Tomco Techtips
TM

ISSUE 34

FORD EGR VALVES

Lets review the PFE EGR system and then continue in our discussion. This system contains a sharp edged metering orifice, the Pressure Feedback EGR (PFE) sensor, the Electronic Vacuum Regulator (EVR) and the PFE EGR valve (Fig. 1).

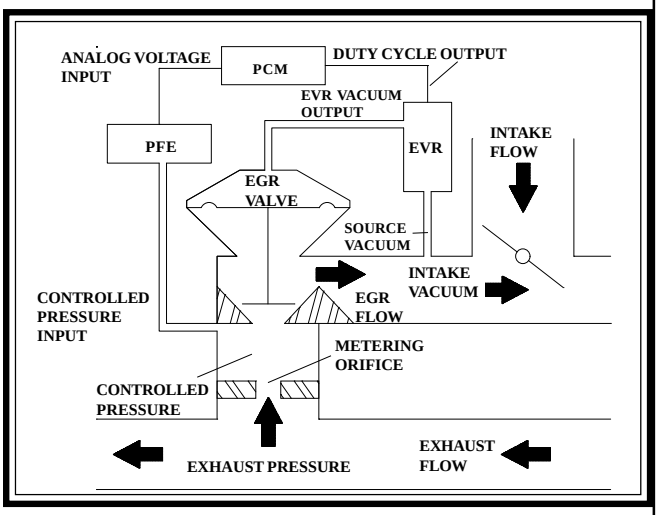
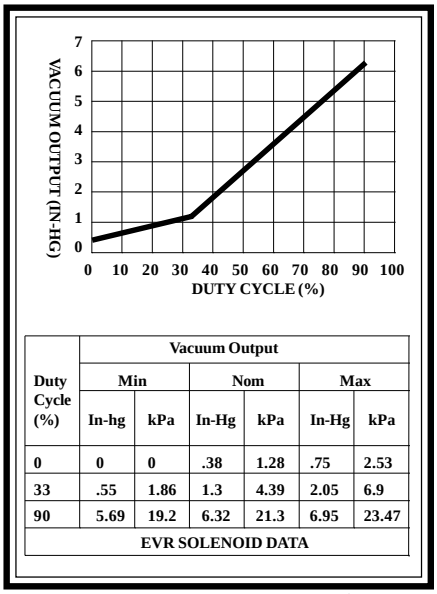


Figure 1

The EGR flow rate is controlled by monitoring the pressure drop across the sharp edged orifice. The amount the EGR valve is open determines the pressure that is in the controlled area above the sharp edged orifice. The PFE sensor is connected to this controlled area by a special hose. The PFE sensor monitors the controlled pressure and converts this pressure into an analog signal. This analog signal is sent to the computer.

The computer uses this signal to control the EGR flow rate. It does this by varying the duty cycle of the EVR. As the duty cycle increases more vacuum is applied to the EGR valve (Fig. 2). This opens the EGR valve more and the controlled pressure above the orifice will change. This results in a change in the pressure to the PFE and therefore a change in the signal to the computer.



Duty Cycle (%)	Vacuum Output					
	Min		Nom		Max	
	In-hg	kPa	In-Hg	kPa	In-Hg	kPa
0	0	0	.38	1.28	.75	2.53
33	.55	1.86	1.3	4.39	2.05	6.9
90	5.69	19.2	6.32	21.3	6.95	23.47
EVR SOLENOID DATA						

Figure 2

The computer reads this value and compares it to the values in its lookup tables. By comparing these values the computer can accurately calculate the EGR flow. The computer can than adjust the flow to match the operating conditions. This makes the PFE EGR system a closed loop system.

TESTING

The tests for the EVR were discussed in detail in Tech Tip 32. Note that in the chart in Figure 2 that a 0% duty cycle allows some vacuum to pass by to the EGR valve. The EGR valve will remain closed however, because it takes about 1.6 inches of vacuum to overcome the spring tension holding the valve closed. So it is not uncommon to feel some vacuum at the EGR valve at an idle.

To functionally test the EGR valve itself, simply apply vacuum to the valve and look for a corresponding rpm drop. There is a chart in Figure 3 that shows the corresponding vacuum to the EGR flow rate. Notice that it only takes approximately 5 inches of vacuum to completely open the valve. This should be taken into consideration when applying vacuum to the EGR valve for a functional test.

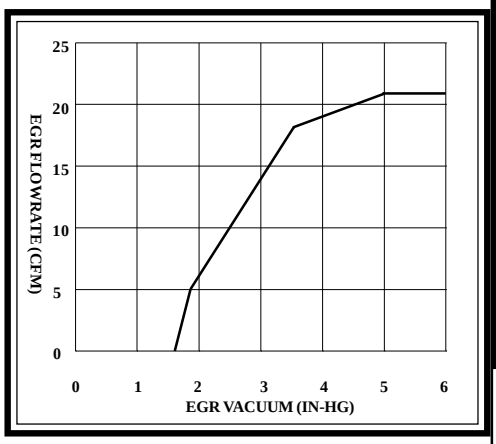


Figure 3

The PFE hose should be examined carefully. We have seen them with pinhole leaks. This causes the exhaust pressure to bleed off giving an inaccurate reading to the PFE sensor. They can also deteriorate because of the corrosive exhaust gases they carry. This weakens the rubber and may cause porosity or cracks. A quick check is to hook a vacuum pump to one side and plug the other side to see if it can hold vacuum.

There are a few tests to perform on the PFE itself. Back probe into the PFE signal wire (Fig. 4) and connect a DVOM set on the volts scale. Turn the Key On Engine Off (KOEO) and read the voltage. It should read 3.25+/- 0.25 volts. If the voltage is off from the spec. the PFE needs to be replaced.

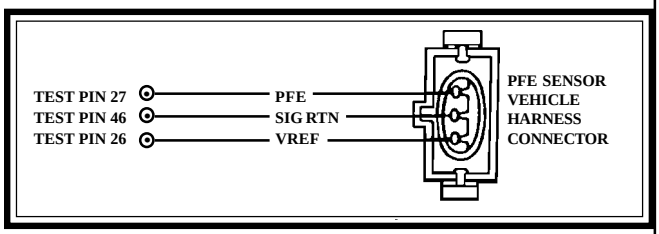


Figure 4

Next apply no more than 7 inches of vacuum to the PFE (Fig. 5). It should hold this vacuum for at least a minute. If the sensor does not hold vacuum it needs to be replaced. If the vacuum test is okay, test the PFE to the specs. shown on the chart in Figure 6. You will need to apply pressure as well as vacuum to the PFE. A throughly cleaned and converted radiator pressure tester works well for this test. Compare the values you receive to the values in the chart. If they are not in spec., replace the PFE.

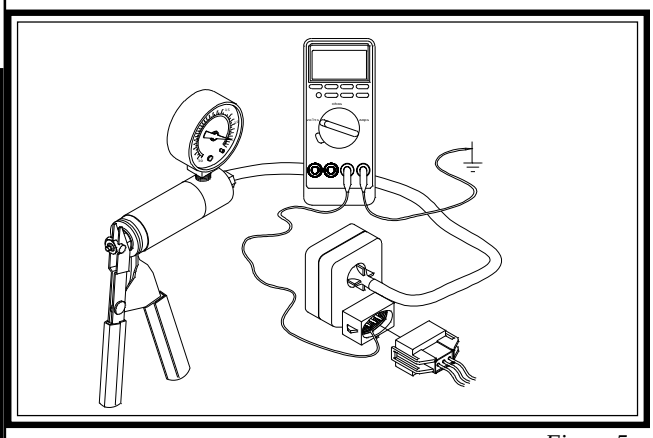


Figure 5

PRESSURE / VACUUM		Voltage
PSI	In-Hg	Volts
1.82	3.70	4.75
1.36	2.79	4.38
0.91	1.85	4.0
0.46	0.94	3.63
0	0	3.25
-2.47	-5.03	1.22
-3.63	-7.40	0.25

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

Figure 6

The PFE can also have water in it. This comes from the moisture in the exhaust and can short the PFE. Ford has a Technical Service Bulletin (TSB 88-26-6) on this stating its not necessary to replace the sensor just because it has water in it. But from experience, it doesn't take long for the water to cause a problem.

If an internal engine coolant leak occurs this will expel coolant into the exhaust. Some of this coolant in the exhaust may travel into the PFE. This can cause the PFE to short. If the PFE does short, it will pull down the VREF signal. This VREF signal also supplies the MAP and TPS (Fig. 7). Pulling down the VREF signal on these sensors may result in a no start condition.

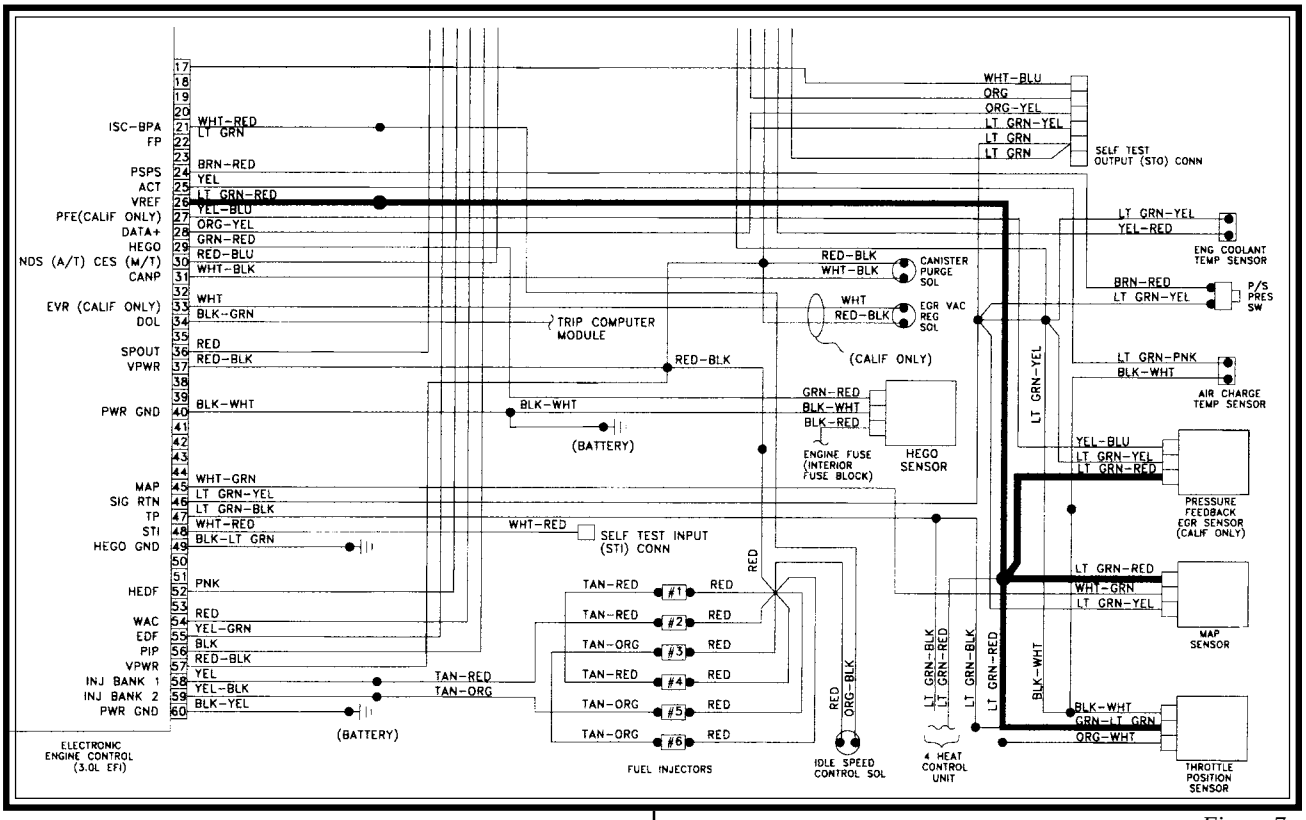


Figure 7

CODES

The code descriptions below are general descriptions to help you understand the system. Look up your code definitions in the appropriate service manual when diagnosing a vehicle.

DTC 31/327 typically means that the PFE signal is less than the self test minimum voltage. This can be due to a bad PFE sensor, a bad PFE hose, improper reference voltage, a bad connection or a bad computer.

An important thing to remember is the sharp edged orifice in this system. This or other passages can clog causing codes and no EGR flow. We have seen a number of such cases, so remember to check for restrictions.

DTC 32/326 typically means that the EGR valve is not fully seated. This can be due to a bad EGR valve, vacuum trapped in the EGR hose, a clogged EVR filter, or a bad EVR solenoid. It is also important to note that if you have an exhaust ventilation system hooked up, that this can also cause an inaccurate reading. Try disconnecting the system and retesting.

DTC 34/336 and 35/337 mean that the PFE voltage is too high. This could be the result of a clogged exhaust or the PFE sensor itself.

ELECTRONICS 101

In Tech Tip 32 we showed the pattern in Figure 8 of the EVR cycling on and off. This signal was taken from a 1992 Ford Taurus with a 3.0L. Some of you have noticed a different style pattern than that which was shown. The pattern shown in Figure 9 is another example of how this pattern might look.

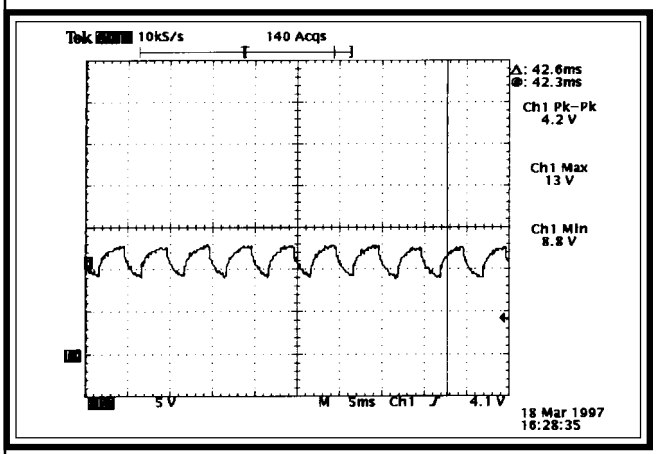


Figure 8

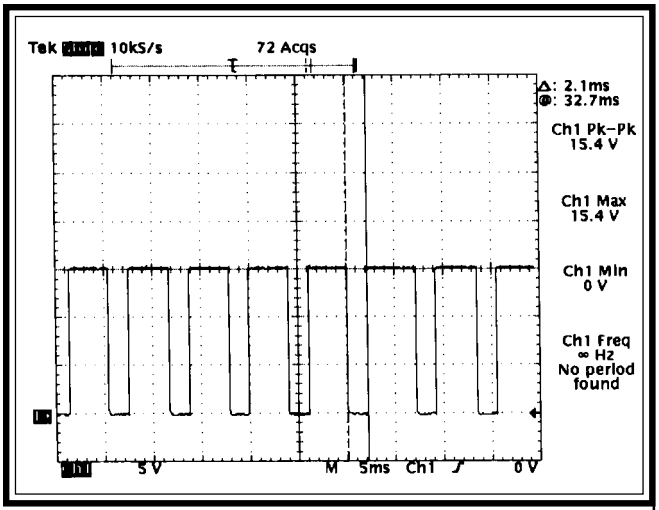


Figure 9

This pattern was taken from a 1991 Ford Ranger 2.3L dual plug engine. As you can see in the second pattern, the computer pulls the voltage all the way to ground when it cycles the EVR on, instead of just part of the way in the first pattern. The same diagnostic principles apply to this solenoid pattern that we looked at in the last pattern.

The scope voltage is set at 5 volts per division and the time base at 5 milliseconds per division. The maximum high of this signal is 15.4 volts while the low voltage is approximately 0.0 volts. If you look at the on-time of the signal (where it drops to a low voltage) it appears to be about 2.1 milliseconds. The total time for one cycle is 6 milliseconds. To find the percentage of on-time divide the on-time by the time for one cycle. This will give us the percentage of on time which calculates to be 35% (2.1 ÷ 6 = .35). This is very close to the 33% duty cycle we have seen on the Scanner.

NOTES:

There are a number of TSBs for the PFE sensor. It would be a good idea to check out your vehicle to see if one of these TSBs apply.

We have seen three different colored sensors; all black, gray and black and all gray. These are all interchangeable according to Ford. The latest and greatest version is the all gray one.