THROTTLE BODY FUEL INJECTION SYSTEM

General Information

See Figures 28 and 29

Electronic fuel injection was introduced on these trucks for 1985 on the 2.5L engine. For the next model year (and all subsequent models covered by this manual) all S/T series trucks were equipped with fuel injection. Most of these late model fuel injected vehicles are equipped with a Throttle Body Injection (TBI) system. The system uses a TBI unit mounted centrally on the intake manifold where a carburetor would normally be found on older vehicles. The throttle body assembly is equipped with 1 (4-cylinder engines) or 2 (V6 engines) electronic fuel injectors in order to supply fuel to regulate the air/fuel mixture. All fuel injection and ignition functions are regulated by the computer control module, which is sometimes also referred to as the ECM, PCM or VCM, depending on the application. It accepts inputs from various sensors and switches, calculates the optimum air/fuel mixture and operates the various output devices to provide peak performance within specific emissions limits. The module will attempt to maintain the ideal air/fuel mixture of 14.7:1 in order to optimize catalytic converter operation. If a system failure occurs that is not serious enough to stop the engine, the module will illuminate the CHECK ENGINE or SERVICE ENGINE SOON light (as applicable) and will continue to operate the engine, although it may need to operate in a backup or fail-safe mode.

Fuel is supplied to the injector(s) through an electric fuel pump assembly which is mounted in the vehicle's fuel tank. The module provides a signal to operate the fuel pump though the fuel pump relay and oil pressure switch.

Other system components include a pressure regulator, an Idle Air Control (IAC) valve, a Throttle Position (TP) sensor, Manifold Air Temperature (MAT) or Intake Air Temperature (IAT) sensor, Engine Coolant Temperature (ECT) sensor, a Manifold Absolute Pressure (MAP) sensor and an oxygen sensor. The fuel injectors are solenoid valves that the control module pulse on and off many times per second to promote proper fuel atomization. The pulse width determines how long an injector is ON each cycle and this regulates the amount of fuel supplied to the engine.

The system pressure regulator is normally part of the TBI unit fuel meter cover. The regulator is designed to keep fuel pressure constant at the injector regardless of engine rpm. This is accomplished by controlling the flow in the return line (a calibrated bypass).

The idle air control valve is a stepper motor that controls the amount of air allowed to bypass the throttle plate. With this valve the computer control module can closely control idle speed even when the engine is cold or when there is a high engine load at idle.

The module used on TBI vehicles has a learning capability which is used to provide corrections for a particular engine's condition. If the battery is disconnected to clear diagnostic codes, or for safety during a repair, the learning process must start all over again. A change may be noted in vehicle performance. In order to "teach" the vehicle, make sure the vehicle is at normal operating temperature, then drive at part throttle, under moderate acceleration and idle conditions, until normal performance returns.

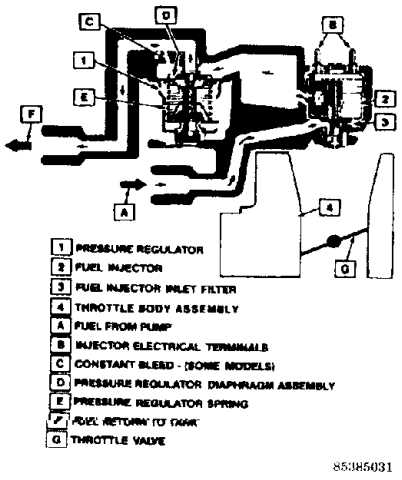


Fig. 28 A cross-sectional view of TBI unit operation — model 220 found on V6 engines

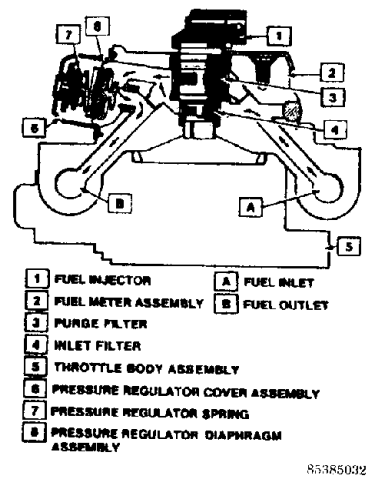


Fig. 29 A cross-sectional view of TBI unit operation — model 700 unit found on late model 4-cylinder engines

OPERATING MODES

Starting Mode

When the ignition switch is first turned **ON**, the fuel pump relay is energized by the module for 2 seconds in order to build system pressure. In the start mode, the computer module checks the ECT, TP sensor and crank signal in order to determine the best air/fuel ratio for starting. The modules on later model vehicles may also use the IAT or MAT (as equipped) and the MAP sensor. Ratios could range from 1.5:1 at approximately -33°F (-36°C), to 14.7:1 at 201°F (94°C).

Clear Flood Mode

If the engine becomes flooded, it can be cleared by opening the accelerator to the full throttle position. When the throttle is open all the way and engine rpm is less than 600, the computer module will pulse the fuel injector at an air/fuel ratio of 20:1 (early vehicles) or 16.5:1 (later model vehicles) while the engine is turning over in order to clear the engine of excess fuel. If throttle position is reduced below 80 percent (early vehicles) or 65 percent (later model vehicles), the module will return to the start mode.

Open Loop Mode

When the engine first starts and engine speed rises above 400 rpm, the computer module operates in the Open Loop mode until specific parameters are met. In Open Loop mode, the fuel requirements are calculated based on information from the MAP and ECT sensors. The oxygen sensor signal is ignored during initial engine operation because it needs time to warm up.

Closed Loop Mode

See Figure 30

When the correct parameters are met, the computer module will use O_2 sensor output and adjust the air/fuel mixture accordingly in order to maintain a narrow band of exhaust gas oxygen concentration. When the module is correcting and adjusting fuel mixture based on the oxygen sensor signal along with the other sensors, this is known as feedback air/fuel ratio control. The computer module will shift into this Closed Loop mode when:

- Oxygen sensor output voltage is varied, indicating that the sensor has warmed up to operating temperature
- The ECT shows an engine coolant temperature above a specified level.
- The engine has been operating for a programmed amount of time.

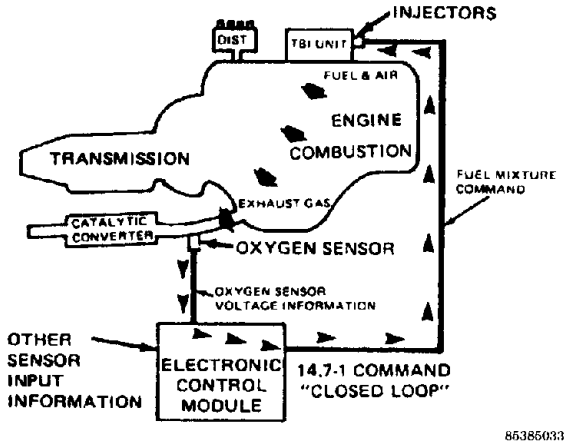


Fig. 30 Computer module fuel control schematic for common closed loop engine operation (same for PCMs and VCMs)

Acceleration Mode

If the throttle position and manifold pressure is quickly increased, the module will provide extra fuel for smooth acceleration.

Deceleration Mode

As the throttle closes and the manifold pressure decreases, fuel flow is reduced by the module. If both conditions remain for a specific number of engine revolutions indicating a very fast deceleration, the module may decide fuel flow is not needed and stop the flow by temporarily shutting off the injectors.

Highway Fuel Mode (Semi-Closed Loop)

On some late model vehicles, the computer control module is programmed to enter a special highway mode to improve fuel economy. If the module senses the correct ECT, ignition control, canister purge activity and a constant engine speed, it will enter highway mode. During this operation, there will be very little adjustment of the long and short term fuel trims, also, the oxygen sensor values will usually read below 100 millivolts.

Decel En-Leanment Mode

On some late model vehicles, the computer control module is programmed to further reduce emissions by leaning the fuel spray on deceleration. The module does this when a high MAP vacuum (low voltage or pressure) is sensed, BUT it should be noted that the module may do this when the vehicle is not moving. This mode of operation may be misdiagnosed as a lean condition. When diagnosing the control system using a scan tool with the transmission in Park, the oxygen sensor signal low (usually below 100 mV), and both fuel trim numbers around 128 counts, lower the engine speed to 1000 rpm. If the sensor and long term trim numbers respond normally, it is possible that the system was fooled into decel en-leanment operation. If the oxygen sensor and long term numbers do not respond at the lower rpm, there are other problems with the vehicle.

Battery Low Mode

If the computer module detects a low battery, it will increase injector pulse width to compensate for the low voltage and provide proper fuel delivery. It will also increase idle speed to increase alternate output and, in some cases, ignition dwell time to allow for proper engine operation.

Field Service Mode

When the diagnostic terminal of the test connector is grounded with the engine running, the computer control module will enter the Field Service Mode. If the engine is running in Open Loop Mode, the CHECK ENGINE or SERVICE ENGINE SOON Malfunction Indicator Lamp (MIL) will flash quickly, about 2½ times per second. When the engine is in Closed Loop Mode, the MIL will flash only about once per second. If the light stays OFF most of the time in Close Loop, the engine is running lean. If the light is ON most of the time, the engine is running rich.

While the engine continues to operate in Field Service Mode certain conditions will apply:

- The distributor operates with a fixed spark advance (some early model vehicles).
- New trouble codes cannot be stored in computer memory.
- The closed loop timer is bypassed.

➡For more information concerning the computer control module, self-diagnosis systems and other electronic engine controls, please refer to Section 4 of this manual.

Fuel Pressure Relief

Prior to servicing any component of the fuel injection system, the fuel pressure must relieved. If fuel pressure is not relieved, serious injury could result.

TBI MODEL 300 OR 700 (2.5L ENGINE)

1. Place the transmission selector in PARK (automatic transmissions) or NEUTRAL (manual transmissions), then set the parking brake and block the drive wheels.
2. Loosen the fuel filler cap to relieve tank pressure.
3. Either remove the FUEL PUMP fuse from the fuse block in the passenger compartment (early model vehicles) or disengage the three terminal electrical connector at the fuel tank (late model vehicles). If you are unsure which method works for your truck, try removing the fuel pump fuse. If this does not disable the pump, the electrical connectors at the fuel tank must be disengaged.
4. Start the engine and allow to run until it stops due to lack of fuel.
5. Engage the starter (turn key to start) for three seconds to dissipate all pressure in the fuel lines.
6. Turn the ignition **OFF**, then re-engage the connector at the fuel tank or install the fuel pump fuse.
7. Disconnect the negative battery cable to prevent accidental fuel spillage should the ignition key accidentally be turned **ON** with a fuel fitting disconnected.
8. When fuel service is finished, tighten the fuel filler cap and connect the negative battery cable.

⁂CAUTION

To reduce the chance of personal injury when disconnecting a fuel line, always cover the fuel line with cloth to collect escaping fuel, then place the cloth in an approved container.

TBI MODEL 220 (2.8L AND 4.3L ENGINES)

1. Disconnect the negative battery cable.
2. Loosen fuel filler cap to relieve fuel tank pressure.
3. The internal constant bleed feature of the Model 220 TBI unit relieves fuel pump system pressure when the engine is turned **OFF**. Therefore, no further action is required.

➡Allow the engine to set for 5-10 minutes; this will allow the orifice (in the fuel system) to bleed off the pressure.

4. When fuel service is finished, tighten the fuel filler cap and connect the negative battery cable.

Electric Fuel Pump

The electric fuel pump is attached to the fuel sending unit, located in the fuel tank.

TESTING

◗ See Figures 31 and 32

1. Properly relieve the fuel system pressure.
2. If necessary for access, remove the air cleaner assembly and plug the vacuum port(s).
3. Disconnect the flexible fuel supply line, located in the engine compartment between the fuel filter and throttle body.
4. Install a fuel pressure gauge, such as J-29658 or equivalent, inline in-line between the fuel filter and throttle body unit (between the steel line and flexible hose). If necessary use an adapter or Tee fitting in order to connect the gauge and complete the fuel circuit.

➡A Tee fitting may be fabricated for this purpose. Depending on the fuel pressure gauge, short lengths of steel tubing, appropriately sized flare nuts and a flare nut adapter may be used.

5. If the engine will run, start the engine and allow it to run at normal idle speed. The fuel pressure should be 9-13 psi (62-90 kPa).
6. If the engine does not run, turn the ignition **ON**, but do not attempt to start the engine. Listen for the fuel pump to run. Within 2 seconds of turning the ignition **ON** pressure should be 9-13 psi (62-90 kPa). If necessary, cycle the ignition **OFF**, then **ON** again, in order to build up system pressure.
7. If the fuel pump did not run or system pressure did not reach specification, locate the fuel pump test connector. The test connector is usually found on the driver's side of the engine compartment (on or near the fender), with a single wire (usually red) leading from the relay to the connector. Using a jumper wire, apply battery voltage to the test connector in order to energize and run the fuel pump. The pump should run and produce fuel pressure of 9-13 psi (62-90 kPa). If the pump does not run, check the relay and fuel pump wiring.
8. If the pump pressure was lower than specification, first check for a restricted fuel line or filter and replace, as necessary. If no restrictions can be found, restrict the fuel supply line between the pressure gauge and the TBI unit (a flexible hose may be temporarily clamped to produce the restriction), then apply voltage to the test connector again. If pressure is now above 13 psi (90 kPa), replace the faulty pressure regulator. If pressure remains below 9 psi (62 kPa), then the problem is located in the fuel tank (the fuel pump, coupling hose or inlet filter).
9. If during Step 7, the pressure was higher than specification, disengage the injector connector, then disconnect the fuel return line flexible hose which connects the line from the throttle body to the tank line. Attach a 5/16 ID flex hose to the fuel line from the throttle body and place the other end into an approved gasoline container. Cycle the ignition in order to energize the fuel pump and watch system pressure. If pressure

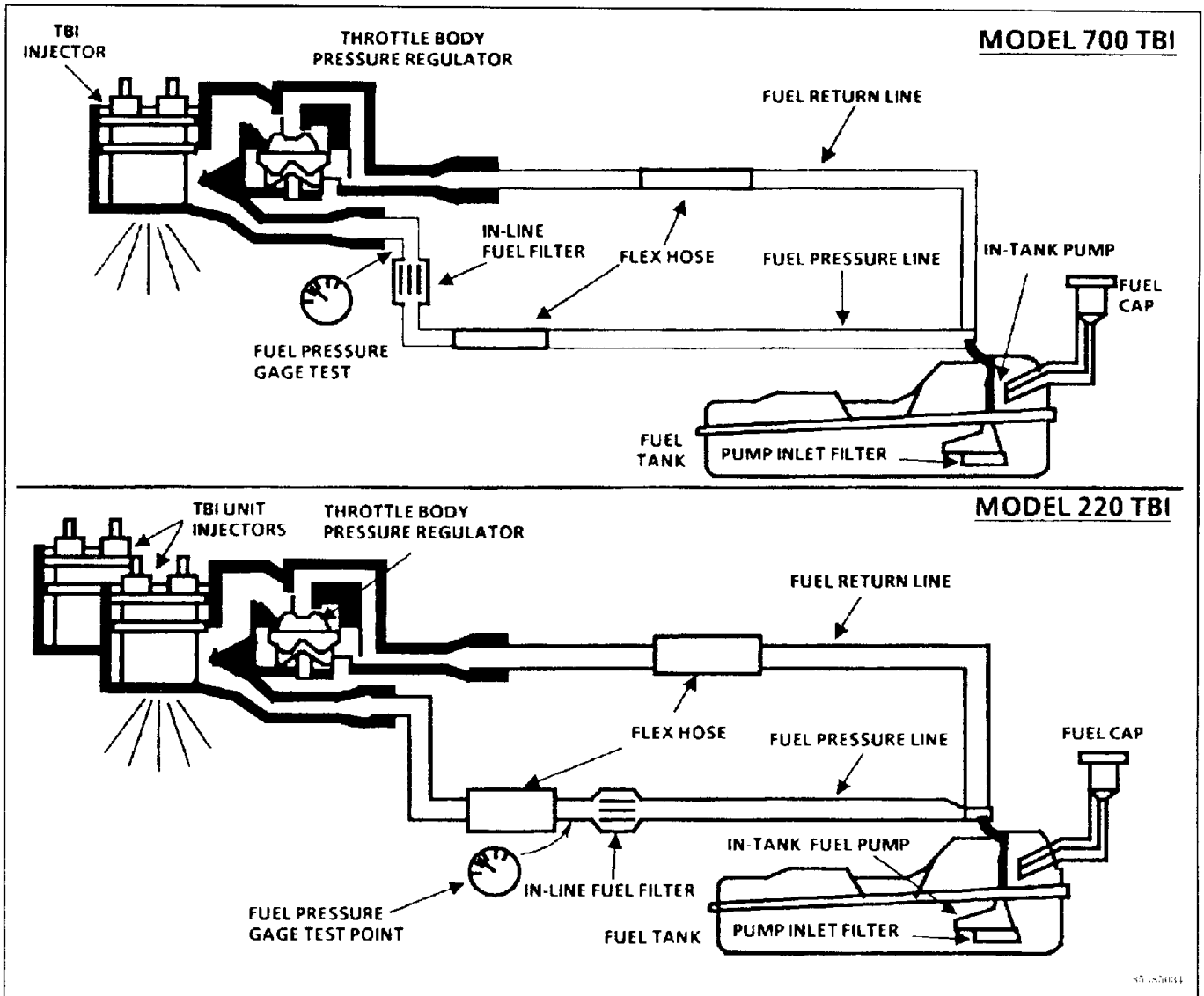
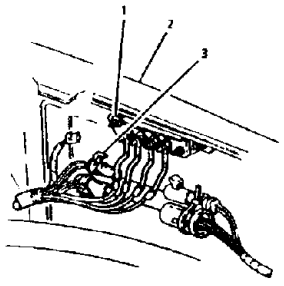


Fig. 31 Fuel system pressure testing



1 FUEL PUMP TEST CONNECTOR
2 LEFT FRONT FENDER
3 FORWARD LAMP HARNESS CONNECTOR

Fig. 32 The fuel pump test connector is normally found in the engine compartment, on the left fender

is still higher, check for restrictions in the throttle body return line. Repair or replace the line if restrictions are found or replace the faulty pressure regulator if no other causes of high pressure are identified. If fuel pressure is normal only with the flexible hose-to-fuel tank line out of the circuit, check that line for restrictions and repair or replace, as necessary.

10. Once the test is completed, depressurize the fuel system and remove the gauge.
11. Secure the fuel lines and check for leaks.
12. If removed, install the air cleaner assembly.

REMOVAL & INSTALLATION

1. Properly relieve the fuel system pressure.

2. Connect the negative battery cable.

➡Be sure to keep a Class B (dry chemical) fire extinguisher nearby.

⁂CAUTION

Due to the possibility of fire or explosion, never drain or store gasoline in an open container.

3. Drain the fuel tank, then remove it from the vehicle. Refer to the procedure found later in this section for details.
4. Using the GM fuel gauge sending unit retaining cam tool No. J-24187, J-36608 (or equivalent) or a brass drift and a hammer, remove the cam locking ring (fuel sending unit) by twisting counterclockwise. With the locking ring released, carefully lift the sending unit from the fuel tank.
5. Remove the fuel pump from the fuel sending unit, by performing the following procedures:
   a. Pull the fuel pump up into the mounting tube, while pulling outward (away) from the bottom support.

➡When removing the fuel pump from the sending unit, be careful not to damage the rubber insulator and the strainer.

   b. When the pump assembly is clear of the bottom support, pull it out of the rubber connector.

To install:

6. Inspect the fuel pump hose and bottom sound insulator for signs of deterioration, then replace, as necessary.
7. Push the fuel pump onto the sending tube.
8. Using a new sending unit-to-fuel tank O-ring, carefully lower the sending unit/fuel pump assembly into the fuel tank.

➡When installing the sending unit, be careful not to fold or twist the fuel strainer or it may restrict the fuel flow.

9. Secure the sending unit by turning or driving the lockring clockwise and into position under the tabs.
10. Install the fuel tank assembly to the vehicle.
11. Connect the negative battery cable and check for proper pump operation.

Fuel Pump Relay

The fuel pump relay is normally found on a relay bracket which is mounted to the left front fender in the engine compartment. Positioning within the bracket will vary according to model and application. Check for loose electrical connections; no other service is possible, except replacement.

REMOVAL & INSTALLATION

◗ See Figure 33

1. Disconnect the negative battery cable.
2. Disengage the relay/electrical connector assembly from the bracket.
3. Pull the fuel pump relay from the electrical connector.
4. If necessary, use a new relay, then reverse the removal procedures.

Throttle Body

◗ See Figures 34, 35 and 36

The Model 300 throttle body assembly is used on early 2.5L engines. It consists of three major casting assemblies:

- Fuel pressure cover with pressure regulator.
- Fuel metering body with fuel injectors.
- Throttle body with an Idle Speed Control (IAC) Valve and a Throttle Position (TP) sensor.

The Model 700 throttle body assembly is used on later 2.5L engines. It consists of two major casting assemblies:

- Fuel metering assembly with pressure regulator and fuel injector.
- Throttle body with an Idle Speed Control (IAC) Valve and a Throttle Position (TP) sensor.

The Model 220 throttle body assembly is used on the 2.8L and 4.3L engines. It consists of three major casting assemblies:

- Fuel pressure cover with pressure regulator.
- Fuel metering body with fuel injectors.
- Throttle body with an Idle Speed Control (IAC) Valve and a Throttle Position (TP) sensor.

The Throttle Position (TP) sensor is a variable resistor used to convert the degree of throttle plate opening to an electrical signal to the computer control module. The module uses this signal as a reference point of throttle valve position. In addition, an Idle Air Control (IAC) assembly, mounted in the throttle body is used to control idle speeds. A cone-shaped valve in the IAC assembly is located in an air passage in the throttle body that leads from the point beneath the air cleaner to below the throttle valve. The module monitors idle speeds and, depending on engine load, moves the IAC cone in the air passage to increase or decrease air bypassing the throttle valve to the intake manifold for control of idle speeds.

The operation of all throttle bodies is basically the same. Each is constantly monitored by the computer control module in order to produce a 14.7:1 air/fuel ratio, which is vital to the catalytic converter operation.

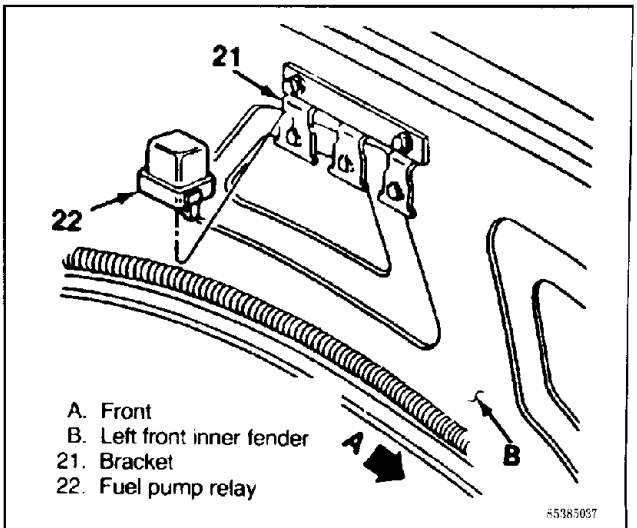
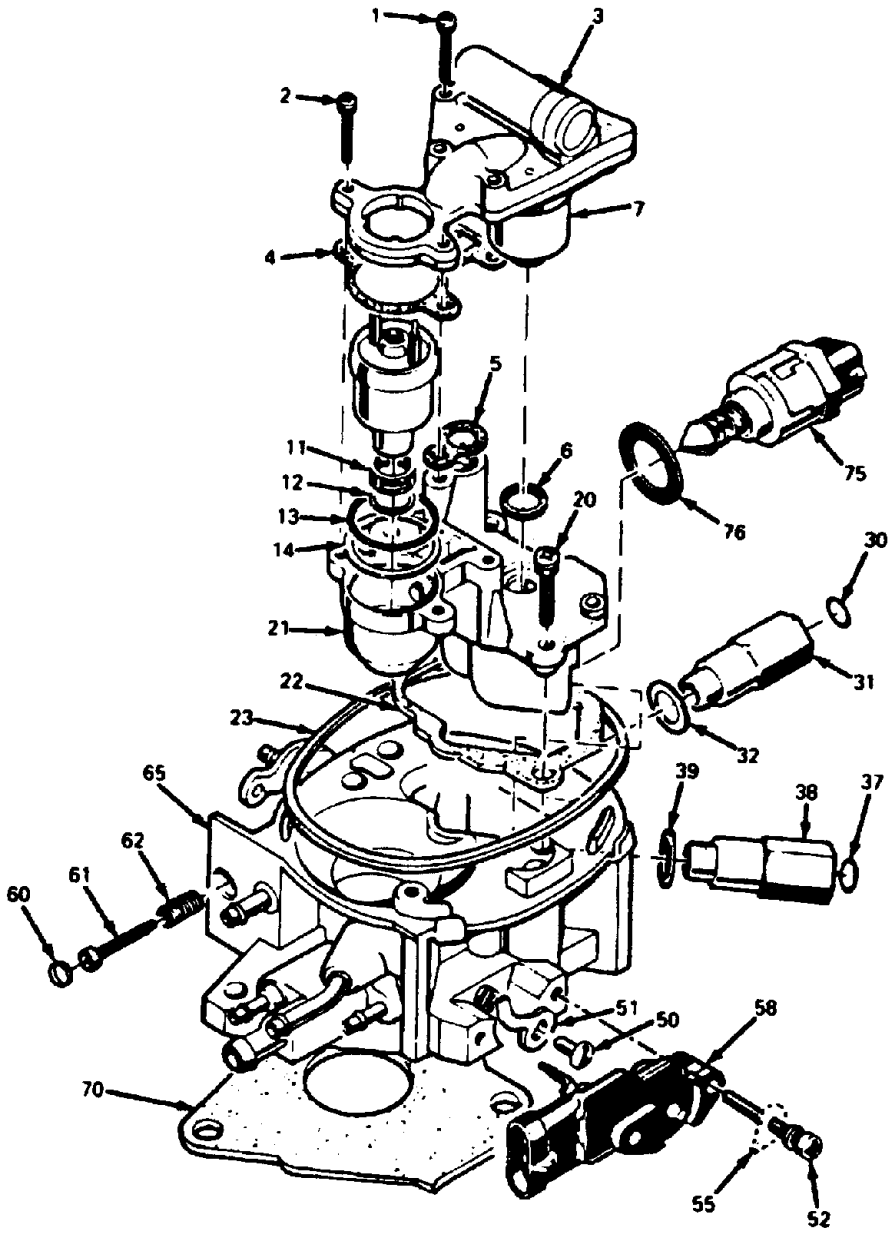


Fig. 33 Common fuel pump relay mounting



1. Screw & washer assembly
2. Screw & washer assembly
3. Fuel meter cover assembly
4. Gasket—fuel meter cover
5. Gasket—fuel meter outlet
6. Dust seal—pressure regulator
7. Pressure regulator
11. Filter—fuel injector nozzle
12. Lower "O" ring
13. Upper "O" ring
14. Back-up washer—fuel injector
20. Screw & washer assembly
21. Fuel meter body assembly
22. Gasket—fuel meter body
23. Gasket—air filter
30. Fuel return line "O" ring
31. Nut—fuel return
32. Gasket—fuel return nut
37. Fuel inlet line "O" ring
38. Nut—fuel inlet
39. Gasket—fuel inlet nut
50. Screw—TPS lever attaching
51. Lever—TPS
52. Screw & washer assembly
55. Retainer—TPS attaching screw
58. Sensor—throttle position
60. Plug—idle stop screw
61. Screw—throttle stop
62. Spring—throttle stop screw
65. Throttle body assembly
70. Gasket—flange mounting
75. Idle air control assembly
76. Gasket—IAC to throttle body

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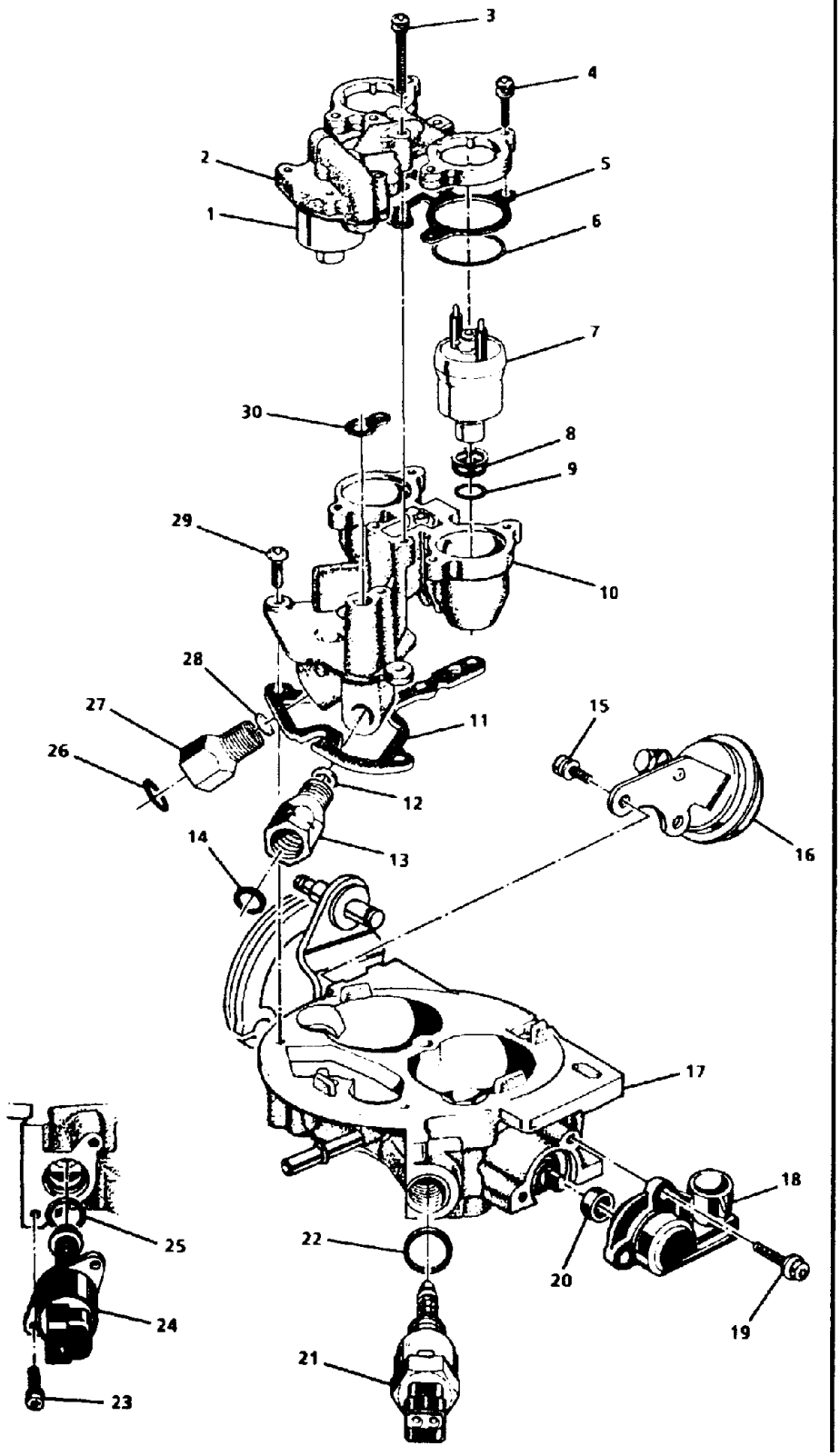
Fig. 34 Exploded view of the model 300 TBI unit — early 2.5L engines



1 REGULATOR ASSEMBLY - FUEL PRESSURE
2 COVER ASSEMBLY - FUEL METER
3 SCREW - FUEL METER COVER ATTACHING - LONG
4 SCREW - FUEL METER COVER ATTACHING - SHORT
5 GASKET - FUEL METER COVER
6 O-RING - FUEL INJECTOR UPPER
7 INJECTOR ASSEMBLY - TBI FUEL
8 FILTER - FUEL INJECTOR INLET
9 O-RING - FUEL INJECTOR LOWER
10 BODY ASSEMBLY - FUEL METER
11 GASKET - THROTTLE BODY TO FUEL METER BODY
12 GASKET - FUEL OUTLET NUT
13 NUT - FUEL OUTLET
14 O-RING - FUEL RETURN LINE
15 SCREW - ISC ACTUATOR ASSEMBLY ATTACHING
16 ACTUATOR ASSEMBLY - IDLE SPEED CONTROL (ISC)
17 BODY ASSEMBLY - THROTTLE
18 SENSOR - THROTTLE POSITION (TP)
19 SCREW - TP SENSOR ATTACHING
20 SEAL - TP SENSOR
21 VALVE ASSEMBLY - IDLE AIR CONTROL (IAC) - THREAD MOUNTED
22 GASKET - IAC VALVE
23 SCREW - IAC VALVE ATTACHING
24 VALVE ASSEMBLY - IDLE AIR CONTROL (IAC) - FLANGE MOUNTED
25 O-RING - IAC VALVE
26 O-RING - FUEL INLET LINE
27 NUT - FUEL INLET
28 GASKET - FUEL INLET NUT
29 SCREW - FUEL METER BODY TO THROTTLE BODY ATTACHING
30 GASKET - FUEL METER OUTLET

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Fig. 36 Exploded view of the model 220 TBI unit — 2.8L and 4.3L engines

REMOVAL & INSTALLATION

See Figures 37, 38, 39 and 40

1. Properly relieve the fuel system pressure, then disconnect the negative battery cable.
2. Remove the air cleaner assembly.
3. Disengage the electrical connectors from the idle air control valve, the throttle position sensor and the fuel injector(s). When disengaging the injector connectors, squeeze the plastic tabs and pull straight upward.
4. If applicable, remove the grommet with wires from the throttle body.
5. Disengage the throttle return spring(s) and linkage (including cruise control and/or throttle valve (as equipped).
6. Tag and disconnect the vacuum hoses from the throttle body.

➡ALWAYS use a backup wrench on the TBI fuel line inlet nuts when disconnecting the fuel lines.

7. Place a rag (to catch the excess fuel) under the fuel line-to-throttle body connection, then disconnect the fuel lines from the throttle body. Remove and discard the old O-rings from the lines.
8. Remove the TBI unit-to-manifold attaching hardware, then remove the throttle body and discard the old gasket.

➡Be sure to place a cloth or plastic cover over the intake manifold opening to prevent dirt from entering the engine.

To install:

9. Clean the gasket mating surfaces taking great care to prevent debris from entering the engine and to make sure the surfaces are not scored or damaged.
10. Position the throttle body to the intake manifold using a new gasket, then thread the retainers and tighten to specification:
    - For early 2.5L engines equipped with the model 300 TBI unit tighten bolts or nuts to 13 ft. lbs. (18 Nm) and studs to 45 inch lbs. (5 Nm).
    - For late 2.5L engines equipped with the model 700 TBI unit: 12 ft. lbs. (17 Nm).

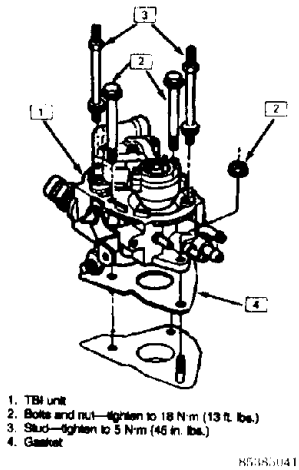


Fig. 37 Model 300 TBI unit mounting — early 2.5L engines

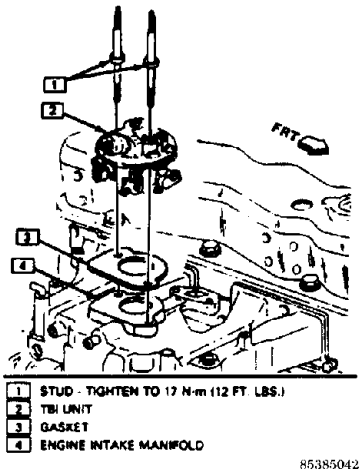


Fig. 38 Model 700 TBI unit mounting — late 2.5L engines

- For 2.8L engines (model 220 TBI unit): 18 ft. lbs. (25 Nm).
- For 4.3L engines (model 220 TBI unit): 12 ft. lbs. (16 Nm).

➡ALWAYS use a backup wrench on the TBI fuel line inlet nuts when connecting the fuel lines.

11. Using new O-rings, connect and tighten the fuel line fittings to 20 ft. lbs. (26 Nm).
12. Connect the vacuum hoses to the throttle body, as tagged during removal.
13. Engage the throttle return spring(s) and linkage (including cruise control and/or throttle valve (as equipped).
14. If applicable, install the grommet with wires to the throttle body.
15. Engage the electrical connectors to the idle air control valve, the throttle position sensor and the fuel injector(s).
16. Install the air cleaner assembly.
17. Connect the negative battery cable.
18. Depress the accelerator pedal to the floor and release it to see if the pedal returns freely. Turn the ignition switch **ON** and check for fuel leaks.

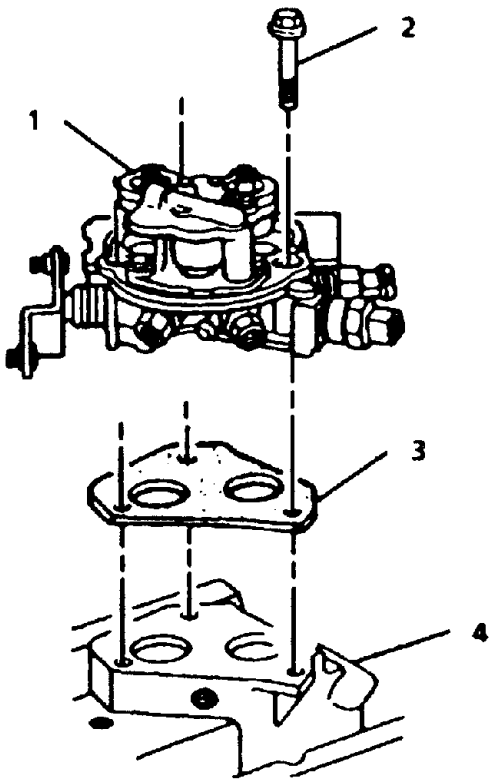
INJECTOR REPLACEMENT

See Figures 41, 42 and 43

⁂CAUTION

When removing the injector(s), be careful not to damage the electrical connector pins (on top of the injector), the injector fuel filter and the nozzle. The fuel injector is serviced as a complete assembly ONLY, it is an electrical component and should not be immersed in any kind of cleaner.

1. Properly relieve the fuel system pressure, then disconnect the negative battery cable.
2. Remove the air cleaner assembly.



1 TBI UNIT
2 BOLT – TIGHTEN TO 25 N·m (18 lb. ft.)
3 GASKET
4 ENGINE INTAKE MANIFOLD

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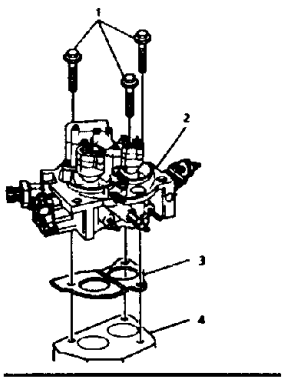
Fig. 39 Model 220 TBI unit mounting — 2.8L engine



1 BOLT
2 TBI UNIT
3 GASKET (MUST BE INSTALLED WITH STRIPE FACING UP)
4 ENGINE INTAKE MANIFOLD

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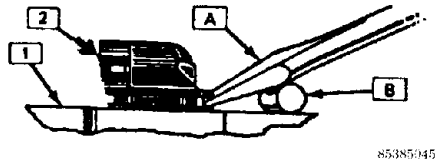
Fig. 40 Model 220 TBI unit mounting — 4.3L engine

3. At the injector connector(s), squeeze the two tabs together and pull straight up to disengage connector from the injector.
4. Except for the model 700 TBI unit, loosen the fuel meter cover retaining screws, then remove the cover from the fuel meter body, but leave the cover gasket in place.
5. For the model 700 TBI unit, loosen the injector retainer screw, then remove the screw and retainer from the top of the throttle body.
6. Using a small prybar and a round fulcrum, carefully pry the injector until it is free, then remove the injector from the fuel meter body.
7. Remove the small O-ring from the nozzle end of the injector. If equipped and removal is necessary, carefully rotate the injector's fuel filter back and forth to remove it from the base of the injector.
8. Except for model 700 TBI unit, remove and discard the fuel meter cover gasket.



1. Fuel meter body
2. Fuel injector
A. Suitable prybar
B. Fulcrum

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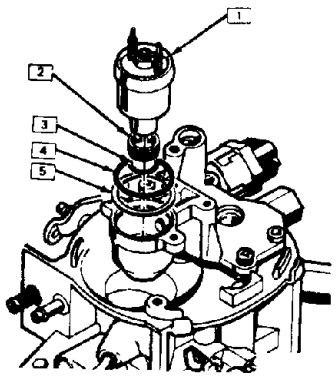
Fig. 41 Most injectors are removed using a prytool and fulcrum



1. Fuel injector
2. Filter
3. Small "O" ring
4. Large "O" ring
5. Steel back-up washer

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Fig. 42 Exploded view of a common injector installation — model 300 TBI unit shown

9. Remove the large O-ring and back-up washer (if equipped) from the top of the counterbore of the fuel meter body injector cavity.

To install:

10. If removed, with the larger end of the filter facing the injector (so that the filter covers the raised rib of the injector base) install the filter by twisting it into position on the injector.

11. Lubricate the new O-rings with clean automatic transmission fluid, then install the small O-ring on the nozzle end of the injector. Be sure the O-ring is pressed up against the injector or injector filter (as applicable).

12. Install the steel backup washer (if equipped) in the top counterbore of the fuel meter body's injector cavity, then install the new large O-ring directly over the backup washer. Make sure the O-ring is properly seated in the cavity and is flush with the top of the fuel meter body casting surface.

➡If the backup washer and large O-ring are not properly installed BEFORE the fuel injector, a fuel leak will likely result.

13. For the model 220 TBI unit, install the fuel injector into the cavity by aligning the raised lug on the injector base with the cast notch in the fuel meter body cavity. Once the injector is aligned, carefully push down on the injector by hand until it is fully seated in the cavity. When properly aligned and installed, the injector terminals will be approximately parallel to the throttle shaft.

14. For the model 300 or model 700 TBI units, carefully align and install the injector to the cavity. Push straight down until the injector is properly seated. For the model 700 unit, the injector connector should be installed parallel to the casting support rib and facing in the general direction of the cut-out in the fuel meter body provided for the wire grommet.

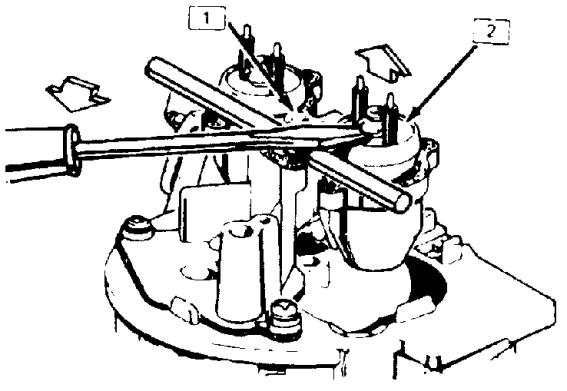
15. Except for the model 700 TBI unit, position a new fuel meter cover gasket, then install the cover to the body, making sure the gasket remains in position. Using a suitable threadlocking compound, install and tighten the cover retainers to 30 inch lbs. (4 Nm).

16. For the model 700 TBI unit, install the injector retainer and coat the retainer screw threads with a suitable threadlocking compound, then install and tighten the screw to secure the injector.

17. Engage the injector electrical connector(s).

18. Connect the negative battery cable, then turn the **ON** to pressurize the fuel system and check for leaks.

19. Install the air cleaner assembly, then start the engine and check for leaks.



1. Fuel meter cover gasket
2. Removing fuel injector

Fig. 43 Removing the injectors from the model 220 TBI unit (2.8L and 4.3L engines)

IDLE AIR CONTROL (IAC) VALVE REPLACEMENT

➧ See Figures 44 and 45

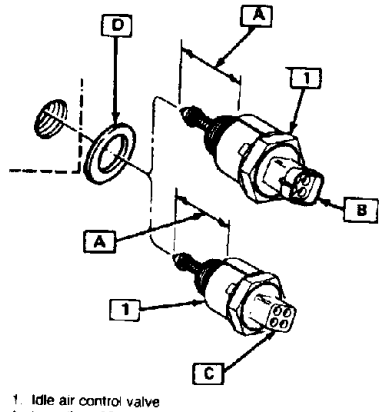
1. Disconnect the negative battery cable.
2. Remove the air cleaner assembly from the engine.
3. Disengage the electrical connector from the idle air control valve.
4. If the valve is threaded into the throttle body, use a 1¼ (32mm) wrench or an IAC removal tool to loosen and remove the idle air control valve from the throttle body unit.
5. If the valve is bolted to the throttle body, loosen and remove the retaining bolts, then remove the valve and gasket from the TBI unit.

To install:

****WARNING**

Before installing a new idle air control valve, measure the distance that the valve extends (from the motor housing to the end of the cone); the distance should be no greater than 1⅛ in. (28mm). If it is extended too far, damage may occur to the valve when it is installed.

6. Measure the valve pintle extension. If a threaded valve pintle length is excessive, identify the valve as a type-I or type-II for all vehicles through the late 1980's. The type I valve has a collar at the electric terminal end while the type-II does not. If the valve is a bolt-on (not thread on) or the vehicle is a 1989 or later model type, then it should be treated as a type-I valve. To retract a new valve pintle on a type-I valve, use firm thumb pressure and, if necessary, rock the pintle with a slight side-to-side motion. For new type-II valves, compress the re-



1. Idle air control valve
A. Less than 28mm (1⅛ in.)
B. Type I (with collar)
C. Type II (without collar)
D. Gasket (part of IAC valve service kit)

Fig. 44 Identifying early model idle air control valves

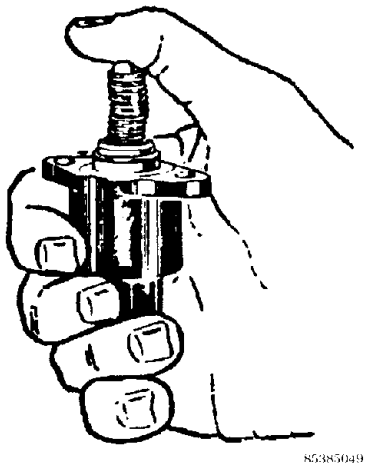


Fig. 45 Retracting the pintle on a NEW IAC valve (late model or early model type I)

taining spring by hand and turn the valve inward using a clockwise motion. Once the pintle is retracted for type-II valves, make sure the straight portion of the spring is again aligned with the flat on the valve.

7. If reinstalling a used valve on which the pintle is extended further than specification, an IAC tester MUST be used to electrically retract the pintle.

➡Do not attempt to physically retract a pintle on an IAC valve that has been in service, the force may damage the pintle threads. The force required to retract the pintle is only safe on NEW IAC valves.

8. If installing a bolt-on valve, position a gasket a new O-ring (coated with clean automatic transmission fluid) on the valve, as applicable. Then install the valve to the throttle body and secure using the retaining bolts.

9. If installing a threaded valve, position the valve to the throttle body using a new gasket or O-ring, then carefully tighten the valve to 13 ft. lbs. (18 Nm).

10. Engage the valve electrical connector, then install the air cleaner assembly.

11. Connect the negative battery cable, then reset the IAC valve pintle:

a. For vehicles through 1988, connect the negative battery cable, then start and run the engine until it reaches normal operating temperature. Shut the engine **OFF** and the computer module will reset the IAC valve pintle.

b. For 1989 and later vehicles equipped with a model 700 TBI unit (2.5L engine), connect the negative battery cable. Depress the accelerator pedal slightly, then start and run the engine for 5 seconds. Turn the ignition **OFF** for 10 seconds, then restart the engine and check for proper idle operation.

c. For 1989 and later vehicles equipped with a model 220 TBI unit (2.8 and 4.3L engines), connect the negative battery cable. Turn the ignition **ON** (engine NOT running) for 5 seconds, then turn the ignition **OFF** for 10 seconds. Start the engine and check for proper idle operation.

THROTTLE POSITION (TP) SENSOR SERVICE

See Figures 46 and 47

The throttle position sensor used on most of the engines covered by this manual is non-adjustable. Some early 2.8L engines (certain models used pre-1989) may be equipped with an adjustable sensor. If so, the sensor can be rotated when the fasteners are loosened. If sensor problems are suspected, test sensor output using a scan tool or voltmeter. If readings are out of specification, the sensor must be adjusted (if possible) or replaced.

Adjustment & Testing

The TP sensor wiring should consist of a 3 wire harness connector. The gray wire is normally the 5 volt reference signal from the computer control module. The dark blue wire should be the TP signal and the black wire is ground.

1. If available, connect a scan tool to the ALDL/DLC. If a scan tool is not available, use a digital voltmeter to backprobe the TP sensor connector terminals for the ground (black wire on end of connector) and sensor signal (dark blue wire usually at center of connector). By backprobing the connector a voltage reading can be taken without disconnecting the circuit and without piercing the wires.

2. Turn the ignition **ON**, but do not start the engine. Check the voltmeter or scan tool for TP sensor output.

a. On all engines with a non-adjustable sensor, voltage should be 1.25 volts or less with the throttle closed. Open the throttle and watch for a smooth change as the voltage increases. Voltage may go as high as 4.5 volts at wide open throttle. If voltage with the throttle closed is greater than 1.25 volts, or if the voltage does not increase smoothly as the throttle is opened, replace the sensor.

b. For early model 2.8L engines with an adjustable sensor, rotate the sensor (with the throttle closed) until a reading of 0.420-0.450 volts is obtained. Tighten the retaining screws and retest to verify proper adjustment. Open the throttle and look for a smooth increase. If proper adjustment cannot be obtained, the sensor must be replaced.

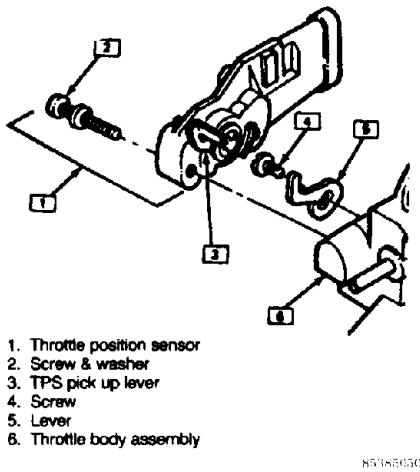


Fig. 46 Common throttle position sensor mounting — early 2.5L engine