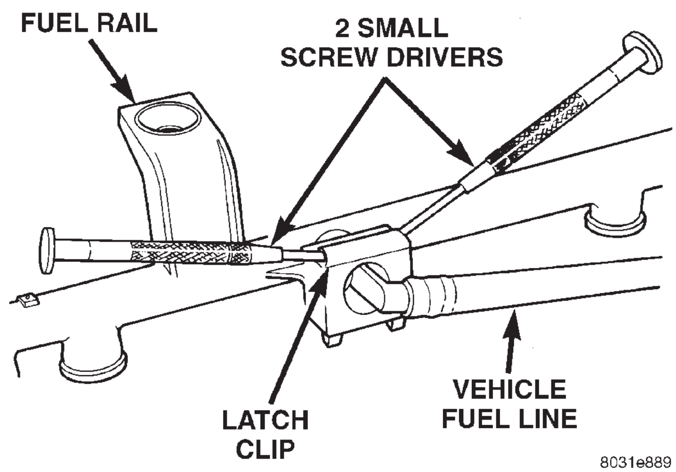


Fig. 23 Latch Clip Removal

(5) Pull the fuel line from the fuel rail.

(6) After disconnection, the locking fingers will remain within the quick-connect fitting in the fuel rail.

(7) Inspect fuel line fitting, locking fingers and fuel rail fitting for damage. Replace as necessary.

(8) Prior to connecting the fuel line to the fuel rail, check condition of both fittings. Clean the parts with a lint-free cloth. Lubricate them with clean engine oil.

(9) Insert the fuel line into the fuel rail.

(10) Install latch clip with fingers down (snaps into position). The fingers should protrude below the fuel rail if properly installed (Fig. 24). **If the latch clip will not fit, this indicates the fuel line is not properly installed to the fuel rail. Recheck the fuel line connection.**

SERVICE PROCEDURES (Continued)

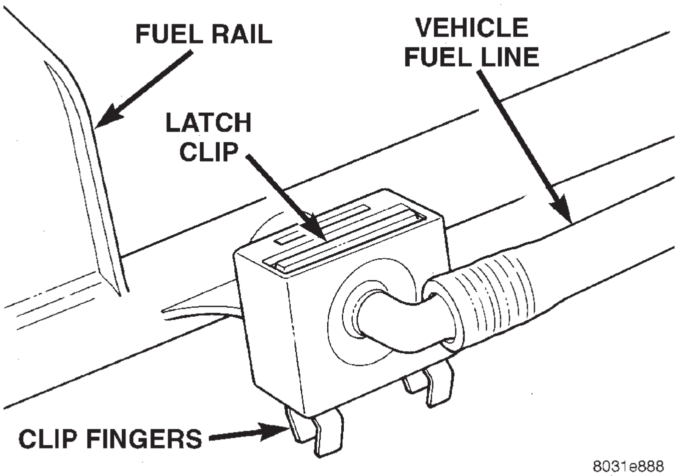


Fig. 24 Latch Clip Installation

(11) Verify a locked condition by firmly pulling on fuel line and fitting (15-30 lbs.).
(12) Connect negative battery cable to battery.
(13) Start engine and check for leaks.

REMOVAL AND INSTALLATION

FUEL FILTER

The filter is located under the vehicle near the front of fuel tank (Fig. 25). Replace fuel filter at intervals specified in the Lubrication and Maintenance Schedule chart found in Group 0, Lubrication and Maintenance.

REMOVAL

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE EVEN WITH THE ENGINE OFF. THIS PRESSURE MUST BE RELEASED BEFORE SERVICING THE FUEL FILTER.

(1) Disconnect negative battery cable. Remove fuel filler cap.
(2) Release fuel system pressure. Refer to the previous Fuel System Pressure Release Procedure in this section.
(3) Raise and support vehicle.
(4) Place shop towels under fuel filter.
(5) Disconnect fuel lines at filter. Refer to Quick-Connect Fittings in this group for procedures.
(6) Remove retaining strap mounting bolt.
(7) Remove filter retaining strap.
(8) Remove filter from mounting bracket.

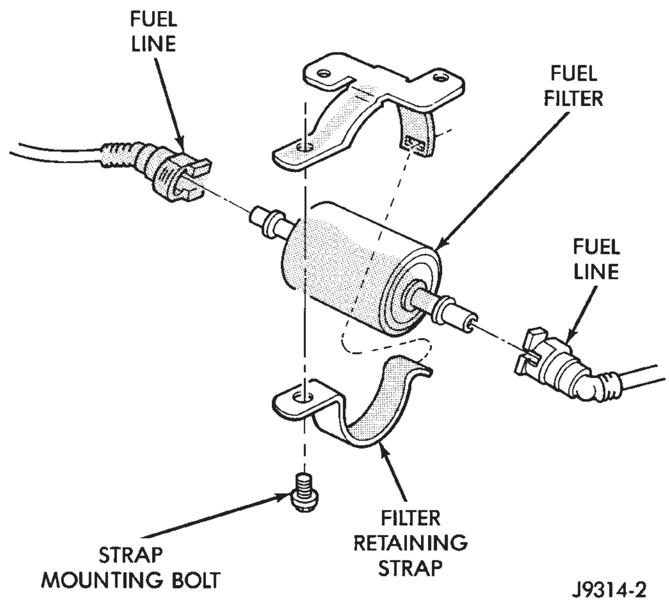


Fig. 25 Fuel Filter

INSTALLATION

CAUTION: The ends of the fuel filter are marked for correct installation. Install filter with the end marked IN towards fuel tank and the end marked OUT towards engine.

(1) Place fuel filter in retaining strap with the marked ends in the correct position.
(2) Install retaining strap bolt. Tighten to 7 N·m (66 in. lbs.) torque.
(3) Install fuel lines to filter. Refer to Fuel Tubes/Lines/Hoses and Clamps in this group. Also refer to Quick-Connect Fittings in this group for procedures.
(4) Lower vehicle.
(5) Connect negative battery cable.
(6) Start engine and check for leaks.

FUEL PRESSURE REGULATOR

The pressure regulator is not serviced separately. If it needs servicing, the entire fuel pump module must be replaced. Refer to Fuel Pump Module for procedures.

FUEL PUMP RELAY

The fuel pump and automatic shutdown (ASD) relays are located in the Power Distribution Center (PDC). The PDC is located in the engine compartment. (Fig. 26). Refer to label on PDC cover for relay location. Check the terminals in the PDC relay connector for corrosion or damage before installation.

REMOVAL AND INSTALLATION (Continued)

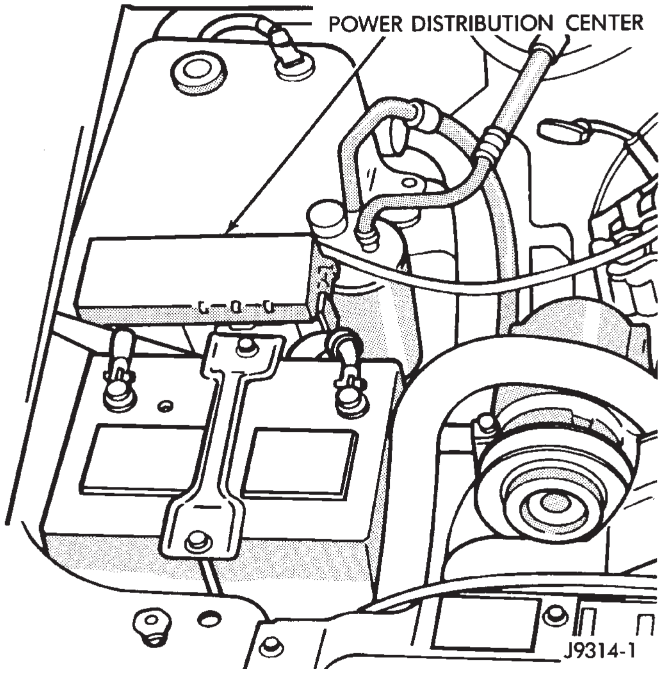


Fig. 26 Power Distribution Center

FUEL PUMP MODULE

REMOVAL

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING THE FUEL PUMP MODULE, THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

CAUTION: Whenever the fuel pump module is serviced, the locknut and gasket must be replaced.

(1) Drain the fuel tank. Refer to Draining Fuel Tank in the Fuel Tank section of this group.

(2) Remove fuel tank. Refer to the Fuel Tank section of this group.

(3) The fuel pump module locknut is threaded onto the fuel tank (Fig. 27). Install Special Tool 6856 to the fuel pump module locknut and remove locknut (Fig. 28). The fuel pump module will spring up when the locknut is removed.

(4) Remove module from fuel tank.

INSTALLATION

CAUTION: Whenever the fuel pump module is serviced, the locknut and gasket must be replaced.

(1) Using a new gasket (Fig. 29), position fuel pump module into opening in fuel tank.

(2) Position new locknut over top of fuel pump module.

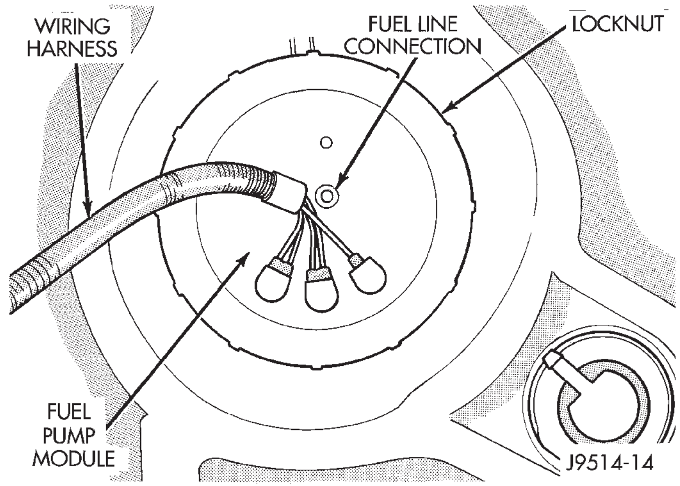


Fig. 27 Top View of Fuel Pump Module

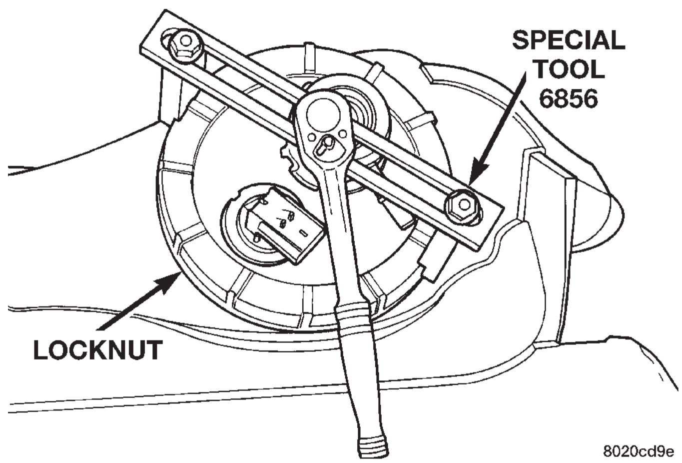


Fig. 28 Locknut Removal/Installation—Typical

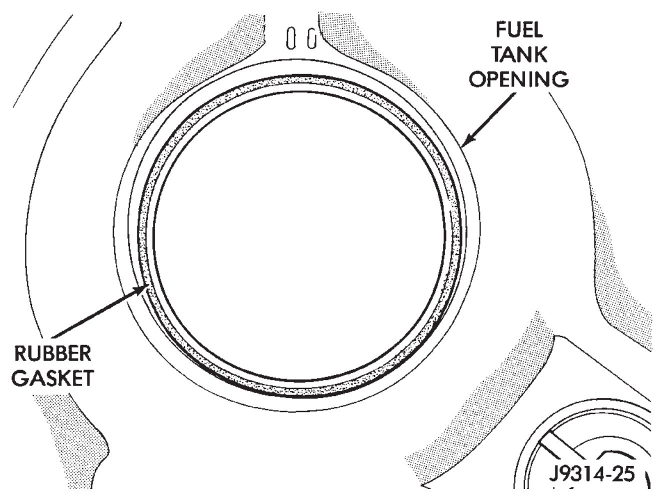


Fig. 29 Rubber Gasket

(3) Install Special Tool 6856 to locknut.

(4) Tighten locknut to 54 N·m (40 ft. lbs.) torque.

(5) Install fuel tank. Refer to Fuel Tank Installation in this section.

REMOVAL AND INSTALLATION (Continued)

FUEL PUMP INLET STRAINER

The fuel pump inlet strainer (in-tank fuel filter) is not serviced separately. If it needs service, the fuel pump module assembly must be replaced. Refer to Fuel Pump Module Removal/Installation.

FUEL LEVEL SENSOR

The fuel level sensor (fuel gauge sending unit) is not serviced separately. If it needs service, the fuel pump module assembly must be replaced. Refer to Fuel Pump Module Removal/Installation.

FUEL INJECTOR RAIL—5.2L ENGINES

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE TURNED OFF). BEFORE SERVICING THE FUEL RAIL ASSEMBLY, THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

To release fuel pressure, refer to the Fuel System Pressure Release Procedure found in this group.

CAUTION: The left and right fuel rails are replaced as an assembly. Do not attempt to separate the rail halves at the connecting hose (Fig. 30). Due to the design of this connecting hose, it does use any clamps. Never attempt to install a clamping device of any kind to the hose. When removing the fuel rail assembly for any reason, be careful not to bend or kink the connecting hose.

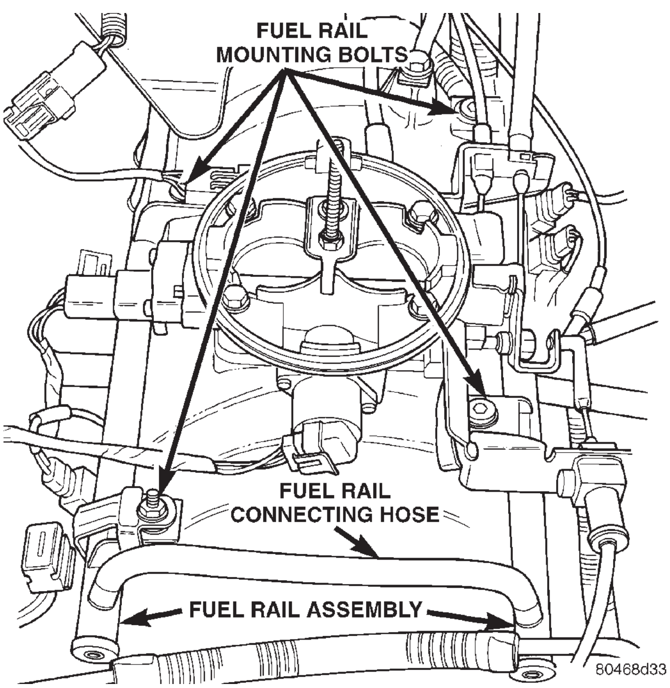


Fig. 30 Fuel Rail Assembly—Typical

REMOVAL

(1) Remove negative battery cable at battery.

(2) Remove air duct at throttle body.

(3) Perform the fuel pressure release procedure.

(4) Remove throttle body from intake manifold. Refer to Throttle Body removal in this group.

(5) If equipped with air conditioning, remove the A-shaped A/C compressor-to-intake manifold support bracket (three bolts) (Fig. 31).

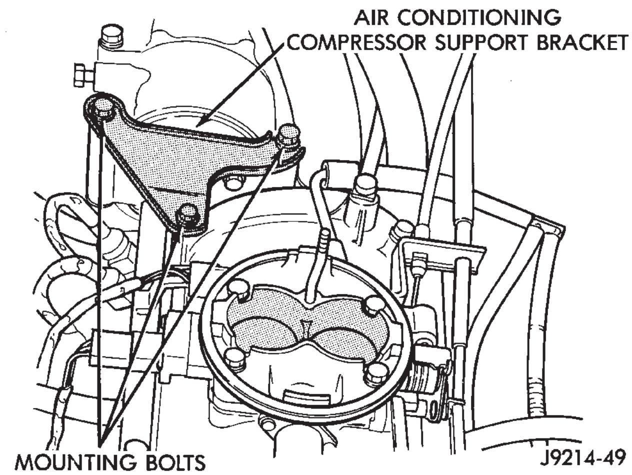


Fig. 31 A/C Compressor Support Bracket—Typical

(6) Disconnect electrical connectors at all fuel injectors (Fig. 32). The factory fuel injection wiring harness is numerically tagged (INJ 1, INJ 2, etc.) for injector position identification.

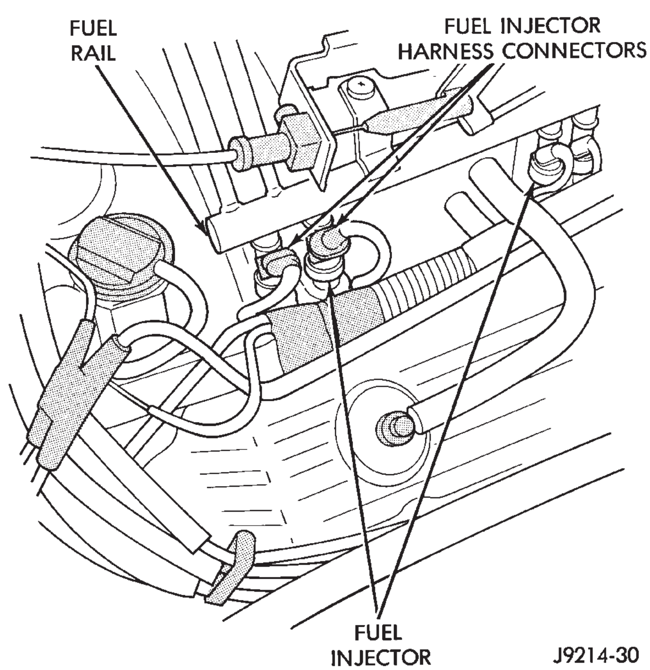


Fig. 32 Fuel Injector Connectors—Typical

(7) Disconnect fuel tube (line) at side of fuel rail. Refer to Quick-Connect Fittings for procedures,

REMOVAL AND INSTALLATION (Continued)

(8) Remove the remaining fuel rail mounting bolts.

(9) Gently rock and pull the **left** fuel rail until the fuel injectors just start to clear the intake manifold. Gently rock and pull the **right** fuel rail until the fuel injectors just start to clear the intake manifold. Repeat this procedure (left/right) until all fuel injectors have cleared the intake manifold.

(10) Remove fuel rail (with injectors attached) from engine.

(11) Remove the clip(s) retaining the injector(s) to fuel rail (Fig. 33) or (Fig. 34).

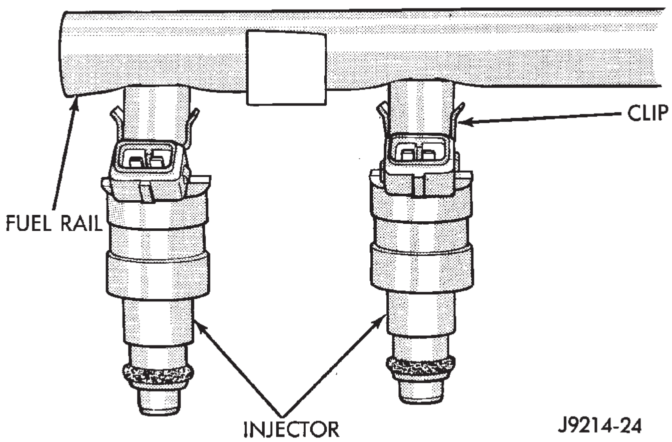


Fig. 33 Fuel Injector Mounting—Typical

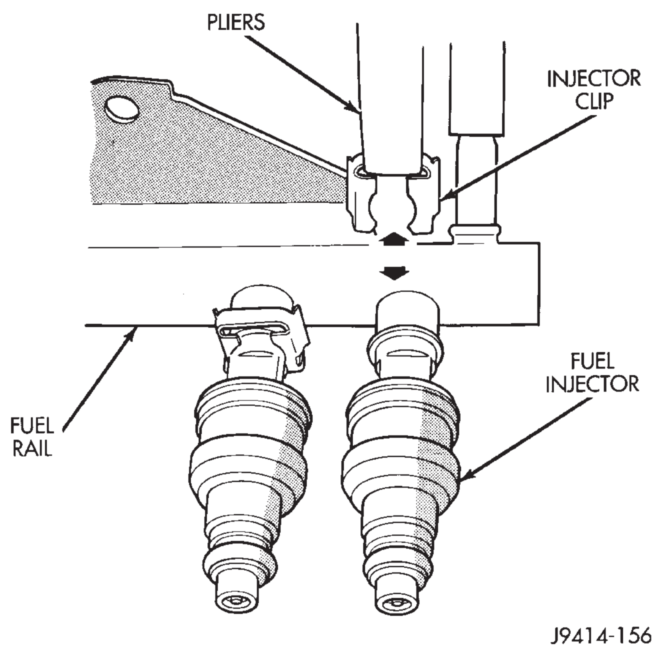


Fig. 34 Injector Retaining Clips—Typical Injector

INSTALLATION

(1) Apply a small amount of engine oil to each fuel injector o-ring. This will help in fuel rail installation.

(2) Install injector(s) and injector clip(s) to fuel rail.

(3) Position the fuel rail/fuel injector assembly to the injector openings on the intake manifold.

(4) Guide each injector into the intake manifold. Be careful not to tear the injector o-ring.

(5) Push the **right** fuel rail down until fuel injectors have bottomed on injector shoulder. Push the **left** fuel rail down until fuel injectors have bottomed on injector shoulder.

(6) Install fuel rail mounting bolts.

(7) Connect electrical connector to intake manifold air temperature sensor.

(8) Connect wiring to all fuel injectors. The injector wiring harness is numerically tagged.

(9) Install the A/C support bracket (if equipped).

(10) Install throttle body to intake manifold. Refer to Throttle Body installation in this section of the group.

(11) Install fuel tube (line) at side of fuel rail. Refer to Quick-Connect Fittings for procedures.

(12) Install air duct to throttle body.

(13) Connect battery cable to battery.

(14) Start engine and check for leaks.

FUEL INJECTOR RAIL—4.0L ENGINE

REMOVAL

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE EVEN WITH THE ENGINE OFF. THIS PRESSURE MUST BE RELEASED BEFORE SERVICING THE FUEL RAIL.

(1) Remove fuel tank filler tube cap.

(2) Disconnect the negative battery cable from battery.

(3) Perform the Fuel System Pressure Release Procedure as described in this Group.

(4) Remove and numerically attach a tag (if fuel injector is not already tagged), the injector harness connectors. Do this at each injector (Fig. 35).

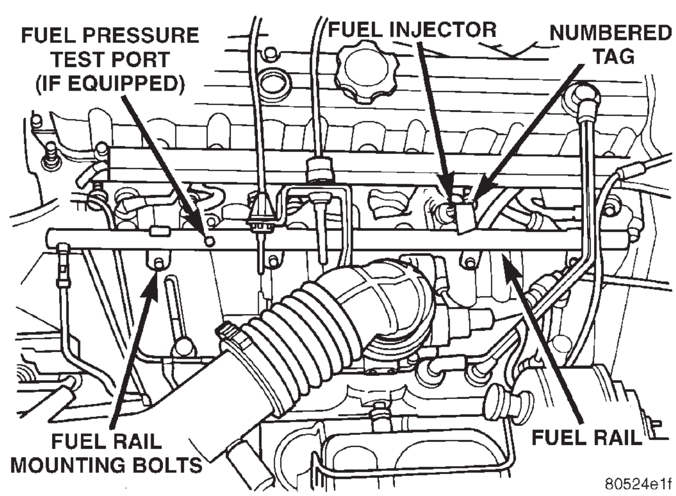


Fig. 35 Fuel Rail Mounting

REMOVAL AND INSTALLATION (Continued)

(5) Disconnect fuel supply line latch clip and fuel line at fuel rail. Refer to Fuel Tubes/Lines/Hoses and Clamps, or Quick-Connect Fittings. These can both be found in the Fuel Delivery section of this group.

(6) Remove fuel rail mounting bolts (Fig. 35).

(7) On models with automatic transmissions, it may be necessary to remove automatic transmission throttle line pressure cable and bracket. This will aid in fuel rail assembly removal.

(8) Remove fuel rail by gently rocking until all the fuel injectors are out of the intake manifold.

INSTALLATION

(1) Apply a small amount of clean engine oil to each injector o-ring. This will aid in installation.

(2) Position tips of all fuel injectors into the corresponding injector bore in the intake manifold. Seat injectors into manifold.

(3) Tighten fuel rail mounting bolts to 27 N·m (20 ft. lbs.) torque.

(4) Connect injector harness connectors to appropriate (tagged) injector.

(5) Connect fuel line and fuel line latch clip to fuel rail. Refer to this group for procedures.

(6) Install protective cap to pressure test port fitting (if equipped).

(7) Install fuel tank cap.

(8) Connect negative battery cable to battery.

(9) Start engine and check for fuel leaks.

FUEL INJECTOR(S)

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE EVEN WITH THE ENGINE TURNED OFF. BEFORE SERVICING THE FUEL INJECTOR(S), THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

To release fuel pressure, refer to the Fuel System Pressure Release Procedure.

To remove one or more fuel injectors, the fuel rail assembly must be removed from engine.

REMOVAL

(1) Remove air duct at throttle body.

(2) Remove fuel injector rail assembly. Refer to Fuel Injector Rail removal in this section.

(3) Remove the clip(s) retaining the injector(s) to fuel rail (Fig. 33) or (Fig. 34).

(4) Remove injector(s) from fuel rail.

INSTALLATION

(1) Apply a small amount of engine oil to each fuel injector o-ring. This will help in fuel rail installation.

(2) Install injector(s) and injector clip(s) to fuel rail.

(3) Install fuel rail assembly. Refer to Fuel Injector Rail installation.

(4) Install air duct at throttle body.

(5) Start engine and check for leaks.

FUEL TANK

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE EVEN WITH THE ENGINE OFF. THIS PRESSURE MUST BE RELEASED BEFORE SERVICING FUEL TANK.

REMOVAL

(1) Disconnect negative battery cable at battery.

(2) Release fuel system pressure. Refer to the Fuel System Pressure Release Procedure in the Fuel Delivery section of this group.

(3) Raise and support vehicle.

(4) Remove the fuel tank filler hose and vent hose retaining clamps (Fig. 36). Remove both tubes at fuel filler tube (Fig. 36).

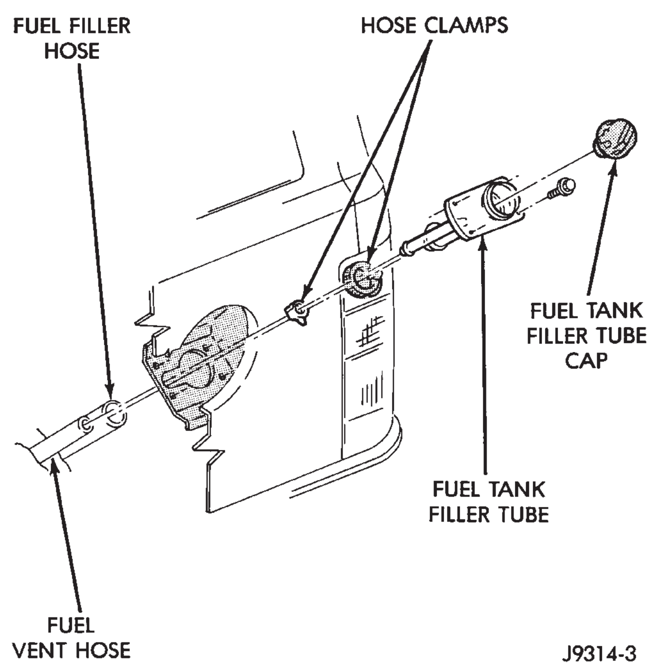


Fig. 36 Fuel Filler Tube and Hoses

(5) Remove the rear tow hooks (if equipped).

(6) Remove the fuel tank skid plate mounting nuts/bolts and remove skid plate (Fig. 37) (if equipped).

(7) Remove the optional trailer hitch (if equipped).

(8) Remove the exhaust tailpipe heat shield mounting bolts and remove shield.

CAUTION: To protect the fuel tank from exhaust heat, this shield must reinstalled after tank installation.

REMOVAL AND INSTALLATION (Continued)

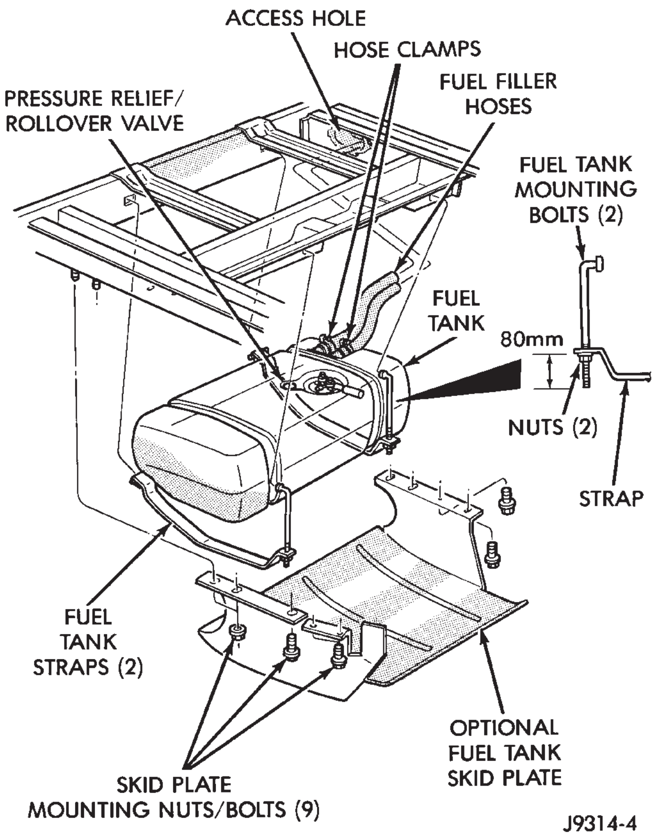


Fig. 37 Fuel Tank Mounting

(9) Place a hydraulic jack to bottom of fuel tank.

WARNING: PLACE A SHOP TOWEL AROUND FUEL LINES TO CATCH ANY EXCESS FUEL.

(10) Disconnect fuel supply line at inlet side of fuel filter. Disconnect fuel vent line near front of tank. Refer to Fuel Tubes/Lines/Hoses and Clamps in this group. Also refer to Quick-Connect Fittings for procedures.

(11) Disconnect fuel pump module electrical connector near front of tank.

CAUTION: The right (passenger side) of the fuel tank must be lowered first to gain access to the two fuel filler hose clamps located on the left side of tank (Fig. 37).

(12) Remove the two fuel tank strap nuts (Fig. 37). Position both tank support straps away from tank.

(13) Carefully lower right side of tank while feeding fuel hoses through access hole in body until fuel tank filler hose clamps can be removed.

(14) Before removing fuel filler hoses from tank, mark their rotational position in relation to tank. Remove both hose clamps and hoses at tank (Fig. 37). Insert the drain hose (from an approved gasoline draining station) into either of the hose openings. Drain tank until empty.

(15) Continue lowering tank and remove from vehicle.

INSTALLATION

(1) Connect the fuel filter-to-fuel pump module supply line to the fuel pump module. Refer to Fuel Tubes/Lines/Hoses and Clamps in this group. Also refer to Quick-Connect Fittings for procedures.

(2) Install fuel filler hoses and hose clamps to tank noting their previously marked position.

(3) Position fuel tank to hydraulic jack.

(4) Raise tank into position while guiding the fuel filler hoses into and through the access hole (Fig. 37) in body.

(5) Continue raising tank until positioned to body.

(6) Attach two fuel tank mounting straps and mounting nuts.

CAUTION: The two mounting nuts must be tightened until 80 mm (3.149 in.) is attained between the end of the mounting bolt and bottom of strap. See insert (Fig. 37). Do not over tighten nuts.

(7) Connect pump module electrical connector.

(8) Install exhaust tailpipe heat shield.

(9) Connect the fuel filter-to-fuel pump module supply line to the fuel filter. Refer to Fuel Tubes/Lines/Hoses and Clamps in this group. Also refer to Quick-Connect Fittings for procedures.

(10) Install the fuel tank skid plate and trailer hitch (if equipped).

(11) Install the rear tow hooks (if equipped).

(12) Install the fuel tank filler hose and vent hose to tank necks. Tighten both retaining clamps.

(13) Lower vehicle and connect battery cable to battery.

ACCELERATOR PEDAL

The accelerator pedal is connected to the throttle body linkage by the throttle cable. The cable is protected by a plastic sheathing and is connected to the throttle body linkage by a ball socket. It is connected to the accelerator pedal arm by a plastic retainer (clip) (Fig. 38). This retainer (clip) snaps into the top of the accelerator pedal arm. Retainer tabs (built into the cable sheathing) fasten the cable to the dash panel.

Dual throttle return springs (attached to the throttle shaft) are used to close the throttle.

CAUTION: Never attempt to remove or alter these springs.

REMOVAL AND INSTALLATION (Continued)

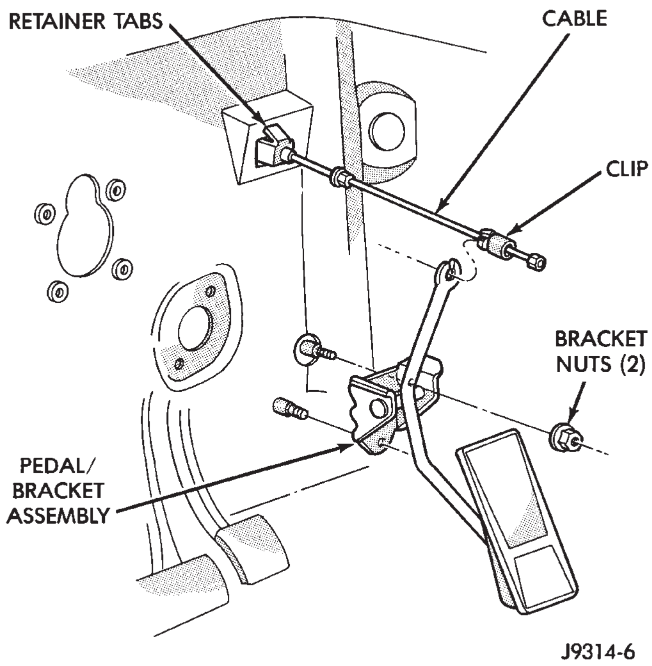


Fig. 38 Accelerator Pedal Mounting

REMOVAL

CAUTION: Be careful not to damage or kink the cable core wire (within the cable sheathing) while servicing accelerator pedal or throttle cable.

(1) From inside the vehicle, hold up accelerator pedal. Remove plastic cable retainer (clip) and throttle cable core wire from upper end of pedal arm. Plastic cable retainer (clip) snaps into pedal arm.

(2) Remove accelerator pedal bracket nuts. Remove accelerator pedal assembly.

INSTALLATION

(1) Place accelerator pedal assembly over studs protruding from floor pan. Tighten mounting nuts to 10 N·m (92 in. lbs.) torque.

(2) Slide throttle cable into opening in top of pedal arm. Push plastic cable retainer (clip) into pedal arm opening until it snaps into place.

(3) Before starting engine, operate accelerator pedal to check for any binding.

THROTTLE CABLE

REMOVAL

(1) From inside the vehicle, hold up accelerator pedal. Remove plastic cable retainer (clip) and throttle cable core wire from upper end of pedal arm (Fig. 38). Plastic cable retainer (clip) snaps into pedal arm.

(2) Remove the cable core wire at pedal arm.

(3) From inside the vehicle, pinch both sides of the cable housing retainer tabs (Fig. 38). at the dash panel. Remove cable housing from dash panel and pull into the engine compartment.

(4) 4.0L Engine: Remove cable from clip on engine valve cover (Fig. 39) and clip at dash panel.

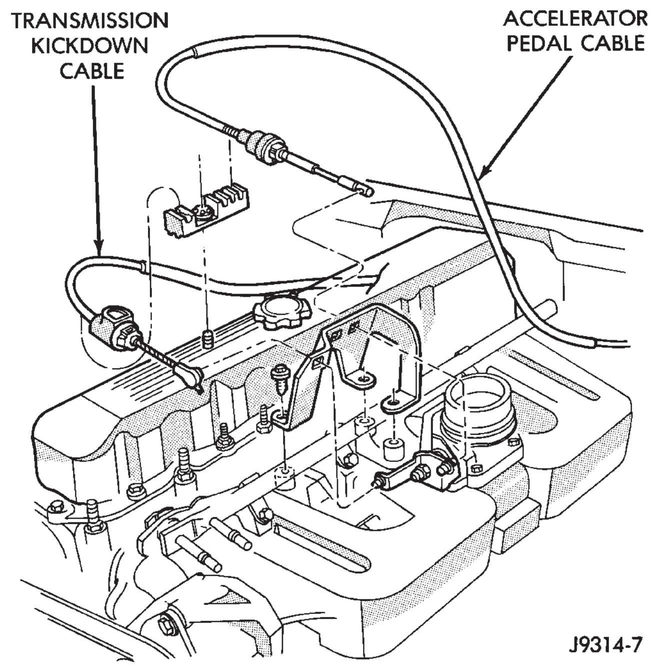


Fig. 39 Throttle Cable—4.0L Engine

(5) Remove the throttle cable ball end socket at throttle body linkage (Fig. 39) or (Fig. 40) (snaps off).

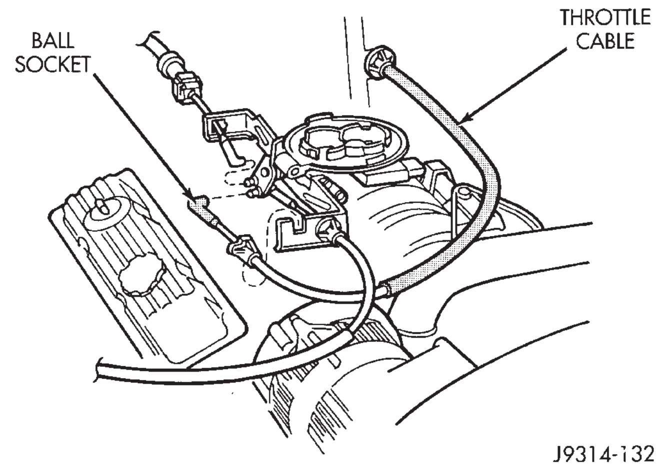


Fig. 40 Throttle Cable—5.2L V-8 Engine

(6) 4.0L Engine: Remove throttle cable from throttle body mounting bracket by compressing retainer tabs and pushing cable through hole in bracket. Remove throttle cable from vehicle.

(7) 5.2L Engine: Remove cable housing at throttle body mounting bracket by pressing forward on release tab with a small screwdriver (Fig. 41). **To prevent cable housing breakage, press on the tab only enough to release the cable from the**

REMOVAL AND INSTALLATION (Continued)

bracket. Lift the cable housing straight up from bracket while pressing on release tab. Remove throttle cable from vehicle.

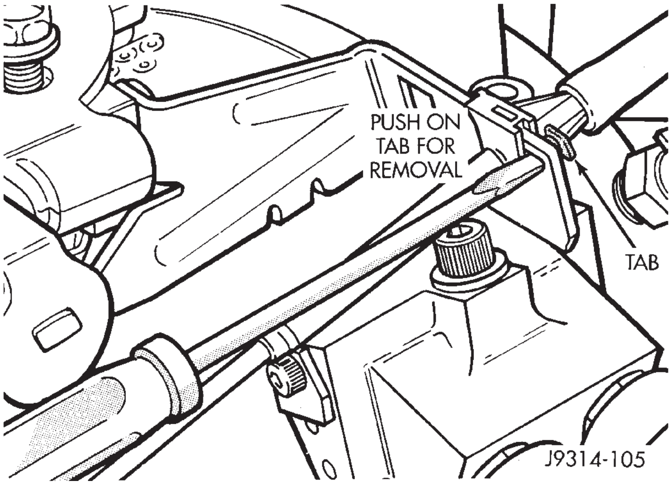


Fig. 41 Cable Release Tab—5.2L Engines—Typical

INSTALLATION

(1) 4.0L Engine: Slide throttle cable through hole in throttle body bracket until retainer tabs lock into bracket. Connect cable ball end to throttle body linkage ball (snaps on).

(2) 5.2L Engine: Connect cable ball end to throttle body linkage ball (snaps on). Connect cable to throttle body bracket (push down and lock).

(3) 4.0L Engine: Snap cable into clip on engine valve cover and clip at dash panel.

(4) Push other end of cable through opening in dash panel until retaining tabs lock into panel.

(5) From inside drivers compartment, slide throttle cable core wire into opening in top of pedal arm. Push cable retainer (clip) into pedal arm opening until it snaps in place.

(6) Before starting engine, operate accelerator pedal to check for any binding.

SPECIFICATIONS

VECI LABEL SPECIFICATIONS

If anything differs between the specifications found on the Vehicle Emission Control Information (VECI) label and the following specifications, use specifications on VECI label. The VECI label is located in the engine compartment.

FUEL TANK CAPACITY

Models	Liters	U.S. Gallons
All	87	23
Nominal refill capacities are shown. A variation may be observed from vehicle to vehicle due to manufacturing tolerance and refill procedure.		

FUEL SYSTEM PRESSURE

338 kPa ± 14 kPa (49.0 psi ± 2 psi).

TORQUE CHART

DESCRIPTION	TORQUE
Accelerator Pedal Bracket Mounting Nuts	10 N·m (92 in. lbs.)
Fuel Filter Mounting Strap Bolt	7 N·m (66 in. lbs.)
Fuel Pump Module Locknut	54 N·m (40 ft. lbs.)
Fuel Rail Mounting Bolts—4.0L Engine	27 N·m (20 ft. lbs.)
Fuel Rail Mounting Bolts—5.2L Engine	23 N·m (200 in. lbs.)
Fuel Tank Mounting Nuts	Refer To Manual Text
Fuel Hose Clamps	1 N·m (15 in. lbs.)

FUEL INJECTION SYSTEM

INDEX

GENERAL INFORMATION

INTRODUCTION

All engines are equipped with sequential Multi-Port Fuel Injection (MFI). The MFI system provides precise air/fuel ratios for all driving conditions.

The powertrain control module (PCM) operates the fuel system. The PCM was formerly referred to as the SBEC or engine controller. The PCM (Fig. 1) is a pre-programmed, dual microprocessor digital computer. It regulates ignition timing, air-fuel ratio, emission control devices, charging system, speed control, air conditioning compressor clutch engagement and idle speed. The PCM can adapt its programming to meet changing operating conditions.

Powertrain Control Module (PCM) Inputs represent the instantaneous engine operating conditions. Air-fuel mixture and ignition timing calibrations for various driving and atmospheric conditions are pre-programmed into the PCM. The PCM monitors and analyzes various inputs. It then computes engine fuel and ignition timing requirements based on these inputs. Fuel delivery control and ignition timing will then be adjusted accordingly.

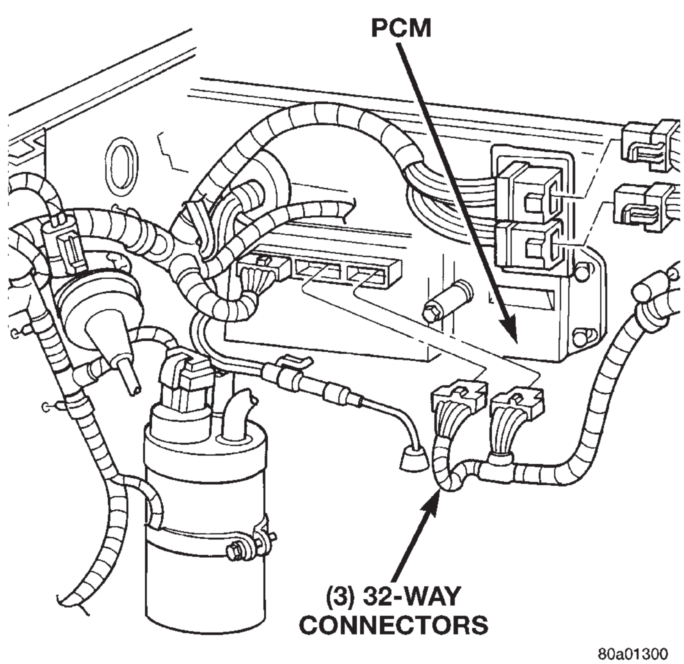


Fig. 1 Powertrain Control Module (PCM)

Other inputs to the PCM are provided by the brake light switch, air conditioning select switch and the

GENERAL INFORMATION (Continued)

speed control switches. All inputs to the PCM are converted into signals.

Electrically operated fuel injectors spray fuel in precise metered amounts into the intake port directly above the intake valve. The injectors are fired in a specific sequence by the PCM. The PCM maintains an air/fuel ratio of 14.7 to 1 by constantly adjusting injector pulse width. Injector pulse width is the length of time that the injector opens and sprays fuel into the chamber. The PCM adjusts injector pulse width by opening and closing the ground path to the injector.

Manifold absolute pressure (air density) and engine rpm (speed) are the primary inputs that determine fuel injector pulse width. The PCM also monitors other inputs when adjusting air-fuel ratio.

MODES OF OPERATION

As input signals to the powertrain control module (PCM) change, the PCM adjusts its response to the output devices. For example, the PCM must calculate different injector pulse width and ignition timing for idle than it does for wide open throttle (WOT).

The PCM will operate in two different modes: **Open Loop and Closed Loop**.

During Open Loop modes, the powertrain control module (PCM) receives input signals and responds only according to preset PCM programming. Input from the oxygen (O2S) sensors is not monitored during Open Loop modes.

During Closed Loop modes, the PCM will monitor the oxygen (O2S) sensors input. This input indicates to the PCM whether or not the calculated injector pulse width results in the ideal air-fuel ratio. This ratio is 14.7 parts air-to-1 part fuel. By monitoring the exhaust oxygen content through the O2S sensor, the PCM can fine tune the injector pulse width. This is done to achieve optimum fuel economy combined with low emission engine performance.

The fuel injection system has the following modes of operation:

- Ignition switch ON
- Engine start-up (crank)
- Engine warm-up
- Idle
- Cruise
- Acceleration
- Deceleration
- Wide open throttle (WOT)
- Ignition switch OFF

The ignition switch On, engine start-up (crank), engine warm-up, acceleration, deceleration and wide open throttle modes are Open Loop modes. The idle and cruise modes, (with the engine at operating temperature) are Closed Loop modes.

IGNITION SWITCH (KEY-ON) MODE

This is an Open Loop mode. When the fuel system is activated by the ignition switch, the following actions occur:

- The powertrain control module (PCM) pre-positions the idle air control (IAC) motor.
- The PCM determines atmospheric air pressure from the MAP sensor input to determine basic fuel strategy.
- The PCM monitors the engine coolant temperature sensor input. The PCM modifies fuel strategy based on this input.
- Intake manifold air temperature sensor input is monitored.
- Throttle position sensor (TPS) is monitored.
- The auto shutdown (ASD) relay is energized by the PCM for approximately three seconds.
- The fuel pump is energized through the fuel pump relay by the PCM. The fuel pump will operate for approximately three seconds unless the engine is operating or the starter motor is engaged.
- The O2S sensor heater element is energized through the fuel pump relay. The O2S sensor input is not used by the PCM to calibrate air-fuel ratio during this mode of operation.

ENGINE START-UP MODE

This is an Open Loop mode. The following actions occur when the starter motor is engaged.

The powertrain control module (PCM) receives inputs from:

- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Starter motor relay
- Camshaft position sensor signal

The PCM monitors the crankshaft position sensor. If the PCM does not receive a crankshaft position sensor signal within 3 seconds of cranking the engine, it will shut down the fuel injection system.

The fuel pump is activated by the PCM through the fuel pump relay.

Voltage is applied to the fuel injectors with the PCM. The PCM will then control the injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off.

The PCM determines the proper ignition timing according to input received from the crankshaft position sensor.

GENERAL INFORMATION (Continued)

ENGINE WARM-UP MODE

This is an Open Loop mode. During engine warm-up, the powertrain control module (PCM) receives inputs from:

- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)

Based on these inputs the following occurs:

- Voltage is applied to the fuel injectors with the powertrain control module (PCM). The PCM will then control the injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off.
- The PCM adjusts engine idle speed through the idle air control (IAC) motor and adjusts ignition timing.
- The PCM operates the A/C compressor clutch through the clutch relay. This is done if A/C has been selected by the vehicle operator and requested by the A/C thermostat.
- When engine has reached operating temperature, the PCM will begin monitoring O2S sensor input. The system will then leave the warm-up mode and go into closed loop operation.

IDLE MODE

When the engine is at operating temperature, this is a Closed Loop mode. At idle speed, the powertrain control module (PCM) receives inputs from:

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Battery voltage
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Oxygen sensors

Based on these inputs, the following occurs:

- Voltage is applied to the fuel injectors with the powertrain control module (PCM). The PCM will then control injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off.
- The PCM monitors the O2S sensor input and adjusts air-fuel ratio by varying injector pulse width. It also adjusts engine idle speed through the idle air control (IAC) motor.
- The PCM adjusts ignition timing by increasing and decreasing spark advance.
- The PCM operates the A/C compressor clutch through the clutch relay. This happens if A/C has been selected by the vehicle operator and requested by the A/C thermostat.

CRUISE MODE

When the engine is at operating temperature, this is a Closed Loop mode. At cruising speed, the powertrain control module (PCM) receives inputs from:

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Oxygen (O2S) sensors

Based on these inputs, the following occurs:

- Voltage is applied to the fuel injectors with the PCM. The PCM will then adjust the injector pulse width by turning the ground circuit to each individual injector on and off.
- The PCM monitors the O2S sensor input and adjusts air-fuel ratio. It also adjusts engine idle speed through the idle air control (IAC) motor.
- The PCM adjusts ignition timing by turning the ground path to the coil on and off.
- The PCM operates the A/C compressor clutch through the clutch relay. This happens if A/C has been selected by the vehicle operator and requested by the A/C thermostat.

ACCELERATION MODE

This is an Open Loop mode. The powertrain control module (PCM) recognizes an abrupt increase in throttle position or MAP pressure as a demand for increased engine output and vehicle acceleration. The PCM increases injector pulse width in response to increased throttle opening.

DECELERATION MODE

When the engine is at operating temperature, this is an Open Loop mode. During hard deceleration, the

GENERAL INFORMATION (Continued)

powertrain control module (PCM) receives the following inputs.

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)
- Park/neutral switch (gear indicator signal—auto. trans. only)

If the vehicle is under hard deceleration with the proper rpm and closed throttle conditions, the PCM will ignore the oxygen sensor input signal. The PCM will enter a fuel cut-off strategy in which it will not supply battery voltage to the injectors. If a hard deceleration does not exist, the PCM will determine the proper injector pulse width and continue injection.

Based on the above inputs, the PCM will adjust engine idle speed through the idle air control (IAC) motor.

The PCM adjusts ignition timing by turning the ground path to the coil on and off.

The PCM opens the ground circuit to the A/C clutch relay to disengage the A/C compressor clutch. This is done until the vehicle is no longer under deceleration (if the A/C system is operating).

WIDE OPEN THROTTLE MODE

This is an Open Loop mode. During wide open throttle operation, the powertrain control module (PCM) receives the following inputs.

- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal (in the distributor)

During wide open throttle conditions, the following occurs:

- Voltage is applied to the fuel injectors with the powertrain control module (PCM). The PCM will then control the injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off. The PCM ignores the oxygen sensor input signal and provides a predetermined amount of additional fuel. This is done by adjusting injector pulse width.
- The PCM adjusts ignition timing by turning the ground path to the coil on and off.
- The PCM opens the ground circuit to the A/C clutch relay to disengage the A/C compressor clutch. This will be done for approximately 15 seconds (if the air conditioning system is operating).

IGNITION SWITCH OFF MODE

When ignition switch is turned to OFF position, the PCM stops operating the injectors, ignition coil, ASD relay and fuel pump relay.

DESCRIPTION AND OPERATION

SYSTEM DIAGNOSIS

The PCM can test many of its own input and output circuits. If the PCM senses a fault in a major system, the PCM stores a Diagnostic Trouble Code (DTC) in memory.

Technicians can display stored DTC's by two different methods. The first is to cycle the ignition switch On - Off - On - Off - On within 5 seconds. Then count the number of times the malfunction indicator (check engine) lamp on the instrument panel flashes on and off. The number of flashes represents the DTC. There is a slight pause between the flashes representing the first and second digits of the code. Longer pauses separate individual trouble codes.

The second method of reading DTC's uses the DRB scan tool. For DTC information, refer to Group 25, Emission Control Systems. See On-Board Diagnostics.

POWERTRAIN CONTROL MODULE (PCM)

The powertrain control module (PCM) (Fig. 1) operates the fuel system. The PCM was formerly referred to as the SBEC or engine controller. The PCM is a pre-programmed, dual microprocessor digital computer. It regulates ignition timing, air-fuel ratio, emission control devices, charging system, speed control, air conditioning compressor clutch engagement and idle speed. The PCM can adapt its programming to meet changing operating conditions.

The PCM receives input signals from various switches and sensors. Based on these inputs, the PCM regulates various engine and vehicle operations through different system components. These components are referred to as Powertrain Control Module (PCM) Outputs. The sensors and switches that provide inputs to the PCM are considered Powertrain Control Module (PCM) Inputs.

The PCM adjusts ignition timing based upon inputs it receives from sensors that react to: engine rpm, manifold absolute pressure, engine coolant temperature, throttle position, transmission gear selection (automatic transmission), vehicle speed and the brake switch.

DESCRIPTION AND OPERATION (Continued)

The PCM adjusts idle speed based on inputs it receives from sensors that react to: throttle position, vehicle speed, transmission gear selection, engine coolant temperature and from inputs it receives from the air conditioning clutch switch and brake switch.

Based on inputs that it receives, the PCM adjusts ignition coil dwell. The PCM also adjusts the generator charge rate through control of the generator field and provides speed control operation.

NOTE: PCM Inputs:

- Generator output
- A/C request (if equipped with factory A/C)
- A/C select (if equipped with factory A/C)
- Auto shutdown (ASD) sense
- Intake manifold air temperature sensor
- Battery voltage
- Brake switch
- Engine coolant temperature sensor
- Crankshaft position sensor
- Ignition circuit sense (ignition switch in run position)
- Manifold absolute pressure (MAP) sensor
- Overdrive/override switch
- Oxygen sensor
- Park/neutral switch (auto. trans. only)
- SCI receive (DRB scan tool connection)
- Speed control resume switch
- Speed control set switch
- Speed control on/off switch
- Camshaft position sensor signal
- Throttle position sensor
- Vehicle speed sensor
- Sensor return
- Power ground
- Signal ground

NOTE: PCM Outputs:

- A/C clutch relay
- Idle air control (IAC) motor
- Auto shutdown (ASD) relay
- Generator field
- Malfunction indicator lamp (Check engine lamp)
- EGR valve control solenoid
- Fuel injectors
- Fuel pump relay
- Ignition coil
- EVAP canister purge solenoid
- SCI transmit (DRB scan tool connection)
- Speed control vacuum solenoid
- Speed control vent solenoid
- Tachometer (on instrument panel, if equipped)

The powertrain control module (PCM) contains a voltage convertor. This converts battery voltage to a regulated 5.0 volts. It is used to power the crankshaft position sensor, camshaft position sensor and vehicle speed sensor. The PCM also provides a five (5) volt supply for the manifold absolute pressure (MAP) sensor and throttle position sensor (TPS).

AIR CONDITIONING (A/C) CONTROLS—PCM INPUT

The A/C control system information applies to factory installed air conditioning units.

A/C SELECT SIGNAL: When the A/C switch is in the ON position, an input signal is sent to the powertrain control module (PCM). The signal informs the PCM that the A/C has been selected. The PCM adjusts idle speed to a pre-programmed rpm through the idle air control (IAC) motor to compensate for increased engine load.

A/C REQUEST SIGNAL: Once A/C has been selected, the powertrain control module (PCM) receives the A/C request signal from the evaporator switch. The input indicates that the evaporator temperature is in the proper range for A/C application. The PCM uses this input to cycle the A/C compressor clutch (through the A/C relay). It will also determine the correct engine idle speed through the idle air control (IAC) motor position.

If the A/C low-pressure switch opens (indicating a low refrigerant level), the PCM will not receive an A/C receive signal. The PCM will then remove the ground from the A/C relay. This will deactivate the A/C compressor clutch.

If the evaporator switch opens, (indicating that evaporator is not in proper temperature range), the PCM will not receive the A/C request signal. The PCM will then remove the ground from the A/C relay, deactivating the A/C compressor clutch.

AUTOMATIC SHUTDOWN (ASD) RELAY SENSE—PCM INPUT

A 12 volt signal at this input indicates to the PCM that the ASD has been activated. The ASD relay is located in the Power Distribution Center (PDC). The PDC is located in the engine compartment (Fig. 2). Refer to label on PDC cover for relay location. The relay is used to connect the oxygen sensor heater element, ignition coil, generator field winding and fuel injectors to 12 volt + power supply.

This input is used only to sense that the ASD relay is energized. If the powertrain control module (PCM) does not see 12 volts at this input when the ASD should be activated, it will set a diagnostic trouble code (DTC).

BATTERY TEMPERATURE SENSOR—PCM INPUT

Provides a signal to the PCM corresponding to the battery temperature. Refer to Group 8C, Charging System for additional information.

DESCRIPTION AND OPERATION (Continued)

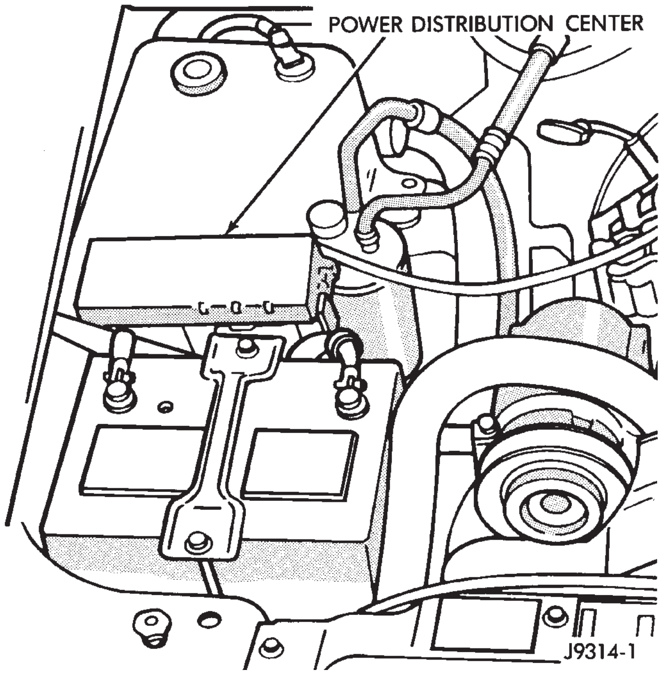


Fig. 2 Power Distribution Center (PDC)

BATTERY VOLTAGE—PCM INPUT

The battery voltage input provides power to the powertrain control module (PCM). It also informs the PCM what voltage level is supplied to the ignition coil and fuel injectors.

If battery voltage is low, the PCM will increase injector pulse width (period of time that the injector is energized). This is done to compensate for the reduced flow through injector caused by the lowered voltage.

FIVE VOLT SENSOR SUPPLY—PRIMARY

Supplies the required 5 volt power source to the crankshaft position sensor, camshaft position sensor, MAP sensor and throttle position sensor.

FIVE VOLT SENSOR SUPPLY—SECONDARY

Supplies the required 5 volt power source to the transmission pressure sensor and the vehicle speed sensor.

FUEL LEVEL SENSOR—PCM INPUT

The fuel level sensor sends a signal to the PCM to indicate fuel level. The purpose of this feature is to prevent a false setting of misfire and fuel system monitor trouble codes if the fuel level is either less than 15 percent, or more than 85 percent of its rated capacity.

BRAKE SWITCH—PCM INPUT

When the brake light switch is activated, the powertrain control module (PCM) receives an input indicating that the brakes are being applied. After receiving this input, the PCM maintains idle speed to a scheduled rpm through control of the idle air control (IAC) motor. The brake switch input is also used to operate the speed control system.

CAMSHAFT POSITION SENSOR—PCM INPUT

A sync signal is provide by the camshaft position sensor. The sensor located in the distributor on all 4.0L/5.2L engines (Fig. 3). The sync signal from this sensor works in conjunction with the crankshaft position sensor to provide the powertrain control module (PCM) with inputs. This is done to establish and maintain correct injector firing order.

Refer to Camshaft Position Sensor in Group 8D, Ignition System for more information.

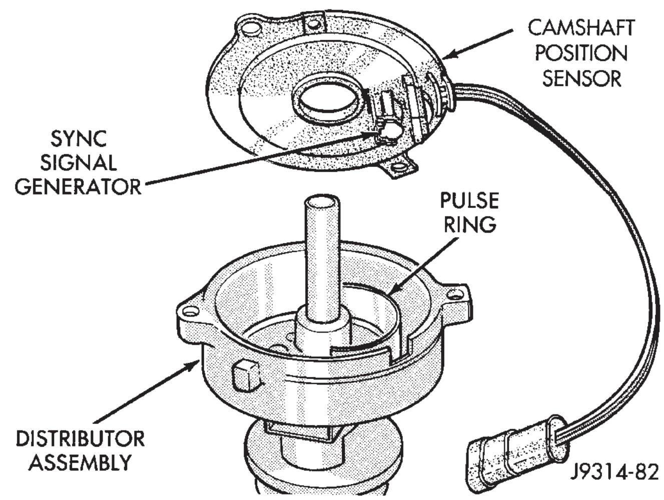


Fig. 3 Camshaft Position Sensor—Typical (5.2L Distributor Shown)

CRANKSHAFT POSITION SENSOR—5.2L ENGINES—PCM INPUT

This sensor is a hall effect device that detects notches in the flywheel (manual transmission) or flexplate (automatic transmission).

This sensor is used to indicate to the powertrain control module (PCM) that a spark and or fuel injection event is to be required. The output from this sensor, in conjunction with the camshaft position sensor signal, is used to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders.

The sensor is bolted to the cylinder block near the rear of the right cylinder head (Fig. 4).

Refer to Group 8D, Ignition System for more crankshaft position sensor information.

The engine will not operate if the PCM does not receive a crankshaft position sensor input.

DESCRIPTION AND OPERATION (Continued)

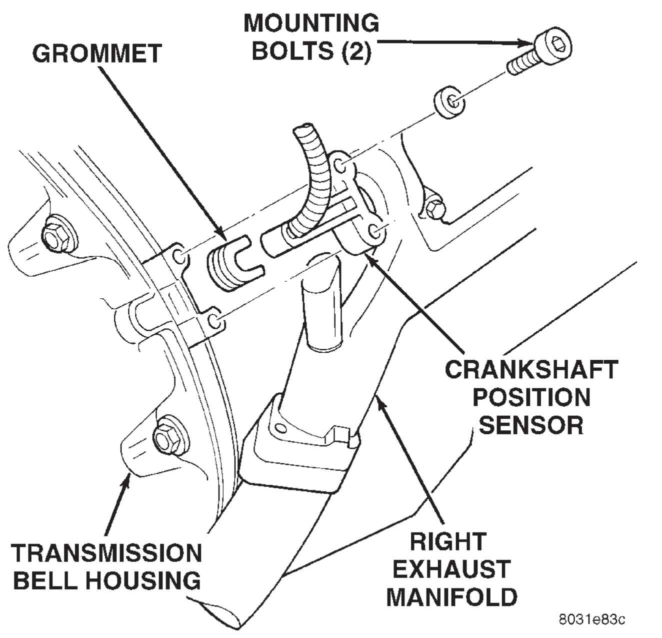


Fig. 4 Crankshaft Position Sensor—5.2L Engine

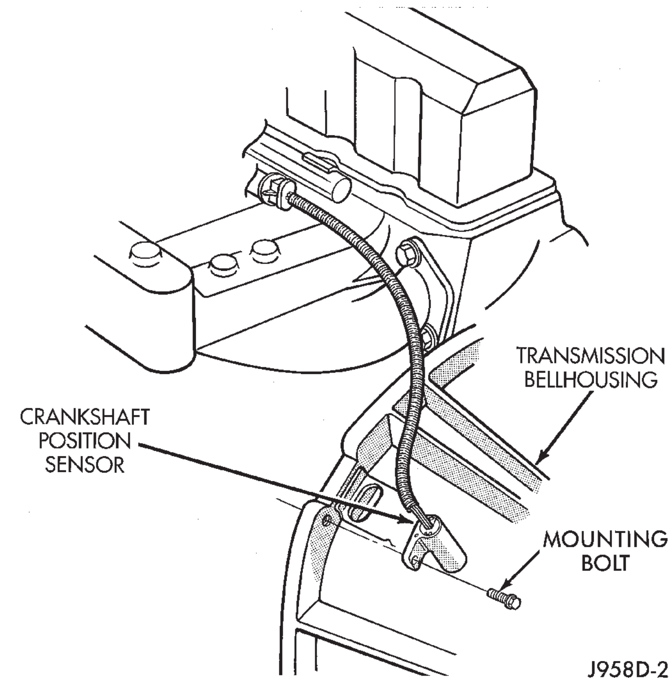


Fig. 5 Crankshaft Position Sensor—4.0L Engine

CRANKSHAFT POSITION SENSOR—4.0L ENGINE—PCM INPUT

This sensor is a hall effect device that detects notches in the flywheel (manual transmission) or flexplate (automatic transmission).

This sensor is used to indicate to the powertrain control module (PCM) that a spark and or fuel injection event is to be required. The output from this sensor, in conjunction with the camshaft position sensor signal, is used to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders.

The sensor is bolted to the transmission bellhousing (Fig. 5).

Refer to Group 8D, Ignition System for more crankshaft position sensor information.

The engine will not operate if the PCM does not receive a crankshaft position sensor input.

ENGINE COOLANT TEMPERATURE SENSOR—5.2L ENGINES—PCM INPUT

The engine coolant temperature sensor is installed next to the thermostat housing (Fig. 6) and protrudes into the water jacket. The sensor provides an input voltage to the powertrain control module (PCM) relating coolant temperature. The PCM uses this input along with inputs from other sensors to determine injector pulse width and ignition timing. As coolant temperature varies, the coolant temperature sensor resistance will change. This change in resistance results in a different input voltage to the PCM.

When the engine is cold, the PCM will operate in Open Loop cycle. It will demand slightly richer air-fuel mixtures and higher idle speeds. This is done until normal operating temperatures are reached.

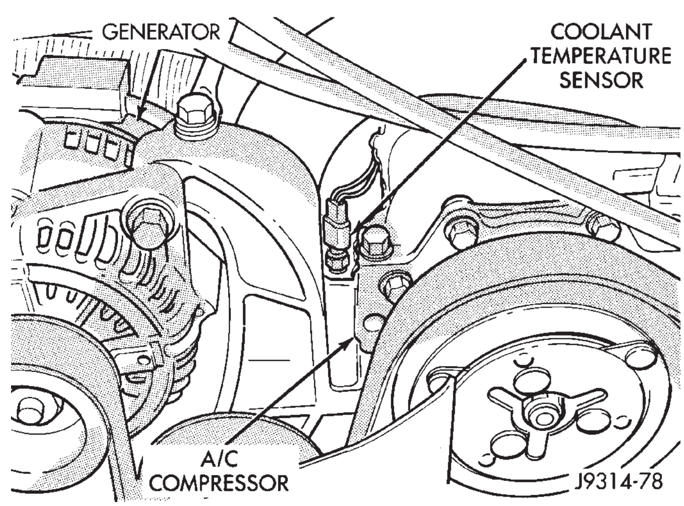


Fig. 6 Engine Coolant Temperature Sensor—5.2L Engines

ENGINE COOLANT TEMPERATURE SENSOR—4.0L ENGINE—PCM INPUT

The engine coolant temperature sensor is installed in the thermostat housing (Fig. 7) and protrudes into the water jacket. The sensor provides an input voltage to the powertrain control module (PCM) relating coolant temperature. The PCM uses this input along with inputs from other sensors to determine injector pulse width and ignition timing. As coolant temperature varies, the coolant temperature sensor's resistance changes. The change in resistance results in a different input voltage to the PCM.

DESCRIPTION AND OPERATION (Continued)

When the engine is cold, the PCM will operate in Open Loop cycle. It will demand slightly richer air-fuel mixtures and higher idle speeds. This is done until normal operating temperatures are reached.

Refer to Open Loop/Closed Loop Modes of Operation in this section of the group for more information.

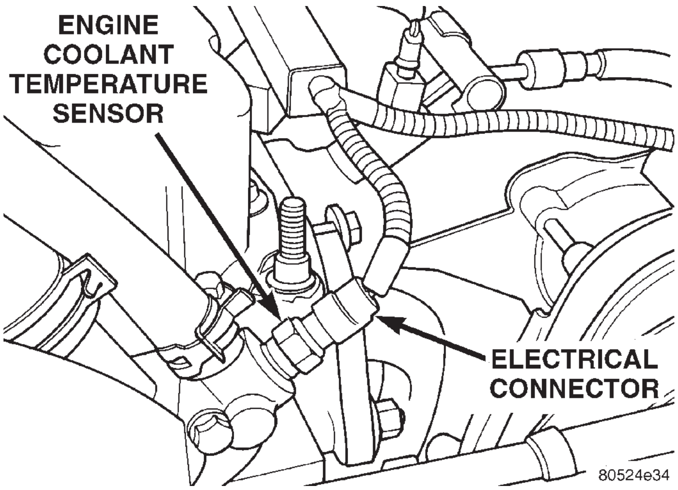


Fig. 7 Engine Coolant Temperature Sensor—4.0L Engine—Typical

OXYGEN SENSOR (O2S)—PCM INPUT

Two heated O2S sensors are used. The sensors produce voltages from 0 to 1 volt, depending upon the oxygen content of the exhaust gas in the exhaust manifold. When a large amount of oxygen is present (caused by a lean air/fuel mixture), the sensors produces a low voltage. When there is a lesser amount present (rich air/fuel mixture) it produces a higher voltage. By monitoring the oxygen content and converting it to electrical voltage, the sensors act as a rich-lean switch.

The oxygen sensors are equipped with a heating element that keeps the sensors at proper operating temperature during all operating modes. Maintaining correct sensor temperature at all times allows the system to enter into closed loop operation sooner. Also, it allows the system to remain in closed loop operation during periods of extended idle.

In Closed Loop operation, the PCM monitors the O2S sensor input (along with other inputs) and adjusts the injector pulse width accordingly. During Open Loop operation, the PCM ignores the O2 sensor input. The PCM adjusts injector pulse width based on preprogrammed (fixed) values and inputs from other sensors.

The Automatic Shutdown (ASD) relay supplies battery voltage to both the upstream and downstream heated oxygen sensors. The oxygen sensors are equipped with a heating element. The heating elements reduce the time required for the sensors to reach operating temperature.

UPSTREAM HEATED OXYGEN SENSOR

The upstream O2S sensor is located near the inlet end of the catalytic converter. It provides an input voltage to the PCM. The input tells the PCM the oxygen content of the exhaust gas. The PCM uses this information to fine tune the air/fuel ratio by adjusting injector pulse width.

DOWNSTREAM HEATED OXYGEN SENSOR

The downstream heated oxygen sensor is located near the outlet end of the catalytic converter. The downstream heated oxygen sensor input is used to detect catalytic convertor deterioration. As the convertor deteriorates, the input from the downstream sensor begins to match the upstream sensor input except for a slight time delay. By comparing the downstream heated oxygen sensor input to the input from the upstream sensor, the PCM calculates catalytic convertor efficiency.

When the catalytic converter efficiency drops below emission standards, the PCM stores a diagnostic trouble code and illuminates the Malfunction Indicator Lamp (MIL). For more information, refer to Group 25, Emission Control Systems.

IGNITION CIRCUIT SENSE—PCM INPUT

The ignition circuit sense input tells the Powertrain Control Module (PCM) the ignition switch has energized the ignition circuit. Refer to the wiring diagrams for circuit information.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR—5.2L ENGINES—PCM INPUT

The intake manifold air temperature sensor is installed in the intake manifold with the sensor element extending into the air stream (Fig. 8). The sensor provides an input voltage to the powertrain control module (PCM) indicating intake manifold air temperature. The input is used along with inputs from other sensors to determine injector pulse width. As the temperature of the air-fuel stream in the manifold varies, the sensor resistance changes. This results in a different input voltage to the PCM.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR—4.0L ENGINE—PCM INPUT

The intake manifold air temperature sensor is installed in the intake manifold with the sensor element extending into the air stream (Fig. 9). The sensor provides an input voltage to the powertrain control module (PCM) indicating intake manifold air temperature. The input is used along with inputs from other sensors to determine injector pulse width. As the temperature of the air-fuel stream in the manifold varies, the sensor resistance changes. This results in a different input voltage to the PCM.

DESCRIPTION AND OPERATION (Continued)

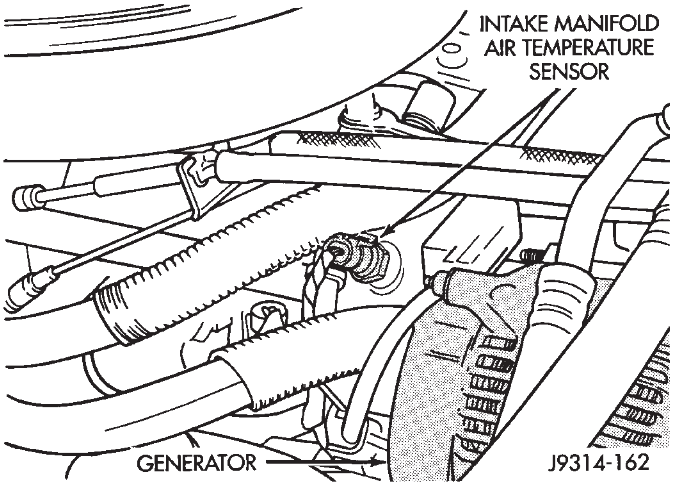


Fig. 8 Intake Manifold Air Temperature Sensor—5.2L Engine

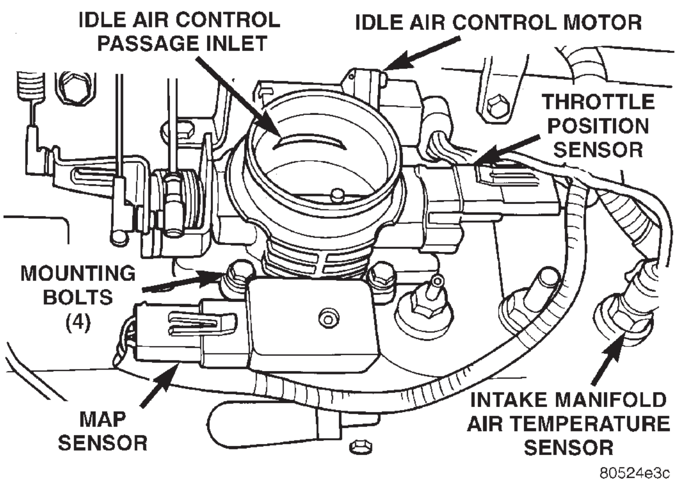


Fig. 9 Intake Air Temp. Sensor Location—4.0L Engine

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR—5.2L ENGINES—PCM INPUT

The MAP sensor reacts to absolute pressure in the intake manifold. It provides an input voltage to the powertrain control module (PCM). As engine load changes, manifold pressure varies. The change in manifold pressure causes MAP sensor voltage to change. The change in MAP sensor voltage results in a different input voltage to the PCM. The input voltage level supplies the PCM with information about ambient barometric pressure during engine start-up (cranking) and engine load while the engine is running. The PCM uses this input along with inputs from other sensors to adjust air-fuel mixture.

The MAP sensor is mounted on the side of the engine throttle body (Fig. 10). The sensor is connected to the throttle body with a rubber L-shaped fitting.

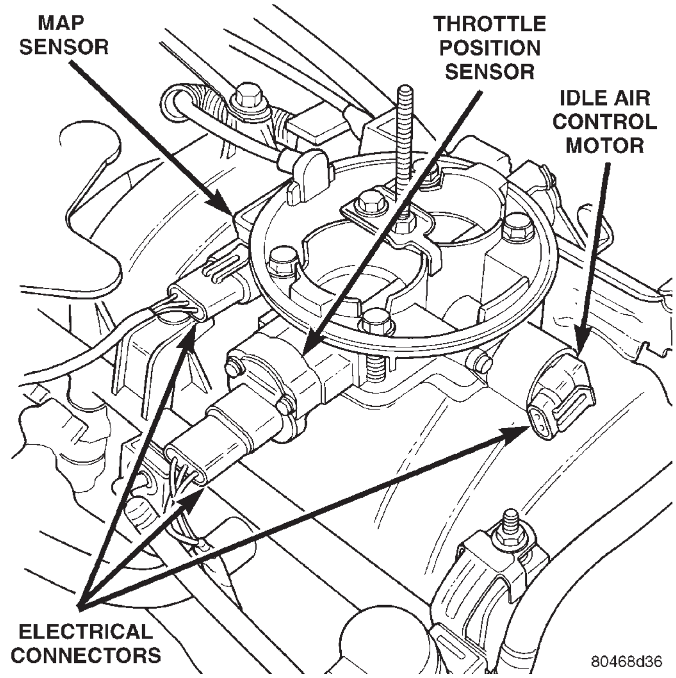


Fig. 10 MAP and Throttle Position Sensor Location—5.2L Engine

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR—4.0L ENGINE—PCM INPUT

The MAP sensor reacts to absolute pressure in the intake manifold. It provides an input voltage to the powertrain control module (PCM). As engine load changes, manifold pressure varies. The change in manifold pressure causes MAP sensor voltage to change. The change in MAP sensor voltage results in a different input voltage to the PCM. The input voltage level supplies the PCM with information about ambient barometric pressure during engine start-up (cranking) and engine load while the engine is running. The PCM uses this input along with inputs from other sensors to adjust air-fuel mixture.

The MAP sensor is mounted on the side of the engine throttle body (Fig. 9). The sensor is connected to the throttle body with a rubber L-shaped fitting.

OUTPUT SHAFT SPEED SENSOR—PCM INPUT

This sensor generates a signal to the PCM relating to the speed of the transmission main drive shaft. This input is used with 4–speed electronic transmissions only. Also refer to Vehicle Speed Sensor—PCM Input for additional information.

OVERDRIVE/OVERRIDE SWITCH-PCM INPUT

On vehicles equipped with an automatic transmission and overdrive, the powertrain control module (PCM) regulates the 3-4 overdrive up-shift and down-shift through the overdrive solenoid. This solenoid is located in the transmission. An overdrive/override

DESCRIPTION AND OPERATION (Continued)

push-button switch is located on the instrument panel.

The PCM circuit for overdrive is controlled by inputs from the engine coolant temperature sensor and vehicle speed sensor. If coolant temperature and vehicle speed are not within the preset PCM specifications, the PCM will not allow the transmission to shift into overdrive. These preset PCM specifications must be met before the push-button switch will be allowed to control overdrive operation.

The overdrive/override push-button switch is normally closed (overdrive allowed) when the lamp is not illuminated. It opens (overdrive not allowed) when the operator presses the switch and the lamp is illuminated. The switch will revert to its normally closed position (lamp off) each time the ignition switch in turned on. The transmission downshifts if the operator presses the override switch while in overdrive.

Refer to Group 21 for more transmission information.

SPEED CONTROL SWITCHES—PCM INPUT

Two separate speed control switch modules are mounted on the steering wheel to the left and right side of the driver's airbag module. Within the two switch modules, five **momentary** contact switches, supporting seven different speed control functions are used. The outputs from these switches are filtered into one input. The Powertrain Control Module (PCM) determines which output has been applied through **resistive multiplexing.** The input circuit voltage is measured by the PCM to determine which switch function has been selected.

A speed control indicator lamp, located on the instrument panel cluster is energized by the PCM via the CCD Bus. This occurs when speed control system power has been turned ON, and the engine is running.

The two switch modules are labeled: ON/OFF, SET, RESUME/ACCEL, CANCEL and COAST. Refer to Group 8H, Speed Control System for more information.

TRANSMISSION PARK/NEUTRAL SWITCH—PCM INPUT

The park/neutral switch is located on the transmission housing and provides an input to the powertrain control module (PCM). This will indicate that the automatic transmission is in Park, Neutral or a drive gear selection. This input is used to determine idle speed (varying with gear selection), fuel injector pulse width, ignition timing advance and vehicle speed control operation. Refer to Group 21, Transmissions, for testing, replacement and adjustment information.

TRANSMISSION GOVERNOR PRESSURE SENSOR—PCM INPUT

Provides a signal proportional to the transmission governor pressure. It provides feedback for control of the variable force solenoid, which regulates transmission governor pressure. This input is used with 4–speed electronic transmissions only.

TRANSMISSION TEMPERATURE SENSOR—PCM INPUT

This input is used in the shift operation for 4–speed electronic transmissions only. The temperature data is used for: torque converter clutch operation, overdrive shift, low temperature shift compensation, wide open throttle shift strategy and governor pressure transducer calibration.

THROTTLE POSITION SENSOR (TPS)—5.2L ENGINE—PCM INPUT

The throttle position sensor (TPS) is mounted on the throttle body (Fig. 10). The TPS is a variable resistor that provides the powertrain control module (PCM) with an input signal (voltage) that represents throttle blade position. The sensor is connected to the throttle blade shaft. As the position of the throttle blade changes, the resistance of the TPS changes.

The PCM supplies approximately 5 volts to the TPS. The TPS output voltage (input signal to the PCM) represents the throttle blade position. The PCM receives an input signal voltage from the TPS. This will vary in an approximate range of from 1 volt at minimum throttle opening (idle), to 4 volts at wide open throttle. Along with inputs from other sensors, the PCM uses the TPS input to determine current engine operating conditions. In response to engine operating conditions, the PCM will adjust fuel injector pulse width and ignition timing.

THROTTLE POSITION SENSOR (TPS)—4.0L ENGINE—PCM INPUT

The throttle position sensor (TPS) is mounted on the throttle body (Fig. 9). The TPS is a variable resistor that provides the powertrain control module (PCM) with an input signal (voltage) that represents throttle blade position. The sensor is connected to the throttle blade shaft. As the position of the throttle blade changes, the resistance of the TPS changes.

The PCM supplies approximately 5 volts to the TPS. The TPS output voltage (input signal to the PCM) represents the throttle blade position. The PCM receives an input signal voltage from the TPS. This will vary in an approximate range of from 1 volt at minimum throttle opening (idle), to 4 volts at wide open throttle. Along with inputs from other sensors, the PCM uses the TPS input to determine current engine operating conditions. In response to engine

DESCRIPTION AND OPERATION (Continued)

operating conditions, the PCM will adjust fuel injector pulse width and ignition timing.

VEHICLE SPEED AND DISTANCE SENSOR—PCM INPUT

The vehicle speed sensor is located on the speedometer pinion gear adapter (Fig. 11). The pinion gear adapter is located on the extension housing of the transmission (drivers side). The sensor input is used by the powertrain control module (PCM) to determine vehicle speed and distance traveled.

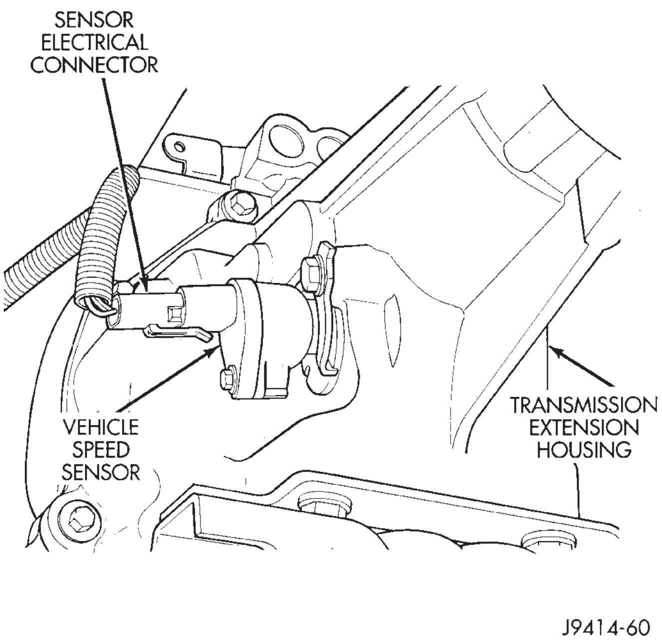


Fig. 11 Vehicle Speed Sensor Location—Typical

The speed sensor generates 8 pulses per sensor revolution. These signals, in conjunction with a closed throttle signal from the throttle position sensor, indicate a closed throttle deceleration to the PCM. When the vehicle is stopped at idle, a closed throttle signal is received by the PCM (but a speed sensor signal is not received).

Under deceleration conditions, the PCM adjusts the idle air control (IAC) motor to maintain a desired MAP value. Under idle conditions, the PCM adjusts the IAC motor to maintain a desired engine speed.

POWER GROUND

The power ground is used to control ground circuits for the following powertrain control module (PCM) loads:

- Generator field winding
- 8 volt (PCM) power supply
- Fuel injectors
- Ignition coil

AIR CONDITIONING (A/C) CLUTCH RELAY—PCM OUTPUT

The A/C relay is located in the Power Distribution Center (PDC). The PDC is located in the engine compartment (Fig. 12). Refer to label on PDC cover for relay location.

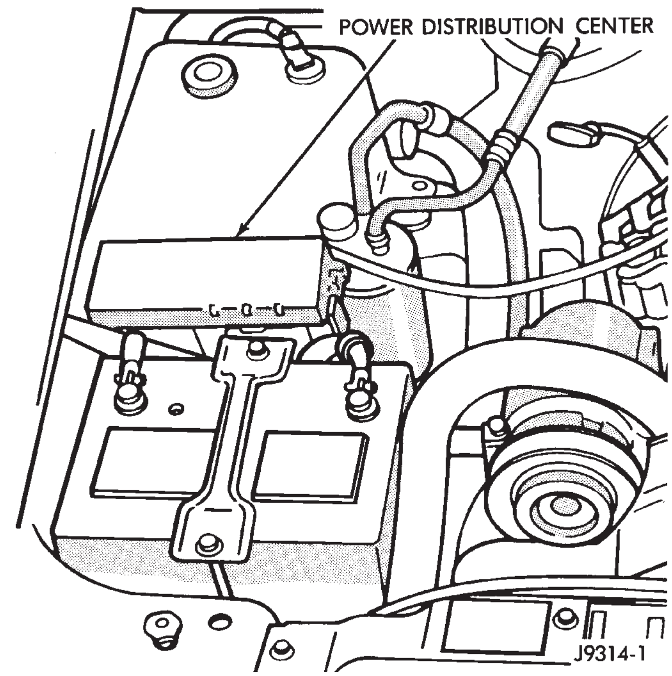


Fig. 12 Power Distribution Center (PDC)

The powertrain control module (PCM) activates the A/C compressor through the A/C clutch relay. The PCM regulates A/C compressor operation by switching the ground circuit for the A/C clutch relay on and off.

When the PCM receives a request for A/C from A/C evaporator switch, it will adjust idle air control (IAC) motor position. This is done to increase idle speed. The PCM will then activate the A/C clutch through the A/C clutch relay. The PCM adjusts idle air control (IAC) stepper motor position to compensate for increased engine load from the A/C compressor.

By switching the ground path for the relay on and off, the PCM is able to cycle the A/C compressor clutch. This is based on changes in engine operating conditions. If, during A/C operation, the PCM senses low idle speeds or a wide open throttle condition, it will de-energize the relay. This prevents A/C clutch engagement. The relay will remain de-energized until the idle speed increases or the wide open throttle condition exceeds 15 seconds or no longer exists. The PCM will also de-energize the relay if coolant temperature exceeds 125°C (257°F).

DESCRIPTION AND OPERATION (Continued)

AUTO SHUTDOWN (ASD) RELAY—PCM OUTPUT

The ASD relay is located in the Power Distribution Center (PDC) (Fig. 12).

The ASD supplies battery voltage to the fuel pump, fuel injector, ignition coil, generator field winding and oxygen (O2S) sensor heating element. The ground circuit for the coil in the ASD relay is controlled by the powertrain control module (PCM). The PCM operates the relay by switching the ground circuit on and off.

The fuel pump relay is controlled by the PCM through same circuit that the ASD relay is controlled.

DATA LINK CONNECTOR—PCM INPUT AND OUTPUT

The 16–way data link connector (diagnostic scan tool connector) links the Diagnostic Readout Box (DRB) scan tool or the Mopar Diagnostic System (MDS) with the powertrain control module (PCM). The data link connector is located under the instrument panel to the left of the steering column (Fig. 13). For operation of the DRB scan tool, refer to the appropriate Powertrain Diagnostic Procedures service manual.

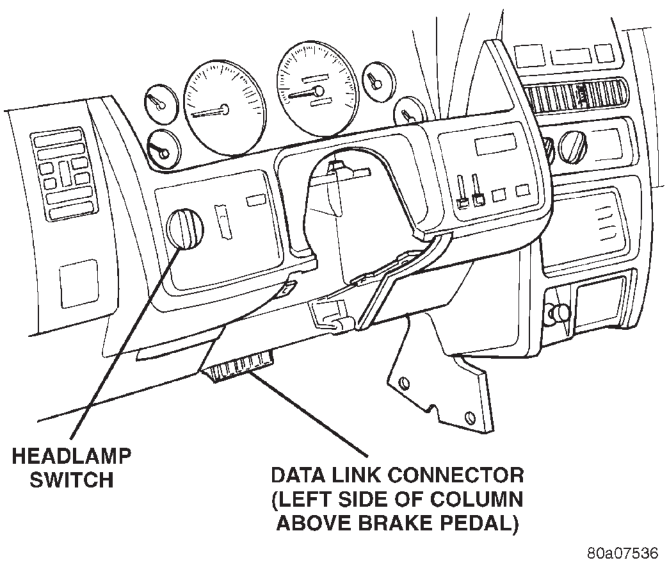


Fig. 13 Data Link Connector Location

DUTY CYCLE EVAP PURGE SOLENOID VALVE-PCM OUTPUT

Refer to Group 25, Emission Control System for information.

FUEL INJECTORS—5.2L ENGINES—PCM OUTPUT

The fuel injectors are attached to the fuel rail (Fig. 14). 5.2L V-8 engines use eight injectors.

The nozzle ends of the injectors are positioned into openings in the intake manifold just above the intake valve ports of the cylinder head. The engine wiring harness connector for each fuel injector is equipped with an attached numerical tag (INJ 1, INJ 2 etc.). This is used to identify each fuel injector with its respective cylinder number.

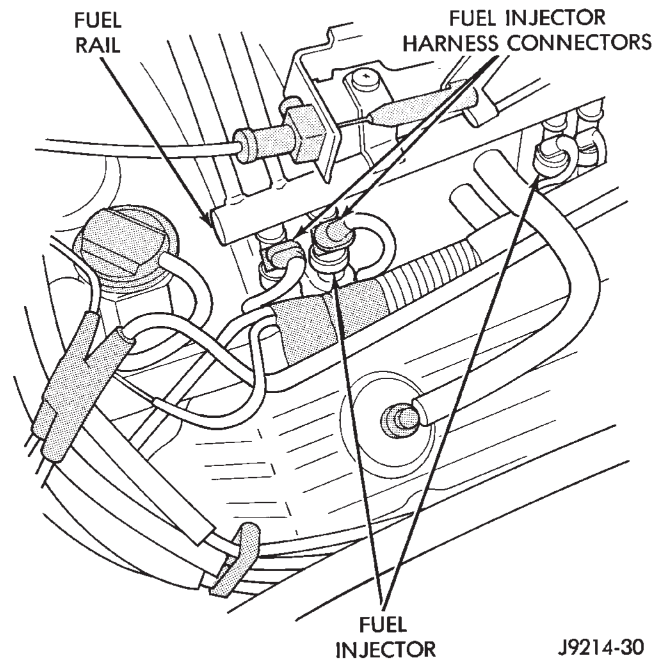


Fig. 14 Fuel Injectors—5.2L Engines—Typical

The injectors are energized individually in a sequential order by the powertrain control module (PCM). The PCM will adjust injector pulse width by switching the ground path to each individual injector on and off. Injector pulse width is the period of time that the injector is energized. The PCM will adjust injector pulse width based on various inputs it receives.

During start up, battery voltage is supplied to the injectors through the ASD relay. When the engine is operating, voltage is supplied by the charging system. The PCM determines injector pulse width based on various inputs.

FUEL INJECTORS—4.0L ENGINE—PCM OUTPUT

Six individual fuel injectors are used with the 4.0L 6-cylinder engine. The injectors are attached to the fuel rail (Fig. 15).

The nozzle ends of the injectors are positioned into openings in the intake manifold just above the intake valve ports of the cylinder head. The engine wiring harness connector for each fuel injector is equipped with an attached numerical tag (INJ 1, INJ 2 etc.). This is used to identify each fuel injector.

The injectors are energized individually in a sequential order by the powertrain control module (PCM). The PCM will adjust injector pulse width by switching the ground path to each individual injector

DESCRIPTION AND OPERATION (Continued)

on and off. Injector pulse width is the period of time that the injector is energized. The PCM will adjust injector pulse width based on various inputs it receives.

During start up, battery voltage is supplied to the injectors through the ASD relay. When the engine is operating, voltage is supplied by the charging system. The PCM determines injector pulse width based on various inputs.

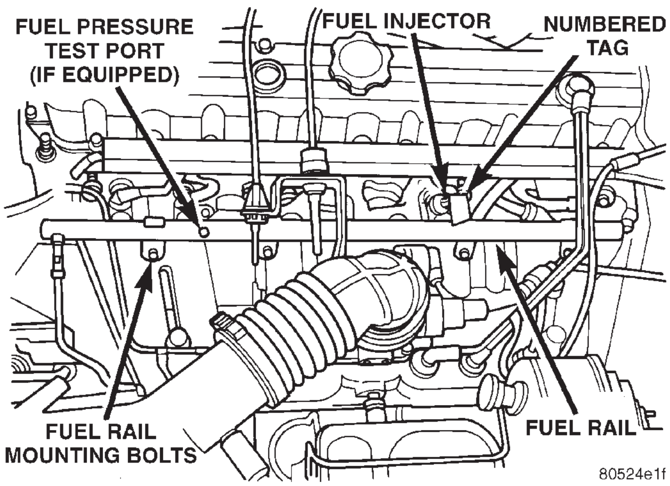


Fig. 15 Fuel Injectors—4.0L Engine

FUEL PUMP RELAY-PCM OUTPUT

The PCM energizes the electric fuel pump and the oxygen sensor (O2S) heating element through the fuel pump relay. Battery voltage is applied to the fuel pump relay when the ignition key is ON. The relay is energized when a ground signal is provided by the PCM.

Refer to Automatic Shutdown Relay—PCM Output for additional information.

The fuel pump will operate for approximately one second unless the engine is operating or the starter motor is engaged.

The fuel pump relay is located in the Power Distribution Center (PDC) (Fig. 12).

GENERATOR FIELD—PCM OUTPUT

The powertrain control module (PCM) regulates the charging system voltage within a range of 12.9 to 15.0 volts. Refer to Groups 8A and 8C for charging system information.

GENERATOR LAMP—PCM OUTPUT

If the powertrain control module (PCM) senses a low charging condition in the charging system, it will illuminate the generator lamp (if equipped) on the instrument panel. For example, during low idle with all accessories turned on, the lamp may momentarily go on. Once the PCM corrects idle speed to a higher rpm, the lamp will go out. Refer to Groups 8A and 8C for charging system information.

IDLE AIR CONTROL (IAC) MOTOR—5.2L ENGINES—PCM OUTPUT

The IAC motor is mounted to the back of the throttle body (Fig. 10) and is controlled by the powertrain control module (PCM).

The throttle body has an air control passage that provides air for the engine at idle (the throttle plate is closed). The IAC motor pintle protrudes into the air control passage (Fig. 16) and regulates air flow through it. Based on various sensor inputs, the powertrain control module (PCM) adjusts engine idle speed by moving the IAC motor pintle in and out of the air control passage. The IAC motor is positioned when the ignition key is turned to the On position.

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the PCM.

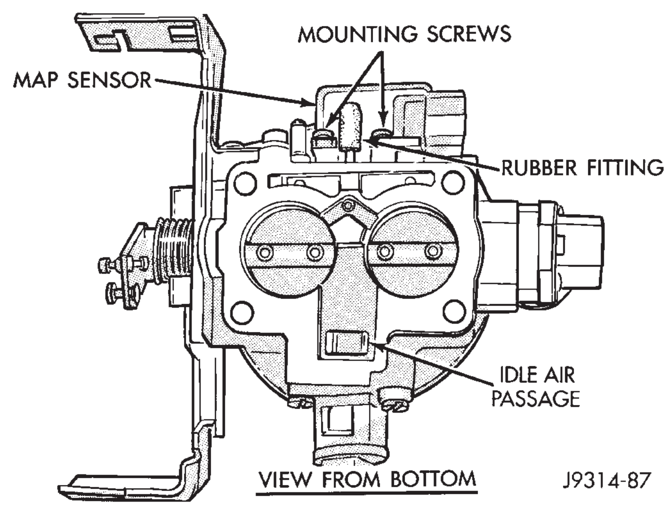


Fig. 16 Throttle Body Air Control Passage—5.2L Engine

IDLE AIR CONTROL (IAC) MOTOR—4.0L ENGINE—PCM OUTPUT

The IAC motor is mounted on the throttle body (Fig. 9) and is controlled by the powertrain control module (PCM).

The throttle body has an air control passage that provides air for the engine at idle (the throttle plate is closed). The IAC motor pintle protrudes into the air control passage and regulates air flow through it. Based on various sensor inputs, the powertrain control module (PCM) adjusts engine idle speed by moving the IAC motor pintle in and out of the air control passage. The IAC motor is positioned when the ignition key is turned to the On position.

DESCRIPTION AND OPERATION (Continued)

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the PCM.

IGNITION COIL—5.2L ENGINES—PCM OUTPUT

System voltage is supplied to the ignition coil positive terminal. The powertrain control module (PCM) operates the ignition coil. **Base (initial) ignition timing is not adjustable.** The PCM adjusts ignition timing to meet changing engine operating conditions.

The ignition coil is located near the front of the right cylinder head (Fig. 17).

Refer to Group 8D, Ignition System for additional information.

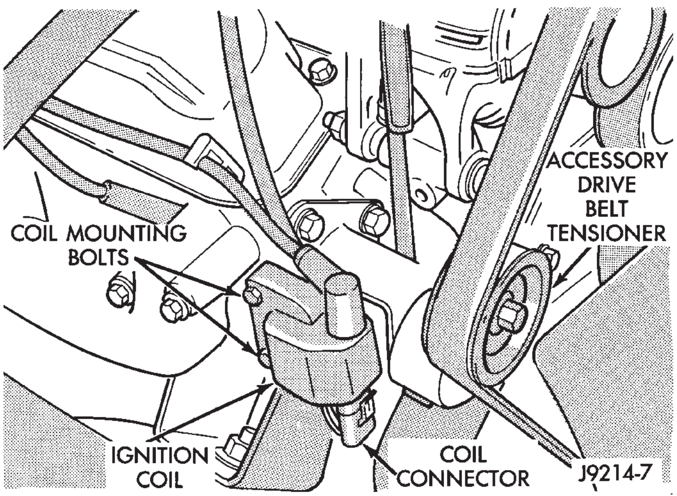


Fig. 17 Ignition Coil—5.2L Engine

IGNITION COIL—4.0L ENGINES—PCM OUTPUT

System voltage is supplied to the ignition coil positive terminal. The powertrain control module (PCM) operates the ignition coil. **Base (initial) ignition timing is not adjustable.** The PCM adjusts ignition timing to meet changing engine operating conditions.

The ignition coil is located near the distributor (Fig. 18).

Refer to Group 8D, Ignition System for additional information.

MALFUNCTION INDICATOR (CHECK ENGINE) LAMP—PCM OUTPUT

The malfunction indicator lamp illuminates each time the ignition key is turned on. It will stay on for approximately three seconds as a bulb test. The lamp is displayed on the instrument panel as the CHECK ENGINE lamp.

If the powertrain control module (PCM) receives an incorrect signal, or no signal from certain sensors or emission related systems, the lamp is turned on. This is a warning that the PCM has recorded a system or

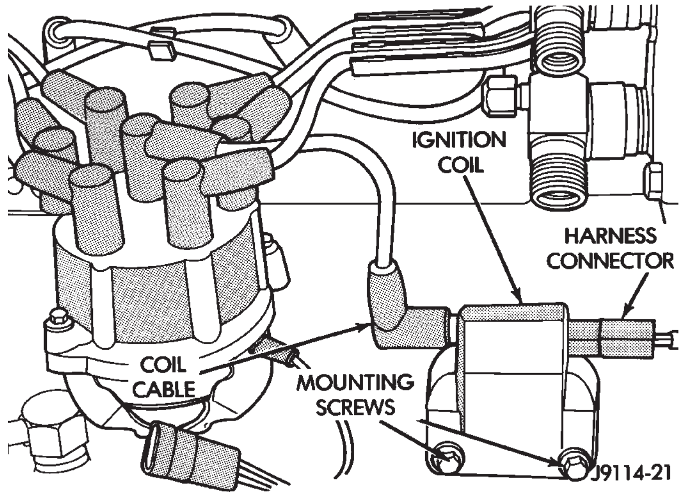


Fig. 18 Ignition Coil—4.0L Engine

sensor malfunction. In some cases, when a problem is declared, the PCM will go into a limp-in mode. This is an attempt to keep the system operating. It signals an immediate need for service.

The lamp can also be used to display a Diagnostic Trouble Code (DTC). Cycle the ignition switch On-Off-On-Off-On within three seconds and any codes stored in the PCM memory will be displayed. This is done in a series of flashes representing digits.

The lamp is also used to detect certain engine misfires. Refer to Group 25, Emission Control System for more information.

OVERDRIVE LAMP—PCM OUTPUT

This circuit controls a signal for the operation of the instrument panel mounted push-button overdrive lamp switch. When the lamp is illuminated, the overdrive is disengaged.

SPEED CONTROL SOLENOIDS—PCM OUTPUT

Speed control operation is regulated by the powertrain control module (PCM). The PCM controls the vacuum to the throttle actuator through the speed control vacuum and vent solenoids. Refer to Group 8H for Speed Control Information.

TACHOMETER—PCM OUTPUT

The powertrain control module (PCM) supplies engine rpm values to the instrument cluster tachometer. Refer to Group 8E for tachometer information.

THREE-FOUR SHIFT SOLENOID—PCM OUTPUT

This output is used to control the transmission three-four shift solenoid. It is used on 4–speed electronically controlled automatic transmissions only.

DESCRIPTION AND OPERATION (Continued)

TORQUE CONVERTOR CLUTCH (TCC) SOLENOID—PCM OUTPUT

This circuit controls operation of the transmission mounted torque convertor clutch (TCC) solenoid used for torque convertor engagement.

The powertrain control module (PCM) will determine when to engage and disengage the solenoid by monitoring vehicle miles per hour (mph) versus the output voltage of the throttle position sensor. Also needed are various inputs from:

- Engine coolant temperature
- Module timer
- Engine rpm
- MAP sensor

MANUAL TRANSMISSION

If equipped with a manual transmission, this PCM output will control operation of the shift indicator lamp (if equipped with lamp). The lamp is controlled by the powertrain control module (PCM). The lamp illuminates on the instrument panel to indicate when the driver should shift to the next highest gear for best fuel economy. The PCM will turn the lamp OFF after 3 to 5 seconds if the shift of gears is not performed. The lamp will remain off until vehicle stops accelerating and is brought back to range of up-shift lamp operation. This will also happen if vehicle is shifted into fifth gear.

The indicator lamp is normally illuminated when the ignition switch is turned on and it is turned off when the engine is started up. With the engine running, the lamp is turned ON/OFF depending upon engine speed and load.

TRANSMISSION RELAY—PCM OUTPUT

The output to this relay provides battery voltage to the overdrive (OD), torque converter clutch (TCC) and variable force (VSS) solenoids. Once battery voltage is applied to the solenoids, they are individually activated by the PCM through OD, TCC and VSS outputs. The relay is located in the Power Distribution Center (PDC). Refer to label on PDC cover for relay location.

VARIABLE FORCE SOLENOID—PCM OUTPUT

This solenoid regulates the transmission fluid line pressure to produce the governor pressure necessary for transmission shift control. It is used on 4–speed electronic transmissions only.

THROTTLE BODY—5.2L ENGINES

Filtered air from the air cleaner enters the intake manifold through the throttle body (Fig. 19). Fuel does not enter the intake manifold through the throttle body. Fuel is sprayed into the manifold by the fuel injectors. The throttle body is mounted on the intake manifold. It contains an air control passage (Fig. 20) controlled by an idle air control (IAC) motor. The air control passage is used to supply air for idle conditions. A throttle valve (plate) is used to supply air for above idle conditions.

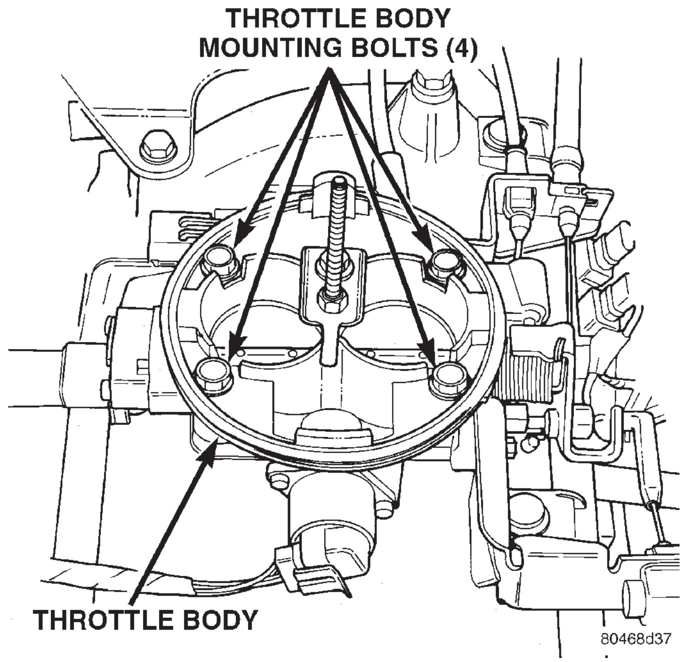


Fig. 19 Throttle Body—5.2L Engine—Typical

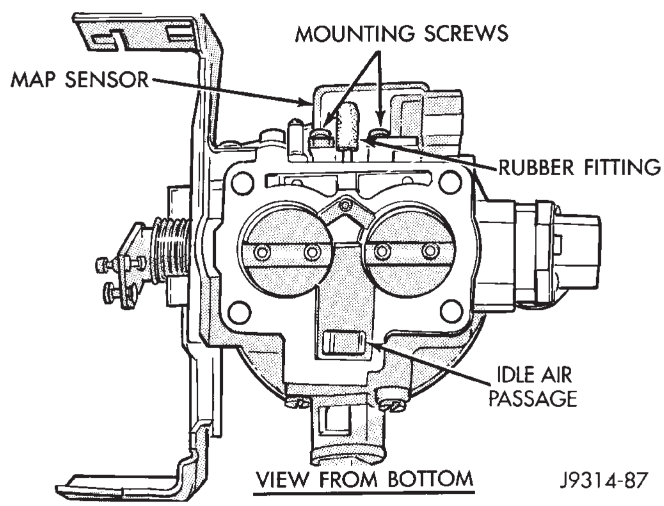


Fig. 20 Air Control Passage—5.2L Engine

The throttle position sensor (TPS), idle air control (IAC) motor and manifold absolute pressure sensor (MAP) are attached to the throttle body. The accelerator pedal cable, speed control cable and transmission control cable (when equipped) are connected to the throttle arm.

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle**

DESCRIPTION AND OPERATION (Continued)

speed using this screw. All idle speed functions are controlled by the PCM.

THROTTLE BODY—4.0L ENGINE

Filtered air from the air cleaner enters the intake manifold through the throttle body (Fig. 21). Fuel does not enter the intake manifold through the throttle body. Fuel is sprayed into the manifold by the fuel injectors. The throttle body is mounted on the intake manifold. It contains an air control passage (Fig. 21) controlled by an idle air control (IAC) motor. The air control passage is used to supply air for idle conditions. A throttle valve (plate) is used to supply air for above idle conditions.

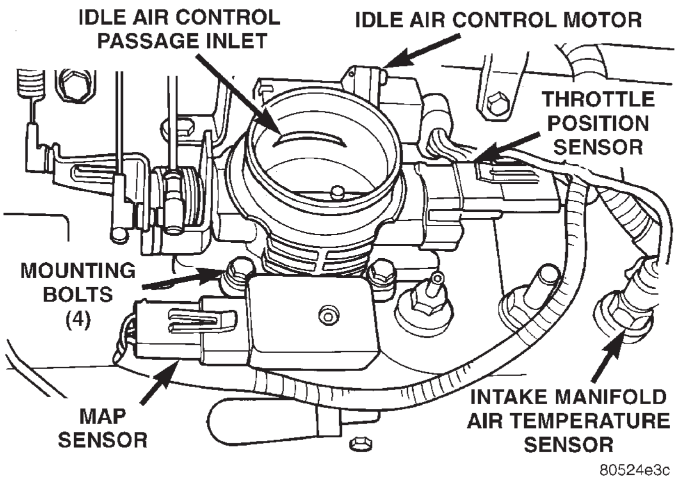


Fig. 21 Throttle Body—4.0L Engine

The throttle position sensor (TPS), idle air control (IAC) motor and manifold absolute pressure sensor (MAP) are attached to the throttle body. The accelerator pedal cable, speed control cable and transmission control cable (when equipped) are connected to the throttle arm.

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the PCM.

DIAGNOSIS AND TESTING

VISUAL INSPECTION—5.2L ENGINE

A visual inspection for loose, disconnected or incorrectly routed wires and hoses should be made. This should be done before attempting to diagnose or service the fuel injection system. A visual check will help spot these faults and save unnecessary test and diagnostic time. A thorough visual inspection will include the following checks:

(1) Verify that the three 32–way electrical connectors are fully inserted into the connector of the powertrain control module (PCM) (Fig. 22).

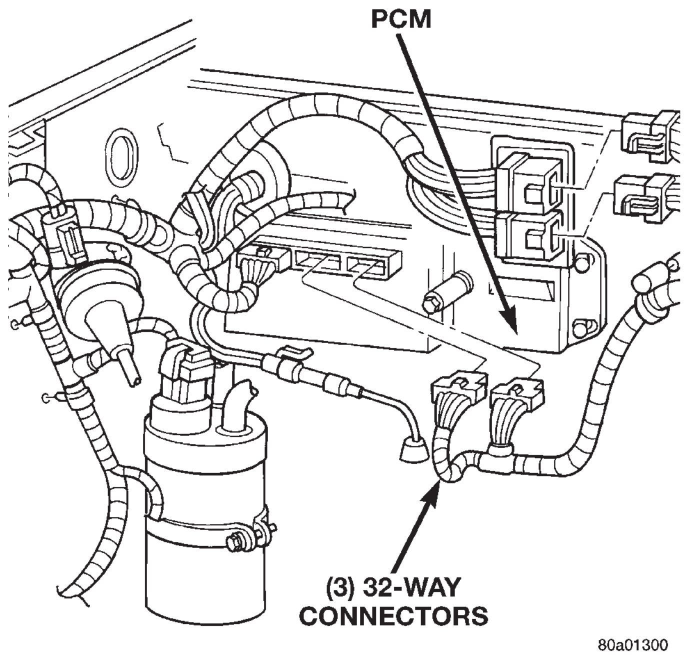


Fig. 22 Powertrain Control Module (PCM)

(2) Inspect the battery cable connections. Be sure that they are clean and tight.

(3) Inspect fuel pump relay and air conditioning compressor clutch relay (if equipped). Inspect the ASD relay connections. Inspect starter motor relay connections. Inspect relays for signs of physical damage and corrosion. The relays are located in the Power Distribution Center (PDC) (Fig. 23). Refer to label on PDC cover for relay location.

(4) Inspect ignition coil connections. Verify that coil secondary cable is firmly connected to coil (Fig. 24).

(5) Verify that distributor cap is correctly attached to distributor. Be sure that spark plug cables are firmly connected to the distributor cap and the spark plugs are in their correct firing order. Be sure that coil cable is firmly connected to distributor cap and coil. Be sure that camshaft position sensor wire connector (at the distributor) is firmly connected to harness connector. Inspect spark plug condition. Refer to Group 8D, Ignition. Connect vehicle to an oscilloscope and inspect spark events for fouled or damaged spark plugs or cables.

(6) Verify that generator output wire, generator connector and ground wire are firmly connected to the generator.

(7) Inspect the system body grounds for loose or dirty connections. Refer to Group 8, Wiring for ground locations.

DIAGNOSIS AND TESTING (Continued)

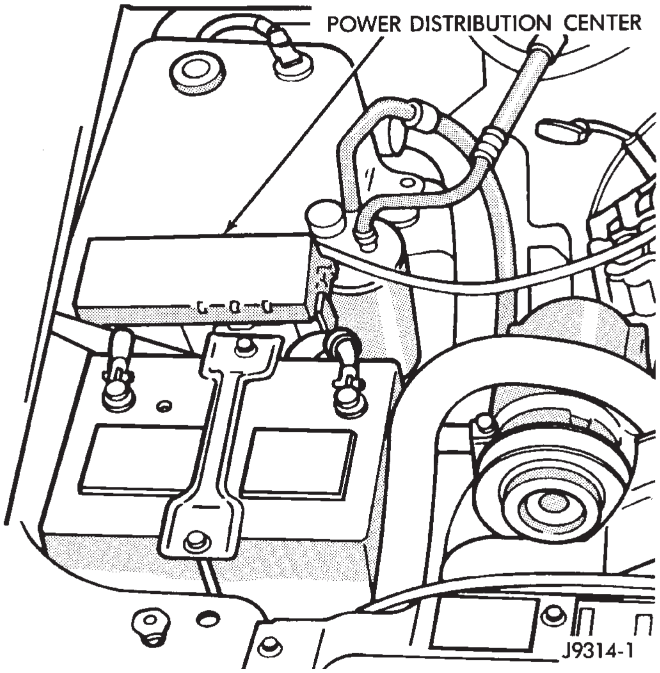


Fig. 23 Power Distribution Center (PDC)

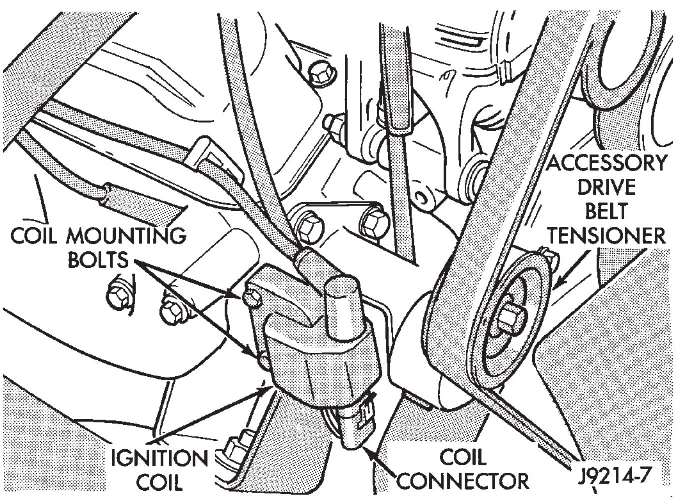


Fig. 24 Ignition Coil—5.2L Engine

(8) Verify positive crankcase ventilation (PCV) valve operation. Refer to Group 25, Emission Control System for additional information. Verify PCV valve hose is firmly connected to PCV valve and manifold (Fig. 25).

(9) Inspect fuel tube quick-connect fitting-to-fuel rail connections.

(10) Verify that hose connections to all ports of vacuum fittings on intake manifold are tight and not leaking.

(11) Inspect accelerator cable, transmission throttle cable (if equipped) and cruise control cable connections (if equipped). Check their connections to the throttle arm of throttle body for any binding or restrictions.

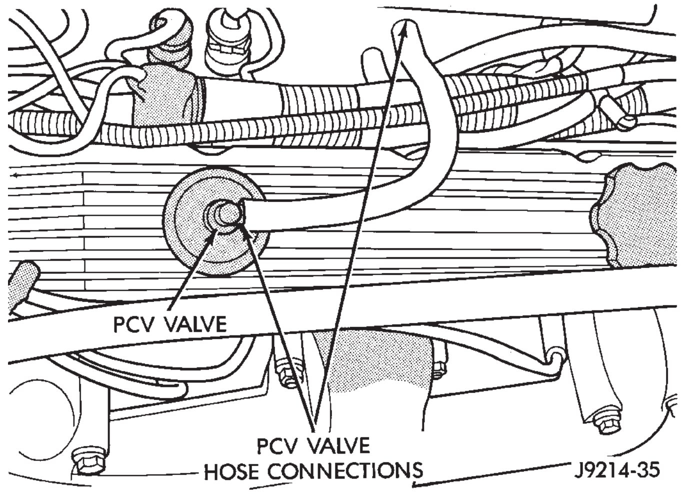


Fig. 25 PCV Valve Hose Connections—5.2L Engines—Typical

(12) If equipped with vacuum brake booster, verify that vacuum booster hose is firmly connected to fitting on intake manifold. Also check connection to brake vacuum booster.

(13) Inspect the air cleaner inlet and air cleaner element for dirt or restrictions.

(14) Inspect radiator grille area, radiator fins and air conditioning condenser for restrictions.

(15) Verify that the intake manifold air temperature sensor wire connector is firmly connected to harness connector (Fig. 26).

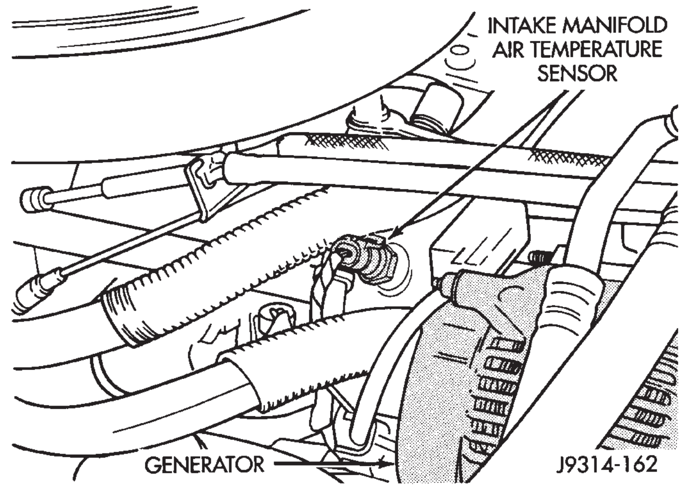


Fig. 26 Air Temperature Sensor—5.2L Engine

(16) Verify that MAP sensor electrical connector is firmly connected to MAP sensor (Fig. 27). Also verify that rubber L-shaped fitting from MAP sensor to the throttle body is firmly connected (Fig. 28).

(17) Verify that fuel injector wire harness connectors are firmly connected to injectors in the correct order. Each harness connector is numerically tagged with the injector number (INJ 1, INJ 2 etc.) of its corresponding fuel injector and cylinder number.

DIAGNOSIS AND TESTING (Continued)

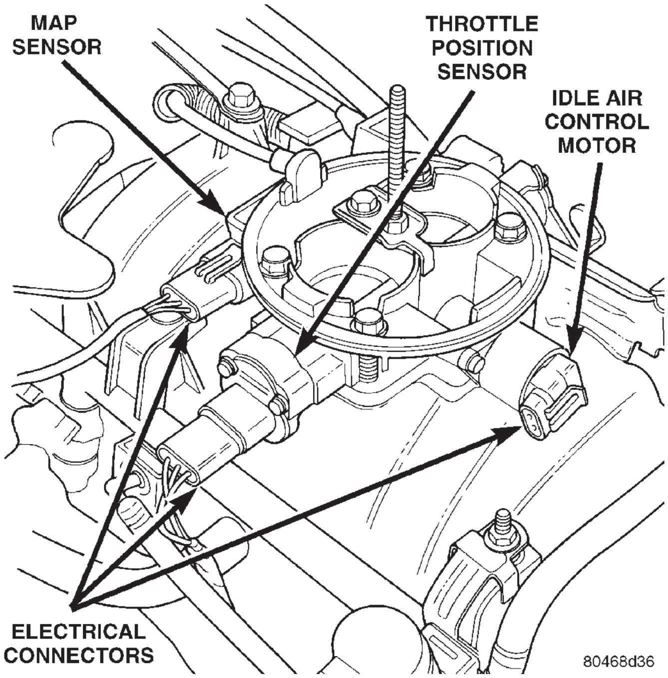


Fig. 27 Sensor and IAC Motor Location—5.2L Engine

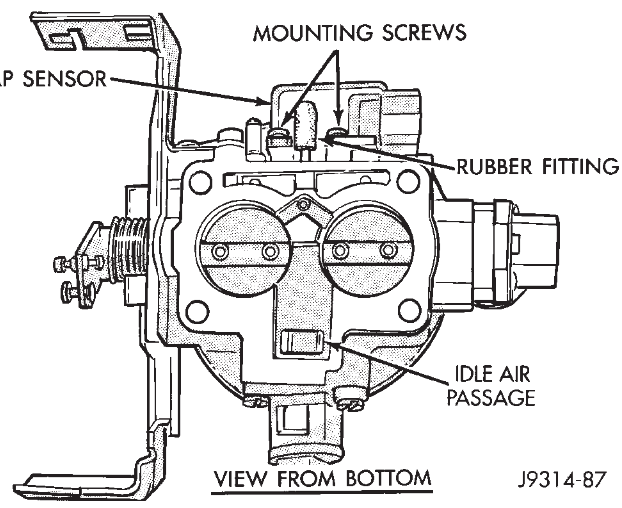


Fig. 28 Rubber L-Shaped Fitting—MAP Sensor-to-Throttle Body

(18) Verify harness connectors are firmly connected to idle air control (IAC) motor, throttle position sensor (TPS) and manifold absolute pressure (MAP) sensor (Fig. 27).

(19) Verify that wire harness connector is firmly connected to the engine coolant temperature sensor (Fig. 29).

(20) Raise and support the vehicle.

(21) Verify that both the upstream and downstream oxygen sensor wire connectors are firmly connected to the sensors. Inspect sensors and connectors for damage (Fig. 30) or (Fig. 31).

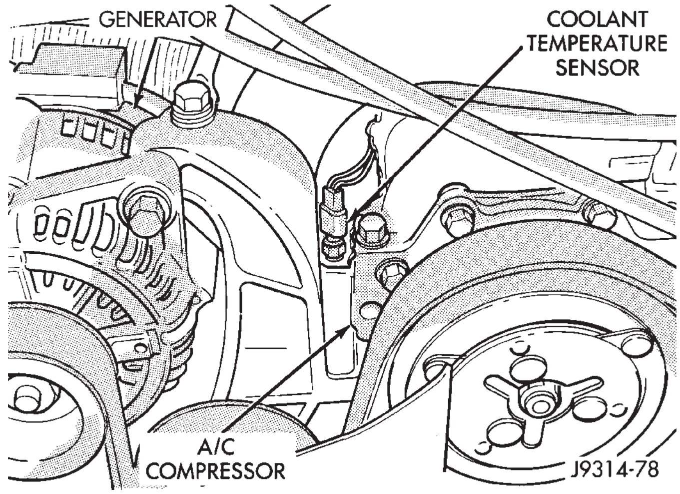


Fig. 29 Engine Coolant Temperature Sensor—5.2L Engines—Typical

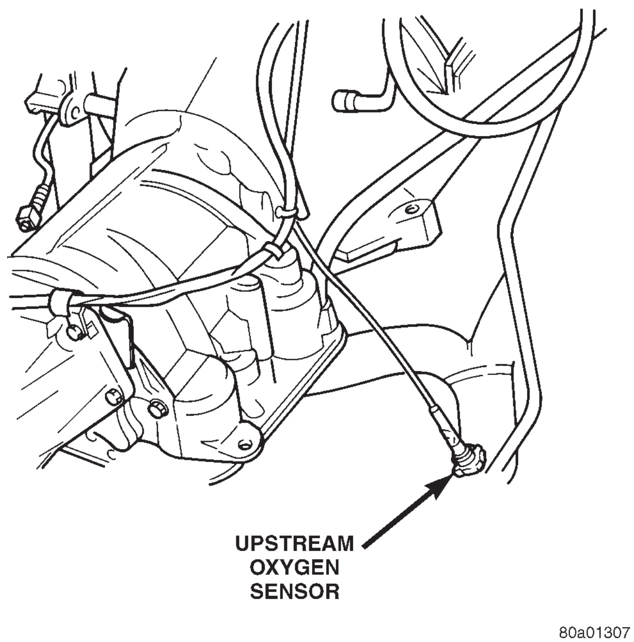


Fig. 30 Upstream Oxygen Sensor—5.2L Engine

(22) Inspect for pinched or leaking fuel tubes. Inspect for pinched, cracked or leaking fuel hoses.

(23) Inspect for exhaust system restrictions such as pinched exhaust pipes, collapsed muffler or plugged catalytic convertor.

(24) If equipped with automatic transmission, verify that electrical harness is firmly connected to park/neutral switch. Refer to Automatic Transmission section of Group 21.

(25) Verify that the electrical harness connector is firmly connected to the vehicle speed sensor (Fig. 32).

(26) Verify that fuel pump/gauge sender unit wire connector is firmly connected to harness connector.

DIAGNOSIS AND TESTING (Continued)

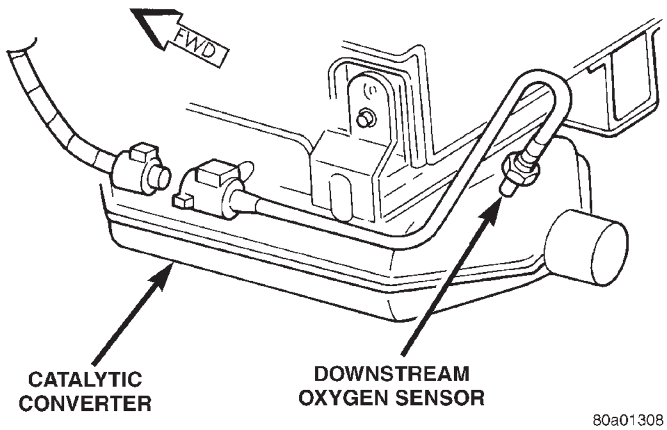


Fig. 31 Downstream Oxygen Sensor—5.2L Engine

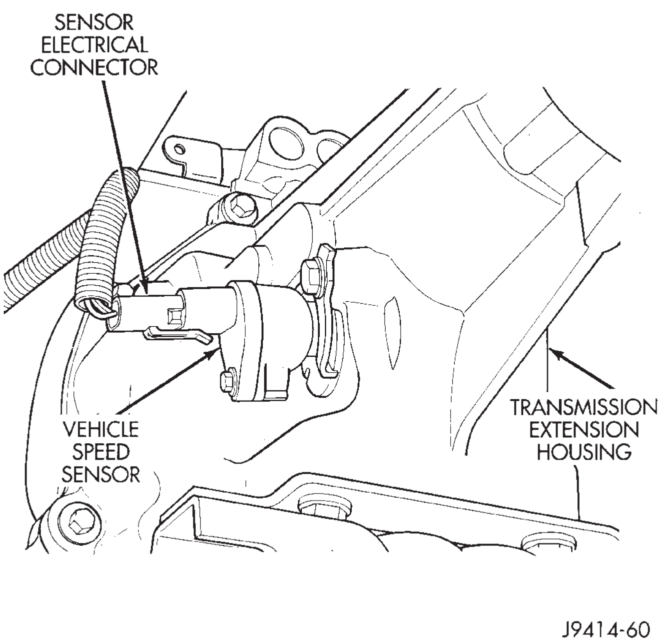


Fig. 32 Vehicle Speed Sensor—Typical

(27) Inspect fuel hoses at fuel pump/gauge sender unit for cracks or leaks.

(28) Inspect transmission torque convertor housing (automatic transmission) or clutch housing (manual transmission) for damage to timing ring on drive plate/flywheel.

(29) Verify that battery cable and solenoid feed wire connections to the starter solenoid are tight and clean. Inspect for chaffed wires or wires rubbing up against other components.

VISUAL INSPECTION—4.0L ENGINE

A visual inspection for loose, disconnected or incorrectly routed wires and hoses should be made. This should be done before attempting to diagnose or service the fuel injection system. A visual check will help spot these faults and save unnecessary test and diagnostic time. A thorough visual inspection will include the following checks:

(1) Verify that the three 32–way electrical connectors are fully inserted into the connector of the powertrain control module (PCM) (Fig. 33).

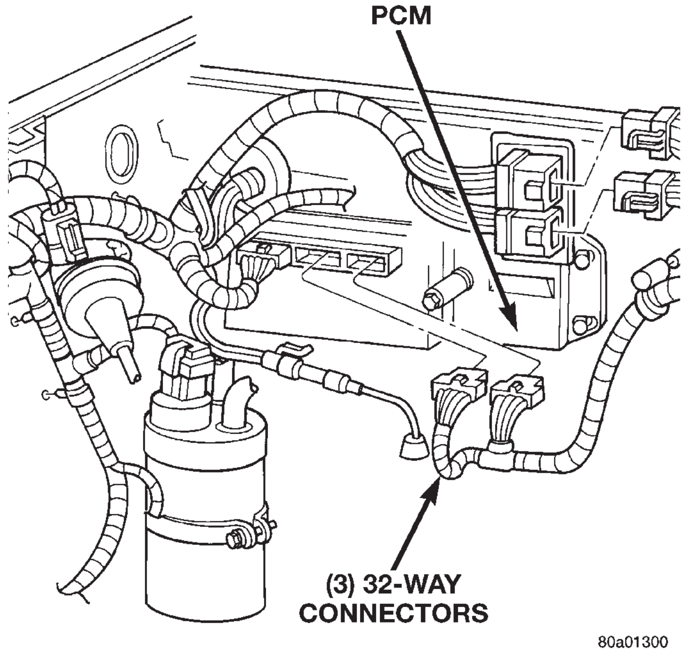


Fig. 33 Powertrain Control Module (PCM)

(2) Inspect the battery cable connections. Be sure that they are clean and tight.

(3) Inspect fuel pump relay and air conditioning compressor clutch relay (if equipped). Inspect the ASD relay connections. Inspect starter motor relay connections. Inspect relays for signs of physical damage and corrosion. The relays are located in the Power Distribution Center (PDC) (Fig. 34). Refer to label on PDC cover for relay location.

(4) Inspect ignition coil connections. Verify that coil secondary cable is firmly connected to coil (Fig. 35).

(5) Verify that distributor cap is correctly attached to distributor. Be sure that spark plug cables are firmly connected to the distributor cap and the spark plugs are in their correct firing order (Fig. 36). Be sure that coil cable is firmly connected to distributor cap and coil. Be sure that camshaft position sensor wire connector (at the distributor) is firmly connected to harness connector. Inspect spark plug condition. Refer to Group 8D, Ignition. Connect vehicle to an oscilloscope and inspect spark events for fouled or damaged spark plugs or cables.

(6) Verify that generator output wire, generator connector and ground wire are firmly connected to the generator.

(7) Inspect the system body grounds for loose or dirty connections. Refer to Group 8, Wiring for ground locations.

DIAGNOSIS AND TESTING (Continued)

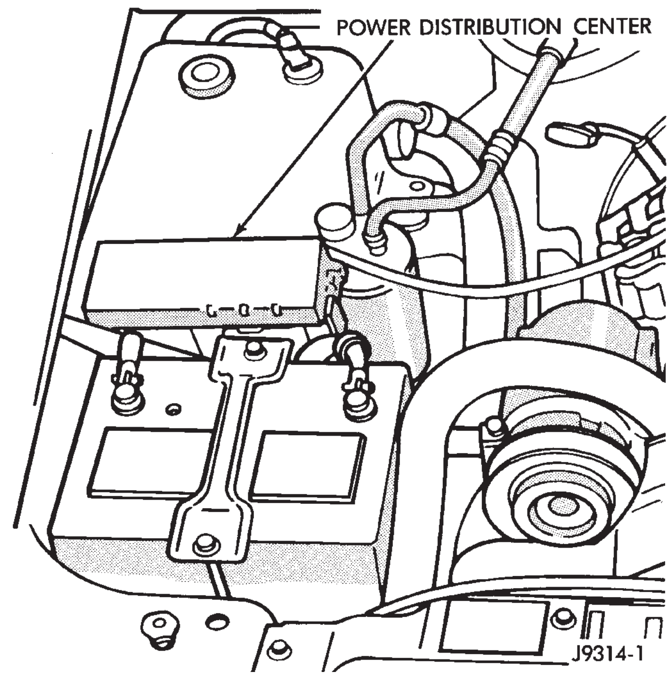


Fig. 34 Power Distribution Center (PDC)

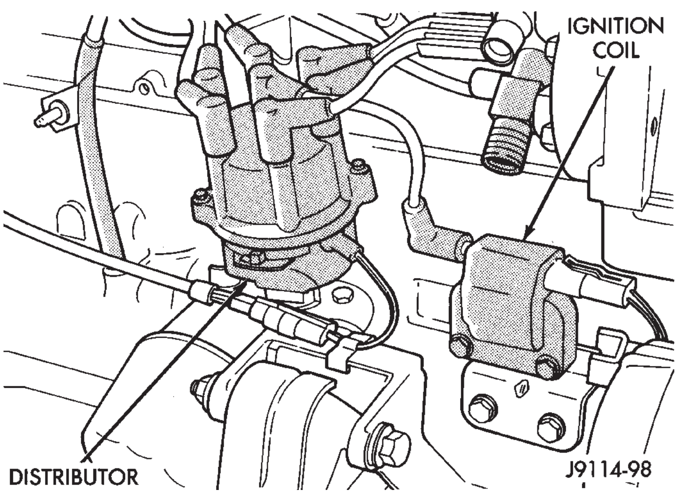


Fig. 35 Ignition Coil—4.0L Engine

(8) Verify crankcase ventilation (CCV) operation. Refer to Group 25, Emission Control System for additional information.

(9) Inspect fuel tube quick-connect fitting-to-fuel rail connections.

(10) Verify that hose connections to all ports of vacuum fittings on intake manifold are tight and not leaking.

(11) Inspect accelerator cable, transmission throttle cable (if equipped) and cruise control cable connections (if equipped). Check their connections to the throttle arm of throttle body for any binding or restrictions.

(12) If equipped with vacuum brake booster, verify that vacuum booster hose is firmly connected to fit-

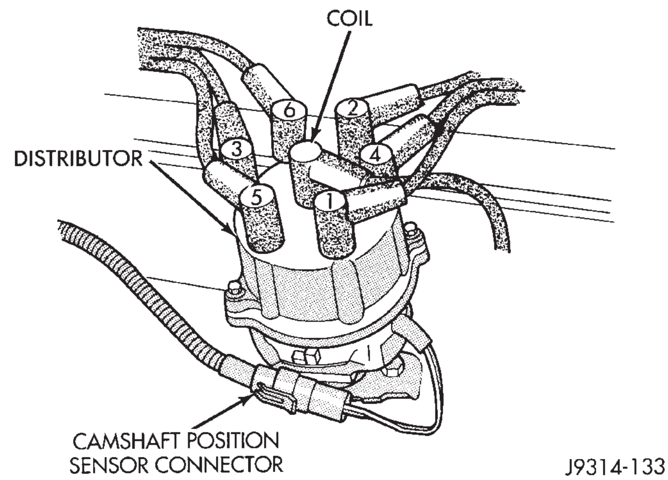


Fig. 36 Distributor and Wiring—4.0L Engine

ting on intake manifold. Also check connection to brake vacuum booster.

(13) Inspect the air cleaner inlet and air cleaner element for dirt or restrictions.

(14) Inspect radiator grille area, radiator fins and air conditioning condenser for restrictions.

(15) Verify that the intake manifold air temperature sensor wire connector is firmly connected to harness connector (Fig. 37).

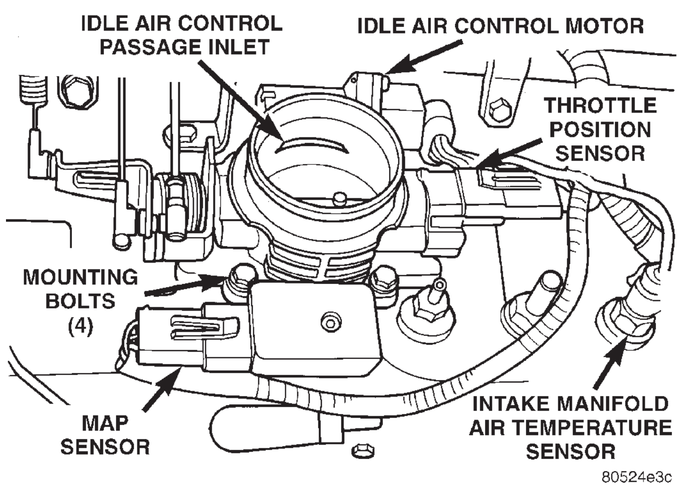


Fig. 37 Sensor Locations—4.0L Engine

(16) Verify that MAP sensor electrical connector is firmly connected to MAP sensor (Fig. 37). Also verify that rubber L-shaped fitting from MAP sensor to the throttle body is firmly connected (Fig. 38).

(17) Verify that fuel injector wire harness connectors are firmly connected to injectors in the correct order. Each harness connector is numerically tagged with the injector number (INJ 1, INJ 2 etc.) of its corresponding fuel injector and cylinder number.

(18) Verify harness connectors are firmly connected to idle air control (IAC) motor and throttle position sensor (TPS) (Fig. 37).

DIAGNOSIS AND TESTING (Continued)

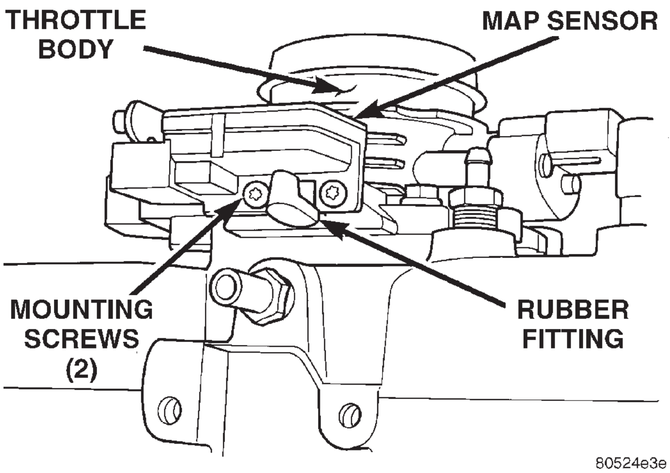


Fig. 38 Rubber L-Shaped Fitting—MAP Sensor-to-Throttle Body

(19) Verify that wire harness connector is firmly connected to the engine coolant temperature sensor (Fig. 39).

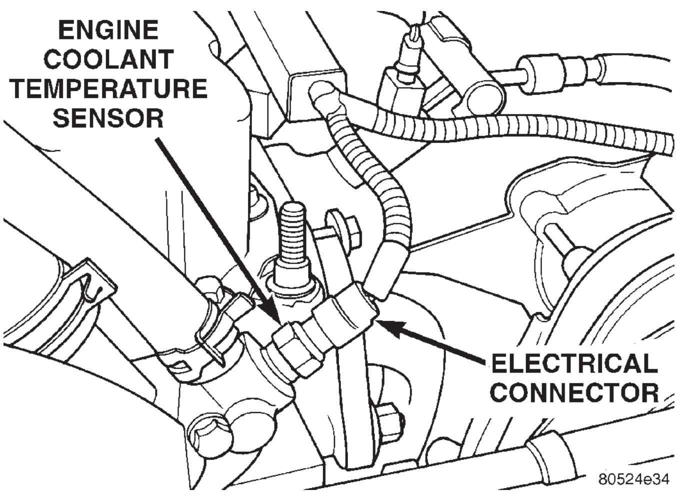


Fig. 39 Engine Coolant Temp. Sensor—4.0L Shown

(20) Raise and support the vehicle.

(21) Verify that both of the oxygen sensor wire connectors are firmly connected to the sensors. Inspect sensors and connectors for damage (Fig. 40) or (Fig. 41).

(22) Inspect for pinched or leaking fuel tubes. Inspect for pinched, cracked or leaking fuel hoses.

(23) Inspect for exhaust system restrictions such as pinched exhaust pipes, collapsed muffler or plugged catalytic convertor.

(24) If equipped with automatic transmission, verify that electrical harness is firmly connected to park/neutral switch. Refer to Automatic Transmission section of Group 21.

(25) Verify that the electrical harness connector is firmly connected to the vehicle speed sensor (Fig. 42).

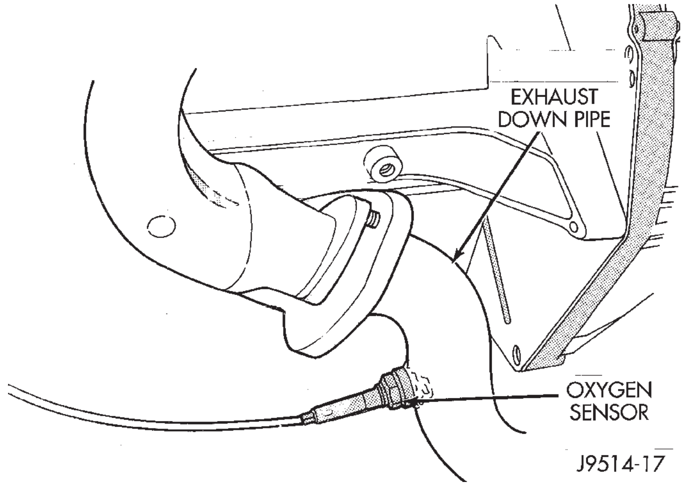


Fig. 40 Upstream Oxygen Sensor—4.0L Engine

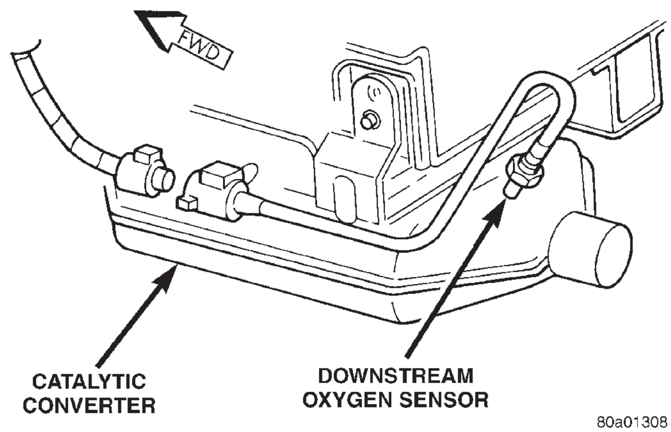


Fig. 41 Downstream Oxygen Sensor—4.0L Engine

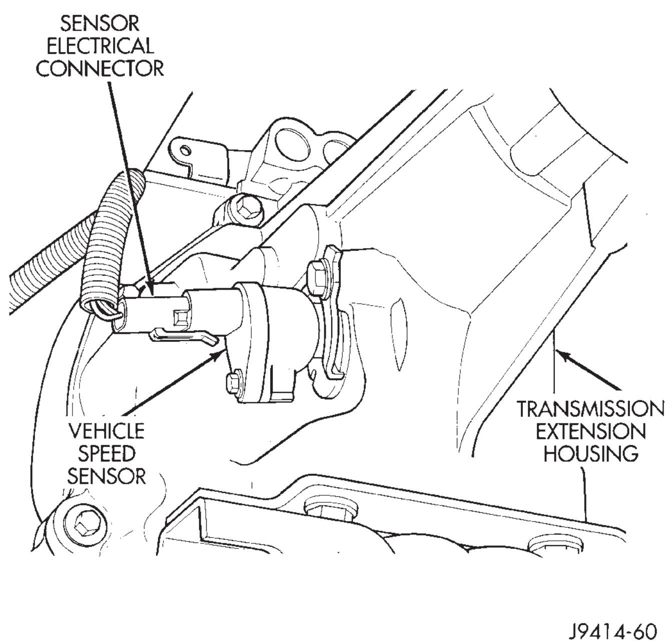


Fig. 42 Vehicle Speed Sensor—Typical

DIAGNOSIS AND TESTING (Continued)

(26) Verify that fuel pump/gauge sender unit wire connector is firmly connected to harness connector.

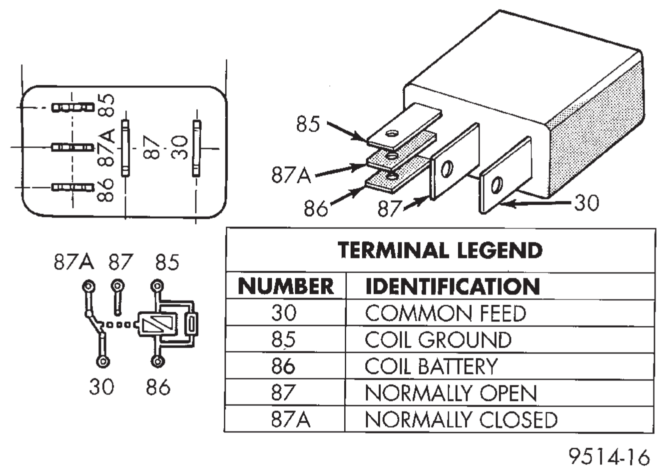
(27) Inspect fuel hoses at fuel pump/gauge sender unit for cracks or leaks.

(28) Inspect transmission torque convertor housing (automatic transmission) or clutch housing (manual transmission) for damage to timing ring on drive plate/flywheel.

(29) Verify that battery cable and solenoid feed wire connections to the starter solenoid are tight and clean. Inspect for chaffed wires or wires rubbing up against other components.

ASD AND FUEL PUMP RELAYS

The following description of operation and tests apply only to the Automatic Shutdown (ASD) and fuel pump relays. The terminals on the bottom of each relay are numbered (Fig. 43).



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 43 ASD and Fuel Pump Relay Terminals

OPERATION

• Terminal number 30 is connected to battery voltage. For both the ASD and fuel pump relays, terminal 30 is connected to battery voltage at all times.

• The PCM grounds the coil side of the relay through terminal number 85.

• Terminal number 86 supplies voltage to the coil side of the relay.

• When the PCM de-energizes the ASD and fuel pump relays, terminal number 87A connects to terminal 30. This is the Off position. In the off position, voltage is not supplied to the rest of the circuit. Terminal 87A is the center terminal on the relay.

• When the PCM energizes the ASD and fuel pump relays, terminal 87 connects to terminal 30. This is the On position. Terminal 87 supplies voltage to the rest of the circuit.

TESTING

The following procedure applies to the ASD and fuel pump relays.

(1) Remove relay from connector before testing.

(2) With the relay removed from the vehicle, use an ohmmeter to check the resistance between terminals 85 and 86. The resistance should be between 75 ±5 ohms.

(3) Connect the ohmmeter between terminals 30 and 87A. The ohmmeter should show continuity between terminals 30 and 87A.

(4) Connect the ohmmeter between terminals 87 and 30. The ohmmeter should not show continuity at this time.

(5) Connect one end of a jumper wire (16 gauge or smaller) to relay terminal 85. Connect the other end of the jumper wire to the ground side of a 12 volt power source.

(6) Connect one end of another jumper wire (16 gauge or smaller) to the power side of the 12 volt power source. **Do not attach the other end of the jumper wire to the relay at this time.**

WARNING: DO NOT ALLOW OHMMETER TO CONTACT TERMINALS 85 OR 86 DURING THIS TEST.

(7) Attach the other end of the jumper wire to relay terminal 86. This activates the relay. The ohmmeter should now show continuity between relay terminals 87 and 30. The ohmmeter should not show continuity between relay terminals 87A and 30.

(8) Disconnect jumper wires.

(9) Replace the relay if it did not pass the continuity and resistance tests. If the relay passed the tests, it operates properly. Check the remainder of the ASD and fuel pump relay circuits. Refer to group 8W, Wiring Diagrams.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR TEST—5.2L ENGINES

To perform a complete test of MAP sensor (Fig. 44) and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the MAP sensor only, refer to the following:

(1) Inspect the rubber L-shaped fitting from the MAP sensor to the throttle body (Fig. 45). Repair as necessary.

CAUTION: When testing the MAP sensor, be sure that the harness wires are not damaged by the test meter probes.

(2) Test the MAP sensor output voltage at the MAP sensor connector between terminals A and B (Fig. 46). With the ignition switch ON and the engine OFF, output voltage should be 4-to-5 volts. The voltage should drop to 1.5-to-2.1 volts with a hot, neutral idle speed condition.

DIAGNOSIS AND TESTING (Continued)

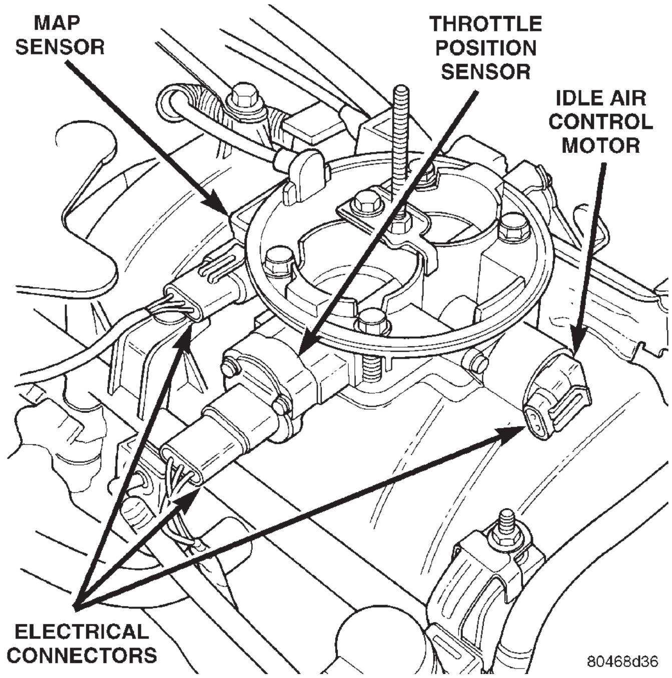


Fig. 44 MAP Sensor—5.2L Engine—Typical

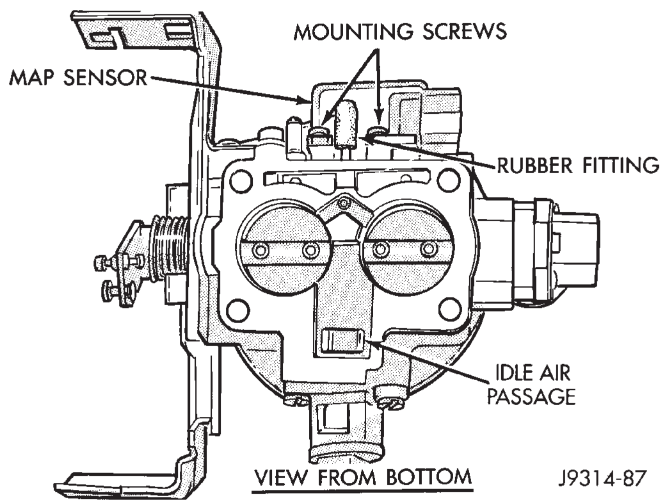


Fig. 45 Rubber L-Shaped Fitting—MAP Sensor-to-Throttle Body

(3) Test powertrain control module (PCM) cavity A-27 for the same voltage described above to verify the wire harness condition. Repair as necessary.

(4) Test MAP sensor supply voltage at sensor connector between terminals A and C (Fig. 46) with the ignition ON. The voltage should be approximately 5 volts (±0.5V). Five volts (±0.5V) should also be at cavity A-17 of the PCM wire harness connector. Repair or replace the wire harness as necessary.

(5) Test the MAP sensor ground circuit at sensor connector terminal—A (Fig. 46) and PCM connector A-4. Repair the wire harness if necessary.

Refer to Group 8W, Wiring Diagrams for cavity locations.

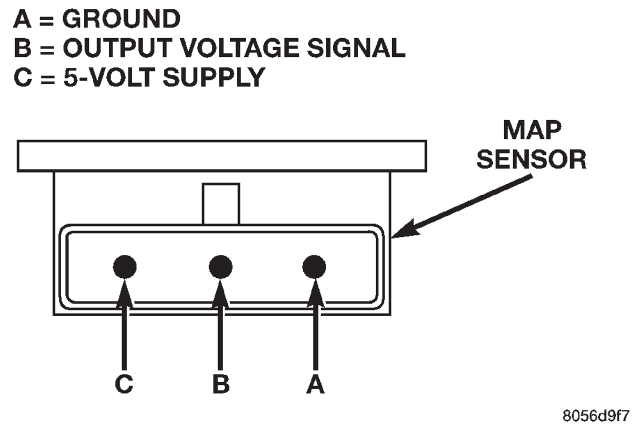


Fig. 46 MAP Sensor Connector Terminals—Typical

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR TEST—4.0L ENGINE

To perform a complete test of MAP sensor (Fig. 47) and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the MAP sensor only, refer to the following:

(1) Inspect the rubber L-shaped fitting from the MAP sensor to the throttle body (Fig. 48). Repair as necessary.

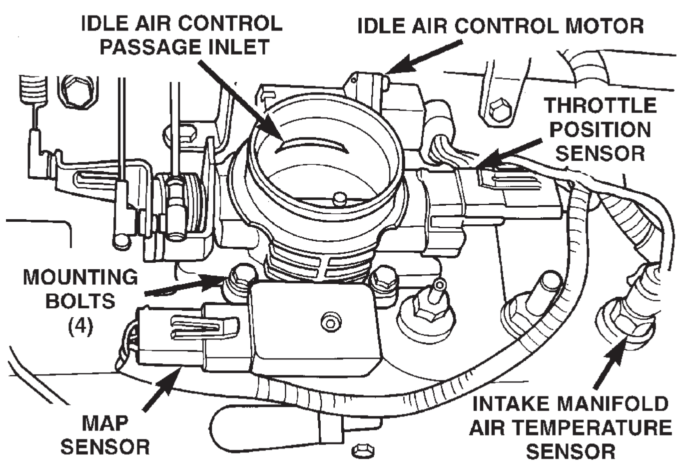


Fig. 47 Sensor Location—4.0L Engine

CAUTION: When testing the MAP sensor, be sure that the harness wires are not damaged by the test meter probes.

(2) Test the MAP sensor output voltage at the MAP sensor connector between terminals A and B (Fig. 49). With the ignition switch ON and the engine OFF, output voltage should be 4-to-5 volts. The voltage should drop to 1.5-to-2.1 volts with a hot, neutral idle speed condition.

DIAGNOSIS AND TESTING (Continued)

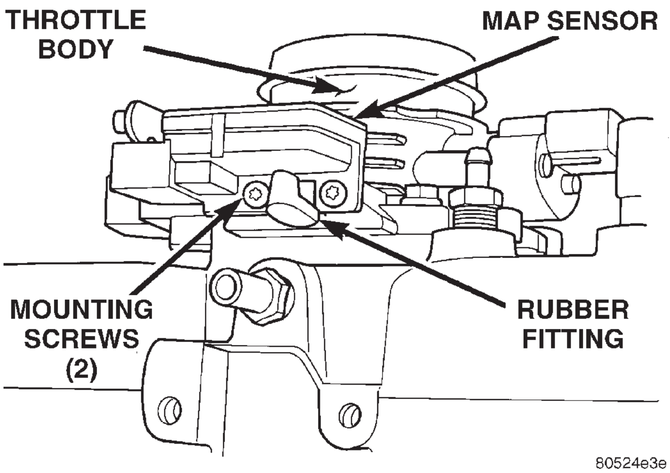


Fig. 48 Rubber L-Shaped Fitting—MAP Sensor-to-Throttle Body

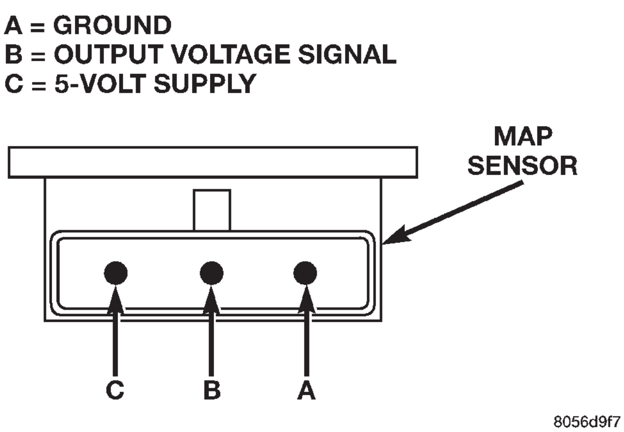


Fig. 49 MAP Sensor Connector Terminals—Typical

(3) Test powertrain control module (PCM) cavity A-27 for the same voltage described above to verify the wire harness condition. Repair as necessary.

(4) Test MAP sensor supply voltage at sensor connector between terminals A and C (Fig. 49) with the ignition ON. The voltage should be approximately 5 volts (±0.5V). Five volts (±0.5V) should also be at cavity A-17 of the PCM wire harness connector. Repair or replace the wire harness as necessary.

(5) Test the MAP sensor ground circuit at sensor connector terminal—A (Fig. 49) and PCM connector A-4. Repair the wire harness if necessary.

Refer to Group 8W, Wiring Diagrams for cavity locations.

OXYGEN (O2S) SENSORS—5.2L ENGINE

To perform a complete test of the O2S sensors and their circuitry, refer to the DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the O2S sensors only, refer to the following:

The upstream O2S sensor is located on the exhaust pipe (Fig. 50).

The downstream O2S sensor is located on the outlet end of the catalytic converter (Fig. 51).

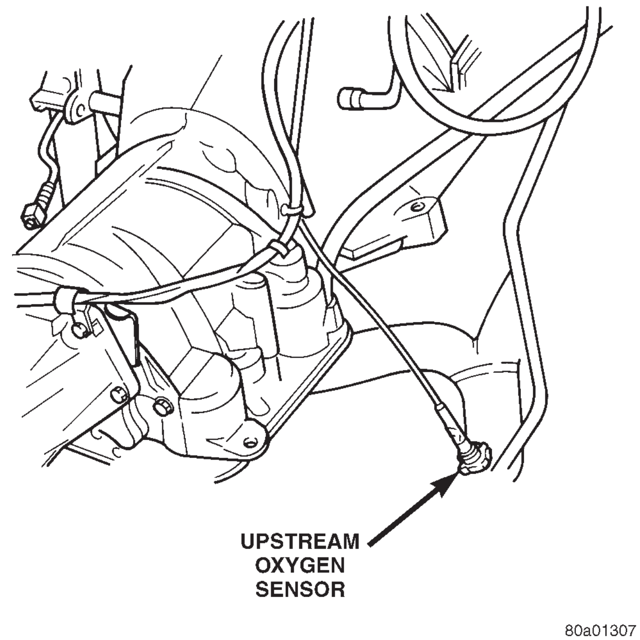


Fig. 50 Upstream Oxygen Sensor Location—5.2L Engine

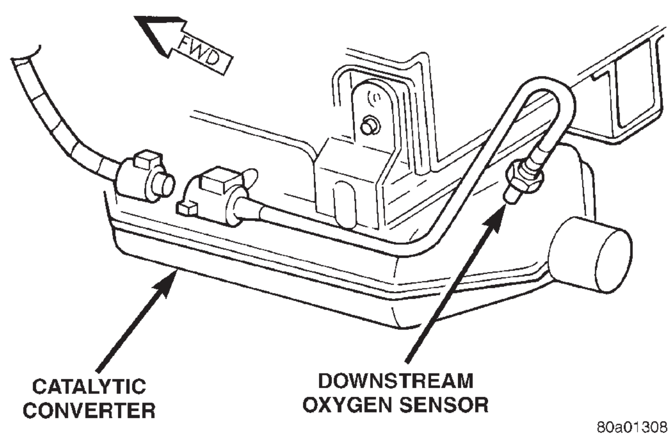


Fig. 51 Downstream Oxygen Sensor Location

Each O2S heating element can be tested with an ohmmeter as follows:

Disconnect the O2S sensor connector. Connect the ohmmeter test leads across the white wire terminals of the sensor connector. Resistance should be between 5 and 7 ohms. Replace the sensor if the ohmmeter displays an infinity (open) reading.

DIAGNOSIS AND TESTING (Continued)

OXYGEN (O2S) SENSORS—4.0L ENGINE

To perform a complete test of the O2S sensors and their circuitry, refer to the DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the O2S sensors only, refer to the following:

The upstream O2S sensor is located on the exhaust pipe (Fig. 52).

The downstream O2S sensor is located on the outlet end of the catalytic converter (Fig. 51).

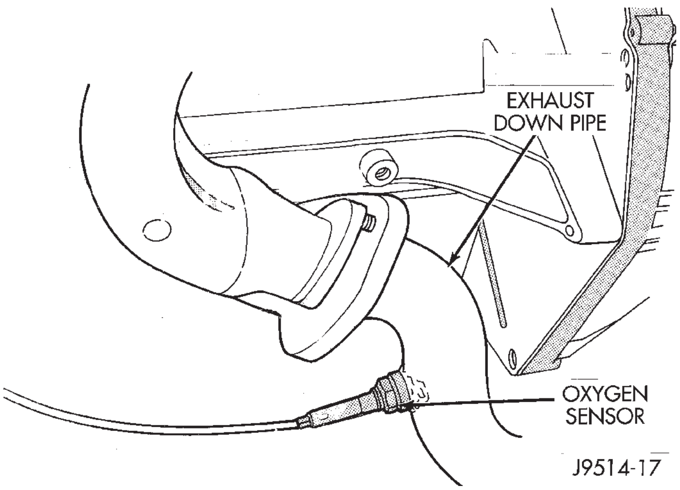


Fig. 52 Upstream Oxygen Sensor Location—4.0L Engine

Each O2S heating element can be tested with an ohmmeter as follows:

Disconnect the O2S sensor connector. Connect the ohmmeter test leads across the white wire terminals of the sensor connector. Resistance should be between 5 and 7 ohms. Replace the sensor if the ohmmeter displays an infinity (open) reading.

CAMSHAFT AND CRANKSHAFT POSITION SENSORS

Refer to Group 8D, Ignition System for information.

ENGINE COOLANT TEMPERATURE SENSOR—5.2L ENGINE

To perform a complete test of the engine coolant temperature sensor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

(1) Disconnect wire harness connector from coolant temperature sensor (Fig. 53).

(2) **Engines with air conditioning:** When removing the connector from sensor, do not pull directly on wiring harness. Fabricate an L-shaped hook tool from a coat hanger (approximately eight inches long). Place the hook part of tool under the connector for removal. The connector is snapped onto the sensor. It is not equipped with a lock type tab.

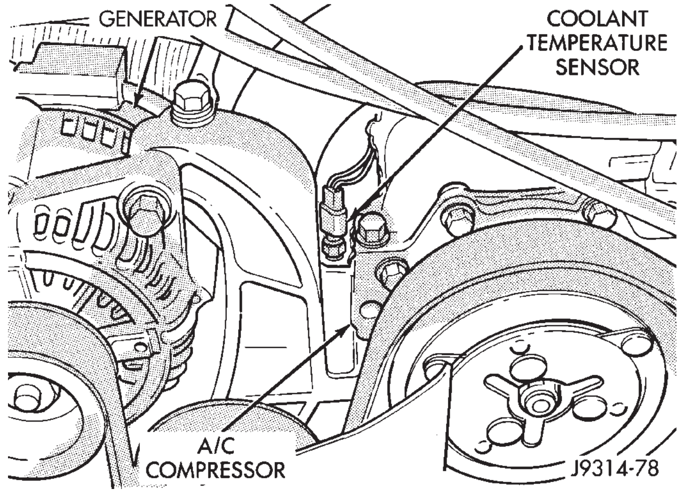


Fig. 53 Engine Coolant Temperature Sensor—5.2L Engines

(3) Test the resistance of the sensor with a high input impedance (digital) volt-ohmmeter. The resistance (as measured across the sensor terminals) should be less than 1340 ohms with the engine warm. Refer to the Coolant Temperature sensor/Intake Air Temperature sensor resistance chart. Replace the sensor if it is not within the range of resistance specified in the chart.

TEMPERATURE		RESISTANCE (OHMS)	
C	F	MIN	MAX
−40	−40	291,490	381,710
−20	−4	85,850	108,390
−10	14	49,250	61,430
0	32	29,330	35,990
10	50	17,990	21,810
20	68	11,370	13,610
25	77	9,120	10,880
30	86	7,370	8,750
40	104	4,900	5,750
50	122	3,330	3,880
60	140	2,310	2,670
70	158	1,630	1,870
80	176	1,170	1,340
90	194	860	970
100	212	640	720
110	230	480	540
120	248	370	410

J928D-4

SENSOR RESISTANCE (OHMS)—COOLANT TEMPERATURE SENSOR/INTAKE AIR TEMPERATURE SENSOR

DIAGNOSIS AND TESTING (Continued)

(4) Test continuity of the wire harness between the PCM wire harness connector and the coolant sensor connector terminals. Refer to Group 8, Wiring for terminal/cavity locations. Repair the wire harness if an open circuit is indicated.

(5) After tests are completed, connect electrical connector to sensor. The sensor connector is symmetrical (not indexed). It can be installed to the sensor in either direction.

ENGINE COOLANT TEMPERATURE SENSOR—4.0L ENGINE

To perform a complete test of the engine coolant temperature sensor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

(1) Disconnect wire harness connector from coolant temperature sensor (Fig. 54).

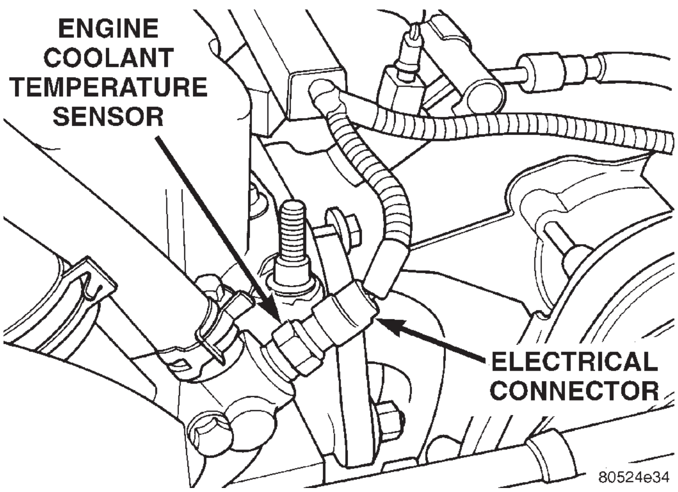


Fig. 54 Engine Coolant Temperature Sensor—4.0L Engine

(2) Test the resistance of the sensor with a high input impedance (digital) volt-ohmmeter. The resistance (as measured across the sensor terminals) should be less than 1340 ohms with the engine warm. Refer to the previous Coolant Temperature sensor/Intake Air Temperature sensor resistance chart. Replace the sensor if it is not within the range of resistance specified in the chart.

(3) Test continuity of the wire harness between the PCM wire harness connector and the coolant sensor connector terminals. Refer to Group 8, Wiring for terminal/cavity locations. Repair the wire harness if an open circuit is indicated.

IDLE AIR CONTROL (IAC) MOTOR—5.2L ENGINE

To perform a complete test of the IAC motor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual.

IDLE AIR CONTROL (IAC) MOTOR—4.0L ENGINE

To perform a complete test of the IAC motor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR—5.2L ENGINE

To perform a complete test of the intake manifold air temperature sensor and its circuitry, refer to DRB tester and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

(1) Disconnect the wire harness connector from the intake manifold air temperature sensor (Fig. 55).

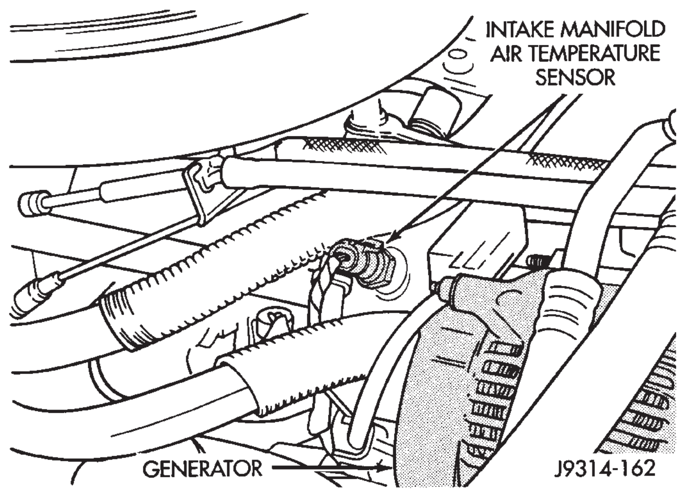


Fig. 55 Air Temperature Sensor—5.2L Engine

(2) Test the resistance of the sensor with an input impedance (digital) volt-ohmmeter. The resistance (as measured across the sensor terminals) should be less than 1340 ohms with the engine warm. Refer to the previous Coolant Temperature sensor/Intake Air Temperature sensor resistance chart. Replace the sensor if it is not within the range of resistance specified in the chart.

(3) Test the resistance of the wire harness. Do this between the PCM wire harness connector A-15 and the sensor connector terminal. Also check between PCM connector A-4 to the sensor connector terminal. Repair the wire harness as necessary if the resistance is greater than 1 ohm.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR—4.0L ENGINE

To perform a complete test of the intake manifold air temperature sensor and its circuitry, refer to DRB tester and appropriate Powertrain Diagnostics Procedures manual. To test the sensor only, refer to the following:

(1) Disconnect the wire harness connector from the intake manifold air temperature sensor (Fig. 56).

DIAGNOSIS AND TESTING (Continued)

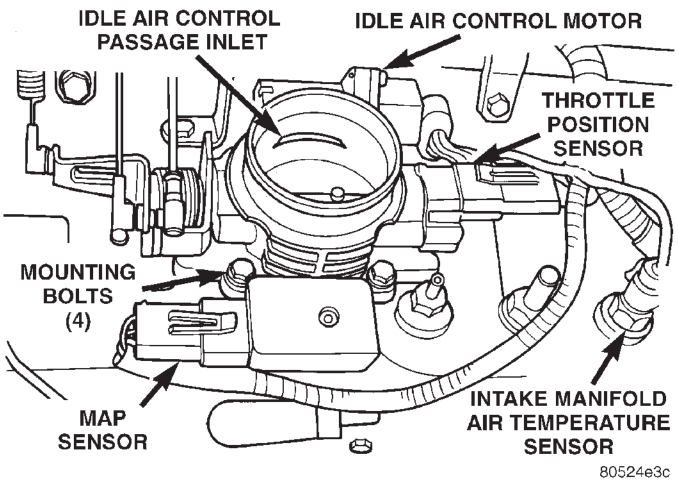


Fig. 56 Intake Manifold Air Temperature Sensor—4.0L Engine

(2) Test the resistance of the sensor with an input impedance (digital) volt-ohmmeter. The resistance (as measured across the sensor terminals) should be less than 1340 ohms with the engine warm. Refer to the previous Coolant Temperature sensor/Intake Air Temperature sensor resistance chart. Replace the sensor if it is not within the range of resistance specified in the chart.

(3) Test the resistance of the wire harness. Do this between the PCM wire harness connector A-15 and the sensor connector terminal. Also check between PCM connector A-4 to the sensor connector terminal. Repair the wire harness as necessary if the resistance is greater than 1 ohm.

VEHICLE SPEED SENSOR

To perform a complete test of the sensor and its circuitry, refer to DRB scan tool and appropriate Powertrain Diagnostics Procedures manual.

THROTTLE POSITION SENSOR (TPS)—5.2L ENGINE

To perform a complete test of the TPS and its circuitry, refer to the DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the TPS only, refer to the following:

The TPS (Fig. 57) can be tested with a digital voltmeter. The center electrical terminal of the TPS is the output terminal.

With the ignition key in the ON position, check the TPS output voltage at the center terminal wire of the connector. Check this at idle (throttle plate closed) and at wide open throttle (WOT). At idle, TPS output voltage should must be greater than 200 millivolts. At wide open throttle, TPS output voltage must be less than 4.8 volts. The output voltage should increase gradually as the throttle plate is slowly opened from idle to WOT.

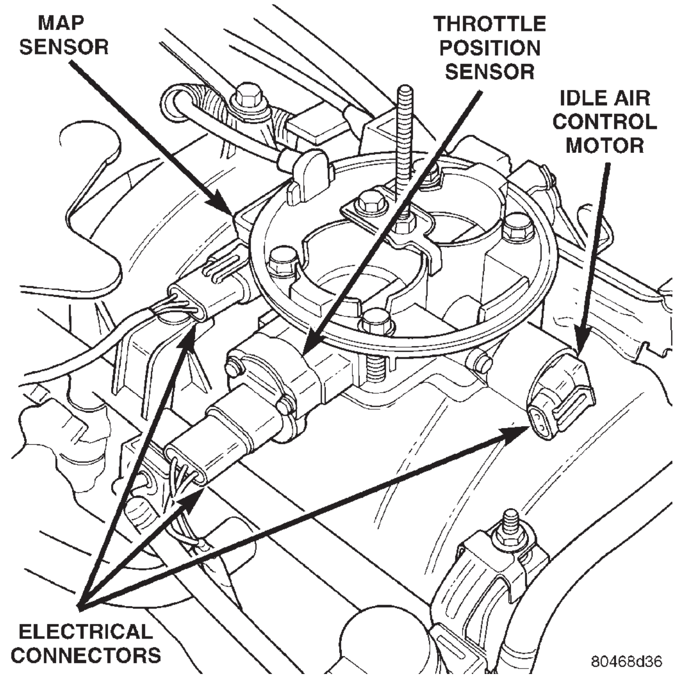


Fig. 57 TPS—5.2L Engine

THROTTLE POSITION SENSOR (TPS)—4.0L ENGINE

To perform a complete test of the TPS (Fig. 56) and its circuitry, refer to the DRB scan tool and appropriate Powertrain Diagnostics Procedures manual. To test the TPS only, refer to the following:

The TPS can be tested with a digital voltmeter. The center terminal of the TPS is the output terminal.

With the ignition key in the ON position, check the TPS output voltage at the center terminal wire of the connector. Check this at idle (throttle plate closed) and at wide open throttle (WOT). At idle, TPS output voltage should must be greater than 200 millivolts. At wide open throttle, TPS output voltage must be less than 4.8 volts. The output voltage should increase gradually as the throttle plate is slowly opened from idle to WOT.

THROTTLE BODY MINIMUM AIR FLOW CHECK PROCEDURE

5.2L ENGINE

The following test procedure has been developed to check throttle body calibrations for correct idle conditions. The procedure should be used to diagnose the throttle body for conditions that may cause idle problems. **This procedure should be used only after normal diagnostic procedures have failed to produce results that indicate a throttle body related problem. Be sure to check for proper operation of the idle air control motor before performing this test.**

DIAGNOSIS AND TESTING (Continued)

A special fixed orifice tool (number 6714) (Fig. 58) must be used for the following test.

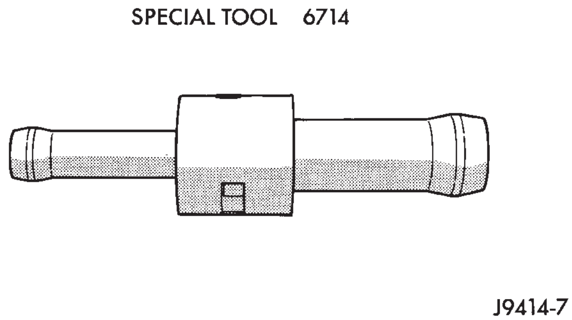


Fig. 58 Fixed Orifice Tool

(1) Start the engine and bring to operating temperature. Be sure all accessories are off before performing this test.

(2) Shut off the engine and remove the air duct at throttle body.

(3) Disconnect the vacuum line at the PCV valve (Fig. 59).

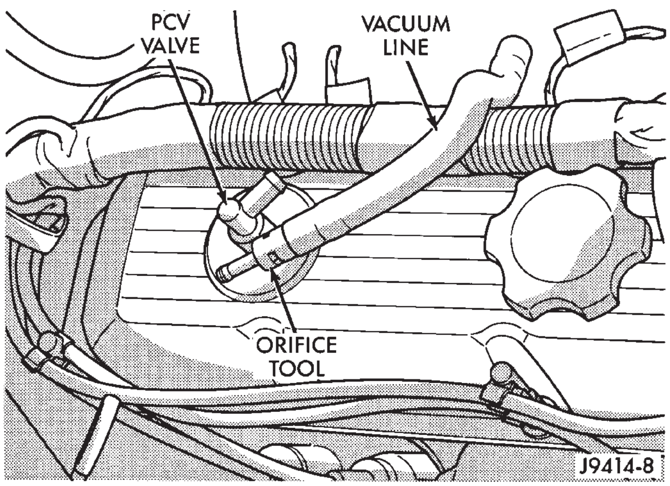


Fig. 59 Install Orifice Tool

(4) Install the 0.185 inch orifice tool (number 6714) into the disconnected vacuum line in place of the PCV valve (Fig. 59).

(5) Disconnect the idle purge vacuum line from fitting at throttle body. This vacuum line is located on the front of throttle body next to the MAP sensor (Fig. 60). Cap the fitting at throttle body after vacuum line has been removed.

(6) Connect the DRB scan tool to the 16–way data link connector. This connector is located under the instrument panel to the left of the steering column. Refer to the appropriate Powertrain Diagnostic Procedures service manual for DRB operation.

(7) Start the engine.

(8) Using the DRB scan tool, scroll through the menus as follows: select—System, select—Engine, select—Fuel and Ignition, select—Actuator Tests, select—Engine rpm and select—Minimum Air Flow.

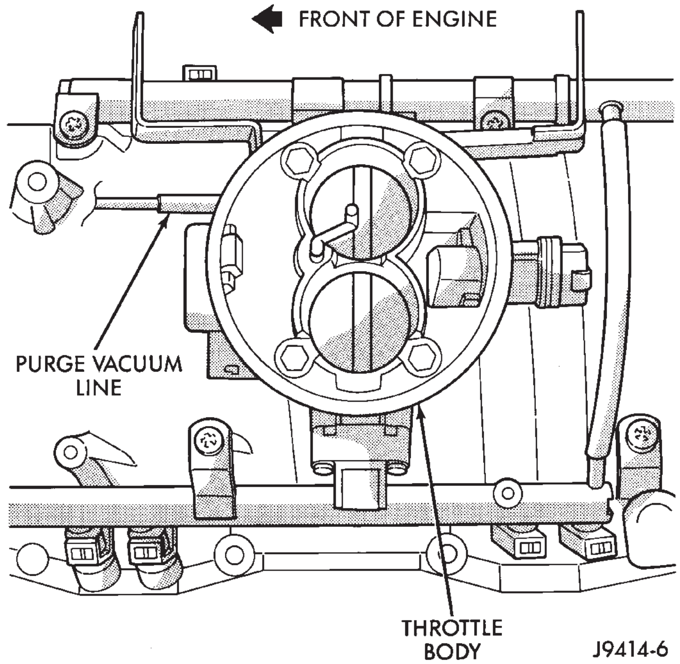


Fig. 60 Idle Purge Line

(9) The DRB scan tool will count down to stabilize the idle rpm and display the minimum air flow idle rpm. The idle rpm should be between **500 and 900 rpm.** If the idle speed is outside of these specifications, replace the throttle body. Refer to Throttle Body in the Component Removal/Installation section of this group.

(10) Disconnect the DRB scan tool from the vehicle.

(11) Remove cap from idle purge fitting at throttle body and install vacuum line.

(12) Remove orifice tool and connect vacuum line to PCV valve.

(13) Install air duct to throttle body.

REMOVAL AND INSTALLATION

AUTOMATIC SHUTDOWN (ASD) RELAY

The ASD relay is located in the Power Distribution Center (PDC) (Fig. 61). Refer to label on PDC cover for relay location. Check terminal connections at PDC and relay for damage/corrosion before installation. Repair as necessary.

FUEL PUMP RELAY

The fuel pump relay is located in the Power Distribution Center (PDC) (Fig. 61). Refer to label on PDC cover for relay location. Check terminal connections at relay and PDC for damage/corrosion before installation. Repair as necessary.

REMOVAL AND INSTALLATION (Continued)

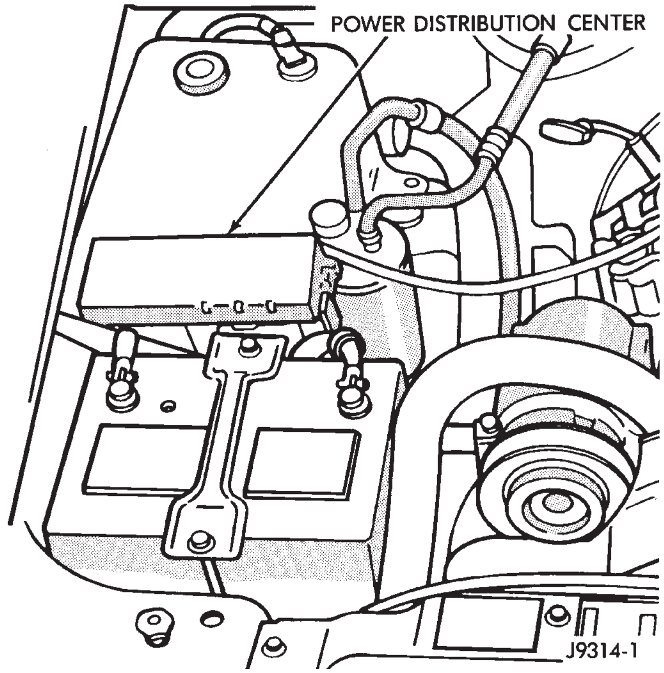


Fig. 61 Power Distribution Center (PDC) Location

THROTTLE BODY—5.2L ENGINE

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the powertrain control module (PCM).

REMOVAL

(1) Remove the air duct at throttle body.

(2) Disconnect throttle body electrical connectors at MAP sensor, IAC motor and TPS (Fig. 62).

(3) Remove vacuum line at throttle body.

(4) Remove all control cables from throttle body (lever) arm. Refer to the Accelerator Pedal and Throttle Cable section of this group for additional information.

(5) Remove four throttle body mounting bolts (Fig. 63).

(6) Remove throttle body from intake manifold.

(7) Discard old throttle body-to-intake manifold gasket.

INSTALLATION

(1) Clean the mating surfaces of the throttle body and the intake manifold.

(2) Install new throttle body-to-intake manifold gasket.

(3) Install throttle body to intake manifold.

(4) Install four mounting bolts. Tighten bolts to 23 N·m (200 in. lbs.) torque.

(5) Install control cables.

(6) Install vacuum line to throttle body.

(7) Install electrical connectors.

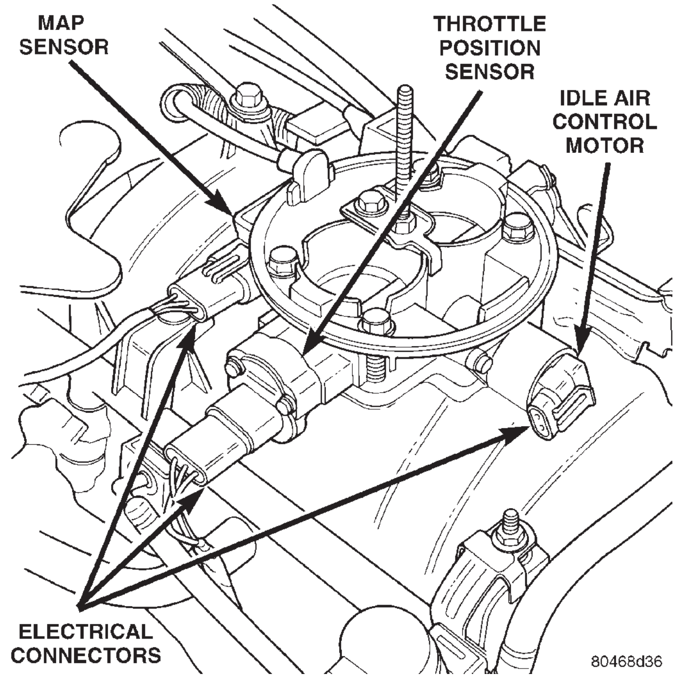


Fig. 62 Sensor Electrical Connectors—5.2L Engine—Typical

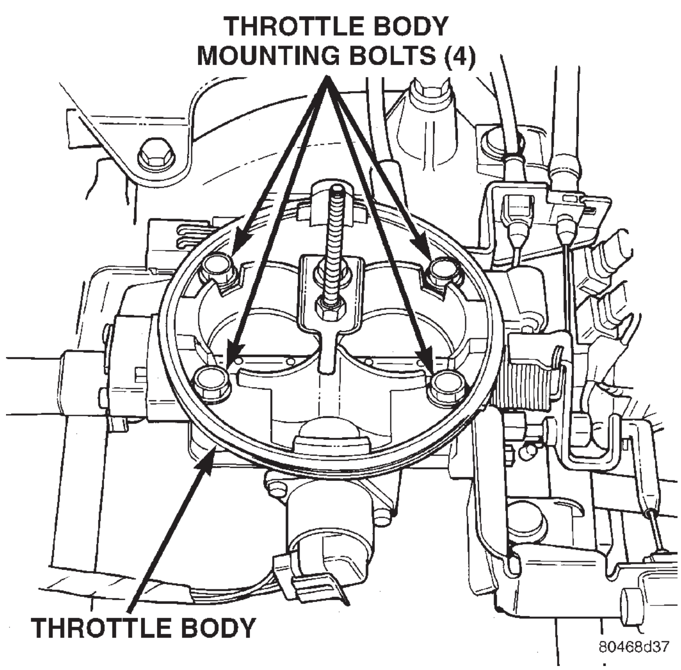


Fig. 63 Throttle Body Mounting Bolts—5.2L Engine—Typical

(8) Install air duct at throttle body.

THROTTLE BODY—4.0L ENGINE

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the powertrain control module (PCM).

REMOVAL AND INSTALLATION (Continued)

REMOVAL

(1) Remove the air cleaner duct at throttle body.

(2) Disconnect throttle body electrical connectors at MAP sensor, IAC motor and TPS (Fig. 64).

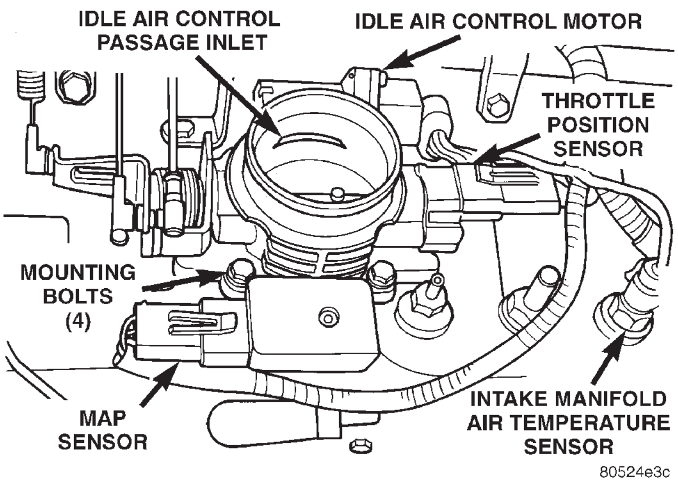


Fig. 64 Throttle Body and Sensor Locations—4.0L Engine

(3) Remove all control cables from throttle body (lever) arm. Refer to the Accelerator Pedal and Throttle Cable section of this group for additional information.

(4) Remove four throttle body mounting bolts.

(5) Remove throttle body from intake manifold.

(6) Discard old throttle body-to-intake manifold gasket.

INSTALLATION

(1) Clean the mating surfaces of the throttle body and the intake manifold.

(2) Install new throttle body-to-intake manifold gasket.

(3) Install throttle body to intake manifold.

(4) Install four mounting bolts. Tighten bolts to 12 N·m (108 in. lbs.) torque.

(5) Install control cables.

(6) Install electrical connectors.

(7) Install air duct at throttle body.

THROTTLE POSITION SENSOR (TPS)—5.2L ENGINE

REMOVAL

The TPS is located on the side of the throttle body.

(1) Remove air duct at throttle body.

(2) Disconnect TPS electrical connector.

(3) Remove two TPS mounting bolts (Fig. 65).

(4) Remove TPS from throttle body.

INSTALLATION

The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 66). The TPS must be installed so that it can be rotated a few degrees. If the sensor will not rotate, install the sensor with the throttle shaft on the other side of the socket tangs. The TPS will be under slight tension when rotated.

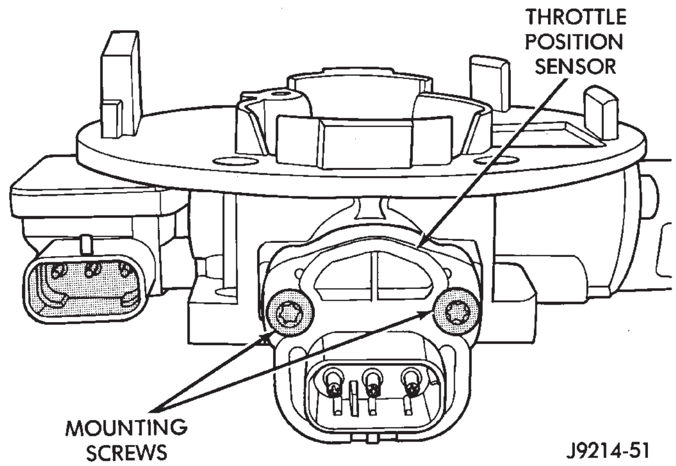


Fig. 65 TPS Mounting Bolts—5.2L Engine

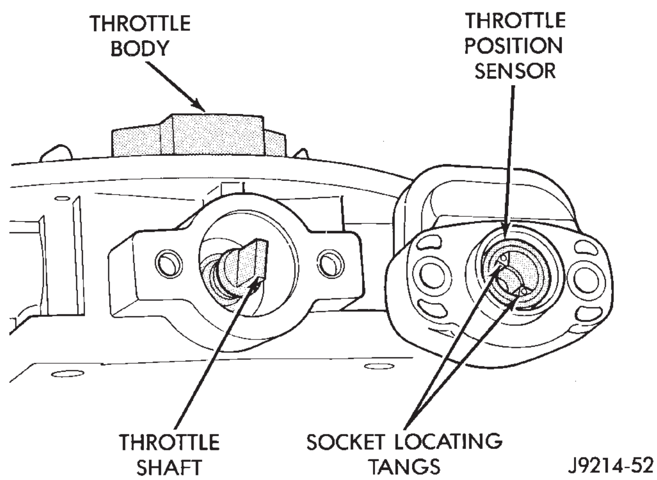


Fig. 66 Installation—5.2L Engine—Typical

(1) Install the TPS and two retaining bolts.

(2) Tighten bolts to 7 N·m (60 in. lbs.) torque.

(3) Manually operate the throttle control lever by hand to check for any binding of the TPS.

(4) Connect TPS electrical connector to TPS.

(5) Install air duct at throttle body.

THROTTLE POSITION SENSOR (TPS)—4.0L ENGINE

The TPS is mounted to the throttle body.

REMOVAL

(1) Disconnect TPS electrical connector.

(2) Remove TPS mounting screws (Fig. 67).

(3) Remove TPS.

REMOVAL AND INSTALLATION (Continued)

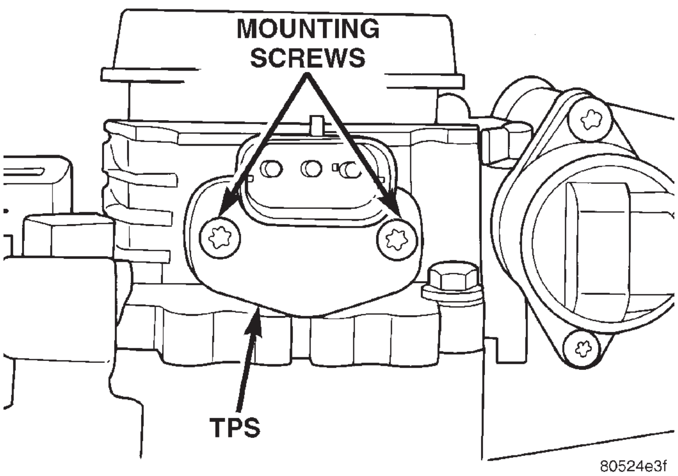


Fig. 67 TPS Mounting Screws—4.0L Engine

INSTALLATION

The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 68). The TPS must be installed so that it can be rotated a few degrees. (If the sensor will not rotate, install the sensor with the throttle shaft on the other side of the socket tangs). The TPS will be under slight tension when rotated.

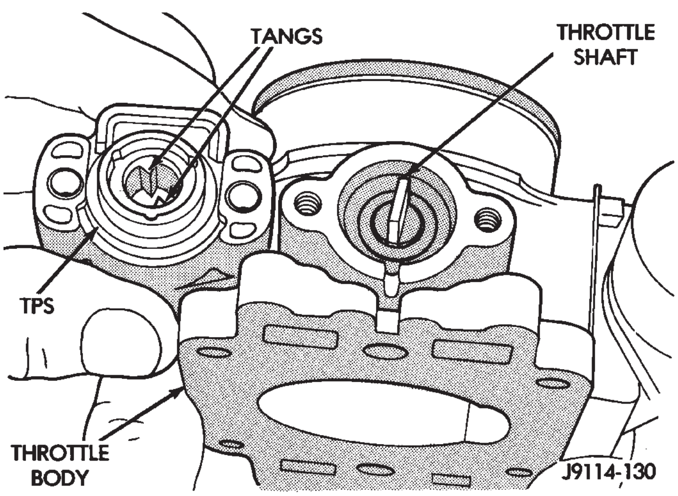


Fig. 68 Throttle Position Sensor Installation—4.0L Engine

(1) Install the TPS and retaining screws.
(2) Tighten screws to 7 N·m (60 in. lbs.) torque.
(3) Connect TPS electrical connector to TPS.
(4) Manually operate the throttle (by hand) to check for any TPS binding before starting the engine.

IDLE AIR CONTROL (IAC) MOTOR—5.2L ENGINE

The IAC motor is located on the back of the throttle body.

REMOVAL

(1) Remove air duct at throttle body.
(2) Disconnect electrical connector from IAC motor.
(3) Remove two mounting bolts (screws) (Fig. 69).

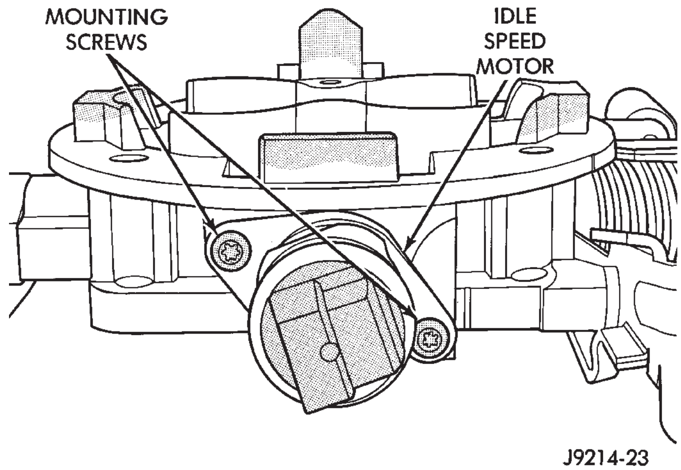


Fig. 69 Mounting Bolts (Screws)—IAC Motor—5.2L Engine

(4) Remove IAC motor from throttle body.

INSTALLATION

(1) Install IAC motor to throttle body.
(2) Install and tighten two mounting bolts (screws) to 7 N·m (60 in. lbs.) torque.
(3) Install electrical connector.
(4) Install air duct at throttle body.

IDLE AIR CONTROL (IAC) MOTOR—4.0L ENGINE

The IAC motor is located on the side of the throttle body.

REMOVAL

(1) Remove air cleaner tube at throttle body.
(2) Disconnect electrical connector from IAC motor.
(3) Remove two mounting bolts (screws) (Fig. 70).
(4) Remove IAC motor from throttle body.

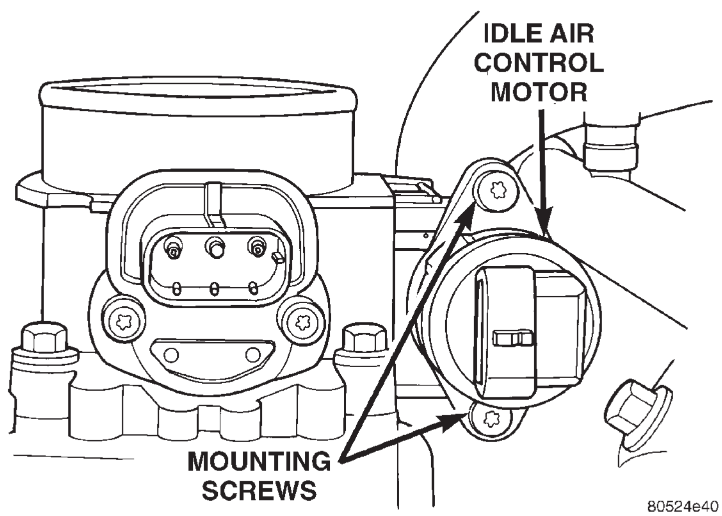


Fig. 70 Mounting Bolts (Screws)—IAC Motor—4.0L Engine

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Install IAC motor to throttle body.

(2) Install and tighten two mounting bolts (screws) to 7 N·m (60 in. lbs.) torque.

(3) Install electrical connector.

(4) Install air cleaner tube to throttle body.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR—5.2L ENGINES

The MAP sensor is located on the front of the throttle body. An L-shaped rubber fitting is used to connect the MAP sensor to throttle body (Fig. 71).

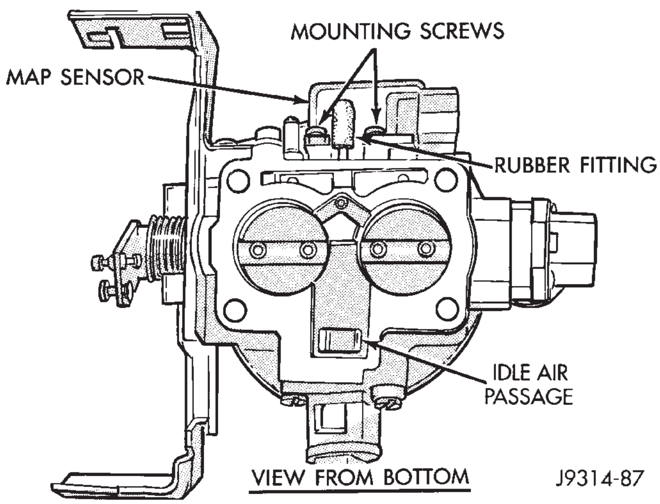


Fig. 71 MAP Sensor L-Shaped Rubber Fitting—5.2L Engine

REMOVAL

The throttle body must be removed from the intake manifold for MAP sensor removal.

(1) Remove air duct at throttle body.

(2) Remove throttle body. Refer to Throttle Body removal in this section.

(3) Remove two MAP sensor mounting bolts (screws) (Fig. 71).

(4) While removing MAP sensor, slide the vacuum rubber L-shaped fitting (Fig. 71) from the throttle body.

(5) Remove rubber L-shaped fitting from MAP sensor.

INSTALLATION

(1) Install rubber L-shaped fitting to MAP sensor.

(2) Position sensor to throttle body while guiding rubber fitting over throttle body vacuum nipple.

(3) Install MAP sensor mounting bolts (screws). Tighten screws to 3 N·m (25 in. lbs.) torque.

(4) Install throttle body. Refer to Throttle Body installation in this section.

(5) Install air duct at throttle body.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR—4.0L ENGINE

The MAP sensor is mounted to the side of the throttle body. An L-shaped rubber fitting is used to connect the MAP sensor to throttle body (Fig. 72).

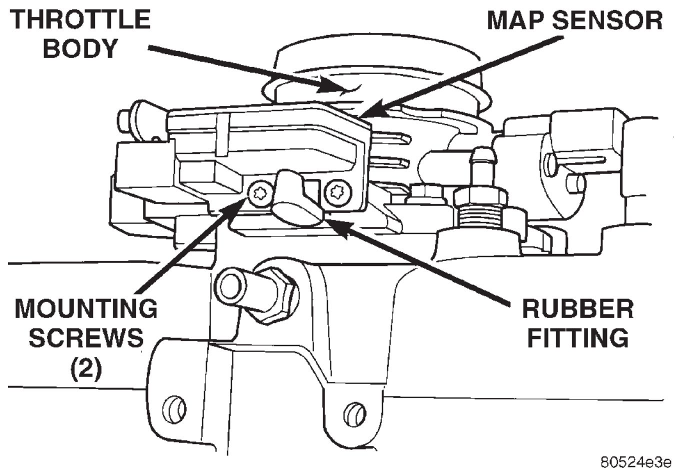


Fig. 72 MAP Sensor Mounting—4.0L Engine

REMOVAL

(1) Remove air cleaner intake tube at throttle body.

(2) Remove two MAP sensor mounting bolts (screws) (Fig. 72).

(3) While removing MAP sensor, slide the rubber L-shaped fitting (Fig. 72) from the throttle body.

(4) Remove rubber L-shaped fitting from MAP sensor.

INSTALLATION

(1) Install rubber L-shaped fitting to MAP sensor.

(2) Position sensor to throttle body while guiding rubber fitting over throttle body vacuum nipple.

(3) Install MAP sensor mounting bolts (screws). Tighten screws to 3 N·m (25 in. lbs.) torque.

(4) Install air cleaner intake tube.

DUTY CYCLE EVAP CANISTER PURGE SOLENOID

Refer to Group 25, Emission Control System for removal/installation procedures.

POWERTRAIN CONTROL MODULE (PCM)

The PCM is located on the cowl panel in the right/rear side of the engine compartment (Fig. 73).

REMOVAL

(1) Disconnect the negative battery cable at battery.

(2) Remove the coolant reserve/overflow tank (one bolt and two nuts) (Fig. 74).

(3) Carefully unplug the three 32–way connectors at PCM.

REMOVAL AND INSTALLATION (Continued)

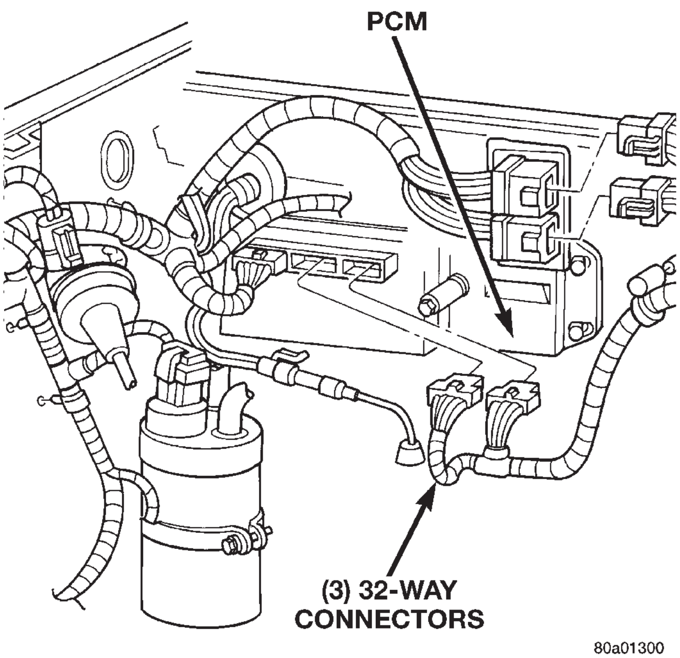


Fig. 73 Powertrain Control Module (PCM) Location

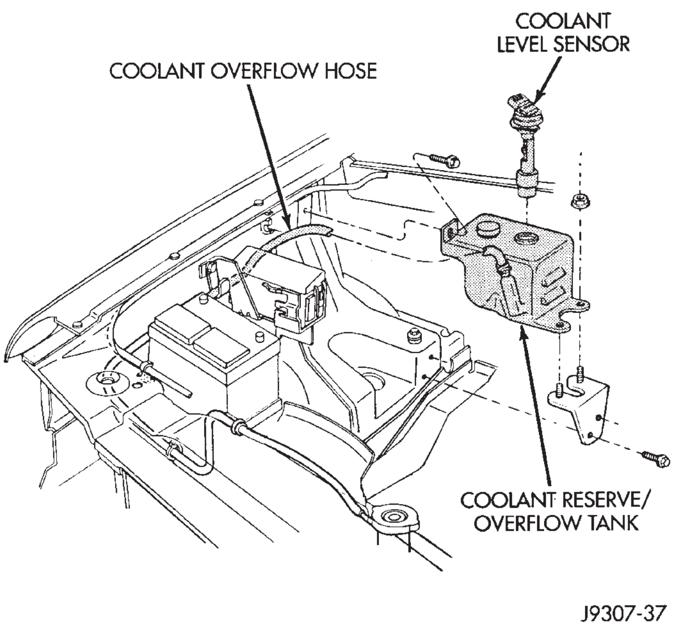


Fig. 74 Coolant Reserve/Overflow Tank Mounting

(4) Remove the three PCM mounting bolts (Fig. 75).

(5) Remove PCM.

INSTALLATION

(1) Check the pins in the three 32–way electrical connectors for damage. Repair as necessary.

(2) Install PCM. Tighten three mounting bolts to 1 N·m (9 in. lbs.) torque.

(3) Install coolant reserve/overflow tank.

(4) Connect negative cable to battery.

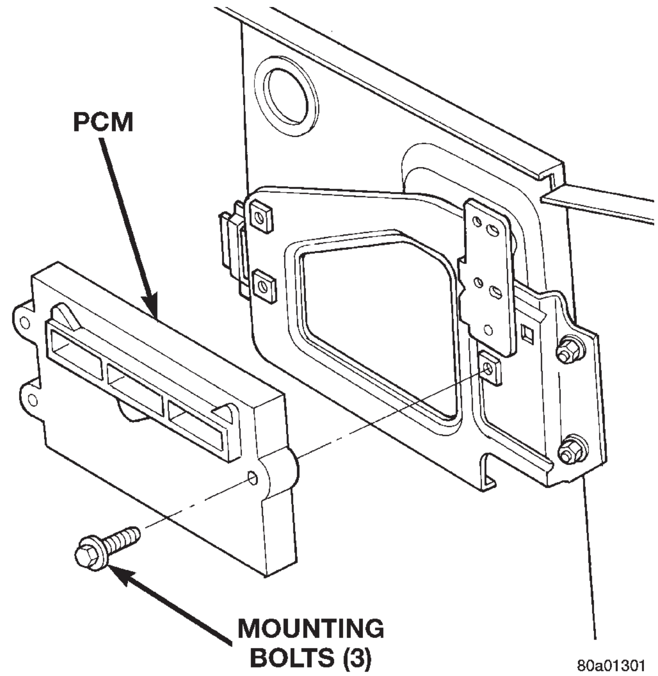


Fig. 75 Powertrain Control Module (PCM) Mounting

CRANKSHAFT POSITION SENSOR

Refer to Group 8D, Ignition System for removal/installation procedures.

CAMSHAFT POSITION SENSOR

For removal/installation procedures, refer to Group 8D, Ignition System. See Camshaft Position Sensor.

OXYGEN SENSOR—5.2L ENGINE

The upstream O2S sensor is located in the exhaust downpipe. The downstream sensor is located near outlet end of catalytic converter. Refer to (Fig. 76) or (Fig. 77).

REMOVAL

WARNING: THE EXHAUST MANIFOLD, EXHAUST PIPES AND CATALYTIC CONVERTER BECOME VERY HOT DURING ENGINE OPERATION. ALLOW ENGINE TO COOL BEFORE REMOVING OXYGEN SENSOR.

(1) Raise and support the vehicle.

(2) Disconnect the wire connector from the O2S sensor.

CAUTION: When disconnecting the sensor electrical connector, do not pull directly on wire going into sensor.

(3) Remove the O2S sensor. Snap-On oxygen sensor wrench (number YA 8875) may be used for removal and installation.

REMOVAL AND INSTALLATION (Continued)

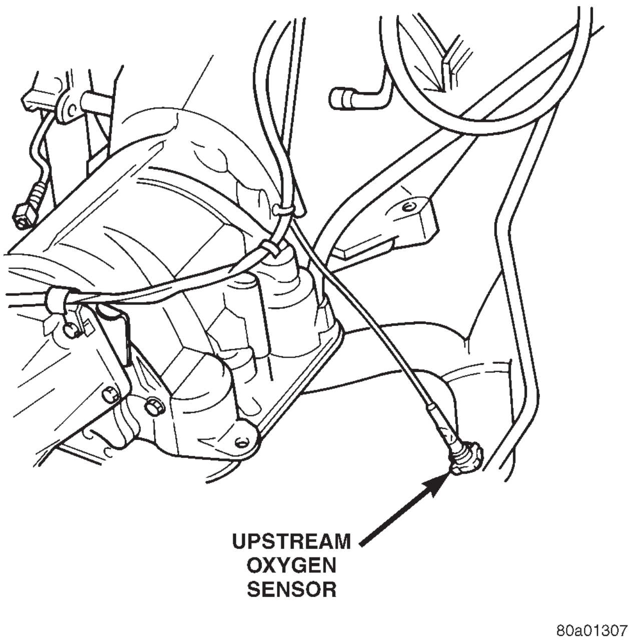


Fig. 76 Upstream Oxygen Sensor Location—5.2L Engine

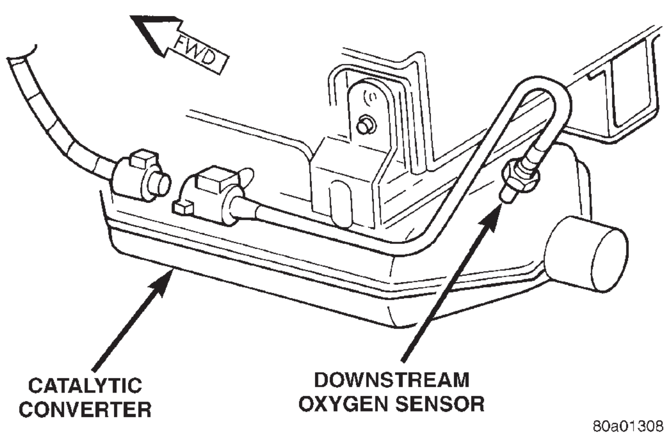


Fig. 77 Downstream Oxygen Sensor Location

INSTALLATION

Threads of new oxygen sensors are factory coated with anti-seize compound to aid in removal. **DO NOT add any additional anti-seize compound to the threads of a new oxygen sensor.**

(1) Install the O2S sensor. Tighten to 30 N·m (22 ft. lbs.) torque.

(2) Connect the O2S sensor wire connector.

(3) Lower the vehicle.

OXYGEN SENSOR—4.0L ENGINE

The upstream O2S sensor is located in the exhaust downpipe. The downstream sensor is located near outlet end of catalytic converter. Refer to (Fig. 78) or (Fig. 77).

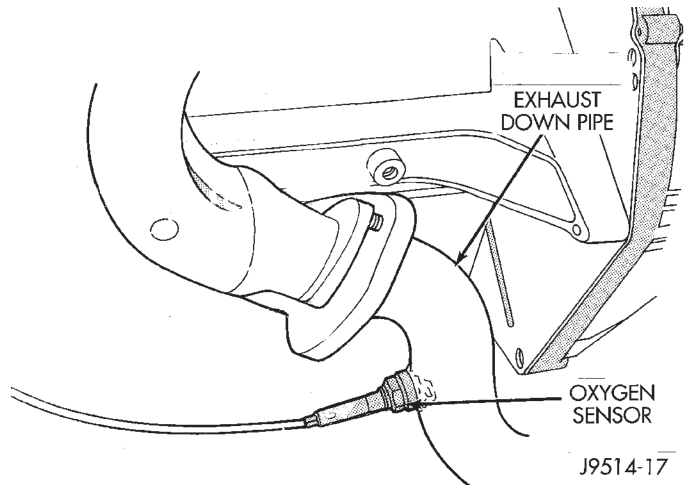


Fig. 78 Upstream Oxygen Sensor Location—4.0L Engine

REMOVAL

WARNING: THE EXHAUST MANIFOLD, EXHAUST PIPES AND CATALYTIC CONVERTER BECOME VERY HOT DURING ENGINE OPERATION. ALLOW ENGINE TO COOL BEFORE REMOVING OXYGEN SENSOR.

(1) Raise and support the vehicle.

(2) Disconnect the wire connector from the O2S sensor.

CAUTION: When disconnecting the sensor electrical connector, do not pull directly on wire going into sensor.

(3) Remove the O2S sensor. Snap-On oxygen sensor wrench (number YA 8875) may be used for removal and installation.

INSTALLATION

Threads of new oxygen sensors are factory coated with anti-seize compound to aid in removal. **DO NOT add any additional anti-seize compound to the threads of a new oxygen sensor.**

(1) Install the O2S sensor. Tighten to 30 N·m (22 ft. lbs.) torque.

(2) Connect the O2S sensor wire connector.

(3) Lower the vehicle.

AIR CLEANER HOUSING

REMOVAL

(1) Unlock clean air hose clamp (Fig. 79) at air cleaner cover. To unlock the clamp, attach adjustable pliers to clamp and rotate pliers as shown in (Fig. 80). Remove clean air hose at cover.

(2) Remove crankcase breather/filter hose at air cleaner cover.

REMOVAL AND INSTALLATION (Continued)

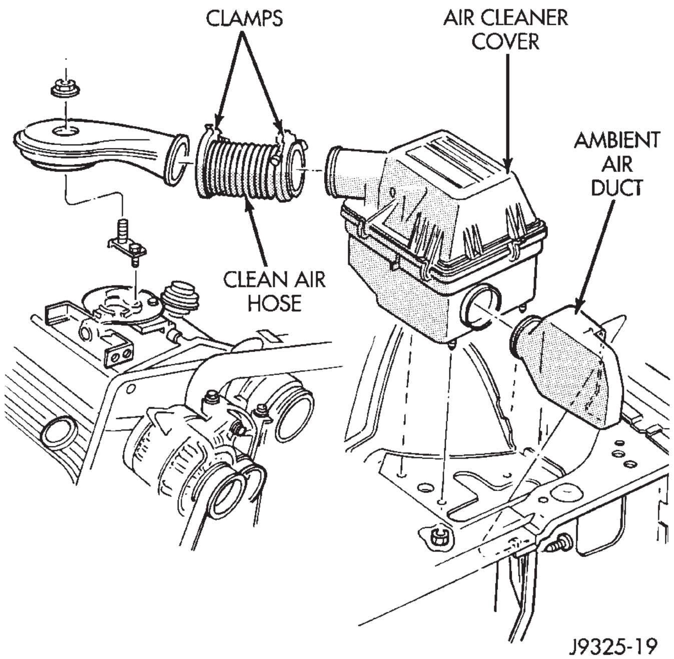


Fig. 79 Air Cleaner—5.2L V-8 Engine Shown

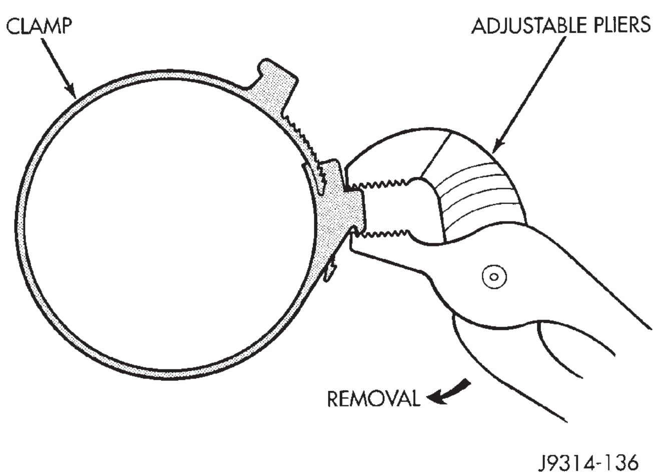


Fig. 80 Clamp Removal

(3) From under vehicle, remove three housing nuts (Fig. 79).

(4) Release the air cleaner housing from the ambient air duct and remove housing from vehicle.

INSTALLATION

(1) Position air cleaner housing to body and ambient air duct (Fig. 79).

(2) Install three nuts and tighten to 10 N·m (93 in. lbs.) torque.

(3) Install crankcase breather/filter hose to cover.

(4) Install clamp to cover. Compress the clamp snugly with adjustable pliers as shown in (Fig. 81).

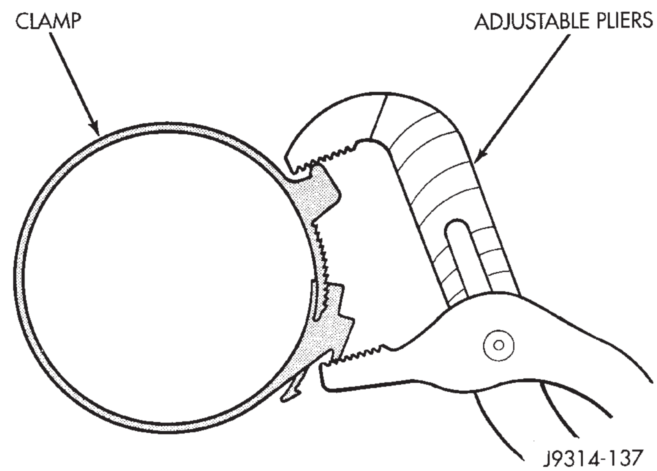


Fig. 81 Clamp Installation

AIR CLEANER ELEMENT (FILTER)

REMOVAL/INSTALLATION

(1) Pry back the six clips retaining the air cleaner cover to the air cleaner housing (Fig. 82).

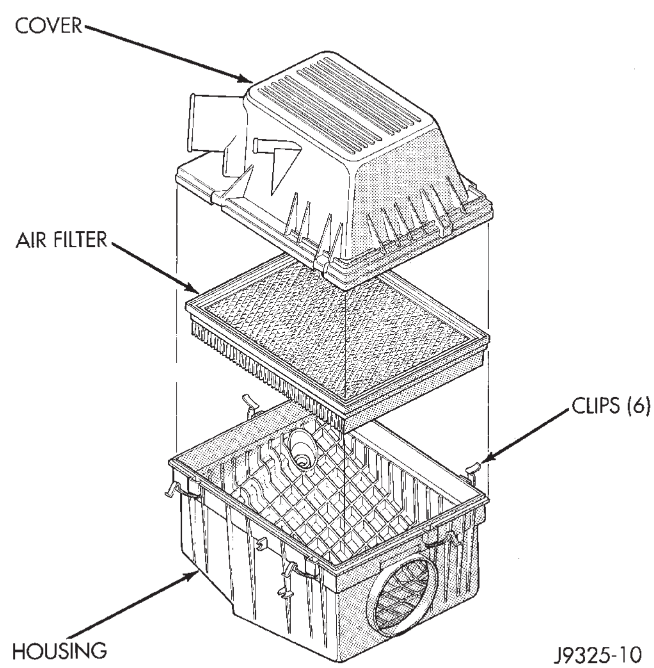


Fig. 82 Air Cleaner Element Removal/Installation

(2) Lift the cover up and position to the side.

(3) Remove air cleaner element.

(4) Clean the inside of air cleaner housing before installing new element.

(5) Reverse the preceding operation for installation. Be sure the air cleaner cover is properly seated to air cleaner housing.

REMOVAL AND INSTALLATION (Continued)

ENGINE COOLANT TEMPERATURE SENSOR—5.2L ENGINE

REMOVAL

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. COOLING SYSTEM MUST BE PARTIALLY DRAINED BEFORE REMOVING THE COOLANT TEMPERATURE SENSOR. REFER TO GROUP 7, COOLING.

(1) Partially drain cooling system. Refer to Group 7, Cooling.

(2) Disconnect electrical connector from sensor (Fig. 83).

(3) **Engines with air conditioning:** When removing the connector from sensor, do not pull directly on wiring harness. Fabricate an L-shaped hook tool from a coat hanger (approximately eight inches long). Place the hook part of tool under the connector for removal. The connector is snapped onto the sensor. It is not equipped with a lock type tab.

(4) Remove sensor from intake manifold.

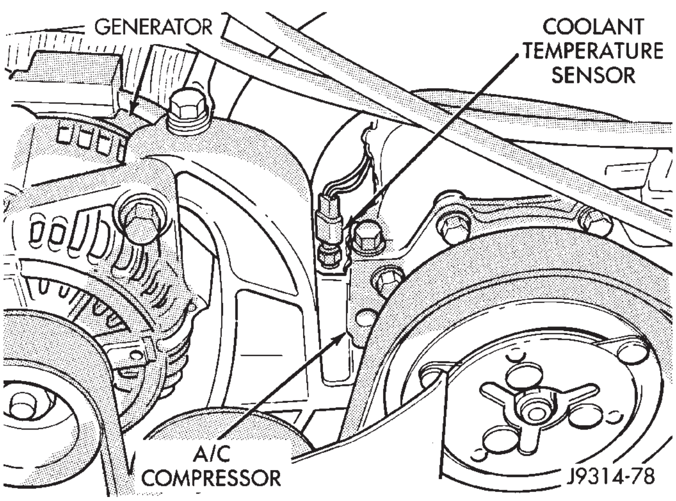


Fig. 83 Engine Coolant Temperature Sensor—5.2L Engine

INSTALLATION

(1) Install sensor.

(2) Tighten to 11 N·m (8 ft. lbs.) torque.

(3) Connect electrical connector to sensor. The sensor connector is symmetrical (not indexed). It can be installed to the sensor in either direction.

(4) Replace any lost engine coolant. Refer to Group 7, Cooling System.

ENGINE COOLANT TEMPERATURE SENSOR—4.0L ENGINE

The coolant temperature sensor is installed in the thermostat housing (Fig. 84).

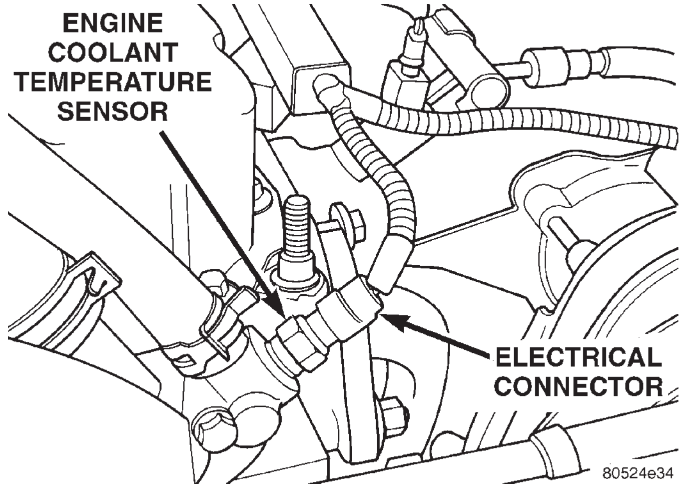


Fig. 84 Engine Coolant Temperature Sensor—4.0L Engine

REMOVAL

(1) Partially drain cooling system until the coolant level is below the cylinder head. Observe the **WARNINGS** in Group 7, Cooling.

(2) Disconnect the coolant temperature sensor wire connector.

(3) Remove the sensor from the thermostat housing.

INSTALLATION

(1) Apply sealant to sensor threads.

(2) Install coolant temperature sensor into the thermostat housing. Tighten to 11 N·m (8 ft. lbs.) torque.

(3) Connect the wire connector.

(4) Fill the cooling system. Refer to Group 7, Cooling System.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR—5.2L ENGINE

The intake manifold air temperature sensor is located in the front/side of the intake manifold (Fig. 85).

REMOVAL

(1) Disconnect electrical connector at sensor (Fig. 85).

(2) Remove sensor from intake manifold.

INSTALLATION

(1) Install sensor to intake manifold. Tighten to 28 N·m (20 ft. lbs.) torque.

(2) Install electrical connector.