2007 High Emitter Remote Sensing Project

Prepared for

Southeast Michigan Council of Governments

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Glossary of Terms and Abbreviations

ADT	Average Daily Traffic
ASM	Acceleration Simulation Mode
Basic I/M	A set of vehicle I/M program inspection requirements defined by the U.S. EPA that may be used in areas not required to implement an Enhanced I/M program; the inspection procedure usually involves idle testing
CAC	Criteria Air Contaminants
CO	Carbon monoxide
CO2	Carbon dioxide
Cutpoint	An emissions level used to classify vehicles as having met an emissions inspection requirement
Enhanced I/M	A set of more rigorous vehicle I/M program inspection requirements defined by the U.S. EPA that usually involves IM240 testing
EPA	United States Environmental Protection Agency
Excess Emissions	Vehicle emissions that exceed an I/M cutpoint
FTP	Federal Test Procedure
g/mi	Grams per mile, the units of measurement for FTP and IM240 tests
GHG	Greenhouse Gases
GVWR	Gross Vehicle Weight Rating
HC	Hydrocarbons
High Emitter Identification	The on-road identification of vehicles with high emission levels
I/M	Inspection and maintenance program
Idle Test	A tailpipe emission test conducted when the vehicle is idling and the transmission is not engaged
IM240 Test	A loaded-mode transient tailpipe emission test conducted when the vehicle is driven for up to 240 seconds on a dynamometer, following a specific speed trace that simulates real world driving conditions
KW/t	Kilowatts per metric ton, the units of measurement for vehicle specific power
LDGV	Light-duty Gasoline-powered Vehicle
LDGT	Light-duty Gasoline-powered Truck
NO_X	Oxides of nitrogen, usually measured as nitric oxide (NO)

OBDII	On board diagnostic system to detect emissions related problems that is required on all 1998 and newer light–duty vehicles
PM	Particulate Matter
Repairable Emissions	The emission reductions that can be obtained by repairing a vehicle. The amount of repairable emissions is equal to or greater than the amount of excess emissions
RSD	Remote Sensing Device
SDM	Source Detector Module
VIN	Vehicle Identification Number
VDR	Vehicle On-road Record
VMT	Vehicle Miles Traveled
VSP	Vehicle Specific Power; estimated engine power divided by the mass of the vehicle
VTM	Vertical Transfer Mirror

Executive Summary

SEMCOG, the Southeast Michigan Council of Governments, is the regional planner in Southeast Michigan, which encompasses Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, and Wayne counties. SEMCOG supports local government planning in the areas of transportation, environment, community and economic development, and education.

In 2007, SEMCOG sponsored a project to identify on-road high emitters using remote sensing. In April and May 2007, on-road emissions of light- and medium-duty vehicles in southeastern Michigan were measured using a remote sensing van. The roadside equipment measured exhaust emissions of passing vehicles. Eleven locations were monitored for one to three days for a total of 24 days. Emissions measurements were obtained on 85,000 vehicles of which 65,000 had visible license plates that were matched to Michigan registrations. About 1.6% of all light vehicles in the region were measured.

The remote sensing equipment is designed to measure running emissions of light- and medium-duty vehicles. The results reported do not include 'cold start' emissions, some evaporative emissions or emissions from heavy-duty vehicles.

Owners of vehicles emitting excessive hydrocarbons or carbon monoxide were notified by mail and asked to return a survey regarding vehicle problems. A follow-up survey requested information about maintenance and repairs that had been performed. Responding owners received a $10 gas card for each survey returned.

Principal goals of the study were to:

- Notify owners of vehicles with high emissions and encourage their repair.
- Determine what proportion of the Southeast Michigan fleet are high emitters and their characteristics.
- Determine how vehicle emissions in Southeast Michigan compare with other areas.
- Compare on-road emissions with those projected by the EPA emissions inventory model, Mobile6.

SEMCOG contracted Environmental Systems Products Holdings (ESP) to perform the project.

Findings

General Characteristics of the Fleet

- Approximately 2% of the light-duty vehicles operating in Southeast Michigan are very high emitters. Of the 65,526 vehicles sampled, 1,373 (2.1%) exceeded pollutant cutpoints for HC, CO, NO or smoke that were three or more times higher than in-use vehicle standards.

- The worst 10% of the vehicles emitted about 70% of the exhaust HC, CO and NOx.
- 1995 and older vehicles comprised 7% of the vehicles measured but emitted 52%, 36% and 37% of HC, CO and NO respectively.
- 20-30% of 1988 and older models were high emitters of HC or CO. In contrast, the rate for new models (2002 to 2007) averaged just 0.13% (i.e. one out of every 750 vehicles).
- The percentage of middle-aged vehicles (1992-1999) that were high emitters was lower than that of older vehicles. But, there are a large number of vehicles in this age range.
- 10% of vehicles that were a high emitter of one pollutant were also a high emitter of at least one other pollutant.
- Diesel vehicles had higher rates of smokers and high NO emitters than gasoline vehicles. Heavier vehicles also had greater rates of high emitters. These vehicles have less stringent emissions control standards.

Southeast Michigan compared to other areas

- On-road emissions of the light-duty vehicle fleet in Southeast Michigan are lower than those in several other areas where remote sensing has been done. This includes Alberta, Canada and Virginia, including the area of northern Virginia that has a mandatory vehicle inspection and maintenance (I/M) program.
- These lower emissions are due to the higher number of newer vehicles in Southeast Michigan. When compared by model year, the rate of high emitters in Michigan is similar to Alberta and the non-I/M areas of Virginia, and higher than the northern Virginia area with I/M.

Remote sensing data in comparison to EPA's Mobile6 model

- There are some significant differences in the emission rates measured by remote sensing compared to those generated by EPA's Mobile6 model.
    - The most dramatic difference is in carbon monoxide emissions. Mobile6 CO emissions are more than 100% higher than those measured through the remote sensing.
    - For hydrocarbons, Mobile6 projects 21% lower hot running exhaust emissions for 1995 & older vehicles, but 20% higher for 1996 and newer vehicles.
    - For oxides of nitrogen, Mobile6 projects 36% higher emissions than were measured. The difference is greatest for 1996 and newer trucks (+62%) and 1995 and older passenger vehicles (+51%). However, for 1996 and older trucks, Mobile6 projected 17% lower NOx emissions.

  These differences need to be investigated further.

High emitting vehicle owner surveys:

- 68% of high emitting vehicle owners who responded to the initial project survey said they had recently noticed a problem with their vehicle.

- 43% said their “check engine” light was on (53% for owners of 1996 and newer vehicles).
- The average mileage reported by owners of high emitting vehicles was high. Over 75% had more than 100,000 miles. The median was 136,602.
- 78% of high emitting vehicle owners said they drive their vehicle everyday.
- 39% of the survey respondents voluntarily took their vehicle in for servicing when informed of its pollution problem, and 29% had repairs done.
- Inability to pay for repairs was the reason most often sighted by those who did not take their vehicle in for servicing and by those who took it in but did not have repairs done.
- The surveys were well received by vehicle owners. Very few negative comments were received.

1. INTRODUCTION

SEMCOG, the Southeast Michigan Council of Governments, is the regional planner in Southeast Michigan. SEMCOG plans in areas that cross jurisdictional boundaries in the Southeast Michigan region that encompasses Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, and Wayne counties. SEMCOG supports local government planning in the areas of transportation, environment, community and economic development, and education.

In 2007, SEMCOG sponsored a project to identify on-road high emitters using remote sensing with the goals of:

- Notifying high emitters and encouraging repairs.
- Determining what proportion of the Southeast Michigan fleet are high emitters.
- Determining the characteristics of the high emitters (e.g. age distribution, make/model distinctions, geographic distribution).
- Determining whether high emitters of one pollutant are often a high emitter of other pollutants as well.
- Determining how the emission rates of high emitters compare to the standards for these vehicles. (e.g. How much higher are the emission rates of high emitting 1998 light-duty passenger vehicles than the emission standards these 1998 vehicles were originally designed to meet, bearing in mind that the standards are in gm/mile while the RSD measurements are in gm/gal.)
- Determining how the data for Southeast Michigan compare with that from other parts of the country.
- Compare RSD emission results with those projected by Mobile6.

SEMCOG contracted Environmental Systems Products Holdings (ESP) to perform the project. On-road data collection for the project ran from April 23 to May 25, 2007.

This report documents the results of the survey. Section 2 discusses the study design and equipment involved. Section 3 reports on-road operations activity and statistics of the fleet of vehicles measured. Section 4 characterizes light vehicle fleet emissions. Section 5 describes the results of survey responses from notified high emitting vehicles.

Sections 6 and 7 characterize high emitters and compare the frequency of SEMCOG area high emitters to those in other regions. Section 8 compares RSD and Mobile6 emissions estimates and Section 9 summarizes the project findings.

2. SURVEY DESIGN

2.1. Equipment Description

The survey utilized the newest addition to ESP's line of products, the RSD4600, which is the fourth generation of ESP commercial remote sensing systems based on the ROVER technology developed by Professor Donald Stedman (University of Denver). The underlying technology is the same as the equipment used in the first ROVER survey. Over time, the equipment has been developed to measure more pollutants, be more durable, easier to operate and more accurate.

The RSD4600 detects vehicle emissions when a car drives through an invisible light beam the system projects across a roadway. Figure 2-1 illustrates the remote sensing equipment set-up. The process of measuring emissions remotely begins when the RSD4000 Source & Detector Module (SDM) sends an infrared (IR) and ultraviolet (UV) light beam across a single lane of road to a lateral transfer mirror. The mirror reflects the beam back across the street (creating a dual beam path) into a series of detectors in the SDM. Concentrations of HC, CO, CO2, NOx and smoke are measured in vehicle exhaust plumes based on their absorption of IR/UV light in the dual beam path[1,2,3]. In advance of the SDM, two low power laser beams spaced 6' apart are projected across the road and reflected back. As each vehicle passes, the equipment measures the interruption and resumption of the two beams and uses the time intervals to calculate the vehicle speed and acceleration.

During this process, a digital camera captures an image of the vehicle's rear license plate and stores it on a data-recording device. The License plate information is stored with the emissions measurement and subsequently matched to motor vehicle registrations to determine the characteristics of the vehicle that was measured.

The RSD units are housed in specially outfitted vans. These vans are equipped with heating/cooling, a generator, and adequate storage for all components. The vans carry a full complement of road safety equipment and are equipped with additional lighting for testing during pre-dawn and post dusk hours. The RSD4600 unit continuously measures ambient conditions and background CO2.

The smoke measurement uses a UV beam with a shorter wavelength than traditional opacity meters to measure both PM10 and the finer PM2.5 particles. PM 2.5 particles are largely invisible to traditional diesel smoke opacity meters and to the naked eye.

More information on remote sensing is available from ESP at www.rsd-remotesensing.com and from Denver University at http://www.feat.biochem.du.edu/.

Figure 2-1 On-Road Remote Sensing Set-Up Schematic

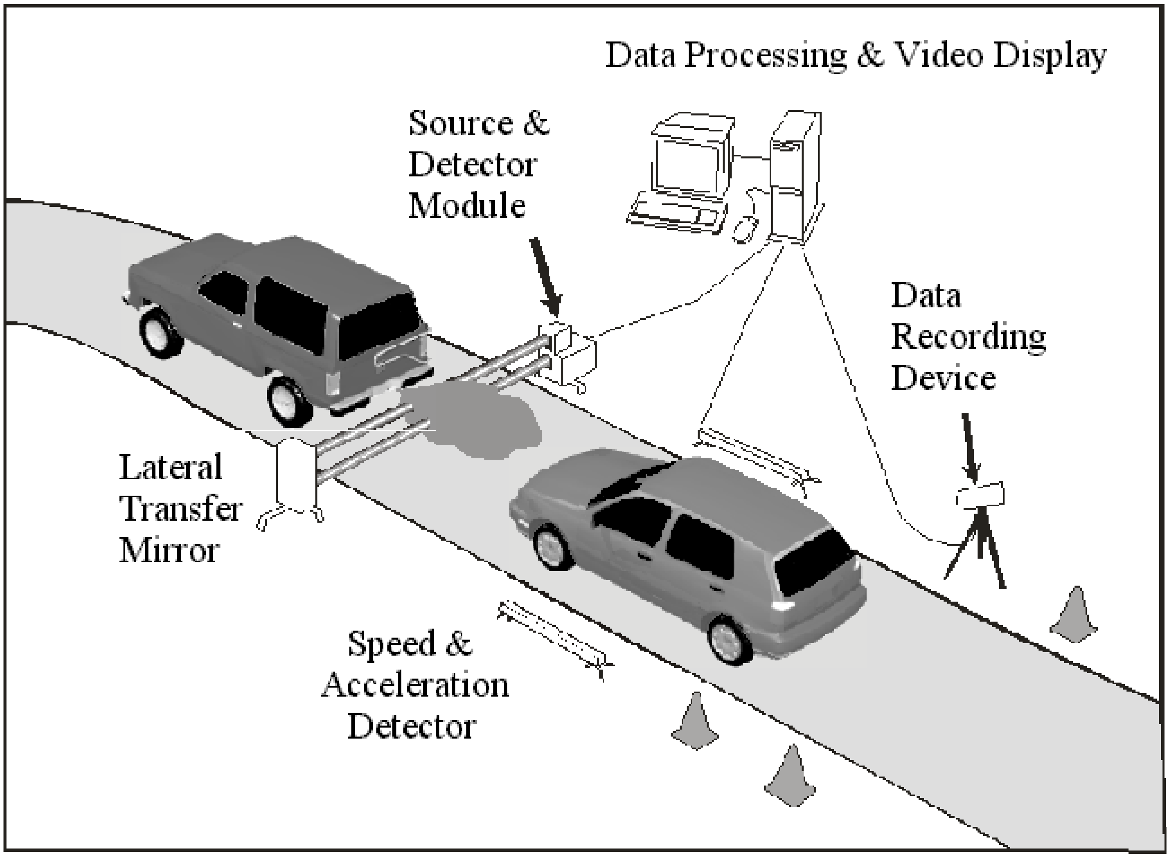


Figure 2-2 On-Road Remote Sensing Equipment Picture

2.2. Equipment QA/QC Audits:

2.2.1. Factory Testing and Certification

When an RSD system is built at the Tucson Technology Center, it undergoes several steps to ensure accuracy. First, the source detector module is bench calibrated. It is then audited using several blends of gas. When the system is fully calibrated and assembled, it is tested again in the parking lot using an audit truck. The unit tests are based on the California Bureau of Automotive Repair On-road Emissions Measurement System (OREMS) specification.

An audit truck is a modified vehicle that uses a long exhaust stack to direct the vehicle engine exhaust upwards and away from the roadway. Audit gases of known concentrations are dispensed through a simulated tailpipe routed to the rear of the audit truck. When the truck is driven past a roadside remote sensing SDM/VTM set of modules, the system measures the pollutant concentrations in the dispensed test gas instead of the vehicle engine exhaust.

The remote sensing unit is setup in a parking lot to avoid interference from other traffic. The auditor drives the audit truck through the remote sensing system 40 times for each gas blend during acceptance testing. ESP detector accuracy, including speed and acceleration, will meet the detector accuracy tolerances shown below for at least 97.5% (39/40) runs for each gas. Six different audit gas blends are used to verify the unit accuracy over a range of pollutant concentrations.

2.2.1.1 Detector Accuracy:

(1) The carbon monoxide (CO%) reading will be within ± 10% of the Certified Gas Sample, or an absolute value of ± 0.25% CO (whichever is greater), for a gas range less than or equal to 3.00% CO. Negative values shall be included and will not be rounded to zero. The CO% reading will be within ± 15% of the Certified Gas Sample for a gas range greater than 3.00% CO. Negative values will be included and will not be rounded to zero.

(2) The hydrocarbon reading (recorded in ppm propane) will be within ± 15% of the Certified Gas Sample, or an absolute value of ± 250 ppm HC, (whichever is greater). Negative values will be included and will not be rounded to zero.

(3) The nitric oxide reading (ppm) will be within ± 15% of the Certified Gas Sample, or an absolute value of ± 250 ppm NO, (whichever is greater). Negative values shall be included and will not be rounded to zero. NO is a surrogate for measuring NOx. We refer to NOx elsewhere in this document.

(4) Speed and Acceleration Accuracy:

(5) The vehicle speed measurement will be accurately recorded within ± 1.0 mile per hour.

(6) The vehicle acceleration measurement will be accurately recorded within ± 0.5 mile per hour / second.

Certification results for the two units used are provided in Appendix A.

2.2.2. Daily Set-Up and Calibration

Every scheduled work day, the operator drives to an existing or new test site. The operator's first duty is to provide themselves and passing motorists with a safe work area. The next step is to set up the source detector module and allow the electronic components within to warm up for a minimum of 30 minutes. Following the set up and alignment of the other components, the SDM is aligned and ready for Calibration.

An automated calibration utilizing a mechanized gas cell within the SDM is a method of testing the equipment without the need to drive an audit truck past the unit. During a gap in the passing traffic, a test gas within a sealed cell, with a known blend of HC, CO, CO2 and NOx, is maneuvered into the optical path of the remote sensing beam. If necessary, the instrument set-up is adjusted so that the pollutant values measured by the unit, match the known concentrations of pollutants in the test gas blend within the cell.

Calibration for the RSD4600 occurs once at the beginning day and at mid-day if conditions warrant.

2.2.3. Equipment Audits

After each daily calibration, the Operator is required to perform an audit to verify an optimal calibration. If the audit demonstrates that the unit is operating within the detector accuracy tolerances described in Section 2.2.1.1 the operator is allowed to begin testing vehicles. If not, the operator is required to realign and recalibrate the system until it passes the audit process.

2.3. Sites

The site selection goal was to identify a network of sites suitable for RSD operation that would provide a representative sampling of the area fleet.

SEMCOG identified the cities / towns and municipal contacts helped to identify the appropriate sites within each. The survey team logged the site locations and captured layouts and configurations using intersection layouts and digital camera images.

Sites needed to have a single lane of traffic, or be able to be coned down to create a single lane, with sufficient space to the side for the roadside van and equipment.

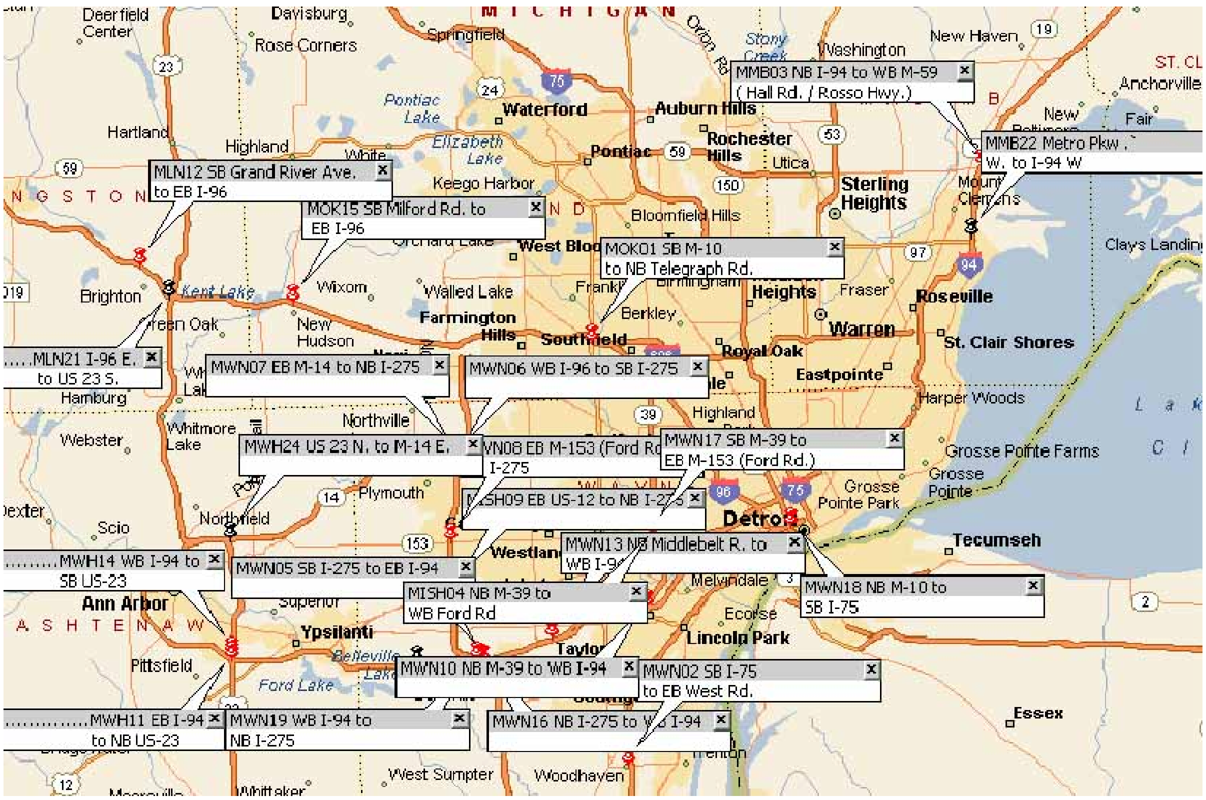
The survey data collection phase lasted a total of 24 van days from 4/23/2007 through 5/25/2007. One van was used to accomplish the data collection.

The eleven sites listed in Table 2-1 were identified and used in the survey. Figure 2-2 displays the distribution of the sites in Southeast Michigan.

Table 2-1: Selected Sites

Site ID	County	Ramp Location
MLN12	Livingston	from Grand River Ave South to I-96 East
MLN21	Livingston	from I-96 East to US 23 South
MMB03	Macomb	from I-94 East to M-59 West
MOK15	Oakland	from Milford Rd. South to I-96 East
MWH24	Washtenaw	from US 23 North to M-14 East
MWN02	Wayne	from I-75 South to West Rd. East
MWN04	Wayne	from M-39 (Southfield Rd.) North to Ford Rd. (M-153) West
MWN05	Wayne	from I-275 South to I-94 East
MWN06	Wayne	from I-96 / M-14 West to I-275 South
MWN08	Wayne	from M-153 (Ford Rd) East to I-275 North
MWN19	Wayne	from I-94 West to I-275 North

Figure 2-2 Site Locations



2.4. <u>***Data Screening***</u>

ESP applied screening checks to the RSD measurements to ensure the data used for fleet evaluation and fleet comparisons were reasonable and consistent:

- Screening of exhaust plumes
- Screening of hourly observations to check for cold starts
- Screening of day-to-day variations in emissions values
- Screening for Vehicle Specific Power (VSP) range

The screening procedures are described briefly in the following paragraphs. Additional tables and charts relating to data screening are provided in Appendix B.

2.4.1. Screening of Exhaust Plumes

The RSD4000 unit samples each exhaust plume approximately every 10 milliseconds during the one half second after each vehicle passes the equipment. The basic gas record validity criteria applied are:

- A gas record is valid if there are at least 5 plume measurements where the sum of the amount of CO2 and CO gas exceed 10%-cm[i]; or
- A gas record is valid if there are at least 5 plume measurements where the sum of the amount of CO2 and CO gas exceed 5%-cm and the background gas values are very stable (not changing faster than a specified rate) at the time the front of the vehicle breaks the measurement beam.

2.4.2. Screening of Hourly Observations

Vehicles operating in cold start mode or under conditions when exhaust plumes condense to steam may appear to have high emissions without any emission system problems. Vehicles produce high emissions in the first minutes after being started when the fuel mixture is enriched and the catalytic converter is not hot enough to function effectively. Exhaust steam plumes can interfere with accurate measurements because the UV and I/R beam path is partly obscured.

To investigate this possibility, ESP tabulated for each site and hour the percentage of 2000 and newer vehicles that exceeded 250 ppm HC. To avoid these measurements ESP checked for observations made during hours when more than 10% of model 2002 and newer vehicles exceeded 250 ppm HC or when the temperature was below zero centigrade. None were found.

2.4.3. Screening of Day-to-Day Variations in Emissions Values

Day-to-day decile values were compared for 2002 and newer vehicles. Only a small percentage of these vehicles are expected to have high emissions. For this group of vehicles, we expect the intermediate decile emission values should not vary significantly from day-to-day, from site-to-site or between the two RSD units that were deployed at different times. The daily median values for all 2002 and newer vehicles are shown in Figures 2-3, 2-4 and 2-5. In each of these charts the y-axis range is set to the detector accuracy specification.

It is evident that the daily median differences are small compared to the claimed detector accuracy but there was a 23ppm difference in HC between the two units that is not insignificant compared to typical emission levels of new vehicles. Adjusted sets of emissions values were created by direct addition or subtraction of a daily offset to the

[i] %-cm is a way of expressing column density. It represents the total amount of gas sensed in the optical measurement path regardless as to how the gas concentration is distributed in the path. A closed transparent cell 10-cm in length that contains 1% concentration of CO (at standard temperature and pressure) would measure as 10 %-cm. A closed cell of 1 cm length containing a CO gas concentration of 10% would also measure 10 %-cm. If both cells were inserted into the path the system would measure 20 %-cm. .

daily median values with the median value for all 2002 and newer vehicle results. Results are provided in Appendix B.

The emissions analyses shown in this report use the adjusted values. In a Virginia survey[4] that used a similar methodology, many statistics were run two ways, 1) using the RSD results as measured and 2) using the adjusted values. The differences between the results were small but the adjusted values resulted in slightly lower average emissions for the newest vehicles and slightly smaller standard deviations from mean values.

Figure 2-3 Daily Median HC hexane for 2002 and Newer Model

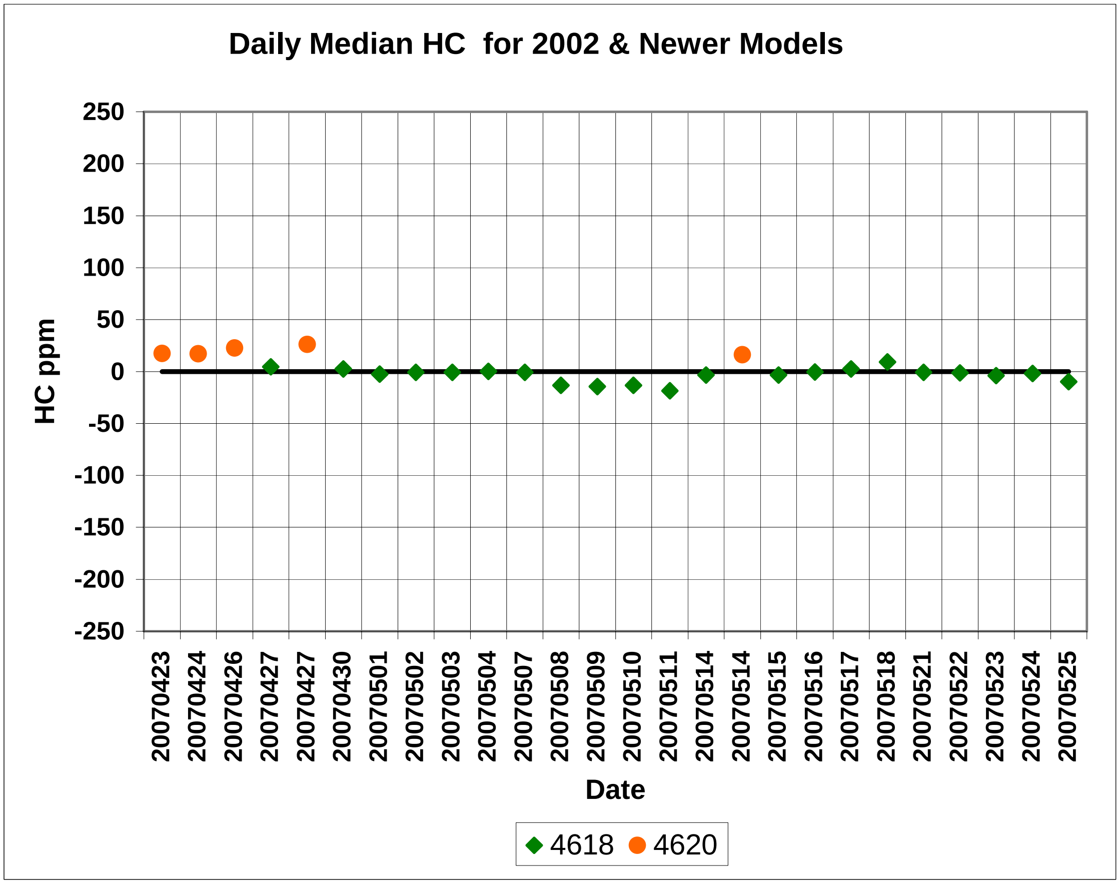


Figure 2-4 Daily Median CO for 2002 and Newer Model

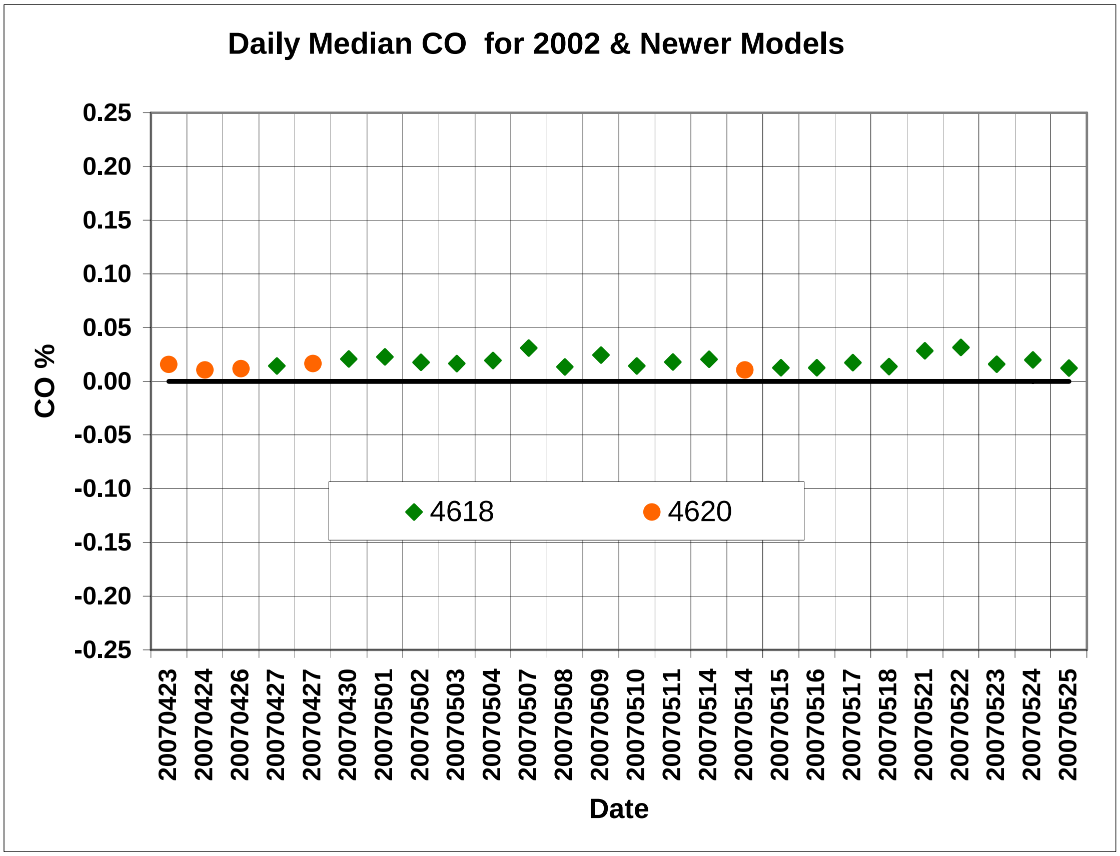
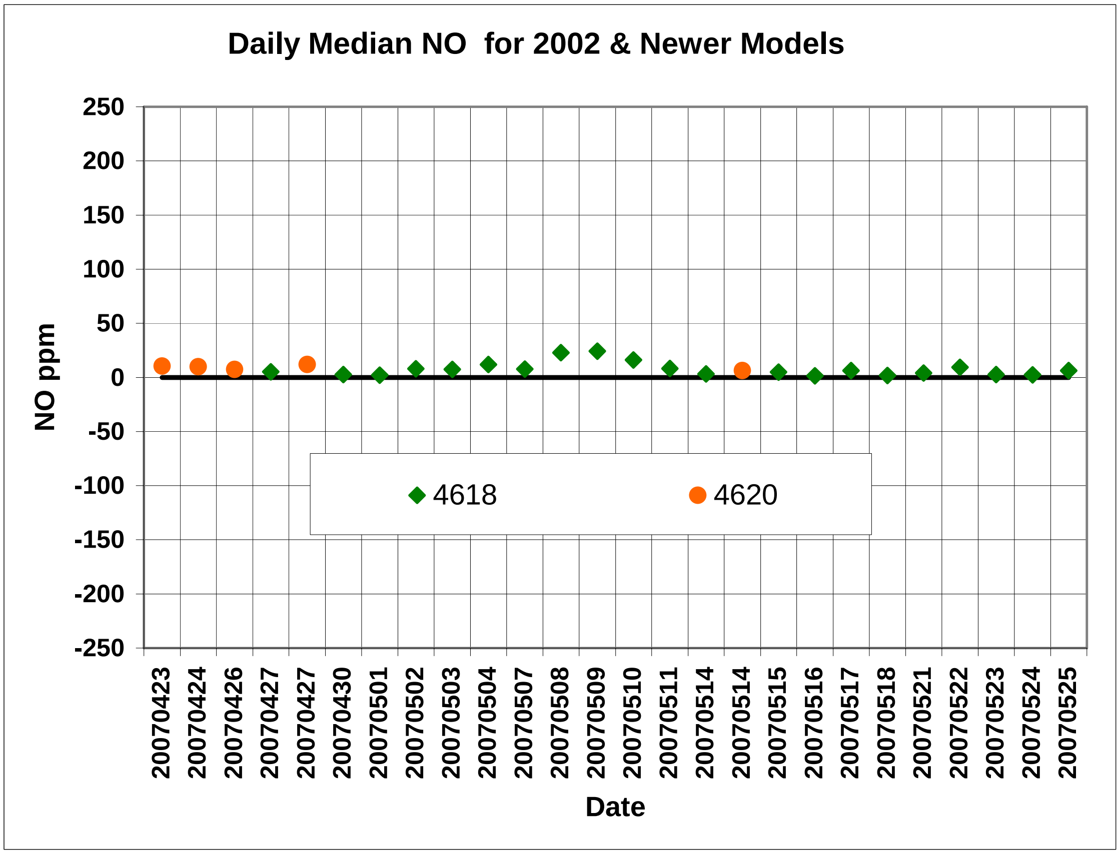


Figure 2-5: Daily Median NOx for 2002 and Newer Models



2.4.4. Effect of Engine Load on Measured Vehicle Emissions

The operating mode of vehicles, e.g. idle, cruise, acceleration, travel uphill and travel downhill, affects engine power output. The mass of pollutants emitted per gallon of fuel can vary significantly at low power and at high power – especially for older vehicles that have less well-controlled emissions.

Vehicle Specific Power (VSP) is the estimated engine power output divided by the vehicle weight. VSP is proportional to the rate of fuel consumption[5]. ESP estimated Vehicle Specific Power (VSP) using the equation recommended by the EPA guidance on the use of remote sensing for evaluation of I/M programs[6]:

VSP kw/t = 4.364*sin(Grade in Deg/57.3)*Speed + 0.22*Speed*Accel + 0.0954*Speed + 0.000027*Speed*Speed*Speed

Where speed is in mph and acceleration is mph/sec.

Newer vehicles have much lower emissions and their emissions concentrations are stable across a wide range of VSP. For older vehicles, HC emissions can be quite unstable when VSP is close to zero or negative. Older vehicles also tend to go into enrichment mode when the VSP is above 22 kw/t, which is the highest load in the federal test procedure (FTP) used to certify new vehicles.

ESP used observations where VSP is between 3 and 22 kW/t in the analysis in section 4. This is broader than the 5 and 20 kW/t range recommended by EPA[7] but retains about 15% more of the measurements and we have used the 3-22kw/t range elsewhere[8].

3. On-road Fleet Observed

Table 3.1 summarizes the records collected during the survey. One RSD van was used and two RSD units. One RSD unit developed a problem during the survey and was replaced. The van was stationed at 11 sites, usually spending two days at each site. Over 201,000 vehicles were observed passing the RSD van. 42% of these vehicles had exhaust plumes that were satisfactorily measured by the RSD systems and had VSP readings within the desired power range[i]. Out of state vehicles accounted for 3%, unreadable plates for 12% and plates were visible and tag edited on 85%. Michigan registration information was obtained for 91% of the license plates resulting in almost 65,000 valid emission measurements associated with Michigan registered vehicles.

Approximately 10,000 vehicles were measured more than once so, in total, 55,000 unique vehicles were measured. This is approximately 1.6% of the light vehicles in the region.

Table 3-1: Number of Remote Sensing Records by License Plate

Data Collection Summary	Number	%
Number of RSD Vans	1	
Number of RSD Units	2	
Number of Sites	11	
Number of Van Days	24	
Total raw records (includes system check records)	201,504	
Valid emissions in acceptable power range (3-22 kw/t)	84,530	42%
Out-of-state plates	2,306	3%
Unreadable / not tag edited	10,276	12%
Valid Emissions and Tag Edited Michigan Plate	71,948	85%
Measurements with Plates Matched to Michigan Registrations	65,526	91%
Unique Michigan vehicles matched	55,584	

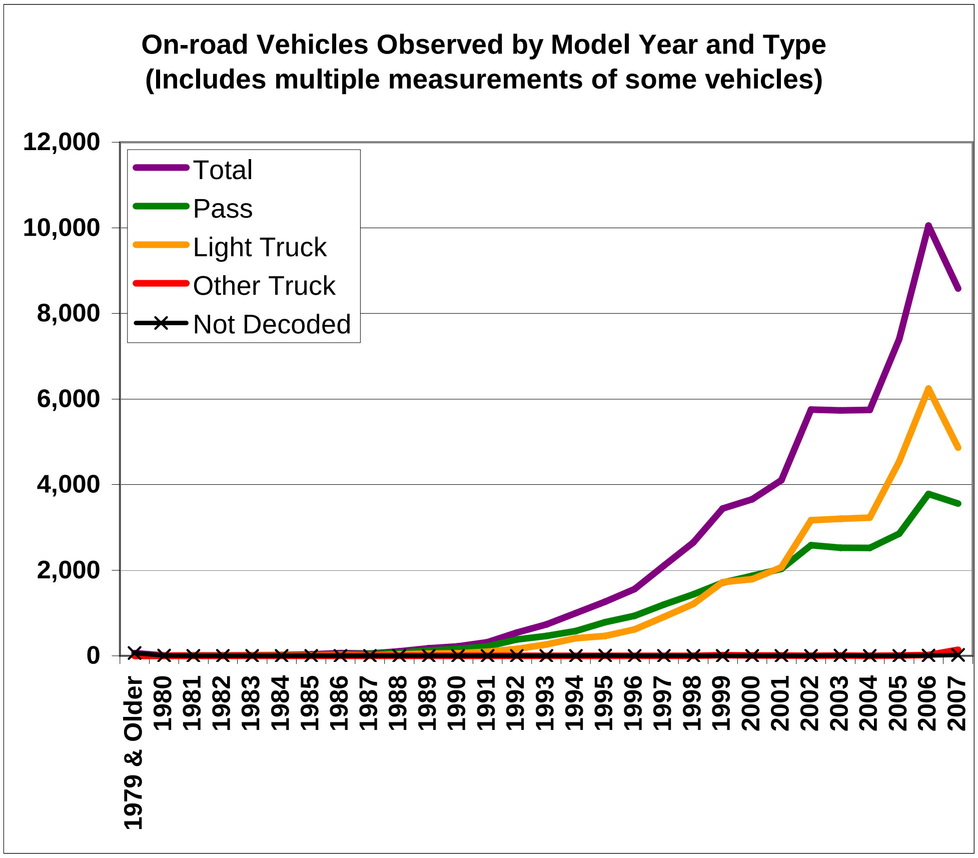
ESP decoded the vehicle identification number (VIN) to yield additional information on virtually all 1981-2007 models. Figure 3-1 shows the distribution of the vehicles observed by age and the type of vehicle. Eighty-seven percent of observations were vehicles ten years old or newer (MY: 1998-2007) and 93% were 1996 & newer.

Since the RSD units were set-up to measure light-duty vehicles, heavy-duty trucks and motorcycles were not fully represented in the RSD data.

Figure 3-2 shows the percentage body style observations within each model year of 1981-2007 models. The body styles are those reported by Michigan Department of State (DOS). We note that SUVs typically are coded as Station Wagons but about 10% may be recorded as 4-door, pick-up or van. The replacement of 2-door vehicles by station wagons over time is very obvious. The 2007 model year was incomplete at the time of the RSD survey and may not be fully represented.

[i] The 58% not valid included: 35% with incomplete emissions measurements, 3% without speed and acceleration and 20% outside the acceptable VSP range. The rate of valid measurements was in the typical range for studies using previously untested RSD sites.

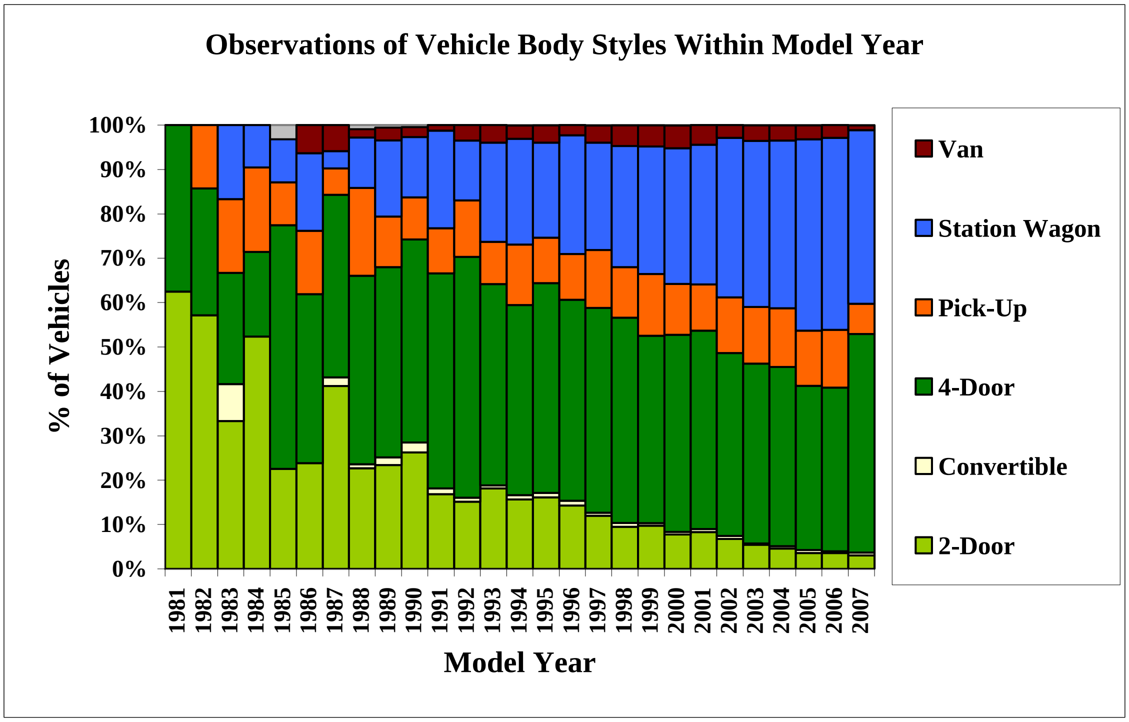
Figure 3-1 On-road Vehicles Measured by Type and Model Year



ESP compared the distributions of passenger vehicle and truck measurements to Mobile6 projected distributions of vehicle miles traveled (VMT). Section 8.2 contains charts of the projections, which showed higher VMT for the newest models and the oldest models. The RSD distributions appear reasonable and the RSD data are believed to be representative of the on-road vehicles in the region.

Up-to-date counts of active registrations were requested from the Secretary of State office to allow a more direct comparison but these were not available by the time this report was completed.

Figure 3-2 Body Styles Observed for 1981-2005 Models



4. Light Vehicle Fleet Emission Rates

The 65,526 valid measurements with plates matched to Michigan registrations were used to estimate emission rates and identify high emitters.

4.1. ***Emission Rates Summary***

Average on road emissions were 19ppm hexane, 0.12% CO, 186ppm NO and 0.02 RSD smoke factor. Results are summarized in Table 4-1 and Figure 4-1. The 15% of vehicles for which vehicles could not be read had higher emissions – roughly two times the HC, NO and Smoke. Unmatched vehicles had similar emissions to Michigan registered vehicles.

The emissions of the overall fleet measured by RSD were 17%, 6% and 20% higher than the DMV matched vehicles for HC, CO and NO respectively. Therefore, estimates of vehicle emissions from just the vehicles matched to registrations would need to be increased by these percentages to reflect all the vehicles measured.

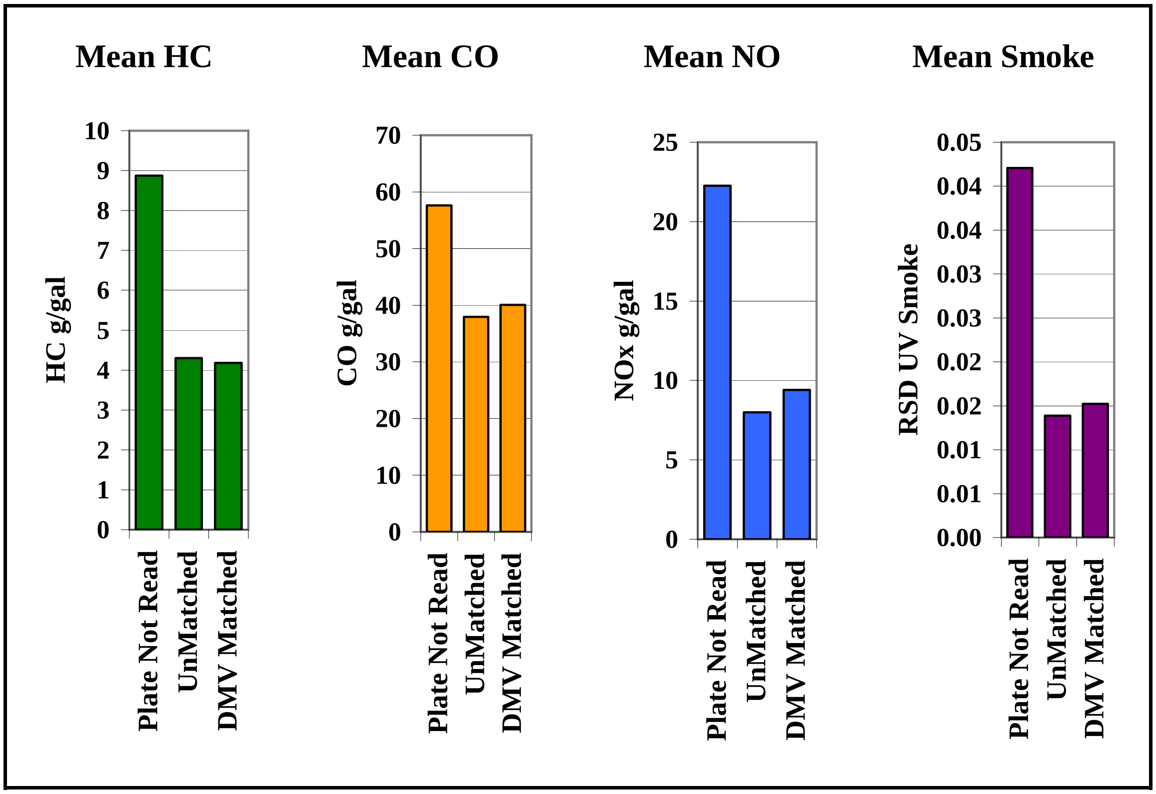
A review of unread plates, described below, found that trucks were a disproportionate fraction of the unread plates and the difference between the average emissions of vehicles matched to DMV records vs. all measured vehicles is largely due to these trucks. We do not anticipate that vehicles with unread plates had materially different emissions than other peer group vehicles. Therefore, estimates of emissions for specific model years or vehicle types are believed to be representative.

The emissions from vehicles with unread plates do not materially affect the conclusions of the high emitter study. RSD data from other areas are likely to have a similar component of unread plates and should be directly comparable.

Table 4-1 On-road Emissions Summary

Status	N	Obs %	HC ppm	CO %	NO ppm	RSD UV Smoke Factor	HC g/gal	CO g/gal	NOx g/gal
Plate Not Read	12,586	15%	34.3	0.17	371	0.04	8.9	57.6	22.3
UnMatched	6,418	8%	16.6	0.11	134	0.01	4.3	38.0	8.0
DMV Matched	65,526	78%	16.1	0.11	156	0.02	4.2	40.1	9.4
Total	84,530	100%	18.8	0.12	186	0.02	4.9	42.5	11.2

Figure 4-1 On-road Emissions Summary



4.2. Unread Plates

ESP examined a 1% random sample of unread plates. Records with RSD ID #'s ending in '05' were selected to obtain a 120-vehicle sample. The RSD images were examined to determine the type of vehicle and the results are shown in Table 4-2.

For light vehicles (94/120), the most common reasons for unread plates were poor lighting conditions and missing plates on new vehicles. A few pick-up trucks had trailers as noted. The side of the vehicle was captured rather than the rear of the vehicle for a few pick-ups and many of the large trucks. The larger vehicles as a group had much higher NO emissions as might be expected if they were carrying loads. Pick-up truck and other trucks also had higher average HC than the overall fleet.

Table 4-2 Unread Plate Sample

Type of Vehicle	Count	CO %	HC ppm	NO ppm	UV Smoke
Coupe	2	0.01	2	-16	0.01
Sedan	35	0.14	5	203	0.00
Mini van	3	0.04	-12	5	0.01
SUV	24	0.05	7	188	0.02
Pick-up Truck	20	0.42	59	653	0.06
Van	6	0.07	27	146	(0.00)
Pick-up w Trailer	4	0.30	46	569	0.04
Flat Bed Truck	5	0.03	35	919	0.12
Motor Home	1	0.07	21	-63	(0.05)
Large Truck	17	0.27	36	685	0.11
Semi-Trailer	1	0.05	35	3103	0.03
RSD Operator	2	0.04	-9	2	0.00
Total	120	0.18	22	392	0.04

4.3. Emissions Distributions

The following series of charts shows the distribution of emissions of Michigan registered vehicles. Colored lines plot the emissions of vehicles (left y-axes) when ordered from dirtiest to cleanest.

The black lines plot the cumulative percentage of emissions (right y-axes) vs. the percentage of vehicles when ordered from dirtiest to cleanest. This makes it easy to determine the emissions contributed by the dirtiest 10% of vehicles. For example, in Figures 4.2-4.5, the dirtiest 10% of vehicles by pollutant contributed 70% of the exhaust HC, CO and NO and 55% of smoke.

The vast majority of vehicles were relatively clean. Significant percentages of vehicles had no measurable exhaust emissions and noise in the RSD measurements resulted in some negative values. Therefore, 100% of exhaust emissions were emitted by fewer than 100% of vehicles.

Pink horizontal lines show a set of gross emitter standards that was used to compare Michigan vehicles to those in other metropolitan areas. These results are described in Section 7.

Figure 4-2 CO Emissions Distribution

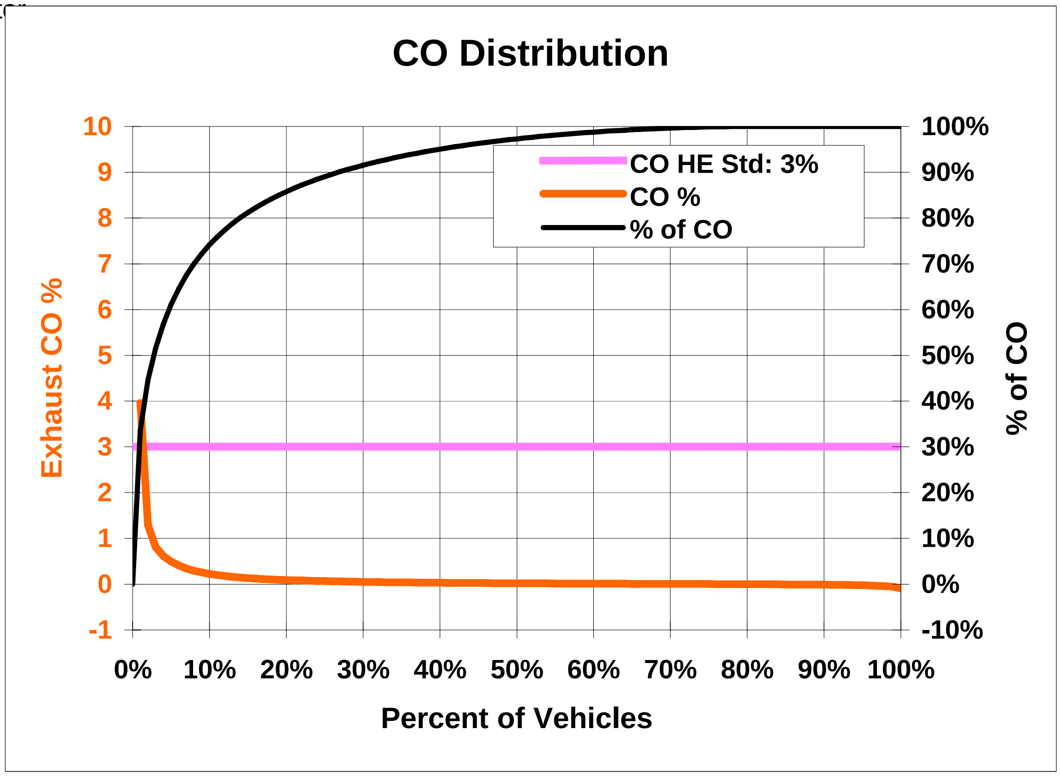


Figure 4-3 HC Emissions Distribution

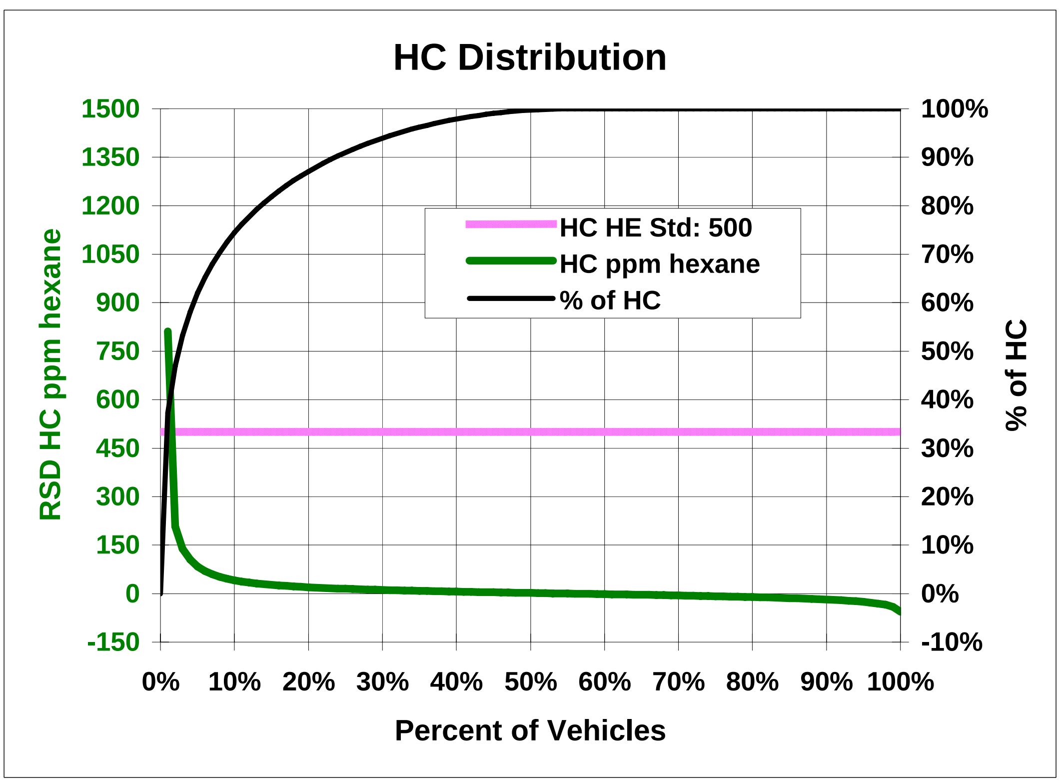


Figure 4-4 NO Emissions Distribution

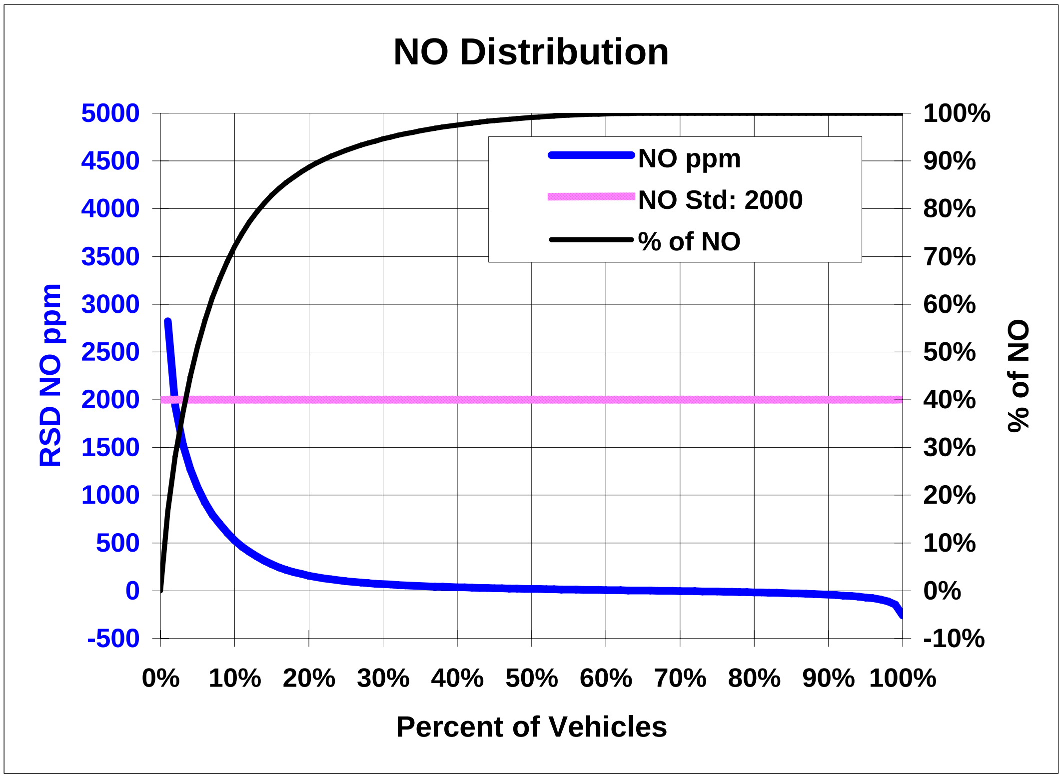
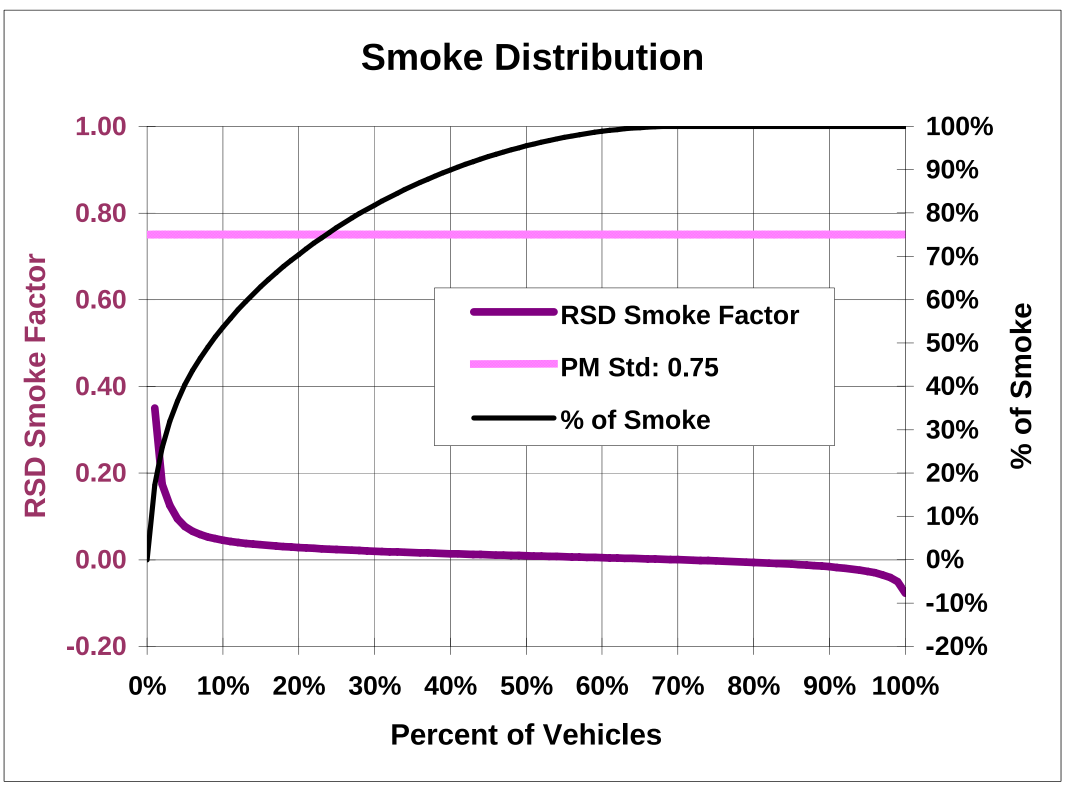


Figure 4-5 UV-Smoke Emissions Distribution



4.4. Conversion to Gram per Gallon

ESP calculated average emission rates by City (Figures 4-6 to 4-10). Exhaust emissions concentrations are often reported in HC ppm hexane, NO ppm and CO %. Test results are typically reported in these units in vehicle inspection programs that use Idle and ASM test procedures. Therefore, the units are useful for considering whether a vehicle is a high emitter.

Emissions concentrations can be converted from ppm and % to grams per gallon of fuel consumed. For many people, grams per gallon are easier to comprehend than ppm or %.

To calculate grams per gallon, the following equations provided by Bishop[9] were used to first convert from concentration percentages to grams per kilogram:

$$\text{gm CO/kg} = (28 \times \%CO/\%CO_2 / (\%CO/\%CO_2 + 1 + 3 \times \%HC / \%CO_2)) / 0.014$$

$$\text{gm HC/kg} = (44 \times \%HC/\%CO_2 / (\%CO/\%CO_2 + 1 + 3 \times \%HC / \%CO_2)) / 0.014$$

$$\text{gm NO/kg} = (30 \times \%NO/\%CO_2 / (\%CO/\%CO_2 + 1 + 3 \times \%HC / \%CO_2)) / 0.014$$

Where the 28, 44 and 30 are grams/mole for CO, HC (as propane) and NO respectively and 0.014 is the kg of fuel per mole of carbon assuming gasoline is stoichiometrically CH2. HC values in ppm hexane were multiplied by two to convert to the propane equivalent.

In a comparison of Non-dispersive Infra-red (NDIR) analyzers vs. Flame ionization detectors (FIDs), Singer and Harley[10] noted that NDIR analyzers are not sensitive to all species of exhaust hydrocarbons. Their results indicate that hydrocarbon concentrations measured by remote sensors with 3.4 micron filters should be multiplied by a factor of 2.0 for light duty vehicles using US reformulated gasoline blends and by 2.2 when conventional gasoline is used. Therefore, %HC values were multiplied by an additional factor of 2.2 when estimating g/kg HC. The limited data on diesel vehicles suggests a factor in the same range and the same factor was used.

NOx emission standards are written as mass of NO_2, even though NO is the molecule emitted. NO is oxidized to NO_2 in the atmosphere. NO results were multiplied by 46/30 to convert to NO_2 mass units.

Fuel densities for gasoline and diesel of 2.76 kg/gallon and 3.07 kg/gallon respectively were used to convert to grams per gallon.

The RSD smoke channel is calibrated such that a value of 1 corresponds approximately (depending on an average size distribution and assuming black smoke) to a diesel particle mass of 1% of fuel by weight. A vehicle with a reading of 1 is a “Black Smoker”.

Approximate conversions from concentrations to grams per liter for gasoline vehicles are then:

- 1% CO ~ 345 g/gal
- 100 ppm HC hexane ~ 25.4 g/gal
- 100 ppm NO ~ 6.0 g/gal NOx
- 1 RSD smoke factor ~ 13.9 g/gallon smoke

The conversion for gasoline smoke is very approximate. There are several different types of gasoline smoke including black smoke (carbon), blue smoke (oil) and white smoke (coolant). Since the mass of particulate matter will vary dependent on the type of smoke, a crude assumption is used of 50% of black smoke.

For diesel vehicles:

- 1% CO ~ 383 g/gal
- 100 ppm HC hexane ~ 28.2 g/gal
- 100 ppm NO ~ 6.7 g/gal NOx
- 1 RSD smoke factor ~ 30.6 g/l black smoke

In the following section, emissions comparisons are based on exhaust pollutant grams per gallon. The mass of pollutant emissions is dependent on vehicle fuel economy and miles driven in addition to grams per gallon. Mass emissions are compared to the EPA Mobile model projections in section 8.

4.5. Emissions by Fuel Type

Measurements by fuel type are shown in Table 4-3. The 'Not Decoded' category includes:

- Plates not read	10,276;
- Out-of-state plates	2,306;
- Michigan plates not matched to registrations	6,422;
- VINs not decoded	471;

Most VINs not decoded were either 1980 and older (70) or 1997 and newer (373).

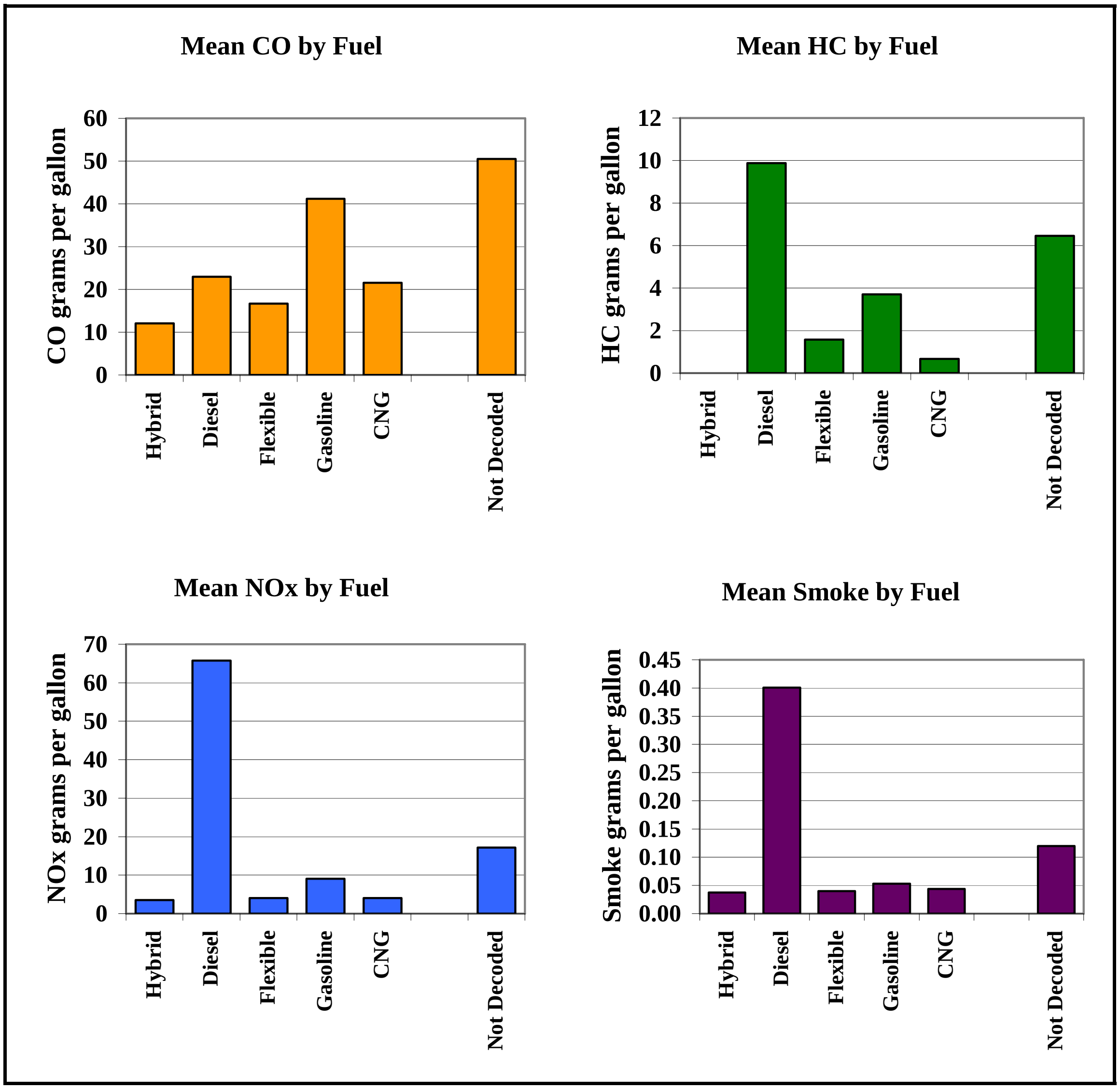
Figure 4-11 shows average emissions by vehicle fuel. Hybrids and flexi-fueled vehicles have the lowest emissions but are also the newest. The sample of CNG vehicles was small and most were 2001-2002 model Chevrolet Cavaliers.

Diesel vehicles were just over 1% of the identified vehicles. Compared to gasoline vehicles, diesel vehicles had moderately high HC, high NOx and high smoke emissions.

Table 4-3: Measurements by Fuel

Fuel	Avg Model	N
Hybrid	2006	114
Diesel	2004	703
Flexible	2002	3,407
Gasoline	2002	60,801
CNG	2002	30
Not Decoded		19,475
Total		84,530

Figure 4-11: Emission by Fuel



Emissions of 2005-2007 model hybrid vehicles were compared to those of 2005-2007 model gasoline vehicles. Hybrid passenger vehicles had lower CO than gasoline passenger vehicles. Other differences in emissions were not statistically significant. Charts are provided in Appendix C.

4.6. Emissions Rates by Model Year Group

Emission rates were compared by model year group for gasoline vehicles and diesel vehicles. The hybrids, flexi-fuel and CNG vehicles were included in the gasoline group. Models 1980 and earlier were not included because their fuel type was unknown.

Table 4-4: Measurements by Model Year

Model Years	Diesel	Gasoline & Other
1981-1990	9	684
1991-1995	23	3,821
1996-2000	132	13,274
2001-2005	383	28,336
2006+	156	18,237
Total	703	64,352

Figures 4-12 to 4-15 show the results of this analysis, which excludes a small number of 1980 and older vehicles because their fuel type was not decoded. It is no surprise that the dirtiest vehicles were the oldest models. 1996 and newer gasoline vehicles were the cleanest and these make up a large majority of the fleet.

On the other hand, even the newest Diesel vehicles had dramatically higher NOx and smoke emissions. New Diesel vehicles also had higher HC than new gasoline vehicles. The diesel sample contains a greater proportion of medium- and heavy-duty vehicles that have less emissions control.

Figure 4-12: Mean CO by Model Year

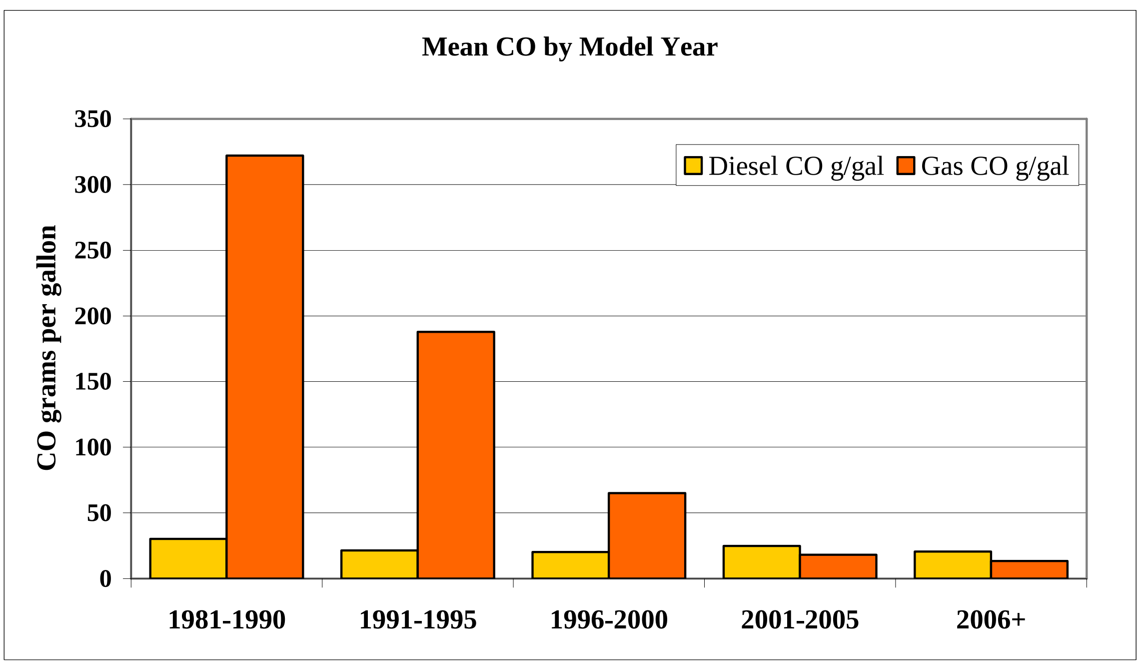


Figure 4-13: Mean HC by Model Year

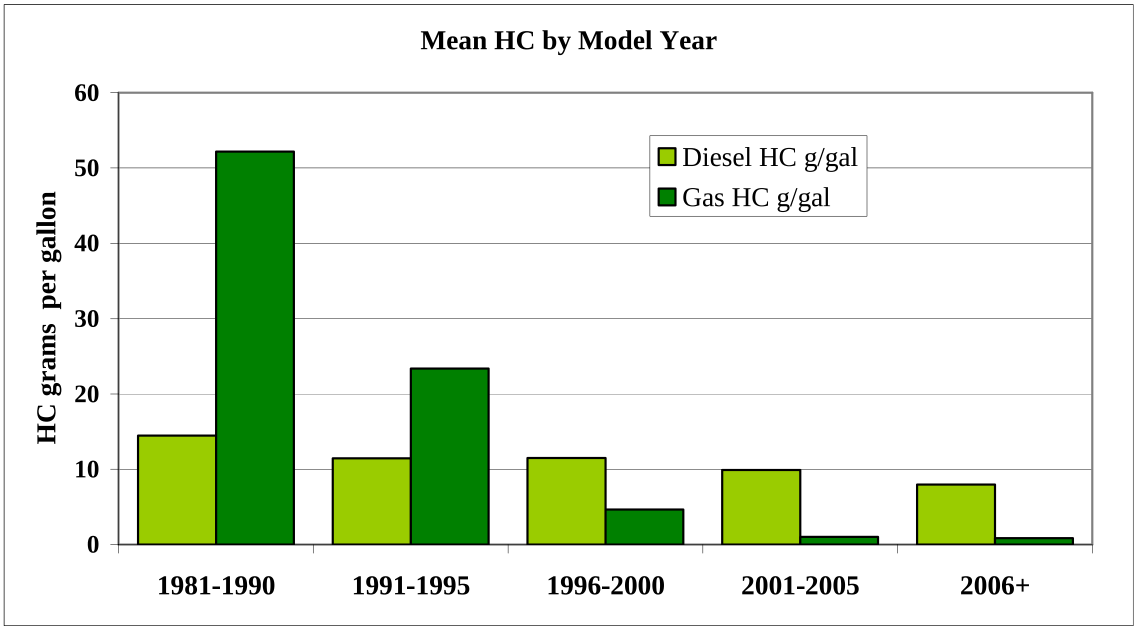


Figure 4-14: Mean NOx by Model Year

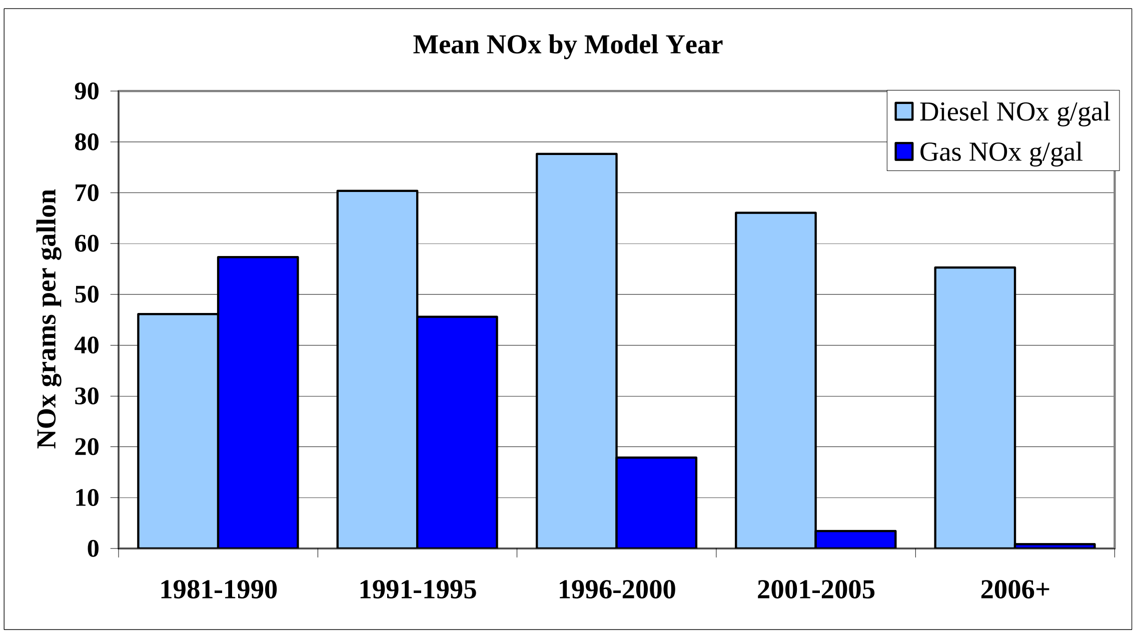
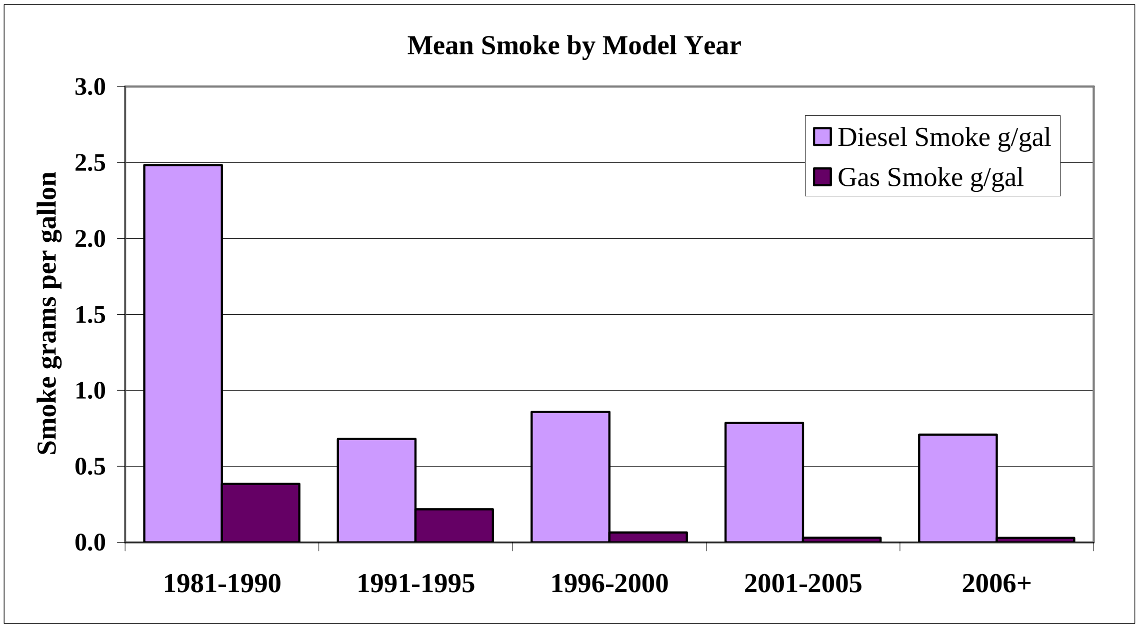


Figure 4-15: Mean Smoke by Model Year



4.7. Emissions Contributions by Model Year

Figure 4-16 shows the distribution of vehicles by fuel and model year group and Figure 4-17 shows the corresponding emissions contributions.

As noted earlier, the contribution charts make the assumption that fuel economy is the same across model years and fuel type. The average fuel economy of each new model year of vehicles has remained approximately the same over the past twenty years. Therefore, to a first approximation, the assumption is reasonable.

Note, however, that the RSD configuration used in the survey was not designed to measure heavy vehicles and the contributions shown are for light vehicles only. The 1% of light vehicles that were diesel emitted approximately 3%, 1%, 8% and 14% of HC, CO, NOx and smoke.

1995 and older models were only 7% of the on-road fleet but contributed more than one third of running emissions; 54% of HC, 37% of CO, 35% of NO and 29% of smoke.

The 1996-2000 gasoline models have significantly lower per vehicle emissions than 1991-1995 models (Figures 4-12 to 15) – especially for HC. Therefore, despite their greater number, total HC emissions for 1996-2000 gasoline models were lower than for 1991-1995 models.

Per vehicle emissions were again substantially lower for 2001-2005 models vs. 1996-2000 but less so for smoke. This resulted in a continuing decline in total emissions for 2001-2005 models except for smoke (Figure 4-17).

Figure 4-16: Composition of Vehicles Measured On-Road

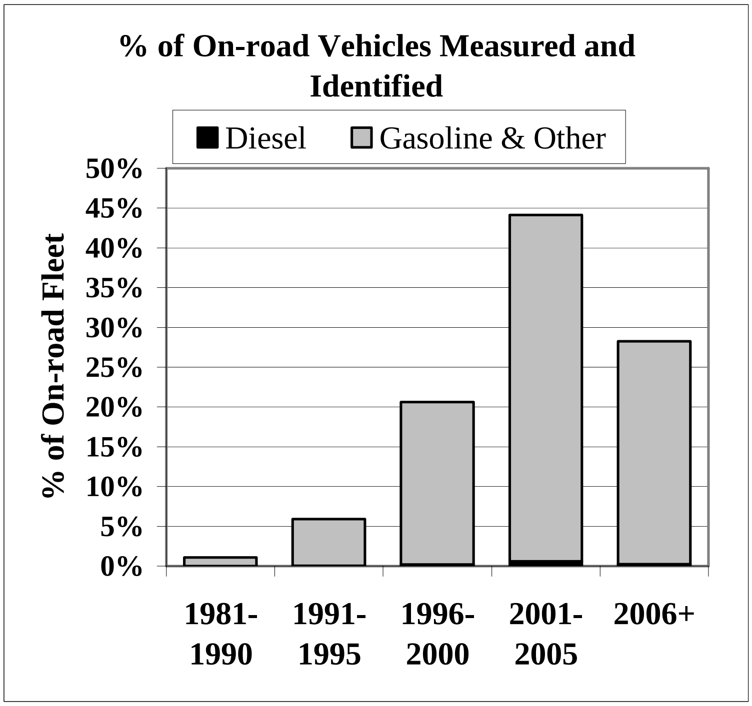
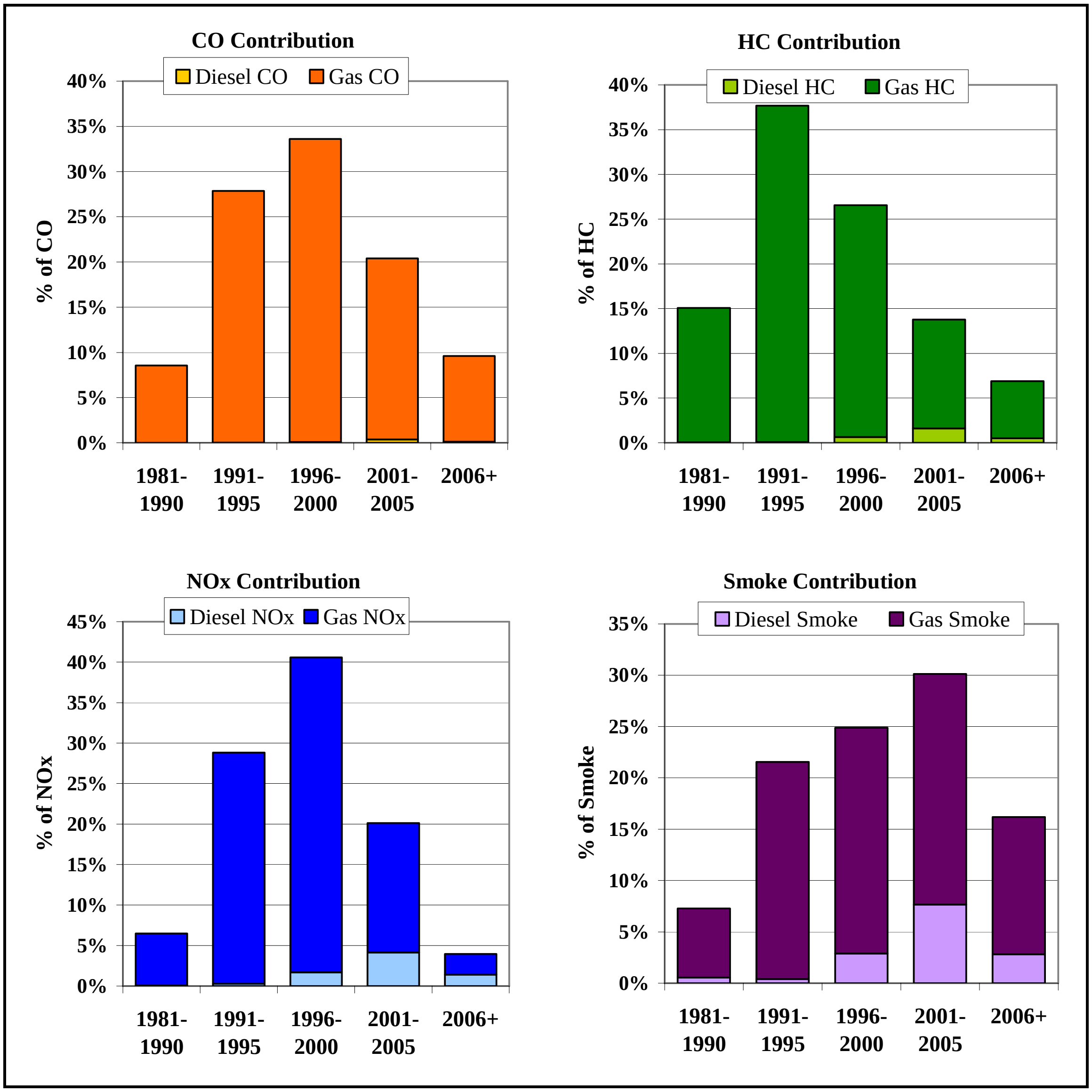


Figure 4-17: Approximate Emissions Contributions



5. High Emitters Notified and Survey Results

Owners of vehicles with high CO or high HC were surveyed regarding their vehicle's high on-road emissions. 706 owners were mailed a letter and survey questionnaire regarding any vehicle performance problems. A follow-up mail survey requested information about maintenance and repairs that had been performed. The letters and survey forms are in Appendix D. Tables of responses by vehicle are in Appendix E.

Respondents received a $10 gas card for each survey returned. 104 owners responded to the first survey and 123 owners responded to the follow-up.

5.1. Vehicle Owners Surveyed

Batches of RSD vehicle emission results were initially ranked by CO and those above 2% CO were notified. In addition, vehicles with HC in excess of 500ppm were notified even if they had low CO.

Table 5-1 shows the number of vehicles notified by four emissions groups. The fraction of vehicles notified was 1.3% of those measured.

Figures 5-1 and 5-2 show the number and percentage of vehicles notified by model year. Notification rates were typically 20-30% for 1988 and older models. For 2002 to 2007 models the rate averaged just 0.13%, i.e. roughly one out of every 750 vehicles.

Table 5-1: Vehicles Notified by Emissions Group

Emissions	**Notified**
HC<=500ppm & CO>2%	448
HC>500ppm & CO<=2%	162
HC>500ppm & CO>2%	35
HC>500ppm & CO>4%	61
Total	706

Figure 5-1: Number of High Emitters by Model Year

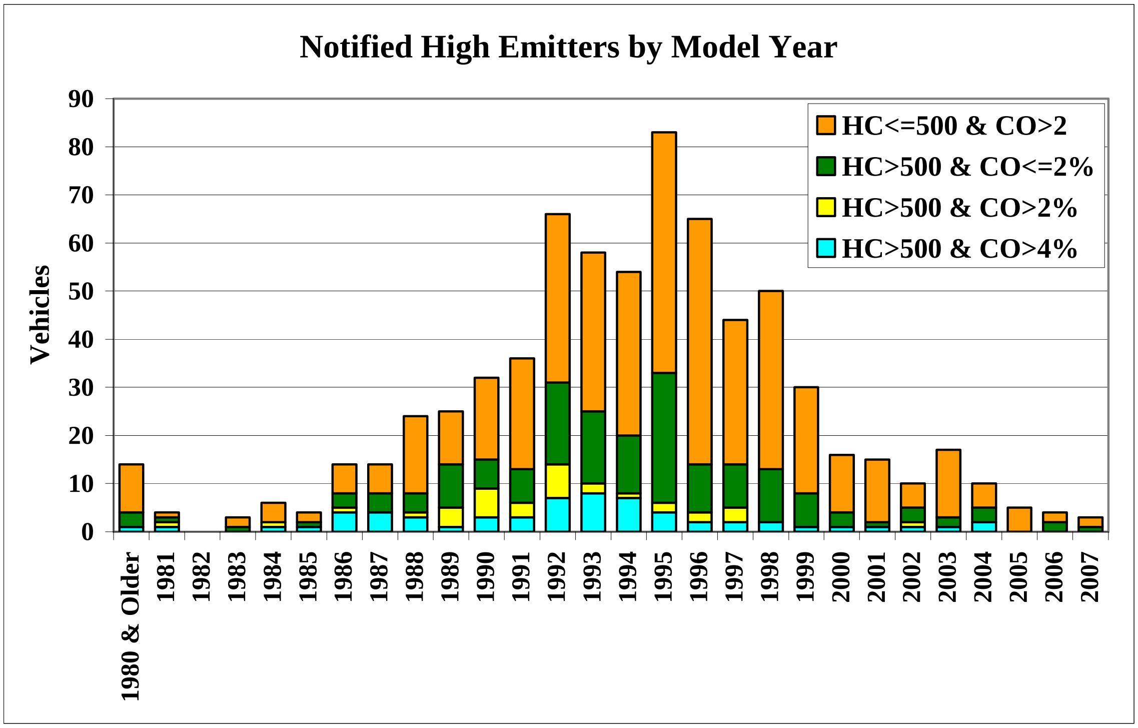
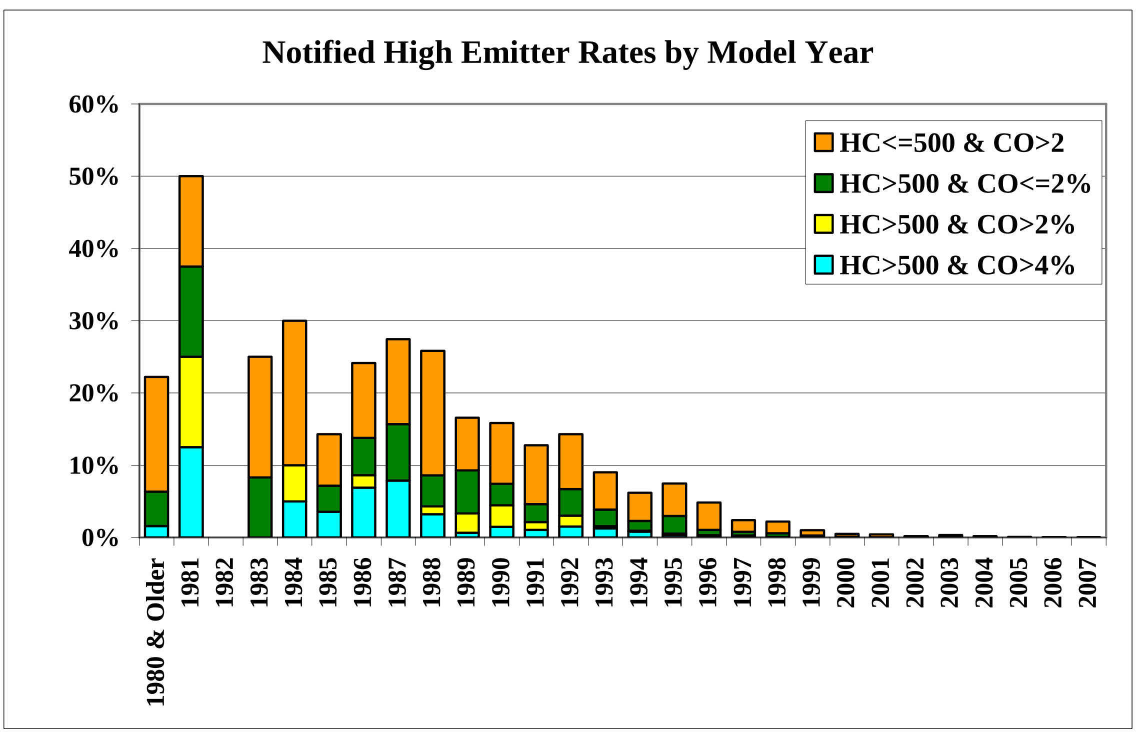


Figure 5-2: Percent of High Emitters by Model Year



5.2. Survey Responses

15% of vehicle owners responded to the initial survey regarding vehicle problems and 19% to the follow-up survey regarding whether the vehicle had been taken in for diagnosis and repair.

Table 5-2 shows a breakdown of reported vehicle problems by age group. Two-thirds of respondents reported some problem with their vehicle, Rates were fairly consistent across all model years, except possibly 2006 & newer vehicles for which only seven candidates were identified and only two surveys returned. The highest rate of problems, 76%, was reported for 1991-1995 models and 61% of owners of 1996-2000 models reported an illuminated Check Engine or Service Engine Soon light.

Fewer components have any malfunction indicators on the older models. It is therefore possible that the lower rates of reported problems for 1990 and older models are the result of a lack of owner awareness of any problem.

Table 5-3 shows the reported action by owners. 18% of follow-up survey respondents said they had sold or were planning to sell the vehicle, 39% took vehicles for service and three-quarters of these reported a repair (29% of follow-up survey respondents). 1996-2000 models were most likely to be taken for service and repaired.

Table 5-2: Vehicle Problems by Age Group

				Vehicle Problems Reported						Previous ECS problem	
MY	Surveys Mailed	Surveys Filled	%	"Check Engine" or "Service Engine Soon" light is on	Unusual vibration when engine running	Smoke on acceleratio nafter running 5 minutes	Stalling of vehicle	Other	One or more of these Problems	Yes	Don't know
1980 & older	14	2	14%	0%	0%	50%	0%	0%	**50%**	0%	0%
1981-1990	126	20	16%	25%	20%	15%	5%	15%	**55%**	20%	5%
1991-1995	297	42	14%	45%	29%	29%	24%	10%	**76%**	21%	24%
1996-2000	205	33	16%	61%	24%	9%	21%	12%	**70%**	9%	27%
2001-2005	57	5	9%	20%	60%	20%	20%	0%	**60%**	0%	20%
2006 & newer	7	2	29%	0%	0%	0%	0%	0%	**0%**	0%	50%
Total	706	104	15%	43%	26%	19%	18%	11%	**67%**	15%	21%

Newer vehicles were more likely to be taken for service, which could be the result of illuminated malfunction indicators, and three-quarters of these were repaired. Stronger encouragement to have a mechanic inspect high emitting vehicles could improve repair rates for older models.

Survey response rates were similar for high HC vs. high CO emitting vehicles (Table 5-4). Vehicles with high HC and moderate CO may have a higher rate of repairs. The sample size is too small to draw definitive conclusions.

Vehicles belonging to owners responding to the survey had higher average CO and HC emissions than those not responding (Figure 5-3).

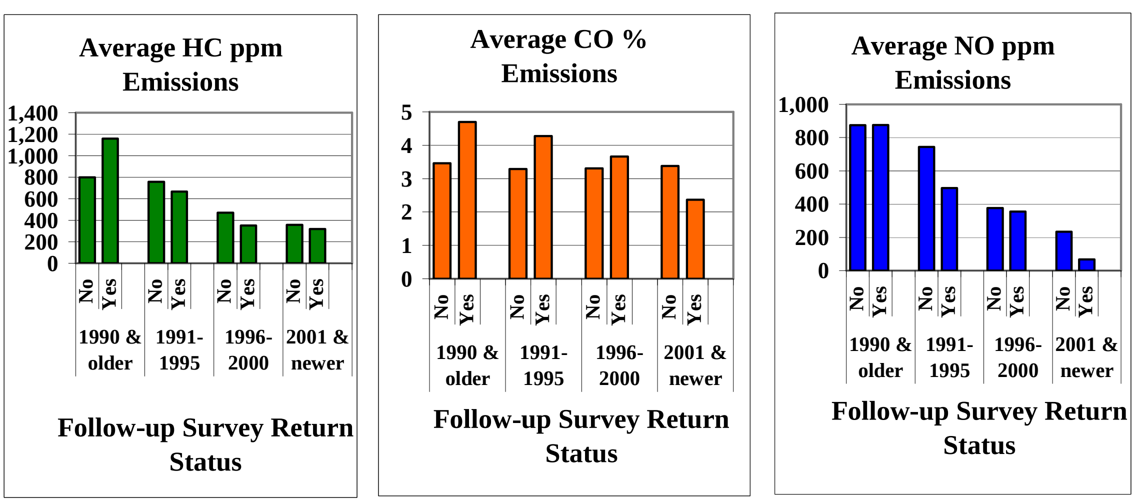
Table 5-3: Vehicle Service Rates by Age Group

MY	Follow-up Surveys Mailed	Surveys Filled	%	Taken for Service	Repaired
1980 & older	11	1	9%	100%	100%
1981-1990	125	24	19%	25%	21%
1991-1995	285	56	20%	36%	27%
1996-2000	197	38	19%	55%	39%
2001-2005	56	5	9%	40%	20%
2006 & newer	7	3	43%	0%	0%
Total	681	127	19%	39%	29%

Table 5-4: Vehicle Service Rates by Emissions Group

Emissions	Follow-up Surveys Mailed	Surveys Filled	%	Taken for Service	Repaired
HC<=500ppm & CO>2%	431	83	19%	41%	28%
HC>500ppm & CO<=2%	157	22	14%	45%	45%
HC>500ppm & CO>2%	33	7	21%	29%	14%
HC>500ppm & CO>4%	60	15	25%	27%	20%
Total	681	127	19%	39%	29%

Figure 5-3: Average Emissions of Vehicles Responding



Yes – follow-up survey completed; No- follow-up survey not completed

5.3. *Vehicle Owner Responses to First Questionnaire*

706 Surveys mailed, 104 (15%) Returned, 28 Undeliverable
September 4, 2007

1. Have you recently noticed any of the following when driving your vehicle?

43% Yes	**53%** No	**4%** NR	"Check Engine" or "Service Engine Soon" light is on
26% Yes	**68%** No	**6%** NR	Unusual vibration when the engine is running
19% Yes	**78%** No	**3%** NR	Smoke coming out of the tailpipe when you accelerate, even after the car has been running for more than five minutes
18% Yes	**76%** No	**6%** NR	Stalling of vehicle
12% Yes	**37%** No	**52%** NR	Other ________________________________

Crosstab of Multiple Responses to Question 1

People answering yes	Check Engine light is on	Unusual vibration	Smoke from tailpipe	Stalling of vehicle	Other
Check Engine light is on	45				
Unusual vibration	19	27			
Smoke from tailpipe	9	8	20		
Stalling of vehicle	10	11	6	19	
Other	7	5	2	1	12

2. Had you already made an appointment to service this vehicle before receiving this letter?

27% Yes **73%** No

3. How long have you owned the vehicle?

Minimum: <1 Year
Maximum:18 years
Median: 3 years

4. Have you ever had problems with its emissions control system before?
(This could include problems with its oxygen sensor, catalytic converter, etc.)

15% Yes **62%** No **21%** Don't know **2%** No Response

5. Is this vehicle still under warranty?

5% Yes **93%** No **2%** Don't know **0%** No Response

6. How often do you change the oil in this vehicle? 75 of 104 respondents answered this question in miles. Their responses are summarized below. If a range was given, the midpoint of the range was used.

Minimum:	1,000 miles
Maximum:	15,000 miles
Median:	3,000 miles

7. How many miles are currently on your vehicle?

Minimum:	3,000 miles
Maximum:	276,379 miles
Median:	138,602 miles

8. How often do you usually drive this vehicle?

78% Every day
14% Several times a week
5% Several times a month
3% Once a month
0% Several times a year

5.4. Vehicle Owner Responses to Second Questionnaire

681 Surveys mailed, 127 (19%) Returned, 11 undeliverable
November 19, 2007

1. Did you take your vehicle in to be serviced? (123 total responses)
   39% Yes **61%** No **0%** NR

2. If yes, were repairs done? (64 total responses)
   58% Yes **42%** No **0%** NR

   a. If yes,
      - Approximately how much did they cost? (37 total responses) — Minimum: $10; Maximum: $860; Average: $272

        What repairs were done? (36 responses)

39%	Tune up, replaced spark plugs and or wires, carburetor or fuel injector adjustment
14%	Oxygen sensor
11%	Oil change, oil and/or air filter replacement
8%	EGR repair
8%	New carburetor or exhaust system
6%	New catalytic converter
25%	Other

      - Were the repairs covered under warranty?
        7 % Yes **93%** No (42 total responses)

   b. If no, please tell us why. (27 total responses)

      37% Mechanic determined repairs were not needed.
      41% Repairs were too expensive
      What was the estimated repair cost? (7 total responses) — Minimum: $200; Maximum: $2,000; Average: $833
      22% Other:

3. If you decided not to take your vehicle in for servicing, please tell us why. (69 total responses)

   38% Couldn't afford to have vehicle serviced
   0% Didn't know where to take the vehicle
   5% Didn't have time
   0% Forgot about it
   13% Don't feel my vehicle has a pollution problem
   0% Just not interested
   44% Other:
      40% Have sold or am selling this vehicle
      13% Do my own repairs
      10% Other more important repairs needed first
      7% Vehicle too old
      7% Not primary vehicle
      23% Other

6. Another View of High Emitters

As noted earlier, high emitters were also identified using cutpoints of 500ppm HC, 3% CO, 2,000ppm NO and 0.75 RSD smoke factor. The cutpoints were selected to facilitate comparison with data from other regions.

Of the 65,526 vehicles measured on-road that were identified by plate and matched to a registration, 1,373 (2.1%) exceeded one or more of the pollutant cutpoints (Table 6-1).

Table 6-2 shows the combinations of cutpoints that were exceeded. A majority of vehicles exceeding a cutpoint were identified for having high NO. One quarter had high CO and one fifth had high HC.

About 10% of vehicles exceeded cutpoints for more than one pollutant. About one third of vehicles with high HC also had high CO. Most vehicles with high NO did not have high emissions of another pollutant. About one third of smoking vehicles failed only for smoke. The other two-thirds failed in roughly equal proportions for 1) smoke plus HC, 2) smoke plus NOx and 3) smoke plus HC and NO.

Table 6-1: High Emitters

	Count
RSD measurements exceeding one or more cutpoints	1,373
Emissions cutpoints exceeded:	
HC 500 ppm hexane	265
CO 3%	334
NO 2000ppm	890
UV Smoke Factor 0.75	33
Total Cutpoints Exceeded	1,522

Table 6-2 Higher Emitters by Pollutant

HE Cutpoint Exceedance Combination	Count
Single pollutant:	
HC Only	140
CO Only	250
NOx Only	843
Smoke Only	9
Two Pollutants:	
HC & CO Only	71
HC & NO Only	29
CO & NO Only	7
HC & Smoke Only	-
CO & Smoke Only	1
NO & Smoke Only	5
Three Pollutants:	
HC & CO & NOx	7
HC, CO & Smoke	5
HC, NOx & Smoke	6
CO, NOx & Smoke	-
Jackpot:	
HC, CO, NOx & Smoke	-
Total	1,373

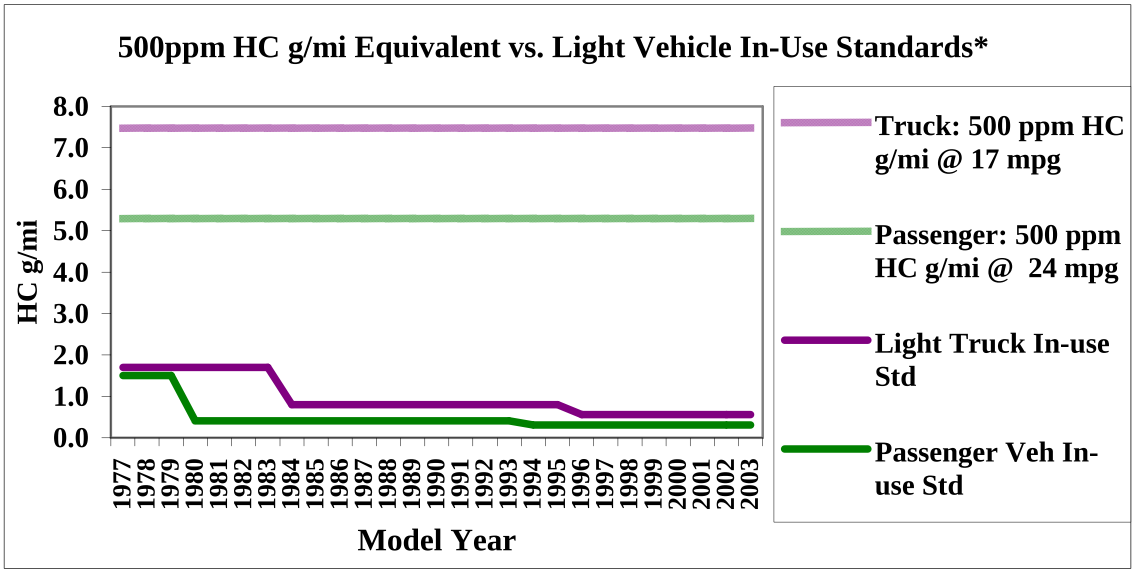
6.1. High Emitter Cutpoints vs. In-Use Standards

Figures 6-1 to 6-4 illustrate the relationship of the adopted RSD high emitter cutpoints to vehicle in-use standards.

The precise g/mi equivalents for RSD g/gal emissions values depend on vehicle fuel economy. Typical average values of 24 mpg for light passenger vehicles and 17 mpg for light trucks were used in these Figures.

In all cases, the selected high emitter cutpoints far exceed the in-use standards. The selected cutpoints of 500ppm HC and 2,000ppm NO are roughly equivalent in terms of grams per mile and the 3% CO cutpoint is about eight times higher. CO is often divided by a factor of 7 compared to HC and NOx when calculating emissions reduction cost-benefits.

Figure 6-1 High Emitter HC Cutpoint and In-Use Standards



*Simplified standards: 10-year/100,000 mile in-use standards or 11-year/120,000 mile in-use standards introduced after 1993. Truck standards are for light duty trucks greater than 5,750lbs test weight.

Figure 6-2 High Emitter CO Cutpoint and In-Use Standards

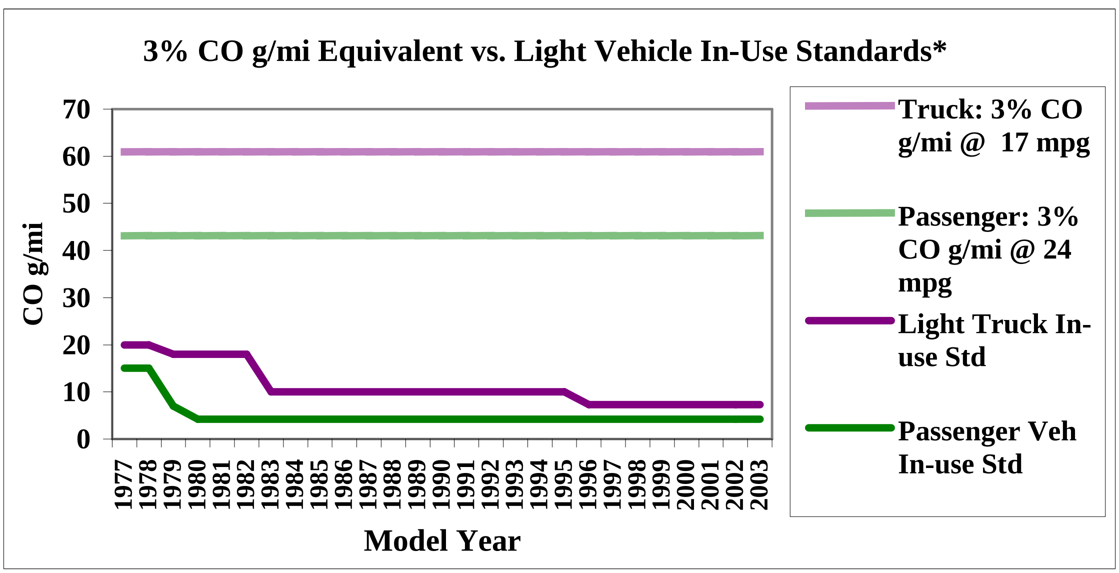


Figure 6-3 High Emitter NOx Cutpoint and In-Use Standards

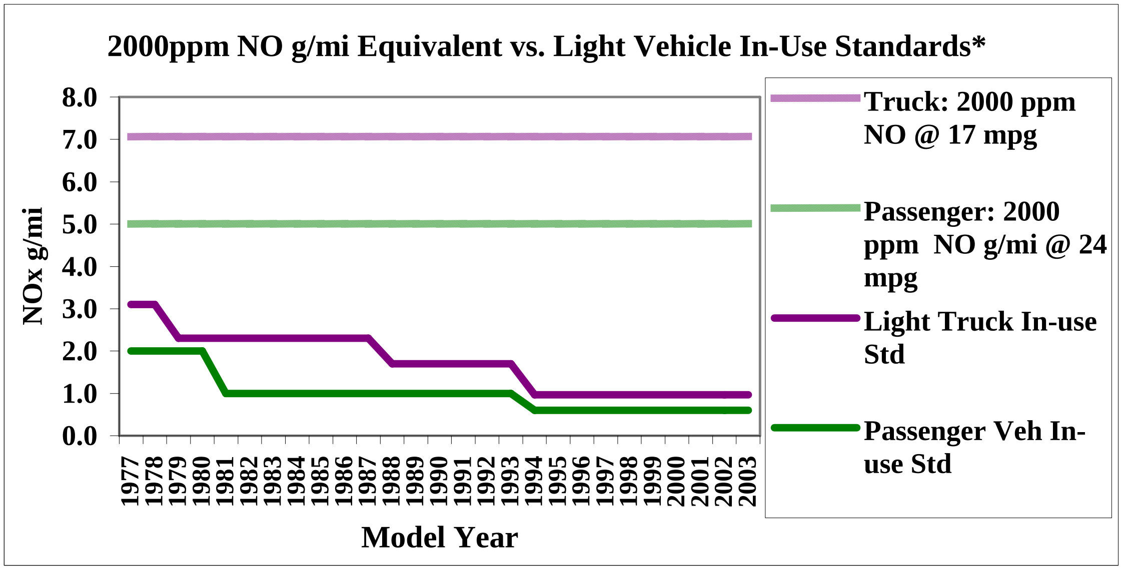
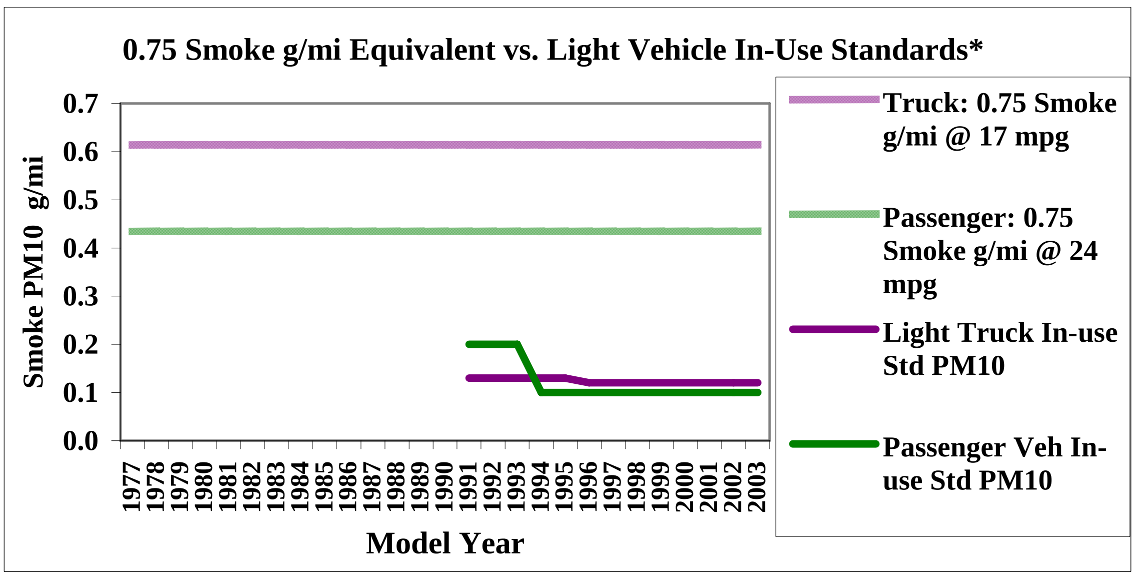


Figure 6-4 High Emitter PM Cutpoint and PM10 In-Use Standards



Figures 6-5 through 6-8 show median and high emitter HC and NOx emissions by model year compared to the in-use standards and cutpoints. There were not any 1981 and only one 1982 model trucks in the sample.

Figure 6-5 High Emitter Cutpoint, In-Use Standards and Median HC

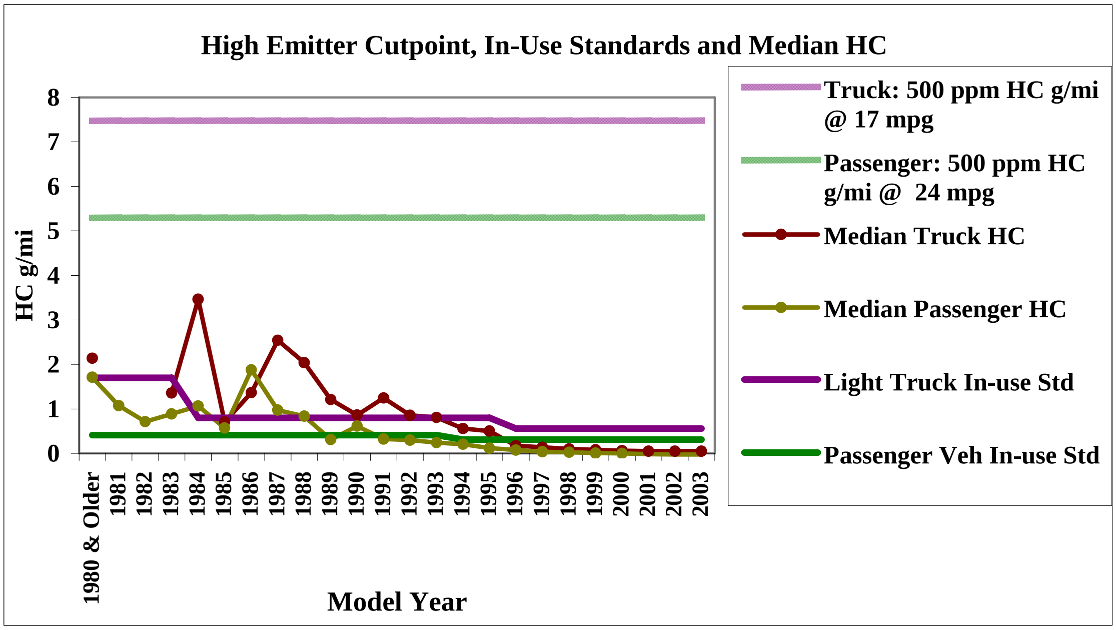


Figure 6-6 High Emitter Cutpoint, In-Use Standards and High Emitter HC

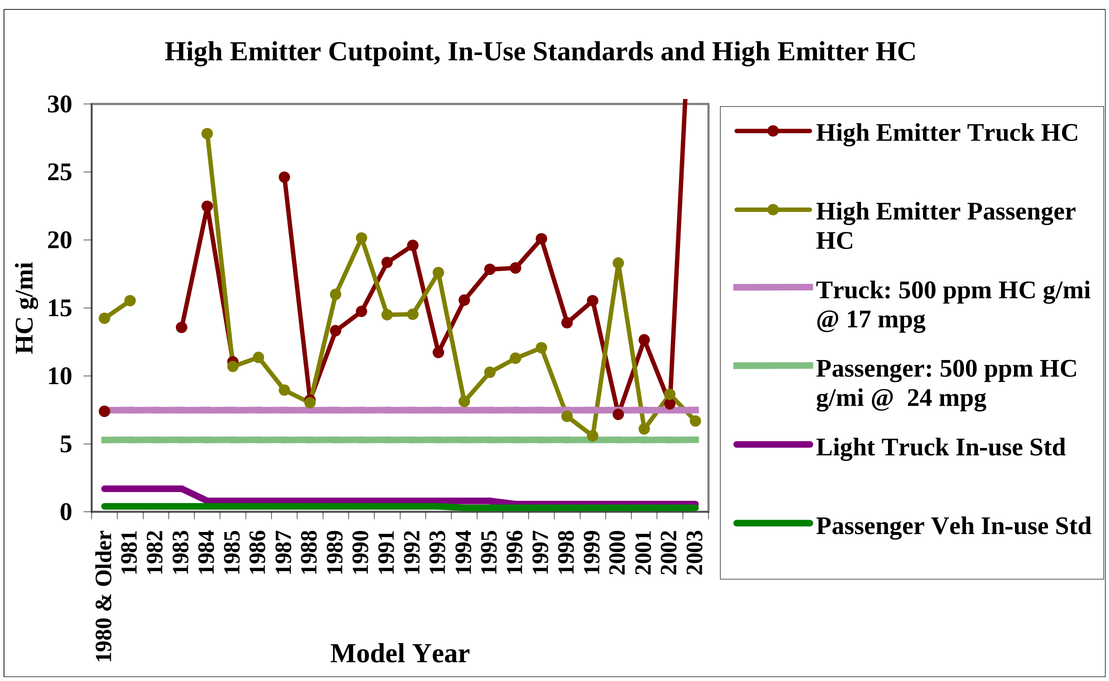


Figure 6-7 High Emitter Cutpoint, In-Use Standards and Median NOx

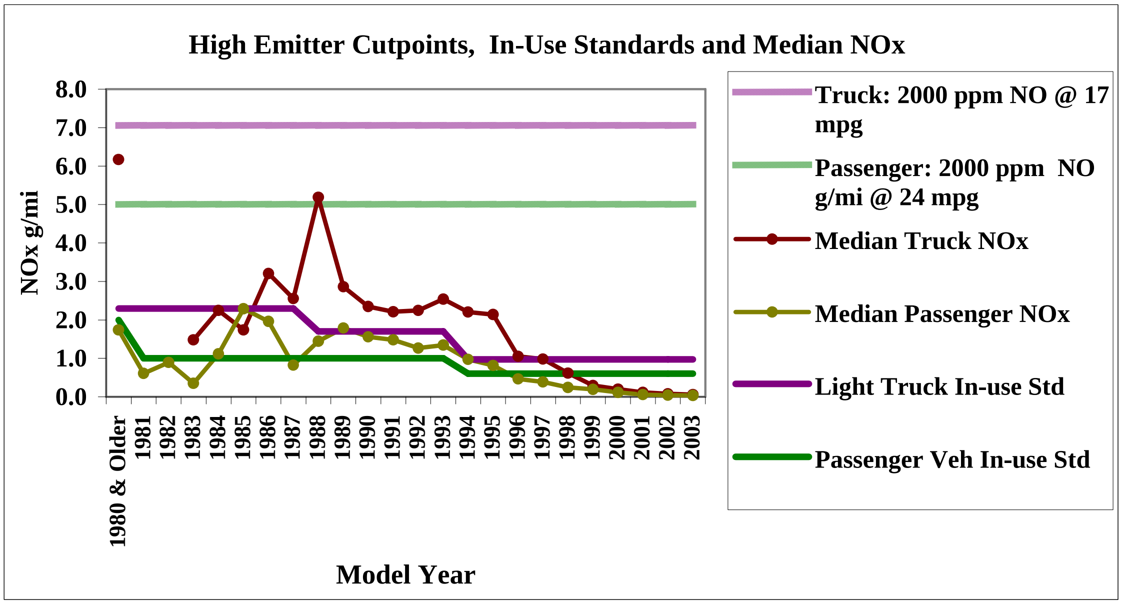
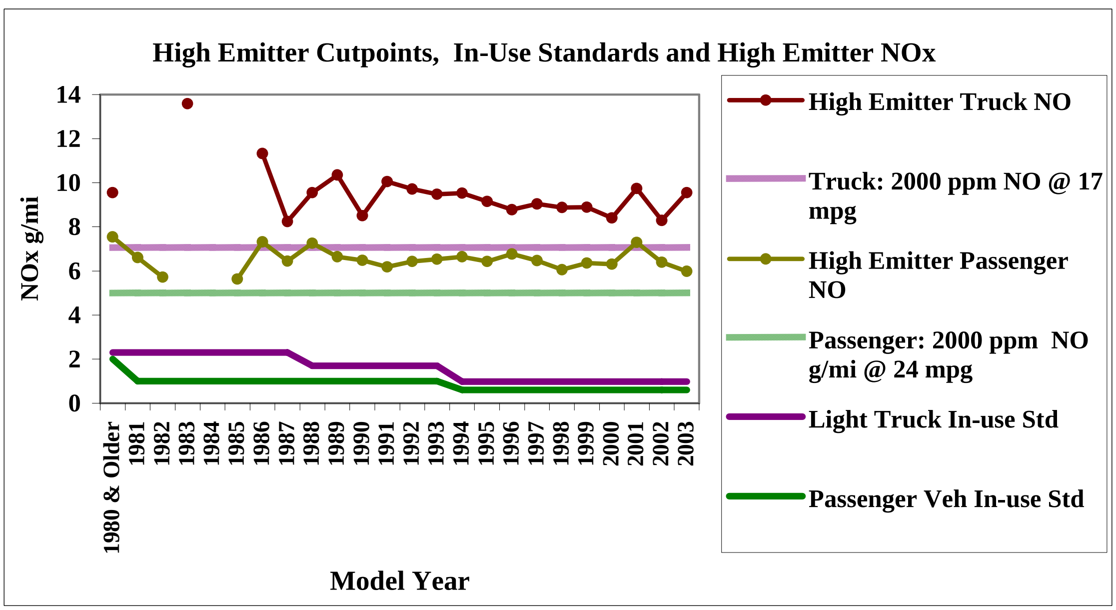


Figure 6-8 High Emitter Cutpoint, In-Use Standards and High Emitter NOx



6.2. High Emitter Rates

The greatest numbers of high emitters were 1988-1999 models (Figure 6-9). Percentages of high emitters varied dramatically by model year, with the oldest models having up to 60% and the newest models having less than 0.1% (Figure 6-10). Fortunately, relatively few of the oldest models remain in operation.

On a positive note, percentages of high emitters among 1996 and newer models remain low – an average of 1.0% vs. 17% for older models. This coincides with the introduction of OBD-II emission control systems. Manufacturers improved component quality considerably to meet OBD-II requirements.

Percentages of high emitters by fuel type are shown in Figure 6-11 for fuel types with more than 500 RSD measurements. Seventeen diesel vehicles out of 700 had NO emissions greater than 2000 ppm. Flexible fueled vehicles were newer with an average model year of 2004.2 compared to 2002.3 for gasoline and 2002.6 for diesel.

Percentages of high emitters by vehicle type are shown in Figure 6-12. T1 trucks are up to 6,000lbs GVWR and T2 trucks are 6,001 to 10,000 lbs GVWR. The lightest category of trucks had a slightly lower percentage of high emitters. Passenger vehicles were older on with an average model year of 2001.8 vs. 2003.0 for both T1 and T2 trucks. The higher rates of NO emitters among T2 trucks compared to T1 trucks could be related to heavier loading.

Passenger vehicles and light trucks with eight cylinder engines were more likely to be high emitters than 4- or 6-cylinder vehicles (Figure 6-13). Six-cylinder engine vehicles had the lowest percentages. 1995 and older 8-cylinder vehicles were slightly older with an average model year of 1992.4 vs. 1992.9 for 4- and 6-cylinder vehicles.

Among gasoline fueled vehicles, the percentage of high emitters appeared to be largely a function age. Odometer readings were not available for analysis.

Figure 6-9: Number of High Emitters by Model Year

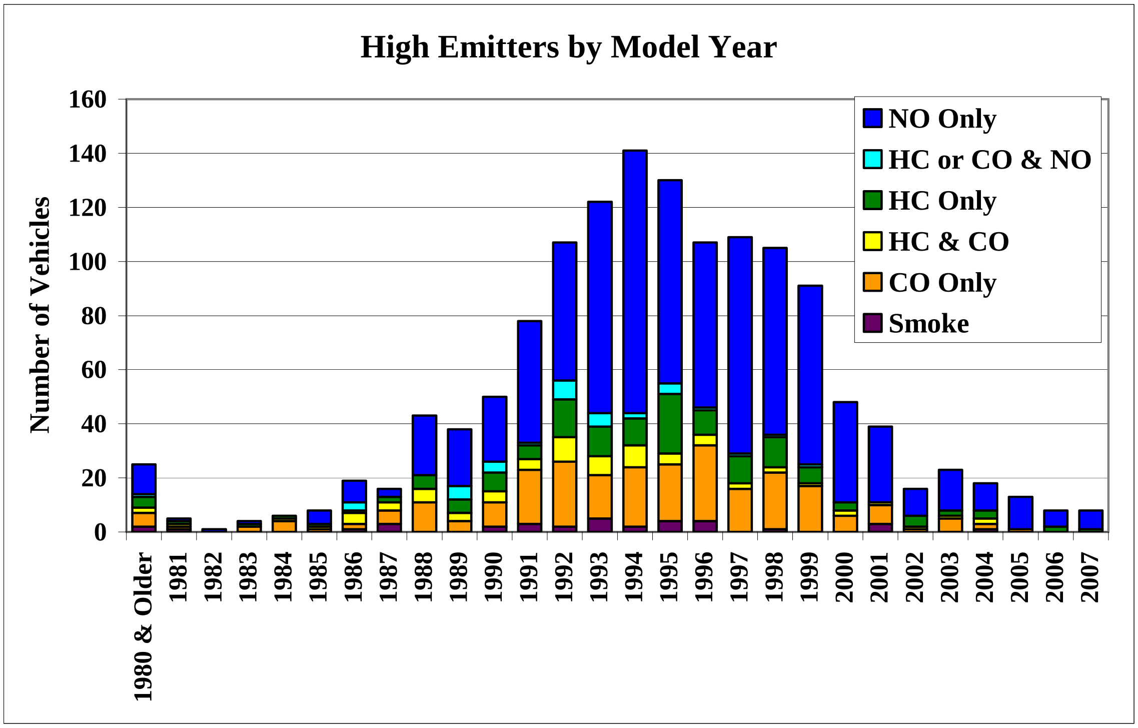


Figure 6-10: Percent of High Emitters by Model Year

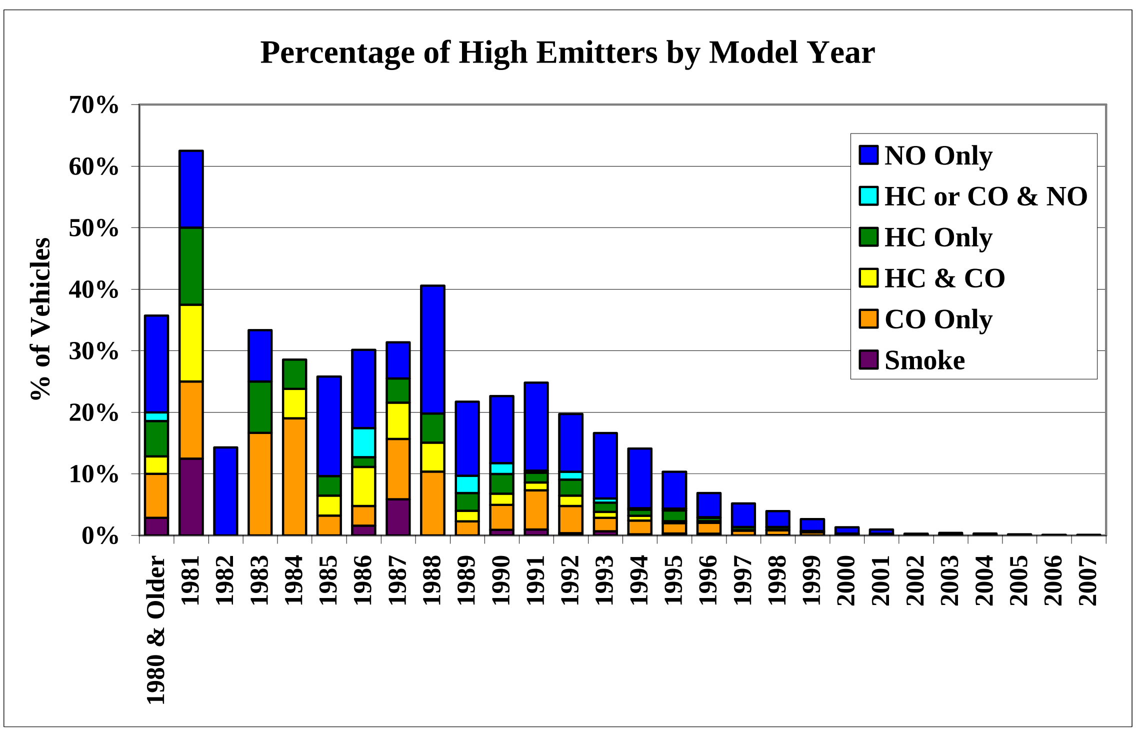


Figure 6-11: High Emitters by Fuel

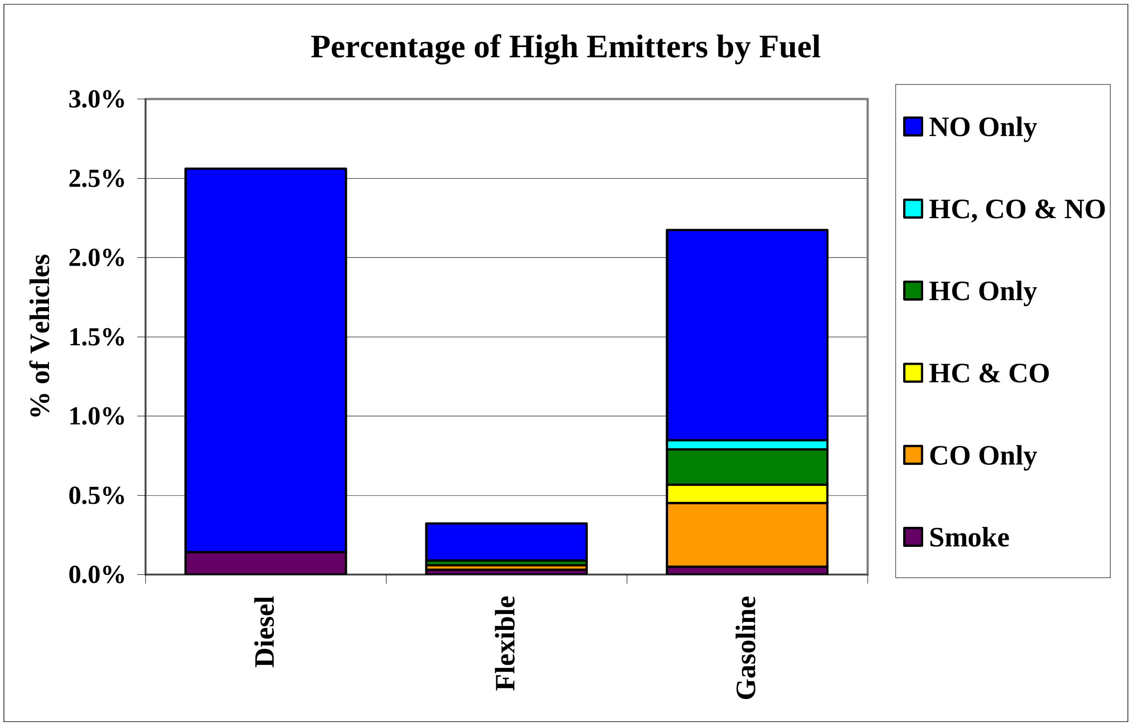


Figure 6-12: High Emitters by Weight Class (1981-2007 models)

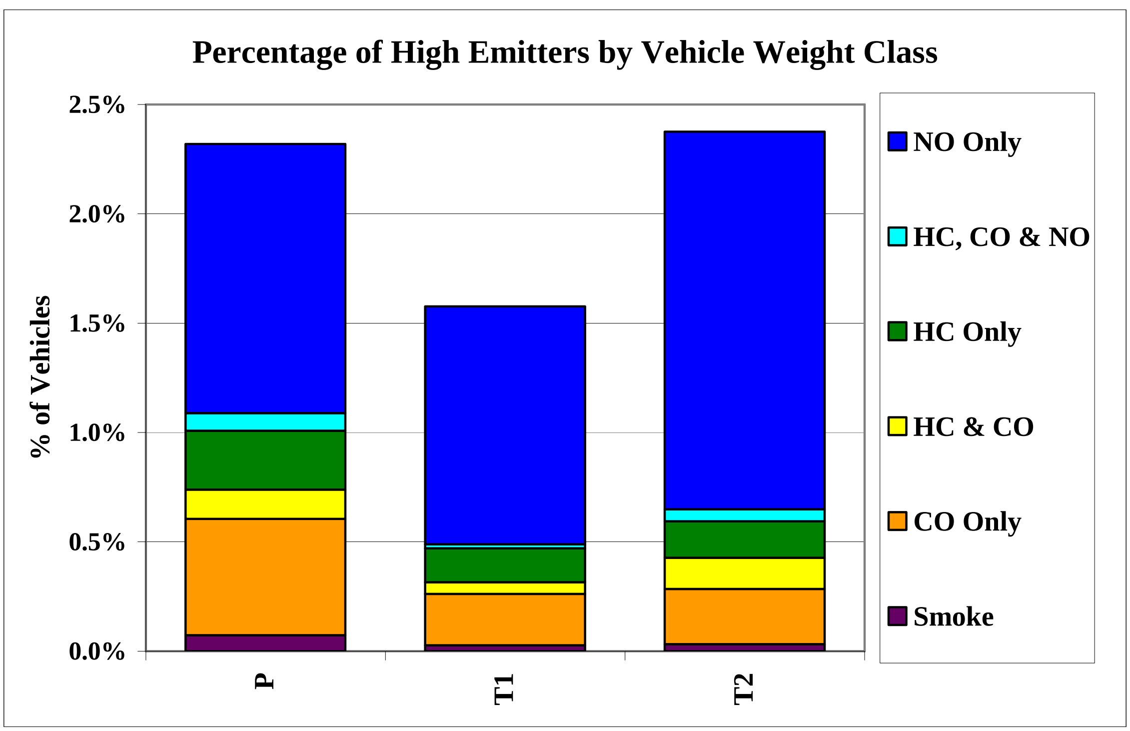
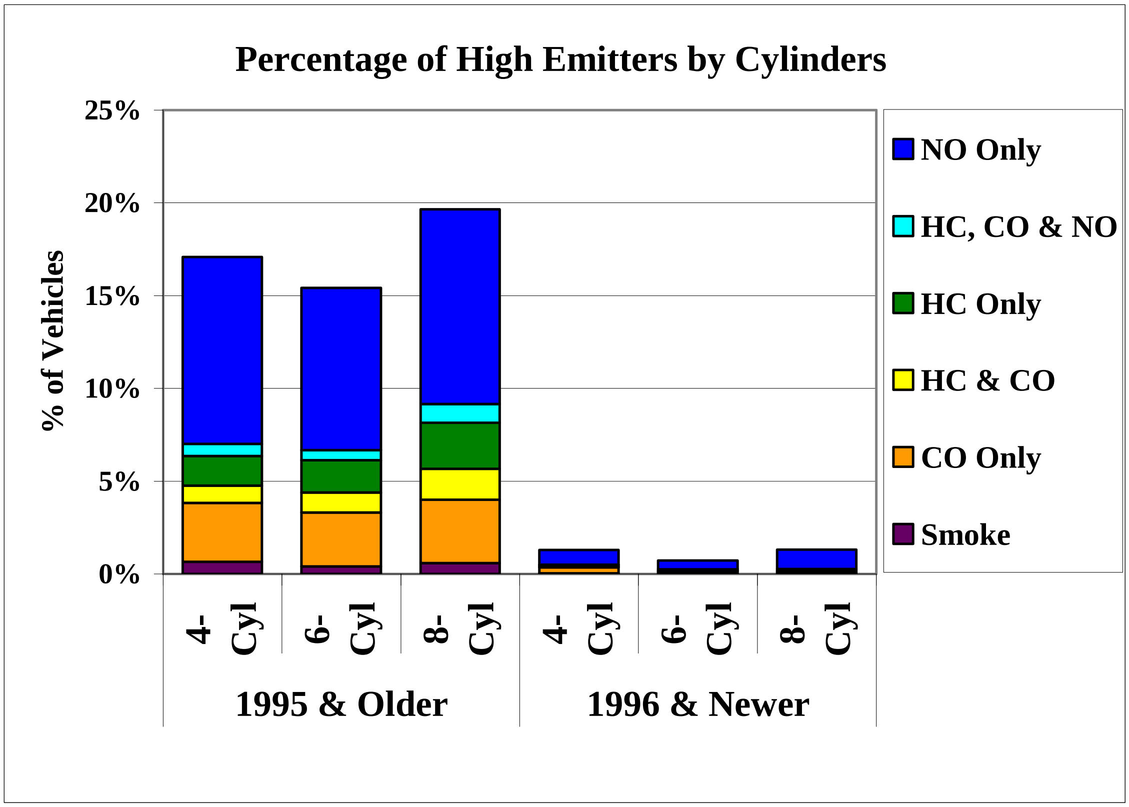


Figure 6-13: High Emitters by Cylinders and Age (1995 & older, 1996 & newer)



7. Comparison with Emissions in Other Regions

Ideally several conditions should be met in order to compare the emissions of vehicles measured in one region with those in another:

- Measurements should be contemporary;
- Made with the same type of equipment
- Under similar operating conditions
- Using similar screening techniques.

ESP operated an ongoing remote sensing program using RSD4000 units in Virginia. Virginia is unique in that remote sensing data was collected in areas subject to an inspection and maintenance program and in areas not subject to the I/M program. The I/M area is in northern Virginia south of Washington DC. The Virginia non-I/M area results included measurements from Fredericksburg, Richmond and Tidewater. Virginia, therefore, provided two points of comparison and the Virginia 2006 remote sensing data had been processed to prepare a 2006 report using similar screening techniques.

ESP performed an RSD survey for Alberta in 2006 and the Alberta survey data was screened using the same techniques. University of Denver also surveyed several cities each year. University of Denver measured vehicles at one site in Chicago in 2006 and made the raw data available. This allowed the same screening techniques to be applied. Therefore, ESP was able to compare the Michigan results to those from Chicago, Virginia and Alberta.

Table 7-1 shows average on-road emissions in these areas. Chicago operated a centralized I/M program in 2006. Michigan had the lowest HC and CO emissions of all the cities and the lowest NO emissions except for Chicago. NO emissions are sensitive to the vehicle operating conditions at the site. It would require further investigation to draw any conclusion from the small difference between the average NO measured in Chicago vs. Michigan.

Table 7-2 compares the number of high emitters where high emitters are defined as HC greater than 500 ppm hexane, CO greater than 3%, NO greater than 2000 ppm or RSD smoke factor greater than 0.75. The fraction of high emitters in Michigan fell between the Virginia I/M area and the Chicago I/M area.

Table 7-3 shows the estimated fraction of total on-road emissions contributed by high emitters. In the Michigan survey these percentages were 27% of HC, 42% of CO and 21% of NOx. The HC and NO high emitter contributions as a percentage of total emissions are higher in Michigan than in the Virginia and Chicago I/M areas and lower than the other non-I/M areas. The CO high emitter contribution in Michigan was similar to the Virginia and Chicago I/M areas.

As subsequent charts illustrate, the frequency of Michigan high emitters by model year was comparable to non-I/M areas. The lower overall frequency of high emitters in Michigan was due to a younger fleet. RSD measured Michigan vehicles averaged 4.7 years old vs. 5.0 in Chicago and 5.7 in Northern Virginia[i].

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[i] Assumes the mid-point of model year sales is one-quarter into the model year.

Table 7-1 Average Emissions

	Alberta VSP 5-20	Virginia Non-I/M	Virginia I/M	Chicago	Michigan
Average HC ppm	48	27	20	20	16
Average CO %	0.18	0.15	0.12	0.12	0.11
Average NO ppm	250	262	208	142	158
UV Smoke RSD	0.027	0.015	0.010	n/a	0.015

Table 7-2 Percentage of Vehicles Observed as High Emitters

	Alberta	Virginia Non-I/M	Virginia I/M	Chicago	Michigan
HC > 500ppm	1.3%	0.7%	0.4%	0.5%	0.4%
CO > 3%	1.2%	0.9%	0.6%	0.3%	0.5%
NO > 2000ppm	2.5%	2.6%	1.6%	0.7%	1.4%
Smoke > 0.75 RSD	0.1%	0.1%	0.1%	n/a	0.1%
Combined	4.6%	3.9%	2.5%	1.4%	2.0%

Table 7-3 High Emitter Contributions to Total On-road Emissions

	Alberta	Virginia Non-I/M	Virginia I/M	Chicago	Michigan
High Emitter % of total HC	31%	30%	20%	12%	27%
High Emitter % of total CO	60%	51%	44%	37%	42%
High Emitter % of total NO	26%	25%	19%	13%	21%
High Emitter % of total Smoke	7%	7%	4%	n/a	3%

Figures 7-1 – 7-4 illustrate the high emitter frequency by model year. The newest models are far more numerous and the newest models have very low rates of high emitters ~ 0.2%. On the other hand, there are few older models on-road and the vehicle sample is small – especially in the Chicago survey, which contained only 830 vehicles 1995 & older. By comparison, the Michigan survey contained 3,900 measurements of 1995 and older models. The other surveys contained a greater quantity of data from these older vehicles. The small quantity of vehicles in the Chicago survey, and the low rates of high emitters, results in large variations in the plotted percentages of high emitters for older years.

Figure 7-1 High Emitter Rates by Year

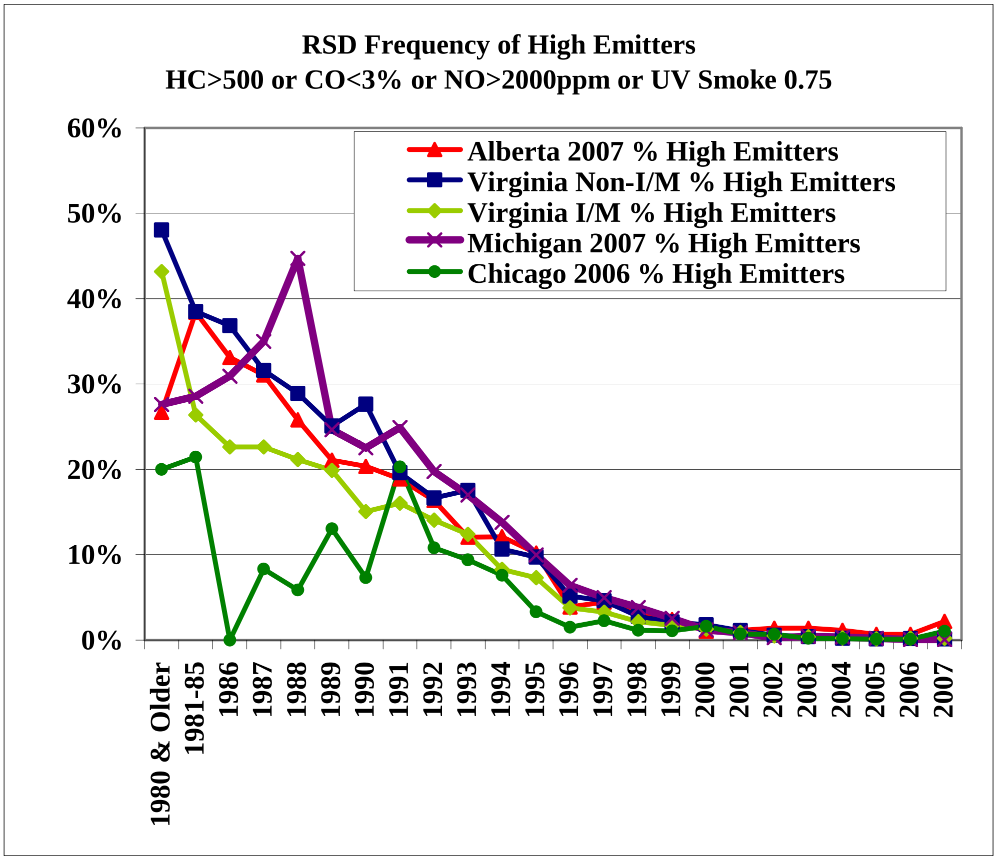


Figure 7-2 HC High Emitter Rates by Year

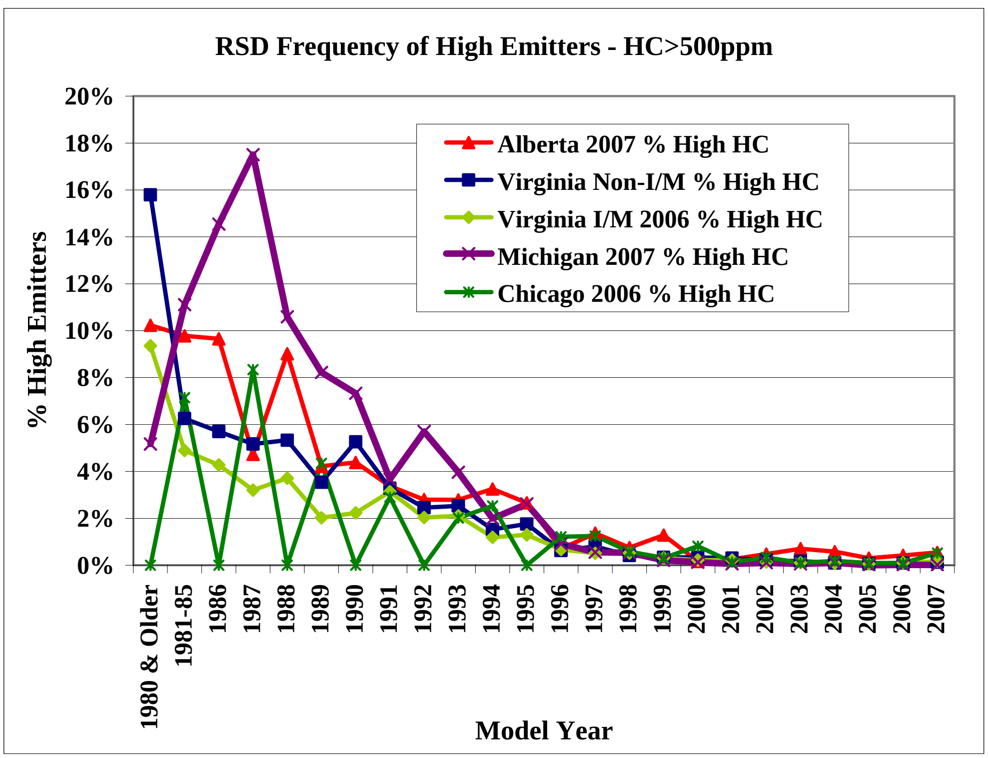


Figure 7-3 CO High Emitter Rates by Year

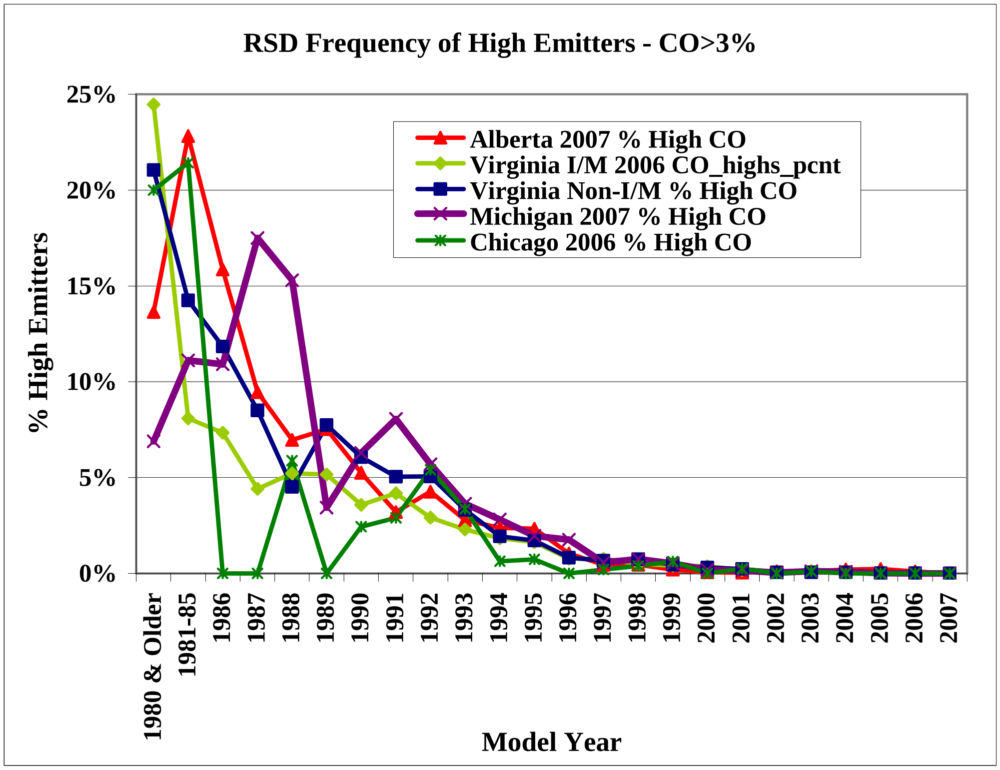
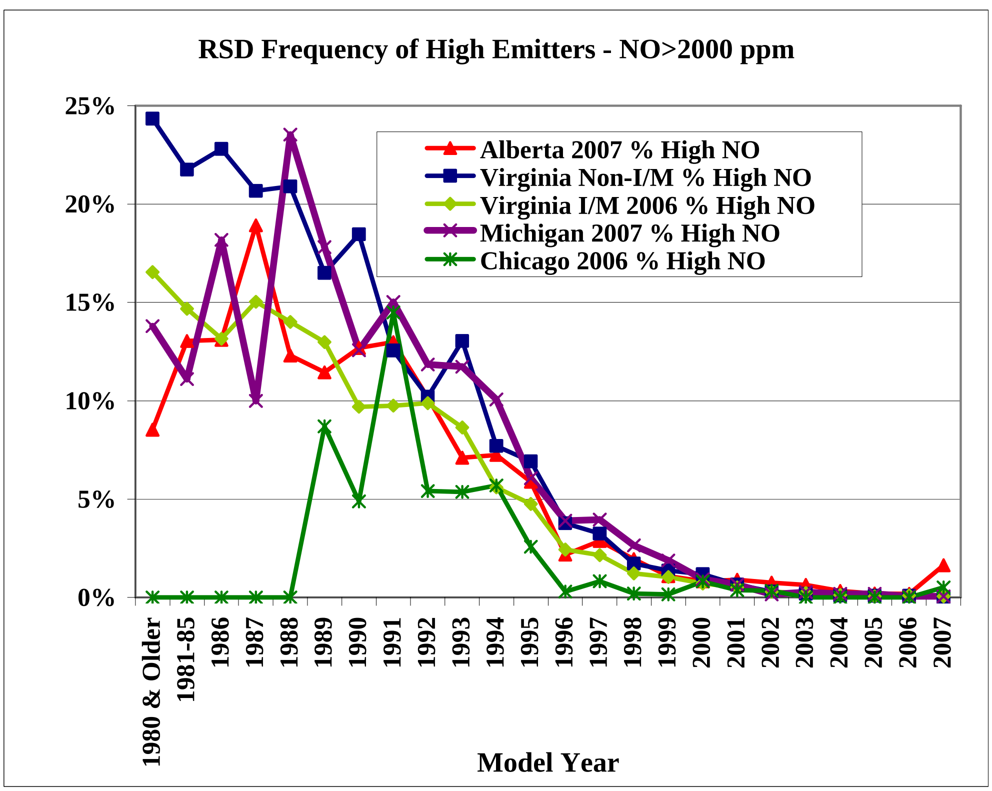


Figure 7-4 NO High Emitter Rates by Year



8. Comparison to Mobile6

On-road RSD measured emission levels were compared to the running exhaust emissions projected in Mobile6.

On-road observed frequencies are used to develop weighted gram per gallon values for RSD. Simple Mobile6 inputs, described below, were used to develop Mobile6 projected gram per gallon values.

The University of Denver developed an inventory for Denver[11] using a slightly different approach based on fuel consumption and remote sensing emissions.

8.1. Mobile6 Model

The Mobile 6.2 model was run to obtain estimates of running exhaust emissions for passenger vehicles and light trucks. Mobile6 gram per mile estimates were multiplied by miles per gallon to obtain grams per gallon.

Mobile6 input values were used to approximate the conditions in Michigan during the RSD survey. These included:

- Min/Max temperatures of 55F and 75F to match morning and afternoon RSD temperatures;
- Absolute humidity of 45 grains per lb to match average RSD conditions[i];
- Conventional fuel;
- 7.8 RVP fuel;
- HC expressed as total hydrocarbon;
- Registration age distribution per SEMCOG (Table 8-1);
- Evaluation month: July 2007.

Mobile6 defaults were used for other parameters, including the facilities network and driving speeds, because the Mobile6 miles per gallon estimates are consistent with these defaults.

Vehicle types 1-7 were included in the Mobile 6 estimates:

1 LDV Light-Duty Vehicles (Passenger Cars)
2 LDT1 Light-Duty Trucks 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW)
3 LDT2 Light Duty Trucks 2 (0-6,001 lbs. GVWR, 3751-5750 lbs. LVW)
4 LDT3 Light Duty Trucks 3 (6,001-8500 lbs. GVWR, 0-3750 lbs. LVW)
5 LDT4 Light Duty Trucks 4 (6,001-8500 lbs. GVWR, 3751-5750 lbs. LVW)

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[i]Absolute humidity is calculated from measured relative humidity and dry bulb temperature.

Absolute humidity in grains of water per pound of dry air = (43.478)*Ra*Pd) / [PB - (Pd*Ra/100)] where Ra is the Relative humidity of the ambient air, percent, Pd is the Saturated vapor pressure, mm Hg, at the ambient dry bulb temperature and PB is barometric pressure, mm Hg.

Saturated vapor pressure Pd =((-4.14438*10^-3) + (5.76645*10^-3 * Td) – (6.32788*10^-5*Td^2) + (2.12294*10^-6 * Td^3) - (7.85415*10^-9 * Td^4) +(6.55263*10^-11 * Td^5)) * 25.4 where Td is the dry bulb temperature in degrees F

6 HDV2B Class 2b Heavy Duty Vehicles (8501-10,000 lbs. GVWR)
7 HDV3 Class 3 Heavy Duty Vehicles (10,001-14,000 lbs. GVWR)

From the RSD measured vehicles, Polk type 'P' were compared to Mobile vehicle type 1 and Polk type 'T' in GVWR weight groups 1 to 3 were compared in aggregate to Mobile vehicle types 2 to 7. GVWR weight classes 1 to 3 are: 1: <6,000lbs, 2: 6-10,000lbs, 3:10-14,000lbs. Therefore, the top end of the group 3 GVWR conveniently aligns with Mobile6 HDV3.

Heavier weight classes were not included because the RSD results do not include a full sample. The review of unread plates, described earlier, suggests that some of the HDV3B and HDV3 trucks may also be under represented in the RSD sample.

Table 8-1 Age Distribution of SEMCOG Area Fleet by Vehicle Class

Vehicle Age (Years)	Vehicle Class							
	Light Duty Vehicle	Light Duty Truck 1	Light Duty Truck 2	Light Duty Truck 3	Light Duty Truck 4	Heavy Duty Truck	Heavy Duty Bus	Motorcycle
1	9.2%	12.7%	15.6%	13.3%	13.8%	3.1%	2.9%	1.7%
2	12.3%	16.9%	20.8%	17.7%	18.3%	8.2%	7.8%	9.8%
3	12.6%	17.4%	21.5%	18.2%	18.9%	6.8%	6.5%	8.8%
4	8.7%	4.2%	11.1%	9.4%	12.6%	7.7%	7.4%	7.1%
5	4.4%	2.1%	5.0%	3.8%	5.7%	6.5%	6.2%	7.2%
6	4.5%	1.6%	4.6%	5.0%	7.6%	8.2%	9.7%	6.3%
7	3.6%	1.7%	3.7%	2.6%	4.3%	6.2%	6.9%	5.2%
8	3.5%	1.2%	2.8%	2.3%	3.5%	4.7%	5.9%	4.0%
9	3.4%	2.1%	2.3%	2.3%	2.6%	3.7%	4.4%	2.7%
10	4.2%	2.6%	2.2%	3.0%	2.5%	3.6%	4.6%	2.0%
11	4.0%	3.9%	2.1%	3.0%	2.9%	4.2%	5.1%	2.0%
12	4.1%	3.6%	2.0%	2.5%	0.9%	4.8%	5.3%	43.2%
13	3.9%	2.9%	1.6%	2.3%	1.2%	4.5%	4.8%	0.0%
14	3.7%	4.4%	1.1%	1.8%	0.4%	4.1%	4.6%	0.0%
15	3.5%	3.9%	0.8%	2.1%	0.7%	3.8%	4.2%	0.0%
16	3.4%	4.3%	0.8%	2.3%	0.5%	3.1%	3.4%	0.0%
17	2.7%	3.2%	0.8%	1.8%	0.5%	2.6%	2.8%	0.0%
18	1.9%	3.5%	0.2%	1.4%	0.4%	1.4%	1.3%	0.0%
19	1.7%	2.8%	0.3%	1.3%	0.7%	1.0%	1.1%	0.0%
20	1.3%	2.0%	0.2%	1.0%	0.6%	1.0%	1.0%	0.0%
21	0.9%	1.2%	0.2%	0.8%	0.3%	1.0%	0.7%	0.0%
22	0.5%	0.5%	0.1%	0.4%	0.2%	1.8%	0.8%	0.0%
23	0.3%	0.4%	0.1%	0.2%	0.1%	1.7%	0.7%	0.0%
24	0.3%	0.3%	0.0%	0.1%	0.0%	1.4%	0.5%	0.0%
25+	1.5%	0.8%	0.2%	1.7%	1.3%	4.9%	1.5%	0.0%

Source:

Light-Duty: 2004 vehicle registration records for the SEMCOG area from the Michigan Department of Motor Vehicles. Compiled by the Lake Michigan Air Directors Consortium (LADCO), June 2004.

Heavy-Duty: National heavy-duty vehicle distribution, based on EPA publication *Fleet Characterization Data for MOBILE6* , September 2001.

Mobile6 Database output was used to obtain emissions results by model year for running exhaust emissions. NB: cold start emissions and evaporative emissions are not considered.

8.2. VMT Comparison

Mobile6 assumes that new model vehicles are driven more miles annually than older models[12]. These assumptions combined with the age distribution in Table 8-1 create the skewed distributions of estimated VMT shown in Figures 8-1 and 8-2. The M6 VMT and RSD observations have been normalized to the SEMCOG estimate of 148.69 million miles per day and 148.69 million observations respectively across passenger vehicles and trucks combined. It is expected that the frequency of RSD observations is proportional to VMT. Figures 8-1 and 8-2 suggest that the combination of the age distribution and the Mobile6 mileage assumptions overestimate VMT of the newest models.

Figure 8.3 shows that on-road observations are more evenly balanced between passenger vehicles and trucks than the Mobile6 VMT. RSD observations split 46:54 for passenger vehicles and trucks compared to a 40:60 split projected by Mobile6.

The age distribution used with Mobile6 is three years old. Irregularities in annual vehicle sales may have caused the model distribution to be out of step with the fleet active in 2007. More recent DOS registration statistics could be reviewed to verify the split between passenger vehicles and trucks and their age distributions.

Figure 8-1 Passenger Vehicle VMT

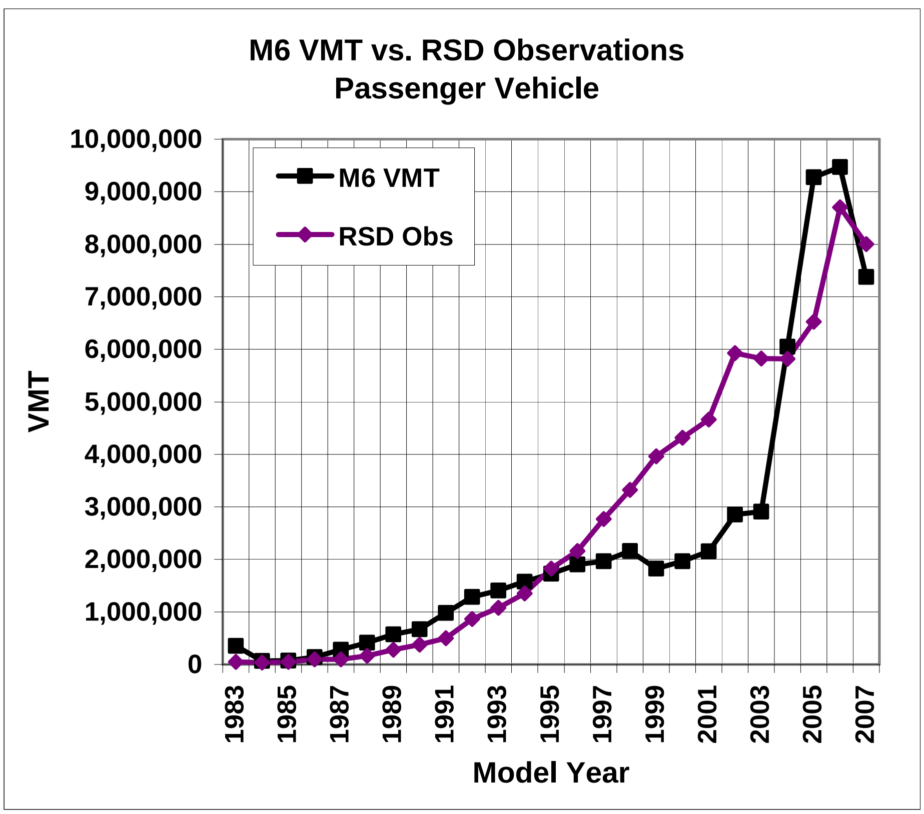


Figure 8-2 Truck VMT

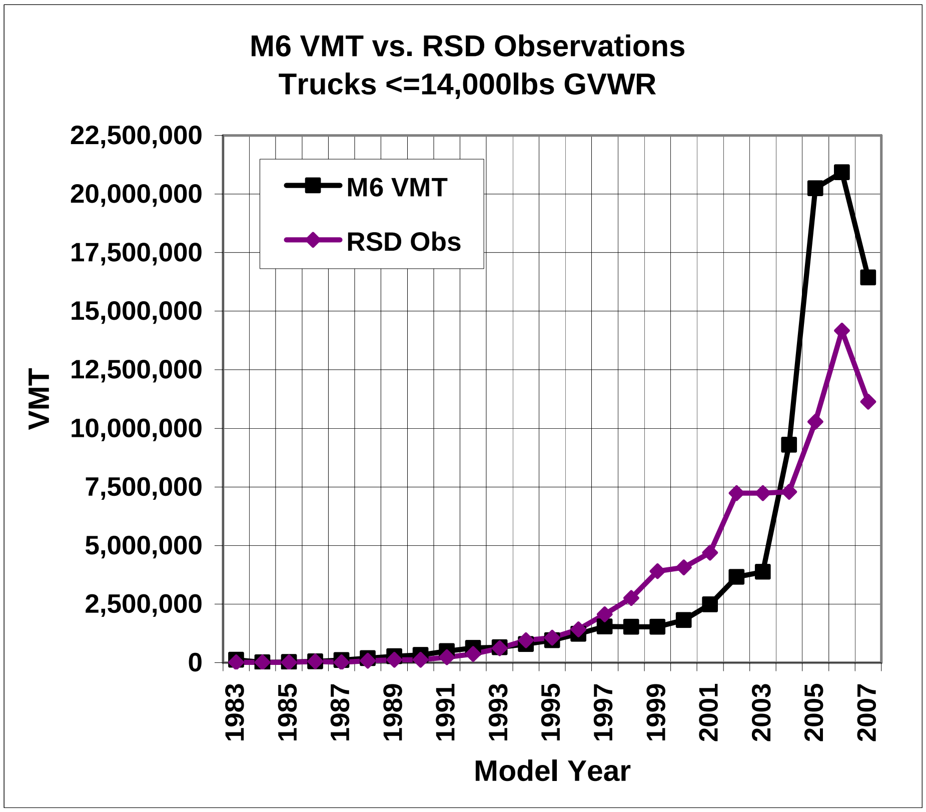
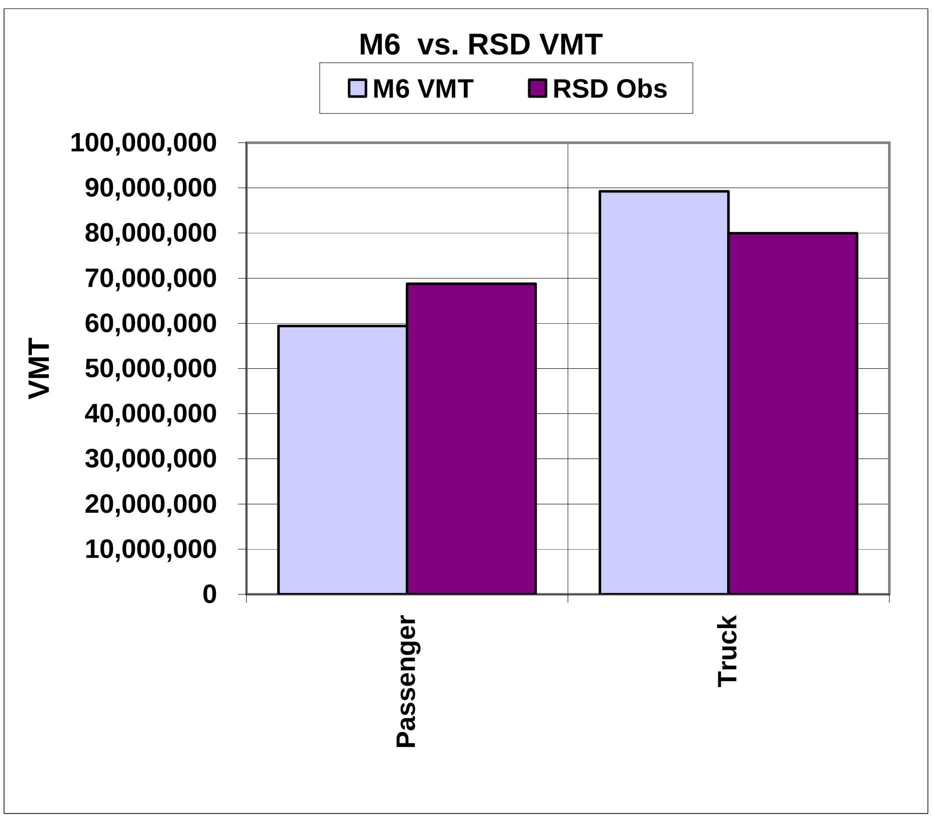


Figure 8-3 Passenger Vehicle vs. Truck VMT



8.3. ***Grams per Gallon Comparison***

Figures 8-4 through 8-9 compare RSD grams per gallon to Mobile6 estimates by model year. RSD samples of 1990 and older models are relatively small and the emissions averages can be significantly influenced by the presence or absence of a small number of dirty vehicles.

Mobile6 estimates represent a mixture of driving conditions. The RSD measurements used in this analysis from vehicles driving past RSD units at on-ramps are in a moderate acceleration mode (VSP 5-22 kw/t) that is something of a sweet spot (low emissions) for HC and CO and may be a little high for NOx. Therefore, RSD grams per gallon emissions are lower for HC and CO, and higher for NO, than average vehicle emissions would be over the full range of daily driving activities simulated in Mobile6. A previous study of Missouri measurements[13] estimated that RSD emissions should be increased by 10% and 6% for HC and CO, respectively, and decreased by 12% for NOx. These driving cycle adjustment factors have been applied to the RSD values for the comparison to Mobile6.

On-road passenger car and truck HC emissions are higher than Mobile6 estimates for 1995 and older models, and lower for 1998 and newer models (Figure 8-4 and 8-5). The same is generally true for NOx (Figures 8-8 and 8-9). On-road CO emissions are substantially lower than Mobile6 estimates for a majority of model years.

Figure 8-4 RSD and Mobile6 Passenger Vehicle HC grams per gallon

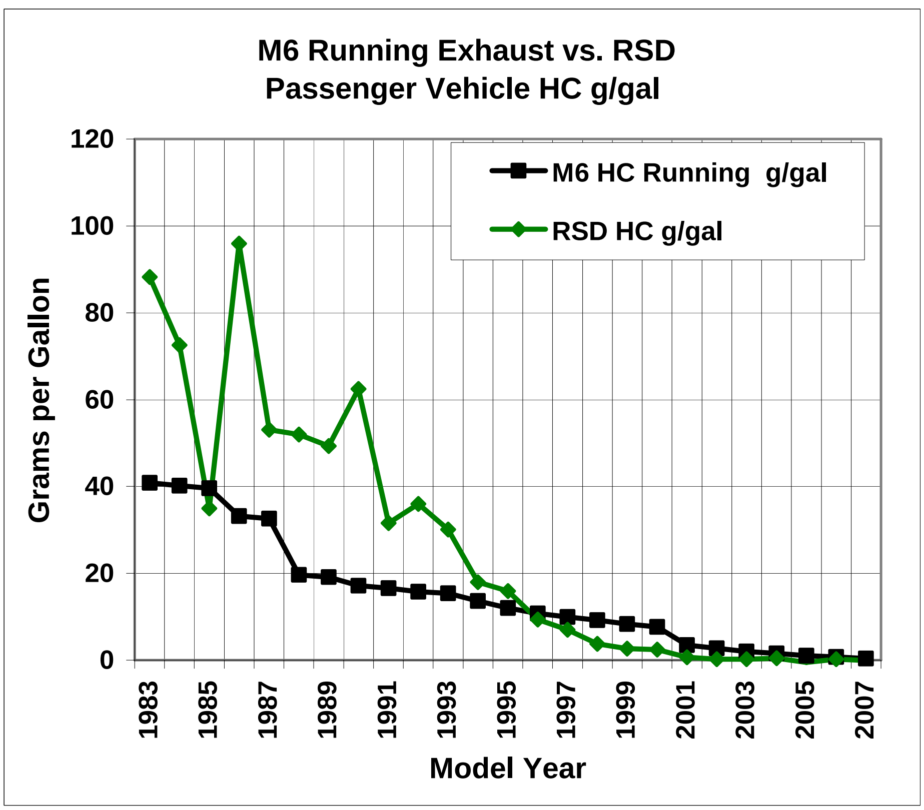


Figure 8-5 RSD and Mobile6 Truck HC grams per gallon

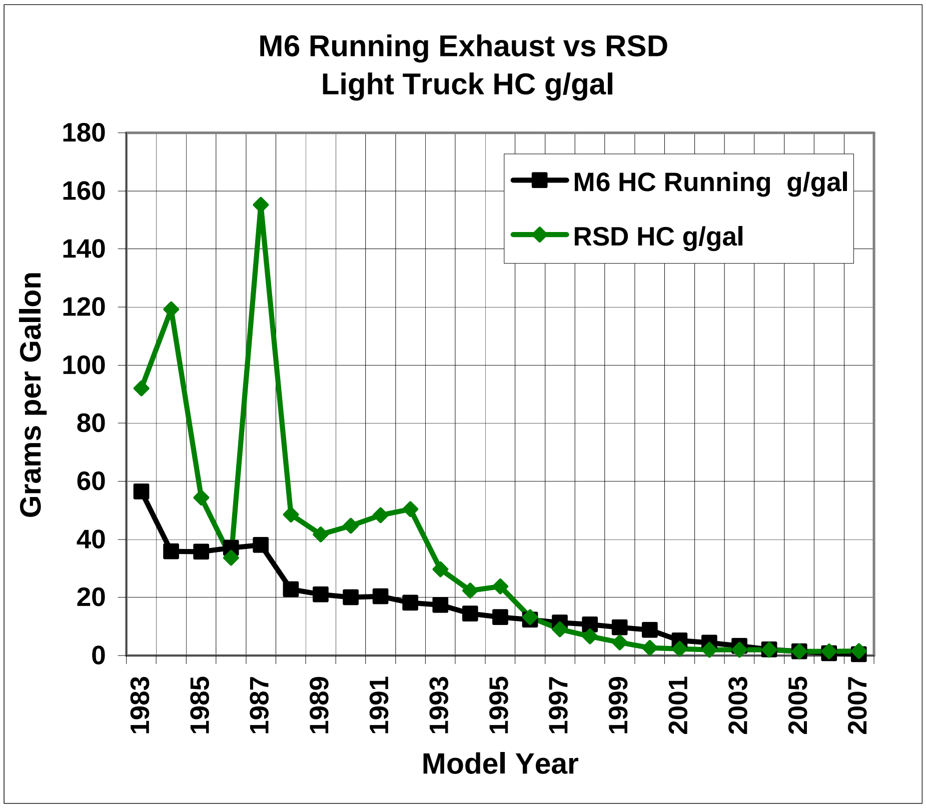


Figure 8-6 RSD and Mobile6 Passenger Vehicle CO grams per gallon

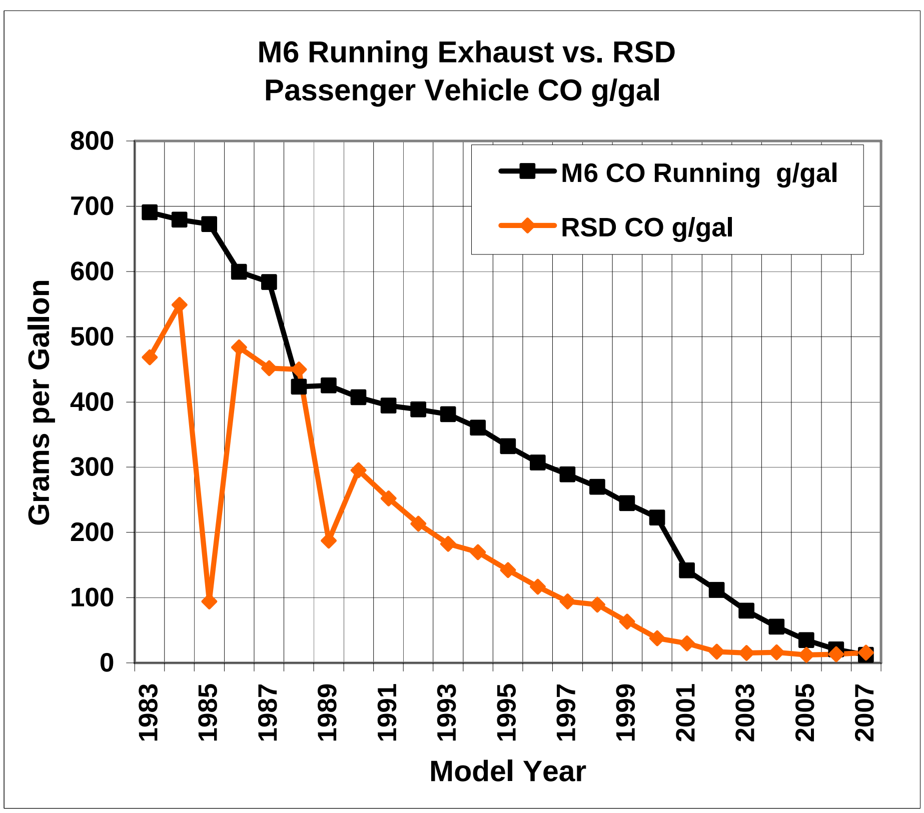


Figure 8-7 RSD and Mobile6 Truck CO grams per gallon

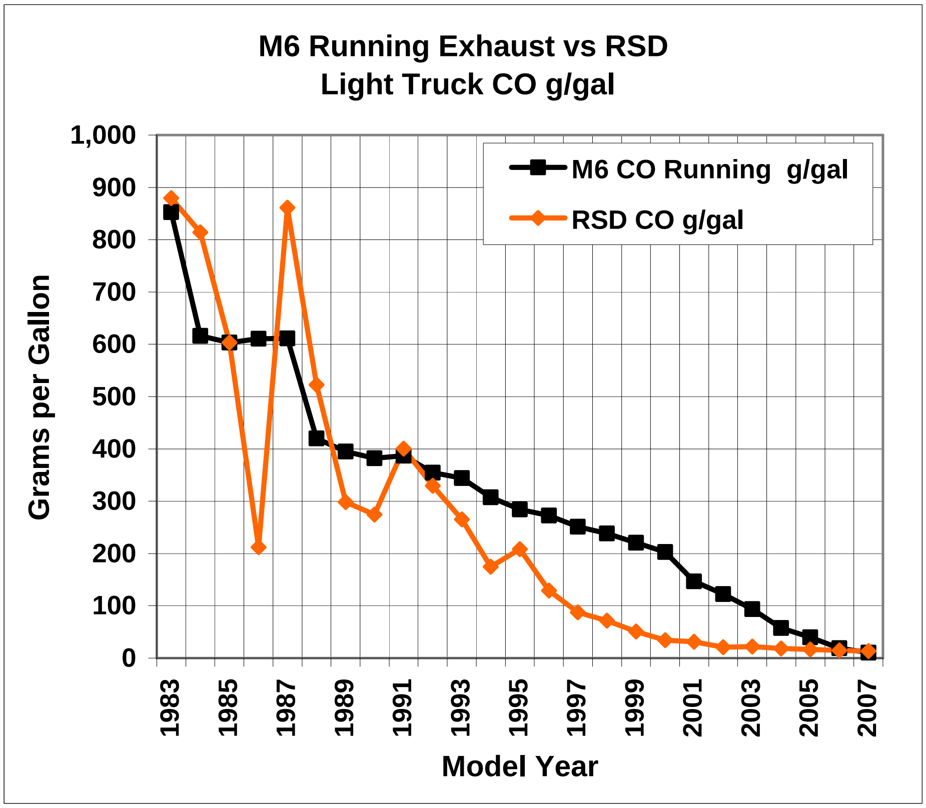


Figure 8-8 RSD and Mobile6 Passenger Vehicle NOx grams per gallon

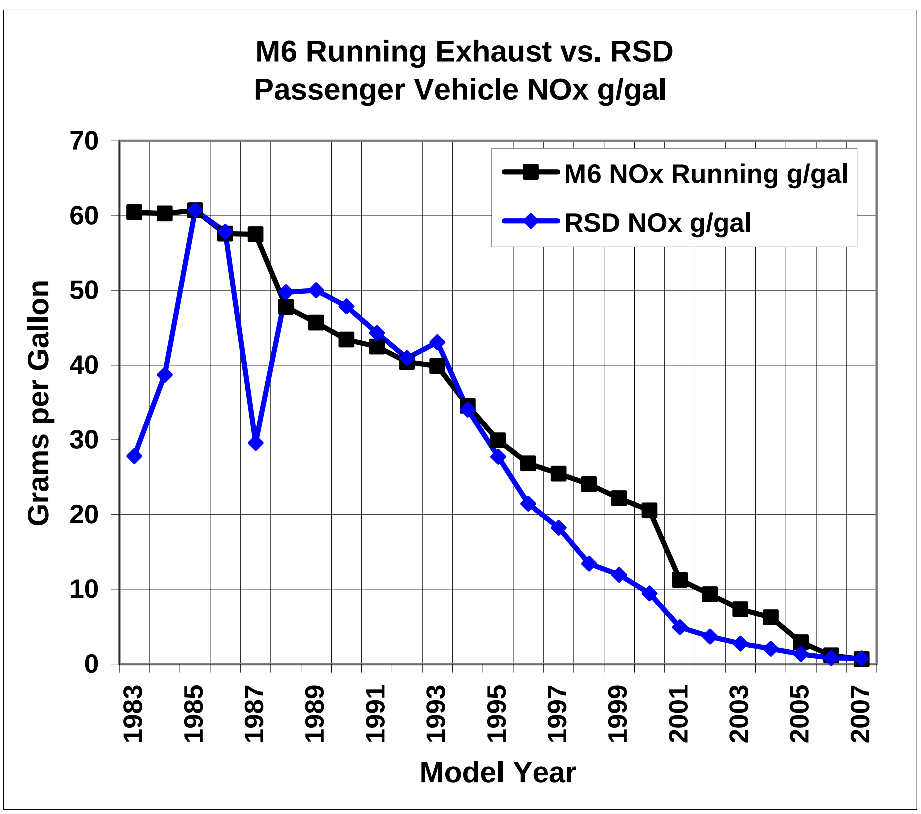
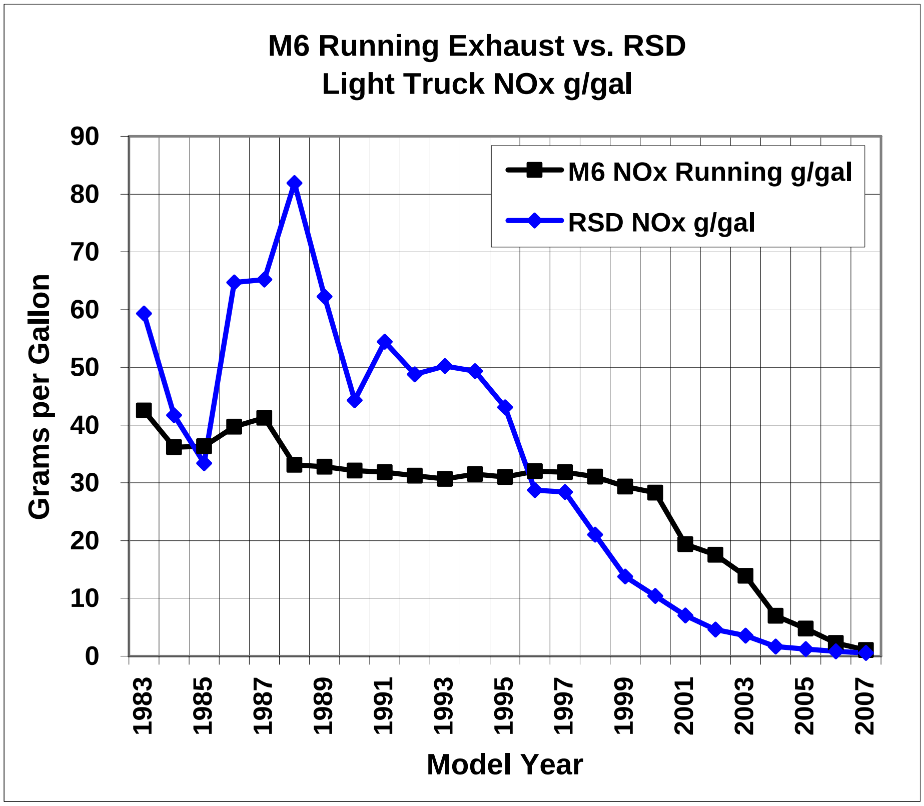


Figure 8-9 RSD and Mobile6 Truck NOx grams per gallon



8.4. <u>Mass Emissions Comparison</u>

To compare mass emissions, Mobile6 VMT and RSD observations were normalized to represent a fleet total estimate of 148.69 million miles per day. Mobile6 miles per gallon fuel economies were used to calculate gallons of fuel (VMT weighted fuel economies for passenger vehicles and trucks were 24.1 and 17.4 mpg respectively with modest variations by model year). The Mobile6 grams per gallon and the RSD grams per gallon results were multiplied by gallons of fuel to obtain the respective estimates of mass emissions:

$$\text{Emissions tons}_{MY} = (\text{VMT}_{MY} / \text{MPG}_{MY}) \times (\text{Grams per gallon}_{MY}/1000) \times (2.205/2000)$$

Figures 8-10 to 8-15 show the RSD and Mobile6 estimated short tons per day of criteria pollutant emissions. The on-road HC emissions are higher for 1989-1997 passenger vehicles and 1991-1999 trucks than Mobile6 estimates. Newer passenger cars have lower on-road HC emissions than Mobile6 projects. On-road CO emissions are lower than Mobile6 projections for both types of vehicle across all years. On-road and Mobile6 NOx emissions are similar for passenger vehicles. On-road NOx emissions are higher for 1993-1999 trucks than Mobile6 estimates and lower for newer trucks.

Figure 8-10 RSD and Mobile6 Passenger HC Tons per Day

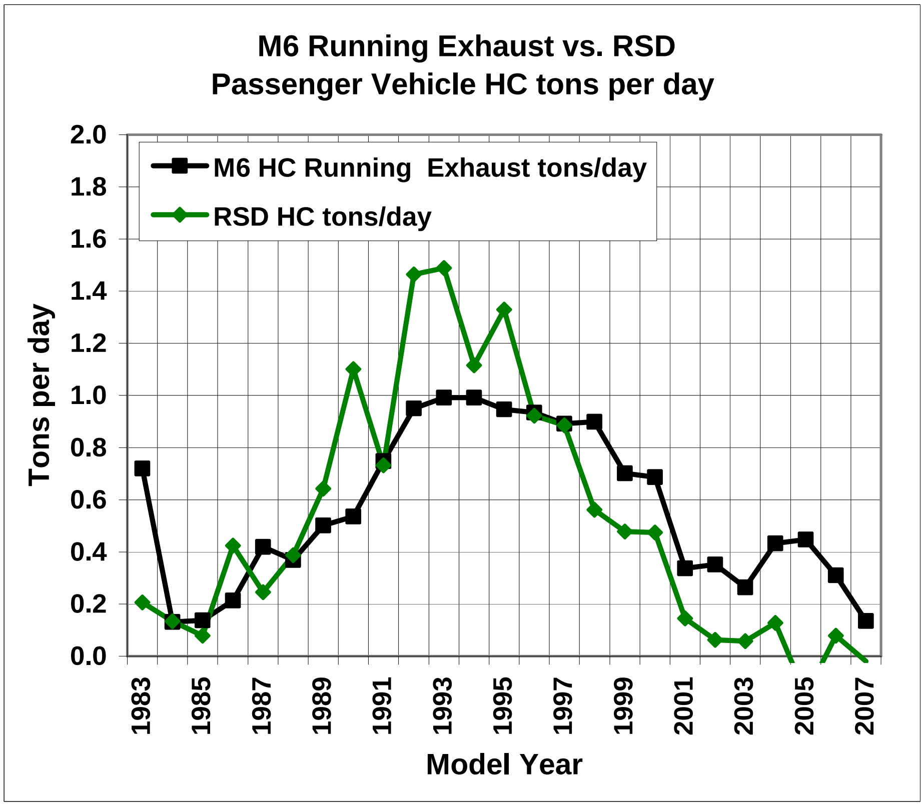


Figure 8-11 RSD and Mobile6 Truck HC kg Tons per Day

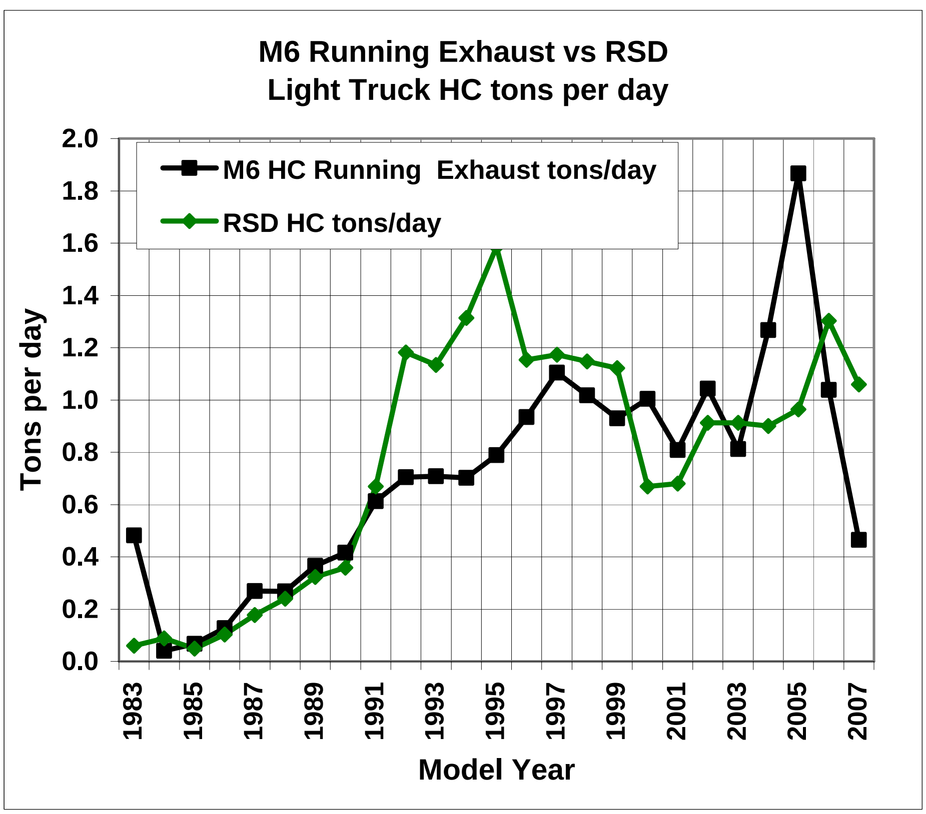


Figure 8-12 RSD and Mobile6 Passenger CO Tons Per Day

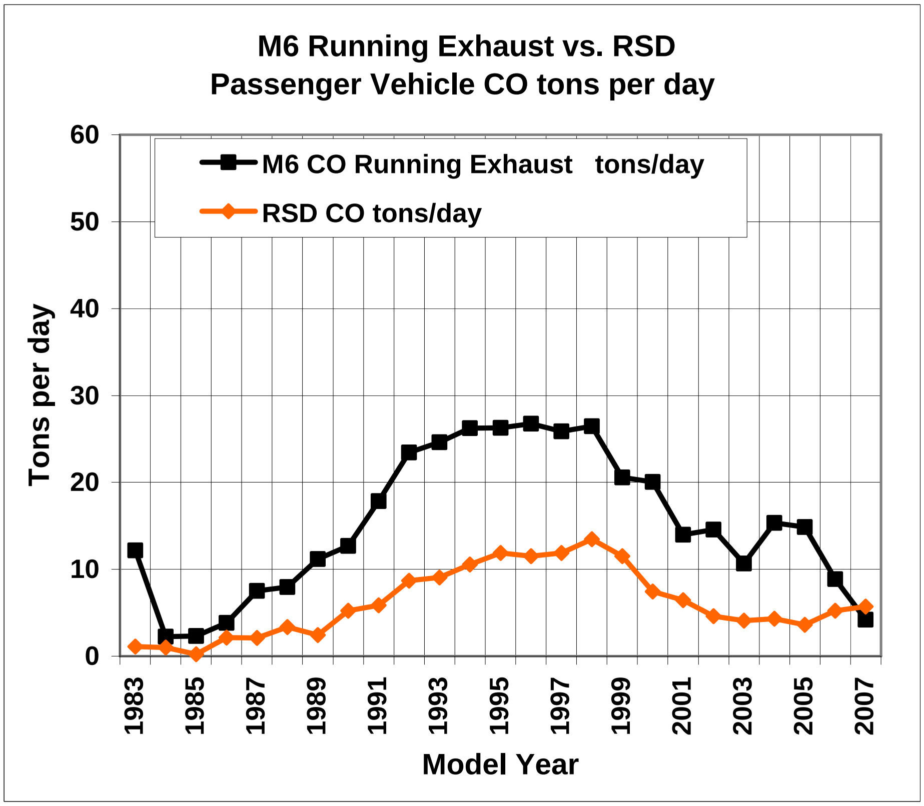


Figure 8-13 RSD and Mobile6 Truck CO Tons per Day

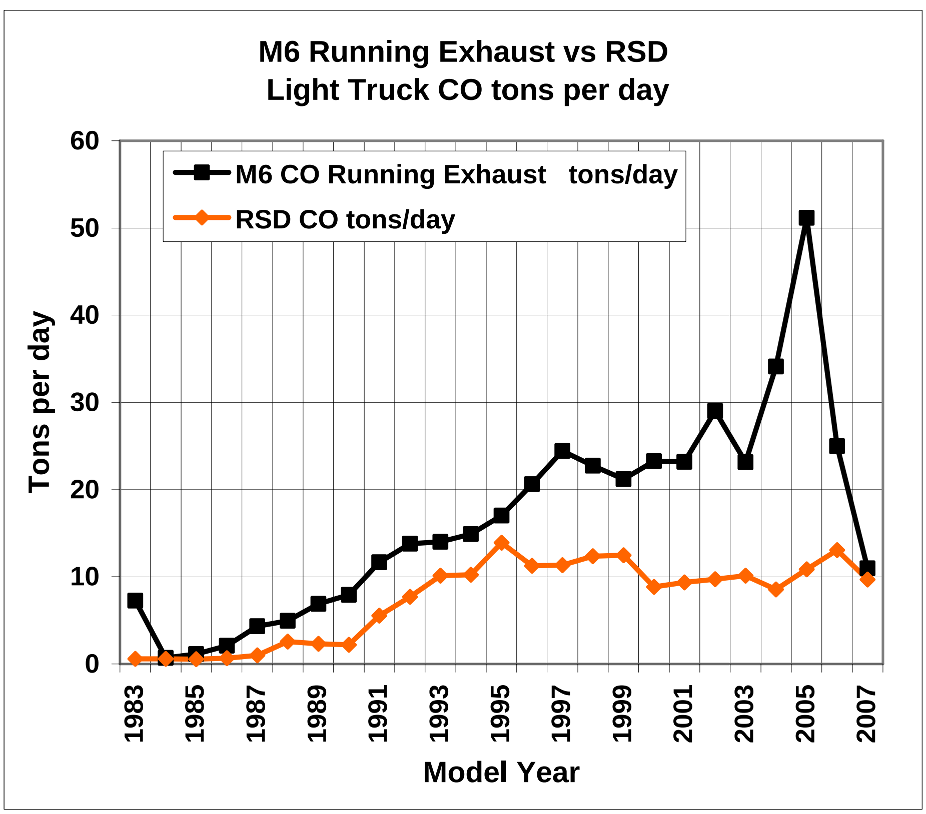


Figure 8-14 RSD and Mobile6 Passenger NOx Tons per Day

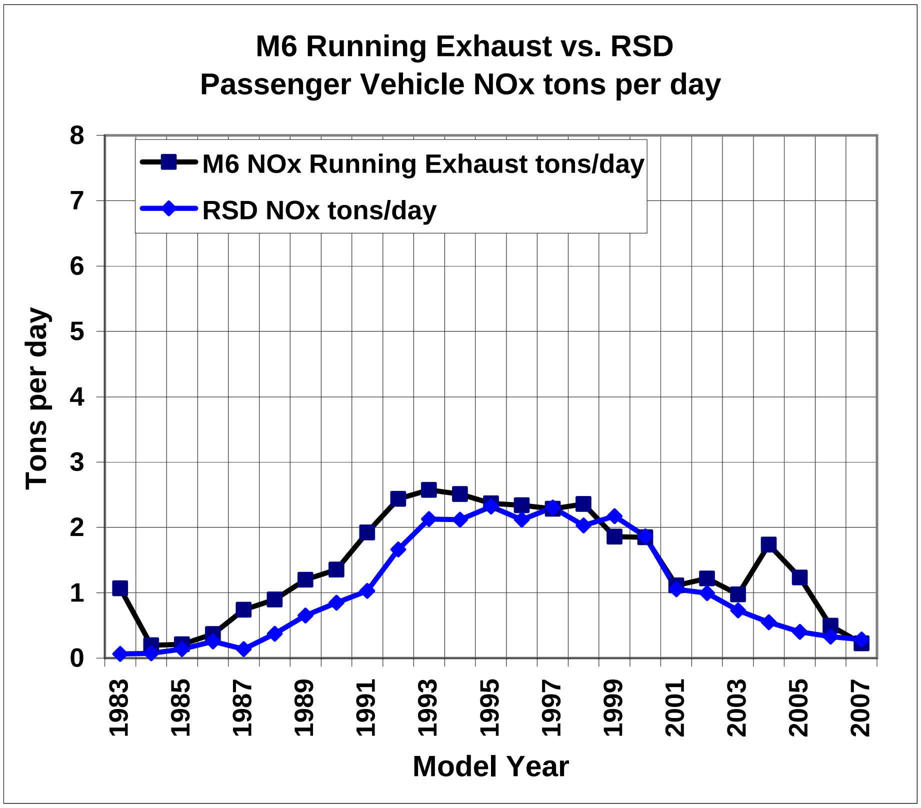


Figure 8-15 RSD and Mobile6 Truck NOx Tons per Day

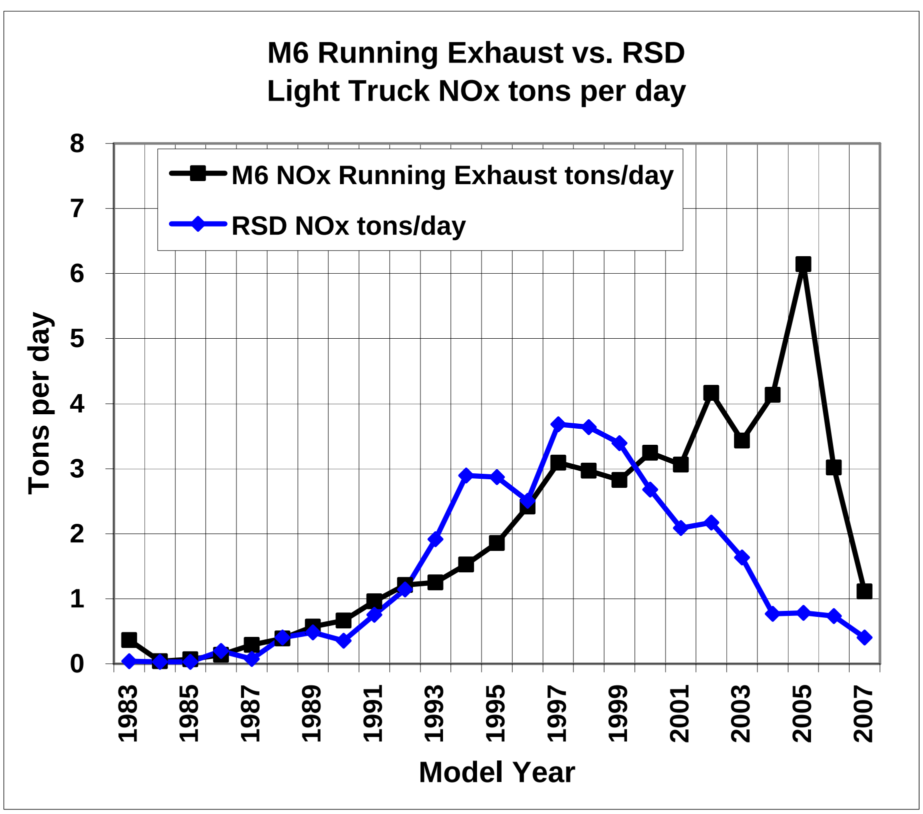


Table 8-2 summarizes variances between on-road emissions and Mobile6 projections for combinations of passenger vehicles, trucks, 1995 and older models and 1996 and newer models. Results are:

- Mobile6 projects lower HC in aggregate by 1%. This is a combination of a 21% lower estimate of 1995 & older vehicle HC and a 20% higher estimate of 1996 & newer vehicle HC.

- Mobile6 projects more than 100% higher CO emissions.

- Mobile6 projects 36% higher NOx. The higher estimates are greatest for 1996 and newer trucks (62%) and 1995 and older passenger vehicles (51%). Mobile6 projects lower emissions from 1996 and older trucks (-17%).

These results are illustrated in Figures 8-16 to 8-18.

Table 8-2 RSD and Mobile6 Variances

		VMT '000			HC tons/day			CO tons/day			NO tons/day		
		RSD	**M6**	**Var %**	**RSD**	**M6**	**Var %**	**RSD**	**M6**	**Var %**	**RSD**	**M6**	**Var %**
1995 & Older	Pass	6,767	9,528	41%	9.3	7.7	-18%	64	178	180%	11.8	17.8	51%
	Truck	3,665	4,648	27%	7.3	5.6	-24%	58	107	84%	11.2	9.3	-17%
1996 & Newer	Pass	61,992	49,926	-19%	3.6	6.4	76%	90	202	125%	14.8	17.7	19%
	Truck	76,266	84,589	11%	12.0	12.3	2%	128	309	142%	24.5	39.6	62%
Total		148,690	148,690		32.2	31.9	-1%	339	796	135%	62.3	84.5	36%
1995 & Older		10,432	14,176	36%	16.6	13.2	-21%	122	285	134%	23.0	27.2	18%
19996 & Newer		138,258	134,514	-3%	15.6	18.7	20%	217	511	135%	39.3	57.3	46%
Total		148,690	148,690		32.2	31.9	-1%	339	796	135%	62.3	84.5	36%
Pass		68,759	59,453	-14%	13.0	14.0	8%	153	380	148%	26.6	35.5	34%
Truck		79,931	89,237	12%	19.3	17.8	-7%	186	415	124%	35.7	48.9	37%
Total		148,690	148,690		32.2	31.9	-1%	339	796	135%	62.3	84.5	36%

Figure 8-16 RSD and Mobile6 HC Tons per Day

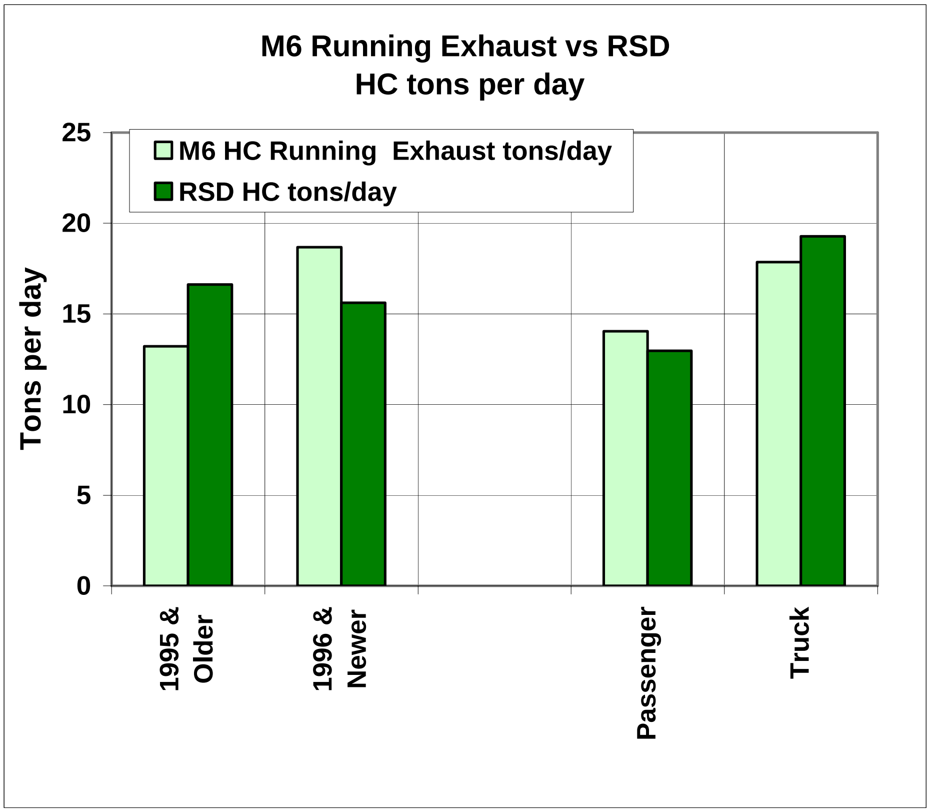


Figure 8-17 RSD and Mobile6 CO Tons per Day

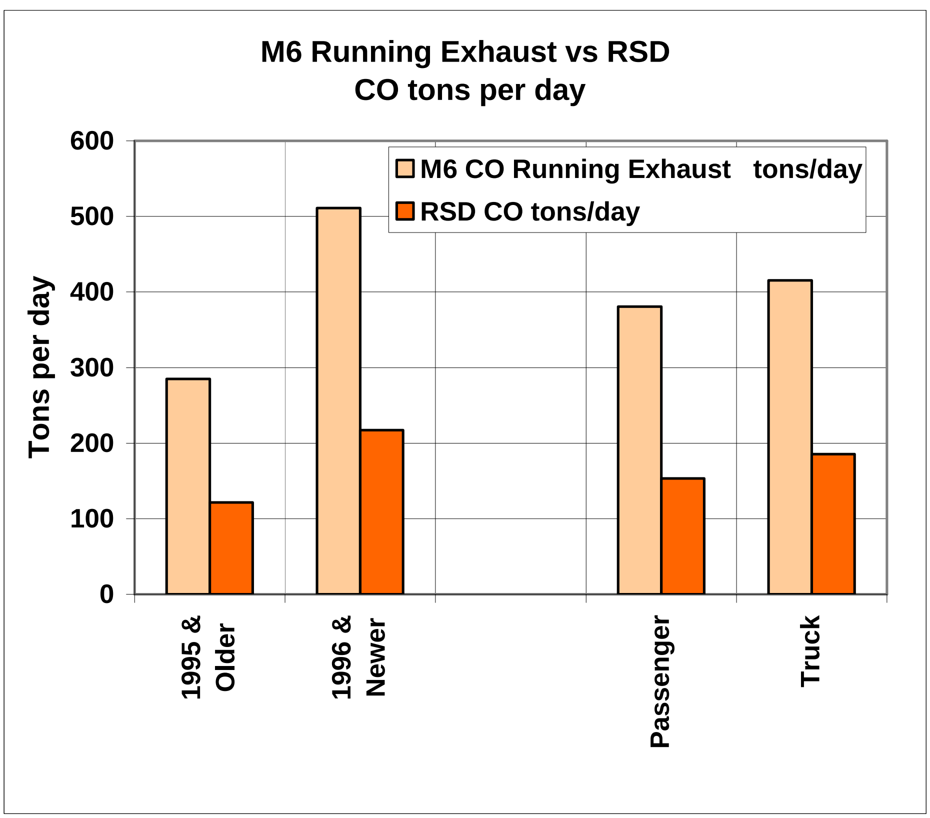
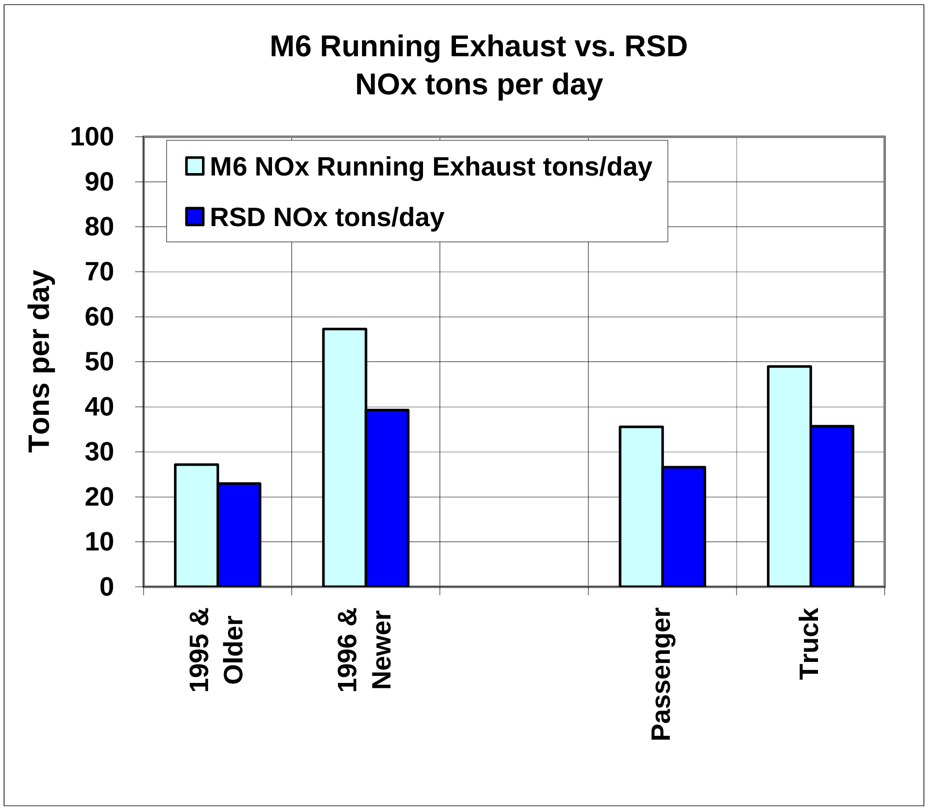


Figure 8-18 RSD and Mobile6 NOx Tons per Day



9. FINDINGS and CONCLUSIONS

Findings:

General Characteristics of the Fleet

- Approximately 2% of the light-duty vehicles operating in Southeast Michigan are very high emitters. Of the 65,526 vehicles sampled, 1,373 (2.1%) exceeded pollutant cutpoints for HC, CO, NO or smoke that are several times higher than in-use vehicle standards.
- The worst 10% of the vehicles emitted about 70% of the exhaust HC, CO and NOx.
- 1995 and older vehicles comprised 7% of the vehicles measured but emitted 52%, 36% and 37% of HC, CO and NO respectively.
- 20-30% of 1988 and older models were high emitters of HC or CO. In contrast, the rate for new models (2002 to 2007) averaged just 0.13% (i.e. one out of every 750 vehicles).
- The percentage of middle-aged vehicles (1992-1999) that were high emitters was lower than that of older vehicles. But, there are a large number of vehicles in this age range.
- 10% of vehicles that were a high emitter of one pollutant were also a high emitter of at least one other pollutant.
- Diesel vehicles had higher rates of smokers and high NO emitters than gasoline vehicles. Heavier vehicles also had greater rates of high emitters. These vehicles have less stringent emissions control standards.

Southeast Michigan compared to other areas

- On-road emissions of the light-duty vehicle fleet in Southeast Michigan are lower than those in several other areas where remote sensing has been done. This includes Alberta, Canada and Virginia, including the area of northern Virginia that has a mandatory vehicle inspection and maintenance (I/M) program.
- These lower emissions are due to the higher number of newer vehicles in Southeast Michigan. When compared by model year, the rate of high emitters in Michigan is similar to Alberta and the non-I/M areas of Virginia, and higher than the northern Virginia area with I/M.

Remote sensing data in comparison to EPA’s Mobile6 model

- There are some significant differences in the emission rates measured by remote sensing compared to those generated by EPA’s Mobile6 model.
    - o The most dramatic difference is in carbon monoxide emissions. Mobile6 CO emissions are more than 100% higher than those measured through the remote sensing.

- For hydrocarbons, Mobile6 projects 21% lower hot running exhaust emissions for 1995 & older vehicles, but 20% higher for 1996 and newer vehicles.
- For oxides of nitrogen, Mobile6 projects 36% higher emissions than were measured. The difference is greatest for 1996 and newer trucks (+62%) and 1995 and older passenger vehicles (+51%). However, for 1996 and older trucks, Mobile6 projected 17% lower NOx emissions.

These differences need to be investigated further.

High emitting vehicle owner surveys:

- 68% of high emitting vehicle owners who responded to the initial project survey said they had recently noticed a problem with their vehicle.
- 43% said their "check engine" light was on. (53% for owners of 1996 and newer vehicles)
- The average mileage reported by owners of high emitting vehicles was high. Over 75% had more than 100,000 miles. The median was 136,602.
- 78% of high emitting vehicle owners said they drive their vehicle everyday.
- 39% of the survey respondents voluntarily took their vehicle in for servicing when informed of its pollution problem, and 29% had repairs done.
- Inability to pay for repairs was the reason most often sighted by those who did not take their vehicle in for servicing and by those who took it in but did not have repairs done.
- The surveys were well received by vehicle owners. Very few negative comments were received.

Conclusions:

- A small fraction of vehicles are high emitters but they contribute a large part of total light-duty vehicle emissions.
- Thus, there is significant emission reduction potential from reducing the number of high emitters in the fleet.
- The Southeast Michigan light vehicle fleet has fewer high emitters than other areas because the region's fleet is newer. The higher rate of new vehicle sales in the region represents a significant air quality benefit to our area.
- A large portion of high emitters are older vehicles that do not have the latest on-board diagnostic (OBDII) equipment (pre-1996 vehicles).
- Older vehicles are more likely to be high emitters. However, age alone does not explain the occurrence of higher emissions. The majority of older vehicles are NOT high emitters.
- While the PERCENTAGE of middle-aged (1992-1999) vehicles that are high emitters is lower than for older vehicles, there are more vehicles in this middle age group.

- These middle-aged vehicles present a greater opportunity for emissions repair than the oldest model vehicles for several reasons:
    - they are likely driven more,
    - they may be more repairable than older vehicles,
    - their owners may be better able to afford repairs, and
    - owners may see the investment in repair as more worthwhile because of expected remaining vehicle life.
- Voluntary efforts to reduce vehicle emissions were met with a high degree of acceptance. Very few negative comments were received and a significant percentage of owners reported taking their vehicle in for repairs. This has major implications for future efforts to reduce vehicle pollution. For example, it calls into question the need to test all vehicles when only a small percentage are high emitters AND a significant percentage of their owners were willing to seek repairs.
- As many high emitters are older vehicles and numerous owners stated they couldn't afford repairs, providing funding to repair or replace these vehicles would be critical to success.
- In the longer term, reducing vehicle emissions should focus more on preventing vehicles from becoming high emitters in the first place.
- One way to accomplish this is to educate vehicle owners on the importance of responding to their "check engine" light and properly maintaining their vehicles so they never become high emitters.

Appendix A RSD Unit Certifications

March 01, 2007

From: Jerry Simms

Re: Certification of the Four-Gas RSD4600 System 4618

The purpose of this letter is to certify that System 4618 was verified to be operating within advertised tolerances for gaseous pollutant monitoring.

The following unit was certified to be functioning within dry gas specifications on the dates indicated:

4618 03-01-07

Pre-Shipment RSD4600 "PUFF" Gas Audit

A standard "puff" audit procedure is performed to test the RSD4600 unit against a known bottle of gas to verify unit accuracy for manufacturing QA. This is conducted in a controlled laboratory environment and provides a baseline assessment of the system's performance. The AccuScan^{TM} must successfully read three different known gas blends for five 'Puffs'.

Pre-Shipment "Truck" Audit

This audit simulates a vehicle pass with a series of known gas mixtures. This is accomplished by means of a truck loaded with gas cylinders that are configured to release a "mock" exhaust plume as it passes the AccuScan^{TM}. The exhaust from the truck itself is diverted well above the chassis and out of the sensor's measurement range. Four different blends of gas must pass the AccuScan^{TM} unit a total ten times reading each pass successfully.

The following table provides Measurement Parameters (*) for detected pollutant gases used in both the 'Puff' audit and 'Truck' Audit:

Pollutant Gases	**Laboratory Using Dry Gas from 20° to 120° F**	**On Road Using Dry Gas from 20° to 120° F**
CO - CO/CO_2	± 0.5 of concentration or ±5% of reading, whichever is larger	± 0.25 of concentration or ±10% of reading, whichever is larger
CO_2 - CO/CO_2	± 0.5 of concentration or ±5% of reading, whichever is larger	± 0.25 of concentration or ±10% of reading, whichever is larger
HC – HC/ CO_2	±80 PPM hexane or ±5% of reading, whichever is larger	±150 PPM hexane or ±15% of reading, whichever is larger
NO – NO/ CO_2	±100PPM or ±10% of reading, whichever is larger (*)	±250 PPM or ±15% of reading, whichever is larger

(*Gas measurements are corrected for excess air)

Pre-Shipment on-Road Data Analysis

> Lastly, the unit is taken onto an on ramp in Tucson, AZ near our facility. Two units are tested side by side in actual traffic conditions for a minimum of one thousand vehicles. The data from each machine is inter-compared to ensure each is reading within specifications to one another.

The gas vendor certifies gas-bottle concentrations used in the Puff Audit and Truck Audit testing. Copies of the certification tags for the actual bottles used in both tests are attached to this document.

Scatter plots, which graphically indicate the results of Truck Audit activities and an Excel printout of the file that create these plots, are attached to this document. Both demonstrate valid gas data readings when compared to the attached copies of the actual gas cylinder labels used in the Truck Audit.

In conclusion, the results from all certification activities confirm that the above listed unit is working within required parameters for 4618.

ENVIRONMENTAL SYSTEMS PRODUCTS, INC.

AccuScan™

BAR LIMITS STAT SHEET FOR UNIT # 4618

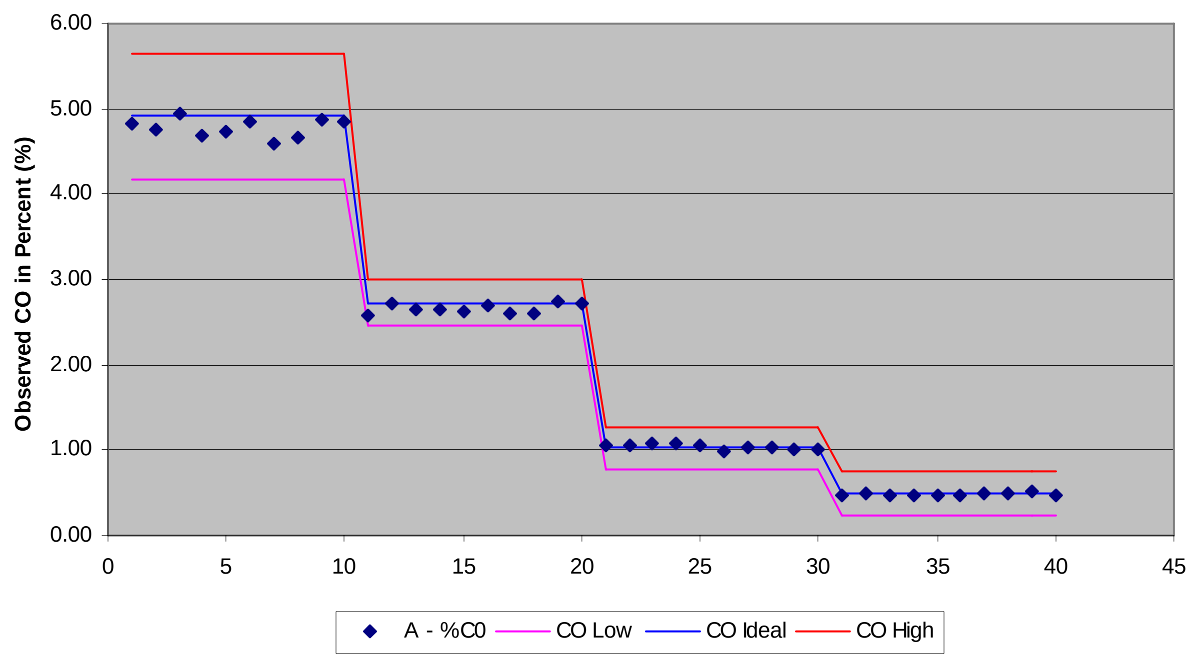
Date: 03-01-07

%CO	Ideal Value	BAR Limits Hi Lim	BAR Limits Lo Lim	+/- Tolerance		Num of Runs	Dry Gas Audit Readings Max	Avg	Min	S.D.	Num of Fails	Avg Error	Max Error
Cyl 1	0.496	0.746	0.246	0.250	%CO	10	0.508	0.481	0.468	0.012	0	-0.015 %CO	-0.028 %CO
Cyl 2	1.020	1.270	0.770	0.250	%CO	10	1.071	1.036	0.996	0.028	0	1.50%	5.00%
Cyl 3	2.725	2.998	2.453	10.000	%	10	2.746	2.658	2.589	0.059	0	-2.50%	-5.00%
Cyl 4	4.916	5.654	4.179	15.000	%	10	4.956	4.782	4.583	0.114	0	-2.70%	-6.80%
Cyl 5													
Cyl 6													

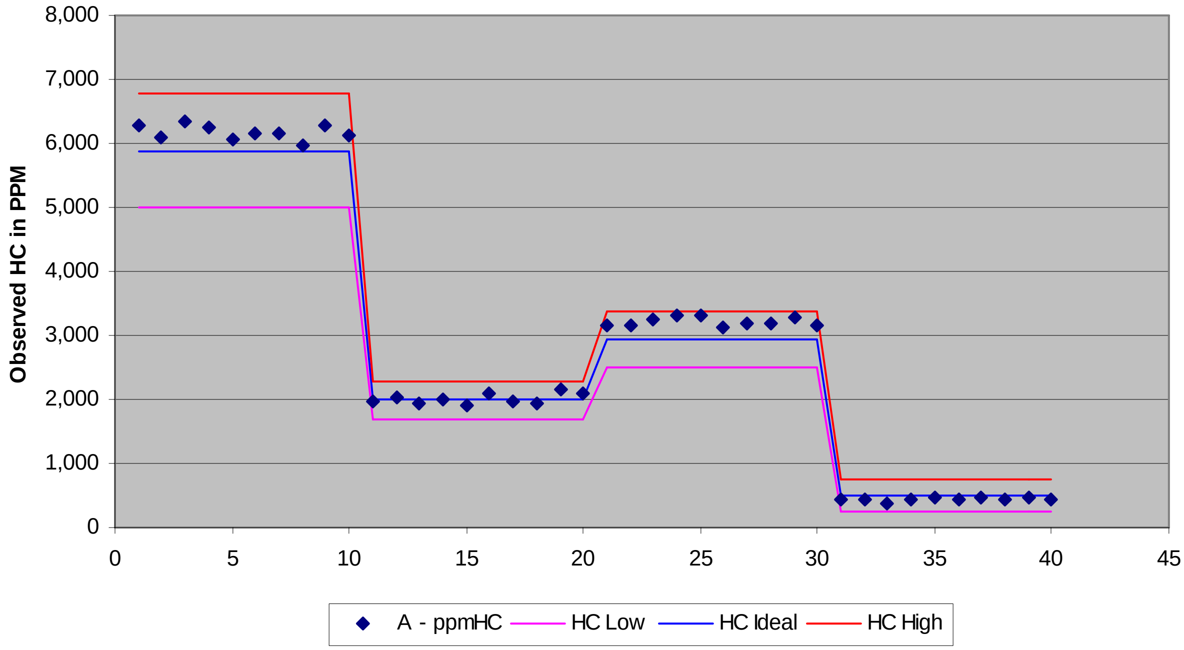
ppm HC	Ideal Value	BAR Limits Hi Lim	BAR Limits Lo Lim	+/- Tolerance		Num of Runs	Dry Gas Audit Readings Max	Avg	Min	S.D.	Num of Fails	Avg Error	Max Error
Cyl 1	495.8	745.8	245.8	250.0	ppm	10	465.4	441.6	390.3	21.9	0	-54.2 ppmHC	-105.5 ppmHC
Cyl 2	2941.6	3382.8	2500.4	15.0	%	10	3308.0	3211.1	3117.5	67.4	0	9.20%	12.50%
Cyl 3	1992.0	2290.8	1693.2	15.0	%	10	2155.3	2013.8	1921.0	78.8	0	1.10%	8.20%
Cyl 4	5887.6	6770.8	5004.5	15.0	%	10	6333.3	6169.6	5967.4	116.9	0	4.80%	7.60%
Cyl 5													
Cyl 6													

ppm NOx	Ideal Value	BAR Limits Hi Lim	BAR Limits Lo Lim	+/- Tolerance		Num of Runs	Dry Gas Audit Readings Max	Avg	Min	S.D.	Num of Fails	Avg Error	Max Error
Cyl 1	2974.9	3421.1	2528.6	15.0	%	10	3092.1	2972.7	2847.1	80.6	0	-0.10%	-4.30%
Cyl 2	1971.0	2266.6	1675.3	15.0	%	10	2199.6	2052.1	1851.7	107.0	0	4.10%	11.60%
Cyl 3	497.5	747.5	247.5	250.0	ppm	10	610.5	542.4	462.4	47.7	0	44.9 ppmNO	113.0 ppmNO
Cyl 4	247.3	497.3	-2.7	250.0	ppm	10	456.9	295.0	94.2	106.6	0	47.7 ppmNO	209.6 ppmNO
Cyl 5													
lethod A for													

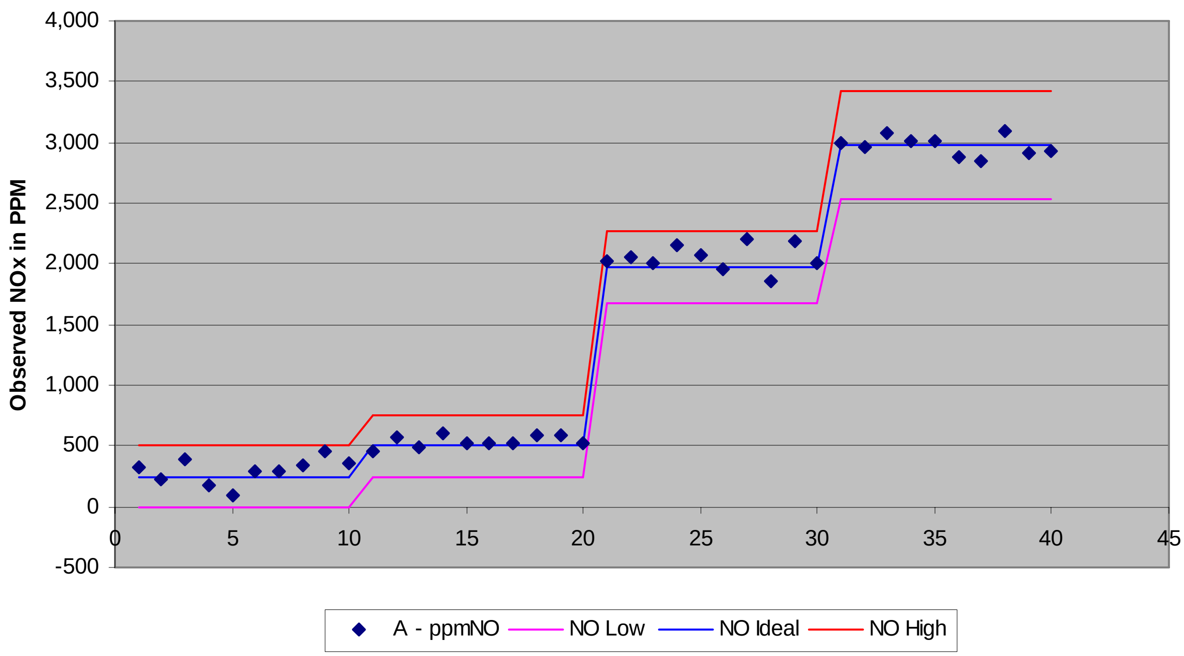
Carbon Monoxide Certification Results
for Unit 4618, conducted on 03-01-07



Total Hydrocarbons Certification Results
for Unit 4618, conducted on 03-01-07



Oxides of Nitrogen Certification Results
for Unit 4618, conducted on 03-01-07



ENVIRONMENTAL SYSTEMS PRODUCTS HOLDINGS

AccuScan™

April 10, 2007

From: Jerry Simms

Re: Certification of the Four-Gas RSD4600 System 4620

The purpose of this letter is to certify that System 4620 was verified to be operating within advertised tolerances for gaseous pollutant monitoring.

The following unit was certified to be functioning within dry gas specifications on the dates indicated:

4620 04-10-07

Pre-Shipment RSD4600 "PUFF" Gas Audit

A standard "puff" audit procedure is performed to test the RSD4600 unit against a known bottle of gas to verify unit accuracy for manufacturing QA. This is conducted in a controlled laboratory environment and provides a baseline assessment of the system's performance. The AccuScan™ must successfully read three different known gas blends for five 'Puffs'.

Pre-Shipment "Truck" Audit

This audit simulates a vehicle pass with a series of known gas mixtures. This is accomplished by means of a truck loaded with gas cylinders that are configured to release a "mock" exhaust plume as it passes the AccuScan™. The exhaust from the truck itself is diverted well above the chassis and out of the sensor's measurement range. Four different blends of gas must pass the AccuScan™ unit a total ten times reading each pass successfully.

The following table provides Measurement Parameters (*) for detected pollutant gases used in both the 'Puff' audit and 'Truck' Audit:

Pollutant Gases	**Laboratory Using Dry Gas from 20° to 120° F**	**On Road Using Dry Gas from 20° to 120° F**
CO - CO/CO_2	± 0.5 of concentration or ±5% of reading, whichever is larger	± 0.25 of concentration or ±10% of reading, whichever is larger
CO_2 - CO/CO_2	± 0.5 of concentration or ±5% of reading, whichever is larger	± 0.25 of concentration or ±10% of reading, whichever is larger
HC – HC/ CO_2	±80 PPM hexane or ±5% of reading, whichever is larger	±150 PPM hexane or ±15% of reading, whichever is larger
NO – NO/ CO_2	±100PPM or ±10% of reading, whichever is larger (*)	±250 PPM or ±15% of reading, whichever is larger

(*Gas measurements are corrected for excess air)

Pre-Shipment on-Road Data Analysis

Lastly, the unit is taken onto an on ramp in Tucson, AZ near our facility. Two units are tested side by side in actual traffic conditions for a minimum of one thousand vehicles. The data from each machine is inter-compared to ensure each is reading within specifications to one another.

The gas vendor certifies gas-bottle concentrations used in the Puff Audit and Truck Audit testing. Copies of the certification tags for the actual bottles used in both tests are attached to this document, and demonstrate valid performance standards when compared to any of the three gas audit computer print-outs.

Scatter plots, which graphically indicate the results of Truck Audit activities and an Excel printout of the file that create these plots, are attached to this document. Both demonstrate valid gas data readings when compared to the attached copies of the actual gas cylinder labels used in the Truck Audit.

In conclusion, the results from all certification activities confirm that the above listed unit is working within required parameters for 4620.

DRY GAS RESULTS

BAR LIMITS STAT SHEET FOR UNIT # 4620

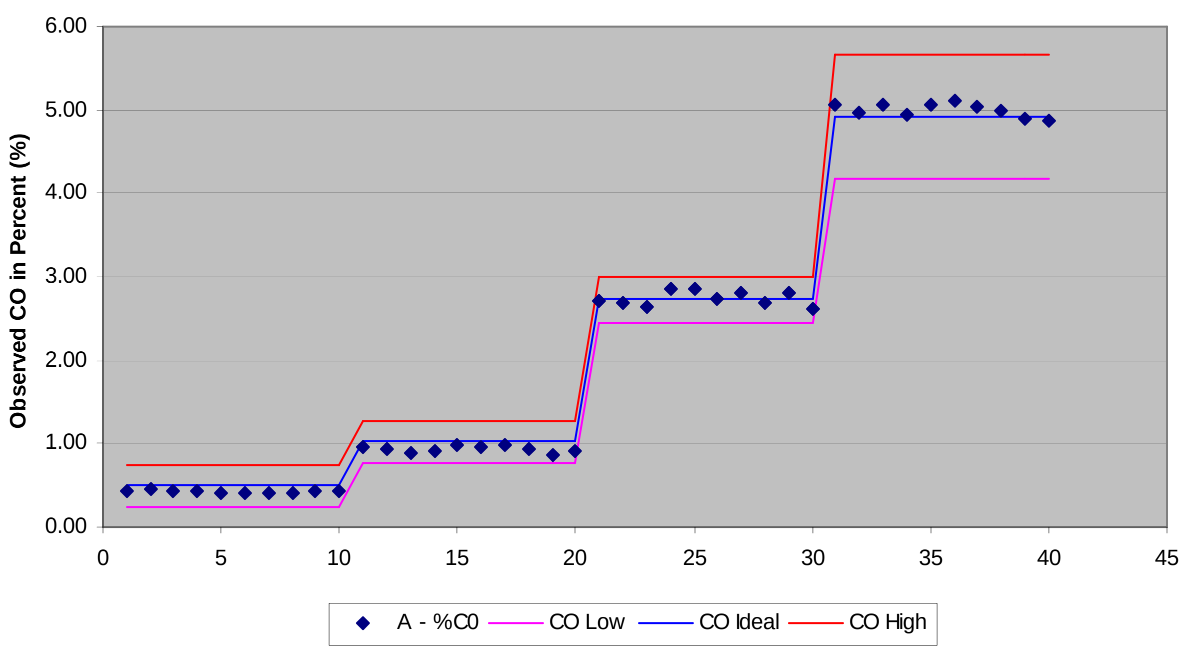
Date: 04-10-07

%CO	Ideal Value	BAR Limits Hi Lim	BAR Limits Lo Lim	+/- Tolerance		Num of Runs	Dry Gas Audit Readings Max	Avg	Min	S.D.	Num of Fails	Avg Error	Max Error
Cyl 1	0.496	0.746	0.246	0.250	%CO	17	0.462	0.417	0.375	0.020	0	-0.079 %CO	-0.120 %CO
Cyl 2	1.020	1.270	0.770	0.250	%CO	12	1.010	0.942	0.871	0.038	0	-7.60%	-14.60%
Cyl 3	2.725	2.998	2.453	10.000	%	12	2.865	2.740	2.625	0.082	0	0.50%	5.10%
Cyl 4	4.916	5.654	4.179	15.000	%	10	5.119	5.003	4.880	0.081	0	1.80%	4.10%
Cyl 5													
Cyl 6													

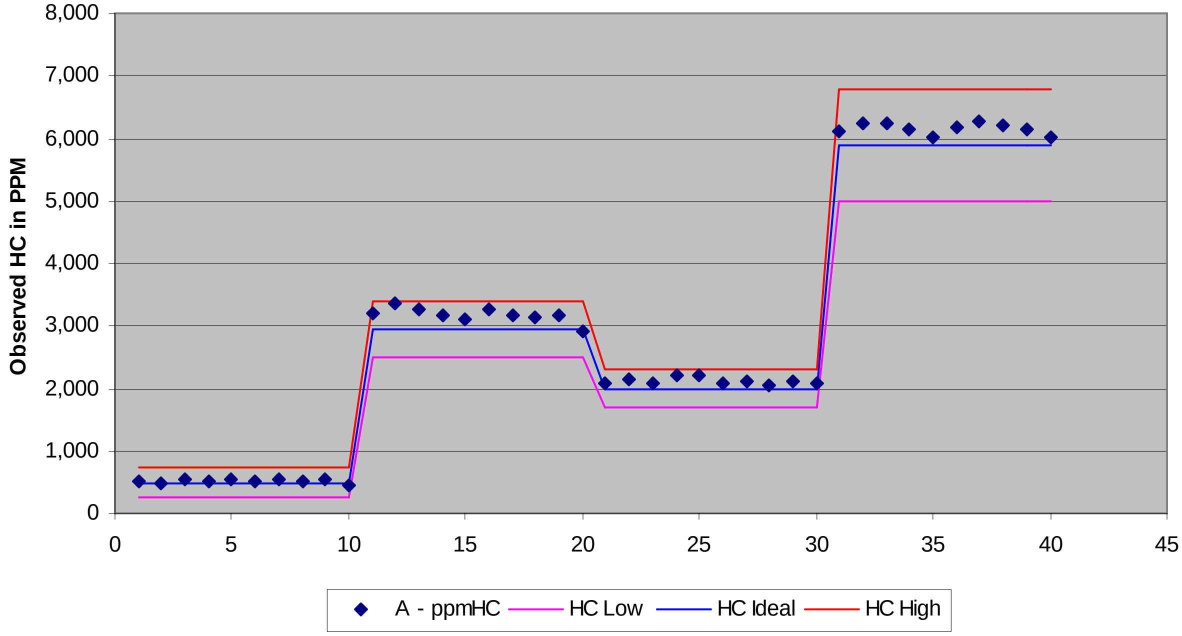
ppm HC	Ideal Value	BAR Limits Hi Lim	BAR Limits Lo Lim	+/- Tolerance		Num of Runs	Dry Gas Audit Readings Max	Avg	Min	S.D.	Num of Fails	Avg Error	Max Error
Cyl 1	495.8	745.8	245.8	250.0	ppm	17	570.6	508.5	457.3	27.8	0	12.7 ppmHC	74.8 ppmHC
Cyl 2	2941.6	3382.8	2500.4	15.0	%	12	3346.3	3175.7	2918.4	116.5	0	8.00%	13.80%
Cyl 3	1992.0	2290.8	1693.2	15.0	%	12	2216.6	2123.8	2063.8	53.4	0	6.60%	11.30%
Cyl 4	5887.6	6770.8	5004.5	15.0	%	10	6273.1	6162.4	6008.0	93.3	0	4.70%	6.50%
Cyl 5													
Cyl 6													

ppm NOx	Ideal Value	BAR Limits Hi Lim	BAR Limits Lo Lim	+/- Tolerance		Num of Runs	Dry Gas Audit Readings Max	Avg	Min	S.D.	Num of Fails	Avg Error	Max Error
Cyl 1	2974.9	3421.1	2528.6	15.0	%	17	3188.6	2998.2	2795.4	96.4	0	0.80%	7.20%
Cyl 2	1971.0	2266.6	1675.3	15.0	%	12	2207.1	2094.9	1941.6	84.7	0	6.30%	12.00%
Cyl 3	497.5	747.5	247.5	250.0	ppm	12	721.8	565.6	504.1	59.9	0	68.1 ppmNO	224.3 ppmNO
Cyl 4	247.3	497.3	-2.7	250.0	ppm	10	307.5	268.0	237.3	22.9	0	20.7 ppmNO	60.2 ppmNO
Cyl 5													
lethod A for													

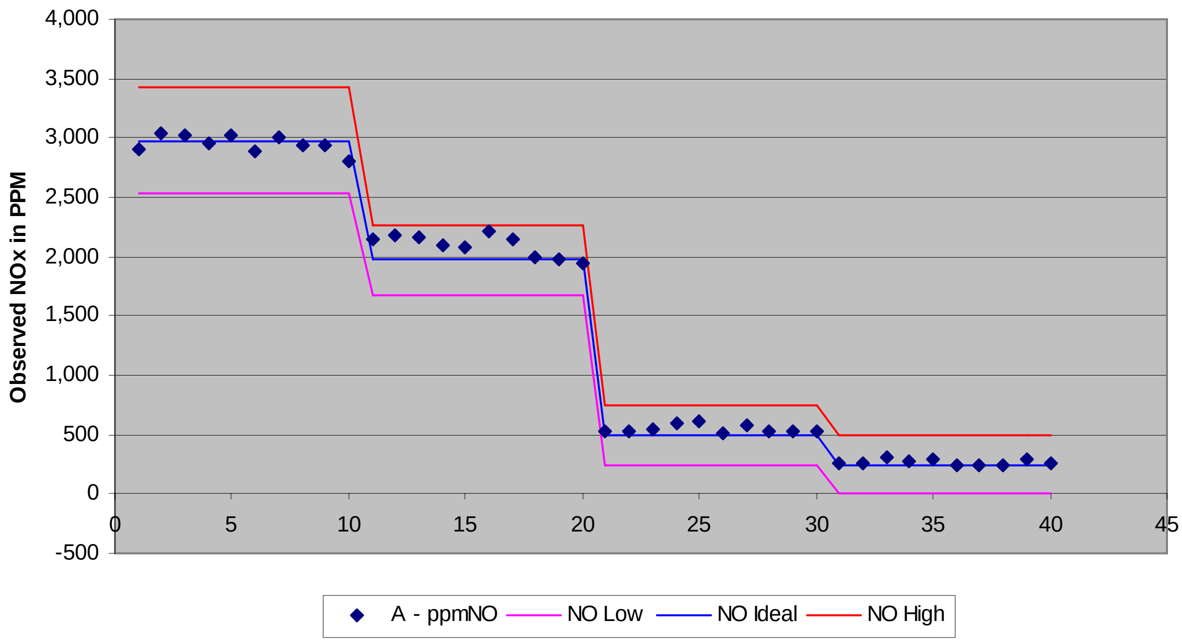
Carbon Monoxide Certification Results
for Unit 4620, conducted on 04-10-07



**Total Hydrocarbons Certification Results
for Unit 4620, conducted on 04-10-07**



**Oxides of Nitrogen Certification Results
for Unit 4620, conducted on 04-10-07**



Appendix B Data Screening Charts

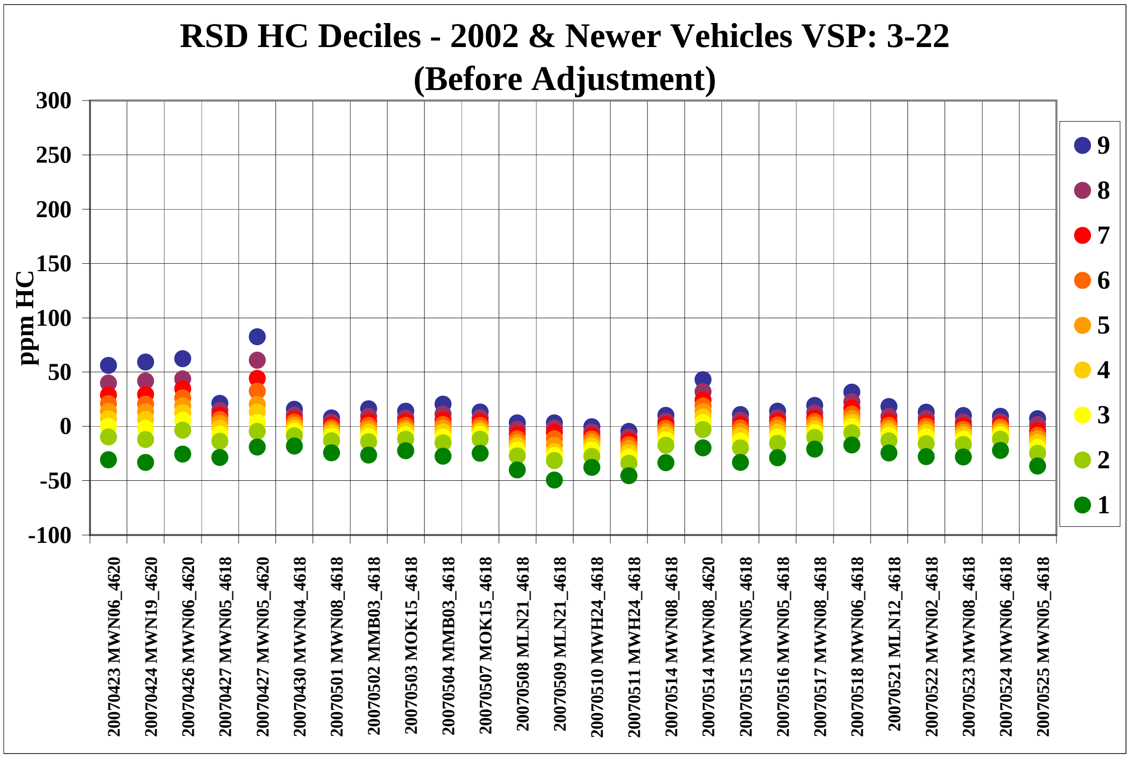
Hourly Temperatures

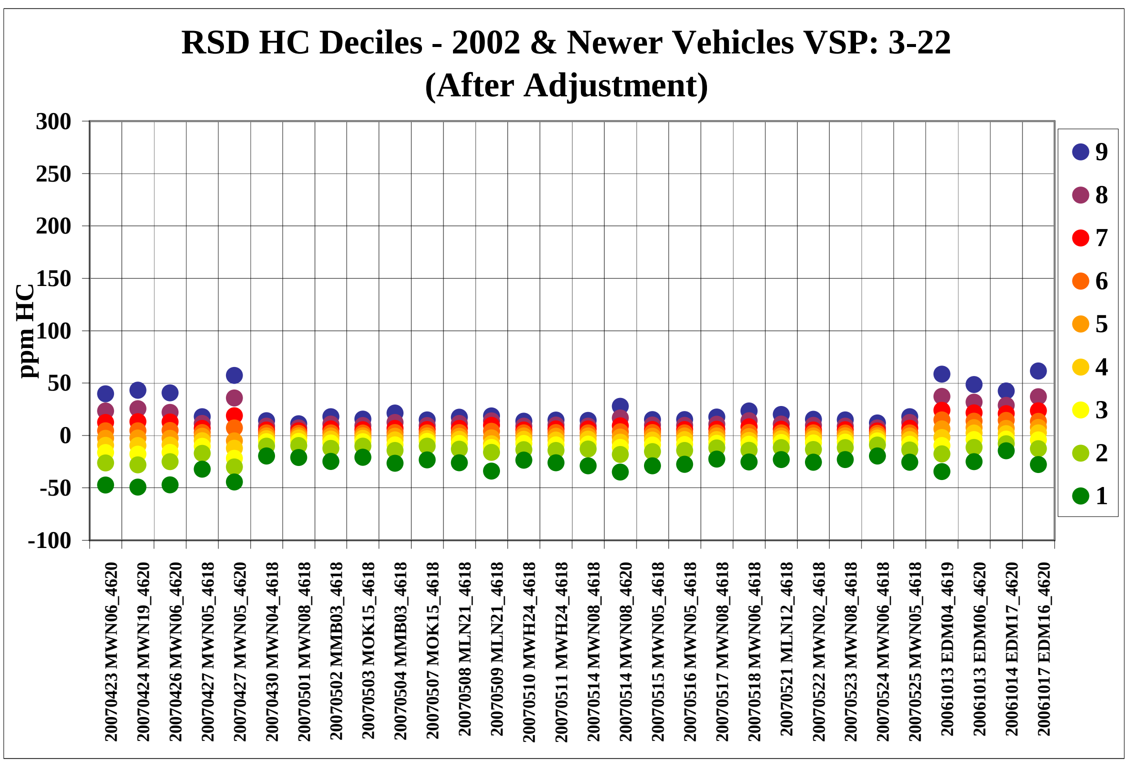
Day	Unit	Site	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
23APR2007	__07064620	MWN06	#N/A	#N/A	21.2	23.3	27.6	27.0	26.6	26.1	25.1	24.8	25.3	24.6	24.6	23.7	22.6
24APR2007	__07064620	MWN19	8.3	7.6	8.2	10.7	13.2	14.9	16.3	20.2	24.7	28.2	31.6	32.0	30.4	23.6	#N/A
26APR2007	__07064620	MWN06	8.5	7.4	7.7	8.1	7.5	7.6	#N/A	#N/A	8.9	9.4	10.5	11.4	11.8	11.7	#N/A
27APR2007	__06064618	MWN05	#N/A	#N/A	15.3	16.2	16.3	15.1	14.3	14.6	14.7	14.5	14.1	13.6	13.3	12.8	#N/A
27APR2007	__07064620	MWN05	0.0	0.0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
30APR2007	__06064618	MWN04	#N/A	17.3	18.4	19.9	23.9	28.7	35.0	36.2	34.4	29.8	23.5	20.8	19.8	18.8	#N/A
01MAY2007	__06064618	MWN08	#N/A	11.1	11.3	13.0	15.5	16.7	18.2	20.6	21.5	14.8	14.9	17.3	16.4	17.3	#N/A
02MAY2007	__06064618	MMB03	#N/A	10.7	17.2	20.8	22.8	20.9	21.8	17.7	17.8	18.4	17.2	16.6	16.2	15.6	#N/A
03MAY2007	__06064618	MOK15	#N/A	8.2	9.1	11.5	13.2	14.6	17.1	18.6	19.7	19.5	19.7	20.8	20.4	21.8	21.8
04MAY2007	__06064618	MMB03	8.6	7.5	13.6	17.2	19.6	21.7	22.3	21.7	19.5	19.0	18.9	18.9	18.9	18.2	16.8
07MAY2007	__06064618	MOK15	9.6	10.0	14.6	16.9	17.5	18.5	20.3	21.4	22.4	23.5	24.8	25.1	25.1	25.0	#N/A
08MAY2007	__06064618	MLN21	17.3	16.3	16.7	21.6	27.5	29.1	30.2	30.4	29.6	29.3	29.8	30.0	29.8	29.0	#N/A
09MAY2007	__06064618	MLN21	21.8	21.9	20.9	17.9	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
10MAY2007	__06064618	MWH24	13.3	13.1	14.5	17.4	19.3	21.6	22.6	24.2	25.1	28.1	26.6	30.9	32.6	31.0	26.4
11MAY2007	__06064618	MWH24	17.0	16.0	16.7	18.0	20.5	23.4	25.3	27.2	29.3	29.4	31.5	33.9	33.3	31.2	#N/A
14MAY2007	__06064618	MWN08	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	24.6	24.1	#N/A
14MAY2007	__07064620	MWN08	9.7	8.8	9.8	13.2	15.2	16.0	18.5	22.1	25.9	25.1	25.4	25.0	#N/A	#N/A	#N/A
15MAY2007	__06064618	MWN05	24.5	22.4	21.1	22.4	26.9	28.5	29.4	30.5	32.1	32.8	32.5	29.0	#N/A	#N/A	#N/A
16MAY2007	__06064618	MWN05	15.0	14.9	15.8	16.4	15.4	14.8	14.7	14.4	14.5	14.7	15.2	14.9	14.8	15.1	14.7
17MAY2007	__06064618	MWN08	10.9	10.9	12.2	10.9	11.7	11.8	11.6	12.3	11.3	11.8	15.0	15.8	15.2	14.5	#N/A
18MAY2007	__06064618	MWN06	8.5	9.1	12.7	14.7	16.4	17.5	18.0	18.3	19.2	21.5	21.5	22.0	22.6	22.4	#N/A
21MAY2007	__06064618	MLN12	10.1	12.7	12.8	12.4	12.7	14.2	16.2	19.1	20.6	21.2	25.7	29.4	31.4	30.4	#N/A
22MAY2007	__06064618	MWN02	15.8	17.3	20.5	22.9	25.0	26.8	27.0	28.3	30.0	32.2	37.7	40.3	42.5	39.4	#N/A
23MAY2007	__06064618	MWN08	0.0	16.8	20.3	31.0	35.3	37.6	38.4	39.4	36.2	35.1	33.3	32.5	32.2	30.1	#N/A
24MAY2007	__06064618	MWN06	17.9	16.8	22.4	28.9	32.0	33.6	34.4	34.3	34.5	33.8	34.5	34.7	34.3	33.9	32.5
25MAY2007	__06064618	MWN05	23.3	22.9	23.7	26.1	29.4	29.3	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

% Hourly Measurements of New Models with High HC

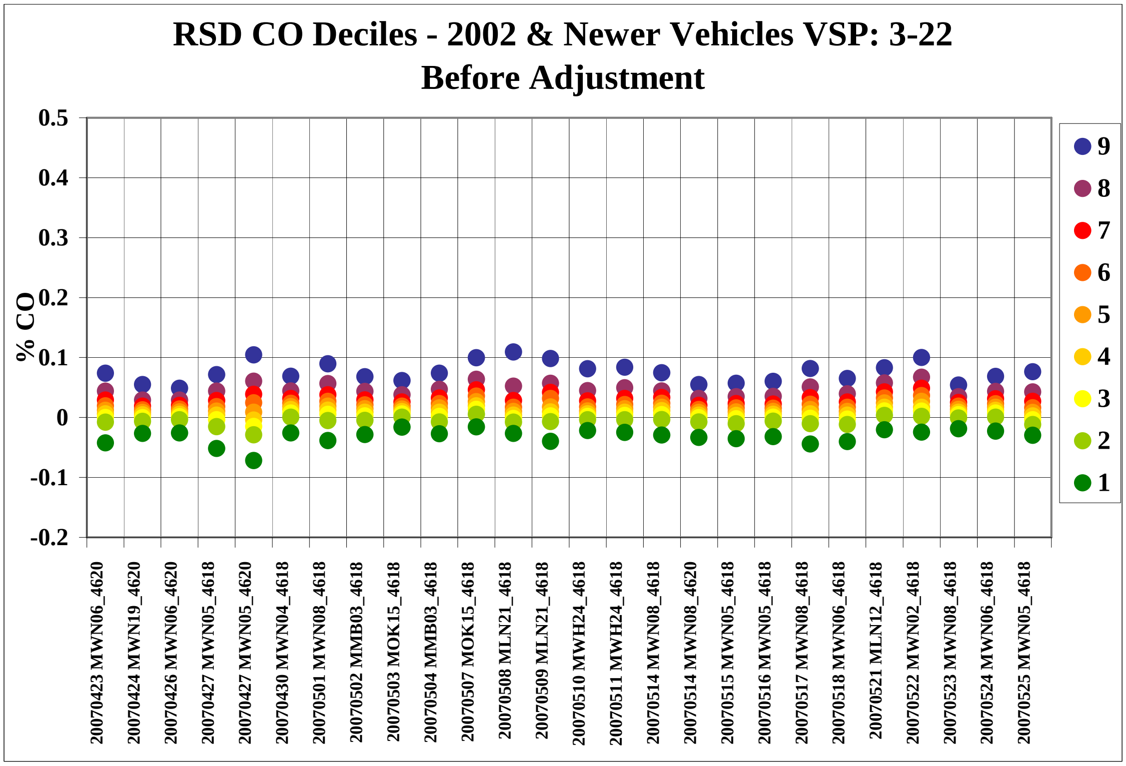
Day	RSD Unit	Site	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
23APR2007	__07064620	MWN06	#N/A	#N/A	0%	0%	1%	0%	1%	0%	1%	0%	0%	0%	0%	0%	0%
24APR2007	__07064620	MWN19	#N/A	0%	0%	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%	2%	#N/A
26APR2007	__07064620	MWN06	0%	0%	0%	0%	0%	0%	#N/A	#N/A	0%	0%	1%	2%	0%	0%	#N/A
27APR2007	__06064618	MWN05	#N/A	#N/A	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	#N/A
27APR2007	__07064620	MWN05	#N/A	2%	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
30APR2007	__06064618	MWN04	#N/A	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	#N/A
01MAY2007	__06064618	MWN08	#N/A	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	#N/A
02MAY2007	__06064618	MMB03	#N/A	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	#N/A
03MAY2007	__06064618	MOK15	#N/A	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	#N/A
04MAY2007	__06064618	MMB03	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
07MAY2007	__06064618	MOK15	#N/A	0%	1%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	#N/A
08MAY2007	__06064618	MLN21	#N/A	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	#N/A
09MAY2007	__06064618	MLN21	#N/A	0%	0%	0%	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
10MAY2007	__06064618	MWH24	#N/A	#N/A	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
11MAY2007	__06064618	MWH24	#N/A	0%	0%	0%	0%	1%	0%	1%	0%	0%	0%	0%	0%	0%	#N/A
14MAY2007	__06064618	MWN08	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0%	0%	#N/A
14MAY2007	__07064620	MWN08	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	#N/A	#N/A	#N/A
15MAY2007	__06064618	MWN05	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	#N/A	#N/A	#N/A	#N/A
16MAY2007	__06064618	MWN05	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
17MAY2007	__06064618	MWN08	0%	0%	0%	1%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	#N/A
18MAY2007	__06064618	MWN06	8%	0%	0%	1%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	#N/A
21MAY2007	__06064618	MLN12	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	#N/A
22MAY2007	__06064618	MWN02	#N/A	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	#N/A
23MAY2007	__06064618	MWN08	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	#N/A
24MAY2007	__06064618	MWN06	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%
25MAY2007	__06064618	MWN05	0%	0%	0%	0%	0%	0%	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

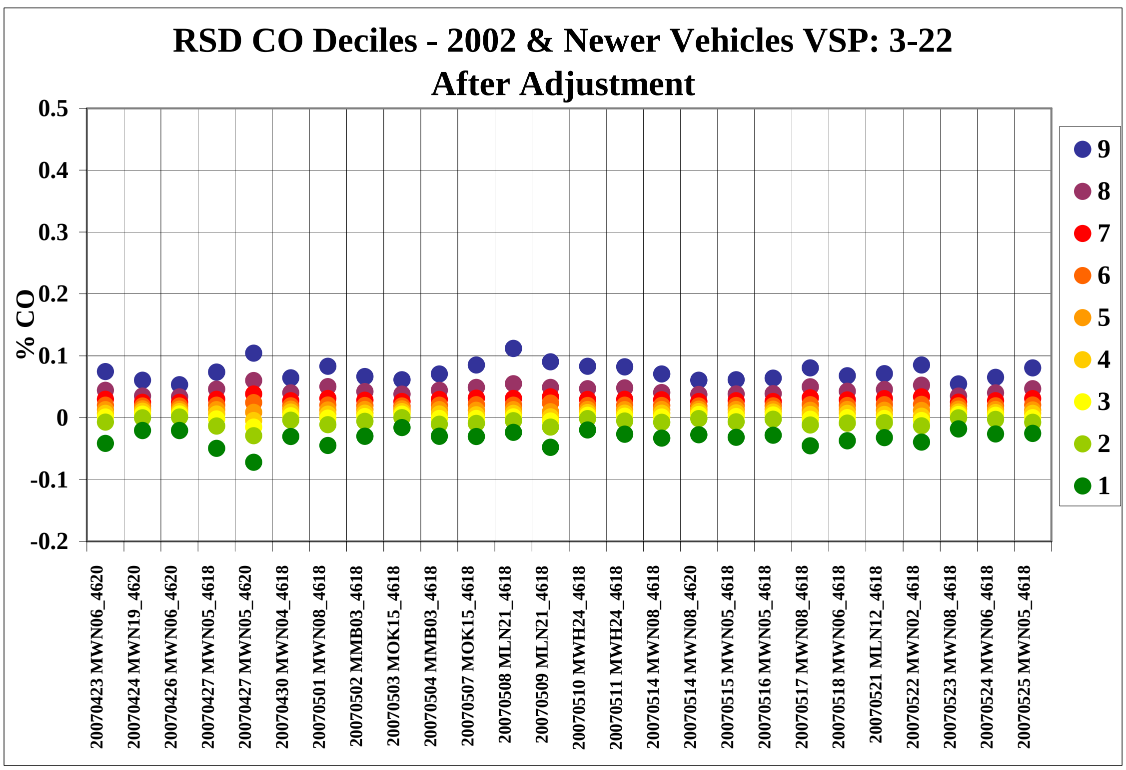
Daily HC Emissions Distribution for New Models



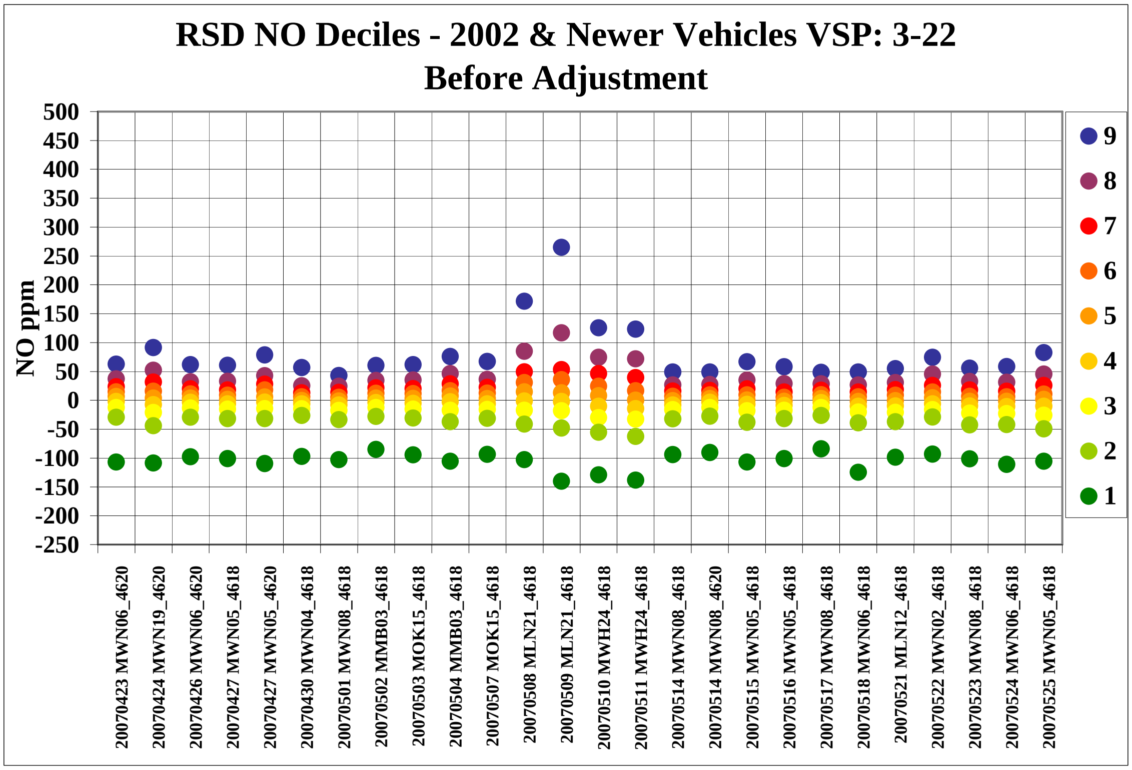


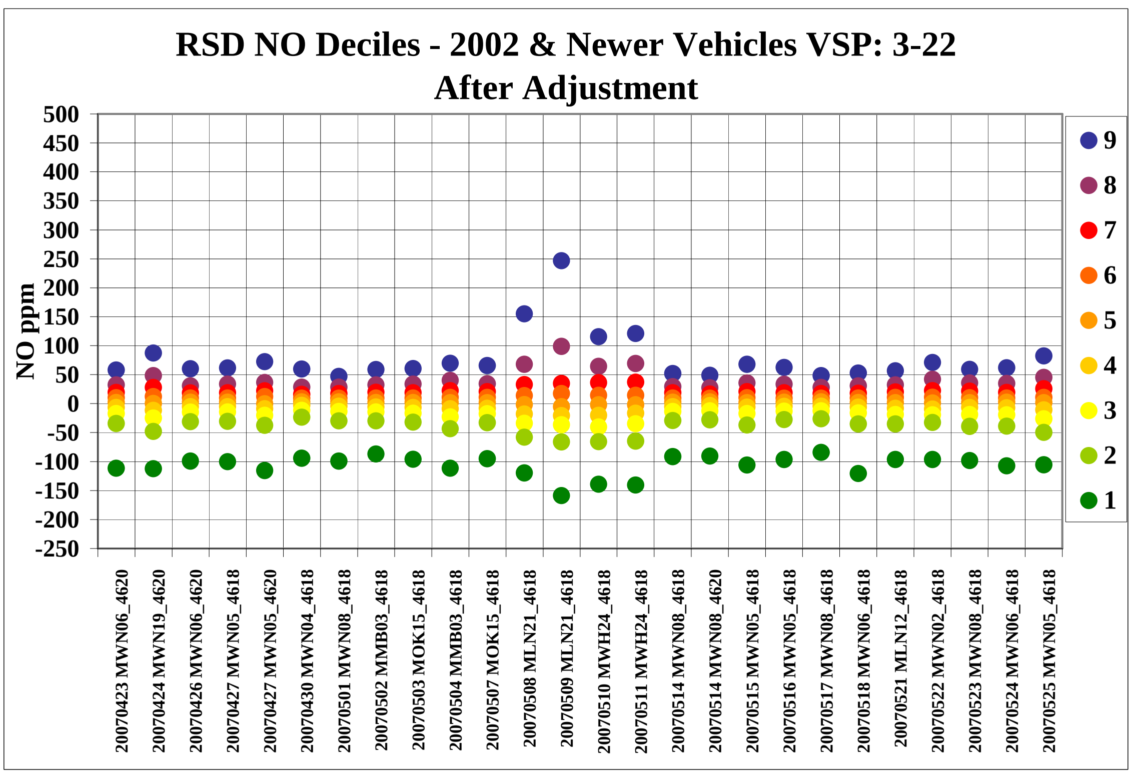
Daily CO Emissions Distribution for New Models



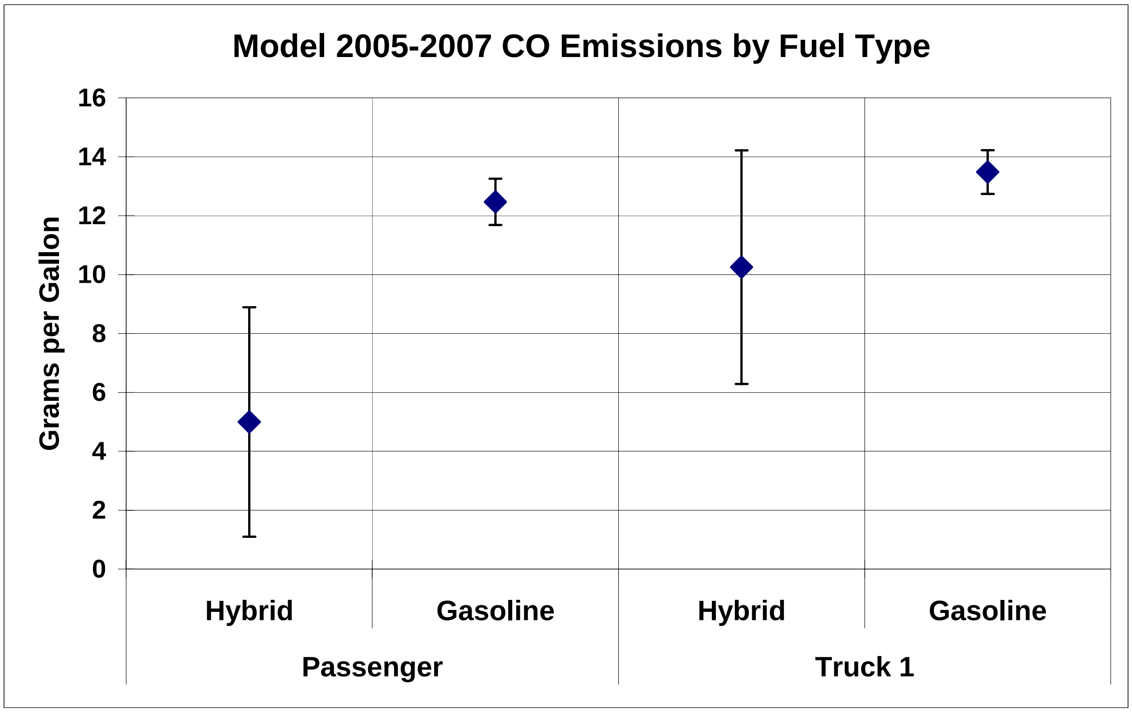


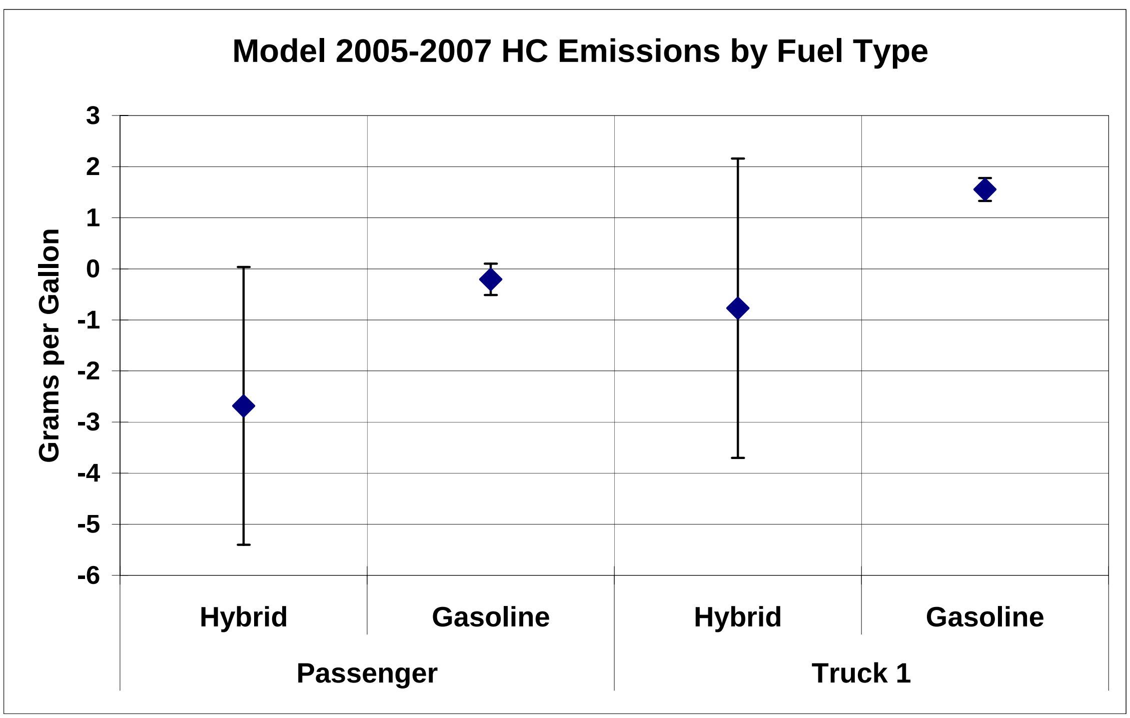
Daily NO Emissions Distribution for New Models

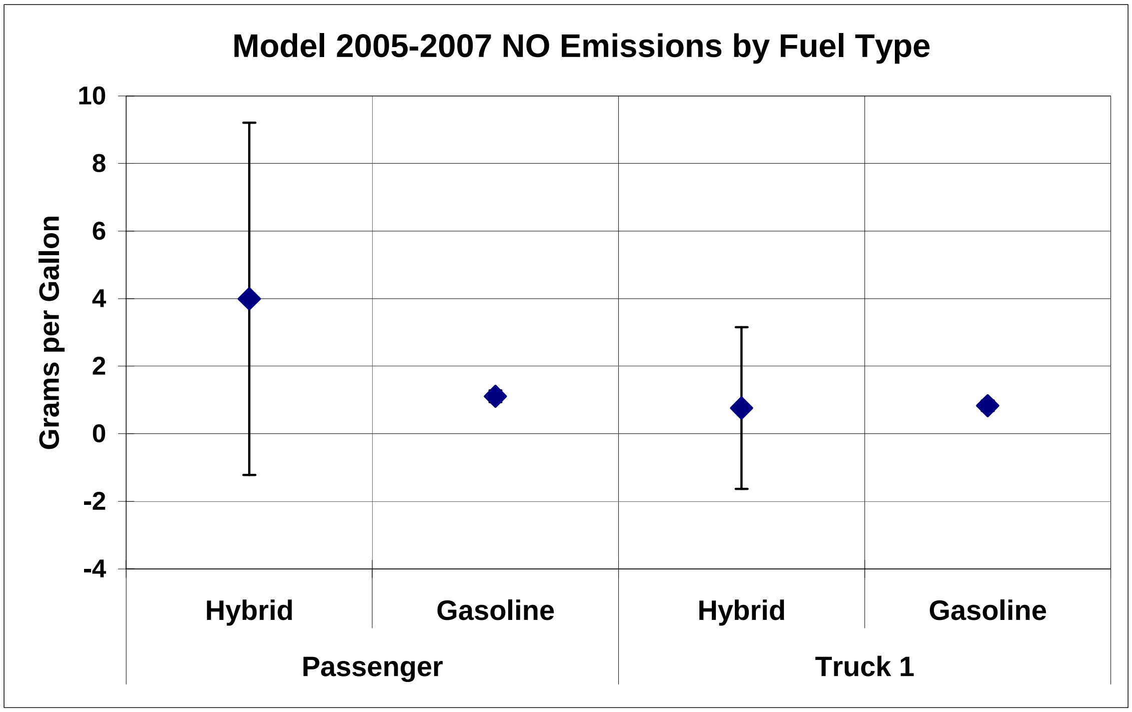




Appendix C Hybrid vs. Gasoline Engine Emissions







Model 2005-2007 NO Emissions by Fuel Type
Grams per Gallon
10
8
6
4
2
0
-2
-4
Hybrid
Gasoline
Hybrid
Gasoline
Passenger
Truck 1

Appendix D Letters & Survey Forms

INITIAL LETTER:

April 2007

VCL Name
VCL Street
VCL City, State & Zip

Dear Vehicle Owner,

High gas prices are a concern to many in Southeast Michigan. We are looking for ways to reduce your fuel cost and, at the same time, improve our air quality. One way to learn if a vehicle is burning more fuel than it should involves using a sampling device at the side of the road that measures a vehicles' pollution as it drives by.

As you may have noticed, your [Vehicle Year and Make] recently passed by such a sampling device. It was identified as using more fuel and emitting more pollution than it should. There are a variety of possible explanations for higher than expected fuel use and pollutant emissions. **Whatever the reason, this could be costing you several hundred dollars a year in extra gasoline use.**

While small in number, vehicles experiencing emission control problems can contribute over half of the total pollution coming from all motor vehicles. In many parts of the country, all vehicles must undergo emissions testing and be repaired if they fail. Instead of implementing this type of mandatory testing program, we are promoting **voluntary** action by informing owners of those vehicles with higher than expected pollution levels.

We ask that you consider taking your vehicle to your regular mechanic or an auto dealership for evaluation and repair. Enclosed is some information to help guide your decisions.

We've also enclosed a brief questionnaire that we hope you will complete and return to us whether or not you decide to take your vehicle in for repairs. Your answers will help us better understand the causes of vehicle pollution problems and how they can be reduced in the future. Once you've completed the questionnaire, please return it in the enclosed postage-paid envelope by June 30, 2007. **As a thank you for completing and returning the questionnaire, we will send you a $10 gas card, courtesy of BP.**

Thank you very much for your help with this effort.

Sincerely,

Paul E. Tait, Executive Director, SEMCOG

SEMCOG, the Southeast Michigan Council of Governments, is a regional planning partnership of local governmental units serving 4.9 million people in the seven-county region of Southeast Michigan. SEMCOG's mission is solving regional problems — improving the efficiency and effectiveness of the region's local governments as well as the quality of life in Southeast Michigan. For additional information, please visit www.semcog.org.

INITIAL SURVEY:

Vehicle Owner Questionnaire

Please fill out and return this form, in the postage-paid envelope provided, by June 22, 2007

1. Have you recently noticed any of the following when driving your vehicle?

☐ Yes	☐ No	"Check Engine" or "Service Engine Soon" light is on (applies mainly to vehicles made after 1995)
☐ Yes	☐ No	Unusual vibration when the engine is running
☐ Yes	☐ No	Smoke coming out of the tailpipe when you accelerate, even after the car has been running for more than five minutes
☐ Yes	☐ No	Stalling of vehicle
☐ Yes	☐ No	Other ____

2. Had you already made an appointment to service this vehicle before receiving this letter?

☐ Yes ☐ No

3. How long have you owned the vehicle? ______________________________

4. Have you ever had problems with its emissions control system before?
(This could include problems with its oxygen sensor, catalytic converter, etc.)

☐ Yes ☐ No ☐ Don't know

5. Is this vehicle still under warranty?
☐ Yes ☐ No ☐ Don't know

6. How often do you change the oil in this vehicle? ____________________

____

7. How many miles are currently on your vehicle? _______________________

8. How often do you usually drive this vehicle?

☐ Every day
☐ Several times a week
☐ Several times a month
☐ Once a month
☐ Several times a year

To receive your free $10 BP gas card, please fill out the information below. Your card should arrive in approximately four weeks.

Name: ____

Address: ____

City: ____ Zip Code: ________________

Additional information about this project

What do I need to do to receive my free $10 gas card?

Simply fill out and return the enclosed survey in the postage-paid envelope provided, by June 30, 2007. You will receive your gas card in approximately four weeks. You are not required to take your vehicle in for servicing in order to receive the gas card. However, we hope you will consider doing so. Either way, we ask that you help us by returning the survey. Your answers will help us learn how we can improve our air quality and reduce unnecessary fuel use through voluntary actions.

Who is SEMCOG and what is this program about?

SEMCOG is a regional planning partnership of local governments. Our mission is to improve the efficiency and effectiveness of the region's local governments as well as the quality of life for the citizens of Southeast Michigan. This includes developing cost-effective strategies for meeting federal air quality standards. As a result of tougher new standards, the federal government was originally going to require that all vehicles in Southeast Michigan be routinely inspected. Vehicles that failed this inspection would have to be repaired. **We successfully appealed to have this testing requirement removed.** In its place, we agreed to promote voluntary actions that result in reduced vehicle pollution.

What should I consider when deciding whether to take my vehicle in for service?

You received this letter because a roadside sample of your vehicle exhaust showed a much-higher-than-expected level of air pollution. Usually this means you are consuming more fuel than necessary. Servicing your vehicle could reduce your fuel cost. At the same time, you would be improving air quality.

Where can I take my vehicle to be serviced and what should I tell the mechanic?

Whether to get your vehicle serviced and where to take it are both entirely up to you. Our suggestion is to use a place of business you trust. Because all repair shops do not have the equipment necessary to diagnose and repair emissions problems, we recommend calling ahead first.

Tell your mechanic that your vehicle was identified as having higher-than-expected carbon monoxide emissions and may have high hydrocarbon emissions as well. Ask your mechanic to examine your vehicle to determine why this is happening. Consider easier things first such as ignition wires and spark plugs that are worn or not working.

What repairs need to be done?

High vehicle emissions can be caused by a number of different things. It could indicate a problem with the vehicle's ignition wires, spark plugs, oxygen sensor, catalytic converter, or some other part of the engine or emissions system. The needed repairs for your vehicle should be determined in consultation with your mechanic, after he/she has inspected it. We want to emphasize that this program is strictly voluntary. **Having any repair work done is entirely up to you.**

What happens if I do not get my vehicle repaired?

You are not required to do anything with your vehicle. Our program is strictly voluntary. However, we encourage you to take your vehicle in to reduce its pollution and improve your gas mileage.

For more information on SEMCOG, please visit our Web site at www.semcog.org.

FOLLOW UP LETTER:

[Date]

[VCL Name]
[VCL Street]
[VCL City, State & Zip]

Dear [VCL Name],

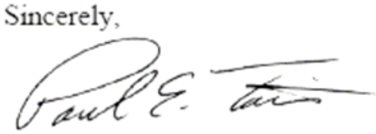
Several weeks ago, we sent you a letter informing you that your [Vehicle Year and Make] had recently driven by a roadside emissions sampling device. This device indicated your vehicle was using more fuel and emitting more pollution than it should. We asked that you consider taking your vehicle to your regular mechanic or an auto dealership for evaluation and repair. We now need to find out how many vehicle owners took their vehicles in for servicing and the results.

Enclosed is a brief questionnaire that we ask you to complete and return to us, regardless of whether you were able to take your vehicle in for repairs. Your answers will help us understand the causes of vehicle pollution problems as well as any barriers that prevent people from repairing them.

Please complete the questionnaire and return it in the enclosed postage-paid envelope by July 30, 2007. **As a thank you for completing and returning the questionnaire, we will send you a $10 gas card, courtesy of BP.**

Thank you very much for your help with this effort. If you would like more information on our project, please visit our Web page:
www.semcog.org/RegPlan/Environment/AirQuality/HighEmitterProgram.htm.

Sincerely,



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FOLLOW UP SURVEY:

Vehicle Owner Questionnaire

Please fill out and return this form, in the postage-paid envelope provided,
by July 20, 2007

1. Did you take your vehicle in to be serviced? ____ Yes ____ No

2. If yes, were repairs done? ____ Yes ____ No

   a. If yes,
      i. Approximately how much did they cost? ___________
      ii. What repairs were done?____________________________
      ____

      iii. Were the repairs covered under warranty? ____Yes ____No

   b. If no, please tell us why. (circle statement below that describes your situation)
      i. Mechanic determined repairs were not needed.
      ii. Repairs were too expensive
      What was the estimated repair cost? ____________
      iii. Other: ____
      ____

3. If you decided not to take your vehicle in for servicing, please tell us why.
   (circle statement below that best describes your decision)

   a. Couldn't afford to have vehicle serviced
   b. Didn't know where to take the vehicle
   c. Didn't have time
   d. Forgot about it
   e. Don't feel my vehicle has a pollution problem
   f. Just not interested
   g. Other: ____

Thank you again for your participation.

To receive your free $10 BP gas card, please fill out the information below and return this survey to us by July 20. 2007. Your card should arrive in approximately four weeks.

Name: ____

Address: ____

City: ____________________________________ Zip Code: ________________

Appendix E Survey Responses

	Q1A_CHECK	Q1B_VIBRATE	Q1C_SMOKE	Q1D_STALL	Q1E_OTHER
Yes	45	27	20	19	12
No	55	71	81	79	38
No response	4	6	3	6	54
	104	104	104	104	104
% of responses:					
Yes	43%	26%	19%	18%	12%
No	53%	68%	78%	76%	37%
No response	4%	6%	3%	6%	52%

	Q2_SERVICE	Q3_OWNED	Q4_EMISS_PROB	Q5_WARRANTY
Yes	28		16	5
No	76		64	97
No response	0		24	2
	104		104	104
% of responses:				
Yes	27%		15%	5%
No	73%		62%	93%
No response	0%		23%	2%

Miles	Q7_MILES
<50000	10
<100000	11
<150000	37
<200000	29
<250000	14
>250000	2
No response	1

Year	Make	Model	CO_PCT	PPMHCHEX	PPMNO	Q1A_CHECK	Q1B_VIBRATE	Q1C_SMOKE	Q1D_STALL	Q1E_OTHER	Q1E_TEXT	Q2_SERVICE	Q3_OWNED	Q4_EMISS_PROB	Q5_WARRANTY	Q6_OILCHANGE	Q7_MILES	SURVEY_COMMENTS
1990	OLDSMOBILE		0.288	540.9	79.6	n	n	n	n			n	1	n	n	3000	165000	Car needs a tune up
1995	GMC	C1500	2.115	170	726.6	n	y	n	n	n		n	10	n	n	2 months	247000	
1995	GMC	JIMMY	2.135	85.8	123	y	y	n	n	n		n	5	d	n	3000	122000	
1990	HONDA		2.882	117.2	203.9	n	n	y	n			n	2	n	n	5000	144000	
1991	CHEVROLET	CAPRICE	0.794	2323	941	n	n	n	y			y	10	n	n	5000	153000	
1993	FORD		4.66	1035	1815	y	n	n	n			y	1	n	n	4000	205000	
1996	DODGE	INTREPID	4.609	122.7	112.6	n	n	n	n	n		n	6	n	n	3000	96000	
1989	CADILLAC		0.474	1655	2369	y	y	n	n			y	1	d	n	4 months	100000	
1997	CHEVROLET	LUMINA	4.945	292.2	543.8	y						n	2	n	n	3000	194000	
1992	TOYOTA	PASEO	1.925	962.4	2035	y		y				n	15	n	n	3000	156328	
1992	GMC		9.271	5671	1251	y	y	y	y			y	1	n	n	3000	202000	
1999	FORD	CONTOUR	9.416	526.2	304.7	y	n	n	n			n	7	d	n	3000	116000	
1994	PONTIAC		4.716	998.2	1143	y	n	y	n			n	2	d	n	5 months	120000	
1997	FORD	LGT CONVTNL `F`	2.282	301.8	111.4	y	n	n	n	n		n	10	n	n	3000 - 6000	180000	
1994	DODGE		12.5	805.2	449.3	n	n	n	y			n	3	n	n	3000-4000	130000	
1998	DODGE	STRATUS	6.657	308.2	132.5	y	n	n	n		Light has been checked even before I got the car and has remained so.	n	0	d	n	3000	126000	On May 31st when you sampled me, I was either on the gas needed or just got gas. It was 4 weeks since I last got gas.
1999	HONDA	PASSPORT	3.162	146.8	38.2	y	n	n	y	n	On 5/22/07 I had the EGR valve and the ingition gaskets replaced.	y	8	y	n	3500	112500	
1979	PONTIAC		2.595	205.1	390.2	n	n	n	n			n	2	n	n	As needed	55546	
1996	FORD		4.068	1614	314.6	y	y	y	y		Stalls only in reverse	n	0	d	n	awh	210560	
1991	DODGE		3.142	1048	306.9	n	n	n	y			y	1	d	n	5000		
2006	SAAB	97X	2.585	-2.7	16.8	n	n	n	n	n		n	1	d	y	Scheduled service	30000	
1996	FORD	LGT CONVTNL `F`	6.741	245.3	212.4	n	n	n	n	n		n	1	n	n	3000	55000	
1996	SAAB		3.572	1652	383.1	y	n	n	y			n	3	n	n	3-4 months	190000	
1995	VOLVO		0.078	654	803.2	n	n	n	n	n		n	4	n	d	3000	30000	
1995	FORD	TAURUS	4.312	36.6	82.7	y	y	n	n	y	It ticks.	n	7	d	n	3000	120000	
1997	SATURN	SL2	6.22	514.6	511.3	y	n	y	n			y	2	n	n	6 months	46000	
1996	JEEP		1.619	640.5	550.3	n	y	n	n			n	5	d	n	3500	197586	
1946	FORD		5.438	66.7	314.3			y				y	5	n	n	4000	10000	
1998	CHEVROLET	CAVALIER	2.039	19.4	-34.7	y	y	n	n			n	9	n	n	3500	202000	
2004	JEEP		2.359	13.1	-106.7	n	n	n	n	n		n	4	n	d	3000	30000	
1998	DODGE	INTREPID	2.748	47.6	171.9	n	n	n	n	y	Absolutely perfect	n	1	d	y	4000	72283	
1999	MERCURY	COUGAR	3.266	112.6	-15.4	n	n	n	n	n		n	1	d	n	3000	108000	
1989	FORD	CLUBWGN	2.627	136.1	415	n	n	n	n			n	14	n	n	3000	128522	
1999	FORD	EXPLORER	0.452	580.6	277.3	y	y	n	n	y	Rough acceleration at times	y	3	n	n	3000	116000	
1997	DODGE		2.029	-7.9	94.5	n	n	n	n			n	0	n	n	4000	144800	
1998	JEEP		11.52	538.7	401	n	n	n	y			y	3	n	n	3000	160000	
1997	PONTIAC		11.23	483.5	245	y	y	y	y			n	4	y	n	5000-8000	138000	Returned both surveys together. Answers reflect condition before repairs. Person replaced his O2 sensor himself.
1987	JEEP		7.645	335.3	205.1	n	n	n	n	y	Runs rich (now fixed)	y	6	n	n	At scheduled intervals	180000	
1996	FORD	ECONOLN VAN SUPR	3.072	22.8	443.4	n	n	n	n	n		n	3	d	n	3000	164306	
1991	CADILLAC		2.623	137.1	680.1	y	n	n	n			n	3	d	n	6 months	88000	
2001	VOLKSWAGEN	CABRIO	7.959	693.2	230	n	y	n	y	n		y	1	n	y	5000	62000	

Year	Make	Model	CO_PCT	PPMHCHEX	PPMNO	Q1A_CHECK	Q1B_VIBRATE	Q1C_SMOKE	Q1D_STALL	Q1E_OTHER	Q1E_TEXT	Q2_SERVICE	Q3_OWNED	Q4_EMISS_PROB	Q5_WARRANTY	Q6_OILCHANGE	Q7_MILES	SURVEY_COMMENTS
2006	FORD	FIVE HUNDRED	0.966	993.6	483	n	n	n	n	n		n	1	n	y	3000	29000	
1992	CHEVROLET		3.944	286.8	793.7	y	n	n	n	n		y	0	n	n	1 month	3000	
1988	BUICK		-0.014	1227	1356	y	n	n	n			y	2	n	n	3 months	210000	
1981	LINCOLN		2.933	2312	13.5	n	n	n	n			n	4	y	n	15000	172000	
1994	PONTIAC		2.855	277.9	954.1	y	y	n	y			n	3	n	n	4 months	190000	
1999	HONDA	CR-V	2.152	131.3	6.5	n	n	n	n	n		n	5	n	n	5000	145000	
1991	PLYMOUTH		7.223	300.7	362.2			y				y	16	n	n	4000	150000	
2005	SATURN	ION	3.302	-16.3	0.5	n	y	y	n	n		n	2	n	n	3000	75000	
1997	TOYOTA	RAV4	3.005	159.3	631.9	n	n	n	n	n		n	10	n	n	4000	133000	My car passed your "watch zones" on at least 4 separate occasions - only one time did the "poor" sign show. My car is maintained by my mechanic every 30,000 miles & is in excellent shape.
1990	CADILLAC		2.053	2409	2161	y	y	y	y			n	2	y	n	3-4 months	168000	
1995	CHEVROLET		2.158	123.4	334.3	n	y	n	y			n		d	n	3000	106436	
1990	OLDSMOBILE		2.762	1418	337.8	n	n	n	n	n		n	5	n	n	3 months	166677	
1992	CHEVROLET		7.637	1407	585.9	n	y	y	y	n		n		y	n	3000	262000	
1995	CHEVROLET		2.065	80.2	156.1	n	n	n	n	n		n	5	n	n	2000	276379	
1986	CHEVROLET		5.923	408.7	317.8	y	n	n	n	n		y	4	n	n	3 months	14812	
1989	CHEVROLET		0.557	511.4	2392	n	n	n	n	n		y	0	n	y	3 months	40475	
1998	OLDSMOBILE	88	2.998	83	19.1	y	n	n	n	n		n	5	n	n	3000-5000	125000	
1991	FORD	PROBE	2.018	226.5	395.5		n	n	n	n		y	15	n	n	2000	162910	
1989	FORD	PROBE	0.628	701.7	1914	n	n	n	n	y	Minor reduction in oil level	n	18	n	n	3000	159000	
2001	TOYOTA	CAMRY	5.829	146.3	-79.6	y	y	n	n	n		n	2	d	n	3 months	60000	
1990	PLYMOUTH		0.476	624	1825	n	n	y	n	n		n	0	n	n	3000	194000	
1995	PLYMOUTH	NEON	0.584	576	2607	y	n	y	n			n	5	n	n	4000	174000	
1993	FORD	LGT CONVTNL \`F\`	9.978	85.1	14.8	n	n	n	n			n	6	d	n	5000	121634	
1994	PLYMOUTH	VOYAGER	12.18	582.7	348.1	n	n	y	n	n		n	13		n	3000	232000	
1989	FORD	CROWN VICTORIA	0.899	1735	739.6	n	n	n	n	y	Gas line leak/bad coil	y	10	y	n	4000	176000	
1998	FORD	CONTOUR	6.485	460.4	-111.2	y	n	n	n	n		n	9	n	n	5000	107000	I already diagnozed the problems after received this notice. I will make appointment to fix the problems.
1998	FORD		5.761	190.3	125.3	y	n	n	n	n		y	8	y	n	3000	150000	
1996	FORD		5.941	28.3	19.1	n	n	n	y			n	1	n	n	4 months	100000	
1993	GMC	SAFARI	2.608	28.1	78.2	n	n	y	n	n		n	7	y	n	once a year	144150	
1988	BUICK		0.794	615.4	-15.7	y	y	n	n			n	5	n	n	3000	200000	
2005	PONTIAC	GRAND PRIX	2.318	-25.6	126.2	n	n	n	n			n	2	n	n	4000	43000	
1998	CHEVROLET	CAVALIER	4.574	196.7	1427	y	y	n	n			n	2	d	n	3000	123588	
1986	CHEVROLET		8.023	2431	734.8	n	n	n	n			n	0	n	n	Often	158409	
1991	OLDSMOBILE		3.881	189.3	137.7	y	y	n	n	n		n	1		n	3000	106000	
1993	SATURN		2.166	493.2	140.6		n	n	y			y	14	n	n	3000	147000	
1995	CHEVROLET		0.796	538.2	3307	n	y	y	n	y	Recently tuned	y	2	y	n	6 months	146000	
1999	MERCURY	COUGAR	7.115	211.6	166.1	y						y	9	n	n	6 months	57431	Car taken to Hines Park Licoln Mercury 5/25/07
1993	PLYMOUTH	ACCLAIM	4.241	101.6	81.9	n	n	n	n	n		n	1	n	n	3 months	100000	
1989	FORD		14.18	898.6	101.9	n	n	n	n			n	3	n	n	3000	160000	
1992	EAGLE	TALON	1.177	651.7	3063	n	n	y	n		Lots of after-market racing components.	n	8	y	n	3000	208000	Passed emission equipment several times. Most at cruise or mid acceleration. These either never registered or said fair. While at full throttle accel., system noted "fail". Has had o2 sensor replace
1995	MERCURY	MARQUIS	2.057	211.8	107.7	y	n	n	n			y	5	y	n	3000	132000	Just replaced oxygen sensor - on 2 days testing was done, my car tested good before I replaced sensor and fair the day after. Any suggestions you have for better gas mileage - let me know.
1993	MERCURY	SABLE	2.403	75.9	287.9	y	n	n	n			n	12	y	n	6000	217000	
1990	CHEVROLET		2.941	8415	2915	n	y	n	n	n		n	2	y	n	3000	138602	
1995	HONDA		2.823	271.7	83.5	n	n	y	n			n	3	d	n	3000	190000	
1993	ACURA		0.853	1784	638.6	n	n	n	n	n		n	2	n	n	4 months	170000	
1996	DODGE		2.008	218.5	469.9	n	n	n	n			n	0	n	n	5000	117000	
1993	FORD		2.125	301.1	153.1	y						n	2	n	n	6 months	210000	
1994	CHEVROLET		2.117	243.5	148.2	y	y	y	y	y	exhaust/odor smell	y	2	y	n	3000-5000	108000	Indicated they took vehcile in. O2 was tuned up, catalytic converter was missing. Equip. was repaire/replaced. Noted that engine/vehicle was "much improved". Included his repair recepts.
1997	FORD	TAURUS	2.004	-12.2	236.8	y	n	n	n	y	vss failed as wire harness burned. It was installed too close to manifold.	n	10	n	n	3000	212000	Fixed vehicle myself.
1994	SATURN		2.387	104.3	60.1	y	y	n	n			n	2	n	n	3000	160000	

Year	Make	Model	CO_PCT	PPMHCHEX	PPMNO	Q1A_CHECK	Q1B_VIBRATE	Q1C_SMOKE	Q1D_STALL	Q1E_OTHER	Q1E_TEXT	Q2_SERVICE	Q3_OWNED	Q4_EMISS_PROB	Q5_WARRANTY	Q6_OILCHANGE	Q7_MILES	SURVEY_COMMENTS
1999	MERCURY	COUGAR	2.688	218.3	51.6	y	n	n	n	y	high gas consumption	y	2	n	n	per manual	102000	
1995	NISSAN		2.035	39.7	101.2	y	n	n	n	y	Vehicle vibrates when driving.	n	1	y	n	3 months	155000	
1993	CHEVROLET		7.854	3017	498.3	n	n	n	n	n		n	1	n	n	15000	123000	
1998	FORD	CONTOUR	8.951	95.4	48.6	y	y	n	y			n	7	d	n	4 months	111000	Recently sold vehicle.
1990	PONTIAC		10.53	1013	307.6	n	n	n	n			n	1	n	n	5000	127754	
1995	FORD	ESCORT	8.214	161.3	45.2	y	y	n	y			n	8	d	n	3500	100000	
1999	CHEVROLET	ASTRO VAN	0.136	652.3	48.8	y	y	n	n	y	Engine running rough during first start. Took car in for service recently for the issue. $800 in repairs.	y	8	n	n	4000	90000	
1992	FORD	LGT CONVTNL `F`	2.978	825.2	680.8	n	n	n	n			n	5	y	n	4000	201486	
1985	FORD		4.238	864.7	952.3	n	n	n	n	n		n	15	n	n	1000	91000	New carb is being installed
1993	BMW		4.956	298.5	48	n	n	n	n			n	3	n	n	4000	152000	
1995	CHRYSLER		1.507	1028	370.3	n	n	n	n	n		y	3	n	n	3000	200000	
1995	CHEVROLET	BLAZER	3.357	222.7	908.7	y	n	n	n	n		n	5	d	n	3000	160000	
1999	FORD	RANGER	2.566	16.6	-1.1	n	n	n	n			n	8	n	n	3000-3500	107000	

	S2_Q1_Serviced	S2_Q2_Repaired	S2_Q2_Yes_Cost	S2_Q2_Yes_Warranty	S2_Q2_NO_Reason
Yes	50	37		3	0
No	77	27		39	0
No response	0	63		85	127
	127	127		127	127
% of responses:					
Yes	39%	29%		2%	0%
No	61%	21%		31%	0%
No response	0%	50%		67%	100%

Year	Make	Model	CO_PCT	PPMHCH	PPMNO	S2_Q1_Serviced	S2_Q2_Repaired	S2_Q2_Yes_Cost	S2_Q2_Yes_Done	S2_Q2_Yes_Warranty	S2_Q2_NO_Reason	S2_Q2_NO_Estimate	S2_Q2_NO_OTHER	S2_Q3_NO_Service	S2_Q3_Other	S2_Q3_Other_Comment	S2_COMMENT
1987	MERC BENZ		5.4	591	473	n								1		Most places not willing to work on a 1987 Merc Benz because of cost and unable to get replacement parts for such an old car. Car is driven for pleasure. Not every day.	
1994	CHEVROLET		4.8	456	320	y	n			n	2	250					Said it needed tires, brakes & oil checked.
1987	LINCOLN		4.9	206	25	n								7		I have since put the vehicle up for sale.	
1997	BMW		4.2	87	183	n	n				2						
1991	CHEVROLET	CAPRICE	0.8	2,323	941	y	y	175	Tune up [ ] wires [rotor & cap], tiiming check, fule filter	n							
1987	BUICK		12.8	1,868	884	n								7			Said she didn't do the survey because a drunk hit her car and totaled it.
1997	DODGE		2.4	78	(83)	y	y	425	At a shop	n							
1998	PONTIAC	TRANS SPORT	2.0	178	59	n					1						Also checked "Didn't have time" on question 3.
1994	CADILLAC		2.4	179	386	n								1			
1989	CADILLAC		0.5	1,655	2,369	y	y	250	Had to get a oil pan.								
1992	FORD	TAURUS	3.4	205	89	n								7		Vehicle was traded for a new one	
1984	CHEVROLET		6.3	303	156	n								1		Working on car at home.	
1997	CHEVROLET	LUMINA	4.9	292	544	n	n				2	1200					
1992	GMC		9.3	5,671	1,251	n							Had replaced fuel pump and filter to improve gas mileage several months ago	7		Vehicle too old and on last legs.	
1996	LINCOLN		4.4	73	39	y	n				2	200					
1991	VOLKSWAGEN	JETTA	5.7	378	368	y	y	280	tune up, oil change, fuel filter, fuel injection adjustment.								
1994	DODGE		12.5	805	449	n								1			
2007	SATURN	VUE	2.1	7	52	n								5			You flagged the wrong vehicle. My 2007 vehicle is fine. I just ransferred the plates from a 1993 Toyota MRZ. That is probably the car with high emissions. Unfortunately, I just sold that car.
1998	DODGE	STRATUS	6.7	308	133	n	n				2		I have it for sale because I'm not working due to cancer. No extra money available.				
1994	FORD		4.6	206	89	y	n			n	1						
1991	DODGE		3.1	1,048	307	n								1		Bad economy, can't afford to drive a nice vehicle.	
1996	SAAB		3.6	1,652	383	n								1		Also checked "Don't feel my vehicle has a pollution problem"	
1995	FORD	TAURUS	4.3	37	83	n								7		car too old	
1990	CHEVROLET		3.5	2,500	1,343	y	y	100	The spark plug wires were bad and were replaced								
1997	SATURN	SL2	6.2	515	511	y	n			n	8	800	They said ther is no hope for my car its just too old.				
1998	DODGE	RAM TRUCK	1.5	1,161	448	y	y	135	clean fuel injector and new spark plug wires	n							
1998	CHEVROLET	CAVALIER	2.0	19	(35)	n								1			hope to purchase a new, more environmentally friendly vehcile soon
1994	OLDSMOBILE		10.4	460	224	n								1			
2004	JEEP		2.4	13	(107)	n					1		Had vehcile in for oil change. They said not needed.				

Year	Make	Model	CO_PCT	PPMHCH	PPMNO	S2_Q1_Serviced	S2_Q2_Repaired	S2_Q2_Yes_Cost	S2_Q2_Yes_Done	S2_Q2_Yes_Warranty	S2_Q2_NO_Reason	S2_Q2_NO_Estimate	S2_Q2_NO_OTHER	S2_Q3_NO_Service	S2_Q3_Other	S2_Q3_Other_Comment	S2_COMMENT
1995	FORD		1.6	754	713	n								5		do my own repairs	
1999	DODGE	RAM VAN	2.0	389	563	y	n				3		Scrapped the vehicle				
1991	JEEP		7.3	215	118	n	n				3		I didn't see a letter telling me to service it before this one.				
1999	MERCURY	COUGAR	3.3	113	(15)	y	y	300	sensor¿								
1989	FORD	ECONOLINE CLUBWGN	2.6	136	415	n								7		Van is idling and running well. Perhaps your test equipment is not accurate?	
1983	CHEVROLET		9.9	399	560	n								7		Motor blew up. Truck is not running. Need new motor.	
1992	CHEVROLET		4.6	260	245	n								1			
2000	CHEVROLET	SILVERADO	3.4	26	(3)	n								7		Vehicle was traded for a new one	
1997	DODGE		2.0	(8)	95	y	y	247	Tune-up, filters, bad belt.	n							
1998	JEEP		11.5	539	401	n								7		My husband is repairing it. Also checked "Couldn't afford"	
1997	PONTIAC		11.2	484	245	y	y	66	O2 sensor replaced	n							Fixed it myself. Mileage fully restored (25 mpg) exhaust gas smell is gone, idle is fine, power is back, stalling is very rare.
2000	CHRYSLER	NEON	5.5	462	738	y	y	627	Brake shoe, wheel cylinder/RT and LT, rotor, drum	y							
1996	FORD	ECONOLN VAN SUPR	3.1	23	443	n								1		Other more urgent needed repairs were done. Shortly, within a month, will take it for estimate to do the needed repairs.	
1991	CADILLAC		2.6	137	680	n								1		Also checked "Didn't know where to take the vehicle"	
2006	FORD	FIVE HUNDRED	1.0	994	483	n								5		Also checked "Didn't have time"	
1992	CHEVROLET		3.9	287	794	n	n			n			Fixed myself	7		Fixed myself	
1988	CADILLAC		4.2	354	1,177	n	n			n	2			1			
1981	LINCOLN		2.9	2,312	14	y	n				1						
1994	SATURN	SC1	2.4	162	103	n								1			
1991	FORD		0.4	650	(9)	y	y	40	aprk plugs, wires	n							
1991	PLYMOUTH		7.2	301	362	y	n				2	2000	Need new engine. Car too old.				
2005	SATURN	ION	3.3	(16)	1	y	n				1						
1997	TOYOTA	RAV4	3.0	159	632	y	n				1		Cost me $80 and nothing is wrong. Nice way to spend $ while my husband is unemployed in this state!				
1989	HONDA		2.5	98	92	n								1			Never received the first notice.
1996	MITSUBISHI	GALANT	2.8	205	434	y	y	300	Muffler	y							
1995	CHEVROLET		2.1	80	156	y	n			n	3		My car has 275,000 miles and the emissions aren't expected to be very good				
1994	DODGE	SHADOW	4.1	374	25	n				n				7		I repair/complete tune-up of this car myself.	
1986	CHEVROLET		5.9	409	318	n	n			n				1			
1987	DODGE		3.3	130	767	y	y	65	carburater adjustment	n							
1994	FORD		3.4	99	152	n								7		It's a car I don't normally drive.	
1989	CHEVROLET		0.6	511	2,392	n								1			
1995	MERCURY		4.1	52	21	n								5			
1994	FORD		3.2	94	63	y	y	300	New exhaust system	n							
1989	FORD	PROBE	0.6	702	1,914	n								7		Due to a major internal engine coolant leak - at the exhaust manifold to turbo interface - the vehicle is currently not drivable. Once the leak is repaired, will take the vehicle in for diagnosis.	
1996	FORD	WINDSTAR	1.5	1,417	923	y	y	484	Muffler shop	n							
1997	EAGLE	VISION ESI	0.0	705	684	n								7		Car being disposed of	
2001	TOYOTA	CAMRY	5.8	146	(80)	y	y	860		n							
1995	PLYMOUTH	NEON	0.6	576	2,607	n								7		Sold the car	
1993	FORD	LGT CONVTNL `F`	10.0	85	15	n								3			No time as of 7-2-07. Planning for a major tune up.
1998	FORD	CONTOUR	6.5	460	(111)	y	y	450	Replaced intake manifold gaskets and oxygen sensors.	n							
1998	FORD		5.8	190	125	y	n				3		Mechanic's part worked for two weeks. Replacement part defective. Will need to take the vehicle back to the mechanic.				
1994	CHEVROLET		4.1	135	993	n								7		No longer own vehicle	
1996	FORD		5.9	28	19	n								1			
1991	CHEVROLET		3.8	337	583	n								1			

Year	Make	Model	CO_PCT	PPMHCH	PPMNO	S2_Q1_Serviced	S2_Q2_Repaired	S2_Q2_Yes_Cost	S2_Q2_Yes_Done	S2_Q2_Yes_Warranty	S2_Q2_NO_Reason	S2_Q2_NO_Estimate	S2_Q2_NO_OTHER	S2_Q3_NO_Service	S2_Q3_Other	S2_Q3_Other_Comment	S2_COMMENT
1993	CHEVROLET		4.6	6,194	1,509	y	n				3		computer sensor				
1993	GMC	SAFARI	2.6	28	78	n								1			
1992	CADILLAC	SEVILLE	6.4	328	256	y	y	140	radiator tubing - overheating	n							
1998	SATURN	SL1	0.7	520	2,795	n								7		Never received other previous letter informing me there was an issue. This lettter was the first I heard about. Please send me a copy of original letter, thank you.	
1988	BUICK		0.8	615	(16)	n								5		Also checked "Didn't know where to take vehicle"	
2005	PONTIAC	GRAND PRIX	2.3	(26)	126	n								1			
1998	CHEVROLET	CAVALIER	4.6	197	1,427	y	n				1						
1986	CHEVROLET		8.0	2,431	735	n								3			
1991	OLDSMOBILE		3.9	189	138	y	y	179	air filter and spark plugs	n							
1993	SATURN		2.2	493	141	n								7		Sold car.	
1995	CHEVROLET		0.8	538	3,307	y	y	100	Plugs, wires & filters	n							
1993	BUICK	LESABRE	2.2	24	274	n								7		I do not own this car any longer.	
1999	FORD	CONTOUR	2.5	20	(12)	n								7			
1999	MERCURY	COUGAR	7.1	212	166	y	y	144	Tune-up, replace O2 sensor	n							
1989	VOLVO		2.0	547	799	n								5			
1993	PLYMOUTH	ACCLAIM	4.2	102	82	y	y	85	Plugs & air filter	n							
1989	FORD		14.2	899	102	y	y	21	oil change	n	1						
1992	EAGLE	TALON	1.2	652	3,063	y	y	85	o2 sensor replaced. Repairs done myself.	n							I still feel it would not pass. Too much after-market racing products on car.
1995	MERCURY	MARQUIS	2.1	212	108	y	y	550	EGR valve and part that controls oxygen flow to valve	n							
1995	FORD		11.6	729	143	n	n							7		I am in process of selling vehicle	
1993	MERCURY	SABLE	2.4	76	288	n								7		Abbv: vehicle had $1,200-$1,300 of other work done recently and still needs air cond. Work. Plus son's vehicle recently had engine work. Also checked "Didn't have time".	
1990	CHEVROLET		2.9	8,415	2,915	n	n				2	379		1			
1984	FORD		2.4	1,800	1,899	n								7		no longer own this vehicle	
2003	FORD	TAURUS	2.0	33	5	n								3			
1996	DODGE		2.6	353	444	n								7		Sold vehicle	
1993	ACURA		0.9	1,784	639	n								5			
1996	DODGE		2.0	219	470	n								1			
1993	FORD		2.1	301	153	n				n				5		Also checked " Couldn't afford to have vehicle serviced" and said "my friend does work on van. Doesn't see a problem".	
1994	CHEVROLET		2.1	244	148	y	y	183	Replaced catalytic convertor (himself)	n							Provided copies of his receipts
1992	CHRYSLER		0.5	1,047	719	n								7		Car is considered a "necessity" vehicle and is only driven as needed - do not want to invest any more than necessary.	
1997	FORD	TAURUS	2.0	(12)	237	n	y		tune up engine, replace plugs - self service	n						Don't trust them and cost est. extremely high. If you have free car check service for exhaust system, I may consider it. Thx	Your effort to check car emission quality is appreciated. However, you need to provide free emission check diagnosis service centers so we can take it and get fixed and not get robbed at Joe's Garage.
1994	SATURN		2.4	104	60	y	n				1						
1999	MERCURY	COUGAR	2.7	218	52	y	y	400	EGR, Catalytic converter	n							
1995	NISSAN		2.0	40	101	n	n				2		Too many things wrong with car, would never be able to affor to repair				
1993	CHEVROLET		7.9	3,017	498	n	n			n	1						
1990	PONTIAC		10.5	1,013	308	n		179						7		I'm not keeping this vehicle.	
1995	FORD	ESCORT	8.2	161	45	n					3		I haven't been driving this vehcile..				I will eventually service the vehicle.
1993	FORD	\`F\`	4.6	293	142	n								7		I do my own vehicle repairs/ tune-ups	
1999	CHEVROLET	ASTRO VAN	0.1	652	49	y	y	600	Tune up, EGR system check/leak repair. Head gasket replaced	n							
1989	GMC		3.7	155	212	n	n							7		Sold Vehicle	
1994	PLYMOUTH		11.9	594	363	n								1			I bought another car and I don't have the money to get repairs on the 92 Tempo yet. But, I do plan on getting a tune-up for the Tempo soon.

Year	Make	Model	CO_PCT	PPMHCH	PPMNO	S2_Q1_Serviced	S2_Q2_Repaired	S2_Q2_Yes_Cost	S2_Q2_Yes_Done	S2_Q2_Yes_Warranty	S2_Q2_NO_Reason	S2_Q2_NO_Estimate	S2_Q2_NO_OTHER	S2_Q3_NO_Service	S2_Q3_Other	S2_Q3_Other_Comment	S2_COMMENT
1992	FORD	LGT CONVTNL `F`	3.0	825	681	n								1			My choice pay med ins., wages, or gas to get to work. My truck need catyl .conv. No money to pay for it.
1996	PONTIAC		3.1	9	(264)	y	n				2	1000					
1997	FORD		0.2	1,233	594	y	y	550	water pump, radiator	n				1			Need more costly repairs, can't afford at tis time.
1985	FORD		4.2	865	952	y	y	400	new carburetor	n			Not completed, needs adjusting. Run for awhile and take back.				
1991	CHEVROLET		9.7	1,238	568	n	y	10	replaced air filter					5		Also checked "Didn't have time" and "Just not interested".	Are there too many emissions by today's standards or by levels a 1991 vehicle is designed to emit? This auto has 160,000 miles on it. It makes 27 mpg on the highway! For a 16 year old auto that is gre
1995	BMW	740I	3.4	242	890	y	y	48	oil and filter change	n							
1993	BMW		5.0	299	48	y	y	50	Replace air filter/cleanup throttle body	n							Note: The vehicle runs much better and smooth in transition between speeds. Thanks.
1995	CHRYSLER		1.5	1,028	370	y	y	150	all the exhaust. Plugs	y							
1977	MERCURY		2.6	58	1,088	y	y	786	Gear box, ball joints	n							
1999	SATURN	SC1	3.3	133	183	y	y	300	changed water pump	n			Additional repairs are also necessary & would cost an additional $1,000				This is a second car I keep for my out-of-state children when they visit me. It has 186,000 miles and the costs for repairing are too high in relation to the value of the car.
2007	CHRYSLER		0.1	1,405	59	n								7		I will talk to the service department about it when I take it in for its next scheduled oil change next month.	
1995	CHEVROLET	BLAZER	3.4	223	909	n								1		Aslo checked "Didn't have time" and "Don't feel vehicle has a problem"	
1999	FORD	RANGER	2.6	17	(1)	n								7		Attached 2-paragraph note detailing extensive routine maintenace done on vehicle. Said also that he "throttles quite heavily when entering freeway traffic".	Respondent had called SEMCOG earlier to ask where and how he was tested. Thinks problem was due to heavy acceleration entering freeway. Not worth repairing if it has a problem.

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