CURE YOUR EVAP HEADACHE

Understanding the EVAP monitor and its diagnostic possibilities can provide the strong medicine your shop needs to shine in front of your customers.

BY VINCE MOW, CONTRIBUTING EDITOR

The Evaporative Control Monitor is an essential part of advancing OBDII emission control strategy, but it is causing headaches in states where OBDII emissions testing is a normal procedure. It is important to realize that the EVAP monitor is tied into readiness issues, enabling criteria, drive cycles and new test equipment for tracking down those worrisome fuel vapor leaks.

But before we get into drive cycles and enabling criteria, it would help if we know exactly what the OBDII EVAP monitor actually monitors in its several different configurations. The possibilities include three distinct types:

1. Two versions of non-enhanced EVAP that only look at purge.

2. Multiple enhanced EVAP configurations that look at purge and leaks of either 0.020 inch or 0.040 inch equivalent holes.

3. The latest variety called Engine Off Natural Vacuum (EONV).

The non-enhanced monitor was featured on most – but not all – pre-1999 on-board diagnostics (OBD) vehicles. This monitor doesn't care about anything other than purge flow. One version can be identified in non-enhanced systems that use a Canister Purge (CANP) solenoid plus a dedicated Purge Flow Sensor (PFS). And if you are confronted by the Vapor Management Valve (VMV) strategy, Idle Air Correction (IAC) is monitored to establish whether Idle Air Flow is changing in proportion to the VMV duty cycle, within an acceptable range.

Although the enhanced EVAP type of system was required by the U.S. Environmental Protection Agency (EPA) in 1996, it wasn't until the 1999 model-year that 100 percent of the fleet was required to be included. That would have been a good thing if it weren't such a complicated subsystem. Let's begin with sensors and components.

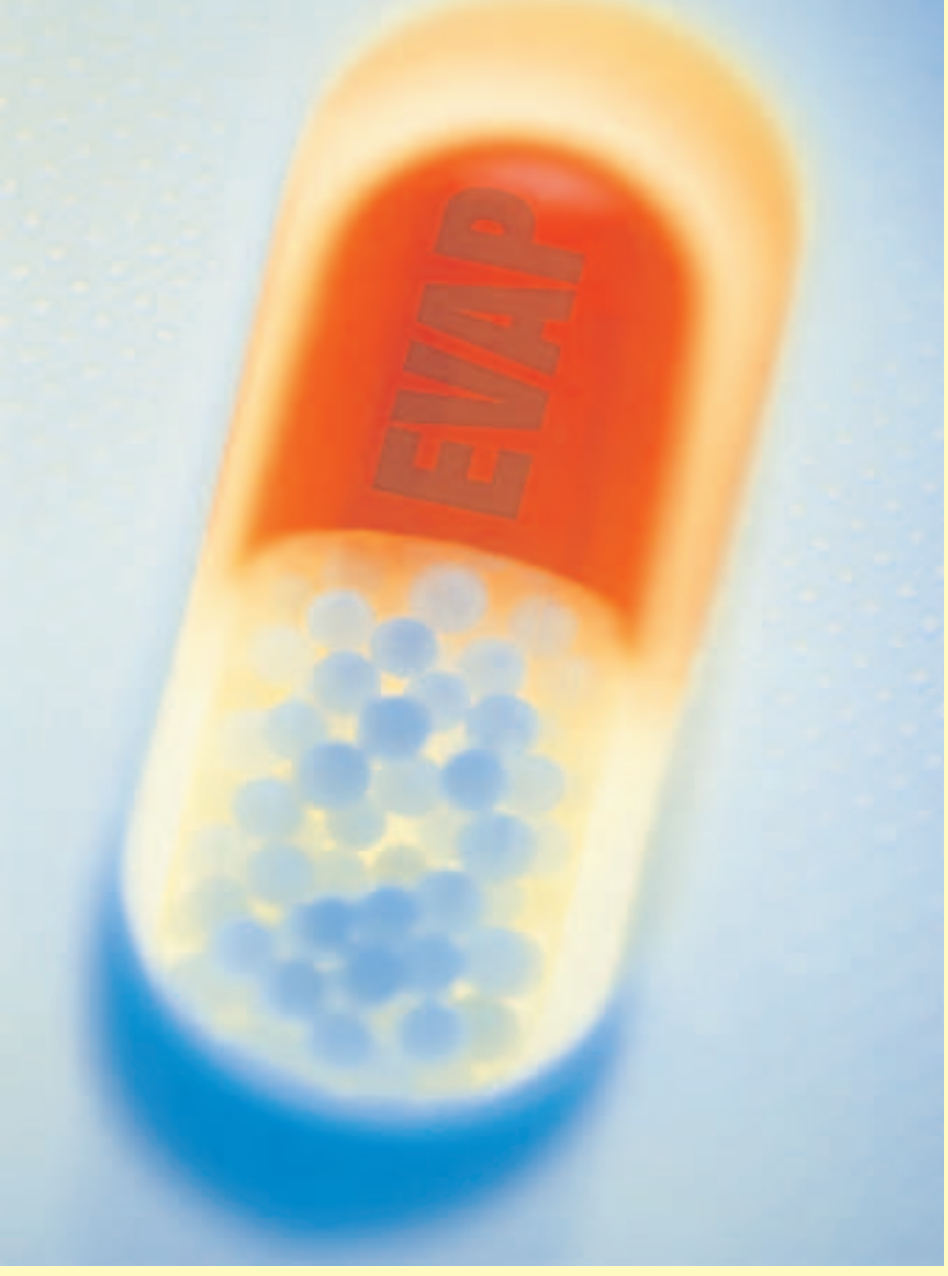
A WHOLE MESS OF COMPONENTS

Besides all the tubing, fittings, wiring and connectors in a typical enhanced EVAP system, take a look at the bewildering assortment of components often found in the belly of this beast:

- Fuel Level Sensor
- Fuel Tank Pressure Sensor (FTP)
- Vent Solenoid
- Vapor Management Valve (VMV)
- Gas Cap
- Fuel Vapor Control Valve
- Fuel Vapor Valve (Rollover valve)
- Charcoal Canister and Filter
- Powertrain Control Module
- 0_2 Sensor (Fuel Trim)
- Service Port
- Vacuum Pump Assembly
- Mass Air Flow Sensor (MAF)
- Three-Way Valve
- Intake Air Temperature (IAT)
- Throttle Position Sensor (TPS)
- Engine Coolant Temp (ECT)
- Crank Position Sensor
- Vehicle Speed Sender (VSS)
- Vacuum Switching Valve (VSV)
- Leak Detection Pump (LDP)

ENABLING CRITERIA ESSENTIAL

In addition to the normal OBD warm-up cycle there are other enabling criteria that must be met for an EVAP monitor to run. For the typ-



ical enhanced version seen most often, these criteria generally include fuel tank level, various component monitors, temperatures, engine RPM, engine load, vehicle speed, time and various continuous and non-continuous tests.

An example of some common enabling criteria to run the EVAP monitor drive cycle is:

- The malfunction indicator lamp (MIL) must be off.
- Barometric pressure exceeds 75 Kpa.
- At start-up, IAT and ECT is between 45°F and 85°F.
- IAT is not more than 2°F greater than ECT.
- ECT is not more than 12°F greater than IAT.
- Fuel tank level is between 26 percent and 74 percent.
- The TPS is between 9 percent and 35 percent.
- The EVAP solenoid is at 50 percent pulse width PWM, within 65 seconds of engine run time.

Special note: For vehicles that use fuel trim to modulate the purge cycle, the O_2 sensor monitor also must be run to completion to enable the EVAP monitor, as well as some other conditions not mentioned here.

BUT WAIT, THERE'S MORE

The newest addition to the mix of OBD EVAP strategies is the EONV EVAP monitor. GM developed this system to take advantage of the physical property of fuel vapor in the tank to contract, and thus cause slightly negative pressure when fuel, which has been heated in average driving, cools down while the vehicle is at rest.

Within five to 30 minutes after the engine stops, both vapor and temperature in the fuel tank will peak and then begin a natural downward slope towards slightly negative pressure. Because even a tiny 0.020-inch leak is enough to prevent this vacuum from developing, the slight 3.5-inch water column (WC) pressure difference – about 0.13 psi – is enough for the on-board computer to determine if a significant leak exists or not.

INEVITABLE VARIATIONS

At least one other manufacturer, Toyota, in certain 2005 vehicles, has a version called a Key-Off EVAP monitor. This one uses a vacuum pump to apply negative pressure to the fuel system. The EVAP monitor then compares the negative pressure to atmospheric pressure. This detects the presence of a leak when the vehicle is either at rest or during periods of slow and steady cruising.

Because both Key-Off and Engine-Off tests can be performed when the vehicle is at rest, these systems appear to be much simpler than their predecessors, with fewer enabling criteria to prevent the monitor from running. Whereas previous EVAP strategies may take days or even weeks to run the EVAP monitor, it is not unlikely that a natural vacuum monitor could run once each day as a result of running a normal drive cycle.

WORDS OF ADVICE

So, let's say you've got one of these late-model EVAP monitor headaches in your service bay. Believe me, you never want to turn one of those bad boys loose again if it's not diagnosed or repaired properly. It will come back to bite you. You know you have to patch that thing up and make sure it stays that way. So what's the secret?

Out of about 30 diagnostic trouble

Illustration: Getty Images

codes (DTCs), which refer to the EVAP system or its components, all but about four of them direct you to specific failure modes such as control circuits or individual sensors. For this type of fault, OBD excels at sending you in the right diagnostic direction. But keep in mind that all the P0442 and P0455 codes can do is report a leak, and that could be anywhere in the entire system.

IS THE FUEL CAP THE CULPRIT?

One of the first dilemmas you may be faced with if you see a gross EVAP leak code, P0455 for example, is to decide whether or not to blame the fuel cap. This code can be set by other conditions, which prevent vacuum from building in the tank when the purge valve opens. These have nothing to do with leaks.

A quick fuel cap test will determine if the cap actually leaks, but it will not tell you if the owner left it loose on the filler neck. That's why it never hurts to tell your customer to always tighten the cap a full three clicks on older cars, or until it stops on late-model vehicles. On some newer vehicles, however, there is a P0457 code. This one is specifically intended to let you know if the cap was left loose after the tank was recently filled, thus saving you some of the uncertainty.

Although OEM service procedures may vary, generally accepted practice for any leak-related EVAP DTC is a pressure, or leak-down, test of the entire EVAP system. Here are some things you should keep in mind:

1. MAKE SURE YOU USE a tester that positively prevents admission of more than 0.5 psi to the system.

2. WITHOUT REMOVING the gas cap, you can pressurize the system through either the service port or the canister side of the VMV by disconnecting the hose. Make sure the canister vent is closed.

3. WITH THE GAS CAP REMOVED, you can use a filler neck adapter to apply pressure to the system. But the vent solenoid must be closed or the vent hose should be pinched off or plugged as close to the canister as practical without damaging the system.

It is impossible for the human eye to tell the difference between a 0.020-inch and a 0.040-inch leak opening, and in some cases even find that elusive leak at all. A diagnostic smoke machine is recommended equipment for effective EVAP emissions diagnosis.

4. THERE ARE SEVERAL CHOICES of diagnostic systems, but most perform either a leak-down (pressure decay) test, in which you pressurize and then watch for a pressure drop to indicate a leak, or run a flow test where a meter lets you compare leakage to a 0.020-inch or 0.040-inch hole.

5. ONCE YOU DETERMINE that the system has a leak, you may need specialized equipment to precisely locate and make the leak source visible. This may be done with a diagnostic smoke machine.

6. MULTIPLE LEAKS are not uncommon, so be prepared to retest one or two more times until all significant leakage is found and fixed.

7. A FACTORY SCAN TOOL and/or a vacuum source may be required to exercise the various valves in the system and determine if they are fully functional and leak tight.

CHOOSING YOUR WEAPONS

Keep in mind that your selection of equipment is crucial. Some of the procedures needed to fully exercise various components like purge and vent solenoids are extremely vehicle-specific to the point of sometimes requiring a factory scan tool or its equivalent. If you want to rely on a manufacturer's claims that any current scan tool will test everything out there, get it in writing with a money-back guarantee.

Unlike scan tools, when it comes to finding leaks there is a one-tool-fits-all solution out there: a diagnostic smoke machine.

A number of manufacturers offer diagnostic smoke technology testers that make otherwise virtually invisible fuel vapors show up as a stream of inert smoke. The patented technology these companies share has already been adopted by almost all OEMs for use on their vehicles, and usually bears the label "EVAP Approved." This technology features a safe, vehicle-friendly and highly visible vapor, which marks the spot for a few days after you perform your initial test.

That last feature is handy for leaks, which require some disassembly of vehicle components before you can pinpoint the trouble. Take, for example, loose connections on top of a fuel tank. You may open the access ports or pull the tank down if you have to. But shine a little UV light on the thing and a bright fluorescent mark shows you exactly where the leak occurred.

Photo: Vince Mow

WHO RUNS THE DRIVE CYCLE?

Even after fixing all significant leaks, and performing functional tests on the components indicated by various EVAP DTCs, the only sure way of knowing the MIL will stay off is a full EVAP drive cycle. Because many shops just don't have the luxury of letting cars sit overnight and then driving them under the exact conditions required, it's best to give customers the whole story.

OEM-specific EVAP drive cycles should be found in most of your common repair info sources or on the OEMs' service information Web sites. A complete printed version of these is the *Motor Manuals Drive Cycle Guide 1996-2004*.

To save the customer the cost of you running the drive cycle at the diagnostic labor rate, some shops give the customer a printed copy of the drive cycle for the vehicle with the advice to perform these steps and bring the vehicle back to the shop later. This can be risky because expecting the motorist to run the drive cycle with printed guidance could expose the shop to liability and repair costs if the driver has a fender-bender while trying to follow the directions provided.

PART OF THE TOTAL JOB

So if you are thinking of saving the vehicle owner the expense of a technician — in some cases, two of them – running the drive cycle, why not consider the performance of a drive cycle a normal part of the job for which you should be paid. What you charge for performing a drive cycle, however, is up to you if you wish to ease the expense of this time-consuming item.

Another strong argument in favor of the shop performing the drive cycle is that while the repairs just completed may enable the monitor to run for the first time in months, the technician may find the MIL can light up for conditions that have nothing to do with the repair. Of course, you could simply explain that normal driving for a few days or a week will probably do the trick and make the MIL go out, but be sure you state that there are no guarantees.

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