Office of the Inspector General

Commonwealth of Massachusetts

Gregory W. Sullivan
Inspector General

Investigation of DEP's Administration of the Massachusetts Motor Vehicle Inspection Program

July 2003

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In 2003, the Office of the Inspector General conducted an investigation of the Massachusetts Department of Environmental Protection's (DEP) administration of the Enhanced Vehicle Inspection and Maintenance Program (I/M Program). The I/M Program requires biennial tests of Massachusetts' automobile emissions for certain gases, including hydrocarbons, oxides of nitrogen, and carbon monoxide. DEP has responsibility for ensuring the accuracy of the automobile emissions tests.

Under the provisions of the Clean Air Act (CAA), Massachusetts is required to submit a proposal to the United States Environmental Protection Agency (EPA) describing in detail its plan to achieve compliance with the CAA. DEP submitted the Massachusetts "State Implementation Plan" (SIP) to the EPA on May 14, 1999, and received conditional approval. Effective January 16, 2001, the EPA granted full approval of Massachusetts' SIP contingent upon Massachusetts' successful completion of a "correlation study to compare IM240 with the Massachusetts 31 second test (MA31 test)."

Based on information obtained during the course of the investigation, the Office found that the DEP had failed to meet the testing requirement in accordance with federal Clean Air Act regulations. The Office review showed that rather than implementing an already-correlated off-the-shelf testing system, DEP officials custom designed a system. DEP's custom-designed testing system, when instituted, produced inordinate variability from test to test. In addition, the Office found that DEP officials had covered-up the results of a federally-mandated independent test of the system conducted in 2001. The results of the independent test showed that the emissions testing system custom-designed by DEP produced overwhelmingly erroneous results.

The Inspector General wrote two letters to Governor Mitt Romney outlining the results of the investigation. The letters recommended that a side-by-side comparison test be conducted as soon as possible of the Massachusetts I/M testing system and the federal

benchmark system. The Inspector General further recommended that the Governor take action to suspend certain DEP officials from any further role in the planning, management, and oversight of a quality-control audit of the I/M Program and that action be taken to protect the integrity of all documents, data, and materials related to that audit process. The two letters are attached.

The Commonwealth of Massachusetts

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July 5, 2003

His Excellency Mitt Romney, Governor
Commonwealth of Massachusetts
State House
Room 360
Boston, MA 02133

Dear Governor Romney,

I am writing to inform you of serious, ongoing problems with the Massachusetts Department of Environmental Protection's (DEP) Enhanced Vehicle Inspection and Maintenance Program (the I/M Program)[1]. Specifically, this Office's investigation has concluded that DEP officials have failed to administer the I/M Program in accordance with federal Clean Air Act regulations. By so doing, DEP officials are currently allowing tens of thousands of vehicles in Massachusetts to emit illegal levels of toxic pollutants into the Massachusetts atmosphere and, by so doing, are jeopardizing future receipt of federal highway funds by the Commonwealth. Furthermore, in 1999, DEP officials instituted a system that has been shown to produce inordinate variability from test to test, thereby, in many cases, subjecting Massachusetts' motorists to invalid rejection stickers and unnecessary repair costs.

The I/M Program biennially tests Massachusetts' automobile emissions for certain gases including hydrocarbons, oxides of nitrogen, and carbon monoxide. Under the provisions of the Clean Air Act (CAA), Massachusetts is required to submit a proposal to the United States Environmental Protection Agency (EPA) describing in detail its plan to achieve compliance with the CAA. This plan, called a State Implementation Plan (SIP), was submitted to the EPA on May 14, 1999 and received conditional approval.

[1] According to the Registry of Motor Vehicles: "The current (I/M) test puts the car on a treadmill-type device called a dynamometer, which will collect and analyze the emissions under simulated driving conditions. Also, the test measures emissions of nitrogen oxides (NOx), not only hydrocarbons (HC) and carbon monoxide (CO), as the former test. Both HC and NOx are key ingredients in the formation of ground-level ozone, or smog... The inspector follows a set procedure, called a driving trace, to test the car for three types of emissions – carbon monoxide (CO), hydrocarbons (HC), and oxides of Nitrogen (NOx)."

Effective January 16, 2001, the EPA granted full approval of Massachusetts' SIP - contingent upon Massachusetts' successful completion of a "correlation study to compare IM240[2] with the Massachusetts 31 second test (MA31 test)." This requirement mirrors the pertinent federal regulation, 40 CFR Section 51, that state:

> § 51.353 Network type and program evaluation.
>
> Basic and enhanced I/M programs can be centralized, decentralized, or a hybrid of the two at the State's discretion, but shall be demonstrated to achieve the same (or better) level of emission reduction as the applicable performance standard described in either § 51.351 or 51.352 of this subpart. [emphasis added] For decentralized programs other than those meeting the design characteristics described in paragraph (a) of this section, the State must demonstrate that the program is achieving the level of effectiveness claimed in the plan within 12 months of the plan's final conditional approval before EPA can convert that approval to a final full approval. The adequacy of these demonstrations will be judged by the Administrator on a case-by-case basis through notice-and-comment rulemaking.

To assess the comparability of the MA31 and IM240 systems, the DEP contracted with a California-based engineering company (testing company) that had earlier designed the EPA's IM240 benchmark test. DEP also chose to use an EPA approved IM240 testing facility in Arizona. The scope of the testing company's contract was to oversee and analyze the Arizona correlation test. A 612-vehicle test occurred in the spring of 2001. DEP used this test data to create EPA-required conversion factors to allow a direct comparison between the MA31 and IM240 tests.

My investigation has concluded that the DEP officials in question have failed to inform the state legislature and the general public about the disturbing results of the federally-mandated test conducted in Arizona in 2001 of the Massachusetts I/M Program. That test showed that the Massachusetts system was producing overwhelmingly erroneous results. In a May 2001 e-mail to DEP, the testing company described the fact that the Massachusetts system was failing twice as many cars as was the federal benchmark emissions test. These results, called "false failures," would result in motorists receiving rejection stickers when they should be passing the test. Thus, many of such motorists would seek emission system repairs to their vehicles instead of receiving the valid inspection sticker they deserve. The testing company wrote, "The false failure rate of 55% is the highest by far ever seen by [the testing company]. The Massachusetts Emission

[2] The IM240 test is the EPA's "gold standard" is a centralized 4 minute emissions test. All state emissions testing protocols are compared to the IM240 test by the EPA before granting approval for the state program.

Test (MA31) failure rate is roughly double that of the [federal benchmark test] IM240."

My investigation has found that DEP officials withheld critical information from and provided misleading information to my investigators in an apparent attempt to fend off criticism of the program and their administration of it. The Clean Air Act regulations link the amount of each state's federal highway funding to the effectiveness of its emission-testing program. Specifically, the EPA requires that unless states use the federal benchmark test system, they must conduct a federally approved independent test of their alternative system and provide the result to the EPA. Based upon the results of the federally mandated independent test, designed to measure the exact correlation between the federal and state tests, EPA is required to establish the amount of emission-reduction credit each state will receive for its I/M Program. These credits are used for the purpose of determining federal highway funding. My investigation has found that following the conclusion of the 2001 test, the testing company advised DEP that Massachusetts' I/M system has inherent flaws that make it impossible to properly correlate highly with the federal system. Thus, the custom-designed I/M program that DEP purchased in 1997 has proven to be technically flawed. By failing to submit data and analysis to the federal government in accordance with the Quality Assurance and Quality Control Plan of the Massachusetts Enhanced Emissions and Safety Inspection Program, dated October 16, 2000, DEP and its testing company appear to have violated federal regulations. No such report has been forwarded to the EPA, according to DEP officials.

Furthermore, in a meeting in December 2002, DEP officials failed to disclose to my investigator and me upon direct questioning that in April and July of 2001 they had altered the I/M Program software that controls Massachusetts' emissions test results. At that December 2002 meeting and in a subsequent report by this Office to then Acting Governor Jane Swift, my Office presented our own test results from a "spot test" the Office conducted of the Massachusetts I/M Program. In that test, five vehicles owned by this Office and its employees, each tested in the preceding months at three Massachusetts I/M testing stations, had inexplicably shown a drop of 40% in the amount of nitrous oxide emitted, compared to emission test results for the same vehicles in 2001. The investigators from my Office explained that none of these vehicles had undergone a tune-up during the intervening period. When I asked DEP officials for an explanation of why such drops in nitrous oxide emissions could have occurred, the officials offered no explanation. Even when I asked directly whether the software had been altered during the intervening period, the officials failed to disclose that DEP had ordered the software to be altered in 2001.

Three months later, after my Office had obtained DEP records concerning the I/M program, the same DEP officials admitted that DEP had, in fact, ordered alteration of the software. When I asked these officials why they had not disclosed this to my Office when directly asked in December 2002, the officials

said that they wanted "to be sure." Subsequent investigation by my Office has shown that the decision to alter the software was a major, controversial issue within DEP, and one that was well known to the officials in question at the time that this Office directly asked about it in December 2002.

At the time of our subsequent meeting with the DEP officials in March 2003, they informed this Office that they had ordered the alteration of the software to match-up our system to the federal benchmark test following a side-by-side test of the state and federal systems in Arizona in 2001. However, subsequent investigation by this Office has found that this explanation by DEP officials is another incomplete and distorted representation of the facts. Documents obtained by this Office tell another story entirely. A non-public, 2001 report produced by the testing company found that the Massachusetts I/M program was producing "false failures" of vehicles at an inordinate rate, compared to the federal benchmark system. In other words, too many vehicles were failing the Massachusetts test that should have passed. After conducting extended statistical analysis, the testing company concluded that Massachusetts faced a problem with no apparent solution. Because of the design of the Massachusetts system, if DEP official were to alter the test to fix the "false failure rate" problem, another problem would be created: too many vehicles would receive "false passes" for other pollutant gases when the vehicles should have failed the test. This would mean that tens of thousands of cars would be allowed to emit illegal levels of pollutants into the atmosphere.

In the course of the investigation, this Office interviewed a DEP technical specialist who worked with the testing consultant company to oversee and implement the Massachusetts I/M program. He told investigators of this Office that the intention of the Arizona study was to determine whether the IM240 and MA31 were equivalent tests. Instead, the tests showed that the MA31 test showed roughly twice the amount of pollution as the IM240 test, measured in grams per mile (GPM) for the same vehicles. When this information came to light, the DEP technical specialist immediately informed the former Branch Chief of the I/M Program about the test results. According to the technical specialist, the former Branch Chief of the I/M program was in denial of the facts. He went on to say that the former Branch Chief told the technical specialist that DEP had to use EPA cut points[3]. and could not change because the "politicians . . . twist our arms." The former Branch Chief repeatedly blamed the "politicians" for the state's having to use EPA cut points. The state would loose federal money if they didn't use the EPA cut points, the former Branch Chief said, according to the DEP technical specialist.

The technical specialist advised that he is sure that Rhode Island dealt with the problem by changing the cut points and not the "actual measurements." Massachusetts, "in an attempt, essentially, to hide what is going on," adjusted

[3] "cut points" are, in layman's terms, the readings - expressed in grams per mile - which determine whether a vehicle passes or fails an emissions test.

the "measurements" in the database . . . by means of software." To compare Massachusetts' readings with Rhode Island's, the data has to be converted to the "same scale." The technical specialist made an analogy using the "Fahrenheit" and "Celsius" scales measuring temperature.

The technical specialist stated, "instead of openly admitting that we have a different scale, and explaining it to everyone, and saying that we just . . . adjusted . . . to make these two measurements comparable, DEP didn't say anything, didn't explain anything, and left the cut points where they were for the IM240 test standard." The technical specialist noted that the cut points had just been tightened to be in compliance with EPA regulations and DEP was reluctant to change them again.

DEP was concerned that they maintain the appearance that "everything is fine, no discrepancies, no changes." The technical specialist described DEP's efforts to keep this information from coming out as "a cover-up."

The technical specialist advised that this cover up hid from the public that the MA31 and IM240 tests produced different emission results and were not comparable to each other. The technical specialist advised that part of the problem rested with the "trace" and equipment differences (between the IM240 and MA31).

The technical specialist advised that the testing company focused their attention on "getting something that the former Branch Chief of the I/M program would like." According to the DEP technical specialist, from the moment the technical specialist mentioned his concerns about the data, the testing company focused on finding someway to manipulate the data to appease the former Branch Chief of the I/M program at the expense of the data.

In the technical specialist's opinion, there is no way to convert this data set from one measurement system to the other with a high degree of accuracy. The technical specialist explained that the nature of mathematics does not permit the easy conversion of one measurement system to another. At this point, the technical specialist believes that it would be easier to describe the nature of "the atom" then the relationship between two traces. The technical specialist believes that "it's impossible" to convert IM240 to MA31 traces using current data sets.

In the technical specialist's opinion, due to flaws in the Arizona test design, the data cannot be made to yield accurate conversion of MA31 to IM240 test results. The technical specialist believes that DEP didn't want to admit that they "goofed" with the MA31 test.

The technical specialist stated, in a June 2001 email to the testing company obtained by this Office, that " . . . lousy data cannot be improved by using

computationally complex methods that might look impressive to a naïve layman . . . "

According to the technical specialist, Massachusetts has approximately 1,500 service stations participating in the program. These stations have either purchased or leased the MASS99[4] equipment from the vendor hired by DEP to implement and administer the Massachusetts I/M Program.

According to the technical specialist, because the MASS99 equipment is so much cheaper that the IM240 equipment, it is not as "fool proof." Because there is no air heater for the ambient air collected, there is greater variability in the test results. The technical specialist advised that if you don't "precondition" the air to remove humidity, the results would have significant variability. According to the technical specialist, the former Branch Chief "sacrificed science to politics."

Records reviewed by this Office reveal that in the spring of 2003, DEP instituted a change in the Massachusetts I/M Program that substituted new problems for old ones. In order to solve some problems with the emissions testing system, DEP instituted a "two-chances to pass system." This new system-fix will not cure the system's problems, according to DEP's testing company, and is likely to substitute false failures for false-passes of polluting vehicles.

This Office recommended to DEP in March 2003 that a side-by-side test comparing the Massachusetts system and the Federal system be conducted. A valid correlation study must be submitted to and approved by the EPA in order to establish the credits necessary for Massachusetts to maximize federal transportation funding.

The Arizona test was designed in part to gather data from six distinct MA31 cycles performed on each vehicle in order to provide data to analyze test-to-test variability, including test driver variability. In DEP's contract with its testing company, the company was required to collect such data for purposes of analysis. Yet DEP officials told this Office that no such analysis has been performed to date, two years after the data was collected. In fact, the correlation test was designed, in part, to determine the level of variability in the MA31 test cycle. The contract between DEP and its testing company provided, in part, the following:

> This entire set of cycles will then be repeated (three MA31 cycles and a MA240 cycle) to gather data for examining test to test variability. Running three of the MA31 humps will also allow evaluation of variations in the MA31 emissions scores and MA31-to-IM140 correlation results due to driver variability (i.e., in matching the target drive trace).

[4] The test equipment used for the Massachusetts IM Program is often referred to as the MASS99 equipment. The testing protocol is usually referred to as the MA31 test.

This Office observed wide variability between test results in the (total of) six Massachusetts cycles performed on each vehicle during the 2001 Arizona study. In many cases, the same vehicle received six widely variant readings, raising serious concerns about the reliability of any particular single test of a single motor vehicle in Massachusetts. The following are examples of some vehicles tested during the Arizona study:

EXAMPLES OF WIDELY VARIABLE EMISSION TEST RESULTS ON MASSACHUSETTS VEHICLES IN 2001 ARIZONA STUDY[5]

Model	1st test Nitrous Oxide g/m	2nd test Nitrous Oxide g/m	3rd test Nitrous Oxide g/m	4th test Nitrous Oxide g/m	5th test Nitrous Oxide g/m	6th test Nitrous Oxide g/m	Percentage High/Low Variability	Fed test g/m
1991 GMC Sierra	13.9	7.5	0.3	1.2	0.2	0.9	7857%	6.9
1991 Chevrolet Astro	10.8	0.9	2.1	0.2	0.5	0.2	4943%	3.4
1989 Chevrolet Cavalier	10.9	0.8	1.9	9.4	8.7	7.2	1317%	5.1
1986 Ford Club Wagon	14.3	4.3	6.2	6.0	5.8	5.1	325%	5.4
1988 Pontiac Grand Prix	9.7	5.1	5.1	2.5	1.7	2.7	559%	2.2
1993 Mazda Protégé	9.2	7.5	6.5	0.2	2.8	3.0	330%	1.6
1990 Nissan 240SX	5.6	7.4	2.6	2.1	1.7	1.5	471%	0.1
1994 Dodge Shadow	5.8	4.8	4.4	3.1	2.6	3.4	220%	1.9
1988 Ford Explorer	1.1	1.0	1.1	6.3	4.8	2.3	616%	0.9
1986 Cadillac Fleetwood	2.2	1.1	1.2	1.0	4.8	5.4	530%	3.1
1991 Chrysler Lebaron	8.1	4.5	5.7	4.3	3.8	4.6	211%	2.1

This data gives examples of the substantial test-to-test variability exhibited during the Massachusetts I/M system test in Arizona.

Below are some quotes taken from a draft DEP report analyzing the results of the correlation study, analyzed by DEP's testing company, following the Arizona test::

> The evaluation of the MA31 test effectiveness showed that the existing test design did not meet the EPA targets for identifying excess hydrocarbons (HC) and oxides of nitrogen (NOx). HC and NOx emissions are a concern because they combine to form ground level ozone in the presence of sunlight. . . .
>
> The data show that the "Fast Pass" test sequence does not meet the SIP target for excess HC emissions identified and falls significantly short for NOx. Based on these data, changes are

[5] The numbers shown in this table are rounded for readability from the original database numbers. Percentage numbers were obtained using original database numbers.

needed to the current Massachusetts program design to meet the SIP targets. . . .

The MA31 test evaluation required development of a Monte Carlo simulation to predict MA31 scores from IM240 scores and use of random sampling of IM240 tests (the AZ 2% data set) to best represent the Massachusetts program. The analysis showed that the MA31 test using the "Fast Pass" test sequence does not meet SIP targets for HC and NOx. As a result, several program changes were explored to determine the optimal method for meeting the SIP targets. By changing the MA31 test to a two-chances-to-pass sequence, the excess HC emissions identified is increased so that it meets the SIP target. However, the excess NOx emissions identified still was significantly below the SIP target. *To meet the NOx SIP target with the MA31 test, the analysis showed it is necessary to increase the NOx conversion factor to the point where false failures become prohibitively high.* (Emphasis added)

To meet the NOx SIP target in the Massachusetts program, it is necessary to implement a different drive, such as the IM240, that is more effective at identifying excess NOx emissions . . .

Our investigation has found that, despite the expressed warning of its testing company that changing from a "Fast Pass" to a "two-chances-to-pass sequence" would cause unacceptably high NOx emissions, DEP made the change to the two-chances-to-pass sequence in March 2003. The testing company had concluded, as shown in its statement above, that the only way to meet the federal NOx target would be to increase the NOx conversion factor to the point where false failures become prohibitively high. Thus, because of inherent problems with the system that DEP had purchased, the Commonwealth was faced with two options. The Commonwealth could either alter its software to correct the NOx readings and allow high false failure rates to occur, or it could alter the software to reduce the false failure rates and allow tens of thousands of Massachusetts motorists to emit illegal levels of NOx pollution into the atmosphere.

This was the problem DEP faced in March 2003 when it opted to adopt a "two-chances-to-pass sequence." As noted above, the testing company offered a third alternative as a solution that could solve both problems simultaneously: the implementation of the federal benchmark test. This analysis by DEP's testing company represents a sobering assessment of Massachusetts' emission testing model.

In conclusion, this Office has seen no evidence that DEP has conducted a scientifically valid correlation study between the MA31 and IM240 tests. According to DEP officials, no side-by-side tests have been conducted since the emission system was modified in 2001. This Office is deeply concerned that the

MA31 emissions test is not properly correlated with EPA's benchmark IM240 test. Without such assurance, the motorists of Massachusetts will be paying millions of dollars for biennial emissions tests that may not accurately identify vehicles that pollute the environment of Massachusetts.

In December 2002, former-Acting Governor Swift asked DEP to conduct a quality assurance audit of the Massachusetts I/M Program, following the issuance of a report by my Office of the I/M Program. Subsequently, the EPA has made the same request. To date, no such audit has been conducted. I recommend that a side-by-side comparison test be conducted as soon as possible of the Massachusetts I/M testing system and the federal benchmark system.

I urge you to address your attention to this important subject matter.

Sincerely,

Gregory W. Sullivan

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July 6, 2003

His Excellency Mitt Romney, Governor
Commonwealth of Massachusetts
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Dear Governor Romney,

In my letter-report yesterday, I informed you of serious, ongoing problems related to the Massachusetts Department of Environmental Protection's (DEP's) Enhanced Vehicle Inspection and Maintenance Program (the I/M Program).

Today, I wish to further recommend that you take action immediately to suspend DEP officials from playing any further role in the planning, management and oversight of an urgently needed quality-control audit of the I/M Program. In December 2002, at my request, former-Secretary of Administration and Finance Kevin Sullivan asked that such an audit be conducted. My Office's investigation of internal DEP documents and e-mail communications has shown that these officials have manipulated data to cover-up serious program inadequacies since Secretary Sullivan ordered that an audit be conducted. Furthermore, I am recommending that you also take action immediately to protect the integrity of all documents, data, and materials related to that audit process, including all materials related to data collected and analyzed by DEP's testing consultant during and following the federally-mandated test of the Massachusetts I/M Program conducted in Arizona in 2001.

In my report yesterday, I explained that the DEP officials in question withheld critical information from and provided misleading information to my investigators during the investigation in an apparent attempt to fend off criticism of the I/M Program and their administration of it. I also reported that these officials violated federal regulations by failing to submit data and analysis from the study to the federal government.

Last December, I requested that EPA Secretary Christy Whitman investigate this matter. Two weeks ago, officials from the office of the Inspector General of the EPA informed my Office that they had begun an investigation.

In order to assure the citizens of Massachusetts that their vehicle emission system is working properly, I believe that independent experts must be engaged to conduct an objective, credible quality-control audit of the reliability of the I/M Program. In order to achieve this result, I believe that the officials who were responsible for procuring and implementing and testing the accuracy of the Massachusetts I/M system should be suspended from participation in the quality control audit of their own work.

Thank you for you attention to this important matter.

Sincerely,

Gregory W. Sullivan

Gregory W. Sullivan
Inspector General