TomcoTechtips

TM

ISSUE 35

FORD EGR VALVES

In this issue we will look at the Delta/Differential Pressure Feedback (DPFE) Ford EGR system. This system is similar to the PFE system we studied, but it uses a DPFE sensor (Fig. 1) to monitor the system.

The DPFE Ford EGR system is a vacuum operated system. This system controls EGR flow rate by monitoring a pressure drop across a metered orifice with the DPFE sensor (Fig. 2).

DPFE Sensor

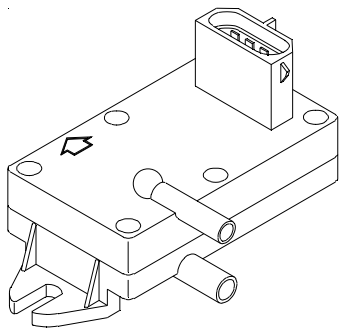


Figure 1

Exhaust Gas Recirculation System

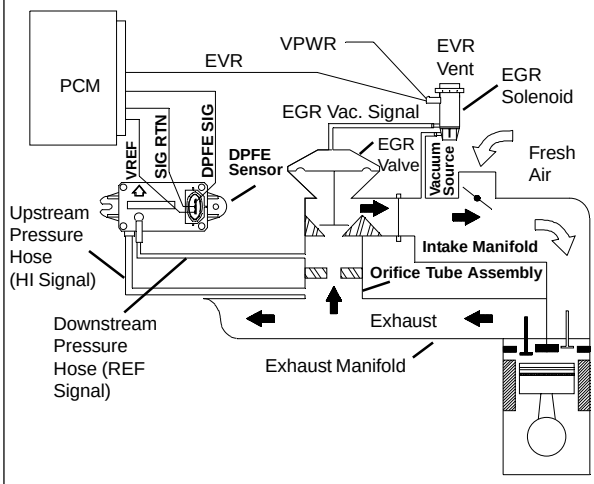


Figure 2

In this system the EGR valve functions more like a pressure regulator than it does a flow metering device. It uses an EGR Valve, Electronic Vacuum Regulator (EVR), Orifice tube and special hoses, and a DPFE Sensor. The EGR Valve (Fig. 3) and the EVR (Fig. 4) are the same style and operate the same way as the ones used in the PFE EGR system studied in the last issues. The Orifice tube, hoses and the DPFE however are different.

DPFE Style EGR Valve

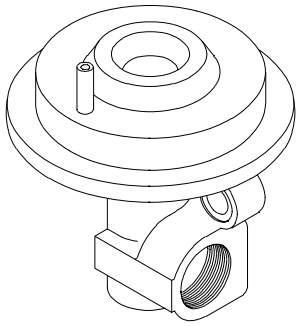


Figure 3

The DPFE sensor consists of an aluminum housing and gasket, a piezo ceramic disc and circuit board and two sealing gaskets (Fig. 5). The metal housing is a two-piece housing sealed by the housing gasket. Each of the housings contains a port. The piezo ceramic disc is sandwiched between the two part housing. There is a sealing gasket above and below the disc. When the assembly is together this forms a chamber

Electronic Vacuum Regulator (EVR)

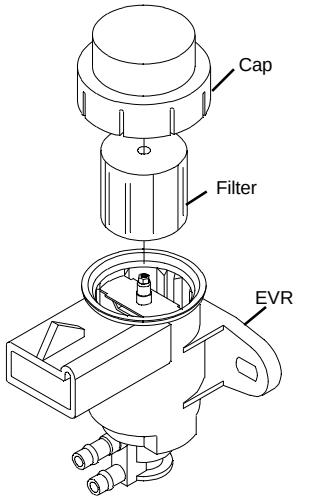


Figure 4

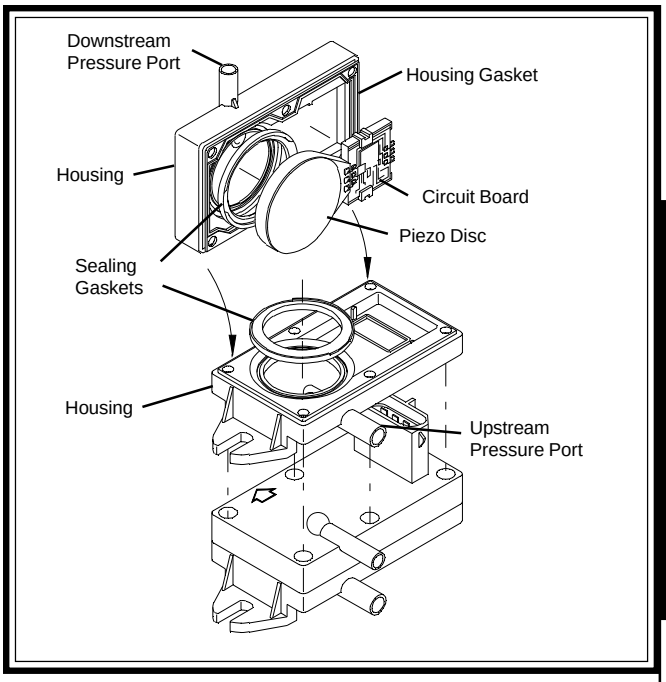


Figure 5

above the disc and below the disc.

One port of the metal housing is located at the chamber below the disc. This is called the upstream pressure port and it is the larger of the ports. The other port on the metal housing is located at the chamber above the disc. This is called the downstream pressure port and is smaller in size.

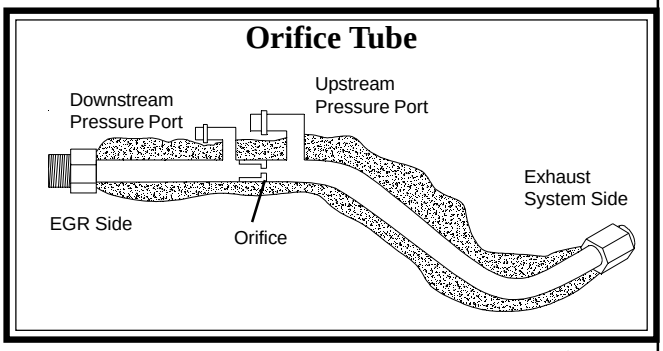


Figure 6

The Orifice tube screws into the exhaust system at one end and into the EGR Valve at the other end (Fig. 6). It contains two ports. The port closest to the exhaust side is connected by a special hose to the high signal side of the DPFE sensor (Fig. 7). This port and hose are the larger of the two and are called the upstream pressure port and hose. The port closest to the EGR Valve side is connected by a special hose to the reference signal side of the DPFE. This port and hose are smaller and are called the downstream pressure port and hose. There is an orifice located in the orifice tube, which is between the upstream and the downstream pressure ports and hoses.

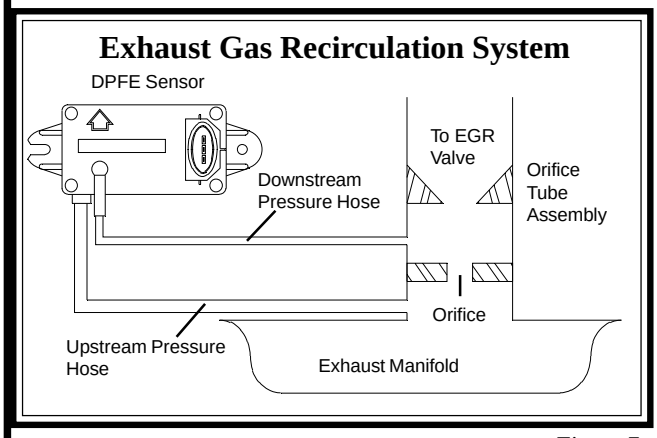


Figure 7

When the EGR valve is closed the exhaust pressure above and below the metered orifice is the same. This means that the pressure at the upstream pressure port and the downstream pressure port are the same. It also means that the pressure above and below the piezo disc in the DPFE is the same.

The ceramic disc in the DPFE is a piezo resistive device which is pressure sensitive. So when pressure is applied to the disc, it produces a voltage. Since this disc is sandwiched between the upstream and downstream ports, it will read the difference in pressure between the two ports. The DPFE sensor is supplied with a 5 volt reference, a ground and a DPFE signal back to the computer (Fig. 8).

In the case when the EGR valve is closed there is no pressure difference so the sensor puts out a small voltage. This voltage at idle is approximately 0.45 volts (Fig. 9).

When the EGR valve opens, the pressure below the orifice at the upstream pressure port reads exhaust pressure. The pressure above the orifice

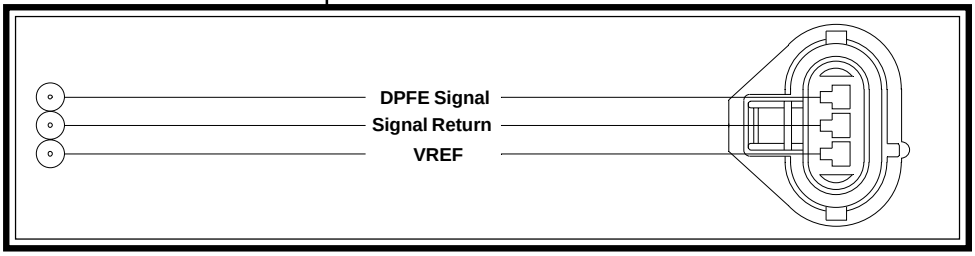
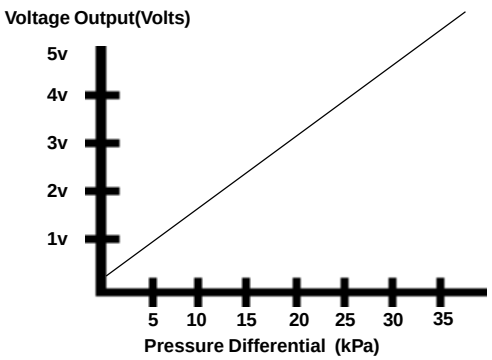


Figure 8

at the downstream pressure port however is lower than exhaust pressure. This is because a pressure drop has occurred by opening the EGR valve. This pressure drop occurs because of several factors. The area above the orifice is influenced by manifold vacuum, which lowers the pressure. Also the metered orifice in the exhaust passage, limits the rate at which the exhaust pressure can be replenished. Therefore there is a pressure difference formed above and below the orifice.

PFE SENSOR GRAPH & DATA



DPFE SENSOR DATA

PRESSURE			VOLTAGE
PSI	in-Hg	kPa	Volts
4.34	8.83	29.81	4.56
3.25	6.62	22.36	3.54
2.17	4.41	14.90	2.51
1.08	2.21	7.46	1.48
0	0	0	0.45

CAUTION: To avoid possible sensor damage do not exceed pressure / vacuum range shown vhen testing.

Figure 9

The DPFE now reads what the current exhaust pressure is at the upstream port below the disc, and reads the lower pressure at the downstream port above the disc. The disc then calculates what the pressure difference is between the two and outputs a corresponding voltage (refer to the chart in Figure 9). This voltage output is directly proportional to the flow of EGR gas entering into the intake manifold. Because the DPFE reads from above and below the orifice it is a more accurate assessment of the EGR flow requirements.

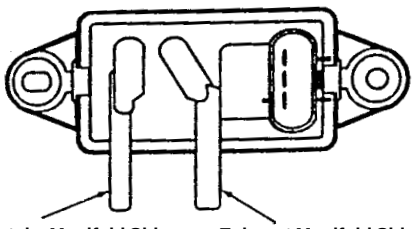
This voltage signal is sent to the PCM. The PCM uses this signal to calculate how much exhaust gas the valve is flowing. The PCM then decides if the EGR flow is correct, needs more or less EGR recirculation, and makes adjustments to ignition timing and in air/fuel ratio as required.

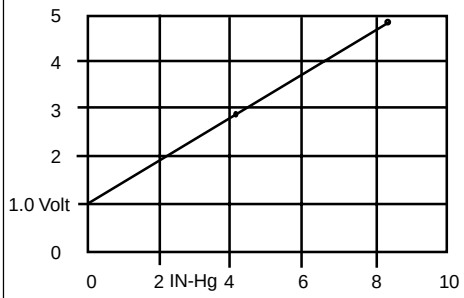
If more EGR flow is required, the PCM increases the duty cycle to the Electronic Vacuum Regulator (EVR). This allows more vacuum to go to the EGR valve, opening the pintle wider, increasing EGR flow. If less EGR flow is needed, the PCM decreases the duty cycle to the EVR. This allows less vacuum to go to the EGR valve, which closes the pintle, decreasing EGR flow. If the desired EGR flow is already achieved, the PCM keeps the duty cycle to the EVR constant.

This EGR system operates the same as the Ford Sonic system with the EVR solenoid. Therefore, the operating parameters are the same. The PCM monitors the Manifold Absolute Pressure (MAP) Sensor or Mass Air Flow (MAF), the Engine Coolant Temperature (ECT) Sensor, the Throttle Position Sensor (TPS) and the DPFE Sensor to determine the correct amount of EGR flow required. The PCM then sends the appropriate signals to the EVR solenoid so precise control of EGR can occur.

There is a new style DPFE Sensor. This DPFE sensor is plastic and has different values. A picture of the sensor along with it's values is located in Figure 10.

PLASTIC HOUSING (1.0 VOLT OUTPUT)





Differential Pressure			
IN-H20	IN-Hg	kPa	Volts
116	8.56	28.9	4.95
58	4.3	14.4	2.97
0	0	0	1.0

Figure 10

OBD II MONITORING

The DPFE system is used in OBDII systems to monitor the integrity and flow characteristics of the EGR system. The OBDII system will test the integrity of the DPFE sensor, the EVR, EGR flow, the system hoses and the orifice.

There are a number of tests that the EGR system is put through. First the DPFE is checked. It is continuously monitored for opens or shorts. The OBD II system looks for the DPFE signal to exceed the minimum or maximum values. If it finds these values out of specs a DTC P01400 or 1401 will be set.

The EVR is continuously tested for opens or shorts. The OBDII system looks for a circuit voltage that is out of range or inconsistent with the EVR commanded output state. If it finds a fault in the EVR circuit voltage a DTC P1409 will be set.

The OBDII system monitors continuosuly the DPFE signal at idle. Since there should be no EGR flow at idle, the DPFE signal should show a no flow voltage signal. The system compares the Key On Engine Off (KOEO) stored voltage to the DPFE signal at idle. If the signal is not consistent with this value, it may indicate a stuck open EGR valve. The DTC for this condition is a P0402.

The OBDII system also tests the upstream hose once per drive cycle. This test checks for a plugged or disconnected hose. When the vehicle is being accelerated, the EGR valve is momentarily closed. The system then looks for a DPFE voltage value that is inconsistent with a no flow situation. If the DPFE voltage increases or decreases this may indicate a fault with the upstream hose. A DTC P1405 will be set for this condition.

A DTC P1406 will be set if there is a problem with the downstream hose.

The OBD II system also monitors the EGR flow rate. At a steady state condition when the engine load and speed are moderate and the EVR duty cycle is high the DPFE voltage is checked. It then compares this DPFE value to a stored desired DPFE value for those conditions. If the two values are inconsistent, the EGR flow is insufficient (Fig. 11). A DTC P0401 will be set for this condition. This test is also performed during a Key On Engine Running (KOER) test. If it fails during this test a DTC 1408 will be set.

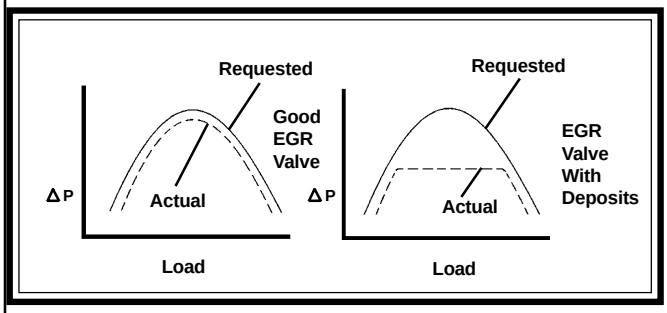


Figure 11

The OBD II system also checks the DPFE signal when the EGR valve is open for a negative voltage. If a negative voltage is detected the hoses may be reversed. If it fails this test a DTC 1403 will be set.