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

INDEX

DESCRIPTION AND OPERATION

FUEL DELIVERY SYSTEM

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

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

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

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

FUEL PUMP MODULE

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

- Electric fuel pump
- Fuel pump reservoir
- Inlet strainer
- Fuel filter/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 requires service, replace the fuel pump module.

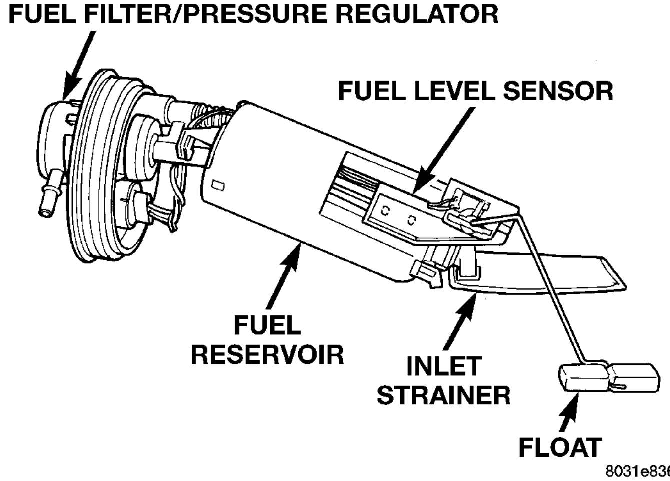


Fig. 1 Fuel Pump Module

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 fuel pump module is suspended in fuel in the fuel tank. The pump draws fuel through a strainer and pushes it through the motor to the outlet. The pump contains a check valves. The 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 880 kPa (130 psi). The regulator adjusts fuel system pressure to approximately 338 kPa (49 psi).

FUEL GAUGE SENDING UNIT

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

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

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

For OBD II emission requirements: The voltage signal is sent from the resistor track to the PCM to indicate fuel level. The purpose of this feature is to prevent a false setting of misfire and fuel system monitor trouble codes. This is if the fuel level in the tank is less than approximately 15 percent of its rated capacity.

FUEL FILTER/FUEL PRESSURE REGULATOR

A combination fuel filter and fuel pressure regulator is used on all gas powered engines. It is located on the top of the fuel pump module. A separate frame mounted fuel filter is not used.

Fuel Pressure Regulator Operation: The pressure regulator is a mechanical device that is calibrated to maintain fuel system operating pressure of approximately 338 kPa (49 psi) at the fuel injectors.

It contains a diaphragm, calibrated springs and a fuel return valve. The internal fuel filter (Fig. 2) is also part of the assembly.

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

The fuel pump module contains a check valve to maintain some fuel pressure when the engine is not operating. This will help to start the engine.

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

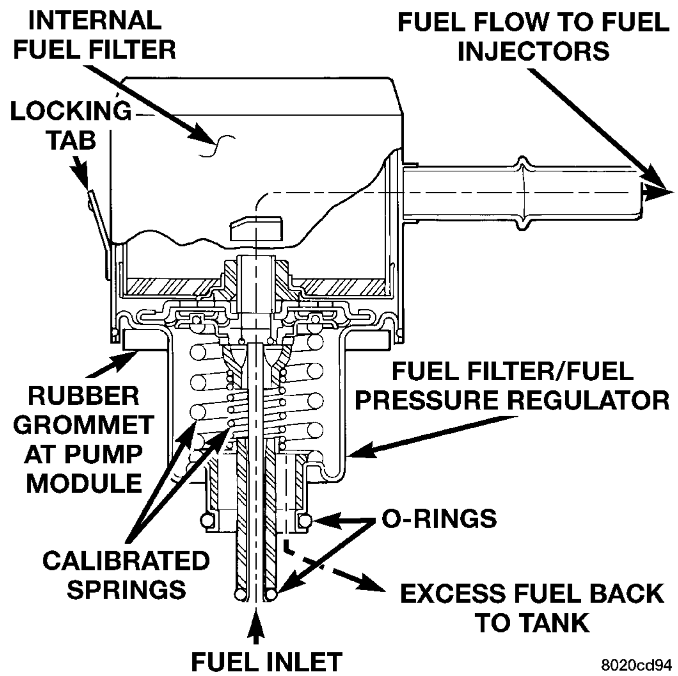


Fig. 2 Side View—Filter/Regulator

FUEL TANK

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

All models have a pressure relief/rollover valve mounted on the top of the fuel pump module.

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

FUEL RAIL

The fuel rail supplies the necessary fuel to each individual fuel injector and is mounted to the intake manifold (Fig. 3). The fuel pressure regulator is no

DESCRIPTION AND OPERATION (Continued)

longer mounted to the fuel rail on any engine. It is now located on the fuel tank mounted fuel pump module. Refer to Fuel Filter/Fuel Pressure Regulator in the Fuel Delivery System section of this group for information. The fuel rail is not repairable.

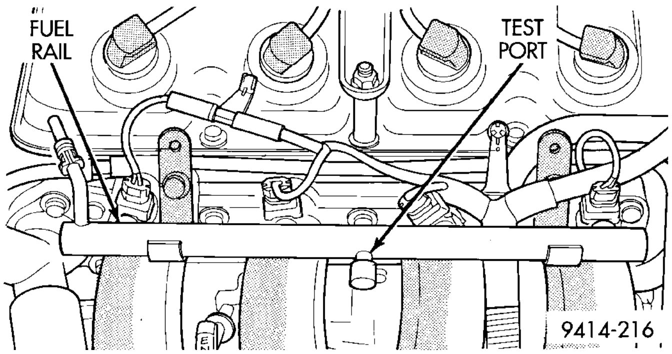


Fig. 3 Fuel Rail—Typical

FUEL INJECTORS

The fuel injectors are 12 ohm electrical solenoids (Fig. 4). 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.

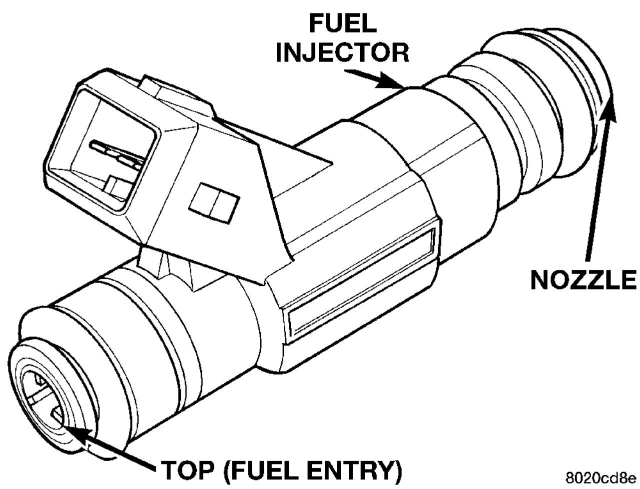


Fig. 4 Fuel Injector

The injectors are positioned in the intake manifold with the nozzle ends directly above the intake valve port (Fig. 5).

PRESSURE-VACUUM FILLER CAP

The loss of any fuel or vapor out of the filler neck is prevented by the use of a safety filler cap. The cap will release pressure only under significant pressure of 10.9 to 13.45 kPa (1.58 to 1.95 psi). The vacuum release for all gas caps is between 0.97 and 2.0 kPa (0.14 and 0.29 psi). The cap must be replaced by a similar unit if replacement is necessary.

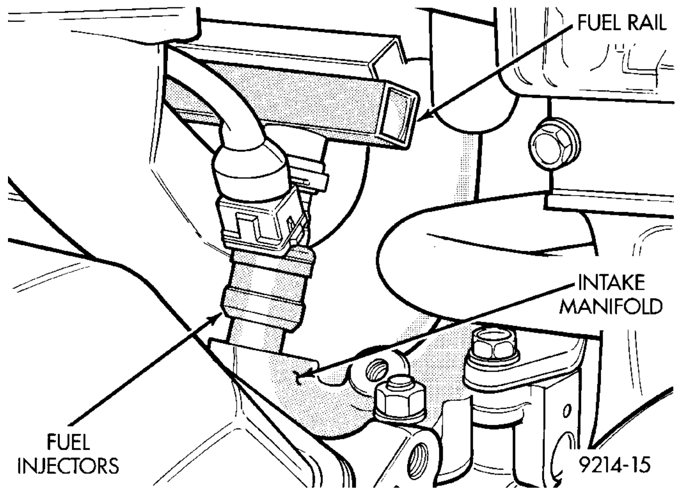


Fig. 5 Fuel Injector Location—Typical

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

Fuel Tank Capacity

Vehicle	Liters	U.S.Gallons
PL	47	12.5

NOTE: 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. 6).

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.

DESCRIPTION AND OPERATION (Continued)

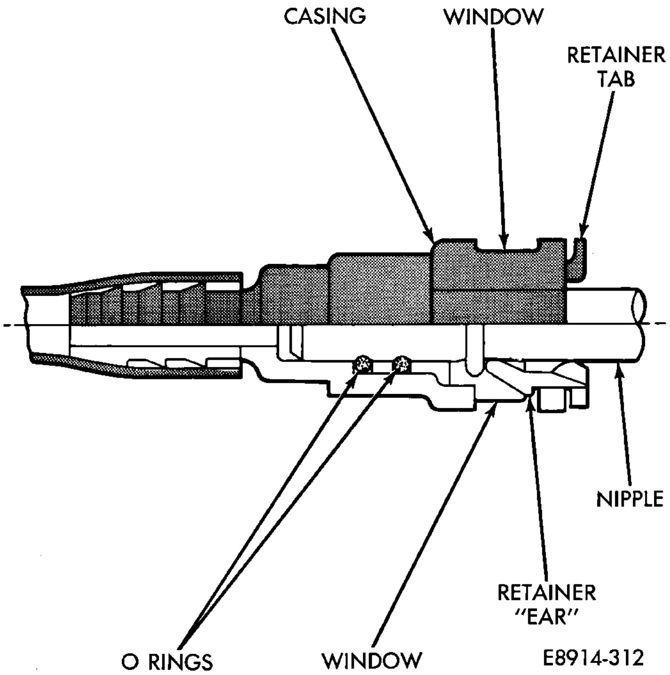


Fig. 6 Plastic Quick-Connect Fittings

The quick-connect fitting consists of the O-rings, retainer and casing (Fig. 6). 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 PL vehicles have two rollover valves. One in the fuel filler tube and the other on the top of the fuel tank. The valves prevent fuel flow through the fuel tank vent valve hoses should the vehicle rollover.

DIAGNOSIS AND TESTING

FUEL PUMP PRESSURE TEST

The fuel system operates at approximately 338 kPa (49 psi). Check fuel system pressure at the test port on the fuel rail (Fig. 7).

(1) Remove cap from fuel pressure test port on fuel rail.

(2) Connect Fuel Pressure Gauge C-4799B to test port (Fig. 8).

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.

(3) 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.

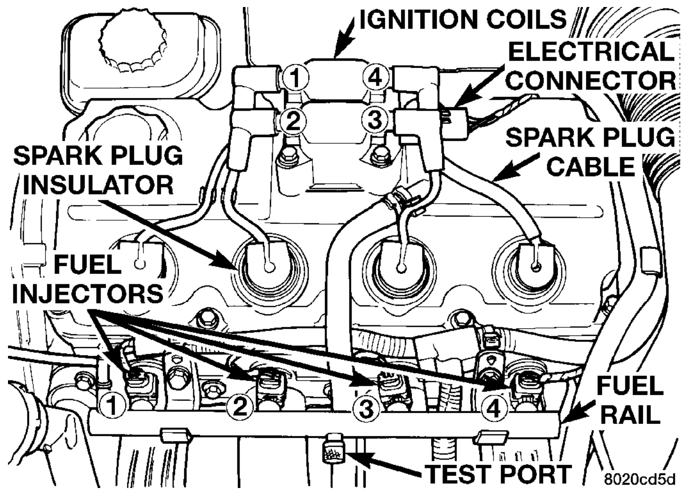


Fig. 7 Fuel Pressure Test Port—Typical

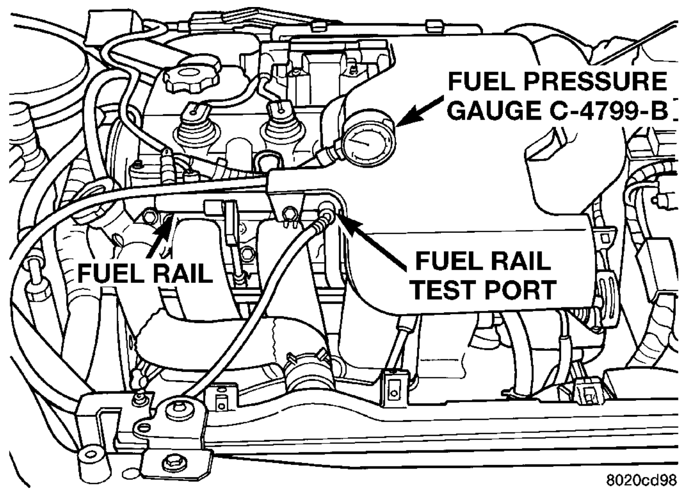


Fig. 8 Checking Fuel Pressure at Intake Manifold—Typical

• If the gauge reading equals 338 kPa (49 PSI) further testing is not required. If pressure is not correct, record the pressure.

• If fuel pressure is below specifications, refer to the Fuel Pressure Diagnosis Chart (Fig. 9).

• If fuel pressure is above specifications (54 psi or higher) check for a kinked or restricted fuel supply line. If the supply line is not kinked or restricted, replace the Fuel Filter/Pressure Regulator.

DIAGNOSIS AND TESTING (Continued)

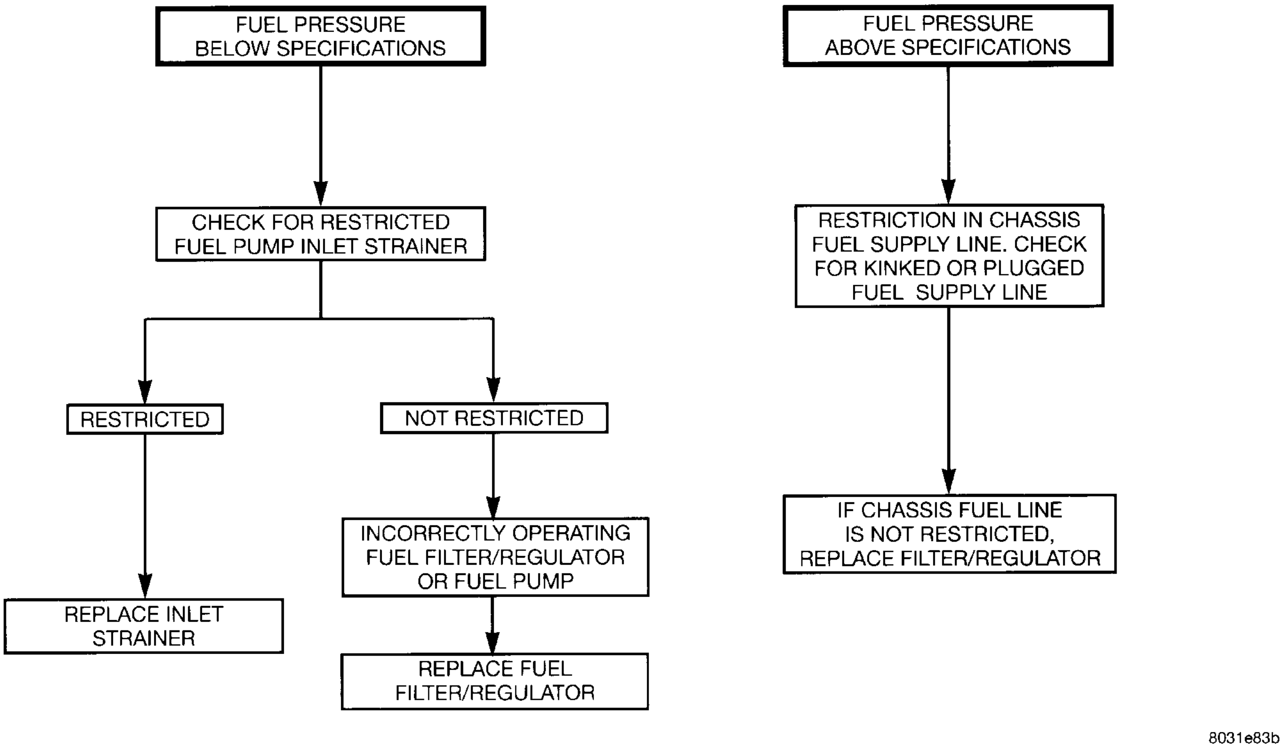


Fig. 9 Fuel Pressure Diagnosis Chart

DIAGNOSIS AND TESTING (Continued)

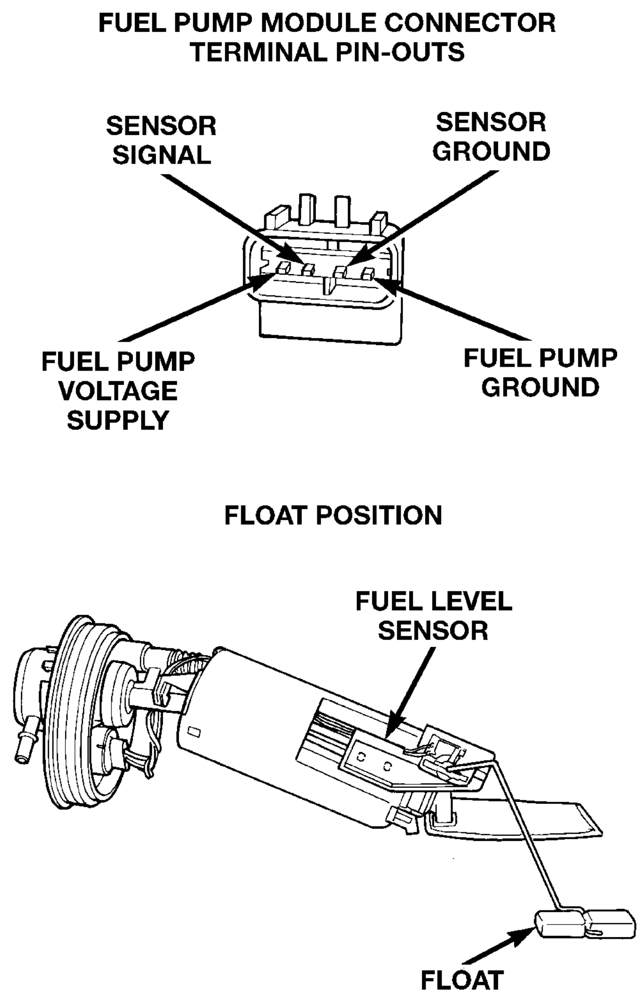
FUEL LEVEL SENSOR

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. 10). Move the float lever to the positions shown in the resistance chart (Fig. 10). Record the resistance at each point. Replace the level sensor if the resistance is not within specifications.

FUEL INJECTORS

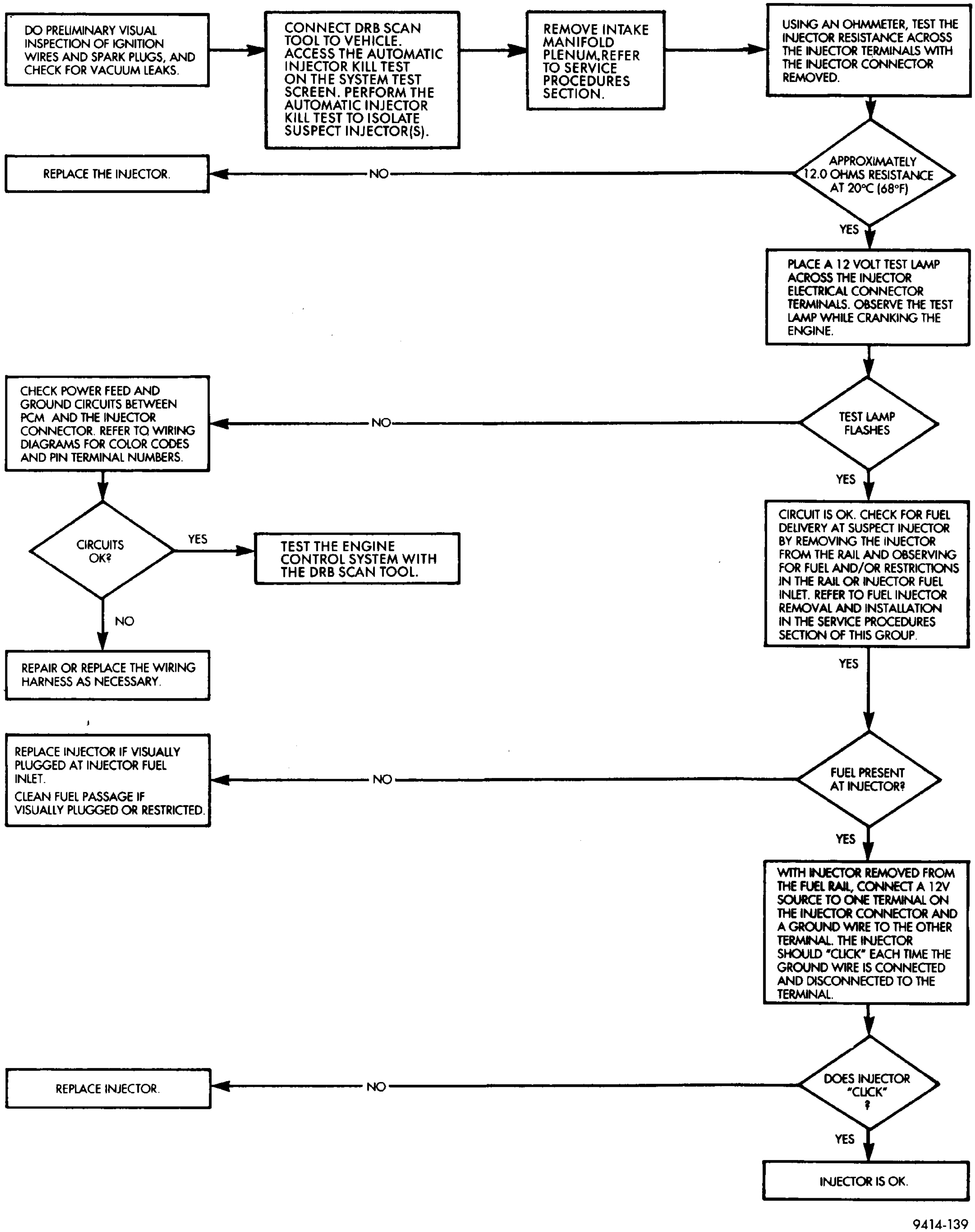
For fuel injector diagnosis, refer to the Fuel Injector Diagnosis charts. For poor fuel economy diagnosis or engine miss, also refer to Transmission Driveplate in this section



FLOAT POSITION (HEIGHT)	RESISTANCE
SENSOR FULL STOP....................	70±20 OHMS
SENSOR EMPTY STOP............	1050±30 OHMS

Fig. 10 Level Sensor Diagnosis 8031e837

DIAGNOSIS AND TESTING (Continued)



FUEL INJECTOR DIAGNOSIS

SERVICE PROCEDURES

FUEL SYSTEM PRESSURE RELEASE PROCEDURE

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 battery.

(2) Remove fuel filler cap.

(3) Remove the protective cap from the fuel pressure test port on the fuel rail (Fig. 11).

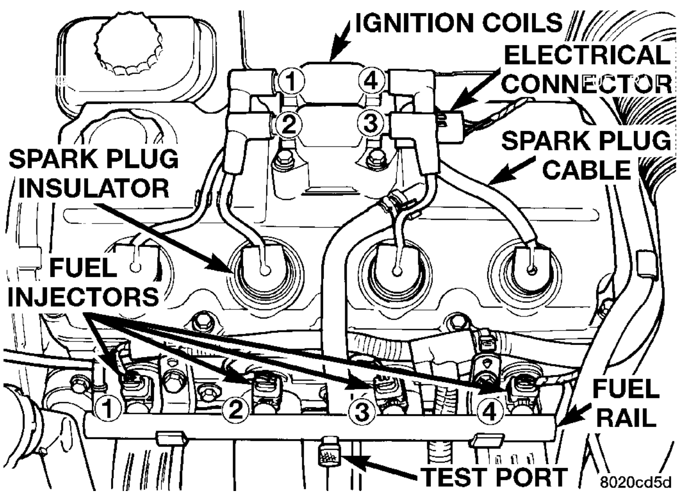


Fig. 11 Fuel Pressure Test Port—Typical

(4) Place the open end of fuel pressure release hose, tool number C-4799-1, into an approved gasoline container. Connect the other end of hose C-4799-1 to the fuel pressure test port (Fig. 12). Fuel pressure will bleed off through the hose into the gasoline container. Fuel gauge C-4799-A contains hose C-4799-1.

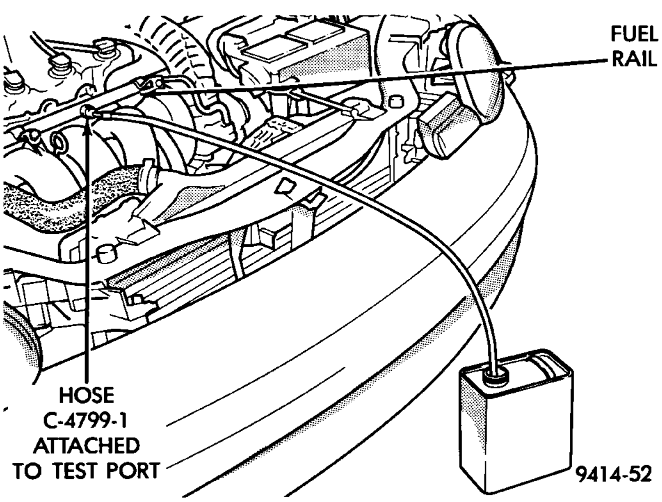


Fig. 12 Releasing Fuel Pressure

DRAINING 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.

(1) Remove fuel filler cap.

(2) Perform the Fuel System Pressure Release procedure.

(3) Disconnect negative cable from battery.

(4) Raise vehicle on hoist.

(5) Remove quick connect cap from drain port. The drain port is located on rear top of fuel tank. Push a siphon hose into the drain port (Fig. 13).

(6) Drain fuel tank into holding tank or a properly labeled **Gasoline** safety container.

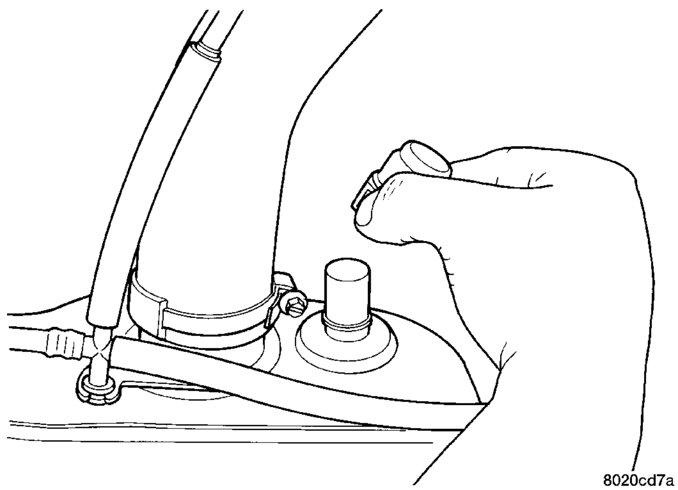


Fig. 13 Drain Port Location

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.

SERVICE PROCEDURES (Continued)

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. 14). **Do not rely upon the audible click to confirm a secure connection.**

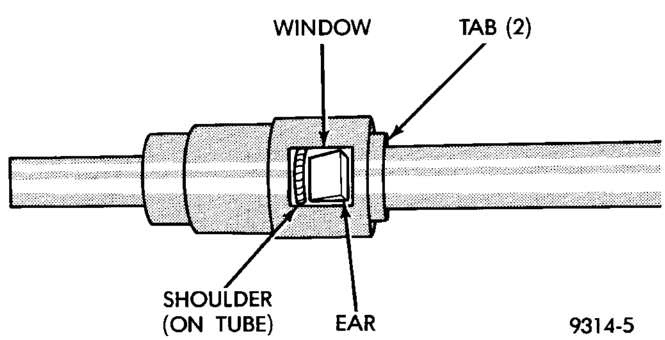


Fig. 14 Plastic Quick-Connect Fitting/Fuel Tube Connection

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. 15) usually black in color.

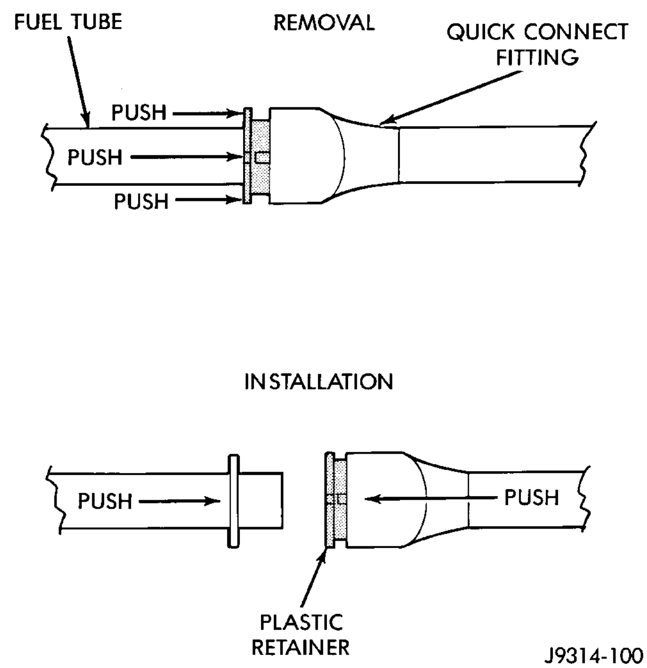


Fig. 15 Plastic Retainer Ring Type Fitting

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

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

DISCONNECTION/CONNECTION

(1) Disconnect negative battery cable from the battery.

SERVICE PROCEDURES (Continued)

(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. 15). 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. 16). 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.

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

REMOVAL

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.

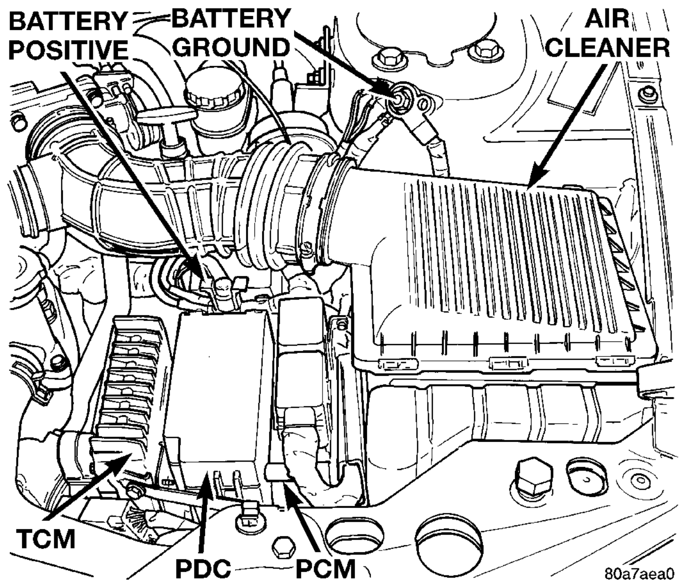


Fig. 16 Power Distribution Center (PDC)

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

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

(2) Disconnect fuel line from fuel pump module by depressing quick connect retainers with thumb and fore finger.

(3) Slide fuel pump module electrical connecter lock to unlock.

(4) Disconnect the electrical connection from the fuel pump module, by pushing down on connector retainer and pulling connector off of module.

(5) Use a transmission jack to support the fuel tank. remove bolts from fuel tank straps.

(6) Lower tank slightly.

(7) Use Special Tool 6856 to remove fuel pump module locknut (Fig. 18).

(8) Remove fuel pump and O-ring seal from tank. Discard old seal.

INSTALLATION

(1) Wipe seal area of tank clean and place a new seal in position in the tank opening.

(2) Position fuel pump in the tank. Make sure the aligment tab on the underside of the fuel pump module flange sits in the notch on the fuel tank.

(3) Position the locknut over the fuel pump module.

REMOVAL AND INSTALLATION (Continued)

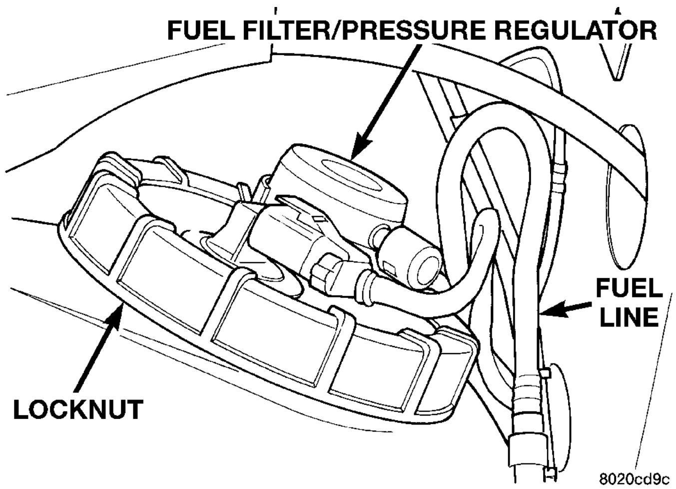


Fig. 17 Fuel Pump Module Removal

(4) Tighten the locknut using Special Tool 6856 to 55 N·m (40.5 ft. lbs.) (Fig. 18).

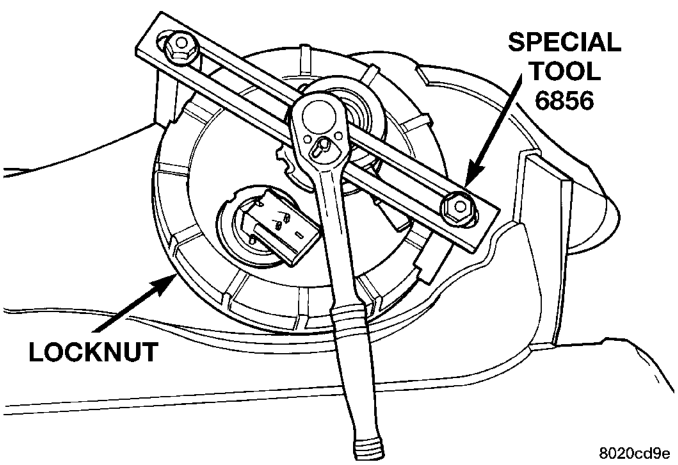


Fig. 18 Fuel Tank Locknut

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

(5) Fill fuel tank. Check for leaks.

FUEL FILTER / PRESSURE REGULATOR

REMOVAL

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

(1) Refer to Fuel System Pressure Release in the Fuel Delivery System section of this group.

The fuel filter/fuel pressure regulator is located on the top of fuel pump module. Fuel pump module removal is not necessary.

(2) Raise vehicle on hoist.

(3) Disconnect fuel supply line at the Filter/Regulator nipple (refer to Quick Connect Fittings in this section).

(4) Depress locking spring tab on side of Fuel/Regulator (Fig. 19) and rotate 90° counter-clockwise and pull out.

NOTE: Make sure that the upper and lower O-rings are on the Filter/Regulator assembly.

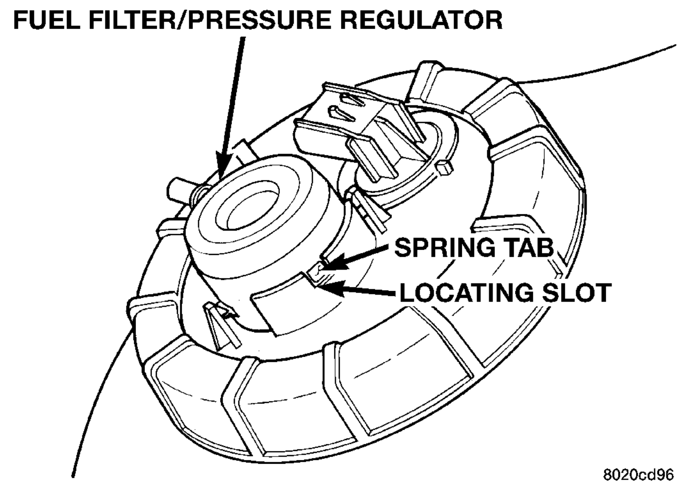


Fig. 19 Locking Spring Tab

INSTALLATION

Lightly lubricate the O-rings with engine oil.

(1) Insert Filter/Regulator into the opening in the fuel pump module, align the two hold down tabs with the flange.

(2) While applying downward pressure, rotate the Filter/Regulator clockwise until the the spring tab engages the locating slot (Fig. 20).

(3) Connect the fuel line to the Filter/Regulator.

(4) Lower vehicle from hoist.

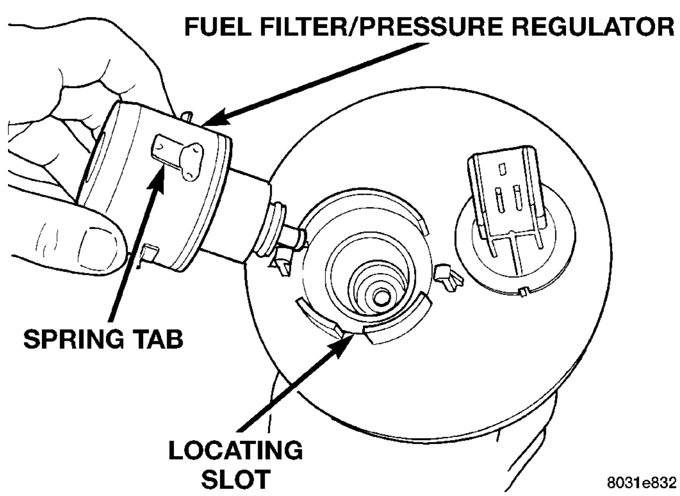


Fig. 20 Spring Tab In Locating Slot

REMOVAL AND INSTALLATION (Continued)

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, pry back the locking tabs on fuel pump reservoir and remove the strainer (Fig. 21).

(3) Remove strainer O-ring from the fuel pump reservoir body.

(4) Remove any contaminants in the fuel tank by washing the inside of the fuel tank.

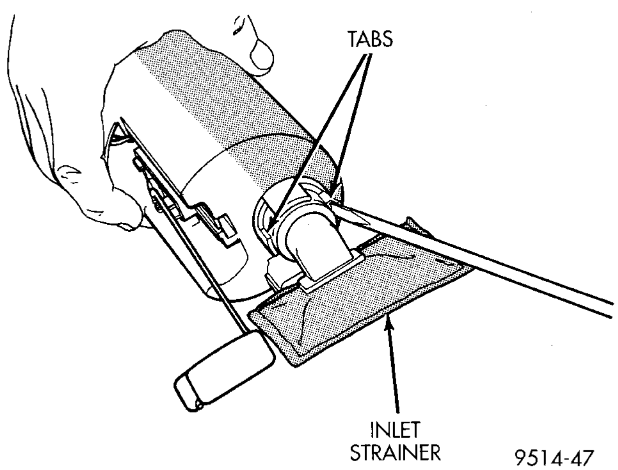


Fig. 21 Inlet Strainer Removal

INSTALLATION

(1) Lubricate the strainer O-ring with clean engine 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. 22).

(2) Pull off blue locking wedge (Fig. 23).

(3) Using a small screwdriver lift locking finger away from terminal and push terminal out of connector (Fig. 24).

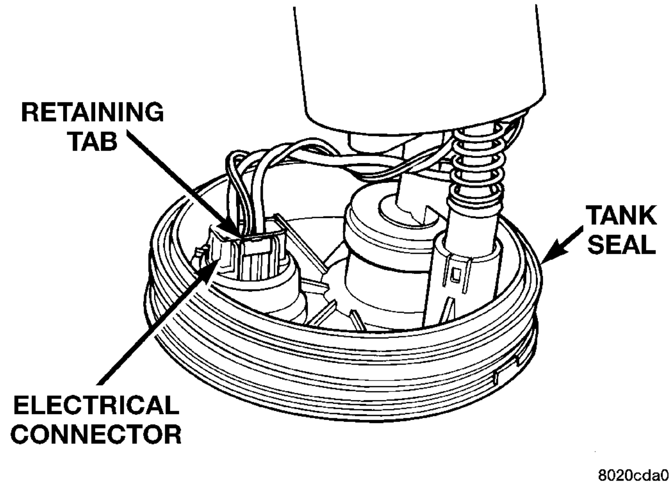


Fig. 22 Fuel Pump/Level Sensor Electrical Connector

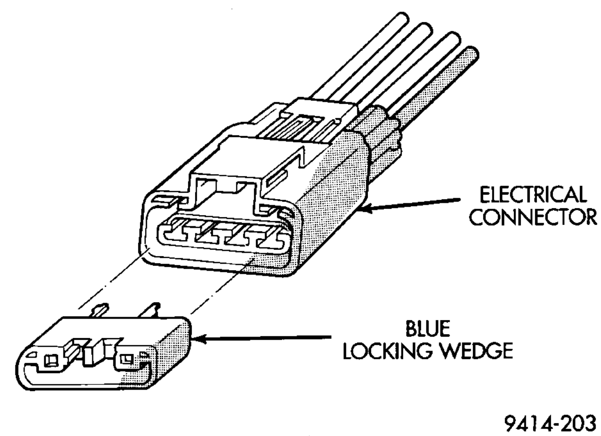


Fig. 23 Wire Terminal Locking Wedge

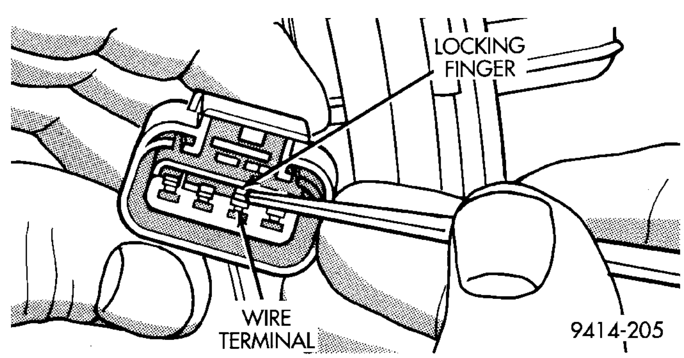


Fig. 24 Wire Terminal Locking Finger

REMOVAL AND INSTALLATION (Continued)

(4) Push level sensor signal and ground terminals out of the connector (Fig. 25).

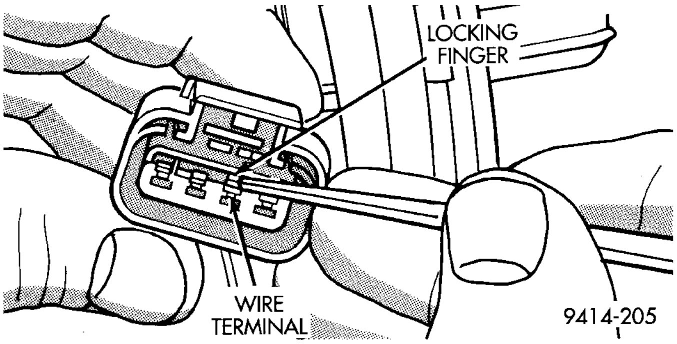


Fig. 25 Removing Wires From Connector

(5) Insert a screwdriver between the fuel pump module and the top of the level sensor housing (Fig. 26). Push level sensor down slightly.

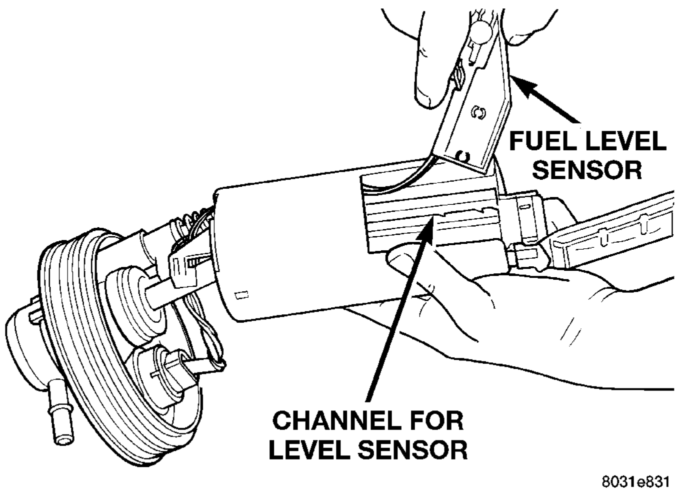


Fig. 26 Loosening Level Sensor

(6) Slide level sensor wires through opening fuel pump module (Fig. 27).

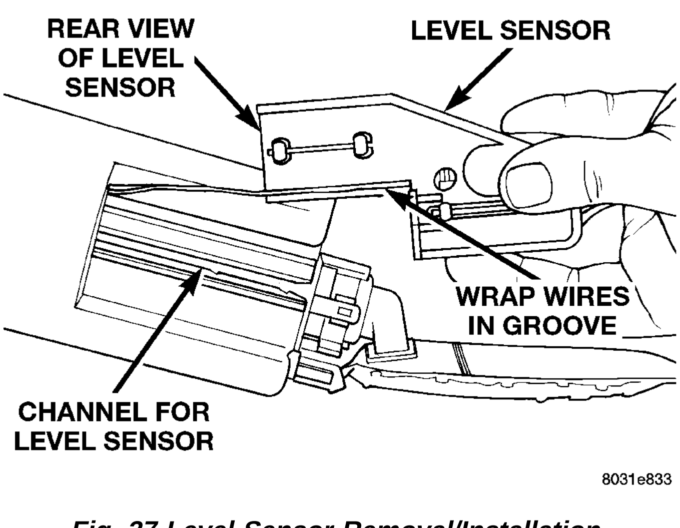


Fig. 27 Level Sensor Removal/Installation

(7) Slide level sensor out of installation 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. 26).

(3) While feeding wires into guide grooves, slide level sensor up into channel until it snaps into place (Fig. 27). 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.

(5) Install locking wedge on connector.

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

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

FUEL INJECTORS

REMOVAL

(1) Disconnect negative cable from battery.

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

(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).

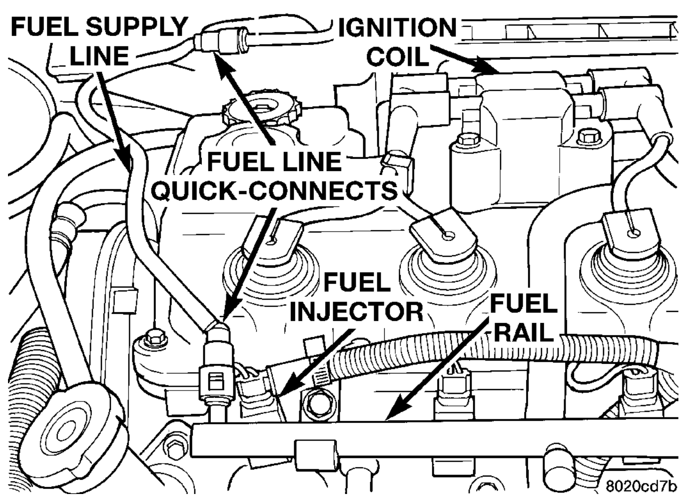


Fig. 28 Fuel Rail and Injectors

REMOVAL AND INSTALLATION (Continued)

(5) Remove fuel rail mounting screws.

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

(7) Remove fuel injector retainer (Fig. 29).

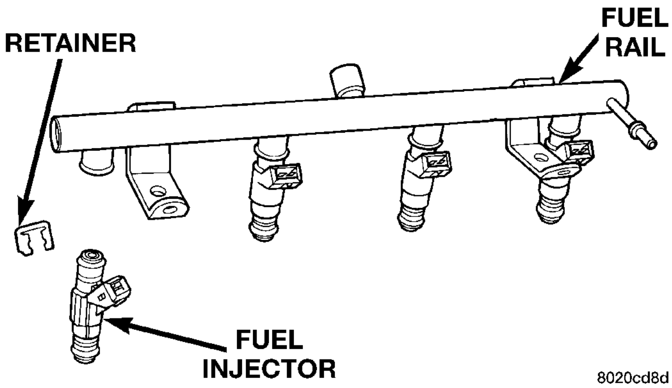


Fig. 29 Fuel Injector Retainer

(8) Pull injector out of fuel rail. Replace fuel injector O-rings (Fig. 30).

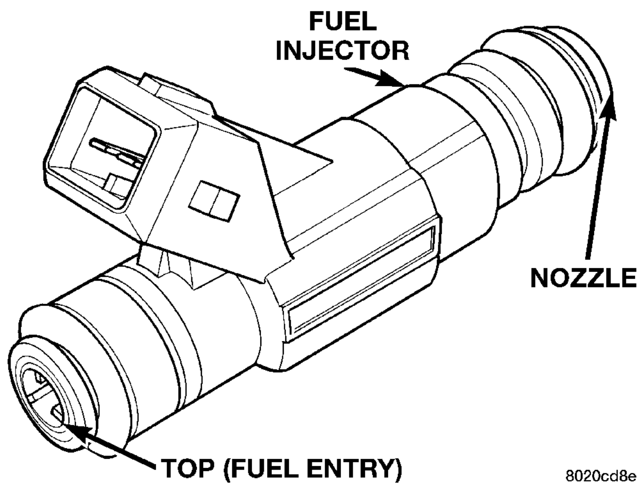


Fig. 30 Fuel Injector O-Rings

INSTALLATION

(1) Apply a light coating of clean engine oil to the upper O-ring.

(2) Install injector in cup on fuel rail.

(3) Install retaining clip.

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

(5) Insert fuel injector nozzles into openings in intake manifold. Seat the injectors in place. Tighten fuel rail mounting screws to 22.5 N·m ± 3 N·m (200±30 in. lbs.).

(6) Attach electrical connectors to fuel injectors.

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

FUEL TANK

REMOVAL

(1) Perform fuel system pressure release.

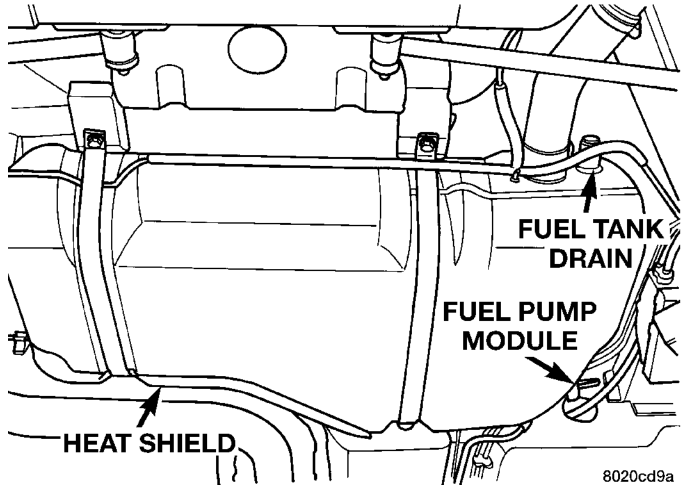


Fig. 31 Fuel Tank

(2) Drain fuel tank. Refer to Draining Fuel Tank in this section (Fig. 31).

(3) Raise vehicle on hoist.

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

(4) Disconnect fuel pump module electrical connector (Fig. 32).

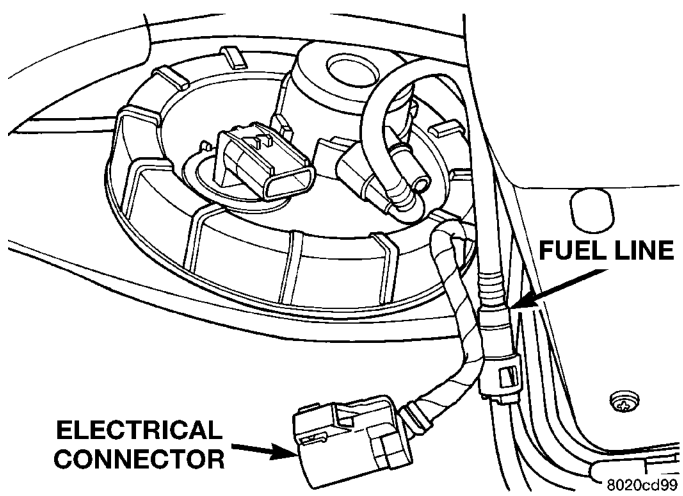


Fig. 32 Fuel Pump Module Electrical Connector

(5) Disconnect the fuel tube from Fuel Filter/Regulator. Refer to Quick Connect Fittings in the Fuel Delivery section of this group.

(6) Support tank with transmission jack. Loosen tank mounting straps and lower tank slightly.

(7) Disconnect fuel filler tube and filler vent tube from filler hose at fuel tank (Fig. 33).

REMOVAL AND INSTALLATION (Continued)

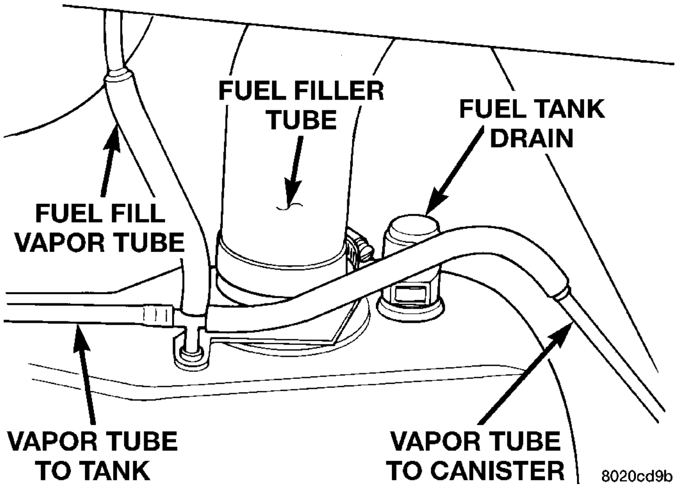


Fig. 33 Fuel Filler Tube and Vent Tubes

(8) Disconnect fuel filler vapor relief tube from tee connecting it to the tank vapor relief tube and EVAP canister tube.

(9) Disconnect vapor line from Evap canister tube.

(10) Remove tank mounting straps and lower tank.

INSTALLATION

(1) Position fuel tank on transmission jack.

(2) Raise tank into position. Connect fuel filler tube tank inlet nipple.

(3) Tighten fuel tank strap nuts to 23 N·m (250 in. lbs.) torque. Remove transmission jack. Ensure straps are not twisted or bent.

(4) Attach fuel tubes to pump module and chassis fuel tube. Refer to Quick Connect Fittings in the Fuel Delivery section of this Group.

(5) Connect fuel vapor tube to tee, then to Evap canister tube.

(6) Attach electrical connector to fuel pump module.

(7) Lower vehicle.

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

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.

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

FUEL FILLER NECK

REMOVAL

(1) Loosen fuel filler tube cap.

(2) Remove fuel filler neck screws (Fig. 34).

(3) Disconnect fuel fill vapor tube.

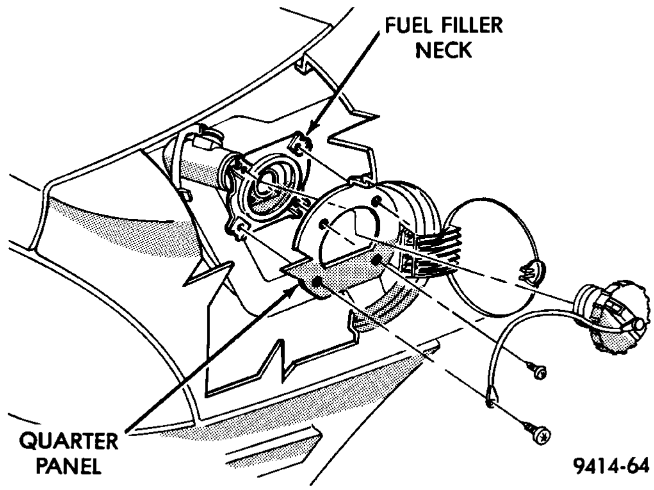


Fig. 34 Fuel Filler Neck

(4) Disconnect fuel filler tube from fuel tank. Remove filler neck.

INSTALLATION

(1) Reverse for installation.

FUEL FILLER TUBE ROLLOVER VALVE

REMOVAL

The rollover valve is mounted in the fuel filler tube (Fig. 35).

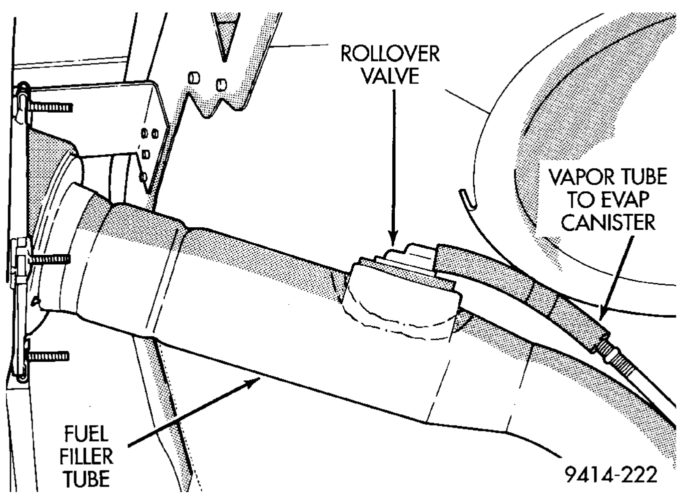


Fig. 35 Fuel Filler Tube Rollover Valve

(1) To release fuel tank pressure, remove the fuel filler tube cap.

(2) Disconnect vapor tube from rollover valve.

(3) Using a straight screwdriver, pry the valve out of the grommet in the fuel filler tube.

INSTALLATION

(1) Apply a light coating of power steering fluid to the grommet.

(2) Install valve in grommet.

REMOVAL AND INSTALLATION (Continued)

(3) Attach vapor tube to valve.

(4) Install fuel filler tube cap.

ACCELERATOR PEDAL

CAUTION: When servicing the accelerator pedal, throttle cable or speed control cable, do not damage or kink the core wire inside the cable sheathing.

REMOVAL

(1) Working from the engine compartment, remove the throttle control shield.

(2) Hold the throttle body throttle lever in the wide open position. Remove the throttle cable from the throttle body cam.

(3) From inside the vehicle, hold up the pedal and remove the cable retainer and throttle cable from the upper end of the pedal shaft (Fig. 36) and (Fig. 37).

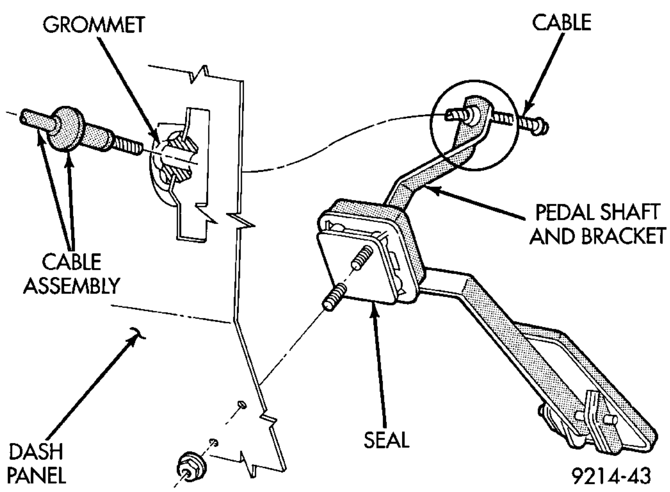


Fig. 36 Accelerator Pedal and Throttle Cable—Front View

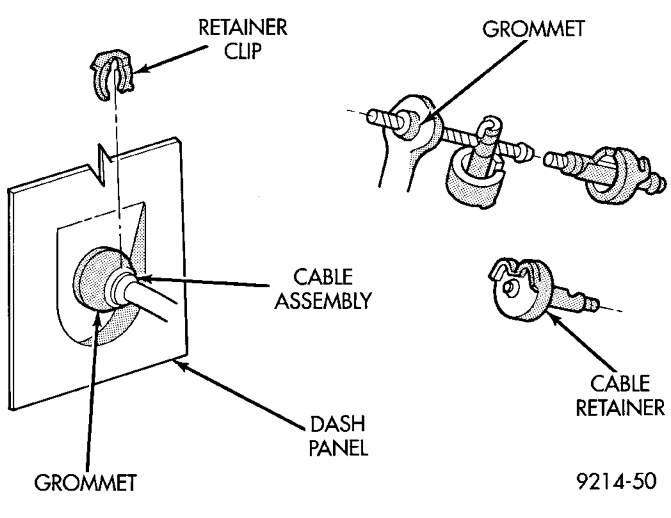


Fig. 37 Accelerator Pedal and Throttle Cable—Rear View

(4) Working from the engine compartment, remove nuts from accelerator pedal attaching studs (Fig. 36). 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) From inside the vehicle, hold up the pedal and install the throttle cable and cable retainer in the upper end of the pedal shaft.

(3) From the engine compartment, hold the throttle body lever in the wide open position and install the throttle cable. Install the throttle control shield.

THROTTLE CABLE—MANUAL TRANSMISSION

REMOVAL

(1) Remove throttle control shield (Fig. 38).

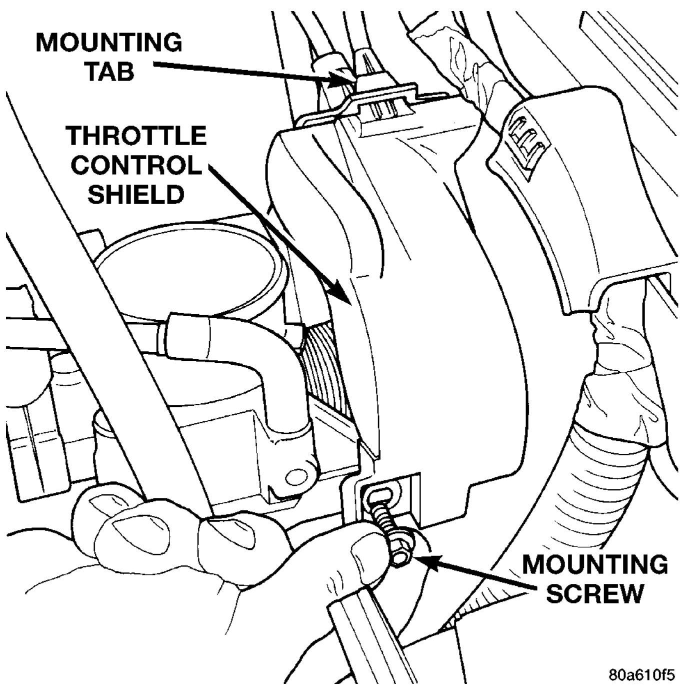


Fig. 38 Throttle Control Shield

(2) Working from the engine compartment, remove the throttle cable from the throttle body lever (Fig. 39) and (Fig. 40).

(3) Compress the retaining tabs on the cable and slide cable out of bracket.

(4) From inside the vehicle, hold the accelerator pedal up and remove the cable retainer and cable from upper end of pedal shaft (Fig. 36) and (Fig. 37).

(5) Remove retainer clip from throttle cable and grommet at the dash panel.

(6) From the engine compartment, pull the throttle cable out of the dash panel grommet. The grommet should remain in the dash panel.

REMOVAL AND INSTALLATION (Continued)

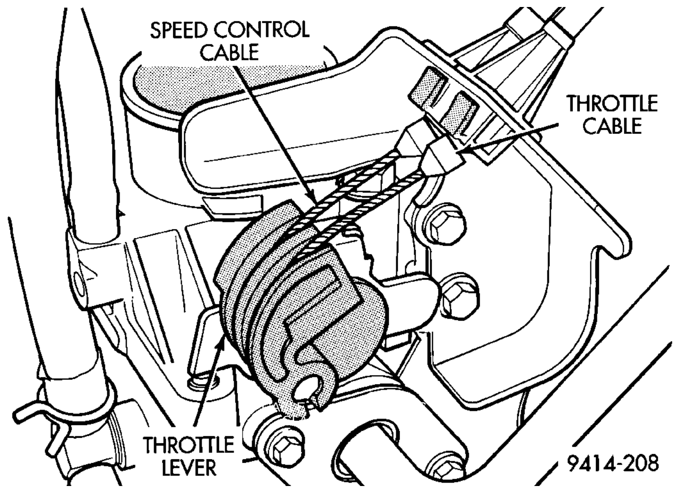


Fig. 39 Throttle Cable Attachment to Throttle Body

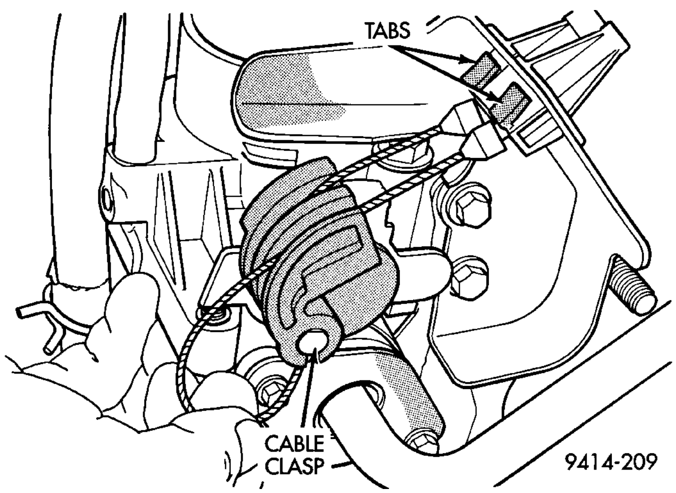


Fig. 40 Disconnecting Throttle Cable

INSTALLATION

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

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

(3) From inside the vehicle, hold up pedal and feed throttle cable core wire through hole in upper end of the pedal shaft. Install cable retainer.

(4) Install cable retainer clip.

(5) From the engine compartment, rotate the throttle lever forward to the wide open position and install cable clasp (Fig. 40).

(6) Install throttle control shield (Fig. 38). Tighten screw to 5.6 N·m (50 in. lbs.).

THROTTLE CABLE—AUTOMATIC TRANSMISSION

REMOVAL

(1) Remove throttle control shield (Fig. 38).

(2) Working from the engine compartment, remove throttle cable from throttle body cam (Fig. 41) and (Fig. 42).

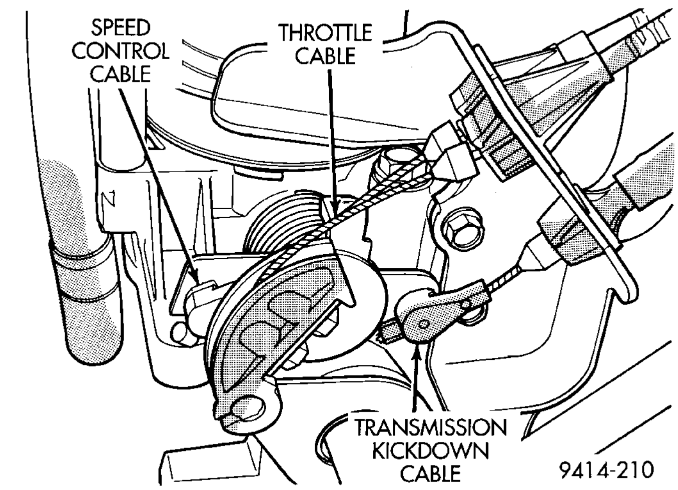


Fig. 41 Throttle Body Cables Attachment to Throttle Body

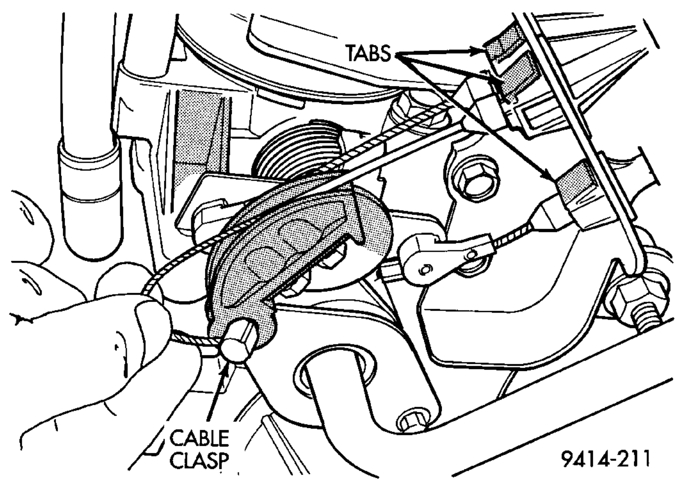


Fig. 42 Disconnecting Throttle Cable

(3) Compress the retaining tabs on the cable and slide cable out of bracket.

(4) From inside the vehicle, hold the throttle pedal up and remove the cable retainer and cable from upper end of pedal shaft (Fig. 36) and (Fig. 37).

(5) Remove retainer clip from throttle cable and grommet at the dash panel.

(6) From the engine compartment, pull the throttle cable out of the dash panel grommet. The grommet should remain in the dash panel.

INSTALLATION

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

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

(3) From inside the vehicle, hold up pedal and feed throttle cable core wire through hole in upper end of the pedal shaft. Install cable retainer (Fig. 37).

(4) Install cable retainer clip.

REMOVAL AND INSTALLATION (Continued)

(5) From the engine compartment, rotate the throttle lever forward to the wide open position and install cable clasp (Fig. 42).

(6) Install throttle ontrol shield (Fig. 38). Tighten to 5.6 N·m (50 in. lbs.).

SPECIFICATIONS

TORQUE SPECIFICATION

DESCRIPTION	TORQUE
Accelerator Pedal to Dash Nuts	12 N·m (105 in. lbs.)
Fuel Pump Module Locknut	55 N·m (40 ft. lbs.)
Fuel Tank Strap Bolts	23 N·m (250 in. lbs.)
Fuel Rail Bolts	23 N·m (195 in. lbs.)
Ignition Coil Mounting Bolts	11 N·m (95 in. lbs.)
Intake Manifold Bolts	11 N·m (95 in. lbs.)
Throttle Control Shield	5.6 N·m (50 in. lbs.)

FUEL INJECTION SYSTEM

INDEX

SPECIFICATIONS (Continued)

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.

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.

IGNITION SWITCH ON (ZERO RPM) MODE

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

GENERAL INFORMATION (Continued)

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

GENERAL INFORMATION (Continued)

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 respones 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.

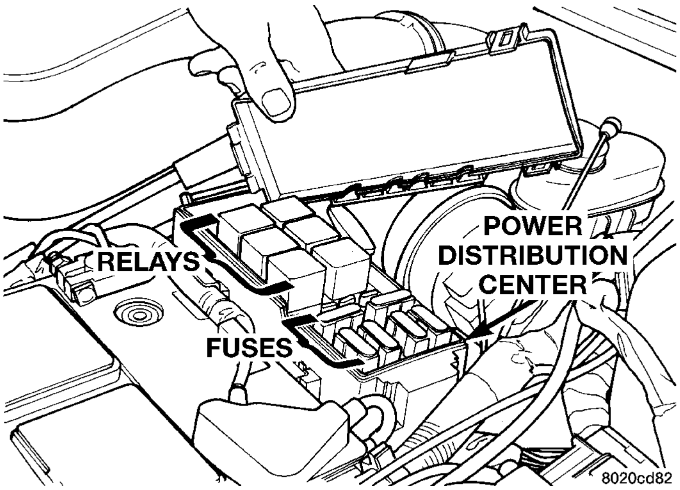


Fig. 1 Power Distribution Center (PDC)

POWERTRAIN CONTROL MODULE

The Powertrain Control Module (PCM) is a digital computer containing a microprocessor (Fig. 2). 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.

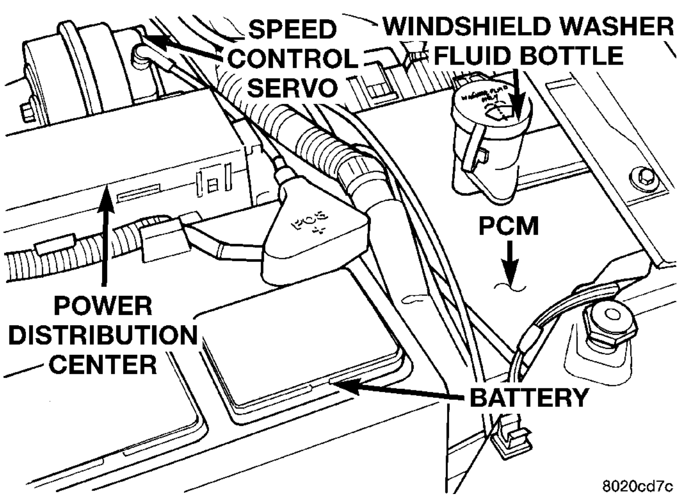


Fig. 2 Powertrain Control Module (PCM)

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
- 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

PCM Outputs:

- Air Conditioning WOT Relay
- Auto Shutdown (ASD) Relay
- Charging Indicator Lamp
- Data Link Connector
- 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 Relay
- Speed Control Solenoids
- Tachometer
- Torque Convertor Clutch Solenoid

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

The PCM adjusts ignition timing based on the following inputs.

- Coolant temperature
- Intake air temperature
- Engine speed (crankshaft position sensor)
- Knock sensor
- Manifold absolute pressure
- Throttle position

DESCRIPTION AND OPERATION (Continued)

- Transmission gear selection (park/neutral switch)

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 mounted externally, but turned on and off by the PCM.

The crankshaft position sensor signal is sent to the PCM. If the PCM does not receive the signal within approximately one second of engine cranking, it deactivates the ASD relay and fuel pump relay. When these relays deactivate, power is shut off from the fuel injectors, ignition coils, heating element in the oxygen sensors and the 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. The brake switch is mounted on the brake pedal support bracket.

DESCRIPTION AND OPERATION (Continued)

CAMSHAFT POSITION SENSOR—PCM INPUT

The PCM determines fuel injection synchronization and cylinder identification from inputs provided by the camshaft position sensor (Fig. 3) or (Fig. 4) and crankshaft position sensor. From the two inputs, the PCM determines crankshaft position.

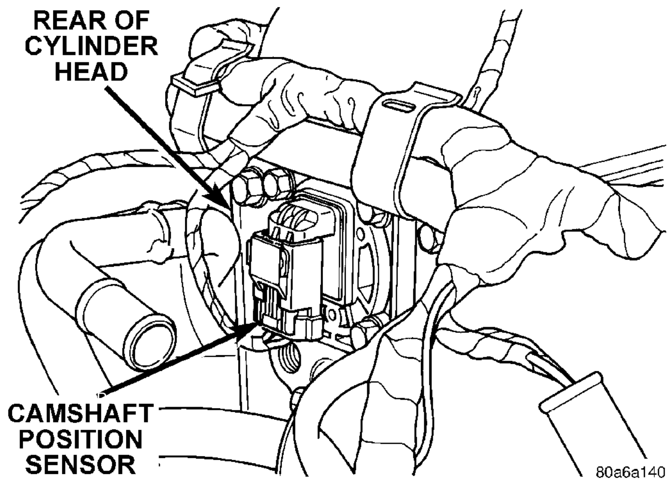


Fig. 3 Camshaft Position Sensor—SOHC

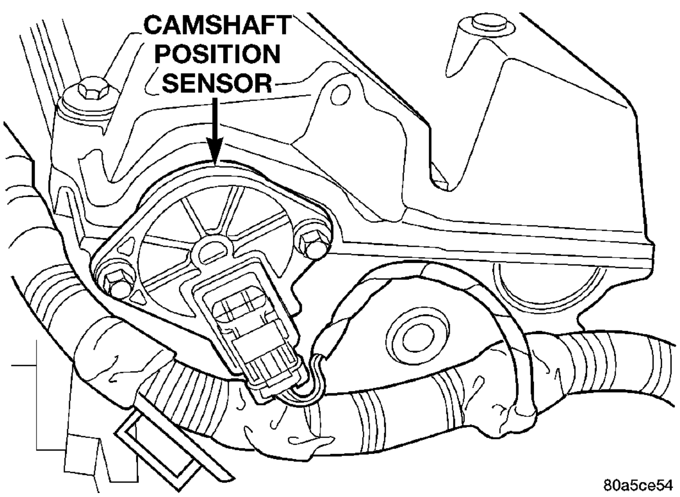


Fig. 4 Camshaft Position Sensor—DOHC

The camshaft position sensor attaches to the rear of the cylinder head. A target magnet attaches to the rear of the camshaft and indexes to the correct position. The target magnet has four different poles arranged in an asymmetrical pattern (Fig. 5). As the target magnet rotates, the camshaft position sensor senses the change in polarity (Fig. 6). The sensor output switch switches from high (5.0 volts) to low (0.5 volts) as the target magnet rotates. When the north pole of the target magnet passes under the sensor, the output switches high. The sensor output switches low when the south pole of the target magnet passes underneath.

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

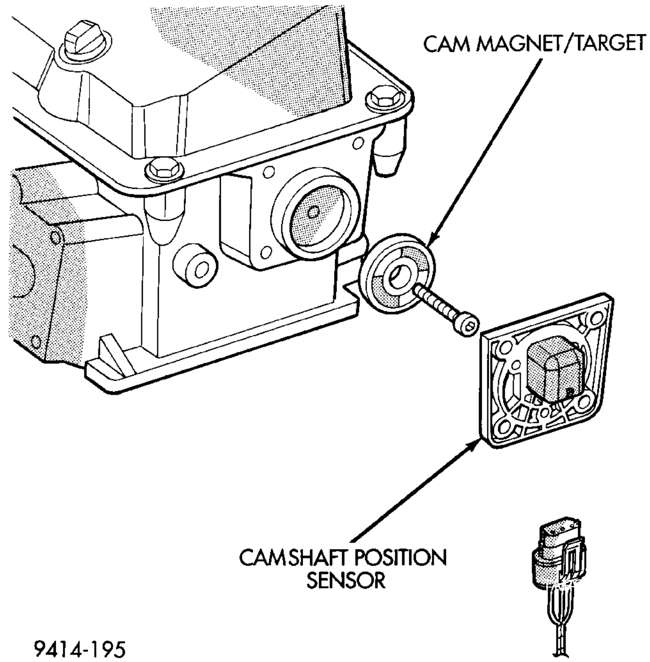


Fig. 5 Target Magnet—Typical

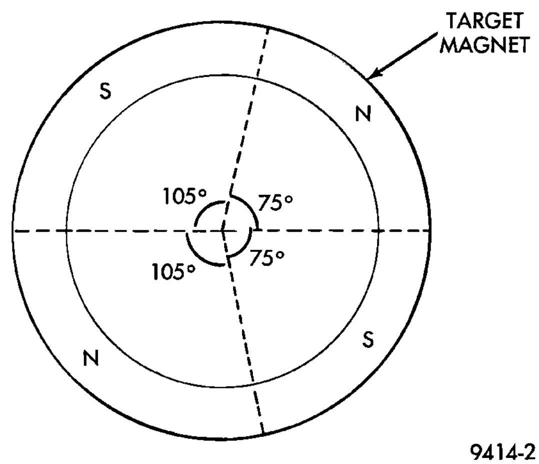


Fig. 6 Target Magnet Polarity

CRANKSHAFT POSITION SENSOR—PCM INPUT

The PCM determines what cylinder to fire from the crankshaft position sensor input and the camshaft position sensor input. The second crankshaft counterweight has two sets of four timing reference notches including a 60 degree signature notch (Fig. 7). From the crankshaft position sensor input the PCM determines engine speed and crankshaft angle (position).

The notches generate pulses from high to low in the crankshaft position sensor output voltage. When a metal portion of the counterweight aligns with the crankshaft position sensor, the sensor output voltage goes low (less than 0.5 volts). When a notch aligns with the sensor, voltage goes high (5.0 volts). As a group of notches pass under the sensor, the output

DESCRIPTION AND OPERATION (Continued)

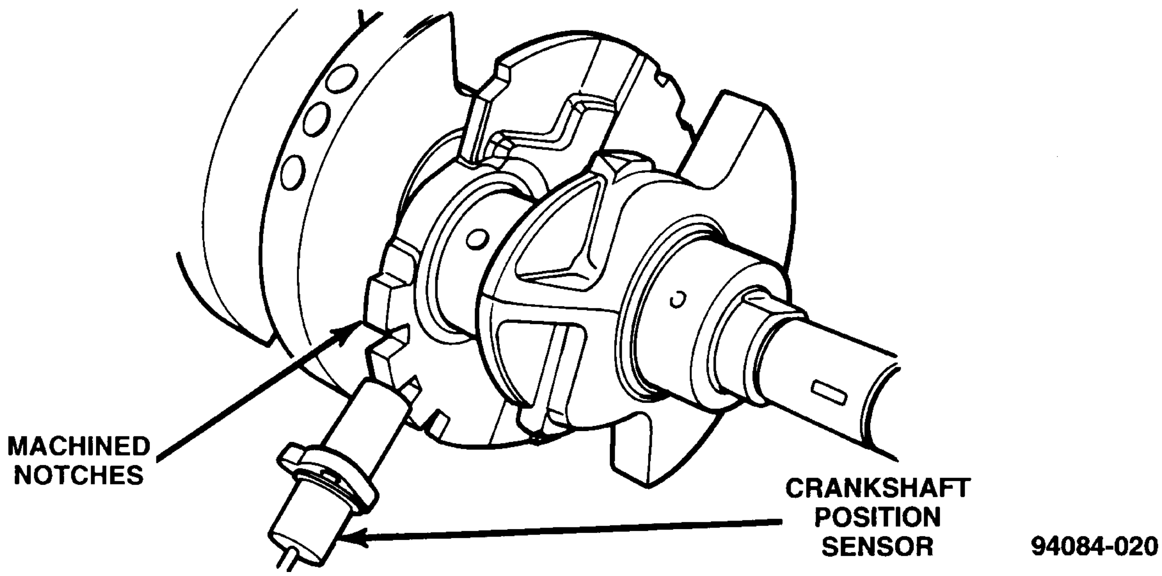


Fig. 7 Timing Reference Notches

voltage switches from low (metal) to high (notch) then back to low.

If available, an oscilloscope can display the square wave patterns of each voltage pulses. From the width of the output voltage pulses, the PCM calculates engine speed. The width of the pulses represent the amount of time the output voltage stays high before switching back to low. The period of time the sensor output voltage stays high before switching back to low is referred to as pulse width. The faster the engine is operating, the smaller the pulse width on the oscilloscope.

By counting the pulses and referencing the pulse from the 60 degree signature notch, the PCM calculates crankshaft angle (position). In each group of timing reference notches, the first notch represents 69 degrees before top dead center (BTDC). The second notch represents 49 degrees BTDC. The third notch represents 29 degrees. The last notch in each set represents 9 degrees before top dead center (TDC).

The timing reference notches are machined at 20° increments. From the voltage pulse width the PCM tells the difference between the timing reference notches and the 60 degree signature notch. The 60 degree signature notch produces a longer pulse width than the smaller timing reference notches. If the camshaft position sensor input switches from high to low when the 60 degree signature notch passes under the crankshaft position sensor, the PCM knows cylinder number one is the next cylinder at TDC.

The crankshaft position sensor mounts to the engine block behind the alternator, just above the oil filter (Fig. 8).

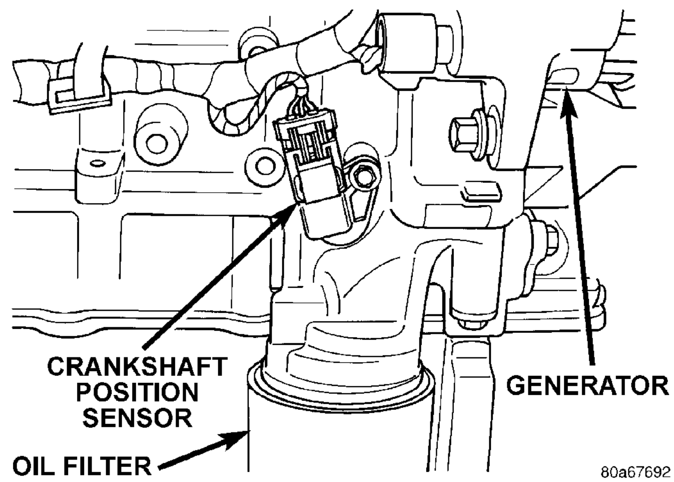


Fig. 8 Crankshaft Position Sensor

ENGINE COOLANT TEMPERATURE SENSOR—PCM INPUT

The combination coolant temperature sensor has two elements. One element supplies coolant temperature signal to the PCM. The other element supplies coolant temperature signal to the instrument panel gauge cluster. The PCM determines engine coolant temperature from the coolant temperature sensor.

As coolant temperature varies the coolant temperature sensors resistance changes resulting in a different input voltage to the PCM and the instrument panel gauge cluster.

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

DESCRIPTION AND OPERATION (Continued)

SOHC

The coolant sensor threads into the rear of the cylinder head, next to the camshaft position sensor (Fig. 9). New sensors have sealant applied to the threads.

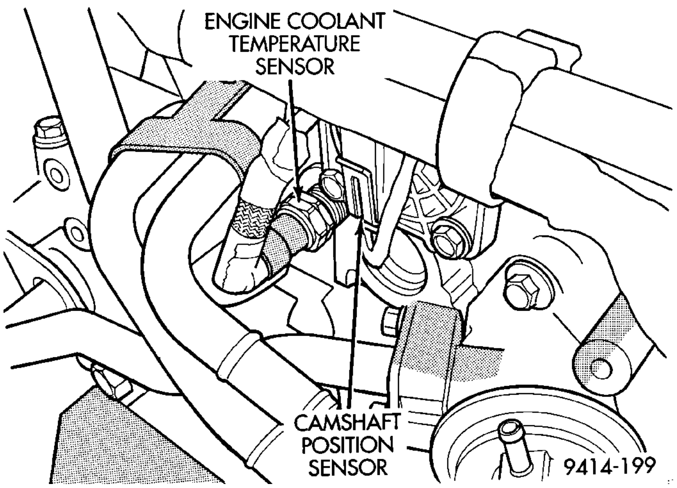


Fig. 9 Engine Coolant Temperature Sensor—SOHC

DOHC

The coolant sensor threads into the intake manifold next to the thermostat housing (Fig. 10). New sensors have sealant applied to the threads.

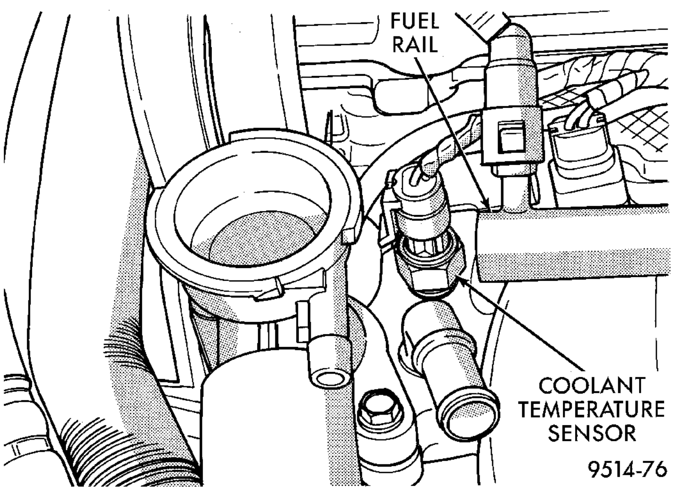


Fig. 10 Engine Coolant Temperature Sensor—DOHC

FUEL LEVEL SENSOR—PCM INPUT

The fuel level sensor (fuel gauge sending unit) sends a signal to the PCM to indicate fuel level. The purpose of this feature is to prevent a false setting of misfire and fuel system monitor trouble codes if the fuel level is less than approximately 15 percent of its rated capacity. It is also used to send a signal for fuel gauge operation via the CCD bus circuits.

HEATED OXYGEN SENSOR (O2S SENSOR)—PCM INPUT

As vehicles accumulate mileage, the catalytic convertor deteriorates. The deterioration results in a less efficient catalyst. To monitor catalytic convertor deterioration, the fuel injection system uses two heated oxygen sensors. One sensor upstream of the catalytic convertor, one downstream of the convertor. The PCM compares the reading from the sensors to calculate the catalytic convertor 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 O2S sensors produce voltages from 0 to 1 volt, depending upon the oxygen content of the exhaust gas in the exhaust manifold. When a large amount of oxygen is present (caused by a lean air/fuel mixture), the sensors produces a low voltage. When there is a lesser amount present (rich air/fuel mixture) it produces a higher voltage. By monitoring the oxygen content and converting it to electrical voltage, the sensors act as a rich- lean switch.

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

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

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

UPSTREAM 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. 11).

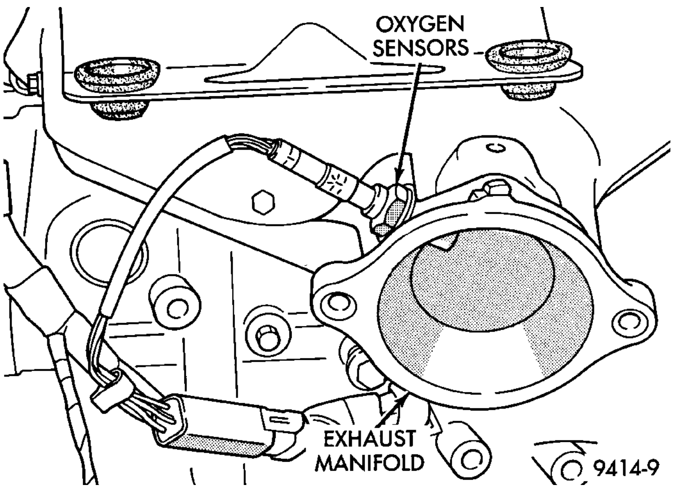


Fig. 11 Upstream Heated Oxygen Sensor

DOWNSTREAM OXYGEN SENSOR

The downstream heated oxygen sensor threads into the outlet pipe at the rear of the catalytic convertor (Fig. 12). The downstream heated oxygen sensor input is used to detect catalytic convertor deterioration. As the convertor deteriorates, the input from the downstream sensor begins to match the upstream sensor input except for a slight time delay. By comparing the downstream heated oxygen sensor input to the input from the upstream sensor, the PCM calculates catalytic convertor efficiency.

IGNITION CIRCUIT SENSE—PCM INPUT

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

INTAKE 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.

As Intake Air temperature varies the Intake Air Temperature sensors resistance changes resulting in a different input voltage to the PCM.

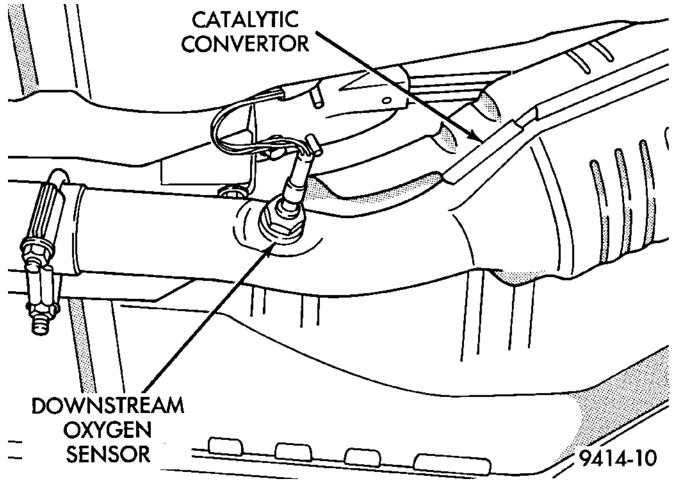


Fig. 12 Downstream Heated Oxygen Sensor

The IAT sensor and Manifold Absolute Pressure (MAP) switch are a combined into a single sensor that attachs to the intake manifold (Fig. 13) or (Fig. 14).

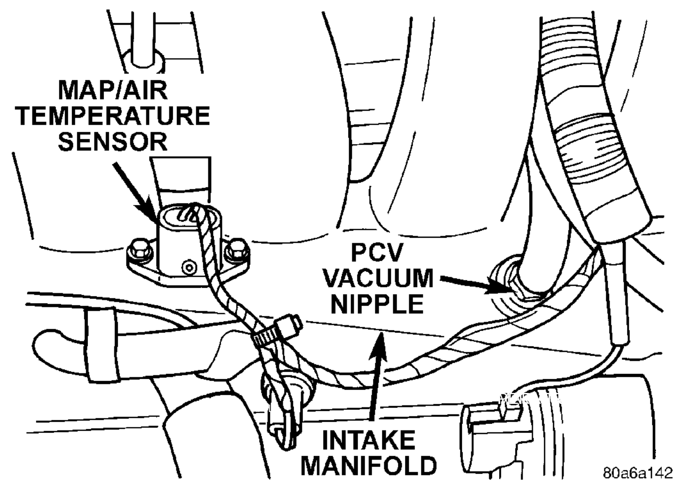


Fig. 13 / MAP/Intake Air Temperature Sensor—SOHC

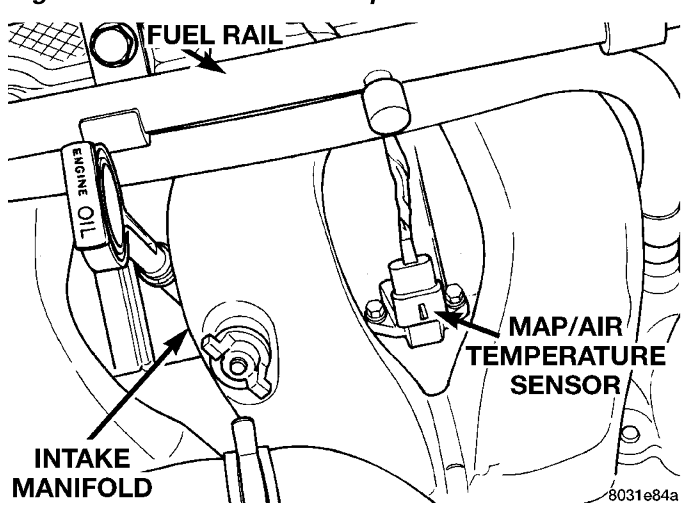


Fig. 14 MAP/Intake Air Temperature Sensor—DOHC

DESCRIPTION AND OPERATION (Continued)

KNOCK SENSOR—PCM INPUT

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.

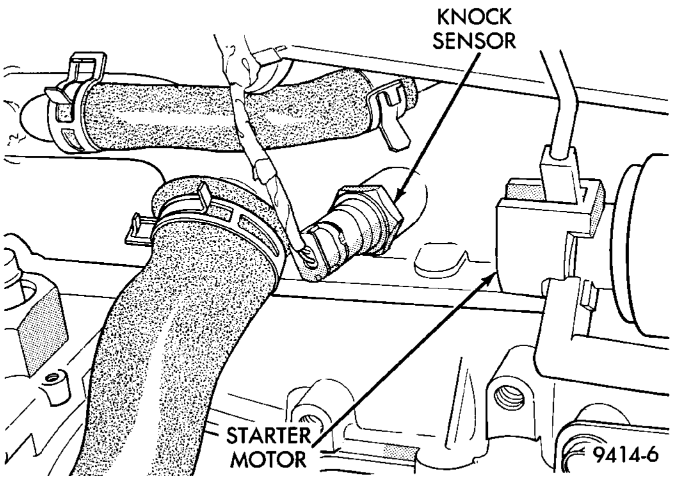


Fig. 15 Knock Sensor

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, 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/Intake Air Temperature sensor mounts to the intake manifold (Fig. 13) and (Fig. 14).

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 2758 kPa (400 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.

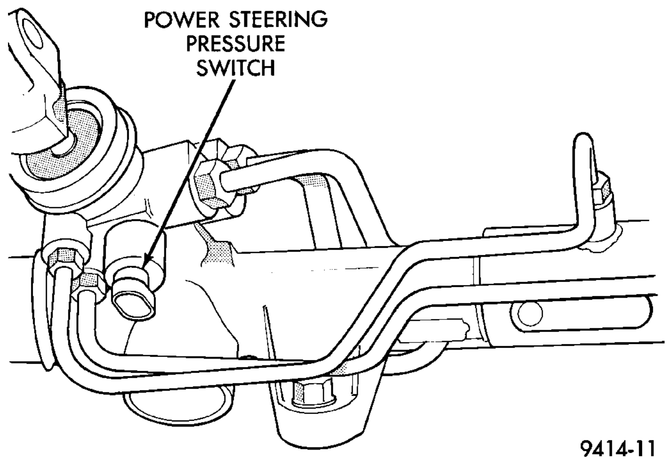


Fig. 16 Power Steering Pressure Switch

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.

DESCRIPTION AND OPERATION (Continued)

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.

PARK/NEUTRAL POSITION SWITCH—PCM INPUT

The park/neutral position switch is located on the automatic transaxle housing (Fig. 17). Manual transaxles do not use park/neutral switches. The switch provides an input to the PCM to indicate whether the automatic transaxle is in Park/Neutral, or a drive gear selection. This input is used to determine idle speed (varying with gear selection) and ignition timing advance. The park/neutral input is also used to cancel vehicle speed control. The park/neutral switch is sometimes referred to as the neutral safety switch.

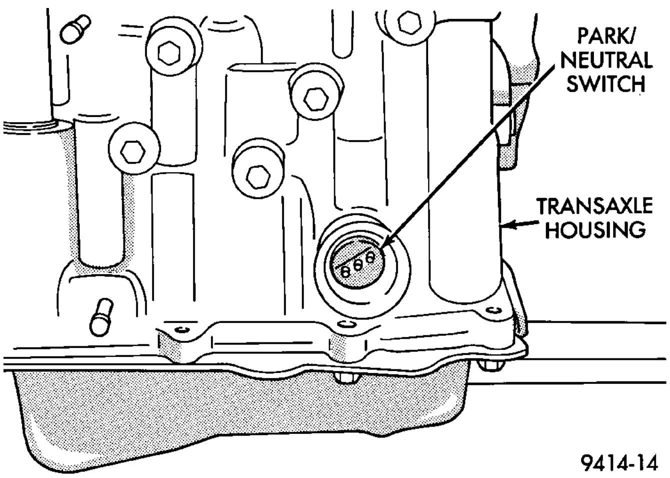


Fig. 17 Park/Neutral Switch

THROTTLE POSITION SENSOR—PCM INPUT

The throttle position sensor mounts to the side of the throttle body (Fig. 18) and (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 powertrain control module) represents throttle blade position. The TPS output voltage to the PCM varies from approximately 0.35 to 1.03 volts at minimum throttle opening (idle) to a maximum of 3.1 to 4.0 volts at wide open throttle.

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

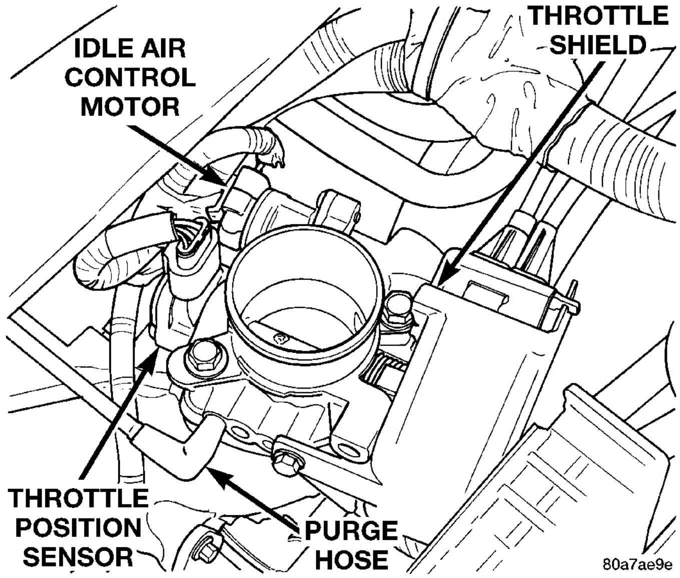


Fig. 18 Throttle Position Sensor and Idle Air Control Motor—SOHC

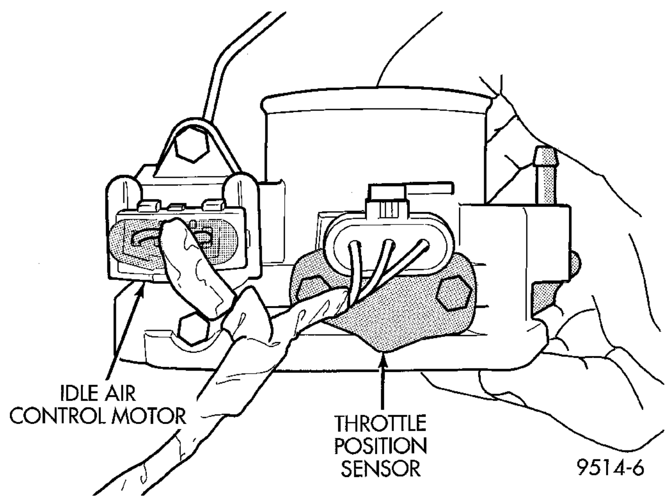


Fig. 19 Throttle Position Sensor and Idle Air Control Motor—DOHC

DESCRIPTION AND OPERATION (Continued)

VEHICLE SPEED SENSOR—PCM INPUT

The vehicle speed sensor is located in the transmission extension housing (Fig. 20) and (Fig. 21). The sensor input is used by the PCM to determine vehicle speed and distance traveled.

The vehicle speed sensor generates 8 pulses per sensor revolution. These signals, in conjunction with a closed throttle signal from the throttle position sensor, indicate a closed throttle deceleration to the PCM. Under deceleration conditions, the PCM adjusts the Idle Air Control (IAC) motor to maintain a desired MAP value.

When the vehicle is stopped at idle, a closed throttle signal is received by the PCM (but a speed sensor signal is not received). Under idle conditions, the PCM adjusts the IAC motor to maintain a desired engine speed.

The vehicle speed sensor signal is also used to operate the following functions or systems:

- Speedometer
- Speed control
- Daytime Running Lights (Canadian Vehicles only).

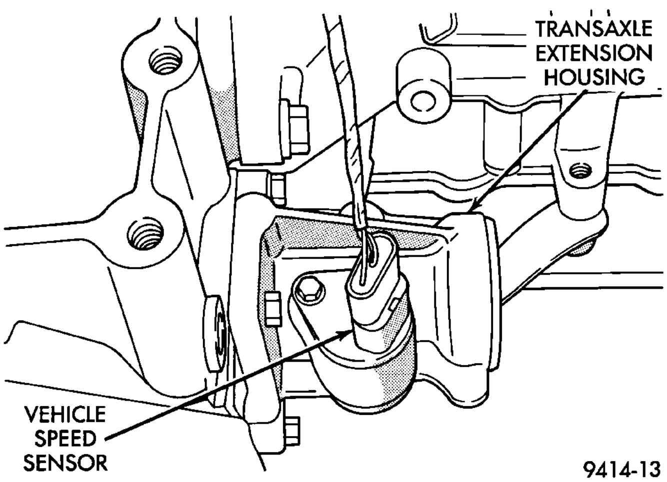


Fig. 20 Vehicle Speed Sensor—Automatic Transmission

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.

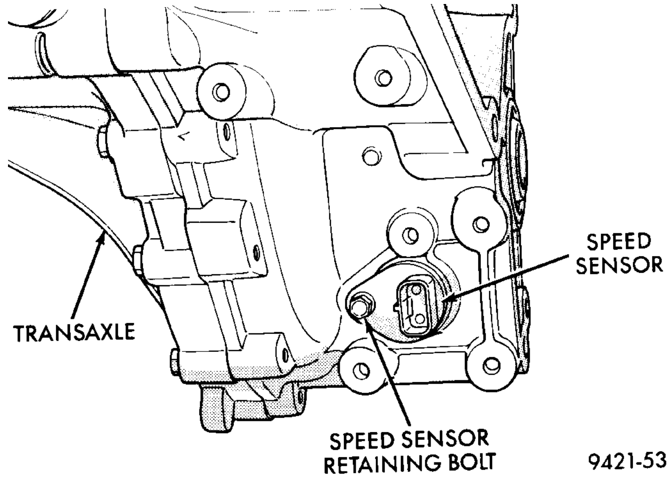


Fig. 21 Vehicle Speed Sensor—Manual Transmission

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 automatic shutdown (ASD) relay supplies battery voltage to the fuel injectors, electronic ignition coil and the heating elements in the oxygen sensors.

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.

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

CHARGING SYSTEM INDICATOR LAMP—PCM OUTPUT

The PCM turns the instrument panel Charging System Lamp on. Refer to Group 8C for charging system information.

DESCRIPTION AND OPERATION (Continued)

FUEL PUMP RELAY—PCM OUTPUT

The fuel pump relay supplies 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 fuel pump 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 Automatic Shutdown (ASD) relay. The fuse is located in the PDC. Refer to Group 8W, Wiring Diagrams for circuit information.

The PCM controls the fuel pump 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. When the ignition switch is in the On position, the PCM energizes the fuel pump. If the crankshaft position sensor does not detect engine rotation, the PCM de- energizes the relay after approximately one second.

The fuel pump relay is located in the PDC. 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. 22). To operate correctly, the solenoid must be installed with the electrical connector on top.

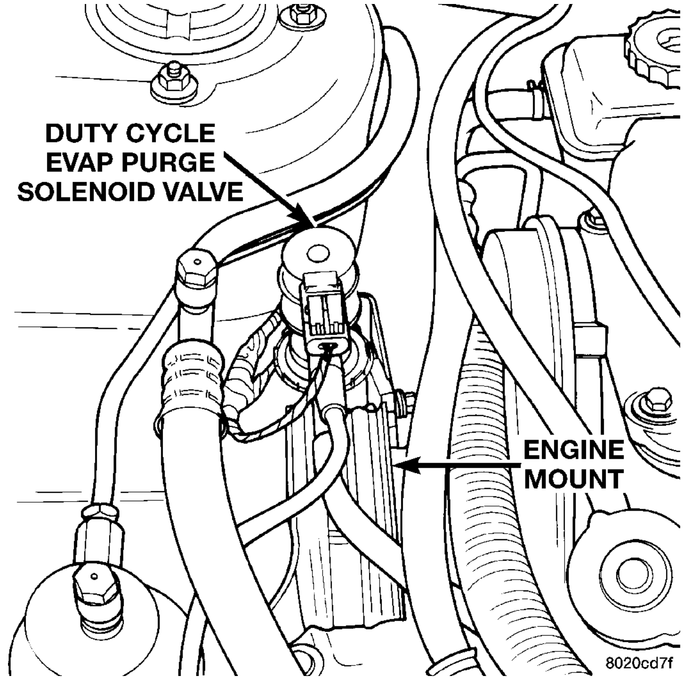


Fig. 22 Duty Cycle EVAP Purge Solenoid

ELECTRIC EGR TRANSDUCER—PCM OUTPUT

The Electric EGR Transducer contains an electrically operated solenoid and a back-pressure controlled vacuum transducer (Fig. 23). The PCM operates the solenoid based on inputs from the multiport fuel injection system. The transducer and EGR valve are serviced as an assembly.

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 transducer and EGR valve mount to the rear of the cylinder head (Fig. 23).

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.

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. 24). 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.

DESCRIPTION AND OPERATION (Continued)

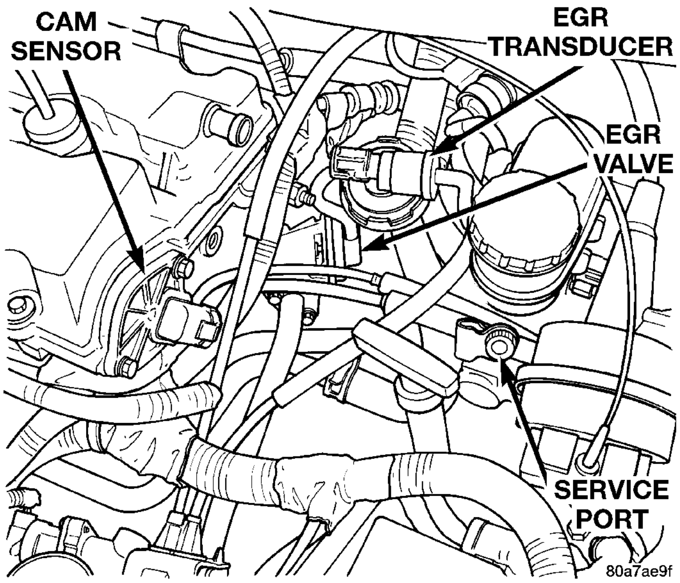


Fig. 23 Electric EGR Backpressure Transducer—Typical

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).

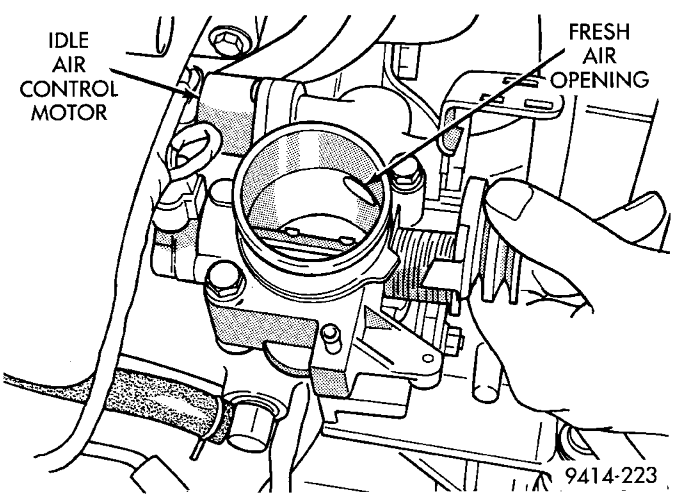


Fig. 24 Idle Air Control Motor Air Bypass Passage—Typical

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 the General Diagnosis section of this group. The data link connector is located inside the vehicle, under the instrument panel, left of the steering column (Fig. 25).

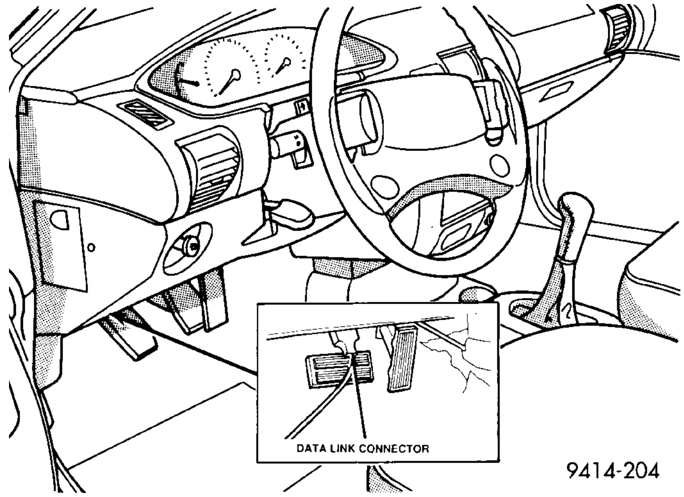


Fig. 25 Data Link Connector

FUEL INJECTORS—PCM OUTPUT

The 2.0L engine uses electrically operated top feed fuel injectors (Fig. 26). 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.

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.

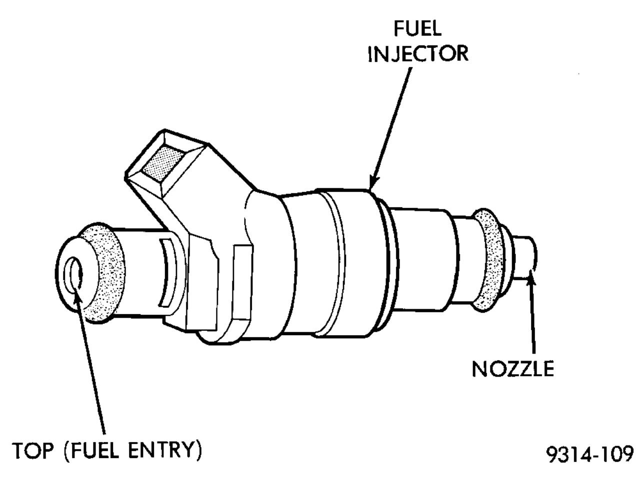


Fig. 26 Fuel Injector

DESCRIPTION AND OPERATION (Continued)

IGNITION COIL—PCM OUTPUT

The coil assembly consists of 2 coils molded together. The coil assembly is mounted over the valve cover (Fig. 27) or (Fig. 28). 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. Coil number one fires cylinders 1 and 4. Coil number two fires cylinders 2 and 3. The PCM determines which of the coils to charge and fire at the correct time.

The Auto 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 Auto Shutdown (ASD) Relay—PCM Output in this section for relay operation.

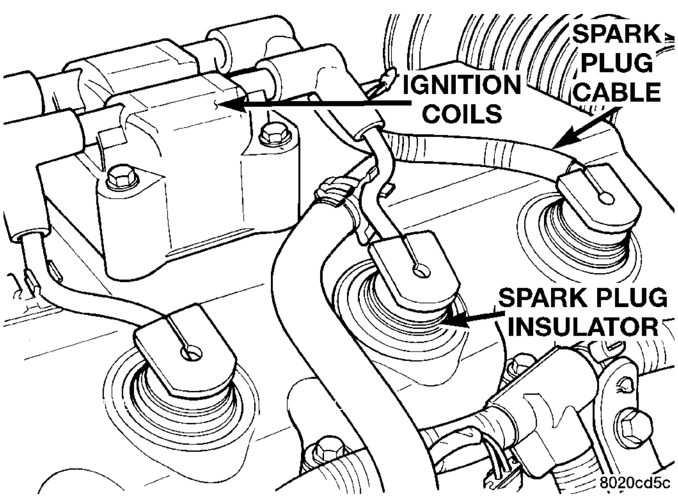


Fig. 27 Ignition Coil Pack—SOHC

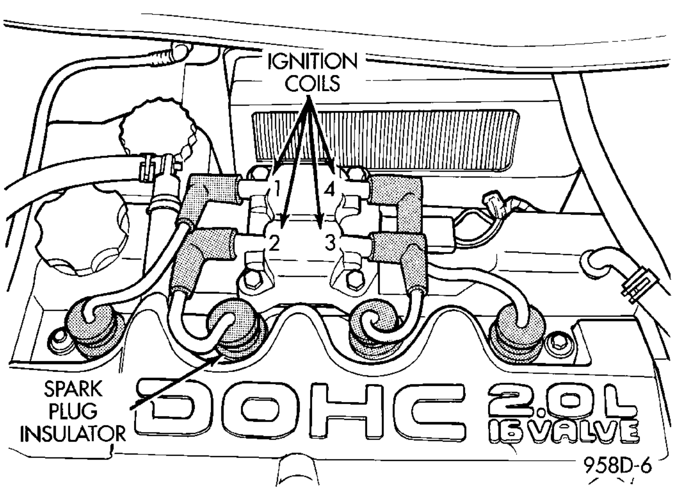


Fig. 28 Ignition Coil Pack—DOHC

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 Dianostics.

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

RADIATOR FAN CONTROL MODULE—PCM OUTPUT

The radiator fan runs when coolant temperature and A/C system pressure demand cooling. The radiator fan circuit contains a Pulse Width Module (PWM). Refer to the Group 8W for a circuit schematic.

A 5 volt signal is supplied to the PWM. The PCM provides a pulsed ground for the PWM. Depending upon the amount of pulse on time, the PWM puts out a proportional voltage to the fan motor at the lower speed. For instance, if the on time is 30 percent, then the voltage to the fan motor will be 3.6 volts.

When engine coolant reaches approximately 99°C (210°F) the PCM grounds the PWM relay. When the PCM grounds the relay it operates at a 30% duty cycle and immediately ramps up to 100% duty cycle. The PCM de-energizes the PWM relay when coolant temperature drops to approximately 93°C (199°F).

Also, when the air conditioning pressure switch closes, the PCM grounds the PWM. The air conditioning switch closes at 285 psi ±10 psi. When air

DESCRIPTION AND OPERATION (Continued)

conditioning pressure drops approximately 40 psi, the pressure switch opens and the fan turns off.

The PWM relay is located on the left front inner frame just behind the radiator.

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.

TACHOMETER—PCM OUTPUT

The PCM operates the tachometer on the instrument panel. The PCM calculates engine RPM from the crankshaft position sensor input.

TORQUE CONVERTOR CLUTCH SOLENOID—PCM OUTPUT

Three-speed automatic transaxles use a torque converter clutch solenoid. The PCM controls the engagement of the torque converter clutch through the solenoid (Fig. 29). The torque converter clutch is engaged up only in direct drive mode. Refer to Group 21 for transmission information.

DIAGNOSIS AND TESTING

VISUAL INSPECTION—SOHC

Before diagnosing or servicing the fuel injection system, perform a visual inspection for loose, disconnected, or misrouted wires and hoses (Fig. 30). A thorough visual inspection that includes the following checks saves unnecessary test and diagnostic time.

(1) Inspect the battery connections. Clean corroded terminals (Fig. 31).

(2) Check the 2 PCM 40-way connector for stretched wires on pushed out terminals (Fig. 31).

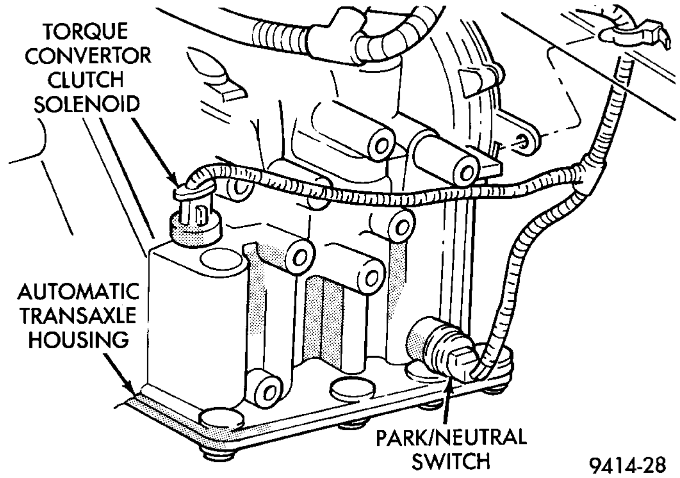


Fig. 29 Torque Convertor Clutch Solenoid

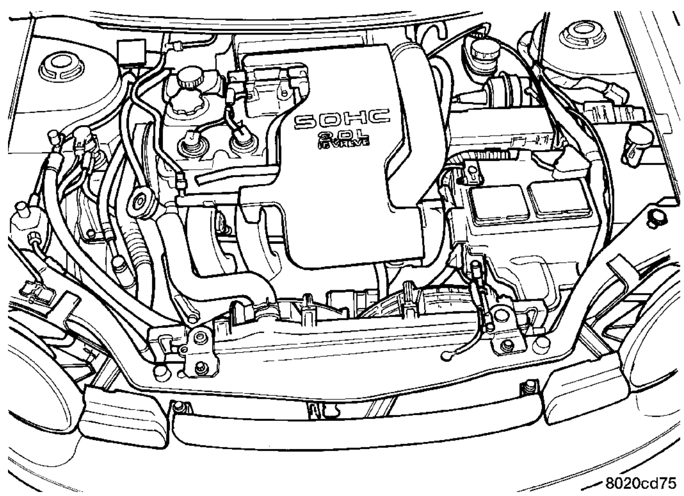


Fig. 30 2.0L SOHC Engine Compartment

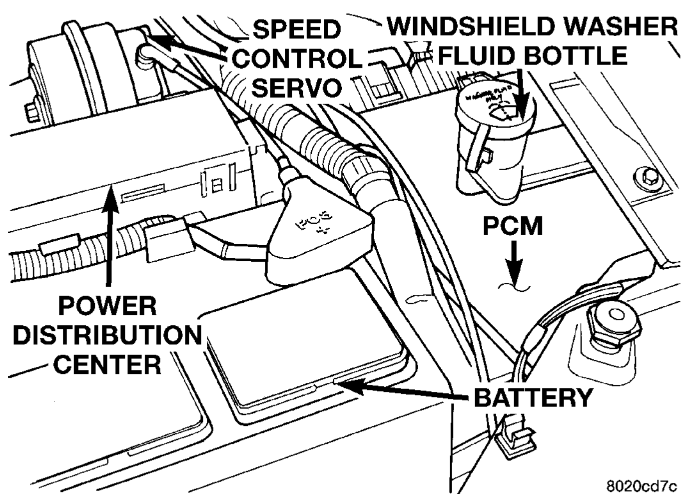


Fig. 31 Battery, PCM, and PDC

DIAGNOSIS AND TESTING (Continued)

(3) Open the Power Distribution Center (PDC). Check for blown fuses. Ensure the relays and fuses are fully seated in the PDC (Fig. 32). A label on the underside of the PDC cover shows the locations of each relay and fuse.

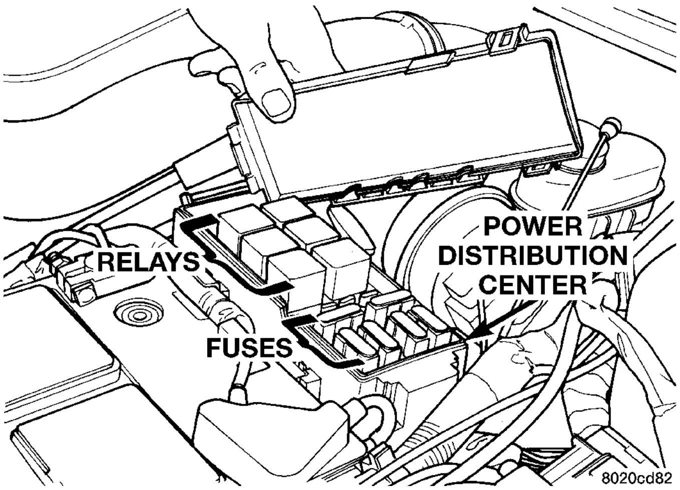


Fig. 32 Power Distribution Center

(4) Verify the throttle cable operates freely (Fig. 33).

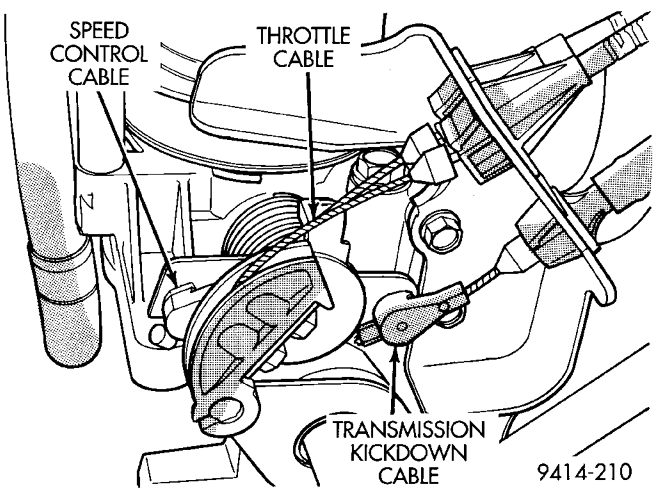


Fig. 33 Throttle Cable—Automatic Transmission

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

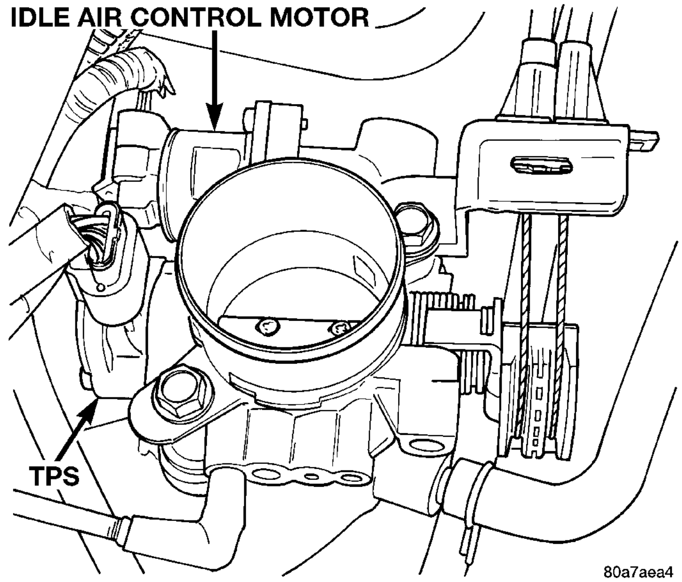


Fig. 34 Idle Air Control Motor and Throttle Position Sensor—Typical

(6) Check hose connections between the PCV valve, vacuum port - intake manifold and the oil separator (Fig. 35).

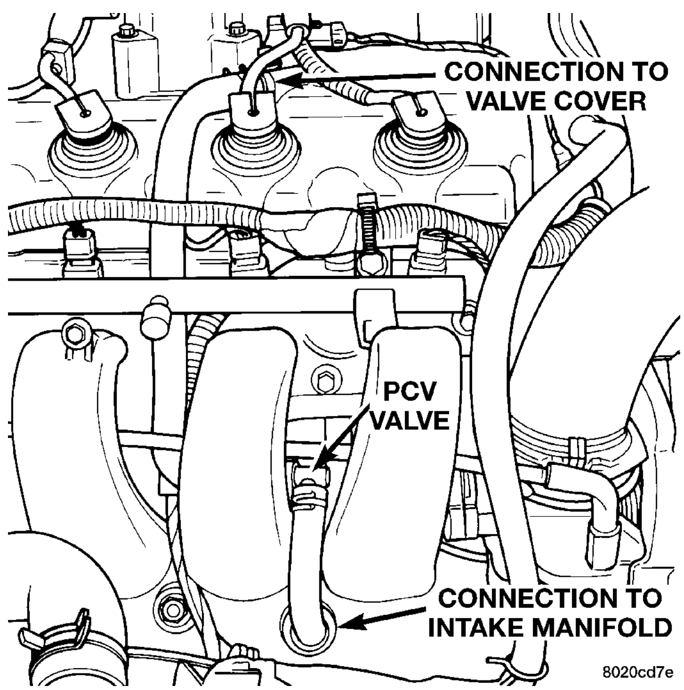


Fig. 35 PCV Valve

DIAGNOSIS AND TESTING (Continued)

(7) Inspect the electrical connections at the MAP sensor/intake air temperature sensor and the (Fig. 36).

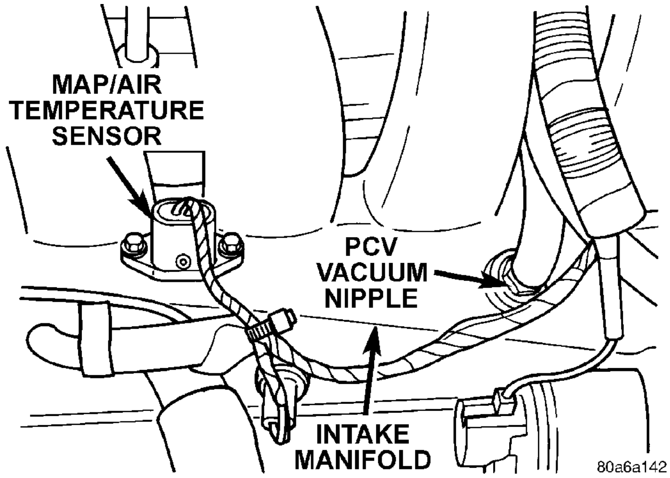


Fig. 36 MAPIntake Air Temperature Sensor

(8) Inspect the fuel injector electrical connections (Fig. 37).

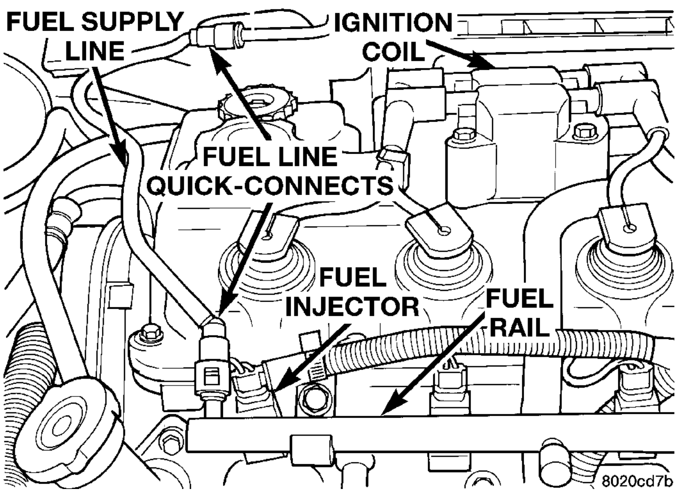


Fig. 37 Fuel Injectors

(9) Inspect the ignition coil electrical connector. Ensure the spark plug insulators are firmly seated over the spark plugs (Fig. 38).

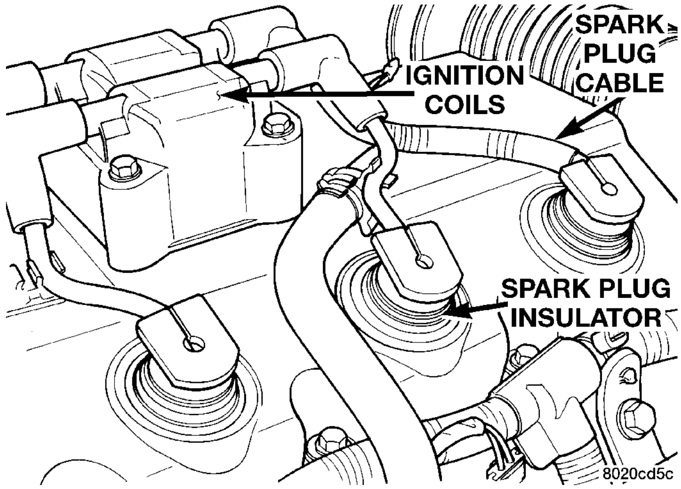


Fig. 38 Ignition Coil and Spark Plugs—Typical

(10) Inspect the electrical and hose connections at the duty cycle purge solenoid (Fig. 39).

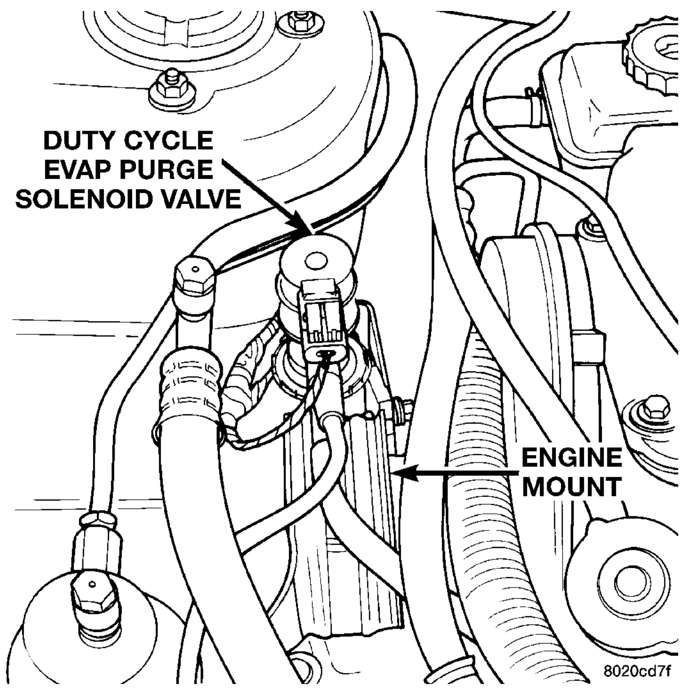


Fig. 39 Duty Cycle Purge Solenoid

DIAGNOSIS AND TESTING (Continued)

(11) Check the electrical connection to the radiator fan.

(12) Inspect for corrosion on the electrical connections at the starter motor solenoid. Check the ground cable connection below the starter motor (Fig. 40).

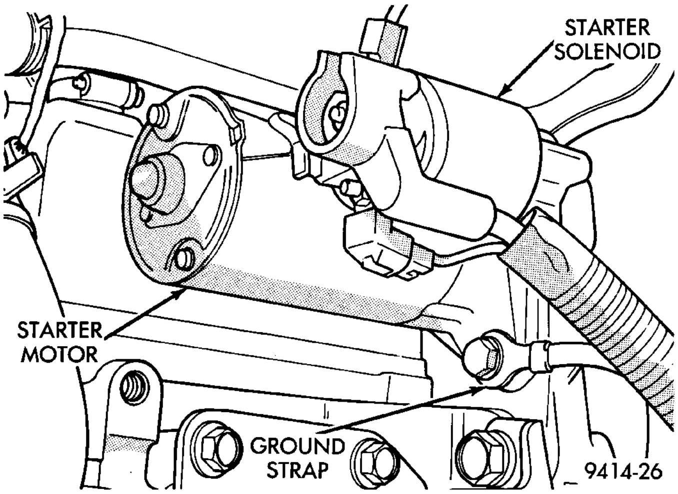


Fig. 40 Starter Motor and Ground Strap

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

(14) Check the electrical connection at the knock sensor (Fig. 41).

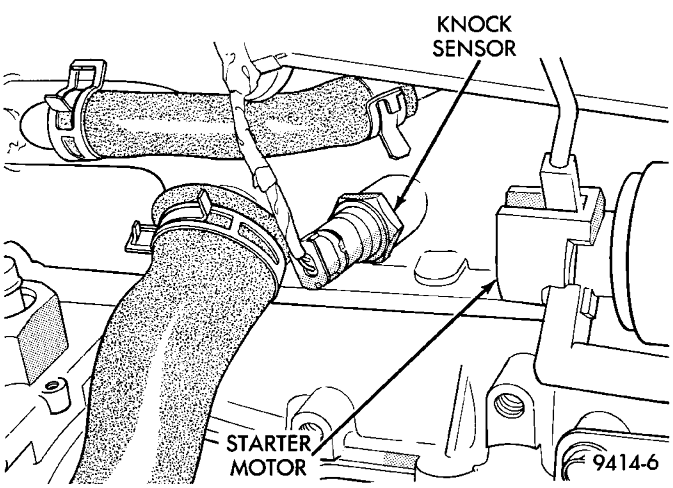


Fig. 41 Knock Sensor

(15) Check the electrical connections at the camshaft position sensor and engine coolant temperature sensor (Fig. 42).

(16) Check the electrical connector at the Electronic EGR Transducer. Inspect the vacuum and back pressure hoses at the solenoid and transducer for leaks (Fig. 43).

(17) Inspect the electrical connections at the generator (Fig. 44). Check the generator belt for glazing or damage.

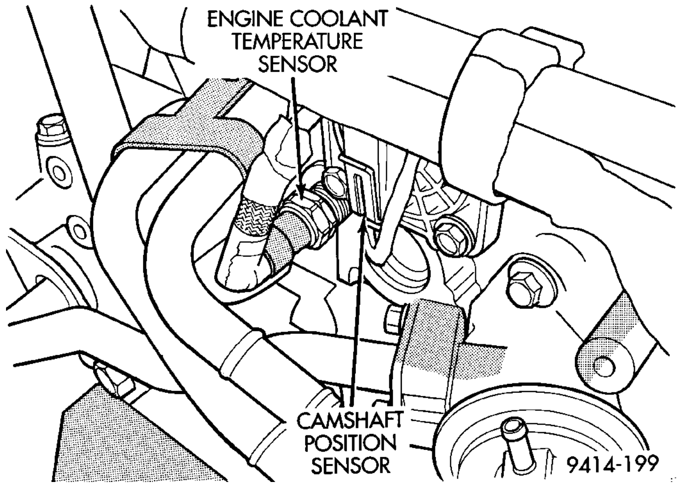


Fig. 42 Camshaft Position Sensor and Engine Coolant Temperature Sensor

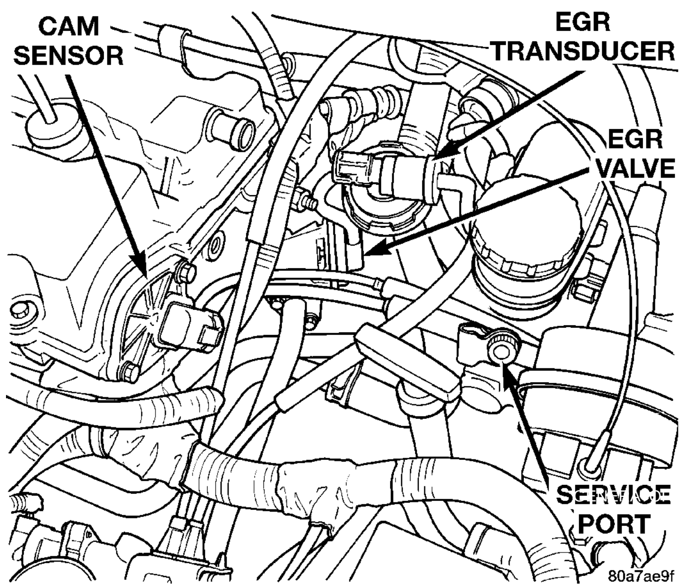


Fig. 43 Electronic EGR Transducer

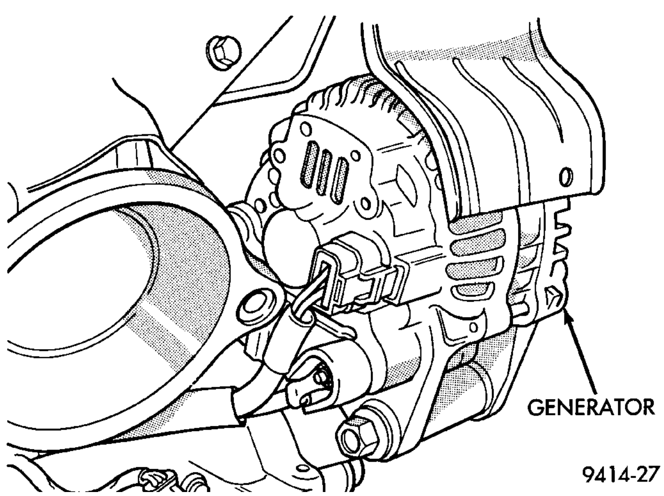


Fig. 44 Generator

DIAGNOSIS AND TESTING (Continued)

(18) Inspect the electrical connector at the crankshaft position sensor (Fig. 45).

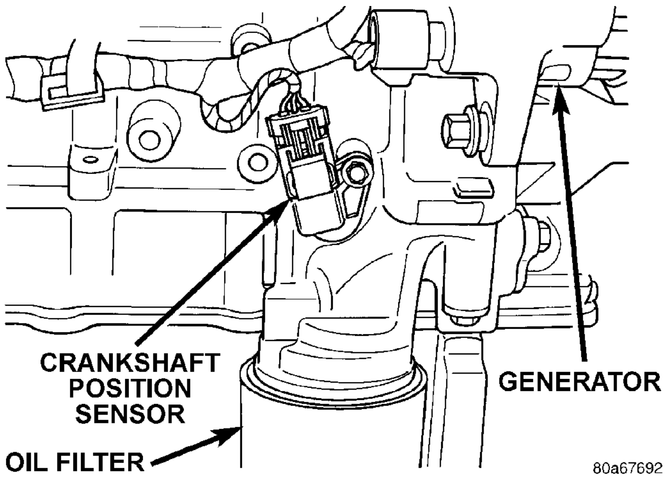


Fig. 45 Crankshaft Position Sensor

(19) Check the electrical connection at the vehicle speed sensor (Fig. 46).

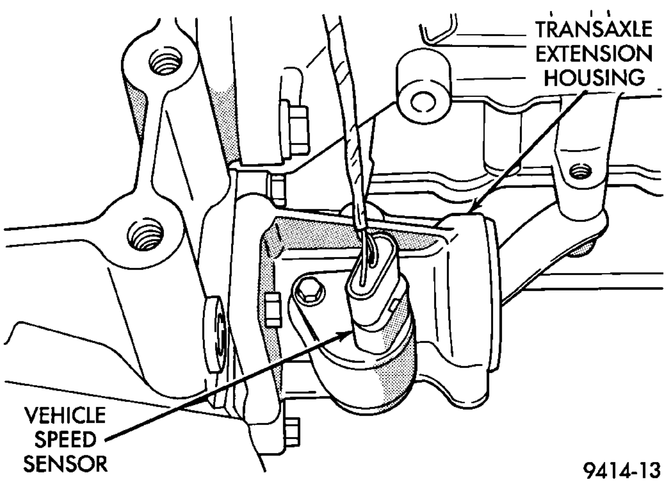


Fig. 46 Vehicle Speed Sensor

(20) Check the electrical connection at the power steering pressure switch on the power steering gear housing (Fig. 47).

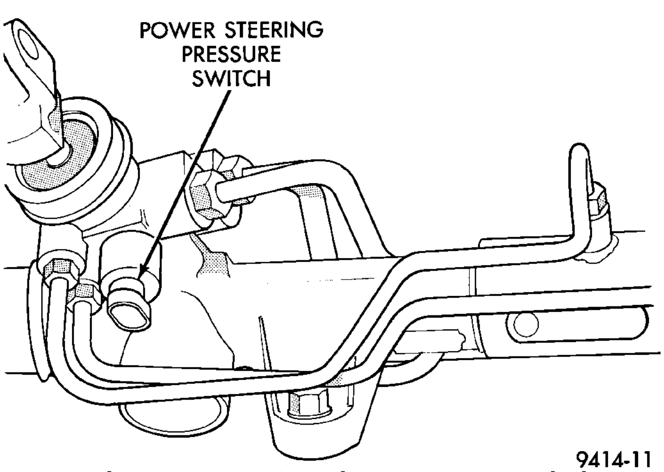


Fig. 47 Power Steering Pressure Switch

(21) On vehicles with automatic transaxles, check the electrical connections at the park/neutral switch and the torque convertor clutch solenoid (Fig. 48).

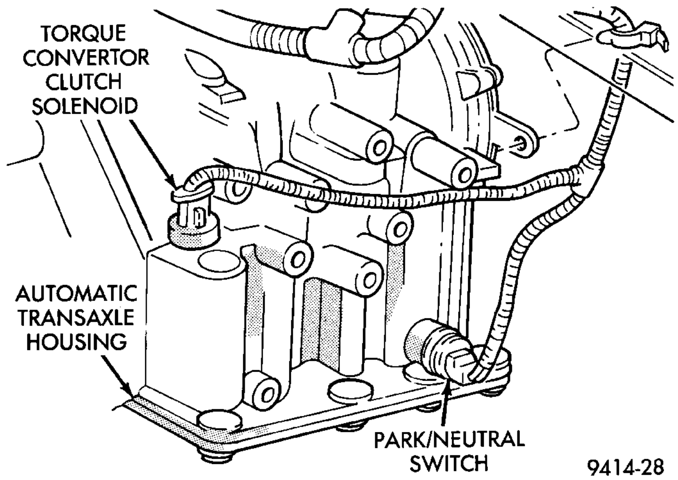


Fig. 48 Park/Neutral Switch and Torque Convertor Clutch Solenoid

(22) Inspect the electrical connections at the upstream and downstream heated oxygen sensors (Fig. 49) and (Fig. 50).

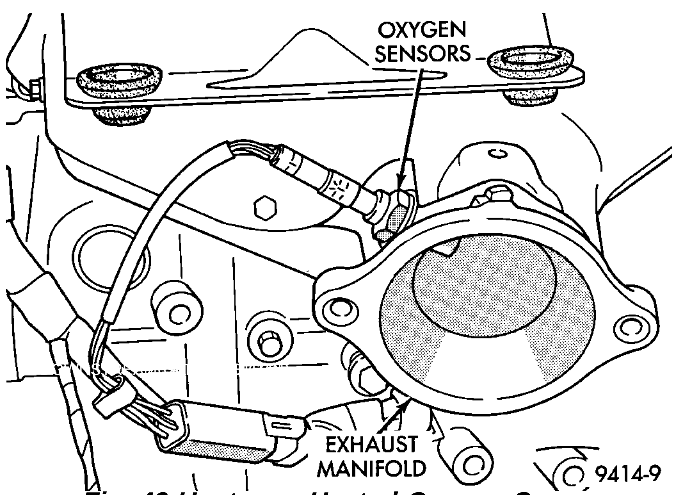


Fig. 49 Upstream Heated Oxygen Sensor

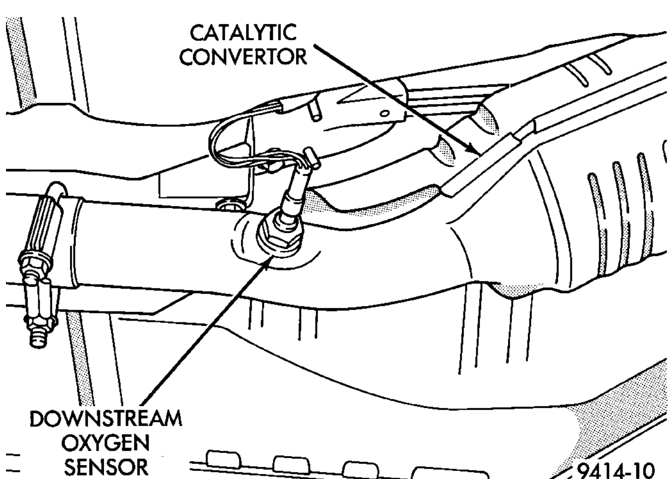


Fig. 50 Downstream Heated Oxygen Sensor

DIAGNOSIS AND TESTING (Continued)

(23) Inspect the fuel pump module electrical connection at the fuel tank for corrosion or damage (Fig. 51). Check for pinched, kinked or damaged fuel supply tube.

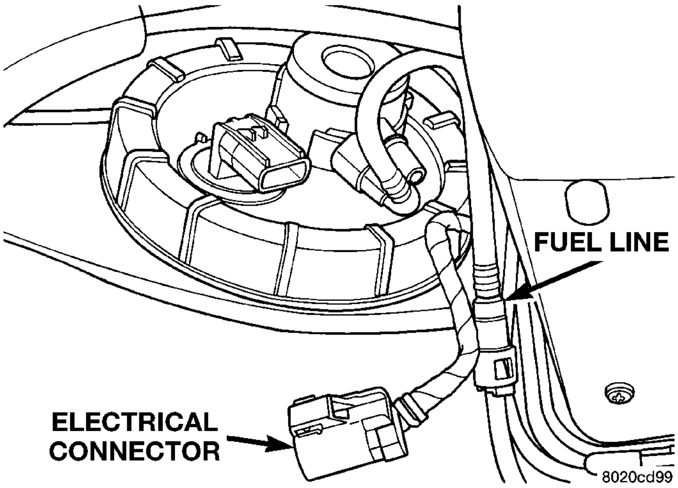


Fig. 51 Fuel Pump Module Electrical Connector

(24) Inspect the connections to the speed control servo, if equipped (Fig. 31). Refer to Group 8H, Vehicle Speed Control.

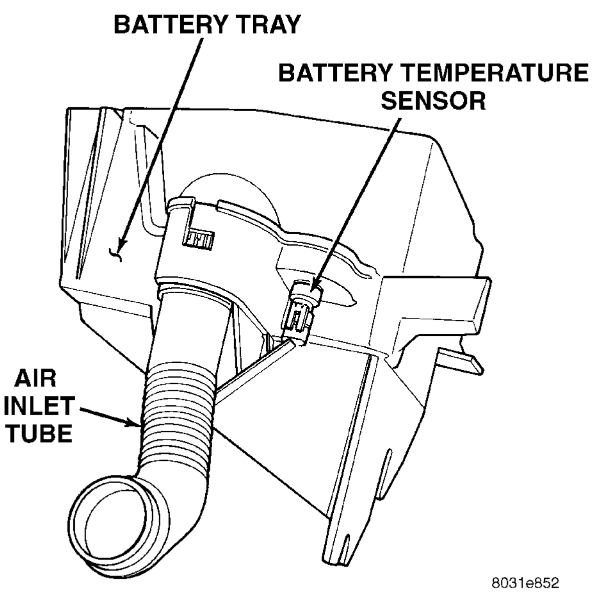


Fig. 52 Battery Temp. Sensor Connectors

(25) Inspect the connection at the battery temperature sensor (Fig. 52).

VISUAL INSPECTION—DOHC

Before diagnosing or servicing the fuel injection system, perform a visual inspection for loose, disconnected, or misrouted wires and hoses (Fig. 53). A thorough visual inspection that includes the following checks saves unnecessary test and diagnostic time.

(1) Inspect the battery connections. Clean corroded terminals (Fig. 31).

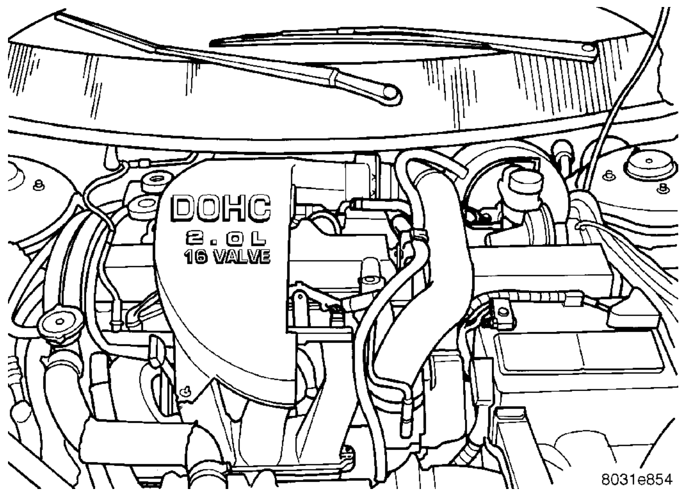


Fig. 53 2.0L DOHC Engine Compartment

(2) Check the 2 PCM 40-way connector for stretched wires on pushed out terminals (Fig. 54).

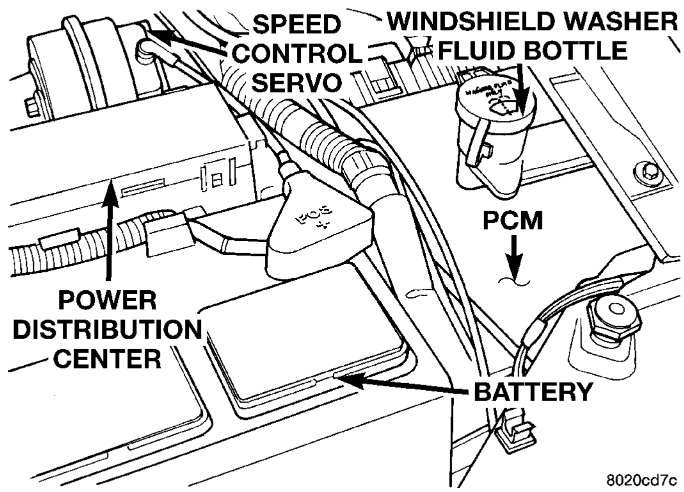


Fig. 54 Battery, PCM, and PDC

(3) Open the Power Distribution Center (PDC). Check for blown fuses. Ensure the relays and fuses are fully seated in the PDC (Fig. 55). A label on the underside of the PDC cover shows the locations of each relay and fuse.

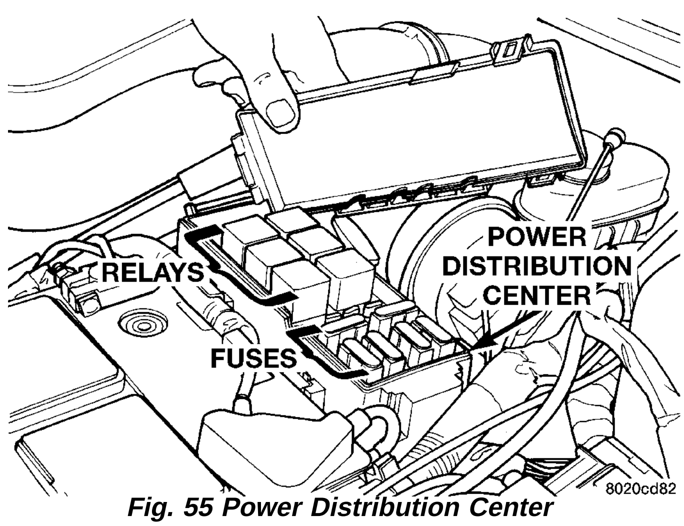


Fig. 55 Power Distribution Center

DIAGNOSIS AND TESTING (Continued)

(4) Verify the throttle cable operates freely (Fig. 56).

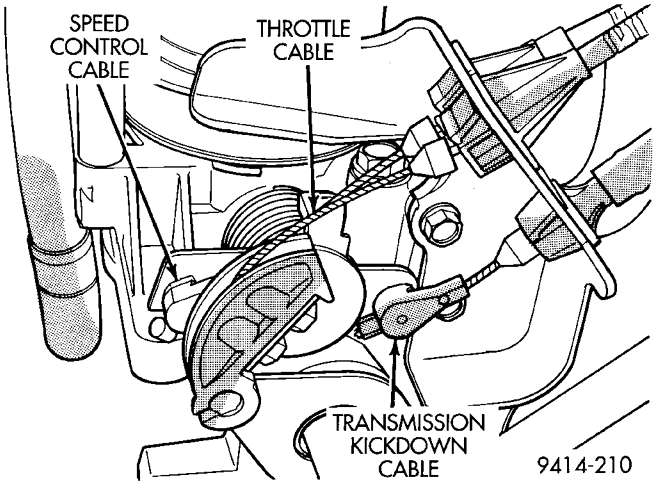


Fig. 56 Throttle Cable—Automatic Transmission

(5) Check the electrical connections at the idle air control motor and throttle position sensor (Fig. 57).

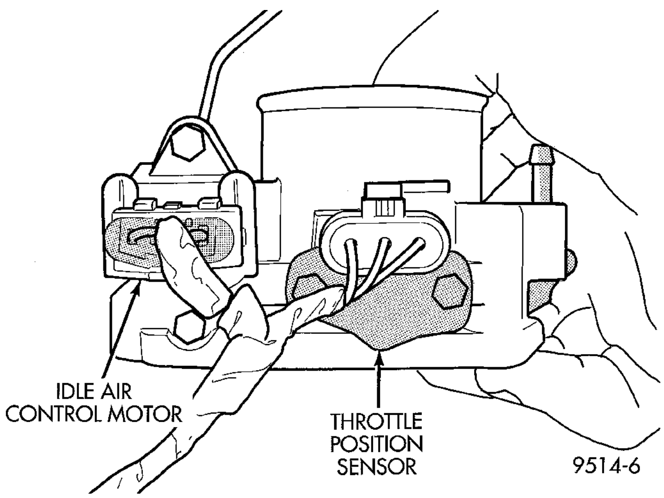


Fig. 57 Idle Air Control Motor and Throttle Position Sensor—Typical

(6) Check hose connections between the PCV valve, vacuum port - intake manifold and the oil separator (Fig. 58).

(7) Inspect the electrical connections at the MAP sensor/intake air temperature sensor and the (Fig. 59).

(8) Inspect the fuel injector electrical connections (Fig. 60).

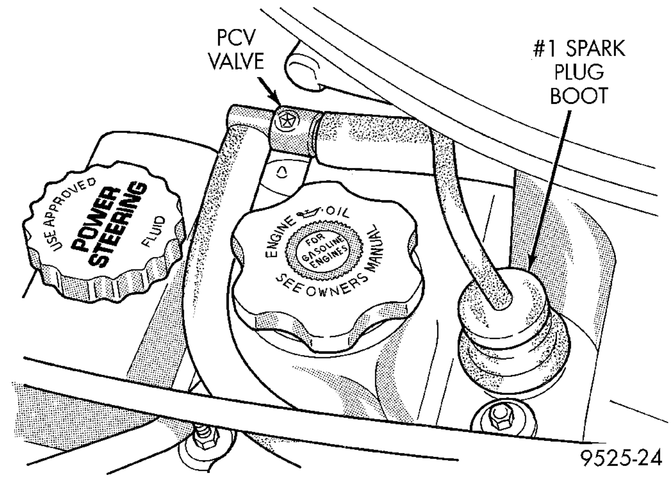


Fig. 58 PCV Valve

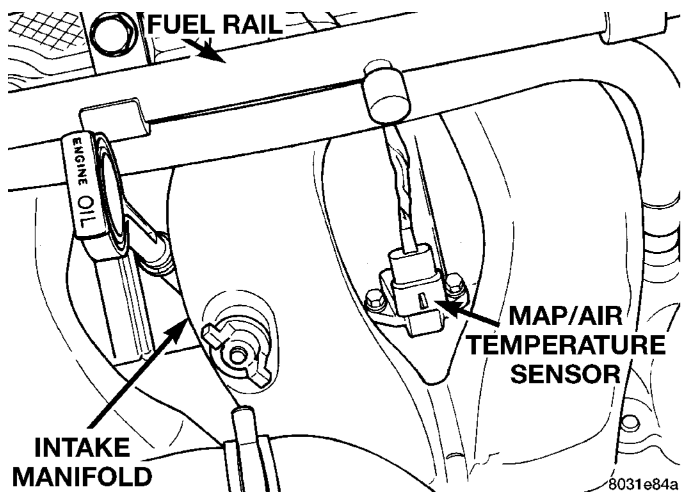


Fig. 59 MAP/Intake Air Temperature Sensor

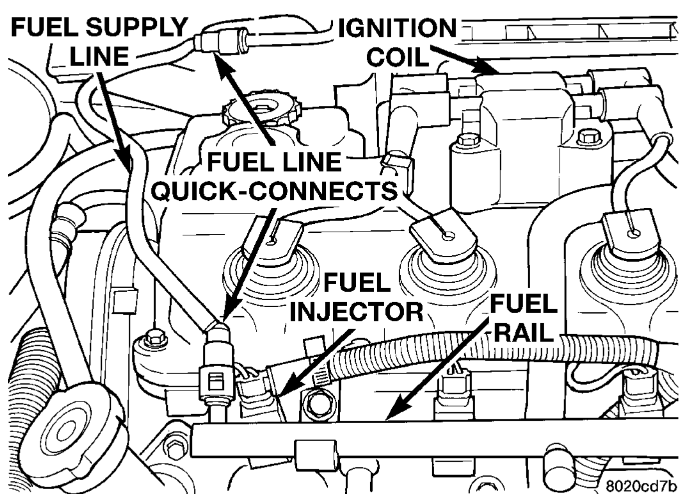


Fig. 60 Fuel Injectors—Typical

DIAGNOSIS AND TESTING (Continued)

(9) Inspect the ignition coil electrical connector. Ensure the spark plug insulators are firmly seated over the spark plugs (Fig. 61).

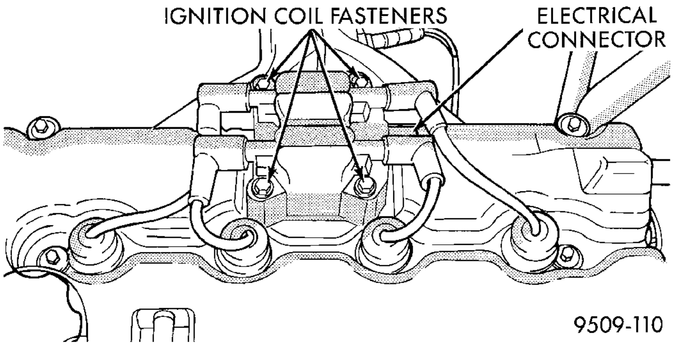


Fig. 61 Ignition Coil and Spark Plugs

(10) Inspect the electrical and hose connections at the duty cycle purge solenoid (Fig. 62).

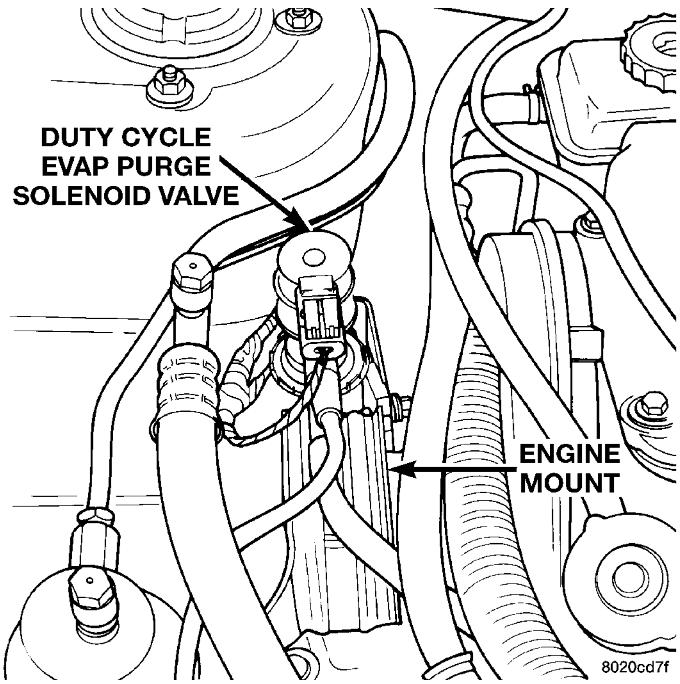


Fig. 62 Duty Cycle Purge Solenoid

(11) Check the electrical connection to the radiator fan.

(12) Inspect for corrosion on the electrical connections at the starter motor solenoid. Check the ground cable connection below the starter motor (Fig. 63).

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

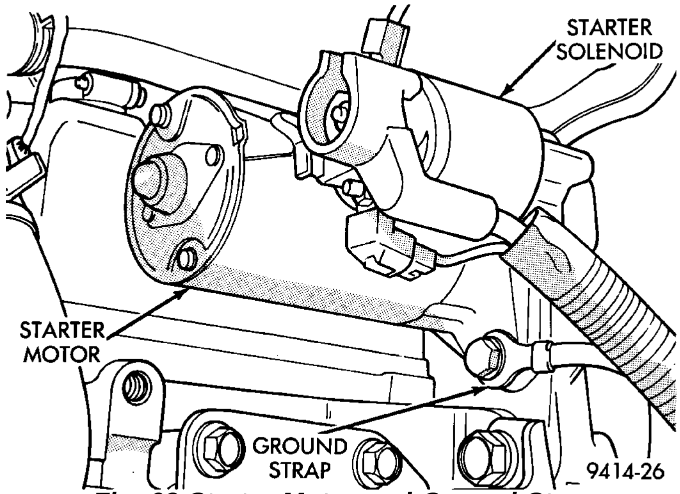


Fig. 63 Starter Motor and Ground Strap

(14) Check the electrical connection at the knock sensor (Fig. 64).

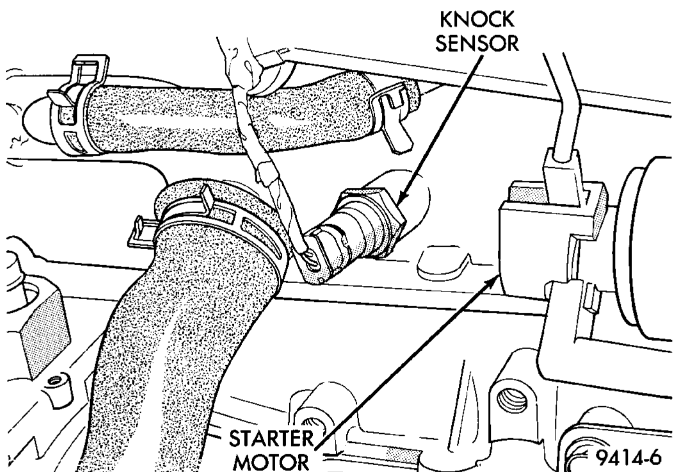


Fig. 64 Knock Sensor

(15) Check the electrical connections at the camshaft position sensor (Fig. 65) and engine coolant temperature sensor (Fig. 66).

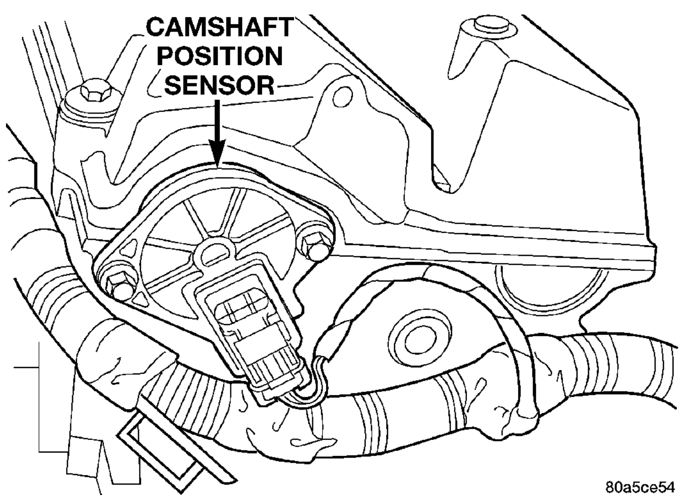


Fig. 65 Camshaft Position Sensor

DIAGNOSIS AND TESTING (Continued)

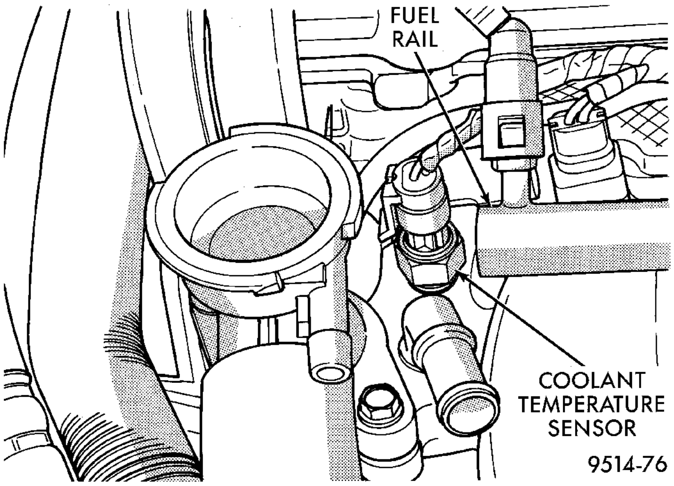


Fig. 66 Engine Coolant Temperature Sensor

(16) Check the electrical connector at the Electronic EGR Transducer. Inspect the vacuum and back pressure hoses at the solenoid and transducer for leaks (Fig. 67).

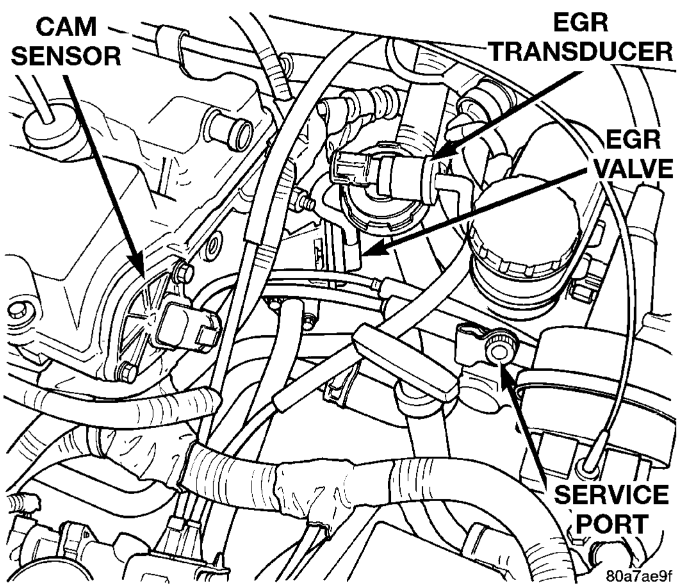


Fig. 67 Electronic EGR Transducer

(17) Inspect the electrical connections at the generator (Fig. 68). Check the generator belt for glazing or damage.

(18) Inspect the electrical connector at the crankshaft position sensor (Fig. 69).

(19) Check the electrical connection at the vehicle speed sensor (Fig. 70).

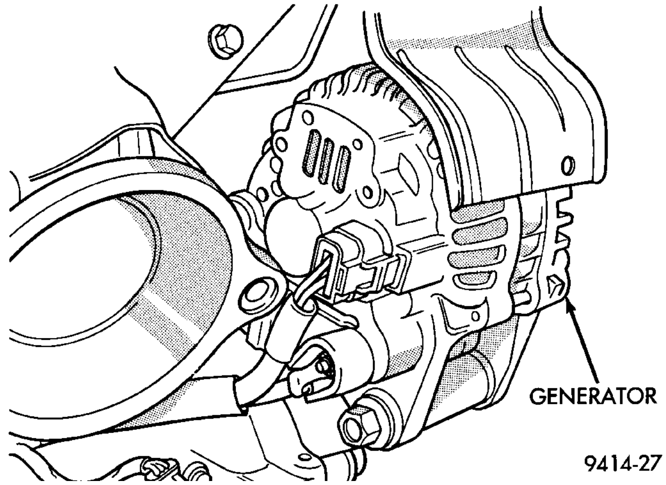


Fig. 68 Generator

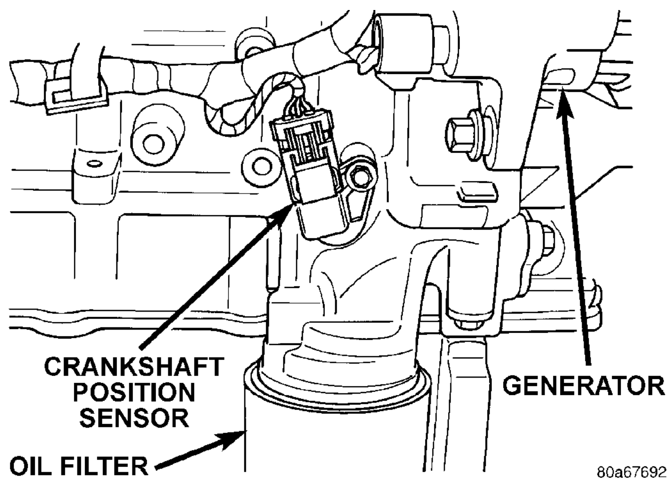


Fig. 69 Crankshaft Position Sensor

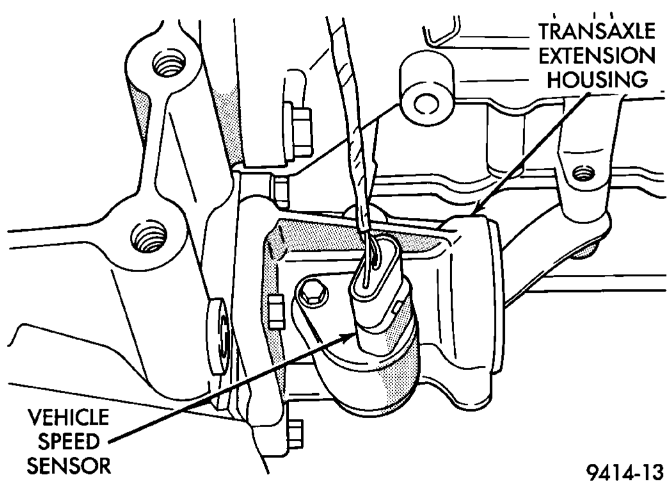


Fig. 70 Vehicle Speed Sensor

DIAGNOSIS AND TESTING (Continued)

(20) Check the electrical connection at the power steering pressure switch on the power steering gear housing (Fig. 71).

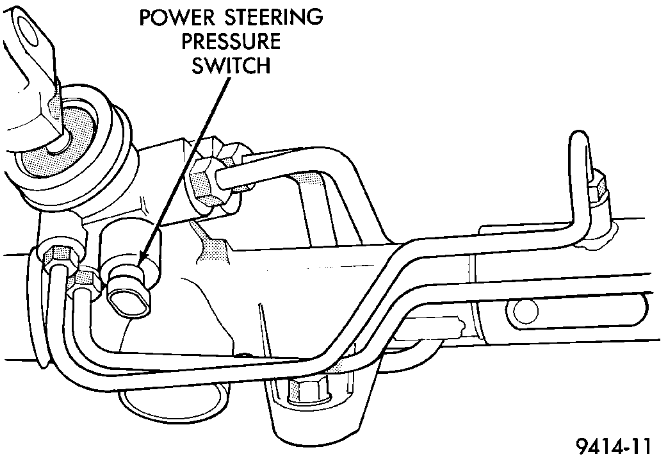


Fig. 71 Power Steering Pressure Switch

(21) On vehicles with automatic transaxles, check the electrical connections at the park/neutral switch and the torque convertor clutch solenoid (Fig. 72).

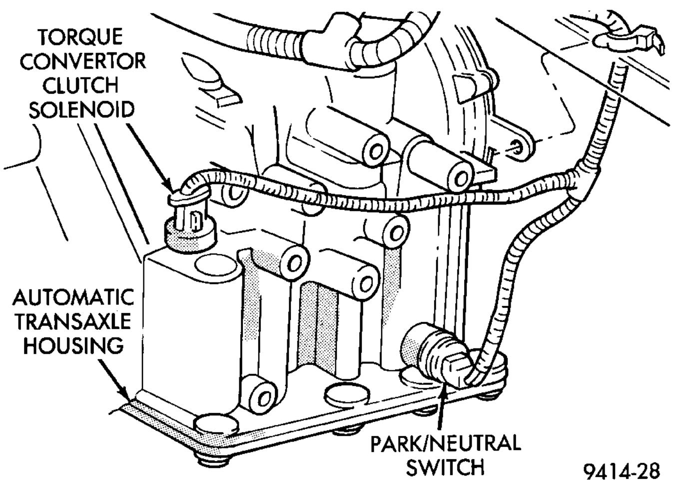


Fig. 72 Park/Neutral Switch and Torque Convertor Clutch Solenoid

(22) Inspect the electrical connections at the upstream and downstream heated oxygen sensors (Fig. 73) and (Fig. 74).

(23) Inspect the fuel pump module electrical connection at the fuel tank for corrosion or damage (Fig. 75). Check for pinched, kinked or damaged fuel supply tube.

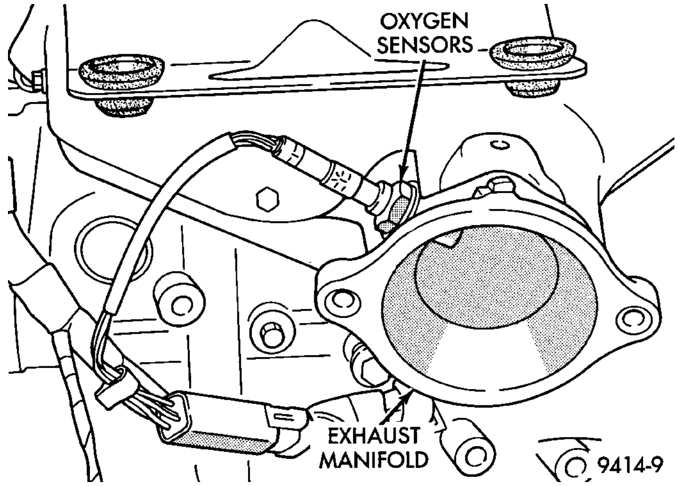


Fig. 73 Upstream Heated Oxygen Sensor

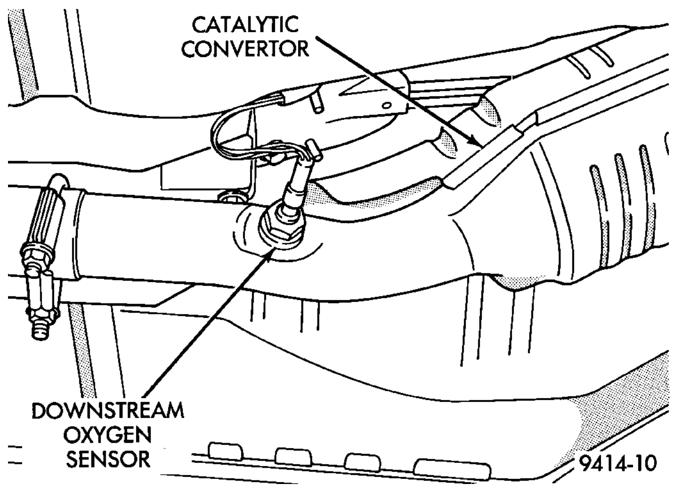


Fig. 74 Downstream Heated Oxygen Sensor

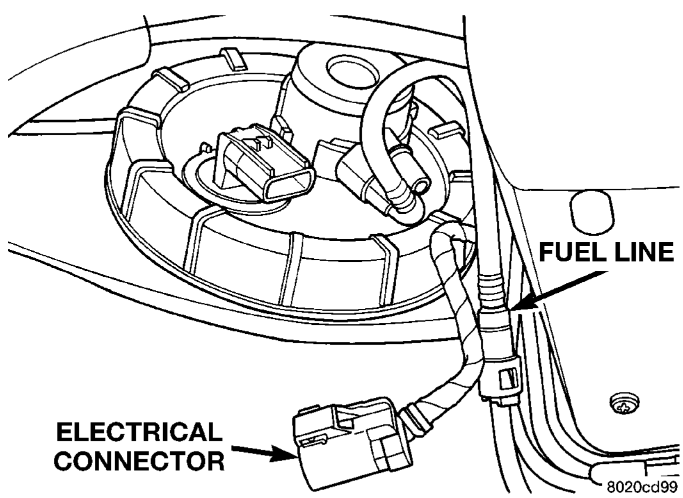


Fig. 75 Fuel Pump Module Electrical Connector

DIAGNOSIS AND TESTING (Continued)

(24) Inspect the connections to the speed control servo, if equipped (Fig. 54). Refer to Group 8H, Vehicle Speed Control.

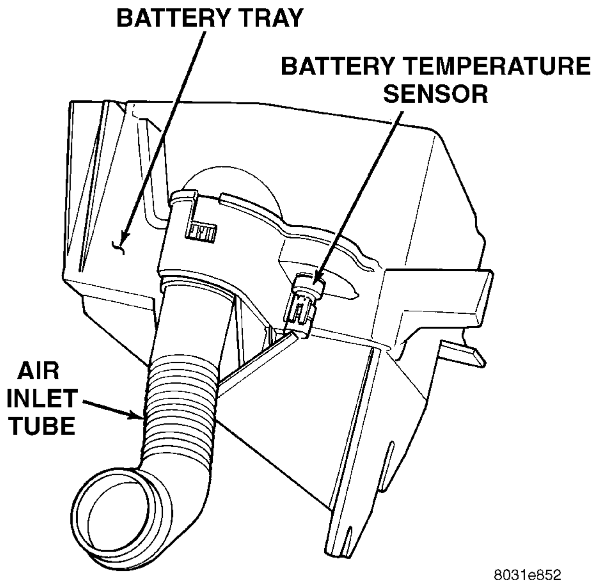
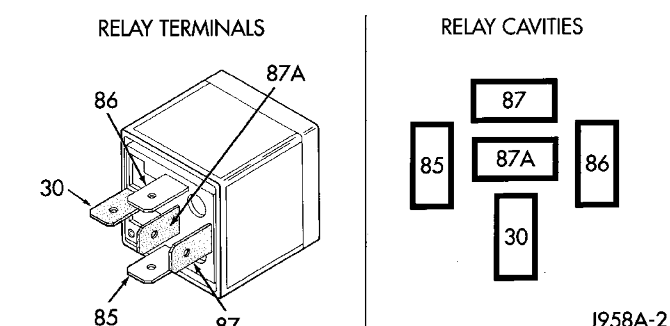


Fig. 76 Battery Temp. Sensor Connectors

(25) Inspect the connection at the battery temperature sensor (Fig. 76).

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. 77).



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

Fig. 77 ASD and Fuel Pump Relay Terminals

OPERATION

- Terminal number 30 is connected to battery voltage. For both the ASD relay and fuel pump relays, terminal 30 is connected to battery voltage at all times.
- The Powertrain Control Module (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 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. There is no wire or terminal in the cavity.
- When the PCM energies ASD and fuel pump relays energize, 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 of the relay. The resistance should be between 75 ±5 ohms.

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

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

(5) Connect one end of a jumper wire (16 gauge or heavier) 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 heavier) 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.

DIAGNOSIS AND TESTING (Continued)

ENGINE COOLANT TEMPERATURE SENSOR

(1) With the key off, disconnect wire harness connector from coolant temperature sensor (Fig. 78) or (Fig. 79).

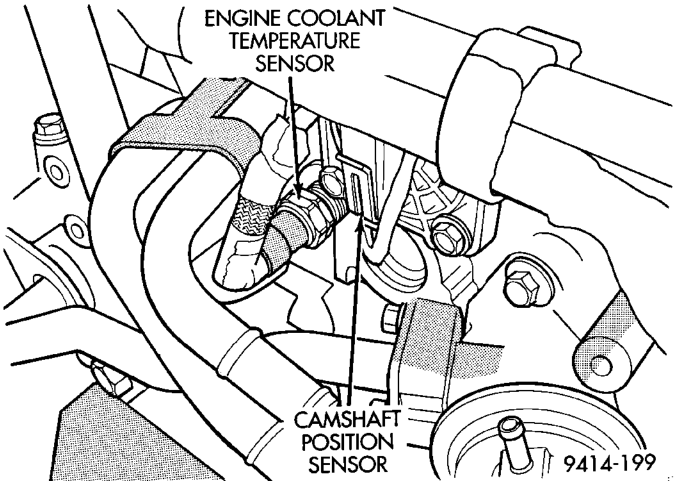


Fig. 78 Engine Coolant Temperature Sensor Location—SOHC

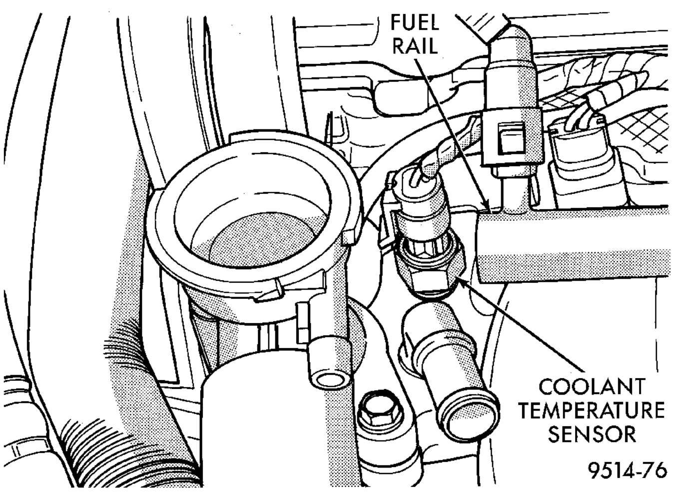


Fig. 79 Engine Coolant Temperature Sensor Location—DOHC

(2) Connect a high input impedance (digital) volt-ohmmeter to terminals A and B (Fig. 80). 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.

(3) Test the resistance of the wire harness between the PCM 60-way connector terminal 28 and the sensor harness connector. Also check for continuity between PCM 60-way connector terminal 51 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.

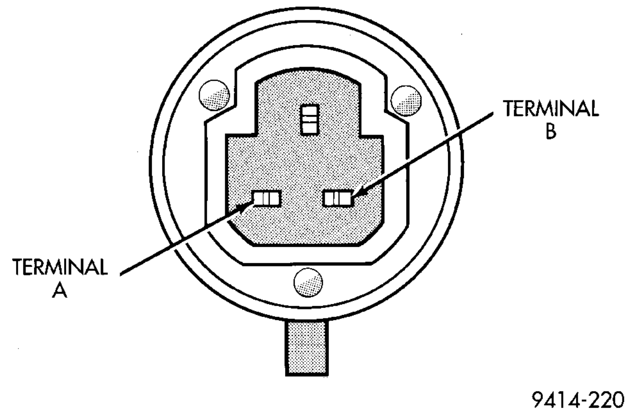


Fig. 80 Engine Coolant Temperature Sensor

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 preform 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 (MAP) 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:

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

(1) Test the MAP sensor output voltage at the MAP sensor connector between terminals 1 and 4 (Fig. 81). With the ignition switch ON and the engine not running, output voltage should be 4 to 5 volts.

DIAGNOSIS AND TESTING (Continued)

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.

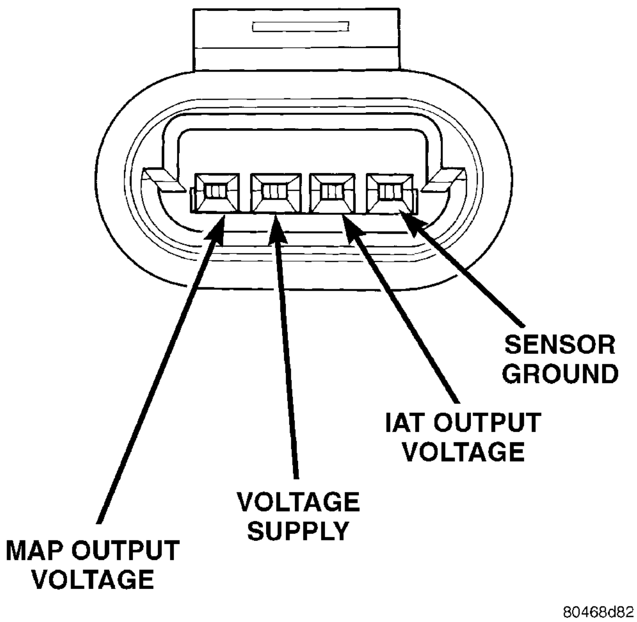


Fig. 81 MAP Sensor Connector

(2) Test PCM terminal 36 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 43. If OK, go to next step. If not OK, repair as required.

(4) Test MAP sensor supply voltage between sensor connector terminals 3 and 1 with the key ON. The voltage should be approximately 5 volts (±.5V). Five volts (±.5V) should also be at terminal 61 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 (DVM). The center terminal of the sensor is the output terminal. One of the other terminals is a 5 volt supply and the remaining terminal is ground.

Connect the DVM between the center and sensor ground terminal. Refer to Group 8W - Wiring Diagrams for correct pinout.

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 approximately 0.38 volts to 1.2 volts. At wide open throttle, TPS output voltage should be approximately 3.1 volts to 4.4 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 (Fig. 82). Cap the PCV vacuum nipple.

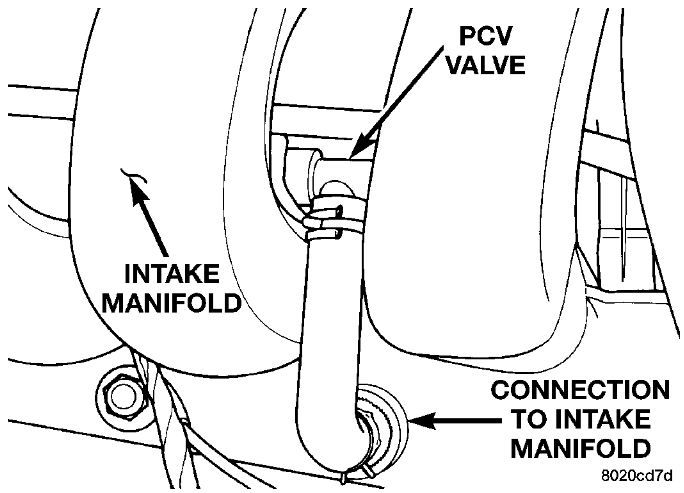


Fig. 82 PCV Vacuum Nipple

(3) Disconnect purge hose from the nipple on the throttle body (Fig. 83).

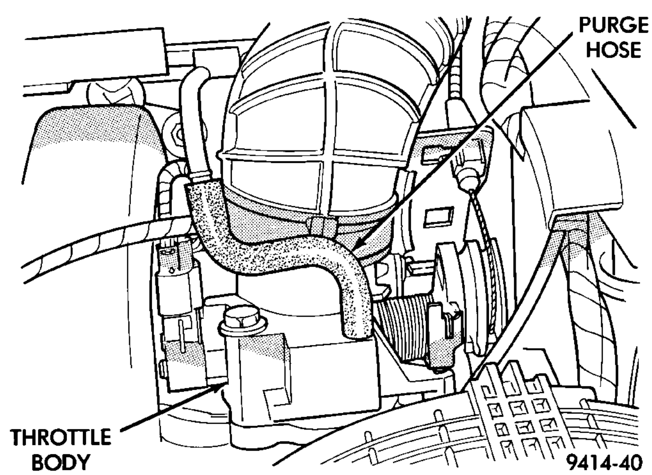


Fig. 83 Purge Hose

DIAGNOSIS AND TESTING (Continued)

(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. 84).

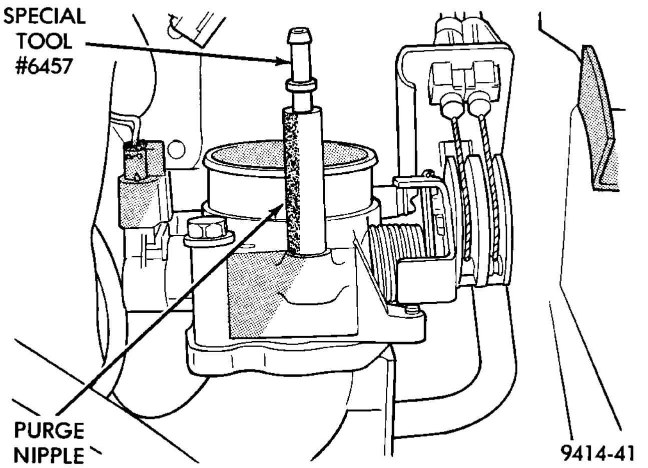


Fig. 84 Orifice 6457 Attached to Purge Nipple

(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 Airflow 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 airflow is set correctly.

IDLE SPECIFICATION —2.0L ENGINE

Odometer Reading	Idle RPM
Below 1000 Miles	550–1300 RPM
Above 1000 Miles	600–1300 Miles

(11) If idle RPM is above specifications, use the DRB scan tool to check idle air control motor operation. 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 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 14. 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.

REMOVAL AND INSTALLATION

THROTTLE BODY—MANUAL TRANSMISSION

Remove throttle body cables using the following procedures.

REMOVAL

(1) Remove throttle cable cover.

(2) Remove throttle cable from the throttle body cam (Fig. 85) and (Fig. 86).

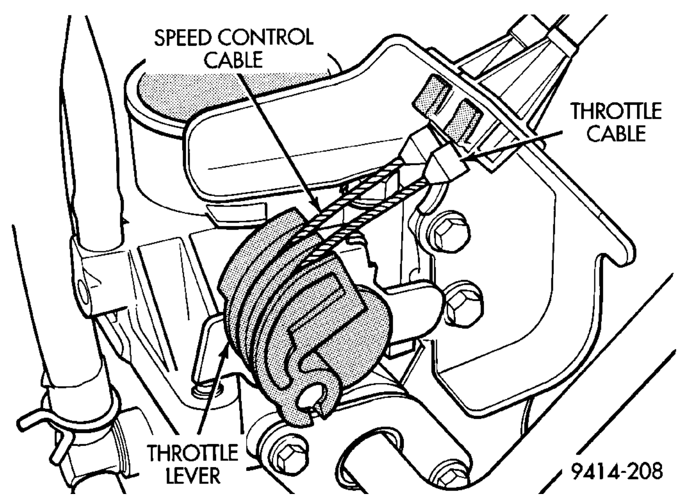


Fig. 85 Throttle Cable Attachment to Throttle Body

REMOVAL AND INSTALLATION (Continued)

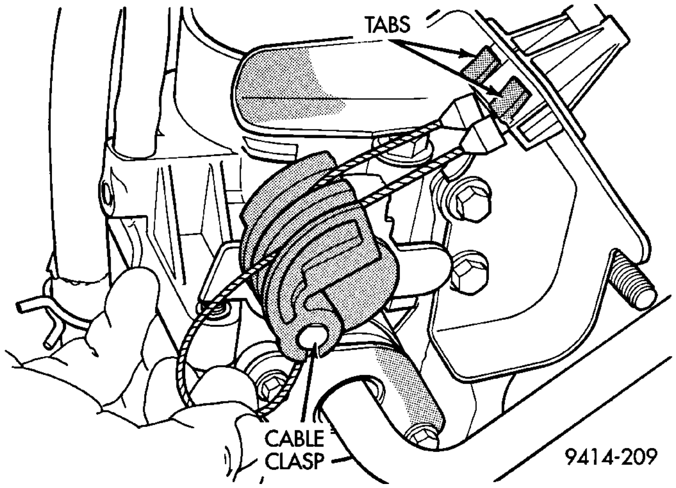


Fig. 86 Disconnecting Throttle Cable

(3) Compress the retaining tabs on the cable and slide cable out of bracket (Fig. 86).

(4) If equipped with speed control, remove speed control cable from throttle lever by sliding clasp out hole used for throttle cable.

(5) Remove 2 screws holding cable mounting bracket and support bracket.

(6) Remove TPS connector.

(7) Remove Idle Air Control motor connector.

(8) Remove the EVAP purge hose.

(9) Remove throttle body mounting bolts. Remove throttle body.

(10) The rubber O-ring gasket on the intake manifold is reusable. Wipe the O-ring clean before installing throttle body (Fig. 91).

INSTALLATION

(1) Install throttle body on intake manifold. Tighten mounting bolts.

(2) Attach cable mounting bracket and support bracket with 2 screws.

(3) Connect the electrical connetion to the throttle body.

(4) Connect the EVAP purge hose to the throttle body.

(5) Install cable housing(s) retainer tabs into bracket.

(6) If equipped with speed control, rotate the throttle lever forward to the wide open position and install speed control cable clasp (Fig. 86).

(7) Rotate throttle lever to wide open position and install throttle cable clasp (Fig. 86).

(8) Install throttle cable cover. Tighten bolt to 5.6 N·m (50 ins. lbs.).

THROTTLE BODY—AUTOMATIC TRANSMISSION

REMOVAL

(1) Remove throttle cable cover.

(2) Remove throttle body cables using the following procedures.

(3) Remove throttle cable from throttle body cam (Fig. 87) and (Fig. 88).

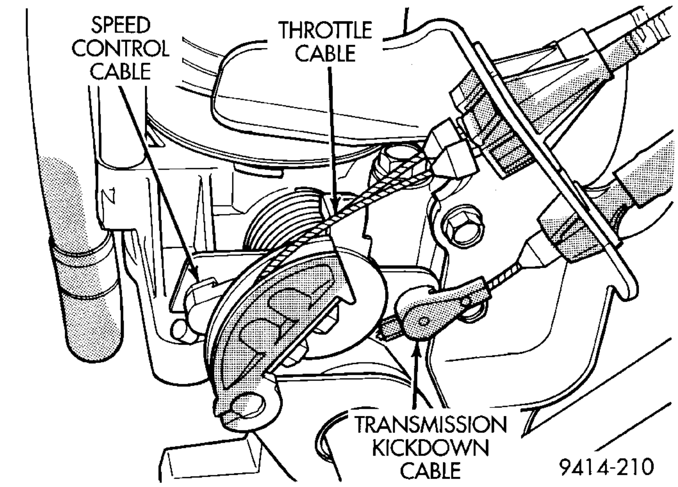


Fig. 87 Throttle Body Cables Attachment to Throttle Body

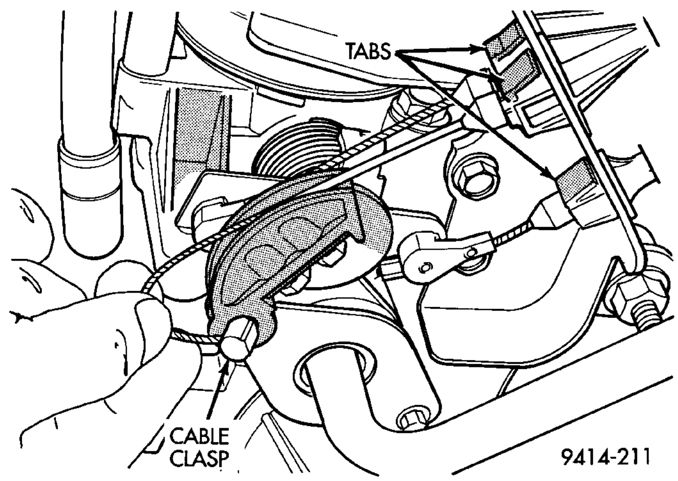


Fig. 88 Disconnecting Throttle Cable

(4) Compress the retaining tabs on the cable and slide cable out of bracket (Fig. 88).

(5) Hold throttle lever in the wide open position. Using finger pressure only, remove kickdown cable by PUSHING connector off the lever nail head (Fig. 87) and (Fig. 89). DO NOT try to pull connector off perpendicular to the lever.

(6) Compress the retaining tabs on the cable and slide cable out of bracket (Fig. 88).

(7) if equipped with speed control, hold throttle lever in the wide open position. Using finger pressure only, remove speed control cable by PUSHING connector off the lever nail head (Fig. 87) and (Fig. 90). DO NOT try to pull connector off perpendicular to the lever.

REMOVAL AND INSTALLATION (Continued)

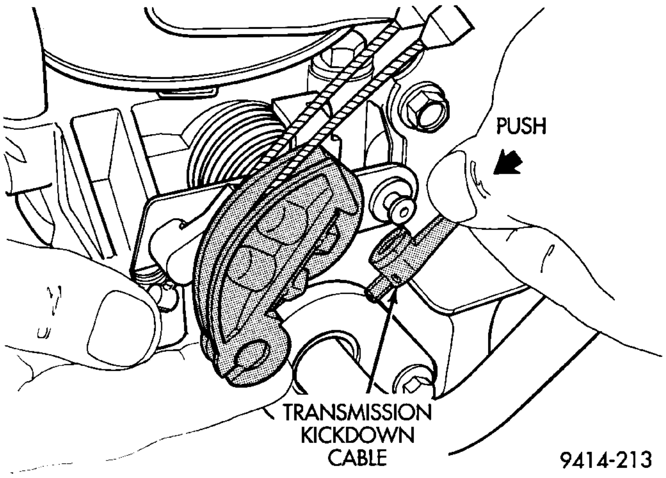


Fig. 89 Transmission Kickdown Cable Connector

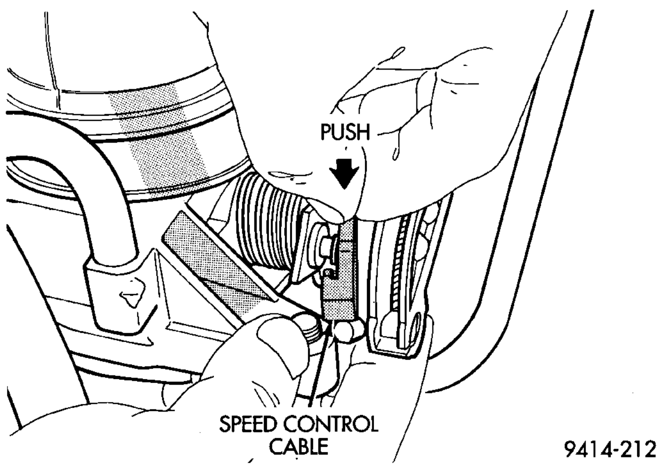


Fig. 90 Speed Control Cable Connector

(8) Compress the retaining tabs on the cable and slide cable out of bracket (Fig. 88).

(9) Remove 2 screws holding cable mounting bracket and support bracket.

(10) Remove TPS connector.

(11) Remove Idle Air Control motor connector.

(12) Remove EVAP purge hose.

(13) Remove throttle body mounting bolts. Remove throttle body.

(14) The rubber O-ring gasket on the intake manifold is reusable. Wipe the O-ring clean before installing throttle body (Fig. 91).

INSTALLATION

(1) Install throttle body on intake manifold. Tighten mounting bolts.

(2) Attach cable mounting bracket and support bracket with 2 screws.

(3) Connect electrical connection to throttle body.

(4) Connect the EVAP purge hose.

(5) Install cable housing(s) retainer tabs into bracket.

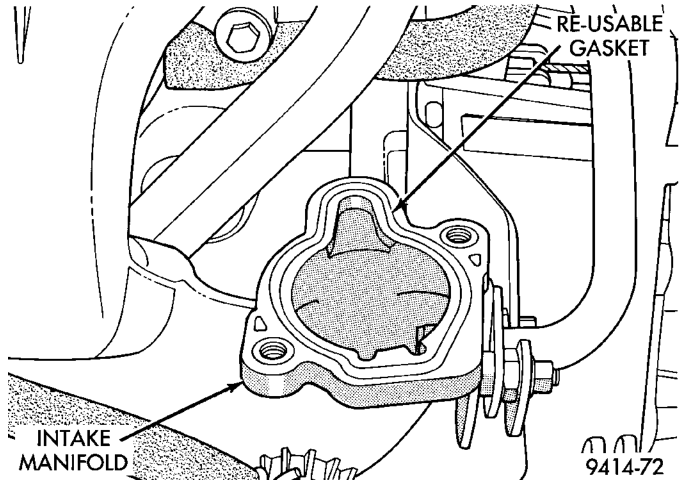


Fig. 91 Re-Usable Throttle Body Gasket

(6) Install throttle body cables using the following procedures.

(7) From the engine compartment, rotate the throttle lever forward to the wide open position and install throttle cable clasp (Fig. 88).

(8) If equipped with speed control, rotate throttle lever forward to the wide open position and slide speed control cable connector onto nail head.

(9) Rotate throttle lever forward to the wide open position and slide kickdown cable connector onto nail head.

(10) Install throttle cable cover. Tighten bolt to 5.6 N·m (50 ins. lbs.).

THROTTLE POSITION SENSOR (TPS)

The throttle position sensor attaches to the side of the throttle body (Fig. 92).

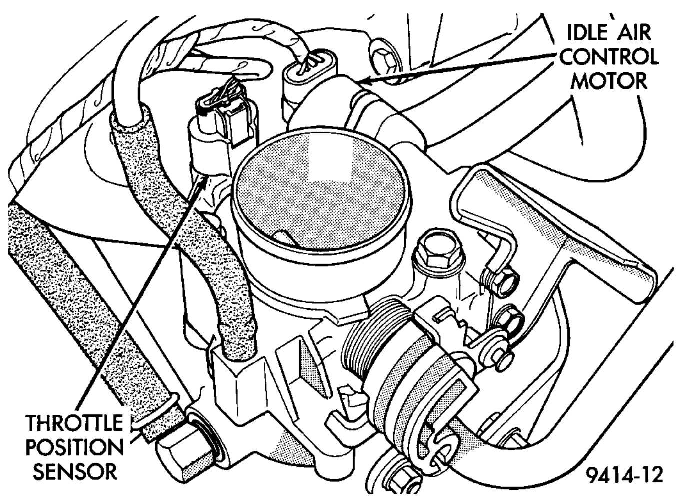


Fig. 92 Throttle Position Sensor and Idle Air Control Motor

REMOVAL

(1) Disconnect EVAP purge hose from throttle body.

REMOVAL AND INSTALLATION (Continued)

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

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

(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. 93). 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.

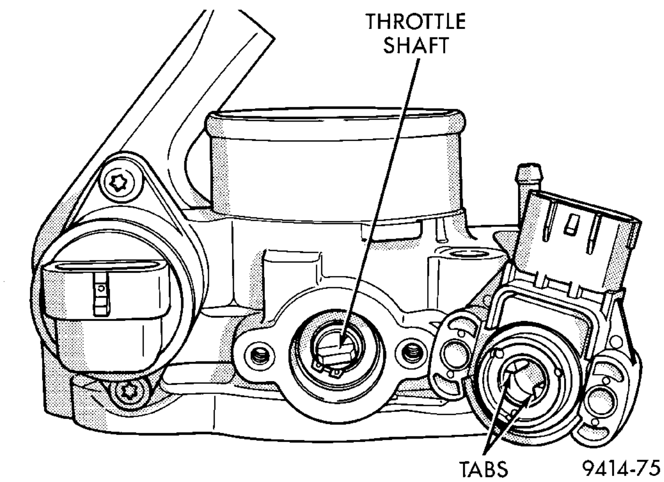


Fig. 93 Throttle Position Sensor Installation

(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.

IDLE AIR CONTROL MOTOR

When servicing throttle body components, always reassemble components with new O-rings and seals where applicable. Never use lubricants on O-rings or seals, damage may result. If assembly of component is difficult, use water to aid assembly. Use care when removing hoses to prevent damage to hose or hose nipple.

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove electrical connector from idle air control motor and throttle position sensor.

(3) Remove the EVAP purge hose from the throttle body.

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

(5) Remove idle air control motor mounting screws (Fig. 94).

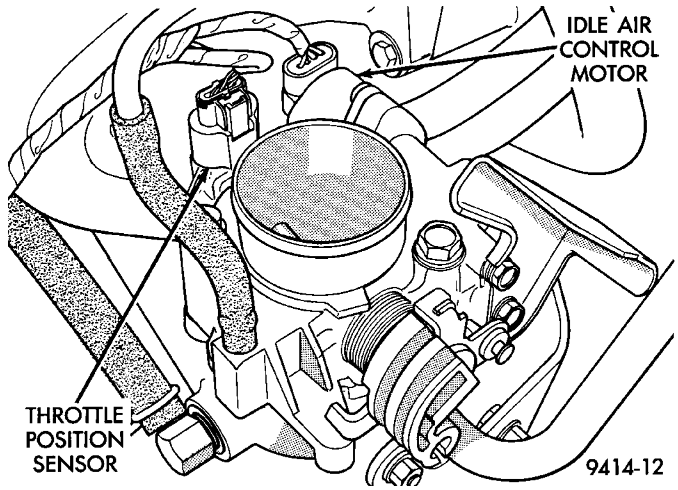


Fig. 94 Servicing Idle Air Control Motor

(6) Remove motor from throttle body. Ensure the O-ring is removed with the motor.

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 Idle Air Control 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 2 N·m (17 in. lbs.) torque.

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

(5) Connect electrical connector to idle air control motor and throttle position sensor.

(6) Connect the EVAP purge hose to the throttle body nipple.

(7) Connect negative cable to battery.

MAP/IAT SENSOR—SOHC

The MAP/IAT sensor attaches to the intake manifold plenum (Fig. 95).

REMOVAL

(1) Disconnect the electrical connector from the MAP/IAT sensor.

(2) Remove sensor mounting screws.

(3) Remove sensor.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Insert sensor into intake manifold while making sure not to damage O-ring seal.

(2) Tighten mounting screws to 2 N·m (20 in. lbs) torque for plastic manifold and 3 N·m (30 in. lbs.) for aluminum manifold.

(3) Attach electrical connector to sensor.

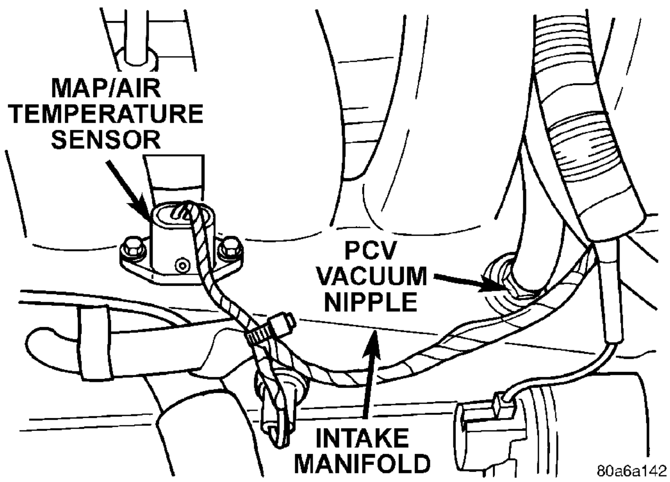


Fig. 95 MAP/IAT Sensor—SOHC

MAP/IAT SENSOR—DOHC

The MAP/IAT sensor attaches to the intake manifold plenum (Fig. 97).

REMOVAL

(1) Remove air inlet duct wing nut and duct from intake manifold (Fig. 96).

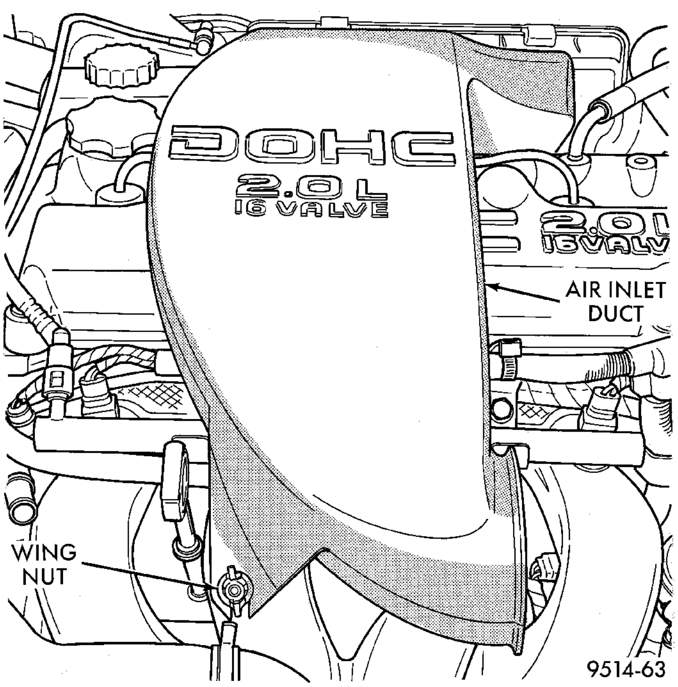


Fig. 96 Air Inlet Duct—DOHC

(2) Disconnect the electrical connector from the MAP/IAT sensor.

(3) Remove sensor mounting screws.

(4) Remove sensor.

INSTALLATION

(1) Insert sensor into intake manifold while making sure not to damage O-ring seals.

(2) Tighten mounting screws to 2 N·m (20 in. lbs) torque foe a plastic manifold and 3 N·m (30 in. lbs) for a aluminum manifold.

(3) Attach electrical connector to sensor.

(4) Install air inlet duct wing nut and duct from intake manifold, insure that the duct does not interfer with ignition cables.

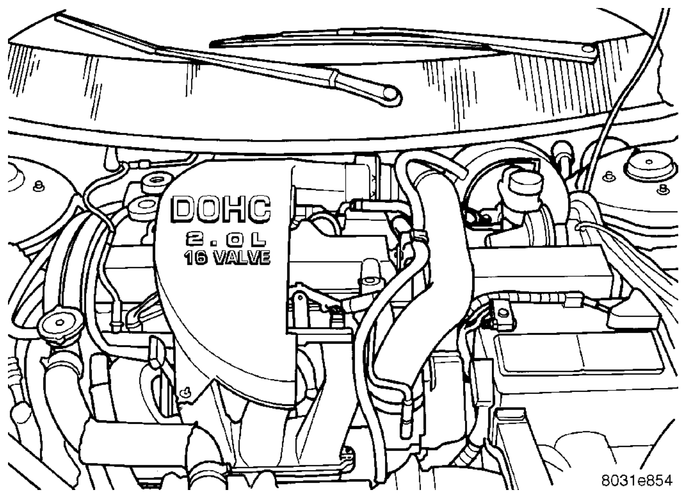


Fig. 97 MAP/IAT Sensor—DOHC

DUTY CYCLE EVAP PURGE SOLENOID VALVE

The solenoid attaches to a bracket near the front engine mount (Fig. 98). The solenoid will not operate unless it is installed correctly.

REMOVAL

(1) Disconnect electrical connector from solenoid.

(2) Disconnect vacuum tubes from solenoid.

(3) Remove solenoid from bracket.

INSTALLATION

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.

POWERTRAIN CONTROL MODULE (PCM)

The PCM attaches to the inner fender panel next to the washer fluid bottle on the passenger side (Fig. 99).

REMOVAL AND INSTALLATION (Continued)

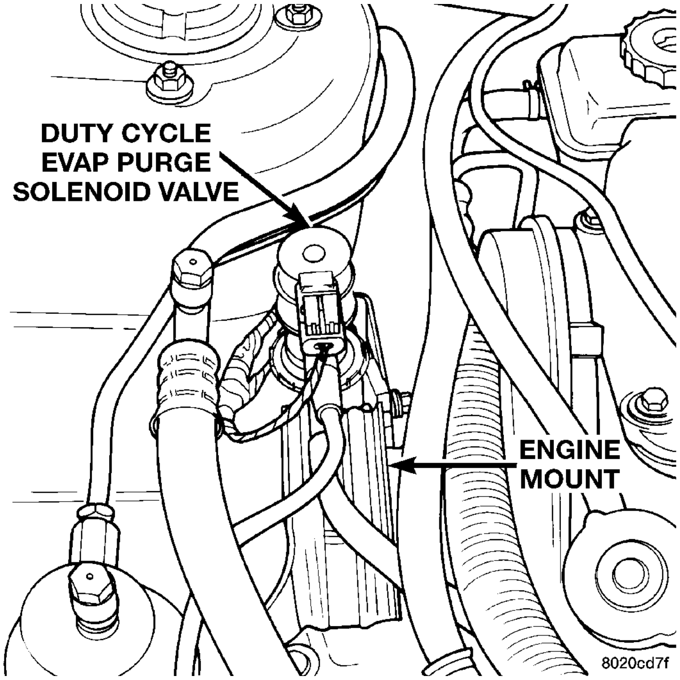


Fig. 98 Duty Cycle EVAP Purge Solenoid Valve

REMOVAL

(1) Disconnect negative cable from battery.

(2) Disconnect positive cable from battery.

(3) Remove washer bottle neck.

(4) Squeeze tabs on PDC while pulling PDC up to remove it from bracket. Lay PDC aside to gain access to PCM bracket screws.

(5) Remove screws attaching PCM to body.

(6) Lift PCM up and disconnect the 2 40-way connector.

(7) Remove PCM.

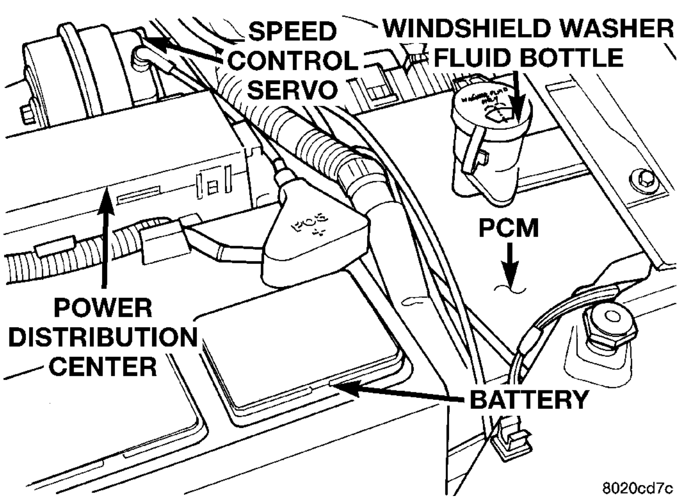


Fig. 99 Powertrain Control Module

INSTALLATION

(1) Attach the 2 40-way connector to PCM.

(2) Install PCM. Tighten mounting screws to 9 N·m (80 in. lbs.) torque.

(3) Install PDC by pushing down into brackets.

(4) Install washer bottle neck.

(5) Connect positive cable to battery.

(6) Connect negative cable to battery.

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

REMOVAL

(1) Raise and support vehicle.

(2) Unplug sensor connector.

(3) Remove sensor using an oxygen sensor crow foot wrench such as Snap-On tool YA8875 or equivalent (Fig. 100).

(4) 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.

INSTALLATION

New sensors have compound on the threads and do not require an additional coating.

(1) Install sensor using an oxygen sensor crow foot wrench such as Snap-On tool YA8875 or equivalent (Fig. 100). Tighten the sensor to 28 N·m (20 ft. lbs.) torque.

(2) Plug sensor connector.

(3) Lower vehicle.

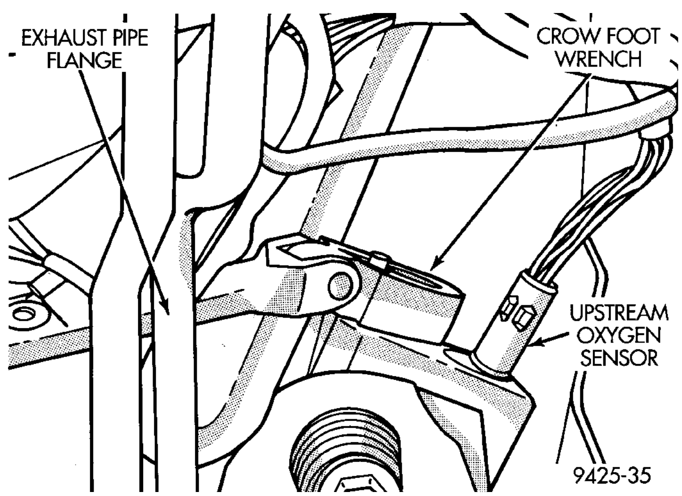


Fig. 100 Upstream Heated Oxygen Sensor Removal/ Installation

REMOVAL AND INSTALLATION (Continued)

DOWNSTREAM HEATED OXYGEN SENSOR

The downstream heated oxygen sensor threads into the exhaust outlet pipe behind the catalytic convertor (Fig. 101).

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. 102).

(5) 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.

INSTALLATION

New sensors have compound on the threads and do not require an additional coating.

(1) Install sensor using an oxygen sensor crow foot wrench such as Snap-On tool YA8875 or equivalent (Fig. 102). Tighten the sensor to 28 N·m (20 ft. lbs.) torque.

(2) Connect sensor electrical harness from clips along body.

(3) Connect electrical connector from sensor.

(4) Lower vehicle.

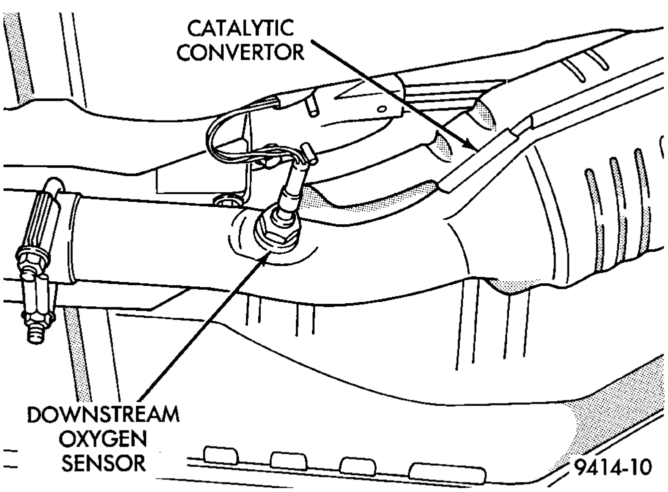


Fig. 101 Downstream Heated Oxygen Sensor

AIR CLEANER ELEMENT

Neon vehicles do not use a heated air inlet system. The PCM adjusts fuel injector pulse width and ignition timing to compensate for different ambient temperatures.

The air cleaner attaches to a bracket on the rear of the cylinder head. An ambient air duct supplies underhood air for the engine.

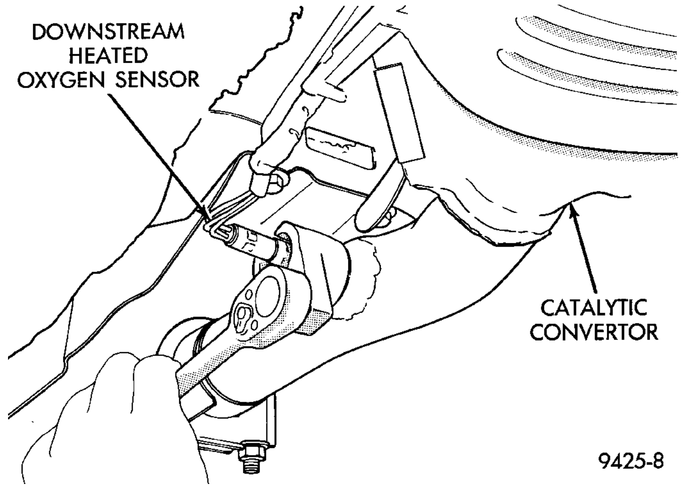


Fig. 102 Downstream Heated Oxygen Sensor Removal/Installation

REMOVAL

(1) Remove air intake tube (Fig. 103) from air cleaner and intake manifold (Fig. 104).

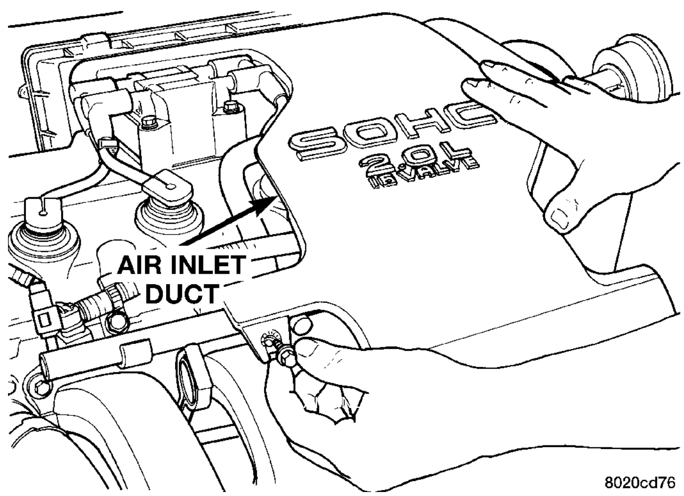


Fig. 103 Air Intake Duct

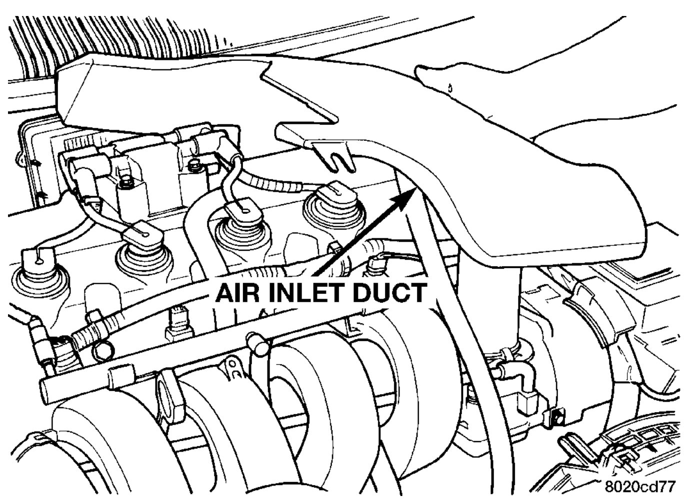


Fig. 104 Removal/Installation of Air Inlet Duct

REMOVAL AND INSTALLATION (Continued)

(2) Unfasten clasps on top of air cleaner housing. Rotate front of housing forward then lift front away from air cleaner housing (Fig. 105).

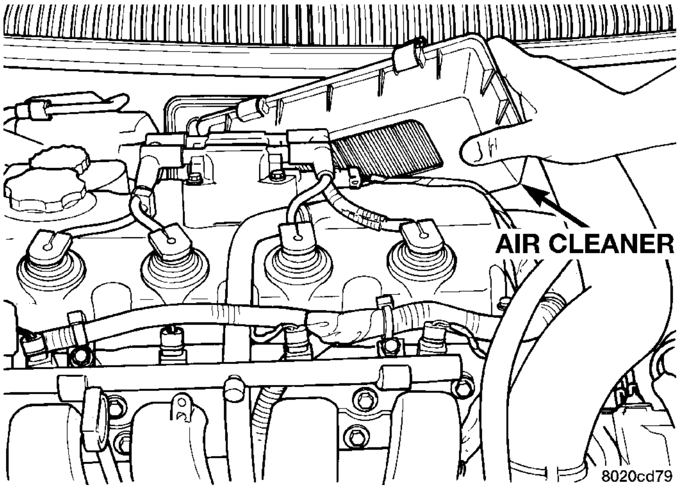


Fig. 105 Removal/Installation Air Cleaner Front Housing and Element

(3) Remove air cleaner element from front housing (Fig. 105).

INSTALLATION

(1) Install air cleaner element into front housing.

(2) Rotate front of housing forward then lower into place and locate tabs in slots. Fasten clasps on top of air cleaner housing.

(3) Install air intake duct at air cleaner and intake manifold.

ENGINE COOLANT TEMPERATURE SENSOR

The engine coolant temperature sensor threads into the rear of the cylinder head (Fig. 106) or (Fig. 107).

REMOVAL

(1) With the engine cold, drain coolant until level drops below cylinder head. Refer to Group 7, Cooling System.

(2) Disconnect coolant sensor electrical connector.

(3) Remove coolant sensor.

INSTALLATION

(1) Install coolant sensor. Tighten sensor to 18 N·m (165 in. lbs.) torque.

(2) Attach electrical connector to sensor.

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

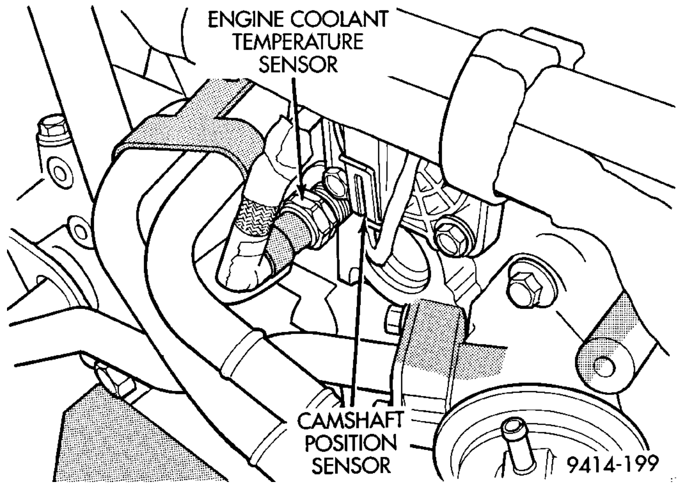


Fig. 106 Engine Coolant Temperature Sensor—SOHC

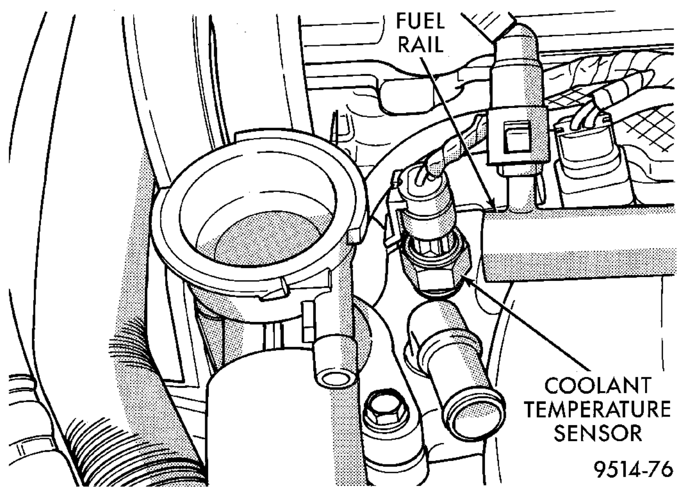


Fig. 107 Engine Coolant Temperature Sensor—DOHC

REMOVAL AND INSTALLATION (Continued)

VEHICLE SPEED SENSOR

The vehicle speed sensor is located in the transmission extension housing (Fig. 108).

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.

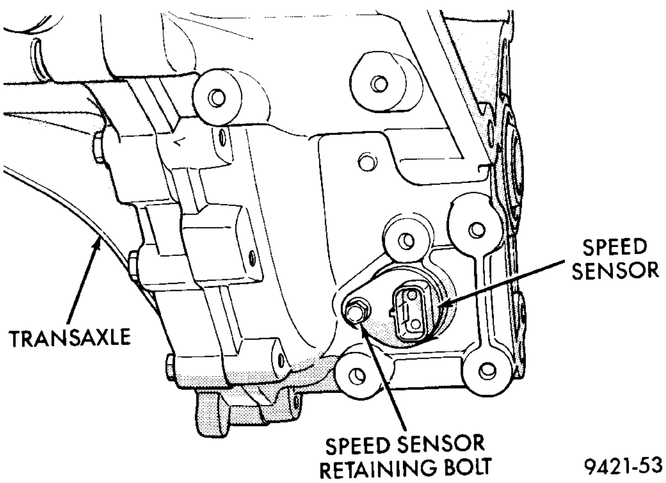


Fig. 108 Vehicle Speed Sensor

KNOCK SENSOR

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

SPECIFICATIONS

VECI LABEL

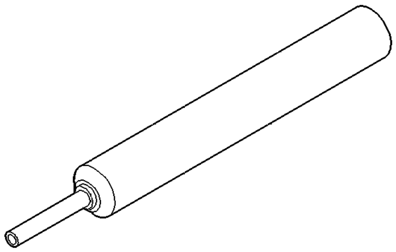
If anything differs between the specifications found on the Vehicle Emission Control Information (VECI) label and the following specifications, use specifications on VECI label. The VECI label is located in the engine compartment.

TORQUE SPECIFICATIONS

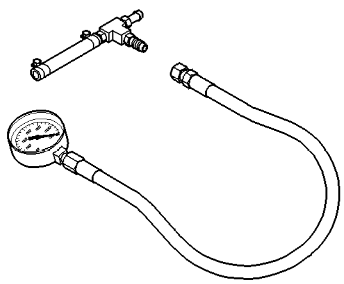
DESCRIPTION	TORQUE
Air Cleaner Wingnut	1.5 N·m (15 in. lbs.)
Air Cleaner Mount. Stud-To-Thrott. Body	10 N·m (90 in. lbs.)
Crankshaft Position Sensor Mounting Bolts	8 N·m (70 in. lbs.)
Engine Coolant Temperature Sensor	18 N·m (165 in. lbs.)
IAC Motor-To-Throttle Body Bolts	7 N·m (60 in. lbs.)
MAP/IAT Sensor	2 N·m (20 in. lbs.)
MAP/IAT Sensor	3 N·m (30 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	23 N·m (200 in. lbs.)
Throttle Position Sensor Mounting Screws	2 N·m (20 in. lbs.)
Vehicle Speed Sensor Mounting Bolt	2.2 N·m (20 in. lbs.)

SPECIAL TOOLS

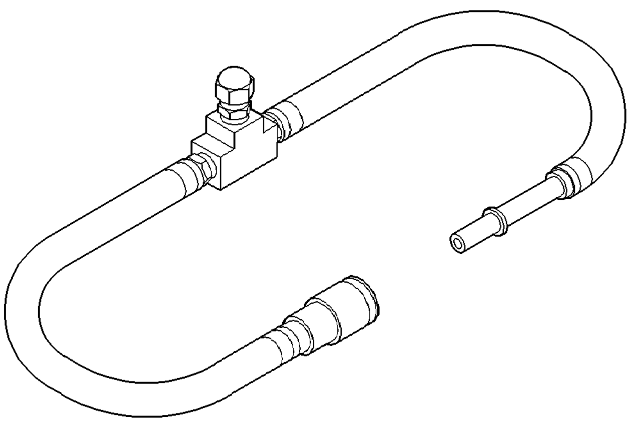
FUEL



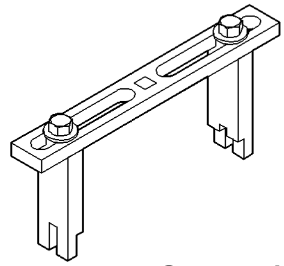
Extractor C–4334



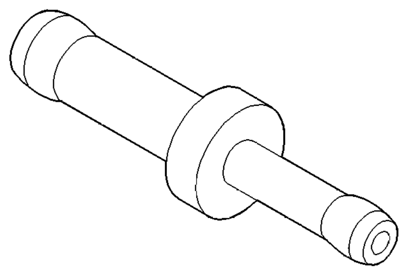
Pressure Gauge Assembly C–4799–B



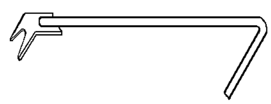
Fuel Pressure Test Adapter 6539



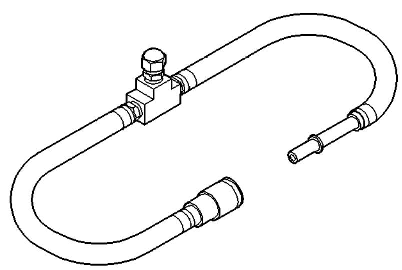
Spanner Wrench 6856



Metering Orifice

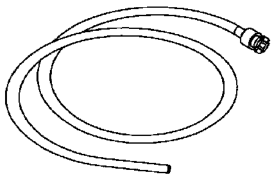


Fuel Line Tool



Fuel Line Adapter

SPECIAL TOOLS (Continued)



Fuel Line Adapter 1/4