FUEL SYSTEM

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FUEL DELIVERY

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FUEL DELIVERY

DESCRIPTION

The fuel delivery system consists of:

- the 2–section fuel pump module containing the electric fuel pump, fuel pressure regulator, fuel gauge sending unit (fuel level sensor) and a fuel filter located inside the lower section of pump module
- fuel tubes/lines/hoses
- A separately mounted main fuel filter
- quick-connect fittings
- fuel injector rail
- fuel tank
- fuel tank filler/vent tube assembly
- fuel tank filler tube cap
- accelerator pedal
- throttle cable

Certain fuel delivery components can be found in (Fig. 1).

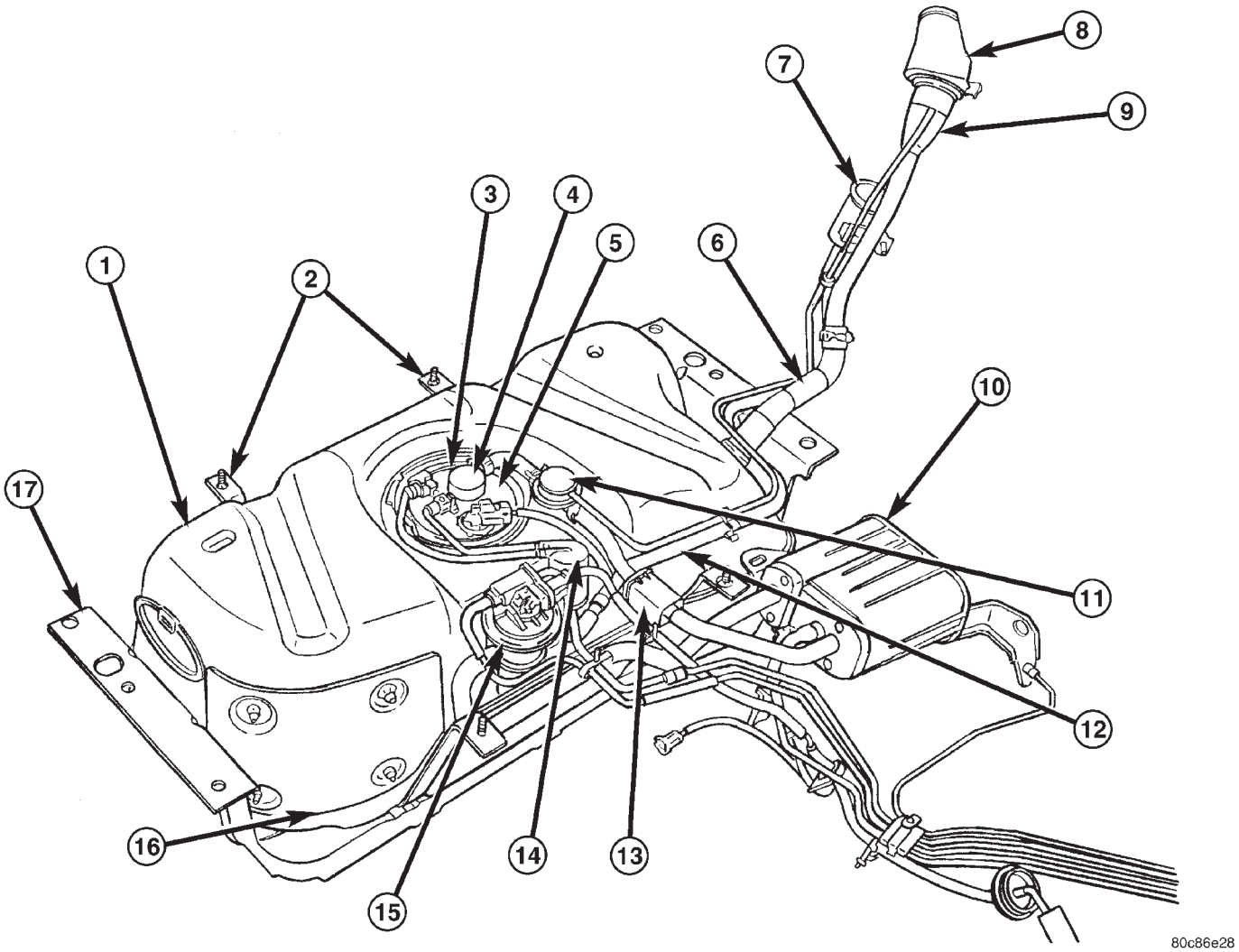


Fig. 1 FUEL DELIVERY COMPONENTS

1 - FUEL TANK
2 - FUEL TANK STRAPS
3 - FUEL PUMP MODULE LOCK RING
4 - CHECK (CONTROL) VALVE
5 - FUEL PUMP MODULE FLANGE
6 - FUEL FILL HOSE
7 - FRESH AIR FILTER
8 - FUEL FILL CAP/BEZEL
9 - FUEL FILL TUBE
10 - EVAP CANISTER
11 - FLOW MANAGEMENT VALVE
12 - FRESH AIR TUBE
13 - HOSE SLEEVE
14 - FUEL FILTER
15 - LEAK DETECTION PUMP
16 - HEAT SHIELD
17 - SKID PLATE

FUEL DELIVERY (Continued)

OPERATION

Fuel is picked up in the fuel tank by the fuel pump module. This module is located on the bottom of the fuel tank.

A fuel return system is provided within the fuel pump module using check valves. A separate fuel return line from the engine to the tank is not used.

The fuel pressure regulator and the main fuel filter are not combined. They are separate items.

The fuel tank assembly consists of: the fuel tank, fuel pump module assembly, fuel pump module lock ring/gasket, ORVR components. Refer to 25, Emission Control System for ORVR information.

A fuel filler/vent tube assembly using a pressure/vacuum, 1/4 turn fuel filler cap is used. The fuel filler tube contains a flap door located below the fuel fill cap. A one-way check valve is installed into the tanks fuel fill fitting.

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

Both fuel filters (mounted to front of fuel tank, and inside the bottom fuel pump module) are designed for extended service. They do not require normal scheduled maintenance. The bottom section of the fuel pump module (with included filter) should only be replaced if a diagnostic procedure indicates to do so. Also, the fuel filter mounted to the front of the fuel tank should only be replaced if a diagnostic procedure indicates to do so.

DIAGNOSIS AND TESTING - FUEL PRESSURE LEAK DOWN TEST

Use this test in conjunction with the Fuel Pump Pressure Test and Fuel Pump Capacity Test.

Check Valve Operation: The electric fuel pump outlet contains a one-way check valve to prevent fuel flow back into the tank and to maintain fuel supply line pressure (engine warm) when pump is not operational. It is also used to keep the fuel supply line full of gasoline when pump is not operational. After the vehicle has cooled down, fuel pressure may drop to 0 psi (cold fluid contracts), but liquid gasoline will remain in fuel supply line between the check valve and fuel injectors. **Fuel pressure that has dropped to 0 psi on a cooled down vehicle (engine off) is a normal condition.** When the electric fuel pump is activated, fuel pressure should **immediately** (1–2 seconds) rise to specification.

Abnormally long periods of cranking to restart a **hot** engine that has been shut down for a short period of time may be caused by:

- Fuel pressure bleeding past a fuel injector(s).
- Fuel pressure bleeding past the check valve in the fuel pump module.

(1) Disconnect the fuel inlet line at fuel rail. Refer to Quick Connect Fittings for procedures. On some engines, air cleaner housing removal may be necessary before fuel line disconnection.

(2) Obtain correct Fuel Line Pressure Test Adapter Tool Hose. Tool number 6539 is used for 5/16” fuel lines and tool number 6631 is used for 3/8” fuel lines.

(3) Connect correct Fuel Line Pressure Test Adapter Tool Hose between disconnected fuel line and fuel rail (Fig. 2).

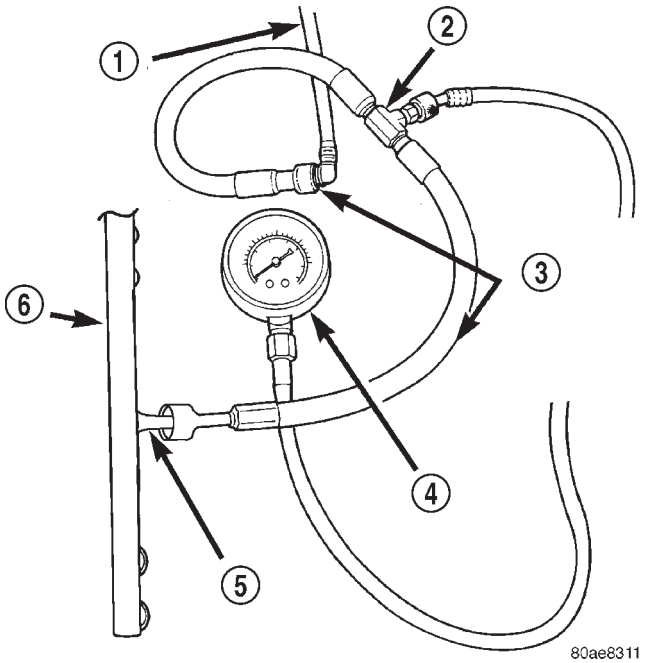


Fig. 2 CONNECTING ADAPTER TOOL—TYPICAL

1 - VEHICLE FUEL LINE
2 - TEST PORT “T”
3 - SPECIAL TOOL 6923, 6631, 6541 OR 6539
4 - FUEL PRESSURE TEST GAUGE
5 - FUEL LINE CONNECTION AT RAIL
6 - FUEL RAIL

(4) Connect the 0-414 kPa (0-60 psi) fuel pressure test gauge (from Gauge Set 5069) to the test port on the appropriate Adaptor Tool. **The DRB® III Scan Tool along with the PEP module, the 500 psi pressure transducer, and the transducer-to-test port adapter may also be used in place of the fuel pressure gauge.**

The fittings on both tools must be in good condition and free from any small leaks before performing the proceeding test.

(5) Start engine and bring to normal operating temperature.

(6) Observe test gauge. Normal operating pressure should be 339 kPa +/–34 kPa (49.2 psi +/–5 psi).

(7) Shut engine off.

FUEL DELIVERY (Continued)

(8) Pressure should not fall below **30 psi for five minutes.**

(9) If pressure falls below 30 psi, it must be determined if a fuel injector, the check valve within the fuel pump module, or a fuel tube/line is leaking.

(10) Again, start engine and bring to normal operating temperature.

(11) Shut engine off.

(12) **Testing for fuel injector or fuel rail leakage:** Clamp off the rubber hose portion of Adaptor Tool between the fuel rail and the test port "T" on Adapter Tool. If pressure now holds at or above 30 psi, a fuel injector or the fuel rail is leaking.

(13) **Testing for fuel pump check valve, filter, regulator check valve or fuel tube/line leakage:** Clamp off the rubber hose portion of Adaptor Tool between the vehicle fuel line and test port "T" on Adapter Tool. If pressure now holds at or above 30 psi, a leak may be found at a fuel tube/line. If no leaks are found at fuel tubes or lines, one of the check valves in either the electric fuel pump, fuel filter or fuel pressure regulator may be leaking.

Note: A quick loss of pressure usually indicates a defective check valve in the pressure regulator. A slow loss of pressure usually indicates a defective check valve in the bottom of the fuel pump module. The check valves are not serviced separately. Also, the electric fuel pump is not serviced separately.

STANDARD PROCEDURE - FUEL SYSTEM PRESSURE RELEASE

Use following procedure if the fuel injector rail is, or is not equipped with a fuel pressure test port.

(1) Remove fuel fill cap.

(2) Remove fuel pump relay from Power Distribution Center (PDC). For location of relay, refer to label on underside of PDC cover.

(3) Start and run engine until it stalls.

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

(5) 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.

(6) Unplug connector from any fuel injector.

(7) Attach one end of a jumper wire with alligator clips (18 gauge or smaller) to either injector terminal.

(8) Connect other end of jumper wire to positive side of battery.

(9) Connect one end of a second jumper wire to remaining injector terminal.

CAUTION: Powering an injector for more than a few seconds will permanently damage the injector.

(10) Momentarily touch other end of jumper wire to negative terminal of battery for no more than a few seconds.

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

(12) Disconnect quick-connect fitting at fuel rail. Refer to Quick-Connect Fittings.

(13) Return fuel pump relay to PDC.

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

FUEL DELIVERY (Continued)

SPECIFICATIONS

FUEL SYSTEM PRESSURE

339 kPa +/- 34 kPa (49.2 psi +/- 2 psi).

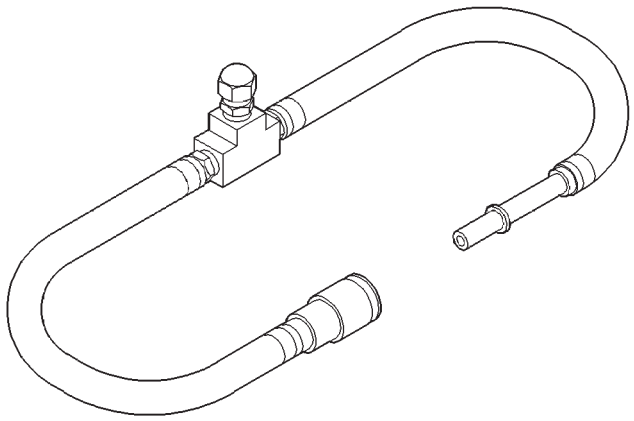
TORQUE

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Accelerator Pedal Bracket Mounting Nuts	12	-	105
Crankshaft Position Sensor - 2.4L	28	21	-
Crankshaft Position Sensor - 3.7L	28	21	-
Camshaft Position Sensor - 2.4L	12	-	106
Camshaft Position Sensor - 3.7L	12	-	106
Engine Coolant Temperature Sensor	11	-	96
EVAP Canister-to-Body Bolts	48	35	-
EVAP Canister-to-Canis. Bracket Bolt/Nut	11	-	100
Fuel Filler Hose Clamp at Tank	3	-	30
Fuel Filler Housing-to-Body Screws	2	-	17
Fuel Filter Mounting Nut at Tank	5.5	-	49
Fuel Pump Module Access Plate Nuts	3	-	26
Fuel Rail Mounting Bolts - 3.7L	11	-	100
Fuel Rail Mounting Bolts - 2.4L	28	-	250
Fuel Tank Heat Sheild Nuts	5.5	-	49
Fuel Tank Mounting Strap Bolts	61	45	-
Fuel Tank Skid Plate and Trailer Hitch	88	65	-
IAC Motor Mounting Screws	7	-	60
Leak Detection Pump Mounting Bracket-to-Fuel Tank Nuts	5.5	-	49
Leak Detection Pump-to-Bracket Nuts	1.2	-	11
Map Sensor Mounting Screws	3	-	25
PCM-to-Mounting Bracket Mounting Screws	4	-	35
Power Steering Pressure Switch	14-22	-	124-195
TPS Mounting Screws	7	-	60
Throttle Body Mounting Bolts	11	-	100
Oxygen Sensors	30	22	-

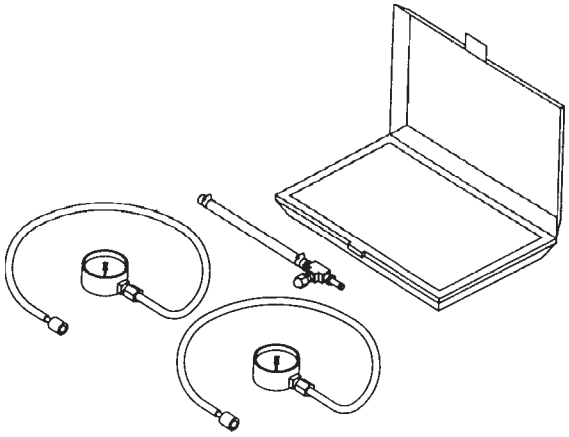
FUEL DELIVERY (Continued)

SPECIAL TOOLS

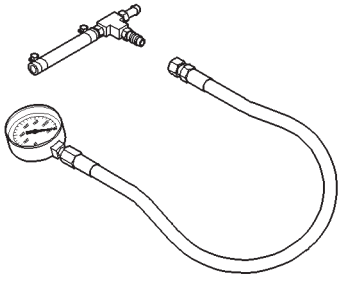
FUEL SYSTEM



ADAPTERS, FUEL PRESSURE TEST—6539 AND/OR 6631



TEST KIT, FUEL PRESSURE—5069



TEST KIT, FUEL

FLOW MANAGEMENT VALVE

DESCRIPTION

The flow management valve is a part of the ORVR system. This plastic valve is placed inline between the fuel tank vent fitting and the EVAP canister. It is located on top of the fuel tank (Fig. 1).

OPERATION

The flow management valve (Fig. 1) is one of the components used in the ORVR system. The valve meters the flow of fuel vapors to the EVAP canister during vehicle run and refueling. Pressure from the tank during refueling opens the main port valve and allows vapors to enter the EVAP canister. During vehicle run, the vapors are metered through an orifice to the EVAP canister. It is also used as a liquid separator to keep liquid fuel out of the EVAP canister.

REMOVAL

The flow management valve is located on top of the fuel tank (Fig. 1).

(1) Four cargo holdown clamps are located inside the vehicle on the floor of the rear cargo area. Remove the 2 rearward mounted clamps by drilling out the clamp rivets.

(2) Fold carpeting forward to gain access to fuel pump module access plate (Fig. 3).

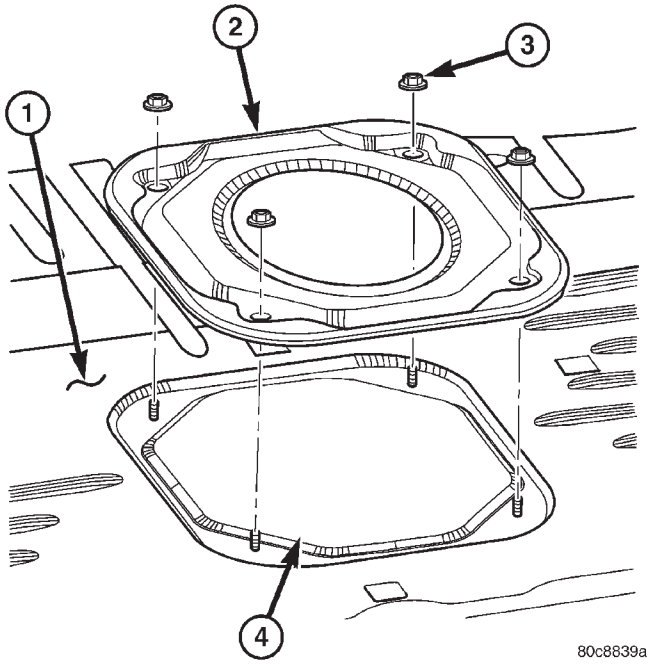


Fig. 3 ACCESS PLATE

1 - FLOORPAN AT REAR
2 - FUEL PUMP MODULE ACCESS PLATE
3 - NUTS (4)
4 - OPENING TO PUMP MODULE

FLOW MANAGEMENT VALVE (Continued)

(3) Remove 4 fuel pump module access plate nuts (Fig. 3).

(4) While applying heat from a heat gun, carefully pry up fuel pump module access plate. Take care not to bend plate.

(5) Disconnect flow management valve hose clamp and hose (Fig. 4) at pump module fitting. Also disconnect small recirculation line at top half of management valve.

(6) Raise vehicle.

(7) Disconnect opposite end of flow management valve hose at EVAP canister (Fig. 1).

(8) Remove valve and 2 hoses as an assembly.

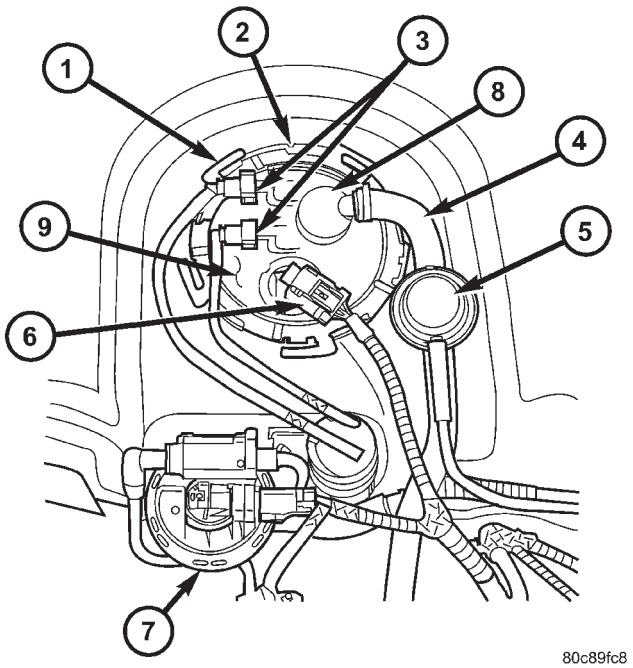


Fig. 4 TOP OF FUEL PUMP MODULE

1 - LOCK RING
2 - ALIGNMENT NOTCH
3 - FUEL FILTER FITTINGS (2)
4 - ORVR SYSTEM HOSE AND CLAMP
5 - FLOW MANAGEMENT VALVE
6 - ELECTRICAL CONNECTOR
7 - LEAK DETECTION PUMP
8 - FUEL TANK CHECK (CONTROL) VALVE
9 - FUEL PUMP MODULE (UPPER SECTION)

INSTALLATION

(1) Raise vehicle.

(2) Attach 2 large hoses and 1 small line to flow management valve. Position this assembly to top of fuel tank.

(3) Connect valve hose at EVAP canister.

(4) Lower vehicle.

(5) Attach valve hose and clamp to top of fuel pump module.

(6) Apply silicone sealant to bottom of fuel pump module metal access plate.

(7) Install fuel pump module metal access plate and 4 nuts. Tighten nuts to 3 N·m (26 in. lbs.) torque.

(8) Position carpet and install 2 new cargo clamp rivets.

FUEL FILTER

DESCRIPTION

The fuel pressure regulator and fuel filter are not combined on this vehicle. The main fuel filter is attached to the front of the fuel tank (Fig. 1) and is a serviceable/replaceable item. Also refer to Inlet Filter and Fuel Pressure Regulator.

REMOVAL

The main fuel filter is attached to the front of fuel tank (Fig. 1). Three fuel lines are used at filter.

Fuel tank removal will not be necessary for fuel filter removal. Access is from rear cargo area.

WARNING: THE FUEL SYSTEM MAY BE UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING MOST FUEL SYSTEM COMPONENTS, THE FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL SYSTEM PRESSURE RELEASE PROCEDURE.

(1) Release fuel system pressure.

(2) Four cargo holdown clamps are located inside vehicle on floor of rear cargo area. Two of these four clamps must be removed. Remove 2 rearward mounted clamps by drilling out clamp rivets.

(3) Fold carpeting forward to gain access to fuel pump module access plate (Fig. 5).

(4) Remove 4 fuel pump module access plate nuts (Fig. 5).

(5) While applying heat from a heat gun, carefully pry up metal fuel pump module access plate. Take care not to bend plate.

(6) Clean top of fuel pump module area around fuel line connection points.

(7) Disconnect 2 fuel lines at fuel pump module (Fig. 6) by pressing on tabs at side of fitting.

(8) Raise vehicle.

(9) Place drain pan under fuel filter.

(10) A third fuel line is attached to bottom of filter (Fig. 7). The disconnection point for this 3rd line is approximately 1 foot towards front of vehicle. Clean fuel line connection point before disconnection. Disconnect by pressing on tabs at side of fitting.

(11) Disconnect 3rd fuel line from body retention clip. Place a small screwdriver into side of clip and twist for removal.

FUEL FILTER (Continued)

(12) Remove filter ground strap at fuel tank mounting strap.

(13) Remove 1 filter mounting nut (Fig. 7) and remove filter.

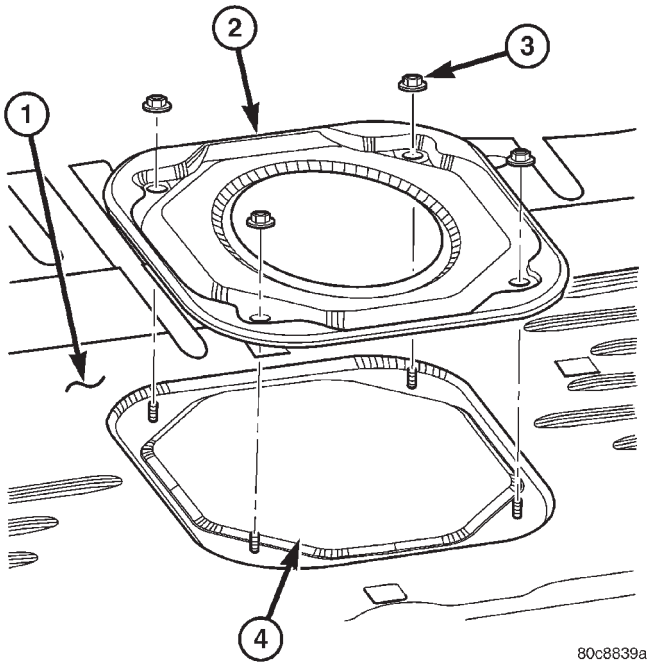


Fig. 5 ACCESS PLATE

1 - FLOORPAN AT REAR
2 - FUEL PUMP MODULE ACCESS PLATE
3 - NUTS (4)
4 - OPENING TO PUMP MODULE

INSTALLATION

(1) Raise vehicle.

(2) Position fuel lines on filter towards top of fuel tank.

(3) Position filter to mounting stud on front of fuel tank.

(4) Install filter mounting nut and tighten. Refer to torque specifications.

(5) A third fuel line is attached to bottom of filter. The connection point for this 3rd line is approximately 1 foot towards front of vehicle. Connect by snapping together.

(6) Connect 3rd fuel line to body retention clip (snaps in).

(7) Attach filter ground strap to tank mounting strap.

(8) Lower vehicle.

(9) Attach (snap on) 2 filter fuel lines at fuel pump module fittings.

(10) Start engine and check fuel line fittings for leaks.

(11) Apply silicone sealant to fuel pump module metal access plate.

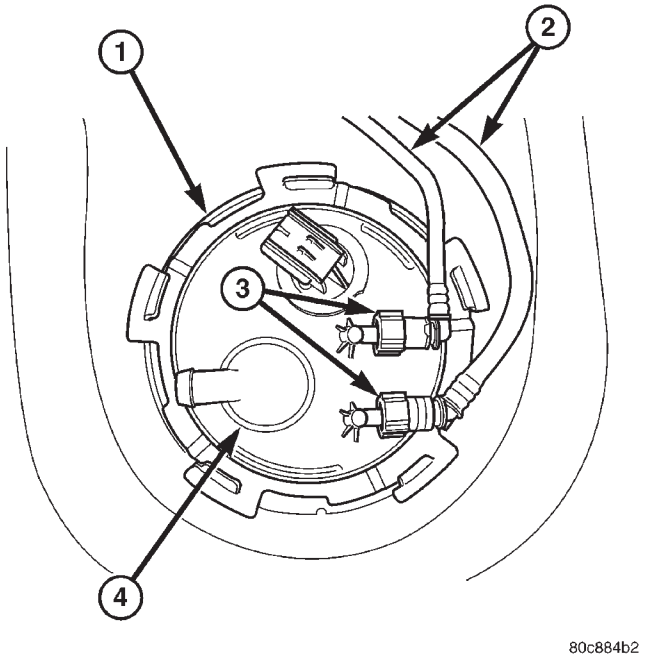


Fig. 6 FUEL LINES AT PUMP MODULE

1 - FUEL PUMP MODULE LOCKRING
2 - FUEL LINES TO FUEL FILTER (2)
3 - QUICK-CONNECT FITTINGS (2)
4 - ROLLOVER VALVE

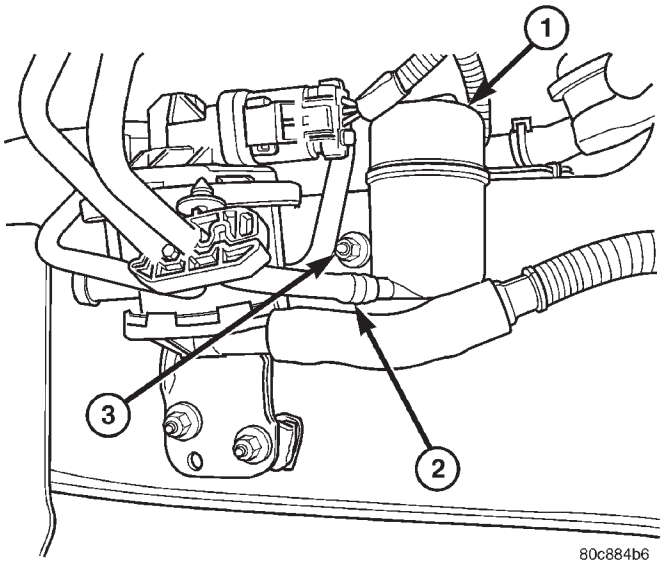


Fig. 7 FUEL FILTER LOCATION

1 - FUEL FILTER
2 - 3RD FUEL LINE TO ENGINE
3 - FILTER MOUNTING NUT

(12) Install fuel pump module metal access plate and 4 nuts. Tighten 4 nuts. Refer to torque specifications.

(13) Position carpet and install 2 new cargo clamp rivets in each cargo holdown clamp.

FUEL LEVEL SENDING UNIT / SENSOR

DESCRIPTION

The fuel gauge sending unit (fuel level sensor) is attached to the side of the fuel pump module. The sending unit consists of a float, an arm, and a variable resistor track (card).

OPERATION

The fuel pump module has 4 different circuits (wires). Two of these circuits are used for the fuel gauge sending unit for fuel gauge operation, and for certain OBD II emission requirements. The other 2 wires are used for electric fuel pump operation.

For Fuel Gauge Operation: A constant current source of approximately 32 milliamps is supplied to the resistor track on the fuel gauge sending unit. This is fed directly from the Powertrain Control Module (PCM). **NOTE: For diagnostic purposes, this 12V power source can only be verified with the circuit opened (fuel pump module electrical connector unplugged). With the connectors plugged, output voltages will vary from about 0.6 volts at FULL, to about 8.6 volts at EMPTY (about 8.6 volts at EMPTY for Jeep models, and about 7.0 volts at EMPTY for Dodge Truck models).** The resistor track is used to vary the voltage (resistance) depending on fuel tank float level. As fuel level increases, the float and arm move up, which decreases voltage. As fuel level decreases, the float and arm move down, which increases voltage. The varied voltage signal is returned back to the PCM through the sensor return circuit.

Both of the electrical circuits between the fuel gauge sending unit and the PCM are hard-wired (not multi-plexed). After the voltage signal is sent from the resistor track, and back to the PCM, the PCM will interpret the resistance (voltage) data and send a message across the multi-plex bus circuits to the instrument panel cluster. Here it is translated into the appropriate fuel gauge level reading. Refer to Instrument Panel for additional information.

For OBD II Emission Monitor Requirements: The PCM will monitor the voltage output sent from the resistor track on the sending unit to indicate fuel level. The purpose of this feature is to prevent the OBD II system from recording/setting false misfire and fuel system monitor diagnostic trouble codes. The feature is activated if the fuel level in the tank is less than approximately 15 percent of its rated capacity. If equipped with a Leak Detection Pump (EVAP system monitor), this feature will also be activated if the fuel level in the tank is more than approximately 85 percent of its rated capacity.

DIAGNOSIS AND TESTING - FUEL LEVEL SENDING UNIT

The fuel level sending unit contains a variable resistor (track). As the float moves up or down, electrical resistance will change. Refer to Instrument Panel and Gauges for Fuel Gauge testing. To test the gauge sending unit only, it must be removed from vehicle. The unit is a separate part of the lower fuel pump module section. Refer to Fuel Pump Module Removal/Installation for procedures (remove only the upper section of the fuel pump module). Measure the resistance across the sending unit terminals. With float in up position, resistance should be 20 ohms (+/- 5%). With float in down position, resistance should be 270 ohms (+/- 5%).

REMOVAL

The fuel level sending unit (fuel level sensor) and float assembly is located on the side of the lower section of the fuel pump module. The lower section of the fuel pump module is located within the fuel tank.

(1) Remove lower section of fuel pump module from fuel tank. Refer to Fuel Pump Module Removal/Installation.

(2) To remove sending unit from pump module, lift on plastic locking tab (Fig. 8) while sliding sending unit upwards.

(3) Disconnect 4–wire electrical connector (Fig. 9) from bottom of upper section of fuel pump module. Separate necessary sending unit wiring.

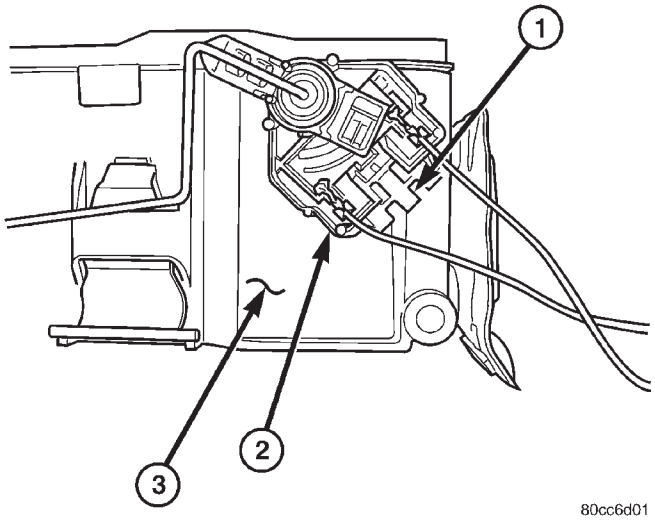


Fig. 8 FUEL LEVEL SENDING UNIT

1 - LIFT TAB HERE FOR REMOVAL
2 - FUEL LEVEL SENDING UNIT
3 - LOWER SECTION OF PUMP MODULE

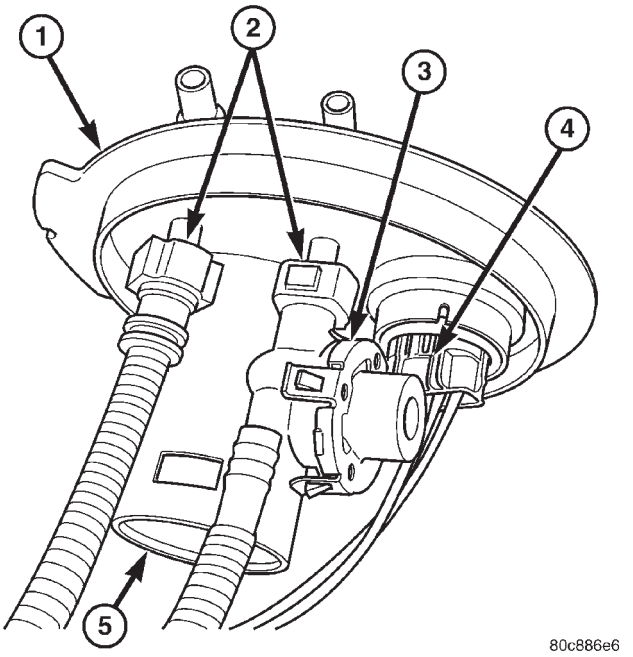


Fig. 9 FUEL PRESSURE REGULATOR/SENDING UNIT ELECTRICAL CONNECTOR

1 - UPPER SECTION OF PUMP MODULE
2 - QUICK-CONNECT FITTINGS
3 - FUEL PRESSURE REGULATOR
4 - 4-WIRE ELECTRICAL CONNECTOR
5 - FUEL TANK CHECK (CONTROL) VALVE

INSTALLATION

(1) Connect necessary wiring into electrical connectors. Connect 4–wire connector to upper section of pump module.

(2) Position sending unit to pump module. Slide and snap into place.

(3) Install lower section of fuel pump module. Refer to Fuel Pump Module Removal/Installation.

FUEL LINES

DESCRIPTION

Also refer to Quick-Connect Fittings.

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

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.

QUICK CONNECT FITTING

DESCRIPTION

Different types of quick-connect fittings are used to attach various fuel system components, lines and tubes. These are: a single-tab type, a two-tab type or a plastic retainer ring type. Some are equipped with safety latch clips. Some may require the use of a special tool for disconnection and removal. Refer to Quick-Connect Fittings Removal/Installation for more information.

CAUTION: The interior components (o-rings, clips) of quick-connect fittings are not serviced separately, but new plastic spacers are available for some types. If service parts are not available, do not attempt to repair the damaged fitting or fuel line (tube). If repair is necessary, replace the complete fuel line (tube) assembly.

STANDARD PROCEDURE - QUICK-CONNECT FITTINGS

Also refer to Fuel Tubes/Lines/Hoses and Clamps.

Different types of quick-connect fittings are used to attach various fuel system components, lines and tubes. These are: a single-tab type, a two-tab type or a plastic retainer ring type. Safety latch clips are used on certain components/lines. Certain fittings may require use of a special tool for disconnection.

DISCONNECTING

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSE, FITTING OR LINE, FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO FUEL SYSTEM PRESSURE RELEASE PROCEDURE.

QUICK CONNECT FITTING (Continued)

CAUTION: The interior components (o-rings, spacers) of some types of quick-connect fitting are not serviced separately. If service parts are not available, do not attempt to repair a damaged fitting or fuel line. If repair is necessary, replace complete fuel line assembly.

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

(2) Disconnect negative battery cable from battery.

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

(4) **2–Button Type Fitting:** This type of fitting is equipped with a push-button located on each side of quick-connect fitting (Fig. 10). Press on both buttons simultaneously for removal.

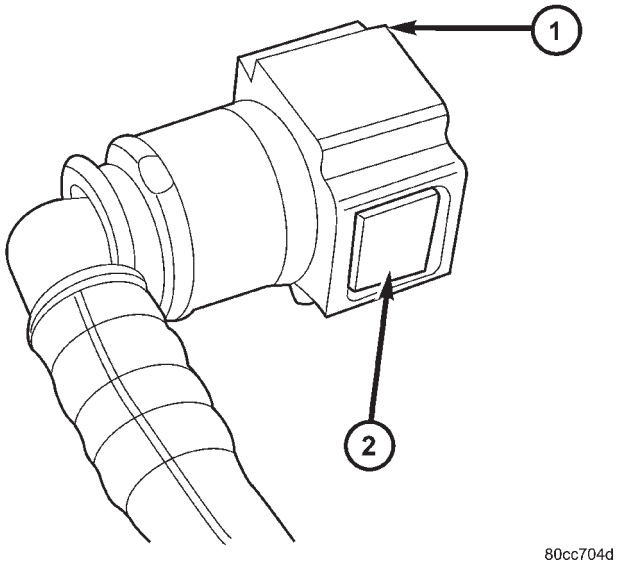


Fig. 10 2-BUTTON TYPE FITTING

1 - QUICK-CONNECT FITTING
2 - PUSH-BUTTONS (2)

(5) **Single-Tab Type Fitting:** This type of fitting is equipped with a single pull tab (Fig. 11). The tab is removable. After tab is removed, quick-connect fitting can be separated from fuel system component.

(a) Press release tab on side of fitting to release pull tab (Fig. 12). **If release tab is not pressed prior to releasing pull tab, pull tab will be damaged.**

(b) While pressing release tab on side of fitting, use screwdriver to pry up pull tab (Fig. 12).

(c) Raise pull tab until it separates from quick-connect fitting (Fig. 13).

(6) **Two-Tab Type Fitting:** This type of fitting is equipped with tabs located on both sides of fitting (Fig. 14). The tabs are supplied for disconnecting quick-connect fitting from component being serviced.

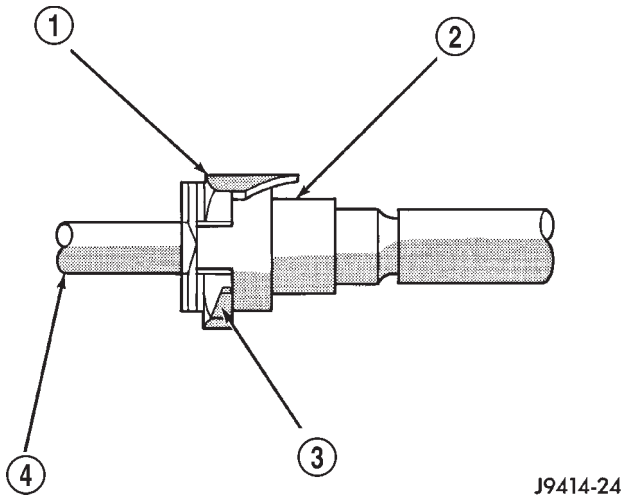


Fig. 11 SINGLE-TAB TYPE FITTING

1 - PULL TAB
2 - QUICK-CONNECT FITTING
3 - PRESS HERE TO REMOVE PULL TAB
4 - INSERTED TUBE END

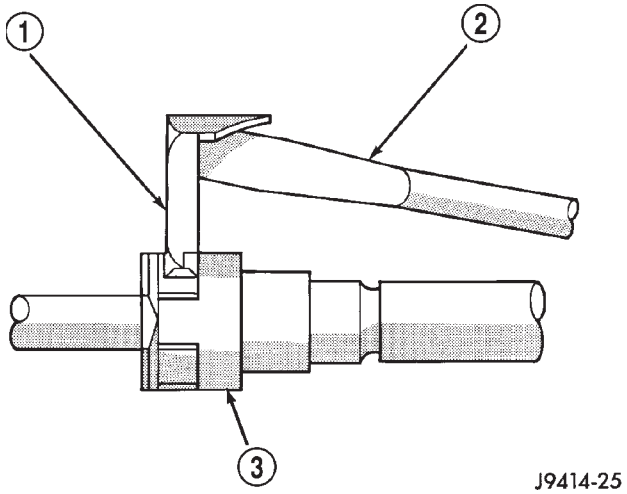


Fig. 12 DISCONNECTING SINGLE-TAB TYPE FITTING

1 - PULL TAB
2 - SCREWDRIVER
3 - QUICK-CONNECT FITTING

(a) To disconnect quick-connect fitting, squeeze plastic retainer tabs (Fig. 14) against sides of quick-connect fitting with your fingers. Tool use is not required for removal and may damage plastic retainer.

(b) Pull fitting from fuel system component being serviced.

(c) 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.

QUICK CONNECT FITTING (Continued)

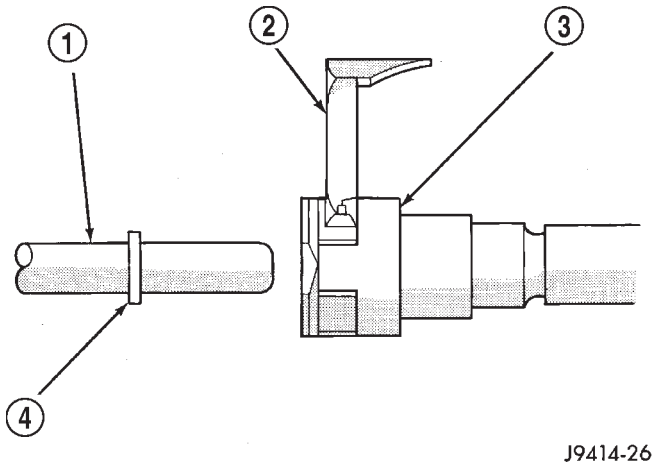


Fig. 13 REMOVING PULL TAB

1 - FUEL TUBE OR FUEL SYSTEM COMPONENT
2 - PULL TAB
3 - QUICK-CONNECT FITTING
4 - FUEL TUBE STOP

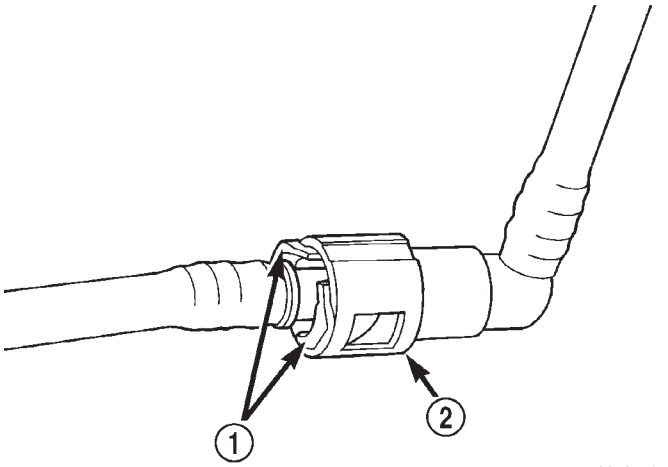


Fig. 14 TYPICAL 2–TAB TYPE FITTING

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

(7) **Plastic Retainer Ring Type Fitting:** This type of fitting can be identified by the use of a full-round plastic retainer ring (Fig. 15) usually black in color.

(a) To release fuel system component from quick-connect fitting, firmly push fitting towards component being serviced while firmly pushing plastic retainer ring into fitting (Fig. 15). 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.**

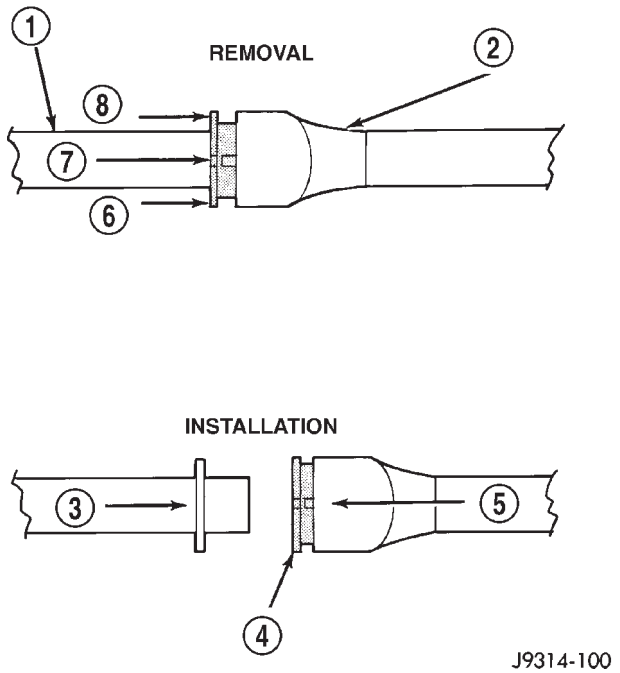


Fig. 15 PLASTIC RETAINER RING TYPE FITTING

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

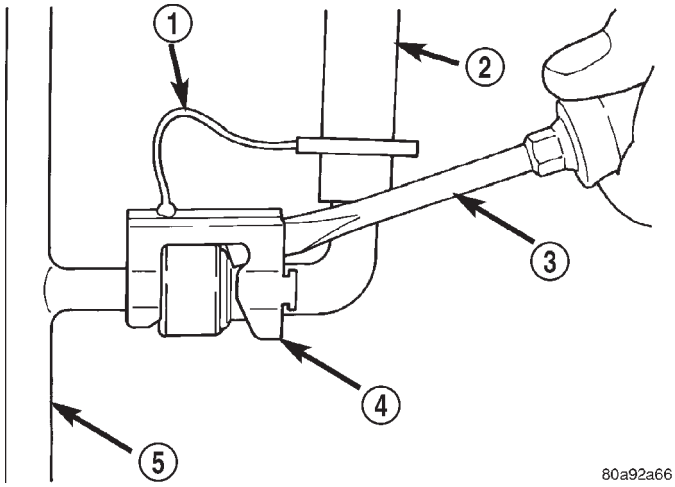


Fig. 16 LATCH CLIP-TYPE 1

1 - TETHER STRAP
2 - FUEL LINE
3 - SCREWDRIVER
4 - LATCH CLIP
5 - FUEL RAIL

QUICK CONNECT FITTING (Continued)

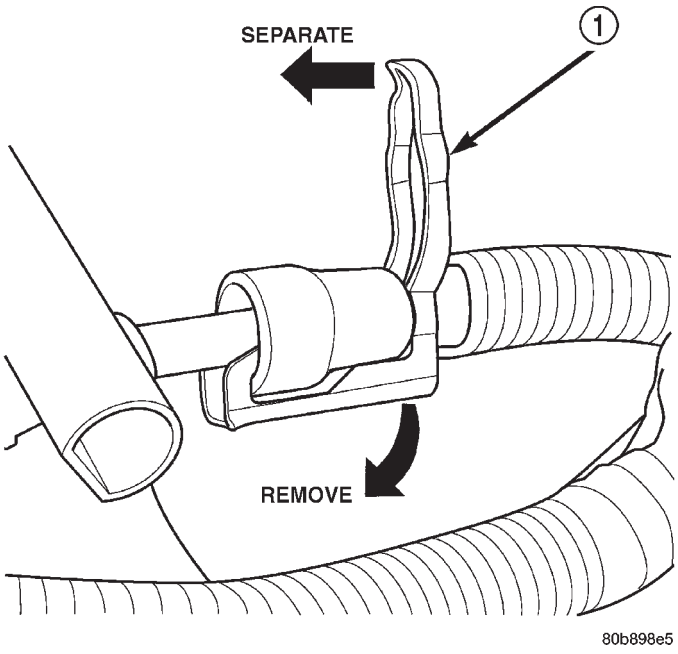


Fig. 17 LATCH CLIP-TYPE 2

1 - LATCH CLIP

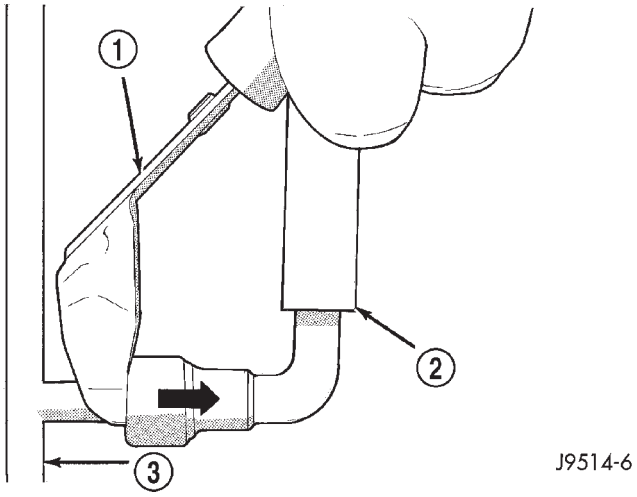


Fig. 18 FUEL LINE DISCONNECTION USING SPECIAL TOOL

1 - SPECIAL FUEL LINE TOOL
2 - FUEL LINE
3 - FUEL RAIL

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

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

(8) **Latch Clips:** Depending on vehicle model and engine, 2 different types of safety latch clips are used (Fig. 16) or (Fig. 17). Type-1 is tethered to fuel line and type-2 is not. A special tool will be necessary to disconnect fuel line after latch clip is removed. The latch clip may be used on certain fuel line/fuel rail connection, or to join fuel lines together.

(a) Type 1: Pry up on latch clip with a screwdriver (Fig. 16).

(b) Type 2: Separate and unlatch 2 small arms on end of clip (Fig. 17) and swing away from fuel line.

(c) Slide latch clip toward fuel rail while lifting with screwdriver.

(d) Insert special fuel line removal tool (Snap-On number FIH 9055-1 or equivalent) into fuel line (Fig. 18). Use tool to release locking fingers in end of line.

(e) With special tool still inserted, pull fuel line from fuel rail.

(f) After disconnection, locking fingers will remain within quick-connect fitting at end of fuel line.

(9) Disconnect quick-connect fitting from fuel system component being serviced.

CONNECTING

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

(2) 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.

(3) Insert quick-connect fitting into fuel tube or fuel system component until built-on stop on fuel tube or component rests against back of fitting.

(4) Continue pushing until a click is felt.

(5) Single-tab type fitting: Push new tab down until it locks into place in quick-connect fitting.

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

(7) Latch Clip Equipped: Install latch clip (snaps into position). **If latch clip will not fit, this indicates fuel line is not properly installed to fuel rail (or other fuel line). Recheck fuel line connection.**

(8) Connect negative cable to battery.

(9) Start engine and check for leaks.

FUEL PRESSURE REGULATOR

DESCRIPTION

The fuel pressure regulator is located on the bottom of the upper section of the fuel pump module. The fuel filter **is not combined** into the pressure regulator on this model.

FUEL PRESSURE REGULATOR (Continued)

OPERATION

The fuel pressure regulator is a mechanical device that is not controlled by engine vacuum or the Powertrain Control Module (PCM).

The regulator is calibrated to maintain fuel system operating pressure of approximately 339 kPa +/- 34 kPa (49.2 psi +/- 5 psi) at the fuel injectors. It contains a diaphragm, calibrated springs and a fuel return valve.

The main fuel filter **is not combined** within the fuel pressure regulator as in other Jeep® models. Three different fuel filters are used: 1. a serviceable, separate, externally mounted, main fuel filter; 2. a non-serviceable primary filter located on the bottom of the electric fuel pump; 3. a non-serviceable secondary filter attached to the side of the fuel pump module.

Fuel Flow: Fuel migrates into the fuel pump module reservoir through a one-way check valve located on the bottom of the module. This check valve prevents the reservoir from running empty such as when going up or down hills with a low amount of fuel in the tank. A primary fuel filter (sock) is located at the bottom of the electric fuel pump. Fuel is drawn in through this filter, and up to the electric fuel pump. High pressure fuel (unregulated) is supplied from the electric fuel pump through a high-pressure line to one of 3 fittings on the main fuel filter. If fuel pressure at the pressure regulator exceeds approximately 49 psi, an internal diaphragm within the regulator closes, and excess fuel is routed through a second fitting on the main fuel filter, and back into the fuel tank (the fuel pressure regulator is installed into the return side of the system). Pressure regulated fuel is then delivered from the third fitting on the fuel filter, up to and through the fuel rail, and on to the fuel injectors.

A secondary fuel filter is attached to the side of the fuel pump module. High-pressure from the electric fuel pump causes a siphoning action across a passage connected to this filter, and fuel is drawn into the fuel pump module reservoir. This is used to help keep the module reservoir full of fuel.

The fuel pressure regulator also acts as a check valve to maintain some fuel pressure when the engine is not operating. This will help to start the engine. A second check valve is located at the outlet of the fuel pump module housing. **Refer to Fuel Pump - Description and Operation for more information. Also refer to the Fuel Pressure Leak Down Test, and the Fuel Pump Pressure Tests.**

A separate fuel return line from the engine is not used with this system.

REMOVAL

The fuel pressure regulator is located in the fuel tank. It is attached to the bottom of the upper section of the fuel pump module with a quick-connect fitting (Fig. 19). The fuel pump module is supplied in 2 sections (upper and lower). To replace the pressure regulator, the bottom section of the fuel pump module must be replaced.

(1) Remove upper and lower sections of fuel pump module from fuel tank. Refer to Fuel Pump Module Removal/Installation.

(2) Replace lower section of fuel pump module (includes fuel pressure regulator).

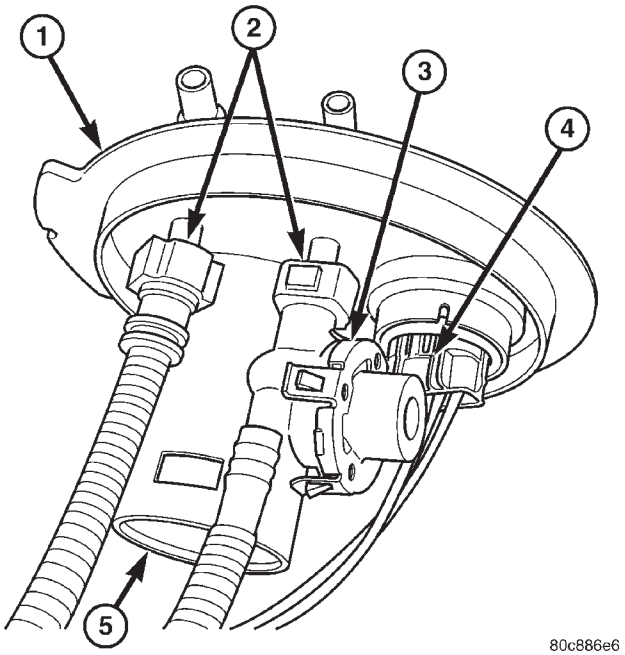


Fig. 19 FUEL PRESSURE REGULATOR/SENDING UNIT ELECTRICAL CONNECTOR

1 - UPPER SECTION OF PUMP MODULE
2 - QUICK-CONNECT FITTINGS
3 - FUEL PRESSURE REGULATOR
4 - 4-WIRE ELECTRICAL CONNECTOR
5 - FUEL TANK CHECK (CONTROL) VALVE

INSTALLATION

The fuel pressure regulator is located in the fuel tank. It is attached to the bottom of the upper section of the fuel pump module with a quick-connect fitting. The fuel pump module is supplied in 2 sections (upper and lower). To replace the pressure regulator, the bottom section of the fuel pump module must be replaced.

(1) Replace lower section of fuel pump module (includes fuel pressure regulator).

(2) Install upper and lower sections of fuel pump module to fuel tank. Refer to Fuel Pump Module Installation.

FUEL PUMP

DESCRIPTION

The electric fuel pump is located inside of the fuel pump module. A 12 volt, permanent magnet, electric motor powers the fuel pump. The electric fuel pump is not a separate, serviceable component.

OPERATION

Voltage to operate the electric pump is supplied through the fuel pump relay.

Fuel is drawn in through a filter at the bottom of the module and pushed through the electric motor gearset to the pump outlet.

Check Valve Operation: The bottom section of the fuel pump module contains a one-way check valve to prevent fuel flow back into the tank and to maintain fuel supply line pressure (engine warm) when pump is not operational. It is also used to keep the fuel supply line full of gasoline when pump is not operational. After the vehicle has cooled down, fuel pressure may drop to 0 psi (cold fluid contracts), but liquid gasoline will remain in fuel supply line between the check valve and fuel injectors. **Fuel pressure that has dropped to 0 psi on a cooled down vehicle (engine off) is a normal condition.** Refer to the Fuel Pressure Leak Down Test for more information.

The electric fuel pump is not a separate, serviceable component.

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - FUEL PUMP CAPACITY TEST

Before performing this test, verify fuel pump pressure. Refer to Fuel Pump Pressure Test. Use this test in conjunction with the Fuel Pressure Leak Down Test.

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

(2) Disconnect fuel supply line at fuel rail. Refer to Quick-Connect Fittings. Some engines may require air cleaner housing removal before line disconnection.

(3) Obtain correct Fuel Line Pressure Test Adapter Tool Hose. Tool number 6539 is used for 5/16” fuel lines and tool number 6631 is used for 3/8” fuel lines.

(4) Connect correct Fuel Line Pressure Test Adapter Tool Hose into disconnected fuel supply line. Insert other end of Adaptor Tool Hose into a graduated container.

(5) Remove fuel fill cap.

(6) To activate fuel pump and pressurize system, obtain DRB® scan tool and actuate ASD Fuel System Test.

(7) A good fuel pump will deliver at least 1/10 liter of fuel in 7 seconds. Do not operate fuel pump for longer than 7 seconds with fuel line disconnected as fuel pump module reservoir may run empty.

(a) If capacity is lower than specification, but fuel pump can be heard operating through fuel fill cap opening, check for a kinked/damaged fuel supply line somewhere between fuel rail and fuel pump module.

(b) If line is not kinked/damaged, and fuel pressure is OK, but capacity is low, replace fuel filter. Refer to Fuel Filter Removal/Installation for additional information.

(c) If both fuel pressure and capacity are low, replace bottom section of fuel pump module. Refer to Fuel Pump Module Removal/Installation.

DIAGNOSIS AND TESTING - FUEL PUMP PRESSURE TEST

Use this test in conjunction with the Fuel Pump Capacity Test, Fuel Pressure Leak Down Test and Fuel Pump Amperage Test found elsewhere in this group.

Check Valve Operation: The bottom section of the fuel pump module contains a one-way check valve to prevent fuel flow back into the tank and to maintain fuel supply line pressure (engine warm) when pump is not operational. It is also used to keep the fuel supply line full of gasoline when pump is not operational. After the vehicle has cooled down, fuel pressure may drop to 0 psi (cold fluid contracts), but liquid gasoline will remain in fuel supply line between the check valve and fuel injectors. **Fuel pressure that has dropped to 0 psi on a cooled down vehicle (engine off) is a normal condition.** When the electric fuel pump is activated, fuel pressure should **immediately** (1–2 seconds) rise to specification.

The fuel system is equipped with a separate fuel pump module mounted, fuel pressure regulator. The fuel filter is remotely mounted. The fuel pressure regulator is not controlled by engine vacuum.

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT FUEL PRESSURE EVEN WITH THE ENGINE OFF. BEFORE DISCONNECTING FUEL LINE AT FUEL RAIL, THIS PRESSURE MUST BE RELEASED. REFER TO THE FUEL SYSTEM PRESSURE RELEASE PROCEDURE.

FUEL PUMP (Continued)

(1) Remove protective cap at fuel rail test port. Connect the 0–414 kPa (0-60 psi) fuel pressure gauge (from gauge set 5069) to test port pressure fitting on fuel rail (Fig. 20). **The DRB® III Scan Tool along with the PEP module, the 500 psi pressure transducer, and the transducer-to-test port adapter may also be used in place of the fuel pressure gauge.**

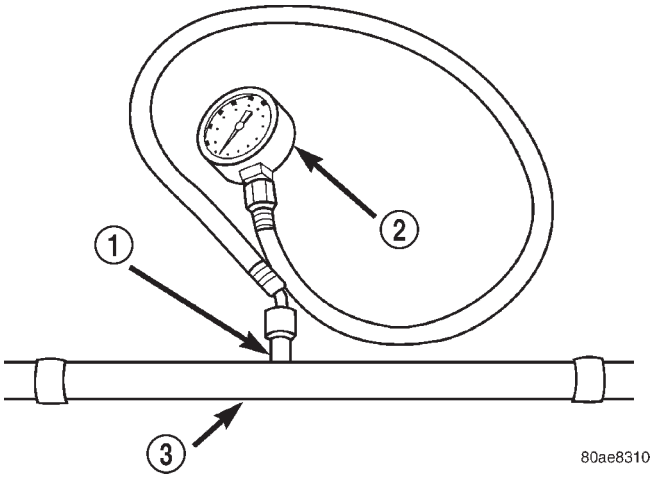


Fig. 20 FUEL PRESSURE TEST GAUGE (TYPICAL GAUGE INSTALLATION AT TEST PORT)

1 - SERVICE (TEST) PORT
2 - FUEL PRESSURE TEST GAUGE
3 - FUEL RAIL

(2) Start and warm engine and note pressure gauge reading. Fuel pressure should be 339 kPa ± 34 kPa (49.2 psi ± 5 psi) at idle.

(3) If engine runs, but pressure is below 44.2 psi, check for a kinked fuel supply line somewhere between fuel rail and fuel pump module. If line is not kinked, but specifications for either the Fuel Pump Capacity, Fuel Pump Amperage or Fuel Pressure Leak Down Tests were not met, replace lower section of fuel pump module. Refer to Fuel Pump Module Removal/Installation.

(4) If operating pressure is above 54.2 psi, electric fuel pump is OK, but fuel pressure regulator is defective. Replace lower section of fuel pump module. Refer to Fuel Pump Module Removal/Installation.

(5) Install protective cap to fuel rail test port.

DIAGNOSIS AND TESTING - FUEL PUMP AMPERAGE TEST

This amperage (current draw) test is to be done in conjunction with the Fuel Pump Pressure Test, Fuel Pump Capacity Test and Fuel Pressure Leak Down Test. Before performing the amperage test, be sure the temperature of the fuel tank is above 50° F (10° C).

The DRB® Scan Tool along with the DRB Low Current Shunt (LCS) adapter (Fig. 21) and its test leads will be used to check fuel pump amperage specifications.

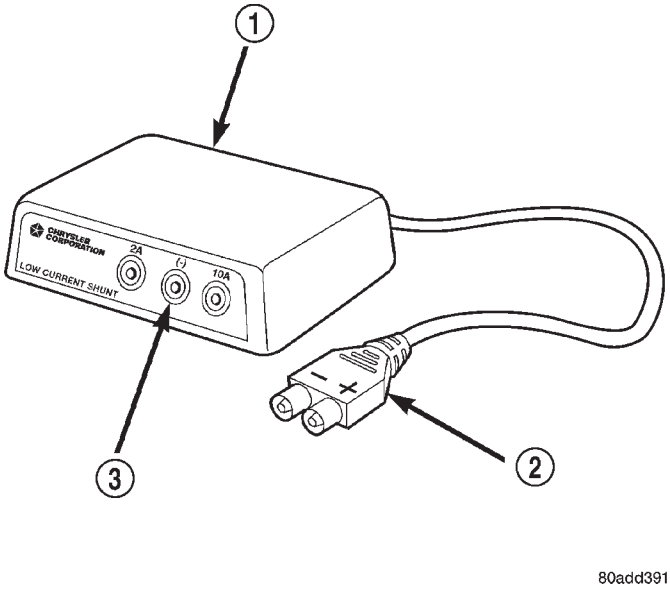


Fig. 21 LOW CURRENT SHUNT

1 - LOW CURRENT SHUNT ADAPTER
2 - PLUG TO DRB
3 - TEST LEAD RECEPTACLES

(1) Be sure fuel tank contains fuel before starting test. If tank is empty or near empty, amperage readings will be incorrect.

(2) Obtain LCS adapter.

(3) Plug cable from LCS adapter into DRB scan tool at SET 1 receptacle.

(4) Plug DRB into vehicle 16–way connector (data link connector).

(5) Connect (-) and (+) test cable leads into LCS adapter receptacles. Use **10 amp (10A +)** receptacle and common (-) receptacles.

(6) Gain access to MAIN MENU on DRB screen.

(7) Press DVOM button on DRB.

(8) Using left/right arrow keys, highlight CHANNEL 1 function on DRB screen.

(9) Press ENTER three times.

(10) Using up/down arrow keys, highlight RANGE on DRB screen (screen will default to 2 amp scale).

(11) Press ENTER to change 2 amp scale to 10 amp scale. **This step must be done to prevent damage to DRB scan tool or LCS adapter (blown fuse).**

(12) Remove cover from Power Distribution Center (PDC).

(13) Remove fuel pump relay from PDC. Refer to label on PDC cover for relay location.

FUEL PUMP (Continued)

WARNING: BEFORE PROCEEDING TO NEXT STEP, NOTE THE FUEL PUMP WILL BE ACTIVATED AND SYSTEM PRESSURE WILL BE PRESENT. THIS WILL OCCUR AFTER CONNECTING TEST LEADS FROM LCS ADAPTER INTO FUEL PUMP RELAY CAVITIES. THE FUEL PUMP WILL OPERATE EVEN WITH IGNITION KEY IN OFF POSITION. BEFORE ATTACHING TEST LEADS, BE SURE ALL FUEL LINES AND FUEL SYSTEM COMPONENTS ARE CONNECTED.

CAUTION: To prevent possible damage to the vehicle electrical system and LCS adapter, the test leads must be connected into relay cavities exactly as shown in following steps.

Depending upon vehicle model, year or engine configuration, three different types of relays may be used: Type-1, type-2 and type–3.

(14) If equipped with **type–1 relay** (Fig. 22), attach test leads from LCS adapter into PDC relay cavities number 30 and 87. For location of these cavities, refer to numbers stamped to bottom of relay (Fig. 22).

(15) If equipped with **type–2 relay** (Fig. 23), attach test leads from LCS adapter into PDC relay cavities number 30 and 87. For location of these cavities, refer to numbers stamped to bottom of relay (Fig. 23).

(16) If equipped with **type–3 relay** (Fig. 24), attach test leads from LCS adapter into PDC relay cavities number 3 and 5. For location of these cavities, refer to numbers stamped to bottom of relay (Fig. 24).

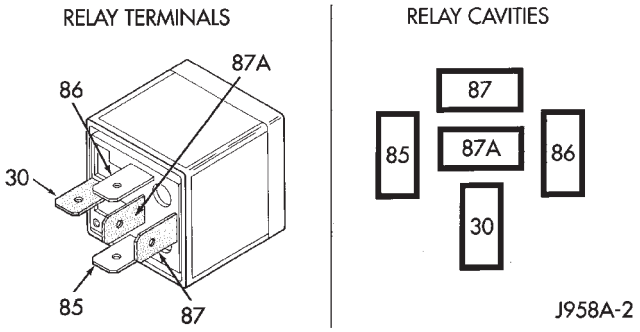


Fig. 22 FUEL PUMP RELAY - TYPE 1

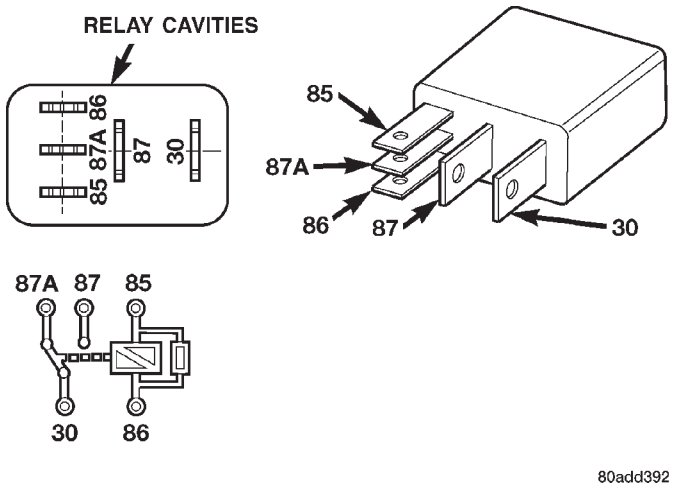


Fig. 23 FUEL PUMP RELAY - TYPE 2

TERMINAL LEGEND

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

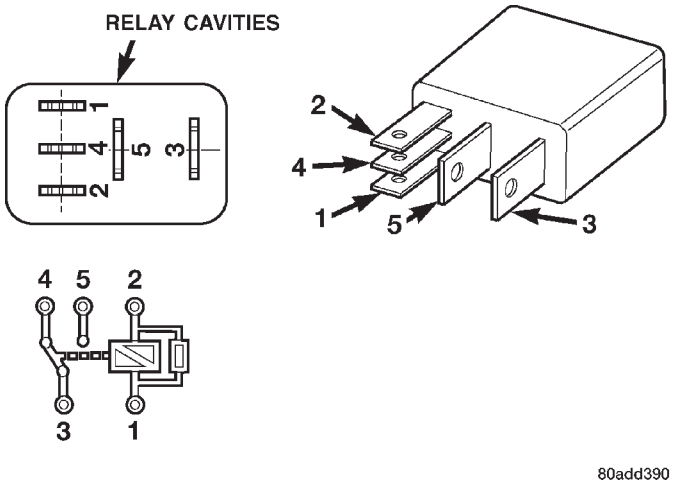


Fig. 24 FUEL PUMP RELAY - TYPE 3

TERMINAL LEGEND

NUMBER	IDENTIFICATION
1	COIL BATTERY
2	COIL GROUND
3	COMMON FEED
4	NORMALLY CLOSED
5	NORMALLY OPEN

FUEL PUMP (Continued)

(17) When LCS adapter test leads are attached into relay cavities, fuel pump **will be activated.** Determine fuel pump amperage on DRB screen. Amperage should be below 10.0 amps. If amperage is below 10.0 amps, and specifications for the Fuel Pump Pressure, Fuel Pump Capacity and Fuel Pressure Leak Down tests were met, the fuel pump module is OK.

(18) If amperage is more than 10.0 amps, replace fuel pump module assembly. The electric fuel pump is not serviced separately.

(19) Disconnect test leads from relay cavities immediately after testing.

FUEL PUMP MODULE

DESCRIPTION

The fuel pump module assembly is located in the fuel tank (Fig. 1). The assembly is divided into 2–sections, upper and lower. The lower section is locked to the bottom of the fuel tank. The complete assembly contains the following components:

- A fuel pressure regulator
- A separate fuel pick-up, or inlet filter
- An electric fuel pump
- A lockring to retain upper section of pump module to tank
- A rollover valve
- A vent fitting for ORVR system
- A soft gasket between tank flange and module
- A fuel gauge sending unit (fuel level sensor)
- Two fuel line connections (supply and return)

The fuel gauge sending unit may be serviced separately. If the electrical fuel pump, primary inlet filter or fuel pressure regulator require service, the lower section of the fuel pump module must be replaced.

OPERATION

Refer to Fuel Pump, Inlet Filter, Fuel Pressure Regulator and Fuel Gauge Sending Unit.

REMOVAL

The fuel pump module is divided into 2 sections, upper and lower. To service the check (control) valve, replace only the upper section. To service the fuel gauge sending unit, remove the upper section. To service the electric fuel pump, fuel pressure regulator or primary inlet filter, remove both sections and replace lower section.

Fuel tank removal will not be necessary for fuel pump module removal. Access is from rear cargo area.

(1) Four cargo holdown clamps are located inside the vehicle on the floor of the rear cargo area. Remove the 2 rearward mounted clamps by drilling out the clamp rivets.

(2) Fold carpeting forward to gain access to fuel pump module access plate (Fig. 25).

(3) Remove 4 fuel pump module access plate nuts (Fig. 25).

(4) While applying heat from a heat gun, carefully pry up fuel pump module access plate. Take care not to bend plate.

(5) Thoroughly clean area around top of pump module to prevent contaminants from entering fuel tank or fuel lines.

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

(6) Release fuel system pressure. Refer to Fuel System Pressure Release procedure.

(7) Disconnect 2 fuel lines at fuel pump module (Fig. 26) by pressing on 2 buttons at sides of fitting.

(8) Disconnect electrical connector (Fig. 26) at top of fuel pump module by sliding red colored tab first to unlock, and push grey colored tab down for removal.

(9) Disconnect ORVR hose clamp and hose (Fig. 26) at pump module fitting.

(10) Remove module lockring (Fig. 26) using a brass drift and hammer (counter-clockwise).

(11) Carefully lift upper section of pump module (Fig. 26) from fuel tank exposing connections **(lift upper section from tank very slowly until rubber gasket can be retained. If not, gasket will fall into fuel tank.)**

(a) Disconnect electrical connector (Fig. 27) at bottom of upper pump module section.

(b) Disconnect fuel pressure regulator (Fig. 27) at bottom of upper pump module section. Press on 2 locking tabs.

(c) Disconnect fuel return line (Fig. 27) at bottom of upper pump module section. Press on 2 locking tabs.

(d) Remove upper section of pump module (Fig. 28) from fuel tank.

(12) Using an approved gas holding tank, drain fuel tank through pump module opening. **If check (control) valve, or, only upper section of pump module is being serviced, tank draining is not necessary. If any other fuel pump module component is being serviced, the tank must be completely drained to the bottom.**

(13) To remove lower section of pump module from fuel tank:

(a) Using finger pressure, push on plastic release tab (Fig. 29) while sliding lock tab upward.

FUEL PUMP MODULE (Continued)

(b) The sides of pump module are equipped with tension springs (Fig. 29). These springs hold module to bottom of fuel tank into 2 formed guides (Fig. 30). Release module assembly from these 2 guides by sliding toward right side of fuel tank.

(c) Lift assembly from fuel tank.

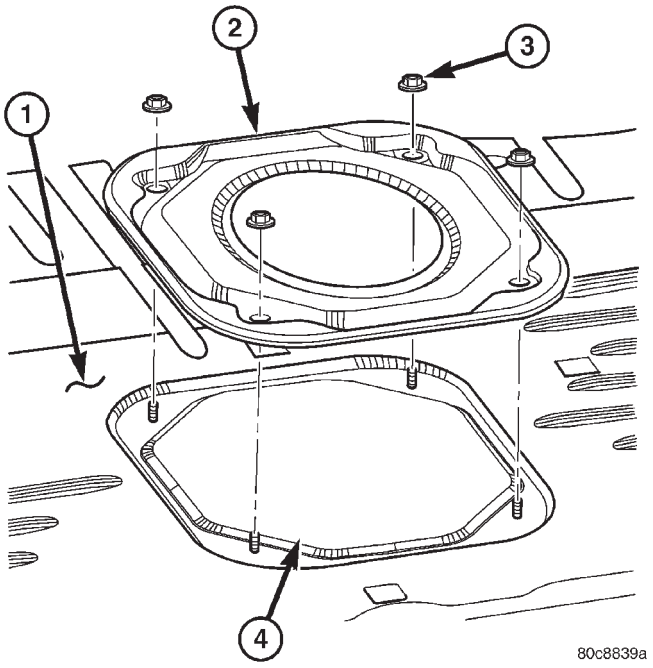


Fig. 25 ACCESS PLATE

1 - FLOORPAN AT REAR
2 - FUEL PUMP MODULE ACCESS PLATE
3 - NUTS (4)
4 - OPENING TO PUMP MODULE

INSTALLATION

CAUTION: Whenever fuel pump module is serviced, pump module gasket must be replaced.

(1) Position lower section of fuel pump module assembly into fuel tank.

(2) The bottom of fuel tank has 2 formed guides. Lock module assembly into these 2 guides by sliding toward left side of fuel tank.

(3) Push down on plastic tab to lock module to fuel tank guides.

(4) Connect fuel supply line to bottom of upper pump module section.

(5) Connect fuel pressure regulator to bottom of upper pump module section.

(6) Connect electrical connector to bottom of upper pump module section.

(7) Position pump module into fuel tank. Notch on module must be facing rear of tank.

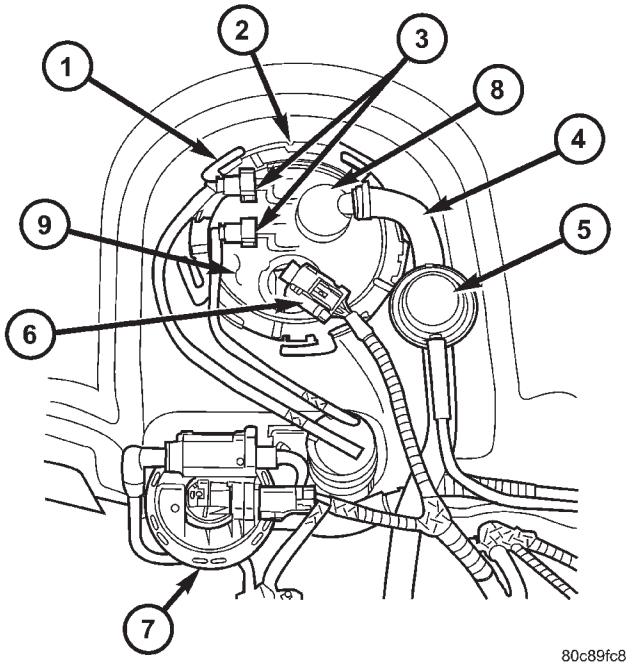


Fig. 26 TOP OF FUEL PUMP MODULE

1 - LOCK RING
2 - ALIGNMENT NOTCH
3 - FUEL FILTER FITTINGS (2)
4 - ORVR SYSTEM HOSE AND CLAMP
5 - FLOW MANAGEMENT VALVE
6 - ELECTRICAL CONNECTOR
7 - LEAK DETECTION PUMP
8 - FUEL TANK CHECK (CONTROL) VALVE
9 - FUEL PUMP MODULE (UPPER SECTION)

(8) Position lock ring to module. Tap lockring using a brass drift and hammer (clockwise) until rotated up to built-on stops.

(9) Attach (snap on) 2 fuel filter fuel lines to top of fuel pump module.

(10) Connect hoses/lines to ORVR components.

(11) Fill fuel tank with fuel.

(12) Start engine and check for fuel leaks.

(13) Apply silicone sealant to bottom of fuel pump module metal access plate.

(14) Install fuel pump module metal access plate and 4 nuts. Tighten nuts to 3 N·m (26 in. lbs.) torque.

(15) Position carpet and install 2 new cargo clamp rivets into each cargo holdown clamp.

FUEL PUMP MODULE (Continued)

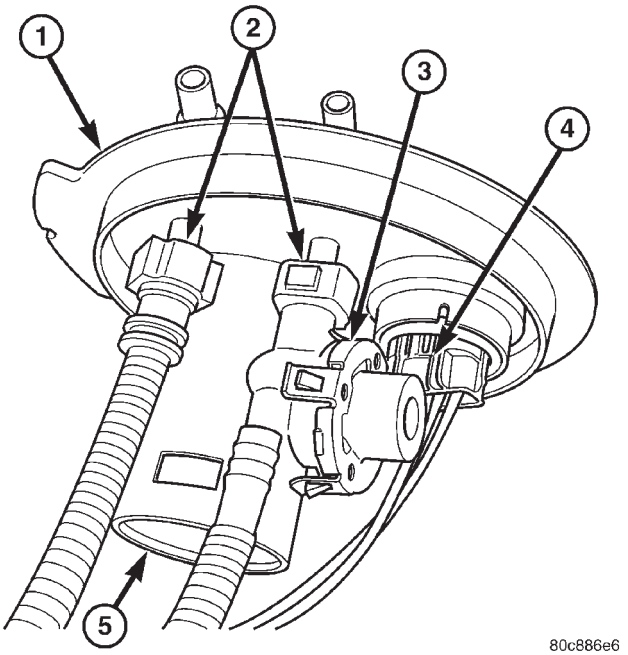


Fig. 27 FUEL PRESSURE REGULATOR/SENDING UNIT ELECTRICAL CONNECTOR

1 - UPPER SECTION OF PUMP MODULE
2 - QUICK-CONNECT FITTINGS
3 - FUEL PRESSURE REGULATOR
4 - 4-WIRE ELECTRICAL CONNECTOR
5 - FUEL TANK CHECK (CONTROL) VALVE

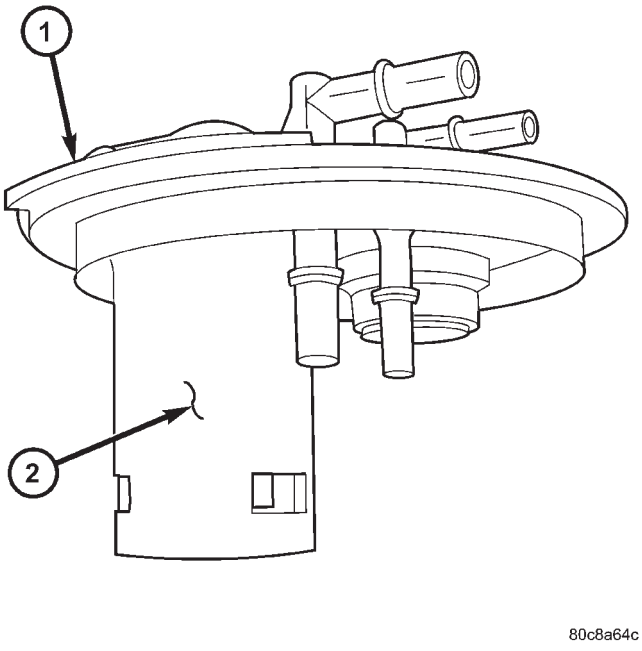


Fig. 28 UPPER SECTION - FUEL PUMP MODULE

1 - UPPER SECTION - FUEL PUMP MODULE
2 - FUEL TANK CHECK (CONTROL) VALVE

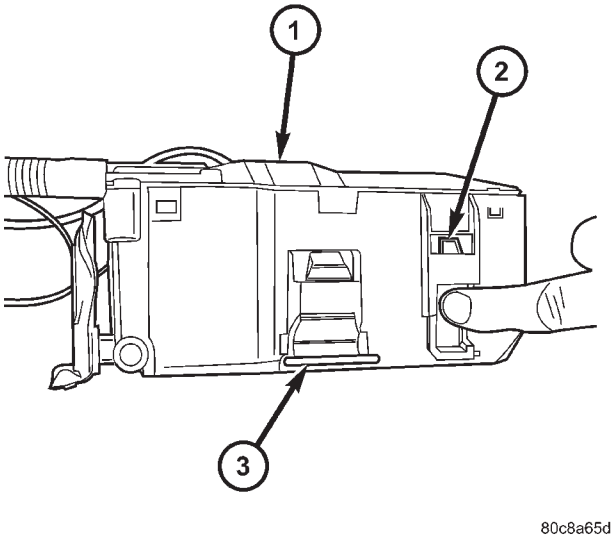


Fig. 29 LOWER SECTION - FUEL PUMP MODULE

1 - LOWER SECTION - FUEL PUMP MODULE
2 - RELEASE LOCK AND TAB
3 - TENSION SPRINGS

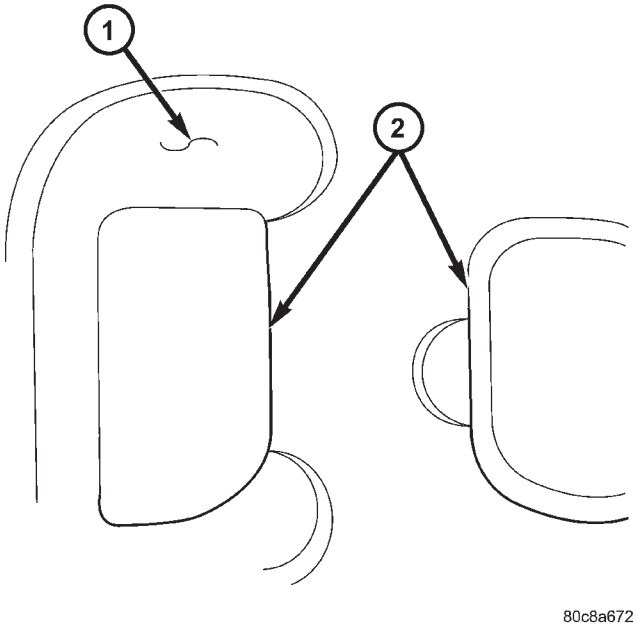


Fig. 30 FUEL PUMP MODULE GUIDES (IN FUEL TANK)

1 - FUEL TANK (INSIDE/LOWER)
2 - FUEL PUMP MODULE GUIDES

FUEL RAIL

DESCRIPTION

2.4L

The fuel injector rail is used to mount the fuel injectors to the engine (Fig. 31). On the 2.4L 4-cylinder engine, a **fuel damper** is located near the front of the fuel rail (Fig. 31).

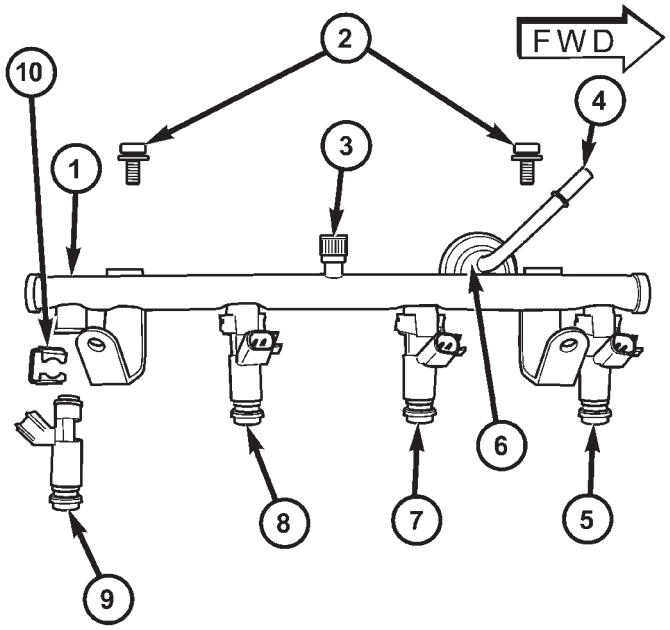


Fig. 31 FUEL RAIL-2.4L

1 - FUEL RAIL
2 - MOUNTING BOLTS
3 - TEST PORT
4 - QUICK-CONNECT FITTING
5 - INJ. #1
6 - DAMPER
7 - INJ #2
8 - INJ #3
9 - INJ #4
10- INJECTOR RETAINING CLIP

3.7L

The fuel injector rail is mounted to the intake manifold (Fig. 32). It is used to mount the fuel injectors to the engine. The rail is equipped with a test port (Fig. 33) to check/test fuel system pressure.

A fuel rail mounted, fuel damper is not used with this engine.

OPERATION

2.4L

The fuel injector rail supplies the necessary fuel to each individual fuel injector.

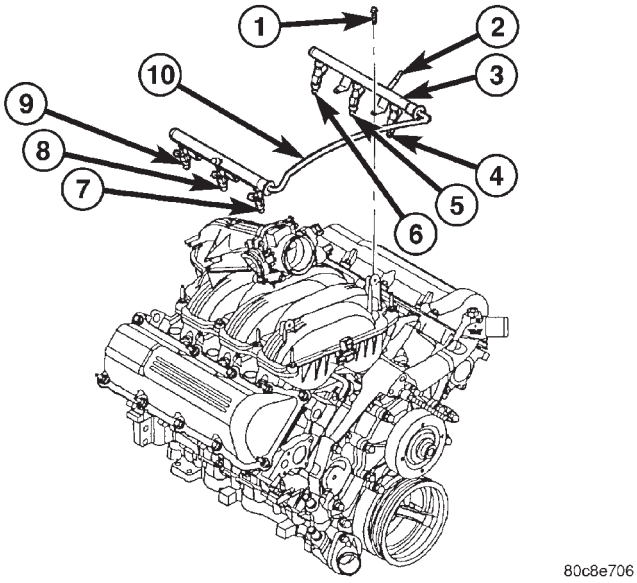


Fig. 32 FUEL RAIL - 3.7L

1 - MOUNTING BOLTS (4)
2 - QUICK-CONNECT FITTING
3 - FUEL RAIL
4 - INJ. #1
5 - INJ. #3
6 - INJ. #5
7 - INJ. #2
8 - INJ. #4
9 - INJ. #6
10 - CONNECTOR TUBE

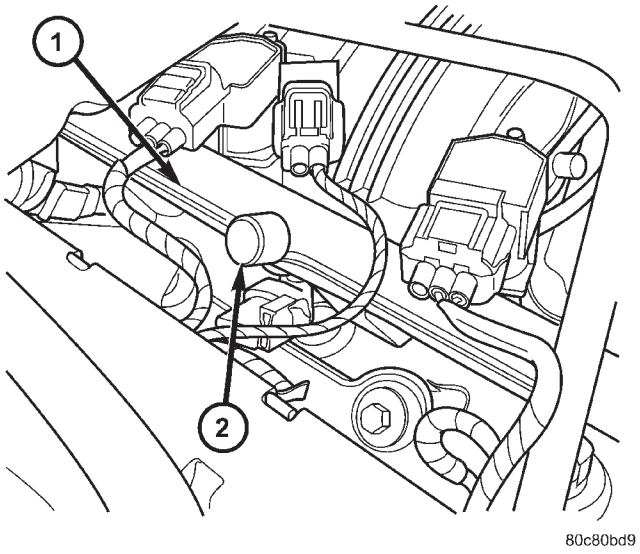


Fig. 33 FUEL RAIL TEST PORT - 3.7L

1 - FUEL RAIL
2 - TEST PORT

The fuel damper is used only to help control fuel pressure pulsations. These pulsations are the result

FUEL RAIL (Continued)

of the firing of the fuel injectors. It is **not used** as a fuel pressure regulator. The fuel pressure regulator is **not mounted** to the fuel rail on any engine. It is located on the fuel tank mounted fuel pump module. Refer to Fuel Pressure Regulator for additional information.

The fuel rail is not repairable.

A quick-connect fitting with a safety latch is used to attach the fuel line to the fuel rail.

3.7L

High pressure fuel from the fuel pump is routed to the fuel rail. The fuel rail then supplies the necessary fuel to each individual fuel injector.

A quick-connect fitting with a safety latch is used to attach the fuel line to the fuel rail.

The fuel rail is not repairable.

REMOVAL

2.4L

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

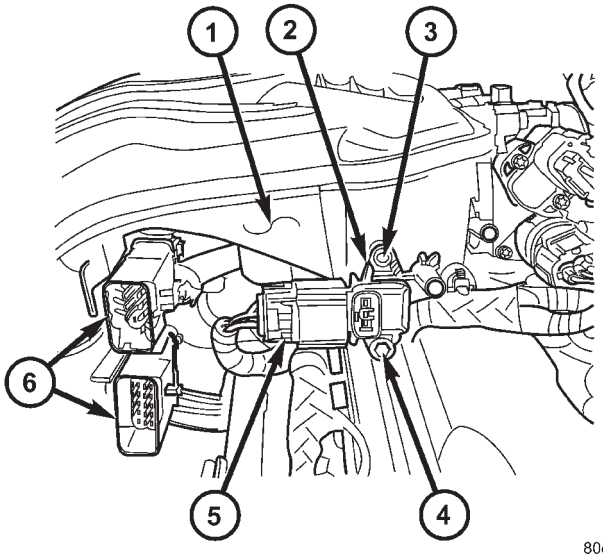


Fig. 34 MAP SENSOR LOCATION-2.4L

1 - REAR OF INTAKE MANIFOLD
2 - MAP SENSOR
3 - ALIGNMENT PIN
4 - MOUNTING BOLT (TORX)
5 - ELECTRICAL CONNECTOR
6 - MAIN ENGINE HARNESS CONNECTORS

The fuel rail can be removed without removing the intake manifold if the following procedures are followed.

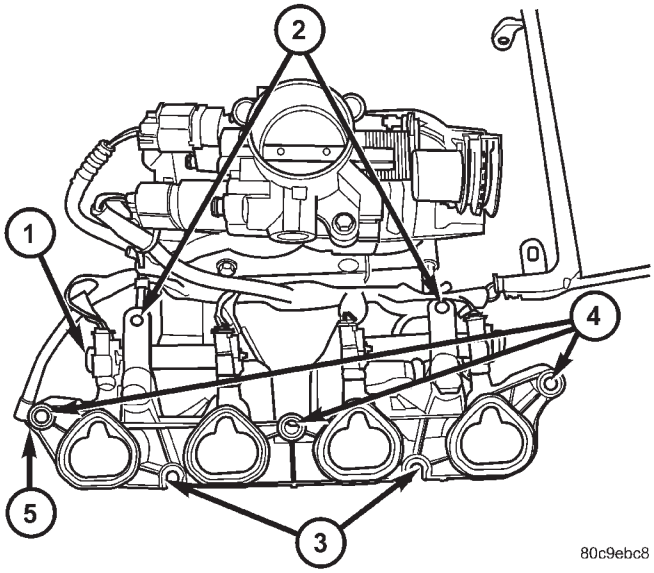


Fig. 35 FUEL RAIL MOUNTING-2.4L

1 - FUEL RAIL
2 - INJECTION HARNESS CLIPS
3 - LOWER MOUNTING HOLES
4 - UPPER MOUNTING HOLES
5 - INTAKE MANIFOLD

(1) Remove fuel tank filler tube cap.

(2) Perform Fuel System Pressure Release Procedure.

(3) Remove negative battery cable at battery.

(4) Remove air duct at throttle body.

(5) Disconnect fuel line latch clip and fuel line at fuel rail. A special tool will be necessary for fuel line disconnection. Refer to Quick-Connect Fittings.

(6) Remove necessary vacuum lines at throttle body.

(7) Drain engine coolant and remove thermostat and thermostat housing.

(8) Remove PCV hose and valve at valve cover.

(9) Remove 3 upper intake manifold mounting bolts (Fig. 35), but only loosen 2 lower bolts about 2 turns.

(10) Disconnect 2 main engine harness connectors at rear of intake manifold (Fig. 34).

(11) Disconnect 2 injection wiring harness clips at harness mounting bracket (Fig. 35).

(12) Disconnect electrical connectors at all 4 fuel injectors. To remove connector refer to (Fig. 37). Push red colored slider away from injector (1). While pushing slider, depress tab (2) and remove connector (3) from injector. The factory fuel injection wiring harness is numerically tagged (INJ 1, INJ 2, etc.) for injector position identification. If harness is not tagged, note wiring location before removal.

(13) Remove 2 injection rail mounting bolts (Fig. 31).

FUEL RAIL (Continued)

(14) Gently rock and pull fuel rail until fuel injectors just start to clear machined holes in intake manifold.

(15) Remove fuel rail (with injectors attached) from intake manifold.

(16) If fuel injectors are to be removed, refer to Fuel Injector Removal/Installation.

3.7L

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

CAUTION: The left and right fuel rails are replaced as an assembly. Do not attempt to separate rail halves at connector tube (Fig. 36). Due to design of tube, it does not use any clamps. Never attempt to install a clamping device of any kind to tube. When removing fuel rail assembly for any reason, be careful not to bend or kink tube.

(1) Remove fuel tank filler tube cap.

(2) Perform Fuel System Pressure Release Procedure.

(3) Remove negative battery cable at battery.

(4) Remove air duct at throttle body air box.

(5) Remove air box at throttle body.

(6) Disconnect fuel line latch clip and fuel line at fuel rail. A special tool will be necessary for fuel line disconnection. Refer to Quick-Connect Fittings.

(7) Remove necessary vacuum lines at throttle body.

(8) Disconnect electrical connectors at all 6 fuel injectors. To remove connector refer to (Fig. 37). Push red colored slider away from injector (1). While pushing slider, depress tab (2) and remove connector (3) from injector. The factory fuel injection wiring harness is numerically tagged (INJ 1, INJ 2, etc.) for injector position identification. If harness is not tagged, note wiring location before removal.

(9) Disconnect electrical connectors at throttle body sensors.

(10) Remove 6 ignition coils. Refer to Ignition Coil Removal/Installation.

(11) Remove 4 fuel rail mounting bolts (Fig. 36).

(12) Gently rock and pull **left** side of fuel rail until fuel injectors just start to clear machined holes in cylinder head. Gently rock and pull **right** side of rail until injectors just start to clear cylinder head holes. Repeat this procedure (left/right) until all injectors have cleared cylinder head holes.

(13) Remove fuel rail (with injectors attached) from engine.

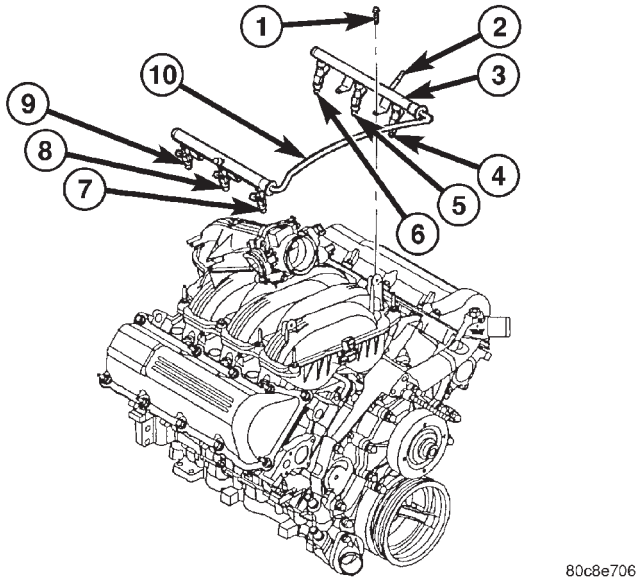


Fig. 36 FUEL RAIL REMOVE/INSTALL - 3.7L

1 - MOUNTING BOLTS (4)
2 - QUICK-CONNECT FITTING
3 - FUEL RAIL
4 - INJ. #1
5 - INJ. #3
6 - INJ. #5
7 - INJ. #2
8 - INJ. #4
9 - INJ. #6
10 - CONNECTOR TUBE

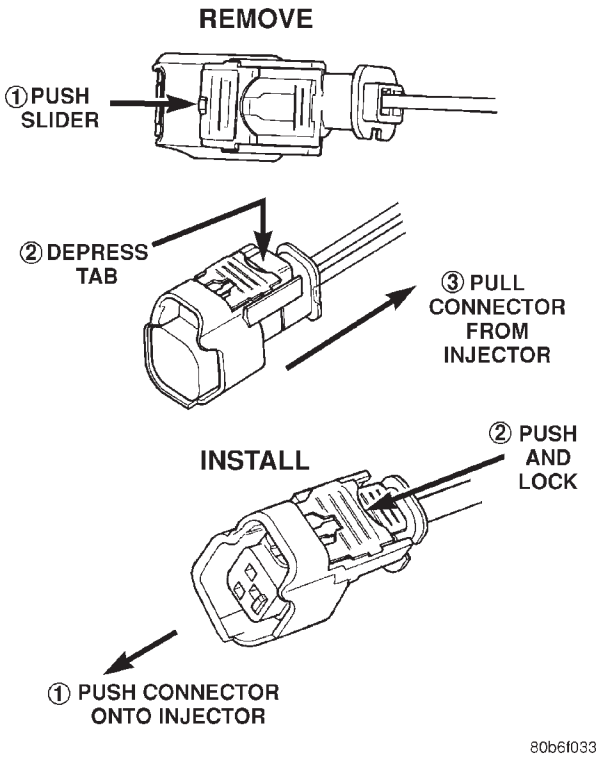


Fig. 37 REMOVE/INSTALL INJECTOR CONNECTOR

FUEL RAIL (Continued)

(14) If fuel injectors are to be removed, refer to Fuel Injector Removal/Installation.

INSTALLATION

2.4L Engine

(1) If fuel injectors are to be installed, refer to Fuel Injector Removal/Installation.

(2) Clean out fuel injector machined bores in intake manifold.

(3) Apply a small amount of engine oil to each fuel injector o-ring. This will help in fuel rail installation.

(4) Position fuel rail/fuel injector assembly to machined injector openings in intake manifold.

(5) Guide each injector into cylinder head. Be careful not to tear injector o-rings.

(6) Push fuel rail down until fuel injectors have bottomed on shoulders.

(7) Install 2 fuel rail mounting bolts and tighten. Refer to torque specifications.

(8) Connect electrical connectors at all fuel injectors. To install connector, refer to (Fig. 37). Push connector onto injector (1) and then push and lock red colored slider (2). Verify connector is locked to injector by lightly tugging on connector.

(9) Snap 2 injection wiring harness clips (Fig. 35) into brackets.

(10) Connect 2 main engine harness connectors at rear of intake manifold (Fig. 34).

(11) Tighten 5 intake manifold mounting bolts. Refer to Engine Torque Specifications.

(12) Install PCV valve and hose.

(13) Install thermostat and radiator hose. Fill with coolant. Refer to Cooling.

(14) Connect necessary vacuum lines to throttle body.

(15) Connect fuel line latch clip and fuel line to fuel rail. Refer to Quick-Connect Fittings.

(16) Install air duct to throttle body.

(17) Connect battery cable to battery.

(18) Start engine and check for leaks.

3.7L Engine

(1) If fuel injectors are to be installed, refer to Fuel Injector Removal/Installation.

(2) Clean out fuel injector machined bores in intake manifold.

(3) Apply a small amount of engine oil to each fuel injector o-ring. This will help in fuel rail installation.

(4) Position fuel rail/fuel injector assembly to machined injector openings in cylinder head.

(5) Guide each injector into cylinder head. Be careful not to tear injector o-rings.

(6) Push **right** side of fuel rail down until fuel injectors have bottomed on cylinder head shoulder. Push **left** fuel rail down until injectors have bottomed on cylinder head shoulder.

(7) Install 4 fuel rail mounting bolts and tighten. Refer to torque specifications.

(8) Install 6 ignition coils. Refer to Ignition Coil Removal/Installation.

(9) Connect electrical connectors to throttle body.

(10) Connect electrical connectors at all fuel injectors. To install connector, refer to (Fig. 37). Push connector onto injector (1) and then push and lock red colored slider (2). Verify connector is locked to injector by lightly tugging on connector.

(11) Connect necessary vacuum lines to throttle body.

(12) Connect fuel line latch clip and fuel line to fuel rail. Refer to Quick-Connect Fittings.

(13) Install air box to throttle body.

(14) Install air duct to air box.

(15) Connect battery cable to battery.

(16) Start engine and check for leaks.

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, and certain ORVR components.

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.

A check (control) valve is mounted into the top section of the 2–piece fuel pump module. Refer to Fuel Tank Check Valve for additional information.

An evaporation control system is connected to the fuel tank to reduce emissions of fuel vapors 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) and/or an ORVR system. Refer to Emission Control System for additional information.

FUEL TANK (Continued)

REMOVAL

Fuel Tank Draining

WARNING: THE FUEL SYSTEM MAY BE UNDER CONSTANT FUEL PRESSURE EVEN WITH THE ENGINE OFF. THIS PRESSURE MUST BE RELEASED BEFORE SERVICING FUEL TANK.

Two different procedures may be used to drain fuel tank: removing fuel pump module access plate, or using DRB® scan tool. Due to a one-way check valve installed into the fuel fill opening fitting at the tank (Fig. 38), the tank cannot be drained conventionally at the fill cap.

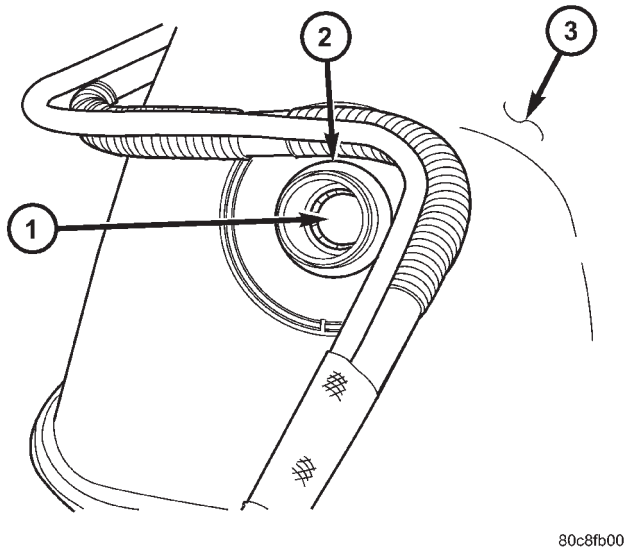


Fig. 38 FUEL FILL CHECK VALVE

1 - ONE-WAY CHECK VALVE
2 - FUEL FILL FITTING
3 - SIDE OF FUEL TANK

The quickest draining procedure involves removing fuel pump module access plate.

As an alternative procedure, the electric fuel pump may be activated allowing tank to be drained at fuel rail connection. Refer to DRB scan tool for fuel pump activation procedures. Before disconnecting fuel line at fuel rail, release fuel pressure. Refer to the Fuel System Pressure Release Procedure for procedures. Attach end of special test hose tool number 6541, 6539, 6631 or 6923 at fuel rail disconnection (tool number will depend on model and/or engine application). Position opposite end of this hose tool to an approved gasoline draining station. Activate fuel pump and drain tank until empty.

If electric fuel pump is not operating, fuel pump module access plate must be removed for fuel draining. Refer to following procedures.

Fuel tank removal will not be necessary for fuel tank draining. Access for draining is from rear cargo area.

(1) Open all windows in vehicle to allow for air ventilation.

(2) Four cargo holdown clamps are located inside the vehicle on the floor of the rear cargo area. Remove the 2 rearward mounted clamps by drilling out the clamp rivets.

(3) Fold carpeting forward to gain access to fuel pump module access plate (Fig. 39).

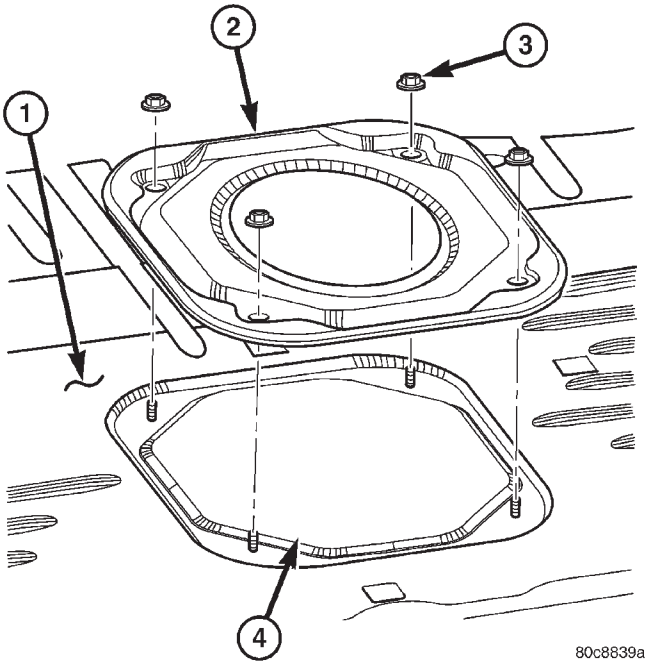


Fig. 39 ACCESS PLATE

1 - FLOORPAN AT REAR
2 - FUEL PUMP MODULE ACCESS PLATE
3 - NUTS (4)
4 - OPENING TO PUMP MODULE

(4) Remove 4 fuel pump module access plate nuts (Fig. 39).

(5) While applying heat from a heat gun, carefully pry up fuel pump module access plate. Take care not to bend plate.

(6) Thoroughly clean area around top of pump module to prevent contaminants from entering fuel tank or fuel lines.

(7) Release fuel system pressure.

(8) Disconnect 2 fuel lines (Fig. 40) at fuel pump module by pressing on tabs at side of fitting.

(9) Disconnect electrical connector (Fig. 40). Slide red tab first to unlock, and push grey tab down for removal.

(10) Disconnect ORVR hose (Fig. 40) at pump module fitting.

FUEL TANK (Continued)

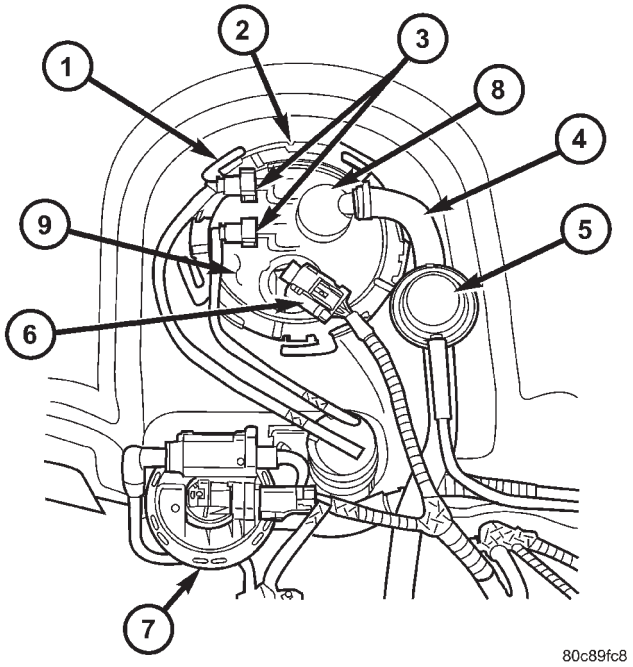


Fig. 40 TOP OF FUEL PUMP MODULE

1 - LOCK RING
2 - ALIGNMENT NOTCH
3 - FUEL FILTER FITTINGS (2)
4 - ORVR SYSTEM HOSE AND CLAMP
5 - FLOW MANAGEMENT VALVE
6 - ELECTRICAL CONNECTOR
7 - LEAK DETECTION PUMP
8 - FUEL TANK CHECK (CONTROL) VALVE
9 - FUEL PUMP MODULE (UPPER SECTION)

(11) Remove module lockring (Fig. 40) using a brass drift and hammer (counter-clockwise).

(12) Carefully lift upper section of pump module from fuel tank a few inches **(lift upper section from tank very slowly until rubber gasket can be retained. If not, gasket will fall into fuel tank).**

(13) Using an approved gas holding tank, drain fuel tank through fuel pump module opening.

Tank Removal

(1) After draining tank, temporarily place upper section of fuel pump module back into fuel tank.

(2) Raise vehicle.

(3) If equipped, remove fuel tank skid plate and tow hooks. Certain equipment packages will also require removal of the trailer hitch. Refer to Tow Hooks, Trailer Hitch or Skid Plate in 23, Body for removal/installation procedures.

(4) Disconnect fuel filter ground strap.

(5) Disconnect fuel filter outlet line from body retention clip located on frame near front/center of tank (Fig. 41). Place a small screwdriver into side of clip and twist for removal. Also disconnect Leak Detection Pump (LDP) line (Fig. 41) from this clip.

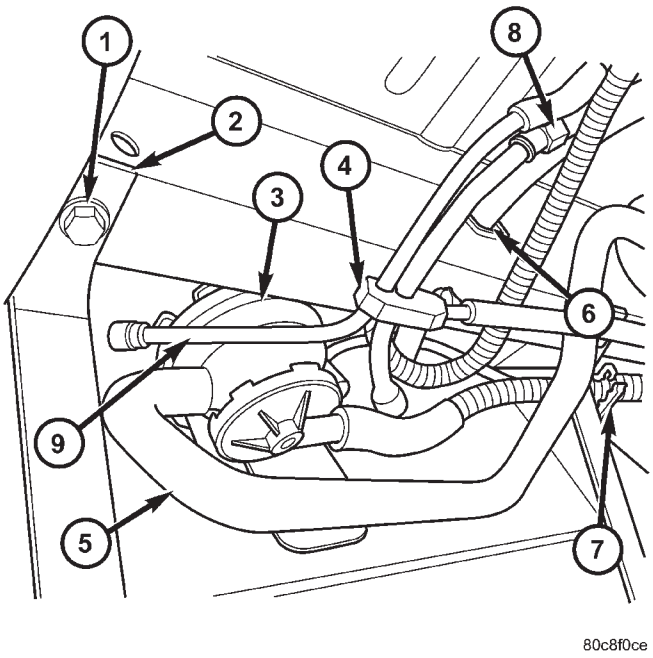


Fig. 41 FRONT OF FUEL TANK

1 - TANK MOUNTING BOLTS (4)
2 - TANK MOUNTING STRAPS (2)
3 - LEAK DETECTION PUMP (LDP)
4 - BODY RETENTION CLIP (CENTER)
5 - LDP HOSES
6 - HOSE TO FUEL MANAGEMENT VALVE
7 - BODY RETENTION CLIP (LEFT/FRONT)
8 - QUICK-CONECT FITTING
9 - LDP LINE

(6) Remove both 3/4” hoses at sides of Leak Detection Pump (LDP) (Fig. 41).

(7) Disconnect 3/4” flow management valve hose (Fig. 41) at EVAP canister.

(8) Remove fuel fill hose clamp (Fig. 42) at fuel tank, and disconnect hose from fuel tank.

(9) A third fuel line is attached to bottom of fuel filter. The disconnection point (quick-connect fitting) for this 3rd line is approximately 1 foot from front of tank towards front of vehicle (Fig. 41). Clean connection point before disconnection. Disconnect by pressing on tabs at side of quick-connect fitting. Also disconnect LDP vent line near this same point.

(10) Disconnect 2 vacuum/vent hoses from plastic retention clip at left/front of fuel tank line (Fig. 41).

(11) Support tank with a hydraulic jack.

(12) Remove 4 fuel tank strap bolts (Fig. 41) (2 at front of tank; 2 at rear of tank), and remove both tank support straps (Fig. 41).

(13) Carefully lower tank a few inches and disconnect electrical connector at top of LDP (Fig. 43). To disconnect electrical connector: Push upward on red colored tab to unlock. Push on black colored tab while removing connector.

FUEL TANK (Continued)

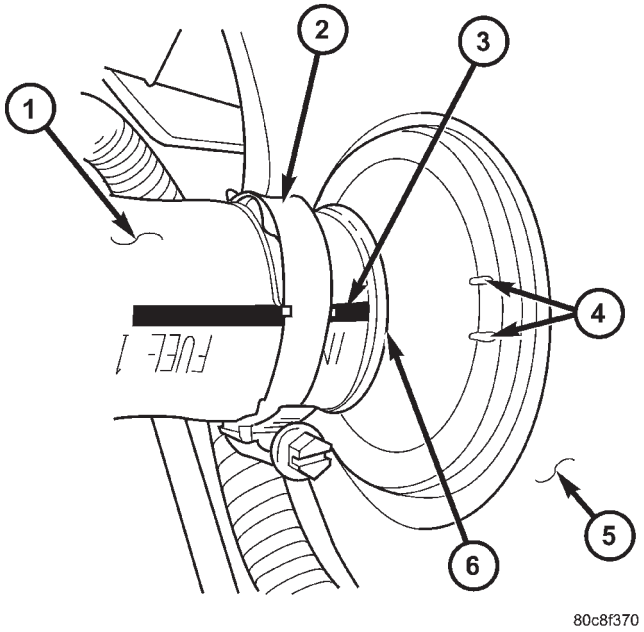


Fig. 42 FUEL FILL HOSE AT TANK

1 - FUEL FILL HOSE AT TANK
2 - HOSE CLAMP
3 - WHITE PAINTED INDEX MARK
4 - ALIGNMENT NOTCHES
5 - LEFT SIDE OF FUEL TANK
6 - FUEL FILL FITTING

(14) Continue lowering tank while guiding remaining hoses and lines.

(15) If fuel tank is to be replaced, remove LDP, fuel filter and fuel pump module from tank. Refer to Leak Detection Pump, Fuel Filter and Fuel Pump Module Removal/Installation procedures.

INSTALLATION

(1) If fuel tank is to be replaced, install LDP, fuel filter and fuel pump module to tank. Refer to Leak Detection Pump, Fuel Filter and Fuel Pump Module Removal/Installation procedures.

(2) Position fuel tank to hydraulic jack.

(3) Raise tank while carefully guiding vent tubes/hoses through frame rail and crossmember. Before tank reaches body, connect electrical connector to Leak Detection Pump (LDP).

(4) Continue raising tank until positioned to body.

(5) Attach two fuel tank mounting straps and 4 mounting bolts. Tighten bolts to 61 N·m (45 ft. lbs.) torque.

(6) Connect 2 hoses to body retention clip at left/front of tank.

(7) Connect fuel filter fuel line to main fuel line (snaps together). After connecting, snap this line into body retention clip. Also connect LDP vacuum hose near this point.

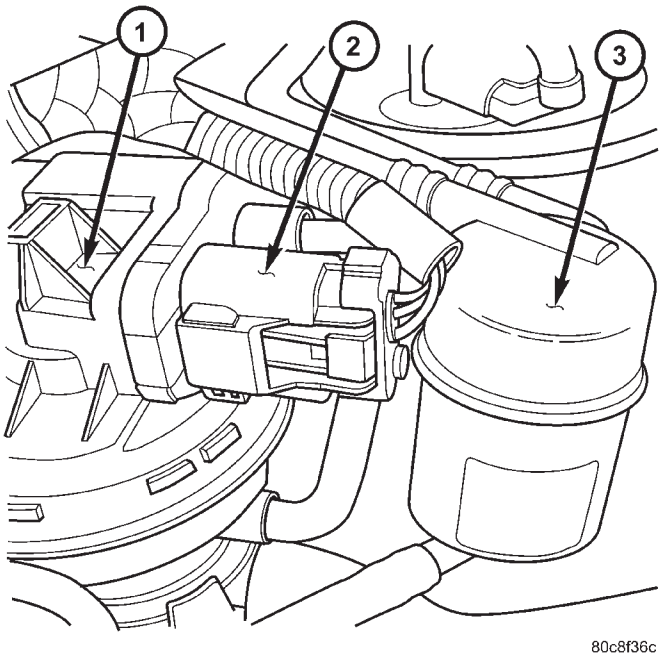


Fig. 43 LDP ELECTRICAL CONNECTOR

1 - LEAK DETECTION PUMP (LDP)
2 - ELECTRICAL CONNECTOR
3 - FUEL FILTER

(8) Install fuel fill hose and hose clamp to fuel tank fitting. Rotate hose until white painted index mark on hose (Fig. 42) is located between alignment notches on fuel tank fitting. Tighten clamp to 3.4 N·m (30 in. lbs.) torque.

(9) Connect fresh air and recirculation lines to fuel fill tube.

(10) Connect 3/4” lines to Leak Detection Pump (LDP).

(11) Connect 3/4” flow management valve hose to EVAP canister.

(12) Snap remaining lines into body retention clip at front/center of fuel tank.

(13) If equipped, install fuel tank skid plate, trailer hitch and tow hooks. Refer to Tow Hooks, Trailer Hitch or Skid Plate in 23, Body for removal/installation procedures.

(14) Lower vehicle.

(15) Attach (snap on) 2 fuel filter fuel lines to top of fuel pump module.

(16) Install electrical connector to top of fuel pump module.

(17) Connect negative battery cable to battery.

(18) Fill fuel tank with fuel.

(19) Start engine and check for fuel leaks near top of module.

(20) Apply silicone sealant to bottom of fuel pump module metal access plate.

FUEL TANK (Continued)

(21) Install fuel pump module metal access plate and 4 nuts. Tighten nuts to 3 N·m (26 in. lbs.) torque.

(22) Position carpet and install 2 new cargo clamp rivets into each cargo holdown clamp.

FUEL TANK CHECK VALVE

DESCRIPTION

The fuel tank is equipped with a check valve. The valve (also referred to as a control valve) is located in the top section of the fuel pump module assembly (Fig. 1).

OPERATION

The fuel tank check valve (also referred to as either a control valve, one-way check valve or float valve) will prevent fuel flow through the fuel tank vent in the event of an accidental vehicle rollover. It is also used as a part of the ORVR system. The EVAP canister and ORVR system draw fuel vapors from the fuel tank through this valve. Refer to ORVR in Emissions for additional information.

The valve may be serviced by replacing the upper section of the fuel pump module assembly.

REMOVAL

The fuel tank check (control) valve is attached into the top section of the fuel pump module (Fig. 44). If replacement is necessary, the top section of the fuel pump module must be replaced. Refer to Fuel Pump Module Removal/Installation.

INSTALLATION

The fuel tank check (control) valve is attached to the top section of the fuel pump module. If replacement is necessary, the top section of the fuel pump module must be replaced. Refer to Fuel Pump Module Removal/Installation.

INLET FILTER

REMOVAL

The fuel pump inlet filter is located on the bottom/side of the lower fuel pump module section (Fig. 45). The fuel pump module assembly is located in the fuel tank.

(1) Remove lower section of fuel pump module. Refer to Fuel Pump Module Removal/Installation.

(2) Remove filter by prying from pump module with 2 small screwdrivers. Filter is snapped to module with 2 release tabs (Fig. 45).

(3) Clean filter entrance into pump module opening.

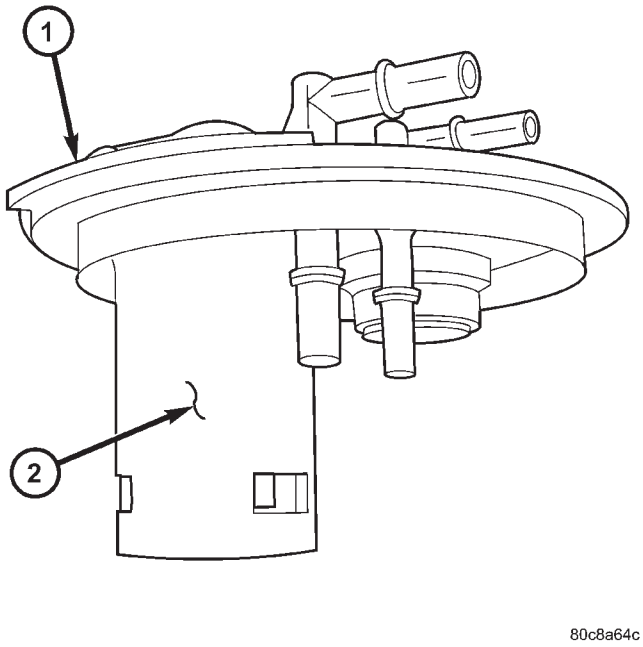


Fig. 44 UPPER SECTION - FUEL PUMP MODULE

1 - UPPER SECTION - FUEL PUMP MODULE
2 - FUEL TANK CHECK (CONTROL) VALVE

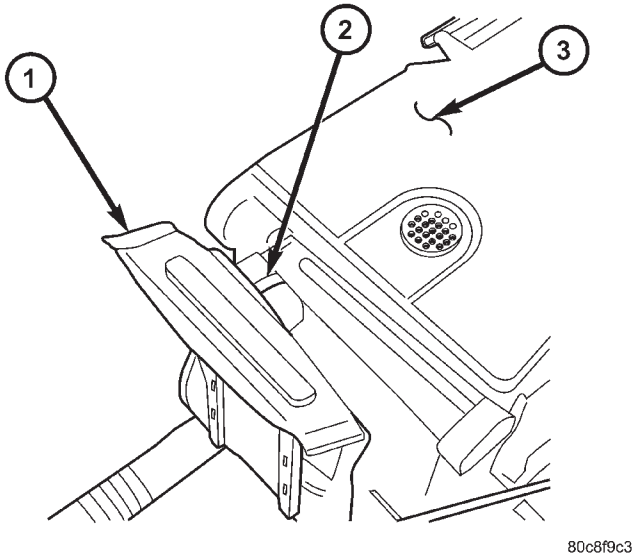


Fig. 45 INLET FILTER

1 - INLET FILTER
2 - RELEASE TABS (2)
3 - BOTTOM OF FUEL PUMP MODULE

INSTALLATION

(1) Snap new filter to bottom of fuel pump module.

(2) Install lower section of fuel pump module. Refer to Fuel Pump Module Removal/Installation.

FUEL INJECTION

TABLE OF CONTENTS

FUEL INJECTION

DESCRIPTION

The Powertrain Control Module (PCM) operates the fuel injection system. Refer to Powertrain Control Module in Electronic Control Modules for information.

ACCELERATOR PEDAL

REMOVAL

The accelerator pedal is serviced as a complete assembly including the bracket.

The accelerator pedal is connected to the upper part of the accelerator pedal arm by a plastic retainer (clip) (Fig. 1). This plastic retainer snaps into the top of the accelerator pedal arm.

(1) From inside the vehicle, hold up accelerator pedal. Remove plastic cable retainer (clip) and throttle cable core wire from upper end of accelerator pedal arm (Fig. 1). Plastic cable retainer (clip) snaps into pedal arm.

(2) Remove 2 accelerator pedal mounting bracket nuts. Remove accelerator pedal assembly.

ACCELERATOR PEDAL (Continued)

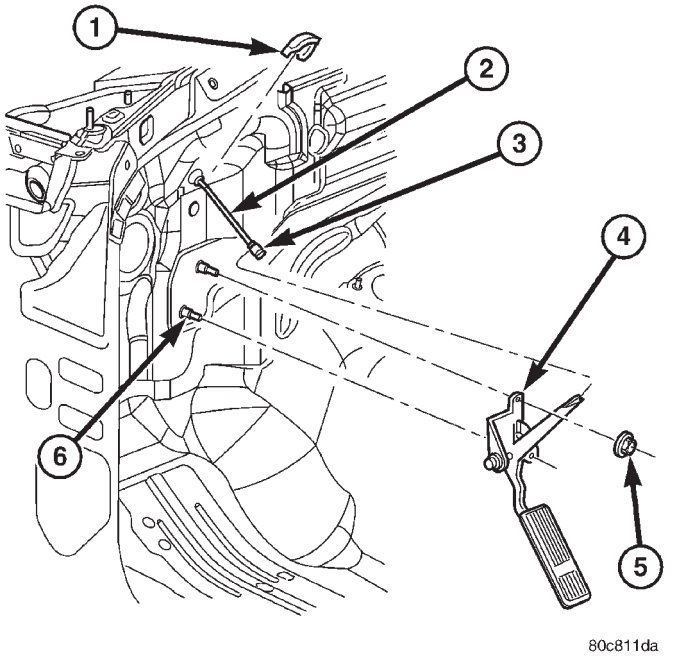


Fig. 1 ACCELERATOR PEDAL/BRACKET ASSEMBLY

1 - METAL THROTTLE CABLE CLIP
2 - THROTTLE CABLE
3 - PLASTIC CABLE RETAINER
4 - PEDAL/BRACKET ASSEMBLY
5 - PEDAL MOUNTING NUTS (2)
6 - PEDAL MOUNTING STUDS (2)

INSTALLATION

(1) Place accelerator pedal assembly over 2 studs (Fig. 1) protruding from floor pan.

(2) Install 2 mounting nuts. Refer to torque specifications.

(3) Slide throttle cable into opening slot in top of pedal arm.

(4) Push plastic cable retainer (clip) into accelerator pedal arm opening until it snaps into place.

(5) Before starting engine, operate accelerator pedal to check for any binding.

CRANKSHAFT POSITION SENSOR

DESCRIPTION

2.4L

The Crankshaft Position (CKP) sensor is mounted into the right front side of the cylinder block (Fig. 2). It is positioned and bolted into a machined hole.

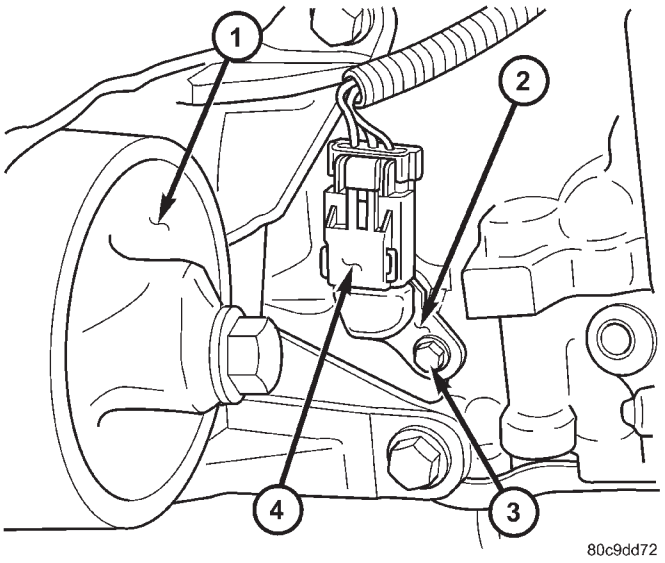


Fig. 2 CKP SENSOR LOCATION-2.4L

1 - RIGHT FRONT ENGINE MOUNT
2 - CKP SENSOR
3 - MOUNTING BOLT
4 - ELECTRICAL CONNECTOR

3.7L

The Crankshaft Position (CKP) sensor is mounted into the right rear side of the cylinder block (Fig. 3). It is positioned and bolted into a machined hole.

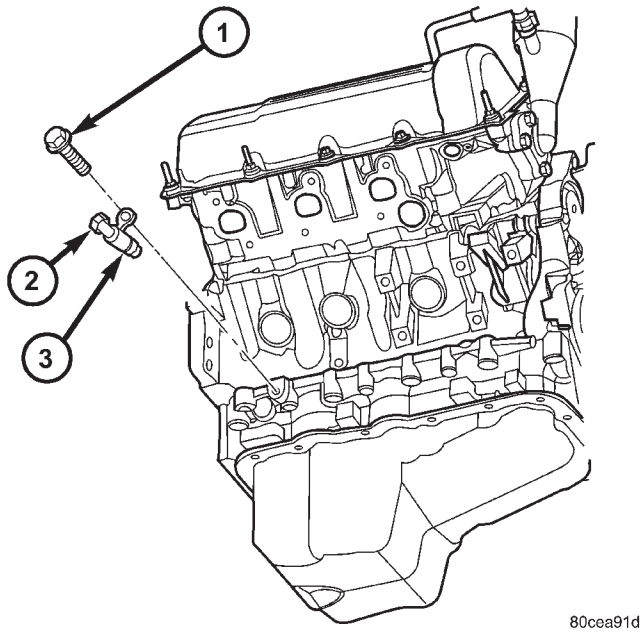


Fig. 3 CKP - 3.7L

1 - MOUNTING BOLT
2 - CKP SENSOR
3 - O-RING

CRANKSHAFT POSITION SENSOR (Continued)

OPERATION

2.4L

Engine speed and crankshaft position are provided through the CKP (Crankshaft Position) sensor. The sensor generates pulses that are the input sent to the Powertrain Control Module (PCM). The PCM interprets the sensor input to determine the crankshaft position. The PCM then uses this position, along with other inputs, to determine injector sequence and ignition timing.

The sensor is a hall effect device combined with an internal magnet. It is also sensitive to steel within a certain distance from it.

A tonewheel (targetwheel) is a part of the engine crankshaft (Fig. 4). This tonewheel has sets of notches at its outer edge.

The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input to the PCM.

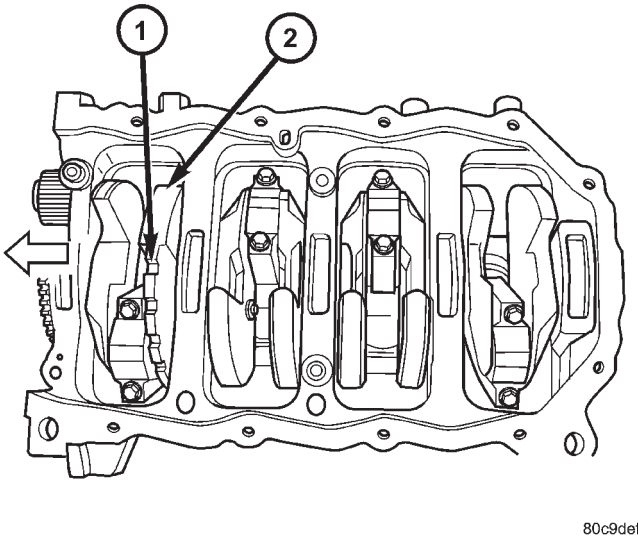


Fig. 4 CKP OPERATION-2.4L

1 - NOTCHES
2 - CRANKSHAFT

3.7L

Engine speed and crankshaft position are provided through the CKP (Crankshaft Position) sensor. The sensor generates pulses that are the input sent to the Powertrain Control Module (PCM). The PCM interprets the sensor input to determine the crankshaft position. The PCM then uses this position, along with other inputs, to determine injector sequence and ignition timing.

The sensor is a hall effect device combined with an internal magnet. It is also sensitive to steel within a certain distance from it.

A tonewheel (targetwheel) is bolted to the engine crankshaft (Fig. 5). This tonewheel has sets of notches at its outer edge (Fig. 5).

The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input to the PCM.

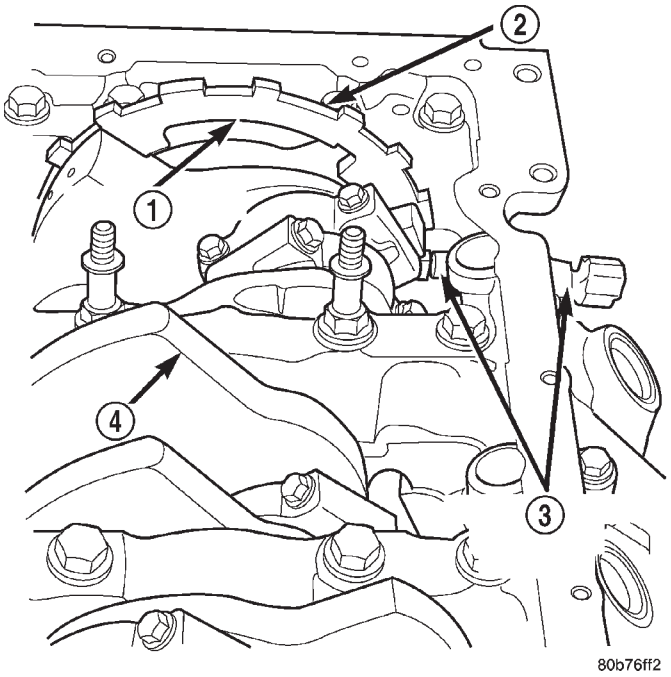


Fig. 5 CKP OPERATION-3.7L

1 - TONEWHEEL
2 - NOTCHES
3 - CRANKSHAFT POSITION SENSOR
4 - CRANKSHAFT

REMOVAL

2.4L

The Crankshaft Position (CKP) sensor is mounted into the right front side of the cylinder block (Fig. 6). It is positioned and bolted into a machined hole.

(1) Disconnect sensor electrical connector.
(2) Remove sensor bolt.
(3) Carefully pry sensor from cylinder block in a rocking action.
(4) Check condition of sensor o-ring (Fig. 7).

3.7L

The Crankshaft Position (CKP) sensor is mounted into the right rear side of the cylinder block (Fig. 8). It is positioned and bolted into a machined hole.

(1) Raise vehicle.
(2) Disconnect sensor electrical connector.
(3) Remove sensor mounting bolt (Fig. 8).
(4) Carefully remove sensor from cylinder block in a rocking and twisting action.
(5) Check condition of sensor o-ring.

CRANKSHAFT POSITION SENSOR (Continued)

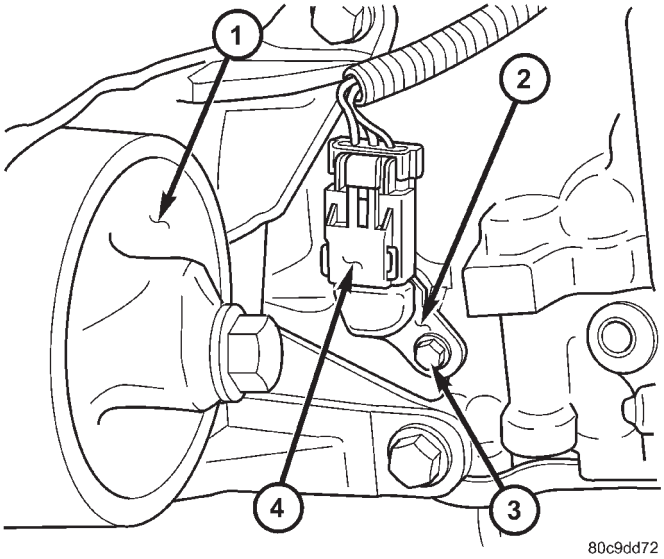


Fig. 6 CKP SENSOR LOCATION-2.4L

1 - RIGHT FRONT ENGINE MOUNT
2 - CKP SENSOR
3 - MOUNTING BOLT
4 - ELECTRICAL CONNECTOR

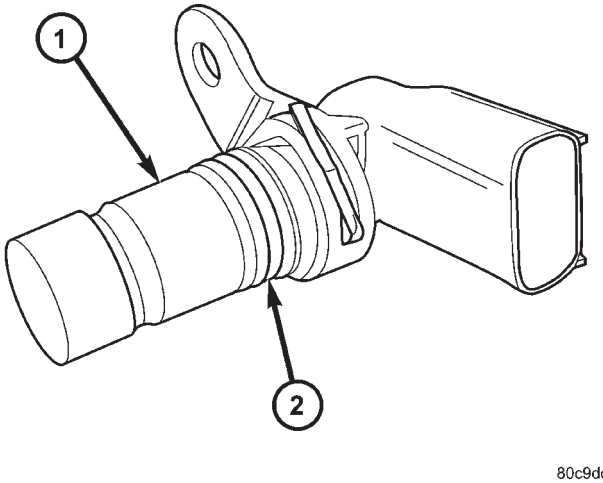


Fig. 7 CKP AND O-RING-2.4L

1 - CKP SENSOR
2 - O-RING

INSTALLATION

2.4L

(1) Clean out machined hole in engine block.
(2) Apply a small amount of engine oil to sensor o-ring.

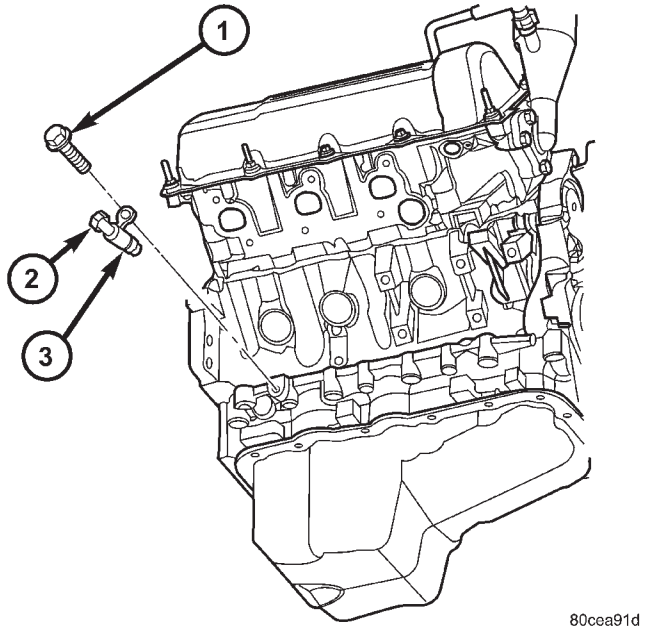


Fig. 8 CKP - 3.7L

1 - MOUNTING BOLT
2 - CKP SENSOR
3 - O-RING

(3) Install sensor into engine block with a slight rocking action. Do not twist sensor into position as damage to o-ring may result.

CAUTION: Before tightening sensor mounting bolt, be sure sensor is completely flush to cylinder block. If sensor is not flush, damage to sensor mounting tang may result.

(4) Install mounting bolt and tighten to 28 N·m (21 ft. lbs.) torque.
(5) Connect electrical connector to sensor.

3.7L

(1) Clean out machined hole in engine block.
(2) Apply a small amount of engine oil to sensor o-ring.
(3) Install sensor into engine block with a slight rocking and twisting action.

CAUTION: Before tightening sensor mounting bolt, be sure sensor is completely flush to cylinder block. If sensor is not flush, damage to sensor mounting tang may result.

(4) Install mounting bolt and tighten to 28 N·m (21 ft. lbs.) torque.
(5) Connect electrical connector to sensor.
(6) Lower vehicle.

FUEL INJECTOR

DESCRIPTION

An individual fuel injector (Fig. 9) is used for each individual cylinder.

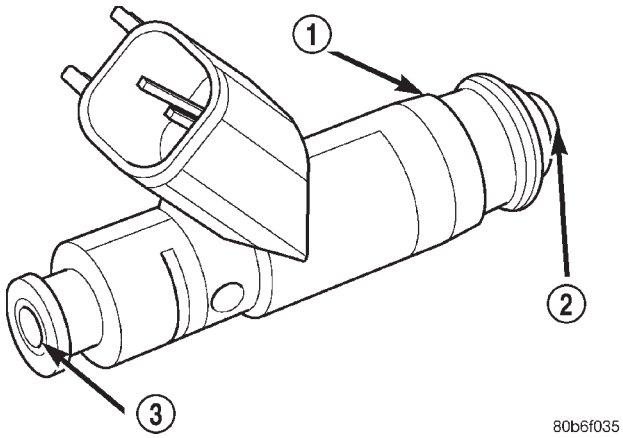


Fig. 9 FUEL INJECTOR — TYPICAL

OPERATION

OPERATION - FUEL INJECTOR

The top (fuel entry) end of the injector (Fig. 9) is attached into an opening on the fuel rail.

The fuel injectors are electrical solenoids. 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 pencil stream. The spraying action atomizes the fuel, adding it to the air entering the combustion chamber.

The nozzle (outlet) ends of the injectors are positioned into openings in the intake manifold just above the intake valve ports of the cylinder head. The engine wiring harness connector for each fuel injector is equipped with an attached numerical tag (INJ 1, INJ 2 etc.). This is used to identify each fuel injector.

The injectors are energized individually in a sequential order by the Powertrain Control Module (PCM). The PCM will adjust injector pulse width by switching the ground path to each individual injector on and off. Injector pulse width is the period of time that the injector is energized. The PCM will adjust injector pulse width based on various inputs it receives.

Battery voltage is supplied to the injectors through the ASD relay.

The PCM determines injector pulse width based on various inputs.

OPERATION - PCM OUTPUT

The nozzle ends of the injectors are positioned into openings in the intake manifold just above the intake valve ports of the cylinder head. The engine wiring harness connector for each fuel injector is equipped with an attached numerical tag (INJ 1, INJ 2 etc.). This is used to identify each fuel injector with its respective cylinder number.

The injectors are energized individually in a sequential order by the Powertrain Control Module (PCM). The PCM will adjust injector pulse width by switching the ground path to each individual injector on and off. Injector pulse width is the period of time that the injector is energized. The PCM will adjust injector pulse width based on various inputs it receives.

Battery voltage (12 volts +) is supplied to the injectors through the ASD relay. The ASD relay will shutdown the 12 volt power source to the fuel injectors if the PCM senses the ignition is on, but the engine is not running. This occurs after the engine has not been running for approximately 1.8 seconds.

The PCM determines injector on-time (pulse width) based on various inputs.

DIAGNOSIS AND TESTING - FUEL INJECTOR

To perform a complete test of the fuel injectors and their circuitry, use the DRB scan tool and refer to the appropriate Powertrain Diagnostics Procedures manual. To test the injector only, refer to the following:

Disconnect the fuel injector wire harness connector from the injector. The injector is equipped with 2 electrical terminals (pins). Place an ohmmeter across the terminals. Resistance reading should be approximately 12 ohms ±1.2 ohms at 20°C (68°F).

FUEL INJECTOR (Continued)

REMOVAL

(1) Remove fuel rail. Refer to Fuel Injector Rail Removal.

(2) Disconnect clip(s) that retain fuel injector(s) to fuel rail (Fig. 10).

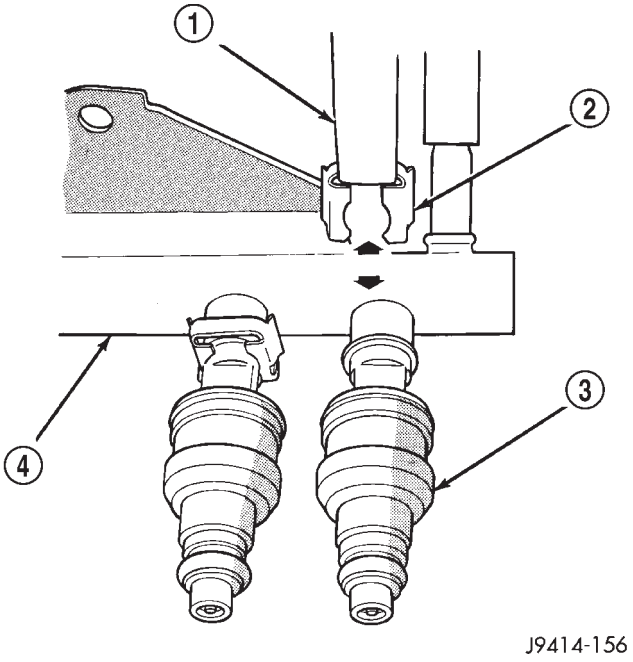


Fig. 10 INJECTOR RETAINING CLIP

1 - PLIERS
2 - INJECTOR CLIP
3 - FUEL INJECTOR
4 - FUEL RAIL - TYPICAL

INSTALLATION

(1) Install fuel injector(s) into fuel rail assembly and install retaining clip(s).

(2) If same injector(s) is being reinstalled, install new o-ring(s).

(3) Apply a small amount of clean engine oil to each injector o-ring. This will aid in installation.

(4) Install fuel rail. Refer to Fuel Rail Installation.

(5) Start engine and check for fuel leaks.

FUEL PUMP RELAY

DESCRIPTION

The 5–pin, 12–volt, fuel pump relay is located in the Power Distribution Center (PDC). Refer to the label on the PDC cover for relay location.

OPERATION

The Powertrain Control Module (PCM) energizes the electric fuel pump through the fuel pump relay. The fuel pump relay is energized by first applying battery voltage to it when the ignition key is turned ON, and then applying a ground signal to the relay from the PCM.

Whenever the ignition key is turned ON, the electric fuel pump will operate. But, the PCM will shutdown the ground circuit to the fuel pump relay in approximately 1–3 seconds unless the engine is operating or the starter motor is engaged.

DIAGNOSIS AND TESTING - FUEL PUMP RELAY

For procedures, refer to ASD Relay Diagnosis and Testing in the Ignition section.

REMOVAL

The fuel pump relay is located in the Power Distribution Center (PDC) (Fig. 11). Refer to label on PDC cover for relay location.

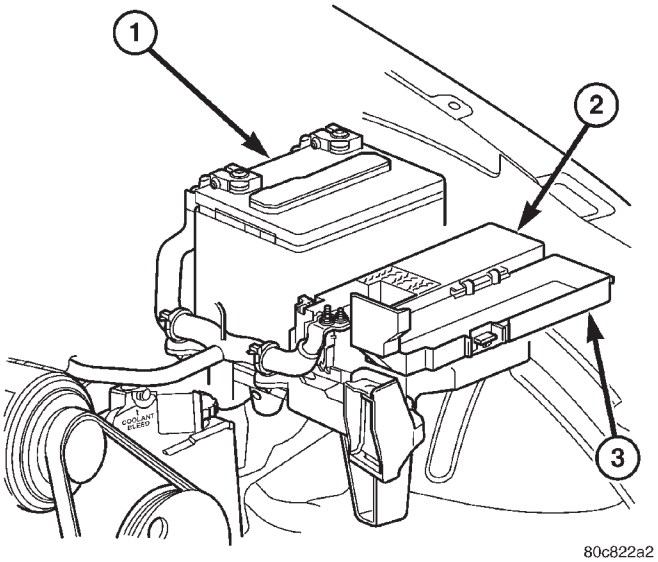


Fig. 11 POWER DISTRIBUTION CENTER (PDC)

1 - BATTERY
2 - PDC
3 - PDC COVER

(1) Remove PDC cover.

(2) Remove relay from PDC.

(3) Check condition of relay terminals and PDC connector terminals for damage or corrosion. Repair if necessary before installing relay.

(4) Check for pin height (pin height should be the same for all terminals within the PDC connector). Repair if necessary before installing relay.

INSTALLATION

The fuel pump relay is located in the Power Distribution Center (PDC). Refer to label on PDC cover for relay location.

(1) Install relay to PDC.

(2) Install cover to PDC.

IDLE AIR CONTROL MOTOR

DESCRIPTION

The IAC stepper motor is mounted to the throttle body, and regulates the amount of air bypassing the control of the throttle plate. As engine loads and ambient temperatures change, engine rpm changes. A pintle on the IAC stepper motor protrudes into a passage in the throttle body, controlling air flow through the passage. The IAC is controlled by the Powertrain Control Module (PCM) to maintain the target engine idle speed.

OPERATION

At idle, engine speed can be increased by retracting the IAC motor pintle and allowing more air to pass through the port, or it can be decreased by restricting the passage with the pintle and diminishing the amount of air bypassing the throttle plate.

The IAC is called a stepper motor because it is moved (rotated) in steps, or increments. Opening the IAC opens an air passage around the throttle blade which increases RPM.

The PCM uses the IAC motor to control idle speed (along with timing) and to reach a desired MAP during decel (keep engine from stalling).

The IAC motor has 4 wires with 4 circuits. Two of the wires are for 12 volts and ground to supply electrical current to the motor windings to operate the stepper motor in one direction. The other 2 wires are also for 12 volts and ground to supply electrical current to operate the stepper motor in the opposite direction.

To make the IAC go in the opposite direction, the PCM just reverses polarity on both windings. If only 1 wire is open, the IAC can only be moved 1 step (increment) in either direction. To keep the IAC motor in position when no movement is needed, the PCM will energize both windings at the same time. This locks the IAC motor in place.

In the IAC motor system, the PCM will count every step that the motor is moved. This allows the PCM to determine the motor pintle position. If the memory is cleared, the PCM no longer knows the position of the pintle. So at the first key ON, the PCM drives the IAC motor closed, regardless of where it was before. This zeros the counter. From this point the PCM will back out the IAC motor and keep track of its position again.

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

- Off-idle dashpot (throttle blade will close quickly but idle speed will not stop quickly)
- 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)
- Power steering load control

The PCM can control polarity of the circuit to control direction of the stepper motor.

IAC Stepper Motor Program: The PCM is also equipped with a memory program that records the number of steps the IAC stepper motor most recently advanced to during a certain set of parameters. For example: The PCM was attempting to maintain a 1000 rpm target during a cold start-up cycle. The last recorded number of steps for that may have been 125. That value would be recorded in the memory cell so that the next time the PCM recognizes the identical conditions, the PCM recalls that 125 steps were required to maintain the target. This program allows for greater customer satisfaction due to greater control of engine idle.

Another function of the memory program, which occurs when the power steering switch (if equipped), or the A/C request circuit, requires that the IAC stepper motor control engine rpm, is the recording of the last targeted steps into the memory cell. The PCM can anticipate A/C compressor loads. This is accomplished by delaying compressor operation for approximately 0.5 seconds until the PCM moves the IAC stepper motor to the recorded steps that were loaded into the memory cell. Using this program helps eliminate idle-quality changes as loads change. Finally, the PCM incorporates a ″No-Load″ engine speed limiter of approximately 1800 - 2000 rpm, when it recognizes that the TPS is indicating an idle signal and IAC motor cannot maintain engine idle.

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the IAC motor through the PCM.

IDLE AIR CONTROL MOTOR (Continued)

REMOVAL

2.4L

The Idle Air Control (IAC) motor is located on the rear side of the throttle body (Fig. 12).

(1) Disconnect electrical connector from IAC motor.
(2) Remove two mounting bolts (screws).
(3) Remove IAC motor from throttle body.

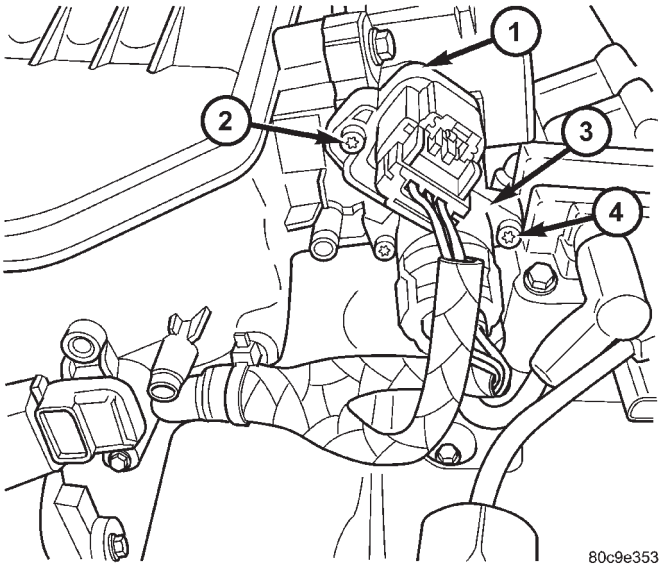


Fig. 12 TPS/IAC MOTOR - 2.4L

1 - THROTTLE POSITION SENSOR (TPS)
2 - MOUNTING SCREWS
3 - IDLE AIR CONTROL MOTOR (IAC)
4 - MOUNTING SCREWS

3.7L

The Idle Air Control (IAC) motor is located on the side of the throttle body (Fig. 13).

(1) Disconnect electrical connector from IAC motor.
(2) Remove two mounting bolts (screws).
(3) Remove IAC motor from throttle body.

INSTALLATION

2.4L

The Idle Air Control (IAC) motor is located on the rear side of the throttle body.

(1) Install IAC motor to throttle body.
(2) Install and tighten two mounting bolts (screws) to 7 N·m (60 in. lbs.) torque.
(3) Install electrical connector.

3.7L

The Idle Air Control (IAC) motor is located on the side of the throttle body (Fig. 13).

(1) Install IAC motor to throttle body.

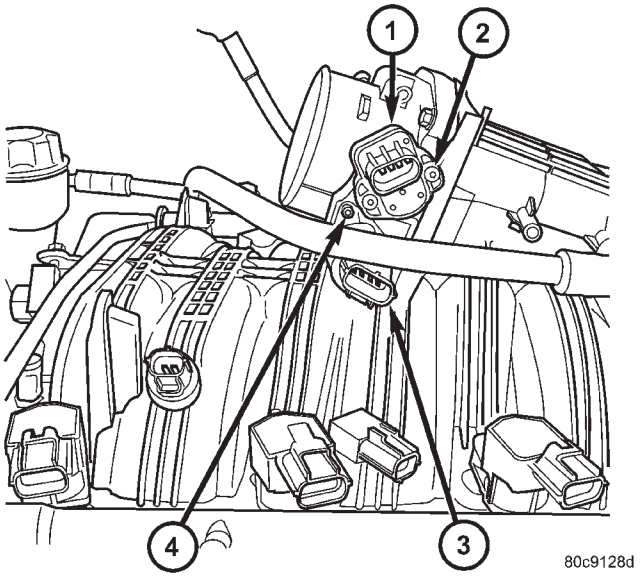


Fig. 13 TPS/IAC MOTOR - 3.7L

1 - THROTTLE POSITION SENSOR (TPS)
2 - MOUNTING SCREWS
3 - IDLE AIR CONTROL MOTOR (IAC)
4 - MOUNTING SCREWS

(2) Install and tighten two mounting bolts (screws) to 7 N·m (60 in. lbs.) torque.
(3) Install electrical connector.

INTAKE AIR TEMPERATURE SENSOR

DESCRIPTION

The 2–wire Intake Manifold Air Temperature (IAT) sensor is installed in the intake manifold with the sensor element extending into the air stream.

The IAT sensor is a two-wire Negative Thermal Coefficient (NTC) sensor. Meaning, as intake manifold temperature increases, resistance (voltage) in the sensor decreases. As temperature decreases, resistance (voltage) in the sensor increases.

OPERATION

The IAT sensor provides an input voltage to the Powertrain Control Module (PCM) indicating the density of the air entering the intake manifold based upon intake manifold temperature. At key-on, a 5–volt power circuit is supplied to the sensor from the PCM. The sensor is grounded at the PCM through a low-noise, sensor-return circuit.

The PCM uses this input to calculate the following:

- Injector pulse-width
- Adjustment of spark timing (to help prevent spark knock with high intake manifold air-charge temperatures)

INTAKE AIR TEMPERATURE SENSOR (Continued)

The resistance values of the IAT sensor is the same as for the Engine Coolant Temperature (ECT) sensor.

REMOVAL

2.4L

The intake manifold air temperature (IAT) sensor is installed into the intake manifold plenum at the rear end of the intake manifold (Fig. 14).

(1) Disconnect electrical connector from IAT sensor.

(2) Clean dirt from intake manifold at sensor base.

(3) Gently lift on small plastic release tab (Fig. 14) or (Fig. 15) and rotate sensor about 1/4 turn counterclockwise for removal.

(4) Check condition of sensor o-ring (Fig. 15).

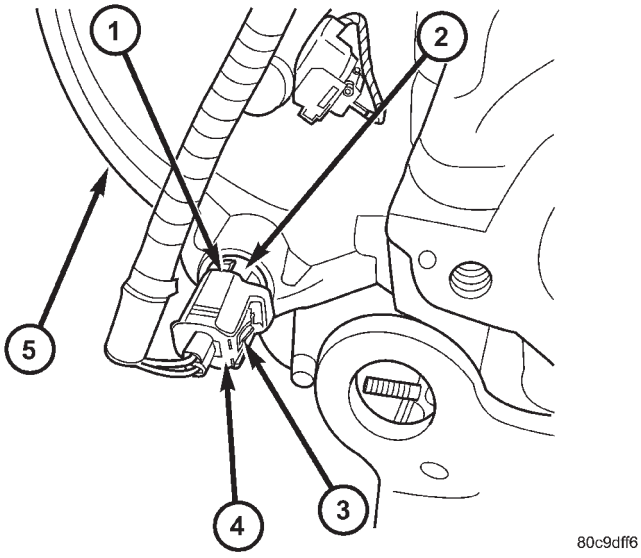


Fig. 14 IAT SENSOR LOCATION-2.4L

1 - RELEASE TAB
2 - IAT SENSOR
3 - PRESS HERE FOR REMOVAL
4 - ELECTRICAL CONNECTOR
5 - REAR END OF INTAKE MANIFOLD

3.7L

The intake manifold air temperature (IAT) sensor is installed into the left side of intake manifold plenum (Fig. 16).

(1) Disconnect electrical connector from IAT sensor.

(2) Clean dirt from intake manifold at sensor base.

(3) Gently lift on small plastic release tab (Fig. 16) or (Fig. 15) and rotate sensor about 1/4 turn counterclockwise for removal.

(4) Check condition of sensor o-ring.

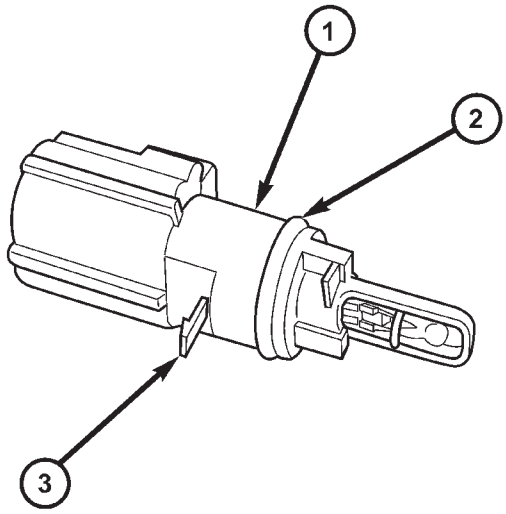


Fig. 15 IAT SENSOR TAB / O-RING

1 - IAT SENSOR
2 - SENSOR O-RING
3 - RELEASE TAB

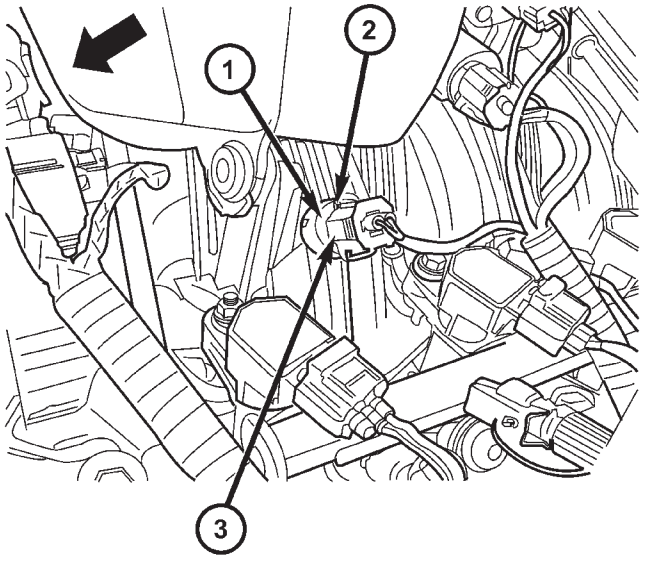


Fig. 16 IAT SENSOR LOCATION- 3.7L

1 - IAT SENSOR
2 - RELEASE TAB
3 - ELECTRICAL CONNECTOR

INTAKE AIR TEMPERATURE SENSOR (Continued)

INSTALLATION

2.4L

The intake manifold air temperature (IAT) sensor is installed into the intake manifold plenum at the rear end of the intake manifold.

(1) Check condition of sensor o-ring.
(2) Clean sensor mounting hole in intake manifold.
(3) Position sensor into intake manifold and rotate clockwise until past release tab.
(4) Install electrical connector.

3.7L

The intake manifold air temperature (IAT) sensor is installed into the left side of intake manifold plenum (Fig. 16).

(1) Check condition of sensor o-ring.
(2) Clean sensor mounting hole in intake manifold.
(3) Position sensor into intake manifold and rotate clockwise until past release tab (Fig. 16).
(4) Install electrical connector.

MAP SENSOR

DESCRIPTION

2.4L

The Manifold Absolute Pressure (MAP) sensor is mounted into the rear of the intake manifold with 1 screw.

3.7L

The Manifold Absolute Pressure (MAP) sensor is mounted into the front of the intake manifold with 2 screws.

OPERATION

The MAP sensor is used as an input to the Powertrain Control Module (PCM). It contains 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 manifold absolute pressure (MAP) equals Barometric pressure, the pulse width will be at maximum.

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. To operate the sensor, it is supplied a regulated 4.8 to 5.1 volts. Ground is provided through the low-noise, sensor return circuit at the PCM.

The MAP sensor input is the number one contributor to fuel injector 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 at a higher altitude, because the air density changes with altitude. It will also help to correct for varying barometric pressure. Barometric pressure and altitude have a direct inverse correlation; as altitude goes up, barometric goes down. At key-on, the PCM powers up and looks at 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 voltage 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 a known good sensor.

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 (WOT), based upon Throttle Position Sensor (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 input to aid in calculating the following:

- Manifold pressure
- Barometric pressure
- Engine load
- Injector pulse-width
- Spark-advance programs
- Shift-point strategies (certain automatic transmissions only)
- 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 manifold pressure 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; meaning as pressure changes, voltage changes proportionately.

MAP SENSOR (Continued)

The range 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. Barometric pressure is the pressure exerted by the atmosphere upon an object. At sea level on a standard day, no storm, barometric pressure is approximately 29.92 in Hg. For every 100 feet of altitude, barometric pressure drops 0.10 in. Hg. If a storm goes through, it can change barometric pressure from what should be present for that altitude. You should know what the average pressure and corresponding barometric pressure is for your area.

REMOVAL

2.4L

The Manifold Absolute Pressure (MAP) sensor is mounted into the rear of the intake manifold (Fig. 17). An o-ring is used to seal the sensor to the intake manifold (Fig. 19).

(1) Disconnect electrical connector at sensor.
(2) Clean area around MAP sensor.
(3) Remove sensor mounting screw (TORX head).
(4) Remove MAP sensor from intake manifold.
(5) Check condition of sensor o-ring (Fig. 19).

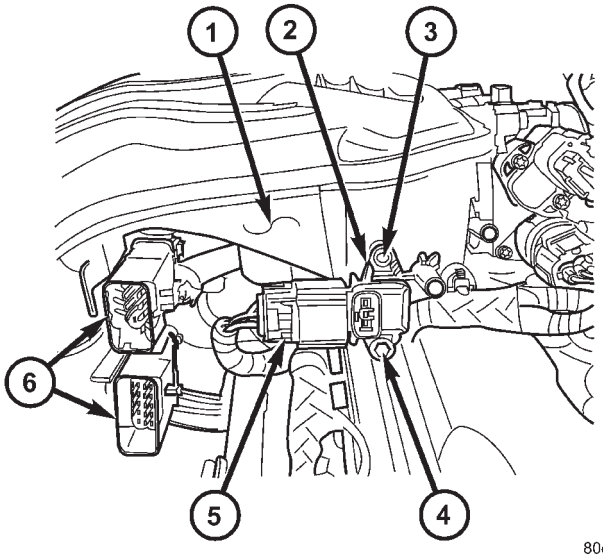


Fig. 17 MAP SENSOR LOCATION-2.4L

1 - REAR OF INTAKE MANIFOLD
2 - MAP SENSOR
3 - ALIGNMENT PIN
4 - MOUNTING BOLT (TORX)
5 - ELECTRICAL CONNECTOR
6 - MAIN ENGINE HARNESS CONNECTORS

3.7L

The Manifold Absolute Pressure (MAP) sensor is mounted into the front of the intake manifold (Fig. 18). An o-ring is used to seal the sensor to the intake manifold (Fig. 19).

(1) Disconnect electrical connector at sensor.
(2) Clean area around MAP sensor.
(3) Remove 2 sensor mounting screws.
(4) Remove MAP sensor from intake manifold.
(5) Check condition of sensor o-ring (Fig. 19).

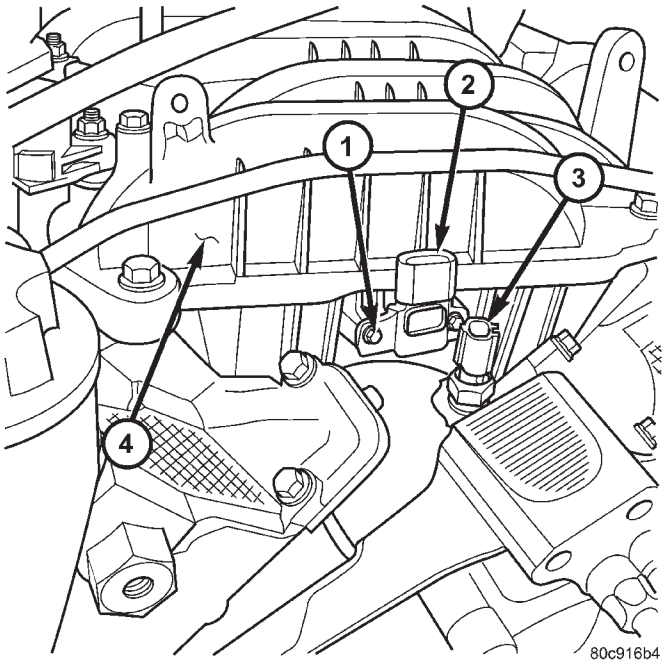


Fig. 18 MAP SENSOR / ECT SENSOR - 3.7L

1 - MOUNTING SCREWS
2 - MAP SENSOR
3 - ECT SENSOR

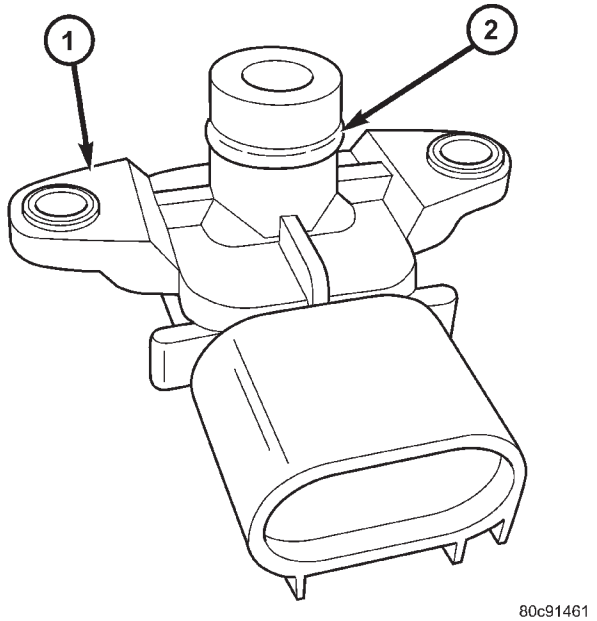


Fig. 19 MAP SENSOR O-RING

1 - MAP SENSOR
2 - O-RING

MAP SENSOR (Continued)

INSTALLATION

2.4L

The Manifold Absolute Pressure (MAP) sensor is mounted into the rear of the intake manifold. An o-ring is used to seal the sensor to the intake manifold (Fig. 19).

(1) Clean MAP sensor mounting hole at intake manifold.

(2) Check MAP sensor o-ring seal for cuts or tears.

(3) Position sensor into manifold.

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

(5) Connect electrical connector.

3.7L

The Manifold Absolute Pressure (MAP) sensor is mounted into the front of the intake manifold (Fig. 18). An o-ring is used to seal the sensor to the intake manifold (Fig. 19).

(1) Clean MAP sensor mounting hole at intake manifold.

(2) Check MAP sensor o-ring seal for cuts or tears.

(3) Position sensor into manifold.

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

(5) Connect electrical connector.

OXYGEN SENSOR

DESCRIPTION

The Oxygen Sensors (O2S) are attached to, and protrude into the vehicle exhaust system. Depending on the engine or emission package, the vehicle may use a total of either 2 or 4 sensors.

2.4L Engine: Two sensors are used: upstream (referred to as 1/1) and downstream (referred to as 1/2). With this emission package, the upstream sensor (1/1) is located just before the main catalytic convertor. The downstream sensor (1/2) is located just after the main catalytic convertor.

3.7L V-6 Engine: On this emissions package, 4 sensors are used: 2 upstream (referred to as 1/1 and 2/1) and 2 downstream (referred to as 1/2 and 2/2). With this emission package, the right upstream sensor (2/1) is located in the right exhaust downpipe just before the mini-catalytic convertor. The left upstream sensor (1/1) is located in the left exhaust downpipe just before the mini-catalytic convertor. The right downstream sensor (2/2) is located in the right exhaust downpipe just after the mini-catalytic convertor, and before the main catalytic convertor. The left downstream sensor (1/2) is located in the left exhaust downpipe just after the mini-catalytic convertor, and before the main catalytic convertor.

OPERATION

An O2 sensor is a galvanic battery that provides the PCM with a voltage signal (0-1 volt) inversely proportional to the amount of oxygen in the exhaust. In other words, if the oxygen content is low, the voltage output is high; if the oxygen content is high the output voltage is low. The PCM uses this information to adjust injector pulse-width to achieve the 14.7–to–1 air/fuel ratio necessary for proper engine operation and to control emissions.

The O2 sensor must have a source of oxygen from outside of the exhaust stream for comparison. Current O2 sensors receive their fresh oxygen (outside air) supply through the O2 sensor case housing.

Four wires (circuits) are used on each O2 sensor: a 12–volt feed circuit for the sensor heating element; a ground circuit for the heater element; a low-noise sensor return circuit to the PCM, and an input circuit from the sensor back to the PCM to detect sensor operation.

Oxygen Sensor Heater Relay - 3.7L Engine: On the 3.7L engine, 4 heated oxygen sensors are used. A separate oxygen sensor relay is used to supply voltage to the sensors heating elements for only the 1/2 and 2/2 downstream sensors. Voltage for the other 2 sensor heating elements is supplied directly from the Powertrain Control Module (PCM) through a Pulse Width Module (PWM) method.

Pulse Width Module (PWM): Voltage to the O2 sensor heating elements is supplied directly from the Powertrain Control Module (PCM) through two separate Pulse Width Module (PWM) low side drivers. PWM is used on both the upstream and downstream O2 sensors on the 2.4L engine, and only on the 2 upstream sensors (1/1 and 2/1) on the 3.7L engine. The main objective for a PWM driver is to avoid overheating of the O2 sensor heater element. With exhaust temperatures increasing with time and engine speed, it's not required to have a full-voltage duty-cycle on the O2 heater elements.

To avoid the large simultaneous current surge needed to operate all 4 sensors, power is delayed to the 2 downstream heater elements by the PCM for approximately 2 seconds.

Oxygen Sensor Heater Elements:

The O2 sensor uses a Positive Thermal Co-efficient (PTC) heater element. As temperature increases, resistance increases. At ambient temperatures around 70°F, the resistance of the heating element is approximately 4.5 ohms. As the sensor's temperature increases, resistance in the heater element increases. This allows the heater to maintain the optimum operating temperature of approximately 930°-1100°F (500°-600° C). Although the sensors operate the same, there are physical differences, due to the envi-

OXYGEN SENSOR (Continued)

ronment that they operate in, that keep them from being interchangeable.

Maintaining correct sensor temperature at all times allows the system to enter into closed loop operation sooner. Also, it allows the system to remain in closed loop operation during periods of extended idle.

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

Upstream Sensor - 2.4L Engine: The upstream sensor (1/1) provides an input voltage to the PCM. The input tells the PCM the oxygen content of the exhaust gas. The PCM uses this information to fine tune fuel delivery to maintain the correct oxygen content at the downstream oxygen sensor. The PCM will change the air/fuel ratio until the upstream sensor inputs a voltage that the PCM has determined will make the downstream sensor output (oxygen content) correct.

The upstream oxygen sensor also provides an input to determine catalytic convertor efficiency.

Downstream Sensor - 2.4L Engine: The downstream oxygen sensor (1/2) is also used to determine the correct air-fuel ratio. As the oxygen content changes at the downstream sensor, the PCM calculates how much air-fuel ratio change is required. The PCM then looks at the upstream oxygen sensor voltage and changes fuel delivery until the upstream sensor voltage changes enough to correct the downstream sensor voltage (oxygen content).

The downstream oxygen sensor also provides an input to determine catalytic convertor efficiency.

Upstream Sensors - 3.7L Engine: Two upstream sensors are used (1/1 and 2/1). The 1/1 sensor is the first sensor to receive exhaust gases from the #1 cylinder. They provide an input voltage to the PCM. The input tells the PCM the oxygen content of the exhaust gas. The PCM uses this information to fine tune fuel delivery to maintain the correct oxygen content at the downstream oxygen sensors. The PCM will change the air/fuel ratio until the upstream sensors input a voltage that the PCM has determined will make the downstream sensors output (oxygen content) correct.

The upstream oxygen sensors also provide an input to determine mini-catalyst efficiency. Main catalytic convertor efficiency is not calculated with this package.

Downstream Sensors - 3.7L Engine: Two downstream sensors are used (1/2 and 2/2). The downstream sensors are used to determine the correct air-fuel ratio. As the oxygen content changes at the downstream sensor, the PCM calculates how much air-fuel ratio change is required. The PCM then looks at the upstream oxygen sensor voltage, and changes fuel delivery until the upstream sensor voltage changes enough to correct the downstream sensor voltage (oxygen content).

The downstream oxygen sensors also provide an input to determine mini-catalyst efficiency. Main catalytic convertor efficiency is not calculated with this package.

Engines equipped with either a downstream sensor(s), or a post-catalytic sensor, will monitor catalytic convertor efficiency. If efficiency is below emission standards, the Malfunction Indicator Lamp (MIL) will be illuminated and a Diagnostic Trouble Code (DTC) will be set. Refer to Monitored Systems in Emission Control Systems for additional information.

REMOVAL

CAUTION: Never apply any type of grease to the oxygen sensor electrical connector, or attempt any soldering of the sensor wiring harness.

Refer to (Fig. 20), (Fig. 21) or (Fig. 22) for O2S (oxygen sensor) location.

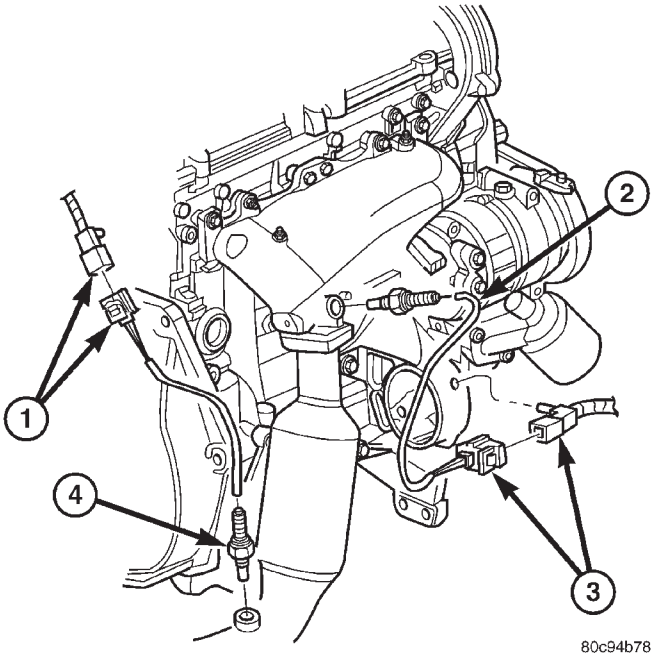


Fig. 20 OXYGEN SENSORS - 2.4L

1 - ELECTRICAL CONNECTORS
2 - UPSTREAM SENSOR (1/1)
3 - ELECTRICAL CONNECTORS
4 - DOWNSTREAM SENSOR (1/2)

OXYGEN SENSOR (Continued)

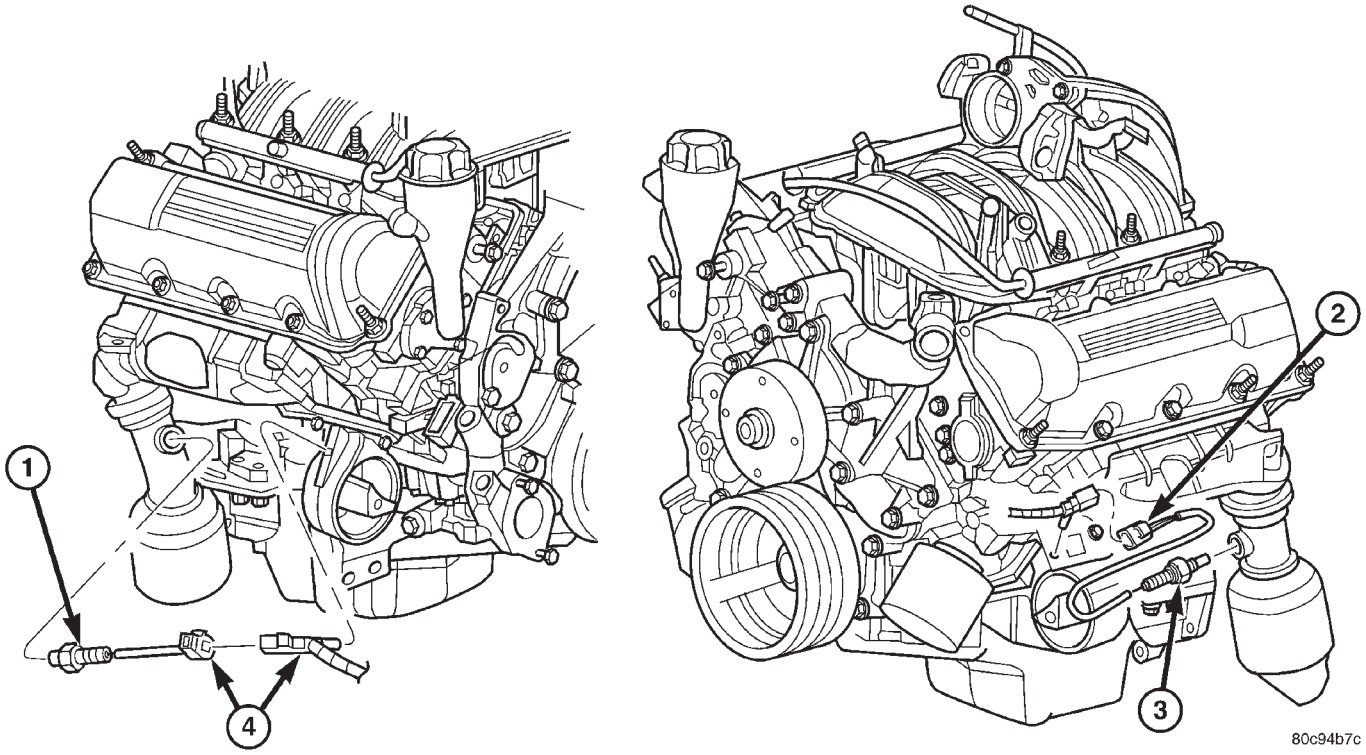


Fig. 21 OXYGEN SENSORS - UPSTREAM - 3.7L

1 - RIGHT UPSTREAM SENSOR (2/1)
2 - ELECTRICAL CONNECTORS
3 - LEFT UPSTREAM SENSOR (1/1)
4 - ELECTRICAL CONNECTORS

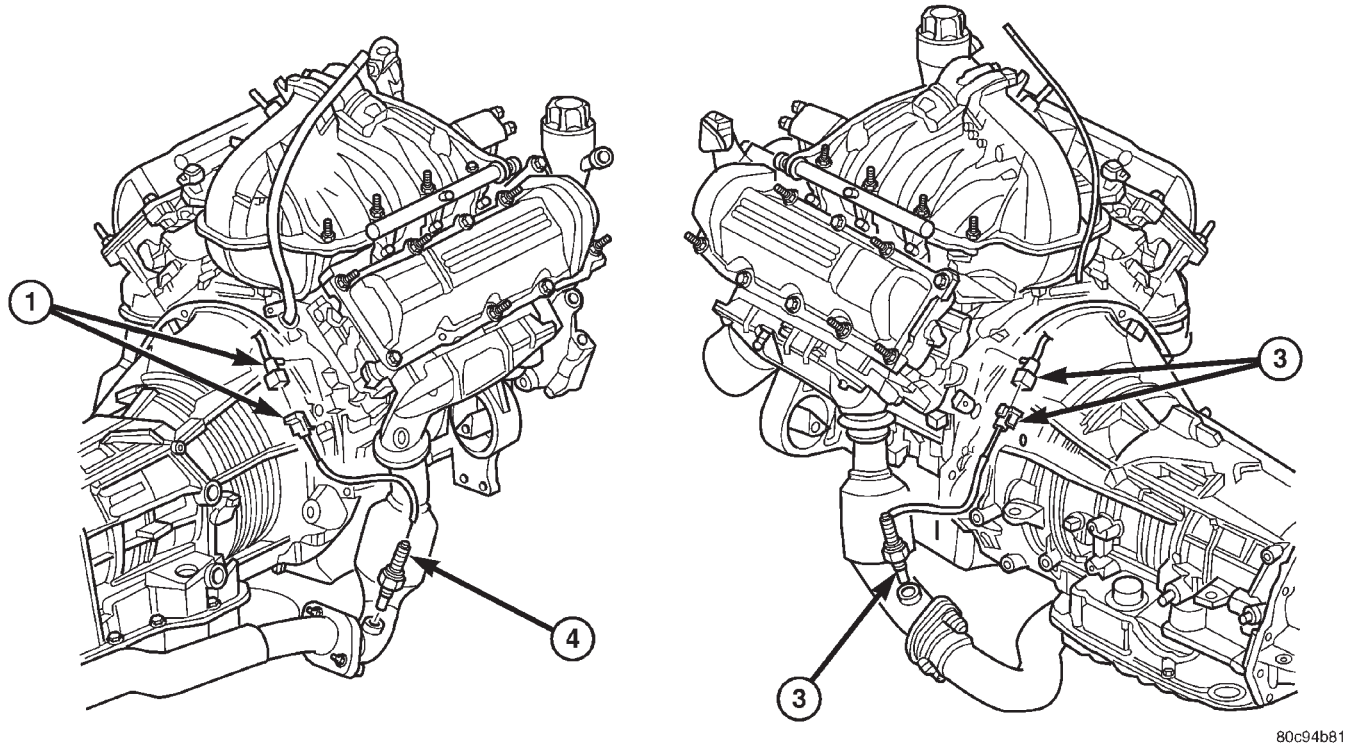


Fig. 22 OXYGEN SENSORS - DOWNSTREAM - 3.7L

1 - ELECTRICAL CONNECTORS
2 - ELECTRICAL CONNECTORS
3 - LEFT DOWNSTREAM SENSOR (1/2)
4 - RIGHT DOWNSTREAM SENSOR (2/2)

OXYGEN SENSOR (Continued)

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

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

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

(3) Remove O2S sensor with an oxygen sensor removal and installation tool.
(4) Clean threads in exhaust pipe using appropriate tap.

INSTALLATION

Threads of new oxygen sensors are factory coated with anti-seize compound to aid in removal. **DO NOT add any additional anti-seize compound to threads of a new oxygen sensor.**
(1) Install O2S sensor. Tighten to 30 N·m (22 ft. lbs.) torque.
(2) Connect O2S sensor wire connector.
(3) Lower vehicle.

THROTTLE BODY

DESCRIPTION

The throttle body is located on the intake manifold. Fuel does not enter the intake manifold through the throttle body. Fuel is sprayed into the manifold by the fuel injectors.

OPERATION

Filtered air from the air cleaner enters the intake manifold through the throttle body. The throttle body contains an air control passage controlled by an Idle Air Control (IAC) motor. The air control passage is used to supply air for idle conditions. A throttle valve (plate) is used to supply air for above idle conditions.

Certain sensors are attached to the throttle body. The accelerator pedal cable, speed control cable and transmission control cable (when equipped) are connected to the throttle body linkage arm.

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the PCM.

REMOVAL

2.4L

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the Powertrain Control Module (PCM).
(1) Remove air cleaner tube at throttle body.
(2) Disconnect throttle body electrical connectors at IAC motor and TPS.
(3) Remove all control cables from throttle body (lever) arm. Refer to the Accelerator Pedal and Throttle Cable section for removal/installation procedures.
(4) Disconnect necessary vacuum lines at throttle body.
(5) Remove 3 throttle body mounting bolts (Fig. 23).
(6) Remove throttle body from intake manifold.
(7) Check condition of old throttle body-to-intake manifold o-ring.

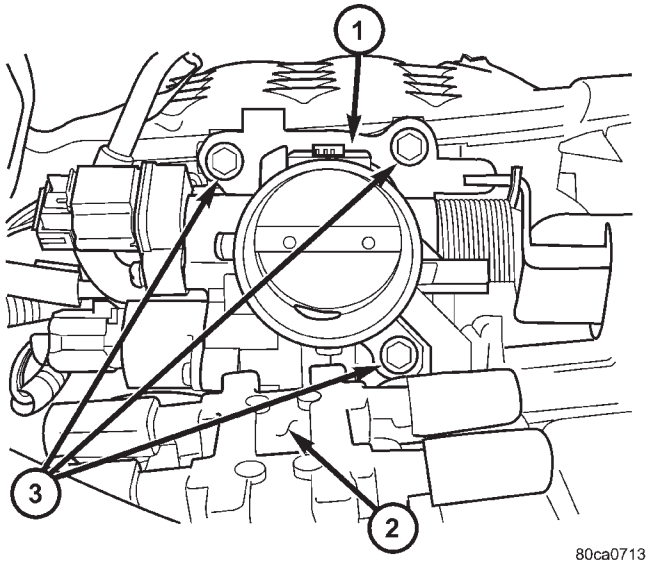


Fig. 23 THROTTLE BODY MOUNTING BOLTS - 2.4L
1 - THROTTLE BODY
2 - IGNITION COIL
3 - MOUNTING BOLTS (3)

3.7L

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the Powertrain Control Module (PCM).
(1) Remove air cleaner tube at throttle body.
(2) Disconnect throttle body electrical connectors at IAC motor and TPS.

THROTTLE BODY (Continued)

(3) Remove all control cables from throttle body (lever) arm. Refer to the Accelerator Pedal and Throttle Cable section for removal/installation procedures.

(4) Disconnect necessary vacuum lines at throttle body.

(5) Remove 3 throttle body mounting bolts (Fig. 24).

(6) Remove throttle body from intake manifold.

(7) Check condition of old throttle body-to-intake manifold o-ring (Fig. 25).

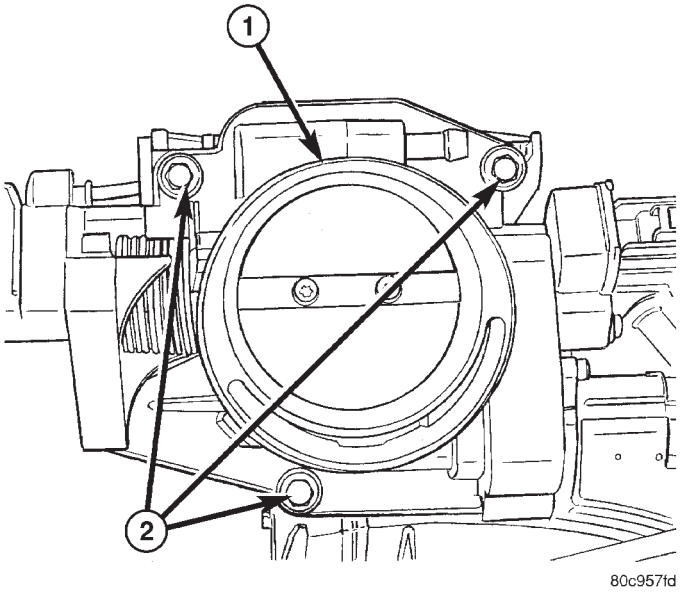


Fig. 24 THROTTLE BODY MOUNTING BOLTS - 3.7L

1 - THROTTLE BODY
2 - MOUNTING BOLTS (3)

INSTALLATION

2.4L

(1) Check condition of throttle body-to-intake manifold o-ring. Replace as necessary.

(2) Clean mating surfaces of throttle body and intake manifold.

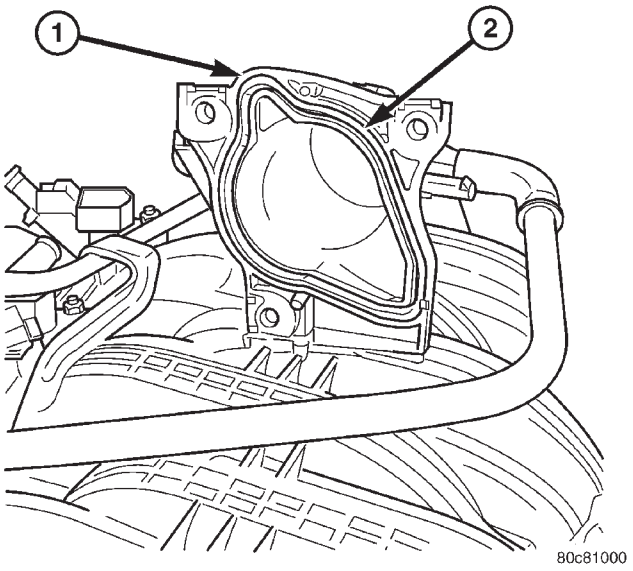


Fig. 25 THROTTLE BODY O-RING - 3.7L

1 - INTAKE MANIFOLD
2 - THROTTLE BODY O-RING

(3) Install throttle body-to-intake manifold o-ring.

(4) Install throttle body to intake manifold.

(5) Install 3 mounting bolts. Tighten bolts to 12 N·m (105 in. lbs.) torque.

(6) Install control cables.

(7) Install electrical connectors.

(8) Install necessary vacuum lines.

(9) Install air cleaner duct at throttle body.

3.7L

(1) Check condition of throttle body-to-intake manifold o-ring. Replace as necessary.

(2) Clean mating surfaces of throttle body and intake manifold.

(3) Install throttle body-to-intake manifold o-ring.

(4) Install throttle body to intake manifold.

(5) Install 3 mounting bolts. Tighten bolts to 12 N·m (105 in. lbs.) torque.

(6) Install control cables.

(7) Install electrical connectors.

(8) Install necessary vacuum lines.

(9) Install air cleaner duct at throttle body.

THROTTLE CONTROL CABLE

REMOVAL

2.4L

CAUTION: Be careful not to damage or kink the cable core wire (within the cable sheathing) while servicing accelerator pedal or throttle cable.

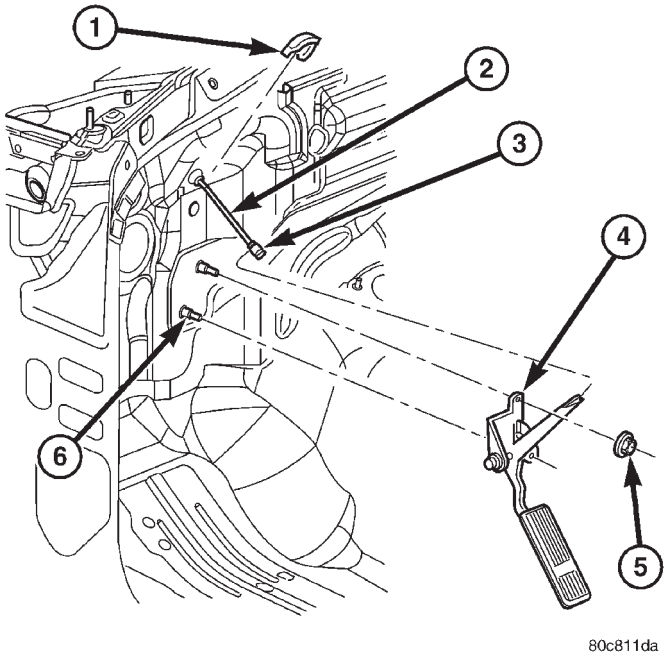


Fig. 26 ACCELERATOR PEDAL/BRACKET ASSEMBLY

1 - METAL THROTTLE CABLE CLIP
2 - THROTTLE CABLE
3 - PLASTIC CABLE RETAINER
4 - PEDAL/BRACKET ASSEMBLY
5 - PEDAL MOUNTING NUTS (2)
6 - PEDAL MOUNTING STUDS (2)

(1) From inside vehicle, hold up accelerator pedal. Remove plastic cable retainer (clip) and throttle cable core wire from upper end of pedal arm (Fig. 26). Plastic cable retainer snaps into top of pedal arm.

(2) Remove cable core wire at pedal arm.

(3) From inside vehicle, remove metal clip holding cable to dashpanel (Fig. 26).

(4) Remove air box at throttle body.

(5) Unsnap cable from dashpanel routing clip.

(6) Remove cable housing from dash panel and pull into engine compartment.

(7) Hold throttle in wide open position. While held in this position, slide throttle cable pin (Fig. 27) from throttle body bellcrank.

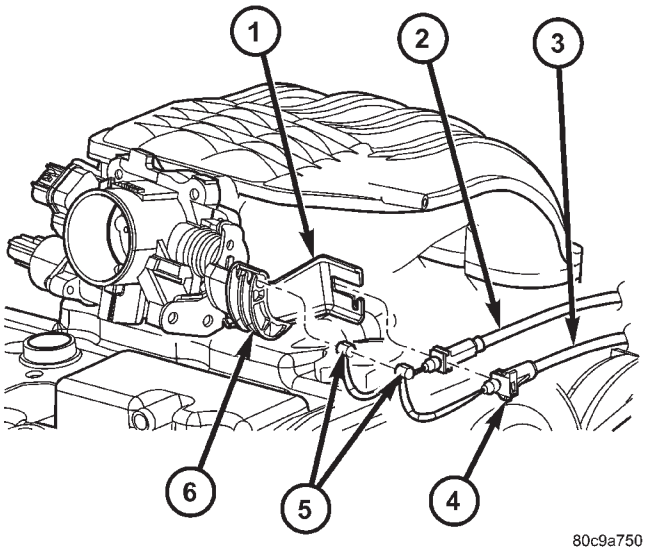


Fig. 27 THROTTLE CABLE, PIN, RELEASE TAB-2.4L

1 - MOUNTING BRACKET
2 - SPEED CONTROL CABLE
3 - THROTTLE CABLE
4 - RELEASE TAB
5 - CABLE PINS
6 - BELLCRANK

(8) Using a pick or small screwdriver, press release tab (Fig. 27) to release plastic cable mount from bracket. **Press on tab only enough to release cable from bracket. If tab is pressed too much, it will be broken.**To remove throttle cable from throttle body bracket, slide cable towards front of vehicle.

(9) Remove throttle cable from vehicle.

3.7L

CAUTION: Be careful not to damage or kink the cable core wire (within the cable sheathing) while servicing accelerator pedal or throttle cable.

(1) From inside vehicle, hold up accelerator pedal. Remove plastic cable retainer (clip) and throttle cable core wire from upper end of pedal arm (Fig. 28). Plastic cable retainer snaps into top of pedal arm.

(2) Remove cable core wire at pedal arm.

(3) From inside vehicle, remove metal clip holding cable to dashpanel (Fig. 28).

(4) Remove air box at throttle body.

(5) Unsnap cable from dashpanel routing clip.

(6) Remove cable housing from dash panel and pull into engine compartment.

(7) Hold throttle in wide open position. While held in this position, slide throttle cable pin (Fig. 29) from throttle body bellcrank.

THROTTLE CONTROL CABLE (Continued)

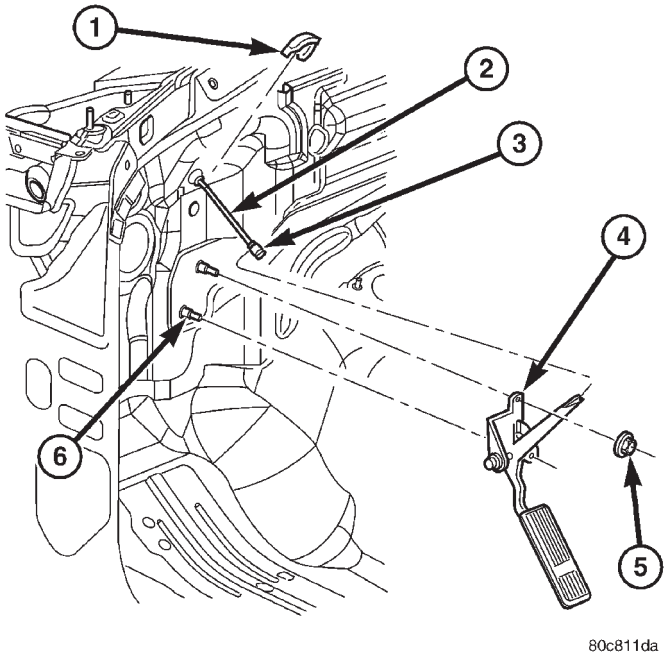


Fig. 28 ACCELERATOR PEDAL/BRACKET ASSEMBLY

1 - METAL THROTTLE CABLE CLIP
2 - THROTTLE CABLE
3 - PLASTIC CABLE RETAINER
4 - PEDAL/BRACKET ASSEMBLY
5 - PEDAL MOUNTING NUTS (2)
6 - PEDAL MOUNTING STUDS (2)

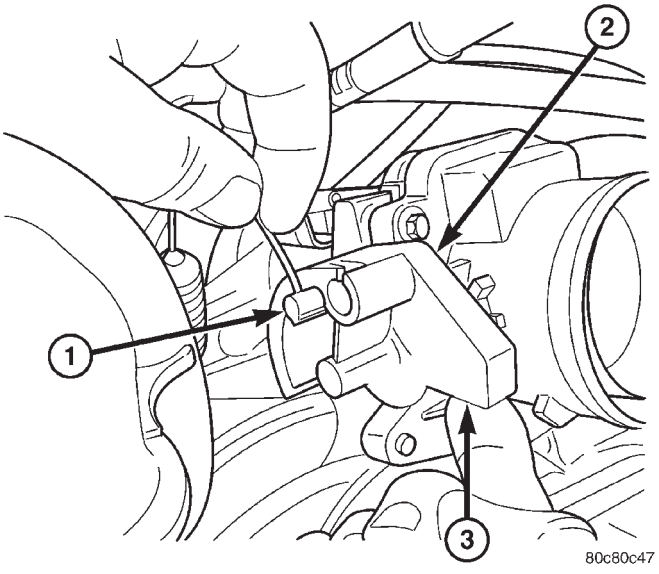


Fig. 29 THROTTLE CABLE PIN-3.7L

1 - THROTTLE CABLE PIN
2 - THROTTLE BODY BELLCRANK
3 - PUSH UP HERE

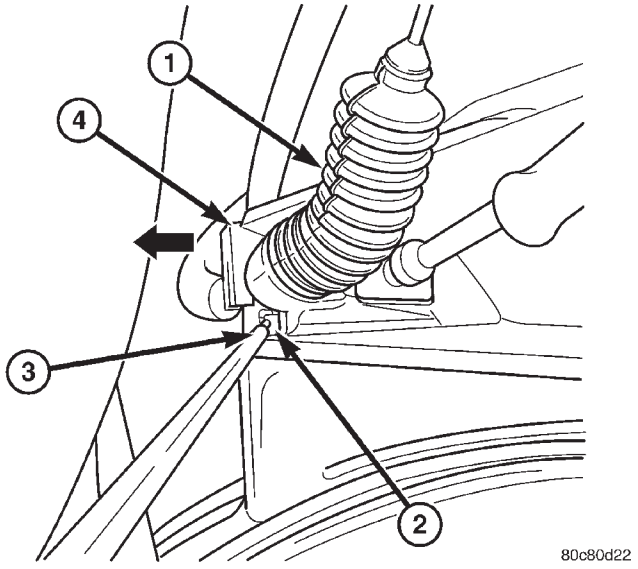


Fig. 30 THROTTLE CABLE RELEASE TAB-3.7L

1 - THROTTLE CABLE
2 - RELEASE TAB
3 - PICK OR SCREWDRIVER
4 - PLASTIC CABLE MOUNT

(8) Using a pick or small screwdriver, press release tab (Fig. 30) to release plastic cable mount from bracket. **Press on tab only enough to release cable from bracket. If tab is pressed too much, it will be broken.** Slide plastic mount (Fig. 30) towards right side of vehicle to remove throttle cable from throttle body bracket.

(9) Remove throttle cable from vehicle.

INSTALLATION

(1) Slide accelerator cable plastic mount into throttle body mounting bracket. Continue sliding until release tab (Fig. 30) is aligned to hole in mounting bracket.

(2) Hold throttle in wide open position. While held in this position, slide throttle cable pin (Fig. 29) into throttle body bellcrank.

(3) Push cable housing into rubber grommet and through opening in dash panel.

(4) From inside vehicle, install metal clip holding cable to dashpanel (Fig. 28).

(5) From inside vehicle, slide throttle cable core wire into opening (slot) in top of pedal arm.

(6) Push plastic cable retainer (clip) into pedal arm opening until it snaps in place.

(7) Install air box to throttle body.

(8) Before starting engine, operate accelerator pedal to check for any binding.

THROTTLE POSITION SENSOR

DESCRIPTION

The 3–wire Throttle Position Sensor (TPS) is mounted on the throttle body and is connected to the throttle blade shaft.

OPERATION

The 3–wire TPS provides the Powertrain Control Module (PCM) with an input signal (voltage) that represents the throttle blade position of the throttle body. The sensor is connected to the throttle blade shaft. As the position of the throttle blade changes, the output voltage of the TPS changes.

The PCM supplies approximately 5 volts to the TPS. The TPS output voltage (input signal to the PCM) represents the throttle blade position. The PCM receives an input signal voltage from the TPS. This will vary in an approximate range of from .26 volts at minimum throttle opening (idle), to 4.49 volts at wide open throttle. Along with inputs from other sensors, the PCM uses the TPS input to determine current engine operating conditions. In response to engine operating conditions, the PCM will adjust fuel injector pulse width and ignition timing.

The PCM needs to identify the actions and position of the throttle blade at all times. This information is needed to assist in performing the following calculations:

- Ignition timing advance
- Fuel injection pulse-width
- Idle (learned value or minimum TPS)
- Off-idle (0.06 volt)
- Wide Open Throttle (WOT) open loop (2.608 volts above learned idle voltage)
- Deceleration fuel lean out
- Fuel cutoff during cranking at WOT (2.608 volts above learned idle voltage)
- A/C WOT cutoff (certain automatic transmissions only)

REMOVAL

2.4L

The Throttle Position Sensor (TPS) is mounted to the throttle body (Fig. 31).

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

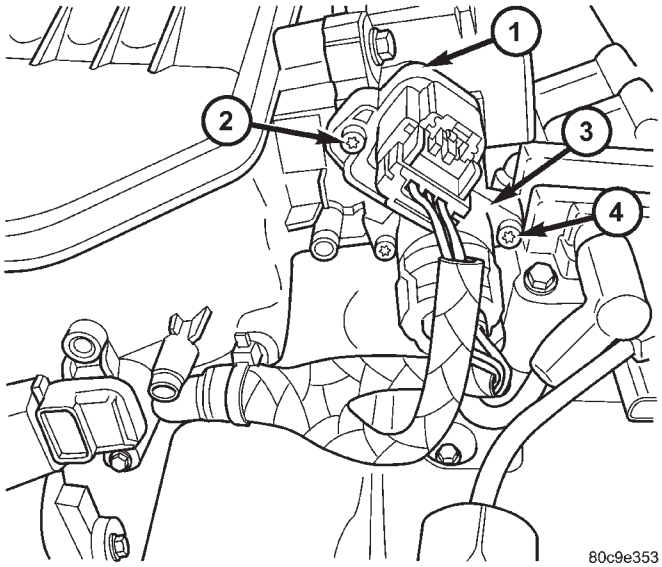


Fig. 31 TPS/IAC MOTOR - 2.4L

1 - THROTTLE POSITION SENSOR (TPS)
2 - MOUNTING SCREWS
3 - IDLE AIR CONTROL MOTOR (IAC)
4 - MOUNTING SCREWS

THROTTLE POSITION SENSOR (Continued)

3.7L

The Throttle Position Sensor (TPS) is mounted to the throttle body (Fig. 32), or (Fig. 33).

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

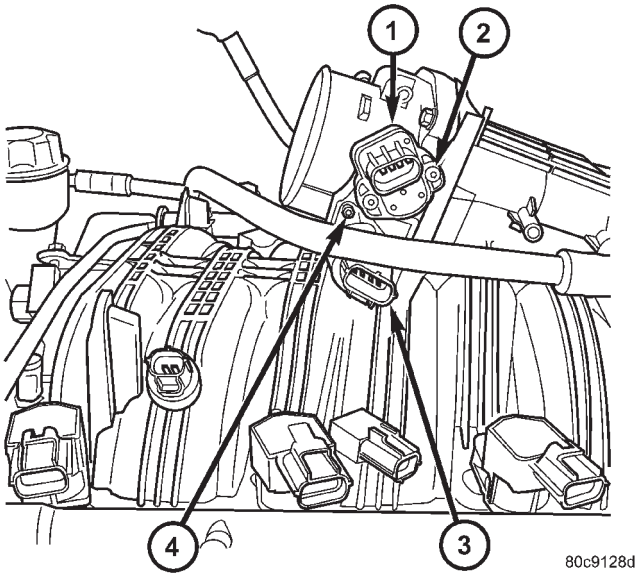


Fig. 32 TPS/IAC MOTOR - 3.7L

1 - THROTTLE POSITION SENSOR (TPS)
2 - MOUNTING SCREWS
3 - IDLE AIR CONTROL MOTOR (IAC)
4 - MOUNTING SCREWS

INSTALLATION

2.4L

The Throttle Position Sensor (TPS) is mounted to the rear of the throttle body.

The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 33). The TPS must be installed so that it can be rotated a few degrees. (If sensor will not rotate, install sensor with throttle shaft on other side of socket tangs). The TPS will be under slight tension when rotated.

(1) Install TPS and retaining screws.
(2) Tighten screws to 7 N·m (60 in. lbs.) torque.
(3) Connect TPS electrical connector to TPS.

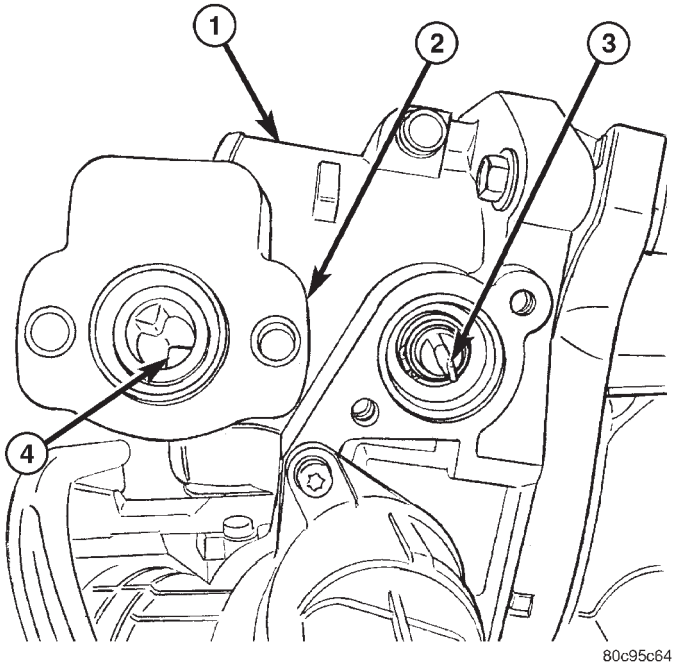


Fig. 33 TPS INSTALLATION - 3.7

1 - THROTTLE BODY
2 - TPS
3 - THROTTLE BODY SHAFT
4 - SOCKET LOCATING TANGS

(4) Manually operate throttle (by hand) to check for any TPS binding before starting engine.
(5) Install air cleaner tube to throttle body.

3.7L

The Throttle Position Sensor (TPS) is mounted to the throttle body (Fig. 32).

The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 33). The TPS must be installed so that it can be rotated a few degrees. (If sensor will not rotate, install sensor with throttle shaft on other side of socket tangs). The TPS will be under slight tension when rotated.

(1) Install TPS and retaining screws.
(2) Tighten screws to 7 N·m (60 in. lbs.) torque.
(3) Connect TPS electrical connector to TPS.
(4) Manually operate throttle (by hand) to check for any TPS binding before starting engine.
(5) Install air cleaner tube to throttle body.