Driveability Diagnosis: Yikes! No Codes!

by Bob Freudenberger

You know and we know that DTCs are superficial and often inaccurate. So, don't let their absence short-circuit your troubleshooting discipline.

*If you see a **"No Codes Present"** message on your scan tool when you know there's trouble, don't panic. There are numerous other ways to skin the driveability/ performance cat.*

Techs tend to malign DTCs (Diagnostic Trouble Codes) as misleading and unreliable. Paradoxically, it's a rare service personage who doesn't use them early on in any driveability troubleshooting effort. Admit it: Pulling codes is an easy and fast way to launch the expedition to find that elusive trouble.

So how about those cases -- and there are many -- in which no codes are present? Where do you start? Easy -- with the basics. We can pretty well imagine you sitting there rolling your eyes and thinking, "How many times have I heard that before?" And well you should hear it. Most authorities from service training instructors to aftermarket engineers agree that skipping the basics is the most prevalent cause of misdiagnosis and of perfectly good parts being returned as defective.

As a manager for one of the major tech hotlines tells us, "I really agree with Ford's stated philosophy. In its manuals, it'll say something like, 'Caution: The following non EEC (Electronic Engine Control) areas may be the cause of the problem,' and, 'Stop! Think! Why are you checking the EEC system?' From our experience on the hotline, the best thing to do is to go back to step one the basics."

Just cause

A brief look at the rationale behind OBD II (and even ancient-history OBD I) systems will help you understand why they don't always work as you might expect them to. As you are perhaps painfully well aware, most of the complications in modern cars are ultimately the result of two momentous challenges to our complacent society: air pollution and the energy crunch. The most logical and straightforward way to clean up engine exhaust and increase fuel efficiency was to enlist electronic engine management.

So, we got environmentally-friendly, great-performing vehicles that turned in impressive mpg, but at the cost of complexity that sometimes seems to approach that of the space shuttle. Engineers and auto execs know that if a car gets a reputation as troublesome and difficult to fix, it'll be hard to sell another one, which made improving the chances of success in diagnosis a high priority with them.

One way to do that was to enlist the help of an "intelligence" that was already on board: the engine management computer (known in universal SAE J-1930 jargon as the PCM -- "Powertrain Control Module"). It "knows" all the proper operating parameters and specifications of the vehicle it manages, so adding a diagnostic program to its little cranium makes sense. The programming itself is not so simple, however, nor is the means of communicating its findings. Some problems will turn on the MIL (Malfunction Indicator Lamp), others won't.

Eventually, all the automakers adopted the idea of using codes to tell us what, if anything, the computer has recognized as out of range or otherwise improper. Armed with the specific list of what the codes refer to (which became standardized and much more comprehensive under OBD II, but that whole subject is fodder for another article), you'll get a pretty good idea of which system or circuit to start investigating more deeply.

When OBD II first appeared in 1994, and became mandatory two years later, cars got the capability of testing themselves. Still, human intelligence teamed with the proper equipment is needed more often than not.

Triggers

The PCM's OBD (On-Board Diagnostic) program monitors the signals received from the sensor network and compares them to the standards that are recorded in permanent memory. If they're out of their specified range or missing entirely for a calibrated amount of time, the OBD sets a code in RAM (Random Access Memory).

The program also looks for situations that don't make sense. For instance, if the coolant temperature sensor continues to send a cold signal after the engine has been running for a while, the OBD will "think" it's discovered a problem in the CTS circuit, so it'll set the appropriate code (actually, a missing thermostat could be the trouble, which is an example of the limitations of self-diagnostics).

Then there's comparison of the signals from two or more sensors. If, for example, the VSS (Vehicle Speed Sensor) is reporting to the computer that the car is at cruising speed, yet the TPS (Throttle Position Sensor) is sending a signal that indicates idle, and the MAP (Manifold Absolute Pressure) sensor doesn't see the high vacuum of decel, a code may be set.

OBD watches actuator circuits, too, such as those that power the canister purge solenoid, AIC (Automatic Idle Control) motor, fuel injectors, etc. If there's a short, open, high resistance, or other trouble present, you might get a code.

Blind spots

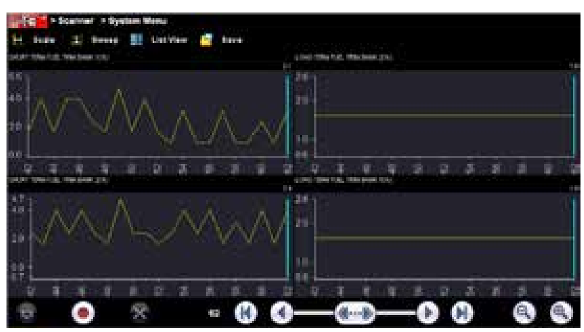
Compression? The self-diagnostic program won't have a clue.

So much for what OBD can recognize. Now let's look at some of the conditions to which it's totally blind. To begin with, the PCM "assumes" that the engine can generate decent compression. If that doesn't happen to be the case, the brain will send out inappropriate commands to the fuel injectors, ignition system, etc., commands that would make an engine with good internal components run properly, but just can't fix a burned valve or a blown head gasket.

OBD II gave us the P0300 code for "random misfire" when a hole in the piston was the cause of the problem.

Injecting smoke into the spark plug hole is what found the bad piston.]

Or, suppose one fuel injector is clogged or otherwise inoperative. That cylinder will then pump enough plain air into the exhaust to make the oxygen sensor produce a lean signal. The computer, assuming that all the injectors are in great shape, will increase the pulse width command to every injector to enrich the air/fuel mixture and thus correct the lean condition. That's not a helpful response since it'll cause the other cylinders to run too rich.



An understanding of the fuel trim function will often point you in the right direction.

The following is a list of some other problems that won't set codes:

Lack of fuel pressure or volume from a clogged filter or a worn-out pump is a very common no-code cause of driveability troubles.

- Low fuel pressure and/or volume are big-time no-code troubles. Always check pressure, running and deadhead. Look at fuel trim numbers -- lean correction points to restriction. Also, read fuel pump amp draw, which will go up like crazy if the filter's clogged.

- Heavy deposits on the backs of the valves can act like a sponge and soak up enough gasoline to cause lean running until they become saturated. The symptoms will appear after start up and before the engine becomes warm enough to enter closed loop. This won't be detected by the OBD.

- Carboned-up throttle bores are causing more and more trouble. Check the automatic idle control percent or steps. Expect to see the idle air system trying to compensate, but don't expect a code.

- Worn camshaft lobes that don't allow a cylinder to fill may cause a dead miss at idle. OBD will be clueless.

- We've seen simple secondary ignition problems trigger full-bore computer system diagnosis efforts, and even engine replacement! Codes? Not a chance.

- A sluggish oxygen sensor can make a V6 feel as weak as a four, yet may not set a code.

A lazy oxygen sensor or a contaminated A/F ratio sensor may not set a code, but it can sure affect performance.

- Speaking of low power, we remember a plugged catalytic converter that kept the top speed of a V8 cop car down to 40 mph, but nobody thought of that until major work had been done. No codes here, either.

- Malfunctions in mechanical emissions controls, such as PCV or air injection, won't be recognized.

Helpful, yet not helpful

The simple facts are that OBD programs miss problems, direct you to a sensor when a wire or connection may be the real culprit, and simply can't know whether an out-of-range situation is due to a sensor, the internal condition of the engine, or numerous other more subtle troubles. So, use codes when available, but don't depend on them.

By the way, a common troubleshooting mistake is assuming that because no DTC is present, a particular sensor or its circuit is not the cause of the problem. If a symptom leads you to believe a component of the electronic engine management or EFI system isn't doing its job properly, check it out even if no code's been set.

Remember, the system can't be designed to be trigger happy. If it were overly critical and too quick to register a fault, just the normal changing conditions every vehicle encounters would generate codes and cause the MIL to come on. So, self-diagnostics watch for patterns that typically represent problems and that exist for a calibrated length of time, not just one moment when a perfectly good sensor may go out of range because of dampness, a bump in the road, etc.

12-Step Program

With all that established, it's time to get real practical and give you a sensible 12 step procedure:

1. Take the time to handle the customer properly -- nothing's more important than good communication with your patron. That means finding out EXACTLY what he's come to you for. Even if it's vague in his own mind, the act of articulating it to you as responses to well-constructed questions will clear it up. When do the symptoms occur? Engine cold

or warm? Under acceleration, decel, or when cruising? Are they present every day? Does anything affect them (different gas, rainy weather, etc.)? Have they developed gradually or did they suddenly appear? Has anybody else worked on the car, even if it was just changing plugs? Was a new accessory grounded to the O2 sensor wire? Also, you should have a schematic of a typical computerized engine control system handy to show him along with a manual full of troubleshooting trees and maybe some of your equipment.

2. A bulletin search should definitely be worked into the early stages of your efforts. This capability is, after all, one of the great benefits of an online service data system.

3. Although we're limiting our discussion here to no-code situations, this is the logical time to try to pull codes. If you've got any, they're a valuable preliminary that will point you in more or less the right direction. Otherwise, proceed to the next step.

4. Start it up and note any unorthodox sounds, rough idle, pungent odors, etc.

5. Take a test drive to zero in on any driveability problems. Have the customer aboard if possible.

6. Stick your head under the hood and look for any obvious problems, such as disconnected vacuum lines, broken or grounded wires, a leaking coolant temperature sensor, etc.

Sometimes the trouble is obvious. This harness was rubbing against the serp.

7. If nothing's jumped out at you so far, explain to the customer that much effort and talent could be required to find the trouble in his high-tech conveyance. Use dollar amounts instead of hours. Try to get authorization for maybe the value of two of your shop hours. Promise to contact him if it looks like you're going to have to go over that amount.

8. Not to belabor a point, but now's the time to check basics. You're not going to get a good MAP signal in an engine that can only muster 12 in. Hg. of vacuum, a missing thermostat will keep any system out of closed loop, and all the electronics in the world can't make up for a jumped timing belt, a deposit bridged plug, etc. In other words, establish your baseline.

Even a sophisticated (and expensive!) scan tool/analyzer such as this XENTRY unit from Mercedes-Benz has its limitations. You need other resources, some of which are traditional.

9. Once you're satisfied that the engine's pumping ability and secondary ignition parts are okay, you can start your investigation of the computerized engine controls. There are numerous ways to go here -- scan tools, lab scopes, and exhaust analyzers -- and we're not going to get into the question of what works best. If you're up against a hard case and you subscribe to a hotline, have some solid data in front of you before you call.

One of the most logical approaches to no-code troubles is the use of a modern five-gas exhaust analyzer, such as this compact Kane unit from ANSED, to find out what's really being pumped out of that engine.

10. If you come to an impasse where you have to install a "known-good" PCM or other expensive component before you can proceed, make sure what you've done so far is right, then call that customer. As Charles Elliott, Oregon shop owner, one-time NAPA/ASE Tech of the Year, and ***Motor Service Magazine*** TAP (Technician Advisory Panel) member, once said, "Keep them apprised of what's happening . . . let them make the decision." Or, as Bob Peppin, New Hampshire shop owner, TAP member and also once Technician of the Year, put it, "In some cases more and more lately the manufacturer tells you to do substitution tests, to install a known good part. Well, if you put a computer in a car, you're not going to take it back out if it doesn't fix the problem, so you have to have authorization. It's essential to keep the customer involved."

11. Make the repairs, clear any codes that may have reset in the process, then take a test drive to verify that any driveability/performance complaints have been rectified and the MIL is out.

12. Write up the job ticket noting any related work that you recommended and the customer declined to have done. Go over this with him when he comes to pick up his vehicle.

Sure, you can shuffle the order of the steps according to the situation maybe you'll want to take a looksee under the hood before your test drive. Just make sure you do all of them.

Engage Contents of Headbone

You can have the best scan tool, lab scope, or exhaust analyzer in the world in front of you presenting the clearest, most accurate data possible, and it won't do you a bit of good unless you understand what it means in terms of how the engine runs.

Unfortunately, even long and hard-won experience won't teach you very much if you don't have a framework of understanding or "matrix" to put it in. We hope the following examples will contribute to the establishment of that framework by illustrating how data stream information can help you fix cars.

Suppose your shop is at sea level, but your scan tool shows a BARO reading of 78 kPa with the engine off. No DTCs are present, but you know that at your altitude barometric pressure should be close to 100 kPa (one bar, or 14.7 psi). It shouldn't take much thought to realize that this faulty signal could cause lean running because the PCM will be supplying the proper amount of fuel for high elevations where there is less oxygen in each cubic unit of air, so the mixture will be lean at sea level.

Similarly, if you see a high resistance/low temperature reading from the intake/manifold air temperature sensor, yet the day is warm, you'll know there's trouble in the IAT/MAT sensor or its circuit because the information it's providing simply doesn't agree with current conditions even though the OBD system has not recognized that fact. This common-sense approach could also apply to a low temperature reading from the coolant temperature sensor when you can feel that the engine is hot.

Signals from mechanically-operated sensors can be checked against reality, too. Say you're driving at cruising speed, yet the VSS registers 0 mph. Something's obviously amiss. Or, maybe you see the at-idle voltage specification for TPS output even though you've put the pedal to the metal.

Besides comparing data stream information to actual conditions, you can compare it to what other sensors are telling you. For example, suppose when you open the throttle half way your scan tool tells you that the throttle angle is 50%, yet when you switch to the throttle position sensor voltage you get a reading of 1.2 volts. Since the reading should be around five volts at WOT (Wide Open Throttle), half throttle should be between two and three volts. By making an intelligent comparison, you've probably located the cause of a hesitation problem.

Another way to make good use of the data stream is to cause artificial conditions and see how the computerized engine management system responds. For instance, if you introduce a large vacuum leak (say, by removing the brake booster vacuum hose), you should see a lean flag, then an increase in fuel injector pulse width milliseconds. If you cause a rich condition (in the days of carburetors, you could close the choke plate; with EFI, you can pinch off the vacuum line to the fuel pressure regulator), you should see a rich flag, then a decrease in pulse width.

With an ordinary NTC CTS (Negative Temperature Coefficient Coolant Temperature Sensor), if you disconnect the sensor's lead you should expect to see a very low temperature reading in the data stream. Grounding the lead should give you a high temperature indication. If you get these results, it is probable that the CTS circuit and the PCM are both okay. The trouble, then, is probably in the sensor itself, or deposits that keep it from warming up as it should.

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He is currently the editorial director of Aftermarket International, and StarTuned, a service technology magazine sponsored by Mercedes-Benz. He earned ASE certification in the late 1970s, then went on to write ASE tests.

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