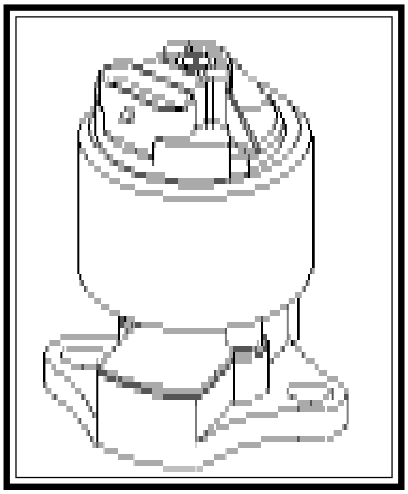
TomcoTechtips™

ISSUE 30

LINEAR EGR VALVES

The Linear EGR Valve is a fully electronic operated EGR Valve. This is the first infinitely variable computer controlled EGR valve (Fig. 1).



"Linear EGR Valve" *Figure 1*

This EGR valve has been used as early as 1992 on the GM L and M series vans and the S and T series trucks. It is used on vehicles with the 4.3L V6 L35 Vortec engine. The Linear EGR valve is also used later on the Cadillac 4.6L VIN 9, E, K, and V car lines.

This valve consists of a number of sub assemblies. These sub assemblies are the base assembly, the solenoid assembly, and the armature assembly (Fig. 2).

The EGR base assembly contains the base, the base plate and a gasket (Fig. 3). The base has a large orifice hole and a small orifice hole. The larger orifice allows the exhaust gas to enter the base of the EGR valve. The smaller orifice allows the exhaust gas to exit the valve into the intake manifold. The base plate and gasket help seal the exhaust gases into the base of the EGR valve. The base also contains the two mounting holes for the EGR valve.

The solenoid assembly consists of a bobbin and coil that is sealed and joined with an EGR pintle position sensor (PPS). This makes the PPS an integral part of the solenoid assembly. The top of the assembly contains the five pin electrical connector for the EGR valve (Fig. 4).

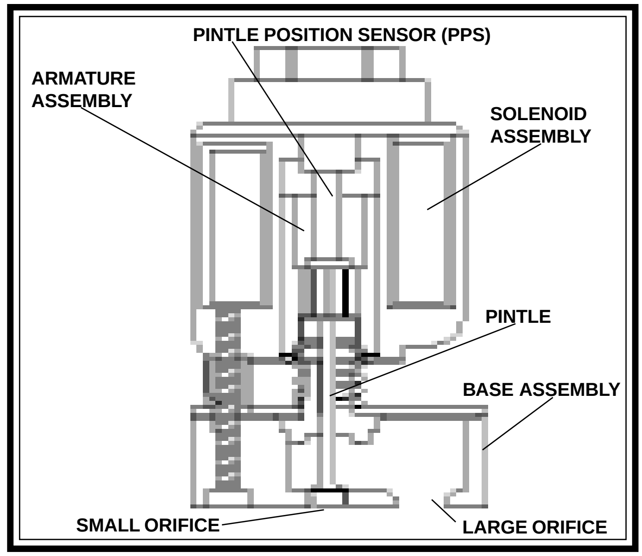


Figure 2

The armature assembly contains the armature and the pintle (Fig. 5). The armature is located inside of the solenoid. The pintle goes through a locating and sealing washer, through the EGR base gasket and baseplate, through a return spring and cap and through the armature where it is secured. The lower end of the pintle is located in the small orifice of the base.

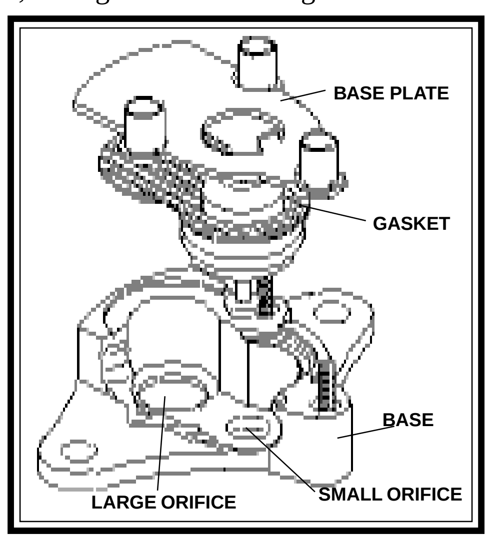


Figure 3

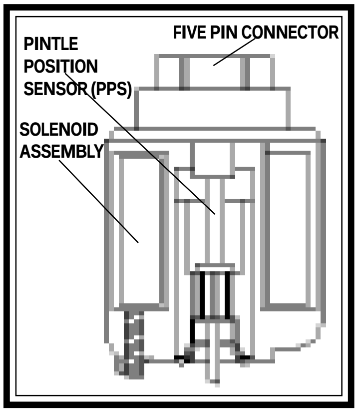


Figure 4

The opening and closing of the pintle is controlled by the solenoid via the Powertrain Control Module (PCM). The solenoid has a power feed pin "E", which comes from the ignition switch through a fuse. This ignition feed supplies battery voltage to the solenoid (Fig. 6).

The solenoid is grounded separately inside the PCM by a Quad driver through pin "A". When the PCM senses a need for EGR flow it sends a variable current pulse width modulated signal to the EGR solenoid through the driver. This causes an electro-magnetic field to be induced, which causes the arma-ture assembly to be raised, lifting the pintle off its seat. Exhaust gas then flows through the valve. This type of linear solenoid provides a fast response and high reliability.

As stated earlier, this is the first infinitely variable computer controlled EGR valve. This means that the Linear EGR valve can allow exhaust gas to flow from 0% (fully closed) to 100% (fully open). In the digital EGR valve and the other valves we have studied, one or more sized orifices were opened. This resulted in a fixed amount of exhaust gas (regulated by the size of the orifice) to be delivered. With the Linear EGR valve, the pintle height can be varied to achieve an infinite number of variable flows. This gives the valve more precise control over EGR flow, therefore improved driveability and lower emissions.

The PCM monitors the Manifold Absolute Pressure (MAP) Sensor, the Engine Coolant Temperature (ECT) Sensor, the Throttle Position Sensor (TPS), RPM, the Vehicle Speed Sensor(VSS) and the EGR Pintle Position Sensor (PPS) to determine the correct amount of EGR flow required. The PCM then sends the appropriate signals to the EGR valve so precise control of EGR can occur.

The tip of the Pintle Position Sensor (PPS) rests on the upper tip of the pintle. As the armature and pintle move upward, so does the pintle shaft of the PPS. As the PPS changes its position, it signals the PCM how far the EGR valve is open. This serves as a check to make sure the EGR is opening the correct amount the PCM has requested.

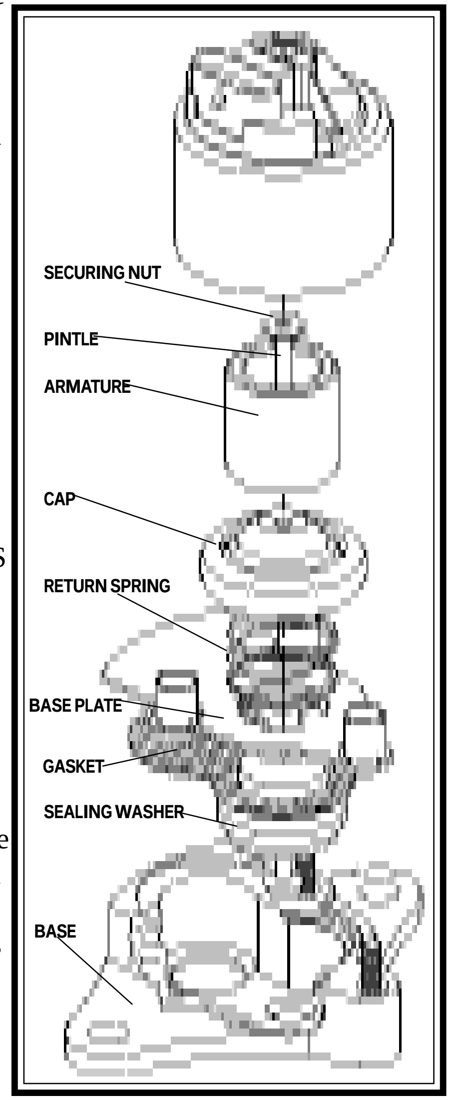


Figure 5

The PCM constantly monitors the PPS for its actual position. If the actual position does not match the desired position the computer changes the pulse width modulated signal until the actual position is the same as the desired position. This makes the system a closed

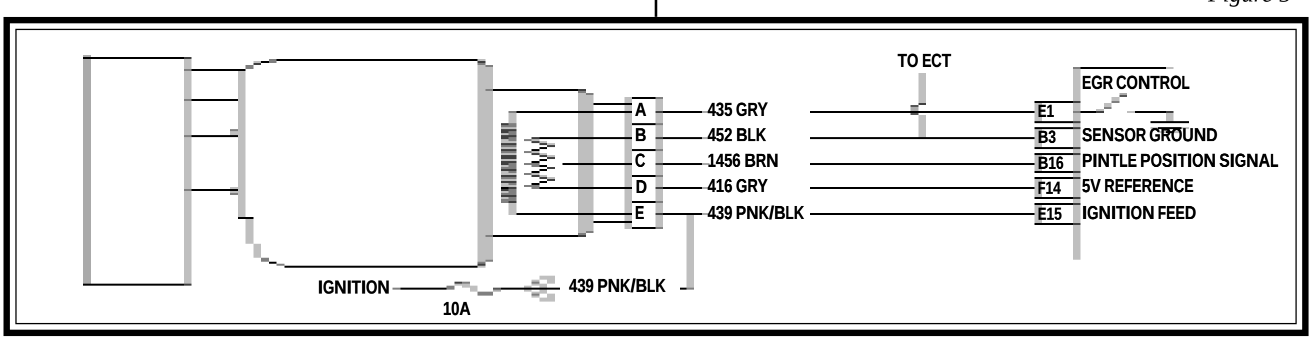


Figure 6

loop allowing for greater control of flow accuracy.

The PPS occupies three pins in the connector (Fig 6). One pin “D” supplies five volts from the computer. Another pin “B” is the ground for the sensor, and the third pin “C” is the signal back to the PCM. This position sensor functions the same as most position sensors. The five volt reference is sent across a resistive material. As the pintle on the position sensor moves up, the five volts travel across less of the resistive material. This allows more of the voltage to return to the computer. As the pintle moves down, the five volts travel across more of the resistive material so less of the voltage returns to the PCM.

OPERATING PARAMETERS

The PCM will not operate the EGR valve unless it sees a coolant temperature sensor reading above 25°C (77°F) and a TPS position value above 5%. It will also shut down EGR flow under the following conditions:

- Low VSS signal
- High TPS values
- Power enrichment
- Low RPM

SOLENOID TESTING

A resistance check can be performed on the EGR solenoid:

Check the resistance between pins “A” and “E”. Resistance should be between 9.5 and 10.5 ohms on some models and 7.8 to 8.6 ohms on others. You will have to check your service manual for the correct specifications for your vehicle.

Remember that a resistance test is just a static test. A current draw test would be the best way to find a fault in the solenoid.

FUNCTIONAL TEST

To functionally test the EGR valve you can backprobe into the ground of the solenoid. Then with the engine running, ground the solenoid manually and monitor the RPM drop. Be careful not to backprobe into the power feed. Grounding this wire will short out the fuse.

PINTLE POSITION SENSOR TESTS

There are a few ways to test the position sensor. One way is to check the sensors resistance. To do this, disconnect the electrical connector. Then connect an analog ohmmeter across the sensor ground pin “B” and the sensor signal pin “C” of the valve. Connect a jumper wire from system voltage to pin “E” of the EGR valve. Connect another jumper wire to pin “A” of the EGR valve. Momentarily ground this jumper wire while watching the analog meter. The sweep should be smooth with no sudden needle dips ranging from 700 to 4,000 ohms (check the manual for specifications specific to your vehicle). Release the ground and carefully watch the needle sweep for any problems.

CAUTION: Do not keep the solenoid energized for longer than five seconds to prevent damage to the solenoid.

A better way to test the sensor would be to leave the sensor connected. Then hook up a DVOM with a bar graph scale to the signal wire and ground. Turn the KOEO. Momentarily ground and release pin "A" of the EGR Valve. Watch for any discrepancies in the bar graph or voltage readings as the EGR valve is moving up and down. This test will put the sensor under a load making it easier to find faults.

Using a labscope would be the best way to find those intermittent glitches. This test would be conducted in the same manner as the DVOM test, looking for glitches in the pattern as the EGR valve is energized and de-energized.

CODES

The PCM checks the EGR to make sure it is functioning correctly. Since there are different methods for each specific vehicle we will give a generic description of the test.

The PCM de-energizes the EGR solenoid under specific conditions, thereby shutting off the EGR flow. Some of these conditions are a certain TPS angle, a steady throttle, above 32 mph, a specific MAP sensor range, and a certain ECT value; just to name a few. The PCM monitors the integrator (short term fuel trim in OBDII terms) during the test. Since the EGR is shut down, the integrator counts should rise, due to the leaner air/fuel mixture. Depending on the vehicle, this test may have to be run several times before a code will be set. If the PCM does not see the change it expects to see after these tests are completed, it will set a Diagnostic Trouble Code (DTC).

The PCM will also set a DTC if the difference between the actual EGR PPS signal and the desired EGR PPS signal is greater than 3% for longer than 200 milliseconds.

HELPFUL TIPS

Some of the Linear EGR valves have tubes or passages that supply the exhaust gas to the valve. These tubes or passages can become clogged with carbon deposits, resulting in poor EGR flow. Remember to check these tubes and passages before you replace the EGR valve.

Another tip from Motor Magazine was listed in their Service Slants. In case you didn't read it here's the gist of it. On 4.3L V6 VIN W and California Emissions VIN Z and 7.4L V8 VIN N found in 1992-1995 compact and full size vans, pick-ups and sport/utility vehicles: Tighten the mounting bolts to 89 inch pounds, then to 18 foot pounds.

ELECTRONICS 101

To perform a current draw test, follow the procedures below. Disconnect the electrical connector. Connect the positive lead of an ampmeter in series with the power lead pin "E" of the connector (Fig. 7). Connect a jumper to the negative lead of the ampmeter and then to pin "E" of the EGR valve. Connect a jumper wire to pin "A" of the EGR valve. Turn the key on engine off (KOEO). Then ground the jumper wire from pin "A", while watching the ampmeter. With the battery voltage not exceeding 12.6 volts, the total current draw should not exceed 1.4 amps on the 9.5 to 10.5 resistance solenoids. With the battery voltage not exceeding 12.6 volts, the total current draw should not exceed 1.7 amps on the 7.8 to 8.6 resistance solenoids.

CAUTION: Do not keep the solenoid energized for longer than five seconds to prevent damage to the solenoid.

How do you determine what the maximum current draw should be? Once again we can use Ohms law to figure this out. Lets look at an EGR solenoid whose resistance is between 9.5 to 10.5 ohms. The system voltage would be battery voltage, lets say 12.6 volts. Using Ohms law (Voltage = Current × Resistance), 12.6 volts divided by 9.5 ohms would give us 1.33 amps.

If your battery voltage was higher - 13.2 volts, the current draw would be higher (13.2 volts divided by 9.5 ohms = 1.39 amps). If the resistance was higher, lets say 10 ohms, the current draw would be lower (12.6 divided by 10 ohms = 1.26 amps).

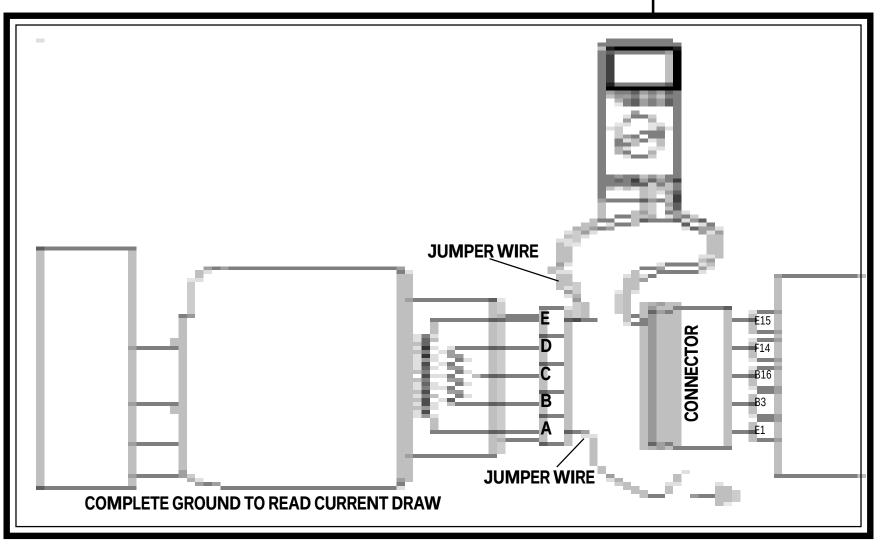


Figure 7

So by plugging in the values you are working with, you can determine what current draw would be excessive. If the amp reading is excessive, this would mean that the solenoid is shorting under load, even if the static resistance check shows okay. The true test of the solenoid is how it functions under load. If the solenoid is shorted, the only option is to replace the valve.