GENERAL MOTORS EXHAUST GAS RECIRCULATION

DESCRIPTION

The Exhaust Gas Recirculation (EGR) System used on General Motors vehicles is designed to reduce emission of oxides of nitrogen (NOx). This process is accomplished by lowering combustion temperatures of burning gases. Recirculated and metered amounts of exhaust gases are reintroduced into the engine through the intake manifold where they are mixed with the air/fuel mixture.

The amount of exhaust gas admitted is determined by a vacuum-operated EGR valve in response to engine operating conditions. A Thermal Vacuum Valve (TVV) or Switch (TVS) or an electrically-operated solenoid controls operating vacuum, depending on engine operating temperature to maintain good cold driveability.

There are two types of EGR systems, the Vacuum Modulated (ported vacuum) and the Exhaust Back Pressure Modulated systems. The major difference between the valves is the method used to control how far each valve opens.

The ported system uses a timed vacuum port in the carburetor to regulate the amount of exhaust gas recirculation. The exhaust back pressure modulated system regulates the timed vacuum according to exhaust back pressure level. A special control valve (transducer) within the EGR valve housing acts as a pressure regulator.

OPERATION

VACUUM MODULATED (PORTED VACUUM) EGR SYSTEM

With this system, the amount of exhaust gas admitted to the intake manifold depends on a vacuum signal (ported vacuum), controlled by throttle position. When the throttle is closed (at idle or deceleration), there is no vacuum signal to the EGR valve because the EGR vacuum port is above the closed throttle valve. As the throttle valve is opened, a ported vacuum signal is supplied to the EGR valve, admitting exhaust gas to the intake manifold.

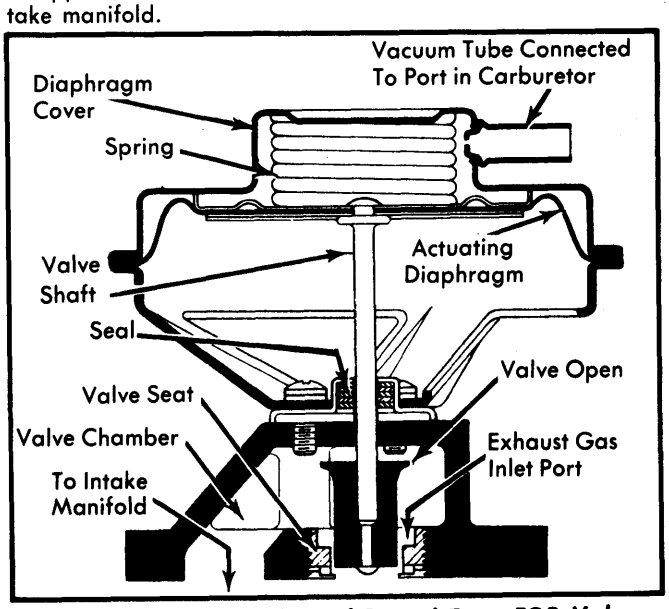

Fig. 1 Cutaway View of Ported Type EGR Valve

EXHAUST BACK PRESSURE MODULATED EGR SYSTEM

Two types of back pressure EGR valves are used by General Motors, either a positive or negative transducer valve. Operation of these two systems is explained as follows:

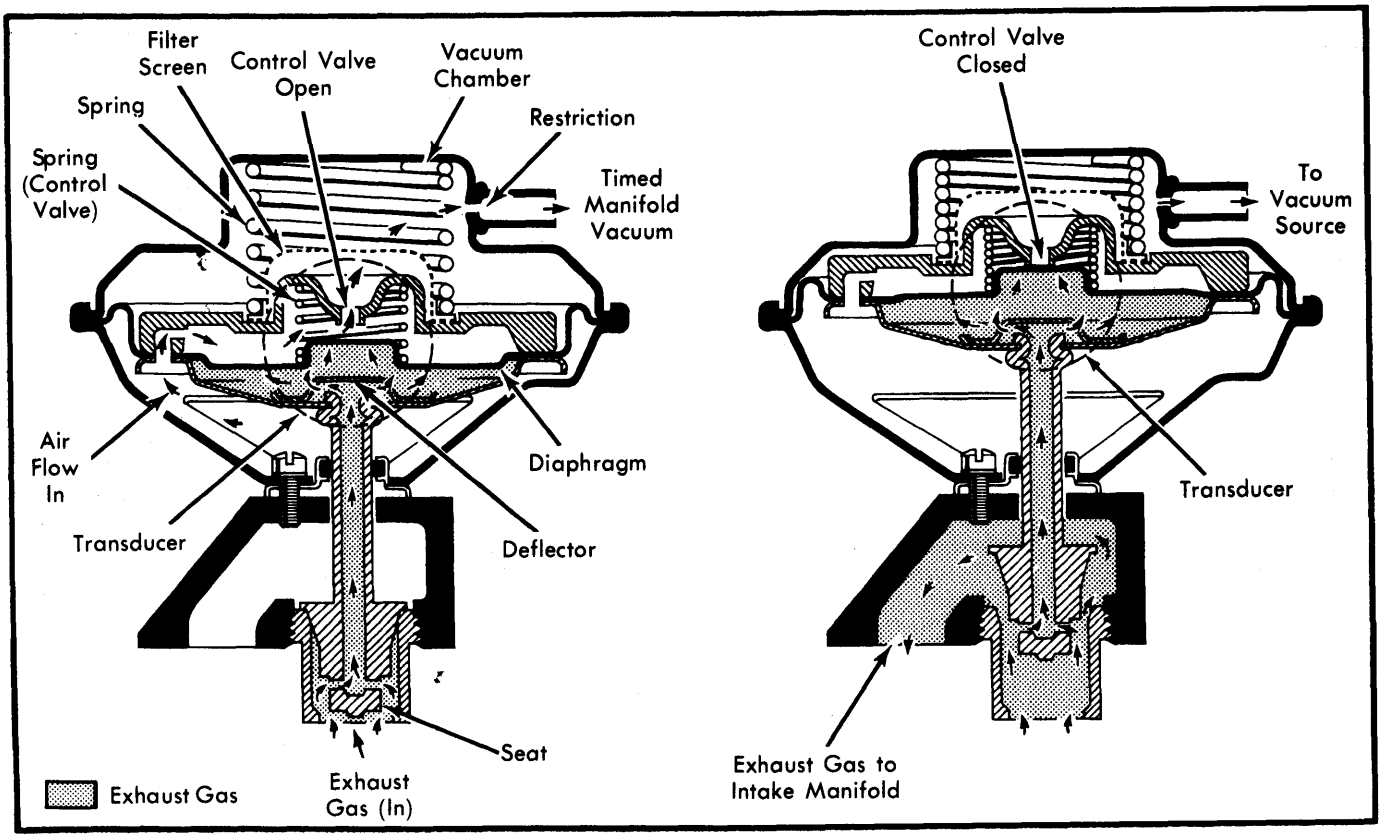

Fig. 2 Cutaway View of Positive Back Pressure EGR Valve

GENERAL MOTORS EXHAUST GAS RECIRCULATION (Cont.)

Positive Back Pressure EGR Valve – A small diaphragm control valve inside the EGR valve assembly acts as a pressure regulator. The control valve receives an exhaust back pressure signal through the hollow shaft which exerts a force on the bottom of the control valve diaphragm, opposed by a light spring. A metal deflector plate prevents hot exhaust gases from flowing directly on the diaphragm.

Vacuum is applied to the EGR valve assembly from the carburetor spark port, to assure no exhaust gas recirculation at idle. During off-idle operation, manifold vacuum is applied to the vacuum chamber through a restriction in the signal tube.

When engine load is light, and back pressure is low, the control valve is open, allowing air to flow from the 6 bleeds in diaphragm plate, through control valve orifice, into the vacuum chamber. The air bleeds off vacuum, decreasing signal trying to open EGR valve. Therefore, if back pressure does not close the control valve, sealing off air flow, there will not be any vacuum built up to open the EGR valve for exhaust gas recirculation.

When power demands are made on the engine, and exhaust gas recirculation is needed, exhaust gas back pressure increases, closing the control valve, thereby shutting off air flow through valve. Vacuum builds up in the vacuum chamber until the spring force holding the EGR valve closed is overcome.

Once the EGR valve opens, the exhaust pressure decreases because some of the exhaust gas is flowing into the intake manifold through the EGR passage. In actual operation, the system will reach a balanced condition providing optimum EGR operation.

Any increase in engine load will momentarily increase the exhaust signal, causing the control valve to close, allowing a stronger vacuum signal. The system will then stabilize at a greater EGR flow.

At maximum engine load, when manifold vacuum is nearly zero, momentarily, there will be no EGR operation. This is because of insufficient vacuum to pull the valve open, even though high exhaust back pressure has closed the control valve.

Negative Transducer Back Pressure EGR Valve – The negative transducer back pressure EGR valve assembly has the same function as the positive back pressure EGR valve except the transducer is designed to allow the valve to open with negative exhaust back pressure.

The flow of the valve is controlled by manifold vacuum, negative exhaust back pressure and the carburetor ported vacuum signal. The control valve spring in the transducer is placed on the bottom side of the diaphragm.

When the carburetor ported vacuum signal is applied to the main vacuum chamber partially opening the valve, the vacuum signal from the manifold side (reduced by exhaust back pressure) is transmitted up the hollow stem of the valve. This enables the signal to act on the diaphragm, opening the bleed and causing the transducer to modulate providing a specific valve flow. Thus the flow of the valve is a constant percentage of engine air flow.

EGR THERMAL CONTROL VALVE

Some models use a temperature sensitive control valve in vacuum line to EGR valve. Valve is closed below 61°F, blocking vacuum to EGR valve and giving better cold driveability.

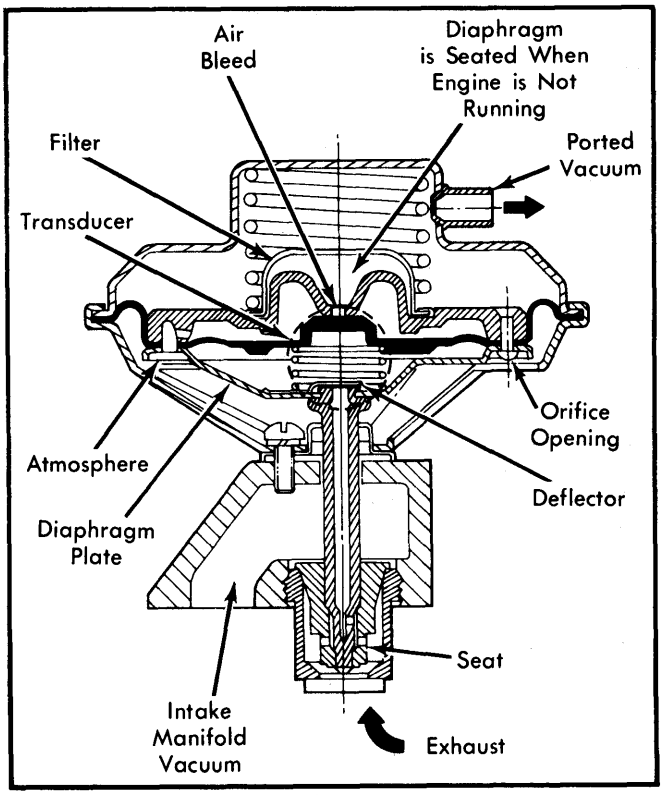

Fig. 3 Cutaway View of Negative Transducer Back Pressure EGR Valve

The thermal control valve is open above 76°F engine temperature allowing EGR ported vacuum to be directed to EGR valve.

EGR THERMAL VACUUM SWITCH

Some models use a temperature sensitive control switch in the vacuum line to EGR valve. The switch prevents vacuum from reaching EGR valve when engine is cold, improving warm-up driveability. When engine coolant reaches a pre-determined level, thermal vacuum switch opens and exhaust gas recirculation begins.

EGR VACUUM CONTROL SOLENOID

Some models having a vacuum activated EGR valve diaphragm are controlled by an electrical solenoid instead of a vacuum switch or valve. The solenoid is controlled by the electronic control module, based on engine coolant temperature signal and engine load. During cold engine operation, a signal from the ECM energizes the EGR solenoid, blocking vacuum to EGR valve.

The solenoid is also energized during cranking and at wide open throttle. Once the engine warms up, the EGR solenoid is turned off and the EGR valve operates according to normal (ported) vacuum and exhaust back pressure signals.

TROUBLE SHOOTING

ROUGH IDLE AND STALLING

Hoses routed improperly. Leaking EGR valve, loose attaching bolts or failed gasket. Thermal control valve or vacuum switch malfunctioning. Improper vacuum to EGR valve.

GENERAL MOTORS EXHAUST GAS RECIRCULATION (Cont.)

RUNS ROUGH ON LIGHT THROTTLE
POOR PART-THROTTLE PERFORMANCE

Hoses routed improperly. Loose EGR valve. Stuck or binding EGR valve, no gasket or spacer. TVS or solenoid opens below calibrated temperature. Failed EGR valve or vacuum control valve.

ENGINE STALLS ON DECELERATION

Control valve blocked or air restricted. Restriction in EGR vacuum line or control valve vacuum signal line.

PART THROTTLE DETONATION

Control valve blocked or air flow restricted. Insufficient EGR flow. Control valve blocked or flow restricted.

ENGINE STARTS AND IMMEDIATELY STALLS WHEN COLD

EGR valve hoses misrouted. EGR thermal vacuum switch malfunction when engine is cold.

TESTING

FUNCTIONAL TESTS

EGR Valve Installed (Exc. Ported and Negative Back Pressure Type Valves) – 1) With engine at normal operating temperature, set engine speed at fast idle (or high enough to obtain at least 8 in. Hg vacuum at EGR valve). Place gloved finger beneath EGR valve so diaphragm movement can be felt.

NOTE – *Engine coolant should be approximately 195° F, vacuum gauge should be connected between EGR signal tube and vacuum hose, and vehicle should be in Park or Neutral.*

2) Disconnect vacuum hose from EGR valve and watch for diaphragm movement. Diaphragm should move downward (valve closed) and an increase in engine RPM should be noticed.

3) Reconnect vacuum hose. Diaphragm should move upward (valve open) and engine RPM should decrease.

NOTE – *A vibration of diaphragm may be noted on back pressure EGR valves. Do not mistake this for a faulty valve.*

4) If no diaphragm movement is noticed during test, check for vacuum at hose. If vacuum is present, replace EGR valve. If no vacuum is present, check for plugged or leaking hose or carburetor port. On back pressure EGR valves, check transducer control valve operation.

5) If diaphragm moves with no change in engine RPM, check manifold EGR passages for blockage.

EGR Valve Installed (Ported and Negative Back Pressure Types) – 1) Check for proper hose routing, according to appropriate diagram. See *"General Motors Vacuum Diagrams" in this section*. Check EGR signal tube orifice for obstructions.

2) Connect vacuum gauge between EGR valve and carburetor, and check vacuum with engine running at normal operating temperature. There should be at least 5 in. Hg vacuum at 3000 RPM.

3) Check operation of Thermal Vacuum Switch by installing a vacuum gauge inline between TVS and its sources and noting presence of vacuum with engine operating warm. Valve can also be removed and checked by placing in pails of warm and cold water (with vacuum source and gauge attached on either side) to check for valve open while warm and closed while cold.

4) With engine off and valve on or off the vehicle, manually depress valve diaphragm. While depressed, hold finger over source tube and release diaphragm.

5) Check for diaphragm and seat movement. Valve is okay if it takes over 20 seconds for diaphragm to move to seated position. If less, replace EGR valve.

EGR Valve Removed (Positive Back Pressure Type Valve Only) – 1) Check hose routing. Check EGR valve signal tube orifice for obstructions. Check EGR-TVS or EGR solenoid (no diaphragm movement below calibration temperature). Remove valve from vehicle and apply external vacuum (10 in. Hg or more) to EGR vacuum signal tube.

NOTE – *A constant vacuum supply must be used.*

2) Valve should not open. If it does, control valve is stuck closed. Clean EGR valve as described under EGR Valve Cleaning in this article. Replace EGR valve if necessary.

3) With vacuum still applied, apply a stream of air from a low pressure source into the EGR valve exhaust gas intake passage. Valve should open completely. If it does not open at all, control valve is stuck open or exhaust passages are plugged. Clean or replace EGR valve, as necessary.

4) If EGR valve and control valve are both functioning properly, clean the mounting surfaces, then using a new gasket, install valve on engine. Reconnect vacuum hose.

MAINTENANCE

EGR VALVE CLEANING

CAUTION – *Do not wash valve assembly in solvents or degreaser, permanent damage to valve diaphragm may result. Also, sand blasting of the valve is not recommended since this can affect the operation of the valve.*

1) Remove air cleaner and EGR valve and discard gasket. Hold valve assembly in hand. Tap lightly on sides and end of valve and on pintle, itself, using a plastic hammer. Shake loose exhaust deposits from valve.

NOTE – *DO NOT place EGR valve in a vise.*

2) With a wire wheel, buff the exhaust deposits from mounting surface and around valve. Depress valve diaphragm and look at valve seating area through valve outlet to ensure it is clean.

3) Inspect for exhaust deposits in valve outlet. Remove deposit build up with a screwdriver.

4) Clean mounting surfaces of intake manifold and valve assembly, then using a new gasket, install valve assembly on intake manifold. Tighten attaching bolts and connect vacuum hose.

EGR PASSAGE CLEANING

If inspection of EGR passages in intake manifold indicates excessive build up of exhaust deposits, the passages should be cleaned. Care should be taken to ensure that all loose particles are completely removed to prevent them from clogging the EGR valve or from being ingested into the engine.