



COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION

2005 Annual Report

Massachusetts Enhanced Emissions and Safety Test
Inspection and Maintenance Program

October 5, 2006

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2005 Annual Report

Massachusetts Enhanced Inspection and Maintenance Program

1 EXECUTIVE SUMMARY

This document is the 2005 Annual Report to the United States Environmental Protection Agency (EPA) on the Massachusetts Enhanced Inspection and Maintenance program (I&M program). This report covers the calendar year January 1 to December 31, 2005.

This Annual Report is required by EPA under 40 CFR 51.366. EPA requires this Report to cover four categories of information:¹

- Station and inspector oversight,
- Quality control,
- Compliance and enforcement, and
- Emissions test data.

In addition, as discussed with EPA-New England and confirmed in an August 16, 2005 letter from MassDEP, this Report summarizes an evaluation of recent program improvements, in terms of their impact on the effectiveness of the Massachusetts emissions test and the program's ability to provide the air quality benefits that Massachusetts committed to in its I&M SIP.

1.1 Major Findings

Emissions Tests Conducted

In 2005, there were approximately 4.6 million vehicles registered in Massachusetts. A biennial emissions test is required for the majority of the fleet. (Exemptions include vehicles less than two years old and pre-1984 vehicles). In 2005, the I&M program conducted initial emissions tests on 1,906,200 unique vehicles (41% of the Massachusetts fleet).

Of the vehicles that received initial emissions tests in 2005, 1,862,000 were gasoline fueled and 44,200 were diesel fueled. Massachusetts is one of the few states that goes beyond EPA requirements by routinely testing heavy duty diesel trucks and buses for excess emissions in order to address the significant health problems associated with diesel exhaust.

In total, the I&M program conducted 2,051,000 gasoline vehicle and diesel vehicle emissions tests in 2005, including initial tests, retests, and off-cycle tests due to change of ownership/registration. All registered vehicles must receive an annual safety inspection.

¹ See "Attachment A: Index of Report Pages Relevant to EPA Regulation Sections" for details about where specific required items appear in this report.

Compliance and Enforcement

As noted above, all vehicles registered in the Commonwealth are required to obtain an annual safety test. Of the 4.6 million vehicles registered in Massachusetts in 2005, 4.5 million (98%) were tested for safety or for safety and emissions.

Of the 1,906,200 gasoline-fueled vehicles receiving initial emissions tests in 2005, all but 42,000 (2.2%) passed the initial test or a subsequent retest, or received a waiver by April 1, 2006. Only 326 waivers from the requirement that failing vehicles pass an emissions re-test were granted in 2005 (0.02% of vehicles receiving initial emissions tests). While some of the vehicles that failed their initial test and did not return for a re-test were taken off the road (with expired registrations), sold out of state, or junked, vehicles failing to receive inspections or emissions tests when required are subject to enforcement by the Registry of Motor Vehicles (RMV).

Emissions Reductions From Transient Tested Vehicles

EPA requires states to calculate emission reductions from vehicles that are repaired after failing a “transient” emissions test (one of the three types of emissions tests used in Massachusetts, which measures specific pollutants in tailpipe exhaust from gasoline-fueled vehicles). Nearly 39,000 transient-tested vehicles that had failed their emissions test in 2005 were successfully repaired and passed a subsequent transient test. These repairs reduced the emissions of those vehicles by an average of 73% for hydrocarbons, 80% for carbon monoxide and 59% for oxides of nitrogen.

Station and Inspector Oversight

In 2005, the RMV performed 6,698 site audits to determine if the inspectors are correctly performing all safety and emissions tests and if the station’s physical conditions continue to meet program requirements. All 1419 stations operating throughout the year received at least one visit. Based on the results of the site audits and other data, the RMV held 459 hearings for stations and issued 271 adverse actions against stations (e.g. license revoked or suspended). During 2005, 5861 licensed inspectors performed at least one test during the year. Based on the results of the site audits and other data, the RMV held 502 hearings for inspectors, and issued 262 adverse actions. The adverse actions taken against inspectors ranged from requiring retraining to revoking licenses.

Program Improvements

In 2005, the accuracy and reliability of emission testing equipment improved significantly, as the result of a contract amendment (No. 4) signed in June 2004 that:

- established specific reliability standards for testing equipment,
- required all testing equipment to be upgraded or replaced, and
- required the contractor to significantly increase its maintenance and monitoring of workstations, to provide early identification of needed adjustments and repairs.

MassDEP continued to audit inspection equipment performance throughout the implementation of the contract amendment. In July 2005, MassDEP started to use its audits to evaluate whether workstations are functioning within the contractually-required

equipment reliability standards (assessing liquidated damages if the standards were not met).

1.2 Summary of Evaluation Conclusions

MassDEP finds that the program improvements established by Contract Amendment No. 4 in June 2004 have substantially improved the reliability and accuracy of the testing equipment, and that the program is delivering its promised air quality benefits:

- Equipment audits conducted since the workstation replacement/upgrade effort was complete have demonstrated that failure rates for equipment components that are critical to accurate identification of excess emissions are consistently below 10%, the standard set in the contract amendment. The failure rate for follow-up audits of these critical components is less than the 5% required by the contract amendment. Section 4 provides detailed equipment audit results.
- The contract amendment's requirements for the contractor to enhance its support for workstation operation and maintenance (as further assurance that the testing equipment reliably provides accurate tests) have contributed to the improvement in audit results. Specifically, the program contractor is required to:
 - Audit each inspection station quarterly to identify equipment that needs to be repaired;
 - Increase its maintenance and monitoring of workstations;
 - Implement comprehensive quality control measures (including Statistical Process Controls) to identify degrading equipment before it fails;
 - Automatically lock workstations out of the computer network when they fail periodic self-checks so they cannot be used until they are repaired; and
 - Provide MassDEP and RMV with improved data and reports that document implementation of these requirements.
- A "Test Effectiveness" study conducted in 2002 (and submitted to EPA in 2003²) identified a 10% shortfall in NO_x emission reductions required by the SIP. Two program changes implemented in 2004 addressed this issue:
 - Contract Amendment No. 4 required that NO_x cells be replaced at all workstations with improved NO_x measurement devices (nondispersive infrared or "NDIR");
 - The program's shift to full-scale use of OBD testing for model year 1996 and newer vehicles in June 2004 reduced reliance on the transient test and began identifying potential NO_x problems before they became serious emission issues.

² Massachusetts Emissions Test Conversion Factor Analysis and Interim Test Effectiveness Evaluation (submitted to US EPA in July 2003, and available at <http://www.vehicletest.state.ma.us/program-reports.html>.)

Modeling (using EPA's MOBILE6 model) indicates that, for 2009, the program will come within 0.1% of meeting its NO_x reduction goal established in the SIP. This difference falls within the model's margin of error, and therefore is not significant. The modeling takes into account the fact that the OBD compliant proportion of the Massachusetts fleet is expected to increase as older vehicles are replaced with newer models, thereby reducing reliance on the transient test. These findings are described in Section 7.

1.3 Contents of This Report

Section 2 of this report describes the Massachusetts I&M Program and provides information on the number of vehicles covered, inspection stations and inspectors, and types of emissions tests administered. The remaining sections of the report describe each of the measures used to evaluate the program, and the results of the analysis:

- Measure 1: Do the Right Vehicles Get Tested? (Section 3)
- Measure 2: Is the Emissions Test Equipment Reliable? (Section 4)
- Measure 3: Station and Inspector Oversight (Section 5)
- Measure 4: Emissions Test Results/Do Failing Vehicles Get Repaired and Pass their Re-test? (Section 6)
- Measure 5: Is the Program Providing the Expected Air Quality Benefits (Section 7)

Attachments contain detailed data on vehicles tested, results of emissions tests, and audit results:

- Attachment A: Index of Report Pages Relevant to EPA Regulation Sections
- Attachment B: Detailed 2005 Emissions Test Data
- Attachment C: 2005 Quality Control Report
- Attachment D: 2005 Test Data by Station

2 THE MASSACHUSETTS I&M PROGRAM

2.1 Why Does Massachusetts Have an I&M Program?

Massachusetts continues to be in non-attainment with federal standards for ground-level ozone pollution. On our “bad air” days, there are increases in asthma attacks and hospitalizations for people with severe respiratory ailments. To reduce the number of “bad air” days and to comply with the Federal Clean Air Act and EPA regulations, Massachusetts must implement a variety of federally mandated programs.³ To reduce pollution from motor vehicles, Massachusetts is required to operate an Enhanced Inspection and Maintenance (I&M) program. The U.S. Environmental Protection Agency (EPA) sets minimum standards for I&M programs⁴.

The current Massachusetts I&M program was authorized by the Legislature by Chapter 210 of the Acts of 1997. The Department of Environmental Protection and the Registry of Motor Vehicles (RMV) jointly administer the Enhanced Emission and Safety Test. The program’s goals are to provide a comprehensive test that provides the emission reductions needed for the Massachusetts SIP, is convenient to motorists, ensures vehicle safety, and works well in local inspection shops. To maximize customer convenience, the legislation combines emissions and safety testing, and requires that the combined test be delivered in local inspection stations, convenient to where people live and work. In January 1999, the Commonwealth contracted with Keating Technologies, Inc.⁵, to supply the inspection equipment and operate the Massachusetts I&M program.

2.1.1 MASSACHUSETTS I&M PROGRAM SUMMARY: VEHICLES SUBJECT TO INSPECTION AND MOTORIST COMPLIANCE

40 CFR 51.366 (d) (1) (i): An estimate of the number of vehicles subject to the inspection program, including the results of an analysis of the registration data base;

In 2005, there were approximately 4.6 million vehicles with active registrations in the Massachusetts fleet. Each vehicle registered in Massachusetts must be inspected annually. All vehicles must receive a safety inspection every year, and the vast majority must receive an emissions test every other year. In 2005, vehicles were exempted from the emissions inspection if they were:

- Model year 1984 or older, or
- Less than 2 years old and still registered to the original owner.

³ These programs are established in legally binding and federally enforceable “State Implementation Plans” or “SIPs”.

⁴ 40 CFR Part 51, Subpart S (§51.350 et seq.).

⁵ In July 2001, the Contractor changed its name to “Agbar Technologies, Inc.”, and in February 2005, changed its name again to “Applus Technologies, Inc”. In this report, the Contractor is referred to as “Applus”, since the firm did business under this name during most of the year covered by this report.

Vehicles are required to receive an emissions inspection within seven days of transfer of ownership, or within seven days of initial registration when entering the Commonwealth. In addition, if a vehicle is more than 60 days late for a scheduled safety-only test, that vehicle also is tested for emissions.

2.1.2 INSPECTION STATIONS

40 CFR 51.366 (b)⁶: (1) The number of inspection stations and lanes:

- (i) Operating throughout the year; and
- (ii) Operating for only part of the year;

Most Massachusetts vehicles receive their inspections at local public stations. The program also allows owners of vehicle fleets to purchase their own testing equipment so they can perform their own tests. The number of public and fleet stations fluctuates as businesses join or leave the program. In 2005, 1,376 stations conducted emissions tests for the public throughout the year, and another 171 conducted tests during part of the year. In addition, 43 fleet stations conducted emissions tests throughout 2005, and 64 fleet stations conducted emissions tests during part of the year.

In Table 1 below, a station must have conducted emissions inspections in each month in 2005 to be counted as “testing all year.” Stations that were licensed for the entire year, but did not test in one or more months are considered “testing for part of the year,” as are stations that entered or left the program during the year. These data include public and fleet stations. A small number of stations have more than one set of inspection equipment (“workstation”). In Massachusetts, the number of workstations is equivalent to the number of lanes in a centralized testing program.

Table 1: Number of Stations and Workstations in 2005

	Workstations ⁷	Stations
Testing All Year	1464	1419
Testing for Part of Year	177	235
Total During Year	1641	1654
Testing in December	1580	1551

⁶For all references to 40 CFR 51.366: 57 FR 52987, Nov. 5, 1992, as amended at 61 FR 40945, Aug. 6, 1996; 65 FR 45534, July 24, 2000; 66 FR 18178, Apr. 5, 2001.

⁷ If a workstation was moved to a different station during 2005, it was counted as a different workstation. Relocated workstations may have tested for all or part of the year. These statistics reflect the circumstances of each relocated workstation.

2.1.3 INSPECTORS

40 CFR 51.366 (b) (5) The number of inspectors licensed or certified to conduct testing;
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Table 2: Number of Inspectors in 2005

	# Of Inspectors
Trained And Licensed on December 31, 2005	6,264
Number of Inspectors Who Inspected at Least One Vehicle in 2005	5,861

2.1.4 EMISSIONS TESTS ADMINISTERED

The Massachusetts I&M Program uses four different emissions tests. Gasoline-fueled vehicles receive one of the following tests: On-Board Diagnostic, transient (tailpipe), or two-speed idle (tailpipe). Diesel-fueled vehicles (heavy duty only) receive a snap acceleration (opacity) test. Each is described below.

1. On-Board Diagnostic: All model year 1996-and-newer gasoline-fueled cars and light trucks have “On Board Diagnostic” (OBD) computers and sensors that assess the condition of the vehicle’s emissions control systems. The emissions test accesses the vehicle’s OBD system to find out whether the emission control system is working properly. Starting on June 15, 2004, all vehicles equipped with modern OBD systems passed or failed their emissions tests based on the data in those systems (Between July 2002 and June 2004, the program made limited use of OBD testing capability for vehicles with this equipment.). In 2005, 68% of vehicles receiving emissions tests were tested using an OBD system.
2. Transient tailpipe tests are used for most gasoline-powered vehicles that are not equipped with modern OBD systems. In this test, vehicles are placed on a dynamometer, a treadmill-like device that puts resistance against the tires to simulate on-road driving. The vehicles are accelerated and decelerated according to a prescribed pattern (“drive trace”), and tailpipe emissions are measured and recorded. Readings for hydrocarbons (HC), Carbon Monoxide (CO) and Oxides of Nitrogen (NOx) are compared to each pollutant’s pass/fail points, which are expressed in grams/mile. The pass/fail points vary by vehicle type [car vs. truck], model year, and, for trucks, by weight category. In 2005, 27% of vehicles receiving emissions tests were tested using the transient test.
3. Two-speed idle (TSI) tests are used for gasoline-fueled vehicles that cannot receive an OBD or transient test. This test measures emissions while the engine is operating at 2500 revolutions per minute with the transmission in neutral, and while the vehicle is idling. The pollutant levels and pass/fail points for TSI tests are measured in concentrations (parts per million for HC, and percent-per-standard volume for CO). This test does not measure emissions of oxides of nitrogen. All vehicles receiving a TSI tailpipe emission

inspection are also visually inspected to confirm that various emissions components, such as the catalytic converter, are present with no apparent tampering. If a vehicle fails the visual inspection, it fails the overall emissions test, even if the vehicle passed the tailpipe portion of the test. Examples of vehicles that receive a TSI test are those with all-wheel drive (where the vehicle cannot be shifted back to two wheel drive) and vehicles weighing more than 10,000 pounds. In 2005, 4% of all vehicles receiving emissions tests were tested using the TSI test.

4. The snap acceleration test uses an opacity meter to identify excess emissions from heavy-duty diesel trucks and buses. While not required by EPA, Massachusetts devotes resources to diesel testing because diesel exhaust is linked to significant health problems. Every diesel truck or bus that is repaired through this program results in an improvement in air quality for children who ride school buses, for people living next to busy urban streets, and for the thousands of Commonwealth residents who suffer from asthma. Diesel testing started in February 2001. In 2005, heavy-duty diesel vehicles comprised 2% of all vehicles receiving an emissions test. Please note that gas caps are tested for most gasoline-fueled vehicles. If a vehicle fails the gas cap test, it fails the overall emissions test, even if the vehicle passed the tailpipe portion of the test.

2.2 Evaluating the Effectiveness of the Massachusetts I&M Program

In 2002 and 2003, evaluations of several aspects of the Massachusetts I&M program indicated that, in two specific ways, the program was not meeting expectations. First, in 2003, the test equipment components that collect and measure exhaust during a transient dynamometer test⁸ failed MassDEP's audit 38% of the time. The failure rate for 2002 was similar (39%). These high failure rates indicated that the tailpipe testing equipment (e.g., the dynamometer and associated equipment) was not identifying excess emissions as accurately or reliably as needed. MassDEP concluded that this failure rate was unacceptable, and that corrective action was necessary to improve performance. MassDEP required the program contractor to audit all workstation performance between October and December 2003, and convened a workgroup with representatives from industry, RMV, and EPA, which met through Fall 2003 to review audit findings. The workgroup submitted its recommendations to Commissioner Robert W. Gолledge, Jr. in a report in December 2003.

These discussions led to an amendment of the Commonwealth's contract with Applus, the program contractor, on June 1, 2004. The contract amendment required Applus to meet specific equipment reliability standards (described in Section 4). To meet those standards, Applus found it necessary to replace one vendor's workstations and to upgrade the remaining workstations. Applus reported to MassDEP that the replacements and upgrades were completed (on schedule) by February 28, 2005. In addition, the contract amendment required Applus to significantly increase its maintenance and monitoring of workstations, and to provide early identification of needed adjustments and repairs.

⁸ Combined gas bench and VMAS audit results: 38% audit failure. See Section 4 and Attachment C for details.

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MassDEP has continued to audit inspection equipment performance throughout this process. In July 2005, MassDEP started to use its audits to evaluate whether workstations were functioning within the contractually-required equipment reliability standards, and to assess liquidated damages when the standards were not met. 2005 audit results are summarized in Section 4.

Second, DEP's 2002 "Massachusetts Emissions Test Conversion Factor Analysis and Interim Test Effectiveness Evaluation"⁹ revealed that the test as implemented at that time fell 10% short of its anticipated NO_x emission reductions. One critical step toward resolving this issue was made by the contract amendment described above, which also required Applus to replace existing NO_x sensors at all workstations with new nondispersive infrared ("NDIR") NO_x sensors by February 28, 2005 (in conjunction with the other equipment upgrades designed to improve test reliability). As noted above, Applus reported that these upgrades had been completed by the deadline. A second critical step toward resolving this issue was the switch in June 2004 to the use of OBD II "Pass/Fail" testing for most vehicles made in model year 1996 and newer. Section 7 describes the resulting improvements in NO_x measurement.

2005 was the first full year in which the program changes required by Contract Amendment #4 were operational. In a letter sent to EPA on July 20, 2005, MassDEP committed to use the 2005 Annual Report to demonstrate how these changes have improved equipment reliability, accuracy and enforcement of the Massachusetts program. The remainder of this report presents the data required by EPA for annual reports, and describes the evaluation of the effectiveness of the Massachusetts I&M Program in 2005 (with the program changes mandated by Contract Amendment #4). The report is organized to reflect several measures of the program's effectiveness:

- Measure #1: Do the right vehicles get tested?
- Measure #2: Is the emissions test equipment reliable?
- Measure #3: Station and inspector oversight
- Measure #4: Do failing vehicles get repaired and pass their retest?
- Measure #5: Is the program providing the expected air quality benefits?

⁹ Submitted to EPA in July 2003.

3 MEASURE #1: DO THE RIGHT VEHICLES GET TESTED?

3.1 Overall Motorist Compliance with Testing Requirements

40 CFR 51.366 (d) (ii): The percentage of motorist compliance based upon a comparison of the number of valid final tests with the number of subject vehicles;

In Massachusetts, the workstation software determines what tests a vehicle will receive each year. Table 3 summarizes the overall 2005 compliance rate, which compares the total number of unique vehicles receiving an I&M test (including safety-only tests) to the average number of unique registered vehicles during the year. In 2005, this compliance rate was 97.1%

Table 3: 2005 Compliance Rates

	Vehicle Count	Compliance %
Overall Testing Compliance Rate		
Vehicles Subject to 2005 Test (Safety Only or Safety and Emissions)	4,607,780	
Unique Vehicles Tested in 2005 (Safety Only or Safety and Emissions Tests)	4,472,965	97.1%

Please note that a compliance rate specifically for emissions tests cannot be calculated due to insufficient data. In 2005, 42,000 of the 176,000 vehicles that failed their initial emissions tests did not get re-tested (the re-test would be considered a “final test” as per EPA’s requirement noted above). However, data indicating the number of vehicles that should have obtained an initial emissions test is not available because the Commonwealth does not track the number of vehicles that are exempt from the emissions testing requirement (those that are less than two model years old, or were made in model year 1984 or earlier).

3.2 Registration File Audits and Compliance with Deadlines

40 CFR 51.366 (d) (2)(ii) [Registration denial based enforcement programs shall provide. . .] The number of registration file audits, number of registrations reviewed, and compliance rates found in such audits. . . .

40 CFR 51.366 (d) (3) Computer-matching based enforcement programs shall provide the following additional information:

(i) The number and percentage of subject vehicles that were tested by the initial deadline, and by other milestones in the cycle;

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The RMV typically completes two scans of the vehicle registration database each month. These registration reviews examine the testing status of each registered vehicle to determine compliance with testing requirements.

Table 4 summarizes the results of these registration reviews for 2005. Please note that the compliance rate is typically higher in the middle of the month than at the start of the month, indicating that a significant number of vehicles were inspected between one day and two weeks after the inspection was due.

A registration-review-based compliance rate understates compliance. Registration reviews determine whether the most recent inspection for each vehicle was performed within the last 12 months and was a "pass." Since the I&M regulations allow up to 60 days for emissions repairs, the registration reviews count vehicles that failed an emissions test as out of compliance, if they have not completed repairs and passed a re-inspection by the time of the registration review. Also, registration reviews only capture compliance status at a particular moment in time. A vehicle that was tested seven weeks late in 2005 would ultimately have been in compliance but would have been counted as out-of-compliance on four registration reviews.

Table 4: 2005 RMV Registration Reviews¹⁰

Date	Active Registrations	Number Non Compliant	Percent In Compliance
1/3/05	4,581,288	538,002	88.3%
1/15/05	4,592,451	485,879	89.4%
2/1/05	4,597,966	577,903	87.4%
3/1/05	4,592,992	584,917	87.3%
3/15/05	4,582,928	515,259	88.8%
4/1/05	4,601,252	576,375	87.5%
4/15/05	4,594,600	498,517	89.2%
5/2/05	4,584,926	557,939	87.8%
5/16/05	4,609,519	496,822	89.9%
6/1/05	4,630,103	571,680	87.7%
6/15/05	4,629,324	494,823	89.3%
7/1/05	4,648,631	579,311	87.5%
10/15/05	4,625,569	467,509	89.9%
11/1/05	4,631,686	584,280	87.4%
11/15/05	4,609,954	505,201	89.0%
12/1/05	4,617,514	575,316	87.5%
12/15/05	4,601,563	506,604	89.0%
Average	4,607,780	536,255	88.4%

¹⁰ While RMV conducted registration scans bi-weekly throughout 2005, data for several scans is not available in either paper or electronic form.

3.2.1 PARKING LOT SURVEYS

40 CFR 51.366 (d) (4) (iii) [Sticker-based enforcement systems shall provide . . .] The number of parking lot sticker audits conducted, the number of vehicles surveyed in each, and the noncompliance rate found during those audits.

Table 5: 2004 Parking Lot Surveys

Parking lot audits conducted	94
Vehicles surveyed	2328
Vehicles with valid inspection stickers	2165
Compliance rate	93%

The RMV's registration enforcement program, originally scheduled to begin in late 2004, had not been implemented by the end of 2005.

3.2.2 RMV COMPLIANCE SURVEYS

40 CFR 51.366 (d) (1) (vi) The number of compliance surveys conducted, number of vehicles surveyed in each, and the compliance rates found;

The RMV conducted registration file audits and parking lot surveys, as described in Sections 3.1.2 and 3.1.3. No other compliance surveys were conducted in 2005.

3.2.3 MOTORIST TIME EXTENSIONS

40 CFR 51.366 (d) (1) (v) The number of time extensions and other exemptions granted to motorists;

No time extensions and other exemptions were granted to motorists, beyond the program's standard exemptions for certain classes of old or new vehicles.

3.2.4 PREVENTING FALSE REGISTRATION BY MOTORISTS

40 CFR 51.366 (d) (2) Registration denial based enforcement programs shall provide the following additional information:

(i) A report of the program's efforts and actions to prevent motorists from falsely registering vehicles out of the program area or falsely changing fuel type or weight class on the vehicle registration, and the results of special studies to investigate the frequency of such activity; and

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40 CFR 51.366 (d) (3) (ii) [Computer-matching based enforcement programs shall provide . . .] A report on the program's efforts to detect and enforce against motorists falsely changing vehicle classifications to circumvent program requirements, and the frequency of this type of activity;

40 CFR 51.366 (d) (4)(ii) [Sticker-based enforcement systems shall provide . . .] A report on the program's efforts to detect and enforce against motorists falsely changing vehicle classifications to circumvent program requirements, and the frequency of this type of activity;

The reporting requirements for efforts to prevent false registration are not relevant to Massachusetts because:

- All of Massachusetts is covered by the program;
- All vehicles are required to be inspected annually for either safety or safety and emissions;
- If a motorist falsely reports fuel type or weight in order to avoid an emissions inspection, the inspector enters corrected data based on his or her examination of the fuel cap and based on vehicle information appearing on the vehicle's door label.

3.2.5 ADDITIONAL STICKER-RELATED ACTIVITIES

40 CFR 51.366 (d) (4) Sticker-based enforcement systems shall provide the following additional information:

(i) A report on the program's efforts to prevent, detect, and enforce against sticker theft and counterfeiting, and the frequency of this type of activity;

To support the state and local police with inspection-sticker motor-vehicle violations, the RMV mailed a detailed memorandum to state and local police departments in the Commonwealth regarding sticker characteristics for 2005.

On a monthly basis, the RMV also analyzed monthly digital audits, which include the number of offline inspections, model year changes, failure rates and emissions testing rates and used the result of the analysis to determine targets for overt audits.

In 2005, state and local police issued 86,145 inspection-sticker motor-vehicle violations.

4 MEASURE 2: IS THE EMISSIONS TEST EQUIPMENT RELIABLE?

40 CFR 51.366 (c) Quality control report. ...Basic statistics on the quality control program for January through December of the previous year, including:

- (1) The number of emission testing sites and lanes in use in the program;
- (2) The number of equipment audits by station and lane;
- (3) The number and percentage of stations that have failed equipment audits; and
- (4) Number and percentage of stations and lanes shut down as a result of equipment audits.

This section summarizes the findings of more than 8,500 audits of emissions testing equipment conducted by MassDEP and Applus Technologies, Inc. in 2005. Please note that the program changes mandated by Contract Amendment No. 4 were largely implemented by the end of February 2005, so audit findings from calendar year 2005 can be used to assess whether the program changes resulted in improvements in equipment reliability and test accuracy. The complete Quality Control Report, with detailed information about the equipment audits and results, can be found in Attachment C.

MassDEP's equipment auditing program is designed to determine whether test-equipment components meet stringent performance standards ("audit criteria") established by the Massachusetts I&M program. Equipment audits are inspections of emissions testing equipment performed throughout the year on site at working inspection stations. Audits are performed overtly and are either randomly selected or targeted. MassDEP's audits are performed by agency staff and SGS Testcom (a MassDEP contractor not connected to Applus).

Applus also audits workstation performance, to ensure that equipment is working properly and to identify maintenance issues. Applus' equipment audits are performed by Applus' staff.

Each state establishes equipment audit criteria and performance standards for its I&M program considering its own program objectives, EPA requirements [40 CFR 363 (c)], and EPA guidance. States can choose to include audit criteria not required by EPA, and some states select performance standards for the equipment audit criteria that differ from EPA guidance. MassDEP's audit criteria are listed in Attachment C.

Massachusetts's criteria are more rigorous and significantly stricter than what EPA requires: while EPA's criteria include 64 checks, Massachusetts' audits cover 88 checks (including everything required by EPA). If a workstation fails to meet one or more of the 88 audit criteria, then that workstation fails the audit, regardless of whether the failure may affect the results of an emissions test. Follow-up audits occurred at stations failing items deemed critical during initial or follow-up audits.

Contract Amendment No. 4 required specific changes in the I&M program that were designed to deal with equipment reliability issues that had been identified through audits in 2002 and 2003. Specifically, the Contract Amendment required:

- Replacing equipment unable to meet new reliability standards;
- Upgrading equipment to improve measurement of nitrogen oxide emissions;
- Upgrading bar code scanners for improved identification of vehicles; and
- Adding computerized test equipment capable of testing newer vehicles equipped with Controller Area Network (“CAN”) On-Board Diagnostic (OBD) systems.

To meet reliability requirements, Applus found it necessary to replace all equipment supplied by one of the program’s two equipment vendors.

The contract amendment mandated specific equipment reliability standards, which in turn required Applus to significantly increase its maintenance and monitoring of workstations, and to provide early identification of needed adjustments and repairs. The new standards ensure that the test equipment works reliably enough that it consistently identifies vehicles with emission systems that need to be repaired. The contract amendment also established specific standards for determining whether the equipment is working at a sufficiently high level of reliability:

- Equipment components that are critical for accurately measuring vehicle emissions (identified as “Tier 1” equipment components) must achieve a 90% reliability rate, based on initial random audits performed by MassDEP or its auditing contractor,¹¹
- Other, less critical equipment components (identified as “Tier 2” equipment components) must achieve an 85% reliability rate, based on initial random audits performed by MassDEP or its auditing contractor; and
- Critical components that are repaired after failing any audit must achieve a 95% reliability rate based on follow-up audits performed by MassDEP or its auditing contractor. (This contract requirement is identified as the “Tier 1 reliability standard for follow-up audits.”)

To ensure that these reliability standards are met, Applus agreed to:

- Audit each inspection station quarterly to identify equipment that needs to be repaired;
- Increase its maintenance and monitoring of workstations;
- Implement comprehensive quality control measures (including Statistical Process Controls) to identify degrading equipment before it fails;
- Automatically lock workstations out of the computer network when they fail periodic self-checks so they cannot be used until they are repaired; and

¹¹ Initial Random Audits are randomly selected using a protocol agreed to by Mass DEP and Applus. MassDEP conducted the first such Initial Random Audits in July 2005.

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- Provide MassDEP and RMV with improved data and reports that document implementation of these requirements.

MassDEP continued to audit the performance of inspection equipment throughout this process. Once Applus advised that the equipment upgrades and replacements were completed in February 2005, MassDEP used audit data to evaluate whether workstations were functioning within the equipment reliability standards, and to hold Applus accountable for deviations.

On December 31, 2005, there were 1543 workstations (lanes) configured to test non-diesel emissions in Massachusetts. In 2005, 1,931 equipment audits were performed at different 1,216 workstations¹². 566 workstations were audited two or more times in 2005.

In 2005, 756 of 1,931 MassDEP equipment audits failed one or more of the 88 audit criteria (described in Attachment C) at a workstation, or 39.2%. This represents continued improvement over the 54.9% failure rate in 2004 and 82.5% failure rate in 2003.

Table 6 below summarizes the results of equipment audits from 2003-2005. Almost all of the failure rates for each audit part were lower in 2005 than in 2004. Failure rates in 2004 were also markedly improved from the 2003 failure rates.

The failure rates were higher in 2005 than in 2004 for only two audit criteria: the gas analyzer visual inspection and the second gas bench audit. For the visual inspection of gas analyzers, the significant new source of failures in 2005 was the delivery of many low-gas calibration gas bottles where the label did not match the bar-code scanned values due to rounding to a different number of decimals for CO₂. For example, if the CO₂ value on the bottle label read 5.98, the scanned value in the workstation was 6.0. During 2005, this inconsistency between the value on the label and the scanned value in the workstation constituted a failure for the gas analyzer visual inspection. In mid-2006, the audit procures were revised so that this rounding issue no longer constituted an audit failure.

Please note that second gas bench audits are conducted only after an initial bench audit failure and a successful calibration. Though the percentage of second bench failures increased from 2004 to 2005, the number of initial failures decreased from 99 failures in 2004 to 59 in 2005. The second bench audit failures were a larger percentage of a smaller group. As a percent of *all* bench audits, second bench failures decreased from 7% in 2004 to 3% in 2005.

¹² Starting in July 2005, MassDEP began to implement a randomly determined audit schedule, to establish a statistical basis for evaluations of workstation performance. While MassDEP's audit program intends to audit each workstation at least once during each 12-month period, the use of randomized scheduling may result in some workstations not being audited during that period. EPA has agreed to the use of this approach for MassDEP's audits.

**Table 6: Equipment Audit Data Summary
2003, 2004, and 2005**

Audit Part	2003 Failure Rate	2004 Failure Rate	2005 Failure Rate
Visual Inspection	7%	6%	4%
Gas Analyzer Visual Inspection	34%	11%	17%
Weather Station	47%	27%	21%
Leak Check	44%	7%	1%
1 st Gas Bench Audit	22%	12%	4%
2 nd Gas Bench Audit ¹³	76%	73%	80%
Gas Cap Tester	17%	7%	2%
Inductive RPM Pickup	2%	3%	1%
OBDII RPM Pickup	1%	1%	<1% ¹⁴
OBDII Tester	5%	1%	<1%
VMAS Visual Inspection	20%	4%	2%
VMAS Dilute O ₂ Sensor	31%	27%	8%
VMAS SAO Flow	11%	4%	2%
Overall Audit Result ¹⁵	83%	55%	39%
Combined Gas Bench and VMAS ¹⁶	38%	32%	12%
Combined Critical Gas Bench/VMAS Audit Items ¹⁷	NA	13%	5%

¹³ Because the 2nd gas bench audit is conducted only after an initial bench audit failure and a successful calibration, a relatively small number of workstations receive a second bench audit (132 in 2003, 99 in 2004, and 59 in 2005).

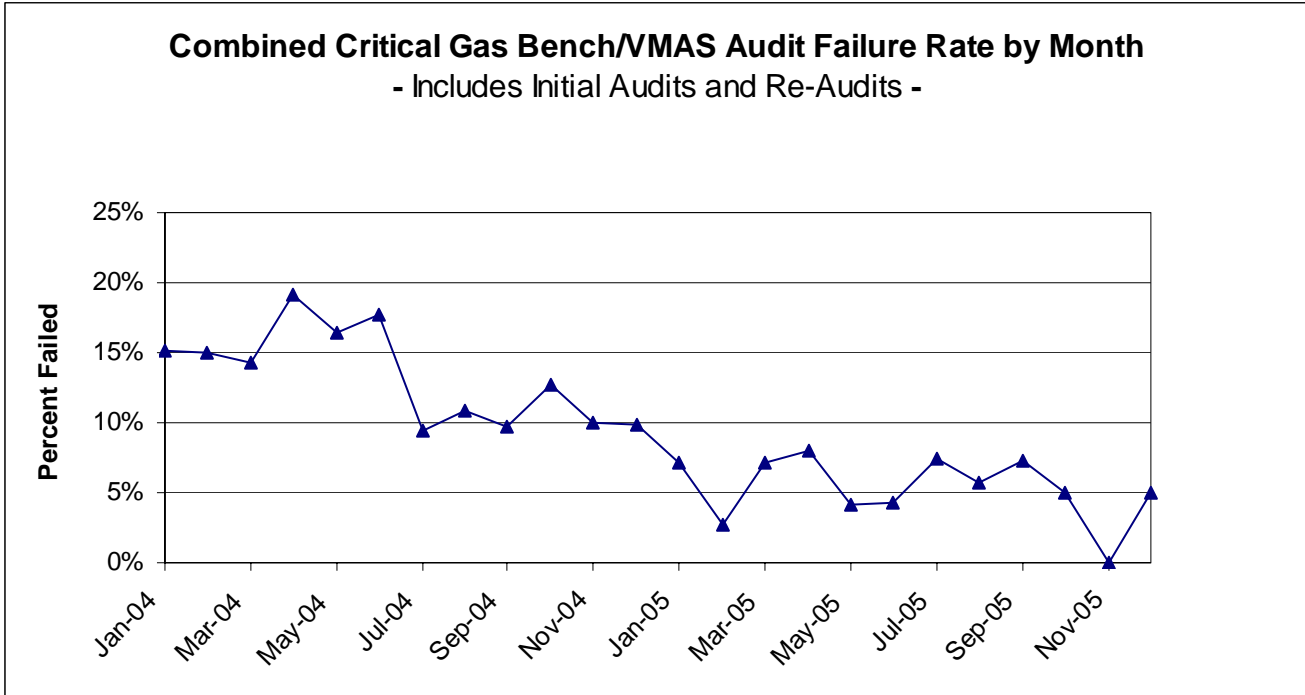
¹⁴ Audit failures less than 1% are indicated as "<1%".

¹⁵ To pass the overall audit, the workstation cannot fail any individual audit part.

¹⁶ Combined results from first gas bench, VMAS dilute O₂, and VMAS flow audits for each workstation audited.

¹⁷ A Critical Gas Bench audit failure occurs when a bench fails its first bench audit, is re-calibrated, and then fails a second bench audit immediately after the calibration. Critical VMAS failure occurs when the VMAS fails the flow audit or 15% dilute O₂ audit. The Combined Critical Gas Bench/VMAS failure occurs when the workstation has a Critical Gas Bench or VMAS failure.

Of the critical workstation components, the accuracy of the gas bench and VMAS has proven to be the most difficult to maintain and is therefore monitored more closely. The following graph presents the critical failure rate for combined gas bench/VMAS audits for 2004 and 2005. The graph highlights the significant improvement in failure rates for these combined critical components during the last half of the 2004, with continued improvements in 2005.



Applus also performs equipment audits using performance standards that are comparable to those used by MassDEP and SGS Testcom. Applus has provided MassDEP with data from their equipment audits conducted in 2005.

**Table 7: Equipment Audit Failure Rate 2005 Comparison
MassDEP and Applus Technologies, Inc.**

Audit Part	2005 MassDEP Failure Rate	2005 Applus Technologies Failure Rate
Visual Inspection	4%	<1%
Gas Analyzer Visual Inspection	17%	18%
Weather Station	21%	NA ¹⁸
Leak Check	1%	2%
1 st Gas Bench Audit	4%	5%
2 nd Gas Bench Audit	80%	NA
Gas Cap Tester	2%	<1%
OBDII RPM Pickup	<1%	NA
OBDII Tester	<1%	NA
VMAS Visual Inspection	2%	2%
VMAS Dilute O2 Sensor	8%	3%
VMAS SAO Flow	2%	2%
Overall Audit Result ¹⁹	39%	26%
Combined Gas Bench and VMAS ²⁰	12%	8%

Please note that Table 7 identifies a few areas where MassDEP and Applus equipment audits found significantly different failure rates. This is due to a few differences in audit procedures. Most significantly, workstation components whose condition would result in a failure of a MassDEP audit are replaced or repaired during Applus' equipment audits. Table 7 identifies audits as "failures" if Applus replaces or repairs a component during the audit. Thus, the audit results reported above reflect the conditions that Applus found upon starting the audit, not the condition of the equipment upon Applus' completion of the audits.

¹⁸ NA means that Applus does not conduct this portion of the audit because they are there to service and audit the equipment and if failures occur during the procedure they do not proceed (e.g., the second bench audit) or may not be concerned with some of the components checked by MassDEP, such as the RPM pick-up

¹⁹ To pass the overall audit, the workstation cannot fail any individual audit part. The Mass DEP audit includes more audit parts than Applus' audit.

²⁰ Combined results from first gas bench, VMAS dilute O2, and VMAS flow audits for each workstation audited.

5 MEASURE 3: STATION AND INSPECTOR OVERSIGHT

In the Massachusetts I&M Program, overt and covert audits are conducted to assess station and inspector performance. The results of each type of audit in 2005 are described in this section.

5.1 Overt Performance Audits

40 CFR 51.366 (b)(2) The number of inspection stations and lanes operating throughout the year:

- (i) Receiving overt performance audits in the year;
- (ii) Not receiving overt performance audits in the year;

The RMV conducts regular site visits/performance audits to determine if the inspectors are correctly performing all tests and the station's physical conditions continue to meet program requirements. RMV staff typically visit inspection stations once per quarter and perform additional visits to follow up on past problems or to investigate stations or inspectors that are suspected of violating regulations based on consumer complaints or data analysis.

Applus (and its subcontractor) maintain records of all inspections in a large computer database to which MassDEP and RMV had access. RMV staff conduct monthly "digital audits" before they visit sites, to identify areas that may need investigation. A "digital audit" is a query of the database for information that may indicate issues warranting attention during the site visit. Digital audit items include the station's inspection failure rate and vehicle characteristics recorded during the inspection that do not match the vehicle information in the registration database.

The RMV site visits cover a wide range of items including:

- Observing inspectors performing an inspection;
- Examining station and inspector licenses;
- Collecting voided inspection stickers and checking to see that stickers are stored in a secure location;
- Examining the inspection equipment and bay;
- Supplementing the inspector's training; and
- Investigating consumer complaints and/or anomalous digital audit findings.

RMV staff prepares a written report summarizing the results of each inspection. Violations of policies or regulations identified at site visits are forwarded to RMV headquarters for possible enforcement action.

In 2005, RMV conducted 6,698 overt station visits/audits. All 1,419 stations that operated throughout the year received at least one audit in 2005, and most stations received an audit each quarter.

5.2 Covert Audits

40 CFR 51.366 (b)(2) The number of inspection stations and lanes operating throughout the year: . . .
 (iii) Receiving covert performance audits in the year;
 (iv) Not receiving covert performance audits in the year;

Covert audits, or "covert performance audits" are under-cover inspections done with vehicles set to fail one or more parts of the emissions test. This section summarizes covert audits performed by Applus. While Registry staff also conduct covert audits as part of their enforcement activities, their covert audits are not included in the following tables.

Stations are selected for covert audits for four reasons, as described in Table 8.

Table 8: 2005 Covert Audit Selection Criteria

Selection Criteria	Count of Audits
Mass DEP or RMV Request	28
Data Analysis	563
Motorist Complaint	1
Random Selection	1209
No Reason Listed	8
TOTAL 2005 COVERT AUDITS	1809

Some stations received more than one covert audit.

Table 9: 2005 Covert Audits Per Station

Number of Audits Per Station	Count of Stations
1	400
2	537
3	97
4	11
5	0
Total Number of Stations Audited	1045
Total Number of 2005 Audits	1809

5.2.1 COVERT AUDIT VEHICLES AND INSPECTORS

40 CFR 51.366 (b) (8) The total number of covert vehicles available for undercover audits over the year;

Covert audit vehicles are selected in order to represent the range of vehicle technology groups (e.g., carbureted and fuel-injected vehicles) covered by the program. Thirteen

vehicles (of the vehicle types and technologies listed in Table 12) were used for covert audits in 2005.

40 CFR 51.366 (b) (9) The number of covert auditors available for undercover audits.

Covert auditors are re-certified on an annual basis to perform covert vehicle and visual audits.

Table 10: Covert Auditors²¹ in 2005

Number of full time auditors on staff at all times during 2005	5
Total full time auditors employed during 2005	6
Additional personnel trained and certified to perform covert audits	10

5.2.2 NUMBER OF COVERT AUDITS CONDUCTED IN 2005

Covert vehicles are set up in one of two ways:

- set to fail the tailpipe test, or
- set to fail both tailpipe and gas cap tests.

Table 11 (below) summarizes the number of covert audits conducted during 2005 for each type of inspection station.

²¹ Though the RMV conducts both covert performance audits and covert visual audits as part of their investigations, the RMV auditors are not included in the counts of covert auditors.

Table 11: Number of Stations and Covert Audits in 2005 with Undercover Vehicles Set to Fail

		2005 # of Stations ²³	2005 Covert Audits ²²	
			Audited Stations ²⁴	# Of Audits
Operating Throughout the Year	Fleet stations	43	0	0
	Public stations	1,376	969	1,719
	All stations	1,419	969	1,719
Operating Part of the Year	Fleet stations	64	0	0
	Public Stations	171	76	90
	All stations	235	76	90
TOTAL		1,654	1045	1,890

5.2.3 COVERT AUDIT RESULTS

40 CFR 51.366 (b) (3) The number of covert audits:

- (i) Conducted with the vehicle set to fail per test type;
- (ii) Conducted with the vehicle set to fail any combination of two or more test types;
- (iii) Resulting in a false pass per test type;
- (iv) Resulting in a false pass for any combination of two or more test types;

A “false pass” on a covert audit is an inspection that passes a vehicle that was set to fail. The covert audit does not indicate whether the cause of a false pass was related to the equipment or the inspector. Follow-up investigations conducted by Applus and the RMV address the cause of any false passes.

RMV staff investigates false passes and, as part of their visit, initiates enforcement actions and/or provides supplementary inspector training on proper test procedures. RMV refers information about possible systemic emissions equipment problems to MassDEP for follow-up.

²² Only public stations can receive covert audits because fleet stations only test vehicles that are part of the company’s fleet, making it impossible for Applus to present a covert, or "undercover" vehicle for testing.

²³ In order to be considered "operating throughout the year" a station must have conducted at least one emissions test during each month of the year.

²⁴ Covert audits for lanes are not reported. The covert auditors do not have control over which lane (workstation) is used.

Table 12 summarizes the number of covert audits conducted by the I&M network contractor in 2005 and the number of false passes on the audits:

- 23% of covert audits resulted in false passes.
- The majority of the false passes were for the gas cap test, with 72% of gas cap audits resulting in a false pass. (The falsely passing gas caps were 21% of all covert audits.)
- Tailpipe tests falsely passed on 2.1% of the covert audits.
- 1.1% of the covert audits that should have received an emissions test received a safety-only test, and 2.4% of the audits received an alternate emissions test (nearly half of these tests switched from transient to TSI test).

Because of the exceptionally high audit failure rates for gas caps, the number of gas cap audits was reduced compared to past years and issues with the gas cap testing equipment were investigated. Problems with gas cap testers were addressed by the Commonwealth and Applus in Contract Amendment No. 4, in which the contractor agreed to replace and upgrade the testing equipment and to meet rigorous equipment reliability standards.

Since more than 30% of covert audits are prompted by suspected problems at stations, the percentage of false passes for the fleet as a whole may be lower than the false-pass rate for covert audits.

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Table 12: 2005 Covert Audit Results²⁵

Model Year	Vehicle Type ²⁶ & Technology	Type of "Tailpipe Failure"	# of Audits				# of Audits Falsely Passing		
			Set to Fail Tailpipe	Set to Fail Gas Cap ²⁷	Safety Only Test	Alternate Tailpipe Test	Tailpipe	Gas Cap	Falsely Pass At Least One When Set To Fail Both ²⁸
1984-1987	LDGV & LDGT	HC and/or CO Failure	96	96	4	1	4	67	68
1988-1995	LDGV & LDGT	HC and/or CO Failure	674	260	12	19	13	212	213
		NOx Failure	657	119	1	9	18	74	74
1996 +	LDGV & LDGT, OBDII equipped	HC and/or CO failure and MIL illumination	0	0	0	0	0	0	0
		NOx failure and MIL illumination	0	0	0	0	0	0	0
		MIL illumination but no NOx failure	252	30	2	9	2	17	17
		MIL illumination but no HC and/or CO failure	92	21	0	0	0	11	11
Any	LDGV, AWD ²⁹	HC and/or CO Failure	16	0	0	5	1	0	0
Total			1787	526	19	43	38	381	383
Percent Falsely Passing							2.1%	72%	73%
% of all audits					1.1%	2.4%	2.1%	21%	21%
Total Audits		1787							
# Falsely Passing One or More Items		414							
% of Total Audits Falsely Passing One or More Items		23%							

²⁵ The Registry also conducts covert audits as part of some of its investigations. Registry audits are not included in the "Covert Audit Results" table.

²⁶ LDGV: light duty gasoline vehicle; LDGT: light duty gasoline truck

²⁷ All audits set to fail the gas cap test were also set to fail a tailpipe test.

²⁸ False passes counted in "Falsely Pass When Set To Fail Both" are also counted in the columns "Falsely Pass Gas Cap" and "Falsely Pass Tailpipe," but does not equal the sum of the two prior columns because some vehicles falsely passed both the tail pipe and gas cap portion of the inspection.

²⁹ The all-wheel drive (AWD) covert audit vehicle requires a two speed idle test. All other audit vehicles should receive transient tests.

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5.2.4 STATION AND INSPECTOR HEARING RESULTS

40 CFR 51.366 (b) (6) The number of hearings:
 (i) Held to consider adverse actions against inspectors and stations; and
 (ii) Resulting in adverse actions against inspectors and stations;

40 CFR 51.366 (b) (4) The number of inspectors and stations:
 (i) That were suspended, fired, or otherwise prohibited from testing as a result of covert audits;
 (ii) That were suspended, fired, or otherwise prohibited from testing for other causes; and

40 CFR 51.366 (b)(2) The number of inspection stations and lanes operating throughout the year: . . .
 (v) That have been shut down as a result of overt performance audits;

The following table summarizes the results of the Registry’s hearings for stations and inspectors, and tabulates the written violations issued to stations and inspectors.³⁰

Table 13: 2005 Audit and Enforcement Statistics

	Overt Audits	Covert Audits	Total
Stations			
Total Number of Written Violations	521	34	555
Warning Letters (no hearing)	75	2	77
Other	18	1	19
Total Number of Hearings	428	31	459
Revoke	8	1	9
Suspensions	243	19	262
Warnings	156	11	167
No action taken	21	0	21
Inspectors			
Total Number of Written Violations	545	39	584
Warning Letters (no hearing)	67	3	70
Total Number of Hearings	467	35	502
Revoke	17	2	19
Suspensions	219	12	231
Retraining	10	2	12
Warnings	208	19	227
No action taken	13	0	13

³⁰ A tally of the adverse actions, such as “cease and desist,” that were instituted on-site before the hearings is not available.

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5.2.5 FINES COLLECTED

40 CFR 51.366 (b) (4) The number of inspectors and stations: . . . (iii) That received fines; 40 CFR 51.366 (b) (7) The total amount collected in fines from inspectors and stations by type of violation;

Massachusetts does not collect fines from stations or inspectors.

5.2.6 STATION COMPLIANCE DOCUMENTS - ISSUED AND MISSING DOCUMENTS

40 CFR 51.366 (d) (1) (iii) The total number of compliance documents issued to inspection stations; (iv) The number of missing compliance documents;

Stations were issued 5,425,932 stickers in 2005. A total of 638 stickers were “unaccounted for” in 2005. These include stickers that were damaged, misprinted, or were otherwise defective, and damaged stickers that were picked up by the RMV on site visits. Specific data describing the 638 “unaccounted for” stickers is not available.

6 MEASURE 4: EMISSIONS TEST RESULTS/DO FAILING VEHICLES GET REPAIRED AND PASS THEIR RE-TEST?

Of the 1,906,000 unique vehicles that received an initial emissions test during 2005, 176,000 (or 9.2%) failed their initial test. The Massachusetts Program requires that the vehicle be repaired and re-tested within 60 days of the failing test.

Table 13 summarizes the failure rates for tailpipe tests of emissions in Massachusetts for 2004:

Table 14: 2005 Failure Rate for Tailpipe Emissions Tests

	Initial Emissions Failure Rate ³¹		
	Model Years 1984-1995	Model Years 1996 and newer ³²	Total
Gasoline-Fueled Vehicles	11.4%	8.6%	9.4%
Diesel fueled	3.6%	0.5%	1.5%
All Initial Emissions Tests	11.2%	8.4%	9.2%

Please note:

- Three-quarters of the vehicles that failed their initial emissions test passed a re-test (76%, presumably by having the problem that caused them to fail repaired).
- A very few vehicles were repaired but were still not able to pass a re-test, and were granted a waiver of the emission requirements. In 2005, waivers were granted for 326 vehicles (or 0.19% of the vehicles that failed their initial emissions test).
- Of the vehicles that failed their initial test during 2005, 41,950 (or 24%) had neither passed a re-test nor obtained a waiver by April 15, 2006.
- Massachusetts started OBD II “Pass Fail” testing on June 15, 2004, for most³³ 1996 and newer vehicles. For the OBDII test, the inspector downloads data from the vehicle's computer regarding its emission control system and those data are used to determine the exhaust emission test result. However, until December 8, 2005, vehicles that did not communicate with the workstation's OBDII test equipment received a tailpipe test. This policy was needed to

³¹ The emissions failure rates only consider OBD and tailpipe results, and do not take into account visual or gas cap failures.

³² For Model Years 1996 and newer, most vehicles received an OBDII test.

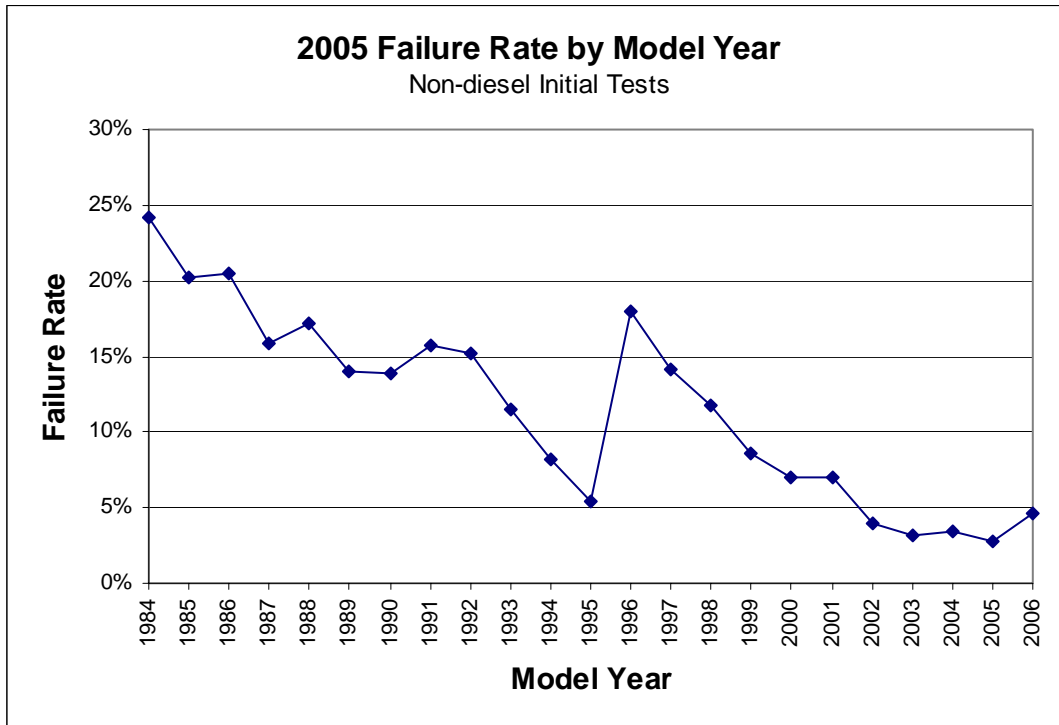
³³ A limited number of vehicles that are 1996 model years or newer are not equipped with OBDII compliant equipment, or can not be OBDII tested. These vehicles receive a tailpipe test.

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prevent false failures due to potential communication problems with the OBDII test equipment. During this period, several brands of older OBDII test equipment were phased out and replaced with new CAN-compatible OBDII test equipment. Starting December 8, 2005, vehicles that do not communicate with the workstation's OBDII test equipment fail the OBDII test and overall emissions test.

Details of all 2005 emissions test results are included in Attachment B.

The following figure shows 2005 emissions failure rates by model year for gasoline-fueled vehicles. As can be seen, the age of the vehicle has a significant impact on failure rate. The Massachusetts I&M program is not designed to achieve a specific overall failure rate or a specific failure rate for any particular test or type of vehicle.



7 MEASURE #5: IS THE PROGRAM PROVIDING THE EXPECTED AIR QUALITY BENEFITS?

This section reports on estimates of emission reductions resulting from vehicles that were repaired after failing a “transient” emissions test in 2005, and on modeling that estimates the overall air quality impacts of the Massachusetts I&M Program. Each is described below.

7.1 Emission Reductions from Repaired Transient-tested Vehicles in 2005

51.366(a) (5) The average increase or decrease in tailpipe emission levels for HC, CO, and NOx (if applicable) after repairs by model year and vehicle type for vehicles receiving a mass emissions test.

EPA requires states to calculate emission reductions from vehicles that are repaired after failing a “transient” emissions test³⁴. Approximately 39,000 transient-tested vehicles that had failed their initial emissions test in 2005 were successfully repaired and passed a subsequent transient test. These repairs reduced the emissions of those vehicles by an average of 73% for hydrocarbons, 80% for carbon monoxide and 59% for oxides of nitrogen.

Section 5 of Attachment B describes the average change in emissions measured by the transient test after repairs, by model year and vehicle type.

7.2 Overall Assessment of Air Quality Benefits from the Massachusetts I&M Program

When Massachusetts designed its I&M program in the late 1990s, it decided not to adopt the EPA IM240 test. Instead, it selected a test that uses less expensive analytical equipment (MASS99), a shorter testing time (the “MA 31” drive trace), and lower speeds than IM240.

These compromises helped keep the inspection fee that motorists pay below what most other states charge, cut equipment costs to inspection stations almost in half, and reduced the amount of time that motorists spent getting tested. However, these compromises also raised a question about whether the Massachusetts tests were equally as effective as the federal IM240 test in terms of identifying excess emissions of hydrocarbons, carbon monoxide, and nitrogen oxide.

³⁴ One of the three types of emissions tests used in Massachusetts, which measures specific pollutants in tailpipe exhaust from gasoline-fueled vehicles

EPA's approval of the design of the Massachusetts program in 2000³⁵ required MassDEP to conduct a study to determine the appropriate Massachusetts-specific factors to be used in converting emissions measured via the Massachusetts test to IM240-equivalent values, to determine a vehicle's pass/fail status. Study results were submitted to EPA in July 2003, in a report titled "Massachusetts Emissions Test Conversion Factor Analysis and Interim Test Effectiveness Evaluation".³⁶

The Interim Test Effectiveness Evaluation found that the Massachusetts test was accurate enough to exceed EPA targets for hydrocarbons and carbon monoxide, but was only identifying 75% of excess emissions of nitrogen oxide, rather than the 85% that was committed to in Massachusetts' one-hour ozone SIP³⁷. With assistance from a stakeholder workgroup that was also developing recommendations to improve the reliability of the equipment used for transient emissions tests, MassDEP determined that the NOx cells used to measure emissions needed to be replaced with new nondispersive infrared or "NDIR" cells. The NDIR NOx cells provide:

- A faster response to changing NOx concentrations, which increases the system's ability to capture emissions as they fluctuate during the MA31 test;
- Reduced interference from water vapor; and
- More reliable operation over a longer lifetime, which reduces equipment variability and provides more consistent test results.

Contract Amendment No. 4 required Applus, the program contractor, to replace the test equipment's NOx cells, as part of a larger effort to upgrade the test equipment. The contractor reported that the equipment upgrades and replacements were complete by February 28, 2005.

Also, the June 2004 switch to full OBD testing for model year 1996 and newer vehicles has improved the program's ability to identify excess NOx emissions. OBD tests use data stored in the vehicle's computer to identify problems with emission control systems, but do not actually measure specific pollutants in tailpipe emissions. OBD testing identifies vehicles with malfunctioning emission control systems, and also identifies systems or components that have begun to drift from established criteria. Therefore, the OBD test fails vehicles with a wider range of problems that may cause excess NOx emissions than the transient test.

In a letter submitted to EPA on August 16, 2005³⁸, MassDEP described the results of MOBILE6 modeling to predict vehicle emissions in 2009 (which is the benchmark year

³⁵ EPA approvals were issued as Federal Register notices on 9/27/99 (64 FR 51937), 11/30/00 (64 FR 66831), 11/15/00 (65 FR 68898), and 11/16/00 (65 FR 69254).

³⁶ Massachusetts Emissions Test Conversion Factor Analysis and Interim Test Effectiveness Evaluation (submitted to US EPA in July 2003, available at <http://www.vehicletest.state.ma.us/program-reports.html>).

³⁷ 1997 and 1999 MassDEP submittals to USEPA as approved in 64 FR 51937 and 64 FR 66831

³⁸ Letter from Nancy L. Seidman, Director of Consumer and Transportation Division, MassDEP Bureau of Waste Prevention, to David B. Conroy, Air Quality Planning Unit, EPA-New England, August 16, 2005.

for the 8-hour ozone SIP), and documented that the improvements in identifying excess NO_x emissions are adequate to meet Massachusetts commitments under its SIP.

MOBILE6 modeling was used to compare vehicle emissions using an I&M program designed to achieve reductions in NO_x of 75% and 85%. This analysis shows that, in 2009, the Massachusetts program as currently designed will reduce NO_x emissions to 203 tons per summer day (tpsd), approximately 0.1% (or 0.2 tpsd) less than a program designed to achieve an 85% NO_x reduction. This difference falls within the model's margin of error, and is therefore not significant. Fleet turnover and the expected growth in the proportion of OBD compliance vehicles from 68% of vehicles tested in 2005 to 88% in 2009 assist in this improvement, along with improved identification of excess NO_x emissions during dynamometer tests using the NDIR equipment. However, the increased use of OBD makes the Massachusetts program much less reliant on transient testing.

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Attachment A: Index of Report Pages Relevant to EPA Regulation Sections

Massachusetts Enhanced Emissions and Safety Test
Inspection and Maintenance Program

October 2006

Attachment A: Index of Report Pages Relevant to EPA Regulation Sections

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