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

Your vehicle was designed to meet all emission regulations and provide excellent fuel economy when using high quality unleaded gasoline.

Use unleaded gasolines having a minimum posted octane of 87.

If your vehicle develops occasional light spark knock (ping) at low engine speeds this is not harmful. However; continued heavy knock at high speeds can cause damage and should be reported to your dealer immediately. Engine damage as a result of heavy knock operation may not be covered by the new vehicle warranty.

In addition to using unleaded gasoline with the proper octane rating, those 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.

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 unleaded 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.

MTBE/ETBE - Gasoline and MTBE (Methyl Tertiary Butyl Ether) blends are a mixture of unleaded gasoline and up to 15 percent MTBE. Gasoline and ETBE (Ethyl Tertiary Butyl Ether) are blends of gasoline and up to 17 percent ETBE. Gasoline blended with MTBE or ETBE may be used in your vehicle.

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

DO NOT USE GASOLINES CONTAINING METHANOL.

GENERAL INFORMATION (Continued)

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 Corporation and may not be covered by the vehicle warranty.

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 fuel pump module containing the electric fuel pump, fuel filter/fuel pressure regulator, fuel gauge sending unit (fuel level sensor) and a separate fuel filter located at bottom of pump module
- fuel tubes/lines/hoses
- quick-connect fittings
- fuel injector rail
- fuel injectors
- fuel tank
- fuel tank filler/vent tube assembly
- fuel tank filler tube cap
- accelerator pedal
- throttle cable

Fuel is returned through the fuel pump module and back into the fuel tank through the fuel filter/fuel pressure regulator. A separate fuel return line from the engine to the tank is not used.

The fuel tank assembly consists of: the fuel tank, fuel pump module assembly, fuel pump module locknut/gasket, and rollover valve (refer to Group 25, Emission Control System for rollover valve information).

A fuel filler/vent tube assembly using a pressure/vacuum fuel filler cap is used. The fuel filler tube contains a spring-loaded flap (door) located below the fuel fill cap. The flap is used as a secondary way of sealing the fuel tank if the fuel fill cap has not been properly tightened. The flap is used as part of the EVAP monitor system when the vehicle is equipped with a Leak Detection Pump (LDP). The flap will be installed to all fuel filler tubes (equipped/not equipped with LDP and EVAP monitor system).

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.

Both fuel filters (at bottom of fuel pump module and within fuel pressure regulator) are designed for extended service. They do not require normal scheduled maintenance. Filters should only be replaced if a diagnostic procedure indicates to do so.

DESCRIPTION AND OPERATION (Continued)

FUEL PUMP MODULE

The fuel pump module is installed in the top of the fuel tank (Fig. 1) or (Fig. 2). The fuel pump module contains the following components:

- A combination fuel filter/fuel pressure regulator
- A separate fuel pick-up filter (strainer)
- An electric fuel pump
- A threaded locknut to retain module to tank
- A gasket between tank flange and module
- Fuel gauge sending unit (fuel level sensor)
- Fuel supply tube (line) connection

The fuel gauge sending unit, pick-up filter and fuel filter/fuel pressure regulator may be serviced separately. If the electrical fuel pump requires service, the entire fuel pump module must be replaced.

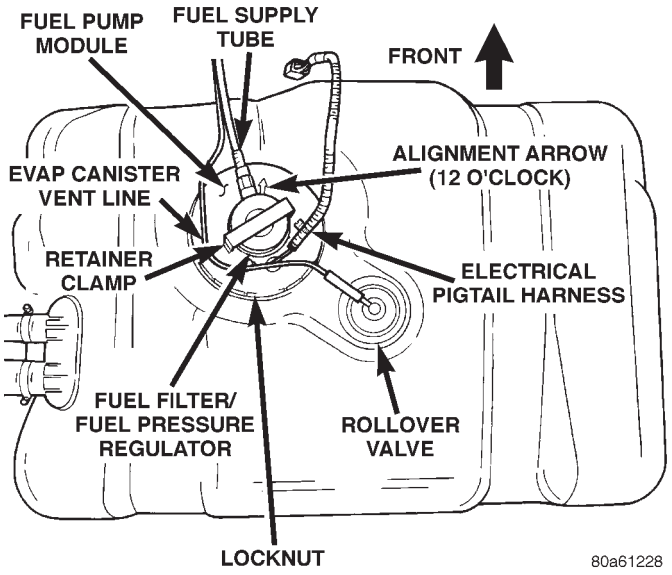


Fig. 1 Fuel Tank/Fuel Pump Module (Top View)

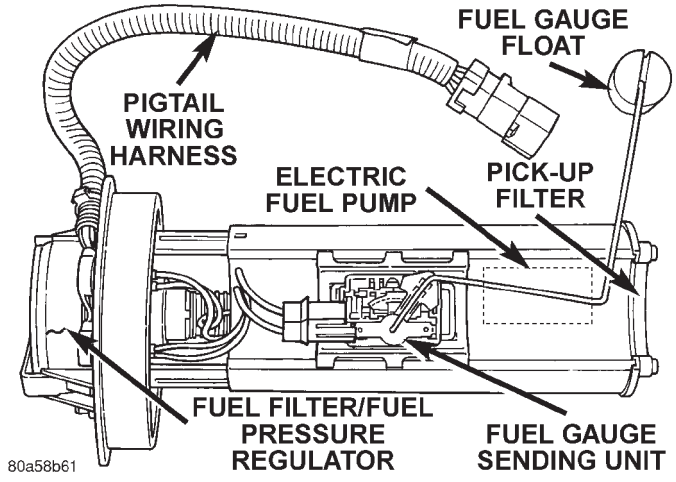


Fig. 2 Fuel Pump Module Components

FUEL PUMP

The fuel pump used in this system has a permanent magnet electric motor. The pump is part of the fuel pump module. Fuel is drawn in through a filter at the bottom of the module and pushed through the electric motor gearset to the pump outlet.

Check Valve Operation: The pump outlet contains a one-way check valve to prevent fuel flow back into the tank and to maintain fuel supply line pressure (engine warm) when pump is not operational. It is also used to keep the fuel supply line full of gasoline when pump is not operational. After the vehicle has cooled down, fuel pressure may drop to 0 psi (cold fluid contracts), but liquid gasoline will remain in fuel supply line between the check valve and fuel injectors. **Fuel pressure that has dropped to 0 psi on a cooled down vehicle (engine off) is a normal condition.** Refer to the Fuel Pressure Leak Down Test in this group for more information.

Voltage to operate the electric pump is supplied through the fuel pump relay.

FUEL GAUGE SENDING UNIT

The fuel gauge sending unit (fuel level sensor) is attached to the side of the fuel pump module. The sending unit consists of a float, an arm, and a variable resistor (track). The resistor track is used to send electrical signals to the Powertrain Control Module (PCM) for fuel gauge operation and for OBD II emission requirements.

For fuel gauge operation: As fuel level increases, the float and arm move up. This decreases the sending unit resistance, causing the fuel gauge to read full. As fuel level decreases, the float and arm move down. This increases the sending unit resistance causing the fuel gauge to read empty.

After this fuel level signal is sent to the PCM, the PCM will transmit the data across the CCD bus circuits to the instrument panel. Here it is translated into the appropriate fuel gauge level reading.

For OBD II emission monitor requirements: A voltage signal is sent from the resistor track on the sending unit to the PCM to indicate fuel level. The purpose of this feature is to prevent the OBD II system from recording/setting false misfire and fuel system monitor trouble codes. The feature is activated if the fuel level in the tank is less than approximately 15 percent of its rated capacity. If equipped with a Leak Detection Pump (EVAP system monitor), this feature will also be activated if the fuel level in the tank is more than approximately 85 percent of its rated capacity.

FUEL FILTER/FUEL PRESSURE REGULATOR

A combination fuel filter and fuel pressure regulator is used on all engines. It is located on the top of fuel pump module (Fig. 1). A separate frame mounted fuel filter is not used with any engine.

DESCRIPTION AND OPERATION (Continued)

Fuel Pressure Regulator Operation: The pressure regulator is a mechanical device that is not controlled by engine vacuum or the Powertrain Control Module (PCM).

The regulator is calibrated to maintain fuel system operating pressure of approximately 339 kPa ± 34 kPa (49.2 psi ± 5 psi) at the fuel injectors. It contains a diaphragm, calibrated springs and a fuel return valve. The internal fuel filter is also part of the assembly.

Fuel is supplied to the filter/regulator by the electric fuel pump through an opening tube at the bottom of filter/regulator (Fig. 3).

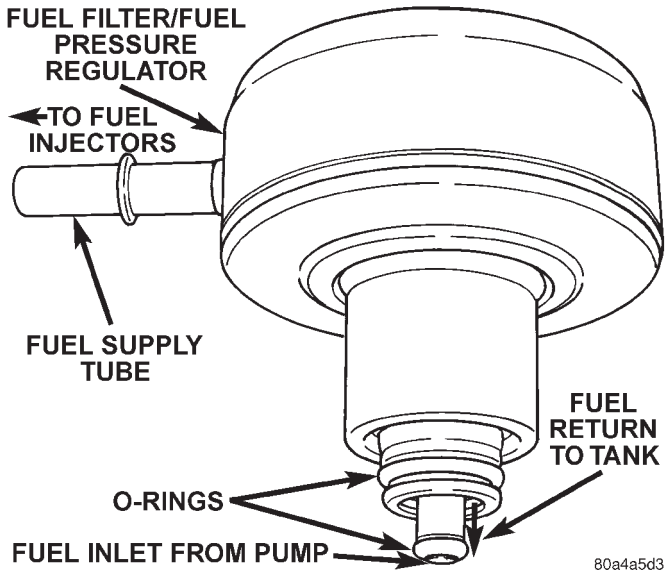


Fig. 3 Fuel Filter/Fuel Pressure Regulator

The regulator acts as a check valve to maintain some fuel pressure when the engine is not operating. This will help to start the engine. A second check valve is located at the outlet end of the electric fuel pump. **Refer to Fuel Pump—Description and Operation for more information. Also refer to the Fuel Pressure Leak Down Test and the Fuel Pump Pressure Tests.**

If fuel pressure at the pressure regulator exceeds approximately 49 psi, an internal diaphragm closes and excess fuel is routed back into the tank through the pressure regulator. A separate fuel return line is not used.

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 are equipped with either one or two rollover valves mounted into the top of the fuel tank (or pump module). Refer to Group 25, Emission Control System for rollover valve information.

An evaporation control system is connected to the rollover valve(s) to reduce emissions of fuel vapors into the atmosphere. When fuel evaporates from the fuel tank, vapors pass through vent hoses or tubes to a charcoal canister where they are temporarily held. When the engine is running, the vapors are drawn into the intake manifold. Certain models are also equipped with a self-diagnosing system using a Leak Detection Pump (LDP). Refer to Group 25, Emission Control System for additional information.

ROLLOVER VALVE(S)

Refer to Group 25, Emission Control System for information.

FUEL INJECTORS

The fuel injectors (Fig. 4) are electrical solenoids. The injector contains a pintle that closes off an orifice at the nozzle end. When electric current is supplied to the injector, the armature and needle move a short distance against a spring, allowing fuel to flow out the orifice. Because the fuel is under high pressure, a fine spray is developed in the shape of a pencil stream. The spraying action atomizes the fuel, adding it to the air entering the combustion chamber.

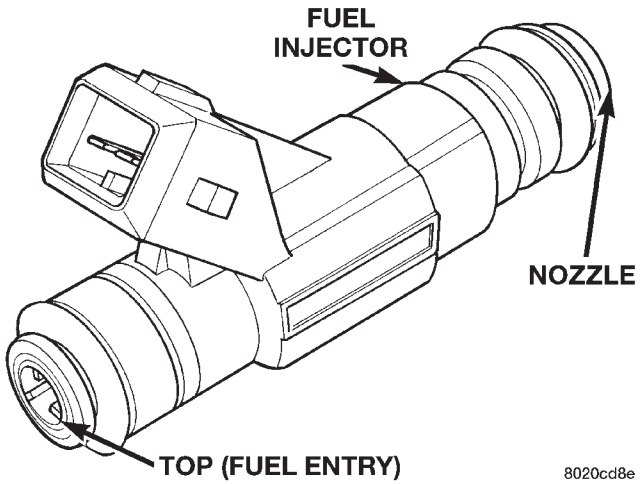


Fig. 4 Fuel Injector—Typical

An individual fuel injector is used for each individual cylinder. The top (fuel entry) end of the injector is attached into an opening on the fuel rail.

The nozzle (outlet) 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.

FUEL RAIL—4.0L ENGINE

The fuel rail supplies the necessary fuel to each individual fuel injector and is mounted to the intake manifold (Fig. 5). The fuel pressure regulator is not mounted to the fuel rail on any 4.0L engine. It is located on the fuel tank mounted fuel pump module. Refer to Fuel Filter/Fuel Pressure Regulator in this group for information.

Depending on vehicle model/engine, the fuel rail may/may not be equipped with a fuel pressure test port. Refer to the Fuel Pump Pressure Test for additional information.

The fuel rail is not repairable.

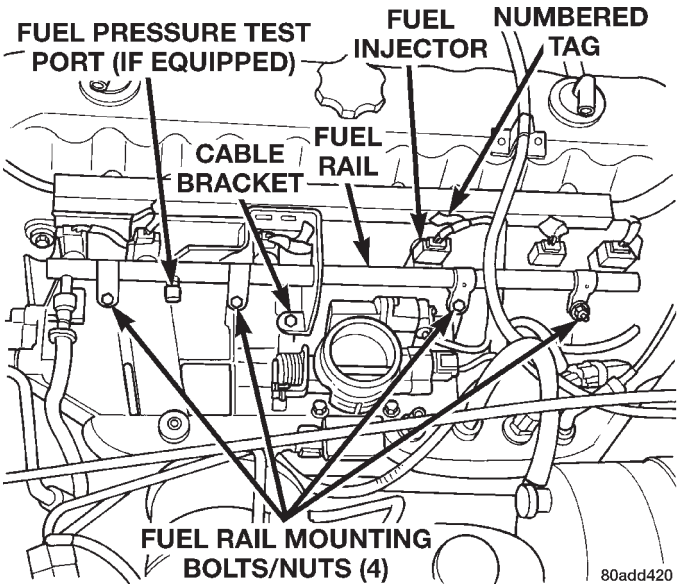


Fig. 5 Fuel Rail—4.0L Engine

FUEL RAIL—5.2L/5.9L ENGINES

The fuel rail supplies the necessary fuel to each individual fuel injector and is mounted to the intake manifold (Fig. 6). The fuel pressure regulator is not mounted to the fuel rail on any 5.2L/5.9L V-8 engine. It is located on the fuel tank mounted fuel pump module. Refer to Fuel Filter/Fuel Pressure Regulator in this group for information.

Depending on vehicle model/engine, the fuel rail may/may not be equipped with a fuel pressure test port. If equipped, it will be located on the left side of fuel rail. Refer to the Fuel Pump Pressure Test for additional information.

The fuel rail is not repairable.

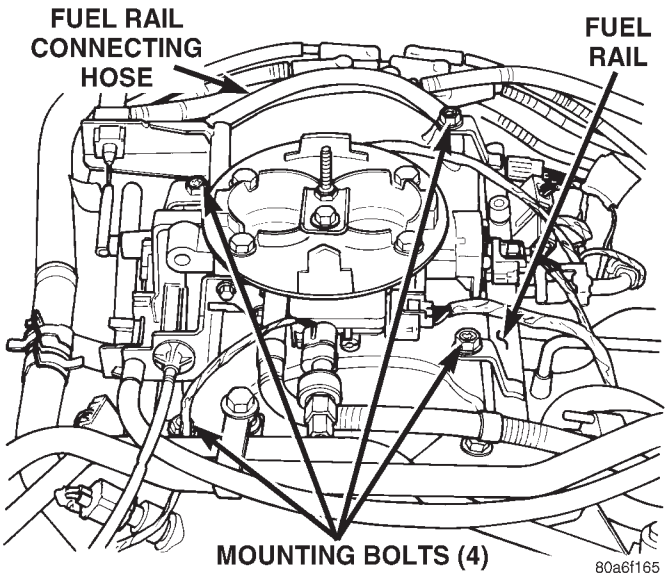


Fig. 6 Fuel Rail—Typical 5.2L/5.9L Engine

CAUTION: 5.2L/5.9L 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 fuel filler tube caps is between .97 and 5.0 kPa (.14 and .72 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.

DESCRIPTION AND OPERATION (Continued)

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—ALL ENGINES WITH PRESSURE TEST PORT

Use this test in conjunction with the Fuel Pump Capacity Test, Fuel Pressure Leak Down Test and Fuel Pump Amperage Test found elsewhere in this group.

Check Valve Operation: The electric fuel pump outlet contains a one-way check valve to prevent fuel flow back into the tank and to maintain fuel supply line pressure (engine warm) when pump is not operational. It is also used to keep the fuel supply line full of gasoline when pump is not operational. After the vehicle has cooled down, fuel pressure may drop to 0 psi (cold fluid contracts), but liquid gasoline will remain in fuel supply line between the check valve and fuel injectors. **Fuel pressure that has dropped to 0 psi on a cooled down vehicle (engine off) is a normal condition.** When the electric fuel pump is activated, fuel pressure should **immediately** (1–2 seconds) rise to specification.

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

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) Remove protective cap at fuel rail test port. Connect the 0–414 kPa (0-60 psi) fuel pressure gauge (from gauge set 5069) to test port pressure fitting on fuel rail (Fig. 7).

(2) Start and warm engine and note pressure gauge reading. Fuel pressure should be 339 kPa ± 34 kPa (49.2 psi ± 5 psi) at idle.

(3) If engine runs, but pressure is below 44.2 psi, check for a kinked fuel supply line somewhere between fuel rail and fuel pump module. If line is not kinked, but specifications for either the Fuel Pump Capacity, Fuel Pump Amperage or Fuel Pressure Leak Down Tests were not met, replace fuel pump module assembly. Refer to Fuel Pump Module Removal/Installation.

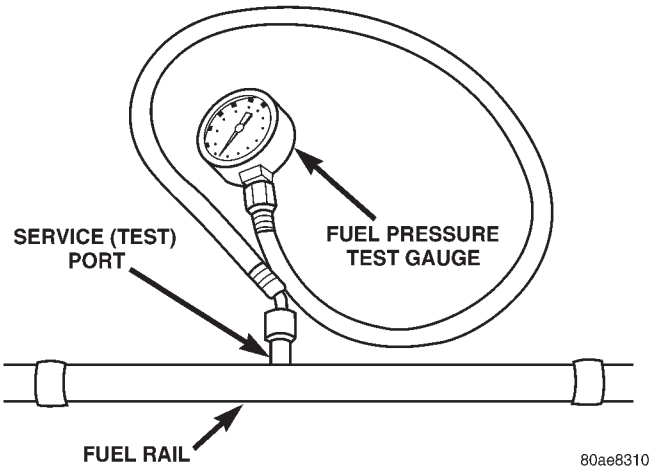


Fig. 7 Fuel Pressure Test Gauge (Typical Gauge Installation at Test Port)

(4) If operating pressure is above 54.2 psi, electric fuel pump is OK, but fuel pressure regulator is defective. Replace fuel filter/fuel pressure regulator. Refer to Fuel Filter/Fuel Pressure Regulator Removal/Installation for more information.

(5) Install protective cap to fuel rail test port.

FUEL PUMP CAPACITY TEST

Before performing this test, verify fuel pump pressure by performing the Fuel Pump Pressure Test. Use this test in conjunction with the Fuel Pressure Leak Down Test found elsewhere in this group.

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

(2) Disconnect fuel supply line at fuel rail. Refer to Quick-Connect Fittings in the Service Procedures section of this group for procedures. Some engines may require air cleaner housing removal before line disconnection.

(3) Connect appropriate Fuel Line Pressure Test Adapter Tool Hose (number 6631, 6923, 6541 or 6539) into disconnected fuel supply line. Insert other end of Adaptor Tool hose into a graduated container.

(4) Remove fuel fill cap.

(5) To activate fuel pump and pressurize system, obtain DRB scan tool and actuate ASD Fuel System Test.

(6) A good fuel pump will deliver at least 1/4 liter of fuel in 7 seconds. Do not operate fuel pump for longer than 7 seconds with fuel line disconnected as fuel pump module reservoir may run empty.

(a) If capacity is lower than specification, but fuel pump can be heard operating through fuel fill cap opening, check for a kinked/damaged fuel sup-

DIAGNOSIS AND TESTING (Continued)

ply line somewhere between fuel rail and fuel pump module.

(b) If line is not kinked/damaged, and fuel pressure is OK, but capacity is low, replace fuel filter/fuel pressure regulator. The filter/regulator may be serviced separately on certain applications. Refer to Fuel Filter/Fuel Pressure Regulator Removal/Installation for additional information.

(c) If both fuel pressure and capacity are low, replace fuel pump module assembly. Refer to Fuel Pump Module Removal/Installation.

FUEL PRESSURE LEAK DOWN TEST

Use this test in conjunction with the Fuel Pump Pressure Test and Fuel Pump Capacity Test.

Check Valve Operation: The electric fuel pump outlet contains a one-way check valve to prevent fuel flow back into the tank and to maintain fuel supply line pressure (engine warm) when pump is not operational. It is also used to keep the fuel supply line full of gasoline when pump is not operational. After the vehicle has cooled down, fuel pressure may drop to 0 psi (cold fluid contracts), but liquid gasoline will remain in fuel supply line between the check valve and fuel injectors. **Fuel pressure that has dropped to 0 psi on a cooled down vehicle (engine off) is a normal condition.** When the electric fuel pump is activated, fuel pressure should **immediately** (1–2 seconds) rise to specification.

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. 8) or (Fig. 9).

(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.**

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

(5) Observe test gauge. Normal operating pressure should be 339 kPa ± 34 kPa (49.2 psi ± 5 psi).

(6) Shut engine off.

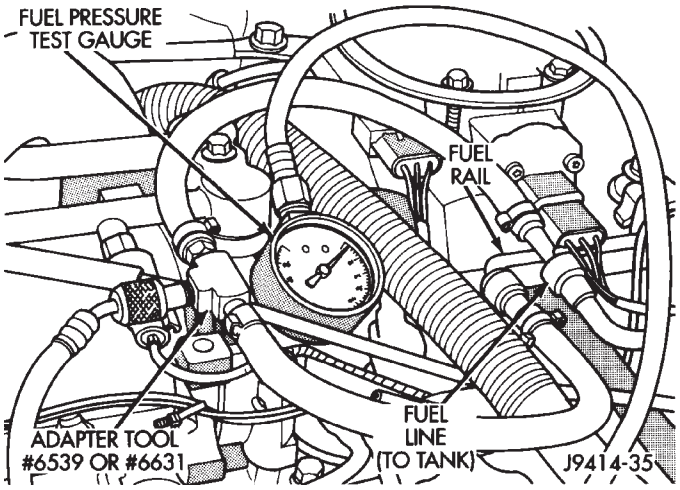


Fig. 8 Connecting Adapter Tool—Typical

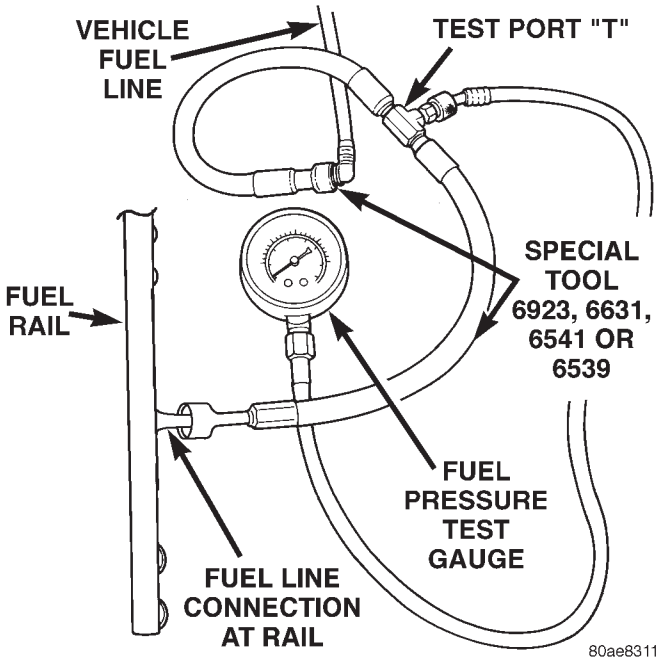


Fig. 9 Connecting Adapter Tool—Typical

(7) Pressure should not fall below **30 psi for five minutes.**

(8) If pressure falls below 30 psi, it must be determined if a fuel injector, the check valve within the fuel pump module, or a fuel tube/line is leaking.

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

(10) Shut engine off.

(11) **Testing for fuel injector or fuel rail 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 30 psi, a fuel injector or the fuel rail is leaking.

(12) **Testing for fuel pump check valve, filter/regulator check valve or fuel tube/line leakage:**

DIAGNOSIS AND TESTING (Continued)

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 30 psi, a leak may be found at a fuel tube/line. If no leaks are found at fuel tubes or lines, one of the check valves in either the electric fuel pump or filter/regulator may be leaking.

Note: A quick loss of pressure usually indicates a defective check valve in the filter/regulator. A slow loss of pressure usually indicates a defective check valve in the electric fuel pump.

The electric fuel pump is not serviced separately. Replace the fuel pump module assembly. The filter/regulator may be replaced separately on certain applications. Refer to Fuel Filter/Fuel Pressure Regulator Removal/Installation for additional information.

FUEL PUMP AMPERAGE TEST

This amperage (current draw) test is to be done in conjunction with the Fuel Pump Pressure Test, Fuel Pump Capacity Test and Fuel Pressure Leak Down Test. Before performing the amperage test, be sure the temperature of the fuel tank is above 50° F (10° C).

The DRB Scan Tool along with the DRB Low Current Shunt (LCS) adapter (Fig. 10) and its test leads will be used to check fuel pump amperage specifications.

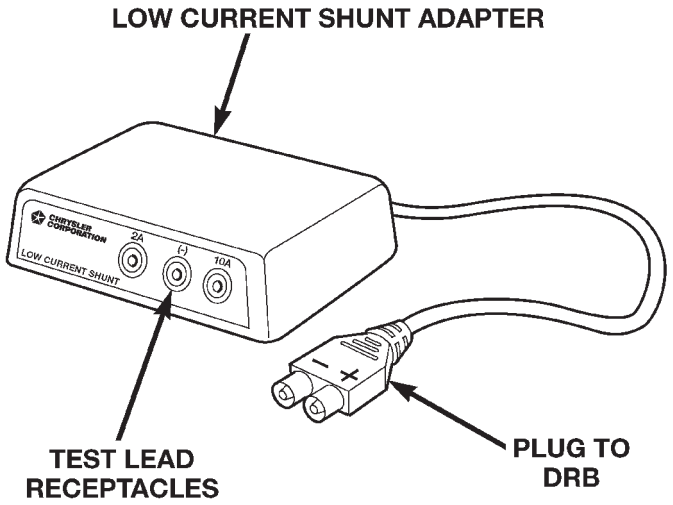


Fig. 10 Low Current Shunt Adapter

(1) Obtain LCS adapter.

(2) Plug cable from LCS adapter into DRB scan tool at SET 1 receptacle.

(3) Plug DRB into vehicle 16–way connector (data link connector).

(4) Connect (-) and (+) test cable leads into LCS adapter receptacles. Use **10 amp (10A +)** receptacle and common (-) receptacles.

(5) Gain access to MAIN MENU on DRB screen.

(6) Press DVOM button on DRB.

(7) Using left/right arrow keys, highlight CHANNEL 1 function on DRB screen.

(8) Press ENTER three times.

(9) Using up/down arrow keys, highlight RANGE on DRB screen (screen will default to 2 amp scale).

(10) Press ENTER to change 2 amp scale to 10 amp scale. **This step must be done to prevent damage to DRB scan tool or LCS adapter (blown fuse).**

(11) Remove cover from Power Distribution Center (PDC).

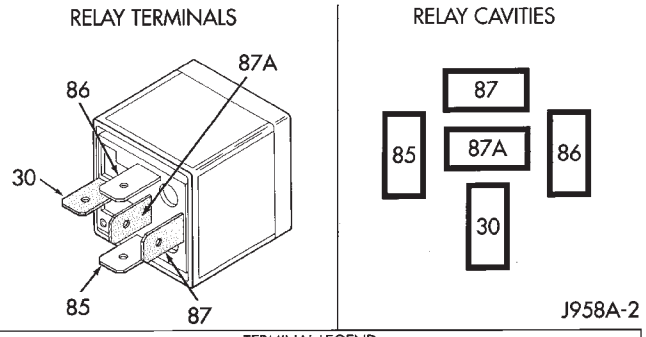
(12) Remove fuel pump relay from PDC. Refer to label on PDC cover for relay location.

WARNING: BEFORE PROCEEDING TO NEXT STEP, NOTE THE FUEL PUMP WILL BE ACTIVATED AND SYSTEM PRESSURE WILL BE PRESENT. THIS WILL OCCUR AFTER CONNECTING TEST LEADS FROM LCS ADAPTER INTO FUEL PUMP RELAY CAVITIES. THE FUEL PUMP WILL OPERATE EVEN WITH IGNITION KEY IN OFF POSITION. BEFORE ATTACHING TEST LEADS, BE SURE ALL FUEL LINES AND FUEL SYSTEM COMPONENTS ARE CONNECTED.

CAUTION: TO PREVENT POSSIBLE DAMAGE TO THE VEHICLE ELECTRICAL SYSTEM AND LCS ADAPTER, THE TEST LEADS MUST BE CONNECTED INTO RELAY CAVITIES EXACTLY AS SHOWN IN FOLLOWING STEPS.

Depending upon vehicle model, year or engine configuration, three different types of relays may be used: Type-1, type-2 and type–3.

(13) If equipped with **type–1 relay** (Fig. 11), attach test leads from LCS adapter into PDC relay cavities number 30 and 87. For location of these cavities, refer to numbers stamped to bottom of relay (Fig. 11).



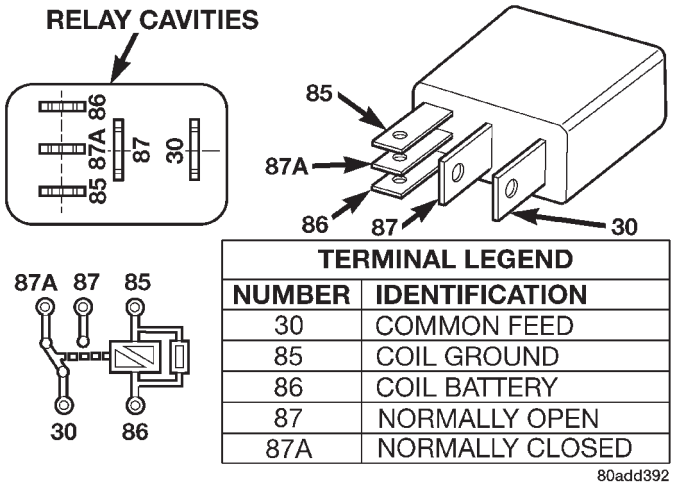
TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 11 Type–1 Relay

DIAGNOSIS AND TESTING (Continued)

(14) If equipped with **type–2 relay** (Fig. 12), attach test leads from LCS adapter into PDC relay cavities number 30 and 87. For location of these cavities, refer to numbers stamped to bottom of relay (Fig. 12).

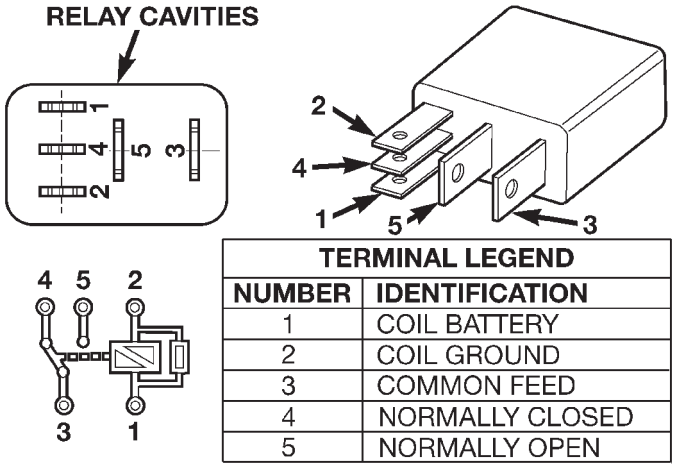
(15) If equipped with **type–3 relay** (Fig. 13), attach test leads from LCS adapter into PDC relay cavities number 3 and 5. For location of these cavities, refer to numbers stamped to bottom of relay (Fig. 13).



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

80add392

Fig. 12 Type–2 Relay



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
1	COIL BATTERY
2	COIL GROUND
3	COMMON FEED
4	NORMALLY CLOSED
5	NORMALLY OPEN

80add390

Fig. 13 Type–3 Relay

(16) When LCS adapter test leads are attached into relay cavities, fuel pump **will be activated.** Determine fuel pump amperage on DRB screen. Amperage should be below 10.0 amps. If amperage is below 10.0 amps, and specifications for the Fuel Pump Pressure, Fuel Pump Capacity and Fuel Pressure Leak Down tests were met, the fuel pump module is OK.

(17) If amperage is more than 10.0 amps, replace fuel pump module assembly. The electric fuel pump is not serviced separately.

(18) Disconnect test leads from relay cavities immediately after testing.

FUEL GAUGE SENDING UNIT

The fuel gauge sending unit contains a variable resistor (track). As the float moves up or down, electrical resistance will change. Refer to Group 8E, Instrument Panel and Gauges for Fuel Gauge testing. To test the gauge sending unit only, it must be removed from vehicle. The unit is part of the fuel pump module. Refer to Fuel Pump Module Removal/Installation for procedures. Measure the resistance across the sending unit terminals. With float in up position, resistance should be 20 ohms. With float in down position, resistance should be 220 ohms.

FUEL INJECTOR TEST

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. Place an ohmmeter across the injector electrical terminals. Resistance reading should be approximately 12 ohms ±1.2 ohms at 20°C (68°F).

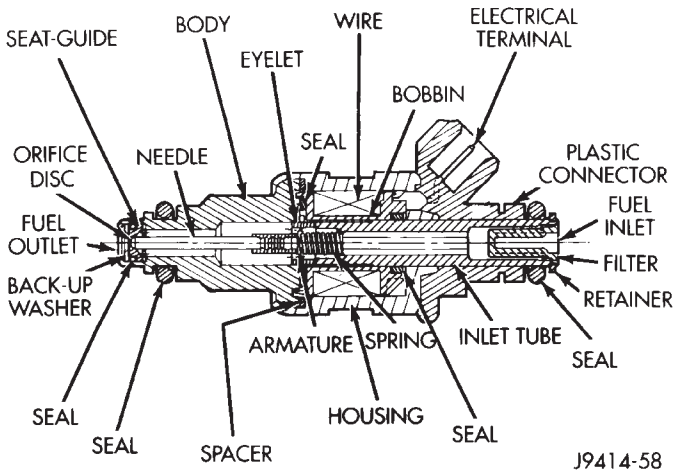


Fig. 14 Fuel Injector Internal Components—Typical

SERVICE PROCEDURES

FUEL SYSTEM PRESSURE RELEASE PROCEDURE

Use the following procedure if the fuel rail is or 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 until it stalls.

(3) Attempt restarting engine until it will no longer run.

SERVICE PROCEDURES (Continued)

(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: Powering an injector for more than a few seconds will permanently damage the injector.

(9) Momentarily touch the other end of this jumper wire to the negative terminal of the battery for no more than a few 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 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.

If equipped: 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 3 N·m (25 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.

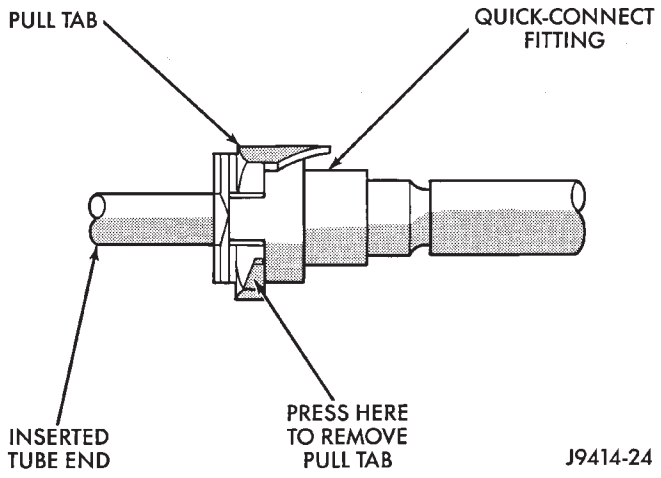


Fig. 15 Single-Tab Type Fitting

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.

SERVICE PROCEDURES (Continued)

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) Perform fuel pressure release procedure. Refer to Fuel Pressure Release Procedure in this group.

(2) Disconnect negative battery cable from battery.

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

(4) Press release tab on 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 release tab on side of fitting, use a screwdriver to pry up pull tab (Fig. 16).

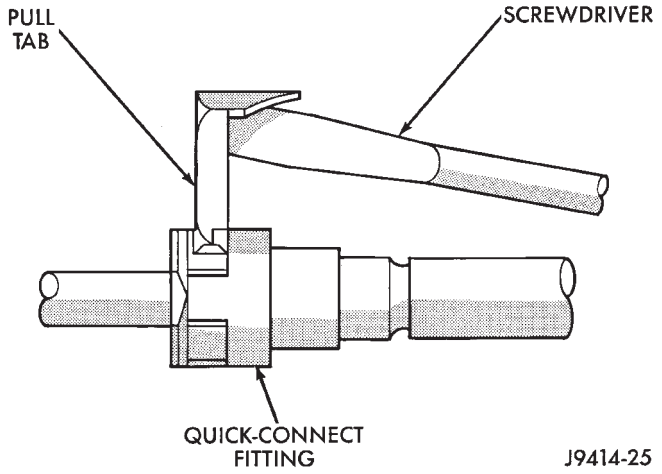


Fig. 16 Disconnecting Single-Tab Type Fitting

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

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

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

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

(10) Insert quick-connect fitting into fuel tube or fuel system component until built-on stop on fuel tube or component rests against back of fitting.

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

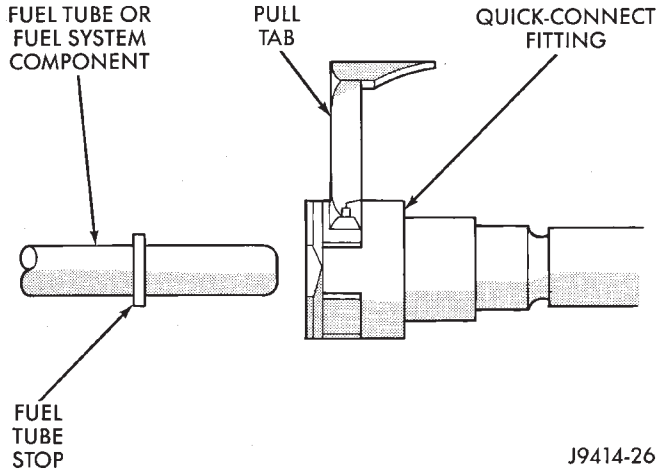


Fig. 17 Removing Pull Tab

(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.

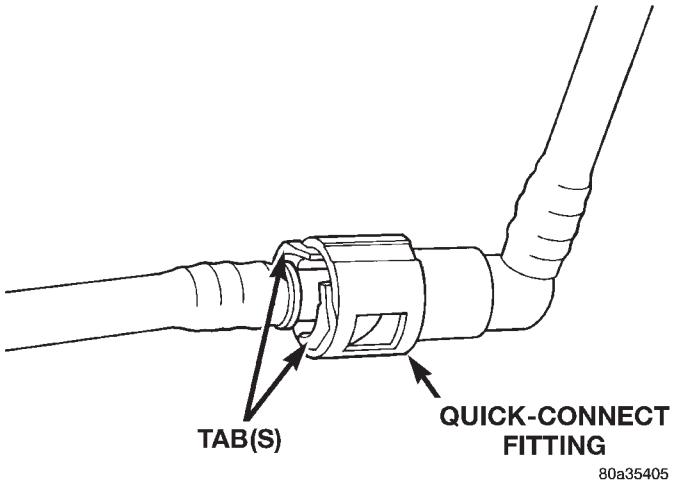


Fig. 18 Typical Two-Tab Type Quick-Connect Fitting

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.

SERVICE PROCEDURES (Continued)

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) Perform fuel pressure release procedure. Refer to Fuel Pressure Release Procedure in this group.

(2) Disconnect negative battery cable from battery.

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

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

(5) Inspect 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 quick-connect fitting to component being serviced, check condition of fitting and component. Clean parts with a lint-free cloth. Lubricate with clean engine oil.

(7) Insert quick-connect fitting to component being serviced and into 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.

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.

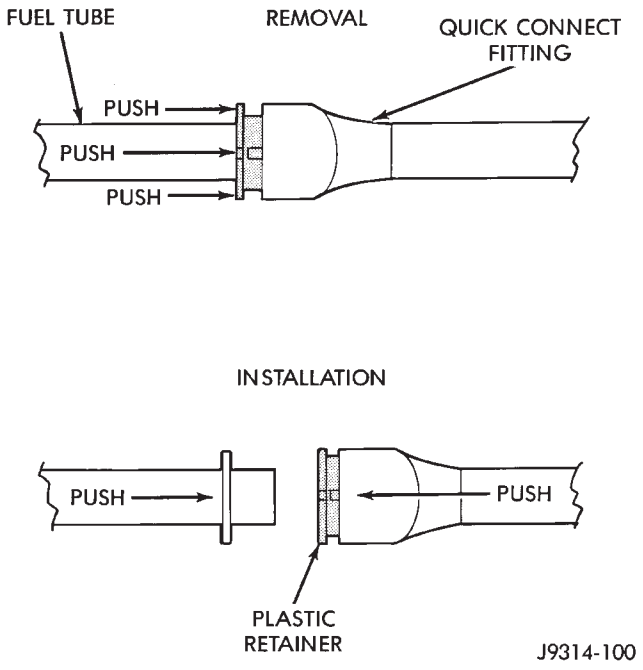


Fig. 19 Plastic Retainer Ring Type Fitting

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

(2) Disconnect negative battery cable from battery.

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

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

(5) After disconnection, plastic retainer ring will remain with 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 quick-connect fitting to component being serviced, check condition of fitting

SERVICE PROCEDURES (Continued)

and component. Clean parts with a lint-free cloth. Lubricate with clean engine oil.

(8) Insert quick-connect fitting into 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.

LATCH CLIP FITTING (FUEL LINE-TO-FUEL RAIL)

A tethered latch clip (Fig. 20) is used to secure the fuel line to the fuel rail. A special tool will be necessary to separate fuel line from fuel rail after latch clip is removed. This same latch clip may also be used to secure other different fuel system components.

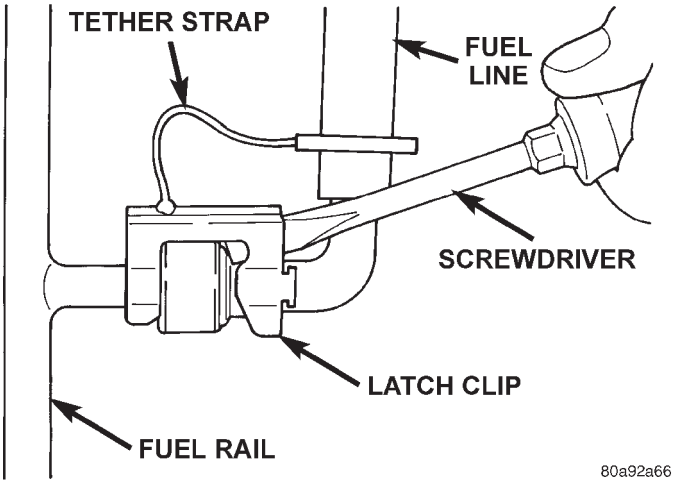


Fig. 20 Latch Clip Removal

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) Perform fuel pressure release procedure. Refer to Fuel Pressure Release Procedure in this group.

(2) Disconnect negative battery cable from battery.

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

(4) Pry up on latch clip with a screwdriver (Fig. 20).

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

(6) Insert special fuel line removal tool (Snap-On number FIH 9055-1 or equivalent) into fuel line (Fig. 21). Use this tool to release locking fingers in end of line.

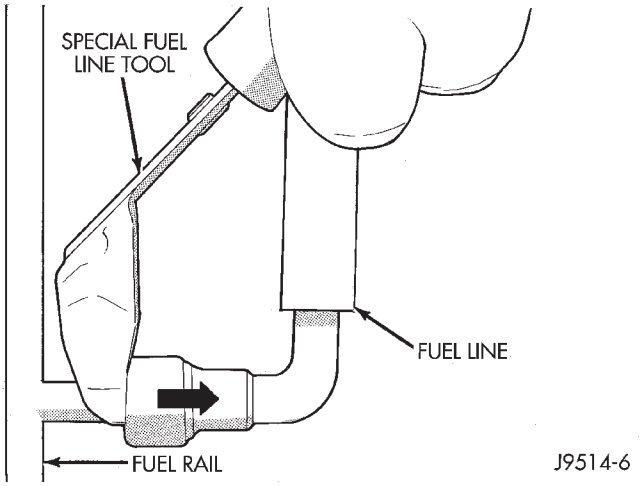


Fig. 21 Fuel Line Disconnection

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

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

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

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

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

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

(13) Connect negative battery cable to battery.

(14) Start engine and check for leaks.

REMOVAL AND INSTALLATION

FUEL FILTER/FUEL PRESSURE REGULATOR

The combination Fuel Filter/Fuel Pressure Regulator is located on the fuel pump module. The fuel pump module is located on top of fuel tank.

The filter/regulator may be removed without removing fuel pump module although fuel tank must be removed.

REMOVAL AND INSTALLATION (Continued)

REMOVAL

(1) Remove fuel tank. Refer to Fuel Tank Removal/ Installation.

(2) Clean area around filter/regulator.

(3) Remove retainer clamp from top of filter/regulator (Fig. 22). Clamp snaps to tabs on pump module. Discard old clamp.

(4) Pry filter/regulator from top of pump module with 2 screwdrivers. Unit is snapped into module.

(5) Discard gasket below filter/regulator (Fig. 23).

(6) Before discarding filter/regulator assembly, inspect assembly to verify that o-rings (Fig. 24) are intact. If the smallest of the two o-rings can not be found on bottom of filter/regulator, it may be necessary to remove it from the fuel inlet passage in fuel pump module.

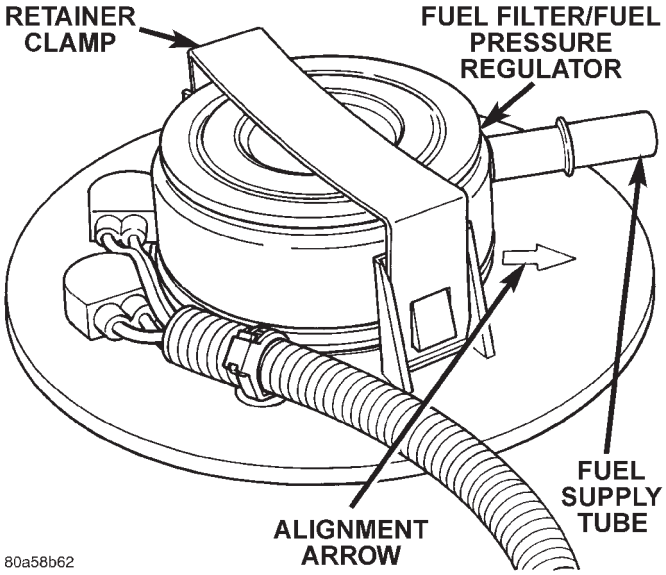


Fig. 22 Fuel Filter/Fuel Pressure Regulator

INSTALLATION

(1) Clean recessed area in pump module where filter/regulator is to be installed.

(2) Obtain new filter/regulator (two new o-rings should already be installed).

(3) Apply a small amount of clean engine oil to o-rings. **Do not install o-rings separately into fuel pump module. They will be damaged when installing filter/regulator.**

(4) Install new gasket to top of fuel pump module.

(5) Press new filter/regulator into top of pump module until it snaps into position (a positive click must be heard or felt).

(6) The molded arrow (Fig. 22) on top of fuel pump module should be pointed towards front of vehicle (12 o'clock position).

(7) Rotate filter/regulator until fuel supply tube (fitting) is pointed to 11 o'clock position.

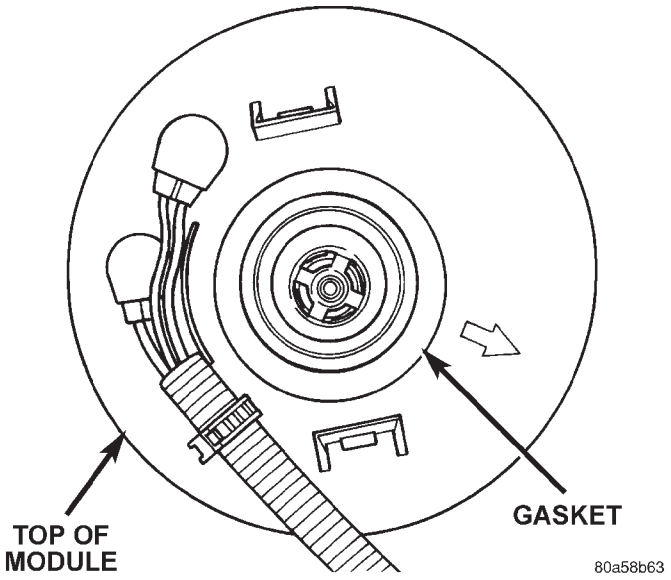


Fig. 23 Fuel Filter/Fuel Pressure Regulator Gasket

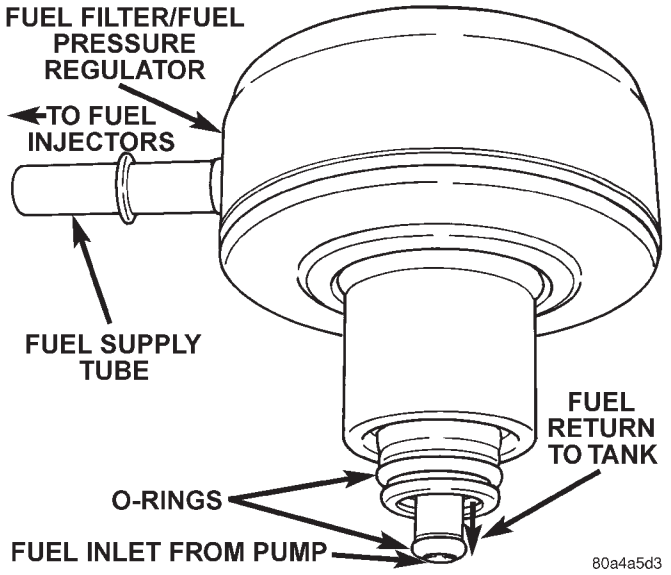


Fig. 24 Fuel Filter/Fuel Pressure Regulator O-Rings

(8) Install new retainer clamp (clamp snaps over top of filter/regulator and locks to flanges on pump module).

(9) Install fuel tank. Refer to Fuel Tank Removal/ Installation.

FUEL PUMP MODULE

Fuel tank removal will be necessary for fuel pump module removal.

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.

REMOVAL AND INSTALLATION (Continued)

(1) Drain fuel tank and remove tank. Refer to the Fuel Tank Removal/Installation section of this group.

(2) Thoroughly wash and clean area around pump module to prevent contaminants from entering tank.

(3) The plastic fuel pump module locknut is threaded onto fuel tank (Fig. 25). Install Special Tool 6856 to fuel pump module locknut and remove locknut (Fig. 26). The fuel pump module will spring up when locknut is removed.

(4) Remove module from fuel tank.

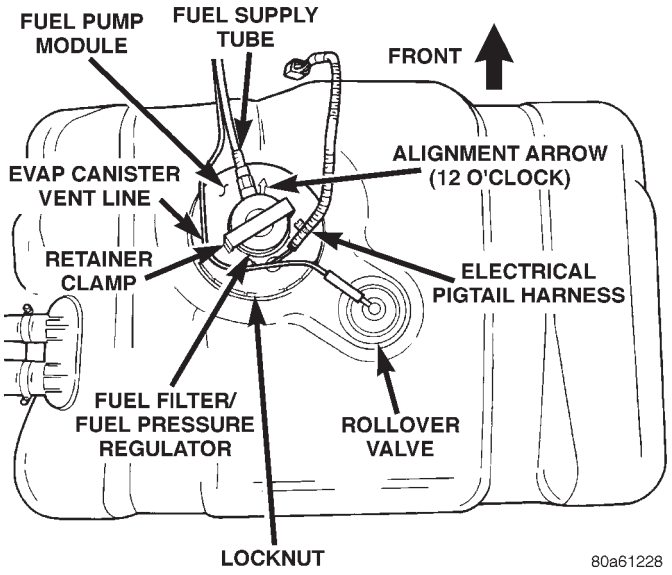


Fig. 25 Top View of Fuel Tank and Fuel Pump Module

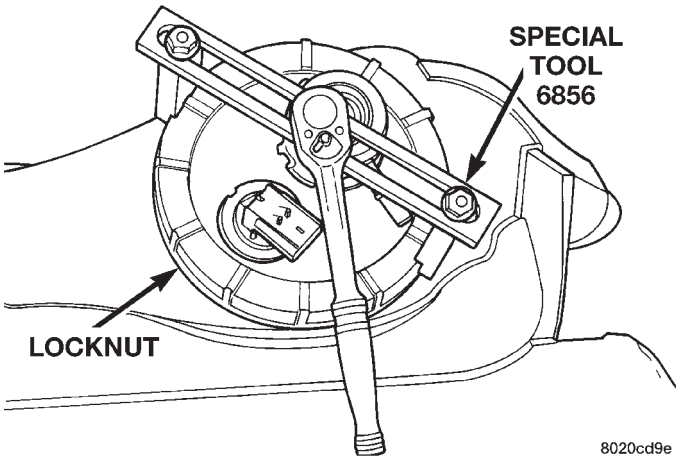


Fig. 26 Locknut Removal/Installation—Typical

INSTALLATION

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

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

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

(3) Rotate module until arrow (Fig. 22) is pointed toward front of vehicle (12 o'clock position). This step must be done to prevent float/float rod assembly from contacting sides of fuel tank.

(4) Install Special Tool 6856 to locknut.

(5) Tighten locknut to 62 N·m (45 ft. lbs.) torque.

(6) Rotate fuel filter/fuel pressure regulator until its fitting is pointed to 11 o'clock position.

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

FUEL PUMP INLET FILTER

The fuel pump inlet filter (strainer) is located on the bottom of fuel pump module (Fig. 27). The fuel pump module is located on top of fuel tank.

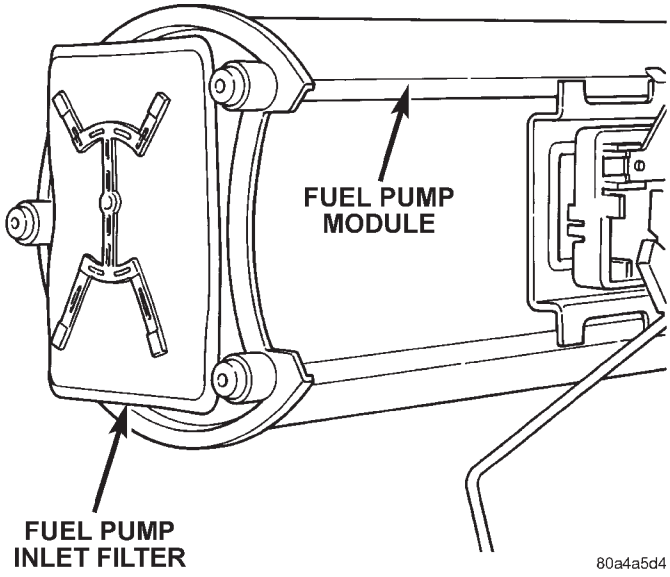


Fig. 27 Fuel Pump Inlet Filter

REMOVAL

(1) Remove fuel tank. Refer to Fuel Tank Removal/Installation.

(2) Remove fuel pump module. Refer to Fuel Pump Module Removal/Installation.

(3) Remove filter by prying from bottom of module with 2 screwdrivers. Filter is snapped to module.

(4) Clean bottom of pump module.

INSTALLATION

(1) Snap new filter to bottom of module.

(2) Install fuel pump module. Refer to Fuel Pump Module Removal/Installation.

(3) Install fuel tank. Refer to Fuel Tank Removal/Installation.

FUEL GAUGE SENDING UNIT

The fuel gauge sending unit (fuel level sensor) and float assembly is located on the side of fuel pump module (Fig. 28). The fuel pump module is located within the fuel tank.

REMOVAL AND INSTALLATION (Continued)

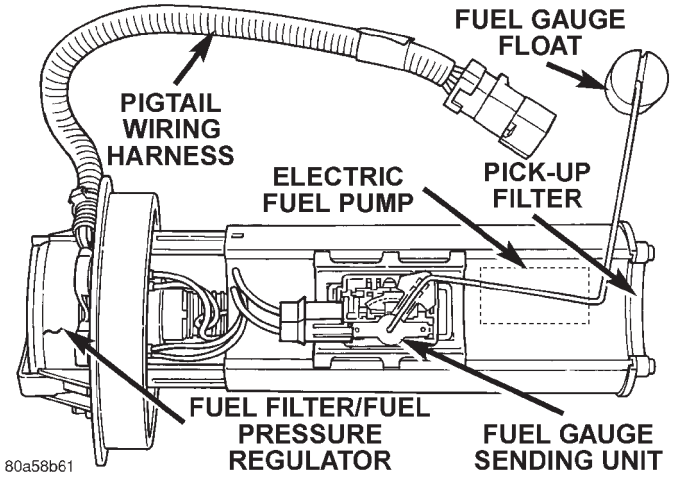


Fig. 28 Fuel Gauge Sending Unit Location

REMOVAL

(1) Remove fuel tank. Refer to Fuel Tank Removal/Installation.

(2) Remove fuel pump module. Refer to Fuel Pump Module Removal/Installation.

(3) Remove electrical wire connector at sending unit terminals.

(4) Press on release tab (Fig. 29) to remove sending unit from pump module.

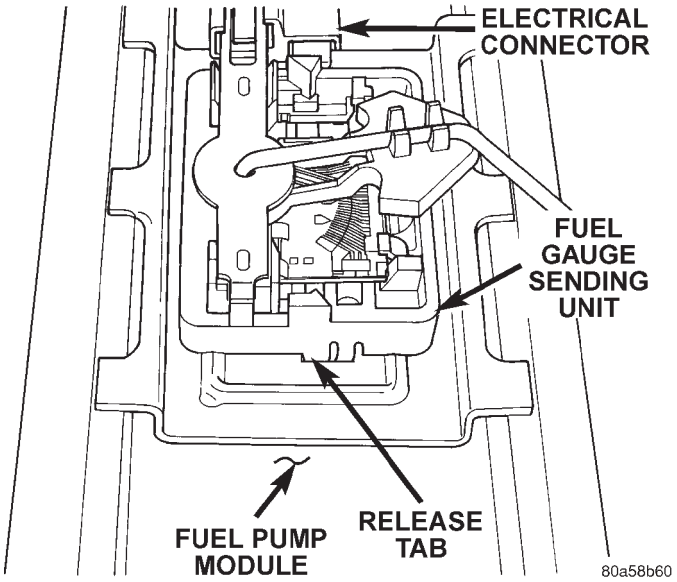


Fig. 29 Fuel Gauge Sending Unit Release Tab

INSTALLATION

(1) Position sending unit to pump module and snap into place.

(2) Connect electrical connector to terminals.

(3) Install fuel pump module. Refer to Fuel Pump Module Removal/Installation.

(4) Install fuel tank. Refer to Fuel Tank Removal/Installation.

FUEL INJECTOR RAIL—5.2L/5.9L 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.

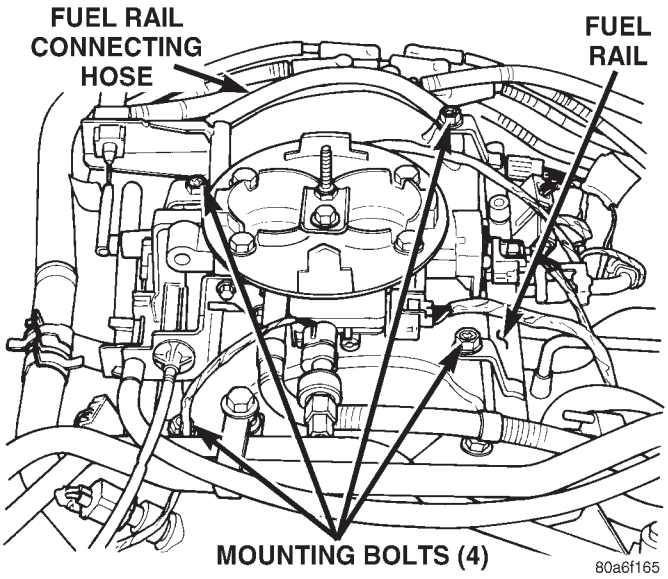


Fig. 30 Fuel Rail Assembly—Typical

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).

(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.

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

(8) Remove the remaining fuel rail mounting bolts.

REMOVAL AND INSTALLATION (Continued)

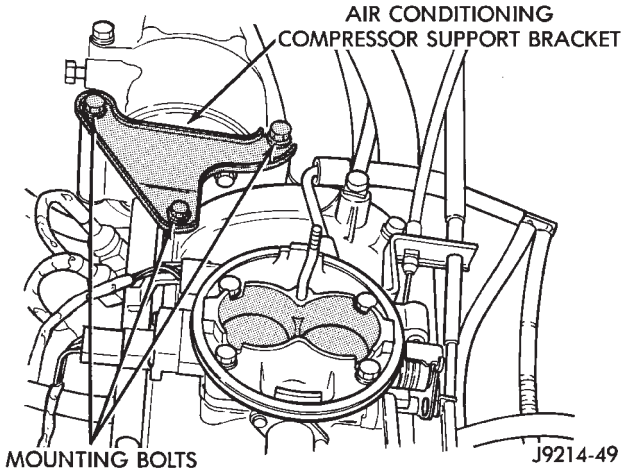


Fig. 31 A/C Compressor Support Bracket—Typical

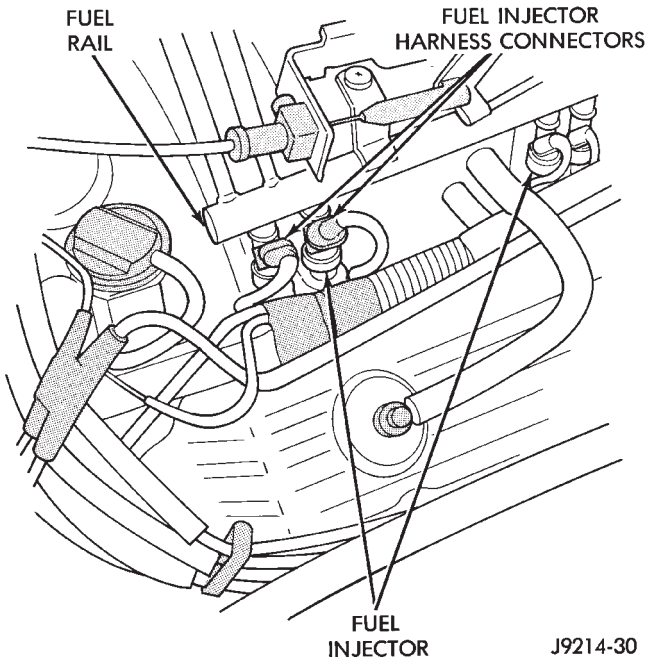


Fig. 32 Fuel Injector Connectors—Typical

(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).

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.

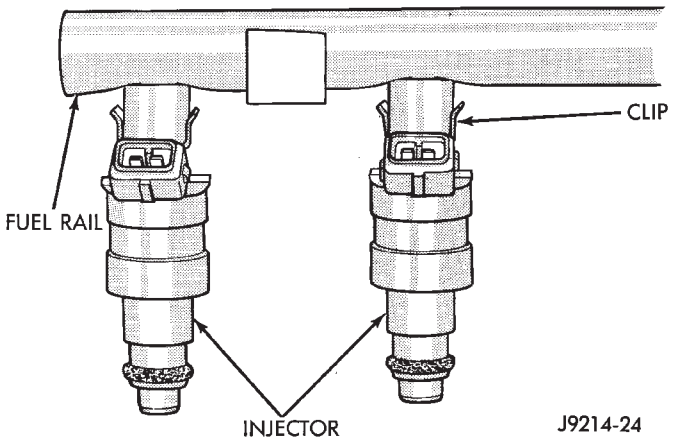


Fig. 33 Fuel Injector Mounting—Typical

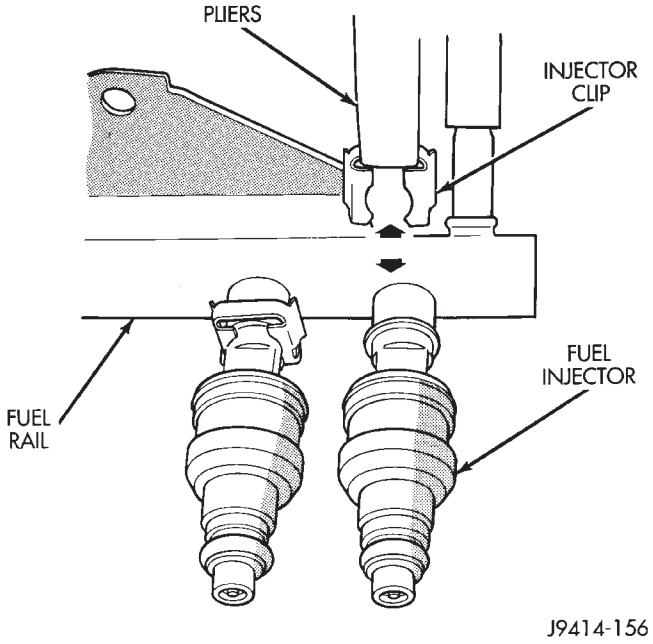


Fig. 34 Injector Retaining Clips—Typical Injector

(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.

REMOVAL AND INSTALLATION (Continued)

(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 ENGINE OFF. THIS PRESSURE MUST BE RELEASED BEFORE SERVICING FUEL RAIL.

(1) Remove fuel tank filler tube cap.
(2) Perform Fuel System Pressure Release Procedure as described in this Group.
(3) Disconnect negative battery cable from battery.
(4) Remove air tube at top of throttle body. Note: Some engine/vehicles may require removal of air cleaner ducts at throttle body.
(5) Remove injector harness electrical connectors at each injector. Each injector connector should have a numerical tag attached identifying its corresponding cylinder (Fig. 35). If not, identify each connector before removal.

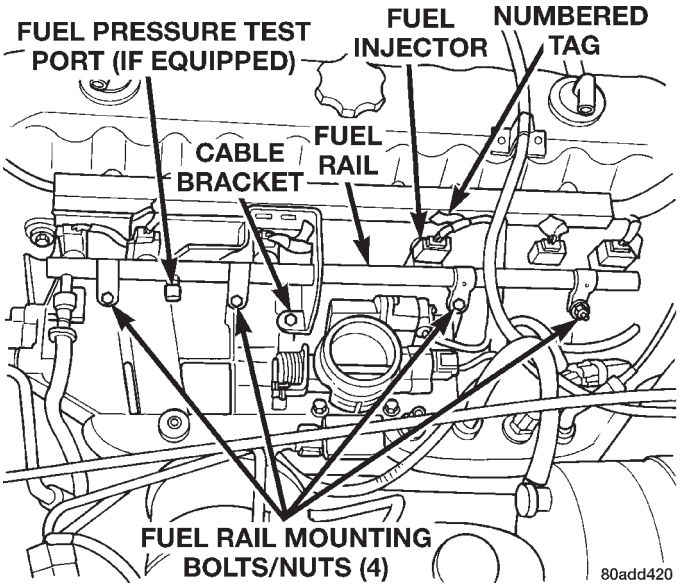


Fig. 35 Fuel Rail Mounting—4.0L Engine

(6) Disconnect fuel supply line latch clip and fuel line at fuel rail. Refer to Quick-Connect Fittings in this group for procedures.
(7) Disconnect throttle cable at throttle body. Refer to Throttle Cable Removal/Installation in this group for procedures.
(8) Disconnect speed control cable at throttle body (if equipped). Refer to Speed Control Cable in Group 8H, Speed Control System for procedures.
(9) Disconnect automatic transmission cable at throttle body (if equipped).
(10) Remove cable routing bracket (Fig. 35) at intake manifold.
(11) Clean dirt/debris from each fuel injector at intake manifold.
(12) Remove fuel rail mounting nuts/bolts (Fig. 35).
(13) Remove fuel rail by gently rocking until all the fuel injectors are out of intake manifold.

INSTALLATION

(1) Clean each injector bore at intake manifold.
(2) Apply a small amount of clean engine oil to each injector o-ring. This will aid in installation.
(3) Position tips of all fuel injectors into the corresponding injector bore in intake manifold. Seat injectors into manifold.
(4) Install and tighten fuel rail mounting bolts to 11 ±3 N·m (100 ±25 in. lbs.) torque.
(5) Connect tagged injector harness connectors to appropriate injector.
(6) Connect fuel line and fuel line latch clip to fuel rail. Refer Quick-Connect Fittings in this group for procedures.
(7) Install protective cap to pressure test port fitting (if equipped).
(8) Install cable routing bracket to intake manifold.
(9) Connect throttle cable at throttle body.
(10) Connect speed control cable at throttle body (if equipped).
(11) Connect automatic transmission cable at throttle body (if equipped).
(12) Install air tube (or duct) at top of throttle body.
(13) Install fuel tank cap.
(14) Connect negative battery cable to battery.
(15) 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.

REMOVAL AND INSTALLATION (Continued)

(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.

Two different procedures may be used to drain fuel tank (lowering tank or using DRB scan tool).

The quickest draining procedure involves lowering the fuel tank.

As an alternative procedure, the electric fuel pump may be activated allowing tank to be drained at fuel rail connection. Refer to DRB scan tool for fuel pump activation procedures. Before disconnecting fuel line at fuel rail, release fuel pressure. Refer to the Fuel System Pressure Release Procedure in this group for procedures. Attach end of special test hose tool number 6541, 6539, 6631 or 6923 at fuel rail disconnection (tool number will depend on model and/or engine application). Position opposite end of this hose tool to an approved gasoline draining station. Activate fuel pump and drain tank until empty.

If electric fuel pump is not operating, tank must be lowered for fuel draining. Refer to following procedures.

REMOVAL

(1) Disconnect negative battery cable at battery.

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

(3) Raise and support vehicle.

(4) Remove fuel tank fill hose and vent hose clamps at fuel tank filler tube (Fig. 36). Remove both hoses at fuel filler tube (Fig. 36).

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

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

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

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

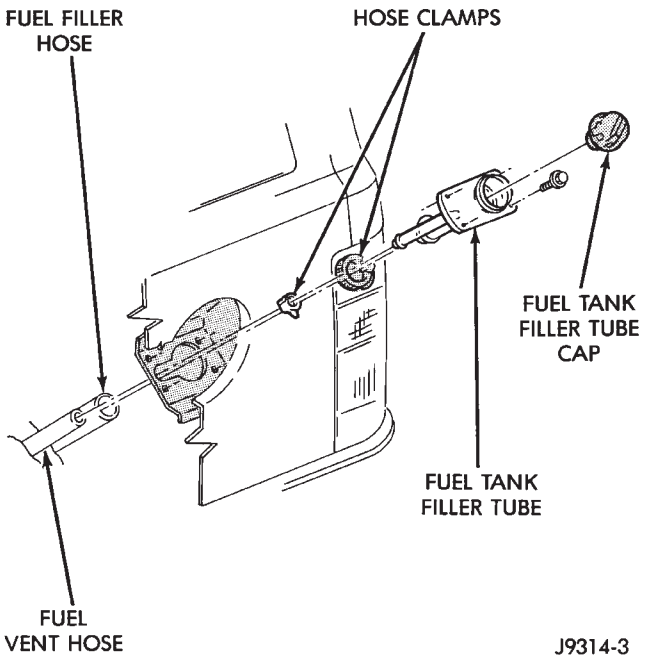


Fig. 36 Fuel Filler Tube and Hoses

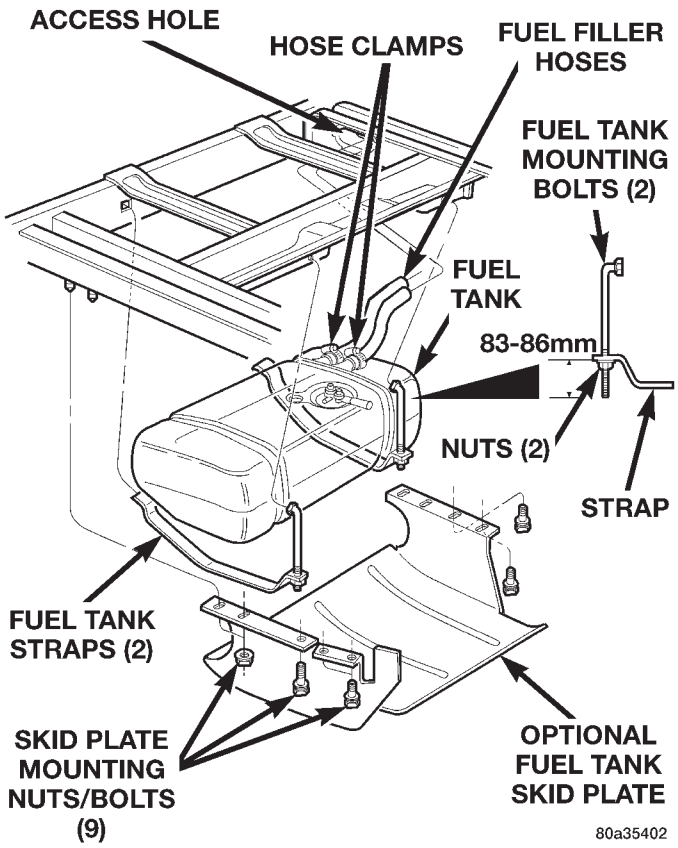


Fig. 37 Fuel Tank Mounting

REMOVAL AND INSTALLATION (Continued)

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

(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 near front of fuel tank (Fig. 38). Refer to Fuel Tubes/Lines/Hoses and Clamps in this group. Also refer to Quick-Connect Fittings for procedures.

(11) Disconnect EVAP canister vent line near front of tank (Fig. 38).

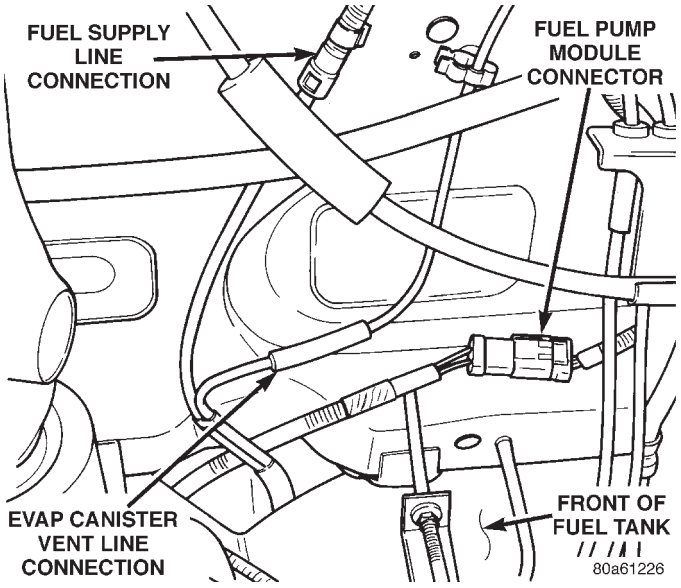


Fig. 38 Fuel Tank Connections at Front of Fuel Tank

(12) Disconnect fuel pump module electrical connector (pigtail harness) near front of tank (Fig. 38). Harness connector is clipped to body.

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

(14) Carefully lower right side of tank while feeding both fuel hoses through access hole in body. **Fuel Tank Full And Not Drained Using DRB Scan Tool:** To prevent fuel loss through hoses, keep left side of tank higher than right side while lowering. Do not allow hose openings to drop lower than top of tank.

(15) Continue lowering tank until clear of vehicle. Place tank on floor with left side (hose side) higher than right side.

(16) Drain tank by removing fuel fill hose at tank. Fuel fill hose is largest of 2 hoses (Fig. 39). Insert the drain hose (from an approved gasoline draining station) into hose opening. Drain tank until empty.

(17) If fuel pump module removal is necessary, refer to Fuel Pump Module Removal/Installation in this group for procedures.

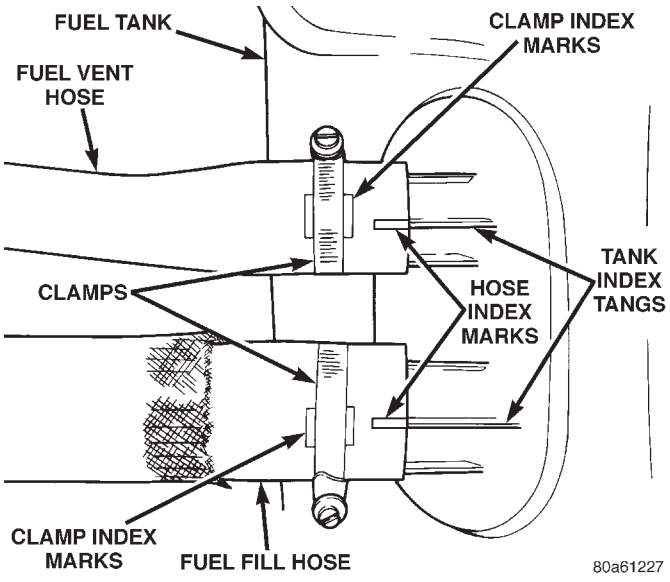


Fig. 39 Fuel Fill/Vent Hose Index Marks

INSTALLATION

(1) If fuel pump module is being installed, refer to Fuel Pump Module Removal/Installation in this group for procedures.

(2) Install fuel fill/vent hoses to tank fittings. To prevent hose from kinking, rotate each hose until index mark on hose is aligned to index tang on fuel tank (Fig. 39).

(3) Install hose clamps to hoses. Position clamps between index marks on each hose (Fig. 39).

(4) Position fuel tank to hydraulic jack.

(5) Raise tank into position while guiding fuel fill and vent hoses into and through access hole in body.

(6) Continue raising tank until positioned to body.

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

CAUTION: The two mounting nuts must be tightened until 83–86 mm (3.27 in.—3.39 in.) is attained between end of mounting bolt and bottom of strap. See insert (Fig. 37). Do not over tighten nuts.

(8) Install both fuel hoses to fuel fill tube. Tighten both retaining clamps.

(9) Connect fuel pump module pigtail harness electrical connector near front of tank.

(10) Connect fuel pump module supply 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) Connect EVAP hose near front of tank.

(12) Install exhaust tailpipe heat shield.

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

(14) Install rear tow hooks (if equipped).

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

REMOVAL AND INSTALLATION (Continued)

FUEL TANK FILLER TUBE CAP

If replacement of the fuel tank filler tube cap is necessary, it must be replaced with an identical cap to be sure of correct system operation.

CAUTION: Remove the fuel tank filler tube cap to relieve fuel tank pressure. The cap must be removed prior to disconnecting any fuel system component or before draining the fuel tank.

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. 40). 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.

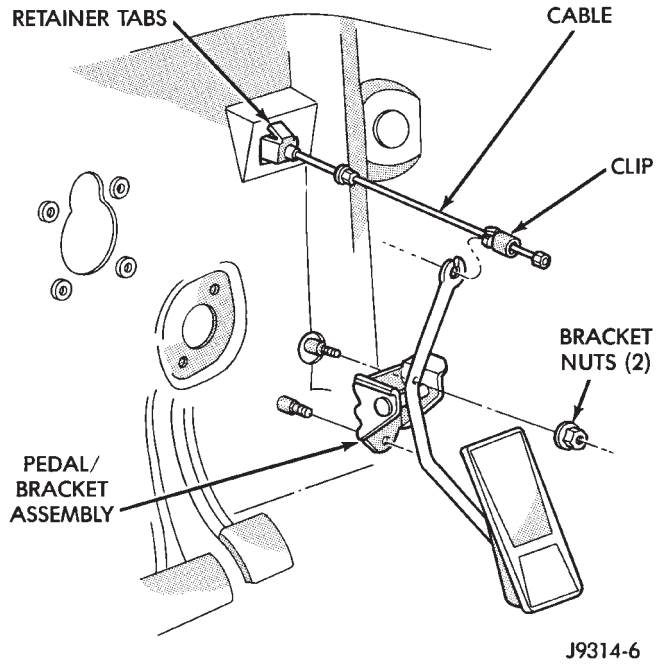


Fig. 40 Accelerator Pedal Mounting

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

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 8.5 N·m (75 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. 40). 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. 40). 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. 41)

(5) Remove the throttle cable ball end socket at throttle body linkage (Fig. 42) or (Fig. 43) (snaps off).

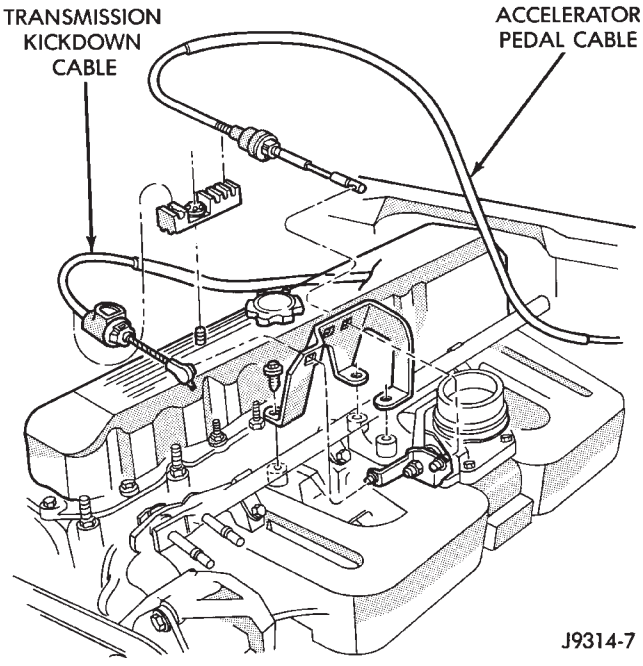


Fig. 41 Throttle Cable Routing—4.0L Engine

REMOVAL AND INSTALLATION (Continued)

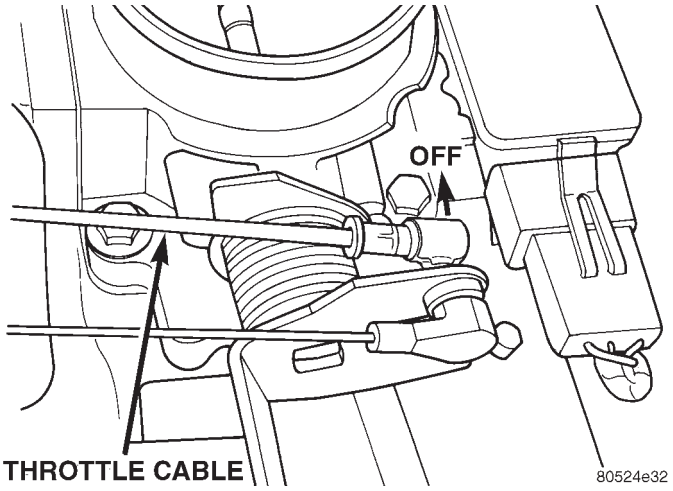


Fig. 42 Throttle Cable at Throttle Body—4.0L Engine

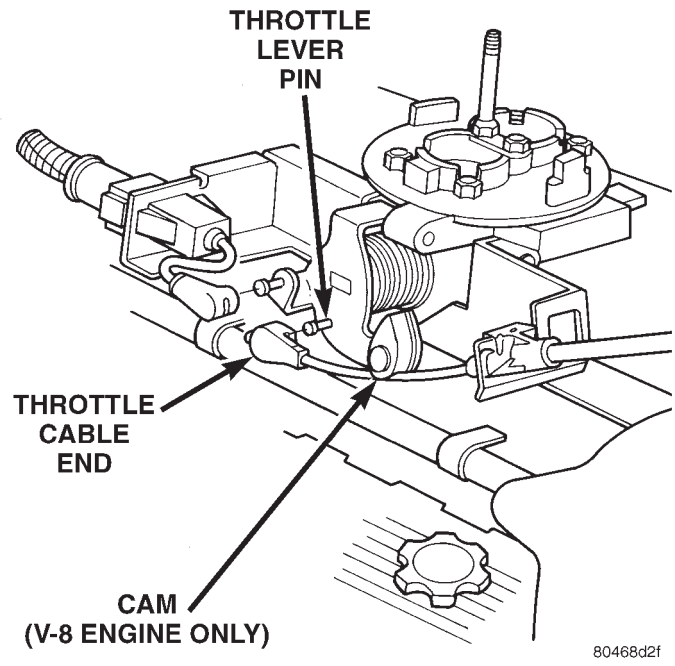


Fig. 43 Throttle Cable at Throttle Body—5.2L/5.9L V-8 Engines

(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/5.9L Engines: Remove cable housing at throttle body mounting bracket by pressing forward on release tab with a small screwdriver (Fig. 44). **To prevent cable housing breakage, press on the tab only enough to release the cable from the bracket.** Lift the cable housing straight up from bracket while pressing on release tab. Remove throttle cable from vehicle.

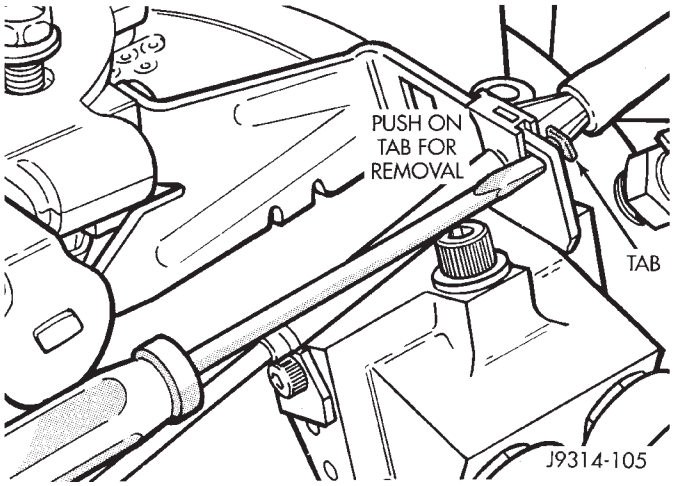


Fig. 44 Cable Release Tab—5.2L/5.9L Engines—Typical

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/5.9L Engines: 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.

(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

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

339 kPa ± 34 kPa (49.2 psi ± 5 psi).

TORQUE CHART

DESCRIPTION	TORQUE
Accelerator Pedal Bracket Mounting Nuts	8.5 N·m (75 in. lbs.)
Fuel Pump Module Locknut	62 N·m (45 ft. lbs.)
Fuel Rail Mounting Bolts—4.0L Engine	11 N·m (100 in. lbs.)
Fuel Rail Mounting Bolts— 5.2L/5.9L Engines	23 N·m (200 in. lbs.)
Fuel Tank Mounting Nuts	Refer To Manual Text
Fuel Hose Clamps	3 N·m (25 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) (Fig. 1) operates the fuel system.

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

GENERAL INFORMATION (Continued)

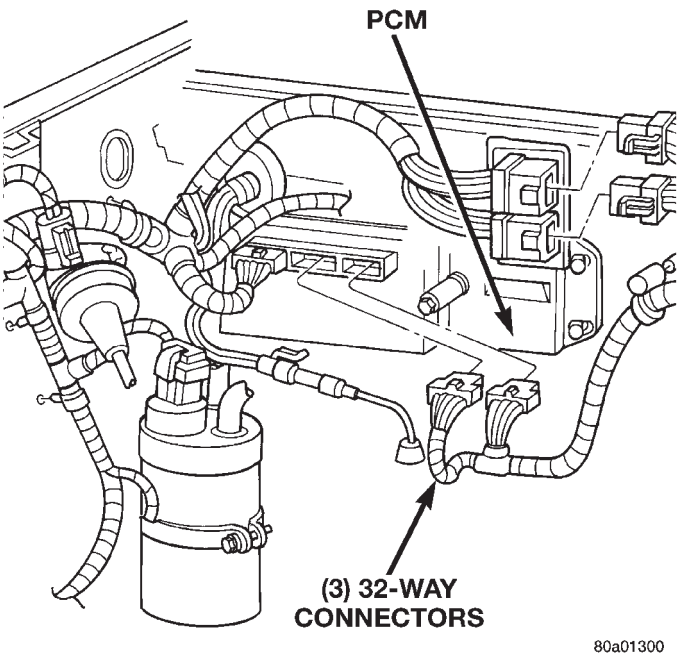


Fig. 1 Powertrain Control Module (PCM)

- 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 via the ASD 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 ASD relay via 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.

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 ASD relay via 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 adjusts engine idle speed through the idle air control (IAC) motor and adjusts ignition timing.

GENERAL INFORMATION (Continued)

• 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 ASD relay via the 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 ASD relay via 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 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)
• Vehicle speed sensor

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 a ground 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.

GENERAL INFORMATION (Continued)

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

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 ASD relay via 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 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.

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

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, triple microprocessor digital computer. It regulates ignition timing, air-fuel ratio, emission control devices, charging system, certain transmission features, 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.

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:

- A/C request (if equipped with factory A/C)
- A/C select (if equipped with factory A/C)
- Auto shutdown (ASD) sense
- Battery temperature
- Battery voltage
- Brake switch
- CCD bus (+) circuits
- CCD bus (-) circuits
- Camshaft position sensor signal
- Crankshaft position sensor
- Data link connection for DRB scan tool
- Engine coolant temperature sensor
- Fuel level
- Generator (battery voltage) output
- Ignition circuit sense (ignition switch in on/off/crank/run position)
- Intake manifold air temperature sensor
- Leak detection pump (switch) sense (if equipped)
- Manifold absolute pressure (MAP) sensor
- Oil pressure
- Output shaft speed sensor
- Overdrive/override switch
- Oxygen sensors
- Park/neutral switch (auto. trans. only)
- Power ground
- Sensor return
- Signal ground
- Speed control multiplexed single wire input
- Throttle position sensor
- Transmission governor pressure sensor
- Transmission temperature sensor
- Vehicle speed sensor

NOTE: PCM Outputs:

- A/C clutch relay
- Auto shutdown (ASD) relay
- CCD bus (+) circuits
- CCD bus (-) circuits
- Data link connection for DRB scan tool
- EGR valve control solenoid (if equipped)

DESCRIPTION AND OPERATION (Continued)

- EVAP canister purge solenoid
- Five volt sensor supply (primary)
- Five volt sensor supply (secondary)
- Fuel injectors
- Fuel pump relay
- Generator field driver (-)
- Generator field driver (+)
- Generator lamp (if equipped)
- Idle air control (IAC) motor
- Ignition coil
- Leak detection pump
- Malfunction indicator lamp (Check engine lamp). Driven through CCD circuits.
- Overdrive indicator lamp (if equipped)
- Speed control vacuum solenoid
- Speed control vent solenoid
- Tachometer (if equipped). Driven through CCD circuits.
- Transmission convertor clutch circuit
- Transmission 3–4 shift solenoid
- Transmission relay
- Transmission temperature lamp (if equipped)
- Transmission variable force solenoid

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 clutch cycling pressure switch. The input indicates that the evaporator pressure 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 or high-pressure switch opens (indicating a low or high refrigerant pressure), the PCM will not receive an A/C request signal. The PCM will then remove the ground from the A/C relay. This will deactivate the A/C compressor clutch.

If the switch opens, (indicating that evaporator is not in proper pressure 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 and fuel injectors to 12 volt + power supply.

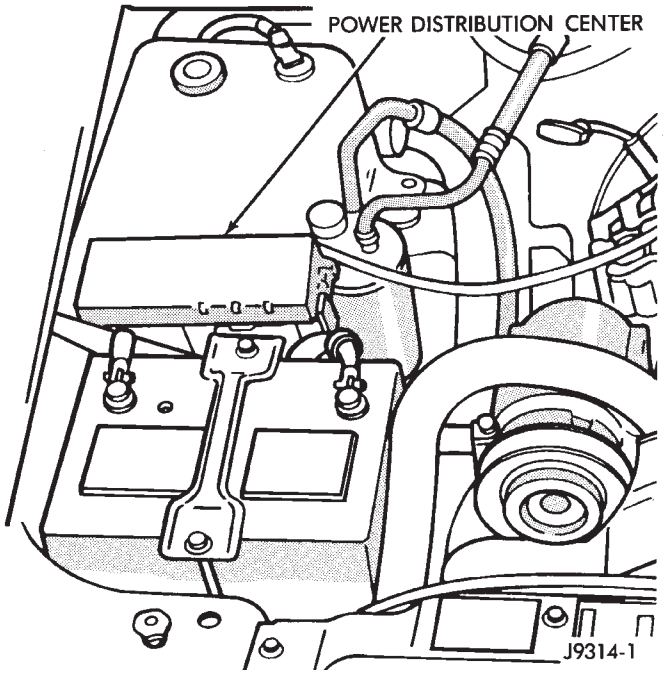


Fig. 2 Power Distribution Center (PDC)

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.

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.

DESCRIPTION AND OPERATION (Continued)

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 supply/deny power to the speed control servo solenoids.

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 source to the vehicle speed sensor.

FUEL LEVEL SENSOR—PCM INPUT

The Powertrain Control Module (PCM) sends a 5 volt signal to the fuel level sensor (fuel gauge sending unit). The fuel level sensor will then return 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. This is if the fuel level is less than approximately 15 percent, or, if equipped with a Leak Detection Pump (LDP), more than approximately 85 percent of its rated capacity. This input is also used to send a signal to the PCM for fuel gauge operation via the CCD bus circuits.

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/5.9L 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.

CRANKSHAFT POSITION SENSOR—5.2L/5.9L 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.

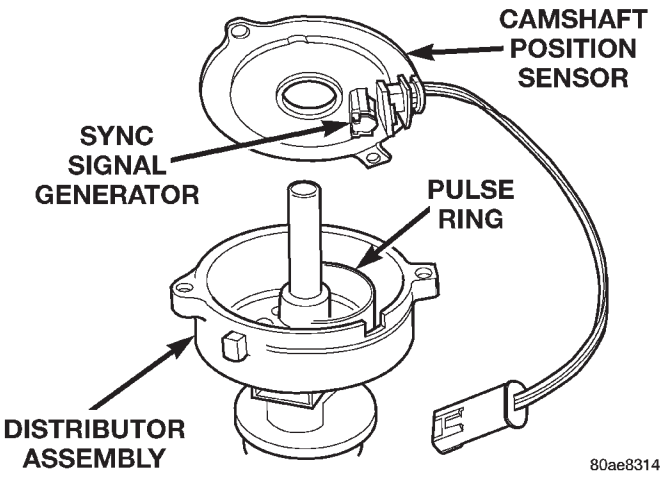


Fig. 3 Camshaft Position Sensor—Typical (5.2L/5.9L Distributor Shown)

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.

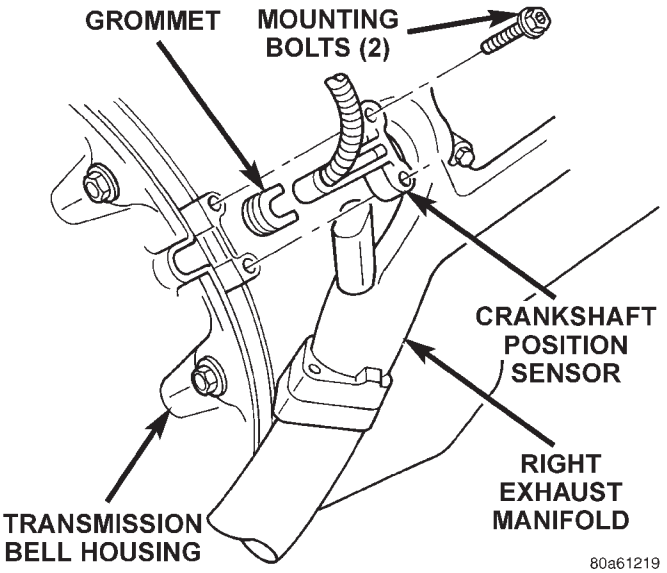


Fig. 4 Crankshaft Position Sensor—5.2L/5.9L Engines

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 sen-

DESCRIPTION AND OPERATION (Continued)

sor 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).

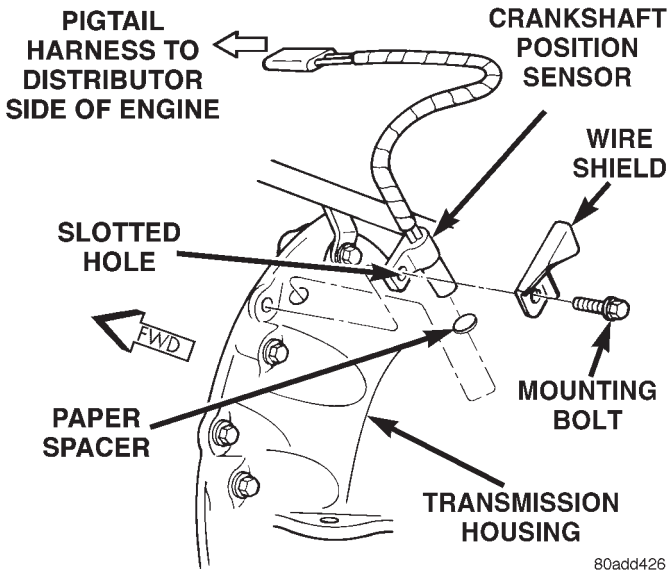


Fig. 5 Crankshaft Position Sensor—4.0L Engine

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/ 5.9L 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.

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.

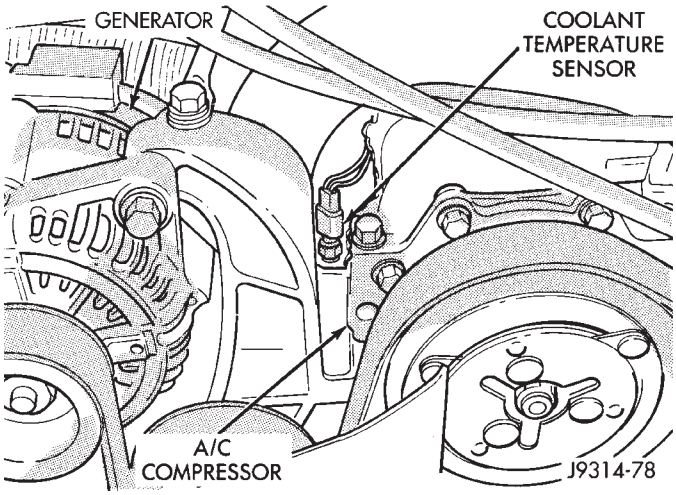


Fig. 6 Engine Coolant Temperature Sensor—5.2L/ 5.9L Engines

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.

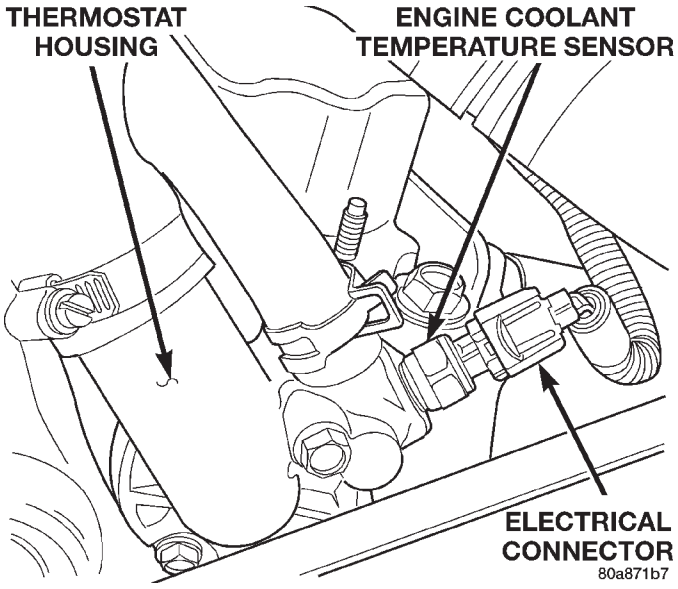


Fig. 7 Engine Coolant Temperature Sensor—4.0L Engine—Typical

GENERATOR OUTPUT—PCM INPUT

Provides a charging system voltage input to the Powertrain Control Module (PCM). It is sensed at the battery input to the PCM.

DESCRIPTION AND OPERATION (Continued)

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.

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 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.

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/5.9L 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.

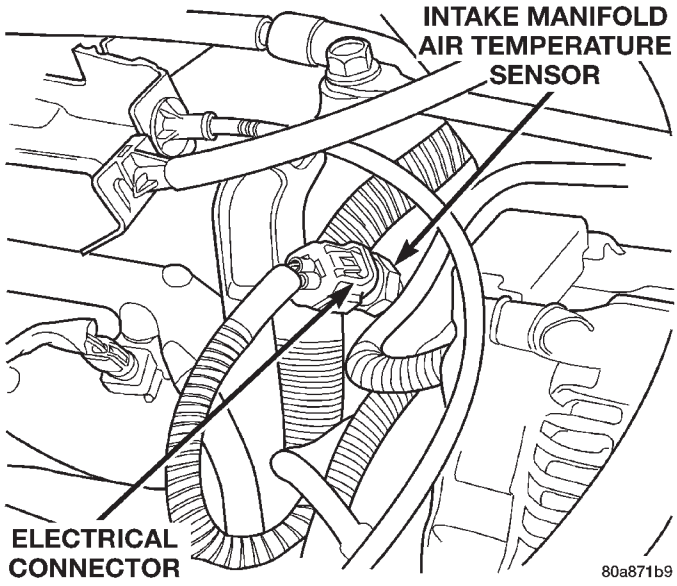


Fig. 8 Intake Manifold Air Temperature Sensor—5.2L/5.9L V-8 Engines—Typical

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)

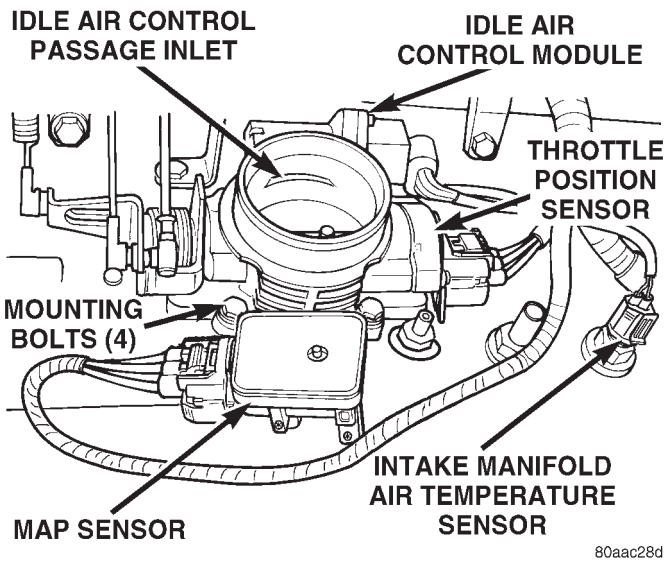


Fig. 9 Throttle Body Sensor Locations—4.0L Engine

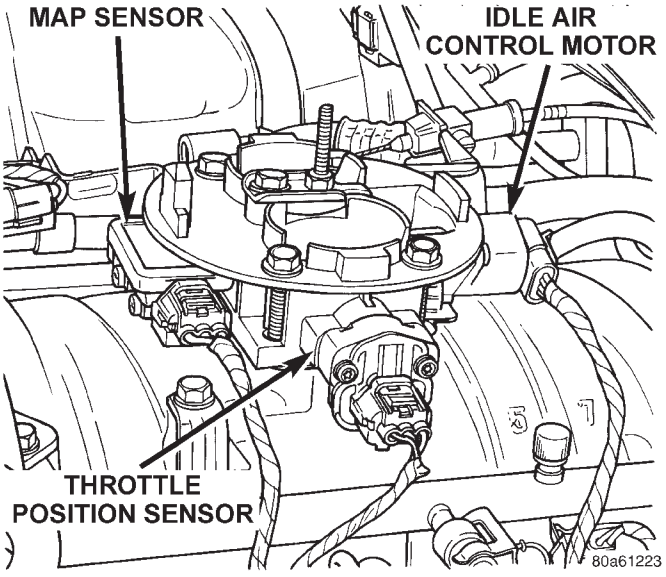


Fig. 10 MAP and Throttle Position Sensor Location—5.2L/5.9L Engines

LEAK DETECTION PUMP (SWITCH) SENSE—PCM INPUT

Provides an input to the PCM that the leak detection pump (LDP) has been activated. Refer to Group 25, Emission Control System for LDP information.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR—5.2L/5.9L 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.

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.

OIL PRESSURE SENSOR—PCM INPUT

Sends a signal from the oil pressure sending unit to the Powertrain Control Module (PCM) relating to engine oil pressure.

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.

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 downshift through the overdrive solenoid. This solenoid is located in the transmission. An overdrive/override push-button switch is located on the instrument panel.

The overdrive/override push-button switch is normally open (overdrive allowed) when the lamp is not illuminated. It momentarily closes (overdrive not allowed) when the operator presses the switch and the lamp is illuminated. Overdrive will revert to ON (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.

DESCRIPTION AND OPERATION (Continued)

POWER GROUND

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

- Generator field winding
- Fuel injectors
- Ignition coil
- Certain relays/solenoids

SENSOR RETURN—PCM INPUT

Sensor Return provides a low noise ground reference for all engine control system sensors.

SIGNAL GROUND—PCM INPUT

Signal ground provides a low noise ground to the data link connector.

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 and ignition timing advance. 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 governor pressure 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/5.9L ENGINES—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 .25 volts at minimum throttle opening (idle), to 4.8 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 .25 volts at minimum throttle opening (idle), to 4.8 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.

DESCRIPTION AND OPERATION (Continued)

VEHICLE SPEED AND DISTANCE SENSOR—PCM INPUT

The vehicle speed sensor is located on the speedometer pinion gear adapter (Fig. 11) or (Fig. 12). The pinion gear adapter is located on the extension housing of the transmission (drivers side—2WD), or on the transfer case (4WD). The sensor input is used by the powertrain control module (PCM) to determine vehicle speed and distance traveled.

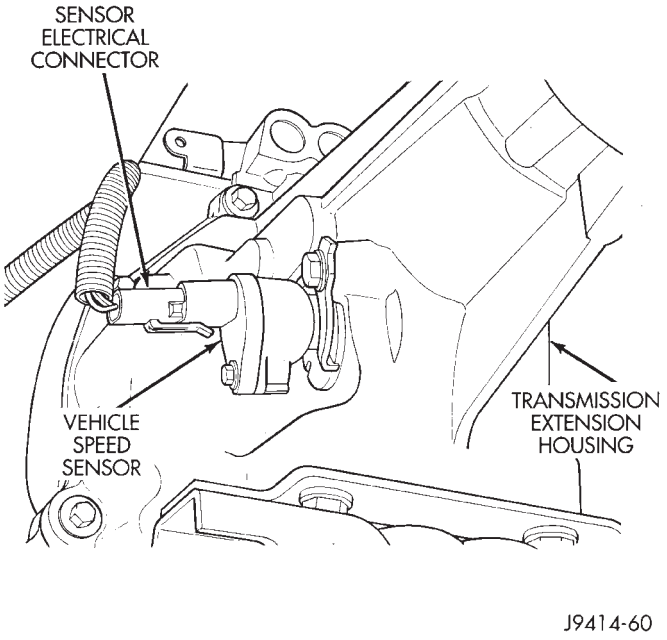


Fig. 11 Vehicle Speed Sensor Location—2WD—Typical

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.

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. 13). Refer to label on PDC cover for relay location.

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.

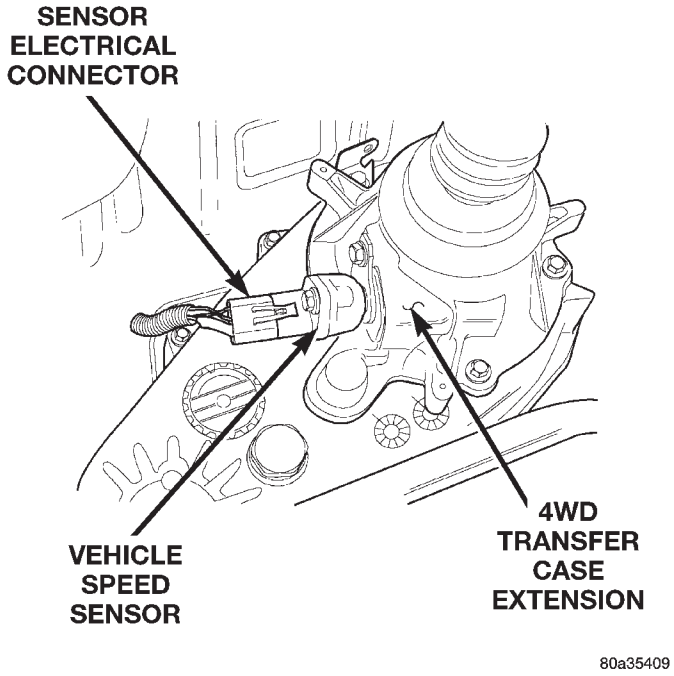


Fig. 12 Vehicle Speed Sensor Location—4WD—Typical

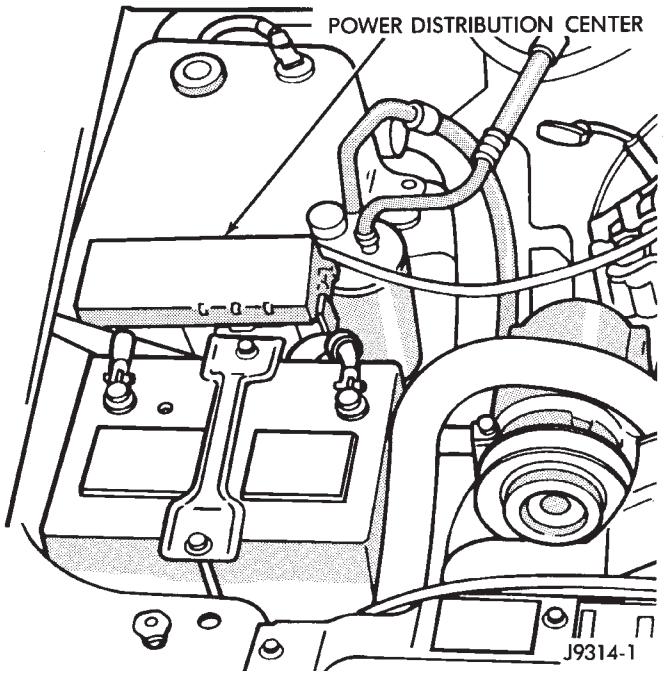


Fig. 13 Power Distribution Center (PDC)

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.

DESCRIPTION AND OPERATION (Continued)

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 abnormally low idle speeds it will de-energize the relay. This prevents A/C clutch engagement. The relay will remain de-energized until the idle speed increases. The PCM will also de-energize the relay if coolant temperature exceeds 125°C (257°F) or low or high system pressure exists.

AUTO SHUTDOWN (ASD) RELAY—PCM OUTPUT

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

The ASD supplies battery voltage to the fuel injectors, ignition coil and oxygen (O2S) sensor heating elements. 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.

CCD BUS (+/-) CIRCUITS-PCM OUTPUTS

The Powertrain Control Module (PCM) sends certain output signals through the CCD bus circuits. These signals are used to control certain instrument panel located items and to determine certain identification numbers.

Refer to Group 8E, Instrument Panel and Gauges for additional information.

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. 14). For operation of the DRB scan tool, refer to the appropriate Powertrain Diagnostic Procedures service manual.

DUTY CYCLE EVAP PURGE SOLENOID VALVE-PCM OUTPUT

Refer to Group 25, Emission Control System for information.

FUEL INJECTORS—5.2L/5.9L ENGINES—PCM OUTPUT

The fuel injectors are attached to the fuel rail (Fig. 15). 5.2L/5.9L 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.).

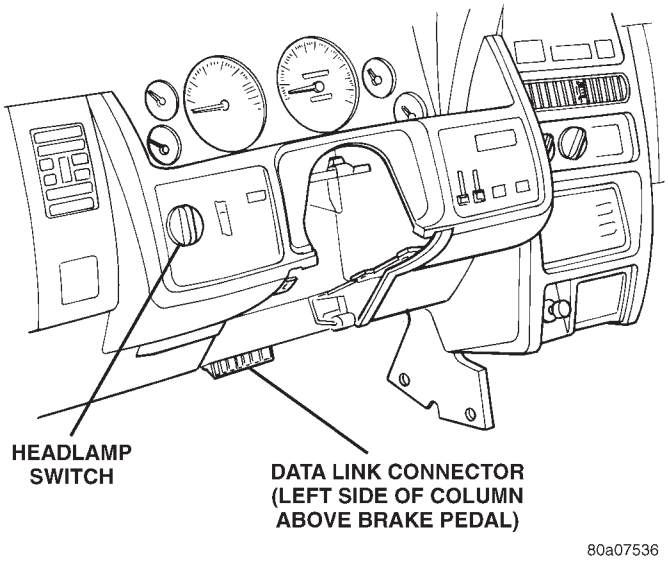


Fig. 14 Data Link Connector Location

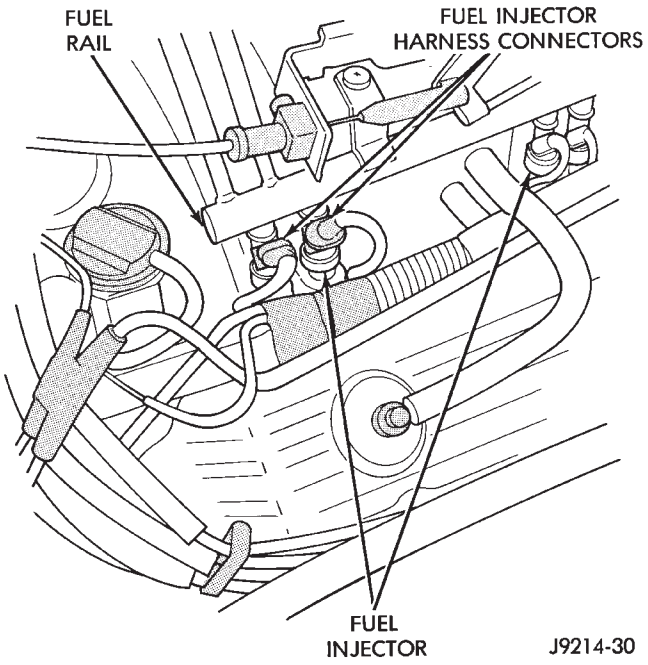


Fig. 15 Fuel Injectors—5.2L/5.9L Engines—Typical

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.

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 sys-

DESCRIPTION AND OPERATION (Continued)

tem. 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. 16).

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.

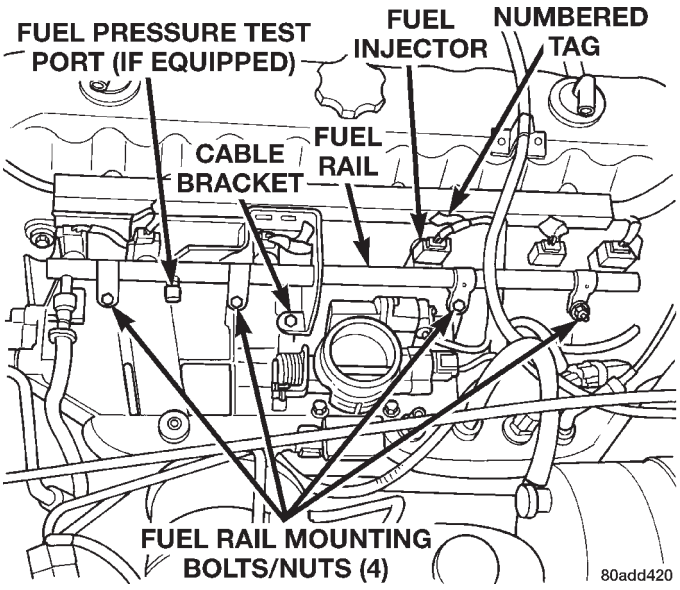


Fig. 16 Fuel Injectors—4.0L Engine

FUEL PUMP RELAY-PCM OUTPUT

The PCM energizes the electric fuel pump 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.

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

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

GENERATOR FIELD SOURCE (+)—PCM OUTPUT

This output from the Powertrain Control Module (PCM) regulates charging system voltage to the generator field source (+) circuit. The voltage range is 12.9 to 15.0 volts. Models of previous years had used the ASD relay (directly) to apply the 12 volt + power supply to the generator field source (+) circuit. Refer to Groups 8A and 8C for charging system information.

GENERATOR FIELD DRIVER (-)—PCM OUTPUT

This output from the Powertrain Control Module (PCM) regulates charging system ground control to the generator field driver (-) circuit. 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. This is done through the CCD Bus circuits. 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/5.9L 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. 17) 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.

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).

DESCRIPTION AND OPERATION (Continued)

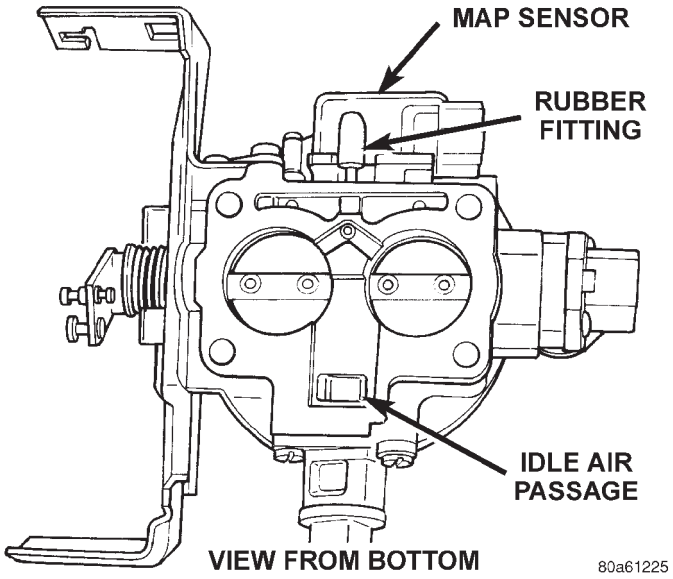


Fig. 17 Throttle Body Air Control Passage—5.2L/ 5.9L Engines—Typical

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.

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/5.9L 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. 18).

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

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. 19).

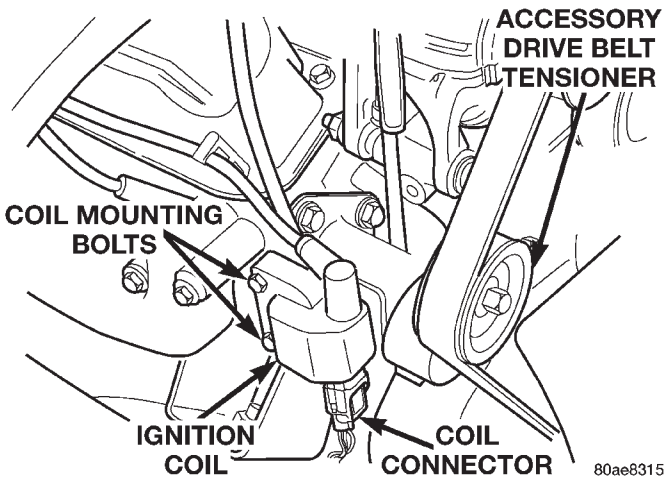


Fig. 18 Ignition Coil—5.2L/5.9L Engines—Typical

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

LEAK DETECTION PUMP—PCM OUTPUT

Certain engines with certain emissions packages are equipped with a leak detection pump (LDP). The LDP is activated through this PCM output. Refer to Group 25, Emission Control System for additional information.

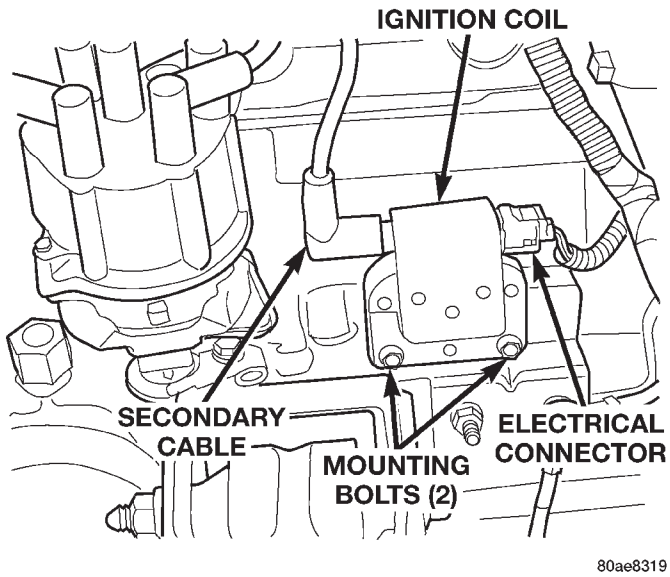


Fig. 19 Ignition Coil—4.0L Engine

MALFUNCTION INDICATOR LAMP—PCM OUTPUT

Refer to Group 25, Emission Control System for 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.

DESCRIPTION AND OPERATION (Continued)

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.

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:

- Transmission temperature sensor
- Output shaft speed sensor
- Module timer
- Engine rpm
- MAP sensor
- Brake switch

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 governor pressure solenoids. Once battery voltage is applied to the solenoids, they are individually activated by the PCM through OD, TCC and governor pressure outputs. The relay is located in the Power Distribution Center (PDC). Refer to label on PDC cover for relay location.

GOVERNOR PRESSURE 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/5.9L ENGINES

Filtered air from the air cleaner enters the intake manifold through the throttle body (Fig. 20). 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.

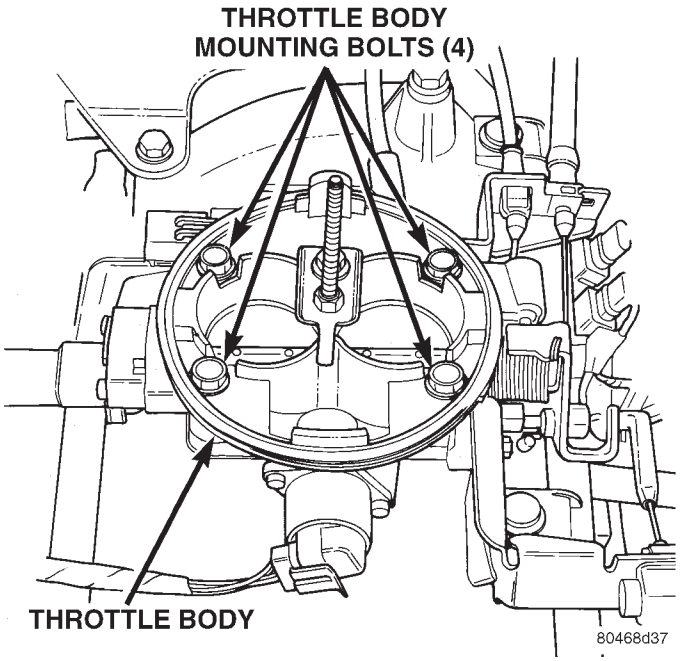


Fig. 20 Throttle Body—5.2L/5.9L Engines—Typical

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)

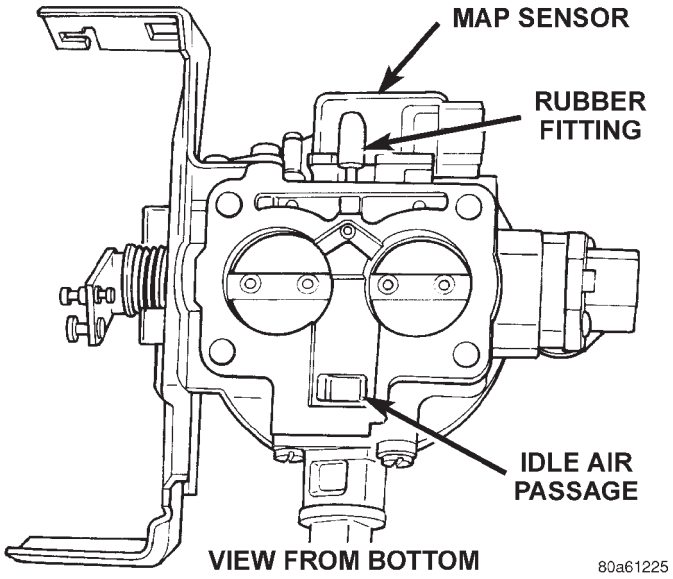


Fig. 21 Air Control Passage—5.2L/5.9L Engines—Typical

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. 22). 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. 22) 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.

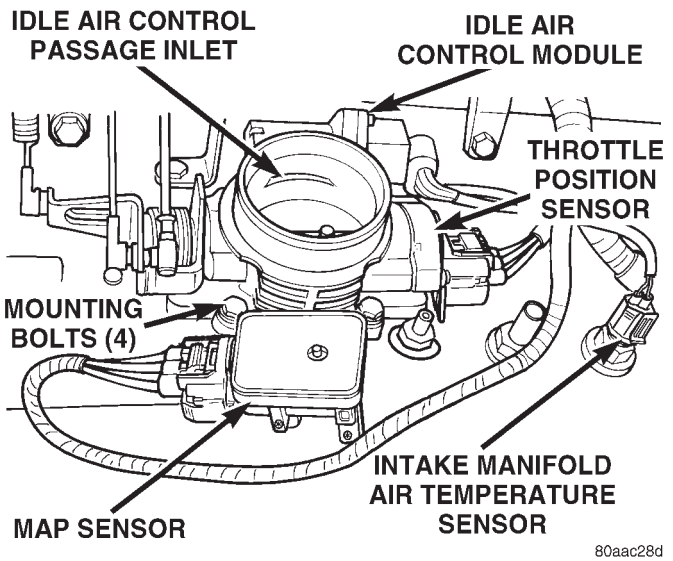


Fig. 22 Throttle Body—4.0L Engine

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/5.9L ENGINES

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. 23).

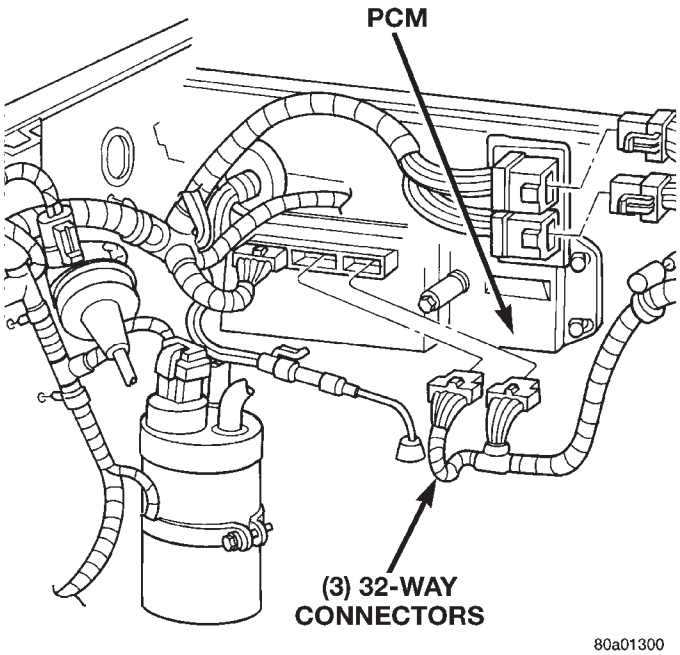


Fig. 23 Powertrain Control Module (PCM)

(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

DIAGNOSIS AND TESTING (Continued)

Power Distribution Center (PDC) (Fig. 24). 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. 25).

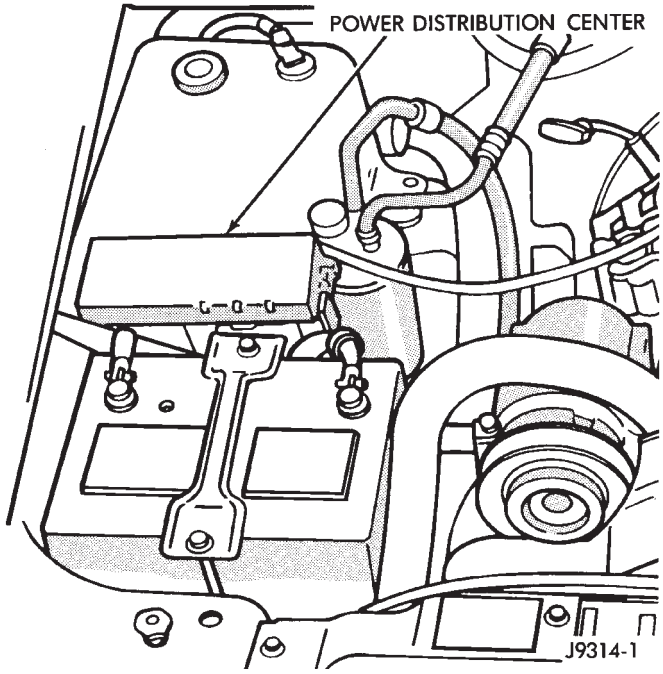


Fig. 24 Power Distribution Center (PDC)

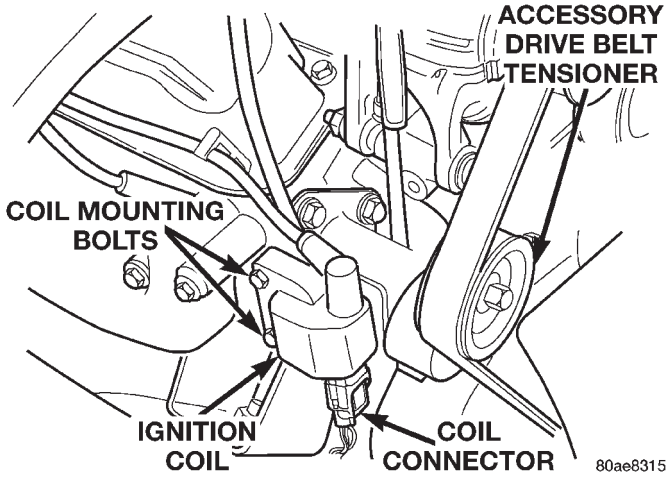


Fig. 25 Ignition Coil—5.2L/5.9L Engines

(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.

(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. 26).

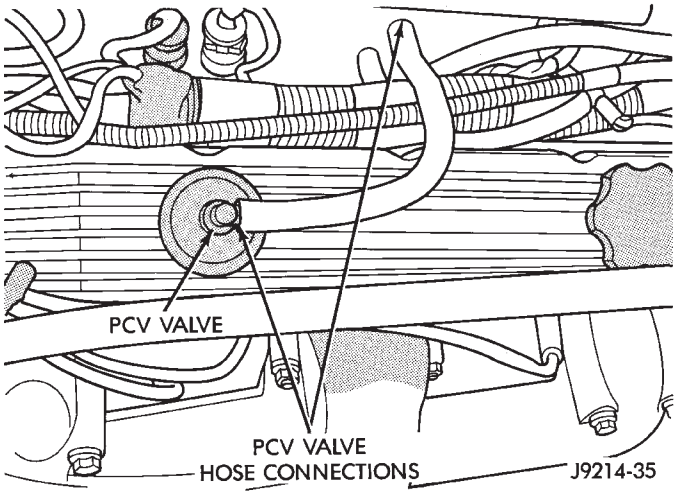


Fig. 26 PCV Valve Hose Connections—5.2L/5.9L Engines—Typical

(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 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. 27).

(16) Verify that MAP sensor electrical connector is firmly connected to MAP sensor (Fig. 28). Also verify

DIAGNOSIS AND TESTING (Continued)

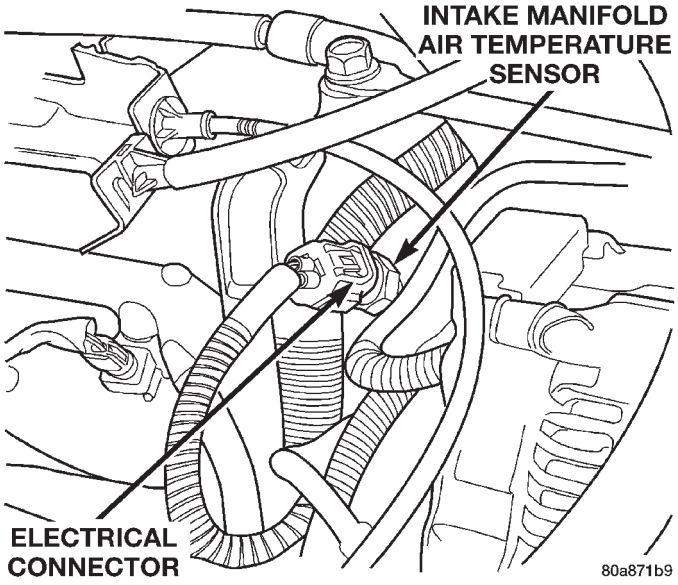


Fig. 27 Air Temperature Sensor—5.2L/5.9L Engines

that rubber L-shaped fitting from MAP sensor to the throttle body is firmly connected (Fig. 29).

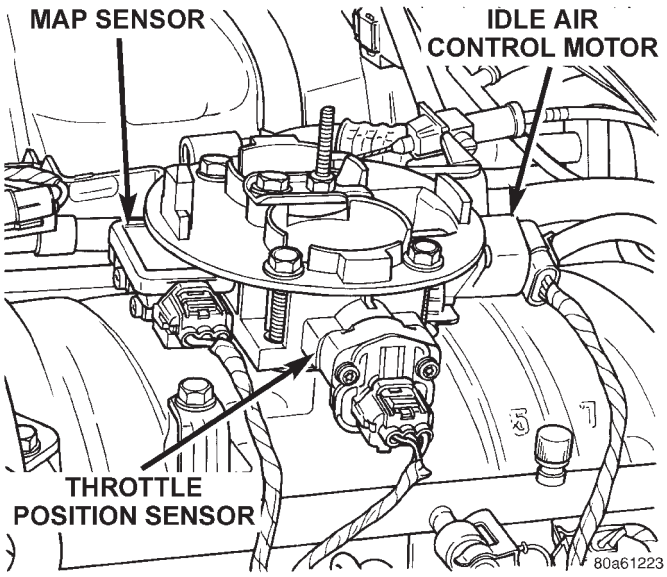


Fig. 28 Sensor and IAC Motor Location—5.2L/5.9L Engines

(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, throttle position sensor (TPS) and manifold absolute pressure (MAP) sensor (Fig. 28).

(19) Verify that wire harness connector is firmly connected to the engine coolant temperature sensor (Fig. 30).

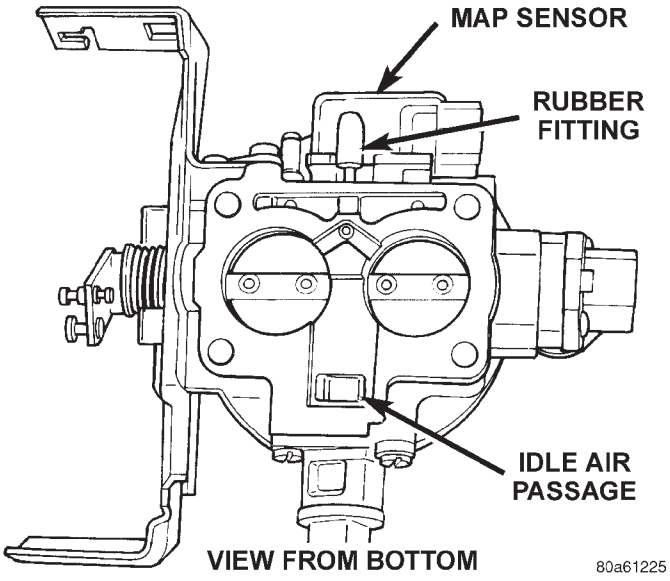


Fig. 29 Rubber L-Shaped Fitting—MAP Sensor-to-Throttle Body

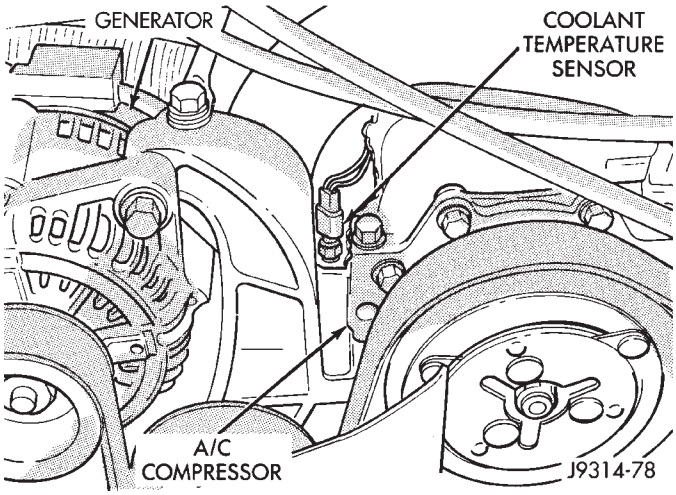


Fig. 30 Engine Coolant Temperature Sensor—5.2L/5.9L Engines—Typical

(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. 31) or (Fig. 32).

(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.

DIAGNOSIS AND TESTING (Continued)

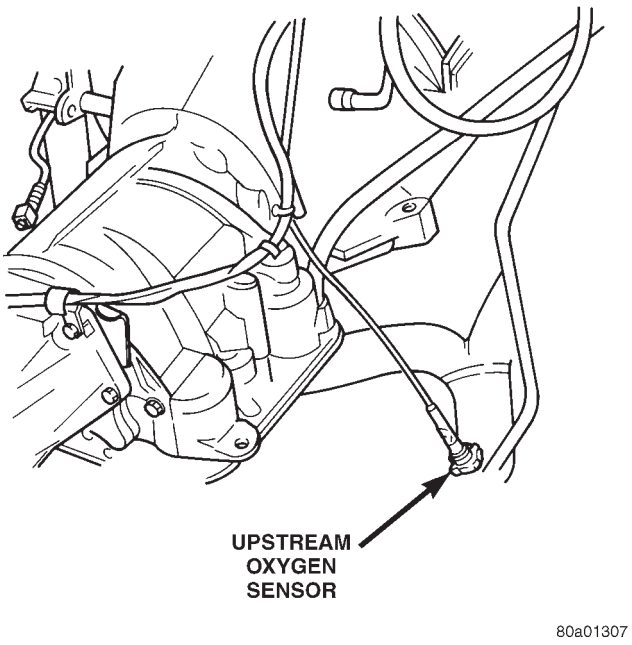


Fig. 31 Upstream Oxygen Sensor—5.2L.5.9L Engines

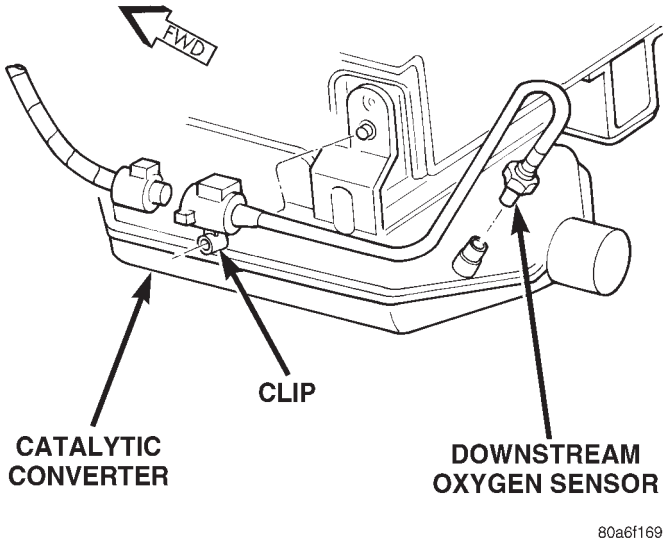


Fig. 32 Downstream Oxygen Sensor—5.2L/5.9L Engines

(25) Verify that the electrical harness connector is firmly connected to the vehicle speed sensor (Fig. 33) or (Fig. 34).

(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.

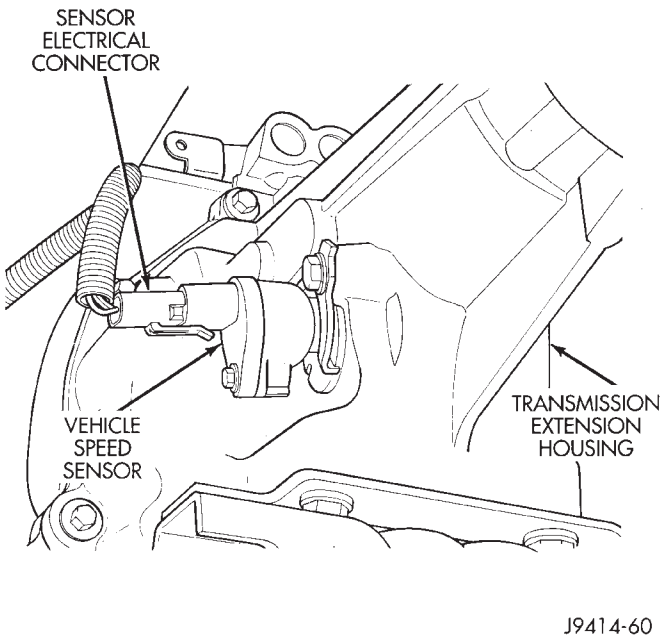


Fig. 33 Vehicle Speed Sensor—2WD—Typical

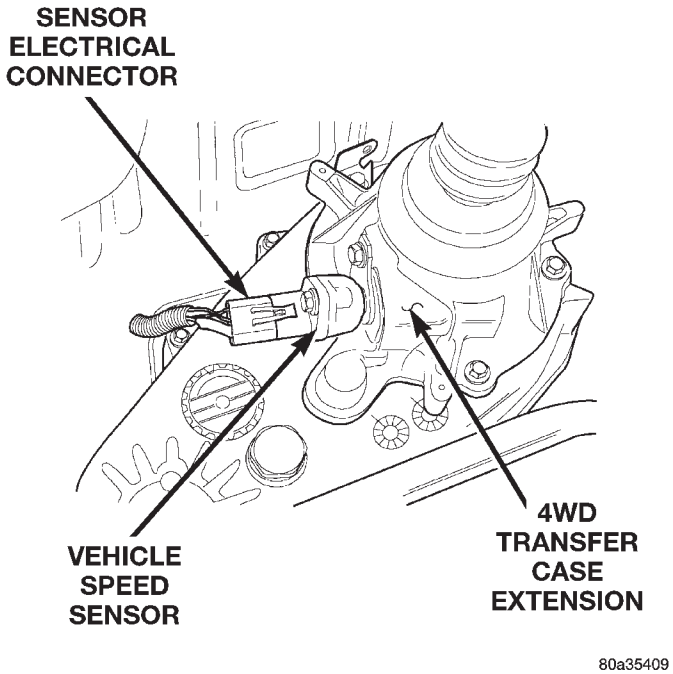


Fig. 34 Vehicle Speed Sensor—4WD—Typical

(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

DIAGNOSIS AND TESTING (Continued)

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. 35).

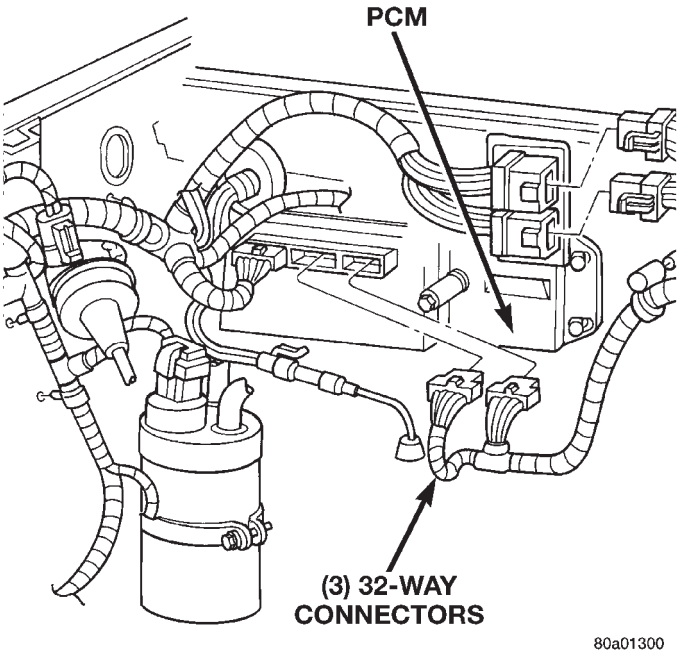


Fig. 35 Powertrain Control Module (PCM)

(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. 36). 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. 37).

(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.

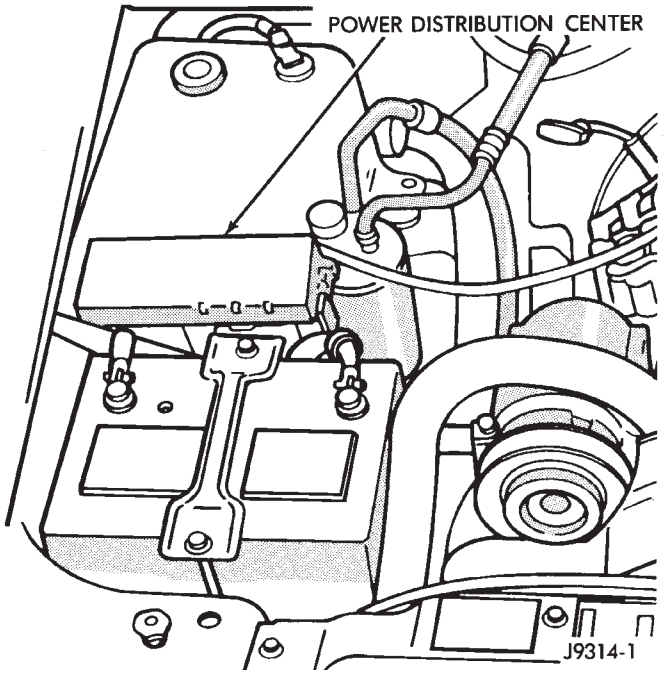


Fig. 36 Power Distribution Center (PDC)

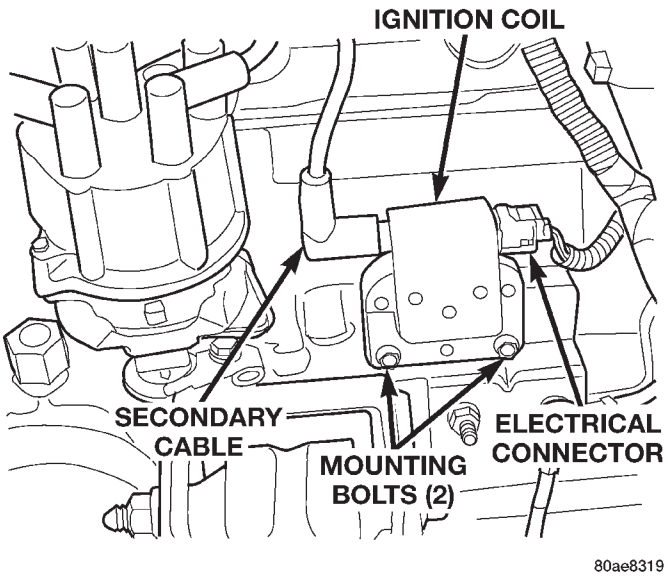


Fig. 37 Ignition Coil—4.0L Engine

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

(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 con-

DIAGNOSIS AND TESTING (Continued)

nections (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 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. 38).

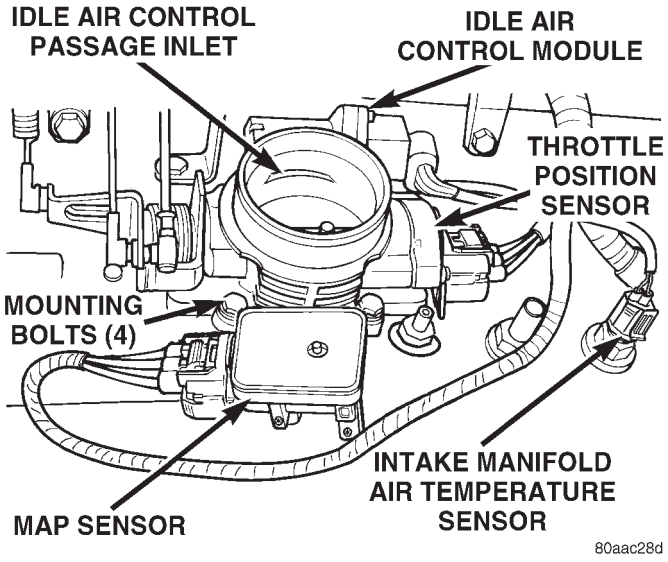


Fig. 38 Sensor Locations—4.0L Engine

(16) Verify that MAP sensor electrical connector is firmly connected to MAP sensor (Fig. 38). Also verify that rubber L-shaped fitting from MAP sensor to the throttle body is firmly connected (Fig. 39).

(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. 38).

(19) Verify that wire harness connector is firmly connected to the engine coolant temperature sensor (Fig. 40).

(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. 41) or (Fig. 42).

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

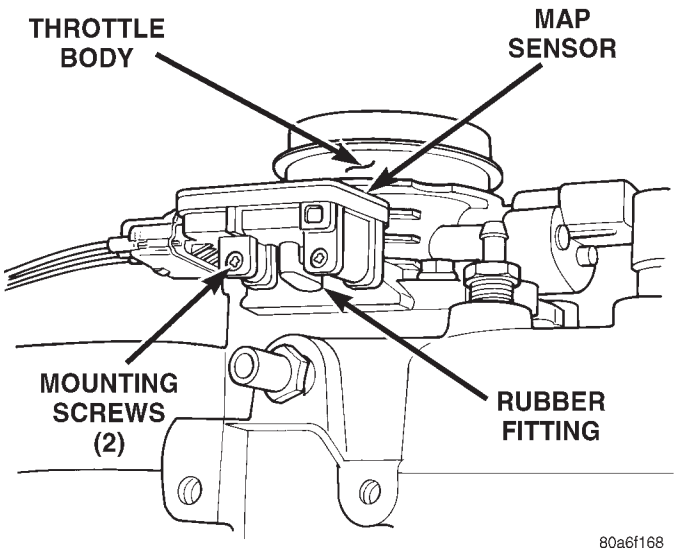


Fig. 39 Rubber L-Shaped Fitting—MAP Sensor-to-Throttle Body

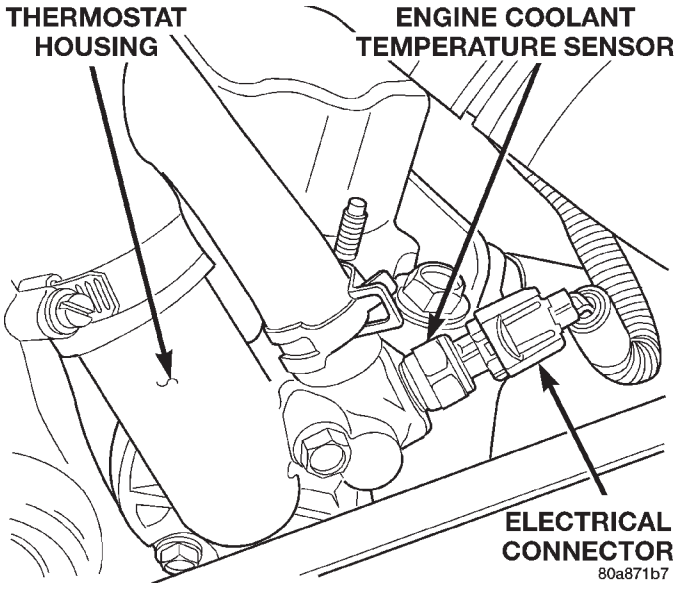


Fig. 40 Engine Coolant Temp. Sensor—4.0L Shown

(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. 43) or (Fig. 44).

(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.

DIAGNOSIS AND TESTING (Continued)

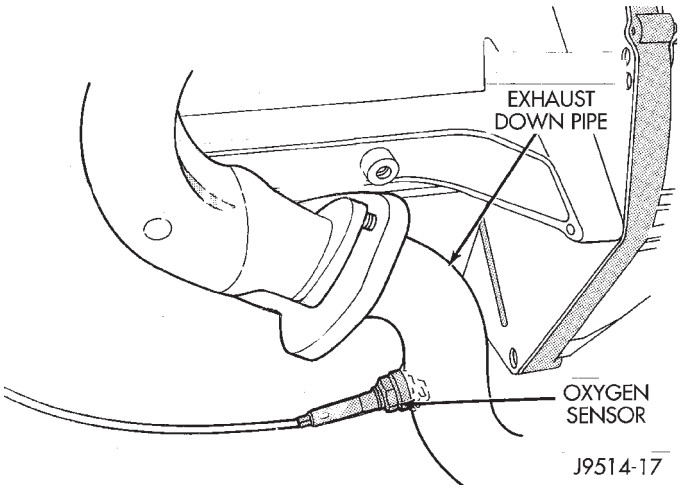


Fig. 41 Upstream Oxygen Sensor—4.0L Engine

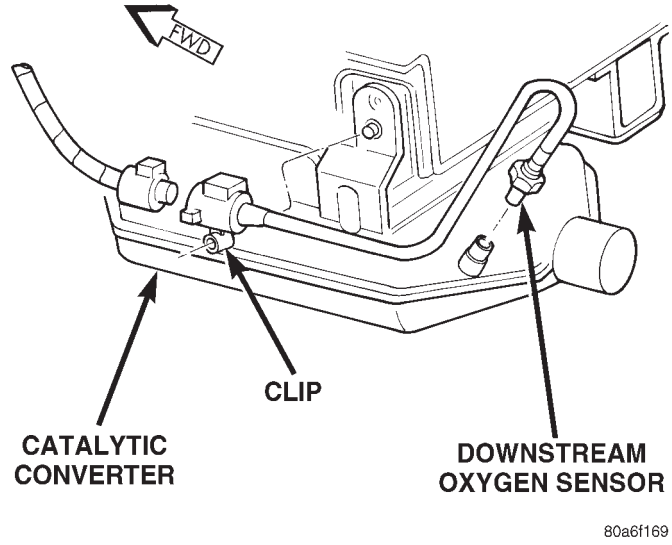


Fig. 42 Downstream Oxygen Sensor—4.0L Engine

(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. 45) or (Fig. 46).

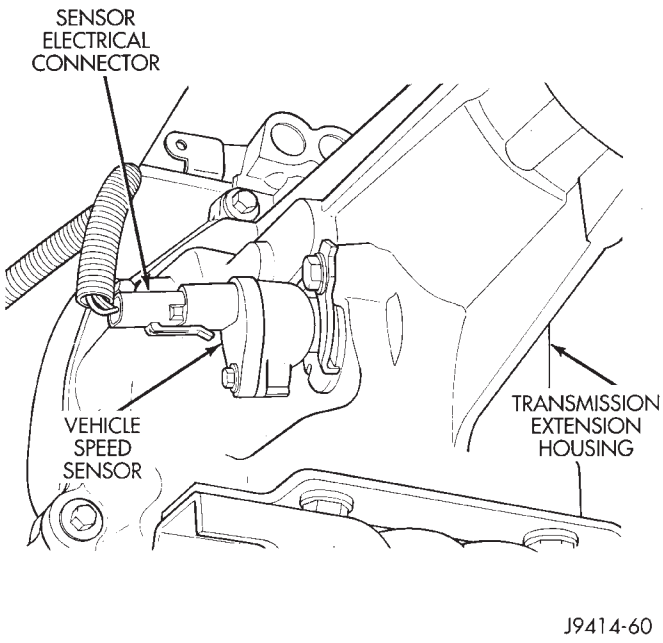


Fig. 43 Vehicle Speed Sensor—2WD—Typical

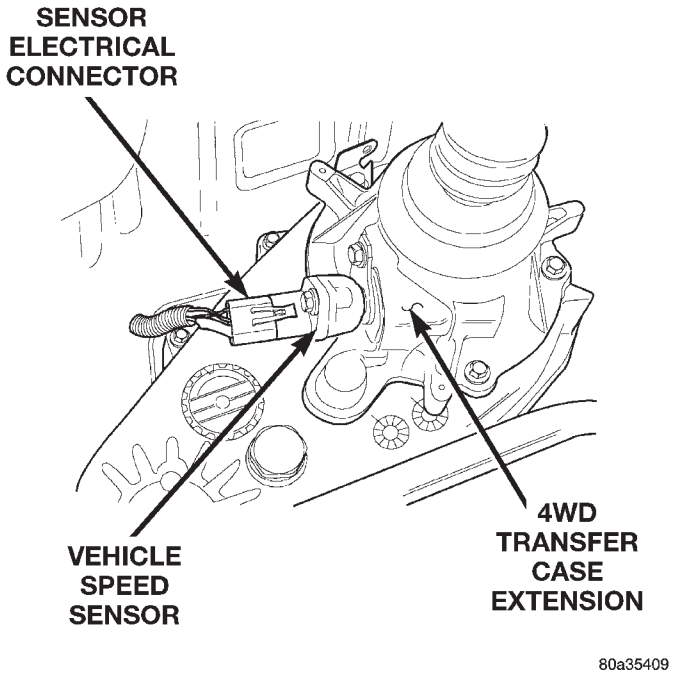
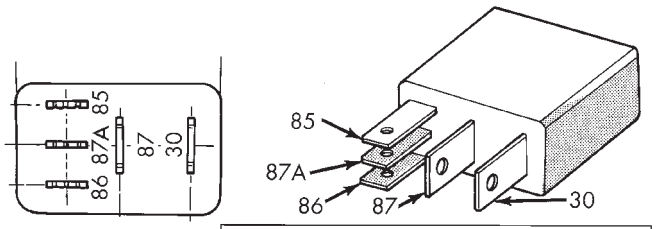


Fig. 44 Vehicle Speed Sensor—4WD—Typical

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 termi-

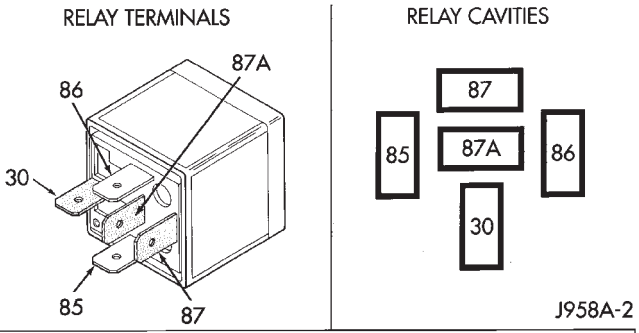
DIAGNOSIS AND TESTING (Continued)



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

9514-16

Fig. 45 ASD and Fuel Pump Relay Terminals



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

Fig. 46 ASD and Fuel Pump Relay Terminals

nal 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.5.9L ENGINES

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.

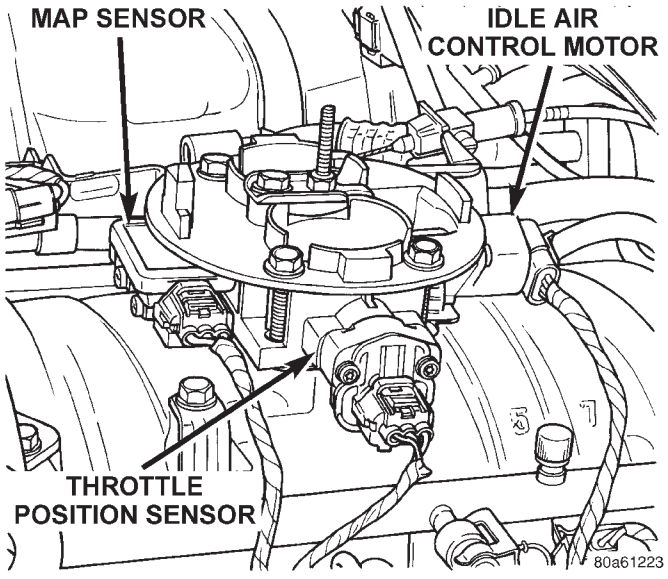


Fig. 47 MAP Sensor—5.2L/5.9L Engines—Typical

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

DIAGNOSIS AND TESTING (Continued)

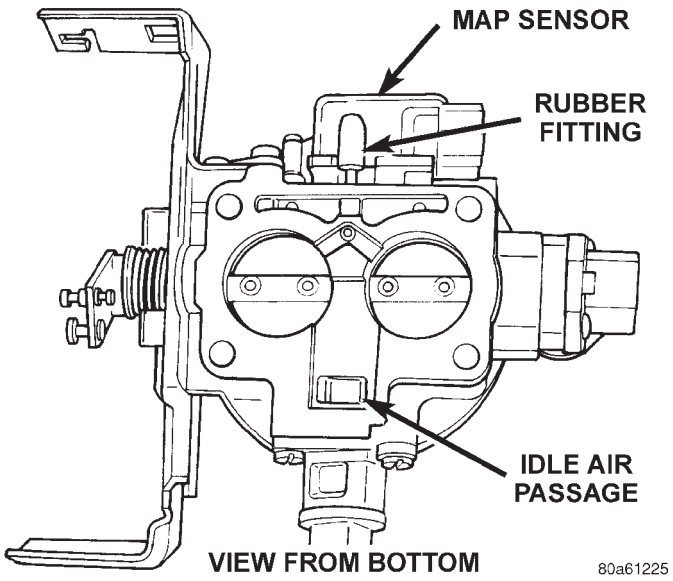


Fig. 48 Rubber L-Shaped Fitting—MAP Sensor-to-Throttle Body

(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.

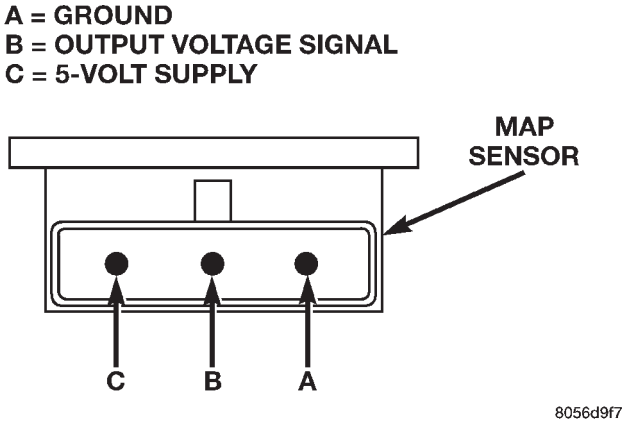


Fig. 49 MAP Sensor Connector Terminals—Typical

(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.

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

To perform a complete test of MAP sensor (Fig. 50) 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. 51). Repair as necessary.

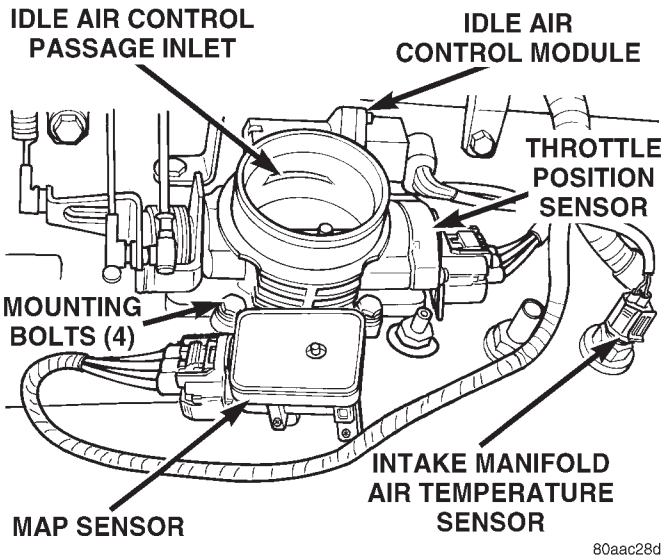


Fig. 50 Sensor Location—4.0L Engine

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.

(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.

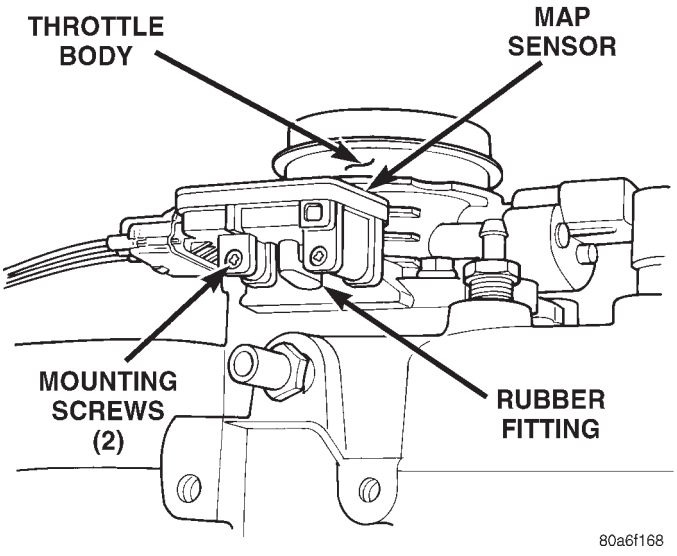


Fig. 51 Rubber L-Shaped Fitting—MAP Sensor-to-Throttle Body

(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/5.9L ENGINES

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. 53).

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 4.5 ± .5 ohms and 7 ohms. Replace the sensor if the ohmmeter displays an infinity (open) reading.

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. 54).

The downstream O2S sensor is located on the outlet end of the catalytic converter (Fig. 53).

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

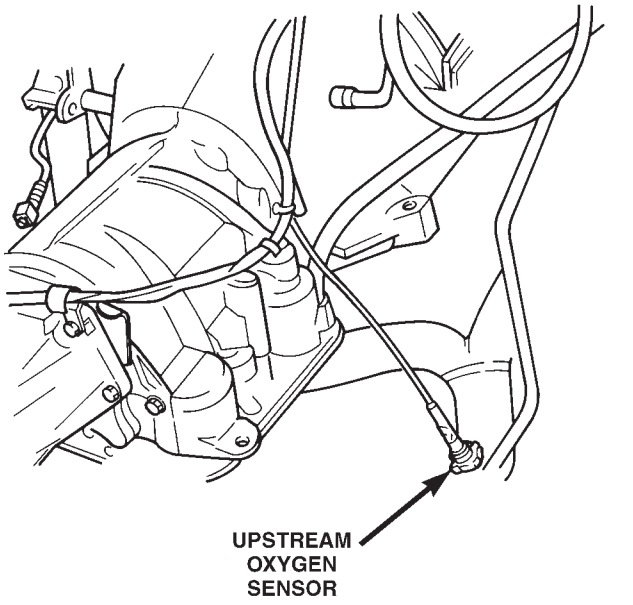


Fig. 52 Upstream Oxygen Sensor Location—5.2L/5.9L Engines

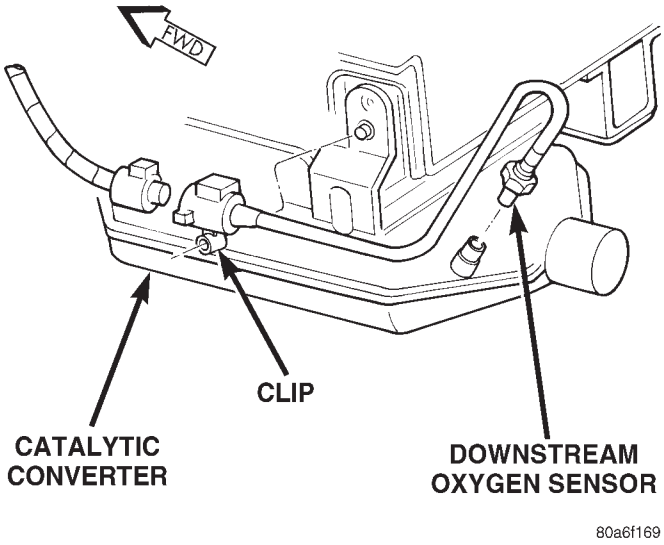


Fig. 53 Downstream Oxygen Sensor Location—All Engines

Disconnect the O2S sensor connector. Connect the ohmmeter test leads across the white wire terminals of the sensor connector. Resistance should be between 4.5 ± .5 ohms and 7 ohms. Replace the sensor if the ohmmeter displays an infinity (open) reading.

DIAGNOSIS AND TESTING (Continued)

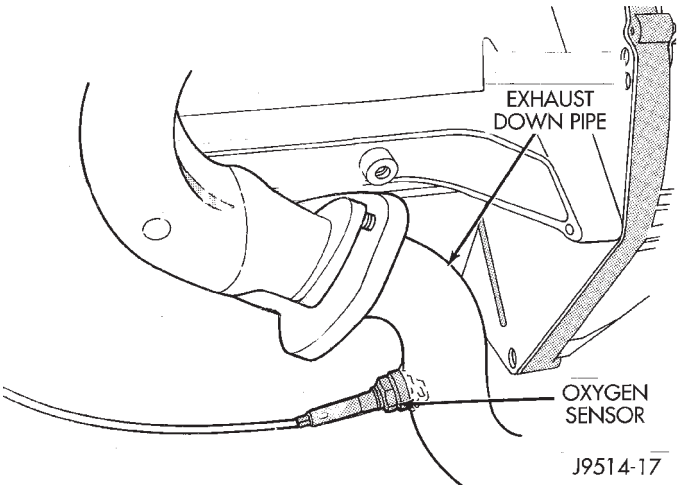


Fig. 54 Upstream Oxygen Sensor Location—4.0L Engine

CAMSHAFT AND CRANKSHAFT POSITION SENSORS

Refer to Group 8D, Ignition System for information.

ENGINE COOLANT TEMPERATURE SENSOR—5.2L/5.9L ENGINES

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. 55).

(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.

(3) Test the resistance of sensor with a high input impedance (digital) volt-ohmmeter. Refer to SENSOR RESISTANCE (OHMS)—COOLANT TEMPERATURE SENSOR/INTAKE AIR TEMPERATURE SENSOR chart. The resistance (as measured across sensor terminals) should be within range shown in chart. If not, replace sensor.

(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.

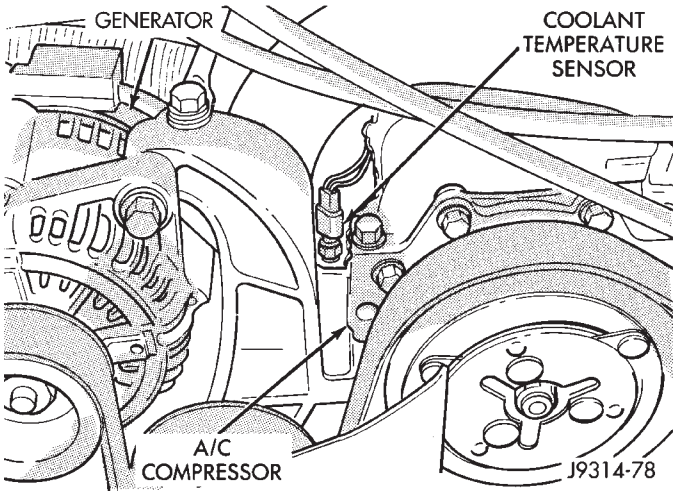


Fig. 55 Engine Coolant Temperature Sensor—5.2L/5.9L Engines

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

TEMPERATURE		RESISTANCE (OHMS)	
°CEL.	°FAHR.	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

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. 56).

(2) Test the resistance of sensor with a high input impedance (digital) volt-ohmmeter. Refer to SENSOR RESISTANCE (OHMS)—COOLANT TEMPERA-

DIAGNOSIS AND TESTING (Continued)

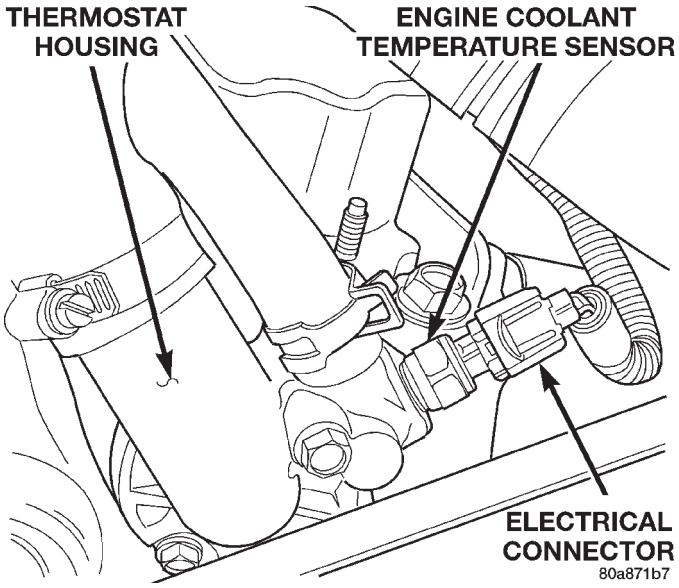


Fig. 56 Engine Coolant Temperature Sensor—4.0L Engine

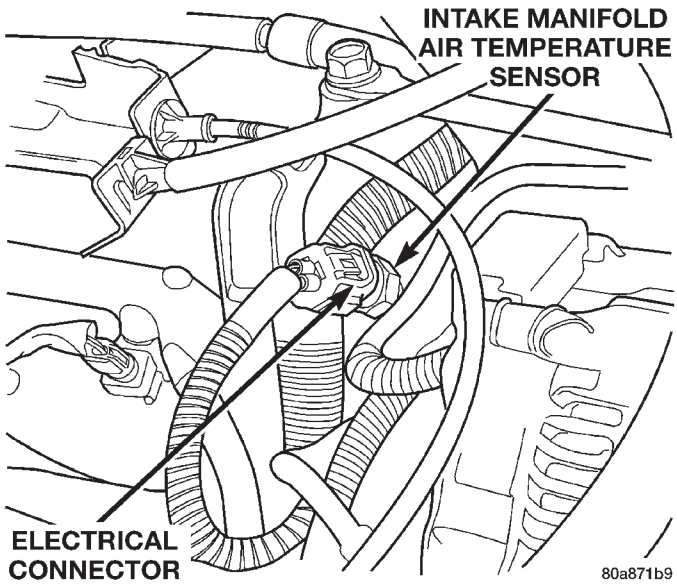


Fig. 57 Air Temperature Sensor—5.2L/5.9L Engines

TURE SENSOR/INTAKE AIR TEMPERATURE SENSOR chart. The resistance (as measured across sensor terminals) should be within range shown in chart. If not, replace sensor.

(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/5.9L ENGINES

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/5.9L 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. 57).

(2) Test the resistance of sensor with a high input impedance (digital) volt-ohmmeter. Refer to SENSOR RESISTANCE (OHMS)—COOLANT TEMPERATURE SENSOR/INTAKE AIR TEMPERATURE SENSOR chart. The resistance (as measured across sensor terminals) should be within range shown in chart. If not, replace sensor.

(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. 58).

(2) Test the resistance of sensor with a high input impedance (digital) volt-ohmmeter. Refer to SENSOR RESISTANCE (OHMS)—COOLANT TEMPERATURE SENSOR/INTAKE AIR TEMPERATURE SENSOR chart. The resistance (as measured across sensor terminals) should be within range shown in chart. If not, replace sensor.

(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.

DIAGNOSIS AND TESTING (Continued)

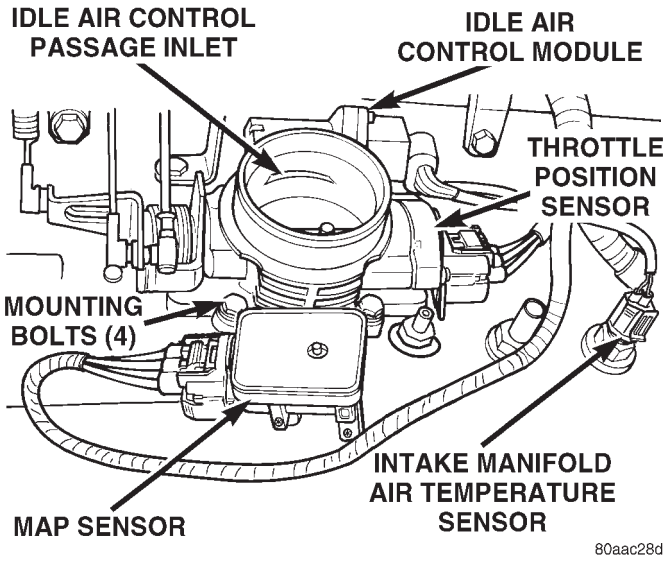


Fig. 58 Intake Manifold Air Temperature Sensor—4.0L Engine

THROTTLE POSITION SENSOR (TPS)—5.2L/5.9L ENGINES

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

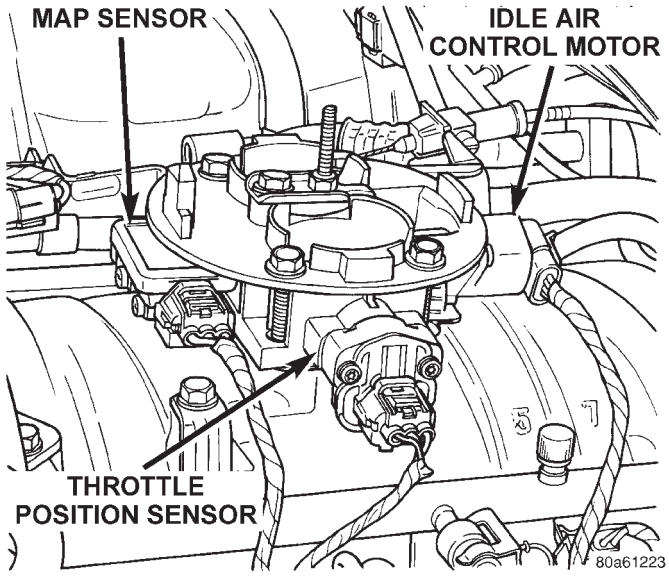


Fig. 59 TPS—5.2L/5.9L Engines

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 be greater than .350 millivolts but less than 900 millivolts. At wide open throttle, TPS output voltage must be less than 4.5 volts. The output voltage should increase gradually as the throttle plate is slowly opened from idle to WOT.

THROTTLE POSITION SENSOR (TPS)—4.0L ENGINE

To perform a complete test of the TPS (Fig. 58) 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 be greater than .350 millivolts and less than 900 millivolts. At wide open throttle, TPS output voltage must be less than 4.5 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/5.9L 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.**

A special fixed orifice tool (number 6714) (Fig. 60) must be used for the following test.

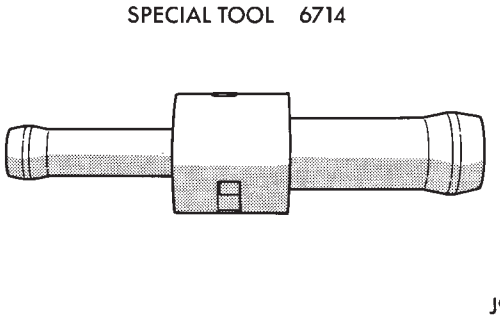


Fig. 60 Fixed Orifice Tool

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

DIAGNOSIS AND TESTING (Continued)

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

(3) Disconnect the vacuum line at the PCV valve (Fig. 61).

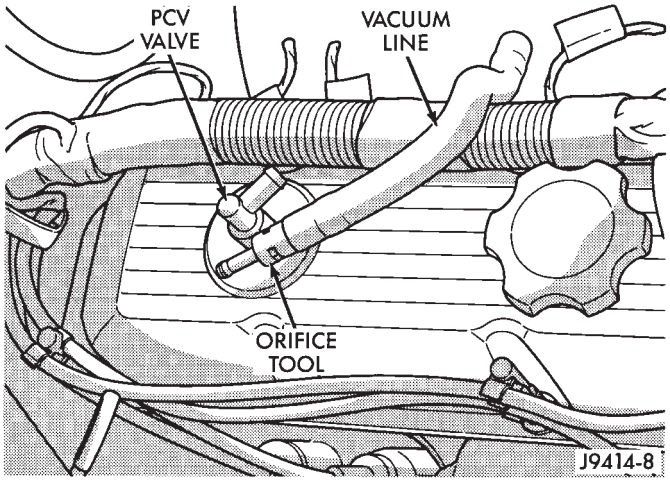


Fig. 61 Install Orifice Tool

(4) Install the 0.185 inch orifice tool (number 6714) into the disconnected vacuum line in place of the PCV valve (Fig. 61).

(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. 62). Cap the fitting at throttle body after vacuum line has been removed.

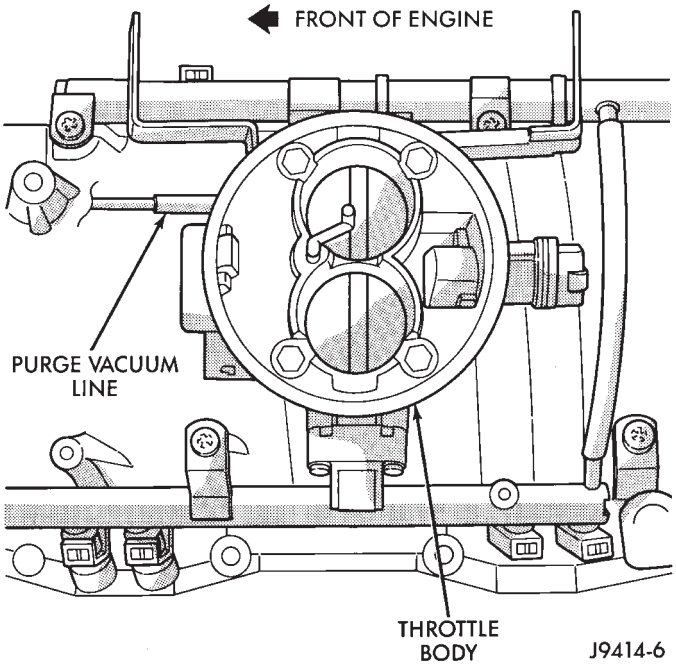


Fig. 62 Idle Purge Line

(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 and allow to warm up.

(8) Using the DRB scan tool, scroll through the menus as follows: select—Stand Alone DRB III, select 1994–1997 Diagnostics, select—Engine, select—System Test, select—Minimum Air Flow.

(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. 63). Refer to label on PDC cover for relay location.

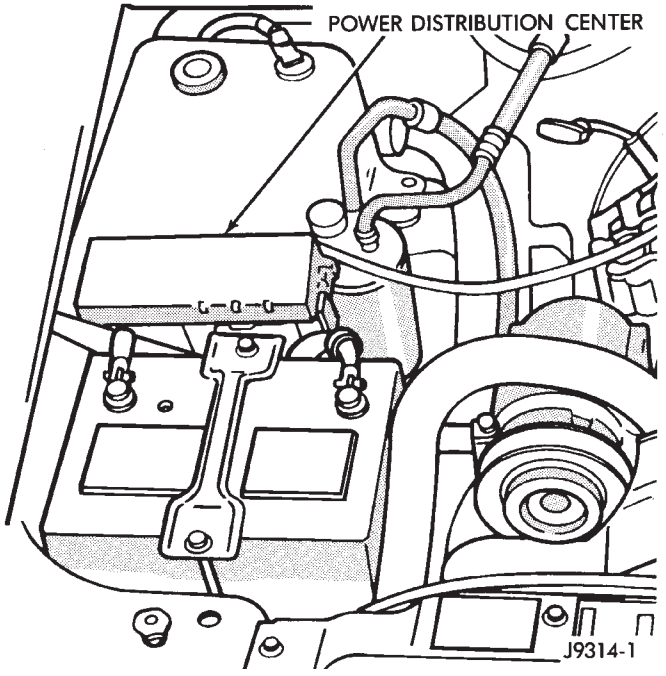


Fig. 63 Power Distribution Center (PDC) Location

REMOVAL

(1) Remove PDC cover.

(2) Remove relay from PDC.

REMOVAL AND INSTALLATION (Continued)

(3) Check condition of relay terminals and PDC connector terminals for damage or corrosion. Repair if necessary before installing relay.

(4) Check for pin height (pin height should be the same for all terminals within the PDC connector). Repair if necessary before installing relay.

INSTALLATION

(1) Install relay to PDC.

(2) Install cover to PDC.

FUEL PUMP RELAY

The fuel pump relay is located in the Power Distribution Center (PDC) (Fig. 63). Refer to label on PDC cover for relay location.

REMOVAL

(1) Remove PDC cover.

(2) Remove relay from PDC.

(3) Check condition of relay terminals and PDC connector terminals for damage or corrosion. Repair if necessary before installing relay.

(4) Check for pin height (pin height should be the same for all terminals within the PDC connector). Repair if necessary before installing relay.

INSTALLATION

(1) Install relay to PDC.

(2) Install cover to PDC.

THROTTLE BODY—5.2L/5.9L ENGINES

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. 64).

(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. 65).

(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.

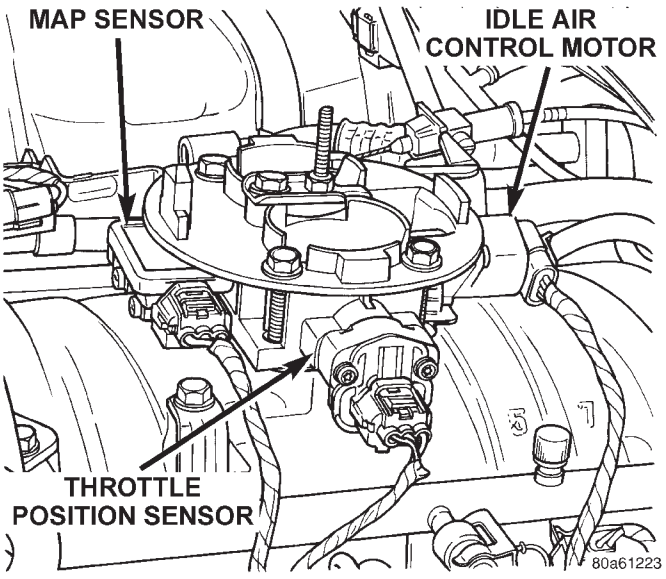


Fig. 64 Sensor Electrical Connectors—5.2L/5.9L Engines—Typical

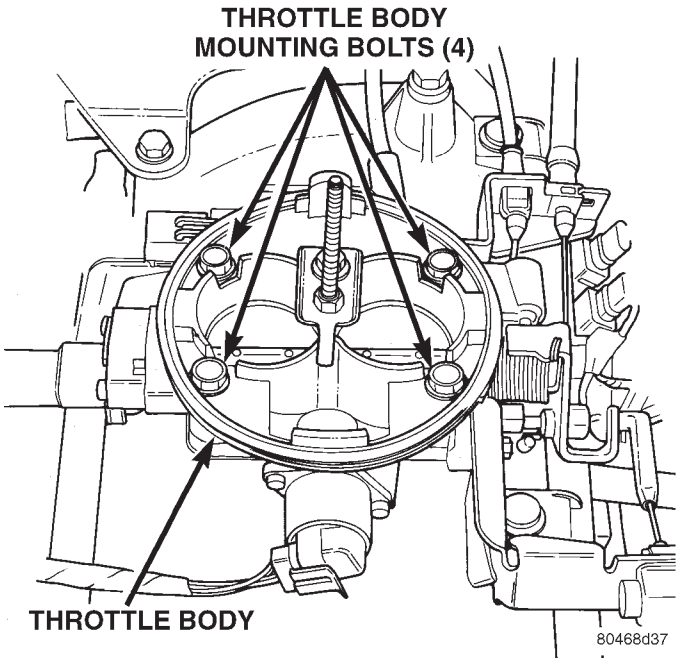


Fig. 65 Throttle Body Mounting Bolts—5.2L/5.9L Engines—Typical

(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.

REMOVAL AND INSTALLATION (Continued)

(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

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

(2) Disconnect throttle body electrical connectors at MAP sensor, IAC motor and TPS (Fig. 66).

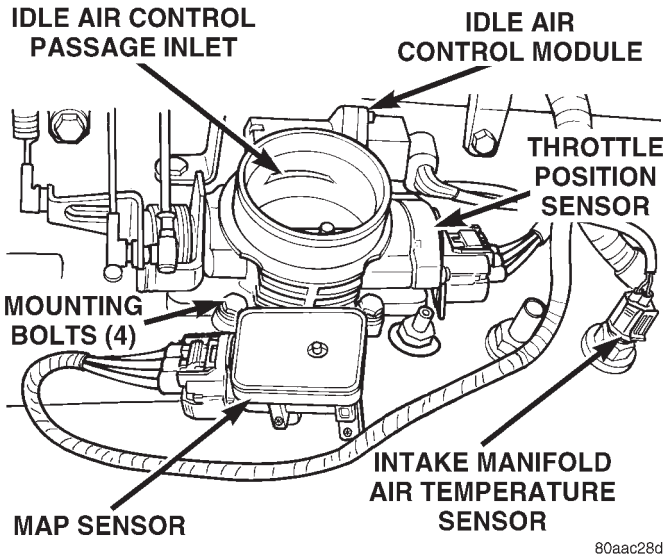


Fig. 66 Throttle Body and Sensor Locations—4.0L Engine

(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 11 N·m (100 in. lbs.) torque.

(5) Install control cables.

(6) Install electrical connectors.

(7) Install air duct at throttle body.

THROTTLE POSITION SENSOR (TPS)—5.2L/5.9L ENGINES

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. 67).

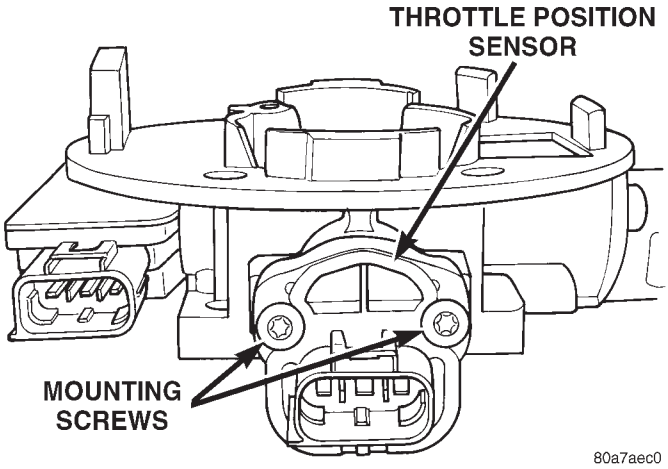


Fig. 67 TPS Mounting Bolts—5.2L/5.9L Engines—Typical

(4) Remove TPS from throttle body.

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.

(1) Install the TPS and two retaining bolts.

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

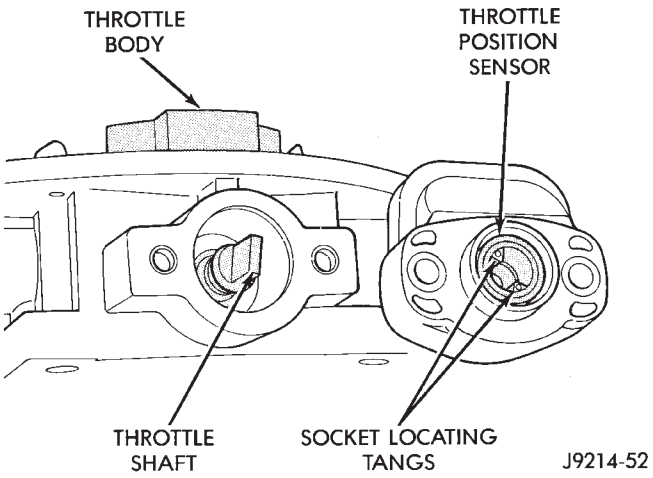


Fig. 68 Installation—5.2L/5.9L Engines—Typical

REMOVAL AND INSTALLATION (Continued)

(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. 69).
(3) Remove TPS.

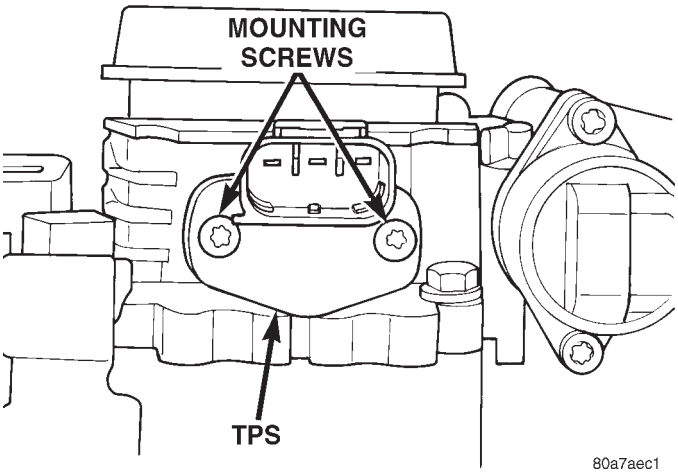


Fig. 69 TPS Mounting Screws—4.0L Engine

INSTALLATION

The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 70). 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.

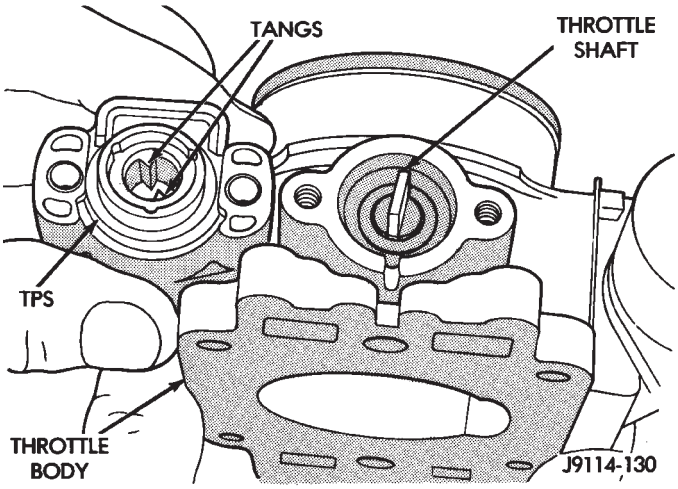


Fig. 70 Throttle Position Sensor Installation—4.0L Engine

(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/5.9L ENGINES

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. 71).

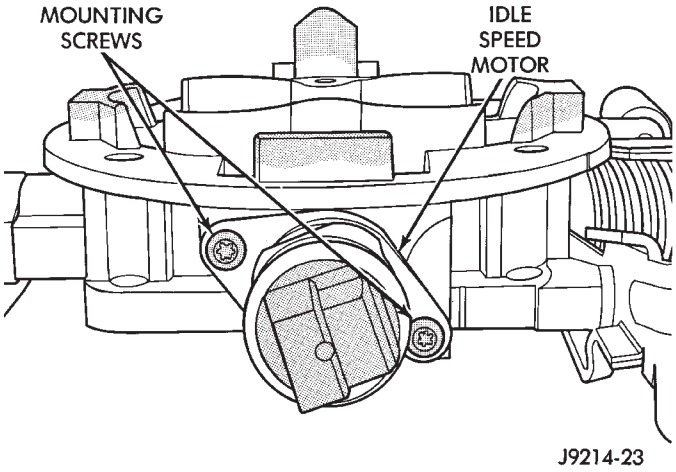


Fig. 71 Mounting Bolts (Screws)—IAC Motor—5.2L/5.9L Engines—Typical

(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. 72).
(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.

REMOVAL AND INSTALLATION (Continued)

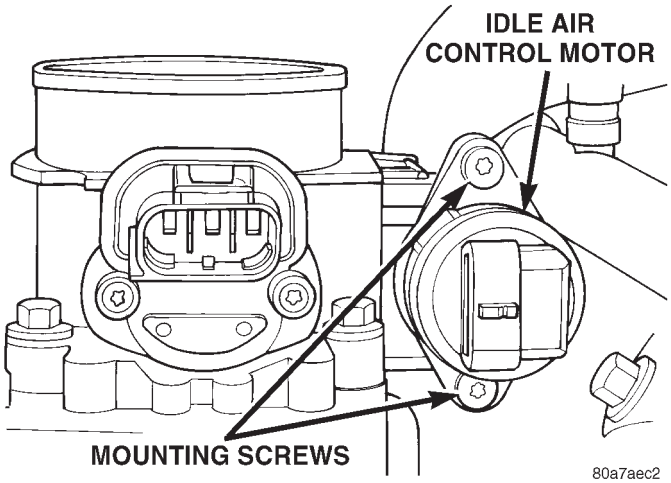


Fig. 72 Mounting Bolts (Screws)—IAC Motor—4.0L Engine

(3) Install electrical connector.
(4) Install air cleaner tube to throttle body.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR—5.2L/5.9L ENGINES

The MAP sensor is located on the front of the throttle body (Fig. 73). An L-shaped rubber fitting is used to connect the MAP sensor to throttle body (Fig. 74).

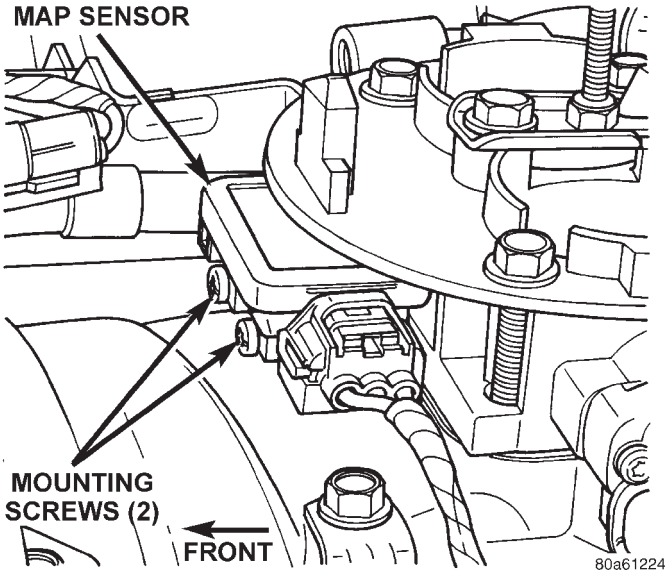


Fig. 73 MAP Sensor Mounting Screws—5.2L/5.9L Engines

REMOVAL

(1) Remove air duct at throttle body.
(2) Disconnect electrical connector at sensor.
(3) Remove two MAP sensor mounting bolts (screws) (Fig. 74).

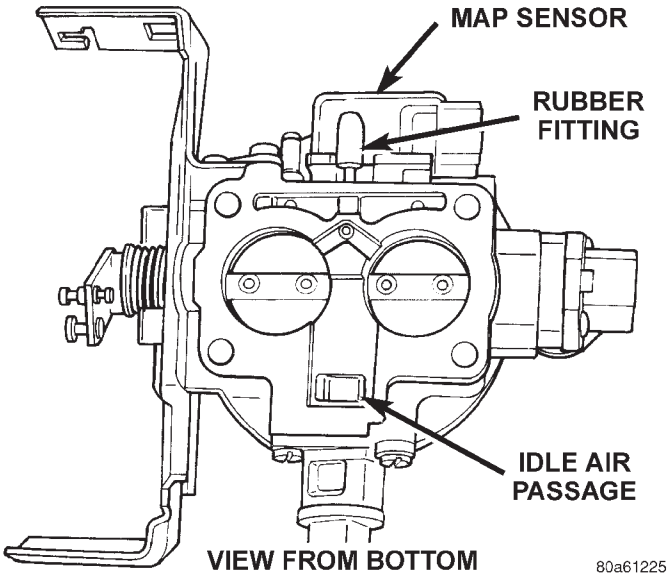


Fig. 74 MAP Sensor L-Shaped Rubber Fitting—5.2L/5.9L Engines

(4) While removing MAP sensor, slide the vacuum rubber L-shaped fitting (Fig. 74) 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) Connect electrical connector.
(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 (Fig. 75). An L-shaped rubber fitting is used to connect the MAP sensor to throttle body (Fig. 76).

REMOVAL

(1) Remove air cleaner intake tube at throttle body.
(2) Remove two MAP sensor mounting bolts (screws) (Fig. 76).
(3) While removing MAP sensor, slide the rubber L-shaped fitting (Fig. 76) from the throttle body.
(4) Remove rubber L-shaped fitting from MAP sensor.

INSTALLATION

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

REMOVAL AND INSTALLATION (Continued)

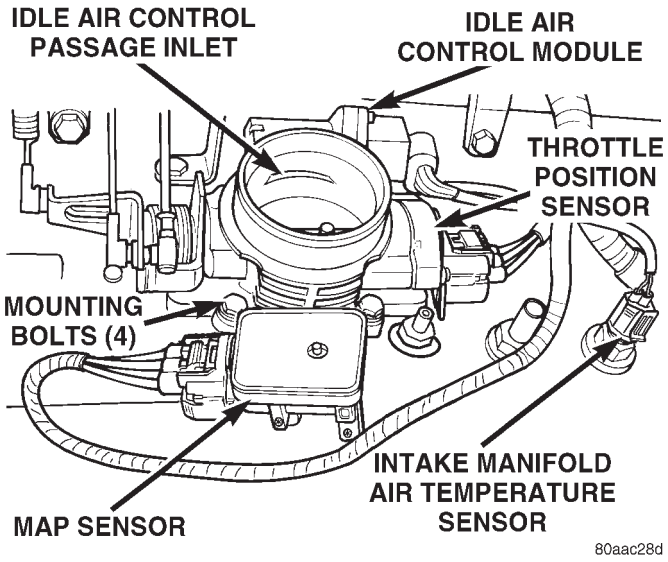


Fig. 75 MAP Sensor Location—4.0L Engine

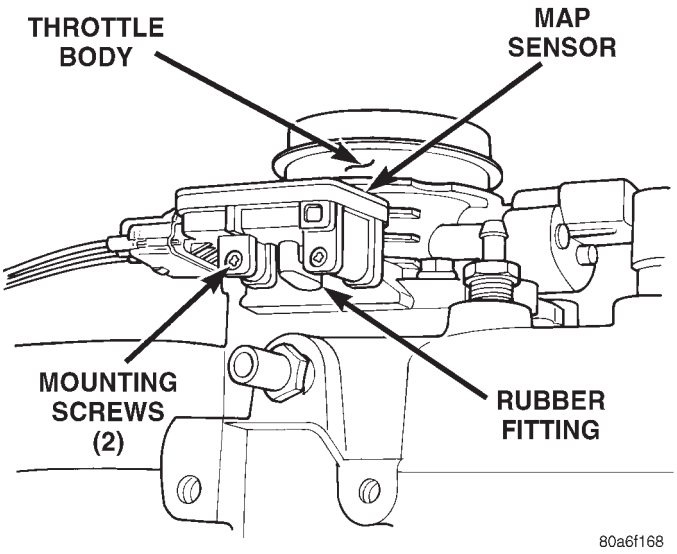


Fig. 76 Rubber L-Shaped Fitting—MAP Sensor-to-Throttle Body—4.0L Engine

(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. 77).

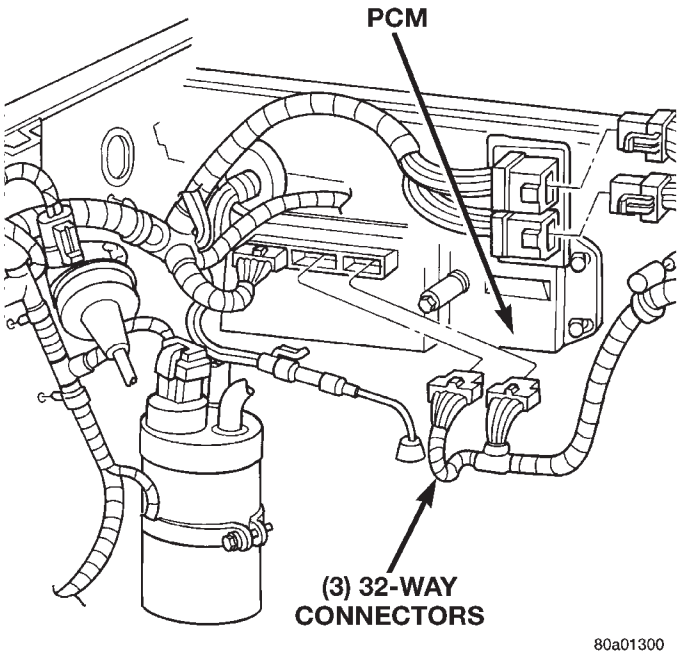


Fig. 77 Powertrain Control Module (PCM) Location

REMOVAL

To avoid possible voltage spike damage to the PCM, ignition key must be off, and negative battery cable must be disconnected before unplugging PCM connectors.

(1) Disconnect negative battery cable at battery.

(2) Remove cover over electrical connectors. Cover snaps onto PCM.

(3) Remove the coolant reserve/overflow tank (one bolt and two nuts) (Fig. 78).

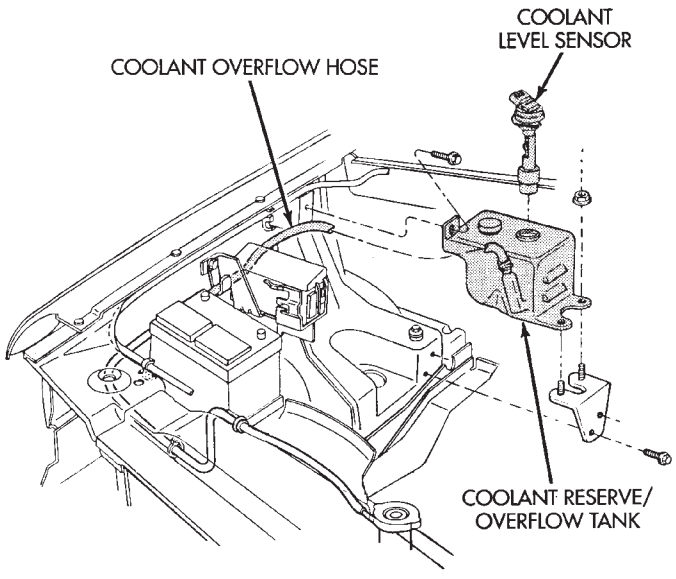


Fig. 78 Coolant Reserve/Overflow Tank Mounting

REMOVAL AND INSTALLATION (Continued)

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

(5) Remove the three PCM mounting bolts (Fig. 79).

(6) Remove PCM.

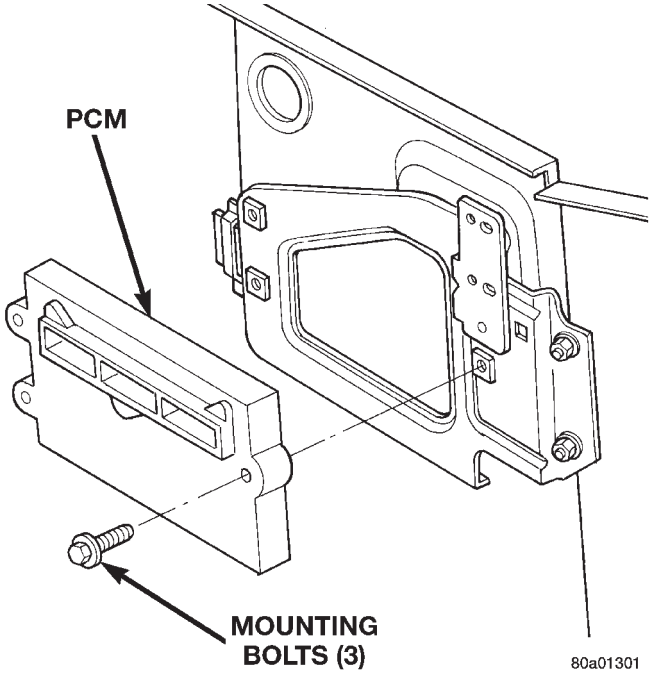


Fig. 79 Powertrain Control Module (PCM) Mounting

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 three 32–way connectors.

(4) Install cover over electrical connectors. Cover snaps onto PCM.

(5) Install coolant reserve/overflow tank.

(6) Connect negative cable to battery.

(7) Use the DRB scan tool to reprogram new PCM with vehicles original Identification Number (VIN) and original vehicle mileage.

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/5.9L ENGINES

The upstream O2S sensor is located in the exhaust downpipe. The downstream sensor is located near outlet end of catalytic converter. Refer to (Fig. 80) or (Fig. 81).

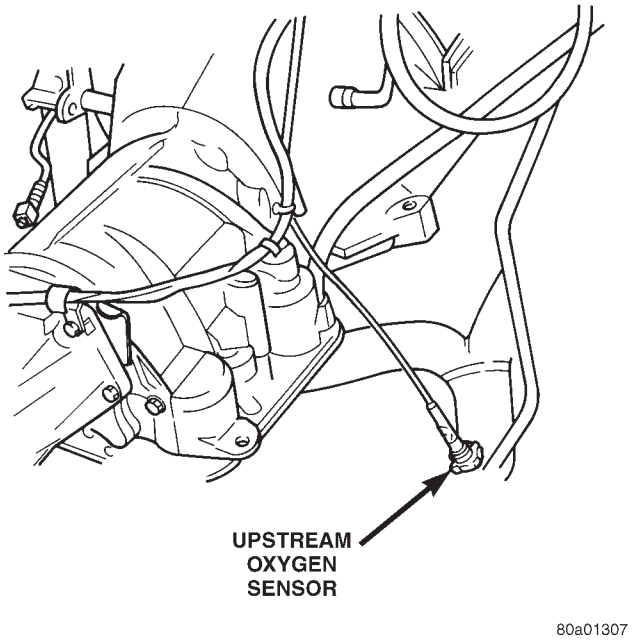


Fig. 80 Upstream Oxygen Sensor Location—5.2L/ 5.9L Engines

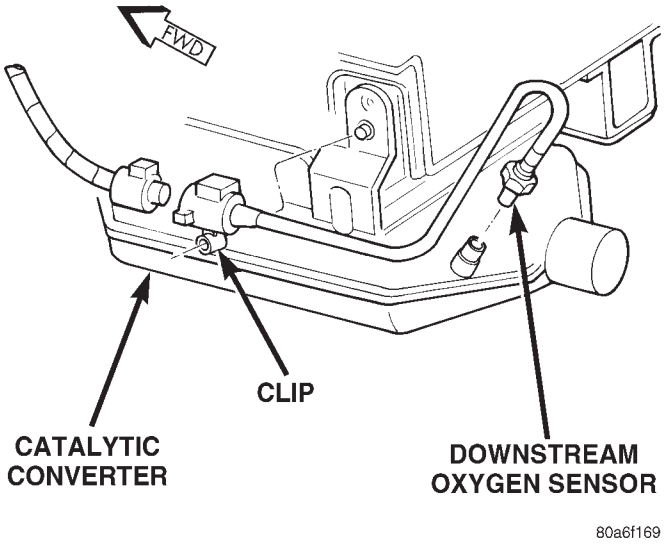


Fig. 81 Downstream Oxygen Sensor Location—All Engines

REMOVAL

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

REMOVAL AND INSTALLATION (Continued)

(1) Raise and support vehicle.
(2) Downstream Sensor Only: Disconnect O2S wiring connector clip (Fig. 81) at body. Remove clip from O2S electrical connector and discard.
(3) Disconnect O2S pigtail harness wire connector from main connector.

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

(4) Remove 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 threads of a new oxygen sensor.**
(1) Install O2S sensor. Tighten to 30 N·m (22 ft. lbs.) torque.
(2) Connect O2S sensor wire connector to main wiring harness.
(3) Downstream Sensor Only: Install new wiring connector clip into O2S electrical connector. Snap this clip to body. The O2S pigtail harness must be clipped to body to prevent mechanical damage from propshaft.
(4) 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. 82) or (Fig. 81).

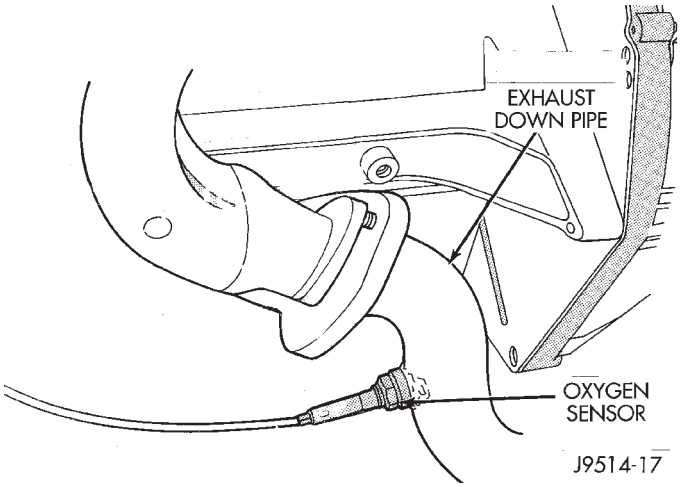


Fig. 82 Upstream Oxygen Sensor Location—4.0L Engine

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 vehicle.
(2) Downstream Sensor Only: Disconnect O2S wiring connector clip (Fig. 81) at body. Remove clip from O2S electrical connector and discard.
(3) Disconnect O2S pigtail harness wire connector from main connector.

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

(4) Remove 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 O2S sensor wire connector to main wiring harness.
(3) Downstream Sensor Only: Install new wiring connector clip into O2S electrical connector. Snap this clip to body. The O2S pigtail harness must be clipped to body to prevent mechanical damage from propshaft.
(4) Lower the vehicle.

AIR CLEANER HOUSING

REMOVAL

(1) Unlock clean air hose clamp (Fig. 83) at air cleaner cover. To unlock the clamp, attach adjustable pliers to clamp and rotate pliers as shown in (Fig. 84). Remove clean air hose at cover.
(2) Remove crankcase breather/filter hose at air cleaner cover.
(3) From under vehicle, remove three housing nuts (Fig. 83).
(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. 83).
(2) Install three nuts and tighten to 10 N·m (93 in. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

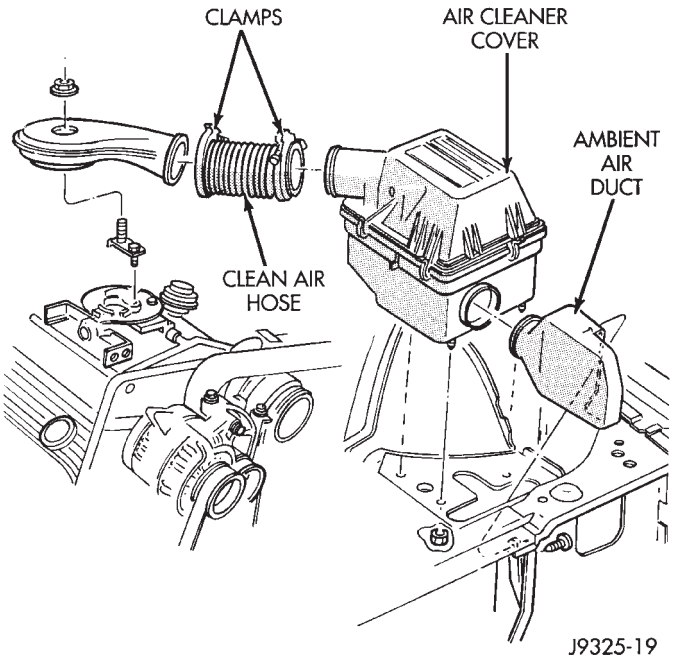


Fig. 83 Air Cleaner—5.2L V-8 Engine Shown

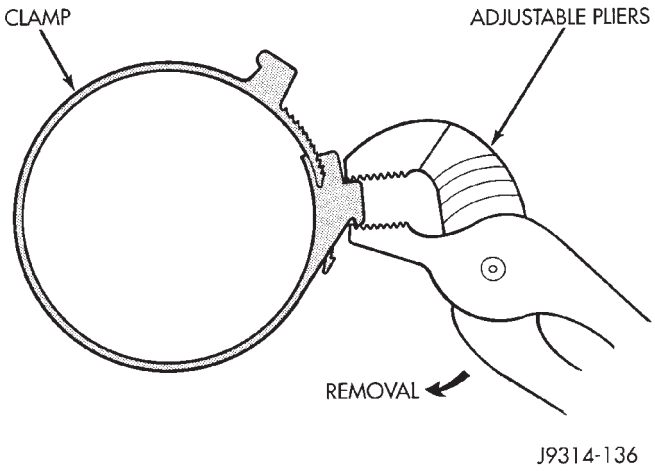


Fig. 84 Clamp Removal

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

(4) Install clamp to cover. Compress the clamp snugly with adjustable pliers as shown in (Fig. 85).

AIR CLEANER ELEMENT (FILTER)

REMOVAL/INSTALLATION

(1) Pry back the six clips retaining the air cleaner cover to the air cleaner housing (Fig. 86).

(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.

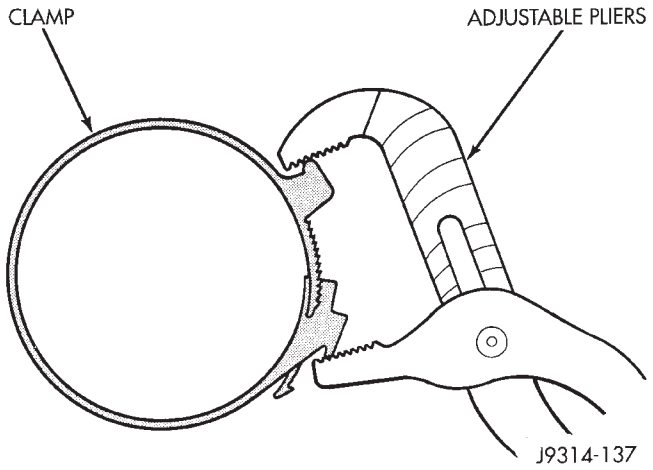


Fig. 85 Clamp Installation

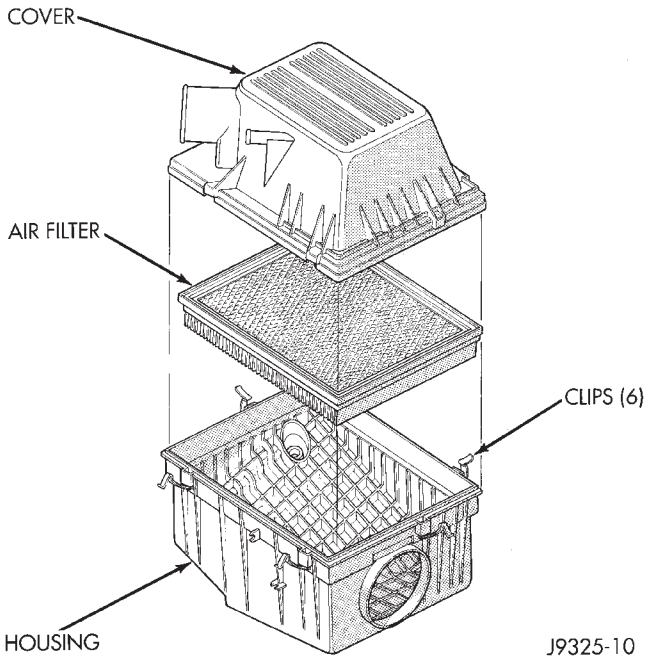


Fig. 86 Air Cleaner Element Removal/Installation

ENGINE COOLANT TEMPERATURE SENSOR—5.2L/ 5.9L ENGINES

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. 87).

REMOVAL AND INSTALLATION (Continued)

(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.

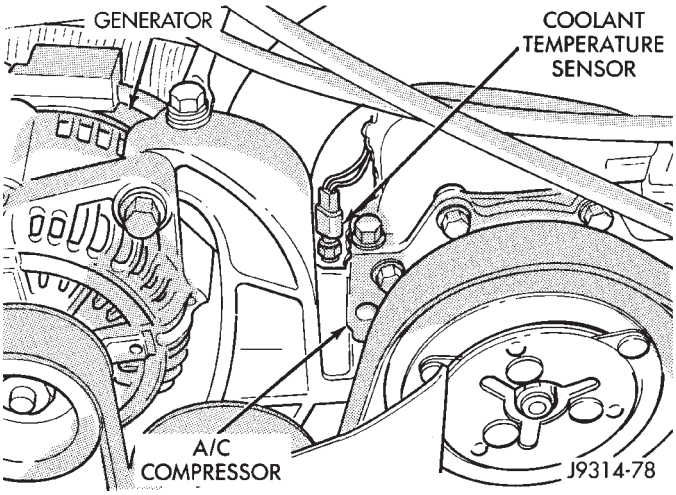


Fig. 87 Engine Coolant Temperature Sensor—5.2L/ 5.9L Engines

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. 88).

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.

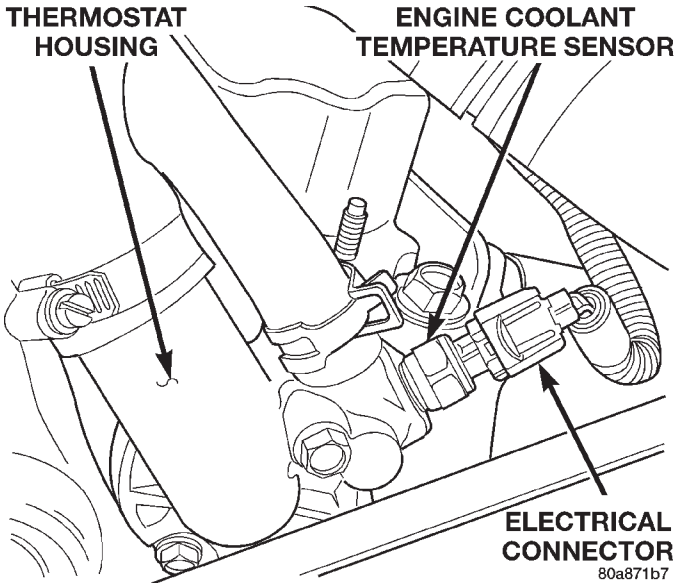


Fig. 88 Engine Coolant Temperature Sensor—4.0L Engine

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

INTAKE MANIFOLD AIR TEMPERATURE SENSOR—5.2L/5.9L ENGINES

The intake manifold air temperature sensor is located in the front/side of the intake manifold (Fig. 89).

REMOVAL

(1) Disconnect electrical connector at sensor (Fig. 89).

(2) Remove sensor from intake manifold.

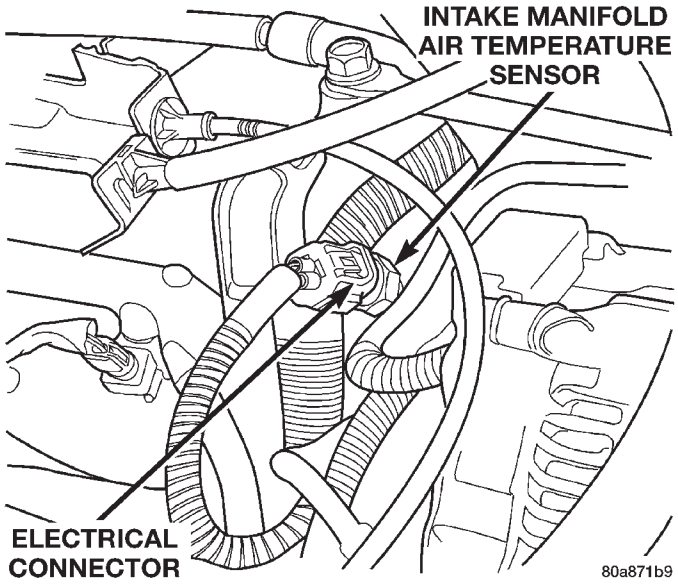


Fig. 89 Air Temperature Sensor—5.2L/5.9L Engines—Typical

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

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

(2) Install electrical connector.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR—4.0L ENGINE

The intake manifold air temperature sensor is installed into the intake manifold plenum near the throttle body (Fig. 90).

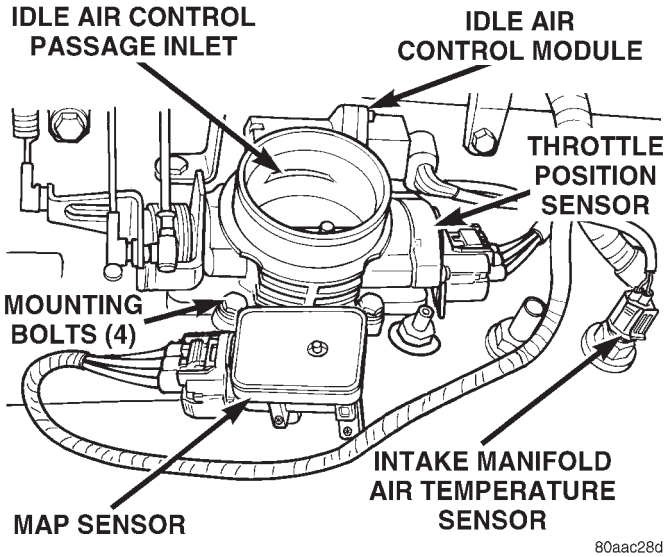


Fig. 90 Intake Air Sensor Location—4.0L Engine

REMOVAL

(1) Disconnect the electrical connector from the sensor.

(2) Remove the sensor from the intake manifold.

INSTALLATION

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

(2) Connect the electrical connector to the sensor.

VEHICLE SPEED SENSOR

The vehicle speed sensor is located on the speedometer pinion gear adapter (Fig. 91) or (Fig. 92). The pinion gear adapter is located on the extension housing of the transmission (drivers side).

REMOVAL

(1) Raise and support vehicle.

(2) Disconnect the electrical connector from the sensor.

(3) Remove the sensor mounting bolt (Fig. 93).

(4) Remove the sensor (pull straight out) from the speedometer pinion gear adapter (Fig. 93). Do not remove the gear adapter from the transmission.

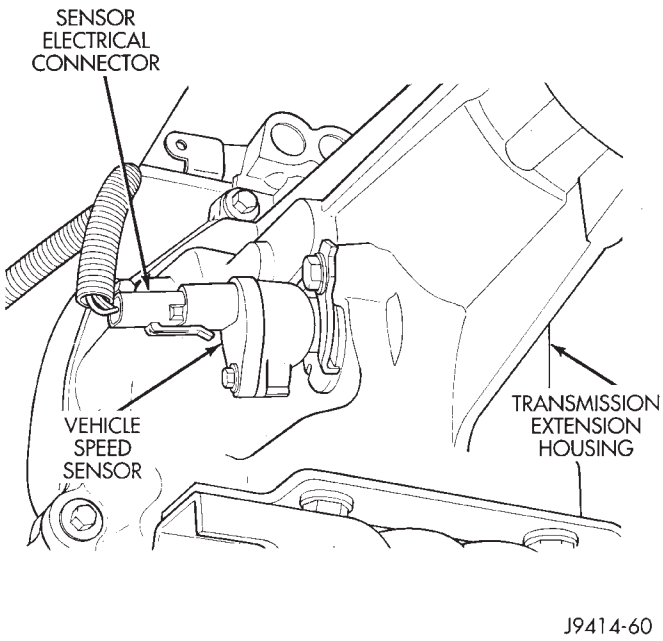


Fig. 91 Vehicle Speed Sensor Location—2WD—Typical

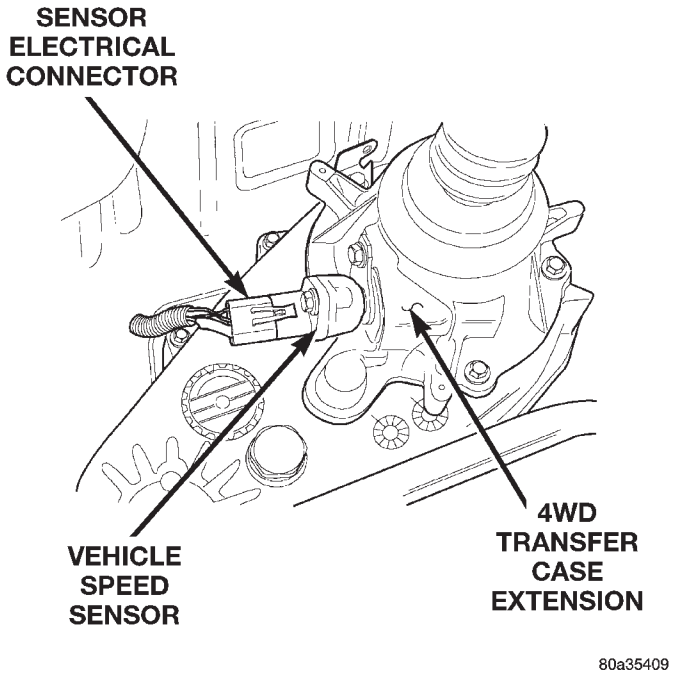


Fig. 92 Vehicle Speed Sensor Location—4WD—Typical

INSTALLATION

(1) Clean the inside of speedometer pinion gear adapter before installing speed sensor.

(2) Install sensor into speedometer gear adapter and install mounting bolt. **Before tightening bolt, verify speed sensor is fully seated (mounted flush) to speedometer pinion gear adapter.**

REMOVAL AND INSTALLATION (Continued)

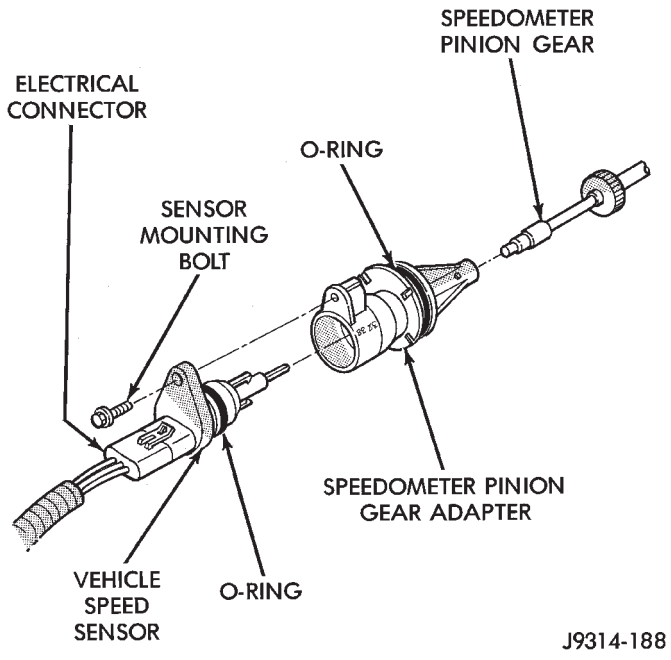


Fig. 93 Sensor Removal/Installation

(3) Tighten sensor mounting bolt to 2.2 N·m (20 in. lbs.) torque.

(4) Connect electrical connector to sensor.

SPECIFICATIONS

VECI LABEL

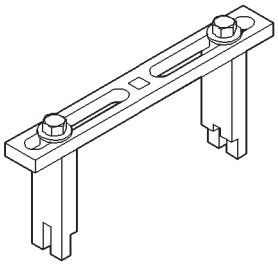
If anything differs between the specifications found on the Vehicle Emission Control Information (VECI) label and the following specifications, use specifications on VECI label. The VECI label is located in the engine compartment.

TORQUE CHART

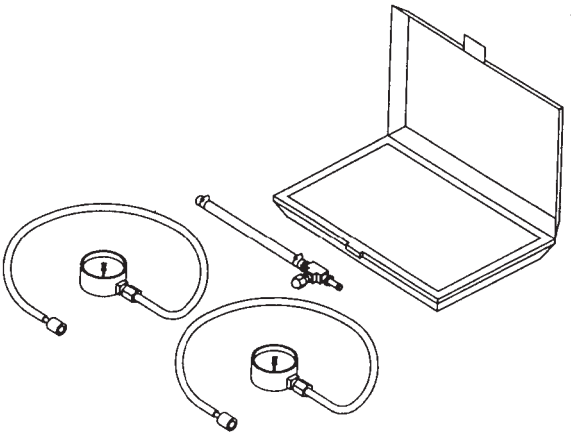
DESCRIPTION	TORQUE
Air Cleaner Housing Mount. Nuts	.10 N·m (93 in. lbs.)
Engine Coolant Temperature Sensor— All Engines	.11 N·m (96 in. lbs.)
Fuel Hose Clamps	.1 N·m (10 in. lbs.)
IAC Motor-To-Throttle Body Bolts	.7 N·m (60 in. lbs.)
Intake Manifold Air Temp. Sensor— All Engines	.28 N·m (20 ft. lbs.)
MAP Sensor Mounting Screws— All Engines	.3 N·m (25 in. lbs.)
Oxygen Sensor—All Engines	.30 N·m (22 ft. lbs.)
Powertrain Control Module Mounting Screws	.1 N·m (9 in. lbs.)
Throttle Body Mounting Bolts— 5.2L/5.9L Engine	.23 N·m (200 in. lbs.)
Throttle Body Mounting Bolts— 4.0L Engine	.11 N·m (100 in. lbs.)
Throttle Position Sensor Mounting Screws—All Engines	7 N·m (60 in. lbs.)
Vehicle Speed Sensor Mounting Bolt	.2.2 N·m (20 in. lbs.)

SPECIAL TOOLS

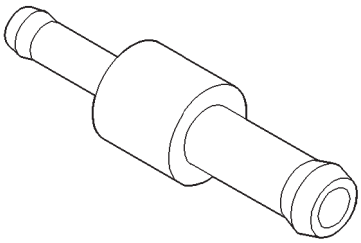
FUEL SYSTEM



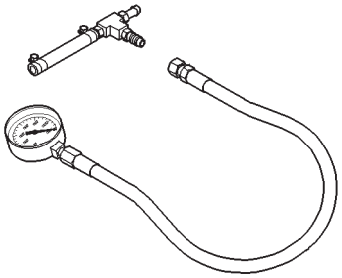
Spanner Wrench—6856



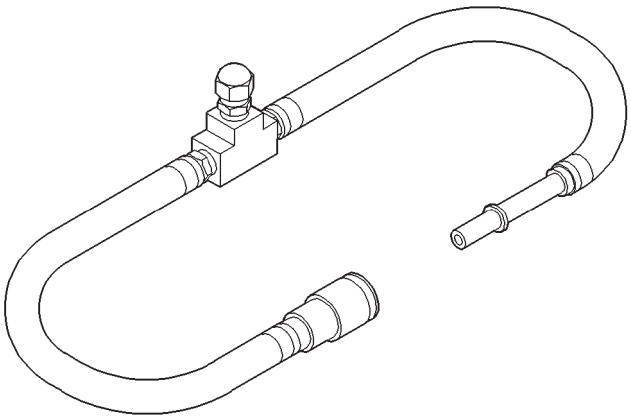
Test Kit, Fuel Pressure—5069



Fitting, Air Metering—6714



Test Kit, Fuel Pressure—C-4799-B



Adapters, Fuel Pressure Test—6541, 6539, 6631 or 6923

Fuel Line Removal Tool—6782

O2S (Oxygen Sensor) Remover/Installer—C-4907