

FUEL SYSTEM

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GENERAL INFORMATION

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GENERAL INFORMATION

INTRODUCTION

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

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

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

FUEL REQUIREMENTS

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

Use unleaded gasolines having a minimum posted octane of 87.

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

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

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

GASOLINE/OXYGENATE BLENDS

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

The following are generally used in gasoline blends:

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

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

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

DO NOT USE GASOLINES CONTAINING METHANOL.

GENERAL INFORMATION (Continued)

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

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

Reformulated Gasoline

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

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

Materials Added to Fuel

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

FUEL DELIVERY SYSTEM

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DESCRIPTION AND OPERATION

FUEL DELIVERY SYSTEM

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

The Fuel Delivery System consists of: the electric fuel pump module, fuel filter, tubes/lines/hoses, fuel rail, and fuel injectors.

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

The fuel filter is a replaceable in-line filter. The filter attaches to a bracket mounted on the frame rail in the fuel lines in front of the fuel tank. Refer to the Maintenance Schedules in the Introduction section of this manual for recommended fuel filter replacement intervals.

FUEL PUMP MODULE—ALL

The fuel pump module contains the fuel pump, fuel reservoir, level sensor, inlet strainer, and pressure relief/rollover valve (Fig. 1). The inlet strainer, level sensor and pressure relief/rollover valve are the only serviceable items. If the fuel pump requires service, replace the fuel pump module

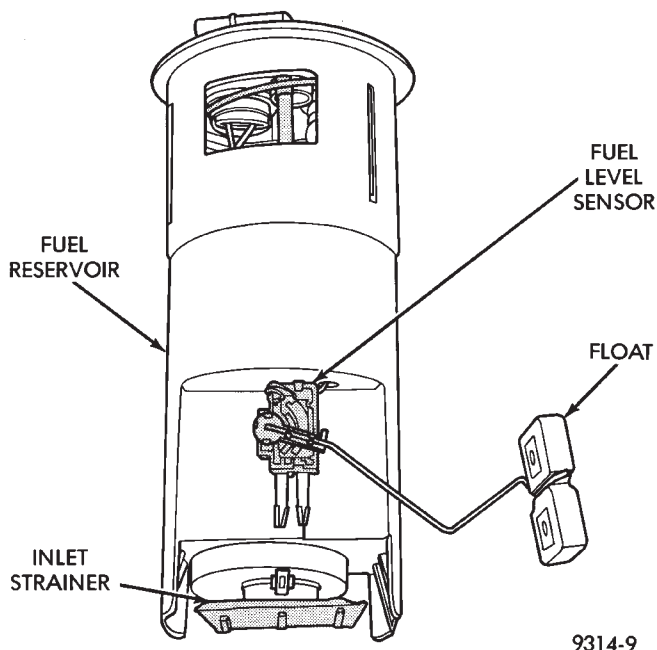


Fig. 1 Fuel Pump Module—Typical

ELECTRIC FUEL PUMP

The fuel system uses a positive displacement, gerotor gear, immersible pump with a permanent magnet

DESCRIPTION AND OPERATION (Continued)

electric motor. The pump draws fuel through a strainer and pushes it through the motor to the outlet. The pump module contains three check valves. One valve relieves internal fuel pump pressure and regulates maximum pump output. Another valve, inside the pump module assembly in the fuel return circuit, prevents fuel tank leakage if the line is damaged during an accident. The third 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 unregulated pressure output of approximately 871 kPa (125 psi). Without vacuum applied to the fuel pressure regulator, the regulator adjusts fuel system pressure to approximately 379 kPa (55 psi) on 3.3L engines and 331 kPa (48 psi) on 3.5L engines. Fuel system pressure varies with different amounts of manifold vacuum.

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. 2). Move the float lever to the positions shown in the resistance chart (Fig. 2). Record the resistance at each point. Replace the level sensor if the resistance is not within specifications.

FUEL TANK

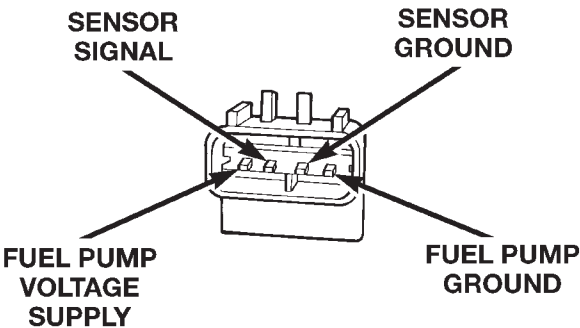
The fuel tanks of all Chrysler Motors built vehicles are equipped with fuel and vapor controls that allow the vehicle to pass a full 360° rollover without fuel leakage.

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

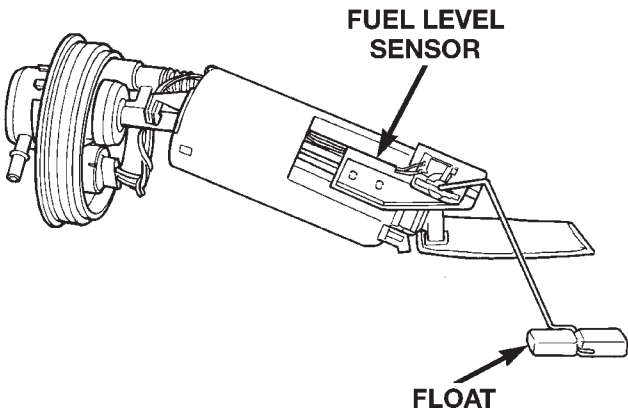
The fuel filler cap acts as a pressure/vacuum relief valve. When air pressure inside the fuel tank gets too high or too low, the fuel filler cap opens to relieve the difference in pressure.

An evaporation control system restricts fuel evaporation into the atmosphere and reduces unburned hydrocarbons. Vapors from the fuel tank are collected in a charcoal filled canister. The vapors are held in

FUEL PUMP MODULE CONNECTOR
TERMINAL PIN-OUTS



FLOAT POSITION



FLOAT POSITION (HEIGHT)	RESISTANCE
-------------------------	------------

SENSOR FULL STOP.....70±20 OHMS
SENSOR EMPTY STOP.....1050±30 OHMS

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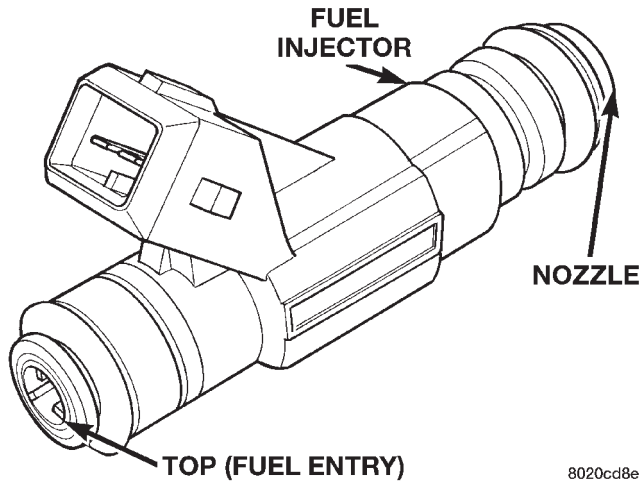
Fig. 2 Level Sensor Diagnosis

the canister until the engine is operating. When the engine is running, the vapors are drawn through the intake manifold into the combustion chambers.

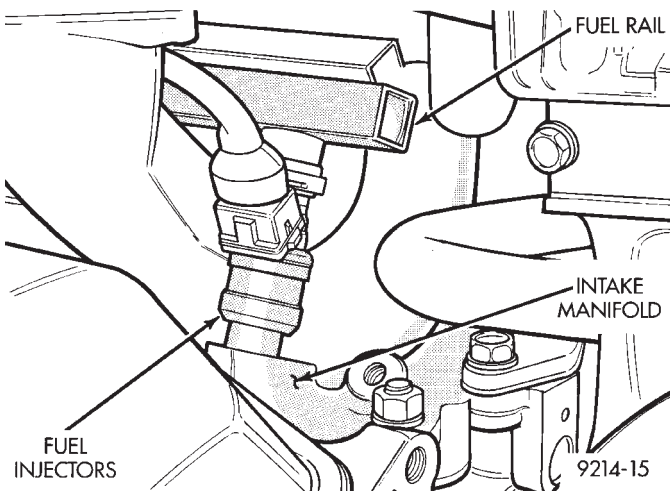
FUEL INJECTORS

The fuel injectors are 12 ohm electrical solenoids (Fig. 3). 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.

DESCRIPTION AND OPERATION (Continued)

**Fig. 3 Fuel Injector**

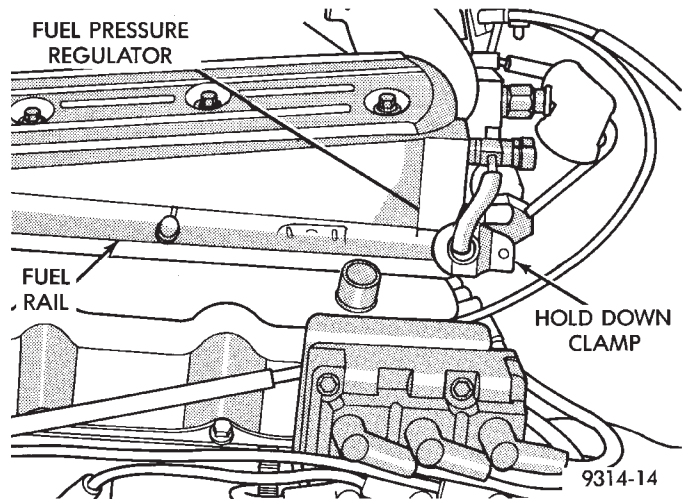
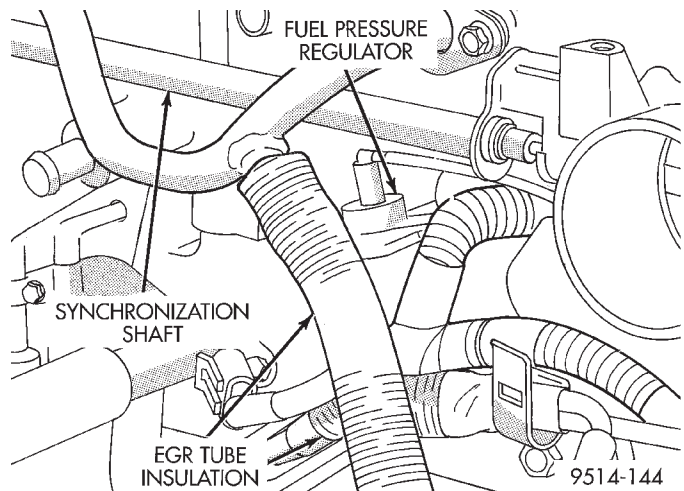
The injectors are positioned in the intake manifold with the nozzle ends directly above the intake valve port (Fig. 4).

**Fig. 4 Fuel Injector Location—Typical****FUEL PRESSURE REGULATOR**

The fuel system uses a vacuum balanced, non-adjustable fuel pressure regulator. The Powertrain Control Module (PCM) does not operate the regulator. On 3.3L engines, the pressure regulator sits in the fuel rail (Fig. 5). On 3.5L engines the regulator attaches to the fuel return tube at the rear of the engine below the intake manifold plenum (Fig. 6).

On 3.3L engines, the regulator maintains fuel system pressure at approximately 317 kPa (46 psi) with manifold vacuum applied to it and the engine idling. Without vacuum applied, the 3.3L regulator maintains pressure at approximately 379 kPa (55 psi).

On 3.5L engines, the regulator maintains fuel system pressure at approximately 317 kPa (46 psi) with manifold vacuum applied to it and the engine idling.

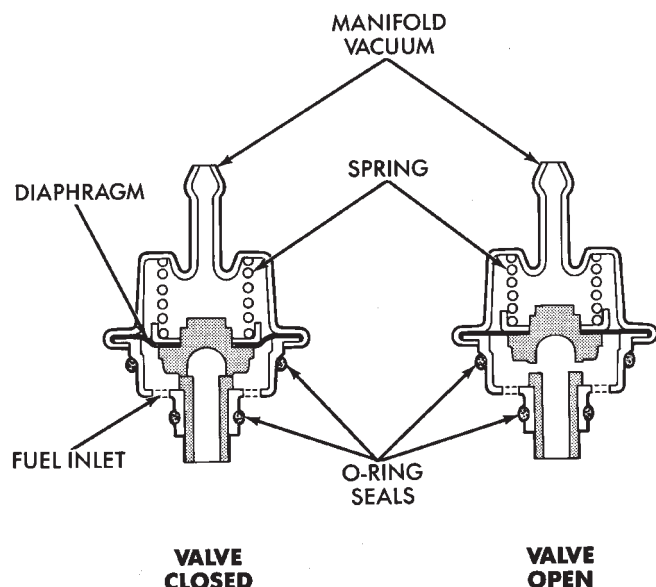
**Fig. 5 Fuel Pressure Regulator—3.3L Engine****Fig. 6 Fuel Pressure Regulator—3.5L Engine**

Without vacuum applied, the 3.5L regulator maintains pressure at approximately 331 kPa (48 psi).

A leaking vacuum supply hose can change fuel system pressure. To determine if the regulator operates correctly, check fuel system without vacuum applied to the regulator.

The pressure regulator contains a diaphragm, calibrated spring and a fuel return valve (Fig. 7). The spring pushes down on the diaphragm and closes off the fuel return port. Manifold vacuum applied to the top of the diaphragm acts against the spring pressure while fuel pressure pushes on the bottom of the diaphragm. The combination of fuel pressure and intake manifold open the return port. The more intake manifold vacuum applied to the regulator, the less fuel pressure required to open the return port. System fuel pressure reflects the amount of fuel pressure required to open the return port. System pressure varies with different amounts of intake manifold vacuum.

DESCRIPTION AND OPERATION (Continued)



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Fig. 7 Fuel Pressure Regulator Operation

With low vacuum, such as during wide open throttle conditions, minimal vacuum assistance is available and full spring pressure is exerted to seal the fuel outlet causing. This causes system pressure to increase. With high vacuum, such as during idle, fuel pressure on the bottom of the diaphragm is balanced by intake manifold pressure on the spring side. This results in lower system fuel pressure.

PRESSURE-VACUUM FILLER CAP

The fuel filler cap incorporates a two-way relief valve that is closed to atmosphere during normal operating conditions. The relief valve is calibrated to open when a pressure of 10 kPa (1.5 psi) or vacuum of 6 kPa (1.8 in. Hg) occurs in the fuel tank. When the pressure or vacuum is relieved, the valve returns to the normally closed position.

FUEL TANK CAPACITY

Vehicle	Liters	U.S. Gallons
LH	68.0	18
Nominal refill capacities are shown. A variation may be observed from vehicle to vehicle due to manufacturing tolerance and refill procedure.		

CAUTION: Remove the fuel filler cap to release fuel tank pressure before disconnecting any fuel system component.

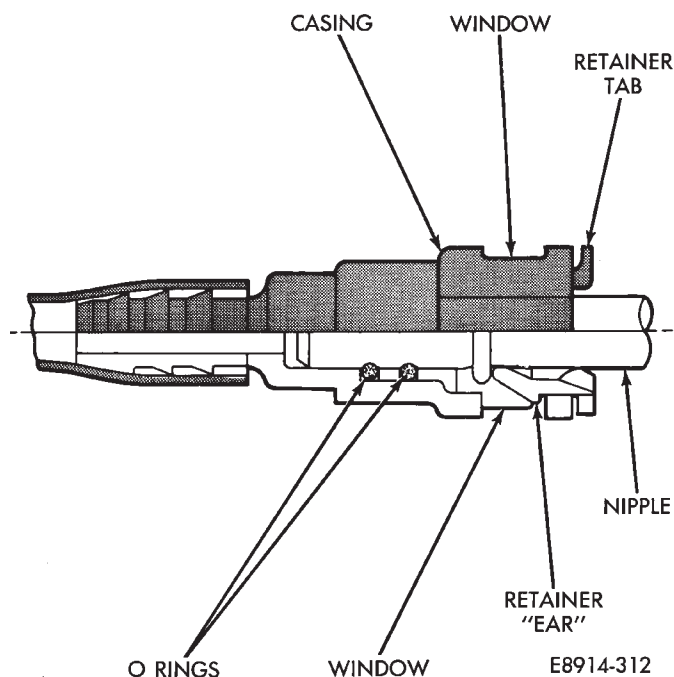
QUICK-CONNECT FITTINGS

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. 8).



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Fig. 8 Plastic Quick-Connect Fittings

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

The quick-connect fitting consists of the O-rings, retainer and casing (Fig. 8). When the fuel tube enters the fitting, the retainer locks the shoulder of the nipple in place and the O-rings seal the tube.

METAL QUICK CONNECT FITTINGS

The fuel filter outlet and fuel rail use metal quick-connect fittings. The fitting contains non-serviceable sealed O-rings. The fittings contain a plastic disconnect tool (release ring). Use special tool 6751 to disconnect and connect the fittings at the fuel rail.

DESCRIPTION AND OPERATION (Continued)

Special tool 6751 could also be used at the fuel filter outlet.

The quick-connect fitting consists of the O-rings, casing, disconnect tool and a retainer (Fig. 9). When the fuel tube enters the fitting, the retainer locks the shoulder of the nipple in place and the O-rings seal the tube.

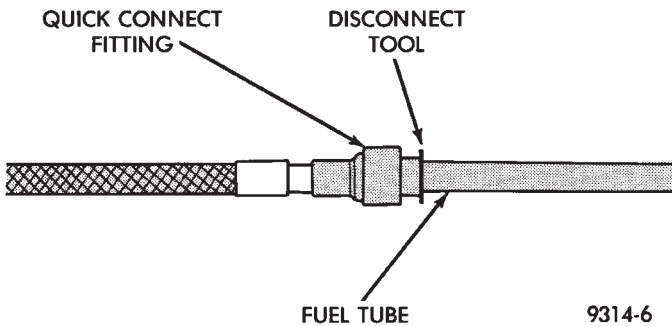


Fig. 9 Metal Quick-Connect Fittings

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.

When installing fuel tubes, route them in the holders along the frame rail, fuel tank and the rear of the engine.

ROLLOVER VALVE

The LH fuel tank has fuel and vapor controls that allow the vehicle to pass a full 360° rollover without fuel leakage.

The fuel pump module contains a pressure relief/rollover valve. The valve is mounted on the top of the fuel pump module on all LH vehicles. With the vehicle upright, the valve functions as a pressure relief valve. The valve also contains a check valve that prevents fuel from escaping the fuel tank if the vehicle rolls over.

DIAGNOSIS AND TESTING

FUEL PUMP PRESSURE TEST

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

The 3.3L and 3.5L fuel systems operate at different pressures. Refer Fuel System Specifications for correct system pressure.

(1) Release fuel system pressure before disconnecting a fuel hose. Perform fuel system pressure release.

(2) Remove protective cover from service valve on the fuel rail.

(3) Connect Fuel Pressure Gauge C-4799B to fuel rail service valve. (Fig. 10) or (Fig. 11).

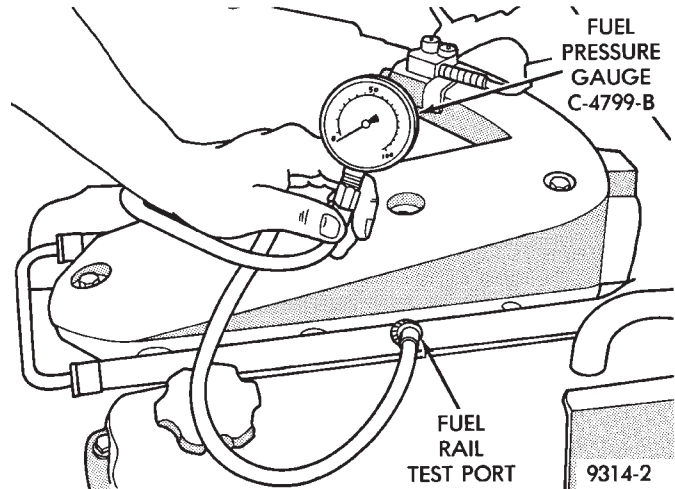


Fig. 10 Checking Fuel Pressure at Fuel Rail—3.3L Engine

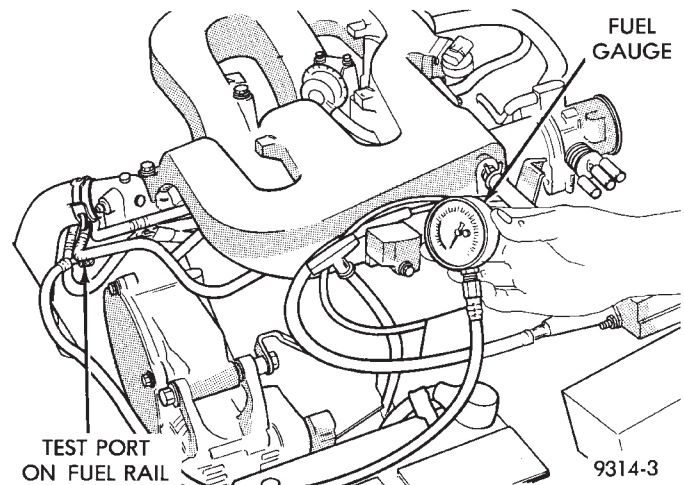


Fig. 11 Checking Fuel Pressure at Fuel Rail—3.5L Engine

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

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

(5) If the gauge reading equals the specification listed in the Fuel System Pressure chart, further testing is not required. If pressure is not correct, record the pressure and remove gauge.

DIAGNOSIS AND TESTING (Continued)

(6) Ensure fuel does not leak from the fuel rail service valve. Install protective cover onto fuel rail service valve.

(7) If pressure is below specifications, proceed to Fuel System Pressure Below Specifications. If pressure is above specifications, proceed to Fuel System Pressure Above Specifications.

Fuel System Pressure Below Specifications

(1) If the fuel pressure reading was below specifications, test the system according to the following procedure.

(a) Perform Fuel Pressure Release procedure.

(b) Install Fuel Pressure Gauge C-4799 and Fuel Pressure Adapter 6631 in the fuel supply line between the fuel tank and fuel filter (Fig. 12).

(c) Using the DRB, with the ignition key in the ON position, repeat the ASD Fuel System Test.

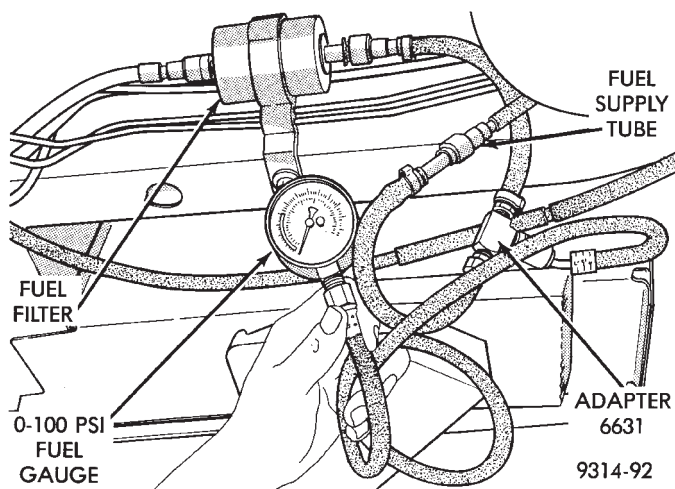


Fig. 12 Checking Fuel Pressure Between Pump and Filter

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

- If pressure is at least 5 psi higher than reading recorded, replace fuel filter.
- If no change is observed, gently squeeze return hose. If pressure increases, replace pressure regulator. If the gauge reading does not change when the return hose is squeezed, the problem is either a plugged inlet strainer or defective fuel pump.

Fuel System Pressure Above Specifications

(1) If the fuel pressure reading was above specifications test the system according to the following procedure.

(a) Perform Fuel Pressure Release procedure.

(b) Install Fuel Pressure Gauge C-4799 and Fuel Pressure Adapter 6631 in the fuel supply line (Fig. 11) between the fuel tank and fuel filter.

(c) Remove the fuel return line hose from the fuel pump at fuel tank. Connect Fuel Pressure Test Adapter 6668 to the return line. Place the other end of adapter 6668 into an approved gasoline container (minimum 2 gallon size). All return fuel will flow into container.

(d) Using the DRB, with the ignition key in the ON position, repeat the ASD Fuel System Test.

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

- If pressure is now correct, replace fuel pump assembly.
- If pressure is still above specifications, remove fuel return hose from chassis fuel tubes (at engine). Attach Fuel Pressure Test Connect Adapter 6668 to the fuel return tube and place other end of hose in clean container (Fig. 13). Repeat test. If pressure is now correct, check for restricted fuel return line. If no change is observed, replace fuel pressure regulator.

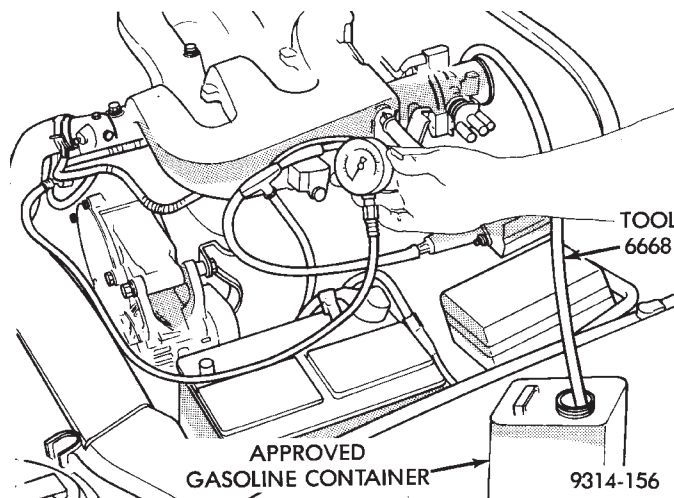


Fig. 13 Fuel Return Line Adapter

*FUEL SYSTEM PRESSURE SPECIFICATIONS***3.3L ENGINE**

Without vacuum applied to the regulator, the 3.3L fuel system operates at 379 kPa (55 PSI). With the engine idling and manifold vacuum applied to the regulator, the system operates at approximately 317 kPa (46 PSI). Fuel system pressure varies with different amounts of manifold vacuum applied to the regulator.

3.5L ENGINE

Without vacuum applied to the regulator, the 3.5L fuel system operates at 331 kPa (48 PSI). With the engine idling and manifold vacuum applied to the regulator, the system operates at approximately 269

DIAGNOSIS AND TESTING (Continued)

kPa (39 PSI). Fuel system pressure varies with different amounts of manifold vacuum applied to the regulator.

SYSTEM	PRESSURE
3.3L	379 kPa (55 PSI)
3.5L	331 kPa (48 PSI)

FUEL SYSTEM PRESSURE—WITHOUT VACUUM APPLIED TO PRESSURE REGULATOR

FUEL LEVEL SENSOR

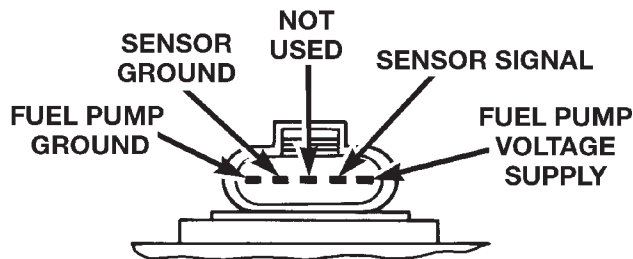
This procedure tests the resistance of the level sensor itself. It does not test the level sensor circuit. Refer to Group 8W - Wiring Diagrams for circuit identification.

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. 14). Move the float lever to the positions shown in the resistance chart (Fig. 14). Record the resistance at each point. Replace the level sensor if the resistance is not within specifications.

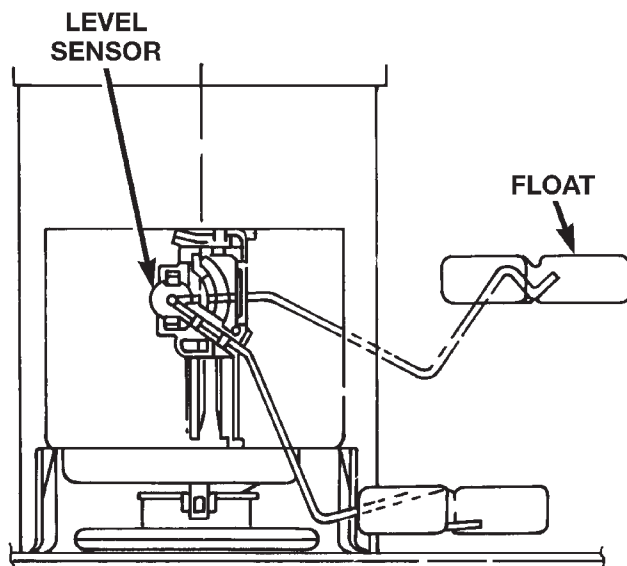
FUEL INJECTORS

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.

FUEL PUMP MODULE CONNECTOR
TERMINAL PIN-OUTS



FLOAT POSITION

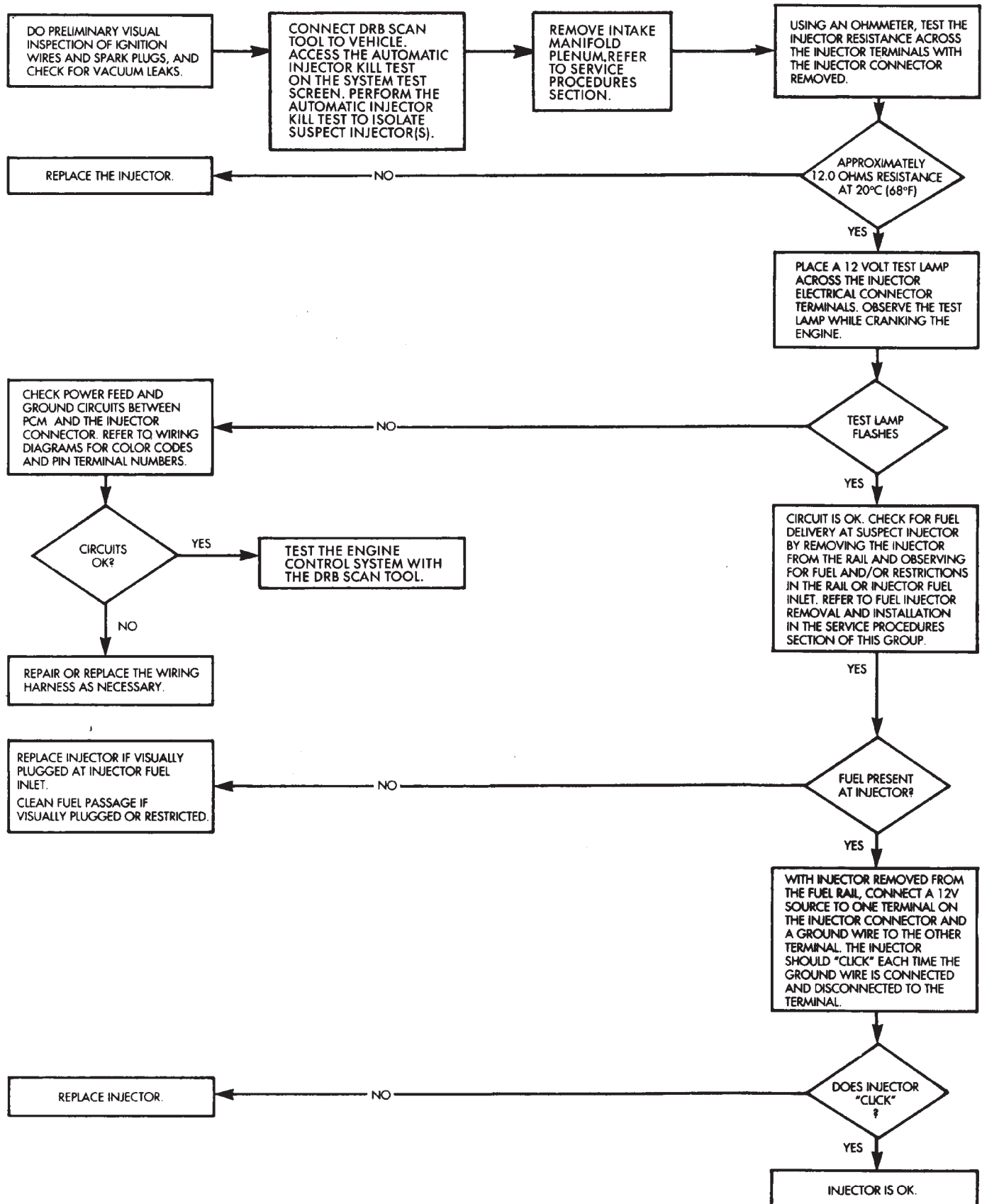


FLOAT POSITION (HEIGHT)	RESISTANCE
187.9 mm (Sensor Full Stop).....	55±5 Ohms
179.3 mm (Stop on Gauge)	130±15 Ohms
135.3 mm (3/4 position)	340±25 Ohms
99.1 mm (1/2 position).....	530±25 Ohms
61.1 mm (1/4 position)	735±25 Ohms
13.4 mm (Empty on Gauge)	970±25 Ohms
2.5 mm (Sensor Empty Stop)	1060±25 Ohms

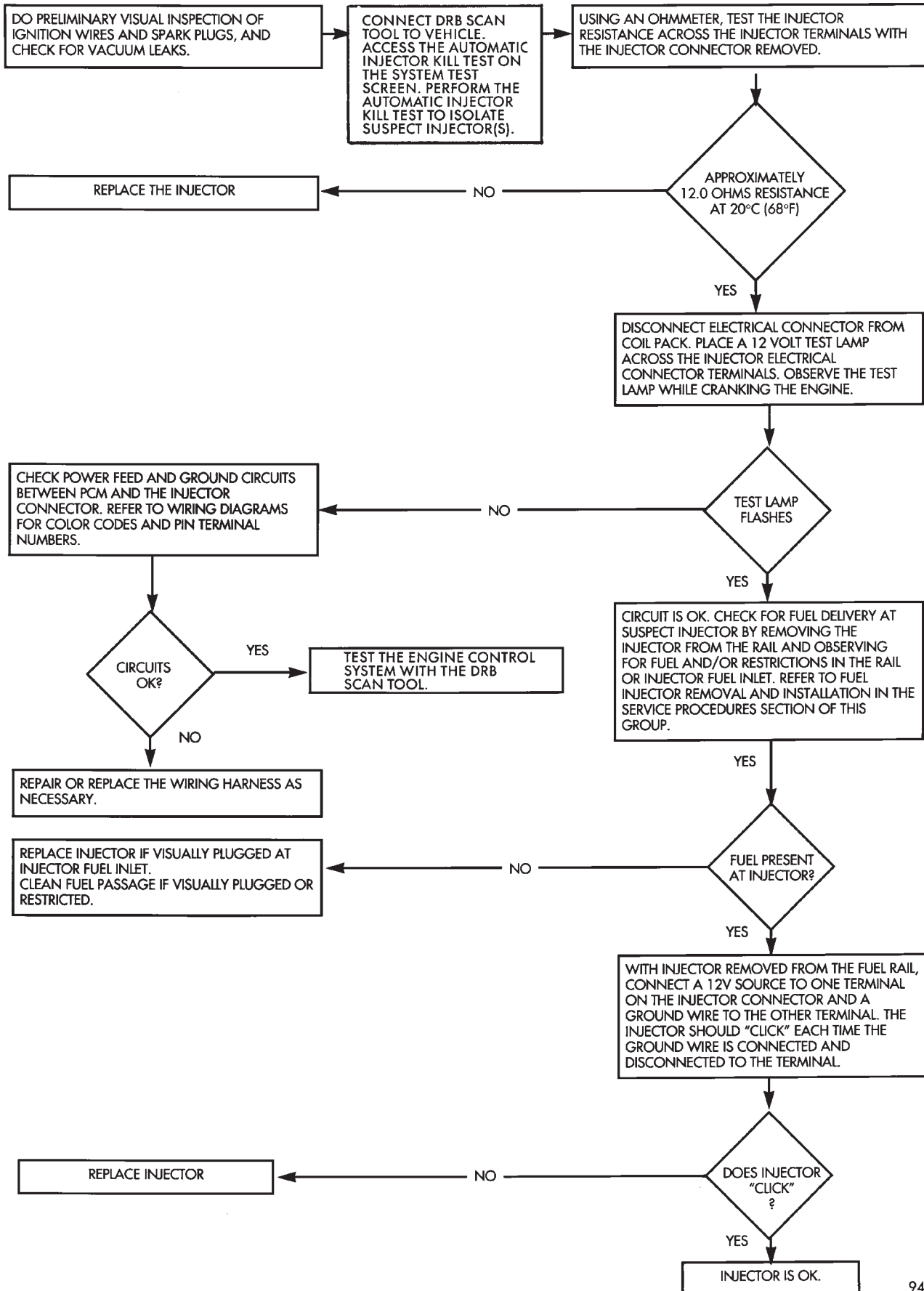
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Fig. 14 Level Sensor Diagnosis

DIAGNOSIS AND TESTING (Continued)



DIAGNOSIS AND TESTING (Continued)



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. 15) or (Fig. 16).

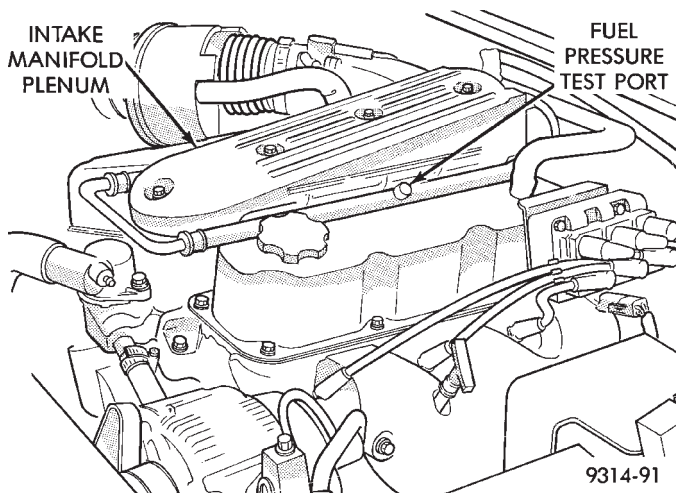


Fig. 15 Fuel Pressure Test Port—3.3L

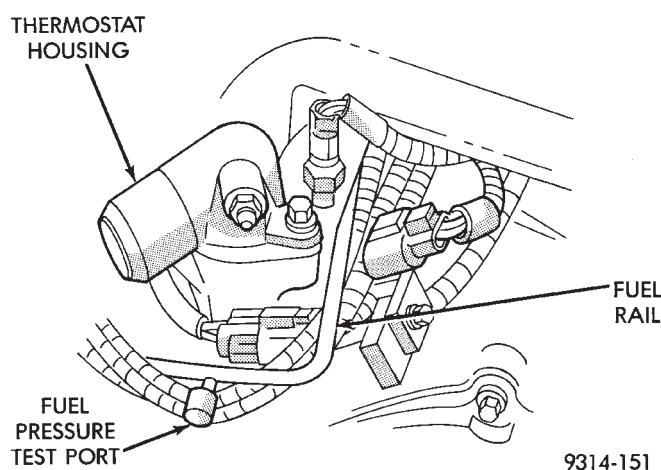


Fig. 16 Fuel Pressure Test Port—3.5L

- (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. 17). Fuel pressure will bleed off through the hose into the gasoline container. Fuel gauge C-4799-A contains hose C-4799-1.

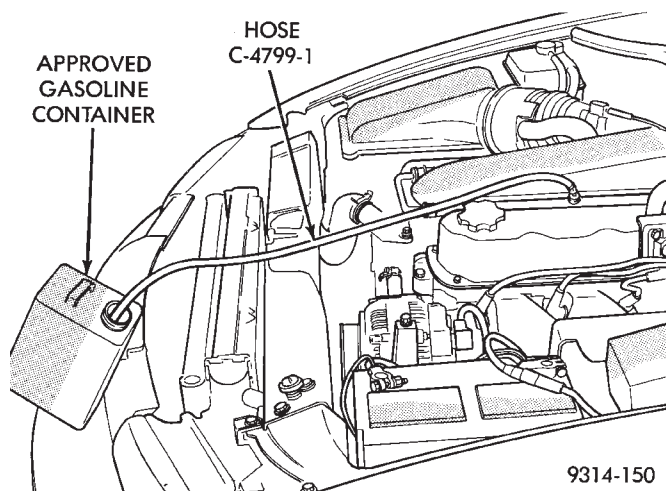


Fig. 17 Releasing Fuel Pressure

DRAINING FUEL TANK

If the fuel pump operates, energize the pump and drain the fuel into a portable fuel siphoning tank. Use the DRB ASD Fuel System test to energize the fuel pump.

If the pump does not operate, remove the fuel pump module through the access panel in the trunk floor. Drain the tank into a portable fuel siphoning tank through the opening for the fuel pump module. Refer to Fuel Pump Module in the Fuel Delivery section of this group.

HOSES AND CLAMPS

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

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

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

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

QUICK-CONNECT FITTINGS

REMOVAL

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

SERVICE PROCEDURES (Continued)

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

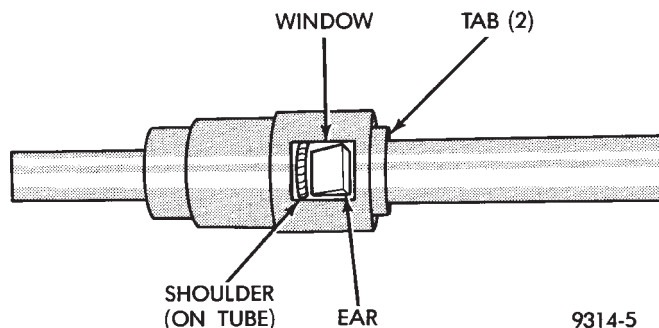
CAUTION: Never install a quick-connect fitting without the retainer being either on the fuel tube or already in the quick-connect fitting. In either case, ensure the retainer locks securely into the quick-connect fitting by firmly pulling on fuel tube and fitting to ensure it is secured.

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



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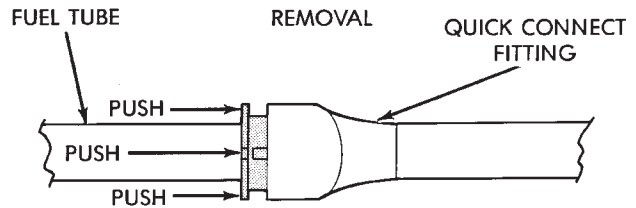
Fig. 18 Plastic Quick-Connect Fitting/Fuel Tube Connection

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.

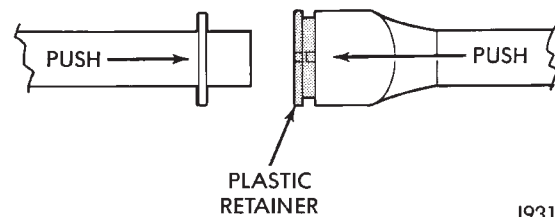
(5) Use the DRB scan tool ASD Fuel System Test to pressurize the fuel system. Check for leaks.

PLASTIC RETAINER RING TYPE FITTING

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



INSTALLATION



J9314-100

Fig. 19 Plastic Retainer Ring Type Fitting

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

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

DISCONNECTION/CONNECTION

(1) Disconnect negative battery cable from the battery.

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

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

(4) To release the fuel system component from the quick-connect fitting, firmly push the fitting towards

SERVICE PROCEDURES (Continued)

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

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

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

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

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

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

(10) Connect negative battery cable to battery.

(11) Start engine and check for leaks.

REMOVAL AND INSTALLATION

AUTOMATIC SHUTDOWN RELAY

The relay is located in the Power Distribution Center (PDC) (Fig. 20). The PDC is located next to the battery in the engine compartment. For the location of the relay within the PDC, refer to the PDC cover for location. Check electrical terminals for corrosion and repair as necessary.

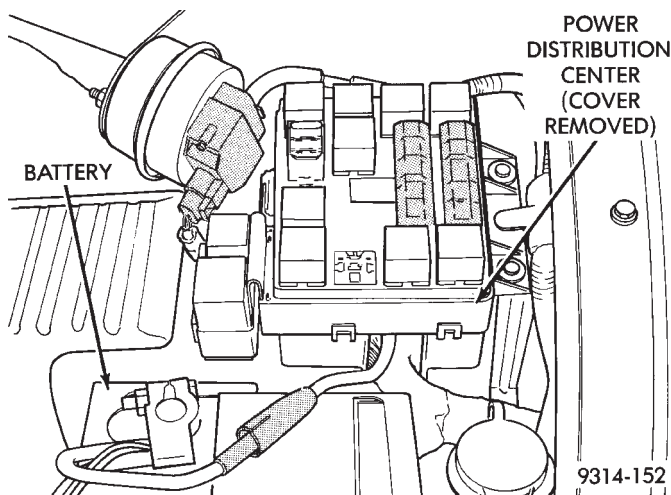


Fig. 20 Power Distribution Center (PDC)

FUEL PUMP RELAY

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

FUEL PUMP MODULE

WARNING: RELEASE FUEL SYSTEM PRESSURE BEFORE SERVICING THE FUEL TANK, FUEL PUMP, FUEL LINES, FUEL FILTER, OR PARTS OF THE FUEL RAIL. FOLLOW THE FUEL SYSTEM PRESSURE RELEASE PROCEDURE TO RELIEVE FUEL SYSTEM PRESSURE.

REMOVAL

The trunk has an access cover in the floor panel for servicing the fuel pump module (Fig. 21).

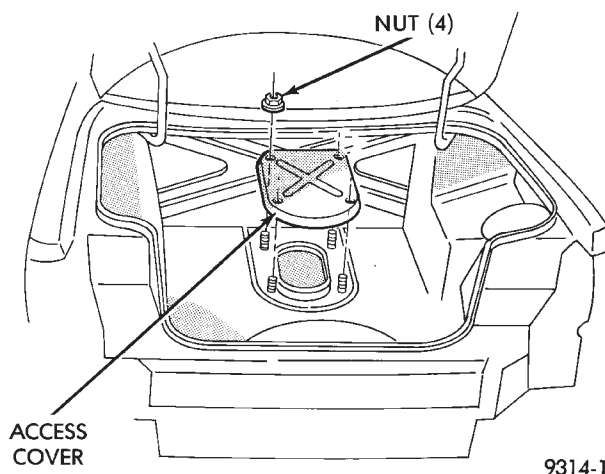
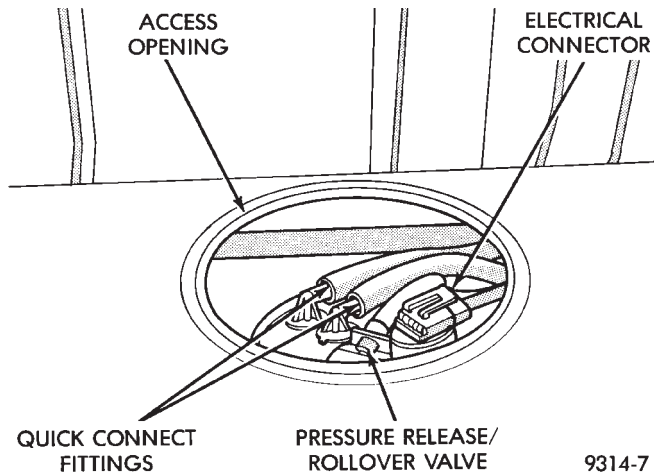


Fig. 21 Fuel Pump Access Panel

WARNING: RELEASE FUEL SYSTEM PRESSURE BEFORE REMOVING THE FUEL PUMP MODULE. REFER TO THE FUEL PRESSURE RELEASE PROCEDURE.

- (1) Release fuel system pressure. Refer to Fuel Pressure Release Procedure.
- (2) Disconnect negative cable from battery.
- (3) Open deck lid. Remove trunk liner.
- (4) Remove access panel fasteners.
- (5) Remove access panel and gasket (Fig. 22). Inspect gasket for damage. If necessary, replace gasket.
- (6) Disconnect electrical connector from top of pump module.
- (7) Disconnect fuel supply and return tubes from fuel pump module. Refer to Quick-Connect Fittings in this section.
- (8) Disconnect hose from pressure relief/rollover valve.

REMOVAL AND INSTALLATION (Continued)

**Fig. 22 Access Opening in Trunk**

(9) A band clamp fastens the fuel pump module to the tank. The module rises up from the tank after loosening the clamp.

(10) Loosen band clamp until fuel pump module rises up from tank.

WARNING: THE FUEL PUMP RESERVOIR MAY CONTAIN FUEL. DO NOT SPILL FUEL WHILE REMOVING THE MODULE.

(11) To absorb possible fuel spillage, place shop towels around access opening. Without removing the module, tip it backwards to allow fuel in the reservoir to run down the side and back into the fuel tank.

(12) The float arm of the level sensor catches on the inside of the tank while removing the module. Tilt the module to one side when removing from tank.

(13) Remove fuel pump module and gasket from tank.

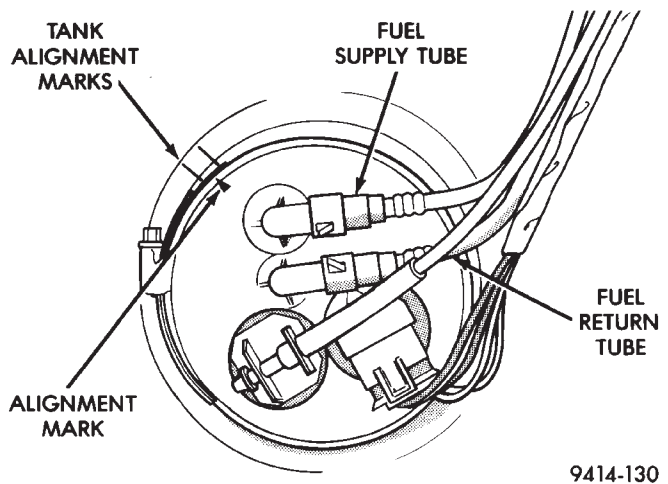
(14) Drain remainder of fuel from reservoir before servicing the pump module.

INSTALLATION

The fuel pump module and fuel tank have alignment marks. The tank has two molded lines at the ten o'clock position. The fuel pump module has a triangular alignment mark (Fig. 23). Align the marks to correctly position the pump module.

(1) With a new gasket, insert the module straight into the tank to set float on bottom. Align marks on module and tank.

(2) Seat module to tank by pushing the top down. Make sure the gasket does not slip over the outside or inside edge of the fuel tank lip. While holding module in seated position, place band clamp over lip of tank and edge of fuel pump module. Tighten band clamp to 4 N·m (31 in. lbs) torque. **Do not over tighten the fuel pump band clamp.**

**Fig. 23 Fuel Pump Module Alignment Mark—Typical**

(3) Install fuel tubes over fuel return and supply nipples on the module. Refer to Fuel Tubes and Quick Connect Fittings in this section.

(4) Connect vent line to pressure relief/rollover valve.

(5) Attach electrical connector to fuel pump module.

(6) Use DRB scan tool to pressurize fuel system. Check for leaks.

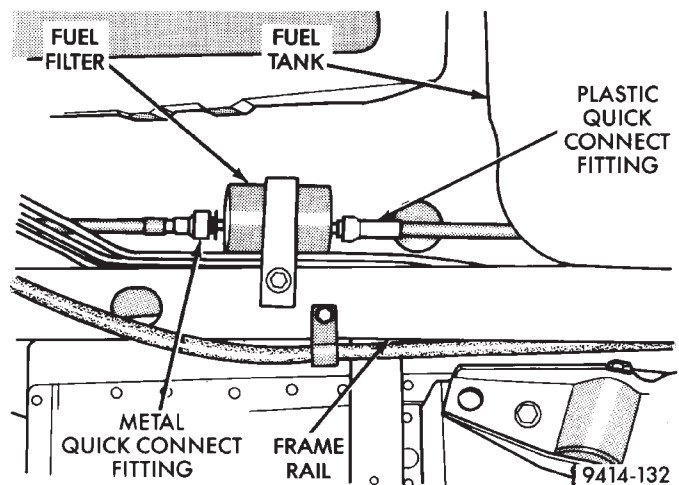
(7) Install access cover and gasket. Tighten fasteners.

(8) Install trunk liner.

(9) Connect negative cable to battery.

FUEL FILTER

The fuel filter mounts to the frame rail in front of the fuel tank (Fig. 24) (Fig. 42). The inlet and outlet ends of the filter are marked for correct installation.

**Fig. 24 Fuel Filter**

REMOVAL AND INSTALLATION (Continued)

REMOVAL

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

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

(2) Disconnect quick-connect fittings from fuel filter. Refer to Fuel Tubes and Quick-Connect Fittings in this section.

(3) Remove fuel filter mounting bracket. Remove filter.

INSTALLATION

(1) The inlet and outlet sides of the filter are marked. Install the filter with the inlet side to the fuel tank.

(2) Place fuel filter into bracket. Place bracket against frame rail. Tighten mounting screw to 12 N·m (110 in. lbs.) torque.

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

FUEL PRESSURE REGULATOR

REMOVAL

The intake manifold plenum must be removed to service the fuel pressure regulator. Refer to 3.5L Intake Manifold Plenum in Multi-Port Fuel Injection—Service Procedures section of this group.

WARNING: RELEASE FUEL SYSTEM PRESSURE BEFORE REMOVING THE FUEL PRESSURE REGULATOR. REFER TO THE FUEL PRESSURE RELEASE PROCEDURE.

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

(2) Tag the injector connectors with their cylinder number.

(3) Remove electrical connector from injectors.

(4) Remove the vacuum tube from the fuel pressure regulator (Fig. 25).

(5) Remove fuel rail mounting bolts.

(6) Remove injector clamp screw (Fig. 26).

(7) Slide the injector clamp toward the rear of the engine, then lift the clamp off of the rail (Fig. 27).

(8) Install fuel rail mounting bolts finger tight.

(9) Using a thin flat screwdriver, pry the fuel pressure regulator out of the fuel rail (Fig. 28).

(10) Ensure the upper O-ring, upper spacer, lower O-ring, and lower spacer were removed with the regulator. If not, remove them from the well in fuel rail.

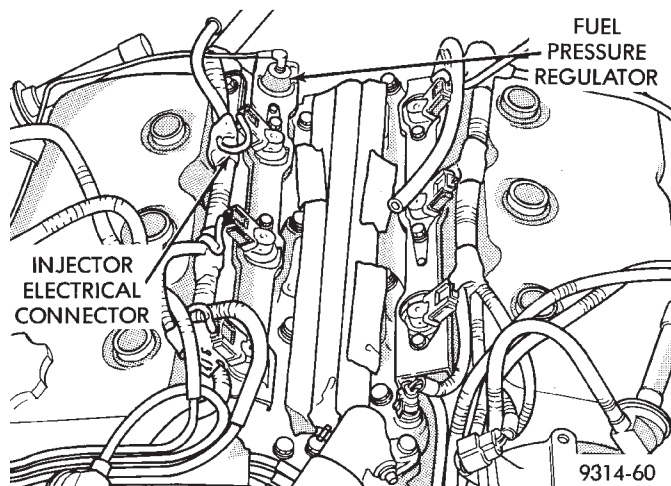


Fig. 25 Fuel Pressure Regulator

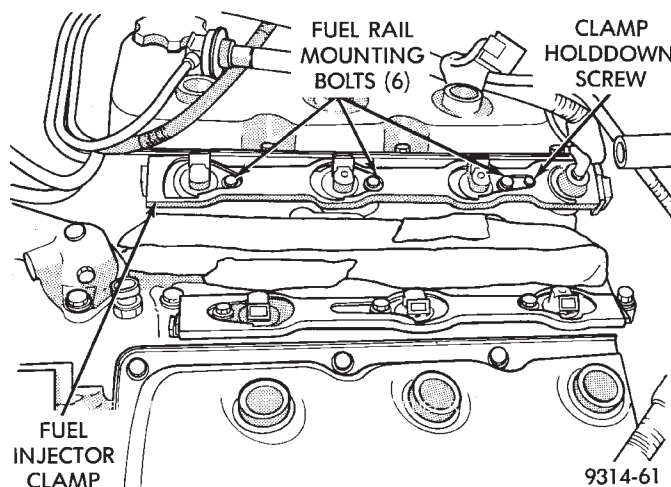


Fig. 26 Fuel Injector Clamp

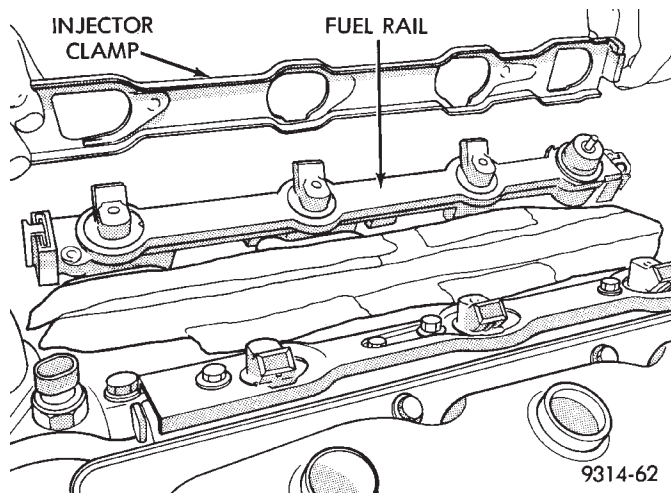


Fig. 27 Injector Clamp Removal/Installation

INSTALLATION

(1) Lightly lubricate the O-rings with a couple drops of clean engine oil.

REMOVAL AND INSTALLATION (Continued)

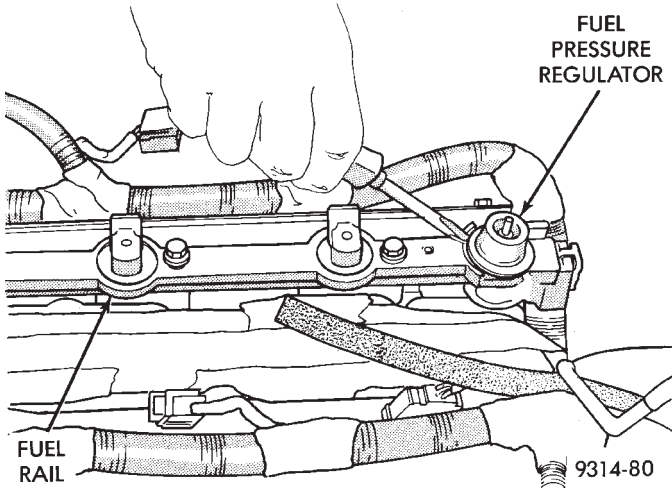


Fig. 28 Fuel Pressure Regulator Removal

- (2) Install fuel pressure regulator flush with fuel rail.
- (3) Remove fuel rail mounting bolts.
- (4) Install fuel injector clamps.
- (5) Tighten fuel rail mounting bolts to 11 N·m (100 in. lbs.) torque.
- (6) Install fuel injector clamp screw.
- (7) Attach electrical connectors to fuel injectors.
- (8) Install intake manifold plenum and new gasket. Refer to Intake Manifold Plenum—3.5L Engine in the Multi-Port Fuel Injection Service Procedure section of this Group.

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. 29).
- (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.

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.

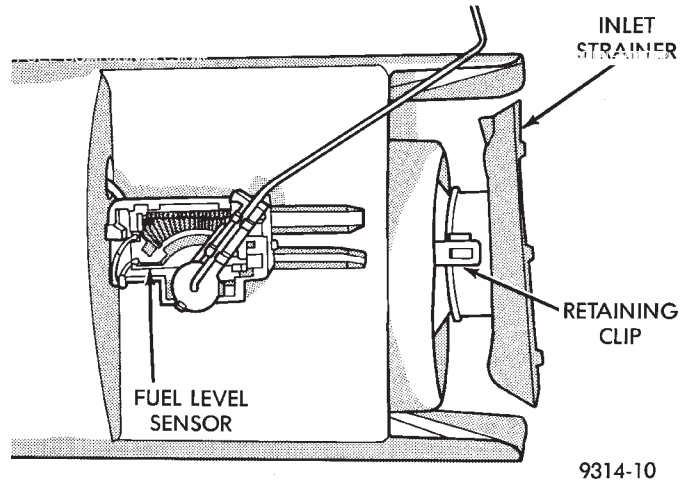


Fig. 29 Inlet Strainer Removal

- (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 the retaining tab and remove the fuel pump/level sensor connector from the bottom of the fuel pump module electrical connector (Fig. 30).

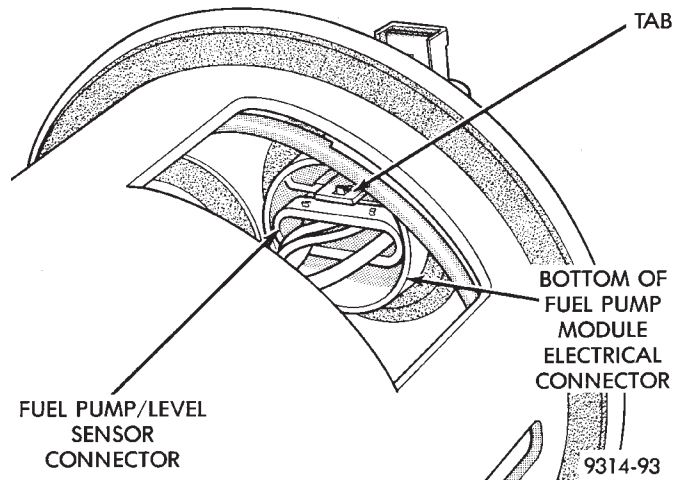


Fig. 30 Fuel Pump/Level Sensor Connector

REMOVAL AND INSTALLATION (Continued)

(2) Remove wire terminal retaining clip from connector (Fig. 31). Note the location of terminals for the level sensor wires (Fig. 32).

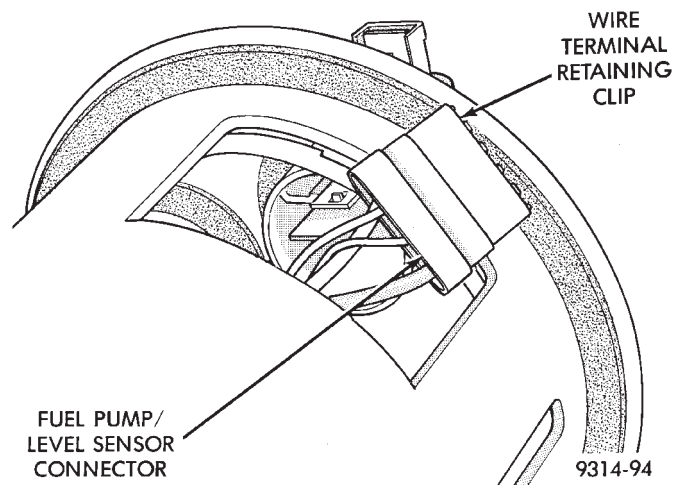


Fig. 31 Wire Terminal Retaining Clip

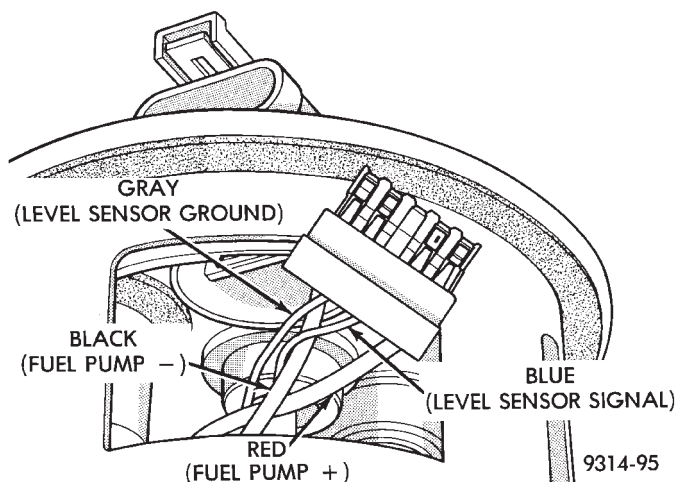


Fig. 32 Wire Terminal Identification

(3) Using special tool 7812 or an equivalent, push level sensor signal and ground terminals out of the connector (Fig. 33).

(4) Insert a screwdriver between the fuel pump module and the top of the level sensor housing (Fig. 34). Push level sensor down slightly.

(5) Slide level sensor wires through standpipe inside fuel pump module (Fig. 35).

(6) Slide level sensor out of installation channel (Fig. 34).

INSTALLATION

(1) Insert level sensor wires in bottom of standpipe.

(2) Wrap wires into groove in back of level sensor (Fig. 36).

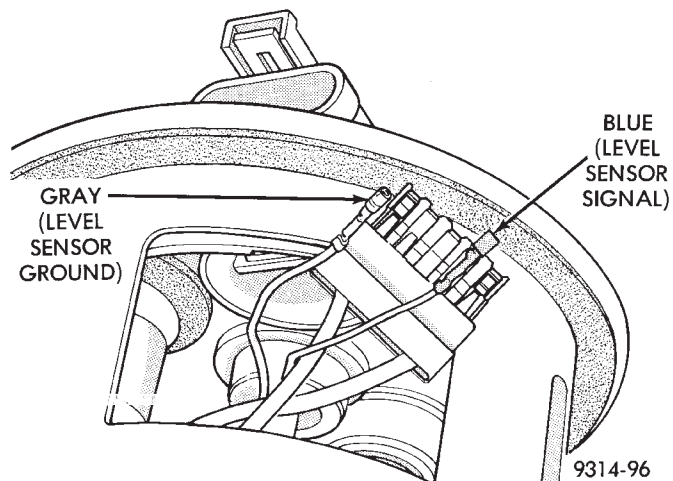


Fig. 33 Level Sensor Signal and Ground Wires

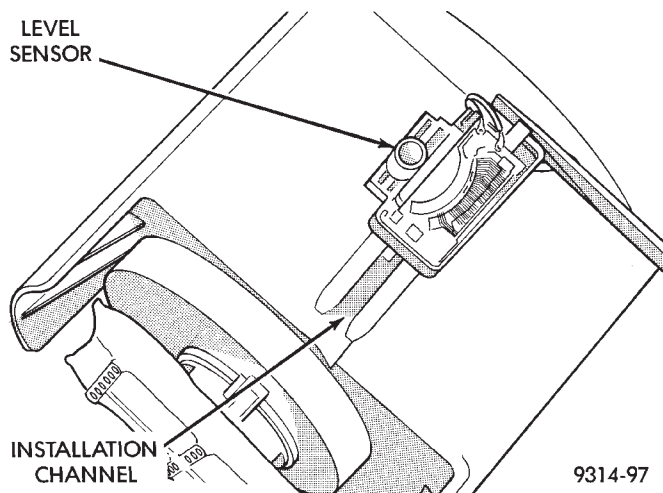


Fig. 34 Fuel Level Sensor Removal

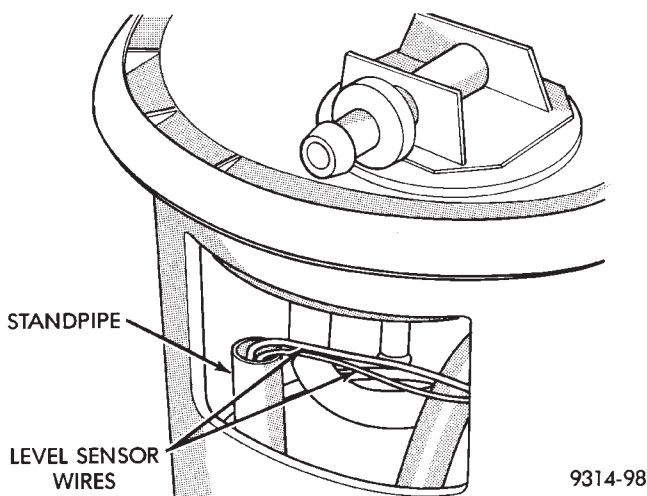
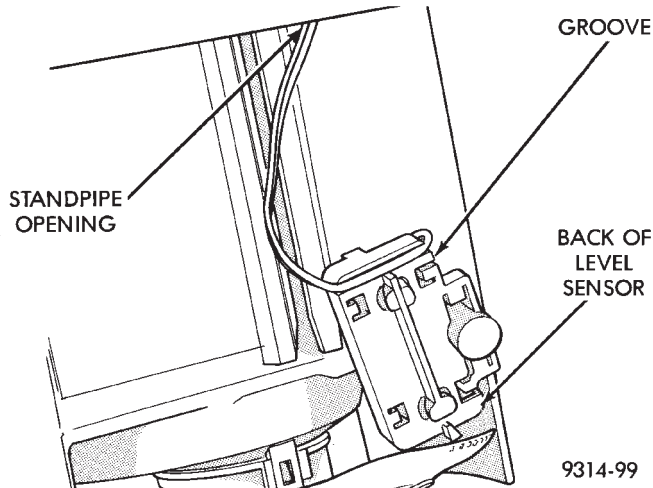


Fig. 35 Standpipe Inside Module

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

REMOVAL AND INSTALLATION (Continued)

**Fig. 36 Level Sensor Installation**

(4) Install level sensor wires in connector. Push the wires up through the connector and then pull them down until they lock in place. Ensure signal and ground wires are installed in the correct position (Fig. 32).

(5) Install retaining clip on connector.

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

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

FUEL RAIL—3.5L ENGINE**REMOVAL**

(1) Drain coolant and disconnect radiator upper hose from thermostat housing. Refer to Group 7, cooling system.

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

(3) Remove intake manifold plenum. Refer to Group 11, Exhaust System and Intake Manifold for intake removal for the 3.5L Engine.

(4) Using tool 6751, disconnect the fuel supply and return tubes from the fuel rail (Fig. 37). Refer to Metal Quick-Connect Fittings in the Fuel Delivery section of this group.

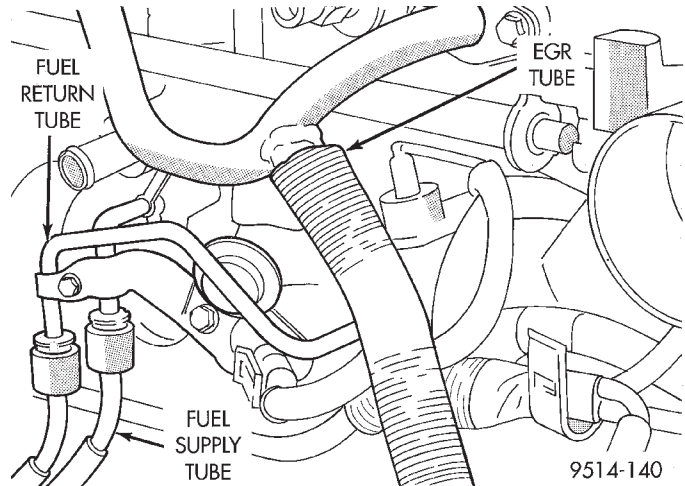
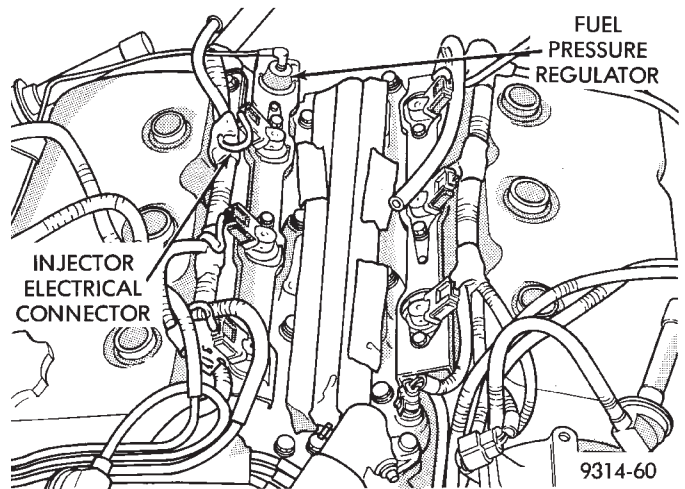
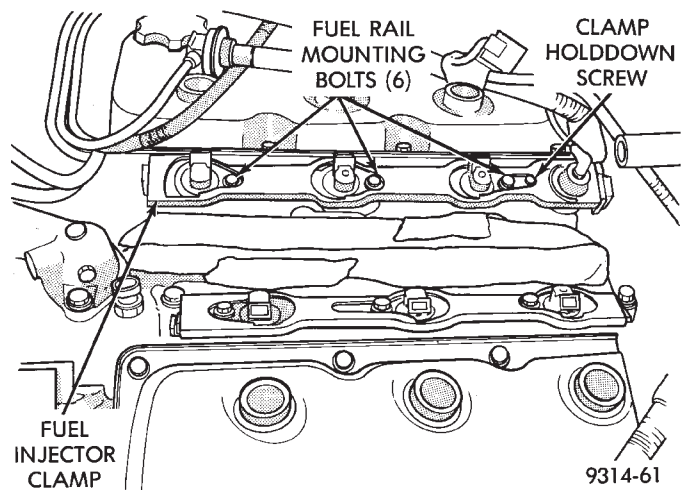
(5) If the injector connectors are not tagged with their cylinder number, tag them to identify the correct cylinder.

(6) Remove electrical connector from injectors.

(7) Remove the vacuum tube from the fuel pressure regulator (Fig. 38).

(8) Remove mounting bolts on both sides of fuel rail (Fig. 39).

(9) Lift fuel rail off of intake manifold plenum. Cover fuel injector openings in intake manifold plenum.

**Fig. 37 Fuel Supply and Return Tubes****Fig. 38 Injector Electrical Connectors****Fig. 39 Fuel Injector Clamp—3.5L Engine****INSTALLATION**

Use a new gasket when installing the rail.

(1) Lightly lubricate the fuel injector O-rings with a couple drops of clean engine oil.

REMOVAL AND INSTALLATION (Continued)

(2) Position fuel rail over openings in intake manifold plenum. Start injectors into openings and push rail into place. Tighten fuel rail mounting bolts to 11 N·m (100 in. lbs.) torque.

(3) Using tool 6751, connect fuel supply and return tubes to fuel rail at rear of engine (Fig. 37). Ensure quick connect fittings are fully seated to fuel rail. Refer to Metal Quick-Connect Fittings in the Fuel Delivery section of this Group.

(4) Attach electrical connectors to fuel injectors.

(5) Connect vacuum supply tube to fuel pressure regulator.

(6) Install intake manifold plenum. Refer to Group 11, Exhaust System and Intake Manifold for intake installation for the 3.5L.

(7) Install radiator upper hose. Fill and bleed cooling system. Refer to Group 7, Cooling System.

FUEL INJECTORS—3.5L ENGINE

REMOVAL

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

(2) Remove intake manifold plenum. Refer to Group 11, Exhaust System and Intake Manifold for intake removal/installation for the 3.5L Engine.

(3) Using tool 6751, disconnect the fuel supply and return tubes from the fuel rail. Refer to Metal Quick-Connect Fittings in the Fuel Delivery section of this group. Connect fuel gauge adapter 6631 to the fuel supply tube end of the rail. Connect fuel hose 6668 to the fuel return tube end of the rail.

(4) Place the other end of fuel hose 6668 into an approved gasoline container.

(5) To purge fuel from rail, spray a maximum of 379 kPa (55 psi) of compressed air into the end of adapter 6631 (Fig. 40).

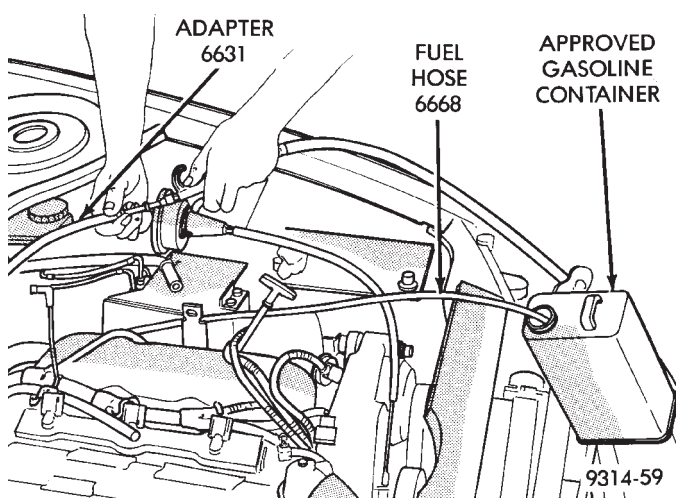


Fig. 40 Purging Fuel From Rail

(6) If the injector connectors are not tagged with their cylinder number, tag them to identify the correct cylinder.

(7) Remove electrical connector from injectors.

(8) Remove the vacuum tube from the fuel pressure regulator.

(9) Remove fuel rail mounting bolts.

(10) Remove injector clamp screw.

(11) Slide the injector clamp toward the rear of the engine, then lift the clamp off of the rail (Fig. 41).

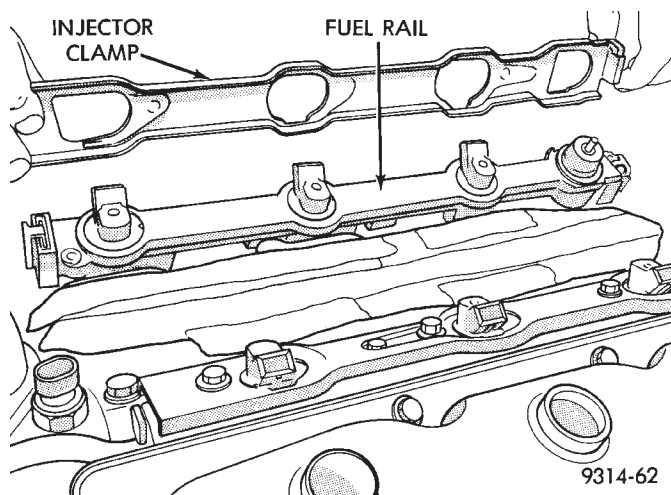


Fig. 41 Injector Clamp—3.5L Engine

(12) Install fuel rail mounting bolts finger tight.

(13) Using a thin flat screwdriver, pry the fuel injector out of the fuel rail (Fig. 42).

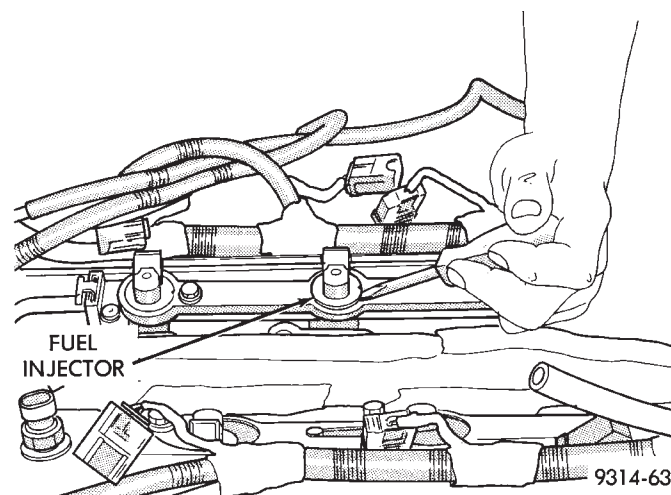


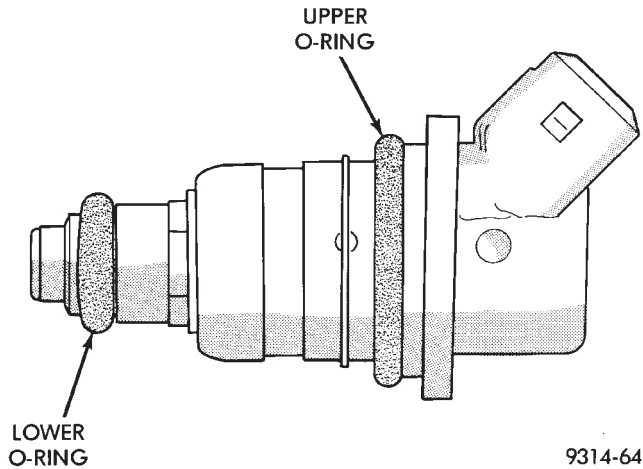
Fig. 42 Fuel Injector Removal—3.5L Engine

(14) Ensure the upper and lower o-rings were removed with the injector. If not, remove them from the injector well in fuel rail (Fig. 43).

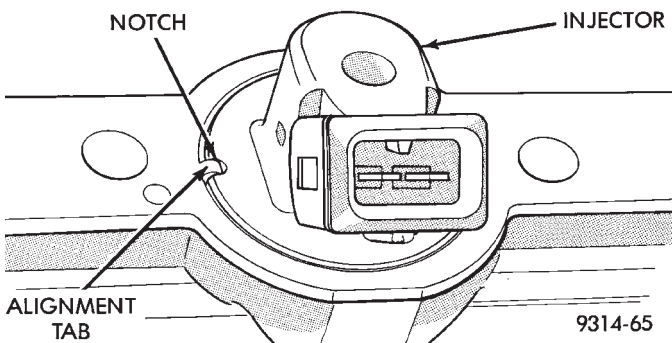
INSTALLATION

If the fuel rail was removed to service the injectors, use a new gasket when installing the rail.

REMOVAL AND INSTALLATION (Continued)

**Fig. 43 Fuel Injector O-rings—3.5L Engine**

- (1) Lightly lubricate the O-rings with a couple drops of clean engine oil.
- (2) When installing the injector, index the notch on the injector with the alignment tab on the fuel rail (Fig. 44).

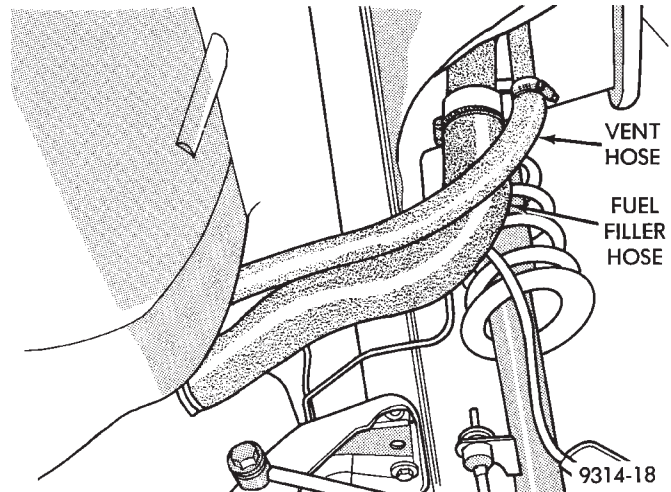
**Fig. 44 Fuel Injector Alignment—3.5L Engine**

- (3) Index injector with tab in fuel rail. Install injector.
- (4) Remove fuel rail mounting bolts.
- (5) Install fuel injector clamps.
- (6) Tighten fuel rail mounting bolts to 11 N·m (100 in. lbs.) torque.
- (7) Install fuel injector clamp screw.
- (8) Attach electrical connectors to fuel injectors.
- (9) Install intake manifold plenum. Refer to Group 11, Exhaust System and Intake Manifold for intake removal/installation for the 3.5L Engine.

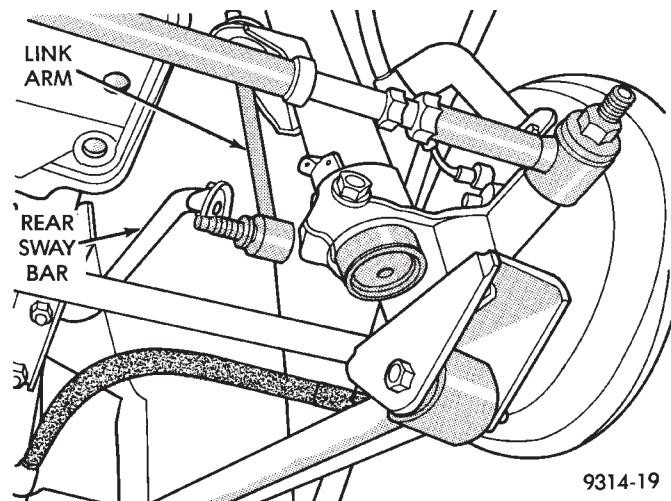
FUEL TANK**REMOVAL**

- (1) Release fuel system pressure. Refer to the Fuel System Pressure Release Procedure.
- (2) Drain the fuel tank. Refer to Draining Fuel Tank in this section.
- (3) Disconnect negative cable from battery.
- (4) Raise and support vehicle

- (5) Remove rear tires.
- (6) Pull exhaust pipe hangers rubber insulators off of mounting studs on frame rail at the rear of the vehicle and in front of the fuel tank.
- (7) Using a grease pencil, place alignment marks on the fuel filler hose and filler tube. Also mark the vent hose and vent tube. Remove splash shield from passenger side rear wheel well.
- (8) Remove the fuel filler and vent hose clamps. Remove the vent hose from the vent tube. Remove the filler hose from the filler tube (Fig. 45).

**Fig. 45 Fuel Filler and Vent Hoses**

- (9) Disconnect fuel supply tube from inlet side of fuel filter. Disconnect fuel return tube and vent tube near fuel filter. Refer to Quick Connect Fittings in the Fuel Delivery section of this group.
- (10) Disconnect both ends of the sway bar from the stabilizer links (Fig. 46).

**Fig. 46 Disconnecting Sway Bar Ends**

- (11) Use a grease pencil or marker to outline the position of the crossmember ends on the frame rail.

REMOVAL AND INSTALLATION (Continued)

- (12) Remove crossmember mounting bolts (Fig. 47).

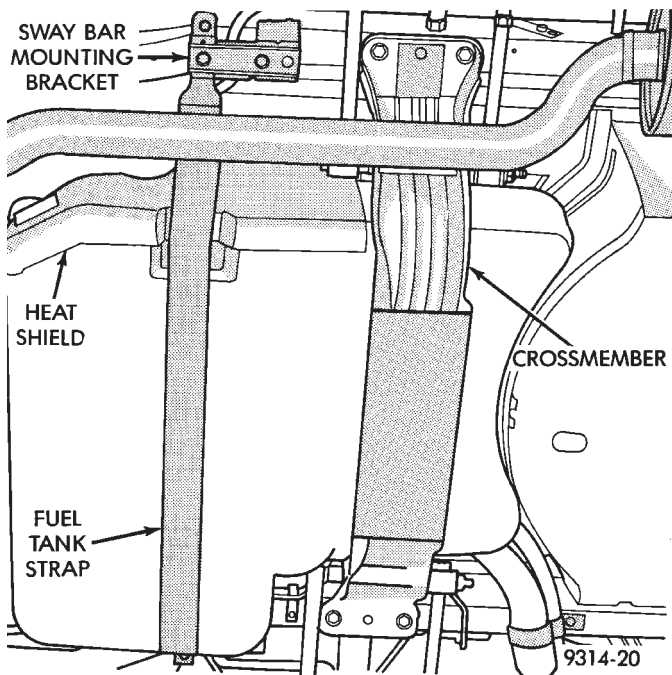


Fig. 47 Crossmember Bolts

- (13) Pull crossmember down until it stops.
(14) Place a transmission jack under fuel tank.

CAUTION: The sway bar bracket bolts must be replaced after loosening or removing them. Only use original equipment bolts as replacements.

- (15) Remove sway bar mounting brackets, heat shield, and fuel tank strap (Fig. 47).

- (16) To prevent sway bar from falling down, install sway bar mounting brackets with bolts finger tight (Fig. 48).

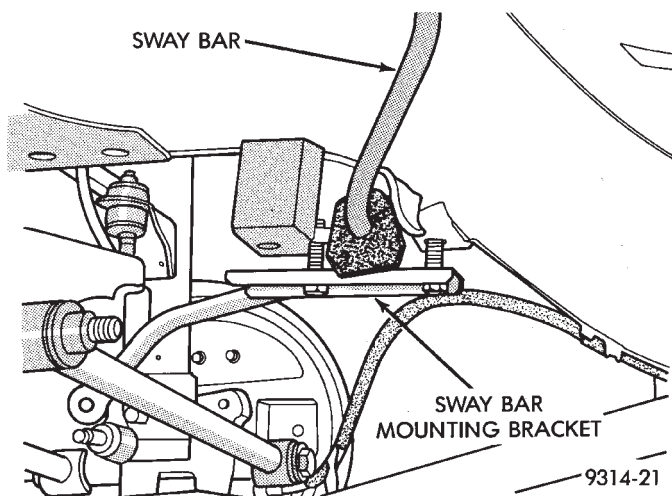


Fig. 48 Holding Sway Bar In Place

- (17) Center transmission jack. Lower jack enough to provide access to the fuel line and electrical connections on the fuel pump module at the top of the tank.

- (18) Disconnect electrical connector from fuel pump module.

- (19) Slightly lower the front of the tank. Slide tank away from crossmember while pushing filler vent and fill tube over the crossmember.

- (20) Lower fuel tank.

INSTALLATION

- (1) Position tank on transmission jack with shield and tank strap in place.

- (2) Raise and position tank over crossmember.

- (3) Raise tank enough to connect fuel pump module electrical connector.

- (4) Push vent and filler tube over the crossmember.

- (5) Rotate sway bar into position. Remove sway bar mounting brackets.

- (6) Raise tank into place. Position sway bar mounting brackets and fuel tank straps in place. Install and tighten bolts to 60 N·m (44 ft. lbs.) torque.

- (7) Raise crossmember into position. Align with outline of crossmember drawn on rail during removal. Install and tighten mounting bolts to 95 N·m (70 ft. lbs.) torque.

- (8) Connect filler tube and vent tube to fuel filler neck. Align marks made on hose and tube during removal.

- (9) Connect sway bar ends to link arms. Tighten sway bar mounting nuts to 100 N·m (74 ft. lbs.) torque.

- (10) Install exhaust system on hangers.

- (11) Connect fuel supply, return and vent tubes. Refer to Quick-Connect Fittings in the Fuel Delivery section of this group.

- (12) Lower vehicle.

- (13) Fill fuel tank.

- (14) Install fuel filler cap.

- (15) Connect negative cable to battery.

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.

- (16) With the ignition key in ON position, access the DRB ASD Fuel System Test to pressurize the fuel system. Check for leaks.

- (17) Install tires. Refer to Group 22 for tightening specifications.

- (18) Perform rear wheel alignment. Refer to Group 2, Suspension.

REMOVAL AND INSTALLATION (Continued)

FUEL FILLER NECK

REMOVAL

- (1) Disconnect negative cable from battery.
- (2) Drain fuel tank.
- (3) Remove 3 screws from filler neck to quarter panel.
- (4) Raise and support vehicle on host.
- (5) Loosen clamps at filler neck and vent tube
- (6) Remove filler neck.

INSTALLATION

- (1) Install filler neck to filler hose and vent hose.
- (2) Tighten clamps.
- (3) Lower vehicle.
- (4) Install 3 screws to filler neck and quarter panel.
- (5) Fill tank and check for leaks.
- (6) Connect negative cable from battery.

FUEL FILLER VENT HOSE

REMOVAL

- (1) Perform fuel system pressure release.
- (2) Disconnect negative cable from battery.
- (3) Drain fuel tank.
- (4) Raise and support vehicle on host.
- (5) Lower fuel tank, refer to Fuel Tank Removal/Installation in this section.
- (6) Remove vent hose from top of tank.
- (7) Remove vent hose from fuel filler neck.

INSTALLATION

- (1) Install vent hose and tighten clamp.
- (2) Install fuel tank, refer to Fuel Tank Removal/Installation in this section.
- (3) Install vent hose to fuel filler neck and tighten clamp.
- (4) Lower vehicle.
- (5) Fill fuel tank and check for leaks.
- (6) Connect negative cable to battery.

ROLLOVER VALVE

REMOVAL

- (1) Remove fuel pump module. Refer to Fuel Pump Module in this section.
- (2) Wedge the blade of a straight screwdriver between the rubber grommet and the fuel pump module. **To prevent damage to the valve, do not pry between the valve and the grommet.**
- (3) Use a second screwdriver as a support to pry the valve and grommet assembly from the module.
- (4) To remove the grommet, place the valve upright on a flat surface. Push down on the grommet and peel it off the valve.

INSTALLATION

- (1) Install the rubber grommet in the fuel pump module.
- (2) Lubricate the grommet with a light coating of **Power Steering Fluid**. Push the valve downward into the grommet. Twist valve until the ports are properly positioned (Fig. 49).
- (3) Install fuel pump module. Refer to Fuel Pump Module Installation in this section.

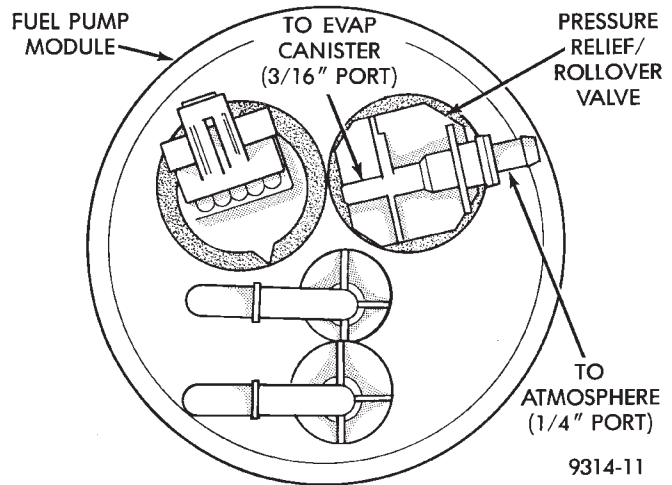


Fig. 49 Pressure Relief/Rollover Valve—Typical ACCELERATOR PEDAL

REMOVAL

- (1) Working from the engine compartment, hold the throttle body throttle lever in the wide open position. Remove the throttle cable from the throttle body cam.
- (2) 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. 50) and (Fig. 51).

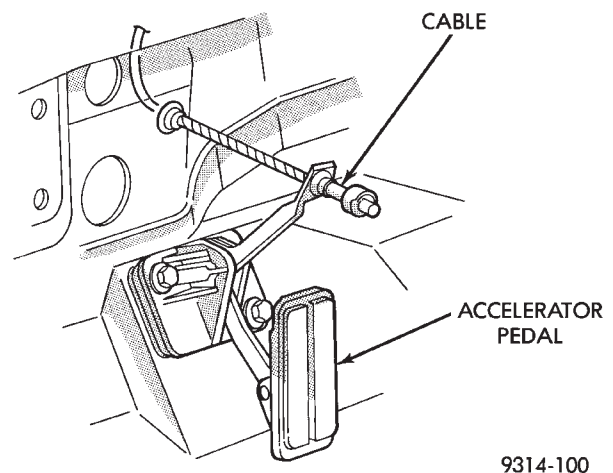
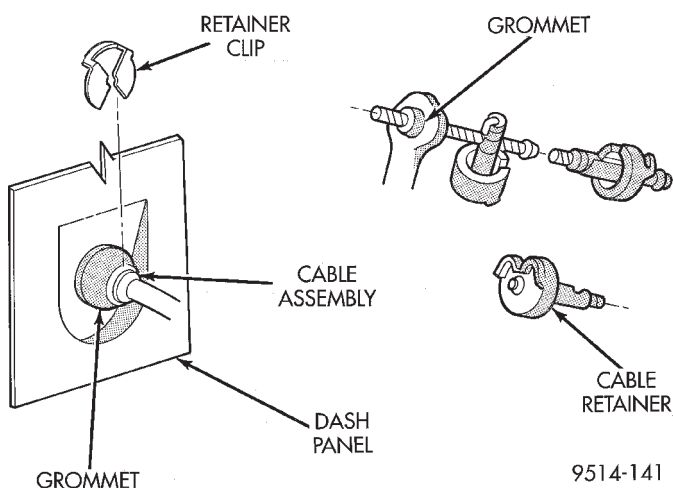
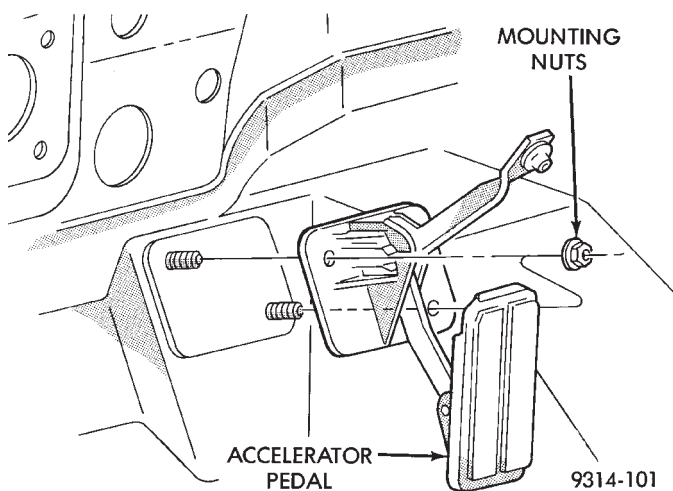


Fig. 50 Accelerator Pedal and Throttle Cable

REMOVAL AND INSTALLATION (Continued)

**Fig. 51 Throttle Cable Removal/Installation**

(3) Working from the passenger compartment, remove nuts from accelerator pedal base (Fig. 52). Remove pedal and base from vehicle.

**Fig. 52 Accelerator Pedal Removal/Installation****INSTALLATION**

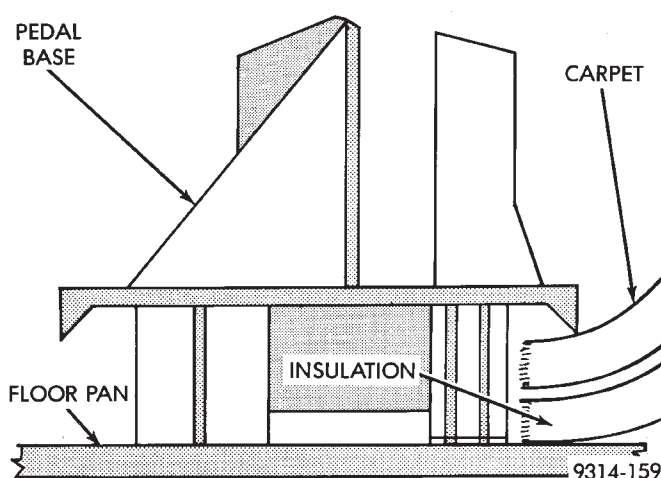
(1) Position accelerator pedal assembly over studs onto dash panel. Ensure carpet and insulation are trapped between the lip of the pedal base and the floor pan (Fig. 53). Install mounting nuts and tighten to 12 N·m (105 in. lbs.) torque.

(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.

THROTTLE CABLE

CAUTION: When servicing the accelerator pedal, throttle cable or speed control cable, do not dam-

**Fig. 53 Carpet and Insulation Placement**

age or kink the core wire inside the cable sheathing.

REMOVAL

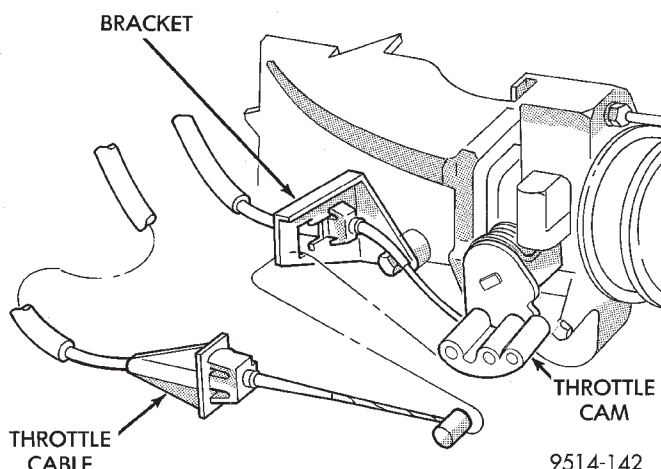
(1) Working from the engine compartment, hold the throttle body throttle lever in the wide open position. Pull the cable forward and slide it out of the throttle body cam (Fig. 54) or (Fig. 55).

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

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

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

(5) Remove the throttle cable from throttle bracket by carefully compressing both retaining ears simultaneously. Then gently pull the throttle cable from throttle bracket.

**Fig. 54 Throttle Cable Removal/Installation—3.3L Engine**

REMOVAL AND INSTALLATION (Continued)

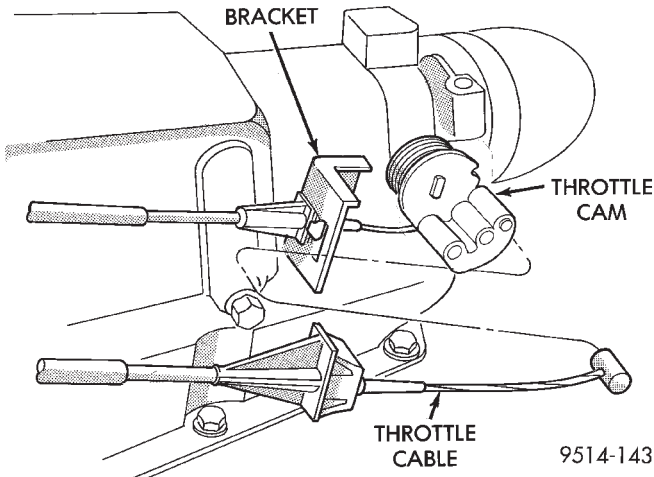


Fig. 55 Throttle Cable Removal/Installation—3.5L Engine

INSTALLATION

- (1) From the engine compartment, push the housing end fitting into the dash panel grommet.
- (2) Install the cable housing (throttle body end) into the cable mounting bracket on the engine.
- (3) From inside the vehicle, hold up the pedal and install throttle cable and cable retainer in the upper end of the pedal shaft.
- (4) At the dash panel, install the cable retainer clip between the end of the throttle cable fitting and grommet.
- (5) From the engine compartment, rotate the throttle lever to wide open and install the throttle cable. **On 3.5L engines, ensure the power steering hose is routed through the hook on the throttle cable mounting bracket (Fig. 56). Make sure the throttle cam and power steering hose do not bind.**

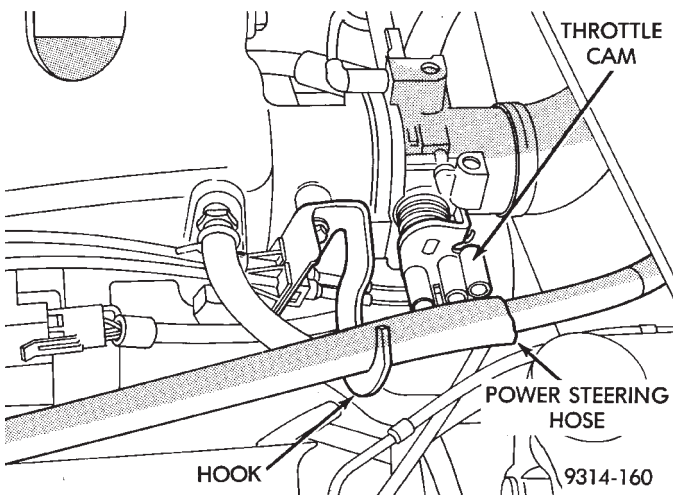


Fig. 56 Power Steering Hose and Bracket—3.5L Engine

METAL QUICK CONNECT FITTINGS

REMOVAL

While this procedure specifies disconnecting and connect fuel tube/quick-connect fittings from the fuel rail, it applies to the same operations for the fuel filter outlet. Special tool 6751 is specified for the fuel rail connections due to limited access. Special tool 6751 is not specified for the fuel filter, although it can be used.

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

- (1) Disconnect negative cable from the battery.
- (2) Perform the Fuel Pressure Release Procedure. Refer to the Fuel Pressure Release Procedure in this section.
- (3) Remove any loose dirt from quick connect fittings.

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

- (4) At the fuel rail, push the quick connect fitting toward the fuel tube while depressing the built-in disconnect tool with special tool 6751. To disconnect fitting from fuel rail, slightly twist the fitting and while maintaining downward pressure on special tool 6751 (Fig. 57).

- (5) Cover the fitting to prevent contamination.

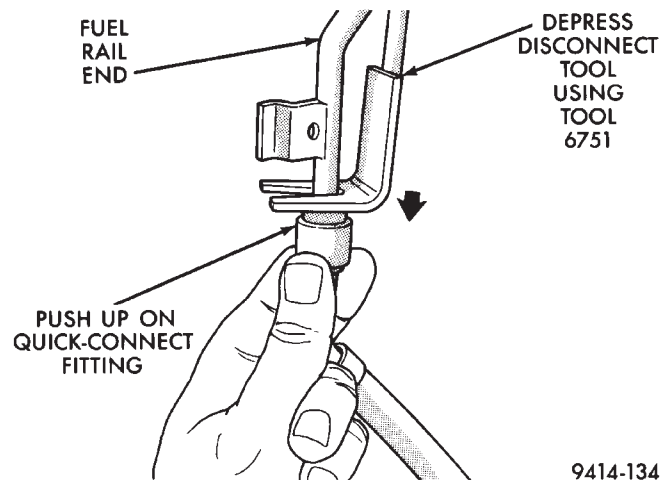


Fig. 57 Disconnecting Quick-Connect Fittings at Fuel Rail

INSTALLATION

- (1) Ensure the black plastic release ring is in the **OUT** position. If the locking retainer is stuck in the **RELEASE** position due to mushrooming of the dis-

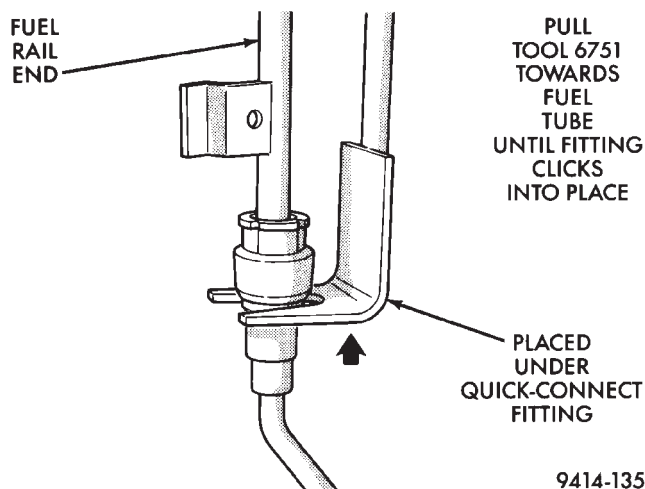
REMOVAL AND INSTALLATION (Continued)

connect tool or dirt accumulation, replace the fitting and tube assembly.

(2) Lubricate the fuel tube nipple with clean 30 weight engine oil.

(3) Start the quick-connect fitting on the fuel rail nipple by hand.

(4) Place special tool 6751 below the largest diameter of the quick-connect fitting (Fig. 58).



9414-135

Fig. 58 Connecting Quick-Connect Fitting to Fuel Rail

(5) Pull special tool 6751 toward fuel tube nipple until quick-connect fitting clicks into place. When quick-connect fitting clicks into place, the retainer holds the fuel nipple shoulder in place and the O-rings seal the tube.

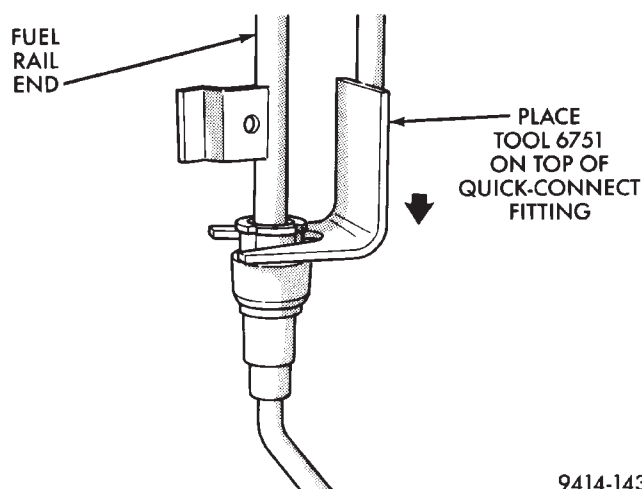
(6) Place special tool 6751 between shoulder of the disconnect tool and the top of the quick-connect body (Fig. 59).

(7) Inspect connection by pushing down on special tool 6751. **When inspecting the connection, a slight downward movement of the quick-connect fitting occurs until the retainer in the fitting contact the fuel tube nipple shoulder. Once the retainer contact the shoulder all movement should stop. If the quick-connect fitting comes off of the fuel rail, attach it according to the installation procedure. Ensure the black plastic**

disconnect tool is not causing the retainer fingers to jam in the release position.

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.

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



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Fig. 59 Inspecting Quick-Connect Fitting Connection

SPECIFICATIONS

TORQUE SPECIFICATION

DESCRIPTION	TORQUE
Accelerator Pedal to Dash Nuts . . .	12 N·m (105 in. lbs.)
Fuel Filter Mounting Screw . . .	12 N·m (110 in. lbs.)
Fuel Pressure regulator	
Holddown Screw	7 N·m (60 in. lbs.)
Fuel Pump Module Band	
Clamp	4 N·m (31 in. lbs.)
Fuel Pump Module Locknut	55 N·m (40 ft. lbs.)
Fuel Tank strap Bolts	60 N·m (44 ft. lbs.)
Fuel Rail Bolts—3.3L	23 N·m (195 in. lbs.)
Fuel Rail Bolts—3.5L	11 N·m (100 in. lbs.)
Ignition Coil Mounting Bolts . .	12 N·m (105 in. lbs.)
Intake Manifold Bolts	23 N·m (200 in. lbs.)

FUEL INJECTION SYSTEM

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GENERAL INFORMATION

INTRODUCTION

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

The PCM regulates:

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

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

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

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

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

MODES OF OPERATION

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

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

During OPEN LOOP modes the PCM receives input signals and responds according to preset PCM

programming. Inputs from the upstream and downstream heated oxygen sensors are not monitored during OPEN LOOP modes, except for heated oxygen sensor diagnostics (they are checked for shorted conditions at all times).

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

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

- (1) Engine coolant temperature must be over 35°F.
 - If the coolant is over 35° the PCM will wait 44 seconds.
 - If the coolant is over 50°F the PCM will wait 38 seconds.
 - If the coolant is over 167°F the PCM will wait 11 seconds.
- (2) For other temperatures the PCM will interpolate the correct waiting time.
- (3) O2 sensor must read either greater than .745 volts or less than .1 volt.
- (4) The multi-port fuel injection systems has the following modes of operation:

- Ignition switch ON (Zero RPM)
- Engine start-up
- Engine warm-up
- Cruise
- Idle
- Acceleration
- Deceleration
- Wide Open Throttle
- Ignition switch OFF

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

GENERAL INFORMATION (Continued)

IGNITION SWITCH ON (ZERO RPM) MODE

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

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

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

ENGINE START-UP MODE

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

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

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

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

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

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

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

- The number of engine revolutions since cranking was initiated

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

ENGINE WARM-UP MODE

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

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

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

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

CRUISE OR IDLE MODE

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

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

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

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

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

GENERAL INFORMATION (Continued)

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

The PCM performs several diagnostic routines. They include:

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

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

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

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

ACCELERATION MODE

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

DECELERATION MODE

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

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

The PCM may receive a closed throttle input from the Throttle Position Sensor (TPS) when it senses an

abrupt decrease in manifold pressure. This indicates a hard deceleration. In response, the PCM may momentarily turn off the injectors. This helps improve fuel economy, emissions and engine braking.

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

WIDE-OPEN-THROTTLE MODE

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

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

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

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

IGNITION SWITCH OFF MODE

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

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

DESCRIPTION AND OPERATION**SYSTEM DIAGNOSIS**

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

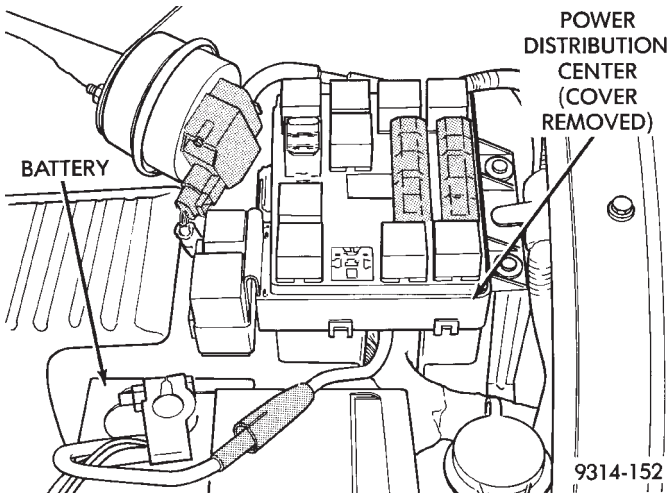
Technicians can display stored DTC's by two different methods.

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

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.

DESCRIPTION AND OPERATION (Continued)

**Fig. 1 Power Distribution Center (PDC)****CCD BUS**

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

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

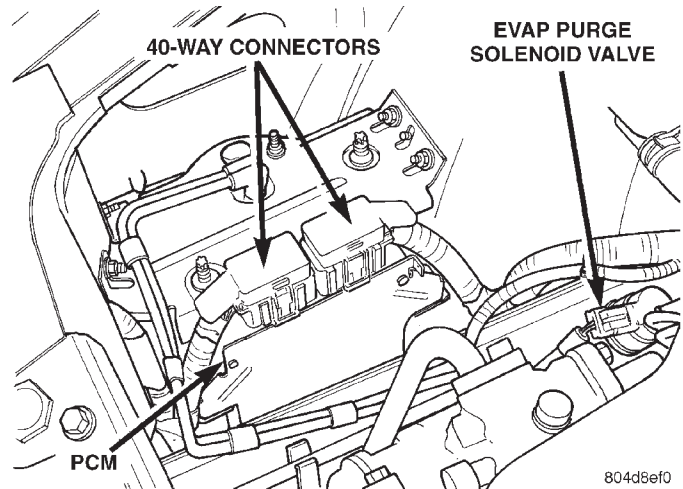
- Instrument Panel
- Body Control Module
- Air Bag System Diagnostic Module
- Full ATC Display Head
- ABS Module
- Transmission Control Module
- Powertrain Control Module
- Overhead Travel Module

POWERTRAIN CONTROL MODULE

The powertrain control module (PCM) is a digital computer containing a microprocessor (Fig. 2). The PCM receives input signals from various switches and sensors referred to as Powertrain Control Module Inputs. Based on these inputs, the PCM adjusts various engine and vehicle operations through devices referred to as Powertrain Control Module Outputs.

NOTE: PCM Inputs:

- Air Conditioning Pressure Transducer
- Battery Voltage
- Brake Switch
- Camshaft Position Sensor
- CCD Bus

**Fig. 2 Powertrain Control Module (PCM)**

- Crankshaft Position Sensor
- Intake Air Temperature Sensor (3.3L Only)
- Distance Sensor (from transmission control module)
- Transaxle Control Module (TCM)
- Transaxle Gear Engagement (From TCM)
- Torque Management Input (From TCM)
- Engine Coolant Temperature Sensor
- Knock Sensor (3.5L Engine only)
- Manifold Absolute Pressure (MAP) Sensor
- Heated Oxygen Sensors
- Ignition sense
- Park/Neutral (from transmission control module)
- SCI Receive
- Speed Control
- Throttle Position Sensor
- Vehicle Speed (from transmission control module)

NOTE: PCM Outputs:

- Air Conditioning Clutch Relay
- Automatic Shut Down (ASD) and Fuel Pump Relays
- Data Link Connector (CCD and SCI Transmit)
- Duty Cycle EVAP Purge Solenoid
- EGR Solenoid
- Fuel Injectors
- Generator Field
- High Speed Fan Relay
- Idle Air Control Motor
- Ignition Coils
- Low Speed Fan Relay
- MTV Solenoid
- Speed Control Relay
- Speed Control Vent Relay
- Speed Control Vacuum Relay

Based on inputs it receives, the powertrain control module (PCM) adjusts fuel injector pulse width, idle

DESCRIPTION AND OPERATION (Continued)

speed, ignition timing, and canister purge operation. The PCM regulates the cooling fans, air conditioning and speed control systems. The PCM changes generator charge rate by adjusting the generator field.

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

- Battery Voltage
- Intake Air Temperature Sensor (3.3L Only)
- Engine Coolant Temperature
- Engine Speed (crankshaft position sensor)
- Exhaust Gas Oxygen Content (heated oxygen sensors)

- Manifold Absolute Pressure

- Throttle Position

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

- Brake Switch
- Engine Coolant Temperature
- Engine Speed (crankshaft position sensor)
- Park/Neutral (transmission gear selection)
- Transaxle Gear Engagement
- Throttle Position
- Vehicle Speed (from transmission control module)

The PCM adjusts ignition timing based on the following inputs.

- Intake Air Temperature (3.3L Only)
- Engine Coolant Temperature
- Engine Speed (crankshaft position sensor)
- Knock Sensor
- Manifold Absolute Pressure
- Park/Neutral (transmission gear selection)
- Transaxle Gear Engagement
- Throttle Position

The automatic shut down (ASD) and fuel pump relays are mounted externally, but turned on and off by the powertrain control module through the same circuit.

The camshaft and crankshaft signals are sent to the powertrain control module. If the PCM does not receive both signals within approximately one second of engine cranking, it deactivates the ASD and fuel pump relays. When these relays are deactivated, power is shut off to the fuel injectors, ignition coils, fuel pump and the heating element in each oxygen sensor.

The PCM contains a voltage converter that changes battery voltage to a regulated 8.0 volts. The 8.0 volts power the camshaft position sensor, crankshaft position sensor and vehicle speed sensor. The PCM also provides a 5.0 volts supply for the engine coolant temperature sensor, intake air temperature sensor, manifold absolute pressure sensor and throttle position sensor.

The PCM engine control strategy prevents reduced idle speeds until after the engine operates for 320 km

(200 miles). If the PCM is replaced after 320 km (200 miles) of usage, update the mileage in new PCM. Use the DRB scan tool to change the mileage in the PCM. Refer to the appropriate Powertrain Diagnostic Manual and the DRB scan tool.

AIR CONDITIONING PRESSURE TRANSDUCER—PCM INPUT

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

AUTOMATIC SHUTDOWN (ASD) SENSE—PCM INPUT

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

When energized, the ASD relay supplies battery voltage to the fuel injectors, ignition coils and the heating element in each oxygen sensor. If the PCM does not receive 12 volts from this input after grounding the ASD relay, it sets a Diagnostic Trouble Code (DTC).

BATTERY VOLTAGE—PCM INPUT

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

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

BATTERY TEMPERATURE SENSOR—PCM INPUT

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

BRAKE SWITCH—PCM INPUT

When the brake switch is activated, the PCM receives an input indicating that the brakes are being applied. After receiving this input the PCM maintains idle speed to a scheduled RPM through control of the idle air control motor. The brake switch is mounted on the brake pedal support bracket.

CAMSHAFT POSITION SENSOR—PCM INPUT

The camshaft position sensor provides cylinder identification to the powertrain control module (PCM) (Fig. 3) or (Fig. 4). The sensor generates

DESCRIPTION AND OPERATION (Continued)

pulses as groups of notches on the camshaft sprocket pass underneath it (Fig. 5) or (Fig. 6). The PCM keeps track of crankshaft rotation and identifies each cylinder by the pulses generated by the notches on the camshaft sprocket. Four crankshaft pulses follow each group of camshaft pulses.

When the PCM receives two cam pulses followed by the long flat spot on the camshaft sprocket, it knows that the crankshaft timing marks for cylinder one are next (on driveplate). When the PCM receives one camshaft pulse after the long flat spot on the sprocket, cylinder number two crankshaft timing marks are next. After 3 camshaft pulses, the PCM knows cylinder four crankshaft timing marks follow. One camshaft pulse after the three pulses indicates cylinder five. The two camshaft pulses after cylinder 5 signals cylinder six (Fig. 5) or (Fig. 6). The PCM can synchronize on cylinders 1 or 4.

When metal aligns with the sensor, voltage goes low (less than 0.3 volts). When a notch aligns with the sensor, voltage spikes high (5.0 volts). As a group of notches pass under the sensor, the voltage switches from low (metal) to high (notch) then back to low. The number of notches determine the amount of pulses. If available, an oscilloscope can display the square wave patterns of each timing events.

Top dead center (TDC) does not occur when notches on the camshaft sprocket pass below the cylinder. TDC occurs after the camshaft pulse (or pulses) and after the 4 crankshaft pulses associated with the particular cylinder. The arrows and cylinder call outs on Figures 5 and 6 represent which cylinder the flat spot and notches identify, they do not indicate TDC position.

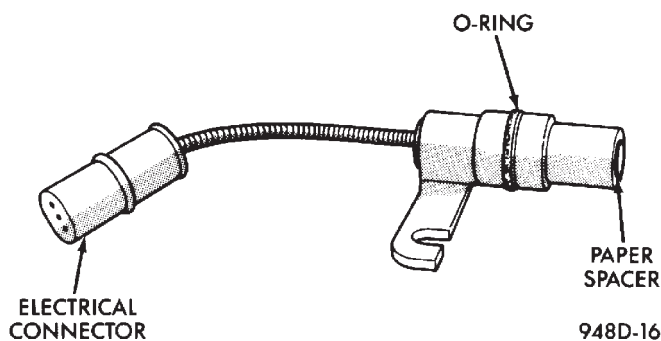


Fig. 3 Camshaft Position Sensor—3.3L Engine

The camshaft position sensor is mounted in the front of the timing case cover (Fig. 7) or (Fig. 8).

CRANKSHAFT POSITION SENSOR—PCM INPUT

The crankshaft position sensor detects slots cut into the transmission driveplate extension. There are 3 sets of slots. Each set contains 4 slots, for a total of 12 slots (Fig. 9). Basic timing is set by the position of the last slot in each group. Once the powertrain

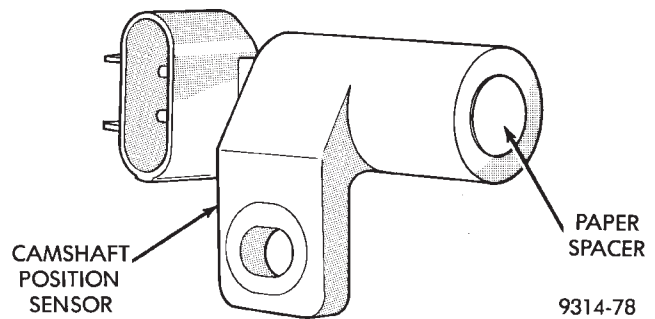


Fig. 4 Camshaft Position Sensor—3.5L Engine

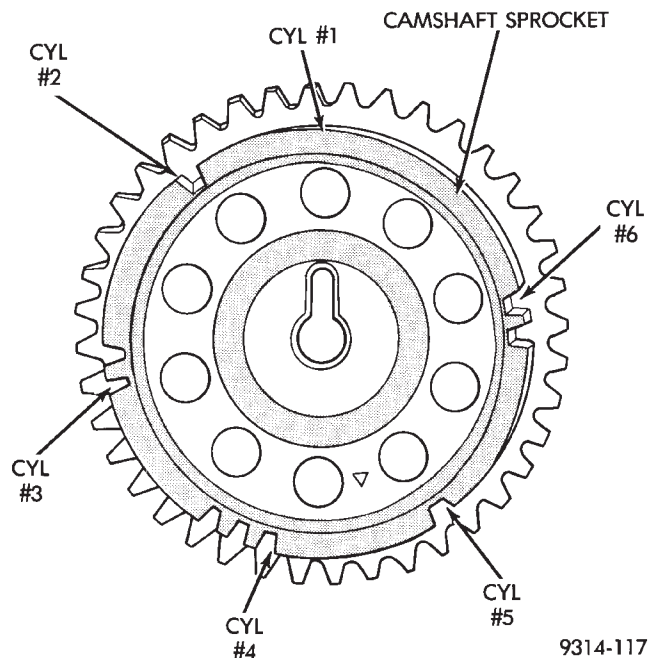


Fig. 5 Camshaft Sprocket—3.3L Engine

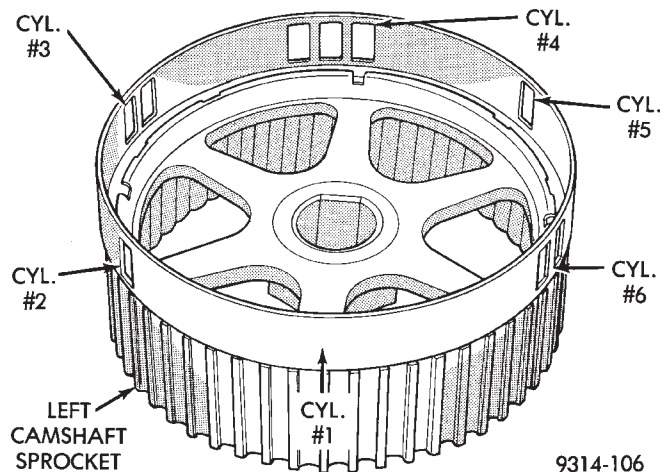


Fig. 6 Camshaft Sprocket—3.5L Engine

control module (PCM) senses the last slot, it determines crankshaft position (which piston will next be at TDC) from the camshaft position sensor input.

DESCRIPTION AND OPERATION (Continued)

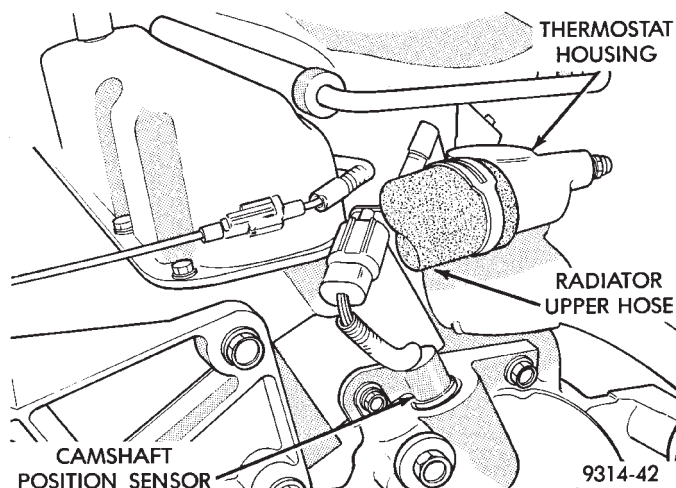


Fig. 7 Camshaft Position Sensor Location—3.3L Engine

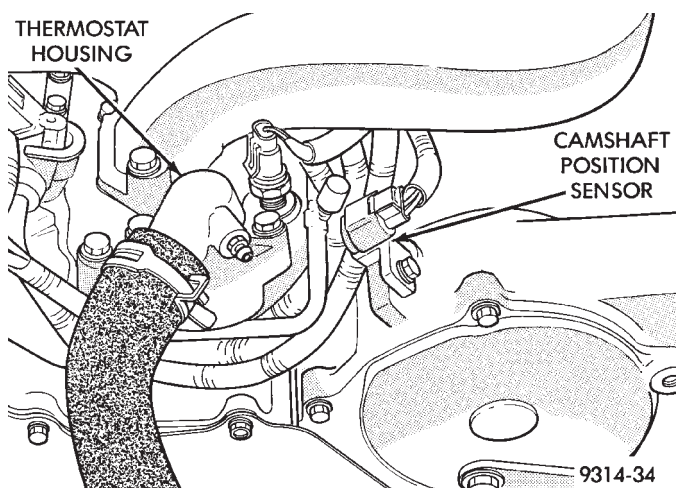


Fig. 8 Camshaft Position Sensor Location—3.5L Engine

The 4 pulses generated by the crankshaft position sensor represent the 69°, 49°, 29°, and 9° BTDC marks. It may take the PCM one engine revolution to determine crankshaft position.

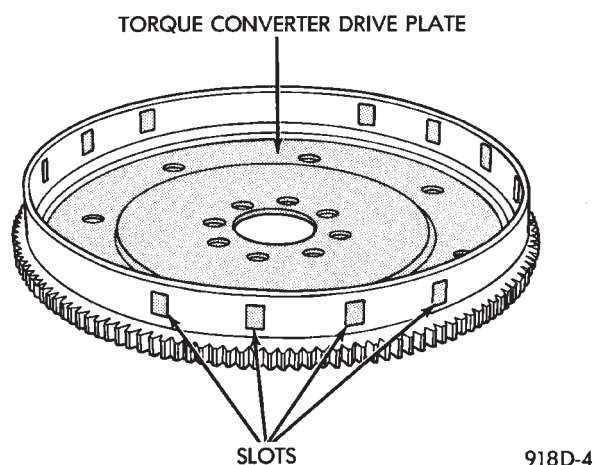


Fig. 9 Timing Slots

The PCM uses crankshaft position reference to determine injector sequence and ignition timing. Once the PCM determines crankshaft position, it begins energizing the injectors in sequence.

The crankshaft sensor is located on the passengers side of the transmission housing, above the differential housing (Fig. 10). The bottom of the sensor is positioned next to the drive plate.

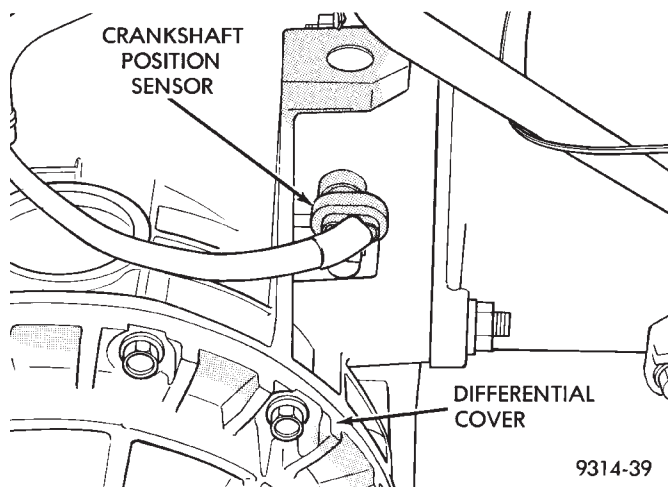


Fig. 10 Crankshaft Position Sensor Location

ENGINE COOLANT TEMPERATURE SENSOR—PCM INPUT

The engine coolant temperature sensor threads into the water jacket next to thermostat housing (Fig. 11) or (Fig. 12). The sensor provides an input to the powertrain control module (PCM). As coolant temperature varies, the sensor resistance changes, resulting in a different input voltage to the PCM.

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

The engine coolant sensor input also determines operation of the low and high speed cooling fans.

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 converter deteriorates. The deterioration results in a less efficient catalyst. To monitor catalytic converter deterioration, the fuel injection system uses two

DESCRIPTION AND OPERATION (Continued)

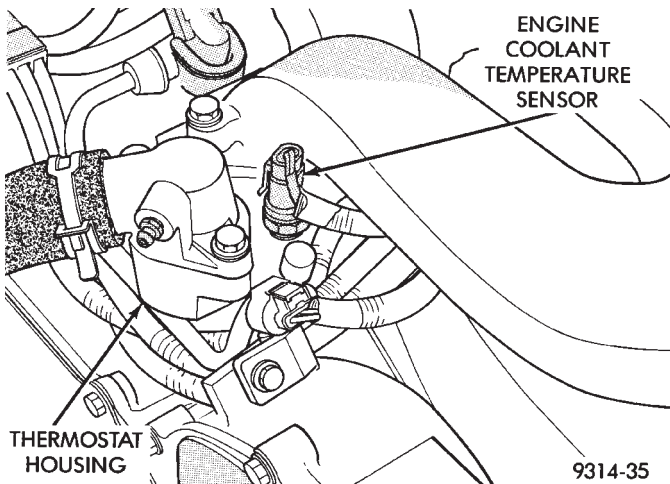


Fig. 11 Engine Coolant Temperature Sensor—3.3L Engine

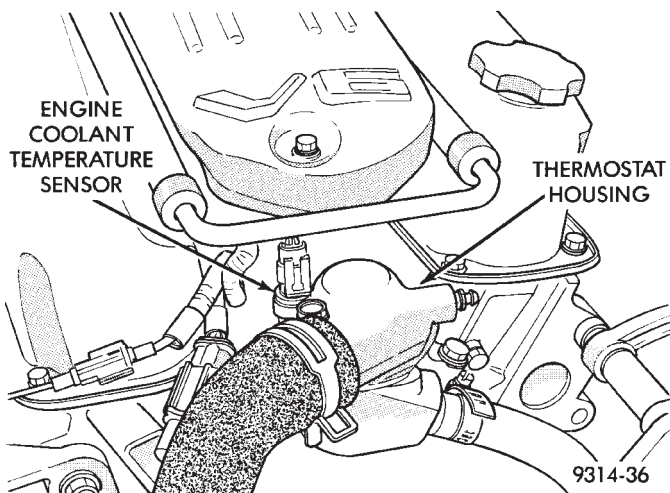


Fig. 12 Engine Coolant Temperature Sensor—3.5L Engine

heated oxygen sensors. One sensor upstream of the catalytic converter, one downstream of the converter. The PCM compares the reading from the sensors to calculate the catalytic converter oxygen storage capacity and converter efficiency. Also, the PCM uses the upstream heated oxygen sensor input when adjusting injector pulse width.

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

The 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.

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. 13) or (Fig. 14).

DOWNSTREAM OXYGEN SENSOR

The downstream heated oxygen sensor threads into the outlet pipe at the rear of the catalytic converter (Fig. 15). The downstream heated oxygen sensor

DESCRIPTION AND OPERATION (Continued)

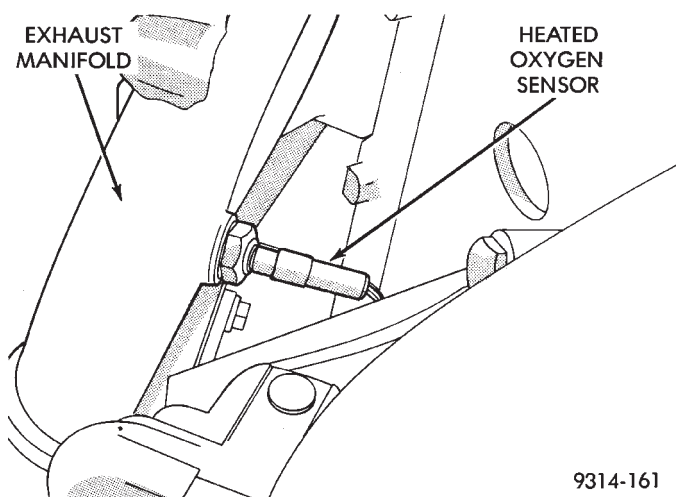


Fig. 13 Upstream Heated Oxygen Sensor—3.3L

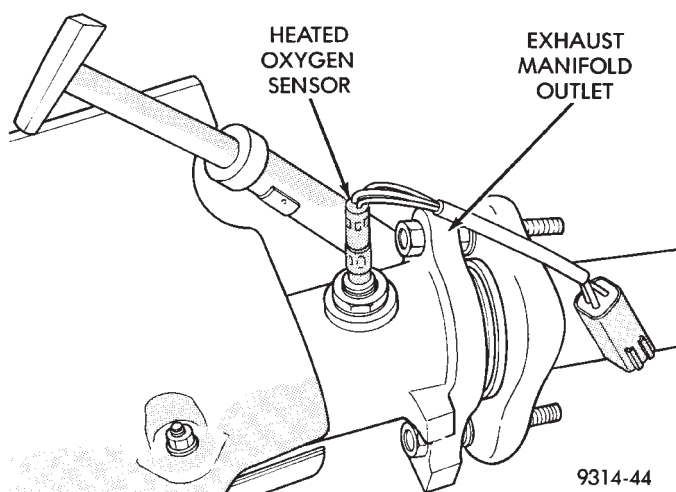


Fig. 14 Upstream Heated Oxygen Sensor—3.5L

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

IGNITION SENSE—PCM INPUT

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

KNOCK SENSORS (3.5L ENGINE)—PCM INPUT

Only the 3.5L engine uses knock sensors. The 3.5L engine has two knock sensors. One sensor for the right bank of cylinders, one for the left bank. The knock sensors thread into the top of the cylinder block below the cylinder heads (Fig. 16). When a knock sensor detects a knock in one of the cylinders,

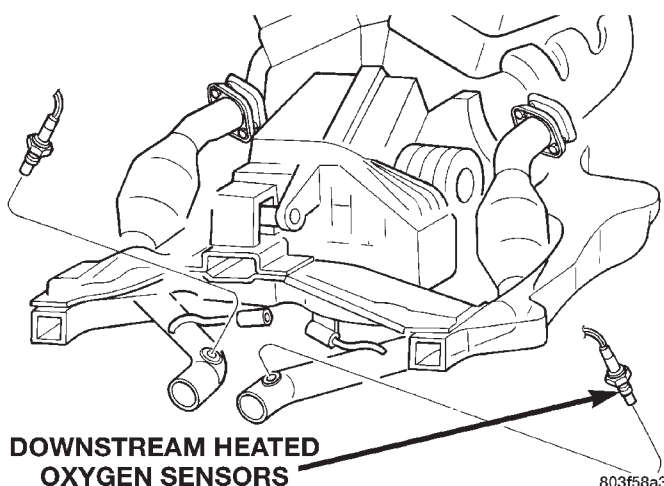


Fig. 15 Downstream Heated Oxygen Sensor

it sends an input signal to the PCM. In response, the PCM retards ignition timing by a scheduled amount.

Knock sensors contain a crystal which constantly vibrates and sends an input voltage (signal) to the PCM while the engine operates. As the intensity of the crystal's vibration increase, the knock sensor output voltage also increases.

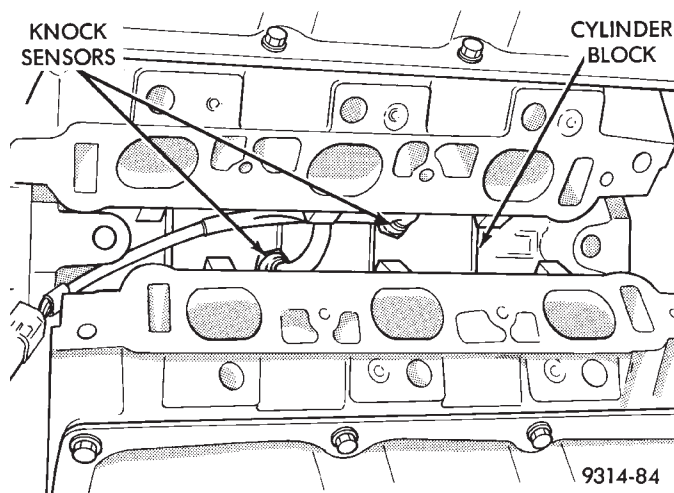


Fig. 16 Knock Sensor Locations—3.5L Engine Only
MANIFOLD ABSOLUTE PRESSURE SENSOR—PCM INPUT

The Powertrain Control Module (PCM) supplies 5 volts 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.

During cranking, before the engine starts running, 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 volt-

DESCRIPTION AND OPERATION (Continued)

age and inputs from other sensors, the PCM adjusts spark advance and the air/fuel mixture.

On the 3.3L engines the MAP sensor mounts to the rear of the intake manifold plenum (Fig. 17). On the 3.5L engines, the MAP sensor mounts to the driver side of the intake manifold plenum (Fig. 18). The MAP sensor must be horizontal.

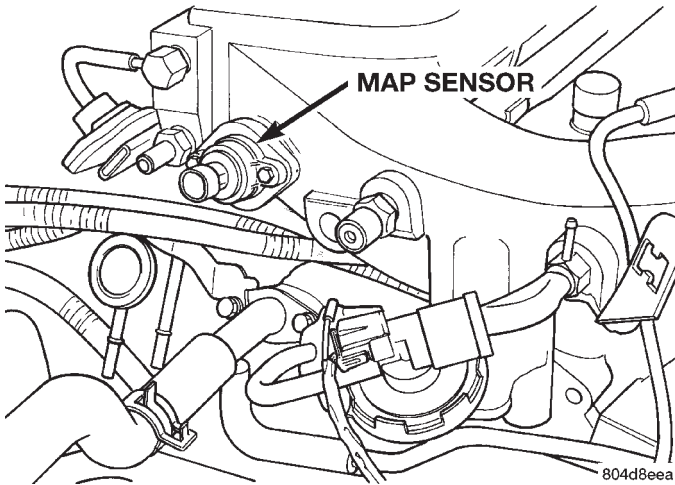


Fig. 17 MAP Sensor—3.3L Engine

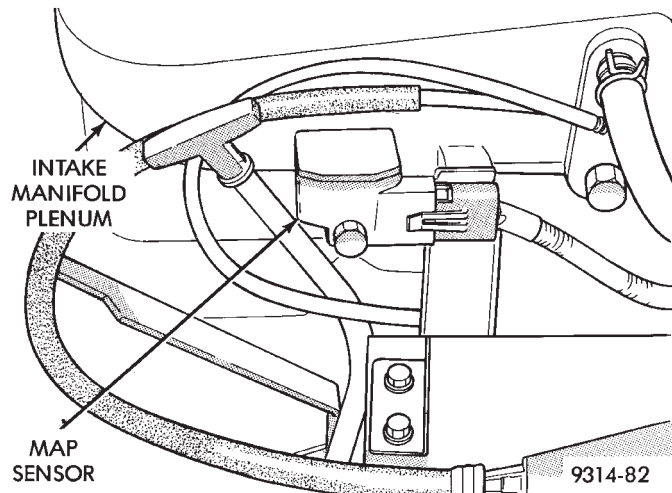


Fig. 18 MAP Sensor—3.5L Engine

SENSOR RETURN—PCM INPUT

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

SPEED CONTROL—PCM INPUT

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

The speed control ON voltage informs the PCM that the speed control system has been activated. The speed control SET voltage informs the PCM that

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

SCI RECEIVE—PCM INPUT

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

PARK/NEUTRAL SWITCH

The automatic transaxle manual valve lever position sensor supplies the park/neutral input to the powertrain control module. The park/neutral switch input tells the PCM whether the transmission is in Park, Neutral, or a drive gear selection. This input effects idle speed, fuel injector pulse width and ignition timing.

THROTTLE POSITION SENSOR—PCM INPUT

The throttle position sensor mounts to the side of the throttle body (Fig. 19) or (Fig. 20). Although the 3.5L engine has two throttle bodies, it only uses one TPS. On 3.5L engines, the TPS is mounted on the right side throttle body.

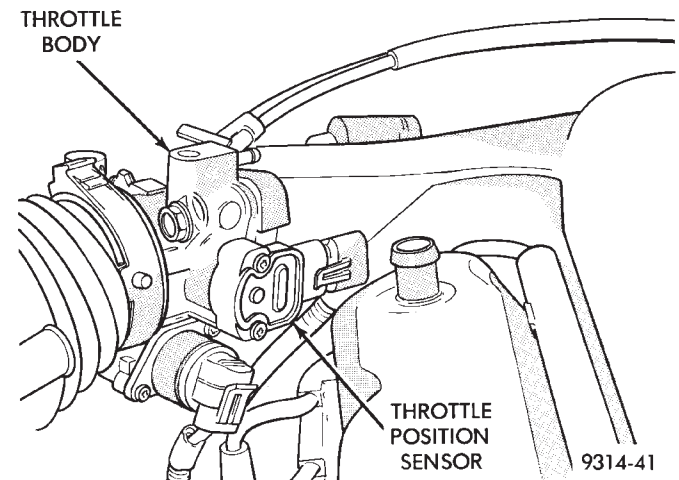


Fig. 19 Throttle Position Sensor—3.3L Engine

The sensor connects to the throttle blade shaft. The TPS is a variable resistor that provides the powertrain control module (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 to the TPS. The TPS output voltage (input signal to the

DESCRIPTION AND OPERATION (Continued)

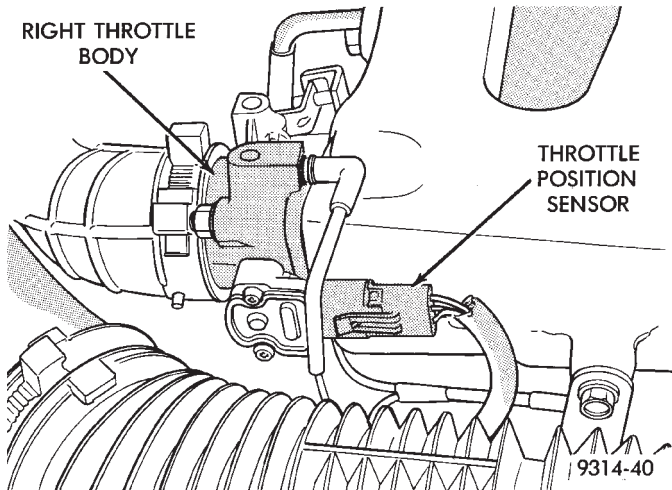


Fig. 20 Throttle Position Sensor—3.5L Engine

powertrain control module) represents throttle blade position. The TPS output voltage to the PCM varies from approximately 0.6 volt at minimum throttle opening (idle) to a maximum of 4.5 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.

VEHICLE SPEED AND DISTANCE—PCM INPUT

The Transmission Control Module (TCM) supplies the road speed and distance traveled inputs to the PCM. From these inputs and the throttle position sensor input, the PCM determines when a deceleration condition occurs.

AIR CONDITIONING COMPRESSOR CLUTCH RELAY—PCM OUTPUT

The powertrain control module (PCM) operates the air conditioning clutch relay ground circuit. The battery supplies power to the solenoid side of the relay. The PCM grounds the relay when the operator puts the A/C or defrost switch in the ON position and it receives an acceptable input from the A/C pressure transducer. If the A/C pressure transducer input indicates high side pressure is too high or too low, the PCM will not ground the A/C compressor clutch relay.

With the engine operating, the PCM cycles the air conditioning clutch on and off during A/C operation. When the PCM senses low idle speeds or wide open throttle through the throttle position sensor, it de-energizes the A/C compressor clutch relay.

The A/C compressor clutch relay is located in the power distribution center (PDC) near the battery (Fig. 21). A decal on the inside of the PDC covers

shows the locations of each relay and fuse contained in the PDC.

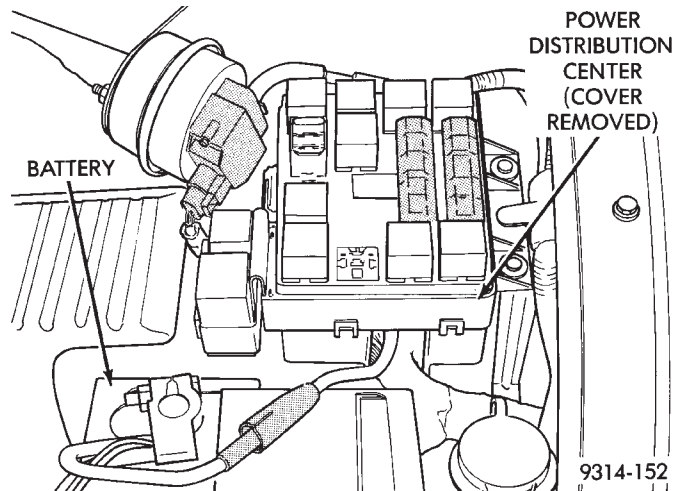


Fig. 21 Power Distribution Center (PDC)

AUTOMATIC SHUT DOWN (ASD) AND FUEL PUMP RELAYS—PCM OUTPUT

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

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

The PCM turns the ground path off when the ignition switch is in the Off position. Both relays are off. 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 a crankshaft position sensor signal and camshaft position sensor signal when the ignition switch is in the Run position, it de-energizes both relays. When the relays are de-energized, battery voltage is not supplied to the fuel injectors, ignition coil and fuel pump.

The ASD relay and fuel pump relay are located in the Power Distribution Center (PDC) near the battery. A decal on the inside of the PDC covers the locations of each relay and fuse contained in the PDC.

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.

DESCRIPTION AND OPERATION (Continued)

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 EVAP purge solenoid and bracket attach to the right inner fender well next to the dash panel (Fig. 22). The top of the solenoid has the word TOP on it. The solenoid will not operate unless it is installed correctly. If the vehicle has a 3.5L engine, the EVAP purge solenoid shares a bracket with the MTV solenoid.

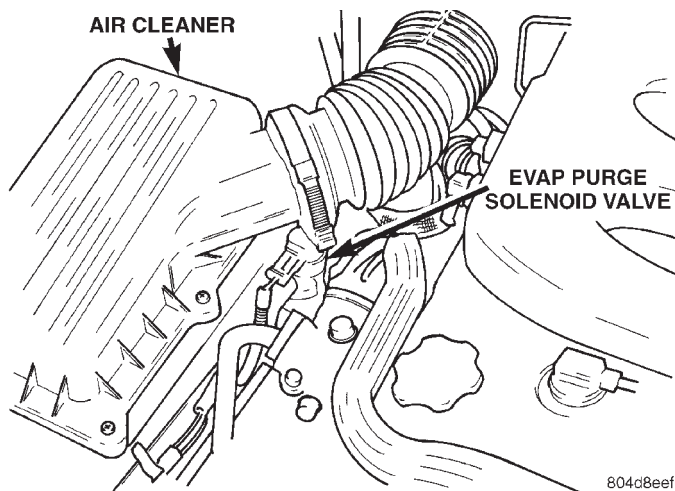


Fig. 22 Duty Cycle EVAP Purge Solenoid

ELECTRONIC EGR TRANSDUCER SOLENOID—PCM OUTPUT

The electronic EGR transducer contains an electrically operated solenoid and a back-pressure transducer (Fig. 23). The Powertrain Control Module (PCM) operates the solenoid. The PCM determines when to energize the solenoid. Exhaust system back-pressure controls the transducer.

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

When exhaust system back-pressure becomes high enough, it fully closes a bleed valve in the 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 vacuum applied to the EGR

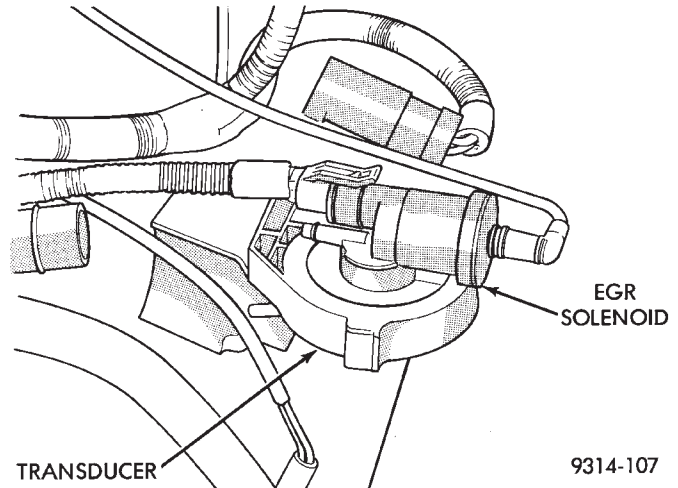


Fig. 23 EGR Solenoid

valve. Varying the strength of the vacuum changes the amount of EGR supplied to the engine. This provides the correct amount of exhaust gas recirculation for different operating conditions.

MANIFOLD TUNING VALVE (MTV) SOLENOID (3.5L)—PCM OUTPUT

The MTV solenoid regulates the supply of vacuum to the manifold tuning valve. The PCM controls the MTV solenoid. The manifold tuning valve optimizes acoustical tuning of the intake system during wide open throttle operation throughout the RPM range. The valve opens a crossover passage in that connects both sides of the intake manifold plenum.

When energized, the MTV solenoid allows vacuum to reach and close the manifold tuning valve. When not energized, the solenoid closes and vacuum bleeds off from the manifold tuning valve vacuum motor. The manifold tuning valve opens the crossover when the solenoid de-energizes.

The MTV solenoid shares a bracket with the duty cycle EVAP purge solenoid. The solenoids and bracket attach to the right inner fender well next to the dash panel (Fig. 24).

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

3.3L ENGINE

The idle air control motor attaches to the throttle body (Fig. 25). The PCM operates the idle air control motor. The PCM adjusts engine idle speed through the idle air control motor to compensate for engine load or ambient conditions.

DESCRIPTION AND OPERATION (Continued)

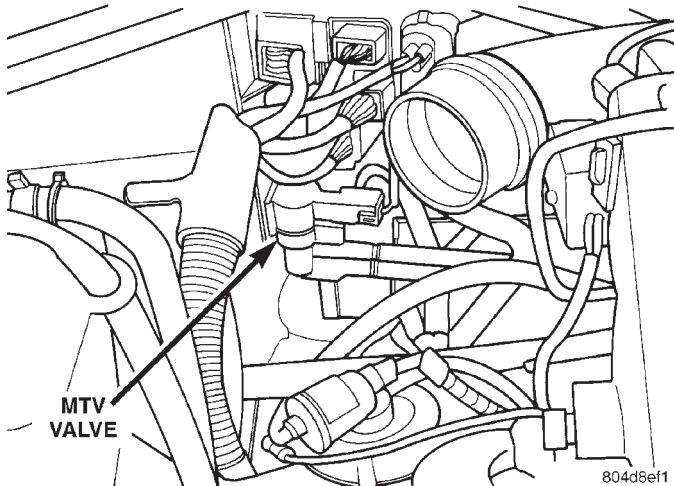


Fig. 24 EVAP Purge and MTV Solenoids

The throttle body has an air bypass passage that provides air for the engine at idle (the throttle blade is closed). The idle air control motor pintle protrudes into the air bypass passage and regulates air flow through it (Fig. 26).

The PCM adjusts engine idle speed by moving the idle air control motor pintle in and out of the bypass passage. The adjustments are based on inputs the PCM receives. The inputs effecting idle speed include the throttle position sensor, road speed (from transmission control module), coolant temperature sensor, battery voltage and battery temperature. Also, various switch operations (brake, park/neutral, air conditioning) effect idle speed. The PCM prevents deceleration die out by increasing airflow when the throttle closes quickly.

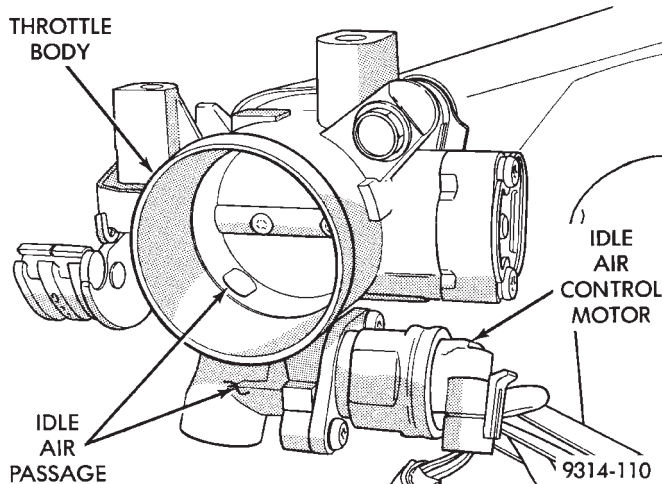


Fig. 25 Idle Air Control Motor—3.3L Engine

3.5L ENGINE

The idle air control motor and housing attaches to the rear of the intake manifold plenum (Fig. 27). The housing opens to the rear runner in the intake manifold plenum. A hose from the air cleaner plenum

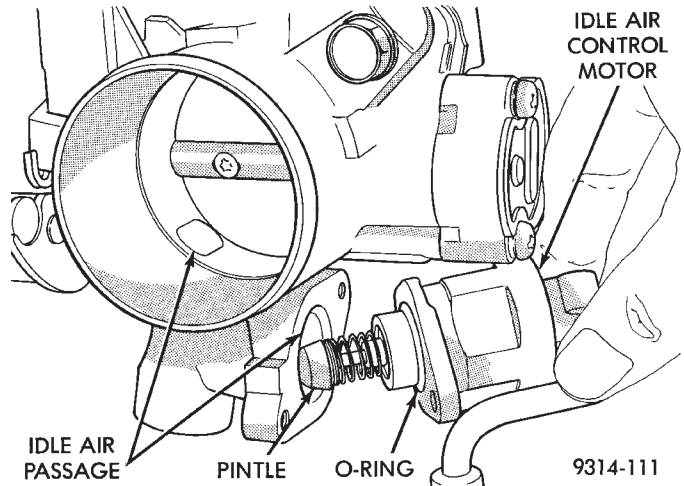


Fig. 26 Idle Air Passage—3.3L Engine

supplies filtered air to idle air control motor housing. The idle air control motor pintle protrudes into the housing and regulates air flow through it (Fig. 28).

The PCM adjusts engine idle speed by moving the idle air control motor pintle in and out of the opening in the housing. The adjustments are based on inputs to the PCM. The inputs effecting idle speed include the throttle position sensor, road speed (from transmission control module), coolant temperature sensor, battery voltage and battery temperature. Also, various switch operations (brake, park/neutral, air conditioning) effect idle speed. The PCM prevents deceleration die out by increasing airflow when the throttle closes quickly.

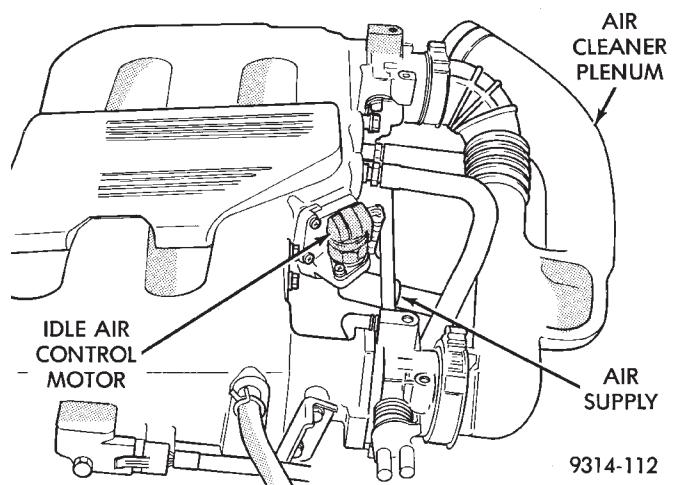
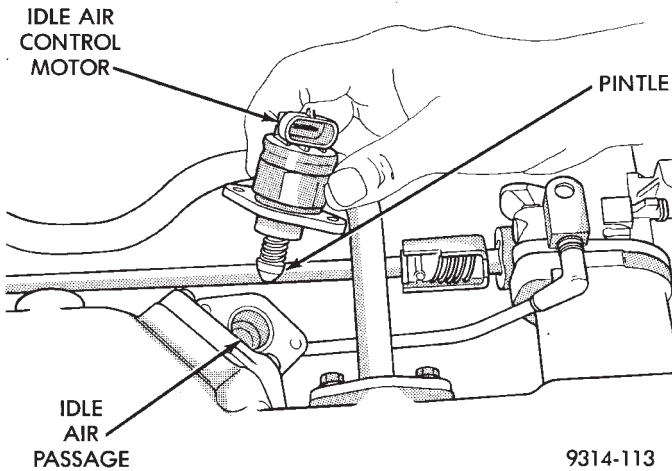


Fig. 27 Idle Air Control Motor—3.5L Engine

DATA LINK CONNECTOR—PCM OUTPUT

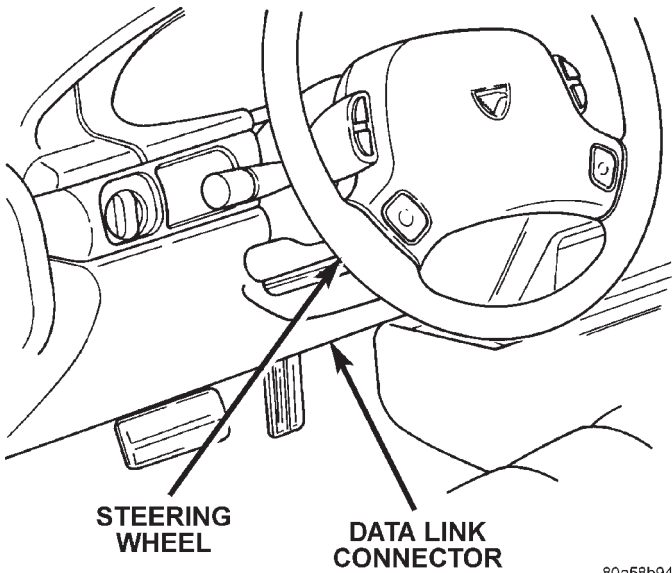
The data link connector (diagnostic connector) links the DRB scan tool with the Powertrain Control Module (PCM). Refer to On-Board Diagnostics in the General Diagnosis section of this group. The data link connector is located inside the vehicle, below instrument panel next to the center column (Fig. 29).

DESCRIPTION AND OPERATION (Continued)



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Fig. 28 Idle Air Passage—3.5L Engine



80a58b94

Fig. 29 Data Link Connector

FUEL INJECTORS—PCM OUTPUT

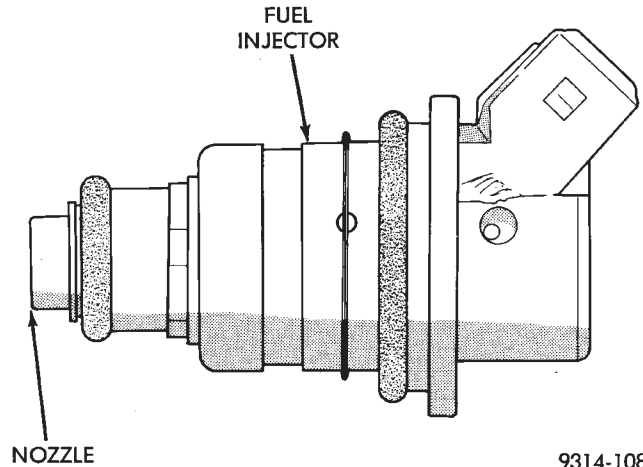
The 3.5L engine uses bottom feed injectors. Fuel from the rail enters the side of the injectors (Fig. 30). The 3.3L engines use top feed injectors (Fig. 31).

The Automatic Shut Down (ASD) relay supplies battery voltage to the 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.

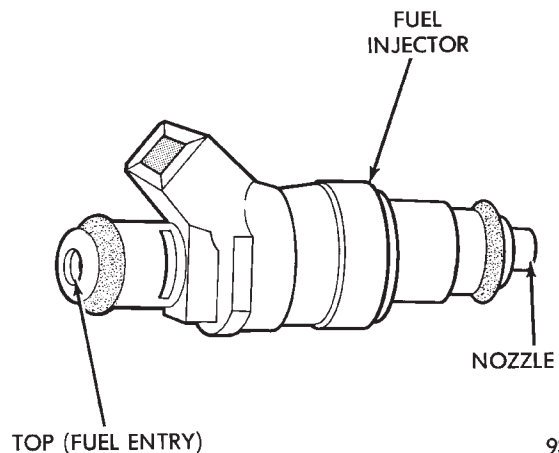
The PCM energizes the injectors in a sequential order during all engine operating conditions except start-up. During start-up, when the coolant tempera-

ture is below 15° C (60° F), all injectors are energized at the same time. Above 15° C, the PCM energizes the injectors in sequence. Once the PCM determines crankshaft position, it begins energizing the injectors in sequence.



9314-108

Fig. 30 Fuel Injector—3.5L Engine



9314-109

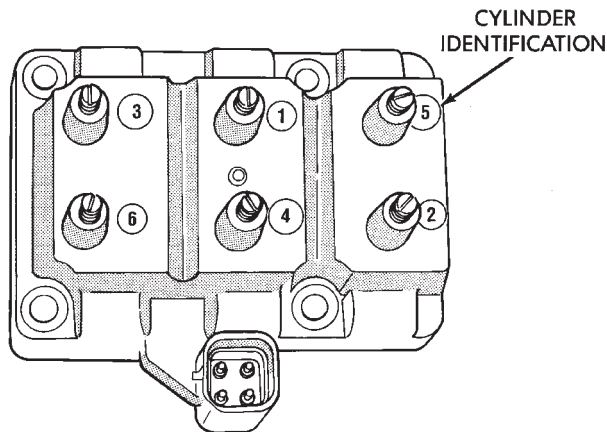
Fig. 31 Fuel Injector—3.3L Engine

IGNITION COIL—PCM OUTPUT

The coil assembly consists of 3 coils molded together (Fig. 32). The coil assembly is mounted on the intake manifold. High tension leads route to each cylinder from the coil. The coil fires two spark plugs every power stroke. One plug is the cylinder under compression, the other cylinder fires on the exhaust stroke. The PCM determines which of the coils to charge and fire at the correct time.

The Automatic Shut Down (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 sensor and cam-

DESCRIPTION AND OPERATION (Continued)



9314-77

Fig. 32 Ignition Coil Pack

shaft sensor inputs. Refer to Automatic Shut Down (ASD) Relay and Fuel Pump Relay—PCM in this section for relay operation.

MALFUNCTION INDICATOR (CHECK ENGINE) LAMP—PCM OUTPUT

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

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

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

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

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

The MIL can also display diagnostic trouble codes. Cycle the ignition switch on, off, on, off, on, within 5 seconds and any diagnostic trouble codes stored in the PCM will be displayed. Refer to On-Board Diagnostics in Group 25, Emission Control Systems Diagnostic Trouble Code Descriptions.

RADIATOR FAN RELAYS—PCM OUTPUT

The cooling system uses two fans. Both fans operate at two different speeds, low and high. Depending on engine coolant temperature and A/C system high side pressure, the both fans operate at either low or high. The PCM controls radiator speed by grounding the coil side of either the low speed fan relay or the high speed fan relay. The ignition switch supplies voltage to the coil sides of the relay. When the PCM grounds the coil side of the relay, the contacts close and the battery supplies power to the fans.

The low speed and high speed fan relays are located in the Power Distribution Center (PDC) near the battery. A decal on the inside of the PDC covers shows the locations of each relay and fuse contained in the PDC.

FAN OPERATION—3.3L ENGINE

With the A/C off, the PCM energizes the low speed fan when engine coolant temperature reaches approximately 99°C (211°F). Also with the A/C off, the PCM de-energizes the low speed fan when coolant temperature drops to approximately 93°C (199°F).

The PCM energizes the high speed fan when engine coolant temperature reaches approximately 110°C (230°F). The PCM de-energizes the high speed fan and energizes the low speed fan when coolant temperature drops to approximately 104°C (219°F).

When the PCM receives an input from the A/C pressure transducer indicating high side pressure is approximately 1448 kPa (210 PSI), it energizes the low speed fan. The PCM de-energizes the low speed when the high side pressure drops to 861 kPa (125 PSI) if engine coolant temperature is below approximately 93°C (200°F).

When the PCM receives an input from the A/C pressure transducer indicating high side pressure is approximately 1724 kPa (250 PSI), it energizes the high speed fan. The PCM de-energizes the high speed fan and energizes the low speed when the high side pressure drops to 1586 kPa (230 PSI).

FAN OPERATION—3.5L ENGINE

With the A/C off, the PCM energizes the low speed fan when engine coolant temperature reaches approximately 104°C (219°F). Also with the A/C off, the PCM de-energizes the low speed fan when coolant temperature drops to approximately 99°C (210°F).

The PCM energizes the high speed fan when engine coolant temperature reaches approximately 110°C (230°F). The PCM de-energizes the high speed fan and energizes the low speed fan when coolant temperature drops to approximately 105°C (221°F).

When the PCM receives an input from the A/C pressure transducer indicating high side pressure is

DESCRIPTION AND OPERATION (Continued)

approximately 1448 kPa (210 PSI), it energizes the low speed fan. The PCM de-energizes the low speed when the high side pressure drops to 861 kPa (125 PSI) if engine coolant temperature is below approximately 99°C (210°F).

When the pcm receives an input from the a/c pressure transducer indicating high side pressure is approximately 1724 kpa (250 psi), it energizes the high speed fan. The pcm de-energizes the high speed fan and energizes the low speed when the high side pressure drops to 1586 kpa (230 psi).

SPEED CONTROL RELAY—PCM OUTPUT

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

SPEED CONTROL SERVOS—PCM OUTPUT

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

TACHOMETER—PCM OUTPUT

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

TORQUE MANAGEMENT (3.5L ENGINE)

On 3.5L engines the PCM receives the torque management input from the transmission control module. The PCM receives the input when the transmission shifts gears. In response, the PCM shuts off a number of fuel injectors when the transmission shifts gears.

5 VOLT SUPPLY—PCM OUTPUT

The PCM supplies 5 volts to the following sensors:

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

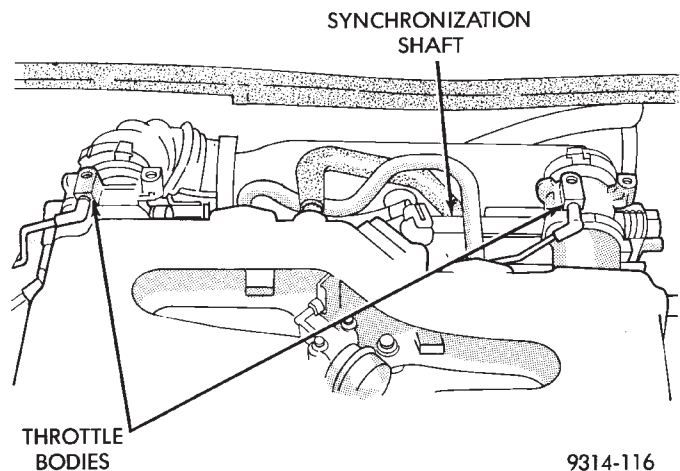
8-VOLT SUPPLY—PCM OUTPUT

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

THROTTLE BODIES—3.5L ENGINE

The 3.5L engine has two throttle bodies. A shaft connects both throttle bodies and maintains synchronization. The throttle bodies connect to the rear of the intake manifold plenum (Fig. 33). The Throttle Position Sensor (TPS) attaches to the right throttle body. Because the shaft maintains throttle body synchronization, the fuel injection system uses only one TPS.

If either throttle body is removed or replaced, the Throttle Body Synchronization procedure must be performed. Refer to Throttle Body Synchronization in the Multi-Port Fuel Injection—Service Procedures section of this group.



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Fig. 33 Throttle Bodies—3.5L Engine

DIAGNOSIS AND TESTING

VISUAL INSPECTION

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

(1) Remove the Power Distribution Center (PDC) cover. Check for blown fuses. Ensure all relays are properly installed (Fig. 34).

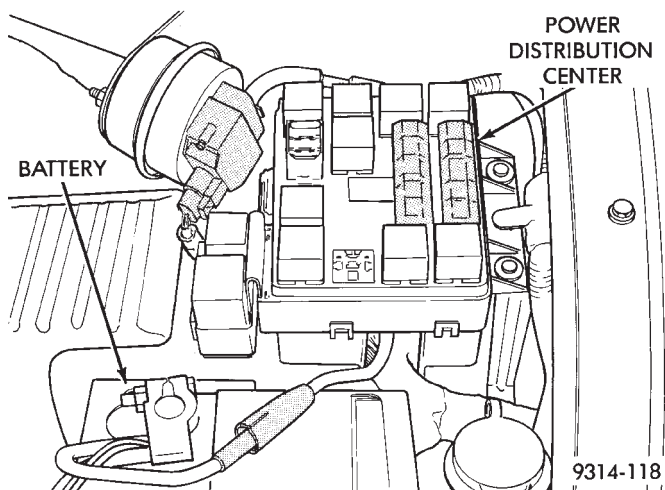


Fig. 34 Power Distribution Center

(2) Check the battery terminal connections for loose cables and corrosion.

(3) Check the MAP sensor electrical connection (Fig. 35) or (Fig. 36).

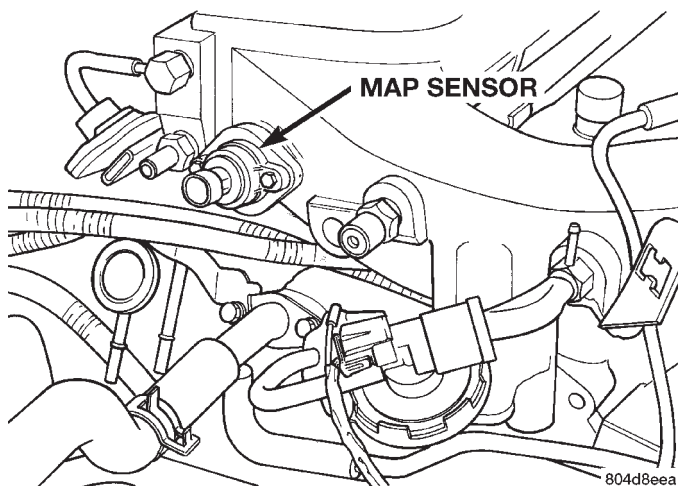


Fig. 35 MAP Sensor—3.3L Engine

(4) Ensure spark plug cables are firmly connected in the correct order to the coil pack and spark plugs.

(5) Ensure the electrical connector is completely attached to the idle air control motor (Fig. 37) or (Fig. 38).

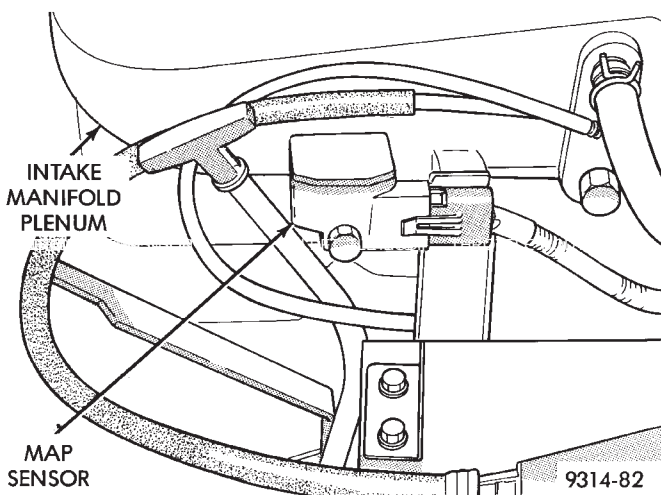


Fig. 36 MAP Sensor—3.5L Engine

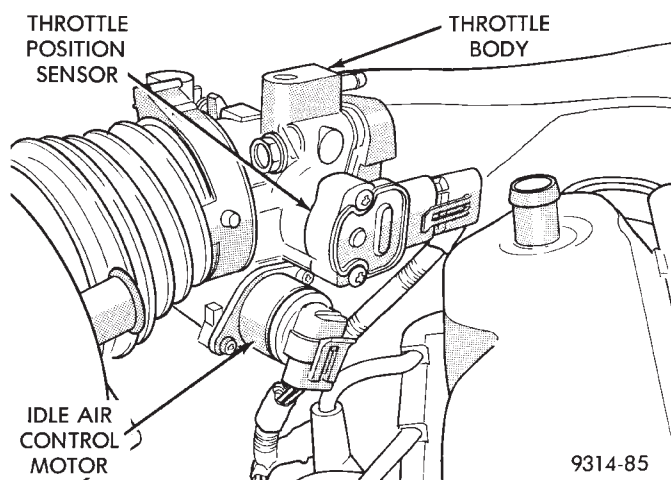


Fig. 37 Idle Air Control Motor—3.3L Engine

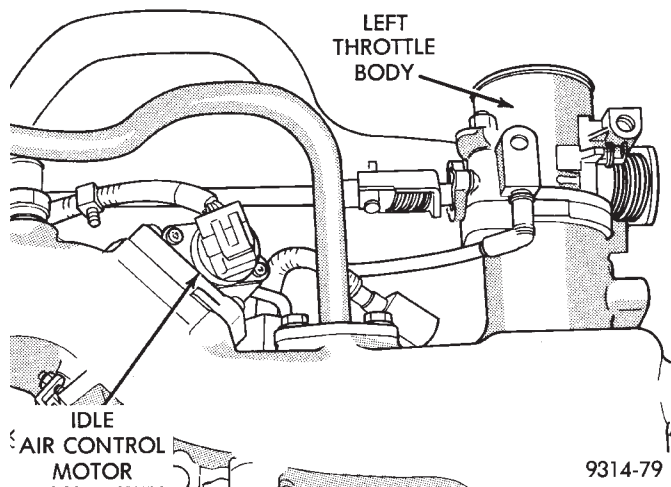


Fig. 38 Idle Air Control Motor—3.5L Engine

(6) Ensure electrical connector is attached to the throttle position sensor (Fig. 37) or (Fig. 39).

DIAGNOSIS AND TESTING (Continued)

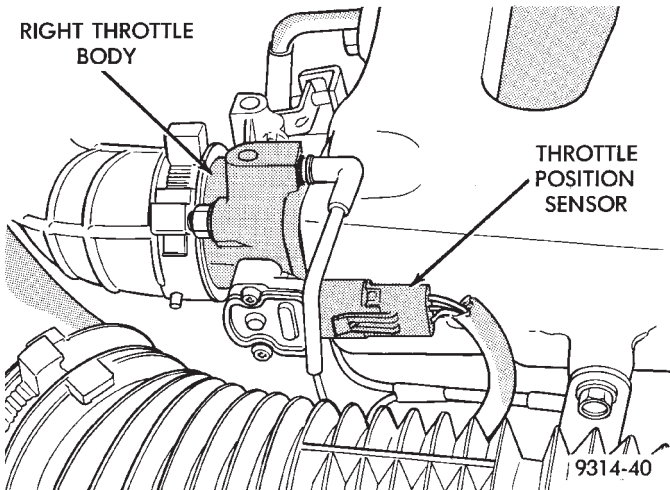


Fig. 39 Throttle Position Sensor—3.5L Engine

(7) Verify the electrical connector is attached to the engine coolant temperature sensor (Fig. 40) or (Fig. 41).

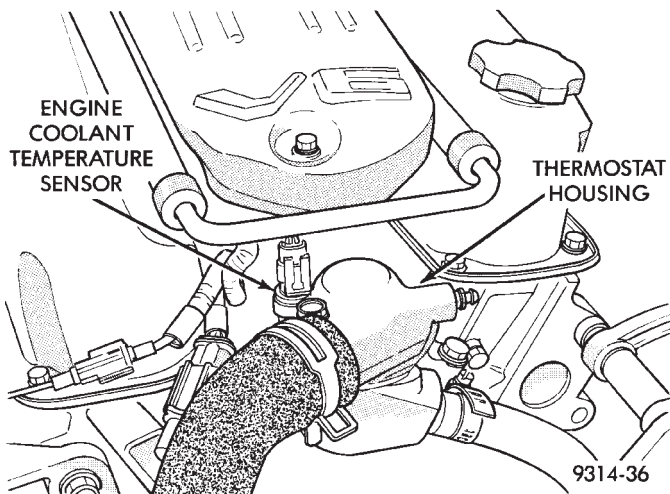


Fig. 40 Engine Coolant Temperature Sensor—3.3L Engine

(8) On 3.5L engines, ensure the air plenum hoses are attached to the idle air control motor and the make up air nipple for the PCV system (Fig. 42). Also ensure the PCV hose is connected to the PCV valve, not the idle air control motor.

(9) Ensure purge hose is connected to throttle body (on 3.5L engines each throttle body has a purge hose).

(10) On 3.5L engines, ensure the vacuum hose is connected to the manifold tuning valve and the vacuum harness (Fig. 43).

(11) Ensure the vacuum hose is attached to the fuel pressure regulator (Fig. 44) or (Fig. 45). Check the hose for cracks or leaks.

(12) Ensure the EVAP solenoid (Fig. 46) and MTV solenoid (3.5L only) (Fig. 47) electrical connectors are attached to the solenoids .

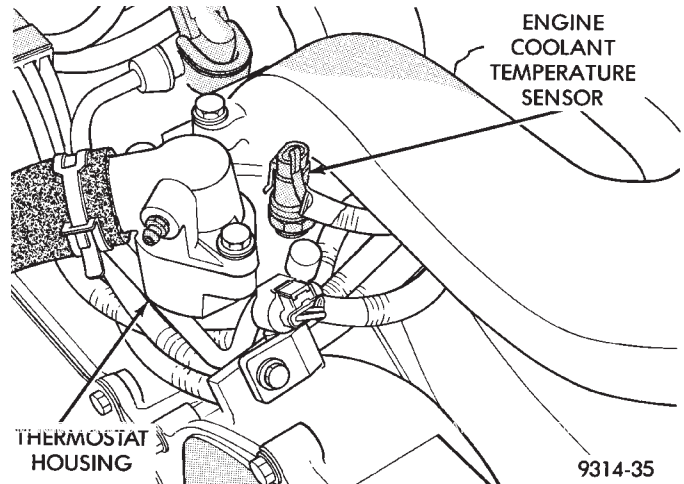


Fig. 41 Engine Coolant Temperature Sensor—3.5L Engine

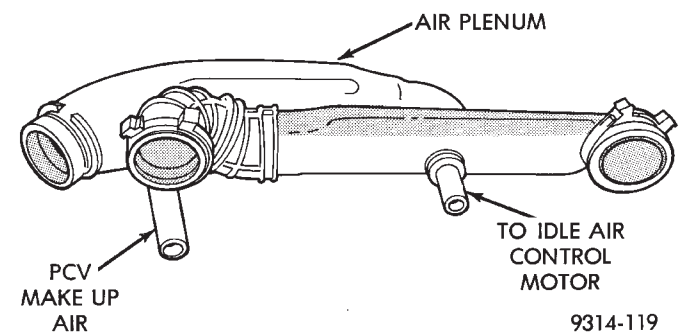


Fig. 42 Air Plenum—3.5L Engine

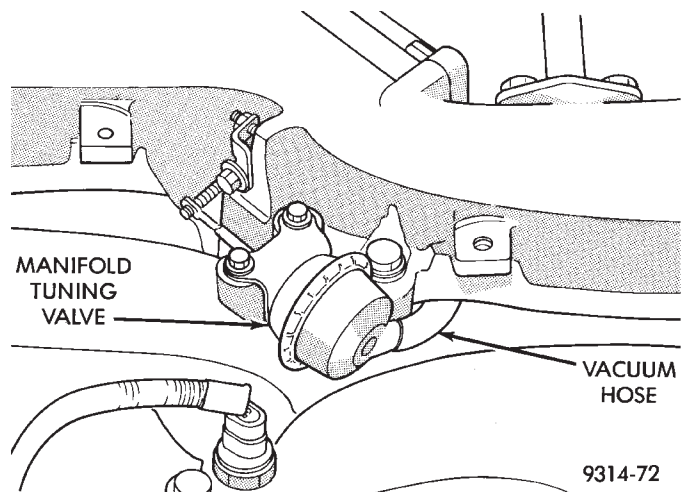


Fig. 43 Manifold Tuning Valve

(13) Inspect the air cleaner filter element. Replace as necessary.

(14) Inspect hose connections at the EVAP canister for leaks (Fig. 48). Remove the air cleaner to access the EVAP canister.

(15) Verify the 2 40-way connector is fully inserted into the Powertrain Control Module (PCM) (Fig. 48).

DIAGNOSIS AND TESTING (Continued)

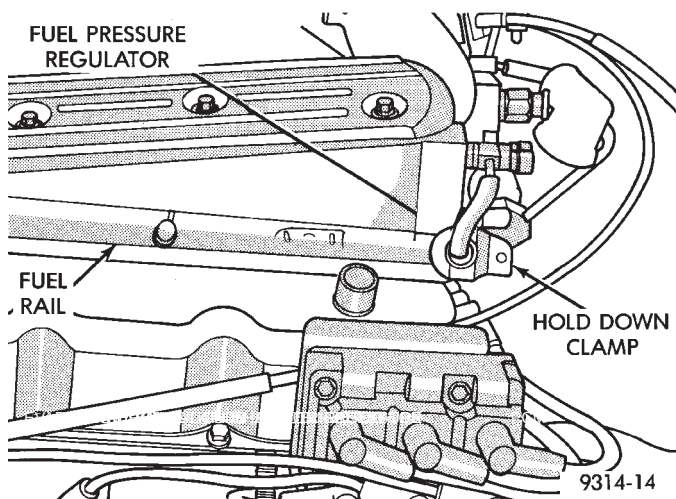


Fig. 44 Fuel Pressure Regulator—3.3L Engine

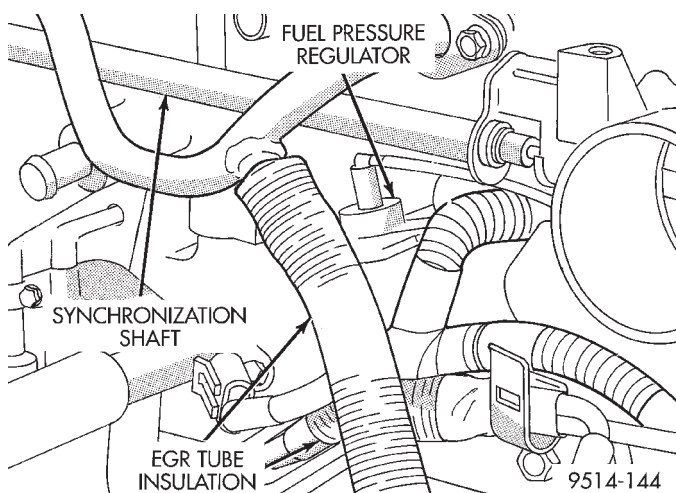


Fig. 45 Fuel Pressure Regulator—3.5L Engine

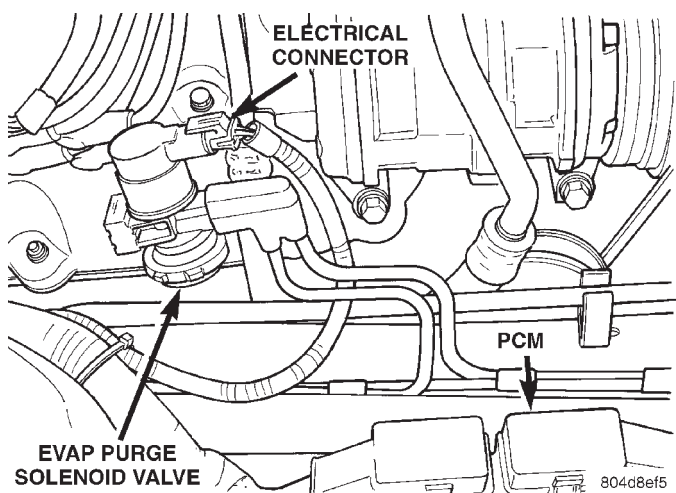


Fig. 46 EVAP Purge Solenoid

Ensure the wires are not stretched or pulled out of the socket.

(16) Ensure the accessory drive belt tension is correct.

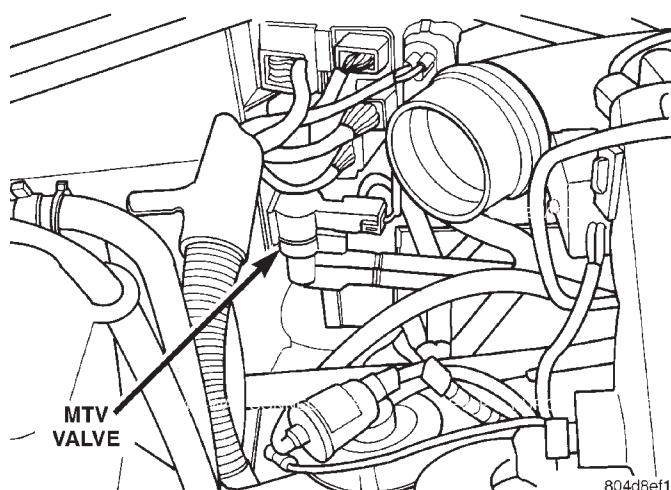


Fig. 47 MTV Solenoid

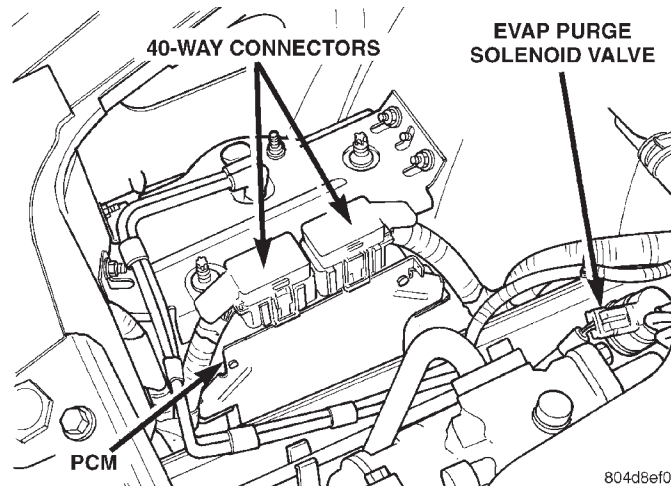


Fig. 48 EVAP Canister Hose Connections

(17) Check for loose or corroded connections at the generator (Fig. 49).

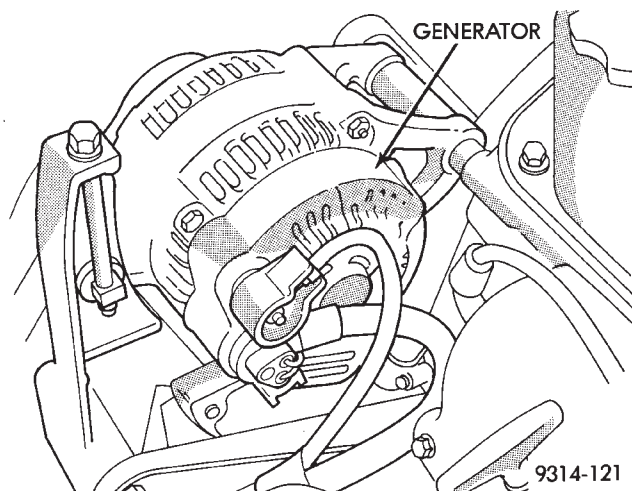


Fig. 49 Generator

(18) Check fuel supply and return tube connections for leaks.

DIAGNOSIS AND TESTING (Continued)

(19) Verify electrical connector is attached to the crankshaft position sensor (Fig. 50).

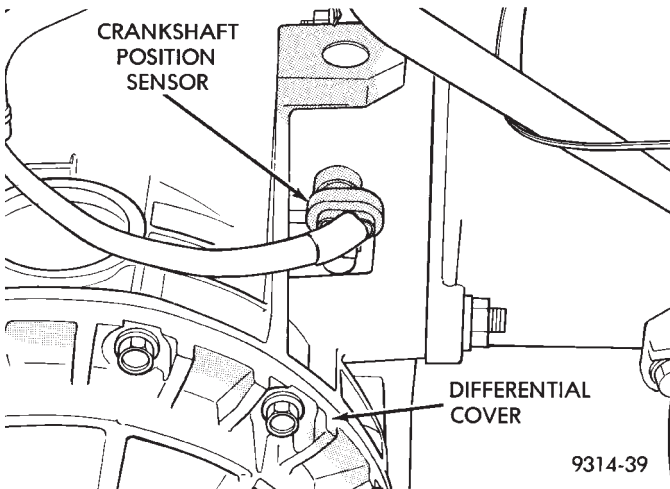


Fig. 50 Crankshaft Position Sensor

(20) Ensure the electrical connectors are attached to the upstream heated oxygens sensors (Fig. 51) or (Fig. 52).

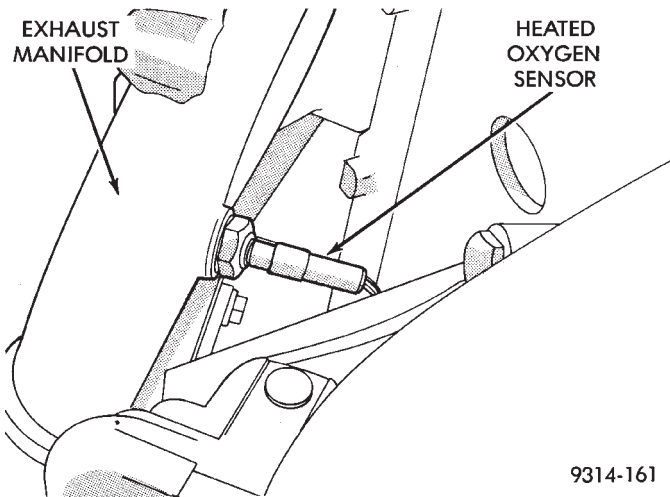


Fig. 51 Heated Oxygen Sensor—3.3L Engine

(21) Ensure the electrical connectors are attached to the downstream heated oxygens sensors (Fig. 53).

(22) Check for loose or corroded electrical connections at the starter motor (Fig. 54) or (Fig. 55).

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. 56).

OPERATION

- Terminal number 30 is connected to battery voltage. For both the ASD relay and fuel pump relays,

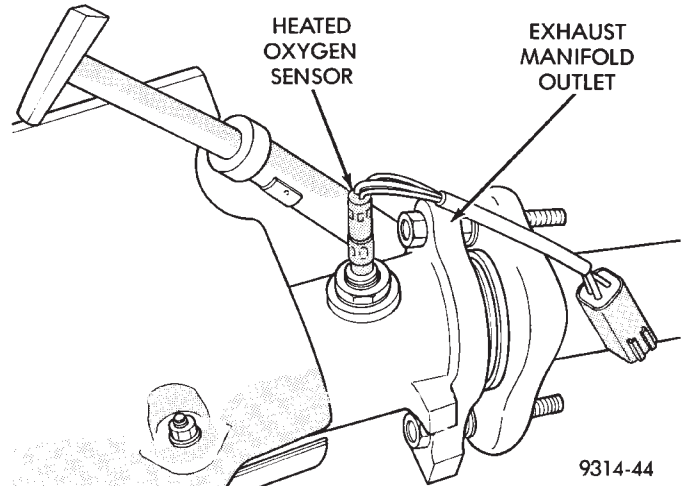


Fig. 52 Heated Oxygen Sensor—3.5L Engine

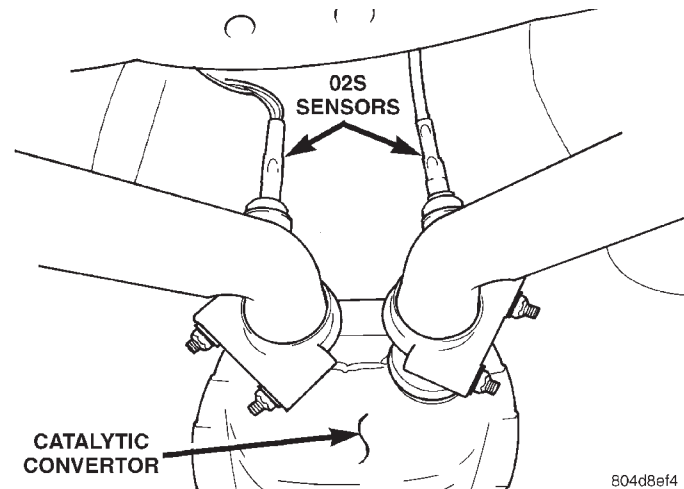


Fig. 53 Downstream Heated Oxygen Sensors

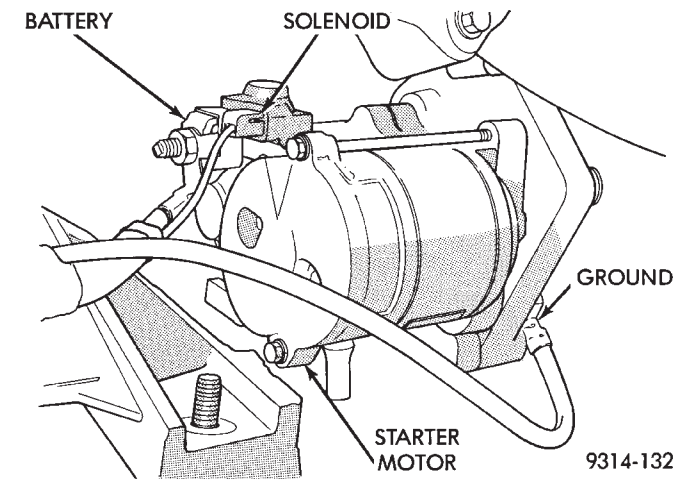


Fig. 54 Starter Motor—3.3L Engine

terminal 30 is connected to battery voltage at all times.

DIAGNOSIS AND TESTING (Continued)

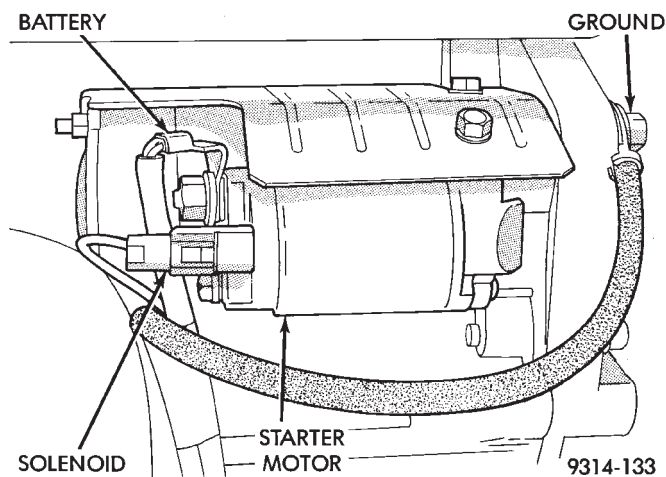


Fig. 55 Starter Motor—3.5L Engine

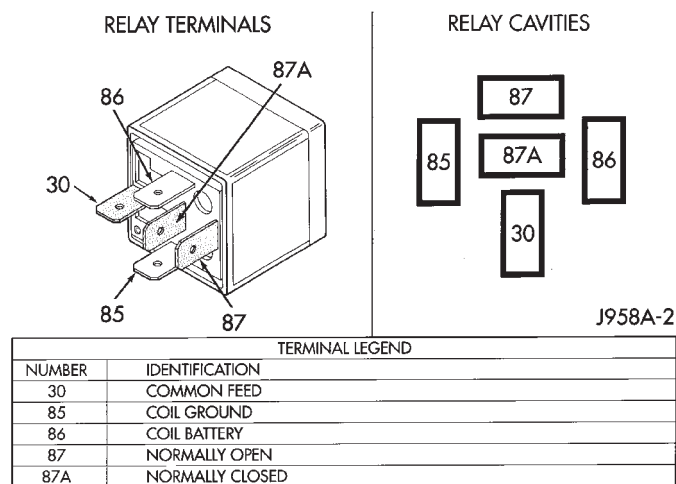


Fig. 56 ASD and Fuel Pump Relay Terminals

- 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 energizes 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.

ENGINE COOLANT TEMPERATURE SENSOR

- (1) With the key off, disconnect wire harness connector from coolant temperature sensor (Fig. 57) or (Fig. 58).

- (2) Connect a high input impedance (digital) volt-ohmmeter to terminals A and B. 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 40-way connector terminal 26 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.

DIAGNOSIS AND TESTING (Continued)

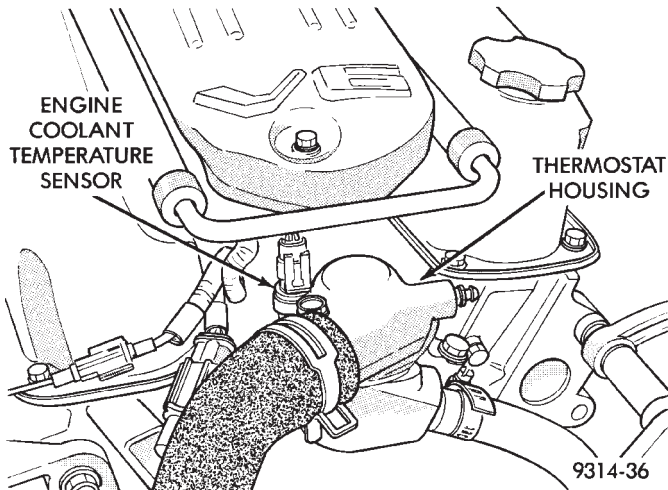


Fig. 57 Engine Coolant Temperature Sensor Location—3.3L

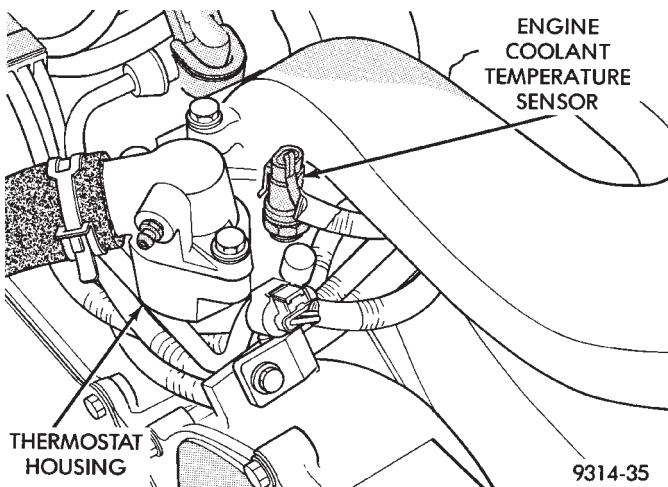


Fig. 58 Engine Coolant Temperature Sensor Location—3.5L

HEATED OXYGEN SENSOR

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

IDLE AIR CONTROL (IAC) MOTOR TEST

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

KNOCK SENSOR

The knock sensor can be tested with a digital voltmeter. Sensor output should be between 80 mV and 4 volts with the engine running between 576 and 2208

rpm. If the output falls outside of this range a DTC will be set.

MANIFOLD ABSOLUTE PRESSURE (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 2 and 3 (Fig. 59). With the ignition switch ON and the engine not running, output voltage should be 4 to 5 volts. The voltage should drop to 1.5 to 2.1 volts with a hot, neutral idle speed condition. If OK, go to next step. If not OK, go to step 3.

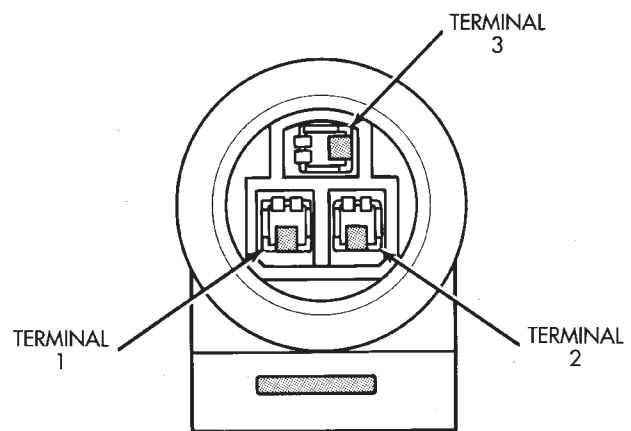


Fig. 59 MAP Sensor Connector

(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 2 and 1 with the key ON. The voltage should be approximately 5 volts ($\pm 0.5V$). Five volts ($\pm 0.5V$) should also be at terminal 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 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:

DIAGNOSIS AND TESTING (Continued)

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

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

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

TESTING MINIMUM AIR FLOW—3.5L ENGINE

- (1) Warm engine in Park or Neutral until the cooling fan has cycled on and off at least once.
- (2) Ensure that all accessories are off.
- (3) Shut off engine.
- (4) Disconnect the PCV valve hose from the PCV valve (Fig. 60). Cap the PCV valve.

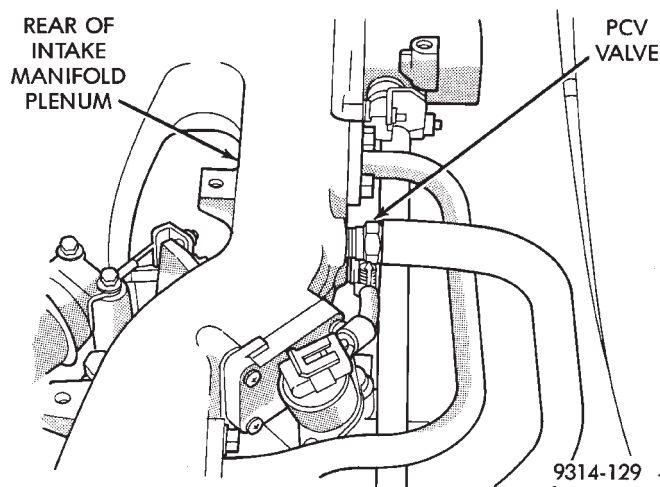


Fig. 60 PCV Valve—3.5L Engine

- (5) Disconnect purge hose from the nipple on each throttle body (Fig. 61).

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

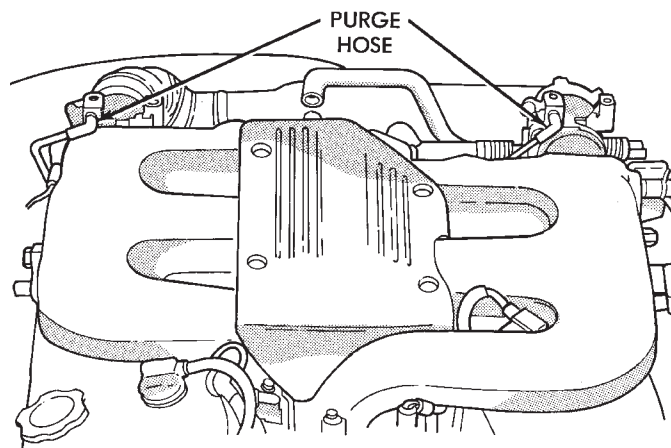
- (7) Connect the DRB scan tool to the data link connector inside the passenger compartment.

- (8) Restart the engine. Allow engine to idle for at least one minute.

- (9) Using the DRB, access Minimum Airflow Idle Speed.

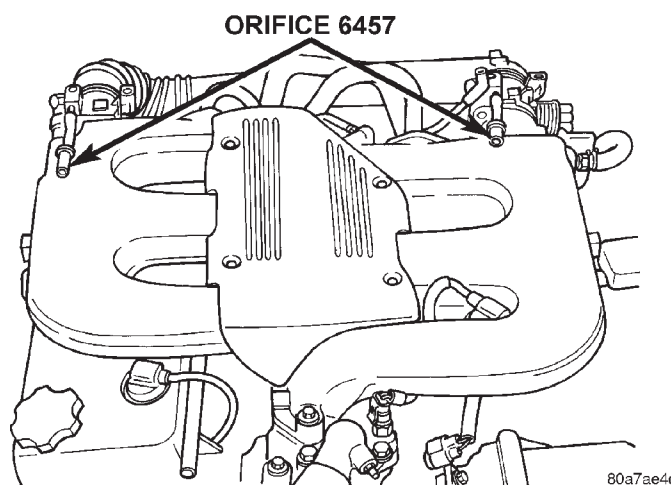
- (10) The following will then occur:

- Idle air control motor will fully close
- Idle spark advance will become fixed
- DRB scan tool displays engine RPM



9314-130

Fig. 61 Purge Hose—3.5L Engine



80a7ae4d

Fig. 62 Orifice 6457 Attached to Purge Nipples—3.5L Engine

- (11) If idle RPM is within the range shown in the Idle Specification chart, throttle body minimum air-flow is set correctly.

- If idle RPM is below specifications even though the idle air control motor operates normally and the throttle bodies were cleaned of coking and synchronized, replace the throttle bodies.

- If idle RPM is above specifications reset throttle body synchronization. Also, recheck idle air control motor operation using the DRB scan tool. If idle RPM is still above specifications after setting throttle body synchronization, check for leaking intake manifold plenum or gaskets.

- (12) Shut off engine.

- (13) Remove orifice 6457 from each throttle body. Install purge hoses.

- (14) Remove cap from PCV valve. Connect hose to PCV valve.

- (15) Remove DRB scan tool.

DIAGNOSIS AND TESTING (Continued)

Odometer Reading	IDLE RPM
Below 1000 Miles	700 - 1000 RPM
Above 1000 Miles	750 - 1100 RPM

9314-128

MINIMUM AIR FLOW IDLE SPECIFICATIONS—3.5L

VEHICLE SPEED SENSOR

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

SERVICE PROCEDURES

CLEANING COKED THROTTLE BODIES

Coked throttle bodies will cause low idle speed and poor idle quality. When replacing one throttle body, always remove and clean the other throttle body. After installing the throttle bodies, set synchronization. Also, if the vehicle has low idle and the idle air control motor operates normally, clean both throttle bodies and synchronize them before checking throttle body minimum air flow. Refer to the General Diagnosis Section of this group for the Throttle Body Minimum Air Flow procedure.

- (1) Remove the throttle bodies from engine.

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

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

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

- (4) Use compressed air to dry the throttle bodies.
- (5) Inspect throttle bodies for foreign material.
- (6) Install throttle bodies on manifold.
- (7) Adjust throttle body synchronization. Refer to Throttle Body Synchronization in this section.

THROTTLE BODY SYNCHRONIZATION—3.5L ENGINE

Synchronize the throttle bodies if there is a gap between the adjustment screw and the linkage lever.

Also, synchronize the throttle bodies after removing and installing the throttle bodies.

- (1) Install .004 inch feeler gauge between the idle speed screw and throttle lever on the right throttle body (Fig. 63).

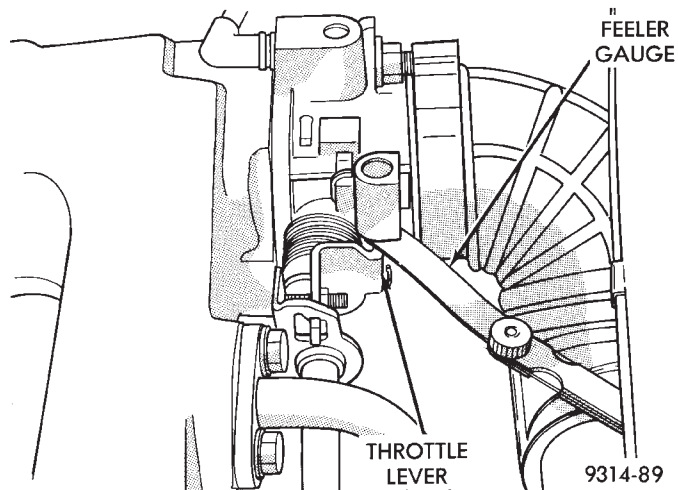


Fig. 63 Idle Speed Screw

- (2) Loosen the adjustment screw locknut on the synchronization shaft (Fig. 64).

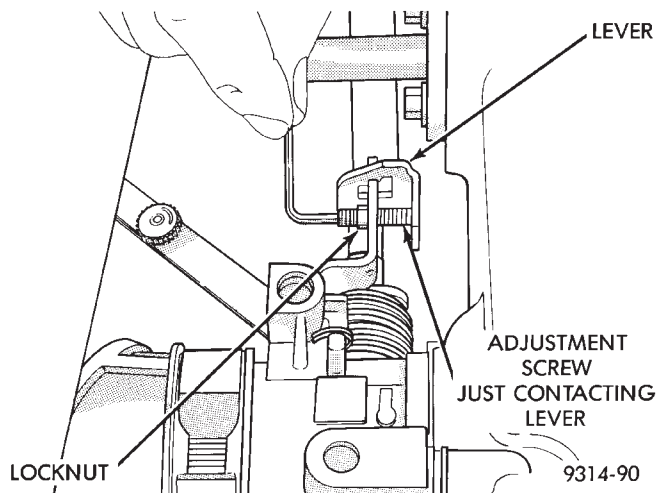


Fig. 64 Adjustment Screw

- (3) Turn adjustment screw until it just contacts the lever on the synchronization shaft. Tighten the locknut to 4 N·m (36 in. lbs.) torque.

(4) Check clearance between the throttle lever and the idle speed screw. The 0.004 inch feeler gauge should drag when removed. Also, a 0.006 inch feeler gauge should not fit between throttle lever and idle speed screw.

REMOVAL AND INSTALLATION

THROTTLE BODIES—3.5L ENGINE

NOTE: If only one throttle body is replaced, the other must be cleaned. Refer to *Cleaning Throttle Bodies*.

LEFT THROTTLE BODY—REMOVAL

- (1) Disconnect negative cable from battery
- (2) Hold throttle lever in wide open position. Remove throttle cable and speed control cables from throttle arm.
- (3) Remove tube connecting air cleaner to air plenum.
- (4) Disconnect air plenum from throttle bodies, PCV make up air tube and idle air control motor. Remove plenum from the right side of the vehicle (Fig. 65).

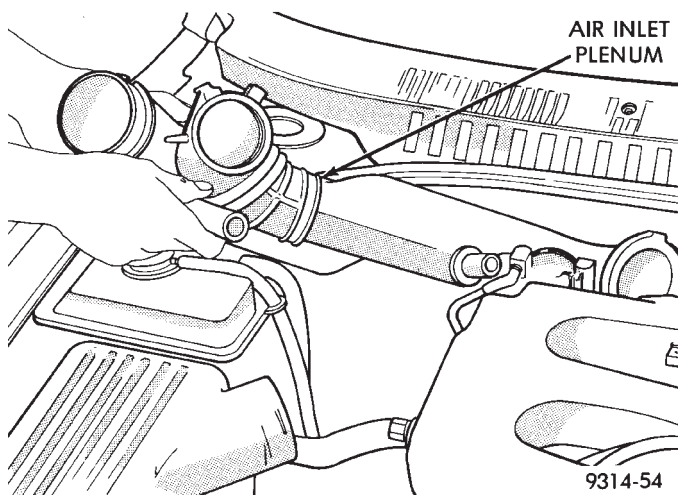


Fig. 65 Air Intake Plenum Removal

- (5) Disconnect purge hose from throttle body.
- (6) Remove throttle body mounting nuts.
- (7) The end throttle body shaft has a ball stud that fits into a socket in the synchronization shaft (Fig. 66).
- (8) Slide throttle body back off of mounting studs. Separate the throttle body from the synchronization shaft. Remove throttle body.
- (9) Clean gasket from mating surfaces.

INSTALLATION

Prior to installing the left throttle body, remove and clean the right throttle body. Refer to *Cleaning Throttle Bodies* in this section.

- (1) Position new gasket over throttle body mounting studs.
- (2) Connect throttle body to synchronization shaft. Ensure ball stud on enters socket in end of synchronization shaft. Ensure spring attaches to shaft and

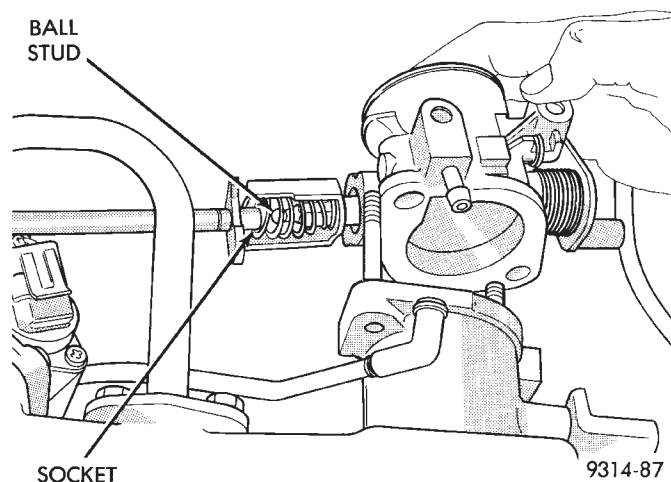


Fig. 66 Left Throttle Body Removal/Installation

- throttle body arm. Also, ensure the spring does not bind when opening and closing the throttle blade.
- (3) Install throttle body over mounting studs.
 - (4) Tighten mounting nuts to 26 N·m (19 ft. lbs.) torque.
 - (5) Connect purge tube to nipple on throttle body.
 - (6) Hold throttle lever in wide open throttle position. Install throttle cable and speed control cable.
 - (7) Check throttle body synchronization. Refer to *Throttle Body Synchronization* in this section.
 - (8) Install air plenum.
 - (9) Install air cleaner to air plenum tube.
 - (10) Connect negative cable to battery.

RIGHT THROTTLE BODY—REMOVAL

- (1) Disconnect negative cable from battery
- (2) Remove tube connecting air cleaner to air plenum.
- (3) Disconnect air plenum from throttle bodies, PCV make up air tube and idle air control motor. Remove plenum from the right side of the vehicle (Fig. 65).
- (4) Disconnect purge hose from throttle body.
- (5) Disconnect electrical connector from throttle position sensor (Fig. 67).
- (6) Remove throttle body mounting nuts.
- (7) The end throttle body shaft has a ball stud that fits into a socket in the synchronization shaft. Also, the tang on the end of the throttle body lever fits into an opening in the bracket on the synchronization shaft (Fig. 68).
- (8) Slide throttle body back off of mounting studs. Separate the throttle body from the synchronization shaft. Remove throttle body.
- (9) Clean gasket from mating surfaces.

REMOVAL AND INSTALLATION (Continued)

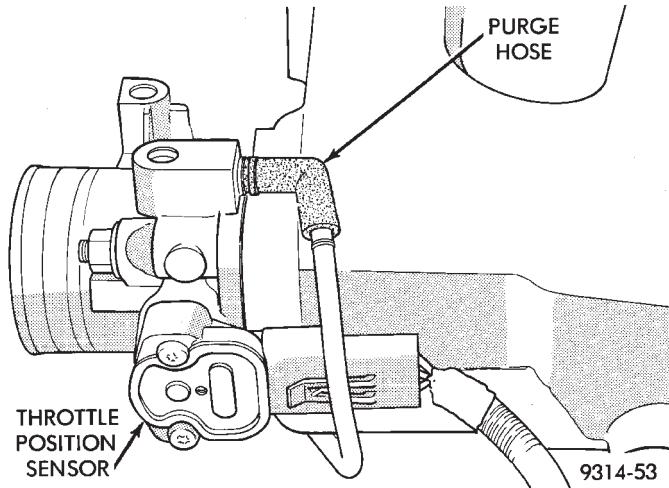


Fig. 67 Throttle Position Sensor—3.5L Engine

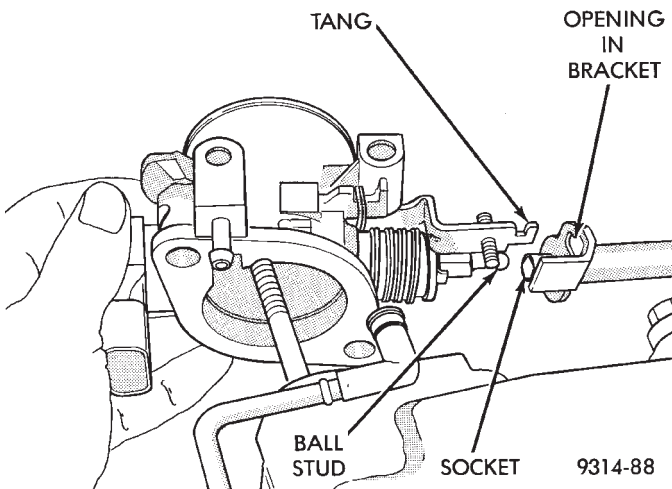


Fig. 68 Right Throttle Body Removal/Installation

INSTALLATION

Prior to installing the right throttle body, remove and clean the left throttle body. Refer to Cleaning Coked Throttle Bodies in this section.

- (1) Position new gasket over throttle body mounting studs.
- (2) Connect throttle body to synchronization shaft. Ensure ball stud on throttle body shaft enters socket in end of synchronization shaft. At the same time, the tang on the throttle lever locks into the bracket on the synchronization shaft (Fig. 68).
- (3) Install throttle body over mounting studs.
- (4) Tighten mounting nuts to 26 N·m (19 ft. lbs) torque.
- (5) Connect purge tube to nipple on throttle body.
- (6) Attach electrical connector to throttle position sensor.
- (7) Check throttle body synchronization. Refer to Throttle Body Synchronization in this section.
- (8) Install air plenum.
- (9) Install air cleaner to air plenum tube.

- (10) Connect negative cable to battery.

THROTTLE POSITION SENSOR (TPS)—3.5L ENGINE

REMOVAL

- (1) Disconnect the TPS electrical connector (Fig. 69).

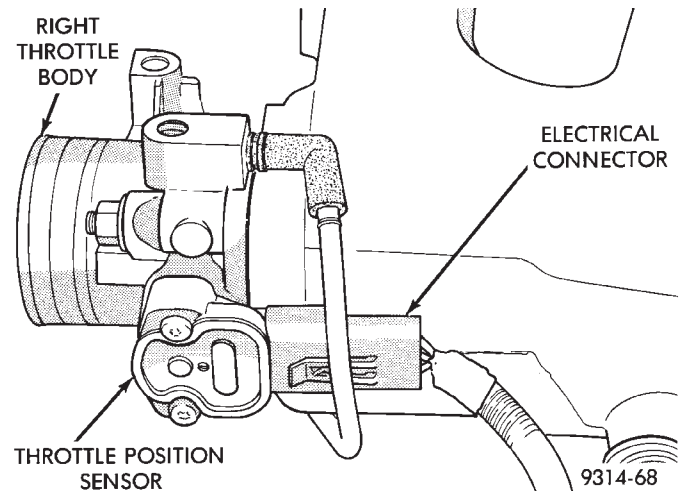


Fig. 69 Throttle Position Sensor—3.5L Engine

- (2) Remove the TPS mounting screws.
- (3) Remove the TPS.

INSTALLATION

(1) The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 70). 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 (Fig. 71). 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 3 N·m (25 in. lbs.) torque.

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

- (3) Attach electrical connector to the TPS.

IDLE AIR CONTROL MOTOR—3.5L ENGINE

REMOVAL

The idle air control motor is located at the rear of the intake manifold plenum next to the left throttle body (Fig. 72).

- (1) Remove electrical connector from idle air control motor.
- (2) Remove idle air control motor mounting screws.

REMOVAL AND INSTALLATION (Continued)

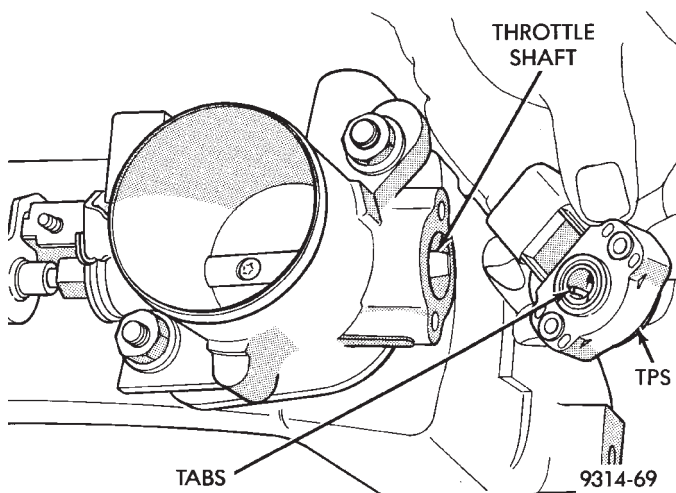


Fig. 70 Throttle Position Sensor Installation—3.5L Engine

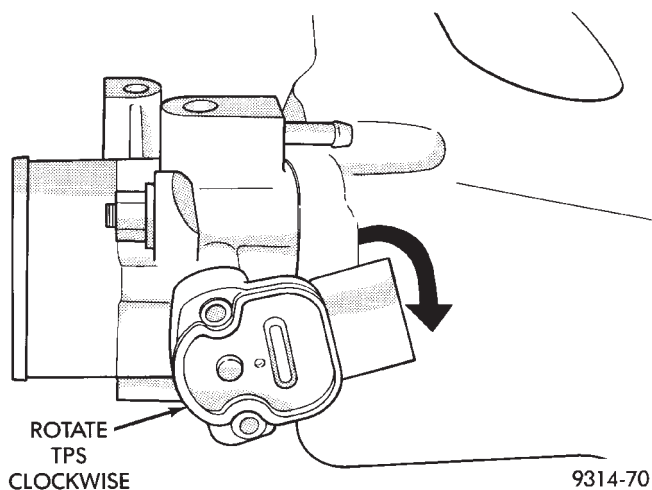


Fig. 71 Rotate TPS Clockwise For Alignment—3.5L Engine

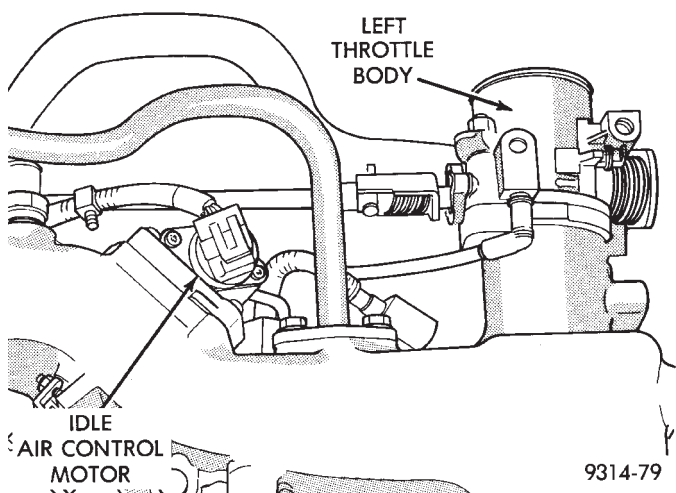


Fig. 72 Idle Air Control Motor

(3) Remove idle air control 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 IAC Motor Open/Close Test to retract the pintle (battery must be connected.)

(2) Carefully place idle air control motor into housing.

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

(4) Attach electrical connector to idle air control motor.

INTAKE AIR TEMPERATURE SENSOR—3.5L ENGINE

REMOVAL

(1) Remove engine cover.

(2) Disconnect electrical connector from sensor.

(3) Remove sensor.

INSTALLATION

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

(2) Attach electrical connector to sensor.

(3) Install engine cover.

DUTY CYCLE EVAP PURGE SOLENOID

The duty cycle EVAP purge solenoid is mounted on the side of the air cleaner. The top of the solenoid has the word TOP on it. The solenoid will not operate unless it is installed correctly.

REMOVAL

(1) Remove air cleaner tube.

(2) Disconnect electrical connector from EVAP solenoid (Fig. 73).

(3) Disconnect vacuum harness from solenoid.

(4) Lift solenoid up off of bracket.

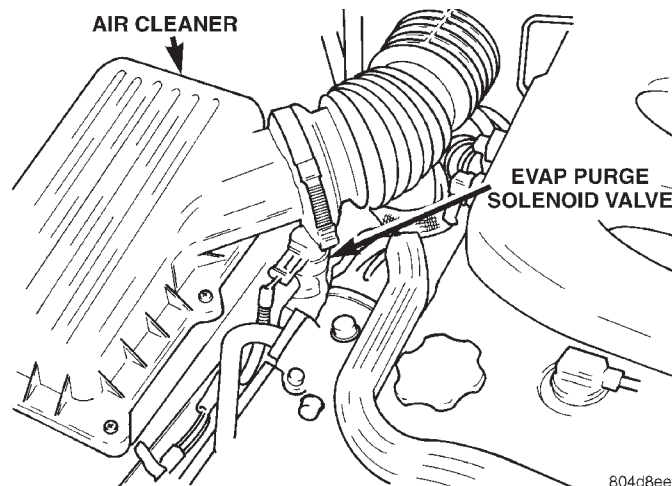


Fig. 73 Duty Cycle EVAP Purge Solenoid

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

- (1) Install solenoid onto bracket with the top side up. The upper end of the solenoid has the word TOP on it.
- (2) Ensure solenoid does not contact other surfaces or components. The solenoid could make a clicking sound if it contacts other surfaces or components.
- (3) Attach electrical connector to solenoid.
- (4) Connect vacuum harness to solenoid.
- (5) Install air cleaner tube.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR-3.5L

On 3.5L engines, the MAP sensor threads into the left side of the intake manifold plenum (Fig. 74).

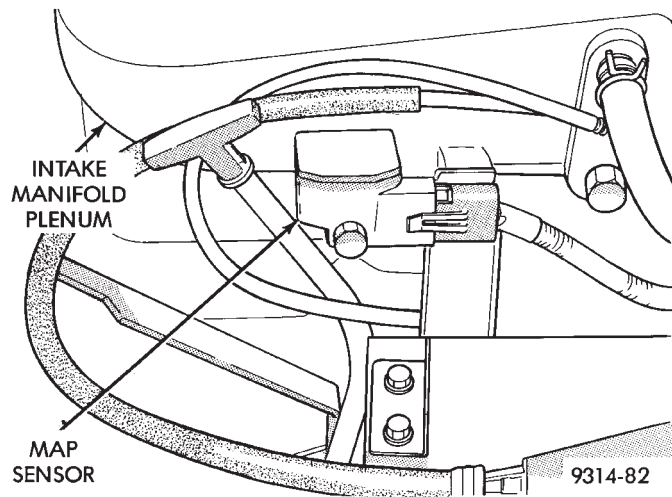


Fig. 74 MAP Sensor—3.5L Engine

REMOVAL

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

INSTALLATION

- (1) Thread sensor into intake manifold plenum. Tighten sensor to 10 N·m (90 in. lbs.) torque and then rotate it to horizontal position.
- (2) Attach electrical connector to sensor.

MANIFOLD TUNING VALVE—3.5L ENGINE

REMOVAL

- (1) Remove engine cover.
- (2) Disconnect vacuum hose from manifold tuning valve vacuum motor (Fig. 75).
- (3) Remove retaining clip from manifold tuning valve arm (Fig. 76).
- (4) Remove manifold tuning valve mounting screws. Remove tuning valve vacuum motor.

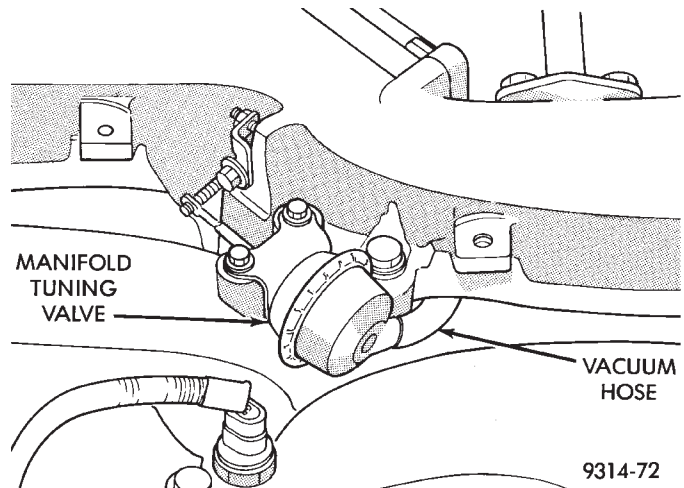


Fig. 75 Manifold Tuning Valve

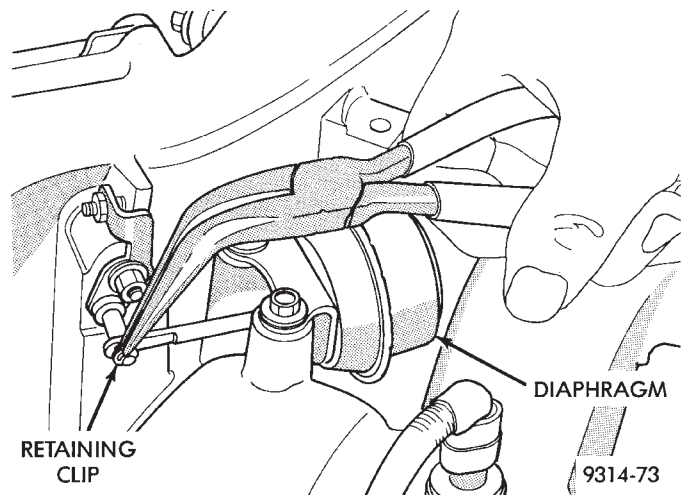


Fig. 76 Retaining Clip

INSTALLATION

- (1) Install tuning valve. Tighten mounting screws to 11 N·m (8 ft. lbs.) torque.
- (2) Install retaining clip.
- (3) Connect vacuum hose to the manifold tuning valve vacuum motor.

MANIFOLD TUNING VALVE SOLENOID—3.5L ENGINE

REMOVAL

- (1) Remove air cleaner tube.
- (2) Remove electrical connectors from the manifold tuning valve solenoid (Fig. 77).
- (3) Remove solenoid mounting bracket screw.
- (4) Remove solenoids and bracket.
- (5) Lift MTV solenoid up off of bracket.
- (1) Reverse procedure for installation.

REMOVAL AND INSTALLATION (Continued)

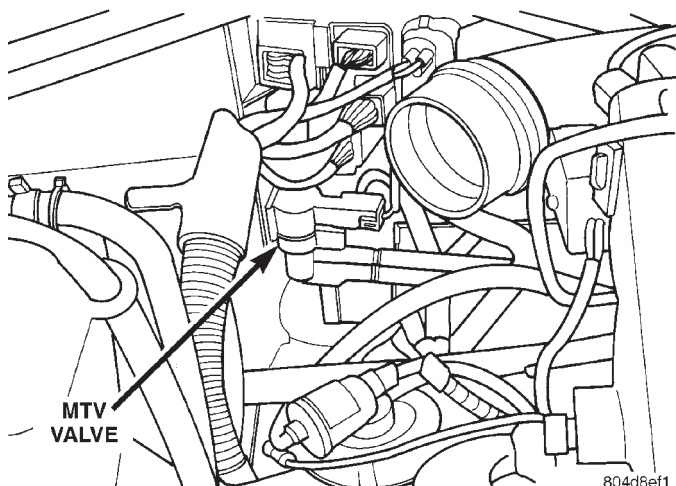


Fig. 77 MTV Solenoid—3.5L Only

POWERTRAIN CONTROL MODULE (PCM)

The PCM engine control strategy prevents reduced idle speeds until after the engine operates for 320 km (200 miles). If the PCM is replaced after 320 km (200 miles) of usage, update the milage in the new PCM. Use the DRB scan tool to change the milage in the PCM. Refer to the appropriate Powertrain Diagnostic Manual and the DRB scan tool.

REMOVAL

- (1) Remove air cleaner.
- (2) Disconnect PCM 2 40-way connector (Fig. 78)
- (3) Remove 2 bolts from PCM bracket.
- (4) Remove PCM.

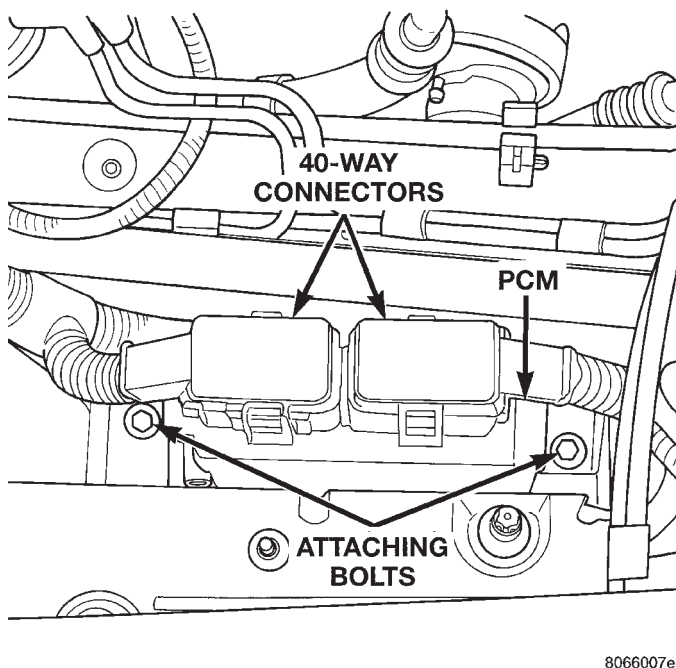


Fig. 78 PCM Location

INSTALLATION

- (1) Install PCM. Tighten bolt to 4 N·m (35 in. lbs.) torque.
- (2) Attach 2 40-way connector to PCM.
- (3) Install air cleaner.
- (4) Using DRB scan tool, program mileage into PCM. Refer to the DRB scan tool and the appropriate Powertrain Diagnostic Manual.

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 SENSORS—3.5L ENGINE

The 3.5L engine uses two heated oxygen sensors, one in each exhaust manifold.

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

REMOVAL

- (1) To access the heated oxygen sensor on the right exhaust manifold, remove the air cleaner tube.

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

- (2) Disconnect the heated oxygen sensor electrical connector.

- (3) Use a socket such as Snap-On YA8875 or a crow foot wrench to remove oxygen sensor (Fig. 79).

INSTALLATION

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

- (2) Connect the heated oxygen sensor electrical connector.

- (3) Install the air cleaner tube

DOWNSTREAM HEATED OXYGEN SENSOR

The O2S are located at the outlet ends of the catalytic converter (Fig. 80).

REMOVAL AND INSTALLATION (Continued)

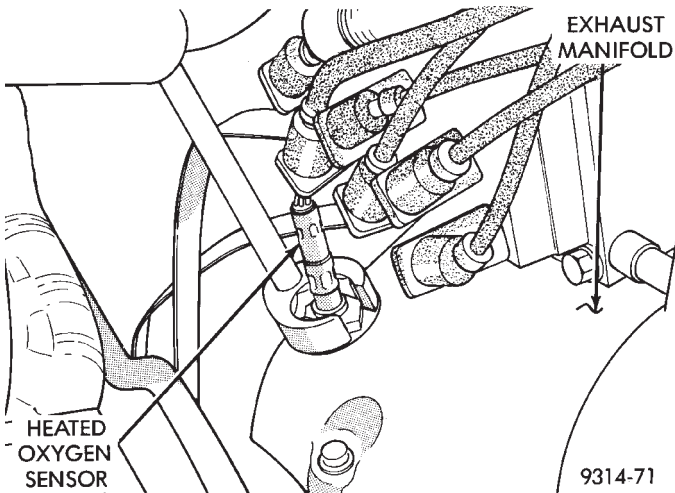


Fig. 79 Heated Oxygen Sensor Removal/Installation—3.5L Engine

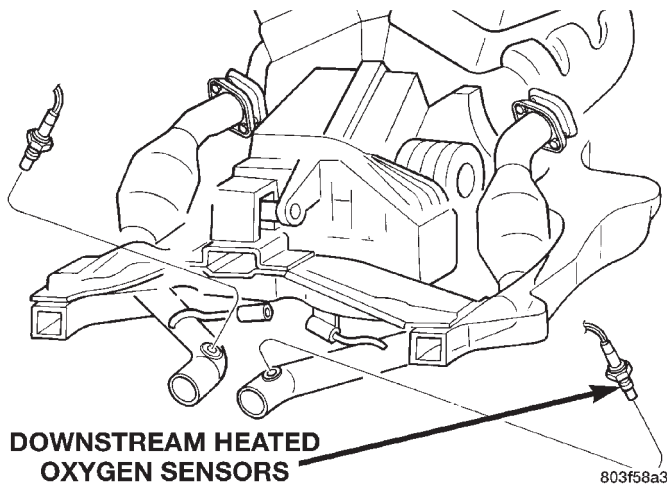


Fig. 80 Downstream Heated Oxygen Sensor

REMOVAL

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

- (1) Raise and support the vehicle.
- (2) Disconnect the wire connector from the O2S.

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

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

INSTALLATION

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

- (1) Install the O2S. Tighten to 30 N·m (22 ft. lbs.) torque.
- (2) Connect the O2S wire connector.
- (3) Lower the vehicle.

AIR CLEANER

LH vehicles do not use a heated air inlet system. The Powertrain Control Module (PCM) adjusts fuel injector pulse width and ignition timing to compensate for different ambient temperatures.

The air cleaner attaches to the a bracket on right inner fender panel (Fig. 81). An opening in the body panel connects the inlet duct to ambient air.

Both the 3.3L and 3.5L air induction systems use plastic attaching clamps. Do not use a screwdriver to open the clamp. It will damage the clamp locking teeth. To remove the clamps use pliers to open the clamp tab. Use water pump pliers to tightening clamps. Tighten clamps until the rubber connecting tube of the air induction system starts to spread.

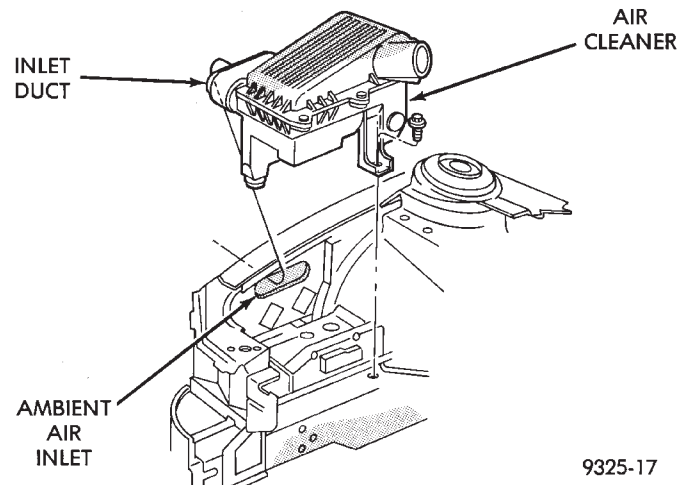


Fig. 81 Air Cleaner and Mounting Bracket

The 3.3L air induction system uses a resonator between the air cleaner and throttle body (Fig. 82). The make-up air hose for the PCV system attaches to the resonator.

The 3.5L air induction system has a plenum that supplies filtered air to the throttle bodies, idle air control motor and PCV make-up air circuit (Fig. 83).

FILTER ELEMENT REPLACEMENT

- (1) Remove air cleaner lid attaching screws. Lift lid off of air cleaner housing.
- (2) Remove filter element (Fig. 84).

REMOVAL AND INSTALLATION (Continued)

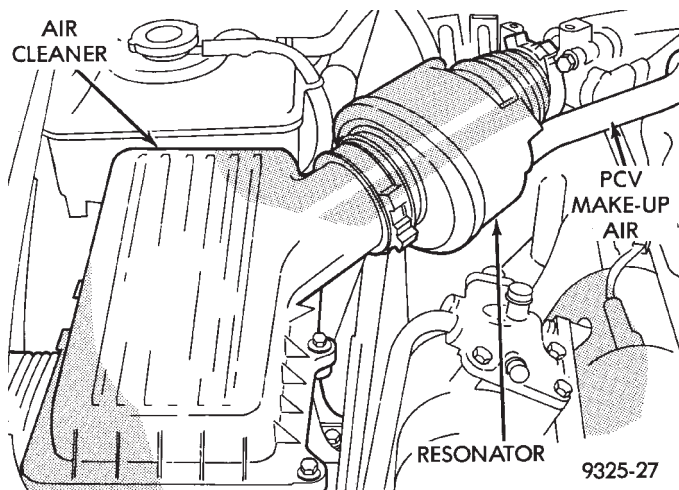


Fig. 82 Air Induction System—3.3L Engine

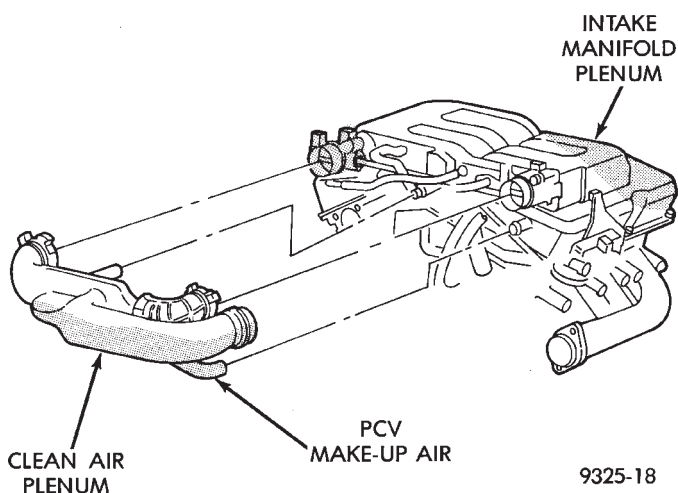


Fig. 83 Clean Air Plenum—3.5L Engine

(3) If necessary, clean the inside of the air cleaner housing.

(4) Install new filter element.

(5) Place lid over air cleaner housing. Tighten screws to 2.2 N.m (20 in. lbs.).

ENGINE COOLANT TEMPERATURE SENSOR

The engine coolant temperature sensor is located next to the thermostat housing (Fig. 85) or (Fig. 86).

REMOVAL

(1) With the engine cold, disconnect coolant sensor electrical connector.

(2) Remove sensor.

INSTALLATION

(1) Install engine coolant temperature sensor. Tighten sensor to 28 N·m (20 ft. lbs.) torque.

(2) Attach electrical connector to sensor.

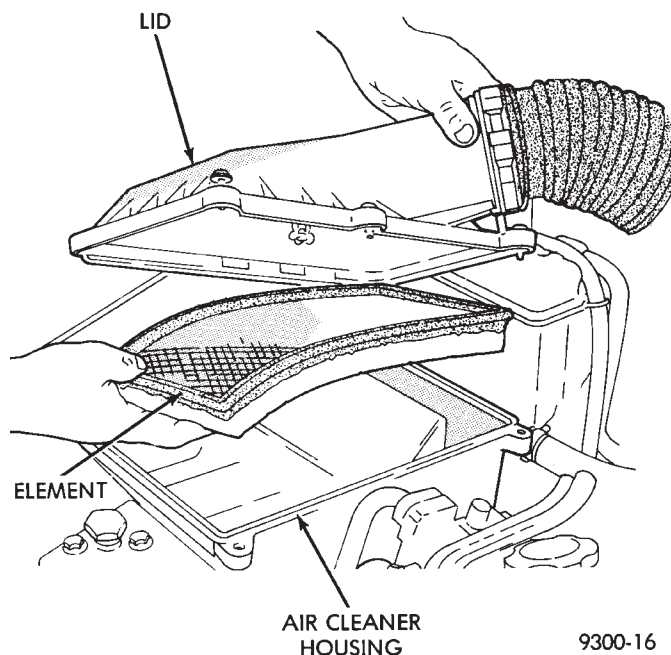


Fig. 84 Air Cleaner Housing and Element

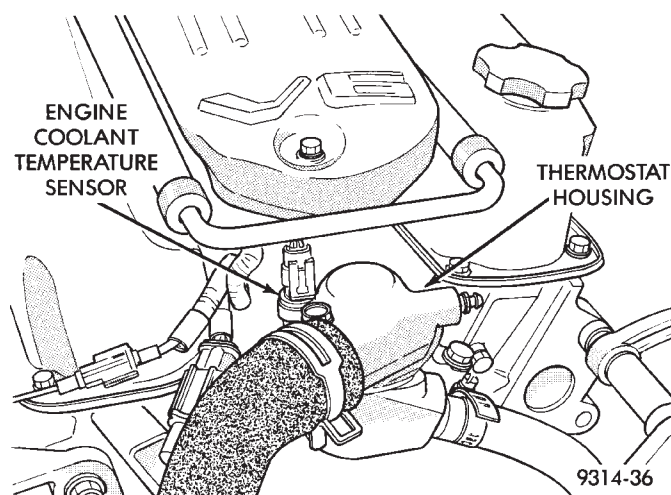


Fig. 85 Engine Coolant Temperature Sensor—3.3L Engine

VEHICLE SPEED SENSOR

For Removal/Installation of speed sensors refer to Group 21, Transaxle.

KNOCK SENSORS—3.5L ENGINE

The 3.5L engine uses two knock sensors. The sensors thread into the cylinder block, directly below the intake manifold.

REMOVAL

(1) Remove intake manifold plenum refer to Group 11, Exhaust System and Intake Manifold.

(2) Disconnect electrical connector from knock sensor(s) (Fig. 87).

REMOVAL AND INSTALLATION (Continued)

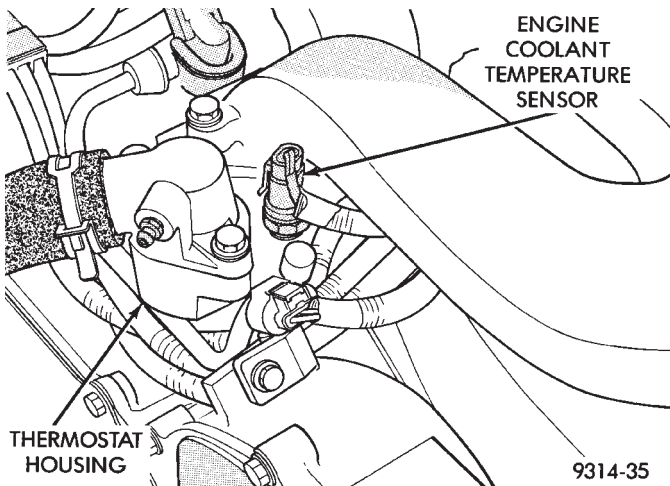


Fig. 86 Engine Coolant Temperature Sensor—3.5L Engine

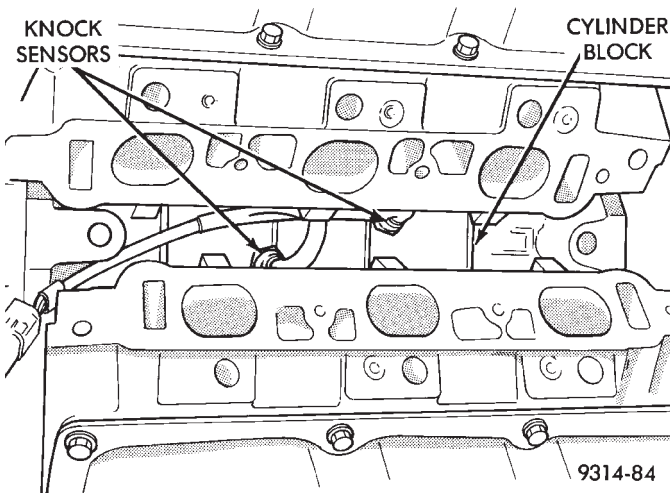


Fig. 87 Knock Sensor Location

(3) Use a crows foot socket to remove the knock sensors.

INSTALLATION

(1) Install knock sensor. Tighten knock sensor to 10 N·m (7 ft. lbs) torque. **Over or under tightening effects knock sensor performance resulting in possible improper spark control.**

(2) Attach electrical connector to knock sensor.

(3) Install intake manifold plenum. Refer to Group 11, Exhaust System and Intake Manifold.

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

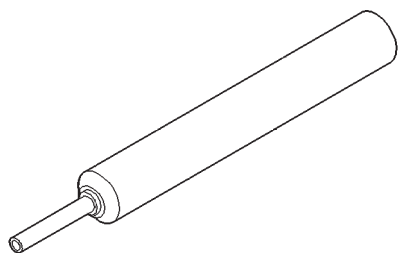
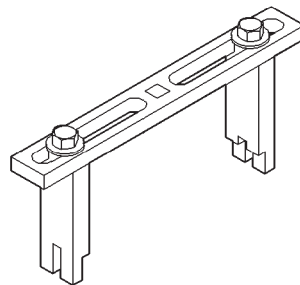
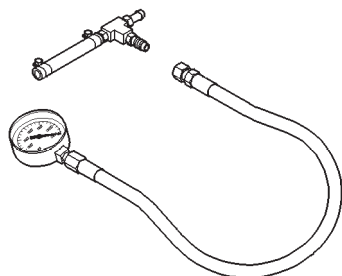
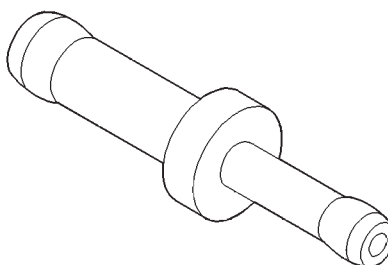
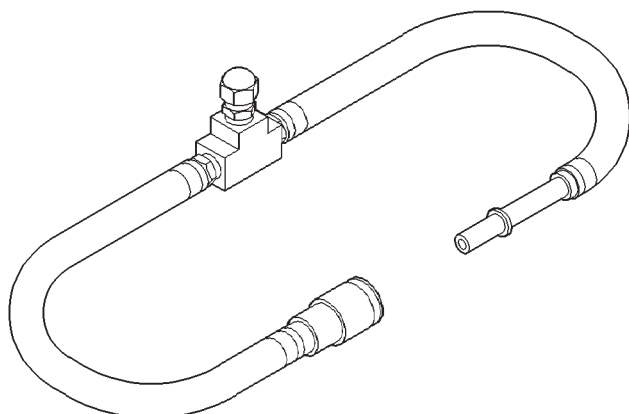
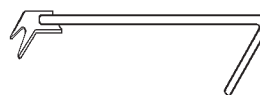
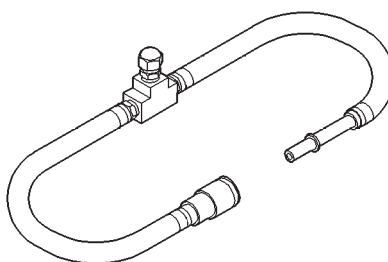
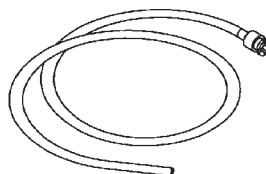
DESCRIPTION

TORQUE

Camshaft Position Sensor	12 N·m (105 in. lbs.)
Crankshaft Position Sensor	
Mounting Bolts	12 N·m (105 in. lbs.)
Engine Coolant Temperature	
Sensor	28 N·m (20 ft. lbs.)
IAC Motor-To-Throttle	
Body Bolts	3 N·m (25 in. lbs.)
Intake Manifold Air Temperature	
Sensor—3.5L	28 N·m (20 ft. lbs.)
Knock Sensor—3.5L	10 N·m (7 ft. lbs.)
Manifold Tuning Valve—3.5L	11 N·m (8 ft. lbs.)
MAP Sensor—3.5L	10 N·m (7 ft. lbs.)
MAP Sensor Mounting Screws . . .	3 N·m (25 in. lbs.)
Oxygen Sensor	28 N·m (20 ft. lbs.)
Powertrain Control Module (PCM)	
Mounting Screws	4 N·m (35 in. lbs.)
Synchronization Shaft Locknut . .	4 N·m (36 in. lbs.)
Throttle Body Mounting Bolts . .	26 N·m (19 ft. lbs.)
Throttle Position Sensor	
Mounting Bolts	3 N·m (25 in. lbs.)
Throttle Shield Bolt	4.5 N·m (40 in. lbs.)

SPECIAL TOOLS

FUEL

**Extractor C-4334****Spanner Wrench 6856****Pressure Gauge Assembly C-4799-B****Metering Orifice****Fuel Pressure Test Adapter 6539****Fuel Line Tool****Fuel Line Adapter****Fuel Line Adapter 1/4**