FUEL SYSTEM

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FUEL DELIVERY SYSTEM

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PCM REPLACEMENT

USE THE DRB SCAN TOOL TO REPROGRAM THE NEW POWERTRAIN CONTROL MODULE (PCM) WITH THE VEHICLES ORIGINAL IDENTIFICATION NUMBER (VIN) AND THE VEHICLES ORIGINAL MILEAGE. IF THIS STEP IS NOT DONE, A DIAGNOSTIC TROUBLE CODE (DTC) MAY BE SET.

FUEL REQUIREMENTS

Your engine is designed to meet all emissions regulations and provide excellent fuel economy and performance when using high quality unleaded gasoline having an octane rating of 87. The use of premium gasoline is not recommended. The use of premium gasoline will provide no benefit over high quality regular gasoline, and in some circumstances may result in poorer performance.

Light spark knock at low engine speeds is not harmful to your engine. However, continued heavy spark knock at high speeds can cause damage and

DESCRIPTION AND OPERATION (Continued)

immediate service is required. Engine damage resulting from operation with a heavy spark knock may not be covered by the new vehicle warranty.

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

The American Automobile Manufacturers Association, AAMA, has issued gasoline specifications to define the minimum fuel properties necessary to deliver enhanced performance and durability for your vehicle. Chrysler recommends the use of gasoline that meet the AAMA specifications if they are available.

REFORMULATED GASOLINE

Many areas of the country require the use of cleaner burning gasoline referred to as "reformulated" gasoline. Reformulated gasoline contain oxygenates, and are specifically blended to reduce vehicle emissions and improve air quality.

Chrysler strongly supports the use of reformulated gasoline. Properly blended reformulated gasoline will provide excellent performance and durability for the engine and fuel system components.

GASOLINE/OXYGENATE BLENDS

Some fuel suppliers blend unleaded gasoline with oxygenates such as 10% ethanol, MTBE, and ETBE. Oxygenates are required in some areas of the country during the winter months to reduce carbon monoxide emissions. Fuels blended with these oxygenates may be used in your vehicle.

CAUTION: DO NOT use gasoline containing METHANOL. Gasoline containing methanol may damage critical fuel system components.

MMT

MMT is a manganese-containing metallic additive that is blended into some gasoline to increase octane. Gasoline blended with MMT provide no performance advantage beyond gasoline of the same octane number without MMT. Gasoline blended with MMT reduce spark plug life and reduce emission system performance in some vehicles. Chrysler recommends that gasoline without MMT be used in your vehicle. The MMT content of gasoline may not be indicated on the gasoline pump; therefore, you should ask your gasoline retailer whether or not his/her gasoline contains MMT.

It is even more important to look for gasoline without MMT in Canada because MMT can be used at levels higher than allowed in the United States. MMT is prohibited in Federal and California reformulated gasoline.

SULFUR IN GASOLINE

If you live in the northeast United States, your vehicle may have been designed to meet California low emission standards with clean-burning, low-sulfur, California gasoline. Gasoline sold outside of California is permitted to have higher sulfur levels which may affect the performance of the vehicle's catalytic converter. This may cause the Check Engine or Service Engine Soon light to illuminate.

Illumination of either light while operating on high sulfur gasoline does not necessarily mean your emission control system is malfunctioning. Chrysler recommends that you try a different brand of unleaded gasoline having lower sulfur to determine if the problem is fuel related prior to returning your vehicle to an authorized dealer for service.

CAUTION: If the Check Engine or Service Engine Soon light is flashing, immediate service is required; see on-board diagnostics system section.

MATERIALS ADDED TO FUEL

All gasoline sold in the United States and Canada are required to contain effective detergent additives. Use of additional detergents or other additives is not needed under normal conditions.

FUEL SYSTEM CAUTIONS

CAUTION: Follow these guidelines to maintain your vehicle's performance:

- The use of leaded gas is prohibited by Federal law. Using leaded gasoline can impair engine performance, damage the emission control system, and could result in loss of warranty coverage.
- An out-of-tune engine, or certain fuel or ignition malfunctions, can cause the catalytic converter to overheat. If you notice a pungent burning odor or some light smoke, your engine may be out of tune or malfunctioning and may require immediate service. Contact your dealer for service assistance.
- When pulling a heavy load or driving a fully loaded vehicle when the humidity is low and the temperature is high, use a premium unleaded fuel to help prevent spark knock. If spark knock persists, lighten the load, or engine piston damage may result.
- The use of fuel additives which are now being sold as octane enhancers is not recommended. Most of these products contain high concentrations of methanol. Fuel system damage or vehicle performance problems resulting from the use of such fuels or additives is not the responsibility of Chrysler Corporation and may not be covered under the new vehicle warranty.

DESCRIPTION AND OPERATION (Continued)

NOTE: Intentional tampering with emissions control systems can result in civil penalties being assessed against you.

FUEL DELIVERY SYSTEM

DESCRIPTION

The fuel delivery system consists of:

- the fuel pump module containing the electric fuel pump, fuel gauge sending unit (fuel level sensor) and a separate fuel filter located at bottom of pump module
- a separate combination fuel filter/fuel pressure regulator
- 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

The fuel tank assembly consists of: the fuel tank, fuel tank shield, fuel tank straps, fuel pump module assembly, fuel pump module locknut/gasket, and roll-over valve (refer to Emission Control System for roll-over 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 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.

FUEL PUMP MODULE

DESCRIPTION

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

- 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
- Fuel return tube (line) connection

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

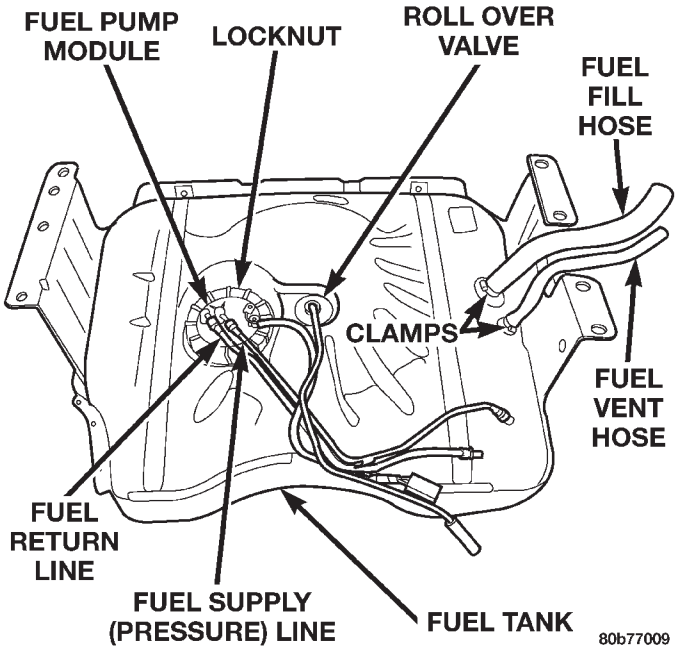


Fig. 1 Fuel Tank/Fuel Pump Module Location (Top View)

FUEL PUMP

DESCRIPTION

The electric fuel pump is located inside of the fuel pump module.

OPERATION

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

DESCRIPTION AND OPERATION (Continued)

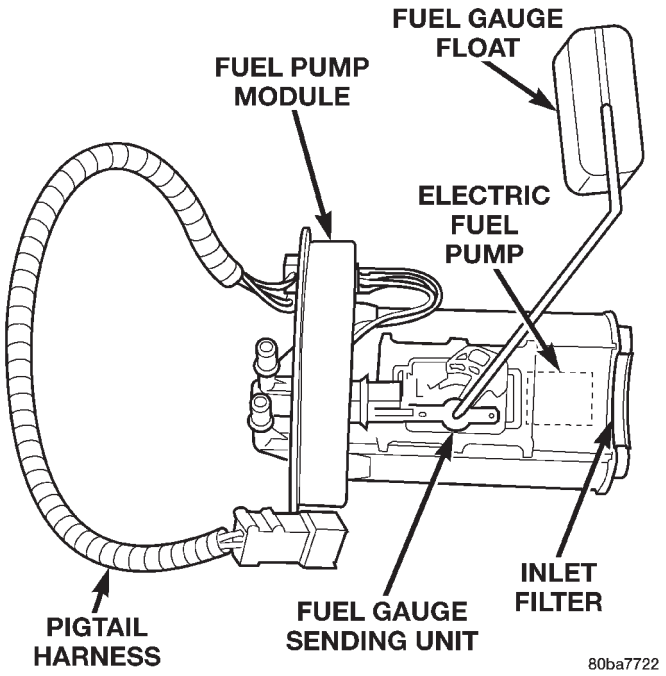


Fig. 2 Fuel Pump Module Components

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 for more information.

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

FUEL GAUGE SENDING UNIT

DESCRIPTION

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).

OPERATION

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 J1850 Programmable Communications Interface (PCI) 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

DESCRIPTION

A combination fuel filter and fuel pressure regulator is used on all engines. It is remotely mounted to the body near the front of the fuel tank (Fig. 3). A separate frame mounted fuel filter is not used with any engine.

The filter/regulator is equipped with three different fuel line connections (Fig. 3). They are used for: fuel pressure (from the fuel pump module to the filter/regulator), fuel return (from the filter/regulator back to the fuel pump module) and fuel supply (to the fuel rail and fuel injectors).

OPERATION

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. 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.

If fuel pressure at the pressure regulator exceeds approximately 49 psi, an internal diaphragm closes. Excess fuel is then routed into a separate fuel return

DESCRIPTION AND OPERATION (Continued)

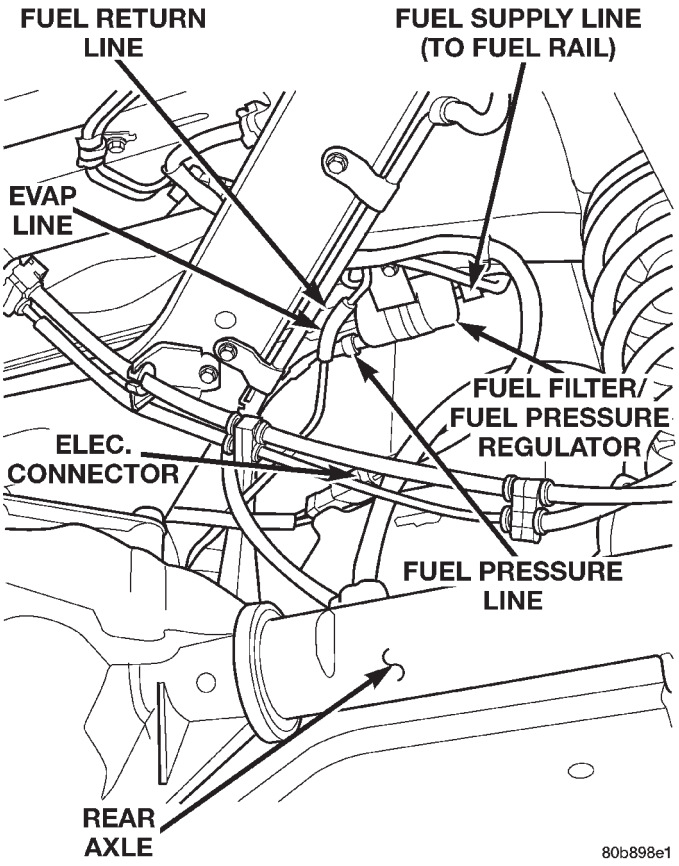


Fig. 3 Fuel Filter/Fuel Pressure Regulator Location

line and returned to the fuel tank through the top of the fuel pump module.

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.

FUEL TANK

DESCRIPTION

The fuel tank is constructed of a plastic material. Its main functions are for fuel storage and for placement of the fuel pump module.

OPERATION

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.

A rollover valve(s) is mounted into the top of the fuel tank (or pump module). Refer to 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 Emission Control System for additional information.

FUEL INJECTORS

DESCRIPTION

A separate fuel injector (Fig. 4) is used for each individual cylinder.

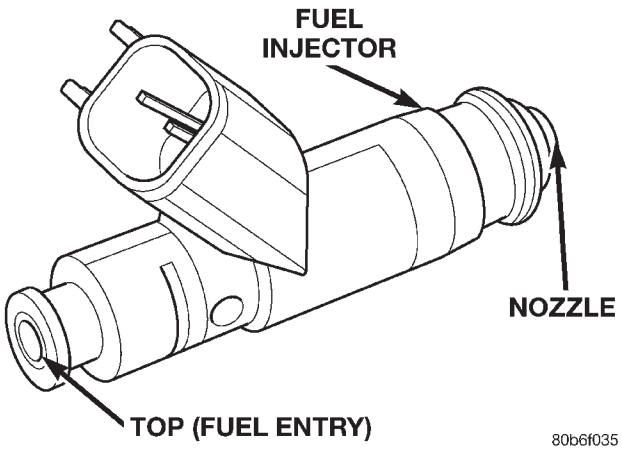


Fig. 4 Fuel Injector—4.0L/4.7L Engines

OPERATION

The fuel injectors 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.

The top (fuel entry) end of the injector (Fig. 4) 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 electrically energized, individually and 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.

DESCRIPTION AND OPERATION (Continued)

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 INJECTOR RAIL—4.0L ENGINE

DESCRIPTION

The metal fuel injector rail is used to mount the fuel injectors to the engine. It is mounted to the intake manifold (Fig. 5).

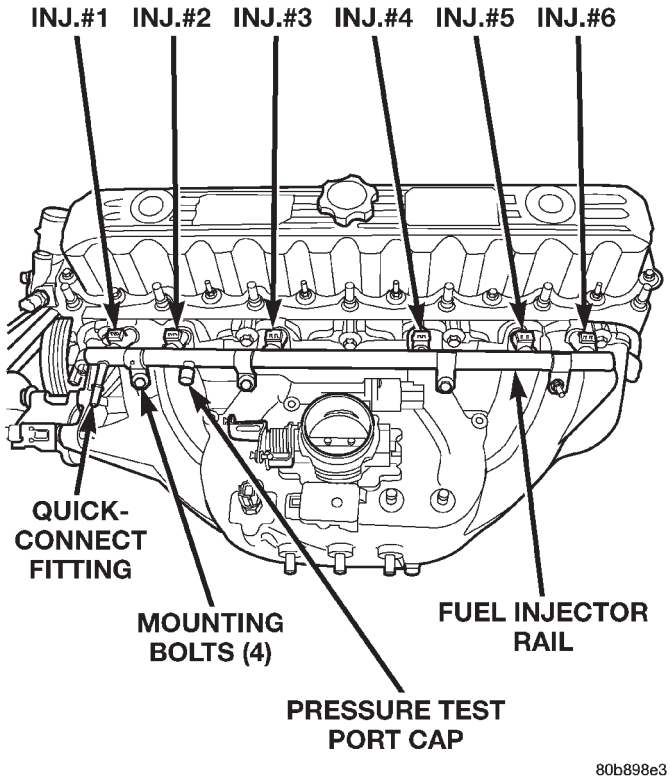


Fig. 5 Fuel Injector Rail—4.0L Engine

OPERATION

High pressure fuel from the fuel pump is routed to the fuel rail. The fuel rail then supplies the necessary fuel to each individual fuel injector.

A fuel pressure test port is located on the fuel rail (Fig. 5). A quick-connect fitting with a safety latch is used to attach the fuel line to the fuel rail.

The fuel rail is not repairable.

FUEL INJECTOR RAIL—4.7L ENGINE

DESCRIPTION

The metal fuel injector rail is used to mount the fuel injectors to the engine. It is mounted to the intake manifold (Fig. 6).

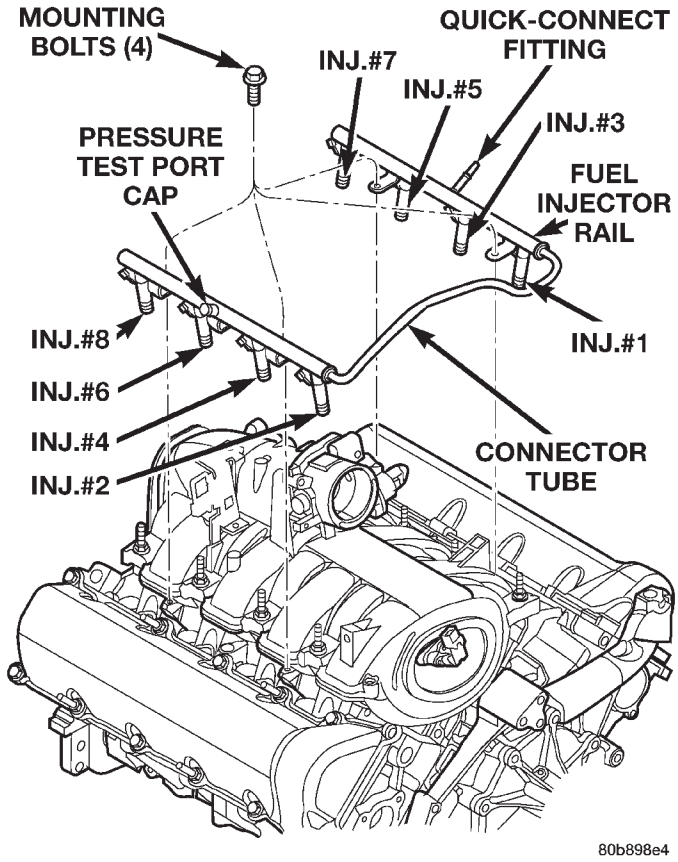


Fig. 6 Fuel Injector Rail—4.7L V-8 Engine

OPERATION

High pressure fuel from the fuel pump is routed to the fuel rail. The fuel rail then supplies the necessary fuel to each individual fuel injector.

A fuel pressure test port is located on the fuel rail (Fig. 6). A quick-connect fitting with a safety latch is used to attach the fuel line to the fuel rail.

The fuel rail is not repairable.

CAUTION: 4.7L Engine Only: The left and right sections of the fuel rail are joined with a connector tube (Fig. 6). Do not attempt to separate the rail halves at this tube. Due to the design of this connecting tube, it does not use any clamps. Never attempt to install a clamping device of any kind to the tube. When removing the fuel rail assembly for any reason, be careful not to bend or kink the connector tube.

DESCRIPTION AND OPERATION (Continued)

FUEL TANK FILLER TUBE CAP

DESCRIPTION

The plastic fuel fill cap is threaded onto the end of the fuel fill tube.

OPERATION

The loss of any fuel or vapor out of fuel filler tube is prevented by the use of a pressure-vacuum fuel fill cap. Relief valves inside the cap will release fuel tank pressure at predetermined pressures. Fuel tank vacuum will also be released at predetermined values. 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 fill cap before servicing any fuel system component. This is done to help relieve tank pressure. If equipped with a California emissions package and a Leak Detection Pump (LDP), the secondary seal below the fill cap must be pressed (opened) to relieve fuel tank pressure.

QUICK-CONNECT FITTINGS

DESCRIPTION

Different types of quick-connect fittings are used to attach various fuel system components, lines and tubes. These are: a single-tab type, a two-tab type or a plastic retainer ring type. Some are equipped with safety latch clips. Some may require the use of a special tool for disconnection and removal. Refer to Quick-Connect Fittings Removal/Installation for more information.

CAUTION: The interior components (o-rings, clips) of quick-connect fittings are not serviced separately, but new plastic spacers are available for some types. If service parts are not available, do not attempt to repair the damaged fitting or fuel line (tube). If repair is necessary, replace the complete fuel line (tube) assembly.

DIAGNOSIS AND TESTING

FUEL PUMP PRESSURE TEST

Use this test in conjunction with other fuel system tests. Refer to the Fuel Pump Capacity Test, Fuel Pressure Leak Down Test and Fuel Pump Amperage 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.

The fuel system is equipped with a 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 pressure test port cap at fuel rail test port (Fig. 7) or (Fig. 8). Connect 0–414 kPa (0-60 psi) fuel pressure gauge (from gauge set 5069) to test port pressure fitting on fuel rail (Fig. 9).

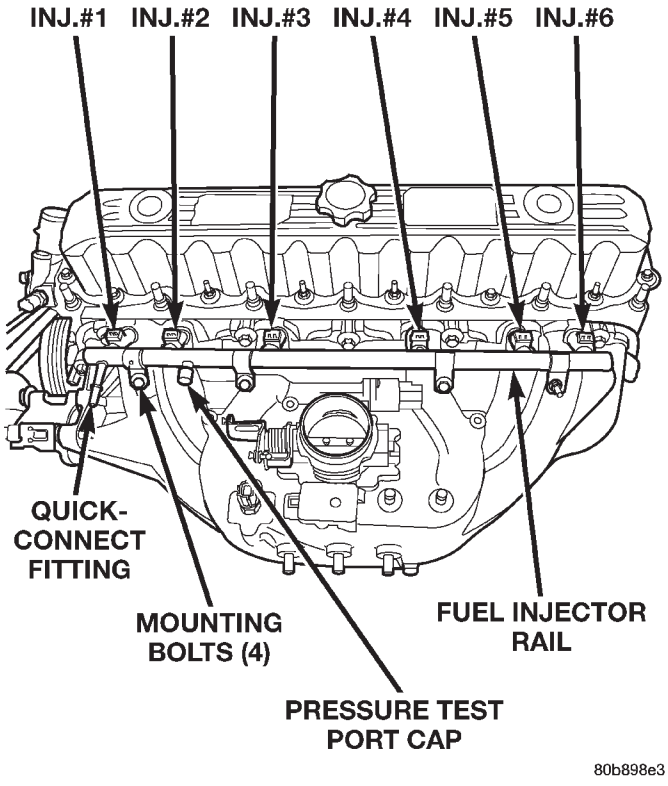


Fig. 7 Test Port Cap Location—4.0L Engine

(2) Start and warm engine and note pressure gauge reading. The DRB scan tool may also be used

DIAGNOSIS AND TESTING (Continued)

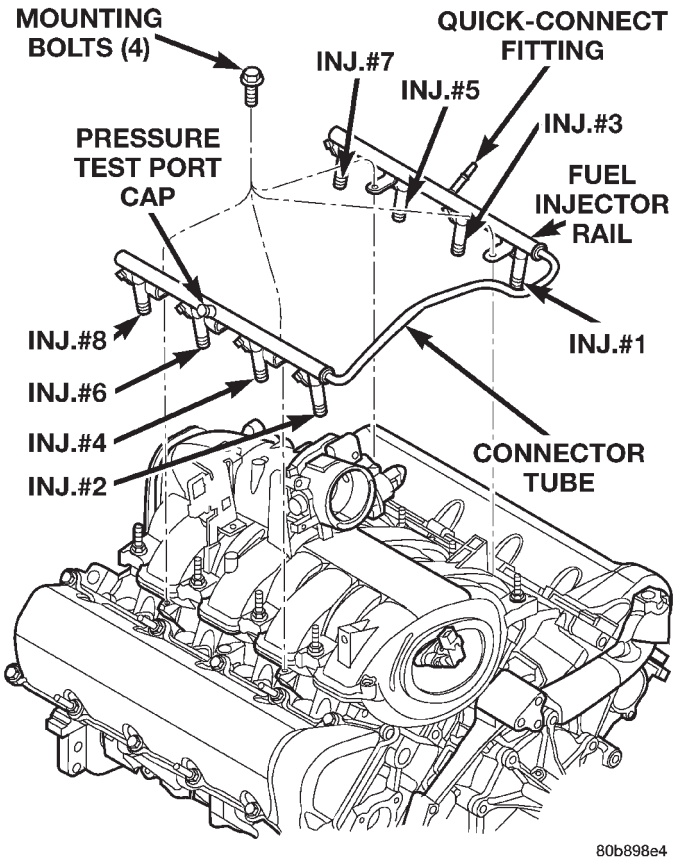


Fig. 8 Test Port Cap Location—4.7L V-8 Engine

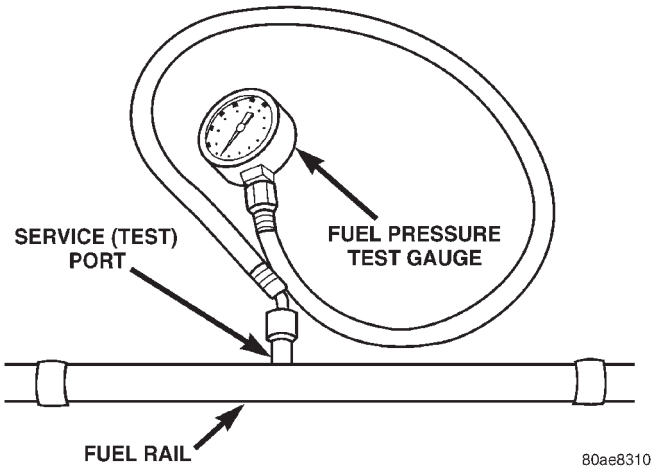


Fig. 9 Fuel Pressure Test Gauge (Typical Gauge Installation at Test Port)

to power fuel pump. 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, determine if fuel pump or filter/regulator is defective. Proceed to next step:

(a) Check for a kinked fuel supply line somewhere between fuel rail and fuel pump module.

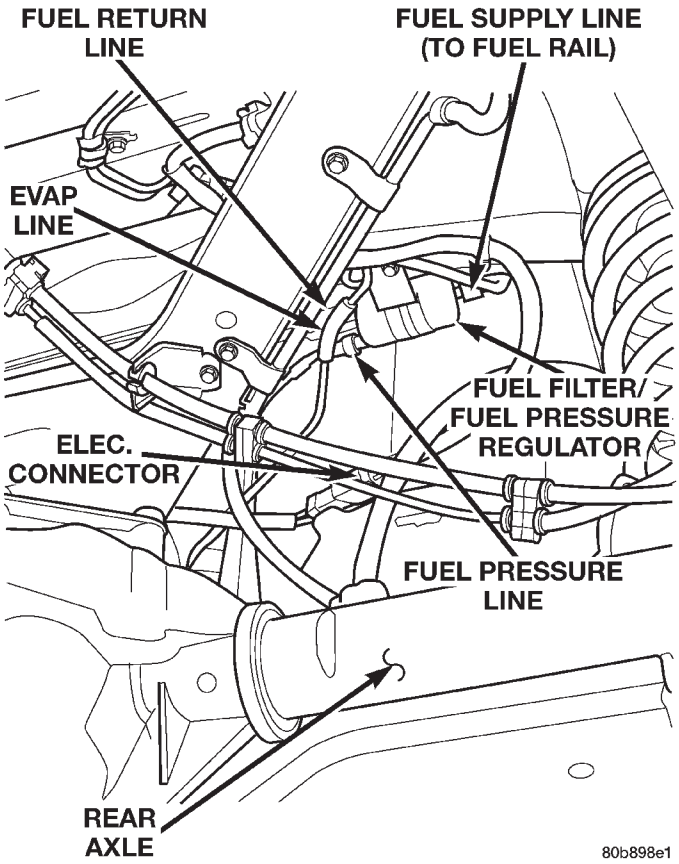


Fig. 10 Fuel Filter/Fuel Pressure Regulator Location

(b) If line is not kinked and pressure is low, raise vehicle and disconnect fuel pressure line at fuel filter/fuel pressure regulator (Fig. 10).

(c) Install Special 5/16" Fuel Line Adapter Tool # 6539 between disconnected fuel line and filter/regulator fitting

(d) Attach 0–60 psi fuel pressure test gauge to "T" fitting on tool 6539.

(e) Use DRB scan tool to power fuel pump. If pressure is now within specifications, replace fuel filter/fuel pressure regulator.

(f) If pressure is still low, replace fuel pump module.

(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.

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

FUEL PUMP CAPACITY TEST

Before performing this test, verify fuel pump pressure. Refer to Fuel Pump Pressure Test. Use this test in conjunction with the Fuel Pressure Leak Down Test.

(1) Release fuel system pressure. Refer to Fuel Pressure Release Procedure.

DIAGNOSIS AND TESTING (Continued)

(2) Disconnect fuel supply line at fuel rail. Refer to Quick-Connect Fittings. Some engines may require air cleaner housing removal before line disconnection.

(3) Obtain correct Fuel Line Pressure Test Adapter Tool Hose. Tool number 6539 is used for 5/16" fuel lines and tool number 6631 is used for 3/8" fuel lines.

(4) Connect correct Fuel Line Pressure Test Adapter Tool Hose into disconnected fuel supply line. Insert other end of Adaptor Tool Hose into a graduated container.

(5) Remove fuel fill cap.

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

(7) 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 supply 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) Obtain correct Fuel Line Pressure Test Adapter Tool Hose. Tool number 6539 is used for 5/16" fuel lines and tool number 6631 is used for 3/8" fuel lines.

(3) Connect correct Fuel Line Pressure Test Adapter Tool Hose between disconnected fuel line and fuel rail (Fig. 11).

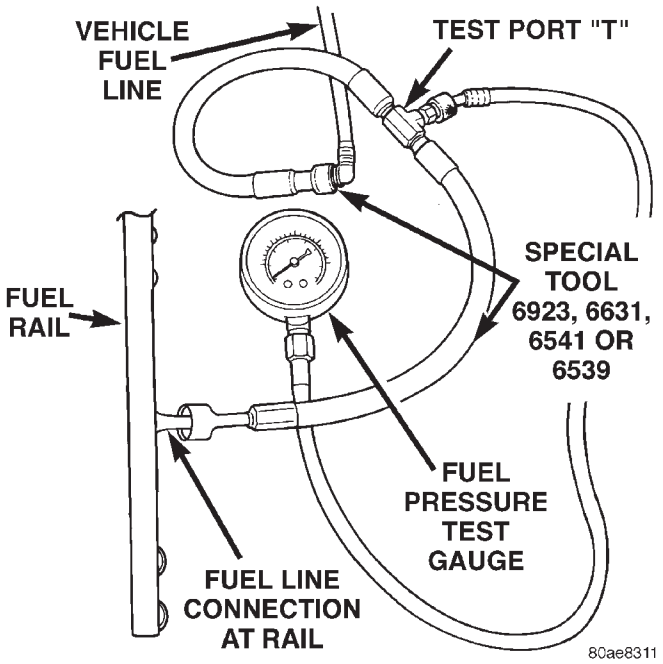


Fig. 11 Connecting Adapter Tool—Typical

(4) 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.**

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

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

(7) Shut engine off.

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

(9) 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.

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

(11) Shut engine off.

(12) **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

DIAGNOSIS AND TESTING (Continued)

Adapter Tool. If pressure now holds at or above 30 psi, a fuel injector or the fuel rail is leaking.

(13) **Testing for fuel pump check valve, filter/ regulator check valve or fuel tube/line leakage:** Clamp off the rubber hose portion of Adaptor Tool between the vehicle fuel line and test port "T" on Adapter Tool. If pressure now holds at or above 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. 12) and its test leads will be used to check fuel pump amperage specifications.

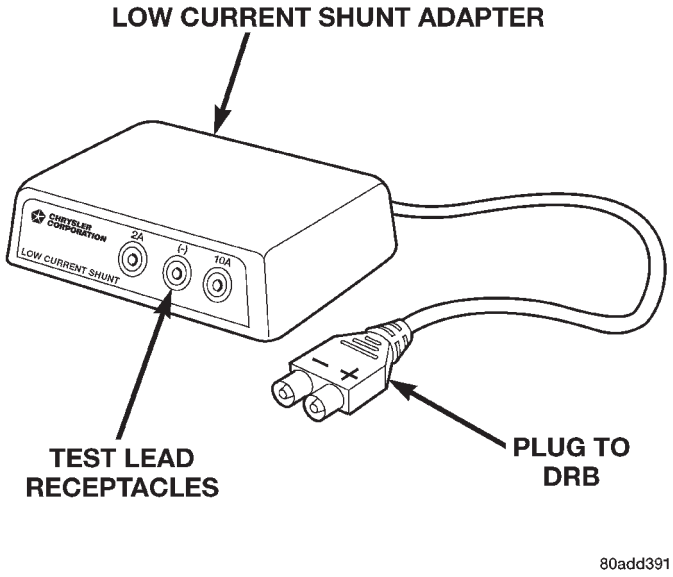


Fig. 12 Low Current Shunt Adapter

(1) Be sure fuel tank contains fuel before starting test. If tank is empty or near empty, amperage readings will be incorrect.

(2) Obtain LCS adapter.

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

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

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

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

(7) Press DVOM button on DRB.

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

(9) Press ENTER three times.

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

(11) 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).**

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

(13) 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.

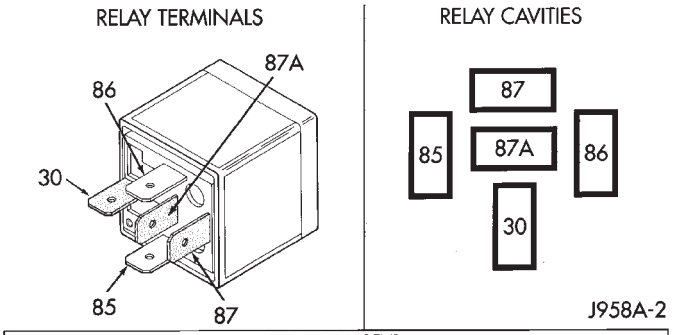
Depending upon vehicle model, year or engine configuration, three different types of relays may be used: Type-1, type-2 and type–3.

(14) If equipped with **type–1 relay** (Fig. 13), 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. 13).

(15) If equipped with **type–2 relay** (Fig. 14), 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. 14).

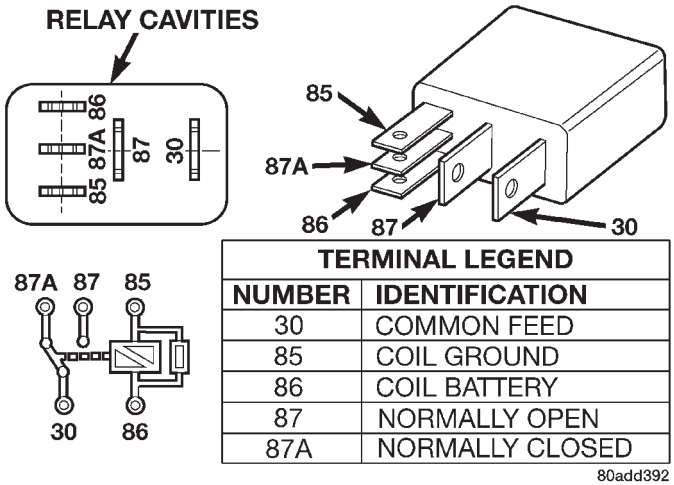
(16) If equipped with **type–3 relay** (Fig. 15), attach test leads from LCS adapter into PDC relay cavities number 3 and 5. For location of these cavities, refer to numbers stamped to bottom of relay (Fig. 15).

DIAGNOSIS AND TESTING (Continued)



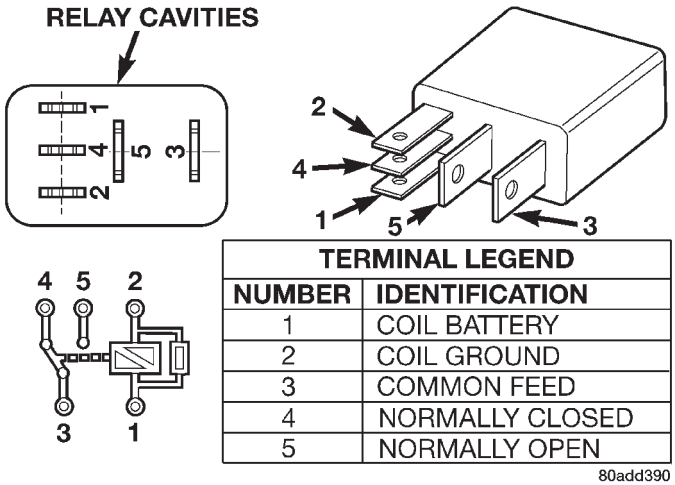
TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Fig. 13 Type–1 Relay



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

Fig. 14 Type–2 Relay



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

Fig. 15 Type–3 Relay

(17) 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.

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

(19) 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 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 (+/- 5%). With float in down position, resistance should be 270 ohms (+/- 5%).

FUEL INJECTOR TEST

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

Disconnect the fuel injector wire harness connector from the injector. The injector is equipped with 2 electrical terminals (pins). Place an ohmmeter across the terminals. Resistance reading should be approximately 12 ohms ±1.2 ohms at 20°C (68°F).

SERVICE PROCEDURES

FUEL SYSTEM PRESSURE RELEASE PROCEDURE

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

(1) Remove fuel fill cap.

(2) The fuel filler tube contains a spring-loaded flap (door) located below fuel fill cap. The flap is used as a secondary way of sealing fuel tank if fuel fill cap has not been properly tightened. It is part of EVAP monitor system when vehicle is equipped with a Leak Detection Pump (LDP). **The vehicle may be equipped with flap installed into fuel filler tube even though vehicle is not equipped with LDP and EVAP monitor system.** Place a nonmetallic object into fuel fill tube and press on flap to relieve any tank pressure.

(3) Remove Fuel Pump relay from Power Distribution Center (PDC). For location of relay, refer to label on underside of PDC cover.

SERVICE PROCEDURES (Continued)

(4) Start and run engine until it stalls.
(5) Attempt restarting engine until it will no longer run.
(6) Turn ignition key to OFF position.

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

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

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

(11) Momentarily touch other end of jumper wire to negative terminal of battery for no more than a few seconds.
(12) Place a rag or towel below fuel line quick-connect fitting at fuel rail.
(13) Disconnect quick-connect fitting at fuel rail. Refer to Quick-Connect Fittings.
(14) Return fuel pump relay to PDC.
(15) One or more Diagnostic Trouble Codes (DTC's) may have been stored in PCM memory due to fuel pump relay removal. The DRB scan tool must be used to erase a DTC.

FUEL TUBES/LINES/HOSES AND CLAMPS

OPERATION

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

Different types of quick-connect fittings are used to attach various fuel system components, lines and tubes. These are: a single-tab type, a two-tab type or a plastic retainer ring type. Safety latch clips are used on certain components/lines. Certain fittings may require use of a special tool for disconnection.

DISCONNECTING

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSE, FITTING OR LINE, FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO FUEL SYSTEM PRESSURE RELEASE PROCEDURE.

CAUTION: The interior components (o-rings, spacers) of some types of quick-connect fitting are not serviced separately. If service parts are not available, do not attempt to repair a damaged fitting or fuel line. If repair is necessary, replace complete fuel line assembly.

(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) **Single-Tab Type Fitting:** This type of fitting is equipped with a single pull tab (Fig. 16). The tab is removable. After tab is removed, quick-connect fitting can be separated from fuel system component.
(a) Press release tab on side of fitting to release pull tab (Fig. 17). **If release tab is not pressed**

SERVICE PROCEDURES (Continued)

prior to releasing pull tab, pull tab will be damaged.

(b) While pressing release tab on side of fitting, use screwdriver to pry up pull tab (Fig. 17).

(c) Raise pull tab until it separates from quick-connect fitting (Fig. 18).

(5) **Two-Tab Type Fitting:** This type of fitting is equipped with tabs located on both sides of fitting (Fig. 19). The tabs are supplied for disconnecting quick-connect fitting from component being serviced.

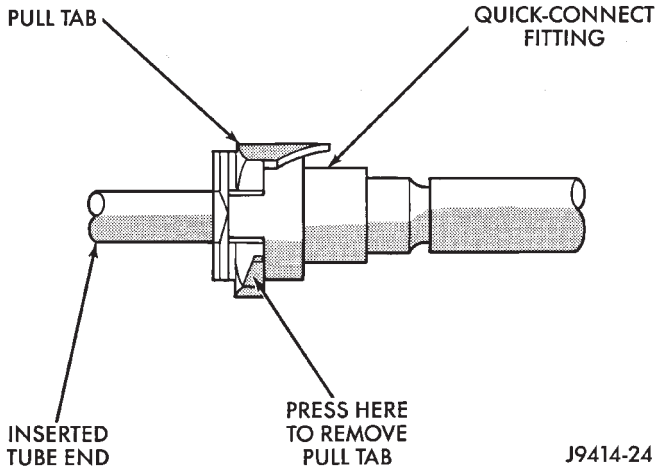


Fig. 16 Single-Tab Type Fitting

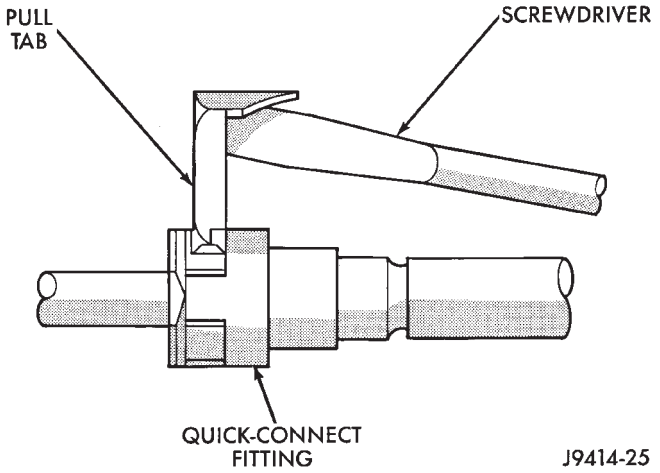


Fig. 17 Disconnecting Single-Tab Type Fitting

(a) To disconnect quick-connect fitting, squeeze plastic retainer tabs (Fig. 19) against sides of quick-connect fitting with your fingers. Tool use is not required for removal and may damage plastic retainer.

(b) Pull fitting from fuel system component being serviced.

(c) 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.

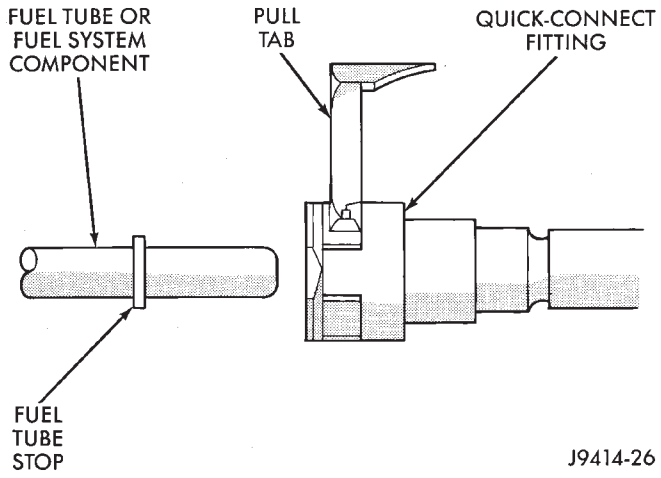


Fig. 18 Removing Pull Tab

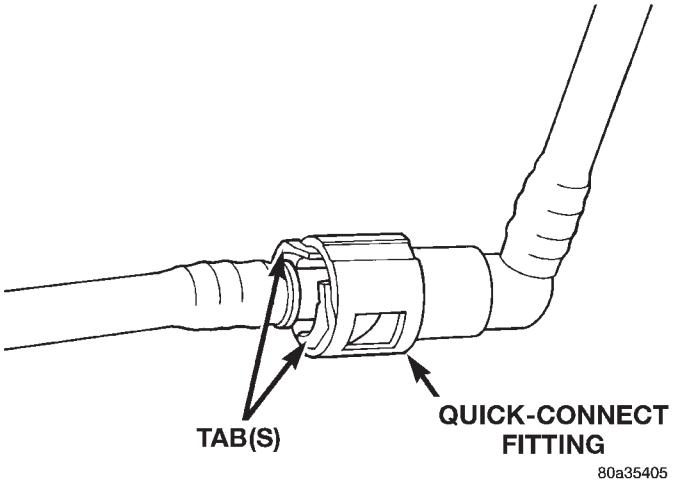


Fig. 19 Typical Two-Tab Type Quick-Connect Fitting

(6) **Plastic Retainer Ring Type Fitting:** This type of fitting can be identified by the use of a full-round plastic retainer ring (Fig. 20) usually black in color.

(a) 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. 20). 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.**

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

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

(7) **Latch Clips:** Depending on vehicle model and engine, 2 different types of safety latch clips are used

SERVICE PROCEDURES (Continued)

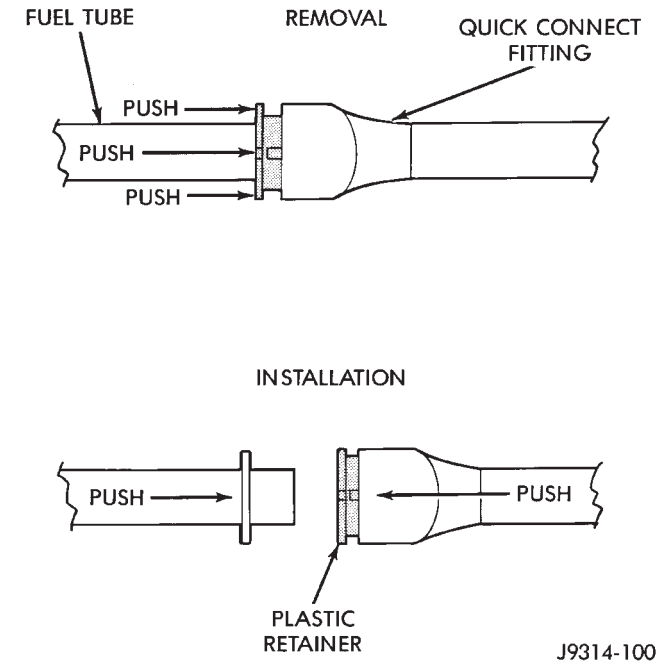


Fig. 20 Plastic Retainer Ring Type Fitting

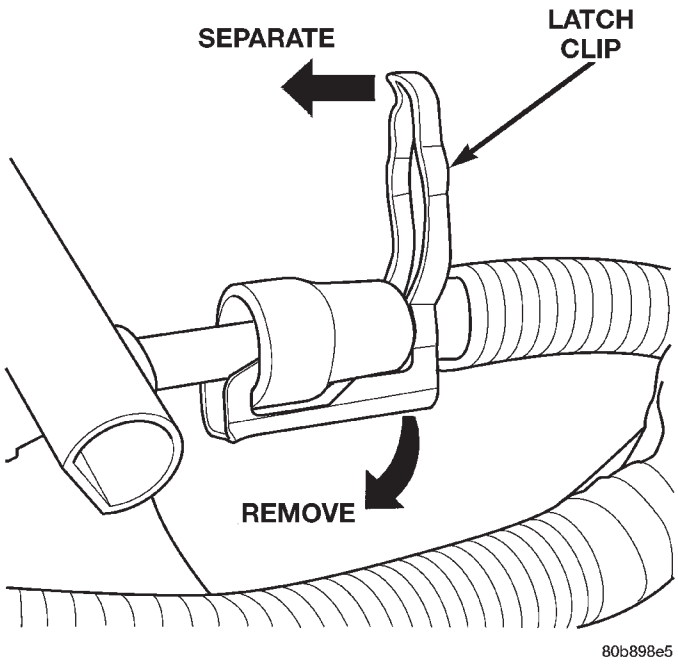


Fig. 22 Latch Clip—Type 2

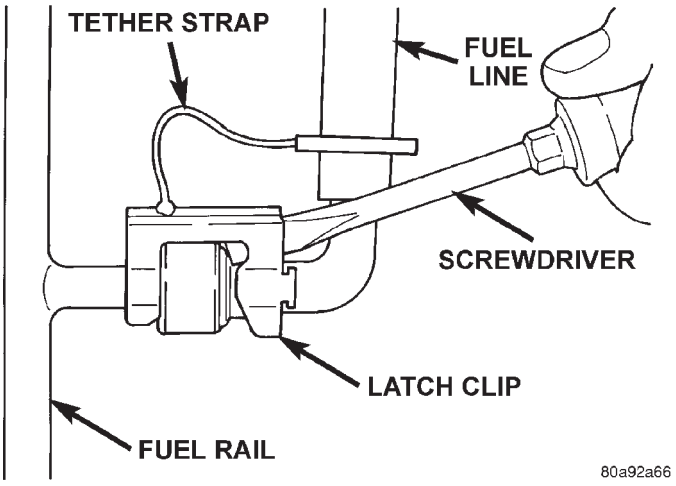


Fig. 21 Latch Clip—Type 1

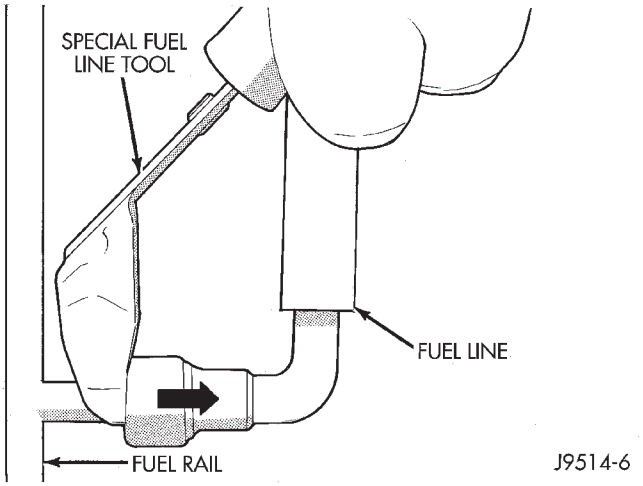


Fig. 23 Fuel Line Disconnection Using Special Tool

(Fig. 21) or (Fig. 22). Type-1 is tethered to fuel line and type-2 is not. A special tool will be necessary to disconnect fuel line after latch clip is removed. The latch clip may be used on certain fuel line/fuel rail connection, or to join fuel lines together.

(a) Type 1: Pry up on latch clip with a screwdriver (Fig. 21).

(b) Type 2: Separate and unlatch 2 small arms on end of clip (Fig. 22) and swing away from fuel line.

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

(d) Insert special fuel line removal tool (Snap-On number FIH 9055-1 or equivalent) into fuel line (Fig. 23). Use tool to release locking fingers in end of line.

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

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

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

CONNECTING

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

(2) 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.

SERVICE PROCEDURES (Continued)

(3) 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.
(4) Continue pushing until a click is felt.
(5) Single-tab type fitting: Push new tab down until it locks into place in quick-connect fitting.
(6) Verify a locked condition by firmly pulling on fuel tube and fitting (15-30 lbs.).
(7) Latch Clip Equipped: Install latch clip (snaps into position). **If latch clip will not fit, this indicates fuel line is not properly installed to fuel rail (or other fuel line). Recheck fuel line connection.**
(8) Connect negative cable to battery.
(9) Start engine and check for leaks.

REMOVAL AND INSTALLATION

FUEL FILTER/FUEL PRESSURE REGULATOR

The combination Fuel Filter/Fuel Pressure Regulator is remotely mounted to the vehicle body near the front of the fuel tank (Fig. 24).

REMOVAL

(1) Perform Fuel System Pressure Release Procedure.
(2) Disconnect negative battery cable at battery.
(3) Raise vehicle.
(4) Clean area around 3 filter/regulator fittings.
(5) Disconnect fuel supply, fuel return and fuel pressure lines at filter/regulator (Fig. 24). Refer to Quick-Connect Fittings.
(6) Remove 2 mounting bolts (Fig. 25) and remove filter/regulator.

INSTALLATION

(1) Before installing filter/regulator, be sure all fittings are cleaned of all dirt and contaminants.
(2) Be sure o-ring is positioned into fuel return fitting in filter/regulator.
(3) Apply a small amount of clean engine oil to o-rings.
(4) Position filter/regulator to body and install 2 bolts. Tighten bolts to 3 N·m (30 in. lbs.) torque.
(5) Connect 3 fittings. Refer to Quick-Connect Fittings.
(6) Connect negative battery cable to battery.
(7) Start engine and check for leaks.

FUEL PUMP MODULE

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

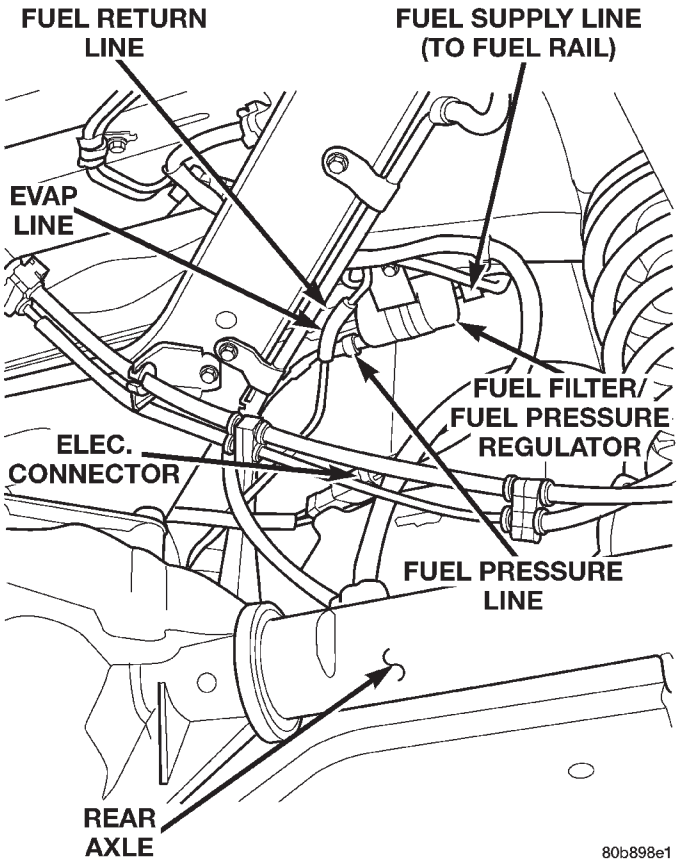


Fig. 24 Fuel Filter/Fuel Pressure Regulator Location

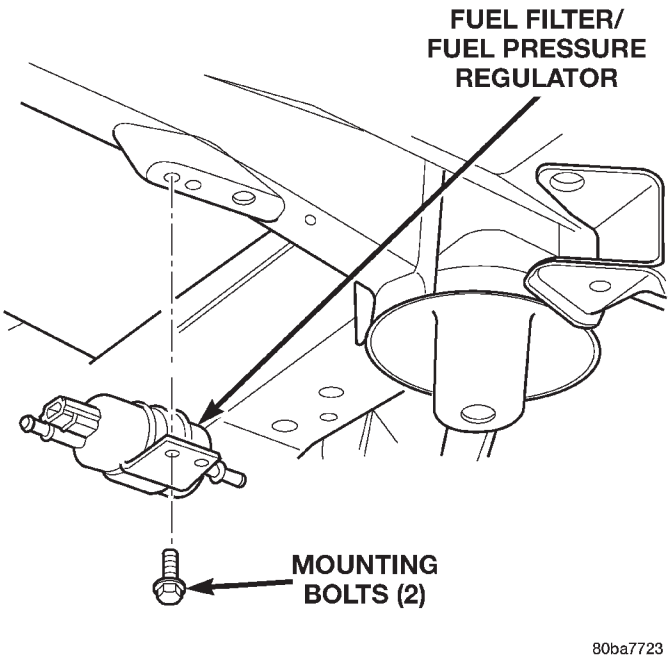


Fig. 25 Fuel Filter/Fuel Pressure Regulator Removal/Installation

REMOVAL AND INSTALLATION (Continued)

REMOVAL

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

(1) Perform Fuel System Pressure Release Procedure.
(2) Drain fuel tank and remove tank. Refer to Fuel Tank Removal/Installation.
(3) Thoroughly wash and clean area around pump module to prevent contaminants from entering tank.
(4) Disconnect fuel return and pressure lines from fuel pump module fittings (Fig. 26). Refer to Quick-Connect Fittings for procedures.
(5) The plastic fuel pump module locknut is threaded onto fuel tank (Fig. 26). Install Special Tool 6856 to fuel pump module locknut and remove locknut (Fig. 27). The fuel pump module will spring up slightly after locknut is removed.
(6) Remove module from fuel tank.

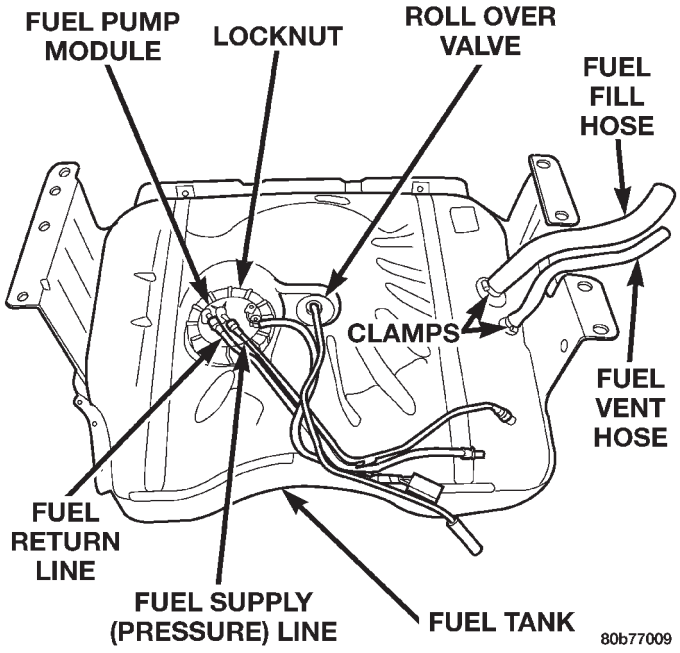


Fig. 26 Top View of Fuel Tank and Fuel Pump Module

INSTALLATION

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

(1) Thoroughly clean locknut threads and mating fuel tank threads. Use a soap/water solution. Do not use carburetor cleaner to clean threads.
(2) Using new gasket, position fuel pump module into opening in fuel tank.

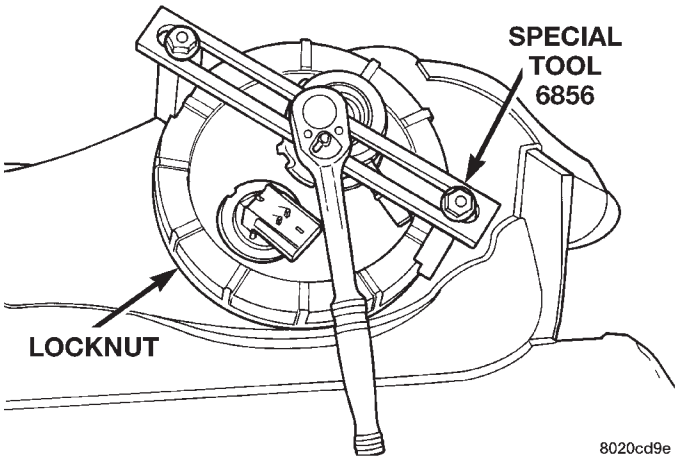


Fig. 27 Locknut Removal/Installation—TYPICAL

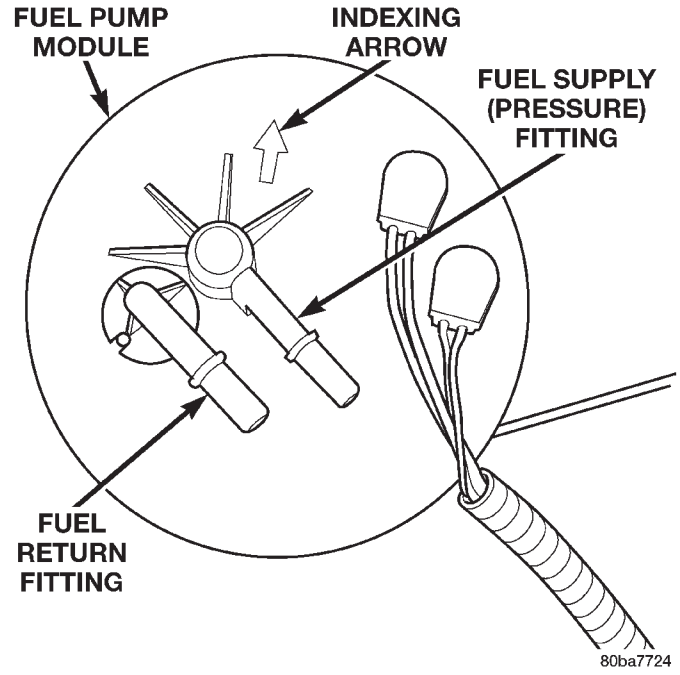


Fig. 28 Fuel Pump Module Indexing Arrow

(3) Apply clean water to locknut threads.
(4) Position locknut over top of fuel pump module.
(5) Rotate module until indexing arrow at top of module (Fig. 28) is pointed toward rear of vehicle. Align arrow to tick mark on top of fuel tank. **This step must be done to prevent float/float rod assembly from contacting sides of fuel tank.**
(6) Install Special Tool 6856 to locknut.
(7) Tighten locknut to 74 N·m (55 ft. lbs.) torque.
(8) Connect fuel return and pressure lines to fuel pump module fittings (Fig. 26). Refer to Quick-Connect Fittings.
(9) Install fuel tank. Refer to Fuel Tank Installation.

REMOVAL AND INSTALLATION (Continued)

FUEL PUMP INLET FILTER

The fuel pump inlet filter (strainer) is located on the bottom of fuel pump module (Fig. 29). The fuel pump module is located on top of fuel tank.

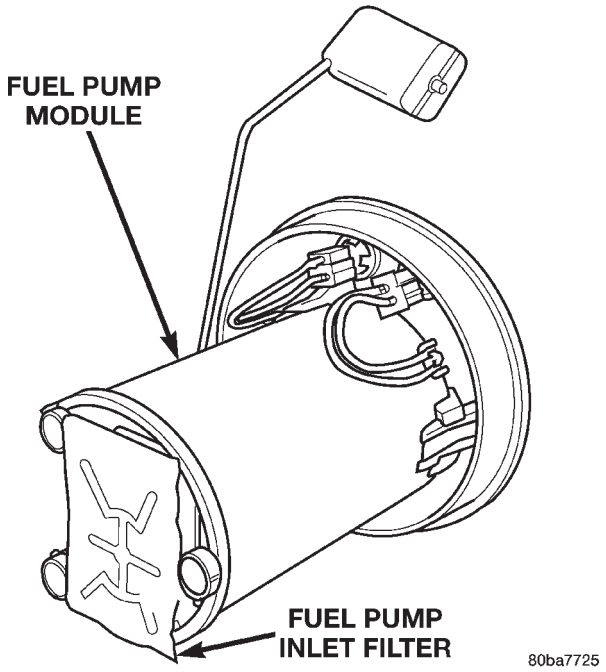


Fig. 29 Fuel Pump Inlet Filter

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. 30). The fuel pump module is located within the fuel tank.

REMOVAL

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

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

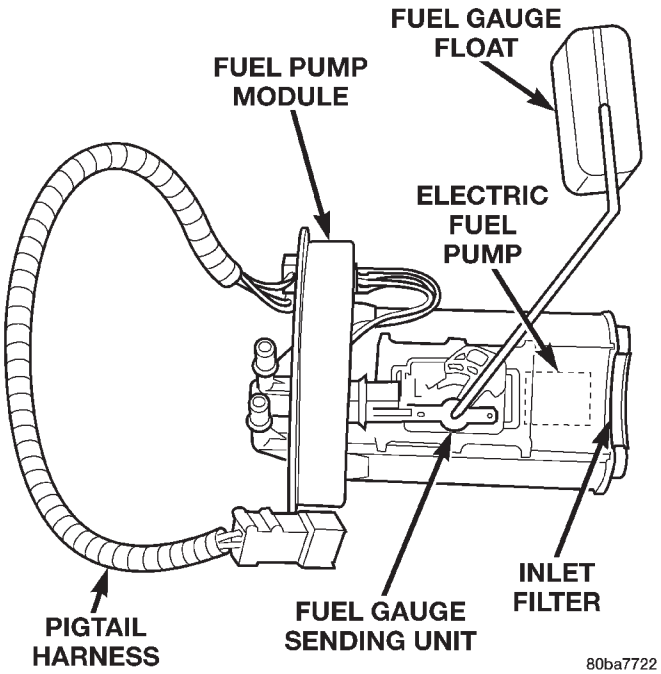


Fig. 30 Fuel Gauge Sending Unit Location

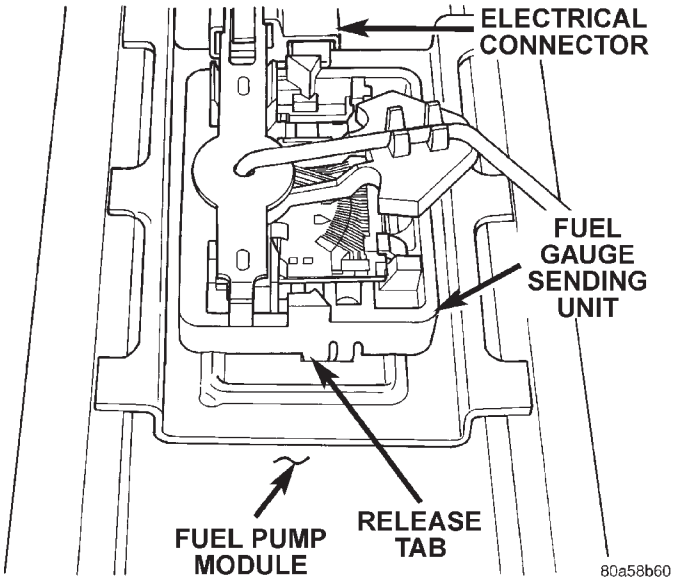


Fig. 31 Fuel Gauge Sending Unit Release Tab

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

(4) Press upward on release tab (Fig. 31) to remove sending unit from pump module.

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.

REMOVAL AND INSTALLATION (Continued)

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.
(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) Disconnect electrical connectors at all 6 fuel injectors. To remove connector refer to (Fig. 33). Push red colored slider away from injector (1). While pushing slider, depress tab (2) and remove connector (3) from injector. The factory fuel injection wiring harness is numerically tagged (INJ 1, INJ 2, etc.) for injector position identification. If harness is not tagged, note wiring location before removal.

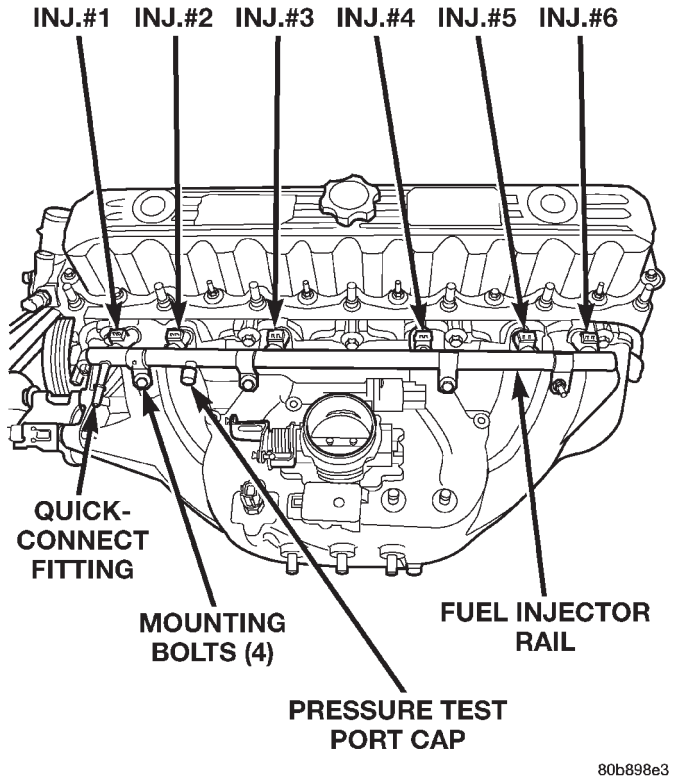


Fig. 32 Fuel Rail Mounting—4.0L Engine

(6) Remove oxygen sensor wiring clip nuts at fuel rail mounting studs (certain emissions packages only).

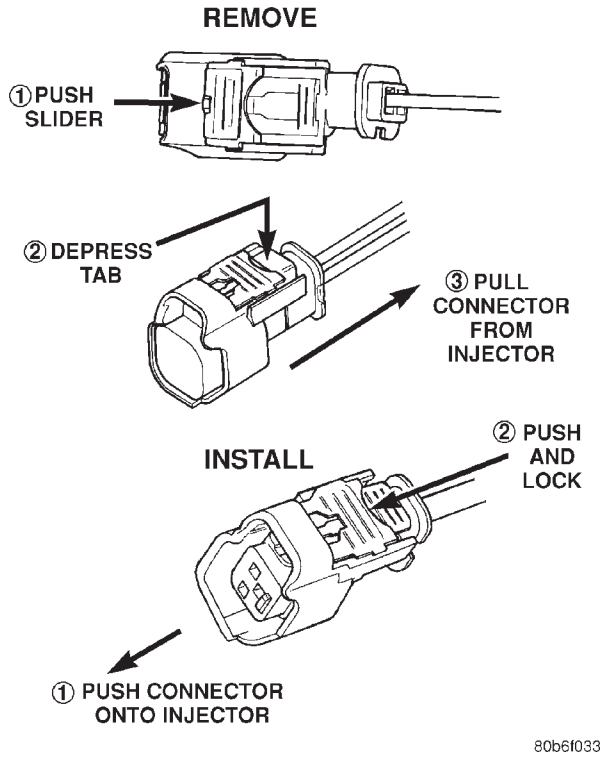


Fig. 33 Remove/Install Injector Connector—4.0L Engine

(7) Disconnect fuel supply line latch clip and fuel line at fuel rail. Refer to Quick-Connect Fittings.
(8) Disconnect throttle cable at throttle body. Refer to Throttle Cable Removal/Installation.
(9) Disconnect speed control cable at throttle body (if equipped). Refer to Speed Control Cable.
(10) Disconnect automatic transmission cable at throttle body (if equipped).
(11) Remove cable routing bracket at intake manifold.
(12) Clean dirt/debris from each fuel injector at intake manifold.
(13) Remove fuel rail mounting nuts/bolts (Fig. 32).
(14) Remove fuel rail by gently rocking until all fuel injectors have cleared machined holes at intake manifold.
(15) If fuel injectors are to be removed, refer to Fuel Injector Removal/Installation.

INSTALLATION

(1) If fuel injectors are to be installed, refer to Fuel Injector Removal/Installation.
(2) Clean each injector bore at intake manifold.
(3) Apply a small amount of clean engine oil to each injector o-ring. This will aid in installation.

REMOVAL AND INSTALLATION (Continued)

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

(5) Install and tighten fuel rail mounting bolts to 11 ±3 N·m (100 ±25 in. lbs.) torque.

(6) Connect electrical connectors at all fuel injectors. To install connector, refer to (Fig. 33). Push connector onto injector (1) and then push and lock red colored slider (2). Verify connector is locked to injector by lightly tugging on connector.

(7) Connect fuel line and fuel line latch clip to fuel rail. Refer Quick-Connect Fittings.

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

(9) Install cable routing bracket to intake manifold.

(10) Connect throttle cable at throttle body.

(11) Connect speed control cable at throttle body (if equipped).

(12) Connect automatic transmission cable at throttle body (if equipped).

(13) Install oxygen sensor wiring clip nuts to fuel rail mounting studs (certain emissions packages only).

(14) Install air tube (or duct) at top of throttle body.

(15) Install fuel tank cap.

(16) Connect negative battery cable to battery.

(17) Start engine and check for fuel leaks.

FUEL INJECTOR RAIL—4.7L V–8 ENGINE

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

CAUTION: The left and right fuel rails are replaced as an assembly. Do not attempt to separate rail halves at connector tube (Fig. 34). Due to design of tube, it does not use any clamps. Never attempt to install a clamping device of any kind to tube. When removing fuel rail assembly for any reason, be careful not to bend or kink tube.

REMOVAL

(1) Remove fuel tank filler tube cap.

(2) Perform Fuel System Pressure Release Procedure.

(3) Remove negative battery cable at battery.

(4) Remove air duct at throttle body air box.

(5) Remove air box at throttle body.

(6) Remove wiring at rear of generator.

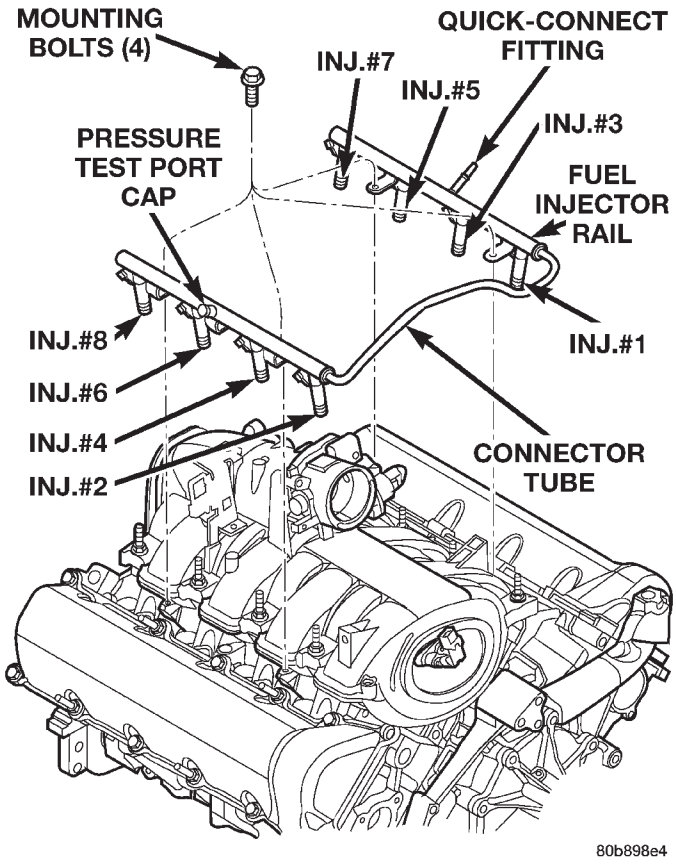


Fig. 34 Fuel Rail Mounting—4.7L V-8 Engine

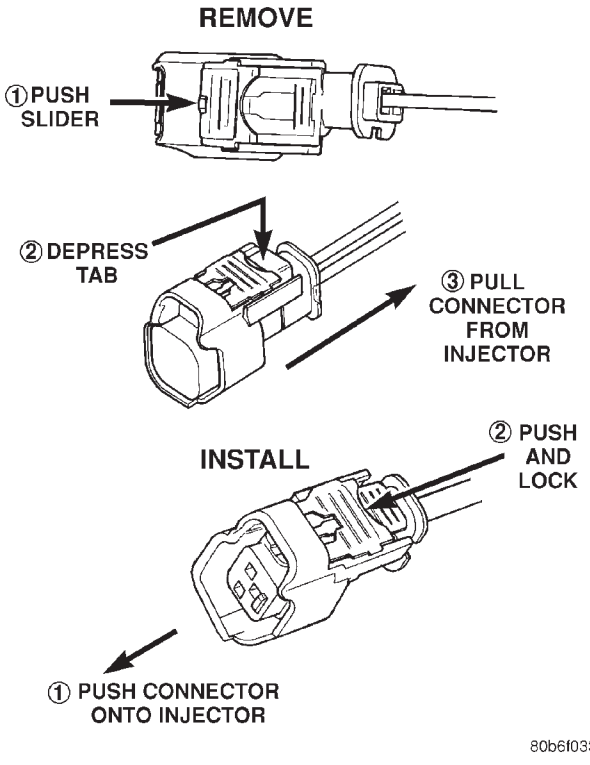


Fig. 35 Remove/Install Injector Connector—4.7L V-8 Engine

REMOVAL AND INSTALLATION (Continued)

(7) Disconnect fuel line latch clip and fuel line at fuel rail. A special tool will be necessary for fuel line disconnection. Refer to Quick-Connect Fittings.

(8) Remove vacuum lines at throttle body.

(9) Disconnect electrical connectors at all 8 fuel injectors. To remove connector refer to (Fig. 35). Push red colored slider away from injector (1). While pushing slider, depress tab (2) and remove connector (3) from injector. The factory fuel injection wiring harness is numerically tagged (INJ 1, INJ 2, etc.) for injector position identification. If harness is not tagged, note wiring location before removal.

(10) Disconnect electrical connectors at throttle body.

(11) Disconnect electrical connectors at MAP and IAT sensors.

(12) Remove first three ignition coils on each bank (cylinders #1, 3, 5, 2, 4 and 6). Refer to Ignition Coil Removal/Installation.

(13) Remove 4 fuel rail mounting bolts (Fig. 34).

(14) Gently rock and pull **left** side of fuel rail until fuel injectors just start to clear machined holes in cylinder head. Gently rock and pull **right** side of rail until injectors just start to clear cylinder head holes. Repeat this procedure (left/right) until all injectors have cleared cylinder head holes.

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

(16) If fuel injectors are to be removed, refer to Fuel Injector Removal/Installation.

INSTALLATION

(1) If fuel injectors are to be installed, refer to Fuel Injector Removal/Installation.

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

(3) Position fuel rail/fuel injector assembly to machined injector openings in cylinder head.

(4) Guide each injector into cylinder head. Be careful not to tear injector o-rings.

(5) Push **right** side of fuel rail down until fuel injectors have bottomed on cylinder head shoulder. Push **left** fuel rail down until injectors have bottomed on cylinder head shoulder.

(6) Install 4 fuel rail mounting bolts and tighten to 27 N·m (20 ft. lbs.).

(7) Install ignition coils. Refer to Ignition Coil Removal/Installation.

(8) Connect electrical connectors to throttle body.

(9) Connect electrical connectors to MAP and IAT sensors.

(10) Connect electrical connectors at all fuel injectors. To install connector, refer to (Fig. 35). Push connector onto injector (1) and then push and lock red colored slider (2). Verify connector is locked to injector by lightly tugging on connector.

(11) Connect vacuum lines to throttle body.

(12) Connect fuel line latch clip and fuel line to fuel rail. Refer to Quick-Connect Fittings.

(13) Connect wiring to rear of generator.

(14) Install air box to throttle body.

(15) Install air duct to air box.

(16) Connect battery cable to battery.

(17) Start engine and check for leaks.

FUEL INJECTORS

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

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

REMOVAL

(1) Perform Fuel System Pressure Release Procedure.

(2) Remove fuel injector rail. Refer to Fuel Injector Rail Removal/Installation.

(3) Remove clip(s) retaining injector(s) to fuel rail (Fig. 36).

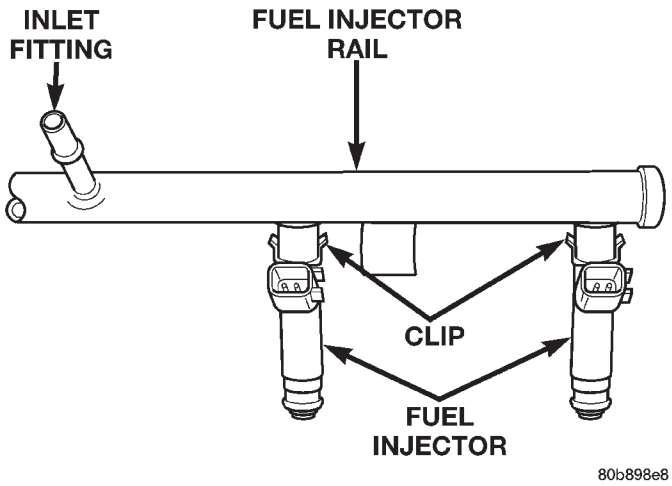


Fig. 36 Fuel Injector Mounting—Typical (4.7L V-8 Engine Shown)

(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 Removal/Installation.

(4) Start engine and check for leaks.

REMOVAL AND INSTALLATION (Continued)

FUEL TANK

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

Two different procedures may be used to drain fuel tank (through tank vent fitting or using DRB scan tool). The quickest is draining through tank vent fitting.

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 for procedures. Attach end of Special Adapter Hose Tool number 6539 at fuel rail disconnection. Position opposite end of 6539 to an approved gasoline draining station. Activate fuel pump with DRB and drain tank until empty.

If electric fuel pump is not operating, tank **MUST** be drained through vent fitting.

REMOVAL

(1) Release fuel system pressure. Refer to Fuel System Pressure Release Procedure.

(2) Disconnect negative battery cable at battery.

(3) Raise and support vehicle.

(4) Working from front of fuel tank, loosen clamp at fuel **vent** hose at fuel tank end of hose (Fig. 37). Remove hose at tank fitting.

(5) Obtain a length of 3/8” O.D. thinwall, clear tubing.

(6) Position 3/8” O.D. tubing into tank vent fitting. Attach 3/8” tubing to an approved gasoline draining station. Drain tank until empty.

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

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

(9) Remove fuel tank-to-rear bumper fascia clips (Fig. 38).

(10) Remove fuel tank heat shield mounting bolts (Fig. 39).

CAUTION: To protect fuel tank from exhaust heat, shield must re-installed after tank installation.

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

(11) Disconnect fuel return line at fuel filter/fuel pressure regulator (Fig. 40). Refer to Quick-Connect Fittings for procedures.

(12) Disconnect fuel pressure line at fuel filter/fuel pressure regulator (Fig. 40). Refer to Quick-Connect Fittings for procedures.

(13) Disconnect EVAP canister vent line near front of tank (Fig. 40).

(14) Disconnect fuel pump module electrical connector (pigtail harness) near front of tank (Fig. 40). Harness connector is clipped to body.

(15) Cut and discard tie strap supporting rear axle vent hose to tank vent hose (Fig. 41).

(16) Remove clamp on axle vent hose at rear axle.

(17) Remove vent hose from fitting at rear axle.

(18) Loosen fill and vent hose clamps at body (Fig. 41). Disconnect fill and vent hoses at filler tube assembly.

(19) Place hydraulic jack to bottom of fuel tank.

(20) Remove tank-to-frame mounting bolts (Fig. 42).

(21) Carefully lower tank until clear of vehicle. Place tank on floor.

(22) If necessary, remove two fuel tank strap nuts (Fig. 42).

(23) If fuel pump module removal is necessary, refer to Fuel Pump Module Removal/Installation.

(24) If hoses are to be removed at fuel tank end, note painted alignment (indexing) markings on hoses, and molded indexing tangs on tank before removal. Remove hoses.

(25) If necessary, remove fuel filler tube assembly mounting bolts (Fig. 43) and remove fuel filler tube.

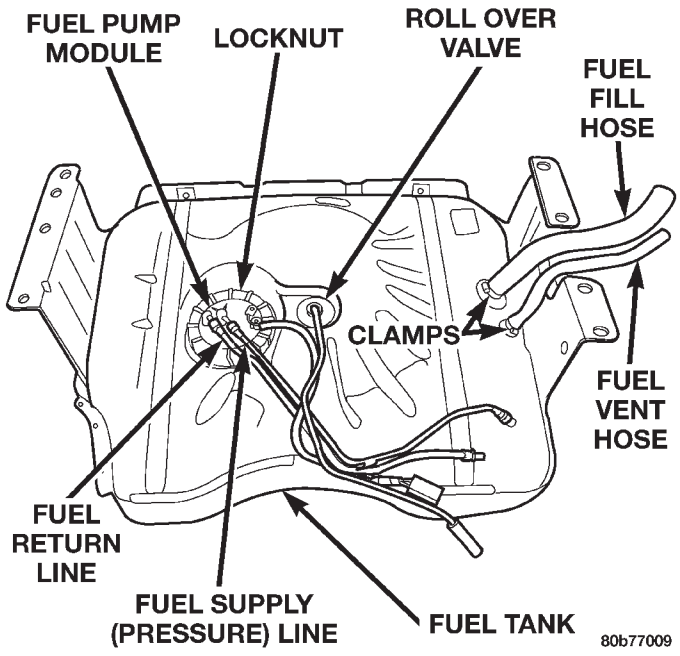


Fig. 37 Fuel Tank Assembly (Top View)

REMOVAL AND INSTALLATION (Continued)

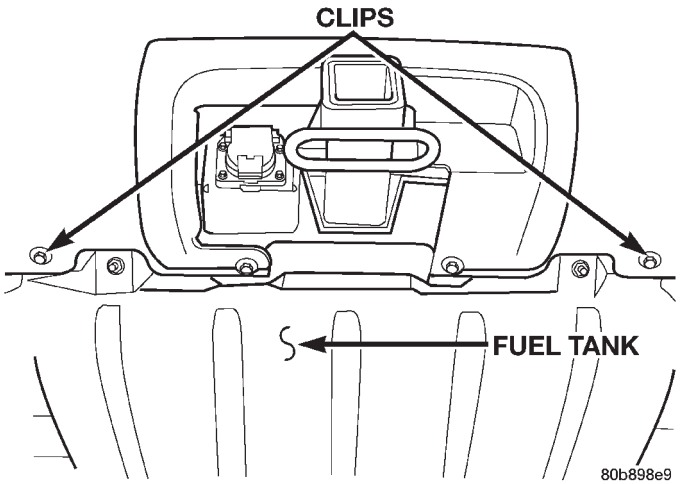


Fig. 38 Fuel Tank-to-Rear Bumper Fascia Clips

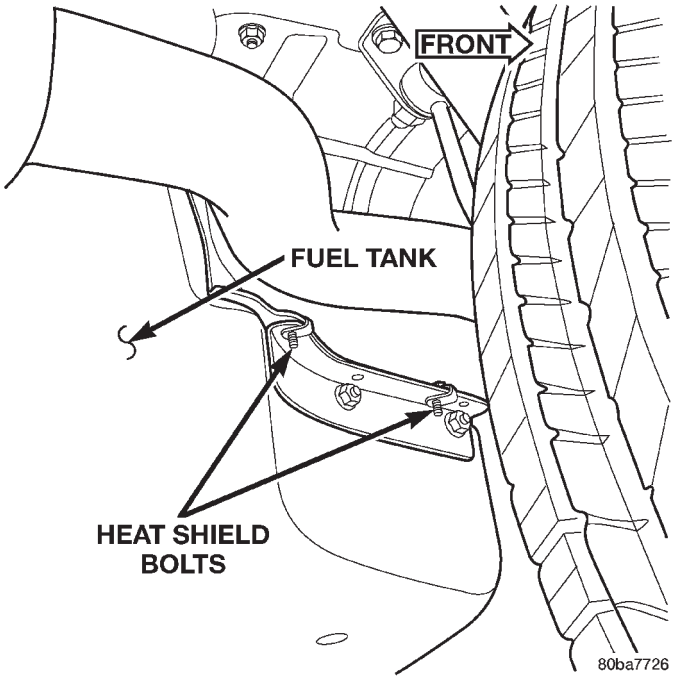


Fig. 39 Fuel Tank Heat Shield Bolts

INSTALLATION

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

(2) If necessary, position fuel filler tube assembly to body. Install bolts and tighten to 3 N·m (25 in. lbs.) torque.

(3) Install fuel fill/vent hoses to tank fittings. To prevent hoses from kinking, rotate each hose until painted indexing mark on hose is aligned to molded indexing tang on tank.

(4) Install hose clamps to hoses. Tighten clamp screws to 3 N·m (25 in. lbs.) torque.

(5) Position fuel tank to hydraulic jack.

(6) Raise tank into position.

(7) Install fuel tank mounting bolts. Tighten bolts to 81 N·m (60 ft. lbs.) torque.

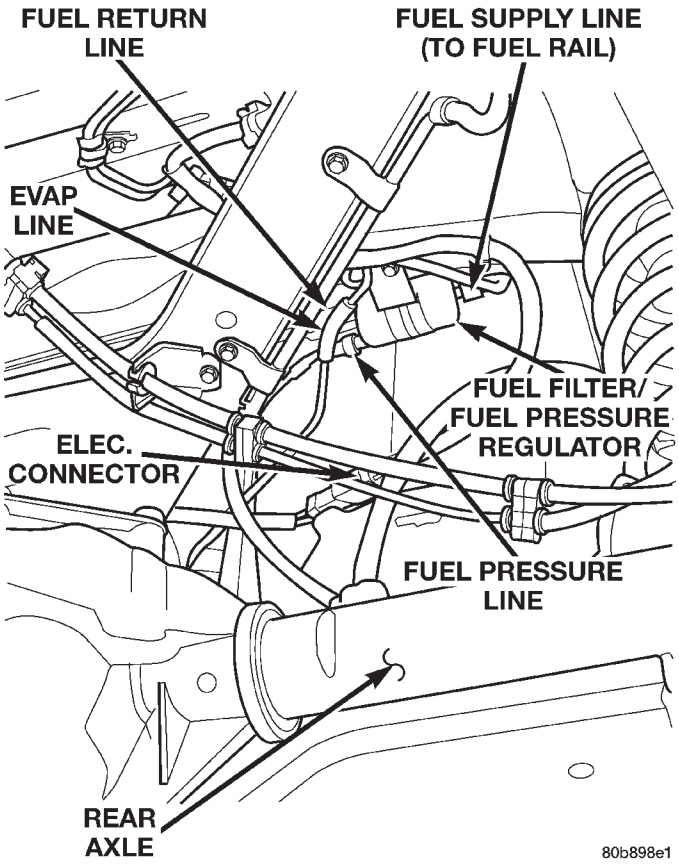


Fig. 40 Fuel Filter/Fuel Pressure Regulator

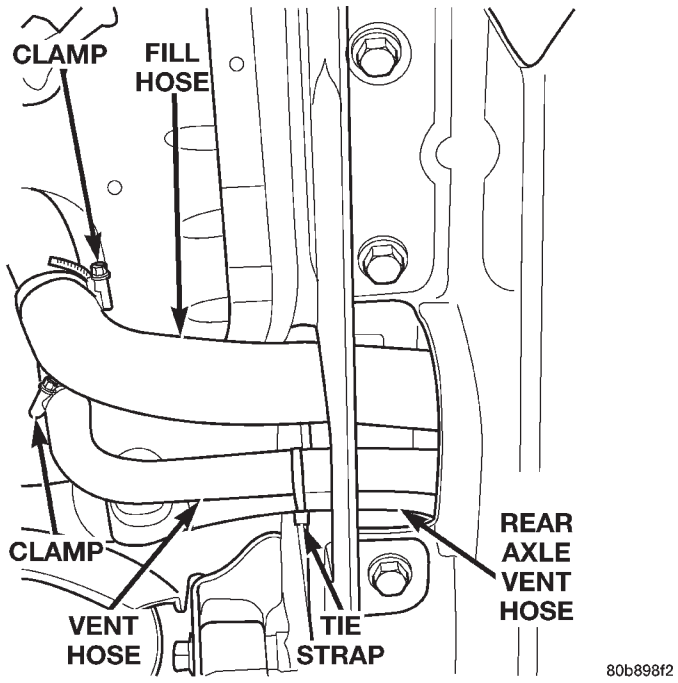


Fig. 41 Fill and Vent Hoses

REMOVAL AND INSTALLATION (Continued)

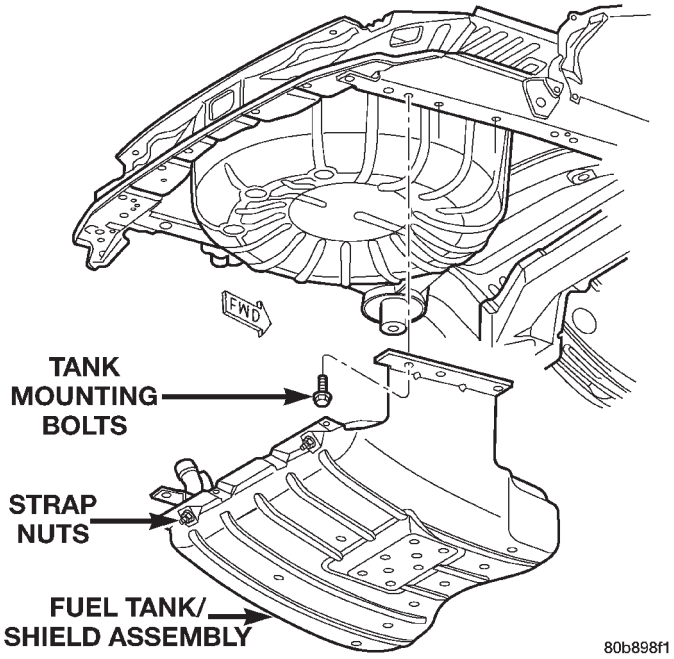


Fig. 42 Fuel Tank Mounting

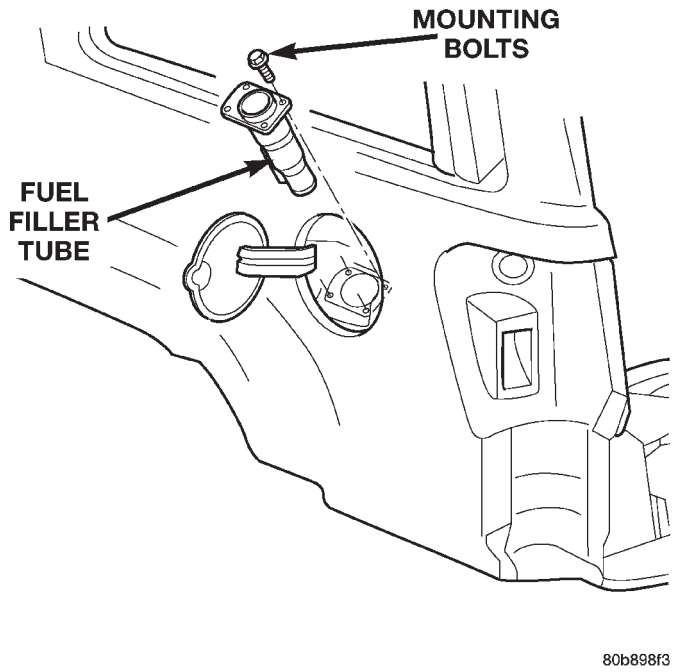


Fig. 43 Fuel Filler Tube

(8) Install fuel fill and vent hoses to fuel fill tube at body. Install clamps and tighten clamp screws to 3 N·m (25 in. lbs.) torque.

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

(10) Connect both fuel lines to fuel filter/fuel pressure regulator. Refer to Quick-Connect Fittings for procedures.

(11) Connect EVAP hose near front of tank.

(12) Position rear axle vent hose and install new tie strap.

(13) Install new clamp to rear axle vent hose.

(14) Install vent hose to fitting at rear axle and tighten clamp.

(15) Install heat shield bolts.

(16) Install trailer hitch (if equipped).

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

(18) Install fuel tank-to-rear bumper fascia clips.

(19) Lower vehicle and connect negative battery cable to battery.

(20) Check for leaks.

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. 44). This retainer (clip) snaps into the top of the accelerator pedal arm. A retainer clip (Fig. 44) is also used to fasten cable to dash panel.

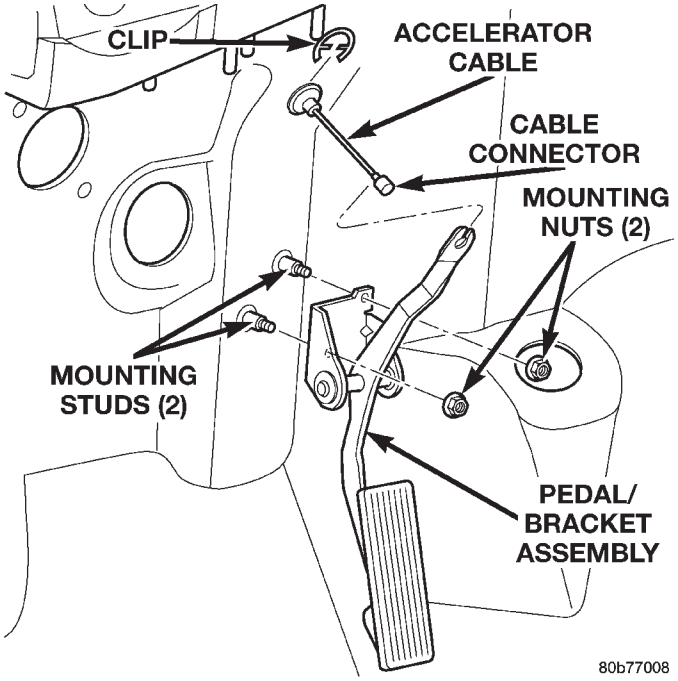


Fig. 44 Accelerator Pedal Mounting

REMOVAL AND INSTALLATION (Continued)

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 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—4.0L ENGINE

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 vehicle, hold up accelerator pedal. Remove plastic cable retainer (clip) and throttle cable core wire from upper end of pedal arm (Fig. 44). Plastic cable retainer (clip) snaps into pedal arm.

(2) Remove cable core wire at pedal arm.

(3) From inside vehicle, remove clip holding cable to dashpanel (Fig. 44).

(4) Remove cable housing from dash panel and pull into engine compartment.

(5) Remove (unsnap) cable from routing clips on engine valve cover.

(6) Remove cable connector at throttle body bellcrank ball by unsnapping rearward (Fig. 45).

(7) Remove throttle cable from bracket by compressing release tabs (Fig. 45) and pushing cable through hole in bracket.

(8) Remove throttle cable from vehicle.

INSTALLATION

(1) Slide throttle cable through hole in bracket until release tabs lock into bracket.

(2) Connect cable ball end to throttle body bellcrank ball (snaps on).

(3) Snap cable into routing clips on engine valve cover.

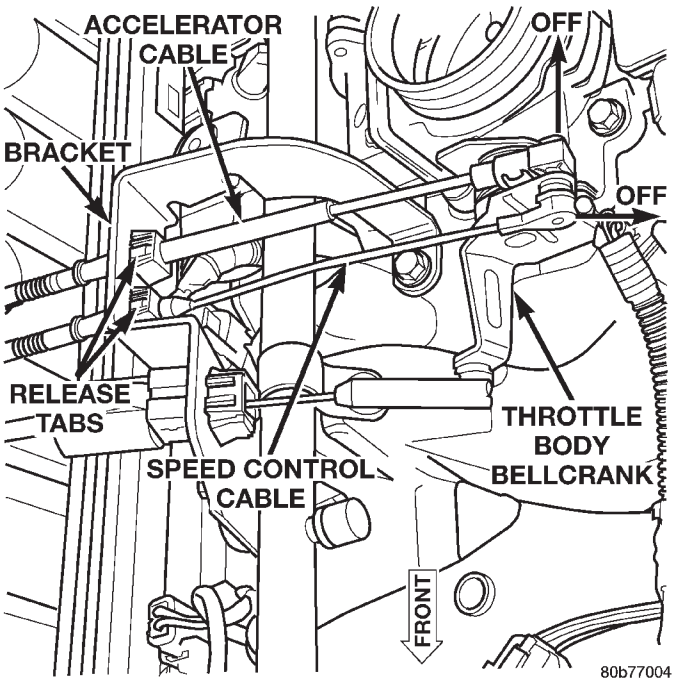


Fig. 45 Throttle (Accelerator) Cable at Throttle Body—4.0L Engine

(4) Slide rubber grommet away from plastic cable housing.

(5) Install rubber grommet into dash panel until seated.

(6) Push cable housing into rubber grommet and through opening in dash panel.

(7) From inside vehicle, install clip holding cable to dashpanel (Fig. 44).

(8) From inside vehicle, slide throttle cable core wire into opening in top of pedal arm.

(9) Push cable retainer (clip) into pedal arm opening until it snaps in place.

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

THROTTLE CABLE—4.7L V-8 ENGINE

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 vehicle, hold up accelerator pedal. Remove plastic cable retainer (clip) and throttle cable core wire from upper end of pedal arm (Fig. 44). Plastic cable retainer (clip) snaps into pedal arm.

(2) Remove cable core wire at pedal arm.

(3) From inside vehicle, remove clip holding cable to dashpanel (Fig. 44).

(4) Remove air box at throttle body.

(5) Unsnap cable from dashpanel routing clip.

REMOVAL AND INSTALLATION (Continued)

(6) Remove cable housing from dash panel and pull into engine compartment.

(7) Using finger pressure only, disconnect accelerator cable connector at throttle body bellcrank pin by pushing connector off bellcrank pin towards front of vehicle (Fig. 46). **DO NOT try to pull connector off perpendicular to the bellcrank pin. Connector will be broken.**

(8) Lift accelerator cable from top of cable cam (Fig. 46).

(9) Press tab (Fig. 47) to release plastic cable mount from bracket. **Press on tab only enough to release cable from bracket. If tab is pressed too much, it will be broken.** Slide plastic mount (Fig. 47) towards passenger side of vehicle to remove cable from bracket.

(10) Remove throttle cable from vehicle.

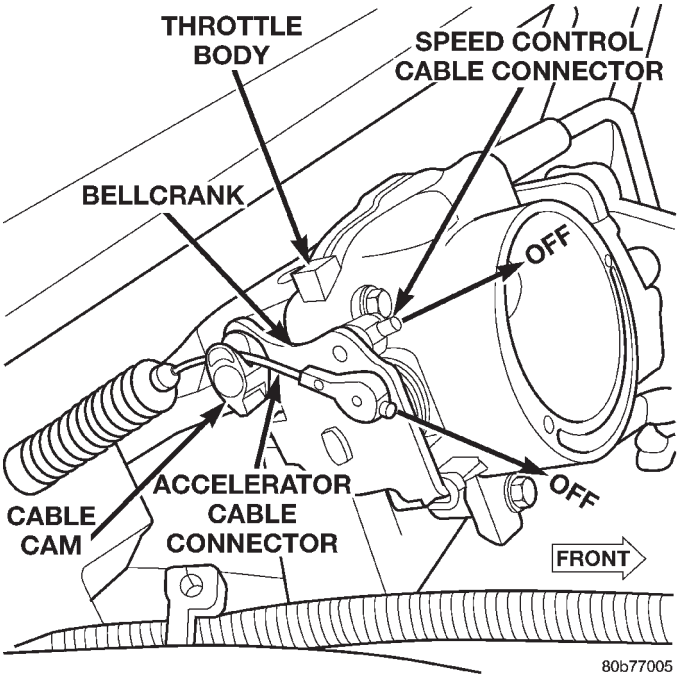


Fig. 46 Accelerator Cable at Bell Crank—4.7L V-8 Engine

INSTALLATION

(1) Slide accelerator cable plastic mount into bracket. Continue sliding until tab (Fig. 47) is aligned to hole in mounting bracket.

(2) Route accelerator cable over top of cable cam.

(3) Connect cable end to throttle body bellcrank pin (snaps on rearward).

(4) Slide rubber grommet away from plastic cable housing.

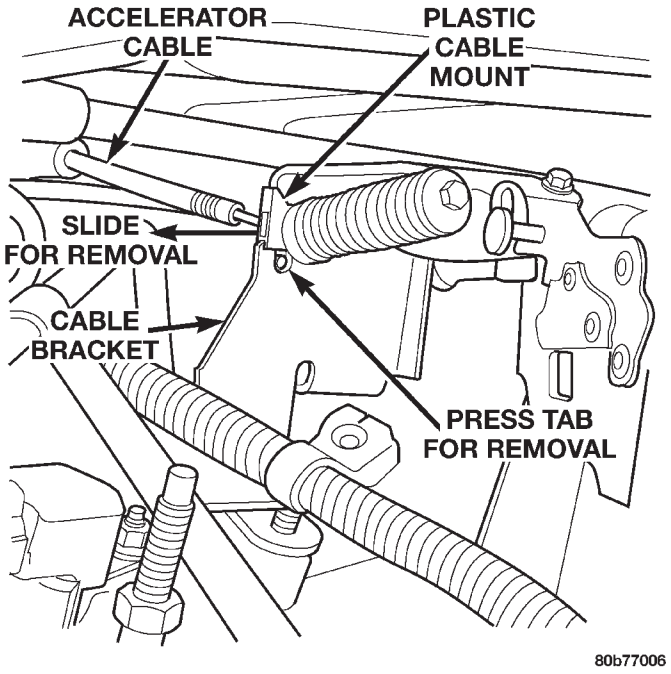


Fig. 47 Accelerator Cable Release Tab—4.7L V-8 Engine

(5) Install rubber grommet into dash panel until seated.

(6) Push cable housing into rubber grommet and through opening in dash panel.

(7) From inside vehicle, install clip holding cable to dashpanel (Fig. 44).

(8) From inside vehicle, slide throttle cable core wire into opening in top of pedal arm.

(9) Push cable retainer (clip) into pedal arm opening until it snaps in place.

(10) Snap cable into dashpanel routing clip.

(11) Install air box to throttle body.

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

SPECIFICATIONS

FUEL TANK CAPACITY

Models	Liters	U.S. Gallons
All	78	20.5
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).

SPECIFICATIONS (Continued)

TORQUE CHART

DESCRIPTION	TORQUE
Accelerator Pedal Bracket Mounting Nuts	8.5 N·m (75 in. lbs.)
Fuel Filter/Fuel Press. Reg. Bolts	3 N·m (30 in. lbs.)
Fuel Hose Clamps	3 N·m (25 in. lbs.)
Fuel Injector Rail Mounting Bolts—4.0L Engine	11 N·m (100 in. lbs.)
Fuel Injector Rail Mounting Bolts—4.7L V–8 Engine	11 N·m (100 in. lbs.)
Fuel Pump Module Locknut	74 N·m (55 ft. lbs.)
Fuel Tank Mounting Bolts	81 N·m (60 ft. lbs.)

FUEL INJECTION SYSTEM

INDEX

DESCRIPTION AND OPERATION

POWERTRAIN CONTROL MODULE (PCM)

DESCRIPTION

The Powertrain Control Module (PCM) is located in the engine compartment (Fig. 1).

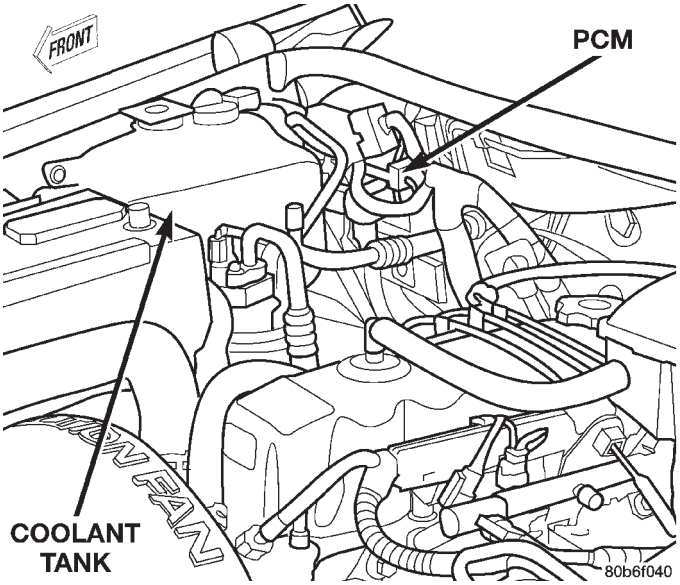


Fig. 1 PCM Location

OPERATION

(1) Also refer to Modes of Operation.

The PCM 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
- Auto shutdown (ASD) sense
- Battery temperature
- Battery voltage
- Brake switch
- J1850 bus circuits
- Camshaft position sensor signal
- Crankshaft position sensor
- Data link connections for DRB scan tool
- Engine coolant temperature sensor
- Five volts (primary)
- Five volts (secondary)
- 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
- 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 (from ABS module)

NOTE: PCM Outputs:

- A/C clutch relay
- Auto shutdown (ASD) relay
- J1850 (+/-) circuits for: speedometer, voltmeter, fuel gauge, oil pressure gauge/lamp, engine temp. gauge and speed control warn. lamp
- Data link connection for DRB scan tool
- EGR valve control solenoid (if equipped)
- EVAP canister purge solenoid
- Fuel injectors
- Fuel pump relay
- Generator field driver (-)
- Generator field driver (+)
- Generator lamp (if equipped)
- Idle air control (IAC) motor

DESCRIPTION AND OPERATION (Continued)

- Ignition coil
- Leak detection pump
- Malfunction indicator lamp (Check engine lamp). Driven through J1850 circuits.
- Overdrive indicator lamp (if equipped). Driven through J1850 circuits.
- Oxygen sensor heater relays (if equipped).
- Radiator cooling fan relay (pulse width modulated)
- Speed control source
- Speed control vacuum solenoid
- Speed control vent solenoid
- Tachometer (if equipped). Driven through J1850 circuits.
- Transmission convertor clutch circuit
- Transmission 3–4 shift solenoid
- Transmission relay
- Transmission temperature lamp (if equipped)
- Transmission variable force solenoid

MODES OF OPERATION

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

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

The fuel injection system has the following modes of operation:

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

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

IGNITION SWITCH (KEY-ON) MODE

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

- The 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 O2S relays. 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 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 approximately 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.

DESCRIPTION AND OPERATION (Continued)

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 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
- 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.
- 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 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
- 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 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
- 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 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 PCM receives the following inputs.

- Air conditioning select signal (if equipped)

DESCRIPTION AND OPERATION (Continued)

- 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
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Vehicle speed

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.

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 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

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.

AIR CONDITIONING (A/C) CONTROLS—PCM INPUT

OPERATION

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 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

DESCRIPTION

The ASD relay is located in the Power Distribution Center (PDC). The PDC is located in the engine compartment. Refer to label on PDC cover for relay location.

OPERATION

A 12 volt signal at this input indicates to the PCM that the ASD has been activated. The relay is used to connect the oxygen sensor heater element, ignition coil and fuel injectors to 12 volt + power supply.

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

DESCRIPTION AND OPERATION (Continued)

BATTERY TEMPERATURE SENSOR—PCM INPUT

OPERATION

Provides a signal to the PCM corresponding to the battery temperature.

BATTERY VOLTAGE—PCM INPUT

OPERATION

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.

BRAKE SWITCH—PCM INPUT

OPERATION

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 disable vent and vacuum solenoid output signals to the speed control servo.

FIVE VOLT SENSOR SUPPLY—PRIMARY

OPERATION

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

OPERATION

Supplies the required 5 volt source to certain sensors.

ENGINE COOLANT TEMPERATURE SENSOR—PCM INPUT

DESCRIPTION

The engine coolant temperature (ECT) sensor is used to sense engine coolant temperature. The sensor protrudes into an engine water jacket.

OPERATION

The ECT 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.

GENERATOR OUTPUT—PCM INPUT

OPERATION

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

OXYGEN SENSOR—PCM INPUT

DESCRIPTION

The oxygen sensors (O2S) are attached to, and protrude in to, the vehicle exhaust system.

OPERATION

The sensors produce voltages from 0 to 1 volt, depending upon the oxygen content of the exhaust gas. 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 switches.

In Closed Loop operation, the PCM monitors certain O2 sensor input(s) 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. Certain emissions packages use the Automatic Shutdown (ASD) relay to supply battery voltage to the heating elements. Other emissions packages use separate oxygen sensor relays to supply battery voltage to the heating elements.

DESCRIPTION AND OPERATION (Continued)

IGNITION CIRCUIT SENSE—PCM INPUT

OPERATION

The ignition circuit sense input tells the Powertrain Control Module (PCM) the ignition switch has energized the ignition circuit.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR—PCM INPUT

DESCRIPTION

The Intake Manifold Air temperature (IAT) sensor is installed in the intake manifold with the sensor element extending into the air stream.

OPERATION

The IAT 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.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR—PCM INPUT

DESCRIPTION

The MAP sensor is mounted to the engine throttle body.

OPERATION

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.

OIL PRESSURE SENSOR—PCM INPUT

DESCRIPTION

The engine oil pressure sensor (sending unit) is located in an engine oil pressure gallery.

OPERATION

A signal is sent from the oil pressure sensor to the Powertrain Control Module (PCM) relating to engine oil pressure.

POWER GROUND

OPERATION

The power ground is used to control ground circuits for the following Powertrain Control Module (PCM) loads:

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

SENSOR RETURN—PCM INPUT

OPERATION

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

THROTTLE POSITION SENSOR (TPS)—PCM INPUT

DESCRIPTION

The throttle position sensor (TPS) is mounted on the throttle body

OPERATION

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 .26 volts at minimum throttle opening (idle), to 4.49 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.

VEHICLE SPEED AND DISTANCE—PCM INPUT

OPERATION

Vehicle speed and distance covered are measured by the Rear Wheel Speed Sensor. The sensor is mounted to the rear axle. A signal is sent from this sensor to the Controller Antilock Brake (CAB) computer. A signal is then sent from the CAB to the Pow-

DESCRIPTION AND OPERATION (Continued)

ertrain Control Module (PCM) to determine vehicle speed and distance covered. The PCM will then determine strategies for fuel system and speed control system operation.

Refer to Odometer and Trip Odometer in Group 8E, Instrument Panel for additional information.

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

DESCRIPTION

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

OPERATION

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

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

By switching the ground path for the relay on and off, the PCM is able to cycle the A/C compressor clutch. This is based on changes in engine operating conditions. If, during A/C operation, the PCM senses 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

DESCRIPTION

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

OPERATION

The ASD supplies battery voltage to the fuel injectors and ignition coil(s). With certain emissions packages it also supplys voltage to the oxygen 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.

J1850—PCM INPUTS/OUTPUTS

OPERATION

The Powertrain Control Module (PCM) sends certain output signals through the J1850 bus circuits. These signals are used to control certain instrument panel located items and to determine certain identification numbers.

Refer to Instrument Panel and Gauges for additional information.

DATA LINK CONNECTOR—PCM INPUT AND OUTPUT

DESCRIPTION

The data link connector is located at the lower edge of the instrument panel near the steering column.

OPERATION

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).

FUEL PUMP RELAY-PCM OUTPUT

DESCRIPTION

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

OPERATION

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.

GENERATOR FIELD SOURCE (+)—PCM OUTPUT

OPERATION

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.

DESCRIPTION AND OPERATION (Continued)

GENERATOR FIELD DRIVER (-)—PCM OUTPUT

OPRATION

This output from the Powertrain Control Module (PCM) regulates charging system ground control to the generator field driver (-) circuit.

IDLE AIR CONTROL (IAC) MOTOR—PCM OUTPUT

DESCRIPTION

The IAC motor is mounted to the throttle body.

OPERATION

The motor is controlled by the Powertrain Control Module (PCM).

The throttle body has an air control passage that provides air for the engine at idle (the throttle plate is closed). The IAC motor pintle protrudes into the air control passage and regulates air flow through it. Based on various sensor inputs, the 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.

OXYGEN SENSOR HEATER RELAYS—PCM OUTPUT

DESCRIPTION

The 2 oxygen (O2) sensor heater relays (upstream and downstream) are located in the Powertrain Distribution Center (PDC).

OPERATION

Engines equipped with the California (NAE) Emissions Package use **four O2 sensors.**

Two of the four sensor heater elements (upstream sensors 1/1 and 2/1) are controlled by the upstream heater relay through output signals from the Powertrain Control Module (PCM).

The other two heater elements (downstream sensors 1/2 and 2/2) are controlled by the downstream heater relay through output signals from the PCM.

To avoid a large simultaneous current surge, power is delayed to the 2 downstream heater elements by the PCM for approximately 2 seconds.

RADIATOR COOLING FAN RELAY—PCM OUTPUT

DESCRIPTION

The pulse width modulated (PWM) radiator cooling fan relay is located behind the front bumper fascia below the right headlamp.

OPERATION

The PWM relay is used to control the speed of the electric radiator cooling fan. It allows for multiple fan speeds. This allows for improved fan noise and A/C performance, better engine cooling, and additional vehicle power.

PWM relay operation is controlled by the Powertrain Control Module (PCM). To operate the PWM relay, the PCM looks at inputs from:

- Engine coolant temperature
- Ambient temperature from the body controller
- Vehicle speed
- Transmission oil temperature
- A/C switch position (A/C request)

THROTTLE BODY

DESCRIPTION

The throttle body is located on the intake manifold.

OPERATION

Filtered air from the air cleaner enters the intake manifold through the throttle body. Fuel does not enter the intake manifold through the throttle body. Fuel is sprayed into the manifold by the fuel injectors. The throttle body contains an air control passage 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.

Certain sensors are attached to the throttle body. The accelerator pedal cable, speed control cable and transmission control cable (when equipped) are connected to the throttle body linkage 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

A visual inspection for loose, disconnected or incorrectly routed wires, vacuum lines and hoses should be made. This should be done before attempting to diagnose or service the fuel injection system. A visual

DIAGNOSIS AND TESTING (Continued)

check will help spot these faults and save unnecessary test and diagnostic time. A thorough visual inspection will include the following checks:

(1) Verify three 32–way electrical connectors are fully inserted into connector of Powertrain Control Module (PCM) (Fig. 2).

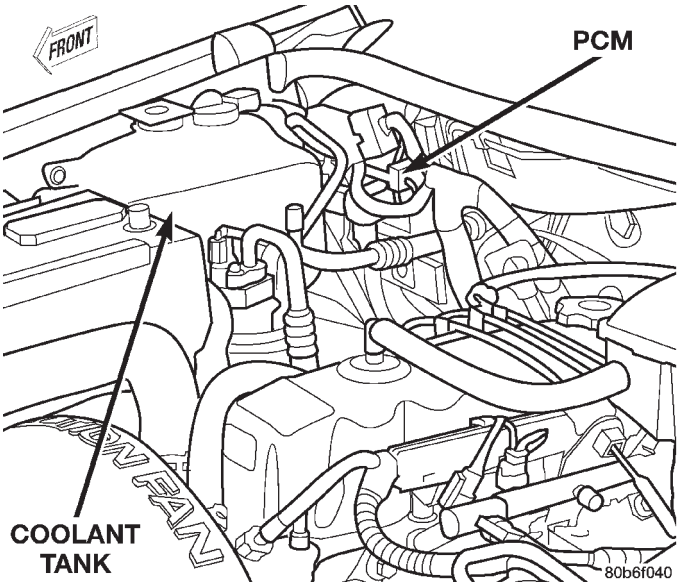


Fig. 2 Powertrain Control Module (PCM) Location

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

(3) Inspect fuel pump relay and air conditioning compressor clutch relay (if equipped). Inspect ASD and oxygen sensor heater 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. 3). Refer to label on PDC cover for relay location.

(4) Inspect ignition coil connections (Fig. 4) or (Fig. 5).

(5) Verify camshaft position sensor wire connector is firmly connected (Fig. 6) or (Fig. 7).

(6) Verify crankshaft position sensor wire connector is firmly connected (Fig. 8) or (Fig. 9).

(7) Verify generator output wire (B+ wire) and generator field connector are firmly connected to generator.

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

(9) Verify crankcase ventilation (CCV) operation. Refer to Emission Control System for additional information.

(10) Inspect all fuel line quick-connect fittings for damage or leaks.

(11) Verify hose connections to all ports of vacuum fittings on intake manifold, and for emission system are tight and not leaking.

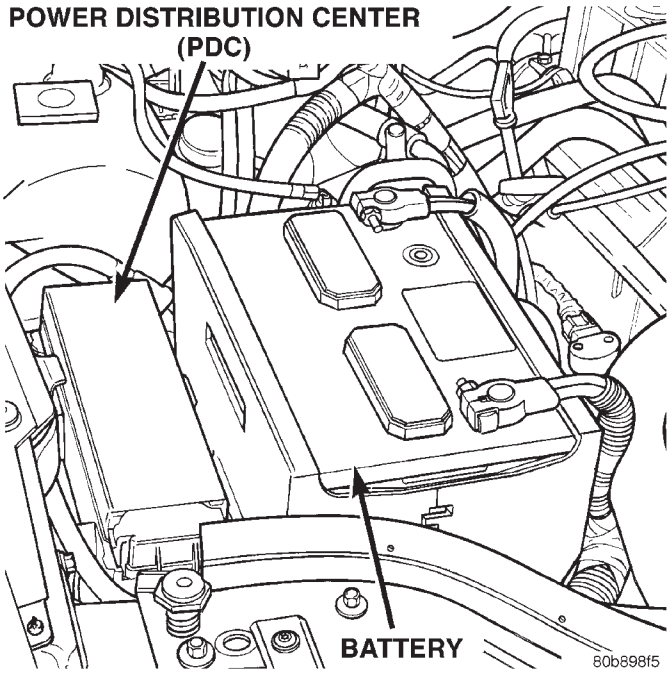


Fig. 3 Power Distribution Center (PDC) Location

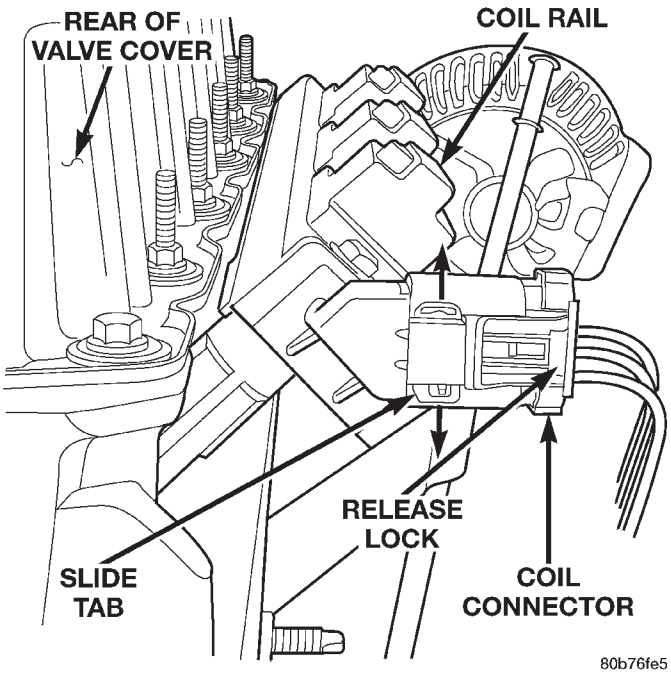


Fig. 4 Ignition Coil Connector—4.0L Engine

(12) Inspect accelerator cable, transmission throttle cable (if equipped) and speed control cable connections (if equipped). Check their connections to throttle body linkage for any binding or restrictions.

(13) Verify vacuum booster hose is firmly connected to fitting on intake manifold. Also check connection to brake vacuum booster.

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

DIAGNOSIS AND TESTING (Continued)

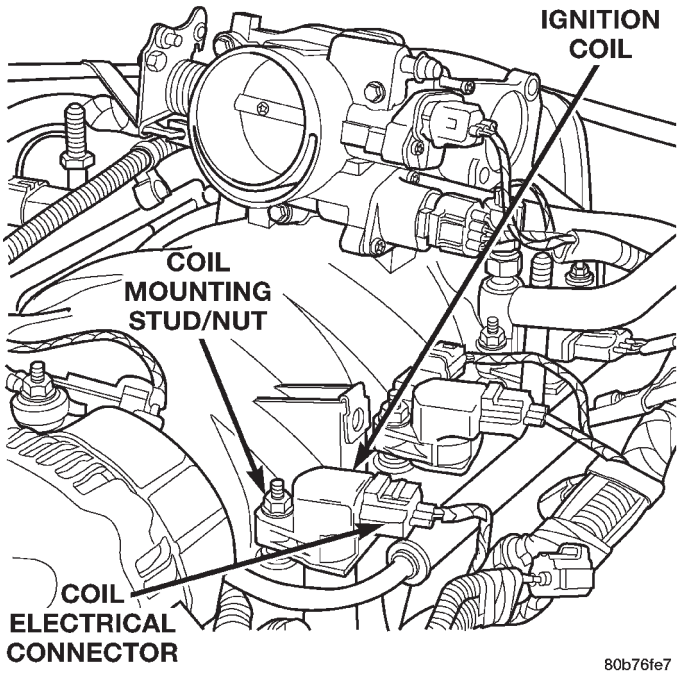


Fig. 5 Ignition Coil Connector—4.7L V-8 Engine

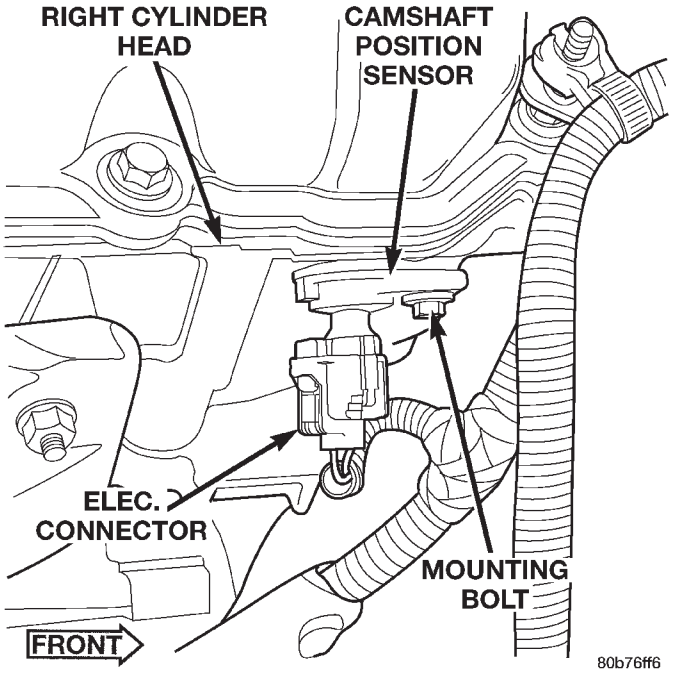


Fig. 7 Camshaft Position Sensor—4.7L V-8 Engine

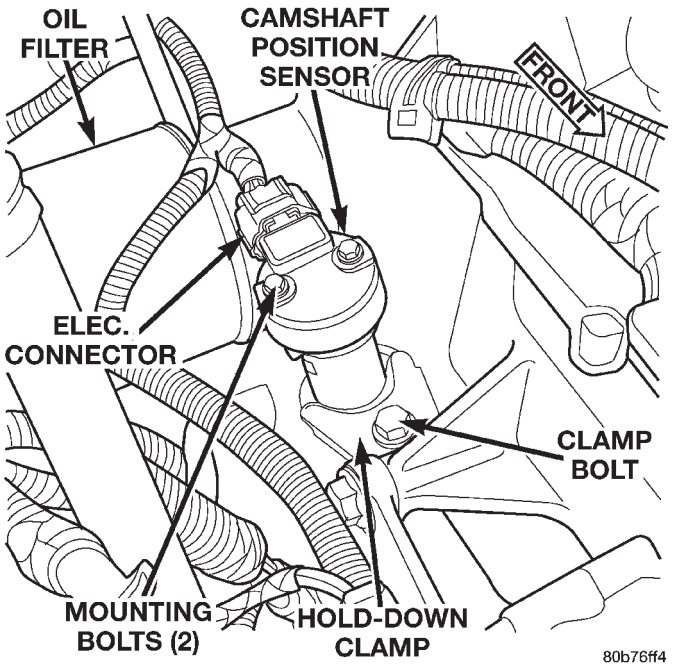


Fig. 6 Camshaft Position Sensor—4.0L Engine

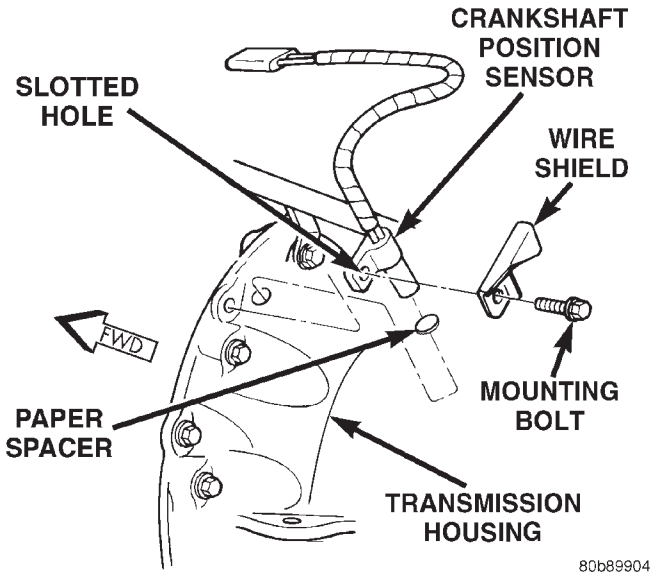


Fig. 8 Crankshaft Position Sensor—4.0L Engine

DIAGNOSIS AND TESTING (Continued)

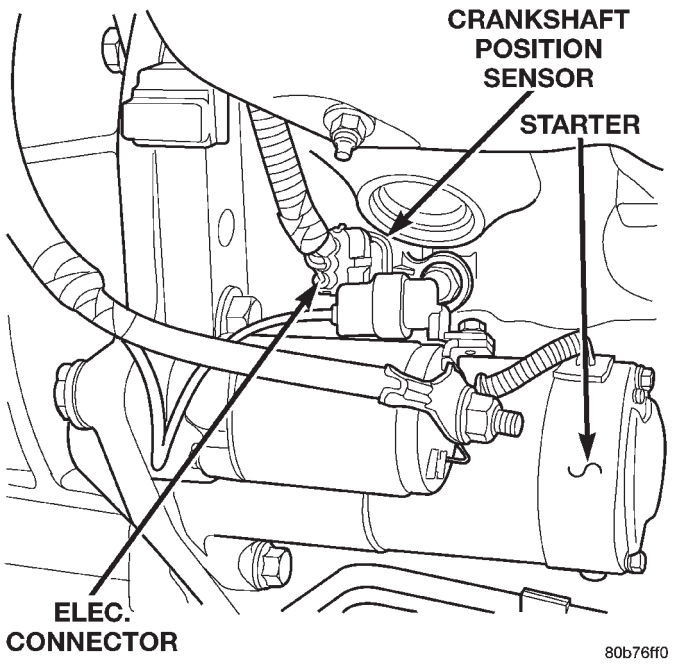


Fig. 9 Crankshaft Position Sensor—4.7L V-8 Engine

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

(16) 4.0L Engine: Verify MAP, Intake Manifold Air Temperature (IAT) sensor, TPS and Idle Air Control (IAC) motor connectors are firmly connected (Fig. 10). Be sure throttle body mounting bolts (Fig. 10) are tight.

(17) 4.7L Engine: Verify Intake Manifold Air Temperature (IAT) sensor, TPS and Idle Air Control (IAC) motor connectors are firmly connected (Fig. 11). Be sure throttle body mounting bolts (Fig. 11) are tight.

(18) 4.0L Engine: Verify wire harness connector is firmly connected to Engine Coolant Temperature (ECT) sensor (Fig. 12).

(19) 4.7L Engine: Verify MAP and Engine Coolant Temperature (ECT) sensor electrical connectors are firmly connected to sensors (Fig. 13).

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

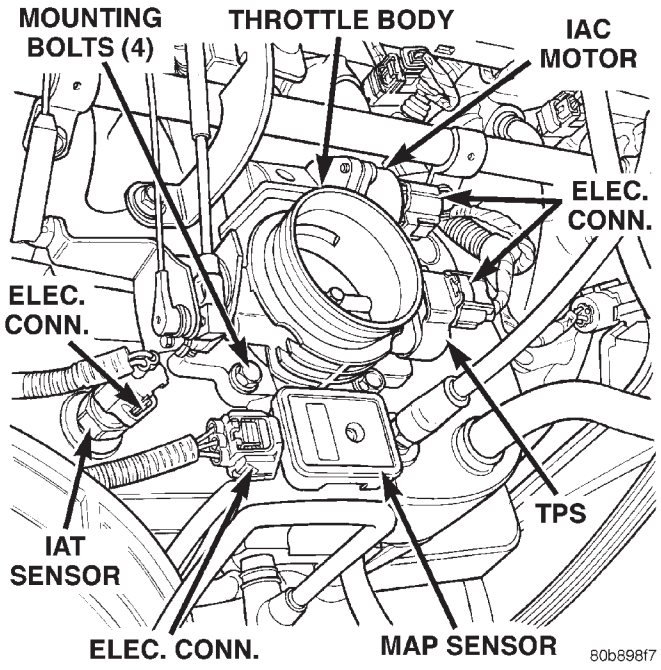


Fig. 10 IAT, MAP, IAC, TPS Sensor Locations—4.0L Engine

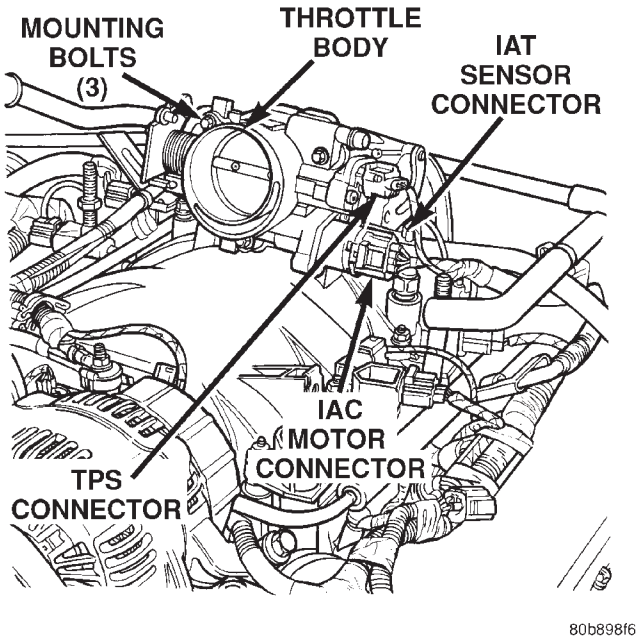


Fig. 11 IAT, IAC, TPS Sensor Locations—4.7L V-8 Engine

DIAGNOSIS AND TESTING (Continued)

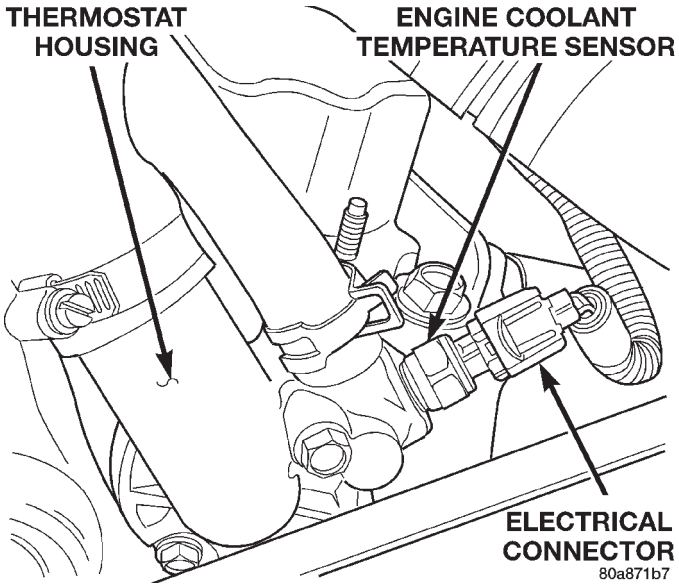


Fig. 12 ECT Sensor Location—4.0L Engine

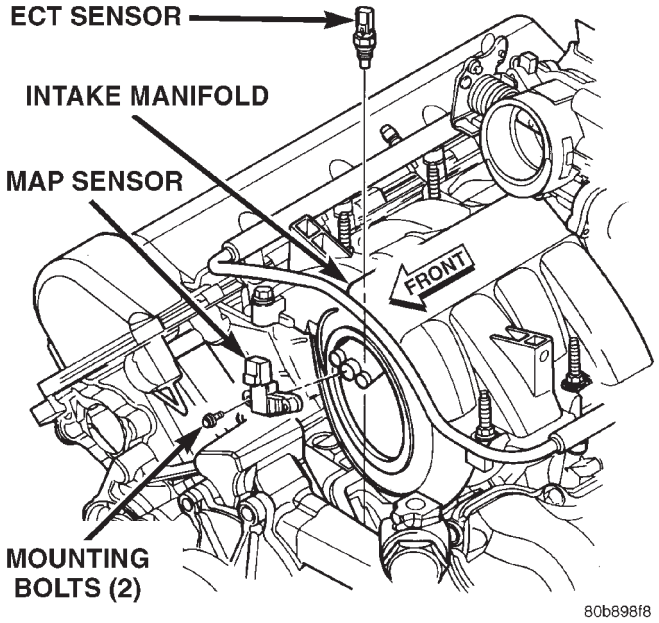


Fig. 13 MAP and ECT Sensor Locations—4.7L V-8 Engine

(21) Raise and support vehicle.

(22) Verify all oxygen sensor wire connectors are firmly connected to sensors. Inspect sensors and connectors for damage (Fig. 14) or (Fig. 15).

(23) Inspect for pinched or leaking fuel tubes/lines. Inspect for pinched, cracked or leaking fuel hoses.

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

(25) If equipped with automatic transmission, verify electrical harness is firmly connected to park/neutral switch and to transmission components.

(26) Verify fuel pump module pigtail harness electrical connector (Fig. 16) is firmly connected to body harness connector.

(27) Inspect fuel line harness (from fuel pump module) at fuel filter/fuel pressure regulator (Fig. 16) for chaffing, cracks or leaks.

(28) Verify battery cable and solenoid feed wire connections to starter solenoid are tight and clean.

(29) Inspect for chaffed wires or wires rubbing up against other components.

(30) Inspect for chaffed vacuum lines or lines rubbing up against other components.

RELAY TESTING

To perform a complete test of the fuel pump, ASD or oxygen sensor heater relay, or its circuitry, refer to the DRB scan tool and the appropriate Powertrain Diagnostic Manual. To test the relay only, refer to the following: . The terminals on bottom of each relay are numbered (Fig. 17) or (Fig. 18).

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 coil side of relay through terminal number 85.
- Terminal number 86 supplies voltage to coil side of relay.
- When the PCM de-energizes the relay, terminal number 87A connects to terminal 30. This is the OFF position. In the OFF position, voltage is not supplied to rest of circuit. Terminal 87A is the center terminal on 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 rest of circuit.

TESTING

The following procedure applies only to ASD, oxygen sensor heater and fuel pump relays.

(1) Remove relay from PDC connector before testing.

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

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

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

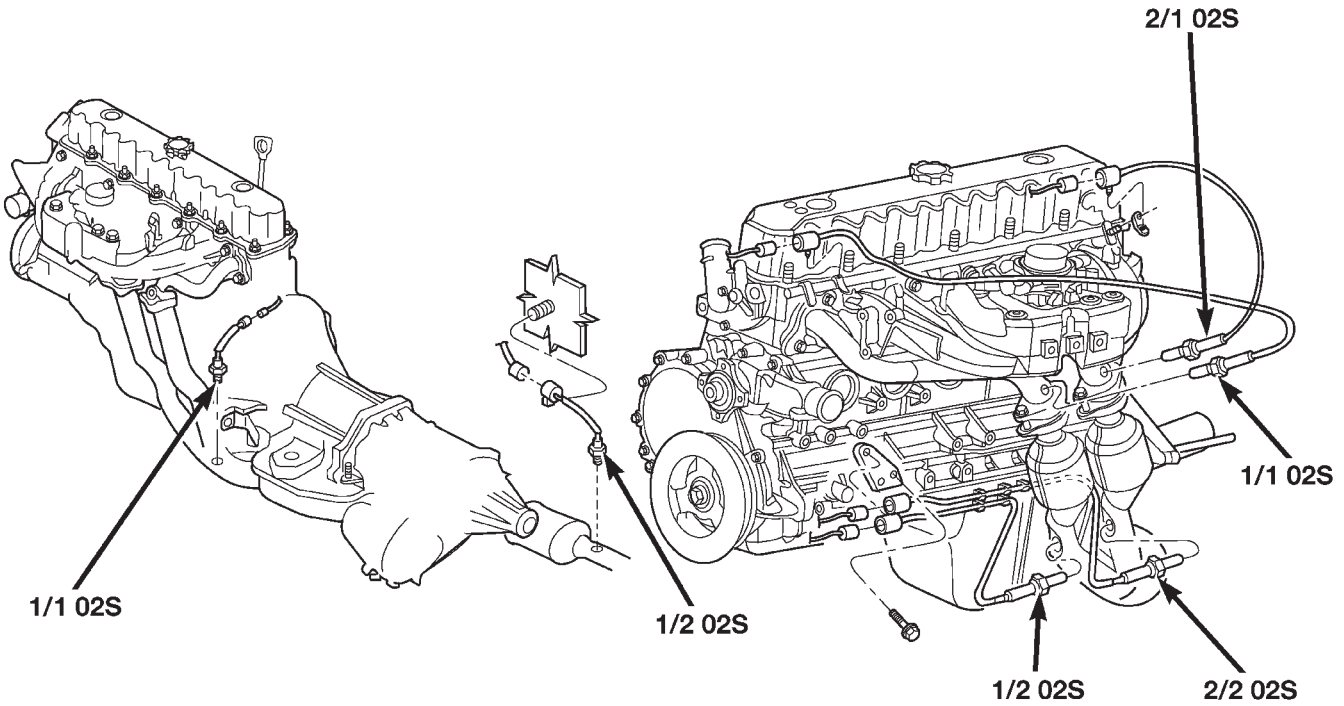


Fig. 14 Oxygen Sensor Locations—4.0L Engine

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

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

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

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

(8) Disconnect jumper wires.

(9) Replace relay if it did not pass continuity and resistance tests. If relay passed tests, it operates properly. Check remainder of relay circuits using DRB scan tool. Also refer to Wiring Diagrams.

THROTTLE BODY MINIMUM AIR FLOW CHECK PROCEDURE

4.0L 6–Cylinder 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. 19) must be used for the following test.

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

(2) Shut off engine and remove air duct and air resonator box from top of throttle body.

DIAGNOSIS AND TESTING (Continued)

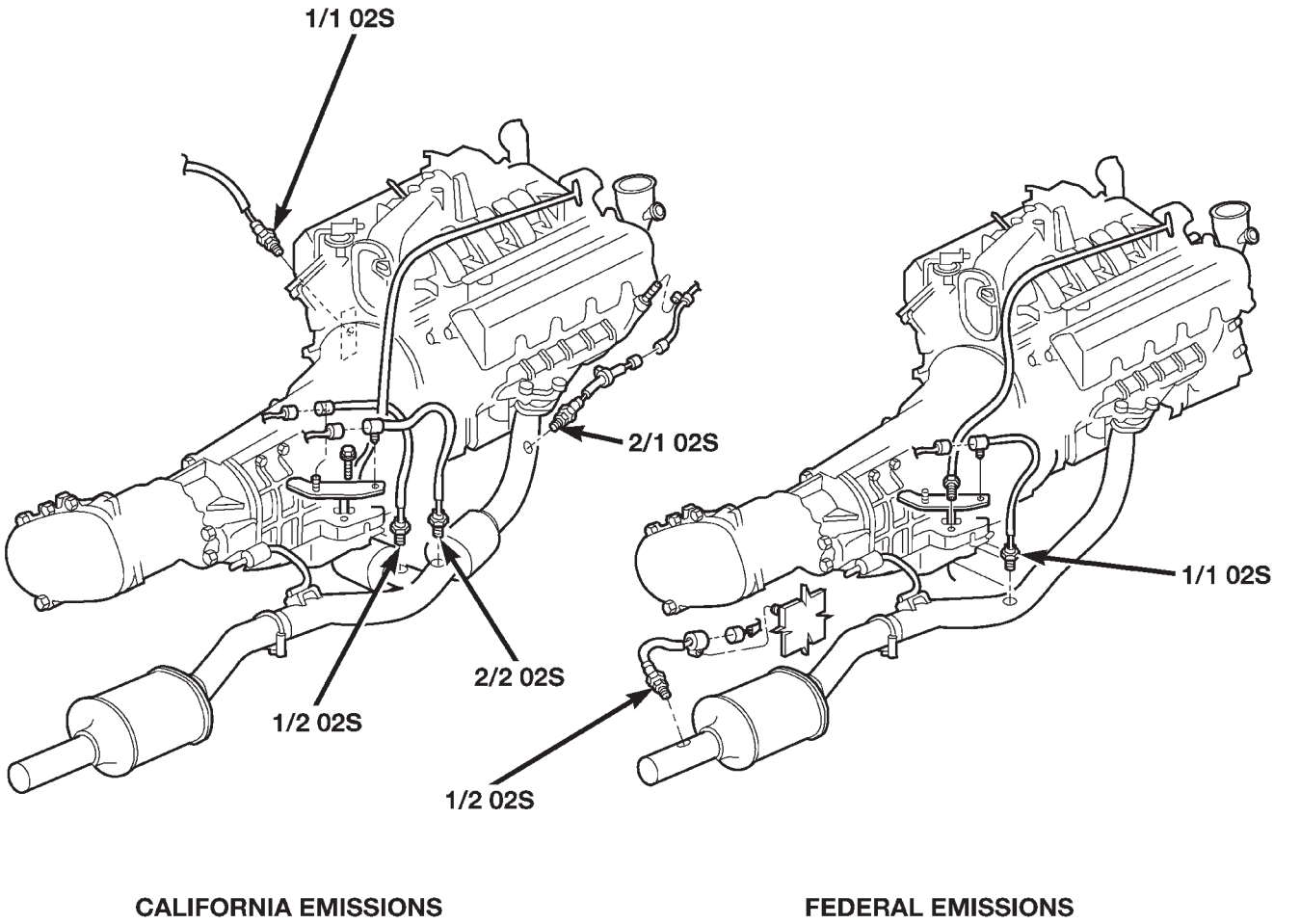


Fig. 15 Oxygen Sensor Locations—4.7L V-8 Engine

(3) Disconnect rear CCV breather tube (Fig. 20) at intake manifold fitting. Let CCV tube hang disconnected at side of engine.

(4) Attach a short piece of rubber hose to special tool 6714 (insert rubber hose to either end of tool). Install this hose/tool assembly to intake manifold fitting.

(5) Connect DRB scan tool to 16–way data link connector. This connector is located at lower edge of instrument panel near steering column.

(6) Start the engine and allow to warm up.

(7) Using the DRB scan tool, scroll through the menus as follows: select—Stand Alone DRB III, select 1999 Diagnostics, select—Engine, select—System Test, select—Minimum Air Flow.

(8) 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.

(9) Disconnect the DRB scan tool from vehicle.

(10) Remove orifice tool and connect CCV tube to engine.

(11) Install air duct and air box to throttle body.

DIAGNOSIS AND TESTING (Continued)

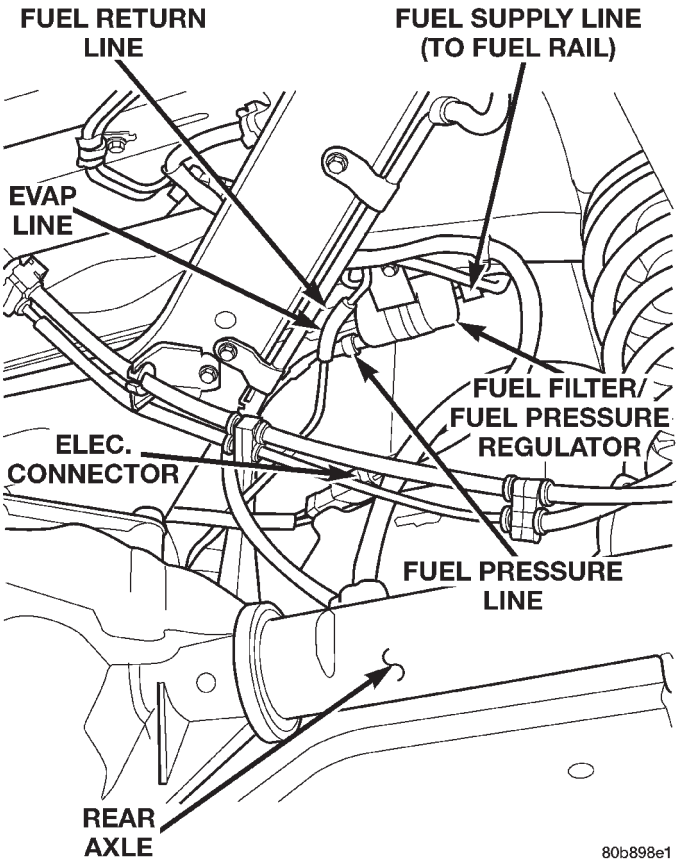
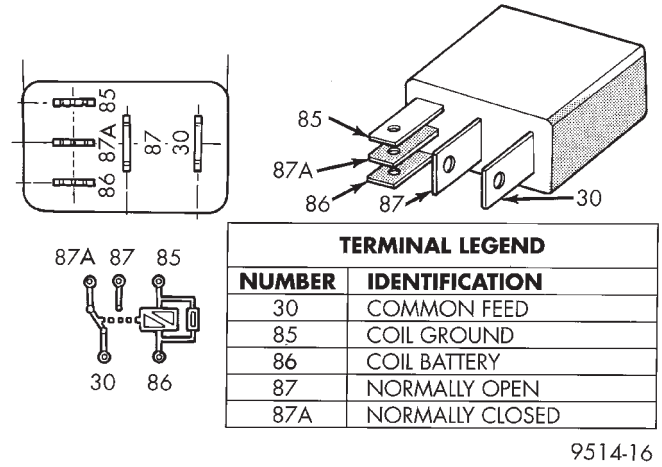
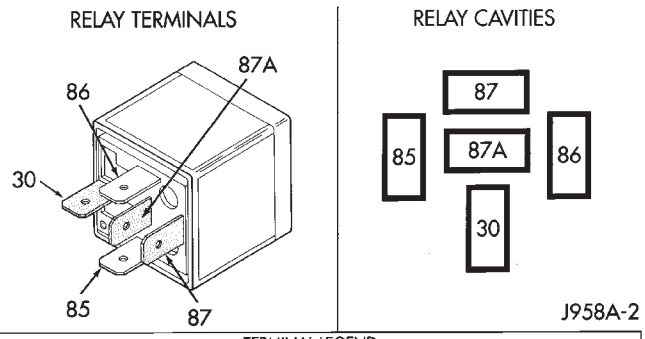


Fig. 16 Fuel Filter/Fuel Pressure Regulator Location



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

Fig. 17 Relay Terminals



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

Fig. 18 Relay Terminals

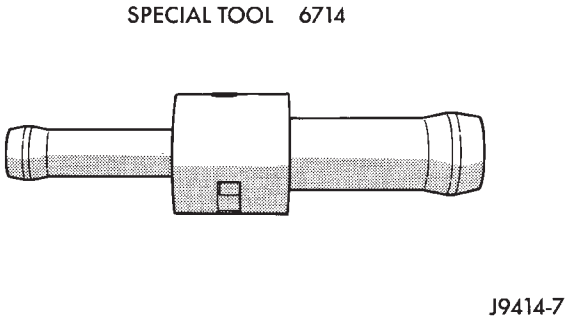


Fig. 19 Fixed Orifice Tool 6714

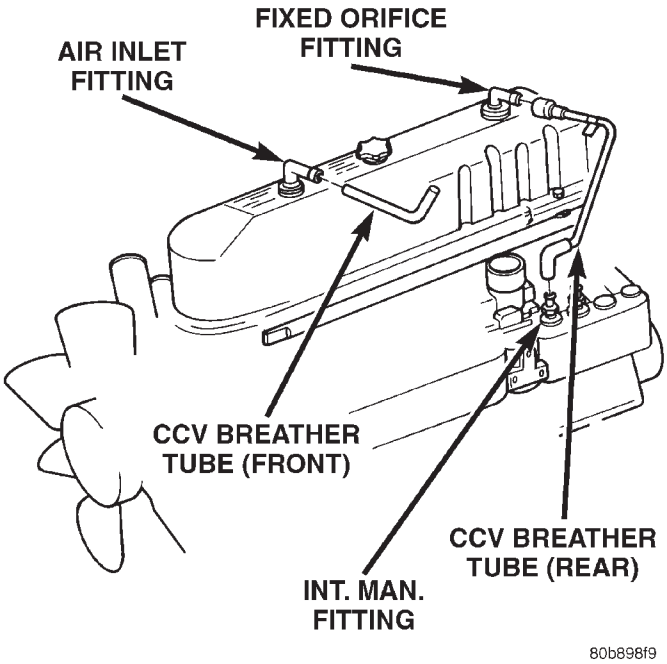


Fig. 20 Fixed Orifice Fitting and CCV Breather Tubes

REMOVAL AND INSTALLATION

AUTOMATIC SHUTDOWN (ASD) RELAY

The ASD relay is located in the Power Distribution Center (PDC) (Fig. 21). Refer to label on PDC cover for relay location.

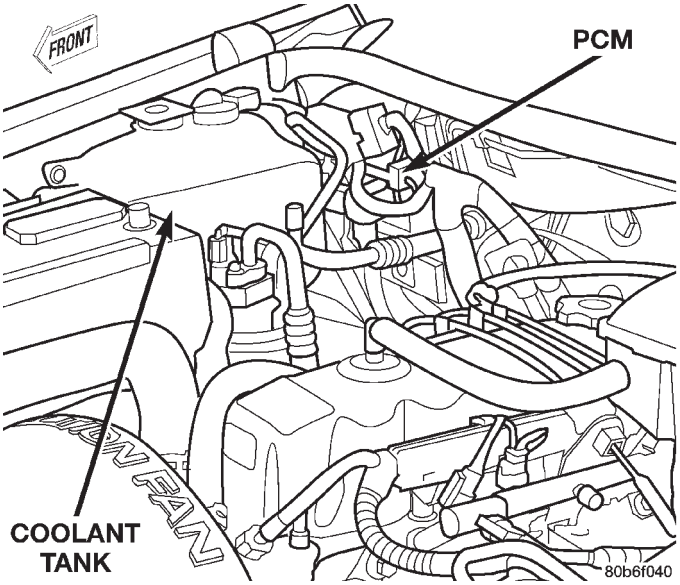


Fig. 21 Power Distribution Center (PDC) Location

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.

FUEL PUMP RELAY

The fuel pump relay is located in the Power Distribution Center (PDC) (Fig. 21). 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.

OXYGEN SENSOR HEATER RELAYS

The oxygen sensor heater relays are located in the Power Distribution Center (PDC) (Fig. 21). 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—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 air cleaner duct and air resonator box at throttle body.
(2) Disconnect throttle body electrical connectors at MAP sensor, IAC motor and TPS (Fig. 22).
(3) Remove all control cables from throttle body (lever) arm. Refer to Accelerator Pedal and Throttle Cable.
(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 and air box at throttle body.

REMOVAL AND INSTALLATION (Continued)

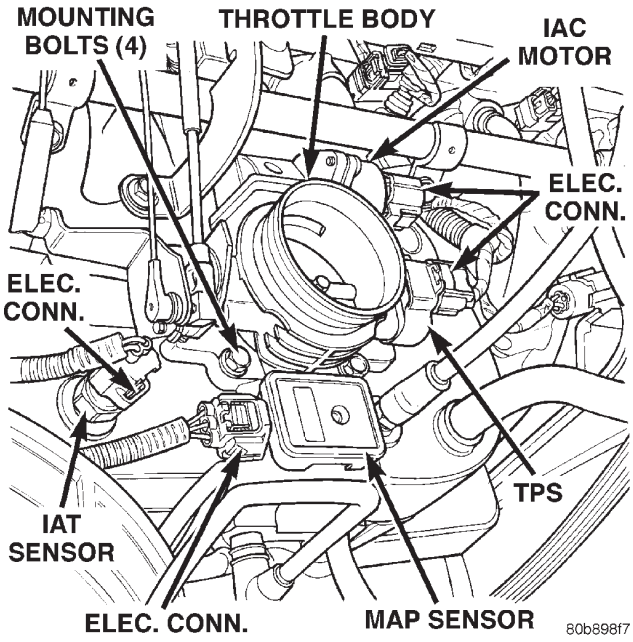


Fig. 22 Throttle Body and Sensor Locations—4.0L Engine

THROTTLE BODY—4.7L V-8 ENGINE

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

REMOVAL

(1) Remove the air duct and air resonator box at throttle body.
(2) Disconnect throttle body electrical connectors at IAC motor and TPS (Fig. 23).
(3) Remove vacuum line at throttle body.
(4) Remove all control cables from throttle body (lever) arm. Refer to Accelerator Pedal and Throttle Cable.
(5) Remove three throttle body mounting bolts (Fig. 23).
(6) Remove throttle body from intake manifold.

INSTALLATION

(1) Clean throttle body-to-intake manifold o-ring.
(2) Clean mating surfaces of throttle body and intake manifold.
(3) Install throttle body to intake manifold by positioning throttle body to manifold alignment pins.
(4) Install three mounting bolts. Tighten bolts to 12 N·m (105 in. lbs.) torque.
(5) Install control cables.
(6) Install vacuum line to throttle body.
(7) Install electrical connectors.
(8) Install air duct/air box at throttle body.

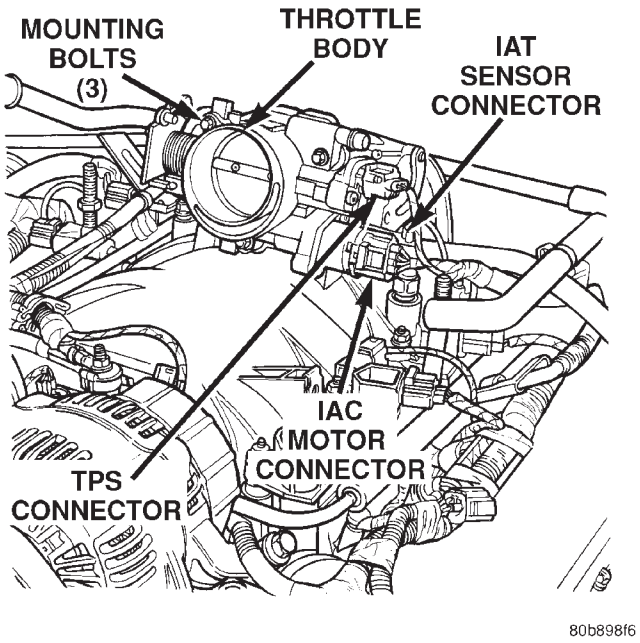


Fig. 23 Throttle Body, Sensors and Electrical Connectors—4.7L V-8 Engine

THROTTLE POSITION SENSOR (TPS)—4.0L ENGINE

The TPS is mounted to the throttle body.

REMOVAL

(1) Disconnect TPS electrical connector (Fig. 24).
(2) Remove TPS mounting screws (Fig. 25).
(3) Remove TPS.

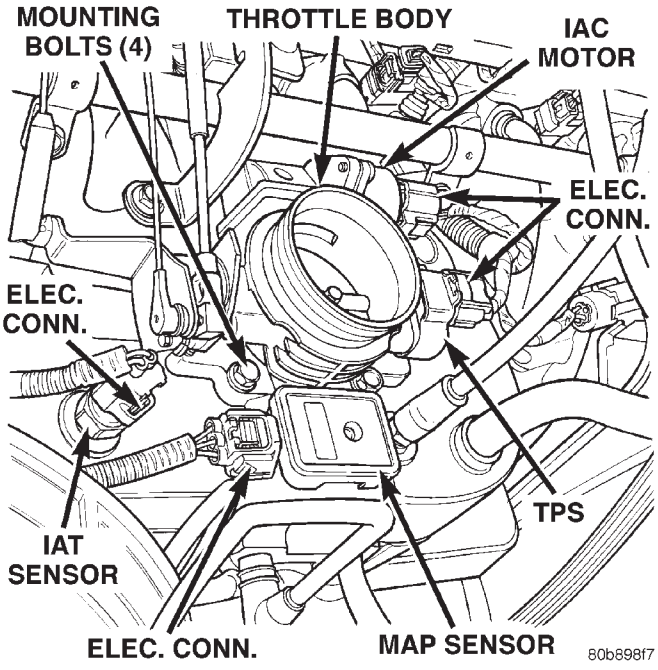


Fig. 24 TPS Electrical Connector—4.0L Engine

REMOVAL AND INSTALLATION (Continued)

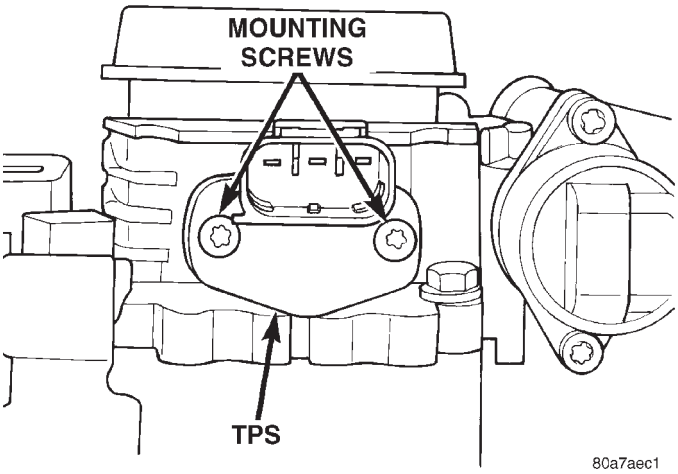


Fig. 25 TPS Mounting Screws—4.0L Engine

INSTALLATION

The throttle shaft end of throttle body slides into a socket in the TPS (Fig. 26). The TPS must be installed so that it can be rotated a few degrees. (If sensor will not rotate, install sensor with throttle shaft on other side of socket tangs). The TPS will be under slight tension when rotated.

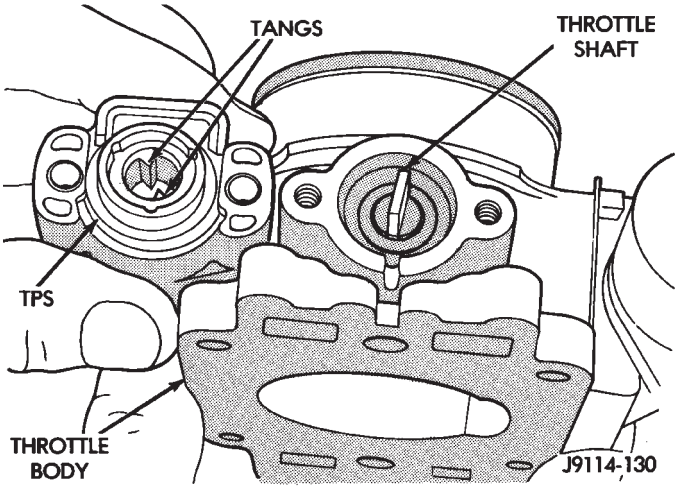


Fig. 26 Throttle Position Sensor Installation—4.0L Engine

(1) Install 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 throttle (by hand) to check for any TPS binding before starting engine.

THROTTLE POSITION SENSOR (TPS)—4.7L V-8 ENGINE

REMOVAL

The TPS is located on the throttle body.
(1) Remove air duct and air resonator box at throttle body.
(2) Disconnect TPS electrical connector (Fig. 23).
(3) Remove two TPS mounting bolts (screws) (Fig. 27).

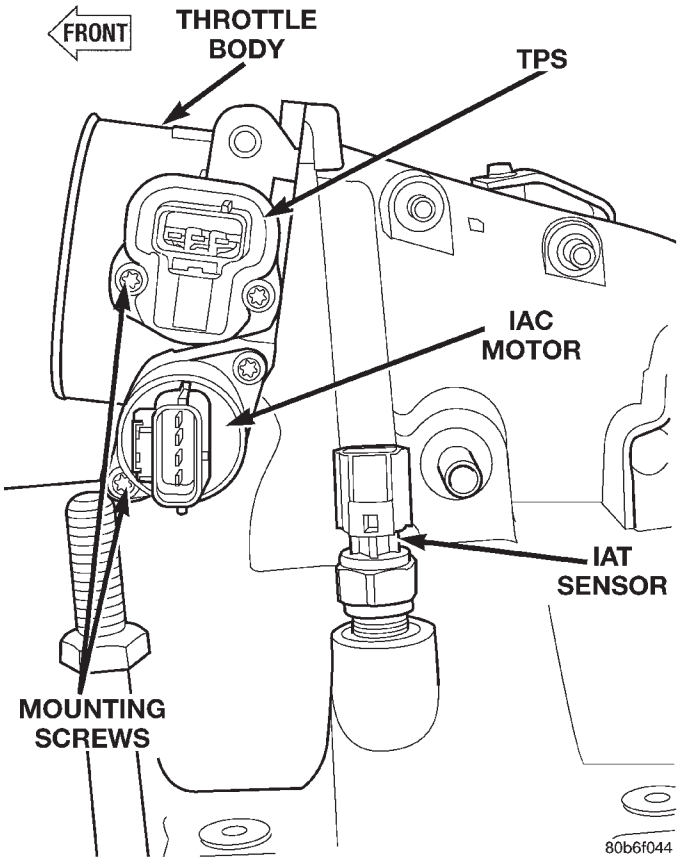


Fig. 27 TPS Mounting Bolts—4.7L V–8 Engine

(4) Remove TPS from throttle body.

INSTALLATION

The throttle shaft end of throttle body slides into a socket in TPS (Fig. 28). The TPS must be installed so that it can be rotated a few degrees. If sensor will not rotate, install sensor with throttle shaft on other side of socket tangs. The TPS will be under slight tension when rotated.
(1) Install TPS and two retaining bolts.
(2) Tighten bolts to 7 N·m (60 in. lbs.) torque.
(3) Manually operate throttle control lever by hand to check for any binding of TPS.
(4) Connect TPS electrical connector to TPS.
(5) Install air duct/air box to throttle body.

IDLE AIR CONTROL (IAC) MOTOR—4.0L ENGINE

The IAC motor is located on the throttle body.

REMOVAL

(1) Remove air duct and air resonator box at throttle body.
(2) Disconnect electrical connector from IAC motor (Fig. 24).
(3) Remove two mounting bolts (screws) (Fig. 29).

REMOVAL AND INSTALLATION (Continued)

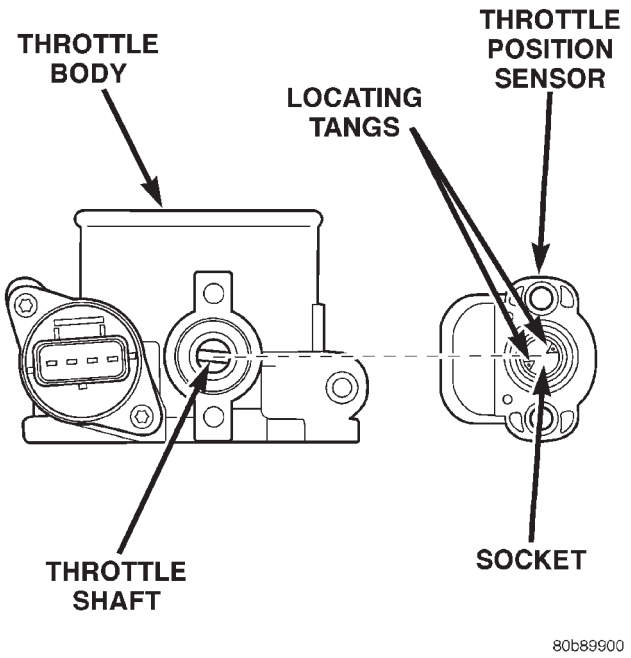


Fig. 28 TPS Installation—4.7L V–8 Engine

(4) Remove IAC motor from throttle body.

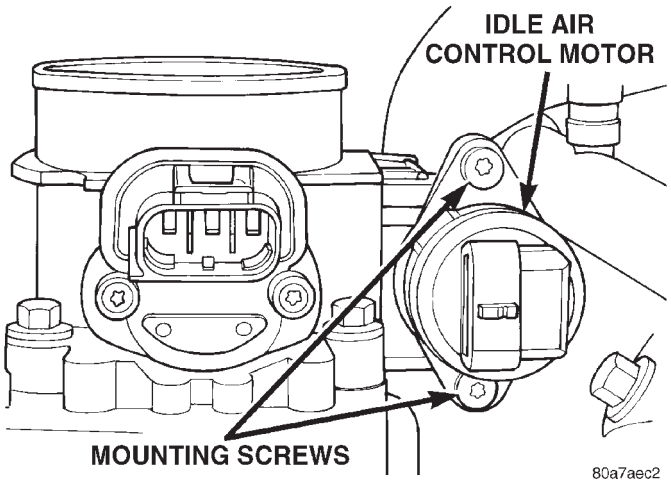


Fig. 29 Mounting Bolts (Screws)—IAC Motor—4.0L Engine

INSTALLATION

(1) Install IAC motor to throttle body.

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

(3) Install electrical connector.

(4) Install air cleaner duct/air box to throttle body.

IDLE AIR CONTROL (IAC) MOTOR—4.7L V–8 ENGINE

The IAC motor is located on the throttle body.

REMOVAL

(1) Remove air duct and air resonator box at throttle body.

(2) Disconnect electrical connector from IAC motor (Fig. 23).

(3) Remove two mounting bolts (screws) (Fig. 27).

(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/air box to throttle body.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR—4.0L ENGINE

The MAP sensor is mounted to the side of the throttle body (Fig. 24). An L-shaped rubber fitting is used to connect the MAP sensor to throttle body (Fig. 30).

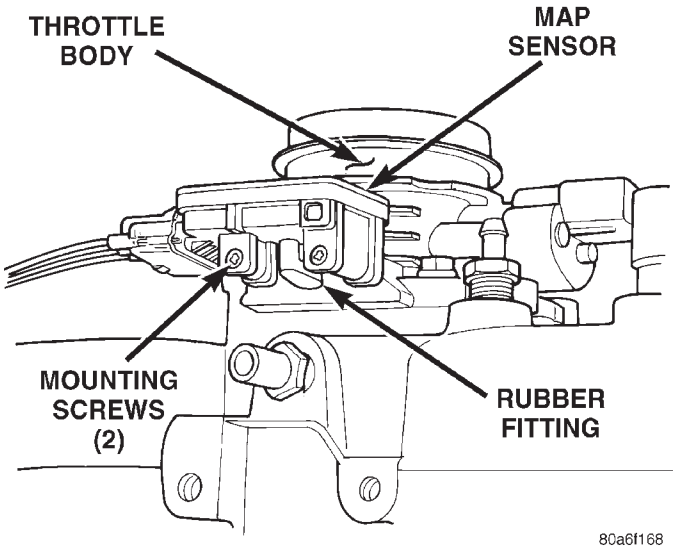


Fig. 30 Rubber L-Shaped Fitting—MAP Sensor-to-Throttle Body—4.0L Engine

REMOVAL

(1) Remove air cleaner duct and air resonator box at throttle body.

(2) Remove two MAP sensor mounting bolts (screws) (Fig. 30).

(3) While removing MAP sensor, slide the rubber L-shaped fitting (Fig. 30) from the throttle body.

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

INSTALLATION

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

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

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

(4) Install air cleanerduct/air box.

REMOVAL AND INSTALLATION (Continued)

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR—4.7L V–8 ENGINE

The MAP sensor is located on the front of the intake manifold (Fig. 31). An o-ring seals the sensor to the intake manifold.

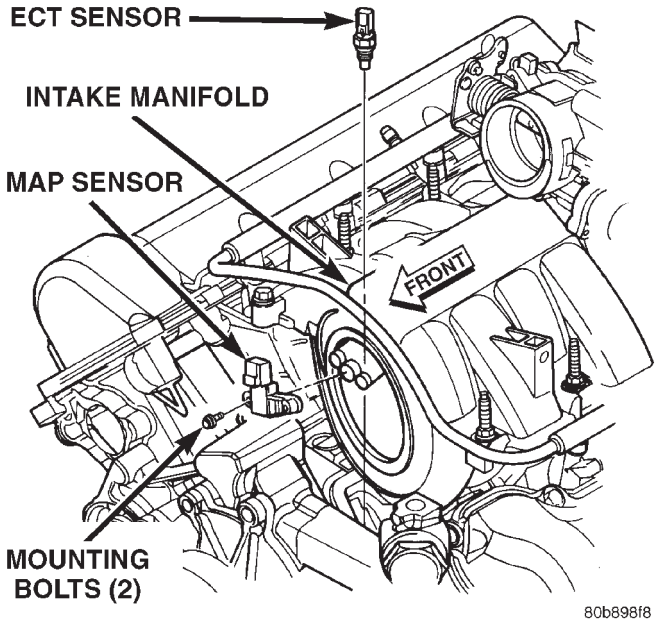


Fig. 31 MAP and ECT Sensor Locations—4.7L V–8 Engine

REMOVAL

(1) Disconnect electrical connector at sensor.
(2) Clean area around MAP sensor.
(3) Remove 2 sensor mounting bolts (Fig. 31).
(4) Remove MAP sensor from intake manifold.

INSTALLATION

(1) Clean MAP sensor mounting hole at intake manifold.
(2) Check MAP sensor o-ring seal for cuts or tears.
(3) Position sensor into manifold.
(4) Install MAP sensor mounting bolts (screws). Tighten screws to 3 N·m (25 in. lbs.) torque.
(5) Connect electrical connector.

POWERTRAIN CONTROL MODULE (PCM)

The PCM is located on the cowl panel in right/rear side of engine compartment (Fig. 32).

REMOVAL

To avoid possible voltage spike damage to 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) If equipped, remove Transmission Control Module (TCM).
(3) Remove coolant reserve/overflow tank.

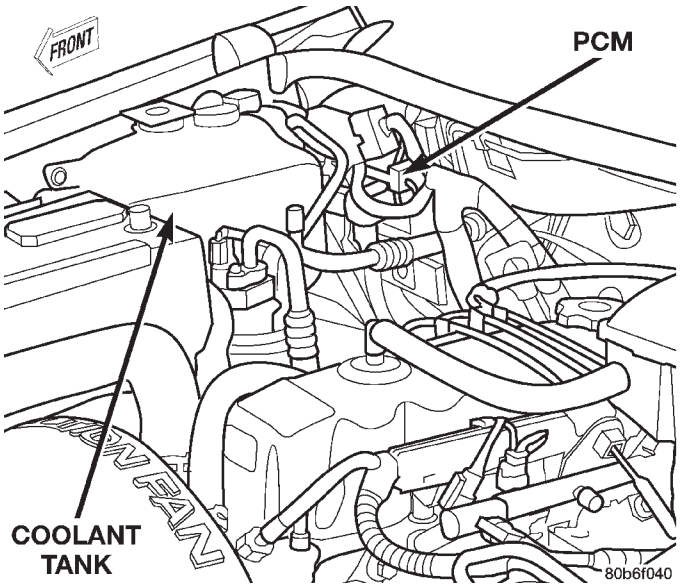


Fig. 32 Powertrain Control Module (PCM) Location

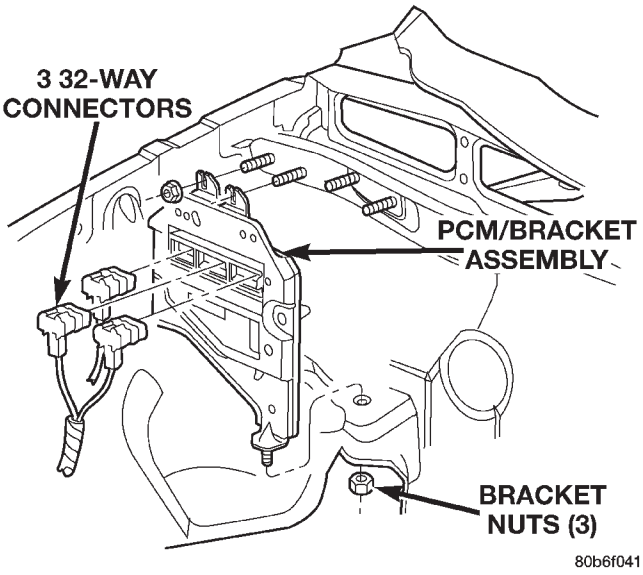


Fig. 33 Powertrain Control Module (PCM) 32–Way Connectors

(4) Remove cover over electrical connectors. Cover snaps onto PCM.
(5) Carefully unplug three 32–way connectors at PCM.
(6) Remove three PCM bracket-to-body mounting nuts (Fig. 33).
(7) Remove PCM/PCM bracket assembly from vehicle.
(8) Remove 3 PCM-to-PCM bracket bolts (screws) (Fig. 34).

INSTALLATION

(1) Check pins in three 32–way electrical connectors for damage. Repair as necessary.
(2) Install PCM to its mounting bracket. Tighten three mounting bolts to 3 N·m (25 in. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

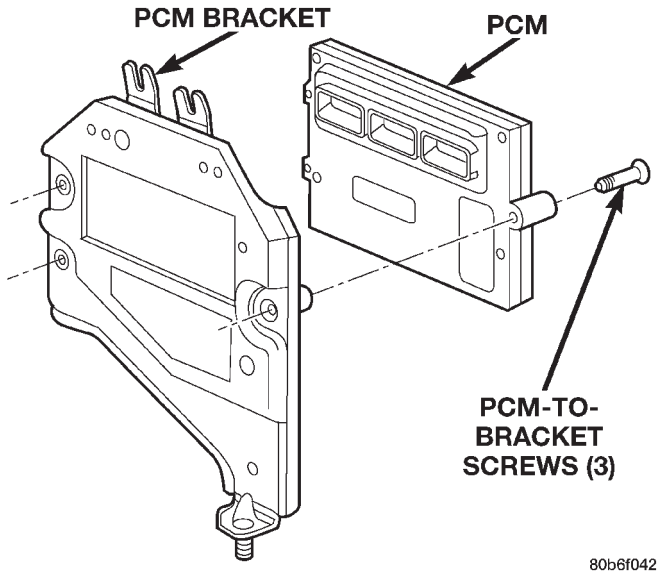


Fig. 34 Powertrain Control Module (PCM) Mounting Bracket

(3) Install PCM/PCM bracket to body. Install 3 nuts and tighten 9 N·m (80 in. lbs.) torque.

(4) Install three 32–way connectors.

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

(6) Install coolant reserve/overflow tank.

(7) If equipped, install Transmission Control Module (TCM).

(8) Connect negative cable to battery.

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

OXYGEN SENSOR

REMOVAL

Oxygen sensor (O2S) locations are shown in (Fig. 35) and (Fig. 36).

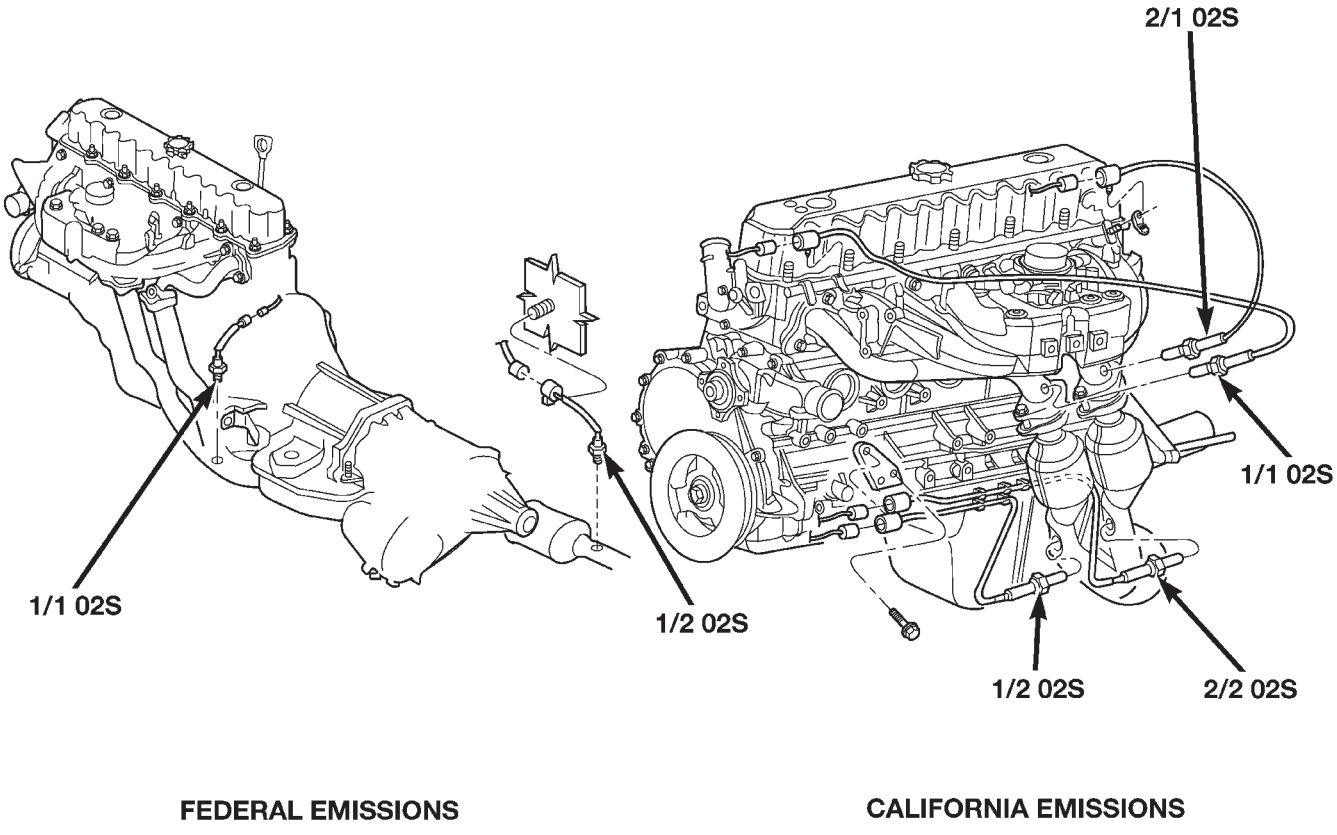


Fig. 35 Oxygen Sensor Locations—4.0L Engine

REMOVAL AND INSTALLATION (Continued)

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

(1) Raise and support vehicle.
(2) Disconnect O2S pigtail harness from main wiring harness.
(3) If equipped, disconnect sensor wire harness mounting clips from engine or body.

CAUTION: When disconnecting 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) If equipped, connect sensor wire harness mounting clips to engine or body. **When Equipped: The O2S pigtail harness must be clipped and/or bolted back to their original positions on engine or body to prevent mechanical damage to wiring.** .
(4) Lower vehicle.

RADIATOR FAN COOLING RELAY

REMOVAL

The Pulse Width Modulated (PWM) cooling fan relay is located below the right headlamp behind the bumper fascia (Fig. 37).
(1) Remove front bumper and grill assembly.

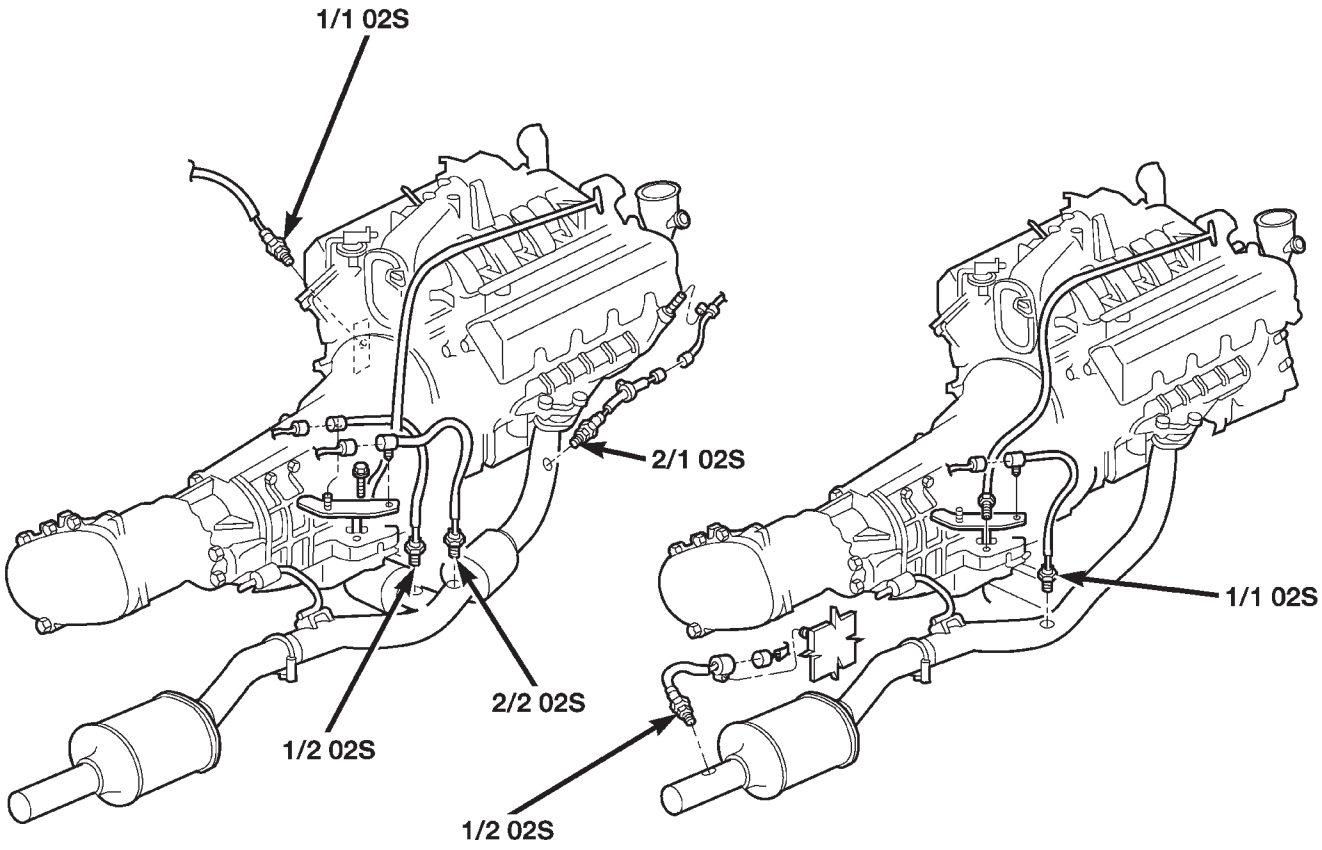


Fig. 36 Oxygen Sensor Locations—4.7L V-8 Engine

REMOVAL AND INSTALLATION (Continued)

(2) Remove 1 support bolt near front of reservoir (Fig. 37).

(3) Remove 2 reservoir mounting bolts.

(4) Remove reservoir from vehicle to gain access to vacuum hose (Fig. 38). Disconnect vacuum hose from reservoir fitting at rear of reservoir.

(5) Disconnect electrical connector at relay (Fig. 39).

(6) Remove 2 relay mounting bolts (Fig. 39) and remove relay.

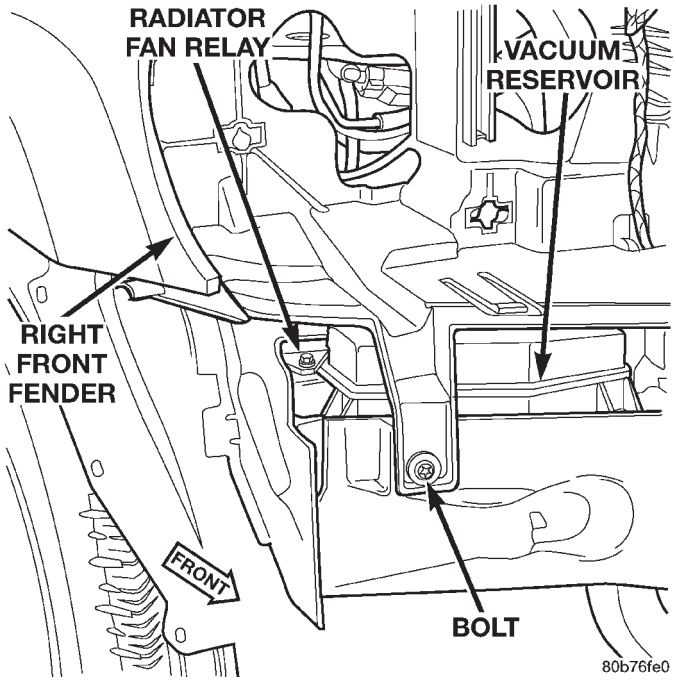


Fig. 37 Radiator Cooling Fan Relay Location

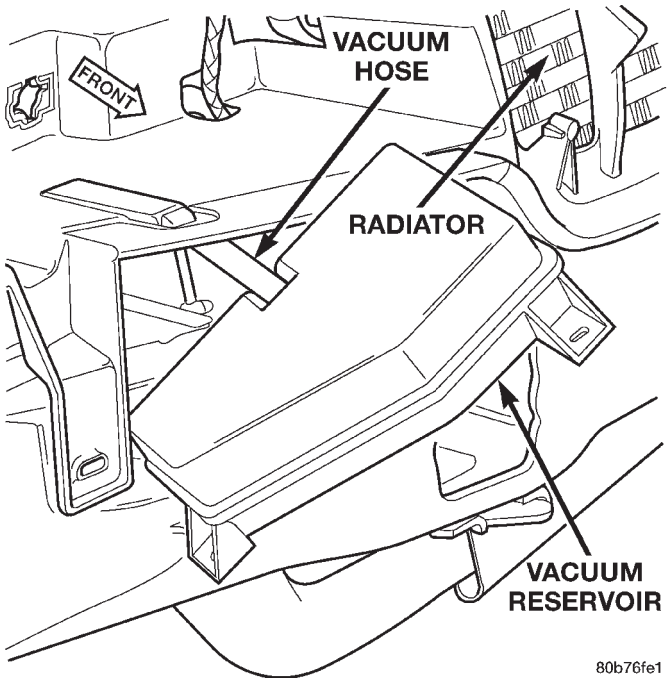


Fig. 38 Vacuum Reservoir Removal/Installation

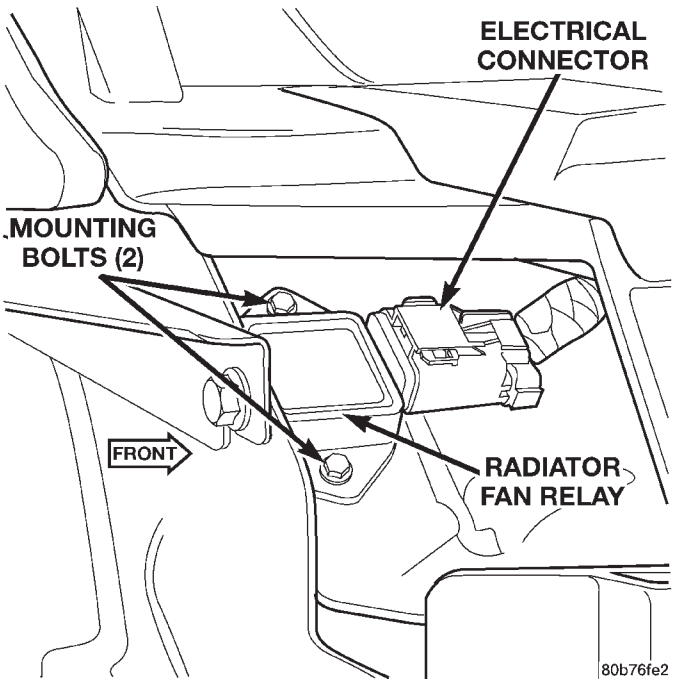


Fig. 39 Radiator Cooling Fan Relay Removal/ Installation

INSTALLATION

(1) Position relay to body and install 2 bolts. Tighten bolts to 3 N·m (25 in. lbs.) torque.

(2) Connect electrical connector to relay.

(3) Connect vacuum hose to reservoir.

(4) Install reservoir and tighten 2 bolts to 3 N·m (25 in. lbs.) torque.

(5) Install front bumper and grill assembly.

AIR CLEANER ELEMENT (FILTER)

REMOVAL

(1) Unlatch four clips retaining air cleaner cover to air cleaner housing (Fig. 40) or (Fig. 41).

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

(3) Remove air cleaner element.

INSTALLATION

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

(2) Install air cleaner element into housing.

(3) Latch clips and clamp cover down to secure. Be sure air cleaner cover is properly seated to air cleaner housing.

AIR CLEANER HOUSING/RESONATOR/DUCTS

REMOVAL

(1) Disconnect air cleaner cover-to-air duct clamp (Fig. 40) or (Fig. 41).

(2) Disconnect air duct at housing.

REMOVAL AND INSTALLATION (Continued)

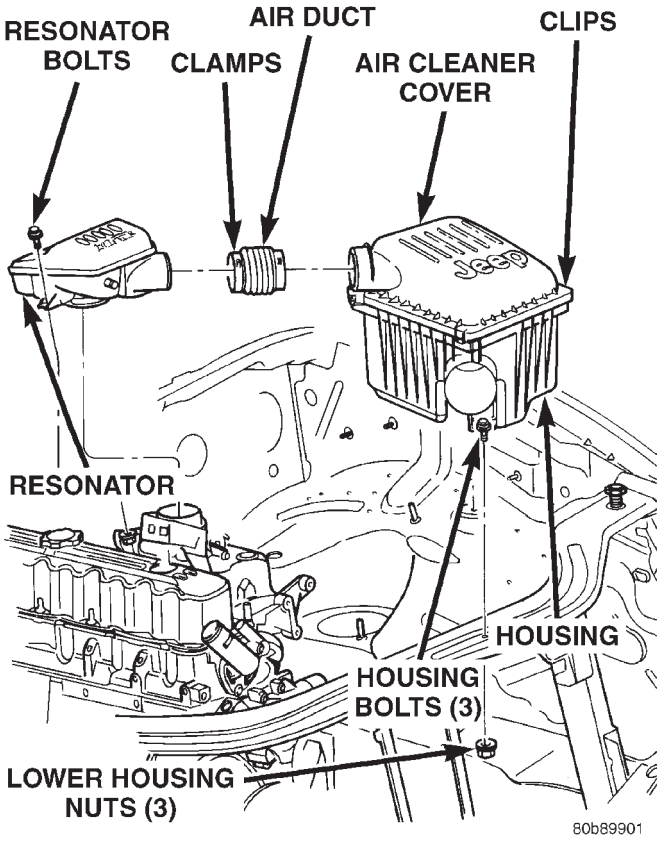


Fig. 40 Air Cleaner Assembly —4.0L Engine

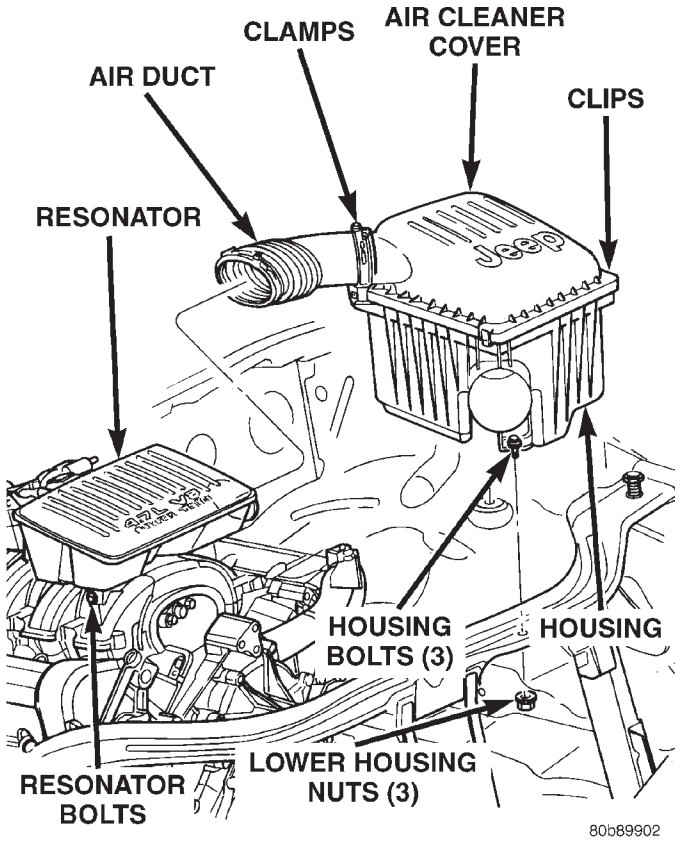


Fig. 41 Air Cleaner Assembly —4.7L V-8 Engine

(3) **Each of the 3 air cleaner housing mounting bolts is attached with 2 nuts (an upper nut and lower nut). DO NOT REMOVE BOLTS. To prevent stripping bolts, only remove lower nuts. The lower housing nuts are located under left front inner fender (Fig. 40) or (Fig. 41).**

(a) To gain access to lower nuts, raise vehicle.

(b) Remove clips retaining rubber inner fender shield.

(c) Pry back shield enough to gain access to lower nuts.

(d) Remove 3 nuts.

(e) Remove air cleaner assembly from vehicle.

(4) 4.0L Engine: If resonator is to be removed, disconnect breather tube at resonator, disconnect air duct clamp at resonator (Fig. 40) and remove 1 resonator mounting bolt. Remove resonator from throttle body by loosening clamp (Fig. 42).

(5) 4.7L V-8 Engine: If resonator is to be removed, disconnect breather tube at resonator, disconnect air duct clamp at resonator (Fig. 41) and remove 2 resonator mounting bolts (at sides of resonator). Remove resonator from throttle body by loosening clamp at throttle body.

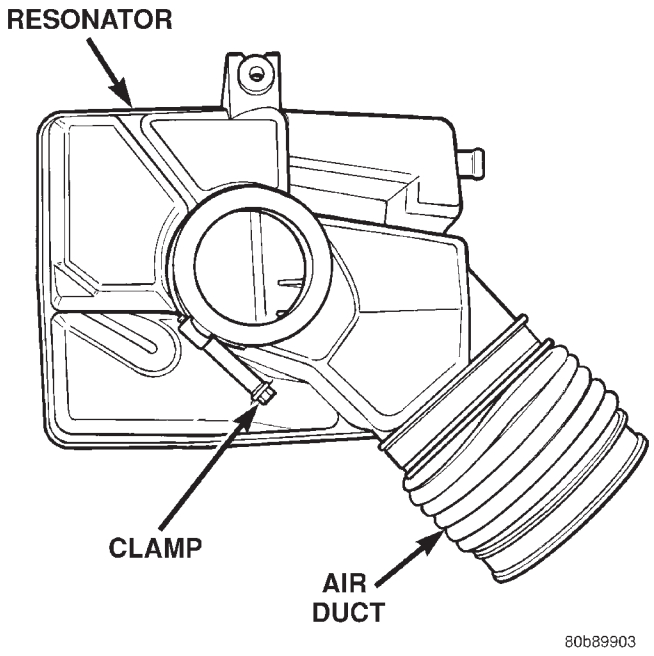


Fig. 42 Air Cleaner Resonator Clamp (Bottom View)—4.0L Engine

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Position air cleaner assembly to body and install 3 nuts. Tighten nuts to 10 N·m (93 in. lbs.) torque. **To prevent excessive vibration transmitted through housing, the nuts must be properly torqued. Do not overtighten nuts.**

(2) If resonator was removed: Install resonator and bolts. Tighten bolts to 4 N·m (35 in. lbs.) torque. Tighten clamp at throttle body to 4 N·m (35 in. lbs.) torque.

(3) Position fender liner and install clips.

(4) Connect air duct at housing (Fig. 40) or (Fig. 41).

(5) Tighten air duct clamp.

ENGINE COOLANT TEMPERATURE SENSOR—4.0L ENGINE

REMOVAL

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

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

(2) Disconnect electrical connector from ECT sensor (Fig. 43).

(3) Remove sensor from thermostat housing.

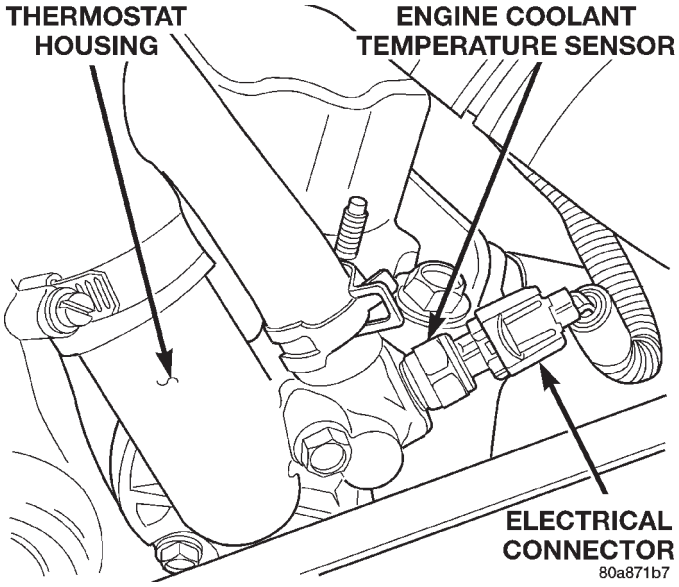


Fig. 43 Engine Coolant Temperature Sensor—4.0L Engine

INSTALLATION

(1) Install sensor.

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

(3) Connect electrical connector to sensor.

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

ENGINE COOLANT TEMPERATURE SENSOR—4.7L V-8 ENGINE

REMOVAL

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

The ECT sensor is located near the front of the intake manifold (Fig. 44).

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

(2) Disconnect electrical connector from ECT sensor.

(3) Remove sensor from intake manifold.

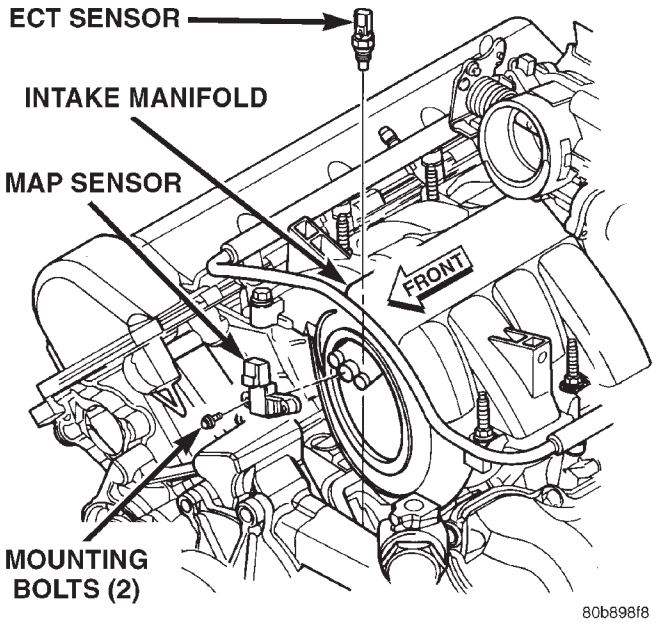


Fig. 44 Engine Coolant Temperature Sensor—4.7L V–8 Engine

INSTALLATION

(1) Install sensor.

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

(3) Connect electrical connector to sensor.

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

REMOVAL AND INSTALLATION (Continued)

INTAKE MANIFOLD AIR TEMPERATURE SENSOR—4.0L ENGINE

The Intake Manifold Air Temperature (IAT) sensor is installed into the intake manifold plenum near the front of the throttle body (Fig. 45).

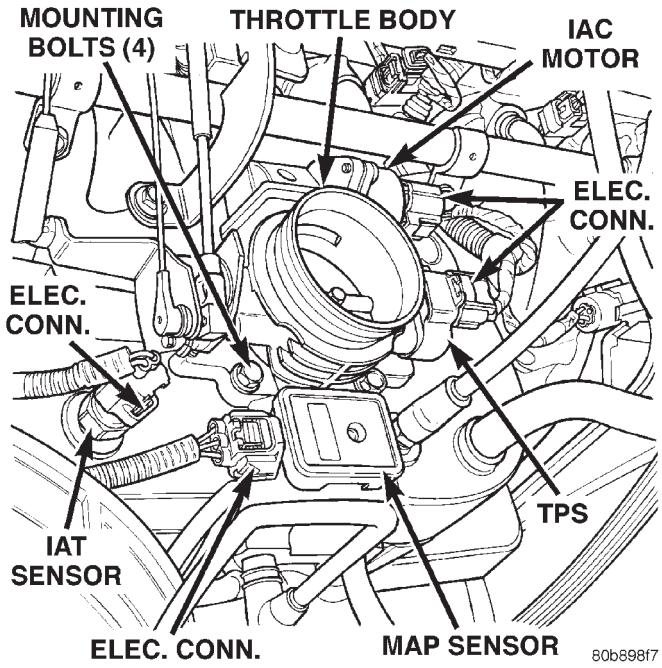


Fig. 45 Intake Manifold Air Sensor Location—4.0L Engine

REMOVAL

(1) Disconnect electrical connector from sensor.
(2) Remove sensor from intake manifold.

INSTALLATION

(1) Install sensor into intake manifold. Tighten sensor to 28 N·m (20 ft. lbs.) torque.
(2) Connect electrical connector to sensor.

INTAKE MANIFOLD AIR TEMPERATURE SENSOR—4.7L V-8 ENGINE

The Intake Manifold Air Temperature (IAT) sensor is installed into the intake manifold plenum near the left side of the throttle body (Fig. 46).

REMOVAL

(1) Disconnect electrical connector from sensor.
(2) Remove sensor from intake manifold.

INSTALLATION

(1) Install sensor into intake manifold. Tighten sensor to 28 N·m (20 ft. lbs.) torque.
(2) Connect electrical connector to sensor.

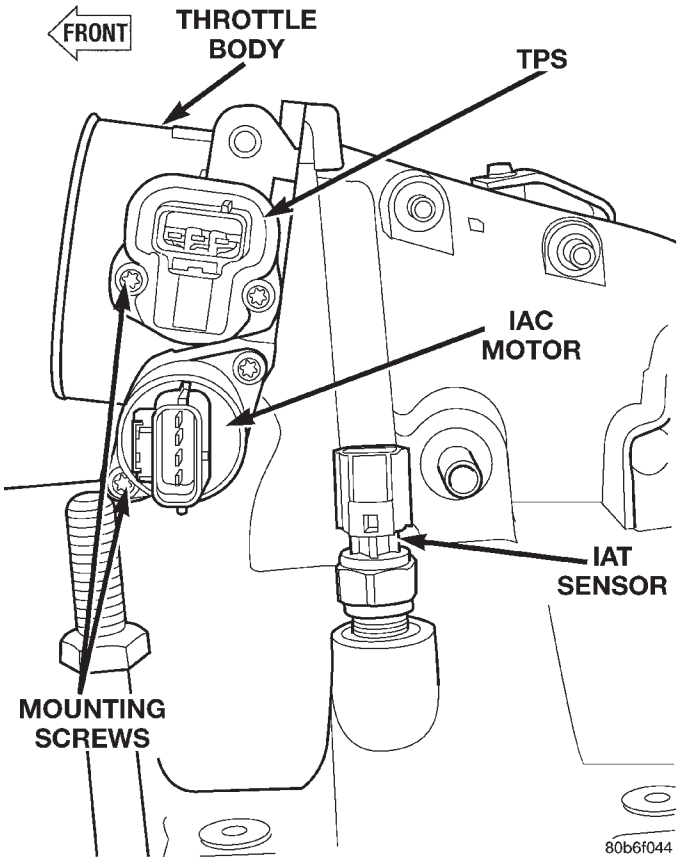


Fig. 46 Intake Manifold Air Sensor Location—4.7L V-8 Engine

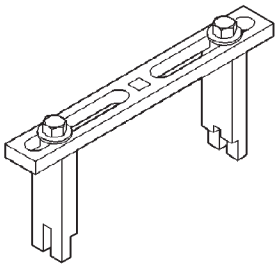
SPECIFICATIONS

TORQUE CHART

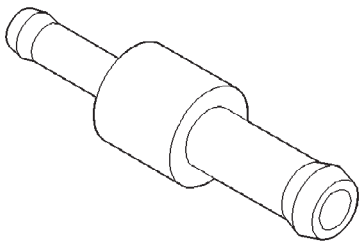
DESCRIPTION	TORQUE
Air Cleaner Housing Mount. Nuts	10 N·m (93 in. lbs.)
Air Cleaner Air Duct Clamps	4 N·m (35 in. lbs.)
Air Cleaner Resonator Bolts	4 N·m (35 in. lbs.)
Engine Coolant Temperature Sensor—4.0L Engine	11 N·m (96 in. lbs.)
Engine Coolant Temperature Sensor—4.7L Engine	11 N·m (96 in. lbs.)
Fuel Hose Clamps	1 N·m (10 in. lbs.)
IAC Motor-To-Throttle Body Bolts—4.0L Engine	7 N·m (60 in. lbs.)
IAC Motor-To-Throttle Body Bolts—4.7L Engine	7 N·m (60 in. lbs.)
Intake Manifold Air Temp. Sensor—4.0L Engine	28 N·m (20 ft. lbs.)
Intake Manifold Air Temp. Sensor—4.7L Engine	28 N·m (20 ft. lbs.)
MAP Sensor Mounting Screws—4.0L Engine	3 N·m (25 in. lbs.)
MAP Sensor Mounting Screws—4.7L Engine	3 N·m (25 in. lbs.)
Oxygen Sensor—All Engines	30 N·m (22 ft. lbs.)
PCM-to-Mounting Bracket Screws	3 N·m (25 in. lbs.)
PCM-to-Mounting Bracket Screws	9 N·m (80 in. lbs.)
Radiator Cooling Fan Relay Bolts	3 N·m (25 in. lbs.)
Throttle Body Mounting Bolts—4.0L Engine	11 N·m (100 in. lbs.)
Throttle Body Mounting Bolts—4.7L Engine	12 N·m (105 in. lbs.)
TPS Mounting Screws—4.0L Engine	7 N·m (60 in. lbs.)
TPS Mounting Screws—4.7L Engine	7 N·m (60 in. lbs.)

SPECIAL TOOLS

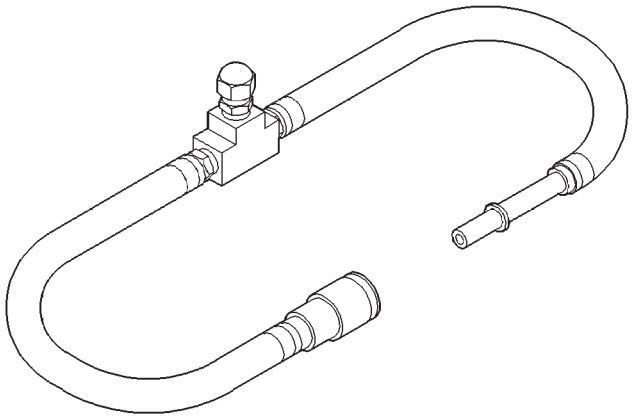
FUEL SYSTEM



Spanner Wrench—6856



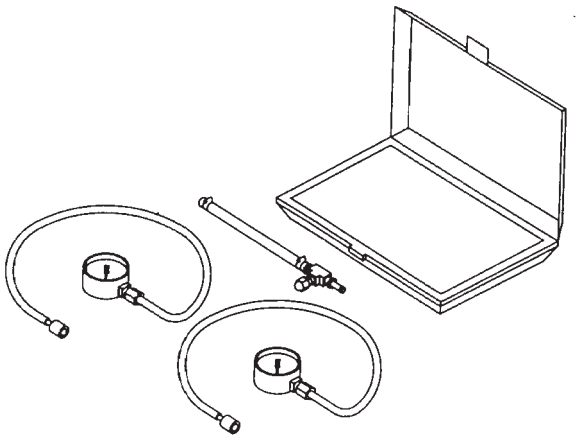
Fitting, Air Metering—6714



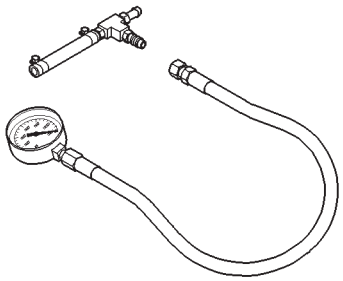
Adapters, Fuel Pressure Test—6539 and/or 6631

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

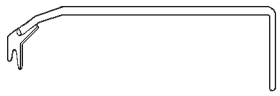
SPECIAL TOOLS (Continued)



Test Kit, Fuel Pressure—5069



Test Kit, Fuel Pressure—C-4799-B



Fuel Line Removal Tool—6782