

SECTION 12B

Air Intake Systems and Throttle Body

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Air Intake Systems and Throttle Body

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SECTION 12B

Air Intake Systems and Throttle Body

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Description and Operation

Air Intake System

The air intake system delivers filtered and controlled airflow to the engine. Three groups of components make up the system: air handling, sensors, and control devices.

Air Intake System Air Handling Components

Air intake system components include:

- Air inlet duct
- Air cleaner
- Throttle body
- Intake manifold
- Resonance chamber(s)
- Resonance duct

The resonance chamber(s) suppress air inlet noise caused by airflow pulsations. One chamber is used for this purpose on the 1.3L, 2.0L, and 2.5L engines, while two chambers are used on the 1.8L engine. The throttle body contains the throttle valve and Throttle Position (TP) sensor. The Idle Air Control (IAC) valve also mounts to the throttle body on all engines except the 1.3L, where it mounts to the intake manifold. The dashpot is used on the 1.6L and the 1.8L engines, and mounts to the throttle body.

Air Intake System Sensors

Air intake system sensors include the airflow sensor, Intake Air Temperature (IAT) sensor, and Throttle Position (TP) sensor, all of which supply data to the Powertrain Control Module (PCM). The PCM also monitors engine speed. The 1.6L and the 1.8L systems use a Volume Air Flow (VAF) sensor with an integrated IAT sensor. The 1.3L and 2.0L systems use a heated resistor-type Mass Air Flow (MAF) sensor with an IAT sensor mounted on the air cleaner housing. The 2.5L system uses a Measuring Core-Volume Air Flow (MC-VAF) sensor with an integrated IAT sensor.

Air Intake System Control Devices

The Idle Air Control (IAC) solenoid valve helps to maintain a steady idle speed when heavy mechanical or electrical loads are added to the engine. The Powertrain Control Module (PCM) responds to changes in the engine idle speed due to changes in the engine load condition by electrically regulating the Idle Air Control (IAC) solenoid valve. The IAC valve is combined with the Bypass Air (BPA) control valve as a combination assembly on all engines except the 1.8L, where it is a separate unit. The IAC valve must be replaced as an assembly with the BPA control valve on all engines except the 1.8L, where it can be replaced separately. A dashpot on the throttle body of the 1.6L and 1.8L engines mechanically slows the action of a rapidly closing throttle in order to eliminate erratic vehicle response to the throttle.

Description and Operation

High Speed Inlet Air (HSIA) Control

A unique High Speed Inlet Air (HSIA) performance control system is used only on the 1.8L engine as a means of improving the engine performance above 5000 rpm. It employs a dual port intake manifold in which the high-speed ports are opened by shutter valves and a shutter valve actuator, controlled by the HSIA solenoid, the vacuum reservoir, and the Powertrain Control Module (PCM). Below 5000 rpm the solenoid is energized, its air vent is closed, and vacuum to keep the shutter valve closed is maintained by the vacuum reservoir and the one-way check valve. Above 5000 rpm the solenoid is de-energized by the PCM, and the vacuum holding the shutters closed is vented, allowing the spring-loaded actuator to pull the shutter valves open.

Variable Resonance Induction System (VRIS) Control

A unique Variable Resonance Induction System (VRIS) is used on the 2.5L engine as a means of improving the engine performance. The Powertrain Control Module (PCM) controls the shutter valves using two VRIS solenoids. The PCM receives information from Crankshaft Position (CKP) sensors and regulates the shutter valves to maximize engine torque.

Description and Operation	All Engines	TB
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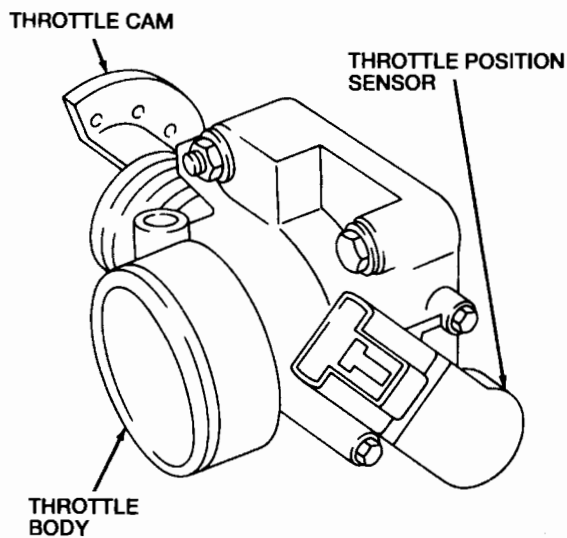
Throttle Body

The Throttle Body (TB) controls the amount of air that flows into the engine through a single butterfly valve. The single butterfly valve opening is determined by the accelerator pedal position. The throttle body is cast with an air bypass channel and houses several emission related components for the Powertrain Control Module (PCM). Refer to illustrations on the following pages.

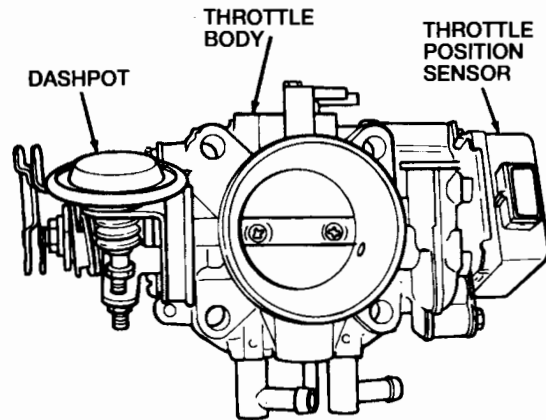
A dashpot is attached to the throttle body on 1.6L and 1.8L engines. The dashpot allows the throttle plate to gradually close during deceleration. This action prevents hesitation during the transition from deceleration to sudden acceleration and prevents engine stalling on sudden deceleration.

1.3L

1.6L



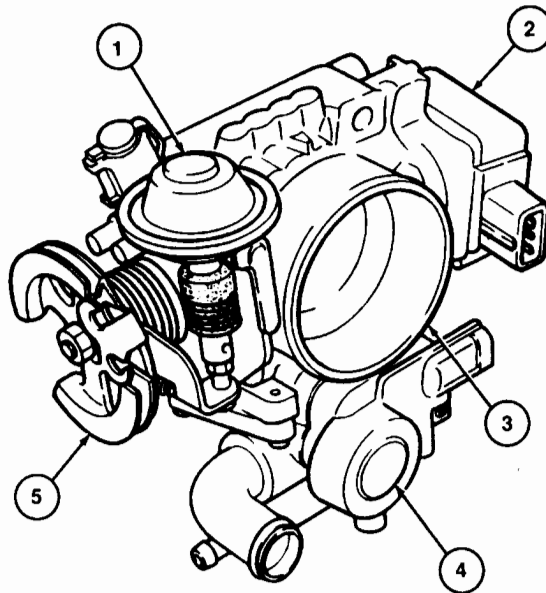
A20218-B



A13870-C

Description and Operation	All Engines	TB
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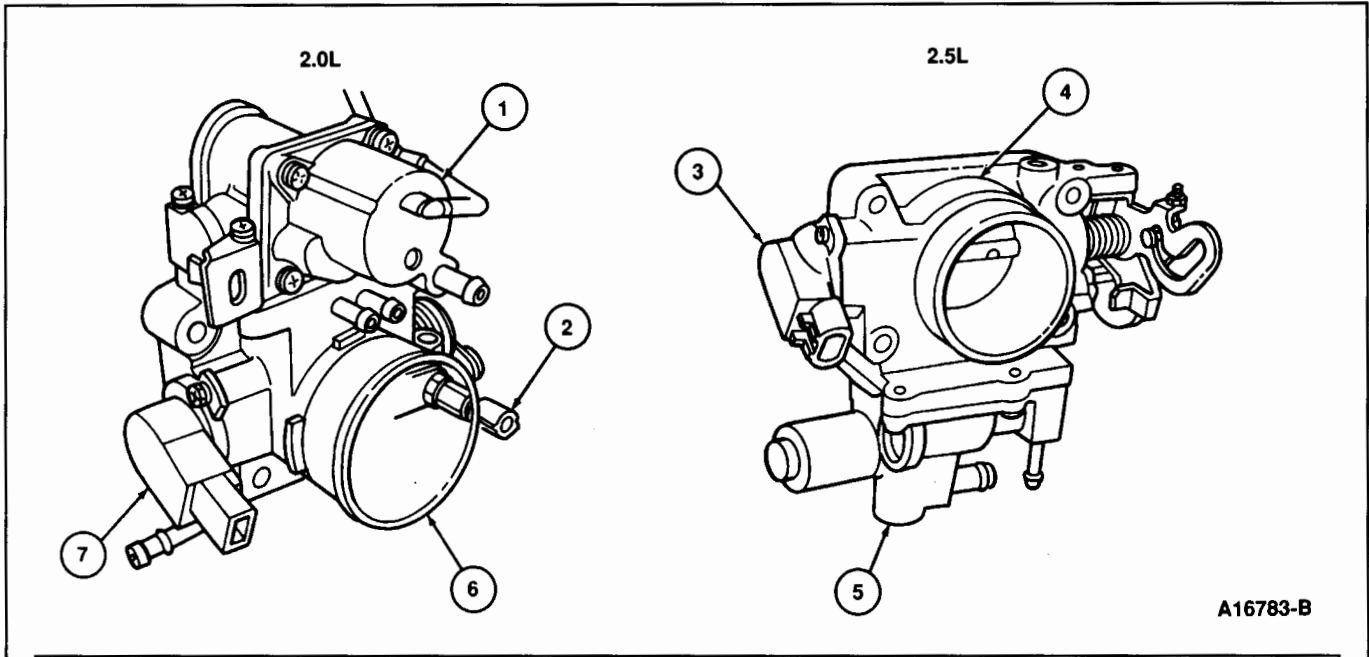
1.8L



A20219-A

Item	Description
1	Dashpot
2	Throttle Position (TP) Sensor
3	Throttle Body
4	Idle Air Control (IAC) Valve
5	Throttle Cam

Description and Operation	All Engines	TB
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Item	Description
1	IAC BPA Valve
2	Idle Switch (CD4E Only)
3	Throttle Position (TP) Sensor
4	Throttle Body
5	IAC BPA Valve
6	Throttle Body
7	Throttle Position (TP) Sensor

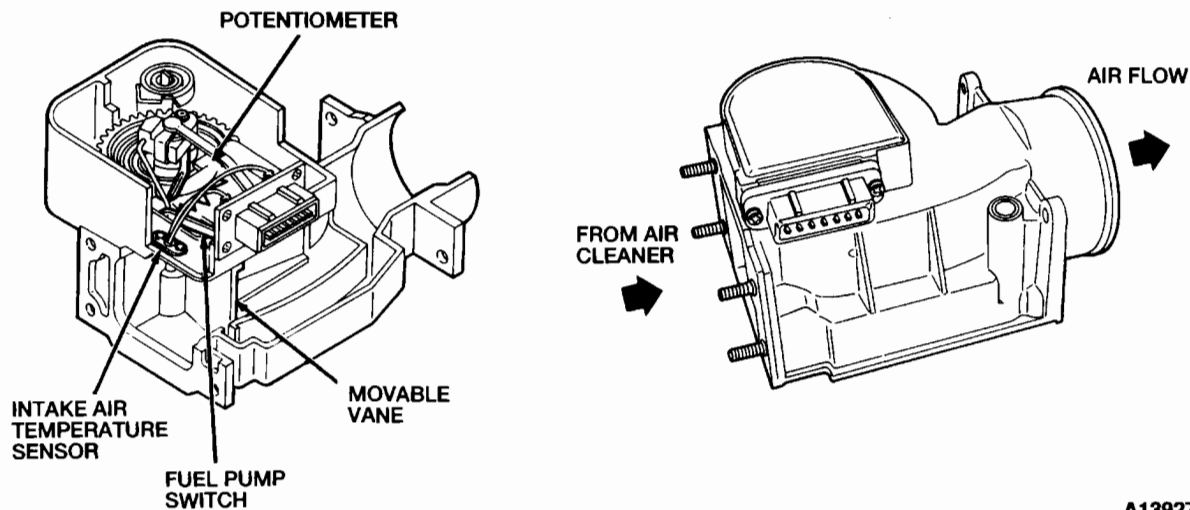
Engine	Location
1.3L, 1.6L	Mounted to the top of the intake manifold.
1.8L, 2.0L, 2.5L	Mounted to the LH side of the intake manifold.

Description and Operation	1.6L, 1.8L	VAF Meter
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Volume Air Flow (VAF) Meter

The Volume Air Flow (VAF) meter measures air flowing into the engine and is mounted between the air cleaner and the throttle body assembly. The VAF meter contains a movable vane which connects to a potentiometer. As air flows through the VAF meter, the movable vane and potentiometer change position and provide an input to the Powertrain Control Module (PCM) with vane position information. The PCM can then translate vane position information into the volume of air flowing into the engine.

Inside the VAF meter is an Intake Air Temperature (IAT) sensor which monitors and relays inlet air temperature to the PCM and a fuel pump switch which provides a ground for the fuel pump circuit after the engine has started.



A13927-E

Engine	Location
1.6L, 1.8L	Mounted to the air cleaner and the throttle body.

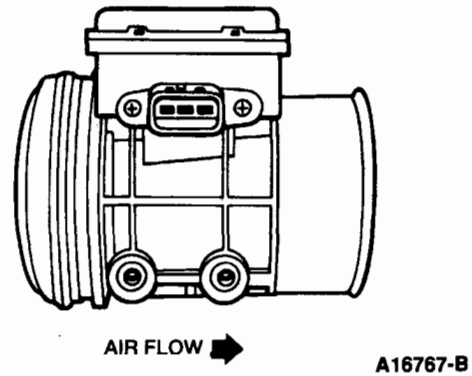
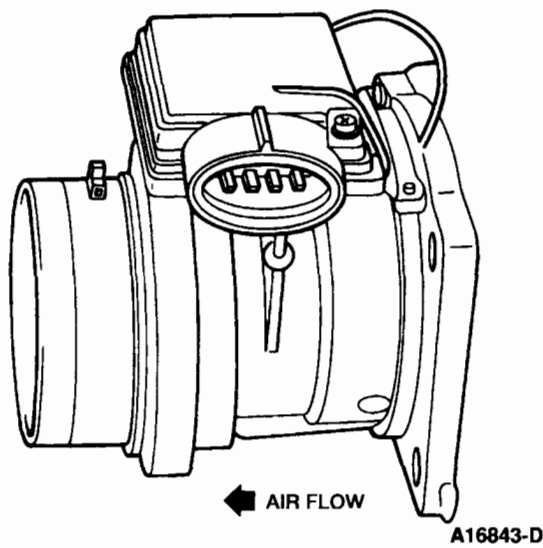
<p>Description and Operation</p>	<p>1.3L, 2.0L</p>	<p>MAF Sensor</p>
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Mass Air Flow (MAF) Sensor

The Mass Air Flow (MAF) sensor measures the amount of airflow passing into the throttle body. The internal element detects the amount of air and notifies the Powertrain Control Module (PCM) with a varying voltage input signal. This input signal helps determine injector pulse width.

2.0L

1.3L

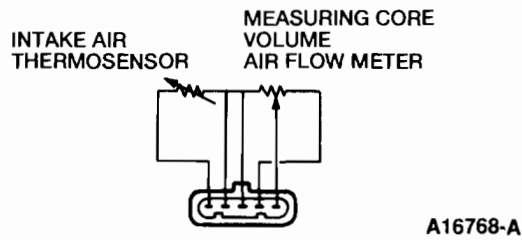
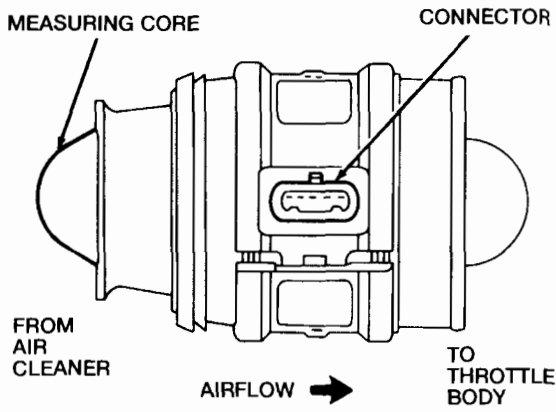


Engine	Location
1.3L, 2.0L	Located between the air cleaning element and the throttle body.

<p>Description and Operation</p>	<p>2.5L</p>	<p>MC-VAF Meter</p>
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Measuring Core-Volume Air Flow (MC-VAF) Meter

When air is passed through the Measuring Core-Volume Air Flow (MC-VAF) meter, the measuring core moves parallel to the direction of the airflow. The movement changes the resistance on a potentiometer and sends this signal to the Powertrain Control Module (PCM).

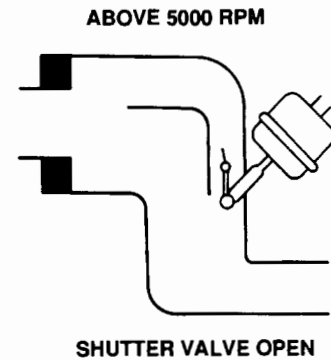
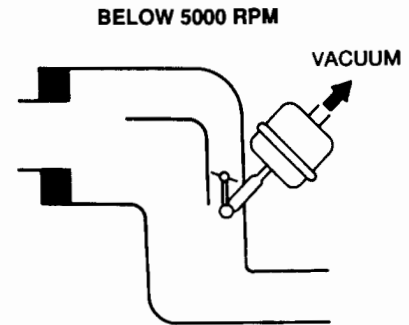
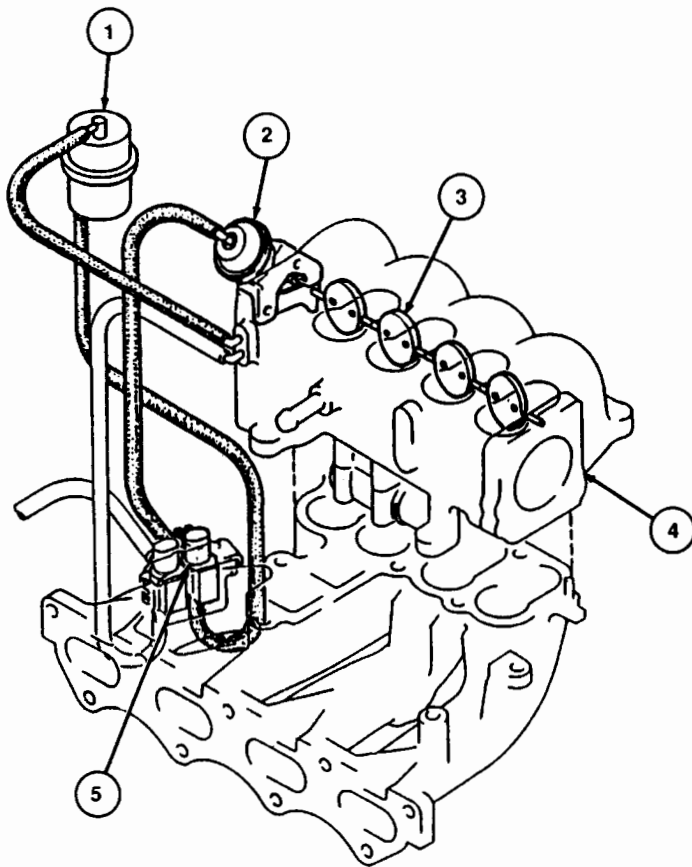


Engine	Location
2.5L	Located between the air cleaning element and the throttle body.

<p>Description and Operation</p>	<p>1.8L</p>	<p>Shutter Valve</p>
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Shutter Valve

The shutter valve, located in the intake manifold, opens and closes an intake path in the intake manifold which increases the length of the intake runner when opened and shortens the runner when closed. This action improves torque characteristics at low and high engine rpm. A High Speed Inlet Air (HSIA) solenoid is used to control the vacuum to the shutter valve actuator as signaled by the Powertrain Control Module (PCM). A vacuum reservoir is used to store needed vacuum which otherwise would not be available during wide-open throttle and other low vacuum engine operating modes.



A13868-C

Item	Description
1	Vacuum Reservoir
2	Shutter Valve Actuator
3	Shutter Valve
4	Intake Manifold
5	HSIA Solenoid

Engine	Location
1.8L	In the intake manifold.

Description and Operation	1.8L, 2.5L	Vacuum Reservoir
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Vacuum Reservoir

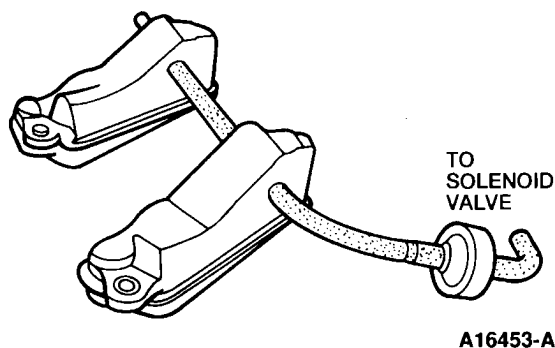
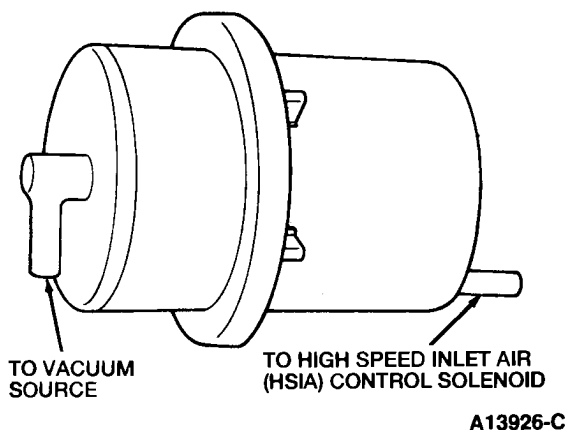
Vacuum reservoirs are used to ensure constant vacuum supply to vacuum operated devices during wide-open throttle operation and other low vacuum situations.

On 1.8L engines, the vacuum reservoir maintains vacuum for the High Speed Inlet Air (HSIA) system.

On 2.5L engines, the vacuum reservoirs maintain vacuum for the Variable Resonance Induction System (VRIS).

1.8L

2.5L

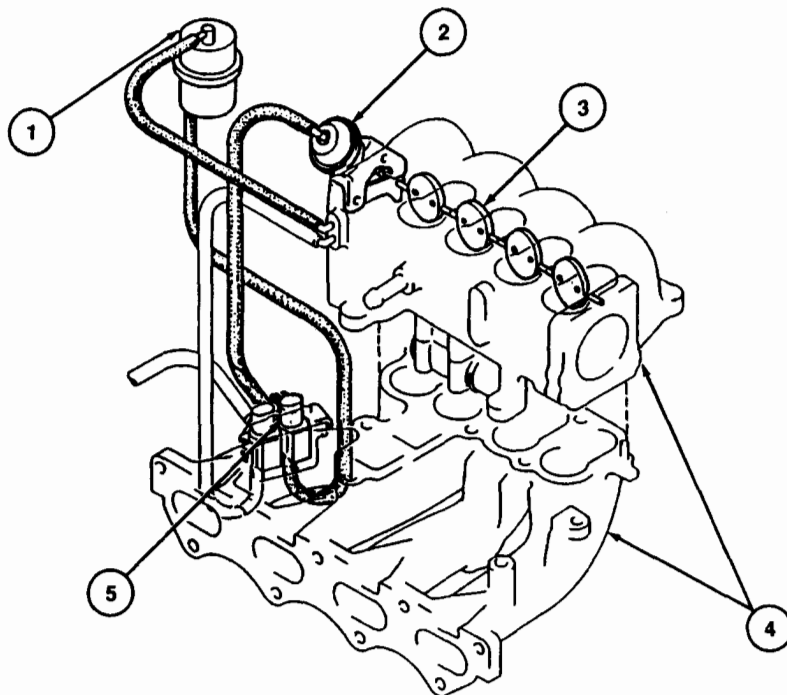


Engine	Location
1.8L	On RH side of intake manifold.
2.5L	Under the intake manifold.

Description and Operation	1.8L	HSIA Solenoid
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High Speed Inlet Air (HSIA) Solenoid

The High Speed Inlet Air (HSIA) solenoid controls the vacuum applied to the shutter valve actuator. The HSIA solenoid applies vacuum to the shutter valve at low rpm which holds the shutter valve closed, and vents the shutter valve actuator vacuum to atmosphere above 5000 rpm to allow the shutter valve to open. The HSIA solenoid is controlled by an output signal from the Powertrain Control Module (PCM).



A13855-E

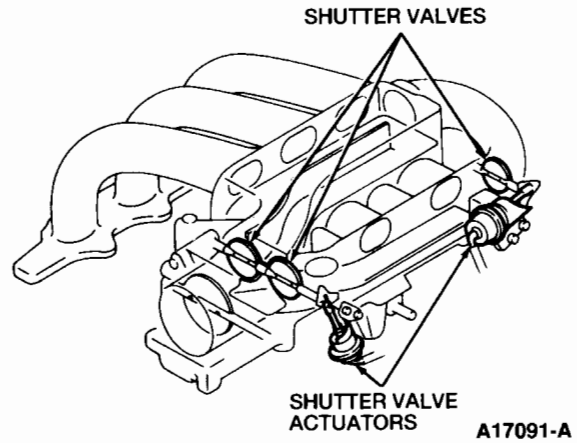
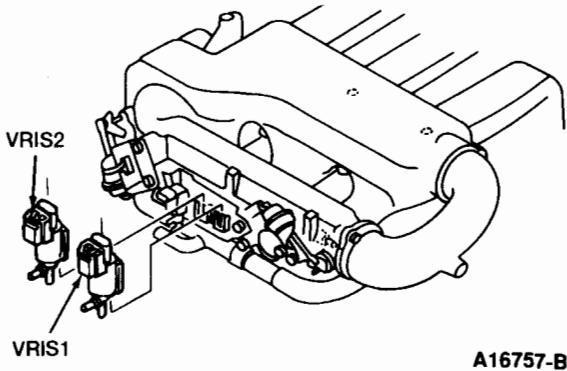
Item	Description
1	Vacuum Reservoir
2	Shutter Valve Actuator
3	Shutter Valve
4	Intake Manifold
5	HSIA Solenoid

Engine	Location
1.8L	Mounted to intake manifold.

Description and Operation	2.5L	VRIS
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Variable Resonance Induction System Solenoids # 1 (VRIS1) and # 2 (VRIS2)

The Variable Resonance Induction System Solenoids # 1 (VRIS1) and # 2 (VRIS2) are operated by output signals from the Powertrain Control Module (PCM). When the solenoids are activated, they allow vacuum to be applied to the shutter valve actuators. The shutter valve actuators then manipulate the shutter valves inside the intake manifold. This process improves charging efficiency and torque characteristics.

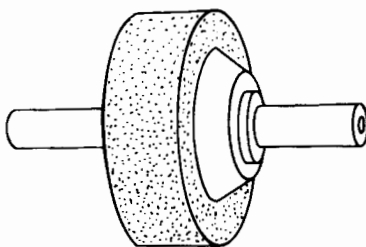


Engine	Location
2.5L	Mounted to the back of the intake manifold near the top.

Description and Operation

One-Way Check Valve

The one-way check valve prevents the Variable Resonance Induction System (VRIS) shutter valves from becoming inoperative during heavy load applications. The check valve keeps the supply from the vacuum reservoirs constant for proper operation. The check valve allows flow in one direction but will not permit passage in the opposite direction.



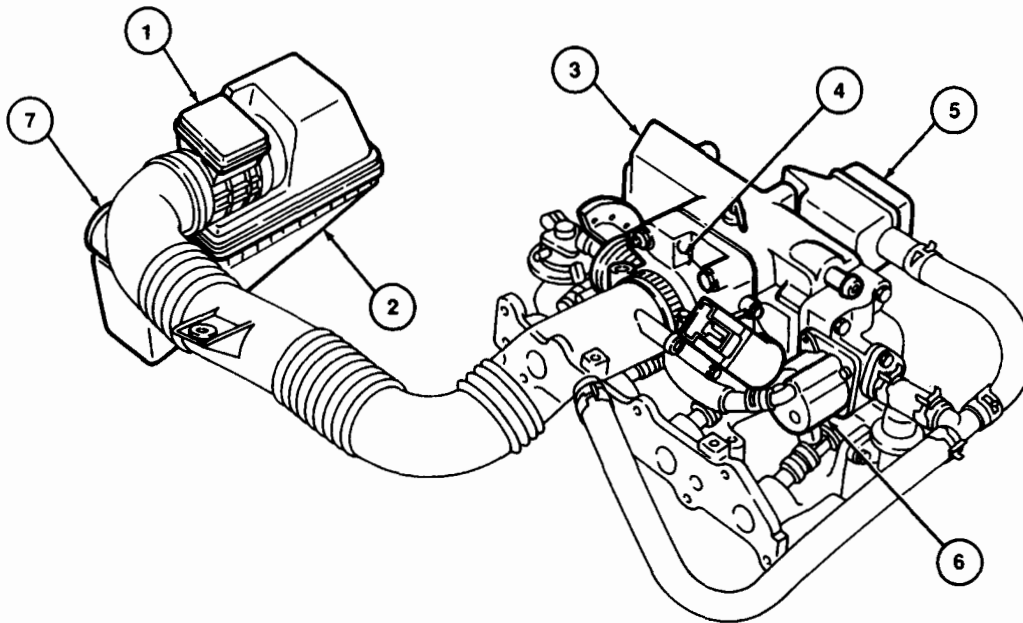
AIRFLOW →

A16756-A

Engine	Location
2.5L	Located beneath the intake manifold, next to the vacuum reservoirs.

Description and Operation

1.3L Component Location — Air Intake System and Throttle Body

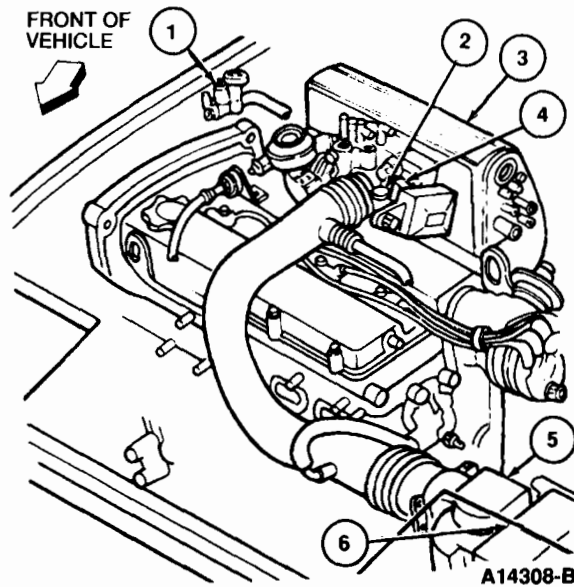


A20222-A

Item	Description
1	Mass Air Flow (MAF) Sensor
2	Air Cleaner
3	Intake Manifold
4	Throttle Body
5	Resonance Chamber
6	Idle Air Control Bypass Air (IAC BPA) Valve
7	Air Inlet Duct

Description and Operation

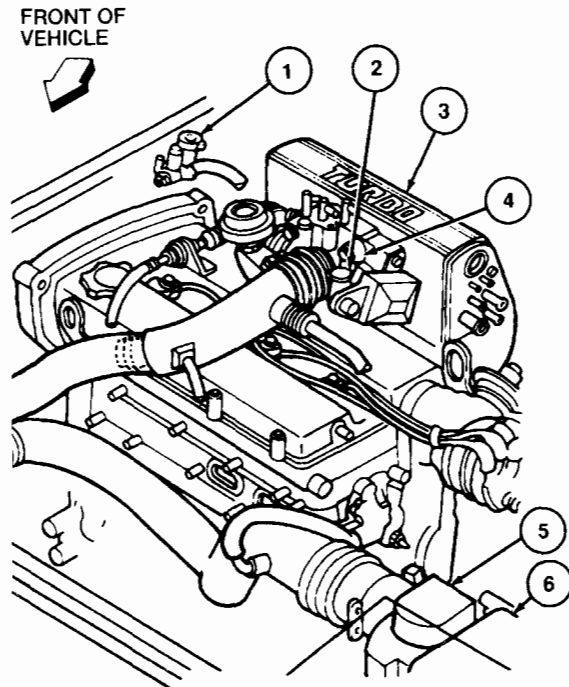
1.6L Non-Turbo Component Location — Air Intake System and Throttle Body



Item	Description
1	Idle Air Control Bypass Air (IAC BPA) Valve
2	Idle Air Adjustment Screw
3	Intake Manifold
4	Throttle Body
5	Volume Air Flow (VAF) Meter
6	Air Cleaner

Description and Operation

1.6L Turbo Component Location — Air Intake System and Throttle Body

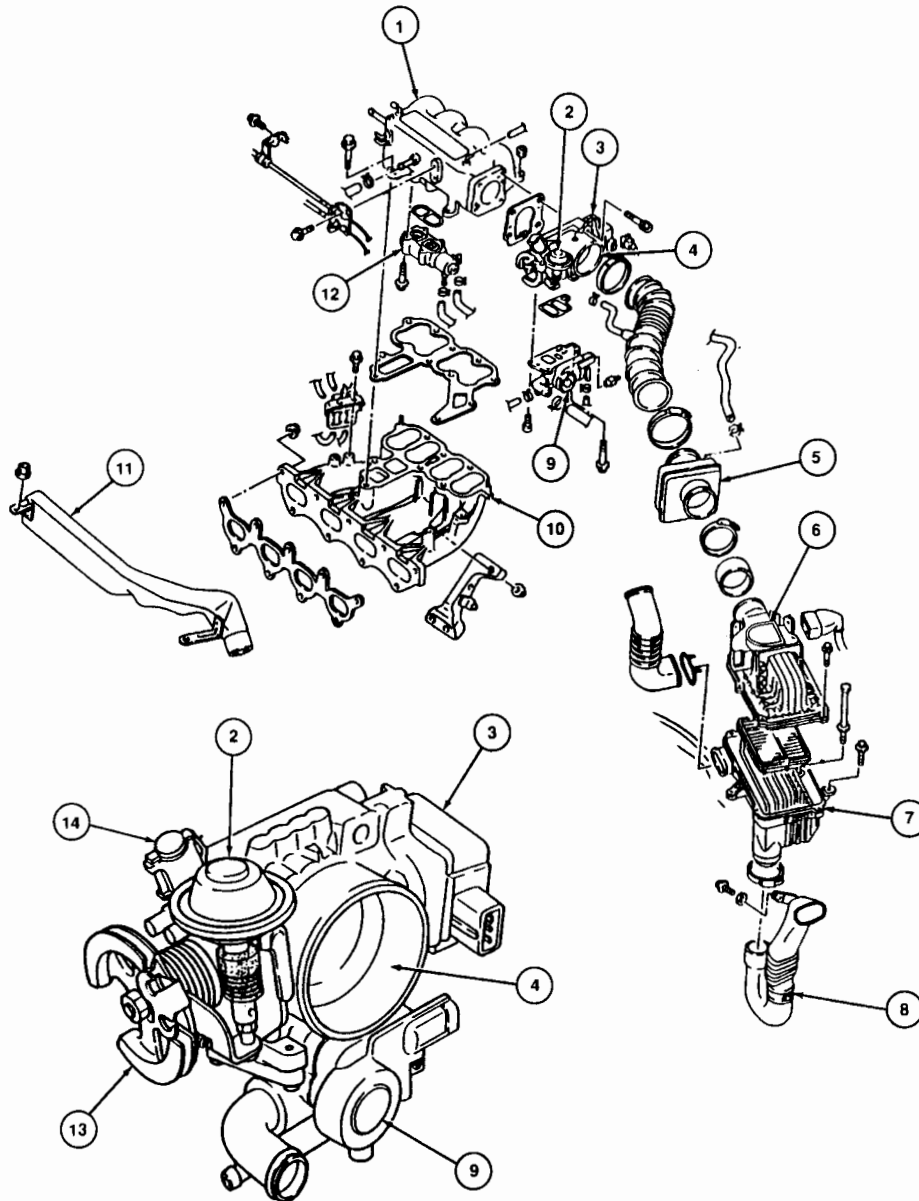


A14307-B

Item	Description
1	Idle Air Control Bypass Air (IAC BPA) Valve
2	Idle Air Adjustment Screw
3	Intake Manifold
4	Throttle Body
5	Volume Air Flow (VAF) Meter
6	Air Cleaner

Description and Operation

1.8L Component Location — Air Intake System and Throttle Body



A13980-C

Item	Description
1	Intake Manifold
2	Dashpot
3	Throttle Position (TP) Sensor

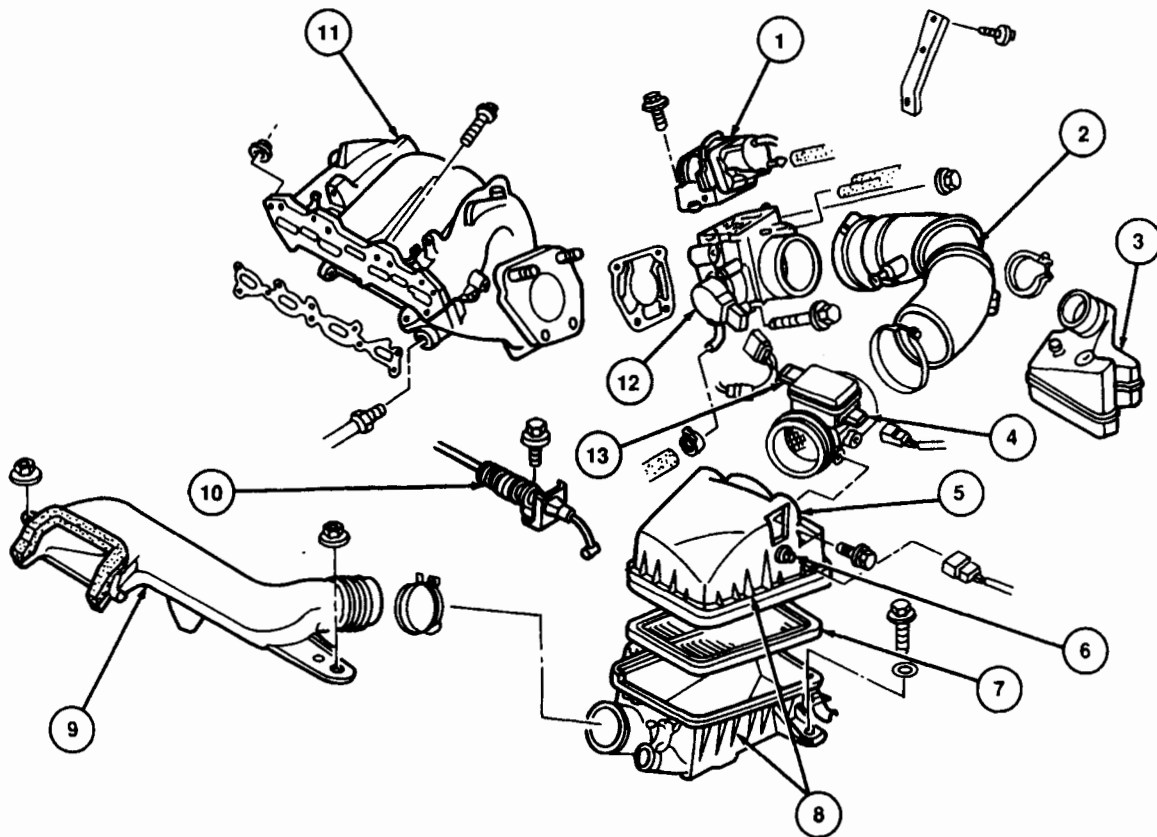
(Continued)

Description and Operation

Item	Description
4	Throttle Body
5	Resonance Chamber
6	Volume Air Flow (VAF) Meter
7	Air Cleaner
8	Inlet Air Duct
9	Idle Air Control (IAC) Valve
10	Intake Manifold
11	Resonance Chamber
12	Bypass Air (BPA) Valve
13	Throttle Lever
14	Idle Air Adjustment Screw

Description and Operation

2.0L Component Location — Air Intake System and Throttle Body

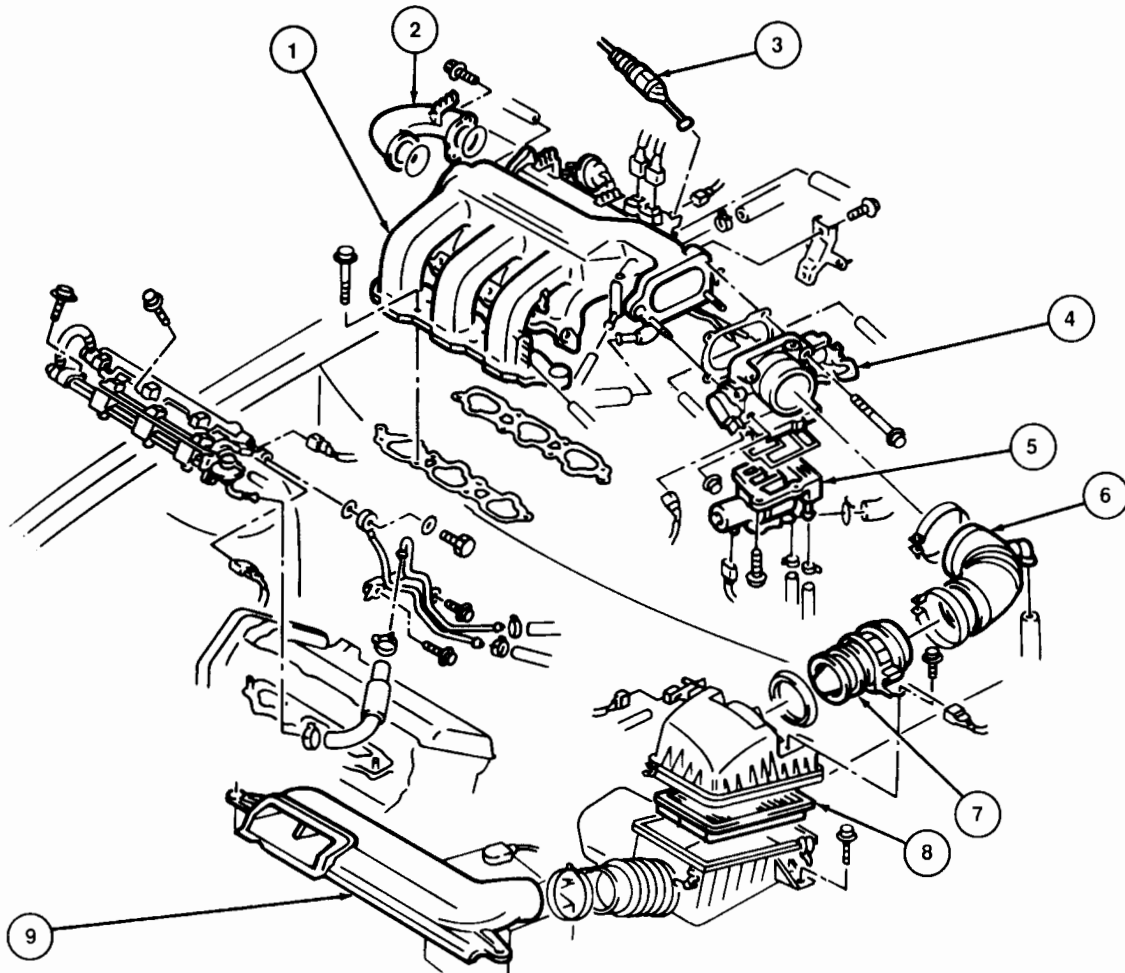


A16443-B

Item	Description
1	IAC BPA Assembly
2	Air Intake Hose
3	Resonance Chamber
4	Mass Air Flow (MAF) Sensor (ATX)
5	Intake Air Temperature (IAT) Sensor (MTX)
6	Intake Air Temperature (IAT) Sensor (ATX)
7	Air Cleaner Element
8	Air Cleaner
9	Inlet Air Duct
10	Accelerator Cable
11	Intake Manifold
12	Throttle Body
13	Mass Air Flow (MAF) Sensor (MTX)

Description and Operation

2.5L Component Location — Air Intake System and Throttle Body



A16444-A

Item	Description
1	Intake Manifold
2	Intake Air Pipe
3	Accelerator Cable
4	Throttle Body
5	IAC BPA Assembly
6	Air Intake Hose
7	Measuring Core-Volume Air Flow (MC-VAF) Sensor
8	Air Cleaner
9	Inlet Air Duct and Resonance Chamber

Diagnosis and Testing

Air Intake System

System Inspection

1. Visually inspect the components of the Air Intake System.

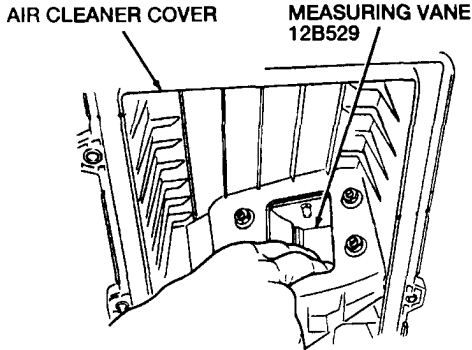
VISUAL INSPECTION CHART

Mechanical	Electrical
<ul style="list-style-type: none">● Loose, kinked, pinched, or damaged air lines● Loose, kinked, pinched, or damaged vacuum lines	<ul style="list-style-type: none">● Damaged or loose connections● Damaged insulation● Damaged airflow meter

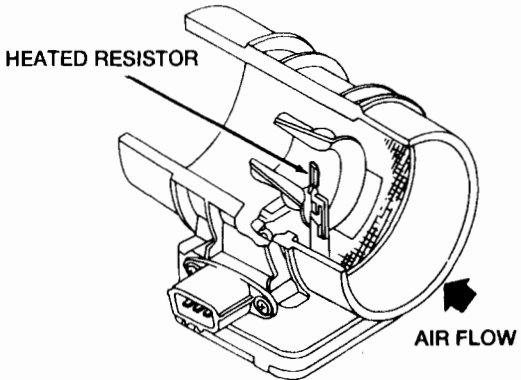
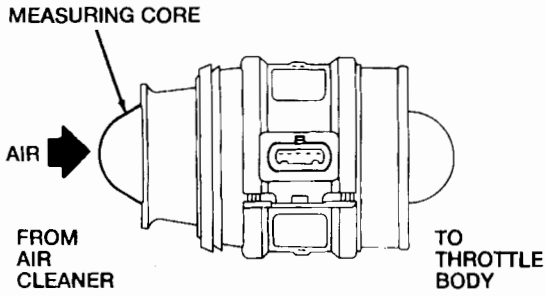
2. Check the air intake hoses for cracking, loose clamps or a disconnected hose.
3. If all checks are OK, proceed to the Pinpoint Tests.

Diagnosis and Testing	All Engines	IA
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Pinpoint Tests — IA

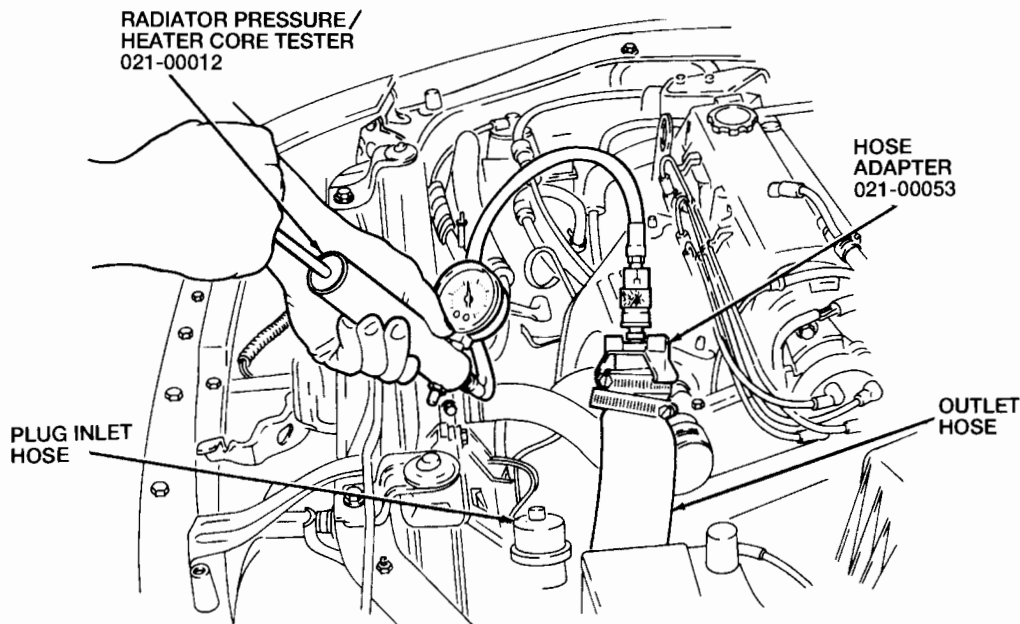
	TEST STEP	RESULT	ACTION TO TAKE
IA1	<p>CHECK AIR CLEANER HOUSING AND ELEMENT CONDITION</p> <ul style="list-style-type: none"> ● Inspect the air cleaner housing, inlet air hoses and connecting components for damage, blockage, looseness, or missing fasteners. ● Inspect air cleaner element for dirt. ● Are the air cleaner housing and element free of damage and dirt blockage? <p>CAUTION: Do not use compressed air to clean the air cleaner element.</p>	<p>Yes (1.6L and 1.8L)</p> <p>Yes (1.3L and 2.0L)</p> <p>Yes (2.5L)</p> <p>No</p>	<p>▶ GO to IA2.</p> <p>▶ GO to IA3.</p> <p>▶ GO to IA4.</p> <p>▶ REPLACE the component in question.</p>
IA2	<p>CHECK VOLUME AIR FLOW (VAF) METER FUNCTION (1.6L AND 1.8L ONLY)</p> <ul style="list-style-type: none"> ● Visually check the Volume Air Flow (VAF) meter for cracks, loose mounting and damage to the electrical connector or the sealed plastic cover. ● Remove the VAF meter and inspect the bottom plate for cracks or loose fasteners. ● Verify that the measuring vane moves smoothly, and the vane springs shut when pushed forward and then released. <div style="text-align: center; margin: 10px 0;">  </div> <p style="text-align: center; margin: 0;">A13985-B</p> <ul style="list-style-type: none"> ● Is the VAF meter free of cracks, damage, restrictions, and measuring vane binding? <p>NOTE: Electronic component troubleshooting is covered in the Pinpoint Tests; Section 6B, of this manual.</p>	<p>Yes</p> <p>No</p>	<p>▶ GO to IA5.</p> <p>▶ REPLACE the Volume Air Flow (VAF) meter.</p>

Diagnosis and Testing	All Engines	IA
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TEST STEP	RESULT	ACTION TO TAKE
<p>IA3 CHECK MASS AIR FLOW (MAF) SENSOR (1.3L AND 2.0L ONLY)</p> <ul style="list-style-type: none"> Visually check the Mass Air Flow (MAF) sensor for cracks, loose mounting, damaged electrical connector, broken or contaminated heated resistor, and torn or restricted protective screen.  <p style="text-align: center;">A16445-A</p> <ul style="list-style-type: none"> Is the MAF sensor free of damage or restrictions? <p>NOTE: Electronic component troubleshooting is covered in the Pinpoint Tests, Section 6B of this manual.</p>	<p>Yes</p> <p>No</p>	<ul style="list-style-type: none"> GO to IA5. REPLACE the Mass Air Flow (MAF) sensor.
<p>IA4 CHECK MEASURING CORE-VOLUME AIR FLOW (MC-VAF) SENSOR (2.5L ONLY)</p> <ul style="list-style-type: none"> Visually check Measuring Core-Volume Air Flow (MC-VAF) sensor for cracks, loose mounting, or damaged electrical connector. Verify that measuring core opens easily.  <p style="text-align: center;">A16446-A</p> <ul style="list-style-type: none"> Is the MC-VAF free of damage, and does the core open easily? 	<p>Yes</p> <p>No</p>	<ul style="list-style-type: none"> GO to IA5. REPLACE the Measuring Core-Volume Air Flow (MC-VAF) sensor.

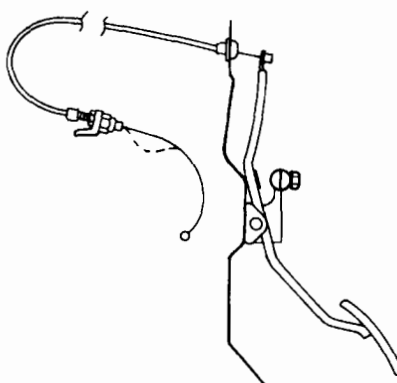
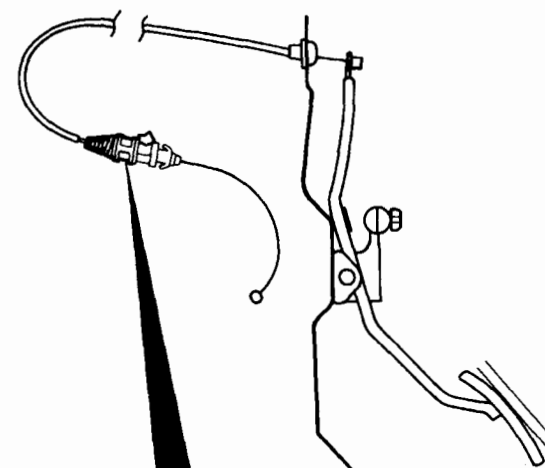
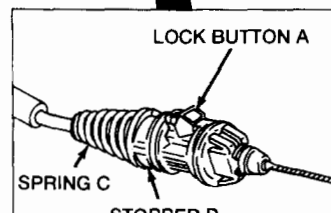
Diagnosis and Testing	All Engines	IA
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TEST STEP	RESULT	ACTION TO TAKE
IA5 CHECK RESONANCE CHAMBER(S) CONDITION <ul style="list-style-type: none"> ● Visually check resonance chamber(s) for a pinched hose connection, or for cracks that allow unfiltered air and moisture to enter the system. ● Check resonance chamber(s) for other damage. ● Is the resonance chamber(s) free of damage or poor connections? 	Yes (1.6L Turbo) Yes (All others) No	► GO to IA6 . ► GO to IA7 . ► SERVICE or REPLACE the resonance chamber(s).
IA6 CHECK CHARGE AIR COOLER CONDITION AND LEAKAGE (1.6L TURBO ONLY) <ul style="list-style-type: none"> ● Visually inspect the charge air cooler for cracks, corrosion, restrictions, or other damage. ● Disconnect the charge air cooler inlet and outlet hoses, plug the inlet hose, and seal securely. ● Connect Rotunda Radiator Pressure /Heater Core Tester 021-00012 and Rotunda Cooling System Adapter 021-00053 or equivalents to the charge air cooler outlet. ● Apply 82.7-103.4 kPa (12 to 15 psi) of pressure. ● Does the charge air cooler maintain pressure? 	Yes No	► GO to IA7 . ► LOCATE and REPAIR the leak or REPLACE the charge air cooler.



A13987-B

Diagnosis and Testing	All Engines	IA
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	TEST STEP	RESULT	ACTION TO TAKE
IA7	<p>CHECK THROTTLE LINKAGE</p> <ul style="list-style-type: none"> Check the throttle linkage for damage, proper installation, and freedom of movement when accelerator pedal is depressed. <p>1.3L, 1.6L and 1.8L</p>  <p style="text-align: right;">A13988-C</p> <p>2.0L and 2.5L</p>  <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> <p style="text-align: center;">LOCK BUTTON A</p>  <p style="text-align: right;">V6958-D</p> </div> <ul style="list-style-type: none"> Is the linkage correctly installed, and does it operate properly? 	<p>Yes</p> <p>No</p>	<ul style="list-style-type: none"> GO to IA8. SERVICE, CLEAN or REPLACE the linkage or part in question. REFER to the appropriate Service Manual, Section 10-02.

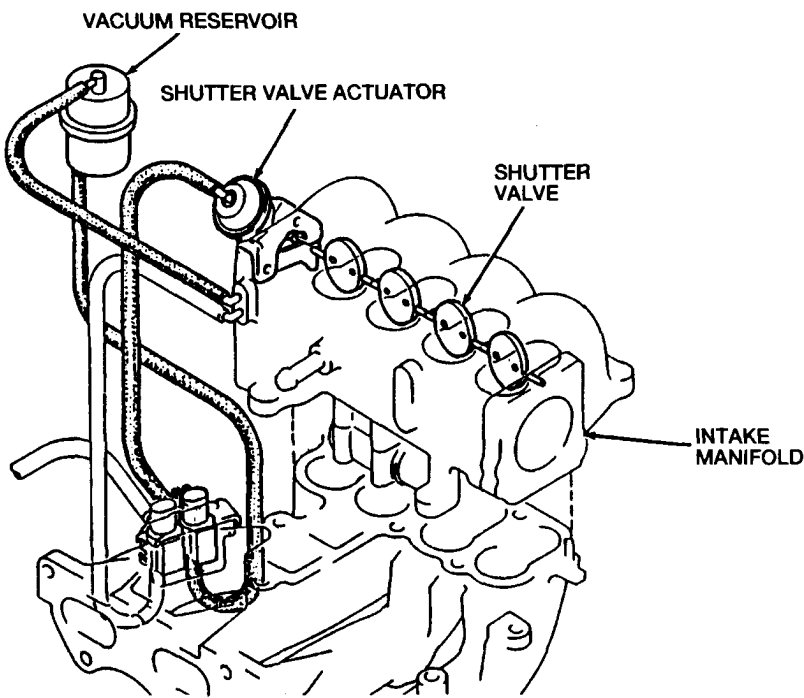
Diagnosis and Testing

All Engines

IA

TEST STEP		RESULT	ACTION TO TAKE
IA8	CHECK THROTTLE BODY CONDITION		
	<ul style="list-style-type: none"> ● Remove the air intake hose and check for oil sludging or oil vapors in the throttle body. ● Reconnect the air intake hose. ● Check throttle body and components for cracks, looseness, or other damage. ● Without removing throttle body from engine, check the integrity of vacuum and electrical lines for looseness, pinching, misrouting, corrosion, or other obvious damage. ● Check the throttle lever for freedom of movement. ● Are the throttle body and attachments OK? <p>NOTE: Electronic component troubleshooting is covered in the Pinpoint Tests, Section 6B, of this manual.</p>	<p>Yes</p> <p>No</p>	<ul style="list-style-type: none"> ▶ GO to IA9. ▶ SERVICE or REPLACE the throttle body and/or related components as required.
IA9	CHECK THROTTLE VALVE(S)		
	<ul style="list-style-type: none"> ● Remove the throttle body from the engine. ● Check that the throttle valve(s) moves smoothly from the fully closed to the fully open position. ● Check for loose, bent, or damaged valves, and for contamination that can cause binding. <p>NOTE: Refer to illustrations after these Pinpoint Test Steps.</p> <p>CAUTION: Do not remove the thin sealant coating from the throttle bore.</p> <ul style="list-style-type: none"> ● Is the throttle valve free from damage, binding, and contamination? 	<p>Yes (1.3L, 1.6L and 2.0L)</p> <p>Yes (1.8L)</p> <p>Yes (2.5L)</p> <p>No</p>	<ul style="list-style-type: none"> ▶ RETURN to Section 2B, Diagnostic Routines. ▶ GO to IA10. ▶ GO to IA13. ▶ SERVICE or REPLACE the throttle body.

Diagnosis and Testing	1.8L	IA
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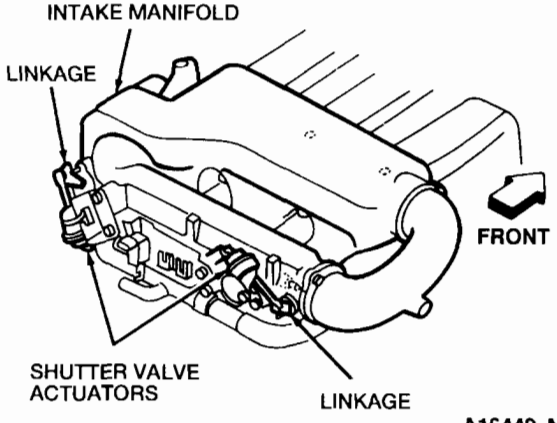
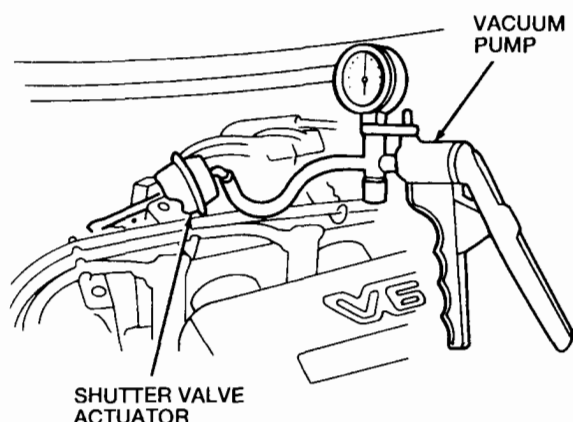
TEST STEP		RESULT	ACTION TO TAKE
IA 10	CHECK SHUTTER VALVE FUNCTION (1.8L ONLY) <ul style="list-style-type: none"> ● Disconnect the shutter valve actuator linkage from the shutter valve. ● Check that the shutter valve moves smoothly from a fully closed position to a fully open position. ● Is the shutter valve assembly free of binding or damage? 	Yes No	<ul style="list-style-type: none"> ▶ GO to IA11. ▶ REPLACE the shutter valve assembly.
			
IA 11	CHECK SHUTTER VALVE VACUUM RESERVOIR LEAKAGE (1.8L ONLY) <ul style="list-style-type: none"> ● Remove the shutter valve vacuum reservoir from the engine. ● Plug or cap the nipple leading to the intake manifold. ● Connect Rotunda Vacuum Tester 021-00037 or equivalent to the nipple leading to the High Speed Inlet Air (HSIA) control solenoid. Apply 508 mm-Hg (20 in-Hg) of vacuum to the reservoir. ● Verify whether the reservoir and its check valve hold vacuum. ● Does the vacuum reservoir and the check valve hold vacuum? 	Yes No	<ul style="list-style-type: none"> ▶ GO to IA12. ▶ REPLACE the vacuum reservoir.

A13991-C

Diagnosis and Testing	1.8L	IA
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TEST STEP		RESULT	ACTION TO TAKE
IA 12	CHECK HIGH SPEED INLET AIR (HSIA) CONTROL SOLENOID FUNCTION (1.8L ONLY)		
	<ul style="list-style-type: none"> ● Connect a Rotunda 88 Digital Multimeter 105-00053 or equivalent as a tachometer to measure the engine speed. ● Run the engine until it is thoroughly warmed up. ● Noting the position of the shutter valve lever and actuator, increase the engine speed to 5000 rpm. ● Does the shutter valve begin to open at approximately 5000 rpm? 	<p>Yes</p> <p>No</p>	<p>▶ RETURN to Section 2B, Diagnostic Routines.</p> <p>▶ GO to Section 6B, Pinpoint Test SCG which covers the High Speed Inlet Air (HSIA) control solenoid for further diagnosis and testing.</p>

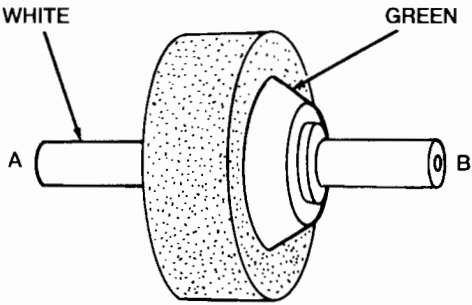
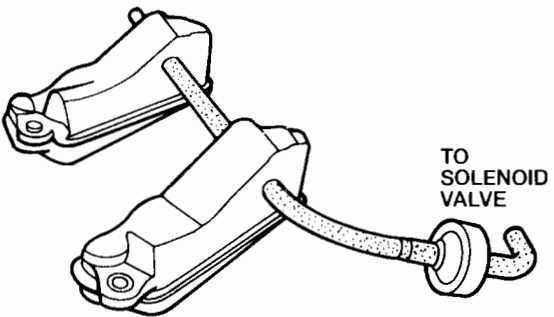
Diagnosis and Testing	2.5L	IA
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TEST STEP	RESULT	ACTION TO TAKE
<p>IA 13 CHECK VRIS SHUTTER VALVES (2.5L ONLY)</p> <ul style="list-style-type: none"> ● Disconnect the shutter valve actuator linkages from the shutter valves. ● Check that the shutter valves move smoothly from the fully closed to the fully open position. <div style="text-align: center;">  <p>A16449-A</p> </div> <ul style="list-style-type: none"> ● Are the shutter valves free of binding or damage? 	<p>Yes</p> <p>No</p>	<ul style="list-style-type: none"> ▶ GO to IA14. ▶ SERVICE or REPLACE the shutter valve assemblies.
<p>IA 14 CHECK VRIS SHUTTER VALVE ACTUATORS (2.5L ONLY)</p> <ul style="list-style-type: none"> ● Disconnect the vacuum hoses from the shutter valve actuators. ● Connect a Rotunda Vacuum Tester 021-00037 or equivalent to the actuators. ● Apply vacuum and verify that the actuator linkages are drawn into the actuators. <div style="text-align: center;">  <p>A16450-A</p> </div> <ul style="list-style-type: none"> ● Do the shutter valve actuators function properly? 	<p>Yes</p> <p>No</p>	<ul style="list-style-type: none"> ▶ GO to IA15. ▶ REPLACE the shutter valve actuator in question.

Diagnosis and Testing	2.5L	IA
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	TEST STEP	RESULT	ACTION TO TAKE																
IA15	<p>CHECK VRIS SOLENOID VALVES (2.5L ONLY)</p> <ul style="list-style-type: none"> Disconnect the solenoid valve vacuum and electrical lines. Verify air flow between ports as shown. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Port</th> <th>Air flow</th> </tr> </thead> <tbody> <tr> <td>A - B</td> <td>No</td> </tr> <tr> <td>A - C</td> <td>No</td> </tr> <tr> <td>B - C</td> <td>Yes</td> </tr> </tbody> </table> <ul style="list-style-type: none"> Apply battery voltage and ground to the terminals of the VRIS solenoid as shown below. Verify air flow between ports as shown. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Port</th> <th>Air flow</th> </tr> </thead> <tbody> <tr> <td>A - B</td> <td>Yes</td> </tr> <tr> <td>A - C</td> <td>No</td> </tr> <tr> <td>B - C</td> <td>No</td> </tr> </tbody> </table> <div style="margin-left: 20px;"> <p style="text-align: center;">A16451-B</p> </div> <ul style="list-style-type: none"> Do solenoid valves function properly? 	Port	Air flow	A - B	No	A - C	No	B - C	Yes	Port	Air flow	A - B	Yes	A - C	No	B - C	No	<p>Yes</p> <p>No</p>	<ul style="list-style-type: none"> GO to IA16. REPLACE the VRIS solenoid valve in question.
Port	Air flow																		
A - B	No																		
A - C	No																		
B - C	Yes																		
Port	Air flow																		
A - B	Yes																		
A - C	No																		
B - C	No																		

Diagnosis and Testing	2.5L	IA
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TEST STEP		RESULT	ACTION TO TAKE
IA 16 CHECK ONE-WAY CHECK VALVE FUNCTION (2.5L ONLY) <ul style="list-style-type: none"> ● Disconnect and remove the check valve located under the intake manifold. Refer to Service Manual Section 03-12B. ● Blow through port A and verify that air flows from port B. ● Blow through port B and verify that air does not flow from port A. <div style="text-align: center;">  <p>A16452-A</p> </div> <ul style="list-style-type: none"> ● Does one-way check valve function properly? 	Yes No	<ul style="list-style-type: none"> ▶ GO to IA 17. ▶ REPLACE the one-way check valve. 	
IA 17 CHECK VACUUM CHAMBERS (2.5L ONLY) <ul style="list-style-type: none"> ● Access the vacuum chambers located under the intake manifold. Refer to Service Manual Section 03-12B. ● Visually check the vacuum chambers for cracks, blockage, or other damage. <div style="text-align: center;">  <p>A16453-A</p> </div> <ul style="list-style-type: none"> ● Are vacuum chambers OK? 	Yes No	<ul style="list-style-type: none"> ▶ RETURN to Section 2B, Diagnostic Routines. ▶ REPLACE the vacuum chamber(s). 	

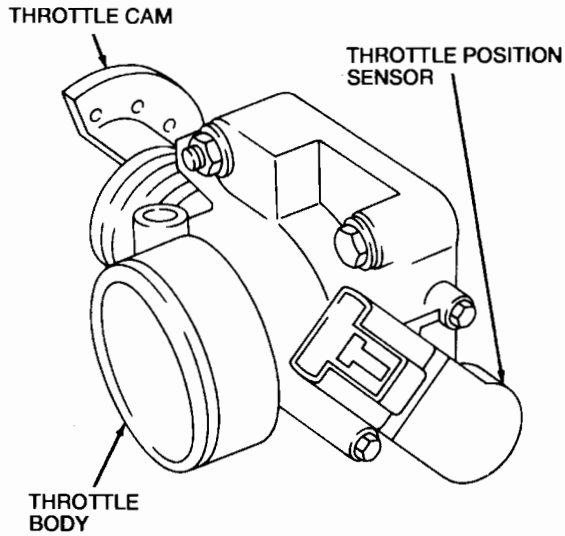
Diagnosis and Testing

All Engines

IA

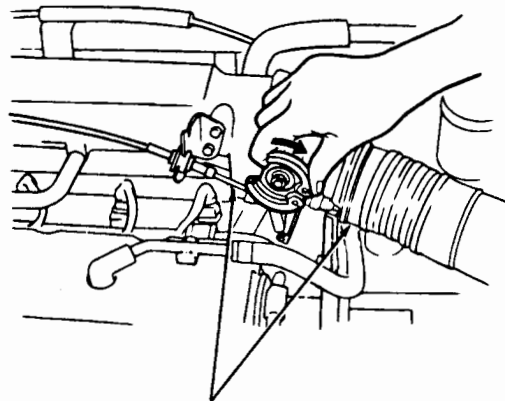
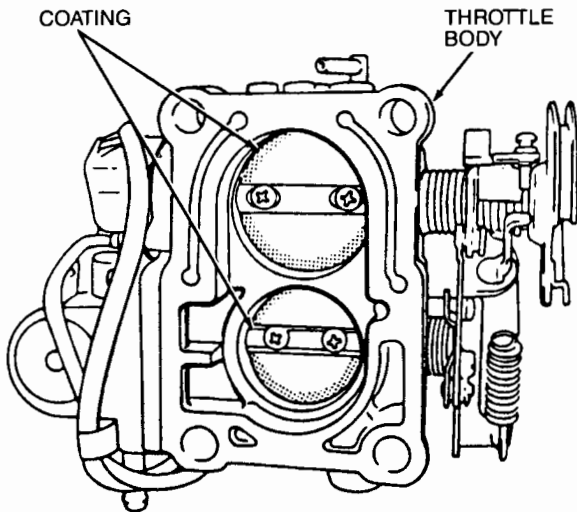
Throttle Valve Checking

1.3L



A20218-B

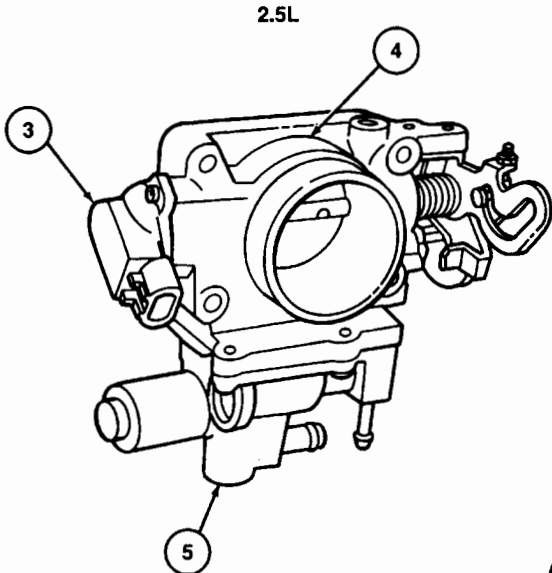
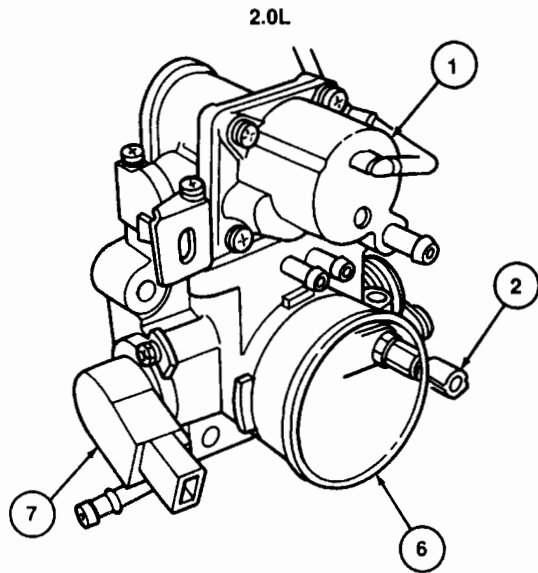
1.6L, 1.8L



DISCONNECT ACCELERATOR CABLE AND AIR HOSE AT THROTTLE BODY PRIOR TO REMOVING FROM ENGINE.

A13990-B

Diagnosis and Testing	All Engines	IA
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A16783-B

Item	Description
1	IAC BPA Valve
2	Idle Switch (CD4E Only)
3	Throttle Position (TP) Sensor
4	Throttle Body
5	IAC BPA Valve
6	Throttle Body
7	Throttle Position (TP) Sensor

Description and Operation

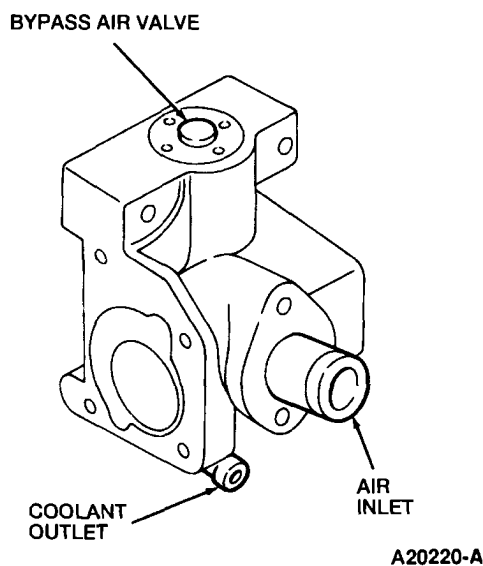
Bypass Air (BPA) Control System

The Bypass Air (BPA) control system maintains engine idle speed quality throughout the engine's operating modes by means of the BPA valve. The valve responds to changes in the engine coolant temperature only, and is not electrically controlled by the Powertrain Control Module (PCM). As the engine warms up, the thermowax expands, pushing the valve closed and reducing the bypass airflow amount. The bypass airflow is at its highest level during cold engine start. It declines steadily until reaching a coolant temperature of 60°C (140°F) for 1.6L, 2.0L and 2.5L engines and 40°-50°C (104°-122°F) for 1.3L and 1.8L engines, at which time the flow is completely cut off.

For further information regarding these systems and their relationship to other engine emission systems, refer to the appropriate schematic diagram in Engine Supplement — Car, Section 3B of this manual.

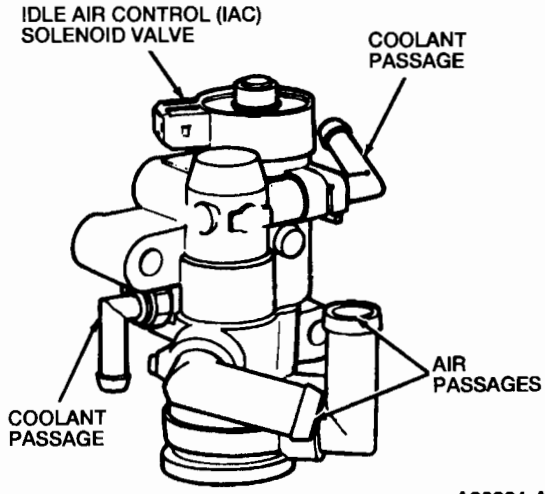
Description and Operation**All Engines****BPA Valve****Bypass Air (BPA) Valve**

The Bypass Air (BPA) valve consists of a thermowax material that expands or contracts depending on the temperature of engine coolant that passes through the valve. When the engine is cold, the Bypass Air (BPA) valve supplies bypass air into the intake manifold to increase idle speed for improved cold engine running performance. During cold weather, the air increases in density, fuel intake increases, and more air is needed to balance the emissions. The BPA valve closes as coolant temperature increases. The BPA valve is one of the two components that make up the Idle Air Control Bypass Air (IAC BPA) valve on all engines except the 1.8L.

1.3L

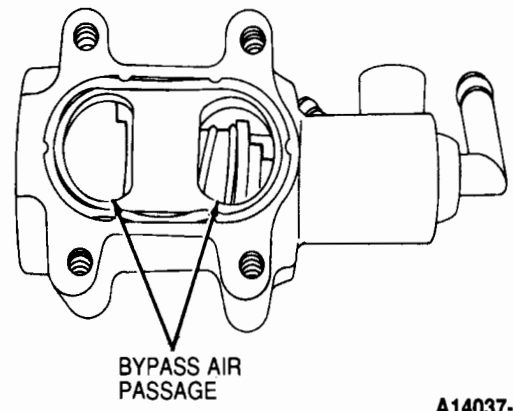
Description and Operation	All Engines	BPA Valve
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1.6L



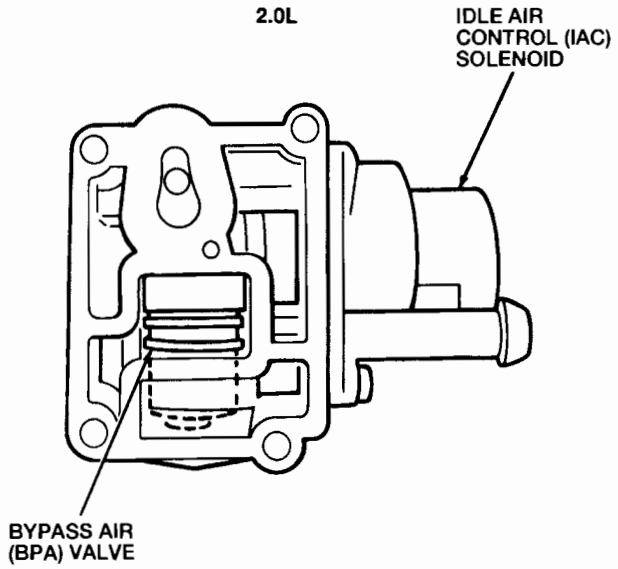
A20224-A

1.8L

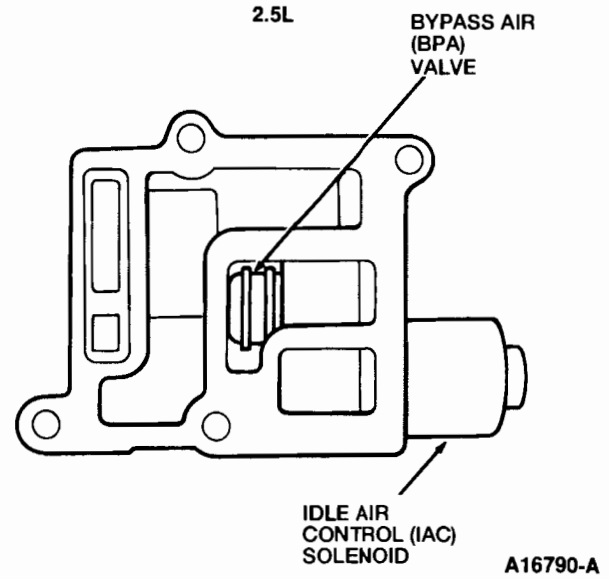


A14037-A

2.0L



2.5L



A16790-A

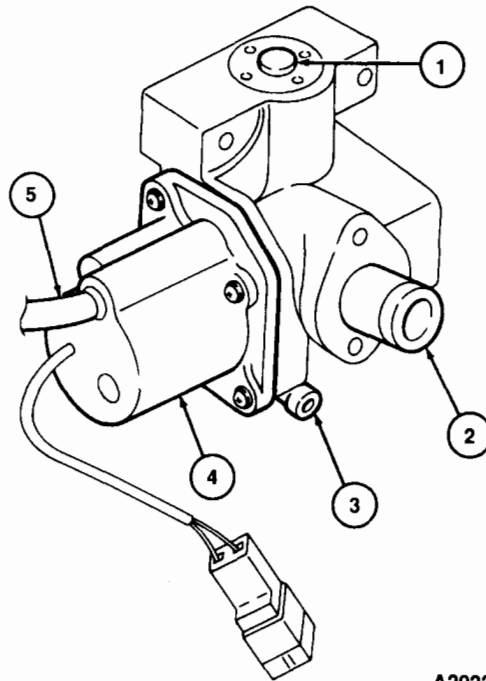
Engine	Location
1.3L	Mounted to LH side of intake manifold.
1.6L	Mounted to RH side of intake manifold.
1.8L	Mounted to intake manifold.
2.0L	Mounted to top of throttle body.
2.5L	Mounted to bottom of throttle body.

<p>Description and Operation</p>	<p>1.3L, 1.6L, 2.0L, 2.5L</p>	<p>IAC BPA Valve</p>
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Idle Air Control Bypass Air (IAC BPA) Valve

The Idle Air Control Bypass Air (IAC BPA) valve allows bypass air to flow into the intake manifold during cold engine conditions. The IAC BPA valve is controlled by two components: the Bypass Air (BPA) valve and the IAC solenoid. The BPA valve consists of a thermowax material affected by coolant temperature. The IAC solenoid valve is controlled by an output signal from the Powertrain Control Module (PCM). When coolant temperature rises enough to close the BPA valve, the IAC solenoid controls the amount of bypass air.

1.3L

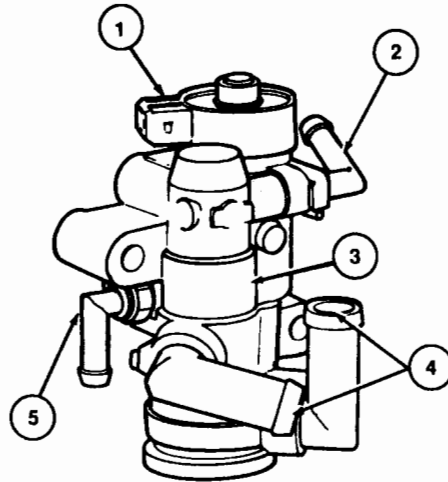


A20221-A

Item	Description
1	Bypass Air Valve
2	Air Inlet
3	Coolant Passage
4	Idle Air Control Valve
5	Coolant Inlet

<p>Description and Operation</p>	<p>1.3L, 1.6L, 2.0L, 2.5L</p>	<p>IAC BPA Valve</p>
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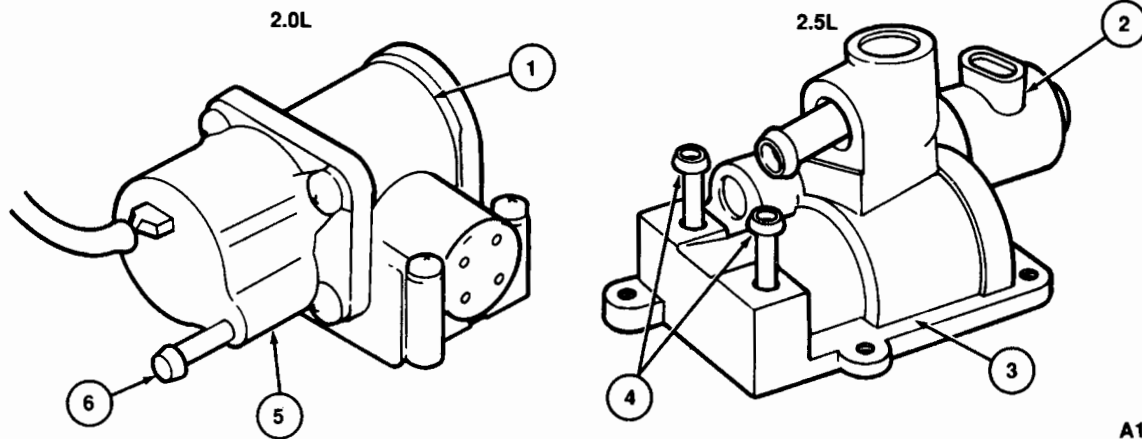
1.6L



A13851-D

Item	Description
1	Idle Air Control (IAC) Solenoid Valve
2	Coolant Passage
3	Bypass Air (BPA) Valve
4	Air Passages
5	Coolant Passage

Description and Operation	1.3L, 1.6L, 2.0L, 2.5L	IAC BPA Valve
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Item	Description
1	Idle Air Control Bypass Air (IAC BPA) Valve
2	IAC Solenoid
3	Idle Air Control Bypass Air (IAC BPA) Valve
4	Coolant Passages
5	IAC Solenoid
6	Coolant Passage

Engine	Location
1.3L	Mounted to the LH side of intake manifold.
1.6L	Mounted to the RH side of intake manifold.
2.0L	Mounted to the top of the throttle body.
2.5L	Mounted to the bottom of the throttle body.

Diagnosis and Testing	1.3L, 1.6L, 1.8L, 2.5L	IDL
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Idle Speed Adjustment — 1.3L, 1.6L, 1.8L, 2.5L

TEST STEP		RESULT	ACTION TO TAKE
IDL1	CHECK IDLE SPEED ADJUSTMENT		
	<ul style="list-style-type: none"> ● Warm up the engine to normal operating temperature. ● Engine off. ● Place the selector lever in Park (ATX) or Neutral (MTX). ● Turn all accessories to off. ● Connect a Rotunda 88 Digital Multimeter 105-00053 or equivalent as a tachometer. ● Ground the PCM STI (TEN) pin at the Data Link Connector on 1.3L, 1.8L, and 2.5L, or at the Self-Test Input (STI) connector on 1.6L. Refer to Connector Location Illustration at the end of Pinpoint Test Steps. ● Start engine. ● Note the idle speed. ● Check the initial ignition timing using Rotunda Timing Analyzer 059-00014 or equivalent. Refer to Section 8B, Ignition Systems, for specifications. Adjust if necessary. ● Adjust the idle speed adjustment screw for the correct idle speed (see General Specifications table in this section). Refer to Idle Speed Adjustment Screw Location Illustrations after Pinpoint Test Steps. ● Turn the engine off, and allow to cool. ● After the engine has cooled, restart and note idle speed. ● Does the engine speed up during warm-up when started cold? 	<p>Yes</p> <p>No</p>	<p>▶ RETURN to Section 2B, Diagnostic Routines.</p> <p>▶ GO to BPA1.</p>

Diagnosis and Testing	2.0L	IDL
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Idle Speed Adjustment — 2.0L

TEST STEP		RESULT	ACTION TO TAKE
IDL 1	CHECK IDLE SPEED ADJUSTMENT		
	<ul style="list-style-type: none"> ● Activate the engine running self-test. Refer to Section 5A of this manual for the procedure. ● After the Diagnostic Trouble Code (DTC) slow code output is completed, unlatch and within 4 seconds latch the HOLD/TEST button on the Super STAR II tester. ● A single pulse code will sound/display on the Super STAR II tester to indicate the entry mode. ● After the entry code, observe the self-test output (STO) of the Super STAR II tester, or the Malfunction Indicator Lamp (MIL), or "CHECK ENGINE" light. <ul style="list-style-type: none"> — A constant tone, MIL, or "STO LO" readout means base idle rpm is within specification. — A beeping tone, flashing MIL, or "STO LO" readout at 8 Hz indicates TP sensor is out of range due to over adjustment. Refer to Service Manual Section 03-14A. — A beeping tone, flashing MIL, or "STO LO" readout at 4 Hz indicates base idle rpm is too fast and needs adjustment. — A beeping tone, flashing MIL, or "STO LO" readout at 1 Hz indicates base idle rpm is too slow and needs adjustment. ● Do not clean the throttle body. Turn the air trim screw counterclockwise to increase idle rpm and clockwise to decrease idle rpm (refer to the illustrations after the test steps). ● To exit test, unlatch the HOLD/TEST button, then wait four seconds for reinitialization. ● Turn the engine off, and allow to cool. ● After the engine has cooled, restart it. ● Does the engine speed up during warm-up when started cold? 	<p>Yes</p> <p>No</p>	<ul style="list-style-type: none"> ▶ RETURN to Section 2A, Diagnostic Routines. ▶ GO to BPA1.

Diagnosis and Testing	All Engines	BPA
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Bypass Air (BPA) Control System

System Inspection

1. Visually inspect the Bypass Air (BPA) valve assembly and associated components.

VISUAL INSPECTION CHART

Mechanical	Electrical
<ul style="list-style-type: none"> ● Loose, leaking, pinching, kinked, or otherwise damaged coolant or air hoses and connections ● Loose fasteners, hose clamps ● White smoke from tail pipe 	<ul style="list-style-type: none"> ● Damaged or loose connections

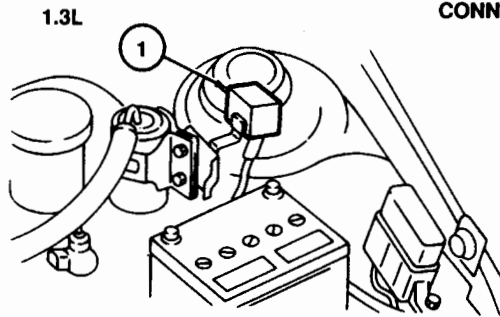
2. If visual checks are OK, proceed to the Pinpoint Tests.

Pinpoint Tests — BPA

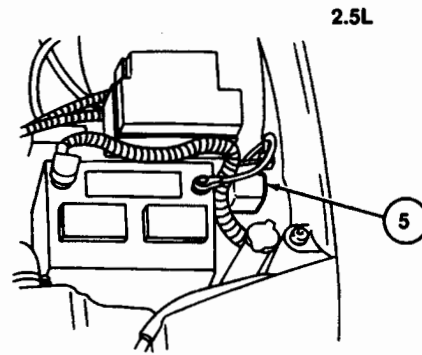
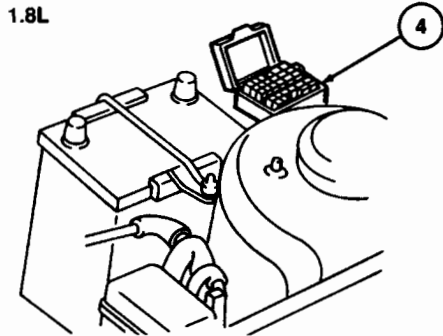
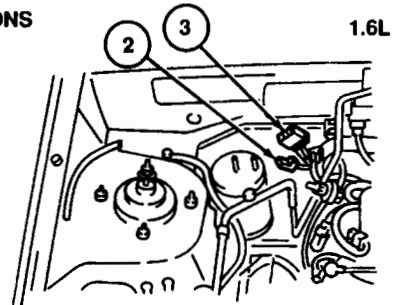
TEST STEP	RESULT	ACTION TO TAKE
BPA1 CHECK IAC VALVE RESISTANCE <ul style="list-style-type: none"> ● Disconnect the Idle Air Control (IAC) valve connector. ● Connect Rotunda 73 Digital Multimeter 105-00051 or equivalent to the terminals of the IAC valve and check the resistance. ● Is the resistance within the specified range (see General Specifications table in this section)? 	Yes No	<ul style="list-style-type: none"> ▶ GO to BPA2. ▶ REPLACE the IAC BPA assembly or IAC valve.
BPA2 CHECK BPA VALVE FUNCTION <ul style="list-style-type: none"> ● Remove the BPA valve from the engine. ● Cool the BPA valve to room temperature. ● When the valve is cold, blow through the valve port or air passage. Refer to illustrations after Test Steps. ● Verify that air flows freely through the valve. ● Heat the BPA valve using a blow dryer or Rotunda Heat Gun 107-R0300 or equivalent. ● Verify that the air valve moves outward to restrict bypass air flow. ● Does the BPA valve function properly? 	Yes No	<ul style="list-style-type: none"> ▶ RETURN to the Diagnostic Routines. ▶ REPLACE the IAC BPA assembly.

Diagnosis and Testing	All Engines	BPA
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Data Link and STI Connector Locations



CONNECTOR LOCATIONS



A17987-C

Item	Description
1	Data Link Connector
2	STI Connector
3	STO Connector
4	Data Link Connector
5	Data Link Connector

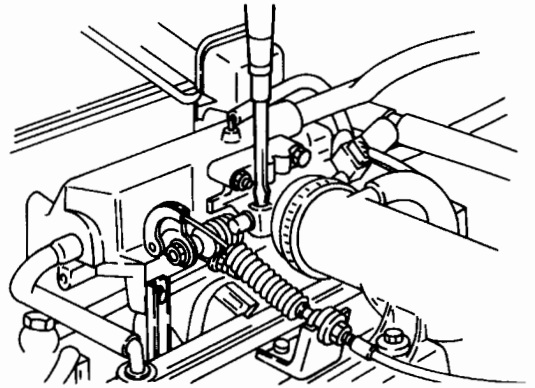
Diagnosis and Testing

All Engines

BPA

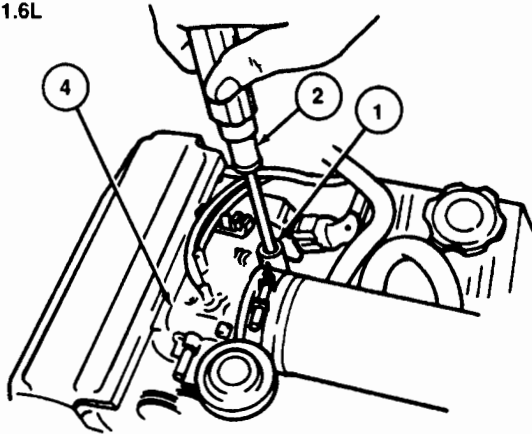
Idle Speed Adjustment Screw Locations

1.3L

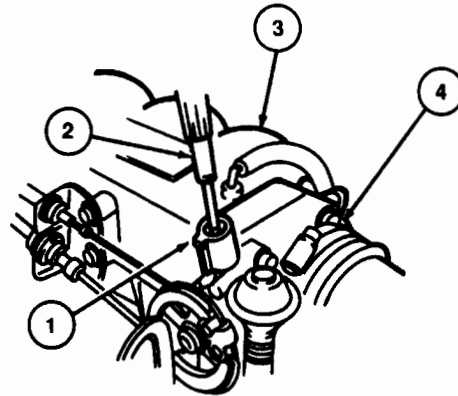


A20223-A

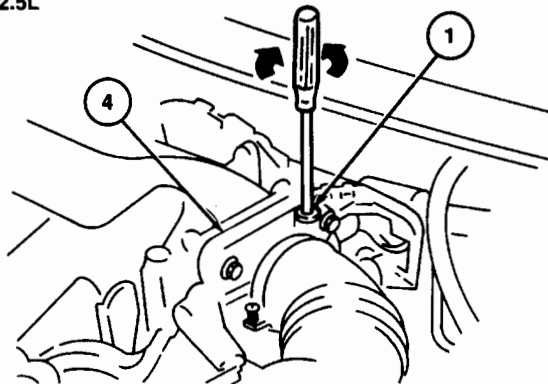
1.6L



1.8L

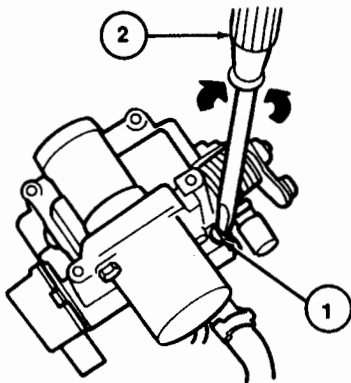


2.5L



A18131-C

2.0L

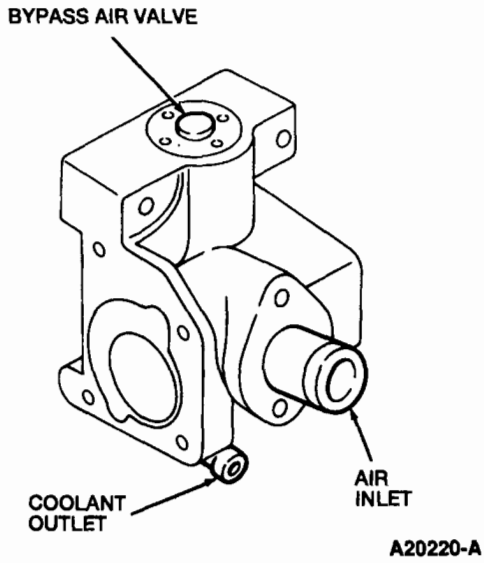


Diagnosis and Testing	All Engines	BPA
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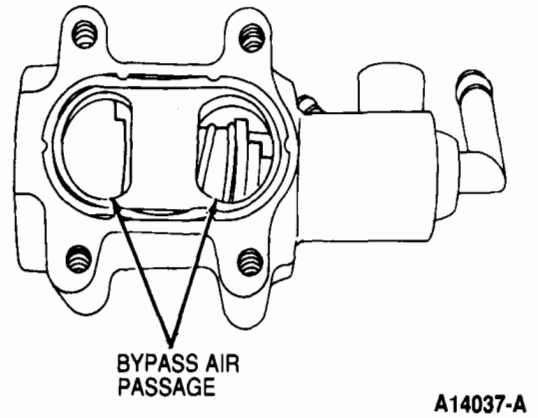
Item	Description
1	Idle Speed Adjustment Screw
2	Screwdriver
3	Intake Manifold
4	Throttle Body

BPA Valve

1.3L

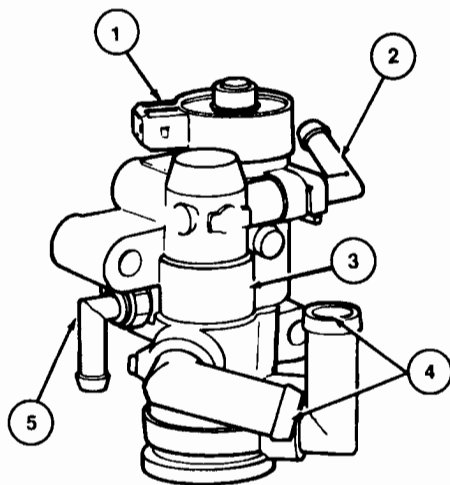


1.8L



Diagnosis and Testing	All Engines	BPA
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1.6L

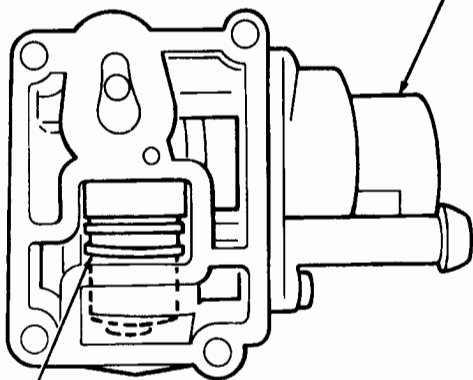


A13851-D

Item	Description
1	Idle Air Control (IAC) Solenoid Valve
2	Coolant Passage
3	Bypass Air (BPA) Valve
4	Air Passages
5	Coolant Passage

2.0L

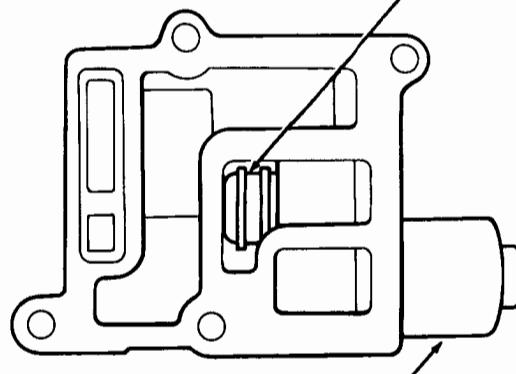
IDLE AIR CONTROL (IAC) SOLENOID



BYPASS AIR (BPA) VALVE

2.5L

BYPASS AIR (BPA) VALVE



IDLE AIR CONTROL (IAC) SOLENOID

A16790-A

Specifications/Special Service Tools

Specifications

GENERAL SPECIFICATIONS

Description	Specifications
PCM controlled idle speed:	
● Vehicle in PARK (ATX) or NEUTRAL (MTX)	
● All accessories off	
● Cooling fan off	
● Ignition timing OK	
● 1.3L MTX	● 650 - 750 rpm
● 1.3L ATX	● 700 - 800 rpm
● 1.6L	● 700 - 800 rpm
● 1.8L	● 700 - 800 rpm (with parking brake applied)
● 2.0L	● 650-750 rpm
● 2.5L	● 600 - 700 rpm
IAC valve resistance:	
● 1.3L	● 7.7 - 9.3 ohms
● 1.6L	● 6.0 - 14.0 ohms
● 1.8L	● 6.0 - 14.0 ohms
● 2.0L	● 7.7 - 9.3 ohms at 23°C (73°F)
● 2.5L	● 10.7 - 12.3 ohms at 20°C (68°F)

Special Service Tools/Equipment

ROTUNDA EQUIPMENT

Model	Description
014-00575	Multimeter Plus
107-R0300	Heat Gun
059-00014	Timing Analyzer
105-00051	73 Digital Multimeter
021-00037	Vacuum Tester
021-00012	Radiator Pressure/Heater Core Tester
021-00053	Cooling System Adapter
007-0041B	Super STAR II Tester
105-00053	88 Digital Multimeter