TomcoTechtips™

ISSUE 33

FORD EGR VALVES

The last few issues we have looked at the Ford Sonic style EGR Valve. This issue we will look at the Ford Pressure Feedback Electronic EGR Valve system.

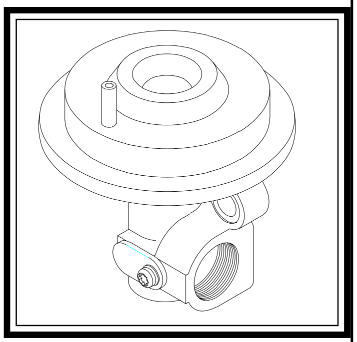


Figure 1

The Ford Pressure Feedback Electronic EGR Valve is a vacuum operated EGR Valve (FIG. 1). This EGR system contains a Pressure Feedback Electronic (PFE) Sensor (Fig. 2) or a Delta/Differential Pressure Feedback Sensor (DPFE)(Fig. 3). The systems with the PFE sensor were used as early as 1986 on some Tempo, Taurus, Bronco and Ranger models. The style with the DFPE sensor started in 1991 with the 4.6L Town Car and are still being used today on many Ford/Lincoln/ Mercury vehicles.

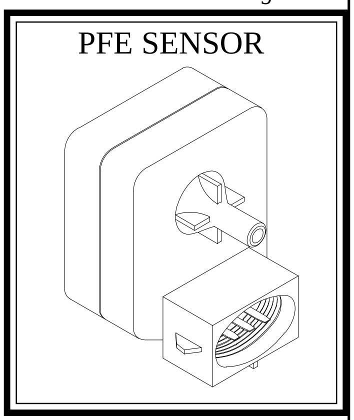


Figure 2

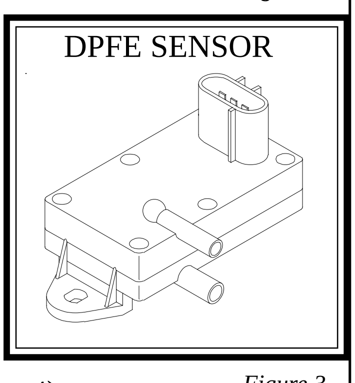


Figure 3

The Pressure Feedback Electronic EGR valve is made up of the base, the pintle assembly and the diaphragm assembly.(Fig. 4).

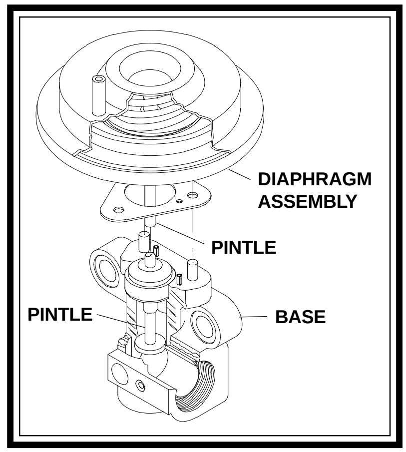


Figure 4

The EGR base assembly consists only of the cast base (Fig. 5). The base contains a threaded inlet hole. There is a tube that comes from the exhaust that screws into this inlet. This tube supplies exhaust gases to the EGR Valve. The base contains the outlet hole for the exhaust gases to pass into the intake passage. The base also contains the bolt holes for mounting the EGR Valve.

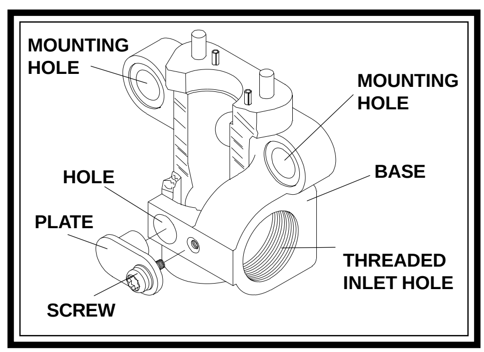


Figure 5

On some applications, the base has a small hole drilled in it at the threaded inlet area. This hole is covered by a plate held onto the base with a small screw (Fig. 6a). On other applications, the plate that covers the hole has a small feed port on it. In these applications, the feed port is the supply for the PFE sensor(Fig. 6b). On later models the EGR base has no hole in it, but is flat across the base (Fig.6c). In the cases where there is no feed port on the EGR valve, the PFE feed port is located on the EGR supply tube.

The pintle assembly consists of the EGR

pintle, EGR pintle shaft, the EGR sealing boss and washer, the sealing gasket and the diaphragm plate (Fig. 7).

The EGR pintle is shaped like a flat button. It sits on a flat seating surface located in the base. The pintle shaft goes through the washer, sealing boss, and sealing gasket and is connected to the diaphragm, by the diaphragm plate.

The sealing boss and washer sit in a cutout in the base. The gasket sits over the top of the base. These parts are used to secure the pintle assembly to the EGR Valve and to seal the exhaust gases in the base and away from the diaphragm.

The diaphragm assembly consists of the upper and lower diaphragm housings, the diaphragm and a diaphragm return spring(Fig. 8). The diaphragm rests in the lower housing. The diaphragm return spring is centered on the diaphragm plate. It is used to assist the pintle to return to a closed position.

The PFE sensor measures exhaust pressure.

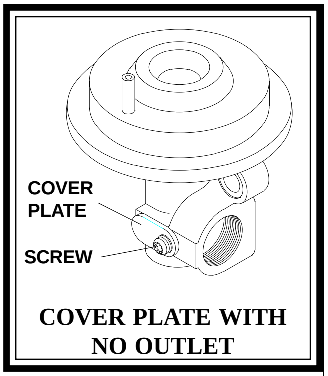


Figure 6a

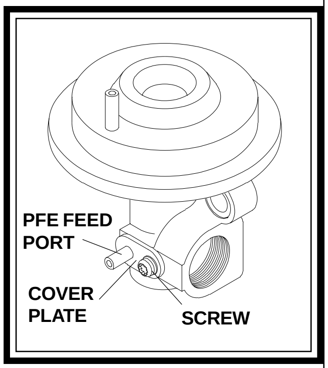


Figure 6b

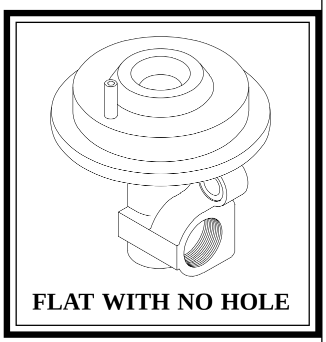


Figure 6c

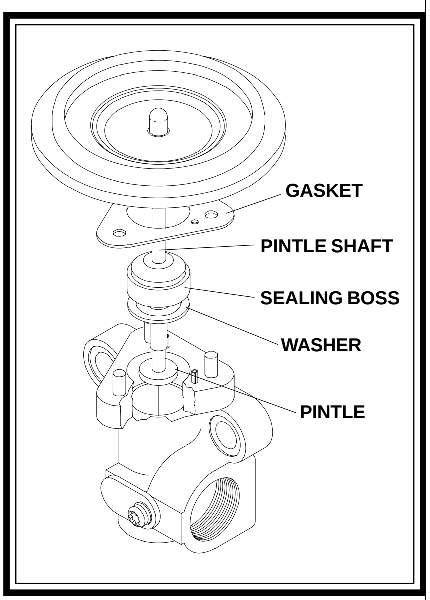


Figure 7

The PFE sensor consists of a plastic housing, the piezo ceramic disc and a sealing plate (Fig. 9). The ceramic disc is a piezo-resistive device. This piezo resistive device is pressure sensitive. This means that when pressure is applied to the device, it changes the resistance in the bridge circuit of the sensor. This change in resistance results in a change in voltage. So when a positive exhaust pressure is applied to the PFE Sensor the voltage increases. When a negative exhaust pressure is applied to the sensor the voltage decreases. The Key On Engine Off (KOEO) voltage is around 3.3 volts. (Figure 10) is a chart showing the PFE voltage range.

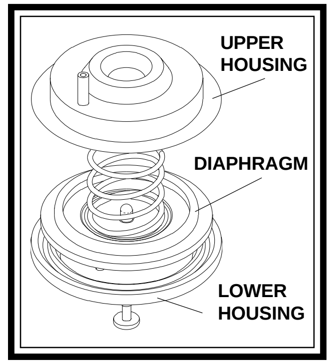


Figure 8

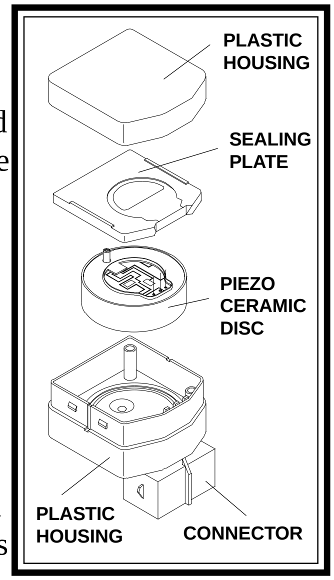


Figure 9

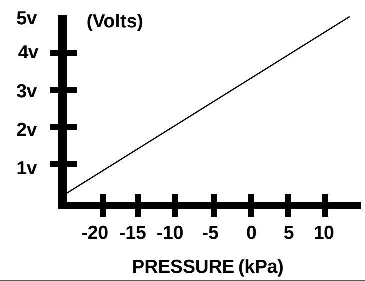
There is a port on the housing of the sensor that is connected to an exhaust port. This exhaust port, as explained earlier, can be on the EGR Valve or it may be located on the exhaust tube that supplies the EGR Valve with exhaust gas (Fig. 11). It is typically connected to the exhaust port by a high temperature silicon hose. These hose come in different lengths and designs depending on the application (Fig. 12). Vacuum hose should never be used as a replacement for this part.

The exhaust passage to the EGR valve contains a metered orifice (Fig. 13). The hose that is connected to the PFE port is located above this metered orifice. When the EGR valve is closed the exhaust pressure above and below the metered orifice is the same. So they both contain the present exhaust pressure.

When the EGR valve opens, the pressure below the orifice reads exhaust pressure, but the pressure above the orifice 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.

This lower pressure puts less pressure on the piezo resistive disc lowering the output voltage. 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 is correct, needs more or less needs EGR recirculation.

PFE SENSOR GRAPH & DATA



PRESSURE / VACUUM Voltage			
PSI	in-Hg	kPa	Volts
1.82	3.70	12.5	4.75
1.36	2.79	9.42	4.38
0.91	1.85	6.25	4.0
0.46	0.94	3.17	3.63
0	0	0	3.25
-2.47	-5.03	-17.0	1.22
-3.63	-7.40	-25.0	0.25

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

Figure 10

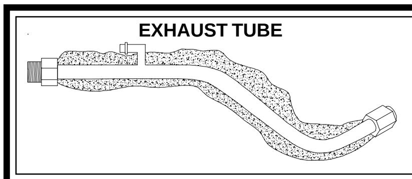


Figure 11

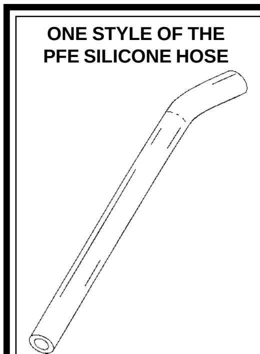


Figure 12

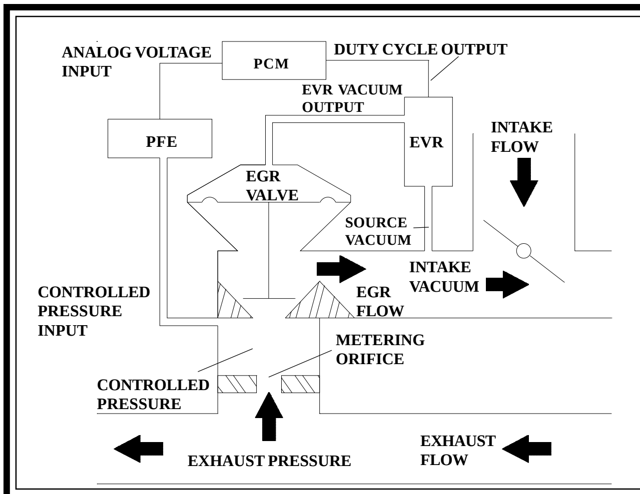


Figure 13

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.

In summary the PFE EGR system is a closed loop system. This system controls EGR flow rate by monitoring the pressure drop across the metered orifice with the PFE Sensor. In this system the EGR valve is more like a pressure regulator rather than a flow metering device.

The PCM monitors the Manifold Absolute Pressure (MAP) Sensor, the Engine Coolant Temperature (ECT) Sensor, the Throttle Position Sensor (TPS) and the PFE 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.

We will continue our discussion of the PFE EGR system next issue.

UNMETERED AIR LEAKS

An unmetered air leak is a source of air coming into the engine that is above the expected amount the PCM has been programmed to respond to. When the vehicle's PCM is programmed, the amount of air that is allowed to bypass the throttle blade and flown through the PCV valve system are calculated and put into the PCM. The PCM then supplies a certain amount of fuel to respond to this constant amount of air and varying load conditions. We can look at this as a calibrated vacuum leak. If the amount of air around the throttle blade or through the PCV valve changes, the PCM's programmed calculations will no longer be correct. This can cause driveability problems.

These unmetered air leaks can also come from cracked or broken vacuum hoses, intake manifold gaskets, EGR gaskets, throttle body gaskets, air induction tube leaks past the Vane Air Flow (VAF) or Mass Air Flow (MAF) sensors, to name just a few. Here are a few examples of some of these that we have found.

A 1992 Ford Escort 1.8L came in with a driveability problem. On acceleration it wold hesitate and/or die. Our first thought, after a test drive, was that it felt like a bad spot in the TPS. There were no codes displayed, so we swept the TPS. The sweep was picture perfect. Fuel pressure and volume checked good as well as the ignition system.

We decided to check for vacuum leaks. While going over the vacuum lines, we also checked the air induction tube. A careful examination of the hose showed some hairline cracks on the underside. On this model the Vane Air Flow Meter (VAF) is located before the air induction. As we torqued the engine these cracks opened up an allowed unmetered air to enter the engine. Since the air did not go through the VAF, the PCM was not aware of it. This caused a lean condition whenever the engine was torqued.

A 1985 Firebird 5.0L came in with a rough idle and a lack of power. As has become our custom during preliminary visual checks, we hooked up the Vacutec to check for vacuum leaks. We noticed smoke coming from the adapter box for the MAF. The seams on the box had split, allowing unmetered air to enter. This vehicle has a MAF located before the adapter box so the unmetered air was causing a lean condition. A new air box and a good cleaning of the throttle bore and IAC passages cured the idle problems.

A 1988 Ranger was also experiencing a rough idle. When we checked for vacuum leaks with the Vacutec we noticed smoke coming from the PCV valve. The PCV valve can contribute as much as 30% of the idle air. If the PCV valve is not the correct one or if it is not functioning correctly, this can cause problems. Looking at the PCV valve closer, showed us that the valve was leaking around the rollover edge where the valve was assembled.

These are just a few of the problems that we have found with unmetered air leaks. One of the tools that has been beneficial to us in diagnosing these problems quickly is the Vacutec. This tool pinpoints the sources of these leaks. Vacuum hoses that are buried and would have required a lot of time to check individually are found quickly with the Vacutec.

The Vacutec can also be used to find EGR valves that are slightly stuck open, exhaust leaks, or leaks in the canister purge system. This is truly a versatile tool. The Vacutec has cut down our diagnostic time and has become one of our preliminary checks.