Trouble Shooter

By Karl Seyfert

Article originally appeared in the June 2004 issue of MOTOR Magazine. It is reprinted in its original form by permission [Editor's note: The Gateway Clean Air Program will implement OBDII testing on a pass/fail basis on Monday, June 6, 2005. Additional information on Missouri's move to pass/fail OBDII testing may be found in this issue or by visiting http://www.gatewaycleanair.com/about/obdii-home.htm.]

Repairing an emissions failure is no longer enough. Changes in testing procedures mean it's also necessary to return the vehicle properly prepped and ready to pass the retest.

Ready Now?

We've had a state EPA-administered vehicle emissions inspection program here in Ohio for the past several years. Several counties within the state, including the county where our shop is located, have been targeted for special vehicle testing procedures, due to their "nonattainment" status.

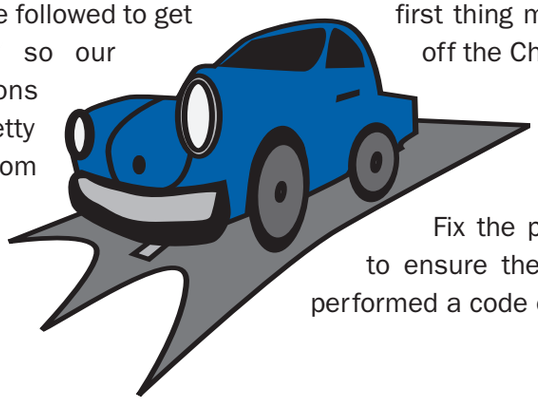
At the beginning of this year, our state EPA began testing 1996 and later OBDII-compliant vehicles using a "plug-and-play" test. The technician at the testing center plugs into the vehicle's data link connector (DLC), then checks for stored diagnostic trouble codes (DTCs). He also checks to see whether the OBDII Readiness Monitors have run to completion and are flagged as "Ready" or "Complete." If the Check Engine light is on, the vehicle cannot pass. And if the Readiness Monitors haven't run to completion, the vehicle gets a conventional tailpipe emissions test.

Since the new testing procedures went into effect, we've been seeing a lot of vehicles that have failed the test because one or more of the Readiness Monitors have reported "Not Ready" or "Incomplete." I understand there are many different time frames and special driving procedures that must be followed to get these monitors to report "Ready" so our customers can pass their emissions tests. Some of them involve some pretty bizarre sequences, like accelerating from 0 to 30, then coming to a complete stop. (Ever try that one in traffic?) Is there an easier and quicker way to ready these vehicles? Also, how do we charge a customer for a service that we once offered for free? We have considered discontinuing emissions-related repairs due to these new testing changes, but this would certainly hurt our business.

John Krouse, Concord, OH

Federal regulations required Ohio to implement the new OBDII test you've described. Extensive field research has already been conducted, and it's been determined that the OBDII systems on these newer vehicles do a very good job of detecting emissions control system problems before they cause costly damage and allow harmful pollutants into the air. When a vehicle fails a plug-and-play emissions test, its OBDII system issues specific diagnostic codes and other information that can help a tech pinpoint the problem and make quicker, more effective repairs. OBDII inspections also can be administered more quickly than the previous emissions tests.

It all sounds pretty great, doesn't it? What your shop needs is a strategy to deal with cars that have failed the new test. There are two general monitor classifications-continuous and noncontinuous. Continuous monitors run all the time. Noncontinuous monitors may run only once per drive cycle. When a vehicle comes in with a DTC relative to a continuous monitor, don't erase it. For some reason, the first thing many techs want to do is turn off the Check Engine light and clear the stored DTCs. This is the wrong approach for a number of reasons.



Fix the problem and drive the vehicle to ensure the light remains out. If you've performed a code erase procedure either before

Photo: Karl Seyfert

On 1996 and later OBDII-compliant vehicles, the PCM does a very good job of spotting problems that could increase emissions to an unsafe level. Some emissions testing programs now are tapping into this information to verify vehicle compliance.

or after repairs were completed, you've also reset all of the monitors to "Not Ready" or "Incomplete." The car must now be driven until all of the required monitors have run. Even if you've been properly trained and have the needed drive cycle information, this adds to your repair time. And if you don't have the drive cycle information, you could be driving around for days before the vehicle runs all the needed monitors to completion and is ready to pass a retest. That means wasted time and money.

Don't worry about the original DTC. If you've successfully repaired the original problem that caused the vehicle to fail the first OBDII test, the DTC will remain in the PCM's memory as a history code for about 60 warm-up cycles before it's erased. The MIL will not be on or commanded on during the retest. And as long as the vehicle meets other test requirements (monitors complete), the vehicle should pass the retest.

A different approach is required if a DTC was set when a noncontinuous monitor was run. Diagnose and repair the problem, then drive the vehicle at the same speed, load, temperature and rpm that were recorded in freeze frame data when the original DTC set. It may be necessary to repeat the drive cycle three or more times, but the PCM should eventually shut off the MIL and the vehicle will be ready to pass the retest.

Once again, you can see the advantage of not erasing the DTCs and resetting the monitors to "Incomplete." With good drive cycle information, it will be necessary to run only the small part of the drive cycle that involves the original DTCs. If you erase the DTCs, you'll have to extend the drive cycle or possibly drive the vehicle several times before all the monitors will have a chance to run.

Although it may be tempting, don't rely on the customer to try to run the drive cycle and complete the monitors for you. Without the necessary drive cycle information, he may never drive the vehicle in the manner required to run all of the required monitors. By contrast, a properly trained repair technician can run the monitors to completion in as little as 10 minutes and in a distance of two miles. Your goal should be to make the proper repair, then send the failed vehicle back for a retest with all the monitors run.

If you're doing performance work, you need drive cycle information, regardless of your state emissions requirements. The Motor OBDII Drive Cycle Guide is an excellent source for this information. It details the exact procedures you'll need to follow and the driving conditions that must be satisfied to get the required monitors to run to completion. Procedures and conditions vary from manufacturer to manufacturer, and even among different models from the same manufacturer. Without this information at your disposal, getting the job done is a hit-or-miss proposition at best.

Customer education, as well as additional technician training, may be required regarding these types of repairs. Your customer needs to understand the steps your shop must take to ensure that his vehicle will pass a retest. Before you begin an OBDII repair, check the monitor status. This will ensure that your shop allots enough time (including road tests) to handle the job. Refer to Sam Bell's "How Not to Get MIL-Stoned" in the April 2004 issue of Motor for OBDII customer relations help.

Training and Special Events

The following is a list of training available in the St. Louis area. This information is for reference only and is not endorsed or sponsored by the Gateway Clean Air Program. To find out what training is currently being offered, please contact any of the training providers listed below. Please contact trainers to confirm dates and course costs.

CARQUEST

The trainer is Lou Nelson. For more information, contact Chris Chesney at (919) 573-3342 or Mike Mulcahy at (314) 566-4303. Courses are held at 800 N. 17th St., St. Louis, MO 63106

Fault Pattern Recognition Application
(course code AD501): June 15-16, 2005
Intermittent Drivability Case Studies
(course code AD511): June 22-23, 2005
All course are approved for MRRT continuing education

Design Technology, Inc.

The trainer is Lou Craven. For information on training offered by DTI, call (636) 939-5670
or fax (636) 477-9093

Advanced Engine Diagnostic for Asian Vehicles
(Honda/Toyota/Nissan)
"Advanced Level 4" course.
Class time is 8:30 a.m. – 3:30 p.m. This course is approved for MRRT continuing education.
June 6

Modern Underhood Systems Technology (M.U.S.T.)
"Level I/Daytime" course. Class time is 8:30 a.m. – 3: 30 p.m. This course is approved for MRRT continuing education.

Compression/Thermodynamics – June 7
Fuel Systems-Hydraulic/Electronic – July 5
Automotive Computer Technology – August 2
02 Waveform Analysis – September 6

Federal Mogul

6565 Wells Ave., St. Louis, MO 63133
Contact: Thomas Martin
(314) 977-0798; fax (314) 512-8398

Technical Information: 1-888-819-5681 (no charge)
Technical Bulletins: 1-888-819-5681 (no charge)
Diagnostic Line: 1-900-486-0400 or
1-866-265-4170 ($3.95/min.)
Training Course Information: 1-888-771-6005
Web site: www.federal-mogul.com/training

TECH 301 - Automotive Electronics
(2.5 days = 20 hours)
Students will become proficient with the diagnostic tools needed to service electrical systems and learn skills necessary to develop diagnostic strategies. Exercises will include use of various diagnostic tools. This course is approved for MRRT continuing education.
July 18-20
September 26-28
October 17-19
October 31 – November 2

TECH 304 - Domestic Drivability

(2.5 days = 20 hours)
Engine controls and components are reviewed as they relate to OBD I & II. Students will become proficient with scanning tools, oscilloscopes, multimeters and understanding the benefits of dynamometers. This course is approved for MRRT continuing education.
July 20-22
September 19-21
October 19-21

TECH 306 - Fuel and Ignition System Diagnostics

(2.5 days = 20 hours)
Practical instruction focuses on the fuel delivery and ignition systems that are essential knowledge for technicians. Major fuel and ignition systems will be reviewed; diagnostic procedures include advanced oscilloscope diagnosis. This course is approved for MRRT continuing education.
August 3-5
November 2-4

TECH 307 - Advanced Drivability

(2 days = 16 hours)
Students will learn the function and purpose of engine management systems. Advanced test equipment is used to show the best procedures to test and repair. Diagnose problems and perform accurate system repairs by incorporating dynamometers and five gas analysis. This course is approved for MRRT continuing education.
September 21-22

St. Louis Community College at Forest Park

The trainers are Angelo Vitullo and Bob Weil. Contact Angelo at (314) 951-9420 for additional details. To register by phone or for payment by credit card, call Andrea at (314) 539-5341 or (314) 644-9287. All courses are held at St. Louis Community College at Forest Park at 5600 Oakland Ave., St. Louis, MO.

Area Trainers!

Are you currently offering automotive repair training in the St. Louis area? If so, please contact the Gateway Clean Air Program to be included in future issues of the Gateway Air Repair. Please include a detailed description of your course, including topics covered, dates, costs and location. Notices may be sent to Robert Arrol at rob.arrol@mo.etest.com or faxed to (314) 739-2901. If the training is emissions-related and you would like it evaluated as a continuing education course offered to all Missouri Recognized Repair Technicians, please contact the Missouri Department of Natural Resources at (314) 416-2115.

Case Study: O2 Codes: "If Life Were Always This Simple, I Could Make Money"

Original case study appears at http://www.obdiicsu.com/Studies/2001CaseStudies/O2Codes.html

The NCVECS OBDII study is primarily designed to observe OBDII system performance in the real world, both in terms of its inspection and maintenance impact, and in terms of overall system performance. As designed by regulation and engineered by manufacturer, all vehicle with a MIL (Malfunction Indicator Lamp) and DTCs (Diagnostic Trouble Codes), should be straight forward repairs, with after repair tailpipe emissions reduction.

Background

NCVECS has received five cars with an illuminated MIL, and an oxygen sensor code (P0132, P0133 or P1131). In each case the O2 failure was confirmed, either by checking the OBDII system with the scan tool, or watching O2 switch times while driving the car.

As part of our laboratory research, we also performed FTPs (Federal Test Procedures) on these vehicles. In 4 out of 5 cases (80%), the emissions were higher than the applicable standard (see chart 1).

Chart 1: O2 Sensor Emissions Results

Vehicle	HC gpm	CO gpm	NO_x
Standard	0.25	3.4	0.4
96 Ford Contour	0.58	21.875	0.324
96 Chevy Cavalier	0.458	10.035	0.264
96 Volkswagen	0.150	2.949	0.071
96 Ford Taurus	0.293	6.378	0.678
96 Hyundai	2.196	42.770	0.592

Repairs Performed

Obviously, in these cases we replaced the O2 Sensor. These cases are perfectly straight forward, and follow normal shop diagnostic and repair procedures. We have no twists or turns to share with you.

OK, one twist. In the case of the 96 Hyundai, the diagnosis was made through a visual inspection. Someone had taken the Hyundai (a perfectly nice little sedan) off road, and destroyed the O2 sensor through impact with a hard object. In fact, the impact had folded over the O2 sensor, and cracked the housing in two.

Emissions Impact

In each case, the post repair FTP test showed an emission reduction. As you can see from the chart, several vehicles shower large emissions reductions, on a percentage basis. Where smaller reductions occurred, or the emissions increase by a small percentage, the vehicle typically was clean during the previous FTP (see chart 2).

Chart 2: O2 Sensor Emissions Results - Post Repair

Vehicle	HC gpm	CO gpm	NO_x
Standard	0.25	3.4	0.4
96 Ford Contour	0.123 (-80%)	1.065 (-95%)	0.343 (+6%)
96 Chevy Cavalier	0.166 (-64%)	2.522 (-75%)	0.186 (-30%)
96 Volkswagen	0.094 (-40%)	0.930 (-68%)	0.080 (12%)
96 Ford Taurus	0.233 (-21%)	3.693 (-43%)	0.622 (-9%)
96 Hyundai	0.231 (-90%)	0.860 (-98%)	0.337 (-41%)

These repairs were all necessary, and demonstrated proper OBDII system function for both diagnostics and emissions reduction.

Fuel Economy Impact

We've all seen O2 sensor advertisements claiming a 10% to 15% fuel economy improvement with your O2 sensor replacement every 60,000 miles. Does our laboratory tests bear this out? Well....sort of. The data shows a trend upward for fuel economy, but more in the range of 2 to 3 percent, certainly not 15%.

Looking at chart 3, you can see that the vehicles that were dirty during the FTP saw a fuel economy improvement after O2 sensor replacement. Furthermore, the more the cars cleaned up, the greater the fuel economy improvement.

Chart 3: O2 Sensor Fuel Economy Results (in mpg)

Vehicle	Before	After	% Change
96 Ford Contour	26.68	27.25	+2
96 Chevy Cavalier	28.33	29.14	+3
96 Volkswagen	27.86	27.46	-1
96 Ford Taurus	22.60	22.53	none
96 Hyundai	22.67	23.99	+6

Lessons Learned

Looking at these vehicles, and others in our study, we can come to three conclusions.

When properly designed, the OBDII system can work as advertised, providing good diagnostic information, and solid emissions reductions.

OBDII repairs are straight forward for a skilled technician. The arrival of OBDII will not require a sweeping change of the automotive repair landscape, but rather a continuation and refinement of the diagnostic strategies already in place.

OBDII equipped Vehicles with an illuminated MIL can see a substantial drop in tailpipe emissions, if properly repaired.

Correction

In the March 2005 Gateway Air Repair, the temperatures listed in the article by Angelo Vitullo were mistakenly listed with an additional zero at the end.

In addition, the last sentence of the article was cut off. The final sentence on page 13 of the March issue should read, "One must approach this system with an open mind and be willing to do research." The online edition of the March 2005 issue has been updated with correct information. It may be viewed or downloaded at http://www.gatewaycleanair.com/mechanic/air7_2/casestdy.htm.

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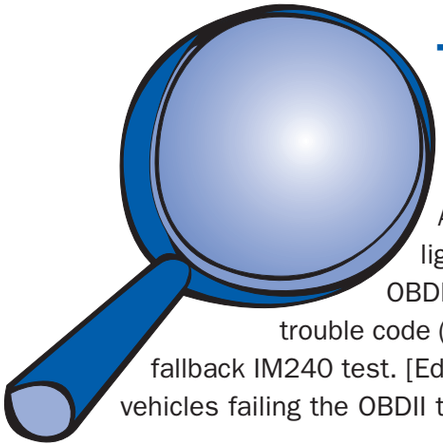


The Baro PID Investigation

By Neil Jost, Missouri Department of Natural Resources

A motorist purchased a 1996 Nissan Maxima with the malfunction indicator light (MIL) illuminated. The vehicle is an automatic V6 with 134,000 miles. An OBDII test at the Manchester emissions testing station indicated that diagnostic trouble code (DTC) P0105 caused the MIL to be commanded "on." The vehicle passed the fallback IM240 test. [Editor's note: as of June 6, 2006, the fallback IM240 test for 1996 and newer vehicles failing the OBDII test will no longer be offered.]

A repair facility evaluated the vehicle and found safety and maintenance issues, including a starter and a Barometric Pressure Sensor replacement. The replacement of the Barometric Pressure Sensor did not turn the MIL "off."

DTC P0105 is "MAP/Barometric Pressure Circuit Malfunction." Based on research using ALLDATA and manufacturer reports, it was determined that 1) the "Baro PID" functions to enable emissions control monitors to run and does not provide combustion control and 2) broken wires in a wiring harness could explain the problem. The vehicle had no drivability symptoms while several non-continuous emissions monitors had not run, including: Catalyst, Evaporative System and EGR System. The vehicle's Comprehensive Components Monitor (CCM) logged the fail related to the Baro PID; but there was no ready conclusion without a successful outcome.

The shop elected to replace the sensor relying on experience rather than a more systematic approach. The shop also elected to clear the codes and turn the MIL "off" via scan tool rather than let the vehicle perform this function. Surprise! The shop could not clear the code with the engine running. The codes cleared with the engine off, but the MIL re-illuminated immediately on startup.

Replacement of the Barometric Pressure Sensor did not correct the problem. Further investigation showed a broken shielded wire. Nissan's recommended solution is to replace the wiring harness, an expensive part. The motorist elected to go with the shop's repair of the shielded wire, gambling that there would be no under hood RF interference. The repair was accomplished and the MIL did not illuminate on startup. Only two readiness monitors showed "not ready" after the repair. The vehicle would have passed the OBDII test at this point. Two unset Readiness Monitors are allowed for model years 1996-2000 (model years 2001 and newer are allowed one unset Readiness Monitor). As of June 6, 2005, GCAP records a Readiness Monitor Fail as a "reject" and retains the motorist's $24 test payment. The owner is granted a sixty-day interval from the date of rejection in which to complete a test without paying an additional test fee.

Following repairs, the vehicle was driven for a couple of weeks and then reevaluated. The MIL was "off" but "pending." Historical codes were observed in a scan of the vehicle using an Ease Diagnostic tool in generic mode. The found codes were the omnipresent P0325 misfire code and a P0150 O2 Sensor Circuit Bank 2/Sensor 1 Malfunction. The previously "not ready" Evaporative System monitor had run during this time. It is likely the Catalyst Efficiency and EGR System monitors did not achieve all the enabling criteria to run. This study did not research enabling criteria. The O2 sensor pre-existing DTC may have kept these monitors from running.

What was learned:

1. A Baro sensor circuit may not affect drivability and control combustion, but its failure can turn the MIL "on." This PID is monitored by the CCM;

continued on next page

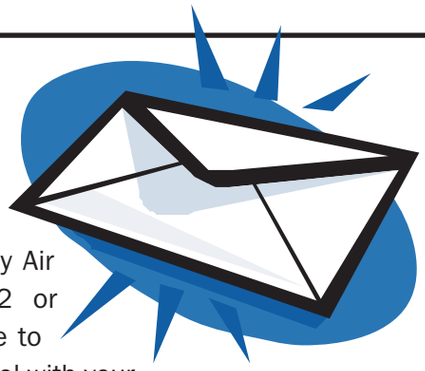
2. The Baro PID as an Input signal to the PCU apparently provided rationality checks that would allow non-continuous monitors to run;

3. Shops need to utilize all possible resources (customer discussion, manufacturer data, Web forums in addition to past shop experiences) in narrowing down the problem so as to avoid needless R/R and to develop the most effective diagnostic logic toward the correct solution;

4. Unavoidably, shops and technicians will learn on the job; it is every shop owner's and technician's responsibility to minimize a reactive mode of performance. Shop Owners should provide technicians with all necessary tools including Web and factory information access. Technicians should keep their knowledge base at a high level with ongoing training, either in the classroom or through independent study; and

5. OBDII systems are a powerful diagnostic tool in reducing the possibilities for repair consideration; technicians with the right tools and well-developed skills will be able to take advantage of it to the benefit of customers and shop owners.

Special Delivery



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Technical Service Bulletin: Mazda6 – Check Engine Light, Emissions Recall Campaigns

Mazda Motor Corporation has determined that a defect exists on certain 2003 model year Mazda6 vehicles produced from October 2, 2002 through February 24, 2003.

On some 2003 Mazda6 vehicles, the Check Engine Light may illuminate under certain conditions and a diagnostic trouble code P2404 may be stored due to improper programming of the Powertrain Control Module (PCM). In July 2003, Mazda issued an Emissions Recall Campaign (1303F) to reprogram the PCM. Owners of affected mail should have been notified by mail. However, owners of vehicles not having received corrective reprogramming are encouraged to visit a Mazda dealership.

In addition, Mazda has determined that a Check Engine Light may illuminate on certain Mazda6 vehicles after an OBDII test if the Data Link Connector (DLC) is unplugged with the engine "on." The Gateway Clean Air Program OBDII testing procedure involves connecting and disconnecting the DLC with the engine "on." Affected vehicles may include 2003-2005 model year Mazda6 vehicles with 2.3L engines and 2004-2005 model year Mazda6 vehicles with 3.0L engines. Faced with this manufacturer defect, Mazda has developed a new calibration to correct the situation. Owners of affected vehicles are encouraged to visit a Mazda dealership for corrective measures.