

SECTION 10B

Exhaust Gas Recirculation (EGR) Systems

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SECTION 10B

Exhaust Gas Recirculation (EGR) Systems

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Description and Operation

Exhaust Gas Recirculation (EGR) Systems

Engine Applications — 1.3L, 2.0L and 2.5L

The Exhaust Gas Recirculation (EGR) system recirculates a portion of the exhaust gases into the intake manifold under average vehicle driving conditions to reduce combustion temperatures and exhaust gas NO_x content. The amount of exhaust gas recirculated varies from zero with a cold engine, to a fixed rate for a hot engine with intermediate load and low engine speed. The flow rate increases steadily as coolant temperature rises above 50°C (122°F) for the 2.0L engine or 55°C (131°F) for the 1.3L and 2.5L engine. Other differences between the EGR systems are described in the following paragraphs.

All the systems use control solenoid(s), activated by the Powertrain Control Module (PCM), to operate the EGR system. The EGR system can be deactivated, aside from component malfunction, by the PCM and sensor inputs to the PCM. The components that help control the EGR system are listed below.

EGR System Components and Applications

Component	1.3L	2.0L MTX California and 2.0L CD4E	2.0L MTX Federal and Canada	2.5L
Crankshaft Position (CKP) Sensor	X	X	X	X
EGR Control (EGRC) Solenoid	X	X		X
EGR Vacuum Modulator (EGRM) Valve			X	
EGR Temperature (EGRT) Sensor			X	
EGR Vacuum Regulator (EVR) Solenoid			X	
EGR Valve	X	X	X	X
EGR Valve Position (EVP) Sensor	X	X		X
EGR Vent (EGRV) Solenoid	X	X		X
Engine Coolant Temperature (ECT) Sensor	X	X	X	X
Idle (IDL) Switch	X			X
Mass Air Flow (MAF) Sensor	X	X	X	
Measuring Core-Volume Air Flow (MC-VAF) Sensor				X
Powertrain Control Module (PCM)	X	X	X	X
Throttle Position (TP) Sensor	X	X	X	X

EGR System Operation

NOTE: Refer to the appropriate Mechanical Emission Related System Schematic Diagram in Section 3B for EGR routing and the EGR system's relationship with other engine / emission systems.

Description and Operation

1.3L, 2.0L MTX California, 2.0L CD4E, 2.5L

Two solenoids control the Exhaust Gas Recirculation (EGR) valve. The solenoids are the Exhaust Gas Recirculation Vent (EGRV) solenoid and the Exhaust Gas Recirculation Control (EGRC) solenoid. If the Powertrain Control Module (PCM) and the sensor inputs determine the EGR valve needs to be opened, the PCM activates the EGRC solenoid. When activated, the EGRC solenoid applies vacuum to the EGR valve for recirculation. If the PCM determines the EGR valve needs to close, the PCM will deactivate the EGRC solenoid and activate the EGRV solenoid. The EGRV solenoid vents the vacuum into the atmosphere until the desired EGR valve position is reached.

The EGR system uses an EGR Valve Position (EVP) sensor that is mounted to the top of the EGR valve. As the EGR valve moves, the EVP sensor detects this motion and notifies the PCM. The PCM uses this information, along with the information received from the previously listed input sensors, to modify the EGR valve position for improved emission control.

If any of these components fail, the Malfunction Indicator Lamp (MIL) will illuminate, informing the operator of a system failure.

2.0L MTX Federal and Canada

The Exhaust Gas Recirculation (EGR) valve operates under two conditions. If the sensors notify the Powertrain Control Module (PCM) that the EGR valve needs to be activated, the PCM will activate the Exhaust Vacuum Regulator (EVR) solenoid. Vacuum is applied from the EVR solenoid to the Exhaust Gas Recirculation Vacuum Modulator (EGRM) valve. The EGRM valve opens the Number 3 port, in turn opening the EGR valve allowing exhaust gas to recirculate.

The second condition occurs when sufficient engine speed and load are reached. Under these conditions, the EGRM valve closes due to moderate levels of exhaust back pressure and intake vacuum. This eliminates the venting of ported vacuum, which is high enough to open the EGR valve.

An Exhaust Gas Recirculation Temperature (EGRT) sensor is threaded into the EGR valve body. The EGRT sensor detects the EGR flow and notifies the PCM with an input signal. The EGRT sensor causes the PCM to illuminate the Malfunction Indicator Lamp (MIL) in the case of an EGR malfunction.

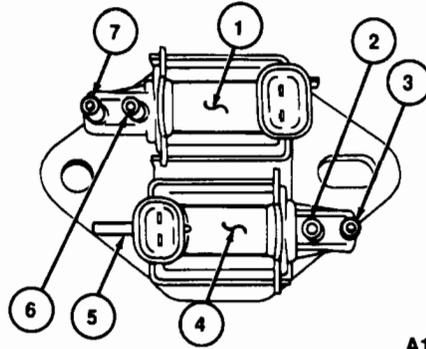
Description and Operation

Exhaust Gas Recirculation Vent (EGRV) Solenoid and Control (EGRC) Solenoid

The Exhaust Gas Recirculation Control (EGRC) solenoid regulates vacuum to the Exhaust Gas Recirculation (EGR) valve by an output signal from the Powertrain Control Module (PCM). The Exhaust Gas Recirculation Vent (EGRV) solenoid, also controlled by an output signal from the PCM, vents vacuum into the atmosphere in order to maintain the EGR valve position. Together, the EGRC and EGRV solenoids are capable of accurately controlling the EGR flow through all modes of engine operation.

<p>Description and Operation</p>	<p>1.3L, 2.0L, 2.5L</p>	<p>EGR/EGRV Solenoids</p>
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2.0L MTX California, 2.0L CD4E, 2.5L



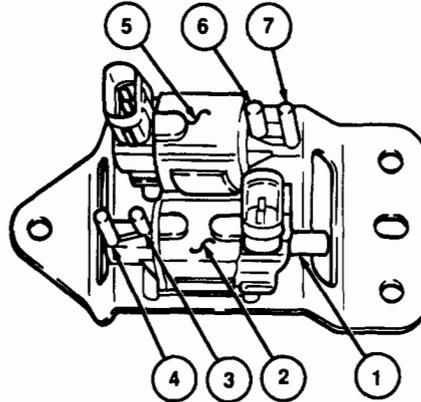
A14727-D

Figure 1.

Item	Description
1	EGR Control Solenoid
2	Interconnecting Hose Port to EGRC
3	Vacuum Port to EGR Valve
4	EGR Vent Solenoid
5	Port to Air Cleaner
6	Interconnecting Hose Port to EGRV
7	Vacuum Supply Port

Description and Operation	1.3L, 2.0L, 2.5L	EGRC/EGRV Solenoids
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1.3L



A20181-B

Figure 2.

Item	Description
1	Port to Air Cleaner
2	EGR Vent Solenoid
3	Interconnecting Hose Port to EGRC
4	Vacuum Port to EGR Valve
5	EGR Control Solenoid
6	Interconnecting Hose Port to EGRV
7	Vacuum Supply Port

Engine	Location
1.3L	Behind engine, mounted on cowl.
2.0L MTX California, 2.0L CD4E, 2.5L	Behind engine, below the intake manifold.

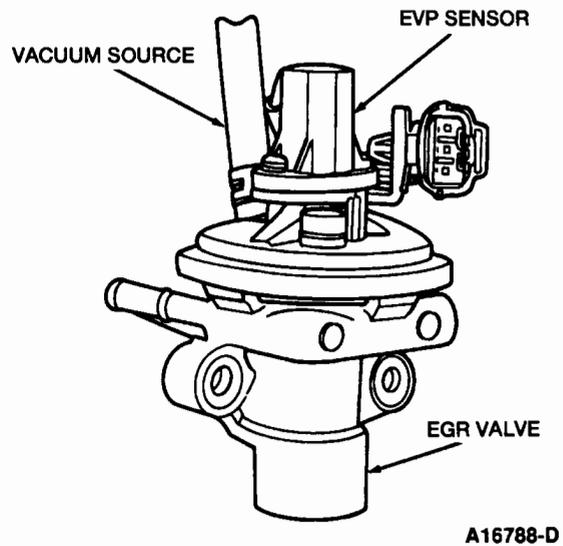
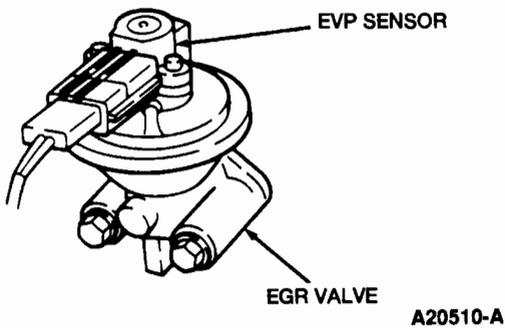
<p>Description and Operation</p>	<p>1.3L, 2.0L, 2.5L</p>	<p>EGR Valve</p>
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Exhaust Gas Recirculation (EGR) Valve

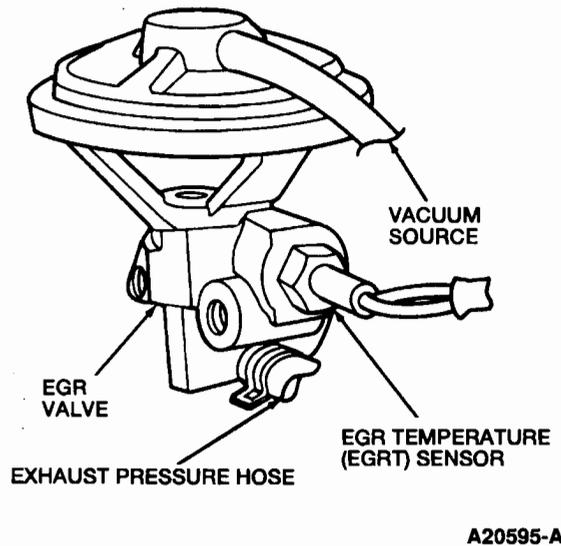
The Exhaust Gas Recirculation (EGR) valve recirculates portions of the exhaust gas back into the engine to reduce the amount of nitrogen released during combustion, and to reduce combustion temperature. The amount of exhaust gases that are released into the engine is proportional to the load on the engine.

1.3L, 2.0L MTX California, 2.0L CD4E

2.5L



2.0L MTX Federal and Canada



Description and Operation	1.3L, 2.0L, 2.5L	EGR Valve
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Engine	Location
1.3L	RH side of engine, below intake manifold.
2.0L, 2.5L	Behind the engine, below the back of the intake manifold.

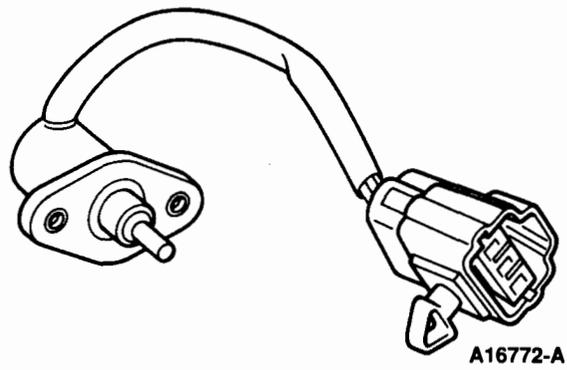
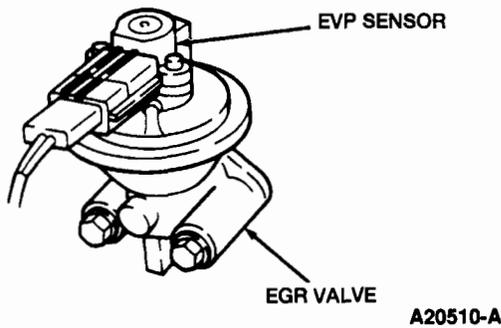
<p>Description and Operation</p>	<p>1.3L, 2.0L, 2.5L</p>	<p>EVP Sensor</p>
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Exhaust Gas Recirculation Valve Position (EVP) Sensor

The Exhaust Gas Recirculation Valve Position (EVP) sensor provides information to the Powertrain Control Module (PCM) reflecting the Exhaust Gas Recirculation (EGR) valve position. There are two purposes of the EVP sensor. The sensor indicates the amount of exhaust gases flowing into the engine by monitoring the EGR valve movement and also notifies the PCM of electrical failure in the EVP sensor.

1.3L, 2.0L MTX California, 2.0L CD4E

2.5L

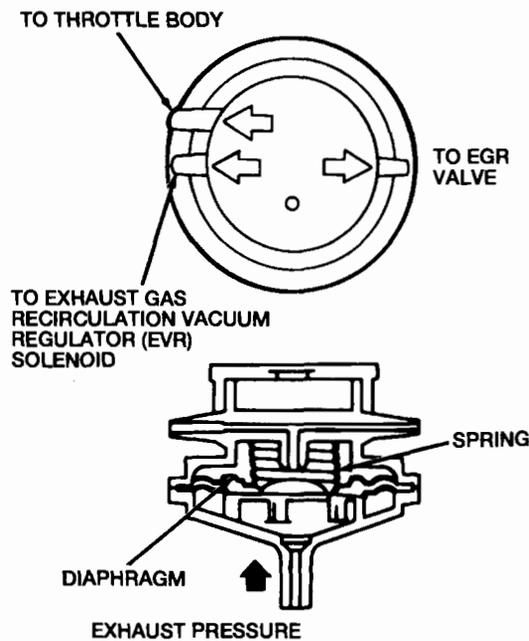


Engine	Location
1.3L, 2.0L MTX California, 2.0L CD4E and 2.5L	Mounted to the top of the EGR valve.

<p>Description and Operation</p>	<p>2.0L MTX</p>	<p>EGRM Valve</p>
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Exhaust Gas Recirculation Modulator (EGRM) Valve

The Exhaust Gas Recirculation Modulator (EGRM) valve uses vacuum supplied by the Exhaust Gas Recirculation Vacuum Regulator (EVR) solenoid and throttle body to control the amount of back-pressure vacuum that is applied to the Exhaust Gas Recirculation (EGR) valve. If the vacuum from the EVR solenoid and the throttle body is not applied to the EGRM valve, the ported vacuum will operate the EGR valve.



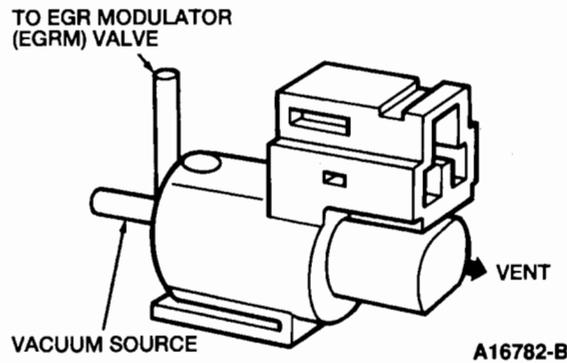
A16781-B

Engine	Location
2.0L MTX Federal and Canada	Mounted to top of intake manifold, above the throttle body.

<p>Description and Operation</p>	<p>2.0L MTX</p>	<p>EVR Solenoid</p>
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Exhaust Gas Recirculation Vacuum Regulator (EVR) Solenoid

The Exhaust Gas Recirculation Vacuum Regulator (EVR) solenoid controls the amount of vacuum applied to the Exhaust Gas Recirculation Modulator (EGRM) valve. The EVR solenoid is controlled by the Powertrain Control Module (PCM) based on a series of inputs from other components. The PCM determines when to activate the EVR solenoid and let vacuum be applied to the Exhaust Gas Recirculation (EGR) valve. If the solenoid is deactivated, it will act as a vent for the EGRM valve.

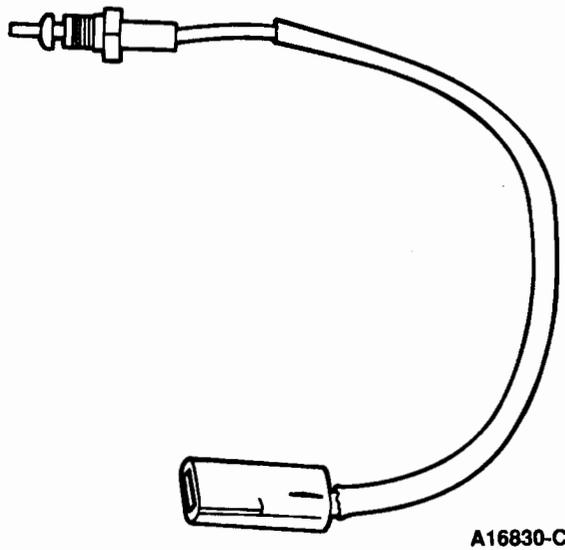


Engine	Location
2.0L MTX Federal and Canada	Mounted to the RH side of the intake manifold.

Description and Operation	2.0L MTX	EGRT Sensor
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Exhaust Gas Recirculation Temperature (EGRT) Sensor

The Exhaust Gas Recirculation Temperature (EGRT) sensor monitors the temperature in the Exhaust Gas Recirculation (EGR) valve. As EGR flow increases, the temperature of the sensor increases. This operation creates a change in resistance of the sensor and sends a signal to the Powertrain Control Module (PCM) to affect engine operating conditions.



Engine	Location
2.0L MTX Federal and Canada	Threaded into the EGR valve.

Diagnosis and Testing

System Inspection

1. Visually inspect the components of the Exhaust Gas Recirculation (EGR) system.

VISUAL INSPECTION CHART

Mechanical	Electrical
<ul style="list-style-type: none"> ● Loose, leaking, or damaged vacuum lines ● EGR valve stuck open ● EGR valve attaching bolts loose or missing ● EGR valve flange gasket damaged or leaking 	<ul style="list-style-type: none"> ● Damaged connectors ● Damaged insulation ● Damaged components that affect EGR ● Damaged EGR components

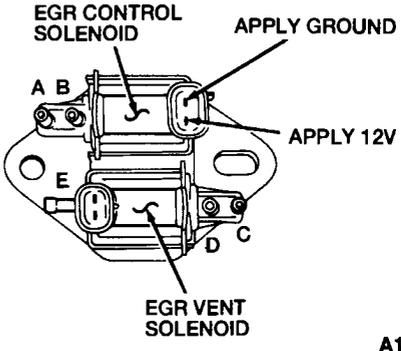
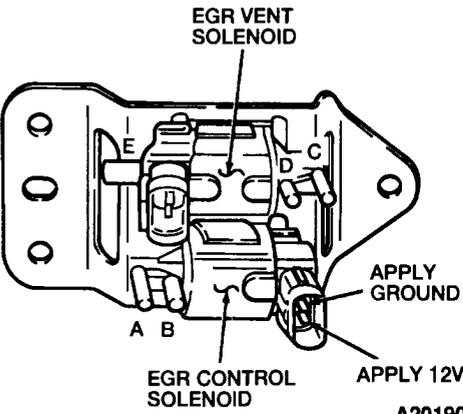
2. Exercise the wiring harness and connectors for the EGR components. Check for looseness, corrosion, or other damage. This must be done after the engine reaches normal operating temperature for activation of all EGR system components.
3. Check the vacuum lines and connections for looseness, pinching, leakage, splitting, blockage, damage, or liquid contamination.
4. If the vehicle System Inspection is OK, proceed to the Pinpoint Tests.

Diagnosis and Testing

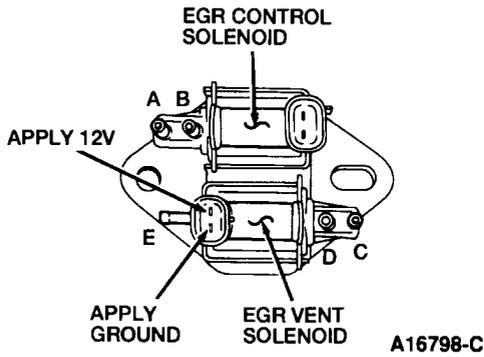
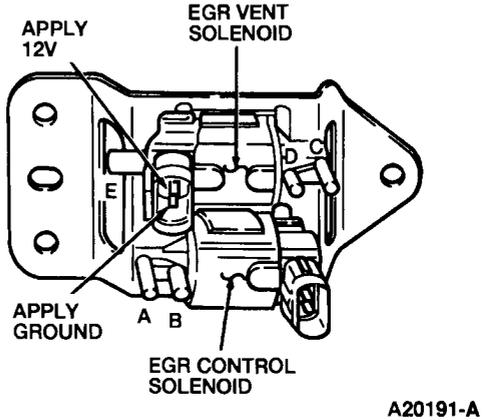
**1.3L, 2.0L MTX
Calif., 2.0L
CD4E, 2.5L**

EGR

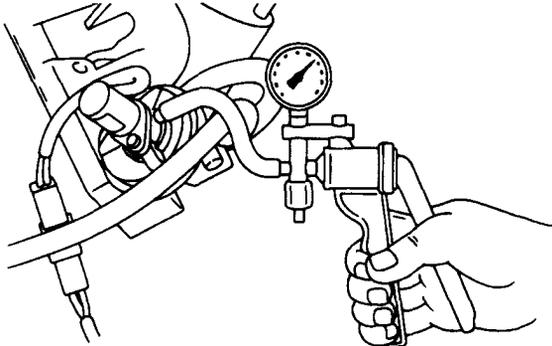
Pinpoint Tests — 1.3L, 2.0L MTX California, 2.0L CD4E, 2.5L

	TEST STEP	RESULT	ACTION TO TAKE
EGR1	<p>CHECK EGR CONTROL (EGRC) SOLENOID</p> <ul style="list-style-type: none"> ● Key OFF. ● Disconnect the Exhaust Gas Recirculation Control (EGRC) solenoid. ● Disconnect the vacuum hoses. ● Attach a hose to port A and blow into it to verify that air does not flow through port B. ● Apply 12 volts and ground to the EGRC solenoid as shown below. <p>2.0L, 2.5L</p>  <p style="text-align: right;">A16797-C</p> <p>1.3L</p>  <p style="text-align: right;">A20190-A</p> <ul style="list-style-type: none"> ● Attach a hose to port A and blow into it to verify that air flows through port B. ● Does the EGRC solenoid function properly? 	<p>Yes</p> <p>No</p>	<p>▶ GO to EGR2.</p> <p>▶ REPLACE the EGRC solenoid.</p>

Diagnosis and Testing	1.3L, 2.0L MTX Calif., 2.0L CD4E, 2.5L	EGR
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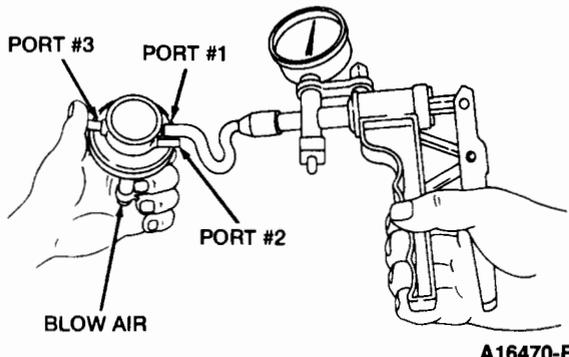
	TEST STEP	RESULT	ACTION TO TAKE
EGR2	<p>CHECK EGR VENT (EGRV) SOLENOID</p> <ul style="list-style-type: none"> ● Key OFF. ● Disconnect the Exhaust Gas Recirculation Vent (EGRV) solenoid. ● Disconnect the vacuum hoses. ● Block port D. ● Blow into port C and verify that air flows through port E (interconnecting hose between port B and port D is not shown in art for solenoid clarification). ● Apply 12 volts and ground to the EGRV solenoid as shown below. <p>2.0L, 2.5L</p>  <p>1.3L</p>  <ul style="list-style-type: none"> ● Blow into port C and verify that air does not flow through port E. ● Does the EGRV solenoid function properly? 	<p>Yes</p> <p>No</p>	<p>▶ GO to EGR3.</p> <p>▶ REPLACE the EGRV solenoid.</p>

<h2 style="text-align: center;">Diagnosis and Testing</h2>	<p style="text-align: center;">1.3L, 2.0L MTX Calif., 2.0L CD4E, 2.5L</p>	<p style="text-align: center;">EGR</p>
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TEST STEP		RESULT	ACTION TO TAKE
EGR3	CHECK EGR VALVE		
<ul style="list-style-type: none"> ● Run the engine until normal operating temperature is reached. ● Key OFF. ● Connect a Rotunda Vacuum Tester 021-00037 or equivalent to the Exhaust Gas Recirculation (EGR) valve vacuum source port as shown below. <div style="text-align: center;">  <p>A16472-A</p> </div> <ul style="list-style-type: none"> ● Key ON, engine running. ● Idle the engine. ● Verify the engine runs rough when applied vacuum reaches the specified value, or the engine stalls at a higher vacuum (refer to General Specifications chart at the end of the section). ● Does the EGR valve function properly? <p>NOTE: For diagnosis of the EGR Valve Position (EVP) sensor, refer to the EEC Pinpoint Tests, Section 6B, for the 1.3L and 2.5L vehicles or refer to the EEC-IV Pinpoint Tests, Section 6A for the 2.0L MTX California and 2.0L CD4E vehicles.</p>		<p>Yes</p> <p>No</p>	<ul style="list-style-type: none"> ▶ RETURN to the Diagnostic Routines. ▶ REPLACE the EGR valve.

Diagnosis and Testing	2.0L MTX Federal and Canada	EGR
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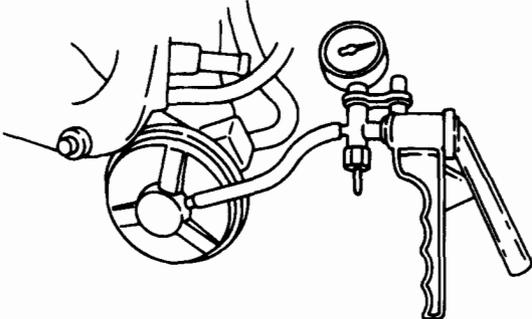
Pinpoint Tests — 2.0L MTX Federal and Canada

TEST STEP		RESULT	ACTION TO TAKE
EGR1	<p>CHECK EGR MODULATOR (EGRM) VALVE</p> <ul style="list-style-type: none"> ● Key OFF. ● Disconnect the vacuum lines from the Exhaust Gas Recirculation Modulator (EGRM) valve. ● Connect a Rotunda Vacuum Tester 021-00037 or equivalent to the Number 1 port on the EGRM valve as shown below. ● Block the Number 3 port as shown below. 	<p>Yes</p> <p>No</p>	<p>▶ GO to EGR2.</p> <p>▶ REPLACE the EGRM valve.</p>
<div style="text-align: center;">  <p style="text-align: center;">A16470-B</p> </div> <ul style="list-style-type: none"> ● Blow into the exhaust port while applying vacuum with the tester. ● Verify that the vacuum is held. ● Release the exhaust port and verify that vacuum is released. ● Does the EGRM valve function correctly? 			

Diagnosis and Testing	2.0L MTX Federal and Canada	EGR
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TEST STEP		RESULT	ACTION TO TAKE						
EGR2	<p>CHECK EGR VACUUM REGULATOR (EVR) SOLENOID</p> <ul style="list-style-type: none"> ● Key OFF. ● Disconnect the Exhaust Gas Recirculation Vacuum Regulator (EVR) solenoid. ● Attach a hose to port B and blow into it to verify that air flows through port C only. ● Apply 12 volts and ground to the EVR as shown below. <div style="text-align: center;"> <p style="text-align: center;">A16796-A</p> </div> <table border="1" style="margin: 10px auto; width: 80%;"> <thead> <tr> <th style="text-align: center;">Port</th> <th style="text-align: center;">Vacuum Hose Color</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">A</td> <td style="text-align: center;">Black with blue stripe</td> </tr> <tr> <td style="text-align: center;">B</td> <td style="text-align: center;">Black with orange stripe</td> </tr> </tbody> </table> <ul style="list-style-type: none"> ● Attach a hose to port A and blow into it to verify that air flows through port B only. ● Does the EVR solenoid function correctly? 	Port	Vacuum Hose Color	A	Black with blue stripe	B	Black with orange stripe	<p>Yes</p> <p>No</p>	<ul style="list-style-type: none"> ▶ GO to EGR3. ▶ REPLACE the EVR solenoid.
Port	Vacuum Hose Color								
A	Black with blue stripe								
B	Black with orange stripe								

Diagnosis and Testing	2.0L MTX Federal and Canada	EGR
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TEST STEP		RESULT	ACTION TO TAKE
<p>EGR3 CHECK EGR VALVE</p> <ul style="list-style-type: none"> ● Run the engine until normal operating temperature is reached. ● Key OFF. ● Connect a Rotunda Vacuum Tester 021-00037 or equivalent to the Exhaust Gas Recirculation (EGR) valve as shown below. <div style="text-align: center;">  <p>A16471-A</p> </div> <ul style="list-style-type: none"> ● Key ON, engine running. ● Idle the engine. ● Verify the engine runs rough when applied vacuum reaches the specified value of 150 mm-Hg (5.91 in-Hg), or the engine stalls at a higher vacuum. ● Does the EGR valve function correctly? <p>NOTE: For diagnosis of the EGR Temperature (EGRT) sensor, refer to the EEC-IV Pinpoint Tests, Section 6A.</p>	<p>Yes</p> <p>No</p>	<ul style="list-style-type: none"> ▶ RETURN to Diagnostic Routines. ▶ REPLACE the EGR valve. 	

Specifications/Special Service Tools

Specifications

GENERAL SPECIFICATIONS

Description	Specification
Combined Conditions Required to Actuate EGR System	Coolant Temperature Minimum: 50°C (122°F) (2.0L) 55°C (131°F) (1.3L and 2.5L) Throttle Opening: Average for Highway Driving Vacuum to Open: 150 mm-Hg (5.91 in-Hg) (2.0L MTX Federal and Canada) 40-60 mm-Hg (1.6-2.4 in-Hg) (2.0L MTX California, 2.0L CD4E and 2.5L) 65mm-Hg (2.59 in-Hg) (1.3L)

Special Service Tools/Equipment

ROTUNDA EQUIPMENT

Model	Description
021-00037	Vacuum Tester