Inspection Update

A Publication of the Massachusetts Enhanced Emissions and Safety Test Program

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Coming Soon: Pass/Fail OBD Emissions Testing, Other Key Improvements to I&M

The *Enhanced Emissions & Safety Test* will enter an important new phase during the first quarter of 2004 with the introduction of full pass/fail On-Board Diagnostics (OBD) emissions testing for all model year 1996 and newer cars, SUVs and most light trucks. Pre-1996 vehicles will continue to receive the current tailpipe test.

"The OBD emissions test provides benefits for motorists, inspection stations and the environment," said Department of Environmental Protection (DEP) Commissioner Robert W. Golledge Jr. "The new test detects emissions control problems earlier – before they cause more pollution, and become bigger and more expensive to fix – and it checks more systems and functions than the tailpipe test."

OBD testing is also about ten minutes faster than the tailpipe test, Golledge said, meaning shorter lines for motorists and better productivity for stations, who will be able to inspect more vehicles in less time. Inspection stations will not need to buy any new equipment – everything needed to perform the new OBD emissions test is already part of the workstation – but the software is being updated to reflect the shift to pass/fail.

Vehicles that fail the OBD test will no longer get a second chance to pass the emissions part of the inspection by being put on a dynamometer for a tailpipe test. The transition will not affect the 25-point safety portion of the *Enhanced Emissions & Safety Test* or the annual inspection fee, which will remain at $29.

About 60 percent of the cars, light trucks and SUVs registered in Massachusetts will receive the new OBD emissions test. As pre-1996 vehicles are retired from the fleet with each passing year, that percentage will grow. But tailpipe testing will continue until a sufficient number of those vehicles are off the road or the state identifies other options for meeting its clean air goals.

In addition to the rollout of OBD pass/fail testing, several other program improvements have been or are being made:

- **Elimination of the Low-Emitter Profile (LEP).** Until the end of 2003, Massachusetts workstations were programmed to excuse certain "low-emitting" 1996 and newer vehicles from

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Equipment Audit Results Under Review

Enhanced Emissions & Safety Test contractor Agbar Technologies and representatives from two software companies completed audits of emissions testing equipment at all 1,505 Massachusetts inspection stations between October 27 and December 20, 2003.

Conducted in response to concerns raised by the Department of Environmental Protection (DEP) and others about testing equipment maintenance and reliability, the audits focused on four key components to ensure that they were providing accurate measurements:

- Gas bench;
- Leak check;
- VMAS; and
- Gas cap tester.

When the Agbar audit teams found problems with equipment, they made the necessary adjustments and repairs on the spot whenever possible. DEP then performed follow-up audits at nearly 15 percent of the state's inspection stations as an independent quality check.

DEP is currently reviewing the results of its own audits and Agbar's, and expects to issue a formal report within a few weeks. The report will include both short-term and long-range plans for improving the *Enhanced Emissions & Safety Test* program.

Acknowledging that equipment audits disrupted work and slowed customer service at some inspection stations, DEP Commissioner Robert W. Golledge Jr. thanked station owners and personnel for being patient and accommodating.

"Providing an accurate emissions test and a thorough safety inspection as quickly and efficiently as possible is in everyone's

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Are You Ready To Explain *Not Ready?*

Before it can undergo an OBD emissions test, a vehicle needs to be "ready." And that doesn't mean washed, waxed and detailed.

Readiness for OBD emissions testing is determined by the information stored in the vehicle's internal computer: if there's not enough there, the OBD monitor will not allow the test to proceed. The inspector will instead hand the motorist either a rejection sticker on the first attempt or a "turn away" document in the case of a re-test.

"A motorist whose vehicle is rejected or turned away for being 'not ready' is going to be disappointed at best, angry and resentful at worst," said Paul Davis, inspection program manager for DEP. "That is

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All Stations to Receive Information Packet on New OBD Phase of I&M

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tailpipe testing. These vehicles are no longer exempt. They will now receive an OBD emissions test every other year.

- **New OBD help prompts for inspectors.** The new workstation software will make it easier to find a vehicle's connector for an OBD emissions test. It provides a new "look up" screen to help inspectors more quickly locate connectors on all model year 1996 and newer vehicles.
- **Implementation of final tailpipe test conversion factors.** Because the Massachusetts tailpipe test differs from the U.S. Environmental Protection Agency (EPA) model, *Enhanced Emissions & Safety Test* workstations use standard factors to automatically convert raw emissions measurements so they can be compared against federal pass/fail cut points for each pollutant. The interim conversion factors currently in use were based on early experience with the Massachusetts test, but more and better data is now available. The final conversion factors will improve the accuracy of tailpipe tests on pre-1996 vehicles.
- **Phase-in of the final tailpipe test dilution check.** A workstation message will alert inspectors to this change, which is aimed at ensuring proper exhaust collection and improving test accuracy. The dilution check evaluates the amount of carbon in emissions during a test and compares it to a nominal value. If too little carbon is present, the vehicle's exhaust is not being measured accurately. The inspector is required to address the problem – usually improper placement of the exhaust collection cone – and restart the test. Currently, the check is performed at 1.5 times the nominal value. This will be reduced to 1.25 times the nominal value a week or two after OBD rollout, and then finally lowered to the nominal value, giving inspection stations time to become familiar with OBD pass/fail testing before the tailpipe test dilution check becomes more stringent.
- **Mandatory emissions tests when inspections and re-tests are overdue.** Any vehicle that fails for safety and does not pass re-inspection within 60 days will automatically be tested for both safety and emissions the next time it is brought in for an inspection. Likewise, any vehicle that is more than 60 days overdue for an annual inspection that would otherwise be safety-only will also be required to have an emissions test when it is next inspected. This will solve the problem of motorists skipping inspections to avoid emissions test failures.
- **Improved Vehicle Inspection Report (VIR).** For a vehicle that passes its emissions test and/or safety inspection, the VIR will be limited to one page. For a vehicle that fails, the redesigned VIR will explain the drive trace, show why the vehicle failed and list any trouble codes that triggered the failure. As a result, inspectors should find it easier to answer customers' questions and motorists will have a more useful report to consult when shopping for repairs. The new VIR should also print faster, and consume less paper and toner.

To help inspection stations make the transition to full OBD emissions testing, program contractor Agbar Technologies is shipping an information packet to every station. That packet includes:

- **OBD = On-board Diagnostics,** a general brochure that should be given to all motorists whose vehicles receive an OBD emissions test;
- **My Vehicle Failed the OBD Test,** a "palm card" only for motorists whose vehicles fail the OBD test; and
- **OBD Q&A for Inspectors and Repairers,** a sheet that covers key points and is intended to help you answer customers' questions.

If your station does not receive this packet shortly, please call the toll-free Station Support Hotline at 877-297-5552. You should also call the hotline when your inventory of materials runs low and you need to order more. Please note that the old OBD Check "palm cards" should not be distributed once full OBD pass/fail emissions testing is underway. ■

Test Readiness Linked to Stored Information

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why it's crucial for inspectors to be able to explain why a vehicle is not ready for the OBD emissions test and what needs to be done to make it ready."

The OBD system collects data whenever a vehicle is being driven, and it uses this data when the vehicle is brought in for an emissions test to determine if the vehicle passes or fails. In some cases, however, not enough data has been collected and the vehicle's internal computer will indicate that it is "not ready" to provide test results.

When a workstation finds a vehicle "not ready," it is often because the vehicle has recently undergone emissions-related repairs or had its battery disconnected and then reconnected. The usual solution is for the motorist to log at least a week of combined highway and city driving so the internal computer can gather information on the effectiveness of the various engine systems monitored by OBD.

There are two common scenarios that Davis says it is particularly important for inspectors and repair technicians to understand:

- If a vehicle is not brought back "ready" for its re-test within 60 days of the original inspection, the motorist will need to pay an additional $29 for each subsequent OBD re-test, whether the vehicle is "ready" or not. This has the potential to make people angry, both at the inspection station and at the repair shop.
- If a vehicle fails the OBD test because the malfunction indicator light (MIL) was commanded on, and one of the listed diagnostic trouble codes is for the catalyst monitor, then the catalyst monitor *must* be reset to "ready" before the vehicle is brought in for a re-test.

Davis urges inspection stations and repair shops to familiarize themselves with the readiness portion of the *OBD Q&A for Inspectors and Repairers* included in the OBD information packet distributed by program contractor Agbar Technologies.

Readiness is also covered during inspector and repairer courses offered at the state's automotive training institutes, and there is a wealth of data on this topic available to inspectors and repairers through online subscriber services and in manuals published by various manufacturers. *See article on page 4, Web sites on page 9.* ■

Testing and Program Improvements:

Q&A with DEP Commissioner Golledge

More than half of the cars, light trucks and SUVs registered in Massachusetts will soon be getting pass/fail On-Board Diagnostics (OBD) emissions tests instead of tailpipe tests. We sat down recently with Department of Environmental Protection (DEP) Commissioner Robert W. Golledge Jr. to talk about the new test and other program improvements now underway.

Inspection Update: Bob, why is Massachusetts introducing OBD testing?

Golledge: An OBD emissions test has been planned ever since DEP launched the *Enhanced Emissions & Safety Test* in 1999 and is also part of our own continuing effort to improve the Massachusetts program for motorists, inspection stations, the repair industry and the environment. Another motivation is a U.S. Environmental Protection Agency (EPA) requirement that Massachusetts and other states harness the advantages of OBD technology to remain in compliance with the federal Clean Air Act.

IU: How is the OBD emissions test an improvement?

RG: It is faster and more comprehensive than the tailpipe test we have used since 1999. The OBD emissions test should cut about 10 minutes from a typical inspection, shortening lines for motorists and boosting productivity at inspection stations, since they will be able to test more vehicles in less time. OBD testing also checks more systems and functions than the tailpipe test and detects emissions control problems earlier, before they become bigger and more expensive to fix, and cause more air pollution.

IU: Are there other benefits for consumers?

RG: Yes. A vehicle's OBD computer is essentially an "early warning system" that alerts the owner to the need for repairs as soon as emissions control problems develop. An illuminated "check engine" or "service soon" light means the vehicle will not pass its next emissions test. The motorist can then get the vehicle repaired right away and avoid an inspection failure. This saves time and money in the long run, and also improves the quality of the air we breathe.

Robert W. Golledge, Jr.

IU: How soon will OBD testing completely replace the current tailpipe test?

RG: Right away for about 60 percent of the cars, light trucks and SUVs registered in Massachusetts, because they are model year 1996 or newer and have the advanced internal computers that make tailpipe testing unnecessary. We expect to continue using the tailpipe test on pre-1996 vehicles until a large number of them are retired from the fleet, or other options for achieving our air quality goals are available.

IU: Are any changes in store for the existing tailpipe test?

RG: The jury is still out on what we need to do to improve the accuracy and reliability of tailpipe testing equipment currently being used by Massachusetts inspection stations. The program contractor, Agbar Technologies, sent special audit teams across the state in October, November and December to check key testing equipment components at all 1,505 of those stations, and to make repairs whenever necessary. DEP then conducted follow-up audits at about 15 percent of the inspection stations to ensure that their installed testing equipment is properly calibrated and providing accurate measurements. We are reviewing the results of both Agbar and DEP audits now and will have a better idea of what our next steps will be within a few weeks.

IU: What might those steps be?

RG: We are looking at a number of options. It's too soon to narrow down the list. In addition to looking carefully at the results of Agbar and DEP auditing, we are also considering recommendations from EPA and a workgroup we convened late last year. That group, which included NESSARA and AASP, reached consensus on some issues, but not all. The bottom line is that we are committed to delivering the most accurate test and the cleanest air we can, and keeping things as convenient as possible for motorists. ■

Audit Results

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interest," Golledge said. "With support from inspection stations, we have made important progress, but there are still some areas in which the program needs to improve."

Bert Cox, chief of vehicle programs for DEP, participated in a number of the audits and agreed with the Commissioner's assessment. He said most stations he visited had taken steps to ensure that their hoses and probes were in good working order, but many had entered calibrating gas bottle values incorrectly. When the wrong bottle values are entered, the calibration will be off and the equipment won't give accurate readings, Cox said.

At many stations, he explained, the bottle values were not scanning correctly. DEP has advised Agbar of this problem and the contractor is now checking all labels prior to shipment. In the meantime, stations should scan all gas bottles in storage and enter values manually for bottles that do not scan correctly. This is critical.

"The new numbers will automatically fill the fields when the inspector selects the prompt for default values during the three-day calibration," Cox said.

Cox noted that the owners and staff of all the stations he audited "deserve a lot of credit for the way they have embraced this effort to improve the program." ■

Need more information on OBD II?

Call toll-free Station Support Hotline, 877-297-5552.

Or visit *Enhanced Emissions & Safety Test* Web site, http://mass.gov/vehicletest, go to "Inspector & Repair Industry Info," click on OBD link.

Tech Tips Column Uses Nissan as Example

How System Readiness Test Supports OBD II

This article is a reprint of a "Tech Tips" column that appeared in the November 2003 edition of AutoInc. magazine, the official publication of the Automotive Service Association. Although its primary focus is system readiness for OBD emissions testing in Nissan-made vehicles, the article contains information that is general enough to be helpful to inspection stations and repair shops that deal with vehicles from a variety of manufacturers.

An excellent source of all-vehicle information on drive trace patterns that can be used by technicians to reset the readiness status of OBD system monitors after OBD II repairs is the "Motor OBD II Drive Cycle Guide" published by Motor Information Systems, a division of Hearst Business Publishing, Inc. The "Motor OBD II Drive Cycle Guide" encompasses most domestic and imported cars, light trucks, vans and SUVs manufactured between 1996 and 2002.

By Paul Kujawa

The System Readiness Test (SRT) is used to support enhanced emissions inspections on vehicles equipped with on-board diagnostics (OBD) II. As you may know, the engine control module (ECM) performs functional tests on a variety of systems, with some of the more critical systems involved in controlling vehicle emissions being selected to be part of the SRT.

The SRT involves the ECM's self-diagnosis system performing an inspection sequence on a given system, and then displaying through a scanner whether that system has been tested and passed the test. A system that has been tested and passed the test is displayed on the scanner as "complete." A system that has not been tested, or has not passed the test, is displayed on the scanner as "incomplete." Some states require that all SRTs be complete and that no diagnostic trouble codes are present for the vehicle to pass the emissions test. Systems commonly selected to be part of the SRT are catalytic converter operation, oxygen (O_2) sensor operation, O_2 sensor heater operation, EGR system operation and evaporative emission system operation.

On Nissan vehicles, the ECM will perform a functional test of a given system once during each trip, as long as specific vehicle operating conditions are met during that trip. Once the functional test has been completed on a system, the ECM will not perform that test again until the key has been turned off, the engine restarted, the vehicle is driven and operating conditions are once again met.

After two trips of successfully testing a system, the SRT will be displayed on the scanner as complete for that system. It is important to note that if the ECM self-diagnosis memory is cleared, the SRT items will be returned to "incomplete" status.

It's often difficult to meet all of the vehicle operating conditions that are required by the ECM for the ECM to perform the functional test for a given system. This results in an "incomplete" next to a given system and a failed emissions test.

To help meet the operating conditions required by the ECM, a driving pattern was designed that provides information such as engine temperature, engine rpm, vehicle speed, transmission gear position and base fuel schedule. The driving pattern is usually supplied in the factory service manual for a particular vehicle, but the pattern is typically a general driving pattern.

Due to difficulty in completing system readiness testing on many 1996 and 1997 Nissan and Infiniti vehicles, Nissan Motor Corp. released technical service bulletins (Infiniti: No. ITB98-011c and Nissan: No NTB98-018c) containing comprehensive road test driving patterns to enable and ECM to complete the SRT.

Note: These service bulletins have specific individual driving patterns for each of the models Nissan builds and can have different driving patterns within a given model and variables such as Federal or California emissions, manual or automatic transmission and even ECM part number.

If a vehicle comes in for repair due to an incomplete SRT, always check SRT status prior to servicing the vehicle to verify the SRT is still incomplete in case a normal driving pattern had been achieved and the SRT completed since the emissions test indicated an "incomplete" status. If the SRT status is still incomplete:

- The engine needs to be cool (less than full warm) prior to beginning the drive pattern. How cool depends on the model, ECM part number, etc.
- Note the amount of fuel in the tank. On some drive patterns, it is necessary to add fuel (between trips, for example) so there needs to be room in the fuel tank to accept the fuel.
- Perform the correct driving pattern as indicated, making sure to follow it carefully.
- Be sure to complete the entire drive pattern.

When you are trying to complete the SRT, the most important thing is to maintain the correct base fuel (B/Fuel) schedule as indicated on the drive pattern. B/Fuel schedule is an indication of engine load and is shown as the injector milliseconds that should be maintained during the drive cycle. Vehicle speed should be allowed to vary as necessary to maintain the correct B/Fuel schedule during cruise portions of the drive pattern as indicated. Also, when required B/Fuel schedule values are high, it can be easier to maintain the correct B/Fuel schedule by driving up a slight hill in the recommended gear range.

Going down slight inclines can make it easier to maintain lower B/Fuel schedule values. A/C "on" will increase B/Fuel schedule. A/C "off" will lower B/Fuel schedule as well, to help try to maintain the correct B/Fuel schedule as well, to help try to maintain the correct B/Fuel schedule needed to complete the SRT. The SRT can also be helpful in confirming a repair if a diagnostic trouble code had been set that is related to a system covered in the SRT.

After completing the repairs and clearing the code, the vehicle can be driven using the correct drive pattern. If a scanner shows the SRT to be "complete" after the drive pattern has been completed, the repair was likely successful. ■

Paul Kujawa is an IDENTIFX Asian specialist with 22 years of diagnostic and repair experience. He is ASE master and L-1 certified.

Workgroup Proposes Three-Tier Approach To Emissions Testing Equipment Standards

A special short-term workgroup studying possible measures for improving the *Enhanced Emissions & Safety Test* program completed its work on schedule in December 2003 and submitted a report on its findings to Commissioner Robert W. Golledge Jr. of the Massachusetts Department of Environmental Protection (DEP).

DEP convened the workgroup in the aftermath of a report it submitted to the U.S. Environmental Protection Agency (EPA), documenting significant problems with the reliability and maintenance of emissions testing equipment. The report showed that, on days testing equipment was checked, one or more components critical for measuring emissions did not meet specifications in 39 percent of the machines tested.

In addition to strongly endorsing the planned switch to full pass/fail OBD emissions testing for most model year 1996 and newer vehicles *(see article, page 1)*, the workgroup recommended adopting a new three-tier set of testing equipment reliability standards, and explored possible alternatives to the program's current MA31 drive trace. The workgroup also advocated field testing of a more durable alternative to the currently used exhaust probe tip – a key piece of the testing equipment that has been prone to breakage and leaks.

Commissioner Golledge thanked workgroup members – including representatives of the automotive service and repair industry, state and federal officials, and managers at Agbar Technologies, the state's vehicle inspection program contractor – for the time, effort and research they invested in their deliberations.

"After sitting down for the first time in October, the members of this group rolled up their sleeves and did a lot of important work," Golledge said. ""I'm impressed with what they did and how they went about doing it, and I know that their ideas will be helpful as we move forward with various program improvements over the next several months."

Given concerns over equipment reliability, the workgroup paid particular attention to performance standards and recommended a three-tiered approach for addressing equipment problems as they arise:

- **First Tier.** Malfunctions that could substantially affect test accuracy, such as problems with VMAS flow, would prompt an immediate, automatic "lock-out" of the workstation in question. Emissions tests would not resume until the problem is corrected. There would be a very low tolerance for equipment failure in this tier.
- **Second Tier.** Equipment problems with marginal effects on test accuracy, such as analyzers that are slightly out of tolerance, would need to be repaired within four days. A service ticket would be opened and repairs ordered, but the station could continue testing during the four-day repair period. This tier would have a slightly higher tolerance for deviation from standards.
- **Third Tier.** Malfunctions in non-critical or supporting components – those with minimal impact on or no direct linkage with test accuracy – would still need to be repaired within four days. This tier would have the most tolerance for deviation.

In tandem with recommending this "triage" approach for responding to equipment failures in the field, the workgroup also spent considerable time discussing the evaluation of system-wide equipment performance. Among the questions debated:

- What is the best performance this equipment should be able to achieve?
- What is a reasonable reliability standard to require for equipment in use in the field?
- If stations are to be locked out automatically (as in First Tier), what is the maximum number that would be acceptable to be locked out at one time without affecting the program's ability to provide motorists with convenient inspections?

When the workgroup drafted its report to Commissioner Golledge in mid-December, neither Agbar nor DEP had completed their equipment audits at inspection stations across the state (*see article, page 1*), and the workgroup did not therefore have the benefit of reviewing audit data and analysis. So, while no consensus was reached on the reliability rates, a framework for further discussion was created.

"A thorough analysis of the audit data will need to be done before anyone can make definitive recommendations on reliability rates," said Nancy Seidman, director of DEP's Consumer and Transportation Division and chair of the workgroup. "That analysis will identify problem areas and possible solutions."

Turning to whether Massachusetts should try to improve the accuracy of tailpipe emissions tests by changing the drive trace during the state's current contract with Agbar, the workgroup noted that states have no choice but to make a "compromise between convenience, effectiveness, cost and other factors" when choosing among the various traces accepted by the federal government.

"All I/M programs are designed to predict if a car is dirty or clean in comparison to the standard established using the FTP (Federal Test Procedure, a certification laboratory test that can take over 24 hours), and all I/M programs use a shorter test trace than that used in the FTP," the workgroup said in its report to Commissioner Golledge.

The alternatives to the currently used MA31 trace considered by the workgroup were:

- **Acceleration Simulation Mode (ASM).** EPA fully approves ASM, but moving to that test would require a major software change that could take between six months and one year to implement.
- **MA147.** This test is 147 seconds long and could be run on existing equip-

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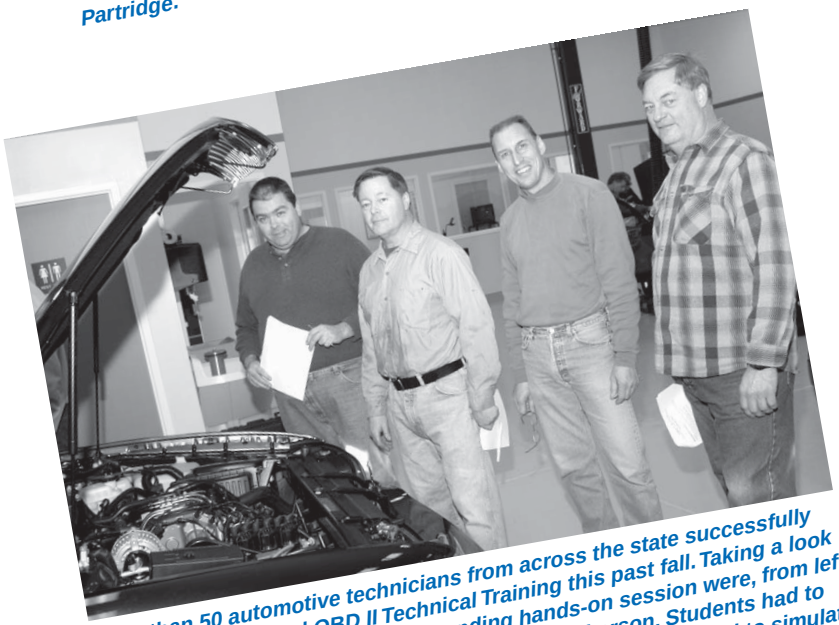
Workgroup Members

Nancy Seidman, DEP, Chair
Bill Cahill, AASP
Jeffrey Choy, AASP
Darrin Greene, Agbar
Terry Hayes, Agbar
Bob Judge, EPA
Mark LaFrance, RMV
Roger Montbleau, NESSARA
Stan Morin, AASP
Jack Pierce, Agbar
Rusty Savignac, NESSARA

Everybody Had a Turn Under the Hoo

Advanced OBD II Technical Training was offered at four locations in Massachusetts this past fall, culminating in four hours of hands-on instruction for all students in a general session at MassBay Technology Center, Ashland. Among those participating in the hands-on session were, from left, Mike Kotarea, Mike Dane, Ernesto Espinal, Joe Gibbons, Mark Subocz and Richard Partridge.



More than 50 automotive technicians from across the state successfully completed Advanced OBD II Technical Training this past fall. Taking a look under the hood during the course-ending hands-on session were, from left, Ted Kajdan, John White, Scott Ganise and John Larson. Students had to evaluate three different vehicles, two of which had been altered to simulate problems detectable through on-board diagnostics, and then make an oral report on their observations and conclusions.

Instructors: OBD No Subs

Craig Van Batenburg likes to tell his students, "OBD is good, but you can be better."

The power of advanced OBD, he means to say, is no match — and no substitute — for the advanced capabilities of the human mind.

"Trouble codes, freeze frame, data stream and monitors are information sources," said Mr. Van Batenburg, a certified emissions repairer who owns and operates the Automotive Career Development Center in Worcester. "They are not specific indicators of whether you should or should not replace a suspect part."

Craig Van Batenburg

Mr. Van Batenburg likens the diagnosis of an emissions failure to a trial where the "indicators nabbed by OBD are proved guilty or innocent."

"Our job as repair technicians," he often says when teaching OBD, "is to put the indicators on the witness stand and get the truth out of them. This requires a sharp analytical intelligence, which is why OBD, even if becomes super-super-advanced, will never replace the critically thinking technician."

This past fall, Mr. Van Batenburg teamed with Bert Cox, chief of vehicle programs for the Massachusetts Department of Environmental Protection, in teaching Advanced OBD II to a group of technicians from the central and western parts of the state. The course was offered at Mr. Van Batenburg's school in association with Massachusetts Bay Community College, which was running the same program at its Technology Center in Ashland.

"Repairers should never change parts just because of a trouble code," said Mr. Cox. "Instead, they should be using the trouble codes to scientifically diagnose and scientifically repair the vehicle."

As an example of how a trouble code can lead a repairer astray, Mr. Cox mentioned what can happen when a vehicle has a fuel pressure problem. "There are no sensors or codes for a fuel pressure problem," he said, "but the fuel pressure problem can trigger other seemingly un-

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stitute for Critical Thinking

related codes, such as 'Misfire,' 'Lean Bank 2' or possibly others. If you haven't looked beyond the code, and if you haven't done a thorough analysis of the problem, you can easily 'fix' the wrong problem, run up a big bill for the customer, and still have a broken car that's producing excessive pollution."

OBD is far more sophisticated and serviceable than when it was introduced in the early 1990s, Mr. Van Batenburg pointed out, "but it is far from the simple solution to every problem that some people want it to be."

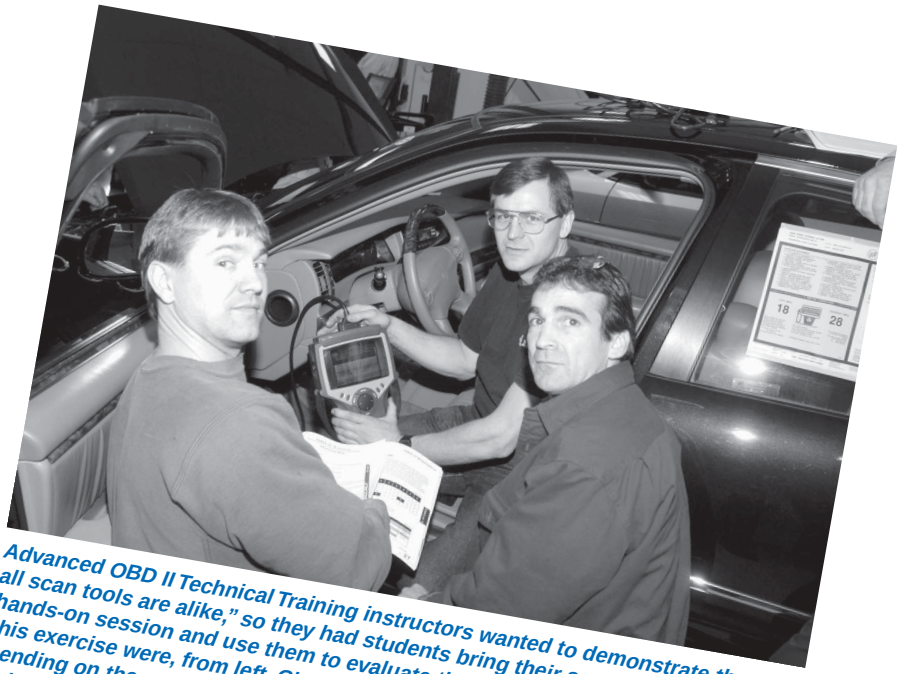

Bert Cox

"Sometimes there are simple solutions to automotive problems, and sometimes the solutions are frustratingly complex," said Mr. Cox. "But I would argue that you cannot know when there is a simple solution unless you have a true understanding of the complexity of today's vehicles, coupled with an ability to deal with the many possible layers and contingencies of a problem."

One develops that kind of understanding and ability, Mr. Van Batenburg and Mr. Cox agree, through training, experience, and independent study and research. They urge all repairers to avail themselves of the continuing opportunities for formal training in Massachusetts, to network with their peers, and to spend time visiting Web sites that contain excellent information on OBD II. *See list of Web sites on Page 9.*

"Repair techs have to invest money and time — lots of time — in their professional development in order to reach their full potential and be seen as professionals in their communities," Mr. Van Batenburg said. "We have to remember: Our profession isn't fixing cars; our profession is cleaning the air."

To contact the subjects of this article, e-mail Craig Van Batenburg at vbginc@ix.netcom.com and Bert Cox at gilbert.cox@state.ma.us. ■


Advanced OBD II Technical Training instructors wanted to demonstrate that "not all scan tools are alike," so they had students bring their scanners to the final hands-on session and use them to evaluate three different vehicles. Performing this exercise were, from left, Chris Unaitis, Bob Powelo and Carl Longo. "Depending on the scan tool used, information may be in many different formats," said instructor Chuck Pearson, "but when the correct diagnostic strategy is applied, the results will be the same."


Instructor Bill Cahill, far left, introduces for discussion a theoretical emissions control problem to Greg Lyman, Rich O'Neil and Ted Kajdan as part of Advanced OBD II Technical Training. "The discussions among the technicians throughout the course were very technical and very spirited," said Mr. Cahill. "And there were a lot of laughs."

Emissions Repair Techs Must Have

By Jeffrey M. Choy

The oxygen (O_2) sensor, a common fix with many enhanced emission failures, can be often misunderstood when it comes to its relationship with other components and conditions. In certain instances, its replacement can even cause emission levels to rise!

No doubt we have all replaced more of these sensors since the start of enhanced emission programs across the country than we did with other symptoms. But do we really understand how this complex device operates, its effect when not working as designed, and how it can be used as a tool for diagnostics before and after its replacement?

O_2 sensor monitoring is critical in determining the overall condition of the fuel management system, as well as other flaws that we may be overlooking in the mix.

Scopes vs. Scan Tools

Generally, there are two ways to observe what our little oxygen analyzer is experiencing: a lab scope or a scan tool. Obviously, most of us grab the latter for ease. Yet, when we use only a scan tool's digital information, are we missing crucial information that could prevent us from seeing the whole picture?

The graphing of parameter identification (PID, or sensor signal) data is useful, and is certainly better than the digital datastream of yesteryear, yet a digital storage oscilloscope (DSO) directly on the circuit in question may yield more complete information. Many believe that our newfangled graphing scan tools will do it all, but with slow processing due to the low data transfer ("baud") rate of the powertrain control module (PCM), they can miss sensor signal drop-outs.

Warning: When using scopes on these sensitive circuits, make sure you're working with the proper cabling, which has the necessary resistance, as you do not want to interrupt the signal you're scoping. And, remember, while the analysis of serial data is easier at the diagnostic link connector (DLC), a two-step confirmation at the PCM will be more instrumental in the accuracy of your diagnosis; hence, there's less chance of getting bitten.

Complex Systems

Relationships we should be aware of with the oxygen sensor are that of the catalytic converter, fuel mapping strategies, OBD II monitor functions and false-air effects. If we do an average number of inspections or emission-related repairs this year, we will encounter every one of these relationships at one time or another.

"Knowing the level of oxygen during various component tests allows us to understand how systems are designed to work, and how well they are performing."

Jeffrey M. Choy

To prepare for these new and not-so-new challenges, let's begin with what we think we understand about oxygen sensor science. Many of us, including this writer, had believed through the years that the way the sensor operated was like this: When high carbon monoxide (CO) is present in the exhaust stream, a lack of oxygen would be the result, in which case the exhaust was known to be rich.

The core of the sensor saw this low oxygen condition and, doing a comparison to the ambient (surrounding) air, calculated the difference and, seeing a greater distance between the values, a voltage increase would occur: less oxygen equals more difference equals more voltage in the circuit. This thought is proportionately correct, yet the way the sensor operates is really quite different. For the purpose of this article, we'll stick with this theory.

Fuel Control

Let's move on to the relationships and flaws that can occur with this critical PCM input. First, our old engineering science used our O_2 sensors primarily for fuel control (trim). By fine-tuning mixture control solenoids to a balance for economy and performance, we would naturally see lower emissions during steady-state driving.

This early method of fuel control is a very important to our understanding of today's inspection and maintenance challenge. Do not make the mistake of confusing the old science with the new. They are worlds apart. Keep in mind that pre-OBD II computers operated at such a low rate of speed that there were limitations on what we could expect from our fuel control strategies. These older vehicles we still see in our inspection lanes and their needs may be vastly different from those that are newer.

To summarize, we had a sensing device that worked well when PCM baud rates were slow, and mechanical devices had limited efficiency. These vehicles were also *not* very intelligent. They did not think like today's PCMs; they might as well have contained mechanical relays in retrospect! These are the vehicles that could possibly run worse with an O_2 sensor replacement due to degeneration of mechanical components, undiscovered flaws in air management systems, and exhaust leakage before the sensor.

It is my opinion and experience that some of these older vehicles on the road today may even perform better with the O_2 sensor disconnected, due to the potential flaws that exist upstream of the sensor. But I would never seriously suggest that. The best approach is simply to fix what is wrong with the vehicle.

Do yourself a favor though: When one of these antiquated vehicles fails in your lane, during your analysis, disconnect the lead and get a baseline of gases with and without the connection. You will likely be very surprised at what you might find. Talk about a quick diagnosis!

Thorough Knowledge of O_2 Sensor

Air Pumps

Our new O_2 feedback systems are really quite different in operation. Due to faster computer processing capacity and electronic fuel injection, we have been able to eliminate costly hang-on components like air pumps and exhaust gas recirculation (EGR) valves. This was why you saw them beginning to vanish from under the hood.

Air pumps have also changed their role from yesteryear; most now operate for merely a few minutes or less during start-up. If you remember, through the '80s, they were in operation from start-up to shutdown, upstream to downstream.

Now, with this new O_2 sensor strategy/operation, we can control/reduce all three gases with the O_2 sensor feedback system and a specially designed catalytic converter ("cat"). By doing these emission-reducing operations electronically, we no longer need these other components and their connections.

There is an unseen benefit to the lack of the plumbing and circuit wiring that controlled these devices. Components that were once in the way of performing many mechanical repairs were likely to be left damaged, unhooked or leaking. Now we don't have to worry about that. (I've always felt that is was a good policy to have the customers receive the vehicles back in better shape than when they brought them in for repairs.) One tiny conductor with resistance or with one split hose inadvertently damaged during repairs surely meant the vehicle's emissions control system would not perform as designed. In fact, it was likely that the vehicle would pollute even more under these conditions. Thank goodness those days are gone.

Cat Chemistry

By the use of an O_2 sensor and a fuel control system that can now switch three or more times faster than before (from lean to rich), we are able to reduce hydrocarbons, carbon monoxide and oxides of nitrogen at the same time. Of course, this can only be accomplished when everything before the (three-way) cat is perfect. In addition, a lazy (slow) O_2 sensor can cause all three gases to increase and a degenerated or contaminated cat substrate will render the whole process useless. These are the new challenges that we are faced with and will increase in complexity with the transition to full pass/fail OBD II emissions testing.

To understand how the three-way catalytic converter works, we must know something about chemistry. Most of us can certainly relate to why we would want a lean mixture, but many may be wondering why we would need intentionally to cause the exhaust gas to go to the rich side. This is one of the most-frequently-asked questions by those just being introduced to enhanced emission failures. The answer lies in the design and chemical makeup of the cat substrate, or honeycomb.

The need for a cat momentarily to switch rich is a requirement for the reduction portion of the converter to reduce oxides of nitrogen, primarily nitric oxide (NO). When oxygen is present during the process, this dangerous gas will pass right through the converter unchanged. This is also why any exhaust leak can render the reduction converter useless. Some NO failures from the inspection lane have been remedied by simply replacing the leaking exhaust component before the cat. This was, of course, after many shops had taken a swing at other things, including the cat itself!

By creating a cycling, momentarily rich condition, the carbon monoxide will gobble up any remaining oxygen from the pre-cat exhaust stream, allowing nasty NO to become CO_2 and N_2 – our happy gases. Formula spelled out: $CO + NO = CO_2 + N$ (which doesn't like to be alone, so it grabs another molecule). By the way, most of us are taking in about 78 percent N_2 with every breath.

The oxidation process is our other goal. When we lean the mixture, we create almost twice the available O_2 to help clean up the hydrocarbons (HC) and carbon monoxide (CO) left from accelerations. Without it, these gases would also continue through the cat unchanged. By the way, our old generation systems delivered 20 times the O_2 in our exhaust manifolds to create a second burn, thus cleaning up HC and CO before the advent of three-way cats that also remove NOx.

So you see a balanced, predictable swing of the O_2 sensor from rich to lean and back again will give us the necessary oxygen, and lack of, to complete all three phases of the catalytic conversion process.

Another unique use for today's O_2 sensor is its role with OBD II. Without proper operation of the sensor, we may not be able to test supplemental air systems, EGR valves and converter degeneration. Keep in mind that we are not able to test the cat for NOx efficiency using an O_2 sensor; typically, only HC reduction is calculated.

Summing It Up

The O_2 sensor is instrumental in component monitoring systems that observe and detect flaws in systems that have absolutely nothing to do with fuel control. Even the evaporative purge system (EVAP) requires the operation of the sensor to evaluate its performance.

Knowing the level of oxygen during various component tests allows us to understand how systems are designed to work, and how well they are performing.

If you take on the challenges of today's I/M failures, including OBD II, your understanding of oxygen and O_2 sensor operation is crucial to making an accurate diagnosis and a successful repair. ■

Jeffrey M. Choy has been a manufacturer representative for various I/M equipment companies. He is an ASPIRE Nationally Accredited Trainer, a Master Trainer and a member of the Council of Advanced Automotive Trainers (CAAT). Recently, he served on the short-term workgroup studying ways to improve the Massachusetts Enhanced Emissions & Safety Test.

Some Web Sites Offering Helpful Info to Repairers

www.iatn.net

www.indentifix.com

www.lindertech.com

www.motorage.com

www.howstuffworks.com

www.hi-tektraining.com

www.asashop.org

www.autoinc.org

www.motor.com

www.nastf.org

A Master Trainer Goes Through the Basics

The Right Way to Check Headlight Alignment

By Karl Schneider

Have you ever seen the light? No, not the light "from above," and not the light at the end of the tunnel that is probably an oncoming train.

I'm talking about the light from a car coming toward you on a two-lane road on a rainy night. When it hits you square in the face, your vision is instantly diminished. And when the wipers sweep the windshield, the problem worsens. Suddenly, that vehicle's misaligned headlights have created a serious hazard.

Misaligned headlights, when shining into your car from behind, can be as big a problem as when they're coming toward you. I've been blinded more times than I can count when beams have hit my rearview mirror the wrong way. Sometimes, the light reflects directly into my eyes and I can't see a thing. So I clutch the wheel and lean to the middle of the car to regain vision and a sense of control over the vehicle.

What about headlights that are more like searchlights? You know, the beams that do a better job illuminating highway signs 20 feet in the air than the road directly in front of the vehicle. (I don't know why, but I always expect these high-shooting beams to be coming from an oversized pick-up truck.)

Proper headlight alignment is vitally important. Lives depend upon it every night.

You may be a new inspector who's still mastering headlight alignment. Or you may have been inspecting cars so long you think that you can do it in your sleep. Regardless, there's something to be gained from reviewing again this crucial component of the safety inspection. While there are several Registry of Motor Vehicles-approved headlight aiming devices, I'll discuss just the "black board," in use at most licensed inspection stations.

Before beginning an alignment check, make sure there's nothing on the vehicle that will interfere with your assessment. For example, there should be no snow or ice on the vehicle or near the headlights, and the vehicle should not be carrying any kind of excessive temporary load.

Start the process by positioning the vehicle squarely in the inspection bay, in accord with the lines painted on the floor, between 10 and 12 feet from the headlight board. (I hope you're keeping those lines sharp; it's one of the first things RMV investigators look for on their periodic inspections!)

Using the approved measuring stick, (which is always at hand because you *do* measure every vehicle), take two measurements. First, measure from the center of the vehicle to the center of the low beam light bulb and record that number. Second, measure from the ground to the center of the low beam light and record that number.

Karl Schneider never turns a blind eye if he sees an inspector doing an improper or incomplete headlight alignment check.

Next, turn on the low beam lights and observe the hot spots on the headlight board. If the lights are properly aligned, the hot spots will be within two inches to the right and two inches down from the measurements you took and carried over to the board. They must *not* be over the height measurement.

Depending on the design of the vehicle's lights, you may or may not have to check the alignment of the high beams.

If the vehicle has separate bulbs for high beams, you will have to check the high beam alignment because they're adjusted with mechanisms separate from the low beams. You measure these kinds of high beams from the center of the vehicle to the center of the high beam bulbs, and from the ground to the center of the high beam bulbs. Then, applying these figures to the headlight board, the hot spot should fall directly on the intersection created by the two measurements.

On vehicles that have one headlight bulb (double filaments) for both low and high beams, you do not have to check high beam alignment — but make sure the lamps have not been installed upside down (illuminating the ground on high beam instead of the area in front of the vehicle), and make sure they are putting out their designated brightness, which is something you do with every lighting device during an inspection.

Other high beam headlights that do *not* require an alignment check are high beam bulbs that are separate from the low beam bulbs, with both encapsulated in one headlight assembly. The low and high beams in such lights are adjusted by a single mechanism on low beam.

Alignment problems sometimes stem from cracked or broken mounting brackets — the "buckets" that hold the bulbs in place. If the beams are to shine correctly, these have to be in good condition. You can fix a problem here only by replacing or fixing the broken pieces.

When checking headlights, make sure that both the high beam switch and the dashboard indicator light for the high beams are working properly. You also have to inspect the lights carefully for cracks and other damage. Moisture enters through even tiny cracks and causes lights to fail prematurely, so you may want to advise the motorist to replace a cracked light in this case.

A headlight problem that often goes unnoticed has to do with the reflective background and plastic lenses. Most bulbs are designed to send the light backward so that it reflects off the background and intensifies greatly as it "bounces" forward. If the background material has faded or peeled, or if the plastic lens is obscured or severely pitted, the light will not shine with the required brightness and the component must be replaced.

The next time you're on the road at night, take a look around for misaligned headlights. You won't have to look long; they're everywhere. Think: The more misalignments you correct at inspection time, the less you and others will be "blinded by the light." ■

Karl Schneider is an ASE-certified L-1 Technician, a Master Technician and a Master Trainer. He operates Karl's Automotive, Inc., Winchendon, MA.

AAA's John Paul Turned a Passion for Cars Into a Successful Career Helping Motorists

"The Car Doctor," a Saturday morning radio show, allows John Paul "to give common sense advice and discuss repairs in English."

He's no longer under the hood, but John Paul, AAA's Manager of Public Affairs & Traffic Safety, is still on top of all things automotive. "The Car Doctor," his car advice radio show, is going strong. He's helping to promote safer roadways, and he's eager to see what the future holds for the automotive industry.

What keeps his motor running?

It all starts with Mr. Paul's love of cars. During his early teens, he saved enough money to buy a car before he even had a license to drive. "I'd skip lunch sometimes and do other things to save the $100 I needed to buy a '63 Rambler. It needed a valve job, but I was thrilled when I finally got it and had a chance to work on it," he said.

Mr. Paul, 48, has been passionate about cars ever since. He enjoyed his tenure as an automotive technician, but as he entered his thirties, the aches and pains associated with working in the shop and a desire for a new challenge led the Abington native to apply for a job at a nearby AAA office in Rockland. Soon after joining as manager of its diagnostic center, Mr. Paul became a regular in AAA's public affairs department, where he would help answer repair questions. His status as an ASE Certified Master Technician and his people skills made him a natural fit for the department when the diagnostic center was closed in 1998. He's been a part of AAA's Southern New England public affairs department in Providence ever since.

In retrospect, the career shift made perfect sense given Mr. Paul's successful guest appearance on the Lovell Dyett show on WBZ radio a few years earlier. "I'll never forget," he said. "It was St. Patrick's Day, and I got a call from public affairs asking if I'd do the show. I almost got lost driving to the studio, but I made it and did OK."

After overcoming some jitters, Mr. Paul realized how much he enjoyed doing radio. He eventually became the host of his own Saturday morning show, "The Car Doctor," on Quincy's 1300 AM and Salem's 1230 AM.

"The show allows me to give common sense advice and discuss repairs in plain English. It's been great," said Mr. Paul, who also hosts a monthly car chat on Boston.com and writes about new cars and all things automotive for AAA's Southern New England monthly publication, *Horizons*, and for AAA's (Merrimack) *Valley News*.

According to Mr. Paul, complex repair lingo contributes to the most common failing on both the repairer and consumer sides: poor communication.

"If your car isn't running properly and is making a noise, you can't drive it to the shop and say, 'It needs a tune-up.' Don't be afraid to make that funny noise to the tech," he said. "They'll have a better idea of what to look for. At the same time, the tech needs to tell the customer exactly what it's going to take to fix the car, and, in some cases, actually show them why their car needs the repair."

"Someone told me, "A good mechanic is not expensive. They're priceless.' That won't ever change."

Keeping up with today's "new" repairs, such as failed on-board computers and faulty electric connections, presents a formidable challenge to everyone involved in the automotive service industry. When Mr. Paul broke into the business, a standard repair manual about the size of the yellow pages fit the bill for most cars. These days, repair manuals contain hundreds of thousands of pages of information. And despite constantly scouring technical service bulletins and adding to his list of ASE certifications, Mr. Paul often finds a whole new world under today's hood.

"I used to be able to pop open the hood and jump right in, but today's car is much different," he said. "I was just looking at a 2004 Subaru, and you could hardly find the spark plugs."

While Mr. Paul sometimes wonders if all the technical advances are worth it, he acknowledges that most have yielded better performance. "Do we really need eight computers in a car to drive to the grocery store? Probably not, but those computers enable techs to diagnose problems more readily. That allows even the cheapest car to go 100,000 miles with just routine maintenance. ■

Short-Term Workgroup Completes Agenda

continued from page 5

ment without requiring a time-consuming or complex transition period. Its major disadvantage is that vehicles need to be brought up to a high speed on the dynamometer (55 miles per hour) and the noise associated with that acceleration can be considerable.

- **MA240.** By adopting this test (an IM240 trace on the existing equipment), Massachusetts would gain additional credit under the federal Clean Air Act for reducing nitrogen oxide (NOx) emissions. As with MA147, however, the MA240 test needs to be conducted at a higher speed and is noisier than the current MA31.

Alliance of Automotive Service Providers (AASP) representatives on the workgroup supported a change to the MA240 test, while members of the New England Service Station and Repair Association (NESSARA) on the panel expressed a preference for ASM, calling it "a simpler and more robust test."

NESSARA said it could be persuaded to support MA240 if a "fast pass" option were included. AASP, on the other hand, said keeping the current MA31 would be better than shifting to the ASM test supported by NESSARA. Members of AASP said ASM tests vehicles "in very limited operating modes, and is not reflective of how the emission control systems are evaluated by the FTP."

The workgroup also decided to recommend heat-testing of an exhaust probe design developed by member Rusty Savignac that features a probe tip end made of high-temperature silicon rubber instead of the standard flexible metal. Savignac told the panel that he has used a prototype of his probe tip for a long time at the shop he co-owns, Paxton Garage in Paxton, and it has held up well. The workgroup wants to know if the silicon rubber in "Rusty's Tip," as the device has come to be known, produces any gases that can corrupt test results when it is warmed by exhaust. ■

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Violations Issued to Stations: 203

Inspectors Required to Retrain: 26

Inspector Privileges Revoked: 12

Inspectors Suspended: 31

Stations Suspended: 82

The direct link to this part of the site is
http://.mass.gov/vehicletest/newsletters.html