SECTION 03-04A Fuel Charging and Controls—1.6L

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VEHICLE APPLICATION

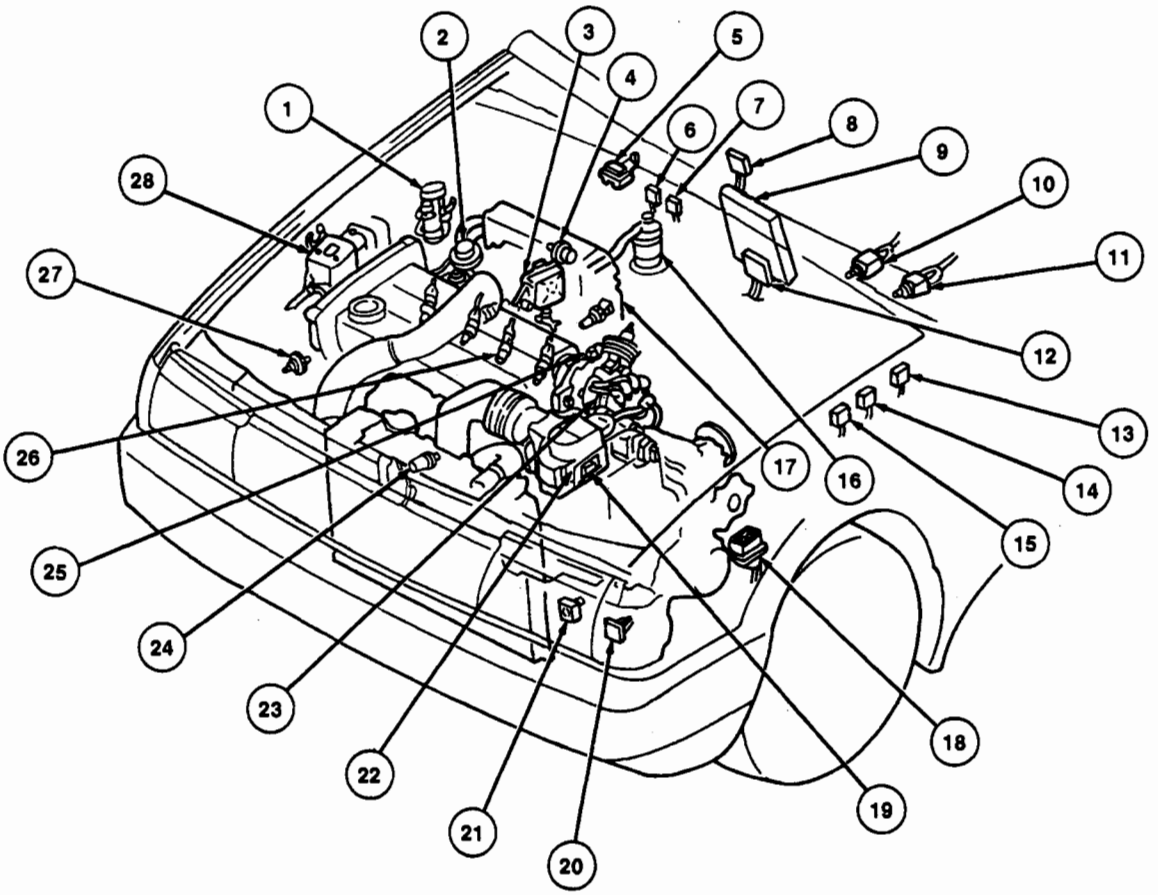
Capri.

DESCRIPTION AND OPERATION

The Multiport Fuel Injection (MFI) system is classified as a multi-point, pulse fuel injection system. This system supplies the engine with the air / fuel mixture necessary for combustion. An air induction system and fuel injection system work in conjunction with an electronic engine control system which consists of various sensors, switches and a powertrain control module (PCM) 12A650. All sensors and switches are connected to the PCM which interprets the data it receives and computes when and for how long the electrically operated injectors are energized.

The basic fuel requirement of the engine is determined from the data supplied to the PCM by the volume air flow sensor which measures the amount of air being drawn into the engine. Other sensors and switches are used to measure air temperature, atmospheric pressure, coolant temperature, engine speed and exhaust oxygen content. The various sensors and switches detect any changes in the operating conditions and send signals to the PCM. This permits proper control over the opening duration of the injectors to maintain optimum exhaust emission control and engine performance for all operating conditions.

DESCRIPTION AND OPERATION (Continued)



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Item	Description
1	ISC / BPA Valve
2	Dashpot
3	Throttle Position Sensor
4	Overboost Pressure Switch
5	Barometric Pressure (BARO) Sensor
6	Pressure Regulator Control Solenoid Valve
7	Canister Purge Solenoid
8	Fuel Pump Relay
9	Powertrain Control Module (PCM)
10	Brake On / Off Switch (BOO)
11	Clutch Engage Switch
12	Electrical Load
13	A / C Fuse (Cooler)

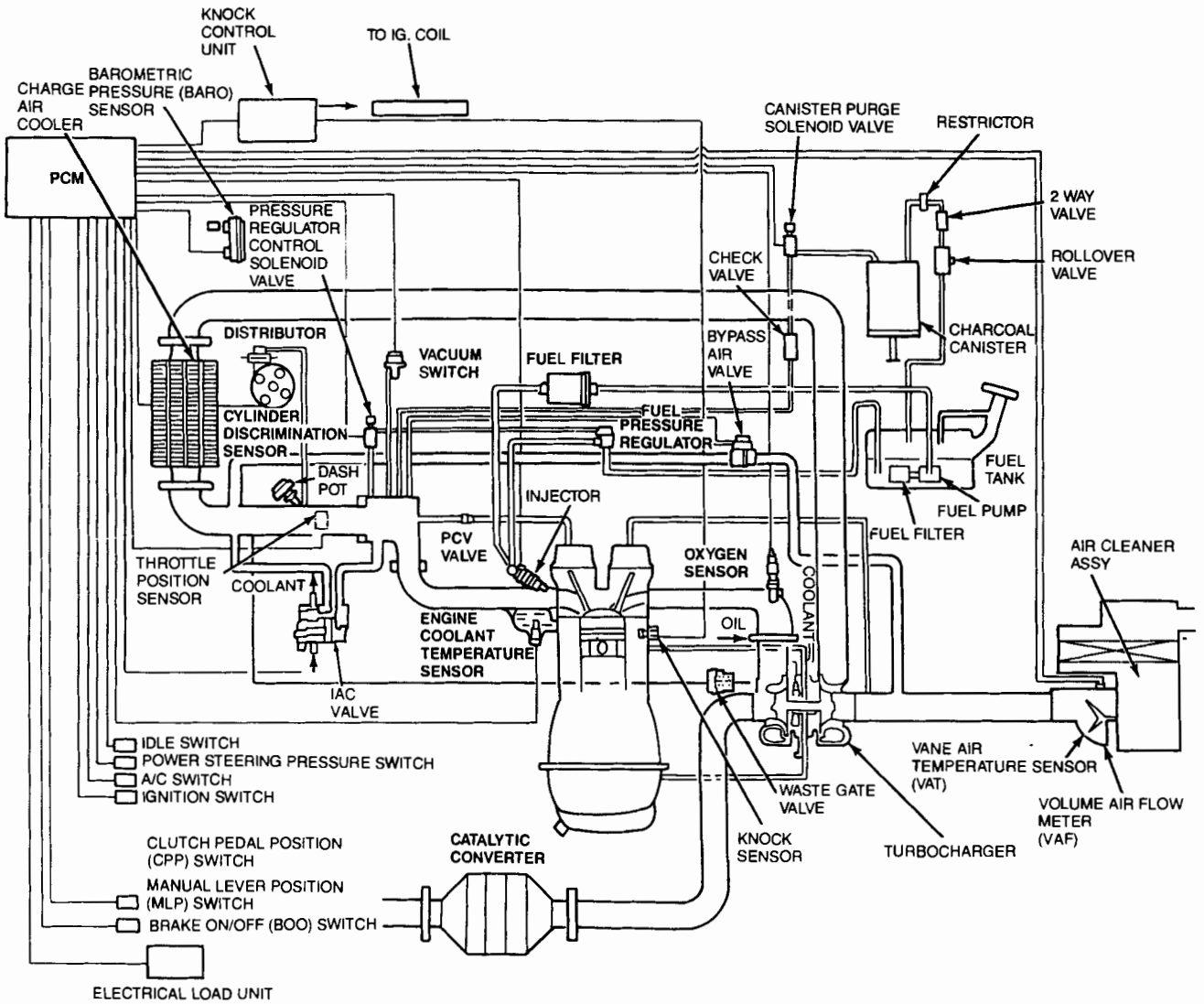
(Continued)

Item	Description
14	A / C Clutch Relay
15	Condenser Fan Relay
16	Fuel Filter
17	Engine Coolant Temperature (ECT) Sensor
18	Power Relay
19	Intake Air Temperature Sensor
20	Manual Lever Position (MLP) Switch
21	Clutch Pedal Position (CPP) Switch
22	Volume Air Flow Meter
23	Distributor
24	Oxygen Sensor
25	Fuel Pressure Regulator
26	Fuel Injector
27	Power Steering Pressure Switch
28	Knock Sensor (Turbo Only)

DESCRIPTION AND OPERATION (Continued)

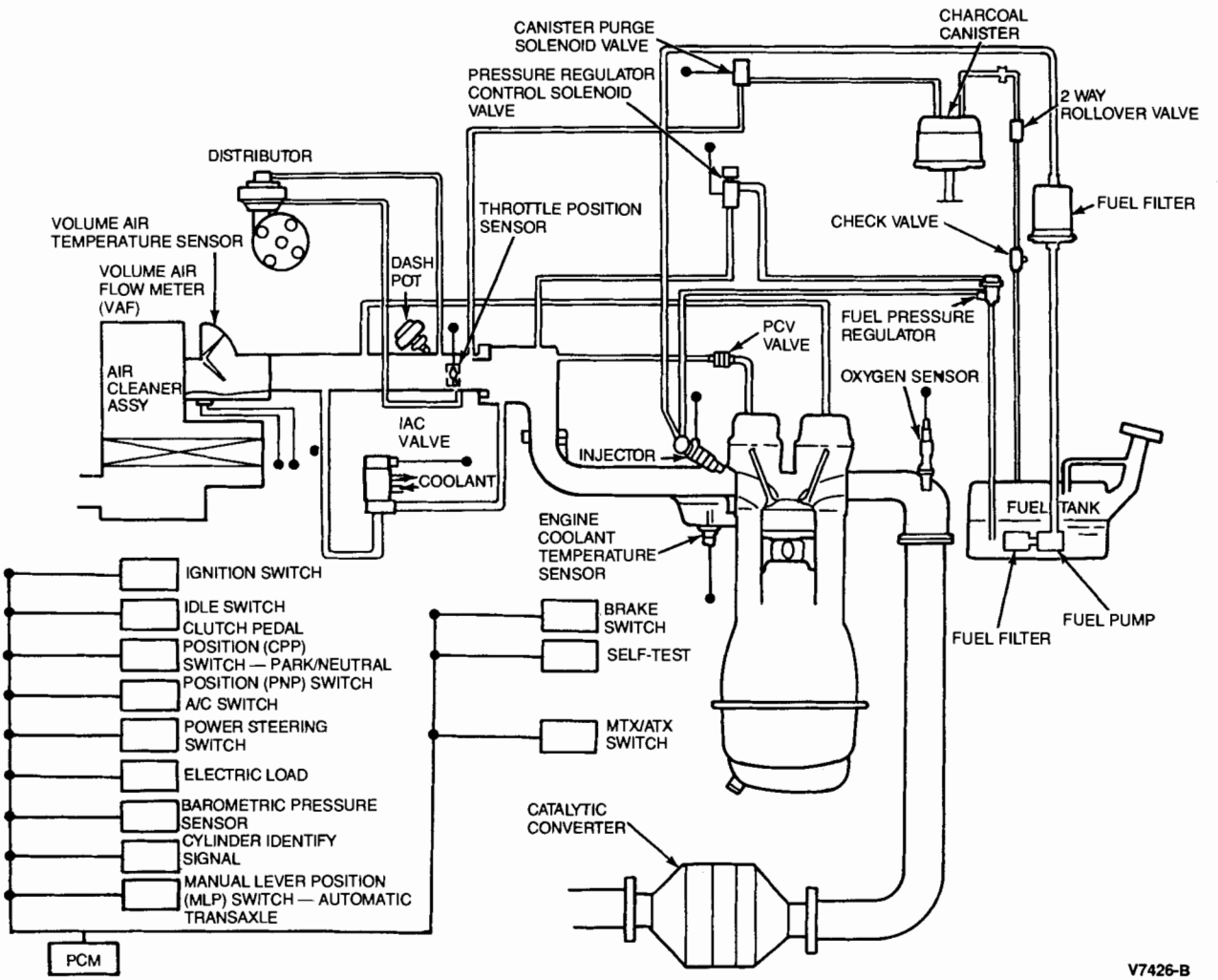
Emission Control Schematic

Turbocharged Vehicles



DESCRIPTION AND OPERATION (Continued)

Naturally Aspirated Vehicles

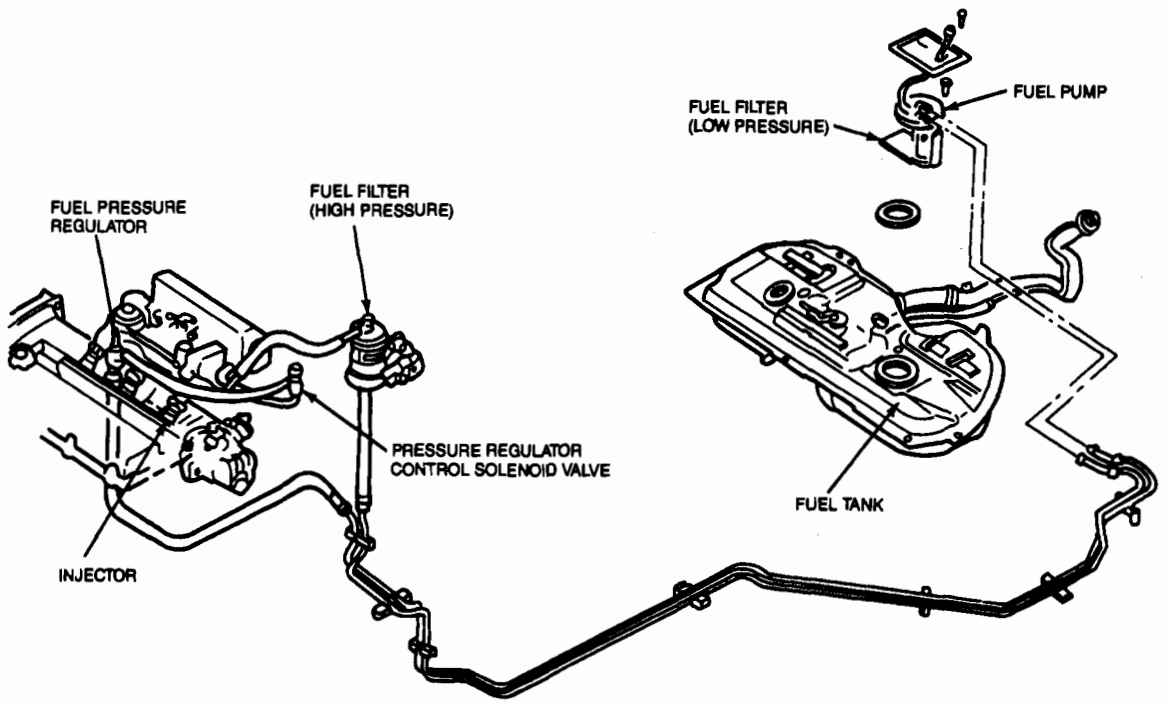


Fuel System

The fuel system supplies filtered, pressurized fuel to each injector. The system consists of the fuel pump, fuel filter, fuel rail, pressure regulator and the injectors. A fuel tank mounted electric fuel pump supplies filtered, pressurized fuel to each injector through the fuel rail. The fuel pressure is regulated by a pressure regulator valve which is located at the return line side of the fuel rail.

DESCRIPTION AND OPERATION (Continued)

Fuel System



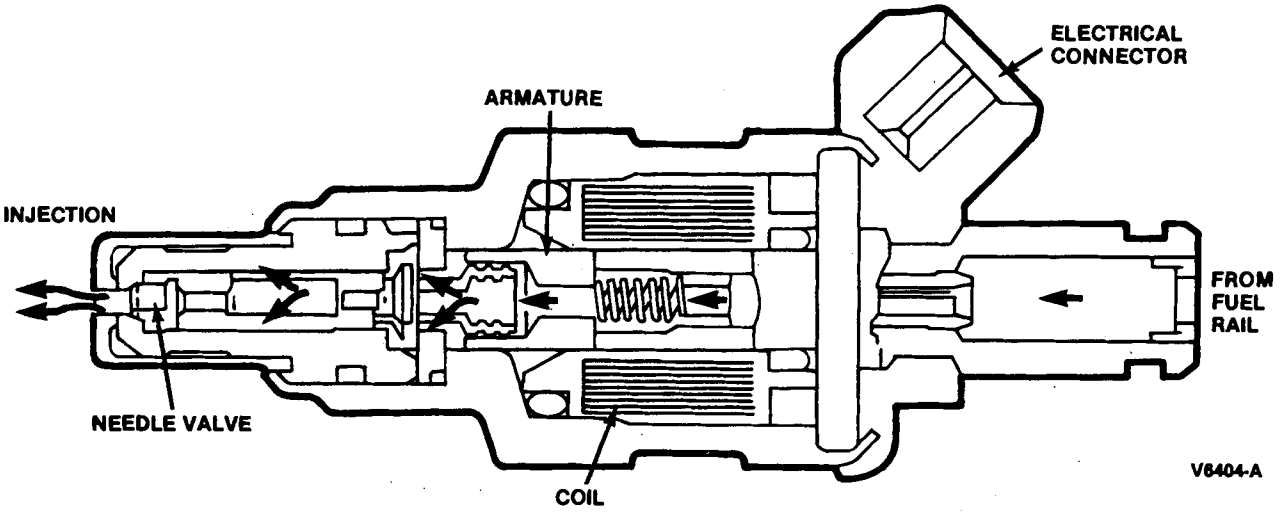
Fuel is metered and injected into the intake ports according to the injection signals received from the PCM. When these injection signals are applied to the coil of the injector, the needle valve is pulled off its seat. Fuel is then injected around the back face of the intake valve. The amount of fuel supplied to the engine depends on the duration of time that the injectors stay open.

At idle speed, fuel is supplied by simultaneously providing one injection per crankshaft rotation (two injections per cycle) to all cylinders.

Between 5,000 and 6,800 rpm, the injectors could remain fully open due to injector lag, resulting in poor performance and fuel control. For this reason, when the engine speed rises above idle there is a changeover to one injection per two crankshaft rotations (one injection per cycle), that is controlled by a signal from the CID sensor distributor. The injectors stay open longer and the amount of fuel necessary for ideal combustion is supplied by one injection.

DESCRIPTION AND OPERATION (Continued)

When engine speed reaches 6,800 rpm or higher, fuel injection is shut off in order to prevent the engine from over revving.



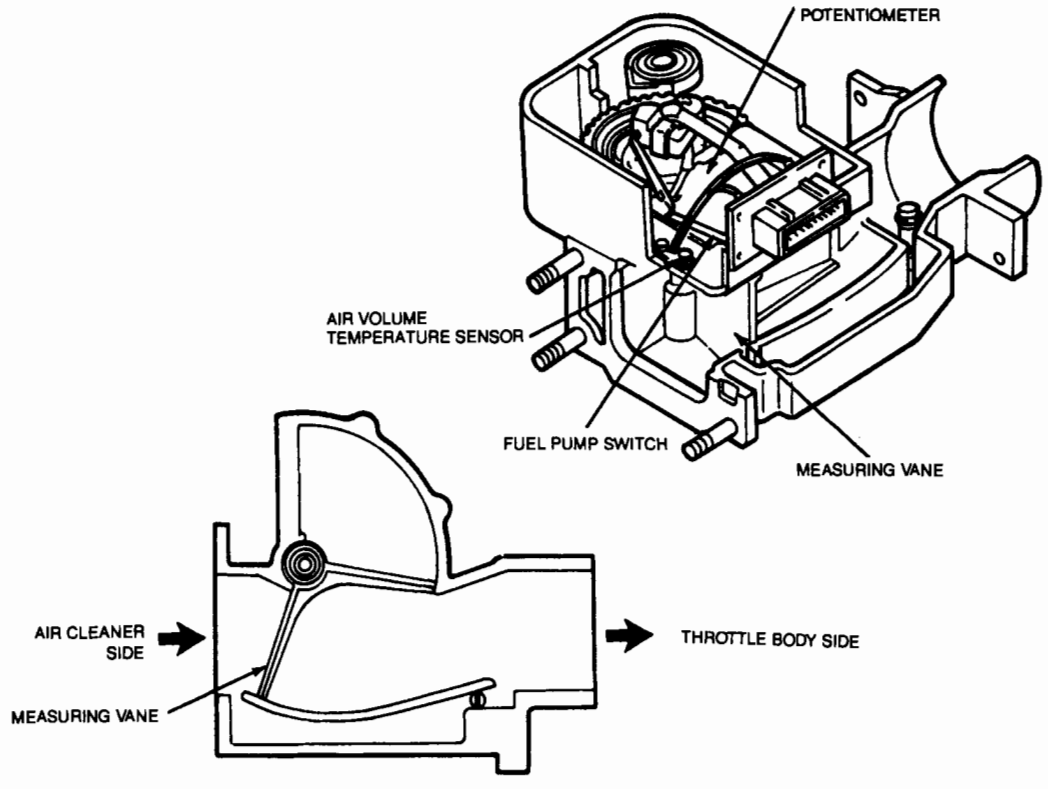
For maximum efficiency and for calibration accuracy, the injector must have very little mechanical working lag of the needle valve for quick response. For this purpose the injection coil has very few windings and low inductance. Such a coil can, however, be burned out due to excessive current flow when energized. When checking the injectors, never apply battery voltage (12v) directly to the solenoid coil.

Air Induction System

The air induction system supplies filtered air to the engine to mix with the fuel for combustion purposes. It consists of an air cleaner assembly, volume air flow meter, throttle body, intake manifold and a bypass air (BPA) valve.

DESCRIPTION AND OPERATION (Continued)

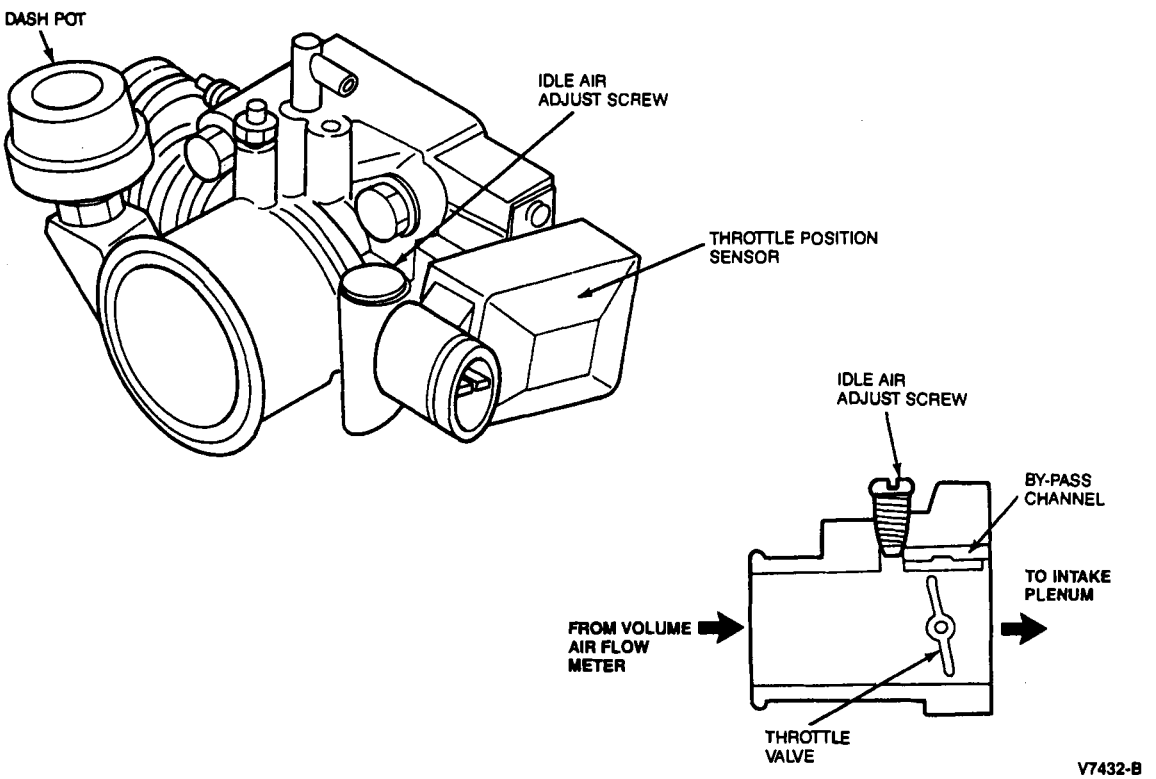
The volume air flow meter mounted to the air filter housing measures the amount of airflow and air temperature and provides this information to the PCM.



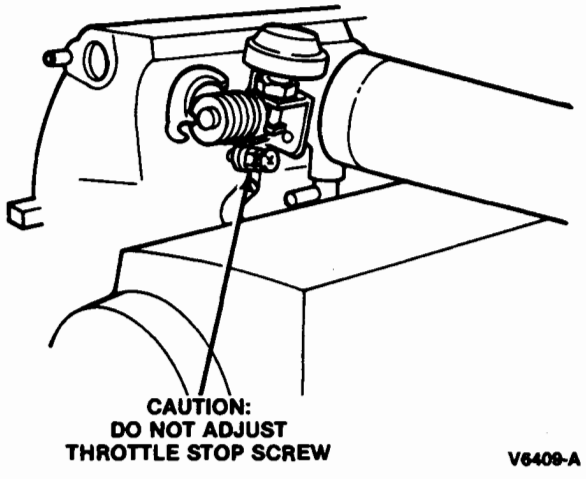
DESCRIPTION AND OPERATION (Continued)

The throttle body controls intake air quantities and consists of an aluminum housing, throttle valve, throttle position sensor and a dash pot. An idle air bypass system supplies small quantities of air during engine idle. A throttle position sensor is mounted on the LH side of the throttle body. It detects the throttle valve position and provides the PCM with this information. A dashpot is mounted on the RH side of the throttle body to control throttle valve closing speed during deceleration.

CAUTION: Do not tamper with the throttle stop adjustment screw. Adjustment will affect driveability and may require throttle body replacement.

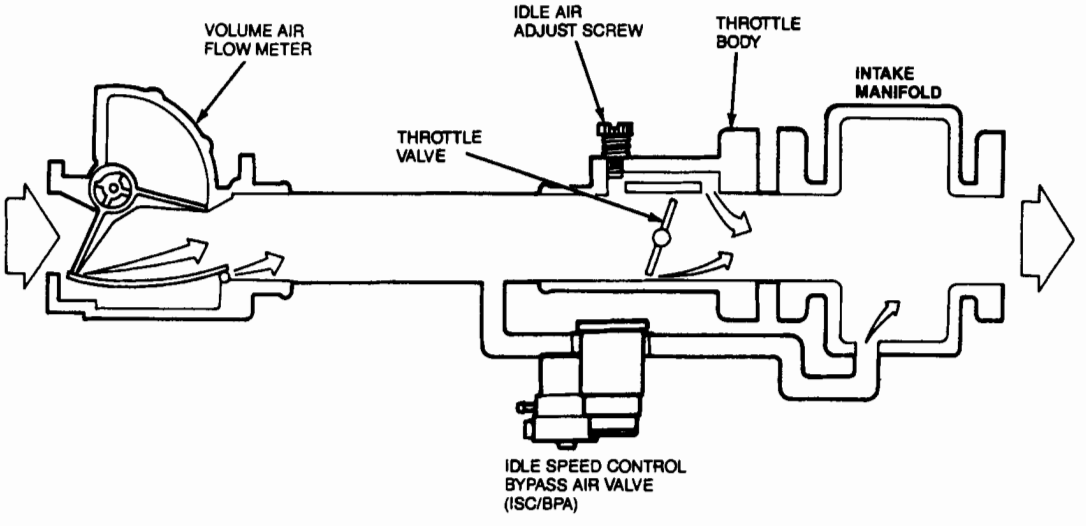


DESCRIPTION AND OPERATION (Continued)



Air Flow

During idle, the throttle valve is almost closed, therefore it is necessary for the idle air bypass valve to supply air for combustion during idle. An air adjustment screw is fitted in the idle air bypass valve to adjust intake airflow for idle speed adjustment. During off idle operation, the throttle valve controls the amount of air admitted into the engine. The PCM will increase the fuel injection output in proportion to the increased airflow to achieve the appropriate air / fuel ratios.



Bypass Air Control Valve

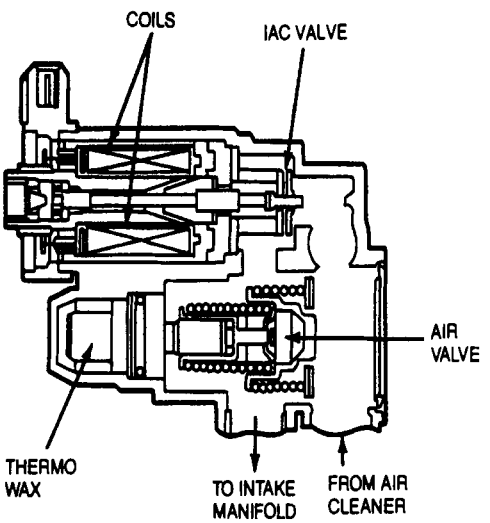
The BPA valve consists of the air bypass valve which functions only during cold engine conditions and the idle air control (IAC) valve which works throughout the entire engine range.

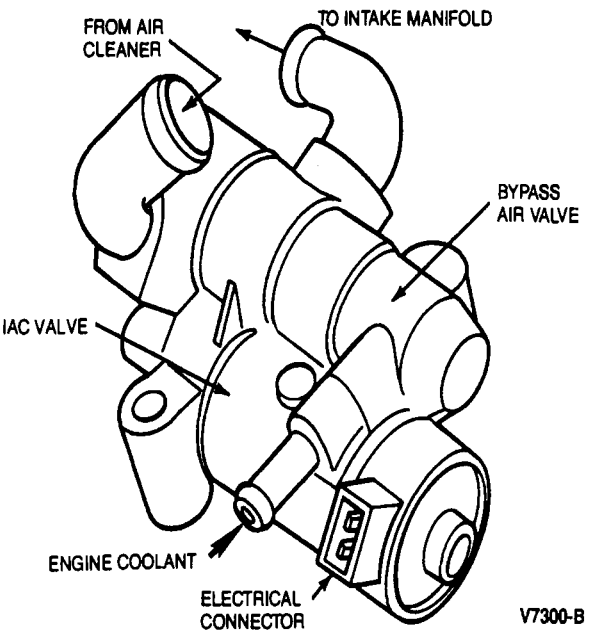
DESCRIPTION AND OPERATION (Continued)

The air bypass valve increases idle speed during cold conditions to quickly warm up the engine. The air valve is made up of a thermo-type wax and a spring-loaded valve assembly. At engine temperatures below 140°C (60°F) the thermo wax is contracted and the air valve is open. As the engine gradually warms up, the thermo wax expands and the valve moves toward the closed position. The amount of air that passes through the valve gradually decreases as temperature increases and the engine speed gradually drops to set idle speed. At engine temperatures above 140°C (60°F) the air bypass valve is fully closed by the thermo wax.

The BPA is located on the engine, mounted to the intake manifold.

The solenoid operated idle air control (IAC) valve controls the amount of bypass air to ensure proper idle speed for all operating conditions. When the engine is cold, below 140°C (60°F), air flows through both the ISC and the air bypass valve in order to maintain the projected engine speed set in the (PCM). During normal operation, at temperatures above 140°C (60°F), only the IAC valve controls the amount of bypass air to maintain the idle speed at the preset 850 ± 50 rpm. To improve idle smoothness the IAC system controls the intake air amount detected by the air flow meter by regulating the amount of bypass air that passes through the throttle body to help maintain a steady idle speed.

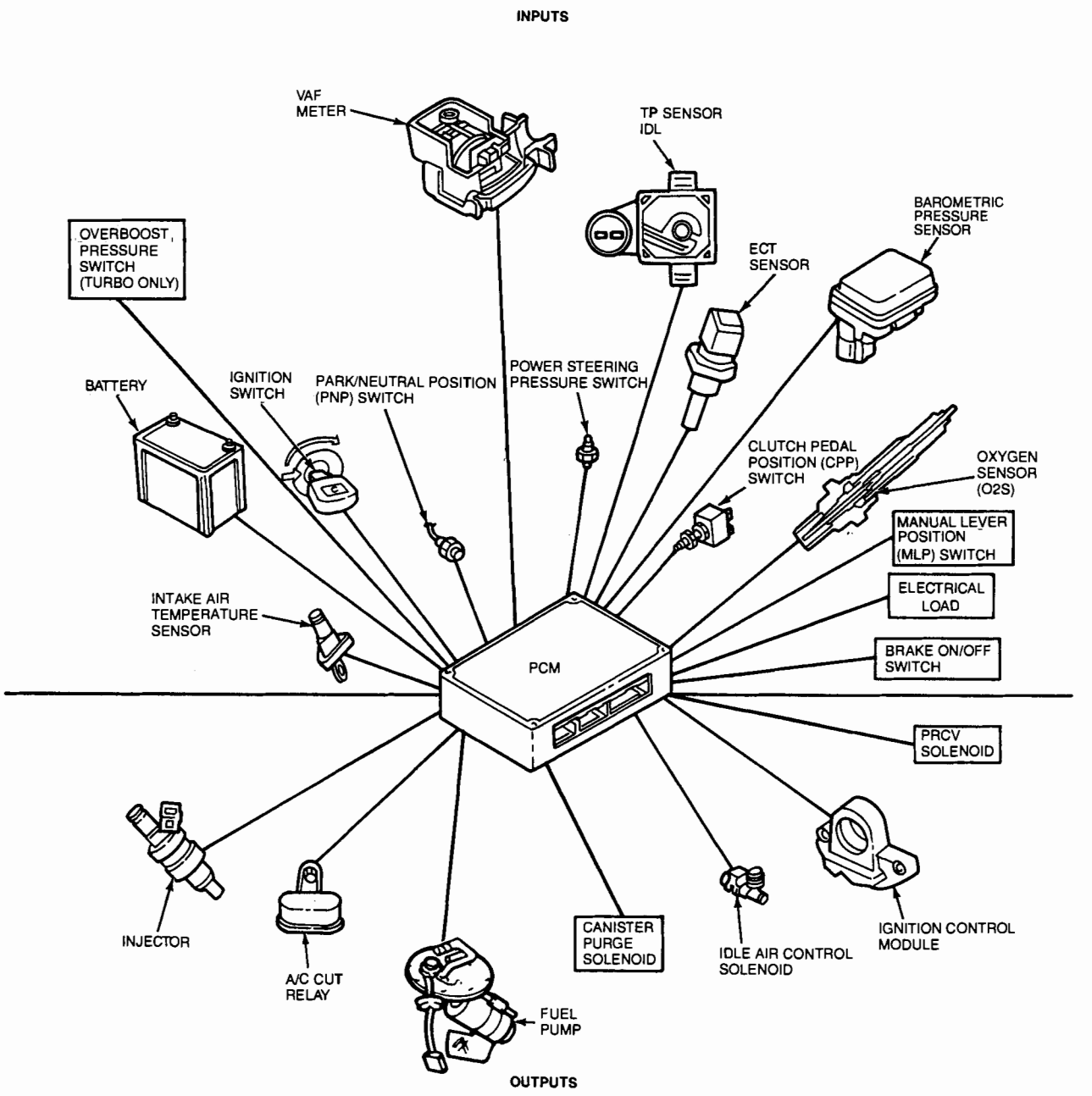




Powertrain Control Module

The PCM detects the engine operating and driving conditions, and the exhaust gas oxygen content, from various switches, sensors and components and then controls the amount of fuel injected into the engine. The PCM also has control of the evaporative emission, idle speed control, ignition and deceleration systems. Refer to the appropriate section for information on these systems. The following identifies all of the inputs and outputs to and from the PCM.

DESCRIPTION AND OPERATION (Continued)



DESCRIPTION AND OPERATION (Continued)

Relation of Inputs and Outputs

Turbocharged Vehicles

Input Device	Output Device					
	Injector		Fuel Pressure Regulator Control Solenoid Valve	Idle Air Control Bypass		Canister Purge Solenoid
	Fuel Injection Amount	Fuel Injection Timing		Bypass Air Valve	IAC Solenoid	
Ignition Coil	O	O	X	X	O	O
Volume Air Flow Meter	O	X	X	X	X	O
Idle Switch	O	X	O	X	O	X
Throttle Position Sensor	O	X	X	X	X	X
Engine Coolant Temperature Sensor	O	X	O	X	O	O
Volume Air Temperature Sensor	O	X	O	X	O	O
Barometric Pressure (BARO) Sensor	O	X	X	X	O	O
Oxygen Sensor	O	X	X	X	O	O
Overboost Pressure Switch	O	X	X	X	X	X
Brake Lamp Switch	O	X	X	X	X	X
Park/Neutral Position (PNP) Switch	O	X	O	X	O	O
Ignition Switch	O	O	O	X	X	X
A/C Switch	X	X	X	X	O	X
P/S Pressure (PSP) Switch	X	X	X	X	O	X
CID Sensor	X	O	X	X	X	X
On-Board Diagnostic	X	X	X	X	O	X

O = Related
X = Not Related

Naturally Aspirated Vehicles

Input Device	Output Device					
	Injector		Fuel Pressure Regulator Control Solenoid Valve	Idle Air Control Bypass		Canister Purge Solenoid
	Fuel Injection Amount	Fuel Injection Timing		Bypass Air Valve	IAC Solenoid	
Ignition Coil	O	O	X	X	O	O
Volume Air Flow Meter	O	X	X	X	X	O
Idle Switch	O	X	O	X	O	X
Throttle Position Sensor	O	X	X	X	X	X
Engine Coolant Temperature Sensor	O	X	O	X	O	O
Volume Air Temperature Sensor	O	X	O	X	O	O
Barometric Pressure (BARO) Sensor	O	X	X	X	O	O
Oxygen Sensor	O	X	X	X	O	O
Brake Lamp Switch	O	X	X	X	X	X
Park/Neutral Position (PNP) Switch	O	X	O	X	O	O
Ignition Switch	O	O	O	X	X	X
A/C Switch	X	X	X	X	O	X

(Continued)

DESCRIPTION AND OPERATION (Continued)

Input Device	Output Device					
	Injector		Fuel Pressure Regulator Control Solenoid Valve	Idle Air Control Bypass		Canister Purge Solenoid
	Fuel Injection Amount	Fuel Injection Timing		Bypass Air Valve	IAC Solenoid	
P/S Pressure (PSP) Switch	X	X	X	X	O	X
CID Sensor	X	O	X	X	X	X
On-Board Diagnostic	X	X	X	X	O	X

O = Related
X = Not Related

DIAGNOSIS AND TESTING

For diagnosis and testing procedures, refer to Powertrain Control/Emissions Diagnosis Manual[1].

REMOVAL AND INSTALLATION

Throttle Body

Removal

1. Disconnect negative battery cable.
2. Remove accelerator cable from throttle body.
3. Remove air duct.
4. Partially drain cooling system. Refer to Section 03-03.
5. Mark all vacuum and coolant hoses for ease of reassembly and disconnect hoses from throttle body.
6. Disconnect throttle position sensor connector.
7. Remove three retaining nuts and one retaining bolt.
8. Remove throttle body and discard gasket(s).

Installation

1. Install new gasket(s) and position throttle body onto intake manifold.
2. Install three retaining nuts and one bolt and tighten to 16-23 N·m (12-16 lb-ft).
3. Connect throttle position sensor connector.
4. Connect all vacuum and coolant hoses to the throttle body in their proper location as noted during removal.
5. Install air duct.
6. Install accelerator cable.
7. Connect negative battery cable.
8. Fill cooling system. Refer to Section 03-03.
9. Check and adjust idle speed as outlined.

Intake Manifold

Refer to Section 03-01.

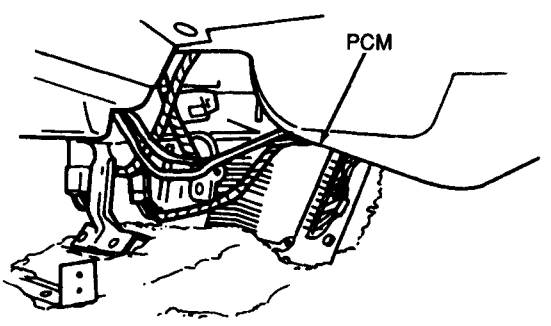
Powertrain Control Module

Removal

1. Disconnect negative battery cable.
2. Pull back on front edges of both center carpet panels disengaging push pin retainers.
3. Remove retaining screws and carpet panels.
4. Remove screws retaining PCM to floorpan.
5. Remove connectors from PCM and remove PCM.

Installation

1. Install connectors to PCM.
2. Install PCM to floorpan and bracket with retaining screws.
3. Install center carpet panels.
4. Connect negative battery cable.



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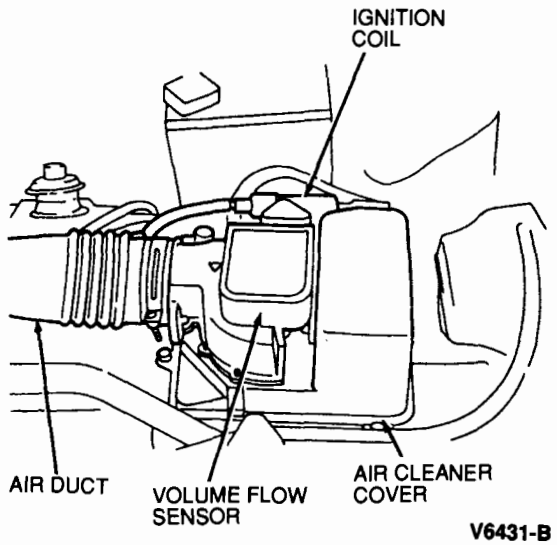
1 Can be purchased as a separate item.

REMOVAL AND INSTALLATION (Continued)

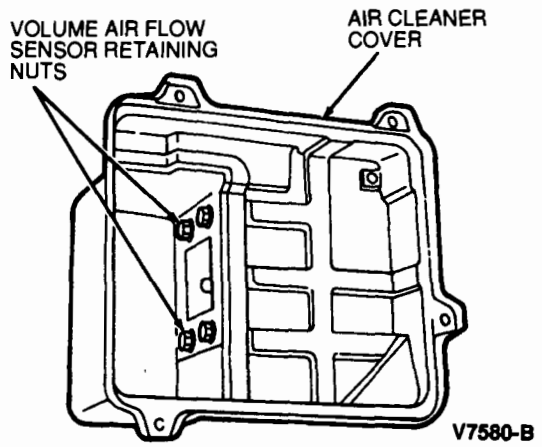
Volume Air Flow (VAF) Sensor

Removal

1. Disconnect negative battery cable.
2. Disconnect primary and secondary wires from coil.
3. Remove air duct from volume air flow sensor.
4. Remove retaining bolt and ground wire from air cleaner cover.
5. Remove air cleaner cover retaining bolts.
6. Remove air cleaner cover.



7. Remove volume air flow sensor retaining nuts from inside air cleaner cover.



8. Remove volume air flow sensor.

Installation

1. Position volume air flow sensor onto air cleaner cover and install retaining nuts.
2. Position air cleaner cover and install retaining bolts.
3. Install ground wire with retaining bolt.
4. Install air duct and secure with clamp.
5. Connect coil primary and secondary wires.
6. Connect negative battery cable.

Fuel Injectors

Removal

1. Relieve fuel line pressure as follows:
   a. Disconnect inertia fuel shutoff (IFS) switch located in luggage compartment.
   b. Run engine while disconnecting fuel pump connector.
   c. Run engine until it stalls. The fuel pressure is now relieved.
2. Remove throttle body as outlined.
3. Disconnect fuel supply line from fuel rail.
4. Disconnect fuel return line from pressure regulator.
5. Remove electrical connectors at injectors.
6. Remove retaining bolts and fuel rail.
7. Remove fuel injectors.
8. Remove O-rings from injectors.

Installation

1. Install new O-rings onto injectors and lubricate with clean engine oil.
2. Position fuel injectors into cylinder head.
3. Position fuel rail onto fuel injectors and install retaining bolts. Tighten to 19-25 N·m (15-18 lb-ft).
4. Install electrical connectors to fuel injectors.
5. Install fuel return line onto pressure regulator.
6. Connect fuel supply line onto fuel rail.
7. Install throttle body as outlined.
8. Connect IFS connector.

Throttle Position (TP) Sensor

Removal

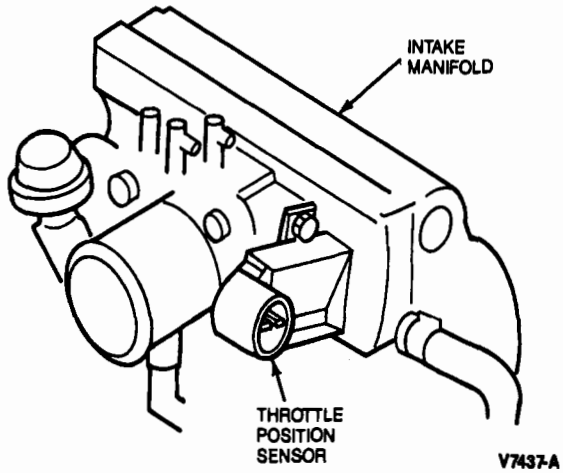
1. Disconnect negative battery cable.
2. Disconnect electrical connector at sensor.
3. Remove two hold-down bolts.
4. Pull sensor from throttle body.

Installation

1. Position sensor onto throttle body.
2. Install two hold-down bolts finger-tight.
3. Adjust sensor as outlined.
4. Connect electrical connector at sensor.

REMOVAL AND INSTALLATION (Continued)

5. Connect negative battery cable.



Bypass Air (BPA) Valve

Removal

1. Disconnect negative battery cable.
2. Disconnect electrical connector at BPA valve.
3. Drain cooling system. Refer to Section 03-03.
4. Remove two coolant hoses and clamps.
5. Remove two air hoses and clamps.
6. Remove retaining bolts and BPA valve assembly.

Installation

1. Position BPA valve and install retaining bolts.
2. Install two air hoses and secure with clamps.
3. Install two coolant hoses and secure with clamps.
4. Connect electrical connector at BPA valve.
5. Fill cooling system. Refer to Section 03-03.
6. Connect negative battery cable.
7. Check and adjust idle speed as outlined.

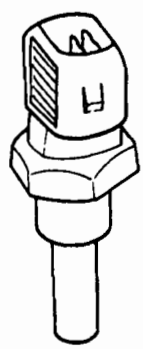
Engine Coolant Temperature (ECT) Sensor

Removal

1. Disconnect negative battery cable.
2. Drain cooling system. Refer to Section 03-03.
3. Disconnect temperature sensor electrical connector.
4. Remove temperature sensor from intake manifold.

Installation

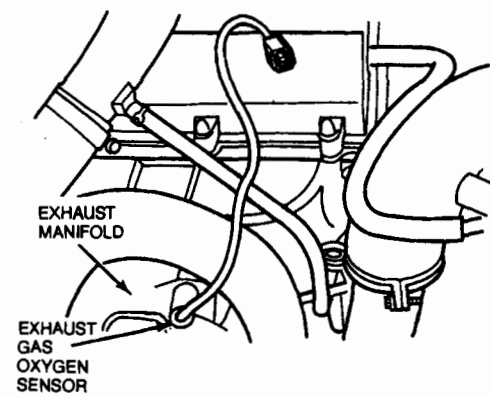
1. Install sensor into cylinder head.
2. Connect temperature sensor electrical connector.
3. Fill cooling system. Refer to Section 03-03.
4. Connect negative battery cable.



Oxygen Sensor

Removal and Installation

1. Disconnect negative battery cable.
2. Disconnect sensor electrical connector.
3. Remove oxygen sensor from manifold.
4. To install, reverse Removal procedure.



Barometric Pressure (BARO) Sensor

Removal and Installation

1. Disconnect negative battery cable.
2. Disconnect electrical connector from sensor.
3. Remove retaining nut and sensor.
4. To install, reverse Removal procedure. Tighten retaining nut to 6-10 N·m (4.5-7 lb-ft).

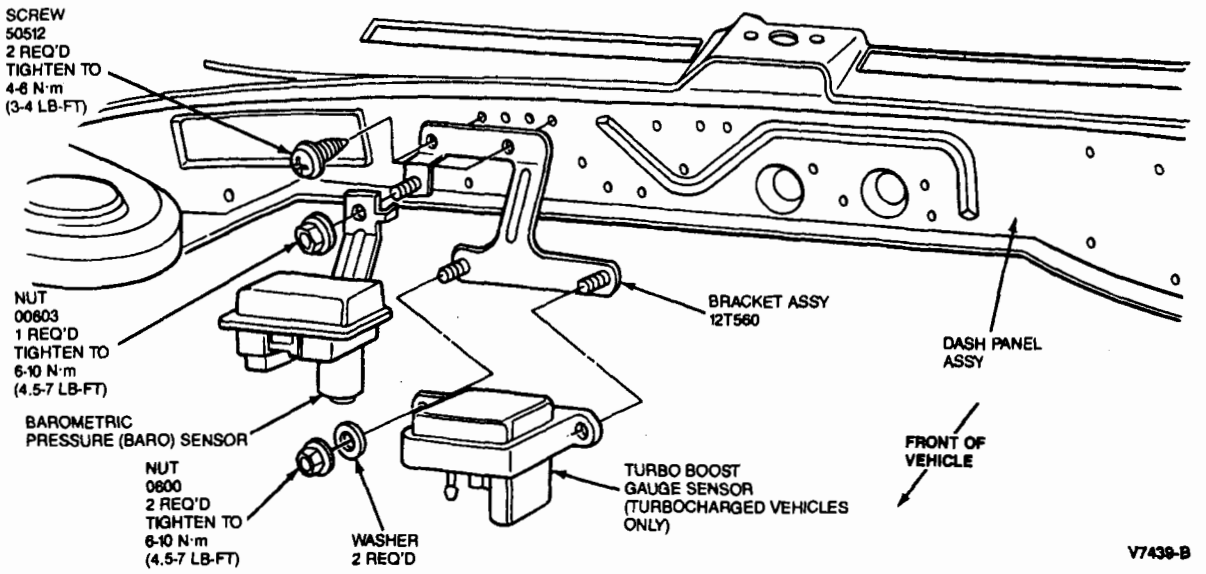
REMOVAL AND INSTALLATION (Continued)

Turbo Boost Gauge Sensor

Turbocharged Vehicles

Removal and Installation

1. Disconnect negative battery cable.
2. Disconnect vacuum hose and electrical connector.
3. Remove two retaining nuts and remove sensor.
4. To install, reverse Removal procedure. Install retaining nuts to 6-10 N·m (4.5-7 lb-ft).



Clutch Pedal Position (CPP) Switch

MTX Only

Refer to Section 07-03A or 07-03B.

Manual Lever Position (MLP) Switch

ATX Only

Refer to Section 03-06.

ADJUSTMENTS

Throttle Position (TP) Sensor

The throttle position sensor is preset at the factory. No adjustments are required.

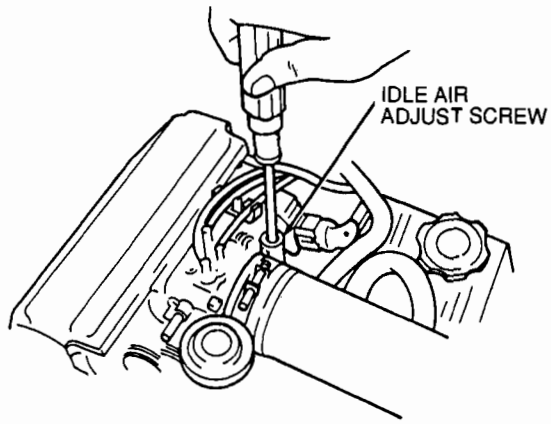
Idle Speed

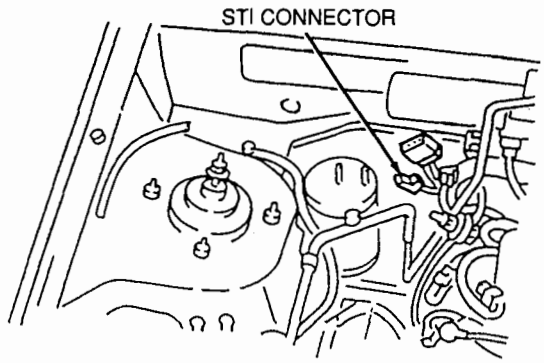
NOTE: Before adjusting the idle speed, make sure the ignition timing is adjusted to specification. Turn OFF all lamps and other unnecessary electrical loads. This adjustment must be done while the cooling fan motor is not operating.

1. Warm up engine to normal operating temperature.
2. Attach Rotunda Dwell-Tach-Volts Ohms Tester 059-00010 or equivalent to test connector (White: Pin 1).
3. Check idle speed on tachometer. Connect jumper wire between STI connector (Green: Pin 1) and ground and turn air adjustment screw to obtain correct idle speed of 800-900 rpm.

ADJUSTMENTS (Continued)

4. Remove jumper wire.





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SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	N·m	Lb-Ft
Throttle Body Retaining Nuts and Bolt	16-23	12-16
BARO Sensor Retaining Nut	6-10	4.5-7
Fuel Rail Retaining Bolts	19-25	15-18
Turbo Boost Gauge	6-10	4.5-7

SPECIAL SERVICE TOOLS

ROTUNDA EQUIPMENT

Model	Description
059-00010	Inductive Dwell-Tach-Volts Ohms Tester