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BIENNIAL EVALUATION OF CONNECTICUT'S INSPECTION/MAINTENANCE PROGRAM

2012 and 2013

AND

ANNUAL EVALUATION OF CONNECTICUT'S INSPECTION/MAINTENANCE PROGRAM

2013

FINAL REPORT

Prepared for:

Connecticut Department of Energy and Environmental Protection

Prepared by:

dKC – de la Torre Klausmeier Consulting
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Executive Summary

As required by the Clean Air Act Amendments of 1990, the Connecticut Department of Energy and Environmental Protection (DEEP) in partnership with the Connecticut Department of Motor Vehicles (DMV) conducts periodic evaluations of its enhanced Motor Vehicle Inspection and Maintenance (I/M) Program. This report is being submitted in fulfillment of the requirements to provide annual and biennial I/M reports per 40 CFR 51.366. This report addresses data collected from January 1, 2012 through December 31, 2013. Comments provided by the United States Environmental Protection Agency (EPA) on Connecticut's 2012 Annual Report are addressed by this report. As evidenced by the high compliance rate, limited fraud and low waiver rate, this report demonstrates that Connecticut's I/M program effectively achieves the expected air quality benefits.

The data elements included in this report are based on a checklist provided by EPA and set forth in Appendix A. The required data, including data collected during 2012 and earlier years, and reports from previous years have been submitted to EPA. Appendix B contains the 2013 data elements and correspond to the indexing system used in EPA's checklist. Due to the structure of Connecticut's I/M Program, the following requirements of the attached checklist are not applicable: (a)(2)(xiii), (xiv), (xv), (xvi), (xvii), (xviii), (xx) and (5); (b)(3)(ii), and (iv); (4)(iii), (6), (7); (d)(3) and (4).

The I/M Program, designed to identify vehicles that emit pollutants that exceed acceptable standards and require such vehicles to get repaired, is an important part of the strategy to ensure that Connecticut is positioned to attain and maintain the 1997 National Ambient Air Quality Standard (NAAQS) for Ozone (i.e., smog). Connecticut's I/M Program, which dates back to 1983, has a long history of effectively reducing vehicle emissions and results in more emission reductions than any other state-implemented reduction strategy. Estimates indicate that in 2010 this program provided approximately 19 of the 200 tons per day of air pollutant reductions that are included in Connecticut's Ozone Attainment Demonstration for the 1997 Ozone National Ambient Air Quality Standard (2008). The emission reductions resulting from this program are an integral part of Connecticut's air quality attainment efforts, and important as part of a balanced strategy that includes reductions from stationary, area and mobile source sectors to ensure that Connecticut attains the Ozone NAAQS. EPA strengthened the Ozone NAAQS in 2008 resulting in Connecticut's designation of nonattainment for the 75 ppb eight-hour ozone standard. EPA is expected to issue an even more stringent Ozone NAAQS by the fall of 2015. If EPA does so, Connecticut will need to achieve even greater emission reductions from motor vehicles.

All of Connecticut continues to experience elevated ozone concentrations during the summer months. While in-state sources of air pollution such as cars and power plants contribute to ozone formation, much of the ozone and precursor emissions transported into Connecticut originate from sources located in upwind states. For example, during elevated ozone episodes in Connecticut, air quality measured along the coast on Long Island Sound in Southwest Connecticut frequently exceeds the Ozone NAAQS, which is indicative of

significant interstate air pollution transport. It is therefore imperative to address the transport challenge to assure clean air for Connecticut's citizens.

This report demonstrates the effectiveness of Connecticut's I/M program. Key program highlights include:

- In May 2011, following a comprehensive evaluation and selection process, DMV entered into a new agreement with a private contractor, Applus, for the next phase of the Connecticut I/M program. This new program provides a much more comprehensive reporting suite that includes several effective fraud detection reports. In addition, the program addresses key equipment problems in the old program:
    - Emission test equipment in the old program frequently failed measurement accuracy audits, raising concerns that motorists were improperly failed. In 2011, 67% of the stations failed equipment (gas) audits, while in 2012 this percentage dropped to 36%. The percentage of stations that failed equipment audits dropped further in 2013 to 29%. The drop was due to the roll out of new, more reliable emission test benches in the new program.
    - No communication is the term used when the OBD inspection equipment cannot download information on the vehicle's emission status and results in the vehicle failing inspection. About 1% of the vehicles failed for this reason in the old program, but this rate has dropped to 0.2% with the equipment used under the new contract, which is the lowest rate dKC has observed in any program.
- Connecticut continues to have a high rate of compliance with I/M requirements. In 2012 and 2013, as well as earlier years, over 99% of the vehicles subject to testing were in compliance with I/M program requirements. The overall compliance rate in Connecticut exceeds the compliance rate of 96% specified in Connecticut's State Implementation Plan. Connecticut actively investigates non-compliance and assesses fines for late inspections. In 2012, 162,665 late fees were assessed. In 2013, 175,221 fines were assessed for late inspections. Linking registration to compliance in addition to late inspection fines contribute to Connecticut's very high compliance rate.
- Approximately 10% of vehicles failed their initial emissions test and 12% of these vehicles also failed their first retest in 2013. These rates are nearly identical to the 2012 failure rates where 11% of vehicles failed their initial emissions test and 12% of the vehicles failed their first retest Failure rates under the decentralized I/M program are equal to or higher than failure rates recorded under centralized I/M programs. Ongoing outreach efforts designed to improve repairs and decrease failure rates will continue to be enhanced.
- DMV performs extensive quality assurance checks on the program. Evaluation of these quality assurance data demonstrates that the program performs accurate

inspections. As mentioned earlier, the percentage of gas audits that find analyzers out of range has dropped with implementation of new emissions test equipment.

- Audits were conducted at all stations as part of an extensive anti-fraud program. A much greater number of video surveillance audits and covert audits were conducted in 2013 than in 2012. 1,920 video surveillance audits and 540 covert audits were conducted during 2013, while in 2012, 438 video surveillance audits and 64 covert audits were conducted. Covert audits addressed OBD, ASM and PCTSI inspection performance. In addition, DMV and Applus run extensive trigger reports. Less than 0.10% of the inspections in Connecticut are suspect, which is far lower than most other states' I/M programs. Connecticut's anti-fraud efforts are models for other I/M programs.

Connecticut reviews and analyzes its vehicle inspection and maintenance program on a consistent basis. This effort has led to numerous enhancements including several new safeguards to ensure correct vehicle identification numbers and review of the fleet testing program. A full iteration of the changes are detailed in Section 8 of this report. Connecticut's analysis repeatedly has demonstrated the program produces the expected air pollutant reductions. DEEP and DMV continue to evaluate opportunities to improve the program and cost effectively increase the air quality benefits.

1.0 Introduction

This report presents an analysis of data collected in Connecticut's Motor Vehicle Inspection and Maintenance (I/M) program in 2012 and 2013 to meet the United States Environmental Protection Agency's (EPA) annual and biennial reporting requirements of 40 CFR Part 51.366. In an I/M program, vehicles are periodically inspected, and those with evidence that they exceed design emission standards must be repaired. I/M programs are mandated by the Clean Air Act and were limited to areas that EPA designated as "serious" or "severe" non-attainment for the ozone National Ambient Air Quality Standard (NAAQS). Connecticut's program, which dates back to 1983, has a long history of effectively reducing vehicle emissions and is an important part of the strategy to ensure that Connecticut is positioned to attain the NAAQS for ozone. Since Connecticut's ozone levels exceed the 2008 ozone NAAQS, additional emission reductions from all sectors, including motor vehicles, remain critical.

Connecticut's I/M program results in more emission reductions than any other state implemented reduction strategy. Estimates indicate that in 2010 this program resulted in approximately 19 of the 200 tons per day of air pollutant reductions that are included in Connecticut's 2008 Ozone Attainment Demonstration[1]. The emissions reductions resulting from this program are an integral part of Connecticut's air quality attainment efforts and important as part of a cost effective and balanced strategy that includes reductions from stationary, area and mobile source sectors.

Emissions reduction determinations are estimated using modeling that is approved by the EPA. The most recent State Implementation Plan (SIP) Revision, which addresses the I/M program, was developed using MOBILE6.2, the model which was approved for use by EPA at that time. EPA has since updated its modeling platform and has begun implementing a new model known as the Motor Vehicle Emissions Simulator (MOVES). States are now required to use MOVES for attainment demonstrations, for hot spot analysis and for regional conformity.

Connecticut's I/M program identifies vehicles that have been tampered with, or have received improper maintenance. These vehicles must be repaired until they comply with emission standards. The Connecticut Department of Motor Vehicles (DMV) oversees the I/M program operated by a private contractor; the Connecticut Department of Energy and Environmental Protection (DEEP) ensures that the program achieves the air quality benefits as outlined in Connecticut's SIP.

The original program implemented in 1983 subjected vehicles to two inspections – an idle test where exhaust concentrations of hydrocarbons (HC) and carbon monoxide (CO) were measured while the vehicle was idling and a visual inspection for the presence of the catalytic converter. Vehicles with gross vehicle weight ratings (GVWR) of 10,000 pounds (lbs.) or less were included in the program. In 1998, Connecticut

1 The 2008 Ozone Attainment Demonstration details Connecticut's strategies designed to bring the state's air quality into compliance with the 1997 8-hour ozone NAAQS of 84 ppb.

substantially enhanced its existing I/M program to meet new SIP requirements, as well as federal requirements for I/M improvements. The emission test changed from an unloaded idle emission test to a loaded-mode test (ASM2525[2]). With this change, Connecticut began evaluating emissions of oxides of nitrogen[3] (NO_x) along with HC and CO. The loaded-mode test uses a chassis dynamometer to simulate on-road driving. If the vehicle could not be safely tested on a dynamometer, it received a pre-conditioned two-speed idle (PCTSI) test. In addition, the inspection included a gas cap pressure test to check to see if the gas cap holds pressure. Leaking gas caps are a major source of evaporative HC emissions. The program continued to include a visual emission control component check. Also, at this time Connecticut began diesel testing.

In 2003, Connecticut again made substantial revisions to the program. The inspection network was changed from a centralized system with about 25 inspection stations to a decentralized system with a contractor equipped limit of 300 stations[4]. The goals of these changes were to improve customer convenience to the public by decreasing the waiting time for emissions testing, directly involve the repair industry with emissions testing, and enhance opportunities for small business development. In addition, 1996 and newer gasoline- powered models started receiving on-board diagnostic (OBD) tests[5], instead of ASM2525 or PCTSI exhaust emissions tests. All 1996 and later model year light-duty vehicles sold in the United States contain the second generation of OBD, termed OBDII. Connecticut also performs OBD tests on diesel powered vehicles that are model year 1997 and newer having a GVWR of 8500 lbs. and less. OBDII systems can detect malfunctions or deterioration of emission control components, often well before the motorist becomes aware of any problem. Inspecting vehicles by reading the OBDII system codes can identify vehicles with serious emission control malfunctions more accurately and cost-effectively than traditional tailpipe tests, and help technicians diagnose and repair those malfunctions. Diesel powered vehicles having a GVWR of 10,000 lbs. or less, receive tests for excessive exhaust smoke, if they cannot receive OBDII tests. Evaluating OBDII test results presents special challenges, since tailpipe emission results are not available for each vehicle.

In 2011, the state embarked upon a new program with upgraded equipment and computer systems to correct challenges faced the previous system. While the new program improved test equipment accuracy and reliability, DMV is working with their contractor, Applus, to evaluate and implement additional new improvement measures to

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2 The ASM2525 or Acceleration Simulation Mode test measures HC, CO and NO emissions while the vehicle is driven at a constant speed (25 MPH) on a treadmill-like device termed a dynamometer.

3 Nitric oxide (NO) is measured as a surrogate for oxides of nitrogen (NO_x). NOx along with HC emissions are considered to be the major ozone precursors.

4 This number dropped from 300 stations to 250 stations by the end of 2008. At the end of 2012, there were 229 stations in the network.

5 1997 and newer light-duty diesels (<8500 lbs. GVWR) also get OBD inspections.

maximize the cost effectiveness and benefits of the program.

The methodology for this report has utilized data on different inspection components to determine if the appropriate number of vehicles are being failed and repaired. This multifactorial approach is consistent with the purpose of the OBDII system, since it assures that Connecticut is identifying, and requiring the repair of vehicles that exceed design emission standards by more than 50%, as required by the EPA. Evaluating decentralized inspections requires a comprehensive assessment of how well stations comply with mandated inspection procedures. Although there are greater opportunities for fraud in decentralized facilities due to the increased numbers of stations that need policing, Connecticut's comprehensive quality assurance program demonstrates there is limited fraud in the state's program. Using data and procedures provided by the DMV, de la Torre Klausmeier Consulting, Inc. (dKC) assessed effectiveness and enforcement of Connecticut's program.

2.0 Observed Failure Rates for Gasoline-Powered Vehicles

Failure rates for gasoline-powered vehicles were calculated using test results from I/M test stations. Below is a brief description of the criteria used to determine if a vehicle passes or fails inspection.

Pass/Fail Criteria

ASM2525 or Pre-Conditioned Two-Speed Idle (PCTSI) Inspection (pre-1996 vehicles): Vehicles fail if they exceed Connecticut's cut points or emissions standards. For the ASM2525 test, HC, CO and NOx emissions are evaluated. For the PCTSI test, HC and CO emissions are evaluated. Connecticut uses EPA's recommended cut points for the ASM2525 and PCTSI tests.

Gas Cap Test: Vehicles fail if their gas cap cannot hold pressure. Beginning in November 2004, only pre-1996 light-duty vehicles receive gas cap tests. The OBDII system adequately tests a vehicle's evaporative system on most 1996 and newer vehicles. Vehicles that are model 1996 and newer and over 8500 lbs. GVWR also receive a gas cap test.

OBDII Inspection: 1996 and newer light-duty vehicles are subject to an OBDII inspection. The emissions test system is plugged into the OBDII connector and information on the status of the vehicle's OBD system is downloaded. Vehicles fail the OBDII inspection if they have the following problems:

- Malfunction Indicator Lamp (MIL[6]) is commanded-on and diagnostic trouble codes (DTCs) are stored;
- MIL not working (Termed Key-On Engine-Off, KOEO, failure[7]);
- The number of readiness monitors that are not ready exceed EPA's limit[8]:
    - 1996-2000 models: Two monitors are allowed to be not ready.
    - 2001+ models: One monitor is allowed to be not ready.
- OBD Diagnostic Link Connector (DLC) damaged; or

[6] MIL is a term used for the light on the instrument panel, which notifies the vehicle operator of an emission-related problem. The MIL is required to display the phrase "check engine" or "service engine soon" or the ISO engine symbol. The MIL is required to illuminate when a problem has been identified that could cause emissions to exceed a specific multiple of the standards the vehicle was certified to meet.

[7] The Key-On Engine-Off (KOEO) determines if the MIL bulb is working. The bulb should illuminate when the vehicle is turned on but not started.

[8] OBDII systems have up to 11 diagnostic monitors, which run periodic tests on specific systems and components to ensure that they are performing within their prescribed range. OBDII systems must indicate whether or not the onboard diagnostic system has monitored each component. Components that have been diagnosed are termed "ready", meaning they were tested by the OBDII system.

- Vehicle could not communicate with the Connecticut inspection system.

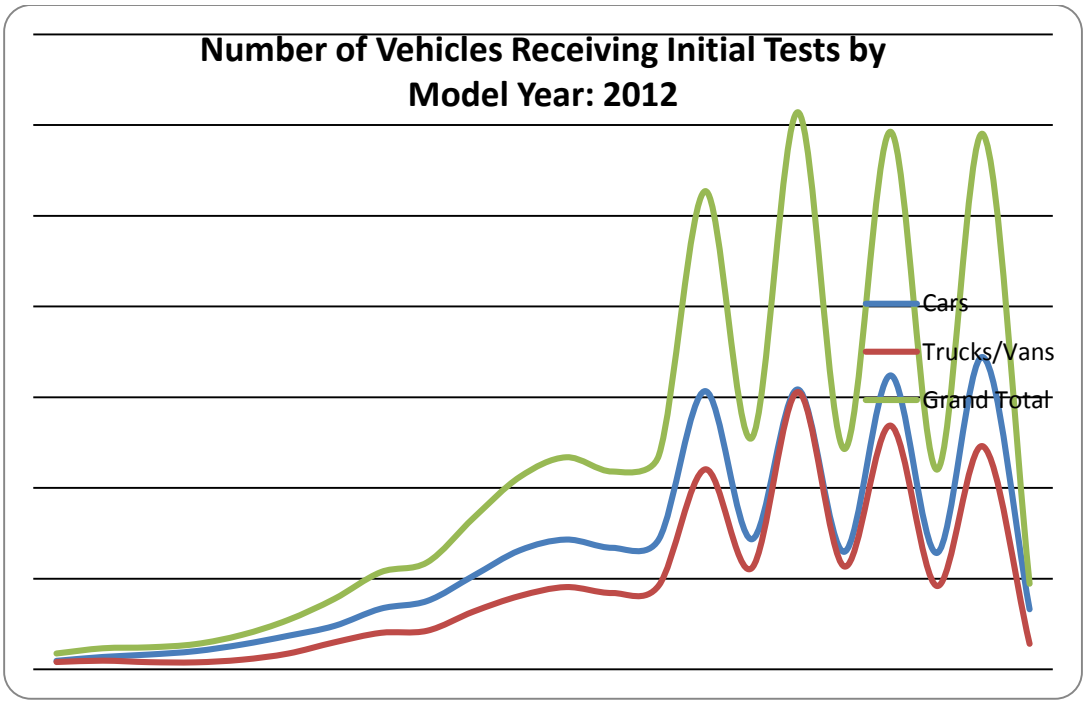
Summary of Fail Rates for Gasoline-Powered Vehicles

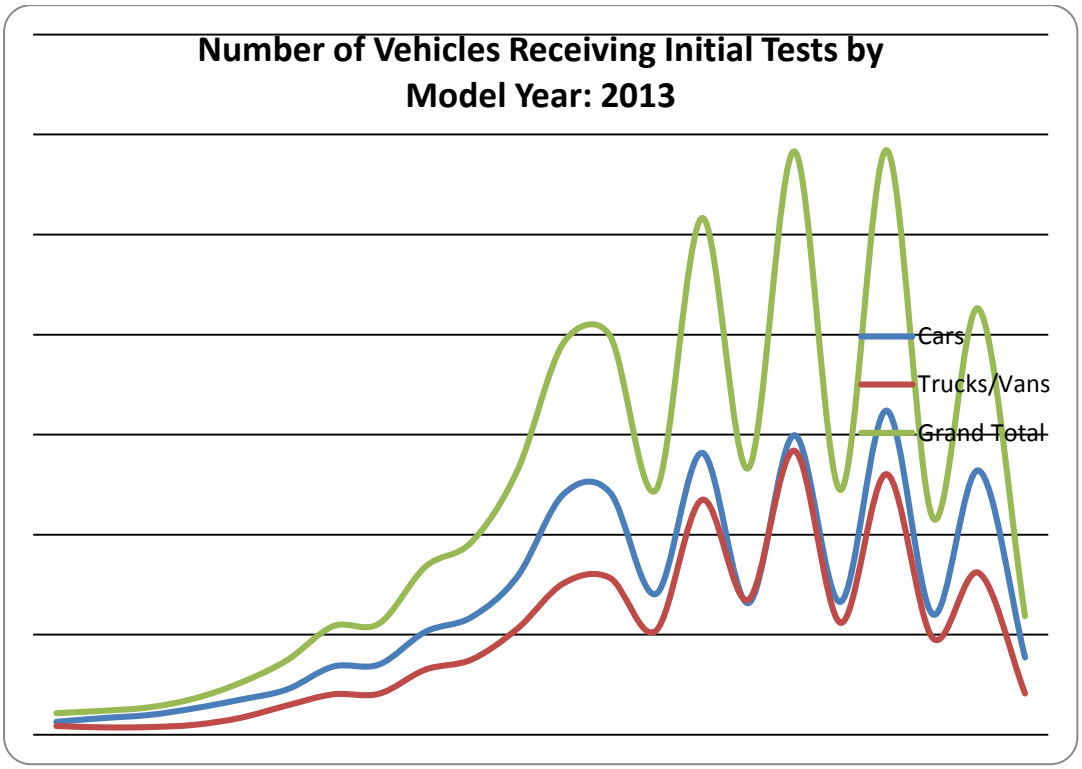
Following is a summary of test results from January 1, 2012 to December 31, 2013. In 2012, 938,160 gasoline-powered vehicles received initial tests. In 2013, 1,014,611 gasoline-powered vehicles received initial tests. The table below compares failure rates in 2012 and 2013 for different tests that are performed on gasoline powered vehicles.

Test Type	Parameter	2012	2013
OBD	% Fail Initial (any reason)	10%	10%
	% Fail for MIL Commanded-on	5.9%	5.7%
	% Fail First Retest	10%	10%
ASM	% Fail Initial	9%	14%
	% Fail First Retest	45%	26%
PCTSI	% Fail Initial	11%	9.7%
	% Fail First Retest	13%	13%
Gas Cap	% Fail Initial	7.9%	7.1%
	% Fail First Retest	6.1%	5.7%
All Tests	% Fail Initial	11%	10%
	% Fail First Retest	12%	12%

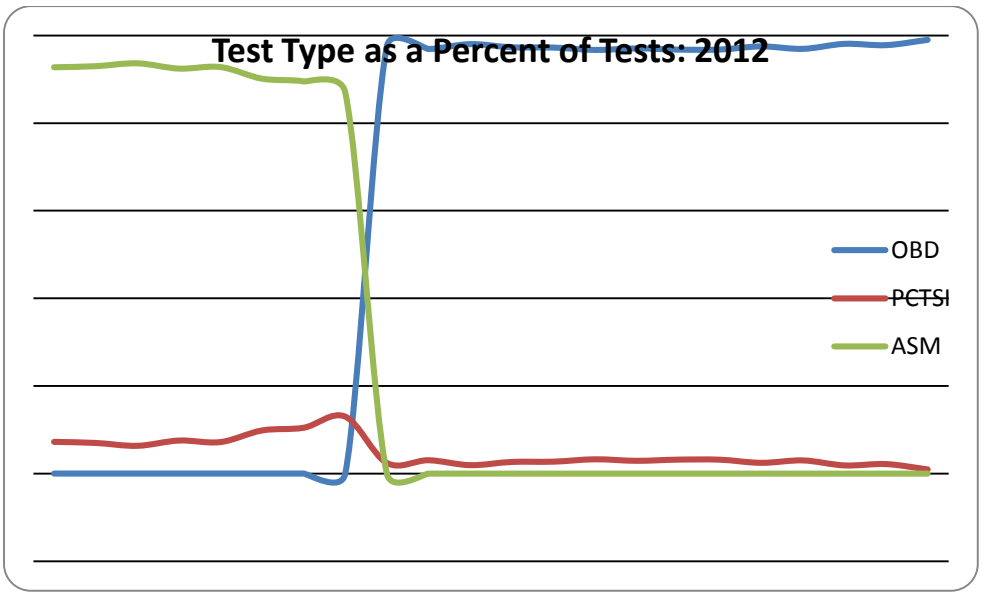
Conclusion: These failure rates are comparable to results in previous years. Failure rates in Connecticut's I/M program are in line with those reported in Test-Only programs[9]. Test-Only programs generally are considered by EPA to be the model for peak I/M performance. Based on failure rates, Connecticut's I/M program is operating at peak performance.

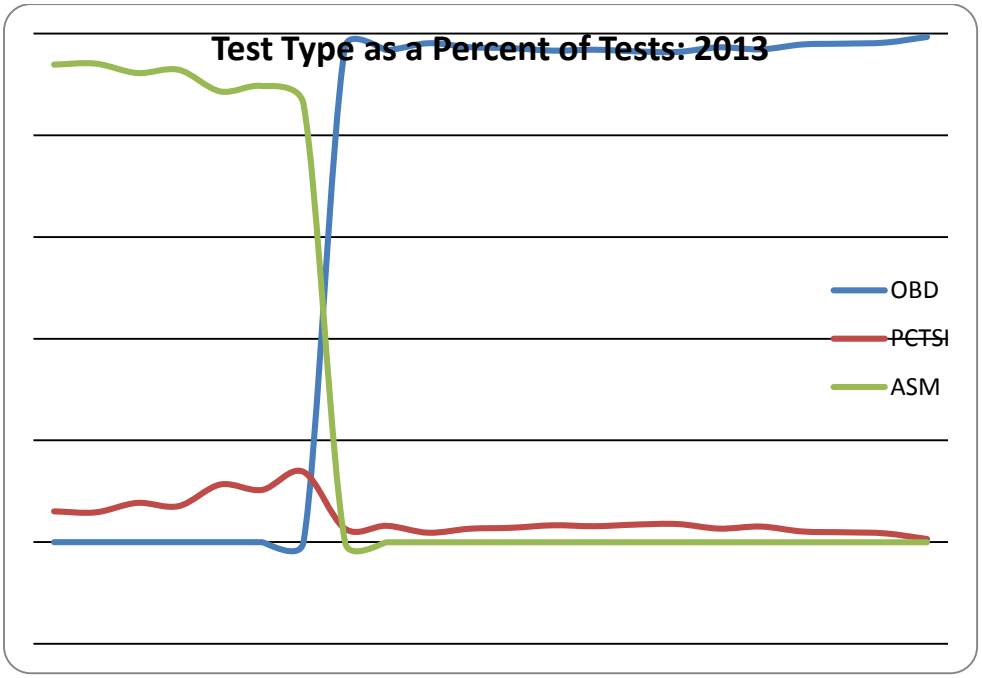
[9] At the end of this section is a chart that compares failure rates for the OBD test in Connecticut with failure rates in Delaware. Delaware is a well enforced Test-Only I/M program. Failure rates in both programs are nearly identical.



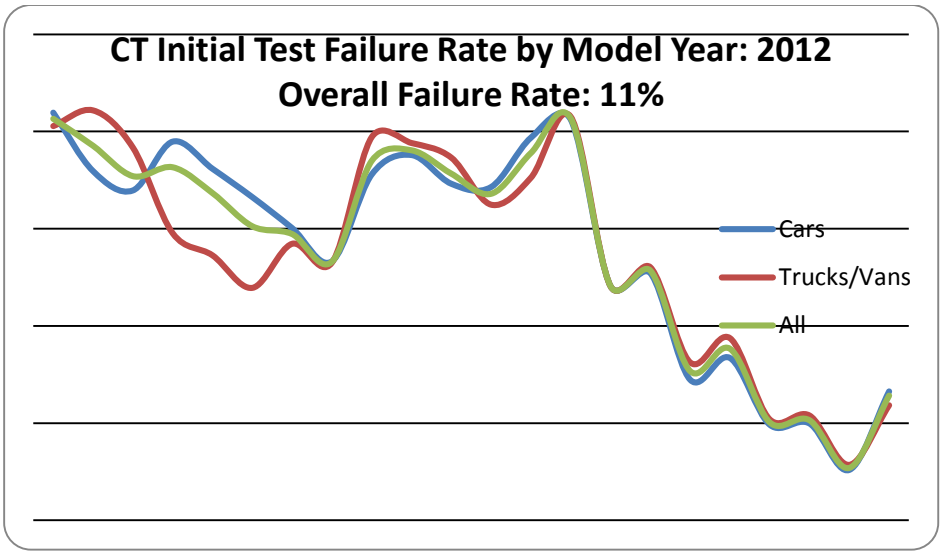


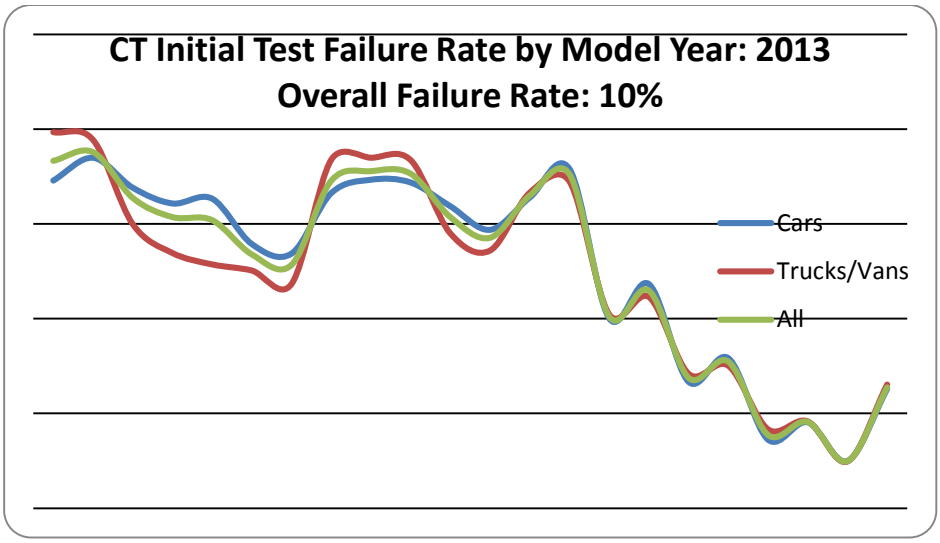
These charts show the total number of inspections by vehicle model year, and vehicle type. The first four vehicle model years are exempted from testing, so the number drops sharply after the 2008 model year for 2012 and the 2009 model year for 2013. All vehicles have a 10,000 lbs. or less GVWR.





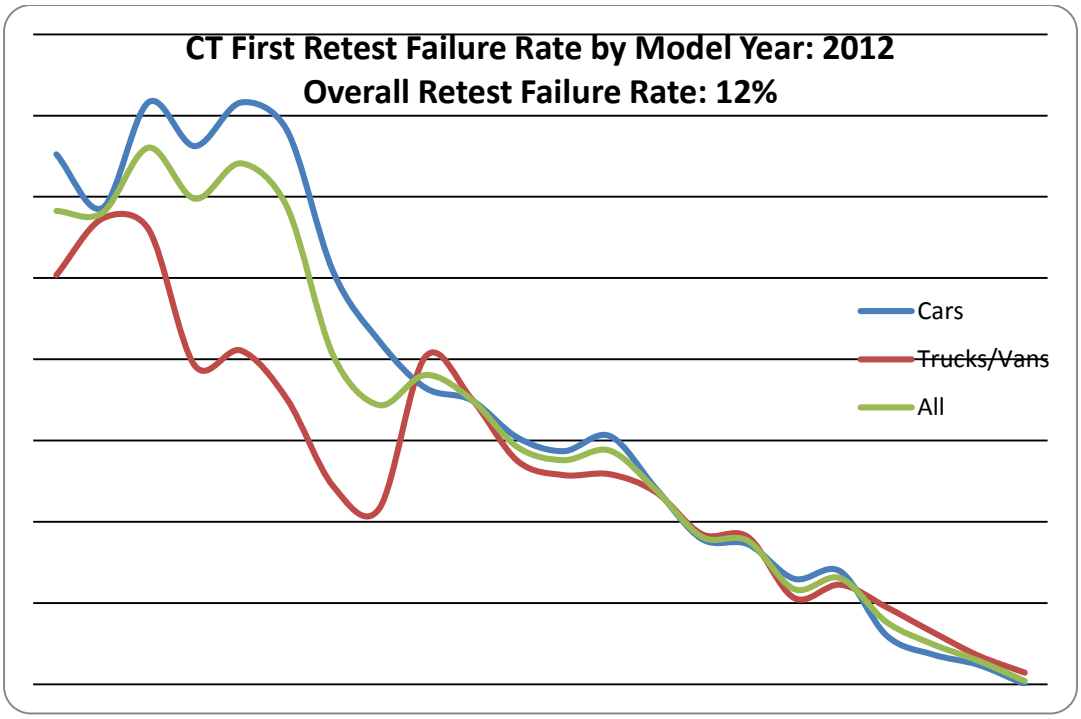
These charts show the total number of inspections by vehicle model year and final inspection type. Most 1996+ vehicles received OBDII tests. A small percent (2%) of the vehicles newer than 1996 were models over 8500 lbs. GVWR without OBD systems.

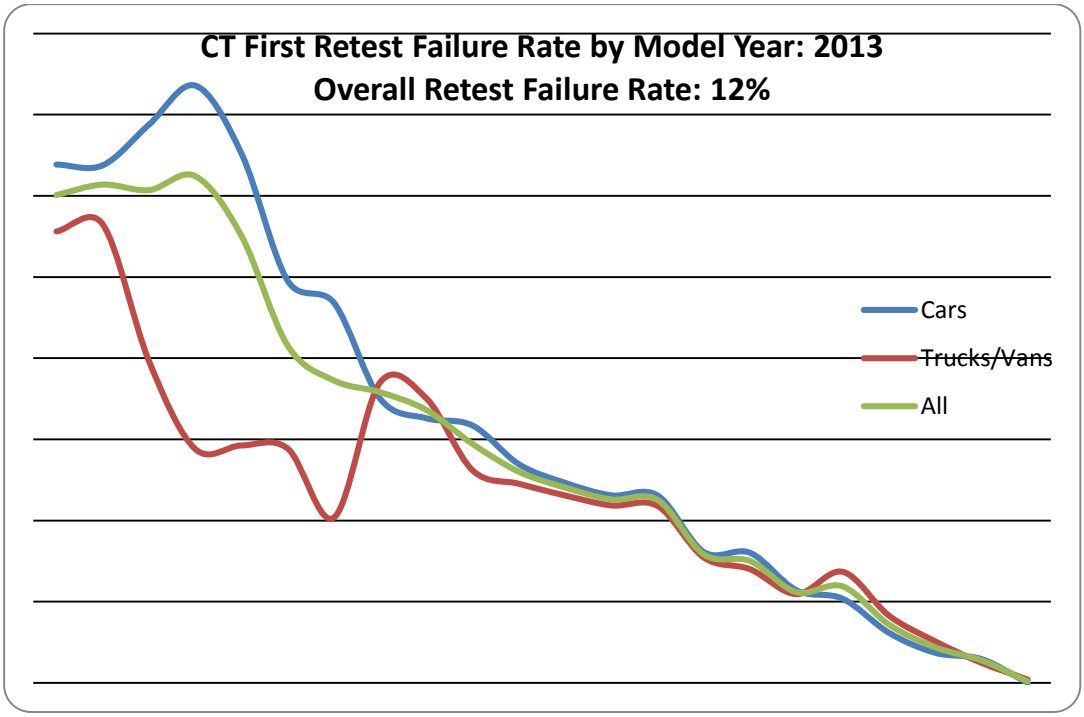




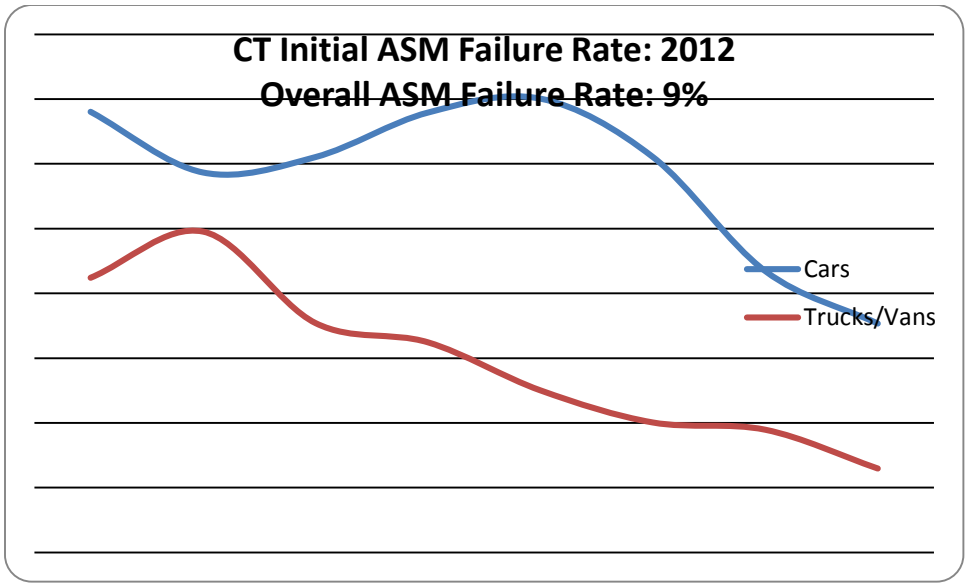
These charts show the overall percentage of vehicles that failed the tailpipe test, gas cap test, visual emission control component test, or the OBD test. Some vehicles failed more than one inspection component. As expected, the failure rate is generally lowest for new vehicles. Following the pattern seen previously, the failure rate for cars and trucks spiked upwards for 1996 model year vehicles, due to increased stringency associated with the implementation of the OBDII test. Compliance with the OBDII test is considered to be more difficult than compliance with the ASM2525 or PCTSI test. The failure rate is consistent with failure rates reported in test-only programs in other jurisdictions. The high initial failure rate for 2009 model year vehicles in 2012 and the 2010 model year vehicles in 2013 is due to the fact that over half of these vehicles tested had dealer plates. Vehicles owned by dealers typically have high not ready rates because their batteries are often insufficiently charged, or had been disconnected during dealer prep[10].

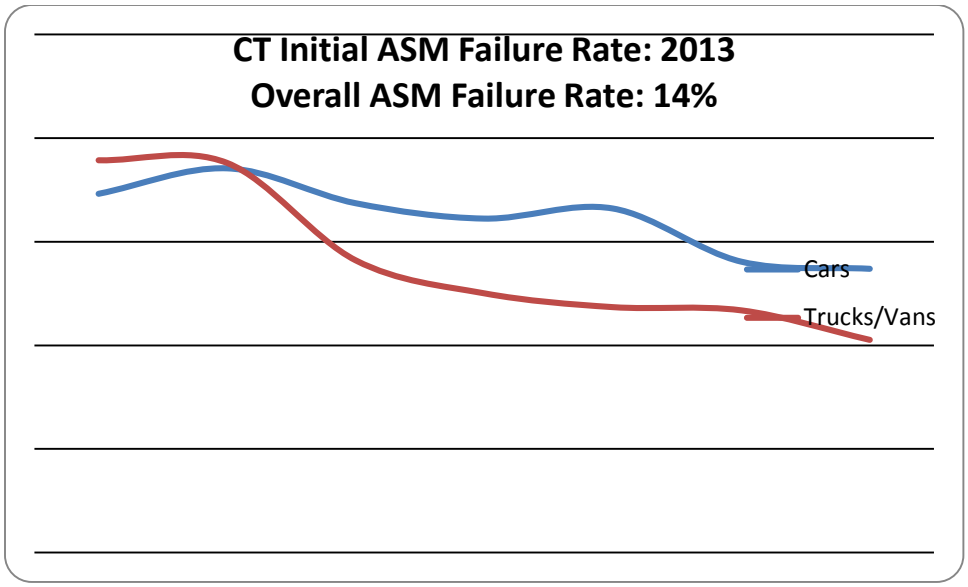
[10] Readiness status for all monitors usually sets to not ready when a vehicle's battery is disconnected.



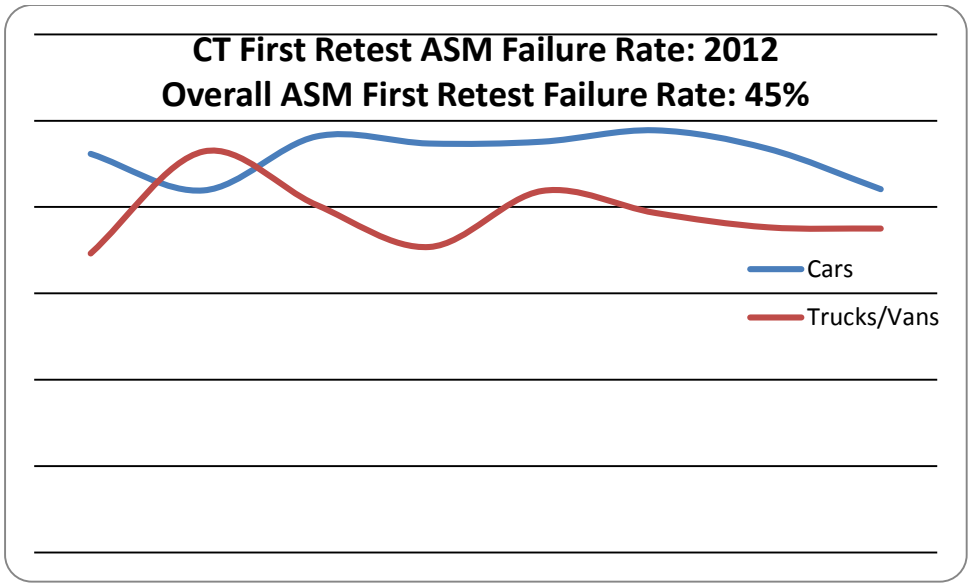


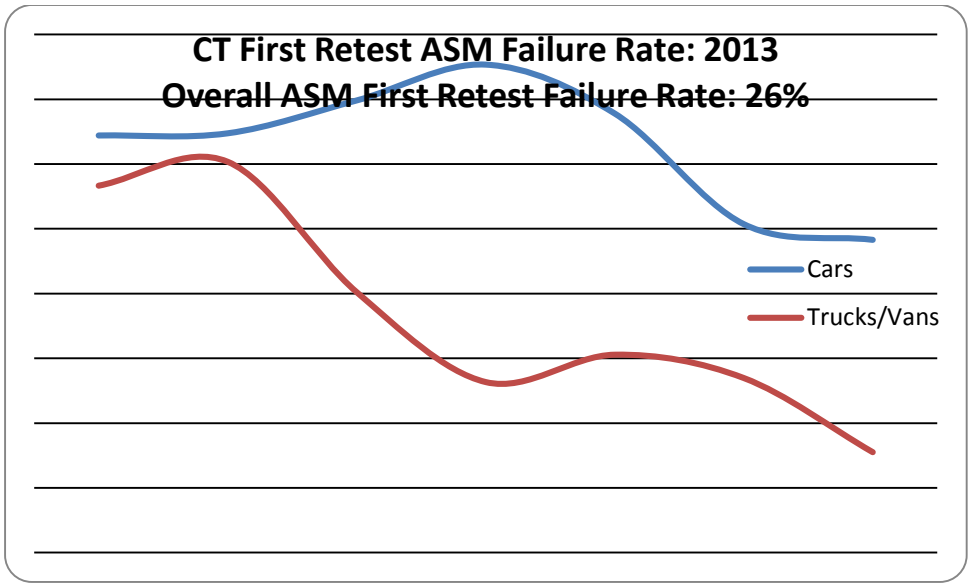
These charts show the percent of vehicles by model year that failed their first retest. The retest failure rate is highest for the older model year vehicles, which is typical. Overall, in both years 12% of the vehicles tested failed their first retest.



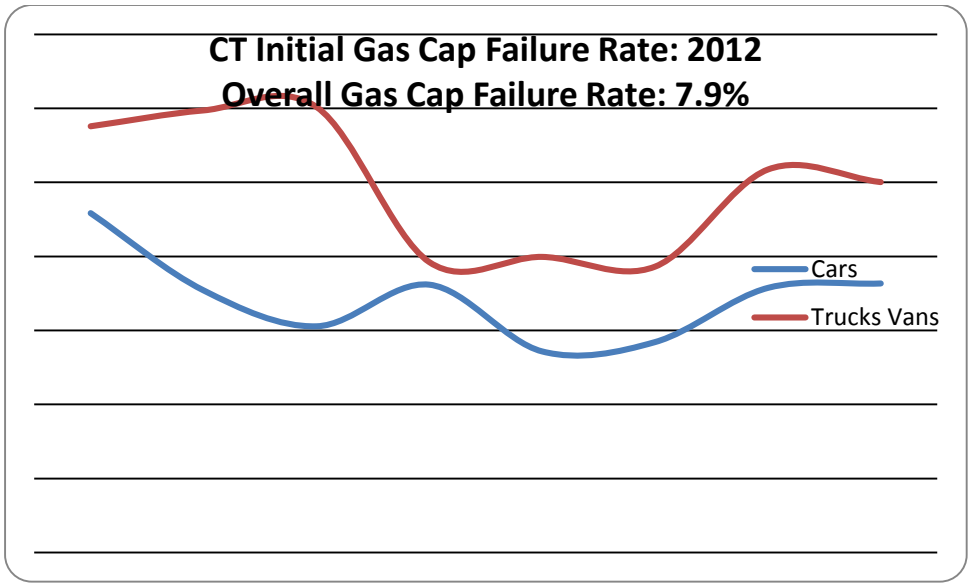


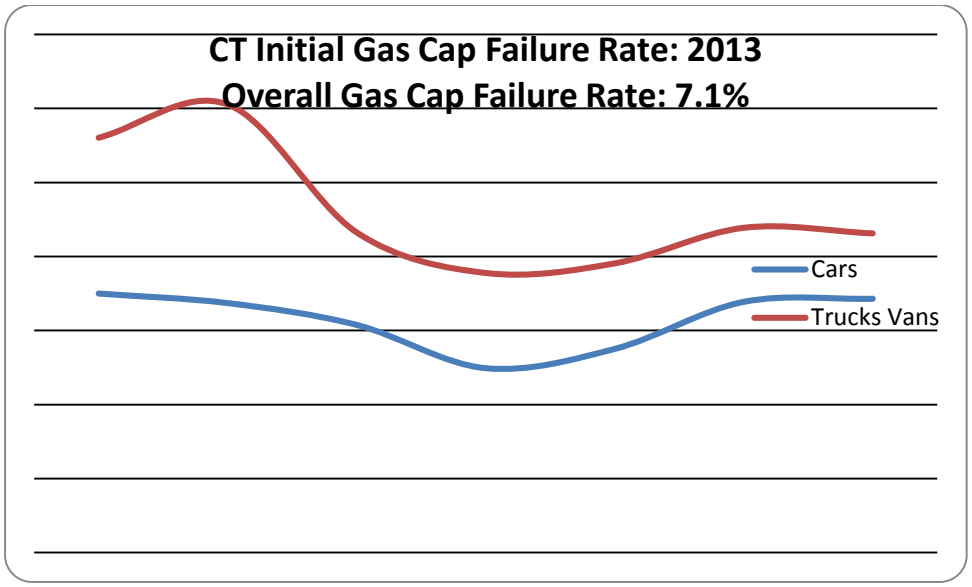
These charts show failure rates by vehicle model year for the ASM test. The average ASM test failure rate for all vehicles was 9% in 2012 and 14% in 2013. Typically, a higher failure rate for older model year vehicles is expected. 1996 and newer model year vehicles received ASM or PCTSI tests, only if they were not equipped with OBDII systems. As a result, there were not enough ASM tests on 1996 and newer vehicles to analyze trends.



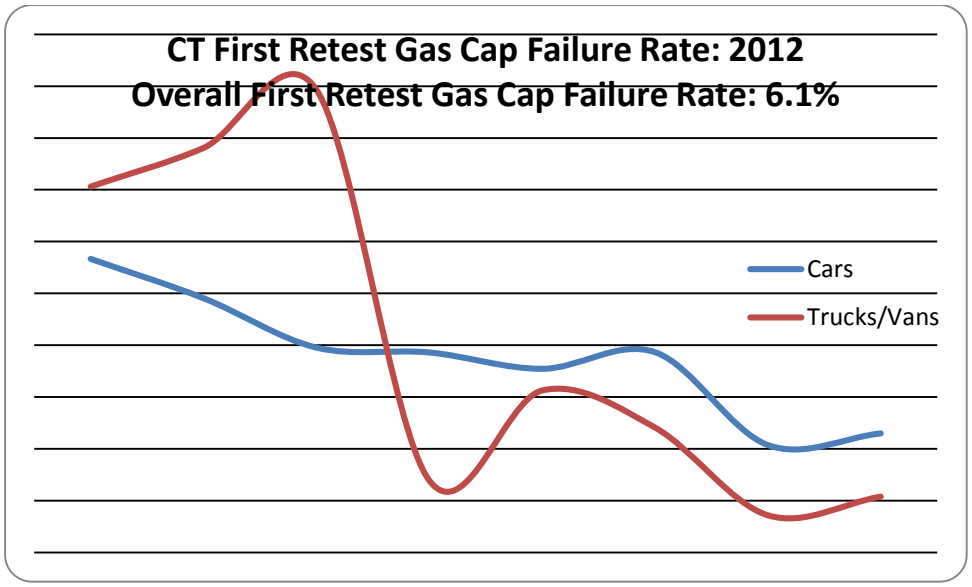


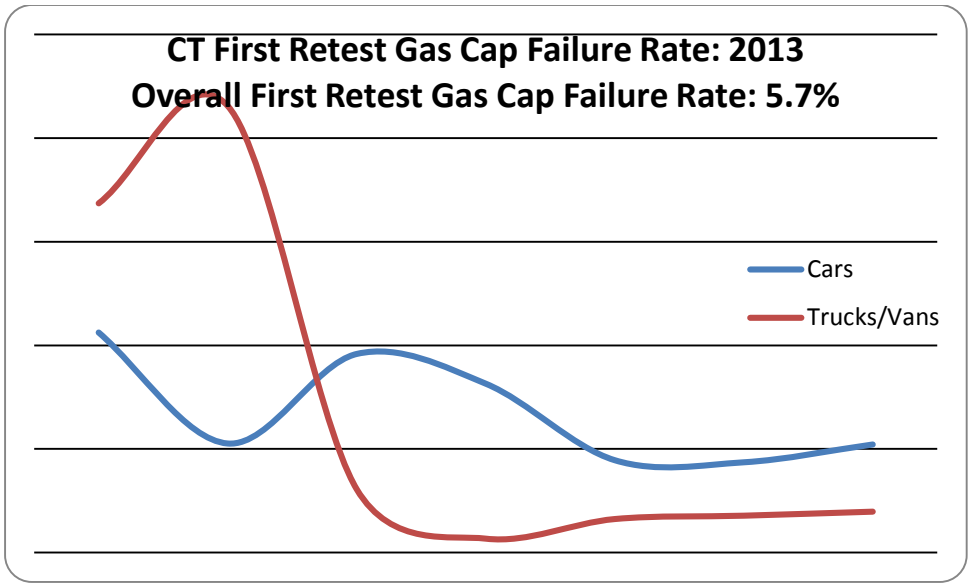
These charts show the percentage of vehicles by vehicle model year that failed their first ASM retest. The retest failure rate generally is highest for the older vehicles. The ASM retest failure rate was much lower in 2013 than in 2012 (26% vs. 45%), which indicates that repair effectiveness improved in 2013.



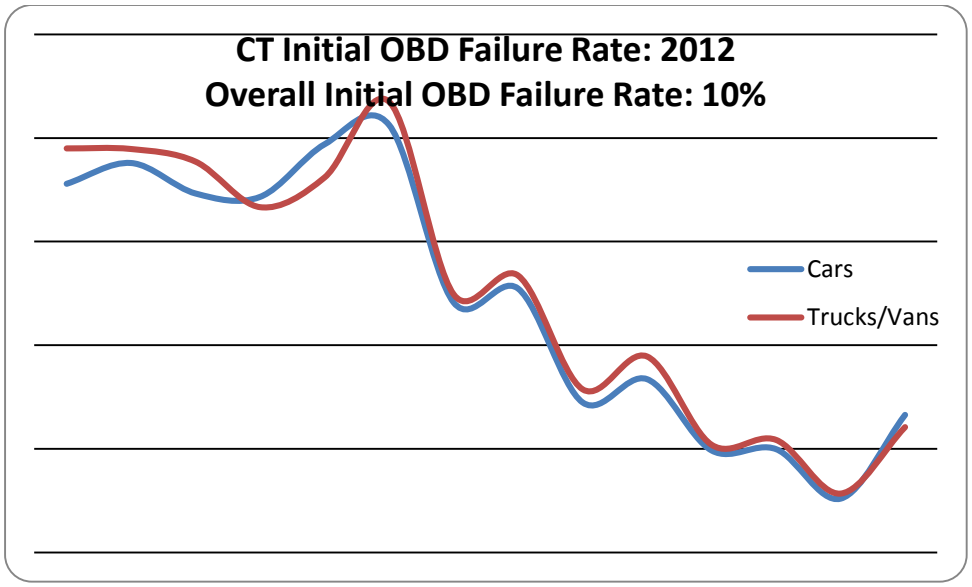


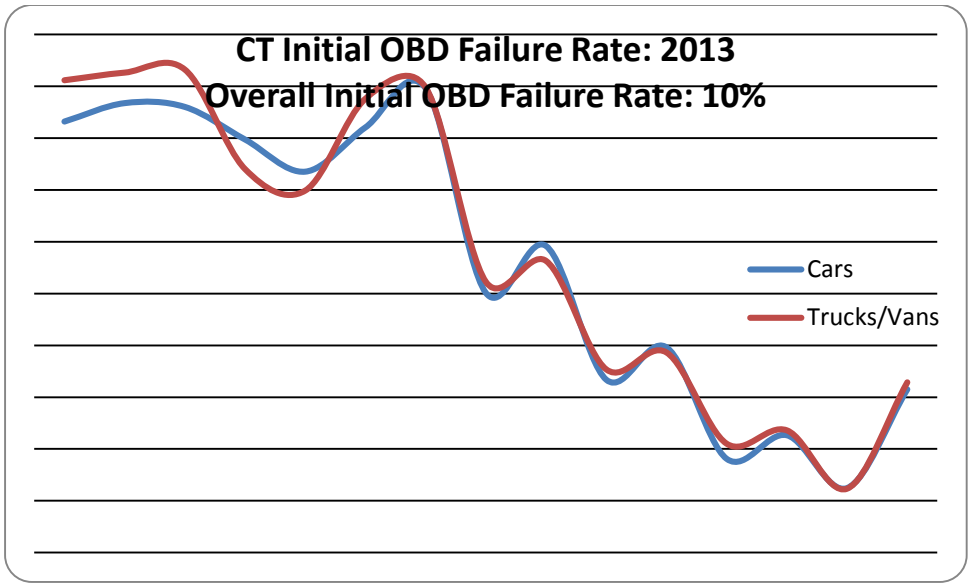
These charts show the gas cap pressure test failure rate by vehicle model year. Overall, 7.1% to 7.9% of the vehicles that receive gas cap tests fail the test. 1996 and newer light-duty vehicles no longer receive gas cap tests. 1996 and newer vehicles over 8500 lbs. GVWR are also tested.



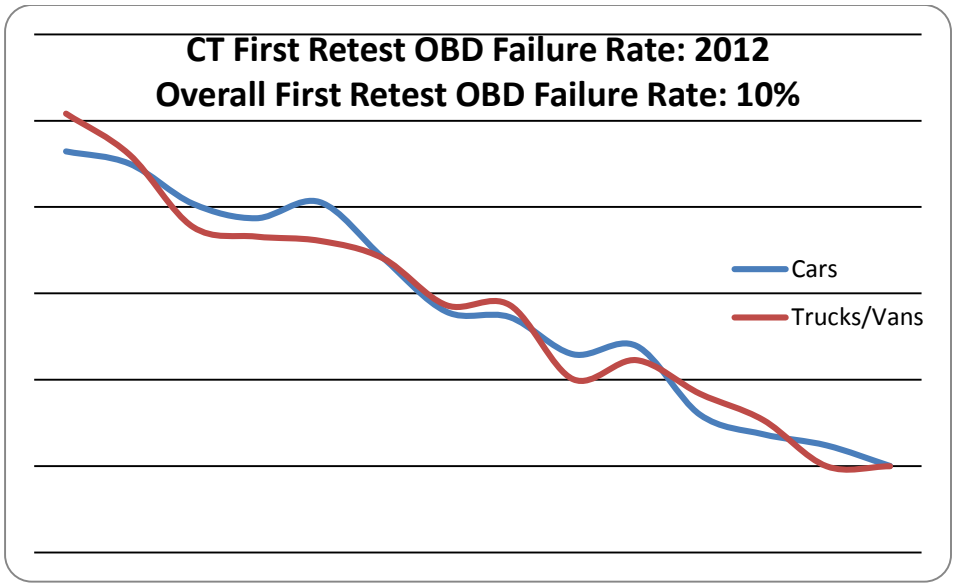


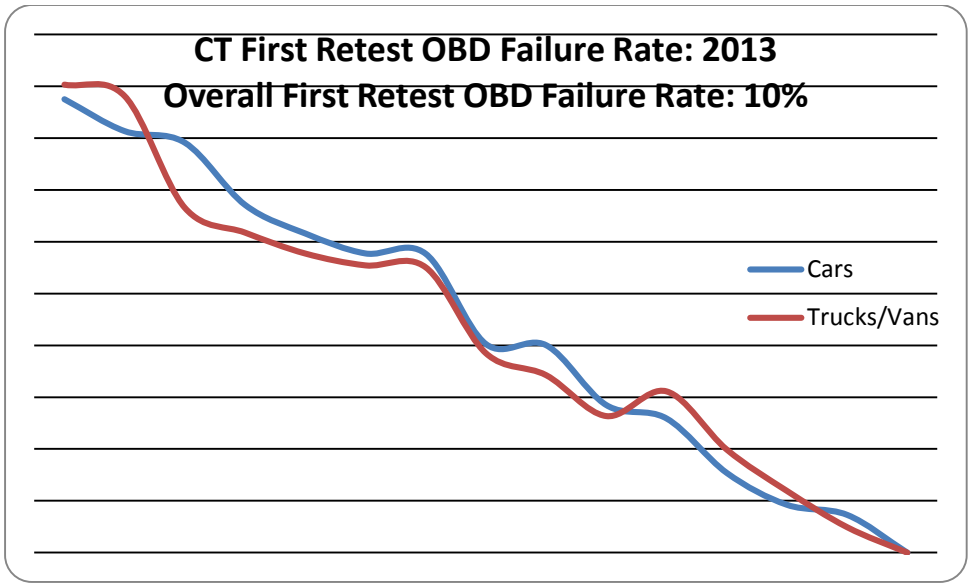
These charts show the gas cap retest failure rate by vehicle model year. Overall, 5.7% to 6.1% of the vehicles fail the first gas cap retest. As expected, the retest failure rate is highest for the older model year vehicles.



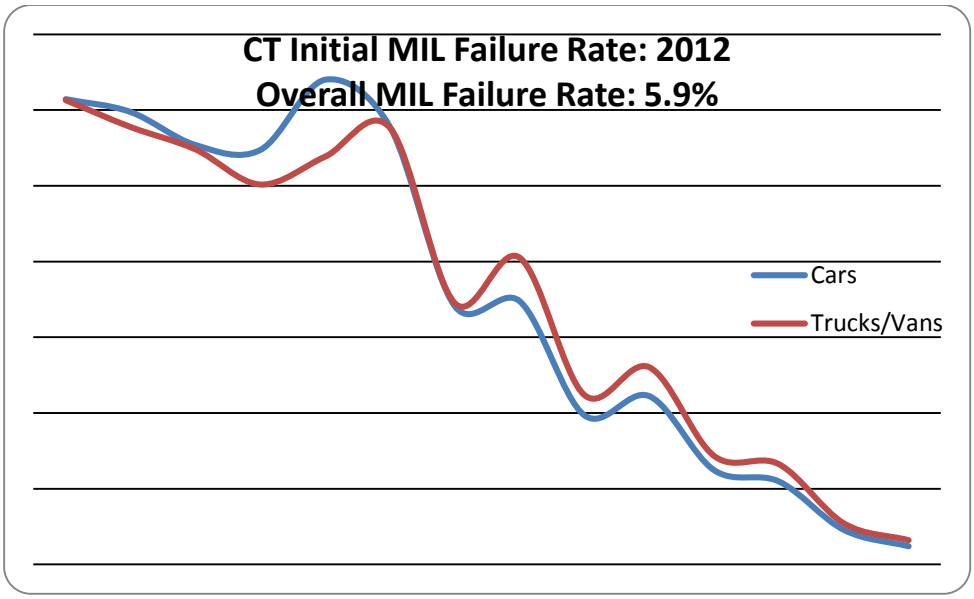


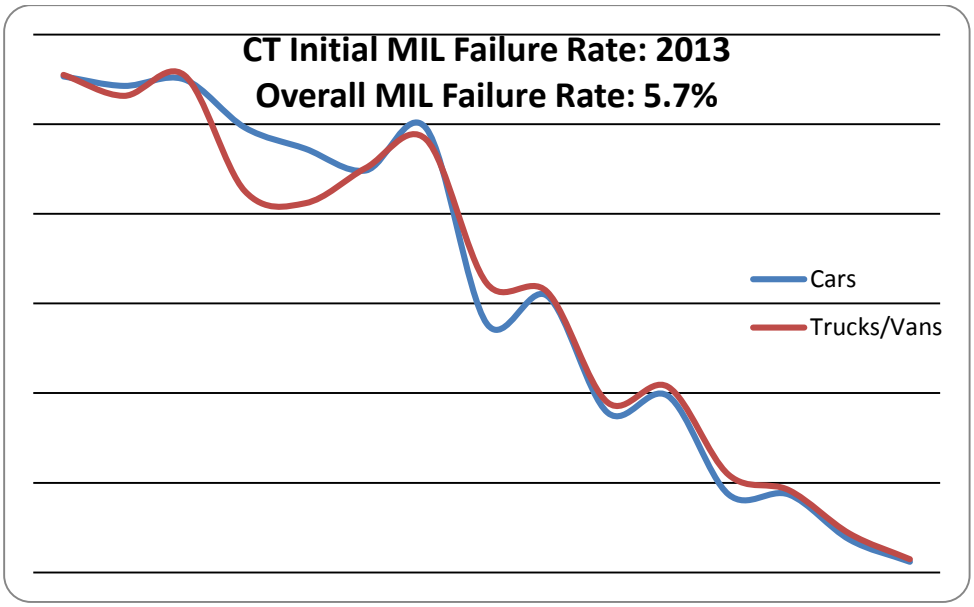
These charts show failure rates by vehicle model year for the OBD test. In both years, the average OBD test failure rate for all vehicles was 10%. Typically, a higher failure rate for older model year vehicles is expected. 18% to 19% of the 1996 model year vehicles failed the test. EPA requires that the 2001 and newer model year vehicles have at most one monitor not ready as opposed to two for 2000 and older model year vehicles. This change in readiness requirement explains the elevated failure rate for 2001 model year vehicles. The increase in failure rates for 2009 model year vehicles in 2012 and the 2010 model year vehicles in 2013 reflects a high "not-ready" rate for these models. The high initial failure rate for 2009 model year vehicles in 2012 and the 2010 model year vehicles in 2013 is due to the fact that over half of these vehicles had dealer plates. Vehicles owned by dealers typically have high not ready rates, because their batteries are often insufficiently charged, or had been disconnected during dealer prep.



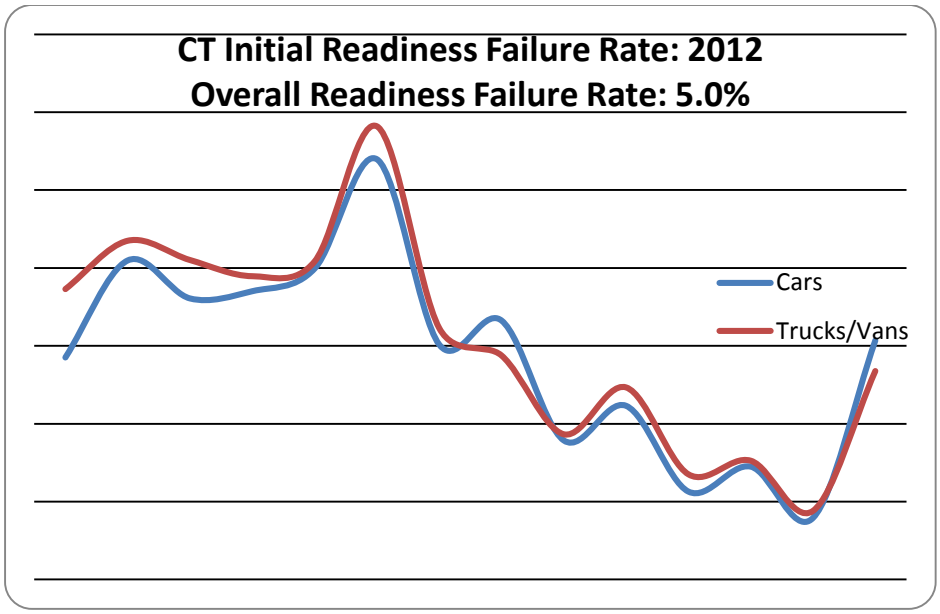


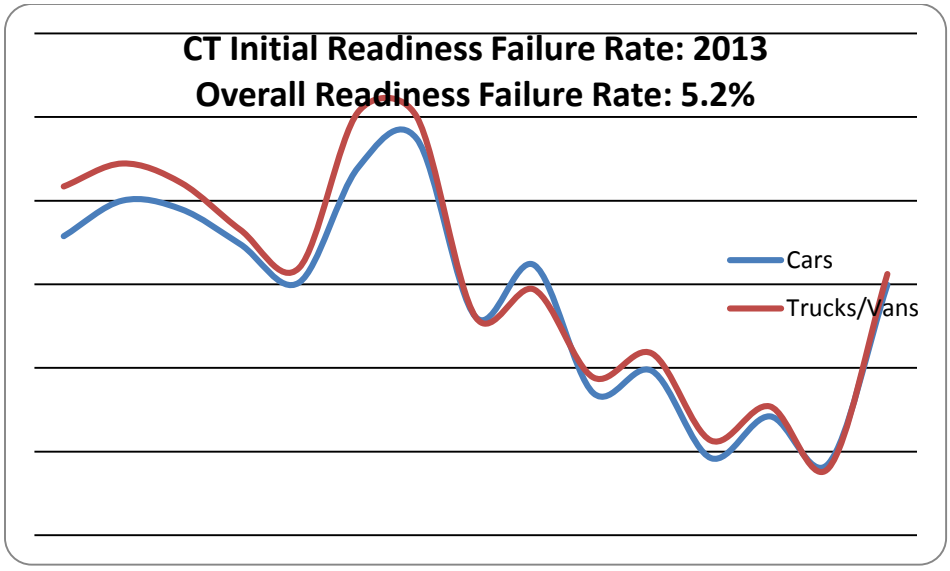
These charts show failure rates by vehicle model year for the first OBD retest. The average failure rate for all vehicles in the first OBD retest was 10%. Connecticut requires OBD failures to meet readiness requirements when retested. If a vehicle does not meet readiness requirements when retested, the inspection is aborted. Vehicles that are not ready on retest are not included in the above failed percentages.





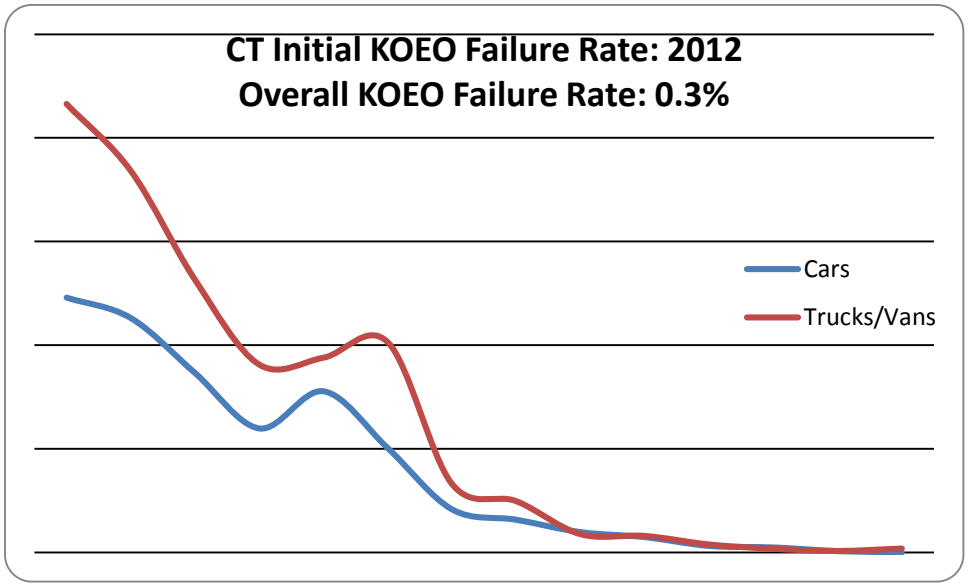
These charts show the percentage of vehicles that fail the MIL Command check that's part of the OBD test. Most OBD failures are for the MIL Command check. The average MIL failure rate for all vehicles was 6% in both years. This graph shows that older model year vehicles have a higher failure rate, as expected.

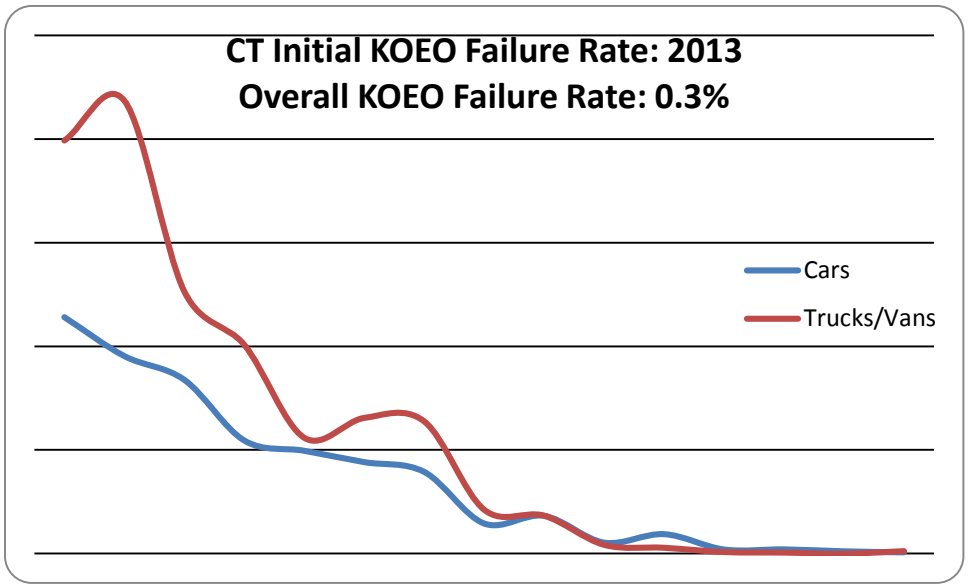




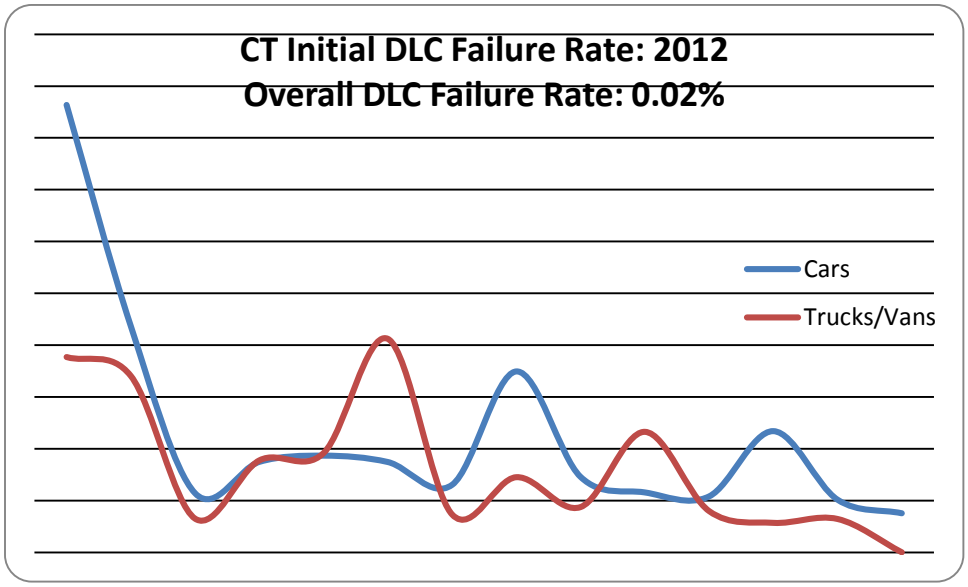
These charts show the percentage of vehicles that exceed EPA's readiness criteria. OBD systems must indicate whether or not the onboard diagnostic system has monitored each component. Components that have been diagnosed are termed "ready", meaning they were tested by the OBD system. EPA requires that 2001 and newer model year vehicles have at most one monitor not ready as opposed to two for 2000 and older model year vehicles. This change in readiness requirement explains the elevated failure rate for 2001 model year vehicles. The high "not ready" rate for 2009 models in 2012 and 2010 models in 2013 is due to the fact that over half of the 2009 and 2010 vehicles tested, had dealer plates. Vehicles owned by dealers typically have high not ready rates, because their batteries are often insufficiently charged, or had been disconnected during dealer prep[11]. Overall, 5% of the vehicles failed EPA's readiness criteria.

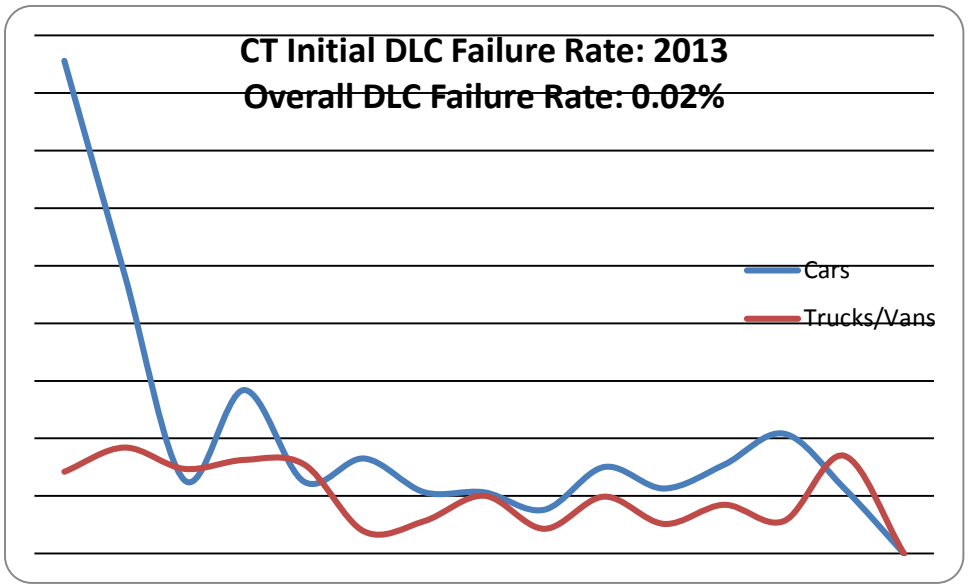
[11] Readiness status for all monitors usually sets to not ready when a vehicle's battery is disconnected.



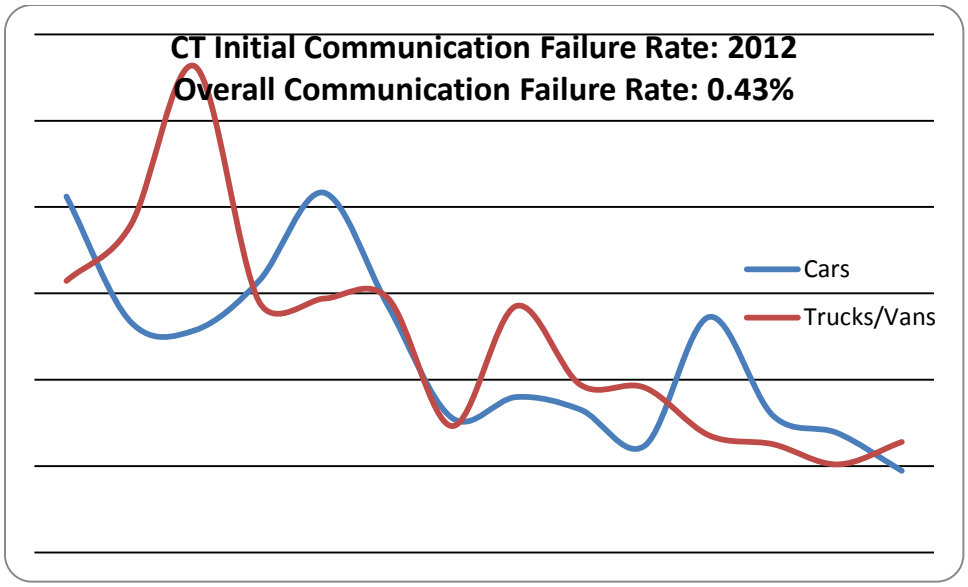


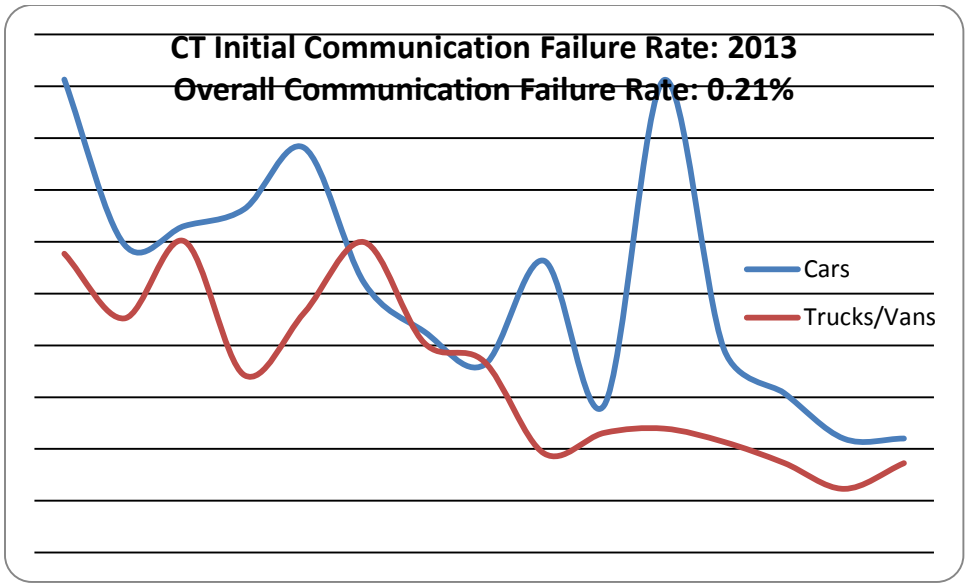
These charts show failure rates by vehicle model year for the Key-On Engine-Off (KOEO) test, which is part of the OBD test. The KOEO determines if the MIL bulb is operational. The bulb should illuminate when the vehicle is turned on, but not started. The average KOEO failure rate for all vehicles was 0.3%.



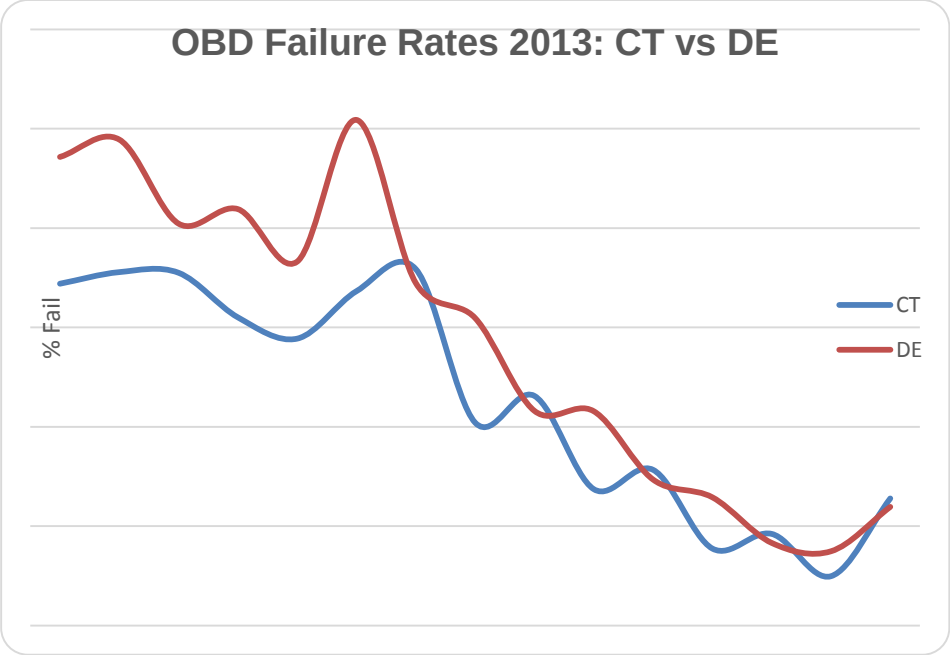


These charts show the percentage of vehicles that failed because the OBD connector, termed the Data Link Connector or DLC, is missing, damaged or obstructed. Overall, few vehicles (0.02%) failed for this reason.





These charts show the percentage of vehicles that failed to communicate with the OBD test equipment. The no communication rate has dropped significantly with the new equipment that was installed in 2011.



This chart compares failure rates for the OBD tests in Connecticut and Delaware. Delaware is a state-operated test-only program, which is considered by EPA to be a model for peak I/M performance. Failure rates in both programs are similar, which indicates that Connecticut is operating at peak performance with regard to failure rates.

3.0 Observed Failure Rates for Diesel-Powered Vehicles

Diesel-powered vehicles with a GVWR of 10,000 lbs. or less are also tested in the I/M program in Connecticut. Although the testing and reporting of diesel-powered vehicles is not required, historically Connecticut has reported on diesel testing. This report includes additional information on diesel initial testing, first retest as well as second and later retesting, to respond to EPA's request in their comments on 2010 Annual Evaluation of the Connecticut Inspection/Maintenance Program (2010 Evaluation). If the vehicle is equipped with an OBDII system, an OBDII test is performed. Otherwise, the vehicle receives a test designed to identify excessive exhaust smoke opacity.

Failure rates for diesel-powered vehicles were calculated using test results from I/M test stations. Below is a brief description of the criteria used to determine if a vehicle passes or fails inspection.

Pass/Fail Criteria

Modified Snap Acceleration (MSA) Test: With this test, the throttle is "snapped" (i.e., accelerator is quickly pressed and then released) and exhaust smoke opacity is measured. This test is performed with the vehicle being in "neutral or park" and based on the J1667 SAE standards. The average of three snaps is calculated, and compared to the standard recommended by the federal government. Current cut-points for are 1990 55% and 1991 and newer are 40%.

Loaded Mode Diesel (LMD) Test: Vehicles are tested using a dynamometer with loading based on body type to simulate driving at 30 mph. Exhaust smoke opacity is measured and cut point is set at 20% for pass or fail.

OBDII Inspection: 1997 and newer model year diesels vehicles with less than 8500 lbs. GVWR get an OBDII inspection. The emissions test system is plugged into the OBDII connector and information on the status of the vehicle's OBD system is downloaded. Diesel-powered vehicles will fail the OBDII inspection if they have any of the following problems:

- Malfunction Indicator Lamp (MIL) is commanded-on and DTCs are stored;
- MIL not working (Termed Key-On Engine-Off, KOEO, failure);
- OBD diagnostic link connector damaged, missing or obstructed; and
- Excessive readiness monitors not ready based on the model year

Summary of Failure Rates for Diesel-Powered Vehicles

Following is a summary of test results for the January 1, 2012 to December 31, 2013 period. In 2012, 10,200 diesel-powered vehicles received opacity tests, and an additional 2,501 vehicles received OBD tests. In 2013, 10,747 diesel-powered vehicles received opacity tests, and an additional 3,224 vehicles received OBD tests. The table below compares failure rates in 2012 and 2013 for different tests that are performed on diesel powered vehicles. The increase in failure rates from 2012 to 2013 could be due to aging of the diesel fleet. There were too few diesel powered vehicles receiving second and later retests to do an analysis of trends.

Test Type	**Parameter**	**2012**	**2013**
OBD	% Fail Initial	8.4%	9.3%
	% Fail First Retest	6.8%	8.6%
MSA	% Fail Initial	3.2%	6.6%
	% Fail First Retest	27%	30%
LMD	% Fail Initial	0.8%	1.3%
	% Fail First Retest	6.1%	9.8%

Appendix B has details on the OBD, MSA, and LMD test results for diesel as well as gasoline powered vehicles.

Conclusion: These failure rates are similar to rates found in previous evaluation reports. Outside of Connecticut, few states perform periodic tests on diesel-powered vehicles, so there is little basis for a comparison of Connecticut's diesel-powered vehicle failure rate with other states.

4.0 Enforcement of Connecticut's I/M Program

Connecticut's program uses both registration denial and late fee assessment to assure compliance. This section presents an analysis of data relevant to the enforcement of Connecticut's I/M program. Statistics required by 40 CFR 51.366 are presented below, and in the Appendix B, with exception of 40 CFR 51.366(d)(1)(iv) and (v) which are not applicable to Connecticut's program.

Overall Compliance Rate

The overall compliance rate is based on the number of passing inspections divided by the number of vehicles subject to inspection. Connecticut committed to a 96% compliance rate for the vehicles subject to I/M requirements in the SIP. In 2013, 984,001 registration renewals were audited, resulting in 52,270 denials, of which 93.1% later complied. This works out to a 99.6% compliance rate, so the overall compliance rate exceeds the SIP compliance rate. A similar compliance rate was observed in 2012 and earlier years.

Late Fees: In 2012, 162,665 late fees were assessed for total fines to motorists of $3.2 million. In 2013, 175,221 late fees were assessed for total fines to motorists of $3.4 million. These fines serve as an effective motivation for compliance with inspection requirements.

Preventing Circumvention of Connecticut's I/M Requirement

EPA requires states to prevent motorists from avoiding I/M requirements by falsely registering vehicles out of the program area, or falsely changing fuel type or weight class on the vehicle registration. EPA also requires states to report on results of special studies to investigate the frequency of such activity.

- **Circumventing I/M Tests in Connecticut –** Circumventing I/M tests in Connecticut is nearly impossible. First, Connecticut implements the I/M program on a statewide basis. Second, Connecticut tests all fuel types, including hybrids, so motorists cannot avoid inspection by changing fuel type. It may be possible to avoid inspection by registering the vehicle with a GVWR greater than 10,000 lbs., but likely is limited in scope due to the added expense. The majority of vehicles registered with an incorrect GVWR are those where the vehicle owner registers the vehicle at a lower weight to avoid the added expense and would not be emission eligible (>10,000 lbs.) with their corrected weight.
- **Detection and Enforcement Against Motorists That Falsely Change Vehicle Classifications To Circumvent Program Requirements –** Historically, 99% of emission eligible vehicles in Connecticut are in the Passenger, Commercial or Combination classifications. Incidents of motorists modifying a vehicle's registration classification to a non-emission eligible class are rare, most likely because of the added expense, documentation and inspection requirements.
- **Vehicles registered in Connecticut that are operated out-of-state –**

Connecticut - DMV has recently changed its policies with respect to detecting vehicles that are registered in the State of Connecticut, but are being operated outside of the state, to avoid being emission tested. Specifically, under its current procedures, DMV will not allow a vehicle owner to receive numerous time extensions. These efforts are definitely helping to make vehicles registered in Connecticut emissions compliant. DMV assumes that vehicles are scrapped or registered out-of-state if they do not comply with I/M requirements.

Percent of Failed Vehicles That Ultimately Pass

To estimate whether vehicles that failed their emissions test ultimately pass, the fate of vehicles failing their I/M test in 2013 was evaluated. As Connecticut has done in previous reports per EPA recommendations, these results are calculated as the percentage of vehicles that initially failed and do not receive a final pass.

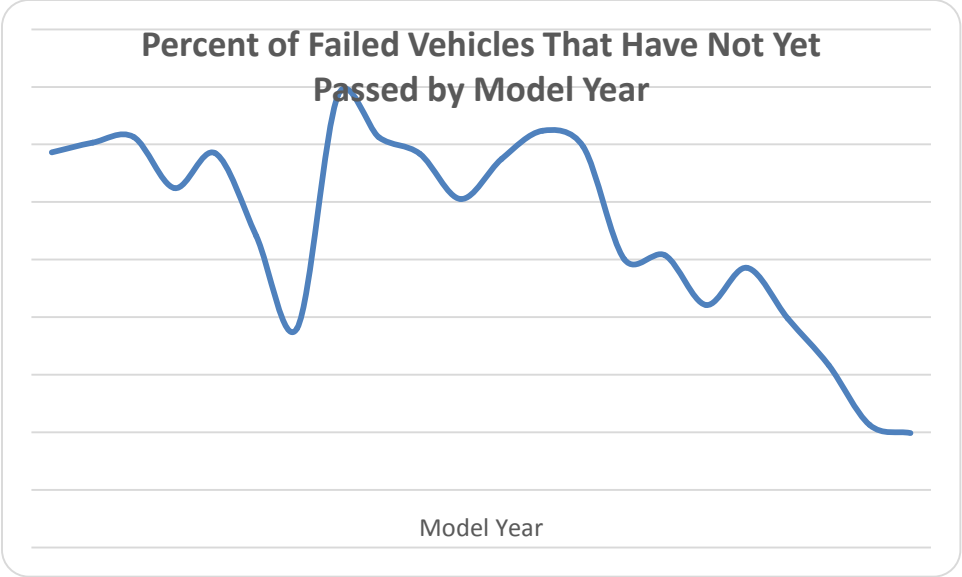
Failures for the first two months of 2013 were tracked through 12/31/2013. Results are shown in the table and figure below. 29% of the failures during this two month period had not yet received a passing result or waiver. This is slightly lower than the percentage for 2012 where 30% of the failures had yet to pass. dKC also compared the total number of vehicles that passed retests in 2013 with the total number of failures in 2013. dKC found that number of vehicles that passed retests equaled 84% of the number of failures in 2013[12]. In 2012, the number of vehicles that passed retests equaled 81% of the number of failures. Ultimately, all vehicles must comply, or they cannot be registered in Connecticut, since I/M compliance is a prerequisite for vehicle registration. As noted above, Connecticut levied $3.4 million in fines for late registration. Overall, over 99% of the vehicles that were tested complied with I/M program requirements.

EPA's comments on the 2012 Annual Evaluation Report encourages states to improve the program performance by reducing the number of vehicles with no final outcome. This year's evaluation demonstrates that only 16% of the failed vehicles had not successfully passed emissions testing by the end of 2013, which is an improvement over the 2012 results. To avoid vehicles that fail in a state with a strong enforcement program, such as Connecticut's, from subsequent re-registration, perhaps in a different state/area with more relaxed testing requirements, EPA suggests that state/areas with I/M programs consider developing Vehicle Identification Number (VIN)-based databases for vehicles that fail I/M tests and do not receive final passing results. Connecticut has not been able to devise a feasible method to identify vehicles that are registered out-of-state due to emissions non-compliance. Connecticut looks forward to EPA's leadership in developing partnerships with other jurisdictions to improve the program by addressing the number of vehicles with no final outcome.

[12] The number of vehicles that passed retests in 2013 included vehicles that failed in 2012. Similarly, the number of vehicles that passed retests in 2012 included vehicles that failed in 2011.

Vehicles Tested from 1/1/13 to 3/1/13
with No Known Outcome

Model Year	Initial Fail	Final Retest Pass	No Final Pass	% No Final Pass
1989	102	67	35	34%
1990	128	83	45	35%
1991	115	74	41	36%
1992	157	108	49	31%
1993	222	146	76	34%
1994	292	213	79	27%
1995	436	353	83	19%
1996	662	402	260	39%
1997	1,005	647	358	36%
1998	1,123	739	384	34%
1999	1,454	1,014	440	30%
2000	1,310	868	442	34%
2001	1,307	834	473	36%
2002	1,417	924	493	35%
2003	1,414	1,060	354	25%
2004	1,013	756	257	25%
2005	1,249	986	263	21%
2006	634	480	154	24%
2007	684	548	136	20%
2008	379	319	60	16%
2009	310	277	33	11%
2010	302	272	30	10%
TOTAL	**15,715**	**11,170**	**4,545**	**29%**



This chart shows the percentage of vehicles that failed the emission test in the first two months of 2013 and never ultimately passed in 2013. The increase from 1995 to 1996 indicates that compliance with the OBD test may be more difficult than the tailpipe test used for pre-1996 vehicles.

Waivers Issued

Another aspect related to enforcement is the number of waivers issued. Program effectiveness is inversely proportional to the waiver rate. As the following table shows, only 0.2% of the vehicles that failed received waivers, indicating that the program is effective. This is much lower than the waiver rates in many other states' I/M programs. Connecticut's I/M SIP committed to a waiver rate of 1%.

Conclusion: Connecticut exceeds SIP requirements for enforcement of motorist compliance. The overall compliance rate in Connecticut exceeds 96%, which is the compliance rate of Connecticut's SIP. Connecticut actively investigates non-compliance and assesses a large number of fines for vehicles that are not presented for emission inspection in a timely manner. Connecticut issues fewer waivers than committed to in Connecticut's SIP.

% of Failed Vehicles Receiving Waivers[13] in 2013

Model Year	Passenger Car (P)	Truck (T)	Total # of Waivers	# of Failed Vehicles	% of Failed Vehicles Receiving Waivers
1989	1	0	1	795	0.13%
1990	1	0	1	904	0.11%
1991	2	0	2	895	0.22%
1992	2	1	3	1127	0.27%
1993	4	0	4	1588	0.25%
1994	3	1	4	2014	0.20%
1995	4	2	6	2830	0.21%
1996	4	3	7	3854	0.18%
1997	6	2	8	6010	0.13%
1998	10	2	12	6834	0.18%
1999	13	6	19	8173	0.23%
2000	22	12	34	11248	0.30%
2001	17	12	29	13214	0.22%
2002	16	8	24	8671	0.28%
2003	10	12	22	10541	0.21%
2004	9	4	13	6158	0.21%
2005	9	3	12	8117	0.15%
2006	3	4	7	3825	0.18%
2007	4	2	6	4593	0.13%
Total	140	74	214	107,154	0.20%

[13] Diagnostic and Cost waivers combined.

Enforcement of Proper Test Procedures Through Trigger Reports and Video Audits

Connecticut is a model for other states in how to enforce proper I/M test procedures. Connecticut actively looks for cases where inspectors may be performing improper inspections, passing vehicles that otherwise should fail. The following is a summary of how Connecticut ensures that stations perform proper inspections:

- DMV and its contractor, Applus, run extensive trigger reports to assure that inspection stations follow proper test procedures. The following demonstrates that DMV has developed a comprehensive set of triggers to verify and enforce compliance with proper test procedures:
    - Trigger reports look for anomalies in data recorded during inspection. These reports help DMV identify stations performing fraudulent or inaccurate inspections;
    - Triggers focus on finding the following types of fraud;
        - Clean Scanning: Performing an OBDII test on a fault-free vehicle instead of the vehicle that should be tested;
        - Clean Piping: Performing a tailpipe test on a passing vehicle instead of the vehicle that should be tested;
    - These reports are generated frequently to identify stations performing improper inspections. Connecticut promptly investigates all significant cases of possible inspection fraud.
- In addition to the auditing conducted by DMV, DMV requires its Contractor to maintain quality assurance measures, which they meet by conducting additional audits.
- On a monthly basis, DMV rotates staff, so that there are two full time video auditors who continually monitor inspections during station operating hours via digital web cameras. Video audits have the following features:
    - Real time monitoring/control of vehicle inspections;
    - Video auditors can selectively view inspections; and
    - If anomalies are detected, DMV requires its contractors to take affirmative actions to halt the inspection.
- No other state does more thorough trigger or video audits and follow-up actions.

Triggers for Clean Scanning/Clean Piping

DMV runs several trigger reports to identify clean scanning and clean piping:

- **Mismatch between entered Vehicle Identification Number (VIN) and OBDII VIN** – Certified Testing Inspectors (CTI) may attempt to pass vehicles with OBDII faults by scanning a problem-free vehicle instead of the one that should be inspected.
    - If the vehicle has an electronic VIN available through the vehicle's OBDII system, clean scanning cases can be identified by comparing entered VIN with VIN provided by vehicle's OBDII system.
    - DMV investigates all VIN mismatches. Most mismatches correspond to vehicles owned by the same person or vehicles that had Program Control Modules replaced without proper programming of the vehicles' computer with the correct VIN, also termed reflashing.
- **Questionable Retests** – Mismatches between initial tests and retests could indicate that the inspector clean-scanned vehicles on retests. DMV checks the following parameters:
    - Supported readiness monitors – different vehicles have different monitors;
    - OBD computer identifiers;
- **Short Time Between Initial OBD Test Fail And Retest Pass** – Stations that often show short time periods, in particular one half hour, between the initial test failure and retest pass could be performing fraudulent inspections. (Short Time Period = ½ hour)
    - It is difficult to repair OBD failures and get failing vehicles to pass within a short time period:
        - MIL-On Fails – It takes time for the MIL to go off, or readiness monitors to reset if codes are cleared.
        - Readiness Fails – It takes time for readiness monitors to set to ready, especially the evaporative monitor.
- **Large Emission Reductions in a Short Time Period (1981-1995 Vehicles)** – Stations reporting large emission reductions in a short time period are more likely to be clean piping the retests. (Short Time Period= ½ hour)

dKC developed a new trigger report and applied it to the Connecticut dataset. dKC found that in 2013 less than 0.10% of the inspections were suspect. The percentage of suspect tests in 2013 was lower than in 2012 when less than 0.20% of the tests were suspect. Being suspect only means there was a chance that fraud occurred. These data indicate that inspection fraud is not a serious problem in Connecticut.

Conclusion: Evaluation of the data demonstrates that Connecticut vigorously enforces proper inspection procedures. Inspection fraud is not a problem in Connecticut's I/M program. Connecticut actively investigates possible cases of inspection fraud and initiates corrective action. Less than 0.1% of the tests in Connecticut are suspect.

5.0 Quality Assurance Audits

The DMV and their contractor, Applus, perform the quality assurance (QA) audits required by EPA. Following is an overview of Connecticut's audits, and other QA activities conducted by DMV.

Overt Audits

EPA requires that Overt Audits be performed twice per year per station. DMV meets these requirements through use of the Emission Test Monitoring Report (ETMR). Connecticut prepares ETMRs more frequently than required by EPA. Most stations receive at least one ETMR per month. In addition, Applus also performs overt audits. Connecticut also checks more items than required by EPA. Connecticut is continuing to evaluate the auditing process to build upon the program's success.

Stations	**2012**	**2013**
Total Overt Audits Performed	3,393	4,401
No. of Stations Audited	228	226
No. of Times Each Station Was Audited (range)	1-30[14]	0-31[15]
No. of Stations That Had No Violations for the Entire Year	71	109
Total Number of Audits for Which One or More Violations Were Reported	391	445
No. of Stations That Had Violations	157	117
No. of Stations That Had 1-3 Violations	121	70
No. of Stations That Had 4-6 Violations	30	29
No. of Stations That Had 7-18 Violations	6	18
Agents	**2012**	**2013**
No. of Agents That Performed Audits During the Course of the Year	9	8
No. of Agents That Are No Longer Performing Overt Audits	1	2[16]
No. of Agents That Are Currently Assigned to Perform Audits	8	6
No. of Audits per Agent (range)	0[17]- 783	14 - 1,138
No. of Station Violations Reported per Agent (range)	1 - 143	2 - 223

[14] All stations except two were visited at least twice. One station was not visited twice, as it joined the program during the second half of the year, and DMV performed one QA audit at this station. As for the other station, it was not audited because DMV inadvertently missed it due to a paperwork error.

[15] All stations except three were visited at least twice. Three stations were added to the program late in the year and were not audited.

[16] In 2013, two MVA's were reassigned from performing both overt and covert audits to performing covert only in an effort to keep them from being recognized by the testing stations during covert audits with the additional goal of keeping the covert vehicles from being recognized.

[17] One agent out on Workman's Comp for the entire year did not perform any audits.

Equipment Audits

EPA requires that each station receive two emission test equipment audits per year. In 2013, DMV performed 433 equipment audits: 18 stations received 3 audits, 179 stations received 2 audits, 21 stations received one audit, and 8 stations were not audited. Of the 8 stations that were not audited, 4 were added in the second half of the year and were audited prior to being activated. One station had a name change; the previously named station was audited. Three (3) stations were not audited due to a staffing shortage because a lead auditor retired. In addition to DMV's audits, Applus also performs equipment audits. Connecticut checks more equipment items than required by EPA. While an audit may require a station to discontinue tailpipe testing, it can continue OBD testing. Therefore, no stations were totally shut down due to a failed gas equipment audit. Results are presented below.

In 2011, 67% of the stations failed equipment (gas) audits, while in 2012 this percentage dropped to 36%. The percentage of stations that failed equipment audits dropped further in 2013 to 29%. The drop was due to the roll out of new, more reliable emission test benches in the new program.

Results of Equipment Audits

Parameter	2012	2013
Total Equipment Audits	717	433
Total Stations that Failed Equipment Audit	219	127
Percentage of stations that failed an equipment (gas) audit	35.92%	29.33%
Number of stations totally shut down as a result of a failed equipment (gas) audit [18]	0	0
Percentage of stations shut down as a result of failed equipment (gas) audit	0.00%	0.00%

[18] Stations that fail equipment audit are prohibited from performing tailpipe emission testing until the equipment problem was resolved. Stations were allowed to continue to perform OBD testing.

Covert Audits

EPA requires that covert audits be performed at least once per year per station. DMV meets these requirements by performing covert audits and video surveillance audits. During 2013, DMV performed 540 covert audits and 1,920 video surveillance audits. During 2012, DMV performed 64 covert audits and 438 video surveillance audits. Video audits repeatedly have been proven to be more effective than covert audits in detecting fraud. DMV performs video surveillance audits on a semi-random basis. After each station receives a video audit, DMV starts a new cycle of audits.

As noted above, DMV performed 540 covert vehicle audits in 2013. Most stations received at least two audits. To address EPA's comments on the 2012 Annual Report, vehicles requiring OBD, ASM and PCTSI tests are used for covert audits. Some of the vehicles are set to fail. Details are provided in Appendix B.

Warnings are routinely issued for false passes if DMV does not find that the CTI intentionally or negligently falsely passed a vehicle, thus there can be a difference between the number of false passes and suspensions. Suspensions are usually associated with violations found from trigger reports and data audits. Most false passes are for minor procedural errors, such as failing to perform the visual MIL check correctly. Unless the station repeats these errors, they are issued warnings rather than being suspended.

As stated in the Applus contract, and in the Applus Station Agreement, a CTI is suspended (pending an investigation) when it is determined that the false pass was the result of "Intentionally improperly passing a failing vehicle." Most errors identified by covert and video surveillance audits were determined to be unintentional and due to poor attention to detail. However, a second occurrence of making a careless error, such as missing or incorrectly answering the MIL question, results in an automatic suspension.

Connecticut is a model for running trigger reports and following-up on the issues identified as a result of those audits. Suspensions for violations other than covert audit findings or triggers were for various reasons as outlined in the contract under "Inspector Violations," including, but not limited to data entry errors or incorrect test procedures. Connecticut often investigates instances of fraudulent testing, clean piping, and clean screening with federal EPA, and the Commercial Vehicle Safety Division. Connecticut recently investigated with help from federal EPA several cases regarding possible use of an OBD simulator to pass vehicles. The statutory and regulatory basis of the program does not allow Connecticut to issue fines or hold hearings concerning inspectors that falsely pass vehicles in covert audits. However, inspectors can be suspended from testing if infractions are found. Whether or not to suspend a station depends on the assessment of the severity of the infraction by Applus.

Contractor QA Activities

Fraud Prevention Systems

In addition to Connecticut's efforts to eliminate fraudulent and inaccurate tests, the State's contractor, Applus, has implemented systems to prevent fraud, including the Connecticut Decentralized Analyzer System (CDAS), provided by Applus, which has features to assure that accurate emissions tests are performed. These systems and features are described below:

- Secure iris recognition system – use of biometrics
- Trend analysis monitoring –
    - Test time duration
    - Initial and retest pass/fail rate
    - Repair costs
    - Waivers
    - Speed variability check
    - Gas cap failure analysis
    - After hours inspection analysis
    - Aborted inspection analysis

Analyzer QA Functions

- Sample system leak check
- Analyzer gas calibrations – Every 72 hours or system will lock out testing
- CDAS units require a two point calibration with BAR 97 high gas followed by BAR 97 low gas blend
- CDAS units have passed BAR 97 certification tests
- Dynamometer undergo a coast down every 72 hours
- Raw transport time verification
- Various other hardware checks are done every 72 hours
- Low sample flow, sample dilution checks etc.

Contractor QA Activities (cont.)

Inspection Results Analysis Audits – monitoring of performance indicators

- # of offline inspections
- Gas cap failures
- OBD failures
- After hours testing

Digital Audits – monitoring of equipment service and repair

- Leak check failures
- NO cell age
- Gas cap calibration failure
- NO response time
- CO response time
- O2 response time
- NO low calibration gas drift
- Bench low calibration failure rate
- Parasitic loss changes

Conclusion: Connecticut exceeds EPA's recommended levels of quality assurance. High quality, fraud-free inspections are the norm in Connecticut.

6.0 Assessment of OBD Testing Issues

Vehicles with Readiness Issues that are Not Currently Exempted from Readiness Requirements

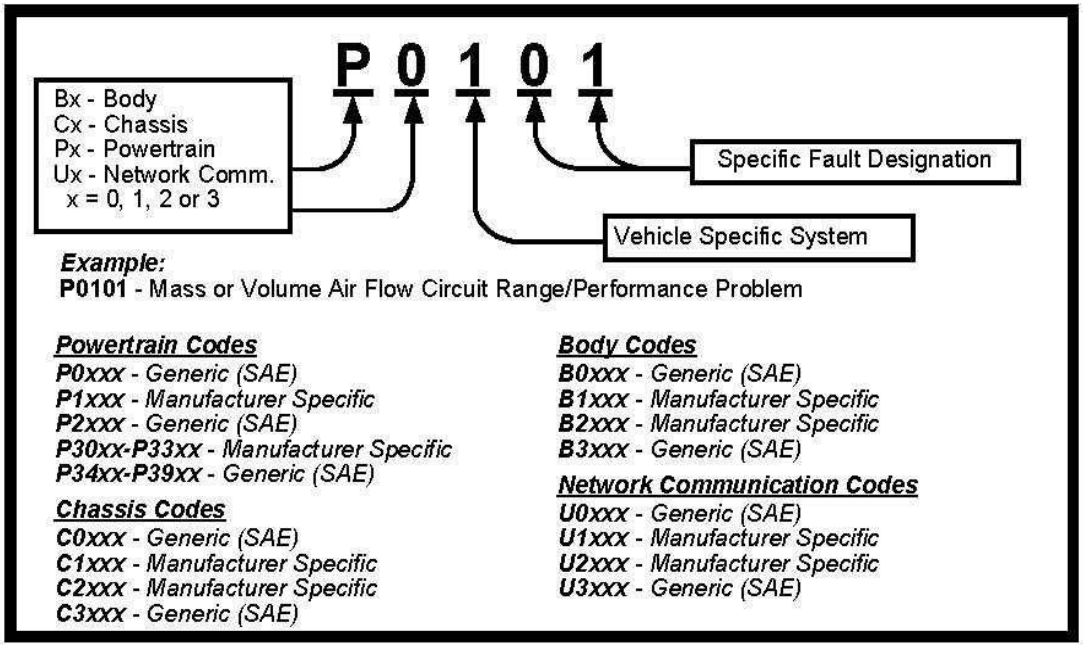
EPA allows states to exempt vehicles from readiness requirements, if they have design flaws that cause them to frequently fail for readiness. In 2007, Connecticut updated its readiness exemption list to include vehicles that had extremely high not ready rates. Based on an analysis of 2013 data, additional vehicles do not need to be added to the readiness exemption list.

Vehicles That Fail to Communicate with Connecticut's Test System

A small percentage (0.2%) of the vehicles with OBDII systems failed to communicate with Connecticut's inspection system in 2013. In 2012, 0.4% of the vehicles with OBDII systems failed to communicate with Connecticut's inspection system. These no communication rates are much lower than the no-communication rates observed with the old testing equipment in 2011 and earlier years, indicating that the new OBD inspection equipment works well. In 2013, only one model, 2006 Mercedes-Benz C-Class, appeared to have high no communication rates; 27% of this model failed for no communication.

Diagnostic Trouble Codes (DTCs) Recorded in OBDII Failures

The Malfunction Indicator Light (MIL) is part of the OBD system and is used to alert the driver of a potential issue with the vehicle's computerized engine management system. Whenever the MIL is illuminated a Diagnostic Trouble Code (DTC) should be stored in the vehicle's computer. DTCs describe the problem that caused the MIL to go on. Before OBDII, each manufacturer had their own specific trouble code list and code definitions. Under the OBDII requirements, all manufacturers must comply with a standardized convention for DTCs. The universal DTC format consists of a 5-character alphanumeric code, consisting of a single letter character followed by four numbers. The following is an example of the standardized coding for DTCs.



Top 10 DTCs in Connecticut

Following is a list of the most prevalent DTCs in Connecticut in 2012 and 2013. This table lists the ranking of the most prevalent DTCs along with the frequency of its occurrence, expressed as a percentage of MIL-On cases. Note that the top 10 DTCs are present in 62% to 64% of the MIL-on cases, even though there are over 1000 possible DTCs. The ranking is nearly identical in both years.

Connecticut's Top 10 DTCs				
	2012		2013	
DTC	Rank	%	Rank	%
P0420 – Low Catalyst Efficiency	1	12.86%	1	13.51%
P0442 -- Evaporative Emission Control System Leak Detected (small leak)	3	7.60%	2	7.86%
P0171 -- System Too Lean: Bank 1	2	7.96%	3	7.75%
P0455 -- Evaporative Emission Control System Leak Detected (gross leak)	4	7.47%	4	7.44%
P0300 -- Random Misfire	6	4.85%	5	5.40%
P0440 -- Evaporative Emission Control System Malfunction	7	4.59%	6	4.37%
P0174 -- System Too Lean: Bank 2	8	4.51%	7	4.22%
P0141 -- 02 Sensor Heater Circuit Malfunction	9	4.29%	8	3.91%
P0401 – Exhaust Gas Recirculation (EGR) Flow Insufficient	5	5.34%	9	3.85%
P0135 -- 02 Sensor Heater Circuit Malfunction	10	4.15%	10	3.52%
Total		63.62%		61.82%

7.0 2011 to 2013 Inspection Cycle Analysis

A dataset of vehicles that were tested in both 2011 and 2013 was created with the goal of determining the durability of repairs performed on vehicles failing in 2011.

Failure Rates

Failure rates (overall, by test type and by model year) in 2013 were determined for the following groups of vehicles that were tested in 2011:

- Passed initial test in 2011; or
- Failed initial test/passed retest in 2011.

The failure rate for 2013 was 9% for the sample of vehicles that passed their initial test in 2011. The failure rate in 2013 was much higher, 22%, for the sample of vehicles that failed in 2011, and were subsequently repaired in order to pass.

Emission Rates

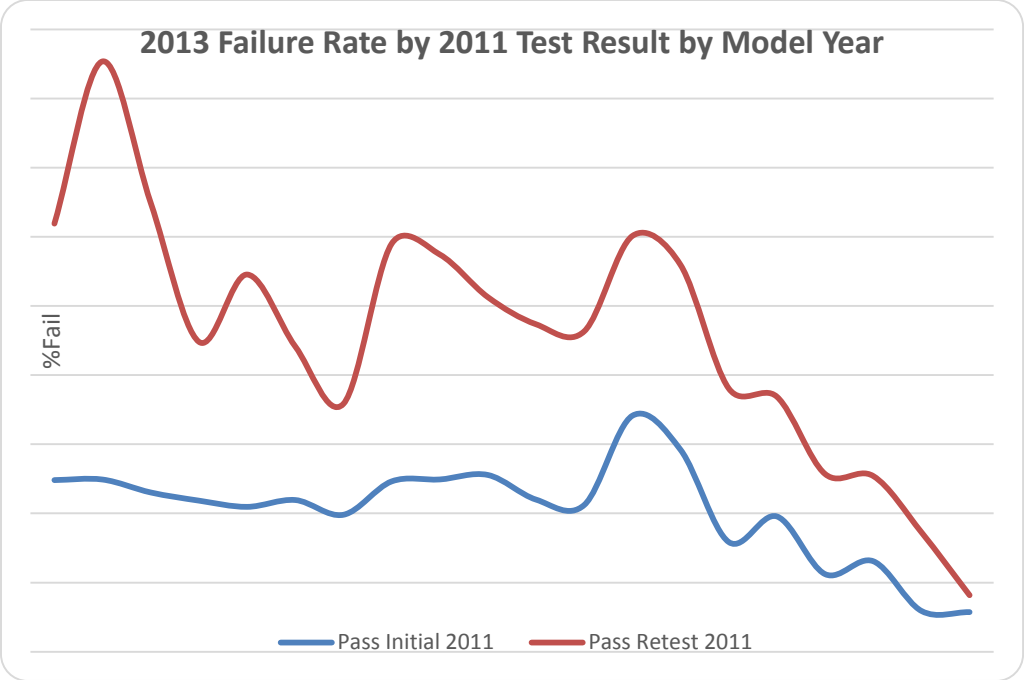
Since the ASM2525 test allows a quantification of emissions levels that the other test procedures do not provide, emissions data from vehicles that had received these tests were evaluated to project how much emissions increased over the two year cycle.

Average ASM2525 emission rates (overall and by model year) for 1995 and older models in 2011 and 2013 were calculated for vehicles for the following groups:

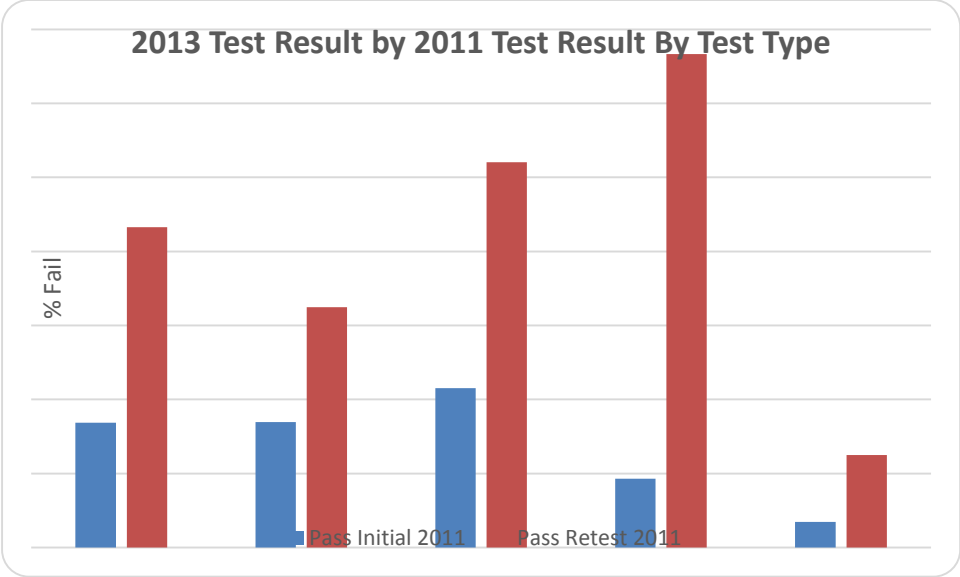
- Passed initial test in 2011; or
- Failed initial test but passed retest in 2011.

Emissions were significantly higher two years later for vehicles that failed and were repaired to pass in 2011. On the other hand, vehicles that passed their initial test in 2011 saw minimal increases in emissions in 2013, which indicates that they were capable of maintaining good control over emissions despite their age.

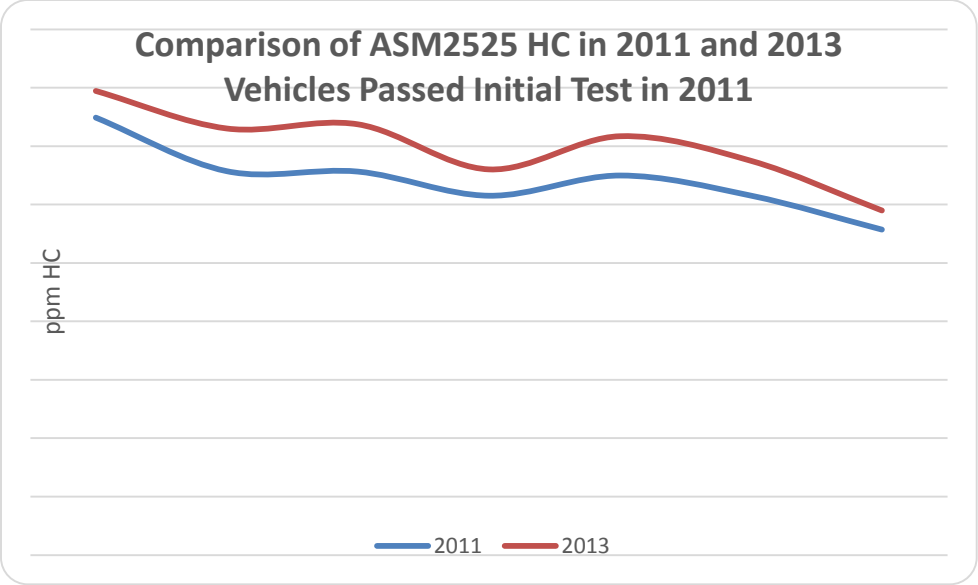
The high failure rates and emissions levels in 2013 for vehicles that failed and were repaired to pass in 2011 may be due to several factors, including that some vehicles are more prone to be high emitters, even after they are repaired. The higher emissions and failure rates for previous failures may also indicate that repair quality can be significantly improved, but an evaluation of this possibility was not possible since the data on who conducted the repairs in 2011, i.e., Certified Repairers, non certified repairers, or self repairs by the motorist were not available. The charts that follow have details on this analysis.



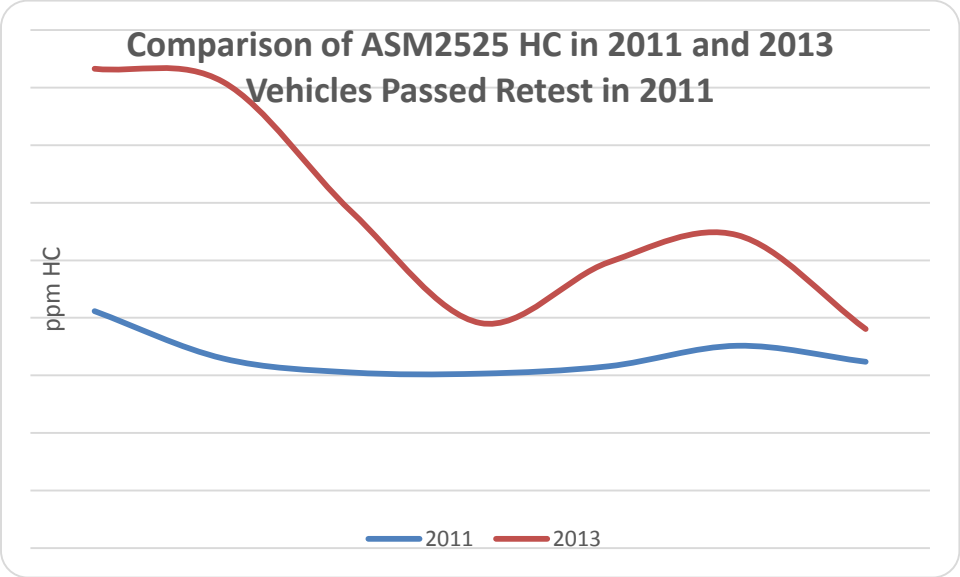
This chart shows failure rates by model year in 2013 for vehicles that passed in 2011. Failure rates in 2013 are compared for two groups of vehicles: 1) vehicles that passed their initial test in 2011 and 2) vehicles that failed and were repaired to pass in 2011. The second group had much higher failure rates in 2013, indicating that these vehicles may be more prone to failing I/M inspections.



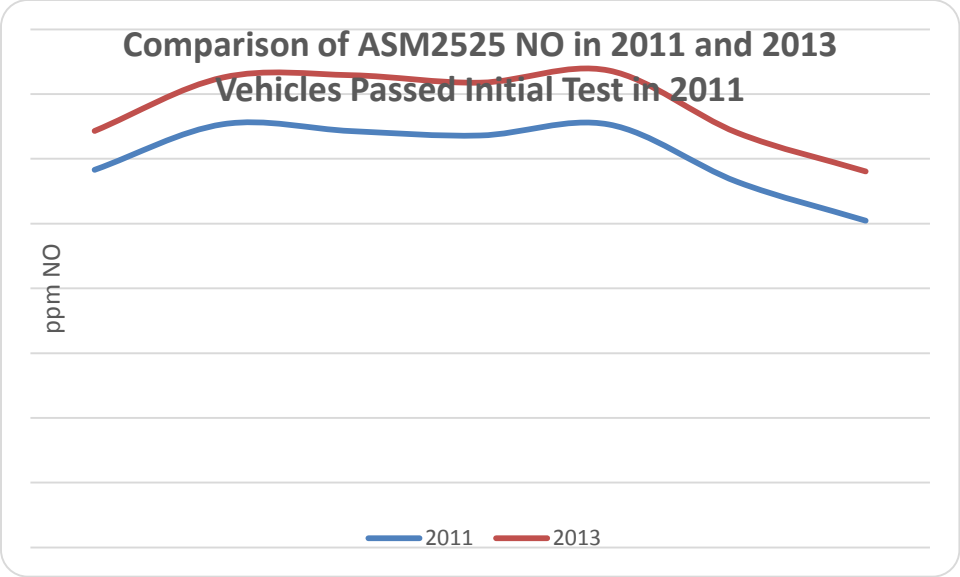
This chart shows failure rates by inspection type in 2013 for vehicles that passed in 2011. Failure rates in 2013 are compared for two groups of vehicles: 1) vehicles that passed their initial test in 2011 and 2) vehicles that failed and were repaired to pass in 2011. The second group had much higher failure rates in 2013 for all inspection types indicating that these vehicles may be more prone to failing I/M inspections.



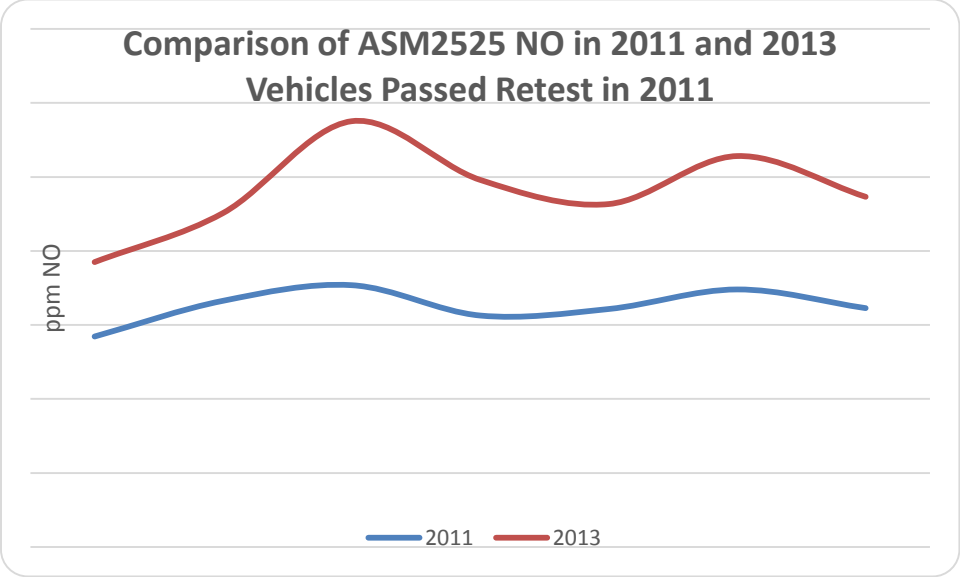
This chart shows average HC emissions by model year in 2011 and 2013 for vehicles that passed their initial test in 2011. Emissions increase slightly from 2011 to 2013. This indicates that many older vehicles can maintain low emissions levels.



This chart shows average HC emissions by model year in 2011 and 2013 for vehicles that passed their retest in 2011. Emissions increase significantly from 2011 to 2013. This may indicate that many repairs may not have fully addressed the emissions problem in any given vehicle.



This chart shows average NO emissions by model year in 2011 and 2013 for vehicles that passed their initial test in 2011 Emissions increase slightly from 2011 to 2013. This indicates that many older vehicles can maintain low emissions levels.



This chart shows average NO emissions by model year in 2011 and 2013 for vehicles that passed their retest in 2011. Emissions increase significantly from 2011 to 2013. This may indicate that many repairs may not have fully addressed the emissions problem in any given vehicle.

8.0 Program Enhancements

DEEP and DMV evaluate Connecticut's I/M program to ensure that it continues to operate accurately and effectively while assuring air quality benefits are achieved. In 2011, DMV executed a new contract to upgrade the I/M program. The new program continues to perform tailpipe tests on pre-1996 vehicles, which do not have OBD systems. This will maintain the air quality benefits necessary to meet Clean Air Act requirements and statutory restrictions.

The new program upgraded the inspection equipment. A new type of bench, which is known to be more reliable, was utilized, resolving the high rate of equipment (gas) auditing failures. The OBDII interface has much lower no-communication rates than the old interface. The vendor will supply the vehicles for covert auditing, with DMV staff continuing to conduct the auditing procedures.

Connecticut will continue with stringent quality assurance and fraud detection activities. In addition to conducting ongoing assessments of the I/M program, Connecticut will seek out additional opportunities to increase the effectiveness of the program. For example, the next generation Connecticut Vehicle Inspection Program will place additional emphasis on the training and evaluation of the effectiveness of the role of the repair industry in overall program compliance.

Improvements made in 2012 and 2013

The following enhancements to the Emissions Program were implemented in 2012:

1. The time extensions policy was changed to disallow a vehicle owner from receiving numerous time extensions, except for special circumstances, such as out of state vehicle owner in the military or college. Across the board multiple extensions for every situation have been eliminated.

2. Iris Enrollments are now done by Applus.

3. Iris enrollment prompts are now included in CDAS. An Iris scan cannot be replaced by badge use without previously calling in a work order and the CTI will be locked out without such a work order. The work order and lockout are not automatic. The CTI is prompted by a screen message to call in a work order if the iris enrollment feature is not functional.

4. VIN enforcement now includes more safeguards to ensure correct VIN is entered.

5. An evaluation of safeguards is being conducted to improve the accuracy of the GVWR that is entered through the registration process.

6. A video of the test is now stored with test record.

7. More cameras are being used per lane. Now there are a total of four (3 plus iris), previously there were a total of 3 (2 plus iris

8. New monitoring with an engine temperature sensor ensures the vehicle is warmed up prior to receiving a tailpipe test.

9. The Testing Reciprocity document with other states was updated. Reciprocity is limited to one inspection cycle except for military and college students.

10. The Dashboard is now equipped with automated audit and includes:

    a. Reports
        i. Official Test Report
        ii. Notification Letters Report
        iii. Offline By Test Center Report
        iv. Video Streaming
        v. Consecutive No Communications Report
        vi. Weather Station Report
        vii. Calibration Reports
        viii. VIR Reprint
        ix. Aborted / Incomplete Test Report
        x. TSI Cutpoint Report
        xi. Inventory Adjustment Report

    b. Test Center Documents
        i. CDAS Materials
        ii. Fast Fact Messages
        iii. Certified Emissions Repair Technicians (CERT)
        iv. Test Center Materials
        v. Certified Testing Inspector (CTI) Form
        vi. Training Materials

    c. Non-Compliance
        i. Software Version Compliance
        ii. Vehicles with GVWR>8,500 Pounds
        iii. Monitor Mismatches
        iv. Inspector ID Entry
        v. Software Version Non-Compliance
        vi. All OBD Monitors Display Unsupported
        vii. OBD Short Time Tests <= ½ Hour
        viii. VIN Entry Type
        ix. Offline Test Rates
        x. OBD VIN Mismatch
        xi. A/C Monitor Ready or Not Ready
        xii. ASM Short Time Test <= ½ Hour
        xiii. PID and PCM Mismatches

xiv. Aborted Inspection

11. Stations and CTIs are locked out of the system if penalties assessed by Applus according to the contract/station participation agreement schedule of infractions, as established in the Compliance Action Plan, are not received.

12. Challenge test process has been streamlined to ensure the equipment is functioning properly. The procedure now entails first contacting Applus to verify the proper operation of equipment.

13. More diesel test station locations have been brought into the program.

14. CO detectors are now required at all test facilities.

15. System lockouts now occur for weather station anomalies.

16. Equipment tamper/malfunctions generate automatic email notifications.

17. DSL or faster internet connection is now required for test equipment.

18. Every CTI was retrained prior to the start of the new program.

19. Emissions staff is now all centrally stationed in Wethersfield to improve logistics.

20. The fleet testing program was reviewed especially with respect to training and maintenance.

21. Cameras with higher megapixel resolution are now being used.

22. DMV now has access directly to the enhanced comprehensive Work Order database, which enhances review.

23. The Work Order database now indicates all work orders.

24. Work Order database now indicates test type affected.

25. There is new guidance for issuing waivers, including how the nature of the repair has to equate to the reason for failure.

26. Presently revising the CTI training manual to allow for DMV review of training evaluations as a tool to modify and amend the training to increase efficiency. The new manual also is intended to be used for oversight of equipment malfunction.

In 2013, additional enhancements were made in the following areas:

1. Improvements to the Dashboard.

    a. New report to ensure camera angles in lanes are aligned to best view the test.
    b. Various other reports were implemented.

2. Work order database was enhanced.

3. Analyzer lane software change so at the initialization of each emissions test, the testing inspector is prompted to verify that every camera angle is aligned to best capture the vehicle in the test lane.

4. New tablet computers have been issued to DMV auditors to speed up and improve auditing capabilities.

    a. Tablets can be used to log onto the Dashboard and view closed station notifications which will help field auditors improve scheduling.
    b. Tablets can be used to view station lane cameras before they arrive for or after they complete an audit.

5. Implementation of an appeals process by which Stations or Testing Inspectors can appeal any compliance action that is taken against them. The appeals board consists of one each: a DMV, a program vendor (Applus), and an automotive industry representative.

6. New software was developed to keep covert vehicles hidden/unknown from the testing network. Previously, if a station looked up the history of a covert vehicle they could see that the vehicle was being tested every day at multiple stations throughout the state, thus allowing them to identify it as a covert vehicle. The new software prevents this from happening.

7. DMV hired a consultant to analyze, compare, and recommend how to improve all aspects including the reporting capabilities of the emissions databases (EDBMS and miniVID.)

Improvements planned in the future

DMV plans to make the following enhancements in the near future:

1. As a result of a self-imposed DMV “lean” audit of the auditing process, DMV will be revamping the performance auditing functions:

    a. DMV will be combining the Overt and QA audits to be done in one visit by one person instead of two separate visits done by two different people.

b. Two additional QA vans are being added to the auditing fleet.
c. All QA vans will be equipped with all tools, supplies, and forms necessary to perform every type of QA and Overt audit.
d. DMV will increase the number of QA zones in the state from four to five.

2. GPS tracking of all DMV QA and Covert auditors will be available (via the new tablets.)

3. DMV plans to retrofit the testing analyzers with a new Data Acquisition Device (DAD) developed by Applus Technologies. The DAD retrofit will incorporate an OBD self-test capability to ensure analyzer and cable integrity. All nine pins and wires in the analyzer DLC and cable will be checked. Below is a list of the additional DAD enhancements:

a. Faster interrogation of vehicle OBD systems over current hardware
b. Ability to collect additional Mode/PID combinations
c. Higher level of accuracy on the Mode/PID data
d. Continuous/ongoing improvement as it relates to connection issues, data accuracy and integrity via firmware updates.
e. Since Applus Technologies is using the DAD as part of the California Smog Check Program, a much larger pool of vehicles will allow problem vehicles to be identified faster.
f. As problematic vehicles are identified, firmware updates can occur outside of the traditional software update cycles.

4. Updated OBD Cable – should reduce cable failures

5. New barcode labels on calibration gas bottles will improve tracking ability and the quality control of analyzer gas calibrations. The barcode will eliminate the ability for the inspector to manually enter gas bottle values eliminating the occurrence of intentionally changing the expiration dates and causing the analyzer to use expired calibration gas.

6. Consolidation improvements to the gas cap screen will reduce the current four screens to two and add option for capless fuel systems.

7. Camera Capture/Camera Verification Screen – software will request inspector to look into camera to capture facial image.

9.0 Conclusions

Key conclusions from this analysis:

- Connecticut's I/M program is achieving air quality benefits. Key indicators include a high compliance rate (99%), limited fraud, low waiver rate and an overall failure rate of 10% in 2012 and 2013, which demonstrates that Connecticut is failing the expected number of vehicles, a key metric of program success.
- Connecticut actively investigates non-compliance and assesses fines for late inspections. In 2012, 162,665 late fees were assessed. In 2013, 175,221 fines were assessed for late inspections. Linking registration to compliance in addition to assessing late inspection fines contribute to Connecticut's very high compliance rate. The enforcement of Connecticut's I/M program exceeds the enforcement levels assumed in emissions modeling for the Connecticut SIP.
- Connecticut conducts extensive compliance assurance activities on the I/M program. Evaluation of these quality assurance data demonstrates that the program performs accurate inspections. Connecticut is a national model for other states' enforcement activities.
- Connecticut's new I/M contract is designed to ensure the I/M program continues to effectively achieve the expected air quality benefits. Of note, the program has successfully addressed key equipment challenges of the old program, including more reliable emission test benches and far better communication between vehicles and the OBD inspection equipment.

Appendix A
EPA Checklist

Appendix A:
40 CFR Part 51 - Subpart S Inspection/Maintenance Program Requirements
51.366 - Data Analysis and Reporting Requirements

Reporting Requirement	Reviewer Comments / Location in State Report	Has the State Met the Requirement?
(a) Test Data Report The program shall submit to EPA by July of each year a report providing basic statistics on the testing program for January through December of the previous year, including:		
(1) The number of vehicles tested by model year and vehicle type;		
(2) By model year and vehicle type, the number and percentage of vehicles:		
(i) Failing initially, per test type;		
(ii) Failing the first retest per test type;		
(iii) Passing the first retest per test type;		

Reporting Requirement	**Reviewer Comments / Location in State Report**	**Has the State Met the Requirement?**
(iv) Initially failed vehicles passing the second or subsequent retest per test type;		
(v) Initially failed vehicles receiving a waiver; and		
(vi) Vehicles with no known final outcome (regardless of reason). *(vii)-(x) [Reserved]*		
(xi) Passing the on-board diagnostic check;		
(xii) Failing the on-board diagnostic check;		
(xiii) Failing the on-board diagnostic check and passing the tailpipe test (if applicable);		
(xiv) Failing the on-board diagnostic check and failing the tailpipe test (if applicable);		
(xv) Passing the on-board diagnostic check and failing the I/M gas cap evaporative system test (if applicable);		
(xvi) Failing the on-board diagnostic check and passing the I/M gas cap evaporative system test (if applicable);		

Reporting Requirement	Reviewer Comments / Location in State Report	Has the State Met the Requirement?
(xvii) Passing both the on-board diagnostic check and I/M gas cap evaporative system test (if applicable);		
(xviii) Failing both the on-board diagnostic check and I/M gas cap evaporative system test (if applicable);		
(xix) MIL is commanded on and no codes are stored;		
(xx) MIL is not commanded on and codes are stored;		
(xxi) MIL is commanded on and codes are stored;		
(xxii) MIL is not commanded on and codes are not stored;		
(xxiii) Readiness status indicates that the evaluation is not complete for any module supported by on-board diagnostic systems;		
(3) The initial test volume by model year and test station;		
(4) The initial test failure rate by model year and test station; and		

Reporting Requirement	Reviewer Comments / Location in State Report	Has the State Met the Requirement?
(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.		
(b) Quality assurance report. The program shall submit to EPA by July of each year a report providing basic statistics on the quality assurance program for January through December of the previous year, including:		
(1) The number of inspection stations and lanes:		
(i) Operating throughout the year; and		
(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;		
(iii) Receiving covert performance audits in the year;		

Reporting Requirement	Reviewer Comments / Location in State Report	Has the State Met the Requirement?
(iv) Not receiving covert performance audits in the year; and		
(v) That have been shut down as a result of overt performance audits;		
(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;		
(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		

Reporting Requirement	Reviewer Comments / Location in State Report	Has the State Met the Requirement?
(iii) That received fines;		
(5) The number of inspectors licensed or certified to conduct testing;		
(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;		
(7) The total amount collected in fines from inspectors and stations by type of violation;		
(8) The total number of covert vehicles available for undercover audits over the year; and		
(9) The number of covert auditors available for undercover audits.		

Reporting Requirement	Reviewer Comments / Location in State Report	Has the State Met the Requirement?
(c) Quality control report The program shall submit to EPA by July of each year a report providing 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.		

Reporting Requirement	Reviewer Comments / Location in State Report	Has the State Met the Requirement?
(d) Enforcement report. (1) All varieties of enforcement programs shall, at a minimum, submit to EPA by July of each year a report providing basic statistics on the enforcement program for January through December of the previous year, including:		
(i) An estimate of the number of vehicles subject to the inspection program, including the results of an analysis of the registration data base;		
(ii) The percentage of motorist compliance based upon a comparison of the number of valid final tests with the number of subject vehicles;		
(iii) The total number of compliance documents issued to inspection stations;		
(iv) The number of missing compliance documents;		
(v) The number of time extensions and other exemptions granted to motorists; and		

Reporting Requirement	Reviewer Comments / Location in State Report	Has the State Met the Requirement?
(vi) The number of compliance surveys conducted, number of vehicles surveyed in each, and the compliance rates found.		
(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		
(ii) The number of registration file audits, number of registrations reviewed, and compliance rates found in such audits.		
(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;		

Reporting Requirement	Reviewer Comments / Location in State Report	Has the State Met the Requirement?
(ii) 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; and		
(iii) The number of enforcement system audits, and the error rate found during those audits.		
(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;		
(ii) 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; and		
(iii) The number of parking lot sticker audits conducted, the number of vehicles surveyed in each, and the noncompliance rate found during those audits.		

Reporting Requirement	Reviewer Comments / Location in State Report	Has the State Met the Requirement?
(e) Additional reporting requirements. In addition to the annual reports in paragraphs (a) through (d) of this section, programs shall submit to EPA by July of every other year, biennial reports addressing:		
(1) Any changes made in program design, funding, personnel levels, procedures, regulations, and legal authority, with detailed discussion and evaluation of the impact on the program of all such changes; and		
(2) Any weaknesses or problems identified in the program within the two-year reporting period, what steps have already been taken to correct those problems, the results of those steps, and any future efforts planned.		

Appendix B
2013 CT I/M Program Data

Appendix B
2013 CT I/M Program Data

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