FUEL SYSTEM

CONTENTS

GENERAL INFORMATION

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 Fuel System consists of the fuel tank, fuel pump, fuel filter, throttle body, fuel injectors, fuel lines and vacuum lines.

The Fuel Delivery System consists of the fuel pump module, fuel filter, fuel lines and fuel hoses.

The Fuel Tank Assembly consists of the fuel tank, fuel pump module, filler tube, and a pressure-vacuum filler cap.

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

Light spark knock at low engine speeds is not harmful to your engine. However, continued heavy spark knock at high speeds can cause damage and should be reported to your dealer immediately. Engine damage resulting from operating with a heavy spark knock may not be covered by the new vehicle warranty.

In addition to using unleaded gasoline with the proper octane rating, gasolines 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. Generally, premium unleaded gasolines contain more additive than regular unleaded.

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 gasoline with materials that contain oxygen such as alcohol, MTBE (Methyl Tertiary Butyl Ether) and ETBE (Ethyl Tertiary Butyl Ether). 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.

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

Do not use gasolines containing Methanol.

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 Motors and may not be covered by the new vehicle warranty.

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

Clean Air Gasoline

Many gasolines are now being blended that contribute to cleaner air, especially in those areas of the country where pollution levels are high. These new blends provide a cleaner burning fuel and some are referred to as reformulated gasoline.

In areas of the country where carbon monoxide levels are high, gasolines are being treated with oxygenated materials such as ETBE, MTBE and ethanol. The use of gasoline blended with these materials also contributes to cleaner air.

Chrysler Corporation supports these efforts toward cleaner air and recommends that you use these gasolines as they become available.

Materials Added to Fuel

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

FUEL DELIVERY SYSTEM

INDEX

GENERAL INFORMATION

The front wheel drive van and the all wheel drive van have different fuel delivery systems. The front wheel drive van uses a metal fuel tank mounted in the rear of the vehicle. The all wheel drive van has a plastic fuel tank located on the left side of the vehicle. The fuel pumps and the chassis fuel tubes used on front wheel drive vans are different from those used on all wheel drive vans.

Both the front wheel drive and all wheel drive fuel pump modules have an internal fuel reservoir, a fuel level sending unit, and a fuel strainer mounted on the pump housing. Both systems use quick connect fittings at the fuel tank and engine. The fuel filter location is the same for both front wheel drive and all wheel drive vehicles.

FUEL SYSTEM PRESSURE RELEASE PROCEDURE—2.5L ENGINE

CAUTION: Before servicing the fuel pump, fuel lines, fuel filter, throttle body, or fuel injector, release fuel system pressure.

(1) Loosen fuel filler cap to release fuel tank pressure.

(2) Disconnect injector wiring harness connector at edge of throttle body (Fig. 1).

(3) Connect a jumper wire between terminal Number 1 of the injector harness and engine ground.

(4) Connect a jumper wire to the positive terminal Number 2 of the injector harness and touch the battery positive post **for no longer than 5 seconds**. This releases system pressure.

(5) Remove jumper wires.

(6) Continue fuel system service.

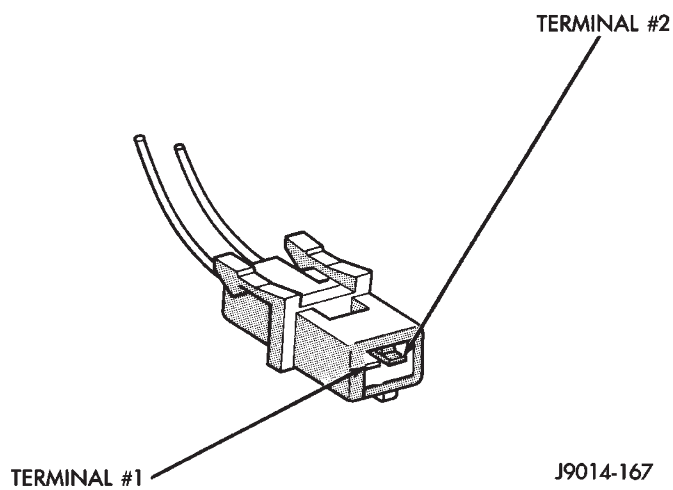

Fig. 1 Injector Harness Connector—2.5L Engine

FUEL SYSTEM PRESSURE RELEASE PROCEDURE—3.0L ENGINE

(1) Disconnect the fuel rail electrical harness from the engine harness. Refer to Group 8W, Wiring Diagrams.

(2) Connect one end of a jumper wire to the A142 circuit terminal of the fuel rail harness connector.

(3) Connect the other end of the jumper wire to a 12 volt power source.

(4) Connect one end of a jumper wire to a good ground source.

(5) Momentarily ground one of the injectors by connecting the other end of the jumper wire to an injector terminal in the harness connector. Repeat procedure for 2 to 3 injectors.

FUEL SYSTEM PRESSURE RELEASE PROCEDURE—3.3L ENGINE

WARNING: THE 3.3L MPI FUEL SYSTEM IS UNDER A CONSTANT PRESSURE OF APPROXIMATELY 330 KPA (48 PSI). RELEASE FUEL SYSTEM PRESSURE BEFORE SERVICING THE FUEL PUMP, FUEL LINES, FUEL FILTER, THROTTLE BODY OR FUEL INJECTORS.

(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. 2).

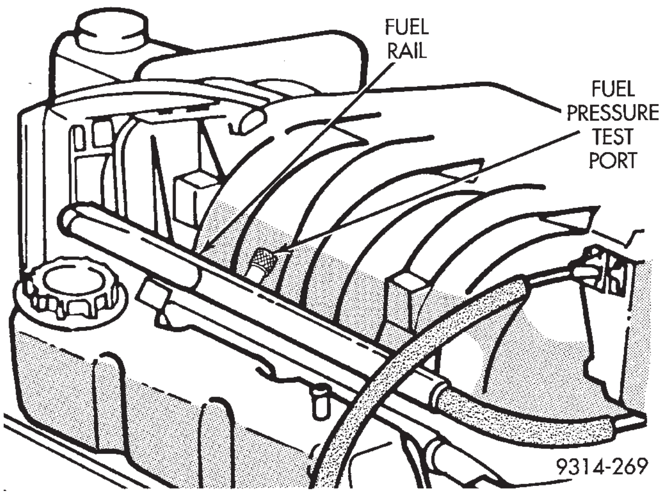

Fig. 2 Fuel Pressure Test Port—3.3L Engine

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

(5) Continue fuel system service.

FUEL HOSES, CLAMPS, AND QUICK CONNECT FITTINGS

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 edge 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

Some fuel lines have quick connect fittings. The fittings are designed to speed up the installation and removal of the fuel lines (Fig. 3).

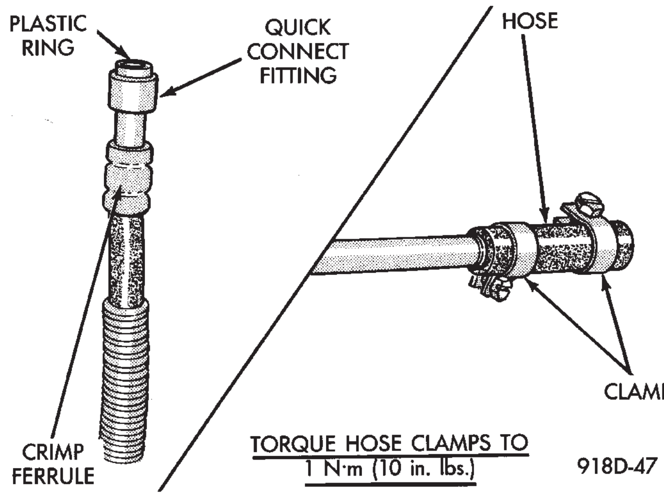

Fig. 3 Quick Connect Fuel Fittings

Quick connect fittings consist of a metal casing, a black plastic release ring, a metal locking retainer, and internal O-rings.

TUBE/FITTING DISASSEMBLY

WARNING: FUEL SYSTEM PRESSURE MUST BE RELEASED BEFORE DISCONNECTING ANY FUEL SYSTEM COMPONENT.

(1) Disconnect the negative battery cable.

(2) Remove the fuel tank gas cap to release fuel tank pressure.

(3) Perform the Fuel System Pressure Release Procedure.

(4) Remove any loose dirt from quick connect fittings.

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

(5) To remove the fuel tube nipple from a quick connect fitting, pull back on the fitting while pushing in on the plastic ring (Fig. 3). To aid in disassembly, an open end wrench may be used to push the plastic ring in.

(6) Cover the quick connector to prevent contamination.

TUBE/FITTING ASSEMBLY

(1) Inspect the quick connect fitting to 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 release ring or dirt accumulation, the fitting should be replaced.

The fuel tube nipples must be lubricated with clean 30 weight engine oil prior to reconnecting the quick-connect fitting.

(2) Lubricate the male end of the fuel tube with 30 weight engine oil.

(3) Insert fuel tube nipple into quick connector fitting. When the fuel tube nipple is inserted into the quick-connect fitting, the shoulder of the nipple is locked in place by the locking retainer and the internal O-rings seal the tube.

(4) Pull back on the quick connect fitting to verify the connection is secure. The tube should be locked in place. If the connection is not complete, make sure the black plastic release is not causing the locking retainer 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.

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

TUBE/FITTING SERVICE

If a quick connect fitting needs to be serviced, the following procedure must be followed:

(1) Disconnect the battery negative battery cable.

(2) Perform the Fuel System Pressure Release Procedure.

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

(3) Remove the quick connect fitting from the fuel tube by pushing in on the plastic ring located on the end of the fitting. Gently pull the fitting from the fuel tube.

(4) Cut off the crimped ferrules at each end of the hose, taking care not to damage the quick connect fitting or the fuel tube.

(5) Discard the ferrules, hose and damaged quick connect fitting.

(6) Replace the hose using hose marked EFM/EFI.

(7) Attach the replacement hose to the quick connect fitting and fuel tube using the correct hose clamps. The hose clamps used are of a special rolled edge construction to prevent the edge of the clamp cutting into the hose. Only original equipment clamps or equivalent may be used in this system. Other types of clamps may cut into the hoses and cause high pressure fuel leaks.

(8) Tighten hose clamps to 1 N●m (10 in. lbs.) torque.

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.

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

FUEL PUMP/LEVEL UNIT ASSEMBLY

The all wheel drive and front wheel drive vehicles use different fuel pumps. The fuel pump/level unit assembly used on front wheel drive systems consists of the fuel pump, reservoir body, and level unit (Fig. 4).

All wheel drive vehicles have a fuel pump module (Fig. 5). The module contains the fuel pump, level unit and reservoir body. The module is spring loaded. The module must be pushed down to install it in the fuel tank.

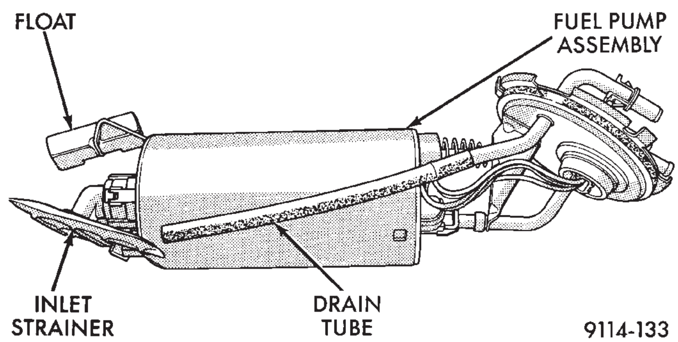

Fig. 4 Fuel Pump/Level Unit—Front Wheel Drive

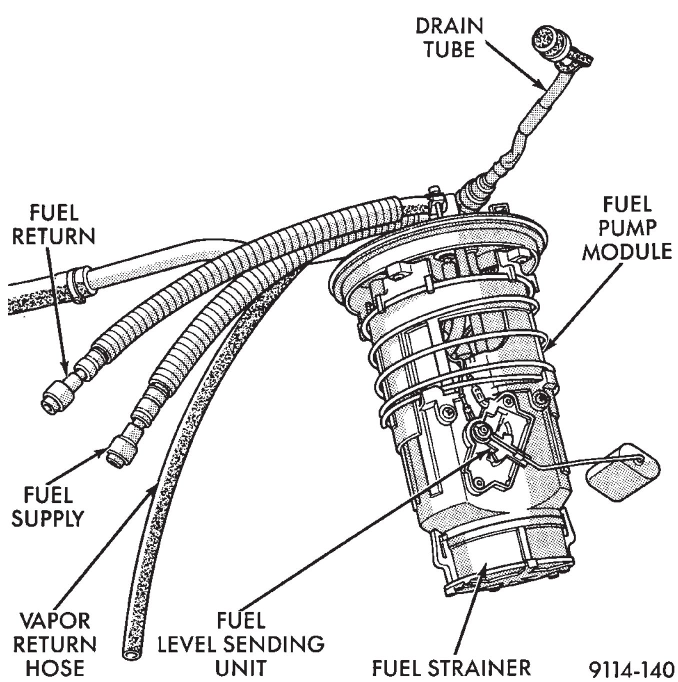

Fig. 5 Fuel Pump Module—All Wheel Drive

On both systems, the reservoir body replaces an internal fuel tank reservoir. The purpose of the reservoir is to provide fuel at the pump intake during all driving conditions, especially those when low fuel levels are present.

The fuel pump used in both systems is a positive displacement, gerotor immersible pump with a permanent magnet electric motor. The fuel is drawn in through an inlet strainer and pushed through the electric motor to the outlet. The pump module contains two check valves. One valve is used to relieve internal fuel pump pressure and regulate maximum pump output. The other check valve is located in the fuel return line. It restricts fuel movement in reverse direction when the pump is not operating. Voltage to operate the pump is supplied through the fuel pump relay.

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

The maximum output pressure of both front wheel drive and all wheel drive fuel pumps is approximately 930 kPa (135 psi).

The pressure regulator adjusts system pressure. On 3.0L and 3.3L engines the pressure regulator is mounted on the fuel rail. On 2.5L engines the regulator is mounted on the throttle body. Fuel system pressures are shown in the Fuel System Pressure chart.

FUEL SYSTEM PRESSURE—WITHOUT VACUUM APPLIED TO PRESSURE REGULATOR

System	Pressure
2.5L TBI	265 kPa (39 psi)
3.0L	330 kPa (48 psi)
3.3L/3.8L	330 kPa (48 psi)

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Fuel system pressure must be released before servicing any fuel system component. Perform the Fuel System Pressure Release procedure.

FUEL PUMP PRESSURE TEST—2.5L and 3.0L ENGINES

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

The specifications listed in the Fuel System Pressure Chart are determined without vacuum applied to the fuel pressure regulator.

(1) Perform fuel system pressure release.

(2) Remove fuel supply hose quick connector from the chassis lines (at the engine). Refer to Quick Connect Fittings in this section.

(3) Connect Fuel Pressure Gauge C-4799 to Fuel Pressure Test Adapter 6539 (Fig. 6). Install the adapter between fuel supply hose and chassis fuel line assembly.

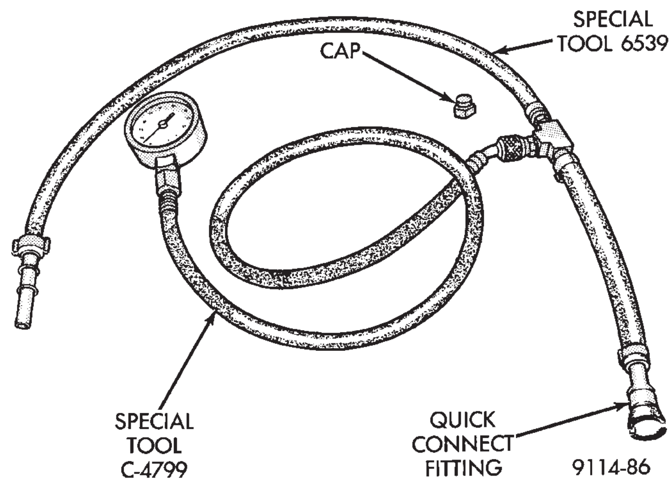


Fig. 6 Gauge and Adapter

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

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

If the gauge reads the pressure shown in the Fuel System Pressure chart, further testing is not required. If pressure is not correct, record the pressure and remove gauge.

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

If the fuel pressure reading in step (4) was below specifications, test the system according to the following procedure.

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

(a) Perform Fuel Pressure Release procedure.

(b) Install Fuel Pressure Gauge C-4799 and Fuel Pressure Adapter 6433 in the fuel supply line (Fig. 7) between the fuel tank and fuel filter.

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

• If pressure is at least 5 psi higher than reading recorded in step (4), replace fuel filter.

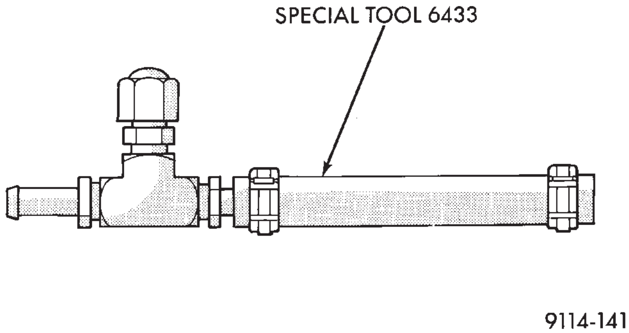


Fig. 7 Fuel Pressure Adapter

• 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

If the fuel pressure reading in step (4) was above specifications test the system according to the following procedure.

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

(a) Perform Fuel Pressure Release procedure.

(b) Install Fuel Pressure Gauge C-4799 and Fuel Pressure Adapter 6433 in the fuel supply line (Fig. 7) 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 6541 to the return line. Place the other end of adapter 6541 into an approved gasoline container (minimum 2 gallon size). All return fuel will flow into container.

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

• 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 6541 to the fuel return hose and place other end of hose in clean container (Fig. 8). Repeat test. If pressure is now correct, check for restricted fuel return line. If no change is observed, replace fuel pressure regulator.

FUEL PUMP PRESSURE TEST—3.3L ENGINE

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

The specifications listed in the Fuel System Pressure Chart are determined without vacuum applied to the fuel pressure regulator.

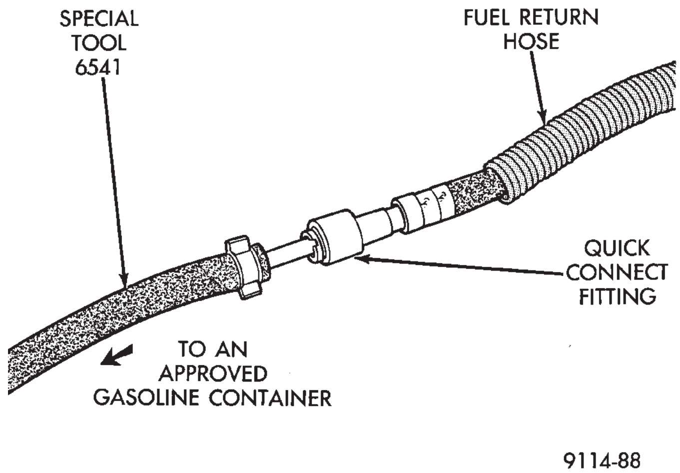


Fig. 8 Fuel Return Connection

(1) Fuel system pressure must be released each time a fuel hose is to be disconnected. Perform fuel system pressure release.

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

(3) Connect Fuel Pressure Gauge C-4799 to fuel rail service valve. (Fig. 9)

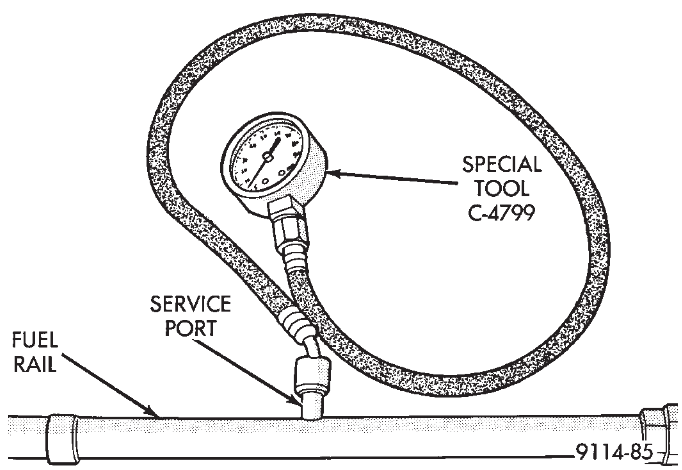


Fig. 9 Pressure Test Gauge

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 DRBII scan tool, access ASD Fuel System Test. The ASD Fuel System Test will activate the fuel pump and pressurize the system.

If the gauge reading 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. Use the DRBII scan tool ASD Fuel System Test to pressurize the system. Ensure fuel does not leak from the fuel rail service valve. Reinstall protective cover onto fuel rail service valve.

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

If the fuel pressure reading in step (4) was below specifications, test the system according to the following procedure.

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

(a) Perform Fuel Pressure Release procedure.

(b) Install Fuel Pressure Gauge C-4799 and Fuel Pressure Adapter 6433 in the fuel supply line between the fuel tank and fuel filter (Fig. 7).

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

- If pressure is at least 5 psi higher than reading recorded in step (4), 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

If the fuel pressure reading in step (4) was above specifications test the system according to the following procedure.

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

(a) Perform Fuel Pressure Release procedure.

(b) Install Fuel Pressure Gauge C-4799 and Fuel Pressure Adapter 6433 in the fuel supply line (Fig. 7) 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 6541 to the return line. Place the other end of adapter 6541 into an approved gasoline container (minimum 2 gallon size). All return fuel will flow into container.

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

- 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 6541 to the fuel return hose and place other end of hose in clean container (Fig. 8). Repeat test. If pressure is now correct, check for restricted fuel return line. If no change is observed, replace fuel pressure regulator.

FUEL LEVEL SENSOR DIAGNOSIS

This procedure test the resistance of the level sensor itself. It does not test the level sensor circuit. Refer to Group 8W, Wiring Diagrams for circuit identification and Group 8E, Instrument Panel and Gauges for fuel gauge information.

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 level sensor connector (Fig. 10 or Fig. 11). Move the float lever to the full stop and empty stop positions shown in the resistance chart (Fig. 10 or Fig. 11). Record the resistance at each point. Replace the level sensor if the resistance is not within specifications.

FUEL PUMP/LEVEL SENSOR ASSEMBLY REMOVAL—FRONT WHEEL DRIVE

The fuel tank must be removed to service the fuel pump/level sensor unit assembly. Refer to Fuel Tank Section for fuel tank removal.

(1) Using a hammer and a brass drift, carefully tap the lock ring counterclockwise to release assembly (Fig. 12).

(2) Remove fuel pump/level sensor assembly and O-ring seal from tank. Discard old seal.

(3) Prevent dirt from entering the tank by covering the fuel tank openings.

FUEL PUMP INLET STRAINER REMOVAL—FRONT WHEEL DRIVE

(1) Gently bend locking tabs on fuel pump reservoir assembly to clear locking tangs on the fuel pump filter (Fig. 13).

(2) Remove strainer.

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

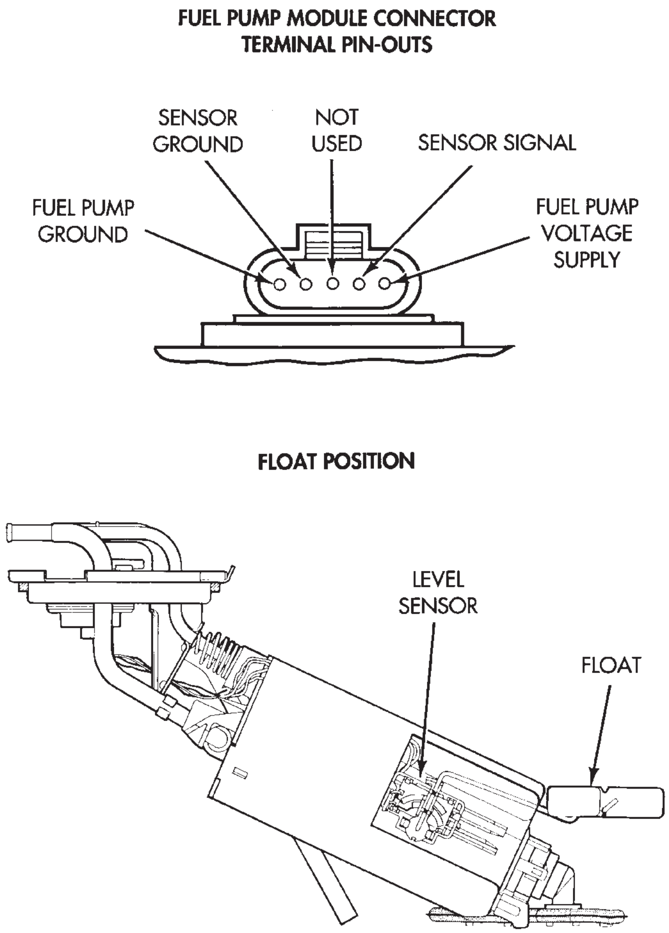
(4) If the inlet strainer is plugged or dirty, clean the fuel tank.

FUEL PUMP INLET STRAINER INSTALLATION—FRONT WHEEL DRIVE

(1) Lightly lubricate the strainer O-ring with Mopar Silicone Spray Lube.

(2) Insert strainer O-ring into outlet of strainer. The O-ring must sit evenly on the step inside the filter outlet.

(3) Push strainer onto the inlet of the fuel pump reservoir body. Ensure the locking tabs on the reservoir body lock over the locking tangs on the filter.



FLOAT POSITION (HEIGHT)	RESISTANCE
SENSOR FULL STOP	8 OHMS MAXIMUM
SENSOR EMPTY STOP	102.25 ±5.75 OHMS

9314-275

Fig. 10 Level Sensor Diagnosis—Front Wheel Drive

FUEL LEVEL SENSOR REMOVAL—FRONT WHEEL DRIVE

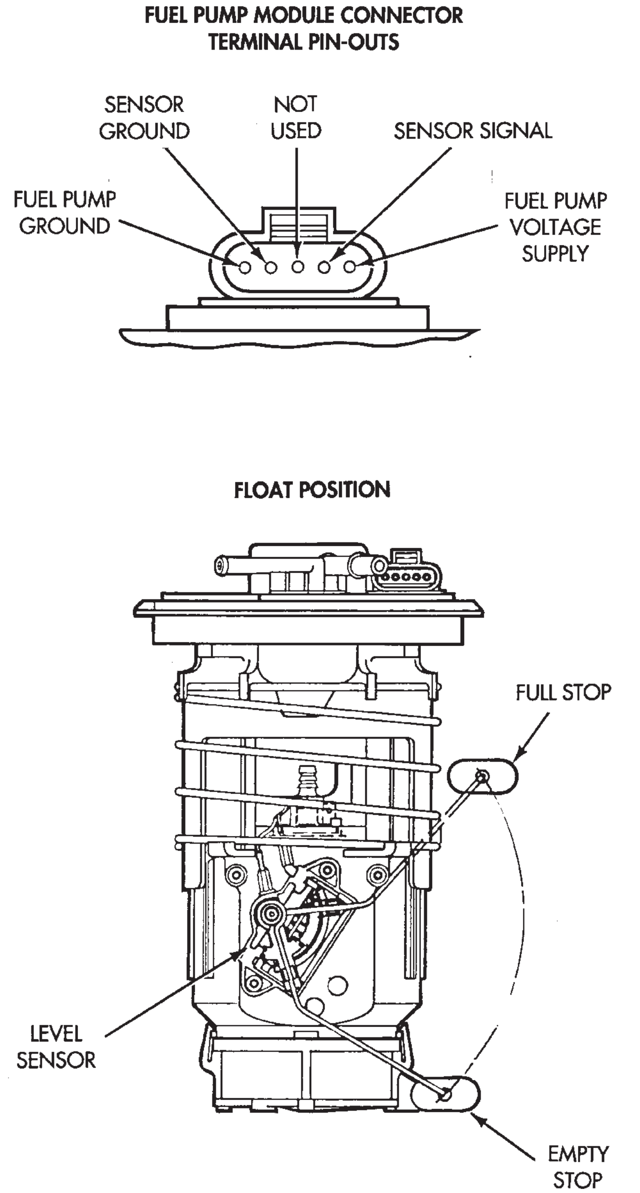
(1) Bend locking tab and remove electrical connector from the bottom of the fuel pump electrical connector (Fig. 14).

(2) Remove terminal locking cover (red). Remove level sensor wiring terminals from the electrical connector.

(3) Use a wide blade screwdriver to release the level sensor locking tab (Fig. 15). Use another wide blade screwdriver to push on the level sensor body.

(4) Slide the entire fuel level sensor off of the fuel pump/reservoir body.

(5) Carefully pull the wires through the coverplate and reservoir body.



FLOAT POSITION (HEIGHT)	RESISTANCE
SENSOR FULL STOP	8 OHMS MAXIMUM
SENSOR EMPTY STOP	102.25 ±5.75 OHMS

9314-276

Fig. 11 Level Sensor Diagnosis—All Wheel Drive

FUEL LEVEL SENSOR INSTALLATION—FRONT WHEEL DRIVE

(1) Carefully bend the level unit wires and lay into the slot on the back of the level sensor.

(2) Slide the level sensor into the slots on the fuel pump/reservoir assembly. Feed the wires through the triangular hole in the fuel pump/reservoir body. Make sure that the tab on the level sensor locks into the detente in the fuel pump/reservoir assembly.

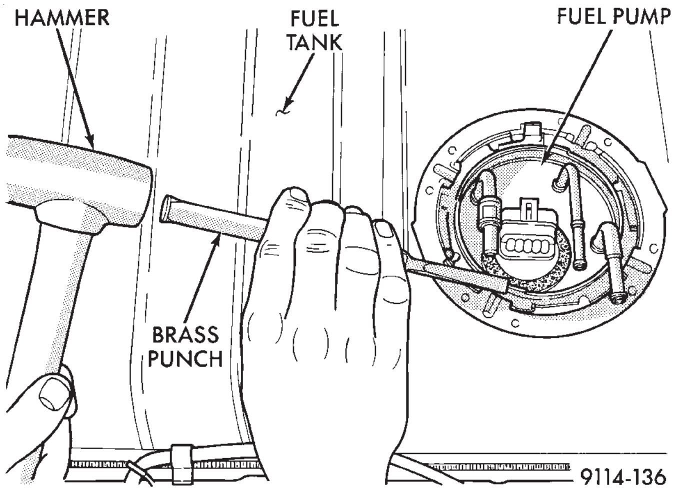


Fig. 12 Fuel Pump Service—Front Wheel Drive

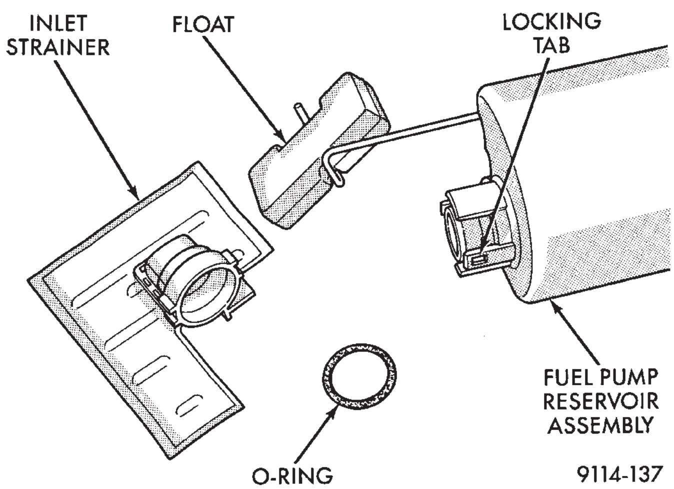


Fig. 13 Fuel Pump Inlet Strainer—Front Wheel Drive

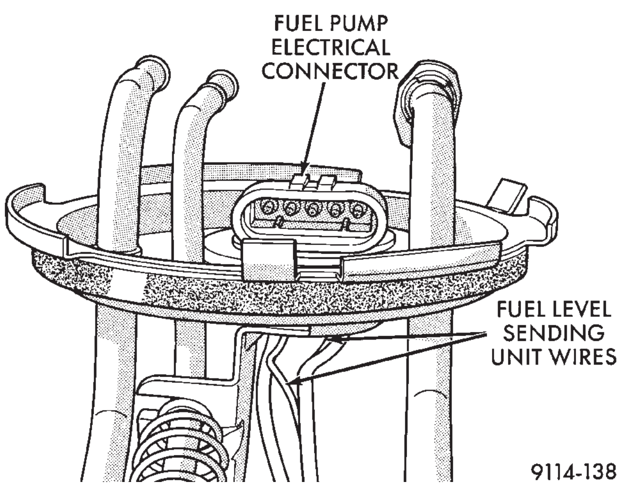


Fig. 14 Fuel Pump Electrical Connector—Front Wheel Drive

(3) Slip wires into tab on the fuel pump/reservoir assembly.

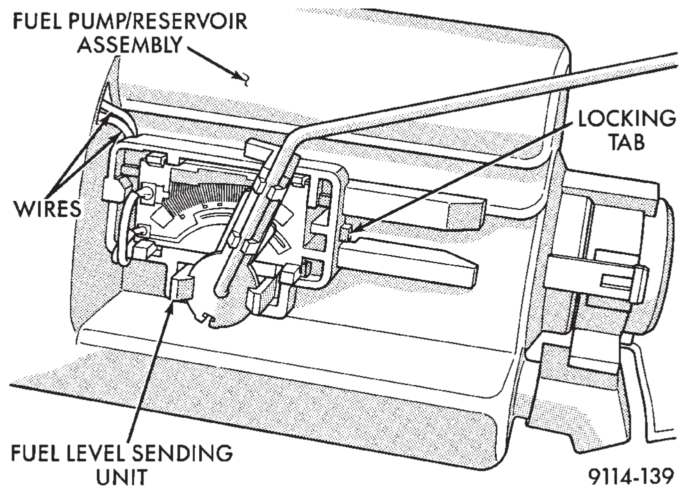


Fig. 15 Fuel Level Sensor—Front Wheel Drive

(4) Carefully install the level sensor wiring terminals into the electrical connector. Install terminal locking cover.

(5) Install the electrical connector into the bottom of the fuel pump electrical connector. Ensure that the connector is fully locked into position.

FUEL PUMP/LEVEL SENSOR ASSEMBLY INSTALLATION—FRONT WHEEL DRIVE

(1) Wipe seal area of tank clean and place a new O-ring seal in position on pump.

(2) Position fuel pump in tank with locking ring.

(3) Using a hammer and brass drift, tap ring around clockwise to lock pump in place.

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

(4) Install tank. Refer to the Fuel Tank Section in this Group.

FUEL PUMP MODULE REMOVAL—ALL WHEEL DRIVE

The fuel tank must be removed to service the fuel pump/level sending unit assembly. Refer to Fuel Tank Section of this Group for fuel tank removal.

(1) Unclip fuel vapor hose and fuel drain hose from fuel tank (Fig. 16).

The fuel pump module is spring loaded. It will rise up slightly when the band clamp is removed.

(2) While holding down on the fuel pump module, remove the band clamp from top of module (Fig. 17).

(3) Remove the fuel pump module from fuel tank. Discard flat rubber seal.

FUEL PUMP INLET STRAINER REMOVAL—ALL WHEEL DRIVE

(1) Remove the fuel pump from the fuel tank. Refer to Fuel Pump Module Removal in this section.

(2) Bend locking tabs on the strainer to clear locking tangs on the fuel pump module (Fig. 18).

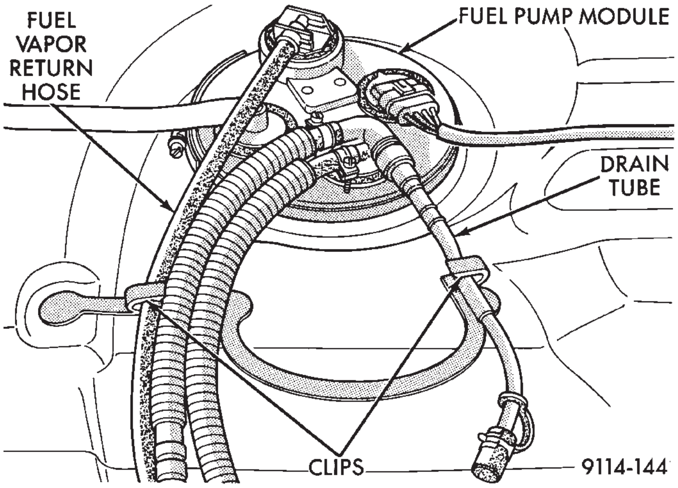


Fig. 16 Hose Tank Clips—All Wheel Drive

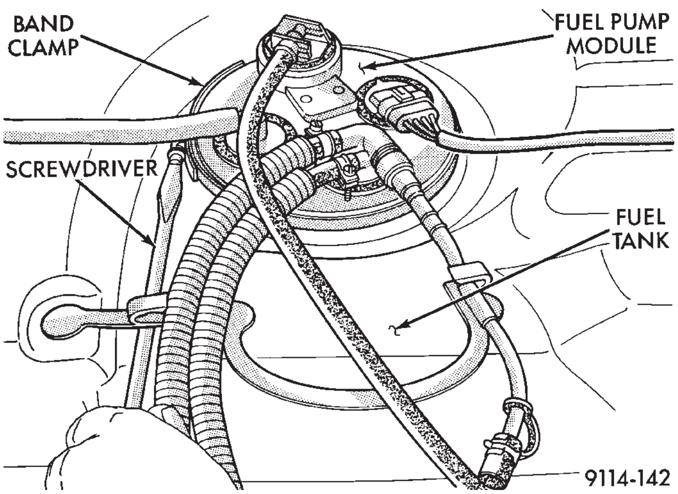


Fig. 17 Band Clamp Removal—All Wheel Drive

(3) Remove strainer.

(4) If the strainer is plugged or dirty, clean the fuel tank.

FUEL PUMP INLET STRAINER INSTALLATION—ALL WHEEL DRIVE

(1) Align the orientation tabs in the strainer with the slot in the bottom of the fuel pump module.

(2) Push strainer onto the inlet of the fuel pump module. Make sure that the locking tabs on the filter snap over the tangs on the pump module.

(3) Install the fuel pump module into the fuel tank. Refer to Fuel Pump Module Installation in this section.

FUEL LEVEL SENSOR REMOVAL—ALL WHEEL DRIVE

(1) Remove the fuel pump from the fuel tank. Refer to Fuel Pump Module Removal in this section.

(2) Remove the two screws holding fuel level sensor unit in place (Fig. 19).

(3) Disconnect electrical leads.

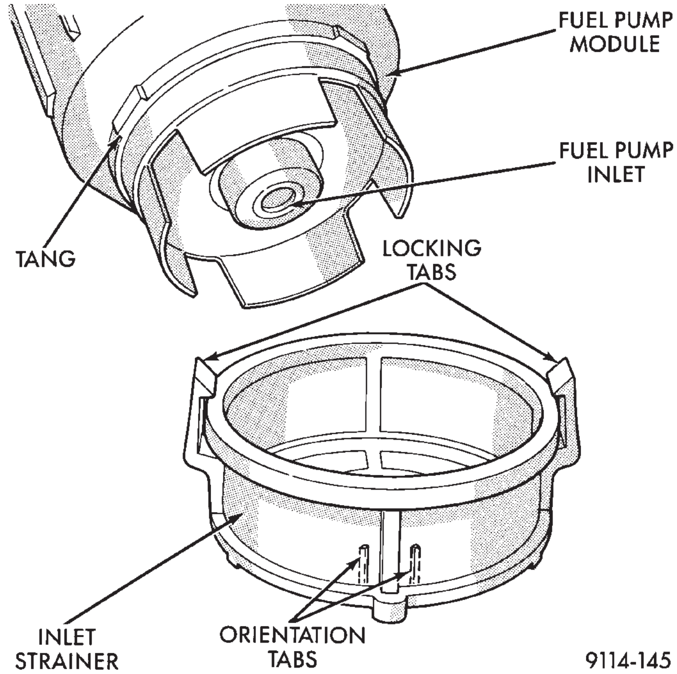


Fig. 18 Fuel Strainer Service—All Wheel Drive

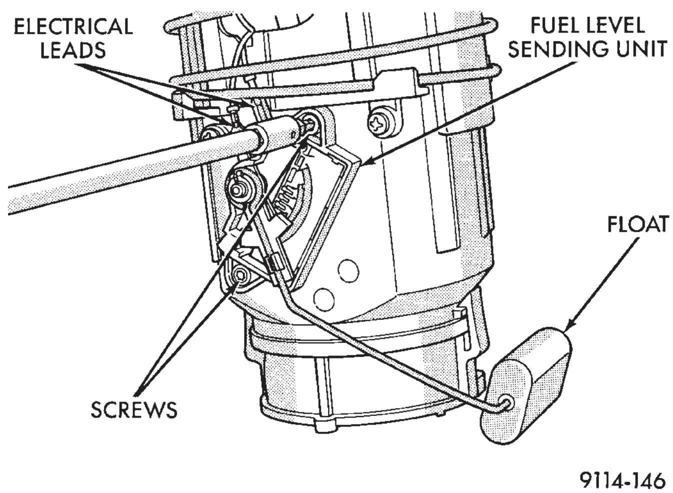


Fig. 19 Fuel Level Sensor—All Wheel Drive

FUEL LEVEL SENDING UNIT INSTALLATION—ALL WHEEL DRIVE

(1) Connect electrical leads to the fuel level sensor.

CAUTION: Do not press against the sensor during installation.

(2) Install level sensor and tighten screws.

(3) Install the fuel pump module into the fuel tank. Refer to Fuel Pump Module Installation in this section.

FUEL PUMP MODULE INSTALLATION—ALL WHEEL DRIVE

(1) Wipe clean the seal area of tank. Place a new seal in position on pump.

CAUTION: Fuel pump module must be properly aligned during installation.

(2) Position fuel pump module so that the arrow on the edge of the module is between the two lines molded into the fuel tank (Fig. 20).

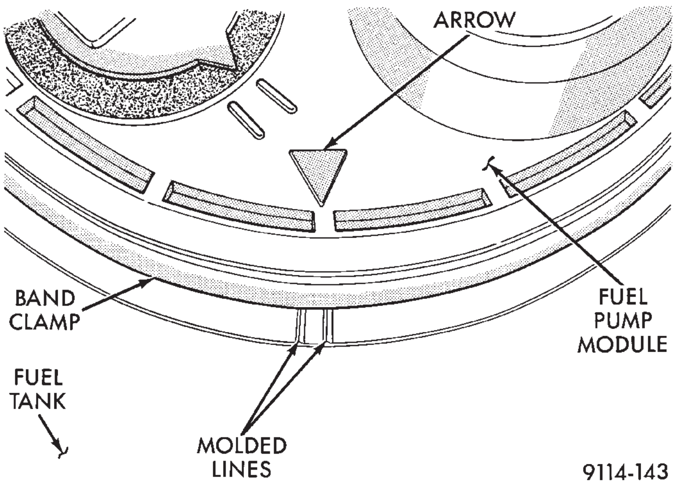


Fig. 20 Fuel Pump Module Alignment—All Wheel Drive

The fuel pump module is spring loaded. The module must be held down when installing the band clamp.

(3) Compress fuel pump module. Install band clamp and tighten to 5 N●m (40 in. lbs.) torque.

(4) Install fuel tank. Refer to the Fuel Tank Section in this Group.

FUEL FILTER—FRONT WHEEL DRIVE

REMOVAL

WARNING: FUEL SYSTEM PRESSURE MUST BE RELEASED BEFORE THE FUEL FILTER IS REMOVED.

(1) Perform fuel system pressure release.

(2) Remove filter retaining screw and remove filter assembly from rail (Fig. 21).

(3) Loosen outlet hose clamp on filter and inlet hose clamp on rear fuel tube.

(4) Wrap a shop towel around hoses to absorb fuel. Remove hoses at filter and fuel tube. Discard clamps.

INSTALLATION

(1) Install inlet hose on fuel tube and tighten new clamp to 1 N●m (10 in. lbs.) torque.

(2) Install outlet hose on filter outlet fitting and torque new clamp to 1 N●m (10 in. lbs.).

(3) Position filter assembly on rail and tighten mounting screw to 8 N●m (75 in. lbs.) torque.

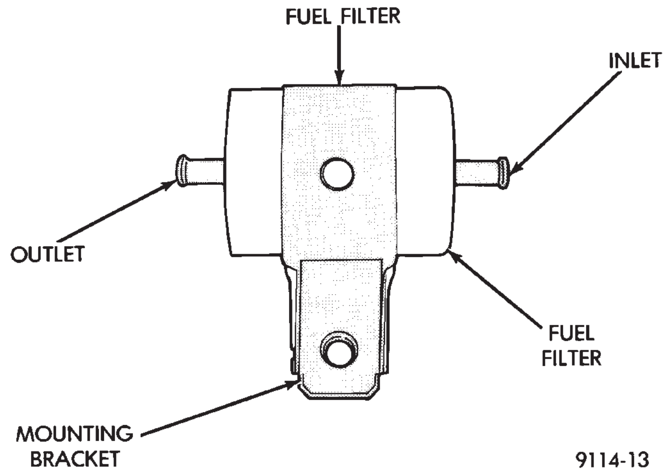


Fig. 21 Fuel Filter—Front Wheel Drive

FUEL FILTER—ALL WHEEL DRIVE

REMOVAL

WARNING: FUEL SYSTEM PRESSURE MUST BE RELEASED BEFORE THE FUEL FILTER IS REMOVED.

(1) Perform Fuel System Pressure Release procedure.

(2) Remove converter support bracket (Fig. 22).

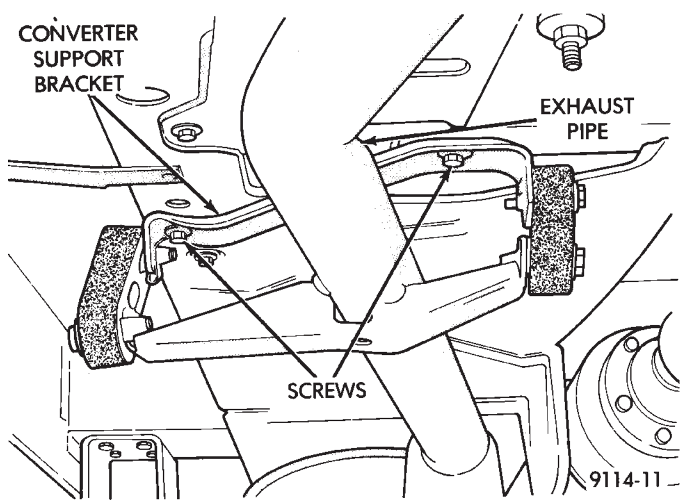


Fig. 22 Support Bracket—All Wheel Drive

(3) Remove exhaust pipe heat shield.

(4) Loosen outlet and inlet hose clamps on filter (Fig. 23).

CAUTION: Wrap shop towels around hoses to catch any gasoline spillage.

(5) Remove filter retaining screw and remove filter assembly from rail.

(6) Remove hoses from fuel filter. Discard clamps.

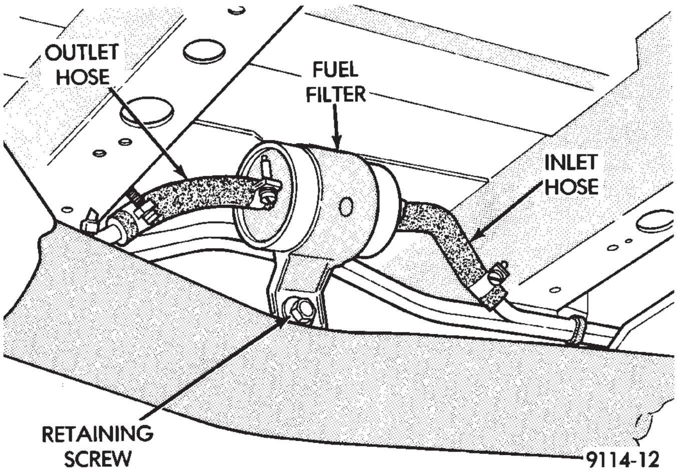


Fig. 23 Fuel Filter—All Wheel Drive

INSTALLATION

(1) Loose install inlet and outlet fuel hoses to fuel filter.

(2) Position filter assembly on rail and tighten mounting screw to 8 N●m (75 in.lbs.) torque.

(3) Tighten new fuel hose clamps to 1 N●m (10 in. lbs.) torque.

(4) Install exhaust pipe heat shield.

(5) Install exhaust pipe support bracket.

CHASSIS FUEL TUBES

Fuel system component locations and chassis fuel tube routings are shown in Fig. 24.

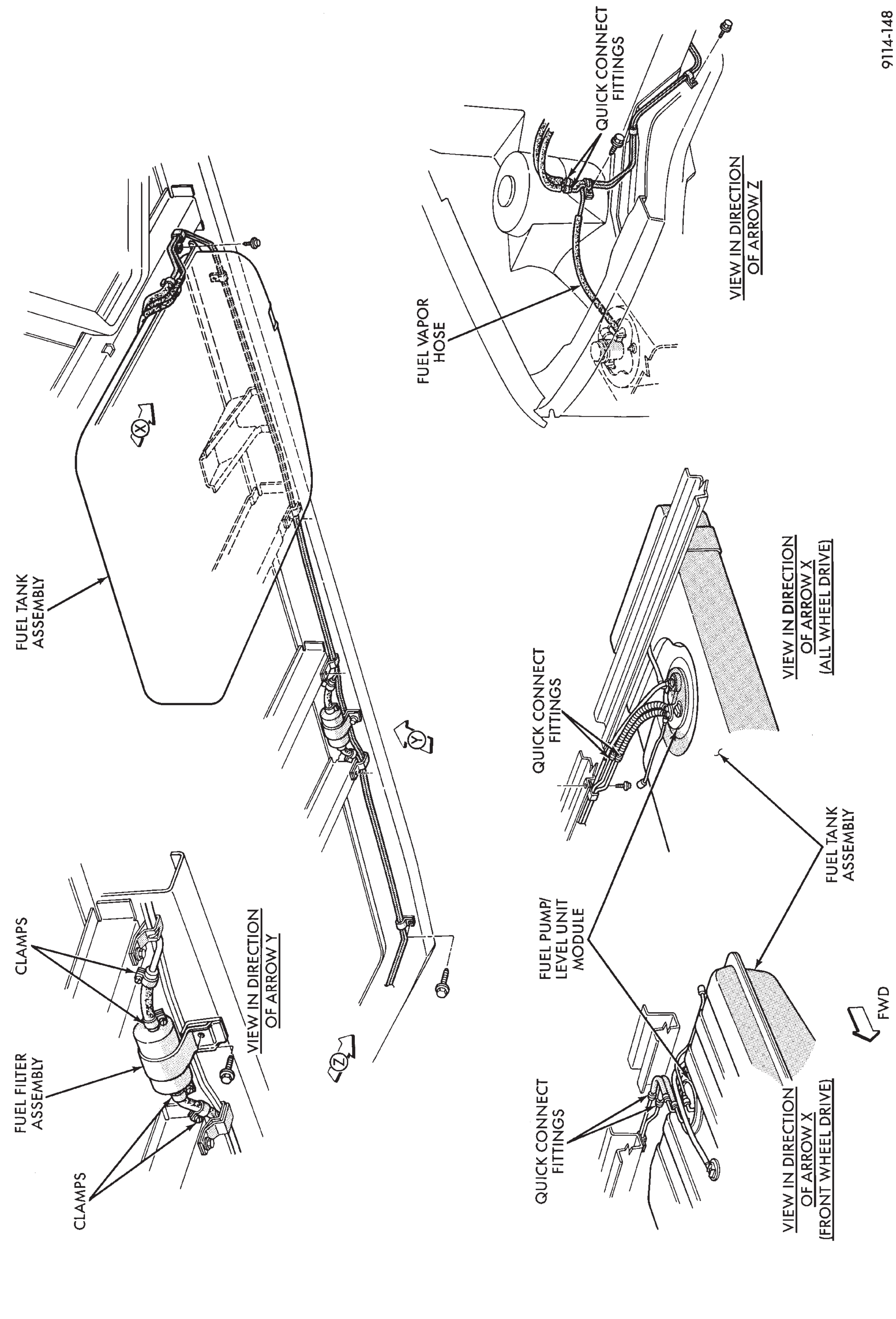


Fig. 24 Fuel Tank, Filter, and Chassis Line Routing

FUEL TANK

INDEX

GENERAL INFORMATION

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.

Both front wheel drive and all wheel drive fuel delivery systems contain a fuel tank pressure relief/rollover valve. The valve is mounted on the top of the fuel tank on front wheel drive vehicles and on top of the fuel pump module on all wheel drive vehicles. The valve functions as a pressure relief 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 also acts as a pressure/vacuum valve. When air pressure inside the fuel tank gets too high or too low, the fuel filler cap opens to relieve the difference in pressure.

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

NO-LEAD FUEL TANK FILLER TUBE

All catalyst equipped vehicles have a special fuel tank filler tube. The fuel filler opening is smaller in diameter than those used for non-catalyst vehicles. Gasoline station pumps for leaded and unleaded fuel have different size nozzles. The unleaded pump nozzle is smaller than the leaded pump nozzle. The fuel tank filler neck opening contains a deflector that the smaller unleaded nozzle pushes back upon entering the filler neck. The deflector prevents the larger diameter leaded fuel nozzles from entering the filler neck. It also deflects fuel away from the filler neck if filling of the tank with leaded fuel is attempted.

The fuel filler tube on these models is equipped with a one way ball check valve. The valve prevents fuel splash back when filling the tank.

As a reminder, a label that reads **UNLEADED FUEL ONLY** is attached to the instrument panel under the fuel gauge. A similar label is located near the fuel tank filler.

PRESSURE-VACUUM FILLER CAP—FRONT WHEEL DRIVE

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

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

FUEL TANK CAPACITIES

Front Wheel Drive	76 Liters	20 U.S. Gallons
All Wheel Drive	68 Liters	18 U.S. Gallons
Nominal refill capacities are shown. A variation may be observed from car to car due to manufacturing tolerance and refill procedure.		

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FUEL SYSTEM PRESSURE RELEASE PROCEDURE—2.5L ENGINE

CAUTION: Before servicing the fuel pump, fuel lines, fuel filter, throttle body, or fuel injector, release fuel system pressure.

(1) Loosen fuel filler cap to release fuel tank pressure.

(2) Disconnect injector wiring harness connector at edge of throttle body (Fig. 1).

(3) Connect a jumper wire between terminal Number 1 of the injector harness and engine ground.

(4) Connect a jumper wire to the positive terminal Number 2 of the injector harness and touch the battery positive post **for no longer than 5 seconds**. This releases system pressure.

(5) Remove jumper wires.

(6) Continue fuel system service.

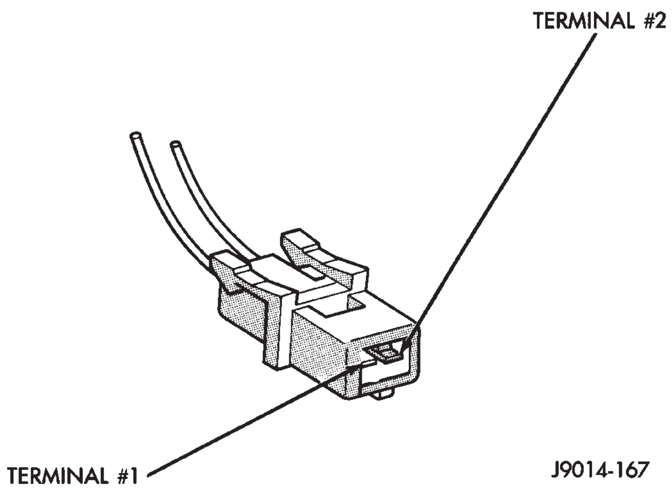

Fig. 1 Injector Harness Connector—2.5L Engine

FUEL SYSTEM PRESSURE RELEASE PROCEDURE—3.0L ENGINE

(1) Disconnect the fuel rail electrical harness from the engine harness. Refer to Group 8W, Wiring Diagrams.

(2) Connect one end of a jumper wire to the A142 circuit terminal of the fuel rail harness connector.

(3) Connect the other end of the jumper wire to a 12 volt power source.

(4) Connect one end of a jumper wire to a good ground source.

(5) Momentarily ground one of the injectors by connecting the other end of the jumper wire to an injector terminal in the harness connector. Repeat procedure for 2 to 3 injectors.

FUEL SYSTEM PRESSURE RELEASE PROCEDURE—3.3L ENGINE

WARNING: THE 3.3L MPI FUEL SYSTEM IS UNDER A CONSTANT PRESSURE OF APPROXIMATELY 330 KPA (48 PSI). RELEASE FUEL SYSTEM PRESSURE BEFORE SERVICING THE FUEL PUMP, FUEL LINES, FUEL FILTER, THROTTLE BODY OR FUEL INJECTORS.

(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. 2).

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

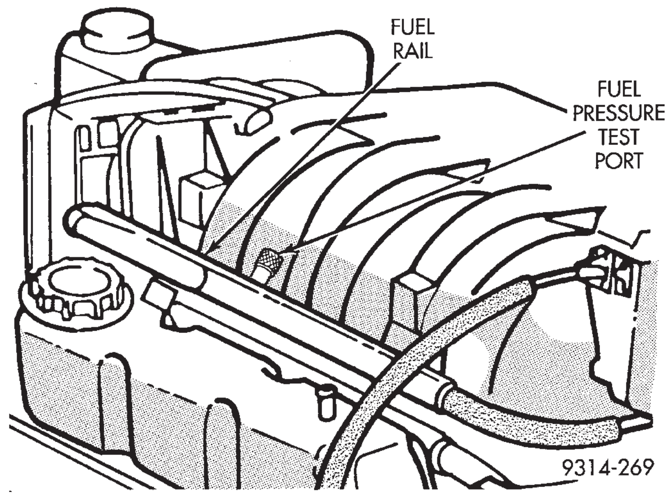

Fig. 2 Fuel Pressure Test Port—3.3L Engine

(5) Continue fuel system service.

FUEL TANK—FRONT WHEEL DRIVE

DRAINING FUEL TANK

(1) Remove fuel filler cap and perform Fuel System Pressure Release procedure.

(2) Disconnect battery ground cable.

(3) Raise vehicle on hoist.

(4) Remove rubber cap from drain tube. The tube is located on rear of fuel tank. Connect a portable holding tank to the drain tube (Fig. 3).

(5) Drain fuel tank dry into holding tank or a properly labeled **gasoline** safety container.

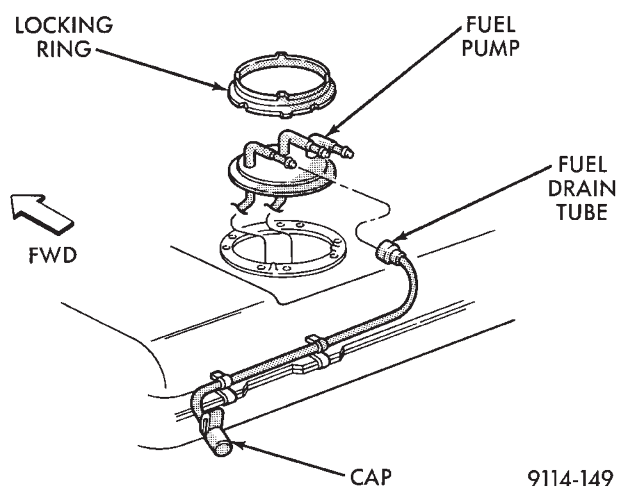

Fig. 3 Fuel Drain Tube—Front Wheel Drive

FUEL TANK REMOVAL—FRONT WHEEL DRIVE

(1) Raise vehicle on hoist.

(2) Drain fuel tank. Refer to Draining Fuel Tank.

(3) Remove fuel filler cap before disconnecting any lines.

(4) Remove screws that hold filler tube to inner and outer quarter panel (Fig. 4).

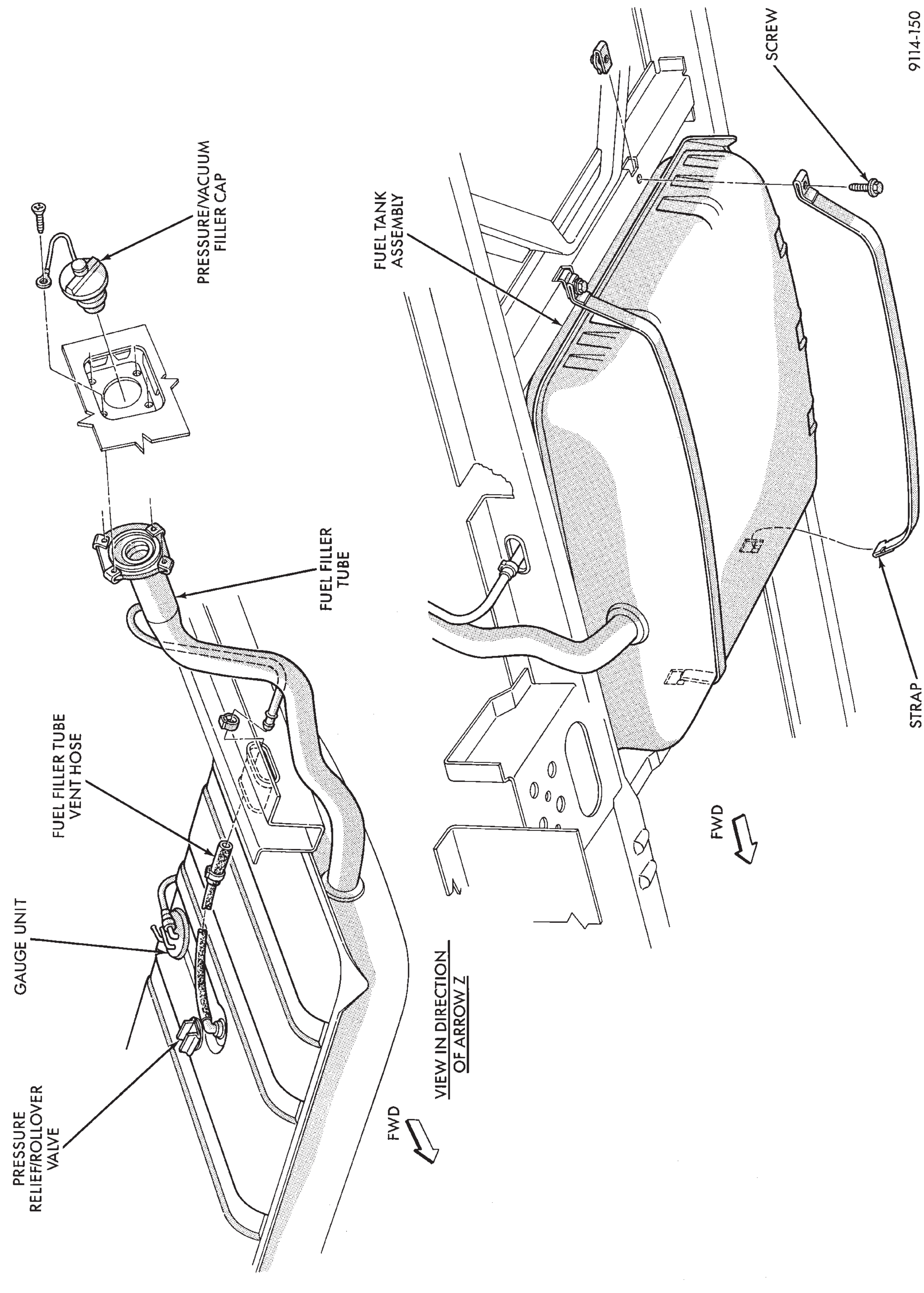

Fig. 4 Fuel Tank Assembly—Front Wheel Drive

(5) Raise vehicle. Disconnect fuel pump/level unit electrical connector.

(6) Disconnect fuel line quick connect fittings from the tank. Refer to Tube/Fitting Disassembly in the Fuel Delivery section of this Group.

(7) Use a transmission jack to support the fuel tank. Remove the bolts from the fuel tank straps.

(8) Lower tank slightly. Carefully remove filler tube from tank.

(9) Lower the fuel tank. Disconnect pressure relief/rollover valve hose. Remove clamp and remove fuel filler tube vent hose. Remove the fuel tank from the vehicle.

FUEL TANK INSTALLATION—FRONT WHEEL DRIVE

(1) Position fuel tank on transmission jack. Connect pressure relief/rollover valve hose. Connect fuel filler tube vent hose and replace clamp.

(2) Raise tank into position and carefully work filler tube into tank. A light coating of transmission fluid on the tube end may be used to aid assembly.

(3) Tighten strap bolts to 54.2 N•m (40 ft. lbs.) torque. Remove transmission jack.

CAUTION: Ensure straps are not twisted or bent before or after tightening strap nuts.

(4) Connect fuel pump/level unit electrical connector.

(5) Lubricate the metal tubes on the fuel pump with clean 30 weight engine oil. Install the quick connect fuel fittings. Refer to Tube/Fitting Assembly in the Fuel Delivery section of this Group.

(6) Attach filler tube to filler neck opening in quarter panel. Tighten quarter panel screws to 1.9 N•m (17 in. lbs.) torque. On affected models be sure to install the gasket between the filler tube and the inner quarter panel, before installing the mounting screws.

(7) Using a new clamp, install cap on fuel tank drain tube.

(8) Fill fuel tank, replace cap, and connect battery ground cable.

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.

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

FUEL TANK—ALL WHEEL DRIVE

DRAINING FUEL TANK—ALL WHEEL DRIVE

(1) Perform the Fuel System Pressure Release procedure.

(2) Disconnect battery ground cable.

(3) Raise vehicle on hoist.

(4) Remove rubber cap from fuel tank drain tube. The cap is located above the rear differential torque tube, on the inboard side of the fuel tank (Fig. 5). Connect a portable holding tank to the drain tube.

(5) Completely drain fuel tank into holding tank or a properly labeled **gasoline** safety container.

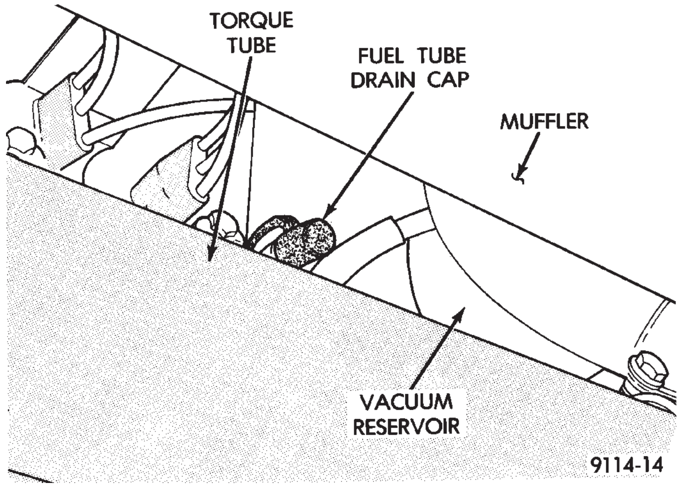

Fig. 5 Fuel Tank Drain Cap

FUEL TANK REMOVAL—ALL WHEEL DRIVE

(1) Perform the Fuel System Pressure Release Procedure. Refer to Fuel System Pressure Release in this section.

(2) Disconnect battery ground cable.

(3) Remove fuel filler cap.

(4) Drain fuel tank. Refer to Draining Fuel Tank—All Wheel Drive in this section.

(5) Remove screws that hold filler tube to opening in quarter panel.

(6) Raise vehicle on hoist.

(7) Remove fasteners holding the park brake cable support bracket assembly in place (Fig. 6).

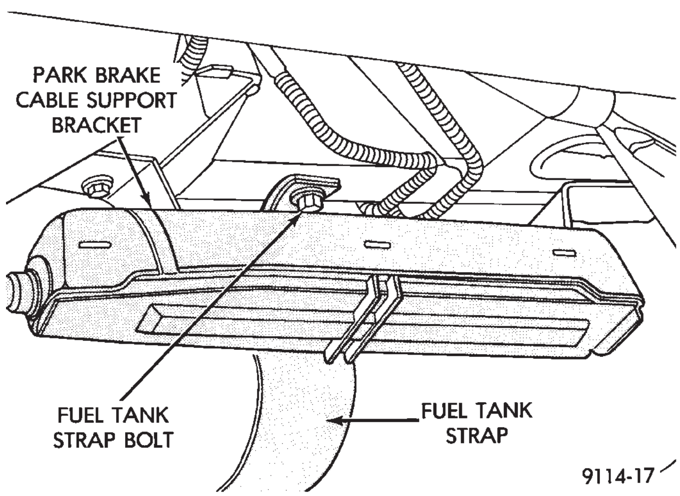

Fig. 6 Brake Cable Support Bracket—All Wheel Drive

(8) Use a transmission jack to support the fuel tank. Remove the bolts from the fuel tank straps (Fig. 7).

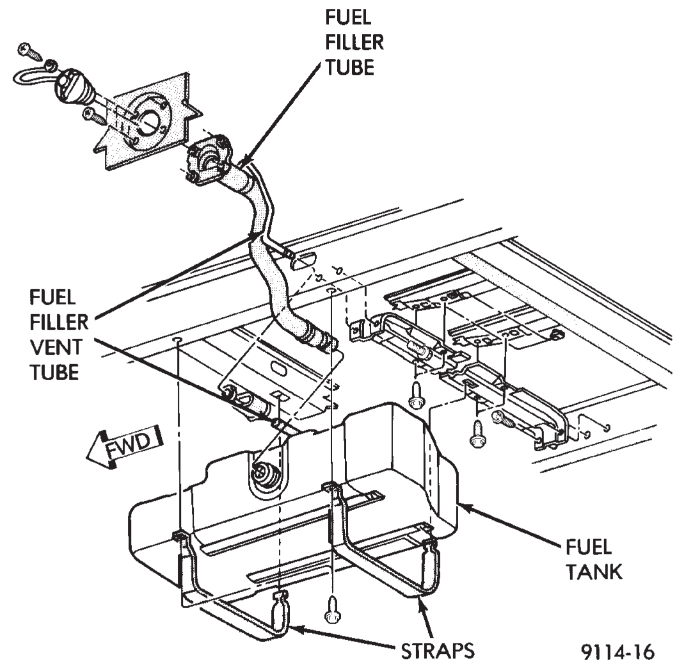

Fig. 7 All Wheel Drive Fuel Tank

(9) Loosen fuel filler tube vent hose clamp and remove hose from tube.

(10) Lower tank slightly.

(11) Clean the quick connectors to remove any dirt. (Use air pressure or an appropriate cleaning agent). Disconnect fuel supply and return hoses from the chassis fuel tubes by pushing in on the black plastic release ring and pulling on the connector. Refer to Tube/Fitting disassembly in the Fuel Delivery Section of this group.

(12) Disconnect the fuel vent hose. Plug hoses to prevent contamination.

(13) Remove electrical connector from the fuel pump module (Fig. 8).

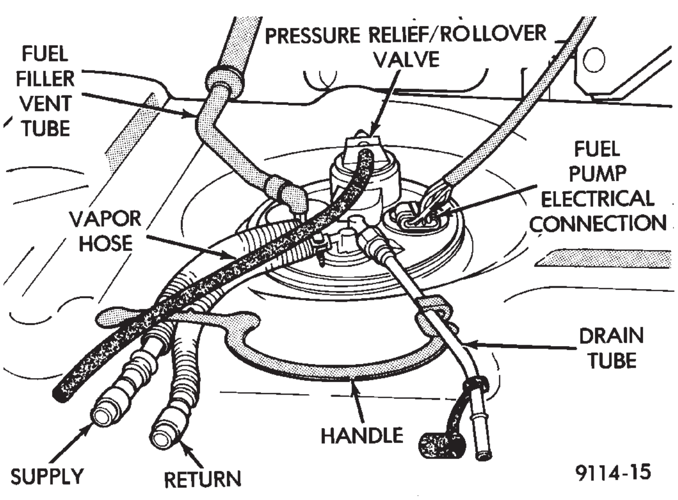

Fig. 8 Fuel Pump Module—All Wheel Drive

(14) Pull fuel filler vent hose through the frame rail.

(15) Lower the fuel tank and remove the fuel filler tube from the fuel tank.

FUEL TANK INSTALLATION—ALL WHEEL DRIVE

(1) Position fuel tank on transmission jack. Insert fuel filler tube into opening in tank.

(2) Raise fuel tank while inserting fuel filler vent hose through hole in frame rail.

(3) Ensure that the black release rings of the supply and return fuel hose quick connect fittings are in the **OUT** position. The release ring should be loose and free floating.

(4) Lubricate the ends of the chassis fuel tubes (supply and return only) with clean 30 weight engine oil.

CAUTION: When making connections with quick connect fittings, always pull back on the fitting to ensure complete engagement. If the fitting will not fully connect, make sure the black release ring is not jammed into the metal casing of the fitting. If the fitting fails, replace it with a new one of the correct size.

(5) Couple quick connect fittings of the fuel supply and return hoses to the chassis fuel tubes. Refer to Tube/Fitting Assembly in the Fuel Delivery Section of this Group.

(6) Connect the fuel tank vent hose to the chassis fuel tube.

(7) Connect fuel pump electrical connector to the fuel pump module.

(8) Install drain tube cap.

(9) Raise fuel tank into position. Carefully twist the filler tube and fuel filler vent tube into position.

CAUTION: Be sure straps are not twisted or bent before or after tightening strap nuts.

(10) Install fuel tank support straps. Tighten fasteners to 54.2 N•m (40 ft.lbs.) torque. Remove the transmission jack.

(11) Connect fuel filler vent hose and tighten hose clamp.

(12) Install park brake cable support bracket. Tighten the fasteners to 22.6 N•m (200 in. lbs.) torque.

(13) Lower vehicle.

(14) Attach filler tube to filler neck opening in quarter panel. Tighten quarter panel screws to 1.9 N•m (17 inch-pounds) torque. On affected models, install gasket between the filler tube and the inner quarter panel before installing the mounting screws.

(15) Fill fuel tank, replace cap, connect battery ground cable and check system operation.

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) Pressurize the system using the DRBII scan tool. With ignition key in the **Run** position, use ASD Fuel System Test. This will activate the fuel pump and pressurize the system. Check system for leaks.

FUEL PUMP/LEVEL UNIT—FRONT WHEEL DRIVE

Refer to the Fuel Delivery Section in this Group for fuel pump/level unit service.

FUEL PUMP MODULE—ALL WHEEL DRIVE

Refer to the Fuel Delivery Section in this Group for fuel pump module service.

FUEL TANK PRESSURE RELIEF/ROLLOVER VALVE—FRONT WHEEL DRIVE

REMOVAL

(1) Remove fuel tank. Refer to fuel tank removal.

(2) Wedge the blade of a screwdriver between the rubber grommet and the fuel tank where the support rib is located. **Do not wedge between the valve and the grommet, this could damage the valve during removal.**

(3) Use a second screwdriver as a support to pry the valve and grommet assembly from the tank (Fig. 9).

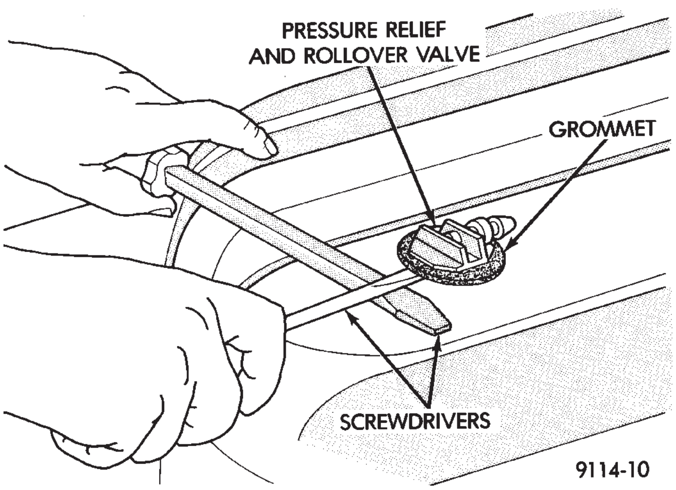

Fig. 9 Removing Pressure Relief/Rollover Valve—Front Wheel Drive.

(4) Place the valve upright on a flat surface to remove the grommet. Push down on the grommet and peel it off the valve.

INSTALLATION

(1) Position the rubber grommet in the fuel tank by rolling it around the curled lip of the tank.

Only use power steering fluid to lubricate the grommet.

(2) Lubricate the grommet with power steering fluid.

(3) Push the valve downward into the grommet. Twist valve until properly positioned (Fig. 10).

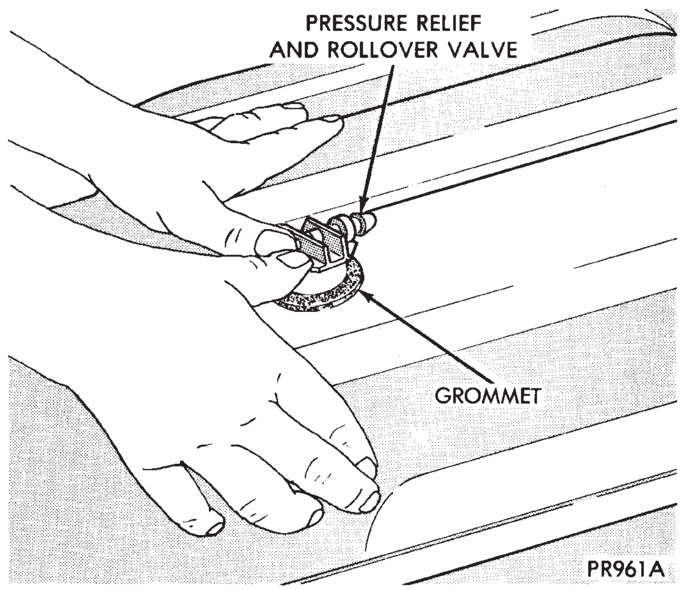

Fig. 10 Installing Pressure Relief/Rollover Valve

(4) Install fuel tank. Refer to fuel tank installation in this section.

FUEL TANK PRESSURE RELIEF/ROLLOVER VALVE—ALL WHEEL DRIVE

REMOVAL

(1) Remove fuel tank. Refer to Fuel Tank Removal in this section.

(2) Wedge the blade of a screwdriver between the rubber grommet and the fuel pump module.

(3) Pry the valve and grommet assembly from the pump (Fig. 11).

(4) Place the valve upright on a flat surface to remove the grommet. Push down on the grommet and peel it off the valve.

INSTALLATION

(1) Install the rubber grommet in the fuel pump module.

Only use power steering fluid to lubricate the grommet.

(2) Lubricate the grommet with power steering fluid.

(3) Push the valve downward into the grommet. Twist valve until properly positioned.

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

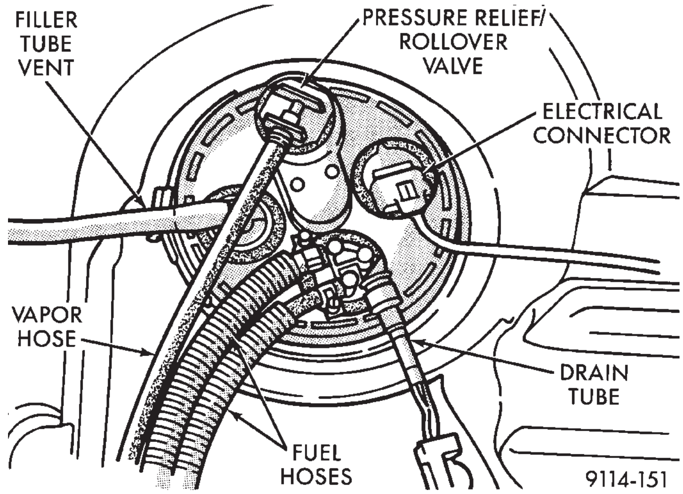

Fig. 11 Removing Pressure Relief/Rollover Valve

ACCELERATOR PEDAL AND THROTTLE CABLE

ACCELERATOR PEDAL SERVICE

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

REMOVAL

(1) Working from the engine compartment, 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. 1 and Fig. 2).

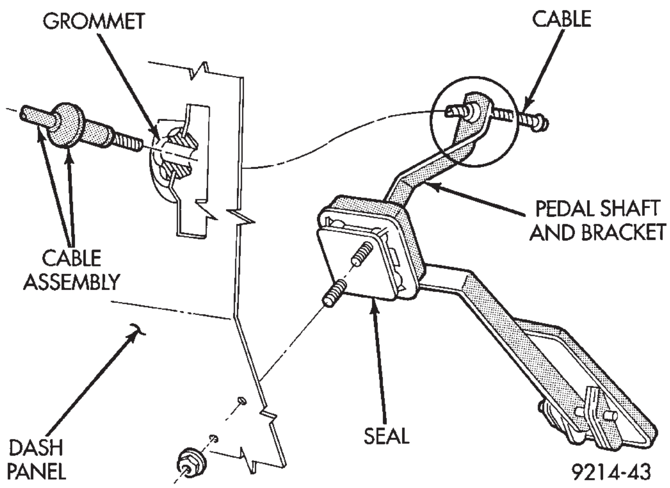

Fig. 1 Accelerator Pedal and Throttle Cable—Front View

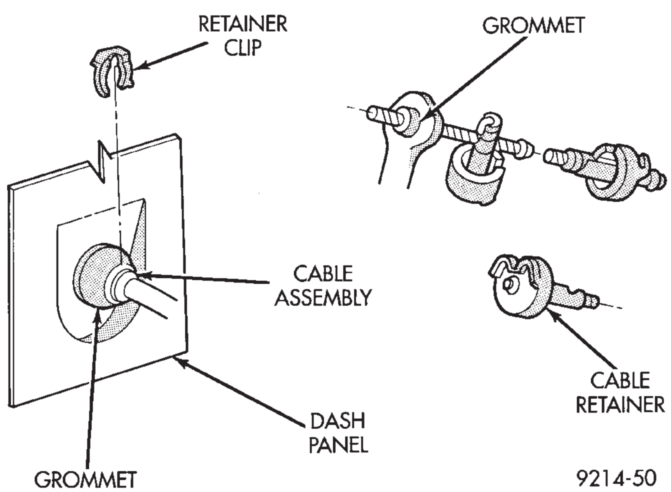

Fig. 2 Accelerator Pedal and Throttle Cable—Rear View

(3) Working from the engine compartment, remove nuts from accelerator pedal assembly studs (Fig. 1). Remove assembly from vehicle.

INSTALLATION

(1) Position accelerator pedal assembly on dash panel. Install retaining nuts. Tighten retaining nuts to 11.8 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 SERVICE

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

REMOVAL

(1) Working from the engine compartment, hold the throttle body throttle lever in the wide open position. remove the throttle cable from the throttle body cam (Figs. 3, 4, and 5).

(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. 1).

(3) Remove retainer clip from throttle cable and grommet at dash panel (Fig. 2).

(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.

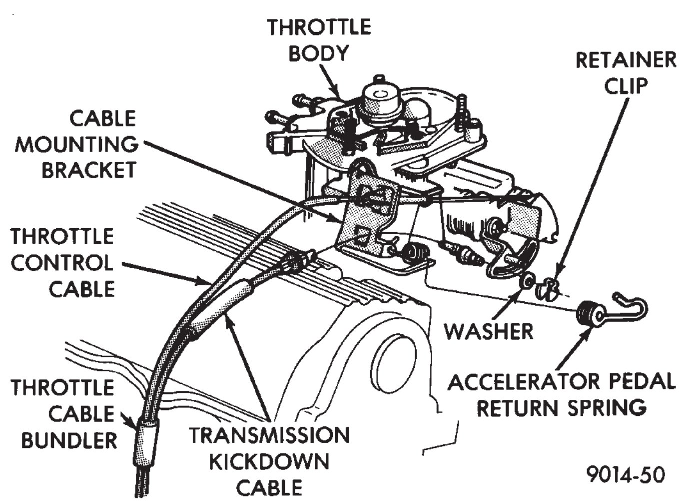

Fig. 3 Throttle Cable to Throttle Body Attachment—2.5L Engines

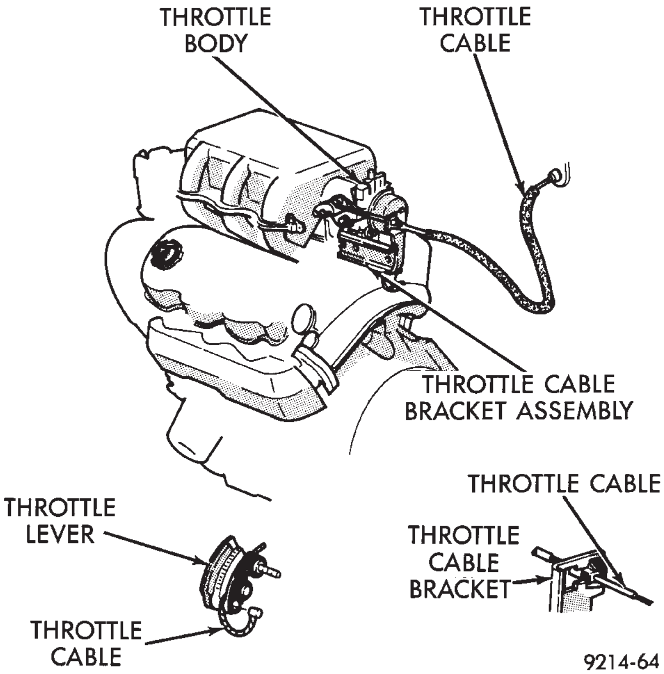

Fig. 4 Throttle Cable Attachment to Throttle Body Attachment— 3.0L Engine

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 (Fig. 2).

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

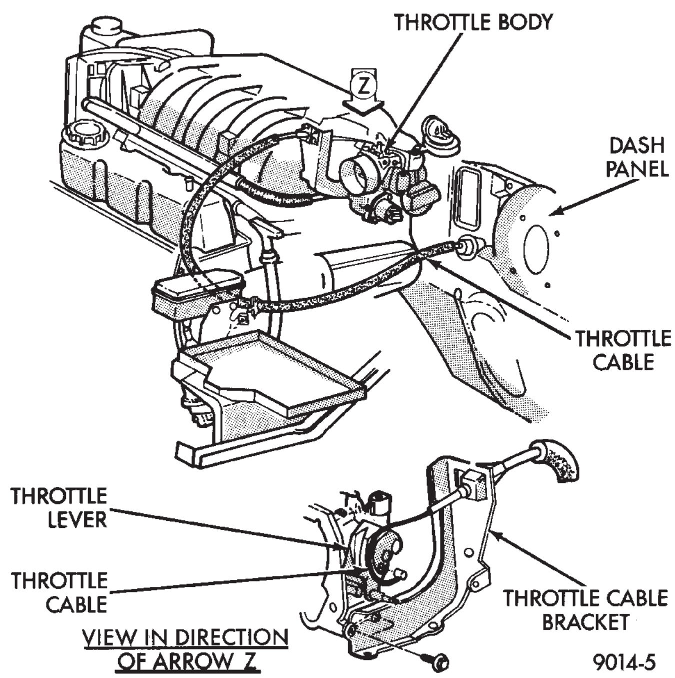

Fig. 5 Throttle Cable Attachment to Throttle Body Attachment—3.3L Engine

2.5L SINGLE POINT FUEL INJECTION—SYSTEM OPERATION

INDEX

GENERAL INFORMATION

The Electronic Fuel Injection System (Fig. 1) is a computer regulated single point fuel injection system that provides precise air/fuel ratio for all driving conditions. The fuel injection system is controlled by the powertrain control module PCM.

The powertrain control module (PCM) is a pre-programmed digital computer. The PCM regulates ignition timing, air-fuel ratio, emission control devices, cooling fan, charging system, speed control, and idle speed. The PCM can adapt its requirement to meet changing operating conditions.

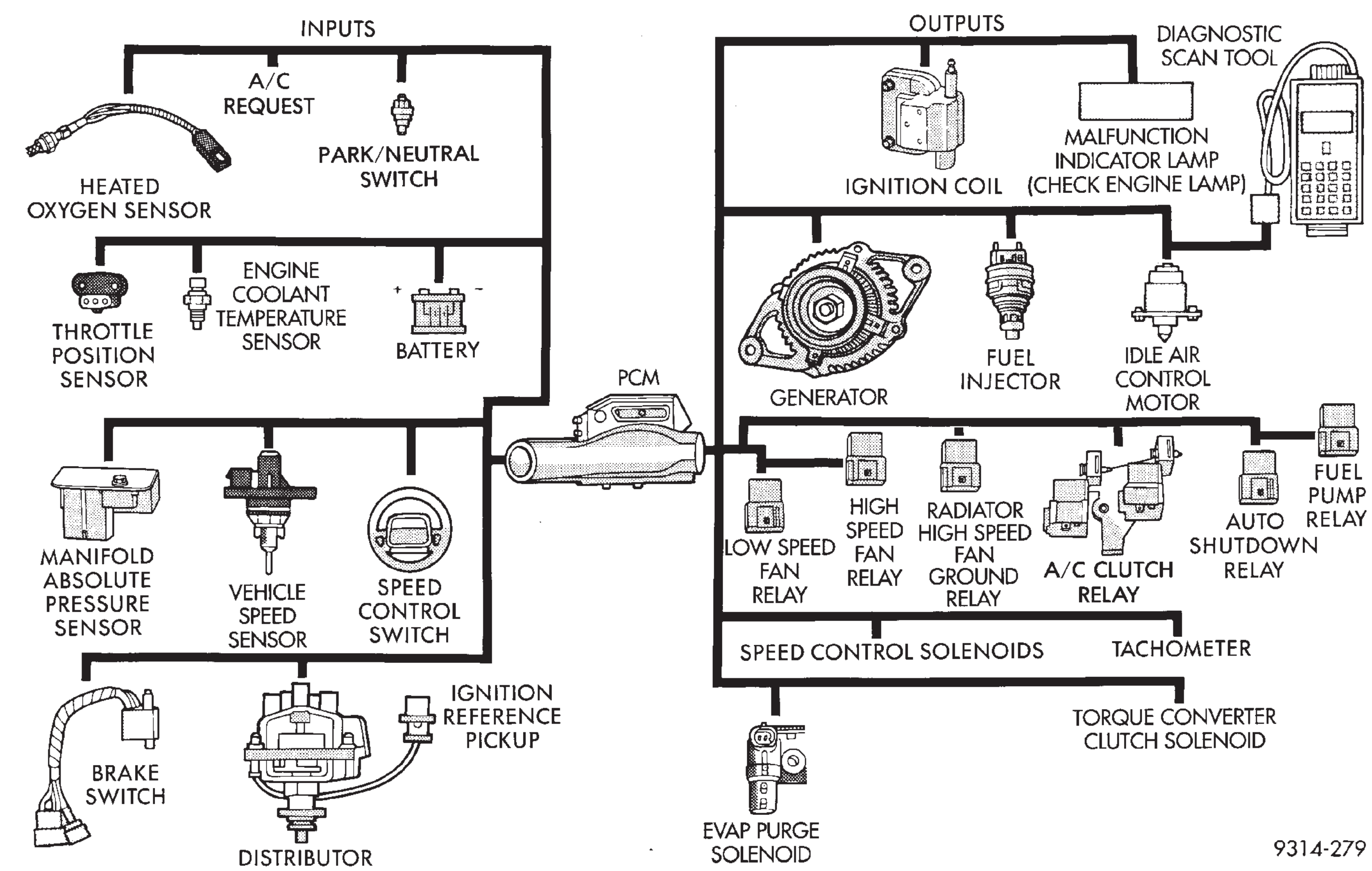

Fig. 1 Electronic Fuel Injection Components

Various sensors provide the inputs necessary for the PCM to correctly regulate fuel flow at the fuel injector. These include the manifold absolute pressure, throttle position, oxygen sensor, coolant temperature, and vehicle speed sensors. In addition to the sensors, various switches and relays provide important information and system control. These include the park/neutral switch, air conditioning clutch switch, auto shutdown relay and fuel pump relay.

All inputs to the PCM are converted into signals. Based on these inputs the PCM adjusts air-fuel ratio, ignition timing and other controlled outputs. The PCM adjusts the air-fuel ratio by changing the injector pulse width. Injector pulse width is the period of time the injector is energized.

SYSTEM DIAGNOSIS

The powertrain control module (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 in memory.

Technicians can display stored diagnostic trouble codes by two different methods. The first is to cycle the ignition switch On - Off - On - Off - On within 5 seconds. Then count the number of times the malfunction indicator lamp (check engine lamp) on the instrument panel flashes on and off. The number of flashes represents the trouble code. There is a slight pause between the flashes representing the first and second digits of the code. Longer pauses separate individual trouble codes.

The second method of reading diagnostic trouble codes uses the DRBII scan tool. For diagnostic trouble code information, refer to the 2.5L Single Point Fuel Injection—On-Board Diagnostics section of this group.

CCD BUS

Various controllers and modules exchange information through a communications port called the CCD Bus. The PCM transmits the malfunction indicator lamp (check engine lamp) On/Off signal, engine RPM and vehicle load data on the CCD Bus.

POWERTRAIN CONTROL MODULE

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

Powertrain control module (PCM) Inputs:

- Air Conditioning Controls
- Battery Voltage
- Brake Switch
- Distributor (Hall Effect) Pick-up
- Engine Coolant Temperature Sensor

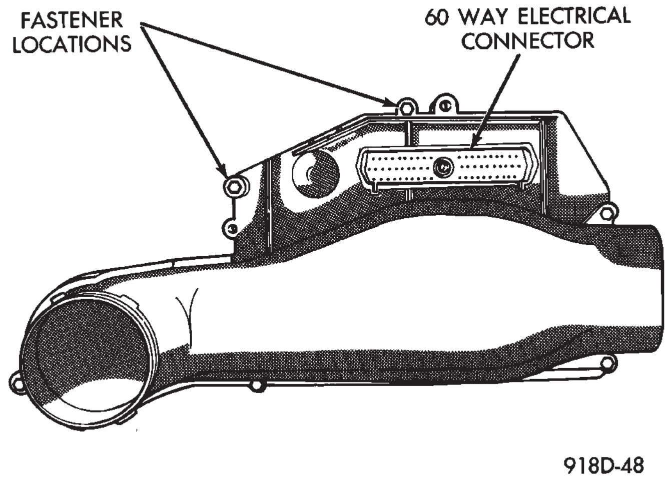

Fig. 2 Powertrain control module (PCM)

- Manifold Absolute Pressure (MAP) Sensor
- Oxygen Sensor
- Serial Communication Interface Receive
- Speed Control System Controls
- Throttle Position Sensor
- Park/Neutral Switch (automatic transmission)
- Vehicle Speed Sensor

Powertrain control module (PCM) Outputs:

- Air Conditioning Clutch Relay
- Auto Shutdown (ASD) Relay
- Canister Purge Solenoid
- Data Link Connector
- Fuel Injectors
- Generator Field
- Idle Air Control Motor
- Malfunction Indicator (Check Engine) Lamp
- Ignition Coil
- Torque Convertor Clutch Solenoid (Automatic Transmission)
- Radiator Fan Low Speed Relay
- Radiator Fan High Speed Relay
- Radiator Fan High Speed Ground Relay
- Speed Control Solenoids
- Tachometer Output

Based on inputs it receives, the PCM adjusts fuel injector pulse width, idle speed, ignition spark advance, ignition coil dwell and canister purge operation. The PCM regulates operation of the EGR, cooling fan, A/C 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
- coolant temperature
- exhaust gas content
- engine speed (distributor pick-up)
- manifold absolute pressure
- throttle position

The PCM adjusts ignition timing based on the following inputs.

- coolant temperature
- engine speed (distributor pick-up)
- manifold absolute pressure
- throttle position

The Automatic Shut Down (ASD) and Fuel Pump relays are mounted externally, but turned on and off by the PCM through the same circuit.

The distributor pick-up signal is sent to the PCM. If the PCM does not receive a distributor signal within approximately one second of engine cranking, the ASD relay and fuel pump relay are deactivated. When these relays are deactivated, power is shut off from the fuel injector, fuel pump, ignition coil, and oxygen sensor heater element.

The PCM contains a voltage converter that changes battery voltage to a regulated 9.0 volts to power the distributor pick-up and vehicle speed sensor. The PCM also provides a 5.0 volts supply for the manifold absolute pressure sensor and throttle position sensor.

AIR CONDITIONING SWITCH SENSE—PCM INPUT

When the air conditioning or defrost switch is put in the ON position and the low pressure switch, combination valve and high pressure switch close, the PCM receives an A/C input. After receiving this input, the PCM activates the A/C compressor clutch by grounding the A/C clutch relay. The PCM also adjusts idle speed to a scheduled RPM to compensate for increased engine load.

BATTERY VOLTAGE—PCM INPUT

The powertrain control module (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).

BRAKE SWITCH—PCM INPUT

When the brake switch is activated, the powertrain control module (PCM) receives an input indicating that the brakes are being applied. After receiving the input, the PCM vents the speed control servo. Venting the servo turns the speed control system off.

COOLANT TEMPERATURE SENSOR—PCM INPUT

The coolant temperature sensor is installed behind the thermostat housing and ignition coil in the hot box. The sensor provides an input voltage to the powertrain control module (PCM) (Fig. 3). 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.

This sensor is also used for cooling fan control.

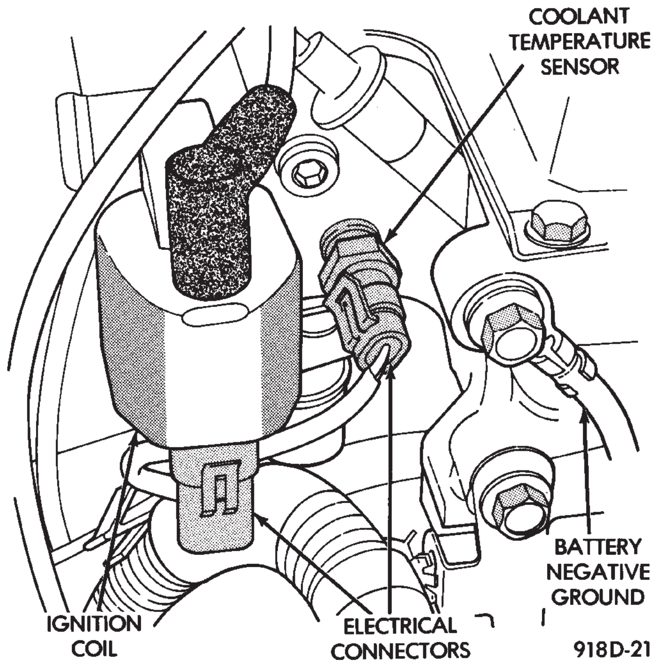

Fig. 3 Coolant Temperature Sensor

DISTRIBUTOR (HALL EFFECT) PICK-UP—PCM INPUT

The engine speed is supplied to the powertrain control module (PCM) by the distributor pick-up. The distributor pick-up is a Hall Effect device (Fig. 4).

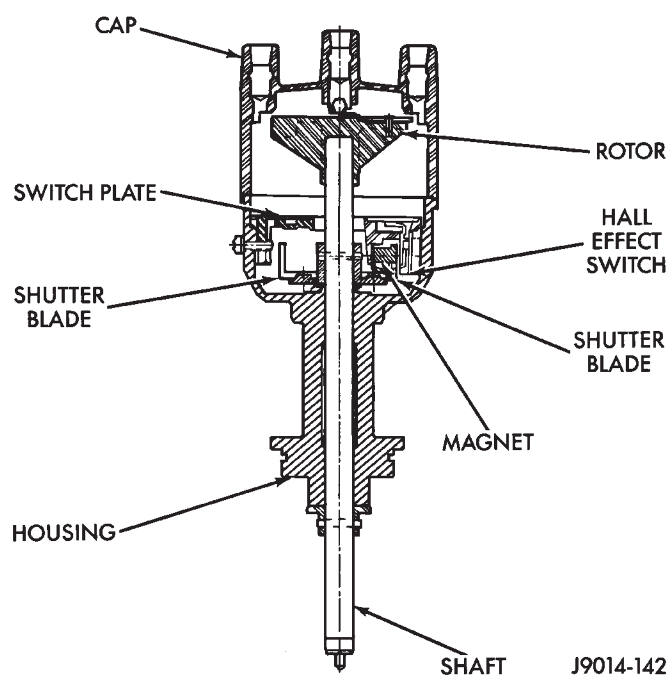

Fig. 4 Distributor Pick-Up—Typical

A shutter (sometimes referred to as an interrupter) is attached to the distributor shaft. The shutter contains four blades, one per engine cylinder. A switch plate is mounted to the distributor housing above the shutter. The switch plate contains the distributor pick-up (a Hall Effect device and magnet) through which the shutter blades rotate. As the shutter blades pass through the pick-up, they interrupt the magnetic field. The Hall effect device in the pick-up senses the change in the magnetic field and switches on and off, creating pulses. The pulses are the input signal to the powertrain control module (PCM). The PCM calculates engine speed through the number of pulses generated.

MANIFOLD ABSOLUTE PRESSURE (MAP) 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 voltage and inputs from other sensors, the PCM adjusts spark advance and the air/fuel mixture.

The MAP sensor mounts on the dash panel (Fig. 5). A vacuum hose connects the sensor to the throttle body.

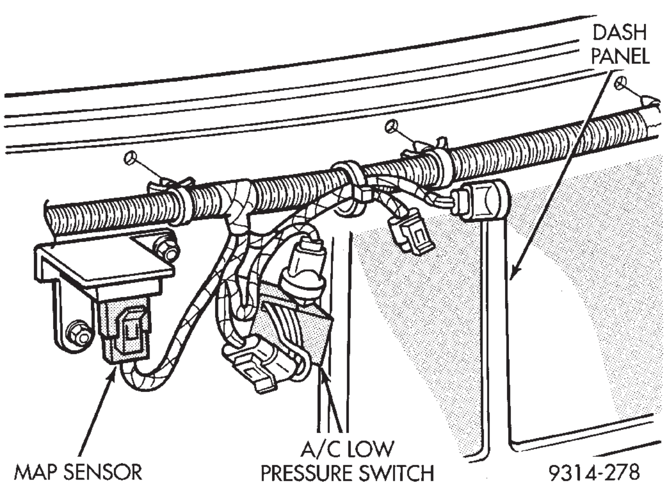

Fig. 5 Manifold Absolute Pressure (MAP) Sensor Location

HEATED OXYGEN SENSOR (O_2 SENSOR)—PCM INPUT

The O_2 sensor is located in the exhaust manifold and provides an input voltage to the powertrain control module (PCM). The input tells the PCM the oxygen content of the exhaust gas (Fig. 6). The PCM uses this information to fine tune the air-fuel ratio by adjusting injector pulse width.

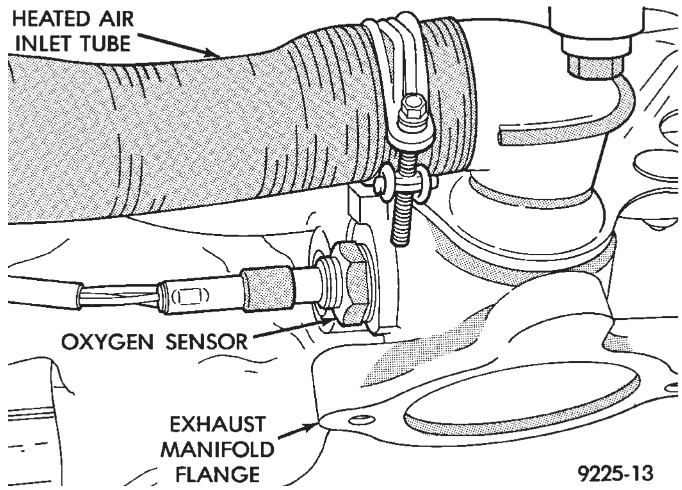

Fig. 6 Oxygen Sensor—2.5L Engine

The O_2 sensor produces 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 sensor 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 sensor acts as a rich-lean switch.

The oxygen sensor is equipped with a heating element that keeps the sensor 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 O_2 sensor input (along with other inputs) and adjusts the injector pulse width accordingly. During "Open Loop" operation the PCM ignores the O_2 sensor input. The PCM adjusts injector pulse width based on preprogrammed (fixed) oxygen sensor input value (along with other sensor inputs).

SPEED CONTROL—PCM INPUT

The speed control system provides four separate voltages (inputs) to the powertrain control module (PCM). The voltages correspond to the On/Off, Set, and Resume.

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 Off voltage tells the PCM that the speed control system has deactivated. Refer to Group 8H for further speed control information.

TRANSAXLE PARK/NEUTRAL SWITCH—PCM INPUT

The park/neutral switch is located on automatic transaxle housing (Fig. 7). Manual transmission do not use park neutral switches. The switch provides an input to the powertrain control module (PCM) that indicates whether the automatic transmission is in Park, Neutral, or a drive gear selection. This input is used to determine idle speed (varying with gear selection), fuel injector pulse width, and ignition timing advance. The park neutral switch is sometimes referred to as the neutral safety switch.

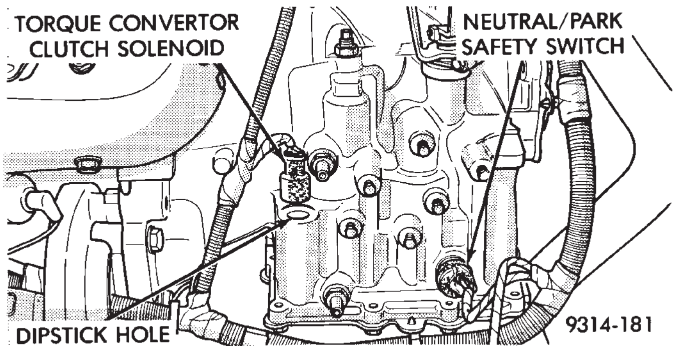

Fig. 7 Park Neutral Switch

THROTTLE POSITION SENSOR (TPS)—PCM INPUT

The Throttle Position Sensor (TPS) is mounted on the throttle body and connected to the throttle blade shaft (Fig. 8). The TPS is a variable resistor that provides the powertrain control module (PCM) with an input signal (voltage) that represents throttle blade position. As the position of the throttle blade changes, the resistance of the TPS changes.

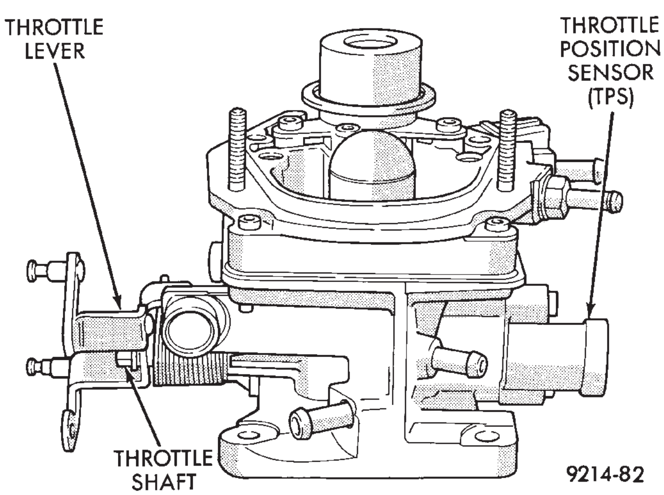

Fig. 8 Throttle Position Sensor

The PCM supplies approximately 5 volts to the TPS. The TPS output voltage (input signal to the PCM) represents the throttle blade position. The TPS output voltage to the PCM varies from approximately 0.5 volt at minimum throttle opening (idle) to 4 volts at wide open throttle. Along with inputs from other sensors, the PCM uses the TPS input to determine current engine operating conditions and adjust fuel injector pulse width and ignition timing.

VEHICLE SPEED SENSOR—PCM INPUT

The vehicle speed sensor (Fig. 9) is located in the transmission extension housing. The sensor input is used by the powertrain control module (PCM) to determine vehicle speed and distance traveled.

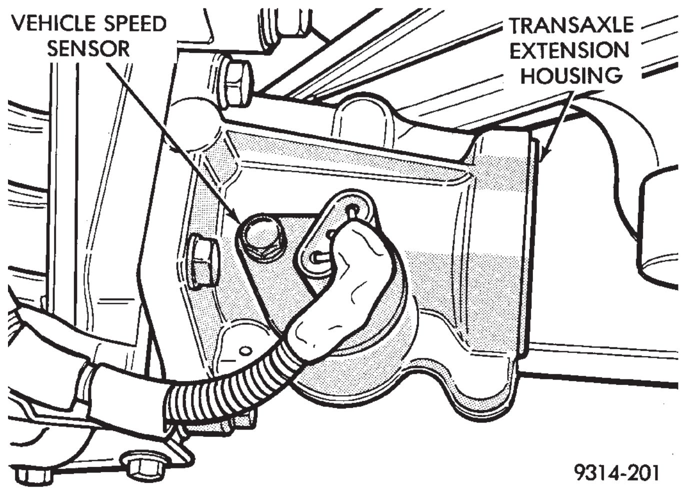

Fig. 9 Vehicle Speed Sensor

The vehicle speed sensor generates 8 pulses per sensor revolution. These signals are interpreted along with a closed throttle signal from the throttle position sensor by the PCM. The inputs are used to determine if a closed throttle deceleration or a normal idle (vehicle stopped) condition exists. Under deceleration conditions, the PCM adjusts the idle air control motor to maintain a desired MAP value. Under idle conditions, the PCM adjusts the idle air control motor to maintain a desired engine speed.

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

The powertrain control module (PCM) operates the air conditioning clutch relay ground circuit (Fig. 10). The low speed fan relay supplies battery power to the solenoid side of the relay. The air conditioning clutch relay will not energize unless the low speed radiator fan relay energizes. The low speed radiator fan relay energizes when the air conditioning or defrost switch is put in the ON position and the low pressure, combination valve, and high pressure switches close.

With the engine operating, the PCM cycles the air conditioning clutch on and off when the A/C switch closes with the blower motor switch in the on position. When the PCM senses low idle speeds or wide open throttle through the throttle position sensor, it de-energizes the A/C clutch relay. The relay contacts open, preventing air conditioning clutch engagement.

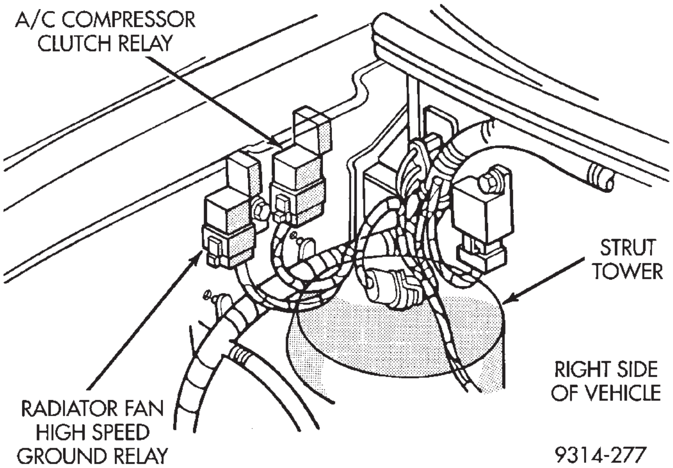

Fig. 10 Relay Identification

GENERATOR FIELD—PCM OUTPUT

The powertrain control module (PCM) regulates the charging system voltage within a range of 12.9 to 15.0 volts. Refer to Group 8A for charging system information.

AUTO SHUTDOWN (ASD) RELAY AND FUEL PUMP RELAY—PCM OUTPUT

The powertrain control module (PCM) operates the auto shutdown (ASD) relay and fuel pump relay through one ground path. The PCM operates the relays by switching the ground path on and off. Both relays turn on and off at the same time.

The ASD relay connects battery voltage to the fuel injector and ignition coil. The fuel pump relay connects battery voltage to the fuel pump and oxygen sensor heating element.

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 distributor pick-up signal to determine engine speed and ignition timing (coil dwell). If the PCM does not receive a distributor signal when the ignition switch is in the Run position, it will de-energize both relays. When the relays are de-energized, battery voltage is not supplied to the fuel injector, ignition coil, fuel pump and oxygen sensor heating element.

The ASD relay and fuel pump relay are mounted on the drivers side fender well, near to the PCM (Fig. 11).

IDLE AIR CONTROL MOTOR—PCM OUTPUT

The idle air control motor is mounted on the throttle body and is controlled by the powertrain control module (PCM) (Fig. 12). The PCM adjusts engine idle speed through the idle air control motor to compensate for engine load or ambient conditions.

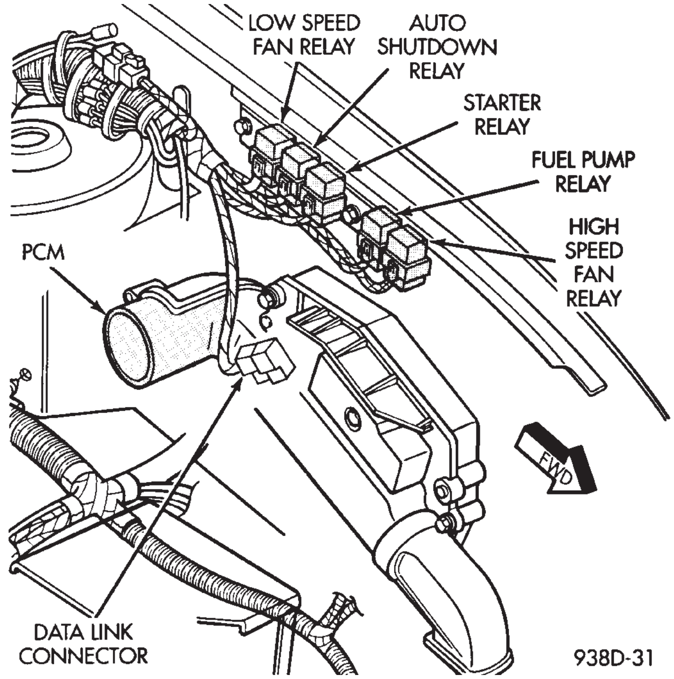

Fig. 11 Auto Shutdown Relay

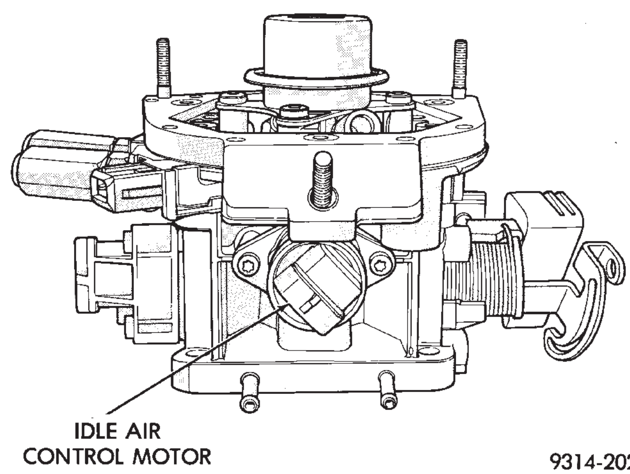

Fig. 12 Idle Air Control Motor

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.

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 are from the throttle position sensor, speed sensor (distributor pick-up coil), coolant temperature sensor, and various switch operations (brake, park/neutral, air conditioning). Deceleration die out is also prevented by increasing airflow when the throttle is closed quickly after a driving (speed) condition.

CANISTER PURGE SOLENOID—PCM OUTPUT

Vacuum for the Evaporative Canister is controlled by the Canister Purge Solenoid (Fig. 13). The solenoid is controlled by the powertrain control module (PCM).

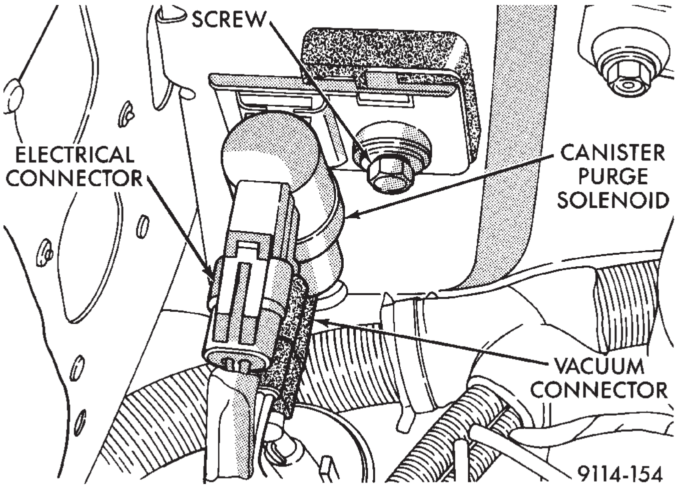

Fig. 13 Canister Purge Solenoid

The PCM operates the solenoid by switching the ground circuit on and off based on engine operating conditions. When energized, the solenoid prevents vacuum from reaching the evaporative canister. When not energized the solenoid allows vacuum to flow to the canister.

During warm-up and for a specified time period after hot starts the PCM grounds the purge solenoid causing it to energize. Vacuum does not operate the evaporative canister valve.

The PCM removes the ground to the solenoid when the engine reaches a specified temperature and the time delay interval has occurred. When the solenoid is de-energized, vacuum flows to the canister purge valve. Vapors are purged from the canister and flow to the throttle body.

The purge solenoid is also energized during certain idle conditions to update the fuel delivery calibration.

MALFUNCTION INDICATOR (CHECK ENGINE) LAMP—PCM OUTPUT

The powertrain control module (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 malfunction indicator 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 warns the operator that the PCM has entered a Limp-in mode. During Limp-in-Mode, the PCM attempts to keep the system operational. The malfunction indicator lamp 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.

Signals that can trigger the malfunction indicator (Check Engine) Lamp.

- Coolant Temperature Sensor
- Manifold Absolute Pressure Sensor
- Throttle Position Sensor
- Battery Voltage Input
- An Emissions Related System
- Charging system

The malfunction indicator lamp can also be used to display diagnostic trouble codes. Cycle the ignition switch on, off, on, off, on, within five seconds and any diagnostic trouble codes stored in the PCM will be displayed. For diagnostic trouble code descriptions refer to 2.5L Single Point Fuel Injection—On-Board Diagnostics section of this group.

DATA LINK CONNECTOR—PCM OUTPUT

The data link connector provides the technician with the means to connect the DRBII scan tool to diagnosis the vehicle.

FUEL INJECTOR—PCM OUTPUT

The Fuel Injector is an electric solenoid driven by the powertrain control module (PCM) (Fig 14).

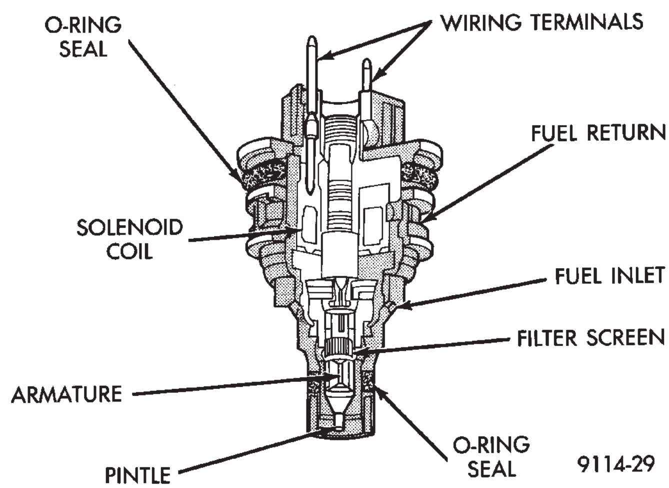

Fig. 14 Fuel Injector

Based on sensor inputs, the PCM determines when and how long the fuel injector should operate.

The amount of time the injector operates is referred to as injector pulse width. The auto shutdown (ASD) relay supplies battery voltage to the injector. The PCM supplies the ground path. By switching the ground path on and off, the PCM adjusts injector pulse width. When the PCM supplies a ground path, a spring loaded needle or armature lifts from its seat. Fuel flows through the orifice and deflects off the sharp edge of the injector nozzle. The resulting fuel sprays forms a 45° cone shaped pattern before entering the air stream in the throttle body.

Fuel is supplied to the injector constantly at regulated 270 Kpa (39 psi). Unused fuel returns to the fuel tank.

IGNITION COIL—PCM OUTPUT

The powertrain control module (PCM) provides a ground contact (circuit) for energizing the ignition coil. When the PCM breaks the contact, the energy in the coil primary transfers to the secondary causing the spark. The auto shutdown (ASD) relay provides battery voltage to the ignition coil positive terminal. The PCM will de-energize the ASD relay if it does not receive an input from the distributor pick-up. Refer to Auto Shutdown (ASD) Relay/Fuel Pump Relay—PCM Output in this section for relay operation.

The ignition coil is mounted on the hot box next to the thermostat housing (Fig. 15).

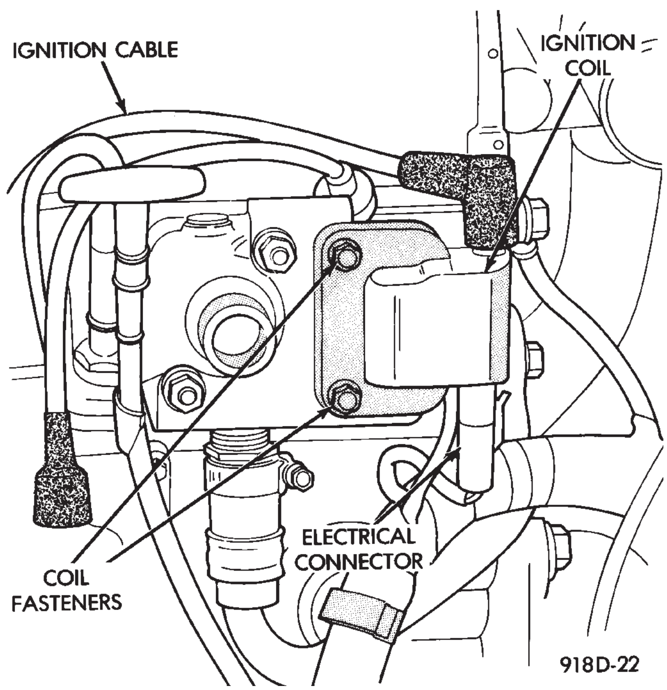

Fig. 15 Ignition Coil

TORQUE CONVERTER CLUTCH SOLENOID—PCM OUTPUT

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

RADIATOR FAN RELAYS—PCM OUTPUT

The rediator fan runs at either low or high speed depending on coolant temperature and A/C system pressure. The radiator fan circuit contains three relays; a low speed relay, high speed relay and a ground relay for high speed operation. Refer to the Group 8W for a circuit schematic.

When the PCM provides a ground for the low speed relay, the radiator fan operates at the lower speed. The PCM does not control the ground circuit for low speed operation.

The PCM controls the ground and power supply for the high speed circuits. When the PCM senses the need for high speed operation, it grounds the high speed relay and high speed ground relay.

When engine coolant reaches aproximately 102°C (215°F) the PCM grounds the low speed relay. If engine coolant reaches 110°C (230°F) the PCM grounds the high speed ground relay and high speed fan relay. If the fan operates at high speed the PCM de-energizes the high speed relay and high speed ground relay when coolant temperature drops to approximately 104°C (219°F). When coolant temperature drops to 104°C (219°F) the fan operates at low speed. The PCM de-energizes the low speed relay when coolant temperature drops to aproximately 93°C (200°F).

Additionally, when the air conditioning pressure switch closes, the fan operates at high speed. The air conditioning switch closes at 285 PSI ±10 PSI. When air conditioning pressure drops approximately 40 PSI, the pressure switch closes and the fan operates at low speed.

The radiator fan low speed relay and high speed relay mount to the inner fender panel above the powertrain control module (Fig. 11). The high speed ground relay is located on the right side fender panel near the strut tower (Fig. 16).

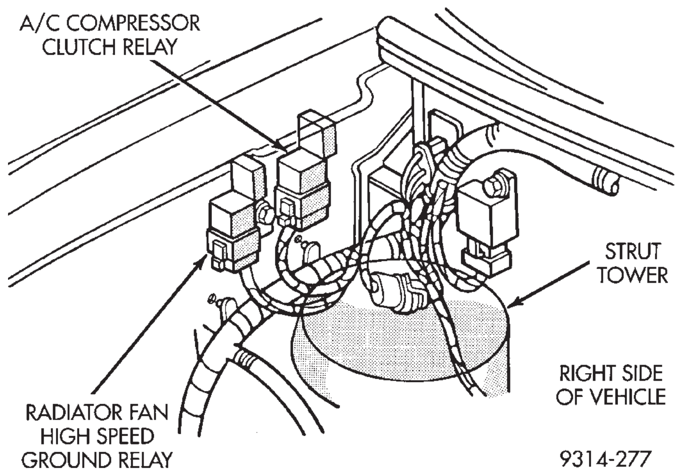

Fig. 16 High Speed Ground Relay and A/C Compressor Clutch Relay

SPEED CONTROL SOLENOIDS—PCM OUTPUT

The speed control vacuum and vent solenoids are operated by the powertrain control module (PCM). When the PCM supplies a ground to the vacuum and vent solenoids, the speed control system opens the throttle plate. When the PCM removes the ground from the vacuum and vent solenoids, the throttle blade closes. The PCM balances the two solenoids to maintain the set speed. Refer to Group 8H for speed control information.

TACHOMETER—PCM OUTPUT

The powertrain control module (PCM) supplies engine RPM to the instrument panel tachometer through the CCD Bus. The CCD Bus is a communications port. Various modules use the CCD Bus to exchange information. Refer to Group 8E for more information.

MODES OF OPERATION

As input signals to the powertrain control module (PCM) change, the PCM adjusts its response to the output devices. For example, the PCM must calculate 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. Input from the oxygen (O_2) sensor is not monitored during OPEN LOOP modes.

During CLOSED LOOP modes, the PCM does monitor the oxygen (O_2) sensor input. This input indicates to the PCM whether or not the calculated injector pulse width results in the ideal air-fuel ratio of 14.7 parts air to 1 part fuel. By monitoring the exhaust oxygen content through the O_2 sensor, the PCM can fine tune the injector pulse width. Fine tuning injector pulse width allows the PCM to achieve optimum fuel economy combined with low emissions.

The single point fuel injection system 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

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

IGNITION SWITCH ON (ZERO RPM) MODE

When the single point fuel injection system is activated by the ignition switch, the following actions occur:

- The powertrain control module (PCM) determines atmospheric air pressure from the MAP sensor input to determine basic fuel strategy.
- The PCM monitors the coolant temperature sensor and throttle position sensor inputs. The PCM modifies fuel strategy based on these inputs.

When the key is in the ON position and the engine is not running or cranking (zero rpm), the auto shutdown (ASD) relay and fuel pump relay are not energized. Therefore battery voltage is not supplied to the fuel pump, ignition coil, fuel injector or oxygen sensor heating element.

ENGINE START-UP MODE

This is an OPEN LOOP mode. The following actions occur when the starter motor is engaged.

If the powertrain control module (PCM) receives a distributor signal, it energizes the auto shutdown (ASD) relay and fuel pump relay. These relays supply battery voltage to the fuel pump, fuel injector, ignition coil and oxygen sensor heating element. If the PCM does not receive a distributor input, the ASD and fuel pump relays will be de-energized after approximately one second.

When the engine is idling within ±64 RPM of the target RPM, the PCM compares current MAP value with the atmospheric pressure value received during the Ignition Switch On (Zero RPM) Mode. If a minimum difference between the two is not detected, a MAP sensor trouble code is set into memory.

Once the ASD relay and fuel pump relay have energized, the PCM:

- Supplies a ground path to the injector. The injector is pulsed four times per engine revolution instead of the normal two pulses per revolution.
- Determines injector pulse width based on coolant temperature, MAP sensor input, throttle position, and the number of engine revolutions since cranking was initiated.
- Monitors the coolant temperature sensor, distributor pick-up, MAP sensor, and throttle position sensor to determine correct ignition timing.

ENGINE WARM-UP MODE

This is a OPEN LOOP mode. The following inputs are received by the powertrain control module (PCM):

- coolant temperature
- manifold absolute pressure (MAP)
- engine speed (distributor pick-up)
- throttle position
- A/C switch
- battery voltage

The PCM provides a ground path for the injector to precisely control injector pulse width (by switching the ground on and off). The PCM energizes the injector twice per engine revolution. The PCM regulates engine idle speed (by adjusting the idle air control motor) and ignition timing.

CRUISE OR IDLE MODE

When the engine is at operating temperature this is a CLOSED LOOP mode. During cruising speed and at idle the following inputs are received by the powertrain control module (PCM):
- coolant temperature
- manifold absolute pressure
- engine speed
- throttle position
- exhaust gas oxygen content
- A/C control positions
- battery voltage

The PCM provides a ground path for the injector to precisely control injector pulse width. The PCM energizes the injector twice per engine revolution. The PCM controls engine idle speed and ignition timing. The PCM controls the air/fuel ratio according to the oxygen content in the exhaust gas.

ACCELERATION MODE

This is a CLOSED LOOP mode. The powertrain control module (PCM) recognizes an abrupt increase in throttle position or MAP pressure as a demand for increased engine output and vehicle acceleration. The PCM increases injector pulse width in response to increased fuel demand.

DECELERATION MODE

This is a CLOSED LOOP mode. During deceleration the following inputs are received by the powertrain control module (PCM):
- coolant temperature
- manifold absolute pressure
- engine speed
- throttle position
- exhaust gas oxygen content
- A/C control positions
- battery voltage

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. The PCM may reduce injector firing to once per engine revolution. This helps maintain better control of the air-fuel mixture (as sensed through the O_2 sensor).

During a deceleration condition, the PCM grounds the exhaust gas recirculation (EGR) and evaporative purge solenoids. When these solenoids are grounded, the EGR and canister purge functions stop.

WIDE OPEN THROTTLE MODE

This is an OPEN LOOP mode. During wide-open-throttle operation, the following inputs are received by the powertrain control module (PCM):
- coolant temperature
- manifold absolute pressure
- engine speed
- throttle position

When the PCM senses a wide open throttle condition through the throttle position sensor (TPS) it will:
- De-energize the air conditioning relay. This disables the air conditioning system.

The exhaust gas oxygen content input is not accepted by the PCM during wide open throttle operation. The PCM will adjust injector pulse width to supply a predetermined amount of additional fuel.

IGNITION SWITCH OFF MODE

When the ignition switch is turned to the OFF position, the following occurs:
- All outputs are turned off.
- No inputs are monitored.
- The powertrain control module (PCM) shuts down.

FUEL PRESSURE REGULATOR

The pressure regulator is a mechanical device located at the top of the throttle body (Fig. 17). Its function is to maintain a constant 270 kPa (39 PSI) across the fuel injector tip.

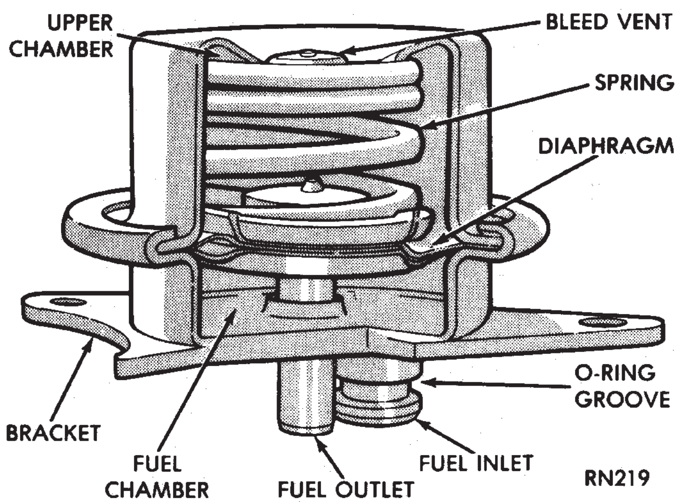

Fig. 17 Fuel Pressure Regulator

The regulator uses a spring loaded rubber diaphragm to uncover a fuel return port. When the fuel pump operates, fuel flows past the injector into the regulator. The blocked return port restricts fuel from flowing any further. When fuel pressure reaches 270 kPa (39 PSI) it pushes on the diaphragm, compressing the spring, and uncovers the fuel return port. The diaphragm and spring will constantly move from an open to closed position to keep the fuel pressure constant.

THROTTLE BODY

The throttle body assembly (Fig. 18) is mounted on top of the intake manifold. It contains the fuel injector, pressure regulator, throttle position sensor and idle air control motor. Air flow through the throttle body is controlled by a cable operated throttle blade located in the base of the throttle body. The throttle body itself provides the chamber for metering, atomizing, and mixing fuel with the air entering the engine.

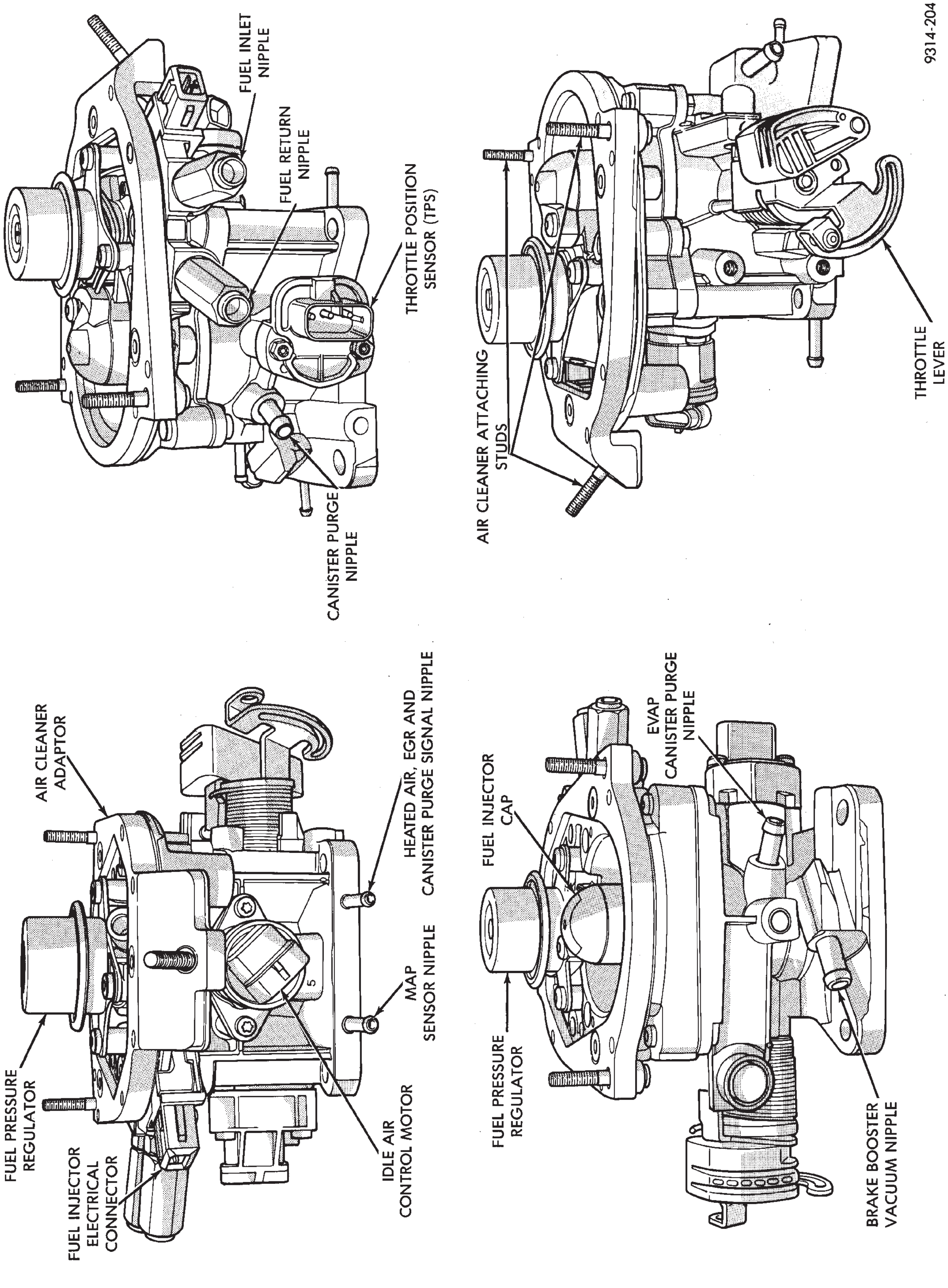

Fig. 18 Throttle Body

2.5L SINGLE POINT FUEL INJECTION—GENERAL DIAGNOSIS

GENERAL INFORMATION

The fuel injection system is managed by the powertrain control module (PCM). The PCM receives inputs from various switches and sensors (Fig. 1). Based on these inputs the PCM adjusts ignition timing and idle speed through output devices. Refer to the Single Point Fuel Injection section of this group for system and component descriptions.

VISUAL INSPECTION

A visual inspection for loose, disconnected, or misrouted wires and hoses should be made before attempting to diagnose or service the fuel injection system. A visual check helps save unnecessary test and diagnostic time. A thorough visual inspection will include the following checks:

(1) Check Ignition Coil Electrical Connections (Fig. 2).

(2) Verify that the electrical connector is attached to the Canister Purge Solenoid (Fig. 3).

(3) Verify that vacuum connection at Canister Purge Solenoid is secure and not leaking.

(4) Verify the harness connector is attached to the MAP sensor (Fig. 4).

(5) Verify manifold absolute pressure sensor vacuum hose is attached at MAP sensor (Fig. 4).

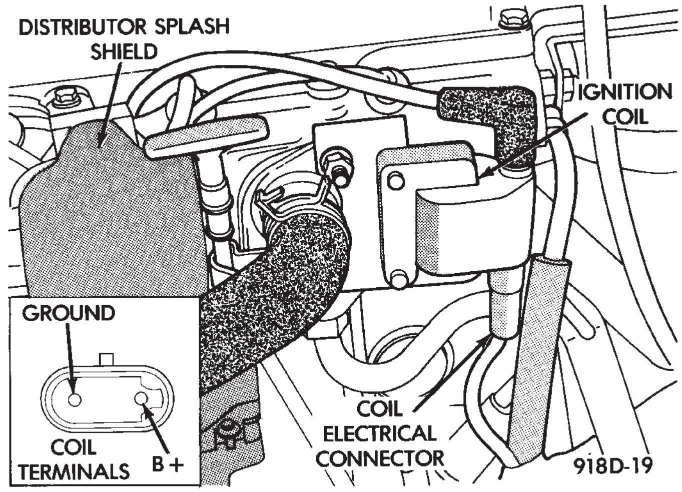

Fig. 2 Ignition Coil

(6) Verify that generator wiring and belt are correctly installed and tightened.

(7) Verify that hoses are securely attached to vapor canister (Fig. 5).

(8) Verify that the throttle body wiring harness is connected to main harness.

(9) Verify the harness connector is attached to the idle air control motor (Fig. 6).

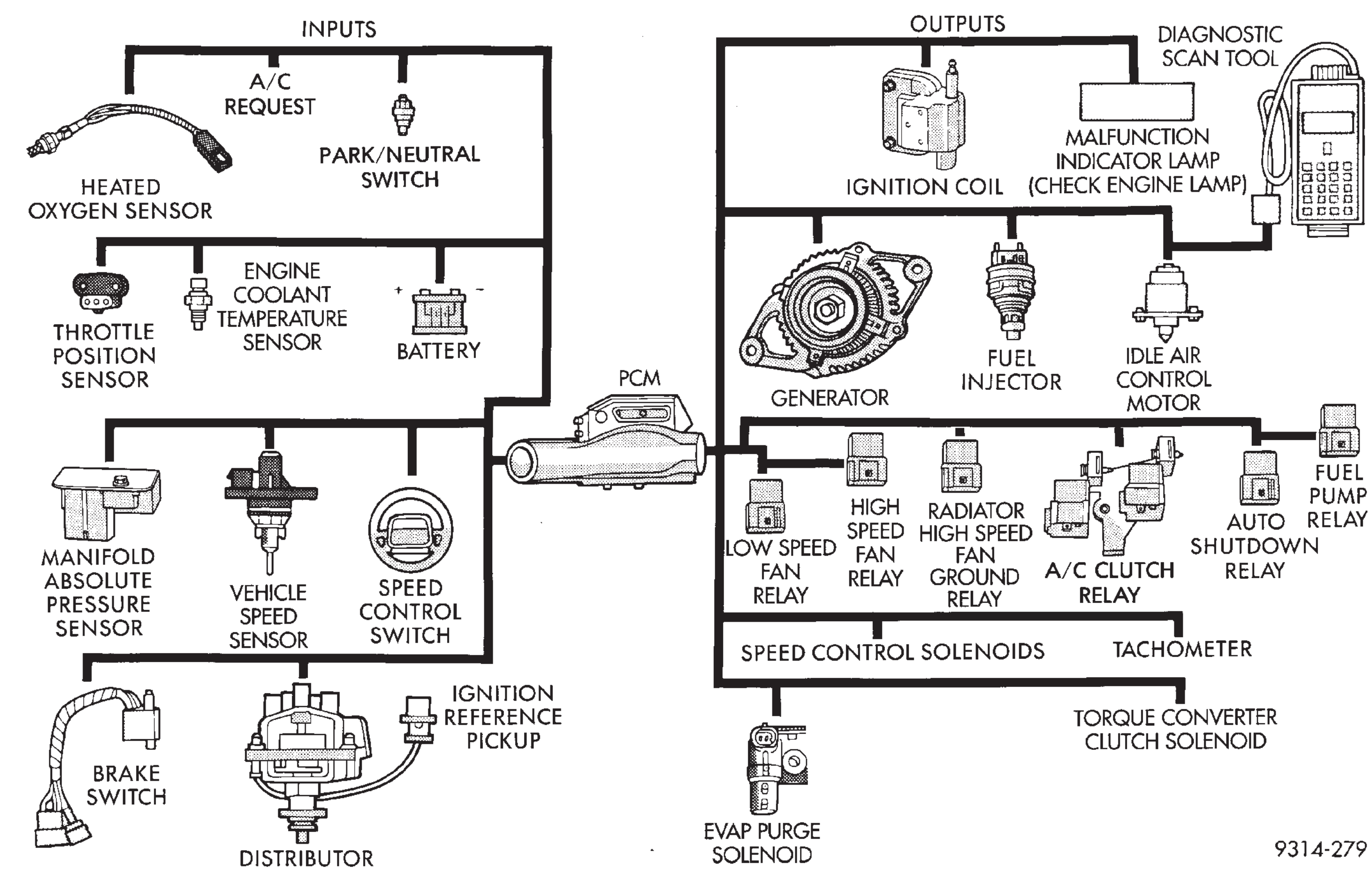

Fig. 1 Throttle Body Fuel Injection Components

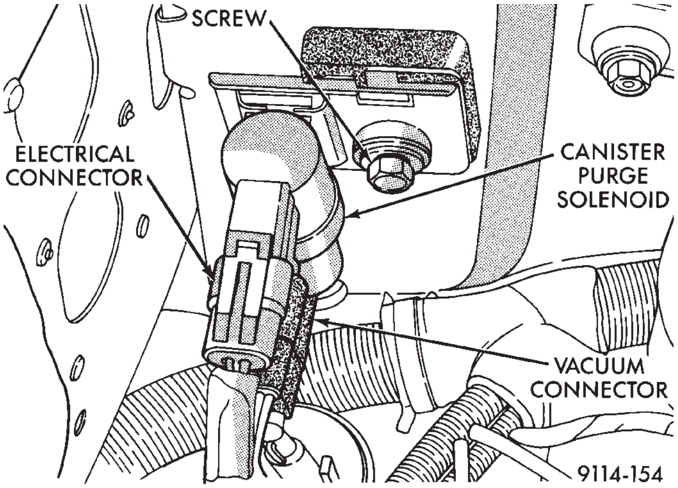

Fig. 3 Canister Purge Solenoid

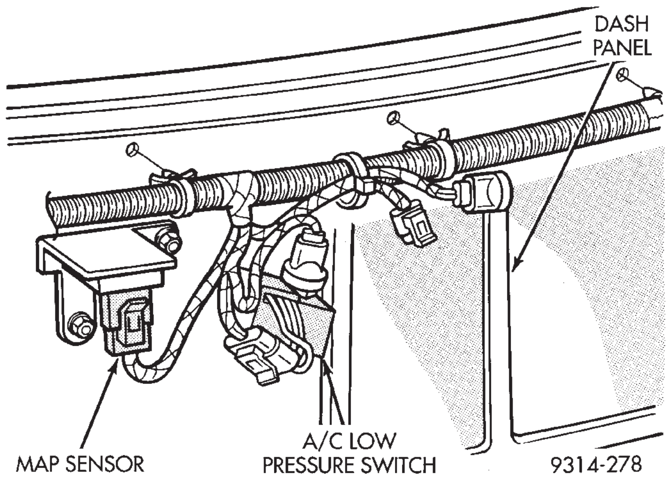

Fig. 4 Manifold Absolute Pressure (MAP) Sensor Location

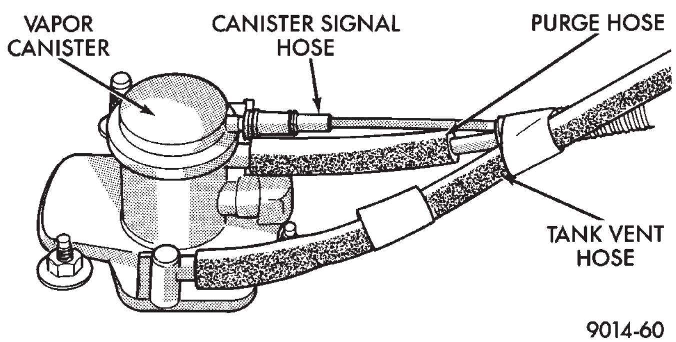

Fig. 5 Vapor Canister

(10) Verify the harness connector is attached to the throttle position sensor (Fig. 6).

(11) Verify the harness connector is attached to the fuel injector (Fig. 6).

(12) Verify the hose from PCV valve is securely attached to the intake manifold vacuum port (Fig. 7).

(13) Verify the vacuum connections on the front and rear of throttle body are secure and not leaking.

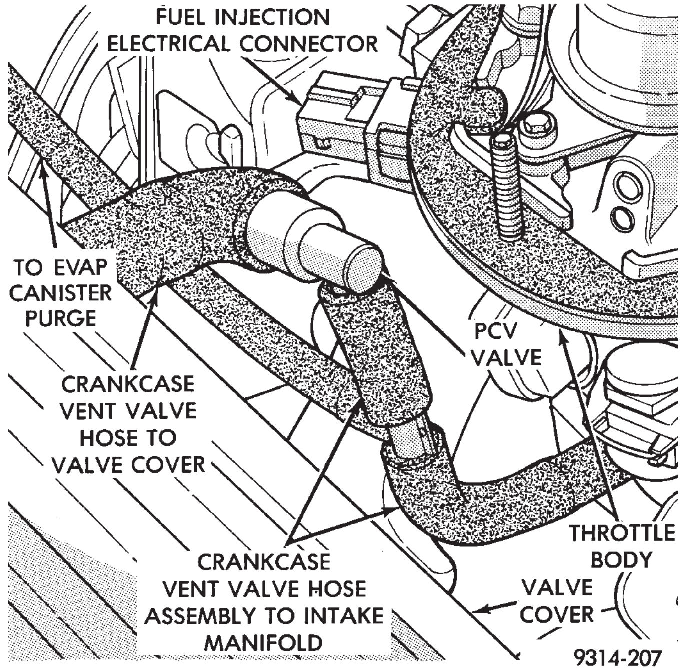

Fig. 6 Throttle Body Wiring Connections

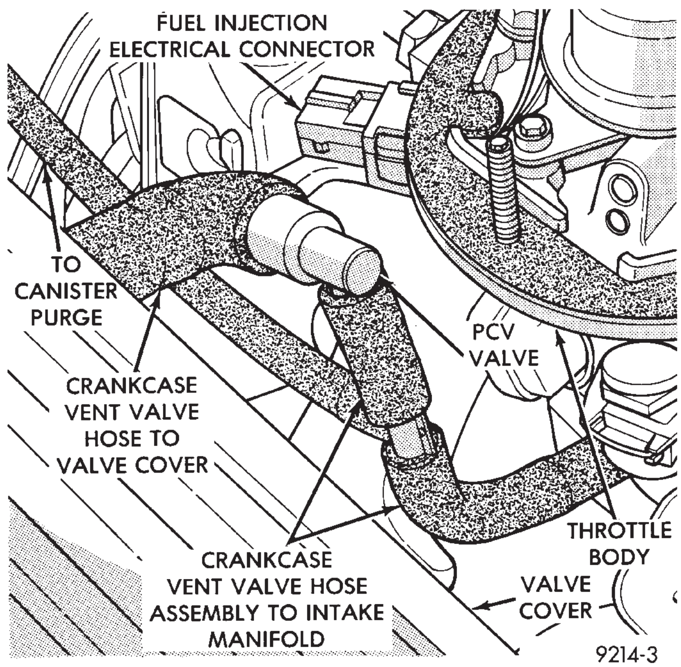

Fig. 7 Vacuum Hose from Intake Manifold to PCV Valve

Refer to the vacuum schematic on the Vehicle Emission Control Information (VECI) label.

(14) Verify the heated air door vacuum connection is connected and not leaking.

(15) Verify power brake and speed control vacuum connectors are tight (Fig. 8).

(16) Verify all ignition cables are in correct order and seated into place (Fig. 9).

(17) Verify electrical connector is attached to coolant temperature sensor (Fig. 10).

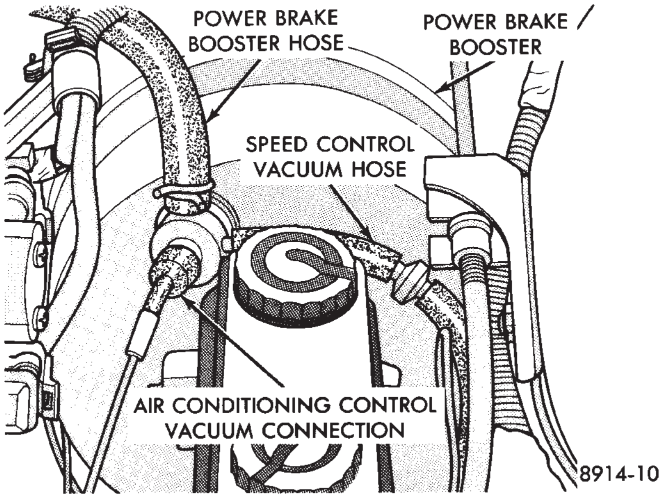

Fig. 8 Power Brake and Speed Control Vacuum Connection

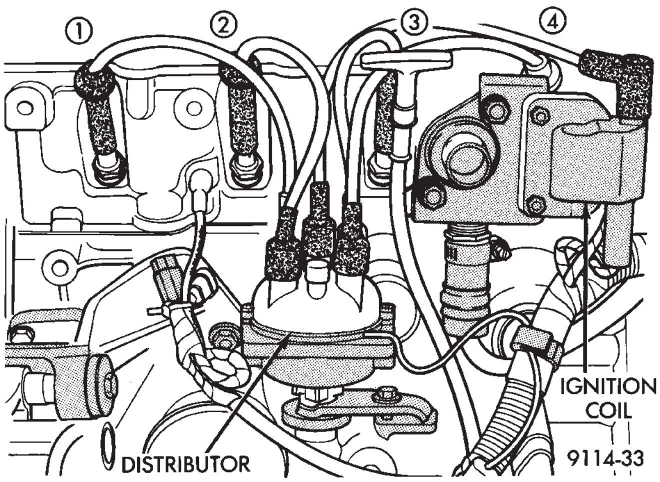

Fig. 9 Ignition Cable Routing and Connection

(18) Verify battery negative ground eyelet is mounted to the cylinder head (left side) (Fig. 10).

(19) Verify the harness connector is attached to distributor (Fig. 11).

(20) Verify oil pressure switch electrical connections are secure (Fig. 11).

(21) On vehicles with an automatic transmission, ensure the neutral safety switch electrical connector is secure (Fig. 12).

(22) On vehicles with an automatic transmission, check torque convertor lockup solenoid electrical connection (Fig. 12).

(23) Check the 60-way electrical connection at the powertrain control module (PCM) for damage or spread terminals. Verify that the 60-way connector is fully inserted into the socket on the PCM (Fig. 13). Ensure that wires are not stretched or pulled out of the connector.

(24) Verify all electrical connectors are fully inserted into relays (Fig. 14 and Fig. 15).

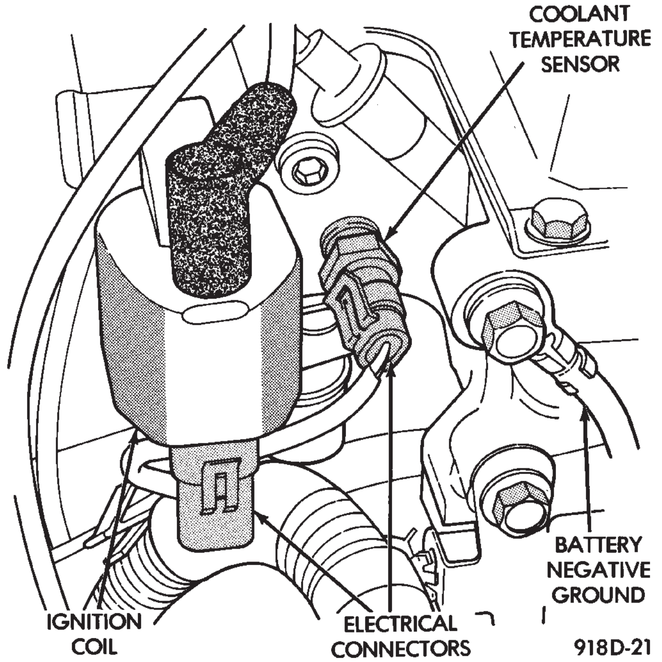

Fig. 10 Coolant Temperature Sensor

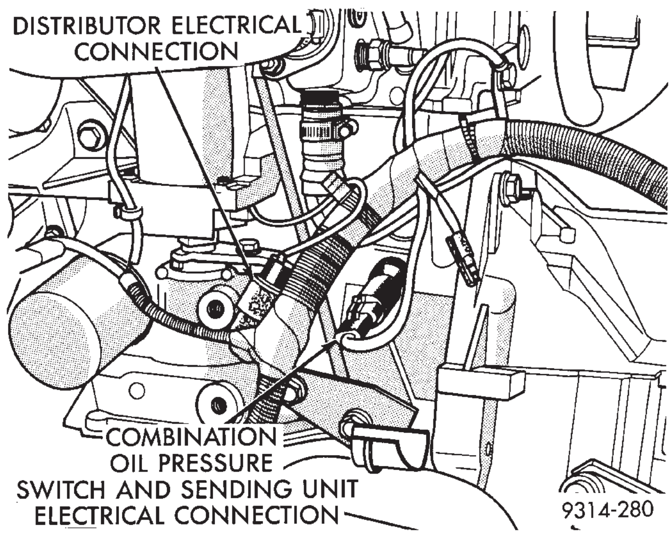

Fig. 11 Distributor and Oil Pressure Switch Electrical Connections

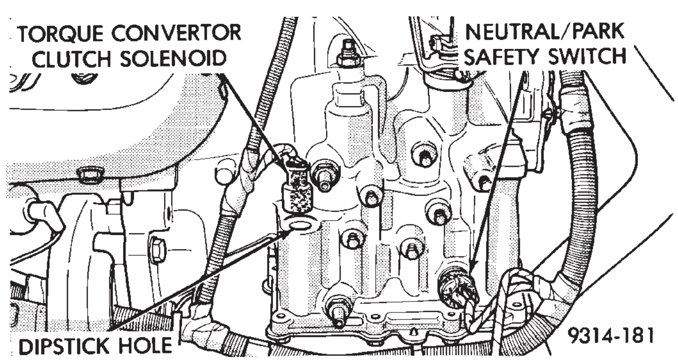

Fig. 12 Automatic Transmission Electrical Connections

(25) Ensure battery connections are clean and tight.

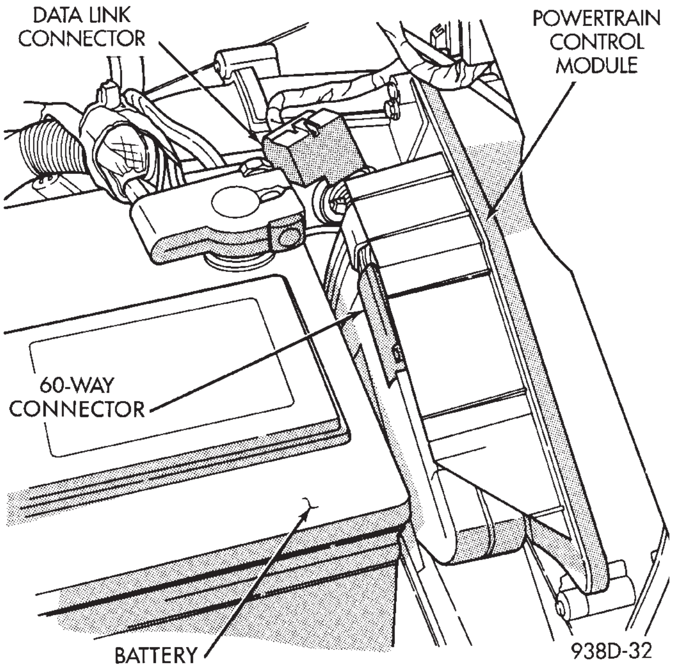

Fig. 13 Powertrain control module (PCM) Electrical Connector

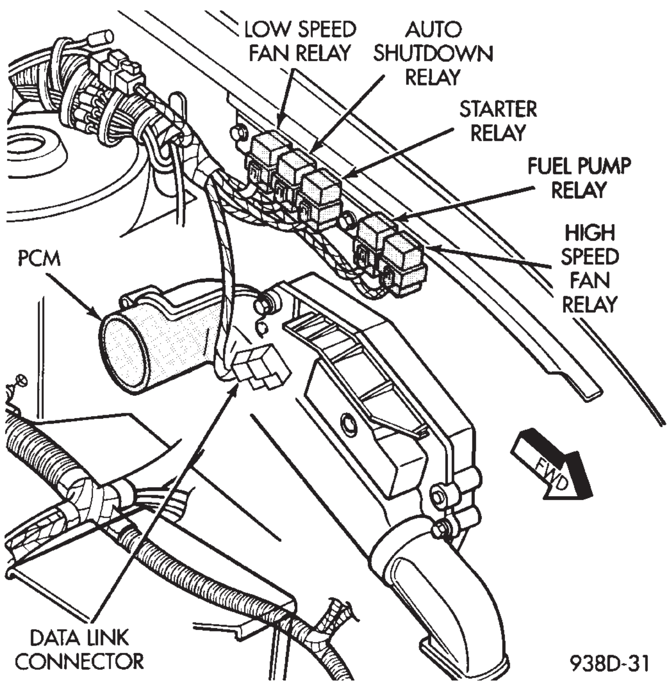

Fig. 14 ASD, Fuel Pump, Low Speed Fan, High Speed Fan and Starter Relays

(26) Verify engine harness to main harness connections are fully inserted.

(27) Check vehicle speed sensor connector (Fig. 16).

(28) Verify engine ground strap is attached at the intake manifold and dash panel.

(29) Verify the harness connector is attached to the heated oxygen sensor (Fig. 17).

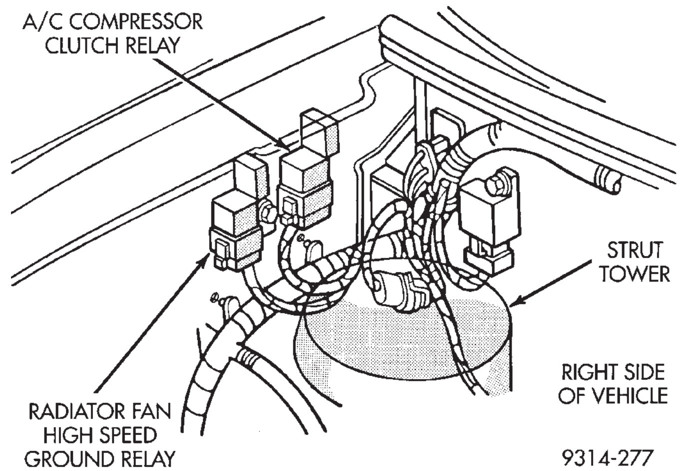

Fig. 15 A/C Clutch Relay and Radiator High Speed Fan Ground Relay

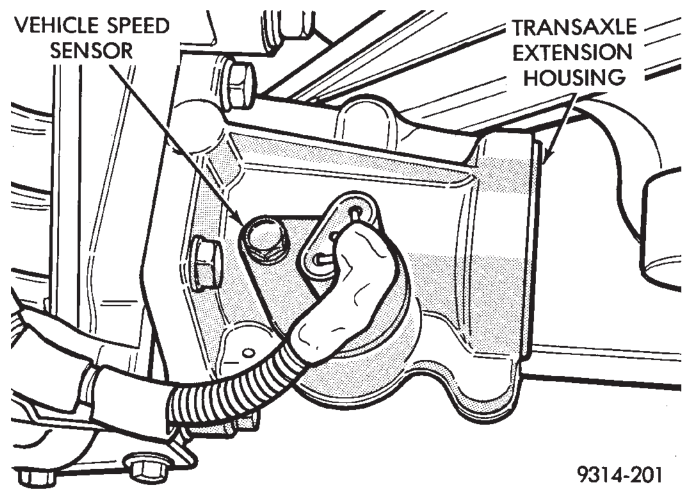

Fig. 16 Vehicle Speed Sensor

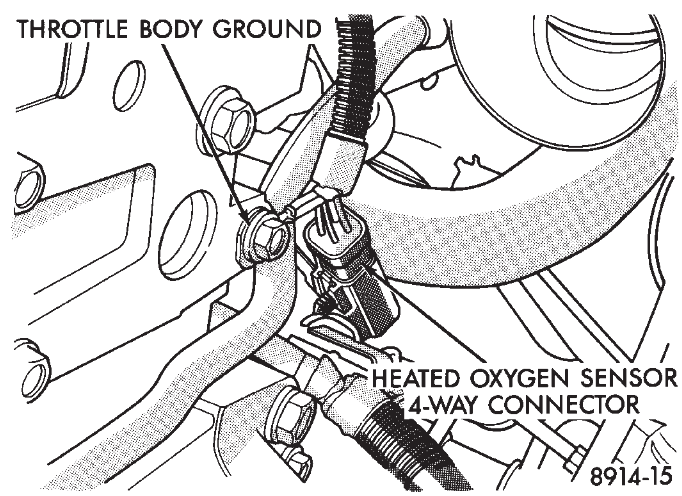

Fig. 17 Heated Oxygen Sensor Electrical Connection

(30) Check Hose and Wiring Connections at Fuel Pump. Check that wiring connector is making contact with terminals on pump.

2.5L SINGLE POINT FUEL INJECTION—ON-BOARD DIAGNOSTICS

INDEX

GENERAL INFORMATION

The powertrain control module (PCM) has been programmed to monitor many different circuits of the fuel injection system. If a problem is sensed with a monitored circuit often enough to indicate an actual problem, the PCM stores a diagnostic trouble code. If the problem is repaired or ceases to exist, the PCM cancels the trouble code after 51 vehicle key on/off cycles.

Certain criteria must be met for a trouble code to be entered into PCM memory. The criteria may be a specific range of engine RPM, engine temperature, and/or input voltage to the PCM.

It is possible that a trouble code for a monitored circuit may not be entered into memory even though a malfunction has occurred. This may happen because one of the trouble code criteria for the circuit has not been met. **For example**, assume the trouble code criteria for a sensor circuit requires the engine to operate between 750 and 2000 RPM. If the sensor output circuit shorts to ground when engine RPM is above 2400 RPM (resulting in a 0 volt input to the PCM) a diagnostic trouble code will not be entered into memory. This is because the condition does not occur within the specified RPM range.

There are several operating conditions that the PCM does not monitor and set diagnostic trouble codes for. Refer to Monitored Circuits and Non-Monitored Circuits in this section.

Stored diagnostic trouble codes can be displayed either by cycling the ignition key On - Off - On - Off - On, or using the DRBII scan tool. The DRBII scan tool connects to the data link connector in the vehicle (Fig. 1).

MONITORED CIRCUITS

The powertrain control module (PCM) can detect certain fault conditions in the fuel injection system.

Open or Shorted Circuit - The PCM can determine if the sensor output (input to PCM) is within proper range. Also, the PCM can determine if the circuit is open or shorted.

Output Device Current Flow - The PCM senses whether the output devices are hooked up. If there is a problem with the circuit, the PCM senses whether the circuit is open, shorted to ground, or shorted high.

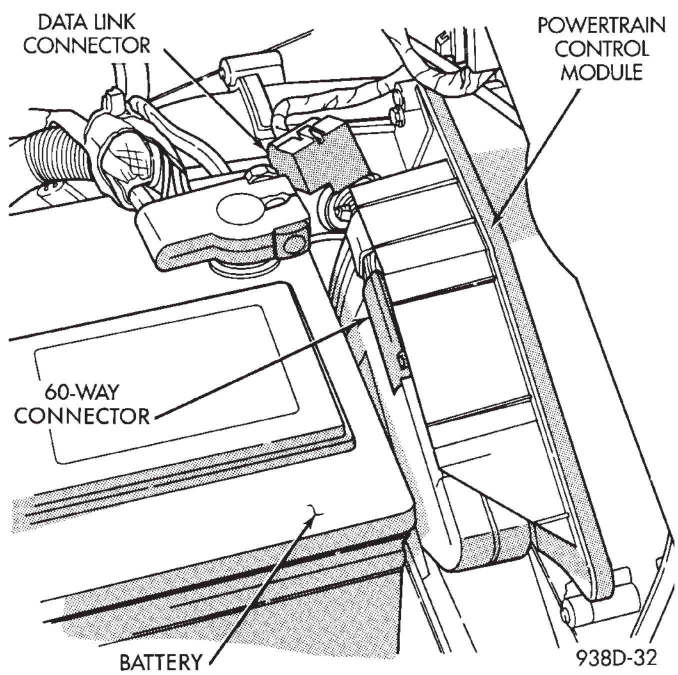

Fig. 1 Data Link Connector Location

Oxygen Sensor - The PCM can determine if the oxygen sensor is switching between rich and lean once the system has entered closed loop. Refer to Modes of Operation in this section for an explanation of closed loop operation.

NON-MONITORED CIRCUITS

The powertrain control module (PCM) does not monitor the following circuits, systems and conditions that could have malfunctions that result in driveability problems. Diagnostic trouble codes may not be displayed for these conditions. However, problems with these systems may cause trouble codes to be displayed for other systems. For example, a fuel pressure problem will not register a trouble code directly, but could cause a rich or lean condition. This could cause an oxygen sensor fault to be stored in the PCM.

Fuel Pressure - Fuel pressure is controlled by the fuel pressure regulator. The PCM cannot detect a clogged fuel pump inlet filter, clogged in-line fuel filter, or a pinched fuel supply or return line. However, these could result in a rich or lean condition causing an oxygen sensor trouble code to be stored in the PCM.

Secondary Ignition Circuit - The PCM cannot detect an inoperative ignition coil, fouled or worn spark plugs, ignition cross firing, or open spark plug cables.

Engine Timing - The PCM cannot detect an incorrectly indexed timing chain, camshaft sprocket and crankshaft sprocket. The PCM also cannot detect an incorrectly indexed distributor. However, these could result in a rich or lean condition causing an oxygen sensor trouble code to be stored in the PCM.

Cylinder Compression - The PCM cannot detect uneven, low, or high engine cylinder compression.

Exhaust System - The PCM cannot detect a plugged, restricted or leaking exhaust system.

Fuel Injector Malfunctions - The PCM cannot determine if the fuel injector is clogged, the pintle is sticking or the wrong injector is installed. However, these could result in a rich or lean condition causing an oxygen sensor trouble code to be stored in the PCM.

Excessive Oil Consumption - Although the PCM monitors exhaust stream oxygen content when the system is in closed loop, it cannot determine excessive oil consumption.

Throttle Body Air Flow - The PCM cannot detect a clogged or restricted air cleaner inlet or filter element.

Evaporative System - The PCM will not detect a restricted, plugged or loaded evaporative purge canister.

Vacuum Assist - Leaks or restrictions in the vacuum circuits of vacuum assisted engine control system devices are not monitored by the PCM. However, these could result in a MAP sensor trouble code being stored in the PCM.

PCM System Ground - The PCM cannot determine a poor system ground. However, a trouble code may be generated as a result of this condition.

PCM Connector Engagement - The PCM cannot determine spread or damaged connector pins. However, a trouble code may be generated as a result of this condition.

HIGH AND LOW LIMITS

The powertrain control module (PCM) compares input signal voltages from each input device with established high and low limits that are programmed into it for that device. If the input voltage is not within specifications and other diagnostic trouble code criteria are met, a trouble code will be stored in memory. (Other criteria might include engine RPM limits or input voltages from other sensors or switches that must be present before a fault condition can be verified).

DIAGNOSTIC TROUBLE CODE DESCRIPTION

When a diagnostic trouble code appears, it indicates that the powertrain control module (PCM) has recognized an abnormal condition in the system. Trouble codes can be obtained from the malfunction indicator lamp (instrument panel Check Engine lamp) or from the DRBII scan tool. Trouble codes indicate the results of a failure but do not identify the failed component directly.

SYSTEMS TEST

Be sure to apply parking brake and/or block wheels before performing idle check or adjustment, or any engine running tests.

OBTAINING DIAGNOSTIC TROUBLE CODES

USING DRBII SCAN TOOL

WARNING: APPLY PARKING BRAKE AND/OR BLOCK WHEELS BEFORE PERFORMING ANY TEST ON AN OPERATING ENGINE.

(1) Connect DRBII scan tool to the data link (diagnostic) connector (Fig. 1).

(2) If possible, start the engine and cycle the **A/C** switch if applicable. Shut off the engine.

(3) Turn the ignition switch on, access Read Fault Screen. Record all the diagnostic trouble codes shown on the DRBII scan tool. [Observe the malfunction indicator lamp (check engine lamp) on the instrument panel. The lamp should light for 2 seconds then go out (bulb check)].

To erase diagnostic trouble codes, use the Erase Trouble Code data screen on the DRBII scan tool.

USING THE MALFUNCTION INDICATOR LAMP

(1) Cycle the ignition key On - Off - On - Off - On within 5 seconds.

(2) Count the number of times the malfunction indicator lamp (check engine lamp) on the instrument panel flashes on and off. The number of flashes represents the trouble code. There is a slight pause between the flashes representing the first and second digits of the code. Longer pauses separate individual trouble codes.

(3) Refer to the Diagnostic Trouble Code Charts at the end of this group.

STATE DISPLAY TEST MODE

The switch inputs used by the powertrain control module (PCM) have only two recognized states, HIGH and LOW. For this reason, the PCM cannot recognize the difference between a selected switch po-

DIAGNOSTIC TROUBLE CODE DESCRIPTION

TROUBLE CODE	DRB II DISPLAY	DESCRIPTION
11	No reference SignaL During Cranking	No camshaft position sensor detected during engine cranking.
13+**	Slow change in Idle MAP signal	MAP output change is slower and/or smaller than expected.
	or	
	No change in MAP from start to run	No difference recognized between the engine MAP reading and the barometric (atmospheric) pressure reading at start-up.
14+**	MAP voltage too low	MAP sensor input below minimum acceptable voltage.
	or	
	MAP voltage too High	MAP sensor input above maximum acceptable voltage.
15**	No vehicle speed signal	No vehicle speed sensor signal detected during road load conditions.
17	Engine is cold too long	Engine coolant temperature remains below normal operating temperatures during vehicle travel (thermostat).
21**	O_2 signal stays at center	Neither rich or lean condition detected from the oxygen sensor input.
	or	
	O_2 signal shorted to voltage	Oxygen sensor input voltage maintained above the normal operating range.
22+**	Coolant sensor voltage too high	Coolant temperature sensor input above the maximum acceptable voltage.
	or	
	Coolant sensor voltage too low	Coolant temperature sensor input below the minimum acceptable voltage.
24+**	Throttle position sensor voltage high	Throttle position sensor input above the maximum acceptable voltage.
	or	
	Throttle position sensor voltage low	Throttle position sensor input below the minimum acceptable voltage.
25**	Idle air control motor circuits	An open or shorted condition detected in one or more of the idle air control motor circuits.
27	Injector control circuit	Injector output driver does not respond properly to the control signal.
31**	EVAP purge solenoid circuit	An open or shorted condition detected in the EVAP purge solenoid circuit.
33	A/C clutch relay circuit	An open or shorted condition detected in the A/C clutch relay circuit.

\+ Check Engine Lamp On
** Check Engine Lamp On (California Only)

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DIAGNOSTIC TROUBLE CODE DESCRIPTION (CON'T)

TROUBLE CODE	DRB II DISPLAY	DESCRIPTION
34	Speed control solenoid circuits	An open or shorted condition detected in the speed control vacuum or vent solenoid circuits.
35	Radiator fan relays	An open or shorted condition detected in the radiator fan low speed relay or high speed relay or high speed ground relay circuits.
37	Torque convertor unlock solenoid CKT	An open or shorted condition detected in the torque convertor part throttle unlock solenoid circuit (3 speed automatic transmission).
41+**	Generator field not switching properly	An open or shorted condition detected in the generator field control circuit.
42	Auto shutdown relay control circuit	An open or shorted condition detected in the auto shutdown relay circuit.
46+**	Charging system voltage too high	Battery voltage sense input above target charging voltage during engine operation.
47+**	Charging system voltage too low	Battery voltage sense input below target charging during engine operation. Also, no significant change detected in battery voltage during active test of alternator output.
51**	O_2 signal stays below center (lean)	Oxygen sensor signal input indicates lean air/fuel ratio condition during engine operation.
52**	O_2 signal stays above center (rich)	Oxygen sensor signal input indicates rich air/fuel ratio condition during engine operation.
53	Internal controller	Engine controller internal fault condition detected.
62	EMR miles	Unsuccessful attempt to update EMR mileage in the PCM.
63	Controller Failure EEPROM write denied	Unsuccessful attempt to write to an EEPROM location by the PCM.
55	N/A	Completion of fault code display on Check Engine lamp.

\+ Check Engine Lamp On
** Check Engine Lamp On (California Only)

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sition versus an open circuit, a short circuit, or a defective switch. If the change is displayed, it can be assumed that the entire switch circuit to the PCM is functional. From the state display screen access either State Display Inputs and Outputs or State Display Sensors.

STATE DISPLAY INPUTS AND OUTPUTS

Connect the DRBII scan tool to the vehicle and access the State Display screen. Then access Inputs and Outputs. The following is a list of the engine control system functions accessible through the Inputs and Outputs screen:

Park/Neutral Switch (automatic transaxle only)
Speed Control Resume
Brake Switch
Speed Control On/Off
Speed Control Set
A/C Switch Sense
S/C (Speed Control) Vent Solenoid
S/C (Speed Control) Vacuum Solenoid
Torque Converter Clutch Solenoid (3 speed automatic transaxle)
A/C Clutch Relay
Auto Shutdown Relay
Radiator Fan Low Speed Relay
Radiator Fan High Speed Relay
Purge Solenoid

STATE DISPLAY SENSORS

Connect the DRBII scan tool to the vehicle and access the State Display screen. Then access Sensor Display. The following is a list of the engine control system functions accessible through the Sensor Display screen.

Oxygen Sensor Signal
Coolant Temperature
Coolant Temp Sensor
Throttle Position
Minimum Throttle
Battery Voltage
MAP Sensor Reading
Idle Air Control Motor Position
Added Adaptive Fuel
Adaptive Fuel Factor
Barometric Pressure
Minimum Airflow Idle Speed
Engine Speed
Fault #1 Key-On Info
Module Spark Advance
Speed Control Target
Fault #2 Key-On Info
Fault #3 Key-On Info
Speed Control Status
Charging System Goal
Theft Alarm Status
Speed Control Switch Voltage
Map Sensor Voltage
Vehicle Speed
Oxygen Sensor State
MAP Gauge Reading
Throttle Opening (percentage)
Total Spark Advance

CIRCUIT ACTUATION TEST MODE

The circuit actuation test mode checks for proper operation of output circuits or devices which the powertrain control module (PCM) cannot internally recognize. The PCM can attempt to activate these outputs and allow an observer to verify proper operation. Most of the tests provide an audible or visual indication of device operation (click of relay contacts, spray fuel, etc.). With the exception of an intermittent condition, if a device functions properly during its test, it can be assumed that the device, its associated wiring, and its driver circuit are in working order.

OBTAINING CIRCUIT ACTUATION TEST

Connect the DRBII scan tool to the vehicle and access the Actuators screen. The following is a list of the engine control system functions accessible through Actuators screens.

Stop All Tests
Ignition Coil #1
Fuel Injector #1
Idle Air Control Motor Open/Close
Radiator Fan Low Speed Relay
Radiator Fan High Speed Relay
A/C Compressor Clutch Relay
Auto Shutdown Relay
EVAP Purge Solenoid
S/C Servo Solenoids
Generator Field
Tachometer Output
Torque Converter Clutch Solenoid (3 speed automatic transaxle only)
All Solenoids/Relays
ASD Fuel System Test
Speed Control Vacuum Solenoid
Speed Control Vent Solenoid

THROTTLE BODY MINIMUM AIR FLOW CHECK PROCEDURE

(1) Connect the DRBII scan tool to the data link connector.

(2) Remove air cleaner assembly. Plug the heated air door vacuum hose.

(3) Warm engine in Park or Neutral until the cooling fan has cycled on and off at least once.

(4) Hook-up timing light and tachometer.

(5) Disconnect the coolant temperature sensor and set basic timing to 12°BTDC ± 2°BTDC.

(6) Shut off engine. Reconnect coolant temperature sensor.

(7) Disconnect the PCV valve hose from the intake manifold nipple.

(8) Attach Air Metering Fitting #6457 (Fig. 2) to the intake manifold PCV nipple.

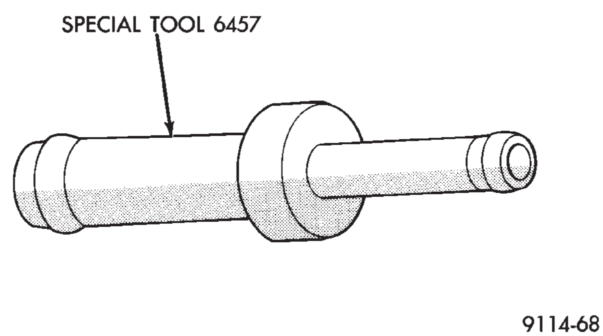

Fig. 2 Air Metering Fitting

(9) Restart the engine, allow engine to idle for at least one minute.

(10) Using the DRBII scan tool, Access Minimum Airflow Idle Speed in the sensor read test mode.

(11) The following will then occur:

- Idle air control motor will fully close.
- Idle spark advance will become fixed.
- Idle fuel will be provided at a set value.
- Engine RPM will be displayed on the DRBII scan tool.

(12) Check idle RPM with tachometer. If idle RPM is within the specifications listed below, then the throttle body minimum air flow is set correctly.

IDLE SPECIFICATIONS

ODOMETER READING	IDLE RPM
Below 1000 Miles	600 - 1200 RPM
Above 1000 Miles	800 - 1200 RPM

9314-272X

If idle RPM is not within specification replace throttle body.

(13) Shut off engine.

(14) Remove Special Tool number 6457 from intake manifold PCV nipple. Reinstall the PCV valve hose.

(15) Remove DRBII scan tool.

(16) Reinstall air cleaner assembly. Reinstall heated air door vacuum hose.

(17) Disconnect timing check device and tachometer.

IGNITION TIMING PROCEDURE

Refer to Group 8D Ignition System

60-WAY POWERTRAIN CONTROL MODULE WIRING CONNECTOR

Refer to the powertrain control module (PCM) wiring connector diagrams (Fig. 3) for information regarding wire colors and cavity numbers.

CAV	WIRE COLOR	DESCRIPTION
1	DG/RD*	MAP SENSOR SIGNAL
2	TN/BK*	ENGINE COOLANT TEMPERATURE SENSOR
3	RD/WT*	DIRECT BATTERY VOLTAGE
4	BK/LB*	SENSOR RETURN
5	BK/WT*	SIGNAL GROUND
6	VT/WT*	5.0 VOLT OUTPUT (MAP AND TPS)
7	OR	8.0 VOLT OUTPUT (DISTRIBUTOR PICKUP AND DISTANCE SENSOR)
8	WT	B1 VOLTAGE SENSE (START SIGNAL)
9	DB	A21 SUPPLY (IGNITION START/RUN)
10		
11	BK/TN*	POWER GROUND
12	BK/TN*	POWER GROUND
13		
14		
15		
16	WT/DB*	FUEL INJECTOR DRIVER
17		
18		
19	BK/GY	IGNITION COIL DRIVER
20	DG	GENERATOR FIELD CONTROL
21		
22	OR/DB*	THROTTLE POSITION SENSOR
23	RD/LG*	SPEED CONTROL SENSE
24	GY/BK*	DISTRIBUTOR PICK-UP SIGNAL
25	PK	DATA LINK TRANSMIT
26	VT/BR*	CCD (+) BUS
27	BR	A/C SWITCH SENSE
28		
29	WT/PK*	BRAKE SWITCH
30	BR/YL*	PARK/NEUTRAL SWITCH
31	DB/PK*	RADIATOR FAN LOW SPEED RELAY
32		
33	TN/RD*	SPEED CONTROL VACUUM SOLENOID
34	DB/OR*	A/C COMPRESSOR CLUTCH RELAY
35	GY/YL*	EGR SOLENOID
36		

CAV	WIRE COLOR	DESCRIPTION
37		
38		
39	GY/RD*	IDLE AIR CONTROL MOTOR DRIVER #3
40	BR/WT*	IDLE AIR CONTROL MOTOR DRIVER #1
41	BK/DG*	HEATED OXYGEN SENSOR SIGNAL
42		
43		
44		
45	LG	DATA LINK RECEIVE
46	WT/BK*	CCD (-) BUS
47	WT/OR*	VEHICLE SPEED SENSOR SIGNAL
48		
49		
50		
51	DB/YL*	AUTO SHUTDOWN RELAY AND FUEL PUMP RELAY
52	PK/BK*	EVAP PURGE SOLENOID
53	LG/RD*	SPEED CONTROL VENT SOLENOID
54	OR/BK*	TORQUE CONVERTOR CLUTCH SOLENOID
55	YL	RADIATOR FAN HIGH SPEED RELAYS
56		
57	DG/OR*	A142 CIRCUIT VOLTAGE SENSE
58		
59	VT/BK*	IDLE AIR CONTROL MOTOR DRIVER #4
60	YL/BK*	IDLE AIR CONTROL MOTOR DRIVER #2

WIRE COLOR CODES					
BK	BLACK	LB	LIGHT BLUE	VT	VIOLET
BR	BROWN	LG	LIGHT GREEN	WT	WHITE
DB	DARK BLUE	OR	ORANGE	YL	YELLOW
DG	DARK GREEN	PK	PINK	*	WITH TRACER
GY	GRAY	RD	RED		
		TN	TAN		

CONNECTOR TERMINAL SIDE SHOWN

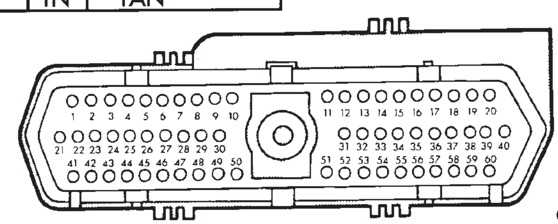

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Fig. 3 Powertrain control module (PCM) Wiring Connector Cavity Description

2.5L SINGLE POINT FUEL INJECTION—SERVICE PROCEDURES

INDEX

FUEL LINES AND HOSES

Release fuel system pressure before servicing the fuel system. Preform the "Fuel System Pressure Relief Procedure".

Do not damage the hose or hose nipple when removing the fuel hoses. Always use new hose clamps, of the correct type, during reassembly. Tighten hose clamps to 1 N•m (10 in. lbs.) torque. **Do not use aviation style clamps on this system or hose damage may result.**

FUEL SYSTEM PRESSURE RELEASE PROCEDURE

CAUTION: Before servicing the fuel pump, fuel lines, fuel filter, throttle body, or fuel injector, the fuel system pressure must be released.

(1) Loosen fuel filler cap to release fuel tank pressure.

(2) Disconnect injector wiring harness connector (Fig. 1).

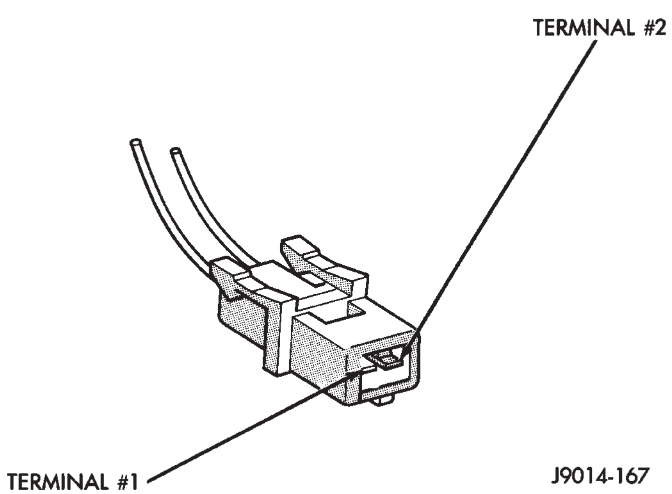


Fig. 1 Injector Harness Connector

(3) Connect a jumper wire between terminal Number 1 of the injector harness and engine ground.

(4) Connect a jumper wire to the positive terminal Number 2 of the injector harness and touch the battery positive post **for no longer than 5 seconds**. This releases system pressure.

(5) Remove jumper wires.

(6) Continue fuel system service.

THROTTLE BODY

CAUTION: The fuel system is under a constant pressure of 270 kPa (39 psi). Perform the Fuel Pressure Release Procedure before servicing the throttle body.

Always reassemble throttle body components with new O-rings and seals where applicable. Never use silicone lubricants on O-rings or seals, damage may result. Use care when removing fuel tubes to prevent damage to quick connect fittings or tube ends. Refer to Fuel Hoses, Clamps, and Quick Connect Fittings in the Fuel Delivery Section of this Group.

REMOVAL

(1) Remove air cleaner (Fig. 2).

(2) Perform fuel system pressure release.

(3) Disconnect negative battery cable.

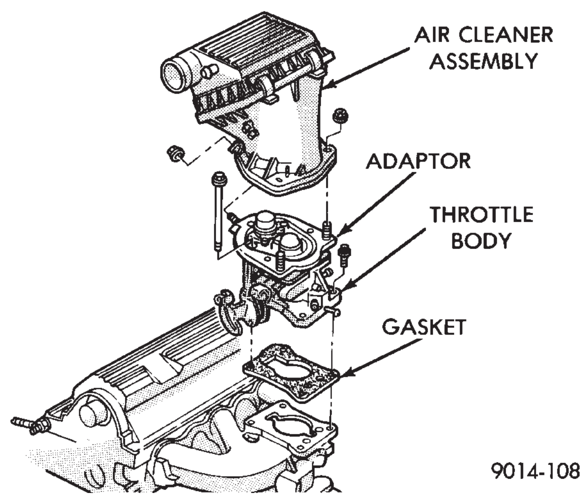


Fig. 2 Throttle Body and Air Cleaner Assembly

(4) Disconnect vacuum hoses and electrical connectors (Fig. 3).

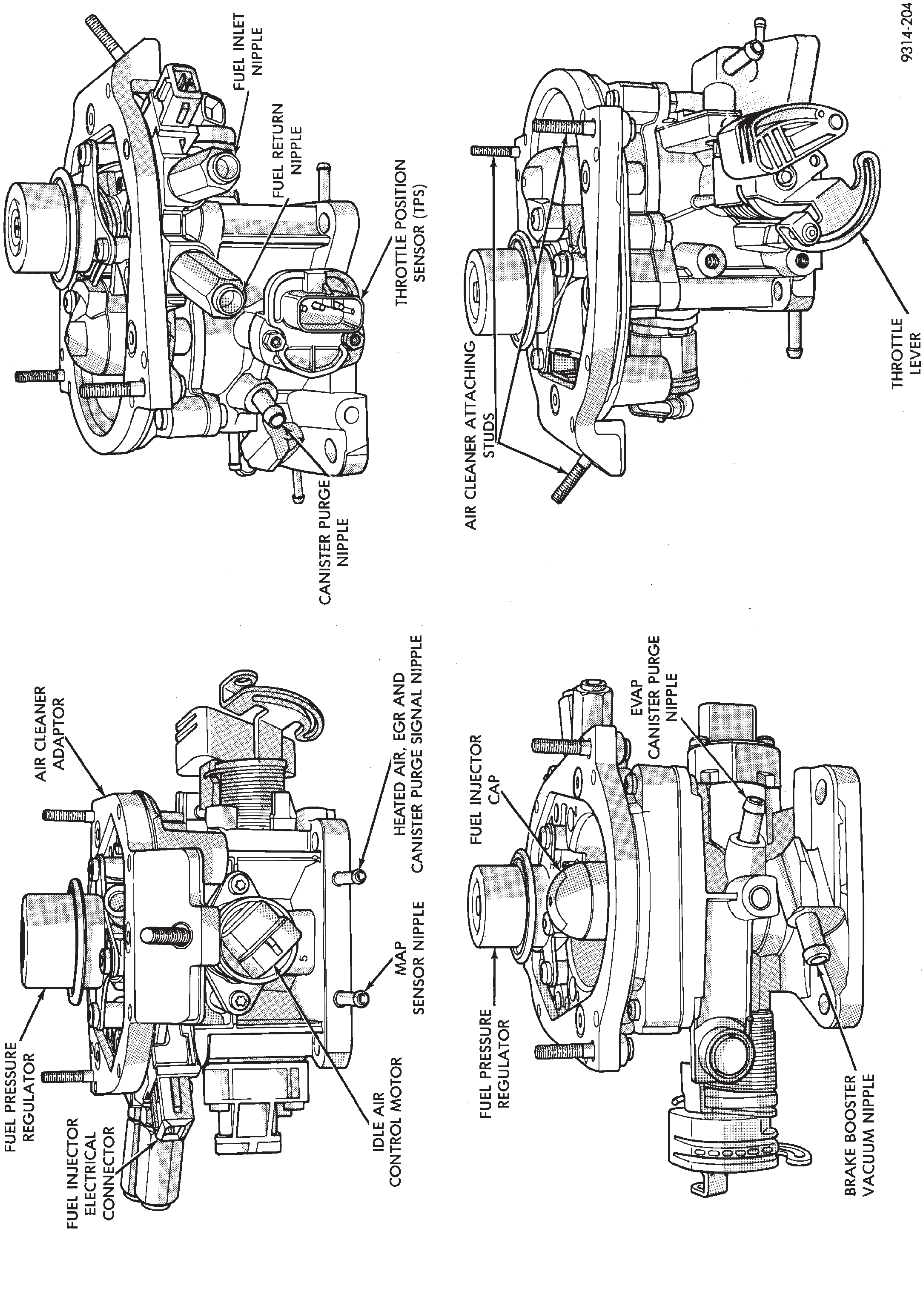


Fig. 3 Throttle Body

(5) Remove throttle cable. If equipped, remove the speed control and transmission kickdown cables.

(6) Remove return spring.

(7) Loosen fuel tube clamp on valve cover (Fig. 4).

(8) Wipe quick connect fittings to remove any dirt.

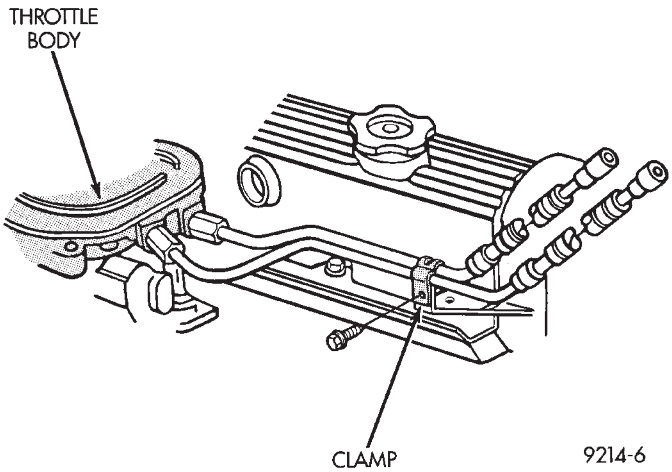


Fig. 4 Fuel Line Clamp

Remove fuel intake and return tubes. **Refer to Fuel Hoses, Clamps and Quick Connect Fittings in the Fuel Delivery Section of this Group.** Place a shop towel under the connections to absorb any fuel spilled.

(9) Remove throttle body mounting screws and lift throttle body from vehicle. Remove throttle body gasket from intake manifold.

INSTALLATION

(1) Using a new gasket, install throttle body and tighten mounting screws to 20 N●m (175 in. lbs.) torque.

(2) Lubricate the ends of the fuel supply and return tubes with 30 weight oil. Connect fuel lines to quick connect fittings. **Refer to Fuel Hoses, Clamps and Quick Connect Fittings in the Fuel Delivery Section of this Group**. After the fuel tubes are connected to the fittings, pull on the tubes to ensure that they are fully inserted and locked into position.

(3) Tighten the fuel tube clamp on the valve cover.

(4) Install return spring.

(5) Install throttle cable. If equipped, install kickdown and speed control cables.

(6) Install wiring connectors and vacuum hoses.

(7) Install air cleaner.

(8) Reconnect negative battery cable.

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.

(9) With the ignition key in ON position, access the DRBII scan tool ASD Fuel System Test to pressurize the fuel system. Check for leaks.

FUEL FITTING

REMOVAL

(1) Remove air cleaner assembly.

(2) Perform Fuel System Pressure Release procedure.

(3) Disconnect negative battery cable.

(4) Loosen fuel tube clamp on valve cover.

(5) Wipe any dirt from around quick connect fittings. (Fig. 5) Place a shop towel under the connections to catch any spilled fuel. Remove fuel tubes from quick connect fittings. **Refer to Fuel Hoses, Clamps and Quick Connect Fittings in the Fuel Delivery Section of this Group**.

(6) Remove each fitting from throttle body and note inlet diameter. Remove copper washers.

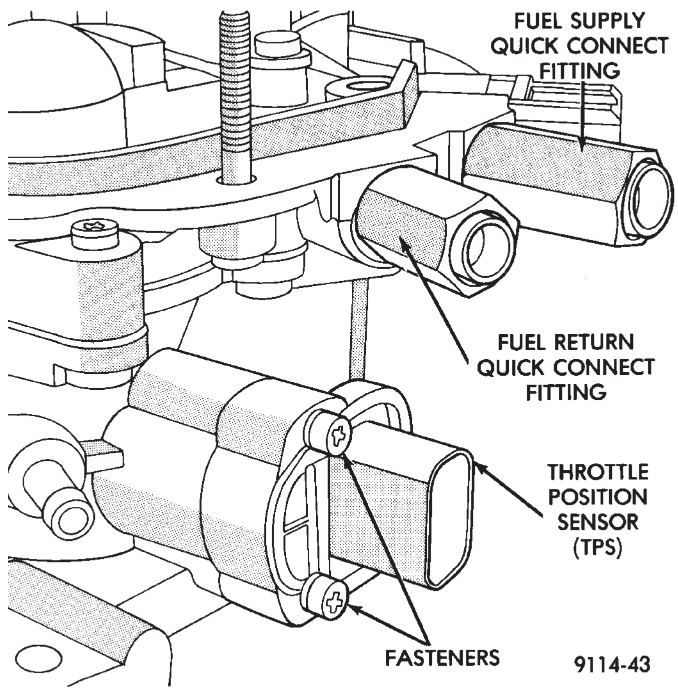


Fig. 5 Servicing Fuel Fitting

INSTALLATION

(1) Replace copper washers with new washers.

(2) Install fuel fittings in proper ports and tighten to 20 N●m (175 in. lbs.) torque.

(3) Lubricate ends of the fuel tubes with 30 weight oil. Insert the tubes into the quick connect fittings. **Refer to Fuel Hoses, Clamps and Quick Connect Fittings in the Fuel Delivery Section of this Group**. After the fuel tubes are connected to the fittings, pull on the tubes to ensure that they are fully inserted and locked into position.

(4) Tighten fuel tube clamp on valve cover.

(5) Reconnect negative battery cable.

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.

(6) With the ignition key in ON position, access the DRBII scan tool ASD Fuel System Test to pressurize the fuel system. Check for leaks.

(7) Reinstall air cleaner assembly.

FUEL PRESSURE REGULATOR

The fuel pressure regulator is mounted on top of the throttle body (Fig. 6).

REMOVAL

(1) Remove air cleaner assembly.

(2) Perform Fuel System Pressure Release procedure.

(3) Disconnect battery negative cable.

(4) Remove pressure regulator mounting screws (Fig. 6).

WARNING: PLACE A SHOP TOWEL AROUND FUEL INLET CHAMBER TO CONTAIN ANY FUEL REMAINING IN THE SYSTEM.

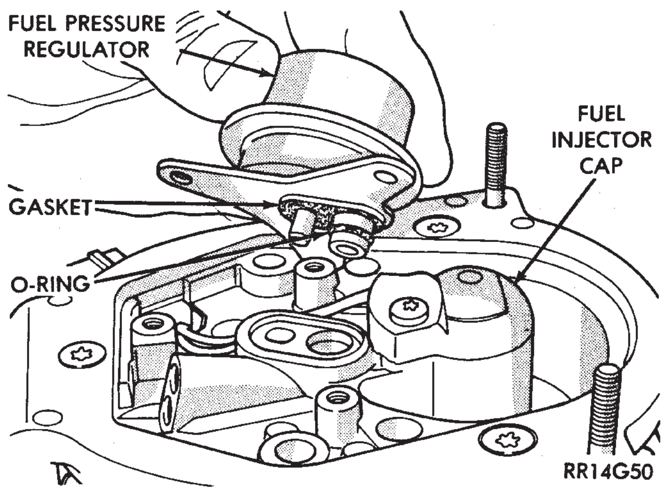


Fig. 6 Servicing Fuel Pressure Regulator

(5) Pull pressure regulator from the throttle body.

(6) Carefully remove O-ring from pressure regulator and remove gasket.

INSTALLATION

(1) Place new gasket on pressure regulator. Carefully install new O-ring.

(2) Position pressure regulator on throttle body. Press regulator into place and install mounting screws. Tighten screws to 5 N•m (40 in. lbs.) torque.

(3) 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.

(4) With the ignition key in ON position, access the DRBII scan tool ASD Fuel System Test to pressurize the fuel system. Check for leaks.

(5) Reinstall air cleaner assembly.

FUEL INJECTOR

The fuel injector is installed in the top of the throttle body. The injector is covered by a cap.

REMOVAL

(1) Remove air cleaner assembly.

(2) Perform Fuel System Pressure Release procedure.

(3) Disconnect negative cable from battery.

(4) Remove injector cap holddown screw (Torx-head).

(5) With two small screwdrivers, lift the top off the injector using the slots provided (Fig. 7).

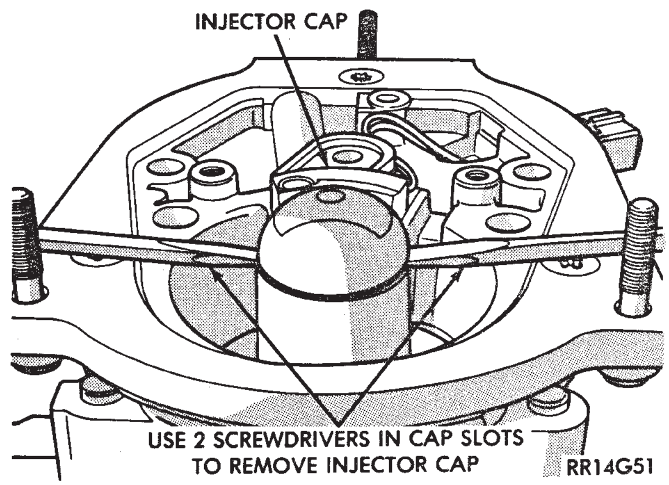


Fig. 7 Removing Injector Cap

(6) Using a small screwdriver placed in the hole in the front of the electrical connector, gently pry the injector from the pod (Fig. 8).

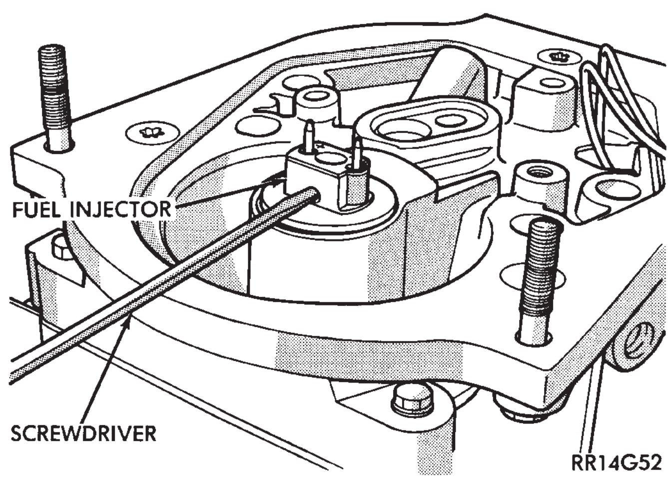


Fig. 8 Removing Fuel Injector

(7) Ensure the injector lower O-ring has been removed from the pod (Fig. 9).

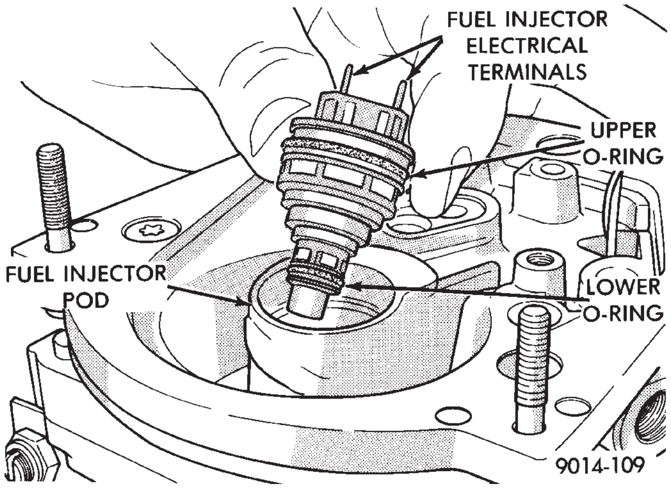


Fig. 9 Servicing Fuel Injector

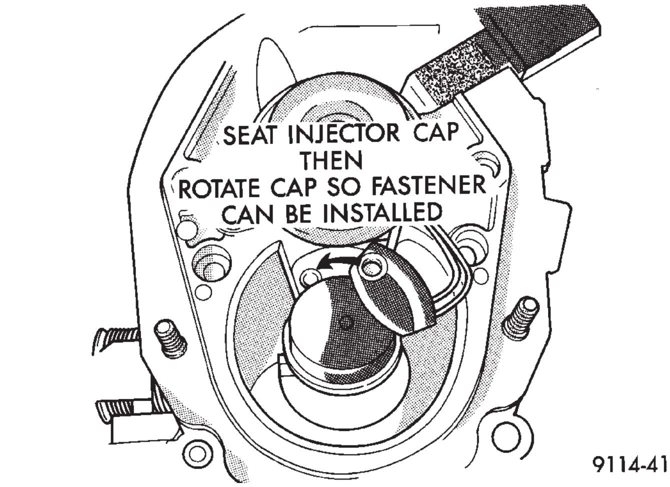


Fig. 11 Installing Fuel Injector Cap

INSTALLATION

(1) Place a new O-ring on the injector cap. The injector will have the upper and lower O-rings already installed (Fig. 9).

(2) Apply a light coating of clean engine oil on the O-rings.

(3) Place assembly in the pod. Align the injector wiring terminals with the injector cap fastener hole (Fig. 10).

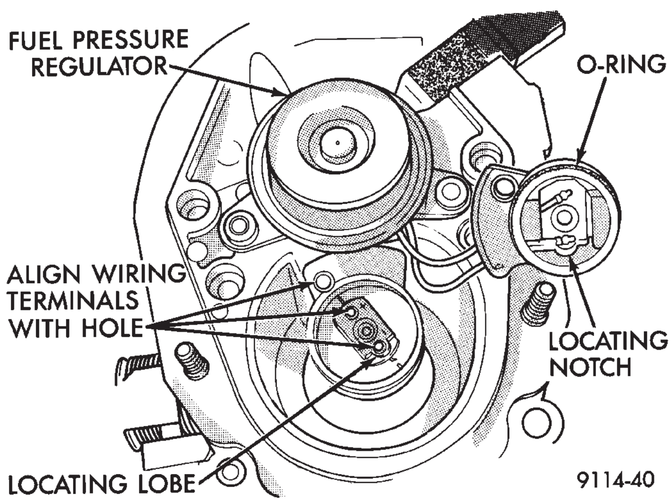


Fig. 10 Fuel Injector Installation

(4) Install injector cap with locating notch aligned with the locating lobe on the injector (Fig. 11).

(5) Push down on the cap to ensure a good seal.

(6) Rotate the cap and injector to line up the attachment hole (Fig. 12).

(7) Install injector cap holddown screw (torx-head screw). Tighten screw to 4-5 N●m (35-45 in. lbs.) torque.

(8) 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.

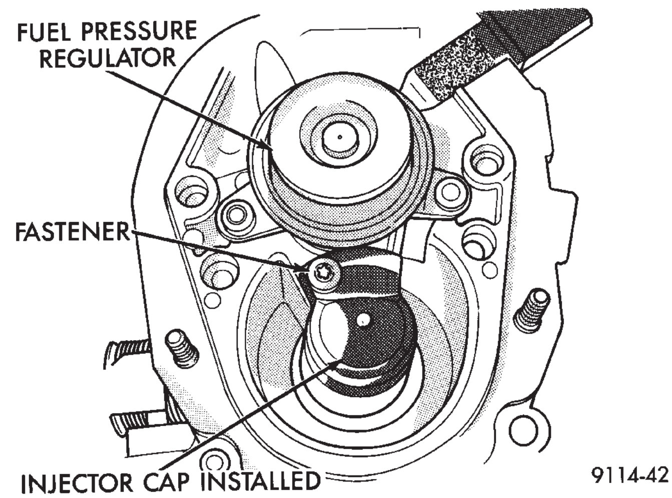


Fig. 12 Fuel Injector Installed

(9) With the ignition key in ON position, access the DRBII scan tool ASD Fuel System Test to pressurize the fuel system. Check for leaks.

(10) Reinstall the air cleaner assembly.

THROTTLE POSITION SENSOR

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove air cleaner.

(3) Disconnect harness connector from throttle position sensor (Fig. 13).

(4) Remove throttle position sensor mounting screws.

(5) Remove throttle position sensor from throttle shaft.

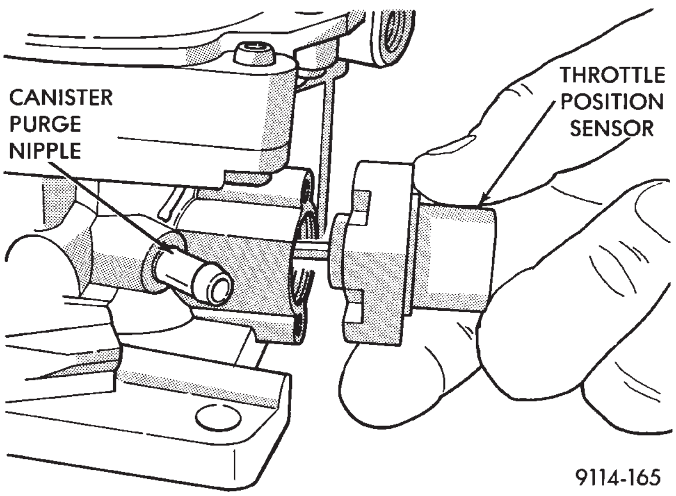


Fig. 13 Servicing Throttle Position Sensor

INSTALLATION

(1) Install throttle position sensor to throttle body, position toward the front of the vehicle. Tighten screws to 2 N●m (20 in. lbs.) torque.

(2) Connect harness connector to throttle position sensor.

(3) Install air cleaner.

(4) Connect negative cable to battery.

IDLE AIR CONTROL MOTOR

The idle air control motor is mounted on the throttle body (Fig. 14).

REMOVAL

(1) Remove air cleaner.

(2) Disconnect negative cable from battery.

(3) Disconnect idle air control motor connector.

(4) Remove idle air control motor mounting screws (Torx head screws, 25 mm long).

(5) Remove motor from throttle body housing. Ensure O-ring is removed with motor (Fig. 14).

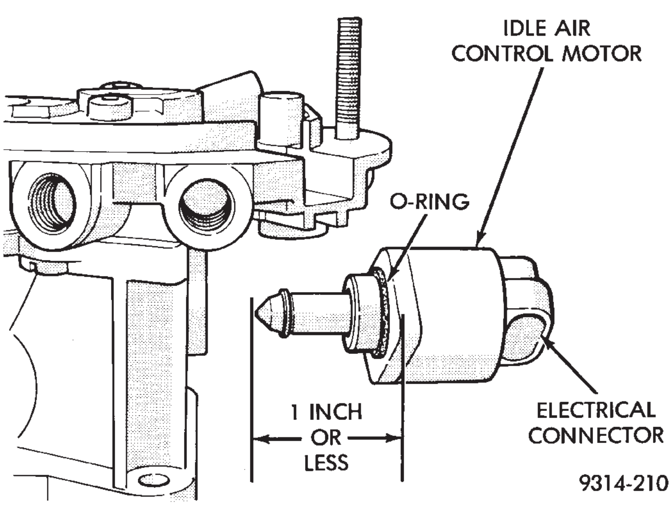


Fig. 14 Servicing Idle Air Control Motor

INSTALLATION

(1) Ensure idle air control motor pintle is in the retracted position. **If pintle measures more than 1 inch (25 mm)** as shown in Fig. 14, it must be retracted. Use the DRBII scan tool Actuate Outputs Test, Idle Air Control Motor OPEN/CLOSE (battery must be connected for this operation).

(2) Install new O-ring on idle air control motor.

(3) Install motor into housing, ensuring the O-ring is in place.

(4) Tighten mounting screws to 2 N●m (20 in. lbs.) torque.

(5) Connect harness electrical connector to idle air control motor.

(6) Connect negative cable to battery.

MANIFOLD ABSOLUTE PRESSURE SENSOR

The MAP sensor is mounted underhood on the dash panel (Fig. 15).

REMOVAL

(1) Remove vacuum hose and electrical connector from sensor (Fig. 15).

(2) Remove sensor mounting screws. Remove sensor.

(3) Reverse the above procedure for installation. Check the vacuum hose and electrical connections to the sensor.

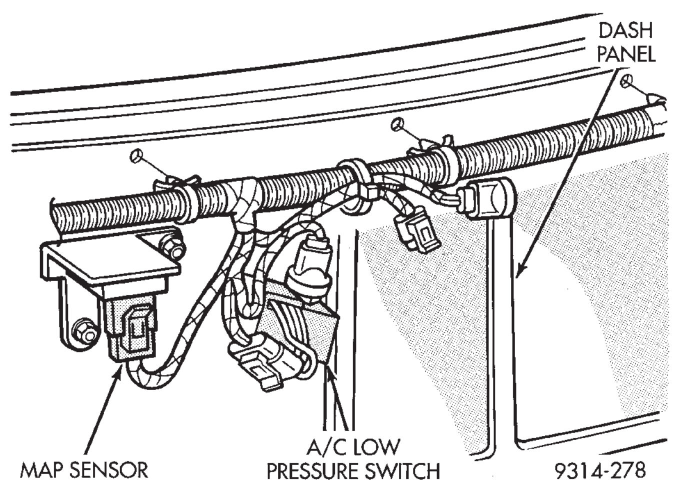


Fig. 15 Manifold Absolute Pressure (MAP) Sensor

CANISTER PURGE SOLENOID

(1) Remove vacuum hose and electrical connector from solenoid (Fig. 16).

(2) Depress tab on top of solenoid and slide the solenoid downward out of mounting bracket.

(3) Reverse the above procedure for installation.

POWERTRAIN CONTROL MODULE (PCM)

The powertrain control module (PCM) is mounted underhood on the drivers side inner fender panel.

(1) Remove air cleaner duct from PCM.

(2) Remove battery.

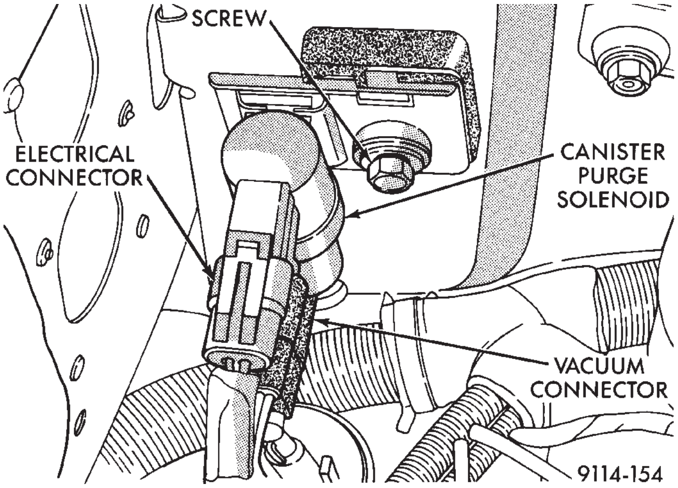


Fig. 16 Canister Purge Solenoid

(3) Remove PCM mounting screws (Fig. 17).

(4) Remove electrical connector from PCM. Remove PCM.

(5) Reverse the above procedure for installation.

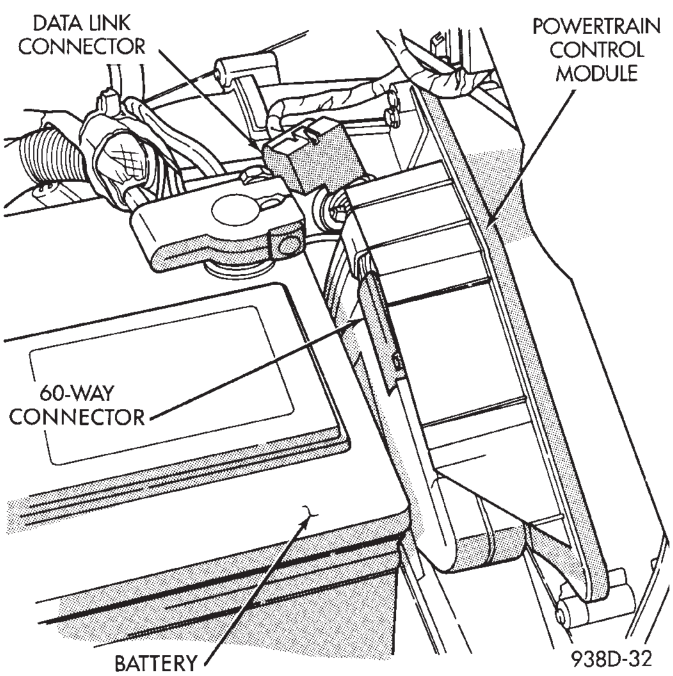


Fig. 17 Powertrain control module (PCM)

HEATED OXYGEN SENSOR (O_2 SENSOR)

The oxygen sensor is installed in the exhaust manifold (Fig. 18).

CAUTION: Do not pull on the oxygen sensor wire when disconnecting the electrical connector.

WARNING: THE EXHAUST MANIFOLD MAY BE EXTREMELY HOT. USE CARE WHEN SERVICING THE OXYGEN SENSOR.

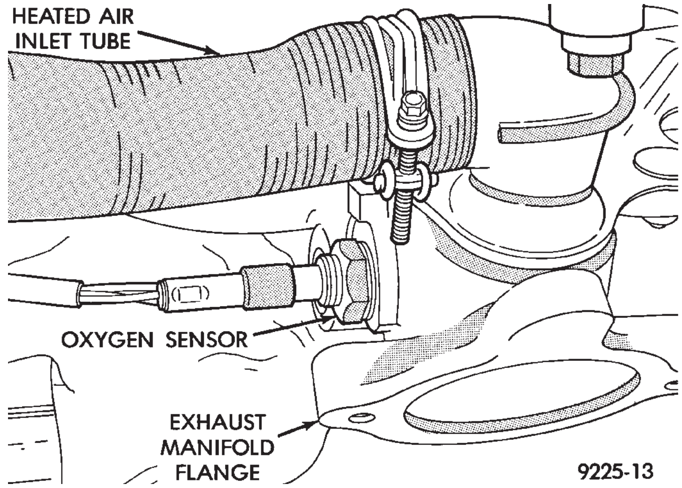


Fig. 18 Heated Oxygen Sensor

(1) Disconnect oxygen sensor electrical connector (Fig. 19).

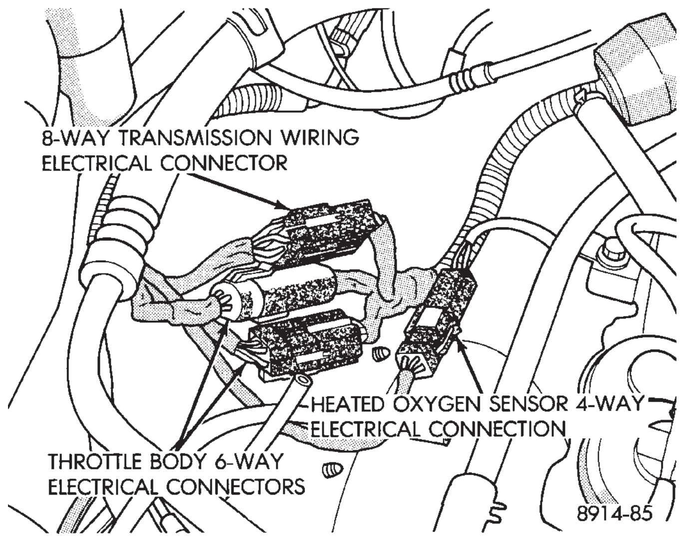


Fig. 19 Oxygen Sensor Electrical Connection

(2) Remove sensor using Tool C-4907 (Fig. 20).

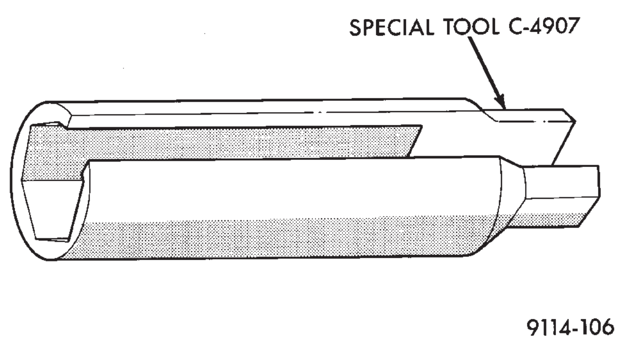


Fig. 20 Oxygen Sensor Socket

When the sensor is removed, the exhaust manifold threads must be cleaned with an 18 mm X 1.5 + 6E tap. If using original sensor, coat the threads with Loctite 771-64 anti-seize compound or equivalent. New sensors are packaged with compound on the threads and no additional compound is required. The sensor must be tightened to 27 N●m (20 ft. lbs.) torque.

3.0L MULTI-PORT FUEL INJECTION—SYSTEM OPERATION

INDEX

GENERAL INFORMATION

The 3.0L engine uses a sequential Multi-port Electronic Fuel Injection system (Fig. 1). The MPI system is computer regulated and provides precise air/fuel ratios for all driving conditions.The MPI system is operated by the powertrain control module (PCM).

The powertrain control module (PCM) regulates ignition timing, air-fuel ratio, emission control devices, cooling fan, charging system, idle speed and 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. 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.

SYSTEM DIAGNOSIS

The powertrain control module (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 in memory.

Technicians can display stored diagnostic trouble codes by two different methods. The first is to cycle the ignition switch On - Off - On - Off - On within 5 seconds. Then count the number of times the malfunction indicator lamp (check engine lamp) on the instrument panel flashes on and off. The number of flashes represents the trouble code. There is a slight pause between the flashes representing the first and second digits of the code. Longer pauses separate individual trouble codes.

The second method of reading diagnostic trouble codes uses the DRBII scan tool. For diagnostic trouble code information, refer to the 3.0L Multi-Port Fuel Injection—On-Board Diagnostics section in this group.

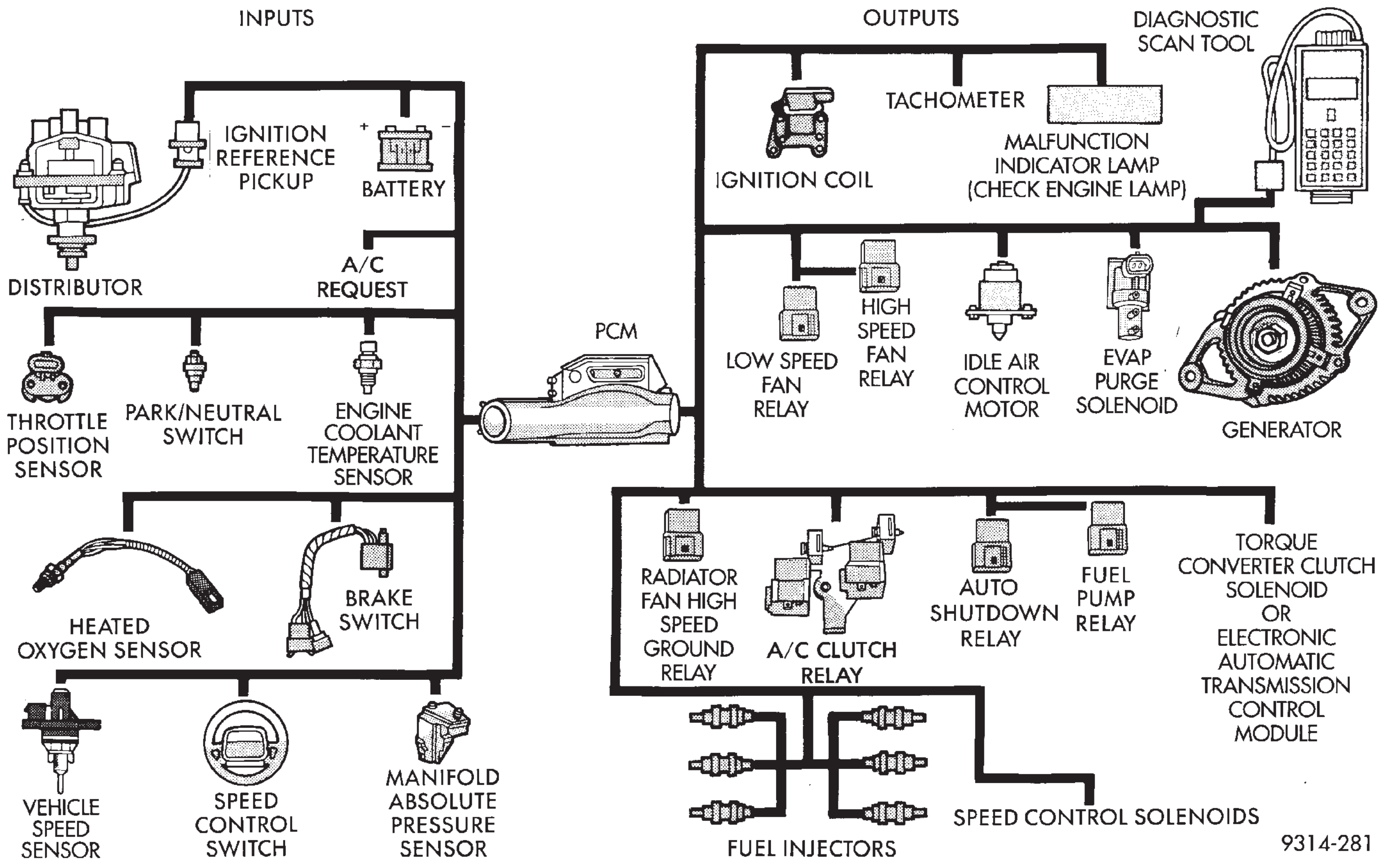


Fig. 1 Multi-Port Fuel Injection Components

CCD BUS

Various controllers and modules exchange information through a communications port called the CCD Bus. The PCM transmits the malfunction indicator lamp (check engine lamp) On/Off signal, engine RPM and vehicle load data on the CCD Bus.

POWERTRAIN CONTROL MODULE (PCM)

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

PCM Inputs:

- Air Conditioning Controls
- Battery Voltage
- Brake Switch
- Coolant Temperature Sensor
- Distributor Pick-up
- Manifold Absolute Pressure (MAP) Sensor
- Oxygen Sensor
- SCI Receive
- Speed Control System Controls
- Throttle Position Sensor
- Park/Neutral Switch (automatic transmission)
- Vehicle Speed Sensor

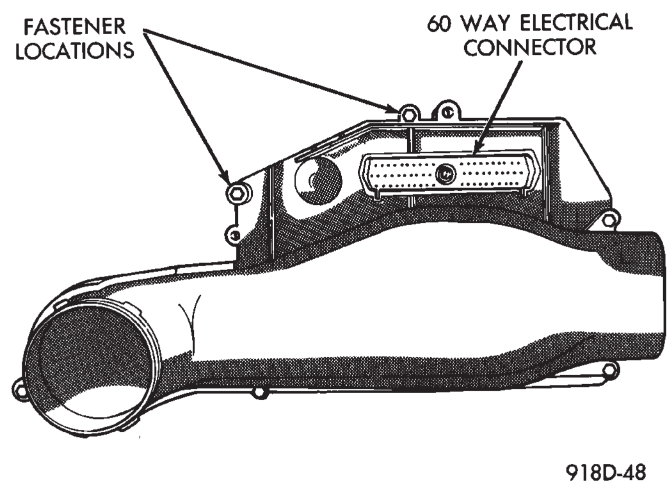


Fig. 2 Powertrain control module (PCM)

PCM Outputs:

- Air Conditioning Clutch Relay
- Generator Field
- Idle Air Control Motor
- Auto Shutdown (ASD) and Fuel Pump Relays
- Duty Cycle EVAP Purge Solenoid
- Malfunction Indicator (Check Engine) Lamp
- Data Link Connector
- Electric EGR Transducer (EET)
- Fuel Injectors
- Ignition Coil

- Torque Converter Clutch Solenoid
- Radiator Fan Low Speed Relay
- Radiator Fan High Speed Relays
- Speed Control Solenoids
- Tachometer Output

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

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

- battery voltage
- coolant temperature
- exhaust gas content
- engine speed (distributor pick-up)
- manifold absolute pressure
- throttle position

The PCM adjusts ignition timing based on the following inputs.

- coolant temperature
- engine speed (distributor pick-up)
- manifold absolute pressure
- throttle position

The Automatic Shut Down (ASD) and Fuel Pump relays are mounted externally, but turned on and off by the PCM through the same circuit.

The distributor pick-up signal is sent to the PCM. If the PCM does not receive a distributor signal within approximately one second of engine cranking, the ASD relay and fuel pump relay are deactivated. When these relays are deactivated, power is shut off to the fuel injector, ignition coil, oxygen sensor heating element and fuel pump.

The PCM contains a voltage converter that changes battery voltage to a regulated 9.0 volts to power the distributor pick-up and vehicle speed sensor. The PCM also provides a 5.0 volts supply for the manifold absolute pressure sensor and throttle position sensor.

AIR CONDITIONING SWITCH SENSE—PCM INPUT

When the air conditioning or defrost switch is put in the ON position and the low pressure switch, combination valve and high pressure switch close, the PCM receives an A/C input. After receiving this input, the PCM activates the A/C compressor clutch by grounding the A/C clutch relay. The PCM also adjusts idle speed to a scheduled RPM to compensate for increased engine load.

BATTERY VOLTAGE—PCM INPUT

The powertrain control module (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).

BRAKE SWITCH—PCM INPUT

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

COOLANT TEMPERATURE SENSOR—PCM INPUT

The coolant temperature sensor is a variable resistor with a range of -40° F to 265° F. The sensor is installed next to the thermostat housing.

The coolant temperature sensor provides an input voltage to the powertrain control module (PCM) (Fig. 3). As coolant temperature varies the coolant temperature sensors 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.

This sensor is also used for cooling fan control.

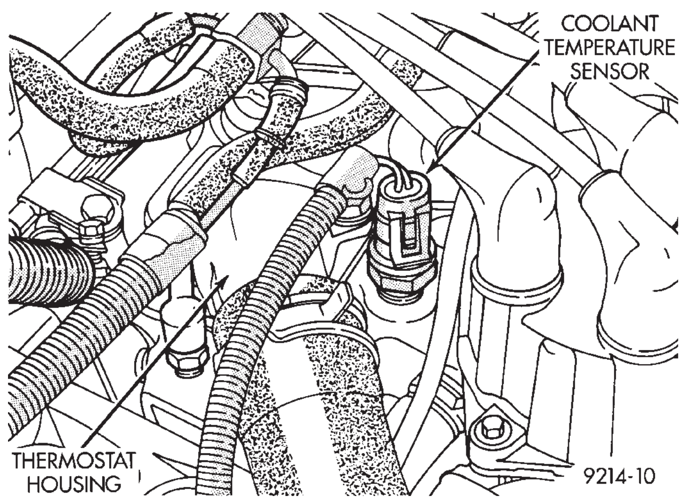


Fig. 3 Coolant Temperature Sensor

DISTRIBUTOR PICK-UP—PCM INPUT

The distributor pick-up provides two inputs to the powertrain control module (PCM). From one input the PCM determines RPM (engine speed). From the other input it derives crankshaft position. The PCM regulates injector synchronization and adjusts ignition timing and engine speed based on these inputs.

The distributor pick-up contains two signal generators. The pick-up unit consists of 2 light emitting diodes (LED), 2 photo diodes, and a separate timing disk. The timing disk contains two sets of slots. Each set of slots rotates between a light emitting diode and a photo diode (Fig. 4). The inner set contains 6 large slots, one for each cylinder. The outer set contains several smaller slots.

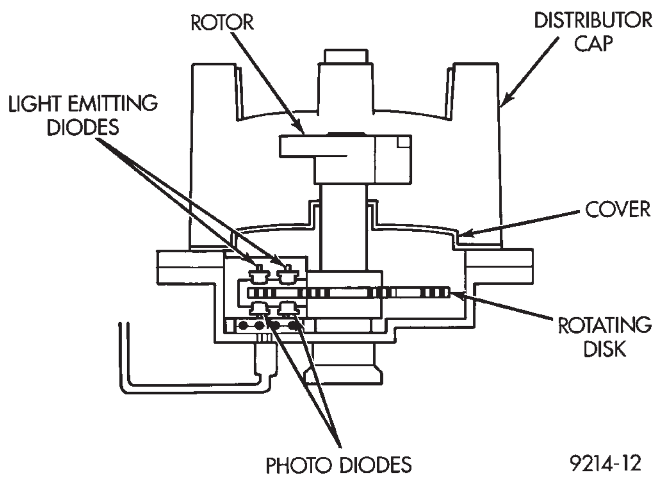


Fig. 4 Distributor Pick-up

The outer set of slots on the rotating disk represents 2 degrees of crankshaft rotation. Up to 1200 engine RPM, the PCM uses the input from the outer set of slots to increase ignition timing accuracy.

The outer set of slots contains a 10 degree flat spot. This area is not slotted (Fig. 5). The flat spot tells the PCM that the next piston at TDC will be number 6. The position of each piston is referenced by one of the six inner slots (Fig. 5).

As each slot on the timing disk passes between the diodes, the beam from the light emitting diode is interrupted. This creates an alternating voltage in each photo diode which is converted into on-off pulses. The pulses are the input to the PCM.

During cranking, the PCM cannot determine crankshaft position until the 10 degree flat spot on the outer set of slots passes through the optical unit. Once the flat spot is detected, the PCM knows piston in cylinder number 6 will be the next piston at TDC.

Since the disk rotates at half crankshaft speed, it may take 2 engine revolutions during cranking for the PCM to determine the position of piston number 6. For this reason the PCM will energize all six injectors at the same time until it senses the position of piston number 6.

MANIFOLD ABSOLUTE PRESSURE (MAP) 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

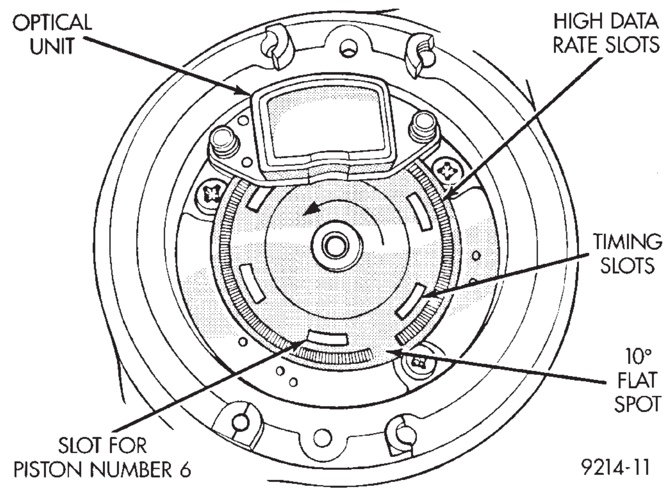


Fig. 5 Inner and Outer Slots of Rotating Disk—3.0L Engine

the MAP sensor voltage. While the engine operates, the PCM determines intake manifold pressure from the MAP sensor voltage.

Based on MAP sensor voltage and inputs from other sensors, the PCM adjusts spark advance and the air/fuel mixture.

The MAP sensor (Fig. 6) mounts on a bracket attached to the generator bracket. The sensor is connected to the intake manifold with a vacuum hose and to the PCM electrically.

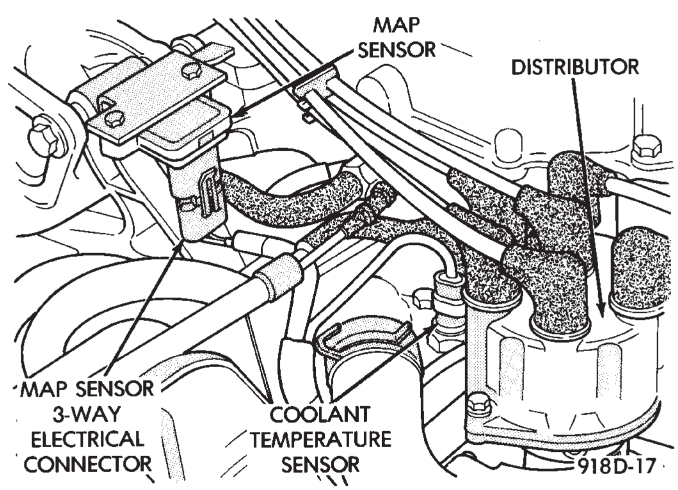


Fig. 6 Map Sensor

HEATED OXYGEN SENSOR (O_2 SENSOR)—PCM INPUT

The O_2 sensor is located in the exhaust manifold and provides an input voltage to the powertrain control module (PCM). The input tells the PCM the oxygen content of the exhaust gas (Fig. 7). The PCM uses this information to fine tune the air-fuel ratio by adjusting injector pulse width.

The O_2 sensor produces voltages from 0 to 1 volt, depending upon the oxygen content of the exhaust gas in the exhaust manifold. When a large amount of

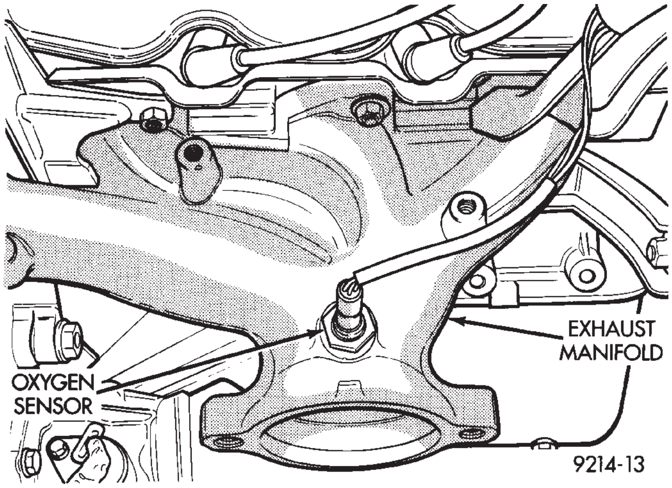


Fig. 7 Oxygen Sensor—3.0L Engine

oxygen is present (caused by a lean air-fuel mixture), the sensor 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 sensor acts as a rich-lean switch.

The oxygen sensor is equipped with a heating element that keeps the sensor 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 allow the system to remain in closed loop operation during periods of extended idle.

In "Closed Loop" operation the PCM monitors the O_2 sensor input (along with other inputs) and adjusts the injector pulse width accordingly. During "Open Loop" operation the PCM ignores the O_2 sensor input. The PCM adjusts injector pulse width based on preprogrammed (fixed) values and from inputs of other sensors.

SPEED CONTROL—PCM INPUT

The speed control system provides four separate voltages (inputs) to the powertrain control module (PCM). The voltages correspond to the On/Off, Set, and Resume.

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 Off voltage tells the PCM that the speed control system has deactivated. Refer to Group 8H for further speed control information.

TRANSAXLE PARK/NEUTRAL SWITCH—PCM INPUT

The park/neutral switch is located on the transaxle housing (Fig. 8 or Fig. 9). It provides an input to the powertrain control module (PCM) indicating whether the automatic transmission is in Park, Neutral, or a drive gear selection. This input is used to determine idle speed (varying with gear selection), fuel injector pulse width, and ignition timing advance. The park/neutral switch is sometimes referred to as the neutral safety switch.

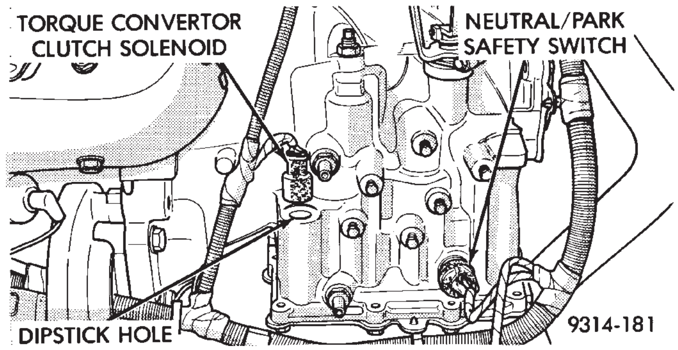


Fig. 8 Park Neutral Switch—3-Speed Automatic Transaxle

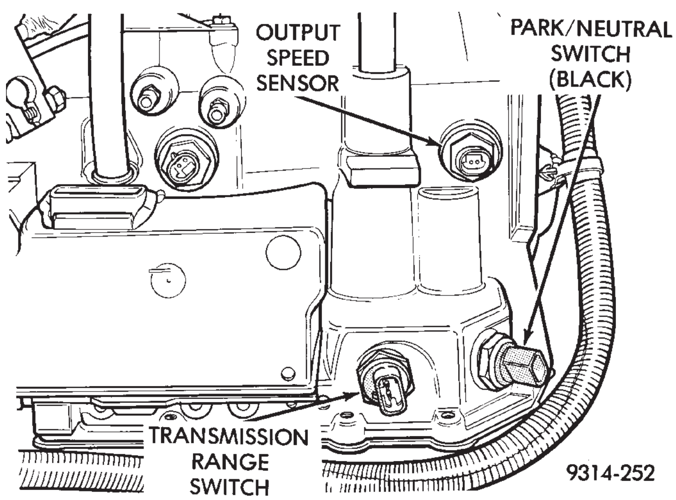


Fig. 9 Park Neutral Switch—4-Speed Electronic Automatic Transaxle

THROTTLE POSITION SENSOR (TPS)—PCM INPUT

The Throttle Position Sensor (TPS) is mounted on the throttle body and connected to the throttle blade shaft (Fig. 10). The TPS is a variable resistor that provides the powertrain control module (PCM) with an input signal (voltage) representing 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 PCM) represents throttle blade position. The TPS output voltage to the PCM varies from approximately 0.5 volt at minimum throttle opening (idle) to 3.5 volts at wide open throttle. The wide open throttle input is approximately 3 volts more than the minimum throttle opening value.

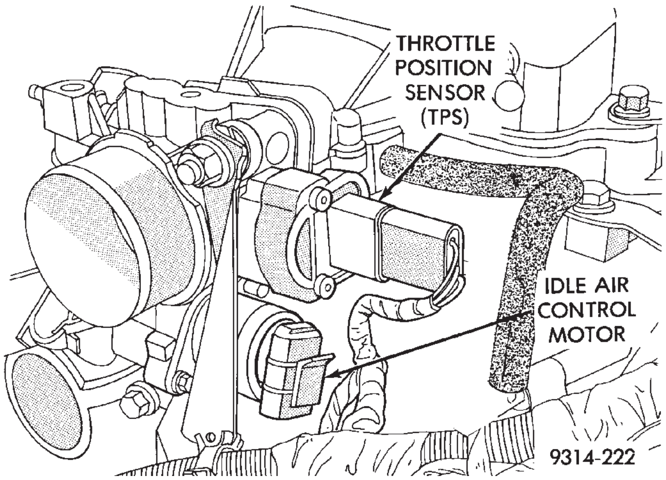


Fig. 10 Throttle Position Sensor

Along with inputs from other sensors, the PCM uses the TPS input to determine current engine operating conditions. After determining the current operating conditions, the PCM adjust fuel injector pulse width and ignition timing.

VEHICLE SPEED SENSOR—PCM INPUT

Vehicles with 3 speed automatic transaxles use vehicle speed sensors. The vehicle speed sensor (Fig. 11) is located on the extension housing. The sensor input is used by the PCM to determine vehicle speed and distance traveled.

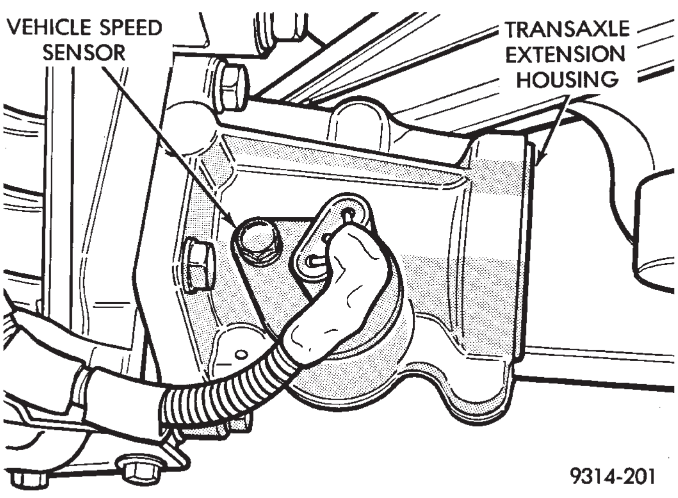


Fig. 11 Vehicle Speed Sensor

The vehicle speed sensor generates 8 pulses per sensor revolution. These signals, along with a closed throttle signal from the TPS, determine if a closed throttle deceleration or normal idle condition (vehicle stopped) exists. Under deceleration conditions, the PCM adjusts the idle air control motor to maintain a desired MAP value. Under idle conditions, the PCM adjusts the idle air control motor to maintain a desired engine speed.

VEHICLE SPEED AND DISTANCE INPUT—PCM INPUT

On vehicles equipped with an electronic transaxle (41TE), the transaxle output speed sensor supplies the vehicle speed and distance inputs to the PCM. The output speed sensor is located on the side of the transaxle (Fig. 9).

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

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

The powertrain control module (PCM) operates the air conditioning clutch relay ground circuit (Fig. 12). The low speed fan relay supplies battery power to the solenoid side of the relay. The air conditioning clutch relay will not energize unless the low speed radiator fan low speed relay energizes. The radiator fan low speed relay energizes when the air conditioning or defrost switch is put in the ON position and the low pressure, combination valve, and high pressure switches close.

With the engine operating, the PCM cycles the air conditioning clutch on and off when the A/C switch closes with the blower motor switch in the on position. When the PCM senses low idle speeds or wide open throttle through the throttle position sensor, it de-energizes the A/C clutch relay. The relay contacts open, preventing air conditioning clutch engagement.

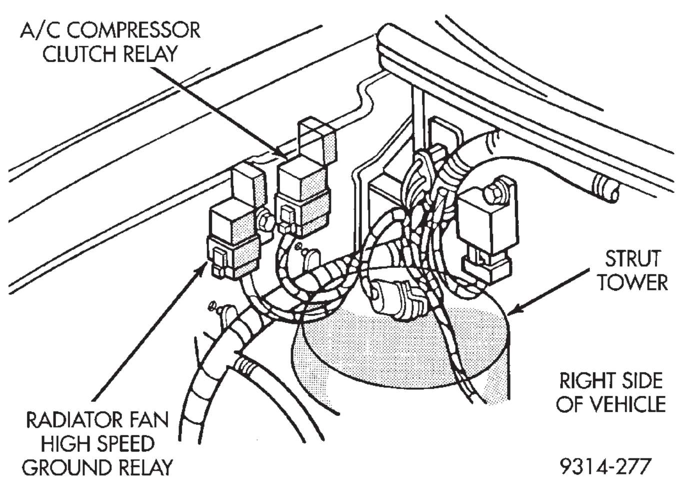


Fig. 12 Relay Identification

GENERATOR FIELD—PCM OUTPUT

The powertrain control module (PCM) regulates the charging system voltage within a range of 12.9 to 15.0 volts. Refer to Group 8A for charging system information.

AUTO SHUTDOWN (ASD) RELAY AND FUEL PUMP RELAY—PCM OUTPUT

The powertrain control module (PCM) operates the auto shutdown (ASD) relay and fuel pump relay through one ground path. The PCM operates the relays by switching the ground path on and off. Both relays turn on and off at the same time.

The ASD relay connects battery voltage to the fuel injector and ignition coil. The fuel pump relay connects battery voltage to the fuel pump and oxygen sensor heating element.

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 distributor pick-up signal to determine engine speed and ignition timing (coil dwell). If the PCM does not receive a distributor signal when the ignition switch is in the Run position, it will de-energize both relays. When the relays are de-energized, battery voltage is not supplied to the fuel injector, ignition coil, fuel pump and oxygen sensor heating element.

The ASD relay and fuel pump relay are mounted on the drivers side fender well, near to the PCM (Fig. 13).

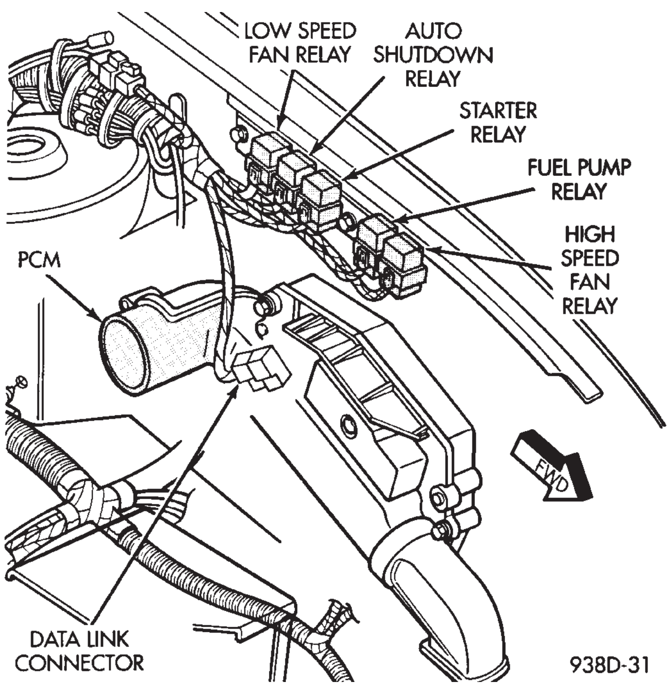


Fig. 13 Auto Shutdown Relay

IDLE AIR CONTROL MOTOR—PCM OUTPUT

The idle air control motor is mounted on the throttle body and is controlled by the powertrain control module (PCM) (Fig. 10). The PCM adjusts engine idle speed through the idle air control motor to compensate for engine load or ambient conditions.

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.

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 are from the throttle position sensor, engine speed sensor (distributor pick-up coil), coolant temperature sensor, and various switch operations (brake, park/neutral, air conditioning). Deceleration die out is also prevented by increasing airflow when the throttle is closed quickly after a driving (speed) condition.

DUTY CYCLE EVAP CANISTER PURGE SOLENOID—PCM OUTPUT

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

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

The engine enters closed loop operation after it reaches a specified temperature and the time delay ends. During closed loop operation, the PCM energizes and de-energizes the solenoid approximately 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 energizes.

A rubber boot covers the EVAP purge solenoid. The solenoid and bracket attach to the EVAP canister mounting studs (Fig. 14). The top of the solenoid has the word TOP on it. The solenoid will not operate unless it is installed correctly.

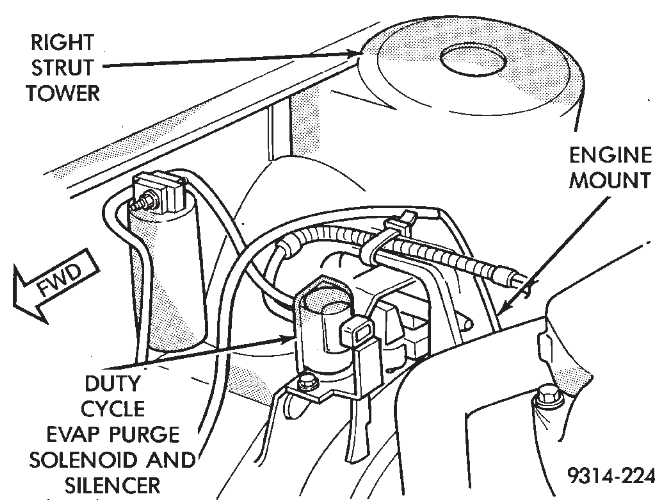


Fig. 14 Duty Cycle EVAP Purge Solenoid

MALFUNCTION INDICATOR (CHECK ENGINE) LAMP—PCM OUTPUT

The powertrain control module (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 malfunction indicator 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 warns the operator that the PCM has entered a Limp-in mode. During Limp-in-Mode, the PCM attempts to keep the system operational. The malfunction indicator lamp 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.

Signals that can trigger the malfunction indicator (Check Engine) Lamp.

- Coolant Temperature Sensor
- Manifold Absolute Pressure Sensor
- Throttle Position Sensor
- Battery Voltage Input
- An Emissions Related System
- Charging system

The malfunction indicator lamp can also be used to display diagnostic trouble codes. Cycle the ignition switch on, off, on, off, on, within five seconds and any diagnostic trouble codes stored in the PCM will be displayed. For Diagnostic Trouble Code Descriptions refer to 2.5L Single Point Fuel Injection—On-Board Diagnostics section of this group.

DATA LINK CONNECTOR—PCM OUTPUT

The data link connector provides the technician with the means to connect the DRBII scan tool to diagnosis the vehicle.

ELECTRONIC AUTOMATIC TRANSMISSION CONTROLLER—PCM OUTPUT

The Electronic Automatic Transmission Controller and the Powertrain control module (PCM) supply information to each other through the CCD Bus. The information includes engine speed and vehicle load. The PCM uses the information when adjusting the fuel and ignition strategy.

FUEL INJECTORS—PCM OUTPUT

The fuel injectors are electrical solenoids (Fig. 15). 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 pintle 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.

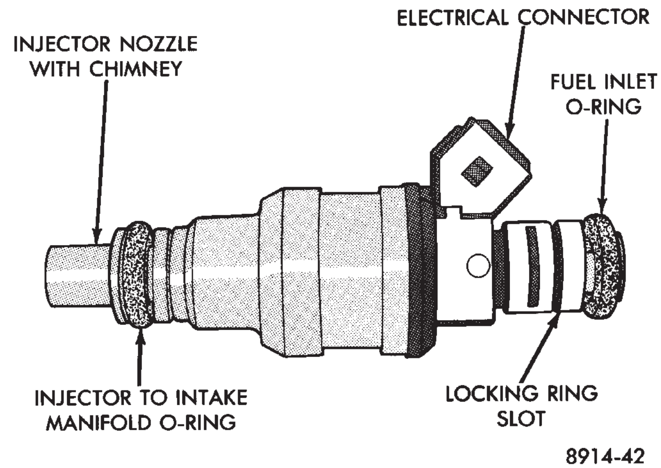


Fig. 15 Fuel Injector—3.0L Engine

The injectors are positioned in the intake manifold with the nozzle ends directly above the intake valve port (Fig. 16).

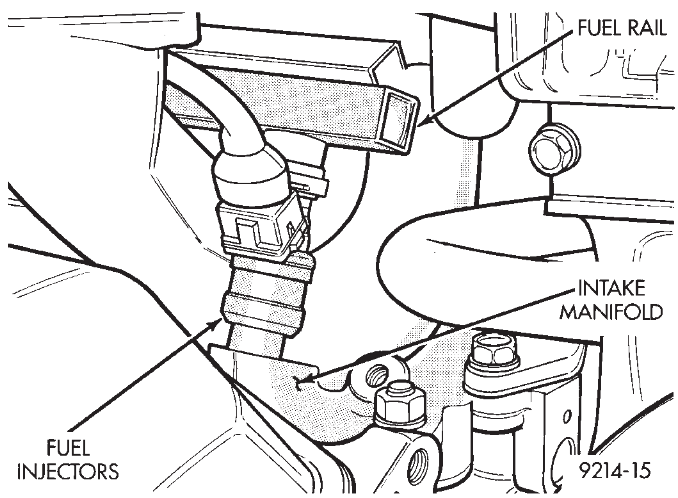


Fig. 16 Fuel Injector Location

The fuel injectors are operated by the PCM. They are energized in a sequential order during all engine operating conditions except start up. The PCM initially energizes all injectors at the same time. Once the PCM determines crankshaft position, it begins energizing the injectors in sequence.

Battery voltage is supplied to the injectors through the ASD relay. The PCM provides the ground path for the injectors. By switching the ground path on and off, the PCM adjusts injector pulse width. Pulse width is the amount of time the injector is energized. The PCM adjusts injector pulse width based on inputs it receives.

IGNITION COIL—PCM OUTPUT

The auto shutdown (ASD) relay provides battery voltage to the ignition coil. The powertrain control module (PCM) provides a ground contact (circuit) for energizing 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 an input from the distributor pick-up. Refer to Auto Shutdown (ASD) Relay/Fuel Pump Relay—PCM Output in this section for relay operation.

The auto shutdown (ASD) relay supplies battery voltage to the positive terminal of the ignition coil. The PCM de-energizes the ASD relay if it does not receive an input from the distributor pick-up. Refer to "Auto Shutdown (ASD) Relay—PCM Output" in this section for relay operation.

The ignition coil is mounted on a bracket next to the air cleaner (Fig. 17).

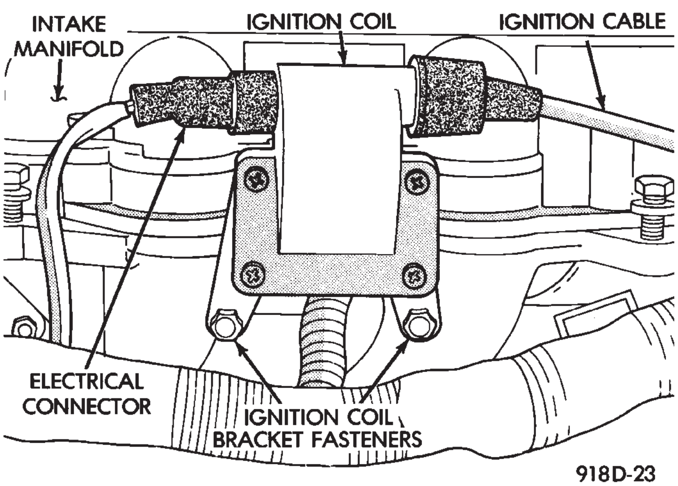


Fig. 17 Ignition Coil

TORQUE CONVERTER CLUTCH SOLENOID—PCM OUTPUT

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

RADIATOR FAN RELAYS—PCM OUTPUT

The radiator fan runs at either low or high speed depending on coolant temperature and A/C system pressure. The radiator fan circuit contains three relays; a low speed relay, high speed relay and a ground relay for high speed operation. Refer to the Group 8W for a circuit schematic.

When the PCM provides a ground for the low speed relay, the radiator fan operates at the lower speed. The PCM does not control the ground circuit for low speed operation.

The PCM controls the ground and power supply for the high speed circuits. When the PCM senses the need for high speed operation, it grounds the high speed relay and high speed ground relay.

When engine coolant reaches approximately 102°C (215°F) the PCM grounds the low speed relay. If engine coolant reaches 107°C (225°F) the PCM grounds the high speed ground relay and high speed fan relay. If the fan operates at high speed, the PCM de-engerizes the high speed relay and high speed ground relay when coolant temperature drops to approximately 101°C (214°F). When coolant temperature drops to 101°C (214°F) the fan operates at low speed. The PCM de-engerizes the low speed relay when coolant temperature drops to approximately 93°C (199°F).

Additionally, when the air conditioning pressure switch closes, the fan operates at high speed. The air conditioning switch closes at 285 PSI ±10 PSI. When air conditioning pressure drops approximately 40 PSI, the pressure switch closes and the fan operates at low speed.

The radiator fan low speed relay and high speed relay mount to the inner fender panel above the powertrain control module (Fig. 13). The high speed ground relay is located on the right side fender panelk near the strut tower (Fig. 18)

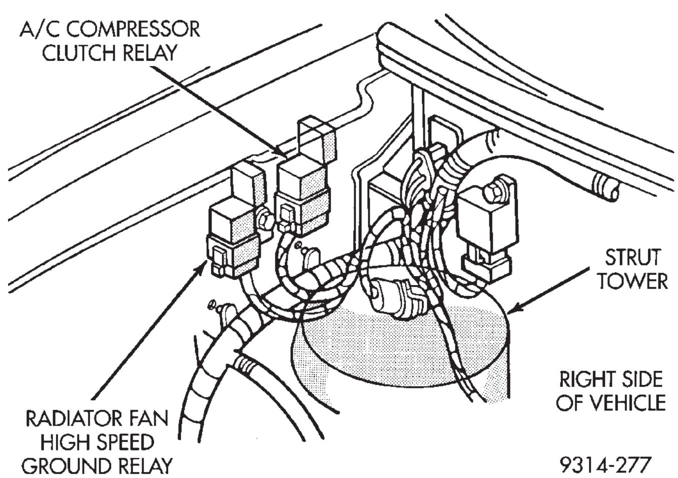


Fig. 18 High Speed Ground Relay and A/C Compressor Clutch Relay

SPEED CONTROL SOLENOIDS—PCM OUTPUT

The speed control vacuum and vent solenoids are operated by the powertrain control module (PCM). When the PCM supplies a ground to the vacuum and vent solenoids, the speed control system opens the throttle plate. When the PCM removes the ground from the vacuum and vent solenoids, the throttle blade closes. The PCM balances the two solenoids to maintain the set speed. Refer to Group 8H for speed control information.

TACHOMETER—PCM OUTPUT

The powertrain control module (PCM) supplies engine RPM to the instrument panel tachometer through the CCD Bus. The CCD Bus is a communications port. Various modules use the CCD Bus to exchange information. Refer to Group 8E for more information.

MODES OF OPERATION

As input signals to the powertrain control module (PCM) change, (PCM) adjusts its response to the output devices. For example, the PCM must calculate a different injector pulse width and ignition timing for idle than 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. Input from the oxygen (O_2) sensor is not monitored during OPEN LOOP modes.

During CLOSED LOOP modes the PCM does monitor the oxygen (O_2) sensor input. This input indicates to the PCM whether or not the calculated injector pulse width results in the ideal air-fuel ratio of 14.7 parts air to 1 part fuel. By monitoring the exhaust oxygen content through the O_2 sensor, the PCM can fine tune the injector pulse width. Fine tuning injector pulse width allows the PCM to achieve optimum fuel economy combined with low emissions.

The 3.0L sequential MPI system 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

The engine start-up (crank), engine warm-up, and wide open throttle modes are OPEN LOOP modes. The acceleration, deceleration, and cruise modes, **with the engine at operating temperature** are CLOSED LOOP modes (under most operating conditions).

IGNITION SWITCH ON (ZERO RPM) MODE

When the multi-port fuel injection system is activated by the ignition switch, the following actions occur:

- The powertrain control module (PCM) determines atmospheric air pressure from the MAP sensor input to determine basic fuel strategy.
- The PCM monitors the coolant temperature sensor and throttle position sensor input. The PCM modifies fuel strategy based on these inputs.

When the key is in the ON position and the engine is not running (zero rpm), the auto shutdown (ASD) relay and fuel pump relay are not energized. Therefore battery voltage is not supplied to the fuel pump, ignition coil, fuel injectors or oxygen sensor heating element.

ENGINE START-UP MODE

This is an OPEN LOOP mode. The following actions occur when the starter motor is engaged.

If the PCM receives a distributor signal, it energizes the auto shutdown (ASD) relay and fuel pump relay. These relays supply battery voltage to the fuel pump, fuel injectors, ignition coil, and oxygen sensor heating element. If the PCM does not receive a distributor input, the ASD relay and fuel pump relay will be de-energized after approximately one second.

The PCM energizes all six injectors until it determines crankshaft position from the distributor pick-up signals. The PCM determines crankshaft position within 2 engine revolutions.

Once crankshaft position is determined, the PCM begins energizing the injectors in sequence. The PCM 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 coolant temperature, manifold absolute pressure (MAP) and the number of engine revolutions since cranking was initiated.
- Monitors the coolant temperature sensor, distributor pick-up, MAP sensor, and throttle position sensor to determine correct ignition timing.

ENGINE WARM-UP MODE

This is a OPEN LOOP mode. The following inputs are received by the powertrain control module (PCM):

- coolant temperature
- crankshaft position (distributor pick-up)
- manifold absolute pressure (MAP)
- engine speed (distributor pick-up)
- throttle position
- A/C switch
- battery voltage

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 by regulating the idle air control motor and ignition timing.

CRUISE OR IDLE MODE

When the engine is at operating temperature this is a CLOSED LOOP mode. During cruising speed the following inputs are received by the powertrain control module (PCM):

- coolant temperature
- crankshaft position (distributor pick-up)
- manifold absolute pressure
- engine speed (distributor pick-up)
- throttle position
- exhaust gas oxygen content
- A/C control positions
- battery voltage

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 controls the air/fuel ratio according to the oxygen content in the exhaust gas.

ACCELERATION MODE

This is a CLOSED LOOP mode. The powertrain control module (PCM) recognizes an abrupt increase in throttle position or MAP pressure as a demand for increased engine output and vehicle acceleration. The PCM increases injector pulse width in response to increased fuel demand.

DECELERATION MODE

This is a CLOSED LOOP mode. During deceleration the following inputs are received by the powertrain control module (PCM):

- coolant temperature
- crankshaft position (distributor pick-up)
- manifold absolute pressure
- engine speed (distributor pick-up)
- throttle position
- exhaust gas oxygen content
- A/C control positions
- battery voltage

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. The PCM may reduce injector firing to once per engine revolution. This helps maintain better control of the air-fuel mixture (as sensed through the O_2 sensor).

During a deceleration condition, the PCM grounds the exhaust gas recirculation (EGR) solenoid and the evaporative purge solenoid. When the solenoids are grounded, EGR and canister purge functions stop.

WIDE OPEN THROTTLE MODE

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

- coolant temperature
- crankshaft position (distributor pick-up)
- manifold absolute pressure
- engine speed (distributor pick-up)
- throttle position

When the PCM senses wide open throttle condition through the throttle position sensor (TPS) it will:

- Provide a ground for the electrical EGR transducer (EET) solenoid (California vehicles only). When the PCM grounds the solenoid, the EGR system stops operating.
- De-energize the air conditioning relay. This disables the air conditioning system.

The exhaust gas oxygen content input is not accepted by the PCM during wide open throttle operation. The PCM will adjust injector pulse width to supply a predetermined amount of additional fuel.

IGNITION SWITCH OFF MODE

When the ignition switch is turned to the OFF position, the following occurs:

- All outputs are turned off.
- No inputs are monitored.
- The powertrain control module (PCM) shuts down.

THROTTLE BODY

The throttle body assembly (Fig. 19) is located at the left end of the air intake plenum. The throttle body houses the throttle position sensor and the idle air control motor. Air flow through the throttle body is controlled by a cable operated throttle blade located in the base of the throttle body.

FUEL SUPPLY CIRCUIT

Fuel is supplied to the fuel rail by an electric pump mounted in the fuel tank. The pump inlet is fitted with a filter to prevent water and other contaminants from entering the fuel supply circuit.

Fuel pressure is controlled to a preset level above intake manifold pressure by a pressure regulator. The pressure regulator is mounted on the fuel rail. The regulator uses intake manifold pressure as a reference.

FUEL PRESSURE REGULATOR

The pressure regulator is a mechanical device located on the fuel rail, downstream of the fuel injectors (Fig. 20). The regulator maintains a constant 328 kPa (47.6 psi) across the fuel injector tip.

The regulator contains a spring loaded rubber diaphragm that covers the fuel return port. When the fuel pump is operating, fuel flows past the injectors into the regulator, and is restricted from flowing any further by the blocked return port. When fuel pressure reaches 328 kPa (47.6 psi) it pushes on the diaphragm, compresses the spring, and uncovers the fuel return port. The diaphragm and spring constantly move from an open to closed position to keep the fuel pressure constant.

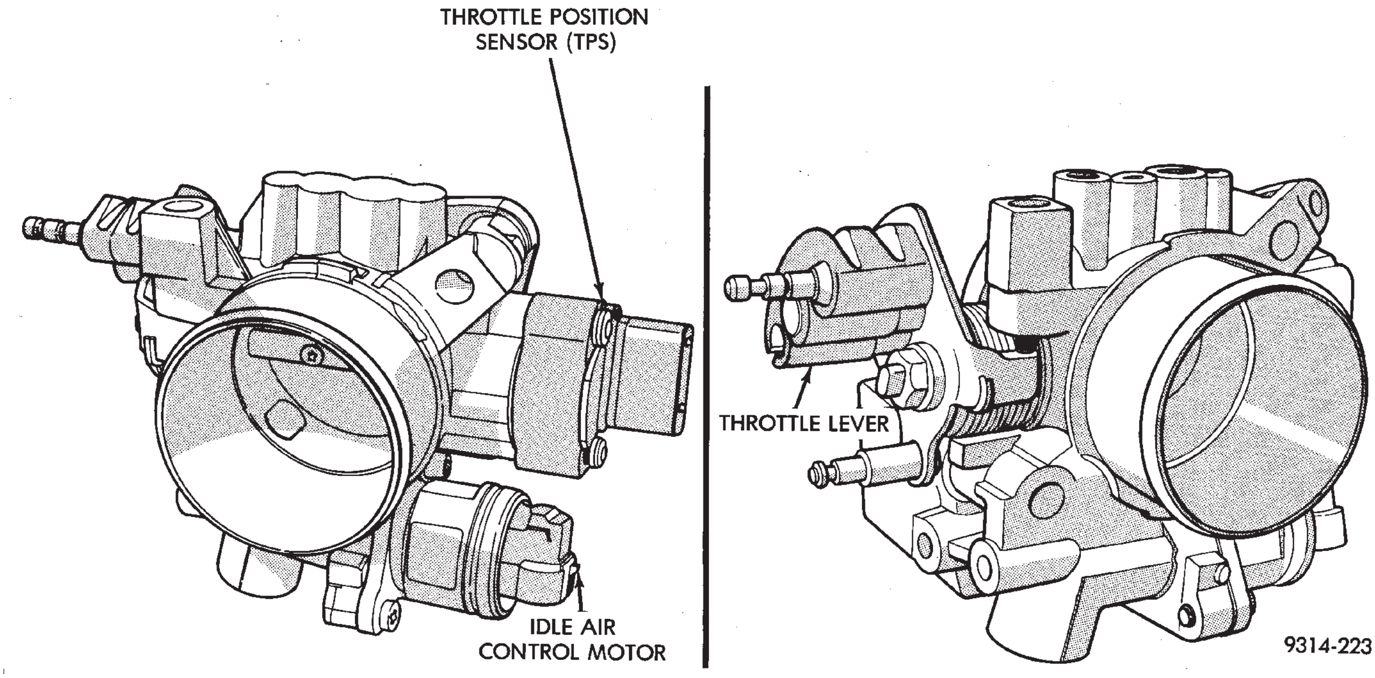


Fig. 19 Throttle Body

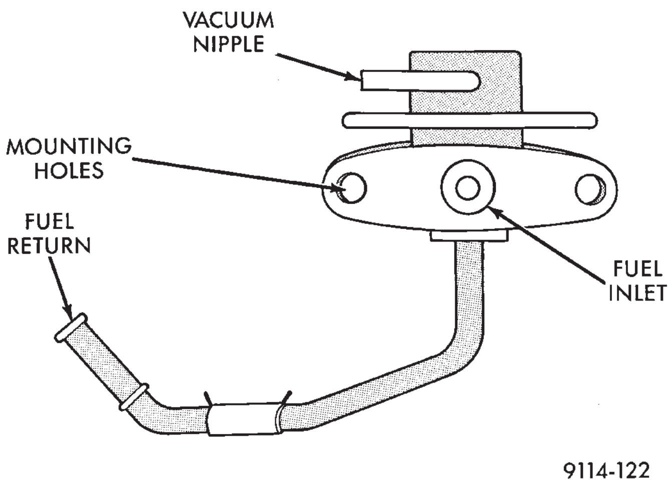


Fig. 20 Fuel Pressure Regulator

3.0L MULTI-PORT FUEL INJECTION—GENERAL DIAGNOSIS

FUEL SYSTEM DIAGRAM

The 3.0L MPI system is managed by the powertrain control module (PCM). The PCM receives inputs from various switches and sensors (Fig. 1). Based on these inputs, the PCM adjusts ignition timing and idle speed through various output devices. Refer to the Multi-Port Fuel Injection—3.0L Engine section of this group for system and component descriptions.

VISUAL INSPECTION

A visual inspection for loose, disconnected, or misrouted wires and hoses should be made before attempting to diagnose or service the fuel injection system. A visual check helps save unnecessary test and diagnostic time. A thorough visual inspection will include the following checks:

(1) Check for correct spark plug cable routing. Ensure that the cables are completely connected to the spark plugs and distributor.

(2) Check ignition coil electrical connections (Fig. 2).

(3) Verify that the electrical connector is attached to the Purge Solenoid (Fig. 3).

(4) Verify that vacuum connection at the duty cycle EVAP purge solenoid is secure and not leaking (Fig. 3).

(5) Verify that the electrical connector is attached to the MAP sensor (Fig. 4).

(6) Check MAP sensor hose at MAP Sensor Assembly (Fig. 4), and at Vacuum Connection at Intake Plenum Fitting.

(7) Check generator wiring connections. Ensure the accessory drive belt is properly tensioned.

(8) Verify that hoses are securely attached to the vapor canister (Fig. 5).

(9) Verify the engine ground strap is attached at the engine and dash panel (Fig. 6 and 7).

(10) Ensure the heated oxygen sensor connector is connected to the harness connector (Fig. 7).

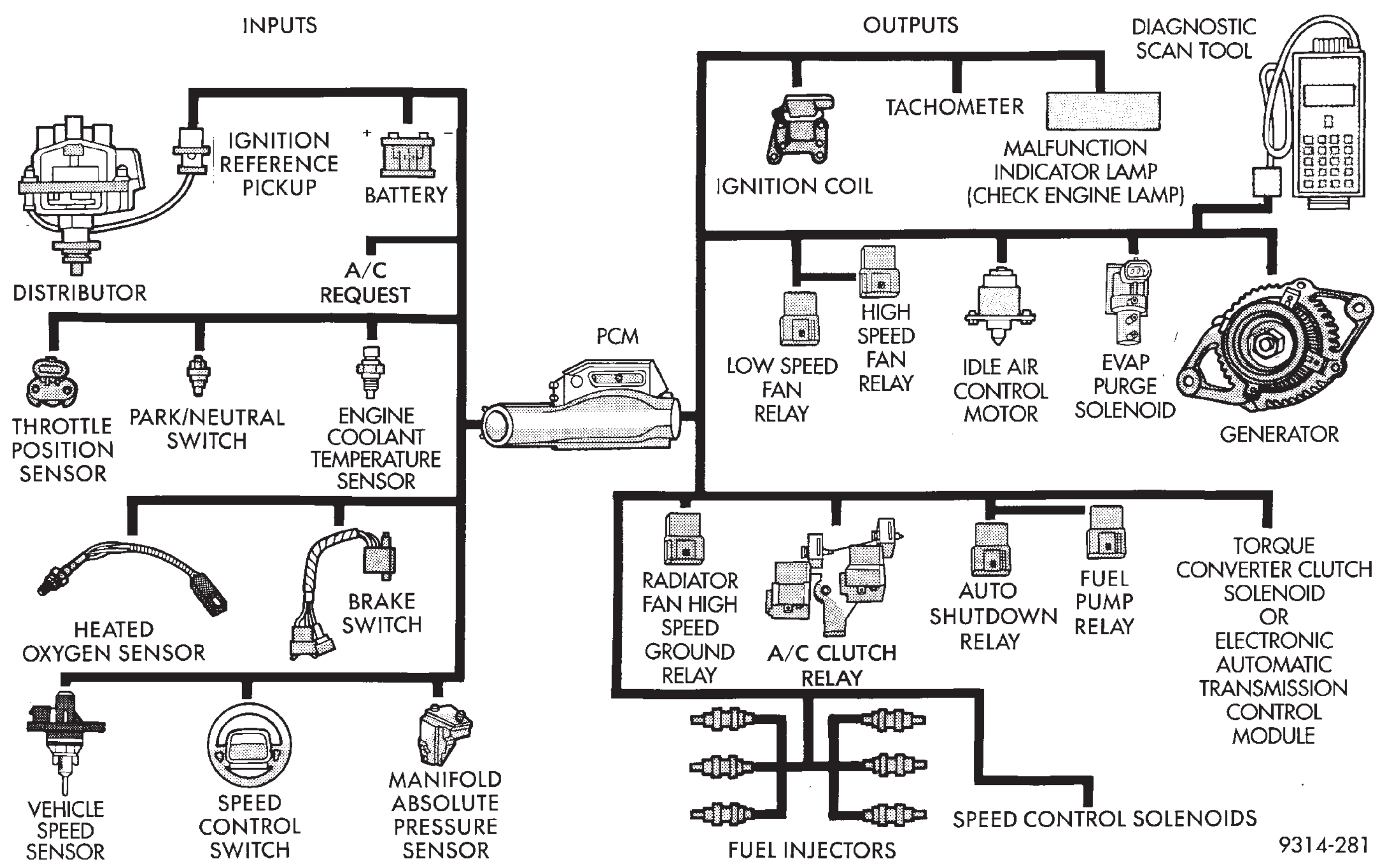


Fig. 1 Multi-Port Fuel Injection Components

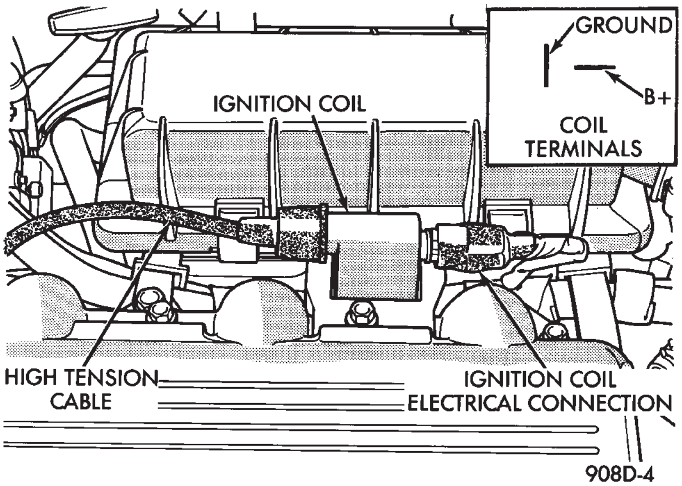


Fig. 2 Ignition Coil Electrical Connection

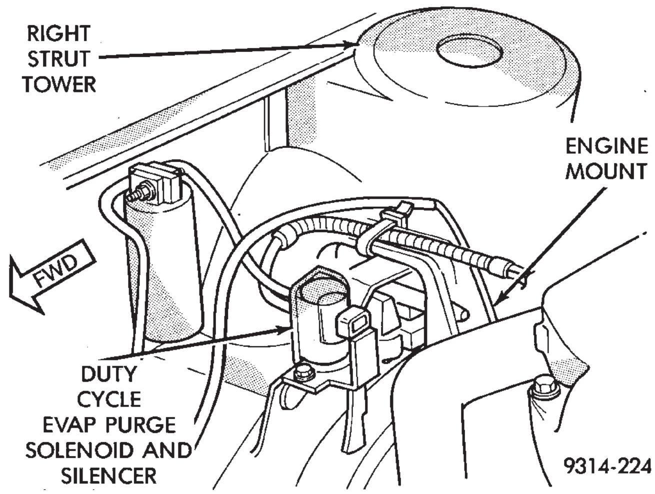


Fig. 3 Duty Cycle EVAP Purge Solenoid

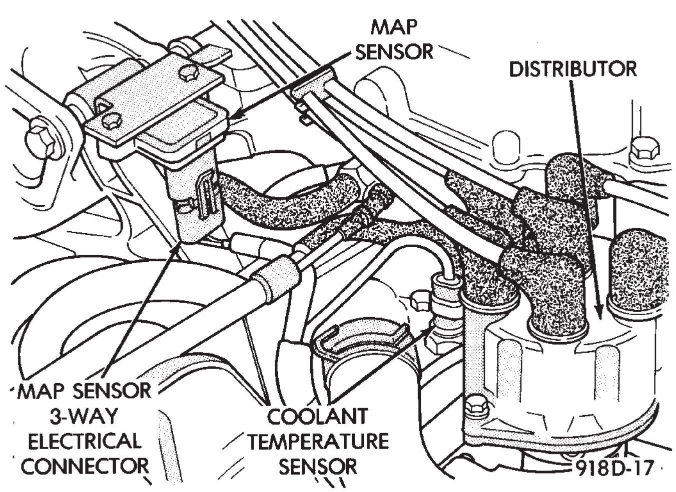


Fig. 4 Map Sensor Electrical and Vacuum Connections

(11) Verify the distributor connector is connected to the harness connector (Fig. 8).

(12) Verify the coolant temperature sensor connector is connected to the harness connector (Fig. 9).

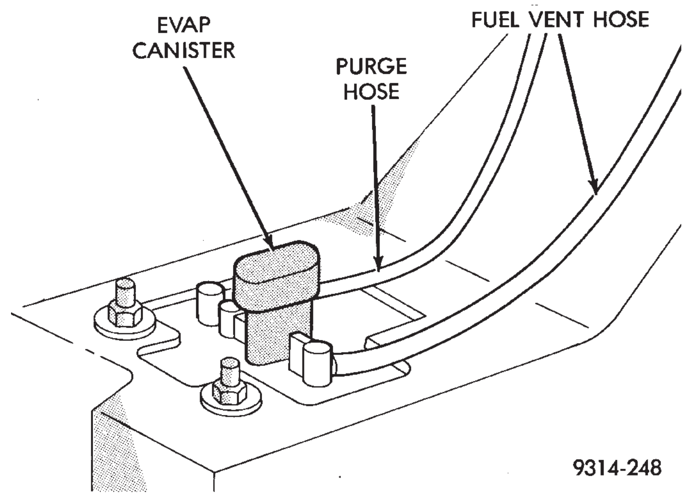


Fig. 5 Vapor Canister

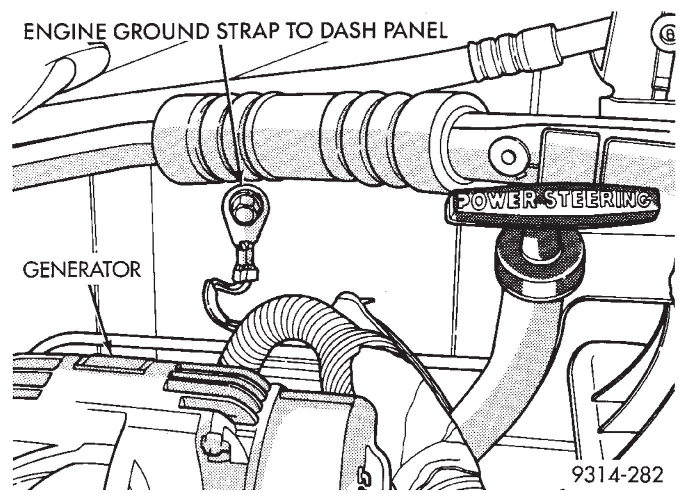


Fig. 6 Engine Ground Strap

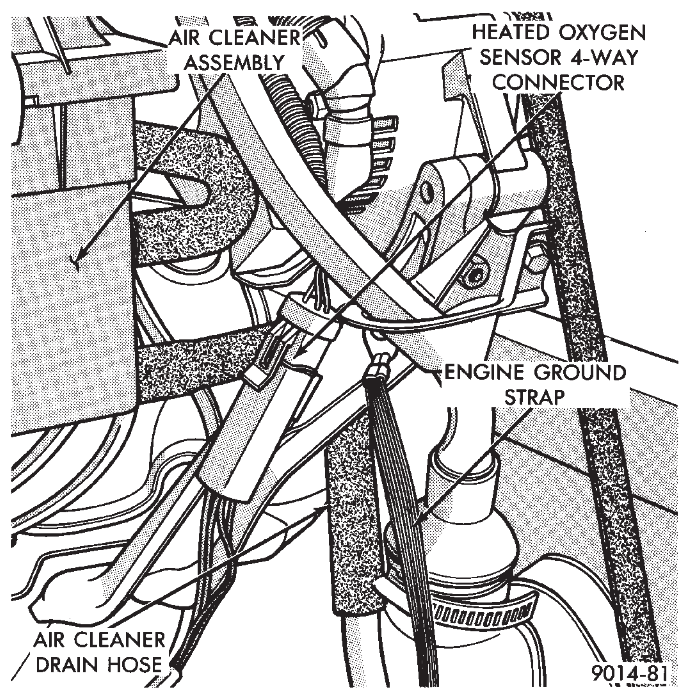


Fig. 7 Oxygen Sensor Connector

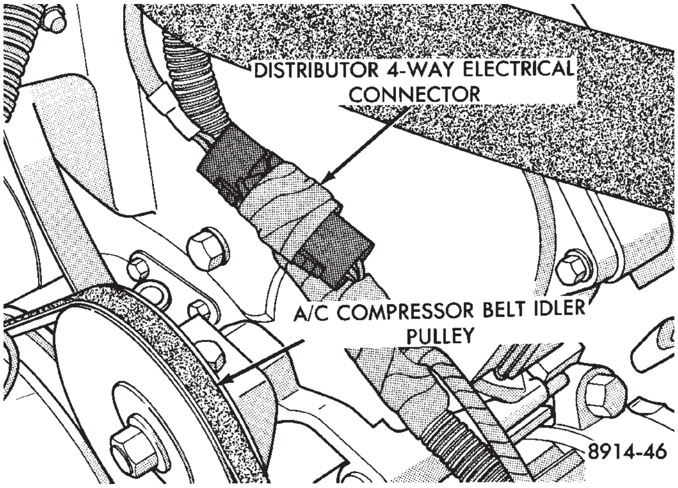


Fig. 8 Distributor Connector

(13) Check vacuum hose connection at fuel pressure regulator and intake plenum connector (Fig. 9).

(14) Ensure the harness connector is securely attached to each fuel injector.

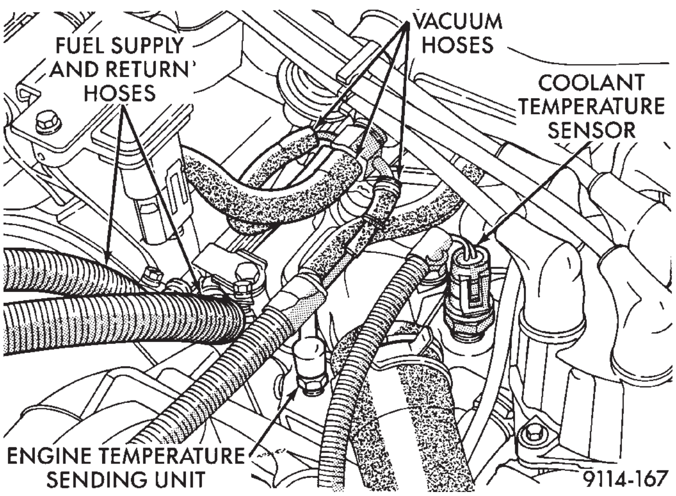


Fig. 9 Coolant Temperature Sensor Electrical Connections and Vacuum Hose Connections at the Air Intake Plenum

(15) Check the oil pressure sending unit electrical connection (Fig. 10).

(16) Check hose connections at throttle body (Fig. 11).

(17) Check throttle body electrical connections (Fig. 11).

(18) Check PCV hose connections (Fig. 12).

(19) If equipped, check EGR system vacuum hose connections (Fig. 13).

(20) If equipped, check EGR tube to intake plenum connections (Fig. 13).

(21) Check power brake booster and speed control connections (Figs. 14).

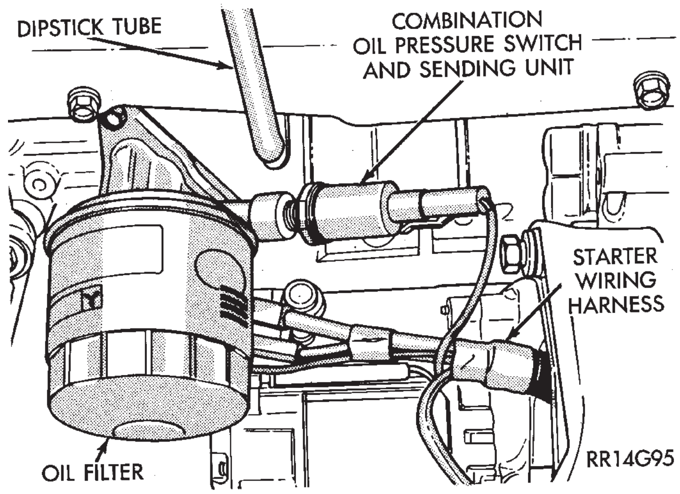


Fig. 10 Oil Pressure Sending Unit Electrical Connection

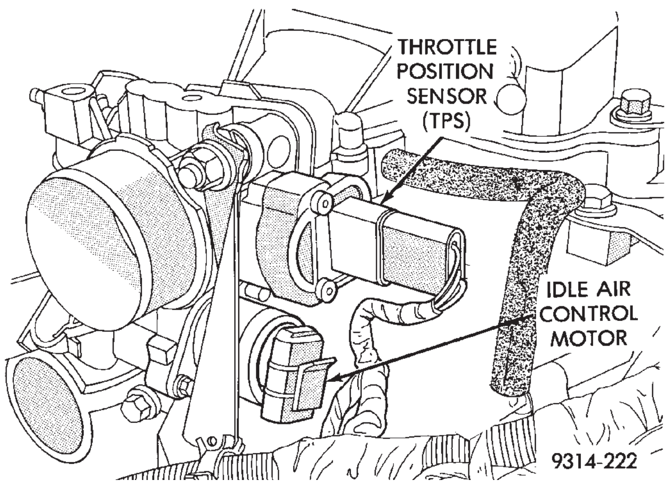


Fig. 11 Throttle Body Electrical and Vacuum Hose Connections

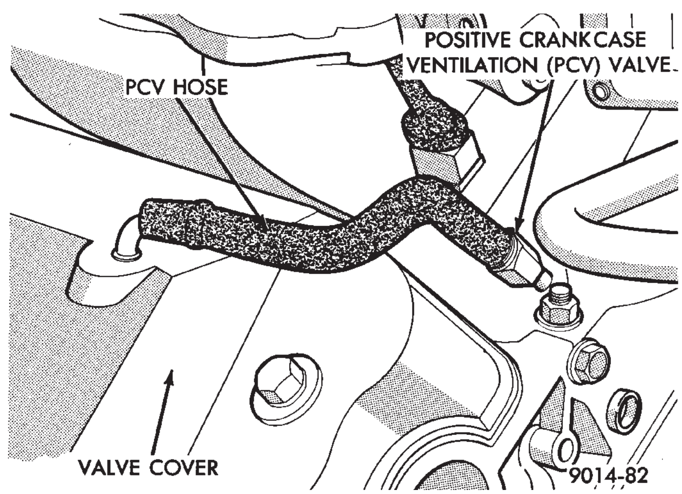


Fig. 12 Positive Crankcase Ventilation (PCV) System

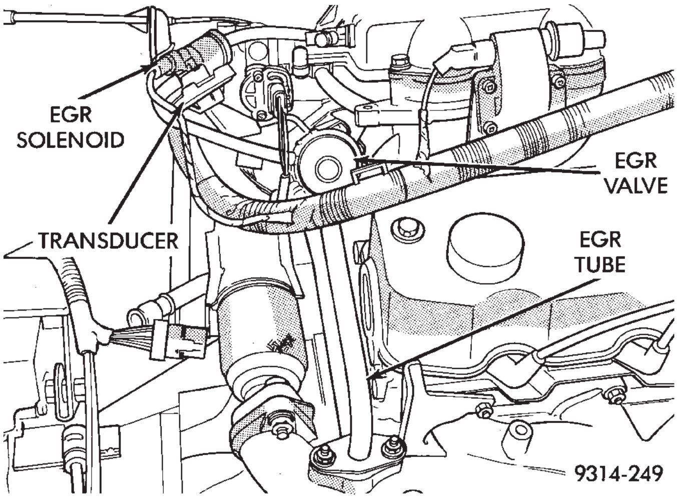


Fig. 13 EGR System

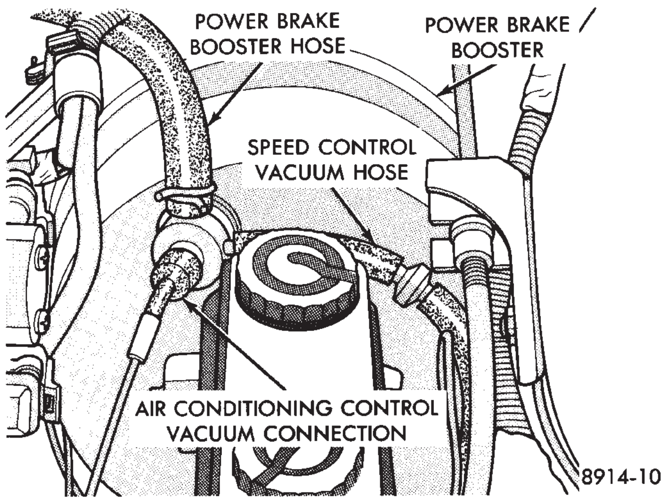


Fig. 14 Power Brake Booster and Speed Control Vacuum Hose Connections

(22) Check engine harness to main harness electrical connections.

(23) Check all automatic transmission electrical connections (Fig. 15 or 16).

(24) Check the vehicle speed sensor electrical connection (Fig. 17).

(25) Inspect the powertrain control module (PCM) 60-way electrical connector for damage or spread terminals. Verify the 60-way connector is fully inserted into the socket of the PCM (Fig. 18). Ensure that wires are not stretched or pulled out of the connector.

(26) Verify that all electrical connectors are fully inserted into relays (Fig. 19 and Fig. 20).

(27) Check Battery Cable Connections.

(28) Check hose and wiring connections at fuel pump. Check that wiring connector is making contact with terminals on pump.

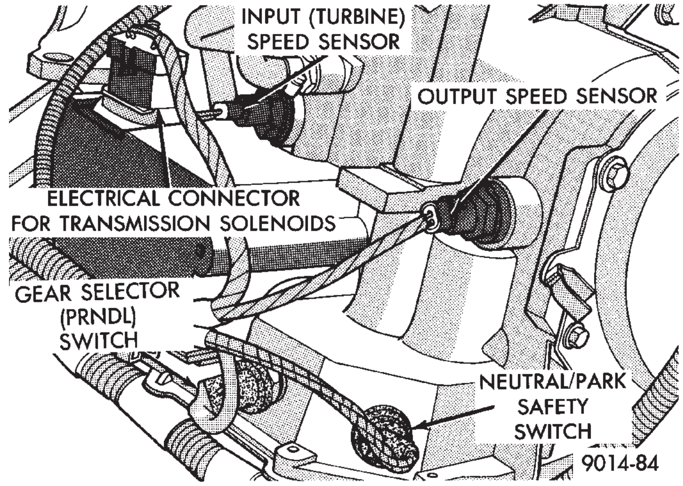


Fig. 15 Electronic Automatic Transmission Electrical Connections

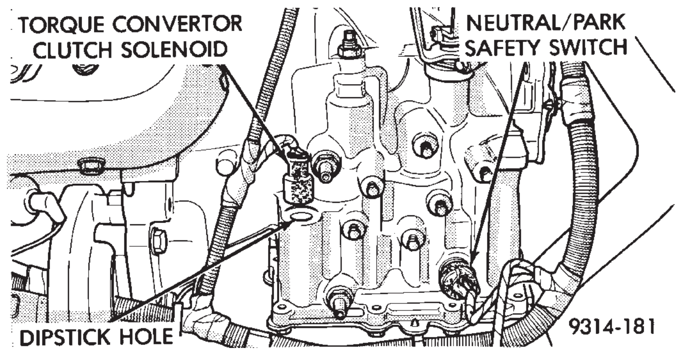


Fig. 16 Automatic Transmission Electrical Connections

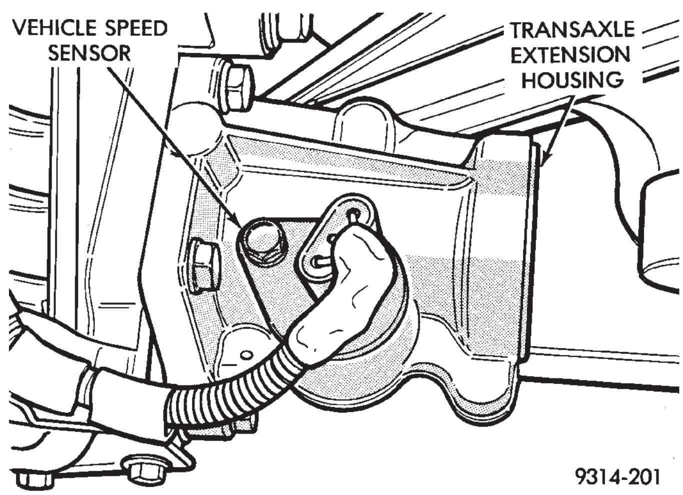


Fig. 17 Vehicle Speed Sensor

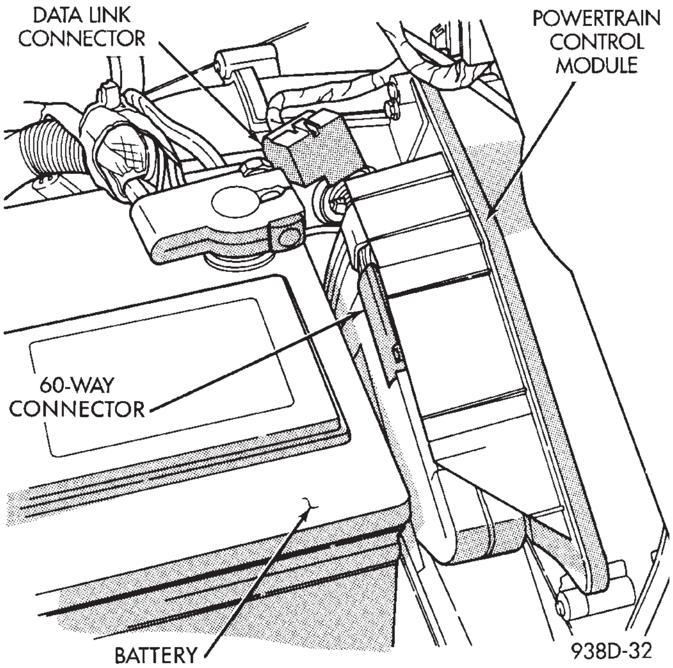


Fig. 18 Powertrain Control Module (PCM)

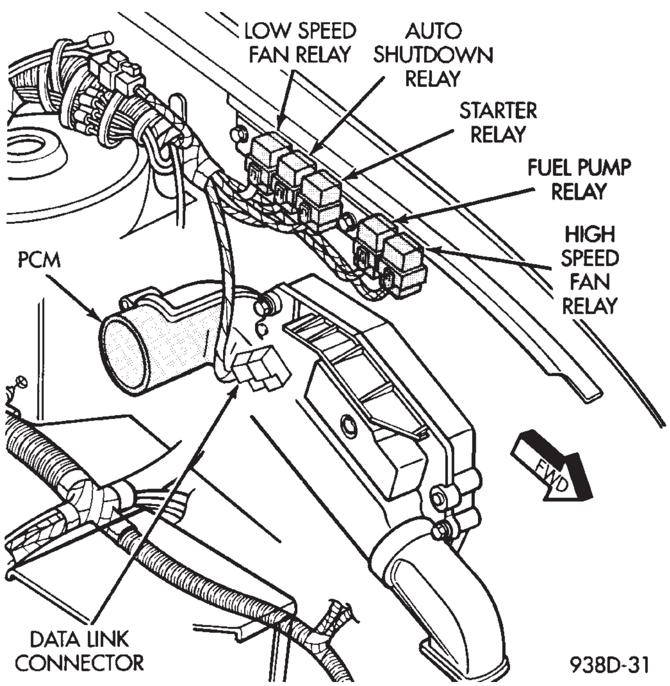


Fig. 19 ASD, Fuel Pump, Low Speed Fan, High Speed Fan, and Starter Relays

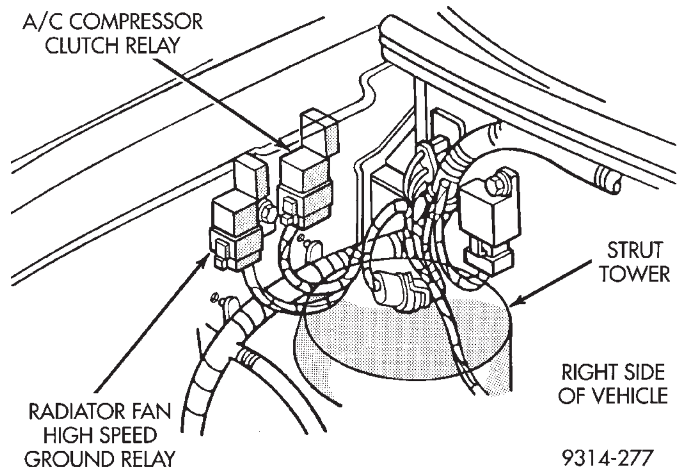


Fig. 20 A/C Clutch Relay and Radiator Fan High Speed Ground Relay

3.0L MULTI-PORT FUEL INJECTION—ON-BOARD DIAGNOSTICS

INDEX

GENERAL INFORMATION

The powertrain control module (PCM) has been programmed to monitor many different circuits of the fuel injection system. If a problem is sensed with a monitored circuit often enough to indicate an actual problem, the PCM stores a diagnostic trouble code. If the problem is repaired or ceases to exist, the PCM cancels the trouble code after 51 vehicle key on/off cycles.

Certain criteria must be met for a diagnostic trouble code to be entered into PCM memory. The criteria may be a specific range of engine RPM, engine temperature, and/or input voltage to the PCM.

It is possible that a fault code for a monitored circuit may not be entered into memory even though a malfunction has occurred. This may happen because one of the fault code criteria for the circuit has not been met. **For example**, assume the trouble code criteria for a sensor circuit requires the engine to operate between 750 and 2000 RPM. If the sensor output circuit shorts to ground when engine RPM is above 2400 RPM (resulting in a 0 volt input to the PCM) a trouble code will not be entered into memory. This is because the condition does not occur within the specified RPM range.

There are several operating conditions that the PCM does not monitor and set diagnostic trouble codes for. Refer to Monitored Circuits and Non-Monitored Circuits in this section.

Stored trouble codes can be displayed either by cycling the ignition key On - Off - On - Off - On, or using the DRBII scan tool. The DRBII scan tool connects to the data link connector in the vehicle (Fig. 1).

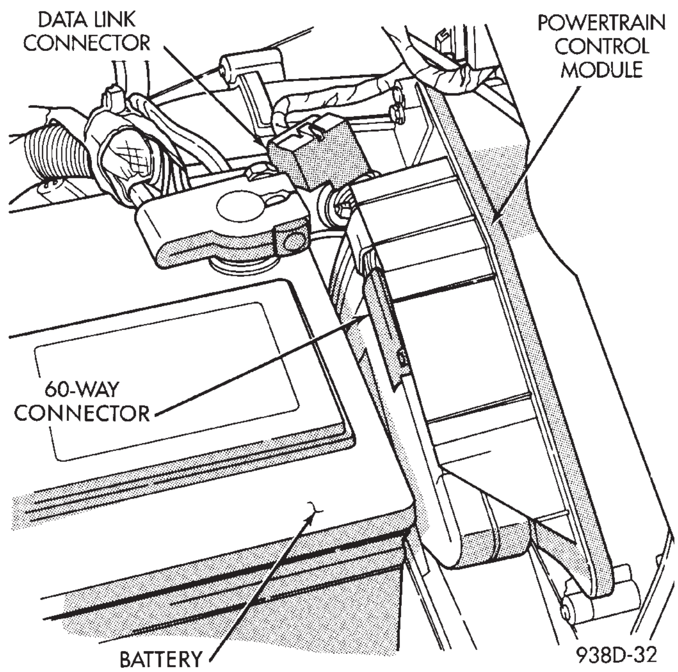


Fig. 1 Data Link Connector

MONITORED CIRCUITS

The powertrain control module (PCM) can detect certain fault conditions in the fuel injection system.

Open or Shorted Circuit - The PCM can determine if the sensor output (input to PCM) is within proper range. Also, the PCM can determine if the circuit is open or shorted.

Output Device Current Flow - The PCM senses whether the output devices are hooked up. If there is a problem with the circuit, the PCM senses whether the circuit is open, shorted to ground, or shorted high.

Oxygen Sensor - The PCM can determine if the oxygen sensor is switching between rich and lean once the system has entered closed loop. Refer to Modes of Operation in this section for an explanation of closed loop operation.

NON-MONITORED CIRCUITS

The powertrain control module (PCM) does not monitor the following circuits, systems and conditions that could have malfunctions that result in driveability problems. Diagnostic trouble codes may not register for these conditions. However, problems with these systems may cause trouble codes to be register for other systems. For example, a fuel pressure problem will not register a trouble code directly, but could cause a rich or lean condition. This could cause an oxygen sensor fault to be stored in the PCM.

Fuel Pressure - Fuel pressure is controlled by the vacuum assisted fuel pressure regulator. The PCM cannot detect a clogged fuel pump inlet filter, clogged in-line fuel filter, or a pinched fuel supply or return line. However, these could result in a rich or lean condition causing an oxygen sensor trouble code to be stored in the PCM.

Secondary Ignition Circuit - The PCM cannot detect an inoperative ignition coil, fouled or worn spark plugs, ignition cross firing, or open spark plug cables.

Engine Timing - The PCM cannot detect an incorrectly indexed timing chain, camshaft sprocket and crankshaft sprocket. The PCM also cannot detect an incorrectly indexed distributor. However, these could result in a rich or lean condition causing an oxygen sensor trouble code to be stored in the PCM.

Cylinder Compression - The PCM cannot detect uneven, low, or high engine cylinder compression.

Exhaust System - The PCM cannot detect a plugged, restricted or leaking exhaust system.

Fuel Injector Malfunctions - The PCM cannot determine if the fuel injector is clogged, the pintle is sticking or the wrong injector is installed. However, these could result in a rich or lean condition causing an oxygen sensor trouble code to be stored in the PCM.

Excessive Oil Consumption - Although the PCM monitors exhaust stream oxygen content when the system is in closed loop, it cannot determine excessive oil consumption.

Throttle Body Air Flow - The PCM cannot detect a clogged or restricted air cleaner inlet or filter element.

Evaporative System - The PCM will not detect a restricted, plugged or loaded evaporative purge canister.

Vacuum Assist - Leaks or restrictions in the vacuum circuits of vacuum assisted engine control system devices are not monitored by the PCM. However, these could result in a MAP sensor trouble code being stored in the PCM.

PCM System Ground - The PCM cannot determine a poor system ground. However, a trouble code may be generated as a result of this condition.

PCM Connector Engagement - The PCM cannot determine spread or damaged connector pins. However, a trouble code may be generated as a result of this condition.

HIGH AND LOW LIMITS

The powertrain control module (PCM) compares input signal voltages from each input device with established high and low limits that are programmed into it for that device. If the input voltage is not within specifications, and other diagnostic trouble code criteria are met, a trouble code will be stored in memory. Other criteria might include engine RPM limits or input voltages from other sensors or switches that must be present before a the PCM verifies a fault condition.

DIAGNOSTIC TROUBLE CODE DESCRIPTION

When a diagnostic trouble code appears, it indicates the powertrain control module (PCM) has recognized an abnormal condition in the system. Trouble codes can be obtained from the malfunction indicator lamp (instrument panel Check Engine lamp) or by using the DRBII scan tool. Trouble codes indicate the results of a failure but do not identify the failed component directly.

SYSTEM TESTS

Apply parking brake and/or block wheels before performing idle check or adjustment, or any engine running tests.

OBTAINING DIAGNOSTIC TROUBLE CODES

USING DRBII SCAN TOOL

WARNING: APPLY PARKING BRAKE AND/OR BLOCK WHEELS BEFORE PERFORMING ANY TEST ON AN OPERATING ENGINE.

(1) Connect DRBII scan tool to the data link (diagnostic) connector (Fig. 1).

(2) If possible, start the engine and cycle the **A/C** switch if applicable. Shut off the engine.

(3) Turn the ignition switch on, access Read Fault Screen. Record all the diagnostic trouble codes shown on the DRBII scan tool. [Observe the malfunction indicator lamp (check engine lamp) on the instrument panel. The lamp should light for 2 seconds then go out (bulb check)].

To erase diagnostic trouble codes, use the Erase Trouble Code data screen on the DRBII scan tool.

USING THE MALFUNCTION INDICATOR LAMP

(1) Cycle the ignition key On - Off - On - Off - On within 5 seconds.

(2) Count the number of times the malfunction indicator lamp (check engine lamp) on the instrument panel flashes on and off. The number of flashes represents the trouble code. There is a slight pause between the flashes representing the first and second digits of the code. Longer pauses separate individual trouble codes.

(3) Refer to the Diagnostic Trouble Code Charts at the end of this group.

STATE DISPLAY TEST MODE

The switch inputs used by the powertrain control module (PCM) have only two recognized states, HIGH and LOW. For this reason, the PCM cannot recognize the difference between a selected switch po-

DIAGNOSTIC TROUBLE CODE DESCRIPTION

TROUBLE CODE	DRB II DISPLAY	DESCRIPTION
11	No reference Signal During Cranking	No camshaft position sensor signal detected during engine cranking.
13+**	No change in MAP from start to run	No difference recognized between the engine MAP reading and the barometric (atmospheric) pressure reading at start-up.
14+**	MAP voltage too low	MAP sensor input below minimum acceptable voltage.
	or	
	MAP voltage too High	MAP sensor input above maximum acceptable voltage.
15**	No vehicle speed signal	No vehicle distance (speed) sensor signal detected during road load conditions.
17	Engine is cold too long	Engine coolant temperature remains below normal operating temperatures during vehicle travel (thermostat).
21**	O_2 signal stays at center	Neither rich or lean condition detected from the oxygen sensor input.
	or	
	O_2 signal shorted to voltage	Oxygen sensor input voltage maintained above the normal operating range.
22+**	Coolant sensor voltage too high	Coolant temperature sensor input above the maximum acceptable voltage.
	or	
	Coolant sensor voltage too low	Coolant temperature sensor input below the minimum acceptable voltage.
24+**	Throttle position sensor voltage high	Throttle position sensor input above the maximum acceptable voltage.
	or	
	Throttle position sensor voltage low	Throttle position sensor input below the minimum acceptable voltage.
25**	Idle air control motor circuits	An open or shorted condition detected in one or more of the idle air control motor circuits.
27	Injector control circuit	Injector output driver does not respond properly to the control signal.
31**	Evap purge solenoid circuit	An open or shorted condition detected in the purge solenoid circuit.
32**	EGR solenoid circuit	An open or shorted condition detected in the EGR transducer solenoid circuit.
	or	
	EGR system failure	Required change in air/fuel ratio not detected during diagnostic test.
33	A/C clutch relay circuit	An open or shorted condition detected in the A/C clutch relay circuit.

+ Check Engine Lamp On
** Check Engine Lamp On (California Only)

9314-253

DIAGNOSTIC TROUBLE CODE DESCRIPTION (CON'T)

TROUBLE CODE	DRB II DISPLAY	DESCRIPTION
34	Speed control solenoid circuits	An open or shorted condition detected in the speed control vacuum or vent solenoid circuits.
35	Radiator fan relays	An open or shorted condition detected in the radiator fan low speed relay or high speed relay or high speed ground relay circuits.
37	Torque convertor clutch solenoid CKT	An open or shorted condition detected in the torque convertor clutch solenoid circuit (automatic transmission).
41+**	Generator field not switching properly	An open or shorted condition detected in the generator field control circuit.
42	Auto shutdown relay control circuit	An open or shorted condition detected in the auto shutdown relay circuit.
46+**	Charging system voltage too high	Battery voltage sense input above target charging voltage during engine operation.
47+**	Charging system voltage too low	Battery voltage sense input below target charging voltage during engine operation. Also, no significant change detected in battery voltage during active test of alternator output.
51**	O_2 signal stays below center (lean)	Oxygen sensor signal input indicates lean air/fuel ratio condition during engine operation.
52**	O_2 signal stays above center (rich)	Oxygen sensor signal input indicates rich air/fuel ratio condition during engine operation.
53	Internal controller failure	Powertrain Control Module internal fault condition detected.
54	No sync pick-up signal	No fuel sync signal detected during engine rotation.
62	Controller Failure EMR miles not stored	Unsuccessful attempt to write to an EEPROM location by the Powertrain Control Module.
63	Controller Failure EEPROM write denied	Unsuccessful attempt to write to an EEPROM location by the Powertrain Control Module.
55	N/A	Completion of fault code display on malfunction indicator lamp (Check Engine lamp).

+Check Engine Lamp On
**Check Engine Lamp ON (California Only)

9314-292

sition versus an open circuit, a short circuit, or a defective switch. If the change is displayed, it can be assumed that the entire switch circuit to the PCM is functional. From the state display screen access either State Display Inputs and Outputs or State Display Sensors.

STATE DISPLAY INPUTS AND OUTPUTS

Connect the DRBII scan tool to the vehicle. Access the State Display screen. Then access Inputs and Outputs. The following is a list of the engine control system functions accessible through the Inputs and Outputs screen.

Park/Neutral Switch
Speed Control Resume
Brake Switch
Speed Control On/Off
Speed Control Set
A/C Switch Sense
S/C Vent Solenoid
S/C Vacuum Solenoid
A/C Clutch Relay

EGR Solenoid
Auto Shutdown Relay
Radiator Fan Low Speed Relay
Radiator Fan High Speed Relays
Duty Cycle EVAP Purge Solenoid
Torque Converter Clutch Solenoid

STATE DISPLAY SENSORS

Connect the DRBII scan tool to the vehicle and access the State Display screen. Then access Sensor Display. The following is a list of the engine control system functions accessible through the Sensor Display screen.

Battery Temperature
Oxygen Sensor Signal
Engine Coolant Temperature
Engine Coolant Temp Sensor
Throttle Position
Minimum Throttle
Battery Voltage
MAP Sensor Reading
Idle Air Control Motor Position
Adaptive Fuel Factor
Barometric Pressure
Min Airflow Idle Speed
Engine Speed
Fault #1 Key-On Info
Module Spark Advance
Speed Control Target
Fault #2 Key-on Info
Fault #3 Key-on Info
Speed Control Status
Speed Control Switch Voltage
Charging System Goal
Theft Alarm Status
Map Sensor Voltage
Vehicle Speed
Oxygen Sensor State
MAP Gauge Reading
Throttle Opening (percentage)
Total Spark Advance

CIRCUIT ACTUATION TEST MODE

The circuit actuation test mode checks for proper operation of output circuits or devices which the powertrain control module (PCM) cannot internally recognize. The PCM can attempt to activate these outputs and allow an observer to verify proper operation. Most of the tests provide an audible or visual indication of device operation (click of relay contacts, spray fuel, etc.). Except for intermittent conditions, if a device functions properly during testing, assume the device, its associated wiring, and driver circuit working correctly.

OBTAINING CIRCUIT ACTUATION TEST

Connect the DRBII scan tool to the vehicle and access the Actuators screen. The following is a list of the engine control system functions accessible through Actuators screens.

Stop All Tests
Ignition Coil #1
Fuel Injector #1
Fuel Injector #2
Fuel Injector #3
Fuel Injector #4
Fuel Injector #5
Fuel Injector #6
Idle Air Control Motor Open/Close
Radiator Fan Low Speed Relay
Radiator Fan High Speed Relay
A/C Clutch Relay
Auto Shutdown Relay
Duty Cycle EVAP Purge Solenoid
S/C Serv Solenoids
Generator Field
Tachometer Output
Torque Converter Clutch Solenoid
EGR Solenoid
All Solenoids/Relays
ASD Fuel System Test
Speed Control Vacuum Solenoid
Speed Control Vent Solenoid

THROTTLE BODY MINIMUM AIR FLOW CHECK PROCEDURE

(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) Hook-up the timing check device and tachometer.
(4) Disconnect the coolant temperature sensor and set basic timing to 12° BTDC ± 2° BTDC.
(5) Shut off engine. Reconnect coolant temperature sensor wire.
(6) Disconnect the PCV valve hose from the PCV valve (Fig. 2).
(7) Plug the PCV valve nipple.

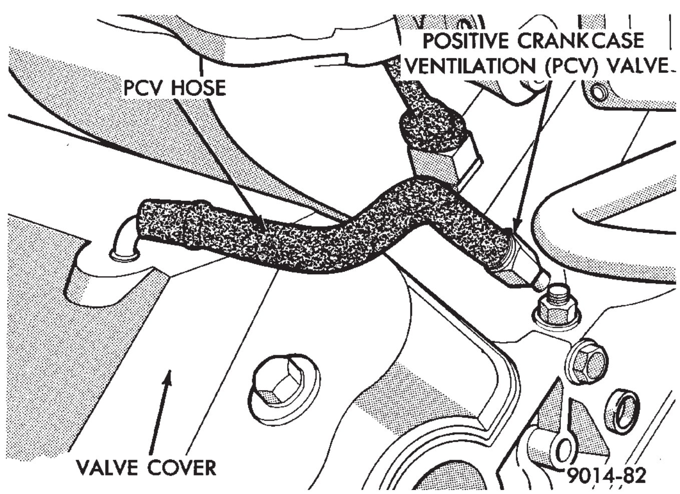


Fig. 2 PCV Valve—3.0L

(8) Disconnect the idle purge hose from the engine vacuum harness tee (Fig. 3).

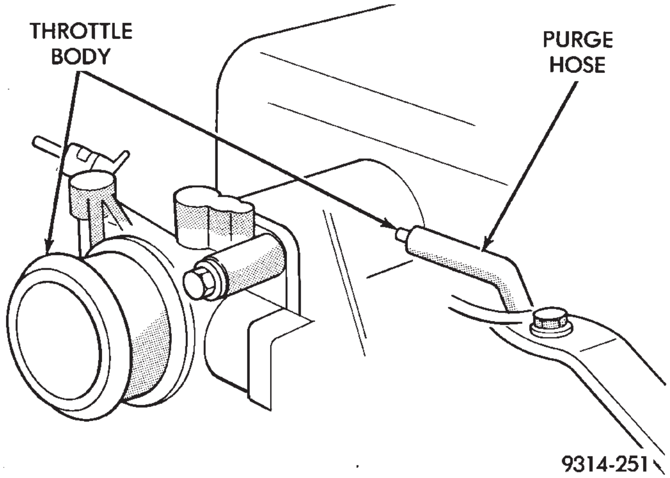


Fig. 3 Idle Purge Hose—3.0L

(9) Install Air Metering Fitting #6457 (0.125 inch orifice) in the intake manifold mounted idle purge hose (Fig. 4).

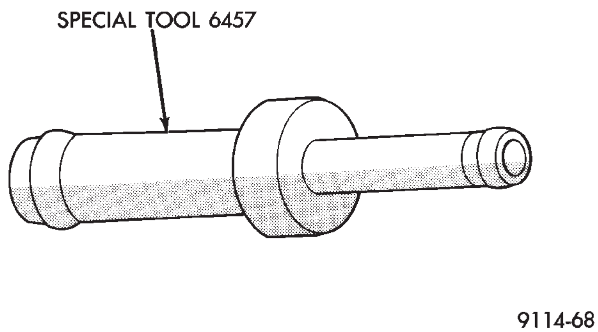


Fig. 4 Air Metering Fitting, Special Tool 6457

(10) Connect the DRBII scan tool to the data link connector.

(11) Restart the engine, allow engine to idle for at least one minute.

(12) Using the DRBII scan tool, access the Minimum Airflow Idle Speed screen.

(13) The following will then occur:

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

(14) Check idle RPM with tachometer, if idle RPM is within the below specification then the throttle body min. air flow is set correctly.

(15) If idle RPM is not within specifications, shut off the engine and clean the throttle body as follows:

(a) Remove the throttle body from engine.

IDLE SPECIFICATIONS

ODOMETER READING	IDLE RPM
Below 1000 Miles	560 - 910 RPM
Above 1000 Miles	610 - 910 RPM

9314-250

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

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

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

(d) Use compressed air to dry the throttle body.

(e) Inspect throttle body for foreign material.

(f) Install throttle body on manifold.

(g) Repeat steps 1 through 14. If the minimum air flow is still not within specifications, the problem is not caused by the throttle body.

(16) Shut off engine.

(17) Remove Air Metering Fitting #6457 from the intake manifold idle purge hose. Reconnect the hose to the engine vacuum harness tee.

(18) Remove the plug from the PCV valve. Reconnect the PCV valve hose to the PCV valve.

(19) Disconnect the DRBII scan tool.

IGNITION TIMING PROCEDURE

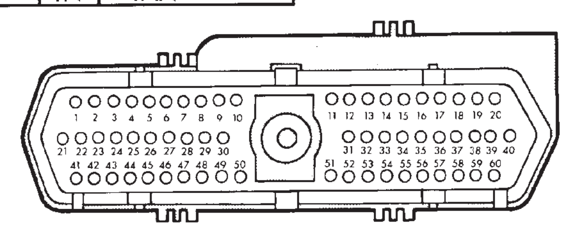
Refer to Group 8D Ignition System.

60-WAY POWERTRAIN CONTROL MODULE WIRING CONNECTOR

Refer to the powertrain control module (PCM) wiring connector diagram (Fig. 5) for information regarding wire colors and cavity numbers.

CAV	WIRE COLOR	DESCRIPTION
1	DG/RD*	MAP SENSOR
2	TN/BK*	ENGINE COOLANT TEMPERATURE SENSOR
3	RD/WT*	DIRECT BATTERY VOLTAGE
4	BK/LB*	SENSOR RETURN
5	BK/WT*	SIGNAL GROUND
6	VT/WT*	5-VOLT OUTPUT (MAP AND TPS)
7	OR	8-VOLT OUTPUT DISTRIBUTOR PICKUP AND DISTANCE SENSOR)
8		
9	DB	A21 SUPPLY IGNITION START/RUN SENSE
10		
11	BK/TN*	POWER GROUND
12	BK/TN*	POWER GROUND
13	LB/BR*	INJECTOR DRIVER #4
14	YL/WT*	INJECTOR DRIVER #3
15	TN	INJECTOR DRIVER #2
16	WT/DB*	INJECTOR DRIVER #1
17		
18		
19	BK/GY	IGNITION COIL DRIVER
20	DG	GENERATOR FIELD CONTROL
21		
22	OR/DB*	THROTTLE POSITION SENSOR (TPS)
23	RD/LG*	SPEED CONTROL SENSE
24	GY/BK*	DISTRIBUTOR PICK-UP SIGNAL
25	PK	DATA LINK TRANSMIT
26	VT/BR*	CCD BUS (+)
27	BR	A/C SWITCH SENSE
28		
29	WT/PK*	BRAKE SWITCH
30	BR/YL*	PARK/NEUTRAL SWITCH
31	DB/PK*	RADIATOR FAN LOW SPEED RELAY
32		
33	TN/RD*	SPEED CONTROL VACUUM SOLENOID
34	DB/OR*	A/C COMPRESSOR CLUTCH RELAY
35	GY/YL	EGR SOLENOID
36		
37		
38	GY	INJECTOR DRIVER #5
39	GY/RD*	IDLE AIR CONTROL MOTOR DRIVER #3
40	BR/WT*	IDLE AIR CONTROL MOTOR DRIVER #1
41	BK/DG*	HEATED OXYGEN SENSOR SIGNAL
42		
43		
44	TN/YL*	HIGH DATA RATE PICKUP (DISTRIBUTOR SYNC PICK-UP SIGNAL)
45	LG	DATA LINK RECEIVE
46	WT/BK*	CCD BUS (-)
47	WT/OR*	VEHICLE SPEED SENSOR
48		
49		
50		
51	DB/YL*	AUTO SHUTDOWN (ASD) RELAY AND FUEL PUMP RELAY
52	PK/BK*	DUTY CYCLE EVAP PURGE SOLENOID
53	LG/RD*	SPEED CONTROL VENT SOLENOID
54	OR/BK*	TORQUE CONVERTOR CLUTCH SOLENOID (3-SPD AUTO TRANS)
55	YL	RADIATOR FAN HIGH SPEED RELAYS
56		
57	DG/OR*	A142 CIRCUIT VOLTAGE SENSE
58	BR/DB*	INJECTOR DRIVER #6
59	VT/BK*	IDLE AIR CONTROL MOTOR DRIVER #4
60	YL/BK*	IDLE AIR CONTROL MOTOR DRIVER #2

WIRE COLOR CODES					
BK	BLACK	LB	LIGHT BLUE	VT	VIOLET
BR	BROWN	LG	LIGHT GREEN	WT	WHITE
DB	DARK BLUE	OR	ORANGE	YL	YELLOW
DG	DARK GREEN	PK	PINK	*	WITH TRACER
GY	GRAY	RD	RED		
		TN	TAN		



CONNECTOR TERMINAL SIDE SHOWN

9314-287

Fig. 5 60—Way PCM Wiring Connector—3.0L Engine

3.0L MULTI-PORT FUEL INJECTION—SERVICE PROCEDURES

INDEX

THROTTLE BODY SERVICE

(1) Disconnect negative battery cable.

(2) Remove air cleaner hose clamp to throttle body and remove hose. (Fig. 1)

(3) Remove throttle cable and transaxle linkage.

(4) Disconnect idle air control motor and throttle position sensor (TPS) wiring connectors.

(5) Remove throttle body to intake manifold attaching nuts. Remove engine harness wiring bracket.

(6) Remove throttle body and gasket.

(7) Reverse procedure for installation. Tighten throttle body mounting nuts to 25.4 N●m (225 in. lbs.) torque.

THROTTLE BODY

When servicing body components, always assemble components with new O-rings and seals where applicable (Fig. 2). Never use lubricants on O-rings or seals, damage may result. If assembly of component

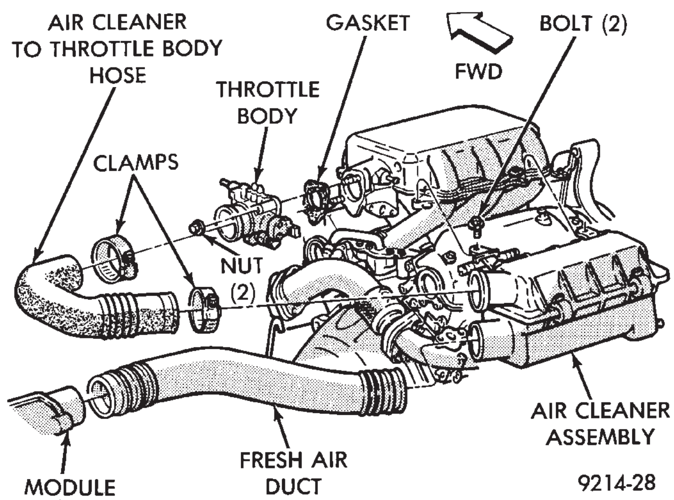


Fig. 1 Throttle Body Assembly

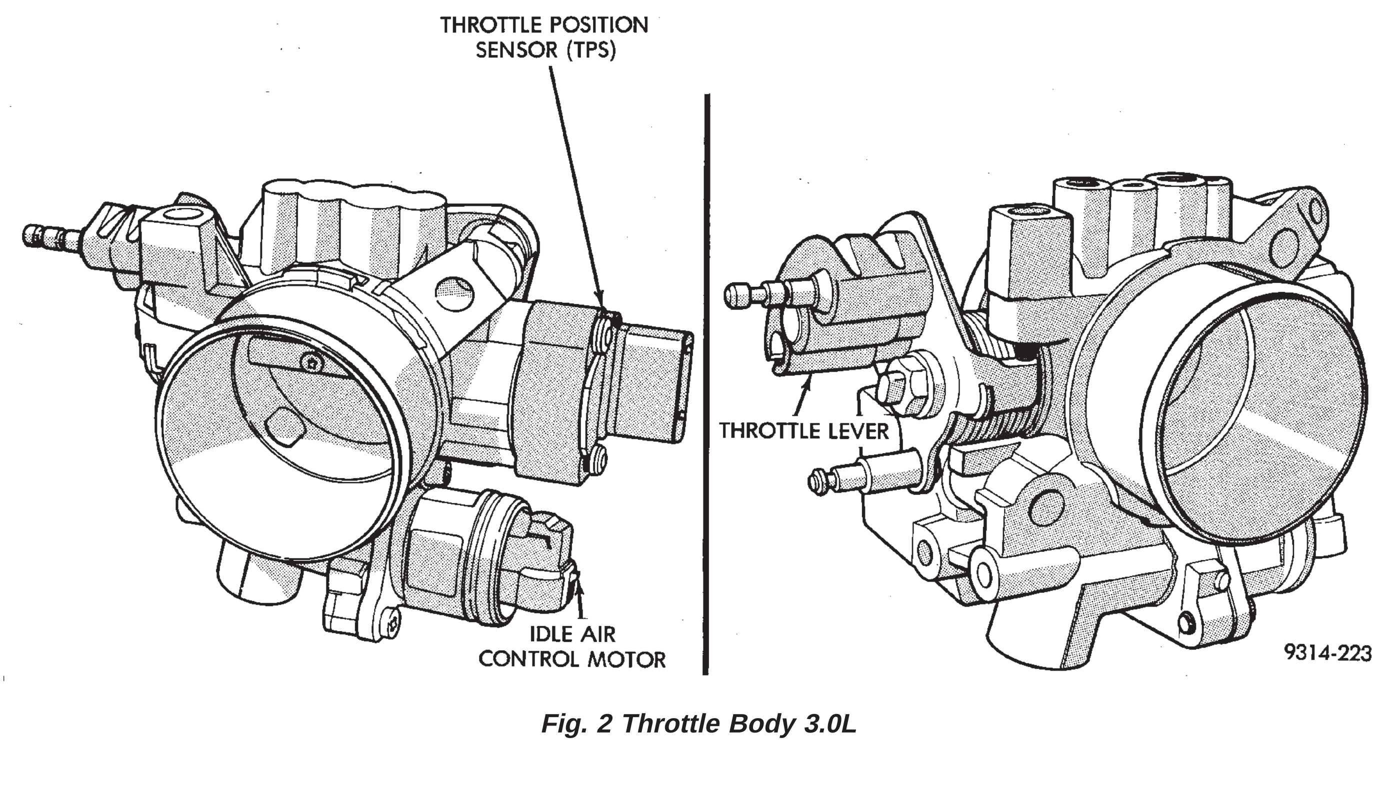


Fig. 2 Throttle Body 3.0L

is difficult, use water to aid assembly. Use care when removing hoses to prevent damage to hose or hose nipple.

FUEL SYSTEM PRESSURE RELEASE PROCEDURE

The 3.0L MPI fuel system is under a constant pressure of approximately 330 kPa (48 psi). Before servicing the fuel pump, fuel lines, fuel filter, throttle body or fuel injectors, the fuel system pressure must be released.

(1) Loosen fuel filler cap to release fuel tank pressure.

(2) Disconnect injector wiring harness from engine harness. Refer to Group 8W, Wiring Diagrams.

(3) Connect one end of a jumper wire to the A142 circuit terminal of the fuel rail harness connector.

(4) Connect the other end of the jumper wire to a 12 volt power source.

(5) Connect one end of a jumper wire to a good ground source.

(6) Momentarily ground one of the injectors by connecting the other end of the jumper wire to an injector terminal in the harness connector. Repeat procedure for 2 to 3 injectors.

(7) Continue fuel system service.

THROTTLE POSITION SENSOR

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove electrical connector from throttle position sensor.

(3) Remove throttle position sensor mounting screws (Fig. 3).

(4) Lift throttle position sensor off throttle shaft.

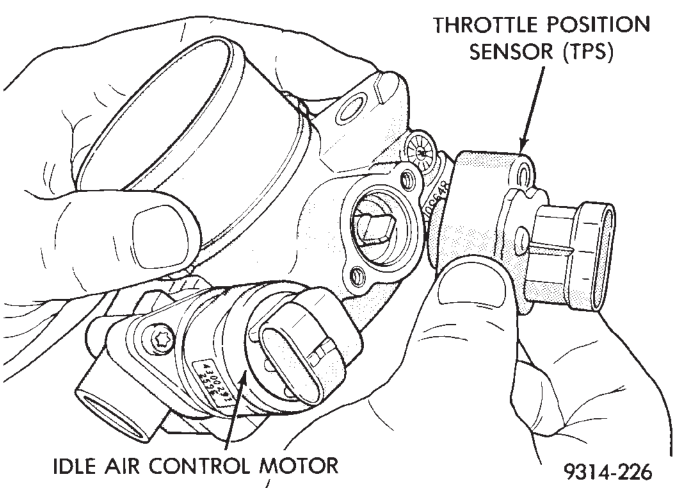


Fig. 3 Servicing Throttle Position Sensor

INSTALLATION

(1) Install throttle position sensor on throttle shaft. Install mounting screws. Tighten screw to 2 N●m (17 in. lbs.) torque.

(2) Connect electrical connector to throttle position sensor.

(3) Connect negative cable to battery.

IDLE AIR CONTROL MOTOR

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove electrical connector from idle air control motor.

(3) Remove idle air control motor mounting screws (Fig. 4).

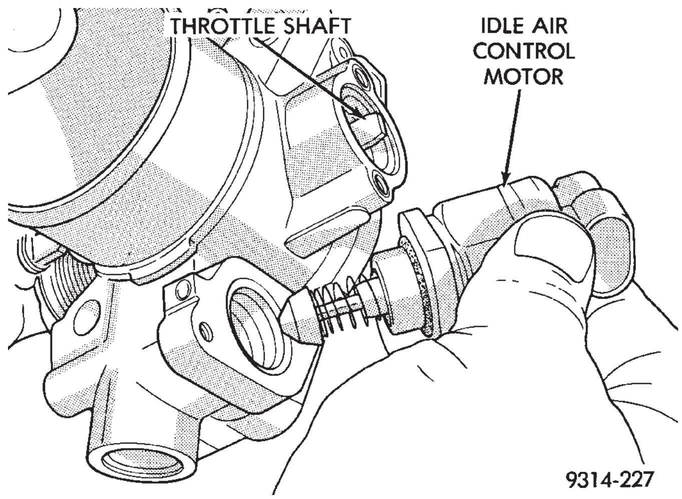


Fig. 4 Servicing Idle Air Control Motor

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

INSTALLATION

(1) The new idle air control motor has a new O-ring installed on it. If pintle measures more than 1 inch (25 mm) it must be retracted. Use the DRBII scan tool Idle Air Control Motor Open/Close Test to retract the pintle (battery must be connected).

(2) Carefully place idle air control motor into throttle body.

(3) Install mounting screws. Tighten screws to 2 N●m (17 in. lbs.) torque.

(4) Connect electrical connector to motor.

(5) Connect negative cable to battery.

FUEL INJECTOR RAIL ASSEMBLY

REMOVAL

WARNING: THE 3.0L MPI FUEL SYSTEM IS UNDER A CONSTANT PRESSURE OF APPROXIMATELY 330 KPA (48 PSI). PERFORM FUEL PRESSURE RELEASE PROCEDURE BEFORE SERVICING THE FUEL RAIL OR FUEL INJECTORS.

(1) Perform the Fuel Pressure Release Procedure.

(2) Disconnect negative cable from battery.

(3) Remove air cleaner to throttle body hose.

(4) Remove throttle cable (Fig. 5).

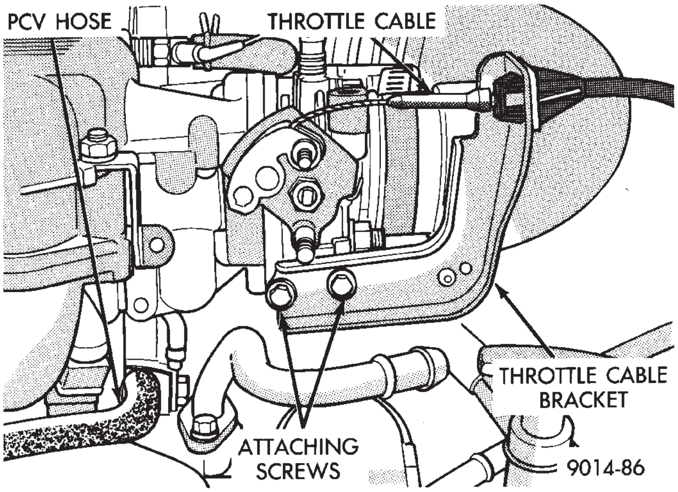


Fig. 5 Throttle Cable Attachment

(5) Disconnect electrical connectors from the idle air control motor and throttle position sensor (TPS).

(6) Remove vacuum hose harness from throttle body (Fig. 6).

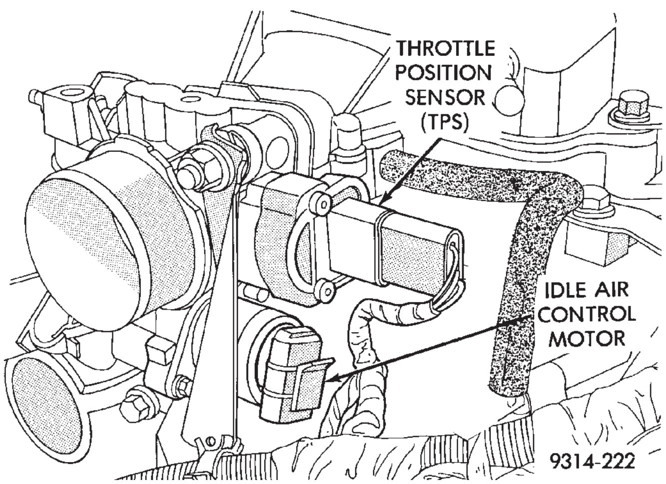


Fig. 6 Electrical and Vacuum Connection to Throttle Body

(7) Remove electrical connector from the coolant temperature sensor (Fig. 7).

(8) Remove vacuum connections from air intake plenum vacuum connector (Fig. 7).

(9) Remove fuel hoses from fuel rail (Fig. 7).

(10) Remove air intake plenum to intake manifold mounting fasteners (Fig. 8).

(11) Remove ignition coil.

(12) Remove air intake plenum (Fig. 9).

(13) Cover intake manifold while servicing injector fuel rail (Fig. 10).

(14) Remove vacuum hoses from fuel rail (Fig. 10).

(15) Disconnect fuel injector wiring harness from engine wiring harness (Fig. 11).

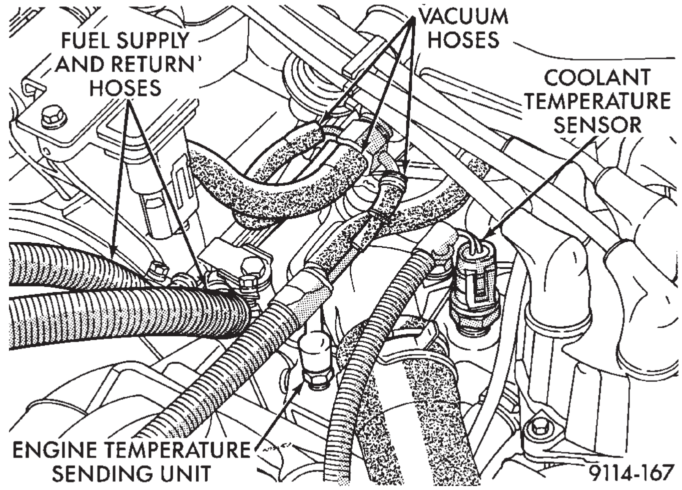


Fig. 7 Coolant Temperature Sensor Electrical Connections

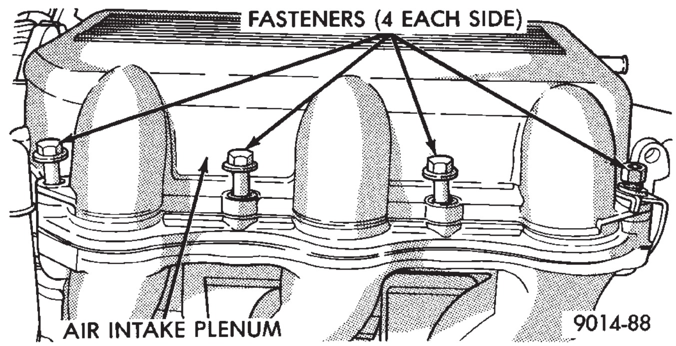


Fig. 8 Air Intake Plenum to Intake Manifold Attaching Fasteners

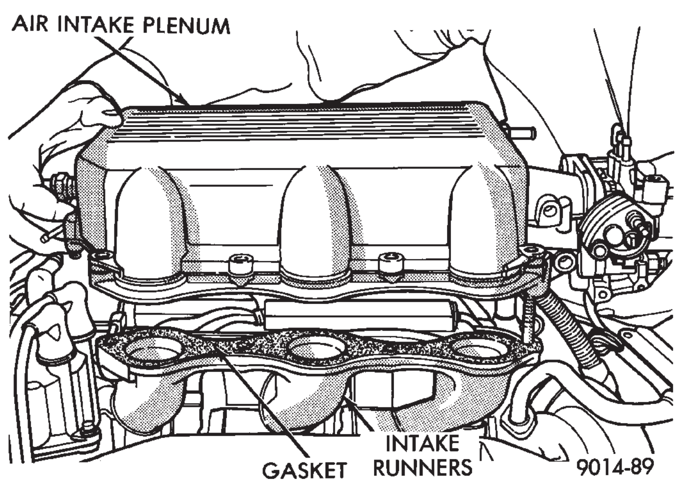


Fig. 9 Removing Air Intake Plenum

CAUTION: Do not damage the injector O-Rings when removing the injectors and fuel rail assembly.

(16) Remove fuel rail mounting bolts. Lift fuel rail assembly off of intake manifold.

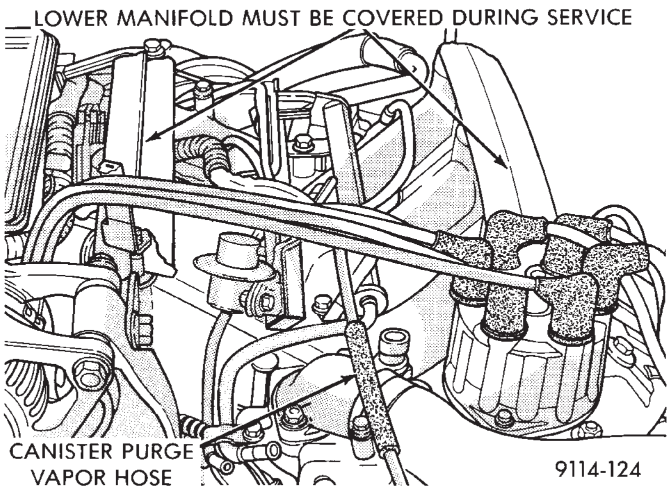


Fig. 10 Vacuum Connections at the Fuel Rail

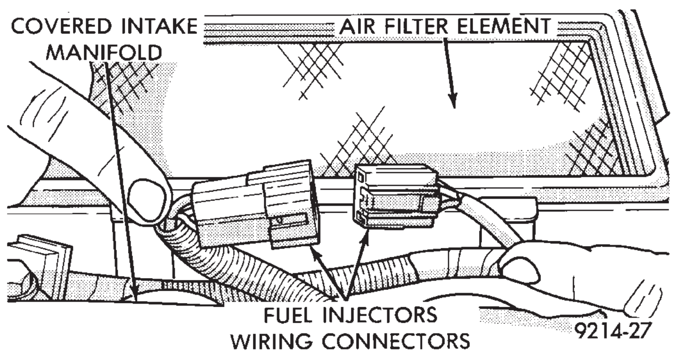


Fig. 11 Fuel Injector Wiring Harness

FUEL INJECTOR RAIL ASSEMBLY

INSTALLATION

(1) Ensure injectors are seated into the receiver cup of fuel rail with lock ring in place.

(2) Make sure the injector holes in the manifold are clean.

(3) To ease installation, lubricate injector O-ring with a drop of clean engine oil.

(4) Put the tip of each injector into their ports. Push the assembly into place until the injectors are seated in the ports.

(5) Install fuel rail attaching bolts. Tighten bolts to 13 N●m (115 in. lbs.) torque.

(6) Install fuel supply and return tube holddown bolt and the vacuum crossover tube holddown bolt. Tighten bolts to 10 N●m (95 in. lbs.) torque.

(7) Connect fuel injector wiring harness to engine wiring harness.

(8) Connect vacuum harness to fuel rail assembly.

(9) Remove covering from lower intake manifold and clean surface.

(10) Place intake manifold gaskets **with beaded sealer up** on lower manifold. Put air intake in place. Install ignition coil. Install attaching fasteners and tighten to 13 N●m (115 in. lbs.) torque.

(11) Connect fuel lines to fuel rail. Tighten hose clamps to 1 N●m (10 in. lbs.) torque.

(12) Connect vacuum harness to air intake plenum and fuel pressure regulator.

(13) Connect coolant temperature sensor electrical connector to sensor.

(14) Connect PCV and brake booster supply hose to intake plenum.

(15) Connect idle air control motor and throttle position sensor (TPS) electrical connectors.

(16) Connect vacuum vapor harness to throttle body.

(17) Install throttle cable.

(18) Install air inlet hose assembly.

(19) 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.

(20) With the ignition key in ON position, access the DRBII scan tool ASD Fuel System Test to pressurize the fuel system. Check for leaks.

FUEL PRESSURE REGULATOR SERVICE

REMOVAL

WARNING: THE 3.0L MPI FUEL SYSTEM IS UNDER A CONSTANT PRESSURE OF APPROXIMATELY 330 KPA (48 PSI). PERFORM FUEL PRESSURE RELEASE PROCEDURE BEFORE SERVICING THE FUEL PRESSURE REGULATOR.

(1) Perform the Fuel Pressure Release Procedure.

(2) Disconnect negative cable from battery.

(3) Loosen fuel return hose clamp and remove fuel return hose from nipple.

(4) Remove vacuum hose from fuel pressure regulator. (Fig. 12).

(5) Remove screw holding fuel return tube to the intake manifold.

(6) Remove fuel pressure regulator screws. Remove fuel pressure regulator from engine.

INSTALLATION

(1) Lubricate O-ring on fuel pressure regulator with clean 30 weight engine oil.

(2) Install fuel pressure regulator into fuel rail. Tighten screws to 10 N●m (90 in. lbs.) torque.

(3) Install screw holding fuel return tube clamp in place. Tighten screw to 10 N●m (95 in. lbs.) torque.

(4) Connect vacuum hose to fuel pressure regulator.

(5) Connect fuel return hose to fuel return tube. Tighten hose clamp to 1 N●m (10 in. lbs.) torque.

(6) Connect negative battery cable.

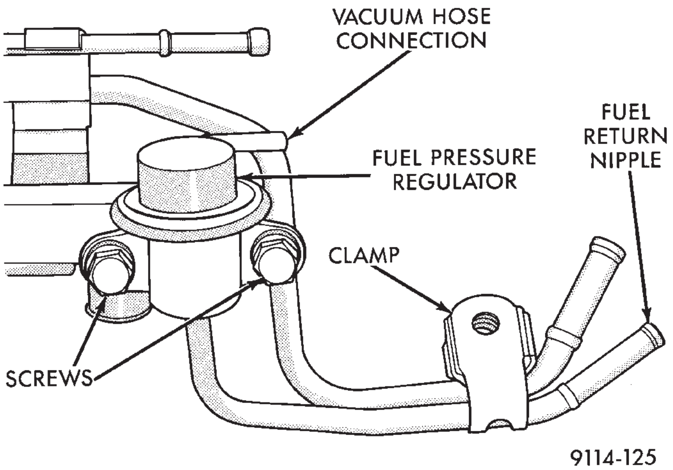


Fig. 12 Fuel Pressure Regulator

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.

(7) With the ignition key in ON position, access the DRBII scan tool ASD Fuel System Test to pressurize the fuel system. Check for leaks.

FUEL INJECTORS

WARNING: THE 3.0L MPI FUEL SYSTEM IS UNDER A CONSTANT PRESSURE OF APPROXIMATELY 330 KPA (48 PSI). PERFORM FUEL PRESSURE RELEASE PROCEDURE BEFORE SERVICING THE FUEL INJECTORS.

REMOVAL

(1) Perform the Fuel Pressure Release Procedure.

(2) Disconnect negative cable from battery.

The fuel rail must be removed first to service the injectors. Refer to Fuel Injector Rail Assembly Removal in this section.

(3) Label each injector connector with its cylinder number. Disconnect electrical connector from injector.

(4) Position fuel rail assembly so that the fuel injectors are easily accessible.

(5) Remove injector clip from fuel rail and injector (Fig. 13).

(6) Pull injector straight out of fuel rail receiver cup (Fig. 14).

(7) Check injector O-ring for damage. If O-ring is damaged, it must be replaced. If injector is to be reused, a protective cap must be installed on the injector tip to prevent damage.

(8) Repeat procedure for remaining injectors.

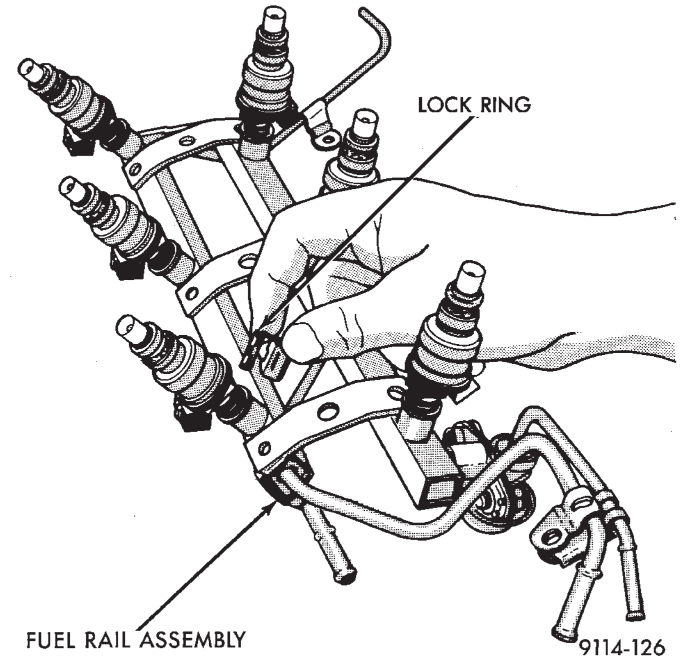


Fig. 13 Fuel Injector and Rail

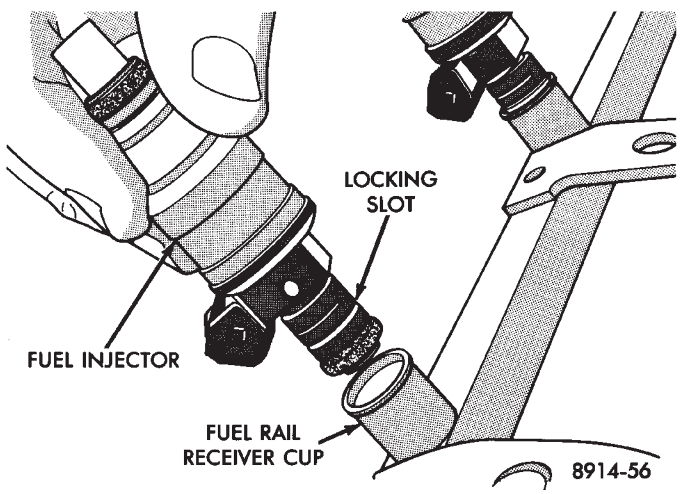


Fig. 14 Servicing Fuel Injector

INSTALLATION

(1) Before installing an injector, the rubber O-ring must be lubricated with a drop of clean engine oil to aid in installation.

(2) Being careful not to damage O-ring, install injector nozzle end into fuel rail receiver cap (Fig. 14).

(3) Install injector clip by sliding open end into **top slot** of the injector. The edge of the receiver cup will slide into the side slots of clip (Fig. 14).

(4) Repeat steps for remaining injectors.

(5) Install fuel rail assembly. Refer to Fuel Rail Assembly Installation in this section.

(6) Connect electrical connectors to injectors in correct order.

(7) Connect negative battery cable.

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) With the ignition key in ON position, access the DRBII scan tool ASD Fuel System Test to pressurize the fuel system. Check for leaks.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

(1) Remove vacuum hose and mounting screws from manifold absolute pressure (MAP) sensor (Fig. 15).

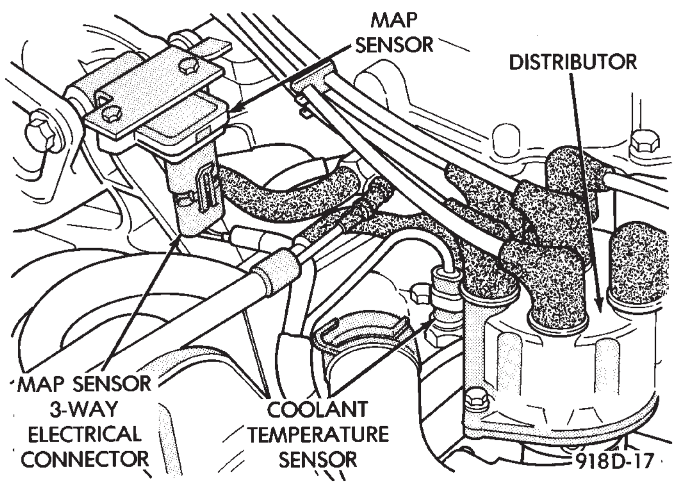


Fig. 15 Manifold Absolute Pressure Sensor

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

(3) Reverse the above procedure for installation.

DUTY CYCLE CANISTER PURGE SOLENOID

(1) Remove vacuum hose and electrical connector from solenoid (Fig. 16).

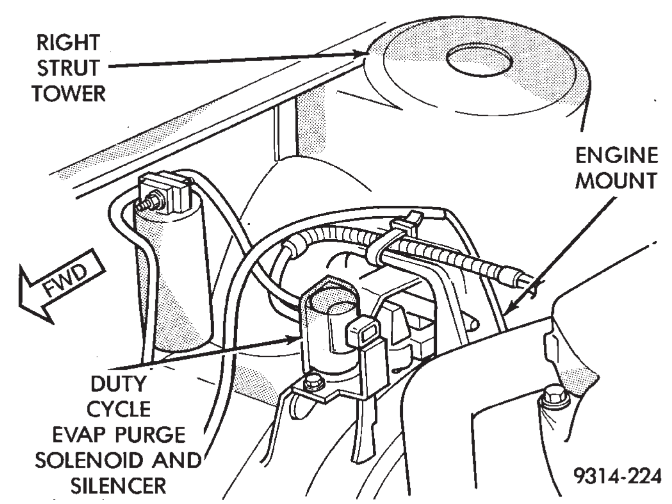


Fig. 16 Duty Cycle Canister Purge Solenoid

(2) Depress tab on top of solenoid and slide the solenoid downward out of mounting bracket.

(3) Reverse above procedure to install.

POWERTRAIN CONTROL MODULE (PCM)

(1) Remove air cleaner duct from powertrain control module (PCM).

(2) Disconnect negative cable from battery. Disconnect positive cable from battery.

(3) Remove battery holddown. Remove battery.

(4) Remove PCM mounting screws (Fig. 17).

(5) Remove the electrical connector from PCM. Remove PCM.

(6) Reverse the above procedure for installation.

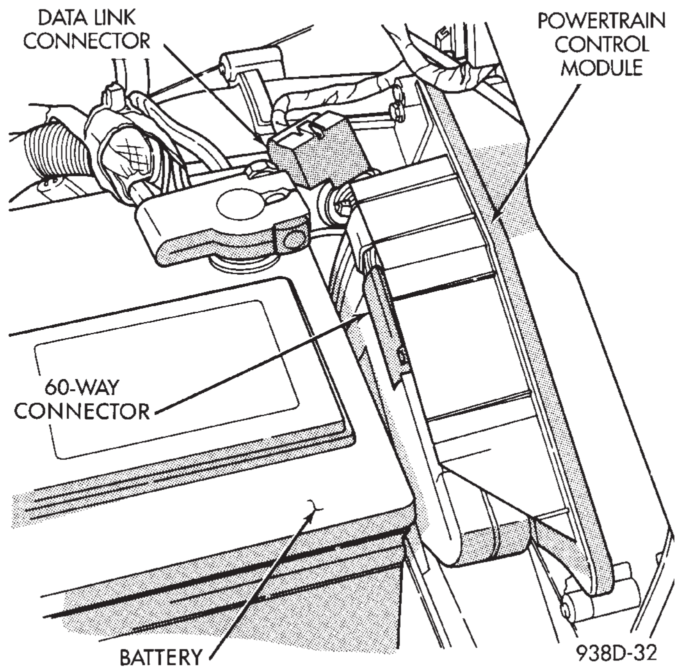


Fig. 17 Powertrain control module (PCM)

HEATED OXYGEN SENSOR (O_2 SENSOR)

The oxygen sensor is installed in the exhaust manifold (Fig. 18).

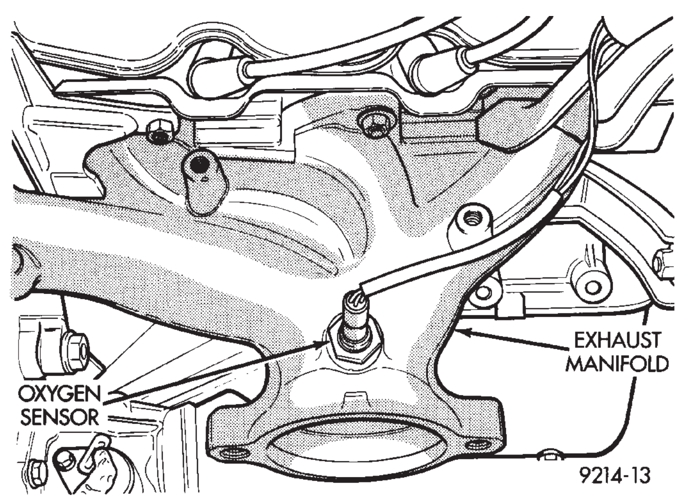


Fig. 18 Heated Oxygen Sensor

CAUTION: Do not pull on the oxygen sensor wires when disconnecting the electrical connector.

WARNING: THE EXHAUST MANIFOLD MAY BE EXTREMELY HOT. USE CARE WHEN SERVICING THE OXYGEN SENSOR.

(1) Disconnect oxygen sensor electrical connector.

(2) Remove sensor using Tool C-4907 (Fig. 19).

When the sensor is removed, the exhaust manifold threads must be cleaned with an 18 mm X 1.5 + 6E tap. If using original sensor, coat the threads with Loctite 771-64 anti-seize compound or equivalent. New sensors are packaged with compound on the threads and no additional compound is required. The sensor must be tightened to 27 N●m (20 ft. lbs.) torque.

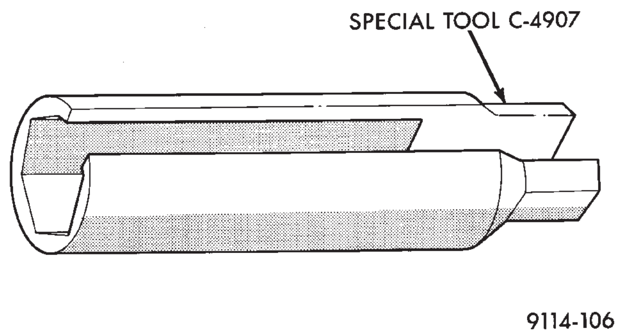


Fig. 19 Oxygen Sensor Socket

3.3L MULTI-PORT FUEL INJECTION—SYSTEM OPERATION

INDEX

GENERAL INFORMATION

The 3.3L engine uses a sequential Multi-Port Electronic Fuel Injection system (Fig. 1). 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 powertrain control module (PCM) regulates ignition timing, air-fuel ratio, emission control devices, cooling fan, charging system, idle speed and 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. 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.

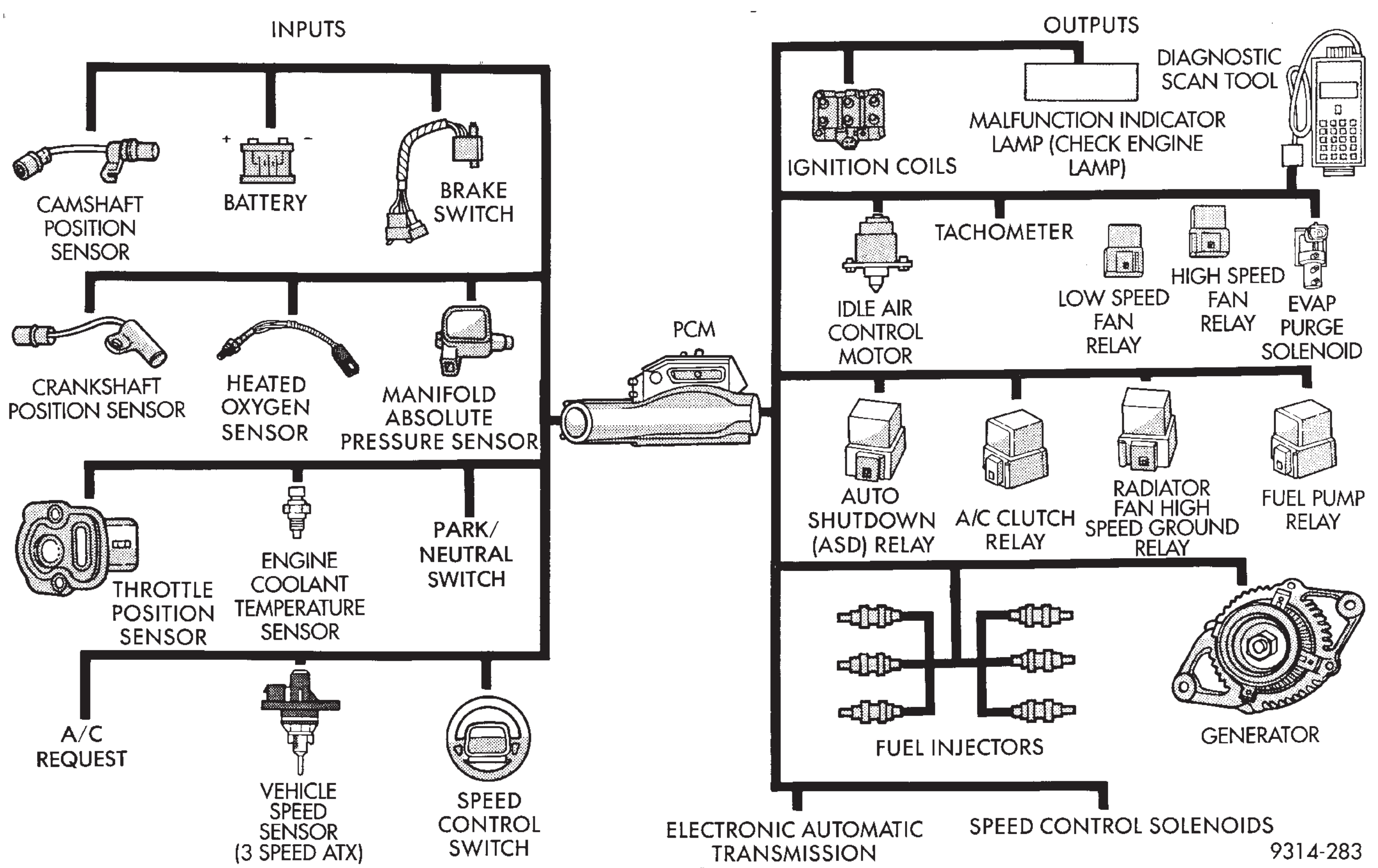


Fig. 1 Multi-Port Fuel Injection Components

SYSTEM DIAGNOSIS

The powertrain control module (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 in memory.

Technicians can display stored diagnostic trouble codes by two different methods. The first is to cycle the ignition switch On - Off - On - Off - On within 5 seconds. Then count the number of times the malfunction indicator lamp (check engine lamp) on the instrument panel flashes on and off. The number of flashes represents the trouble code. There is a slight pause between the flashes representing the first and second digits of the code. Longer pauses separate individual trouble codes.

The second method of reading diagnostic trouble codes uses the DRBII scan tool. For diagnostic trouble code information, refer to the 3.3L Multi-Port Fuel Injection—On-Board Diagnostics section in this group.

CCD BUS

Various controllers and modules exchange information through a communications port called the CCD Bus. The powertrain control module (PCM) transmits the malfunction indicator lamp (check engine lamp) On/Off signal, engine RPM and vehicle load information on the CCD Bus.

POWERTRAIN CONTROL MODULE (PCM)

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

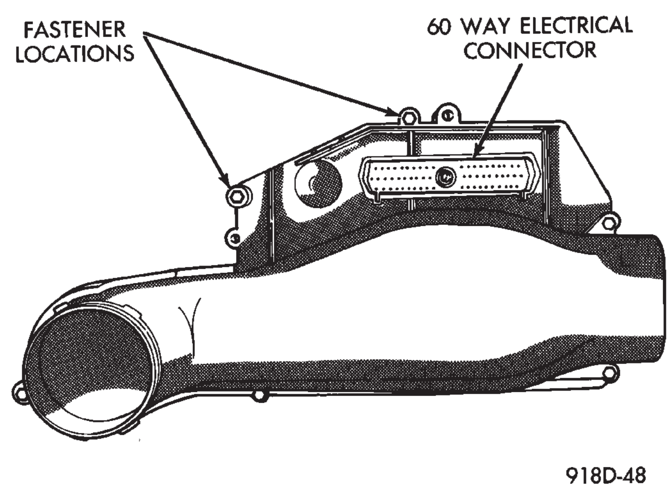


Fig. 2 Powertrain control module (PCM)

PCM Inputs:

- Air Conditioning Controls

• Battery Voltage
• Brake Switch
• Camshaft Position Sensor
• Crankshaft Position Sensor
• Coolant Temperature Sensor
• Manifold Absolute Pressure (MAP) Sensor
• Oxygen Sensor
• SCI Receive
• Speed Control System Controls
• Throttle Position Sensor
• Transmission Park/Neutral Switch (automatic transmission)
• Vehicle Speed Sensor

PCM Outputs:

• Air Conditioning Clutch Relay
• Generator Field
• Idle Air Control Motor
• Auto Shutdown (ASD) and Fuel Pump Relays
• Canister Purge Solenoid
• Malfunction Indicator (Check Engine) Lamp
• Data Link Connector
• Fuel Injectors
• Ignition Coil
• Radiator Fan Low Speed Relay
• Radiator Fan High Speed Relay
• Speed Control Solenoids
• Tachometer Output

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

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

• battery voltage
• coolant temperature
• exhaust gas content (oxygen sensor)
• engine speed (crankshaft position sensor)
• manifold absolute pressure
• throttle position

The PCM adjusts ignition timing based on the following inputs.

• coolant temperature
• engine speed (crankshaft position sensor)
• manifold absolute pressure
• throttle position
• transmission gear selection (park/neutral switch)

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

• air conditioning select switch
• brake switch
• coolant temperature
• engine speed (crankshaft position sensor)
• manifold absolute pressure
• throttle position
• transmission gear selection (park/neutral switch)
• vehicle distance (speed)

The auto shutdown (ASD) and fuel pump relays are mounted externally, but turned on and off by the PCM through the same circuit.

The camshaft position sensor and crankshaft position sensor signals are sent to the PCM. If the PCM does not receive both signals within approximately one second of engine cranking, it deactivates the ASD relay and fuel pump relay. When these relays are deactivated, power is shut off to the fuel injector, ignition coil, oxygen sensor heating element and fuel pump.

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

Beginning in this model year, the 3.3L engine uses sequential fuel injection. The PCM for this model year differs from previous model years. Do not use a previous model year PCM to test the system.

AIR CONDITIONING SWITCH SENSE—PCM INPUT

When the air conditioning or defrost switch is put in the ON position and the low pressure switch, combination valve and high pressure switch close, the PCM receives an A/C input. After receiving this input, the PCM activates the A/C compressor clutch by grounding the A/C clutch relay. The PCM also adjusts idle speed to a scheduled RPM to compensate for increased engine load.

BATTERY VOLTAGE—PCM INPUT

The powertrain control module (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).

BRAKE SWITCH—PCM INPUT

When the brake switch is activated, the powertrain control module (PCM) receives an input indicating that the brakes are being applied. After receiving this input the PCM maintains idle speed to a scheduled RPM through control of the idle air control 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). The sensor generates pulses as groups of notches on the camshaft sprocket pass underneath it (Fig. 4). 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.

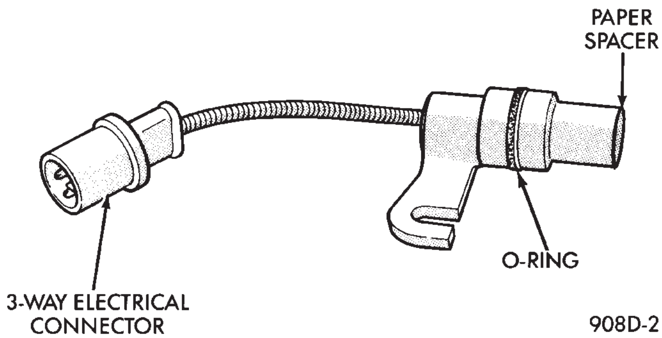


Fig. 3 Camshaft Position Sensor

When the PCM receives two camshaft 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. 4). The PCM can synchronize on cylinders 1 or 4.

When metal aligns with the sensor, voltage goes low (less than 0.5 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 Figure 4 represent which cylinder the flat spot and notches identify, they do not indicate TDC position.

The camshaft position sensor is mounted to the top of the timing case cover (Fig. 5). The bottom of the sensor is positioned above the camshaft sprocket. **The distance between the bottom of sensor and the camshaft sprocket is critical to the operation of the system. When servicing the camshaft position sensor, refer to the 3.3L and 3.8L Multi-Port Fuel Injection—Service Procedures section in this Group.**

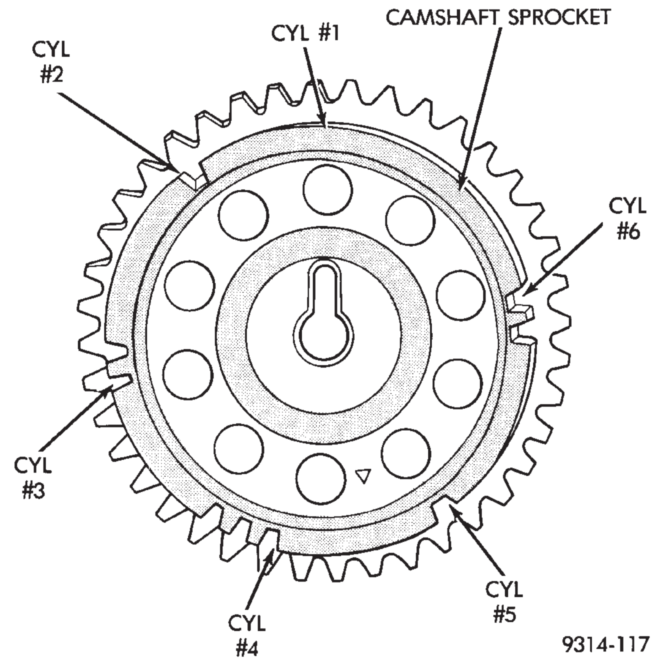


Fig. 4 Camshaft Sprocket

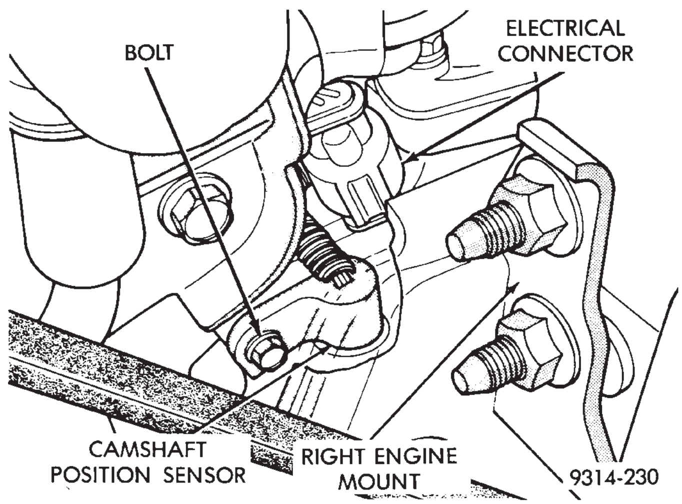


Fig. 5 Camshaft Position Sensor Location

ENGINE COOLANT TEMPERATURE SENSOR—PCM INPUT

The coolant temperature sensor is a variable resistor with a range of -40° F to 265° F. The sensor is installed next to the thermostat housing (Fig. 6).

The coolant temperature sensor provides an input voltage 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 coolant sensor is also used for cooling fan control.

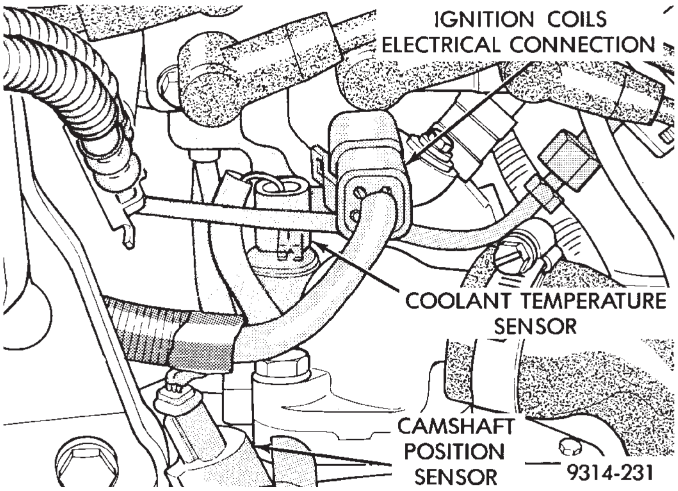


Fig. 6 Coolant Temperature Sensor

CRANKSHAFT POSITION SENSOR—PCM INPUT

The crankshaft position sensor (Fig. 7) senses slots cut into the transmission driveplate extension. There are a 3 sets of slots. Each set contains 4 slots, for a total of 12 slots (Fig. 8). Basic timing is set by the position of the last slot in each group. Once the powertrain control module (PCM) senses the last slot, it determines crankshaft position (which piston will next be at TDC) from the camshaft position sensor input. It may take the PCM one engine revolution to determine crankshaft position.

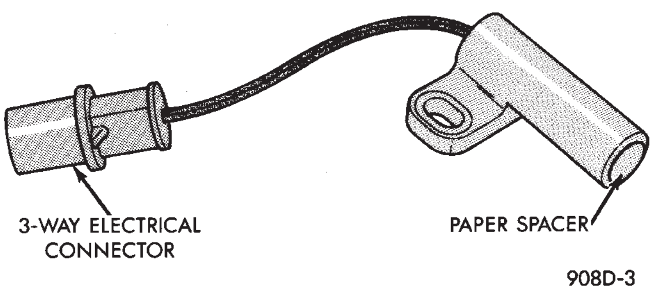


Fig. 7 Crankshaft Position Sensor

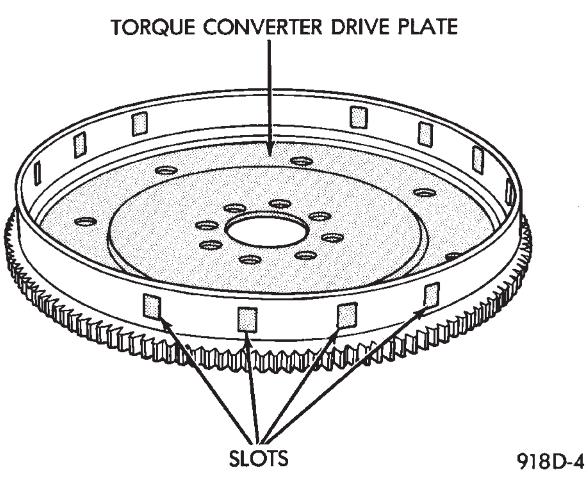


Fig. 8 Timing Slots

The PCM uses the crankshaft position sensor signal to determine injector sequence and ignition timing. Once crankshaft position has been determined, the PCM begins energizing the injectors in sequence.

The crankshaft position sensor is located in the transmission housing, above the vehicle speed sensor (Fig. 9). The bottom of the sensor is positioned next to the drive plate. **The distance between the bottom of sensor and the drive plate is critical to the operation of the system. When servicing the crankshaft position sensor, refer to the Multi-Port Fuel Injection Service Procedures—3.3L Engine section in this Group.**

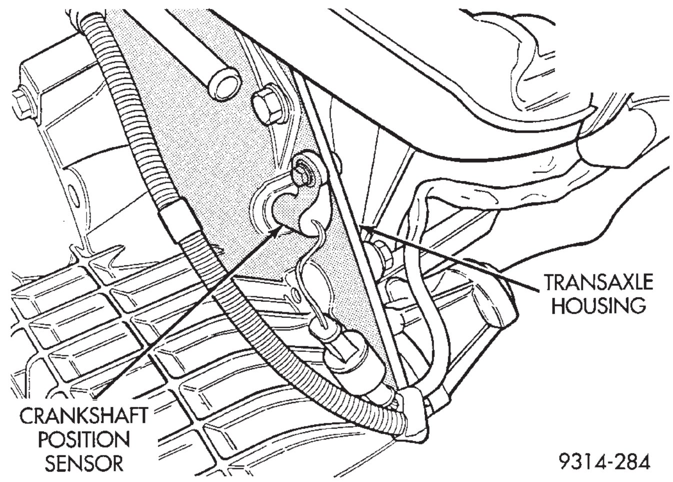


Fig. 9 Crankshaft Position Sensor Location

MANIFOLD ABSOLUTE PRESSURE (MAP) 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 voltage and inputs from other sensors, the PCM adjusts spark advance and the air/fuel mixture.

The MAP sensor (Fig. 10) mounts to the side of the intake manifold, below the positive crankcase ventilation (PCV) valve. The sensor connects electrically to the PCM.

HEATED OXYGEN SENSOR (O_2 SENSOR)—PCM INPUT

The O_2 sensor is located in the exhaust manifold and provides an input voltage to the powertrain control module (PCM). The input tells the PCM the ox-

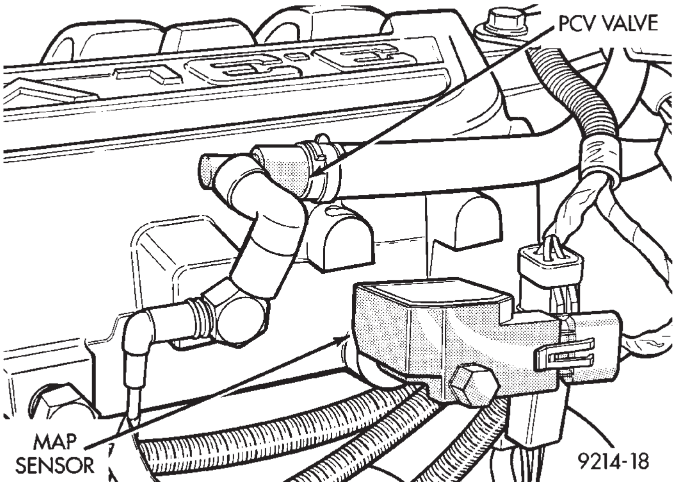


Fig. 10 Map Sensor

ygen content of the exhaust gas (Fig. 11). The PCM uses this information to fine tune the air-fuel ratio by adjusting injector pulse width.

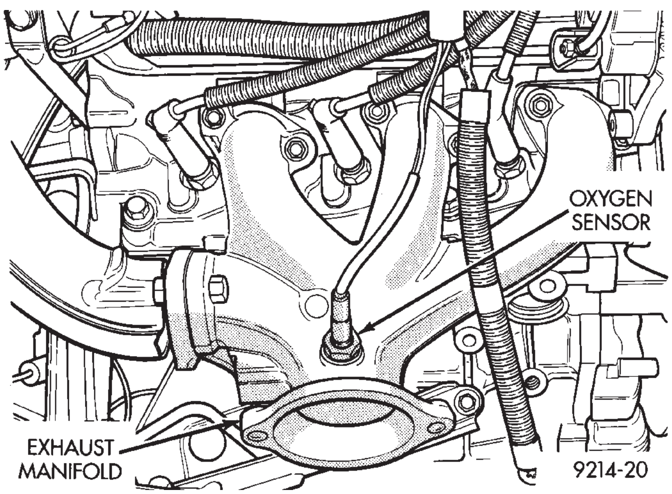


Fig. 11 Oxygen Sensor—3.3L Engine

The O_2 sensor produces 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 sensor 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 sensor acts as a rich-lean switch.

The oxygen sensor is equipped with a heating element that keeps the sensor 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 O_2 sensor input (along with other inputs) and adjusts the injector pulse width accordingly. During “Open Loop” operation the PCM ignores the O_2 sensor input. The PCM adjusts injector pulse width based on preprogrammed (fixed) values and inputs from other sensors.

SPEED CONTROL—PCM INPUT

The speed control system provides four separate voltages (inputs) to the powertrain control module (PCM). The voltages correspond to the On/Off, Set, and Resume.

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 Off voltage tells the PCM that the speed control system has deactivated. Refer to Group 8H for further speed control information.

TRANSAXLE PARK/NEUTRAL SWITCH—PCM INPUT

The park/neutral switch is located on the transaxle housing (Fig. 12). It provides an input to the PCM indicating whether the automatic transaxle is in Park or Neutral. This input is used to determine idle speed (varying with gear selection) and ignition timing advance. The park neutral switch is sometimes referred to as the neutral safety switch.

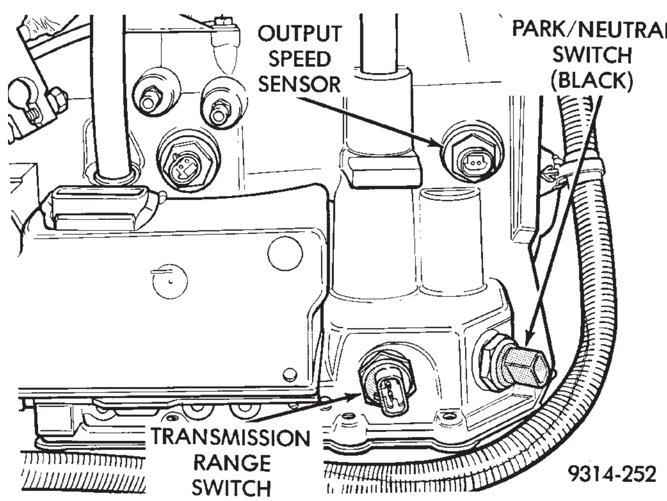


Fig. 12 Park Neutral Switch—4-Speed Electronic Automatic Transaxle

THROTTLE POSITION SENSOR (TPS)—PCM INPUT

The Throttle Position Sensor (TPS) is mounted on the throttle body and connected to the throttle blade shaft (Fig. 13). The TPS is a variable resistor that provides the powertrain control module (PCM) with an input signal (voltage) representing throttle blade position. As the position of the throttle blade changes, the resistance of the TPS changes.

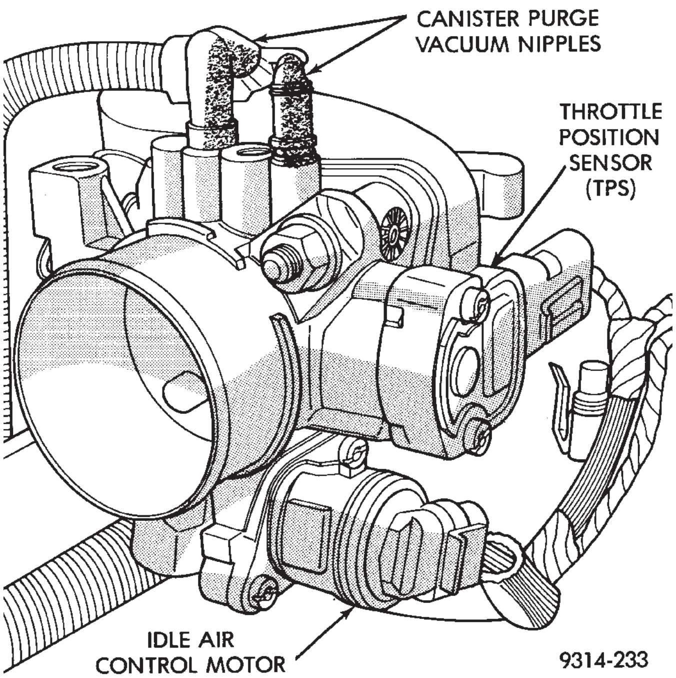


Fig. 13 Throttle Position Sensor

The PCM supplies approximately 5 volts to the TPS. The TPS output voltage (input signal to the PCM) represents the throttle blade position. The TPS output voltage to the PCM varies from approximately 0.5 volt at minimum throttle opening (idle) to 4 volts at wide open throttle. Along with inputs from other sensors, the PCM uses the TPS input to determine current engine operating conditions and adjust fuel injector pulse width and ignition timing.

VEHICLE SPEED AND DISTANCE INPUT—PCM INPUT

The transaxle output speed sensor supplies the vehicle speed and distance inputs to the PCM. The output speed sensor is located on the side of the transaxle (Fig. 12).

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

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

The powertrain control module (PCM) operates the air conditioning clutch relay ground circuit (Fig. 14). The radiator fan low speed relay supplies battery power to the solenoid side of the relay. The air conditioning clutch relay will not energize unless the radiator fan low speed relay energizes. The radiator fan low speed relay energizes when the air conditioning or defrost switch is put in the ON position and the low pressure, combination valve, and high pressure switches close.

With the engine operating, the PCM cycles the air conditioning clutch on and off when the A/C switch closes with the blower motor switch in the on position. When the PCM senses low idle speeds or wide open throttle through the throttle position sensor, it de-energizes the A/C clutch relay. The relay contacts open, preventing air conditioning clutch engagement.

GENERATOR FIELD—PCM OUTPUT

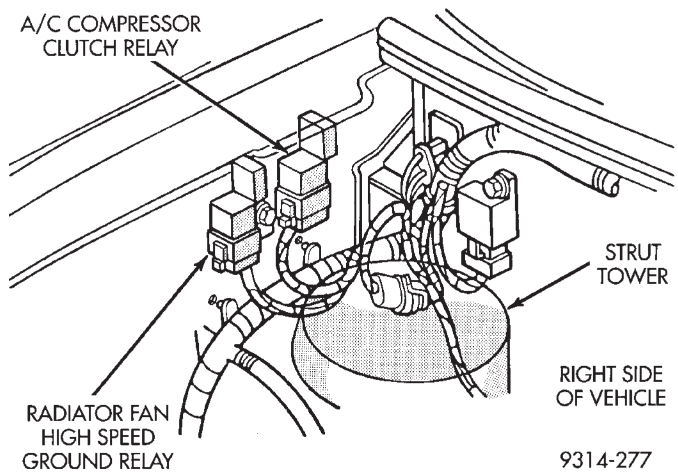


Fig. 14 Relay Identification

The powertrain control module (PCM) regulates the charging system voltage within a range of 12.9 to 15.0 volts. Refer to Group 8A for charging system information.

AUTO SHUTDOWN (ASD) RELAY AND FUEL PUMP RELAY—PCM OUTPUT

The powertrain control module (PCM) operates the auto shutdown (ASD) relay and fuel pump relay through one ground path. The PCM operates the relays by switching the ground path on and off. Both relays turn on and off at the same time.

The ASD relay connects battery voltage to the fuel injector and ignition coil. The fuel pump relay connects battery voltage to the fuel pump and oxygen sensor heating element.

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 the crankshaft position sensor and camshaft position sensor signals when the ignition switch is in the Run position, it will de-energize both relays. When the relays are de-energized, battery voltage is not supplied to the fuel injector, ignition coil, fuel pump and oxygen sensor heating element.

The ASD relay and fuel pump relay are mounted on the drivers side fender well, near to the PCM (Fig. 15).

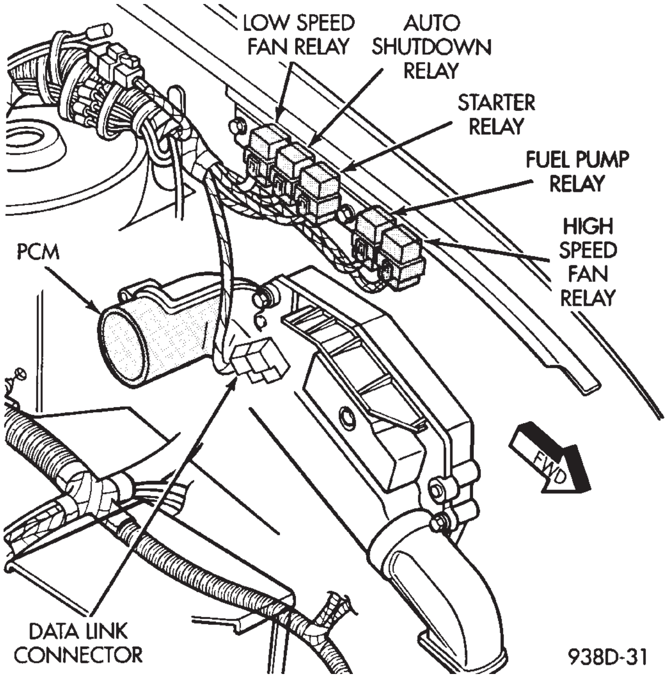


Fig. 15 Auto Shutdown Relay and Fuel Pump Relay

IDLE AIR CONTROL MOTOR—PCM OUTPUT

The idle air control motor is mounted on the throttle body. The PCM operates the idle air control motor (Fig. 13). The PCM adjusts engine idle speed through the idle air control motor to compensate for engine load or ambient conditions.

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.

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 are from the throttle position sensor, crankshaft position sensor, coolant temperature sensor, and various switch operations (brake, park/neutral, air conditioning). Deceleration die out is also prevented by increasing airflow when the throttle is closed quickly after a driving (speed) condition.

CANISTER PURGE SOLENOID—PCM OUTPUT

Vacuum for the Evaporative Canister is controlled by the Canister Purge Solenoid (Fig. 16). The solenoid is controlled by the powertrain control module (PCM).

The PCM operates the solenoid by switching the ground circuit on and off based on engine operating conditions. When energized, the solenoid prevents

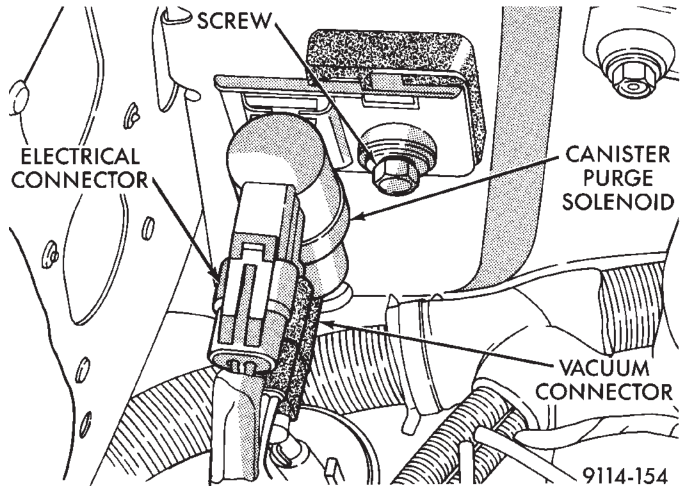


Fig. 16 Canister Purge Solenoid

vacuum from reaching the evaporative canister. When not energized the solenoid allows vacuum to flow to the canister.

During warm-up and for a specified time period after hot starts, the PCM grounds the purge solenoid. When grounded, the solenoid is energized and vacuum does not operate the evaporative canister valve.

The PCM removes the ground to the solenoid when the engine reaches a specified temperature and the time delay interval has occurred. When the solenoid is de-energized, vacuum flows to the canister purge valve. Vapors are purged from the canister and flow to the throttle body.

The purge solenoid will also be energized during certain idle conditions, in order to update the fuel delivery calibration.

MALFUNCTION INDICATOR LAMP (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 malfunction indicator lamp (instrument panel 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 warns the operator that the PCM has entered a Limp-in mode. During Limp-in Mode, the PCM attempts to keep the system operational. The malfunction indicator 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.

Signals that can trigger the Malfunction Indicator lamp (Check Engine Lamp).

- Engine Coolant Temperature Sensor
- Manifold Absolute Pressure Sensor

- Throttle Position Sensor
- Battery Voltage Input
- An Emission Related System (California vehicles)
- Charging system

The malfunction indicator (Check Engine Lamp) can also display diagnostic trouble codes. Cycle the ignition switch on, off, on, off, on, within five seconds and any diagnostic trouble codes stored in the PCM will be displayed. Refer to the 3.3L and 3.8L Multi-Port Fuel Injection—On-Board Diagnostics section of this Group for Diagnostic Trouble Code Descriptions.

DATA LINK CONNECTOR—PCM OUTPUT

The data link connector provides the technician with the means to connect the DRBII scan tool to diagnosis the vehicle.

AUTOMATIC TRANSAXLE CONTROL MODULE—PCM OUTPUT

The electronic automatic transaxle control module and the powertrain control module (PCM) supply information to each other through the CCD Bus. The information includes engine speed and vehicle load. The PCM uses the information when adjusting the fuel and ignition strategy.

FUEL INJECTORS—PCM OUTPUT

The fuel injectors are electrical solenoids (Fig. 17). The injector contains a pintle that closes off an orifice at the nozzle end. When electric current is supplied to the injector, the armature and needle move a short distance against a spring, allowing fuel to flow out the orifice. Because the fuel is under high pressure, a fine spray is developed in the shape of a hollow cone. The spraying action atomizes the fuel, adding it to the air entering the combustion chamber. The injectors are positioned in the intake manifold.

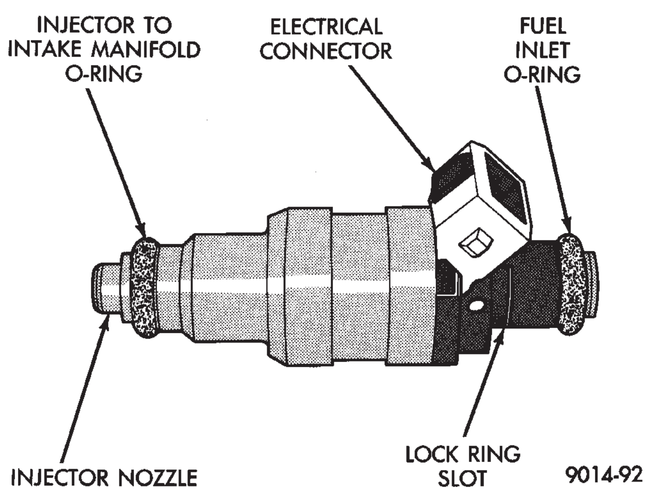


Fig. 17 Fuel Injector—3.3L Engine

The fuel injectors are operated by the PCM. They are energized in a sequential order during all engine operating conditions except start up. The PCM initially energizes all injectors at the same time. Once PCM determines crankshaft position, it begins energizing the injectors in sequence.

The auto shutdown (ASD) relay supplies battery voltage to the injectors. The PCM provides the ground path for the injectors. By switching the ground path on and off, the PCM adjusts injector pulse width. Pulse width is the amount of time the injector is energized. The PCM adjusts injector pulse width based on inputs it receives.

IGNITION COIL—PCM OUTPUT

The coil assembly consists of 3 molded coils together (Fig. 18). 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 powertrain control module (PCM) determines which of the coils to charge and fire at the correct time.

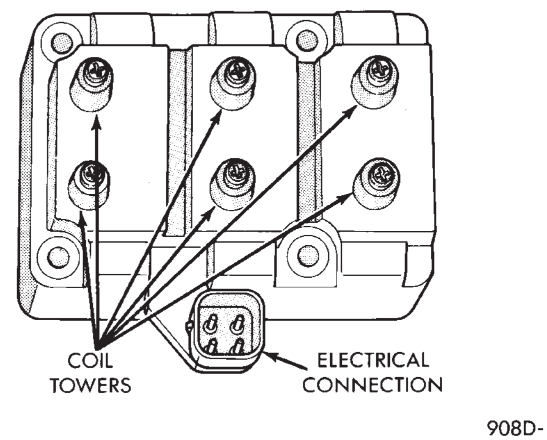


Fig. 18 Coil Pack—3.3L Engine

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

RADIATOR FAN RELAYS—PCM OUTPUT

The radiator fan runs at either low or high speed depending on coolant temperature and A/C system pressure. The radiator fan circuit contains three relays; a low speed relay, high speed relay and a ground relay for high speed operation. Refer to the Group 8W for a circuit schematic.

When the PCM provides a ground for the low speed relay, the radiator fan operates at the lower speed. The PCM does not control the ground circuit for low speed operation.

The PCM controls the ground and power supply for the high speed circuits. When the PCM senses the need for high speed operation, it grounds the high speed relay and high speed ground relay.

When engine coolant reaches approximately 102°C (215°F) the PCM grounds the low speed relay. If engine coolant reaches 107°C (225°F) the PCM grounds the high speed ground relay and high speed fan relay. If the fan operates at high speed, the PCM de-engerizes the high speed relay and high speed ground relay when coolant temperature drops to approximately 101°C (214°F). When coolant temperature drops to 101°C (214°F) the fan operates at low speed. The PCM de-energizes the low speed relay when coolant temperature drops to approximately 93°C (199°F).

Additionally, when the air conditioning pressure switch closes, the fan operates at high speed. The air conditioning switch closes at 285 PSI ±10 PSI. When air conditioning pressure drops approximately 40 PSI, the pressure switch closes and the fan operates at low speed.

The radiator fan low speed relay and high speed relay mount to the inner fender panel above the powertrain control module (Fig. 15). The high speed ground relay is located on the right side fender panel near the strut tower (Fig. 19).

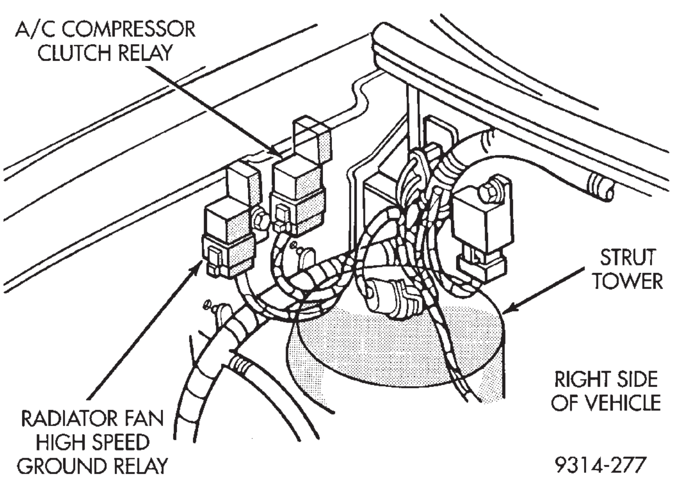


Fig. 19 High Speed Ground Relay and A/C Compressor Clutch Relay

SPEED CONTROL SOLENOIDS—PCM OUTPUT

The speed control vacuum and vent solenoids are operated by the powertrain control module (PCM). When the PCM supplies a ground to the vacuum and vent solenoids, the speed control system opens the throttle plate. When the PCM removes the ground from the vacuum and vent solenoids, the throttle blade closes. The PCM balances the two solenoids to maintain the set speed. Refer to Group 8H for speed control information.

TACHOMETER—PCM OUTPUT

The powertrain control module (PCM) supplies engine RPM to the instrument panel tachometer through the CCD Bus. The CCD Bus is a communications port. Various modules use the CCD Bus to exchange information. Refer to Group 8E for more information.

MODES OF OPERATION

As input signals to the powertrain control module (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. Input from the oxygen (O_2) sensor is not monitored during OPEN LOOP modes.

During CLOSED LOOP modes the PCM does monitor the oxygen (O_2) sensor input. This input indicates to the PCM whether or not the calculated injector pulse width results in the ideal air-fuel ratio of 14.7 parts air to 1 part fuel. By monitoring the exhaust oxygen content through the O_2 sensor, the PCM can fine tune the injector pulse width. Fine tuning injector pulse width allows the PCM to achieve optimum fuel economy combined with low emissions.

The 3.3L multi-port fuel injection system 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

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

IGNITION SWITCH ON (ZERO RPM) MODE

When the multi-port fuel injection system is activated by the ignition switch, the following actions occur:

- The powertrain control module (PCM) determines atmospheric air pressure from the MAP sensor input to determine basic fuel strategy.

• The PCM monitors the coolant temperature sensor and throttle position sensor input. The PCM modifies fuel strategy based on this input.

When the key is in the ON position and the engine is not running (zero rpm), the auto shutdown (ASD) relay and fuel pump relay are not energized. Therefore battery voltage is not supplied to the fuel pump, ignition coil, fuel injectors or oxygen sensor heating element.

ENGINE START-UP MODE

This is an OPEN LOOP mode. The following actions occur when the starter motor is engaged.

If the powertrain control module (PCM) receives the camshaft position sensor and crankshaft position sensor signals, it energizes the auto shutdown (ASD) relay and fuel pump relay. These relays supply battery voltage to the fuel pump, fuel injectors, ignition coil, and oxygen sensor heating element. If the PCM does not receive the camshaft position sensor and crankshaft position sensor signals within approximately one second, it de-energizes the ASD relay and fuel pump relay.

The PCM energizes all six injectors 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. The PCM 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 coolant temperature, manifold absolute pressure (MAP) and the number of engine revolutions since cranking was initiated.

• Monitors the coolant temperature sensor, camshaft position sensor, crankshaft position sensor, MAP sensor, and throttle position sensor to determine correct ignition timing.

ENGINE WARM-UP MODE

This is a OPEN LOOP mode. The following inputs are received by the powertrain control module (PCM):

- coolant temperature
- manifold absolute pressure (MAP)
- engine speed (crankshaft position sensor)
- throttle position
- A/C switch
- battery voltage

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 speed the following inputs are received by the powertrain control module (PCM):

- coolant temperature
- manifold absolute pressure
- engine speed (crankshaft position sensor)
- throttle position
- exhaust gas oxygen content
- A/C control positions
- battery voltage

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.

ACCELERATION MODE

This is a CLOSED LOOP mode. The powertrain control module (PCM) recognizes an abrupt increase in throttle position or MAP pressure as a demand for increased engine output and vehicle acceleration. The PCM increases injector pulse width in response to increased fuel demand.

DECELERATION MODE

This is a CLOSED LOOP mode. During deceleration the following inputs are received by the powertrain control module (PCM):

- coolant temperature
- manifold absolute pressure
- engine speed
- throttle position
- exhaust gas oxygen content
- A/C control positions
- battery voltage

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. The PCM may reduce injector firing to once per engine revolution. This helps maintain better control of the air-fuel mixture (as sensed through the O_2 sensor).

During a deceleration condition, the PCM grounds the evaporative purge solenoid. When the solenoid is grounded, the canister purge function stops.

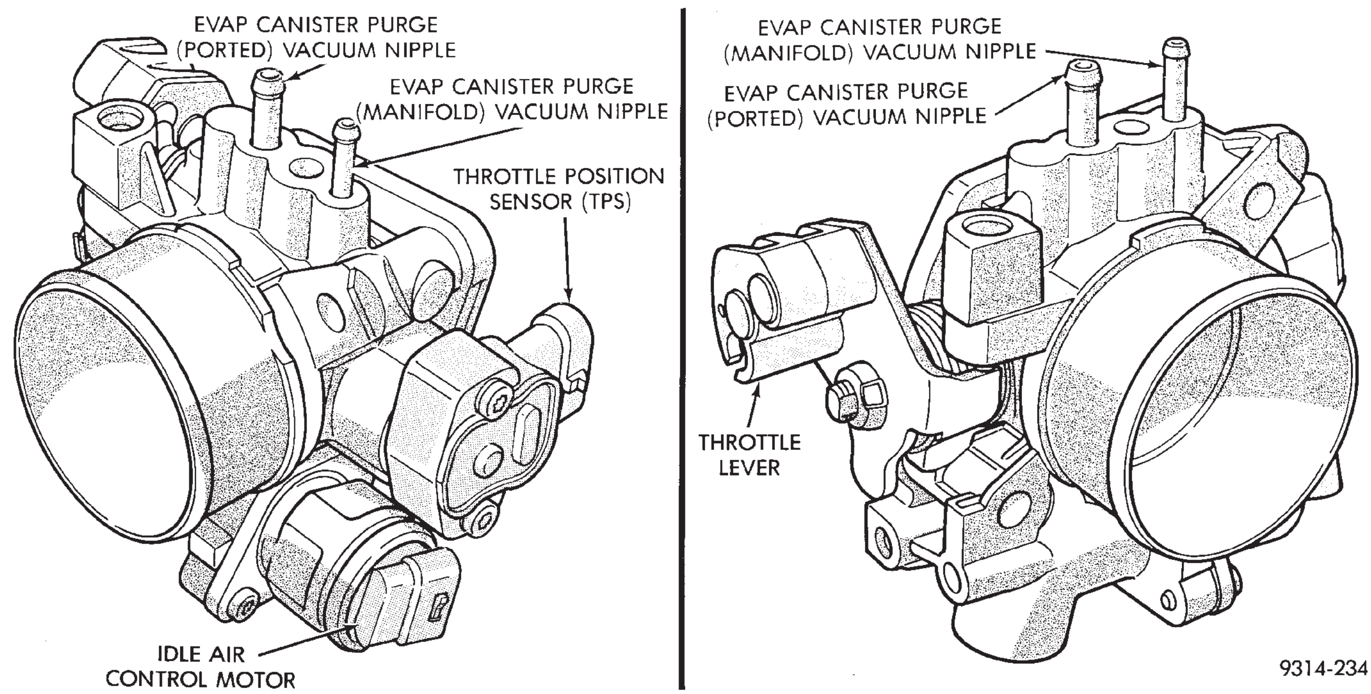


Fig. 20 Throttle Body

WIDE OPEN THROTTLE MODE

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

- coolant temperature
- manifold absolute pressure
- engine speed
- throttle position

When the PCM senses wide open throttle condition through the throttle position sensor (TPS) it will:

- De-energize the air conditioning relay. This disables the air conditioning system.

The exhaust gas oxygen content input is not accepted by the PCM during wide open throttle operation. The PCM will adjust injector pulse width to supply a predetermined amount of additional fuel.

IGNITION SWITCH OFF MODE

When the ignition switch is turned to the OFF position, the following occurs:

- All outputs are turned off.
- No inputs are monitored.
- The powertrain control module (PCM) shuts down.

THROTTLE BODY

The throttle body assembly is located on the left side of the intake manifold plenum (Fig. 20). The throttle body houses the throttle position sensor and the idle air control motor. Air flow through the throttle body is controlled by a cable operated throttle blade located in the base of the throttle body.

FUEL SUPPLY CIRCUIT

Fuel is pumped to the fuel rail by an electrical pump in the fuel tank. The pump inlet is fitted with a filter to prevent water and other contaminants from entering the fuel supply circuit.

Fuel pressure is controlled to a preset level above intake manifold pressure by a pressure regulator. The regulator is mounted on the fuel rail. The regulator uses intake manifold pressure as a reference.

FUEL INJECTORS AND FUEL RAIL ASSEMBLY

Six fuel injectors are retained in the fuel rail by lock rings (Fig. 21). The rail and injector assembly is installed in position with the injectors inserted in recessed holes in the intake manifold.

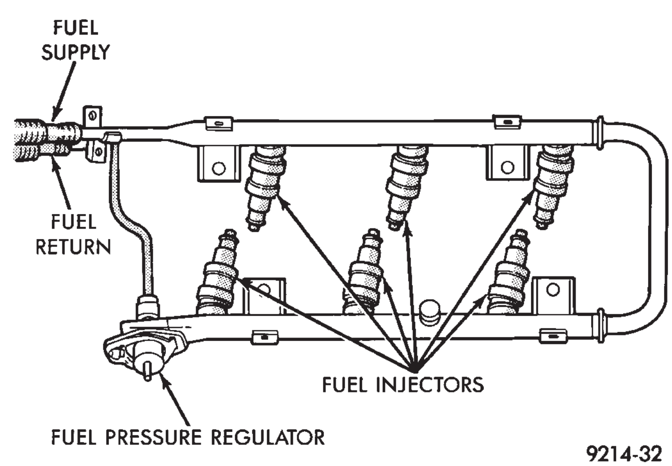


Fig. 21 Fuel Rail Assembly

FUEL PRESSURE REGULATOR

The pressure regulator is a mechanical device located on the fuel rail, downstream of the fuel injectors (Fig. 22). The regulator maintains a constant 330 kPa (48 psi) across the fuel injector tip.

The regulator contains a spring loaded rubber diaphragm that covers the fuel return port. When the fuel pump is operating, fuel flows past the injectors into the regulator, and is restricted from flowing any further by the blocked return port. When fuel pressure reaches 330 kPa (48 psi) it pushes on the diaphragm, compresses the spring, and uncovers the fuel return port. The diaphragm and spring constantly move from an open to closed position to keep the fuel pressure constant.

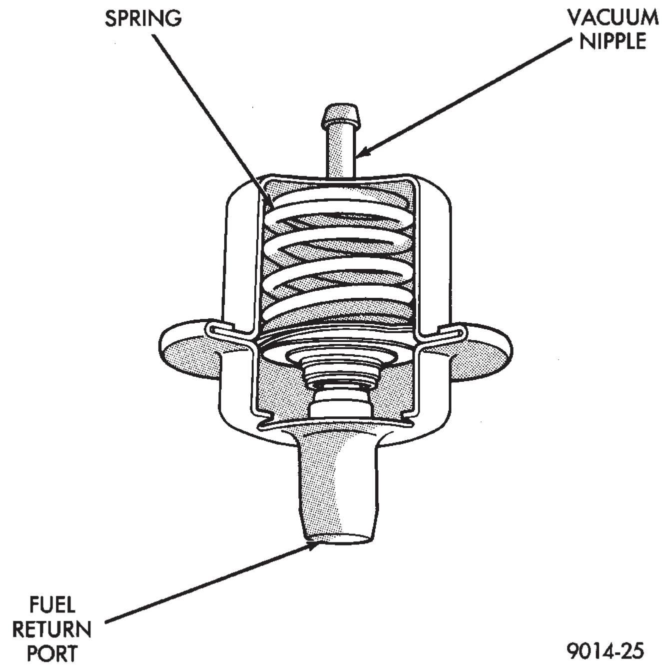


Fig. 22 Fuel Pressure Regulator

3.3L MULTI-PORT FUEL INJECTION—GENERAL DIAGNOSIS

FUEL SYSTEM DIAGRAM

Refer to the System Operation portion of this section for a more complete description of the components shown in Fig. 1.

VISUAL INSPECTION

A visual inspection for loose, disconnected, or misrouted wires and hoses should be made before attempting to diagnose or service the fuel injection system. A visual check helps save unnecessary test and diagnostic time. A thorough visual inspection will include the following checks:

(1) Check ignition cable routing from the coil pack to the spark plugs. Verify the cable are routed in the correct order and are fully seated to the coil and spark plug.

(2) Check direct ignition system (DIS) coil electrical connection for damage and a complete connection to the coil (Fig. 2).

(3) Verify the camshaft position sensor electrical connector is connected to the harness and not damaged (Fig. 3).

(4) Ensure the engine temperature sensor electrical connector is connected to the sensor and not damaged (Fig. 3).

(5) Ensure the coolant temperature sensor electrical connector is connected to the sensor and not damaged (Fig. 4).

(6) Verify the quick connect fuel fittings are fully inserted on the fuel supply and return tubes.

(7) Check the vacuum hose connection at the fuel pressure regulator for damage or leakage (Fig. 5).

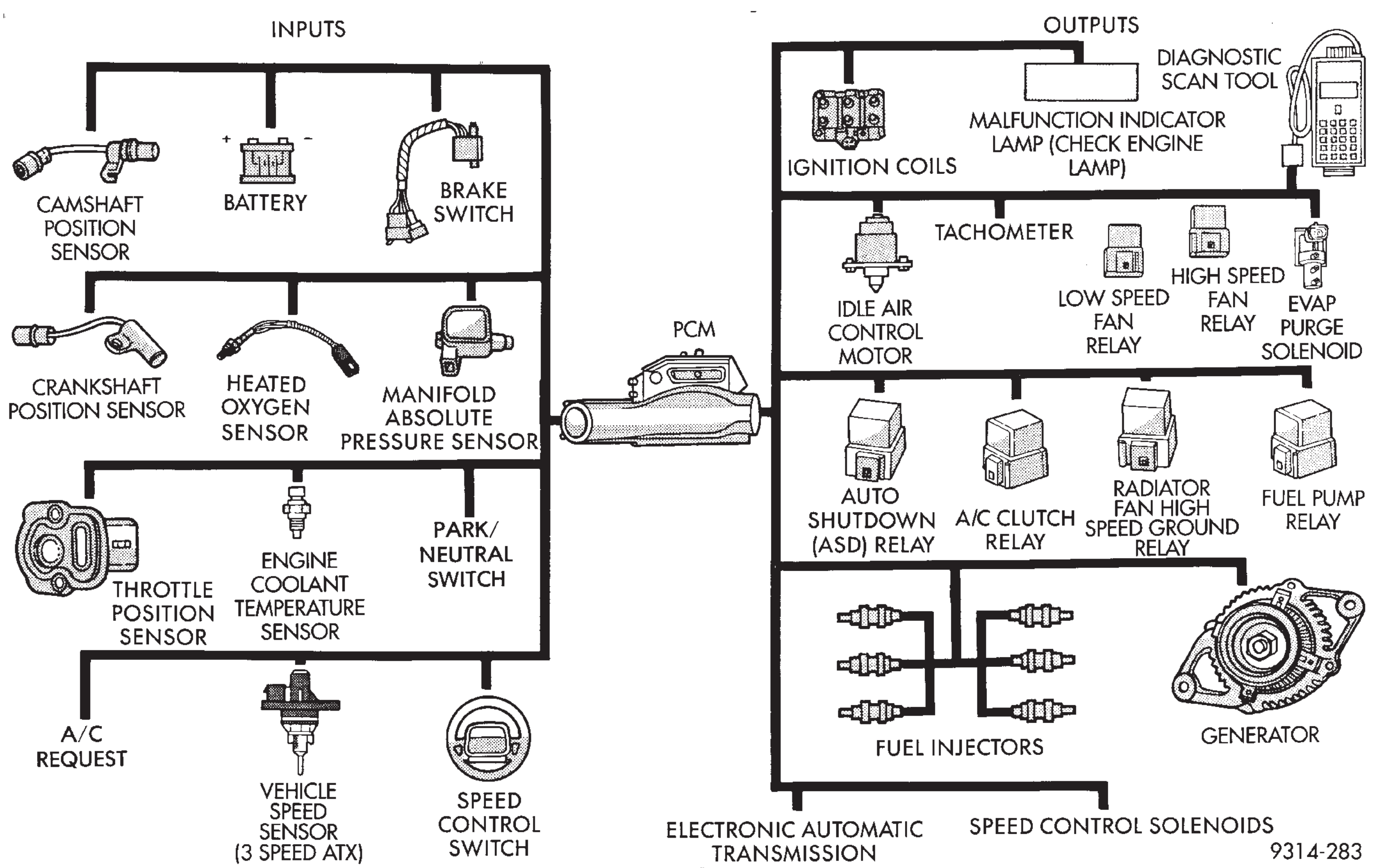


Fig. 1 Multi-Port Fuel Injection Components

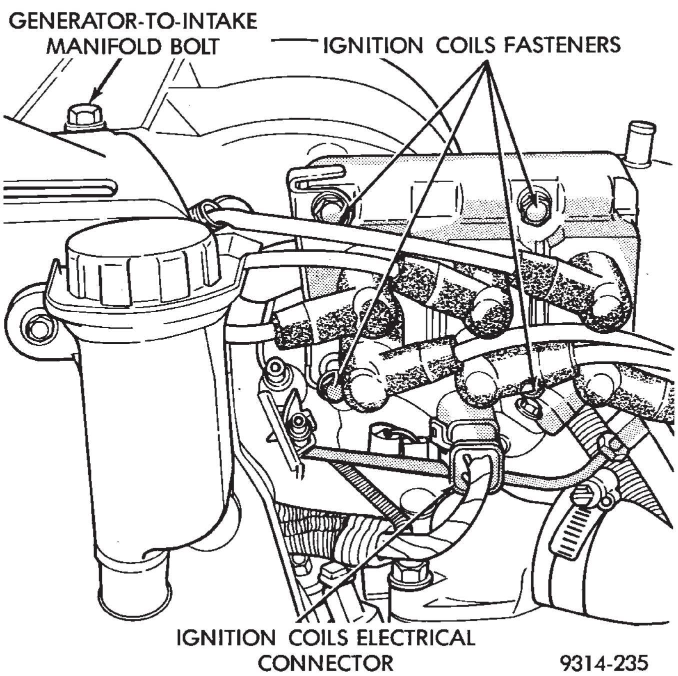


Fig. 2 Ignition Coils Electrical Connection

(8) Check the oil pressure sending unit electrical connection (Fig. 6).

(9) Verify the electrical connector is attached to the Purge Solenoid (Fig. 7) and not damaged.

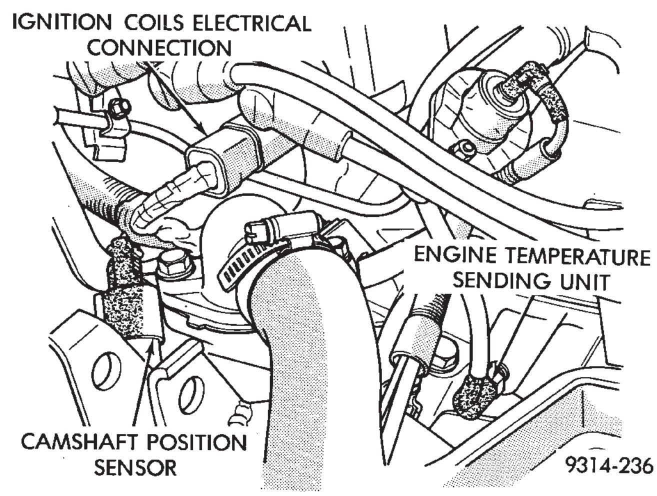


Fig. 3 Camshaft Position Sensor

(10) Verify the vacuum connection at the purge solenoid is secure and not leaking (Fig. 7).

(11) Verify the hoses are securely attached to the vapor canister (Fig. 8).

(12) Ensure the harness connectors for the fuel injector are attached to the correct injector and not damaged.

(13) Verify the fuel injector harness and engine wiring harness connectors are fully inserted into the main wiring harness.

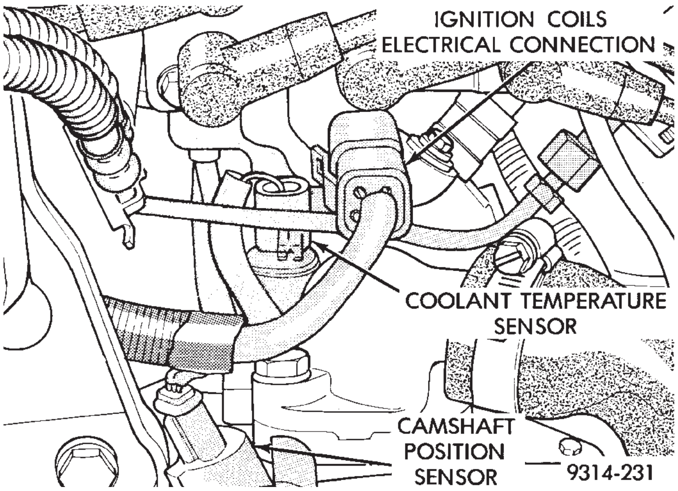


Fig. 4 Engine Coolant Temperature Sensor

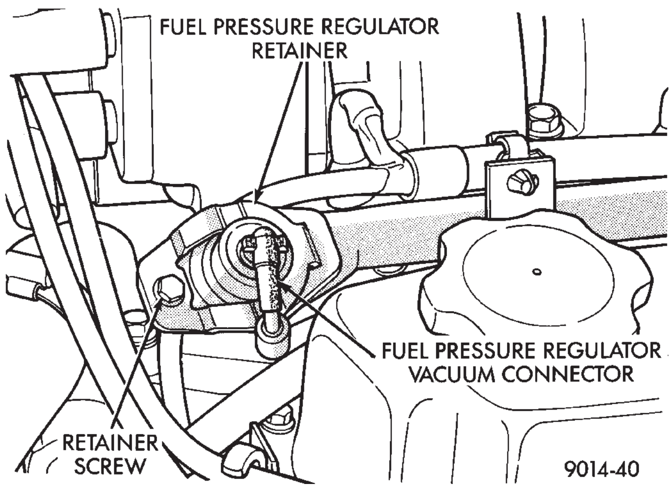


Fig. 5 Fuel Pressure Regulator Vacuum Connection

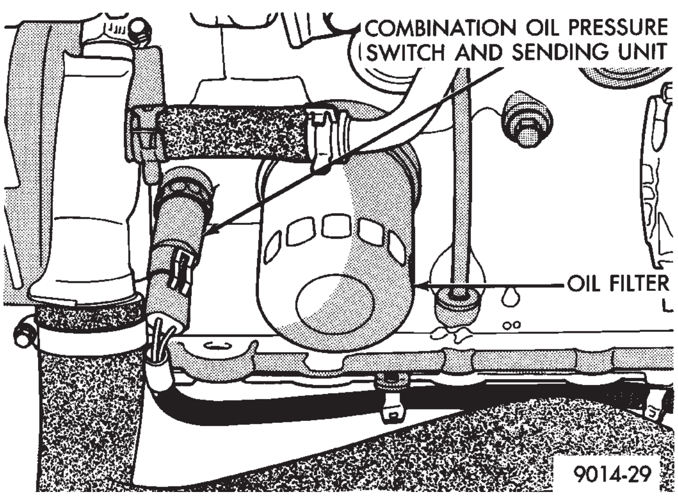


Fig. 6 Oil Pressure Sending Unit Electrical Connection

(14) Check the vacuum connections at the throttle body (Fig. 9).

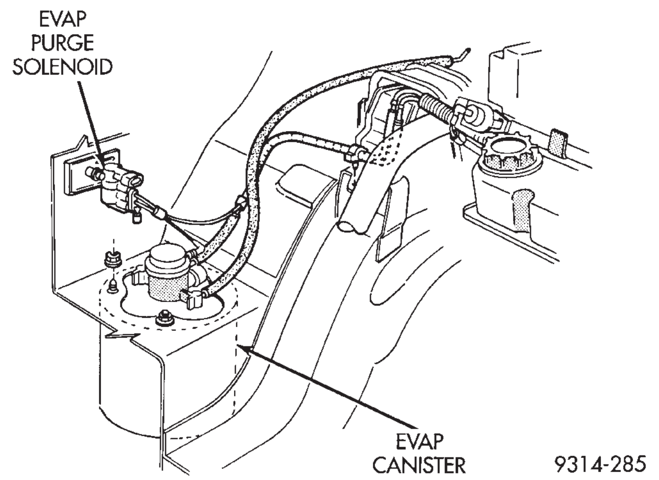


Fig. 7 Canister Purge Solenoid Electrical Connector

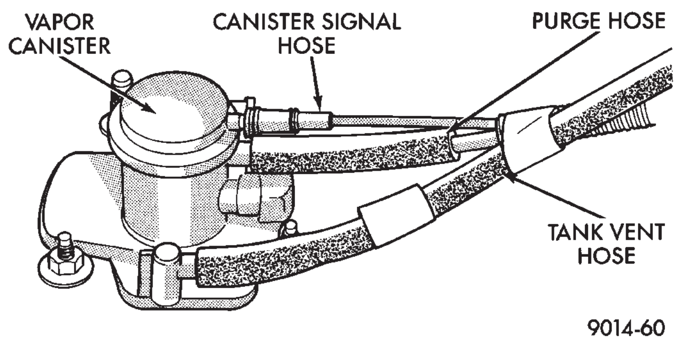


Fig. 8 Vapor Canister

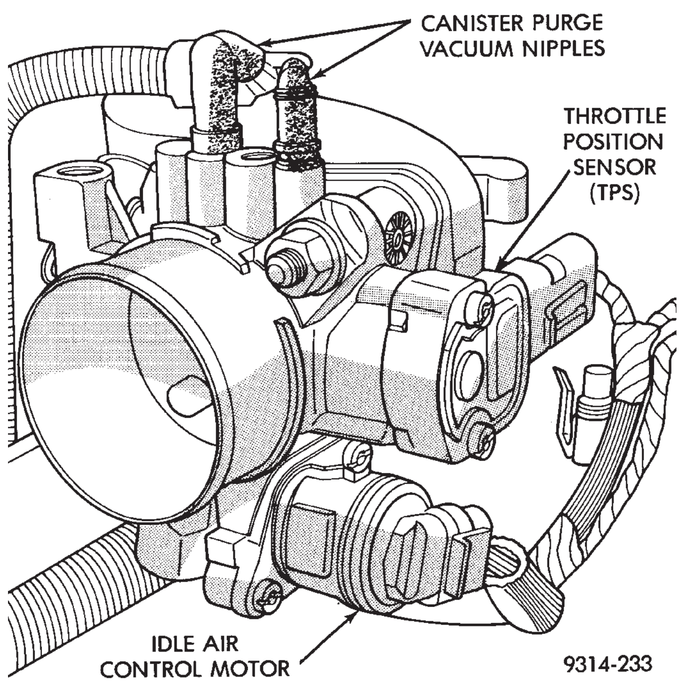


Fig. 9 Throttle Body Electrical and Vacuum Connections

(15) Ensure the idle air control motor and TPS electrical connectors are fully seated and not dam-

aged (Fig. 9).

(16) Inspect the park/neutral switch wiring connection for damage. Ensure the automatic transmission electrical connections are not damaged (Fig. 10).

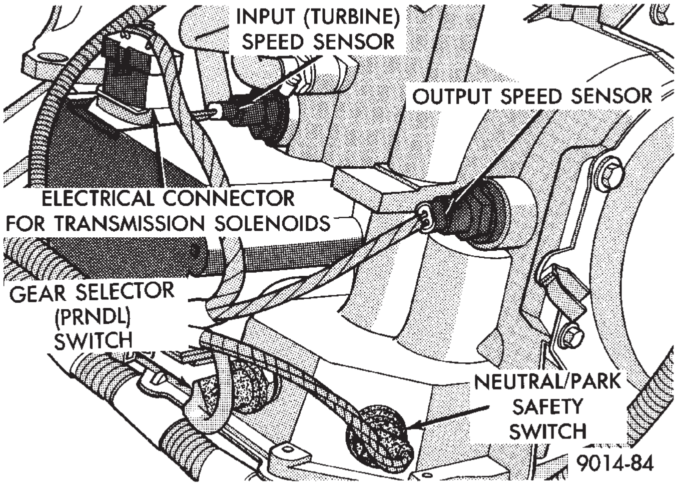


Fig. 10 Automatic Transmission Electrical Connections

(17) Check the Vacuum Hose Harness connections at the Intake Plenum (Fig. 11).

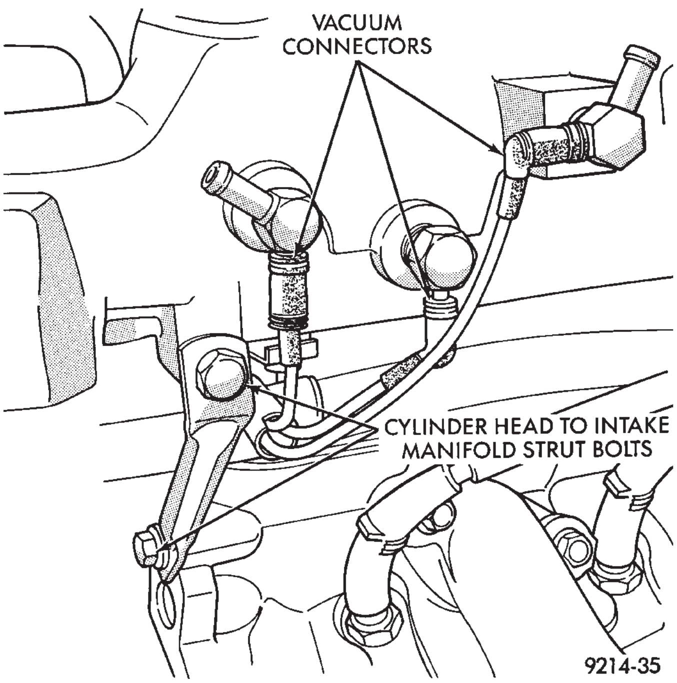


Fig. 11 Vacuum Hose Connections

(18) Inspect the PCV system connections for damage (Fig. 12).

(19) Inspect the crankshaft position sensor electrical connector for damage (Fig. 13).

(20) Verify the manifold absolute pressure (map) sensor electrical connector is attached to the sensor and not damaged (Fig. 14).

(21) Check the heated oxygen sensor electrical connector for damage (Fig. 14).

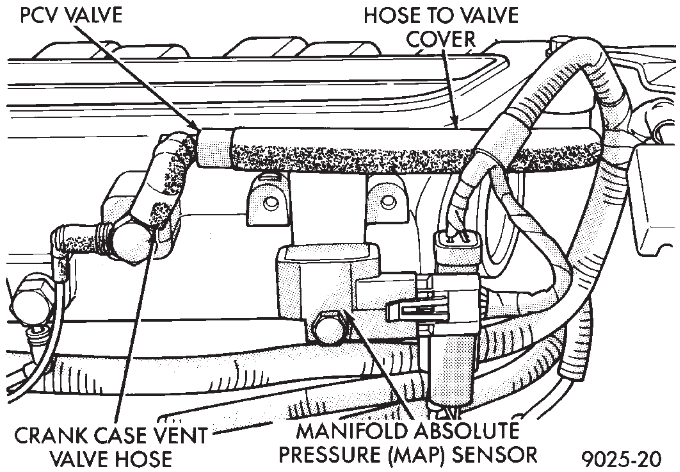


Fig. 12 PCV System

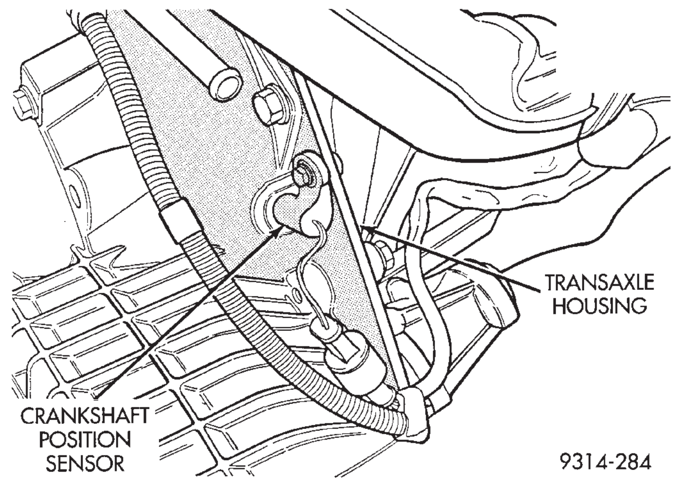


Fig. 13 Crankshaft Position Sensor

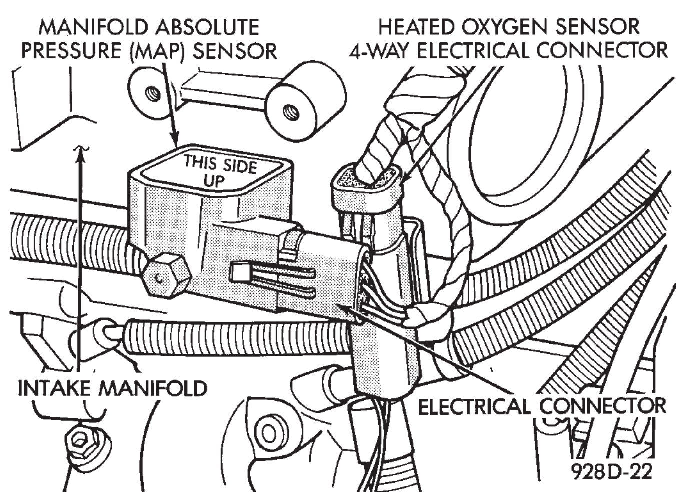


Fig. 14 MAP Sensor and Heated Oxygen Sensor

(22) Verify the engine ground strap is attached at the engine and dash panel. Inspect the strap for corrosion or damage.

(23) Inspect the generator wiring connections for damage.

(24) Check the accessory drive belt tension.

(25) Check the 60-way electrical connection at the Powertrain control module (PCM) (Fig. 15) for damage or spread terminals. Verify that the 60-way connector is fully inserted into the PCM socket. Ensure the wires are not stretched or pulled out of the connector.

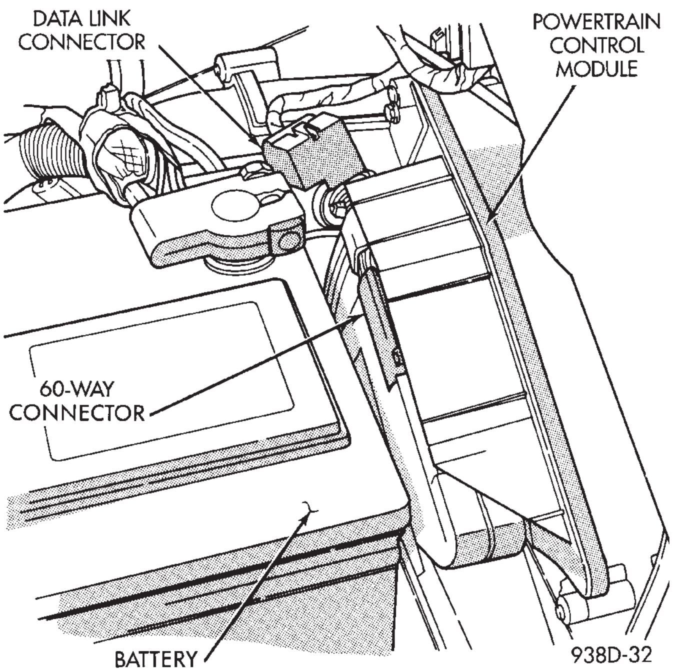


Fig. 15 Powertrain control module (PCM)

(26) Ensure the relays are connected to the harness connectors (Fig. 16 and Fig. 17) Inspect the connections for damage.

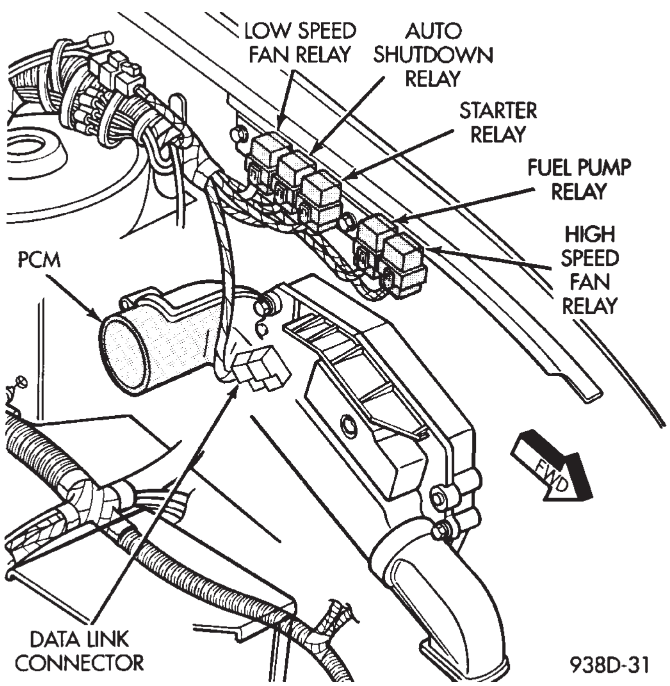


Fig. 16 Relay Identification

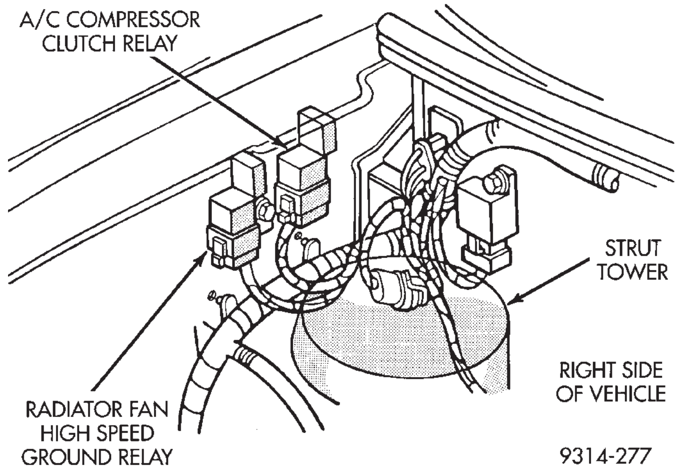


Fig. 17 A/C Clutch Relay and Radiator Fan High Speed Ground Relay

(27) Inspect battery cable connections for corrosion.

(28) Check the power brake booster hose connection (without anti-lock brake systems) (Fig. 18).

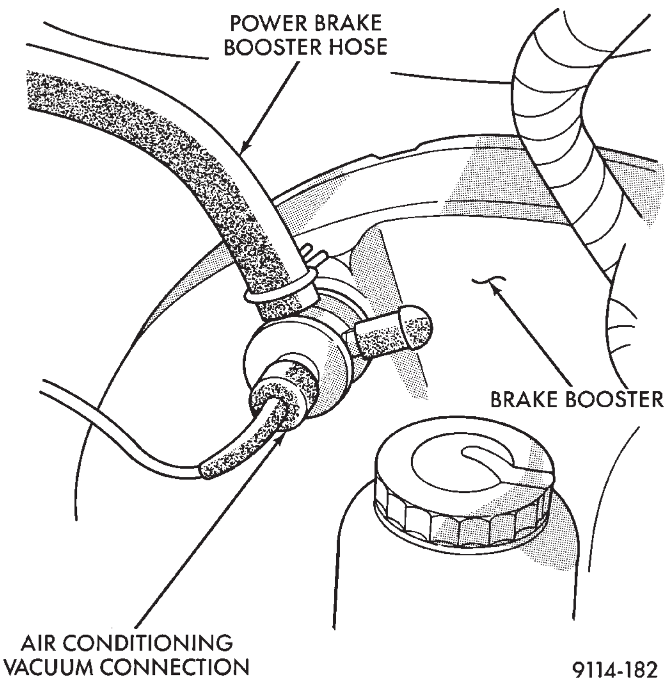


Fig. 18 Power Brake Booster Hose

(29) Inspect the speed control vacuum connection (Fig. 19).

(30) Inspect hose and wiring connections at fuel pump. Check that wiring connector is making contact with terminals on pump.

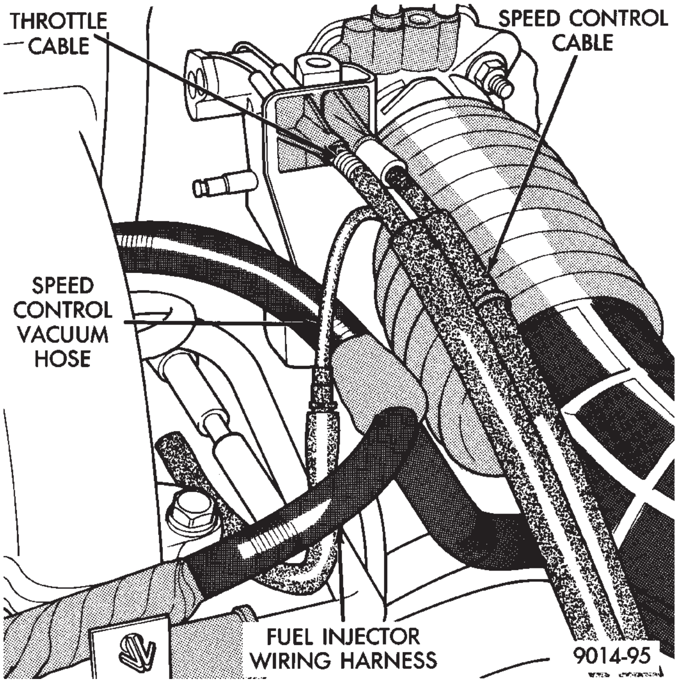


Fig. 19 Speed Control Vacuum

3.3L MULTI-PORT FUEL INJECTION—ON-BOARD DIAGNOSTICS

INDEX

GENERAL INFORMATION

The powertrain control module (PCM) has been programmed to monitor many different circuits of the fuel injection system. If a problem is sensed with a monitored circuit often enough to indicate an actual problem, the PCM stores a diagnostic trouble code. If the problem is repaired or ceases to exist, the PCM cancels the trouble code after 51 vehicle key on/off cycles.

Certain criteria must be met for a trouble code to be entered into the PCM memory. The criteria may be a specific range of engine RPM, engine temperature, and/or input voltage to the PCM.

It is possible that a trouble code for a monitored circuit may not be entered into memory even though a malfunction has occurred. This may happen because one of the fault code criteria for the circuit has not been met. **For example**, assume the trouble code criteria for a sensor circuit requires the engine to operate between 750 and 2000 RPM. If the sensor output circuit shorts to ground when engine RPM is above 2400 RPM (resulting in a 0 volt input to the PCM) a trouble code will not be entered into memory. This is because the condition does not occur within the specified RPM range.

There are several operating conditions that the PCM does not monitor and set trouble codes for. Refer to Monitored Circuits and Non-Monitored Circuits in this section.

Stored diagnostic trouble codes can be displayed either by cycling the ignition key On - Off - On - Off - On, or using the DRBII scan tool. The DRB II connects to the data link connector in the vehicle (Fig. 1).

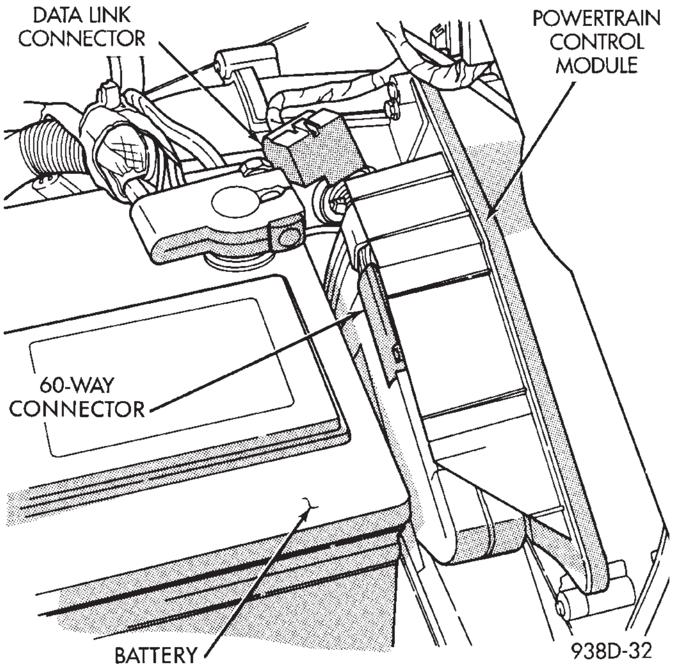


Fig. 1 Powertrain Control Module (PCM)

MONITORED CIRCUITS

The powertrain control module (PCM) can detect certain fault conditions in the fuel injection system.

Open or Shorted Circuit - The PCM can determine if the sensor output (input to PCM) is within proper range. Also, the PCM can determine if the circuit is open or shorted.

Output Device Current Flow - The PCM senses whether the output devices are hooked up. If there is a problem with the circuit, the PCM senses whether the circuit is open, shorted to ground, or shorted high.

Oxygen Sensor - The PCM can determine if the oxygen sensor is switching between rich and lean once the system has entered closed loop. Refer to Modes of Operation in this section for an explanation of closed loop operation.

NON-MONITORED CIRCUITS

The powertrain control module (PCM) does not monitor the following circuits, systems and conditions that could have malfunctions that result in driveability problems. Diagnostic trouble codes may not be displayed for these conditions. However, problems with these systems may cause trouble codes to be displayed for other systems. For example, a fuel pressure problem will not register a trouble code directly, but could cause a rich or lean condition. This could cause an oxygen sensor fault to be stored in the PCM.

Fuel Pressure - Fuel pressure is controlled by the vacuum assisted fuel pressure regulator. The PCM cannot detect a clogged fuel pump inlet filter, clogged in-line fuel filter, or a pinched fuel supply or return line. However, these could result in a rich or lean condition causing an oxygen sensor trouble code to be stored in the PCM.

Secondary Ignition Circuit - The PCM cannot detect an inoperative ignition coil, fouled or worn spark plugs, ignition cross firing, or open spark plug cables.

Engine Timing - The PCM cannot detect an incorrectly indexed timing chain, camshaft sprocket and crankshaft sprocket. However, these could result in a rich or lean condition causing an oxygen sensor trouble code to be stored in the PCM.

Cylinder Compression - The PCM cannot detect uneven, low, or high engine cylinder compression.

Exhaust System - The PCM cannot detect a plugged, restricted or leaking exhaust system.

Fuel Injector Malfunctions - The PCM cannot determine if a fuel injector is clogged, the needle is sticking or the wrong injector is installed. However, these could result in a rich or lean condition causing an oxygen sensor trouble code to be stored in the PCM.

Excessive Oil Consumption - Although the PCM monitors exhaust stream oxygen content when the system is in closed loop, it cannot determine excessive oil consumption.

Throttle Body Air Flow - The PCM cannot detect a clogged or restricted air cleaner inlet or filter element.

Evaporative System - The PCM will not detect a restricted, plugged or loaded evaporative purge canister.

Vacuum Assist - Leaks or restrictions in the vacuum circuits of vacuum assisted engine control system devices are not monitored by the PCM. However, these could result in a MAP sensor trouble code being stored in the PCM.

PCM System Ground - The PCM cannot determine a poor system ground. However, a trouble code may be generated as a result of this condition.

PCM Connector Engagement - The PCM cannot determine spread or damaged connector pins. However, a trouble code may be generated as a result of this condition.

HIGH AND LOW LIMITS

The powertrain control module (PCM) compares input signal voltages from each input device with established high and low limits that are programmed into it for that device. If the input voltage is not within specifications and other diagnostic trouble code criteria are met, a trouble code will be stored in memory. Other fault code criteria might include engine RPM limits or input voltages from other sensors or switches that must be present before a fault condition can be verified.

DIAGNOSTIC TROUBLE CODE

A diagnostic trouble code indicates the powertrain control module (PCM) has recognized an abnormal condition in the system. Trouble codes can be obtained from the malfunction indicator lamp (instrument panel Check Engine lamp) or from the DRBII scan tool. Trouble codes indicate the results of a failure but do not identify the failed component directly.

SYSTEM TESTS

Be sure to apply parking brake and/or block wheels before performing idle check or adjustment, or any engine running tests.

OBTAINING DIAGNOSTIC TROUBLE CODES

USING DRBII SCAN TOOL

WARNING: APPLY PARKING BRAKE AND/OR BLOCK WHEELS BEFORE PERFORMING ANY TEST ON AN OPERATING ENGINE.

(1) Connect DRBII scan tool to the data link (diagnostic) connector (Fig. 1).

(2) If possible, start the engine and cycle the **A/C** switch if applicable. Shut off the engine.

(3) Turn the ignition switch on, access Read Fault Screen. Record all the diagnostic trouble codes shown on the DRBII scan tool. [Observe the malfunction indicator lamp (check engine lamp) on the instrument panel. The lamp should light for 2 seconds then go out (bulb check)].

To erase diagnostic trouble codes, use the Erase Trouble Code data screen on the DRBII scan tool.

USING THE MALFUNCTION INDICATOR LAMP

(1) Cycle the ignition key On - Off - On - Off - On within 5 seconds.

(2) Count the number of times the malfunction indicator lamp (check engine lamp) on the instrument panel flashes on and off. The number of flashes represents the trouble code. There is a slight pause between the flashes representing the first and second digits of the code. Longer pauses separate individual trouble codes.

(3) Refer to the Diagnostic Trouble Code Charts at the end of this group.

STATE DISPLAY TEST MODE

The switch inputs used by the powertrain control module (PCM) have only two recognized states, HIGH and LOW. For this reason, the PCM cannot recognize the difference between a selected switch position versus an open circuit, a short circuit, or a defective switch. If the change is displayed, it can be assumed that the entire switch circuit to the PCM is functional. From the state display screen access either State Display Inputs and Outputs or State Display Sensors.

STATE DISPLAY INPUTS AND OUTPUTS

Connect the DRBII scan tool to the vehicle and access the State Display screen. Then access Inputs and Outputs. The following is a list of the engine control system functions accessible through the Inputs and Outputs screen.

Park/Neutral Switch
Speed Control Resume
Brake Switch
Speed Control On/Off
Speed Control Set
A/C Switch Sense
S/C Vent Solenoid
S/C Vacuum Solenoid
A/C Clutch Relay
EGR Solenoid
Auto Shutdown Relay
Radiator Fan Low Speed Relay
Radiator Fan High Speed Relay
Purge Solenoid

STATE DISPLAY SENSORS

Connect the DRBII scan tool to the vehicle and access the State Display screen. Then access Sensor Display. The following is a list of the engine control system functions accessible through the Sensor Display screen.

Oxygen Sensor Signal
Engine Coolant Temperature
Engine Coolant Temp Sensor
Throttle Position
Minimum Throttle
Battery Voltage
MAP Sensor Reading
Idle Air Control Motor Position
Adaptive Fuel Factor
Barometric Pressure
Minimum Airflow Idle Speed
Engine Speed
DIS Sensor Status
Fault #1 Key-On Info
Module Spark Advance
Speed Control Target
Fault #2 Key-on Info
Fault #3 Key-on Info
Speed Control Status
Speed Control Switch Voltage
Charging System Goal
Theft Alarm Status
Map Sensor Voltage
Vehicle Speed
Oxygen Sensor State
MAP Gauge Reading
Throttle Opening (percentage)
Total Spark Advance

DIAGNOSTIC TROUBLE CODE DESCRIPTION

TROUBLE CODE	DRB II DISPLAY	DESCRIPTION
11	No reference Signal During Cranking	No camshaft position sensor signal detected during engine cranking.
13+**	No change in MAP from start to run	No difference recognized between the engine MAP reading and the barometric (atmospheric) pressure reading at start-up.
14+**	MAP voltage too low	MAP sensor input below minimum acceptable voltage.
	or	
	MAP voltage too High	MAP sensor input above maximum acceptable voltage.
15**	No vehicle speed signal	No vehicle distance (speed) sensor signal detected during road load conditions.
17	Engine is cold too long	Engine coolant temperature remains below normal operating temperatures during vehicle travel (thermostat).
21**	O_2 signal stays at center	Neither rich or lean condition detected from the oxygen sensor input.
	or	
	O_2 signal shorted to voltage	Oxygen sensor input voltage maintained above the normal operating range.
22+**	Coolant sensor voltage too high	Coolant temperature sensor input above the maximum acceptable voltage.
	or	
	Coolant sensor voltage too low	Coolant temperature sensor input below the minimum acceptable voltage.
24+**	Throttle position sensor voltage high	Throttle position sensor input above the maximum acceptable voltage.
	or	
	Throttle position sensor voltage low	Throttle position sensor input below the minimum acceptable voltage.
25**	Idle air control motor circuits	An open or shorted condition detected in one or more of the idle air control motor circuits.
27	Injector control circuit	Injector output driver does not respond properly to the control signal.
31**	Evap purge solenoid circuit	An open or shorted condition detected in the purge solenoid circuit.
32**	EGR solenoid circuit	An open or shorted condition detected in the EGR transducer solenoid circuit.
	or	
	EGR system failure	Required change in air/fuel ratio not detected during diagnostic test.
33	A/C clutch relay circuit	An open or shorted condition detected in the A/C clutch relay circuit.

+ Check Engine Lamp On
** Check Engine Lamp On (California Only)

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DIAGNOSTIC TROUBLE CODE DESCRIPTION (CON'T)

Trouble Code	DRB II Display	Description
34	Speed control solenoid circuits	An open or shorted condition detected in the speed control vacuum or vent solenoid circuits.
35	Radiator fan relays	An open or shorted condition detected in the radiator fan low speed relay or high speed relay or high speed ground relay circuits.
41+**	Generator field not switching properly	An open or shorted condition detected in the generator field control circuit.
42	Auto shutdown relay control circuit	An open or shorted condition detected in the auto shutdown relay circuit.
43+**	Ignition coil #1 primary circuit	Peak primary circuit current not achieved with maximum dwell time.
	or	
	Ignition coil #2 primary circuit	Peak primary circuit current not achieved with maximum dwell time.
	or	
	Ignition coil #3 primary circuit	Peak primary circuit current not achieved with maximum dwell time.
44	Battery temp voltage	An open or shorted condition exists in the coolant temperature sensor circuit or a problem exists in the engine controller's battery temperature voltage circuit.
46+**	Charging system voltage too high	Battery voltage sense input above target charging voltage during engine operation.
47+**	Charging system voltage too low	Battery voltage sense input below target charging during engine operation. Also, no significant change detected in battery voltage during active test of alternator output.
51**	O_2 signal stays below center (lean)	Oxygen sensor signal input indicates lean air/fuel ratio condition during engine operation.
52**	O_2 signal stays above center (rich)	Oxygen sensor signal input indicates rich air/fuel ratio condition during engine operation.
53	Internal PCM failure	PCM internal fault condition detected.
62	PCM Failure EMR miles not stored	Unsuccessful attempt to update EMR mileage in the PCM EEPROM.
63	Control Failure EEPROM write denied	Unsuccessful attempt to write to an EEPROM location by the PCM.
55	N/A	Completion of fault code display on malfunction indicator lamp (Check Engine).

+ Check Engine Lamp On
** Check Engine Lamp On (California Only)

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CIRCUIT ACTUATION TEST MODE

The circuit actuation test mode checks for proper operation of output circuits or devices which the powertrain control module (PCM) cannot internally recognize. The PCM can attempt to activate these outputs and allow an observer to verify proper operation. Most of the tests provide an audible or visual indication of device operation (click of relay contacts, spray fuel, etc.). Except for intermittent conditions, if a device functions properly during testing, assume the device, its associated wiring, and driver circuit working correctly.

OBTAINING CIRCUIT ACTUATION TEST

Connect the DRBII scan tool to the vehicle and access the Actuators screen. The following is a list of the engine control system functions accessible through Actuators screens.

Stop All Tests
Ignition Coil #1
Ignition Coil #2
Ignition Coil #3
Fuel Injector #1
Fuel Injector #2
Fuel Injector #3
Fuel Injector #4
Fuel Injector #5
Fuel Injector #6
Idle Air Control Motor Open/Close
Radiator Fan Low Speed Relay
Radiator Fan High Speed Relays
A/C Compressor Clutch Relay
Auto Shutdown Relay
EVAP Purge Solenoid
S/C Servo Solenoids
Generator Field
EGR Solenoid
All Solenoids/Relays
ASD Fuel System Test
Speed Control Vacuum Solenoid
Speed Control Vent Solenoid

THROTTLE BODY MINIMUM AIR FLOW CHECK PROCEDURE

(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 intake manifold nipple.

(5) Attach Air Metering Fitting #6457 (0.125 in. orifice) to the intake manifold PCV nipple (Fig. 2).

(6) Disconnect the 3/16 inch idle purge line from the throttle body nipple. Cap the 3/16 inch nipple.

(7) Connect the DRBII scan tool to the data link connector.

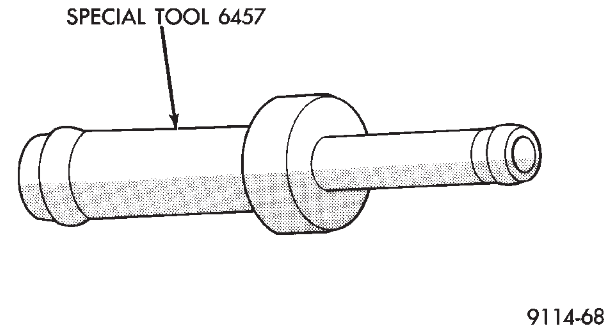


Fig. 2 Air Metering Fitting #6457

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

(9) Using the DRBII scan tool, access the Minimum Airflow Idle Speed screen.

(10) The following will then occur:

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

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

IDLE SPECIFICATIONS

Odometer Reading	Idle RPM
Below 1000 Miles	525 – 875 RPM
Above 1000 Miles	575 – 875 RPM

9314-270

(12) If idle RPM is not within specifications, shut off the engine and clean the throttle body as follows:

(a) Remove the throttle body from engine.

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

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

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

(d) Use compressed air to dry the throttle body.

(e) Inspect throttle body for foreign material.

(f) Install throttle body on manifold.

(g) Repeat steps 1 through 14. If the minimum air flow is still not within specifications, the problem is not caused by the throttle body.

(13) Shut off engine.

(14) Remove Air Metering Fitting #6457 from the intake manifold PCV nipple. Reinstall the PCV valve hose.

(15) Uncap the throttle body idle purge nipple and connect the idle purge line.

(16) Remove DRBII scan tool.

60-WAY POWERTRAIN CONTROL MODULE WIRING CONNECTOR

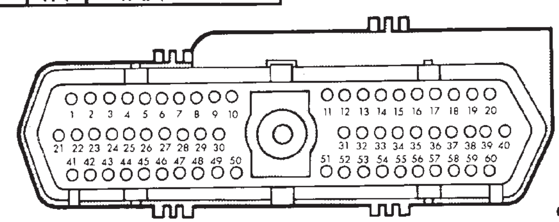
Refer to the powertrain control module (PCM) wiring connector diagram (Fig. 3) for wire colors and cavity numbers.

CAV	WIRE COLOR	DESCRIPTION
1	DG/RD*	MAP SENSOR
2	TN/BK*	ENGINE COOLANT TEMPERATURE SENSOR
3	RD/WT*	DIRECT BATTERY
4	BK/LB*	SENSOR RETURN
5	BK/WT*	SIGNAL GROUND
6	VT/WT*	5-VOLT OUTPUT (MAP AND TPS)
7	OR	8-VOLT OUTPUT
8		
9	DB	A21 SUPPLY (IGNITION START/RUN SENSE)
10		
11	BK/TN*	POWER GROUND
12	BK/TN*	POWER GROUND
13	LB/BR*	INJECTOR DRIVER #4
14	YL/WT*	INJECTOR DRIVER #3
15	TN	INJECTOR DRIVER #2
16	WT/DB*	INJECTOR DRIVER #1
17	DB/YL*	IGNITION COIL DRIVER #2
18	RD/YL*	IGNITION COIL DRIVER #3
19	BK/GY*	IGNITION COIL DRIVER #1
20	DG	GENERATOR FIELD CONTROL
21		
22	OR/DB*	THROTTLE POSITION SENSOR (TPS)
23	RD/LG*	SPEED CONTROL SENSE
24	GY/BK*	CRANKSHAFT POSITION SENSOR
25	PK	DATA LINK TRANSMIT
26	VT/BR*	CCD BUS (+)
27	BR	A/C SWITCH SENSE
28		
29	WT/PK*	BRAKE SWITCH
30	BR/YL*	PARK/NEUTRAL SWITCH
31	DB/PK*	RADIATOR FAN LOW SPEED RELAY
32		
33	TN/RD*	SPEED CONTROL VACUUM SOLENOID
34	DB/OR*	A/C COMPRESSOR CLUTCH RELAY
35	GY/YL	EGR SOLENOID
36		

CAV	WIRE COLOR	DESCRIPTION
37		
38	GY	INJECTOR DRIVER #5
39	GY/RD*	IDLE AIR CONTROL MOTOR DRIVER #3
40	BR/WT*	IDLE AIR CONTROL MOTOR DRIVER #1
41	BK/DG*	HEATED OXYGEN SENSOR SIGNAL
42		
43		
44	TN/YL*	CAMSHAFT POSITION SENSOR
45	LG	DATA LINK RECEIVE
46	WT/BK*	CCD BUS (-)
47	WT/OR*	VEHICLE SPEED SENSOR
48		
49		
50		
51	DB/YL*	AUTO SHUTDOWN (ASD) RELAY AND FUEL PUMP RELAY
52	PK/BK*	EVAP PURGE SOLENOID
53	LG/RD*	SPEED CONTROL VENT SOLENOID
54		
55	YL	RADIATOR FAN HIGH SPEED RELAYS
56		
57	DG/OR*	A142 CIRCUIT VOLTAGE SENSE
58	BR/DB*	INJECTOR DRIVER #6
59	VT/BK*	IDLE AIR CONTROL MOTOR DRIVER #4
60	YL/BK*	IDLE AIR CONTROL MOTOR DRIVER #2

WIRE COLOR CODES					
BK	BLACK	LB	LIGHT BLUE	VT	VIOLET
BR	BROWN	LG	LIGHT GREEN	WT	WHITE
DB	DARK BLUE	OR	ORANGE	YL	YELLOW
DG	DARK GREEN	PK	PINK	*	WITH TRACER
GY	GRAY	RD	RED		
		TN	TAN		

CONNECTOR TERMINAL SIDE SHOWN



9314-288

Fig. 3 60—Way PCM Wiring Connector

3.3L MULTI-PORT FUEL INJECTION—SERVICE PROCEDURES

INDEX

THROTTLE BODY REMOVAL

(1) Disconnect negative battery cable.

(2) Remove the air cleaner to throttle body hose clamp and the nut holding the air cleaner assembly to the air cleaner bracket. Remove the air cleaner (Fig. 1).

(3) Remove throttle and the speed control cables.

(4) Disconnect electrical connectors from the idle air control motor and throttle position sensor (TPS).

(5) Disconnect vacuum hoses from throttle body.

(6) Remove throttle body to intake manifold attaching nuts.

(7) Remove throttle body and gasket.

(8) Reverse the above procedure for installation.

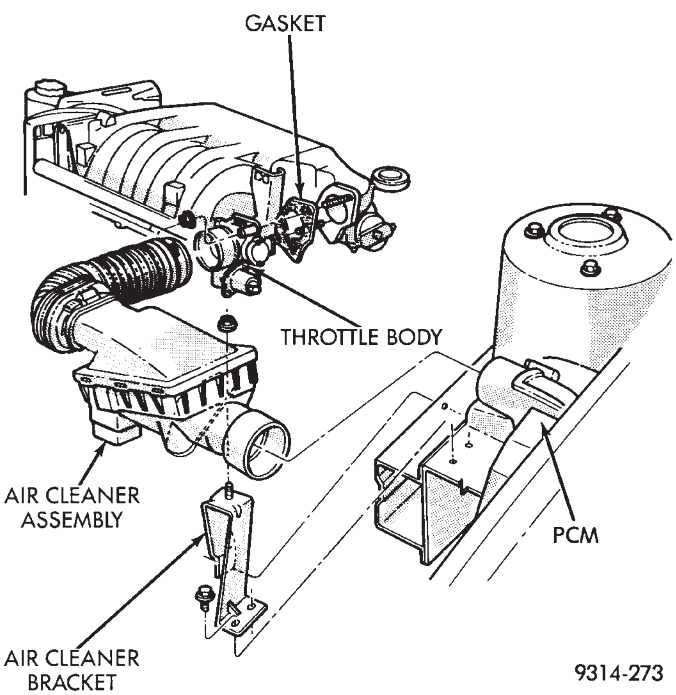


Fig. 1 Throttle Body Assembly

THROTTLE BODY

When servicing throttle body components, always reassemble components with new O-rings and seals where applicable (Fig. 2). Never use lubricants on O-rings or seals, damage may result. If assembly of component is difficult, use water to aid assembly. Use care when removing hoses to prevent damage to hose or hose nipple.

FUEL SYSTEM PRESSURE RELEASE PROCEDURE

WARNING: THE 3.3L AND 3.8L MPI FUEL SYSTEMS ARE UNDER A CONSTANT PRESSURE OF APPROXIMATELY 330 KPA (48 PSI). RELEASE FUEL SYSTEM PRESSURE BEFORE SERVICING THE FUEL PUMP, FUEL LINES, FUEL FILTER, THROTTLE BODY OR FUEL INJECTORS.

(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. 3).

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

(5) Continue fuel system service.

THROTTLE POSITION SENSOR

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove electrical connector from throttle position sensor.

(3) Remove throttle position sensor mounting screws (Fig. 4).

(4) Lift throttle position sensor off throttle shaft.

INSTALLATION

(1) Install throttle position sensor on throttle shaft. Install mounting screws. Tighten screw to 2 N•m (17 in. lbs.) torque.

(2) Connect electrical connector to throttle position sensor.

(3) Connect negative cable to battery.

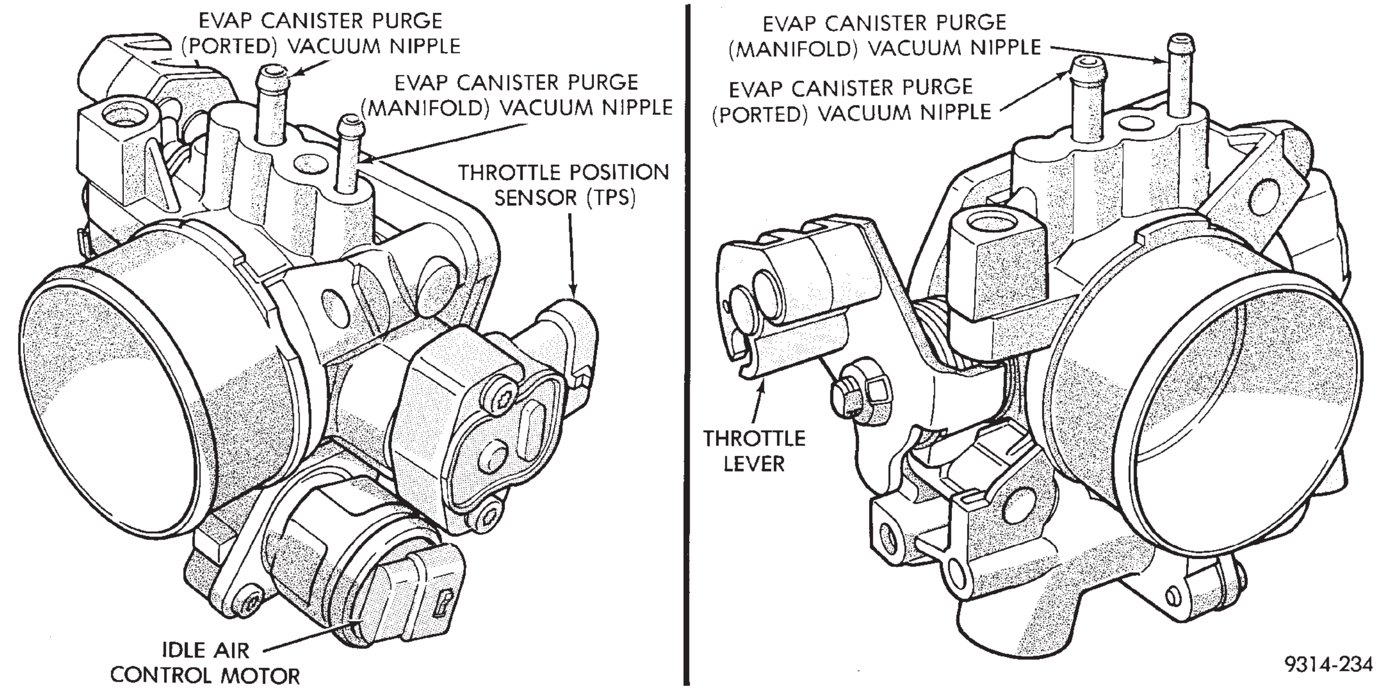


Fig. 2 Throttle Body

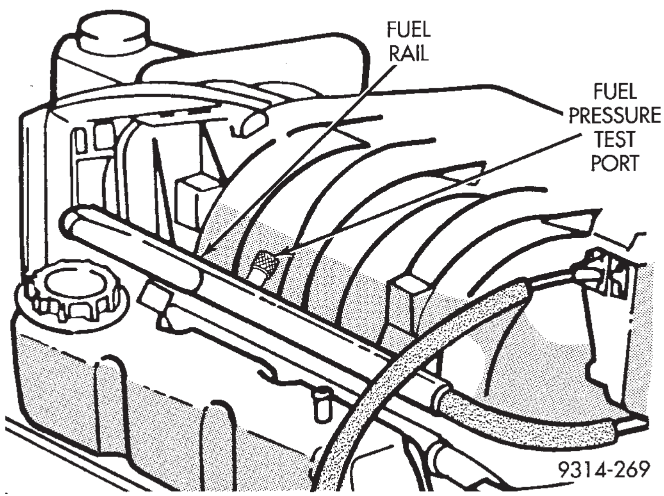


Fig. 3 Fuel Pressure Test Port

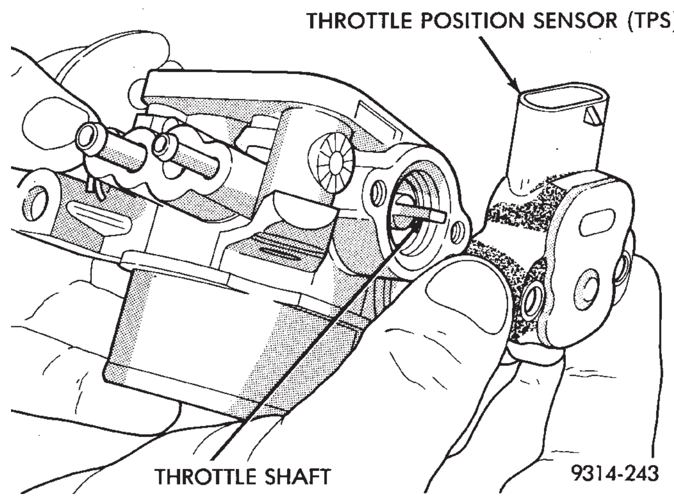


Fig. 4 Servicing Throttle Position Sensor

IDLE AIR CONTROL MOTOR

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove electrical connector from idle air control motor.

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

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

INSTALLATION

(1) The new idle air control motor has a new O-ring installed on it. If pintle measures more than 1 inch (25 mm) it must be retracted. Use the DRBII Idle Air Control Motor Open/Close Test to retract the pintle (battery must be connected.)

(2) Carefully place idle air control motor into throttle body.

(3) Install mounting screws. Tighten screws to 2 N●m (17 in. lbs.) torque.

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

(5) Connect negative cable to battery.

FUEL INJECTOR RAIL ASSEMBLY

REMOVAL

(1) Perform fuel system pressure release procedure **before servicing or starting repairs.** Refer to Fuel System Pressure Release Procedure in this section.

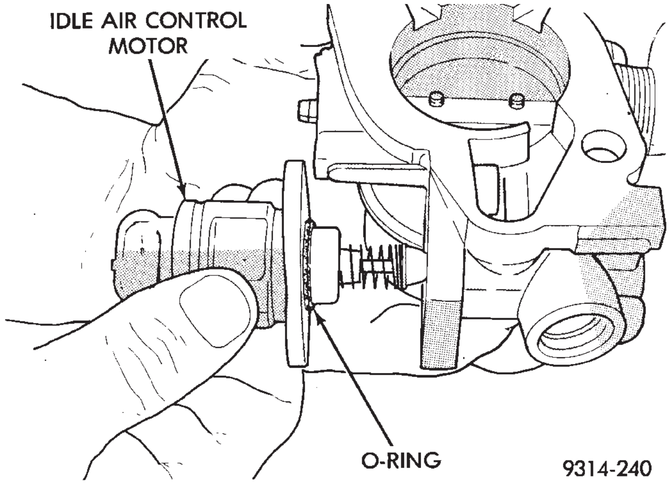


Fig. 5 Servicing Idle Air Control Motor

(2) Disconnect negative cable from battery.

(3) Remove air cleaner and hose assembly (Fig. 1).

(4) Remove throttle cable (Fig. 6). Remove wiring harness from throttle cable bracket and intake manifold water tube.

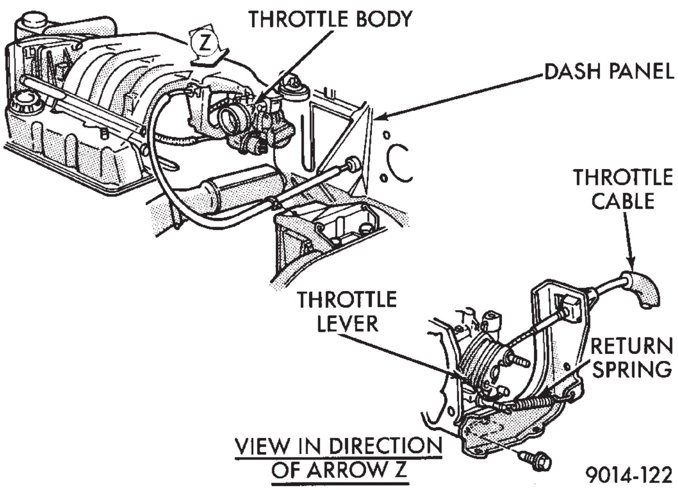


Fig. 6 Throttle Cable Attachment

(5) Disconnect idles air control motor and throttle position sensor (TPS) electrical connectors (Fig. 7). Refer to Idle Air Control Motor and Throttle Position Sensor in this section.

(6) Remove vacuum hose harness from throttle body (Fig. 7).

(7) Remove PCV and brake booster vacuum hoses from air intake plenum.

(8) Remove EGR tube to intake manifold flange bolts (Fig. 8).

(9) Remove vacuum harness connectors from intake plenum (Fig. 9).

(10) Remove cylinder head to intake plenum strut (Fig. 9).

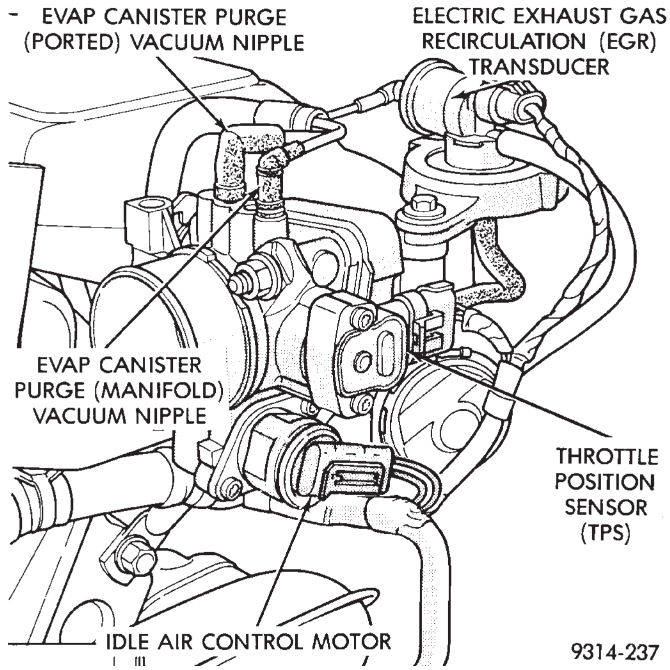


Fig. 7 Electrical and Vacuum Connection to Throttle Body

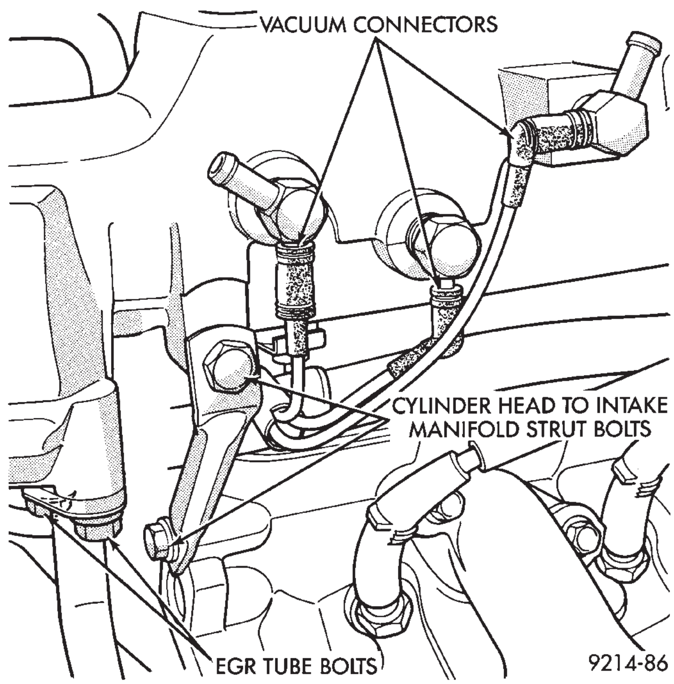


Fig. 8 EGR Tube

(11) Disconnect electrical connectors from the MAP sensor and heated oxygen sensor electrical connection. Remove the engine mounted ground strap (Fig. 10).

(12) Remove the fuel hose quick connect fittings from the chassis tubes. **Refer to Fuel Hoses, Clamps and Quick Connect Fittings in the Fuel Delivery Section of this Group.** Place a shop towel under the connections to absorb any fuel spilled. fittings.

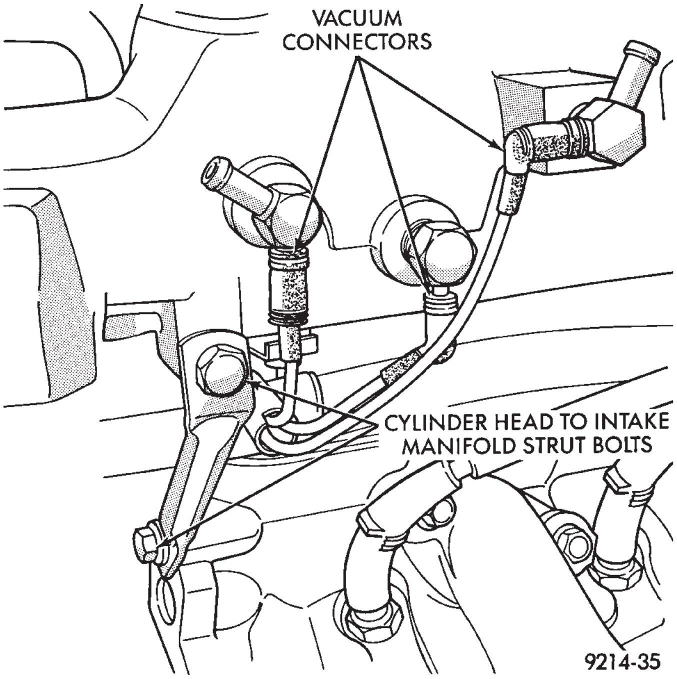


Fig. 9 Electrical and Vacuum Connections To Intake Manifold

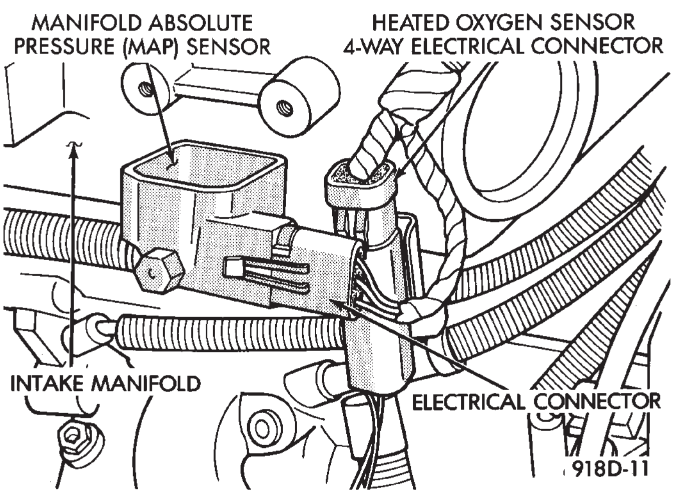


Fig. 10 MAP Sensor Electrical Connector

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

(13) Remove direct ignition system (DIS) coils and generator bracket to intake manifold bolt (Fig. 11).

(14) Remove intake mounting manifold bolts and rotate manifold back over rear valve cover (Fig. 12).

(15) Cover intake manifold with suitable cover when servicing (Fig. 12).

(16) Remove vacuum harness connector from Fuel Pressure Regulator.

(17) Remove fuel tube retainer bracket screw and fuel rail attaching bolts (Fig. 13). Spread the retainer bracket to allow fuel tube removal clearance.

(18) Remove fuel rail injector wiring clip from the generator bracket (Fig. 14).

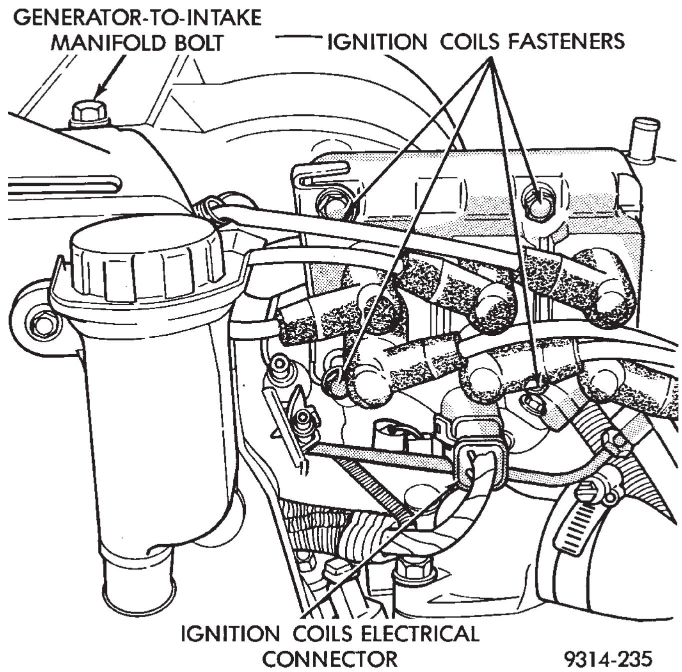


Fig. 11 Ignition Coils

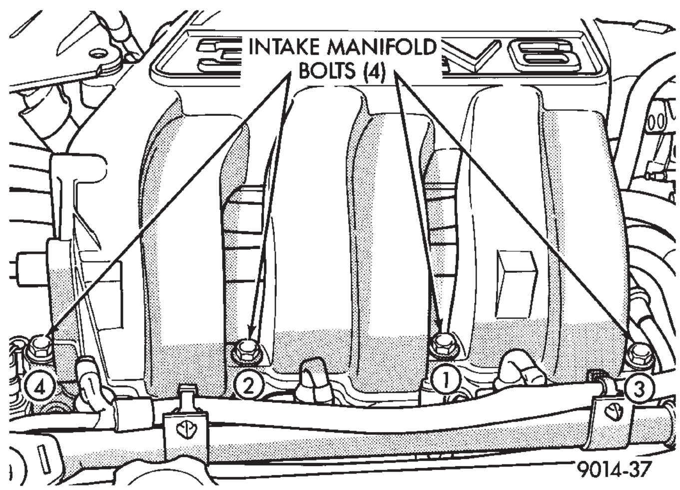


Fig. 12 Intake Manifold Bolts

(19) Disconnect cam sensor, coolant temperature sensor, and engine temperature sensors (Fig. 14).

(20) Remove fuel rail. Be careful not to damage the injector O-rings upon removal from their ports (Fig. 15).

INSTALLATION

(1) Ensure injector holes are clean. Replace O-rings if damaged.

(2) Lube injector O-rings with a drop of clean engine oil to ease installation.

(3) Put the tip of each injector into their ports. Push the assembly into place until the injectors are seated in the ports (Fig. 15).

(4) Install the fuel rail mounting bolts. Tighten bolts to 22 N•m (200 in. lbs.) torque (Fig. 13).

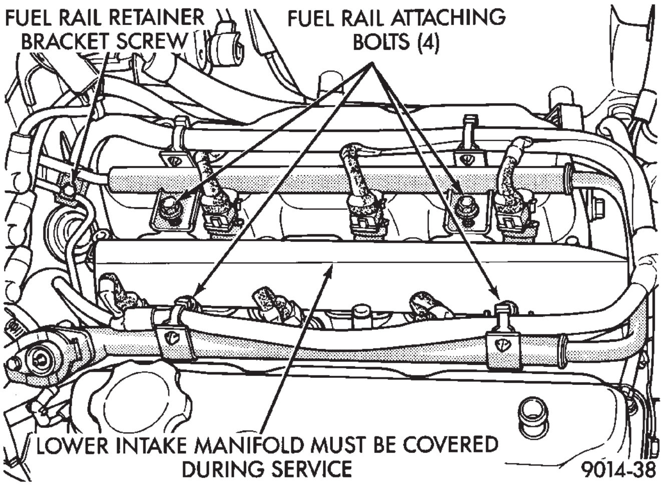


Fig. 13 Fuel Rail Attaching Bolts

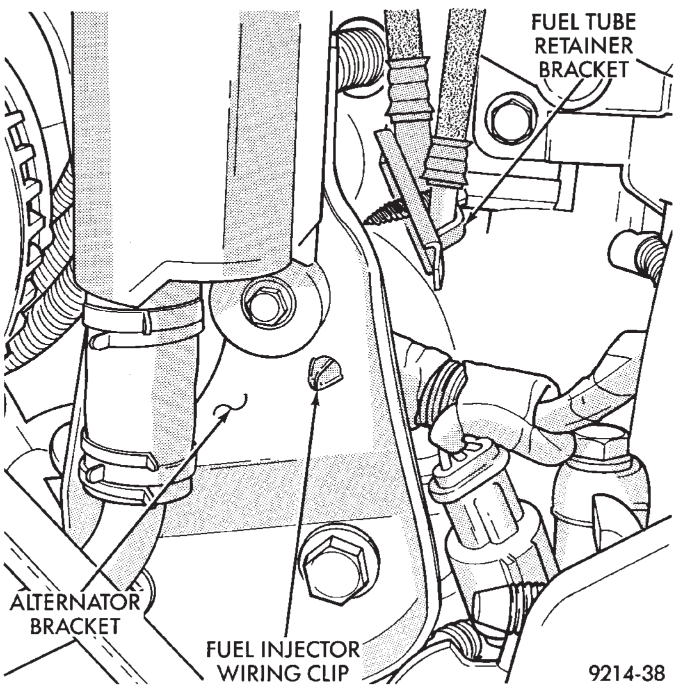


Fig. 14 Fuel Injector Wiring Clip

(5) Install fuel tube retaining bracket screw. Tighten screw to 4 N●m (35 in. lbs.) torque.

(6) Connect electrical connectors to cam sensor, coolant temperature sensor and engine temperature sensors.

(7) Install fuel injector harness wiring clips on the generator bracket and intake manifold water tube (Fig. 14).

(8) Connect vacuum line to fuel pressure regulator.

(9) Remove covering on lower intake manifold and clean surface.

(10) Place intake manifold gasket on lower manifold. Put upper manifold into place and install bolts finger tight.

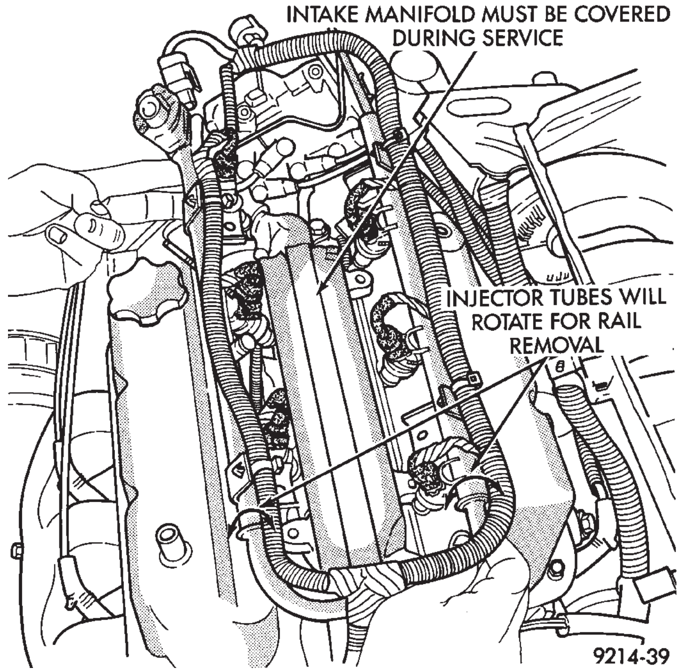


Fig. 15 Fuel Rail Removal

(11) Install the generator bracket to intake manifold bolt and the cylinder head to intake manifold strut bolts. (Do not tighten.)

(12) Following the tightening sequence in Figure 12, tighten intake manifold bolts to 28 N●m (250 in. lbs.) torque.

(13) Tighten generator bracket to intake manifold bolt to 54 N●m (40 ft. lbs.) torque.

(14) Tighten the cylinder head to intake manifold strut bolts to 54 N●m (40 ft. lbs.) torque (Fig. 9).

(15) Connect ground strap, MAP and heated oxygen sensor electrical connectors.

(16) Connect vacuum harness to intake plenum. Connect PCV system hoses.

(17) Using a new gasket, connect the EGR tube to the intake manifold plenum. Tighten screws to 22 N●m (200 in. lbs.) torque.

(18) Clip wiring harness into the hole in the throttle cable bracket.

(19) Connect electrical connectors to the throttle position sensor (TPS) and idle air control motor.

(20) Connect vacuum harness to throttle body.

(21) Install the direct ignition system (DIS) coils. Tighten fasteners to 12 N●m (105 in. lbs.) torque.

(22) Install fuel hose quick connectors fittings to chassis tubes. **Refer to Fuel Hoses, Clamps and Quick Connect Fittings in the Fuel Delivery Section of this Group.** Push the fittings onto the chassis tubes until they click into place. Pull on the fittings to ensure complete insertion. Fuel supply fitting is 5/16 inch and fuel return fitting is 1/4 inch.

(23) Install throttle cable.

(24) Install air cleaner and hose assembly.

(25) 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.

(26) With the ignition key in ON position, access the DRBII scan tool ASD Fuel System Test to pressurize the fuel system. Check for leaks.

FUEL PRESSURE REGULATOR

REMOVAL

(1) Perform fuel system pressure release procedure before attempting any repairs. Refer to Fuel Pressure Regulator Procedure in this section.

(2) Remove fuel pressure regulator vacuum connector (Fig. 16).

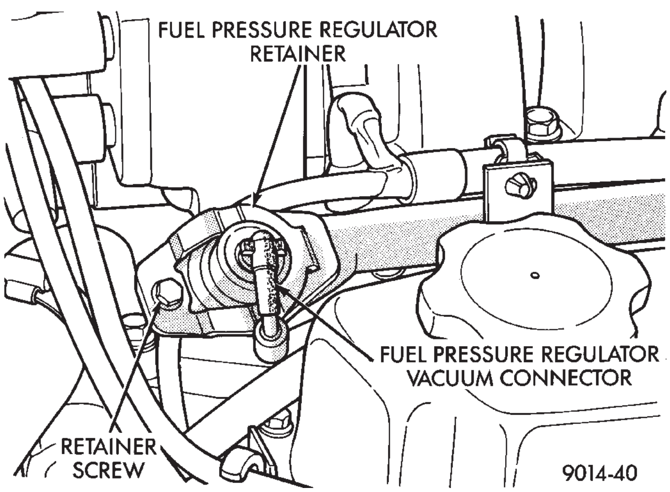


Fig. 16 Fuel Pressure Regulator

(3) Remove regulator retainer screw (Fig. 16).

(4) Remove the fuel pressure regulator retainer (Fig. 16).

WARNING: PLACE A SHOP TOWEL UNDER FUEL PRESSURE REGULATOR TO ABSORB ANY FUEL SPILLAGE.

(5) Remove fuel pressure regulator and O-rings (Fig. 17).

INSTALLATION

(1) Ensure fuel pressure regulator has two plastic spacers (Fig. 17). Place O-rings in the fuel pressure regulator cavity (Fig. 18). Do not install O-rings on the fuel pressure regulator.

(2) Insert fuel pressure regulator into the fuel rail.

(3) Install fuel pressure regulator retainer (Fig. 16).

(4) Install retainer screw. Tighten to 7 N●m (60 in. lbs.) torque.

(5) Connect vacuum line to the fuel pressure regulator.

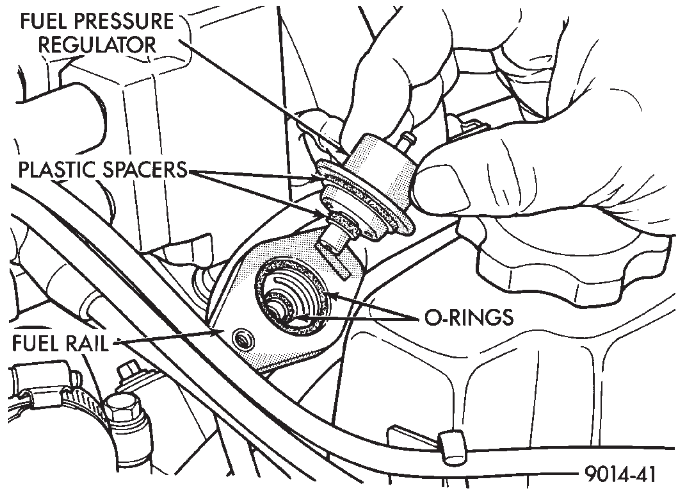


Fig. 17 Fuel Pressure Regulator Removal/Installation

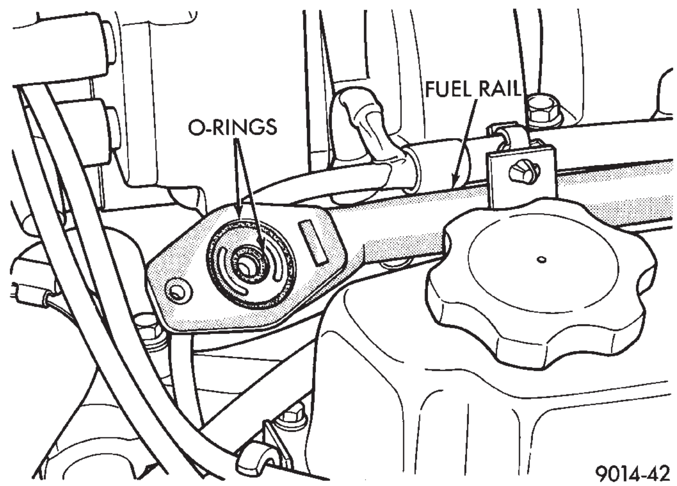


Fig. 18 Fuel Pressure Regulator O-Rings

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.

(6) With the ignition key in ON position, access the DRBII scan tool ASD Fuel System Test to pressurize the fuel system. Check for leaks.

FUEL INJECTOR

The fuel rail must be removed first. Refer to Fuel Injector Rail Assembly Removal in this section.

REMOVAL

(1) Disconnect injector wiring connector from injector.

(2) Position fuel rail assembly so that the fuel injectors are easily accessible (Fig. 19).

(3) Rotate injector and pull injector out of fuel rail. The clip will stay on the injector.

(4) Check injector O-ring for damage. If O-ring is damaged, it must be replaced. If injector is reused, a

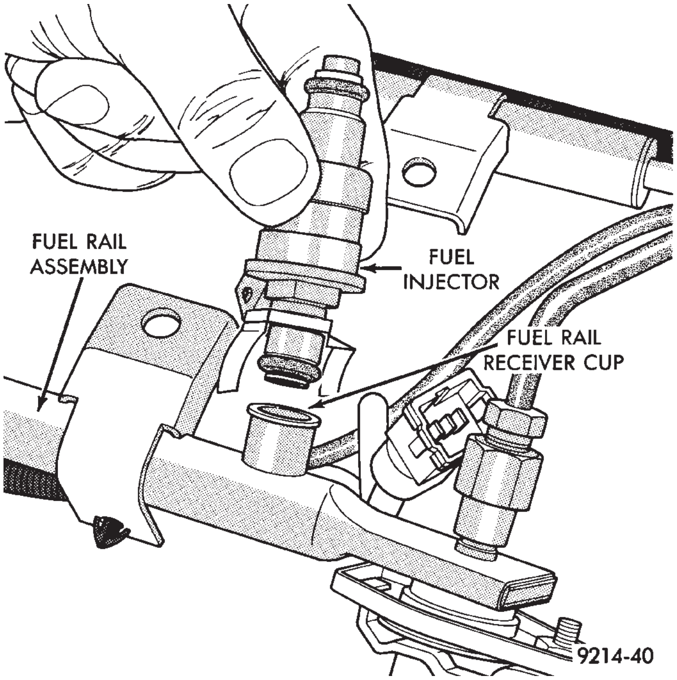


Fig. 19 Fuel Injector and Rail—Typical

protective cap must be installed on the injector tip to prevent damage. Replace the injector clip if it is damaged.

(5) Repeat for remaining injectors.

INSTALLATION

(1) Before installing an injector the rubber O-ring must be lubricated with a drop of clean engine oil to aid in installation.

(2) Install injector clip by sliding open end into **top slot** of the injector. The edge of the receiver cup will slide into the side slots of clip (Fig. 20).

(3) Install injector top end into fuel rail receiver cap. Be careful not to damage O-ring during installation (Fig. 20).

(4) Repeat steps for remaining injectors.

(5) Connect fuel injector wiring.

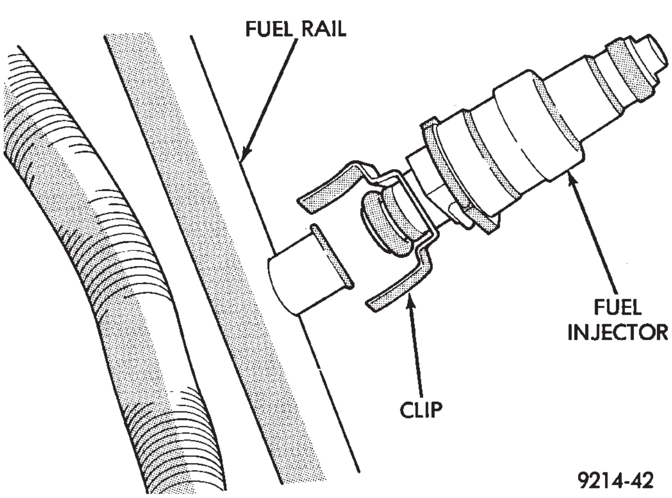


Fig. 20 Servicing Fuel Injector—Typical

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

(1) Disconnect electrical connector from MAP sensor.

(2) Remove sensor by unscrewing from the intake manifold (Fig. 21).

(3) Reverse the above procedure for installation.

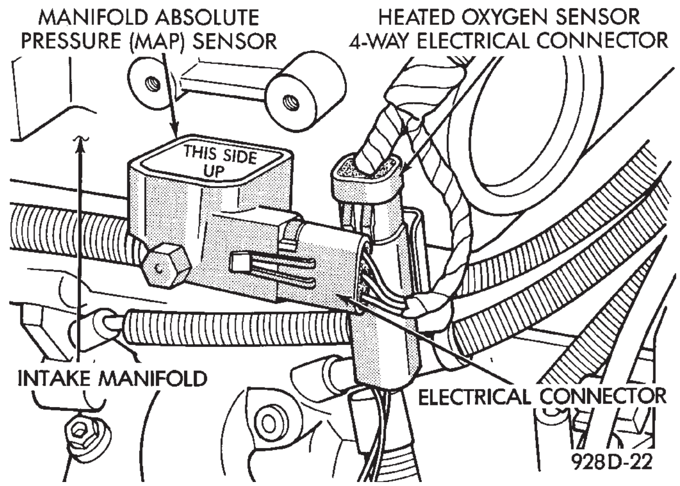


Fig. 21 Manifold Absolute Pressure Sensor

CANISTER PURGE SOLENOID SERVICE

(1) Remove vacuum hose and electrical connector from solenoid (Fig. 22).

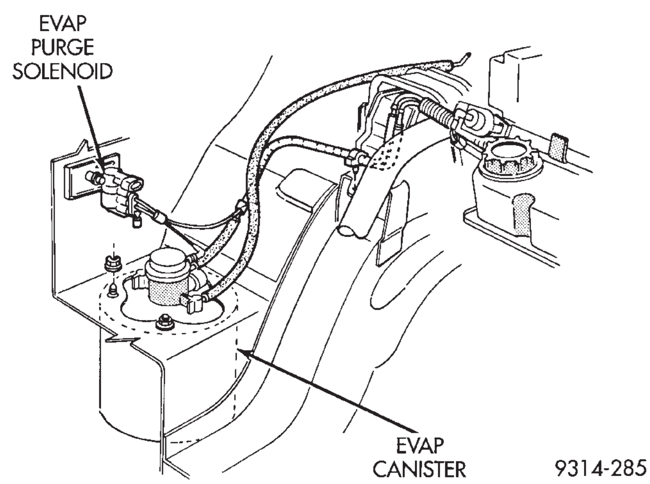


Fig. 22 Canister Purge Solenoid

(2) Depress tab on top of solenoid and slide the solenoid downward out of mounting bracket.

(3) Reverse above procedure for installation.

POWERTRAIN CONTROL MODULE

(1) Remove air cleaner duct from powertrain control module (PCM).

(2) Remove battery.

(3) Remove PCM mounting screws (Fig. 23).

(4) Remove 60-way electrical connector from PCM.

(5) Reverse the above procedure for installation.

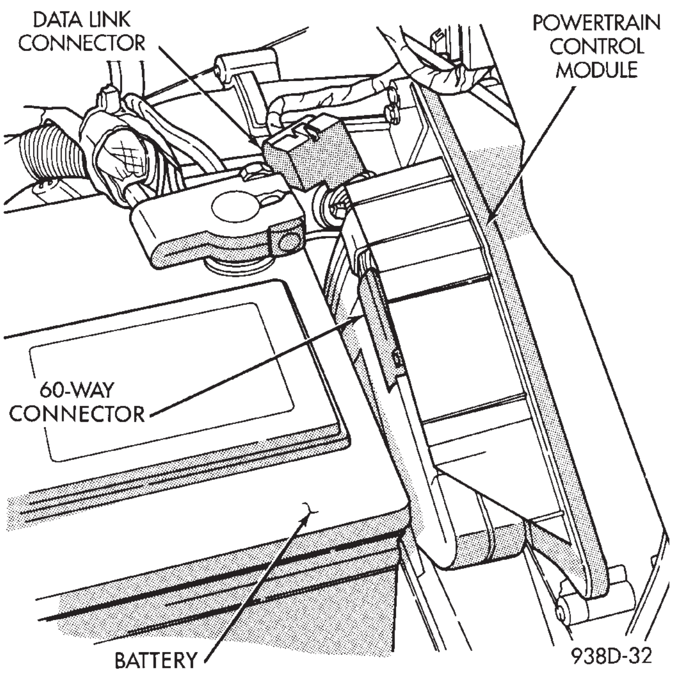


Fig. 23 Powertrain Control Module

CRANKSHAFT POSITION SENSOR

REMOVAL

(1) Disconnect crankshaft position sensor electrical connector from the wiring harness connector (Fig. 24).

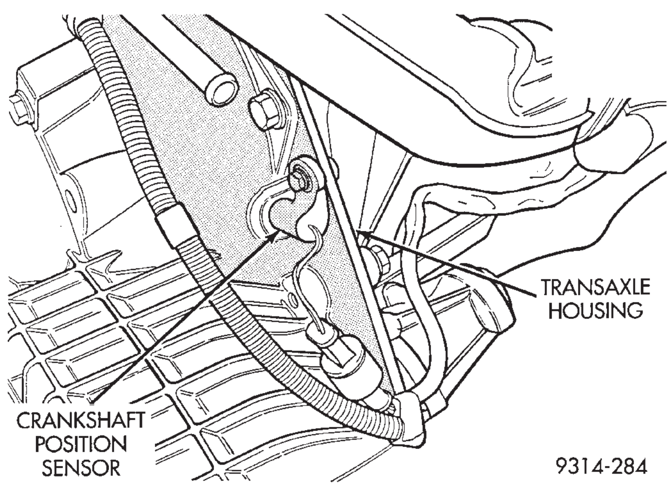


Fig. 24 Crankshaft Position Sensor

(2) Remove crankshaft position sensor retaining bolt.

(3) Pull crankshaft position sensor straight up out of the transaxle housing.

INSTALLATION

If the removed sensor is to be reinstalled, clean off the old spacer on the sensor face. A NEW SPACER must be attached to the sensor face before installation. If the sensor is being replaced, confirm that the paper spacer is attached to the face of the new sensor (Fig. 25).

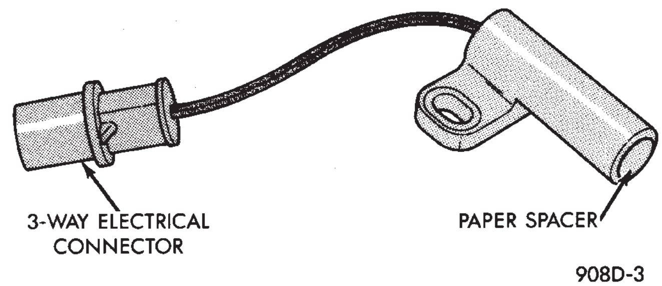


Fig. 25 Crankshaft Position Sensor and Spacer

(1) Install sensor in transaxle and push sensor down until contact is made with the drive plate. While holding the sensor in this position, install and tighten the retaining bolt to 11.9 N●m (105 in. lbs.) torque.

(2) Connect crankshaft position sensor electrical connector to the wiring harness connector.

CAMSHAFT POSITION SENSOR

REMOVAL

(1) Disconnect camshaft position sensor electrical connector from the wiring harness connector (Fig. 26).

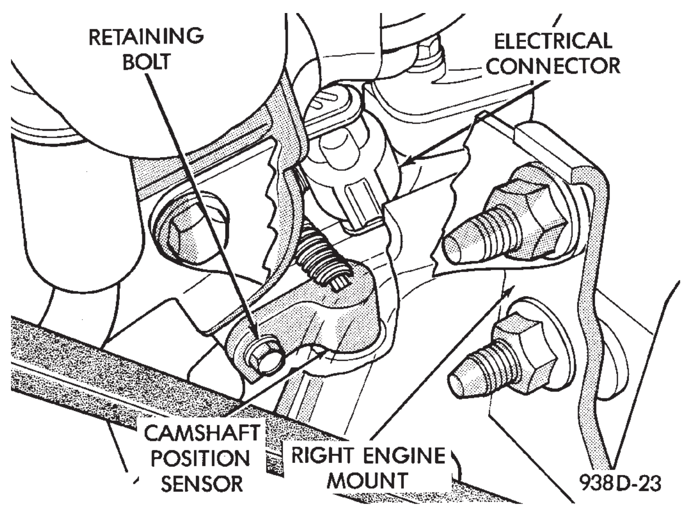


Fig. 26 Camshaft Position Sensor Location

(2) Loosen camshaft position sensor retaining bolt enough to allow slot in sensor to slide past the bolt.

(3) Pull sensor up out of the chain case cover. **Do not pull on the sensor lead.** There is an O-ring on the sensor case. The O-ring may make removal difficult. A light tap to top of sensor prior to removal may reduce force needed for removal.

INSTALLATION

If the removed sensor is reinstalled, clean off the old spacer on the sensor face. A NEW SPACER must be attached to the face before in-

stallation. Inspect O-ring for damage, replace if necessary. If the sensor is being replaced, confirm that the paper spacer is attached to the face and O-ring is positioned in groove of the new sensor (Fig. 27).

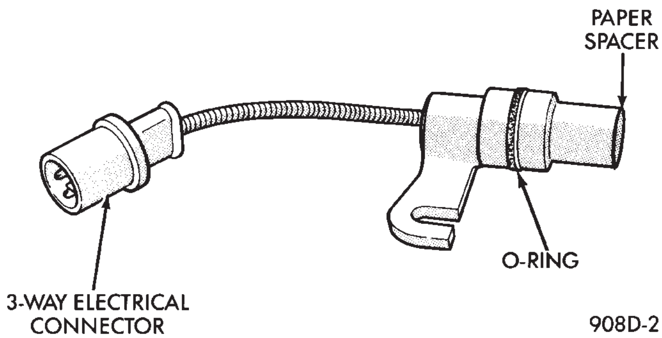


Fig. 27 Camshaft Position Sensor

(1) Apply a couple drops of clean engine oil to the O-ring prior to installation. Install sensor in the chain case cover and push sensor down until contact is made with the cam timing gear. While holding the sensor in this position, install and tighten the retaining bolt 11.9 N●m (105 in. lbs.) torque.

(2) Connect camshaft position sensor electrical connector to harness connector. Position connector away from the accessory belt.

HEATED OXYGEN SENSOR (O_2 SENSOR) SERVICE

The oxygen sensor is installed in the exhaust manifold (Fig. 28).

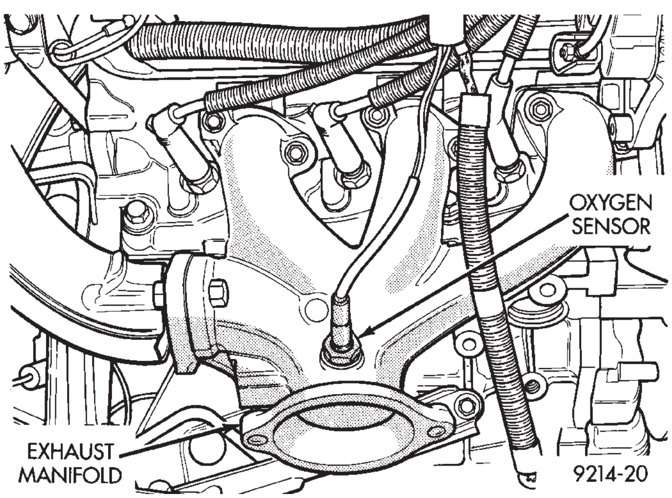


Fig. 28 Oxygen Sensor—3.3L Engine

CAUTION: Do not pull on the oxygen sensor wire when disconnecting the electrical connector.

WARNING: THE EXHAUST MANIFOLD MAY BE EXTREMELY HOT. USE CARE WHEN SERVICING THE OXYGEN SENSOR.

(1) Disconnect oxygen sensor electrical connector (Fig. 29).

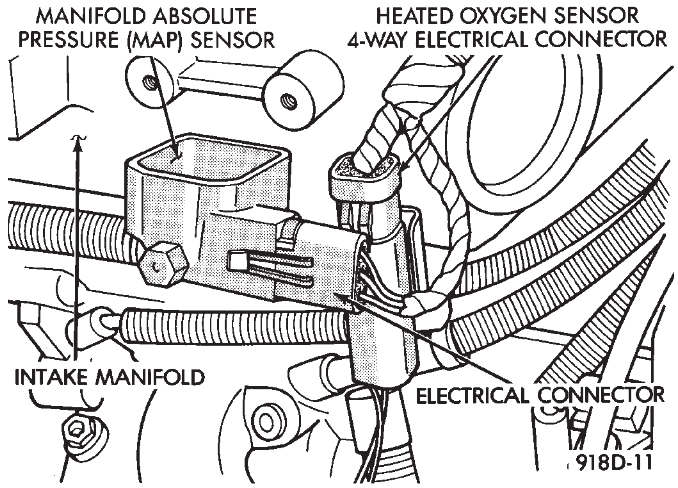


Fig. 29 Oxygen Sensor Connector

(2) Remove sensor using Tool C-4907 (Fig. 30).

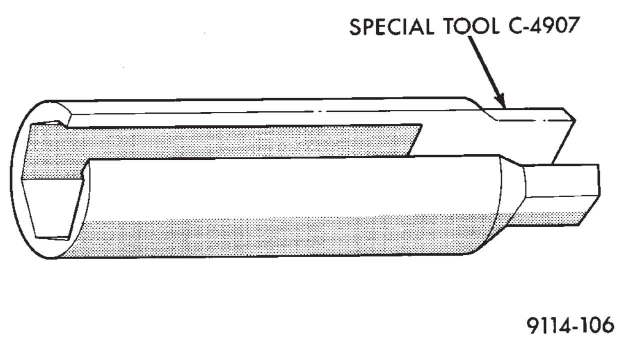


Fig. 30 Oxygen Sensor Socket

When the sensor is removed, the exhaust manifold threads must be cleaned with an 18 mm X 1.5 + 6E tap. If using original sensor, coat the threads with Loctite 771-64 anti-seize compound or equivalent. New sensors are packaged with compound on the threads and no additional compound is required. The sensor must be tightened to 27 N●m (20 ft. lbs.) torque.

SPECIFICATIONS

TORQUE

DESCRIPTION	TORQUE
2.5L injector hold down clamp	5 N•m (45 in. lbs.)
2.5L throttle body	20 N•m (175 in. lbs.)
2.5L fuel pressure regulator	5 N•m (40 in. lbs.)
3.0L throttle body mounting screws	25 N•m (225 in. lbs.)
3.0L fuel injector rail	13 N•m (115 in. lbs.)
3.3L fuel rail mounting bolts	22 N•m (200 in. lbs.)
3.3L ignition coil pack	12 N•m (105 in. lbs.)
3.3L fuel pressure regulator	7 N•m (60 in. lbs.)
3.3L camshaft position sensor mounting screw	12 N•m (105 in. lbs.)
3.3L crankshaft position sensor mounting screw	12 N•m (105 in. lbs.)
Accelerator pedal mounting nuts	12 N•m (105 in. lbs.)
Idle air control motor	2 N•m (20 in. lbs.)
Fuel tank straps	54 N•m (40 ft. lbs.)
Fuel filter	8 N•m (75 in. lbs.)
Fuel pump module clamp	5 N•m (40 in. lbs.)
Fuel filler tube to body	2 N•m (17 in. lbs.)
Oxygen sensor	27 N•m (20 ft. lbs.)
Throttle position sensor	2 N•m (20 in. lbs.)
Throttle body fuel fittings	20 N•m (175 in. lbs.)

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