Case Study: The Phantom MIL

By Randy Bernklau

Original case study is found at http://www.obdiicsu.com/Studies/1999CaseStudies/study.html. It is reprinted in its entirety.

Background

This vehicle was purchased new in North Carolina and had experienced no problems with its performance. The "Service Engine Soon" light first came on six months before the car was brought in for this case study. The owner tried to solve the problem by replacing the filters (air, etc.) and by putting better gas in the car. Despite these efforts, the light continued to go on and off. The light would go off when the car was filled with gas and during long trips. If the car had been producing visible emissions or had experienced a drop in performance, the owner would have taken it to the dealer.

Introduction

This vehicle was a 1997 5.0 liter V8 Ford Explorer that came to the NCVECS as part of a research project on OBDII. The complaint was that the MIL light was illuminated. OBDII regulations require a light to be illuminated in the event of a malfunction of any powertrain components which can affect emissions and which provide input to, or receive output from, the on-board computer(s); or the malfunction of the on-board computer(s) itself. The MIL shall be of sufficient illumination and location to be readily visible under all lighting conditions. The MIL shall illuminate in the engine-run key position before engine cranking to indicate that the MIL is functional and shall, when illuminated, display the phrase "Check Engine" or "Service Engine Soon." The word "Powertrain" may be substituted for "Engine." OBDII vehicles shall also be equipped with an on-board diagnostic system capable of identifying the likely area of the malfunction by means of fault codes stored in computer memory. These vehicles shall be equipped with a standardized electrical connector to provide access to the stored fault codes.

Before we can determine the cause of an illuminated MIL, we must retrieve the code(s) that are causing it to light. We do this by connecting a scanner to the standardized OBDII connector inside the passenger compartment. On this truck I was able to retrieve a code P0402 via a generic scanner. The enhanced mode did not reveal any other codes. What does code P0402 mean?

Deciphering the code

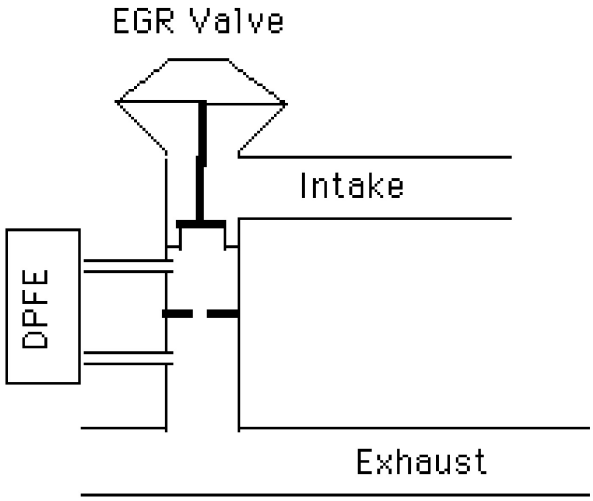
Generic OBDII codes are written in a standardized format according to SAE J 2012 guidelines. The first letter indicates the vehicle function: Body, Chassis or Powertrain. Code P0402 begins with the letter "P", which indicates a powertrain code. The next character tells us whether it is a generic or manufacturer specific code. "0" is generic, so P0402 is a generic code. The next three characters tell us more about the problem area. In this case a "4" indicates an auxiliary emission control code. The last two characters tell us what the code refers to which is "Excessive EGR Flow".

Freeze Frames

Now that I know the code definition, I can begin the diagnosis. Freeze frames are another OBDII function and can become very useful when chasing intermittent problems. The freeze frame the last time code P0402 was set is shown below.

Freeze Frames Code P0402

Item	Value
RPM	673
Fuel System 1	Closed
Fuel System 2	NA
Coolant Temperature	198 Degrees F
Bank 1 Short Term Fuel Trim	- 1.6 %
Bank 1 Long Term Fuel Trim	- 5.5 %
Bank 2 Short Term Fuel Trim	- 1.6 %
Bank 2 Long Term Fuel Trim	- 5.5 %
Vehicle Speed	0 MPH
Engine Load	41.4 %



Analyzing this data tells me that the code was set at idle and since EGR flow should not occur at idle, I know that the PCM was told that there was EGR flow without an EGR command. Normally, the diagnosis would lead to checking the EGR system, but I decided to clear the code and see if it returned. This step is not always necessary, but I felt it would be interesting to see if the code would reset. It should be noted that some steps are taken for the sake of research and may not be necessary during a normal diagnosis. After clearing the code, all the monitors were reset to "Not Ready."

The next morning, with an ambient temperature of 70 degrees F, I started the vehicle and began a test drive. The test drive included some in-town as well as 50 MPH driving. Back in the shop I noticed all but one monitor flag reset to "Ready." The only one to say "Not Ready" was the catalytic monitor. No codes were set during this test drive and the MIL was not illuminated. The test drive did uncover a drivability concern that was noted. It had a noticeable surge off idle.

Diagnosis

Ford uses a Differential Pressure Feedback EGR (DPFE) sensor on these vehicles to measure EGR flow. Ford tests to see if the EGR valve is stuck open by checking the DPFE sensor at idle. The DPFE sensor tests for a differential in pressure across a restriction. As flow increases, DPFE voltage rises. Typical DPFE readings at idle are around 0.6 volts DC. The code will set if this voltage exceeds 0.6 volts above the base voltage taken at key on engine off. So, is the voltage too high at idle? Using the scanner I find these readings:

Data at idle	Value
RPM	1000
Load	45 %
Coolant Temperature	91 Degrees F.
DPFE Voltage	0.62
EGRVR%	1.6
Trip Ct	9
TPS	16 % (closed throttle)

It seems to me the source of the code is evident. I needed a little more testing to find the exact cause but the likely culprit had been found. When I compare the two data values I see that both are indicating nearly the same load and both were taken at idle even though the coolant temperature and RPM were not the same. I know that the engine was idling smoothly when I took the scanner readings, so I can assume there is no EGR flow. The DPFE voltage confirms this assumption by indicating a voltage of 0.62. The freeze frame data also indicates that no EGR flow is occurring because the load is nearly the same as mine. Load is inferred from the mass air flow sensor, and excessive EGR flow would change the load reading.

My conclusion at this time is that there is a sensor malfunction and not an EGR malfunction. My experience tells me it is the DPFE, but I think another test is in order. I apply vacuum to the EGR valve with a handheld vacuum pump and watch the DPFE voltage on the scanner.

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Options #2 and #3 apply to transmission related DTCs and require specific documentation from the vehicle owner and involvement of the department. **The owner of a vehicle exhibiting transmission-related DTCs only, may apply for a waiver from the Department of Natural Resources** when the following documentation is provided:

- the last failed test's DTR indicating the vehicle passed all other parts of the OBDII test and the only DTCs are transmission related;
- an invoice from a MRRT shop showing a diagnosis has been performed that determined what component(s) of the transmission or engine created the DTC(s); and
- an estimate from a MRRT of what it would cost to perform an effective repair. Statements such as: 'needs new transmission' are not viewed as a "diagnosis", without a written explanation as to how the DTC noted on the DTR cannot be repaired without replacing the whole transmission.

Vehicle owners should contact the department at 314-416-2115 to apply for a waiver due to transmission DTCs.

Clarification of Emission Control System Monitors Status Wording

The Diagnostic Trace Report (DTR), provided to every motorist whose vehicle received a "Fail" or "Reject," notes the status of the non-continuous emissions control system monitors at the bottom left of the DTR. The Gateway Clean Air Program uses the term "Ready" to indicate a system that may note as "Completed" on a scan tool. A "Ready" or "Completed" monitor is one that has performed the manufacturer established drive cycle and whose reference components are working correctly. The term "Not Ready" indicates a system that may be noted as "Not Completed" on a scan tool. This means either it has not driven the manufacturer established drive cycle, or it is receiving information from a reference component that indicates the physical operating conditions of the vehicle do not comply with the manufacturer established specifications to allow a drive cycle to be accepted.

Articles Wanted

The Gateway Clean Air Program wants to continue to bring readers pertinent repair information. If you have an idea for an article, or have a topic you would like discussed in a future issue, please contact Robert Arrol by fax at (314) 739-2901 or by e-mail at rob.arrol@mo.etest.com.

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Several seconds before decaying towards the base reading, I shut the engine off and turn the key back on. The voltage is still falling slowly towards base. After several seconds it reaches 0.6 volts KOEO. This confirms my suspicions and I order a new DPFE sensor. The new DPFE was tested under the same conditions and the voltage would change immediately to base after having the EGR opened. It also reached a higher voltage with the EGR open, 2.7 volts DC.

Observations

This repair example provides a good example of OBDII system limitations. No component was specifically identified by the SAE code. The code directed the technician to a system, but did not identify what part of the system was malfunctioning. In this case, the technician's knowledge and skill led to a successful repair. However, car owners that attempted a "shade tree repair" would probably replace the EGR valve, since the computer condemned that system. Despite the increasing complexity of on-board systems, technicians must still perform detailed diagnoses of the engine control systems. Since this repair addressed a monitor problem and not an emission control component problem, the vehicle tailpipe emissions were unaffected. Once again, the OBDII system needed repair despite the fact that the car remained clean.

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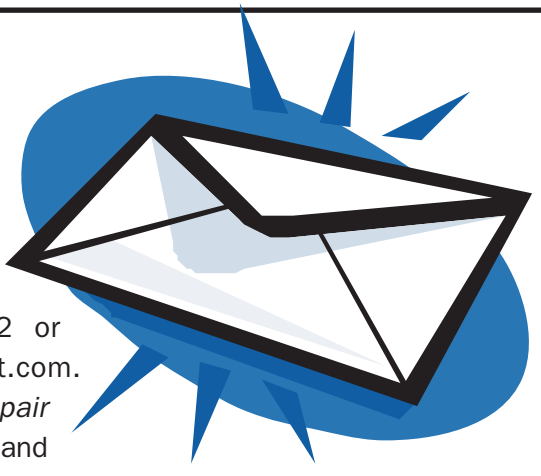

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