PARSONS

Final Report

Evaluation of the Effectiveness of the Clark County Vehicle Inspection and Maintenance Program

December 13, 2002
Submitted in compliance with the requirements of
CBE Number 1746-02; Contract for Consulting Services for Decentralized Vehicle Inspection and Maintenance Program Analysis

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Executive Summary

On behalf of the Clark County Department of Air Quality Management (DAQM), Parsons, on July 16, 2002, initiated an analysis to determine the emission reductions achieved by test-only and test-and-repair stations participating in the inspection and maintenance (I/M) program. The goal of the analysis is the determination of the comparative effectiveness of test-and-repair and test-only stations in identifying and reducing Carbon Monoxide (CO) emissions of tested motor vehicles.

In accordance with the guidance documentation developed by the United States Environmental Protection Agency (USEPA) in 1992, the existing State Implementation Plan (SIP) filed in 1996, discounted by 50 percent all of the excess CO emissions benefits generated by the County's I/M program. The USEPA performed numerous studies in several states showing that a substantially higher number of fraudulent emission tests occur at inspection stations that perform both emissions tests and vehicle repairs. Based on these studies, the USEPA required states to discount emissions benefits generated at test-and-repair stations by 50 percent. However, the USEPA allows 100 percent credit for emissions reduced on vehicles inspected at test-only stations.

The analysis used emission results from motor vehicles failing their emissions test for the period from July 1, 2001 through June 30, 2002. The analysis uses these test results to determine if the emissions reduced on after-repairs tests at test-and-repair stations are equivalent to emissions benefits generated by test-only stations. Parsons used Microsoft Excel and standard statistical tools and methods to analyze the data. The analysis includes both parametric and nonparametric statistical analyses. The analysis includes calculation of the overall average reductions of CO emissions and the average reductions for each vehicle model-year category.

Based on the data analysis contained in this evaluation, test-and-repair stations are equally as effective as test-only stations at reducing emissions. Therefore, the input for the I/M effectiveness rate in the MOBILE6 model for the I/M program in Clark County should be 100 percent.

Acronyms

CO – Carbon Monoxide
CFR – Code of Federal Regulations
DAQM – Clark County Department of Air Quality Management
DMV – Nevada Department of Motor Vehicles
DTC – Diagnostic Trouble Codes are generated by the vehicle's on-board diagnostic computer to assist a technician in locating problems with emissions-related engine/vehicle components
GVWR – Gross Vehicle Weight Rating
I/M – Vehicle Inspection and Maintenance Program
MOBILE6 – USEPA computer model used to generate emission factors for making decisions about air quality program strategies designed to reduce emissions from vehicles
NHSDA – National Highway System Designation Act of 1995
OBD – On-Board Diagnostic computer systems designed to monitor and manage critical engine emission controls and operating parameters
RPM – Revolutions Per Minute allowed on emissions tests
SIP – State Implementation Plan
TSI – Two-speed Idle Test to measure vehicle emissions
USEPA – United States Environmental Protection Agency
VID – Vehicle Identification Database storing vehicle emissions inspection results
VIN – Vehicle Identification Number

Introduction

The United States Environmental Protection Agency (USEPA) indicates that motor vehicles are the source of more than 90 percent of the Carbon Monoxide (CO) pollution in urban areas[1]. As a result, the USEPA promotes the use of vehicle inspection and maintenance (I/M) programs as one of the major strategies to address excess vehicle emissions.

Clark County implemented a pilot I/M program in 1974. In 1983, the I/M program became mandatory, requiring CO emission tests for motor vehicles. The Clark County I/M program is a decentralized, registration-based program (i.e., inspections performed at privately-owned, state licensed stations), requiring annual inspections, using a USEPA-approved two-speed idle (TSI) test measuring CO emissions at idle and 2500 RPM. In 1999, the program began converting all stations to an electronic data transmission system. All of these program features remain today. The program consists of two types of emissions inspection stations:

- Test-only stations that only perform emissions inspections; and
- Test-and-repair stations that perform both emissions inspections and motor vehicle repairs.

The USEPA uses a computer model (MOBILE6) to calculate current and future emission factors for motor vehicles based on various inputs including changes in emission standards, vehicle fleet characteristics, and environmental conditions. Past policy only allowed partial credit for model defaults to I/M programs utilizing private test-and-repair stations to perform vehicle emissions inspections. Currently, unless states petition the USEPA and supply a justification for additional credit, only 50 percent of the credit granted to programs utilizing privately or publicly operated test-only stations is allowed for a program utilizing test-and-repair stations.

On behalf of the Clark County Department of Air Quality Management (DAQM), Parsons completed an independent assessment of the emissions test data collected as part of the current motor vehicle I/M program in Clark County. This evaluation, based on the analysis of those emissions test results, seeks to quantify the appropriate effectiveness rate for test-and-repair stations and a combined I/M effectiveness rate to use in the MOBILE6 model for the I/M program in Clark County.

The following sections provide background information about the I/M program, the data analysis performed to determine the effectiveness rates, and the conclusions drawn from that analysis.

[1] EPA 400-F-92-005, January 1993 OMS Fact Sheet #3

Background for the Analysis

Program Background

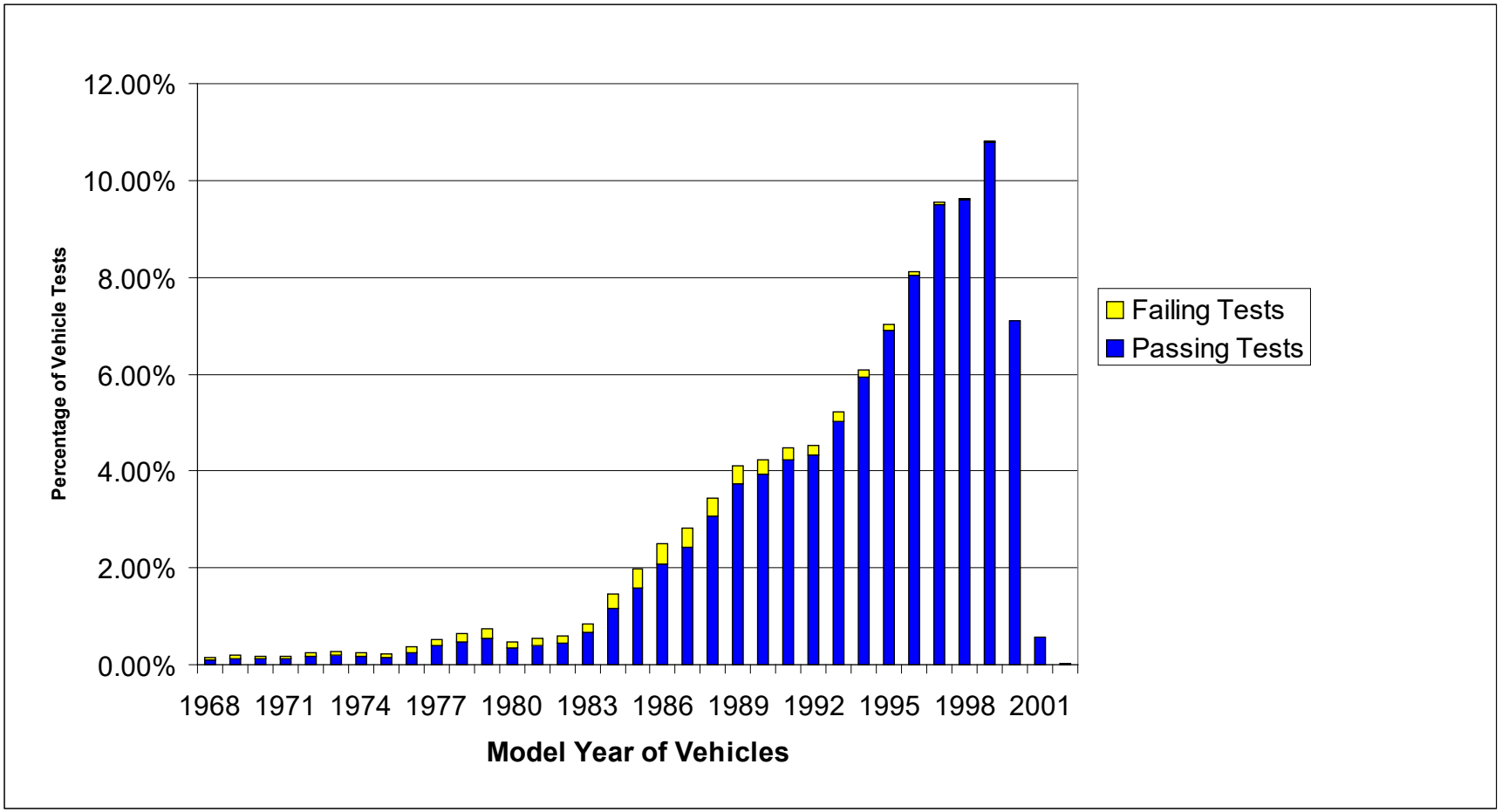
The Nevada Department of Motor Vehicles (DMV) operates the statewide vehicle inspection and maintenance (I/M) program. The DMV's Mission Statement reads in part: "Our mission is to …assist Nevada in meeting its federally mandated air quality standards." The vehicle inspection program affects vehicles located in Clark County meeting the following criteria:

- Gasoline powered;
- Diesel powered with a gross vehicle weight under 8,500 pounds; and
- 1968 model-year or newer.
  (new vehicles on their first or second registration are exempted; a test is required upon a vehicle's third registration)

Vehicle emission inspection certificates are required for registration on an annual basis. Vehicles with model years between 1968 and 1995 are administered an idle and 2500 RPM test. The common name of this test is the two-speed idle test (TSI). The USEPA developed the two-speed idle test in the late 1970's and early 1980's. Studies show that the 2500-RPM test capably identifies excess CO emissions resulting from high-speed misfires. 1996 and newer model year vehicles may receive either the TSI test or the new On-Board Diagnostics (OBD) test in 2002. In 2003, the OBD test becomes mandatory for all 1996 and newer vehicles. The On-Board Diagnostics (OBD) test checks diagnostic trouble codes (DTC) generated by the vehicle's on-board computer sensor system. Nevada emissions stations gradually implemented OBD testing throughout 2002.

Figure 1 shows the distribution by model year of the total initial tests, and the passing and failing percentages. 94.8 percent of the vehicles participating in the program pass their initial emissions inspection with an overall failure rate of 5.2 percent. However, 20 percent of 1989 and older vehicles fail the initial emissions inspection while only 0.2 percent of 1990 and newer model year vehicles fail.

Figure 1 Distribution by Model Year of Initial Test Results



Failing vehicles must be either repaired or obtain a waiver in order to complete the vehicle registration process. In Clark County, vehicle owners that cannot obtain the repairs required to make their vehicle meet emissions standards, may apply for a waiver. Vehicle owners must supply receipts from a licensed station showing that they have spent a minimum of $450 on emission related repairs other than the replacement of the catalytic converter, fuel inlet restrictor or air injection system to qualify for a waiver. The waiver process cannot certify smoking vehicles or vehicles eligible for warranty repairs.

Emission inspection stations electronically transmit vehicle emissions test results to the DMV. This allows vehicle registration renewal by mail, over the Internet, by telephone, in person at a DMV office or in the future at participating inspection stations. Vehicle owners receive a printed emissions inspection report at the conclusion of the inspection for their records. The electronic data transmission system provides a number of other benefits besides convenience for vehicle owners. The system allows the DMV to monitor operations at stations in real-time, produces a number of standardized reports on the program, assists the department in evaluating program performance, and identifies potential enhancements to the system.

USEPA I/M Program Requirements

Title 40 Section 51 of the Code of Federal Regulations (CFR) contains the regulations for Inspection and Maintenance (I/M) programs. The I/M program used by Clark County is a decentralized hybrid program that includes both test-only and test-and-repair stations. Clark County is subject to the Alternate Low Enhanced I/M Performance Standard of Subsection 51.352 (g) of Title 40 of the Code of Federal Regulations. While the foregoing Subsection requires that testing be a centralized network, Subsection 51.353 (a) of Title 40 CFR allow for presumptive equivalency and states: “A decentralized network consisting of stations that only perform official I/M testing (which may include safety-related inspections) and in which owners and employees of those stations, or companies owning those stations, are contractually or legally barred from engaging in motor vehicle repair or service, motor vehicle parts sales, and motor vehicle sale and leasing, either directly or indirectly, and are barred from referring vehicle owners to particular providers of motor vehicle repair services (except as provided in § 51.369(b)(1) of this subpart), shall be considered presumptively equivalent to a centralized, test-only system including comparable test elements.” Regarding programs that permit facilities to engage in motor vehicle repair or service, motor vehicle parts sales, and motor vehicle sales and leasing, either directly or indirectly, Section 51.353 of Title 40 CFR, states: “For decentralized programs other than those meeting the design characteristics described in paragraph (a) of this section, the State must demonstrate that the program is achieving the level of effectiveness claimed in the plan within 12 months of the plan’s final conditional approval before EPA can convert that approval to a final full approval. The adequacy of these demonstrations will be judged by the Administrator on a case-by-case basis through notice-and-comment rulemaking.”

Clark County has a hybrid program, which includes both test-and-repair and test-only stations. The USEPA revised their regulations in 1995, 1996, 1999 and 2000 to provide additional flexibility to states regarding the various alternative program designs and to recognize hybrid programs. The initial modifications, made in 1995, resulted from the passage of the National Highway System Designation Act (NHSDA). Congress felt that the States should receive additional flexibility regarding implementation of their I/M programs and prohibited the USEPA from applying any automatic discounts to emission benefits based strictly on the type of program.

Based on Subsection 51.353 (a) of the Title 40 CFR, Clark County's test-only stations have the presumption of equivalency to a centralized test network and should receive the same emission reduction credits as a centralized system. In addition, Section 51.353 of Title 40 CFR allows the test and repair station component to receive the same credit if it demonstrates that those types of facilities achieve the same level of effectiveness as the test-only stations.

On January 29, 2002, the USEPA announced the approval and availability of the MOBILE6 model for use by state and local governments to meet Clean Air Act requirements[2]. The MOBILE6 model calculates current and future emission factors of motor vehicle emissions. Air pollution programs use the emission factors to make decisions about policies and meet SIP requirements. The model accounts for the emission impacts of factors such as changes in vehicle emission standards, vehicle populations, and changes in local environmental conditions. MOBILE6 is a major revision to the MOBILE model and it provides more options for users to incorporate local inputs. Unlike previous versions of the model, users can now adapt the model to local conditions and special situations that are not reflected in the model's default settings. For I/M programs with test-and-repair stations, states must specify effectiveness rates for the program. Because the 1995 NHSDA allows states to make a demonstration of effectiveness, states should consult with the USEPA regarding appropriate levels of effectiveness for the local I/M program[3].

This analysis of emission test results provides a means to quantify the appropriate effectiveness rate for the state I/M program in Clark County. It does this through a comparative analysis of the emissions reductions achieved by the test-and-repair and test-only emissions inspection stations located in the Las Vegas Valley.

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[2] The Federal Register, Volume 67, Number 19, Notices, Tuesday, January 29, 2002.

[3] Page 66, Section 6.11, Technical Guidance on the Use of MOBILE6 for Emission Inventory Preparation, USEPA, Office of Air and Radiation, Office of Transportation and Air Quality, January, 2002.

Methodology

The Nevada Department of Motor Vehicles (DMV) provided the set of emissions inspection data analyzed in this report. Parsons used pre- and post-repair inspection data from that data set to compare and evaluate the effectiveness of repairs made on vehicles failed at test-only and test-and-repair emissions inspection stations. The differences between the initial and the after-repairs tests indicate the level of emission benefits obtained by each type of station.

The analysis contained two steps: "Development of a Protocol to Perform the Analysis" and "Data Analysis."

Development of a Protocol to Perform the Analysis

DMV Data Set

Parsons provided data specifications (see Appendix B) to the DMV. Parsons received the data in an electronic format for the analysis from the DMV's Vehicle Identification Database (VID).

The data specifications outlined the fields needed to perform the analysis. Vehicle test records contained the following fields:

- Facility identification information indicating whether the facility is a test-only or a test-and-repair station;
- Vehicle license plate and Vehicle Identification Number (VIN);
- Vehicle type, Gross Vehicle Weight (GVWR), model year, make and model;
- Test type (i.e., initial, after-repair or waiver);
- Test date and time;
- Emission standards category and cut points;
- Pre-repair idle test results for CO;
- Pre-repair 2500-RPM test results for CO;
- Repair information;
- Post-repair idle test results for CO;
- Post-repair 2500-RPM test results and CO; and
- Pass/Fail result.

Parsons analyzed only vehicle test records meeting the following criteria:

- 1968 and newer light-duty vehicles that failed an initial emissions inspection and had a post-repair emissions inspection performed at the same type of station (i.e., either a test-only or test-and-repair station);
- Gasoline powered; and
- Vehicles registered within Clark County.

Parsons also requested information delineating the model-year distribution of the overall fleet in Clark County and the numbers for each model-year category subject to the program.

Protocol

The data analysis used Microsoft Excel and the following rules for the analysis:

- The analysis used only initial and after-repair test records that were both performed at either a test-only or a test-and-repair station.
- For vehicles that are given multiple initial inspections, the analysis used the oldest initial test within 90-days prior to the vehicle receiving a certificate. Many times, vehicle owners perform their own repairs and take the vehicle to a different inspection facility for another inspection. This looks like a second initial test in the database. Parsons sorted the data by the VIN and the date/time to find the correct initial test, regardless of where the inspection was performed as long as it was at the same type of station;

- For vehicles given multiple after-repair tests, the analysis used only the final emission test results;

- DMV's contractor, WorldCom, performed a quality assurance check of the data fields and Parsons performed additional checks for bad records during the analysis. Bad test records usually result from missing fields and misaligned data entries. For unsalvageable records, Parsons removed those records from the data set. However, while no records lacked critical information, some records contained blanks and/or inaccurate characters. To maximize the number of vehicle records included in the analysis, Parsons used the test records if both the pre- and post-repair emission results had a matching VIN at the same type of station.

- Exclusion of undercover vehicle test records, or records for issued waivers from the data set analyzed. Parsons requested removal of those records from the data set before shipment of the data to Parsons. The DMV's contractor confirmed they excluded those records; and

- To match the test records, Parsons used the VIN and license number on each vehicle to identify the first initial test and final after-repairs test. The analysis excluded intermediate tests (i.e., multiple initial or after-repair tests between the first initial and final after-repairs inspection).

Data Analysis

Parsons performed an analysis of the emission test results and provided the following:

- Proportion of emissions tests conducted by station type;
- Average CO reductions achieved:
  - For each type of station; and
  - For different model year vehicles.
- Categorization of station performance; and
- Combined I/M program effectiveness (between 50 – 100 percent);

After sorting the vehicle test by station type and VIN, Parsons took the difference between the first test and last post-repair test listed for each vehicle to average the CO emissions for the idle and 2500-RPM tests for each vehicle model-year category. Based on the amount of emissions reduced, Parsons calculated the effectiveness of repairs made on vehicles that had failed at test-only stations compared to vehicles failed at test-and-repair stations in the program. Appendix C contains a description of the detailed analysis steps for each of the deliverables.

The analysis used vehicle test records for the period of July 1, 2001 to June 30, 2002. Below is a description of the analysis for each of the items requested in the contract.

Proportion of Emissions Tests by Station Type

As of October 2002, 94 test-only and 159 test-and-repair stations participate in the I/M program in Clark County. Although only 37 percent of the inspection facilities are test-only stations, they perform 57.5 percent of the total tests. Test-and-repair stations make up 63 percent of the facilities in the County and perform 42.5 percent of the emissions tests. Table 1 below shows that of the total number of vehicles failing emission tests, 59.7 percent of the failed vehicles are initially tested at test-only stations and 40.3 percent at test-and-repair stations.

Table 1 Volume of Initial Tests, Percent Failures and Number of Stations

Station Type	Number of Stations	Total Initial Tests	Percent	Number of Initial Failures	Percent
Test-Only	94	469,676	57.5	37,732	59.7
Test-and-Repair	159	347,749	42.5	25,512	40.3

Table 2 shows the failure rate of vehicles inspected at each of the two types of stations. The failure rates are between two and three percent higher than the initial failure rate shown in Figure 1 because the overall percentage includes retests. The difference in percentage of vehicles failed at each type of station is less than one percent. This indicates that in Clark County emissions reductions

achieved by test-and-repair stations are comparable to those achieved by test-only stations.

Table 2 Failure Rate by Station Type

Station Type	Total Test Volume	Number of I/M Failures	Percent Failed
Test-Only	469,676	37,732	8.0
Test-and-Repair	347,749	25,512	7.3

The historical test data shown in Table 3 below for fiscal years 2000-2001 and 2001-2002 indicate increasing inspection volumes for test-only stations since 2001. Test-only stations on average performed 57 percent of the emission tests both of the subject fiscal years.

Table 3 Historical Test Volumes by Station Type

Fiscal Quarter	Total Tests	Test-Only	Percent Test-Only	Test-and-Repair	Percent Test-and-Repair
Jul-Sept, 00	196,751	107,761	55	88,989	45
Oct-Dec, 00	178,323	97,437	55	80,885	45
Jan-Mar, 01	209,839	115,493	55	94,345	45
Apr-Jun, 01	208,646	116,064	56	92,581	44
Jul-Sept, 01	209,467	122,889	59	86,577	41
Oct-Dec, 01	192,710	111,633	58	81,076	42
Jan-Mar, 02	214,874	126,517	59	88,356	41
Apr-Jun, 02	219,389	131,678	60	87,711	40

Average Reductions Achieved for Each Type of Station

Parsons sorted the DMV data by the vehicle identification number (VIN), and the date and time of the inspection for each type of station (i.e., test-only and test-and-repair). Parsons calculated the reductions by subtracting the first test from the last for each set of matching test records, summing the emissions and dividing by the number of vehicles for the station type. The number of retests on failing vehicles ranged from one to seven inspections. Table 4 below shows the average CO emissions reduced by station type.

Table 4 Average Emissions Reductions per Vehicle by Station Type

Station Type	Average Idle Test CO Emission Reduction (% by Volume)	Average 2500 RPM Test CO Emission Reduction (% by Volume)
Test-Only	2.12	1.76
Test-and-Repair	2.16	1.92

The results shown in Table 4 include vehicles without a passing test record in the analysis period. Reasons for this include destruction of the vehicles or relocation of the vehicle out of the program area. Also, some vehicle owners have difficulties paying for needed emissions repairs or they may be planning on selling the vehicle in the near future. To provide a reference point, Parsons did some additional analysis on the data set with these vehicles removed. Table 5 below contains that data for comparative purposes.

Table 5 Average Emission Reductions per Vehicle by Station Type for Passing Vehicles

Station Type	Average Idle Test CO Emission Reduction (% by Volume)	Average 2500 RPM Test CO Emission Reduction (% by Volume)
Test-Only	2.20	1.84
Test-and-repair	2.20	1.96

When these vehicles are removed from the data set, the average reductions are identical for the idle test and closer on the 2500 RPM test. This demonstrates that both types of stations are reducing emissions significantly, and the test-and-repair stations on average are achieving higher emissions reductions.

Average Reductions Achieved for Different Model-Year Vehicles

The model-year grouping selections reflect changes in emission control applications and/or balance the volume of tests in each category. The model-year categories of 1968-74 and 1975-79 reflect the initial installation of catalytic converters starting in 1975, and the initiation of the 3-way catalyst and feedback control systems in 1980. For the 1980-85, 1986-89, and 1990-95, the categories primarily reflect an effort to balance the volume.

A separate category created for the 1996 and newer vehicles reflect the introduction of the second-generation of on-board diagnostic (OBDII) systems. Early in 2002, the USEPA authorized states to perform a check of the OBDII systems instead of the TSI emissions test. The OBDII check can be performed more quickly on late model vehicles where the standardized OBD connector is readily accessible.

The largest category is the 1986-89 category; the next two largest model-year categories are the 1990-1995 and 1980-1985 categories respectively.

Table 6 shows the volume of vehicles that failed I/M tests in each model-year category described above for test-only and test-and-repair stations.

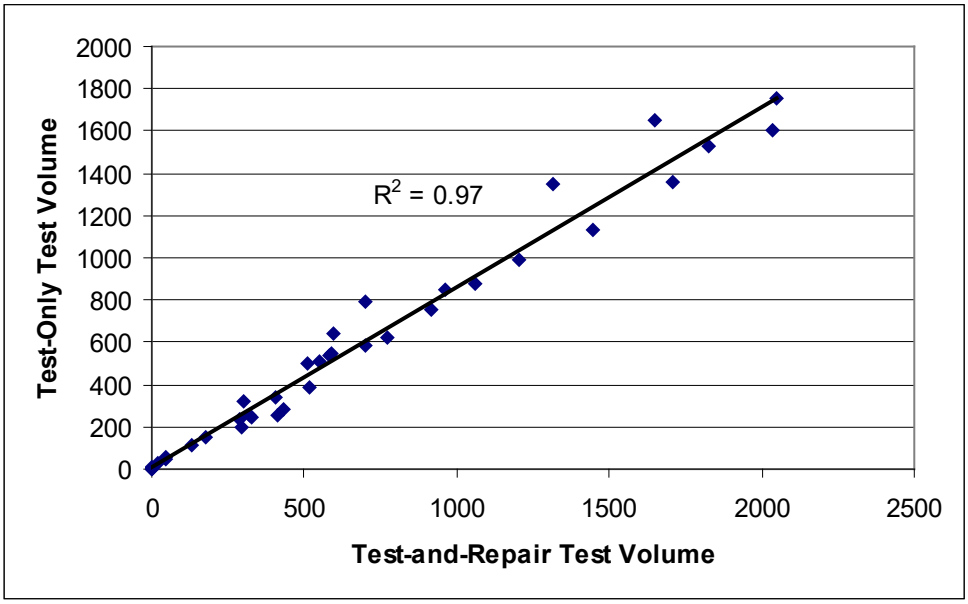
Table 6 Volume of I/M Failures by Model Year Categories

Station Type	1968-74	1975-79	1980-85	1986-89	1990-95	1996+	Total
Test-Only	2,475	3,494	5,423	7,611	5,457	419	**24,879**
Test-and-Repair	1,816	3,044	5,519	6,249	4,475	397	**21,500**
Total	4,291	6,538	10,942	13,860	9,932	816	**46,379**

Table 7, shown on the following page, contains a tabulation of the volume of failed vehicles by model year and station type[4]. The means and standard deviations of the two distributions differ, but the correlation coefficient of 0.97 indicates an extremely good correlation. Figure 2 contains the regression line.

Figure 2 shows the data points grouped tightly around the regression line. Some differences between the volumes of older vehicles tested at test-only and test-and-repair stations do exist, but the differences are relatively small compared to the newer model-year categories. Therefore, the difference in the volume of older cars tested at each type of station has little effect on the overall correlation coefficient.

Figure 2 Regression of Test-Only and Test-and-Repair Volumes by Model Year Category



[4] The percentage of tests performed at the test-only and test-and-repair stations shown in Table 7 are slightly different from those shown in Table 1 because Table 8 includes retests.

Table 7 Volume of Test Failures by Model Year and Station Type

Model Year	Number of Vehicles Failed at Test-Only Stations	Percentage of Vehicles Failed at Test-Only Stations	Number of Vehicles Failed at Test-and-Repair Stations	Percentage of Vehicles Failed at Test-and-Repair Stations	Total Number of Vehicles Failed
1968	294	0.6%	202	0.4%	496
1969	322	0.7%	257	0.6%	579
1970	325	0.7%	249	0.5%	574
1971	287	0.6%	233	0.5%	520
1972	434	0.9%	281	0.6%	715
1973	403	0.9%	338	0.7%	741
1974	410	0.9%	256	0.6%	666
1975	302	0.7%	320	0.7%	622
1976	513	1.1%	502	1.1%	1015
1977	700	1.5%	583	1.3%	1283
1978	916	2.0%	757	1.6%	1673
1979	1063	2.3%	882	1.9%	1945
1980	580	1.3%	534	1.2%	1114
1981	585	1.3%	549	1.2%	1134
1982	594	1.3%	638	1.4%	1232
1983	701	1.5%	794	1.7%	1495
1984	1313	2.8%	1351	2.9%	2664
1985	1650	3.6%	1653	3.6%	3303
1986	2049	4.4%	1753	3.8%	3802
1987	2035	4.4%	1605	3.5%	3640
1988	1822	3.9%	1532	3.3%	3354
1989	1705	3.7%	1359	2.9%	3064
1990	1447	3.1%	1128	2.4%	2575
1991	1207	2.6%	986	2.1%	2193
1992	963	2.1%	852	1.8%	1815
1993	773	1.7%	618	1.3%	1391
1994	548	1.2%	505	1.1%	1053
1995	519	1.1%	386	0.8%	905
1996	178	0.4%	148	0.3%	326
1997	134	0.3%	112	0.2%	246
1998	43	0.1%	49	0.1%	92
1999	44	0.1%	56	0.1%	100
2000	18	0.0%	27	0.1%	45
2001	2	0.0%	5	0.0%	7
2002					
	24879	**54%**	**21500**	**46%**	**46379**

As shown in Figure 3 below, test-only stations tested more vehicles in the 1968-74 model-year category than did test-and-repair stations. However, the greatest number of tests at both types of station occurs for 1985-92 model-year vehicles.

Figure 3 Vehicle Failure Rate by Model Year and Station Type

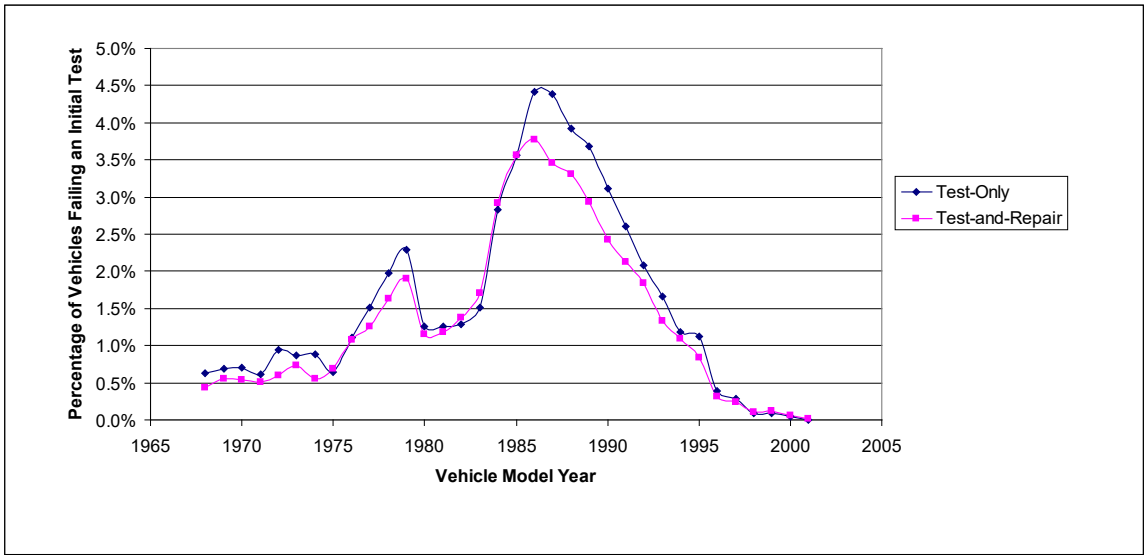


Table 8 shows the difference between the idle and the 2500-RPM CO emission reductions for test-only and test-and-repair stations by model-year category. Overall, the test-and repair stations show higher CO emissions reductions for the idle and the 2500-RPM emissions tests.

Table 8 Average Emissions Reductions by Model Year Category and Station Type

Model Year Category	Average Test-Only Idle CO Reductions (% by Vol.)	Average Test-and-Repair Idle CO Reductions (% by Vol.)	Percent Difference	Average Test-Only 2500 RPM CO Reductions (% by Vol.)	Average Test-and-Repair 2500 RPM CO Reductions (% by Vol.)	Percent Difference
68-74	3.35	2.99	-5.7	1.85	1.68	-4.9
75-79	2.68	2.57	-2.1	1.69	1.71	+0.6
80-85	1.95	2.07	+2.8	1.79	2.16	+9.3
86-89	1.75	1.92	+4.8	1.75	1.94	+5.1
90-95	1.77	1.93	+4.3	1.69	1.83	+4.0
96+	2.74	2.38	-7.0	2.34	2.09	-5.8
Overall	2.12	2.16	+0.7	1.78	1.92	+3.9

For the idle test, the resulting difference between the test-only and test-and-repair stations is less than one percent, and for the 2500-RPM test about 4 percent.

Figure 4 shows the combined average-emissions-reduced for each station type for the idle and 2500-RPM tests by the following method:

- Subtraction of the initial test from the final retest to calculate the emission benefits for each vehicle;
- Summed the emission benefits;
- Calculated the average emissions benefit by dividing the sum of the emissions benefits by the number of vehicles in each model-year category.

This operation included the data for each type of station and each model-year category.

Figure 4 Average Emissions Reduced by Station Type and Model Year for Idle and 2500 RPM Tests Combined

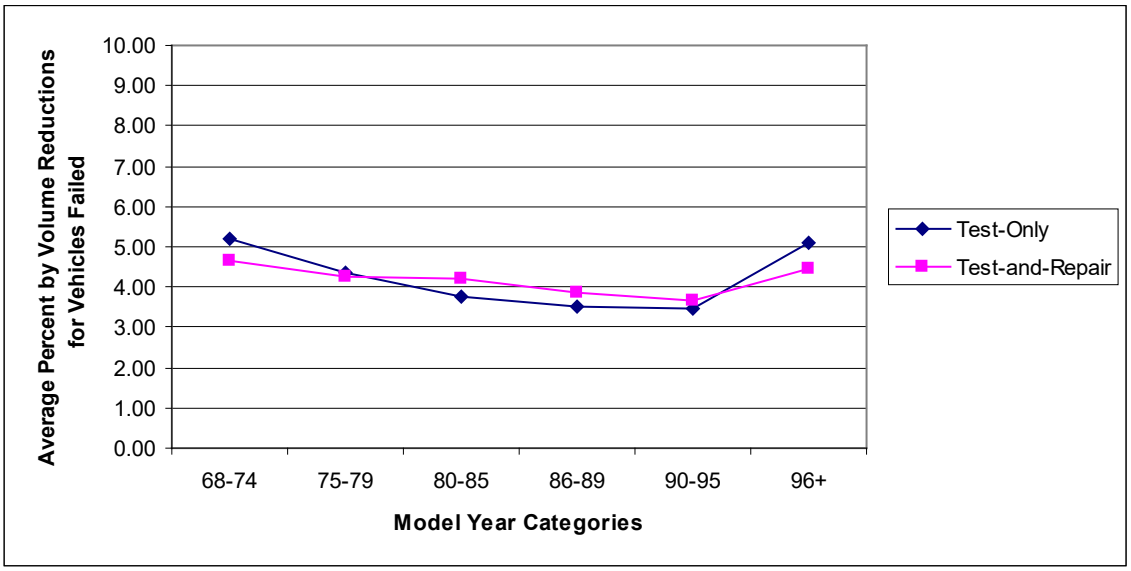


Table 9 shows the overall proportion of CO emissions reduced by station type. Test-only stations reduce emissions slightly more than the test-and-repair stations.

Table 9 Proportion of CO Emissions Reduced by Station Type

Type of Station	Proportion of Emissions Reduced
Test-Only	50.7 %
Test-and-Repair	49.3%

Overall, the test-only stations generate approximately 51 percent of the emission reductions and the test-and-repair stations generate 49 percent of the emission reductions. Although test-and-repair stations reduce more emissions on

average, they inspect approximately 122,000 fewer vehicles and they fail about 12,000 less vehicles than the test-only stations as shown in Tables 1 and 2. As a result, the overall proportion of emissions reduced at test-only stations is slightly higher.

Since the proportion of emission reductions achieved by both types of stations are so close to 50 percent, it is clear that they are both making a significant contribution towards reducing excess CO emissions in Clark County.

Categorization of Station Performance

As part of this analysis, Parsons agreed to evaluate the average emissions reduced for all stations and group them into upper, middle and lower categories of performance. The evaluation is contained in Appendix D. Although the analysis is not crucial to the objective of this study (i.e., to identify an I/M effectiveness rate that can be used in the MOBILE6 model for the Clark County I/M program), the information could be useful to the Nevada Department of Motor Vehicles I/M program enforcement staff.

Combined I/M Program Effectiveness

Based on the results of the analysis contained in this report by Parsons, both the test-only and test-and-repair stations play a critical role in reducing nearly equivalent amounts of excess CO emissions in Clark County. The USEPA does not discount the emissions benefits generated at test-only stations, and the data analyzed by Parsons for Clark County indicates that the test-and-repair stations generate nearly the same level of emission benefits as the test-only stations. Therefore, the input for the I/M effectiveness rate in the MOBILE6 emissions model for the I/M program in Clark County should be 100 percent.

Conclusions

After the USEPA released the 1990 Clean Air Act Amendments and promulgated the I/M regulations in the Federal Register, many regulatory agencies, including Clark County, who administered decentralized I/M programs, utilized the default value of 50 percent effectiveness for the emissions reduced by all the stations in their program. 40 CFR, Section 51.353(a) provides that a "…decentralized network consisting of stations that only perform official I/M (test-only stations)…shall be considered equivalent to a centralized, test-only system."

Based on this and the flexibility added by the NHSDA, Clark County should receive 100 percent of credit for the emissions benefits from inspections performed at test-only stations.

The data analysis in this report also indicates that the test-only and test-and-repair stations are equally effective at reducing excess CO emissions and improving air quality in Clark County. Therefore, the input for the I/M effectiveness rate in the MOBILE6 model for the I/M program in Clark County should be 100 percent.

Appendix A Model-Year Distribution of Vehicle Initial Tests in the IM Program During the Analysis Period of Fiscal Year 2001-2002 in Clark County

	3rd Quarter 2001				4th Quarter 2001				1st Quarter 2002				2nd Quarter 2002			
Model Year	Total Initial Tests	Initial Passing	Initial Failing	Failure %	Total Initial Tests	Initial Passing	Initial Failing	Failure %	Total Initial Tests	Initial Passing	Initial Failing	Failure %	Total Initial Tests	Initial Passing	Initial Failing	Failure %
1968	348	249	99	28.4%	321	239	82	25.5%	164	114	50	30.5%	266	178	88	33.1%
1969	410	295	115	28.0%	424	299	125	29.5%	257	201	56	21.8%	296	202	94	31.8%
1970	448	327	121	27.0%	379	275	104	27.4%	208	152	56	26.9%	315	212	103	32.7%
1971	448	329	119	26.6%	358	260	98	27.4%	201	143	58	28.9%	270	184	86	31.9%
1972	584	449	135	23.1%	554	421	133	24.0%	302	215	87	28.8%	442	297	145	32.8%
1973	685	500	185	27.0%	498	376	122	24.5%	359	279	80	22.3%	453	308	145	32.0%
1974	655	449	206	31.5%	492	368	124	25.2%	301	228	73	24.3%	391	284	107	27.4%
1975	530	357	173	32.6%	456	326	130	28.5%	273	190	83	30.4%	331	238	93	28.1%
1976	923	656	267	28.9%	757	569	188	24.8%	428	320	108	25.2%	566	384	182	32.2%
1977	1310	956	354	27.0%	1122	863	259	23.1%	624	456	168	26.9%	817	588	229	28.0%
1978	1566	1,166	400	25.5%	1279	997	282	22.0%	845	637	208	24.6%	1032	731	301	29.2%
1979	1911	1,441	470	24.6%	1596	1,200	396	24.8%	906	666	240	26.5%	1179	830	349	29.6%
1980	1167	867	300	25.7%	989	760	229	23.2%	596	449	147	24.7%	722	531	191	26.5%
1981	1416	1,072	344	24.3%	1077	832	245	22.7%	632	475	157	24.8%	864	632	232	26.9%
1982	1537	1,146	391	25.4%	1204	948	256	21.3%	754	576	178	23.6%	999	731	268	26.8%
1983	2165	1,729	436	20.1%	1716	1,379	337	19.6%	1016	816	200	19.7%	1426	1,077	349	24.5%
1984	3769	3,040	729	19.3%	2946	2,387	559	19.0%	1826	1,433	393	21.5%	2316	1,791	525	22.7%
1985	5081	4,171	910	17.9%	4001	3,270	731	18.3%	2440	1,954	486	19.9%	3200	2,487	713	22.3%
1986	6531	5,493	1038	15.9%	5042	4,315	727	14.4%	2982	2,471	511	17.1%	4051	3,224	827	20.4%
1987	7307	6,315	992	13.6%	5680	5,001	679	12.0%	3336	2,837	499	15.0%	4623	3,844	779	16.9%
1988	8998	7,998	1000	11.1%	6879	6,205	674	9.8%	4158	3,682	476	11.4%	5577	4,893	684	12.3%
1989	10628	9,797	831	7.8%	8305	7,687	618	7.4%	4879	4,420	459	9.4%	6729	6,000	729	10.8%
1990	10887	10,225	662	6.1%	8390	7,788	602	7.2%	5031	4,666	365	7.3%	7156	6,572	584	8.2%
1991	11550	10,977	573	5.0%	9058	8,581	477	5.3%	5227	4,940	287	5.5%	7565	7,069	496	6.6%
1992	11811	11,364	447	3.8%	9082	8,713	369	4.1%	5239	5,002	237	4.5%	7541	7,122	419	5.6%
1993	13557	13,161	396	2.9%	10393	10,075	318	3.1%	6002	5,775	227	3.8%	8872	8,494	378	4.3%
1994	15909	15,601	308	1.9%	12263	11,998	265	2.2%	6993	6,840	153	2.2%	10127	9,871	256	2.5%
1995	18141	17,877	264	1.5%	14422	14,236	186	1.3%	8072	7,939	133	1.6%	11690	11,445	245	2.1%
1996	18321	18,149	172	0.9%	13444	13,340	104	0.8%	14142	14,027	115	0.8%	14495	14,394	101	0.7%
1997	21378	21,251	127	0.6%	15988	15,897	91	0.6%	16825	16,694	131	0.8%	17041	16,945	96	0.6%
1998	22022	21,969	53	0.2%	16567	16,519	48	0.3%	16193	16,148	45	0.3%	16835	16,795	40	0.2%
1999	23789	23,747	42	0.2%	17925	17,896	29	0.2%	18902	18,859	43	0.2%	19983	19,940	43	0.2%
2000	3470	3,464	6	0.2%	9980	9,960	20	0.2%	19261	19,224	37	0.2%	20230	20,194	36	0.2%
2001	120	116	4	3.3%	320	318	2	0.6%	1289	1,286	3	0.2%	2483	2,479	4	0.2%
2002									21	21	0	0.0%	73	72	1	0.0%
2,002	***229,372***	***216,703***	***12,669***	***5.5%***	***183,907***	***174,298***	***9,609***	***5.2%***	***150,684***	***144,135***	***6,549***	***4.3%***	***180,956***	***171,038***	***9,918***	***5.5%***

Appendix B Parsons Data Request Specifications

Appendix B
Parsons Data Request Specifications

August 2, 2002

A request for data meeting the following specifications was submitted to the Clark County Department of Air Quality Management to meet the requirements of the contract for Consulting Services for Decentralized Vehicle Inspection and Maintenance Program Analysis – CBE Number 1746-02

The data will be taken from the DMV's Vehicle Identification Database (VID) for July 1, 2001through June 30, 2002. Parsons will need the data to be provided on a compact disk readable in Microsoft Access 2002.

Only vehicle test records meeting the following criteria were used in the analysis:

- 1968 and newer light-duty vehicles for which a tailpipe inspection is performed and failed, and post-repair tailpipe inspection results are available and were performed at the same type of station (i.e., either a test-only or test-and-repair station);
- Gasoline powered; and
- Vehicles registered within Clark County.

Vehicle data test records provided to Parsons need to contain the following fields:

- Facility identification information
- Vehicle license plate and VIN
- Vehicle type, GVWR, model year, make and model
- Test type (i.e., initial, after-repair or waiver)
- Test date and time
- Emission standards category and cut points
- Pre-repair idle test results for HC and CO
- Pre-repair 2500 RPM test results for HC and CO
- Repair information
- Post-repair idle test results for HC and CO
- Post-repair 2500 RPM test results for HC and CO
- Pass/Fail result

Vehicle tests resulting in the issuance of a waiver and undercover vehicle tests will need to be removed from the data set. It is assumed that vehicle test records will have been through a quality assurance check to ensure that only valid entries are included in each of the fields.

The test records will need to be matched according to the VIN on each vehicle to identify the first initial test and final after-repairs test. Each matched test record were given a consecutively assigned number with the information above listed in columns across the page.

It is unlikely that the inspection information provided will include all vehicles in the entire fleet of vehicles subject to inspection in Clark County because of bad records, inability to match before- and after-repair tests or other reasons. Therefore, Parsons will need information from the State delineating the model-year distribution of the overall fleet in Clark County and the numbers for each model-year category that are subject to the program in Clark County.

Appendix C Description of Detailed Analysis

Detailed Analysis Steps

The following is a listing of the steps that were taken to perform the analysis of the data once the data is provided to Parsons:

1. Data were extracted from the zip file into an ASCII file in Microsoft Notepad.
2. Extracted data were imported into Microsoft Excel if less than 65,536 records (maximum number of rows in a single Excel spreadsheet) and into Microsoft Access if greater.
3. Data were checked to ensure that it meets all the requirements contained in the data specifications. For example, if there is no matching record for a particular test, the initial test was deleted from the data set.
4. The following identifies the number of characters for each record and whether it is numeric, alpha or a combination of the two:
5. There are numerous records where the VIN is the same for initial and retest inspections, but the license plate entries are different. In those cases the comparison was done by the VIN.
6. Additional rows were created to add column headings.
7. Additional columns were created to store a sequential ID number and calculated reductions in 2500 RPM and idle emission readings between the initial and retests.
8. Data were sorted by Station Type.
9. Data with no license plate number or is shown as “Non-NV” were left in the data set in order to increase the sample size.
10. Data will then be sorted by VIN, date and time to establish a match and the sequence of testing.

Record	Length of Record	Alpha, Numeric or Combination	Acceptable Range
Station ID	8	Alpha-numeric	**N/A**
Station Type	3	Alpha-numeric	**A1G or A2G**
License	6	Alpha-numeric	**N/A**
VIN	17	Alpha-numeric	**N/A**
Vehicle Type	1	Alpha	**P, M or T**
GVWR	4	Numeric	**Max = 8500**
Model Year	4	Numeric	**N/A**
Make	4	Alpha	**N/A**
Test Type	1	Alpha	**I or R**
Test Date	9	Numeric	**7/1/01 to 6/30/02**
Test Time (Military)	5	Numeric	**0 – 2400**
CO Emission Std	4	Numeric	**N/A**
HC Emission Std	4	Numeric	**N/A**
Idle CO Reading	4	Numeric	
Idle HC Reading	4	Numeric	
2500 CO Reading	4	Numeric	
2500 HC Reading	4	Numeric	
Test Result	**1**	**Alpha**	**P or F**

Data manipulation required for each contract deliverable was performed as indicated below:

Overall proportion of emissions reduced by station type

11. Additional columns were created to store calculated reductions in 2500 RPM and idle emission readings between the initial and retests.
12. Data were sorted by VIN, date and time.
13. Reductions were calculated by subtracting the initial test results from the last test result.
14. Overall average emissions benefits were calculated for the data set using macro contained in Excel which sums the change from the initial and last retest and divides by the number of vehicles.
15. The proportion, in terms of percent reduction of emissions, was calculated by dividing the average amount of emissions reduced by each station type, by the total reduction and converting to a percentage.

Proportion of each type of station that falls into the upper, middle and low categories of effectiveness

16. Categories of effectiveness were defined based on the average level of emissions reduced for each type of station
17. The emission results were sorted by station number for all stations performing more than 100 inspections per year.
18. The proportion of emissions reduced for each station was calculated as shown in items #12 - #15 above.

Average reductions achieved for each type of station

19. The proportion of emissions reduced for each station was calculated as shown in items #12 - #15 above.

Average reductions achieved for different year model vehicles

20. Data for each type of station were sorted by vehicle model year.
21. The reductions were calculated by subtracting the initial test results from the last test result.
22. The average emissions benefits were calculated for CO for each model year using a formula entered into the Excel spreadsheet cells, which sums the change from the initial and last retest and then sum of the reductions were divided by the number of records.

Note: The sample size was small for some model years, so several model years were grouped together to make a category of appropriate size. Groupings were approved by the DAQM.

Additional tasks:

1. Calculate the average of the CO emissions results for the passing test for all matched vehicles for each type of station.

Appendix D Performance Categories of Stations

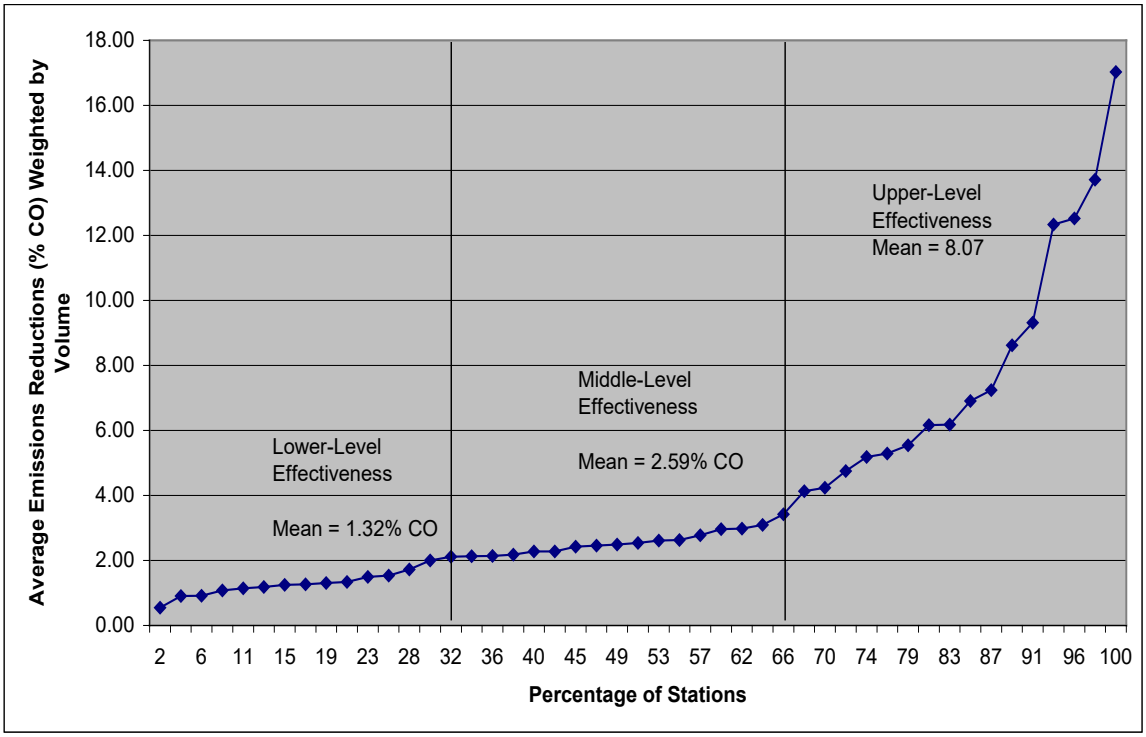
Proportion of Each Type of Station Falling into the Upper, Middle and Low Categories of Performance

For the purposes of identifying performance levels for each type of station, stations were divided into upper, middle or lower categories of performance. This provides information about the number of test-only and test-and-repair stations providing the greatest emission benefits for the program. This analysis helps program compliance staff to identify where resources may be allocated most cost effectively. Historically, the USEPA has been very concerned about compliance with program regulations. If illegal testing practices are rampant, those practices may negate emission benefits accrued. Stations not attaining at least a middle level category of performance warrant a careful review of their inspection practices.

This analysis sorts the test records by station type where there was an initial and a retest inspection performed on vehicles at the same type of station. The data were then sorted by Station ID number. Stations performing fewer than 100 inspections per year were considered insignificant and excluded from this portion of the analysis. Emission benefits generated by the remaining stations were analyzed for the first and last test for each matching VIN. The average emissions reduced were calculated for each vehicle, summed and tabulated into a summary table. The stations were ranked by the average emissions reduced in the summary table and a cumulative percentage of stations were calculated. Since some stations perform many more inspections than others do, the emissions reduced were weighted by the volume (i.e., the “average emissions reduced” were multiplied by a factor that was generated based on the percentage of tests performed by each station).

Once the benefits were calculated, cut points were identified to categorize the stations into Upper, Middle and Lower Level performance groups. The cut points chosen to separate the stations into categories of performance were selected by the magnitude of change in the slope of the curve joining a group of points. Figure 5 below shows the distribution of average emission reductions weighted by the volume of tests performed, at the test-and-repair stations. The vertical lines indicate the cut points selected for the Low, Middle and Upper Level categories of performance. The Lower Level category includes 32 percent of the test-and-repair stations. This occurs where the curve of the line crosses over below the two percent horizontal grid line. Stations in the Upper Level category of performance constitute approximately 34 percent of the test-and-repair stations. The curve climbs steadily, increasing in slope, from this point to the right side of the graph.

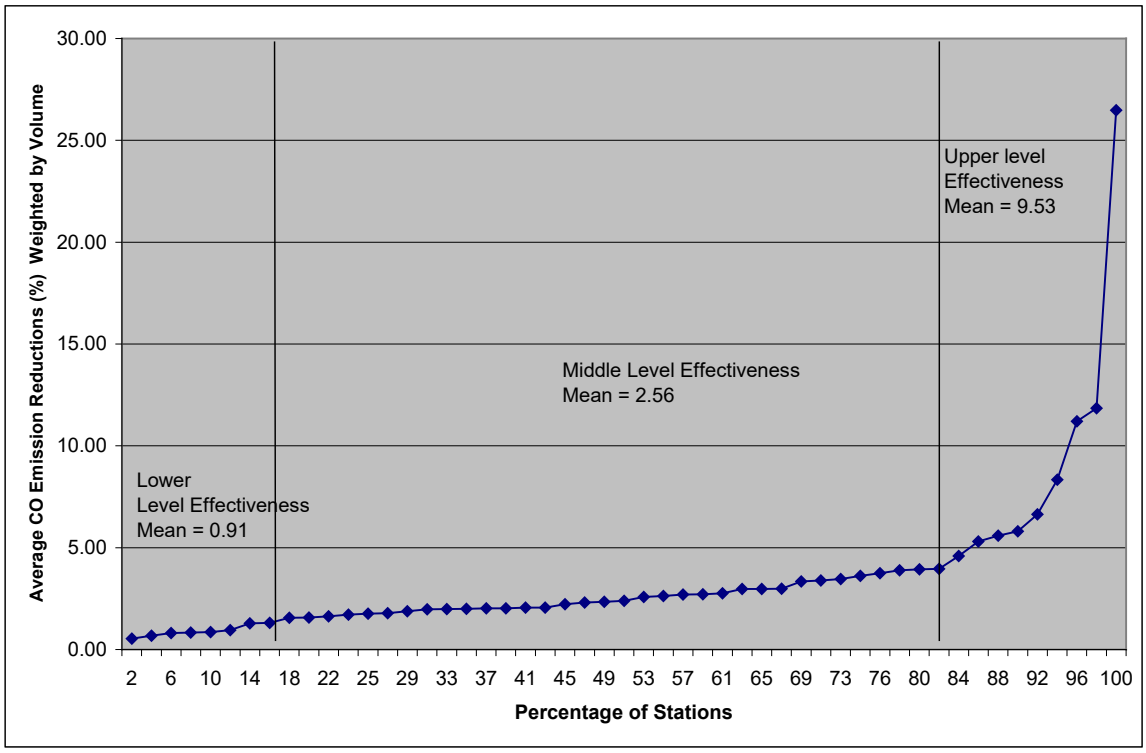
Figure 5 Test-and-Repair Station Average Emissions Reduced by Percentage of Stations



A dramatic difference exists between the test-and-repair stations in the upper level of performance and test-and-repair stations ranked in the lower and middle levels. Based on this information, the DMV may choose to evaluate the inspection practices at the stations ranked in the middle and lower level categories. Test-and-repair stations have an inherent conflict of interest because it is important to maintain the loyalty of customers. Test-and-repair stations may avoid failing vehicles more often than test-only stations to maintain their customer base. Because of the dramatic change in the slope of the curve, further investigation may be warranted.

Figure 6 presents data for the test-only stations and it shows a similar pattern for emissions reduced but with significantly different inflection points (i.e., where the slope of the curve changes). The curve drops off gradually on the left side of the first vertical marker indicating that approximately 16 percent of the stations rank in the Lower Level performance category and about 18 percent of the stations rank in the Upper Level performance category.

Figure 6 Test-Only Station Average Emissions Reduced by Percent of Stations



Test-only stations do not have the same inherent conflict of interest as the test-and-repair stations, however, the DMV may want to investigate the difference between the upper level stations and the lower and middle level stations in the interest of optimizing the performance of the I/M program.