

FUEL SYSTEM

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GENERAL INFORMATION

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GENERAL INFORMATION

INTRODUCTION

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

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

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

FUEL REQUIREMENTS

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

Use unleaded gasolines having a minimum posted octane of 87.

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

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

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

GASOLINE/OXYGENATE BLENDS

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

The following are generally used in gasoline blends:

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

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

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

DO NOT USE GASOLINES CONTAINING METHANOL.

GENERAL INFORMATION (Continued)

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

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

Reformulated Gasoline

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

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

Materials Added to Fuel

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

FUEL DELIVERY SYSTEM

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DESCRIPTION AND OPERATION

FUEL DELIVERY SYSTEM

The front wheel drive car uses a plastic fuel tank located rear center of the vehicle.

The in-tank fuel pump module contains the fuel pump and pressure regulator. The pump is serviced as part of the fuel pump module. Refer to Fuel Pump Module.

The fuel delivery system contains a replaceable in-line filter. The filter attaches to the frame above the rear of the fuel tank. Refer to the Maintenance Schedules in the Introduction section of this manual for recommended fuel filter replacement intervals.

A returnless fuel system is used on all vehicles. Fuel is returned through the fuel pump module and back to the fuel tank. A separate fuel return line from the tank to the engine is no longer used.

Relieve fuel system pressure before servicing fuel system components. Refer to the Fuel System Pressure Release Procedure and follow all Cautions and Warnings. Most fuel system components attach to the fuel lines with quick connect fittings. Refer to Quick Connect Fittings in this section.

FUEL PUMP MODULE

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

- Electric fuel pump
- Fuel pump reservoir
- Inlet strainer
- Fuel pressure regulator
- Fuel gauge sending unit
- Fuel supply line connection

The inlet strainer, fuel pressure regulator and fuel level sensor are the only serviceable items. If the fuel pump or electrical wiring harness requires service, replace the fuel pump module.

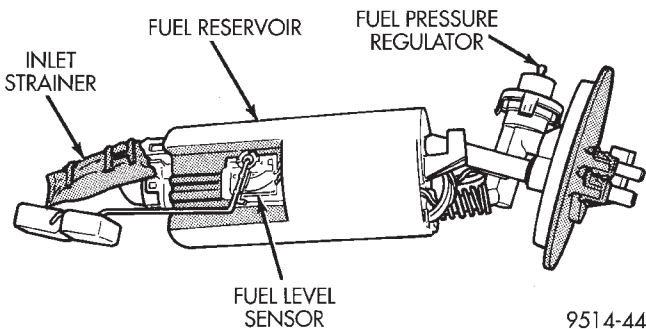


Fig. 1 Fuel Pump Module

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DESCRIPTION AND OPERATION (Continued)

ELECTRIC FUEL PUMP

The electric fuel pump is located in and is part of the fuel pump module. It is a positive displacement, gerotor type, immersible pump with a permanent magnet electric motor. The pump draws fuel through a strainer and pushes it through the motor to the outlet. The pump contains one check valve. The check valve, in the pump outlet, maintains pump pressure during engine off conditions. The fuel pump relay provides voltage to the fuel pump.

The fuel pump has a maximum deadheaded pressure output of approximately 635 kPa (95 psi). The regulator adjusts fuel system pressure to approximately 338 kPa (49 psi).

FUEL PUMP ELECTRICAL CONTROL

Voltage to operate the electric pump is supplied through the fuel pump relay. For an electrical operational description of the fuel pump refer to fuel Pump Relay—PCM Output.

ELECTRICAL PUMP REPLACEMENT

The electric fuel pump is not serviceable. If the fuel pump or electrical wiring harness needs replacement, the complete fuel pump module must be replaced. Perform the Fuel System Pressure Release procedure before servicing the fuel pump.

FUEL LEVEL SENSOR

The level sensor is attached to the side of the fuel pump module. The level sensor consists of a float, an arm, and a variable resistor. As the fuel level increases, the float and arm move up. This decreases the sending unit resistance, causing the fuel gauge on the instrument panel to read full.

FUEL TANK

The fuel tanks of all Chrysler Motors built vehicles are equipped with fuel and vapor controls that allow the vehicle to pass a full 360° rollover without fuel leakage.

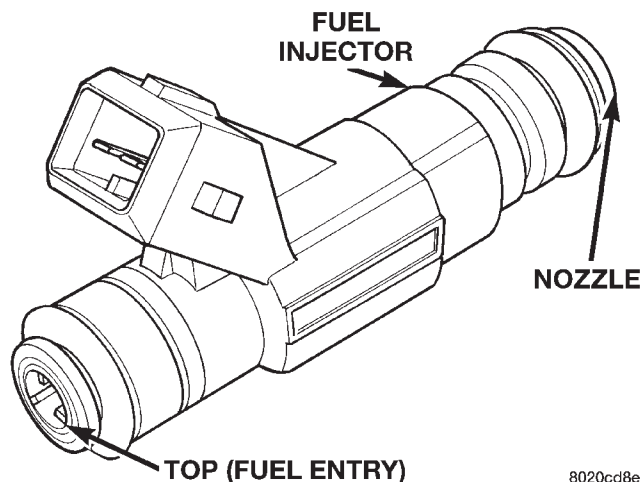
Front Wheel Drive fuel delivery systems contain a fuel tank rollover valve. The valve is mounted on top of the fuel tank. The valve functions as a tank pressure control valve while the vehicle is upright, but contains a check valve that prevents fuel from escaping from the fuel tank when the vehicle is turned over.

The fuel filler cap acts as a pressure/vacuum relief valve. When air pressure inside the fuel tank gets too high or too low, the fuel filler cap opens to relieve the difference in pressure.

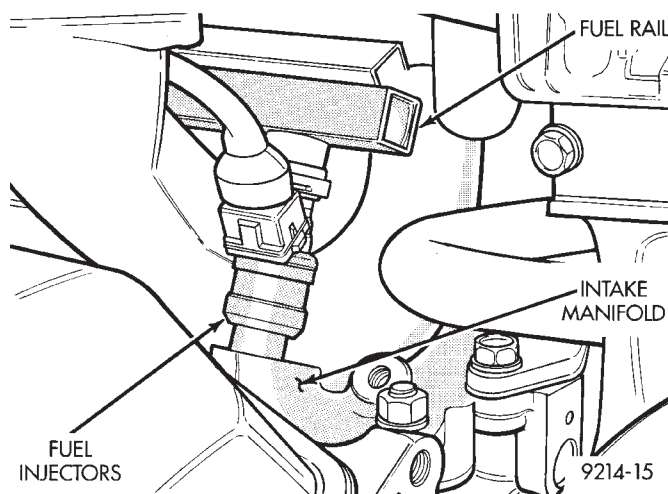
An evaporation control system restricts fuel evaporation into the atmosphere and reduces unburned hydrocarbons. Vapors from the fuel tank are collected in a charcoal filled canister. The vapors are held in the canister until the engine is operating. When the engine is running, the vapors are drawn through the intake manifold into the combustion chambers.

FUEL INJECTORS

The fuel injectors are 12 ohm electrical solenoids (Fig. 2). 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 hollow cone. The spraying action atomizes the fuel, adding it to the air entering the combustion chamber. The injectors are positioned in the intake manifold.

**Fig. 2 Fuel Injector**

The injectors are positioned in the intake manifold with the nozzle ends directly above the intake valve port (Fig. 3).

**Fig. 3 Fuel Injector Location—Typical****FUEL PRESSURE REGULATOR**

The fuel system uses a nonadjustable pressure regulator that maintains fuel system pressure at approximately 338 kPa (49 psi). The fuel pressure regulator contains a diaphragm, calibrated spring and a fuel return valve. The spring pushes down on

DESCRIPTION AND OPERATION (Continued)

the diaphragm and closes off the fuel return port. System fuel pressure reflects the amount of fuel pressure required to open the return port.

The pressure regulator is a mechanical device that is NOT controlled by the PCM or engine vacuum.

PRESSURE-VACUUM FILLER CAP

The loss of any fuel or vapor out of the filler tube neck is prevented by the use of a safety filler cap. The cap releases only under significant pressure 10.9 to 13.45 kPa (1.58 to 1.95 psi). The vacuum release for all gas caps is between .97 and 2.0 kPa (.14 and .29 psi). The cap must be replaced by a similar unit in order for the system to remain effective.

WARNING: REMOVE FUEL FILLER TUBE CAP TO RELIEVE TANK PRESSURE BEFORE REMOVING OR REPAIRING FUEL SYSTEM COMPONENTS.

Vehicle	Liters	U.S. Gallons
JX	60.0	16.0

Nominal refill capacities are shown. A variation may be observed from vehicle due to manufacturing tolerance and refill procedure.

QUICK-CONNECT FITTINGS

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

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

Fuel tubes connect fuel system components with plastic quick-connect fuel fittings. The fitting contains non-serviceable O-ring seals (Fig. 4).

CAUTION: Quick-connect fittings are not serviced separately. Do not attempt to repair damaged quick-connect fittings or fuel tubes. Replace the complete fuel tube/quick-connect fitting assembly.

The quick-connect fitting consists of the O-rings, retainer and casing (Fig. 4). When the fuel tube enters the fitting, the retainer locks the shoulder of the nipple in place and the O-rings seal the tube.

ROLLOVER VALVES

All vehicles have 2 rollover valves on top of the fuel tank. The valves prevent fuel flow through the fuel tank vent valve hoses should the vehicle rollover.

The rollover valves on the fuel tank are not serviceable.

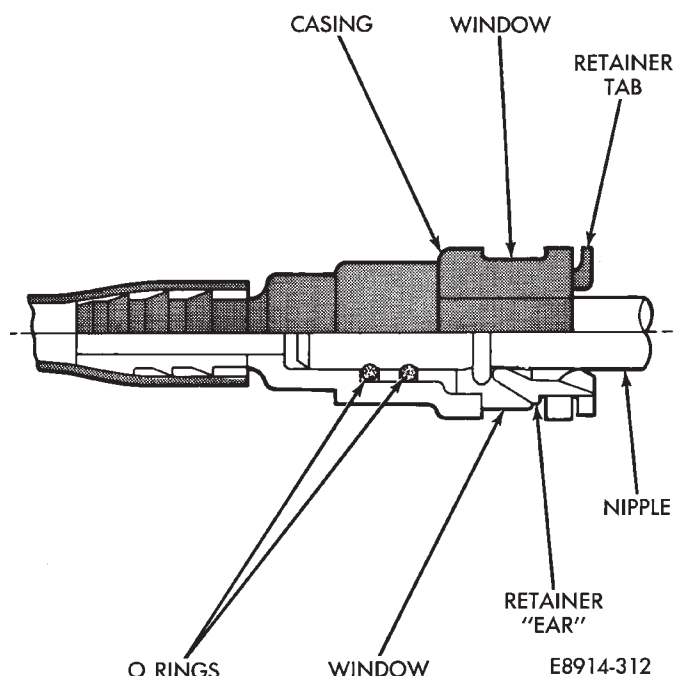


Fig. 4 Plastic Quick-Connect Fittings

DIAGNOSIS AND TESTING

FUEL PUMP PRESSURE TEST—2.4L ENGINES

The fuel system operates at approximately 338 kPa (48 psi). Check fuel system pressure at the test port on the fuel rail.

- (1) Remove cap from fuel pressure test port on fuel rail.
- (2) Connect Fuel Pressure Gauge C-4799B to test port (Fig. 5).

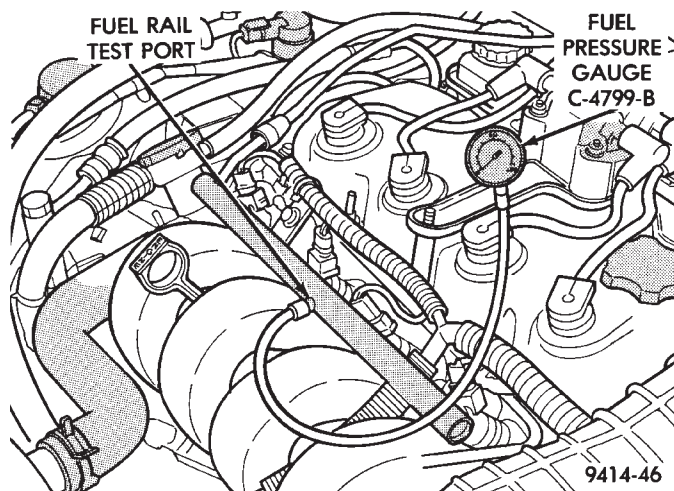


Fig. 5 Checking Fuel Pressure at Intake Manifold

CAUTION: When using the ASD Fuel System Test, the ASD relay and fuel pump relay remain energized for 7 minutes or until the test is stopped, or until the ignition switch is turned to the Off position.

DIAGNOSIS AND TESTING (Continued)

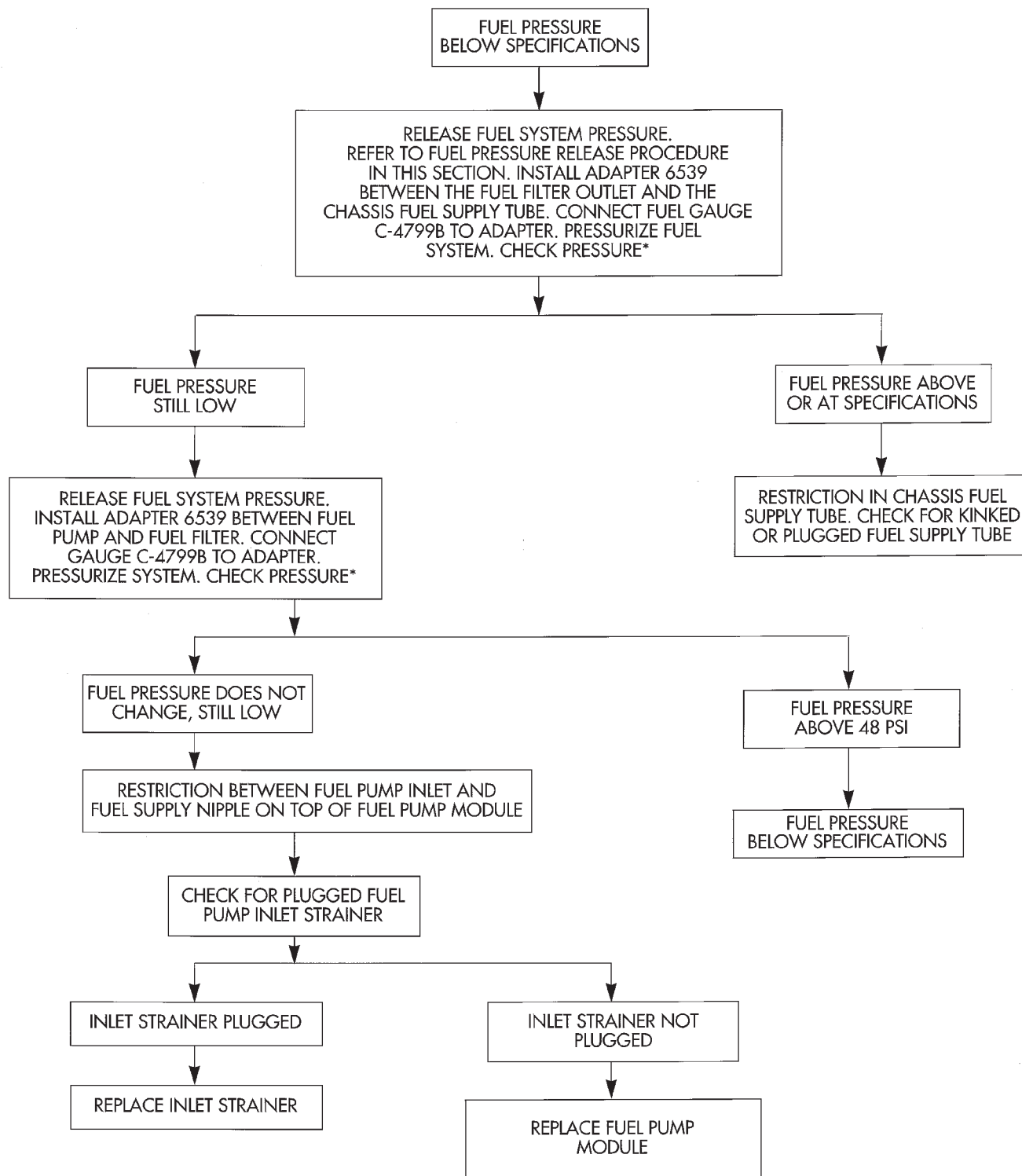
(3) Place ignition key in the ON position. Using DRB scan tool, access ASD Fuel System Test. The ASD Fuel System Test will activate the fuel pump and pressurize the system.

- If the gauge reading equals 338 kPa (48 psi) further testing is not required. If pressure is not correct, record the pressure.

- If pressure is above specifications, check for a kinked or restricted fuel return tube (from filter to pump module). If the fuel return tube is not pinched or restricted, replace the fuel pressure regulator.

- If fuel pressure is below specifications, refer to the diagnosis chart for Fuel Pressure Below Specifications.

DIAGNOSIS AND TESTING (Continued)

FUEL PRESSURE BELOW SPECIFICATIONS

*Pressure gauge should rise rapidly. If pressure rises slowly, inlet strainer is plugged enough to cause drive ability problems.

DIAGNOSIS AND TESTING (Continued)

FUEL PUMP PRESSURE TEST—2.5L ENGINE

WARNING: FUEL SYSTEM PRESSURE MUST BE RELEASED BEFORE A FUEL SYSTEM HOSE OR COMPONENT IS DISCONNECTED.

The fuel system operates at approximately 338 kPa (49±2 psi).

- (1) Perform fuel system pressure release procedure.
- (2) Remove fuel supply hose quick connector from the chassis line (at the engine). Refer to Quick Connect Fittings in this section.
- (3) Connect Fuel Pressure Gauge C-4799 to Fuel Pressure Test Adapter 6539 (Fig. 6). Install the adapter between fuel supply hose and chassis fuel line assembly.

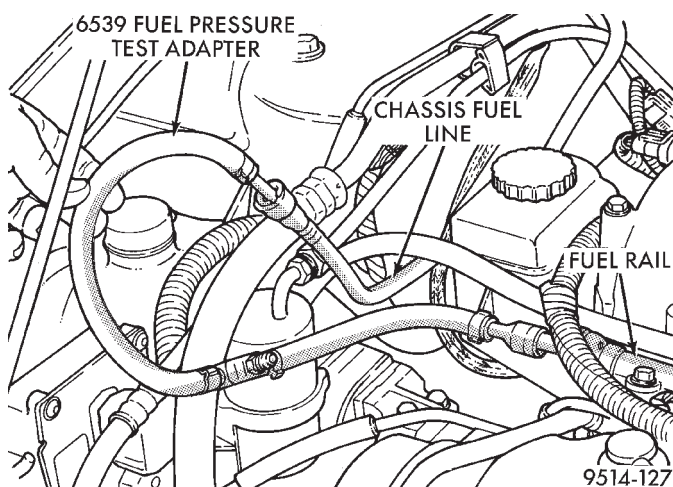


Fig. 6 Fuel Pressure Test Adapter

CAUTION: When using the ASD Fuel System Test, the ASD relay and fuel pump relay remain energized for 7 minutes or until the test is stopped, or until the ignition switch is turned to the Off position.

- (4) Place the ignition key in the ON position. Using the DRB scan tool, access ASD Fuel System Test. The ASD Fuel System Test will activate the fuel pump and pressurize the system.

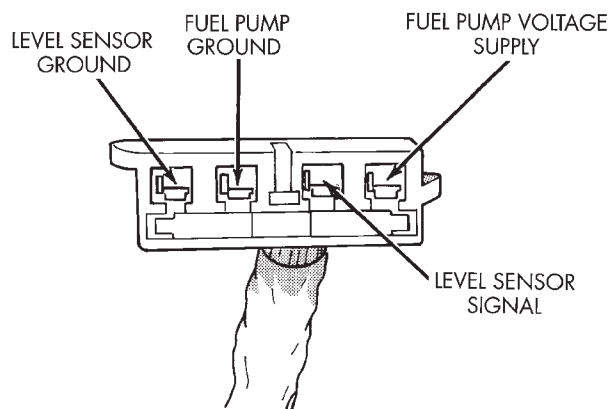
- If the gauge reading equals 338 kPa (49±2 psi) further testing is not required. If pressure is not correct, record the pressure.
- If pressure is above specifications, check for a kinked or restricted fuel return tube (from filter to pump module). If the fuel return tube is not pinched or restricted, replace the fuel pressure regulator.
- If pressure is below specifications, refer to Fuel Pressure Below Specifications chart.

FUEL LEVEL SENSOR

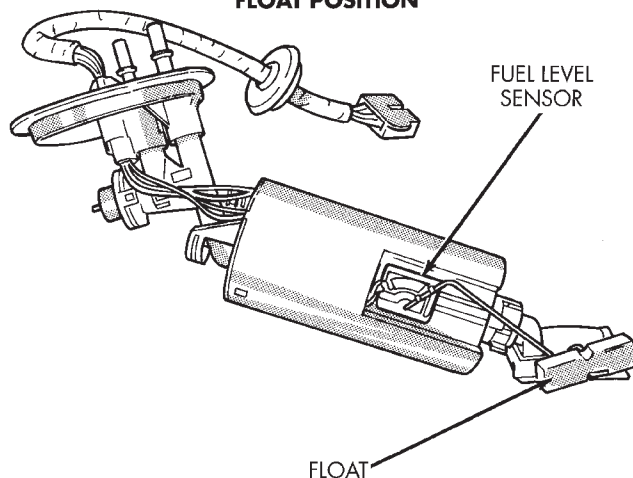
This procedure tests the resistance of the level sensor itself. It does not test the level sensor circuit. Refer to Group 8W - Wiring Diagrams for circuit identification.

The level sensor is a variable resistor. Its resistance changes with the amount of fuel in the tank.

The float arm attached to the sensor moves as the fuel level changes. To test the level sensor, connect an ohmmeter across the sensor signal and sensor ground terminals of the fuel pump module connector (Fig. 7). Move the float lever over the entire range to the positions shown in the resistance chart (Fig. 7). **Record the resistance at each end point. Replace the level sensor if the resistance is not within specifications, or an open circuit is noted during the entire range inspection.**

FUEL PUMP MODULE CONNECTOR
TERMINAL PIN-OUTS

FLOAT POSITION



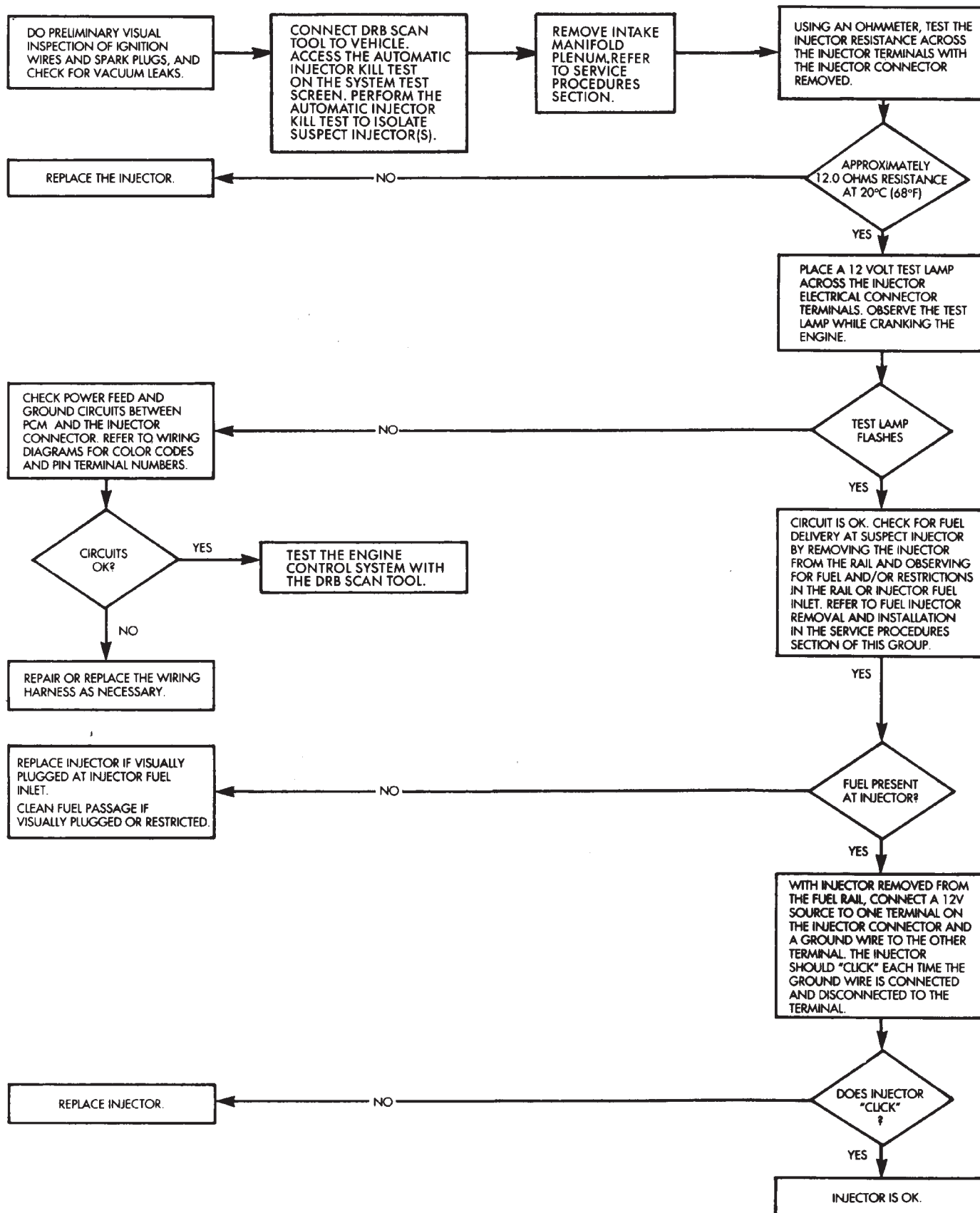
FLOAT POSITION (HEIGHT)	RESISTANCE
SENSOR FULL STOP	.50 OHMS MINIMUM
SENSOR EMPTY STOP	1050 ± 10 OHMS

9514-120

Fig. 7 Level Sensor Diagnosis

FUEL INJECTORS

For fuel injector diagnosis, refer to the Fuel Injector Diagnosis charts. For poor fuel economy diagnosis or engine miss, also refer to Transmission Driveplate in this section.



SERVICE PROCEDURES

FUEL SYSTEM PRESSURE RELEASE
PROCEDURE—2.4L

WARNING: RELEASE FUEL SYSTEM PRESSURE BEFORE SERVICING FUEL SYSTEM COMPONENTS. SERVICE VEHICLES IN WELL VENTILATED AREAS AND AVOID IGNITION SOURCES. NEVER SMOKE WHILE SERVICING THE VEHICLE.

- (1) Disconnect negative cable from auxiliary jumper terminal.
- (2) Remove fuel filler cap.
- (3) Remove protective cap from fuel pressure test port on fuel rail (Fig. 8).

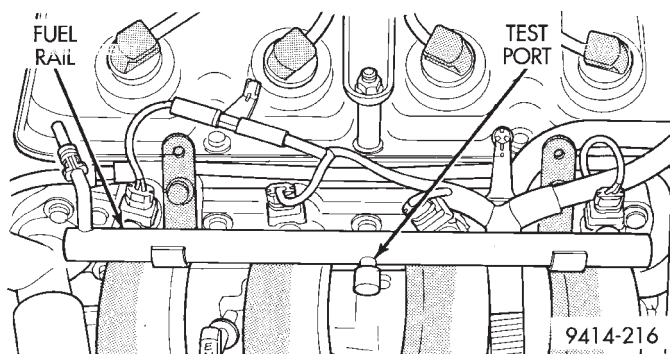


Fig. 8 Fuel Pressure Test Port—Typical

- (4) Place open end of fuel pressure release hose, Special Tool number C-4799-1, into an approved gasoline container. Connect other end of hose C-4799-1 to fuel pressure test port (Fig. 9). Fuel pressure will bleed off through the hose into the gasoline container. Fuel gauge C-4799-A contains hose C-4799-1.

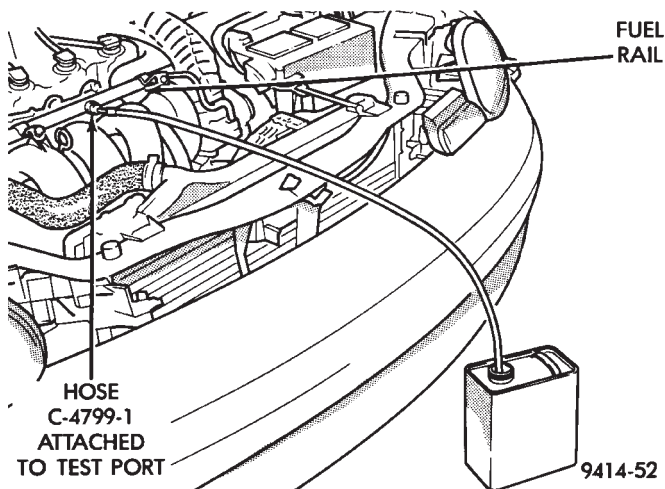


Fig. 9 Releasing Fuel Pressure

FUEL SYSTEM PRESSURE RELEASE
PROCEDURE—2.5L

CAUTION: Do not attempt to start the engine for several minutes to avoid hydrostatic lock.

- (1) Disconnect the fuel rail electrical harness from the engine harness. Refer to Group 8W, Wiring Diagrams.
- (2) Connect one end of a jumper wire to the A142 circuit terminal of the fuel rail harness connector.
- (3) Connect the other end of the jumper wire to a 12 volt power source.
- (4) Connect one end of a jumper wire to a good ground source.
- (5) Momentarily ground one of the injectors by connecting the other end of the jumper wire to an injector terminal in the harness connector. Repeat procedure for 2 to 3 injectors.

FUEL TANK DRAINING

- (1) Remove fuel cap slowly to release tank pressure.
- (2) With vehicle on a hoist, drain fuel from tank. Support fuel tank with a support such as a transmission jack stand.
- (3) Position a fuel approved container, with a capacity of at least 16 gallons, under the drain plug located on the bottom left edge of the tank.
- (4) Remove drain plug and allow fuel to drain (Fig. 10).

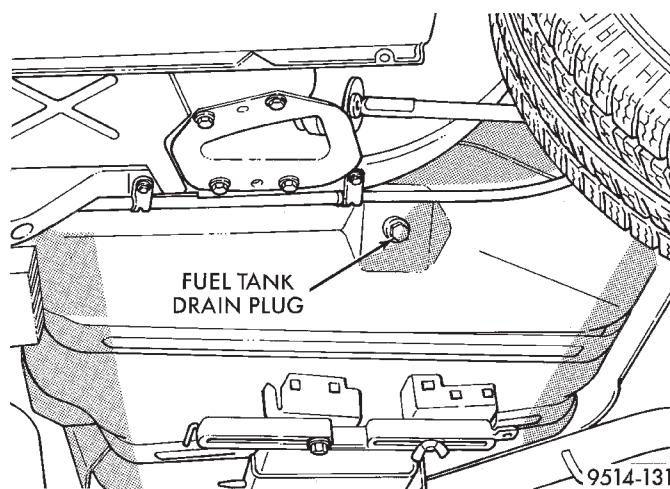


Fig. 10 Fuel Tank Drain Plug

WARNING: DRAIN PLUG MUST BE INSTALLED AT THIS TIME AS THERE WILL BE 1 TO 2 GALLONS OF FUEL LEFT IN THE TANK.

- (5) When tank is no longer draining, install drain plug. Tighten plug to 32 in. lbs.

SERVICE PROCEDURES (Continued)

HOSES AND CLAMPS

Inspect all hose connections (clamps and quick connect fittings) for completeness and leaks. Replace cracked, scuffed, or swelled hoses. Replace hoses that rub against other vehicle components or show sign of wear.

Fuel injected vehicles use specially constructed hoses. When replacing hoses, only use hoses marked EFM/EFI.

When installing hoses, ensure that they are routed away from contact with other vehicle components that could rub against them and cause failure. Avoid contact with clamps or other components that cause abrasions or scuffing. Ensure that rubber hoses are properly routed and avoid heat sources.

The hose clamps have rolled edges to prevent the clamp from cutting into the hose. Only use clamps that are original equipment or equivalent. Other types of clamps may cut into the hoses and cause high pressure fuel leaks. Tighten hose clamps to 1 N·m (10 in. lbs.) torque.

QUICK-CONNECT FITTINGS

REMOVAL

When disconnecting a quick-connect fitting, the retainer will remain on the fuel tube nipple.

WARNING: RELEASE FUEL SYSTEM PRESSURE BEFORE DISCONNECTING A QUICK-CONNECT FITTINGS. REFER TO THE FUEL PRESSURE RELEASE PROCEDURE.

- (1) Disconnect negative cable from battery.
- (2) Perform Fuel Pressure Release Procedure. Refer to the Fuel Pressure Release Procedure in this section.
- (3) Squeeze retainer tabs together and pull fuel tube/quick-connect fitting assembly off of fuel tube nipple. The retainer will remain on fuel tube.

INSTALLATION

CAUTION: Never install a quick-connect fitting without the retainer being either on the fuel tube or already in the quick-connect fitting. In either case, ensure the retainer locks securely into the quick-connect fitting by firmly pulling on fuel tube and fitting to ensure it is secured.

- (1) Using a clean lint free cloth, clean the fuel tube nipple and retainer.
- (2) Prior to connecting the fitting to the fuel tube, coat the fuel tube nipple with clean 30 weight engine oil.
- (3) Push the quick-connect fitting over the fuel tube until the **retainer seats and a click is heard.**

(4) The plastic quick-connect fitting has windows in the sides of the casing. When the fitting completely attaches to the fuel tube, the retainer locking ears and the fuel tube shoulder are visible in the windows. If they are not visible, the retainer was not properly installed (Fig. 11). **Do not rely upon the audible click to confirm a secure connection.**

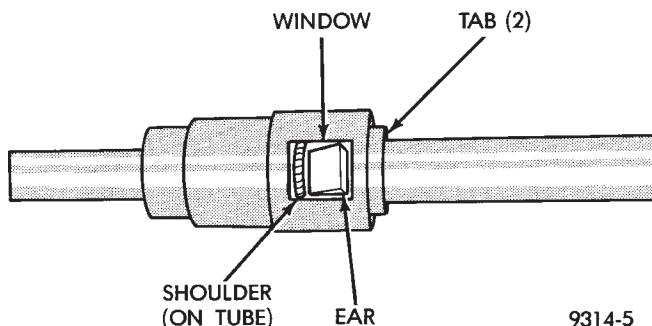


Fig. 11 Plastic Quick-Connect Fitting/Fuel Tube Connection

CAUTION: When using the ASD Fuel System Test, the Auto Shutdown (ASD) Relay remains energized for either 7 minutes, until the test is stopped, or until the ignition switch is turned to the Off position.

(5) Use the DRB scan tool ASD Fuel System Test to pressurize the fuel system. Check for leaks.

PLASTIC RETAINER RING TYPE FITTING

This type of fitting can be identified by the use of a full-round plastic retainer ring (Fig. 12) usually black in color.

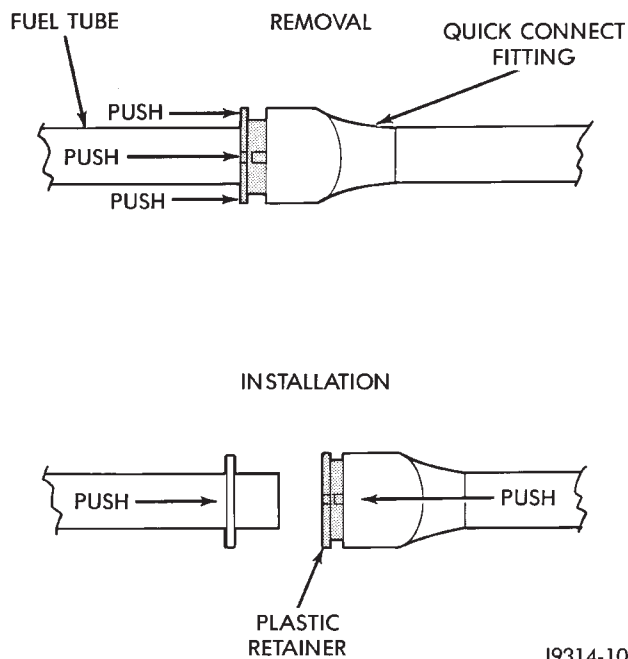


Fig. 12 Plastic Retainer Ring Type Fitting

SERVICE PROCEDURES (Continued)

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

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

DISCONNECTION/CONNECTION

- (1) Disconnect negative battery cable from the battery.
- (2) Perform the fuel pressure release procedure. Refer to the Fuel Pressure Release Procedure in this section.
- (3) Clean the fitting of any foreign material before disassembly.
- (4) To release the fuel system component from the quick-connect fitting, firmly push the fitting towards the component being serviced while firmly pushing the plastic retainer ring into the fitting (Fig. 12). With the plastic ring depressed, pull the fitting from the component. **The plastic retainer ring must be pressed squarely into the fitting body. If this retainer is cocked during removal, it may be difficult to disconnect fitting. Use an open-end wrench on the shoulder of the plastic retainer ring to aid in disconnection.**
- (5) After disconnection, the plastic retainer ring will remain with the quick-connect fitting connector body.
- (6) Inspect fitting connector body, plastic retainer ring and fuel system component for damage. Replace as necessary.
- (7) Prior to connecting the quick-connect fitting to component being serviced, check condition of fitting and component. Clean the parts with a lint-free cloth. Lubricate them with clean engine oil.
- (8) Insert the quick-connect fitting into the component being serviced until a click is felt.
- (9) Verify a locked condition by firmly pulling on fuel tube and fitting (15-30 lbs.).
- (10) Connect negative battery cable to battery.
- (11) Start engine and check for leaks.

REMOVAL AND INSTALLATION

AUTOMATIC SHUTDOWN RELAY

The relay is located in the Power Distribution Center (PDC) (Fig. 13). The PDC is located next to the battery in the engine compartment. For the location of the relay within the PDC, refer to the PDC cover for location. Check electrical terminals for corrosion and repair as necessary.

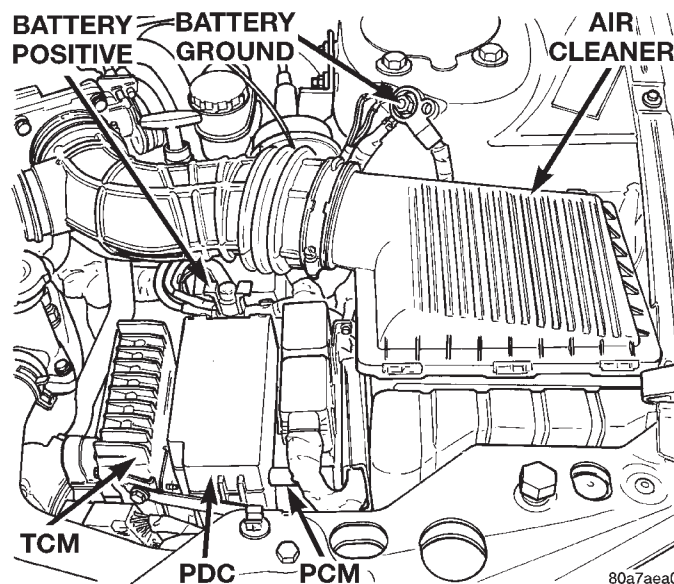


Fig. 13 Power Distribution Center (PDC)

FUEL PUMP RELAY

The fuel pump relay is located in the PDC. The inside top of the PDC cover has a label showing relay and fuse location.

FUEL PUMP MODULE

WARNING: RELEASE FUEL SYSTEM PRESSURE BEFORE SERVICING FUEL SYSTEM COMPONENTS. SERVICE VEHICLES IN WELL VENTILATED AREAS AND AVOID IGNITION SOURCES. NEVER SMOKE WHILE SERVICING THE VEHICLE.

REMOVAL

- (1) Remove fuel filler cap and perform Fuel System Pressure Release procedure. Refer to Fuel Delivery System in this Group.
- (2) Disconnect negative cable from auxiliary jumper terminal.
- (3) Remove fuel tank. Refer to Fuel Tank in this group.
- (4) Disconnect fuel filter lines from fuel pump module.
- (5) Clean top of tank to remove loose dirt and debris.

REMOVAL AND INSTALLATION (Continued)

(6) Using Special Tool #6856 Fuel Pump Module Ring Spanner, remove locknut to release pump module (Fig. 14).

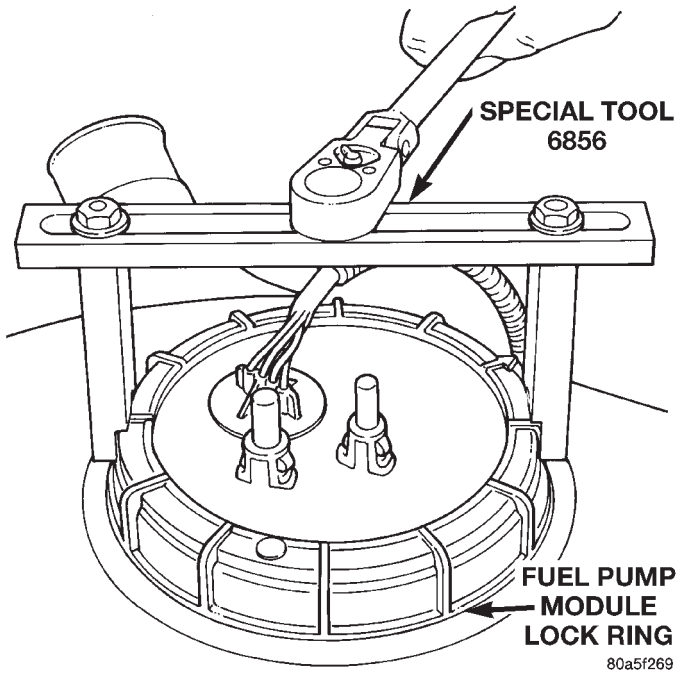


Fig. 14 Fuel Pump Module Locknut

WARNING: THE FUEL RESERVOIR OF THE FUEL PUMP MODULE DOES NOT EMPTY OUT WHEN THE TANK IS DRAINED. THE FUEL IN THE RESERVOIR MAY SPILL OUT WHEN THE MODULE IS REMOVED.

(7) Remove fuel pump module and O-ring from tank (Fig. 15). Discard O-ring.

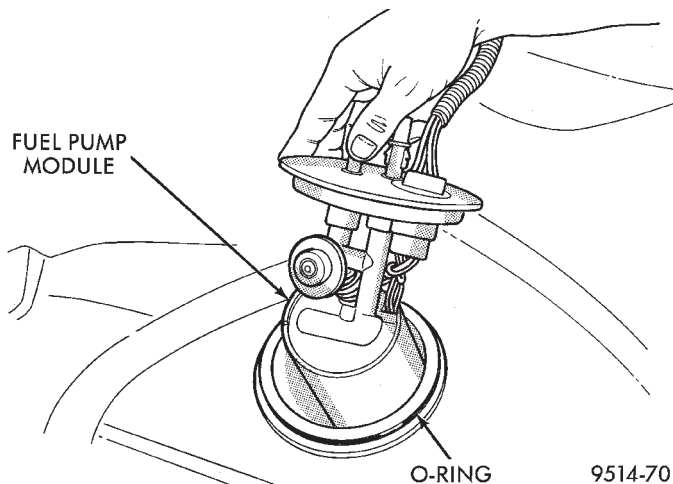


Fig. 15 Fuel Pump Module Removal

INSTALLATION

(1) Wipe seal area of tank clean. Place a new O-ring on the ledge between the tank threads and the pump module opening.

(2) Position fuel pump module in tank. Make sure the alignment tab on the underside of the pump mod-

ule flange sits in the corresponding notch in the fuel tank.

CAUTION: Over tightening the pump lock ring may result in a leak.

(3) While holding the pump module in position, install locknut. Tighten locknut to 61 N·m (45 ft. lbs) torque using special tool #6856.

(4) Install fuel tank and fuel filter. Refer to Fuel Tank in this group.

(5) Fill fuel tank with clean fuel. Check for leaks.

(6) Install negative cable to auxiliary jumper terminal.

FUEL FILTER

The fuel filter mounts to the frame above the rear of the fuel tank. The inlet and outlet tubes are permanently attached to the filter.

REMOVAL

WARNING: RELEASE FUEL SYSTEM PRESSURE BEFORE DISCONNECTING QUICK-CONNECT FITTINGS AT FUEL FILTER AND FUEL PUMP MODULE. REFER TO THE FUEL PRESSURE RELEASE PROCEDURE

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

(2) From inside trunk, disconnect fuel pump module wiring jumper from main body harness. The 4 pin connector is located under the trunk mat on the left side of trunk near the base of the shock tower. Locate body grommet for jumper near base of rear seat. Push grommet out and feed jumper completely through hole in body.

(3) Remove fuel cap slowly to release tank pressure.

(4) With vehicle on a hoist, drain fuel from tank. Support fuel tank with a support such as a transmission jack stand.

(5) Position a fuel approved container, with a capacity of at least 16 gallons, under the drain plug located on the bottom left edge of the tank.

(6) Remove drain plug and allow fuel to drain.

WARNING: Drain plug must be installed at this time as there will be 1 to 2 gallons of fuel left in the tank.

(7) When tank is no longer draining, install drain plug. Tighten plug to 32 in. lbs.

(8) Remove driver's side fuel tank strap. Loosen, do not remove, passenger side fuel tank strap allowing fuel tank fill neck to touch rear suspension cross-member.

REMOVAL AND INSTALLATION (Continued)

WARNING: WRAP SHOP TOWELS AROUND HOSES TO CATCH ANY GASOLINE SPILLAGE.

(9) Disconnect fuel lines from fuel pump module (Fig. 16). These are quick connect fittings. Refer to Quick Connect Fittings in this section.

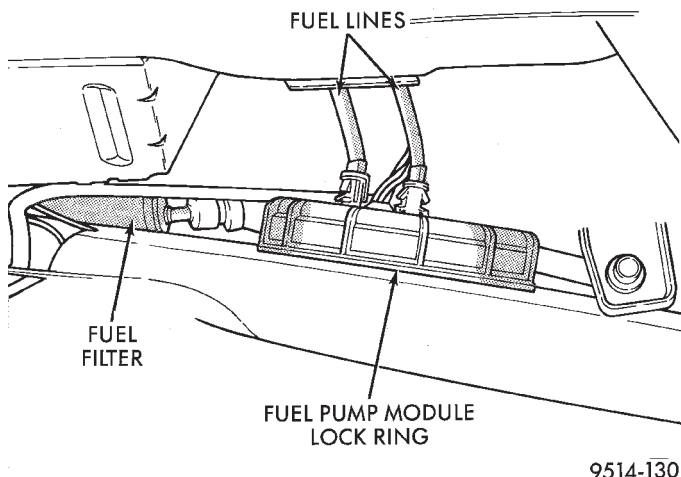


Fig. 16 Fuel Lines at Fuel Pump Module

(10) Disconnect fuel supply line from the fuel brake module.

(11) Remove fuel filter (Fig. 17).

INSTALLATION

The fuel supply (to filter) tube, return tube (to pump module) are permanently attached to the fuel filter. The ends of the fuel supply and return tubes have different size quick-connect fittings. The larger quick-connect fitting connects to the large nipple (supply side) on the fuel pump module. The smaller quick-connect fitting attaches to the small nipple (return side) on the fuel pump module.

(1) Apply a light coating of clean 30 weight engine oil to the fuel filter nipples. Install fuel tubes. Refer to Fuel Tubes and Quick-Connect Fittings in this section.

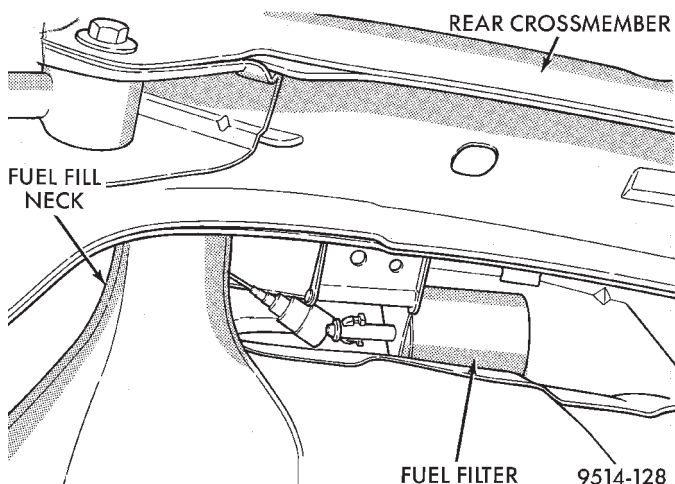


Fig. 17 Fuel Filter

(2) Install fuel tank, filter and tank straps, install the front bolts first and then the rear bolts. Torque tank strap bolts to 23 N·m (250. in. lbs.). **Make sure pump module harness grommet is installed in body as tank is raised into position.**

(3) Lower vehicle and connect pump module connector.

(4) Fill tank with fuel.

(5) Connect negative cable to auxiliary jumper terminal.

FUEL PRESSURE REGULATOR

The fuel pressure regulator is part of the fuel pump module (Fig. 18). Remove the fuel pump module from the fuel tank to access the fuel pressure regulator.

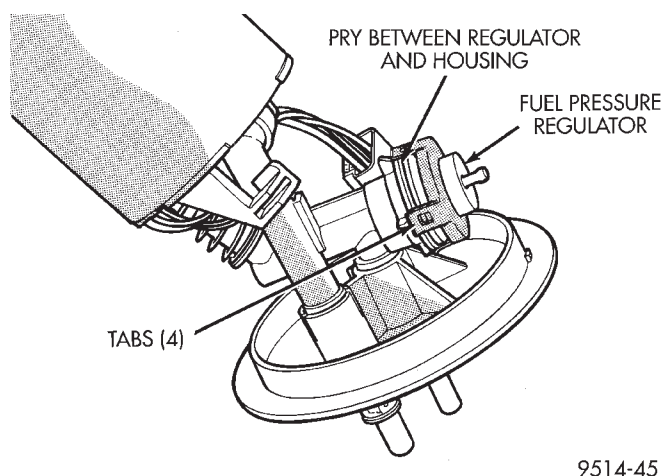


Fig. 18 Fuel Pressure Regulator

WARNING: FUEL SYSTEM PRESSURE MUST BE RELEASED BEFORE SERVICING ANY FUEL SYSTEM COMPONENT. PERFORM THE FUEL SYSTEM PRESSURE RELEASE PROCEDURE.

REMOVAL

(1) Spread tangs on pressure regulator retainer (Fig. 18).

(2) Pry fuel pressure regulator out of housing.

(3) Ensure both upper and lower O-rings were removed with regulator.

INSTALLATION

(1) Lightly lubricate the O-rings with clean engine oil and place them into opening in pump module (Fig. 19).

(2) Push regulator into opening in pump module.

(3) Fold tangs on regulator retainer over tabs on housing.

REMOVAL AND INSTALLATION (Continued)

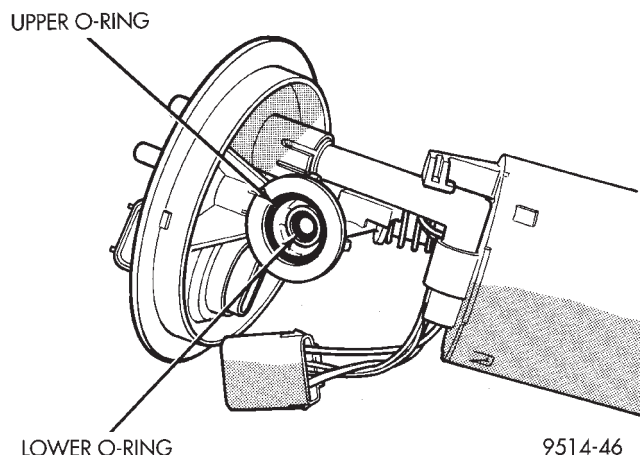


Fig. 19 Fuel Pressure Regulator O-rings

FUEL PUMP INLET STRAINER

REMOVAL

- (1) Remove fuel pump module. Refer to Fuel Pump Module Removal in this section.
- (2) Using a thin straight blade screwdriver, carefully pry back the locking tabs on fuel pump reservoir and remove the strainer (Fig. 20).
- (3) Remove strainer O-ring from the fuel pump reservoir body.
- (4) Remove any contaminants by washing the inside of the fuel tank.

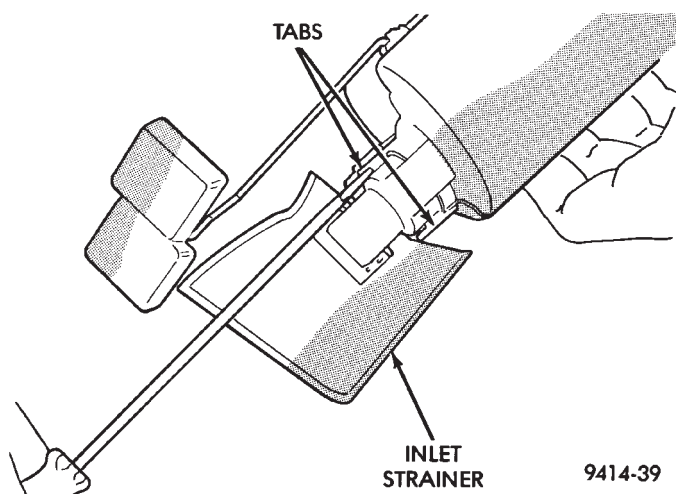


Fig. 20 Inlet Strainer Removal

INSTALLATION

- (1) Lubricate the strainer O-ring with clean motor oil.
- (2) Insert strainer O-ring into outlet of strainer so that it sits evenly on the step inside the outlet.
- (3) Push strainer onto the inlet of the fuel pump reservoir body. Make sure the locking tabs on the reservoir body lock over the locking tangs on the strainer.

- (4) Install fuel pump module. Refer to Fuel Pump Module Installation in this section.

FUEL LEVEL SENSOR

REMOVAL

Remove fuel pump module. Refer to Fuel Pump Module in this section.

- (1) Depress retaining tab and remove the fuel pump/level sensor connector from the **BOTTOM** of the fuel pump module electrical connector (Fig. 21).

NOTE: The pump module harness on TOP of flange is not serviceable or removable.

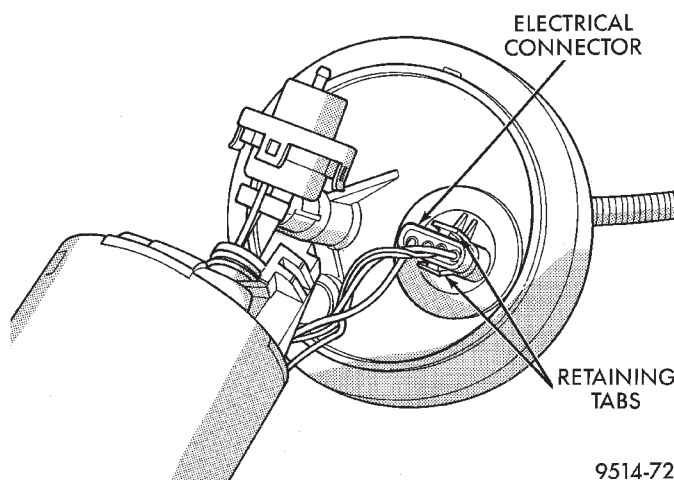


Fig. 21 Fuel Pump/Level Sensor Electrical Connector

- (2) Using Special Tool C-4334 terminal remover or equivalent, remove terminals from level sensor connector (Fig. 22).

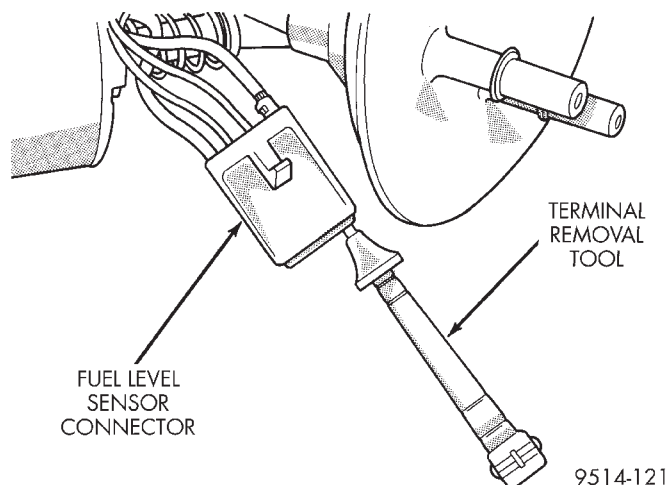


Fig. 22 Terminal Removal Tool

REMOVAL AND INSTALLATION (Continued)

(3) Insert a screwdriver between the fuel pump module and the top of the level sensor housing (Fig. 23). Push level sensor down slightly.

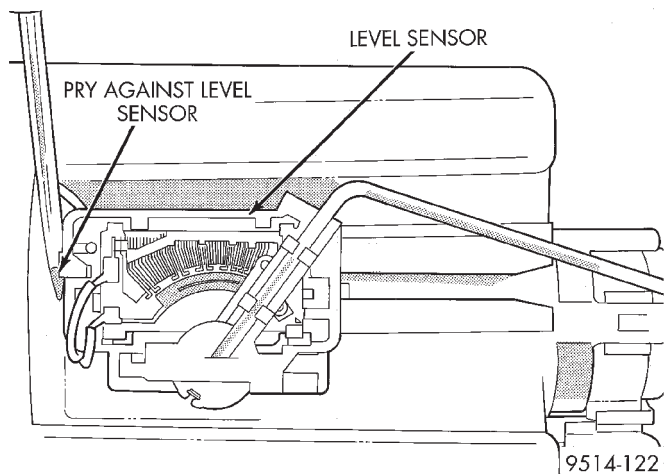


Fig. 23 Loosening Level Sensor

(4) Slide level sensor wires through opening fuel pump module (Fig. 24).

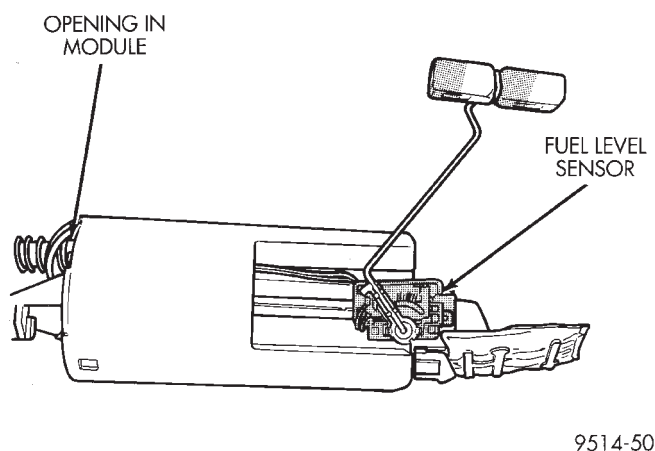


Fig. 24 Level Sensor Removal/Installation

(5) Slide level sensor out of channel in module.

INSTALLATION

(1) Insert level sensor wires into bottom of opening in module.

(2) Wrap wires into groove in back of level sensor (Fig. 25).

(3) While feeding wires into guide grooves, slide level sensor up into channel until it snaps into place (Fig. 26). Ensure tab at bottom of sensor locks in place.

(4) Install level sensor wires in connector. Push the wires up through the connector and then pull them down until they lock in place. Ensure signal and ground wires are installed in the correct position (Fig. 27).

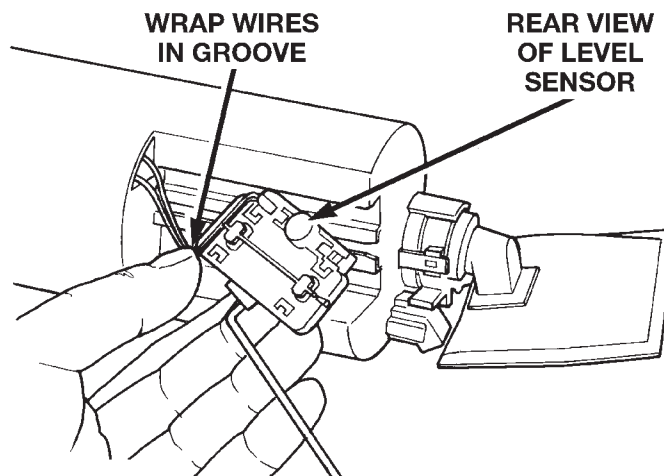


Fig. 25 Groove in Back Side of Level Sensor

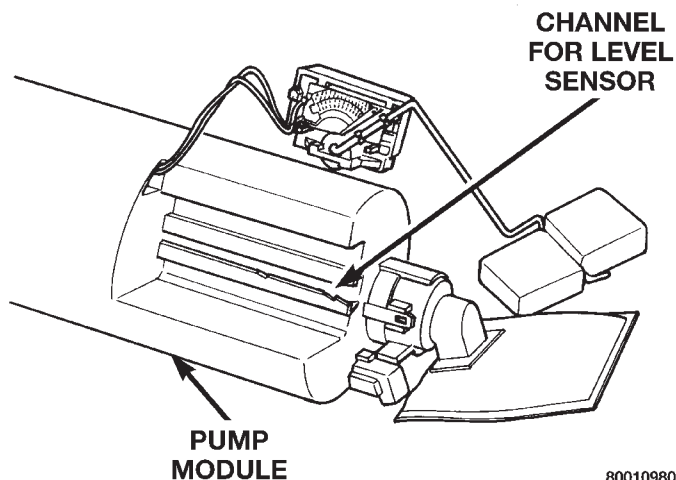


Fig. 26 Installation Channel

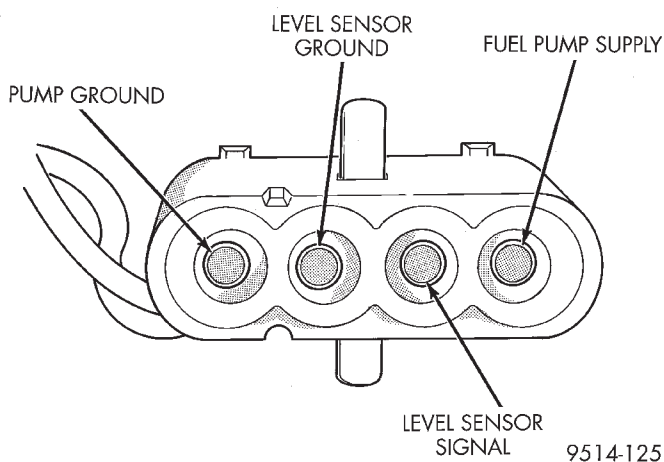


Fig. 27 Fuel/Pump/Level Sensor Electrical Connector

(5) Install locking wedge on connector.

(6) Push connector up into bottom of fuel pump module electrical connector.

REMOVAL AND INSTALLATION (Continued)

(7) Install fuel pump module. Refer to Fuel Pump Module in this section.

FUEL RAIL—2.4L**REMOVAL**

(1) Disconnect negative cable from auxiliary jumper terminal.

WARNING: RELEASE FUEL SYSTEM PRESSURE BEFORE SERVICING FUEL SYSTEM COMPONENTS. SERVICE VEHICLES IN WELL VENTILATED AREAS AND AVOID IGNITION SOURCES. NEVER SMOKE WHILE SERVICING THE VEHICLE.

(2) Release fuel system pressure. Refer to Fuel System Pressure Release procedure in this section.

WARNING: WRAP SHOP TOWELS AROUND HOSE TO CATCH ANY GASOLINE SPILLAGE.

(3) Disconnect fuel supply tube from rail. Refer to Quick-Connect Fittings in the Fuel Delivery section of this group.

(4) Disconnect electrical connectors from fuel injectors (Fig. 28).

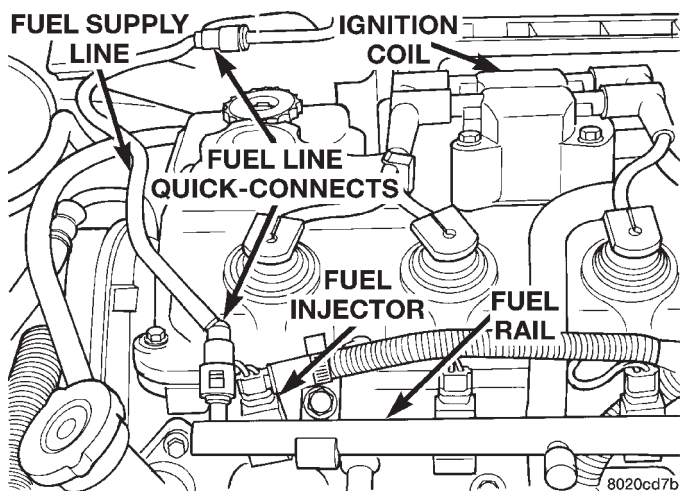


Fig. 28 Fuel Rail and Injectors

(5) Remove fuel rail mounting screws.

(6) Lift rail off of intake manifold. Cover the fuel injector openings in the intake manifold.

INSTALLATION

(1) Apply a light coating of clean engine oil to the O-ring on the nozzle end of each injector.

(2) Insert fuel injector nozzles into openings in intake manifold. Seat the injectors in place. Tighten fuel rail mounting screws to $22.5 \text{ N}\cdot\text{m} \pm 3 \text{ N}\cdot\text{m}$ ($200 \pm 30 \text{ in. lbs.}$).

(3) Attach electrical connectors to fuel injectors.

(4) Connect fuel supply tube to fuel rail. Refer to Quick Connect Fittings in the Fuel Delivery Section of this Group.

(5) Connect negative cable to auxiliary jumper terminal.

FUEL RAIL—2.5L**REMOVAL**

(1) Disconnect negative cable from auxiliary jumper terminal.

WARNING: RELEASE FUEL SYSTEM PRESSURE BEFORE SERVICING FUEL SYSTEM COMPONENTS. SERVICE VEHICLES IN WELL VENTILATED AREAS AND AVOID IGNITION SOURCES. NEVER SMOKE WHILE SERVICING THE VEHICLE.

(2) Release fuel system pressure. Refer to Fuel System Pressure Release procedure in this section.

WARNING: WRAP SHOP TOWELS AROUND HOSE TO CATCH ANY GASOLINE SPILLAGE.

(3) Disconnect fuel supply tube from rail. Refer to Quick-Connect Fittings in the Fuel Delivery section of this group.

(4) Unplug connectors from MAP and intake air temperature sensors (Fig. 29).

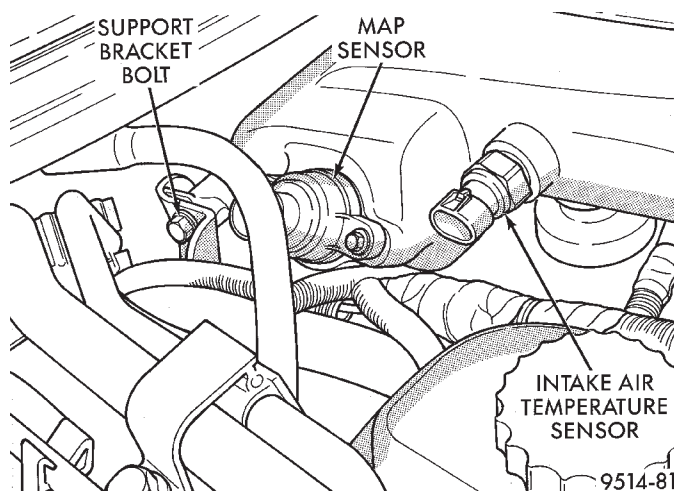


Fig. 29 Intake Manifold Plenum Sensors and Left Plenum Support Bolt

(5) Remove plenum support bracket bolt located rearward of MAP sensor (Fig. 29).

(6) Remove bolt holding air inlet resonator to intake plenum.

(7) Loosen throttle body air inlet hose clamp.

(8) Release snaps holding air cleaner housing cover to housing.

(9) Remove air cleaner cover and inlet hoses from engine.

REMOVAL AND INSTALLATION (Continued)

(10) Unplug TPS and idle air control motor connectors (Fig. 30) and (Fig. 31).

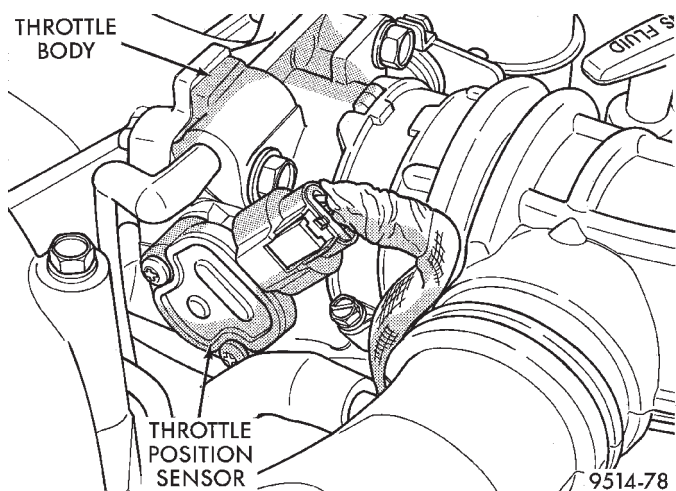


Fig. 30 Throttle Position Sensor

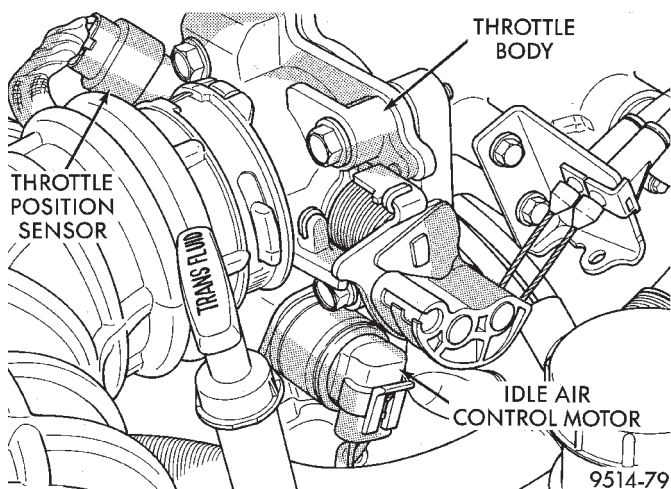


Fig. 31 Idle Air Control Motor

(11) Pry retainer tab back on throttle cable and slide cable out of bracket (Fig. 32).

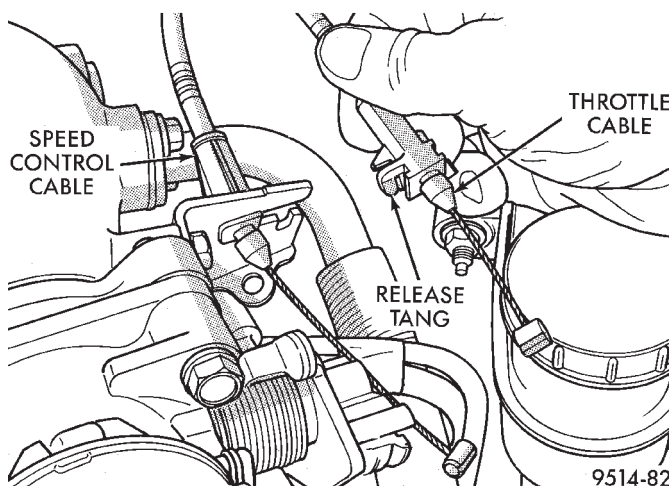


Fig. 32 Throttle Cable Attachment

(12) Slide Speed control cable out of bracket, if equipped (Fig. 32).

(13) Remove EGR tube from intake plenum (Fig. 33).

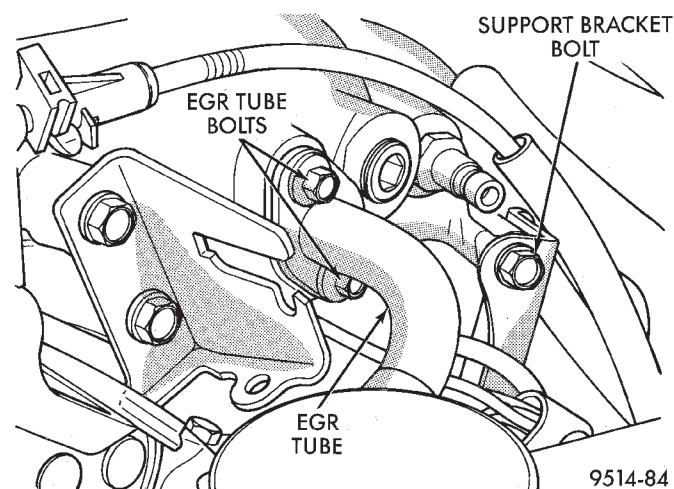


Fig. 33 Tube and Right Plenum Support Bolt

(14) Remove plenum support bracket bolt located rearward of EGR tube (Fig. 33).

(15) Remove 7 bolts holding upper intake plenum and remove plenum.

(16) Disconnect electrical connectors from fuel injectors.

(17) Remove 4 bolts holding fuel rail (Fig. 34).

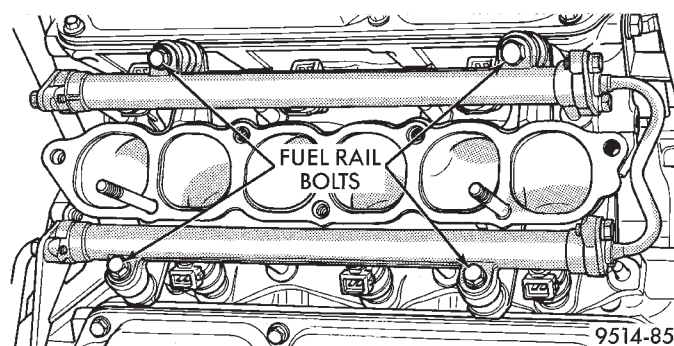


Fig. 34 Fuel Rail Attachment

(18) Lift fuel rail off engine. **There are spacers under each fuel rail bolt (Fig. 35).**

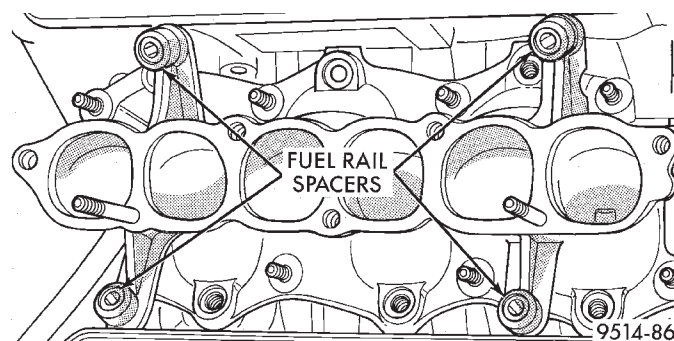


Fig. 35 Fuel Rail Spacers

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Apply a light coating of clean engine oil to the O-ring on the nozzle end of each injector.

CAUTION: Make sure spacers are located under each fuel rail mounting position.

(2) Insert fuel injector nozzles into openings in intake manifold. Seat the injectors in place. Tighten fuel rail bolts to 12 N·m (8 ft. lbs.).

(3) Attach electrical connectors to fuel injectors.

(4) Connect fuel supply tube to fuel rail. Refer to Quick Connect Fittings in the Fuel Delivery Section of this Group.

(5) Install new gasket and position upper intake plenum. Tighten plenum bolts to 18 N·m (13 ft. lbs.) torque.

(6) Install bolts at plenum support brackets. Tighten bolts to 18 N·m (13 ft. lbs.).

(7) Install EGR tube to plenum. Tighten EGR tube to intake manifold plenum screws to 11 N·m (95 in. lbs) torque.

(8) Install throttle cables.

(9) Attach electrical connectors to sensors.

(10) Tighten air inlet tube clamps to 3 N·m $\pm$ 1 (25 in. lbs. $\pm$ 5) torque.

(11) Connect negative terminal to auxiliary jumper terminal.

FUEL INJECTORS

REMOVAL

(1) Remove fuel rail. Refer to appropriate Fuel Rail Removal in this section.

(2) Remove fuel injector clip (Fig. 36) or (Fig. 37).

(3) Pull injector out of fuel rail. Replace fuel injector O-rings.

INSTALLATION

(1) Reverse procedure for installation.

FUEL TANK

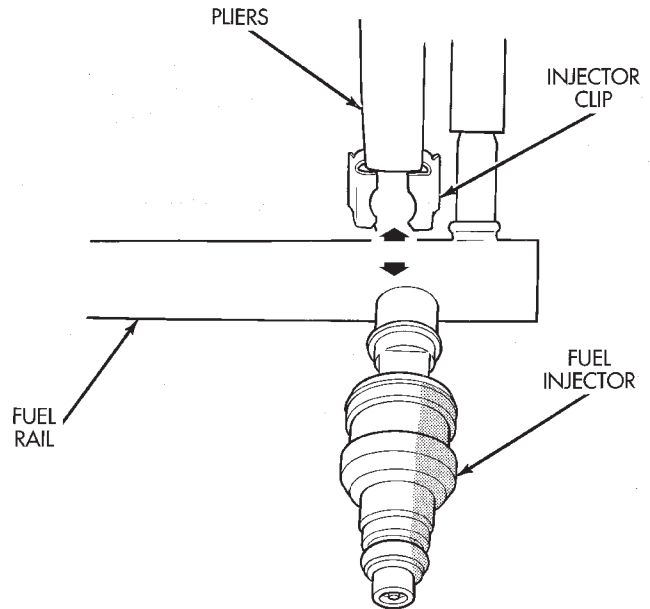
WARNING: RELEASE FUEL SYSTEM PRESSURE BEFORE SERVICING FUEL SYSTEM COMPONENTS. SERVICE VEHICLES IN WELL VENTILATED AREAS AND AVOID IGNITION SOURCES. NEVER SMOKE WHILE SERVICING THE VEHICLE.

REMOVAL

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

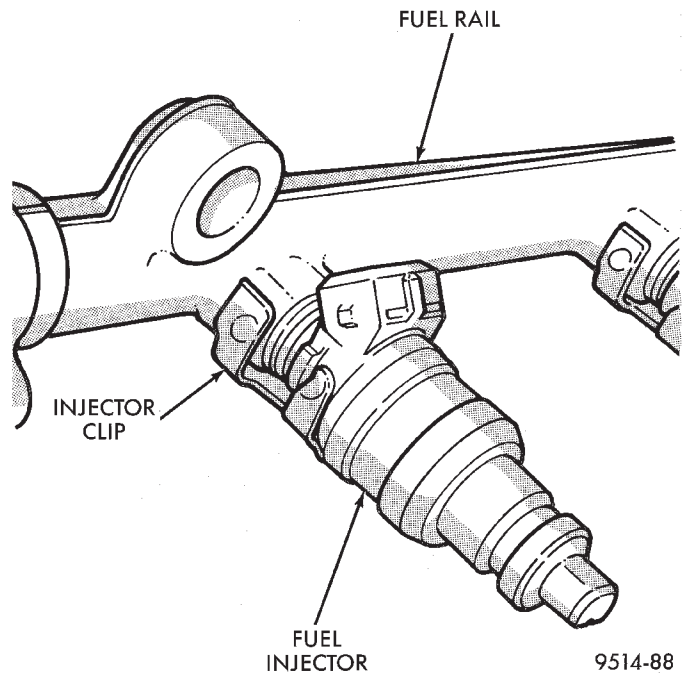
(2) Disconnect negative cable from auxiliary jumper terminal.

(3) From inside trunk, disconnect pump wiring jumper from main body harness. The 4 pin connector is located under the trunk mat on the left side of trunk near the base of the shock tower. Locate body



9514-87

Fig. 36 Fuel Injector Clip—2.0/2.4L Engines



9514-88

Fig. 37 Fuel Injector Clip—2.5L Engine

grommet for jumper near base of rear seat. Push grommet out and feed jumper completely through hole in body.

(4) Remove fuel cap slowly to release tank pressure.

(5) With vehicle on a hoist, drain fuel from tank. Support fuel tank with a support such as a transmission jack stand.

(6) Position a fuel approved container, with a capacity of at least 16 gallons, under the drain plug located on the bottom left edge of the tank.

REMOVAL AND INSTALLATION (Continued)

(7) Remove drain plug and allow fuel to drain (Fig. 38).

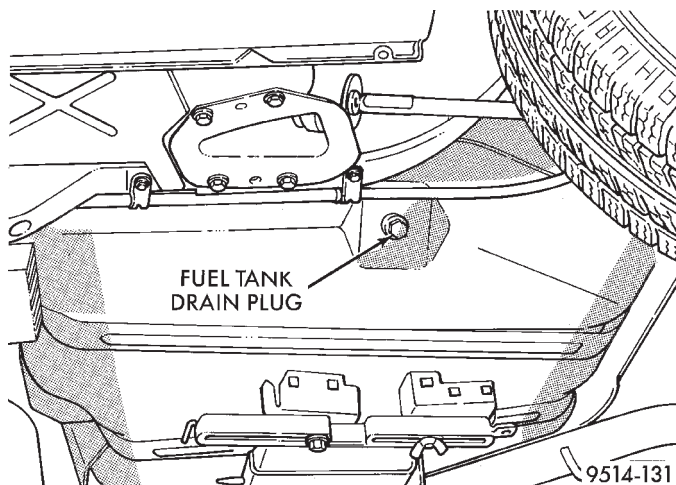


Fig. 38 Fuel Tank Drain Plug

WARNING: DRAIN PLUG MUST BE INSTALLED AT THIS TIME AS THERE WILL BE 1 TO 2 GALLONS OF FUEL LEFT IN THE TANK.

(8) When tank is no longer draining, install drain plug. Tighten plug to 32 in. lbs.

WARNING: There may be fuel in the fill tube. Remove hose carefully to reduce fuel splash.

(9) Disconnect fuel tank from rubber fill hose (Fig. 39).

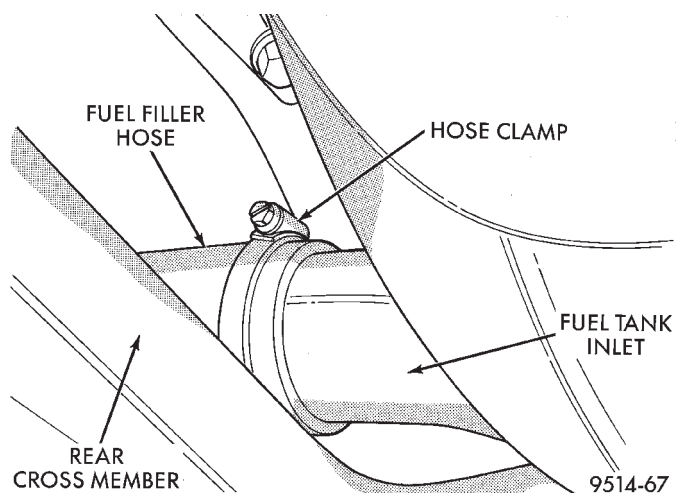


Fig. 39 Fuel Filler Hose Clamp

WARNING: WRAP SHOP TOWELS AROUND HOSES TO CATCH ANY GASOLINE SPILLAGE.

(10) Disconnect fuel lines from fuel pump module. These are quick connect fittings (Fig. 40).

(11) Disconnect vapor line from tank mounted rollover valve. The valve is located at the rear of the tank and connects to the vapor line with a rubber hose.

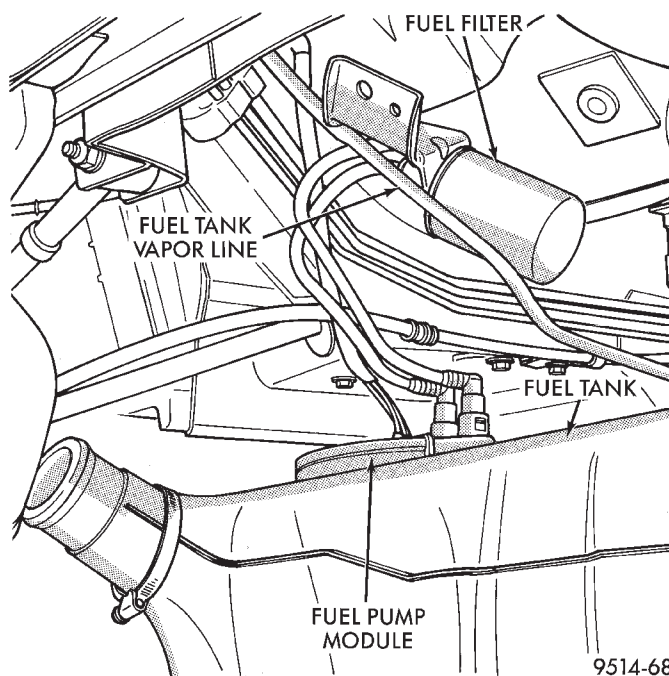


Fig. 40 Fuel Tank Removal

(12) Remove bolts and fuel tank straps.

(13) Remove tank from vehicle. Slide tank forward during removal to allow fill neck to clear suspension cross-member.

INSTALLATION

(1) Position fuel tank on transmission jack.

(2) Raise tank into position.

(3) Connect vapor line to rollover valve.

(4) Connect chassis fuel tube to fuel filter. Refer to Quick Connect Fittings in the Fuel Delivery section of this Group.

(5) Connect fuel fill tube to tank inlet. Tighten hose clamp to 3.5 N·m (31 in. lbs.) torque.

(6) Install pump module harness grommet into body.

(7) Position fuel filter and fuel tank straps. Install the front bolts first and then the rear bolts. Tighten fuel tank strap bolts to 23 N·m (250 in. lbs.) torque. Remove transmission jack. Ensure straps are not twisted or bent.

(8) Lower vehicle.

(9) Connect fuel pump module connector.

(10) Fill fuel tank, install filler cap, and connect battery cable.

CAUTION: When using the ASD Fuel System Test, the ASD relay remains energized for either 7 minutes, until the test is stopped, or until the ignition switch is turned to the Off position.

(11) Use the DRB scan tool ASD Fuel System Test to pressurize the fuel system. Check for leaks.

REMOVAL AND INSTALLATION (Continued)

FUEL FILLER NECK

REMOVAL

- (1) Loosen fuel filler tube cap (Fig. 41).

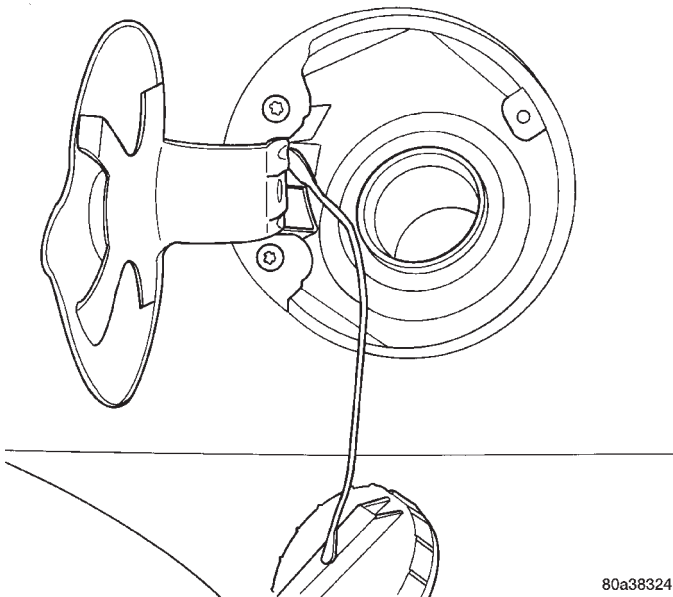


Fig. 41 Fuel Filler Cap

- (2) Remove fuel filler neck from grommet in body housing (Fig. 42).

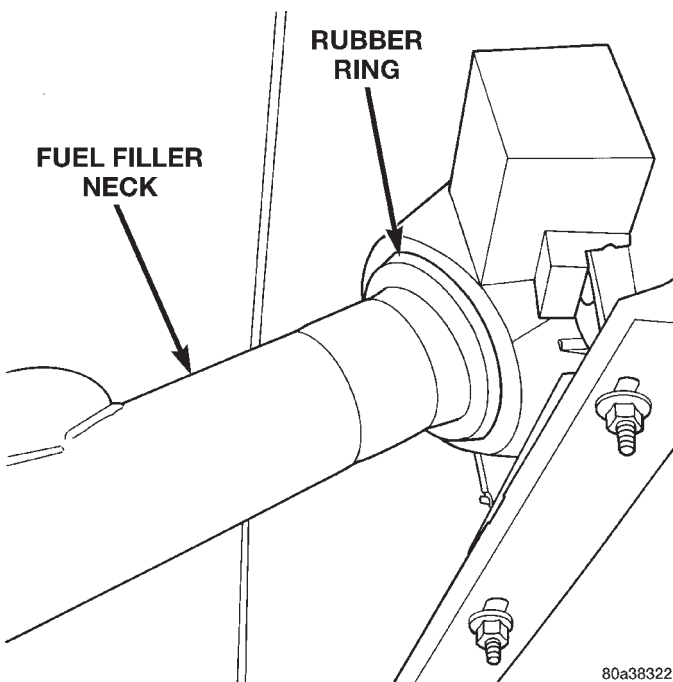


Fig. 42 Rubber Grommet and Body Housing

- (3) Disconnect fuel filler ground strap from body.
- (4) Disconnect fuel filler tube hose from fuel tank neck.
- (5) Remove fuel filler tube assembly.

INSTALLATION

- (1) Install rubber grommet in body housing (Fig. 43). Make sure chamfer is in the proper location (Fig. 44).

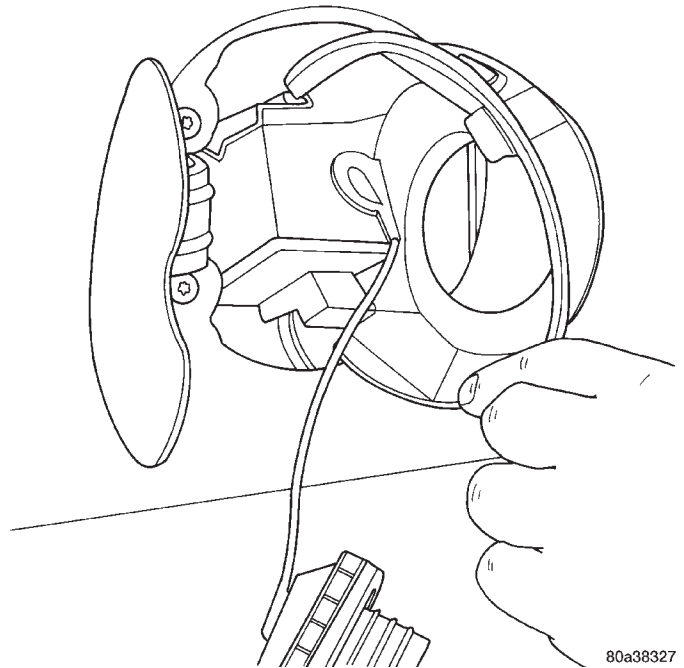


Fig. 43 Body Housing

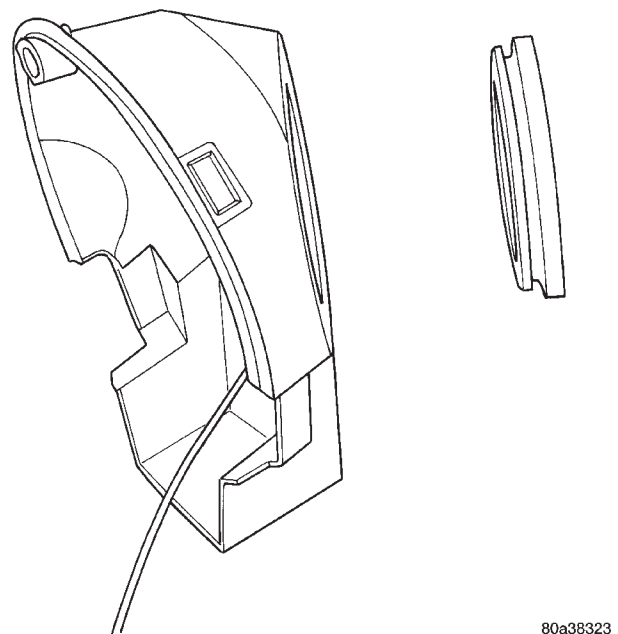


Fig. 44 Rubber Grommet

- (2) Use a lubrication on fuel filler tube when inserting it in the rubber grommet.
- (3) Install fuel tube onto the fuel tank neck.
- (4) Tighten hose clamp to 3.5 N.m (31 in. lbs.).
- (5) Install fuel filler ground strap on to body lip.

REMOVAL AND INSTALLATION (Continued)

ACCELERATOR PEDAL**REMOVAL**

(1) Remove the throttle cable from the throttle body cam as described in Throttle Cable of this section.

(2) Reach behind the top of the pedal shaft and push the retainer toward rear of vehicle (Fig. 45). It may be necessary to squeeze retainer ears together on dash side of pedal shaft.

(3) Lift cable up through slot in top of pedal shaft.

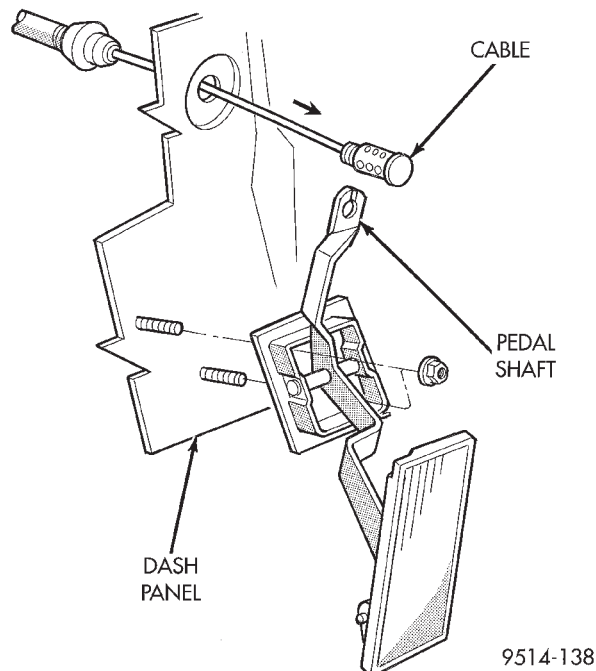


Fig. 45 Accelerator Pedal and Throttle Cable

(4) Remove nuts from accelerator pedal assembly studs. Remove assembly from vehicle.

INSTALLATION

(1) Position accelerator pedal assembly on dash panel. Install retaining nuts. Tighten retaining nuts to 12 N·m (105 in. lbs.) torque.

(2) Place cable through slot in top of pedal shaft.

(3) Step on pedal and retainer will snap into place.

(4) Hold the throttle body lever in the wide open position and install the throttle cable.

THROTTLE CABLE—2.4L**REMOVAL**

(1) Working from the engine compartment, remove the throttle cable from the throttle body lever (Fig. 46) and (Fig. 47).

(2) Compress the retaining tabs on the cable and slide cable out of bracket (Fig. 47).

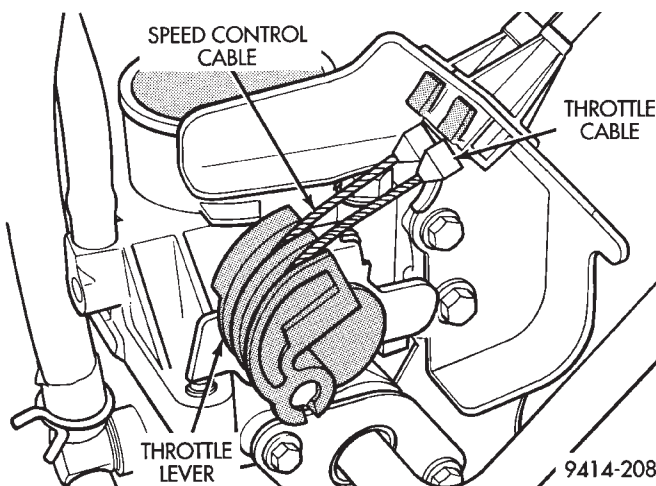


Fig. 46 Throttle Cable Attachment to Throttle Body

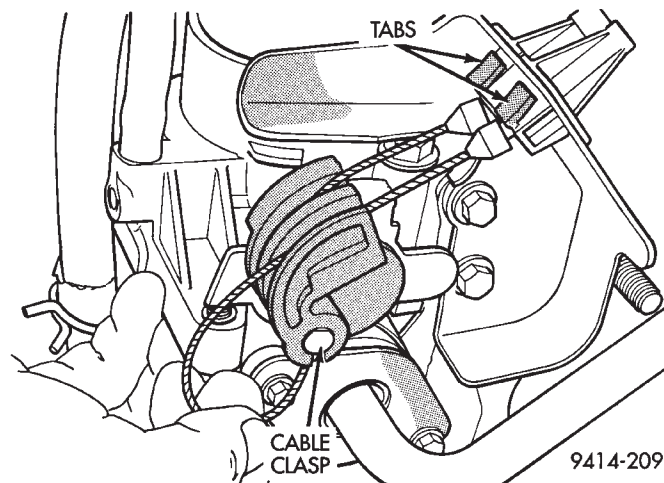


Fig. 47 Disconnecting Throttle Cable

(3) From inside vehicle, reach behind the top of the pedal shaft and push the retainer toward rear of vehicle. It may be necessary to squeeze retainer ears together on dash side of pedal shaft.

(4) Lift cable up through slot in top of pedal shaft.

(5) From the engine compartment, pull the throttle cable and grommet out of the dash panel.

INSTALLATION

(1) From the engine compartment, push the cable end fitting and grommet into the dash panel.

(2) Install cable housing (throttle body end) into the cable mounting bracket on the engine.

(3) Place cable through slot in top of pedal shaft.

(4) Step on pedal and retainer will snap into place.

(5) From the engine compartment, rotate the throttle lever forward to the wide open position and install cable clasp.

REMOVAL AND INSTALLATION (Continued)

THROTTLE CABLE—2.5L

REMOVAL

(1) Working from the engine compartment, remove throttle cable from the throttle body lever (Fig. 48).

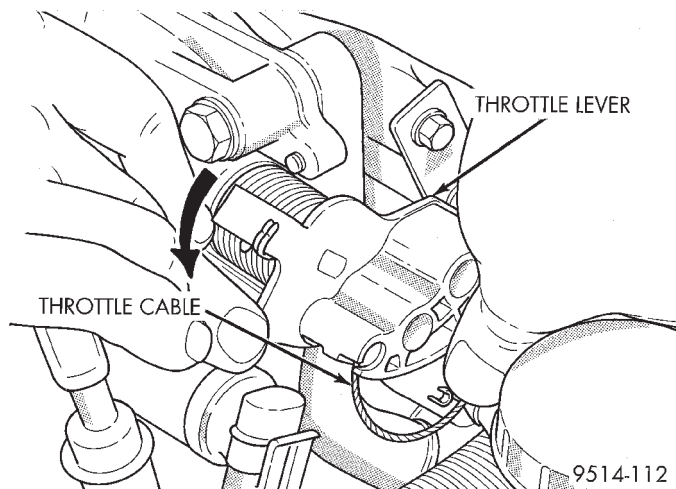


Fig. 48 Throttle Cable Attachment to Throttle Body

(2) Push release tang toward dash panel on throttle cable and slide cable out of bracket (Fig. 49).

(3) From inside the vehicle, reach behind the top of the pedal shaft and push the retainer toward rear of vehicle. It may be necessary to squeeze retainer ears together on dash side of pedal shaft.

(4) Lift cable up through slot in top of pedal shaft.

(5) From the engine compartment, pull the throttle cable and grommet out of the dash panel.

INSTALLATION

(1) From the engine compartment, push the cable end fitting and grommet into the dash panel.

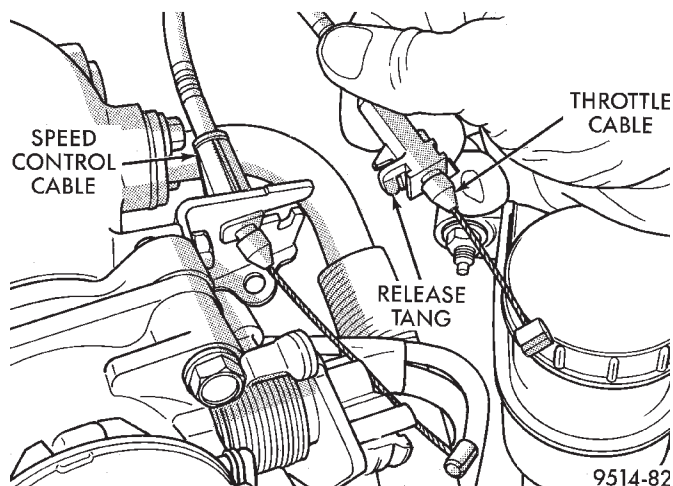


Fig. 49 Throttle Cable Attachment

(2) Install cable housing (throttle body end) into the cable mounting bracket on the engine.

(3) Place cable through slot in top of pedal shaft.

(4) Step on pedal and retainer will snap into place.

(5) From the engine compartment, rotate the throttle lever forward to the wide open position and install cable clasp.

SPECIFICATIONS

TORQUE

DESCRIPTION	TORQUE
Accelerator Pedal to Dash Nuts . . .	12 N·m (105 in. lbs.)
Fuel Filter Mounting Screw . . .	12 N·m (110 in. lbs.)
Fuel Pump Module Locknut	61 N·m (45 ft. lbs.)
Fuel Tank strap Bolts	60 N·m (44 ft. lbs.)
Fuel Rail Bolts—2.0/2.4L . . .	22.5 N·m (200 in. lbs.)
Fuel Rail Bolts—2.5L	12 N·m (106 in. lbs.)
Ignition Coil Mounting Bolts . .	12 N·m (105 in. lbs.)

FUEL INJECTION SYSTEM

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GENERAL INFORMATION

INTRODUCTION

All engines used in this section have a sequential Multi-Port Electronic Fuel Injection system. The MPI system is computer regulated and provides precise air/fuel ratios for all driving conditions. The Powertrain Control Module (PCM) operates the fuel injection system.

The PCM regulates:

- Ignition timing
- Air/fuel ratio
- Emission control devices
- Cooling fan
- Charging system
- Idle speed
- Vehicle speed control

Various sensors provide the inputs necessary for the PCM to correctly operate these systems. In addition to the sensors, various switches also provide inputs to the PCM.

All inputs to the PCM are converted into signals. The PCM can adapt its programming to meet changing operating conditions.

Fuel is injected into the intake port above the intake valve in precise metered amounts through electrically operated injectors. The PCM fires the injectors in a specific sequence. Under most operating conditions, the PCM maintains an air fuel ratio of 14.7 parts air to 1 part fuel by constantly adjusting injector pulse width. Injector pulse width is the length of time the injector is open.

The PCM adjusts injector pulse width by opening and closing the ground path to the injector. Engine RPM (speed) and manifold absolute pressure (air density) are the primary inputs that determine injector pulse width.

MODES OF OPERATION

As input signals to the PCM change, the PCM adjusts its response to output devices. For example, the PCM must calculate a different injector pulse width and ignition timing for idle than it does for Wide Open Throttle (WOT). There are several different modes of operation that determine how the PCM responds to the various input signals.

There are two different areas of operation, OPEN LOOP and CLOSED LOOP.

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During OPEN LOOP modes the PCM receives input signals and responds according to preset PCM programming. Inputs from the upstream and downstream heated oxygen sensors are not monitored during OPEN LOOP modes, except for heated oxygen sensor diagnostics (they are checked for shorted conditions at all times).

During CLOSED LOOP modes the PCM monitors the inputs from the upstream and downstream heated oxygen sensors. The upstream heated oxygen sensor input tells the PCM if the calculated injector pulse width resulted in the ideal air-fuel ratio of 14.7 to one. By monitoring the exhaust oxygen content through the upstream heated oxygen sensor, the PCM can fine tune injector pulse width. Fine tuning injector pulse width allows the PCM to achieve optimum fuel economy combined with low emissions.

For the PCM to enter CLOSED LOOP operation, the following must occur:

- (1) Engine coolant temperature must be over 35°F.
 - If the coolant is over 35° the PCM will wait 44 seconds.
 - If the coolant is over 50°F the PCM will wait 38 seconds.
 - If the coolant is over 167°F the PCM will wait 11 seconds.
- (2) For other temperatures the PCM will interpolate the correct waiting time.
- (3) O2 sensor must read either greater than .745 volts or less than .1 volt.
- (4) The multi-port fuel injection systems has the following modes of operation:
 - Ignition switch ON (Zero RPM)
 - Engine start-up
 - Engine warm-up
 - Cruise
 - Idle
 - Acceleration
 - Deceleration
 - Wide Open Throttle
 - Ignition switch OFF

(5) The engine start-up (crank), engine warm-up, deceleration with fuel shutoff and wide open throttle modes are OPEN LOOP modes. Under most operating conditions, the acceleration, deceleration (with A/C on), idle and cruise modes, **with the engine at operating temperature** are CLOSED LOOP modes.

GENERAL INFORMATION (Continued)

IGNITION SWITCH ON (ZERO RPM) MODE

When the ignition switch activates the fuel injection system, the following actions occur:

- The PCM monitors the engine coolant temperature sensor and throttle position sensor input. The PCM determines basic fuel injector pulse width from this input.
- The PCM determines atmospheric air pressure from the MAP sensor input to modify injector pulse width.

When the key is in the ON position and the engine is not running (zero rpm), the Auto Shutdown (ASD) and fuel pump relays de-energize after approximately 1 second. Therefore, battery voltage is not supplied to the fuel pump, ignition coil, fuel injectors and heated oxygen sensors.

ENGINE START-UP MODE

This is an OPEN LOOP mode. If the vehicle is in park or neutral (automatic transaxles) or the clutch pedal is depressed (manual transaxles) the ignition switch energizes the starter relay. The following actions occur when the starter motor is engaged.

- If the PCM receives the camshaft position sensor and crankshaft position sensor signals, it energizes the Auto Shutdown (ASD) and fuel pump relays. If the PCM does not receive both signals within approximately one second, it will not energize the ASD relay and fuel pump relay. The ASD and fuel pump relays supply battery voltage to the fuel pump, fuel injectors, ignition coil and heated oxygen sensors.

- The PCM energizes all four injectors (on the 69° degree falling edge) for a calculated pulse width until it determines crankshaft position from the camshaft position sensor and crankshaft position sensor signals. The PCM determines crankshaft position within 1 engine revolution.

- After determining crankshaft position, the PCM begins energizing the injectors in sequence. It adjusts injector pulse width and controls injector synchronization by turning the individual ground paths to the injectors On and Off.

- When the engine idles within ± 64 RPM of its target RPM, the PCM compares current MAP sensor value with the atmospheric pressure value received during the Ignition Switch On (zero RPM) mode. If the PCM does not detect a minimum difference between the two values, it sets a MAP diagnostic trouble code into memory.

Once the ASD and fuel pump relays have been energized, the PCM determines injector pulse width based on the following:

- Battery voltage
- Engine coolant temperature
- Engine RPM
- Intake air temperature (IAT)
- Throttle position

- The number of engine revolutions since cranking was initiated

During Start-up the PCM maintains ignition timing at 9° BTDC.

ENGINE WARM-UP MODE

This is an OPEN LOOP mode. The following inputs are received by the PCM:

- Engine coolant temperature
- Manifold Absolute Pressure (MAP)
- Intake air temperature (IAT)
- Crankshaft position (engine speed)
- Camshaft position
- Knock sensor
- Throttle position
- A/C switch
- Battery voltage
- Power steering pressure switch
- Vehicle speed
- Speed control
- Both O2 sensors
- All diagnostics

The PCM adjusts injector pulse width and controls injector synchronization by turning the individual ground paths to the injectors On and Off.

The PCM adjusts ignition timing and engine idle speed. Engine idle speed is adjusted through the idle air control motor.

CRUISE OR IDLE MODE

When the engine is at operating temperature this is a CLOSED LOOP mode. During cruising or idle the following inputs are received by the PCM:

- Intake air temperature
- Engine coolant temperature
- Manifold absolute pressure
- Crankshaft position (engine speed)
- Camshaft position
- Knock sensor
- Throttle position
- Exhaust gas oxygen content
- A/C control positions
- Power steering pressure switch
- Battery voltage
- Vehicle speed

The PCM adjusts injector pulse width and controls injector synchronization by turning the individual ground paths to the injectors On and Off.

The PCM adjusts engine idle speed and ignition timing. The PCM adjusts the air/fuel ratio according to the oxygen content in the exhaust gas (measured by the upstream and downstream heated oxygen sensor).

The PCM monitors for engine misfire. During active misfire and depending on the severity, the PCM either continuously illuminates or flashes the malfunction indicator lamp (Check Engine light on

GENERAL INFORMATION (Continued)

instrument panel). Also, the PCM stores an engine misfire DTC in memory.

The PCM performs several diagnostic routines. They include:

- Oxygen sensor monitor
- Downstream heated oxygen sensor diagnostics during open loop operation (except for shorted)
- Fuel system monitor
- EGR monitor
- Purge system monitor
- All inputs monitored for proper voltage range.
- All monitored components (refer to Group 25 for On-Board Diagnostics).

The PCM compares the upstream and downstream heated oxygen sensor inputs to measure catalytic convertor efficiency. If the catalyst efficiency drops below the minimum acceptable percentage, the PCM stores a diagnostic trouble code in memory.

During certain idle conditions, the PCM may enter a variable idle speed strategy. During variable idle speed strategy the PCM adjusts engine speed based on the following inputs.

- A/C sense
- Battery voltage
- Battery temperature
- Engine coolant temperature
- Engine run time
- Power steering pressure switch
- Vehicle mileage

ACCELERATION MODE

This is a CLOSED LOOP mode. The PCM recognizes an abrupt increase in Throttle Position sensor output voltage or MAP sensor output voltage as a demand for increased engine output and vehicle acceleration. The PCM increases injector pulse width in response to increased fuel demand.

DECELERATION MODE

This is a CLOSED LOOP mode. During deceleration the following inputs are received by the PCM:

- A/C pressure transducer
- A/C sense
- Battery voltage
- Intake air temperature
- Engine coolant temperature
- Crankshaft position (engine speed)
- Exhaust gas oxygen content (upstream heated oxygen sensor)
- Knock sensor
- Manifold absolute pressure
- Power steering pressure switch
- Throttle position
- IAC motor control changes in responses to MAP sensor feedback

The PCM may receive a closed throttle input from the Throttle Position Sensor (TPS) when it senses an abrupt decrease in manifold pressure. This indicates a hard deceleration. In response, the PCM may momentarily turn off the injectors. This helps improve fuel economy, emissions and engine braking.

If decel fuel shutoff is detected, downstream oxygen sensor diagnostics is performed.

WIDE-OPEN-THROTTLE MODE

This is an OPEN LOOP mode. During wide-open-throttle operation, the following inputs are received by the PCM:

- Intake air temperature
- Engine coolant temperature
- Engine speed
- Knock sensor
- Manifold absolute pressure
- Throttle position

When the PCM senses a wide-open-throttle condition through the Throttle Position Sensor (TPS) it de-energizes the A/C compressor clutch relay. This disables the air conditioning system.

The PCM does not monitor the heated oxygen sensor inputs during wide-open-throttle operation except for downstream heated oxygen sensor and both shorted diagnostics. The PCM adjusts injector pulse width to supply a predetermined amount of additional fuel.

IGNITION SWITCH OFF MODE

When the operator turns the ignition switch to the OFF position, the following occurs:

- All outputs are turned off, unless 02 Heater Monitor test is being run. Refer to Group 25, On-Board Diagnostics.
- No inputs are monitored except for the heated oxygen sensors. The PCM monitors the heating elements in the oxygen sensors and then shuts down.

DESCRIPTION AND OPERATION

SYSTEM DIAGNOSIS

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

Technicians can display stored DTC's by two different methods.

For DTC information, refer to Group 25, Emission Control Systems. See On-Board Diagnostics.

DESCRIPTION AND OPERATION (Continued)

POWER DISTRIBUTION CENTER

The Power Distribution Center (PDC) is located next to the battery (Fig. 1). The PDC contains the starter relay, radiator fan relay, A/C compressor clutch relay, auto shutdown relay, fuel pump relay and several fuses.

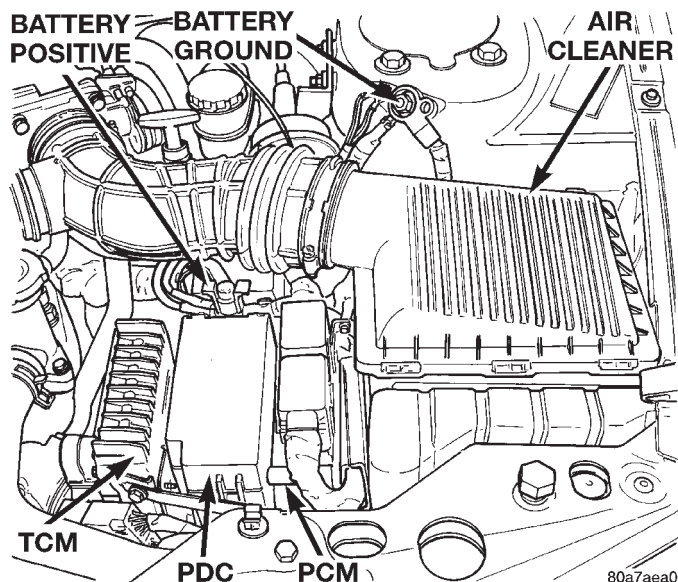


Fig. 1 Power Distribution Center and Powertrain Control Module

CCD BUS

Various modules exchange information through a communications port called the CCD Bus. The powertrain control module (PCM) transmits the Malfunction Indicator Lamp (Check Engine) On/Off signal and engine RPM on the CCD Bus. The PCM receives the Air Conditioning select input, transaxle gear position input and speed control engage inputs over the CCD Bus. The PCM also receives the air conditioning evaporator temperature signal from the CCD Bus.

The following components access or send information on the CCD Bus.

- Instrument Panel
- Body Control Module
- Air Bag System Diagnostic Module
- Full ATC Display Head
- ABS Module
- Transmission Control Module
- Powertrain Control Module
- Overhead Travel Module

POWERTRAIN CONTROL MODULE

The Powertrain Control Module (PCM) is a digital computer containing a microprocessor. The PCM receives input signals from various switches and sensors that are referred to as PCM Inputs. Based on these inputs, the PCM adjusts various engine and vehicle operations through devices that are referred to as PCM Outputs.

NOTE: PCM Inputs:

- Air Conditioning Controls
- Battery Voltage
- Battery Temperature Sensor
- Brake Switch
- Camshaft Position Sensor
- Crankshaft Position Sensor
- Engine Coolant Temperature Sensor
- Fuel Level Sensor
- Ignition Switch
- Intake Air Temperature Sensor
- Knock Sensor (2.0/2.4L only)
- Manifold Absolute Pressure (MAP) Sensor
- Oxygen Sensors
- Power Steering Pressure Switch
- SCI Receive
- Speed Control Switches
- Throttle Position Sensor
- Transmission Park/Neutral Switch (automatic transmission)
- Vehicle Speed Sensor

NOTE: PCM Outputs:

- Air Conditioning Clutch Relay
- Auto Shutdown (ASD) Relay
- Charging Indicator Lamp
- SCI Transmit
- Duty Cycle EVAP Canister Purge Solenoid
- EGR Solenoid
- Fuel Injectors
- Fuel Pump Relay
- Generator Field
- Idle Air Control Motor
- Ignition Coils
- Malfunction Indicator (Check Engine) Lamp
- Radiator Fan Relays
- Speed Control Solenoids

Based on inputs it receives, the PCM adjusts fuel injector pulse width, idle speed, ignition spark advance, ignition coil dwell and EVAP canister purge operation. The PCM regulates the cooling fan, air conditioning and speed control systems. The PCM changes generator charge rate by adjusting the generator field. The PCM also performs diagnostics.

The PCM adjusts injector pulse width (air-fuel ratio) based on the following inputs.

- Battery voltage
- Coolant temperature
- Exhaust gas content (oxygen sensor)
- Engine speed (crankshaft position sensor)
- Intake air temperature
- Manifold absolute pressure
- Throttle position

The PCM adjusts ignition timing based on the following inputs.

- Coolant temperature

DESCRIPTION AND OPERATION (Continued)

- Engine speed (crankshaft position sensor)
- Knock sensor
- Manifold absolute pressure
- Throttle position
- Transmission gear selection (park/neutral switch)
- Intake air temperature

The PCM also adjusts engine idle speed through the idle air control motor based on the following inputs.

- Air conditioning sense
- Battery voltage
- Battery temperature
- Brake switch
- Coolant temperature
- Engine speed (crankshaft position sensor)
- Engine run time
- Manifold absolute pressure
- Power steering pressure switch
- Throttle position
- Transmission gear selection (park/neutral switch)
- Vehicle distance (speed)

The Auto Shutdown (ASD) and fuel pump relays are located in the Power Distribution Center (PDC).

The camshaft position sensor (distributor pick-up signal 2.5L) and crankshaft position sensor signals are sent to the PCM. If the PCM does not receive the signal within approximately 1 second of engine cranking, it deactivates the ASD relay and fuel pump relay. When these relays are deactivated, power is shut off from the fuel injectors, ignition coils, oxygen sensor heating elements and fuel pump.

The PCM contains a voltage converter that changes battery voltage to a regulated 9 volts direct current to power the camshaft position sensor, crankshaft position sensor and vehicle speed sensor. The PCM also provides a 5 volt direct current supply for the manifold absolute pressure sensor and throttle position sensor.

AIR CONDITIONING PRESSURE TRANSDUCER—PCM INPUT

The Powertrain Control Module (PCM) monitors the A/C compressor discharge (high side) pressure through the air conditioning pressure transducer. The transducer supplies an input to the PCM. The PCM engages the A/C compressor clutch if pressure is sufficient for A/C system operation.

AUTOMATIC SHUTDOWN (ASD) SENSE—PCM INPUT

The ASD sense circuit informs the PCM when the ASD relay energizes. A 12 volt signal at this input indicates to the PCM that the ASD has been activated. This input is used only to sense that the ASD relay is energized.

When energized, the ASD relay supplies battery voltage to the fuel injectors, ignition coils and the heating element in each oxygen sensor. If the PCM

does not receive 12 volts from this input after grounding the ASD relay, it sets a Diagnostic Trouble Code (DTC).

BATTERY VOLTAGE—PCM INPUT

The PCM monitors the battery voltage input to determine fuel injector pulse width and generator field control.

If battery voltage is low the PCM will increase injector pulse width (period of time that the injector is energized).

BATTERY TEMPERATURE SENSOR—PCM INPUT

The PCM uses the temperature of the battery area to control the charge rate. The signal is used to regulate the system voltage. The system voltage is higher at cold temperatures and is gradually reduced as temperature is increased.

BRAKE SWITCH—PCM INPUT

When the brake switch is activated, the 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 motor. The brake switch is mounted on the brake pedal support bracket.

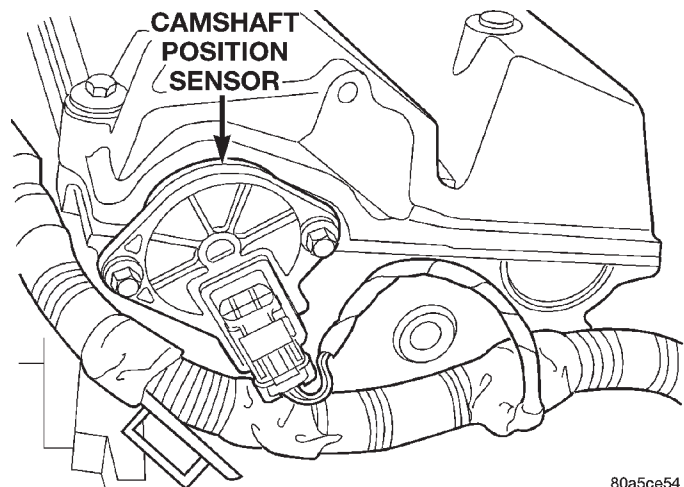
CAMSHAFT POSITION SENSOR—PCM INPUT

The PCM determines fuel injection synchronization and cylinder identification from inputs provided by the camshaft position sensor and crankshaft position sensor. From the two inputs, the PCM determines crankshaft position.

Refer to Group 8D - Camshaft Position Sensor for more information.

2.4L ENGINES

The camshaft position sensor attaches to the rear of the cylinder head (Fig. 2).



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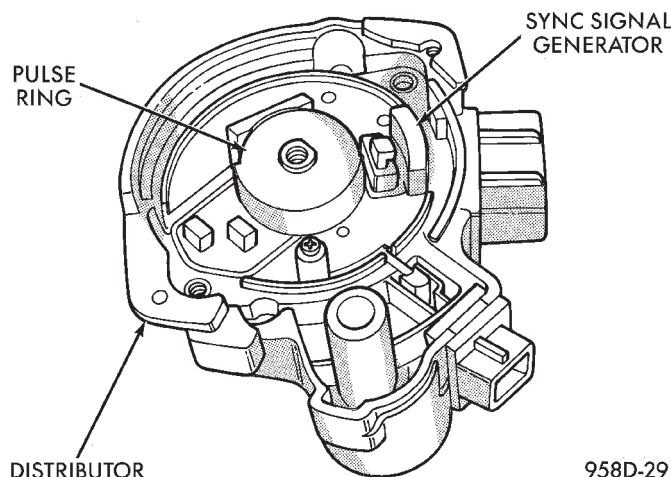
Fig. 2 Camshaft Position Sensor—2.4L

The sensor also acts as a thrust plate to control camshaft endplay.

DESCRIPTION AND OPERATION (Continued)

2.5L ENGINE

The 2.5L engine is equipped with a camshaft driven mechanical distributor. The distributor is also equipped with an internal camshaft position (fuel sync) sensor (Fig. 3).



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Fig. 3 Camshaft Position Sensor—2.5L

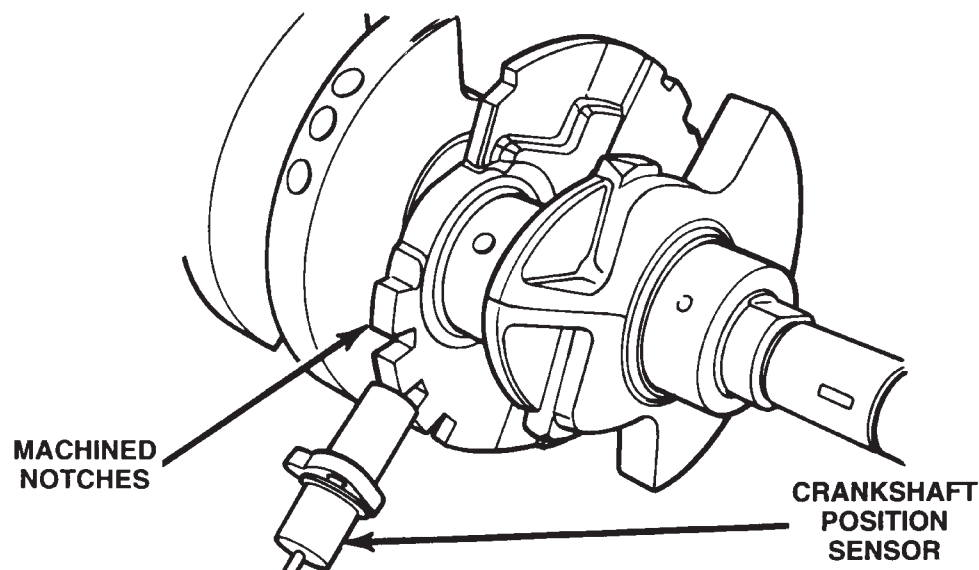
CRANKSHAFT POSITION SENSOR—PCM INPUT

The PCM determines what cylinder to fire from the crankshaft and camshaft position sensor input. It is also used to synchronize the fuel injectors with their respective cylinders.

Refer to Group 8D - Crankshaft Position Sensor for more information.

2.4L ENGINES

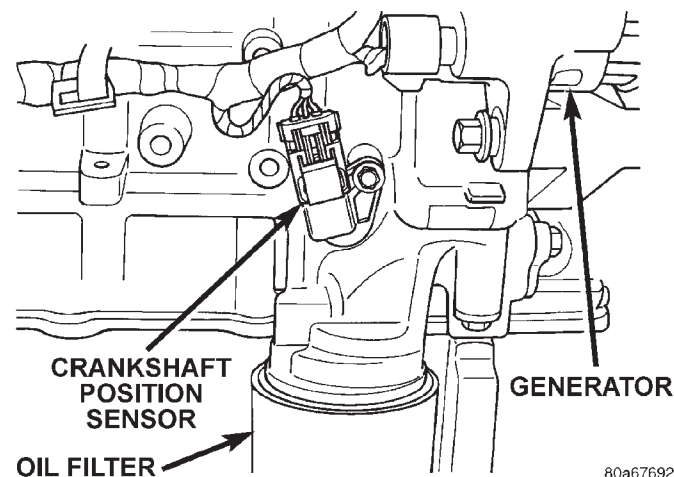
On 2.4L engines, the second crankshaft counterweight has two sets of four timing reference notches including a 60 degree signature notch (Fig. 4). From the crankshaft position sensor input the PCM determines engine speed and crankshaft angle (position).



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Fig. 4 Timing Reference Notches

The crankshaft position sensor mounts to the engine block behind the generator, just above the oil filter (Fig. 5).



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Fig. 5 Crankshaft Position Sensor—2.4L Engines

2.5L ENGINE

On a 2.5L engine, this sensor is a hall effect device that detects notches in the flexplate.

The sensor is located in the transaxle housing, above the vehicle speed sensor (Fig. 6).

ENGINE COOLANT TEMPERATURE SENSOR—PCM INPUT

The coolant temperature sensor has one element. The element supplies coolant temperature signal to the PCM. The PCM supplies coolant temperature information on the CCD Bus to the Body Control Module (BCM) for the instrument panel gauge cluster. The PCM determines engine coolant temperature from the coolant temperature sensor.

DESCRIPTION AND OPERATION (Continued)

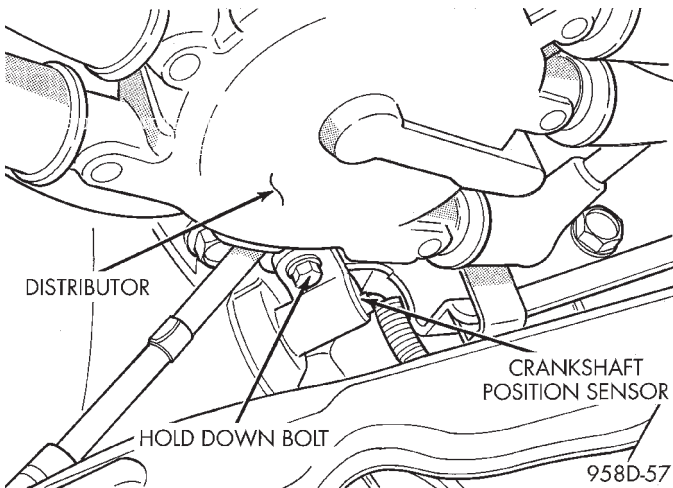


Fig. 6 Crankshaft Position Sensor—2.5L Engine

As coolant temperature varies, the coolant temperature sensor resistance changes resulting in a different current draw from the PCM.

When the engine is cold, the PCM will provide slightly richer air-fuel mixtures and higher idle speeds until normal operating temperatures are reached.

The coolant sensor threads into the front of the cylinder head 2.4L (Fig. 7); next to the coolant fill neck 2.5L (Fig. 8). New sensors have sealant applied to the threads.

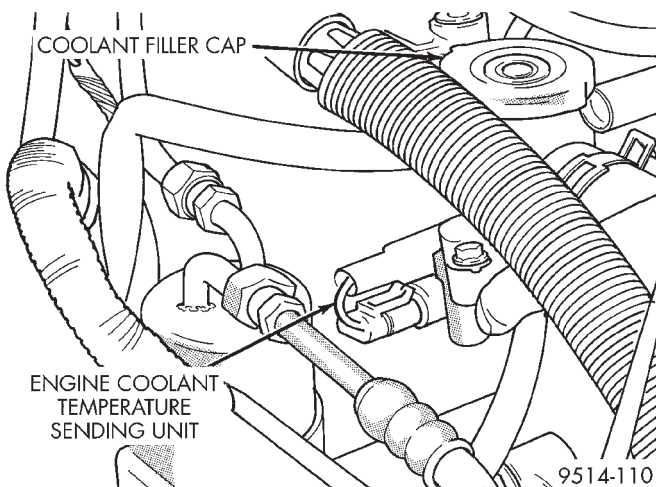


Fig. 7 Engine Coolant Temperature Sensor—2.4L

FUEL LEVEL SENSOR—PCM INPUT

The fuel level sensor (fuel gauge sending unit) sends a variable voltage to the PCM to indicate fuel level. The purpose of this feature is to prevent a false setting of misfire and fuel system monitor trouble codes if the fuel level is less than approximately 15 percent of its rated capacity.

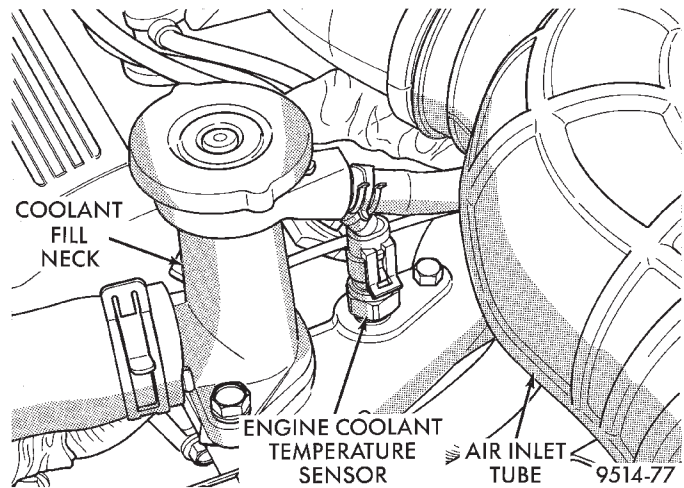


Fig. 8 Engine Coolant Temperature Sensor—2.5L

HEATED OXYGEN SENSORS—PCM INPUT

As vehicles accumulate mileage, the catalytic converter deteriorates. The deterioration results in a less efficient catalyst. To monitor catalytic converter deterioration, the fuel injection system uses two heated oxygen sensors. One sensor upstream of the catalytic converter, one downstream of the converter. The PCM compares the reading from the sensors to calculate the catalytic converter oxygen storage capacity and converter efficiency. Also, the PCM uses the upstream heated oxygen sensor input when adjusting injector pulse width.

When the catalytic converter efficiency drops below emission standards, the PCM stores a diagnostic trouble code and illuminates the malfunction indicator lamp (MIL).

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

UPSTREAM OXYGEN SENSOR

The input from the upstream heated oxygen sensor tells the PCM the oxygen content of the exhaust gas. Based on this input, the PCM fine tunes the air-fuel ratio by adjusting injector pulse width.

The sensor input switches from 0 to 1 volt, depending upon the oxygen content of the exhaust gas in the exhaust manifold. When a large amount of oxygen is present (caused by a lean air-fuel mixture), the sensor produces voltage as low as 0.1 volt. When there is a lesser amount of oxygen present (rich air-fuel mixture) the sensor produces a voltage as high as 1.0 volt. By monitoring the oxygen content and converting it to electrical voltage, the sensor acts as a rich-lean switch.

DESCRIPTION AND OPERATION (Continued)

The heating element in the sensor provides heat to the sensor ceramic element. Heating the sensor allows the system to enter into closed loop operation sooner. Also, it allows the system to remain in closed loop operation during periods of extended idle.

In Closed Loop, the PCM adjusts injector pulse width based on the upstream heated oxygen sensor input along with other inputs. In Open Loop, the PCM adjusts injector pulse width based on preprogrammed (fixed) values and inputs from other sensors.

The upstream oxygen sensor threads into the outlet flange of the exhaust manifold (Fig. 9) or (Fig. 10).

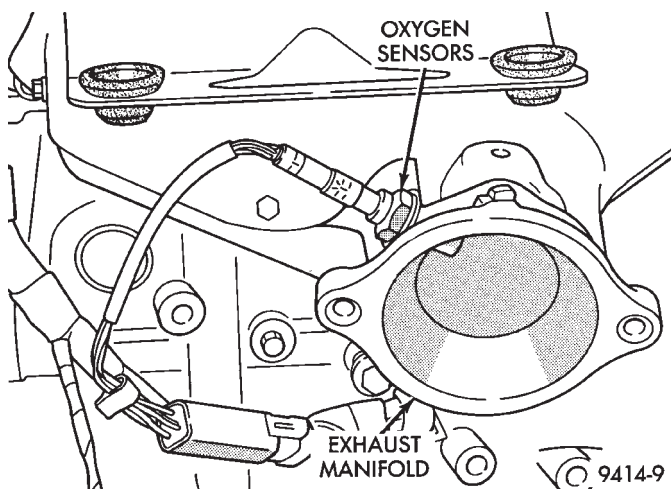


Fig. 9 Upstream Heated Oxygen Sensor—2.0/2.4L Engines

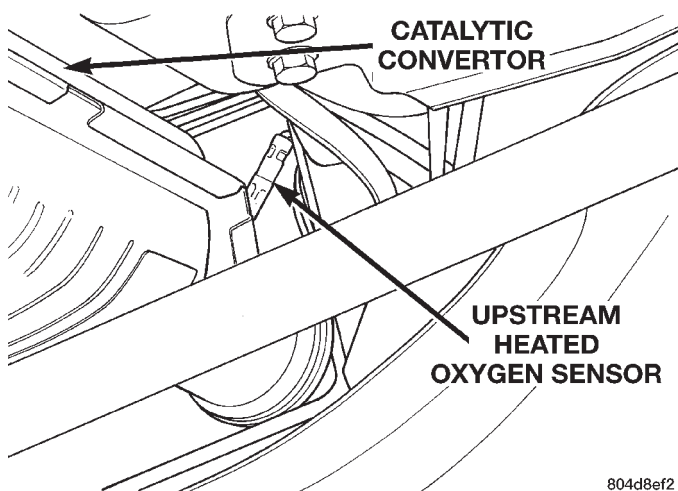


Fig. 10 Upstream Oxygen Sensor—2.5L

DOWNSTREAM OXYGEN SENSOR

The downstream heated oxygen sensor threads into the outlet pipe at the rear of the catalytic converter (Fig. 11). The downstream heated oxygen sensor input is used to detect catalytic converter deterioration. As the converter deteriorates, the input from the downstream sensor begins to match the upstream sensor input except for a slight time delay. By com-

paring the downstream heated oxygen sensor input to the input from the upstream sensor, the PCM calculates catalytic converter efficiency.

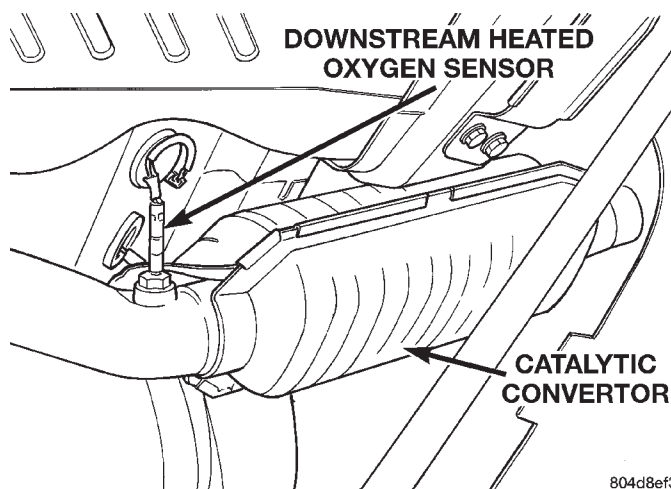


Fig. 11 Downstream Heated Oxygen Sensor

IGNITION SENSE—PCM INPUT

The ignition sense input informs the Powertrain Control Module (PCM) that the ignition switch is in the crank or run position.

INTAKE AIR TEMPERATURE SENSOR—PCM INPUT

The Intake Air Temperature (IAT) sensor measures the temperature of the intake air as it enters the engine. The sensor supplies one of the inputs the PCM uses to determine injector pulse width and spark advance.

The IAT sensor and Manifold Absolute Pressure (MAP) switch they are a combined sensor that attach to the intake manifold (Fig. 12).

The IAT sensor threads into the intake manifold (Fig. 13) or (Fig. 14).

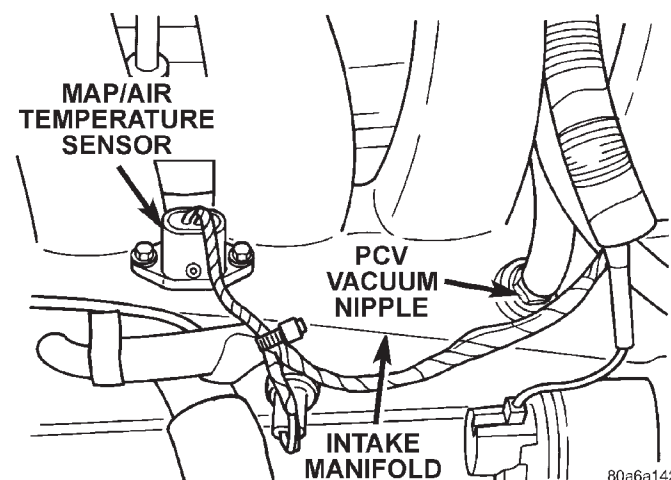


Fig. 12 Intake Air Temperature Sensor and MAP Sensor—2.0L

DESCRIPTION AND OPERATION (Continued)

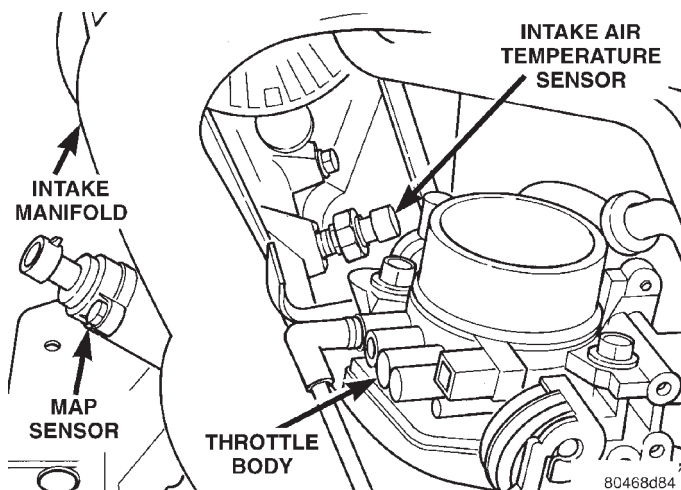


Fig. 13 Intake Air Temperature Sensor and MAP Sensor—2.4L

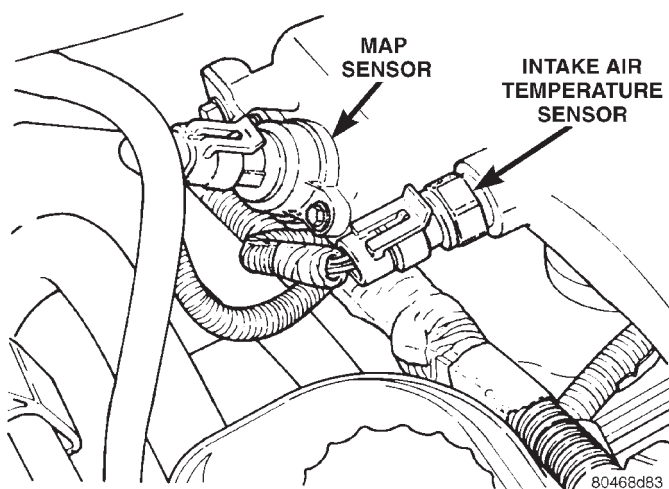


Fig. 14 Intake Air Temperature Sensor and MAP Sensor—2.5L

KNOCK SENSOR—PCM INPUT (2.0L/2.4L ENGINES)

The knock sensor threads into the side of the cylinder block in front of the starter (Fig. 15). When the knock sensor detects a knock in one of the cylinders, it sends an input signal to the PCM. In response, the PCM retards ignition timing for all cylinders by a scheduled amount.

Knock sensors contain a piezoelectric material which sends an input voltage (signal) to the PCM. As the intensity of the engine knock vibration increases, the knock sensor output voltage also increases.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR—PCM INPUT

The PCM supplies 5 volts direct current to the MAP sensor. The MAP sensor converts intake manifold pressure into voltage. The PCM monitors the MAP sensor output voltage. As vacuum increases,

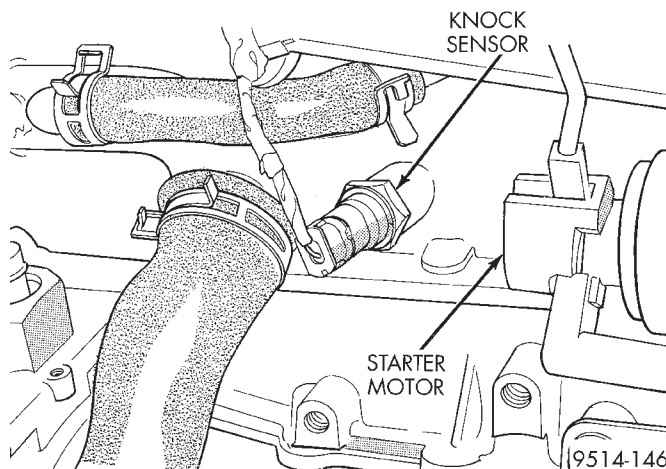


Fig. 15 Knock Sensor

MAP sensor voltage decreases proportionately. Also, as vacuum decreases, MAP sensor voltage increases proportionately.

At key on, before the engine is started, the PCM determines atmospheric air pressure from the MAP sensor voltage. While the engine operates, the PCM determines intake manifold pressure from the MAP sensor voltage. Based on MAP sensor voltage and inputs from other sensors, the PCM adjusts spark advance and the air/fuel mixture.

The MAP sensor mounts to the intake manifold.

POWER STEERING PRESSURE SWITCH—PCM INPUT

A pressure sensing switch is located on the power steering gear. The switch (Fig. 16) provides an input to the PCM during periods of high pump load and low engine RPM; such as during parking maneuvers.

When power steering pump pressure exceeds 4137 kPa (600 psi), the switch is open. The PCM increases idle air flow through the IAC motor to prevent engine stalling. When pump pressure is low, the switch is closed.

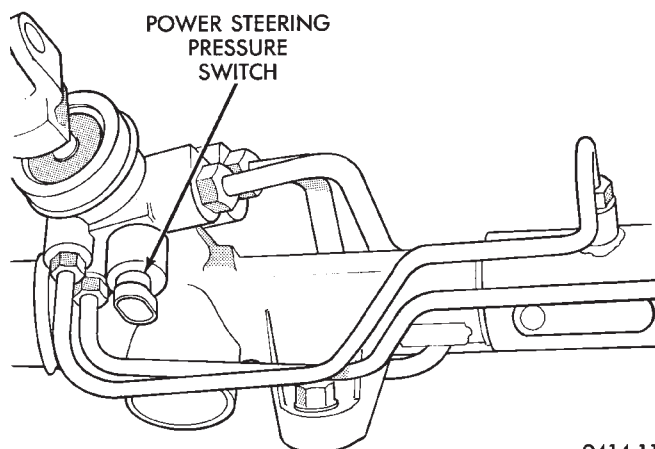


Fig. 16 Power Steering Pressure Switch

DESCRIPTION AND OPERATION (Continued)

SENSOR RETURN—PCM INPUT

The sensor return circuit provides a low electrical noise ground reference for all of the systems sensors. The sensor return circuit connects to internal ground circuits within the powertrain control module.

SPEED CONTROL—PCM INPUT

The speed control system provides five separate voltages (inputs) to the Powertrain Control Module (PCM). The voltages correspond to the ON/OFF, SET, RESUME and CANCEL.

The speed control ON voltage informs the PCM that the speed control system has been activated. The speed control SET voltage informs the PCM that a fixed vehicle speed has been selected. The speed control RESUME voltage indicates the previous fixed speed is requested. The speed control CANCEL voltage tells the PCM to deactivate but retain set speed in memory (same as depressing the brake pedal). The speed control OFF voltage tells the PCM that the speed control system has deactivated. Refer to Group 8H for more speed control information.

SCI RECEIVE—PCM INPUT

SCI Receive is the serial data communication receive circuit for the DRB scan tool. The Powertrain Control Module (PCM) receives data from the DRB through the SCI Receive circuit.

TRANSAXLE PARK/NEUTRAL SWITCH—PCM INPUT

The park/neutral switch is located on the transaxle housing (Fig. 17). It provides an input to the PCM indicating whether the automatic transaxle is in Park or Neutral. This input is used to determine idle speed (varying with gear selection) and ignition timing advance. The park neutral switch is sometimes referred to as the neutral safety switch.

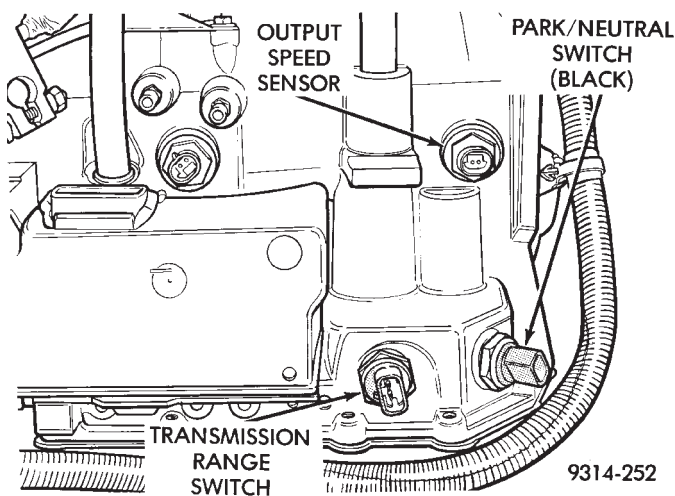


Fig. 17 Park Neutral Switch—4-Speed Electronic Automatic Transaxle—Typical

THROTTLE POSITION SENSOR—PCM INPUT

The throttle position sensor mounts to the side of the throttle body (Fig. 18) or (Fig. 19).

The Throttle Position Sensor (TPS) connects to the throttle blade shaft. The TPS is a variable resistor that provides the PCM with an input signal (voltage). The signal represents throttle blade position. As the position of the throttle blade changes, the resistance of the TPS changes.

The PCM supplies approximately 5 volts DC to the TPS. The TPS output voltage (input signal to the PCM) represents throttle blade position. The TPS output voltage to the PCM varies from approximately 0.5 volt at minimum throttle opening (idle) to a maximum of 3.7 volts at wide open throttle.

Along with inputs from other sensors, the PCM uses TPS input to determine current engine operating conditions. The PCM also adjusts fuel injector pulse width and ignition timing based on these inputs.

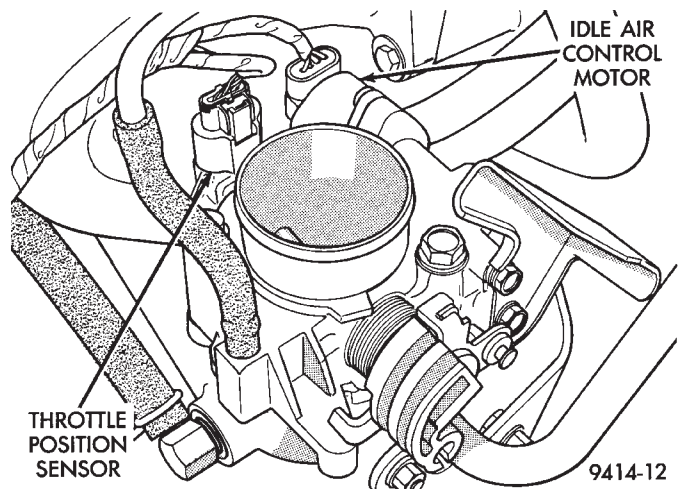


Fig. 18 Throttle Position Sensor—2.0/2.4L Engines

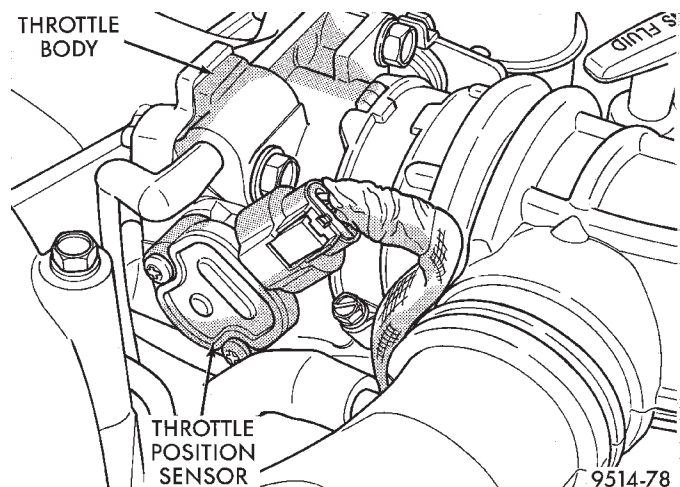


Fig. 19 Throttle Position Sensor—2.5L Engine

DESCRIPTION AND OPERATION (Continued)

VEHICLE SPEED AND DISTANCE—PCM INPUT

The transaxle output speed sensor supplies the vehicle speed and distance inputs to the PCM. The output speed sensor is located on the side of the transaxle (Fig. 17).

The speed and distance signals, along with a closed throttle signal from the TPS, determine if a closed throttle deceleration or normal idle condition (vehicle stopped) exists. Under deceleration conditions, the PCM adjusts the idle air control motor to maintain a desired MAP value. Under idle conditions, the PCM adjusts the idle air control motor to maintain a desired engine speed.

AIR CONDITIONING CLUTCH RELAY—PCM OUTPUT

The PCM controls the air conditioning clutch relay ground circuit. Buss bars in the Power Distribution Center (PDC) supply voltage to the solenoid side and power side of the relay. When the PCM receives an air conditioning input, it grounds the A/C compressor clutch relay and the radiator fan relay.

When the PCM senses low idle speeds or wide open throttle through the throttle position sensor, it removes the ground for the A/C compressor clutch relay. When the relay de-energizes, the contacts open preventing air conditioning clutch engagement. Also, if the PCM senses a part throttle launch condition, it disables the A/C compressor clutch for several seconds.

The air conditioning clutch relay is located in the PDC. The inside top of the PDC cover has a label showing relay and fuse location.

AUTOMATIC SHUTDOWN RELAY—PCM OUTPUT

The PCM operates the automatic shut down (ASD) relay and fuel pump relay through one ground path. The PCM operates them by switching the ground path for the solenoid side of the relays on and off. Both relays turn on and off at the same time.

The ASD relay connects battery voltage to the fuel injectors and ignition coil. The fuel pump relay connects battery voltage to the fuel pump.

A buss bar in the power distribution center (PDC) supplies voltage to the solenoid side and contact side of the relay. The ASD relay power circuit contains a 20 amp fuse between the buss bar in the PDC and the relay. The fuse also protects the power circuit for the fuel pump relay and pump. The fuse is located in the PDC. Refer to Group 8W, Wiring Diagrams for circuit information.

The PCM controls the relay by switching the ground path for the solenoid side of the relay on and off. The PCM turns the ground path off when the ignition switch is in the Off position unless the 02 Heater Monitor test is being run. Refer to Group 25,

On-Board Diagnostics. When the ignition switch is in the On or Crank position, the PCM monitors the crankshaft position sensor and camshaft position sensor signals to determine engine speed and ignition timing (coil dwell). If the PCM does not receive the crankshaft position sensor and camshaft position sensor signals when the ignition switch is in the Run position, it will de-energize the ASD relay.

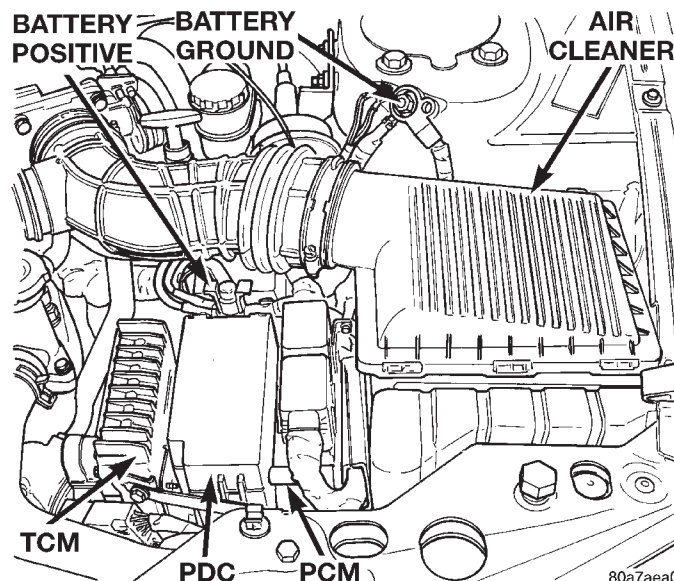


Fig. 20 Power Distribution Center (PDC)

The ASD relay and fuel pump relay are located in the power distribution center (PDC) near the battery (Fig. 20). The inside top of the PDC cover has a label showing relay and fuse location.

DUTY CYCLE EVAP PURGE SOLENOID—PCM OUTPUT

The duty cycle EVAP purge solenoid regulates the rate of vapor flow from the EVAP canister to the throttle body. The powertrain control module operates the solenoid.

During the cold start warm-up period and the hot start time delay, the PCM does not energize the solenoid. When de-energized, no vapors are purged.

The engine enters closed loop operation after it reaches a specified temperature and the programmed time delay ends. During closed loop operation, the PCM energizes and de-energizes the solenoid 5 to 10 times per second, depending upon operating conditions. The PCM varies the vapor flow rate by changing solenoid pulse width. Pulse width is the amount of time the solenoid is energized.

The solenoid attaches to a bracket near the front engine mount (Fig. 21). To operate correctly, the solenoid must be installed with the electrical connector on top.

DESCRIPTION AND OPERATION (Continued)

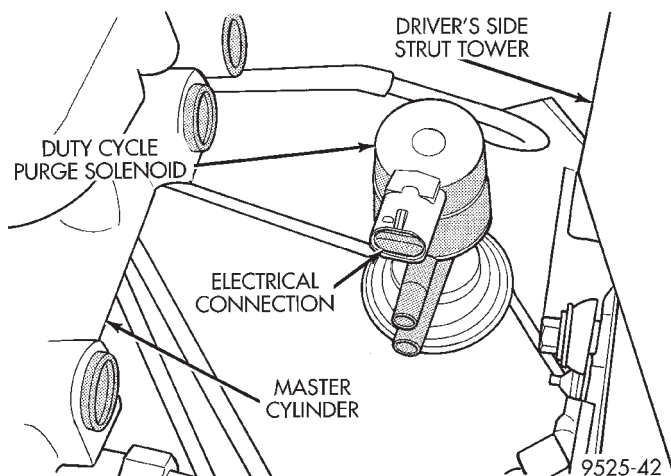


Fig. 21 Duty Cycle EVAP Purge Solenoid

ELECTRIC EGR TRANSDUCER—PCM OUTPUT—2.4/2.5L ENGINES

The Electric EGR Transducer contains an electrically operated solenoid and a back-pressure controlled vacuum transducer (Fig. 22). The PCM operates the solenoid based on inputs from the multi-port fuel injection system. The solenoid/transducer and EGR valve are serviced as an assembly.

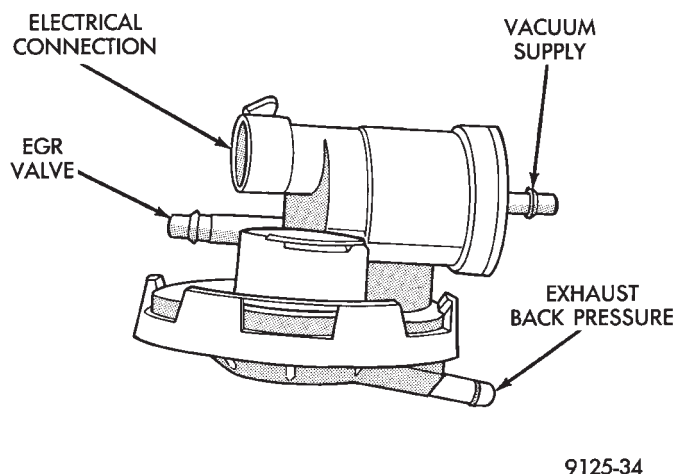


Fig. 22 Electronic EGR Transducer

When the PCM energizes the solenoid, vacuum does not reach the transducer. Vacuum flows to the transducer when the PCM de-energizes the solenoid.

When exhaust system back-pressure becomes high enough, it fully closes a bleed valve in the vacuum transducer. When the PCM de-energizes the solenoid and back-pressure closes the transducer bleed valve, vacuum flows through the transducer to operate the EGR valve.

De-energizing the solenoid, but not fully closing the transducer bleed hole (because of low back-pressure), varies the strength of the vacuum signal applied to the EGR valve. Varying the strength of the vacuum signal changes the amount of EGR supplied to the engine. This provides the correct amount of exhaust gas recirculation for different operating conditions.

The solenoid/transducer and EGR valve mount to the rear of the cylinder head (Fig. 23) or (Fig. 24).

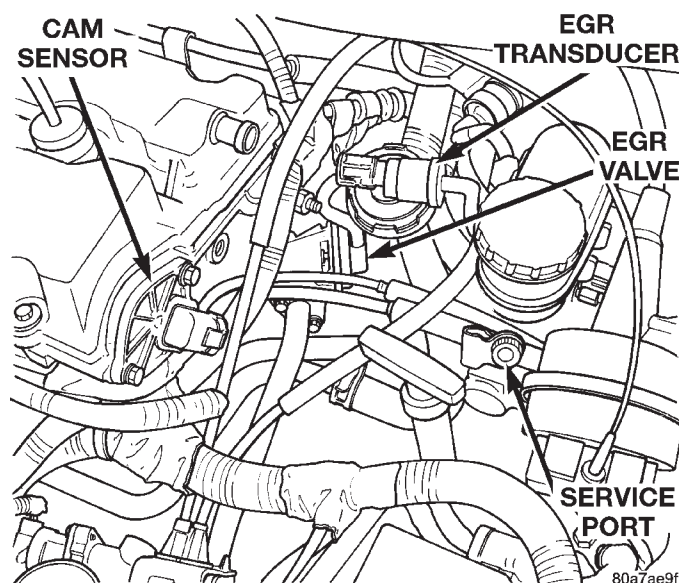


Fig. 23 Electric EGR Transducer—2.4L Engine

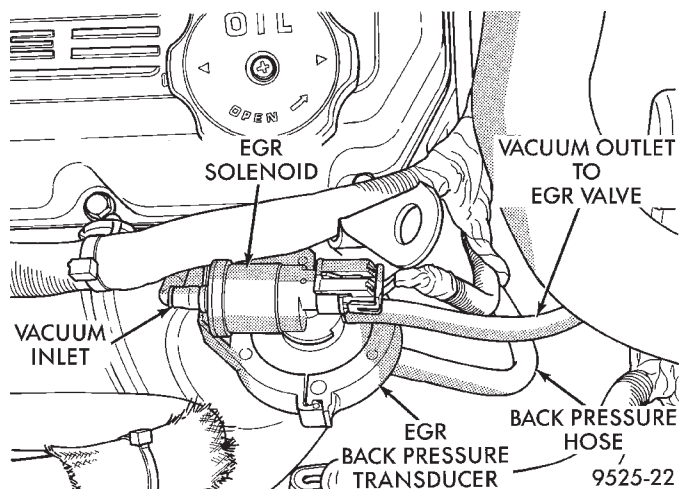


Fig. 24 EGR Control Valve—2.5L Engine

GENERATOR FIELD—PCM OUTPUT

The PCM regulates the charging system voltage within a range of 12.9 to 15.0 volts. Refer to Group 8A for Battery system information and 8C for charging system information.

DESCRIPTION AND OPERATION (Continued)

IDLE AIR CONTROL MOTOR—PCM OUTPUT

The Idle Air Control (IAC) motor is mounted on the throttle body. The PCM operates the idle air control motor (Fig. 25) or (Fig. 26). The PCM adjusts engine idle speed through the idle air control motor to compensate for engine load, coolant temperature or barometric pressure changes.

The throttle body has an air bypass passage that provides air for the engine during closed throttle idle. The idle air control motor pintle protrudes into the air bypass passage and regulates air flow through it.

The PCM adjusts engine idle speed by moving the IAC motor pintle in and out of the bypass passage. The adjustments are based on inputs the PCM receives. The inputs are from the throttle position sensor, crankshaft position sensor, coolant temperature sensor, MAP sensor, vehicle speed sensor and various switch operations (brake, park/neutral, air conditioning).

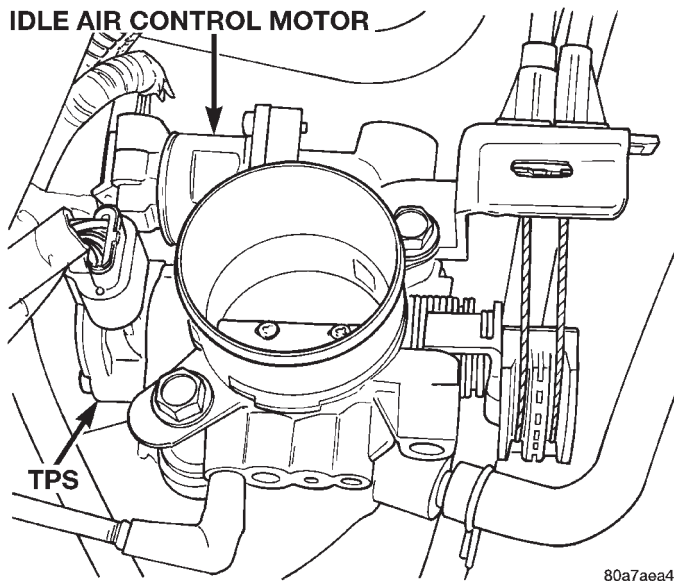


Fig. 25 Idle Air Control Motor Air Bypass Passage—2.4L

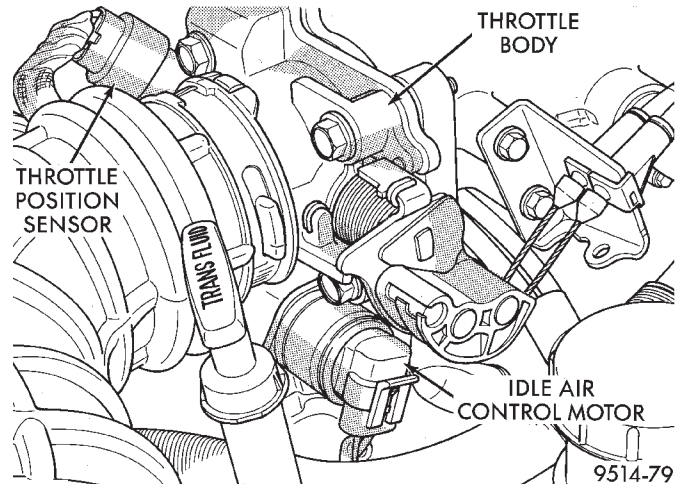


Fig. 26 Idle Air Control Motor Air Bypass Passage—2.5L

DATA LINK CONNECTOR

The data link connector (diagnostic connector) links the DRB scan tool with the Powertrain Control Module (PCM). Refer to On-Board Diagnostics in Group 25 - Emission Control Systems. The data link connector is located inside the vehicle, under the instrument panel, at the driver's kick panel (Fig. 27).

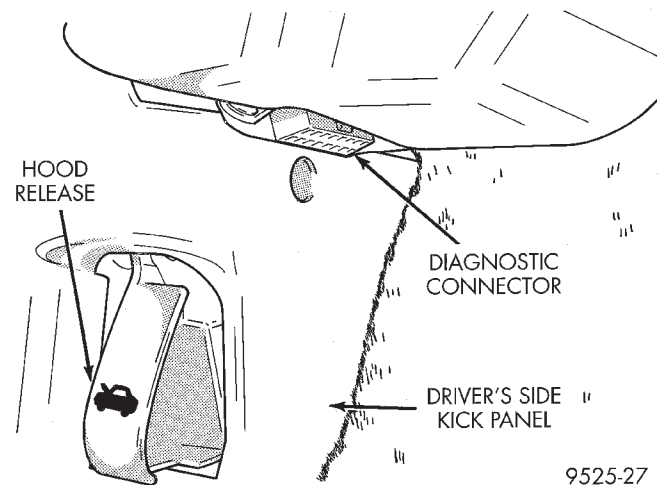


Fig. 27 Data Link (Diagnostic) Connector

FUEL INJECTORS—PCM OUTPUT

All engines use electrically operated top feed fuel injectors (Fig. 28). The Automatic Shutdown (ASD) relay supplies battery voltage to the fuel injectors. The PCM controls the ground path for each injector in sequence. By switching the ground paths on and off, the PCM fine-tunes injector pulse width. Injector pulse width refers to the amount of time an injector operates.

The PCM determines injector synchronization from the camshaft position sensor and crankshaft position sensor inputs. The PCM grounds the ASD and fuel pump relays after receiving the camshaft position sensor and crankshaft position sensor inputs.

DESCRIPTION AND OPERATION (Continued)

The PCM energizes the injectors in a sequential order during all engine operating conditions except start-up. For the first injector pulse width during start-up, all injectors are energized at the same time. Once the PCM determines crankshaft position, it begins energizing the injectors in sequence.

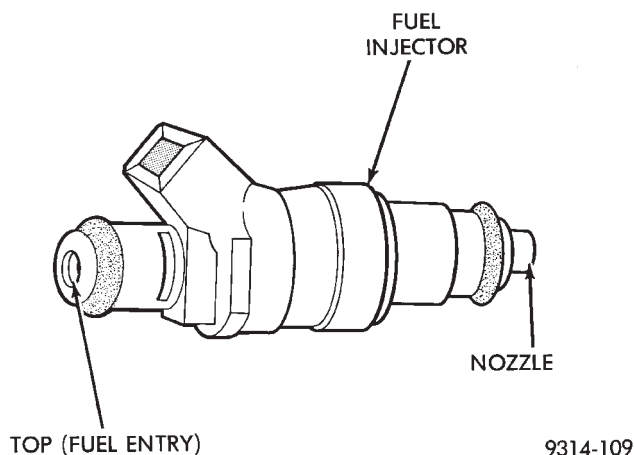


Fig. 28 Fuel Injector

IGNITION COIL—PCM OUTPUT

The coil assembly consists of independent coils molded together (Fig. 29) or (Fig. 30). The coil assembly is mounted on the intake manifold. High tension leads route to each cylinder from the coil. The coil fires two spark plugs every power stroke. One plug is the cylinder under compression, the other cylinder fires on the exhaust stroke. The PCM determines which of the coils to charge and fire at the correct time.

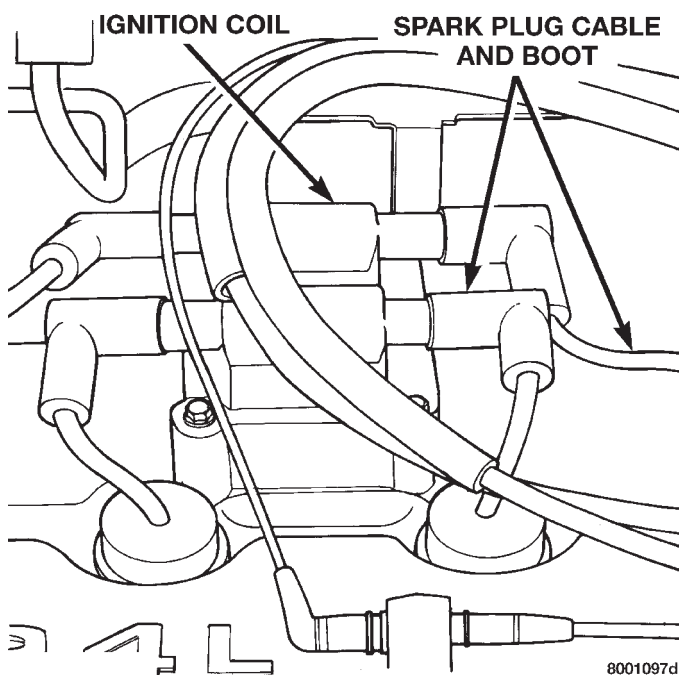


Fig. 29 Ignition Coil—2.4L

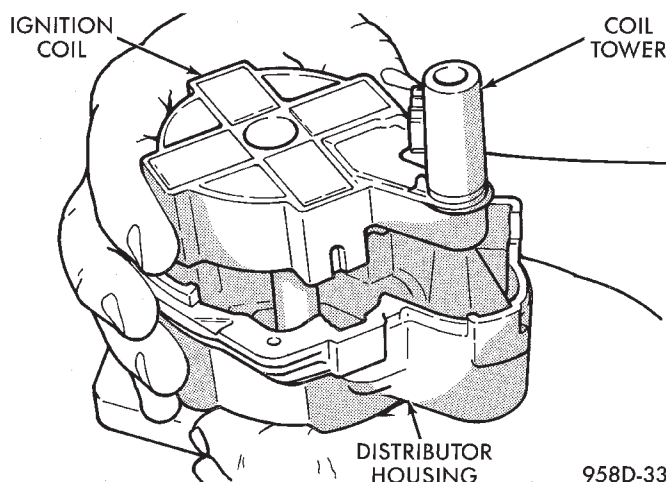


Fig. 30 Ignition Coil—2.5L

The Automatic Shutdown (ASD) relay provides battery voltage to the ignition coil. The PCM provides a ground contact (circuit) for energizing the coil. When the PCM breaks the contact, the energy in the coil primary transfers to the secondary causing the spark. The PCM will de-energize the ASD relay if it does not receive the crankshaft position sensor and camshaft position sensor inputs. Refer to Automatic Shutdown (ASD) Relay—PCM Output in this section for relay operation.

MALFUNCTION INDICATOR (CHECK ENGINE) LAMP—PCM OUTPUT

The PCM supplies the malfunction indicator (check engine) lamp on/off signal to the instrument panel through the CCD Bus. The CCD Bus is a communications port. Various modules use the CCD Bus to exchange information.

The Check Engine lamp comes on each time the ignition key is turned ON and stays on for 3 seconds as a bulb test.

The Malfunction Indicator Lamp (MIL) stays on continuously, when the PCM has entered a Limp-In mode or identified a failed emission component. During Limp-in Mode, the PCM attempts to keep the system operational. The MIL signals the need for immediate service. In limp-in mode, the PCM compensates for the failure of certain components that send incorrect signals. The PCM substitutes for the incorrect signals with inputs from other sensors.

If the PCM detects active engine misfire severe enough to cause catalyst damage, it flashes the MIL. At the same time the PCM also sets a Diagnostic Trouble Code (DTC).

For signals that can trigger the MIL (Check Engine Lamp) refer to Group 25, On-Board Diagnostics.

The MIL can also display diagnostic trouble codes. Cycle the ignition switch on, off, on, off, on, within 5 seconds and any diagnostic trouble codes stored in

DESCRIPTION AND OPERATION (Continued)

the PCM will be displayed. Refer to On-Board Diagnostics in Group 25, Emission Control Systems Diagnostic Trouble Code Descriptions.

RADIATOR FAN RELAYS—PCM OUTPUT

The PCM energizes the radiator fans through either the low or high speed radiator fan relay. The PCM controls the ground circuit for the solenoid side of the relay. Power for both relay solenoids is supplied through a 10 amp fuse in the PDC. Power for both relay contacts is supplied power through a 40 amp fuse in the PDC. Refer to Group 8W - Wiring Diagrams for circuit information.

The PCM monitors the A/C compressor discharge (high side) pressure through the air conditioning pressure transducer. Depending on engine coolant temperature and A/C system high side pressure, both fans operate at either low or high speed.

The radiator fan relays are located in the PDC. The inside top of the PDC cover has a label showing relay and fuse location.

SPEED CONTROL RELAY—PCM OUTPUT

When the operator engages the speed control PCM receives a input from the speed control On switch. In response to the input, the PCM grounds the coil side of the speed control relay. The ignition switch supplies power to the coil and contact sides of the relay. When energized, the speed control relay supplies battery voltage to the speed control vacuum and vent servos. Refer to Group 8H for speed control information.

SPEED CONTROL SERVOS—PCM OUTPUT

The PCM operates the speed control vacuum and vent servos. The PCM supplies a ground for both servos. The speed control relay supplies, also operated by the PCM, supplies battery voltage to the servos. When the PCM supplies a ground to the vacuum servo, the speed control system opens the throttle plate to obtain or maintain the selected road speed. When the PCM supplies a ground to the vent servo, the speed control system releases the throttle plate. The PCM balances the two servos to maintain the set speed. Refer to Group 8H for speed control information.

TACHOMETER—PCM OUTPUT

The tachometer receives its information across the CCD Bus from the Body Control Module (BCM). Information on engine RPM is transmitted from the Powertrain Control Module (PCM) across the CCD Bus to the BCM. The BCM calculates the position of the tachometer pointer based on the input from the PCM and adjusts the position of the gauge pointer to the necessary position. This signal is sent over the CCD Bus to the instrument cluster.

5 VOLT SUPPLY—PCM OUTPUT

The PCM supplies 5 volts to the following sensors:

- A/C pressure transducer
- Engine coolant temperature sensor
- Manifold absolute pressure sensor
- Throttle position sensor

8-VOLT SUPPLY—PCM OUTPUT

The PCM supplies 8 volts to the crankshaft position sensor, camshaft position sensor.

THROTTLE BODY

The throttle body mounts to the intake manifold. The throttle position sensor and idle air control motor attach to the throttle body (Fig. 31) or (Fig. 32).

At above idle conditions, air flow through the throttle body is controlled by a cable operated throttle blade. During closed throttle idle conditions, the idle air control motor controls air flow. Refer to Idle Air Control Motor in this section.

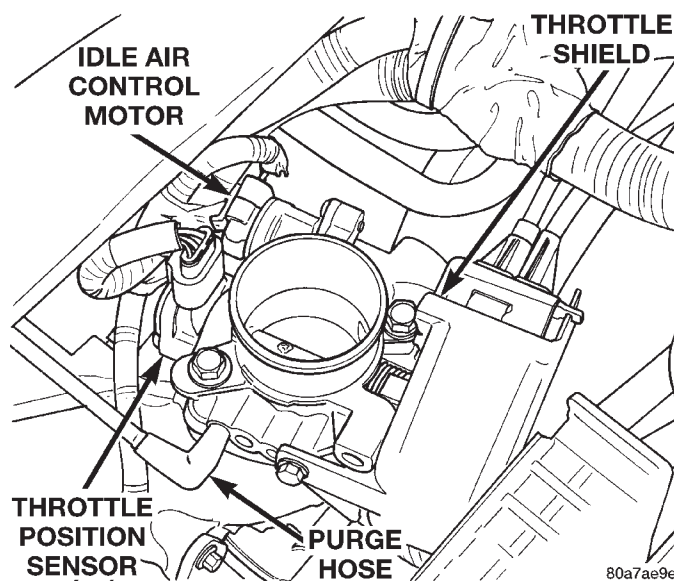


Fig. 31 Throttle Body—2.4L Engines

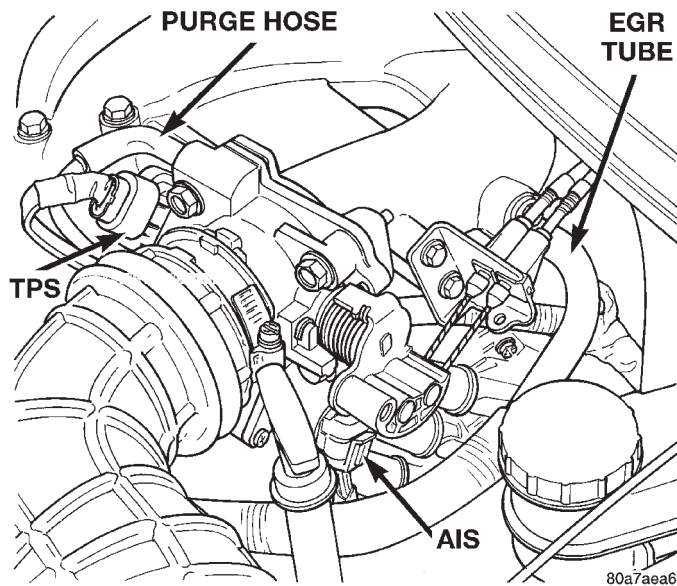


Fig. 32 Throttle Body—2.5L Engine

DIAGNOSIS AND TESTING

VISUAL INSPECTION

Before diagnosing or servicing the fuel injection system, perform a visual inspection for loose, disconnected, or misrouted wires and hoses. A thorough visual inspection that includes the following checks saves unnecessary test and diagnostic time.

(1) Inspect remote battery cable connections. Be sure they are clean and tight. Clean corroded terminals (Fig. 33).

(2) Verify that the PCM's 2 40-way connectors are fully inserted into their sockets on the PCM (Fig. 33).

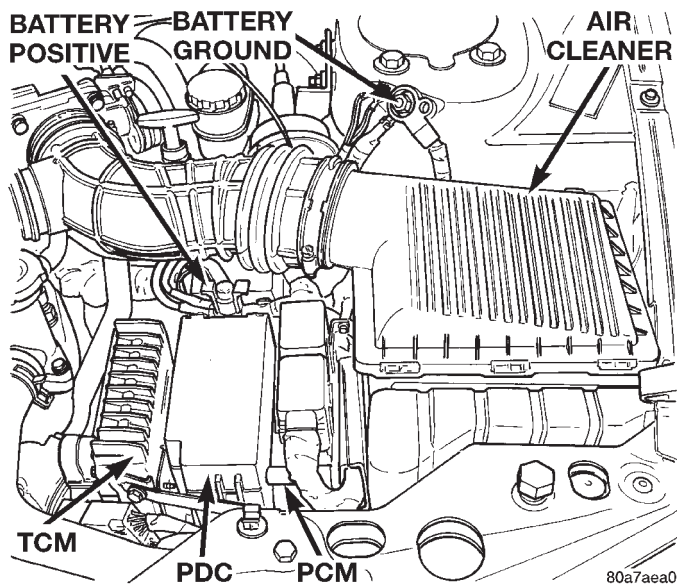


Fig. 33 Remote Battery Terminals and PCM Connectors

(3) Open the Power Distribution Center (PDC). Check for blown fuses. Ensure the relays and fuses

are fully seated in the PDC (Fig. 33). A label on the underside of the PDC cover shows the locations of each relay and fuse.

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

(5) Check the electrical connections at the idle air control motor and throttle position sensor (Fig. 34) or (Fig. 35).

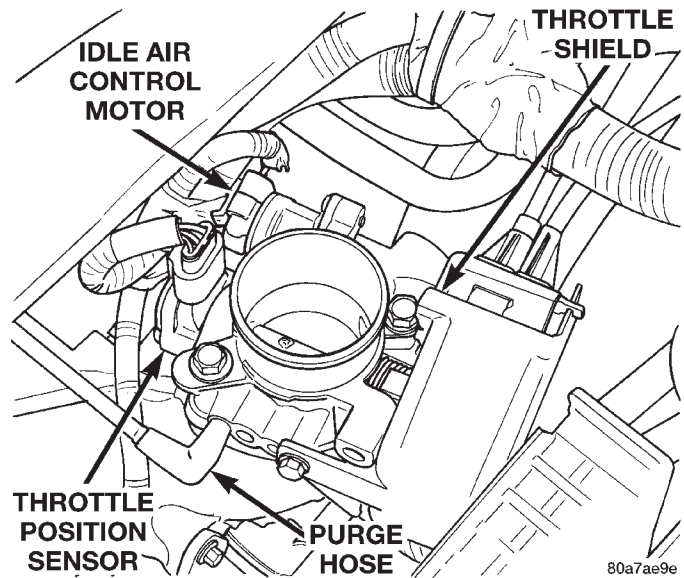


Fig. 34 Idle Air Control Motor and Throttle Position Sensor—2.4L Engine

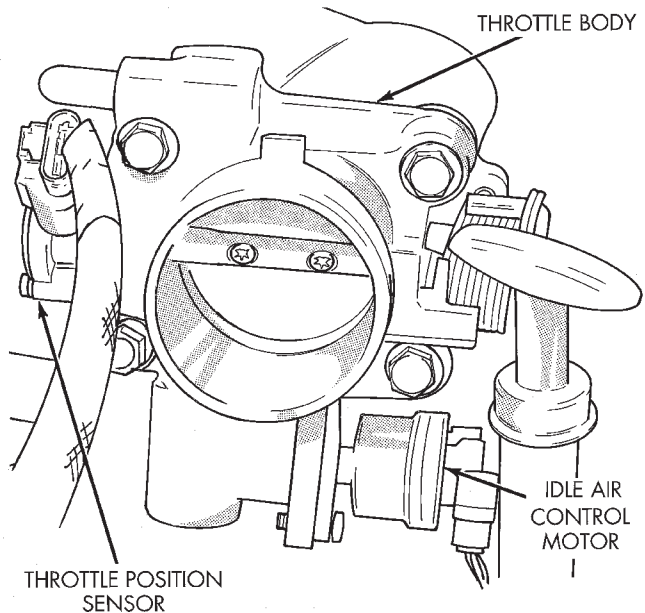


Fig. 35 Idle Air Control Motor and Throttle Position Sensor—2.5L Engine

DIAGNOSIS AND TESTING (Continued)

(6) Check hose connections between the PCV valve, vacuum port-intake manifold (Fig. 36) or (Fig. 37).

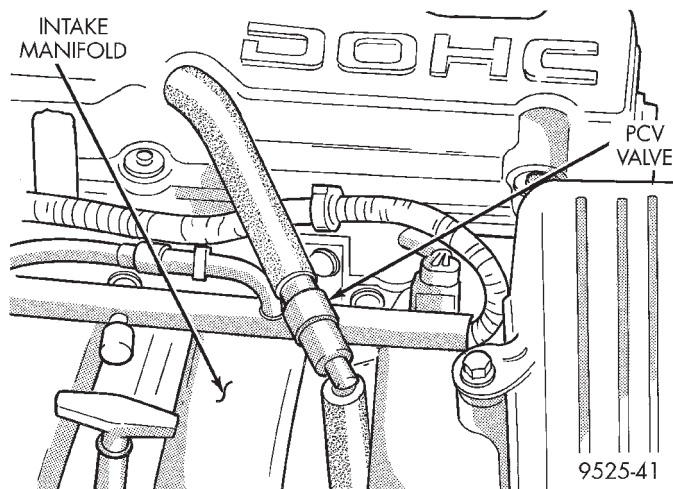


Fig. 36 PCV Valve—2.4L Engine

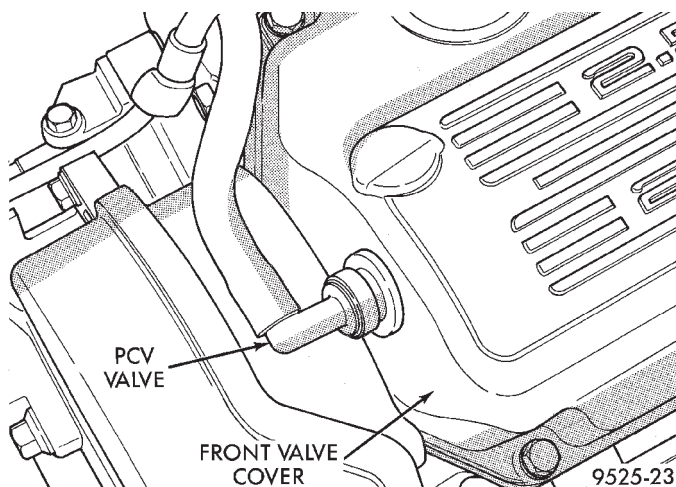


Fig. 37 PCV Valve—2.5L Engine

(7) Inspect the electrical connections at the intake air temperature sensor and the MAP sensor (Fig. 38) or (Fig. 39).

(8) Inspect the fuel injector electrical connections (Fig. 40). Use the DRB Scan Tool to verify connection on a 2.5L engine.

2.4L

(a) Inspect the ignition coil electrical connector. Ensure the spark plug insulators are firmly seated over the spark plugs (Fig. 41).

2.5L

(b) Inspect distributor connectors (Fig. 42) and spark plug cables at distributor.

(9) Inspect the electrical and hose connections at the duty cycle purge solenoid (Fig. 43).

(10) Check electrical connection to the radiator fan.

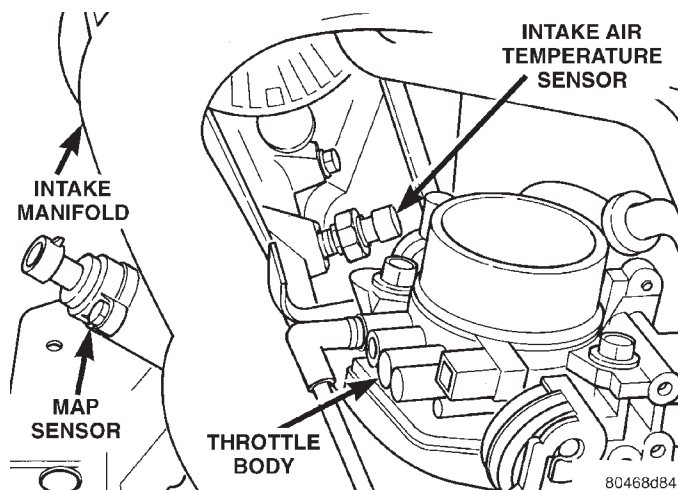


Fig. 38 MAP Sensor and Intake Air Temperature Sensor—2.4L Engine

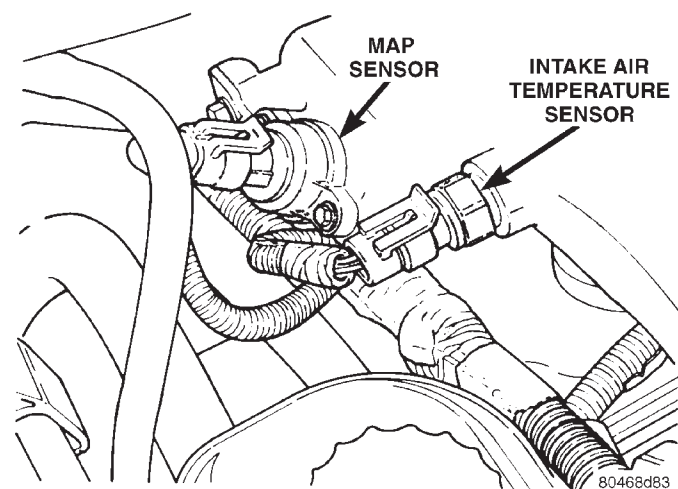


Fig. 39 MAP Sensor and Intake Air Temperature Sensor—2.5L Engine

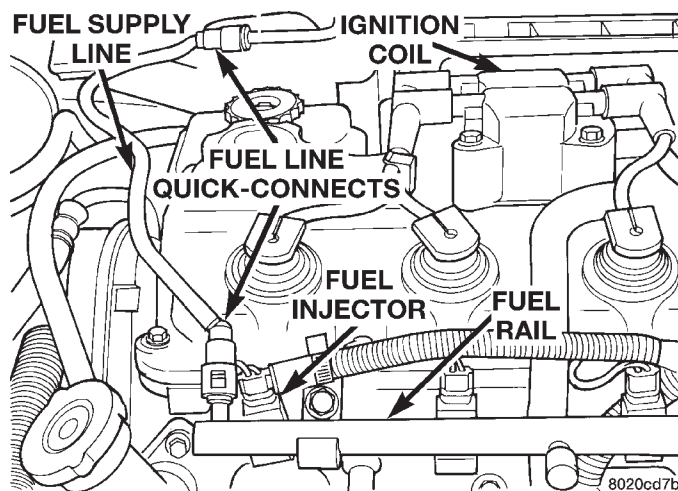


Fig. 40 Fuel Injectors—2.4L Engines

DIAGNOSIS AND TESTING (Continued)

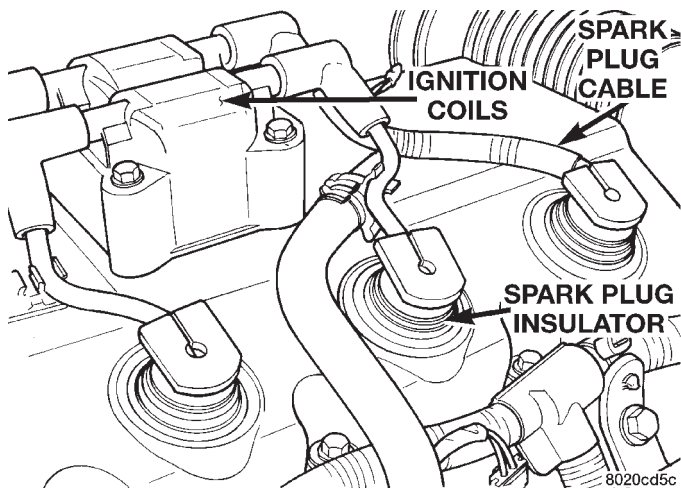


Fig. 41 Ignition Coil and Spark Plugs

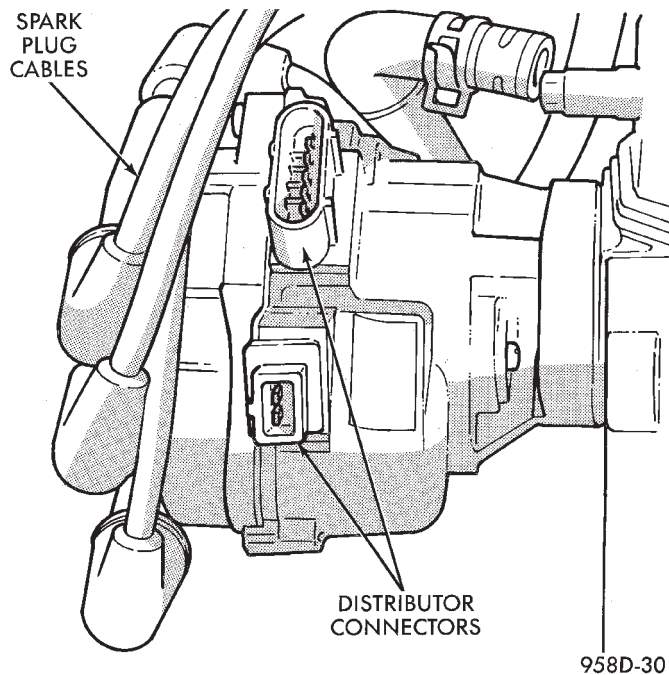


Fig. 42 Distributor Electrical Connectors-Viewed From Rear of Distributor

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

(12) Inspect air cleaner filter element. Replace as necessary. Check air induction system for restrictions.

(13) Check electrical connection at the knock sensor (Fig. 44), 2.4L engines only.

(14) Check electrical connections at the camshaft position sensor (Fig. 45).

(15) Check electrical connections at the engine coolant temperature sensor (Fig. 46) or (Fig. 47).

(16) Check electrical connector at Electronic EGR Transducer. Inspect vacuum and back pressure hoses at the solenoid and transducer for leaks (Fig. 48) or (Fig. 49).

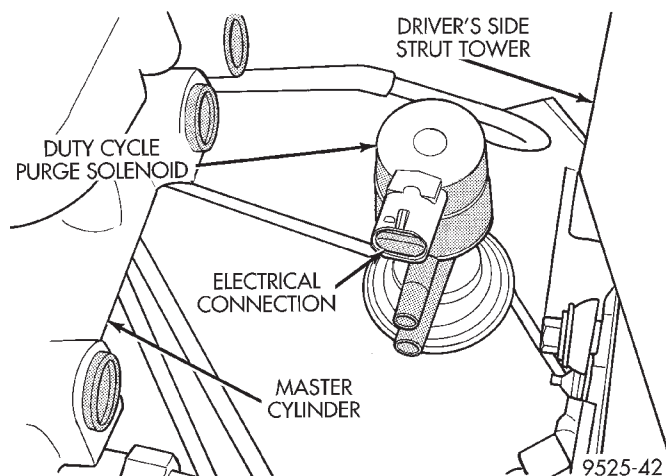


Fig. 43 Duty Cycle EVAP Purge Solenoid

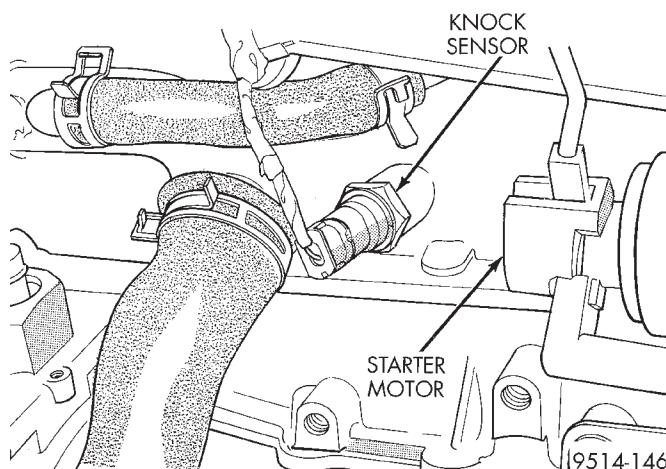


Fig. 44 Knock Sensor—2.4L

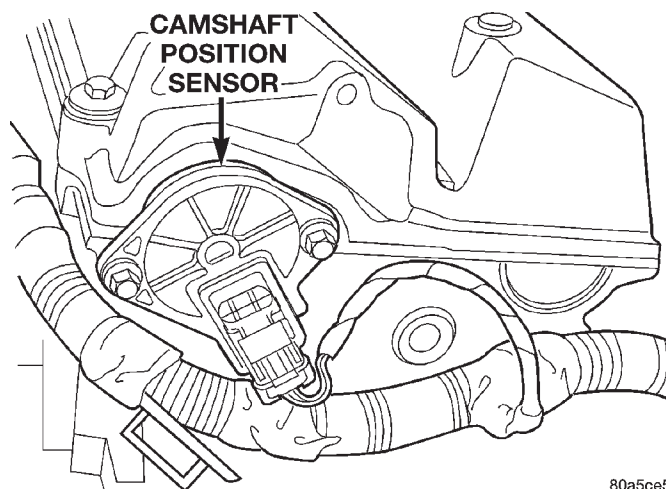


Fig. 45 Camshaft Position Sensor—2.4L Engine

(17) Inspect electrical connections at the generator. Check the generator belt for glazing or damage.

(18) Inspect electrical connector at the crankshaft position sensor (Fig. 50) or (Fig. 51).

DIAGNOSIS AND TESTING (Continued)

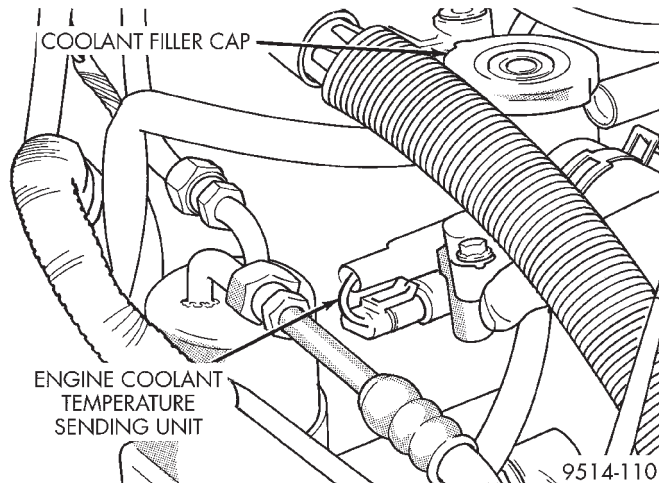


Fig. 46 Engine Coolant Temperature Sensor—2.4L Engine

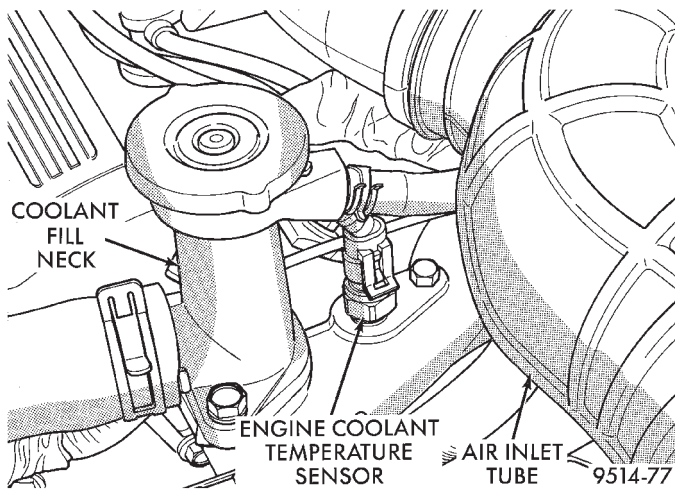


Fig. 47 Engine Coolant Temperature Sensor—2.5L Engine

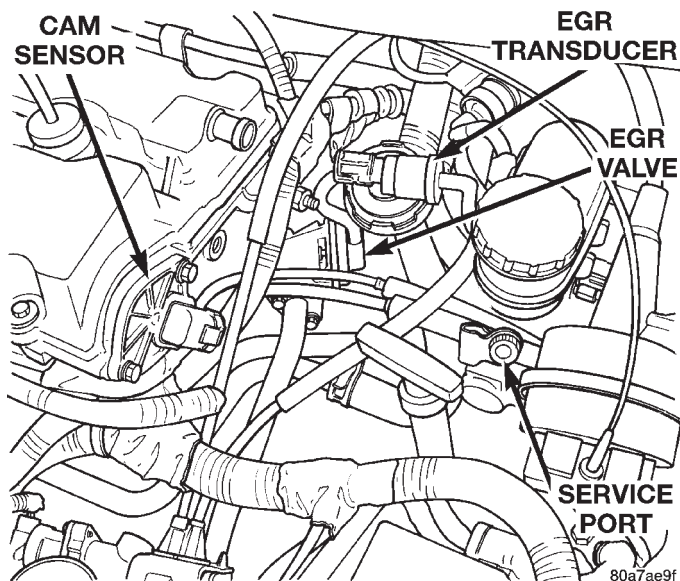


Fig. 48 Electronic EGR Transducer—2.4L Engine

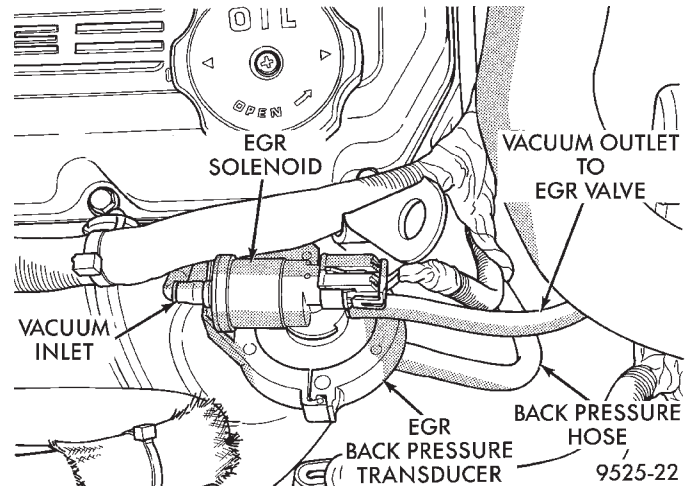


Fig. 49 Electronic EGR Transducer—2.5L Engine

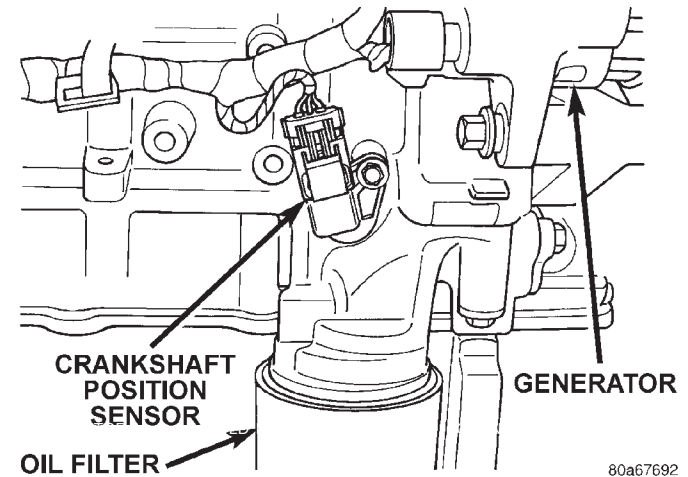


Fig. 50 Crankshaft Position Sensor—2.4L Engines—Typical

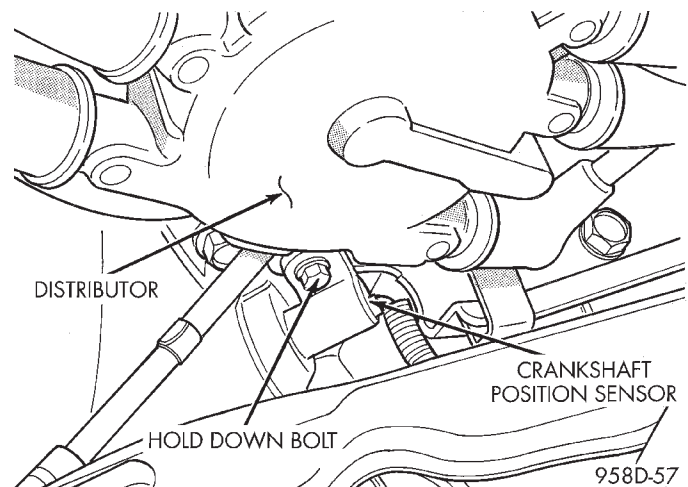


Fig. 51 Crankshaft Position Sensor—2.5L Engine

DIAGNOSIS AND TESTING (Continued)

(19) Check electrical connection at the vehicle speed sensor (Fig. 52).

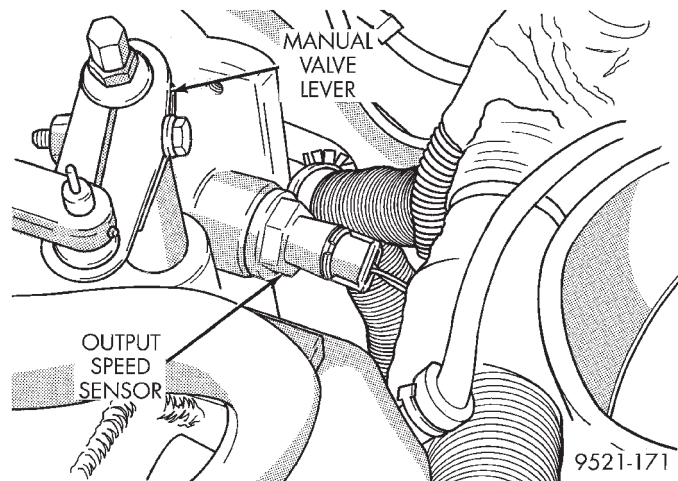


Fig. 52 Output Speed Sensor—Automatic Transmission

(20) Check electrical connection at the power steering pressure switch on the power steering gear housing (Fig. 53).

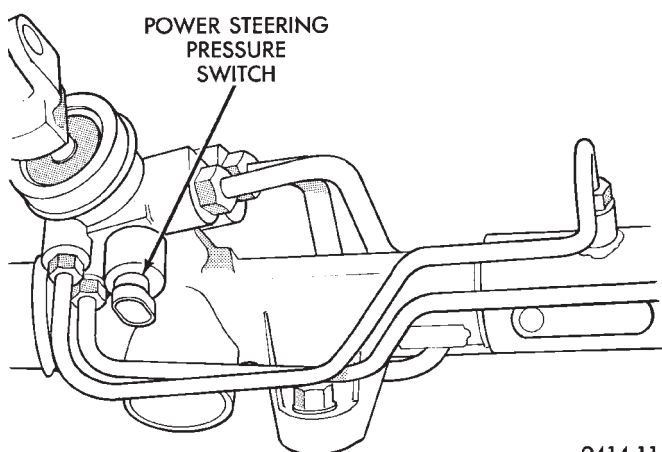


Fig. 53 Power Steering Pressure Switch

(21) On vehicles with automatic transaxles, check the electrical connections at the Transmission Range Sensor (TRS).

(22) Inspect the electrical connections at the upstream and downstream heated oxygen sensors (Fig. 54), or (Fig. 55), and (Fig. 56).

(23) Inspect the fuel pump module electrical connection in the trunk for corrosion or damage (Fig. 57).

(24) Inspect the connections to the speed control servo, if equipped. Refer to Group 8H, Vehicle Speed Control.

ASD AND FUEL PUMP RELAYS

The following description of operation and tests apply only to the Automatic Shutdown (ASD) and fuel pump relays. The terminals on the bottom of each relay are numbered (Fig. 58).

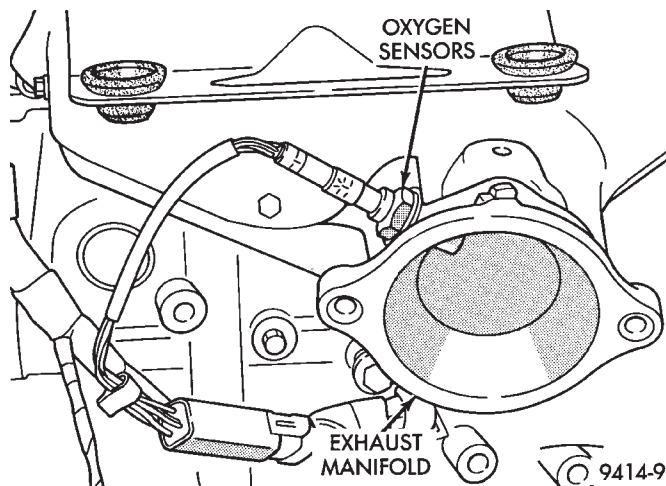


Fig. 54 Upstream Heated Oxygen Sensor—2.4L Engines

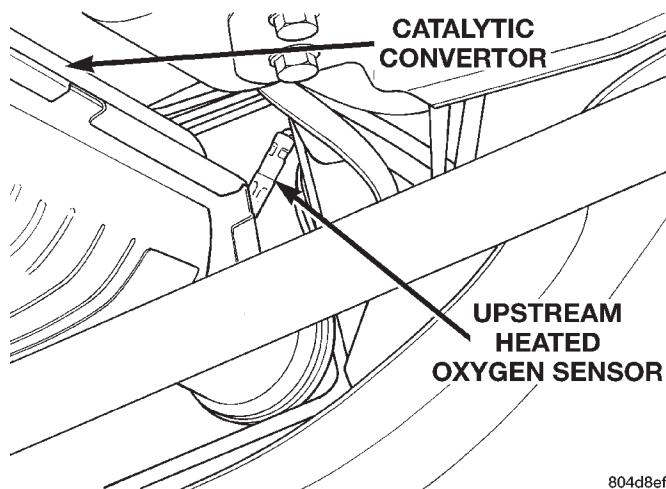


Fig. 55 Upstream Heated Oxygen Sensor—2.5L Engine

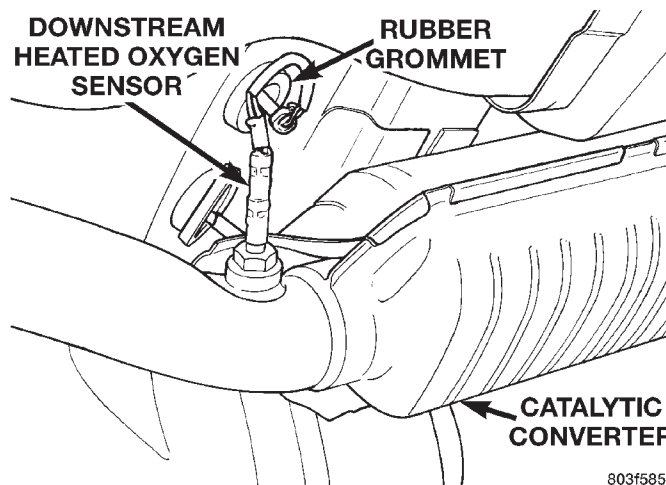


Fig. 56 Rear Heated Oxygen Sensor

DIAGNOSIS AND TESTING (Continued)

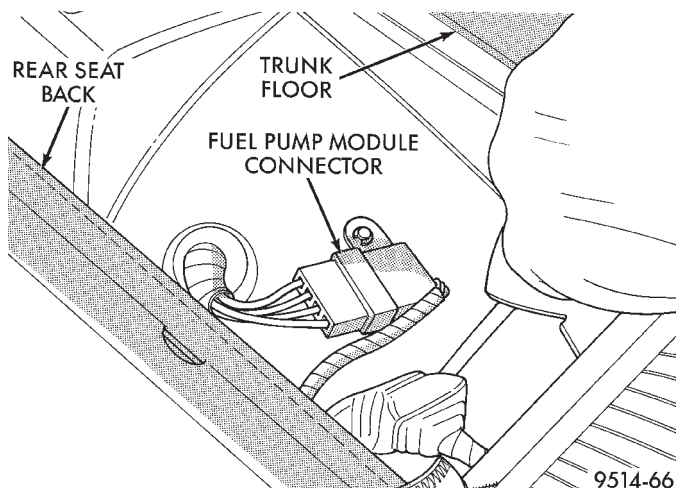


Fig. 57 Fuel Pump Module Electrical Connector

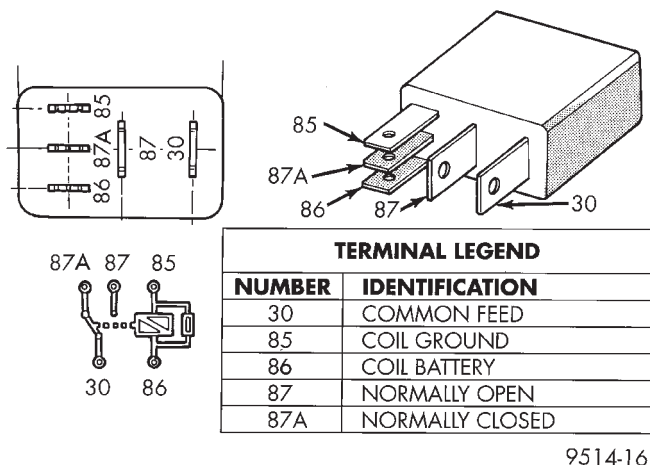


Fig. 58 ASD and Fuel Pump Relay Terminals

OPERATION

- Terminal number 30 is connected to battery voltage. For both the ASD and fuel pump relays, terminal 30 is connected to battery voltage at all times.
- The PCM grounds the coil side of the relay through terminal number 85.
- Terminal number 86 supplies voltage to the coil side of the relay.
- When the PCM de-energizes the ASD and fuel pump relays, terminal number 87A connects to terminal 30. This is the Off position. In the off position, voltage is not supplied to the rest of the circuit. Terminal 87A is the center terminal on the relay.
- When the PCM energizes the ASD and fuel pump relays, terminal 87 connects to terminal 30. This is the On position. Terminal 87 supplies voltage to the rest of the circuit.

TESTING

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

- (1) Remove relay from connector before testing.

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

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

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

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

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

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

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

- (8) Disconnect jumper wires.

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

CAMSHAFT AND CRANKSHAFT POSITION SENSOR

Refer to Group 8D, Ignition for Diagnosis and Testing of Camshaft and Crankshaft Sensors.

ENGINE COOLANT TEMPERATURE SENSOR

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

- (1) With the key off, disconnect wire harness connector from coolant temperature sensor.

- (2) Connect one lead of a high input impedance (digital) volt- ohmmeter to one terminal of sensor.

- (3) Connect the other ohmmeter lead to remaining terminal of sensor. The ohmmeter should read as follows:

- Engine/Sensor at normal operating temperature around 200°F should read approximately 700 to 1,000 ohms.

- Engine/Sensor at room temperature around 70°F ohmmeter should read approximately 7,000 to 13,000 ohms.

- (4) Test the resistance of the wire harness between the PCM connector terminal 26 and the sensor harness connector. Also check for continuity between

DIAGNOSIS AND TESTING (Continued)

connector terminal 43 and the sensor harness connector. Refer to Group 8W, Wiring diagrams for circuit information. If the resistance is greater than 1 ohm, repair the wire harness as necessary.

HEATED OXYGEN SENSOR

Use an ohmmeter to test the heating element of the oxygen sensors. Disconnect the electrical connector from each oxygen sensor. The white wires in the sensor connector are the power and ground circuits for the heater. Connect the ohmmeter test leads to terminals of the white wires in the heated oxygen sensor connector. Replace the heated oxygen sensor if the resistance is not between 4 and 7 ohms.

IDLE AIR CONTROL (IAC) MOTOR TEST

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

KNOCK SENSOR

The knock sensor can be tested with a digital voltmeter. Sensor output should be between 80 mV and 4 volts with the engine running between 576 and 2208 rpm. If the output falls outside of this range a DTC will be set.

MANIFOLD ABSOLUTE PRESSURE SENSOR

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

(1) Test the MAP sensor output voltage at the MAP sensor connector between terminals 1 and 3 (Fig. 33). With the ignition switch ON and the engine not running, output voltage should be 4 to 5 volts. The voltage should drop to 1.5 to 2.1 volts with a hot, neutral idle speed condition. If OK, go to next step. If not OK, go to step 3.

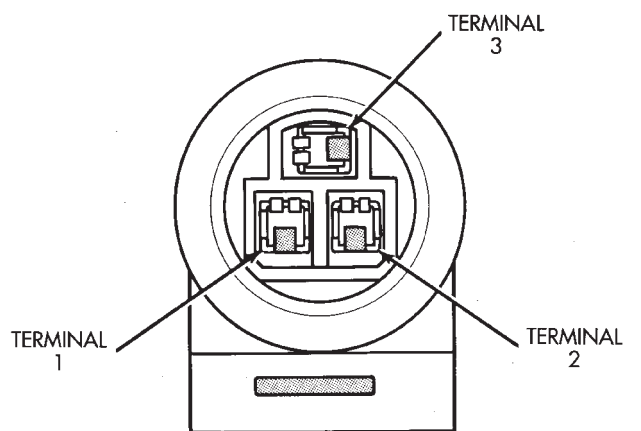


Fig. 59 MAP Sensor Connector

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(2) Test PCM terminal 29 for the same voltage described in the previous step to verify wire harness condition. Repair as required.

(3) Test the MAP sensor ground circuit at sensor connector terminal 1 and PCM terminal 51. If OK, go to next step. If not OK, repair as required.

(4) Test MAP sensor supply voltage between sensor connector terminals 2 and 1 with the key ON. The voltage should be approximately 5 volts ($\pm 0.5V$). Five volts ($\pm 0.5V$) should also be at terminal 43 of the PCM. If OK, replace MAP sensor. If not OK, repair or replace the wire harness as required.

THROTTLE POSITION SENSOR

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

The Throttle Position Sensor (TPS) can be tested with a digital voltmeter. The center terminal of the sensor is the output terminal.

With the ignition switch in the ON position, check the output voltage at the center terminal wire of the connector. Check the output voltage at idle and at wide-open-throttle (WOT). At idle, TPS output voltage should be greater than 0.6 volts. At wide open throttle, TPS output voltage should be less than 4.5 volts. The output voltage should gradually increase as the throttle plate moves slowly from idle to WOT.

Check for spread terminals at the sensor and PCM connections before replacing the TPS.

THROTTLE BODY MINIMUM AIR FLOW

- (1) Turn ignition key to Off.
- (2) Disconnect the PCV valve hose from the intake manifold nipple. Cap the PCV vacuum nipple.
- (3) Disconnect purge hose from the nipple on the throttle body (Fig. 60) or (Fig. 61).

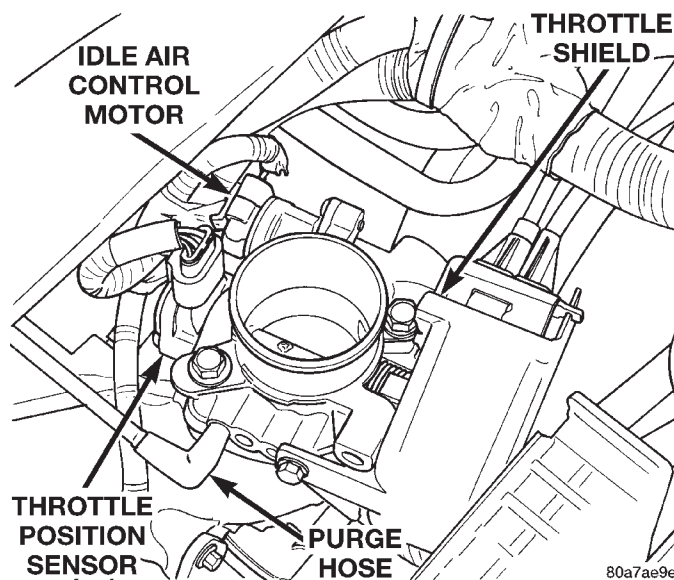


Fig. 60 Purge Hose—2.4L Engines

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DIAGNOSIS AND TESTING (Continued)

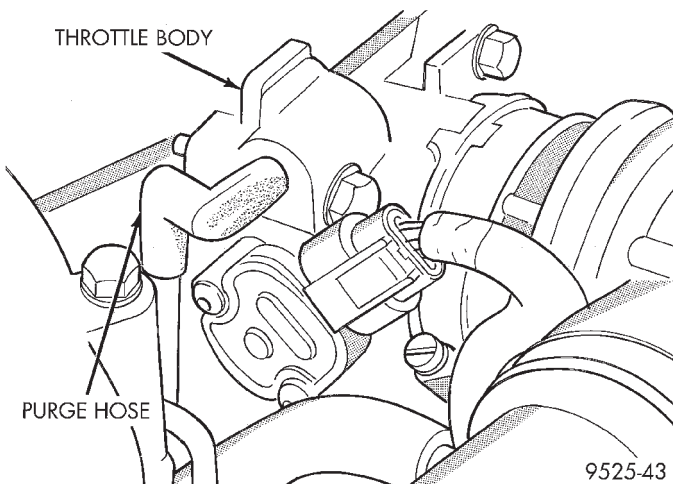


Fig. 61 Purge Hose—2.5L Engine

(4) Use a piece of hose to attach Air Metering Orifice 6457 (0.125 in. orifice) to the purge nipple on the throttle body (Fig. 62).

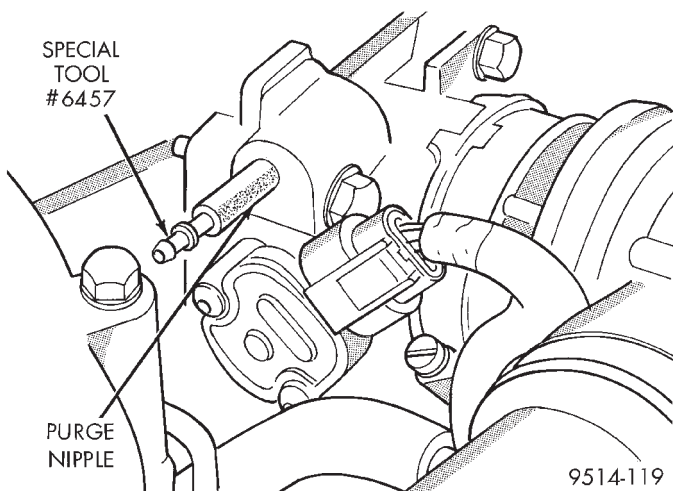


Fig. 62 Orifice 6457 Attached to Purge Nipple—2.5L Engine

- (5) Ensure that all accessories are off.
- (6) Connect the DRB scan tool to the data link connector inside the passenger compartment.
- (7) Run engine in Park or Neutral until the cooling fan has cycled on and off at least once (180°F).
- (8) Using the DRB scan tool, access Minimum Air-flow Idle Speed.
- (9) The following will then occur:
 - Idle air control motor will fully close
 - Idle spark advance will become fixed
 - PCM will go open loop enriched
 - DRB scan tool displays engine RPM
- (10) If idle RPM is within the range shown in the Idle Specification chart, throttle body minimum air-flow is set correctly.
- (11) If idle RPM is above specifications, use the DRB scan tool to check idle air control motor opera-

Odometer Reading	IDLE RPM
------------------	----------

Below 1000 Miles.....	550 - 1300 RPM
Above 1000 Miles.....	600 - 1300 RPM

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2.4L Minimum Air Flow Idle Specifications

Odometer Reading	IDLE RPM
------------------	----------

Below 1000 Miles	450 - 1100 RPM
Above 1000 Miles	500 - 1100 RPM

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2.5L Minimum Air Flow Idle Specifications

tion. If idle air control motor is OK, replace throttle body. If idle air flow is below specification, shut off the engine and clean the throttle body as follows:

WARNING: CLEAN THROTTLE BODY IN A WELL VENTILATED AREA. WEAR RUBBER OR BUTYL GLOVES, DO NOT LET MOPAR PARTS CLEANER COME IN CONTACT WITH EYES OR SKIN. AVOID INGESTING THE CLEANER. WASH THOROUGHLY AFTER USING CLEANER.

- (a) Remove the throttle body from engine.
- (b) While holding the throttle open, spray the entire throttle body bore and the manifold side of the throttle plate with Mopar Parts Cleaner. **Only use Mopar Parts Cleaner to clean the throttle body.**
- (c) Using a soft scuff pad, clean the top and bottom of throttle body bore and the edges and manifold side of the throttle blade. **The edges of the throttle blade and portions of the throttle bore that are closest to the throttle blade when is closed, must be free of deposits.**
- (d) Use compressed air to dry the throttle body.
- (e) Inspect throttle body for foreign material.
- (f) Install throttle body on manifold.
- (g) Repeat steps 1 through 10. If the minimum air flow is still not within specifications, the problem is not caused by the throttle body.
- (12) Shut off engine.
- (13) Remove Air Metering Orifice 6457. Install purge hose.
- (14) Remove cap from PCV valve. Connect hose to PCV valve.
- (15) Remove DRB scan tool.

VEHICLE SPEED SENSOR

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

SERVICE PROCEDURES

CLEANING COKED THROTTLE BODIES

Coked throttle bodies will cause low idle speed and poor idle quality. Also, if the vehicle has low idle and the idle air control motor operates normally, clean the throttle body before checking throttle body minimum air flow. Refer to the General Diagnosis Section of this group for the Throttle Body Minimum Air Flow procedure.

- (1) Remove the throttle body from engine.

WARNING: CLEAN THROTTLE BODY IN A WELL VENTILATED AREA. WEAR RUBBER OR BUTYL GLOVES, DO NOT LET MOPAR PARTS CLEANER COME IN CONTACT WITH EYES OR SKIN. AVOID INGESTING THE CLEANER. WASH THOROUGHLY AFTER USING CLEANER.

- (2) While holding the throttle open, spray the entire throttle body bore and the manifold side of the throttle plate with Mopar Parts Cleaner. **Only use Mopar Parts Cleaner to clean the throttle body.**

- (3) Using a soft scuff pad, clean the top and bottom of throttle body bore and the edges and manifold side of the throttle blade. **The edges of the throttle blade and portions of the throttle bore that are closest to the throttle blade when it is closed, must be free of deposits.**

- (4) Use compressed air to dry the throttle bodies.
- (5) Inspect throttle body for foreign material.
- (6) Install throttle body on manifold.

REMOVAL AND INSTALLATION

THROTTLE BODY—2.4L ENGINES

REMOVAL

- (1) Remove air inlet resonator as described in this section.
- (2) Remove throttle shield (Fig. 63).
- (3) Remove throttle cable from the throttle body lever (Fig. 64) and (Fig. 65).
- (4) Compress the retaining tabs on the cable and slide cable out of bracket.
- (5) If equipped with speed control, remove speed control cable from throttle lever by sliding clasp out hole used for throttle cable.
- (6) Remove EVAP purge hose from nipple on throttle body.
- (7) Remove 2 screws holding cable mounting bracket and support bracket.
- (8) Remove throttle body mounting bolts.
- (9) Lift throttle body far enough to remove connectors from the throttle position sensor and idle air control motor. Remove throttle body.

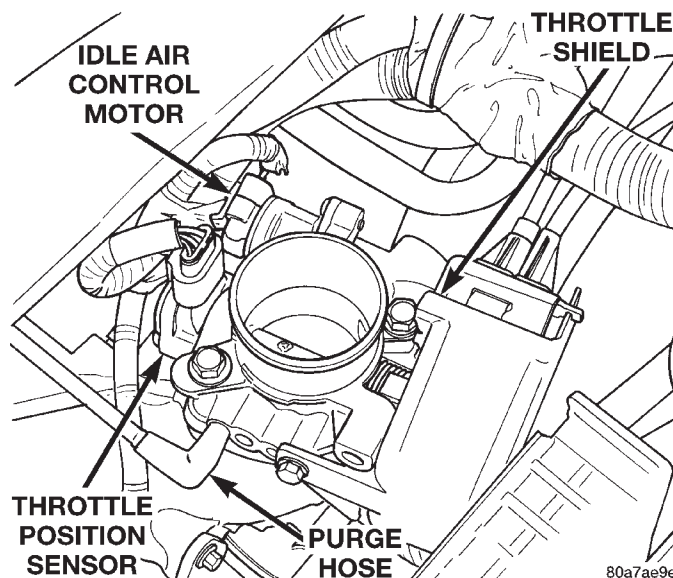


Fig. 63 Throttle Body—2.4L

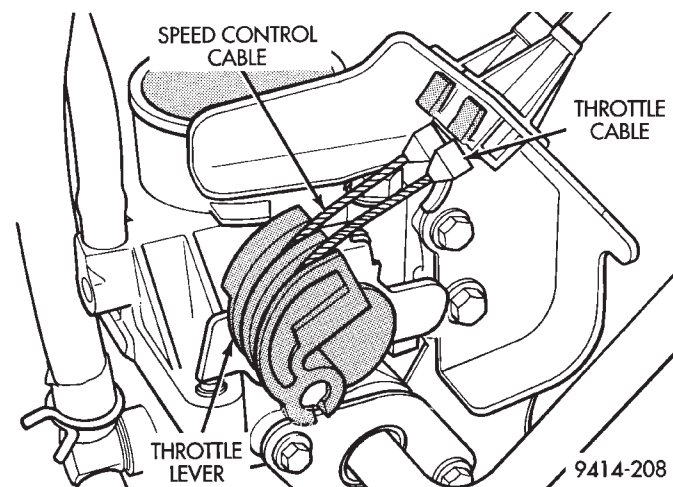


Fig. 64 Throttle Cable Attachment to Throttle Body

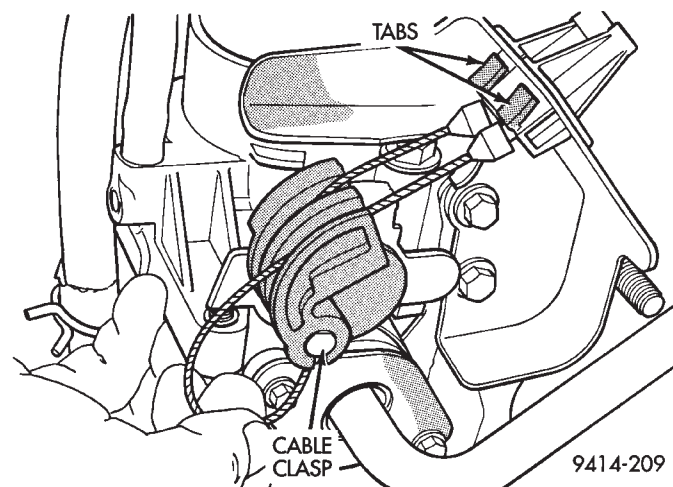


Fig. 65 Disconnecting Throttle Cable

- (10) Remove paper gasket from intake manifold.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

- (1) Attach electrical connectors to idle air control motor and throttle position sensor.
- (2) Install paper gasket.
- (3) Position throttle body on intake and install mounting bolts. Do Not tighten bolts at this time.
- (4) Install throttle cable bracket. Do Not tighten bolts at this time.
- (5) Tighten throttle body bolts to $22.5 \pm 3 \text{ N}\cdot\text{m}$ (200 ± 25 in. lbs.) torque.
- (6) Tighten throttle cable bracket bolts to $11.75 \pm 2.25 \text{ N}\cdot\text{m}$ (105 ± 20 in. lbs.) torque.
- (7) Install EVAP purge hose to throttle body nipple.
- (8) Install cable housing(s) retainer tabs into bracket.
- (9) Install throttle body cables by rotating the throttle lever forward to the wide open position.
- (10) Install throttle shield and tighten bolt to $4.5 \text{ N}\cdot\text{m}$ (40 in. lbs.).
- (11) Install air inlet resonator as described in this section.

THROTTLE BODY—2.5L ENGINE

REMOVAL

- (1) Remove air tube from throttle body.
- (2) Remove throttle cable from the throttle body lever (Fig. 66).

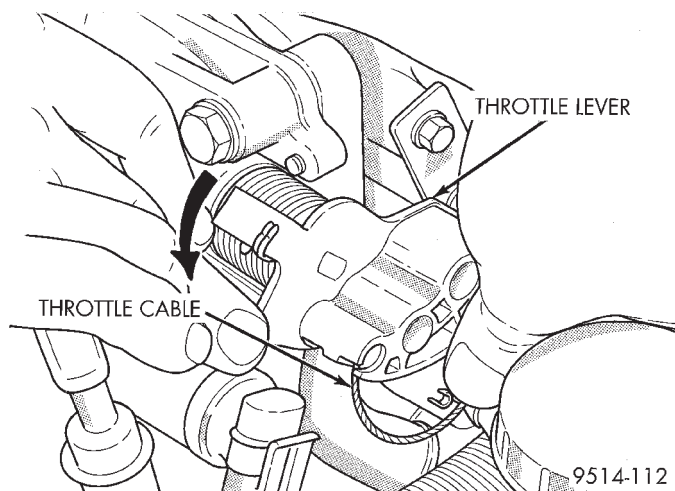


Fig. 66 Throttle Cable Attachment to Throttle Body

- (3) Push release tang toward dash panel on throttle cable and slide cable out of bracket (Fig. 67).
- (4) Slide speed control cable out of bracket, if equipped (Fig. 67).
- (5) Remove EVAP purge hose from nipple on throttle body.
- (6) Remove connectors from throttle position sensor and idle air control motor.
- (7) Remove bolts holding throttle body to intake manifold. Remove throttle body.

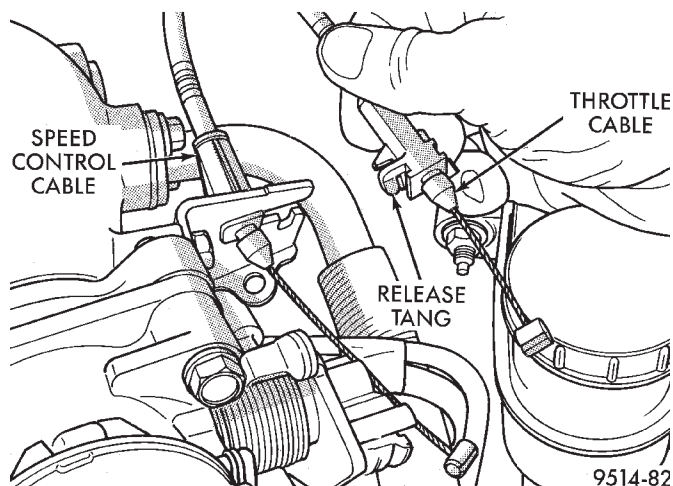


Fig. 67 Throttle Cable Attachment

INSTALLATION

- (1) Attach electrical connectors to idle air control motor and throttle position sensor.
- (2) Install new gasket.
- (3) Position throttle body on intake and install mounting bolts. Tighten bolts to $28.25 \text{ N}\cdot\text{m}$ (250 in. lbs.).
- (4) Install speed control cable (if equipped) and throttle cable into throttle lever.
- (5) Install cables into cable bracket.
- (6) Install air inlet tube. Tighten clamps to $3 \pm .5 \text{ N}\cdot\text{m}$ (25 ± 5 in. lbs.) torque.

THROTTLE POSITION SENSOR (TPS)—2.4L

The throttle position sensor attaches to the side of the throttle body (Fig. 68).

IDLE AIR CONTROL MOTOR

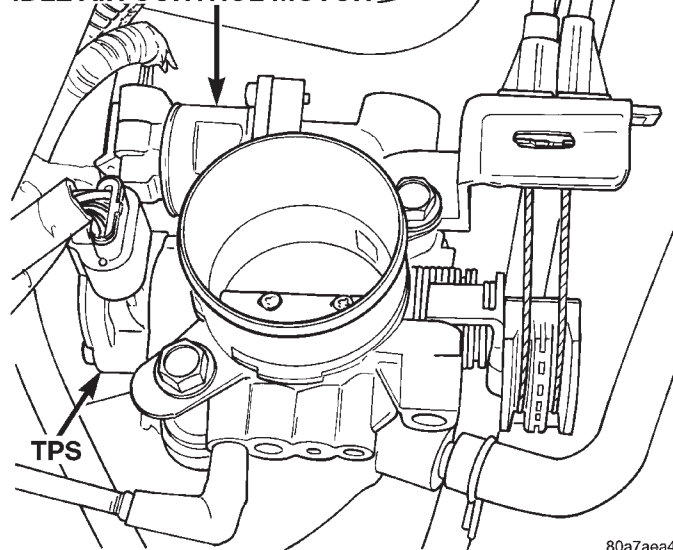


Fig. 68 Throttle Position Sensor and Idle Air Control Motor

REMOVAL

- (1) Disconnect EVAP purge hose from throttle body.

REMOVAL AND INSTALLATION (Continued)

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

(3) Disconnect electrical connector from idle air control motor and throttle position sensor.

(4) Remove throttle position sensor mounting screws.

(5) Remove throttle position sensor.

INSTALLATION

(1) The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 69). The socket has two tabs inside it. The throttle shaft rests against the tabs. When indexed correctly, the TPS can rotate clockwise a few degrees to line up the mounting screw holes with the screw holes in the throttle body. The TPS has slight tension when rotated into position. If it is difficult to rotate the TPS into position, install the sensor with the throttle shaft on the other side of the tabs in the socket. Tighten mounting screws to 2 N·m (17 in. lbs.) torque.

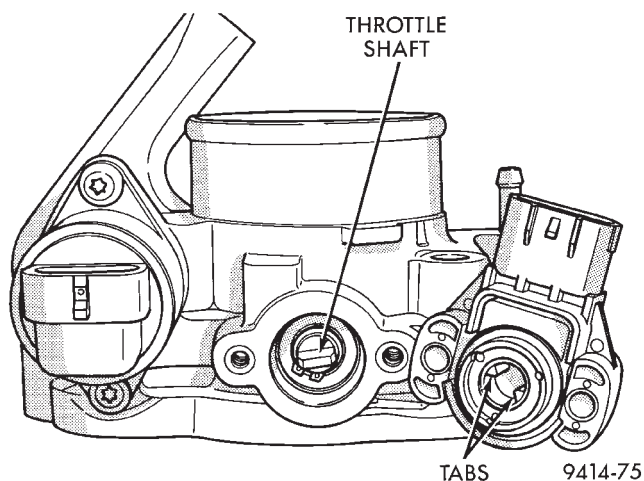


Fig. 69 Throttle Position Sensor Installation

(2) After installing the TPS, the throttle plate should be closed. If the throttle plate is open, install the sensor on the other side of the tabs in the socket.

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

(4) Attach electrical connectors to idle air control motor and throttle position sensor.

(5) Install EVAP purge hose to throttle body nipple.

THROTTLE POSITION SENSOR (TPS)—2.5L

The TPS attaches to the side of the throttle body (Fig. 70).

REMOVAL

(1) Disconnect EVAP purge hose from throttle body.

(2) Disconnect electrical connector from idle air control motor and TPS.

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

(4) Remove TPS mounting screws.

(5) Remove throttle position sensor.

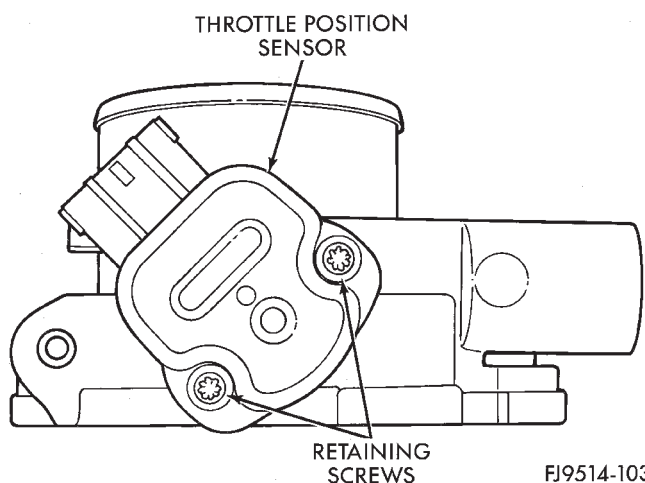


Fig. 70 Throttle Position Sensor—2.5L Engine

INSTALLATION

(1) The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 71). The socket has two tabs inside it. The throttle shaft rests against the tabs. When indexed correctly, the TPS can rotate clockwise a few degrees to line up the mounting screw holes with the screw holes in the throttle body. The TPS has slight tension when rotated into position. If it is difficult to rotate the TPS into position, install the sensor with the throttle shaft on the other side of the tabs in the socket. Tighten mounting screws to 2 N·m (17 in. lbs.) torque.

(2) After installing the TPS, the throttle plate should be closed. If the throttle plate is open, install the sensor on the other side of the tabs in the socket.

(3) Install throttle body to intake manifold. Refer to throttle body in this section.

(4) Attach electrical connectors to idle air control motor and throttle position sensor.

(5) Install EVAP purge hose to throttle body nipple.

IDLE AIR CONTROL MOTOR—2.0/2.4/2.5L

The idle air control motor attaches to the side of the throttle body (Fig. 72) or (Fig. 73) or (Fig. 74).

REMOVAL

(1) Disconnect EVAP purge hose from throttle body.

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

(3) Disconnect electrical connector from idle air control motor and throttle position sensor.

(4) Remove idle air control motor mounting screws.

(5) Remove idle air control motor. Ensure O-ring is removed with the motor.

REMOVAL AND INSTALLATION (Continued)

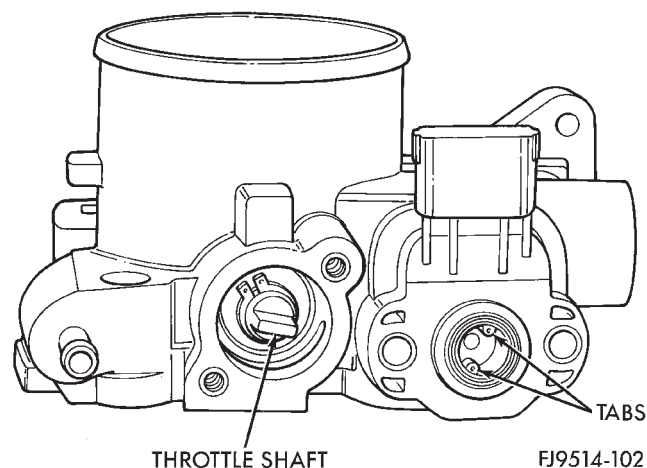


Fig. 71 Indexing Throttle Position Sensor—2.5L Engine

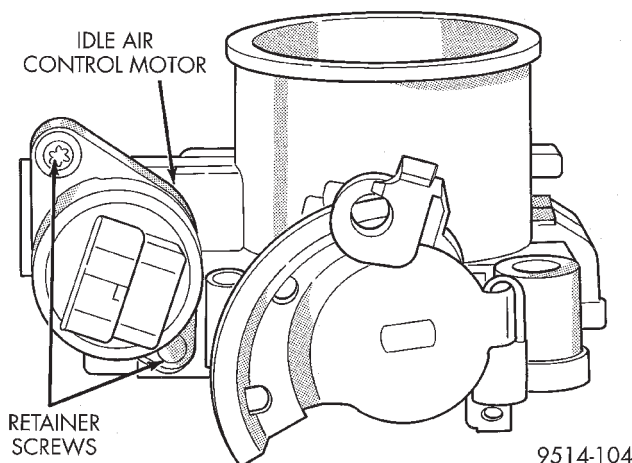


Fig. 74 Throttle Position Sensor and Idle Air Control Motor—2.5L

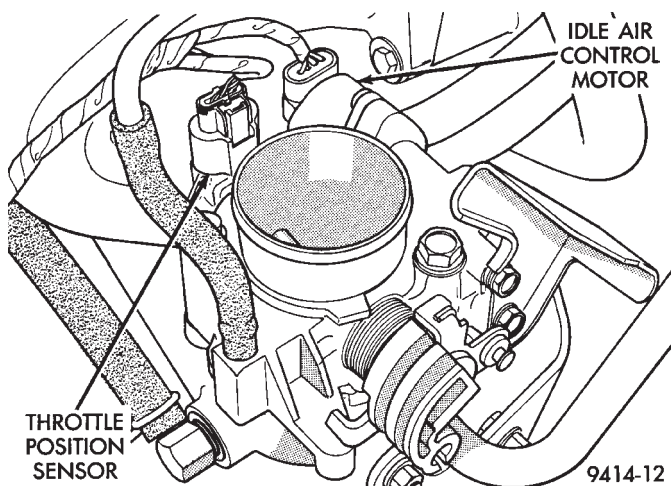


Fig. 72 Throttle Position Sensor and Idle Air Control Motor—2.0L

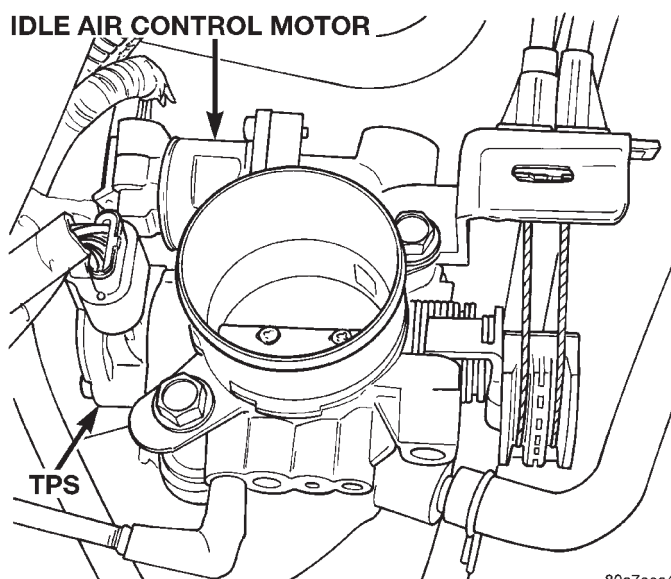


Fig. 73 Throttle Position Sensor and Idle Air Control Motor—2.4L

INSTALLATION

- (1) The new idle air control motor has a new O-ring installed on it. If pintle measures more than 1 inch (25 mm) it must be retracted. Use the DRB AIS Motor Open/Close Test to retract the pintle (battery must be connected.)
- (2) Carefully place idle air control motor into throttle body.
- (3) Install mounting screws. Tighten screws to 3 N·m (25 in. lbs.) torque.
- (4) Install throttle body. Refer to Throttle Body in this section.
- (5) Attach electrical connectors to idle air control motor and throttle position sensor.
- (6) Install EVAP purge hose to throttle body nipple.

INTAKE AIR TEMPERATURE SENSOR—2.4L

The intake air temperature sensor threads into the intake manifold plenum (Fig. 75).

REMOVAL

- (1) Remove air inlet resonator.
- (2) Reaching through intake manifold from throttle body end, disconnect sensor connector.
- (3) Remove sensor.

INSTALLATION

- (1) Install sensor. Tighten sensor to 28 N·m (20 ft. lbs.) torque.
- (2) Attach electrical connector to sensor.
- (3) Install air inlet resonator.

INTAKE AIR TEMPERATURE SENSOR—2.5L

The intake air temperature sensor threads into the intake manifold plenum (Fig. 76).

REMOVAL AND INSTALLATION (Continued)

REMOVAL

- (1) Disconnect electrical connector from sensor.
- (2) Remove sensor.

INSTALLATION

- (1) Install sensor. Tighten sensor to 28 N·m (20 ft. lbs.) torque.
- (2) Attach electrical connector to sensor.

DUTY CYCLE EVAP PURGE SOLENOID

REMOVAL

- (1) If equipped with speed control, remove speed control servo and bracket. **Cover the ends of the speed control servo studs to allow easier service of the purge solenoid.**
- (2) Disconnect electrical connector from solenoid.
- (3) Disconnect vacuum tubes from solenoid.
- (4) Remove solenoid from bracket by pulling up on solenoid.

INSTALLATION

NOTE: To eliminate a chance of transmitting noises into the body, make sure the hood release cable is installed in all of its clamps. Make sure the solenoid is not touching a brake line.

The top of the solenoid has TOP printed on it. The solenoid will not operate unless it is installed correctly.

- (1) Install solenoid on bracket.
- (2) Connect vacuum tube to solenoid.
- (3) Connect electrical connector to solenoid.
- (4) Install speed control servo and bracket. Tighten nuts to 9 N·m (80 in. lbs.).

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

2.4L

The MAP sensor attaches to the intake manifold plenum (Fig. 75).

2.5L

The MAP sensor attaches to the intake manifold plenum (Fig. 76).

REMOVAL

- (1) Disconnect electrical connector from MAP sensor.
- (2) Remove sensor mounting screws.
- (3) Remove sensor.

INSTALLATION

- (1) Insert sensor into intake manifold while making sure not to damage O-ring seal.
- (2) Tighten mounting screws to:
 - 2.4L**
 - (3) 2 N·m (20 in. lbs.) torque.
 - 2.5L**

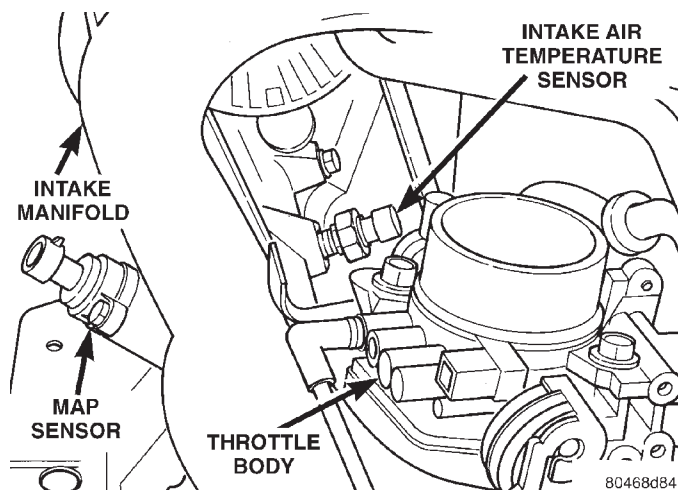


Fig. 75 Intake Air Temperature Sensor and MAP Sensor—2.4L

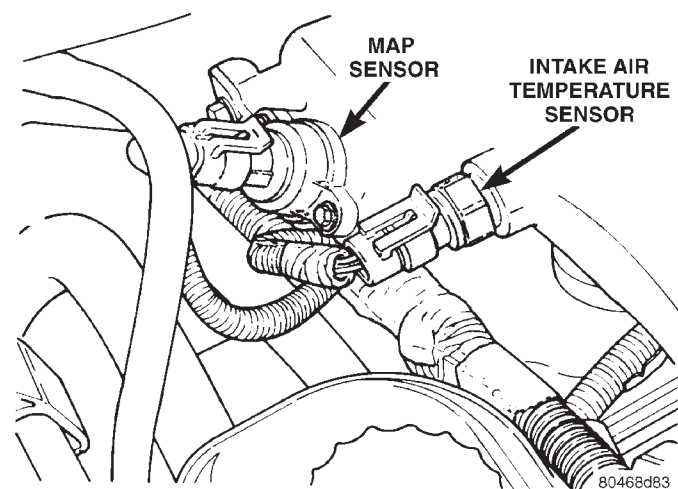


Fig. 76 Intake Air Temperature Sensor and MAP Sensor—2.5L

- (4) 3.4 N·m (30 in. lbs) torque.
- (5) Attach electrical connector to sensor.

POWERTRAIN CONTROL MODULE SERVICE

The PCM attaches to a bracket between the air cleaner housing and Power Distribution Center (PDC).

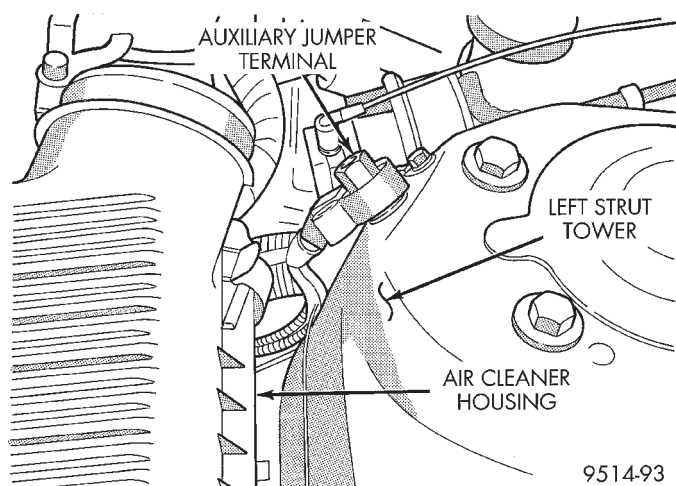
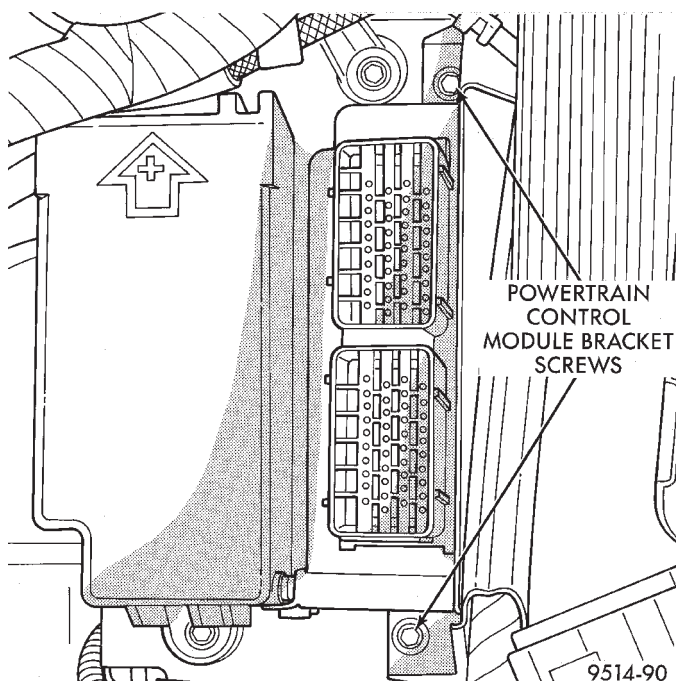
REMOVAL

- (1) Disconnect negative cable from auxiliary jumper terminal (Fig. 77).
- (2) Disconnect both 40-way connectors from PCM.
- (3) Remove screws attaching PCM to bracket (Fig. 78).
- (4) Lift PCM up to remove it from vehicle.

INSTALLATION

- (1) Install PCM. Tighten mounting screws.
- (2) Attach both 40-way connectors to PCM.

REMOVAL AND INSTALLATION (Continued)

**Fig. 77 Auxiliary Jumper Terminal****Fig. 78 PCM Bracket Screws**

(3) Connect negative cable to auxiliary jumper terminal.

CRANKSHAFT POSITION SENSOR

For removal/installation procedures refer to group 8D - Ignition System, Service Procedures.

CAMSHAFT POSITION SENSOR

For removal/installation procedures refer to group 8D - Ignition System, Service Procedures.

UPSTREAM HEATED OXYGEN SENSOR—2.0/2.4L**REMOVAL**

- (1) Raise and support vehicle.
- (2) Disconnect electrical connector from sensor.

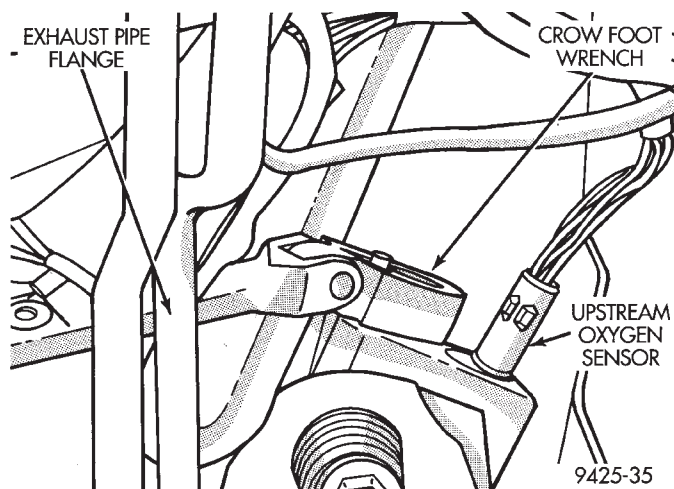
(3) Remove sensor using an oxygen sensor crow foot wrench such as Snap-On tool YA8875 or equivalent (Fig. 79).

INSTALLATION

(1) After removing the sensor, the exhaust manifold threads must be cleaned with an 18 mm X 1.5 + 6E tap. If reusing the original sensor, coat the sensor threads with an anti-seize compound such as Loctite® 771-64 or equivalent. New sensors have compound on the threads and do not require an additional coating. Tighten the sensor to 28 N·m (20 ft. lbs.) torque.

(2) Connect electrical connector to sensor.

(3) Lower vehicle.

**Fig. 79 Upstream Heated Oxygen Sensor Removal/Installation****UPSTREAM HEATED OXYGEN SENSOR—2.5L****REMOVAL**

- (1) Raise and support vehicle.
- (2) Disconnect electrical connector from sensor.
- (3) Remove sensor using an oxygen sensor crow foot wrench such as Snap-On tool YA8875 or equivalent (Fig. 80).

INSTALLATION

(1) After removing the sensor, the exhaust manifold threads must be cleaned with an 18 mm X 1.5 + 6E tap. If reusing the original sensor, coat the sensor threads with an anti-seize compound such as Loctite® 771-64 or equivalent. New sensors have compound on the threads and do not require an additional coating. Tighten the sensor to 28 N·m (20 ft. lbs.) torque.

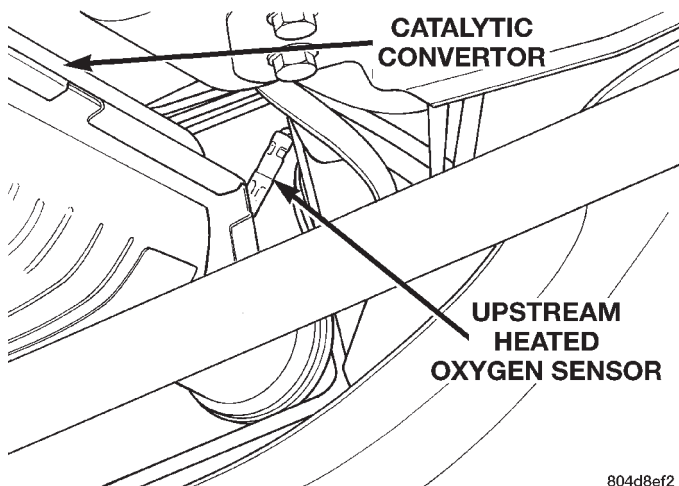
(2) Connect electrical connector to sensor.

(3) Lower vehicle.

DOWNSTREAM HEATED OXYGEN SENSOR—2.0/2.4L

The downstream heated oxygen sensor threads into the exhaust pipe behind the catalytic convertor.

REMOVAL AND INSTALLATION (Continued)



804d8ef2

Fig. 80 Upstream Heated Oxygen Sensor Removal/Installation

REMOVAL

- (1) Raise vehicle.
- (2) Disconnect electrical connector from sensor.
- (3) Disconnect sensor electrical harness from clips along body.
- (4) Remove sensor using an oxygen sensor crow foot wrench such as Snap-On tool YA8875 or equivalent (Fig. 81).

INSTALLATION

- (1) After removing the sensor, the exhaust manifold threads must be cleaned with an 18 mm X 1.5 + 6E tap. If reusing the original sensor, coat the sensor threads with an anti-seize compound such as Loctite® 771-64 or equivalent. New sensors have compound on the threads and do not require an additional coating. Tighten the sensor to 28 N·m (20 ft. lbs.) torque.
- (2) Connect sensor electrical harness to clips along body.
- (3) Connect electrical connector to sensor.
- (4) Lower vehicle.

AIR INLET RESONATOR

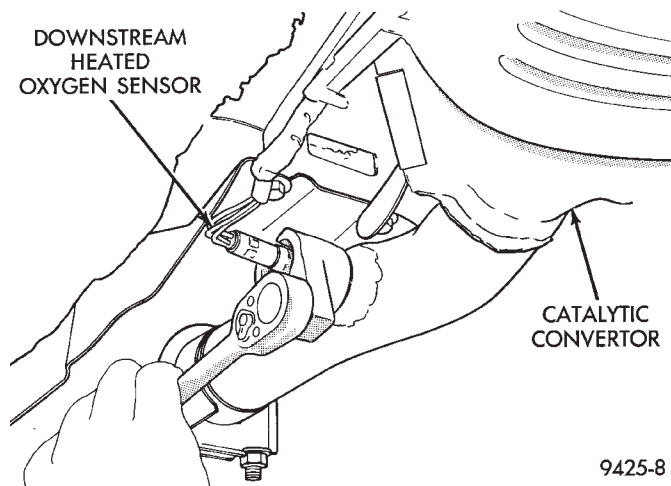
2.0L

REMOVAL

- (1) Remove 2 bolts holding air inlet resonator to intake manifold (Fig. 82).
- (2) Loosen screw holding resonator to throttle body (Fig. 83).
- (3) Loosen clamp holding resonator to air inlet tube. Remove resonator.

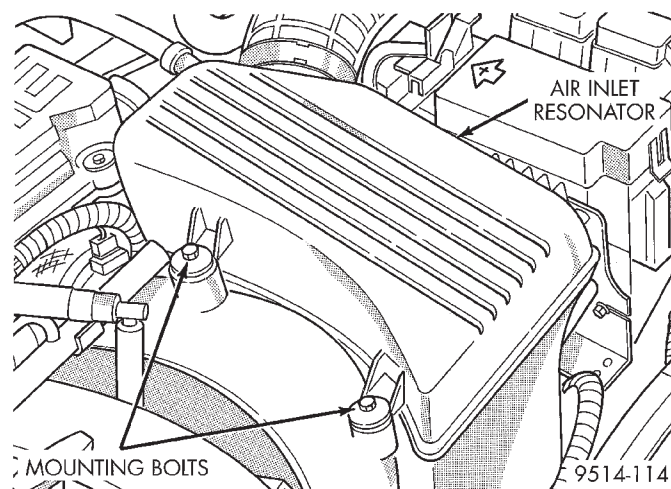
INSTALLATION

- (1) Install air inlet resonator to throttle body.
- (2) Install air inlet tube to resonator.



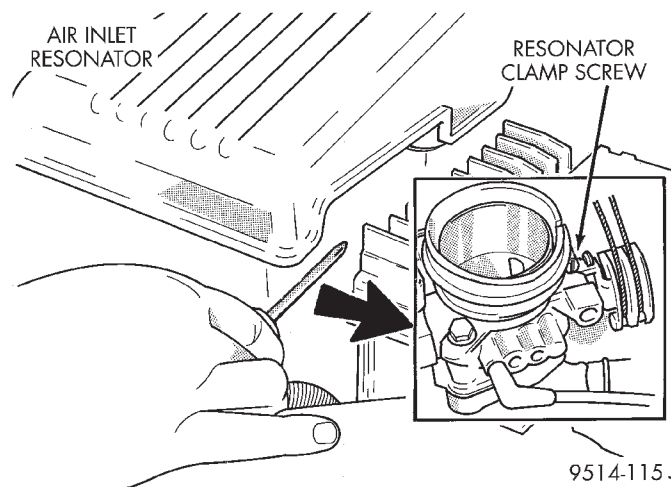
9425-8

Fig. 81 Downstream Heated Oxygen Sensor Removal/Installation



9514-114

Fig. 82 Air Inlet Resonator



9514-115

Fig. 83 Air Inlet Resonator Attachment to Throttle Body

- (3) Tighten clamps to 3±.5 N·m (25±5 in. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

2.4L

REMOVAL

- (1) Loosen screw holding resonator to throttle body (Fig. 83).
- (2) Loosen clamp holding resonator to air inlet tube. Remove resonator.

INSTALLATION

- (1) Install air inlet resonator to throttle body.
- (2) Install air inlet tube to resonator.
- (3) Tighten clamps to $3\pm.5$ N·m (25 ± 5 in. lbs.) torque.

2.5L

REMOVAL

- (1) Remove bolt holding resonator to intake manifold (Fig. 84).

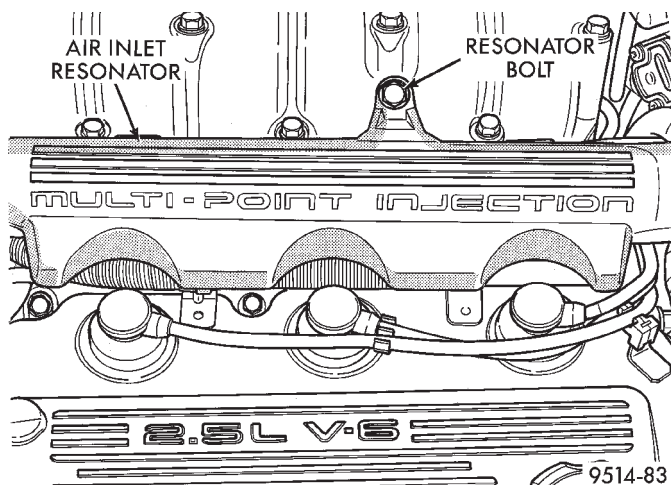


Fig. 84 Air Inlet Resonator

- (2) Loosen clamp holding resonator to air inlet tube. Remove resonator.

INSTALLATION

- (1) Install air inlet tube to resonator.
- (2) Tighten clamp to $3\pm.5$ N·m (25 ± 5 in. lbs.) torque.
- (3) Install bolt holding resonator to intake manifold. Tighten to $5\pm.5$ N·m (45 ± 5 in. lbs.) torque.

AIR CLEANER

The air cleaner housing attaches to the inner fender in front of the driver's side strut tower (Fig. 85). An ambient air duct supplies underhood air for the engine.

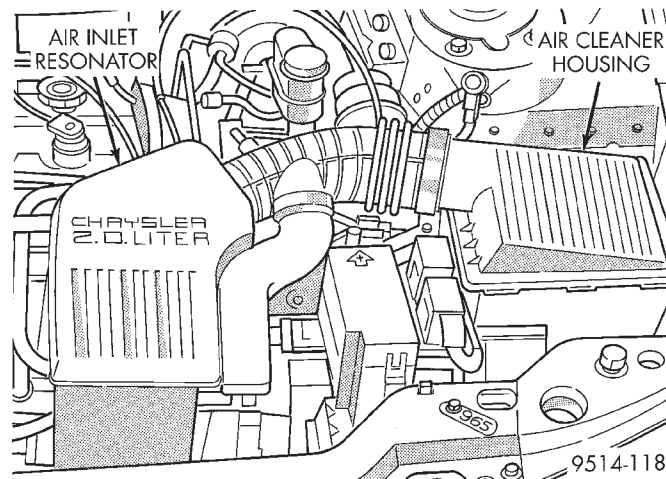


Fig. 85 Air Inlet System

FILTER ELEMENT REPLACEMENT

REMOVAL

- (1) Unfasten clasps on rear of air cleaner housing cover. Lift cover off air cleaner housing (Fig. 86).

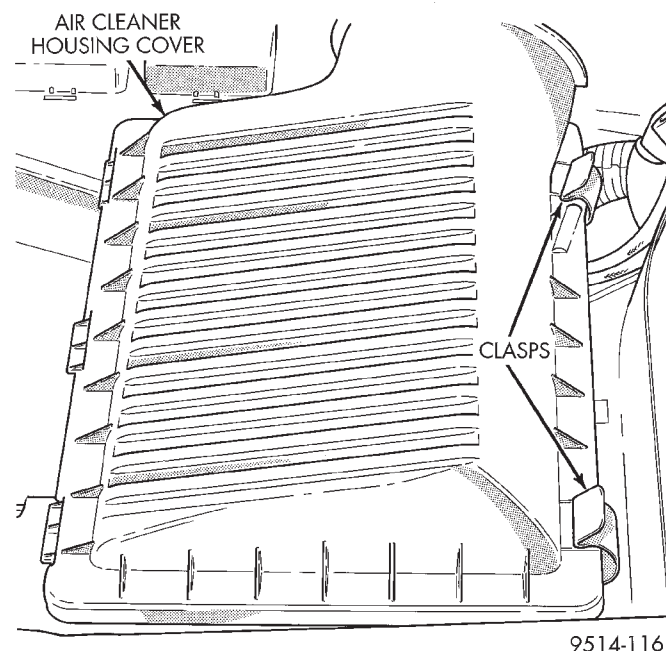


Fig. 86 Air Cleaner Cover Clasps

- (2) Remove filter element (Fig. 87).
- (3) If necessary, clean the inside of the air cleaner housing.

INSTALLATION

- (1) Install new filter element.
- (2) Place cover over air cleaner housing. Snap clasps in place.

REMOVAL AND INSTALLATION (Continued)

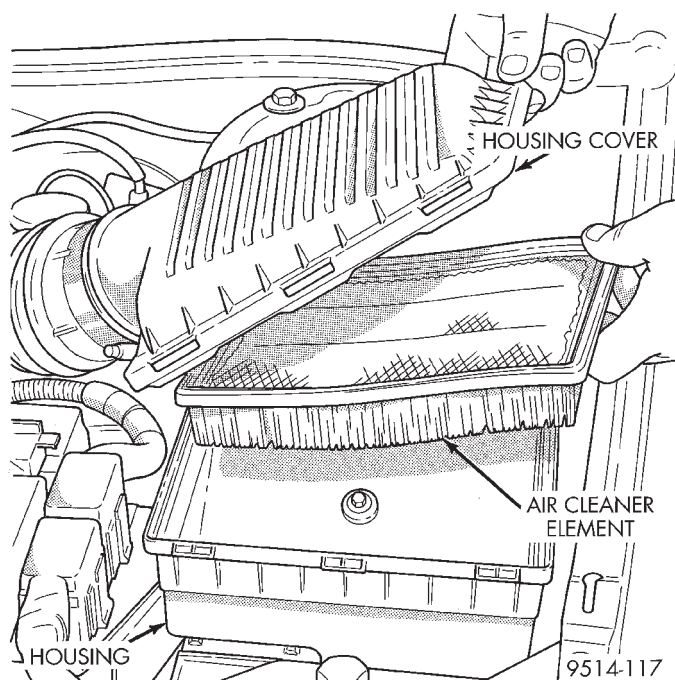


Fig. 87 Air Cleaner Housing and Element

ENGINE COOLANT TEMPERATURE SENSOR**2.4L**

The engine coolant temperature sensor threads into the front of the cylinder head (Fig. 88).

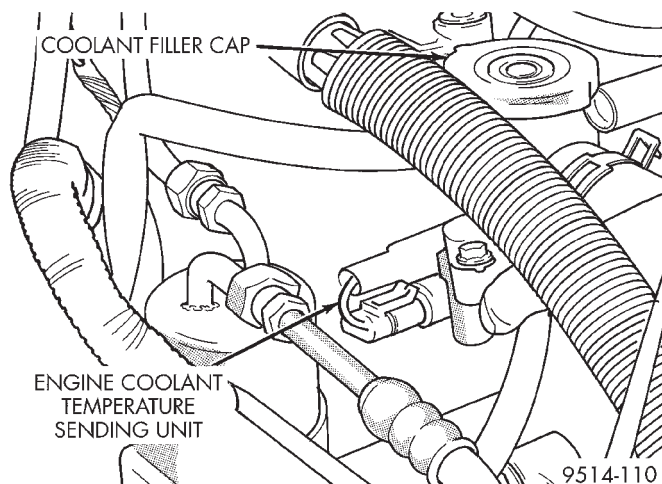


Fig. 88 Engine Coolant Temperature Sensor—2.4L Engine

2.5L

The engine coolant temperature sensor is located next to the fill neck (Fig. 89).

REMOVAL

- (1) With the engine cold, drain coolant until level drops below sensor level. Refer to Group 7, Cooling System.
- (2) Disconnect coolant sensor electrical connector.
- (3) Remove coolant sensor.

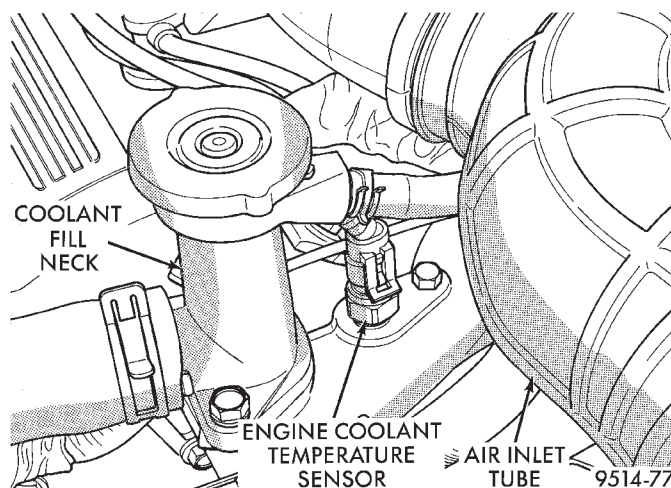


Fig. 89 Engine Coolant Temperature Sensor—2.5L Engine

INSTALLATION

- (1) Install coolant sensor. Tighten sensor to:
 - 2.4L**
 - (2) 27 N·m (20 ft. lbs.) torque.
 - 2.5L**
 - (3) 7 N·m (60 in. lbs.) torque.
- (4) Attach electrical connector to sensor.
- (5) Fill cooling system. Refer to Group 7, Cooling System.

VEHICLE SPEED SENSOR

The vehicle speed sensor is located in the transmission extension housing (Fig. 90).

REMOVAL

- (1) Disconnect electrical connector from sensor.
- (2) Remove the sensor mounting bolt.
- (3) Lift the sensor out of the transaxle extension housing. Ensure the O-ring was removed with the sensor.

INSTALLATION

The speed sensor gear meshes with a gear on the output shaft.

- (1) With O-ring in place, install sensor.
- (2) Install mounting bolt.
- (3) Connect electrical connector to sensor.

KNOCK SENSOR

For removal/installation procedures refer to Group 8D- Ignition System, Service Procedures.

SPECIFICATIONS**VECI LABEL**

If anything differs between the specifications found on the Vehicle Emission Control Information (VECI) label and the following specifications, use specifica-

SPECIFICATIONS (Continued)

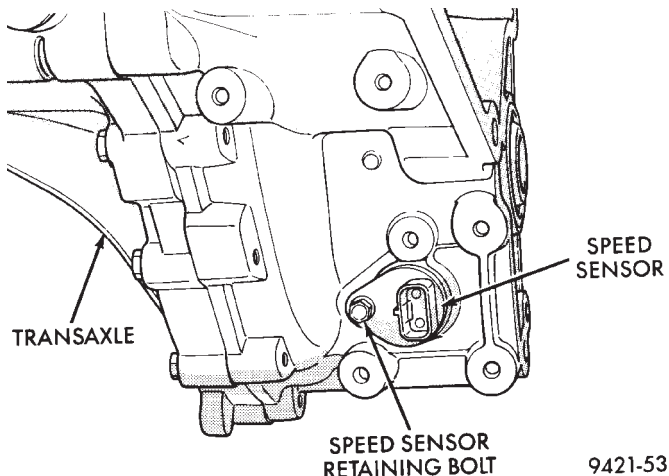


Fig. 90 Vehicle Speed Sensor

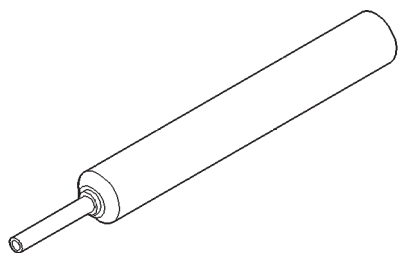
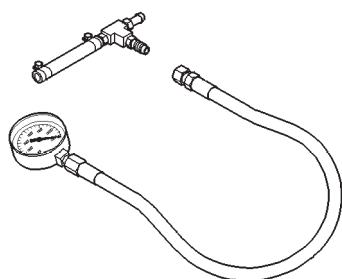
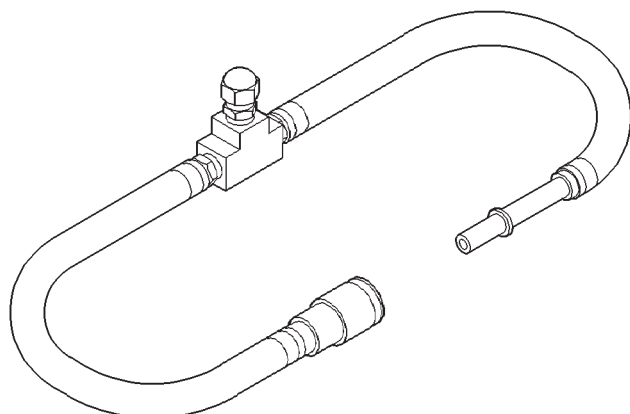
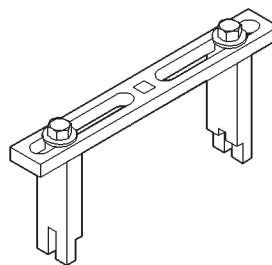
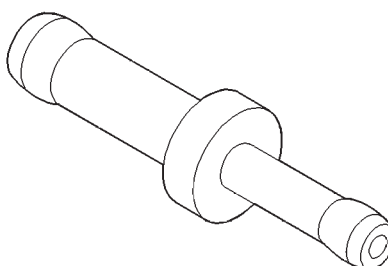
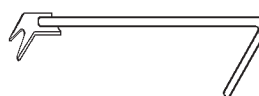
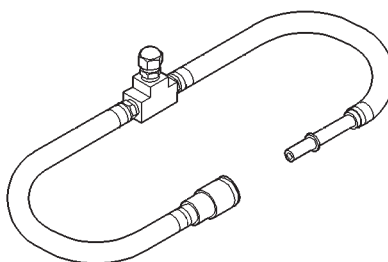
tions on VECI label. The VECI label is located in the engine compartment.

TORQUE

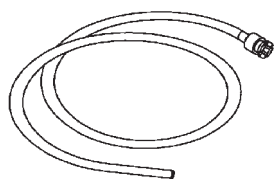
DESCRIPTION	TORQUE
Camshaft Position Semsor	12 N·m (105 in. lbs.)
Crankshaft Position Sensor . . .	12 N·m (105 in. lbs.)
Engine Coolant Temperature Sensor	28 N·m (20 ft. lbs.)
IAC Motor-To-Throttle Body Bolts .	3 N·m (25 in. lbs.)
MAP Sensor Mounting Screws . . .	3 N·m (25 in. lbs.)
Oxygen Sensor	28 N·m (20 ft. lbs.)
Powertrain Control Module (PCM) Mounting Screws	4 N·m (35 in. lbs.)
Throttle Body Mounting Bolts . .	26 N·m (19 ft. lbs.)
Throttle Position Sensor	3 N·m (25 in. lbs.)
Throttle Shield Bolt	4.5 N·m (40 in. lbs.)

SPECIAL TOOLS

FUEL

*Extractor C-4334**Pressure Gauge Assembly C-4799-B**Fuel Pressure Test Adapter 6539**Spanner Wrench 6856**Metering Orifice**Fuel Line Tool**Fuel Line Adapter*

SPECIAL TOOLS (Continued)



Fuel Line Adapter 1/4

