

Tomco Techtips

TM

ISSUE 27

Negative Backpressure EGR Valves

The negative backpressure EGR valve is similar in design to the positive backpressure EGR valve. It contains many of the same parts and has a control built into it, but it works in sort of a reverse manner. Lets take a look at the mechanics and function of the negative backpressure valve.

The negative backpressure EGR valve contains two diaphragms inside the canister (Fig.1). This may be one large diaphragm sandwiched between two plates to make two diaphragms, or two separate diaphragms. We will call the top diaphragm the "upper diaphragm" and the bottom one the "lower diaphragm." There is a heavy spring located on top of the upper diaphragm. There is a hole in the lower diaphragm that is open to the atmosphere. There is also a hole in the center of the upper diaphragm. All of this is the same as the positive backpressure valve.

In the negative backpressure valve, however, there is a spring located below the lower diaphragm. This is different than the positive backpressure valve, where the spring was located between the two diaphragms. Since the lower spring is located below the lower diaphragm, the spring pushes the lower diaphragm upward, sealing the center hole.

The sealed center hole creates a sealed vacuum chamber in the upper portion of the valve (Fig. 2). This means when vacuum is applied to the vacuum port the EGR valve will open. So how does the control section work? To find this out once again we have to look at the lower half of the valve.

The lower half of the valve contains a pintle and a shaft that is connected to the plate below

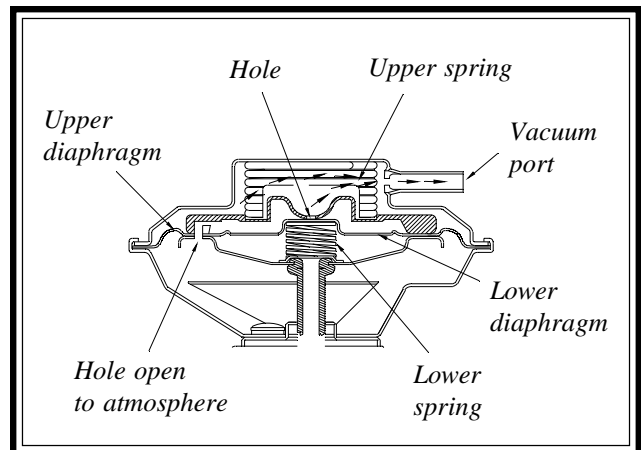


Figure 1

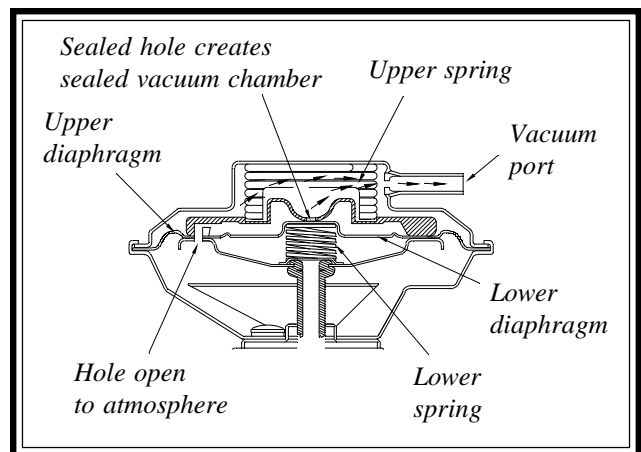


Figure 2

the lower diaphragm. The pintle has two holes drilled in its tip. The pintle shaft is hollow up to the lower diaphragm (Fig. 3). This is the same as the positive backpressure valve. Now lets see what happens in the lower half of the negative backpressure EGR valve during engine operation.

As stated earlier, when vacuum is applied to the negative backpressure EGR valve, it opens. Once the pintle is lifted it is affected by

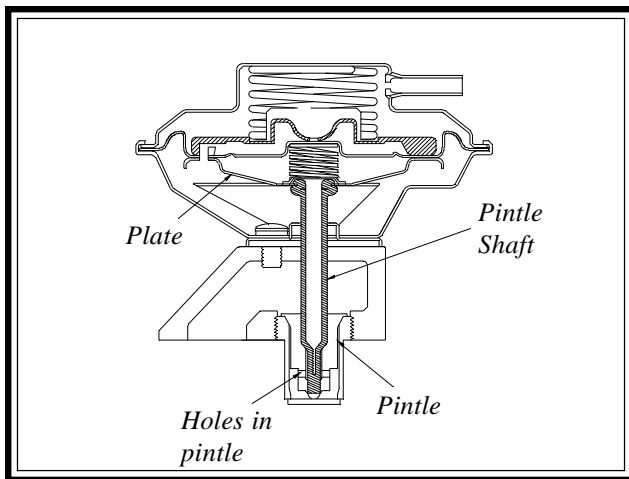


Figure 3

the negative pressure of the intake manifold. This negative pressure travels up the pintle shaft and begins to pull down on the lower diaphragm (Fig. 4). When the negative pressure overcomes the tension of the lower spring, the lower diaphragm moves downward. This opens the center hole creating a path to the hole which is open to the atmosphere (Fig. 5). This results in a break of the vacuum seal. Since there is no longer a sealed chamber, the upper diaphragm falls. This causes the pintle to lower on its seat, thus shutting off EGR flow.

Now that the pintle is seated, the pintle is not being affected by the negative pressure of the intake manifold. This allows the spring below the lower diaphragm to push the lower diaphragm upwards and seal off the center hole. Once again the vacuum chamber is sealed and when vacuum is applied to the vacuum port, the pintle will begin to lift off its seat. This starts the process again.

The cycle is repeated over and over as the valve opens and allows the pintle to be subjected to manifold vacuum. This up and down movement of the EGR valve is known as dithering.

As stated last issue the backpressure method was used because it was a more effective way of correlating EGR operation with load.

EGR PROBLEMS

One problem that can occur with these valves is carbon clogging. The small holes in the pintle tip can become clogged very easily. Once the pintle is clogged, the lower diaphragm can no longer operate. This may result in an

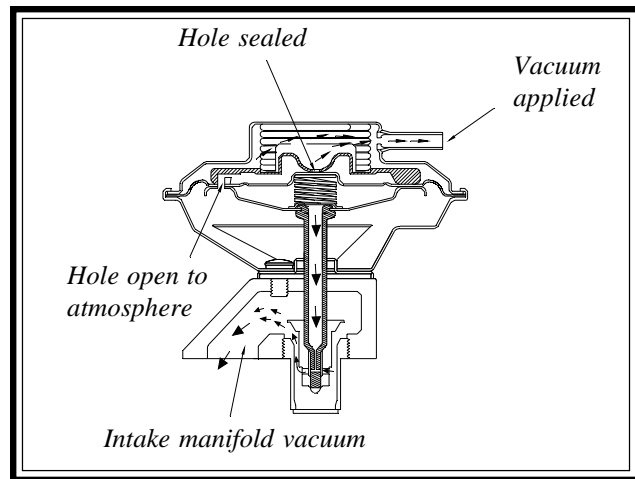


Figure 4

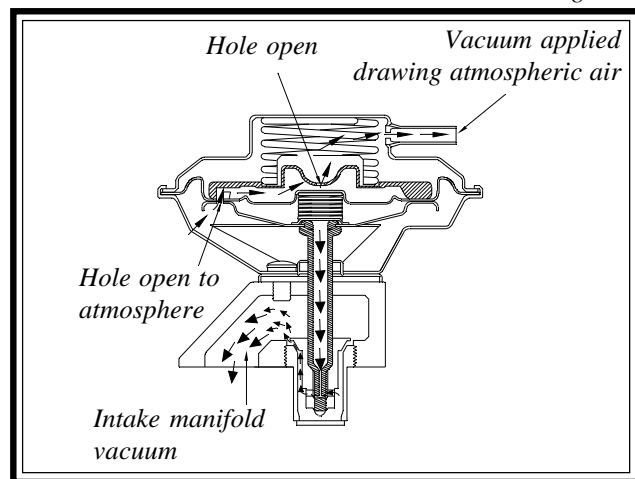


Figure 5

EGR that opens but may have difficulty in closing.

The spring below the lower diaphragm can become weak. This may allow the lower diaphragm not to seal to the upper diaphragm correctly. This will cause the EGR not to open. Or the lower spring may not have enough tension to keep the seal long enough. In this case the EGR may open, but as soon as it opens the manifold vacuum overcomes the weak spring and the valve closes. Replacing the valve is the only solution to these problems.

Remember that the negative backpressure EGR valve opens when vacuum is applied to the vacuum port. But to get the valve to close, the lower portion of the valve must be operating properly. Once again a proper understanding of how these valves function is essential in repairing Nox failures.

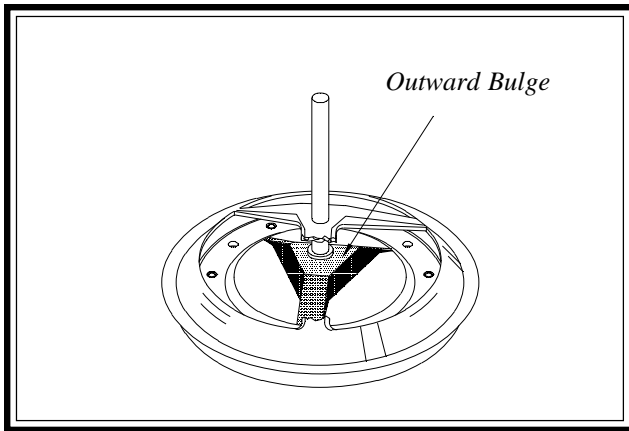


Figure 6

Now that we have looked at both styles of valves, how do you tell the difference between a negative and a positive backpressure EGR Valve? In most cases, the valves will have an indication of which type it is after the OEM part number. This will be a "P" for positive backpressure valves and an "N" for negative backpressure valves.

In some cases the designation may not be

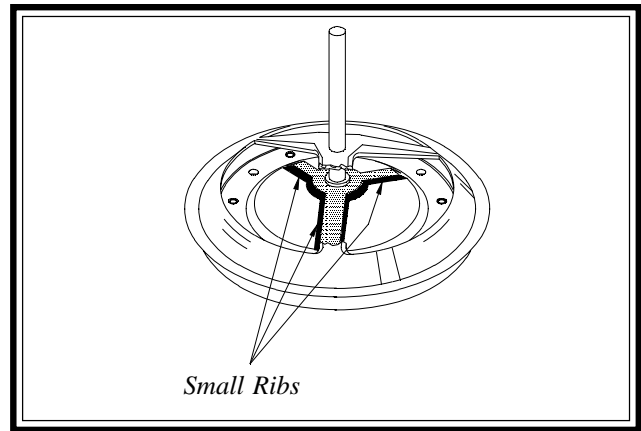


Figure 7

readable. To determine which style valve you have in this case you will need to look at the underside of the valve. Look at the steel silver plate under the diaphragm. If the center of the plate has a large outward bulge, it is a negative backpressure valve (Fig. 6). If the steel silver plate has small ribs, it is a positive backpressure EGR valve (Fig. 7).

Electronics 101: Voltage Drops

We have looked at a number of the automotive electrical components and their applications in issues 13 to 26. Now let's turn our attention to a critical area of electrical diagnosis in automotive applications called *voltage drops*.

A voltage drop is the measurement of electrical pressure that is lost or dropped across a load or a resistance in a circuit. This means every time our voltage is sent across a resistance or load some of it will be used up.

We should remember from our earlier electronics lessons our formula for Ohms Law (Voltage = Current x Resistance). Using this formula we can calculate the voltage drops in a circuit.

In Figure 8 we have a simple series circuit. We know that our voltage = 12 volts. Our total resistance is the sum of the two resistances of the lights, 4 ohms + 2 ohms which equals 6 ohms. If we calculate for amperage in the circuit, we come up with 2 amps (12 volts = Amperage x 6 ohms, therefore Amperage = 2). To calculate the voltage drop across each lamp we simply use Ohms Law again.

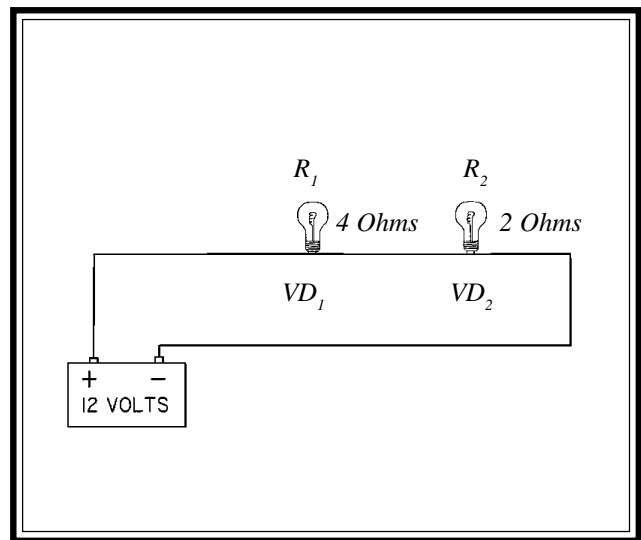


Figure 8

$$V \text{ drop \#1} = 4 \text{ ohms} \times 2 \text{ amps} = 8 \text{ volts.}$$

$$V \text{ drop \#2} = 2 \text{ ohms} \times 2 \text{ amps} = 4 \text{ volts.}$$

This gives us a total voltage drop of 12 volts (V drop #1 + V drop #2, or 8 volts + 4 volts). As you may remember, in a series circuit the sum of the voltage drops has to equal the total circuit voltage. This is true of the circuit we

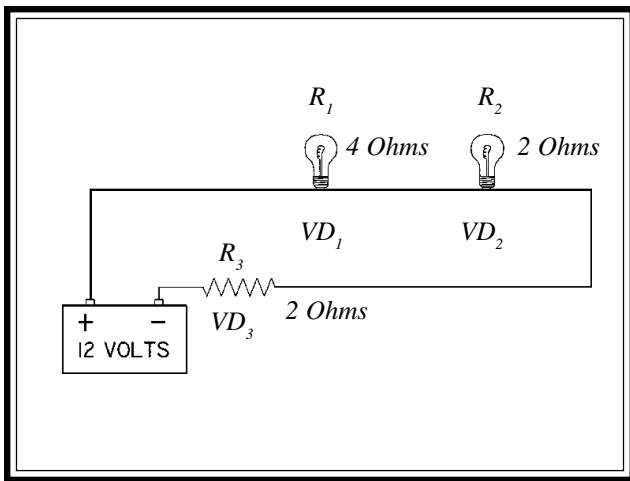


Figure 9

have just looked at.

Now lets take a look at what happens when there is some resistance built up in the circuit. Lets say that there are two ohms of resistance at the ground, as may be found with a corroded terminal. We will represent this as a two-ohm resistor at the battery connection (Fig 9). There are now three areas that will cause voltage to drop.

We know that the circuit voltage is still 12 volts. The total resistance however has changed to 8 ohms ($R_1 + R_2 + R_3$, or 4 ohms + 2 ohms + 2 ohms). This will also change the current flow or amperage. An amperage draw in this configuration will be 1.5 amps (12 volts = Amperage x 8, therefore Amperage = 1.5 amps). So now instead of 2 amps of current there are only 1.5 amps of current available to drive the circuit. This is going to decrease current flow through the lights, causing the lights to be dim.

The voltage drops at the two lights will also be different.

$$V \text{ drop \#1} = 4 \text{ ohms} \times 1.5 \text{ amps} = 6 \text{ volts}$$

$$V \text{ drop \#2} = 2 \text{ ohms} \times 1.5 \text{ amps} = 3 \text{ volts}$$

As you can see the total voltage drop of the two lights now only equals 9 volts (V drop #1 + V drop #2, or 6 volts + 3 volts) . The lights in this case have not used up the total source voltage, but there is also a third voltage drop.

$$V \text{ drop \#3} = 2 \text{ ohms} \times 1.5 \text{ amps,}$$

$$\text{so } V \text{ drop \#3} = 3 \text{ volts.}$$

This now gives us the correct total voltage drop (V drop #1 + V drop #2, or 6 volts + 3 volts)

This third voltage drop has reduced the amount of current and voltage available to the two lights. Since there is less voltage and current flow the bulbs will not be as bright. This is because there is another resistance at the battery that is causing a voltage drop of 3 volts.

Every electrical device requires a certain amount of voltage to work. If there is resistance in the circuit, this voltage may be decreased to the point where the electrical device does not operate properly. This is especially true for computer circuits, where a voltage drop as shown above may cause the computer to get a bad sensor reading or an actuator not to respond correctly.

Although you may not use the Ohms Law formula to find out how much voltage is being dropped, you can use your DVOM to read these voltage drops. This will be helpful in tracing circuit problems. Next issue we will take a look at how to do some specific voltage drop tests.