FUEL SYSTEM

CONTENTS

GENERAL INFORMATION

The 3.0L engine employs a Multi-Point Fuel Injection (MPI) system. The MPI system injects fuel into the intake manifold above the intake valve port of each cylinder through separate injectors. Refer to MPI section of this group for further information.

The Fuel System consists of the fuel tank, electric fuel pump, fuel filter, fuel tubes, fuel hoses, vacuum hoses, throttle body, and fuel injector(s).

The **Fuel Delivery System** consists of the fuel pump, fuel filter, fuel tubes, and fuel hoses.

A Fuel Return System is used on all vehicles. The system consists of the fuel tubes and hoses that route fuel back to the fuel tank.

The **Fuel Tank Assembly** consists of the fuel tank, filler tube, a fuel gauge sending unit/fuel pump assembly, and a pressure vacuum filler cap.

Also to be considered part of the fuel system is the **Evaporation Control System,** which is designed to reduce the emission of fuel vapors into the atmosphere. The description and function of the Evporative Control System is found in Group 25 of this manual.

WARNING: THE FUEL SYSTEM USED ON THE PREMIER HAS A PLASTIC FUEL TANK AND PLASTIC FUEL TUBES. KEEP OPEN FLAME SUCH AS A CUTTING TORCH AWAY FROM THESE COMPONENTS WHEN SERVICING THE VEHICLE.

Fuel Requirements

Your vehicle was designed to use high quality gasoline. In order to retain the performance qualities of your vehicle and enjoy maintenance free operation, it is recommended that only unleaded gasolines from reputable dealers be used.

Use only unleaded gasolines having a minimum octane rating of 87 (R+M)/2.

Should your vehicle develop spark knock (ping), purchase your fuel from another source. Vehicles may respond differently to gasolines having the same octane rating. Occasional trace knock at low engine speeds is not harmful; however, continued knock at high speeds can damage your engine and should be reported to your dealer immediately. Engine damage as the result of prolonged operation of a vehicle with continuous high speed 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 detergent and corrosion control additives are recommended. The use of gasoline containing these additives will help improve fuel economy, reduce emissions and maintain vehicle performance. If in doubt, premium unleaded gasolines generally contain more additive than the regular unleaded gasolines.

Low quality fuel can cause problems such as hard starting, stalling and driveability deterioration. If problems of this type are experienced, it is recommended that another brand of gasoline be used prior to considering service for the vehicle.

The exhaust emission system of your vehicle is designed to meet all emission regulations while, at the same time, providing excellent fuel economy. Catalyst systems require that only unleaded gasoline be used. Use of leaded fuel will not only destroy the effectiveness of the catalytic converter used to reduce exhaust emissions, but will also make part of the fuel control system inoperative and lead to high fuel consumption. All vehicles have warning labels on the instrument panel and adjacent to the fuel filler cap or door that state UNLEADED FUEL ONLY. These vehicles also have fuel filler tubes designed to accept only the unleaded gasoline dispensing nozzle. Damage resulting from the use of leaded gasoline may not be covered by the new vehicle warranty.

GASOLINES CONTAINING ALCOHOL

Your vehicle was designed to obtain the best performance and efficiency using unleaded gasoline. Some fuel suppliers sell gasoline/alcohol blends as a motor fuel. The type and amount of alcohol used in the blend are important. Many states require that the service station pumps dispensing gasoline containing alcohol be properly labeled with the type and amount of alcohol present. If your state does not have this requirement, we recommend that you ask the gasoline station operator if their fuel contains alcohol and if so, what type and amount.

The following two types of alcohols are generally used in gasoline blends:

ETHANOL (Ethyl or Grain Alcohol) is used as a mixture of 10% ethanol and 90% unleaded gasoline and identified as "Gasohol", "Ethanol Enhanced", or "Contains Ethanol". Gasoline blended with ethanol may be used in your vehicle. Note that these blends, due to their generally higher volatility, may adversely affect the starting, driveability and fuel efficiency of your vehicle. If problems are experienced with ethanol/gasoline blends, it is recommended that the vehicle be operated on gasoline.

METHANOL (Methyl or Wood Alcohol) is used in a variety of concentrations blended with unleaded gasoline. You may encounter fuels containing 3% 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 deterioration and damage to critical fuel system components.

Fuel system damage and vehicle performance problems resulting from the use of gasolines containing methanol are not the responsibility of Chrysler Corporation and may not be covered by the new vehicle warranty.

GASOLINES CONTAINING MTBE

Gasoline and MTBE (Methyl Tertiary Butyl Ether) blends are a mixture of unleaded gasoline and up to 15% MTBE. Gasoline blended with MTBE may be used in your vehicle.

FUEL DELIVERY SYSTEM

INDEX

GENERAL INFORMATION

The electric fuel pump is attached to the gauge sender unit. The pump/sender unit is suspended in the fuel tank and immersed in fuel.

A 64.4 liter (17 gallon) capacity, molded fuel tank is used in Premier vehicles. The fuel tank filler door is located on the passengers rear quarter panel. Some models have a remote operated fuel filler door. The release lever is located on the passenger compartment floor to the left of the driver's seat. **If the release lever should malfunction, there is a manual override fuel filler door release in the trunk (Fig. 1).**

Fuel Return System

The fuel return system consists of the tubes that route from the pressure regulator to the fuel tank. On the MPI system used on 3.0L engines, during normal operation, the fuel pump delivers fuel in excess of the maximum required by the engine. The excess fuel flows back to the fuel tank from the pressure regulator via the fuel return tube.

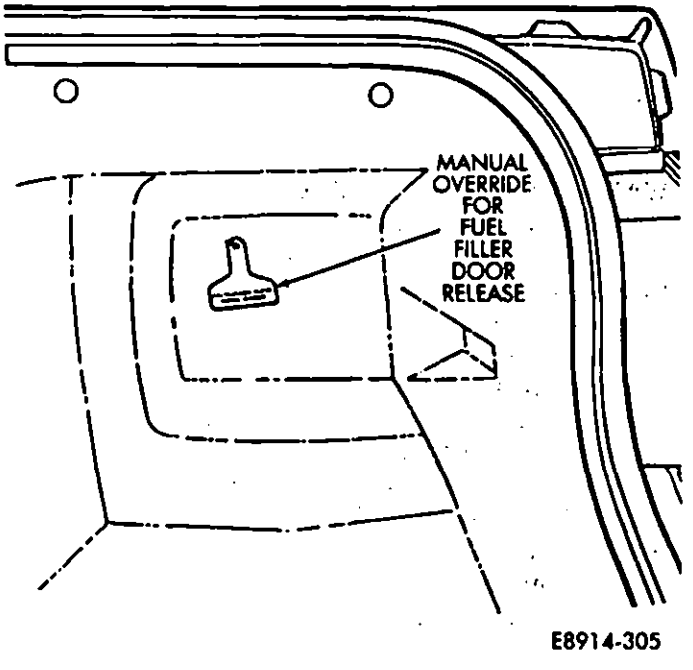

Fig. 1—Remote Operated Fuel Filler Door Manual Override Lever

FUEL PUMP

The fuel pump is a positive displacement, single speed, multi-cell roller type pump driven by a permanent magnet, 12 volt electric motor. The pump is integral with the fuel sender unit. The pump/sender assembly is installed inside the fuel tank. The pump runs whenever the engine is operating.

The fuel pump contains a check valve at the outlet end that consists of a steel ball held against a seat by force applied from a spring. When the pump is operating, fuel pressure overcomes spring pressure and forces the ball off its seat allowing fuel to flow. When the pump is not operating, spring pressure forces the ball back against the seat preventing fuel backflow through the pump. The check valve prevents the system from losing prime when the engine is not operating.

A pressure relief valve inside the pump prevents fuel pressure inside the pump from exceeding approximately 689 kPa (100 psi). Should internal pump pressure reach this range, the relief valve will bypass fuel to the suction side of the pump.

MPI (used on 3.0L engine) system fuel pressure is maintained at 248-255 kPa (36-37 psi) when the pump is operating and vacuum is supplied to the fuel pressure regulator (located on the fuel rail—not the pump's internal pressure regulator). If vacuum is not supplied to the pressure regulator, because of a broken or clogged vacuum line, fuel pressure will be higher.

Fuel Pump Controls

For the 3.0L MPI system, voltage to operate the fuel pump is supplied through the Fuel Pump Relay when the relay is grounded by the Engine Electronic Control Unit (ECU).

MPI FUEL SYSTEM PRESSURE TEST

WARNING: WEAR EYE PROTECTION WHEN SERVICING THE FUEL SYSTEM. DO NOT SMOKE OR ALLOW OPEN FLAME NEAR FUEL SYSTEM COMPONENTS DURING FUEL SYSTEM SERVICE.

(1) Remove the fuel tank filler cap to relieve the fuel tank pressure.

WARNING: SYSTEM FUEL PRESSURE WILL BE RELEASED WHEN DISCONNECTING THE FUEL SUPPLY TUBE. WRAP SHOP TOWELS AROUND THE TUBE AND QUICK-CONNECT FITTING TO ABSORB SPILLED FUEL.

(2) Use tool 6182 to remove the black fuel supply tube from the fuel rail (Fig. 2). Slide the tool over the nipple and up into the connector until the handle fits the connector. Pull the fuel supply tube off the fuel rail.

(3) Install fuel tube adapter, tool number 6175.

(4) Push the female end with the quick-connect fitting over the fuel rail until a click is heard. Pull the connector back to ensure that it is locked in place.

(5) Push the male end with the nipple into the black fuel supply tube until a click is heard. Pull the nipple back to ensure that it is locked in place.

(6) Attach the 0-60 psi gauge from fuel gauge set 5069 or equivalent to the port on fuel tube adapter 6175.

(7) Start the engine and check the fuel pressure. It should be 193-207 kPa (28-30 psi).

The fuel pressure regulator is non-adjustable.

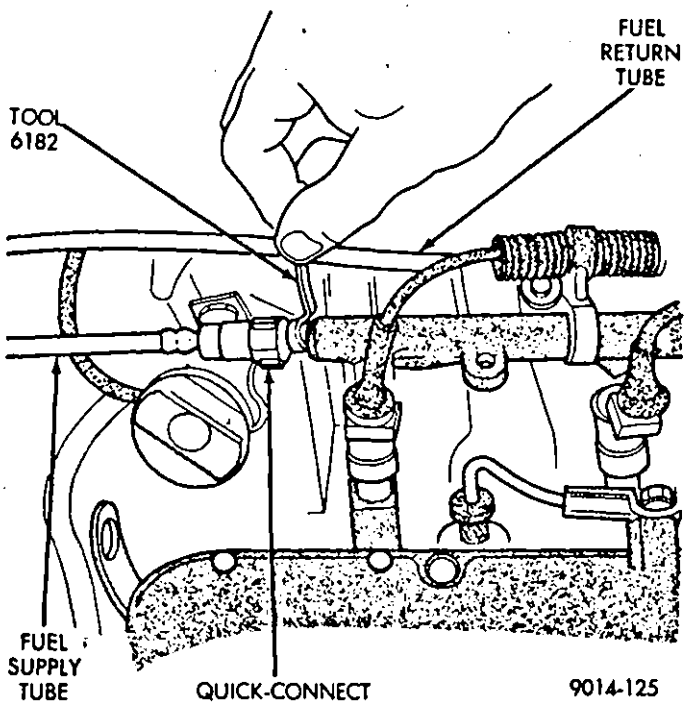

Fig. 2—Disconnecting Fuel Supply Tube at Fuel Rail—MPI

(8) If the fuel pressure is low, check for fuel flow through the return tube.

- If fuel is returning to the fuel tank through the fuel return tube, replace the fuel pressure regulator.
- If fuel is not returning to the fuel tank through the return tube, inspect for a faulty fuel pump, possible clogged fuel filter or other restriction between the fuel pressure regulator and the fuel pump.

(9) If the fuel pressure is high, check the pressure regulator vacuum hose for leaks and for a kink or restriction in the fuel return tube. If the pressure regulator vacuum hose is not leaking and the return tube is not kinked or does not have a restriction, the fuel pressure regulator should be replaced.

(10) Remove the pressure gauge.

(11) Disconnect the fuel tube adaptor 6175 with disconnect tool 6182.

(12) Prior to installing the fuel tubes to the regulator and fuel rail the tube ends **MUST** be lightly lubricated with clean 30 weight engine oil. Refer to Fuel Tubes and Quick-Connect Fittings in this section.

(13) Install the black fuel supply tube to the fuel rail and the grey fuel return tube to the pressure regulator. Refer to Fuel tubes and Quick-Connect Fittings in this section for correct installation procedure.

(14) Install fuel filler cap.

FUEL FILTER

(1) Disconnect negative cable from battery.

(2) Remove the fuel tank filler cap to relieve the fuel tank pressure.

WARNING: WEAR EYE PROTECTION WHEN SERVICING THE FUEL SYSTEM. DO NOT SMOKE OR ALLOW OPEN FLAME NEAR FUEL SYSTEM COMPONENTS DURING FUEL SYSTEM SERVICE.

Wrap shop towels around the fuel line quick-connectors before disconnecting them from the filter. The system pressure will bled off when the quick-connector is removed. The shop towels will prevent fuel spillage.

(4) Depress retainer tabs and slowly pull the connectors from fuel filter. Note that the retainers stay on the fuel filter nipples.

(5) Remove screw holding the fuel filter in place (Fig. 3). Remove fuel filter.

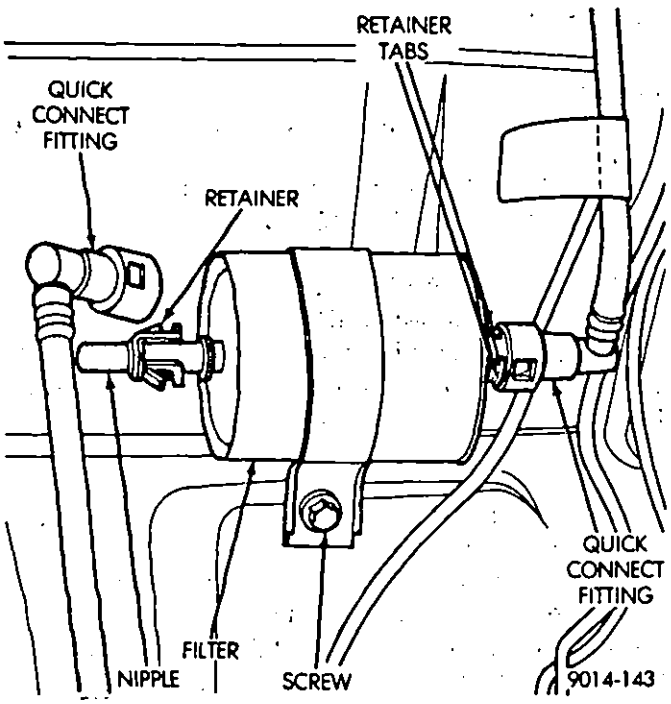

Fig. 3—Fuel Filter Removal/Installation

Carefully remove the retainers from fuel filter nipples with a thin straight blade screwdriver. Insert the screwdriver between the filter nipple and the wedge portion of the retainer that seats against the shoulder on the nipple. Press the wedge back and slip the wedge over the nipple shoulder. Repeat this on the other side of the retainer and then pull the retainer off the nipple.

Push the retainers back into the fuel line quick-connect fittings. Ensure that the locking "ears" and the shoulder (stop bead) on the fuel tube are completely visible in the "windows" on the side of the quick-connect fittings.

Installation

The fuel filter is marked IN and OUT at the nipple ends. The side marked IN is connected to the fuel line from the fuel tank. The side of the filter marked OUT is connected to the fuel line that runs to the engine.

(1) Position fuel filter in place. Secure with screw. Tighten screw to 12 N·m (110 in-lbs) torque.

(2) Lightly lubricate the fuel tube ends with clean 30 weight engine oil prior to reinstallation. Refer to Fuel Tubes and Quick-Connect Fittings in this section.

(3) Refer to Fuel Tube and Quick-Connect Fittings in this section for correct quick-connect fitting connection procedures. Connect the fuel line quick-connect fittings to the fuel filter nipples.

(4) Connect negative cable to battery.

(5) Install fuel tank filler cap.

(6) Turn the key to the ON position to pressurize the fuel system and check for leaks.

FUEL TUBES AND QUICK-CONNECT FITTINGS

The fuel system used on this vehicle utilizes plastic fuel tubes with quick-connect fittings that have sealed O-ring seals. The O-rings of the quick-connect fittings do not have to be replaced when the fittings are disconnected.

The quick-connect fitting consists of the O-rings, retainer and casing (Fig. 4). When the fuel tube nipple is inserted into the quick-connect fitting, the shoulder of the nipple is locked in place by the retainer, and the O-rings seal the tube.

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

When the fittings are disconnected the retainer will stay on the nipple of the component that the tube is being disconnected from. A fuel tube should never be inserted into a quick-connect fitting without the retainer being either on the tube or already in the quick-connect fitting. In either case, care must be taken to ensure that the retainer is locked securely into the quick-connect fitting.

If the quick-connect fitting has "windows" in the sides of the casing, the retainer locking "ears" and the shoulder (stop bead) on the tube must be visible in the windows or the retainer is not properly installed (Fig. 5). After connecting a quick-connect fitting, the connection should be verified by pulling on the lines to ensure that the lock is secure.

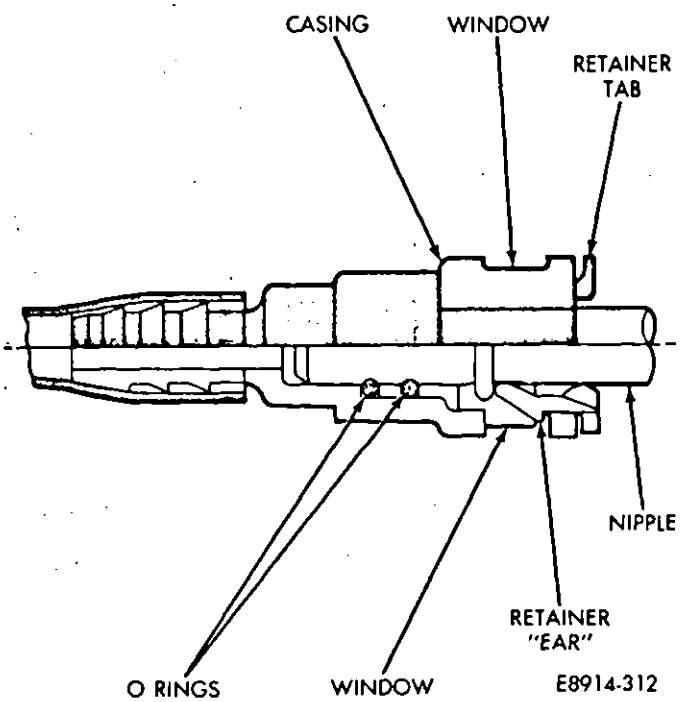

Fig. 4—Quick-Connect Fitting

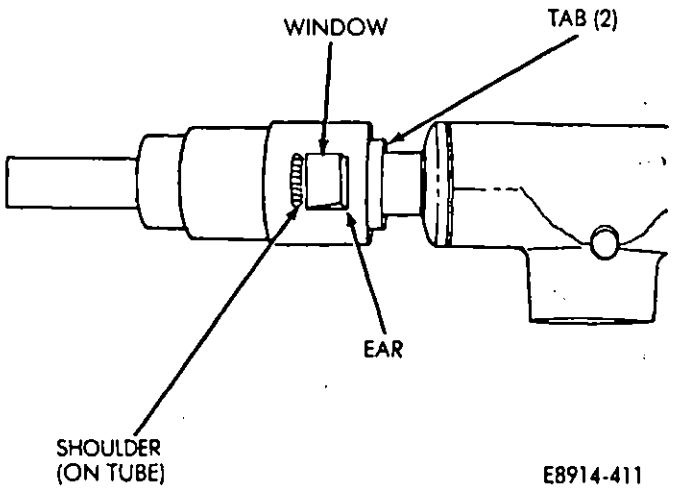

Fig. 5—Correct Quick-Connect Fitting Installation

Fuel tube disconnect tool 6182 can be used at the 3.0L engine fuel rail and fuel pressure regulator to remove the quick-connect fitting and retainer as an assembly (Fig. 6). The retainer will remain in the fitting in the correct position. To install the fuel tube, push it over the nipple until a click is heard. Pull back on the tube to ensure that the connector is locked in place.

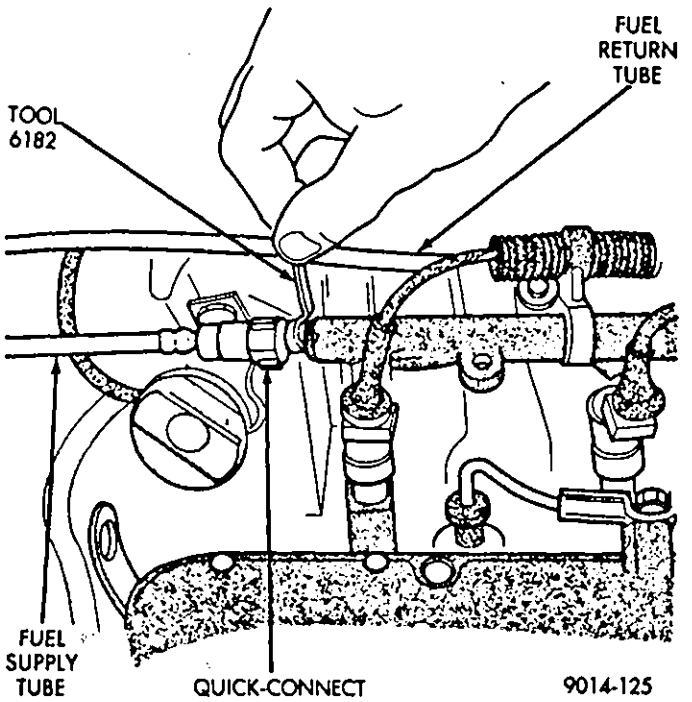

Fig. 6—Fuel Tube to Fuel Rail Quick-Disconnect Tool—3.0L Engine

Tube/Fitting Disassembly

(1) Disconnect battery negative cable from battery.

(2) Remove fuel tank filler cap to remove fuel tank pressure.

WARNING: FUEL SYSTEM PRESSURE WILL BE RELEASED WHEN THE QUICK-CONNECT FITTING IS DISCONNECTED. PLACE SHOP TOWELS AROUND TUBE TO ABSORB SPILLED FUEL. WEAR EYE PROTECTION AND EXTINGUISH ALL SMOKING DEVICES.

(3) Squeeze retainer tabs together and pull quick-connect fitting apart (Fig. 4). Note that retainer tabs stay on the nipple.

Tube/Fitting Assembly

(1) Using a clean lint free cloth, wipe clean the tube end (nipple) and retainer.

(2) Apply a light film of clean 30 weight engine oil to the tube end. **DO NOT use any other lubricant.**

(3) Push the quick-connect fitting over the fuel tube until the retainer seats and a click is heard.

(4) If, the quick-connect fitting is the type that has "windows" on the side, ensure that the locking "ears" on the retainer and the shoulder (stop bead) on the fuel tube are completely visible in the "windows." Do not rely upon the audible click to confirm that a secure connection has been made. Pull back on the quick-connect fitting to further ensure that the connection is complete and the connector is locked in place.

(5) Install fuel tank filler cap.

(6) Connect negative cable to battery.

(7) Turn key to on position. Inspect for leaks.

FUEL TANK

INDEX

GENERAL INFORMATION

A 64.4 liter (17 gallon) capacity, molded fuel tank is used in these vehicles. The fuel tank is equipped with fuel and vapor controls that allow the vehicles to pass a 360 rollover without fuel leakage.

An evaporative control system prevents raw fuel vapor from escaping into the atmosphere. Fuel vapor from the fuel tank is collected in an evporative canister. When the engine is operating the vapors are drawn into the intake manifold to be consumed in combustion.

Inspect all hose/clamp connections for completeness and ensure that no leaks are present. Hoses that are cracked, scuffed, swelled, have rubbed against other vehicle components or show any other sign of wear that could lead to failure should be replaced.

When installing hoses, ensure that they are routed away from contact with other vehicle components that could rub against them and cause failure.

No-Lead Fuel Tank Filler Tube

These vehicles are designed to operate using Unleaded fuels. The diameter of the opening in the fuel tank filler neck is sized to only accept unleaded fuel nozzles. Gasoline station pumps for unleaded and leaded fuels have different size nozzles. Leaded fuel nozzles are larger in diameter than unleaded nozzles. The fuel tank filler neck opening is also equipped with a deflector which the smaller unleaded nozzle pushes back upon entering the filler neck. The deflector will prevent the larger diameter leaded fuel nozzles from entering the filler neck and will deflect fuel away from the filler neck if filling of the tank with leaded fuel is attempted.

PRESSURE-VACUUM FILLER CAP

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

CAUTION: The fuel filler cap must be removed to release fuel tank pressure prior to disconnecting any fuel system component.

FUEL TANK

Draining Fuel Tank

WARNING: GASOLINE IS AN EXTREMELY VOLATILE SUBSTANCE. KEEP OPEN FLAME AND HIGH HEAT AWAY FROM THE FUEL SYSTEM COMPONENTS WHEN SERVICING THE FUEL SYSTEM. WEAR EYE PROTECTION AND EXTINGUISH ALL SMOKING DEVICES WHEN SERVICING THE FUEL TANK

(1) Disconnect battery negative cable.

(2) Remove fuel filler cap.

(3) Using a portable gasoline siphon/storage tank drain the fuel tank until dry.

Removal

(1) Disconnect the battery negative cable.

(2) Remove the fuel tank filler cap to relieve the fuel tank pressure.

(3) Drain the fuel tank. Refer to Draining Fuel Tank.

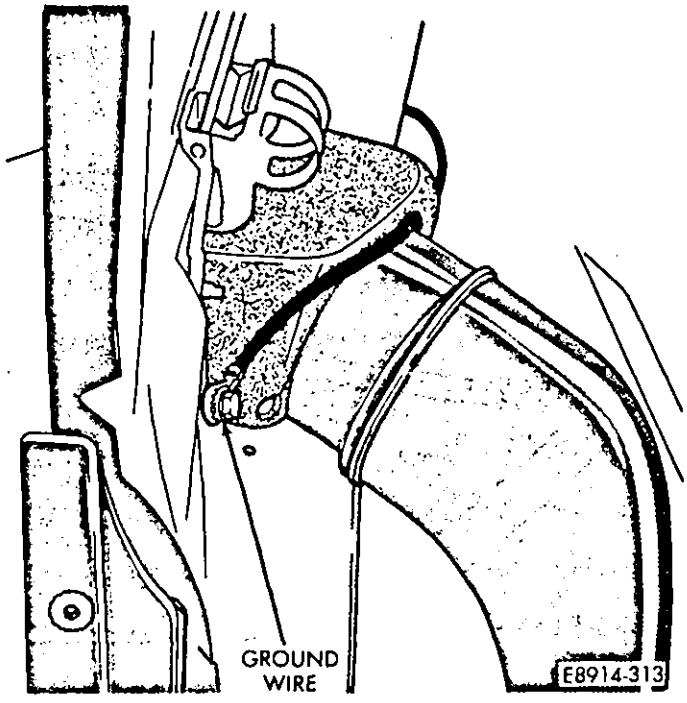

Fig. 7—Ground Wire

(4) Raise the vehicle on a hoist (Refer to Engine/Transmission/Cradle Removal/Installation Section—Vehicle Lifting Information).

(5) Remove the right rear tire and wheel.

(6) Remove the splash shield from the wheel well.

(7) Remove ground wire retaining screw (Fig. 7).

(8) Loosen hose clamp and disconnect fuel tank vent hose from fuel tank filler neck (Fig. 8).

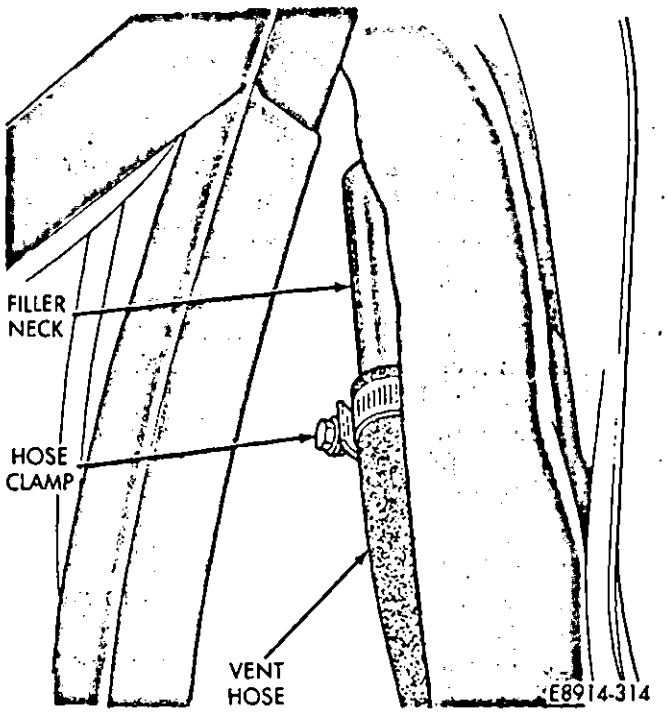

Fig. 8—Fuel Filler Vent Hose Removal/Installation

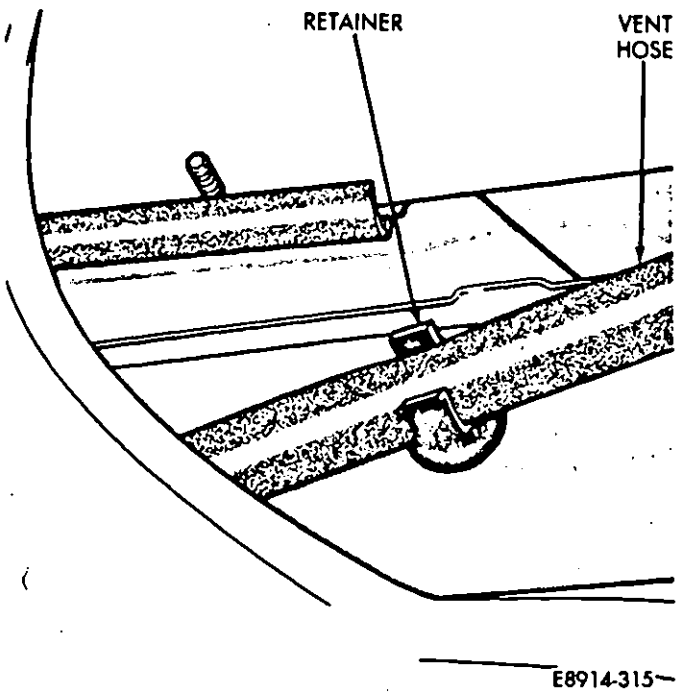

Fig. 9—Vent Hose Retainer Clip

(9) Slide fuel tank vent hose out of retainer clip on the frame (Fig. 9).

(10) Loosen and remove both nuts securing fuel tank support strap (Fig. 10). Push the other end of the strap up and out the left side frame rail.

(11) Place a transmission jack under the fuel tank to support it while removing the tank.

The black colored tube is the fuel supply tube and the gray colored tube is the return tube.

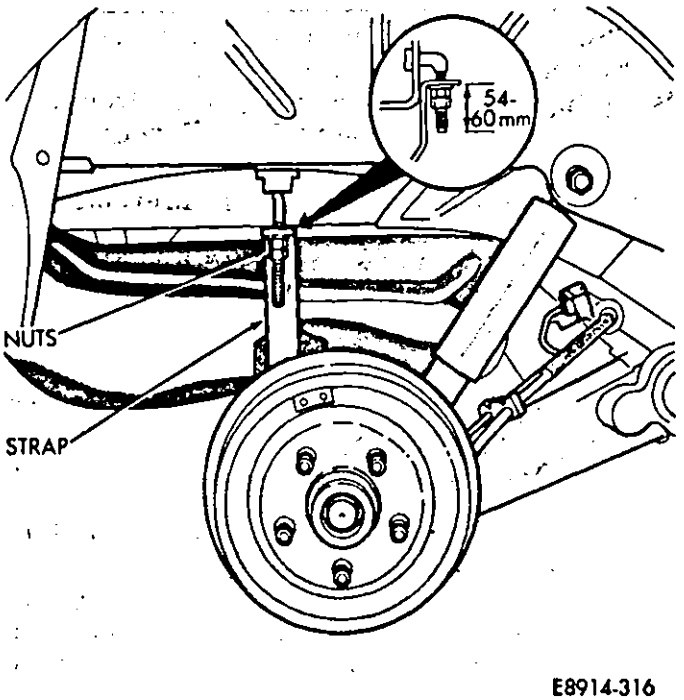

Fig. 10—Fuel Tank Strap

WARNING: THE FUEL SUPPLY SYSTEM MAY BE PRESSURIZED. WRAP SHOP TOWELS AROUND THE FUEL SUPPLY TUBE AND FUEL FILTER TO ABSORB FUEL SPRAY WHEN DISCONNECTING THE QUICK-CONNECT FITTING. WEAR EYE PROTECTION AND EXTINGUISH ALL SMOKING DEVICES WHEN SERVICING THE FUEL TANK.

(12) Using a clean lint free cloth, wipe the quick-connect fitting connections at fuel filter inlet nipple and in the grey fuel return tube clean of dirt and/or road salt. Spray compressed air around the retainer area of the fittings to remove any loosened dirt or road salt. Disconnect the quick-connect fittings by squeezing the retainer tabs and pulling the fitting back (Fig. 11). **The quick-connect retainer will stay on the nipple.**

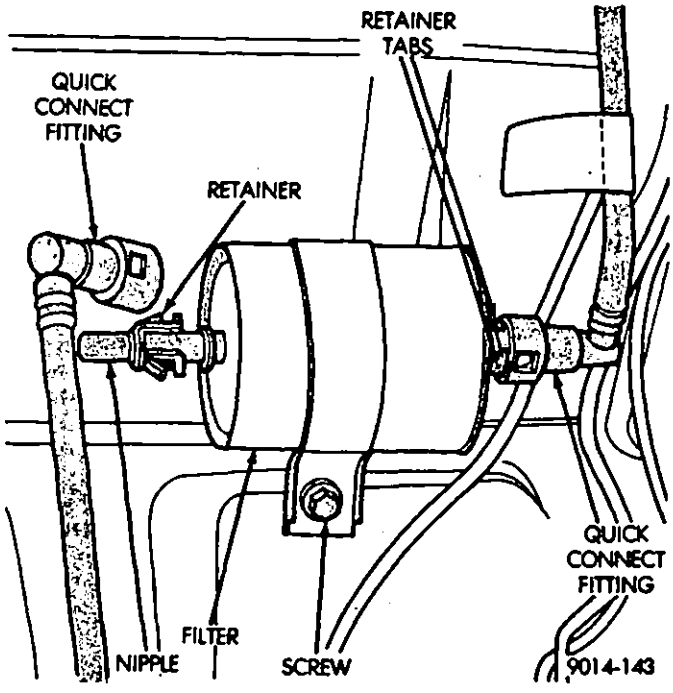

Fig. 11—Fuel Supply Tube and Fuel Filter Quick-Connect Fitting

(13) Pull fuel tank to fuel filter supply tube through the access hole in frame towards fuel tank.

(14) Disconnect fuel pump/sending unit electrical connector. The connector is slid onto a mounting bar attached to the frame.

(15) Disconnect the fuel tube from the fuel tank rollover/pressure release valves to the fuel tank to evaporator canister vapor tube at the connecting hose.

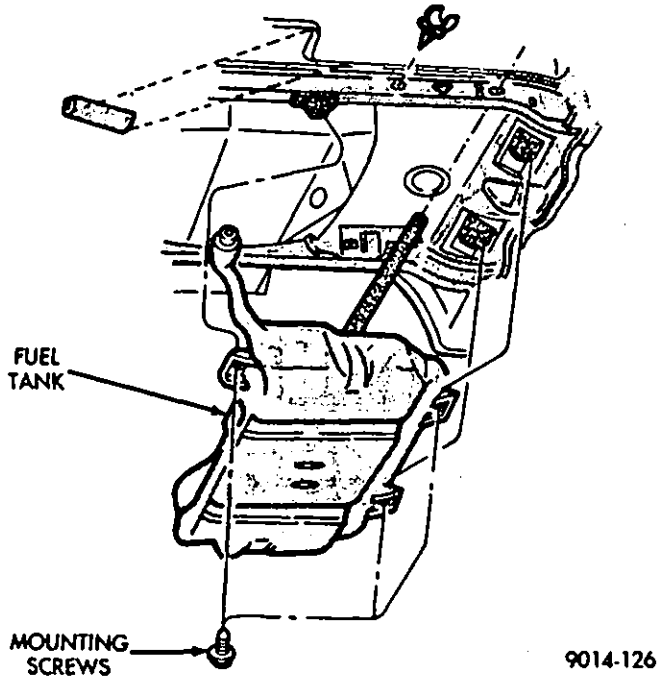

Fig. 12—Fuel Tank Removal/Installation

(16) Remove fuel tank mounting bolts (Fig. 12). The fuel tank is now supported by the transmission jack only.

(17) Lower the fuel tank on the transmission jack 2 to 3 inches.

(18) Push fuel tank vent hose towards the fuel tank through access hole in frame (Fig. 13).

CAUTION: When lowering the fuel tank on the transmission jack, it is necessary to tip the rear of the tank down to allow the two mounting flanges to slide out from above the rear axle. Support the tank so that it does not fall from the transmission jack.

(19) Lower the tank and remove it from the transmission jack.

Installation

(1) Center fuel tank on transmission jack.

(2) Raise jack until the fuel tank is 8 to 10 inches below vehicle.

(3) Tip front of fuel tank up over rear axle and continue raising tank until it is 1 to 2 inches away from being in place.

(4) Route the fuel tank filler vent hose through access hole in the frame (Fig. 13).

(5) Continue raising tank into place.

(6) Install fuel tank mounting bolts. Tighten the bolts to 16 N·m (12 ft-lbs) torque.

(7) Remove transmission jack.

(8) Install fuel tank support strap. Tighten top nut until distance between the bottom of the strap bolt and the strap is 54-60 mm (2.125-2.362 in.). Refer to Figure 10.

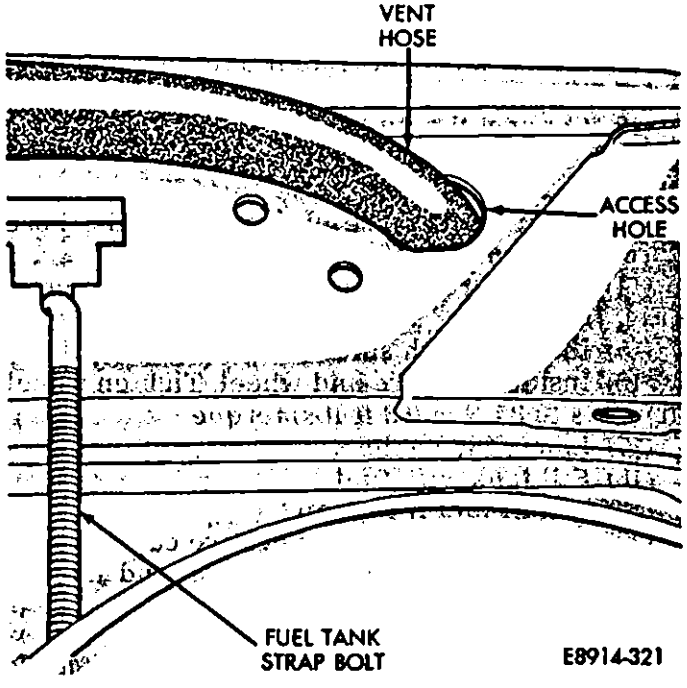

Fig. 13—Vent Hose Removal/Installation

(9) Push black fuel support hose through hole in body.

The O-Rings in the fuel tube quick-connect fittings are sealed in place and do not have to be replaced each time the quick-connect fittings are disconnect.

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

When the fuel supply tube to fuel filter quick-connect fitting, and the fitting in the gray fuel return tube were disassembled, the quick-connect fitting retainers remained on the nipples of the filter and fuel tube.

CAUTION: The retainer is required as a part of the quick-connect fitting to lock the tube into the fitting. A fuel tube should never be inserted into a quick-connect fitting without the retainer being either on the tube or already in the quick-connect fitting. In either case, care must be taken to ensure that the retainer is locked securely into the quick-connect fitting.

If the quick-connect fitting is the type that has "windows" in the sides, the retainer locking "ears" and the shoulder (stop bead) on the fuel tube must be completely visible in the windows. After connecting a quick-connect fitting, the connection should always be verified by pulling on the lines to ensure that the lock is secure. Refer to Fuel Tubes and Quick-Connect Fittings in this Group.

(10) Connect the quick-connect fittings at the fuel filter (Fig. 11) and the in-line fitting in the gray fuel return tube.

(11) Connect electrical connector for the fuel pump/sender unit and slide it onto the mounting bar attached to the frame.

(12) Connect the fuel tank to evaporator canister tube.

(13) Attach fuel vent hose to fuel tank filler neck. Secure with hose clamp. Route the hose through the clip on the body (Fig. 9).

(14) Install ground wire with retaining screw (Fig. 7).

(15) Install splash shield in wheel well.

(16) Install rear tire and wheel. Tighten wheel lug nuts to 85 N·m (63 ft-lbs) torque.

(17) Lower the vehicle.

(18) Fill tank with fuel.

(19) Install fuel filler cap.

(20) Connect the battery negative cable.

(21) Turn key to the ON position and inspect for leaks.

FUEL PUMP/GAUGE SENDER UNIT REPLACEMENT

The Fuel Pump/Sender Unit is located in the fuel tank.

Removal

(1) Disconnect the battery negative cable.

(2) Remove fuel tank. Refer to Fuel Tank Removal.

(3) Disconnect the quick-connect fittings of the black fuel supply tube and grey fuel return tube by squeezing retainer tabs and then pulling connectors away from nipples (Fig. 14). Retainers will stay on the nipples (Fig. 15).

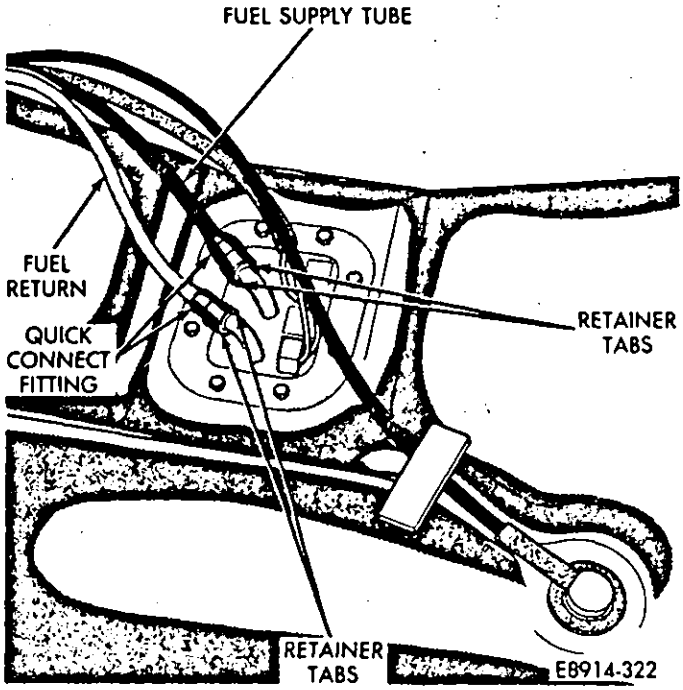

Fig. 14—Disconnecting Fuel Supply and Return Tubes

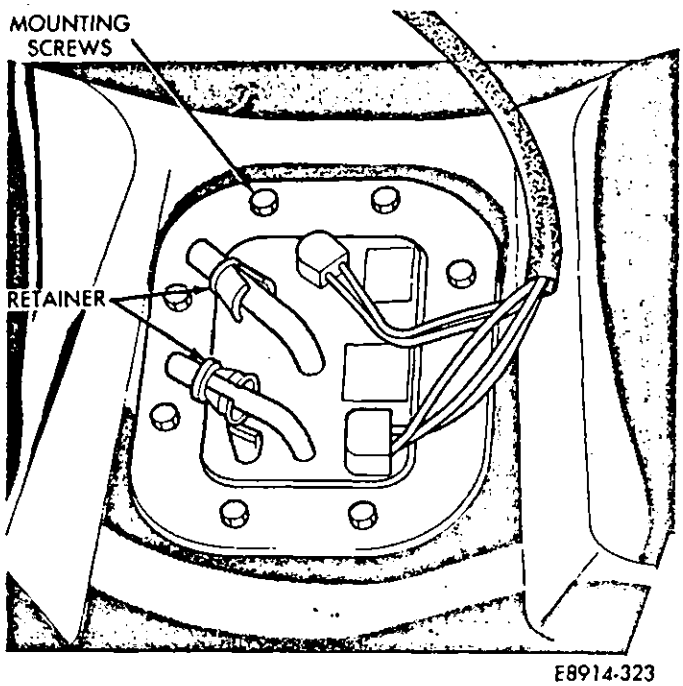

Fig. 15—Quick-Disconnect Fitting Retainers

(4) Remove bolts that hold fuel pump/sender unit face plate to the fuel tank (Fig. 15).

(5) Carefully pull fuel pump/sender unit out from the fuel tank. It will be necessary to tilt the unit forward and backwards to allow the fuel filter and float arm room for removal. Note the position of gasket for correct reassembly (Fig. 16).

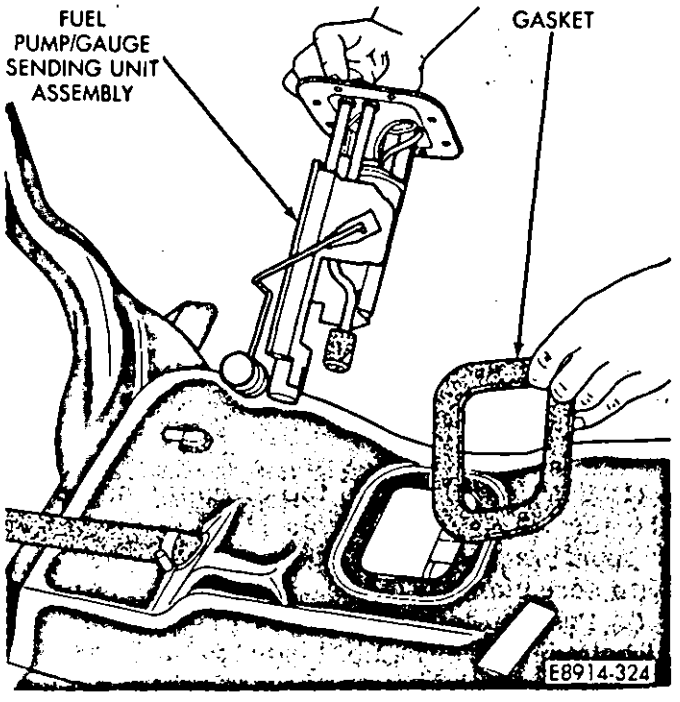

Fig. 16—Fuel Pump/Gauge Sending Unit Removal/ Installation

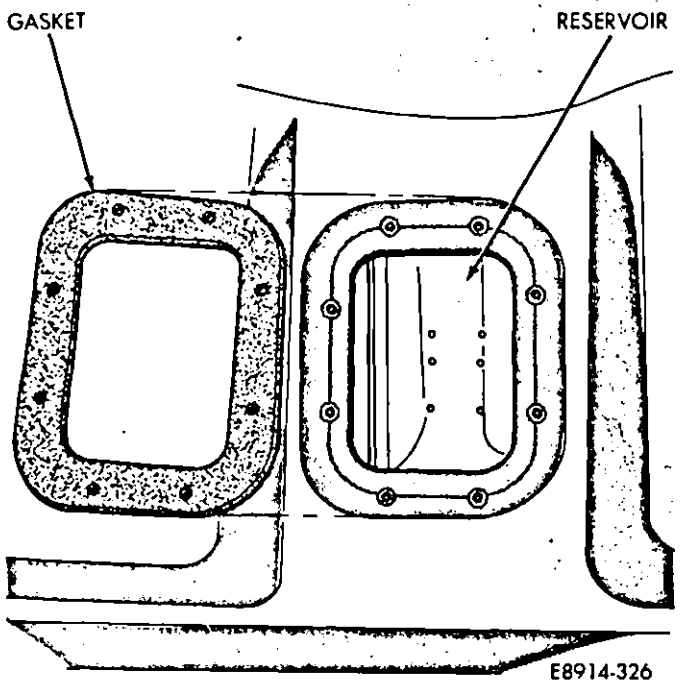

Fig. 17—Fuel Reservoir

Installation

There is a fuel reservoir (tray) in the bottom of the fuel tank that is contoured to hold the fuel filter (Fig. 17). Be sure to install the fuel pump/ sender unit so that the filter correctly fits into the tray.

(1) Position gasket so that the holes in the gasket line up with the bolt holes in the fuel tank.

(2) Lower the fuel pump/sender unit into the fuel tank. It will be necessary to tilt the assembly backwards and forwards to provide clearance for the fuel filter and float arm.

(3) Screw the retaining bolts into the tank.

The O-Rings in the fuel tube quick connectors are sealed in place. They do not have to be replaced each time the Quick-Connect fittings are disconnected.

The fuel tube nipples on the faceplate of the fuel pump/gage sending unit must be lubricated with clean 30 weight engine oil before reconnecting the quick-connect fittings.

When the fuel supply and return tubes were disconnected, the retainers remained on the nipples of the fuel pump/gauge sending unit faceplate.

CAUTION: The retainer is required as a part of the quick-connect fitting to lock the tube into the fitting. A fuel tube should never be inserted into a quick-connect fitting without the retainer being either on the tube or already in the quick-connect fitting. In either case, care must be taken to ensure that the retainer is locked securely into the quick-connect fitting.

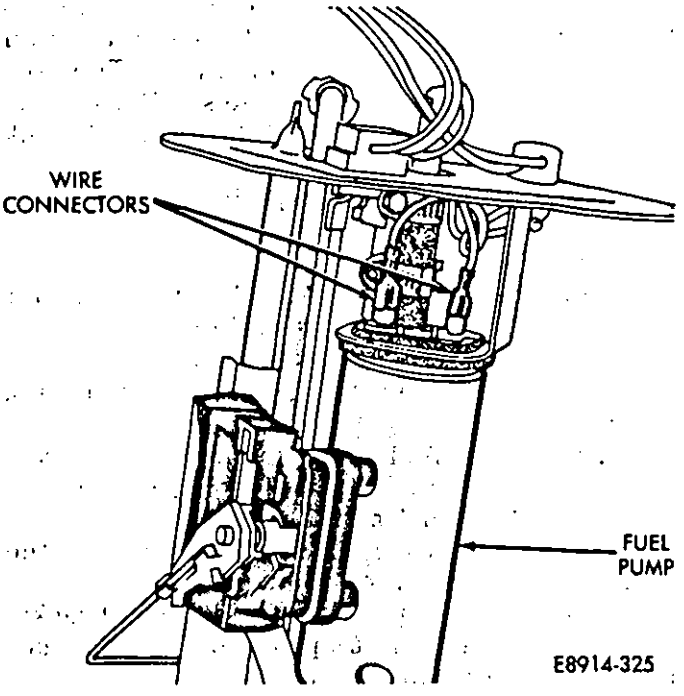

Fig. 18—Fuel Pump Wire Connectors

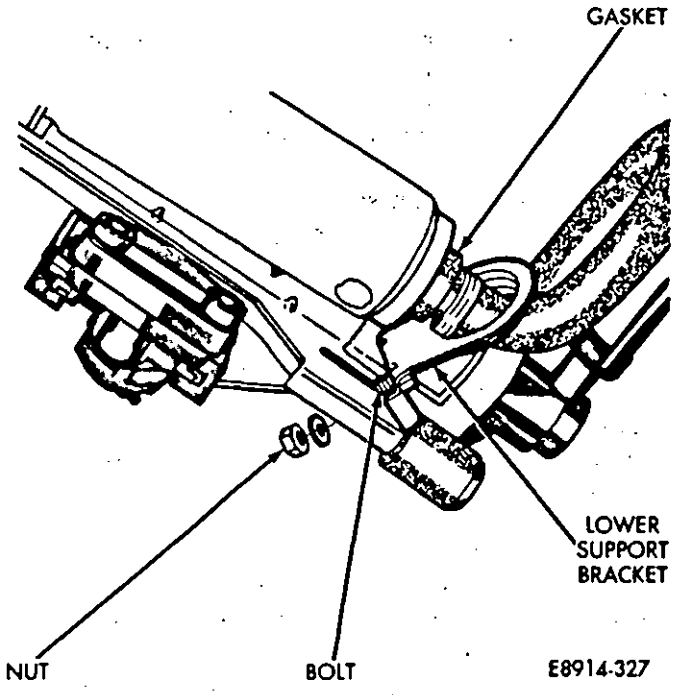

Fig. 19—Fuel Pump Lower Support Bracket

If the quick-connect fitting has "windows" in the sides, the retainer locking "ears" and the shoulder (stop bead) on the fuel tube must be completely visible in the windows. After connecting a quick-connect fitting, the connection should always be verified by pulling on the lines to ensure that the lock is secure. Refer to Fuel Tubes and Quick-Connect Fittings in this group.

(4) Connect the fuel tube Quick-Connect fittings to the nipples on the face plate. The black fuel supply tube goes to the larger nipple. The grey tube fuel return tube goes to the smaller nipple.

(5) Install the fuel tank. Refer to Fuel Tank Installation.

(6) Connect the battery negative cable.

Fuel Pump Removal

The fuel pump is part of the fuel pump/sender unit which is located in the fuel tank.

(1) Disconnect battery ground cable.

(2) Remove the fuel tank. Refer to Fuel Tank Removal.

(3) Remove the fuel pump/sender assembly from the fuel tank. (See Fuel Supply System Section—Fuel Pump/Sender Unit Removal).

(4) Disconnect wire connectors and from the terminals on top of fuel pump (Fig. 18).

(5) Unscrew fuel pump lower support bracket nut. Remove the fuel pump support bracket, gasket and bolt (Fig. 19).

(6) Disconnect hose clamp at inlet port of fuel pump (Fig. 20).

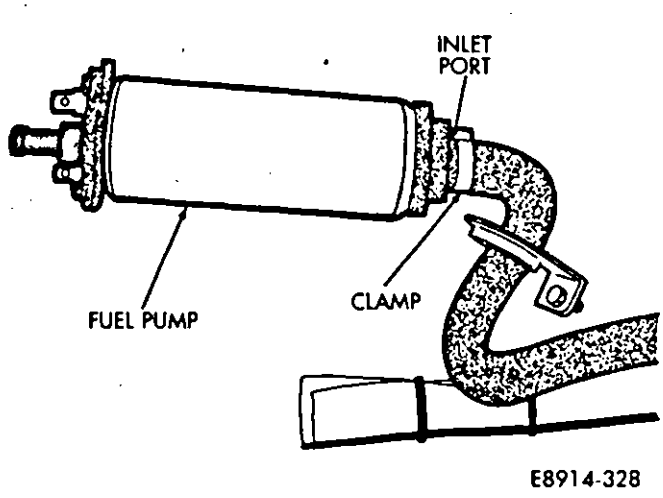

Fig. 20—Fuel Inlet Port Hose

(7) Unscrew hose clamp and pull fuel pump out (Fig. 21). Keep gasket for installation.

Fuel Pump Installation

(1) Position gasket on top of fuel pump. Push the fuel pump up into outlet hose and upper support bracket. Secure the hose to the fuel pump with hose clamp (Fig. 22).

(2) Position lower gasket and holding bracket at bottom of fuel pump. Install the bolt through lower support bracket and rail. Tighten nut and bolt securely (Fig. 19).

(3) Connect the hose to inlet port of the fuel pump and secure with hose clamp (Fig. 20).

(4) Install electrical connectors to terminals on fuel pump (Fig. 18).

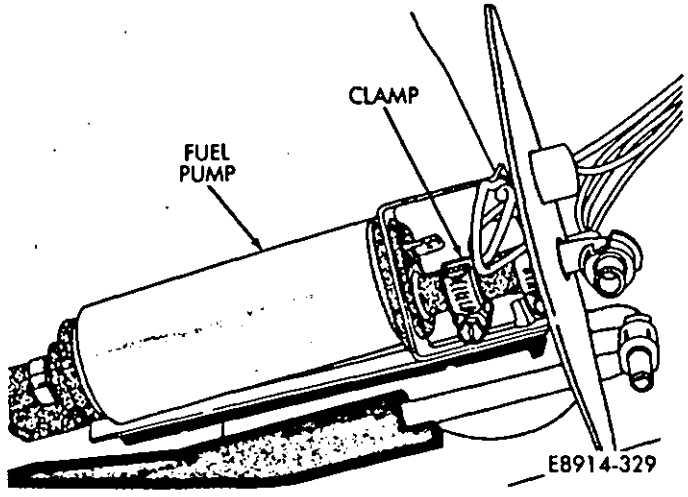

Fig. 21—Fuel Pump Removal

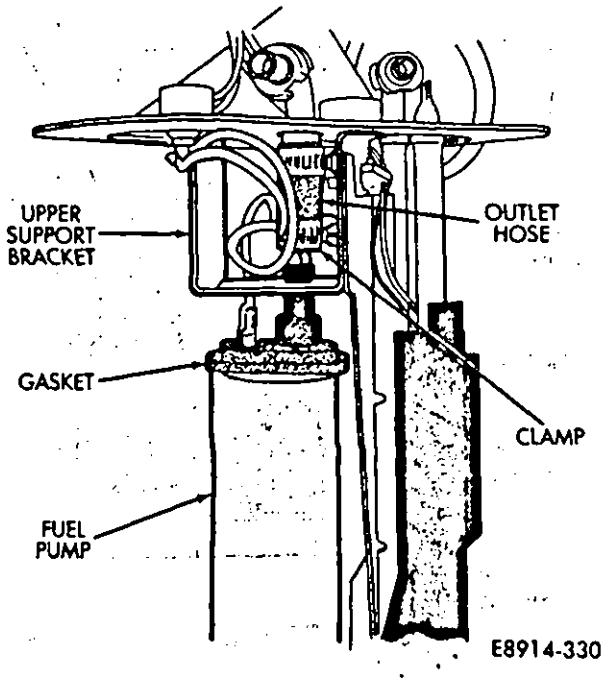

Fig. 22—Fuel Pump Installation

(5) Install fuel pump/sender unit into fuel tank. Refer to Fuel Pump/Gauge Sending Unit Installation.

(6) Install the fuel tank. Refer to Fuel Tank Installation.

(7) Connect battery negative cable to battery.

In-Tank Fuel Filter Removal

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

(2) Remove the fuel pump/sender unit from the fuel tank. Refer to Fuel Pump/Gauge Sending Unit Removal.

(3) Remove fuel filter from the fuel pump/gauge sending unit by pulling the filter down (Fig. 23).

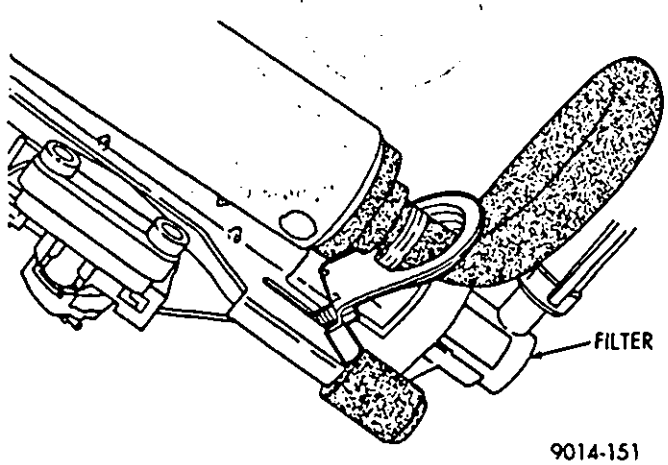

Fig. 23—In-Tank Fuel Filter Removal/Installation

In-Tank Fuel Filter Installation

(1) Push fuel filter onto bottom of unit.

(2) Install fuel pump/sender unit into fuel tank. Refer to Fuel Pump/Sender Unit Installation.

(3) Install fuel tank. Refer to Fuel Tank Installation.

FUEL RESERVOIR

The fuel tanks are equipped with a fuel reservoir (Fig. 24) that provides fuel to the fuel pump inlet during all driving conditions, especially when the fuel tank has a low level of fuel. The reservoir is a small tray with raised sides that the fuel pump inlet sits in. The fuel return tube empties into a small cup in the reservoir that is ported to the rest of the tank. The combination of return fuel and fuel from the main tank keeps the reservoir full even when the fuel level in the main tank is below the level in the reservoir.

FUEL TANK ROLLOVER VALVE

The fuel tanks are equipped with two rollover valves. The dual function valves relieve fuel tank pressure and prevent fuel flow through the fuel tank vent hoses in the event of vehicle rollover.

The valve consists of a plunger, spring, and an orifice and guide plate (Fig. 25). The valve is normally open. In the closed position, force applied by spring pressure seats the plunger against the guide plate, shutting off the flow of fuel vapor from the fuel tank to the evaporative canis-

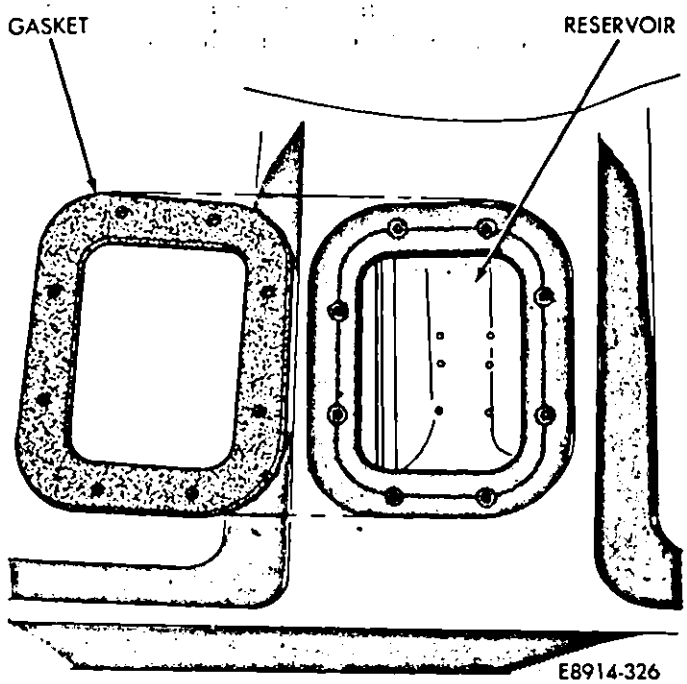

Fig. 24—Fuel Tank Reservoir

ter. When fuel does not reach the valve, the spring pressure is overcome and the plunger moves away from the guide plate allowing fuel vapor to flow through the valve orifice.

In vehicle rollover the valve is inverted. In this position the plunger is forced against the guide plate and raw fuel is prevented from flowing through the valve orifice into the fuel tank vent tube.

Removal

(1) Disconnect battery negative cable from the battery.

(2) Remove the fuel filler cap and drain fuel tank. Refer to Draining Fuel Tank.

(3) Remove fuel tank. Refer to Fuel Tank Removal.

(4) The rollover valve is seated in a grommet. Remove by prying one side upward and then roll the grommet out of tank (Fig. 26). **Do not pry on the nipple of the rollover valve.**

Installation

(1) Start one side of grommet into opening in fuel tank and using finger pressure only, roll the grommet into place.

(2) Use finger pressure only, roll the rollover valve into the grommet. It may be necessary to lightly lubricate the valve with silicon spray or power steering fluid to ease valve installation.

(3) Install fuel tank. Refer to Fuel Tank Installation.

(4) Fill fuel tank. Install fuel tank filler cap.

(5) Connect battery negative cable to battery.

(6) Start vehicle and check for leaks.

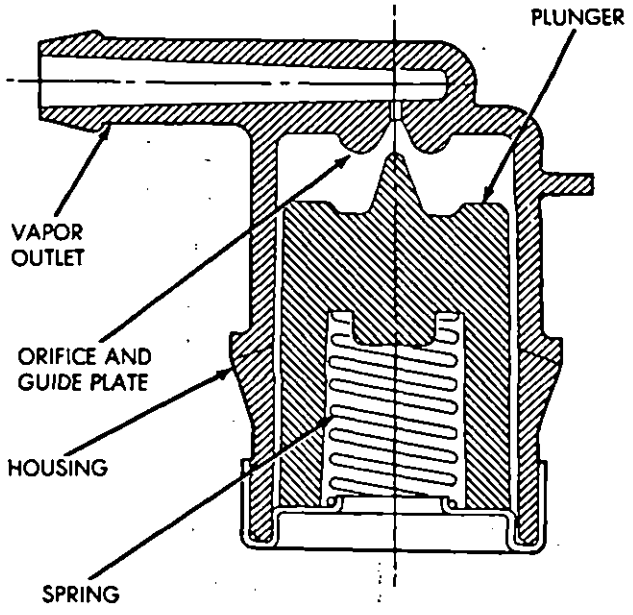

Fig. 25—RollOver Valve Operation

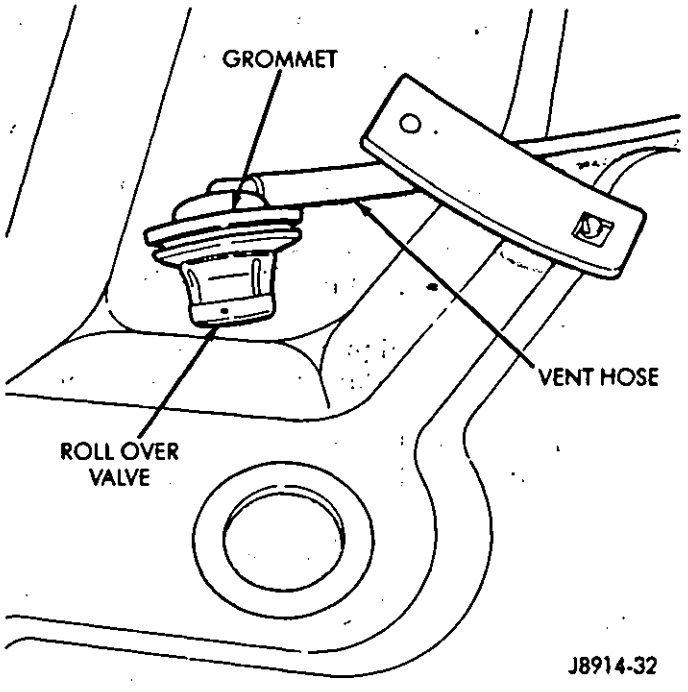

Fig. 26—RollOver Valve

ACCELERATOR PEDAL AND CABLE

INDEX

GENERAL INFORMATION

The accelerator pedal is connected to the throttle lever by the accelerator cable. The cable is protected by an outer sheathing. The cable is connected to the throttle lever by a clasp and to the accelerator pedal by a clip that snaps into the top of the pedal arm.

SERVICE PROCEDURES

Accelerator Pedal

Removal

(1) The clip connecting the accelerator cable and pedal has tabs on the backside. Compress the tabs and pull clip forward. Gently slide accelerator cable out of opening in top of pedal arm taking care not to damage or kink throttle core wire.

(2) Remove accelerator pedal mounting nuts. Remove accelerator pedal (Fig. 1).

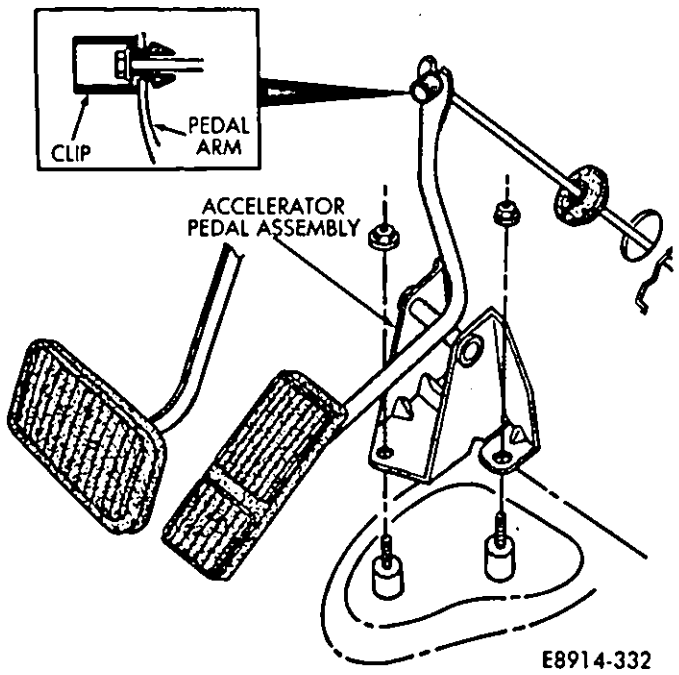

Fig. 1—Accelerator Pedal Removal/Installation

Installation

(1) Place accelerator pedal over studs protruding from floorpan (Fig. 1). Tighten mounting nuts to 4.3 N·m (36 in-lbs) torque.

(2) Slide accelerator cable into opening in top of pedal arm. Push cable clip into pedal arm opening until it snaps in place (Fig. 1).

Accelerator Cable

Removal

(1) The clip connecting the accelerator cable and pedal has tabs on the backside. Compress the tabs and pull clip forward. Gently slide accelerator cable out of opening in top of pedal arm taking care not to damage or kink cable core wire (Fig. 1).

(2) The accelerator cable is anchored to dash panel by retainer tabs built into the cable sheathing. The tabs are located behind the accelerator pedal arm. From inside the drivers compartment, compress the retainer tabs and push cable through dash panel.

(3) At the throttle body, use a straight blade screwdriver to disconnect the accelerator cable clasp from throttle lever (Fig. 2).

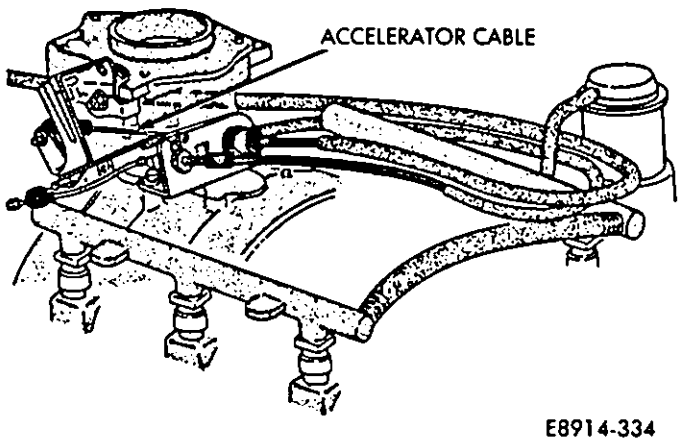

Fig. 2—Accelerator Cable Removal/Installation—3.0L Engine

(4) Remove accelerator cable from throttle bracket by compressing retainer tabs and gently pushing cable through hole in bracket (Fig. 2). Remove accelerator cable.

Installation

(1) Slide clasp end of accelerator cable through hole in throttle bracket until retainer tabs lock into bracket (Fig. 2).

(2) Connect cable clasp to ball stud on throttle lever (Fig. 2).

(3) Push other end of cable through opening in dash panel until retaining tabs lock onto panel (Fig. 2).

(4) From inside drivers compartment, slide accelerator cable into opening on top of pedal arm. Push cable clip into pedal arm opening until it snaps into place (Fig. 1).

MULTI-POINT FUEL INJECTION (MPI) 3.0L ENGINE

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COMPONENT IDENTIFICATION

INDEX

GENERAL INFORMATION

The 3.0L engines' Multi-Point Fuel Injection system is a simultaneous double fire type. All injectors fire simultaneously once every engine revolution, delivering half of the fuel needed for combustion. Since two engine revolutions are required to complete one engine cycle, the injectors fire twice every cycle. Hence the term "simultaneous double fire."

The injectors fire into the intake manifold directly above each intake valve port. There is one injector per engine cylinder. Each injector protrudes through the intake manfold into the top of the corresponding intake valve port. The injectors are controlled exclusively by the engines' Electronic Control Unit (ECU).

The ECU constantly adjusts the amount of fuel injected to meet changing operating conditions by controlling injector pulse width (the length of time the injector is energized). The ECU also adjusts ignition timing by controlling the ignition coil operation through the ignition control module. The ECU determines air-fuel mixture and ignition timing based on inputs it receives from various sensors that monitor engine operating conditions.

The ECU receives inputs from sensors that react to exhaust gas oxygen content, coolant temperature, manifold absolute pressure, engine speed (crankshaft position), throttle position, battery voltage, intake manifold, air temperature, and transmission gear selection. These inputs represent the engines' instantaneous operating conditions. Air-Fuel mixture and ignition timing calibrations for various driving and atmospheric conditions are pre-programmed into the ECU. The ECU monitors and analyzes its various inputs; computes engine fuel and ignition timing requirements based on these inputs, and controls fuel delivery and ignition timing accordingly. The ECU, the various sensors and switches that provide input to the ECU, and the ECU outputs (engine control devices controlled by the ECU) comprise the engine control system.

The engine control system consists of:

- Battery voltage
- Manifold absolute pressure (MAP) sensor
- Coolant temperature sensor
- Manifold air temperature (MAT) sensor
- Exhaust Oxygen (O_2) sensor
- Speed (crankshaft position) sensor
- Throttle position sensor
- Injector power signal
- Air conditioning select signal
- Air conditioning request signal
- Neutral safety switch (gear selection—auto, trans.)
- Ignition ON signal
- Engine crank signal
- Vehicle speed sensor
- Fuel pump relay

- Fuel injectors
- Idle speed regulator
- B+ latch relay
- Air Conditioning Control Module
- EGR valve solenoid
- Ignition control module

System Diagnosis

For diagnosing MPI electronic control system malfunctions refer to the DRB II Service Diagnostic Tester and accompanying manual. The DRB II tester plugs into two diagnostic connectors inside the engine compartment. After performing the required diagnostic test the tester will display a fault code if a malfunction is detected. Diagnostic charts for all fault codes are listed in the tester manual. Individual component diagnosis is included in this section.

ELECTRONIC CONTROL UNIT (ECU)

The Eletronic Control Unit (ECU) is a digital microprocessor. Air-Fuel mixture calibrations for various driving and atmospheric conditions are preprogrammed into the ECU. The ECU monitors and analyzes its various inputs, computes engine fuel and ignition timing requirements based on these inputs, and controls fuel delivery and ignition timing accordingly. As operating conditions change, the ECU adjusts injector pulse width and ignition timing for optimum performance and fuel economy.

ECU Inputs

The ECU is powered by the vehicle's battery. When the ignition is turned to the ON or START position, the following inputs are supplied to the ECU:

- Battery voltage
- Manifold absolute pressure (MAP) sensor
- Coolant temperature sensor
- Manifold air temperature (MAT) sensor
- Exhaust Oxygen (O_2) sensor
- Speed (crankshaft position) sensor
- Throttle position sensor
- Injector power signal
- Air conditioning select signal
- Air conditioning request signal
- Neutral safety switch (gear selection—auto, trans.)
- Ignition relay—ON signal
- Starter relay—engine crank signal
- Vehicle speed sensor

ECU Outputs

Based upon input signals from the various input sensors and switches, the ECU adjusts the following components (ECU outputs):

- Fuel pump relay
- B+ latch relay
- Air Conditioning Control Module
- Fuel injectors
- Idle speed regulator
- EGR valve solenoid
- Ignition control module

BATTERY VOLTAGE—ECU INPUT

The battery voltage input to the ECU is used to ensure that proper voltage is applied to the fuel injector. The ECU varies the injector pulse width to compensate for battery voltage fluctuations and their effects on injector opening time.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR—ECU INPUT

The MAP sensor reacts to absolute pressure in the intake manifold and provides an input voltage to the ECU. As engine load changes manifold pressure varies, causing the MAP sensors resistance to change. The change in MAP sensor resistance results in a different input voltage to the ECU. The input voltage level supplies the ECU with information relating to ambient barometric pressure during engine start-up (cranking) and to engine load while the engine is running. The ECU uses this information to adjust the air-fuel mixture accordingly.

The MAP sensor is mounted in the engine compartment on the dash panel and is connected to the throttle body with a vacuum hose (Fig. 1).

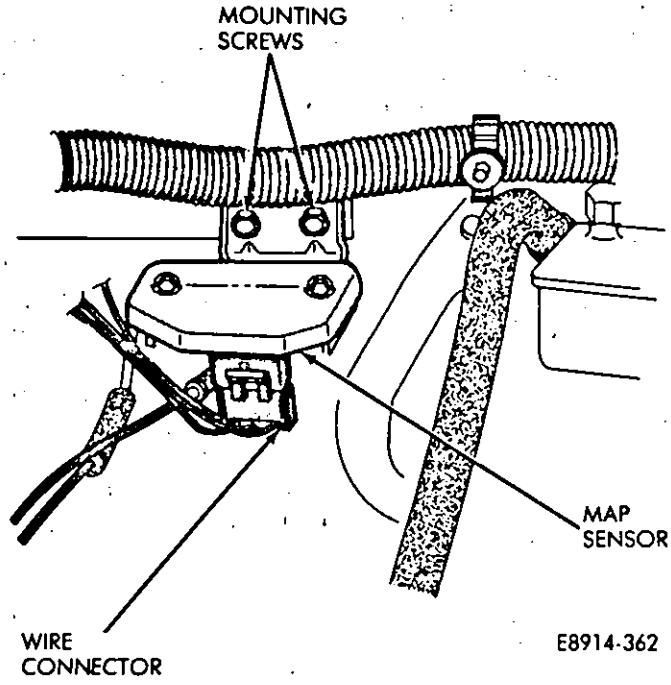


Fig. 1—MAP Sensor

COOLANT TEMPERATURE SENSOR—ECU INPUT

The coolant temperature sensor is installed in the thermostat housing (Fig. 2). It provides an input voltage to the ECU. As coolant temperature varies, the Coolant Temperature Sensor resistance changes resulting in a different input voltage to the ECU. Based on this input the ECU will:

- Adjust fuel injector pulse with. Colder coolant temperatures will result in longer injector pulse width and richer air-fuel mixtures.
- Compensate for fuel condensation in the intake manifold.
- Control engine warm-up idle speed.
- Increase ignition advance when the coolant is cold.
- Energize the EGR valve solenoid thus preventing the flow of vacuum to the EGR valve.

MANIFOLD AIR TEMPERATURE (MAT) SENSOR—ECU INPUT

The Manifold Air Temperature (MAT) sensor is installed in the throttle body adapter at the rear of the intake manifold with sensor element extending into the air stream (Fig. 3) The MAT sensor provides an input voltage to the ECU. As the temperature of the air stream in the manifold varies, the MAT sensor resistance changes resulting in a different input voltage to the ECU.

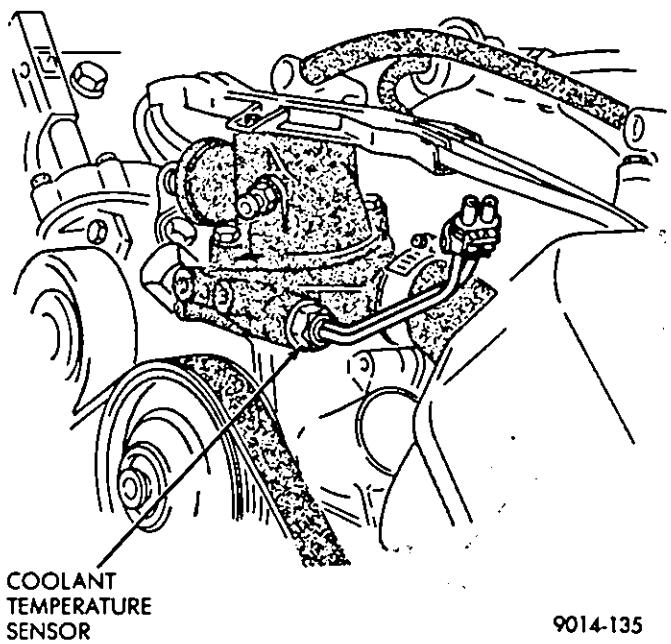


Fig. 2—Coolant Temperature Sensor

EXHAUST GAS OXYGEN SENSOR (O_2 SENSOR)—ECU INPUT

The oxygen sensor is located in the exhaust "Y" pipe and provides an input voltage to the ECU relating the oxygen content of the exhaust gas (Fig. 4). The ECU uses this information to vary the air-fuel ratio.

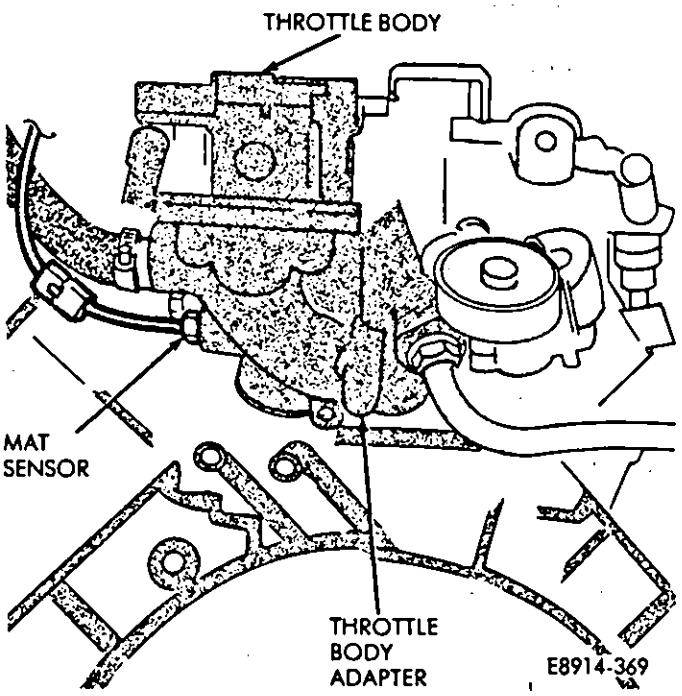


Fig. 3—Manifold Air Temperature Sensor

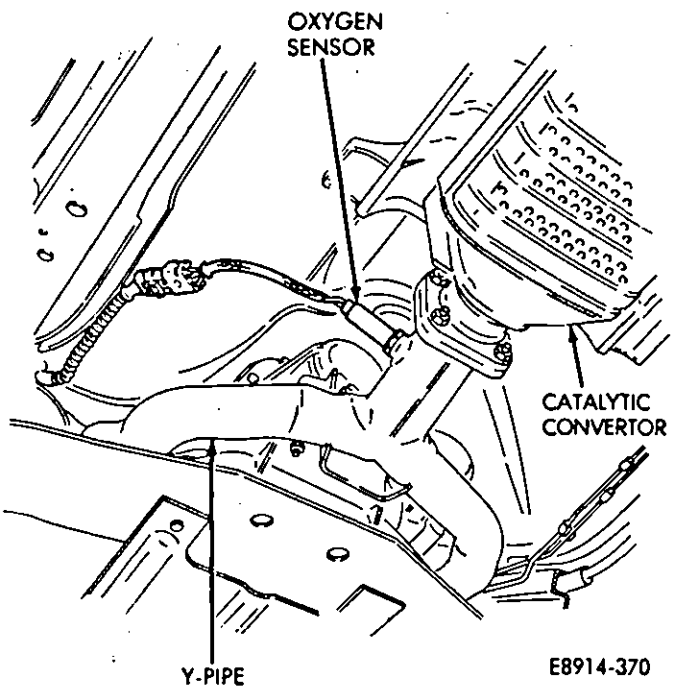


Fig. 4—Heated Oxygen Sensor

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 and to remain in closed loop operation during periods of extended idle. Refer to Modes of Operation for an explanation of OPEN and CLOSED LOOP operation.

Voltage is supplied to the Oxygen sensor heater through the ignition relay.

SPEED SENSOR (CRANKSHAFT POSITION SENSORS—CPS)—ECU INPUT

The speed sensor, attached to the torque converter drive plate housing, provides an input signal to the ECU relating to crankshaft angle (position) (Fig. 5). The ECU converts the rate of change of crankshaft angle into engine RPM and the crankshaft angle to piston position. The speed sensor senses TDC, BDC and engine speed by detecting the flywheel teeth as they pass during engine operation. The speed sensor is nonadjustable.

The drive plate pulse ring has three trigger notches, 120° apart. There are 20 small teeth (windows) between each trigger notch. Each large trigger notch is located 12 small teeth before each Top Dead Center (TDC) position of the corresponding pistons (Fig. 6).

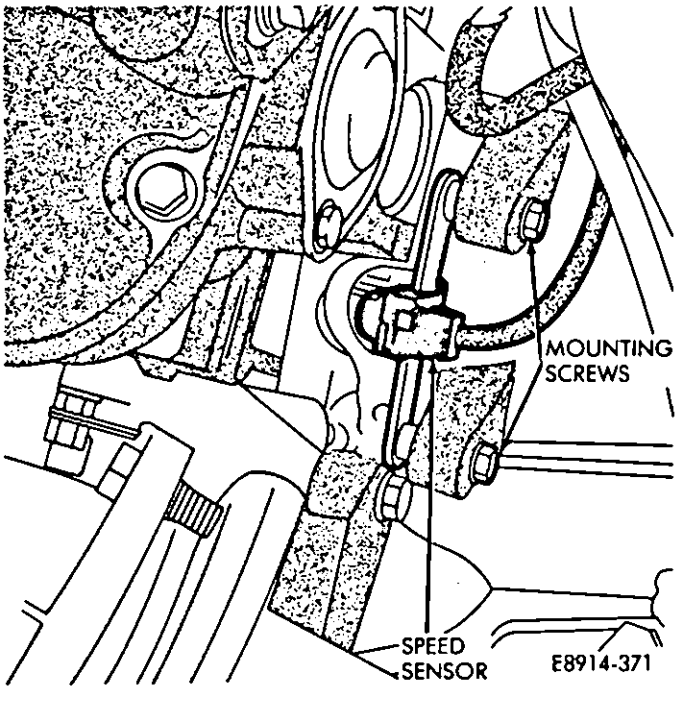


Fig. 5—Engine Speed Sensor

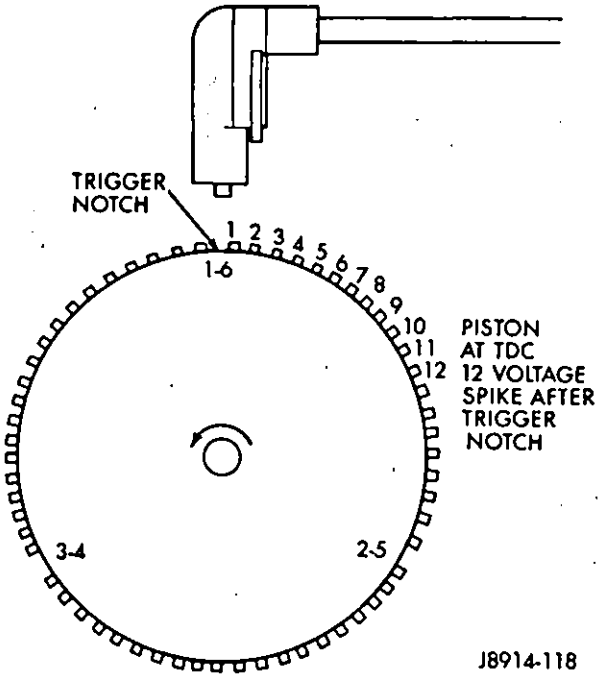


Fig. 6—Engine Speed Sensor, Trigger Notches and TDC Position

When a tooth and notch pass the magnet core of the speed sensor, a voltage spike is induced in the sensor pick-up coil winding (Fig. 7). The voltage spikes allow the ECU to count the teeth as they pass the sensor. When a trigger notch passes the speed sensor there is a longer than usual delay between voltage spikes. This longer delay tells the ECU that a piston will be at the TDC

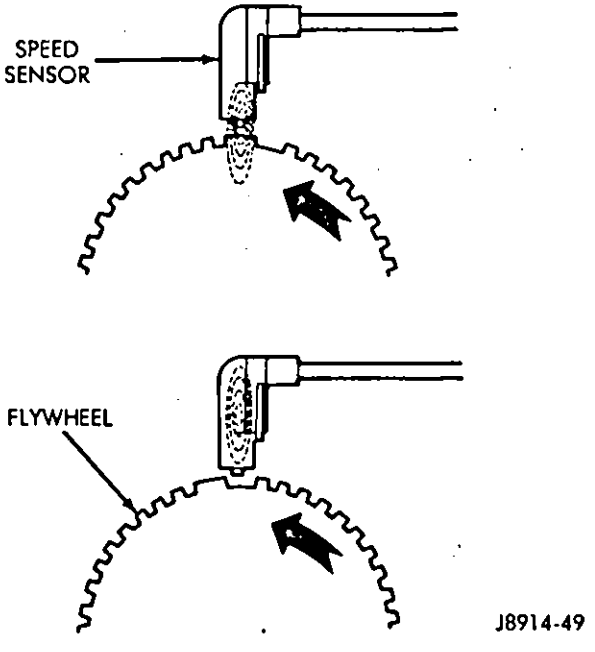


Fig. 7—Engine Speed Sensor Operation

position 12 voltage spikes later. The ECU uses information from the speed sensor to control spark timing and fuel injection timing for each cylinder.

The longer voltage spike indicates to the ECU that a piston will soon be at the TDC position, 12 teeth later. The ignition timing for the particular cylinder is either advanced or retarded as necessary by the ECU according to sensor inputs.

THROTTLE POSITION SENSOR (TPS)—ECU INPUT

The Throttle Position Sensor (TPS) is mounted on the throttle body and connected to the throttle valve shaft (Fig. 8). The sensor is a variable resistor that provides the ECU with an input voltage that represents throttle valve position. Input voltage to the ECU from the TPS varies in an approximate range or from 1 volt at minimum throttle opening (idle) to 4.5 volts at wide open throttle. The ECU uses TPS input voltage to determine current engine operating conditions.

NEUTRAL SAFETY SWITCH—ECU INPUT

On vehicles equipped with automatic transmissions, a gear selection indicator signal is sent to the ECU from the neutral safety switch. When the transmission is in a drive range the ECU will adjust engine idle speed to compensate for increased engine load. Refer to group 21 for Neutral Safety Switch service.

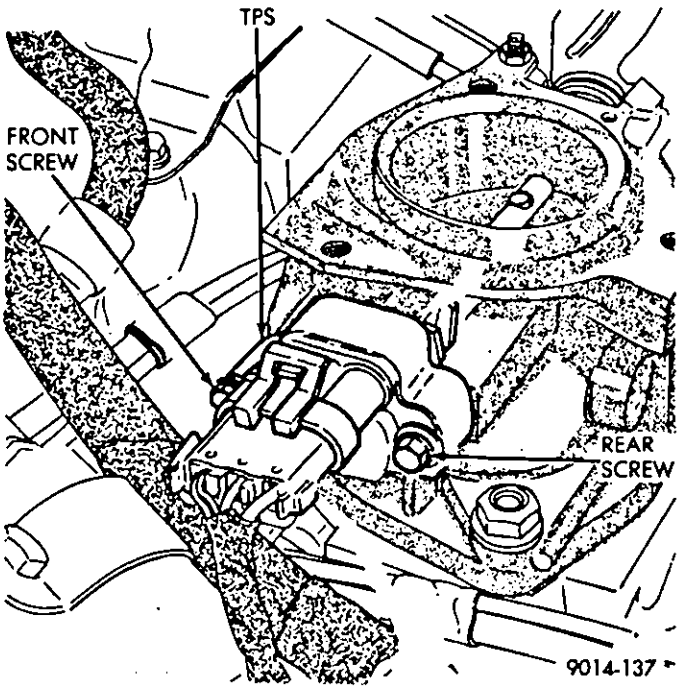


Fig. 8—Throttle Position Sensor

IGNITION "ON" RELAY

The ignition "ON" relay, which is mounted beneath a labeled cover with several other relays on the left strut tower (Fig. 10), provides I-1 power (from ignition switch) to the ECU when the ignition switch is turned to the "ON" position. After receiving this input, the ECU will energize the B+ latch relay and the idle speed regulator. The position of the ignition relay is imprinted on the top of the relay cover (Fig. 11).

STARTER RELAY (ENGINE CRANK SIGNAL)—ECU INPUT

The starter relay, which is mounted beneath a labeled cover with several other relays on the left strut tower (Fig. 10), provides a signal to the ECU informing it that the starter motor has been engaged. The ECU then begins monitoring engine sensors to determine correct engine timing. The position of the starter relay is imprinted on the top of the relay cover (Fig. 11).

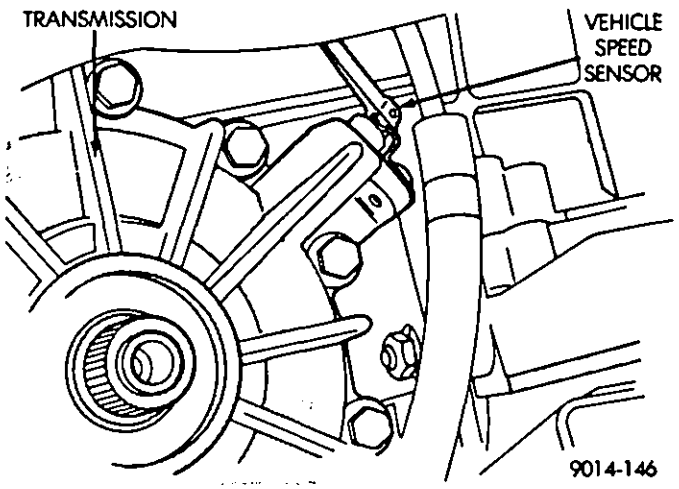


Fig. 9—Vehicle Speed Sensor

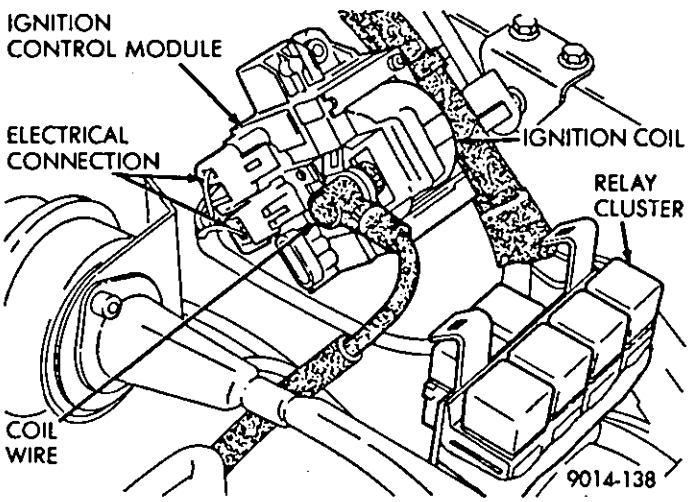


Fig. 10—Relay Cluster

INJECTOR POWER SIGNAL—ECU INPUT

The injector power input signal is a function of the fuel pump relay when the ignition switch is in the ON position. It informs the ECU about the amount of battery voltage supplied to the injectors. If battery power for the injectors is low, the ECU will increase injector pulse width to compensate for a slower injector opening time. The position of the fuel pump relay is imprinted on the top of the relay cover (Fig. 11).

VEHICLE SPEED SENSOR—ECU INPUT

The vehicle speed sensor is mounted on the right side of the transaxle and provides an input to the ECU pertaining to the vehicles speed. The ECU adjusts the fuel delivery rate in response to this and other inputs.

AIR CONDITIONING SELECT AND PREDICT SIGNALS—ECU INPUT

The air conditioning system is equipped with an Air Conditioning Control Module (ACM). Each time the vehicle operator selects an air conditioning mode, the ACM sends a signal to the ECU. Hence the term select signal.

One of the ACM's functions is control of the air conditioning compressor clutch. The ACM sends a predict signal to the ECU approximately 0.5 seconds before it energizes the clutch. The ECU increases engine idle speed to compensate for increased engine load. 0.5 seconds before de-energizing the compressor clutch, the ACM stops sending the predict signal to the ECU. The ECU then reduces idle speed to compensate for the decrease in engine load.

FUEL PUMP RELAY—ECU OUTPUT

The fuel pump relay is mounted below a labeled cover with several other relays on the left strut tower (Fig. 10 and Fig. 11). The ECU controls the fuel pump relay and activates it when the ignition switch is in the START or RUN positions. The relay supplies a path for battery voltage to operate the fuel pump, EGR valve solenoid, and fuel injectors.

B+ LATCH RELAY—ECU OUTPUT

The B+ (power) latch relay is mounted beneath a labeled cover on the left strut tower (Fig. 10 and Fig. 11). When the ignition switch is to the START or ON position, the B+ latch relay is energized by the ECU. The B+ latch relay provides voltage to the idle speed regulator in anticipation of engine start-up.

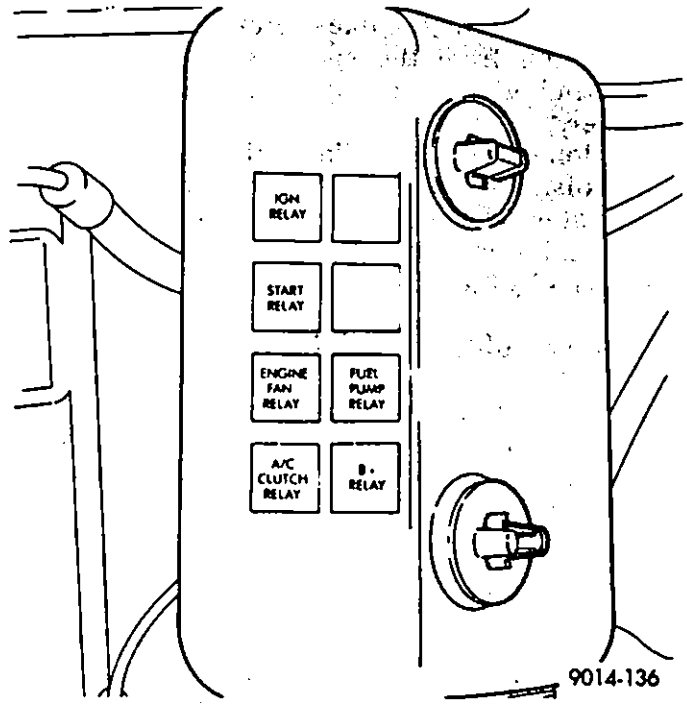


Fig. 11—Relay Cover

FUEL INJECTORS—ECU OUTPUT

The 3.0L engines Multi-Point Fuel Injection system is a simultaneous double fire type. All injectors fire simultaneously once every engine revolution, delivering half of the fuel needed for combustion. Since two engine revolutions are required to complete one engine cycle, the injectors fire twice every cycle. Hence the term "simultaneous double fire."

The fuel injectors spray fuel into each intake manifold runner above the intake valve ports in the cylinder heads (Fig. 12). There is one injector per engine cylinder. The ground path for the injectors is controlled by the ECU, while battery voltage is supplied through the fuel pump relay. When the ECU determines that it is time to operate the injectors, it supplies a ground for the injectors and all six injectors fire simultaneously. The ECU constantly adjusts the amount of fuel injected to meet changing operating conditions by controlling injector pulse width (the length of time the injector is energized).

IDLE SPEED REGULATOR—ECU OUTPUT

The idle speed regulator allows a controlled amount of air from the air cleaner to reach the intake manifold during closed throttle conditions to maintain engine idle. The inlet side of the

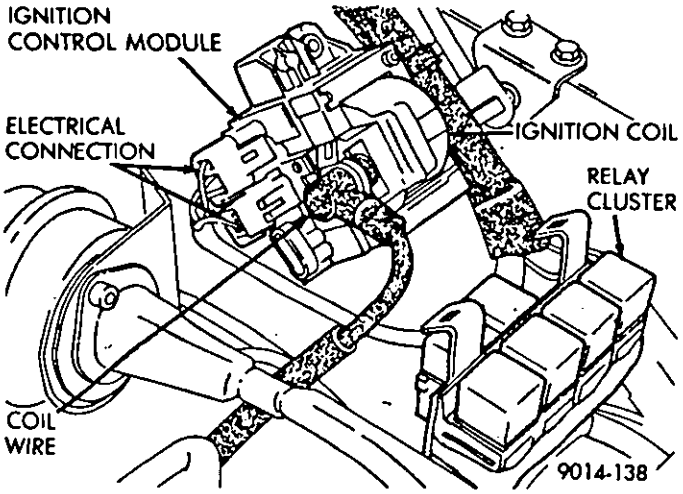


Fig 15—Ignition Control Module

When the engine is at wide open throttle, a time when the engine needs maximum power, the ECU sends a signal to the ACM to disengage the A/C compressor clutch. Refer to group 24 for further information regarding the ACM.

THROTTLE BODY

Filtered air from the air cleaner enters the intake manifold through the throttle body. Fuel does not enter the intake manifold through the throttle body, fuel is sprayed into the manifold by the fuel injectors. The throttle body, which is mounted on an adapter at the rear of the intake manifold, supplies air for above closed throttle operating conditions (Fig. 16). During closed throttle conditions air is supplied through the idle speed regulator (refer to Idle Speed Regulator—ECU OUTPUT). The throttle body is not controlled by the ECU.

The throttle position sensor is attached to the throttle body. The accelerator cable, throttle valve cable and cruise control cable are connected to the throttle lever.

FUEL RAIL

The fuel rail, which supplies fuel to the injectors and is mounted to the intake manifold (Fig. 17), consists of two rails that are connected to each other by a non-replaceable reinforced hose that is pressed onto nipple ends on both rails. One rail supplies fuel to injectors 1, 2, and 3 while the other supplies fuel to injectors 4, 5 and 6.

The fuel pressure regulator is attached to the rail which supplies injectors 4, 5, and 6. It is connected to the outlet end of the rail that supplies fuel to injectors 1, 2, and 3 by a non-replaceable reinforced hose.

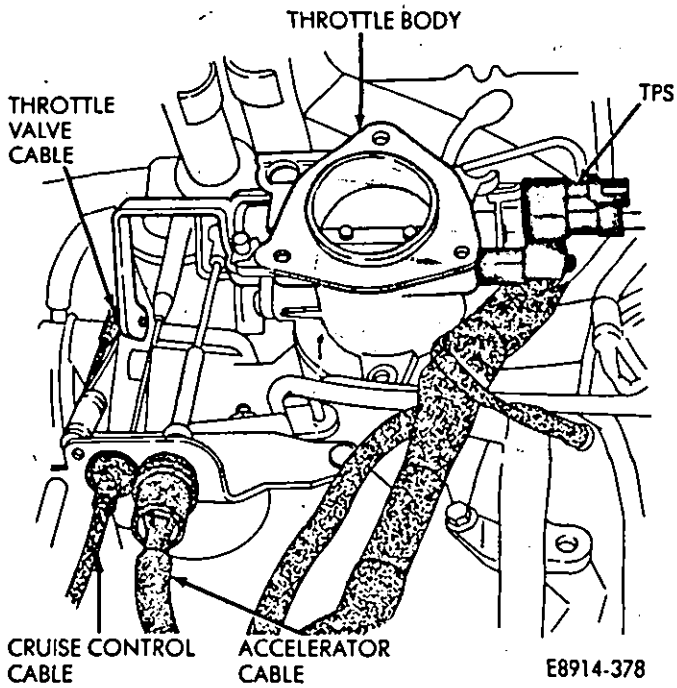


Fig. 16—MPI Throttle Body

The fuel rail and hoses are not repairable. They **MUST** be replaced as an assembly. The fuel pressure regulator is replaceable *and* can be removed from the fuel rail.

FUEL PRESSURE REGULATOR

The fuel pressure regulator used with the MPI fuel system is a vacuum assisted, non-adjustable type. The regulator is mounted on the intake manifold and is connected to the output end of the fuel rail by a non-replaceable reinforced hose. The pressure regulator is connected to intake manifold vacuum by a hose (Fig. 18). The regulator is calibrated to maintain fuel system pressure at approximately 193-207 kPa (28-30 psi) with vacuum applied while the engine is at idle. Fuel pressure will be slightly higher if vacuum is not applied to the regulator.

MODES OF OPERATION

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

Modes of operation are of two different types. OPEN LOOP and CLOSED LOOP.

During OPEN LOOP modes the ECU receives input signals and responds only according to pre-

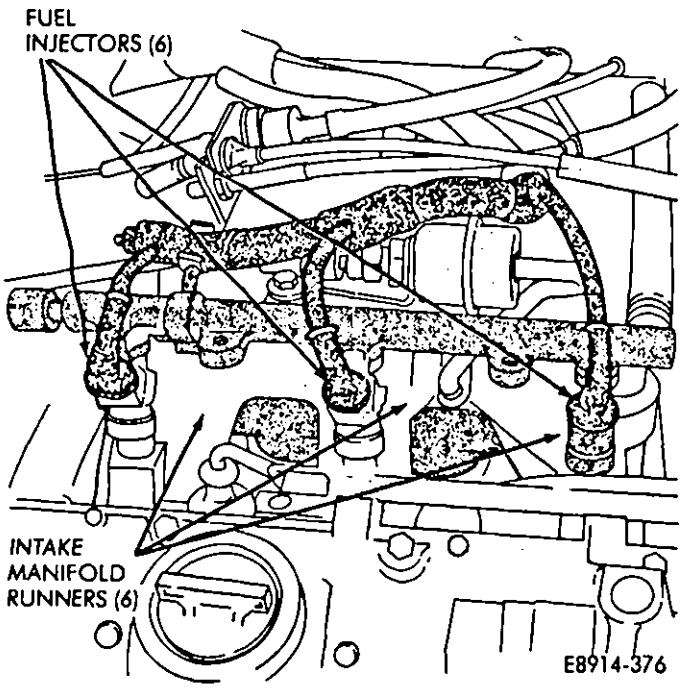


Fig. 12—Fuel Injectors, 4,5,6

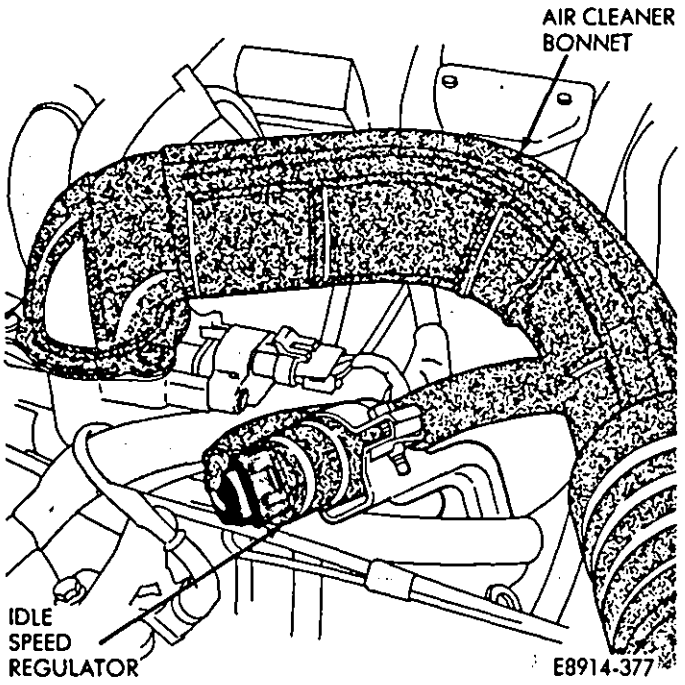


Fig. 13—Idle Speed Regulator

regulator is connected to the air cleaner bonnet, while the outlet side is connected to the throttle body adapter below the throttle plate by a hose (Fig. 13).

The idle speed regulator consists of a permanent magnet motor that operates a vane type valve. The ECU controls the amount of air routed through the regulator by opening and closing the valve. Voltage is supplied to the idle speed regulator through the B+ Latch relay, while the ECU controls the ground path to extend or retract (open or close) the valve.

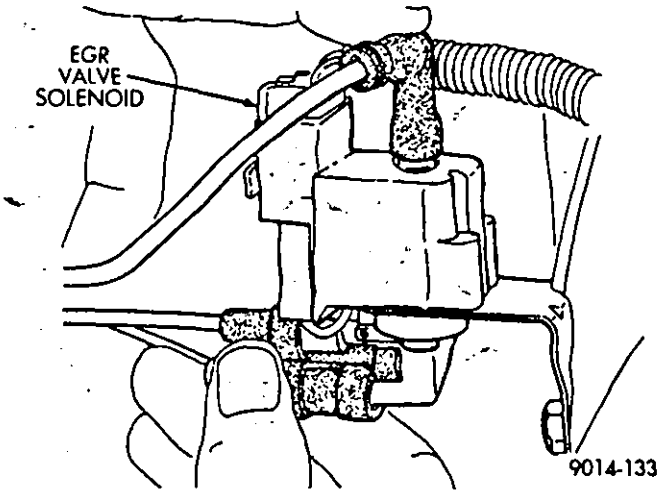


Fig. 14—EGR Valve Solenoid

EGR VALVE SOLENOID—ECU OUTPUT

Vacuum for the EGR valve function is controlled by the EGR valve solenoid. The solenoid is mounted to the left inner fender panel below the ignition control module (Fig. 14).

When the solenoid is energized by the ECU, it prevents vacuum from reaching the EGR valve transducer and EGR valve. The solenoid is energized during engine warm-up, closed throttle (idle), wide open throttle and rapid acceleration/deceleration. **If the solenoid wire connector is disconnected, the EGR valve function will be operational at all times, resulting in poor engine idle, performance, and driveability.**

IGNITION CONTROL MODULE—ECU OUTPUT

The ignition control module is mounted to the ignition coil (Fig. 15). Based on control system inputs, the ECU triggers the ignition coil via the ignition control module. The ECU is able to advance or retard ignition timing by controlling the ignition coil through the ignition control module.

AIR CONDITIONING CONTROL MODULE—ECU OUTPUT

During normal engine operation with the A/C selected, the Air Conditioning Control Module (ACM) sends a signal to the ECU indicating that the A/C has been selected. The ECU in turn adjusts idle speed to compensate for the increased engine load from the A/C compressor clutch (Refer to Air Conditioning Select and Predict Signals —ECU INPUT).

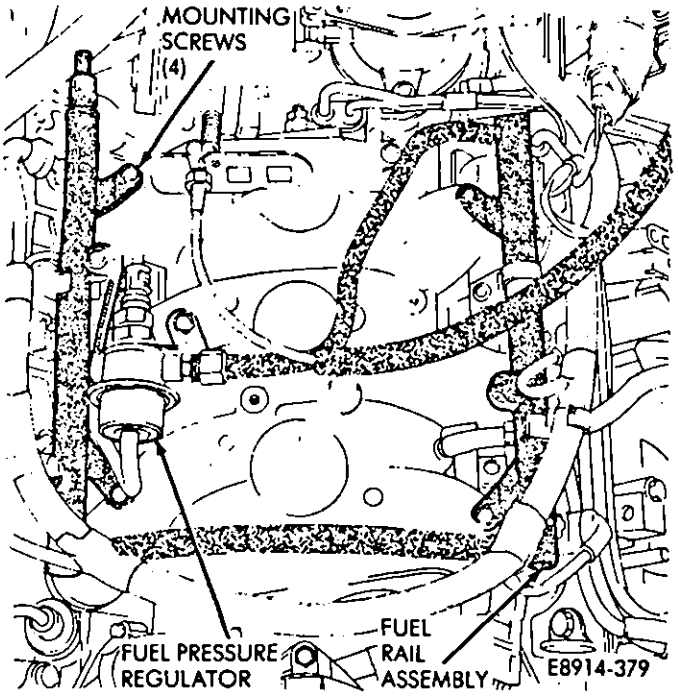


Fig. 17—Fuel Rail Assembly

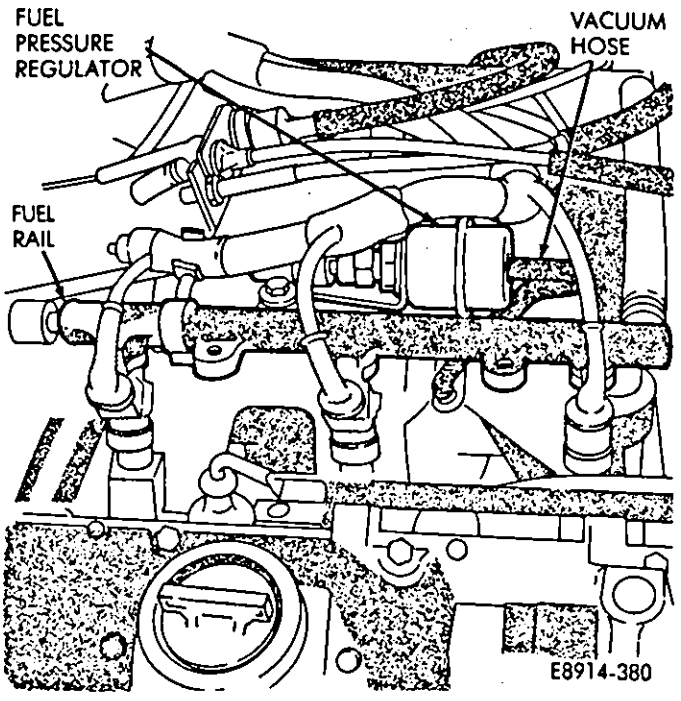


Fig. 18—MPI Fuel Pressure Regulator

set ECU programming. Input from the exhaust gas oxygen (O_2) sensor is not monitored during OPEN LOOP modes.

During CLOSED LOOP modes the ECU does monitor the exhaust gas oxygen (O_2) sensor input. This input indicates to the ECU 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 oxygen content in the exhaust gas through the O_2 sensor, the ECU can "fine tune" the injector pulse width to achieve optimum fuel economy combined with low emission engine performance.

The MPI system has the following modes of operation:

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

The ignition switch on, engine start-up (crank), engine warm-up, deceleration, and wide open throttle modes are OPEN LOOP modes. The idle and cruise modes, **with the engine at operating temperature** are CLOSED LOOP modes.

Ignition Switch ON Mode—OPEN LOOP

This is an OPEN LOOP mode. When the ignition switch is placed in the ON position, before cranking, the ECU receives information from the following system inputs:

- Manifold Absolute Pressure (MAP) Sensor
- Coolant Temperature Sensor
- Manifold Air Temperature Sensor
- Throttle Position Sensor (TPS)
- Battery Voltage Signal

Voltage is supplied to the fuel pump relay and the ECU completes the pump relay ground circuit for 1 to 3 seconds to pressurize the fuel system. The power latch relay is energized for 1 to 3 seconds and the ECU stores a barometric pressure value in preparation for engine start-up. The ECU opens the Idle Speed Regulator. The heating element in the Oxygen Sensor is activated by the ECU through the ignition ON relay via the ignition switch. The EGR solenoid is energized by the ECU which restricts EGR operation at this time. The fuel pump relay supplies voltage to the injectors but the ECU does provide a ground path, preventing injector operation.

Engine Start-up Mode—OPEN LOOP

This is an OPEN LOOP mode. During engine cranking, the ECU receives the following inputs:

- Manifold Absolute Pressure (MAP) Sensor
- Manifold Air Temperature Sensor
- Coolant Temperature Sensor
- Throttle Position Sensor
- Battery Signal
- Engine Speed Sensor
- Engine Crank Signal
- Ignition ON Input
- Injector Power

The ECU restricts EGR operation by energiz-

ing the EGR solenoid. Voltage is supplied to the injectors for simultaneous injection. The ECU controls injector pulse width by controlling the length of time that it supplies a ground path for the injector circuit. The ECU controls ignition timing through the ignition control module and ignition coil based on input received from the engine speed sensor.

If a wide open throttle (WOT) condition occur during this mode, the ECU assumes that a flooding condition exists and will open all circuits to the injectors, preventing fuel spray to the cylinders. As long as this WOT condition exists, the injectors will not be energized by the ECU.

Engine Warm-up Mode—OPEN LOOP

This is an OPEN LOOP mode. During engine warm up the ECU receives the following inputs:

- Manifold Absolute Pressure (MAP) Sensor
- Manifold Air Temperature Sensor
- Coolant Temperature Sensor
- Throttle Position Sensor (TPS)
- Battery voltage signal
- Neutral Safety Switch (gear selection)
- Air Conditioning Select and Predict Signals
- Ignition ON input
- Injector Power

During this mode of operation the ECU restricts EGR operation by energizing the EGR solenoid, voltage is supplied to the injectors for simultaneous injection, and injector pulse width is controlled by the ECU through control of the ground path for the injector circuit.

The ECU establishes the proper idle speed by providing a ground path for the idle speed regulator. The ECU controls ignition timing through the ignition control module based on various sensor inputs. If an engine knock is detected by the knock sensor, the ECU will retard ignition timing until the knock is eliminated. Following the elimination of the knock, ignition timing will gradually be returned to its prior value.

Also, during this mode of operation, the throttle position sensor provides input to the ECU relating to throttle position. The throttle position input is used in conjunction with other sensor inputs to determine correct injector pulse width and ignition timing. If, during this mode, the ECU receives a select signal from the Air Conditioning Control Module (ACM), the ECU adjusts idle speed to compensate for increased engine load.

Idle Mode—CLOSED LOOP

This is a CLOSED LOOP mode only when the engine is at operating temperature. During this mode, the ECU responds to Exhaust Gas Oxygen Sensor input. During this mode the ECU receives the following inputs:

- Manifold Absolute Pressure (MAP) Sensor
- Engine Speed Sensor
- Manifold Air Temperature Sensor
- Coolant Temperature Sensor
- Throttle Position Sensor
- Battery Voltage Signal
- Neutral Safety Switch (gear selection)
- Exhaust Gas Oxygen Sensor
- Air Conditioning Select and Predict Signals
- Ignition On Input
- Injector Power

During this mode of operation, when the engine is at operating temperature and the fuel injection system has entered CLOSED LOOP operation, the ECU adjusts injector pulse width to obtain an air-fuel ratio of 14.7 to 1 based on input it receives from the exhaust gas oxygen sensor.

The ECU supplies a ground path for the injectors, controls idle speed through the idle speed regulator, adjusts injector pulse width if an air conditioning selection is made, restricts EGR operation by energizing the EGR solenoid, and controls ignition timing through the ignition control module.

Cruise Mode—CLOSED LOOP

This is a CLOSED LOOP mode only when the engine is at operating temperature. When the vehicle is at cruising speed, the ECU receives the following inputs:

- Manifold Absolute Pressure (MAP) Sensor
- Engine Speed Sensor
- Manifold Air Temperature Sensor
- Coolant Temperature Sensor
- Throttle Position Sensor
- Battery Voltage Signal
- Exhaust Gas Oxygen Sensor
- Air Conditioning Select and Predict Signals
- Injector Power

The ECU opens the ground path for the EGR solenoid, allowing the flow of vacuum from the solenoid to the EGR valve transducer. If engine speed and load result in enough exhaust system back pressure to close the transducer, vacuum flow to the EGR valve.

The ECU monitors the exhaust gas oxygen sensor and adjusts injector pulse width to obtain a 14.7 to 1 air fuel ratio. All injectors fire simultaneously.

The ECU controls ignition timing through the ignition control module.

Deceleration Mode—OPEN LOOP

This is an OPEN LOOP mode. During this mode of operation, the ECU ignores the exhaust gas oxygen sensor input. The ECU receives the following inputs:

- Manifold Absolute Pressure (MAP) Sensor
- Engine Speed Sensor
- Manifold Air Temperature Sensor
- Coolant Temperature Sensor
- Throttle Position Sensor (TPS)
- Battery Voltage Signal
- Air Conditioning Select and Predict Signals

If the ECU receives a closed throttle signal from the TPS while the engine speed is over 1200 rpm, the ECU will determine that the engine is in hard deceleration and in response stop fuel injection and suspend EGR operation. The ECU continue injection once the closed throttle conditions no longer exists or when engine speed is below 1200 rpm.

If the ECU detects only a gradual deceleration it will adjust injector pulse width based on inputs from the engine control system sensors.

Wide Open Throttle Mode—OPEN LOOP

This is an OPEN LOOP mode. During wide open throttle (WOT) the ECU receives the following inputs:

- Manifold Absolute Pressure (MAP) Sensor
- Engine Speed Sensor
- Manifold Air Temperature Sensor
- Coolant Temperature Sensor
- Throttle Position Sensor (TPS)
- Battery Voltage Signal
- Ignition ON Input
- Injector Power

During wide open throttle conditions, the ECU monitors the barometric pressure of the air through the MAP sensor. Injector pulse width is adjusted by the ECU through control of the ground path for the injector circuit. The ECU controls ignition timing through the ignition control module. The ECU suspends EGR operation through control of the EGR solenoid and sends a signal to the Air Conditioning Control Module (ACM) to deactivate the air conditioning compressor clutch for 15 seconds.

Ignition Switch Off Mode—OPEN LOOP

This is an OPEN LOOP mode. When the ignition key is turned to the off position, the following takes place:

- The ECU stops providing a ground path for the injectors and fuel injection stops
- The fuel pump is de-energized
- The ignition power module is deactivated
- The ECU opens the ground circuit for the power latch relay and all voltage to the injection circuit stops.

GENERAL DIAGNOSIS

INDEX

VISUAL INSPECTION

A visual inspection for loose, disconnected, or improperly routed wires and hoses should be made before attempting to diagnose the fuel injection system. A visual check will help spot these faults and save unnecessary test and diagnostic time. A thorough visual inspection includes the following checks:

(1) Inspect battery cable connections. They should be tight. The top of the battery should be free of corrosion and grime (Fig. 19). Check the color of the test indicator on the top of the battery. Refer to group 8B.

(2) Inspect engine control system ground connections on side of frame rail between battery and air cleaner (Fig. 20).

(3) Inspect all engine control system relays connections. Inspect relays for signs of physical damage and corrosion (Fig. 21).

(4) Inspect ignition control module connections. Verify that coil wire is connected to coil (Fig. 21).

(5) Inspect the air cleaner element (filter) for blockage or clogging (Fig. 22).

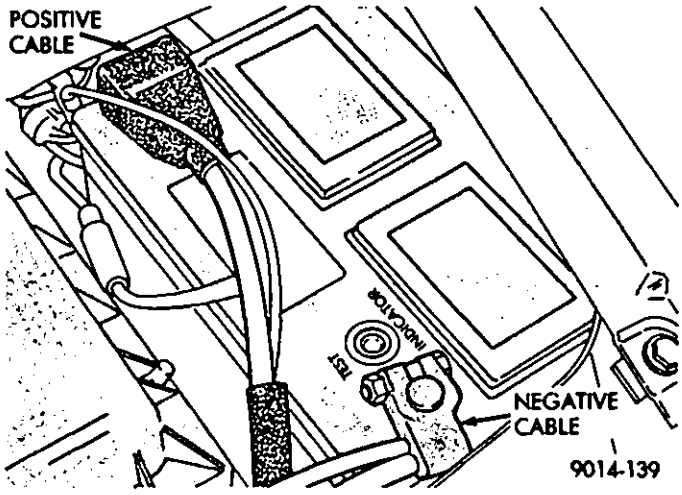


Fig. 19—Battery Cable Connections

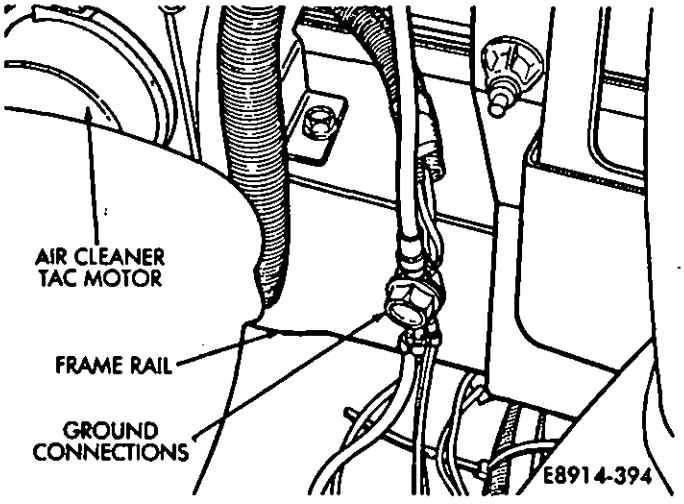


Fig. 20—Engine Control System Ground Connections

(6) Verify that the thermal vacuum switch vacuum (TVS) supply tube and the TVS to vacuum motor vacuum tube are connected to the thermal vacuum switch (TVS) in the air cleaner cover (Fig. 23).

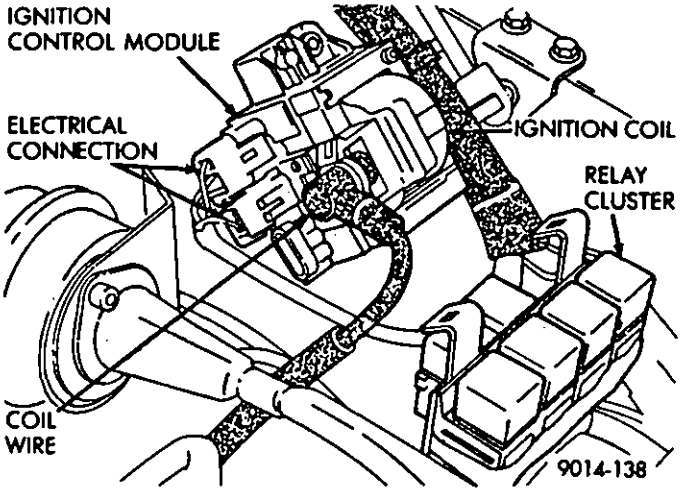


Fig. 21—Engine Control System Relays, Ignition Control Module/Ignition Coil

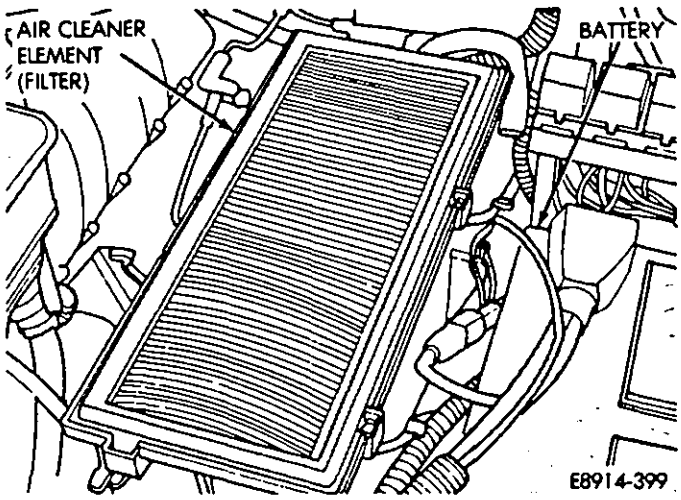


Fig. 22—Air Cleaner Element (Filter)

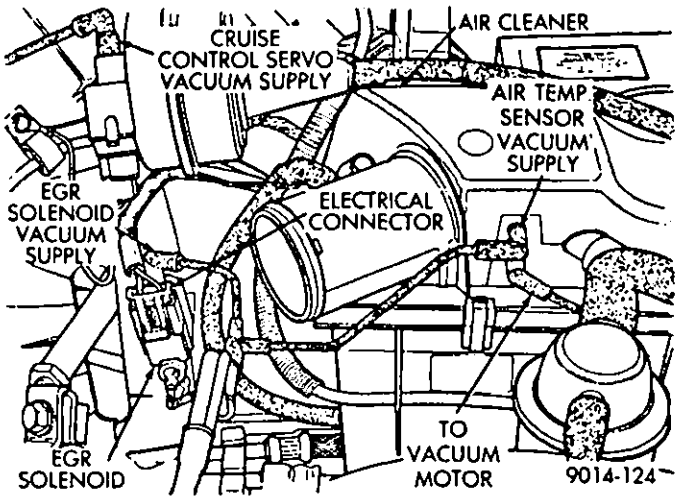


Fig. 23—TVS, EGR Solenoid and Cruise Control Servo Vacuum Tubes

(7) Inspect the vacuum tube and electrical connections at the EGR valve vacuum solenoid (Fig. 23). Ensure that they are tight.

(8) Verify that the cruise control servo vacuum supply tube is connected to the servo.

(9) Inspect the brake vacuum booster hose connections at the vacuum booster and below the throttle body (Fig. 24).

(10) Inspect the pre-heated air hose connections at the air cleaner and heat stove on the manifold. Inspect the hose for rips or tears (Fig. 25).

(11) Inspect the air cleaner ambient air opening for blockage. Ensure that the TAC vacuum motor vacuum is connected to the motor (Fig. 25).

(12) Inspect the CCV fresh air and vacuum hoses for signs of damage or fatigue. Ensure that they are connected securely (Fig. 26).

(13) Ensure that the Throttle Position Sensor (TPS) and Idle Speed Regulator electrical connectors are connected. Inspect the connections for corrosion (Fig. 27).

(14) Inspect the Idle Speed Regulator inlet and outlet hoses for fatigue (Fig. 27).

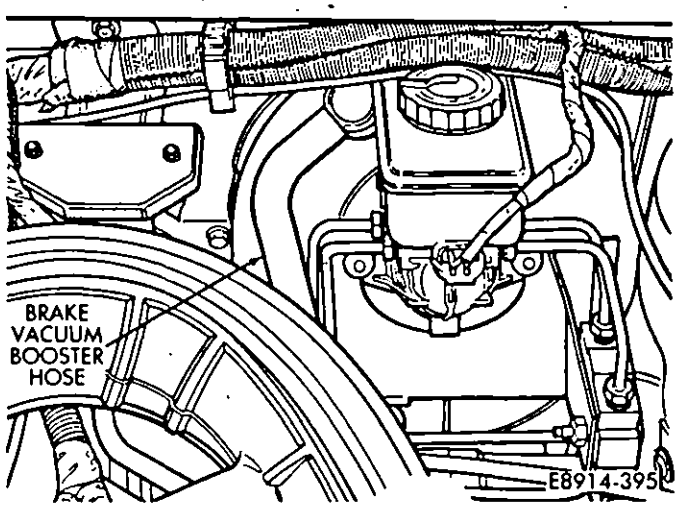


Fig. 24—Brake Vacuum Booster Hose

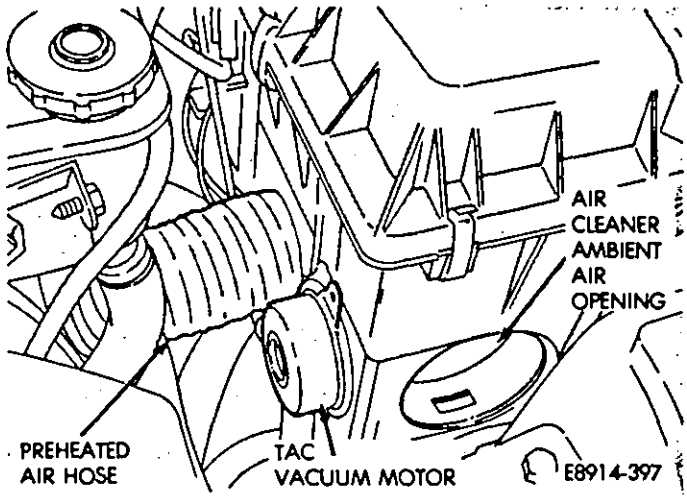


Fig. 25—Pre-heated Air Hose

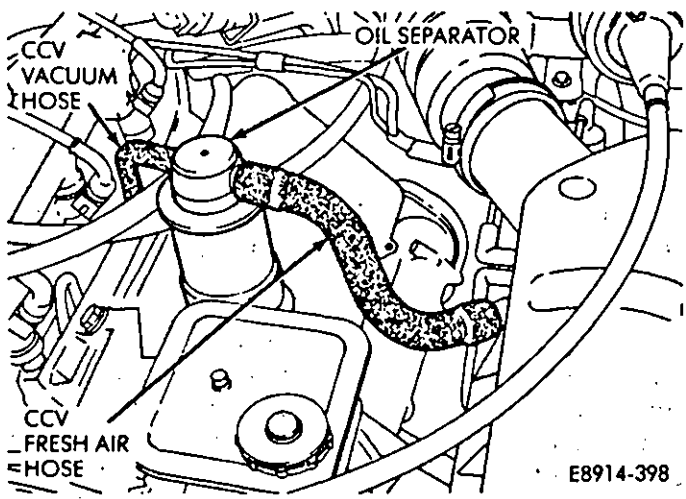


Fig. 26—CCV Hoses

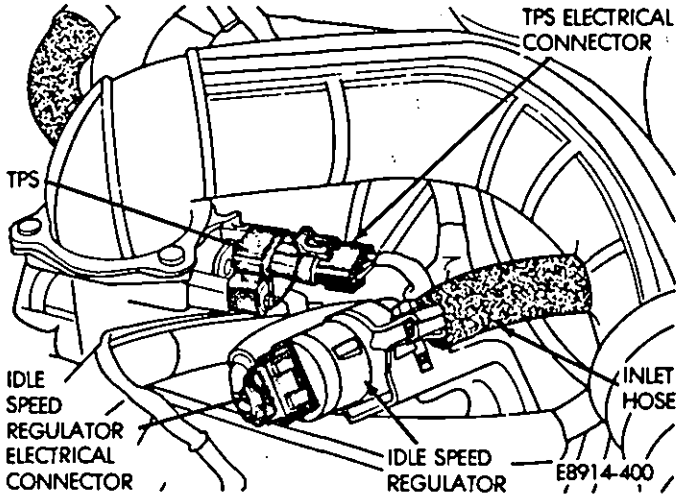


Fig. 27—TPS and Idle Speed Regulator

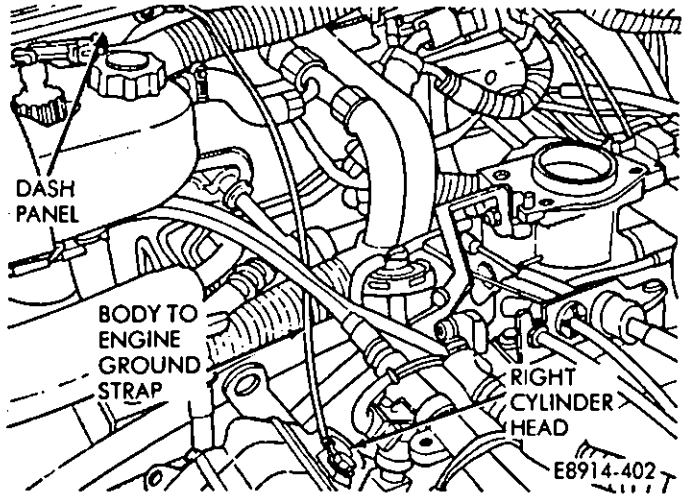


Fig. 29—Body to Engine Ground Strap

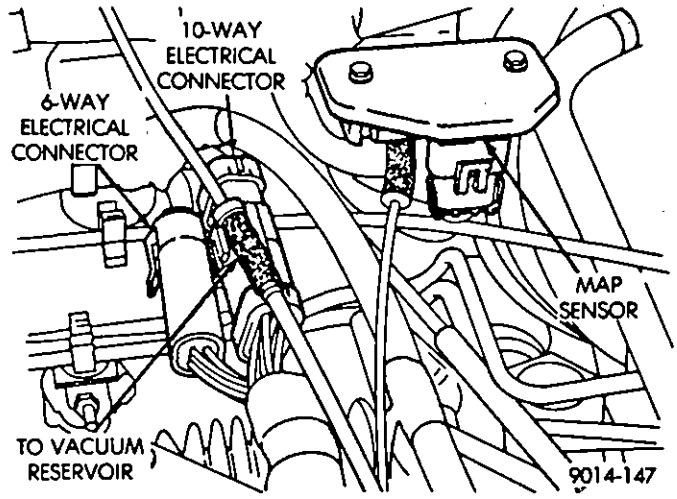


Fig. 28—Engine Harness Connector and MAP Sensor

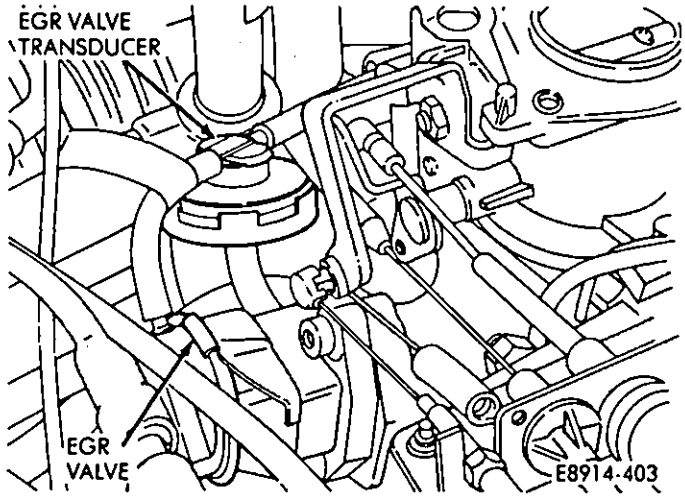


Fig. 30—EGR Valve and Transducer

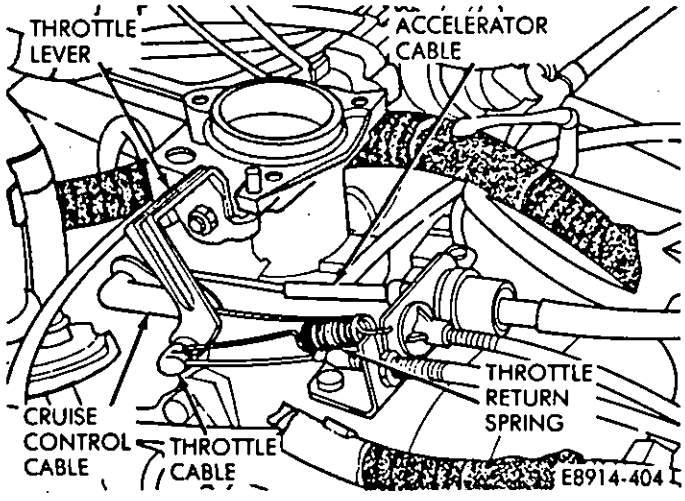


Fig. 31—Throttle Linkage

(15) Verify that the engine harness connector is connected (Fig. 28).

(16) Ensure that the MAP sensor vacuum tube and electrical connector are connected to the sensor (Fig. 28).

(17) Inspect the body to engine ground strap, and the ground strap connections, for corrosion (Fig. 29).

(18) Inspect the EGR valve and transducer vacuum hoses for evidence of fatigue (Fig. 30).

(19) Verify that the engine speed sensor (crankshaft position sensor-CPS) wire harness is connected to the engine harness. Inspect the harness and connectors for corrosion.

(20) Inspect the throttle linkage, accelerator cable, throttle cable and cruise control cable for binding or sticking conditions (Fig. 31).

(21) Check the condition of the throttle return spring. Replace the spring if it is weak (Fig. 31).

(22) Ensure that the terminal connector ends in the boots of the spark plug wires are completely engaged to the terminals on the distributor cap and spark plugs (Fig. 32). Inspect for corrosion of the connectors or terminals.

(23) Ensure that the injector harness connec-

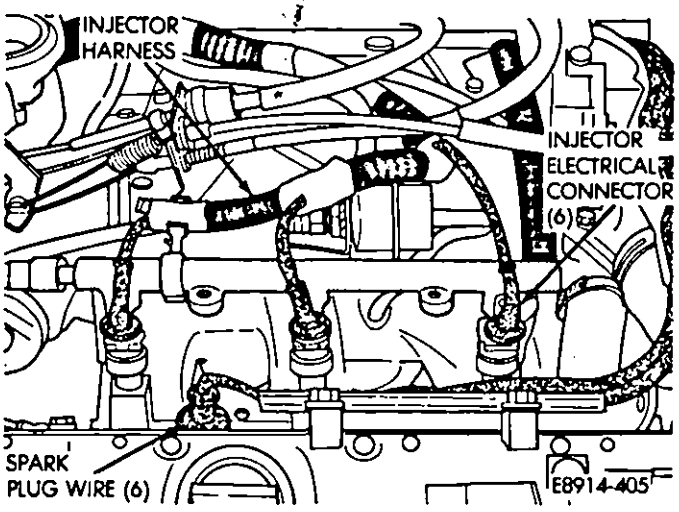


Fig. 32—Spark Plug Wires and Injector Connectors

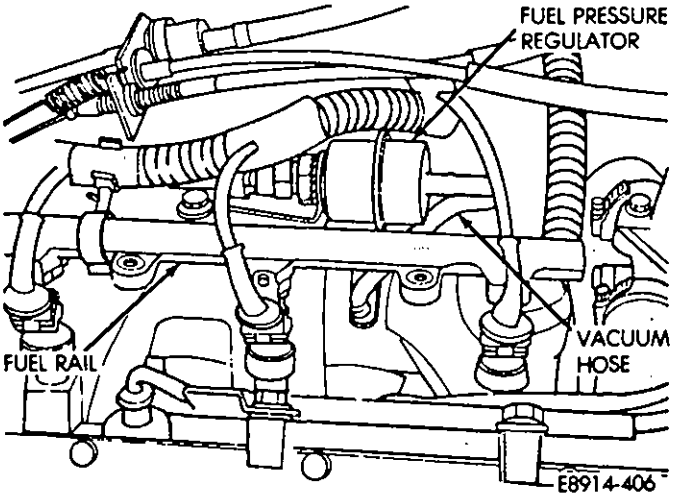


Fig. 33—Fuel Pressure Regulator Vacuum Hose

tors are completely connected to the injectors (Fig. 32). Inspect the connectors for corrosion.

(24) Inspect the fuel pressure regulator vacuum hose for fatigue or damage (Fig. 33). Replace the hose if necessary.

(25) Verify that the coolant temperature sensor electrical connector is connected to the sensor (Fig. 34). Inspect the sensor and connector for corrosion.

(26) Verify that the electric cooling fan switch connector is connected to the switch (Fig. 35). Inspect the connector and switch for corrosion.

(27) Verify that cooling fan connector is connected to harness connector (Fig. 35). Inspect connectors for corrosion.

(28) Raise vehicle and inspect starter motor connections for corrosion.

(29) Check hose and wiring connections at Fuel Pump.

COMPONENT DIAGNOSTIC PROCEDURES

This section contains information for determining individual MPI system component performance. Diagnosis of ECU/Engine Control System is performed using the DRB II Service Diagnostic Tester. Refer to the Tester Manual for the appropriate system test procedures.

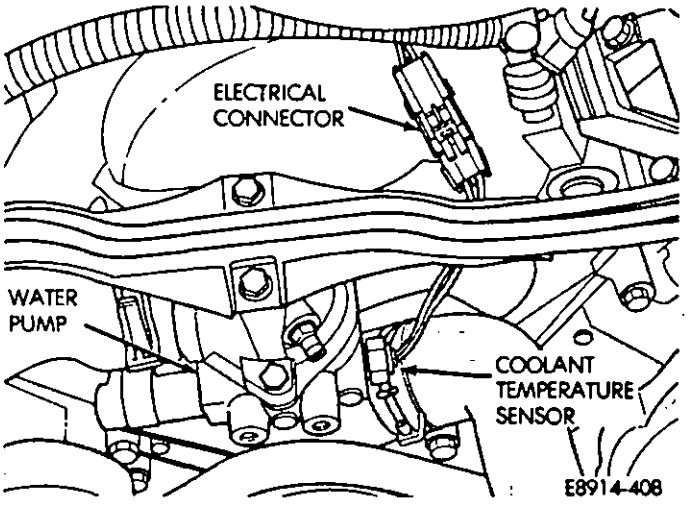


Fig. 34—Coolant Temperature Sensor

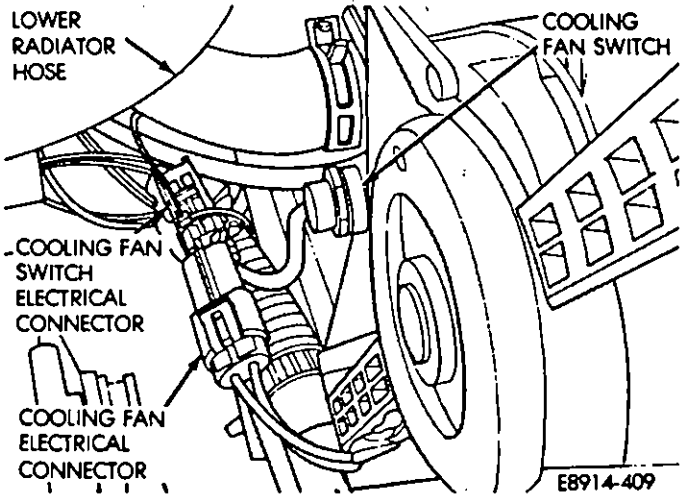
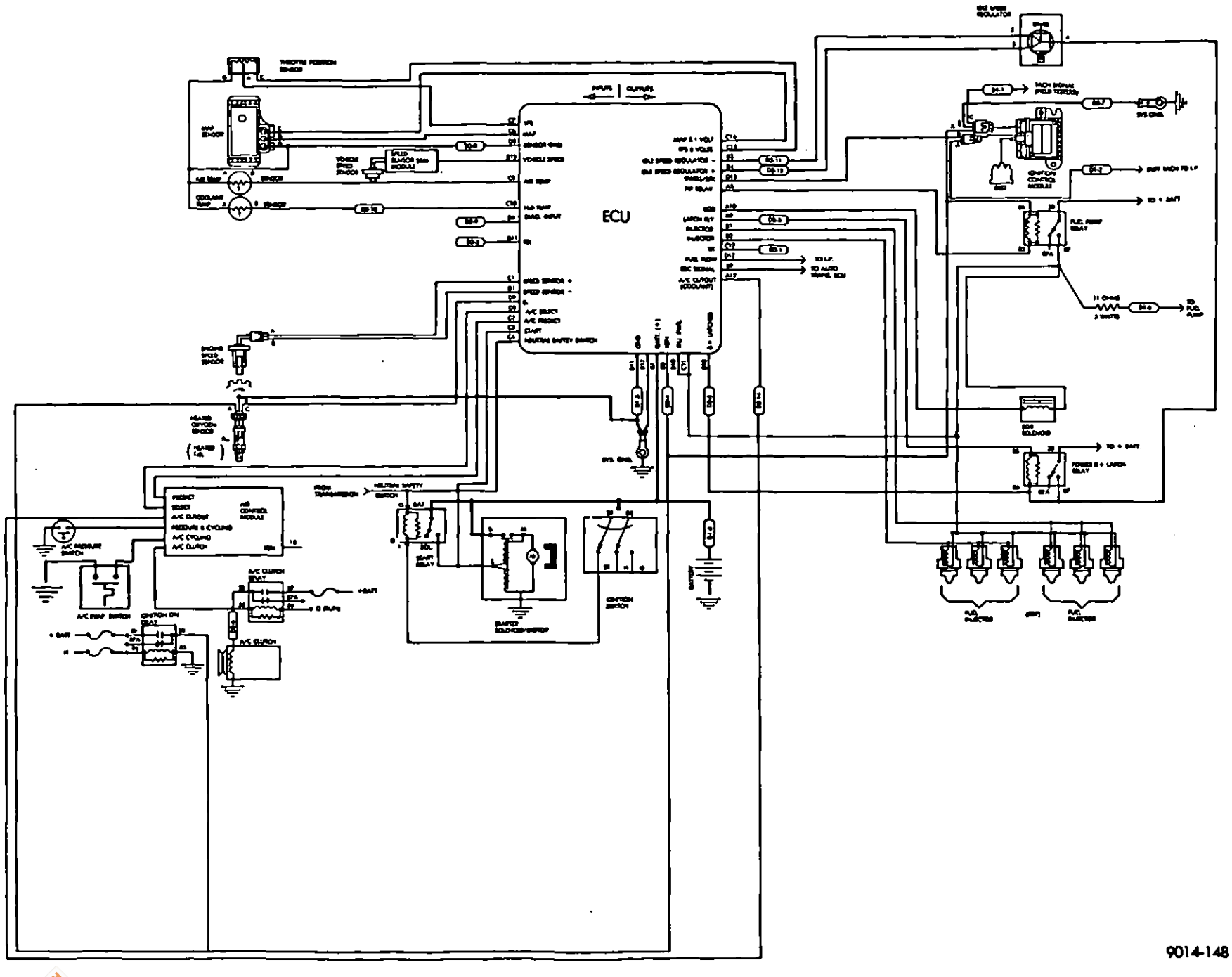
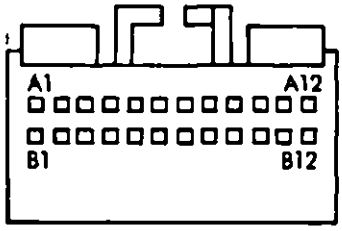
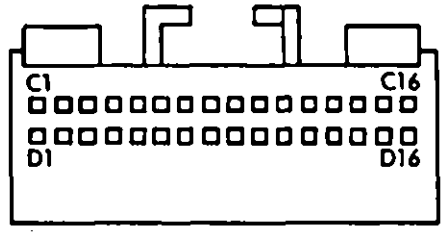


Fig. 35—Cooling Fan Switch


ECU
9014-148





A

1. NOT USED
2. NOT USED
3. NOT USED
4. NOT USED
5. FUEL PUMP RELAY
6. NOT USED
7. NOT USED
8. NOT USED
9. LATCH RELAY
10. EGR SOLENOID
11. NOT USED
12. A/C CUTOUT (COOLANT)

B

1. INJECTOR
2. INJECTOR
3. IDLE SPEED REGULATOR (-)
4. IDLE SPEED REGULATOR (+)
5. NOT USED
6. NOT USED
7. BATTERY (+)
8. IGNITION
9. TDC SIGNAL—TO TCU
10. LATCHED B+
11. GROUND
12. GROUND

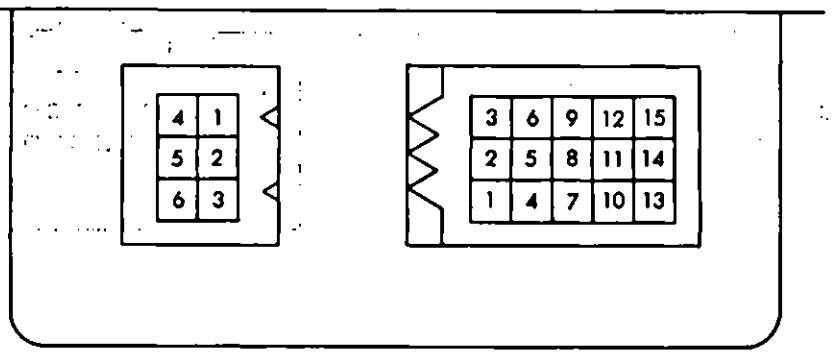
C

1. SPEED SENSOR (+)
2. A/C PREDICT
3. START
4. P/N SWITCH
5. NOT USED
6. MAP SENSOR
7. TPS SENSOR
8. AIR TEMPERATURE SENSOR
9. NOT USED
10. COOLANT TEMPERATURE SENSOR
11. INJECTION SUPPLY
12. TX (SERIAL DATA)
13. NOT USED
14. MAP SENSOR SUPPLY (+)
15. TPS SUPPLY (+)
16. NOT USED

D

1. SPEED SENSOR (-)
2. A/C SELECT
3. SENSOR GROUND
4. NOT USED
5. NOT USED
6. DIAGNOSTIC INPUT
7. NOT USED
8. NOT USED
9. OXYGEN SENSOR INPUT
10. INJECTION SUPPLY
11. RX (SERIAL DATA)
12. FUEL FLOW—TO I.P.
13. SPARK/DWELL
14. NOT USED
15. VEHICLE SPEED
16. NOT USED

9014-149



CONNECTOR D1

1. TACH SIGNAL
2. BUFF TACK SIGNAL
3. POWER GROUND
4. TRANS. MALFUNCTION LIGHT
5. BATTERY
6. FUEL PUMP RELAY

CONNECTOR D2

1. ECU OUTPUT (TX)
2. RX DATA (ECU)
3. LATCH RELAY
4. IGNITION
5. B+ LATCH
6. A/C CLUTCH RELAY
7. SYSTEM GROUND
8. SENSOR GROUND
9. DIAGNOSTIC INPUT
10. ECU COOLANT SENSOR
11. IDLE SPEED REGULATOR (-)
12. NOT USED
13. IDLE SPEED REGULATOR (+)
14. A/C CONTROL MODULE
15. TCU DATA OUT

E8914-381

Diagnostic Connectors

The diagnostic connectors are located in the engine compartment. The connectors are protected by black rubber covers. Cavity identification and specific engine function is listed in connector illustration.

Coolant Temperature Sensor Test

Disconnect wire harness connector from coolant temperature sensor (Fig. 36).

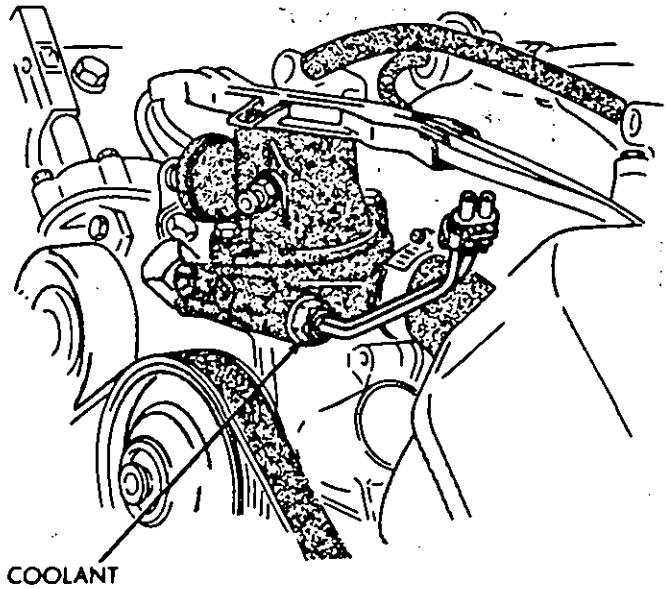


Fig. 36—Coolant Temperature Sensor

Test the resistance of the sensor with a high input impedance (digital) volt-ohmmeter. The resistance should be less than 1000 ohms with the engine warm. Refer to the resistance chart. Replace the sensor if it is not within the range of resistance specified in the chart.

Test the resistance of the wire harness between ECU wire harness connector terminal D-3 and the sensor connector terminal, and wire harness terminal C-10 to the sensor connector terminal. Repair the wire harness if the resistance is greater than one ohm.

Coolant Temperature Sensor Temperature-to-Resistance Values (Approximate)

°F	°C	Ohms
212	100	185
160	70	450
100	38	1,600
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

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Manifold Air/Fuel Temperature (MAT) Sensor Test

Disconnect the wire harness connector from the MAT sensor (Fig. 37).

Test the resistance of the sensor with a high impedance (digital) volt-ohmmeter. The resistance should be less than 1000 ohms with the engine warm. Refer to the resistance chart. Replace the sensor if it is not within the range of resistance specified in the chart.

Test the resistance of the wire harness between the ECU wire harness connector terminal D-3 and the sensor connector terminal, and terminal C-8 to the sensor connector terminal. Repair the wire harness as necessary if the resistance is greater than 1 ohm.

Manifold Absolute Pressure (MAP) Sensor Test

Inspect the MAP sensor vacuum hose connections at the throttle body and sensor. Repair as necessary.

Manifold Air/Fuel Temperature Sensor Temperature-to-Resistance Values (Approximate)		
°F	°C	Ohms
212	100	185
160	70	450
100	38	1,600
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

J8914-90

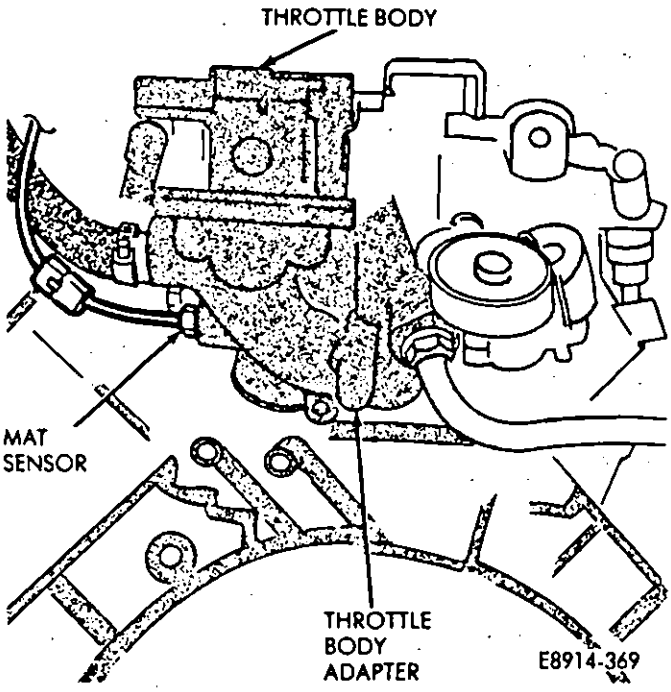


Fig. 37—Manifold Air Temperature Sensor

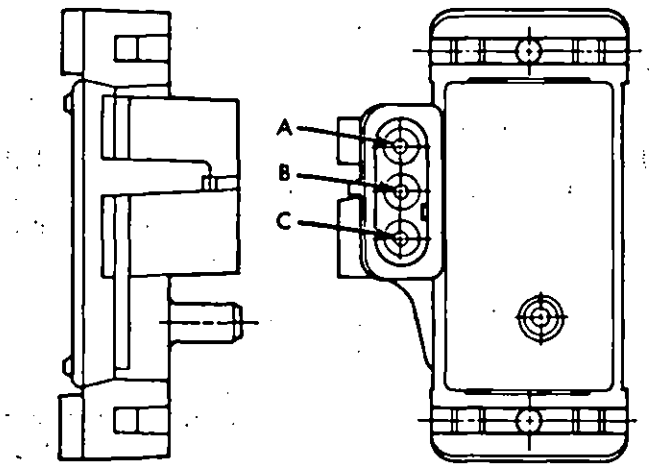


Fig. 38—MAP Sensor Connector Terminals

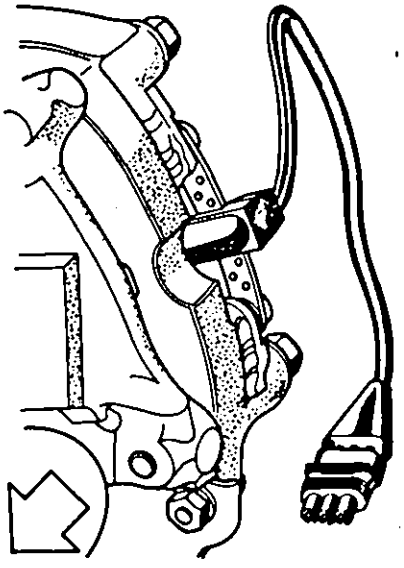
CAUTION: When testing the MAP sensor, insert the tester leads through the back of the connector, ensure that the harness wires are not damaged by the test meter leads.

Test the MAP sensor output voltage at the MAP sensor connector terminal B (as marked on the sensor body) with the ignition switch ON and the engine OFF (Fig. 39). Output voltage should be 4-5 volts. Start the engine and allow idle to stabilize. Recheck output voltage at terminals B. The voltage should drop to 1.5-2.1 volts with a hot, neutral idle speed condition.

Test ECU terminal C-6 for the same voltage described above to verify the wire harness condition. Repair as necessary.

Test MAP sensor supply voltage at sensor connectot terminal C with the ignition ON. The voltage should be 5 volts (±0.5V). Five volts (±0.5V) should also be at terminal C-14 of the ECU wire harness connector. Repair or replace the wire harness as necessary.

Test the MAP sensor ground circuit at sensor connector terminal A and ECU connector terminal D-3. Repair the wire harness if necessary.



J8914-93

Fig. 39—Engine Speed Sensor

Speed Sensor (Crankshaft Position Sensor-CPS) Test

Disconnect the speed sensor connector from the harness (Fig. 39).

Place an ohmmeter across terminals A and B (marked on connector). The meter reading should be 200±75 ohms (hot engine). Replace sensor if readings are not to specifications.

Throttle Position Sensor (TPS) Test

(1) Turn key to ON position.

(2) Unplug the TPS harness connector.

CAUTION: When testing the TPS, insert the tester leads through the back of the connector, ensure that the harness wires are not damaged by the test meter leads.

(3) Measure voltage between connector terminal C and B of the TPS harness connector with a high impedance digital volt-ohmmeter.

• Meter should register approximately 5 volts. If voltage is incorrect, test the vehicle using the DRB II tester.

(4) Turn the ignition key to the OFF position.

(5) Test for continuity between TPS connector pin B and ground using a high-impedance digital volt-ohmmeter.

• If circuit is open, test the vehicle with the DRB II tester.

(6) Reconnect TPS connector.

(7) Turn Key to ON position.

(8) Back probe TPS connector with a high impedance digital volt-meter (such as tool number C4845 or an equivalent) and measure voltage from terminal A and ground.

• Meter should register approximately 0.5 to 1.0 volts. If voltage is incorrect, attempt to adjust the TPS using either the method in the MPI Service Adjustments section of this group, or using the DRB II tester. If the sensor cannot be adjusted, the sensor is defective and should be replaced.

Exhaust Gas Oxygen (O_2) Sensor Heating Element Test

The oxygen sensor heating element can be tested with an ohmmeter as follows:

Disconnect the O_2 sensor connector. Connect the ohmmeter test leads to connector terminals A and B of the sensor connector. Resistance should be less than 10 ohms. Replace the sensor if the ohmmeter displays an infinity reading.

Idle Speed Regulator

(1) Attach the adapter harness, tool number 7195 to Idle Speed Exerciser tool 7088 and to the idle speed regulator (Fig. 40).

(2) Attach the exerciser power leads to the battery; red to positive, black to negative.

(3) Start the engine.

(4) Push the exerciser in the extend direction and then the retract direction. The engine idle speed will change if the regulator is operating normally.

(5) If the engine idle speed does not change, remove the regulator. Leave the exerciser and the adapter attached.

(6) Look inside the regulator ports and cycle the exerciser from extend to retract. The valve

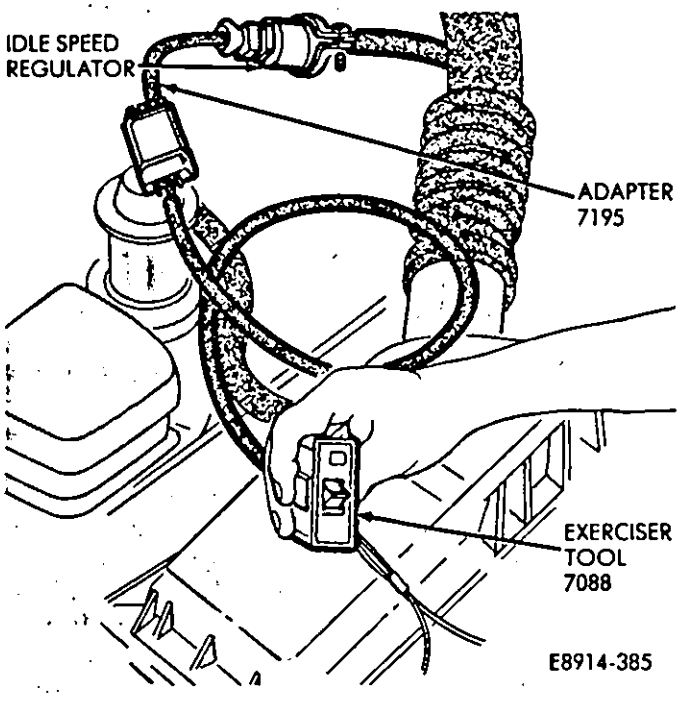


Fig. 40—Idle Speed Regulator Testing

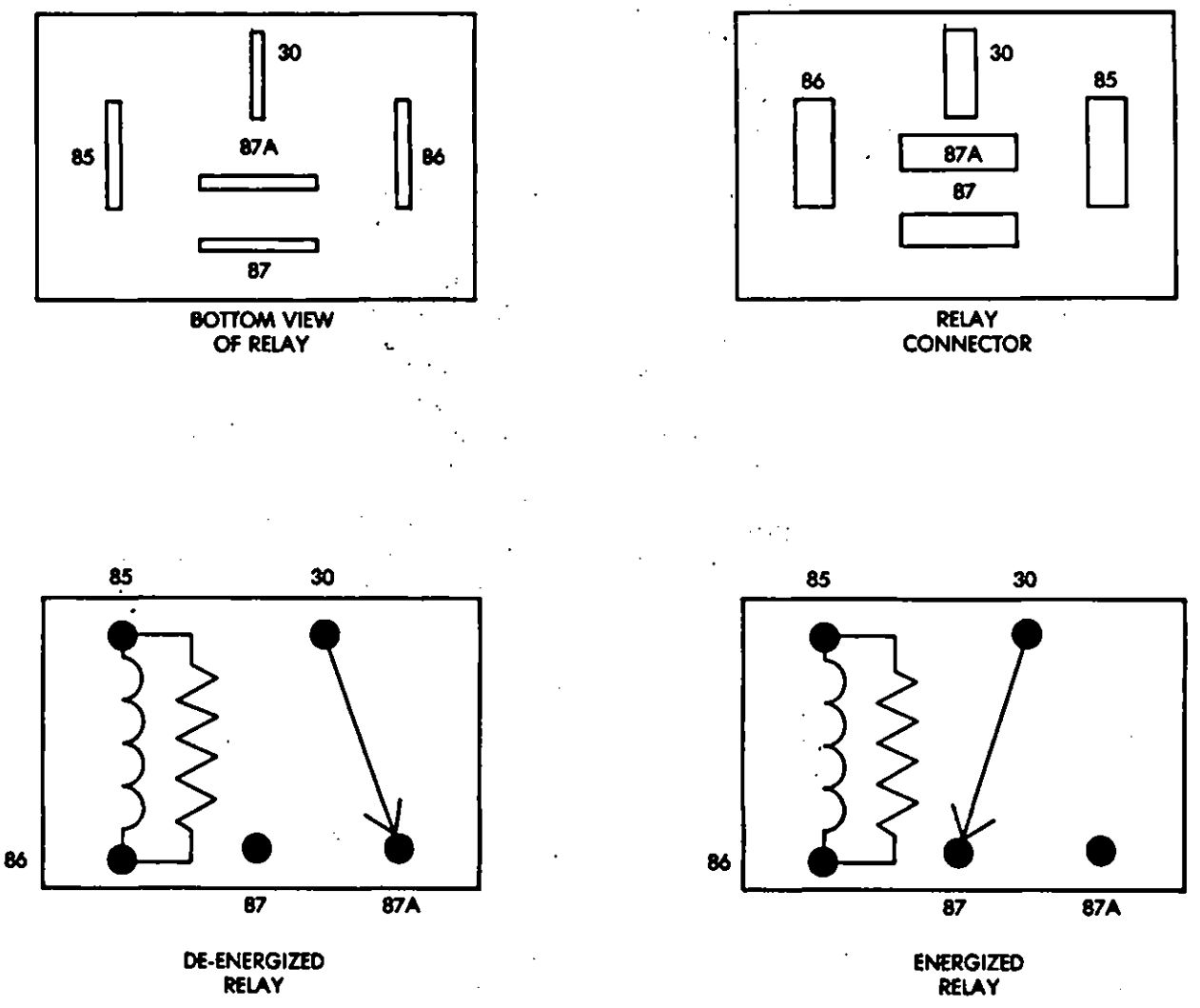


Fig. 41—Relay Terminals

inside should open and close while cycling the exerciser. If it does not, replace the idle speed regulator.

Relay Operation/Testing

Operation

- Terminal No. 30 is usually connected to battery voltage and can be switched or B+ at all times (Fig. 42).
- Terminal No. 87A is connected to terminal 30 in the de-energized position. (Fig. 41).
- Terminal No. 87 is connected to terminal 30 in the energized position which supplies battery voltage to the operated device (Fig. 41).
- Terminal No. 86 is connected to the electromagnet and usually connected to a switched power source (Fig. 41).
- Terminal No. 85 is connected to the electromagnet and is usually grounded by a switch or ECU (Fig. 41).

Testing

- A relay in the de-energized position should have continuity between terminal 87A and terminal 30.
- Resistance value between terminals 85 and 86 (electromagnet) is 75±5 ohms for resistor relays and 86±5 ohms for diode relays.

Not all relays have battery voltage connected to terminal No. 30. Some may have battery voltage connected to terminals 87 or 87A.

EGR Solenoid Test

(1) Unplug solenoid electrical connector.

(2) Connect a 12 volt source to one of the solenoid terminals.

(3) Connect and Disconnect a ground to the other solenoid terminal.

- If the solenoid clicks each time the ground is provided, the solenoid is operating properly.
- If the solenoid does not click when the ground is provided, the solenoid is not operating correctly and should be replaced.

Injector Test

(1) Check system fuel pressure. The fuel pressure should be between 193-207 kPa (28-30 psi). Repair fuel supply system if fuel pressure is not within specifications.

(2) If fuel pressure is within specifications, start the vehicle and disconnect the fuel injector electrical connectors one at a time while observing engine rpm on a tachometer. An injector that is not operating will not cause the engine rpm to change when its' electrical connector is disconnected. If rpm does change, injectors are firing.

(3) If an injector is found not to be operating, measure the resistance between injectors terminals with an ohmmeter. There should be approximately 2.4 ohms resistance (at 20°C–68°F). Replace the injector if resistance is not within specifications.

(4) If resistance is within specifications, connect a 12 volt test lamp across the injector connector terminals (wire harness side). Observe the test lamp while cranking the engine. If the test lamp flashes on and off proceed to step (5). If the test lamp does not flash on and off, proceed to (a).

(a) Check the power and ground circuits to the injector. Refer the wiring diagrams. If the circuits are not OK, repair as necessary. If the circuits are OK, test the vehicle with the DRB-II tester.

(5) Remove the suspect injector from the fuel rail and intake manifold. Inspect the injector inlet for blockage. If the injector inlet is plugged, replace the injector. If the inlet is not plugged, proceed to (6).

(6) Inspect the fuel supply line and fuel rail for blockage. Repair as necessary. If blockage is not found, proceed to (7)..

(7) Connect a 12 volt source to one of the terminals on the injector. Repeatedly connect and disconnect a ground source to the other terminal. The injector should click each time the ground is supplied. Replace the injector if it does not click when the ground is supplied.

Fuel Pressure Test

WARNING: WEAR EYE PROTECTION WHEN SERVICING THE FUEL SYSTEM. DO NOT SMOKE OR ALLOW OPEN FLAME NEAR FUEL SYSTEM COMPONENTS DURING FUEL SYSTEM SERVICE.

(1) Remove the fuel tank filler cap to relieve the fuel tank pressure.

WARNING: SYSTEM FUEL PRESSURE WILL BE RELEASED WHEN DISCONNECTING THE FUEL SUPPLY TUBE. WRAP SHOP TOWELS AROUND THE TUBE AND QUICK-CONNECT FITTING TO ABSORB SPILLED FUEL.

(2) Use tool 6182 to remove the black fuel supply tube from the fuel rail (Fig. 42). Slide the tool over the nipple and up into the connector until the handle fits the connector. Pull the fuel supply tube off of the fuel rail.

(3) Install fuel line adaptor, tool number 6175.

(4) Push the female end with the quick-connect fitting over the fuel rail until a click is heard. Pull the connector back to ensure that it is locked in place.

(5) Push the male end with the nipple into the black fuel supply tube until a click is heard. Pull the nipple back to ensure that it is locked in place.

(6) Attach the 0-60 psi gauge from fuel gauge set 5069 or equivalent to the port on fuel tube adapter 6175.

(7) Start the engine and check the fuel pressure. It should be 193-207 kPa (28-30 psi).

The fuel pressure regulator is non-adjustable.

(8) If the fuel pressure is low, check for fuel flow through the return tube.

- If fuel is returning to the fuel tank through the fuel return tube, replace the fuel pressure regulator.
- If fuel is not returning to the fuel tank through the return tube, inspect for faulty fuel pump, possible clogged fuel filter or other restrictions between the fuel pressure regulator and the fuel pump.

(9) If the fuel pressure is high, check the pressure regulator vacuum hose for leaks and for a kink or restriction in the fuel return tube. If the pressure regulator vacuum hose is not leaking and the return tube is not kinked or does not

have a restriction, the fuel pressure regulator should be replaced.

(10) Remove the pressure gauge.

(11) Disconnect the fuel tube adaptor 6175 with disconnect tool 6182.

(12) Prior to installing the fuel tubes to the regulator and fuel rail the tube ends **MUST be lightly lubricated with clean 30 weight engine oil. Refer to Fuel Tubes and Quick-Connect Fittings in this section.**

(13) Install the black fuel supply tube to the fuel rail and the grey fuel return tube to the pressure regulator. Refer to Fuel tubes and Quick-Connect Fittings in this section for correct installation procedure.

(14) Install fuel filler cap.

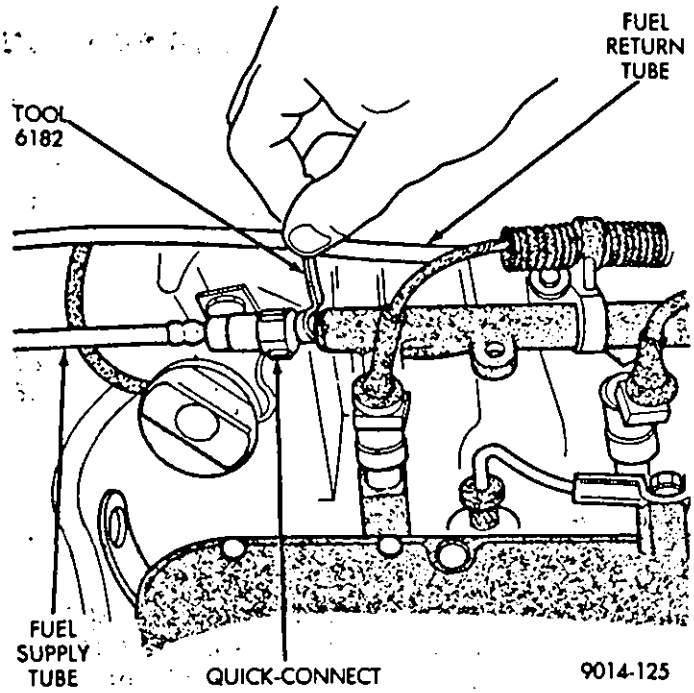


Fig. 42—Disconnecting Fuel Supply Tube at Fuel Rail—MPI

MPI SERVICE PROCEDURES

INDEX

THROTTLE BODY

Remove

(1) Remove the air bonnet to throttle body mounting screws (Fig. 1).

(2) Disconnect idle speed actuator inlet hose and move the air bonnet to the side (Fig. 1).

(3) Disconnect the TPS electrical connector (Fig. 1).

(4) Disconnect accelerator cable at throttle lever (Fig. 2).

(5) If the vehicle is equipped with cruise control, disconnect the cruise control cable at throttle lever (Fig. 2).

CAUTION: Use finger pressure only to remove the cruise control cable connector. If the connector is damaged, the complete cruise control servo and cable assembly must be replaced.

(6) Remove the throttle return spring (if applicable).

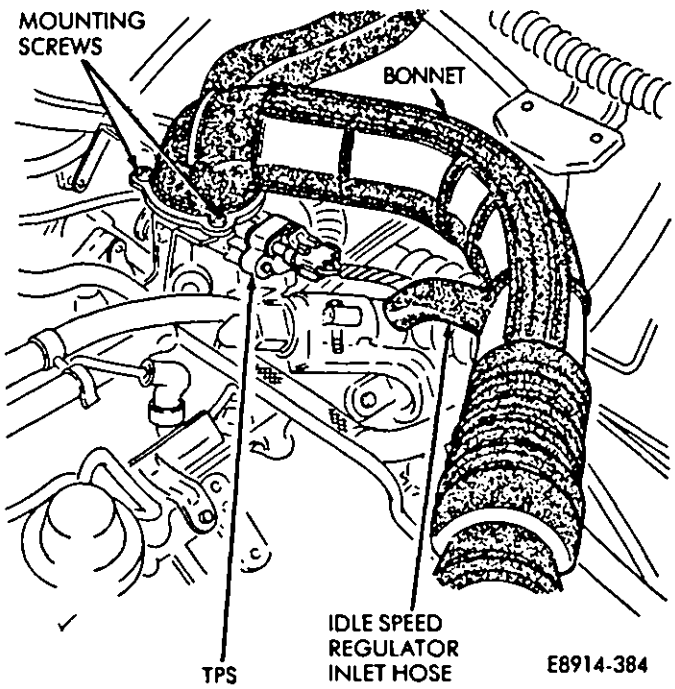


Fig. 1—Throttle Body Removal/Installation

(7) Remove throttle body mounting nuts at the base of the throttle body (Fig. 2) Remove throttle body.

(8) Remove old gasket.

CAUTION: If throttle position sensor is removed or the mounting screws are loosened, the sensor setting must be readjusted. New throttle bodies are equipped with an adjusted throttle position sensor (TPS).

Installation

(1) Install the gasket and throttle body. Tighten throttle body mounting nuts to 17.5 N·m (13 ft-lbs) torque (Fig. 2).

(2) Connect the cruise control cable (if equipped) to throttle lever.

(3) Connect accelerator cable to the throttle lever.

(4) Connect TPS electrical connector to TPS (Fig. 1).

(5) Connect idle speed regulator inlet hose.

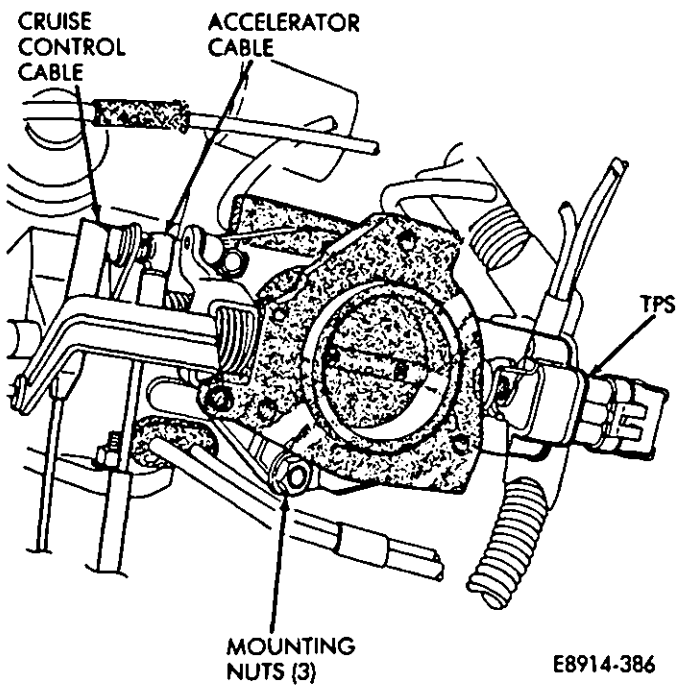


Fig. 2—Throttle Body Mounting Nuts

(6) Connect the air bonnet to the throttle body. Tighten mounting screws to 3.9 N·m (35 in-lbs) torque (Fig. 1).
(7) Connect throttle return spring (if applicable)

IDLE SPEED REGULATOR

Removal

(1) Remove regulator electrical connector (Fig. 3).
(2) Remove air inlet hose (Fig. 3).
(3) Disconnect regulator outlet hose at the regulator (Fig. 3).
(4) Remove regulator clamp bolt (Fig. 3).
(5) Remove regulator (Fig. 3).

Installation

(1) Install the regulator with the arrow (cast into the ports) pointing towards the throttle body adapter.
(2) Secure clamp with bolt (Fig. 3).
(3) Attach air inlet hose and outlet hoses to regulator.
(4) Connect electrical connector to regulator.

THROTTLE POSITION SENSOR

The Throttle Position Sensor (TPS) is attached to the throttle body (Fig. 4).

Removal

(1) Disconnect electrical connector (Fig. 4).
(2) Remove TPS mounting screws (Fig. 4).

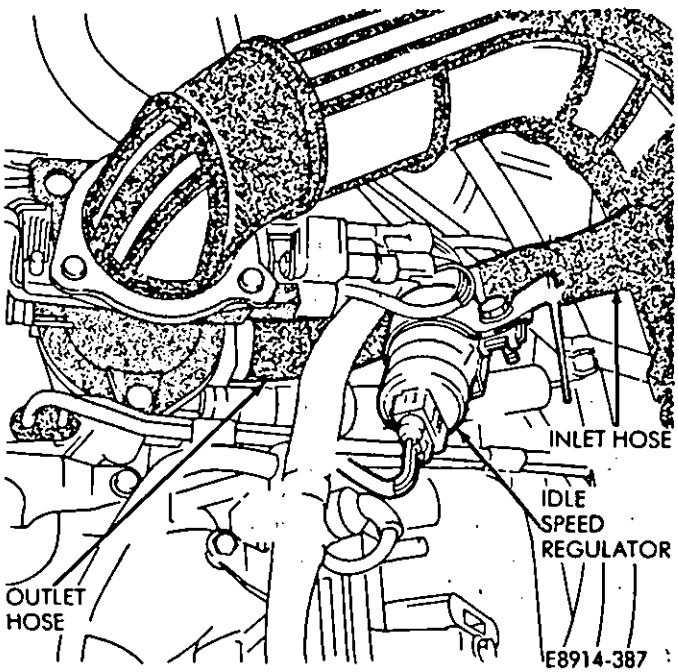


Fig. 3—Idle Speed Regulator Removal/Installation

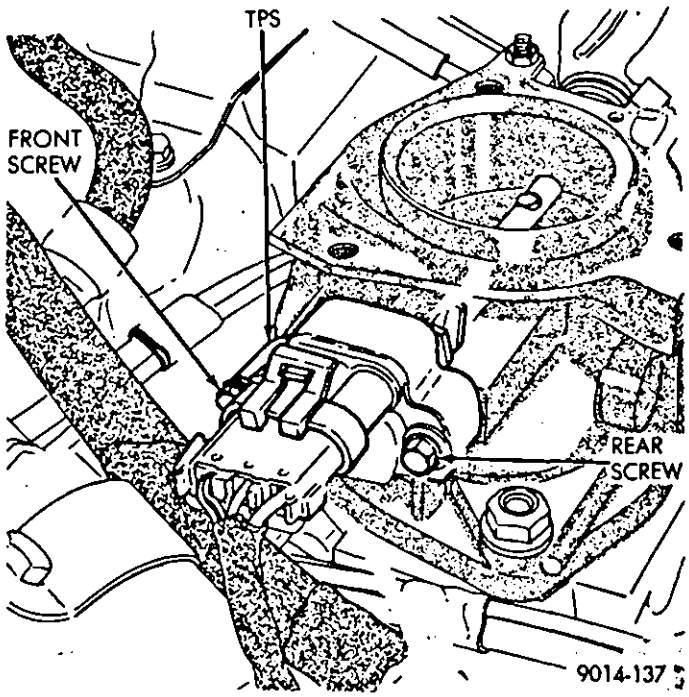


Fig. 4—Throttle Position Sensor Removal/Installation

(3) Remove the wire harness mounting bracket screws.
(4) Remove TPS (Fig. 4).

Installation

(1) Install TPS wire harness mounting bracket screws.
When installing the TPS, ensure that the TPS lever is on top of the throttle lever.
(2) Install TPS (Fig. 4).
(3) Connect electrical connector.
(4) Adjust TPS. Refer to TPS adjustment in the MPI Service Adjustments section of this group.
(5) Tighten TPS mounting screws (Fig. 4).

COOLANT TEMPERATURE SENSOR

Removal

The coolant temperature sensor is located in the thermostat housing, above the water pump (Fig. 5).
CAUTION: It is essential that coolant does not contact the accessory drive belt or pulleys because it may cause the belt to slip and/or squeak. Cover the belt and pulleys with shop towels to protect them from coolant spillage. If coolant contacts the belt or pulleys, flush them with clean water.
(1) Disconnect electrical connector.
(2) Remove coolant temperature sensor and immediately plug the opening in the water pump (Fig. 5).

Installation

(1) Screw coolant temperature sensor into the thermostat housing.

(2) Tighten the sensor to 28 N·m (21 ft-lbs) torque.

(3) Connect coolant temperature sensor electrical connector to wiring harness.

(4) Remove the shop towels from the accessory drive belt and pulleys.

(5) Replace any lost coolant.

MANIFOLD AIR TEMPERATURE SENSOR

Manifold Air Temperature (MAT) sensor is located in the throttle body adaptor below the throttle body and behind the fitting for the Brake Vacuum Booster (Fig. 6).

Removal

(1) Disconnect electrical connector (Fig. 6).

(2) Unscrew MAT sensor from the adaptor (Fig. 6).

Installation

(1) Install MAT sensor in throttle body adapter (Fig. 6).

(2) Tighten the MAT sensor to 28 N·m (21 ft-lbs) torque.

(3) Connect MAT sensor electrical connector to wiring harness.

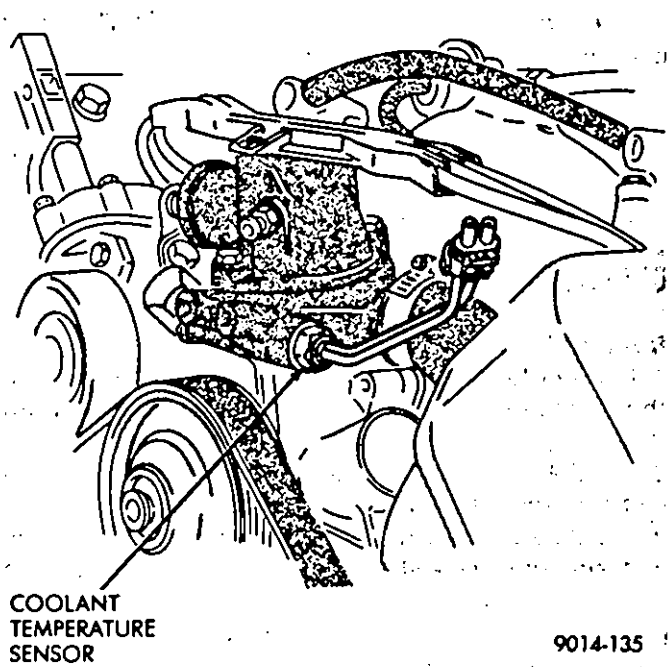


Fig. 5—Coolant Temperature Sensor Removal/Installation

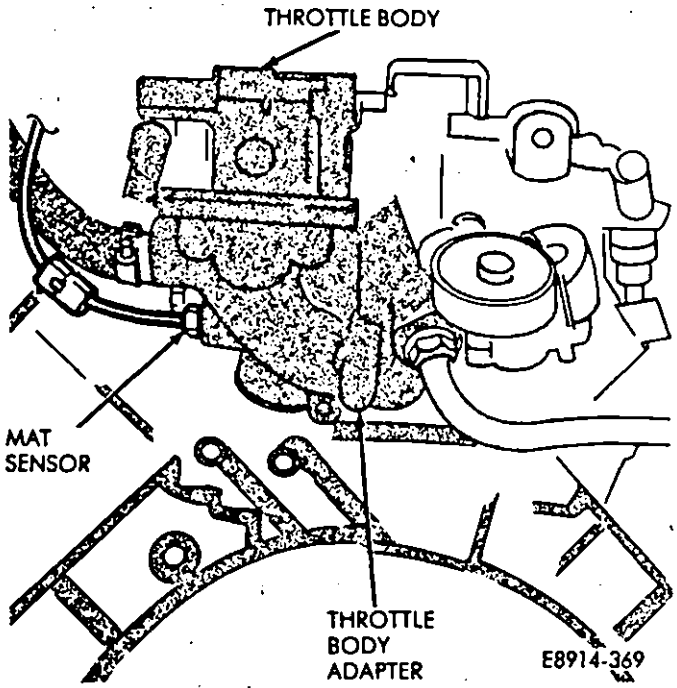


Fig. 6—MAT Sensor Removal/Installation

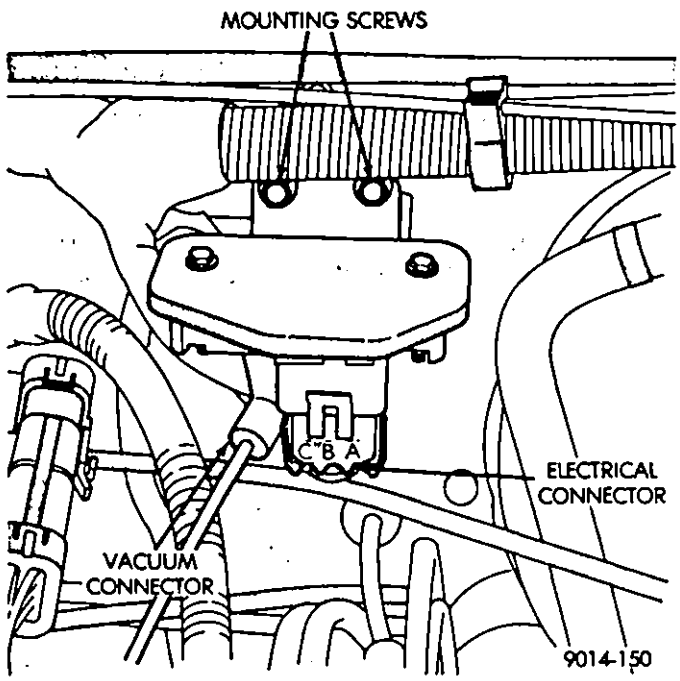


Fig. 7—MAP Sensor Removal/Installation

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

The Manifold Absolute Pressure (MAP) Sensor is located on the dash panel, next to the Brake Power Booster (Fig. 7).

Removal

(1) Disconnect electrical connector from MAP sensor (Fig. 7).

(2) Disconnect vacuum hose from MAP sensor.
(3) Remove MAP sensor mounting screws.
(4) Remove MAP sensor.

Installation

(1) Install MAP sensor on the dash panel with mounting screws. Tighten the mounting screws.
(2) Connect vacuum hose to MAP sensor.
(3) Connect electrical connector to MAP sensor.

EXHAUST GAS OXYGEN (O_2) SENSOR

The exhaust gas oxygen (O_2) sensor is located in the exhaust "Y" pipe before the catalytic convertor (Fig. 8).

Removal

(1) Raise the car on a hoist.
(2) Disconnect electrical connector from O_2 sensor (Fig. 8).
(3) Unscrew O_2 oxygen sensor from the Y-pipe.
(4) Clean the threads in the Y-pipe.

Installation

The threads of new O_2 sensors are coated with an anti-seize compound to aid in installation and removal.
(1) Thread oxygen O_2 sensor into the Y-pipe.
(2) Tighten the sensor to 30 N·m (22 ft.-lbs.) torque.
(3) Connect electrical connector to O_2 sensor.
(4) Lower the car.

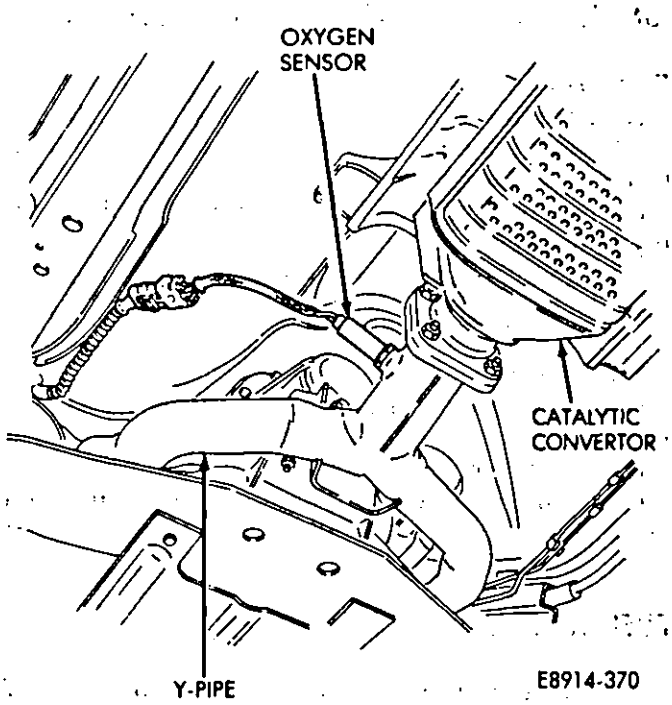


Fig. 8—O_2 Sensor Removal/Installation

ENGINE SPEED SENSOR (CRANKSHAFT POSITION SENSOR—CPS)

The Speed Sensor is located on the left side of the transmission converter housing behind the rear face of the engine (Fig. 9).

Removal

(1) Remove the speed sensor mounting screws (Fig. 9).
(2) Disconnect speed sensor wire connector.
(3) Remove speed sensor.

Installation

(1) Install speed sensor (Fig. 9).
(2) Tighten mounting screws to 8 N·m (71 in-lbs) torque.
(3) Connect wire connector to speed sensor.

EGR VALVE SOLENOID

The Exhaust Gas Recirculation (EGR) Solenoid is located on the drivers side on the fender panel of the engine compartment (Fig. 10).

Removal

(1) Disconnect vacuum lines at solenoid (Fig. 10).
(2) Remove solenoid mounting screw.
(3) Remove solenoid.

Installation

(1) Install solenoid and tighten mounting screw (Fig. 10).

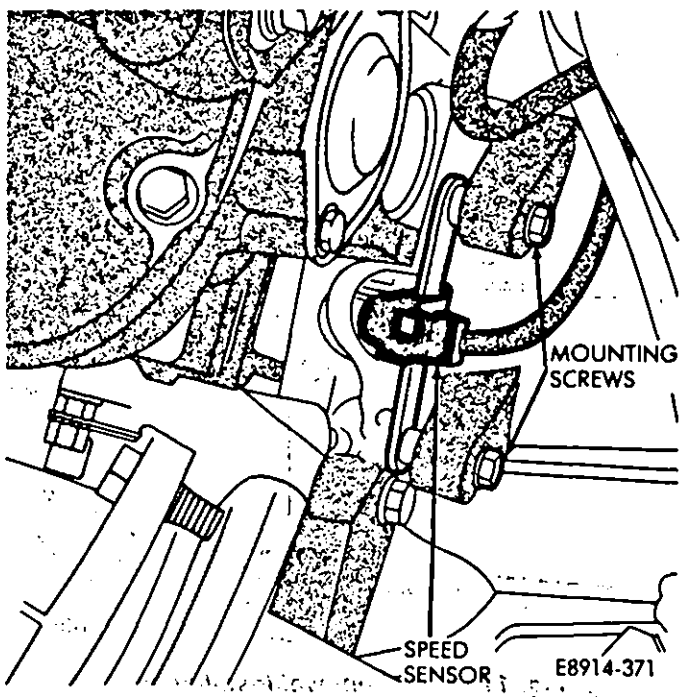


Fig. 9—Engine Speed Sensor Removal/Installation

(2) Connect electrical connector to solenoid.
(3) Connect vacuum lines to solenoid.

ELECTRONIC CONTROL UNIT (ECU)

The ECU is located under the instrument panel on the passenger side of the vehicle (Fig. 11).

Removal

(1) Raise the hood and disconnect the battery negative cable.
(2) Remove the ECU mounting nuts and ground strap, remove the ECU from the vehicle (Fig. 11).
(3) Disconnect the harness connectors from the ECU (Fig. 12).

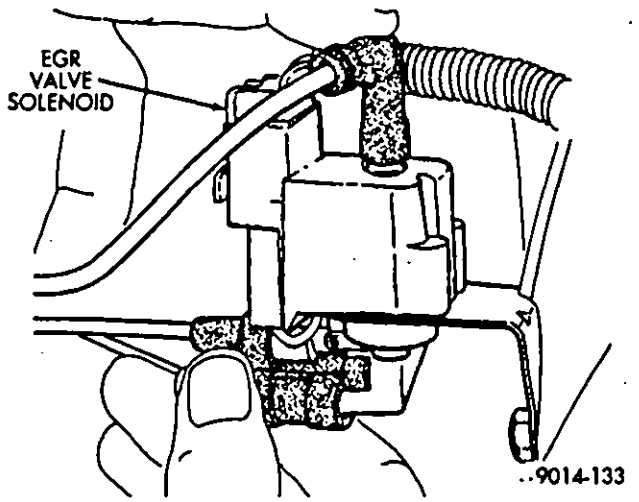


Fig. 10—EGR Valve Solenoid Removal/Installation

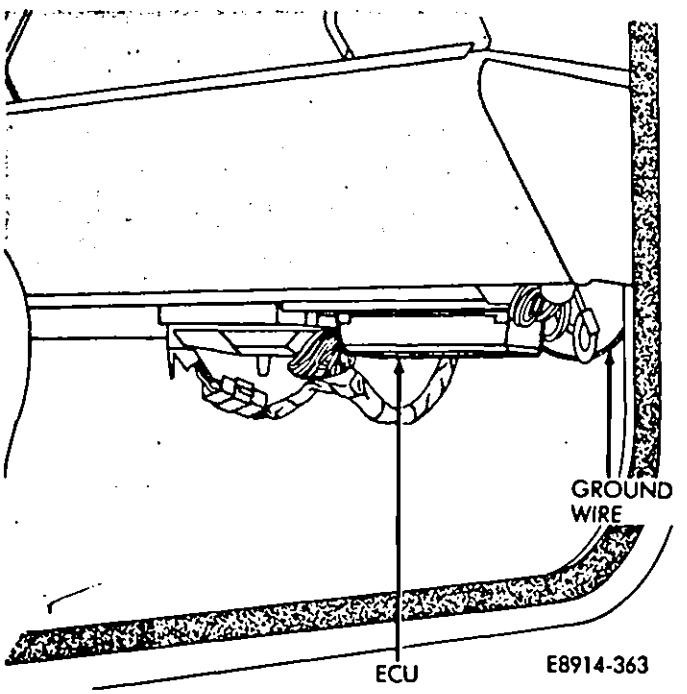


Fig. 11—ECU Removal/Installation

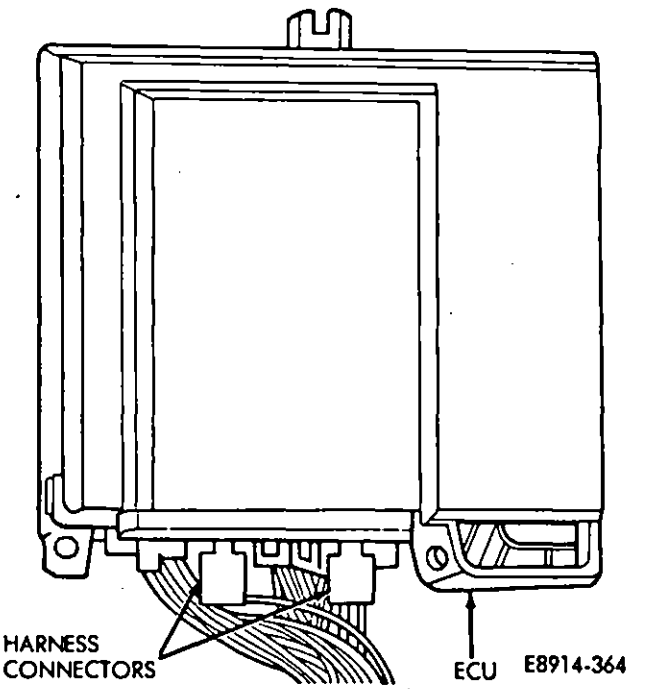


Fig. 12—ECU Connectors

Installation

(1) Connect harness connectors to the ECU.
(2) Push the ECU over the positioning studs.
(3) Install the ground strap and tighten the mounting nuts.
(4) Connect the battery negative cable.
(5) Close the hood.

IGNITION CONTROL MODULE/COIL ASSEMBLY

Removal

(1) Disconnect coil wire from coil (Fig. 13).
(2) Disconnect electrical connectors from ignition control module (Fig. 13).
(3) Remove ignition control module/coil assembly mounting nuts.
(4) Remove ignition control module/coil assembly.

Installation

(1) Install ignition control module/coil assembly.
(2) Tighten mounting nuts.
(3) Connect electrical connectors to ignition control module.
(4) Connect coil wire to coil.

FUEL TUBES AND HOSES

The MPI fuel system pressure is not bled off when the fuel pump stops operating. Fuel spray will result when disconnecting fuel system hoses and tubes. Wrap shop towels around tubes and

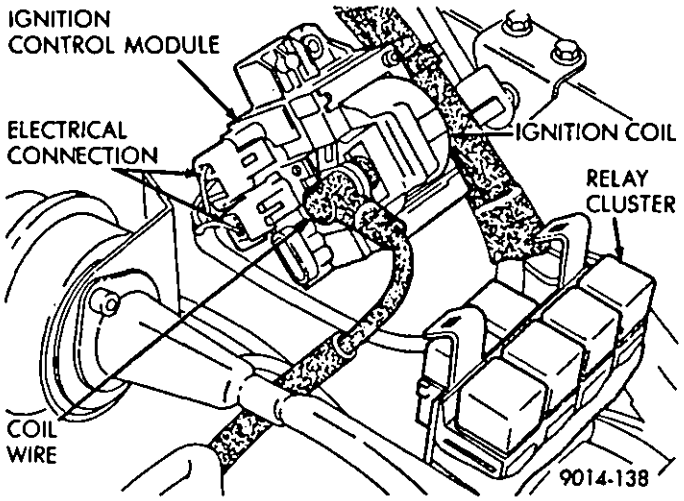


Fig. 13—Ignition Control Module/Coil Assembly

hoses to absorb fuel spray before disconnecting them. When removing fuel system hoses and tubes use care to avoid damaging the hoses or tube ends.

Fuel Tubes

This vehicle utilizes plastic fuel tubes with quick-connect fittings. The fuel tubes are connected to fuel system components by integral quick-connect fittings.

CAUTION: If a quick-connect fitting is damaged, do not attempt to remove the fitting from the fuel tube to replace it, the complete fuel tube and quick-connect fitting must be replaced as an assembly.

WARNING: KEEP OPEN FLAME SUCH AS CUTTING TORCHES AWAY FROM THE FUEL TUBES AND FUEL TANK WHEN SERVICING THE VEHICLE AND EXTINGUISH ALL TOBACCO SMOKING MATERIALS.

Quick Connect Fittings

The fuel system used on this vehicle utilizes plastic fuel tubes with quick-connect fittings that have sealed O-ring seals. The O-rings of the quick-connect fittings do not have to be replaced when the fittings are disconnected.

The quick-connect fitting consists of the O-rings, retainer and casing (Fig. 14). When the fuel tube nipple is inserted into the quick-connect fitting, the shoulder of the nipple is locked in place by the retainer, and the O-rings seal the tube.

The fuel tube nipples must be lubricated with clean 30 weight engine oil prior to reconnecting the quick-connect fitting. **No other lubricant may be used.**

When the fittings are disconnected the retainer will stay on the nipple of the component that the tube is being disconnected from. Either remove the retainer from the nipple and reinstall it in the quick connect fitting prior to reconnecting the fitting, or leave the retainer on the nipple and push the fitting over the nipple and retainer when reconnecting the fitting. In either case, care must be taken to ensure that the retainer is locked securely into the quick-connect fitting.

If the quick-connect fitting has "windows" in the sides of the casing, the retainer locking "ears" and the shoulder (stop bead) on the fuel tube must be visible in the windows or the retainer is not properly installed (Fig. 15). After connecting a quick-connect fitting, the connection should be verified by pulling on the lines to ensure that the lock is secure.

Fuel tube disconnect tool 6182 can be used at the 3.0L engine fuel rail and fuel pressure regulator to remove the quick-connect fitting and retainer as an assembly (Fig. 16). The retainer will remain in the fitting in the correct position. To install the fuel tube, push it over the nipple until a click is heard. Pull back on the tube to ensure that the connector is locked in place.

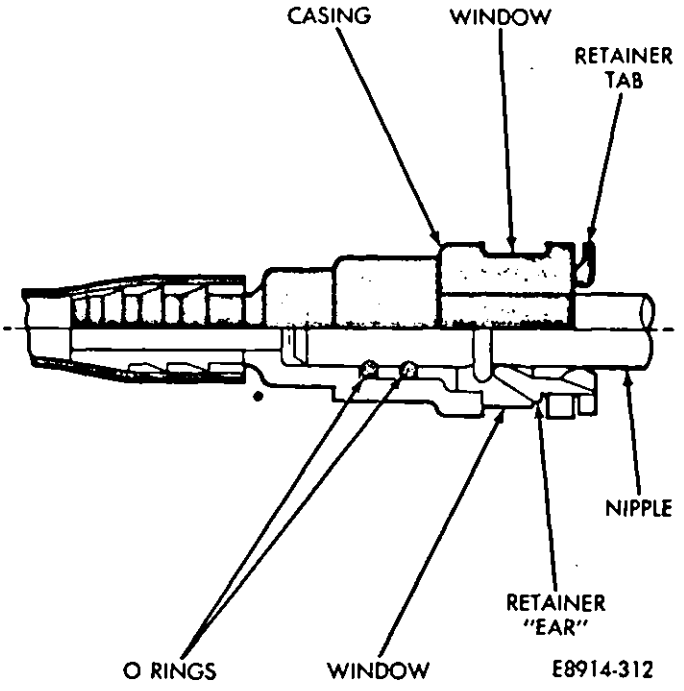


Fig. 14—Quick-Connect Fitting

Tube/Fitting Disassembly

(1) Disconnect battery negative cable from battery.

WARNING: FUEL SYSTEM PRESSURE WILL BE RELEASED WHEN THE QUICK-CONNECT FITTING IS DISCONNECTED. PLACE SHOP TOWELS AROUND TUBE TO ABSORB SPILLED FUEL. WEAR EYE PROTECTION AND EXTINGUISH ALL SMOKING DEVICES.

(2) Squeeze retainer tabs together and pull quick-connect fitting apart (Fig. 14). Note that retainer tabs stay on the nipple.

Tube/Fitting Assembly

(1) Using a clean lint free cloth, wipe clean the tube end (nipple) and retainer.

(2) Apply a light film of clean 30 weight engine oil to the tube end. **DO NOT use any other lubricant.**

(3) Push the quick-connect fitting over the fuel tube until the retainer seats and a click is heard.

(4) If the quick-connect fitting is the type that has "windows" on the side, ensure that the locking "ears" on the retainer and the shoulder (stop bead) on the fuel tube are completely visible in the "windows." Do not rely upon the audible click to confirm that a secure connection has been made. Pull back on the quick-connect fitting to further ensure that the connection is complete and the connector is locked in place.

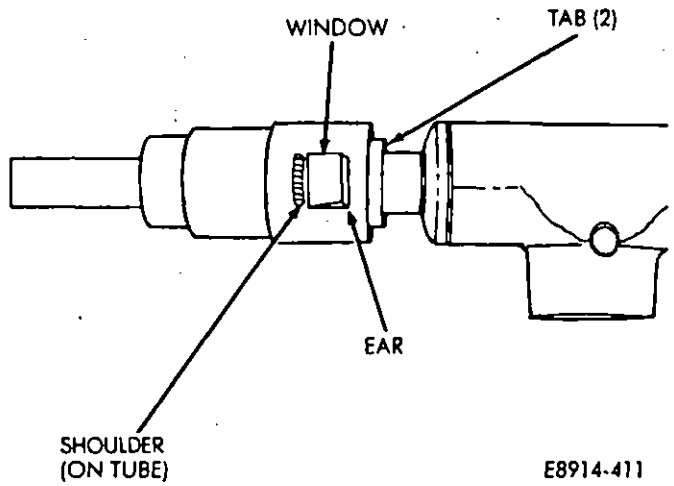


Fig. 15—Correct Connection of Quick-Connect Fitting

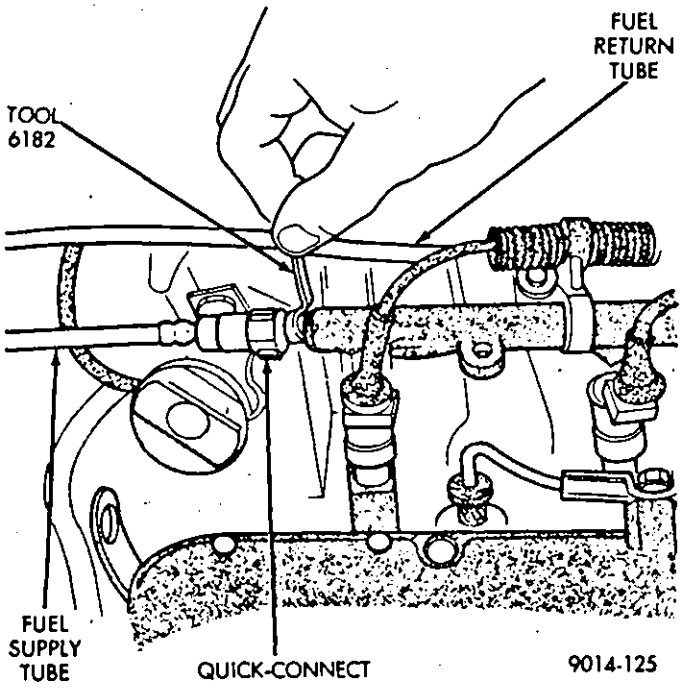


Fig. 16—Fuel Tube to Fuel Rail Quick-Disconnect Tool—3.0L Engine

(5) Connect negative cable to battery.

(6) Turn key to on position. Inspect for leaks.

FUEL INJECTOR/FUEL RAIL/REGULATOR ASSEMBLY

Removal

(1) Disconnect the battery negative cable.

Place shop towels under the fuel tubes to catch any spillage of fuel.

(2) Remove the fuel tank filler cap to relieve the fuel tank pressure.

(3) Install the fuel tank filler cap.

(4) Disconnect the grey fuel return tube from pressure regulator and black fuel supply tube from fuel rail using fuel tube disconnect tool number 6182. Slide the tool onto the nipple and push it forward into quick-connector until the handle stops on the connector casing. Pull the fuel tubes off (Fig. 17).

WARNING: FUEL SYSTEM PRESSURE WILL BE RELEASED WHEN THE QUICK-CONNECT FITTING IS DISCONNECTED. PLACE SHOP TOWELS AROUND TUBE TO ABSORB SPILLED FUEL. WEAR EYE PROTECTION AND EXTINGUISH ALL SMOKING DEVICES.

(5) Mark the injector electrical connector with the number of the corresponding injector for installation reference.

(6) Disconnect the electrical connector from the injectors. Remove the injector wire harness and lay to the side.

(7) Disconnect the accelerator cable from the throttle body and holding bracket.

(8) If equipped, disconnect the cruise control cable from the throttle body and holding bracket.

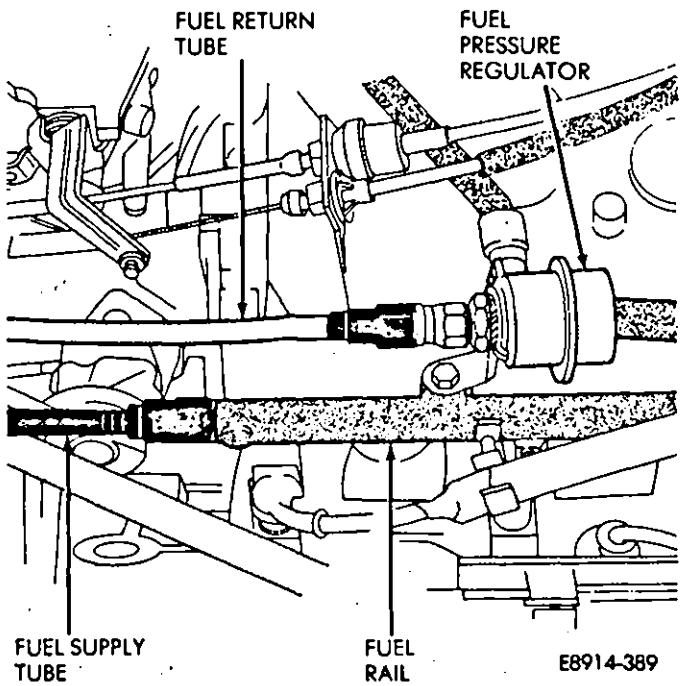


Fig. 17—Fuel Rail Removal/Installation

CAUTION: Use finger pressure only to remove the cruise control cable connector. If the connector is damaged, the complete cruise control servo and cable assembly must be replaced.

(9) Remove fuel rail mounting screws. Remove the fuel pressure regulator mounting screws (Fig. 18).

(10) Disconnect vacuum hose from fuel pressure regulator.

(11) Pull the fuel rails, regulator and injector assembly up until the injectors are out of the openings in the intake manifold.

(12) Pull the assembly out from under the throttle cable.

Installation

(1) Lubricate the injector O-rings with a drop of clean engine oil.

(2) Position the assembly so that the injectors are above the openings in the intake manifold.

(3) Push the injectors into the openings. Be sure not to damage the injector O-rings.

(4) Install fuel rail and regulator hold down bolts (Fig. 18).

(5) Connect the acceleration and cruise control cables to the throttle body.

(6) Connect the fuel injector electrical connectors in the correct order.

(7) Refer to Fuel Tubes and Quick-Connect Fittings in this group for quick-connect fitting connection procedures and connect the black fuel supply tube to the fuel rail and the grey fuel return tube to the fuel pressure regulator accordingly.

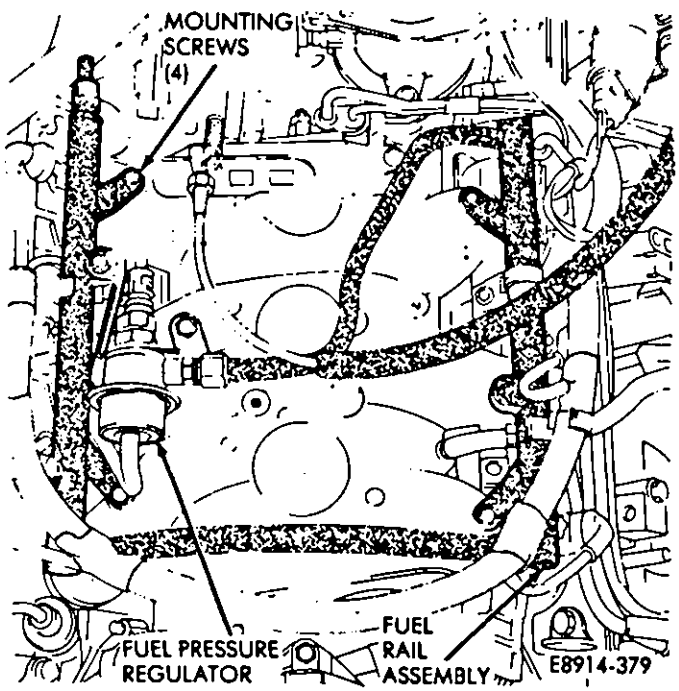


Fig. 18—Fuel Rail and Regulator Mounting Screws

(8) Connect vacuum hose to fuel pressure regulator.

(9) Connect the battery negative cable.

(10) Turn the key to the ON position to pressurize the fuel system and check for leaks.

FUEL INJECTOR

Removal

(1) Remove the fuel injector, fuel rail and regulator assembly. Refer to Fuel Injector/Fuel Rail/Regulator Assembly in this section.

(2) Remove clip holding fuel injector to fuel rail.

(3) Pull the injector out of the fuel rail (Fig. 19).

Installation

(1) Lubricate the injector O-ring with a drop of clean engine oil.

(2) Install fuel injector into fuel rail.

(3) Connect clip (Fig. 19).

(4) Install the fuel injector, fuel rail and regulator assembly. Refer to Fuel Injector/Fuel Rail/Regulator Assembly in this section.

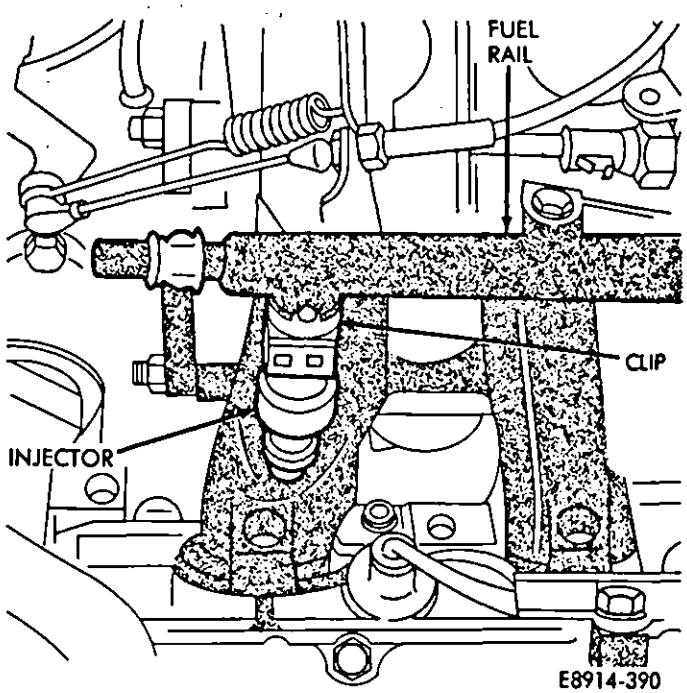


Fig. 19—Fuel Injector Removal/Installation

FUEL PRESSURE REGULATOR

CAUTION: When disconnecting the fuel return tube from the fuel pressure regulator, wrap shop towels around the quick-connect fitting to catch any fuel spillage that occurs when disconnecting the tube. Do not disconnect the fuel tubes on a hot engine.

Removal

(1) Disconnect fuel return tube from fuel pressure regulator using tool 6182 (Fig. 16). Slide the tool over the nipple and push the tool into the connector until it stops on the casing. Slowly pull the connector away.

(2) Disconnect vacuum hose from pressure regulator (Fig. 20).

(3) Unscrew line nut from the fitting at the side of the fuel pressure regulator (Fig. 20).

(4) Remove nipple fitting at the return side of the regulator.

(5) Remove locknut and washer. Remove the regulator.

Installation

(1) Install the fuel pressure regulator, washer, and locknut. Tighten the locknut.

(2) Refer to Fuel Tubes and Quick-Connect Fittings in this group for quick-connect fitting connection procedures and install the nipple fitting on the pressure regulator accordingly.

(3) Connect the fuel return line to the fuel pressure regulator. Push the connector over the nipple until a click is heard. Pull back on the connector to verify that the connector is locked in place.

(4) Connect the fuel hose at the side of the pressure regulator.

(5) Connect the vacuum hose to the rear of the regulator.

(6) Turn the key to the ON position and check for leaks.

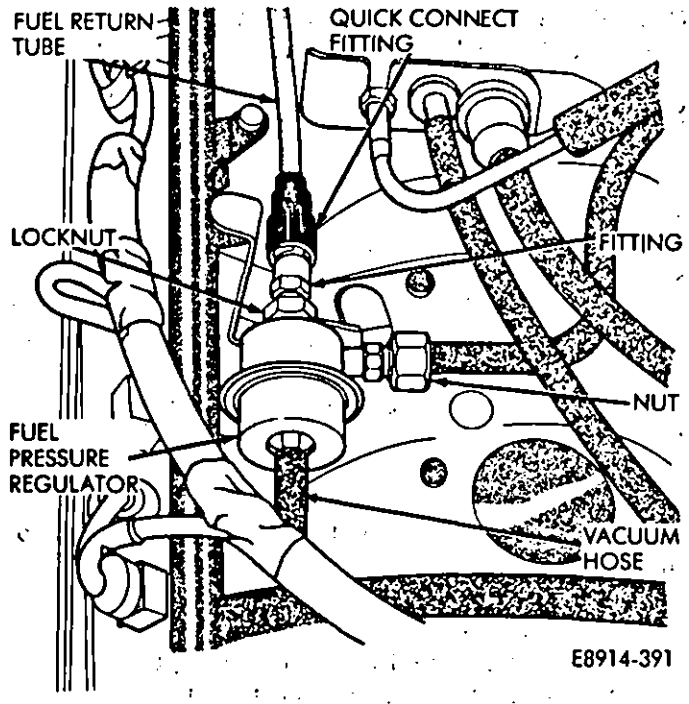


Fig. 20—MPI Fuel Pressure Regulator Removal/Installation

MPI SERVICE ADJUSTMENTS

THROTTLE POSITION SENSOR (TPS) ADJUSTMENT

Automatic Transmission

This throttle position sensor adjustment uses a high impedance digital voltmeter (such as C4845 or an equivalent). This adjustment can also be performed on the DRB II tester and is the preferred method. Refer to the tester manual.

(1) Turn the ignition key to the ON position.

(2) Do not unfasten the TPS wire harness connector (Fig. 21). Insert the voltmeter test leads through the back of the wire harness connector.

The TPS connector terminals are marked A, B, C.

(3) Check the TPS input voltage at the harness connector. Locate terminal B and insert the negative lead of the voltmeter into it. Insert the positive lead of the voltmeter to TPS terminal C.

(4) Note the sensor input voltage on the voltmeter (at terminal B and C).

(5) Check the TPS output voltage. Disconnect the voltmeter positive lead from sensor terminal C and connect it to sensor terminal A.

(6) Note the sensor output voltage on the voltmeter (at terminals B and A).

(7) Divide the output voltage by the input voltage. The resulting output ratio should be .075 to .085 (7.5 to 8.5).

EXAMPLE: If the input voltage is 5 volts and the output voltage is .4 volts; divide .4 by 5 (.4/5 = .08 or 8).

(8) If necessary, adjust the TPS sensor until the correct ratio is obtained. To adjust the voltage readings, loosen the sensor rear retaining screw and pivot the sensor for a fine adjustment. Loosen the sensor front retaining screw and pivot the sensor for a course adjustment (Fig. 21).

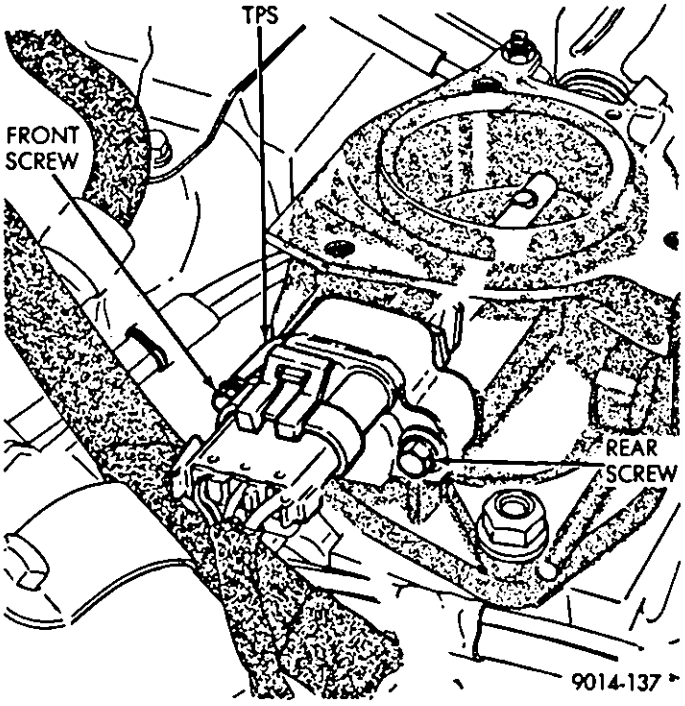


Fig. 21—TPS Adjustment