These programs use dynamometers to check vehicle emissions under simulated driving conditions. So knowing how to diagnose the EGR system when a NOX failure occurs should reduce the unnecessary replacement of EGR valves.

First, a little background: the basic concept of EGR hasn't changed since it was introduced back in 1973 to meet federal emission regulations. An EGR valve is used to open a small passageway that connects the intake and exhaust manifolds. Intake vacuum then siphons some exhaust back into the engine to dilute the air/fuel mixture. This lowers combustion temperatures to reduce the formation of NOX. EGR also helps the engine resist detonation under load. (A typical earlier-style vacuum EGR valve is shown in Figure A.)

When the EGR valve opens, it has much the same effect on engine performance as a vacuum leak (idle roughness, lean misfire and hesitation). For this reason, the EGR valve should not open until the engine is warm and above idle speed. On earlier vehicles with vacuum-operated EGR valves, a ported vacuum switch prevents vacuum from reaching the EGR valve until the engine is warm.

In the 1980's, computer-controlled solenoids began to replace vacuum-actuated EGR valves because they can respond much faster to changes in operating conditions and work independent of intake vacuum. Several different types are used:

- **Single-stage** (A single solenoid is used to open the exhaust passageway valve). The computer monitors various sensor inputs to determine when EGR is needed, then cycles the EGR valve solenoid on and off to control the amount of exhaust gas recirculation.
- **Multi-stage** (Used on various late-model General Motors applications, this type has two or three solenoids that open separate exhaust passageway valves. See Figure B.) With this setup, the computer uses a step strategy to increase EGR in stages. If only a little EGR is needed, one solenoid is energized. As more EGR is needed, the second and third solenoids are energized. On the three-solenoid applications, up to seven different combinations may be used to control EGR flow.
- **Linear** (Uses a small stepper motor instead of solenoids or a vacuum diaphragm to open the exhaust passageway valve). A linear EGR valve works much like an idle speed control motor in that it moves in small increments. This allows the recirculation of exhaust gas to be increased or decreased with a higher degree of precision.

In the 1990's, electronic (digital) EGR valves began to replace vacuum-actuated EGR valves because they can respond much faster to changes in operating conditions and work independent of intake vacuum. Several different types are used:

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Q: “We have a super charged 1995 Pontiac Bonneville 3.8 VIN 1 that has a surge at idle with codes P0131 and P0171. We have checked the O2 sensor, fuel pressure, timing, and vacuum hoses and connections for leaks. The ISC counts are low but seem to be okay at around 13 or 14. This car does this all the time and temperature seems to have no effect.”

Stevens Shell, Elizabeth, NJ

With your scan tool connected, if the ISC counts stay less than 15, and the long/short-term fuel trim remains greater than 140, you should expect an air leak. One place you didn’t mention checking was the supercharger outlet gasket. Check for leaks, especially around the pulley end, as this is a common area for leakage to occur.

Q: “I have a 1996 Buick Skylark with the 2.4L SFI that has a problem with a rough idle, repetitive stalling and hard starting. This problem is very intermittent and only seems to happen after the car has been sitting for a while, like overnight, and seems worse in colder weather. Scan tool data seems to check out OK, but sometimes there are misfire codes (P0300 through P0304). Any suggestions?”

Bill Renton, Billings, MT

If you haven’t checked the oil pressure, you should do so, as there have been reports of the type of problem you are having due to excessive oil pressure caused by a sticking relief valve. This would cause the lifters to raise the valves off of their seats, resulting in a loss of compression and engine misfire and/or stalling on initial start-up. To check this, install an oil-pressure gauge that can read at least 150 psi in an oil pressure port and check the oil pressure at 3000 rpm. The oil pressure should not exceed 100 psi even in very cold operating conditions and should not exceed 85 psi with the engine warmed up to operating temperature. If the oil pressure exceeds these limits, you will have to replace the oil pump cover that has an improved pressure relief valve.

Q: “I am working on a 1997 Chevy Astro with the 4.3 VIN W engine. This van has an intermittent stalling condition and lousy performance and has a DTC P0300. Distributor cap, rotor, coil, plugs, plug wires, engine vacuum, compression, fuel pressure are all good. Cam and crank position sensor signals are consistent. The primary wiring and connectors have all been checked as well. The engine runs good at idle and in gear most of the time, but when driven, performance is poor. Any ideas?”

Brian Williams, St. Louis, MO

Check the ignition coil wires where they attach to the primary terminals. These wires can get brittle near the connector and the wire strands can break inside of the insulation and not be easily detected. This can cause reduced primary current flow, resulting in engine misfire under load. Eventually, all of the strands can break resulting in a no-start condition.

Q: “We are working on a 1995 Chrysler Concorde with a 3.3L MFI. The problem we are trying to fix is an extremely rich mixture. You can smell the gas in the exhaust. No codes. Injection goes from 5.9 to 6.2 ms right at start-up and doesn’t change with propane or induced vacuum leak. I used both a scanner and a scope to verify that injection was really what was indicated. The scanner shows MAP output to be 2.9 volts at idle, but I can’t find any information for voltage specs for Chrysler from idle to WOT that we can use for reference. Thanks for any help.”

George Mills, Atlanta, GA

The MAP sensor should read about 4.5 volts with the key on, engine off (KOE0) at sea level and about 1.5 volts or so at about 20’ of vacuum. Since the average vacuum at idle is about 17” to 23”, a MAP output of 2.9 volts is too high. Besides a defective MAP sensor or cracked sensor housing, be sure to check for damaged gaskets, hoses, EGR, ignition or cam timing, engine mechanical damage, etc.

Quality Points

These CAPS Are Lightweight & Tough

Distributor caps and rotors may seem like a “generic” product to some. After all, most replacement caps and rotors look pretty much the same. But appearances can be deceiving because the performance of the materials from which these parts are made can vary significantly.

As a leading supplier of original equipment ignition components, WELLS’ engineers have the inside track on what works and what doesn’t. OEM caps and rotors must meet rigorous test standards for performance and durability. That’s why WELLS uses a special lightweight thermoplastic polyester resin in its OEM and aftermarket distributor caps and rotors that outperforms the heavy, mica-filled components of yesterday.

The thermoplastic polyester resin that WELLS uses has outstanding chemical resistance to oil, gasoline, underhood chemicals and other automotive fluids. It also has excellent dimensional stability. The dimensions remain stable regardless of temperature, humidity or chemical attack, so the parts fit correctly when they’re installed, and continue to fit perfectly for years to come.

WELLS caps and rotors have very low moisture-absorption characteristics resulting in superior dielectric strength. This allows them to better
Loose wiring connector, faulty coolant sensor, or powertrain control module (PCM) or one of its sensor circuits (coolant, manifold air pressure (MAP) sensor, oxygen (O2) sensor, throttle position sensor (TPS), a plugged intake manifold passageway, a clogged catalytic converter, a blown fuse or a wiring problem. Failed driver circuit in the computer. With digital EGR valves, a “Check Engine” light accompanied by any of the following fault codes may indicate a problem in the EGR system:
- Ford: 31, 32, 33, 34, 83, 84
- Chrysler: 31
- General Motors: 75, 76 and 77
- All OBD II vehicles (1996 & up): Diagnostic Trouble Code (DTC) P0401 insufficient flow, P1406 EGR sensor

On some vehicle applications, a scan tool can also be used to access and display EGR valve position and status.

**BENCH TESTS FOR A DIGITAL EGR VALVE**

To check a three-solenoid GM digital EGR valve, (Refer to Figure C) and measure the resistance of each solenoid:
- Terminal A to B: 20 ohms
- Terminal A to C: 10 to 17 ohms
- Terminal A to D: 20 to 30 ohms

If any resistance reading is outside the range of specifications, the unit is defective and needs to be replaced.

Using a 9-volt battery or sensor tester, run battery positive (+) current to the “A” terminal, then ground each of the other terminals (B, C & D) one at a time (see Figure C). Each solenoid should click and open its respective pintle valve. No click or movement would indicate a faulty solenoid.

With the battery and jumpers disconnected, spray a small amount of carburetor cleaner into each orifice (Figure D), being careful not to get the cleaner in the center hole. If the cleaner seeps out of any orifice hole into the center, the pintle is not seating properly and the EGR valve needs to be replaced.

If a digital EGR valve passes the above tests but is not seating properly and the EGR valve needs to be replaced.

To check for the rpm drop.

Using a bi-directional scan tool by selecting EGR output test and then energizing each solenoid position and status.

**Testing a Digital EGR Valve on the Vehicle**

The same resistance checks can be made between the terminals (A to B, A to C and A to D). If resistance is within specs, check the operation of the EGR valve by back-probing and grounding each solenoid terminal (B, C & D). This must be done with the engine at normal operating temperature, idling in closed loop. When each solenoid is grounded (energized), there should be a momentary drop in idle speed if the EGR valve is opening and the intake passageways are unobstructed. The computer will immediately compensate for the drop in idle speed by opening up the idle air-control valve to increase rpm, so you may have to use a tachometer to detect the rpm drop. No change in idle speed would indicate a faulty EGR valve or blocked passageways.

Note: This test can also be done with a scan tool by selecting EGR output test and then energizing each solenoid to check for the rpm drop.

If the EGR valve passes these tests but is not functioning, the problem is in the wiring, PCM or one of its sensor circuits (coolant, MAP, TPS or O2). These items should all be checked to isolate the fault.
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INSIDE:
DIAGNOSING DIGITAL EGR VALVES