

FUEL SYSTEM

TABLE OF CONTENTS

	page		page
FUEL DELIVERY SYSTEM.....	1	FUEL INJECTION SYSTEM	21

FUEL DELIVERY SYSTEM

TABLE OF CONTENTS

	page		page
DESCRIPTION AND OPERATION		HOSES AND CLAMPS	7
FUEL DELIVERY SYSTEM.....	1	QUICK-CONNECT FITTINGS	7
FUEL PUMP MODULE	2	REMOVAL AND INSTALLATION	
ELECTRIC FUEL PUMP	2	AUTOMATIC SHUTDOWN RELAY	9
FUEL LEVEL SENSOR.....	2	FUEL PUMP RELAY.....	9
FUEL TANK	2	FUEL PUMP MODULE	9
FUEL INJECTORS	3	FUEL FILTER	11
FUEL PRESSURE REGULATOR	3	FUEL PRESSURE REGULATOR.....	11
PRESSURE-VACUUM FILLER CAP	3	FUEL PUMP INLET STRAINER	12
ONBOARD REFUELING VAPOR RECOVERY		FUEL LEVEL SENSOR.....	13
(ORVR).....	4	FUEL RAIL—2.0L	14
CONTROL VALVE	5	FUEL INJECTORS	15
QUICK-CONNECT FITTINGS	5	FUEL TANK	15
ROLLOVER VALVES	5	FUEL FILLER NECK.....	17
FUEL TUBES/LINES/HOSES AND CLAMPS	5	ACCELERATOR PEDAL	17
VEHICLE DOES NOT FILL.....	6	THROTTLE CABLE—2.0L	18
SERVICE PROCEDURES		SPECIFICATIONS	
FUEL SYSTEM PRESSURE RELEASE		TORQUE	19
PROCEDURE	6	FUEL TANK CAPACITY	19
FUEL PUMP REPLACEMENT.....	6	FUEL REQUIREMENTS	19
FUEL TANK DRAINING	6		

DESCRIPTION AND OPERATION

FUEL DELIVERY SYSTEM

DESCRIPTION

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

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

The fuel delivery system consists of:

- the fuel pump module containing the electric fuel pump, fuel filter/fuel pressure regulator, fuel

gauge sending unit (fuel level sensor) and a separate fuel filter located at bottom of pump module

- Fuel tubes/lines/hoses
- Quick-connect fittings
- Fuel injector rail
- Fuel injectors
- Fuel tank
- Fuel tank filler/vent tube assembly
- Fuel tank filler tube cap

The fuel delivery system contains a replaceable in-line filter. The filter attaches to the frame above the rear of the fuel tank.

DESCRIPTION AND OPERATION (Continued)

OPERATION

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

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

FUEL PUMP MODULE

DESCRIPTION

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

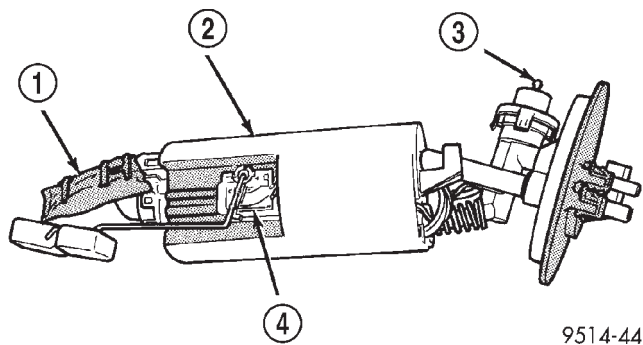


Fig. 1 Fuel Pump Module

- 1 - INLET STRAINER
- 2 - FUEL RESERVOIR
- 3 - FUEL PRESSURE REGULATOR
- 4 - FUEL LEVEL SENSOR

The fuel pump module contains the following:

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

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

ELECTRIC FUEL PUMP

DESCRIPTION

The electric fuel pump is located in and is part of the fuel pump module. It is a positive displacement, gerotor type, immersible pump with a permanent magnet electric motor. The fuel pump module is suspended in fuel in the fuel tank.

OPERATION

The pump draws fuel through a strainer and pushes it through the motor to the outlet. The pump contains a check valve. The valve, in the pump outlet, maintains pump pressure during engine off conditions. The fuel pump relay provides voltage to the fuel pump. The fuel pump has a maximum dead-headed pressure output of approximately 880 kPa (130 psi). The regulator adjusts fuel system pressure to approximately 338 kPa (49 psi).

FUEL PUMP ELECTRICAL CONTROL

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

FUEL LEVEL SENSOR

DESCRIPTION

The level sensor is attached to the side of the fuel pump module. The level sensor consists of a float, an arm, and a variable resistor.

OPERATION

As the fuel level increases, the float and arm move up. This decreases the sending unit resistance, causing the fuel gauge on the instrument panel to read full. The fuel level sensor (fuel gauge sending unit) sends a signal to the BCM and the BCM sends the signal over the PCI bus circuit to the PCM to indicate fuel level. The purpose of this feature is to prevent a false setting of misfire and fuel system monitor trouble codes if the fuel level is less than approximately 15 percent of its rated capacity. It is also used to send a signal for fuel gauge operation via the PCI bus circuits.

FUEL TANK

DESCRIPTION

The fuel tank is constructed of a plastic material. Its main functions are for fuel storage and for placement of the fuel pump module. The tank is made from High density Polyethylene (HDPE) material.

OPERATION

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

All models are equipped with either one or two rollover valves mounted into the top of the fuel tank (or pump module).

An evaporation control system is connected to the rollover valve(s) to reduce emissions of fuel vapors

DESCRIPTION AND OPERATION (Continued)

into the atmosphere. When fuel evaporates from the fuel tank, vapors pass through vent hoses or tubes to a charcoal canister where they are temporarily held. When the engine is running, the vapors are drawn into the intake manifold. Certain models are also equipped with a self-diagnosing system using a Leak Detection Pump (LDP). Refer to the Emission Control System for additional information.

FUEL INJECTORS

DESCRIPTION

The injectors are positioned in the intake manifold with the nozzle ends directly above the intake valve port (Fig. 2).

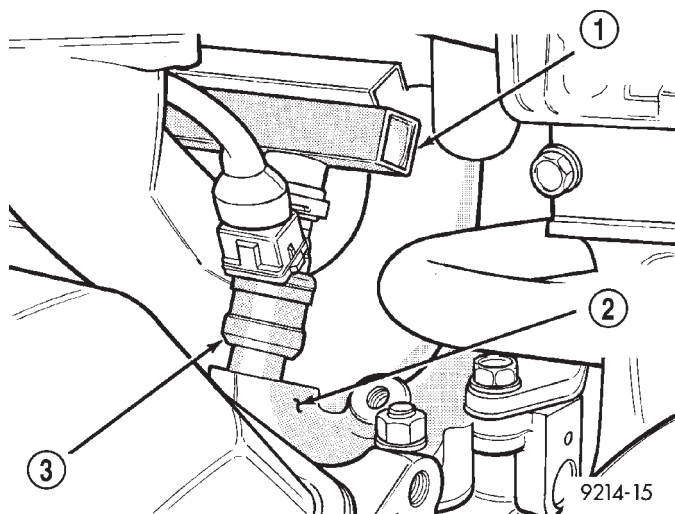


Fig. 2 Fuel Injector Location—Typical

- 1 – FUEL RAIL
- 2 – INTAKE MANIFOLD
- 3 – FUEL INJECTORS

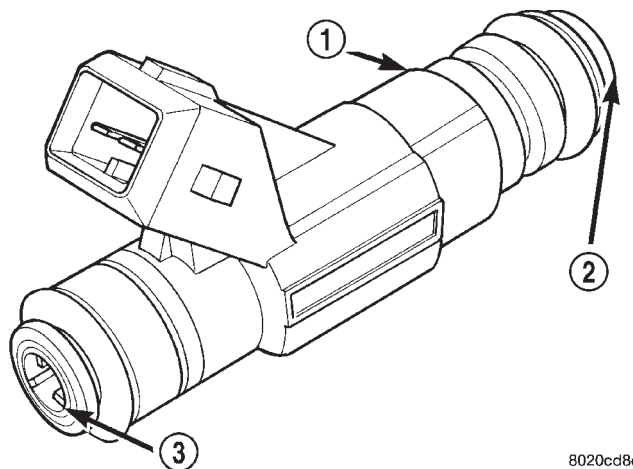
OPERATION

The fuel injectors are electrical solenoids (Fig. 3). The injector contains a pintle that closes off an orifice at the nozzle end. When electric current is supplied to the injector, the armature and needle move a short distance against a spring, allowing fuel to flow out the orifice. Because the fuel is under high pressure, a fine spray is developed in the shape of a hollow cone. The spraying action atomizes the fuel, adding it to the air entering the combustion chamber. Fuel injectors are not interchangeable between engines.

FUEL PRESSURE REGULATOR

DESCRIPTION

The fuel pressure regulator contains a diaphragm, calibrated spring and a fuel return valve. The regulator is mounted in the fuel pump module.



8020cd8e

Fig. 3 Fuel Injector

- 1 – FUEL INJECTOR
- 2 – NOZZLE
- 3 – TOP (FUEL ENTRY)

OPERATION

The fuel system uses a nonadjustable pressure regulator that maintains fuel system pressure at approximately 338 kPa (49 psi). The spring pushes down on the diaphragm and closes off the fuel return port. System fuel pressure reflects the amount of fuel pressure required to open the return port.

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

PRESSURE-VACUUM FILLER CAP

DESCRIPTION

The plastic fuel fill cap is threaded/quarter turn onto the end of the fuel filler tube. Its purpose is to retain vapors and fuel in the fuel tank.

OPERATION

The loss of any fuel or vapor out of the filler tube neck is prevented by the use of a safety filler cap. The cap releases only under significant pressure 17 kPa (2.5 psi). The vacuum release for all gas caps is between 2.0 and 3.0 kPa (.29 and .43 psi). The cap must be replaced by a similar unit in order for the system to remain effective.

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

NOTE: THE MALFUNCTION INDICATOR LAMP COULD BE TURNED ON IF THE FUEL FILLER CAP IS LOOSE OR MISSING.

DESCRIPTION AND OPERATION (Continued)

ONBOARD REFUELING VAPOR RECOVERY (ORVR)**DESCRIPTION**

ORVR System Schematic and components.

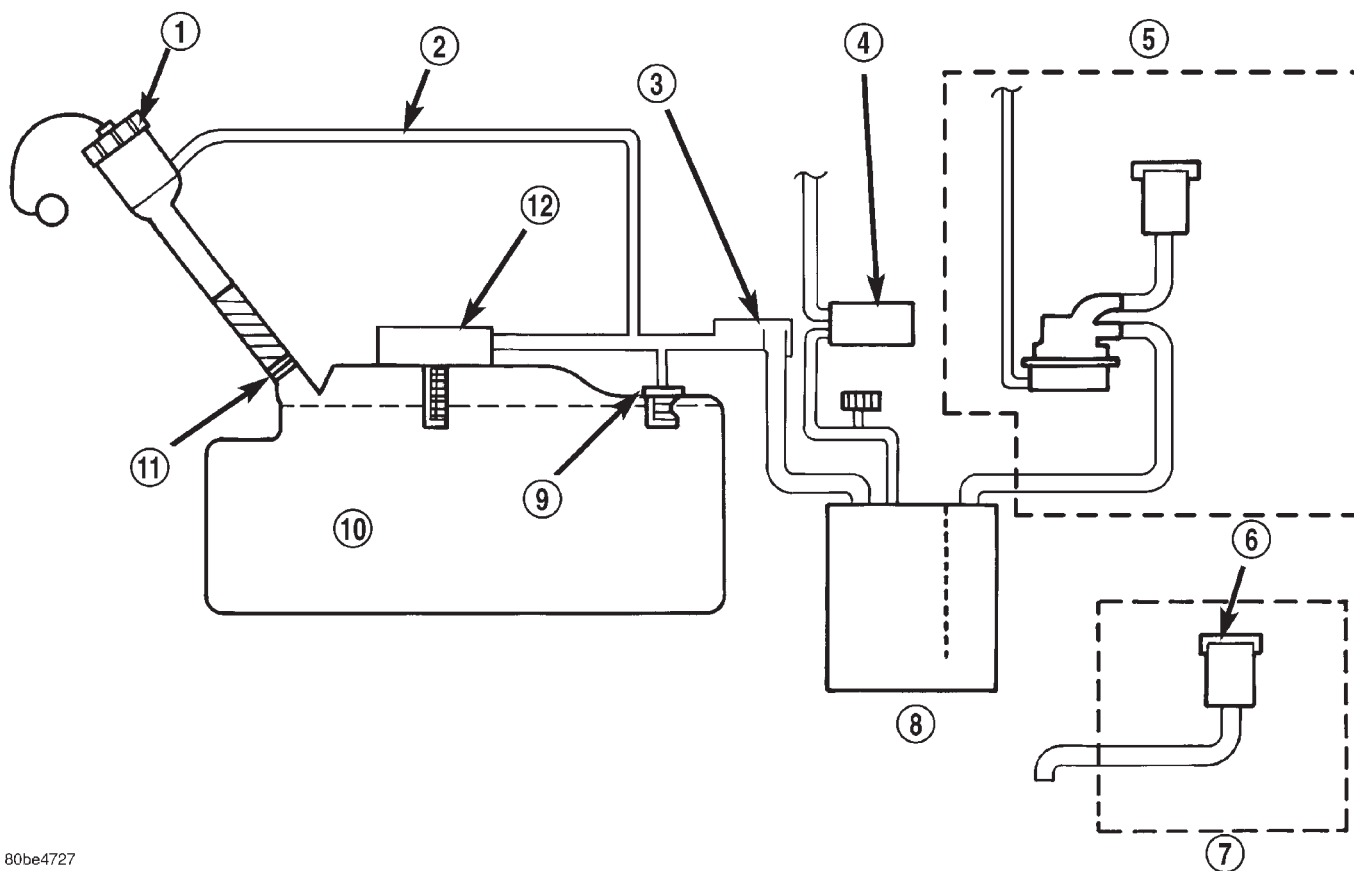
OPERATION

The emission control principle used in the ORVR system is that the fuel flowing into the filler tube (appx. 1" I.D.) creates an aspiration effect which draws air into the fill tube (Fig. 4). During refueling, the fuel tank is vented to the vapor canister to capture escaping vapors. With air flowing into the filler tube, there are no fuel vapors escaping to the atmosphere. Once the refueling vapors are captured by the canister, the vehicle's computer controlled purge system draws vapor out of the canister for the engine to burn. The vapors flow is metered by the purge

solenoid so that there is no or minimal impact on driveability or tailpipe emissions.

As fuel starts to flow through the fill tube, it opens the normally closed check valve and enters the fuel tank. Vapor or air is expelled from the tank through the control valve to the vapor canister. Vapor is absorbed in the canister until vapor flow in the lines stops, either following shut-off or by having the fuel level in the tank rise high enough to close the control valve. The control valve contains a float that rises to seal the large diameter vent path to the canister. At this point in the fueling of the vehicle, the tank pressure increase, the check valve closes (preventing tank fuel from spitting back at the operator), and fuel then rises up the filler tube to shut-off the dispensing nozzle.

If the engine is shut-off while the On-Board diagnostics test is running, low level tank pressure can be trapped in the fuel tank and fuel can not be added



80be4727

Fig. 4 ORVR System Schematic

- 1 - FUEL CAP
- 2 - RECIRCULATION TUBE
- 3 - LIQUID SEPARATOR
- 4 - PURGE
- 5 - W/LDP
- 6 - BREATHER ELEMENT

- 7 - W/O LDP
- 8 - CANISTER
- 9 - ROLLOVER VALVE
- 10 - FUEL TANK
- 11 - CHECK VALVE
- 12 - CONTROL VALVE

DESCRIPTION AND OPERATION (Continued)

to the tank until the pressure is relieved. This is due to the leak detection pump closing the vapor outlet from the top of the tank and the one-way check valve not allowing the tank to vent through the fill tube to atmosphere. Therefore, when fuel is added, it will back-up in the fill tube and shut off the dispensing nozzle. The pressure can be eliminated in two ways: 1. Vehicle purge must be activated and for a long enough period to eliminate the pressure. 2. Removing the fuel cap and allowing enough time for the system to vent thru the recirculation tube.

CONTROL VALVE

DESCRIPTION

It is a valve in the top of the fuel tank that controls fuel fill rate and fuel fill level and directs fuel vapors to a storage area.

OPERATION

The valve controls the fuel fill rate and set the fuel level in the fuel tank. It also allows the proper operation of OBDII leak detection monitor. It prevent liquid fuel carry over into the EVAP system (Fig. 4).

QUICK-CONNECT FITTINGS

DESCRIPTION

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

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

Fuel tubes connect fuel system components with plastic quick-connect fuel fittings. The fitting contains non-serviceable O-ring seals (Fig. 5).

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

OPERATION

The quick-connect fitting consists of the O-rings, retainer and casing (Fig. 5). When the fuel tube enters the fitting, the retainer locks the shoulder of the nipple in place and the O-rings seal the tube.

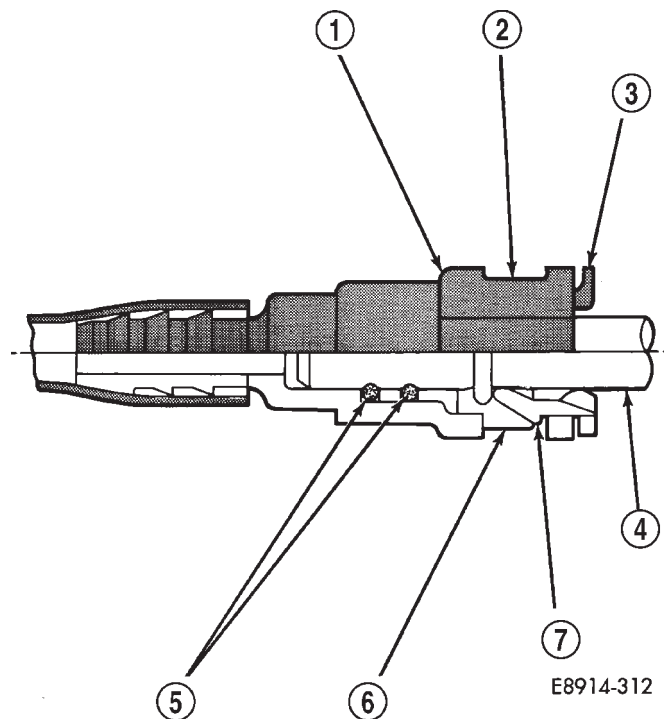


Fig. 5 Typical Plastic Quick-Connect Fittings

- 1 - CASING
- 2 - WINDOW
- 3 - RETAINER TAB
- 4 - NIPPLE
- 5 - O RINGS
- 6 - WINDOW
- 7 - RETAINER "EAR"

ROLLOVER VALVES

DESCRIPTION

All vehicles have rollover valve(s) on top of the fuel tank.

OPERATION

The valves prevent fuel flow through the fuel tank vent valve hoses should the vehicle rollover.

The rollover valves on the fuel tank are not serviceable.

FUEL TUBES/LINES/HOSES AND CLAMPS

DESCRIPTION

Also refer to Quick-Connect Fittings.

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

DESCRIPTION AND OPERATION (Continued)

The lines/tubes/hoses used on fuel injected vehicles are of a special construction. This is due to the higher fuel pressures and the possibility of contaminated fuel in this system. If it is necessary to replace these lines/tubes/hoses, only those marked EFM/EFI may be used.

If equipped: The hose clamps used to secure rubber hoses on fuel injected vehicles are of a special rolled edge construction. This construction is used to prevent the edge of the clamp from cutting into the hose. Only these rolled edge type clamps may be used in this system. All other types of clamps may cut into the hoses and cause high-pressure fuel leaks.

Use new original equipment type hose clamps.

VEHICLE DOES NOT FILL

Pre-Mature Nozzle Shut-Off.	Defective fuel tank assembly components.	Fill tube improperly installed (sump).
		Fill tube hose pinched.
		Check valve stuck shut.
		Control valve stuck shut.
	Defective vapor/vent components.	Vent line from control valve to canister pinched
		Vent line from canister to vent filter pinched.
		Canister vent valve failure (Requires double failure, plugged to LDP and atmosphere).
		Leak detection pump failed closed.
	On-Board diagnostics evaporative system leak test just conducted.	Leak detection pump filter plugged.
		Canister vent valve vent plugged to atmosphere.
Fuel Spits Out Of Filler Tube.	Defective fill nozzle.	Engine still running when attempting to fill (System designed not to fill).
	During fill.	See Pre-Mature Shut-Off
		Defective fuel handling component. (Check valve stuck open).
		Defective vapor/vent handling component
	At conclusion of fill.	Defective fill nozzle

SERVICE PROCEDURES

FUEL SYSTEM PRESSURE RELEASE PROCEDURE

(1) Remove Fuel Pump relay from Power Distribution Center (PDC). For location of relay, refer to label on underside of PDC cover.

(2) Start and run engine until it stalls.

(3) Attempt restarting engine until it will no longer run.

(4) Turn ignition key to OFF position.

CAUTION: Steps 1, 2, 3 and 4 must be performed to relieve high pressure fuel from within fuel rail. Do

not attempt to use following steps to relieve this pressure as excessive fuel will be forced into a cylinder chamber.

(5) Place a rag or towel below fuel line quick-connect fitting at fuel rail.

(6) Return fuel pump relay to PDC.

(7) One or more Diagnostic Trouble Codes (DTC's) may have been stored in PCM memory due to fuel pump relay removal. The DRB III® scan tool must be used to erase a DTC.

FUEL PUMP REPLACEMENT

The electric fuel pump is not serviceable. If the fuel pump or electrical wiring harness needs replacement, the complete fuel pump module must be

replaced. Perform the Fuel System Pressure Release procedure before servicing the fuel pump.

FUEL TANK DRAINING

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

(2) With vehicle on a hoist, drain fuel from tank.

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

CAUTION: Use a Back-Up wrench on tank to remove drain plug.

SERVICE PROCEDURES (Continued)

- (4) Remove drain plug and allow fuel to drain (Fig. 6).

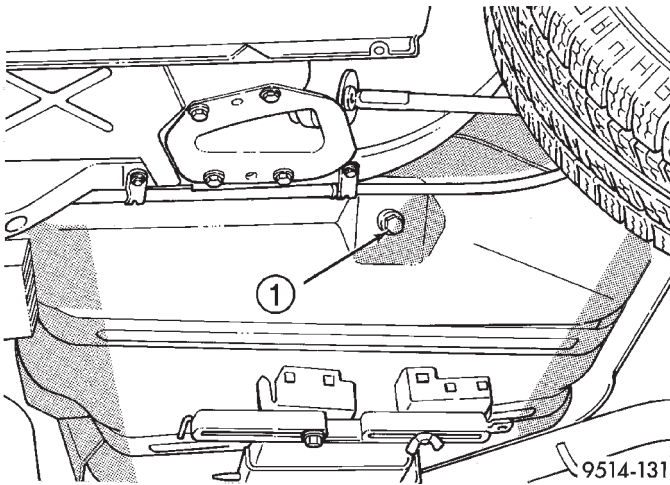


Fig. 6 Fuel Tank Drain Plug

1 – FUEL TANK DRAIN PLUG

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

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

HOSES AND CLAMPS

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

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

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

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

Inspect all hose connections such as clamps, couplings and fittings to make sure they are secure and leaks are not present. The component should be replaced immediately if there is any evidence of degradation that could result in failure.

Never attempt to repair a plastic fuel line/tube. Replace as necessary.

Avoid contact of any fuel tubes/hoses with other vehicle components that could cause abrasions or scuffing. Be sure that the plastic fuel lines/tubes are properly routed to prevent pinching and to avoid heat sources.

QUICK-CONNECT FITTINGS

REMOVAL

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

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

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

- (2) Disconnect negative cable from battery or auxiliary jumper terminal.

- (3) Squeeze retainer tabs together and pull fuel tube/quick-connect fitting assembly off of fuel tube nipple. The retainer will remain on fuel tube.

INSTALLATION

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

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

- (2) Prior to connecting the fitting to the fuel tube, coat the fuel tube nipple with clean 30 weight engine oil.

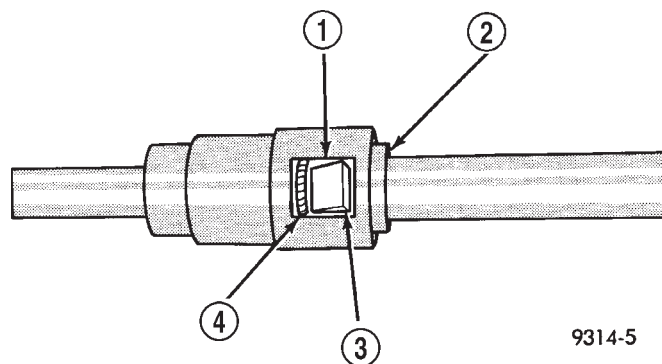
- (3) Push the quick-connect fitting over the fuel tube until the **retainer seats and a click is heard**.

- (4) The plastic quick-connect fitting has windows in the sides of the casing. When the fitting completely attaches to the fuel tube, the retainer locking ears and the fuel tube shoulder are visible in the windows. If they are not visible, the retainer was not properly installed (Fig. 7). **Do not rely upon the audible click to confirm a secure connection.**

- (5) Connect negative cable to battery or auxiliary jumper terminal.

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

SERVICE PROCEDURES (Continued)



9314-5

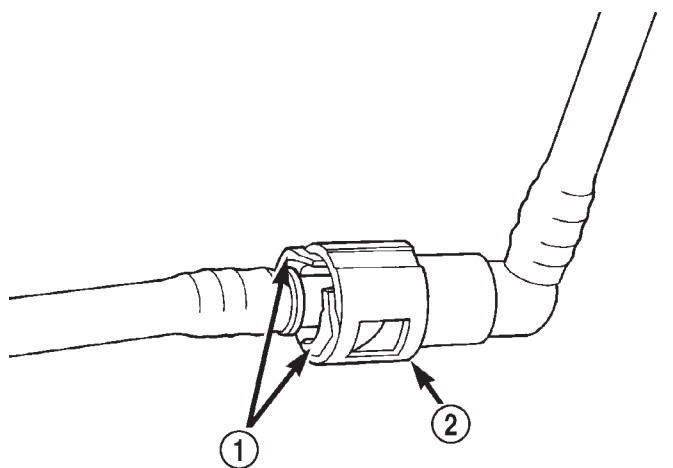
Fig. 7 Plastic Quick-Connect Fitting/Fuel Tube Connection

- 1 - WINDOW
- 2 - TAB (2)
- 3 - EAR
- 4 - SHOULDER (ON TUBE)

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

TWO-TAB TYPE FITTING

This type of fitting is equipped with tabs located on both sides of the fitting (Fig. 8). These tabs are supplied for disconnecting the quick-connect fitting from component being serviced.



80a35405

Fig. 8 Typical Two-Tab Type Quick-Connect Fitting

- 1 - TAB(S)
- 2 - QUICK-CONNECT FITTING

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

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

DISCONNECTION/CONNECTION

(1) Perform fuel pressure release procedure. Refer to Fuel Pressure Release Procedure in this group.

(2) Disconnect negative battery cable from battery or auxiliary jumper terminal.

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

(4) To disconnect quick-connect fitting, squeeze plastic retainer tabs (Fig. 8) against sides of quick-connect fitting with your fingers. Tool use is not required for removal and may damage plastic retainer. Pull fitting from fuel system component being serviced. The plastic retainer will remain on component being serviced after fitting is disconnected. The O-rings and spacer will remain in quick-connect fitting connector body.

(5) Inspect quick-connect fitting body and component for damage. Replace as necessary.

CAUTION: When the quick-connect fitting was disconnected, the plastic retainer will remain on the component being serviced. If this retainer must be removed, very carefully release the retainer from the component with two small screwdrivers. After removal, inspect the retainer for cracks or any damage.

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

(7) Insert quick-connect fitting to component being serviced and into plastic retainer. When a connection is made, a click will be heard.

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

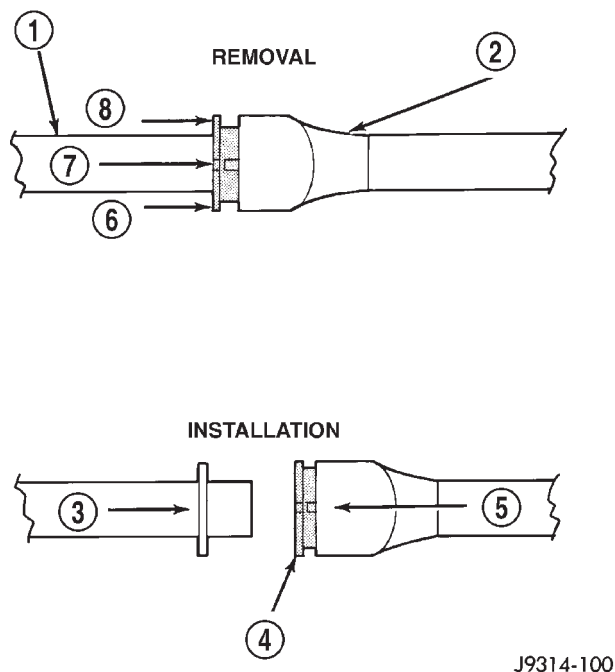
(9) Connect negative cable to battery or auxiliary jumper terminal.

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

PLASTIC RETAINER RING TYPE FITTING

This type of fitting can be identified by the use of a full-round plastic retainer ring (Fig. 9) usually black in color.

SERVICE PROCEDURES (Continued)

**Fig. 9 Plastic Retainer Ring Type Fitting**

- 1 - FUEL TUBE
- 2 - QUICK CONNECT FITTING
- 3 - PUSH
- 4 - PLASTIC RETAINER
- 5 - PUSH
- 6 - PUSH
- 7 - PUSH
- 8 - PUSH

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

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

DISCONNECTION/CONNECTION

- (1) Perform fuel pressure release procedure. Refer to Fuel Pressure Release Procedure in this section.
- (2) Disconnect negative battery cable from battery or auxiliary jumper terminal.
- (3) Clean fitting of any foreign material before disassembly.
- (4) To release fuel system component from quick-connect fitting, firmly push fitting towards compo-

nent being serviced while firmly pushing plastic retainer ring into fitting (Fig. 9). With plastic ring depressed, pull fitting from component. **The plastic retainer ring must be pressed squarely into fitting body. If this retainer is cocked during removal, it may be difficult to disconnect fitting. Use an open-end wrench on shoulder of plastic retainer ring to aid in disconnection.**

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

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

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

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

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

(10) Connect negative battery cable to battery or auxiliary jumper terminal.

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

REMOVAL AND INSTALLATION**AUTOMATIC SHUTDOWN RELAY**

The relay is located in the Power Distribution Center (PDC) (Fig. 10). For the location of the relay within the PDC, refer to the PDC cover for location. Check electrical terminals for corrosion and repair as necessary.

FUEL PUMP RELAY

The fuel pump relay is located in the PDC (Fig. 10). The inside top of the PDC cover has a label showing relay and fuse location.

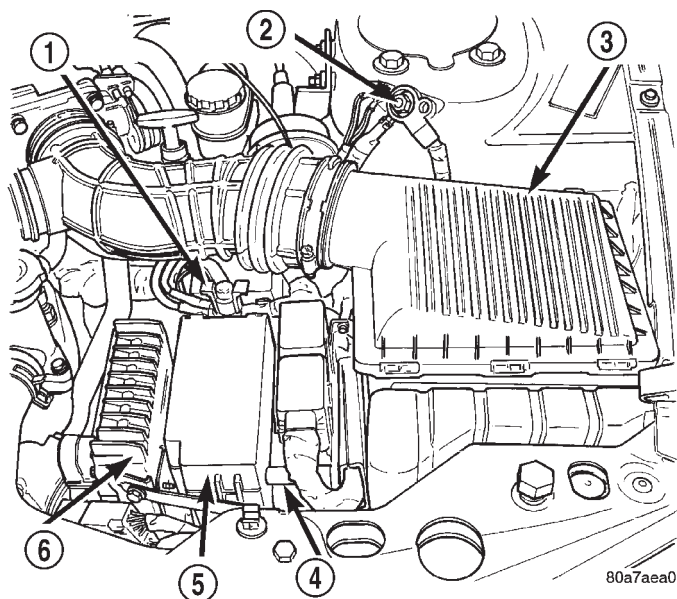
FUEL PUMP MODULE

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

REMOVAL

- (1) Remove fuel filler cap and perform Fuel System Pressure Release procedure.
- (2) Disconnect negative cable from auxiliary jumper terminal.
- (3) Remove fuel tank, refer to the Fuel Tank removal section.

REMOVAL AND INSTALLATION (Continued)

**Fig. 10 Power Distribution Center (PDC)**

- 1 - BATTERY POSITIVE
- 2 - BATTERY GROUND
- 3 - AIR CLEANER
- 4 - PCM
- 5 - PDC
- 6 - TCM

(4) Disconnect fuel filter lines from fuel pump module.

(5) Clean top of tank to remove loose dirt and debris.

(6) Using Special Tool #6856 Fuel Pump Module Ring Spanner, remove locknut to release pump module (Fig. 11).

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

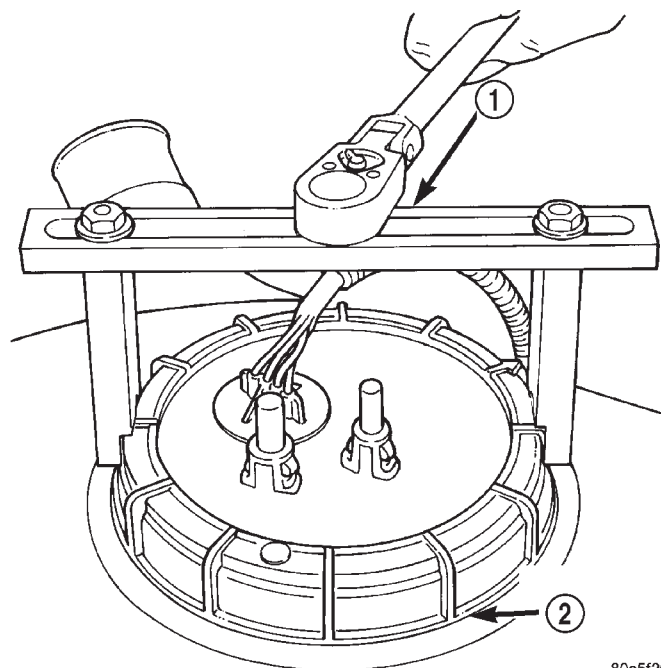
(7) Remove fuel pump module and O-ring from tank (Fig. 12). Discard O-ring.

INSTALLATION

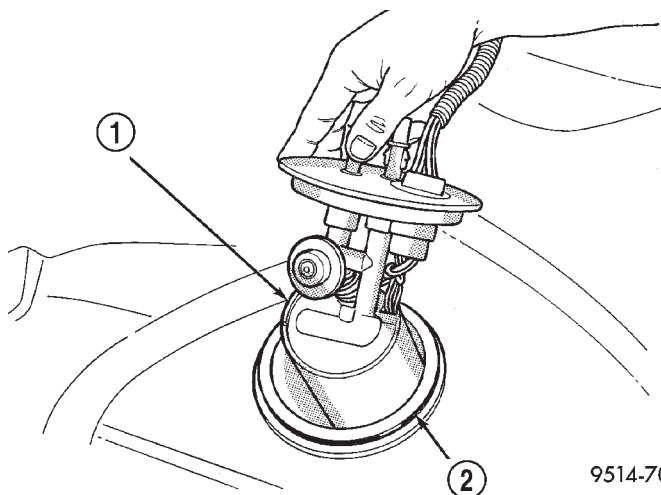
(1) Wipe seal area of tank clean. Place a new O-ring on the ledge between the tank threads and the pump module opening.

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

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

**Fig. 11 Fuel Pump Module Locknut**

- 1 - SPECIAL TOOL 6856
- 2 - FUEL PUMP MODULE LOCK RING

**Fig. 12 Fuel Pump Module Removal**

- 1 - FUEL PUMP MODULE
- 2 - O-RING

(3) While holding the pump module in position, install locknut. Tighten locknut to 74.5 N·m (55 ft. lbs) torque using special tool #6856.

(4) Install fuel tank and fuel filter, refer to the Fuel Tank installation section.

(5) Install negative cable to auxiliary jumper terminal.

(6) Fill fuel tank with clean fuel. Use the DRB scan tool to pressurize the system and check for leaks.

REMOVAL AND INSTALLATION (Continued)

FUEL FILTER

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

REMOVAL

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

- (1) Remove rear seat.
- (2) Disconnect fuel pump electrical connector. Push grommet out and feed jumper completely through hole in body.
- (3) Remove fuel cap slowly to release tank pressure.
- (4) With vehicle on a hoist, drain fuel from tank. Refer to Fuel Tank Draining in this section.
- (5) Remove driver's side fuel tank strap. Loosen, do not remove, passenger side fuel tank strap allowing fuel tank fill neck to touch rear suspension cross-member.

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

- (6) Disconnect fuel lines from fuel pump module (Fig. 13). These are quick connect fittings. Refer to Quick Connect Fittings in this section.

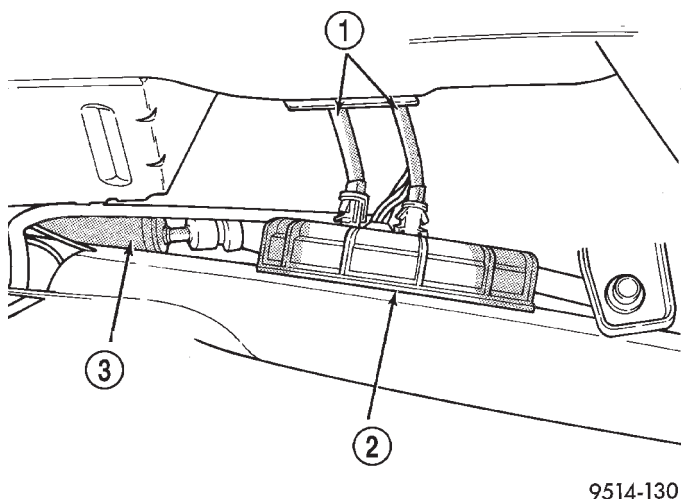


Fig. 13 Fuel Lines at Fuel Pump Module

- 1 - FUEL LINES
- 2 - FUEL PUMP MODULE LOCK RING
- 3 - FUEL FILTER

- (7) Disconnect fuel supply line from the fuel brake module.

- (8) Remove fuel filter (Fig. 14).

INSTALLATION

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

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

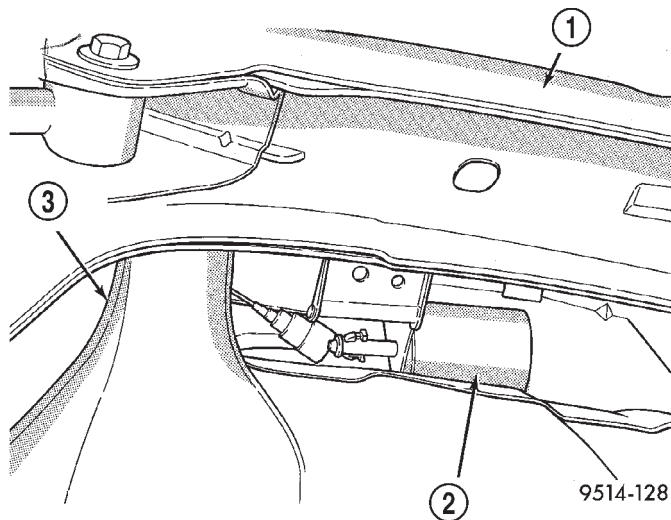


Fig. 14 Fuel Filter

- 1 - REAR CROSSMEMBER
- 2 - FUEL FILTER
- 3 - FUEL FILL NECK

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

- (3) Lower vehicle and connect pump module connector.

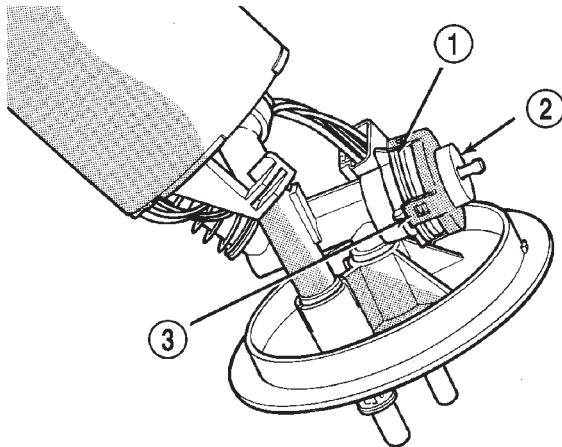
- (4) Install rear seat.
- (5) Fill tank with fuel.
- (6) Connect negative cable to auxiliary jumper terminal.

- (7) Use the DRB scan tool ASD Fuel system test to pressurize the the fuel system. Check for leaks.

FUEL PRESSURE REGULATOR

The fuel pressure regulator is part of the fuel pump module (Fig. 15). Remove the fuel pump module from the fuel tank to access the fuel pressure regulator. Refer to the Fuel Pump Module removal in this section.

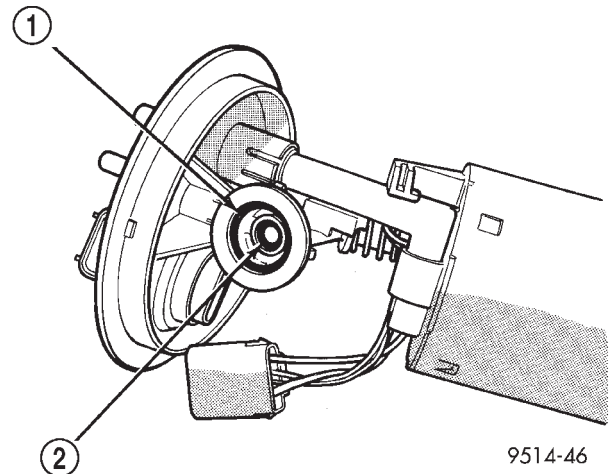
REMOVAL AND INSTALLATION (Continued)



9514-45

Fig. 15 Fuel Pressure Regulator

- 1 - PRY BETWEEN REGULATOR AND HOUSING
- 2 - FUEL PRESSURE REGULATOR
- 3 - TABS (4)



9514-46

Fig. 16 Fuel Pressure Regulator O-rings

- 1 - UPPER O-RING
- 2 - LOWER O-RING

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

REMOVAL

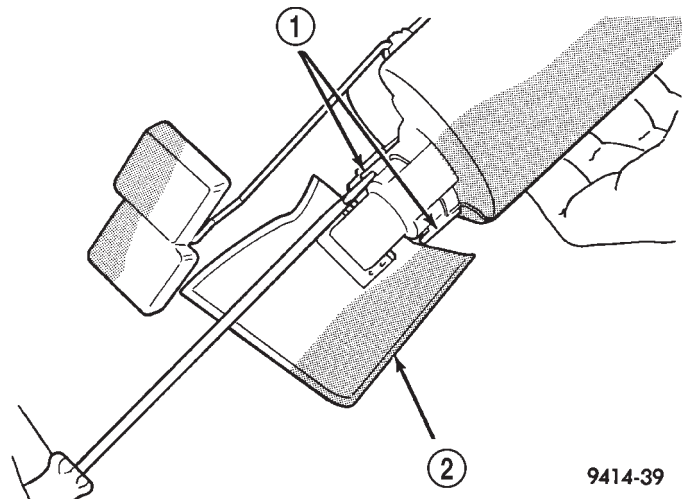
- (1) Spread tangs on pressure regulator retainer (Fig. 15).
- (2) Pry fuel pressure regulator out of housing.
- (3) Ensure both upper and lower O-rings were removed with regulator.

INSTALLATION

- (1) Lightly lubricate the O-rings with clean engine oil and place them into opening in pump module (Fig. 16).
- (2) Push regulator into opening in pump module.
- (3) Fold tangs on regulator retainer over tabs on housing.
- (4) Install Fuel Pump Module, refer to the Fuel Pump Module installation in this section.

FUEL PUMP INLET STRAINER**REMOVAL**

- (1) Remove fuel pump module. Refer to Fuel Pump Module Removal in this section.
- (2) Using a thin straight blade screwdriver, carefully pry back the locking tabs on fuel pump reservoir and remove the strainer (Fig. 17).
- (3) Remove strainer O-ring from the fuel pump reservoir body.
- (4) Remove any contaminants by washing the inside of the fuel tank.



9414-39

Fig. 17 Inlet Strainer Removal

- 1 - TABS
- 2 - INLET STRAINER

INSTALLATION

- (1) Lubricate the strainer O-ring with clean motor oil.
- (2) Insert strainer O-ring into outlet of strainer so that it sits evenly on the step inside the outlet.
- (3) Push strainer onto the inlet of the fuel pump reservoir body. Make sure the locking tabs on the reservoir body lock over the locking tangs on the strainer.
- (4) Install fuel pump module. Refer to Fuel Pump Module Installation in this section.

REMOVAL AND INSTALLATION (Continued)

FUEL LEVEL SENSOR

REMOVAL

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

(1) Depress retaining tab and remove the fuel pump/level sensor connector from the **BOTTOM** of the fuel pump module electrical connector (Fig. 18).

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

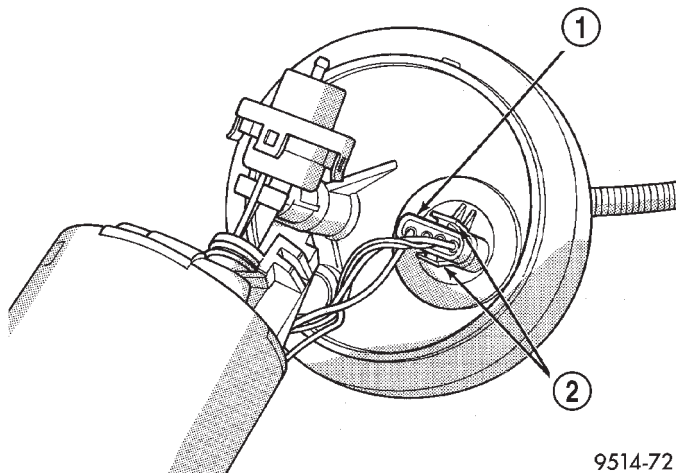


Fig. 18 Fuel Pump/Level Sensor Electrical Connector

- 1 – ELECTRICAL CONNECTOR
2 – RETAINING TABS

(2) Using Special Tool C-4334 terminal remover or equivalent, remove terminals from level sensor connector (Fig. 19).

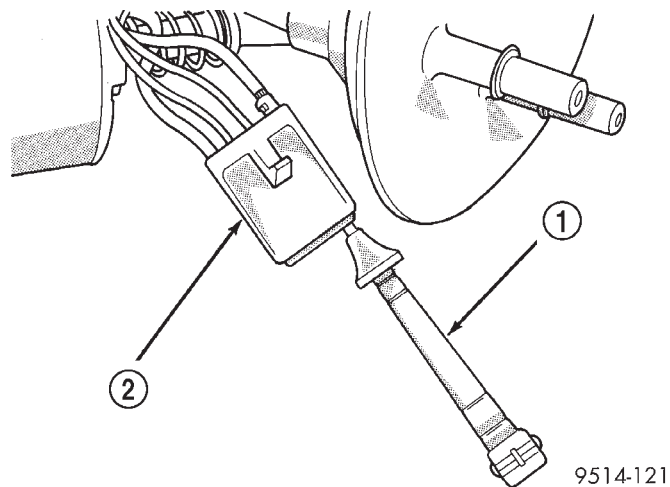


Fig. 19 Terminal Removal Tool

- 1 – TERMINAL REMOVAL TOOL
2 – FUEL LEVEL SENSOR CONNECTOR

(3) Insert a screwdriver between the fuel pump module and the top of the level sensor housing (Fig. 20). Push level sensor down slightly.

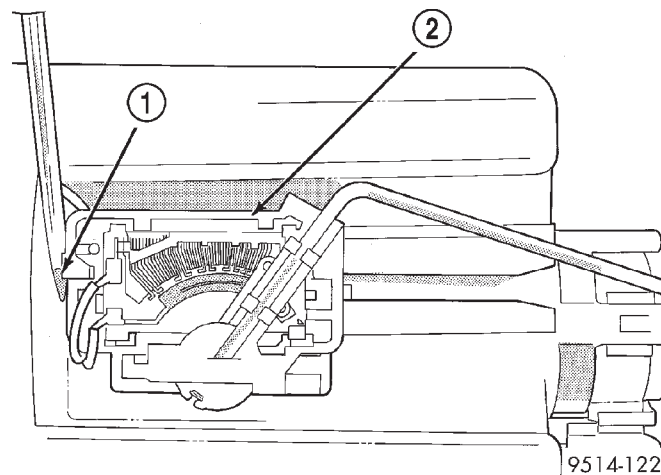


Fig. 20 Loosening Level Sensor

- 1 – PRY AGAINST LEVEL SENSOR
2 – LEVEL SENSOR

(4) Slide level sensor wires through opening fuel pump module (Fig. 21).

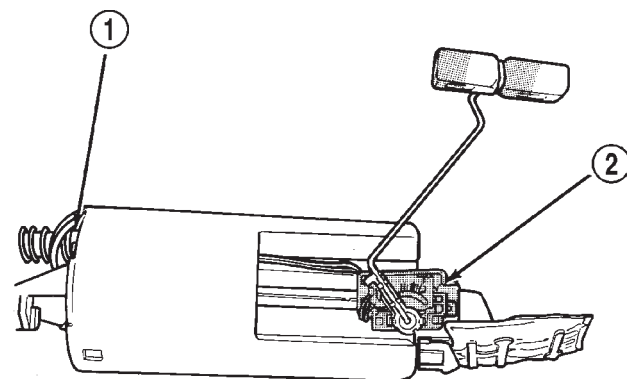


Fig. 21 Level Sensor Removal/Installation

- 1 – OPENING IN MODULE
2 – FUEL LEVEL SENSOR

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

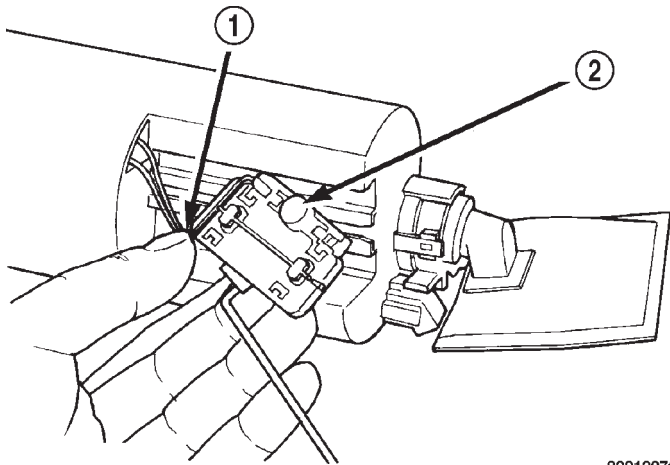
INSTALLATION

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

(2) Wrap wires into groove in back of level sensor (Fig. 22).

(3) While feeding wires into guide grooves, slide level sensor up into channel until it snaps into place (Fig. 23). Ensure tab at bottom of sensor locks in place.

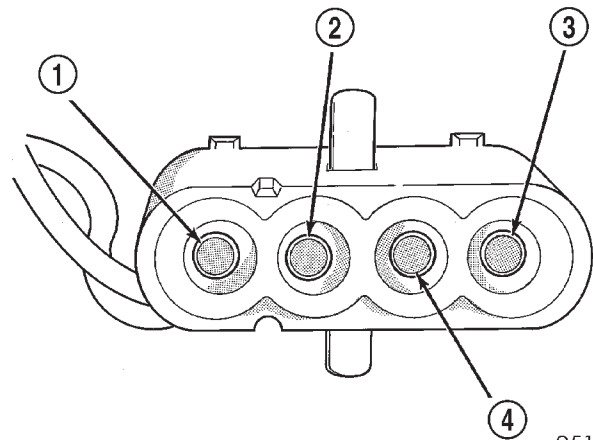
REMOVAL AND INSTALLATION (Continued)



80010971

Fig. 22 Groove in Back Side of Level Sensor

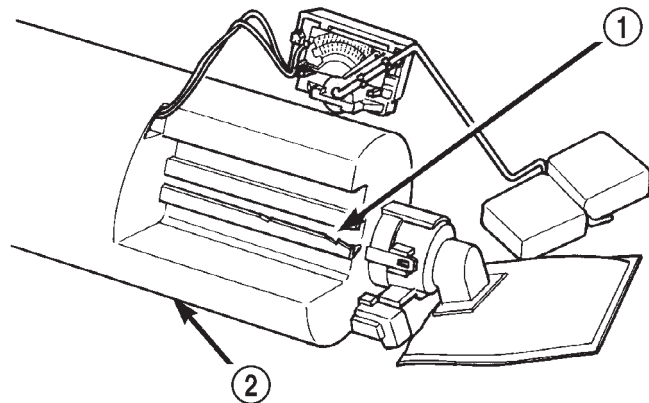
- 1 - WRAP WIRES IN GROOVE
2 - REAR VIEW OF LEVEL SENSOR



9514-125

Fig. 24 Fuel/Pump/Level Sensor Electrical Connector

- 1 - PUMP GROUND
2 - LEVEL SENSOR GROUND
3 - FUEL PUMP SUPPLY
4 - LEVEL SENSOR SIGNAL



80010980

Fig. 23 Installation Channel

- 1 - CHANNEL FOR LEVEL SENSOR
2 - PUMP MODULE

(4) Install level sensor wires in connector. Push the wires up through the connector and then pull them down until they lock in place. Ensure signal and ground wires are installed in the correct position (Fig. 24).

(5) Install locking wedge on connector.

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

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

FUEL RAIL—2.0L**REMOVAL**

(1) Disconnect negative cable from auxiliary jumper terminal.

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

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

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

(3) Disconnect fuel supply tube from rail. Refer to Quick-Connect Fittings in this section.

(4) Disconnect electrical connectors from fuel injectors (Fig. 25).

(5) Remove fuel rail mounting screws.

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

(7) Remove injectors.

INSTALLATION

(1) Install injectors.

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

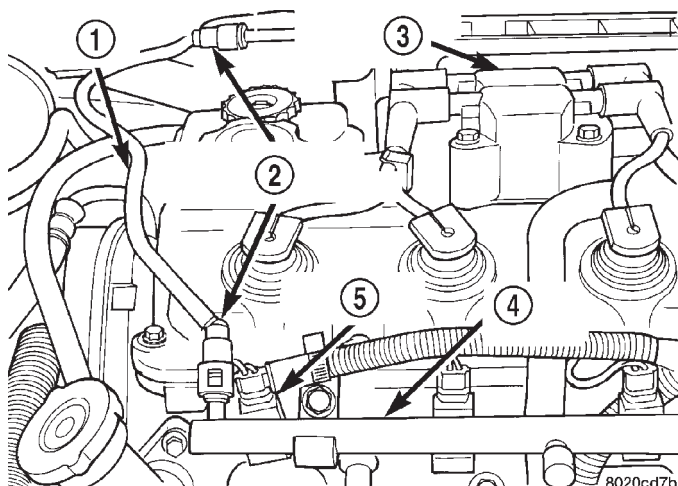
(3) Insert fuel injector nozzles into openings in intake manifold. Seat the injectors in place. Tighten fuel rail mounting screws to $22.5 \text{ N}\cdot\text{m} \pm 3 \text{ N}\cdot\text{m}$ ($200 \pm 30 \text{ in. lbs.}$).

(4) Attach electrical connectors to fuel injectors.

(5) Connect fuel supply tube to fuel rail. Refer to Quick Connect Fittings in this section.

(6) Connect negative cable to auxiliary jumper terminal.

REMOVAL AND INSTALLATION (Continued)

**Fig. 25 Fuel Rail and Injectors**

- 1 - FUEL SUPPLY LINE
- 2 - FUEL LINE QUICK-CONNECTS
- 3 - IGNITION COIL
- 4 - FUEL RAIL
- 5 - FUEL INJECTOR

(7) Use the DRB scan tool ASD Fuel system test to pressurize the the fuel system. Check for leaks.

FUEL INJECTORS**REMOVAL**

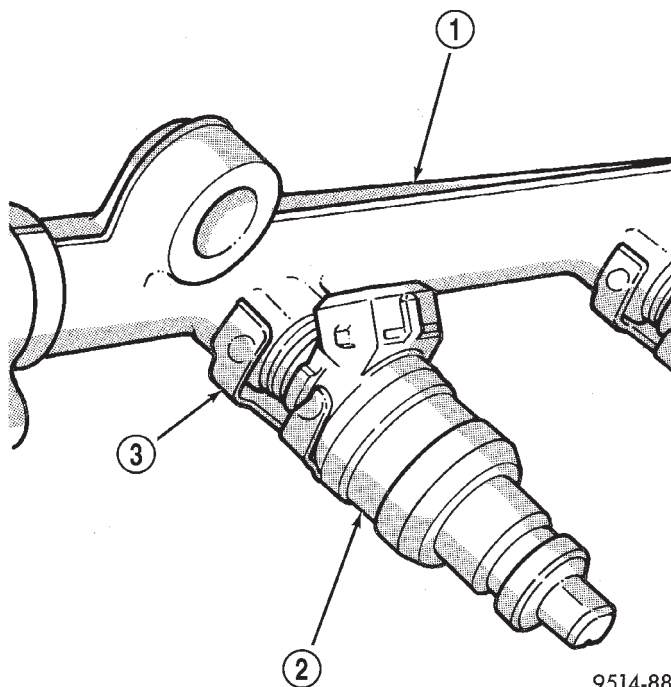
- (1) Remove the negative battery cable.
- (2) Remove fuel rail. Refer to appropriate Fuel Rail Removal in this section.
- (3) Remove fuel injector (Fig. 26).
- (4) Pull injector out of fuel rail. Replace fuel injector O-rings.

INSTALLATION

- (1) Install injector to fuel rail.
- (2) Install fuel injector clip.
- (3) Install fuel rail refer to the Fuel Rail installation in this section.
- (4) Install the negative battery cable.
- (5) Use the DRB scan tool ASD Fuel system test to pressurize the the fuel system. Check for leaks.

FUEL TANK

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

**Fig. 26 Fuel Injector Clip—2.5L Engine**

- 1 - FUEL RAIL
- 2 - FUEL INJECTOR
- 3 - INJECTOR CLIP

REMOVAL

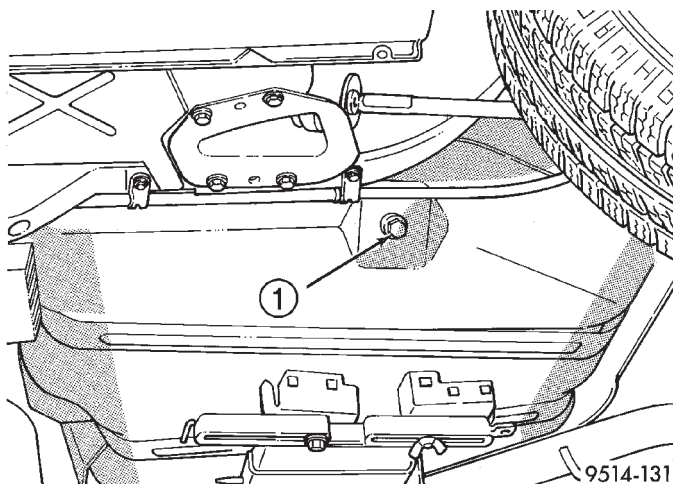
- (1) Release fuel system pressure. Refer to Fuel Pressure Release Procedure in this section.
- (2) Disconnect negative cable from auxiliary jumper terminal.
- (3) Remove lower rear seat cushion, disconnect pump wiring jumper from main body harness. Locate body grommet for jumper near base of rear seat. Push grommet out and feed jumper completely through hole in body.
- (4) Remove fuel cap slowly to release tank pressure.
- (5) With vehicle on a hoist, drain fuel from tank. Support fuel tank with a support such as a transmission jack stand.
- (6) Position a fuel approved container, with a capacity of at least 16 gallons, under the drain plug located on the bottom left edge of the tank.

CAUTION: Use a Back-Up wrench on tank to remove drain plug.

- (7) Remove drain plug and allow fuel to drain (Fig. 27).

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

REMOVAL AND INSTALLATION (Continued)

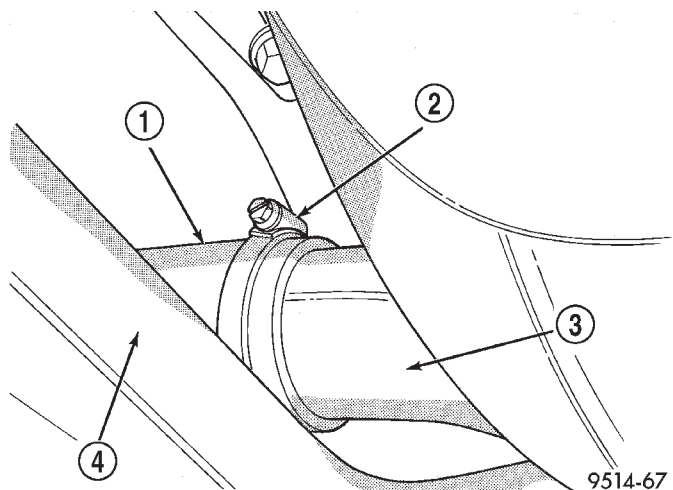
**Fig. 27 Fuel Tank Drain Plug**

1 - FUEL TANK DRAIN PLUG

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

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

(9) Disconnect fuel tank from rubber fill hose (Fig. 28).

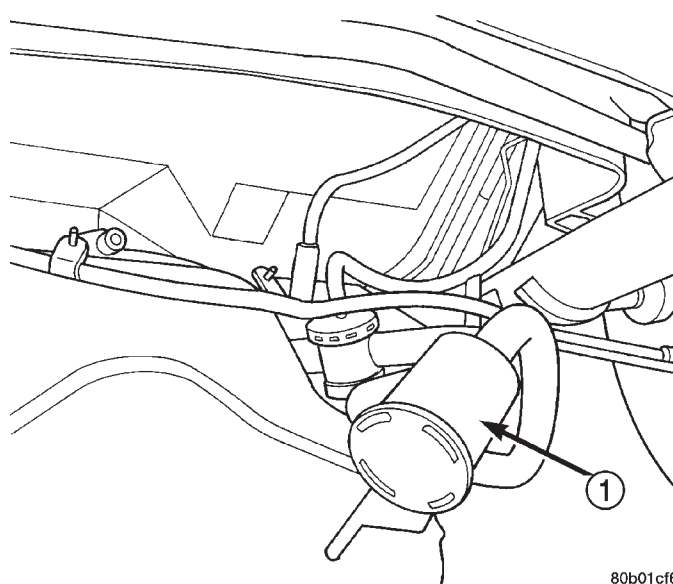
**Fig. 28 Fuel Filler Hose Clamp**

1 - FUEL FILLER HOSE
2 - HOSE CLAMP
3 - FUEL TANK INLET
4 - REAR CROSS MEMBER

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

(10) Remove bolts and fuel tank straps. Passenger side first.

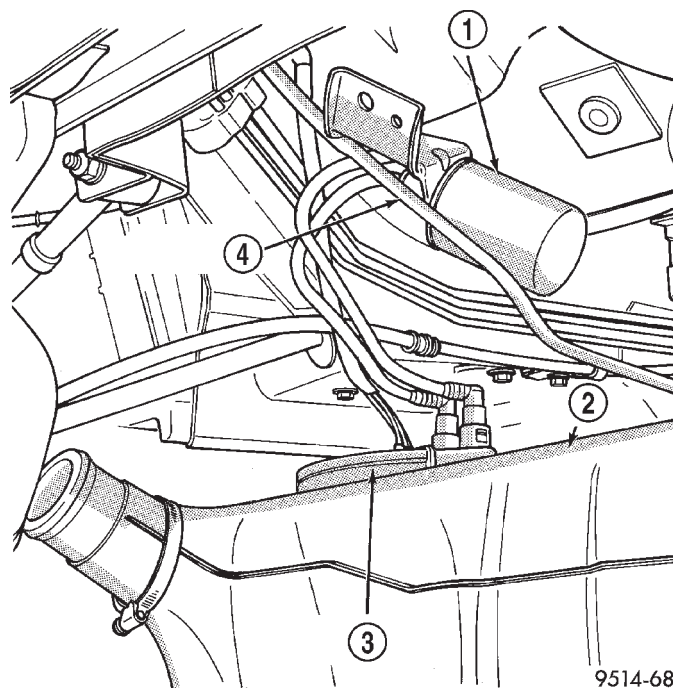
(11) Lower fuel tank and remove the EVAP line and recirculation line (Fig. 29).

**Fig. 29 Evap Components**

1 - LDP FILTER

(12) Remove vacuum line from LDP.

(13) Disconnect fuel lines from fuel pump module. These are quick connect fittings (Fig. 30).

**Fig. 30 Fuel Tank Removal**

1 - FUEL FILTER
2 - FUEL TANK
3 - FUEL PUMP MODULE
4 - FUEL TANK VAPOR LINE

(14) Remove hoses from EVAP canister.

REMOVAL AND INSTALLATION (Continued)

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

INSTALLATION

- (1) Position fuel tank on transmission jack.
- (2) Raise tank into position.
- (3) Connect vapor line to tee to rollover valve.
- (4) Install EVAP hoses and lines.
- (5) Connect fuel pump electrical connector.
- (6) Install pump module harness grommet into body.
- (7) Connect chassis fuel tube to fuel filter. Refer to Quick Connect Fittings in this section.
- (8) Connect fuel fill tube to tank inlet. Tighten hose clamp to 3.5 N·m (31 in. lbs.) torque.
- (9) Position fuel filter and fuel tank straps. Install the front bolts first and then the rear bolts. Tighten fuel tank strap bolts to 23 N·m (250 in. lbs.) torque. Remove transmission jack. Ensure straps are not twisted or bent.
- (10) Lower vehicle.
- (11) Connect fuel pump module connector, inside of vehicle. Install rear seat cushion.
- (12) Fill fuel tank, install filler cap, and connect battery cable.

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

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

FUEL FILLER NECK

REMOVAL

- (1) Loosen fuel filler tube cap.
- (2) Remove fuel filler neck screws (Fig. 31).
- (3) Disconnect Ground strap from body.
- (4) Disconnect fuel filler tube hose from fuel tank neck. Remove fuel filler tube assembly.

INSTALLATION

- (1) Install fuel filler tube. Connect fuel filler tube hose to fuel tank neck.
- (2) Install fuel filler neck screws (Fig. 31).
- (3) Install fuel filler tube cap.

ACCELERATOR PEDAL

REMOVAL

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

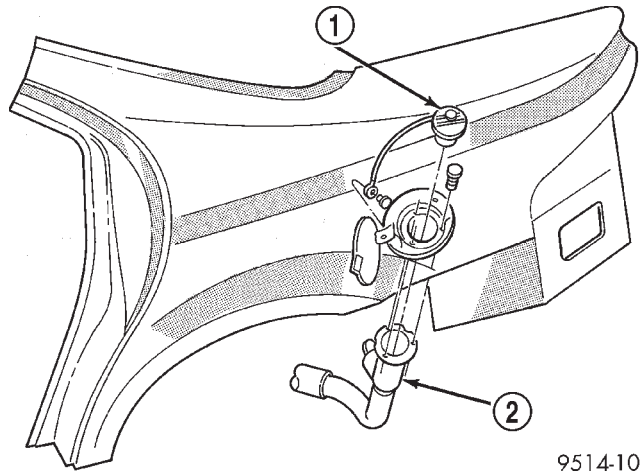


Fig. 31 Fuel Filler Neck Removal/Installation

- 1 – FILLER CAP
- 2 – FILLER NECK

(2) Reach behind the top of the pedal shaft and push the retainer toward rear of vehicle (Fig. 32). It may be necessary to squeeze retainer ears together on dash side of pedal shaft.

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

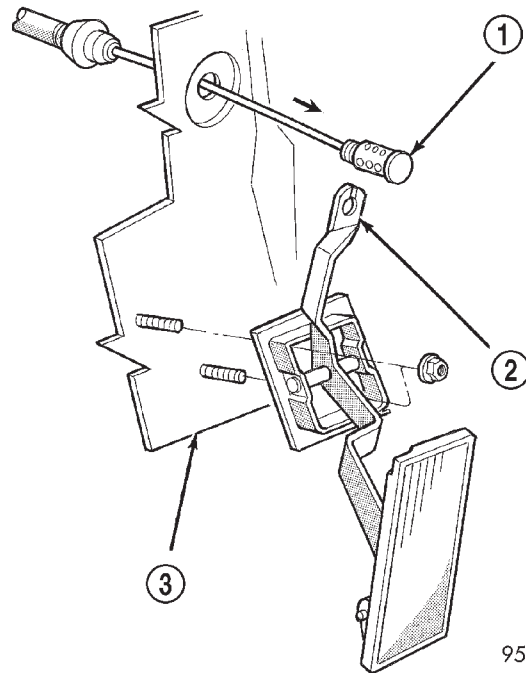


Fig. 32 Accelerator Pedal and Throttle Cable

- 1 – CABLE
- 2 – PEDAL SHAFT
- 3 – DASH PANEL

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

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

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

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

(3) While holding pedal lever, Push retainer clip forward in vehicle engaging it into the pedal lever.

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

THROTTLE CABLE—2.0L

REMOVAL

(1) Working from the engine compartment, remove the throttle cable from the throttle body lever (Fig. 33) and (Fig. 34).

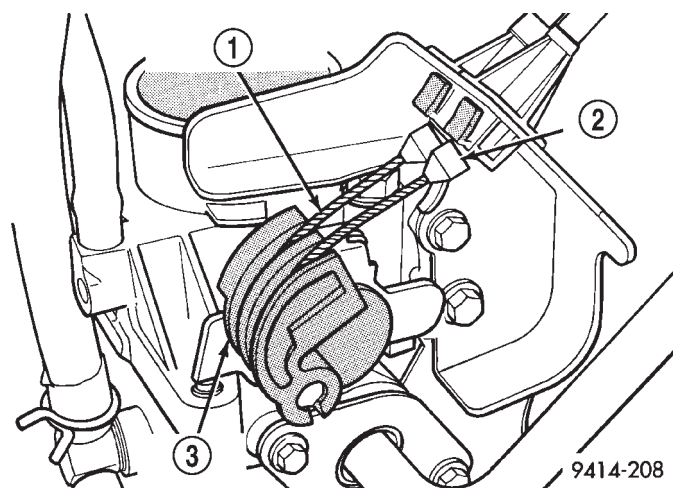


Fig. 33 Throttle Cable Attachment to Throttle Body

- 1 - SPEED CONTROL CABLE
- 2 - THROTTLE CABLE
- 3 - THROTTLE LEVER

(2) Compress the retaining tabs on the cable and slide cable out of bracket (Fig. 34).

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

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

(5) Remove throttle cable clip attached at grommet in front of dash panel.

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

INSTALLATION

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

(2) Install throttle cable clip.

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

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

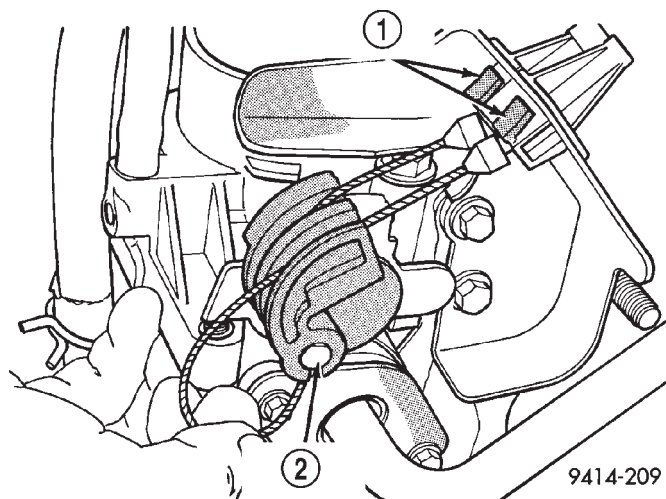


Fig. 34 Disconnecting Throttle Cable

- 1 - TABS
- 2 - CABLE CLASP

(5) While holding the pedal lever, push retainer clip forward in vehicle engaging it into the pedal lever.

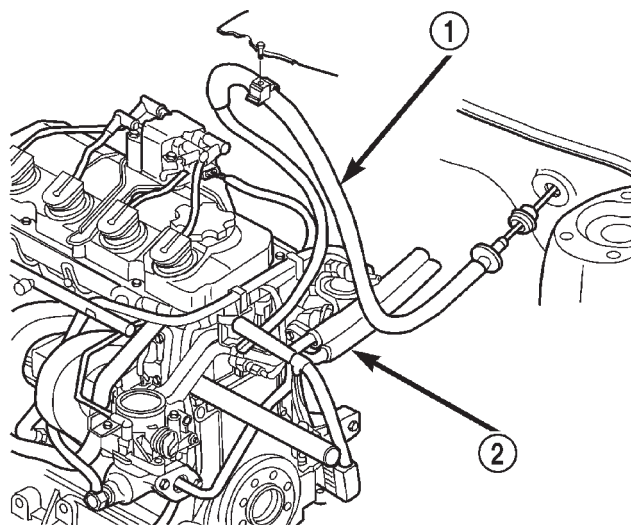


Fig. 35 Cable Routing 2.0L

- 1 - THROTTLE CABLE
- 2 - HEATER HOSES

(6) From the engine compartment, rotate the throttle lever forward to the wide open position and install cable clasp (Fig. 34).

SPECIFICATIONS

TORQUE

DESCRIPTION	TORQUE
Accelerator Pedal to Dash Nuts	12 N·m (105 in. lbs.)
Fuel Filter Mounting Screw . .	12 N·m (110 in. lbs.)
Fuel Pump Module Locknut . .	74.5 N·m (55 ft. lbs.)
Fuel Tank strap Bolts	28.2 N·m (250 in. lbs.)
Fuel Rail Bolts—2.0L	22.5 N·m (200 in. lbs.)
Ignition Coil Mounting Bolts .	12 N·m (105 in. lbs.)

FUEL TANK CAPACITY

Vehicle	Liters	U.S. Gallons
JX	60	16
Nominal refill capacities are shown. A variation may be observed from vehicle to vehicle due to manufacturing tolerance and refill procedure.		

FUEL REQUIREMENTS

Your engine is designed to meet all emissions regulations and provide excellent fuel economy and performance when using high quality unleaded gasoline having an octane rating of 87. The use of premium gasoline is not recommended. The use of premium gasoline will provide no benefit over high quality regular gasoline, and in some circumstances may result in poorer performance.

Light spark knock at low engine speeds is not harmful to your engine. However, continued heavy spark knock at high speeds can cause damage and immediate service is required. Engine damage resulting from operation with a heavy spark knock may not be covered by the new vehicle warranty.

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

Over 40 auto manufacturers world-wide have issued and endorsed consistent gasoline specifications (the Worldwide Fuel Charter, WWFC) to define fuel properties necessary to deliver enhanced emissions, performance and durability for your vehicle. We recommend the use of gasolines that meet the WWFC specifications if they are available.

REFORMULATED GASOLINE

Many areas of the country require the use of cleaner burning gasoline referred to as “reformulated” gasoline. Reformulated gasoline contain oxygenates, and are specifically blended to reduce vehicle emissions and improve air quality.

We strongly supports the use of reformulated gasoline. Properly blended reformulated gasoline will provide excellent performance and durability for the engine and fuel system components.

GASOLINE/OXYGENATE BLENDS

Some fuel suppliers blend unleaded gasoline with oxygenates such as 10% ethanol, MTBE, and ETBE. Oxygenates are required in some areas of the country during the winter months to reduce carbon monoxide emissions. Fuels blended with these oxygenates may be used in your vehicle.

CAUTION: DO NOT use gasoline containing METHANOL. Gasoline containing methanol may damage critical fuel system components.

MMT IN GASOLINE

MMT is a manganese-containing metallic additive that is blended into some gasoline to increase octane. Gasoline blended with MMT provide no performance advantage beyond gasoline of the same octane number without MMT. Gasoline blended with MMT reduce spark plug life and reduce emission system performance in some vehicles. We recommend that gasolines free of MMT be used in your vehicle. The MMT content of gasoline may not be indicated on the gasoline pump; therefore, you should ask your gasoline retailer whether or not his/her gasoline contains MMT.

It is even more important to look for gasoline without MMT in Canada because MMT can be used at levels higher than allowed in the United States. MMT is prohibited in Federal and California reformulated gasoline.

SULFUR IN GASOLINE

If you live in the northeast United States, your vehicle may have been designed to meet California low emission standards with Cleaner-Burning California reformulated gasoline with low sulfur. If such fuels are not available in states adopting California emission standards, your vehicles will operate satisfactorily on fuels meeting federal specifications, but emission control system performance may be adversely affected. Gasoline sold outside of California is permitted to have higher sulfur levels which may affect the performance of the vehicle's catalytic converter. This may cause the Malfunction Indicator Lamp (MIL), Check Engine or Service Engine Soon light to illuminate. We recommend that you try a different brand of unleaded gasoline having lower sulfur to determine if the problem is fuel related prior to returning your vehicle to an authorized dealer for service.

SPECIFICATIONS (Continued)

CAUTION: If the Malfunction Indicator Lamp (MIL), Check Engine or Service Engine Soon light is flashing, immediate service is required; see on-board diagnostics system section.

MATERIALS ADDED TO FUEL

All gasoline sold in the United States and Canada are required to contain effective detergent additives. Use of additional detergents or other additives is not needed under normal conditions.

FUEL SYSTEM CAUTIONS

CAUTION: Follow these guidelines to maintain your vehicle's performance:

- The use of leaded gas is prohibited by Federal law. Using leaded gasoline can impair engine performance, damage the emission control system, and could result in loss of warranty coverage.
- An out-of-tune engine, or certain fuel or ignition malfunctions, can cause the catalytic converter to

overheat. If you notice a pungent burning odor or some light smoke, your engine may be out of tune or malfunctioning and may require immediate service. Contact your dealer for service assistance.

- When pulling a heavy load or driving a fully loaded vehicle when the humidity is low and the temperature is high, use a premium unleaded fuel to help prevent spark knock. If spark knock persists, lighten the load, or engine piston damage may result.

- The use of fuel additives which are now being sold as octane enhancers is not recommended. Most of these products contain high concentrations of methanol. Fuel system damage or vehicle performance problems resulting from the use of such fuels or additives is not the responsibility of Daimler-Chrysler Corporation and may not be covered under the new vehicle warranty.

NOTE: Intentional tampering with emissions control systems can result in civil penalties being assessed against you.

FUEL INJECTION SYSTEM

TABLE OF CONTENTS

	page	page
DESCRIPTION AND OPERATION		
INJECTION SYSTEM	21	
PCM REPLACEMENT	22	
MODES OF OPERATION	22	
SYSTEM DIAGNOSIS	24	
CCD BUS	24	
POWERTRAIN CONTROL MODULE	24	
AUTOMATIC SHUTDOWN (ASD) SENSE—		
PCM INPUT	25	
BATTERY VOLTAGE—PCM INPUT	26	
ENGINE COOLANT TEMPERATURE		
SENSOR—PCM INPUT	26	
HEATED OXYGEN SENSORS—PCM INPUT	27	
IGNITION SENSE—PCM INPUT	27	
INTAKE AIR TEMPERATURE SENSOR—PCM		
INPUT	27	
MANIFOLD ABSOLUTE PRESSURE (MAP)		
SENSOR—PCM INPUT	28	
POWER STEERING PRESSURE SWITCH—		
PCM INPUT	29	
SENSOR RETURN—PCM INPUT	29	
SCI RECEIVE—PCM INPUT	29	
THROTTLE POSITION SENSOR—PCM INPUT	29	
VEHICLE SPEED SIGNAL—PCM INPUT	30	
AUTOMATIC SHUTDOWN RELAY—PCM		
OUTPUT	30	
PROPORTIONAL PURGE SOLENOID—PCM		
OUTPUT	31	
IDLE AIR CONTROL MOTOR—PCM OUTPUT	31	
DATA LINK CONNECTOR	32	
MALFUNCTION INDICATOR (CHECK ENGINE)		
LAMP—PCM OUTPUT	32	
RADIATOR FAN RELAYS—PCM OUTPUT	33	
TACHOMETER—PCM OUTPUT	33	
5-VOLT SUPPLY—PCM OUTPUT	33	
8-VOLT SUPPLY—PCM OUTPUT	33	
THROTTLE BODY	33	
REMOVAL AND INSTALLATION		
THROTTLE BODY—2.0L ENGINES	33	
THROTTLE POSITION SENSOR (TPS)—2.0L	34	
IDLE AIR CONTROL MOTOR—2.0L	35	
MAP/IAT SENSOR—SOHC	35	
POWERTRAIN CONTROL MODULE	36	
OXYGEN SENSOR 1/1 UPSTREAM—2.0/2.4L	37	
OXYGEN SENSOR 1/2 DOWNSTREAM	37	
AIR INLET RESONATOR	37	
AIR CLEANER	37	
FILTER ELEMENT REPLACEMENT	38	
ENGINE COOLANT TEMPERATURE SENSOR	39	
VEHICLE SPEED SENSOR	39	
SPECIFICATIONS		
VEHICLE EMISSION CONTROL		
INFORMATION LABEL	40	
TORQUE	40	
SPECIAL TOOLS		
FUEL	40	

DESCRIPTION AND OPERATION

INJECTION SYSTEM

OPERATION

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

The PCM regulates:

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

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

The PCM can adapt its programming to meet changing operating conditions.

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

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

DESCRIPTION AND OPERATION (Continued)

PCM REPLACEMENT

DESCRIPTION

USE THE DRB SCAN TOOL TO REPROGRAM THE NEW PCM WITH THE VEHICLES ORIGINAL IDENTIFICATION NUMBER (VIN) AND THE VEHICLES ORIGINAL MILEAGE. IF THIS STEP IS NOT DONE A DIAGNOSTIC TROUBLE CODE (DTC) MAY BE SET.

MODES OF OPERATION

OPERATION

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

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

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

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

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

- (1) Engine coolant temperature must be over 35°F.
 - If the coolant is over 35° the PCM will wait 44 seconds.
 - If the coolant is over 50°F the PCM will wait 38 seconds.
 - If the coolant is over 167°F the PCM will wait 11 seconds.
- (2) For other temperatures the PCM will interpolate the correct waiting time.
- (3) O2 sensor must read either greater than 0.745 volts or less than 0.1 volt.
- (4) The multi-port fuel injection systems has the following modes of operation:
 - Ignition switch ON (Zero RPM)
 - Engine start-up

- Engine warm-up
- Cruise
- Idle
- Acceleration
- Deceleration
- Wide Open Throttle
- Ignition switch OFF

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

IGNITION SWITCH ON (ZERO RPM) MODE

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

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

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

ENGINE START-UP MODE

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

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

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

- After determining crankshaft position, the PCM begins energizing the injectors in sequence. It adjusts injector pulse width and controls injector synchroni-

DESCRIPTION AND OPERATION (Continued)

zation by turning the individual ground paths to the injectors On and Off.

- When the engine idles within ± 64 RPM of its target RPM, the PCM compares current MAP sensor value with the atmospheric pressure value received during the Ignition Switch On (zero RPM) mode.

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

- Battery voltage
- Engine coolant temperature
- Engine RPM
- Inlet/Intake air temperature (IAT)
- MAP
- Throttle position
- The number of engine revolutions since cranking was initiated

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

ENGINE WARM-UP MODE

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

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

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

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

CRUISE OR IDLE MODE

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

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

- Power steering pressure switch
- Battery voltage
- Vehicle speed

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

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

The PCM monitors for engine misfire. During active misfire and depending on the severity, the PCM either continuously illuminates or flashes the malfunction indicator lamp (Check Engine light on instrument panel). Also, the PCM stores an engine misfire DTC in memory.

The PCM performs several diagnostic routines. They include:

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

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

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

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

ACCELERATION MODE

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

DESCRIPTION AND OPERATION (Continued)

DECELERATION MODE

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

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

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

WIDE-OPEN-THROTTLE MODE

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

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

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

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

IGNITION SWITCH OFF MODE

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

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

SYSTEM DIAGNOSIS**OPERATION**

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

For DTC information see On-Board Diagnostics.

CCD BUS**DESCRIPTION**

Various controllers and modules exchange information through a two-wire communication port called the CCD Bus. The PCM transmits various monitored input information and control requests to other modules on the CCD Bus. The PCM also receives information and requests that effects the control of its outputs from other controllers over the CCD Bus. The CCD Bus has a measurable voltage of approximately 2.5 volts.

OPERATION

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

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

- Instrument Panel
- Body Control Module
- Air Bag System Diagnostic Module
- Full ATC Display Head
- ABS Module
- Transmission Control Module
- Powertrain Control Module
- Travel Module (if equipped)

POWERTRAIN CONTROL MODULE**DESCRIPTION**

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

OPERATION

The PCM receives input signals from various switches and sensors that are referred to as PCM Inputs. Based on these inputs, the PCM adjusts various engine and vehicle operations through devices that are referred to as PCM Outputs.

DESCRIPTION AND OPERATION (Continued)

NOTE: PCM Inputs:

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

NOTE: PCM Outputs:

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

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

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

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

- Throttle position

The PCM adjusts ignition timing based on the following inputs.

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

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

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

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

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

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

AUTOMATIC SHUTDOWN (ASD) SENSE—PCM INPUT**DESCRIPTION**

It is an input to the Powertrain Control Module from the relay in the Power Distribution Center, refer to the cover for relay location.

OPERATION

The ASD sense circuit informs the PCM when the ASD relay energizes. A 12 volt signal at this input

DESCRIPTION AND OPERATION (Continued)

indicates to the PCM that the ASD has been activated. This input is used only to sense that the ASD relay is energized.

When energized, the ASD relay provides power to operate the injectors, ignition coil, generator field, O2 sensor heaters (both upstream and downstream), and also provides a sense circuit to the PCM for diagnostic purposes. The PCM energizes the ASD any time there is a Crankshaft Position sensor signal that exceeds a predetermined value. The ASD relay can also be energized after the engine has been turned off to perform an O2 sensor heater test, if vehicle is equipped with OBD II diagnostics.

With SBEC III, the ASD relay's electromagnet is fed battery voltage, not ignition voltage. The PCM still provides the ground. As mentioned earlier, the PCM energizes the ASD relay during an O2 sensor heater test. This test is performed only after the engine has been shut off. The PCM still operates internally to perform several checks, including monitoring the O2 sensor heaters. This and other DTC tests are explained in detail in the On-Board Diagnostic Student Reference Book.

BATTERY VOLTAGE—PCM INPUT**DESCRIPTION**

The direct battery feed to the PCM is used as a reference point to sense battery voltage.

OPERATION

In order for the PCM to operate, it must be supplied with battery voltage and ground. The PCM monitors the direct battery feed input to determine battery charging rate and to control the injector initial opening point. It also has back-up RAM memory used to store Diagnostic Trouble Codes (supply working DTCs). Direct battery feed is also used to perform key-OFF diagnostics and to supply working voltage to the controller for OBDII.

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

Effect on Fuel Injectors

Fuel injectors are rated for operation at a specific voltage. If the voltage increases, the plunger will open faster and conversely, if voltage is low the injector will be slow to open. Therefore, if sensed battery voltage drops, the PCM increases injector pulse-width to maintain the same volume of fuel through the injector.

Charging

The PCM uses sensed battery voltage to verify that target charging voltage (determined by Battery Tem-

perature Sensor) is being reached. To maintain the target charging voltage, the PCM will full field the generator to 0.5 volt above target then turn OFF to 0.5 volt below target. This will continue to occur up to a 100 Hz frequency, 100 times per second.

ENGINE COOLANT TEMPERATURE SENSOR—PCM INPUT**DESCRIPTION**

The coolant sensor threads into the rear of the cylinder head on the 2.0L (Fig. 1). New sensors have sealant applied to the threads.

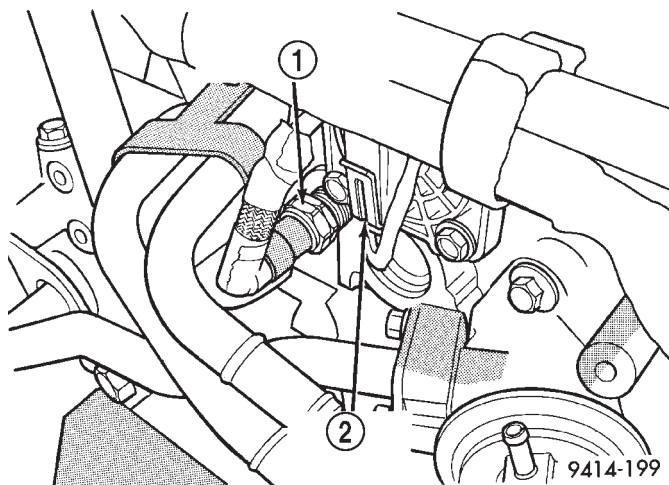


Fig. 1 Engine Coolant Temperature Sensor—2.0L

- 1 – ENGINE COOLANT TEMPERATURE SENSOR
- 2 – CAMSHAFT POSITION SENSOR

OPERATION

The PCM determines engine coolant temperature from the coolant temperature sensor. The ECT sensor is a two wire Negative Thermal Coefficient (NTC) sensor. The PCM sends 5 volts to the sensor and is grounded through the sensor return line. As temperature increases, resistance in the sensor decreases. As coolant temperature varies, the coolant temperature sensor resistance changes resulting in a different voltage value at the PCM engine coolant sense circuit.

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

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

DESCRIPTION AND OPERATION (Continued)

HEATED OXYGEN SENSORS—PCM INPUT**DESCRIPTION**

The upstream oxygen sensor threads into the outlet flange of the exhaust manifold (Fig. 2).

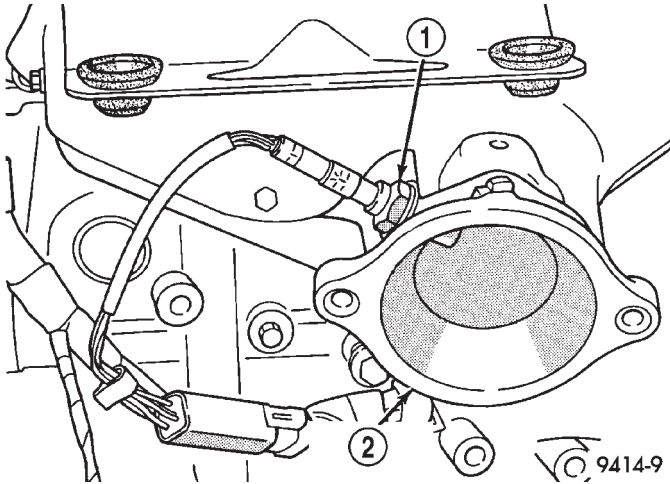


Fig. 2 Oxygen Sensor 1/1 Upstream—2.0L Engines

- 1 - OXYGEN SENSORS
- 2 - EXHAUST MANIFOLD

The downstream heated oxygen sensor threads into the outlet pipe at the rear of the catalytic converter (Fig. 3).

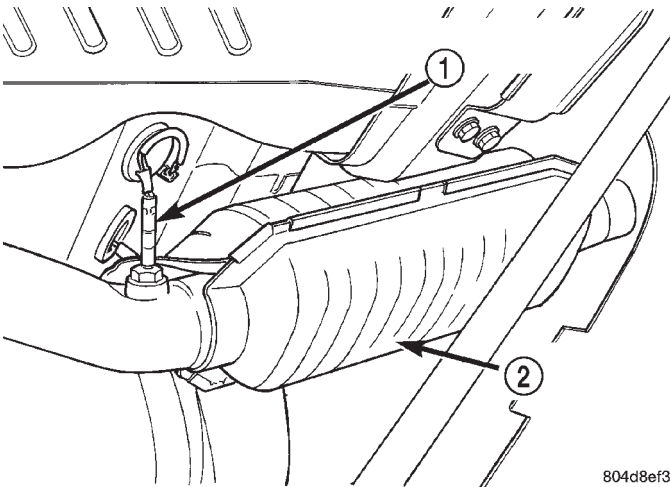


Fig. 3 Oxygen Sensor 1/2 Downstream

- 1 - DOWNSTREAM HEATED OXYGEN SENSOR
- 2 - CATALYTIC CONVERTOR

OPERATION**OXYGEN SENSOR 1/1 UPSTREAM**

The O₂ Sensors are zirconium dioxide, four wire and heated. The heater uses two of the sensors' four wires. One is common ground, the other provides battery voltage to the heater from the ASD Relay. One of

the remaining wires is a sensor signal input to the PCM. The fourth wire is signal ground. The input from the upstream heated oxygen sensor tells the PCM the oxygen content of the exhaust gas. Based on this input, the PCM fine tunes the air-fuel ratio by adjusting injector pulse width.

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

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

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

OXYGEN SENSOR 1/2 DOWNSTREAM

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

IGNITION SENSE—PCM INPUT**OPERATION**

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

INTAKE AIR TEMPERATURE SENSOR—PCM INPUT**DESCRIPTION**

The IAT sensor and Manifold Absolute Pressure (MAP) sensor are a combined sensor that attach to the intake manifold (Fig. 4) for 2.0L engine.

OPERATION

The Intake Air Temperature (IAT) sensor measures the temperature of the intake air as it enters the

DESCRIPTION AND OPERATION (Continued)

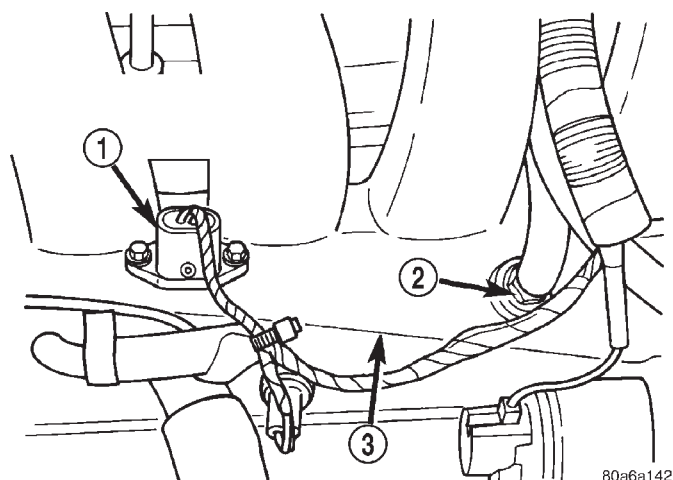


Fig. 4 Intake Air Temperature Sensor and MAP Sensor—2.0L

- 1 - MAP/AIR TEMPERATURE SENSOR
- 2 - PCV VACUUM NIPPLE
- 3 - INTAKE MANIFOLD

engine. The sensor supplies one of the inputs the PCM uses to determine injector pulse width and spark advance.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR—PCM INPUT

DESCRIPTION

The MAP sensor mounts to the intake manifold (Fig. 4).

OPERATION

The MAP serves as a PCM input, using a silicon based sensing unit, to provide data on the manifold vacuum that draws the air/fuel mixture into the combustion chamber. The PCM requires this information to determine injector pulse width and spark advance. When MAP equals Barometric pressure, the pulse width will be at maximum.

Also like the cam and crank sensors, a 5 volt reference is supplied from the PCM and returns a voltage signal to the PCM that reflects manifold pressure. The zero pressure reading is 0.5V and full scale is 4.5V. For a pressure swing of 0 — 15 psi the voltage changes 4.0V. The sensor is supplied a regulated 4.8 to 5.1 volts to operate the sensor. Like the cam and crank sensors ground is provided through the sensor return circuit.

The MAP sensor input is the number one contributor to pulse width. The most important function of the MAP sensor is to determine barometric pressure. The PCM needs to know if the vehicle is at sea level or is it in Denver at 5000 feet above sea level, because the air density changes with altitude. It will

also help to correct for varying weather conditions. If a hurricane was coming through the pressure would be very, very low or there could be a real fair weather, high pressure area. This is important because as air pressure changes the barometric pressure changes. Barometric pressure and altitude have a direct inverse correlation, as altitude goes up barometric goes down. The first thing that happens as the key is rolled on, before reaching the crank position, the PCM powers up, comes around and looks at the MAP voltage, and based upon the voltage it sees, it knows the current barometric pressure relative to altitude. Once the engine starts, the PCM looks at the voltage again, continuously every 12 milliseconds, and compares the current voltage to what it was at key on. The difference between current and what it was at key on is manifold vacuum.

During key On (engine not running) the sensor reads (updates) barometric pressure. A normal range can be obtained by monitoring known good sensor in your work area.

As the altitude increases the air becomes thinner (less oxygen). If a vehicle is started and driven to a very different altitude than where it was at key On the barometric pressure needs to be updated. Any time the PCM sees Wide Open throttle, based upon TPS angle and RPM it will update barometric pressure in the MAP memory cell. With periodic updates, the PCM can make its calculations more effectively.

The PCM uses the MAP sensor to aid in calculating the following:

- Barometric pressure
- Engine load
- Manifold pressure
- Injector pulse-width
- Spark-advance programs
- Shift-point strategies (F4AC1 transmissions only, via the CCD bus)
- Idle speed
- Decel fuel shutoff

The MAP sensor signal is provided from a single piezoresistive element located in the center of a diaphragm. The element and diaphragm are both made of silicone. As the pressures changes the diaphragm moves causing the element to deflect which stresses the silicone. When silicone is exposed to stress its resistance changes. As manifold vacuum increases, the MAP sensor input voltage decreases proportionally. The sensor also contains electronics that condition the signal and provide temperature compensation.

The PCM recognizes a decrease in manifold pressure by monitoring a decrease in voltage from the reading stored in the barometric pressure memory cell. The MAP sensor is a linear sensor; as pressure changes, voltage changes proportionately. The range

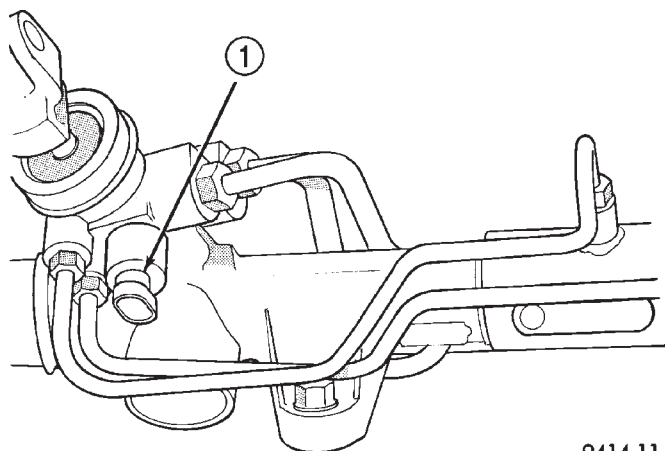
DESCRIPTION AND OPERATION (Continued)

of voltage output from the sensor is usually between 4.6 volts at sea level to as low as 0.3 volts at 26 in. of Hg (Table 1). Barometric pressure is the pressure exerted by the atmosphere upon an object. At sea level on a standard day, no storm, barometric pressure is 29.92 in. Hg. For every 100 feet of altitude barometric pressure drops 10 in. Hg. If a storm goes through it can either add, high pressure, or decrease, low pressure, from what should be present for that altitude. You should make a habit of knowing what the average pressure and corresponding barometric pressure is for your area. Always use the Diagnostic Test Procedures Manual for MAP sensor testing.

POWER STEERING PRESSURE SWITCH—PCM INPUT

DESCRIPTION

A pressure sensing switch is located on the power steering gear.



9414-11

Fig. 5 Power Steering Pressure Switch

1 – POWER STEERING PRESSURE SWITCH

OPERATION

The switch (Fig. 5) provides an input to the PCM during periods of high pump load and low engine RPM; such as during parking maneuvers.

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

SENSOR RETURN—PCM INPUT

OPERATION

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

circuits within the Powertrain Control Module (PCM).

SCI RECEIVE—PCM INPUT

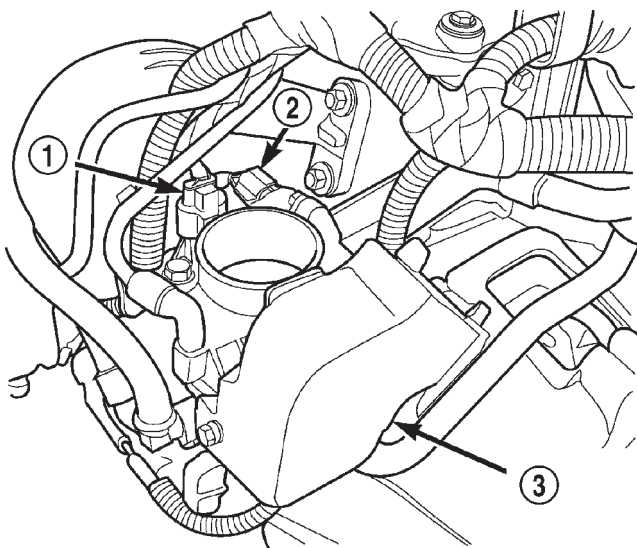
OPERATION

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

THROTTLE POSITION SENSOR—PCM INPUT

DESCRIPTION

The throttle position sensor mounts to the side of the throttle body (Fig. 6).



80b6efe7

Fig. 6 Throttle Position Sensor—2.0L Engines

1 – TPS

2 – IAC

3 – THROTTLE CONTROL SHIELD

OPERATION

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

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

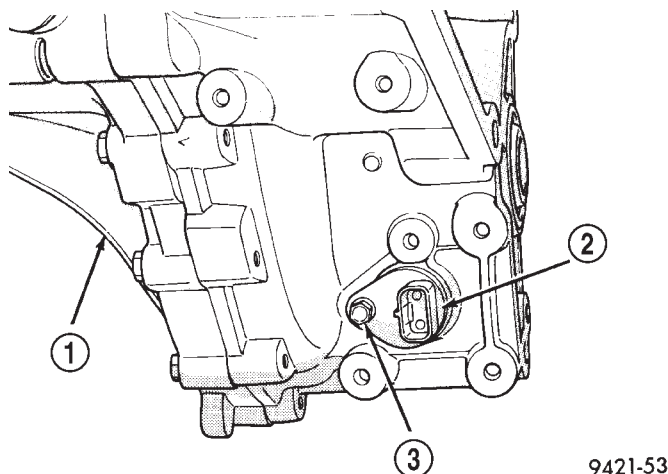
Along with inputs from other sensors, the PCM uses TPS input to determine current engine operating conditions. The PCM also adjusts fuel injector

DESCRIPTION AND OPERATION (Continued)

pulse width and ignition timing based on these inputs.

VEHICLE SPEED SIGNAL—PCM INPUT**DESCRIPTION**

The vehicle speed sensor is located in the transmission extension housing (Fig. 7).



9421-53

Fig. 7 Vehicle Speed Sensor—Manual Transmission

- 1 - TRANSAXLE
- 2 - SPEED SENSOR
- 3 - SPEED SENSOR RETAINING BOLT

OPERATION**AUTOMATIC**

The transaxle control module (TCM) supplies the vehicle speed signal to the PCM based on the output shaft speed. The PCM sends a 5 volt signal to the TCM. The TCM switches this signal to a ground, and then opens the circuit at a rate of 8000 pulses per mile. When the PCM counts 8000 pulses, the PCM assumes the vehicle has traveled one mile. The output speed sensor is located on the side of the transaxle (Fig. 8).

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

MANUAL

The sensor input is used by the PCM to determine vehicle speed and distance traveled.

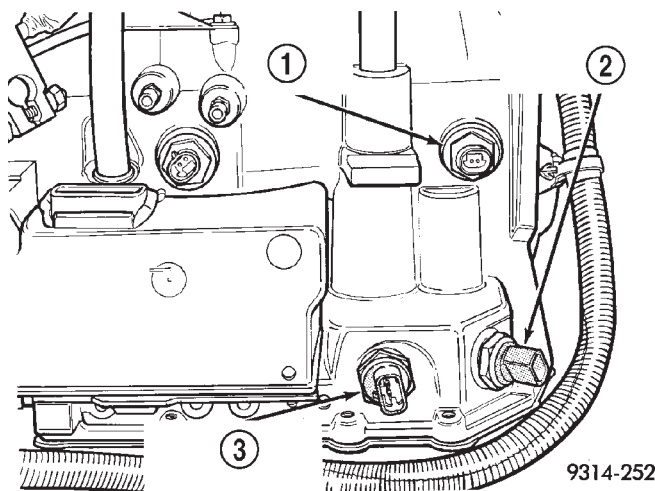
The vehicle speed sensor generates 8 pulses per sensor revolution. These signals, in conjunction with a closed throttle signal from the throttle position sen-

sor, indicate a closed throttle deceleration to the PCM. Under deceleration conditions, the PCM adjusts the Idle Air Control (IAC) motor to maintain a desired MAP value.

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

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

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



9314-252

Fig. 8 Output Speed Sensor—Automatic Transaxle

- 1 - OUTPUT SPEED SENSOR
- 2 - PARK/NEUTRAL SWITCH (BLACK)
- 3 - TRANSMISSION RANGE SWITCH

AUTOMATIC SHUTDOWN RELAY—PCM OUTPUT**DESCRIPTION**

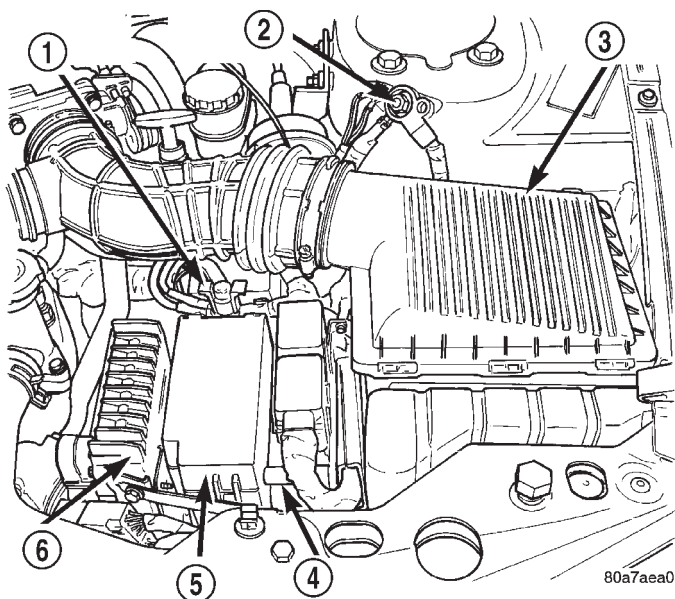
The ASD relay and fuel pump relay are located in the Power Distribution Center (PDC) near the Air Cleaner (Fig. 9). The inside top of the PDC cover has a label showing relay and fuse location. They are ISO relays.

OPERATION

The PCM operates the Automatic Shut Down (ASD) relay and fuel pump relay through one ground path. The PCM operates them by switching the ground path for the relays on and off.

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

DESCRIPTION AND OPERATION (Continued)

**Fig. 9 Power Distribution Center (PDC)**

- 1 - BATTERY POSITIVE
- 2 - BATTERY GROUND
- 3 - AIR CLEANER
- 4 - PCM
- 5 - PDC
- 6 - TCM

The PCM turns the ground path off when the ignition switch is in the Off position. Both relays are off. When the ignition switch is in the On or Crank position, the PCM monitors the crankshaft position sensor and camshaft position sensor signals to determine engine speed. If the PCM does not receive a crankshaft position sensor signal and camshaft position sensor signal when the ignition switch is in the Run position, it de-energizes both relays. When the relays are de-energized, battery voltage is not supplied to the fuel injectors, ignition coil and fuel pump.

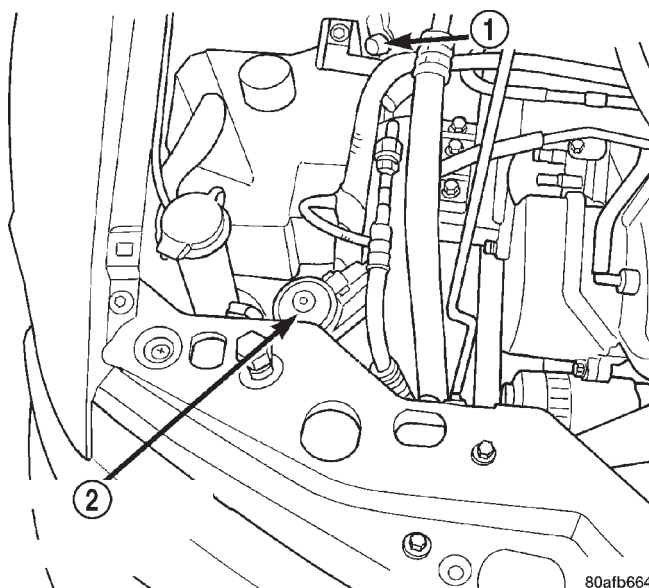
PROPORTIONAL PURGE SOLENOID—PCM OUTPUT

DESCRIPTION

The solenoid attaches to a bracket near the front engine mount (Fig. 10). To operate correctly, the solenoid must be installed with the electrical connector on top.

OPERATION

The purge solenoid regulates the rate of vapor flow from the EVAP canister to the throttle body. The PCM operates the solenoid.

**Fig. 10 Proportional Purge Solenoid**

- 1 - TEST PORT
- 2 - PROPORTIONAL PURGE SOLENOID

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

The proportional purge solenoid operates at a frequency of 200 hz and is controlled by an engine controller circuit that senses the current being applied to the proportional purge solenoid and then adjusts that current to achieve the desired purge flow. The proportional purge solenoid controls the purge rate of fuel vapors from the vapor canister and fuel tank to the engine intake manifold.

IDLE AIR CONTROL MOTOR—PCM OUTPUT

DESCRIPTION

The Idle Air Control (IAC) motor is mounted on the throttle body. The PCM operates the idle air control motor (Fig. 11).

OPERATION

The PCM adjusts engine idle speed through the idle air control motor to compensate for engine load, coolant temperature or barometric pressure changes.

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

The PCM adjusts engine idle speed by moving the IAC motor pintle in and out of the bypass passage. The adjustments are based on inputs the PCM receives. The inputs are from the throttle position sensor, crankshaft position sensor, coolant temperature sensor, MAP sensor, vehicle speed sensor and

DESCRIPTION AND OPERATION (Continued)

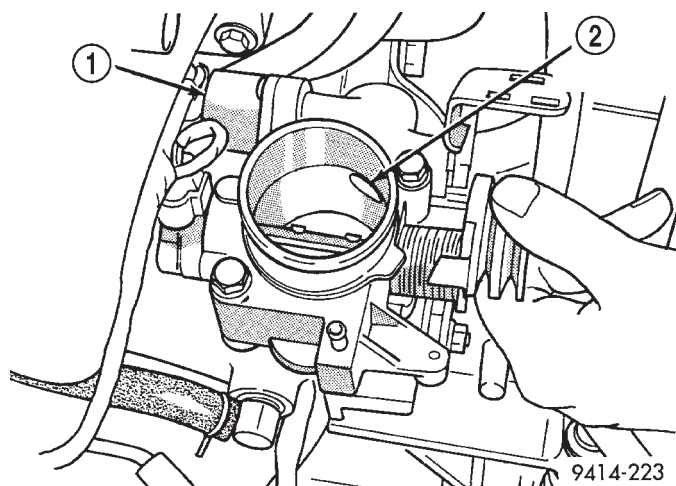


**Fig. 11 Idle Air Control Motor Air Bypass Passage—
2.0L**

- 1 – IDLE AIR CONTROL MOTOR
2 – FRESH AIR OPENING

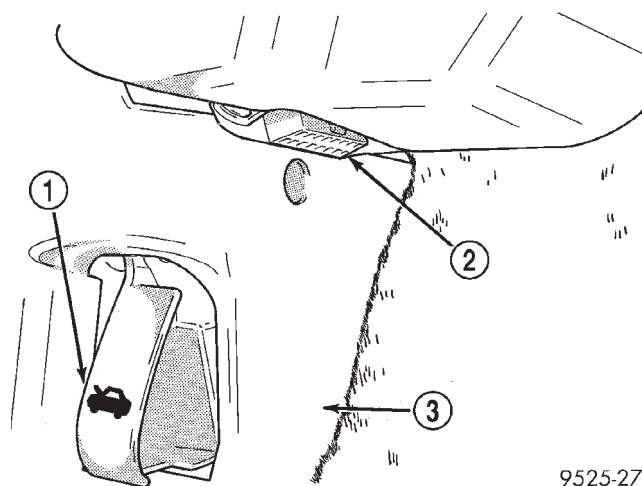


Fig. 12 Data Link (Diagnostic) Connector

- 1 – HOOD RELEASE
2 – DIAGNOSTIC CONNECTOR
3 – DRIVER'S SIDE KICK PANEL

various switch operations (brake, park/neutral, air conditioning).

When engine rpm is above idle speed, the IAC is used for the following functions:

- Off-idle dashpot
- Deceleration air flow control
- A/C compressor load control (also opens the passage slightly before the compressor is engaged so that the engine rpm does not dip down when the compressor engages)

Target Idle

Target idle is determined by the following inputs:

- Gear position
- ECT Sensor
- Battery voltage
- Ambient/Battery Temperature Sensor
- VSS
- TPS
- MAP Sensor

DATA LINK CONNECTOR

DESCRIPTION

The data link connector is located inside the vehicle, under the instrument panel, at the driver's kick panel (Fig. 12).

OPERATION

The data link connector (diagnostic connector) links the DRB scan tool with the Powertrain Control Module (PCM). Refer to On-Board Diagnostics in the Emission Control section.

MALFUNCTION INDICATOR (CHECK ENGINE) LAMP—PCM OUTPUT

DESCRIPTION

Refer to the Instrument Panel Systems for more information.

OPERATION

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

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

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

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

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

DESCRIPTION AND OPERATION (Continued)

RADIATOR FAN RELAYS—PCM OUTPUT**DESCRIPTION**

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

OPERATION

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

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

TACHOMETER—PCM OUTPUT**DESCRIPTION**

Refer to the Instrument panel System for more information.

OPERATION

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

5-VOLT SUPPLY—PCM OUTPUT**OPERATION**

The PCM supplies 5 volts to the following sensors:

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

8-VOLT SUPPLY—PCM OUTPUT**OPERATION**

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

THROTTLE BODY**DESCRIPTION**

The throttle body mounts to the intake manifold. The throttle position sensor and idle air control motor attach to the throttle body (Fig. 13).

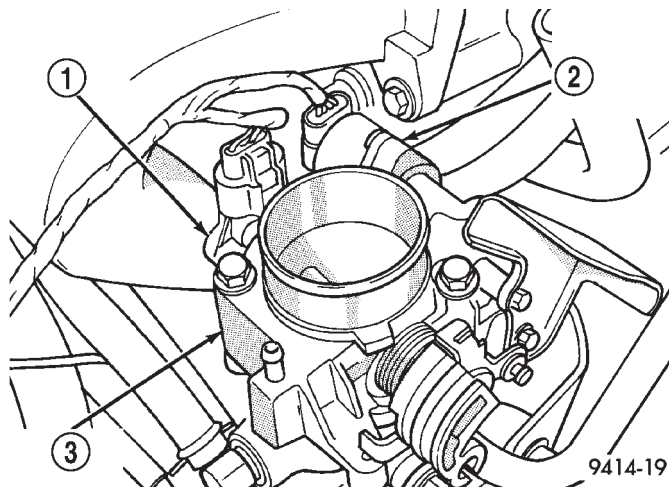


Fig. 13 Throttle Body—2.0L Engines

- 1 – THROTTLE POSITION SENSOR
- 2 – IDLE AIR CONTROL MOTOR
- 3 – THROTTLE BODY

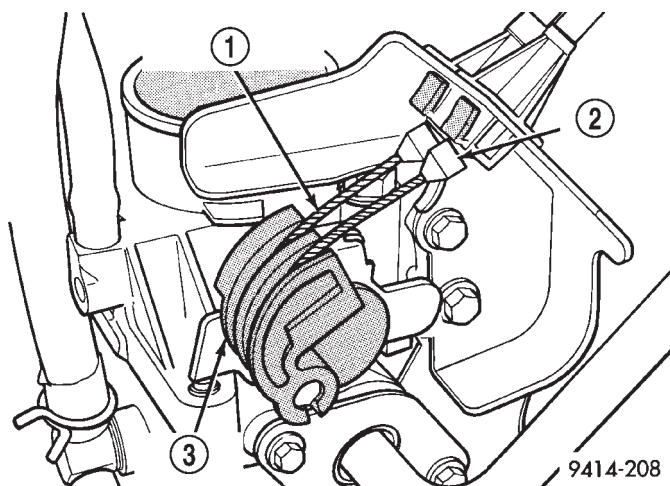
OPERATION

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

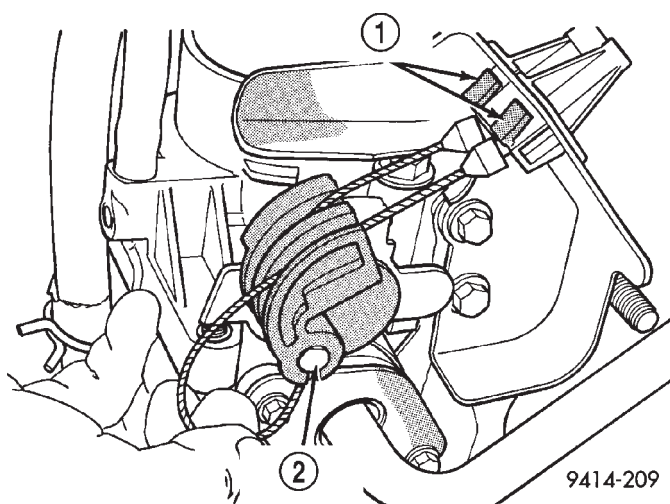
REMOVAL AND INSTALLATION**THROTTLE BODY—2.0L ENGINES****REMOVAL**

- (1) Remove the negative battery cable.
- (2) Remove air inlet resonator as described in this section.
- (3) Remove the throttle control shield.
- (4) Remove throttle cable from the throttle body lever (Fig. 14) and (Fig. 15).
- (5) Compress the retaining tabs on the cable and slide cable out of bracket.
- (6) If equipped with speed control, remove speed control cable from throttle lever by sliding clasp out hole used for throttle cable.
- (7) Remove EVAP purge hose from nipple on throttle body.
- (8) Remove 2 screws holding cable mounting bracket and support bracket.

REMOVAL AND INSTALLATION (Continued)

**Fig. 14 Throttle Cable Attachment to Throttle Body**

- 1 - SPEED CONTROL CABLE
- 2 - THROTTLE CABLE
- 3 - THROTTLE LEVER

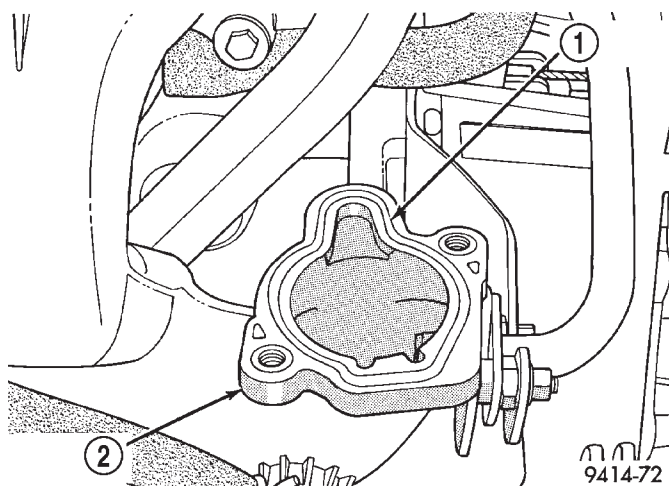
**Fig. 15 Disconnecting Throttle Cable**

- 1 - TABS
- 2 - CABLE CLASP

- (9) Remove throttle body mounting bolts.
- (10) Lift throttle body far enough to remove connectors from the throttle position sensor and idle air control motor. Remove throttle body.
- (11) **2.0L** The rubber O-ring gasket on the intake manifold is reusable. Wipe the O-ring clean before installing throttle body (Fig. 16).

INSTALLATION

- (1) Attach electrical connectors to idle air control motor and throttle position sensor.
- (2) Position throttle body on intake and install mounting bolts. Do Not tighten bolts at this time.

**Fig. 16 Re-Usable Throttle Body Gasket**

- 1 - RE-USABLE GASKET
- 2 - INTAKE MANIFOLD

- (3) Install throttle cable bracket. Do Not tighten bolts at this time.
- (4) Tighten throttle body bolts to 28.5 ± 4 N·m (250 $\pm$ 35 in. lbs.) torque.
- (5) Tighten throttle cable bracket bolts to 11.75 ± 2.25 N·m (105 $\pm$ 20 in. lbs.) torque.
- (6) Install EVAP purge hose to throttle body nipple.
- (7) Install cable housing(s) retainer tabs into bracket.
- (8) Install throttle body cables by rotating the throttle lever forward to the wide open position.
- (9) Install air inlet resonator as described in this section.
- (10) Install throttle control shield. Tighten screw to 5.6 N·m (50 in. lbs.).
- (11) Install the negative battery cable.

THROTTLE POSITION SENSOR (TPS)—2.0L

The throttle position sensor attaches to the side of the throttle body (Fig. 17).

REMOVAL

- (1) Remove the negative battery cable.
- (2) Remove throttle body. Refer to Throttle Body in this section.
- (3) Disconnect electrical connector from idle air control motor and throttle position sensor.
- (4) Remove throttle position sensor mounting screws.
- (5) Remove throttle position sensor.

INSTALLATION

- (1) The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 18). The socket has two tabs inside it. The throttle shaft rests

REMOVAL AND INSTALLATION (Continued)

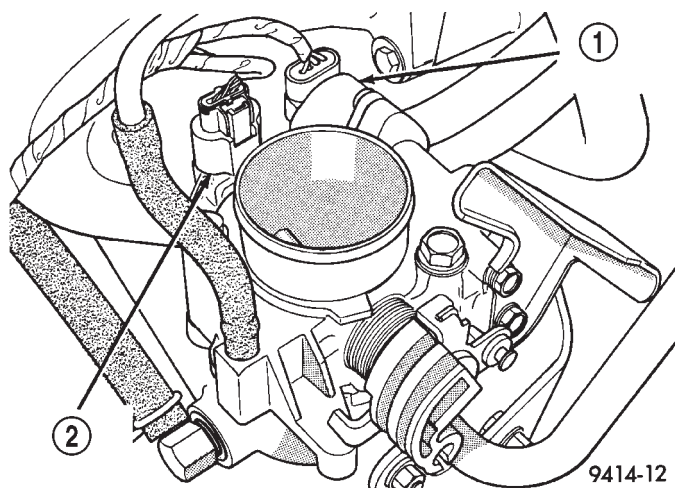


Fig. 17 Throttle Position Sensor and Idle Air Control Motor

- 1 - IDLE AIR CONTROL MOTOR
2 - THROTTLE POSITION SENSOR

against the tabs. When indexed correctly, the TPS can rotate clockwise a few degrees to line up the mounting screw holes with the screw holes in the throttle body. The TPS has slight tension when rotated into position. If it is difficult to rotate the TPS into position, reinstall the sensor with the throttle shaft on the other side of the tabs in the socket of the TPS. Tighten mounting screws to: 2.0 L = 5.3 N·m (45 in. lbs.) 2.4 L = 6.2 N·m (55 in. lbs.) torque.

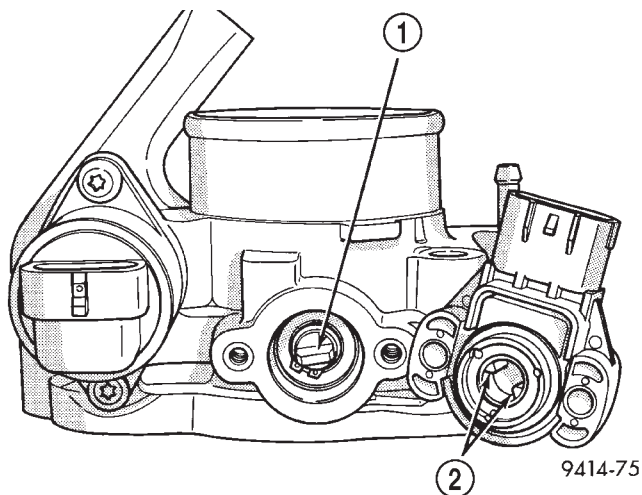


Fig. 18 Throttle Position Sensor Installation

- 1 - THROTTLE SHAFT
2 - TABS

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

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

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

(5) Install the negative battery cable.

IDLE AIR CONTROL MOTOR—2.0L

The idle air control motor attaches to the side of the throttle body (Fig. 19).

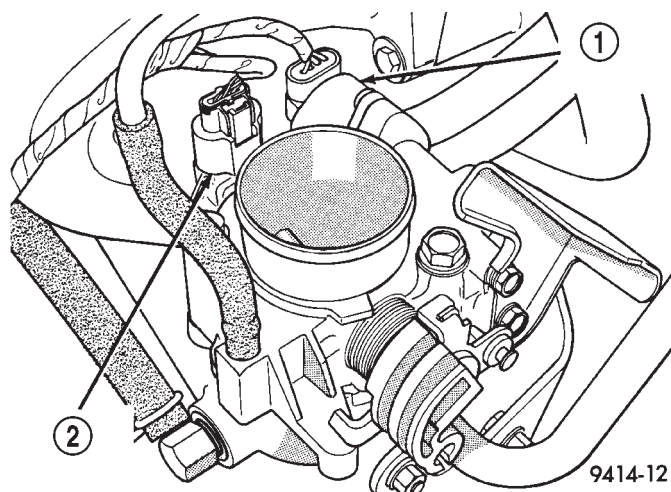


Fig. 19 Throttle Position Sensor and Idle Air Control Motor—2.0L

- 1 - IDLE AIR CONTROL MOTOR
2 - THROTTLE POSITION SENSOR

REMOVAL

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

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

(3) Remove idle air control motor mounting screws.

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

INSTALLATION

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

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

(3) Install mounting screws. Tighten screws to: 2.0L = 5.3 N·m (45 in. lbs.) torque.

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

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

MAP/IAT SENSOR—SOHC

The MAP/IAT sensor attaches to the intake manifold plenum (Fig. 20).

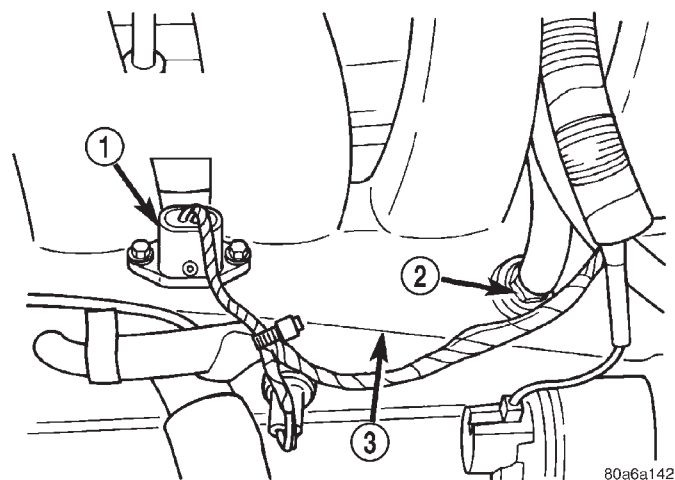
REMOVAL AND INSTALLATION (Continued)

REMOVAL

- (1) Remove the negative battery cable.
- (2) Disconnect the electrical connector from the MAP/IAT sensor.
- (3) Remove sensor mounting screws.
- (4) Remove sensor.

INSTALLATION

- (1) Insert sensor into intake manifold while making sure not to damage O-ring seal.
- (2) Tighten mounting screws to 2 N·m (20 in. lbs) torque for plastic manifold and 3 N·m (30 in. lbs.) for aluminum manifold.
- (3) Attach electrical connector to sensor.
- (4) Install the negative battery cable.

**Fig. 20 MAP/IAT Sensor—SOHC**

- 1 - MAP/AIR TEMPERATURE SENSOR
- 2 - PCV VACUUM NIPPLE
- 3 - INTAKE MANIFOLD

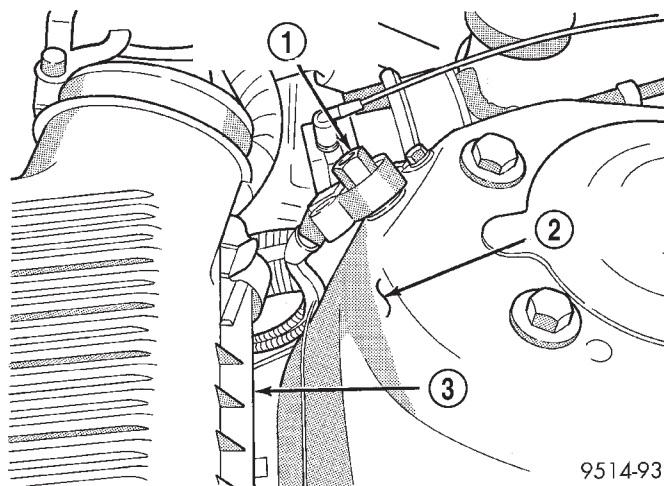
POWERTRAIN CONTROL MODULE

The PCM engine control strategy prevents reduced idle speeds until after the engine operates for 320 km (200 miles). If the PCM is replaced after 320 km (200 miles) of usage, update the mileage and vehicle identification number (VIN) in the new PCM. Use the DRB scan tool to change the mileage and VIN in the PCM. If this step is not done a Diagnostic Trouble Code (DTC) may be set. Refer to the appropriate Powertrain Diagnostic Manual and the DRB scan tool.

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

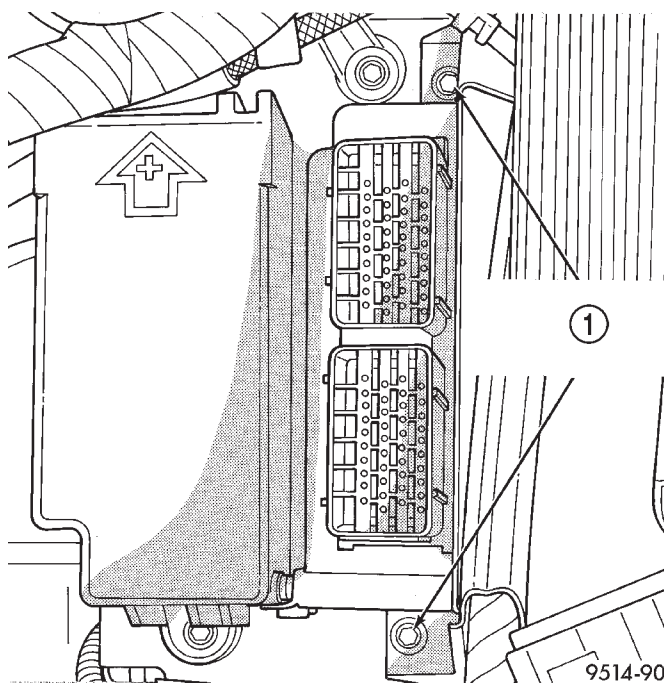
REMOVAL

- (1) Disconnect negative cable from auxiliary jumper terminal (Fig. 21).
- (2) Disconnect both 40-way connectors from PCM.

**Fig. 21 Auxiliary Jumper Terminal**

- 1 - AUXILIARY JUMPER TERMINAL
- 2 - LEFT STRUT TOWER
- 3 - AIR CLEANER HOUSING

- (3) Remove screws attaching PCM to bracket (Fig. 22).

**Fig. 22 PCM Bracket Screws**

- 1 - POWERTRAIN CONTROL MODULE BRACKET SCREWS

- (4) Lift PCM up to remove it from vehicle.

INSTALLATION

- (1) Install PCM. Tighten mounting screws.
- (2) Attach both 40-way connectors to PCM.
- (3) Connect negative cable to auxiliary jumper terminal.

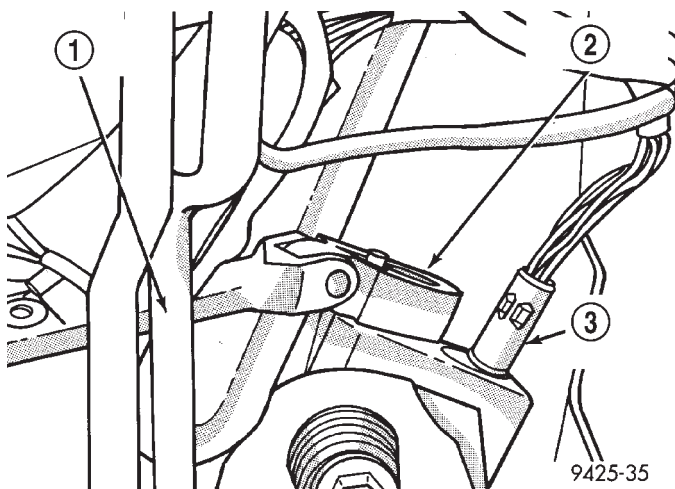
REMOVAL AND INSTALLATION (Continued)

OXYGEN SENSOR 1/1 UPSTREAM—2.0/2.4L**REMOVAL**

- (1) Remove the negative battery cable.
- (2) Raise and support vehicle.
- (3) Disconnect electrical connector from sensor.
- (4) Remove sensor using an oxygen sensor crow foot wrench such as Snap-On tool YA8875 or equivalent (Fig. 23).

INSTALLATION

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

**Fig. 23 Oxygen Sensor 1/1 Upstream**

- 1 - EXHAUST PIPE FLANGE
2 - CROW FOOT WRENCH
3 - UPSTREAM OXYGEN SENSOR

OXYGEN SENSOR 1/2 DOWNSTREAM

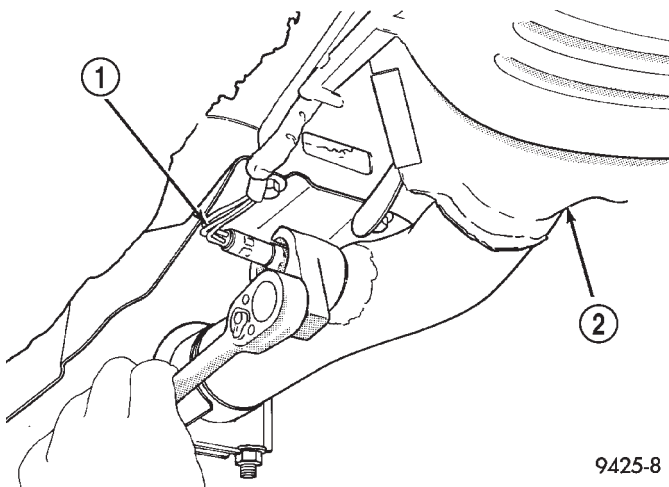
The downstream heated oxygen sensor threads into the exhaust pipe behind the catalytic converter.

REMOVAL

- (1) Remove the negative battery cable.
- (2) Raise vehicle.
- (3) Disconnect electrical connector from sensor.
- (4) Disconnect sensor electrical harness from clips along body.
- (5) Remove sensor using an oxygen sensor crow foot wrench such as Snap-On tool YA8875 or equivalent (Fig. 24).

INSTALLATION

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

**Fig. 24 Oxygen Sensor 1/2 Downstream**

- 1 - DOWNSTREAM HEATED OXYGEN SENSOR
2 - CATALYTIC CONVERTOR

AIR INLET RESONATOR**2.0L****REMOVAL**

- (1) Loosen screw holding resonator to throttle body (Fig. 25).
- (2) Loosen clamp holding resonator to air inlet tube. Remove resonator.

INSTALLATION

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

AIR CLEANER

The air cleaner housing attaches to the inner fender in front of the driver's side strut tower (Fig. 26). An ambient air duct supplies underhood air for the engine.

REMOVAL AND INSTALLATION (Continued)

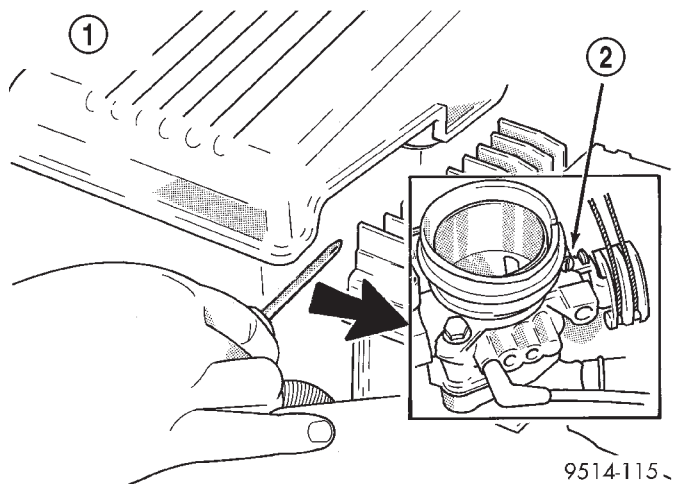


Fig. 25 Air Inlet Resonator Attachment to Throttle Body

- 1 - AIR INLET RESONATOR
2 - RESONATOR CLAMP SCREW

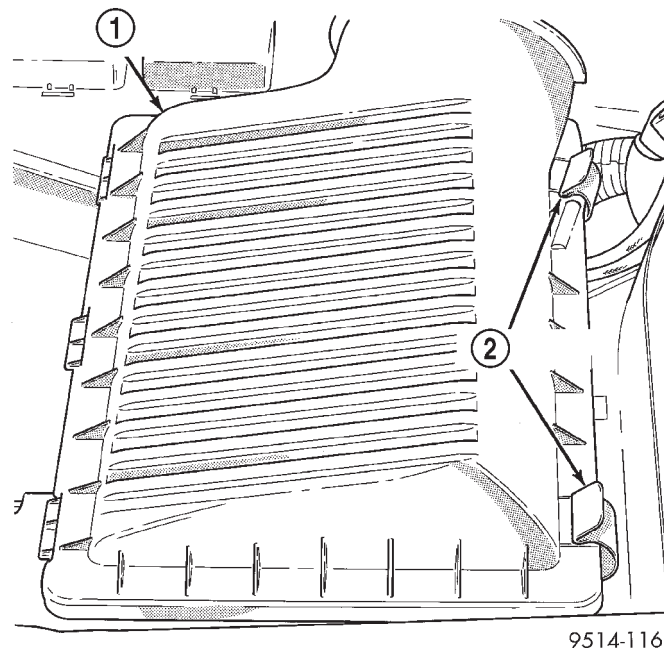


Fig. 27 Air Cleaner Cover Clasps

- 1 - AIR CLEANER HOUSING COVER
2 - CLASPS

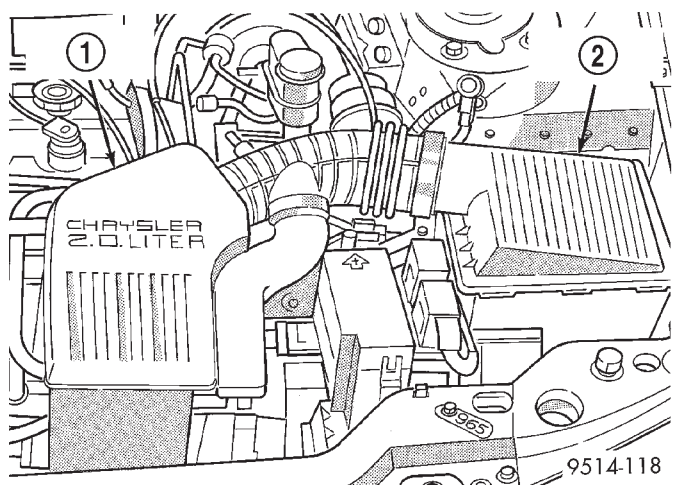


Fig. 26 Air Inlet System

- 1 - AIR INLET RESONATOR
2 - AIR CLEANER HOUSING

FILTER ELEMENT REPLACEMENT

REMOVAL

- (1) Unfasten clasps on rear of air cleaner housing cover. Lift cover off air cleaner housing (Fig. 27).
- (2) Remove filter element (Fig. 28).
- (3) If necessary, clean the inside of the air cleaner housing.

INSTALLATION

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

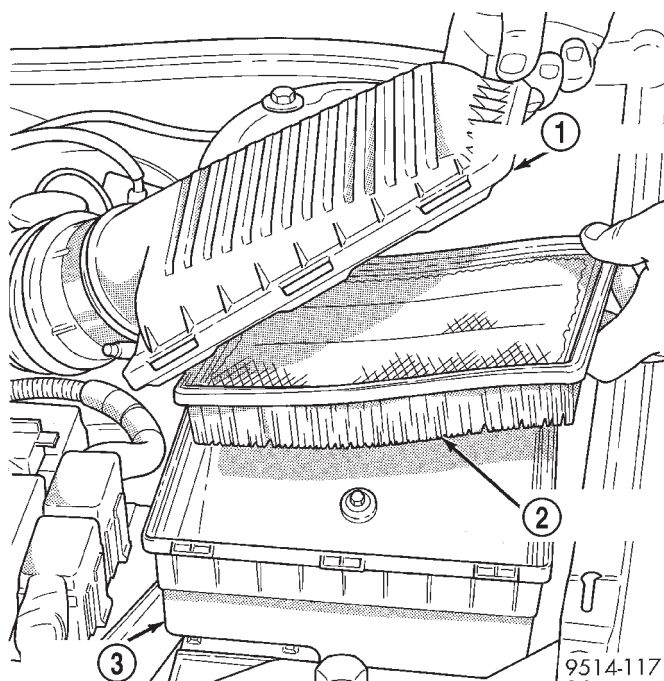


Fig. 28 Air Cleaner Housing and Element

- 1 - HOUSING COVER
2 - AIR CLEANER ELEMENT
3 - HOUSING

REMOVAL AND INSTALLATION (Continued)

ENGINE COOLANT TEMPERATURE SENSOR**2.0L**

The engine coolant temperature sensor threads into the rear of the cylinder head (Fig. 29).

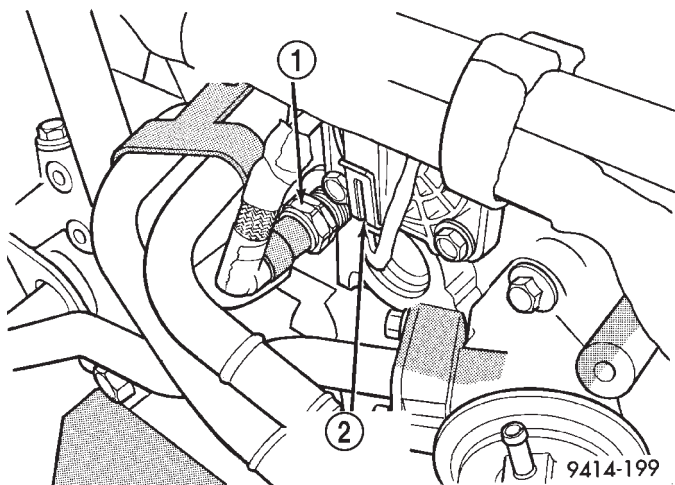


Fig. 29 Engine Coolant Temperature Sensor—2.0L Engine

- 1 - ENGINE COOLANT TEMPERATURE SENSOR
2 - CAMSHAFT POSITION SENSOR

REMOVAL

- (1) Remove the negative battery cable.
- (2) With the engine cold, drain coolant until level drops below sensor level. Refer to the Cooling System section.
- (3) Disconnect coolant sensor electrical connector.
- (4) Remove coolant sensor.

INSTALLATION

- (1) Install coolant sensor. Tighten sensor to: 19 ± 2 N·m (14 ± 2 ft. lbs.) torque.
- (2) Attach electrical connector to sensor.
- (3) Fill cooling system. Refer to the Cooling System section.
- (4) Install the negative battery cable.

VEHICLE SPEED SENSOR

The vehicle speed sensor is located in the transmission extension housing (Fig. 30) or (Fig. 31).

REMOVAL

- (1) Remove the negative battery cable.
- (2) Raise and support vehicle.
- (3) Disconnect electrical connector from sensor.
- (4) Remove the sensor mounting bolt.
- (5) Lift the sensor out of the transaxle extension housing. Ensure the O-ring was removed with the sensor.

INSTALLATION

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

- (1) With O-ring in place, install sensor.
- (2) Install mounting bolt and tighten to 7 N·m (60 in.lbs.).
- (3) Connect electrical connector to sensor.
- (4) Lower vehicle.
- (5) Install the negative battery cable.

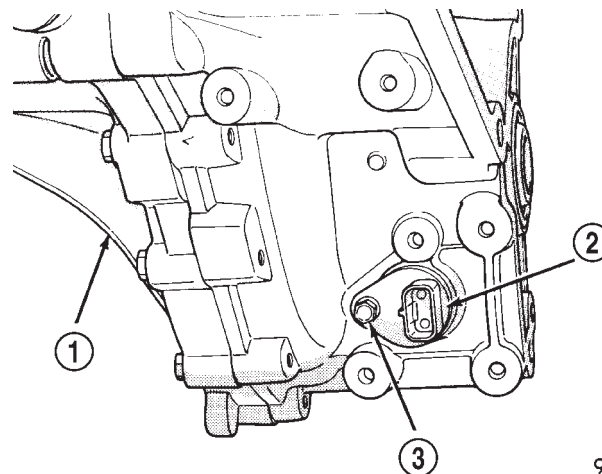


Fig. 30 Vehicle Speed Sensor Manual

- 1 - TRANSAXLE
2 - SPEED SENSOR
3 - SPEED SENSOR RETAINING BOLT

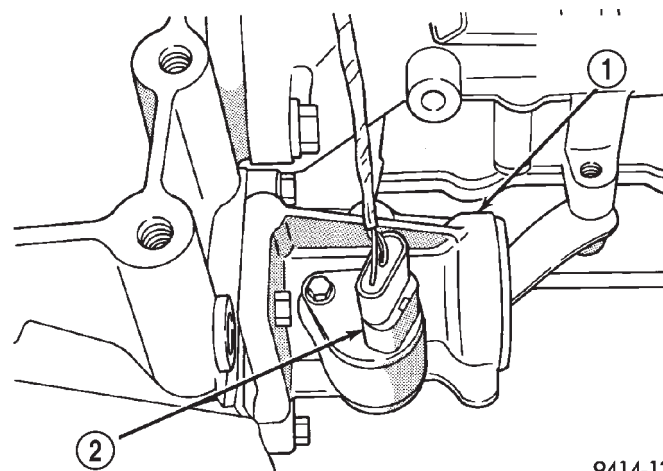


Fig. 31 Vehicle Speed Sensor Automatic

- 1 - TRANSAXLE EXTENSION HOUSING
2 - VEHICLE SPEED SENSOR

SPECIFICATIONS

VEHICLE EMISSION CONTROL INFORMATION LABEL

DESCRIPTION

All models have a Vehicle Emission Control Information (VECI) Label. Chrysler permanently attaches the label in the engine compartment. It cannot be removed without defacing information and destroying the label.

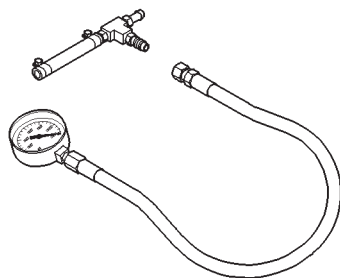
The label contains the vehicle's emission specifications and vacuum hose routings. All hoses must be connected and routed according to the label.

TORQUE

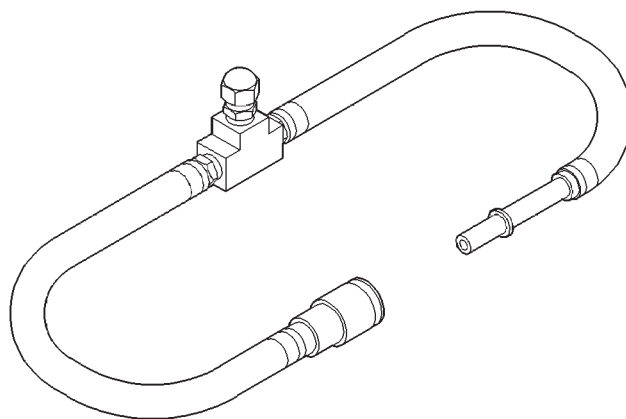
DESCRIPTION	TORQUE
Camshaft Position Sensor . . .	12 N·m (105 in. lbs.)
Crankshaft Position Sensor . .	12 N·m (105 in. lbs.)
Engine Coolant Temperature Sensor	28 N·m (20 ft. lbs.)
IAC Motor-To-Throttle Body Bolts	3 N·m (25 in. lbs.)
MAP Sensor Mounting Screws . .	3 N·m (25 in. lbs.)
Oxygen Sensor	28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

SPECIAL TOOLS

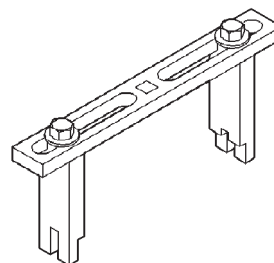
FUEL



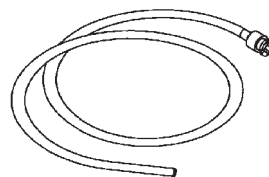
Pressure Gauge Assembly C-4799-B



Fuel Pressure Test Adapter 6539



Spanner Wrench 6856



Fuel Line Adapter 1/4



O2S (Oxygen Sensor) Remover/Installer—C-4907