1994

On-Road Remote Sensing of CO and HC Emissions in California

Donald H. Stedman

Gary A. Bishop

Stuart P. Beaton

James E. Peterson

Paul L. Guenther

See next page for additional authors

Authors
Donald H. Stedman, Gary A. Bishop, Stuart P. Beaton, James E. Peterson, Paul L. Guenther, Iain F. McVey, and Yi Zhang

CONTRACT NO. A032-093
FINAL REPORT
FEBRUARY 1994

On-Road Remote Sensing of CO and HC Emissions in California

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

AIR RESOURCES BOARD
Research Division

ON-ROAD REMOTE SENSING OF CO AND HC EMISSIONS IN CALIFORNIA

Final Report
Contract No. A032-093

Prepared for:

Research Division
California Air Resources Board
1800 15th Street
Sacramento, CA. 95812

Submitted by:

University of Denver
Chemistry Department
Denver CO, 80208

Prepared by:

Donald H. Stedman
Gary A. Bishop
Stuart P. Beaton
James E. Peterson
Paul L. Guenther
Iain F. McVey
Yi Zhang

February 1994

DISCLAIMER

The statements and conclusions in this report are those of the contractor and not necessarily those of the California Air Resources Board. The mention of commercial products, their source, or their use in connection with material reported herein is not to be construed as actual or implied endorsement of such products.

ACKNOWLEDGMENTS

The California Air Resources Board supported the University of Denver for this research as part of contract A032-093. The Auto/Oil Air Quality Improvement Program funded General Motors to participate. The Environmental Protection Agency supported the participation of the University of Nevada, Las Vegas. We thank the management of Santa Anita Park for their cooperation in allowing us to perform work in their parking lot. We are indebted to the U.S. EPA Mobile Source Emissions Research Branch under Kenneth T. Knapp for supply of the portable dynomometer and contractor to operate it. We thank Mary Edens and Ian Stedman for their awesome tape reading abilities. The authors would like to acknowledge and thank Automotive Testing and Development Services and Aersol Dynamics which were contractors on this project. The authors would also like to thank the project officers Lowell Ashbaugh and Doug Lawson for all of their help and scientific expertise.

This report was submitted in fulfillment of A032-093, On-Road Remote Sensing of CO and HC Emissions in California by the University of Denver under the sponsorship of the California Air Resources Board. Work was completed as of February 1994.

ABSTRACT

The University of Denver remote sensor for on-road measurement of motor vehicle carbon monoxide and hydrocarbon emissions was used for 30 days in California in 1991. The resulting data set is the largest ever collected by a remote sensor emissions testing program. We made more than 130,000 measurements, resulting in 91,679 records with emissions and vehicle information (from the California Department of Motor Vehicles). We measured vehicles in a mix of many driving modes and speeds ranging from deceleration approaching a red traffic light through idling in heavy congestion to accelerations and cruises entering a freeway ramp at highway speeds. The remote sensing device measures the CO/CO_2 and HC/CO_2 ratios for one-half second behind each vehicle, from which the exhaust %CO and %HC are calculated. The mass emission rates in grams CO or HC per gallon of gasoline used can also be derived.

The study consisted of three phases; a series of controlled tests, a pullover study of high-emitters, and a series of measurements at a variety of sites around the South Coast Air Basin and northern California. The controlled tests included a blind comparison of remote sensor measurements to those made by an instrumented vehicle, and a series of tests of nearly two dozen vehicles under controlled conditions of cruise, acceleration, and deceleration. The pullover study was designed to investigate the ability of the remote sensor to identify high-emitting vehicles, during on-road conditions, for further roadside testing by a crew of California Air Resources Board and Bureau of Automotive Repair technicians. The third phase surveyed the fleet emissions at a variety of locations and under a variety of driving conditions. Vehicles that fail to participate in random roadside inspections appear to have much higher on-road emissions than those of participants. For this reason these studies should not be assumed to be "random".

During the controlled testing phase, the on-road measurements were compared in a blind test to those measured by a vehicle equipped with a tailpipe probe, trunk-mounted CO and HC monitors, and computer control of the vehicle's air/fuel ratio. Compared to this vehicle of known emissions, the remote sensing measurements are shown to be accurate within ±5% for CO and within ±15% for HC. We investigated inter-vehicle and intra-vehicle emissions variability by measuring the emissions of 23 vehicles under a variety of operating conditions. The most consistent emissions occurred for most vehicles at a steady cruise of 15-45 mph. The highest CO emissions occurred during hard accelerations, while the highest HC emissions occurred during decelerations. Hydrocarbon emissions were lowest during the acceleration modes.

The results of this study verify those found in previous CARB studies of CO emissions and extend the results to HC. On-road hot exhaust emissions of both CO and HC are dominated by the 10%-20% of vehicles that are gross polluters, while the majority of vehicles in all model years are relatively clean. Gross polluters can be found in all model years, although their fraction increases in the older model years. The majority of the on-road emissions at the locations studied comes from vehicles less than ten years old. The pullover study is

consistent with the previous study (Stedman *et al.*, 1991b), and indicates that gross polluters identified by on-road testing have more than a 92% chance of failing a roadside Smog Check, and that more than 60% have either tampered or defective emission control equipment. In comparison to a roadside IM240 we show that the remote sensor had a zero false failure rate.

Maintenance seems to be an important factor in mobile source emissions. The emissions of older well-maintained non-catalyst vehicles in Sweden are nearly the same as those of the equivalent fleet of originally catalyst equipped vehicles in Los Angeles. The primary difference between the two fleets appears to be the level of maintenance. The emissions of well-maintained non-catalyst vehicles in Sweden are higher, however, than the well-maintained catalyst-equipped Swedish vehicles in Los Angeles. The primary difference here is the emission control technology. Emission controls and maintenance are <u>both</u> required for low emissions of the on-road fleet.

These results are consistent with the idea that the beneficial effects of tighter new car emissions standards and reformulated fuels may be obscured by the emissions of a small fraction (10%-20%) of poorly maintained and tampered vehicles. Nearly all on-road gross polluters identified in 1991 had passed the biennial Smog Check. One explanation for this is that Smog Check fraud or outright cheating may be common. However, we also show that many high emitting vehicles have variable emissions. This latter result, which seems to be independent of the test procedure, allows owners to "pass the test" without repairing the vehicle.

As before we have shown that assuming equal exhaust volumes on-road emissions are dominated by a few gross polluters, and many vehicles emissions are negligible. For instance for 3,624 vehicles measured three or more times, 60% of the vehicles consistently emit less than 12% of the total CO and 50% of the vehicles account for less than 20% of the total HC emissions. On the other extreme are 3% of the vehicles which emit 23% of the CO and 27% of the hydrocarbon emissions. The presence of these gross polluters, the fact that many are not old cars, have implications bearing upon the cost effectiveness of any program which treats all vehicles, or all vehicles of a given age, as equally polluting.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

Urban air quality does not meet the federal standards in many cities. Violations of the ozone standard arise from photochemical transformation of oxides of nitrogen (NO_x) and hydrocarbons (HC). Carbon monoxide (CO) standards are primarily violated as a result of direct emission of the gas. Mobile sources are a major factor in all urban emissions inventories for carbon monoxide, hydrocarbons, and oxides of nitrogen.

Air pollution control measures to mitigate mobile source emissions in non-attainment areas include inspection and maintenance (I/M) programs, oxygenated fuel mandates, and transportation control measures. Nonetheless, many areas remain non-attainment past the 1987 deadline for compliance with federal standards, and some are projected to remain in non-attainment for several more years despite the measures currently undertaken. The remote sensing techniques discussed in this report may have the potential to contribute to further control measures in non-compliance areas.

In 1987, with support from the Colorado Office of Energy Conservation, the University of Denver developed an infra-red (IR) remote monitoring system for automobile carbon monoxide (CO) exhaust emissions (Bishop *et al.*, 1989). Significant fuel economy improvements result if rich-burning (high CO and HC emissions) or misfiring (high HC emissions) vehicles are tuned to a more stoichiometric and more efficient air/fuel (A/F) ratio. Therefore, the University of Denver CO/HC remote sensor is named Fuel Efficiency Automobile Test (FEAT). The basic instrument measures the carbon monoxide to carbon dioxide ratio (CO/CO_2) and the hydrocarbon to carbon dioxide ratio (HC/CO_2) in the exhaust of any vehicle passing through an infra-red light beam which is transmitted across a single lane of roadway. Figure 1 shows a schematic diagram of the instrument (U.S. Patent No. 5210702).

The 1990 U. S. Clean Air Act amendments require non-attainment areas to include "on-road emissions monitoring" in their post-1990 I/M programs. This language, the "Barton Clean Air Smog Trap Amendment" was included based on literature and demonstrations of remote sensing to the U. S. Congress by the University of Denver.

Objectives

The research described here was divided into three field tasks aimed at further testing the remote sensing technology under controlled and on-road conditions. The first task involved extensive testing of the remote sensor's ability to measure vehicles under carefully controlled conditions. This work included testing the recently added capability of the remote sensor to measure tailpipe hydrocarbon emissions. In addition, we verified both the CO and HC channels in a more extensive manner than during the previous study (Stedman *et al.*, 1991b). The second task involved using the remote sensing technology in the California Air Resources Board (CARB) and California Bureau of Automotive Repairs (BAR) random roadside pullover studies. The sensors were used both to preselect vehicles for the pullovers, and to

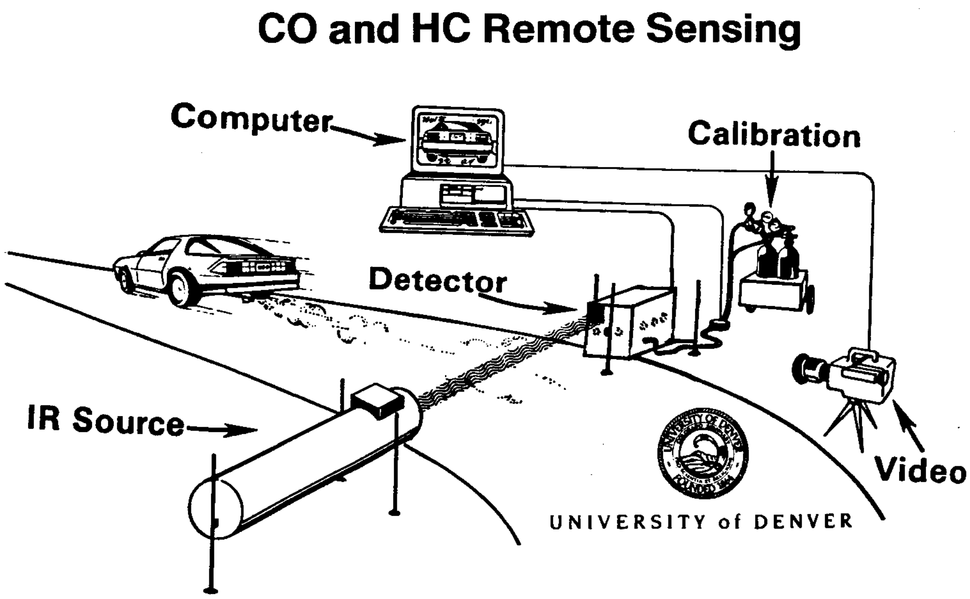


Figure 1. A schematic diagram of the University of Denver on-road emissions monitor. It is capable of monitoring emissions at vehicle speeds between 2.5 and 150 mph in under one second per vehicle.

remotely measure vehicles chosen at random by the roadside testing team. The third task was to field test multiple remote sensors and obtain information about on-road emissions variability as a function of operating mode. A fourth task consisted of analysis of data. The Request for Proposals specified analysis to include 1) variability of vehicle emissions by make, model year, and emissions control technology; 2) comparison of remote sensing to dynamometer tests; 3) analysis of emissions variability for the same vehicle under different operating conditions; and 4) analysis of the relationship between remote sensing measurements and the random roadside inspection tests.

In the first task, we repeatedly measured vehicles under controlled conditions in a variety of operating modes. This task was divided into two phases, one to verify the accuracy and precision of the remote sensors for CO and HC, and a second phase to study vehicle emissions variability as a function of operating mode. Both studies took place in a large empty parking lot where it was possible to drive the vehicles in a wide variety of controlled operating conditions. We verified the CO and HC channels by comparing them to measurements made by an instrumented vehicle capable of controlling and monitoring its own emissions over a wide range. In the second phase, we measured the emissions of twenty-three vehicles driven by trained drivers through a series of cruises, accelerations and decelerations.

We conducted the second task in conjunction with the BAR and CARB (both Mobile Source Division and the Research Division). Three remote sensors were set up during the 1991 Random Roadside Survey in various configurations to investigate the emissions of vehicles from different categories (e.g. volunteers versus refusals). In addition, we used the remote sensor emissions measurements for a ten day period in southern California to determine whether a vehicle would be stopped for inspection.

The third task involved the study of vehicle emissions variability under on-road, and therefore uncontrolled, driving conditions. This part of the field work attempted to quantify emission levels from vehicles operating in cold and warm start modes and vehicles operating under varying degrees of acceleration or deceleration. We also revisited some of the sites measured during the 1989 study.

In the fourth task, we analyzed the data in a number of ways. We examined the emissions variability of 23 vehicles under a variety of operating conditions, and compared the emissions of each vehicle for at least two different runs. We compared the emissions distribution at Lynwood to the distribution obtained in 1989-90 during the earlier CARB study. We compared the remote sensing measurements to those obtained on the random roadside inspections in both northern and southern California. We compared the emissions of vehicles in northern California to those of southern California, and for cars entering (warm engines) and leaving (cold engines) parking lots. We also compared automatic to manual transmission vehicles, examined the emissions by continent of origin, specifically examined Hyundais (which showed high emissions in 1989), and Swedish-manufactured vehicles. We also examined the variability of emissions as measured by remote sensing, low and high idle tests, and IM240 and the Federal Test Procedure (FTP) dynamometer tests. Finally, we examined the potential use of remote sensing to identify high-emitting vehicles.

The University of Denver analyzed the data, including video tape transcription, submission to BAR and Department of Motor Vehicle to obtain matching records, error checking, and final analysis. We carried this out in a similar manner to the previous DU/CARB and DU/State of Illinois projects. In particular, we compared the data to both our previous study in Los Angeles (Stedman *et al.*, 1991b) and other relevant data sets to which the University has access.

Structure of This Report

This report is organized in general accordance with the objectives described above. The remainder of this introductory section describes the FEAT instrument operation and calibration, and how to compute CO and HC emissions from the measurements obtained. The following section contains the bulk of the report, and discusses the results of each task of the research. The controlled testing conducted at Santa Anita park constitutes the first part of the results section. The results of the high emitter pullover study on Rosemead Boulevard follows next. The measurements at various sites around the Los Angeles basin are discussed third, including the analyses of the data. Finally, our conclusions from the overall research project are presented at the end of the report. The appendices contain data from the controlled testing and the high emitter pullover study. The remaining data are available on diskette from the Air Resources Board.

Theory of Operation

The FEAT instrument was designed to emulate the results one would obtain using a conventional non-dispersive infra-red (NDIR) exhaust gas analyzer.   Thus, FEAT is also based on NDIR principles. An IR source sends a horizontal beam of radiation across a single traffic lane, approximately 10 inches above the road surface. This beam is directed into the detector on the opposite side and divided between four individual detectors; CO, CO_2, HC, and reference. An optical filter that transmits infra-red (IR) light of a wavelength known to be uniquely absorbed by the molecule of interest is placed in front of each detector, determining its specificity. Reduction in the signal caused by absorption of light by the molecules of interest reduces the voltage output. One way of conceptualizing the instrument is to imagine a typical garage-type NDIR instrument in which the separation of the IR source and detector is increased from 10 cm to 20-40 feet. Instead of pumping exhaust gas through a flow cell, a car now drives between the source and the detector.

Because the effective plume path length and amount of plume seen depends on turbulence and wind, the FEAT can only directly measure ratios of CO or HC to CO_2. These ratios, termed Q for CO/CO_2 and Q' for HC/CO_2, are constant for a given exhaust plume. By themselves, Q and Q' are useful parameters to describe the combustion system. With a fundamental knowledge of combustion chemistry, we can determine many parameters of the vehicle's operating characteristics, including the instantaneous air/fuel ratio, grams of CO or HC emitted per gallon of gasoline (gCO/gallon or gHC/gallon) burned, and the %CO or %HC in the exhaust gas. Most vehicles show a Q and Q' of zero since they emit little to no CO or HC. To observe a Q greater than near-zero, the engine must have a fuel-rich air/fuel ratio and the emission control system, if present, must not be fully operational. A high Q' can be associated with either fuel-rich or fuel-lean air/fuel ratios coupled with a missing or malfunctioning emission control system. A lean air/fuel ratio, while impairing driveability, does not produce CO in the engine. If the air/fuel ratio is lean enough to induce misfire then a large amount of unburned fuel (HC) is present in the exhaust manifold. If the catalyst is absent or non-functional, then high HC will be observed in the exhaust without the presence of high CO. To the extent that the exhaust system of this misfiring vehicle contains some residual catalytic activity, the HC may be partially or totally converted to a CO/CO_2 mixture.

Instrument Details

The present design of University of Denver FEAT instruments incorporates CO (4.6µ), CO_2 (4.3µ), HC (3.3µ or in upgraded versions 3.4µ) and background (3.9µ) channels using interference filters built into Peltier-cooled lead selenide detectors. The instrument uses a mirror to collect the light and focus it onto a spinning twelve-faceted polygon mirror that provides a chopping frequency of 2,400 hz. The reflected light from each facet of the rotating mirror sweeps across a series of four focussing mirrors which in turn direct the light to the four detectors. Each detector thus gets a burst of full signal from the source in a sequential fashion for each measurement mode.

Each detector provides a pulse train at 2,400 Hz equivalent to the intensity of the IR radiation detected at its specific wavelength. Electronic circuitry averages twenty-four of these pulses, subtracts any background signal, and provides the averaged DC level to four signal ports. These are connected to the computer through an analog-to-digital converter.

All data from the CO, CO_2, and HC channels are corrected by ratio to the reference channel. This procedure eliminates other sources of opacity such as soot, turbulence, spray, license plates, etc. from providing data that could be incorrectly identified as CO or HC. Voltage levels are monitored in front of and behind each passing vehicle to eliminate effects of variable background concentrations.

Software written for these instruments computes %CO, %CO_2, and %HC on a dry basis from the measured CO/CO_2 and HC/CO_2 ratios. The %HC is reported as an equivalent concentration of propane. This procedure is different from the reported HC measurements in most I/M programs. Most I/M instruments are tested for a single propane/hexane response ratio. All subsequent calibrations are performed with propane. The I/M data are reported as "hexane equivalent" by dividing the measured number by the propane/hexane response factor (a divisor usually close to two). We measured this response factor for the FEAT using our calibration system, and obtained a divisor of 2.0. Nevertheless, we report our HC data in propane units because the device is, in fact, calibrated daily with propane.

Calibration

We perform two separate calibration procedures on every remote sensing unit. The first consists of exposure in the laboratory, using a path length of about 22 feet, to known absolute concentrations of CO, CO_2, and propane in an 8 cm IR flow cell. The curves so generated are used to establish the fundamental sensitivity of each detector to the gas of interest, and to derive an equation relating the observed lowered voltages to those concentrations. As expected, CO and CO_2 curves are non-linear. Because of the small amount of HC to which the instrument is exposed, the HC curve is closer to linear and is approximated by a linear equation. The equation for the calibration lines becomes an empirical component of the instrument data analysis algorithm.

Before each day's operation in the field, we perform a quality assurance calibration on the instrument with the system set up in the field. A puff of gas designed to simulate all measured components of the exhaust is released into the instrument's path from a cylinder containing industry certified amounts of CO, CO_2, and propane. The ratio readings from the instrument are compared to those certified by the cylinder manufacturer. Because of the curvature of the response functions, particularly for CO_2, the field calibrations (often made close to sea level) usually show higher ratios to CO_2 than those derived from the laboratory equations at 5300 ft. in Denver. The data for each day are adjusted by that day's correction factor.

We are currently working on a system to measure the concentration of NO in the exhaust gas using UV light. This system is currently undergoing on-road testing.

Software

The software that runs the system has been written with the philosophy that it is better to declare that a given vehicle's emissions are not correctly measured than to allow erroneous data into the database. The copyrighted software contains many checks that are used to detect potential errors. When errors are detected the measurement is rejected. A rejection sets an invalid data flag in the database. Two major criteria for rejection are: 1) observing insufficient signal change to measure any exhaust components accurately, and 2) observing excessive scatter in the HC or CO to CO_2 correlations from which the ratios are derived. The slope of the best fit straight line correlation is used to determine the ratio. The first rejection criterion could occur for passing pedestrians, diesel vehicles, gasoline vehicles with an elevated exhaust, or any other instance in which the beam is blocked without the appearance of exhaust. The second criterion is set based on the expected signal/noise of the system. For CO, the standard error of the measurement must be less than 20% of the mean for CO > 1%, or greater than 0.2% (absolute) for CO ≤ 1%. For HC, the standard error must be less than 20% of the mean for HC > 0.375% (as propane), or less than 0.075% (propane) for HC ≤ 0.375%.

The FEAT remote sensor is accompanied by a video system to record license plates. The video camera is coupled directly into the data analysis computer so that the image of each passing vehicle is frozen onto the video screen. The computer writes the date, time, and the calculated exhaust CO, HC, and CO_2 percentage concentrations at the bottom of the image. These images are stored on videotape or digital storage media.

Field Experience

The FEAT is effective across traffic lanes of up to 50 feet in width. It can be operated across double lanes of traffic with additional video hardware; however, the normal operating mode is on single lane traffic (Bishop *et al.*, 1993a). The FEAT operates most effectively on dry pavement, as rain, snow, and very wet pavement scatter the IR beam. These interferences cause the frequency of invalid readings to increase, ultimately to the point that all data are rejected as being contaminated by too much "noise". At suitable locations we have monitored exhaust from over two thousand vehicles per hour. The FEAT has been used to measure the emissions of more than 500,000 vehicles in Denver (PRC Environmental Management Inc., 1992 and Bishop *et al.*, 1991), Chicago (Stedman *et al.*, 1991a), the Los Angeles Basin (Stedman *et al.*, 1991b), Toronto (Peterson *et al.*, 1991), Sweden (Sjödin, 1991), and Mexico (Beaton *et al.*, 1992).

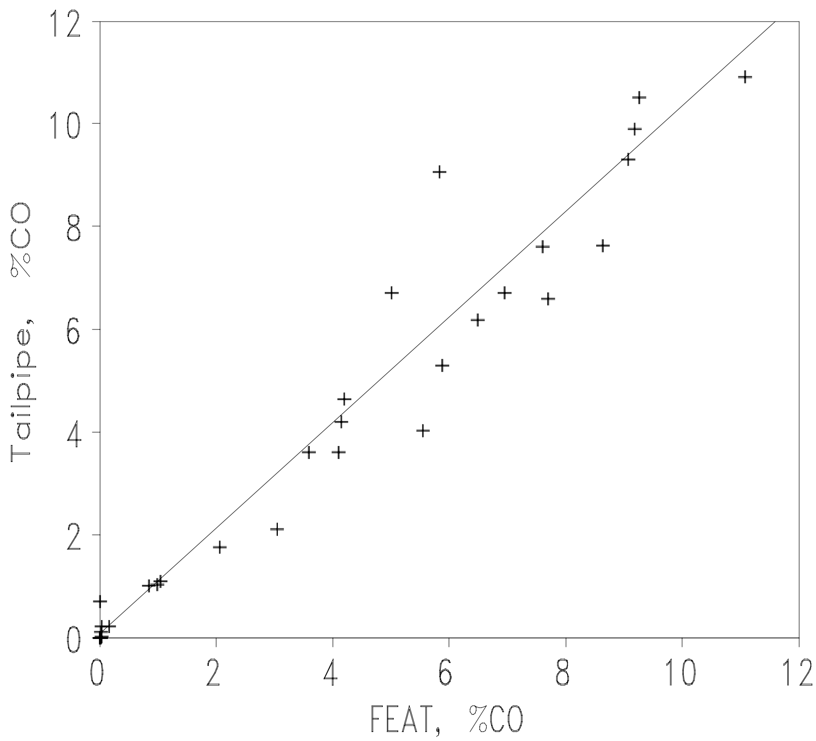


Figure 2. Comparison of tailpipe %CO measured by on-board analyzer and remote sensor in December 1989 (n=34). The regression equation is [Tailpipe %CO]=1.03[FEAT %CO]+0.08, r=0.97 (Lawson, *et al.*, 1990).

The FEAT has been shown to give accurate readings for CO in double-blind studies of vehicles both on the road and on dynamometers (Lawson *et al.*, 1990; Stedman and Bishop, 1991; Elliott *et al.*, 1992). Lawson *et al.* (1990) used a vehicle with emissions controlled by the driver/passenger to confirm the accuracy of the on-road readings. The results of that study can be seen in Figure 2. Further validation studies, particularly for HC, are presented later in this report. A unit that adds NO measurement capability to CO, HC, and CO_2 emissions monitoring has been constructed and tested in Denver, Dearborn, MI., and El Paso, TX. Third party validation was undertaken in April of 1993. The report will be available from the Coordinating Research Council in 1994.

Chemistry of CO and HC Emissions from Automobiles

This section is a short summary of the parameters that influence HC and CO emissions from automobiles. The interested reader should consult a text book such as Heywood (1988) for a more detailed discussion.

Hydrocarbon and carbon monoxide emissions in the exhaust manifold are a function of the air-to-fuel ratio at which the engine is operating. These "engine out" emissions are altered by any tailpipe emission controls that may be present. Figure 3 shows an schematic diagram of engine out emissions as a function of the air-to-fuel ratio, where 7.09 (14.7% air to fuel by weight) is the stoichiometric ratio at which there is exactly enough air to fully oxidize the fuel to carbon dioxide and water. Carbon monoxide emissions are caused by the lack of sufficient air for complete combustion. The CO is formed uniformly throughout the volume of the combustion chamber if the air/fuel mix is uniform.

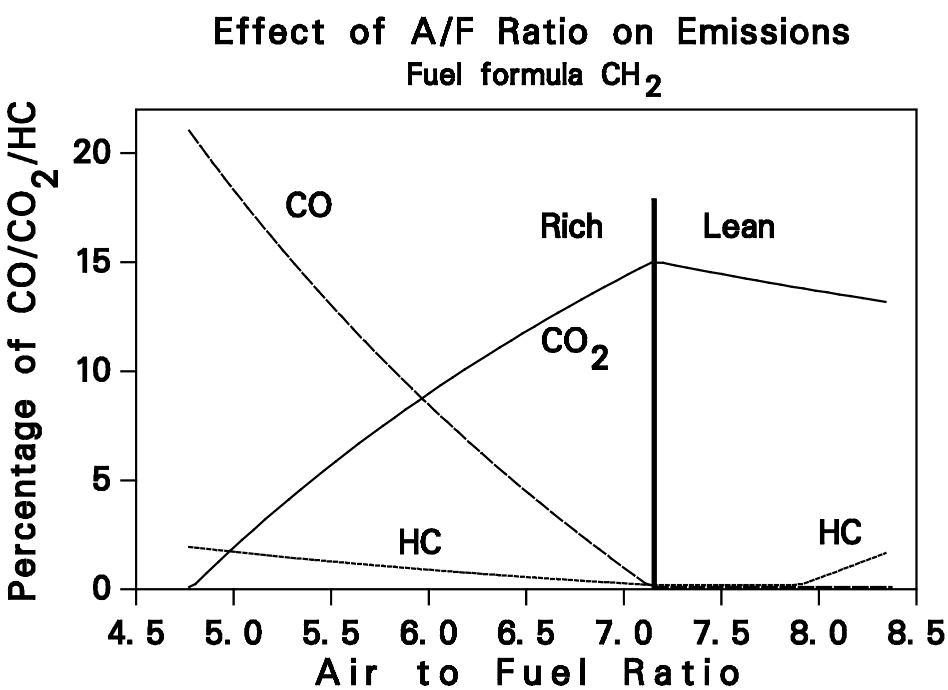


Figure 3. A schematic diagram showing the relative concentrations of CO and HC produced by a spark ignited engine as a function of molar air/fuel ratio. Air to fuel ratio by weight is approximately twice the molar ratio.

For HC the situation is more complex. In the main part of the combustion chamber, away from the walls, essentially all the HC is burned; however, the flame front initiated by the spark plug cannot propagate within about one millimeter of the relatively cold cylinder walls. This phenomenon causes a "quench layer", a thin layer of unburned fuel, next to the walls and in the cylinder orifices. Upon opening the exhaust valve, the rising piston scrapes this layer off the walls and sends it out the exhaust manifold. As the mixture becomes richer, the quench layer contains more HC; thus, more HC is emitted when the vehicle is operating with rich mixtures. There is a second peak in HC emissions indicated on the right-hand (fuel lean) side of Figure 3. This phenomenon is known as "lean burn misfire" or "lean miss"; it is the cause of the hesitation experienced at idle before a cold vehicle has fully warmed up. When this misfiring occurs a whole cylinder full of unburned air/fuel mix is discharged into the exhaust manifold. Misfiring also occurs if a spark plug lead is missing, or if the ignition system to one cylinder is otherwise fatally compromised. Severe fuel economy losses occur when significant misfiring is taking place.

The fact that there are two regions of high HC and only one of high CO indicates that one would not expect a high correlation between HC and CO exhaust emissions. High HC would be expected for some very low CO vehicles as well as for high CO vehicles. One would not expect to see many very low HC readings in the presence of high CO. This conclusion is confounded however, by the presence of catalytic converters in the exhaust system. If a vehicle running with a rich mixture has a functioning air injection system and catalyst then both the HC and CO will be removed. If the catalyst is functioning, but there is no air injection, then some or all of the HC will be converted to CO. In this case, the CO will remain since there is inadequate oxygen for its oxidation. Similarly, it is possible for a catalyst-equipped vehicle which is, in fact, in the lean burn misfire region to emit CO into the air even though it was not emitting CO into its own exhaust manifold.

Remote Sensing Equations

The method FEAT uses to measure a ratio is explained in Bishop *et al.* (1989). The CO/CO_2 and HC/CO_2 ratios can be determined by remote sensing independent of wind, temperature, and turbulence in 0.9 seconds per passing car. The software described above computes the CO and HC concentrations in the exhaust gas from the CO/CO_2 and HC/CO_2 ratios. FEAT can measure the CO and HC concentrations in the exhaust of all vehicles, including gasoline and diesel-powered vehicles, as long as the exhaust plume exits the vehicle within a few feet of the ground. Due to the height of the sensing beam, FEAT will not register emissions from high exhausts, such as heavy duty diesel vehicles (carbon monoxide and hydrocarbon emissions from diesel vehicles are in any case relatively small).

The instantaneous mass emission rates in grams CO per gallon of gasoline burned can be derived from the reported %CO and %HC (as propane) using an estimated fuel density of 0.726 g/ml. The equation is:

$$\frac{gCO}{gallon} = 5506 * \frac{\%CO}{(\%CO + 3 * \%HC + \%CO_2)}$$

The instantaneous mass emission rates in grams HC per gallon can be estimated from:

$$\frac{gHC}{gallon} = 8644 * \frac{\%HC}{(\%CO + 3 * \%HC + \%CO_2)}$$

Glover and Clemmens (1991) found that the on-road remote sensing test has a predictive power similar to that of the idle/2500 rpm test when compared to the EPA IM240 test. They used Corporate Average Fuel Economy (CAFE) fuel economy estimates to convert remote sensing measurements of grams/gallon to grams/mile to compare fleet on-road emissions with IM240 grams/mile CO emissions for the same vehicles. The comparison of fleet emissions measured by on-road remote sensing to those made by IM240 is shown in Figure 4. New data collected during our pullover study of on-road gross polluters in California is shown as a filled circle (●) in Figure 4 (Knapp, 1992). The underprediction of 13% for the remote sensing average may be due to the fact that the high-emitting vehicles pulled over in this study actually had lower fuel economy than the CAFE estimates. This would occur for vehicles that are predominantly fuel-rich, as we expect for the high-emitting vehicles. In a similar pullover study in Michigan 37 remotely identified vehicles (average before repair FTP emissions of 63 g/mile for CO and 5.09 g/mile HC) upon repairs experienced a 13.5% increase in their FTP fuel economy (Gorse, 1993; Octane Week, 1993). These data indicate that, even for small fleets of vehicles, average IM240 emissions agree with average measured on-road emission data when the on-road grams/gallon data are converted to grams/mile using CAFE fuel economy estimates.

General

Throughout this report we use the term "on-road CO emissions" to describe the measurements obtained by the remote sensor in the sense of "on-road" intended by the U.S. Congress in the 1990 Clean Air Act Amendments (CAAA, 1990). The term "fleet", unless otherwise stated, is used to mean those vehicles monitored by on-road remote sensing. When fleet data are analyzed as a whole, we find that half the CO is emitted by a small fraction of the vehicles. These vehicles are termed "gross polluters" throughout this text. The cut point for the gross polluter category varies somewhat from fleet to fleet depending mainly on the average age of the vehicles. We also refer to a vehicle whose on-road CO reading is less than 1% CO as a "clean car".

Each FEAT measurement is a snapshot of the on-road CO and HC emissions at the instant

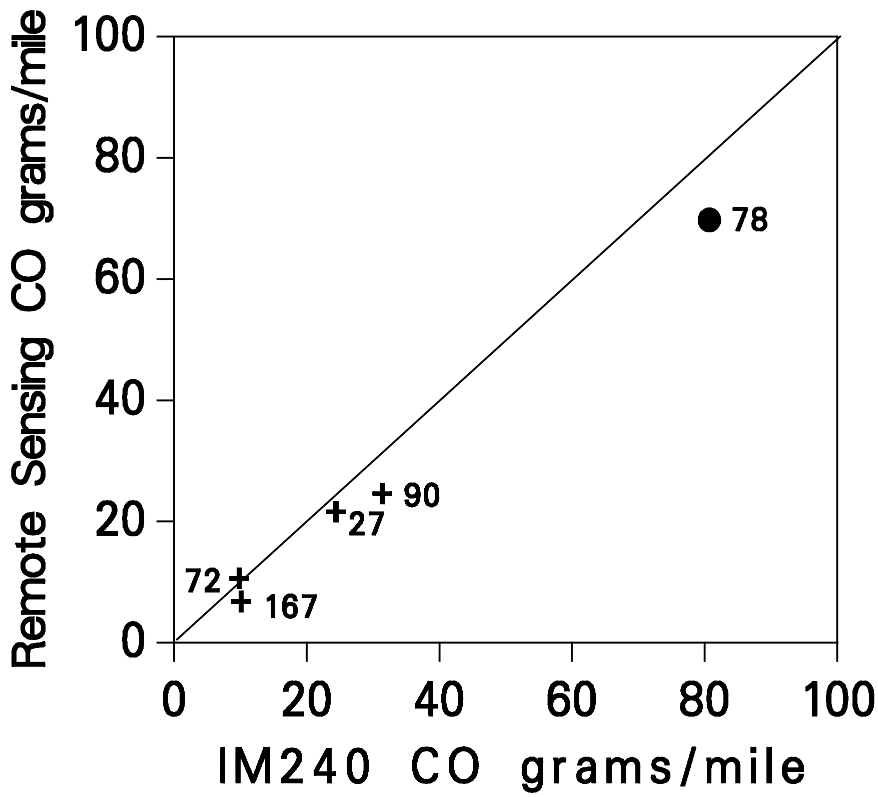


Figure 4. On-road fleet %CO emissions converted to grams/mile emissions compared to IM240 CO grams/mile emissions. The fleet sizes are noted next to the symbol.

the vehicle passes the FEAT beam, and monitors whatever stable or transient mode the vehicle was in at the time of measurement. In this study vehicles were monitored in a mix of all operating modes. At the freeway on-ramps, fast cruise and acceleration were common. At the off ramps the vehicles were generally travelling uphill in cruise mode, but sometimes congestion created very low speed accelerations and decelerations. On the urban streets all modes of driving common to urban streets were observed, including low speed cruise, idle emissions as vehicles moved by in congested traffic, and decelerations and accelerations associated with traffic control signals at the end of the block on which the measurements were made.

On-road HC emission rates are dependent on driving mode in a different manner than are CO emission rates. Significantly higher HC emission rates are seen at sites with deceleration than sites with a steady load (Zhang *et al.*, 1993). CO emission rates, on the other hand, are higher under hard acceleration and very slow cruise, i.e. heavy load (Ashbaugh *et al.*, 1992). On-road studies show there are fewer gross HC emitters than there are gross CO emitters. At a typical on-road location one might measure 700 vehicles in an hour of operation from which one would identify about 70 gross emitters for CO and only 15 for HC, with some overlap in the populations.

Data are available on disk through Dr. Lowell L. Ashbaugh of the CARB Research Division, P.O. Box 2815, Sacramento CA., 95812, phone (916) 323-1507. All data will be provided in DBASE III+ compatible file format, and contain complete records of all available remote sensing measurements. The database also contains make and model year obtained by matching license plates to California Department of Motor Vehicle records.

RESULTS AND ANALYSIS

The remote sensing instrumentation was set up at a variety of sites in southern and northern California between May and August, 1991 for a total of 30 days. We obtained 91,679 valid CO and HC measurements matched to vehicle registration records via the California Department of Motor Vehicles. The database represents 66,053 unique vehicles; the information has been organized and stored in a computer database.

Figures 5 and 6 are quintile plots for the entire database. The figures contain data from only one sensor at any given site; duplicate measurements have been eliminated. The figures are derived by first dividing the fleet into model years, then dividing each model year into five groups (quintiles) according to their exhaust concentrations of CO or HC, and plotting the average CO and HC for each quintile on a three-dimensional graph. The benefits of the introduction of catalysts in 1975 and closed-loop technology in the early 1980's are readily apparent in these displays. The bars for 1974 represent all vehicles of model year 1974 and older; thus, all vehicles in those bars had no catalyst technology. In every category, the CO quintiles from these data are lower than those from Los Angeles in 1989 (Stedman *et al.*, 1991b), and are more comparable to those from Denver. We speculate later in this report that this is because the neighborhoods tested in Los Angeles represent higher average income (thus, better maintenance).

The quintile graphs show (as reported previously in Stedman *et al.*, 1991b) that up to 60% of the pre-catalyst vehicles are lower emitters than 20% of the new vehicles, for both CO and HC emissions. The data reported here show that most new vehicles that are high emitters have broken or disabled emission control equipment. This clearly shows that all cars are not equal emitters, and that the effects of broken emission control equipment are greater than the effects of age, technology, or mileage. When the data are analyzed in terms of their contribution to total emissions, it is apparent that there are too few old vehicles to be major contributors to mobile source emissions. Instead, the large number of newer vehicles that are not working properly are the greatest contributor to emissions.

Numerical results for the entire database (91,679 records) are mean %CO of 0.82, %HC of 0.076 and model year (model years only available for 91,515 records) of 1984.9. The median %CO of 0.14, %HC of 0.042 and model year of 1986. One half of the CO emissions is produced by 7% of the measurements while 10.7% of the measurements account for half of the HC emissions.

Santa Anita Validation and Controlled Operation Mode Studies

In December 1989, the CARB, the South Coast Air Quality Management District (SCAQMD), and General Motors Research Laboratories (GMRL) jointly sponsored a study to investigate the reasons for persistent high CO concentrations near Lynwood in the Los Angeles basin. As part of that study, we used the FEAT to measure the CO emissions of the

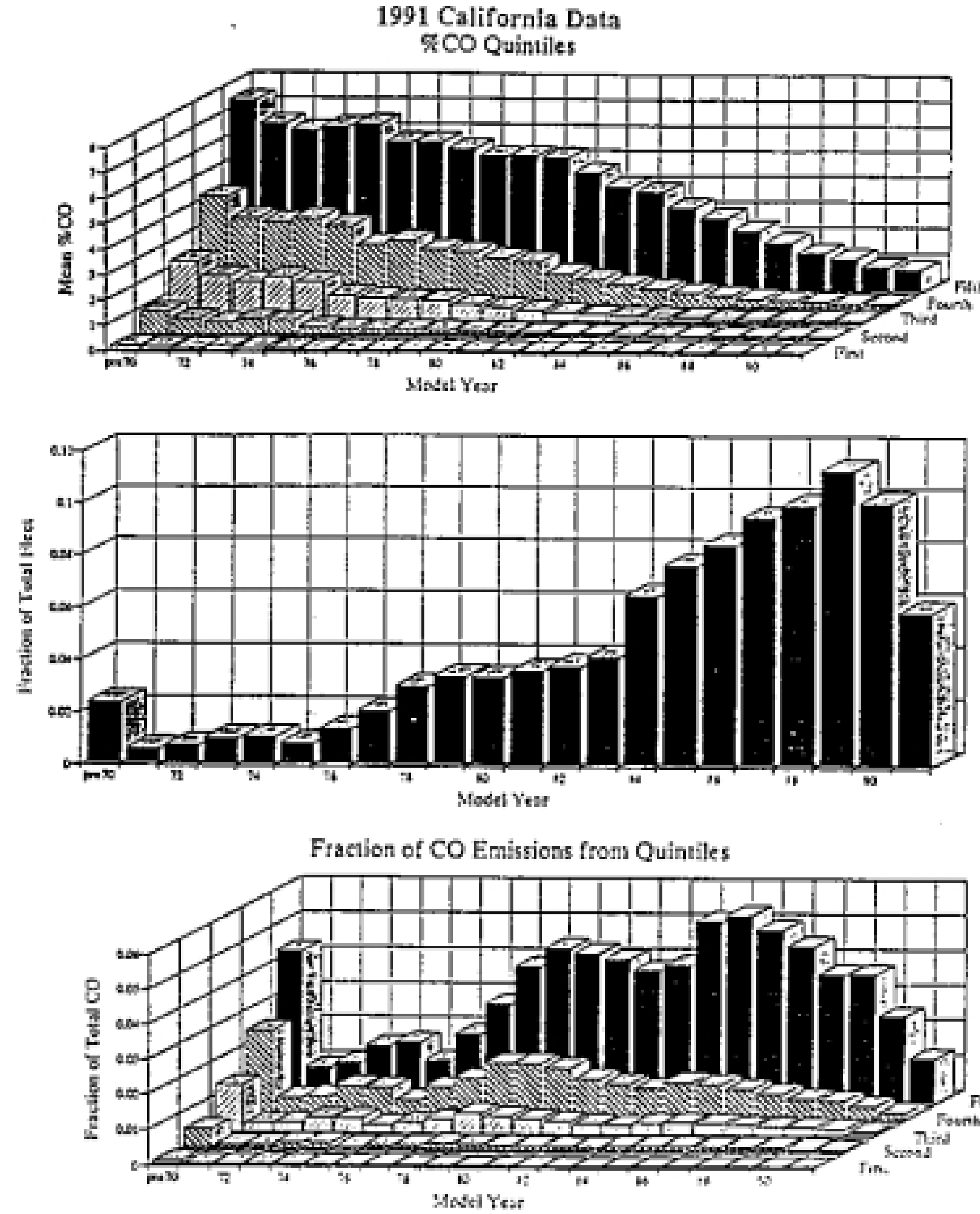


Figure 5. The California data for CO presented as; top) Emission factors by model year divided into quintiles; middle) Fleet distribution; and bottom) The product of the top and middle graphs.

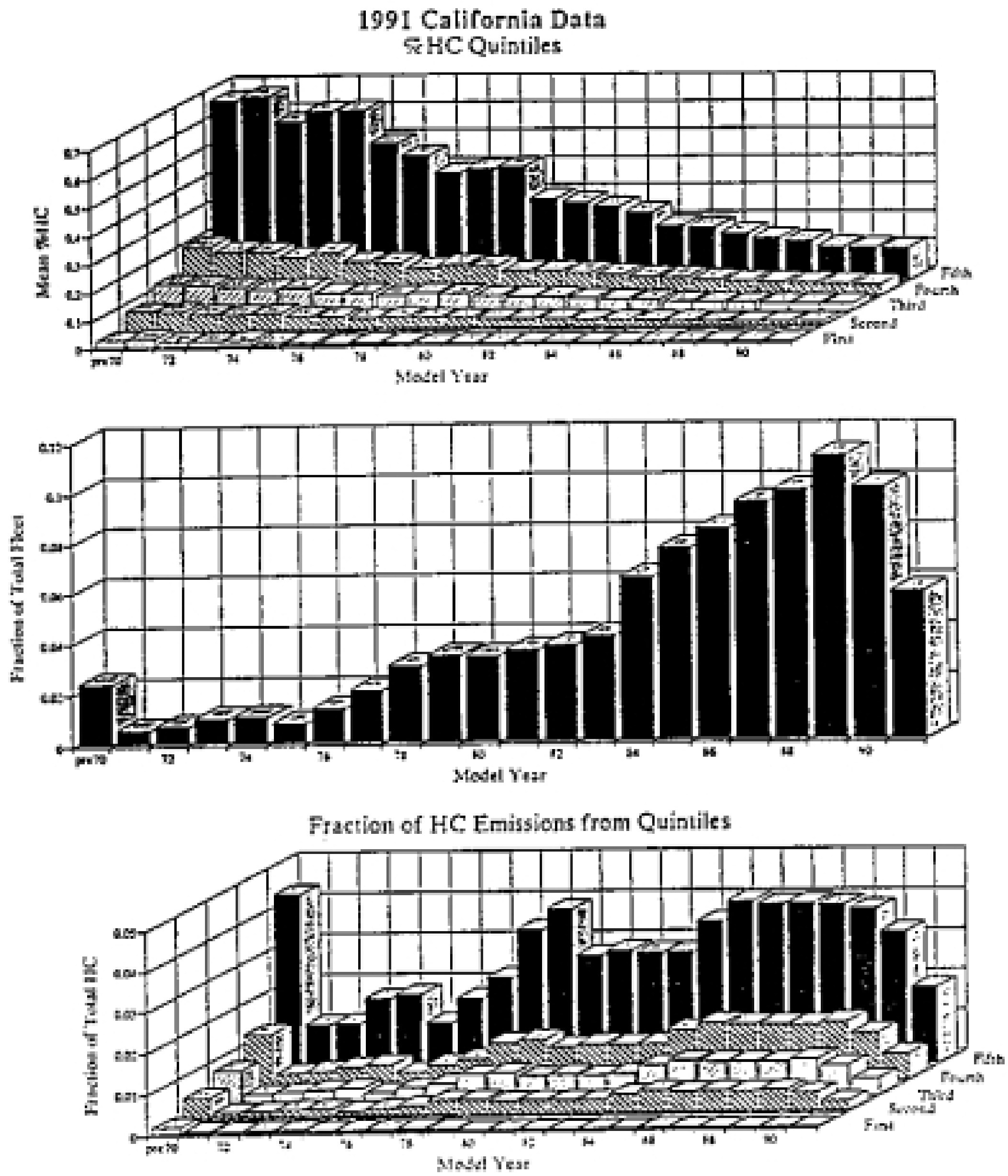


Figure 6. The California data for HC (as propane) presented as; top) Emission factors by model year divided into quintiles; middle) Fleet distribution; and bottom) The product of the top and middle graphs.

in-use fleet on surface streets and freeway ramps in the Lynwood area (Lawson *et al.*, 1990, Stedman *et al.*, 1991b). The device accurately measured CO concentrations in double-blind tests using a specially equipped GM vehicle. This study concluded that 10 percent of the in-use vehicle fleet was responsible for 55 percent of the CO emissions, based on the mass of CO emitted per gallon of fuel burned. In separate studies, DU and GMRL have reported similar results in other cities (Stedman and Bishop, 1990, Stephens and Cadle, 1990).

The results of the previous studies showed sufficient promise that the CARB decided additional research was needed to investigate the use of remote sensing as a tool for measuring instantaneous emissions of in-use motor vehicles. Furthermore, both DU and GMRL added the capability to measure hydrocarbon emissions simultaneously with CO emissions. In this section we describe the work performed to test the remote sensors built by DU and GMRL.

Study Design

This first task had three main objectives: (1) to validate the remote sensor measurements, particularly for HC; (2) to compare measurements made by different remote sensors; and (3) to compare emissions of a variety of vehicles under a prescribed set of operating modes. To achieve the first objective, we measured emissions from an instrumented vehicle at steady cruise. We addressed the second objective by measuring emissions from the GM car using three FEAT remote sensors and one GMRL sensor. To achieve the third objective, we tested 12 vehicles provided by CARB and 11 vehicles provided by Automotive Testing and Development Services, Inc. (ATDS), an automobile testing lab.

We used a specially-instrumented General Motors vehicle to test the accuracy and repeatability of the remote sensors. The vehicle, a 1989 Pontiac SSE with a 3.8 L "3800" 6-cylinder engine, carried two Horiba MEXA non-dispersive infrared analyzers to measure exhaust gas concentrations. One measured HC and CO, while the other measured CO and CO_2. A data logger digitized the signal from the analyzer and passed the results to an on-board Toshiba 3200 laptop computer. The computer was also interfaced to the "Assembly Line Data Link" (ALDL) to provide two-way communication between the laptop computer and the engine computer. With this link, the driver was able to vary the air/fuel ratio while driving, and also to obtain parameters such as vehicle speed and engine rpm from the engine computer. The laptop computer merged the data from the engine computer and the data logger, and could be triggered to print the results and store them on the hard disk. This arrangement provided us with an on-board data acquisition and analysis system to obtain near real-time (the system had an overall delay of 4 seconds) analysis of exhaust emissions.

All measurements involving the GM instrumented car were made with the car cruising at about 30 mph. After selecting an air/fuel ratio on the computer, the driver accelerated to 30 mph, then set the cruise control. We took this precaution to ensure that all remote sensors were exposed to exhaust emissions that were as uniform as possible. The sensors were separated by up to 200 feet for some tests. As the car passed the first sensor, the driver activated a print program to record emissions throughout the test course. The results of these test runs provided data for the first two objectives of this task.

We compared the measurements of four remote sensors in this task. Both the FEAT and GMRL sensors are non-dispersive infrared absorption instruments. The sensors measure the plume concentrations of CO, CO_2, and HC in the dispersing exhaust, then compute the plume CO/CO_2 and HC/CO_2 ratios by regressing the CO and HC against CO_2. The CO, CO_2, and HC exhaust concentrations are computed from the ratios. The FEAT data reduction algorithm rejects a measurement if the regression uncertainty exceeds a threshold. For CO, the standard error of the measurement must be less than 20% of the mean for CO > 1%, or greater than 0.2% (absolute) for CO ≤ 1%. For HC, the standard error must be less than 20% of the mean for HC > 0.375% (as propane), or less than 0.075% (propane) for HC ≤ 0.375%. The General Motors instrument did not have this feature.

We calibrated all the sensors, including the on-board Horiba instruments, with one of a variety of known mixtures of propane, CO, and CO_2. Both DU and GMRL used mixtures appropriate for their own sensors, and we each measured all of the calibration gases to obtain a cross-comparison. For the purpose of comparison, we applied a multiplication factor of 0.5 to convert the FEAT propane measurements to hexane equivalent (this conversion factor may, in fact, differ slightly for each remote sensor).

To examine the variability of vehicles under different operating modes, we tested 23 vehicles provided by CARB and ATDS (Automotive Testing and Development Services, Inc., an independent subcontractor). One of the ARB vehicles was a dedicated methanol-fueled (M85) vehicle, and one was a flexible-fueled vehicle that was running on gasoline. The other CARB vehicles were part of an ongoing study of the effectiveness of California's Inspection and Maintenance (I/M) program. No information was available on the type of fuel used in these other vehicles, except that they all used gasoline. These vehicles all received Smog Check inspections within a few days of this task, and all received FTP dynamometer tests at ARB's Haagen-Smit Laboratory. All of the vehicles from ATDS were powered by gasoline. Some vehicles from ATDS were tested with and without a catalytic converter. All but two of the ATDS vehicles had been tested on a dynamometer using the FTP. Finally, we tested three 1991 model year rental cars on a series of acceleration runs.

A trained driver from ATDS drove each of the cars provided by ATDS and CARB. The test procedure consisted of 10 passes through the test course under different operating modes. The parking lot had a very slight slope, so we repeated the 10 passes in each direction. We tested most cars twice in this manner, but some were tested a total of four times. The 10 passes included rolling idle (car in gear but foot off the accelerator); steady cruise at 5, 15, 30, and 45 mph; light, medium, and hard acceleration; and two passes decelerating from 30 mph. We tried to make the two deceleration passes similar to each other. We used a radar gun to measure speed and acceleration as the car passed one or two FEAT units.

We conducted this task from May 21-23, 1991 in an empty parking lot at the Santa Anita Race Track in Arcadia, California. The weather on these days was typical for southern California. Ozone peaked at 18 pphm on May 23 at Glendora and Pasadena, the nearest monitoring stations, while temperatures peaked at 80ºF. On the first day, we set up all five sensors side-by-side with a distance of 39 feet separating the first and last sensors. Most of the runs conducted on the first day involved the instrumented GM car, although several runs were made with test vehicles. On May 22 and 23, we separated the sensors by a total distance of approximately 200 feet. We placed one FEAT at each end of the test course, with another FEAT and the GM sensor near the middle of the test course. These two sensors were separated by 11 feet. FEAT 3004 was located on the west end, FEAT 3002 was in the middle, and FEAT 3005 was at the east end of the test run. We made most runs on May 22 and 23 with test vehicles. General Motors ran the instrumented car on several runs on May 22, but did not use it on May 23.

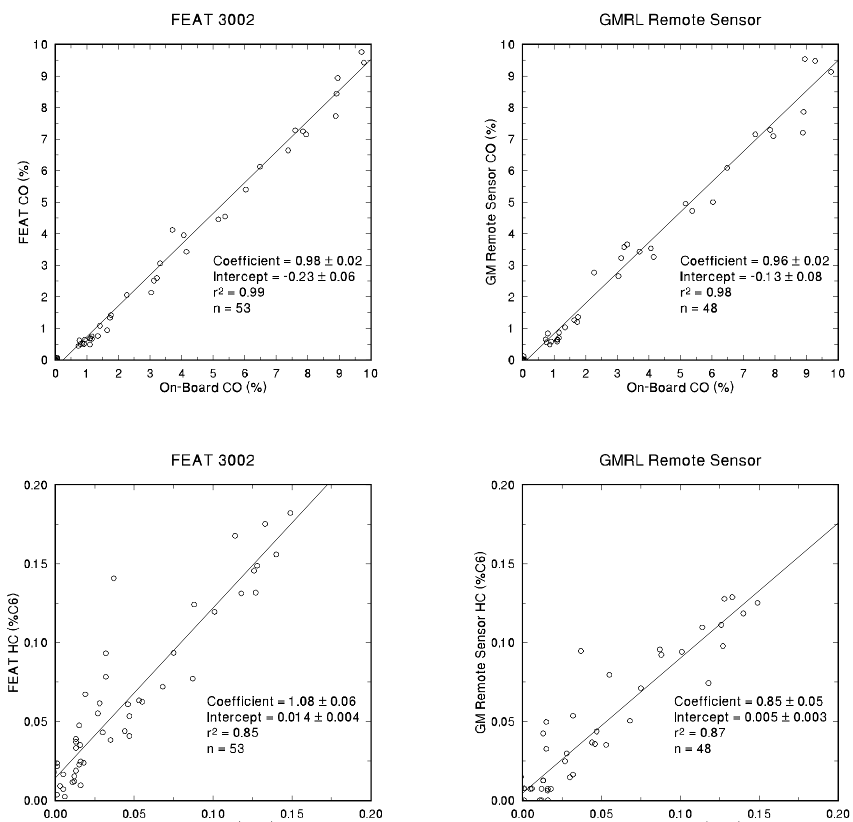


Figure 7. Comparison of remote sensor measurements to on-board measurements of carbon monoxide and hydrocarbons.

Results

The results of this task will be presented in three parts corresponding to the main objectives. Figure 7 plots the CO and HC measurements for each remote sensor against the GM On-Board (GMOB) measurements. The FEATs and the GM remote sensor (GMRS) compared very well to the GMOB CO measurements. The HC measurements exhibited more scatter than the CO measurements for all three remote sensors. These analyses show that the FEAT and GMRS devices accurately measure the instantaneous emissions of CO and HC.

We were able to achieve a wide range of on-board CO emissions (zero to ten percent) by varying the air/fuel ratio on the GM vehicle. The HC emissions, however, could not be increased enough to be comparable to many high emitters we have observed on the road, even after we induced a misfire by disconnecting an ignition wire. For example, the highest emissions we measured from the GM vehicle were less than 0.2% hexane. In the high-emitter part of this project, over 55 of 337 vehicles (16%) pulled over for further testing emitted more than 0.2% hexane. Of all 60,000 vehicles measured, nearly 5,000 (8%) were observed emitting over 0.2% hexane (0.4% propane). Although the remote sensor HC measurements correlate at a lower level than the CO measurements, some of the scatter evident in the HC measurements may be due to the generally low HC emissions. Despite the scatter, the remote sensors measure HC within ±15% of the calibrated, on-board measurement. The remote sensors measure CO within ±5% of the on-board measurement. These accuracies are derived from the slope of the regression lines.

Figure 8 shows all the remote sensors plotted against FEAT 3002. The three FEATS and the GMRS compared quite well to one another for CO (although 3004 and 3005 are biased high compared to 3002), but the HC comparisons again exhibited more scatter. FEAT 3005 did not measure hydrocarbons as well as the other two FEATs, as indicated by its lower r^2 of 0.76 and its coefficient of 1.88 compared to FEAT 3002. Just prior to the start of this task, FEAT 3005 lost the mirror that focuses the IR beam on the HC detector. We repaired it temporarily, but there was insufficient time to align it properly, which may have resulted in poorer HC data quality for this sensor.

The third objective of this task was to test a variety of vehicles under a prescribed set of operating modes. We tested most of the 23 vehicles at least twice. Overall, we analyzed a total of 50 test runs. We obtained measurements for 10 passes for each test run. For this analysis, we will present only the results from FEAT 3002, located at the center of the test array.

Figure 9 shows a box and whisker plot of all CO and HC measurements from the 23 vehicles as a function of operating mode. This diagram shows the distribution of emissions of the set of vehicles measured. The box represents the 20th and 80th percentile groupings, and the bar within the box represents the median measurement. In most instances, the exhaust CO concentrations showed the least variability between different vehicles at cruising speeds of 15-45 mph, and for light acceleration. There were only a few high emitters when the vehicles operated at 45 mph and under light acceleration. The greatest variation and highest median

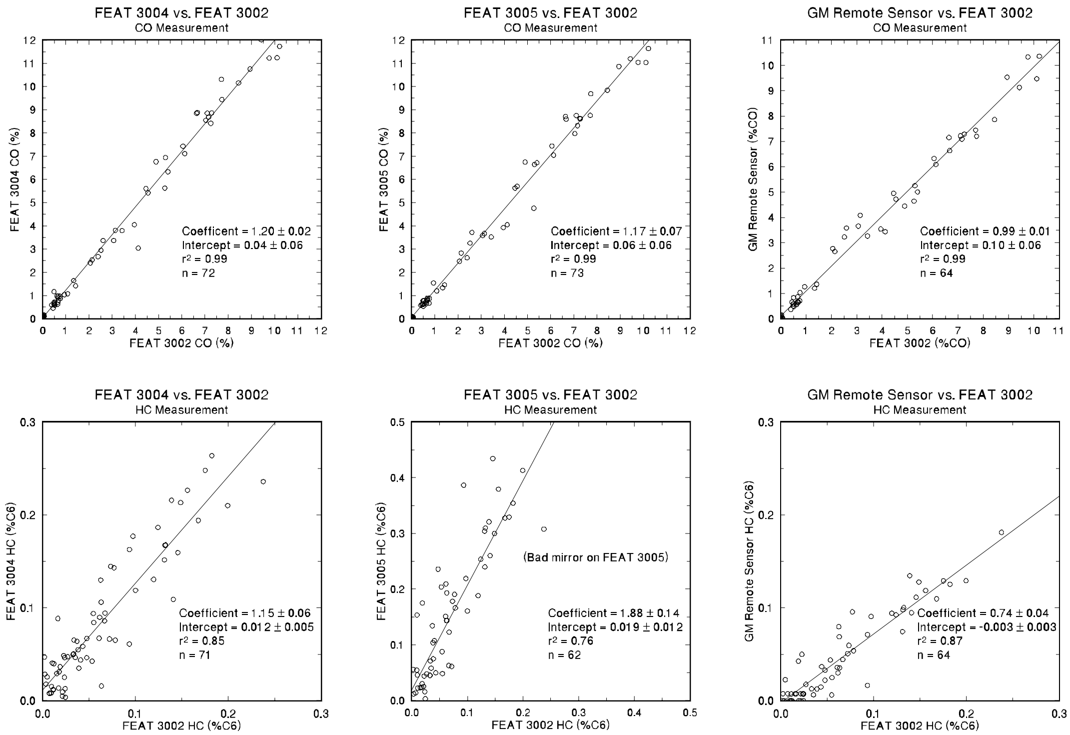
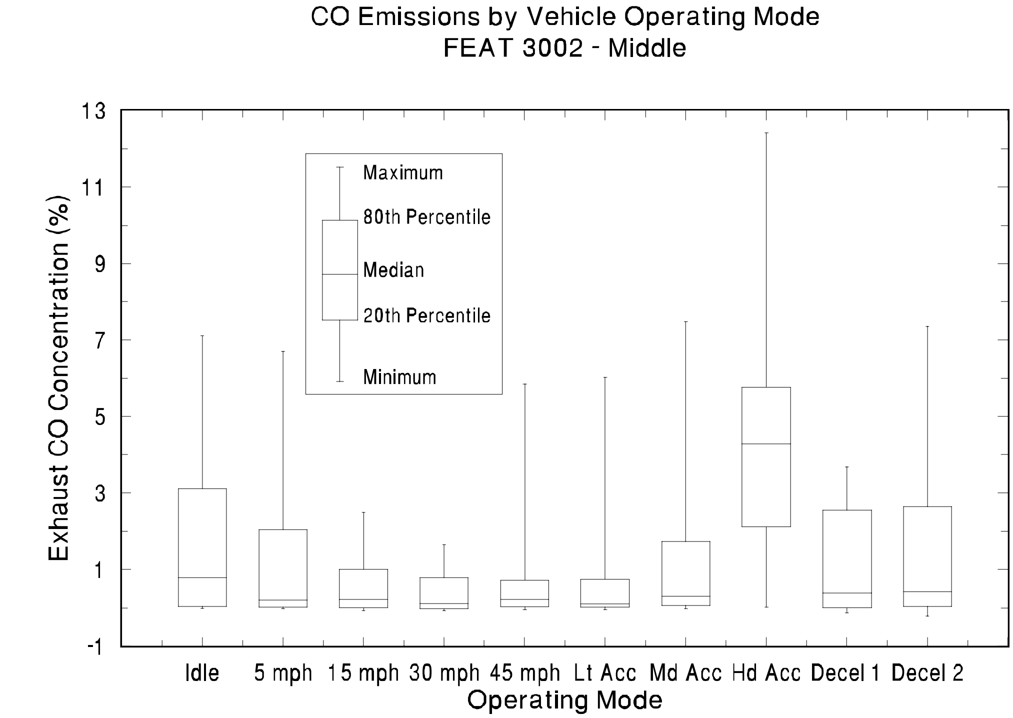


Figure 8. Comparison of remote sensors to one another. The sensors were not aligned to measure exhaust at the same point.

exhaust concentrations of CO occurred under hard acceleration. The medium acceleration showed variations between vehicles similar to 5 mph cruise. The idle pass and the two deceleration passes were comparable for CO emissions. The HC measurements showed the least variability between different vehicles during accelerations. The greatest variation between vehicles and the highest median exhaust concentrations of HC occurred during decelerations. At cruising speeds, the 15 mph and 30 mph passes showed the least variation. The idle, 5 mph and 45 mph passes showed slightly higher variability.

We measured the emissions of most vehicles at least two times. Figure 10 shows how consistent the emissions of the same vehicle were for different runs. The diagram shows the distribution of the difference between the highest and lowest emissions of each vehicle for each operating mode. For CO, the repeat emissions were within 1% CO for more than 80 percent of the vehicles measured for all operating modes except hard acceleration. For HC, the repeat emissions were within 0.4% hydrocarbon (as propane) for over 80 percent of the vehicles in all cases except deceleration and 5 mph cruise. The acceleration emissions were remarkably consistent for HC, with nearly all repeat emissions within 0.2% HC, measured as propane. For steady cruise of 15-45 mph, a few vehicles were highly variable (up to 1.4%



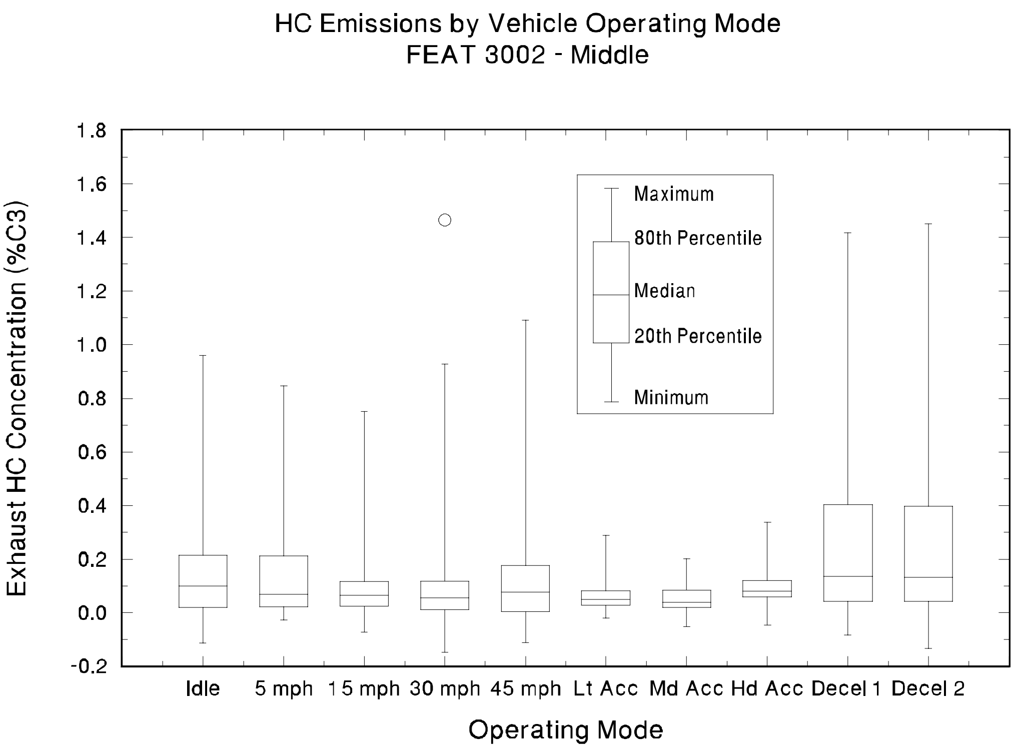
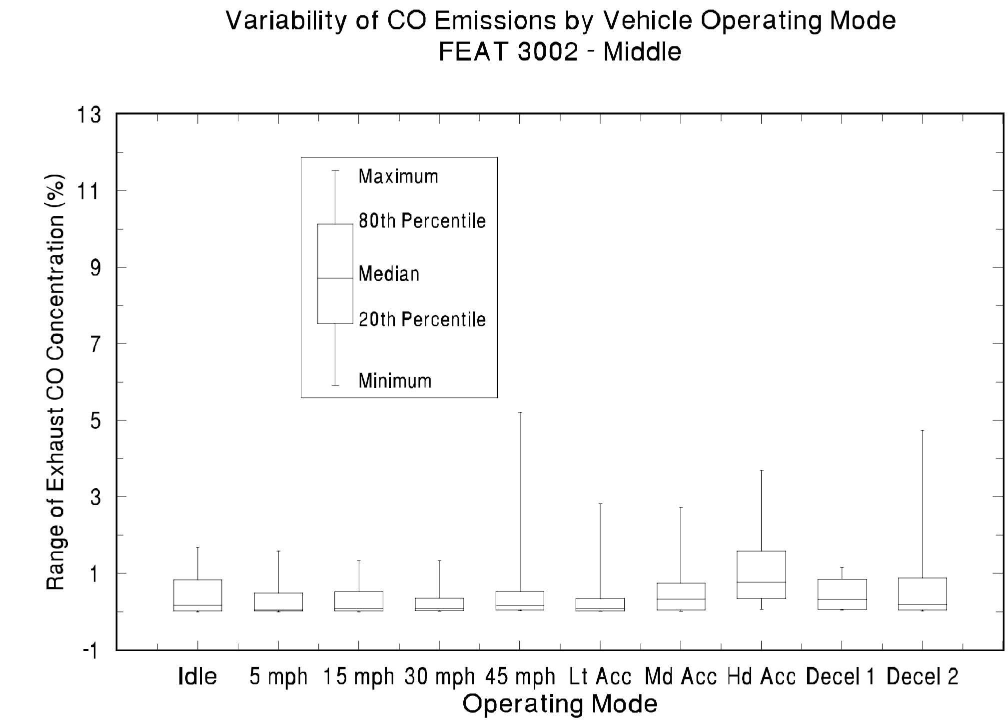


Figure 9. Differences between emissions of 23 vehicles according to vehicle operating mode.



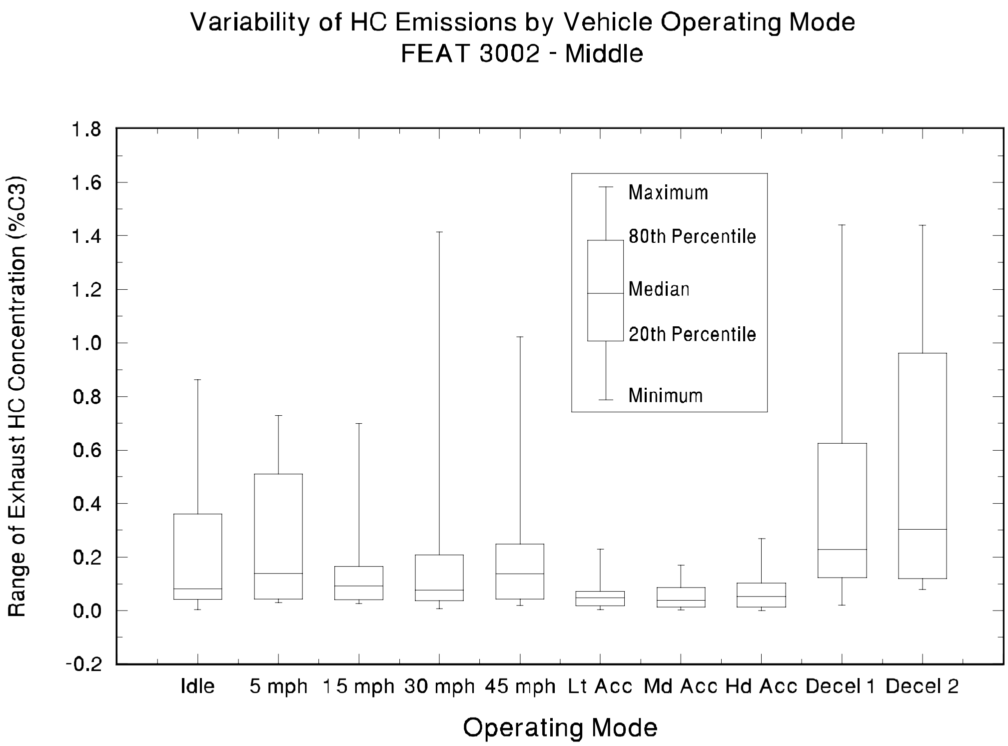


Figure 10. Range of emissions of repeated runs on 23 vehicles according to vehicle operating mode.

HC) between measurements. We refer to these vehicles as "flippers", because they flip between high and low emissions. A few vehicles were "flippers" for CO also (not necessarily the same vehicles as for HC).

We tested two CARB vehicles, a 1982 Nissan Stanza and a 1979 Cadillac, four times each, twice on May 22 and twice on May 23. In the interim, the Cadillac had a Smog Check and an ignition timing adjustment. The Nissan had no adjustment between the two sets of tests. Tables I-IV show the individual CO and HC measurements from each pass for these two vehicles, as well as the mean and standard deviation of the readings for each operating mode. The tables show all reported measurements, including reported zero values and negative numbers. The negative numbers are all within the measurement uncertainty of the instrument, and are retained in the data set so as not to bias the means. The Nissan appears to be a "flipper" for CO at medium acceleration. On May 22, the emissions averaged 4.1% CO, while on May 23, they averaged 1.5% CO. For the other vehicle operating modes, the differences from one run to the next are insignificant. The emissions for the Cadillac were consistent for all four runs, even though it had a Smog Check and a timing adjustment between the first two and the last two runs.

All the vehicles tested in this task were clean compared to the vehicles pulled over for inspections in the high-emitter pullover task conducted later on. Only under conditions of hard accelerations ("foot to the floor") did emissions of some vehicles approach the cut point we applied in the high-emitter task of this study.

Table I. Percent CO Emissions for a 1982 Nissan Sentra.

Date	Idle	Cruise (mph)				Acceleration			Deceleration	
		5	15	30	45	Lt	Med	Hard	1	2
5/22	2.8	2.2	0.4	0.4	0.2	1.5	4.1	9.5	2.1	7.3
5/22	3.7	3.3	1.3	0	0.1	1.4	4.2	5.8	3.3	3.4
5/23	2.0	1.7	0	0	*	0.1	1.5	7.9	2.5	2.6
5/23	3.7	2.4	0.9	1.3	0.8	0.2	1.5	7.5	2.9	3.4
Mean	3.1	2.5	0.7	0.4	0.4	0.6	2.4	7.1	2.9	3.1
Std Dev	0.7	0.6	0.5	0.5	0.3	0.7	1.3	1.3	0.4	1.9

Table II. Percent CO emissions for a 1979 Cadillac.

Date	Idle	Cruise (mph)				Acceleration			Deceleration	
		5	15	30	45	Lt	Med	Hard	1	2
5/22	0.3	0.3	0.3	0.8	0.3	0.1	0.1	4.4	0.4	0.4
5/22	0.2	0.3	0.3	0.7	0.3	0.2	0.1	4.0	0.4	0.5
5/23	0.9	0.3	0.2	0.8	0.7	0.3	0.6	4.6	0.4	2.6
5/23	0.3	0.2	0.1	0.5	0.6	0.4	0.1	5.0	0.4	0.2
Mean	0.5	0.2	0.2	0.7	0.5	0.3	0.3	4.5	0.4	1.1
Std Dev	0.3	0.1	0.1	0.1	0.2	0.1	0.2	0.4	0.1	1.0

Table III. Percent HC (propane) emissions for a 1982 Nissan Sentra.

Date	Idle	Cruise (mph)				Acceleration			Deceleration	
		5	15	30	45	Lt	Med	Hard	1	2
5/22	0.112	0.118	0.090	-0.044	-0.012	0.054	0.096	0.162	*	0.480
5/22	0.128	0.128	0.080	0.174	0.28	0.028	0.066	0.090	0.280	0.240
5/23	0.092	0.16	0.092	0.030	*	0.044	0.044	0.130	0.194	0.146
5/23	0.144	0.132	0.098	0.138	0.05	0.026	0.054	0.114	0.220	0.184
Mean	0.119	0.135	0.090	0.075	0.106	0.038	0.065	0.124	0.231	0.263
Std Dev	0.019	0.016	0.006	0.086	0.122	0.012	0.020	0.026	0.036	0.130

Table IV. Percent HC (propane) emissions for a 1979 Cadillac.

Date	Idle	Cruise (mph)				Acceleration			Deceleration	
		5	15	30	45	Lt	Med	Hard	1	2
5/22	0.074	0.032	0.062	0.078	0.062	0.032	0.046	0.072	0.080	0.084
5/22	0.052	0.060	0.056	0.056	0.060	0.010	0.014	0.044	0.064	0.078
5/23	0.046	0.022	0.034	0.042	0.002	0.028	0.032	0.110	0.094	0.178
5/23	0.048	0.020	-0.036	0.050	0.046	0.058	-0.002	0.046	0.074	0.050
Mean	0.055	0.034	0.029	0.057	0.043	0.032	0.023	0.068	0.078	0.098
Std Dev	0.011	0.016	0.039	0.013	0.024	0.017	0.018	0.027	0.011	0.048

Roadside Survey Studies

Rosemead High Emitter Pullover Study

We conducted the high emitter pullover task to verify results of the CARB-sponsored program conducted in the Hawthorne area in 1989 (Lawson *et al.*, 1990). In this task, we wanted to determine whether the remote sensing device could be used as a surveillance tool to find high CO- or HC-emitting vehicles. The University of Denver operated three remote sensors, two on the traffic lane and one at the inspection site. The California Highway Patrol (CHP) provided officers to pull over the vehicles to be inspected. The California Air Resources Board and the Bureau of Automotive Repair provided two Smog Check inspection teams, and the U.S. EPA Mobile Source Emissions Research Branch provided a portable dynamometer operated by a contractor. General Motors Research Laboratories participated in the first week of this task conducting comparisons between its own remote sensor and the University of Denver's instruments.

The task was conducted on southbound Rosemead Boulevard north of the cloverleaf intersection with the Pomona Freeway (I-60) in South El Monte in the Los Angeles area, between June 3 and June 14, 1991. We placed two FEAT units 25 meters apart on the southbound, three-lane surface street, which had been narrowed by cones so that all traffic passed by the remote sensors in a single lane. When a vehicle passed the FEAT units, we decided, based upon high CO and/or HC readings, whether we wanted a roadside test performed on the vehicle. When the roadside crews were ready for the next vehicle, and we observed a candidate vehicle (preferably post-1980) that had remote sensing readings sufficiently high on both FEAT units, we radioed the Highway Patrol officer, who flagged over the vehicle for a roadside inspection, similar to California's Smog Check test. We then requested (the inspection was voluntary) the driver to submit his or her vehicle to a roadside Smog Check. One of two roadside inspection crews (from CARB's Mobile Source Division and the Bureau of Automotive Repair) first inspected the vehicles visually for obvious tampering with the engine and emission control equipment. Following the visual test, the inspection team performed functional tests to see whether the equipment was operating properly. Finally, the team performed tailpipe CO and HC emissions tests with the BAR-90 analyzer, which is the same equipment used in the State's Smog Check program. The EPA performed additional IM240 testing, via a portable EPA dynamometer, on some vehicles (Knapp, 1992).

The site was selected based mostly on the availability of a multiple lane roadway with roomy shoulders to allow for a safe setup for all of the various support vehicles and equipment. In addition, an accessible parking area, preferably lighted for night time security, was needed for the portable dynamometer. We selected a location on Rosemead Boulevard, a six-lane divided highway, in a section of El Monte, California. Figure 11 gives a schematic representation of the layout and the relationship of the equipment and different research groups. The two right lanes were closed and used for support vehicles and remote sensing equipment while the left lane remained open for the vehicle traffic. A nearby park provided ample room for the U.S. EPA's dynamometer and related equipment.

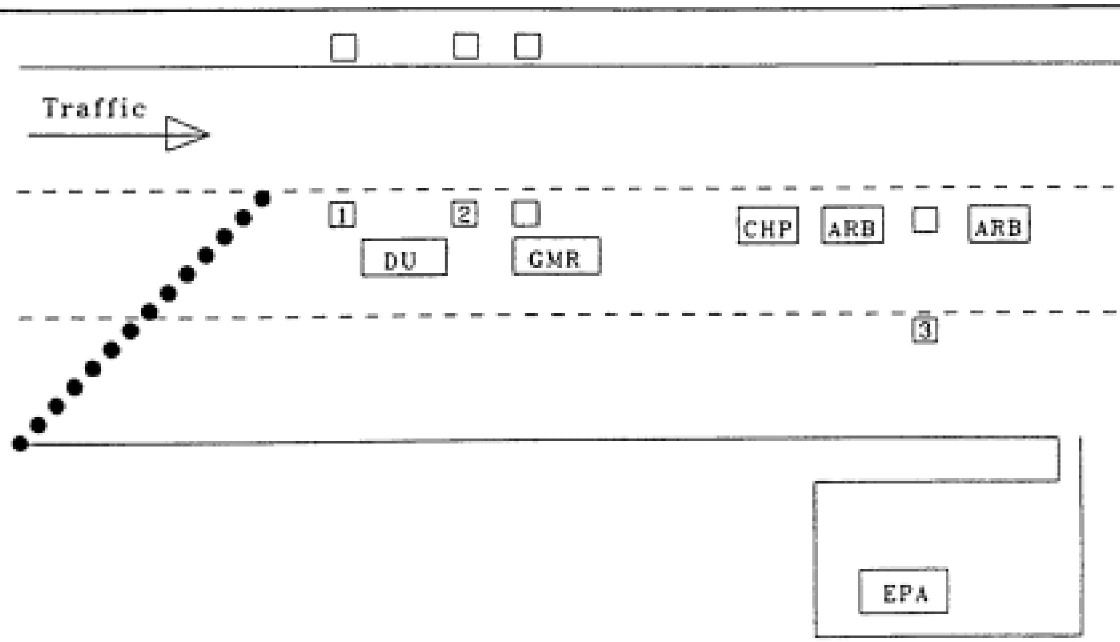


Figure 11. Schematic layout of equipment used in the Rosemead Boulevard high emitter study. The numbered remote sensing detectors were manned by the University of Denver.

The equipment was situated such that the two remote sensors were located approximately 750 feet upstream of a CHP officer and the dual CARB/BAR Smog Check teams. Communication with the CHP officer and the remote sensing operators was maintained via two-way radios supplied by the CHP. Upon the availability of an CARB Smog Check lane a vehicle would be identified by the remote sensing crew, who would relay a description of the vehicle (usually by color and relative traffic position) to the officer. After pulling over the vehicle, the driver would be asked by a member of the CARB staff to volunteer their vehicle for inspection.

Because a previous analysis by CARB staff of California's roadside surveys had shown that there were a significant number of high emitters in 1980 and later model year vehicles (Ashbaugh and Lawson, 1991), we decided to focus our efforts on identifying new technology cars, since these might be more difficult to visually identify as high emitters without the aid of remote sensing. We set remote sensing cutpoints of 4% CO and 0.3% HC (propane equivalent) as nominal values for stopping the cars. We occasionally stopped cars with lower readings than these, however, with the lowest CO readings at 3.2% on both remote sensors. Nearly all of our emphasis was on high CO emitters because the numbers were much easier to read on the video display terminal, and the greater than unity values for CO emissions were easier to evaluate visually than the corresponding HC readings. For example, on the first three days we didn't stop any vehicle that was high only in HC emissions. Because high CO often indicates high HC emissions, when a car was high in CO, it was usually also somewhat high in HC emissions.

During ten days of operation between June 3 and June 14, 1991 between the hours of 9 a.m. and 3 p.m., we performed a total of 60,487 remote sensing measurements on 58,063 unique vehicles. More than 3,000 gross polluters were identified of which 334 vehicles were successfully recruited for the roadside Smog Check. A total of 78 (this includes 8 vehicles which were not submitted to a Smog Check inspection) vehicles were tested with the EPA IM240 test.

Table V provides summary statistics of the remote sensing data for all of the days from the first sensor and one day for which license plates were transcribed from the second sensor. Notice that the Rosemead data are provided for all of the measurements made (60,487 measurements) and for the database with valid and matching information from the California Department of Motor Vehicle Records (42,546 measurements). The following discussion will focus on the data for which Department of Motor Vehicle records are available, unless otherwise indicated. Appendix C provides a complete listing of all data collected from the 342 vehicles subjected to roadside inspection or IM240 or both.

Three hundred thirty-four vehicles were given a roadside inspection. Four cars were not correctly identified in the communication with the CHP, and thus were stopped by mistake, four others were methanol-fueled (M85) vehicles volunteered by CARB, and 19 had no recorded FEAT values. The 19 vehicles without FEAT records arose due to a video failure on the afternoon of June 4 and therefore we were unable to match these vehicles to their remote sensor readings. Of the remaining 307 vehicles, 9 had only one FEAT reading, seven were "flippers" (high reading on one remote sensor and low on the other) and 10 were in cold start mode (driven 5 minutes or less as reported by the motorist). Sixty-one percent of the high-emitting vehicles were 1980 and newer models, 28 percent were from 1975-1979, and 11 percent were from pre-1975 technology groups. Nearly every automobile manufacturer was represented in the high emitter data set, and vehicles from nearly all countries of manufacture were represented.

Of the 307 vehicles with FEAT measurements inspected 41% had emissions control equipment that had definitely been tampered with, and an additional 25% with defective equipment, but the defects (missing belts for instance) may not have been caused by intentional tampering. Eighty-five percent of the high emitters failed the tailpipe portion of the test. Overall, 92% failed the roadside inspection, although all were showing valid registration stickers. Of the 25 on-road high emitters that passed the roadside inspection test, four subsequently went on to the IM240 test. All four failed the IM240 test (see Table VI), and all were pulled by the remote sensing team for excessive CO emissions except the 1980 Nissan which was pulled for excessive HC. Another ten of the 25 vehicles were in cold start mode. Excluding these 14 vehicles from the data set, less than 3% of the 307 vehicles identified as on-road gross polluters passed the roadside inspection. Of the four M85 vehicles tested by IM240 and smog-check two passed and two failed. All four M85 vehicles were not subjected to rigorous maintenance procedures. This included a basic oil change and lube every 6,000 miles and a minor engine tune-up and safety inspection every 24,000 miles (unless conditions warranted earlier service). However, the two vehicles that failed the

Table V. Rosemead Boulevard Remote Sensing Statistics

Rosemead Boulevard Data Summary						
Date	Number of Measurements	Average %CO	Median %CO	Average %HC (propane)	Median %HC (propane)	Average Model Year
6/3 - 6/10	60,487 (Full Database)	0.86	0.16	0.083	0.042	N/A
6/3 - 6/10	42,546 (DMV Matches)	0.79	0.15	0.074	0.040	1984.6
6/3	1,835	0.89	0.18	0.075	0.043	1984.5
6/4*	1,743	0.85	0.15	0.072	0.037	1985.0
6/5	5,542	0.79	0.16	0.074	0.042	1984.5
6/6	5,594	0.82	0.15	0.073	0.040	1984.5
6/7	3,351	0.82	0.17	0.072	0.036	1984.5
6/10	5,400	0.78	0.14	0.077	0.041	1984.8
6/11	5,238	0.79	0.15	0.077	0.041	1984.7
6/12	5,521	0.72	0.12	0.060	0.033	1984.7
6/13	5,030	0.72	0.14	0.074	0.039	1984.8
6/13†	5,162	0.83	0.17	0.099	0.061	1984.7
6/14	3,292	0.82	0.15	0.089	0.048	1984.7

*Data reported for only the morning measurements because of video failure.
†Data collected from second DU sensor.

roadside inspection were at the end of there useful life, and had not been maintained or used immediately prior to this study. They were included by ARB (by request) to serve as examples of poorly-running M85 vehicles with expected high emissions. They were removed from service and sold to a junk yard shortly afterward.

There were 58,063 unique vehicles measured on Rosemead Blvd. during the ten day period; 3,271 exceeded the 4% CO cutpoint we used to define a high-emitting vehicle. Presumably,

Table VI. On-road gross polluting vehicles that passed their Smog Check standards and were measured by IM240.

Make/ Model Year	Smog Check Data				IM240 Data*		
	%CO Low Idle	ppm HC Low Idle	%CO 2500rpm	ppm HC 2500rpm	CO g/mile	HC g/mile	NOx g/mile
Nissan 87	0	5	0	4	43.9	1.4	1.2
Nissan 80	0.24	78	0.32	12	11.1	1.2	3.2
Dodge 73	0.24	44	7.02	202	142.4	4.5	0.9
Olds 85	0.07	13	0	5	113.6	4.1	0.7

*EPA suggested Failure points for 1980 and newer vehicles are 15 g/mile for CO, 0.8 g/mile for HC and 2 g/mile for NOx.

the 307 vehicles examined by the two Smog Check teams are representative of the 3,271 on-road gross polluters. Therefore, if inspection of the entire lot were possible one would find that 3,005, or 5.2% of the on-road fleet, would have failed the Smog Check inspections, while only 266 vehicles, or 0.5% of the on-road fleet, would have passed the Smog Check inspection.

At least half the population of each model year before 1986 in the high emitter data set failed the visual underhood inspection, as shown in Figure 12. This suggests, contrary to earlier expectations, that emission control equipment in late model, high-technology vehicles continues to be subject to modifications (tampering) that have always been exhibited in the motor vehicle fleet. On average, 3.3, 4.0 and 4.3 control device failures per tampered vehicle were present in the pre-1975, 1975-1979, and 1980 and newer model year vehicle groupings, respectively. Figure 13 illustrates the roadside inspection failure rates by model year, again showing the high efficiency of the remote sensors to correctly identify vehicles that would fail the Smog Check. We were able to locate Smog Check records for more than a third of the 307 vehicles tested. In Figure 14, we plot the maximum ratio of the in-use, idle CO or HC emissions to the idle test standards for those respective vehicles against the time since Smog Check for each vehicle. This plot shows no relationship between the on-road idle test values and the time since the car was inspected in the Smog Check program, confirming earlier findings (Lawson *et al.*, 1990; Ashbaugh and Lawson, 1991).

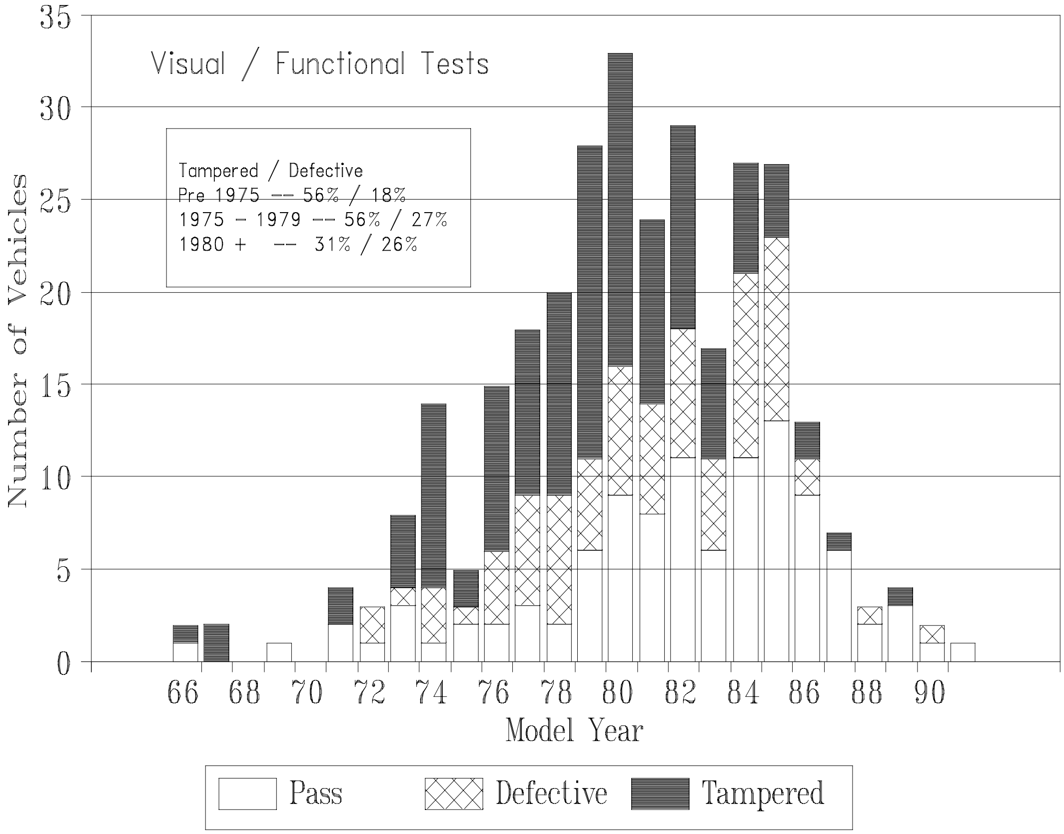


Figure 12. Visual and functional underhood inspections results performed by the CARB and BAR on the 307 vehicles that were confirmed on-road gross polluters.

Of the 74 vehicles that were given the IM240 dynamometer test (excluding the four M85 vehicles), 23 emitted more than 100 grams of CO per mile. The six highest HC emitters each produced more than 20 grams per mile, while three emitted more than 10 grams NO_x per mile. Of these 74 vehicles 69 received a roadside Smog Check. By segregating the vehicles according to the results of the visual underhood inspection, we find that 70% of the total IM240 HC and 60% of the total IM240 CO and NO_x emissions result from vehicles identified as tampered or non-conforming. Performing a similar analysis using the on-road data from the 307 inspected vehicles we find that those identified as tampered or non-conforming are responsible for 70% of the CO and 74% of the on-road HC emissions.

These results show that the vehicles identified as high emitters by the remote sensors produce extremely high IM240 emissions rates for CO, HC and NO_x, even though NO_x was not used as a screening parameter. The average (82 grams/mile) and the distribution of emissions of CO were almost identical to the vehicles recruited and scrapped by Unocal (84 grams CO/mile, Unocal, 1991). The major difference is that the average model year of the vehicles stopped on Rosemead Blvd. was 1984, fifteen years newer than the SCRAP vehicles (1984 vs. 1969). Since 1984 vehicles are driven more than 1969 vehicles, and on-road monitoring

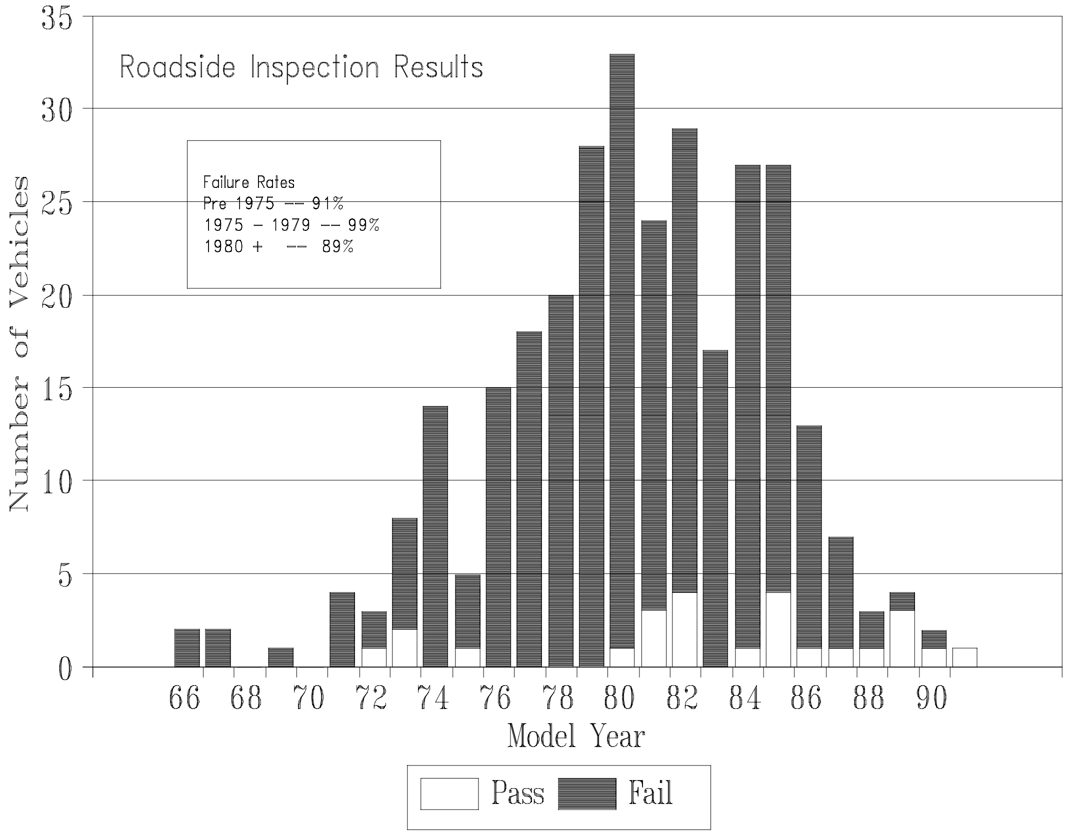


Figure 13. Overall pass/fail results from the roadside Smog Checks performed on the 307 confirmed on-road gross polluting vehicles.

necessarily identifies vehicles the more they are driven, we conclude that scrapping newer on-road gross polluters would be more effective (although not cost-effective) than scrapping older vehicles. We note later that recent studies show that repairing these vehicles is even more cost-effective.

The average (6 gm/mi) and the distribution of HC emissions from the IM240 data were about half the readings found by UNOCAL. However, the conclusions above for CO also hold for HC because the VMT of 1984 model year vehicles is estimated to be more than double that of 1969.

The setup at Rosemead Boulevard produced video images of high quality that enabled us to transcribe a larger percentage of the older blue California license plates than at some other sites. This helped to eliminate most, but not all, of the age bias in the database with motor vehicle records. This bias has arisen in other studies because the less visible blue license plates are found more often on older vehicles, while the newer vehicles have more visible white plates. Since the white plates are transcribed more easily, the database contains relatively more newer (younger) vehicles than the on-road fleet. We were also concerned

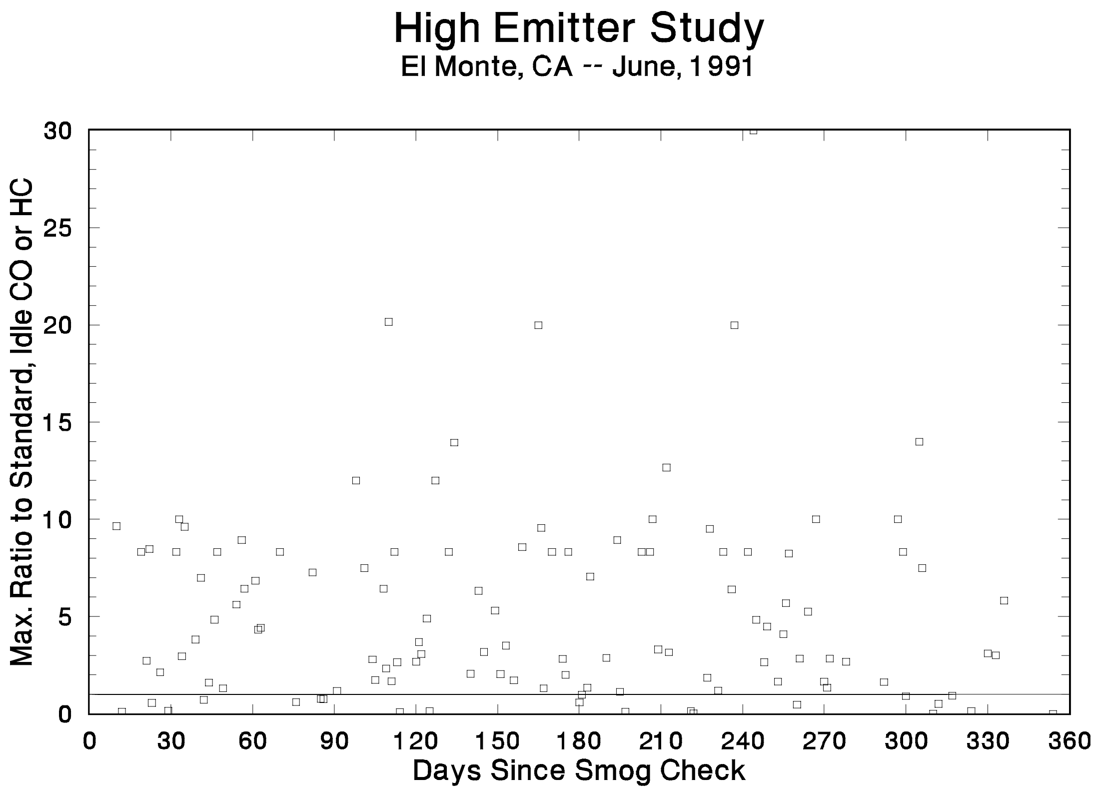


Figure 14. Normalized (see text) roadside idle %CO or %HC vs. the number of days since the vehicle's Smog Check inspection. A total of 118 vehicles are plotted.

whether or not news reports in the first week on Rosemead alerting the public to our presence changed the age of the fleet at the site. The measured traffic volume did not change. The weighted average model year of the fleet during the first week was 1984.5; in the second week it was consistently higher at 1984.75. This difference is small, so we do not believe the age distribution of the fleet changed during our presence.

Figure 15 displays the fleet emissions divided into ten groups (deciles) in order of emissions for the Rosemead Boulevard data. As we have observed in all previous locations tested in California and elsewhere, the emissions distributions are highly skewed. Assuming equal exhaust volumes, at Rosemead Boulevard 7% of the measurements were responsible for 50% of the on-road, hot exhaust, instantaneous CO emissions, while 11% of the measurements were responsible for half of the on-road, hot exhaust, instantaneous HC emissions. The distribution of emissions can be characterized by a gamma distribution. The particular mathematical characteristics of a gamma distribution (Zhang *et al.*, 1994) results in this statistic regardless of whether measurements are used or unique vehicle emissions. For example, at Rosemead Boulevard we remotely measured 3,622 vehicles 3 or more times.

Using these vehicles' average readings as the basis for rank ordering we find that 9% and 18% are responsible for half of the emissions of CO and HC, respectively.

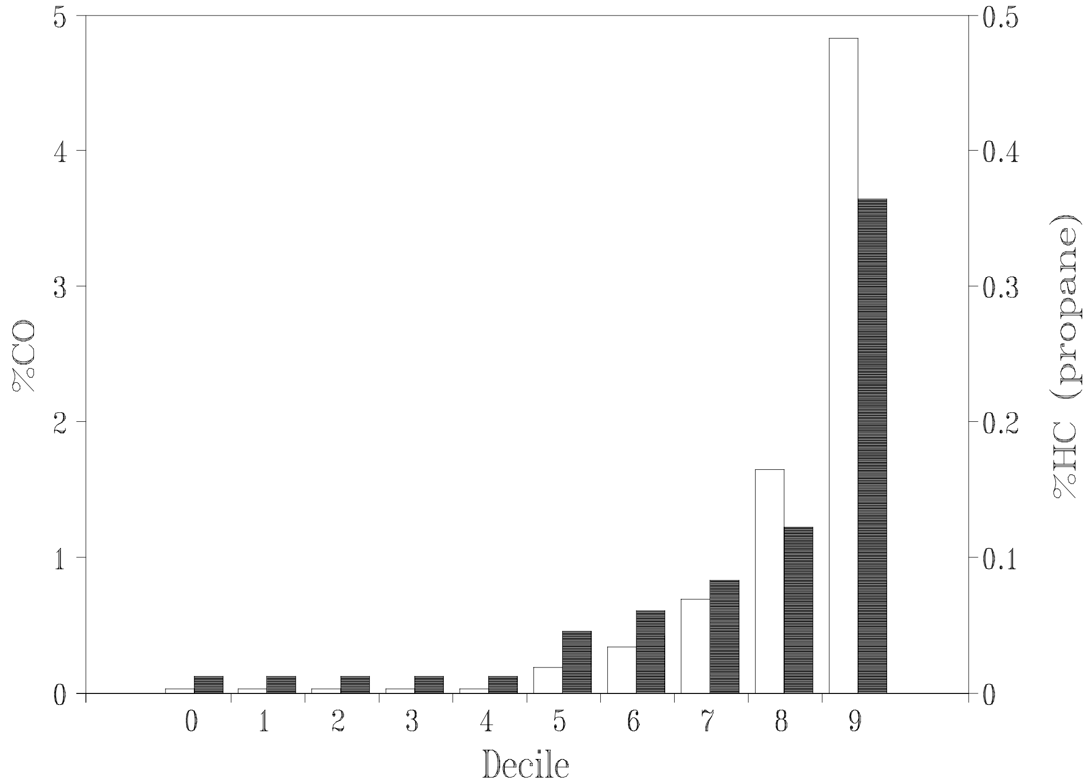


Figure 15. Remote sensing data from Rosemead Boulevard for all days. The solid bars denote CO while the empty bars are HC data. The first five deciles are displayed as an average of all five (the measurements are very low).

Figure 16 is a plot of average %CO versus model year for the 1989 Lynwood data (■) compared to the data obtained at Rosemead Boulevard (+) in 1991. Most vehicles (13,354 out of 16,511 total vehicles) in 1989 were measured on or near Long Beach Boulevard in the Lynwood area. The vehicles measured in this task were uniformly cleaner than those measured in Lynwood in 1989. Age of the vehicles is accounted for in this graph, thus the differences in vehicle CO emissions must arise for other reasons. For example, there may be a socio-economic difference between the two areas (regions with higher incomes might spend more money on vehicle maintenance), the California Smog Check program could have a different effectiveness in different parts of the city (perhaps the El Monte area has generally better trained mechanics available for vehicle repair), vehicles of a given model year have become significantly cleaner in the intervening two years, or the vehicle operating mode was significantly different.

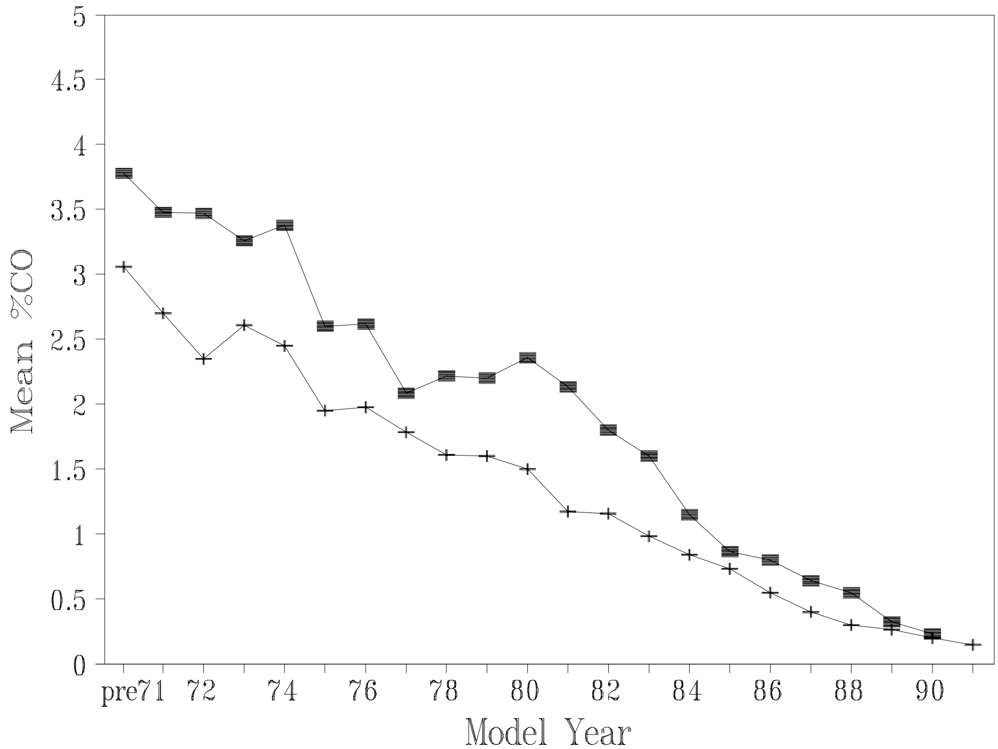


Figure 16. Average %CO data measured in Los Angeles during 1989 (■, 16,511 records) compared to measurements made during 1991 at Rosemead Boulevard (+, 45,546 records).

Random Pullover Survey in Northern California

Starting July 15, we accompanied the CARB/BAR random roadside survey crew with two remote sensors, one to monitor all the passing vehicles, including a reading on the vehicles that were pulled over (when possible logistically), and one to measure vehicles pulled over. For the first three days, most vehicles have two readings; one at "idle", which is the reading from the vehicle just after it moved away from the testing lane to pull out into the traffic, and the second 40 feet downstream in the traffic lane as it passed the second sensor. The "idle" readings were quite hard to obtain in some cases because the vehicle would sometimes sit in the beam for a long time waiting for a break in traffic. The last two days there is only one reading per tested vehicle. On June 17, the equipment was set up such that the inspected vehicles left the inspection by simply driving straight ahead and out onto the traffic lane, which had no traffic because it had been closed by the testing team. On June 18, the situation was more complex since the two testing teams were one behind the other. The vehicles from the first team were let out into the traffic by the CHP and were usually measured when travelling quite fast in the traffic lane. The vehicles from the second team were monitored with the "idle" sensor which was configured in the same way as the day before.

We accompanied the roadside survey crew at the following locations:

Sunnyvale, CA - July 15, 1991

The FEAT unit monitored vehicles eastbound on Evelyn about 200 meters west of Mathilda. The driving mode was typical urban straight and level, slowed down somewhat by the lane closure used by CARB/BAR for the survey. The site never experienced significant congestion because Evelyn travels under Mathilda, and is in any case a lightly travelled street.

Hayward, CA - July 16, 1991

The FEAT unit was set up on eastbound Winton 0.25 mile west of Hesperian. This straight and level road was heavily travelled both by heavy trucks from the local warehouses and by significant traffic of light duty vehicles. The traffic flow was fairly continuous at 15-25 mph with little congestion at the remote sensor location. At that location the vehicles had reached the end of the constricted one lane section and drivers could see the open two lane road ahead. The traffic flow was such that the lane closure caused some backups upstream.

Berkeley, CA - July 17, 1991

The FEAT unit was set up on eastbound Ashby just west of Martin Luther King. This slightly uphill urban road frequently had traffic completely stopped because of the traffic lights at the end of the short block for the cross street Adeline.

Lafayette, CA - July 18, 1991

The original plan was to monitor northbound Camino Pablo in Antioch. This site was determined to be unsuitable, though, since the central island with generator and light source was run over by a construction truck. The FEAT unit was unharmed, but was set up on southbound Pleasant Hill Road about 0.5 mile south of Highway 24. This idyllic site was in the middle of a long straight and level stretch of rural/suburban road and typically observed mostly light duty vehicles cruising at speeds between 30 and 50 mph. A few vehicles were measured in the slow lane as they left the CARB/BAR roadside tests. This site never became congested.

Pittsburgh, CA - July 19, 1991

The FEAT unit was set up on northbound Bailey about 200 meters north of Highway 4. This site was distinctly more proletarian than Lafayette, but otherwise similar except that the traffic speeds were approximately 10 mph slower. This site also never became congested.

There are several reasons why the Random Roadside Surveys are not truly random. First, the police officers who are pulling over the vehicles are instructed to pull over the fourth vehicle after they are told that the inspection team is ready. They are further instructed not to pull

Table VII. On-road %CO and %HC data for all passing vehicles in Northern California locations.

Location (Date)	Number of Measurements	Average %CO	Average %HC (propane)	Average Model Year
Sunnyvale (7/15)	1092	0.63	0.083	84.2
Hayward (7/16)	3634	0.71	0.059	84.2
Berkeley (7/17)	3474	0.72	0.053	84.1
Lafayette (7/18)	1763	0.39	0.078	85.3
Pittsburgh (7/19)	387	0.59	0.083	83.3
Weighted Average	10,350	0.65	0.064	84.3

over vans with engines reached via the van interior, vehicles with bras, or Volvos (hoods with bras are difficult to open and Volvos with automatic transmissions tend to incur engine problems with subject to high idle in neutral). In fact they tend to do their own thing. Some prefer to pull over vehicles driven by young ladies, others feel that since they know that it is an air pollution study they should try to pull over vehicles which look to them to be likely offenders. The most serious non-randomness arises because the operator tells the driver that participation is voluntary. For one reason or another about 30% of the drivers do not allow the testing team look under their hoods. This voluntary aspect was a problem in the pullover task discussed earlier because at least one owner of a late model Porsche repeatedly refused to have his on-road gross polluting vehicle inspected. Table VII shows the summary statistics for all remote sensor measurements at Northern California locations.

We analyzed the emissions of the vehicles that refused the inspection in an attempt to quantify any bias that may exist with these vehicles. Table VIII compares the emissions of vehicles that were inspected to those that refused inspection. The vehicles that refused inspection show higher emissions, with a bias that is quite large. In five days we made 55 CO and 46 HC measurements on vehicles whose drivers refused the test. For both CO and HC the average on-road emissions of these vehicles was more than double those of the vehicles which accepted the inspection. These findings are independent of instrument calibration, placement, or driving mode, as all readings were taken with the same instrument

Table VIII. Data from a remote sensor accompanying the CARB/BAR roadside pullover teams.

Remote Sensing Measurements for "Random" pullovers July 15 - 19, 1991								
Date	Average Emissions for Stopped Vehicles		Average Emissions for Inspected Vehicles		Vehicles that Refused Inspection		%CO Ratio refuse to accept	%HC Ratio refuse to accept
	%CO (n)	%HC (n)	%CO (n)	%HC (n)	%CO	%HC		
7/15/93	0.95 (25)	0.17 (23)	0.51 (17)	0.07 (15)	1.89	0.37	3.7	5.6
7/16/93	2.53 (41)	0.26 (32)	1.2 (25)	0.07 (22)	4.61	0.67	3.8	9
7/17/93	1.77 (25)	0.12 (20)	0.6 (20)	0.09 (17)	6.45	0.27	10.8	3
7/18/93	0.91 (36)	0.07 (37)	0.67 (22)	0.08 (23)	1.29	0.05	1.9	0.7
7/19/93	2.15 (26)	0.11 (23)	3.24 (14)	0.18 (12)	0.88	0.03	0.3	0.2
Weighted Totals	1.7 (153)	0.14 (135)	1.13 (98)	0.09 (89)	2.72	0.25	2.4	2.8

at the same location for both inspected and uninspected vehicles. Interestingly, the data for July 19 show lower emissions for vehicles that refused the inspection. Close examination of the data reveals that the inspected vehicles included at least one very high emitter on July 19. The CO emissions for the 14 vehicles measured were more than four times the weighted CO emissions of the other four days. For the entire five day period, the weighted CO and HC emissions of the refusing vehicles was 2.4 and 2.8 times those of the vehicles that accepted the inspection. It is unfortunate that the results from the roadside surveys are biassed in this way. The information would be greatly improved if the surveys could be conducted with mandatory inspection of randomly selected vehicles.

A second source of possible bias is the zeal with which the CHP select vehicles which they believe are more "interesting" to the CARB/BAR crew. This potential source of bias depends entirely on the whim of the pullover officer. We tested the representativeness of the surveyed fleet by comparing the weighted average CO and HC emissions from Table VII to those in Table VIII. We found that, for the five days studied, the 153 vehicles pulled over had CO and HC emissions that were 2.6 and 2.2 times, respectively, those of the passing fleet of over 10,000 vehicles.

On-Road Emission Measurements In the Los Angeles Area

Site Descriptions

Figure 17 shows a map of the Los Angeles area with the approximate locations of the measurement sites indicated by a site abbreviation. The date, time and instrument number positively identify each measurement site. All these sites were selected by the Air Resources Board in consultation with the University of Denver. The sites were selected to provide a cross-section of vehicle operational behavior, and to observe special cases, such as out-of-state vehicles and warm versus cold operation. A number of additional sites were selected in case any of them proved to be unacceptable for measurements. The sites measured are identified on Figure 17 as indicated below:

PECK / Peck Road to I-10 - May 19-20, 1991

Interchange where moderate accelerations were monitored with one instrument during the morning periods and decelerations on a curved off ramp were monitored during the afternoon.

BEACH / Beach Boulevard to South Bound I-405 - June 18, 1991
Beach Boulevard to South Bound I-405 - June 19, 1991

Typical clover leaf intersection with an uphill (~2% slope) metered on-ramp. Two remote sensors were set up on the ramp. One unit was 30 feet up the ramp from the meter lights; the second was a further 39 feet up the ramp. The vehicles were accelerating past both units in order to join the freeway which was a further 40 feet beyond the second unit. Traffic was heavy most of the day and congested during the morning rush hour. The freeway was at near standstill for several periods of up to 30 minutes, so the on-ramp meters were restricting the traffic flow quite severely. While collecting data at this site on June 19 instrument 3004 was hit by a large truck, damaging the focusing mirror for the CO_2 channel. This damage crippled the unit's ability to collect accurate data due to a damaged mirror; however, this was not discovered until June 24 when the mirror completely fell off. Evidence of the damage can easily be seen in the instrument's calibration records. On June 19 the unit had an average CO calibration factor of 1.6. The next date the instrument was used was on June 21 when the average CO calibration factor was 4.3. This change can not be accounted for by the changing location. Therefore, data from June 21, 22, 23, and 24 collected with this detector are not reported and have been excluded from the computerized database.

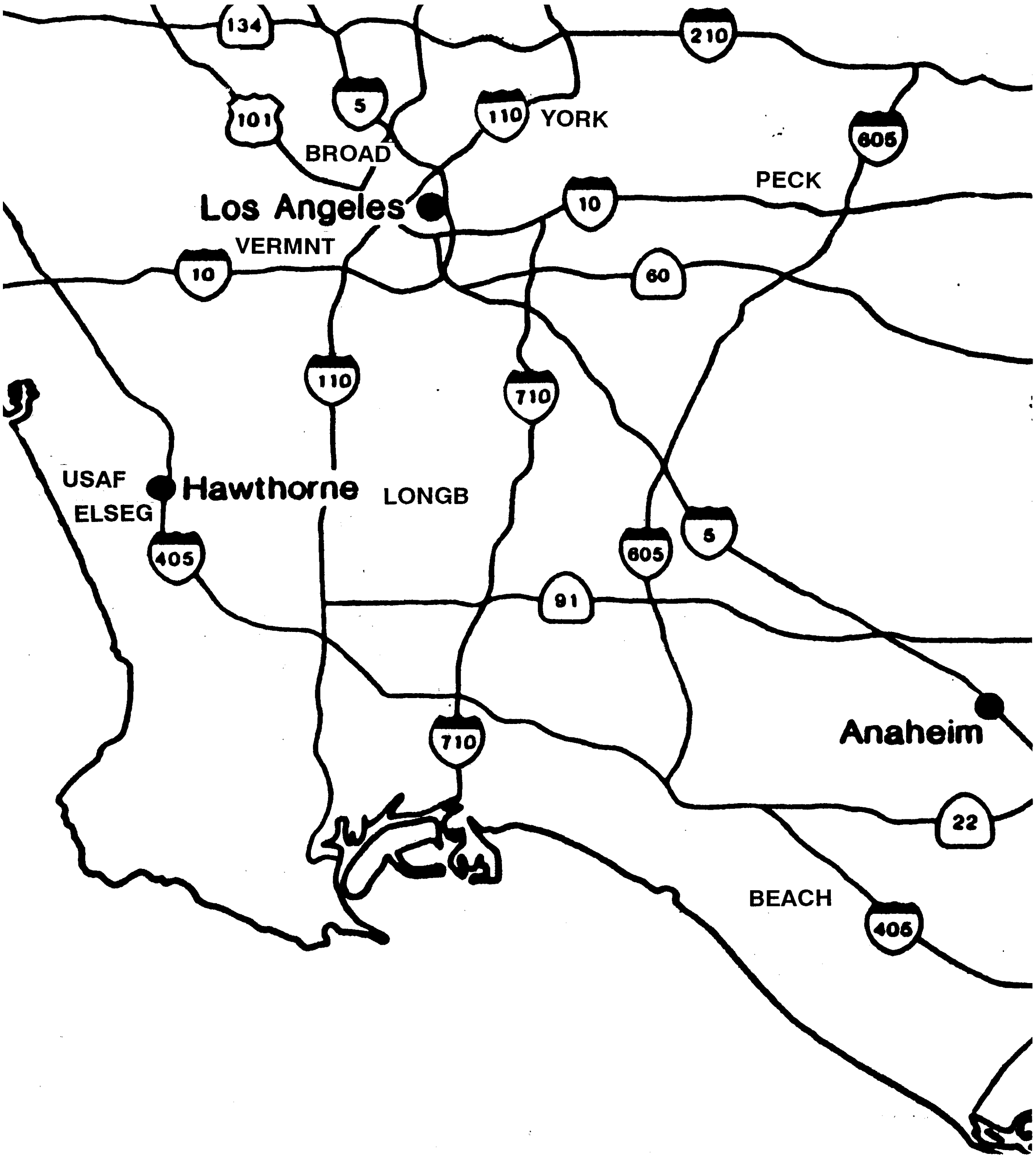


Figure 17. Map of the Los Angeles basin with the approximate locations of the monitoring sites visited.

LONGB / Long Beach Boulevard - June 20, 1991

Level two lane road with light traffic flow throughout the day. This site was at approximately the same location as used in the 1989 study in which we monitored vehicles southbound on Long Beach Boulevard in Lynwood one block north of the junction with Norton. Set unit in the median and the source in an island of cones between the two lanes. In the afternoon we obtained permission to close the second lane of Long Beach Boulevard so that the unit could observe a greater number of vehicles. Traffic speeds averaged between 10 and 25 mph.

USAF / Los Angeles Air Force Base - June 21, 1991

ELSEG / El Segundo to South bound I-405 - June 21, 1991

Monitored traffic at the parking lot entrance with instrument 3004 from 7:20 a.m. to 3 p.m. and then relocated to the exit of the parking lot. The parking lot was level and the traffic in both directions was moving slowly without apparent accelerations and was free from congestions except in one or two cases where traffic on El Segundo prevented vehicles from leaving the site easily. Due to the damage previously discussed these data have been omitted. Instruments 3002 and 3005 were located on an uphill on-ramp with a 90^{o} bend in the middle. The metering light was located on the lower half of the ramp, below the bend. Unfortunately, there was no space to park the monitoring vehicle on the lower half of the ramp so the remote sensors were placed on the second half of the ramp approximately 200 feet away from the meter lights. The unit 3002 was 100 feet from the exit from the curve; the second instrument (3005) was eighty feet further along the ramp. The vehicles were still accelerating gently as they passed the first unit but seemed to be in a cruise mode as they passed the second. It is unclear whether this cruising was caused by the presence of the monitoring vehicle and the associated road cones or was the normal driving mode for the ramp. The ramp has a long acceleration lane that feeds into a slip road rather than the main freeway, so the passing vehicles were entering a mostly uncongested section of road.

SITED / Test Site D - June 22, 1991

Flat parking lot. The remote sensor was located 30 feet inside the entrance. We planned to measure vehicles while gently accelerating into the lot. Unfortunately, a significant proportion of the cars went past the unit under a hard acceleration regime, presumably to vent the frustration of the drivers after queuing for some time to get into the lot.

At 2 p.m. the unit was relocated to the exit of the lot, and we began monitoring the exiting vehicles at 4 p.m. The remote sensor was located 20 feet inside the exit. Traffic was light and rarely backed up to the unit. At the exit the vehicles were moving slowly and were predominantly in a slight deceleration mode.

We had hoped that a significant number of out-of-state vehicles would be observed at this site, and a survey of 100 vehicles entering the parking lot showed that we were seeing about 12% out-of-state plates. While observing the cars for the out-of-state plates no vehicles were seen displaying rental company stickers on their rear bumpers. Unfortunately, the data from this site were omitted due to the damaged detector (see above).

YORK / York Ave. to South Bound 110 (Pasadena) Freeway - June 24, 1991

A single unit was operated at the entrance to the 110 freeway from Salonica Street, which is the feed road from York Ave. The roadway was level, but the traffic had a very limited space between the stop sign and the freeway, so almost all of the vehicles observed were accelerating hard. The unit was placed 2 feet on the freeway side of the stop line which meant that the vehicles were stopping in the infrared light beam while waiting for a space in the freeway traffic. As a site to monitor accelerating vehicles this was very successful. The data were omitted due the damaged detector (see above).

BROAD / Northbound Broadway to North Bound I-101 - June 25, 1991

A long downhill on-ramp with a 270º bend at the top followed by a long straight run to the freeway. One unit was set up at the egress from the curve, a second unit 180 feet down the ramp from the first unit, and the third unit was a further 150 feet along the road. The vehicles were either under light acceleration passing the first unit or in a cruise at about 20 mph. They then accelerated past the second unit and either continued accelerating, or passed into a cruise at around 40 mph passing the third unit.

VERMNT / Southbound Vermont Ave. to I-10 west - June 26, 1991

Two units were used instead of three due to damage to instrument 3004. The on ramp consisted of a steep uphill slope (~5%) followed by a more gentle slope, feeding into a slip road which runs parallel to the freeway and feeds into the freeway about ¼ mile downstream. The remote sensors were placed at the top of the slope and a further 140 feet down the road where the vehicles were about to join the slip road. Typically the vehicles were accelerating as they passed the first sensor and were either cruising or slowing down slightly as they passed the second unit.

SITEK / Test Site K - June 27, 1991

A single unit was used to monitor the traffic entering and subsequently exiting this parking lot. The vehicles entering the lot were moving slowly, generally at idle speeds, and were rarely accelerating. A survey of 100 vehicles was taken to assess the percentage of out-of-state vehicles present in the fleet observed and again ~12% had out-of-state plates. We observed no rental company bumper stickers. The unit was moved to the exit gate at 3 p.m. and we resumed monitoring at 5 p.m.

Results
The remainder of this section is devoted to various analyses of the data collected from all the sites monitored. Table IX summarizes the data collected at the southern California locations. The northern California data and the Rosemead Boulevard data are summarized in Tables VII and V, respectively.

Table IX. Data from the various Los Angeles locations.

Date	FEAT	Number of Measurements	Average %CO	Median %CO	Average %HC (propane)	Median %HC (propane)	Average Model Year
5/19	3002	2950	1.03	0.18	0.087	0.052	83.7
5/20	3002	2217	0.87	0.14	0.078	0.042	84.5
6/18	3002	3341	0.63	0.09	0.036	0.024	85.8
6/18	3004	1722	0.79	0.14	0.063	0.049	85.7
6/19	3002	4145	0.70	0.09	0.042	0.027	85.7
6/20	3002	1815	1.77	0.40	0.157	0.072	81.3
6/21	3002	3027	0.86	0.13	0.073	0.035	85.7
6/21	3005	2317	0.90	0.12	0.103	0.059	85.5
6/25	3002	2194	0.72	0.09	0.056	0.041	86.4
6/25	3005	3411	0.80	0.12	0.096	0.064	85.6
6/26	3002	3238	1.11	0.23	0.071	0.041	84.1
6/26	3005	2690	1.19	0.20	0.127	0.082	84.5
6/27	3002	554	0.62	0.08	0.050	0.030	86.1

Lynwood. The CO data collected at Long Beach Boulevard in Lynwood in 1989 and 1991 are plotted by model year in Figure 18. With minor exceptions, the data from 1989 and 1991 appear identical. Most of the variation between the two studies appears in the older model years where there are few data points. These averages in the older model years are more strongly influenced by the fraction of high emitters in the data than are the newer model years where there are significantly more vehicles.

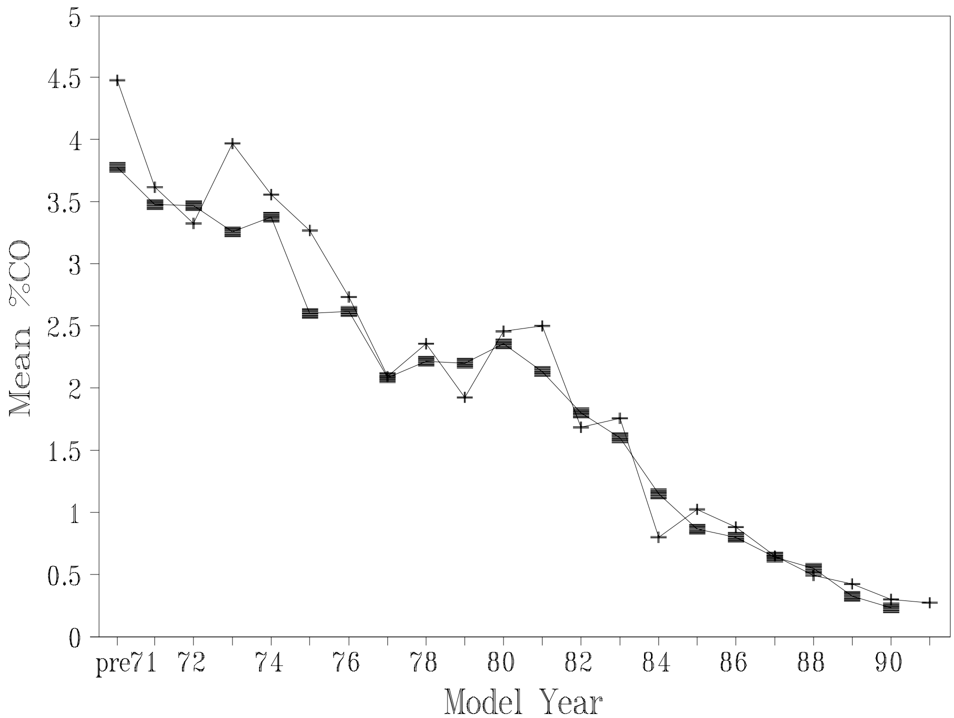


Figure 18. Average %CO data measured during 1989 (■, 16,511 records) on or near Long Beach Boulevard in Lynwood, CA. compared to measurements made during 1991 (+, 1,815 records) in the same area.

Northern versus Southern California. Figures 19 and 20 show the measured on-road CO and HC emissions as a function of model year from studies in Los Angeles and at the five locations tested in northern California. All of the five CO readings from northern California are below the comparable data from Los Angeles. As shown elsewhere in this report, with the exception of hard accelerations average on-road CO is not a strong function of driving mode; thus, this difference probably relates to differences in the maintenance/tampering levels between the Bay Area and the southern California fleets. According to the CARB 1989 tampering survey the San Francisco Bay Area tampering rate is 10% compared to 15% in southern California.

For HC the data are less clear. The on-road HC readings average ten times lower than CO; thus, they show more noise relative to signal. Also, on-road HC data show more variability because they are more load dependent. Three northern California readings appear to be lower, but two appear to be the same or higher than for southern California.

Parking Lot Data. We were not able to use the data from site D, as FEAT 3004 sustained undetected damage earlier in the study. Nevertheless, we were able to analyze the data from

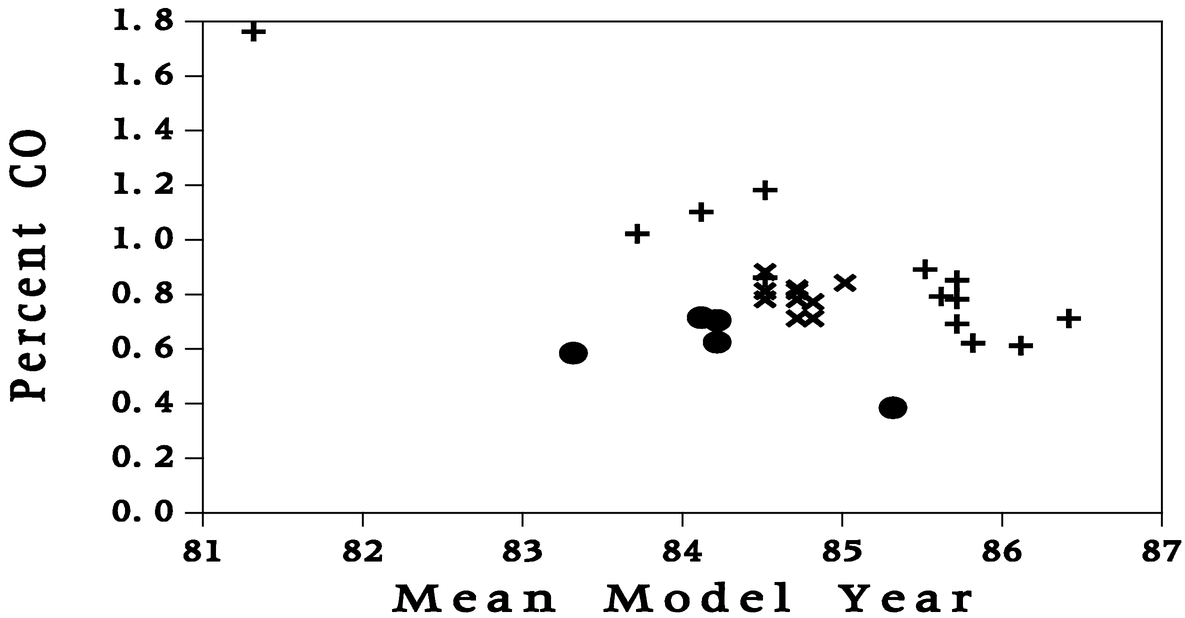


Figure 19. Daily mean %CO measurements obtained from the Los Angeles (+) and Rosemead Blvd. (x) locations compared to northern California locations (●).

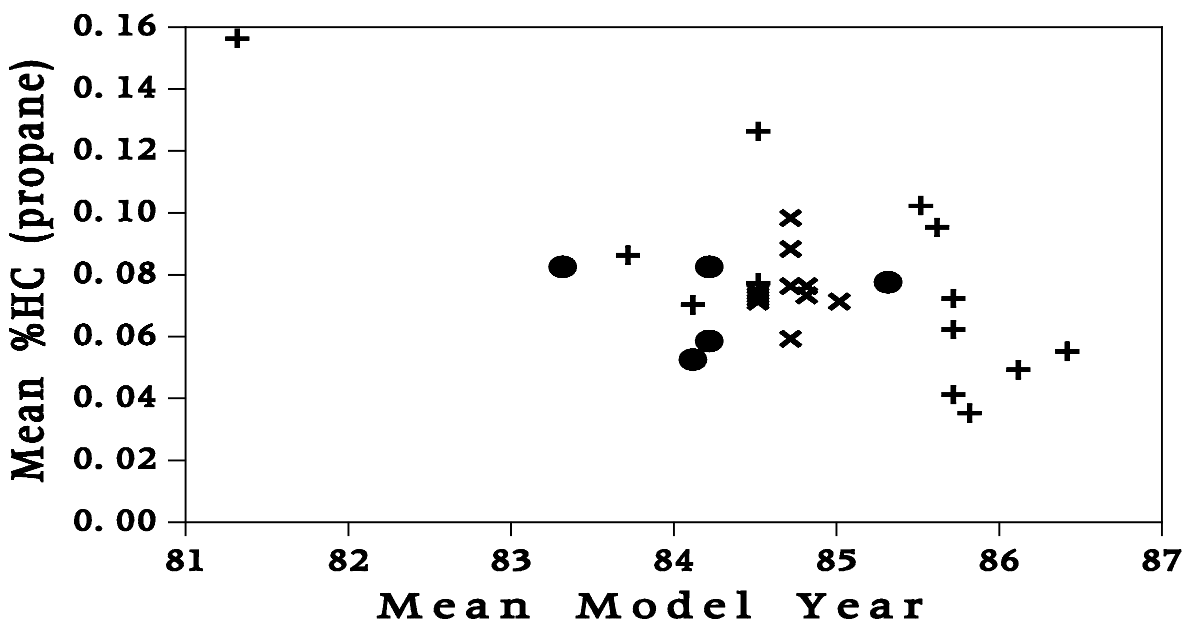


Figure 20. Daily mean %HC measurements obtained from the Los Angeles (+) and Rosemead Blvd. (x) locations compared to the northern California locations (●).

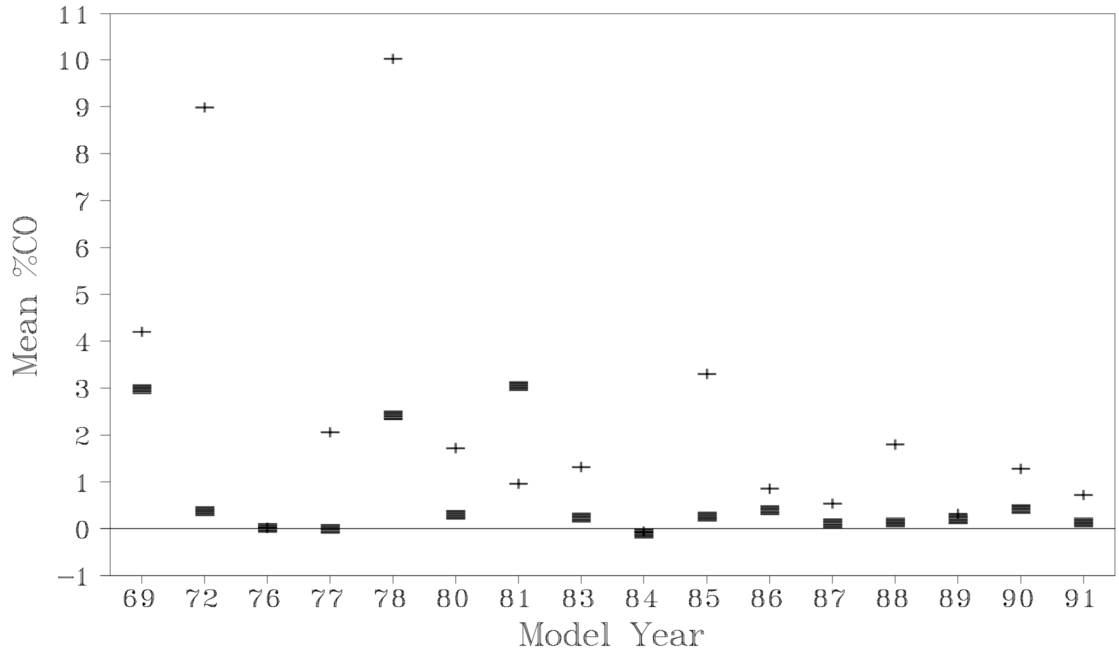


Figure 21. Average %CO data by model year for 101 paired vehicles entering (■) and leaving (+) the parking lot at site K.

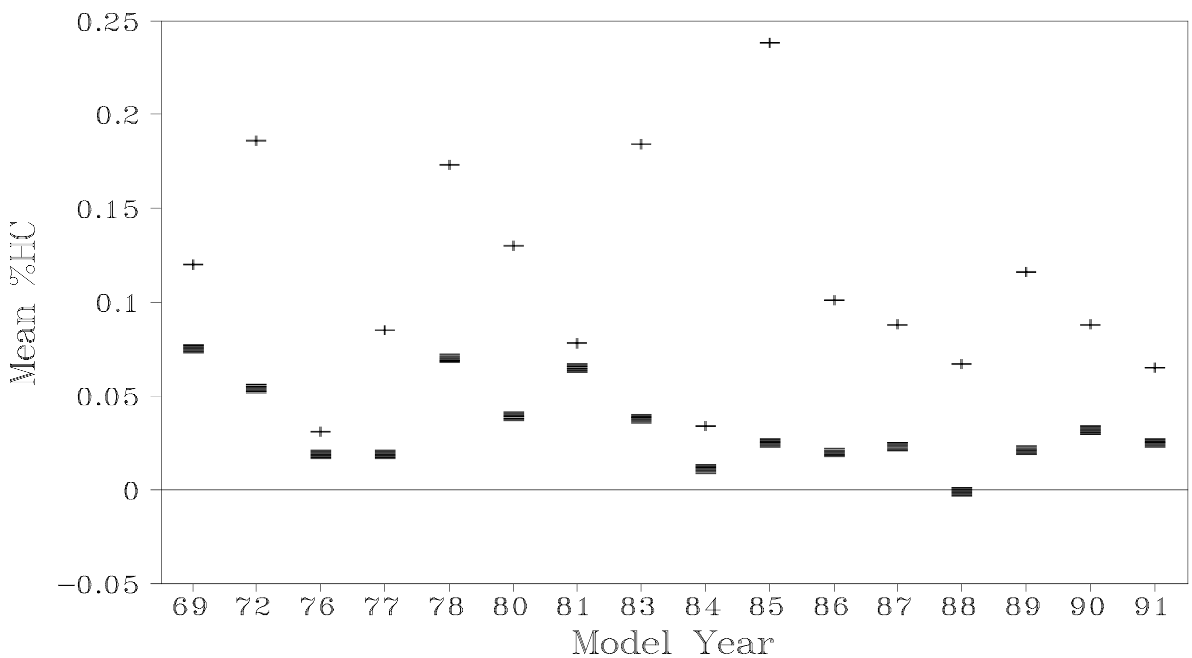


Figure 22. Average %HC data by model year for 101 paired vehicles entering (■) and leaving (+) the parking lot at site K.

site K. We searched the database for vehicles observed both entering and exiting the lot. Figures 21 and 22 display CO and HC data collected from 101 vehicles entering and leaving the parking lot at site K. The average CO and HC emissions for these vehicles upon entering the site were 0.35% and 0.026% respectively. Upon exiting the averages had increased to 1.37% for CO and 0.100% for HC. Data collected by Bridges and Hannah (1993) working in a parking garage show similar results. The average time between entrance and exit was 7 hours and 16 minutes. This time period is more than sufficient for catalysts to be cold and inactive when exiting.

There is considerable noise from such a small set of data, but the afternoon measurements are almost always higher than the morning measurements. The weighted sum of the afternoon emissions is 3.8 times that of the morning emissions for both species measured. In the afternoon five vehicles exceeded the Rosemead cutpoint of 0.3% for HC and six vehicles exceeded the 4% CO cutpoint. The only vehicle that exceeded a gross polluting cutpoint in the morning was a 1985 model year vehicle for CO.

Other Analyses

Automatic Versus Manual Transmission

According to Haskew and Liberty (1991) there is a measurable difference in engine-out HC emissions for new (well-controlled) vehicles undertaking an FTP cycle between automatic and manual transmissions. They surmise that each manual gearshift necessarily requires a throttle dropout, thus a burst of high manifold vacuum accompanied by a burst of HC emissions. We have also observed a large difference in %HC emissions between downhill (off throttle) and uphill (on throttle) on-road emissions (Zhang *et al.*, 1993).

Honda includes an indication of transmission type in the Vehicle Identification Number (VIN). Therefore, we used the Los Angeles data set to see if there is an observable on-road emissions difference for CO or HC between 1,006 Honda manual transmissions and 1,706 Honda automatic transmissions. Figures 23 and 24 show the results. For 1987 and newer model years the expected HC difference is observed. The automatic transmission vehicles show 30-40% lower %HC (or gm/gallon) emissions than manual transmission vehicles.

The same effect is observed for CO, possibly arising because engine-out HC emissions become tailpipe CO emissions from vehicles with well-functioning catalysts. For 1986 and older vehicles, little HC differences are observed, but the CO differences switch (unexpectedly) so that for all model years 1986 and older the manual transmission vehicles are, on average, lower emitting on-road than are the automatic vehicles. Honda engineers have suggested three possible explanations which may account for this switch in 1986-87, namely the advent of four speed automatics, the advent of computer controlled shifting, and the elimination of transmission slippage. All these improvements lead to more efficient (thus probably lower emitting) automatic transmissions.

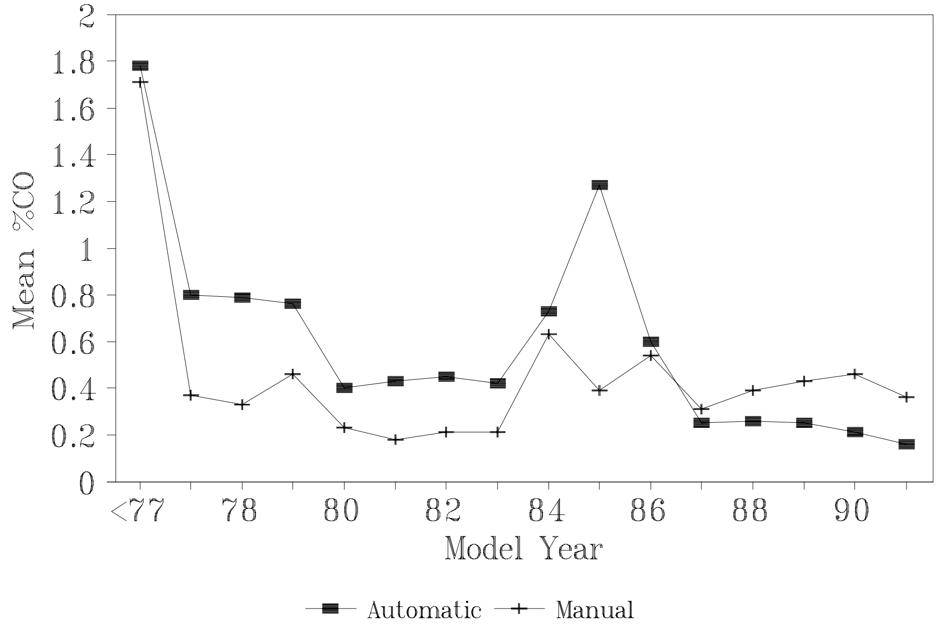


Figure 23. Average %CO emissions by model year for Honda automobiles identified by their VIN as having manual (1,006 vehicles) or automatic transmissions (1,706 vehicles).

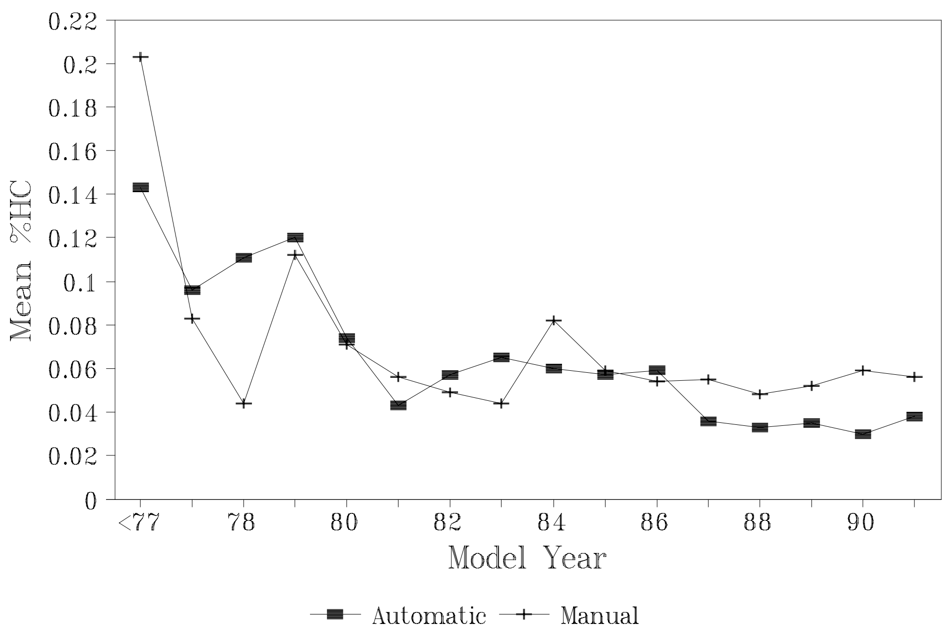


Figure 24. Average %HC emissions by model year for Honda vehicles identified by their VIN as having a manual (1,006 vehicles) or automatic transmission (1,706 vehicles).

Emissions Comparisons

Figures 25 and 26 show average CO and HC exhaust concentrations as a function of vehicle model year from four studies. The Los Angeles data are from this study. The Denver uphill and Denver downhill data are from a 1992 study in Denver intentionally investigating the emissions effects of an uphill but tightly curved roadway and a high speed downhill location (Zhang *et al.*, 1993). The Chicago data are from a 1991 study (Stedman *et al.*, 1991a) and is a straight uphill on-ramp where power enrichment events ("off cycle emissions") occurred on some vehicles (Stephens, 1992). As with all our data sets there is more noise among the oldest model years because of the smaller numbers of vehicles. The least noisy fleet is from Los Angeles, with over 47,000 entries compared to only about 9,000 each for the other studies.

On average we observe lower emitting new cars and higher emitting older vehicles. For CO, all fleets except Chicago appear to have essentially identical emissions as a function of model year. This shows that for normal road loads, as well as for uphill and downhill, and in Denver and Los Angeles, the average air to fuel ratios are similar. The Chicago CO data are an exception; they have been shown to include some power enrichment emissions (Stephens, 1992).

For hydrocarbons, the results are dramatically different. The Denver uphill data show a smooth increase from low emitting new vehicles to higher emitting older vehicles. The downhill data parallel the uphill data but with a large positive offset. This has been attributed to the fact that vehicles at 50-60 mph which temporarily are travelling with the throttle closed (e.g. downhill) generally emit very little CO_2 and a lot of unburned fuel evaporating from the intake system. The Los Angeles and Chicago data fall between the extremes defined by the fully loaded and fully unloaded Denver data. This is not surprising since the Los Angeles situation was mainly straight and level urban driving at 15-30 mph.

Although there is more noise among the older model years, the Chicago emissions tend to drop significantly below those from other locations for the 1975 and older model years. We speculate that this effect is caused by the increased tendency for vehicles to rust in Chicago. Thus, 1975 and older vehicles still operating in the Chicago area must be subject to a higher level of maintenance than present in Denver or Los Angeles. We have observed, when attending old car shows, that the emissions of the 1950's vehicles at the shows are usually lower than the early 1970's vehicles in the same city. Again, we speculate that this arises because of the high level of maintenance and attention being given to the "show" vehicles. We suggest that gross polluter cut points should be set based on the observed statistics at a particular location, particularly because of the load dependence of on-road HC. Nevertheless, note that the cut points used for our Rosemead Blvd. study (4% CO and 0.3% HC as propane) are both off scale in Figures 25 and 26.

Repeat Emission Measurements. Table X provides an analysis of emissions from 3624 vehicles with three or more valid measurements successfully identified by license plates on Rosemead Boulevard. Sixty-two percent of the vehicles that are consistently low emitting

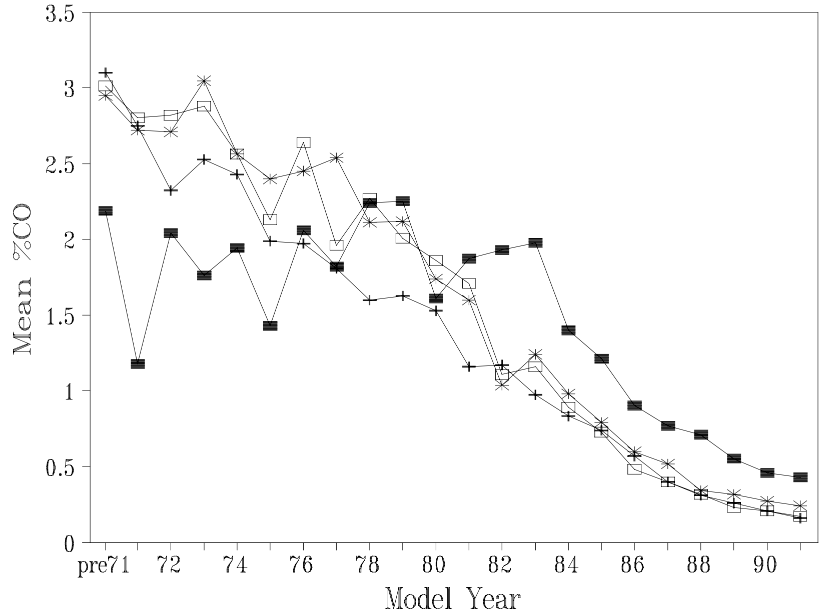


Figure 25. A comparison of average %CO emissions by model year from an uphill (□) and downhill (⋆) sites in Denver, an uphill site in Chicago (■) and the data from Los Angeles (+).

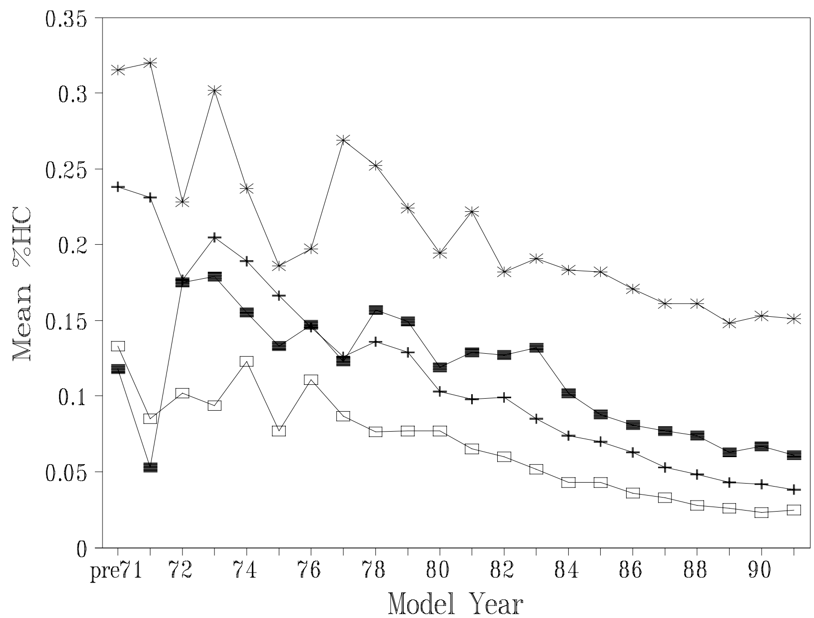


Figure 26. A comparison of average %HC emissions by model year from an uphill (□) and downhill (⋆) sites in Denver, an uphill site in Chicago (■) and the data from Los Angeles (+).

Table X. An analysis of emissions from 3624 vehicles with three or more valid measurements.

CO Data Groups	Number of Vehicles	Percent of Vehicles	Number of Measurements	Mean %CO	Sum %CO	Percent of Total CO
all	3624	100	15611	0.76	11859	100
all <1%	2257	62.3	9385	0.15	1365.7	11.52
all <4%	3194	88.1	13601	0.39	5246	44.23
1 time >4%	219	6.04	1006	2.13	2144.9	18.09
2 times >4%	103	2.84	472	3.73	1759.6	14.84
3+ times >4%	69	1.9	397	4.58	1819.6	15.34
all >4%	39	1.07	135	6.59	889.5	7.5

HC Data Groups	Number of Vehicles	Percent of Vehicles	Number of Measurements	Mean %HC	Sum %HC	Percent of Total
all	3624	100	15611	0.073	1135.5	100
all <0.1%	1871	51.63	7511	0.031	230.9	20.33
all <0.3%	3285	90.65	14002	0.053	728.1	65.01
1 time >0.3%	249	6.87	1166	0.177	206.4	18.18
2 times >0.3%	45	1.24	211	0.328	69.3	3.09
3+ times >0.3%	21	0.58	142	0.405	57.5	5.07
all >0.3%	24	0.66	90	0.713	64.1	5.65

account for less than 12% of the CO emissions, and 52% account for only 20% of the HC emissions. At the other end of the scale the most consistently high emitting 3% of the vehicles emit 23% of the CO and more than 27% of the HC. The variable CO emitters account for 65% of the CO, and the variable HC emitters account for 53% of the HC. Note that these variable emissions could be caused by inherent variability of high-emitting vehicles, or could be due to variable operating conditions for the different measurements.

Continent of Origin

A study of the CO emissions distribution for various fleets by model years was presented in the 1991 CARB Report (Stedman *et al.*, 1991b). Although the fleets were defined as U.S. (U), Asian (A) and European (E) according to the manufacturer's nameplate, the name and the actual manufacturing continent are not necessarily synonymous. The previous study suggested that the major observed differences in emissions were not caused by differences between manufacturers, but rather by societal differences between the maintenance/tampering practices of owners with U.S., Asian and European nameplate vehicles. A minor effect among newer Asian nameplate vehicles was noted and ascribed to some emissions problems experienced with some Hyundai models.

The data reported in 1991 consisted of 16,511 vehicles from several sites in Los Angeles. We repeated this analysis using a database of 47,708 readings from 30,411 individual vehicles, all measured on Rosemead Boulevard in El Monte, California. Figure 27 shows the CO analysis and Figure 28 the HC analysis. The similarities between the CO graphs for the 1991 study and this study are striking (see Stedman, 1991). Small variations between different model years that we might have attributed to noise in the 1991 study are repeated in the 1993 study. In both analyses, the U.S. vehicles emissions peaked in 1980, the European emissions dipped in both 1981 and 1986, and the overall trends are remarkably similar. The overall picture shows a smooth increase in emissions from the newest vehicles where the emissions are low and essentially identical for all three fleets, back to 1982 when the average CO emissions are about four times and the average HC emissions about three times higher than the newer vehicles.

The 1975 to 1985 U.S. manufactured vehicles are consistently higher emitters for CO and HC than are the other fleets. From 1987 to 1991 Asian and U.S. manufacturers vie for the highest emitting position. For every model year from 1975 onwards, European nameplates are the lowest emitting, on average. This is not to say that there are no gross polluting Volkswagens, or tampered Jaguars. These vehicles exist, but on average, there are fewer gross polluting European nameplates than Asian or U.S. This supports EPA tampering surveys that consistently find less tampering among European nameplates than among U.S. (U.S. EPA, 1990)

The effects of technology-forcing standards in the USA are very hard to discern by examining the average emissions since the average is dominated by broken vehicles whose emissions no longer bear any relationship to the standards they were designed to meet. One way to look for the potential effects of U.S. standards is to look at a fleet which the evidence

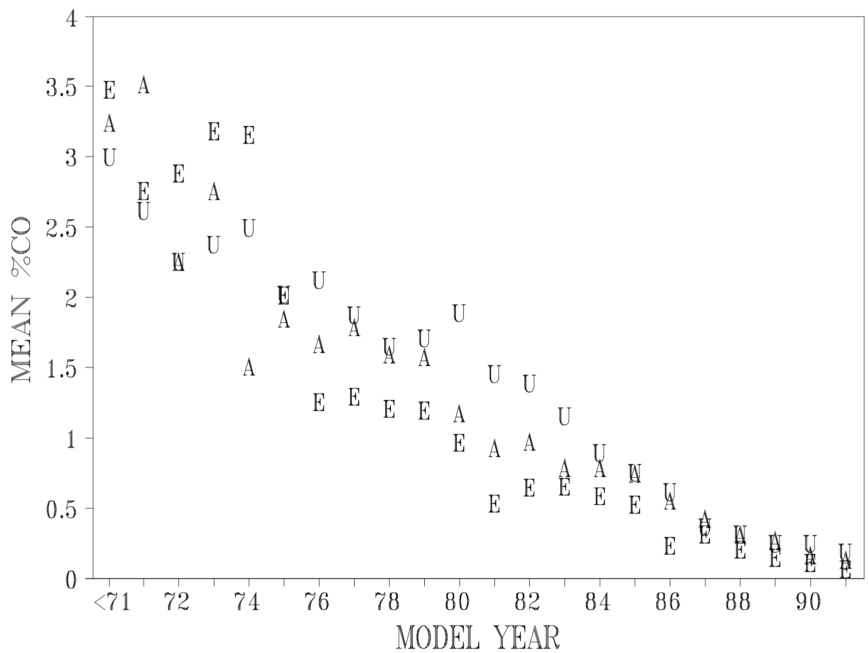


Figure 27. Average %CO emission by model year for vehicles whose manufacturing country of origin is the United States (U), Europe (E) or Asia (A).

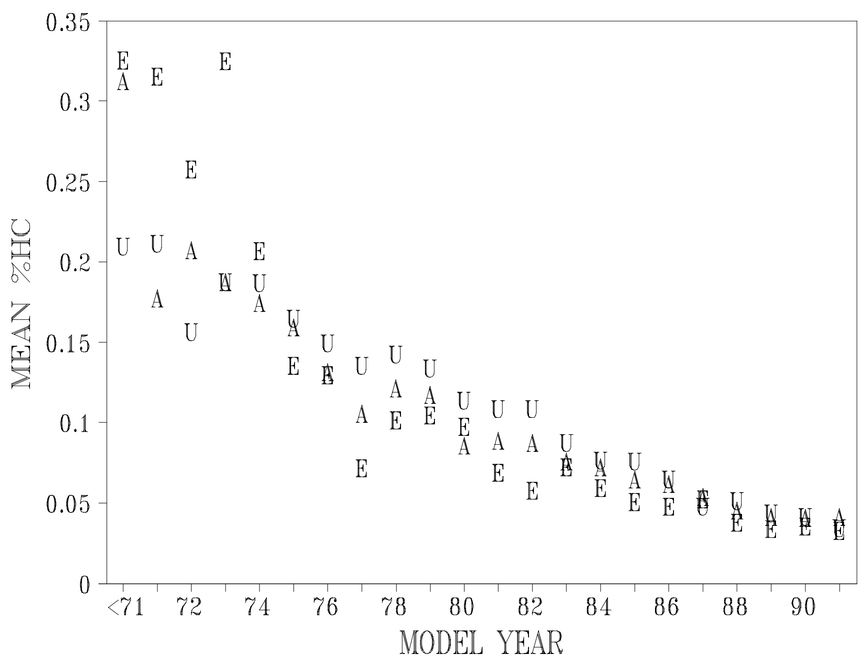


Figure 28. Average %HC emission by model year for vehicles whose manufacturing country of origin is the United States (U), Europe (E) or Asia (A).

suggests is, on average, relatively well maintained, i.e. the European nameplate vehicles.

Figures 27 and 28 show that the pre-1974 European nameplate fleet is uniformly high, the 1975 - 1980 fleet is uniformly lower, then there is a step down to 1981 and later vehicles which taper down in emissions slowly toward the newest (1991) model year shown. This suggest that the effects of modern catalyst and fuel injection technology are detectable even after fifteen years for well-maintained vehicles. From 1975 onwards, most European models were port fuel- injected, often without catalysts, while the U.S. fleet did not become fully port fuel-injected until the late 1980's. This topic will be revisited in a later comparison between Swedish manufactured vehicles in Sweden and Swedish manufactured vehicles in Los Angeles.

Hyundai Analysis
In the 1991 report, we suggested that high emissions of Asian nameplate vehicles in 1987-1990 model years were caused by an emissions problem specific to vehicles manufactured by Hyundai Motors during those years. There are enough Hyundais in the current data set to show that our previous hypothesis was correct for 1986-1989 models. The results are illustrated in Figures 29 and 30. The emissions of Hyundais do not appear to be significantly higher for 1990 and newer vehicles. Note that Hyundais tend to have higher fuel economy for their model year, thus equivalent %HC or %CO (or equivalent gm/gallon emissions) translates to lower gm/mile emissions.

Swedish Vehicle Study
In Los Angeles, the European nameplate vehicles tend to have the lowest emissions. We speculate this is because they are very well maintained. Data from the CARB listing manufacturer-specific failure rates for Smog Check reinforces this perception (CARB, 1992a). The CARB data show Saab and Volvo with the lowest and third lowest Smog Check failure rates, respectively.

In September 1991, a study was conducted in Goteborg, Sweden (Sjödin, 1991). The location was a freeway interchange ramp (Gullbergsmotet) just across the river from the Volvo factory and downriver from the Saab manufacturing facility. In the Swedish study, emissions from 4011 Saabs and Volvos were measured. Sweden has a very stringent Inspection and Maintenance program (fail badly and the vehicle is TOWED to a repair shop). Sweden mandated closed-loop catalytically-controlled systems in 1988. They were phased in during the 1987 model year, with about 50% of the vehicles. The 1986 and older Saabs & Volvos in Sweden are not equipped with any type of catalytic convertor.

We used the data from Sweden and Los Angeles to examine the effects of technology and maintenance on vehicle emissions. In this study, we measured emissions from 536 Saabs and Volvos. By comparing these presumably well-maintained high technology vehicles to the well-maintained lower technology Swedish vehicles, the effects of technology ought to be readily observable. Figures 31 and 32 show the emission data for CO and HC. For 1978-86 model years, the CO and HC emissions of the Los Angeles vehicles average about 0.4% and

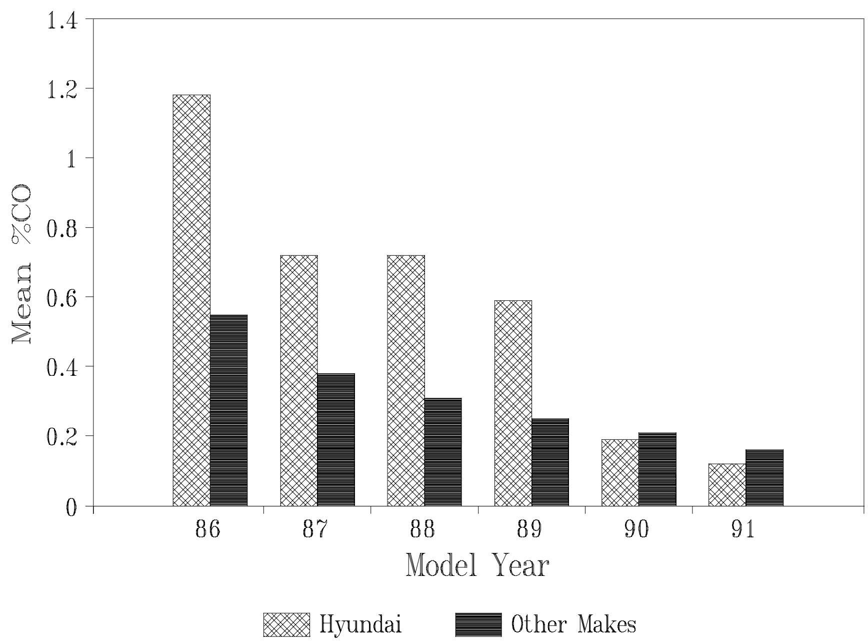


Figure 29. Average %CO emissions for Hyundai compared to vehicles produced by other manufacturers.

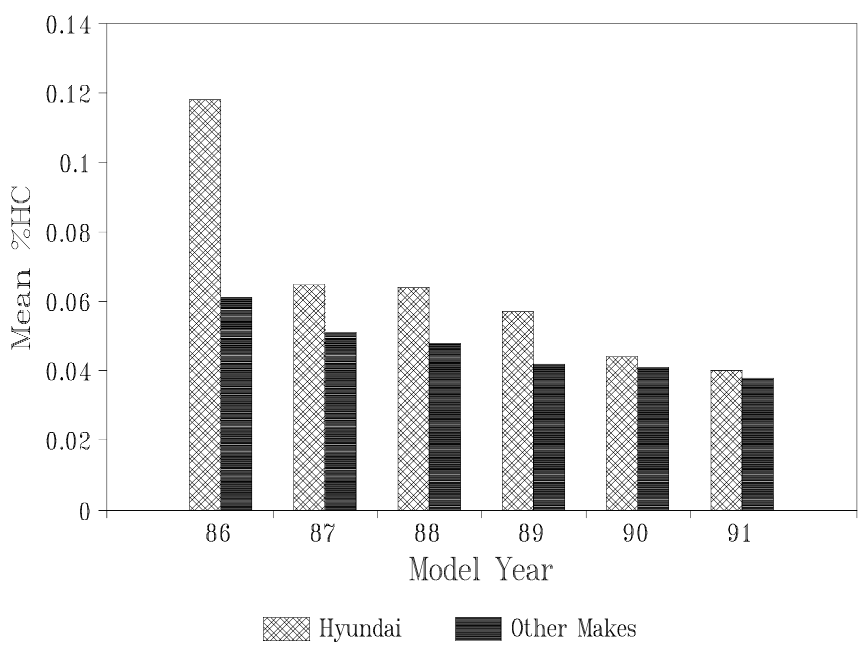


Figure 30. Average %HC emissions for Hyundai compared to vehicles produced by other manufacturers.

0.04%, respectively. For the Swedish vehicles of the same model years, the CO and HC emissions average about 1.5% and 0.08%, respectively. The improved technology of the Los Angeles fleet of Saabs and Volvos has clearly resulted in lower emissions, even for older vehicles. For 1988 model years and newer, when both fleets incorporated the same technology, the Swedish vehicles in Los Angeles and Goteborg are indistinguishable.

To examine the effect of maintenance on emissions, we compared emissions from the Los Angeles fleet of 1978-86 model year U.S. vehicles with the same model year non-catalyst vehicles in Sweden. The Swedish vehicles averaged 1.5% CO and 0.08% HC. The emissions of U.S. vehicles were slightly lower for CO and comparable for HC. In other words, the well-maintained Swedish non-catalyst vehicles emit nearly the same CO and HC as the overall (less well-maintained) U.S. fleet in Los Angeles. This demonstrates that a high level of maintenance is as important as technology to the higher emitting (on average) older model year vehicles.

The dramatic drop in average vehicle emissions in Sweden following the 1987-88 introduction of catalysts is not detectable in the U.S. data base since catalysts were introduced longer ago. In Melbourne, Australia, catalysts were introduced in 1986. The dramatic improvement shown in Swedish vehicles is also not observed in the 15,908 vehicle Australian database. We suspect that Australian maintenance is more like California and less like Sweden.

Finally, emissions from Saabs and Volvos in Los Angeles are higher in the pre-1976 fleet than in the Swedish fleet. Because vehicles rust faster in Sweden, the pre-1976 fleet is much older, on average, in Los Angeles. The older Saabs have two-stroke engines which are notorious for HC emissions and often tuned to produce high CO; thus, it is not surprising that the older fleet in Los Angeles has higher average emissions.

Swedish manufactured vehicles appear to be well maintained in both Sweden and Los Angeles. In both locations they have used computer controlled port fuel injection for over twenty years. In Los Angeles, these vehicles have used catalysts since 1980, whereas in Sweden catalysts were not introduced until 1987. We have used these data to conduct two thought experiments in which the citizens of Los Angeles are imagined to all drive Swedish nameplate vehicles. The first assumes that all vehicles are constructed, operated and maintained as in Los Angeles (i.e., their emissions match the entire Los Angeles fleet for all makes). The second assumes they are constructed, operated and maintained as in Sweden. The overall emissions of the vehicle fleet measured in Los Angeles in this study averaged 0.79% CO and 0.076% HC. Using the same age distribution as the overall fleet, but the emissions distribution of the Swedish manufactured vehicles currently in use in Los Angeles, we would obtain average CO and HC emissions of 0.49% and 0.056%, respectively. Using the same age distribution again, but the emissions of the Swedish manufactured vehicles currently in use in Sweden, the average CO and HC are 0.9% and 0.066% respectively. The better maintenance <u>with</u> catalytic control provides a reduction of 38% and 26% for CO and HC, respectively. The better maintenance alone provides an increase of 14% for CO

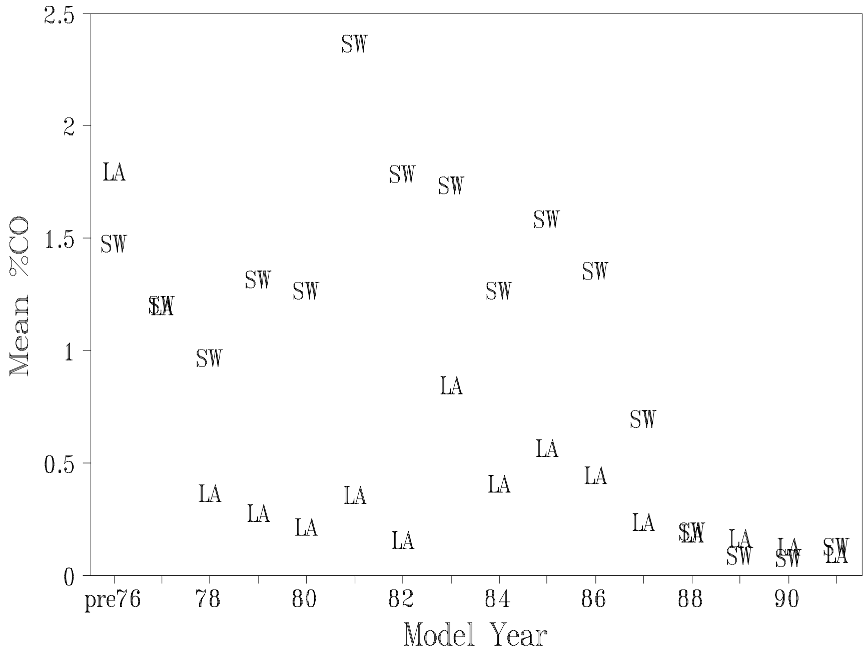


Figure 31. Average %CO for Saabs and Volvos measured in Los Angeles (LA) compared to the same model year vehicles measured in Sweden.

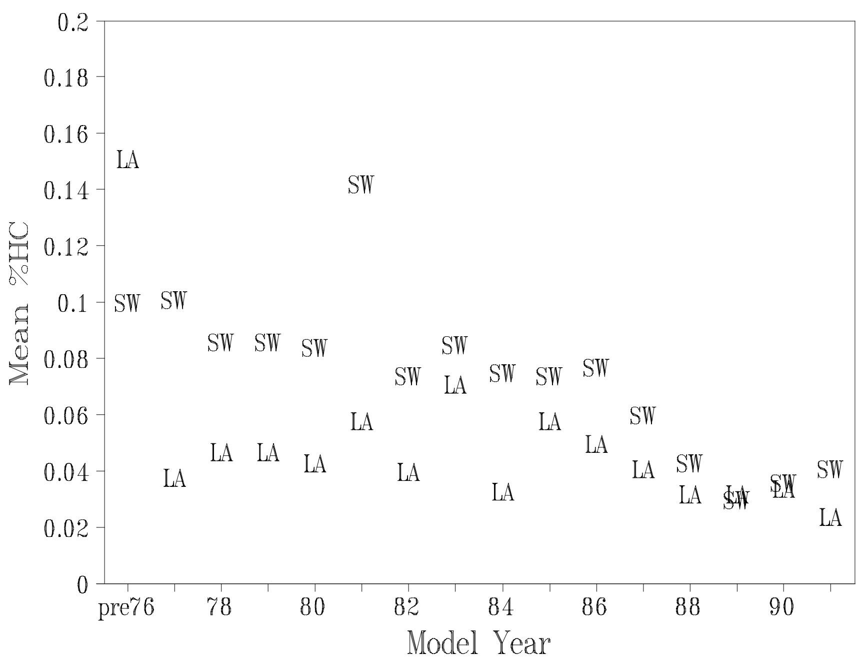


Figure 32. Average %HC for Saabs and Volvos measured in Los Angeles (LA) compared to the same model year vehicles measured in Sweden.

and a reduction of 13% for HC. We conclude that better maintenance of the current fleet in Los Angeles could provide on-road emissions reductions greater than 25% for both CO and HC.

Vehicle Emissions Variability

Remote sensing has been criticized for displaying highly variable emissions on duplicate remote sensing measurements. Typical data obtained from Rosemead Boulevard for two sensors located approximately 100 feet apart are shown in Figure 33. Initially, the concern focused on the validity of the measurements, i.e. the lack of correlation could result from the inability of a remote sensor to accurately measure the instantaneous exhaust emissions. This concern has been alleviated by blind comparisons to vehicles with known on-road emissions. However, the results from this and earlier studies show that, for some vehicles, emissions variability is intrinsic to the vehicle. If this is correct, then the intrinsic variability may be exhibited on other tests, and should be characterized for all emissions tests used.

In this analysis, we will show that there are four aspects of emissions variability that are important in the design of a testing program. First, the test-to-test emissions variability has similar characteristics for all current test methods. This includes idle testing, FTP testing, the related dynamometer short tests, and remote sensing measurements. Second, vehicle emissions variability increases with increasing emissions. Restated, low-emitting vehicles exhibit little test to test variability, while high-emitting vehicles can have very large (absolute factors of 10 to 20) changes in emissions from one test run to another. Third, emissions variability cannot be eliminated; it can only be bounded or defined through multiple tests. Fourth, some vehicles are more likely to exhibit large test-to-test emissions variability. These variable-emission vehicles (flippers) may be as few as 4% of the fleet, but can contribute more than 20% to the overall tailpipe emissions.

Vehicle Emissions Variability Independent of Test Method. Since the early 1970's each preproduction vehicle/drive train combination sold in the United States has been required to have exhaust emissions certified to various limits using a test called the Federal Test Procedure (Federal Register, 1966, 1968, 1970, 1971). The FTP is a rigidly defined test procedure which measures and calculates average emissions for carbon monoxide, hydrocarbons, oxides of nitrogen and particulate matter in units of grams per mile. The loaded mode component of the test is divided into three phases labeled cold transient, cold stabilized, and hot transient.

Vehicles are certified by remaining below certain emission limits on two consecutive tests. The vehicle is operated under a series of accelerations, decelerations, stops and starts on a chassis dynamometer whose inertia and friction are set for each vehicle. The emissions from each phase are collected at a constant volume into three sample bags and the concentrations of each species are determined. The final result is a weighted average from the three phases. The driving course is modeled after a "typical" summertime commute to work in Los Angeles in the early seventies. Each test takes at least 12 hours to complete and costs more than $1000. Precision of the results for a given vehicle is claimed to be ±20% (Berg, 1978) and is

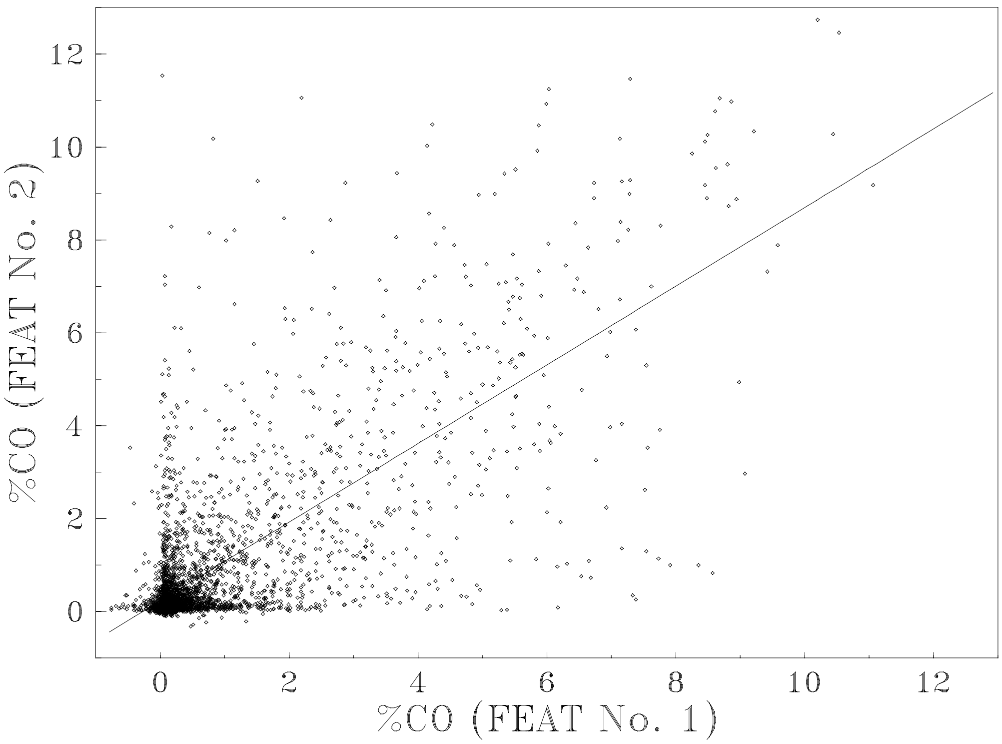


Figure 33. Data collected from 4,122 vehicles on Rosemead Boulevard using two FEAT units approximately 75 feet apart. The equation of the regression line is FEAT(2)=0.23+0.85*FEAT(1), with $r^2 = 0.54$.

controlled mainly by the reproducibility of the automobile's emission system, not by the test system or gas analysis protocols. The results of the FTP test have been used as the basis for computer models of on-road emissions even though the test was not designed for that purpose.

The expense and time requirements of the procedure have eliminated it as a choice for vehicle inspection programs. This has caused the U.S. EPA and other state agencies to design a shorter, less expensive test that can be used on the millions of in-use vehicles on the road today. The quandary that has developed involves the ability of the short test (including vehicle emission tests such as the California Smog Check test, IM240, or instantaneous remote sensing measurements) to faithfully reproduce the FTP results. So much is staked on the FTP measurements that:

> *Correlation with the FTP is critical for any test procedure that might be used to trigger vehicle maintenance requirements. The FTP is known to be a "representative" driving cycle in terms of average speed, stops per mile, major speed deviations per mile, and minor speed deviation pattern.* (Sierra Research, Inc. 1990).

This has lead to the widespread belief that FTP measurements are invariant. This belief has been reinforced in the minds of many by the fact that FTP measurements are rarely duplicated on the same vehicles, especially high emitting vehicles, under similar conditions. Because the data are averaged over a long driving cycle, variability was thought to be eliminated or reduced to the point of being irrelevant. Vehicle emissions variability has only recently become an issue in FTP testing.

In 1992, a consortium of automobile manufacturers and oil companies undertook a study (the Air Quality Improvement Research Program, or AQIRP) of the effects on emissions of late model cars from many of the proposed fuel modifications outlined in the Clean Air Act Amendments of 1990 (Knepper *et al.*, 1993; CAAA, 1990). Vehicles were recruited and segregated into two categories, normal emitters and high emitters. The high emitter study included 9 vehicles, defined by AQIRP as 1986 model year vehicles and later with untampered emission control systems and with initial IM240 emissions for CO greater than 15 g/mile and/or HC greater than 1 g/mile. Confirmatory IM240 testing eliminated two of the nine vehicles upon delivery from the study for failing to meet the high emitter definition. Fourteen separate FTP tests were performed on the remaining seven vehicle using various fuels. Figure 34 shows the results for carbon monoxide and hydrocarbon emissions from five of these tests, all performed on the same base fuel. The absolute test-to-test variability for these repeat measurements is quite high, with the worst cases varying by more than an order of magnitude. These data beg the question of which FTP test represents the "true" emissions of these high emitters, the highest, the lowest or an average of all of them? The FTP cycle ensures that each measurement accurately reflects the emissions of that vehicle at the time of the test. It is apparent that the vehicle, and not the test, is responsible for the variability. Because the FTP test is so rigidly defined, if the vehicle is truly the source of the variability then all testing methods should show similar results.

Figure 35 shows remote sensor data collected by the California Air Resources Board at its El Monte, CA. facility (CARB, 1992b). The 334 vehicles each received two remote sensor measurements and one FTP measurement. They are rank ordered along the x-axis by carbon monoxide emissions, measured by the single FTP measurement, from lowest (0.51 grams/mile) to highest (187.13 grams/mile). The average FTP CO emissions for the entire fleet was 21.2 grams/mile. The vertical axis shows the two separate remote sensor exhaust measurements, which were recorded on a flat and level roadway at a constant speed of 20 mph. As the FTP emissions increase, the variability of the remote sensing measurements also increases; the onset begins at approximately vehicle number 250 (27 grams/mile). The variability observed by the remote sensor in this study is consistent with the observed FTP variability of the high emitters plotted in Figure 34. There is high variability for a few vehicles with low FTP results. We suspect these vehicles would show high variability if given another FTP test.

Figure 36 shows combined CO emissions data from 20 vehicles measured by the State of Delaware in its Vehicle Retirement Program (McConnell, 1993) and 213 vehicles recruited by the U.S. EPA for a total of 233 vehicles (U.S. GAO, 1992). The figure compares CO

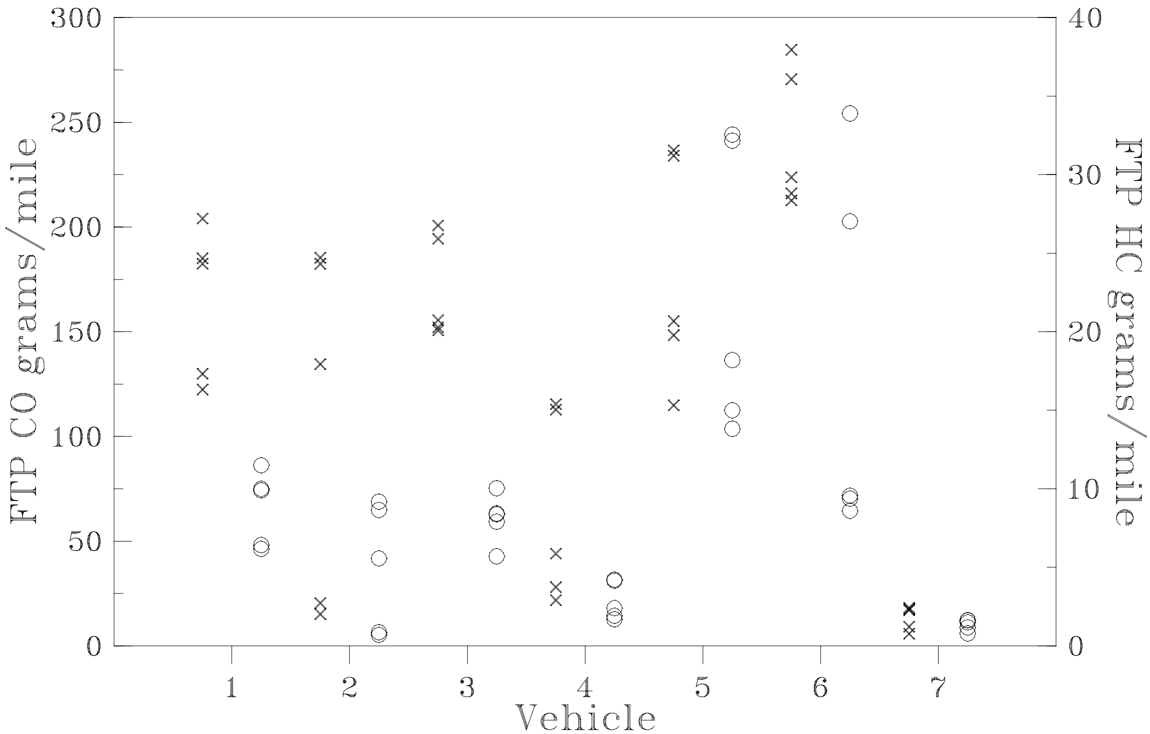


Figure 34. FTP data for CO and HC emissions from seven 1986 and newer model year high emitters. Five separate tests on the same fuel (gasoline) are plotted for each vehicle for CO (x) and HC (o).

emissions from two separate IM240 dynamometer tests performed on each vehicle. For the EPA data, the first test was performed by an EPA contractor in its emissions laboratory while the second test was performed at the IM240 lane in Hammond, IN. As in Figure 35, the vehicles are listed along the x-axis by increasing CO gram/mile FTP emissions. For the 233 vehicles, the lowest emitter is 0.62 grams/mile CO, and the highest is 271.82 grams/mile CO. The average for the entire fleet is 28.4 grams/mile CO. The onset of variability occurs around vehicle 175, which has an FTP emissions level of 32 grams/mile CO. The similarity between this and Figure 35 is apparent.

Figure 37 shows the hydrocarbon data for the same vehicles shown for CO in Figure 36. The main difference is that there are fewer gross polluting hydrocarbon vehicles than for carbon monoxide; however, a large test-to-test variability is still observed for hydrocarbon among the higher emitting vehicles. The FTP HC emissions range from a low of 0.09 grams/mile to a high of 32.6 grams/mile; the average for this data set is 2.24 grams/mile. The FTP emissions for vehicle number 200 is 3.63 grams/mile and marks an approximate boundary for the onset of high variability.

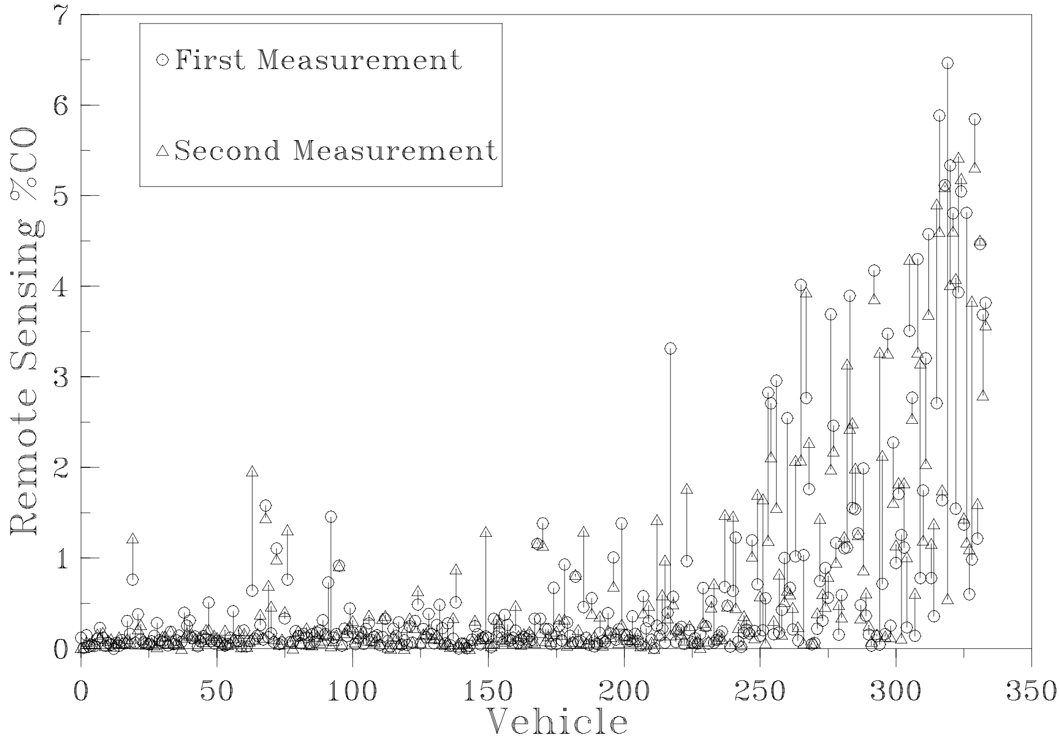


Figure 35. California Air Resources data for 334 vehicles measured twice by a remote sensor at constant load and speed versus rank ordered FTP CO grams/mile emissions (CARB, 1992b).

Figure 38 displays idle test data collected by Southwest Research Institute for the U.S. EPA (Smith, 1988). The data includes idle and 2500 rpm %CO emissions for 25 fully warmed-up vehicles measured weekly upon arrival at work over a fifteen week period. Because of the numerous measurements, only the minimum and maximum are plotted as a function of the rank ordered average %CO idle emissions. The emissions range from the lowest average of zero percent CO to the highest average of 0.9% CO. The results shown here are very similar to those of the previous figures.

These analyses show similar vehicle emissions variability in all types of emissions testing. "Snapshot" remote sensing measurements (0.5 second to 1 second measurements) exhibit similar absolute measurement to measurement variability as do "shortshot" IM240 measurements (240 seconds) or "longshot" FTP measurements (8 hour soak + 1879 seconds test). The variability is introduced by the vehicle, not by the measurement system or testing protocol. These results are consistent with the view that computer controlled closed-loop emissions control systems, when broken or non-operable, are superseded by an open-loop system which may or may not be capable of properly controlling the vehicle's emissions.

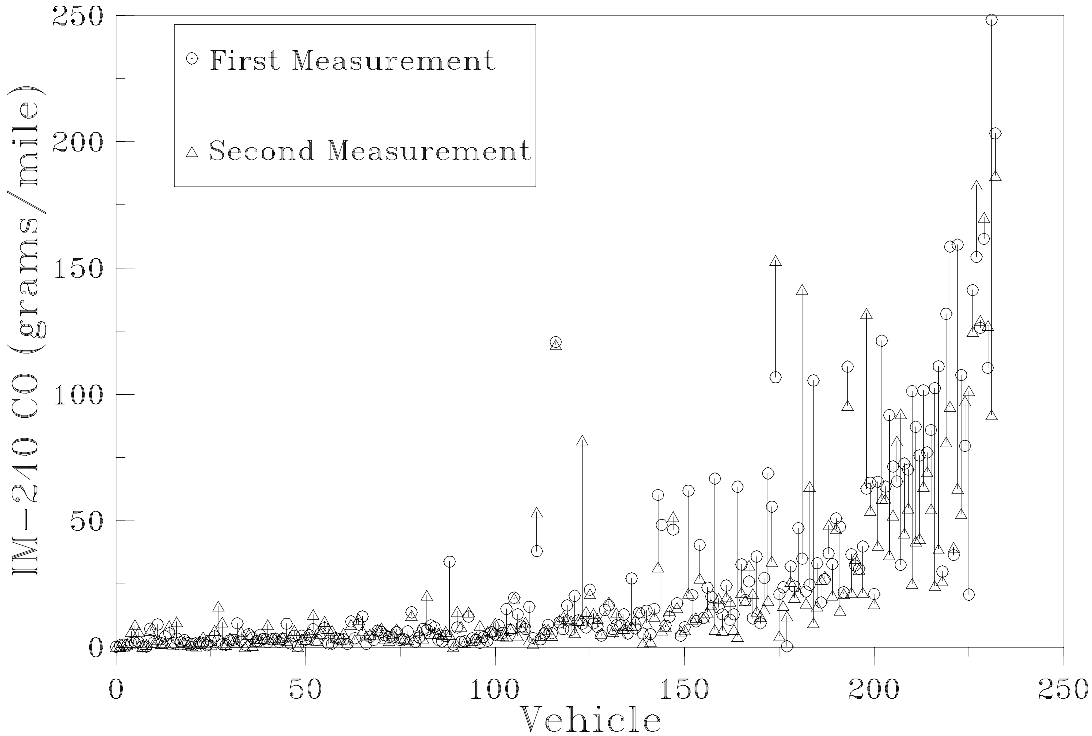


Figure 36. Combined data of 233 vehicles from the U.S. EPA and the State of Delaware's Vehicle Retirement program. Data along the x-axis is ranked ordered FTP CO emissions in grams/mile from the lowest to the highest.

Test-to-Test Variability Increases with Increasing Emission Levels. Remote sensing data sets have consistently shown many variable high emitters (Stedman and Bishop, 1990, Stedman *et al.*, 1991a). This has been interpreted by some to mean that remote sensing measurements are unable to consistently identify high emitting vehicles (Austin, *et al.*, 1990). However, as Figures 35-38 clearly show, absolute test-to-test variability of vehicle emissions is a direct function of the average emission levels. The higher the average vehicle emissions the higher on average is its variability. This does not mean that every average high HC, CO or NO_x emitter will display high absolute variability, but only that vehicles with high average emissions are more likely to exhibit high absolute emissions variability.

A survey of emission study databases shows clearly that variability increases with increasing emissions. Table XI summarizes data comparing FTP measurements to other dynamometer short tests which are reported to favorably correlate with the FTP (California I/M Review Committee, 1993). The data sets are ordered according to increasing average FTP emissions for each pollutant species. As the average FTP emissions increase the correlation coefficients decrease, indicating the higher test-to-test absolute and relative variability that occurs among the higher emitters.

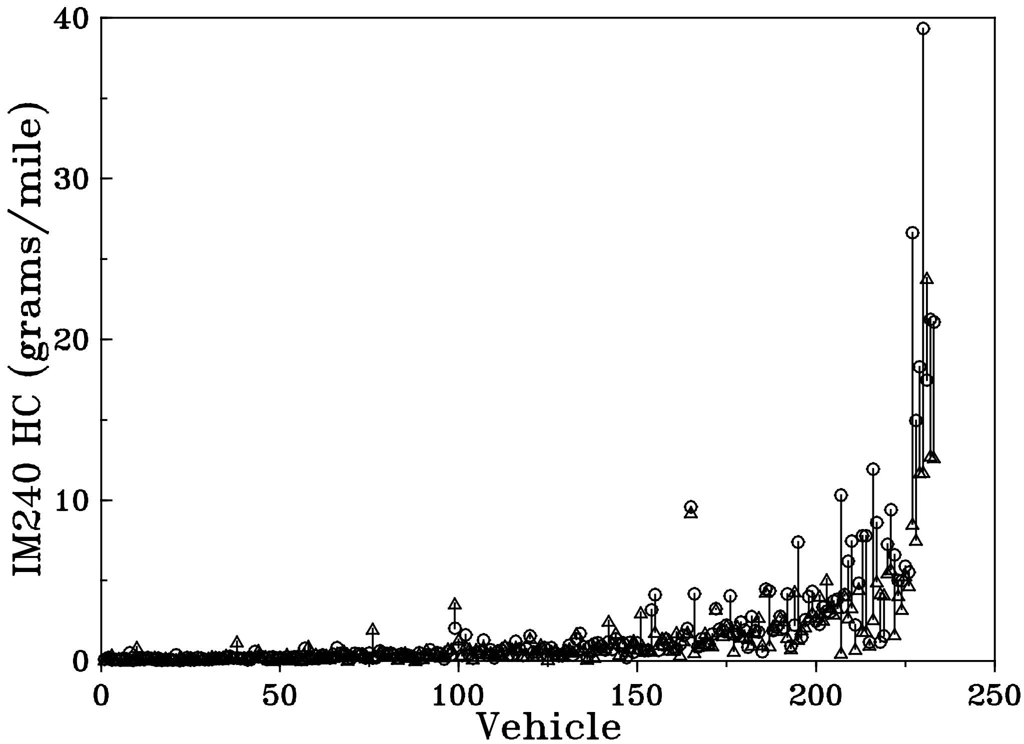


Figure 37. Combined data of 233 vehicles from the U.S. EPA and the State of Delaware's Vehicle Retirement program. Data along the x-axis is ranked ordered FTP HC emissions in grams/mile from the lowest to the highest.

Figures 39 and 40 show measurements of CO and HC, respectively, from 3,624 vehicles on Rosemead Boulevard for which three or more remote sensing measurements were obtained. We calculated the average %CO and %HC emissions and the variance for each of the vehicles, and divided the data set into deciles by average emissions. The average for each decile is plotted as a horizontal line, the vertical bar represents the average variance for each decile. Both the CO and HC plots show that as the average emissions increase the average variance does, as well. This subfleet from Rosemead Boulevard is representative of all of the measurements we made. The overall averages for these vehicles were 0.77% CO and 0.073% HC (propane); the mean model year was 1985. Assuming equal exhaust volumes, the last decile contributed 53% of the CO emissions and 27% of the hydrocarbon emissions. For all the measurements we made on Rosemead Boulevard (with matched license plates), the averages were 0.79% CO and 0.074% HC; the average model year was 1984.6.

Figures 39-40 and Table XI clearly show that test-to-test variability is low for the typical low emitting vehicle, but increases with increasing emissions. At Rosemead Boulevard, low emitting vehicles accounted for approximately 80% of the vehicles, 47% of the fleet HC emissions and only 27% of the CO emissions. It is only in the last decile that vehicles

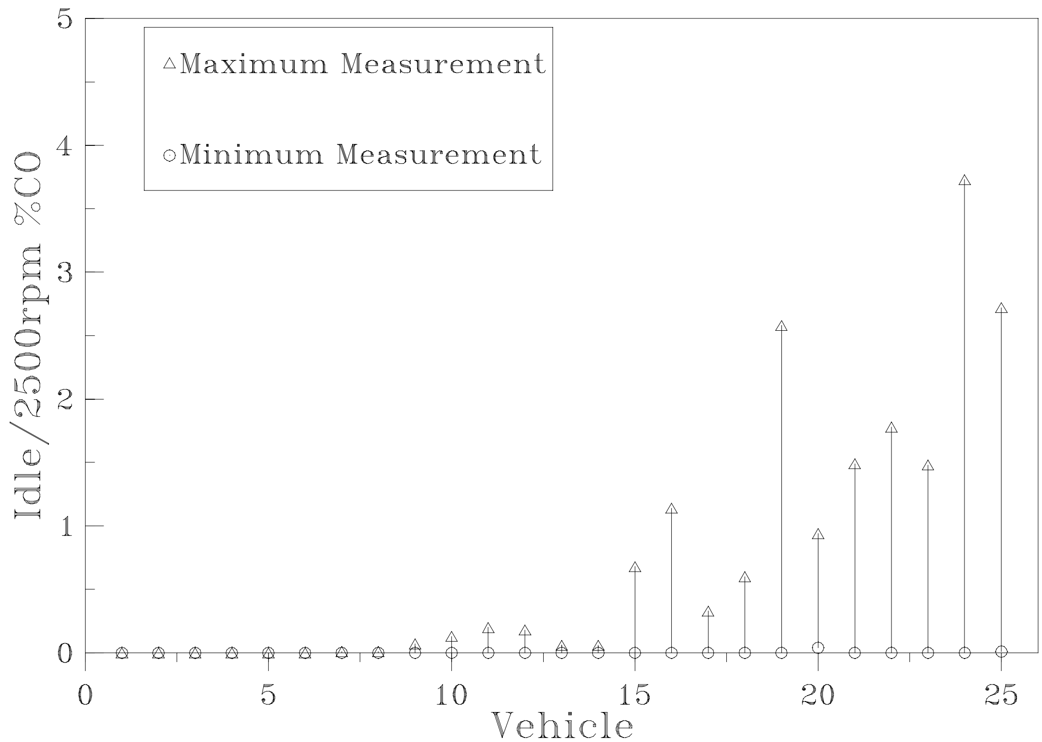


Figure 38. Twenty-five vehicles tested weekly over a 15 week period with minimum and maximum %CO idle/2500rpm values plotted as a function of rank ordered (lowest to highest) average %CO idle/2500rpm emissions (Smith, 1988).

consistently exceeded the cutpoints of 0.3% HC (propane) and 4% CO that we used to pull over vehicles for further testing. The low variability of the low emitting vehicles allowed us to set high cutpoints that excluded the well-controlled low emitting vehicles. As a result, we were able to examine a large number of high emitters without pulling over many low emitters.

Emissions Variability can be Defined but not Eliminated. Dynamometer driving cycles, like the Federal Test Procedure and IM240, were developed to average emissions over a long enough period of time (and over enough operating conditions) to avoid the problems illustrated in Figure 34. However, while averaging emissions over long time periods can decrease variability, it cannot eliminate it especially of the type shown in Figure 34. The U.S. General Accounting Office also documented this (U.S. GAO, 1992) with a list of 18 vehicles that failed an initial IM240 test but passed a second test without any repairs being made to the vehicle (data shown in Figures 36 and 37). Since emissions variability cannot be eliminated, the only option is to define it or, at the very least, document its range through the use of multiple tests.

Table XI. Variability of dynamometer short tests at various fleet emission levels versus FTP emissions.

Dynamometer Short Test Results versus FTP Emissions					
Source	Species	Average FTP Emissions (g/mile)	Short Test	Number of Vehicles	r^2
CDH[1]	HC	2.0	CDH226	81	0.86
EPA[2]	HC	2.2	IM240	213	0.91
EPA[3]	HC	2.2	IM240	213	0.84
DVRP[4]	HC	7.2	IM240	20	0.75
CDH	CO	27.3	CDH226	81	0.66
EPA	CO	28.4	IM240	213	0.73
EPA	CO	28.4	IM240	213	0.62
DVRP	CO	80.5	IM240	20	0.32
EPA	NOx	1.3	IM240	213	0.80
EPA	NOx	1.3	IM240	213	0.73
CDH	NOx	1.8	CDH226	81	0.73
DVRP	NOx	2.2	IM240	20	0.32

[1]Colorado Department of Health Data, 1988 OCE Study
[2]EPA Data, Laboratory performed both tests (U.S. GAO, 1992)
[3]EPA Data, Short test performed by IM240 Lane at Hammond, IN. (U.S. GAO, 1992)
[4]Delaware Vehicle Retirement Program, non-wavered vehicles. (McConnell, 1993)

Variable Emission Vehicle Profile. The overall contribution of the variable emitting vehicles is significant. Using the data shown in Figure 33, we estimate that the vehicles with variable emissions on the two remote sensors (those that exceeded 4% CO on one sensor, were less than 4% on the other, and differed by more than 1%) account for only **3.8%** of the vehicles, but they account for **22%** of the total emissions (assuming equal exhaust volumes). If it were possible to compile a profile of a variable emitting vehicle, it might be possible to identify diagnostic tests and/or repair methods to reduce their emissions.

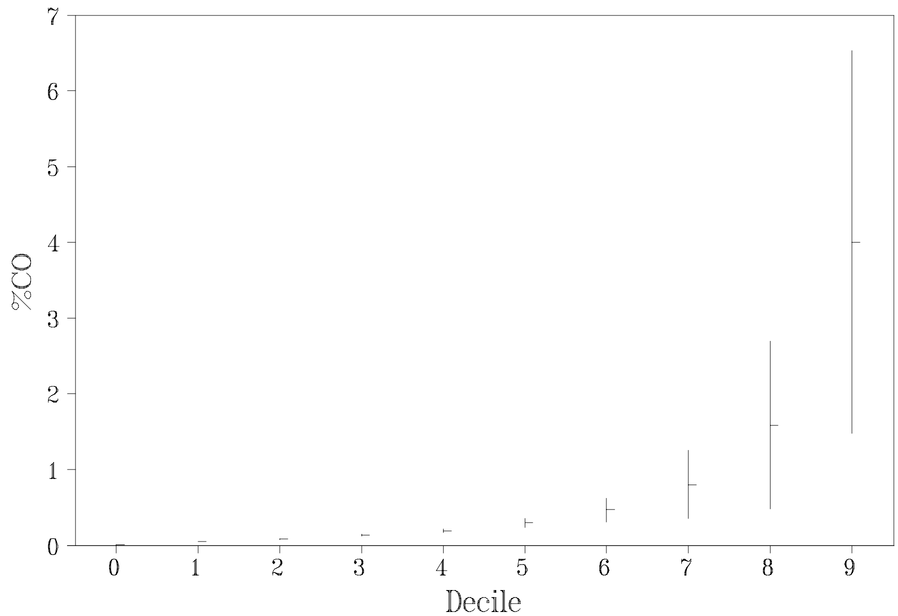


Figure 39. Carbon monoxide emissions by decile for vehicles measured 3 or more times on Rosemead Boulevard. The average %CO emissions are plotted as the horizontal bar with the vertical line being equal in length to the average variance.

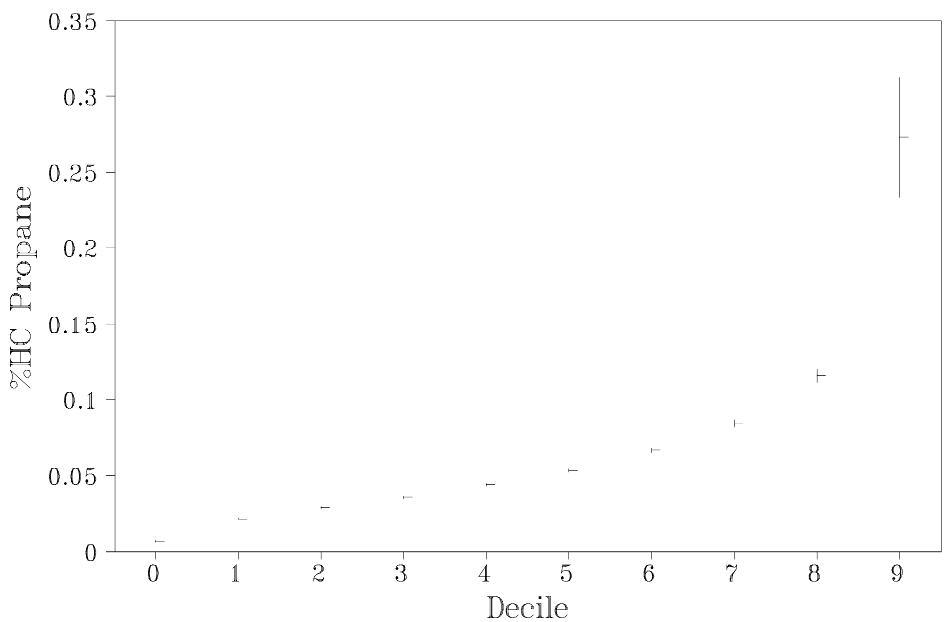


Figure 40. Hydrocarbon emissions by decile for vehicles measured 3 or more times on Rosemead Boulevard. The average %HC emissions are plotted as the horizontal bar with the vertical line being equal in length to the average variance.

The pullover data obtained on Rosemead Boulevard indicates that non-tampered vehicles are more likely to show variable emissions than tampered vehicles. We identified 111 vehicles that were given an underhood inspection and that were measured on-road at least twice by remote sensing. We arbitrarily defined a variable emitter as one with at least one remote sensor measurement less than half of the high emitter pullover cutpoints (4% CO and 0.3% HC). We then examined the on-road emissions of all 111 vehicles as a function of the underhood inspection results on the roadside survey. Out of 51 vehicles that passed the underhood inspection, a total of 22 (or 43%) had variable emissions. Of 21 vehicles determined to be non-conforming on the underhood inspection, 9 (or 43%) had variable emissions. For the 39 vehicles found to be deliberately tampered, only 7 (or 18%) had variable on-road emissions.

In the Auto/Oil study, all of the seven high emitting vehicles studied were modern closed-loop computer controlled vehicles that had not been tampered with. All of the vehicles were diagnosed to have at least one malfunctioning or broken control component or subsystem. AQIRP originally acquired nine vehicles to study; however, two of the nine ceased to be high emitters after delivery to the test facility. One of the two vehicles, when identified as a high emitter, was diagnosed as having a partially torn oxygen sensor wire. Upon delivery to the test lab this wire had completely torn. The oxygen sensor was no longer a part of the emissions control system and the vehicle no longer displayed high FTP CO and HC emissions. This was despite the fact that the control system was broken and a check-engine light, if present, would be on (Knepper, 1993).

These data suggest that vehicles likely to exhibit high on-road vehicle emissions variability are most likely to be modern computer-controlled vehicles that have broken emission control systems, but have not been tampered with. They are likely to be overall high emitters that contribute significantly to excess on-road emissions.

Inspection and Maintenance

Of 84,794 vehicles measured, we identified 268 that were registered to counties not in the California Smog Check program in 1991. An additional 188 were registered to counties that entered the program in 1991. It is possible that these vehicles are well-maintained long-distance commute cars, but we undertook the following analysis to compare them to the vehicles registered in I/M counties. The average exhaust concentrations for the entire fleet of 84,794 vehicles were 0.82% CO and 0.076% HC. The average age of the smaller fleets, however, was several years older than the overall fleet. Because this large age difference can obscure differences in exhaust emissions, we compared the non-I/M and recent-I/M fleets to age-adjusted control fleets. To do this, we created two control fleets with the same model year distributions as the non-I/M and recent-I/M fleets, but with exhaust concentrations (by model year) of the fleet that had been subjected to I/M (procedure of Radian Corp., 1992). We then calculated the average exhaust concentrations of these age-adjusted fleets. The results, shown in Table XII, suggest that vehicles registered in non-I/M and recent-I/M counties had lower CO exhaust concentrations than equivalently aged vehicles from the I/M areas. Note, however, that the differences are not statistically significant.

Table XII. Comparison of non-I/M or recent I/M fleets with age adjusted I/M fleets.

Species	Non-I/M Fleet	I/M Fleet Age-Adjusted to Non-I/M Fleet	Recent-I/M Fleet	I/M Fleet Age-Adjusted to Recent-I/M Fleet
%CO	0.96 ± 0.12	1.04	0.82 ± 0.12	0.92
%HC (propane)	0.080 ± 0.01	0.090	0.083 ± 0.01	0.083

Use of Remote Sensing to Identify High Emitters

Remote sensing was used in Los Angeles in 1992 to provide "probable cause" to investigate the maintenance behavior of Bell Cabs. Out of 27 Bell Cabs measured by remote sensors in October 1992 at the Los Angeles Airport, 18 were identified as gross polluters. An investigation by BAR engineers revealed that a large fraction of Bell Cab's 93 vehicles had been tampered and had fraudulent Smog Check certificates. One vehicle was emitting more than its own weight of pollution per year. Bell Cabs was fined and required to repair their fleet as a result of this action (LA Times, 1993). Incidentally, we investigated our database from this study and found that we measured one of the tampered Bell Cabs during our Rosemead Boulevard study on June 10, 1991, more than a year and a half before the enforcement action, at greater than 5% CO.

Partly because of the success of the Bell Cabs action, it has been suggested that two or more on-road readings in excess of some cut point could be used to trigger "probable cause" for a roadside inspection, followed by enforcement action or an advisory, as appropriate. We used the data from the Rosemead study to investigate the effects of using the remote sensor in this manner.

Table XIII and Figure 41 show the fraction of vehicles that would be targeted as a function of model year using various %CO cutpoints, based on vehicles measured at least twice on Rosemead Boulevard. For the newest vehicles, i.e. those less than about 3-4 years, only a tiny fraction exceeded even the lowest cutpoints. For vehicles older than the 1987 model year, the fraction exceeding the 2% CO cut point rises linearly to nearly 50% for the 1971 model year vehicles. The other cutpoints of 3%, 4%, 5%, and 6% also show a nearly linear increase with vehicle age for vehicles older than about 4 years. The rate of increase of cut point failures with vehicle age is 2.8%/yr for the 2% CO cut point; and 2.0%/yr, 1.2%/yr, 0.9%/yr, and 0.5%/yr for the 3%, 4%, 5%, and 6% CO cutpoints, respectively.

Overall, ninety percent of the vehicles measured two times or more would not be targeted at cutpoints as low as 2% CO. This supports the idea that low emitting vehicles are consistent

Table XIII. Number of vehicles by model year which would exceed various %CO cutpoints based on remote sensing.

Model Year	Number of Vehicles	Number Exceeded 2% CO	Number Exceeded 3% CO	Number Exceeded 4% CO	Number Exceeded 5% CO	Number Exceeded 6% CO
<71	159	77	59	45	30	16
71	40	19	13	9	7	5
72	46	19	13	4	4	1
73	65	29	20	11	8	4
74	65	28	17	10	7	3
75	55	20	10	5	3	2
76	109	42	27	19	12	9
77	157	43	31	25	18	13
78	283	69	42	24	17	8
79	328	77	53	39	25	15
80	278	61	43	31	23	12
81	330	46	30	16	10	5
82	350	57	37	17	11	9
83	350	44	28	21	14	5
84	592	64	40	25	13	4
85	694	58	34	23	18	6
86	737	47	27	19	12	6
87	849	24	8	4	3	2
88	958	11	5	4	3	2
89	1031	9	5	2	1	0
90	927	7	4	4	1	1
91	521	2	0	0	0	0
92	2	0	0	0	0	0
Totals	8926	853	546	357	240	128

in their emissions. As discussed earlier, we believe that modern vehicles that show variable emissions under normal on-road conditions are in need of repair. Furthermore, the Rosemead Boulevard study indicates that the consistent high emitters (those that exceeded the CO cut

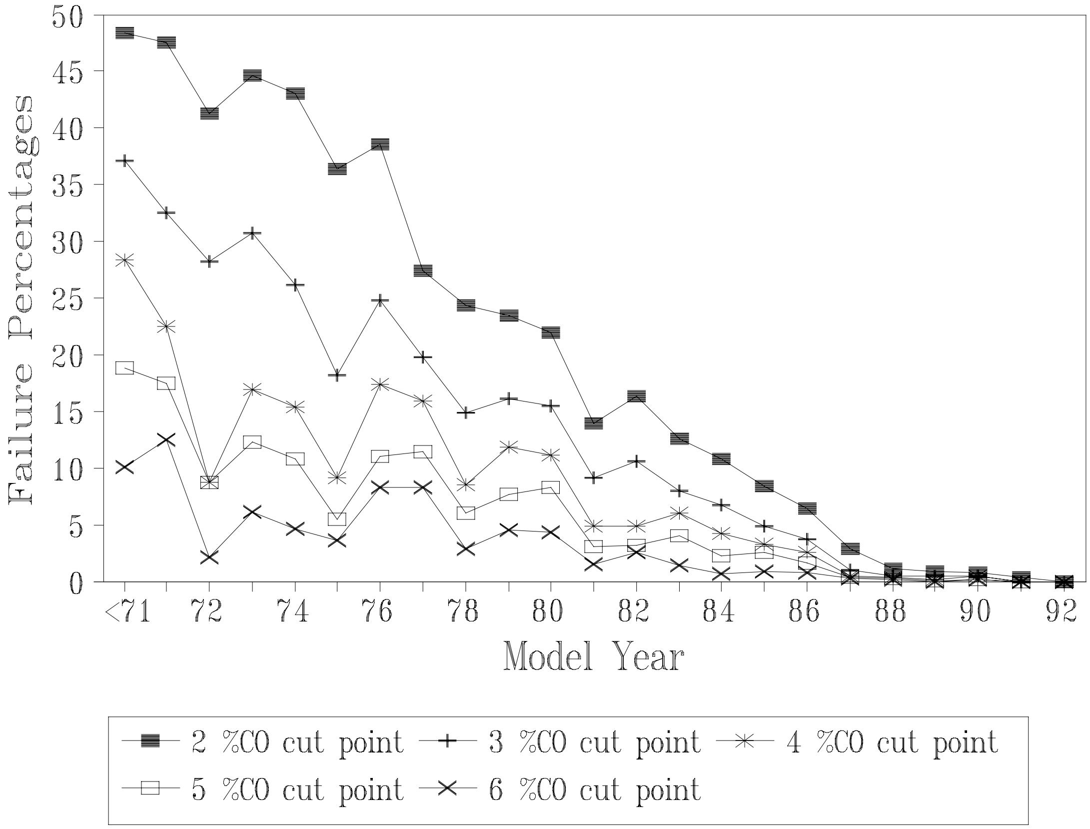


Figure 41. Percent fleet failure rates one would obtain in California using remote sensing with various %CO cut points on two consecutive remote sensors.

point on two remote sensors 25m apart) have a high probability of being tampered.

The Rosemead study showed that vehicles detected by remote sensor as high HC emitters also have major emissions problems. The four highest HC emitters as measured by IM240 on the portable dynamometer all exceeded 24 gm/mi, and were measured by the remote sensors at 0.6-1.5% HC (the cut point for pullover was 0.3%; i.e. 3000 ppm propane or 1500 ppm hexane equivalent).

Table XIII and Figure 41 indicate that when a uniform on-road emissions cut point is applied to vehicles of all model years very few new vehicles (newer than about 4 years) would fail. This suggests that most relatively new vehicles are properly maintained (possibly because they are under warranty), and shows that the remote sensor does not arbitrarily fail a significant number of vehicles because of gross polluting readings which are not "normal" vehicle behavior. Nevertheless, there are circumstances in which an on-road snapshot of vehicle emissions will not represent the "normal" behavior of the vehicle. There are at least three circumstances in which a vehicle that would routinely pass an FTP test might be measured as an on-road gross polluter. These circumstances are:

Cold Start Operation: For the first few minutes after starting a cold engine, all modern vehicles have a designed-in fuel enrichment (choke or equivalent) that is released as soon as an appropriate operating temperature is reached. The cold start time is usually a minute or two at normal outdoor temperatures and may result in elevated emission levels (see discussion of Site K data). At Rosemead Boulevard, these vehicles amounted to about 5% of the vehicles pulled over. Assuming this fraction is representative of all vehicles we that exceeded our cut points, less than 0.5% of the passing fleet would have been pulled over due to cold starts. It is desirable, however, for high emitter identification studies, to place remote sensors at sites where cold start operation is unlikely (freeway off ramps, for example).

Power enrichment: This mode is also called "off cycle" to indicate that manufacturers do not allow this high emitting mode to occur during the FTP cycle. Kelly and Groblicki (1993) showed that these high emissions occur only about 1.2% of the time when driving around Los Angeles, and then primarily on fairly steep uphill freeway sections where remote sensing would not be possible. It can also occur during heavy acceleration; for example, entering a freeway with an uphill on-ramp. In any case, for high emitter identification studies it is desirable to locate the remote sensor where heavy acceleration is not likely.

Uncontrolled Purge: Literature on this subject is hard to obtain, but there have been reports that some manufacturers have such an aggressive evaporative canister purge that the range of control of the fuel injection system can be exceeded, and the vehicle goes into a rich operating mode. These vehicles appear to have been programmed so as not to purge their evaporative canisters during dynamometer testing. They are probably a small component of the fleet, but this mode of canister purging may lead to a perplexing identification of a high emitter that does not fail a followup test.

Of the three operational modes identified above, two can be avoided by locating a remote sensor selectively. Cold starts can be avoided by locating on freeway off ramps, and on surface streets sufficiently far from residential areas. Surface streets similar to Rosemead Boulevard, which carries a heavy volume of through traffic, are also suitable. Power enrichment can be avoided by placing the remote sensor where heavy acceleration (high engine loads) are uncommon. If the uncontrolled purge occurs for some vehicles, it is unavoidable by selective siting of the remote sensor.

Implications for Scrappage Programs

In "Guidelines for the Generation and Use of Mobile Source Emission Reduction Credits" (CARB, 1993), the Air Resources Board used EMFAC7F/BURDEN7F (Draft) to model average emissions for the 1992 vehicle fleet in different age groups. The model includes mileage assumptions for vehicles by age group for the purpose of calculating scrappage credits. The Guidelines recommend using the average emissions for calculating emission reduction credits because "an accelerated retirement program will likely attract vehicles which emit at levels both above and below the average emission level for any given model-year group" (CARB, 1993).

Table XIV. Modeled emission credits compared to identified on-road gross polluting vehicles.

Model Year Group (Mileage)	CARB Model/Rosemead Gross Polluter Emission Rates (grams/mile)						Number of Cars
	ROG		NOx		CO		
	Model	IM240	Model	IM240	Model	IM240	
1972-74 (4,900)	7.6	13	3.8	6.5	46	99	4
1975-81 (6,400)	2.6	7	3.0	2.7	36	82	30
1982-92 (11,000)	0.6	5	0.9	1.8	10	79	42

We compared the data obtained in our gross polluter pullover study on Rosemead Boulevard to the modeled average emissions recommended for calculating emission reduction credits. Table XIV gives the modeled emissions compared to the emissions measured by EPA on the IM240 cycle at Rosemead Boulevard (the high emitter study). For the oldest group the IM240 measured emissions are twice the modelled emissions. For the newest model years the ROG and CO emissions of the on-road gross polluters are almost ten times the modelled emissions. This suggests that active recruitment of on-road high-emitters using a remote sensor as a screening tool could double the emission reduction benefits of a scrappage program.

Using the measured emissions and the CARB modeled annual mileage, the total annual combined ROG and CO emissions of the 1982-92 on-road gross polluters are greater than those of the 1972-74 vehicles. These gross polluting 1982-1992 vehicles have a significantly greater active life ahead of them than the older vehicles; thus, they represent a source of potentially greater emissions reductions over a long period. It could be argued that a scrappage program for late model on-road gross polluters could generate even larger emission reduction credits, although scrappage credits may be unobtainable at reasonable cost.

A study conducted in Provo, Utah showed that repairing broken, on-road gross polluting vehicles costs an average of $200 per vehicle (Bishop, 1993b). This indicates that repair of newer model high emitters would be even more cost-effective than scrapping them. Scrapping them would be problematic in any case since the owners are likely to value these later model vehicles more highly than the scrappage value. Successful repairs would guarantee VMT accumulation by vehicles with lower emissions, for a time as long as the repairs are effective.

Table XV shows an analysis of the measured emissions of over 90,000 vehicles (in 1991) as a function of model year. They are expressed as mass emissions in grams of pollutant per gallon of fuel used. The three columns on the right show the cumulative fractional contribution for each model year. Thus, 1978 and older model year vehicles account for 12% of the vehicles, and contribute 30% of the total CO emissions and 25% of the total HC emissions. On this basis, half the HC emissions come from vehicles of model year 1984 and newer, and half the CO emissions come from vehicles of model year 1982 and newer. These vehicles were all equipped with catalytic converters when new. The data show that, in 1991, the majority of the on-road pollution came from relatively new (less than ten years old) vehicles. Only a small fraction of the total was derived from vehicles older than model year 1974.

The average fuel economy of the oldest vehicles in Table XV (14 mpg for 1974 model year vehicles and older) is approximately one half that of the newer vehicles (28 mpg for 1985 and newer). Thus, to obtain emissions on a gram per mile basis the columns should be weighted so as to increase the contribution from the older vehicles. However, the average annual VMT for older vehicles (4,900 miles per year) is close to one half the VMT for the newer vehicles (11,000 miles per year) (CARB, 1993). These two factors offset each other so that relatively new high-emitting vehicles remain a significant contributor to on-road emissions.

Conclusions

The University of Denver FEAT (and the General Motors Research Laboratories remote sensor) measure carbon monoxide exhaust emissions accurately to ±5% and hydrocarbon exhaust emissions to ±15%. Both remote sensors exhibit high correlations ($r^2 > 0.98$ for CO, $r^2 > 0.85$ for HC) with on-board measurements of emissions, and correlate highly with each other ($r^2 \sim 0.99$ for CO, $r^2 \sim 0.85$ for HC).

The operating modes of a small fleet of relatively clean vehicles affects their on-road emissions. Exhaust carbon monoxide concentrations showed the least variation between different vehicles and the lowest median concentrations during 15-45 mph cruise modes and light acceleration. The greatest variation of exhaust CO emissions between different vehicles and the highest concentrations occurred during hard accelerations. Exhaust hydrocarbon measurements showed the least variation between different vehicles and the lowest average concentrations during accelerations. The greatest variation between different vehicles and the highest average concentrations of HC occurred during decelerations. Overall, the cruise passes at 15 and 30 mph were the most consistent of the cruise patterns tested.

On-road exhaust carbon monoxide emissions for the same vehicle on different runs were within 1% CO of one another for over 80 percent of the vehicles tested for all operating modes except hard acceleration. On-road exhaust hydrocarbon emissions for the same vehicle on different runs were within 0.4% HC (as propane) of one another for over 80 percent of the vehicles tested during 15-45 mph cruise and all accelerations. For very slow cruise and deceleration, the exhaust HC emissions ranged over a wider span for repeated tests. Based on

Table XV. Cumulative mass emissions per gallon of fuel by model year for the 1991 California fleet.

Model Year	Average Emissions		Cumulative Fractions		
	CO grams/gallon	HC grams/gallon	Fleet Fraction	CO Contribution	HC Contribution
pre71	1031	115	0.02	0.07	0.05
71	860	115	0.02	0.08	0.07
72	805	101	0.03	0.10	0.08
73	851	101	0.04	0.13	0.10
74	821	104	0.05	0.15	0.12
75	681	89	0.06	0.17	0.14
76	672	79	0.07	0.20	0.16
77	635	73	0.09	0.24	0.20
78	587	75	0.12	0.30	0.25
79	563	73	0.15	0.37	0.31
80	550	57	0.18	0.43	0.35
81	456	55	0.22	0.49	0.40
82	404	53	0.26	0.54	0.45
83	369	50	0.30	0.59	0.50
84	309	41	0.36	0.66	0.56
85	274	40	0.44	0.73	0.63
86	228	35	0.53	0.80	0.70
87	178	31	0.62	0.86	0.77
88	142	29	0.72	0.91	0.84
89	116	25	0.84	0.95	0.91
90	88	24	0.94	0.98	0.97
91	80	23	1.00	1.00	1.00
Fleet Averages	291	42	Average Fleet Model Year of 1984.9		

this analysis, we have determined that steady cruise at 15-45 mph (typical surface street speeds), and light to medium accelerations produce stable emissions of exhaust CO and HC for most vehicles. These modes are most favorable for using the University of Denver remote sensor. We did not examine exhaust emissions at speeds in excess of 45 mph in this study, however. Highway-speed cruises of 55-65 mph may also produce stable emissions, and may be as favorable as 15-45 mph cruises. Modes of hard acceleration, deceleration, and very slow (0-5 mph) cruise do not yield such stable, reproducible emissions of exhaust CO or HC. Furthermore, the relatively clean vehicles in this study averaged higher CO emissions only during hard accelerations, and higher HC emissions only during decelerations and very slow cruise.

The remote sensor is a highly effective tool for identifying high emitting vehicles on the road, and is also effective at targeting tampered and defective vehicles. Of the 58,063 individual vehicles monitored, the system identified 3,271 for potential pullover. Of these, 307 vehicles were actually pulled over for roadside inspection. Ninety-two percent failed the roadside Smog Check, 41% were tampered, and an additional 25% were defective (but without clear evidence of tampering). Every vehicle we identified as an on-road gross polluter that was subsequently subjected to an IM240 test failed. Of the 24 vehicles we identified as on-road high emitters that passed the roadside Smog Check, four subsequently were tested by IM240. All four of those vehicles failed the IM240 test. When compared to IM240 the remote sensor did not "falsely fail" any vehicles. By way of comparison, the "random" pullover program in 1991 found an overall 41% failure rate for roadside smog check measurements.

The analysis of data from the third task reveals several interesting results. A significant finding is that high-emitting vehicles exhibit greater variability in their emissions than clean vehicles, regardless of the test method used. The vehicles most likely to exhibit variable emissions are late-model computer-controlled vehicles that are not deliberately tampered but have broken emission control components. The variable emitting vehicles ("flippers") have been noted since early in the history of remote sensing measurements. Further analysis shows that they appear in all data sets that include high-emitting vehicles, whether the test is instantaneous remote sensing, short-term idle measurements using BAR-84, or longer cycle dynamometer measurements using the IM240 or FTP cycles. This finding has important implications for the design of vehicle testing programs.

Vehicles measured in northern California have lower CO emissions, for equivalent model years, and may have lower HC emissions, than vehicles in southern California. The reason for this is not known. Data from the parking lot study shows the clear influence of cold engines on emissions of both CO and HC. As expected, the cold engine measurements are about four times higher than the warm engine measurements (1.37% CO at exit versus 0.35% at the entrance, 0.1% HC at exit versus 0.026% at the entrance).

As we saw in the earlier CARB study, the emissions of European nameplate vehicles are lower than American or Asian nameplates. Asian nameplate vehicles are lower emitters than American nameplate vehicles. Our analysis suggests that these differences mostly arise from owner maintenance/tampering behavior differences, and to a lesser extent from manufacturer differences. Improved maintenance of the current vehicle fleet in Los Angeles could provide on-road emissions reductions greater than 25% for both CO and HC.

The remote sensor is an effective screening tool for recruiting vehicles into an accelerated retirement program, compared to the proposed method of self-screening by the vehicle owners. Not only would it obtain vehicles with higher emissions than the average, but it would also recruit vehicles that are actually being driven. Our analysis cannot recommend accelerated retirement as a component of an emissions reduction program, because in most cases repair is likely to be a better option. When used in a manner similar to our work on Rosemead Boulevard, the remote sensor is a highly effective tool for identifying tampered vehicles for enforcement actions, and could be used to advise motorists with high-emitting non-tampered vehicles to repair their cars.

Overall we have found that the so-called "random" roadside inspections are not random, and that relatively new vehicles contribute significantly to on-road emissions because of the presence of a small minority of gross polluters. A majority of the vehicles of all ages are not gross polluters. Half the vehicles measured only contributed 2% of the total on-road CO emissions and 10% of the hydrocarbons.

Recommendations

The 1990 Clean Air Act Amendments call for the use of on-road emissions monitoring such as that provided by remote sensing. We believe routine on-road monitoring of fleet emissions is the best way to evaluate whether legislated emission reduction mandates (performance standards) are, in fact, being met. Three advantages of remote sensing are that on-road emissions are the parameter which we are hoping to control, tests can be conducted with minimal driver inconvenience, and they can be performed frequently.

The use of remote sensing devices in I/M programs allows for several concepts to be investigated. California Air Resources Board data (1992b) has shown that repeated low emissions on the remote sensor are a very good predictor of low dynamometer emissions. This leads to the possibility of using remote sensing as a screening tool at an emission test station such that the majority of low emitting vehicles could be screened "clean" and go on their way. This idea needs further research.

Further research is needed to determine the logistical and operational constraints of using remote sensors to routinely measure on-road emissions in the sense called for in the 1990 Clean Air Act Amendments. In particular, it is important to know how the selection of remote sensor cut point would affect the discrimination between "clean" and "dirty" vehicles, as determined by either a dynamometer test or a properly conducted Smog Check. This study examined the discrimination using a 5% CO cut point, and found the remote sensor to be highly effective at excluding low-emitting vehicles. Further research is needed to understand how this would change with lower cutpoints.

It is also important to understand the effect of using an exceedance on a single remote sensor versus an exceedance on two consecutive remote sensors. Since many variable emission vehicles seem to have emissions problems, it would be desirable to include these vehicles in any high-emitter identification program. We do not know how this would affect the rate of pulling over vehicles without emissions problems. We suspect, however, based on the data shown in Figure 41, that the effect would be minor. Figure 41 shows that only a very small fraction of new vehicles (less than four years old) exceeded the 5% CO cut point on two separate occasions.

The possibility to use remote sensing as a tool to inform owners of their vehicle behavior has not been fully investigated. It may be that real-time drive-by information would lead to improved maintenance behavior between the times of scheduled testing. Other states have discussed Low Emissions Vehicle lanes and/or tolls proportional to pollution as concepts accessible to scrutiny now that a suitable tool is available.

The effect of using a remote sensor to improve the effectiveness of vehicle scrappage programs needs further research. Our data indicate that selected targeting of high-emitters for scrappage could increase the effectiveness by a factor of at least two. Moreover, the effectiveness of repairs to late model high emitters has been demonstrated in Utah and Michigan. Similar research should be conducted in California, with long-term followup of repaired vehicles to document longevity of repairs. Through the use of elevated remote sensors it is possible to monitor emissions of heavy duty diesels, with NOx and opacity being of primary interest, to supplement the successful California truck inspection program. In addition with the passage of the North American Free Trade Agreement a program to monitor and screen auto’s and trucks at the border crossing becomes an important area for California to research.

Our work with the Roadside Survey has indicated that the survey does not inspect a representative sample of passing vehicles. It also indicates that the emissions of northern California vehicles are lower than those of southern California vehicles. These two issues need further research to verify them.

REFERENCES

L.L Ashbaugh and D.R. Lawson, "A Comparison of Emissions from Mobile Sources Using Random Roadside Surveys Conducted in 1985, 1987, and 1989," paper number 91-180.58, presented at the 84th A&WMA Annual Meeting, Vancouver, B.C., June 1991.

L.L Ashbaugh, D.R. Lawson, G.A. Bishop, P.L. Guenther, D.H. Stedman, R.D. Stephens, P.J. Groblicki, B.J. Johnson and S.C. Huang, "On-Road Remote Sensing of Carbon Monoxide and Hydrocarbon Emissions During Several Vehicle Operating Conditions", Presented at A&WMA International Specialty Conference on PM10 Standards and Non-traditional Source Controls, Phoenix, 1992.

L.L. Ashbaugh, personal communication, 1993.

Thomas C. Austin, Thomas R. Carlson and Kathryn A. Gianolini, "An Evaluation of 'Remote Sensing' for the Measurement of Vehicle Emissions", No. SR90-08-02, report to the California Air Resources Board and the California I/M Review Committee, Sacramento, August 28, 1990.

S.P. Beaton, G.A. Bishop and D.H. Stedman, "Emission Characteristics of Mexico City Vehicles", J. Air Waste Manage. Assoc., 42(11):1424, 1992.

D. Berg, "Survey of Sources of Test Variability in the 1975 Federal Test Procedure", U.S. Environmental Protection Agency, Motor Vehicle Emissions Laboratory, Ann Arbor, MI., 1978.

G.A. Bishop, J.R. Starkey, A. Ihlenfeldt, W.J. Williams, and D.H. Stedman. "IR Long-Path Photometry, A Remote Sensing Tool For Automobile Emissions", Anal. Chem., 61:671A, 1989.

G.A. Bishop, Y. Zhang, S.E. Mclaren, P.L. Guenther, S.P. Beaton, J.E. Peterson, D.H. Stedman, W.R. Pierson, K.T. Knapp, R.B. Zweidinger, J.W. Duncan, A.Q. McArver, P.J. Groblicki and J.F. Day, "Enhancements of Remote Sensing for Vehicle Emissions in Tunnels," J. Air & Waste Mange. Assoc., in press, 1993a.

G.A. Bishop, D.H. Stedman, J.E. Peterson, T.J. Hosick and P.L. Guenther, "A Cost-Effectiveness Study of Carbon Monoxide Emissions Reduction Utilizing Remote Sensing," J. Air & Waste Mange. Assoc., 43, 978, 1993b.

J.L. Bridges and W.C. Hannah, "Quantifying the Effects of Oxygenated Gasoline on Cold Start Automobile Emissions Using Remote Sensing," presented at the International Symposium on Optical Sensing for Environmental Monitoring, Atlanta, October 1993.

California Air Resources Board, Mobile Source Division, "Report on the ARB/BAR 1989 Random Roadside Inspection Survey," Report MS-90-14, July 1990.

California Air Resources Board, Mobile Source Division, "Report on the ARB/BAR 1990 Random Roadside Inspection Survey," Report MS-91-06, July 1991.

California Air Resources Board data as reported in CVS News, January 1992a.

California Air Resources Board, "Technologies to Improve the Detection of High-Emitting Vehicles in a Vehicle Inspection Program", El Monte, December 1992b.

California Air Resources Board, "Guidelines for the Generation and Use of Mobile Source Emission Reduction Credits," Sacramento, April 1993.

California I/M Review Committee, "Evaluation of the California Smog Check Program and Recommendations for Program Improvements", Fourth Report to the Legislature, Sacramento, 1993.

J.G. Calvert, J.B. Heywood, R.F. Sawyer, J.H. Seinfeld, "Achieving Acceptable Air Quality: Some Reflections on Controlling Vehicle Emissions," Science, 261, 37, 1993.

D. Elliott, C. Kaskavaltizis and T. Topaloglu, "Evaluation of the Stedman (FEAT) Vehicle Emissions Sensing System," Soc. Automotive Eng., #922314, 1992.

Regulation XV Cost Survey, Ernst & Young for the South Coast Air Quality Management District, Los Angeles, CA., 1992.

Federal Register, 21(60), Part II, 1966.

Federal Register, 33(108), Part II, 1968.

Federal Register, 35(214), Part II, 1970.

Federal Register, 36(128), Part II, 1971.

E.L. Glover and W.B. Clemmens, "Identifying excess emitters with a remote sensing device: A preliminary analysis," Soc. Automotive Eng. , #911672, 1991.

R.A. Gorse Jr., private communication, 1993.

P. Guenther, D. Stedman, G. Bishop, J. Hannigan, J. Bean, R. Quine, Remote Sensing of Automobile Exhaust. Final report to the American Petroleum Institute. June 1991.

H.M. Haskew and T.F. Liberty, "In-use Emissions with Today's Closed-Loop Systems," Soc. Automotive Eng., #910339, 1991.

J.B. Heywood, Internal Combustion Engine Fundamentals, McGraw Hill, New York, 1988.

S. Hsu and D. Sperling, "The Uncertain Air Quality Impacts of Automobile Retirement Programs", Institute of Transportation Studies, Univ. of California Davies, August 10, 1993.

N.A. Kelly and P.J. Groblicki, "Real-World Emissions from a Modern Production Vehicle Driven in Los Angeles," J. Air Waste Manage. Assoc., 43:1351, 1993.

K.T. Knapp, "Dynamometer Testing of On-Road Vehicles from the Los Angeles in-use Emissions Study," Presented at A&WMA International Specialty Conference on PM10 Standards and Non-traditional Source Controls, Phoenix, 1992.

J.C. Knepper, W.J. Koehl, J.D. Benson, V.R. Burns, R.A. Gorse, Jr., A.M. Hochhauser, W.R. Leppard, L.A. Rapp and R.M. Reuter, "Fuel Effects in Auto/Oil High Emitting Vehicles," Soc. Automotive Eng., #930137, 1993.

D.R. Lawson, "'Passing the Test' - Human Behavior and California's Smog Check Program,", J. Air Waste Manage. Assoc., 43:1567, 1993.

D.R. Lawson, P.J. Groblicki, D.H. Stedman, G.A. Bishop and P.L. Guenther, "Emissions from In-use Motor Vehicles in Los Angeles: A Pilot Study of Remote Sensing and the Inspection and Maintenance Program", J. Air Waste Manage. Assoc., 40(8):1096, 1990.

D.R. Lawson and J.A. Gunderson, Presentation to California I/M Review Committee, January 29, 1992.

Los Angeles Times, "D.A. Sues Bell Cab Over Alleged Smog Violations", May 10, 1993.

C.E. Lyons and D.H. Stedman, "Remote Sensing Enhanced Motor Vehicle Emissions Control for Pollution Reduction in the Chicago Metropolitan Area: Siting and Issue Analysis", ILENR/RE-AQ-91/15, Illinois Department of Energy and Natural Resources, Springfield, 1991.

V. McConnell, private communication, 1993.

J.E. Peterson, D.H. Stedman and G.A. Bishop, "Remote Sensing of Automotive Emissions in Toronto", in A&WMA Ontario Section "Currents", 1991.

M. Pitchford and B. Johnson, "Empirical Model of Vehicle Emissions," Environ. Sci. & Tech., 27:741, 1993.

Octane Week, "Automakers See Promise in Remote Sensor Emission Tests", August 9, 1993.

Performance Audit of Colorado's Oxygenated Fuels Program, Final Report to the Colorado State Auditor Legislative Services, PRC Environmental Management, Inc., Denver, December 1992.

Performance Audit of Colorado Automobile Inspection and Readjustment Program, Final Report to the Colorado State Auditor Legislative Services, Radian Corp., Denver, 1992.

R.M. Rueff, "The Cost of Reducing Emissions from Late-Model High-Emitting Vehicles Detected via Remote Sensing", J. Air & Waste Manage. Assoc., 42:921, 1992.

"An Evaluation of "Remote Sensing" for the Measurement of Vehicle Emission", SR90-08-02, prepared for the California Air Resources Board and the California I/M Review Committee by Sierra Research, Inc., 1990.

Å. Sjödin, RENA OCH SMUTSIGA BILAR: En pilotstudie av avgasutsläpp från svenska fordon i verklig trafik, Swedish Environmental Research Institute, Göteborg, 1991.

L.R. Smith, Variability of I/M Test Scores Over Time, EPA 460/3-88-008, U.S. Environmental Protection Agency, Ann Arbor, 1988.

D.H. Stedman and G.A. Bishop, An Analysis of On-Road Remote Sensing as a Tool for Automobile Emissions Control, ILENR/RE-AQ-90/05, Illinois Department of Energy and Natural Resources, Springfield, 1990.

D.H. Stedman and G.A. Bishop, Remote Sensing for Mobile Source CO Emission Reduction, EPA 600/4-90/032, U.S. Environmental Protection Agency, Las Vegas, 1991.

D.H. Stedman, G.A. Bishop, J.E. Peterson, P.L. Guenther, I.F. McVey and S.P. Beaton, On-Road Carbon Monoxide and Hydrocarbon Remote Sensing in the Chicago Area, ILENR/RE-AQ-91/14, Illinois Department of Energy and Natural Resources, Springfield, 1991a.

D.H. Stedman, G. Bishop, J.E. Peterson and P.L. Guenther, On-Road CO Remote Sensing in the Los Angeles Basin, Contract No. A932-189, California Air Resources Board, Sacramento, 1991b.

D.H. Stedman, G.A. Bishop, J.E. Peterson, T. Hosick, Provo Pollution Prevention Program, University of Denver, Denver, 1993.

R.D. Stephens and S.H. Cadle, "Remote Sensing of Carbon Monoxide Emissions," *J. Air Waste Manage. Assoc.*, *41(1)*, 39, 1990.

R.D. Stephens, "Analysis of Carbon Monoxide Emissions Data from In-use Closed Loop Emissions Controlled Cars During Open-Loop Fuel Enrichment Operating Modes," GMR #7691, June 8, 1992.

SCRAP A Clean-Air Initiative from UNOCAL, Unocal Corporation, Los Angeles, CA., 1991.

K.A. Whitney and E.L. Glover, "Evaluation of a Remote Sensing Device at a Centralized I/M Lane", Soc. Automotive Eng. #922315, 1992.

Clean Air Act as Amended., "Provisions for Attainment and Maintenance of National Ambient Air Quality Standards, Public Law 101-549, U.S. Government Printing Office, Washington, D.C., November 15, 1990.

United States Environmental Protection Agency, "Motor Vehicle Tampering Survey 1989," Office of Air and Radiation, Washington, D.C., May 1990.

United States General Accounting Office, "Air Pollution: Unresolved Issues may Hamper Success of EPA's Proposed Emissions Program", No. GAO/RCED-92-288, report to the Chairman, Subcommitte on Oversight and Investigations, Committee on Energy and Commerce, House of Representatives, Washington, D.C., 1992.

Y. Zhang, D.H. Stedman, G.A. Bishop, P.L. Guenther, S.P. Beaton and J.E. Peterson, "On-Road Hydrocarbon Remote Sensing in the Denver Area," Environ. Sci. & Tech., 27(9), 1885, 1993.

Y. Zhang, G.A. Bishop and D.H. Stedman, "Automobile Emissions are Statistically Gamma Distributed", submitted to EST, 1994.

GLOSSARY OF TERMS

ATDS	-	Automotive Testing and Development Services, Inc.
BAR	-	California Bureau of Automotive Repair
CAAA	-	Clean Air Act Amendments of 1990
CAFE	-	Corporate Average Fuel Economy
CARB	-	California Air Resources Board
CHP	-	California Highway Patrol
DU	-	Denver University
EPA	-	United States Environmental Protection Agency
FEAT	-	Fuel Efficiency Automobile Test
GM	-	General Motors
GMOB	-	General Motors On-Board
GMRL	-	General Motors Research Laboratories
GMRS	-	General Motors Remote Sensor
I/M	-	Inspection and Maintenance
IM240	-	Inspection and Maintenance 240 dynomometer test
M85	-	Automotive fuel with 85% methanol and 15% gasoline
NDIR	-	Non-Dispersive InfraRed spectroscopy
ROG	-	Reactive Organic Gases

APPENDIX A: Remote Sensing versus Instrumented Vehicle Data

Data is provided for each of the University of Denver instruments. The FEAT %HC data are recorded as percent propane while the GM vehicle reports its HC data as percent hexane. Also note that instrument #3005 had a damaged HC channel during this experiment.

FEAT	Date	Time	FEAT %CO	FEAT %HC	GM %CO	GM %HC	Speed (mph)	Accel (mph/s)	DIR
3005	05/21/91	14:30:55	0.059	0.028	0.052	0.004	27.4	-0.18	W-E
3005	05/21/91	14:31:52	0.023	-0.039	NA	NA	27.1	-0.57	W-E
3005	05/21/91	14:32:48	7.977	0.142	NA	NA	29.2	-0.61	W-E
3005	05/21/91	14:37:32	0.076	0.019	0.04	0.001	27.6	-0.56	W-E
3005	05/21/91	14:44:01	11.040	0.333	9.68	0.032	27.8	-0.56	W-E
3005	05/21/91	14:45:00	11.640	0.387	NA	NA	27.2	-0.93	W-E
3005	05/21/91	14:45:55	3.587	0.088	3.32	0.015	27.6	-0.16	W-E
3005	05/21/91	14:46:55	3.721	0.116	3.57	0.015	26.8	-0.64	W-E
3005	05/21/91	14:50:48	0.071	0.000	NA	NA	26.8	-0.83	W-E
3005	05/21/91	14:51:51	2.473	0.472	2.4	0.011	27.2	-1.84	W-E
3005	05/21/91	16:38:44	8.619	0.246	7.61	0.019	28.0	0.37	E-W
3005	05/21/91	16:39:27	8.706	0.521	7.38	0.037	26.4	0.29	E-W
3005	05/21/91	16:40:19	1.542	0.062	1.64	0.013	26.7	0.42	E-W
3005	05/21/91	16:41:17	1.195	0.269	1.41	0.013	27.3	0.16	E-W
3005	05/21/91	16:43:46	0.035	0.091	NA	NA	27.0	0.08	E-W
3005	05/21/91	16:44:43	0.047	0.351	NA	NA	35.6	0.71	E-W
3005	05/21/91	16:47:27	0.094	0.113	0.03	0.006	25.0	0.17	E-W
3005	05/21/91	16:51:53	3.257	0.091	3.13	0.013	27.4	0.14	E-W
3005	05/21/91	16:52:54	3.674	0.176	NA	NA	28.5	0.49	E-W
3005	05/21/91	16:53:51	10.861	0.000	8.95	0.032	25.2	0.64	E-W
3005	05/21/91	16:57:55	0.537	0.287	0.8	0.055	27.3	0.19	E-W
3005	05/21/91	16:59:12	2.834	0.508	3.04	0.088	27.0	0.17	E-W
3005	05/21/91	17:01:05	5.627	0.656	5.17	0.114	26.5	-0.32	E-W
3005	05/21/91	17:02:05	5.706	0.869	5.38	0.126	27.2	0.27	E-W
3005	05/21/91	17:03:42	7.048	0.659	6.49	0.133	27.0	0.10	E-W
3005	05/21/91	17:04:38	7.435	0.620	NA	NA	26.7	-0.07	E-W
3005	05/21/91	17:05:32	8.317	0.709	7.76	0.149	27.2	0.21	E-W
3005	05/21/91	17:07:05	8.752	0.826	NA	NA	25.8	0.21	E-W
3005	05/21/91	17:08:04	0.856	0.123	1.16	0.068	27.7	0.40	E-W
3005	05/21/91	17:09:02	0.874	0.302	1.25	0.047	27.3	0.24	E-W
3005	05/21/91	17:11:36	8.622	0.760	7.95	0.137	26.7	-1.13	E-W
3005	05/21/91	17:12:29	8.600	0.642	NA	NA	26.4	-1.39	E-W
3005	05/21/91	17:19:11	2.619	0.322	NA	NA	0.0	0.00	E-W
3005	05/21/91	17:20:09	0.622	0.215	0.91	0.047	24.0	6.26	E-W
3005	05/21/91	17:21:08	0.647	0.208	0.93	0.035	26.8	-0.11	E-W
3005	05/22/91	15:15:47	0.059	0.024	0.01	-0.001			E-W
3005	05/22/91	15:16:55	0.078	0.109	0.01	-0.001			E-W
3005	05/22/91	15:18:04	0.059	0.000	0.003	0			E-W
3005	05/22/91	15:19:06	0.046	0.000	NA	NA			E-W
3005	05/22/91	15:20:09	4.043	0.150	3.9	0.013			E-W
3005	05/22/91	15:21:14	4.758	0.096	NA	NA			E-W

FEAT	Date	Time	FEAT %CO	FEAT %HC	GM %CO	GM %HC	Speed (mph)	Accel (mph/s)	DIR
3005	05/22/91	15:22:17	0.078	0.051	0.05	0			E-W
3005	05/22/91	15:24:42	0.072	0.047	0.03	-0.001			E-W
3005	05/22/91	15:26:01	11.037	0.097	9.25	0.026			E-W
3005	05/22/91	15:27:15	11.198	0.419	9.28	0.026			W-E
3005	05/22/91	15:28:23	0.111	0.000	NA	NA			W-E
3005	05/22/91	15:33:10	0.065	0.000	-0.01	0.004			W-E
3005	05/22/91	15:34:15	0.013	0.000	0	-0.001			W-E
3005	05/22/91	15:35:16	0.091	0.000	0.01	0.008			W-E
3005	05/22/91	15:36:18	0.039	0.092	0.02	0.001			W-E
3005	05/22/91	15:37:26	0.065	0.000	0.02	0.002			W-E
3005	05/22/91	15:38:25	0.091	0.307	0	0.002			W-E
3005	05/22/91	15:54:59	0.581	0.126	NA	NA			W-E
3005	05/22/91	15:57:26	0.710	0.000	0.76	0.046			W-E
3005	05/22/91	15:59:08	0.614	0.408	0.7	0.05			W-E
3005	05/22/91	16:00:21	3.923	0.377	4.02	0.102			W-E
3005	05/22/91	16:01:39	3.525	0.381	3.78	0.088			W-E
3005	05/22/91	16:02:56	1.330	0.773	1.72	0.073			W-E
3005	05/22/91	16:04:07	1.457	0.288	1.59	0.052			W-E
3005	05/22/91	16:05:20	9.837	0.600	8.61	0.133			W-E
3005	05/22/91	16:07:13	8.757	0.616	NA	NA			W-E
3005	05/22/91	16:09:48	9.684	0.608	9.08	0.119			E-W
3005	05/22/91	16:10:52	6.721	0.479	6.06	0.121			E-W
3005	05/22/91	16:11:49	6.745	0.357	NA	NA			E-W
3005	05/22/91	16:14:12	6.641	0.439	NA	NA			E-W
3005	05/22/91	16:15:20	0.804	0.045	NA	NA			E-W
3005	05/22/91	16:18:53	0.656	-0.010	NA	NA			E-W
3005	05/22/91	16:19:57	0.791	0.032	NA	NA			E-W
3005	05/22/91	16:21:40	0.893	0.006	1.14	0.019			E-W
3005	05/22/91	16:22:45	0.777	-0.017	0.99	0.021			E-W
3005	05/22/91	16:23:48	0.670	0.000	1.14	0.014			E-W
3005	05/22/91	16:26:37	0.763	0.100	0.83	0.029			W-E
3005	05/22/91	16:28:23	0.777	0.047	0.9	0.023			W-E
3002	05/21/91	14:30:54	0.048	0.014	0.052	0.005			W-E
3002	05/21/91	14:31:51	0.036	0.034	NA	NA			W-E
3002	05/21/91	14:32:48	7.038	0.067	NA	NA			W-E
3002	05/21/91	14:37:32	-0.041	-0.040	0.04	-0.001			W-E
3002	05/21/91	14:44:01	9.763	0.157	9.71	0.032			W-E
3002	05/21/91	14:44:59	10.210	0.126	NA	NA			W-E
3002	05/21/91	14:45:54	3.060	0.045	3.32	0.015			W-E
3002	05/21/91	14:46:54	2.598	0.070	3.22	0.0158			W-E
3002	05/21/91	14:50:48	0.018	0.009	NA	NA			W-E

FEAT	Date	Time	FEAT %CO	FEAT %HC	GM %CO	GM %HC	Speed (mph)	Accel (mph/s)	DIR
3002	05/21/91	14:51:51	2.056	0.095	2.27	0.015			W-E
3002	05/21/91	16:38:45	7.278	0.135	7.61	0.019			E-W
3002	05/21/91	16:39:28	6.642	0.282	7.38	0.037			E-W
3002	05/21/91	16:40:20	0.942	0.038	1.64	0.013			E-W
3002	05/21/91	16:41:18	1.081	0.074	1.41	0.013			E-W
3002	05/21/91	16:43:47	-0.006	0.066	NA	NA			E-W
3002	05/21/91	16:44:45	0.024	0.039	NA	NA			E-W
3002	05/21/91	16:47:28	0.006	0.005	0.03	0.006			E-W
3002	05/21/91	16:51:54	2.516	0.067	3.13	0.013			E-W
3002	05/21/91	16:52:54	3.137	0.109	NA	NA			E-W
3002	05/21/91	16:53:52	8.941	0.187	8.95	0.032			E-W
3002	05/21/91	16:57:56	0.506	0.125	0.8	0.055			E-W
3002	05/21/91	16:59:13	2.136	0.248	3.04	0.088			E-W
3002	05/21/91	17:01:06	4.457	0.335	5.17	0.114			E-W
3002	05/21/91	17:02:06	4.545	0.291	5.38	0.126			E-W
3002	05/21/91	17:03:43	6.127	0.351	6.49	0.133			E-W
3002	05/21/91	17:04:39	6.052	0.265	NA	NA			E-W
3002	05/21/91	17:05:33	7.153	0.365	7.95	0.137			E-W
3002	05/21/91	17:07:06	7.097	0.399	NA	NA			E-W
3002	05/21/91	17:08:05	0.666	0.144	1.16	0.068			E-W
3002	05/21/91	17:09:03	0.759	0.122	1.35	0.046			E-W
3002	05/21/91	17:11:37	7.250	0.312	7.85	0.14			E-W
3002	05/21/91	17:12:30	6.667	0.278	NA	NA			E-W
3002	05/21/91	17:19:12	2.389	0.200	NA	NA			E-W
3002	05/21/91	17:20:10	0.506	0.082	0.91	0.047			E-W
3002	05/21/91	17:21:09	0.641	0.077	0.93	0.035			E-W
3002	05/22/91	15:15:46	0.022	0.007	0	0.001	27.1	0.0	E-W
3002	05/22/91	15:16:54	0.000	0.018	0.01	0.003	27.5	0.4	E-W
3002	05/22/91	15:18:03	0.065	0.047	0.01	0.001	25.4	0.2	E-W
3002	05/22/91	15:19:04	-0.022	0.015	NA	NA	25.6	0.6	E-W
3002	05/22/91	15:20:06	4.121	0.078	3.71	0.013	27.6	-0.1	E-W
3002	05/22/91	15:21:13	5.262	0.054	NA	NA	27.9	0.3	E-W
3002	05/22/91	15:22:16	0.015	0.043	0.02	0.001	27.8	0.3	E-W
3002	05/22/91	15:24:40	0.058	0.036	0.07	-0.001	27.2	0.1	E-W
3002	05/22/91	15:25:58	10.109	0.110	9.28	0.027	26.8	0.2	E-W
3002	05/22/91	15:27:19	9.426	0.123	9.78	0.028	27.5	0.5	W-E
3002	05/22/91	15:28:26	-0.022	0.004	NA	NA	27.0	0.7	W-E
3002	05/22/91	15:33:14	0.007	0.049	0	-0.001	27.2	0.5	W-E
3002	05/22/91	15:34:19	-0.065	-0.007	-0.01	-0.001	27.1	0.5	W-E
3002	05/22/91	15:35:19	-0.015	0.023	0	0.011	26.4	0.5	W-E
3002	05/22/91	15:36:22	-0.015	0.021	0	-0.01	27.9	0.4	W-E

FEAT	Date	Time	FEAT %CO	FEAT %HC	GM %CO	GM %HC	Speed (mph)	Accel (mph/s)	DIR
3002	05/22/91	15:37:30	-0.029	0.043	0.03	-0.009	26.8	0.4	W-E
3002	05/22/91	15:38:28	-0.058	0.019	0.01	0.016	27.9	0.5	W-E
3002	05/22/91	15:54:58	0.394	0.133	NA	NA	27.7	0.4	W-E
3002	05/22/91	15:57:25	0.616	0.088	0.76	0.044	27.5	0.4	W-E
3002	05/22/91	15:59:07	0.446	0.107	0.73	0.047	26.0	0.6	W-E
3002	05/22/91	16:00:19	3.952	0.239	4.07	0.101	26.8	0.4	W-E
3002	05/22/91	16:01:38	3.427	0.154	4.16	0.087	28.3	0.7	W-E
3002	05/22/91	16:02:55	1.336	0.187	1.73	0.075	27.4	0.6	W-E
3002	05/22/91	16:04:06	1.421	0.127	1.76	0.053	27.6	0.4	W-E
3002	05/22/91	16:05:19	8.440	0.297	8.91	0.128	27.6	0.5	W-E
3002	05/22/91	16:07:12	7.699	0.476	NA	NA	27.2	0.0	W-E
3002	05/22/91	16:09:53	7.729	0.262	8.89	0.118	26.3	0.5	E-W
3002	05/22/91	16:10:55	5.402	0.263	6.04	0.127	26.9	0.4	E-W
3002	05/22/91	16:11:52	4.891	0.147	NA	NA	28.9	0.5	E-W
3002	05/22/91	16:14:15	5.297	0.195	NA	NA	27.4	0.6	E-W
3002	05/22/91	16:15:23	0.660	0.023	NA	NA	27.4	0.5	E-W
3002	05/22/91	16:18:56	0.483	0.095	NA	NA	26.6	0.5	E-W
3002	05/22/91	16:20:02	0.675	0.048	NA	NA	27.0	0.7	E-W
3002	05/22/91	16:21:43	0.690	0.049	1.11	0.016	27.3	0.3	E-W
3002	05/22/91	16:22:49	0.490	0.033	1.1	0.005	28.4	0.5	E-W
3002	05/22/91	16:23:52	0.750	0.024	1.15	0.012	28.8	0.6	E-W
3002	05/22/91	16:26:36	0.520	0.086	0.86	0.03	27.0	0.2	W-E
3002	05/22/91	16:28:22	0.512	0.031	0.91	0.012	29.4	0.3	W-E
3004	05/21/91	14:25:42	0.074	0.063	NA	NA			
3004	05/21/91	14:26:42	0.043	0.060	NA	NA			
3004	05/21/91	14:27:50	8.495	0.082	NA	NA			
3004	05/21/91	14:30:55	0.080	0.016	0.05	0.005			
3004	05/21/91	14:31:52	0.105	0.027	NA	NA			
3004	05/21/91	14:32:49	8.543	0.130	NA	NA			
3004	05/21/91	14:37:33	0.099	0.033	0.04	-0.001			
3004	05/21/91	14:44:02	11.229	0.130	9.71	0.032			
3004	05/21/91	14:45:00	11.732	0.212	NA	NA			
3004	05/21/91	14:45:55	3.369	0.097	3.32	0.015			
3004	05/21/91	14:46:55	3.371	0.093	3.22	0.015			
3004	05/21/91	14:50:49	0.068	0.051	NA	NA			
3004	05/21/91	14:51:52	2.411	0.134	2.27	0.011			
3004	05/21/91	16:38:46	8.864	0.188	7.61	0.019			
3004	05/21/91	16:39:30	8.842	0.218	7.27	0.024			
3004	05/21/91	16:40:21	1.037	0.073	1.64	0.013			
3004	05/21/91	16:41:19	1.081	0.128	1.41	0.013			
3004	05/21/91	16:43:48	0.037	0.099	NA	NA			

FEAT	Date	Time	FEAT %CO	FEAT %HC	GM %CO	GM %HC	Speed (mph)	Accel (mph/s)	DIR
3004	05/21/91	16:47:30	0.068	0.057	0.02	0.001			
3004	05/21/91	16:51:57	2.951	0.100	3.16	0.002			
3004	05/21/91	16:52:56	3.808	0.188	NA	NA			
3004	05/21/91	16:53:54	10.754	0.122	8.93	0.027			
3004	05/21/91	16:57:58	0.654	0.260	0.82	0.062			
3004	05/21/91	16:59:14	2.537	0.373	3.04	0.088			
3004	05/21/91	17:01:07	5.607	0.388	5.17	0.114			
3004	05/21/91	17:02:08	5.428	0.319	5.38	0.128			
3004	05/21/91	17:03:44	7.110	0.496	6.49	0.133			
3004	05/21/91	17:04:40	7.424	0.335	NA	NA			
3004	05/21/91	17:05:34	8.677	0.527	7.52	0.140			
3004	05/21/91	17:07:08	8.852	0.420	NA	NA			
3004	05/21/91	17:08:06	0.724	0.133	1.16	0.068			
3004	05/21/91	17:09:05	0.873	0.135	1.51	0.047			
3004	05/21/91	17:11:38	8.413	0.453	7.76	0.135			
3004	05/21/91	17:12:32	8.882	0.432	NA	NA			
3004	05/21/91	17:19:14	2.674	0.237	NA	NA			
3004	05/21/91	17:20:10	0.615	0.088	0.91	0.047			
3004	05/21/91	17:21:12	0.622	0.110	0.91	0.042			
3004	05/21/91	17:22:13	0.211	0.101	NA	NA			
3004	05/22/91	15:15:45	0.170	0.036	0.01	0.005			E-W
3004	05/22/91	15:16:53	0.088	0.017	0.01	0.009			E-W
3004	05/22/91	15:18:01	0.100	0.050	0.01	0.000			E-W
3004	05/22/91	15:19:02	0.056	0.015	NA	NA			E-W
3004	05/22/91	15:20:04	3.044	0.070	3.21	0.001			E-W
3004	05/22/91	15:21:11	5.626	0.095	NA	NA			E-W
3004	05/22/91	15:22:15	0.056	0.010	0.03	0.010			E-W
3004	05/22/91	15:24:39	0.157	0.062	0.06	-0.005			E-W
3004	05/22/91	15:25:56	11.240	0.168	9.49	0.026			E-W
3004	05/22/91	15:27:23	12.014	0.179	9.28	0.026			W-E
3004	05/22/91	15:28:30	0.157	0.094	NA	NA			W-E
3004	05/22/91	15:33:18	0.138	0.026	0.02	0.000			W-E
3004	05/22/91	15:34:22	0.107	0.010	-0.01	0.004			W-E
3004	05/22/91	15:35:22	0.056	0.024	0.01	0.007			W-E
3004	05/22/91	15:36:25	0.075	0.081	-0.01	-0.001			W-E
3004	05/22/91	15:37:33	0.031	0.019	-0.01	-0.001			W-E
3004	05/22/91	15:38:30	0.075	0.031	-0.01	-0.004			W-E
3004	05/22/91	15:54:56	0.591	0.172	NA	NA			W-E
3004	05/22/91	15:57:23	0.975	0.000	0.64	0.038			W-E
3004	05/22/91	15:59:05	0.456	0.085	0.74	0.044			W-E
3004	05/22/91	16:00:19	4.048	0.261	3.96	0.103			W-E

FEAT	Date	Time	FEAT %CO	FEAT %HC	GM %CO	GM %HC	Speed (mph)	Accel (mph/s)	DIR
3004	05/22/91	16:01:36	3.793	0.286	4.11	0.085			W-E
3004	05/22/91	16:02:52	1.648	0.325	1.84	0.090			W-E
3004	05/22/91	16:04:05	1.411	0.032	1.83	0.037			W-E
3004	05/22/91	16:05:17	10.161	0.426	9.43	0.134			W-E
3004	05/22/91	16:07:10	10.311	0.472	NA	NA			W-E
3004	05/22/91	16:09:56	9.441	0.303	8.64	0.115			E-W
3004	05/22/91	16:10:58	6.332	0.335	6.08	0.130			E-W
3004	05/22/91	16:11:57	6.765	0.289	NA	NA			E-W
3004	05/22/91	16:14:18	6.940	0.354	NA	NA			E-W
3004	05/22/91	16:15:26	0.904	0.024	NA	NA			E-W
3004	05/22/91	16:18:59	0.675	0.092	NA	NA			E-W
3004	05/22/91	16:20:05	0.976	0.093	NA	NA			E-W
3004	05/22/91	16:21:48	0.806	0.007	1.09	0.011			E-W
3004	05/22/91	16:22:51	1.168	0.177	1.27	0.013			E-W
3004	05/22/91	16:23:55	0.963	0.080	1.22	0.003			E-W
3004	05/22/91	16:26:34	0.578	0.117	0.82	0.043			W-E
3004	05/22/91	16:28:21	0.721	0.059	0.85	0.029			W-E

APPENDIX B: Santa Anita Race Track Modal Data

Data are provided for each vehicle as a function of the operating condition (OPCON) and the direction of travel (DIR). Hydrocarbon data from FEAT #3005 should be disregarded due to the damaged received in transit. The hydrocarbon data are provided as percent propane. Several vehicles provided by Automotive Testing and Development Services were tested with and without their catalytic converter.

Vehicles Tested:

License	Vehicle	Model Year	Source	Comments
E383185	Ford Escort M-40	83	CARB	
2SLZ483	Ford Crown Victoria	90	CARB	
403XWL	Cadillac	79	CARB	
BSYSGNL	Chevrolet Impala	68	CARB	
2LQL052	Toyota Cressida	84	CARB	
1GXH362	82 Nissan Stanza	82	CARB	
686YIH	Toyota Celica	79	CARB	
1GXM762	Dodge Dart	75	CARB	
850VNV	Toyota Corolla	78	CARB	
1PXT969	Dodge Colt	85	CARB	
1CTH703	Honda Civic	81	CARB	
2CPU143	Pontiac Catalina	79	CARB	
CSB624	Chevy Nova	63	ATDS	
3K19467	Chevy pickup		ATDS	with and w/o CAT
1EHA995	Nissan Sentra		ATDS	with CAT
5926SM	Chevy Cheyenne pu	89	ATDS	
3J72817	Pickup		ATDS	with CAT
1T70015	Ford pickup		ATDS	w/o CAT
2NYL716	Toyota Camry		ATDS	with CAT
1S55445	Ford F250 Ranger		ATDS	with and w/o CAT
3B32521	Ford F250		ATDS	w/o CAT
2WFC709	Mercedes	72	ATDS	
1KHM895	Ford Club Wagon	84	ATDS	with and w/o CAT
2VUL554	Dodge Caravan	91	Rental	
2WBP517	Ford Escort	91	Rental	
2WCS125	Buick Skylark	91	Rental	

Operating Conditions Codes:

1	Idle
2	Cruise 5 mph
3	Cruise 15 mph
4	Cruise 30 mph
5	Cruise 45 mph
6	Light acceleration
7	Medium acceleration
8	Hard acceleration (foot to the floor)
9	Deceleration 1
10	Deceleration 2

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/21/91	15:11:29	2NYL716	TOYOTA CAMRY	1	E-W	3005	0.04	0.000
05/21/91	15:11:31	2NYL716	TOYOTA CAMRY	1	E-W	3002	0.04	0.018
05/21/91	15:11:33	2NYL716	TOYOTA CAMRY	1	E-W	3004	0.05	0.034
05/21/91	15:12:46	2NYL716	TOYOTA CAMRY	2	E-W	3005	0.02	0.038
05/21/91	15:12:47	2NYL716	TOYOTA CAMRY	2	E-W	3002	0.02	0.022
05/21/91	15:12:50	2NYL716	TOYOTA CAMRY	2	E-W	3004	0.05	0.068
05/21/91	15:13:48	2NYL716	TOYOTA CAMRY	3	E-W	3005	0.06	0.082
05/21/91	15:13:49	2NYL716	TOYOTA CAMRY	3	E-W	3002	0.02	-0.002
05/21/91	15:13:50	2NYL716	TOYOTA CAMRY	3	E-W	3004	0.30	0.268
05/21/91	15:14:42	2NYL716	TOYOTA CAMRY	4	E-W	3005	0.00	-0.002
05/21/91	15:14:43	2NYL716	TOYOTA CAMRY	4	E-W	3002	0.00	-0.002
05/21/91	15:14:44	2NYL716	TOYOTA CAMRY	4	E-W	3004	0.00	-0.002
05/21/91	15:15:38	2NYL716	TOYOTA CAMRY	5	E-W	3005	0.00	-0.002
05/21/91	15:15:38	2NYL716	TOYOTA CAMRY	5	E-W	3002	0.00	-0.002
05/21/91	15:15:40	2NYL716	TOYOTA CAMRY	5	E-W	3004	0.00	-0.002
05/21/91	15:17:06	2NYL716	TOYOTA CAMRY	6	E-W	3005	0.02	0.052
05/21/91	15:17:07	2NYL716	TOYOTA CAMRY	6	E-W	3002	0.05	0.052
05/21/91	15:17:09	2NYL716	TOYOTA CAMRY	6	E-W	3004	0.06	0.062
05/21/91	15:18:10	2NYL716	TOYOTA CAMRY	7	E-W	3005	0.02	0.126
05/21/91	15:18:11	2NYL716	TOYOTA CAMRY	7	E-W	3002	0.02	0.034
05/21/91	15:18:13	2NYL716	TOYOTA CAMRY	7	E-W	3004	0.05	0.036
05/21/91	15:19:20	2NYL716	TOYOTA CAMRY	8	E-W	3005	1.03	0.068
05/21/91	15:19:20	2NYL716	TOYOTA CAMRY	8	E-W	3002	5.40	0.040
05/21/91	15:19:22	2NYL716	TOYOTA CAMRY	8	E-W	3004	6.39	0.124
05/21/91	15:21:17	2NYL716	TOYOTA CAMRY	9	E-W	3005	0.00	-0.002
05/21/91	15:21:18	2NYL716	TOYOTA CAMRY	9	E-W	3002	0.00	-0.002
05/21/91	15:21:19	2NYL716	TOYOTA CAMRY	9	E-W	3004	0.00	-0.002
05/21/91	15:22:07	2NYL716	TOYOTA CAMRY	10	E-W	3005	0.00	-0.002
05/21/91	15:22:08	2NYL716	TOYOTA CAMRY	10	E-W	3002	0.00	-0.002
05/21/91	15:22:09	2NYL716	TOYOTA CAMRY	10	E-W	3004	0.00	-0.002
05/21/91	15:32:35	5926SM	’89 CHEVY CHEYENNE PU	1	E-W	3005	0.59	0.116
05/21/91	15:32:37	5926SM	’89 CHEVY CHEYENNE PU	1	E-W	3002	0.78	0.370
05/21/91	15:32:40	5926SM	’89 CHEVY CHEYENNE PU	1	E-W	3004	0.63	0.172
05/21/91	15:34:43	5926SM	’89 CHEVY CHEYENNE PU	2	E-W	3005	0.40	0.508
05/21/91	15:34:45	5926SM	’89 CHEVY CHEYENNE PU	2	E-W	3002	0.44	0.748
05/21/91	15:34:48	5926SM	’89 CHEVY CHEYENNE PU	2	E-W	3004	0.39	0.446
05/21/91	15:36:12	5926SM	’89 CHEVY CHEYENNE PU	3	E-W	3005	0.28	0.018
05/21/91	15:36:13	5926SM	’89 CHEVY CHEYENNE PU	3	E-W	3002	0.61	0.212
05/21/91	15:36:15	5926SM	’89 CHEVY CHEYENNE PU	3	E-W	3004	0.26	0.100
05/21/91	15:37:26	5926SM	’89 CHEVY CHEYENNE PU	4	E-W	3005	0.33	-0.002
05/21/91	15:37:27	5926SM	’89 CHEVY CHEYENNE PU	4	E-W	3002	-0.06	-0.002
05/21/91	15:37:29	5926SM	’89 CHEVY CHEYENNE PU	4	E-W	3004	0.42	-0.002
05/21/91	15:38:56	5926SM	’89 CHEVY CHEYENNE PU	5	E-W	3005	0.00	-0.002
05/21/91	15:38:57	5926SM	’89 CHEVY CHEYENNE PU	5	E-W	3002	0.00	-0.002
05/21/91	15:38:58	5926SM	’89 CHEVY CHEYENNE PU	5	E-W	3004	0.00	-0.002
05/21/91	15:40:06	5926SM	’89 CHEVY CHEYENNE PU	6	E-W	3005	0.05	0.048
05/21/91	15:40:07	5926SM	’89 CHEVY CHEYENNE PU	6	E-W	3002	0.15	-0.020
05/21/91	15:40:09	5926SM	’89 CHEVY CHEYENNE PU	6	E-W	3004	0.04	-0.002
05/21/91	15:41:11	5926SM	’89 CHEVY CHEYENNE PU	7	E-W	3005	0.06	0.118
05/21/91	15:41:12	5926SM	’89 CHEVY CHEYENNE PU	7	E-W	3002	0.08	-0.052
05/21/91	15:41:14	5926SM	’89 CHEVY CHEYENNE PU	7	E-W	3004	2.01	0.058
05/21/91	15:42:50	5926SM	’89 CHEVY CHEYENNE PU	8	E-W	3005	2.68	0.138
05/21/91	15:42:50	5926SM	’89 CHEVY CHEYENNE PU	8	E-W	3002	3.25	-0.046
05/21/91	15:42:52	5926SM	’89 CHEVY CHEYENNE PU	8	E-W	3004	3.42	0.064
05/21/91	15:44:11	5926SM	’89 CHEVY CHEYENNE PU	9	E-W	3005	-0.01	-0.002
05/21/91	15:44:11	5926SM	’89 CHEVY CHEYENNE PU	9	E-W	3002	0.00	-0.002
05/21/91	15:44:13	5926SM	’89 CHEVY CHEYENNE PU	9	E-W	3004	0.20	0.266
05/21/91	15:46:04	5926SM	’89 CHEVY CHEYENNE PU	10	E-W	3005	0.08	0.074
05/21/91	15:46:05	5926SM	’89 CHEVY CHEYENNE PU	10	E-W	3002	0.11	0.142

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/21/91	15:46:07	5926SM	’89 CHEVY CHEYENNE PU	10	E-W	3004	0.08	0.106
05/21/91	15:55:49	1KHM895	’84 FORD CLUB WAGON	1	E-W	3005	1.03	-0.002
05/21/91	15:55:52	1KHM895	’84 FORD CLUB WAGON	1	E-W	3002	1.29	-0.002
05/21/91	15:55:57	1KHM895	’84 FORD CLUB WAGON	1	E-W	3004	0.00	-0.002
05/21/91	15:58:48	1KHM895	’84 FORD CLUB WAGON	2	E-W	3005	1.11	0.082
05/21/91	15:58:51	1KHM895	’84 FORD CLUB WAGON	2	E-W	3002	0.79	0.066
05/21/91	15:58:53	1KHM895	’84 FORD CLUB WAGON	2	E-W	3004	0.56	-0.066
05/21/91	16:00:35	1KHM895	’84 FORD CLUB WAGON	3	E-W	3005	0.22	0.154
05/21/91	16:00:36	1KHM895	’84 FORD CLUB WAGON	3	E-W	3002	0.22	0.226
05/21/91	16:00:38	1KHM895	’84 FORD CLUB WAGON	3	E-W	3004	0.24	0.054
05/21/91	16:02:12	1KHM895	’84 FORD CLUB WAGON	4	E-W	3005	0.24	0.150
05/21/91	16:02:13	1KHM895	’84 FORD CLUB WAGON	4	E-W	3002	0.11	-0.002
05/21/91	16:02:14	1KHM895	’84 FORD CLUB WAGON	4	E-W	3004	0.07	0.112
05/21/91	16:03:24	1KHM895	’84 FORD CLUB WAGON	5	E-W	3005	5.33	0.112
05/21/91	16:03:24	1KHM895	’84 FORD CLUB WAGON	5	E-W	3002	5.33	-0.012
05/21/91	16:03:26	1KHM895	’84 FORD CLUB WAGON	5	E-W	3004	4.46	0.188
05/21/91	16:04:53	1KHM895	’84 FORD CLUB WAGON	6	E-W	3005	0.06	-0.002
05/21/91	16:14:51	1KHM895	’84 FORD CLUB WAGON	6	E-W	3005	0.01	0.158
05/21/91	16:14:53	1KHM895	’84 FORD CLUB WAGON	6	E-W	3002	0.02	0.030
05/21/91	16:04:55	1KHM895	’84 FORD CLUB WAGON	6	E-W	3002	0.02	0.036
05/21/91	16:04:57	1KHM895	’84 FORD CLUB WAGON	6	E-W	3004	0.03	0.002
05/21/91	16:14:54	1KHM895	’84 FORD CLUB WAGON	6	E-W	3004	-0.04	0.082
05/21/91	16:06:23	1KHM895	’84 FORD CLUB WAGON	7	E-W	3005	0.05	-0.020
05/21/91	16:16:21	1KHM895	’84 FORD CLUB WAGON	7	E-W	3005	0.01	0.014
05/21/91	16:06:24	1KHM895	’84 FORD CLUB WAGON	7	E-W	3002	0.02	0.044
05/21/91	16:16:21	1KHM895	’84 FORD CLUB WAGON	7	E-W	3002	0.02	0.056
05/21/91	16:16:23	1KHM895	’84 FORD CLUB WAGON	7	E-W	3004	0.02	0.042
05/21/91	16:06:26	1KHM895	’84 FORD CLUB WAGON	7	E-W	3004	0.00	-0.002
05/21/91	16:07:44	1KHM895	’84 FORD CLUB WAGON	8	E-W	3005	1.28	0.166
05/21/91	16:07:45	1KHM895	’84 FORD CLUB WAGON	8	E-W	3002	1.67	0.068
05/21/91	16:07:47	1KHM895	’84 FORD CLUB WAGON	8	E-W	3004	2.67	0.086
05/21/91	16:09:10	1KHM895	’84 FORD CLUB WAGON	9	E-W	3005	0.06	-0.042
05/21/91	16:09:11	1KHM895	’84 FORD CLUB WAGON	9	E-W	3002	0.14	0.166
05/21/91	16:09:13	1KHM895	’84 FORD CLUB WAGON	9	E-W	3004	0.07	0.022
05/21/91	16:10:32	1KHM895	’84 FORD CLUB WAGON	10	E-W	3005	0.10	-0.002
05/21/91	16:10:32	1KHM895	’84 FORD CLUB WAGON	10	E-W	3002	0.08	-0.024
05/21/91	16:10:34	1KHM895	’84 FORD CLUB WAGON	10	E-W	3004	0.07	0.232
05/22/91	10:16:03	3K19467	ATDS TRUCK (CHEVY)	1	W-E	3005	0.21	0.084
05/22/91	10:15:57	3K19467	ATDS TRUCK (CHEVY)	1	W-E	3002	0.51	0.096
05/22/91	10:15:47	3K19467	ATDS TRUCK (CHEVY)	1	W-E	3004	0.21	0.150
05/22/91	10:17:36	3K19467	ATDS TRUCK (CHEVY)	2	W-E	3005	0.23	0.084
05/22/91	10:17:33	3K19467	ATDS TRUCK (CHEVY)	2	W-E	3002	0.21	0.104
05/22/91	10:17:24	3K19467	ATDS TRUCK (CHEVY)	2	W-E	3004	0.33	0.160
05/22/91	10:18:54	3K19467	ATDS TRUCK (CHEVY)	3	W-E	3005	0.21	-0.002
05/22/91	10:18:55	3K19467	ATDS TRUCK (CHEVY)	3	W-E	3002	0.33	0.112
05/22/91	10:18:52	3K19467	ATDS TRUCK (CHEVY)	3	W-E	3004	0.19	0.156
05/22/91	10:20:24	3K19467	ATDS TRUCK (CHEVY)	4	W-E	3005	-0.03	-0.002
05/22/91	10:20:27	3K19467	ATDS TRUCK (CHEVY)	4	W-E	3002	0.25	0.086
05/22/91	10:20:26	3K19467	ATDS TRUCK (CHEVY)	4	W-E	3004	0.37	0.002
05/22/91	10:21:41	3K19467	ATDS TRUCK (CHEVY)	5	W-E	3005	0.00	-0.002
05/22/91	10:21:44	3K19467	ATDS TRUCK (CHEVY)	5	W-E	3002	0.37	0.124
05/22/91	10:21:44	3K19467	ATDS TRUCK (CHEVY)	5	W-E	3004	0.68	0.190
05/22/91	10:23:53	3K19467	ATDS TRUCK (CHEVY)	6	W-E	3005	0.29	0.146
05/22/91	10:23:54	3K19467	ATDS TRUCK (CHEVY)	6	W-E	3002	0.25	0.092
05/22/91	10:23:51	3K19467	ATDS TRUCK (CHEVY)	6	W-E	3004	0.33	-0.052
05/22/91	10:24:55	3K19467	ATDS TRUCK (CHEVY)	7	W-E	3005	0.18	-0.002
05/22/91	10:24:57	3K19467	ATDS TRUCK (CHEVY)	7	W-E	3002	0.71	0.082
05/22/91	10:24:55	3K19467	ATDS TRUCK (CHEVY)	7	W-E	3004	0.60	0.080
05/22/91	10:25:55	3K19467	ATDS TRUCK (CHEVY)	8	W-E	3005	4.44	0.030
05/22/91	10:25:58	3K19467	ATDS TRUCK (CHEVY)	8	W-E	3002	5.87	0.116

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/22/91	10:25:57	3K19467	ATDS TRUCK (CHEVY)	8	W-E	3004	2.84	0.114
05/22/91	10:27:32	3K19467	ATDS TRUCK (CHEVY)	9	W-E	3005	0.65	-0.002
05/22/91	10:27:35	3K19467	ATDS TRUCK (CHEVY)	9	W-E	3002	0.30	0.794
05/22/91	10:27:34	3K19467	ATDS TRUCK (CHEVY)	9	W-E	3004	0.00	-0.002
05/22/91	10:29:05	3K19467	ATDS TRUCK (CHEVY)	10	W-E	3005	0.09	-0.002
05/22/91	10:29:08	3K19467	ATDS TRUCK (CHEVY)	10	W-E	3002	0.43	0.254
05/22/91	10:29:07	3K19467	ATDS TRUCK (CHEVY)	10	W-E	3004	0.39	-0.002
05/22/91	10:30:22	3K19467	ATDS TRUCK (CHEVY)	1	E-W	3005	0.58	0.132
05/22/91	10:30:41	3K19467	ATDS TRUCK (CHEVY)	1	E-W	3002	0.75	0.116
05/22/91	10:30:57	3K19467	ATDS TRUCK (CHEVY)	1	E-W	3004	0.26	0.186
05/22/91	10:31:56	3K19467	ATDS TRUCK (CHEVY)	2	E-W	3005	0.44	-0.002
05/22/91	10:32:08	3K19467	ATDS TRUCK (CHEVY)	2	E-W	3002	0.18	0.102
05/22/91	10:32:19	3K19467	ATDS TRUCK (CHEVY)	2	E-W	3004	0.26	0.184
05/22/91	10:33:18	3K19467	ATDS TRUCK (CHEVY)	3	E-W	3005	0.37	0.000
05/22/91	10:33:26	3K19467	ATDS TRUCK (CHEVY)	3	E-W	3002	0.40	0.072
05/22/91	10:33:32	3K19467	ATDS TRUCK (CHEVY)	3	E-W	3004	0.59	0.018
05/22/91	10:34:30	3K19467	ATDS TRUCK (CHEVY)	4	E-W	3005	1.51	-0.002
05/22/91	10:34:37	3K19467	ATDS TRUCK (CHEVY)	4	E-W	3002	0.17	0.088
05/22/91	10:34:40	3K19467	ATDS TRUCK (CHEVY)	4	E-W	3004	0.19	0.024
05/22/91	10:35:38	3K19467	ATDS TRUCK (CHEVY)	5	E-W	3005	0.52	-0.002
05/22/91	10:35:44	3K19467	ATDS TRUCK (CHEVY)	5	E-W	3002	0.18	0.164
05/22/91	10:35:47	3K19467	ATDS TRUCK (CHEVY)	5	E-W	3004	0.24	-0.002
05/22/91	10:38:56	3K19467	ATDS TRUCK (CHEVY)	6	E-W	3005	0.43	-0.002
05/22/91	10:39:03	3K19467	ATDS TRUCK (CHEVY)	6	E-W	3002	0.35	0.070
05/22/91	10:39:08	3K19467	ATDS TRUCK (CHEVY)	6	E-W	3004	0.47	0.096
05/22/91	10:39:50	3K19467	ATDS TRUCK (CHEVY)	7	E-W	3005	0.47	-0.002
05/22/91	10:39:57	3K19467	ATDS TRUCK (CHEVY)	7	E-W	3002	0.18	0.036
05/22/91	10:40:00	3K19467	ATDS TRUCK (CHEVY)	7	E-W	3004	0.60	0.088
05/22/91	10:40:38	3K19467	ATDS TRUCK (CHEVY)	8	E-W	3005	5.97	0.270
05/22/91	10:40:45	3K19467	ATDS TRUCK (CHEVY)	8	E-W	3002	4.08	0.056
05/22/91	10:40:48	3K19467	ATDS TRUCK (CHEVY)	8	E-W	3004	5.90	0.212
05/22/91	10:37:01	3K19467	ATDS TRUCK (CHEVY)	9	E-W	3005	0.00	0.000
05/22/91	10:37:08	3K19467	ATDS TRUCK (CHEVY)	9	E-W	3002	0.26	-0.014
05/22/91	10:37:12	3K19467	ATDS TRUCK (CHEVY)	9	E-W	3004	0.12	-0.002
05/22/91	10:38:07	3K19467	ATDS TRUCK (CHEVY)	10	E-W	3005	0.04	-0.002
05/22/91	10:38:14	3K19467	ATDS TRUCK (CHEVY)	10	E-W	3002	0.25	0.048
05/22/91	10:38:18	3K19467	ATDS TRUCK (CHEVY)	10	E-W	3004	0.51	0.626
05/22/91	10:55	1KHM895	’84 FORD CLUB WAGON	1	W-E	3005	5.19	-0.002
05/22/91	10:54:59	1KHM895	’84 FORD CLUB WAGON	1	W-E	3002	1.96	0.916
05/22/91	10:54:42	1KHM895	’84 FORD CLUB WAGON	1	W-E	3004	2.15	0.204
05/22/91	10:57	1KHM895	’84 FORD CLUB WAGON	2	W-E	3005	2.58	-0.002
05/22/91	10:56:57	1KHM895	’84 FORD CLUB WAGON	2	W-E	3002	1.19	0.300
05/22/91	10:56:46	1KHM895	’84 FORD CLUB WAGON	2	W-E	3004	3.84	0.240
05/22/91	10:58:27	1KHM895	’84 FORD CLUB WAGON	3	W-E	3005	1.25	-0.002
05/22/91	10:58:28	1KHM895	’84 FORD CLUB WAGON	3	W-E	3002	0.61	0.008
05/22/91	10:58:24	1KHM895	’84 FORD CLUB WAGON	3	W-E	3004	0.33	0.116
05/22/91	10:59:51	1KHM895	’84 FORD CLUB WAGON	4	W-E	3005	0.60	0.100
05/22/91	10:59:54	1KHM895	’84 FORD CLUB WAGON	4	W-E	3002	0.24	0.168
05/22/91	10:59:53	1KHM895	’84 FORD CLUB WAGON	4	W-E	3004	0.30	0.200
05/22/91	11:01:04	1KHM895	’84 FORD CLUB WAGON	5	W-E	3005	0.56	-0.002
05/22/91	11:01:08	1KHM895	’84 FORD CLUB WAGON	5	W-E	3002	0.41	0.124
05/22/91	11:01:08	1KHM895	’84 FORD CLUB WAGON	5	W-E	3004	0.44	0.168
05/22/91	11:02:07	1KHM895	’84 FORD CLUB WAGON	6	W-E	3005	1.20	0.192
05/22/91	11:02:10	1KHM895	’84 FORD CLUB WAGON	6	W-E	3002	0.77	0.106
05/22/91	11:02:08	1KHM895	’84 FORD CLUB WAGON	6	W-E	3004	0.71	0.198
05/22/91	11:03:08	1KHM895	’84 FORD CLUB WAGON	7	W-E	3005	4.59	0.038
05/22/91	11:03:11	1KHM895	’84 FORD CLUB WAGON	7	W-E	3002	5.13	0.078
05/22/91	11:03:10	1KHM895	’84 FORD CLUB WAGON	7	W-E	3004	3.29	0.088
05/22/91	11:04:03	1KHM895	’84 FORD CLUB WAGON	8	W-E	3005	4.77	-0.002
05/22/91	11:04:06	1KHM895	’84 FORD CLUB WAGON	8	W-E	3002	5.16	0.080

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/22/91	11:04:06	1KHM895	’84 FORD CLUB WAGON	8	W-E	3004	4.03	0.098
05/22/91	11:11:03	1KHM895	’84 FORD CLUB WAGON	9	W-E	3005	2.32	-0.002
05/22/91	11:11:05	1KHM895	’84 FORD CLUB WAGON	9	W-E	3002	2.02	0.466
05/22/91	11:11:04	1KHM895	’84 FORD CLUB WAGON	9	W-E	3004	0.40	0.210
05/22/91	11:29:49	1KHM895	’84 FORD CLUB WAGON	10	W-E	3005	2.89	1.680
05/22/91	11:29:51	1KHM895	’84 FORD CLUB WAGON	10	W-E	3002	1.48	0.944
05/22/91	11:29:50	1KHM895	’84 FORD CLUB WAGON	10	W-E	3004	0.00	-0.002
05/22/91	11:31:23	1KHM895	’84 FORD CLUB WAGON	1	E-W	3005	1.24	-0.002
05/22/91	11:31:40	1KHM895	’84 FORD CLUB WAGON	1	E-W	3002	1.14	-0.002
05/22/91	11:31:55	1KHM895	’84 FORD CLUB WAGON	1	E-W	3004	1.13	0.500
05/22/91	11:32:51	1KHM895	’84 FORD CLUB WAGON	2	E-W	3005	1.14	-0.002
05/22/91	11:33:05	1KHM895	’84 FORD CLUB WAGON	2	E-W	3002	0.69	0.206
05/22/91	11:33:17	1KHM895	’84 FORD CLUB WAGON	2	E-W	3004	0.96	0.272
05/22/91	11:34:08	1KHM895	’84 FORD CLUB WAGON	3	E-W	3005	0.47	-0.002
05/22/91	11:34:18	1KHM895	’84 FORD CLUB WAGON	3	E-W	3002	0.40	0.102
05/22/91	11:34:25	1KHM895	’84 FORD CLUB WAGON	3	E-W	3004	0.35	0.148
05/22/91	11:35:18	1KHM895	’84 FORD CLUB WAGON	4	E-W	3005	0.31	-0.002
05/22/91	11:35:25	1KHM895	’84 FORD CLUB WAGON	4	E-W	3002	0.58	0.112
05/22/91	11:35:29	1KHM895	’84 FORD CLUB WAGON	4	E-W	3004	0.36	0.176
05/22/91	11:36:26	1KHM895	’84 FORD CLUB WAGON	5	E-W	3005	0.54	-0.002
05/22/91	11:36:33	1KHM895	’84 FORD CLUB WAGON	5	E-W	3002	0.26	0.178
05/22/91	11:36:36	1KHM895	’84 FORD CLUB WAGON	5	E-W	3004	0.37	-0.078
05/22/91	11:37:34	1KHM895	’84 FORD CLUB WAGON	6	E-W	3005	0.29	0.040
05/22/91	11:37:42	1KHM895	’84 FORD CLUB WAGON	6	E-W	3002	0.42	0.084
05/22/91	11:37:47	1KHM895	’84 FORD CLUB WAGON	6	E-W	3004	0.63	0.128
05/22/91	11:38:29	1KHM895	’84 FORD CLUB WAGON	7	E-W	3005	3.06	0.110
05/22/91	11:38:37	1KHM895	’84 FORD CLUB WAGON	7	E-W	3002	4.08	0.110
05/22/91	11:38:41	1KHM895	’84 FORD CLUB WAGON	7	E-W	3004	4.94	0.126
05/22/91	11:39:21	1KHM895	’84 FORD CLUB WAGON	8	E-W	3005	2.60	0.096
05/22/91	11:39:28	1KHM895	’84 FORD CLUB WAGON	8	E-W	3002	5.62	0.090
05/22/91	11:39:31	1KHM895	’84 FORD CLUB WAGON	8	E-W	3004	4.26	0.144
05/22/91	11:40:34	1KHM895	’84 FORD CLUB WAGON	9	E-W	3005	0.84	-0.002
05/22/91	11:40:41	1KHM895	’84 FORD CLUB WAGON	9	E-W	3002	0.87	-0.002
05/22/91	11:40:46	1KHM895	’84 FORD CLUB WAGON	9	E-W	3004	2.41	0.340
05/22/91	11:41:39	1KHM895	’84 FORD CLUB WAGON	10	E-W	3005	0.00	0.000
05/22/91	11:41:46	1KHM895	’84 FORD CLUB WAGON	10	E-W	3002	1.36	0.120
05/22/91	11:41:50	1KHM895	’84 FORD CLUB WAGON	10	E-W	3004	0.00	-0.002
05/22/91	12:00:27	1GXH362	’82 NISSAN STANZA	1	W-E	3005	3.60	-0.002
05/22/91	12:00:20	1GXH362	’82 NISSAN STANZA	1	W-E	3002	2.82	0.112
05/22/91	12:00:12	1GXH362	’82 NISSAN STANZA	1	W-E	3004	3.15	0.214
05/22/91	12:01:42	1GXH362	’82 NISSAN STANZA	2	W-E	3005	3.07	0.350
05/22/91	12:01:35	1GXH362	’82 NISSAN STANZA	2	W-E	3002	2.17	0.118
05/22/91	12:01:27	1GXH362	’82 NISSAN STANZA	2	W-E	3004	2.91	0.264
05/22/91	12:02:42	1GXH362	’82 NISSAN STANZA	3	W-E	3005	0.94	0.216
05/22/91	12:02:38	1GXH362	’82 NISSAN STANZA	3	W-E	3002	0.44	0.090
05/22/91	12:02:34	1GXH362	’82 NISSAN STANZA	3	W-E	3004	0.45	0.098
05/22/91	12:04:02	1GXH362	’82 NISSAN STANZA	4	W-E	3005	0.00	-0.002
05/22/91	12:04:00	1GXH362	’82 NISSAN STANZA	4	W-E	3002	0.40	-0.044
05/22/91	12:03:58	1GXH362	’82 NISSAN STANZA	4	W-E	3004	2.40	0.282
05/22/91	12:05:18	1GXH362	’82 NISSAN STANZA	5	W-E	3005	0.27	-0.002
05/22/91	12:05:17	1GXH362	’82 NISSAN STANZA	5	W-E	3002	0.22	-0.012
05/22/91	12:05:16	1GXH362	’82 NISSAN STANZA	5	W-E	3004	0.12	0.062
05/22/91	12:06:41	1GXH362	’82 NISSAN STANZA	6	W-E	3005	1.64	0.068
05/22/91	12:06:39	1GXH362	’82 NISSAN STANZA	6	W-E	3002	1.51	0.054
05/22/91	12:06:36	1GXH362	’82 NISSAN STANZA	6	W-E	3004	1.31	0.048
05/22/91	12:07:58	1GXH362	’82 NISSAN STANZA	7	W-E	3005	5.57	0.198
05/22/91	12:07:56	1GXH362	’82 NISSAN STANZA	7	W-E	3002	4.11	0.096
05/22/91	12:07:54	1GXH362	’82 NISSAN STANZA	7	W-E	3004	0.40	0.022
05/22/91	12:09:13	1GXH362	’82 NISSAN STANZA	8	W-E	3005	9.55	0.254
05/22/91	12:09:12	1GXH362	’82 NISSAN STANZA	8	W-E	3002	9.46	0.162

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/22/91	12:09:10	1GXH362	'82 NISSAN STANZA	8	W-E	3004	3.36	0.064
05/22/91	12:10:34	1GXH362	'82 NISSAN STANZA	9	W-E	3005	0.00	-0.002
05/22/91	12:10:32	1GXH362	'82 NISSAN STANZA	9	W-E	3002	2.13	-0.002
05/22/91	12:10:30	1GXH362	'82 NISSAN STANZA	9	W-E	3004	1.49	0.274
05/22/91	12:11:46	1GXH362	'82 NISSAN STANZA	10	W-E	3005	0.00	-0.002
05/22/91	12:11:44	1GXH362	'82 NISSAN STANZA	10	W-E	3002	7.34	0.472
05/22/91	12:11:42	1GXH362	'82 NISSAN STANZA	10	W-E	3004	1.42	0.802
05/22/91	12:12:32	1GXH362	'82 NISSAN STANZA	1	E-W	3005	4.68	0.282
05/22/91	12:12:40	1GXH362	'82 NISSAN STANZA	1	E-W	3002	3.70	0.128
05/22/91	12:12:50	1GXH362	'82 NISSAN STANZA	1	E-W	3004	4.63	0.288
05/22/91	12:14:16	1GXH362	'82 NISSAN STANZA	2	E-W	3005	4.56	0.210
05/22/91	12:14:23	1GXH362	'82 NISSAN STANZA	2	E-W	3002	3.31	0.128
05/22/91	12:14:31	1GXH362	'82 NISSAN STANZA	2	E-W	3004	4.65	0.172
05/22/91	12:15:20	1GXH362	'82 NISSAN STANZA	3	E-W	3005	0.91	0.104
05/22/91	12:15:24	1GXH362	'82 NISSAN STANZA	3	E-W	3002	1.30	0.080
05/22/91	12:15:29	1GXH362	'82 NISSAN STANZA	3	E-W	3004	1.51	0.132
05/22/91	12:16:21	1GXH362	'82 NISSAN STANZA	4	E-W	3005	0.67	-0.002
05/22/91	12:16:23	1GXH362	'82 NISSAN STANZA	4	E-W	3002	-0.02	0.174
05/22/91	12:16:26	1GXH362	'82 NISSAN STANZA	4	E-W	3004	0.12	0.146
05/22/91	12:17:23	1GXH362	'82 NISSAN STANZA	5	E-W	3005	1.67	-0.002
05/22/91	12:17:25	1GXH362	'82 NISSAN STANZA	5	E-W	3002	0.11	0.272
05/22/91	12:17:27	1GXH362	'82 NISSAN STANZA	5	E-W	3004	1.18	0.406
05/22/91	12:18:28	1GXH362	'82 NISSAN STANZA	6	E-W	3005	0.09	0.108
05/22/91	12:18:31	1GXH362	'82 NISSAN STANZA	6	E-W	3002	1.38	0.028
05/22/91	12:18:35	1GXH362	'82 NISSAN STANZA	6	E-W	3004	1.50	0.042
05/22/91	12:19:36	1GXH362	'82 NISSAN STANZA	7	E-W	3005	3.59	0.100
05/22/91	12:19:39	1GXH362	'82 NISSAN STANZA	7	E-W	3002	4.18	0.066
05/22/91	12:19:42	1GXH362	'82 NISSAN STANZA	7	E-W	3004	7.39	0.184
05/22/91	12:20:30	1GXH362	'82 NISSAN STANZA	8	E-W	3005	4.35	0.238
05/22/91	12:20:32	1GXH362	'82 NISSAN STANZA	8	E-W	3002	5.78	0.090
05/22/91	12:20:35	1GXH362	'82 NISSAN STANZA	8	E-W	3004	8.47	0.152
05/22/91	12:21:39	1GXH362	'82 NISSAN STANZA	9	E-W	3005	0.00	-0.002
05/22/91	12:21:41	1GXH362	'82 NISSAN STANZA	9	E-W	3002	3.28	0.278
05/22/91	12:21:45	1GXH362	'82 NISSAN STANZA	9	E-W	3004	0.00	-0.002
05/22/91	12:22:37	1GXH362	'82 NISSAN STANZA	10	E-W	3005	0.15	-0.002
05/22/91	12:22:39	1GXH362	'82 NISSAN STANZA	10	E-W	3002	3.36	0.236
05/22/91	12:22:42	1GXH362	'82 NISSAN STANZA	10	E-W	3004	0.00	-0.002
05/22/91	12:29:07	1S55445	FORD F250 RANGER	1	W-E	3005	2.21	0.130
05/22/91	12:29:00	1S55445	FORD F250 RANGER	1	W-E	3002	2.01	0.074
05/22/91	12:28:51	1S55445	FORD F250 RANGER	1	W-E	3004	2.22	0.116
05/22/91	12:31	1S55445	FORD F250 RANGER	2	W-E	3005	6.08	0.398
05/22/91	12:31:48	1S55445	FORD F250 RANGER	2	W-E	3002	5.29	0.174
05/22/91	12:31:40	1S55445	FORD F250 RANGER	2	W-E	3004	5.62	0.066
05/22/91	12:34:07	1S55445	FORD F250 RANGER	3	W-E	3005	1.73	-0.002
05/22/91	12:34:03	1S55445	FORD F250 RANGER	3	W-E	3002	1.81	0.028
05/22/91	12:33:59	1S55445	FORD F250 RANGER	3	W-E	3004	1.81	0.206
05/22/91	12:35:45	1S55445	FORD F250 RANGER	4	W-E	3005	1.24	0.234
05/22/91	12:35:43	1S55445	FORD F250 RANGER	4	W-E	3002	1.18	0.108
05/22/91	12:35:41	1S55445	FORD F250 RANGER	4	W-E	3004	1.20	0.168
05/22/91	12:37:05	1S55445	FORD F250 RANGER	5	W-E	3005	0.87	-0.002
05/22/91	12:37:04	1S55445	FORD F250 RANGER	5	W-E	3002	0.65	0.090
05/22/91	12:37:03	1S55445	FORD F250 RANGER	5	W-E	3004	0.90	0.006
05/22/91	12:38:34	1S55445	FORD F250 RANGER	6	W-E	3005	4.82	0.156
05/22/91	12:38:32	1S55445	FORD F250 RANGER	6	W-E	3002	3.21	0.044
05/22/91	12:38:30	1S55445	FORD F250 RANGER	6	W-E	3004	4.57	0.106
05/22/91	12:41:17	1S55445	FORD F250 RANGER	7	W-E	3005	5.97	0.116
05/22/91	12:41:15	1S55445	FORD F250 RANGER	7	W-E	3002	4.13	0.068
05/22/91	12:41:13	1S55445	FORD F250 RANGER	7	W-E	3004	5.70	0.072
05/22/91	12:42:34	1S55445	FORD F250 RANGER	8	W-E	3005	0.15	0.120
05/22/91	12:42:32	1S55445	FORD F250 RANGER	8	W-E	3002	1.19	0.070

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/22/91	12:42:31	1S55445	FORD F250 RANGER	8	W-E	3004	1.44	0.084
05/22/91	12:44:07	1S55445	FORD F250 RANGER	9	W-E	3005	1.09	-0.002
05/22/91	12:44:05	1S55445	FORD F250 RANGER	9	W-E	3002	0.88	0.298
05/22/91	12:44:04	1S55445	FORD F250 RANGER	9	W-E	3004	1.05	0.048
05/22/91	12:45:23	1S55445	FORD F250 RANGER	10	W-E	3005	1.15	-0.002
05/22/91	12:45:21	1S55445	FORD F250 RANGER	10	W-E	3002	0.98	0.158
05/22/91	12:45:19	1S55445	FORD F250 RANGER	10	W-E	3004	0.90	0.058
05/22/91	12:30:16	403XWL	'79 CADILLAC	1	W-E	3005	0.49	0.130
05/22/91	12:30:10	403XWL	'79 CADILLAC	1	W-E	3002	0.35	0.074
05/22/91	12:30:02	403XWL	'79 CADILLAC	1	W-E	3004	0.44	-0.132
05/22/91	12:33	403XWL	'79 CADILLAC	2	W-E	3005	0.35	0.042
05/22/91	12:33:01	403XWL	'79 CADILLAC	2	W-E	3002	0.26	0.032
05/22/91	12:32:54	403XWL	'79 CADILLAC	2	W-E	3004	0.33	0.020
05/22/91	12:35:01	403XWL	'79 CADILLAC	3	W-E	3005	0.46	0.152
05/22/91	12:34:57	403XWL	'79 CADILLAC	3	W-E	3002	0.31	0.062
05/22/91	12:34:52	403XWL	'79 CADILLAC	3	W-E	3004	0.51	0.128
05/22/91	12:36:25	403XWL	'79 CADILLAC	4	W-E	3005	0.62	0.166
05/22/91	12:36:23	403XWL	'79 CADILLAC	4	W-E	3002	0.75	0.078
05/22/91	12:36:21	403XWL	'79 CADILLAC	4	W-E	3004	0.84	0.100
05/22/91	12:37:40	403XWL	'79 CADILLAC	5	W-E	3005	0.48	-0.002
05/22/91	12:37:39	403XWL	'79 CADILLAC	5	W-E	3002	0.33	0.062
05/22/91	12:37:38	403XWL	'79 CADILLAC	5	W-E	3004	0.45	0.174
05/22/91	12:40:32	403XWL	'79 CADILLAC	6	W-E	3005	0.25	0.220
05/22/91	12:40:29	403XWL	'79 CADILLAC	6	W-E	3002	0.10	0.032
05/22/91	12:40:24	403XWL	'79 CADILLAC	6	W-E	3004	1.47	0.068
05/22/91	12:41:50	403XWL	'79 CADILLAC	7	W-E	3005	0.41	0.100
05/22/91	12:41:48	403XWL	'79 CADILLAC	7	W-E	3002	0.07	0.046
05/22/91	12:41:45	403XWL	'79 CADILLAC	7	W-E	3004	0.05	0.046
05/22/91	12:43:07	403XWL	'79 CADILLAC	8	W-E	3005	5.57	-0.002
05/22/91	12:43:05	403XWL	'79 CADILLAC	8	W-E	3002	4.41	0.072
05/22/91	12:43:03	403XWL	'79 CADILLAC	8	W-E	3004	1.83	-0.118
05/22/91	12:44:49	403XWL	'79 CADILLAC	9	W-E	3005	0.43	0.098
05/22/91	12:44:47	403XWL	'79 CADILLAC	9	W-E	3002	0.36	0.080
05/22/91	12:44:45	403XWL	'79 CADILLAC	9	W-E	3004	0.54	0.292
05/22/91	12:45:58	403XWL	'79 CADILLAC	10	W-E	3005	0.43	0.124
05/22/91	12:45:56	403XWL	'79 CADILLAC	10	W-E	3002	0.42	0.084
05/22/91	12:45:54	403XWL	'79 CADILLAC	10	W-E	3004	0.50	0.160
05/22/91	12:46:42	1S55445	FORD F250 RANGER	1	E-W	3005	1.57	-0.002
05/22/91	12:46:48	1S55445	FORD F250 RANGER	1	E-W	3002	2.18	0.098
05/22/91	12:46:55	1S55445	FORD F250 RANGER	1	E-W	3004	5.34	0.348
05/22/91	12:50:14	1S55445	FORD F250 RANGER	2	E-W	3005	1.60	0.246
05/22/91	12:50:20	1S55445	FORD F250 RANGER	2	E-W	3002	0.00	-0.002
05/22/91	12:50:29	1S55445	FORD F250 RANGER	2	E-W	3004	1.64	0.286
05/22/91	12:52:49	1S55445	FORD F250 RANGER	3	E-W	3005	1.81	0.212
05/22/91	12:52:53	1S55445	FORD F250 RANGER	3	E-W	3002	1.83	0.184
05/22/91	12:52:58	1S55445	FORD F250 RANGER	3	E-W	3004	1.49	0.014
05/22/91	12:55:52	1S55445	FORD F250 RANGER	4	E-W	3005	1.10	-0.002
05/22/91	12:55:55	1S55445	FORD F250 RANGER	4	E-W	3002	0.91	0.020
05/22/91	12:55:58	1S55445	FORD F250 RANGER	4	E-W	3004	0.81	0.074
05/22/91	12:57:43	1S55445	FORD F250 RANGER	5	E-W	3005	0.70	0.064
05/22/91	12:57:45	1S55445	FORD F250 RANGER	5	E-W	3002	5.84	0.078
05/22/91	12:57:47	1S55445	FORD F250 RANGER	5	E-W	3004	3.91	0.074
05/22/91	12:59:58	1S55445	FORD F250 RANGER	6	E-W	3005	4.01	0.112
05/22/91	13:00:02	1S55445	FORD F250 RANGER	6	E-W	3002	6.02	0.082
05/22/91	13:00:05	1S55445	FORD F250 RANGER	6	E-W	3004	5.31	0.074
05/22/91	13:01:23	1S55445	FORD F250 RANGER	7	E-W	3005	5.56	-0.002
05/22/91	13:01:26	1S55445	FORD F250 RANGER	7	E-W	3002	3.82	0.032
05/22/91	13:01:29	1S55445	FORD F250 RANGER	7	E-W	3004	3.00	0.060
05/22/91	13:02:57	1S55445	FORD F250 RANGER	8	E-W	3005	2.26	0.366
05/22/91	13:03:00	1S55445	FORD F250 RANGER	8	E-W	3002	0.65	0.044

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/22/91	13:03:02	1S55445	FORD F250 RANGER	8	E-W	3004	0.31	0.064
05/22/91	13:06:40	1S55445	FORD F250 RANGER	9	E-W	3005	1.10	0.164
05/22/91	13:06:43	1S55445	FORD F250 RANGER	9	E-W	3002	0.82	0.292
05/22/91	13:06:46	1S55445	FORD F250 RANGER	9	E-W	3004	1.09	0.300
05/22/91	13:08:13	1S55445	FORD F250 RANGER	10	E-W	3005	1.06	0.596
05/22/91	13:08:16	1S55445	FORD F250 RANGER	10	E-W	3002	0.80	0.214
05/22/91	13:08:19	1S55445	FORD F250 RANGER	10	E-W	3004	1.04	0.330
05/22/91	12:47:22	403XWL	’79 CADILLAC	1	E-W	3005	0.56	0.178
05/22/91	12:47:29	403XWL	’79 CADILLAC	1	E-W	3002	0.25	0.052
05/22/91	12:47:37	403XWL	’79 CADILLAC	1	E-W	3004	0.38	0.134
05/22/91	12:51:07	403XWL	’79 CADILLAC	2	E-W	3005	0.42	0.082
05/22/91	12:51:14	403XWL	’79 CADILLAC	2	E-W	3002	0.31	0.060
05/22/91	12:51:21	403XWL	’79 CADILLAC	2	E-W	3004	0.32	0.154
05/22/91	12:53:36	403XWL	’79 CADILLAC	3	E-W	3005	0.51	0.100
05/22/91	12:53:40	403XWL	’79 CADILLAC	3	E-W	3002	0.32	0.056
05/22/91	12:53:46	403XWL	’79 CADILLAC	3	E-W	3004	0.42	0.104
05/22/91	12:56:32	403XWL	’79 CADILLAC	4	E-W	3005	1.12	0.034
05/22/91	12:56:34	403XWL	’79 CADILLAC	4	E-W	3002	0.71	0.056
05/22/91	12:56:37	403XWL	’79 CADILLAC	4	E-W	3004	0.66	0.096
05/22/91	12:58:24	403XWL	’79 CADILLAC	5	E-W	3005	0.56	-0.002
05/22/91	12:58:26	403XWL	’79 CADILLAC	5	E-W	3002	0.29	0.060
05/22/91	12:58:28	403XWL	’79 CADILLAC	5	E-W	3004	0.35	0.128
05/22/91	13:00:38	403XWL	’79 CADILLAC	6	E-W	3005	0.21	0.124
05/22/91	13:00:42	403XWL	’79 CADILLAC	6	E-W	3002	0.16	0.010
05/22/91	13:00:46	403XWL	’79 CADILLAC	6	E-W	3004	0.13	0.050
05/22/91	13:02:08	403XWL	’79 CADILLAC	7	E-W	3005	0.05	0.110
05/22/91	13:02:11	403XWL	’79 CADILLAC	7	E-W	3002	0.08	0.014
05/22/91	13:02:15	403XWL	’79 CADILLAC	7	E-W	3004	0.06	0.062
05/22/91	13:03:41	403XWL	’79 CADILLAC	8	E-W	3005	2.12	0.100
05/22/91	13:03:44	403XWL	’79 CADILLAC	8	E-W	3002	3.97	0.044
05/22/91	13:03:46	403XWL	’79 CADILLAC	8	E-W	3004	5.57	0.124
05/22/91	13:07:21	403XWL	’79 CADILLAC	9	E-W	3005	0.55	-0.002
05/22/91	13:07:24	403XWL	’79 CADILLAC	9	E-W	3002	0.40	0.064
05/22/91	13:07:27	403XWL	’79 CADILLAC	9	E-W	3004	0.50	0.136
05/22/91	13:08:52	403XWL	’79 CADILLAC	10	E-W	3005	0.40	0.008
05/22/91	13:08:54	403XWL	’79 CADILLAC	10	E-W	3002	0.47	0.078
05/22/91	13:08:58	403XWL	’79 CADILLAC	10	E-W	3004	0.41	0.186
05/22/91	14:30:03	2SLZ483	’90 FORD CROWN VICTORIA	1	W-E	3005	0.01	0.056
05/22/91	14:29:53	2SLZ483	’90 FORD CROWN VICTORIA	1	W-E	3002	0.03	0.102
05/22/91		2SLZ483	’90 FORD CROWN VICTORIA	1	W-E	3004		
05/22/91	14:31:46	2SLZ483	’90 FORD CROWN VICTORIA	2	W-E	3005	0.03	0.160
05/22/91	14:31:39	2SLZ483	’90 FORD CROWN VICTORIA	2	W-E	3002	0.01	0.082
05/22/91	14:31:29	2SLZ483	’90 FORD CROWN VICTORIA	2	W-E	3004	-0.10	-0.002
05/22/91	14:33:37	2SLZ483	’90 FORD CROWN VICTORIA	3	W-E	3005	0.03	0.084
05/22/91	14:33:33	2SLZ483	’90 FORD CROWN VICTORIA	3	W-E	3002	0.01	0.044
05/22/91	14:33:28	2SLZ483	’90 FORD CROWN VICTORIA	3	W-E	3004	0.04	0.052
05/22/91	14:35:23	2SLZ483	’90 FORD CROWN VICTORIA	4	W-E	3005	0.14	-0.002
05/22/91	14:35:22	2SLZ483	’90 FORD CROWN VICTORIA	4	W-E	3002	0.03	0.048
05/22/91	14:35:20	2SLZ483	’90 FORD CROWN VICTORIA	4	W-E	3004	0.08	0.118
05/22/91	14:36:51	2SLZ483	’90 FORD CROWN VICTORIA	5	W-E	3005	-0.06	-0.002
05/22/91	14:36:51	2SLZ483	’90 FORD CROWN VICTORIA	5	W-E	3002	0.05	0.178
05/22/91	14:36:50	2SLZ483	’90 FORD CROWN VICTORIA	5	W-E	3004	0.15	0.182
05/22/91	14:38:23	2SLZ483	’90 FORD CROWN VICTORIA	6	W-E	3005	-0.01	0.058
05/22/91	14:38:22	2SLZ483	’90 FORD CROWN VICTORIA	6	W-E	3002	-0.05	-0.002
05/22/91	14:38:19	2SLZ483	’90 FORD CROWN VICTORIA	6	W-E	3004	0.00	0.042
05/22/91	14:39:45	2SLZ483	’90 FORD CROWN VICTORIA	7	W-E	3005	0.05	0.020
05/22/91	14:39:44	2SLZ483	’90 FORD CROWN VICTORIA	7	W-E	3002	0.04	0.038
05/22/91	14:39:42	2SLZ483	’90 FORD CROWN VICTORIA	7	W-E	3004	0.01	0.052
05/22/91	14:41:12	2SLZ483	’90 FORD CROWN VICTORIA	8	W-E	3005	3.57	0.294
05/22/91	14:41:11	2SLZ483	’90 FORD CROWN VICTORIA	8	W-E	3002	4.47	0.118

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/22/91	14:41:10	2SLZ483	'90 FORD CROWN VICTORIA	8	W-E	3004	2.32	0.132
05/22/91	14:42:41	2SLZ483	'90 FORD CROWN VICTORIA	9	W-E	3005	0.15	-0.002
05/22/91	14:42:40	2SLZ483	'90 FORD CROWN VICTORIA	9	W-E	3002	0.02	0.046
05/22/91	14:42:38	2SLZ483	'90 FORD CROWN VICTORIA	9	W-E	3004	0.06	0.100
05/22/91	14:44:16	2SLZ483	'90 FORD CROWN VICTORIA	10	W-E	3005	0.06	-0.002
05/22/91	14:44:15	2SLZ483	'90 FORD CROWN VICTORIA	10	W-E	3002	0.01	0.046
05/22/91	14:44:13	2SLZ483	'90 FORD CROWN VICTORIA	10	W-E	3004	0.08	0.030
05/22/91	14:30:58	CSB624	'63 CHEVY NOVA	1	W-E	3005	4.09	0.242
05/22/91	14:30:51	CSB624	'63 CHEVY NOVA	1	W-E	3002	3.78	-0.114
05/22/91	14:30:41	CSB624	'63 CHEVY NOVA	1	W-E	3004	3.76	0.332
05/22/91	14:32:35	CSB624	'63 CHEVY NOVA	2	W-E	3005	4.60	0.300
05/22/91	14:32:29	CSB624	'63 CHEVY NOVA	2	W-E	3002	4.09	0.228
05/22/91	14:32:22	CSB624	'63 CHEVY NOVA	2	W-E	3004	4.36	0.384
05/22/91	14:34:22	CSB624	'63 CHEVY NOVA	3	W-E	3005	2.81	-0.002
05/22/91	14:34:19	CSB624	'63 CHEVY NOVA	3	W-E	3002	2.49	0.154
05/22/91	14:34:14	CSB624	'63 CHEVY NOVA	3	W-E	3004	2.83	0.368
05/22/91	14:36:02	CSB624	'63 CHEVY NOVA	4	W-E	3005	1.78	-0.002
05/22/91	14:36:01	CSB624	'63 CHEVY NOVA	4	W-E	3002	1.45	0.162
05/22/91	14:35:59	CSB624	'63 CHEVY NOVA	4	W-E	3004	0.00	-0.002
05/22/91	14:37:27	CSB624	'63 CHEVY NOVA	5	W-E	3005	2.64	0.318
05/22/91	14:37:27	CSB624	'63 CHEVY NOVA	5	W-E	3002	3.09	0.274
05/22/91	14:37:26	CSB624	'63 CHEVY NOVA	5	W-E	3004	7.34	0.252
05/22/91	14:39:11	CSB624	'63 CHEVY NOVA	6	W-E	3005	0.46	0.220
05/22/91	14:39:08	CSB624	'63 CHEVY NOVA	6	W-E	3002	0.52	0.210
05/22/91	14:39:04	CSB624	'63 CHEVY NOVA	6	W-E	3004	2.01	0.244
05/22/91	14:40:34	CSB624	'63 CHEVY NOVA	7	W-E	3005	8.51	0.226
05/22/91	14:40:32	CSB624	'63 CHEVY NOVA	7	W-E	3002	7.13	0.192
05/22/91	14:40:29	CSB624	'63 CHEVY NOVA	7	W-E	3004	7.42	0.240
05/22/91	14:42:00	CSB624	'63 CHEVY NOVA	8	W-E	3005	5.50	0.232
05/22/91	14:41:59	CSB624	'63 CHEVY NOVA	8	W-E	3002	4.26	0.144
05/22/91	14:41:57	CSB624	'63 CHEVY NOVA	8	W-E	3004	2.40	0.180
05/22/91	14:43:23	CSB624	'63 CHEVY NOVA	9	W-E	3005	5.01	1.214
05/22/91	14:43:21	CSB624	'63 CHEVY NOVA	9	W-E	3002	3.32	1.178
05/22/91	14:43:19	CSB624	'63 CHEVY NOVA	9	W-E	3004	1.41	0.326
05/22/91	14:44:53	CSB624	'63 CHEVY NOVA	10	W-E	3005	5.36	0.692
05/22/91	14:44:51	CSB624	'63 CHEVY NOVA	10	W-E	3002	4.13	0.824
05/22/91	14:44:49	CSB624	'63 CHEVY NOVA	10	W-E	3004	0.00	-0.002
05/22/91		2SLZ483	'90 FORD CROWN VICTORIA	1	E-W	3005	0.03	-0.002
05/22/91	14:48:16	2SLZ483	'90 FORD CROWN VICTORIA	1	E-W	3002	0.06	0.178
05/22/91	14:48:25	2SLZ483	'90 FORD CROWN VICTORIA	1	E-W	3004	0.08	0.156
05/22/91	14:49:53	2SLZ483	'90 FORD CROWN VICTORIA	2	E-W	3005	0.00	0.094
05/22/91	14:50:01	2SLZ483	'90 FORD CROWN VICTORIA	2	E-W	3002		
05/22/91	14:50:10	2SLZ483	'90 FORD CROWN VICTORIA	2	E-W	3004	0.03	0.024
05/22/91	14:51:25	2SLZ483	'90 FORD CROWN VICTORIA	3	E-W	3005	0.03	-0.034
05/22/91	14:51:30	2SLZ483	'90 FORD CROWN VICTORIA	3	E-W	3002	-0.02	-0.014
05/22/91	14:51:36	2SLZ483	'90 FORD CROWN VICTORIA	3	E-W	3004	0.06	0.120
05/22/91	14:52:56	2SLZ483	'90 FORD CROWN VICTORIA	4	E-W	3005	0.03	0.054
05/22/91	14:52:58	2SLZ483	'90 FORD CROWN VICTORIA	4	E-W	3002	-0.01	0.060
05/22/91	14:53:01	2SLZ483	'90 FORD CROWN VICTORIA	4	E-W	3004	0.00	0.000
05/22/91	14:54:40	2SLZ483	'90 FORD CROWN VICTORIA	5	E-W	3005	0.02	0.014
05/22/91	14:54:42	2SLZ483	'90 FORD CROWN VICTORIA	5	E-W	3002	0.02	0.004
05/22/91	14:54:45	2SLZ483	'90 FORD CROWN VICTORIA	5	E-W	3004	0.06	0.062
05/22/91	14:55:58	2SLZ483	'90 FORD CROWN VICTORIA	6	E-W	3005	0.07	-0.002
05/22/91	14:56:01	2SLZ483	'90 FORD CROWN VICTORIA	6	E-W	3002	-0.04	-0.012
05/22/91	14:56:04	2SLZ483	'90 FORD CROWN VICTORIA	6	E-W	3004	-0.02	-0.002
05/22/91	14:57:43	2SLZ483	'90 FORD CROWN VICTORIA	7	E-W	3005	0.01	0.146
05/22/91	14:57:47	2SLZ483	'90 FORD CROWN VICTORIA	7	E-W	3002	-0.02	0.030
05/22/91	14:57:50	2SLZ483	'90 FORD CROWN VICTORIA	7	E-W	3004	0.02	0.052
05/22/91	14:58:54	2SLZ483	'90 FORD CROWN VICTORIA	8	E-W	3005	2.46	0.172
05/22/91	14:58:57	2SLZ483	'90 FORD CROWN VICTORIA	8	E-W	3002	1.89	0.106

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/22/91	14:59:00	2SLZ483	'90 FORD CROWN VICTORIA	8	E-W	3004	3.04	0.150
05/22/91	15:00:16	2SLZ483	'90 FORD CROWN VICTORIA	9	E-W	3005	0.02	-0.002
05/22/91	15:00:19	2SLZ483	'90 FORD CROWN VICTORIA	9	E-W	3002	-0.01	-0.024
05/22/91	15:00:23	2SLZ483	'90 FORD CROWN VICTORIA	9	E-W	3004	-0.01	-0.002
05/22/91	15:01:18	2SLZ483	'90 FORD CROWN VICTORIA	10	E-W	3005	0.15	-0.002
05/22/91	15:01:21	2SLZ483	'90 FORD CROWN VICTORIA	10	E-W	3002	-0.02	-0.028
05/22/91	15:01:25	2SLZ483	'90 FORD CROWN VICTORIA	10	E-W	3004	0.16	0.194
05/22/91		CSB624	'63 CHEVY NOVA	1	E-W	3005	5.09	-0.002
05/22/91	14:49:18	CSB624	'63 CHEVY NOVA	1	E-W	3002	4.62	0.234
05/22/91	14:49:27	CSB624	'63 CHEVY NOVA	1	E-W	3004	4.72	0.530
05/22/91	14:50:37	CSB624	'63 CHEVY NOVA	2	E-W	3005	5.47	-0.002
05/22/91	14:50:44	CSB624	'63 CHEVY NOVA	2	E-W	3002	4.70	0.212
05/22/91	14:50:51	CSB624	'63 CHEVY NOVA	2	E-W	3004	4.19	0.534
05/22/91	14:52:03	CSB624	'63 CHEVY NOVA	3	E-W	3005	2.16	-0.002
05/22/91	14:52:08	CSB624	'63 CHEVY NOVA	3	E-W	3002	1.93	0.280
05/22/91	14:52:12	CSB624	'63 CHEVY NOVA	3	E-W	3004	2.04	0.290
05/22/91	14:53:38	CSB624	'63 CHEVY NOVA	4	E-W	3005	1.56	0.230
05/22/91	14:53:41	CSB624	'63 CHEVY NOVA	4	E-W	3002	1.25	0.154
05/22/91	14:53:44	CSB624	'63 CHEVY NOVA	4	E-W	3004	0.81	0.210
05/22/91	14:55:14	CSB624	'63 CHEVY NOVA	5	E-W	3005	5.22	-0.002
05/22/91	14:55:16	CSB624	'63 CHEVY NOVA	5	E-W	3002	3.03	0.180
05/22/91	14:55:19	CSB624	'63 CHEVY NOVA	5	E-W	3004	2.28	0.402
05/22/91	14:57:07	CSB624	'63 CHEVY NOVA	6	E-W	3005	3.90	-0.002
05/22/91	14:57:13	CSB624	'63 CHEVY NOVA	6	E-W	3002	1.43	0.216
05/22/91	14:57:17	CSB624	'63 CHEVY NOVA	6	E-W	3004	1.02	0.294
05/22/91	14:58:24	CSB624	'63 CHEVY NOVA	7	E-W	3005	6.28	0.266
05/22/91	14:58:28	CSB624	'63 CHEVY NOVA	7	E-W	3002	7.48	0.200
05/22/91	14:58:31	CSB624	'63 CHEVY NOVA	7	E-W	3004	6.93	0.212
05/22/91	14:59:34	CSB624	'63 CHEVY NOVA	8	E-W	3005	2.38	0.256
05/22/91	14:59:37	CSB624	'63 CHEVY NOVA	8	E-W	3002	3.26	0.118
05/22/91	14:59:40	CSB624	'63 CHEVY NOVA	8	E-W	3004	4.92	-0.132
05/22/91	15:00:50	CSB624	'63 CHEVY NOVA	9	E-W	3005	1.27	-0.002
05/22/91	15:00:53	CSB624	'63 CHEVY NOVA	9	E-W	3002	2.62	1.418
05/22/91	15:00:56	CSB624	'63 CHEVY NOVA	9	E-W	3004	0.00	-0.002
05/22/91	15:01:56	CSB624	'63 CHEVY NOVA	10	E-W	3005	1.46	-0.002
05/22/91	15:01:59	CSB624	'63 CHEVY NOVA	10	E-W	3002	4.17	1.030
05/22/91	15:02:02	CSB624	'63 CHEVY NOVA	10	E-W	3004	0.00	-0.002
05/22/91	15:15:02	1T70015	FORD TRUCK	1	W-E	3005	0.04	0.066
05/22/91	15:14:55	1T70015	FORD TRUCK	1	W-E	3002	0.00	-0.002
05/22/91	15:14:45	1T70015	FORD TRUCK	1	W-E	3004	0.01	0.020
05/22/91	15:16:14	1T70015	FORD TRUCK	2	W-E	3005	0.03	0.092
05/22/91	15:16:09	1T70015	FORD TRUCK	2	W-E	3002	-0.03	-0.018
05/22/91	15:16:02	1T70015	FORD TRUCK	2	W-E	3004	0.04	0.066
05/22/91	15:17:15	1T70015	FORD TRUCK	3	W-E	3005	-0.01	-0.002
05/22/91	15:17:11	1T70015	FORD TRUCK	3	W-E	3002	0.00	0.012
05/22/91	15:17:07	1T70015	FORD TRUCK	3	W-E	3004	0.11	0.180
05/22/91	15:18:30	1T70015	FORD TRUCK	4	W-E	3005	0.07	-0.002
05/22/91	15:18:28	1T70015	FORD TRUCK	4	W-E	3002	0.01	0.062
05/22/91	15:18:26	1T70015	FORD TRUCK	4	W-E	3004	-0.03	-0.002
05/22/91	15:19:24	1T70015	FORD TRUCK	5	W-E	3005	0.03	0.090
05/22/91	15:19:23	1T70015	FORD TRUCK	5	W-E	3002	0.01	0.026
05/22/91	15:19:22	1T70015	FORD TRUCK	5	W-E	3004	0.07	-0.002
05/22/91	15:20:27	1T70015	FORD TRUCK	6	W-E	3005	0.34	0.002
05/22/91	15:20:26	1T70015	FORD TRUCK	6	W-E	3002	0.17	0.036
05/22/91	15:20:23	1T70015	FORD TRUCK	6	W-E	3004	0.17	0.030
05/22/91	15:21:36	1T70015	FORD TRUCK	7	W-E	3005	1.13	0.046
05/22/91	15:21:35	1T70015	FORD TRUCK	7	W-E	3002	0.04	0.014
05/22/91	15:21:33	1T70015	FORD TRUCK	7	W-E	3004	0.16	-0.050
05/22/91	15:22:42	1T70015	FORD TRUCK	8	W-E	3005	1.06	0.046
05/22/91	15:22:42	1T70015	FORD TRUCK	8	W-E	3002	0.01	0.014

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/22/91	15:22:40	1T70015	FORD TRUCK	8	W-E	3004	0.22	0.048
05/22/91	15:24:08	1T70015	FORD TRUCK	9	W-E	3005	0.07	-0.002
05/22/91	15:24:06	1T70015	FORD TRUCK	9	W-E	3002	0.01	0.048
05/22/91	15:24:04	1T70015	FORD TRUCK	9	W-E	3004	0.26	0.506
05/22/91	15:25:21	1T70015	FORD TRUCK	10	W-E	3005	0.07	-0.002
05/22/91	15:25:19	1T70015	FORD TRUCK	10	W-E	3002	-0.01	0.034
05/22/91	15:25:17	1T70015	FORD TRUCK	10	W-E	3004	0.35	0.720
05/22/91	15:26:34	1T70015	FORD TRUCK	1	E-W	3005	0.02	-0.002
05/22/91	15:26:41	1T70015	FORD TRUCK	1	E-W	3002	-0.01	0.034
05/22/91	15:26:48	1T70015	FORD TRUCK	1	E-W	3004	0.06	0.080
05/22/91	15:27:50	1T70015	FORD TRUCK	2	E-W	3005	0.01	-0.002
05/22/91	15:27:57	1T70015	FORD TRUCK	2	E-W	3002	-0.01	0.074
05/22/91	15:28:04	1T70015	FORD TRUCK	2	E-W	3004	0.05	0.074
05/22/91	15:29:13	1T70015	FORD TRUCK	3	E-W	3005	0.01	-0.020
05/22/91	15:29:19	1T70015	FORD TRUCK	3	E-W	3002	0.00	0.116
05/22/91	15:29:25	1T70015	FORD TRUCK	3	E-W	3004	-0.04	-0.094
05/22/91	15:30:23	1T70015	FORD TRUCK	4	E-W	3005	0.04	-0.002
05/22/91	15:30:26	1T70015	FORD TRUCK	4	E-W	3002	-0.04	-0.002
05/22/91	15:30:30	1T70015	FORD TRUCK	4	E-W	3004	-0.01	-0.034
05/22/91	15:31:24	1T70015	FORD TRUCK	5	E-W	3005	0.09	-0.002
05/22/91	15:31:27	1T70015	FORD TRUCK	5	E-W	3002	0.64	-0.032
05/22/91	15:31:29	1T70015	FORD TRUCK	5	E-W	3004	0.04	0.000
05/22/91	15:32:26	1T70015	FORD TRUCK	6	E-W	3005	0.12	0.046
05/22/91	15:32:30	1T70015	FORD TRUCK	6	E-W	3002	0.02	0.036
05/22/91	15:32:33	1T70015	FORD TRUCK	6	E-W	3004	0.07	0.070
05/22/91	15:33:25	1T70015	FORD TRUCK	7	E-W	3005	1.88	0.066
05/22/91	15:33:29	1T70015	FORD TRUCK	7	E-W	3002	0.85	0.018
05/22/91	15:33:32	1T70015	FORD TRUCK	7	E-W	3004	1.41	0.048
05/22/91	15:34:29	1T70015	FORD TRUCK	8	E-W	3005	1.25	0.100
05/22/91	15:34:33	1T70015	FORD TRUCK	8	E-W	3002	2.67	0.054
05/22/91	15:34:35	1T70015	FORD TRUCK	8	E-W	3004	4.52	0.060
05/22/91	15:35:45	1T70015	FORD TRUCK	9	E-W	3005	0.04	-0.002
05/22/91	15:35:48	1T70015	FORD TRUCK	9	E-W	3002	-0.09	-0.050
05/22/91	15:35:52	1T70015	FORD TRUCK	9	E-W	3004	0.07	0.202
05/22/91	15:37:40	1T70015	FORD TRUCK	10	E-W	3005	0.07	0.078
05/22/91	15:37:43	1T70015	FORD TRUCK	10	E-W	3002	-0.04	0.016
05/22/91	15:37:47	1T70015	FORD TRUCK	10	E-W	3004	-0.02	-0.014
05/22/91	15:54:09	3B32521	FORD F250	1	W-E	3005	4.82	0.214
05/22/91	15:54:01	3B32521	FORD F250	1	W-E	3002		
05/22/91	15:53:50	3B32521	FORD F250	1	W-E	3004	4.97	0.134
05/22/91	15:55:42	3B32521	FORD F250	2	W-E	3005	1.12	-0.002
05/22/91	15:55:35	3B32521	FORD F250	2	W-E	3002	0.51	-0.076
05/22/91	15:55:26	3B32521	FORD F250	2	W-E	3004	0.42	0.046
05/22/91	15:56:59	3B32521	FORD F250	3	W-E	3005	-0.01	0.072
05/22/91	15:56:56	3B32521	FORD F250	3	W-E	3002	-0.07	-0.056
05/22/91	15:56:52	3B32521	FORD F250	3	W-E	3004	0.09	0.260
05/22/91	15:58:19	3B32521	FORD F250	4	W-E	3005	0.05	-0.024
05/22/91	15:58:18	3B32521	FORD F250	4	W-E	3002	-0.01	0.074
05/22/91	15:58:17	3B32521	FORD F250	4	W-E	3004	0.49	1.364
05/22/91	15:59:30	3B32521	FORD F250	5	W-E	3005	0.05	0.094
05/22/91	15:59:30	3B32521	FORD F250	5	W-E	3002	0.07	-0.012
05/22/91	15:59:29	3B32521	FORD F250	5	W-E	3004	0.01	-0.068
05/22/91	16:00:55	3B32521	FORD F250	6	W-E	3005	0.07	0.094
05/22/91	16:00:55	3B32521	FORD F250	6	W-E	3002	0.00	0.082
05/22/91	16:00:52	3B32521	FORD F250	6	W-E	3004	0.00	0.024
05/22/91	16:02:14	3B32521	FORD F250	7	W-E	3005	0.10	0.150
05/22/91	16:02:13	3B32521	FORD F250	7	W-E	3002	0.74	-0.022
05/22/91	16:02:11	3B32521	FORD F250	7	W-E	3004	0.71	0.114
05/22/91	16:03:25	3B32521	FORD F250	8	W-E	3005	4.02	0.176
05/22/91	16:03:25	3B32521	FORD F250	8	W-E	3002	5.01	0.110

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/22/91	16:03:23	3B32521	FORD F250	8	W-E	3004	2.04	0.018
05/22/91	16:04:42	3B32521	FORD F250	9	W-E	3005	0.01	-0.024
05/22/91	16:04:41	3B32521	FORD F250	9	W-E	3002	-0.14	0.080
05/22/91	16:04:39	3B32521	FORD F250	9	W-E	3004	0.23	0.488
05/22/91	16:06:18	3B32521	FORD F250	10	W-E	3005	0.08	-0.012
05/22/91	16:06:17	3B32521	FORD F250	10	W-E	3002	0.05	-0.084
05/22/91	16:06:15	3B32521	FORD F250	10	W-E	3004	0.06	0.100
05/22/91	16:07:57	3B32521	FORD F250	1	E-W	3005	-0.07	-0.002
05/22/91	16:08:07	3B32521	FORD F250	1	E-W	3002	-0.25	-0.002
05/22/91	16:08:16	3B32521	FORD F250	1	E-W	3004	0.69	0.320
05/22/91	16:09:07	3B32521	FORD F250	2	E-W	3005	0.00	-0.002
05/22/91	16:09:16	3B32521	FORD F250	2	E-W	3002	0.15	-0.002
05/22/91	16:09:25	3B32521	FORD F250	2	E-W	3004	0.57	0.368
05/22/91	16:10:08	3B32521	FORD F250	3	E-W	3005	4.78	-0.002
05/22/91	16:10:13	3B32521	FORD F250	3	E-W	3002	1.25	0.080
05/22/91	16:10:19	3B32521	FORD F250	3	E-W	3004	0.43	-0.002
05/22/91	16:11:14	3B32521	FORD F250	4	E-W	3005	0.05	-0.002
05/22/91	16:11:17	3B32521	FORD F250	4	E-W	3002	-0.07	0.030
05/22/91	16:11:20	3B32521	FORD F250	4	E-W	3004	0.09	0.130
05/22/91	16:12:13	3B32521	FORD F250	5	E-W	3005	0.10	0.150
05/22/91	16:12:16	3B32521	FORD F250	5	E-W	3002	-0.05	0.002
05/22/91	16:12:18	3B32521	FORD F250	5	E-W	3004	0.00	0.000
05/22/91	16:13:29	3B32521	FORD F250	6	E-W	3005	0.01	-0.004
05/22/91	16:13:34	3B32521	FORD F250	6	E-W	3002	-0.02	0.054
05/22/91	16:13:37	3B32521	FORD F250	6	E-W	3004	0.04	0.082
05/22/91	16:14:42	3B32521	FORD F250	7	E-W	3005	0.06	-0.010
05/22/91	16:14:45	3B32521	FORD F250	7	E-W	3002	0.21	0.032
05/22/91	16:14:48	3B32521	FORD F250	7	E-W	3004	0.13	0.034
05/22/91	16:15:53	3B32521	FORD F250	8	E-W	3005	1.96	0.124
05/22/91	16:15:56	3B32521	FORD F250	8	E-W	3002	4.31	0.060
05/22/91	16:15:59	3B32521	FORD F250	8	E-W	3004	3.87	-0.070
05/22/91	16:17:16	3B32521	FORD F250	9	E-W	3005	0.10	-0.002
05/22/91	16:17:19	3B32521	FORD F250	9	E-W	3002	-0.07	-0.036
05/22/91	16:17:22	3B32521	FORD F250	9	E-W	3004	0.04	-0.016
05/22/91	16:18:18	3B32521	FORD F250	10	E-W	3005	0.03	-0.002
05/22/91	16:18:21	3B32521	FORD F250	10	E-W	3002	0.04	0.028
05/22/91	16:18:25	3B32521	FORD F250	10	E-W	3004	0.11	0.094
05/22/91	16:25:51	3K19467	ATDS TRUCK (CHEVY)	1	W-E	3005	-0.01	0.080
05/22/91	16:25:38	3K19467	ATDS TRUCK (CHEVY)	1	W-E	3002	0.00	-0.002
05/22/91	16:25:21	3K19467	ATDS TRUCK (CHEVY)	1	W-E	3004	-0.02	-0.002
05/22/91	16:27:34	3K19467	ATDS TRUCK (CHEVY)	2	W-E	3005	0.01	0.022
05/22/91	16:27:28	3K19467	ATDS TRUCK (CHEVY)	2	W-E	3002	0.02	0.038
05/22/91	16:27:18	3K19467	ATDS TRUCK (CHEVY)	2	W-E	3004	-0.01	-0.074
05/22/91	16:29:10	3K19467	ATDS TRUCK (CHEVY)	3	W-E	3005	0.01	-0.002
05/22/91	16:29:07	3K19467	ATDS TRUCK (CHEVY)	3	W-E	3002	-0.01	0.046
05/22/91	16:29:03	3K19467	ATDS TRUCK (CHEVY)	3	W-E	3004	0.04	0.070
05/22/91	16:30:33	3K19467	ATDS TRUCK (CHEVY)	4	W-E	3005	0.17	-0.002
05/22/91	16:30:32	3K19467	ATDS TRUCK (CHEVY)	4	W-E	3002	-0.03	0.036
05/22/91	16:30:30	3K19467	ATDS TRUCK (CHEVY)	4	W-E	3004	0.03	0.074
05/22/91	16:31:47	3K19467	ATDS TRUCK (CHEVY)	5	W-E	3005	0.00	0.000
05/22/91	16:31:46	3K19467	ATDS TRUCK (CHEVY)	5	W-E	3002	0.04	0.094
05/22/91	16:31:46	3K19467	ATDS TRUCK (CHEVY)	5	W-E	3004	0.44	0.066
05/22/91	16:33:03	3K19467	ATDS TRUCK (CHEVY)	6	W-E	3005	0.05	0.122
05/22/91	16:33:02	3K19467	ATDS TRUCK (CHEVY)	6	W-E	3002	0.03	0.052
05/22/91	16:33:00	3K19467	ATDS TRUCK (CHEVY)	6	W-E	3004	0.03	0.040
05/22/91	16:34:04	3K19467	ATDS TRUCK (CHEVY)	7	W-E	3005	0.01	-0.030
05/22/91	16:34:03	3K19467	ATDS TRUCK (CHEVY)	7	W-E	3002	0.06	0.020
05/22/91	16:34:01	3K19467	ATDS TRUCK (CHEVY)	7	W-E	3004	0.02	0.044
05/22/91	16:35:00	3K19467	ATDS TRUCK (CHEVY)	8	W-E	3005	4.71	-0.082
05/22/91	16:35:00	3K19467	ATDS TRUCK (CHEVY)	8	W-E	3002	5.19	0.060

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/22/91	16:34:58	3K19467	ATDS TRUCK (CHEVY)	8	W-E	3004	3.11	0.076
05/22/91	16:36:30	3K19467	ATDS TRUCK (CHEVY)	9	W-E	3005	0.45	-0.002
05/22/91	16:36:30	3K19467	ATDS TRUCK (CHEVY)	9	W-E	3002	-0.06	-0.084
05/22/91	16:36:28	3K19467	ATDS TRUCK (CHEVY)	9	W-E	3004	0.18	0.242
05/22/91	16:37:47	3K19467	ATDS TRUCK (CHEVY)	10	W-E	3005	0.02	-0.002
05/22/91	16:37:46	3K19467	ATDS TRUCK (CHEVY)	10	W-E	3002	0.00	0.130
05/22/91	16:37:45	3K19467	ATDS TRUCK (CHEVY)	10	W-E	3004	0.16	-0.002
05/22/91	16:40:10	3K19467	ATDS TRUCK (CHEVY)	1	E-W	3005	0.04	-0.064
05/22/91	16:40:22	3K19467	ATDS TRUCK (CHEVY)	1	E-W	3002	-0.01	0.082
05/22/91	16:40:34	3K19467	ATDS TRUCK (CHEVY)	1	E-W	3004	0.02	0.048
05/22/91	16:43:01	3K19467	ATDS TRUCK (CHEVY)	2	E-W	3005	0.05	0.026
05/22/91	16:43:11	3K19467	ATDS TRUCK (CHEVY)	2	E-W	3002	0.00	0.014
05/22/91	16:43:21	3K19467	ATDS TRUCK (CHEVY)	2	E-W	3004	0.06	0.080
05/22/91	16:47:42	3K19467	ATDS TRUCK (CHEVY)	3	E-W	3005	0.03	-0.002
05/22/91	16:47:47	3K19467	ATDS TRUCK (CHEVY)	3	E-W	3002	0.00	0.074
05/22/91	16:47:52	3K19467	ATDS TRUCK (CHEVY)	3	E-W	3004	0.00	-0.028
05/22/91	16:50:08	3K19467	ATDS TRUCK (CHEVY)	4	E-W	3005	0.14	-0.002
05/22/91	16:50:11	3K19467	ATDS TRUCK (CHEVY)	4	E-W	3002	-0.07	0.044
05/22/91	16:50:14	3K19467	ATDS TRUCK (CHEVY)	4	E-W	3004	-0.01	-0.010
05/22/91	16:52:09	3K19467	ATDS TRUCK (CHEVY)	5	E-W	3005	0.19	-0.002
05/22/91	16:52:12	3K19467	ATDS TRUCK (CHEVY)	5	E-W	3002	0.12	0.022
05/22/91	16:52:14	3K19467	ATDS TRUCK (CHEVY)	5	E-W	3004	0.04	-0.014
05/22/91	16:54:23	3K19467	ATDS TRUCK (CHEVY)	6	E-W	3005	0.01	0.030
05/22/91	16:54:28	3K19467	ATDS TRUCK (CHEVY)	6	E-W	3002	0.01	0.028
05/22/91	16:54:32	3K19467	ATDS TRUCK (CHEVY)	6	E-W	3004	0.03	0.020
05/22/91	16:56:05	3K19467	ATDS TRUCK (CHEVY)	7	E-W	3005	0.07	-0.002
05/22/91	16:56:09	3K19467	ATDS TRUCK (CHEVY)	7	E-W	3002	0.15	0.038
05/22/91	16:56:13	3K19467	ATDS TRUCK (CHEVY)	7	E-W	3004	0.28	0.026
05/22/91	16:57:30	3K19467	ATDS TRUCK (CHEVY)	8	E-W	3005	0.76	0.078
05/22/91	16:57:33	3K19467	ATDS TRUCK (CHEVY)	8	E-W	3002	5.52	0.080
05/22/91	16:57:36	3K19467	ATDS TRUCK (CHEVY)	8	E-W	3004	4.96	0.072
05/22/91	16:59:30	3K19467	ATDS TRUCK (CHEVY)	9	E-W	3005	0.18	-0.002
05/22/91	16:59:33	3K19467	ATDS TRUCK (CHEVY)	9	E-W	3002	0.00	0.060
05/22/91	16:59:36	3K19467	ATDS TRUCK (CHEVY)	9	E-W	3004	0.15	-0.002
05/22/91	17:00:46	3K19467	ATDS TRUCK (CHEVY)	10	E-W	3005	0.08	-0.002
05/22/91	17:00:49	3K19467	ATDS TRUCK (CHEVY)	10	E-W	3002	0.03	0.152
05/22/91	17:00:53	3K19467	ATDS TRUCK (CHEVY)	10	E-W	3004	0.25	0.428
05/22/91	16:41:17	3J72817	ATDS TRUCK #2	1	E-W	3005	0.02	-0.016
05/22/91	16:41:32	3J72817	ATDS TRUCK #2	1	E-W	3002	0.00	0.012
05/22/91	16:41:49	3J72817	ATDS TRUCK #2	1	E-W	3004	-0.03	-0.012
05/22/91	16:44:33	3J72817	ATDS TRUCK #2	2	E-W	3005	0.06	-0.026
05/22/91	16:44:44	3J72817	ATDS TRUCK #2	2	E-W	3002	0.01	0.048
05/22/91	16:44:54	3J72817	ATDS TRUCK #2	2	E-W	3004	0.01	0.016
05/22/91	16:46:23	3J72817	ATDS TRUCK #2	3	E-W	3005	0.03	0.138
05/22/91	16:46:28	3J72817	ATDS TRUCK #2	3	E-W	3002	-0.01	0.054
05/22/91	16:46:33	3J72817	ATDS TRUCK #2	3	E-W	3004	-0.06	-0.024
05/22/91	16:48:45	3J72817	ATDS TRUCK #2	4	E-W	3005	0.04	0.024
05/22/91	16:48:49	3J72817	ATDS TRUCK #2	4	E-W	3002	-0.04	-0.148
05/22/91	16:48:52	3J72817	ATDS TRUCK #2	4	E-W	3004	0.08	0.066
05/22/91	16:51:13	3J72817	ATDS TRUCK #2	5	E-W	3005	0.07	-0.002
05/22/91	16:51:15	3J72817	ATDS TRUCK #2	5	E-W	3002	0.00	0.072
05/22/91	16:51:18	3J72817	ATDS TRUCK #2	5	E-W	3004	0.24	-0.002
05/22/91	16:53:34	3J72817	ATDS TRUCK #2	6	E-W	3005	0.05	0.032
05/22/91	16:53:40	3J72817	ATDS TRUCK #2	6	E-W	3002	0.01	0.040
05/22/91	16:53:44	3J72817	ATDS TRUCK #2	6	E-W	3004	0.03	0.036
05/22/91	16:55:17	3J72817	ATDS TRUCK #2	7	E-W	3005	0.03	0.086
05/22/91	16:55:22	3J72817	ATDS TRUCK #2	7	E-W	3002	0.01	0.036
05/22/91	16:55:25	3J72817	ATDS TRUCK #2	7	E-W	3004	0.09	0.104
05/22/91	16:56:45	3J72817	ATDS TRUCK #2	8	E-W	3005	-0.01	0.098
05/22/91	16:56:49	3J72817	ATDS TRUCK #2	8	E-W	3002	4.81	0.090

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/22/91	16:56:51	3J72817	ATDS TRUCK #2	8	E-W	3004	4.30	0.088
05/22/91	16:58:27	3J72817	ATDS TRUCK #2	9	E-W	3005	0.12	-0.002
05/22/91	16:58:31	3J72817	ATDS TRUCK #2	9	E-W	3002	-0.12	-0.002
05/22/91	16:58:35	3J72817	ATDS TRUCK #2	9	E-W	3004	0.06	-0.002
05/22/91	17:00:23	3J72817	ATDS TRUCK #2	10	E-W	3005	0.04	-0.002
05/22/91	17:00:26	3J72817	ATDS TRUCK #2	10	E-W	3002	-0.22	-0.002
05/22/91	17:00:30	3J72817	ATDS TRUCK #2	10	E-W	3004	0.11	0.096
05/22/91	17:08:44	3J72817	ATDS TRUCK #2	1	W-E	3005	-0.01	-0.050
05/22/91	17:08:31	3J72817	ATDS TRUCK #2	1	W-E	3002	-0.01	-0.022
05/22/91	17:08:15	3J72817	ATDS TRUCK #2	1	W-E	3004	-0.06	-0.026
05/22/91	17:11:23	3J72817	ATDS TRUCK #2	2	W-E	3005	0.01	0.060
05/22/91	17:11:18	3J72817	ATDS TRUCK #2	2	W-E	3002	-0.02	-0.028
05/22/91	17:11:13	3J72817	ATDS TRUCK #2	2	W-E	3004	0.01	0.052
05/22/91	17:12:28	3J72817	ATDS TRUCK #2	3	W-E	3005	0.02	0.092
05/22/91	17:12:26	3J72817	ATDS TRUCK #2	3	W-E	3002	-0.04	-0.012
05/22/91	17:12:22	3J72817	ATDS TRUCK #2	3	W-E	3004	-0.03	-0.002
05/22/91	17:13:23	3J72817	ATDS TRUCK #2	4	W-E	3005	0.03	-0.046
05/22/91	17:13:22	3J72817	ATDS TRUCK #2	4	W-E	3002	-0.03	0.018
05/22/91	17:13:21	3J72817	ATDS TRUCK #2	4	W-E	3004	0.09	0.116
05/22/91	17:14:22	3J72817	ATDS TRUCK #2	5	W-E	3005	0.14	-0.002
05/22/91	17:14:22	3J72817	ATDS TRUCK #2	5	W-E	3002	0.02	0.076
05/22/91	17:14:21	3J72817	ATDS TRUCK #2	5	W-E	3004	0.10	0.234
05/22/91	17:15:32	3J72817	ATDS TRUCK #2	6	W-E	3005	0.02	0.088
05/22/91	17:15:30	3J72817	ATDS TRUCK #2	6	W-E	3002	0.01	0.004
05/22/91	17:15:26	3J72817	ATDS TRUCK #2	6	W-E	3004	0.04	0.056
05/22/91	17:16:26	3J72817	ATDS TRUCK #2	7	W-E	3005	0.02	0.046
05/22/91	17:16:26	3J72817	ATDS TRUCK #2	7	W-E	3002	0.01	0.020
05/22/91	17:16:23	3J72817	ATDS TRUCK #2	7	W-E	3004	0.03	0.056
05/22/91	17:17:27	3J72817	ATDS TRUCK #2	8	W-E	3005	4.20	0.120
05/22/91	17:17:26	3J72817	ATDS TRUCK #2	8	W-E	3002	3.96	0.084
05/22/91	17:17:25	3J72817	ATDS TRUCK #2	8	W-E	3004	0.16	0.074
05/22/91	17:18:34	3J72817	ATDS TRUCK #2	9	W-E	3005	0.05	0.076
05/22/91	17:18:32	3J72817	ATDS TRUCK #2	9	W-E	3002	-0.01	0.034
05/22/91	17:18:30	3J72817	ATDS TRUCK #2	9	W-E	3004	0.17	0.322
05/22/91	17:19:30	3J72817	ATDS TRUCK #2	10	W-E	3005	0.10	-0.050
05/22/91	17:19:28	3J72817	ATDS TRUCK #2	10	W-E	3002	-0.01	0.062
05/22/91	17:19:26	3J72817	ATDS TRUCK #2	10	W-E	3004	0.10	0.116
05/23/91	10:49:42	1EHA995	NISSAN SENTRA	1	W-E	3005	0.00	0.030
05/23/91	10:49:38	1EHA995	NISSAN SENTRA	1	W-E	3002	0.00	0.012
05/23/91	10:49:27	1EHA995	NISSAN SENTRA	1	W-E	3004	-0.01	0.016
05/23/91	10:51:05	1EHA995	NISSAN SENTRA	2	W-E	3005	0.02	0.064
05/23/91	10:51:01	1EHA995	NISSAN SENTRA	2	W-E	3002	0.02	0.014
05/23/91	10:50:52	1EHA995	NISSAN SENTRA	2	W-E	3004	-0.03	0.008
05/23/91	10:52:09	1EHA995	NISSAN SENTRA	3	W-E	3005	0.04	0.000
05/23/91	10:52:10	1EHA995	NISSAN SENTRA	3	W-E	3002	0.01	0.024
05/23/91	10:52:06	1EHA995	NISSAN SENTRA	3	W-E	3004	0.07	0.138
05/23/91	10:53:24	1EHA995	NISSAN SENTRA	4	W-E	3005	0.14	-0.002
05/23/91	10:53:27	1EHA995	NISSAN SENTRA	4	W-E	3002	0.11	0.054
05/23/91	10:53:25	1EHA995	NISSAN SENTRA	4	W-E	3004	0.28	0.240
05/23/91	10:54:26	1EHA995	NISSAN SENTRA	5	W-E	3005	0.06	-0.002
05/23/91	10:54:30	1EHA995	NISSAN SENTRA	5	W-E	3002	-0.04	0.126
05/23/91	10:54:29	1EHA995	NISSAN SENTRA	5	W-E	3004	0.19	-0.002
05/23/91	10:55:21	1EHA995	NISSAN SENTRA	6	W-E	3005	0.02	0.064
05/23/91	10:55:24	1EHA995	NISSAN SENTRA	6	W-E	3002	0.02	0.044
05/23/91	10:55:20	1EHA995	NISSAN SENTRA	6	W-E	3004	0.02	0.040
05/23/91	10:56:06	1EHA995	NISSAN SENTRA	7	W-E	3005	0.90	0.114
05/23/91	10:56:10	1EHA995	NISSAN SENTRA	7	W-E	3002	0.11	0.036
05/23/91	10:56:07	1EHA995	NISSAN SENTRA	7	W-E	3004	1.68	0.066
05/23/91	10:57:01	1EHA995	NISSAN SENTRA	8	W-E	3005	4.31	0.168
05/23/91	10:57:05	1EHA995	NISSAN SENTRA	8	W-E	3002	3.26	0.090

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/23/91	10:57:03	1EHA995	NISSAN SENTRA	8	W-E	3004	4.83	0.082
05/23/91	10:58:20	1EHA995	NISSAN SENTRA	9	W-E	3005	0.00	-0.002
05/23/91	10:58:24	1EHA995	NISSAN SENTRA	9	W-E	3002	1.23	-0.002
05/23/91	10:58:22	1EHA995	NISSAN SENTRA	9	W-E	3004	0.00	-0.002
05/23/91	10:59:29	1EHA995	NISSAN SENTRA	10	W-E	3005	0.34	-0.002
05/23/91	10:59:32	1EHA995	NISSAN SENTRA	10	W-E	3002	0.00	-0.002
05/23/91	10:59:31	1EHA995	NISSAN SENTRA	10	W-E	3004	0.00	-0.002
05/23/91	11:00:07	1EHA995	NISSAN SENTRA	1	E-W	3005	0.04	0.052
05/23/91	11:00:22	1EHA995	NISSAN SENTRA	1	E-W	3002	0.01	-0.006
05/23/91	11:00:32	1EHA995	NISSAN SENTRA	1	E-W	3004	-0.03	-0.046
05/23/91	11:01:21	1EHA995	NISSAN SENTRA	2	E-W	3005	0.01	-0.002
05/23/91	11:01:36	1EHA995	NISSAN SENTRA	2	E-W	3002	-0.01	0.038
05/23/91	11:01:47	1EHA995	NISSAN SENTRA	2	E-W	3004	0.01	-0.010
05/23/91	11:02:28	1EHA995	NISSAN SENTRA	3	E-W	3005	0.03	0.066
05/23/91	11:02:39	1EHA995	NISSAN SENTRA	3	E-W	3002	0.02	-0.002
05/23/91	11:02:45	1EHA995	NISSAN SENTRA	3	E-W	3004	0.05	0.098
05/23/91	11:03:26	1EHA995	NISSAN SENTRA	4	E-W	3005	0.10	-0.028
05/23/91	11:03:34	1EHA995	NISSAN SENTRA	4	E-W	3002	-0.01	0.022
05/23/91	11:03:38	1EHA995	NISSAN SENTRA	4	E-W	3004	0.00	-0.002
05/23/91	11:04:25	1EHA995	NISSAN SENTRA	5	E-W	3005	0.00	-0.002
05/23/91	11:04:33	1EHA995	NISSAN SENTRA	5	E-W	3002	0.01	-0.002
05/23/91	11:04:36	1EHA995	NISSAN SENTRA	5	E-W	3004	0.28	0.308
05/23/91	11:05:32	1EHA995	NISSAN SENTRA	6	E-W	3005	0.02	0.072
05/23/91	11:05:42	1EHA995	NISSAN SENTRA	6	E-W	3002	0.02	0.036
05/23/91	11:05:47	1EHA995	NISSAN SENTRA	6	E-W	3004	0.03	0.040
05/23/91	11:06:18	1EHA995	NISSAN SENTRA	7	E-W	3005	1.46	0.088
05/23/91	11:06:27	1EHA995	NISSAN SENTRA	7	E-W	3002	0.10	0.012
05/23/91	11:06:31	1EHA995	NISSAN SENTRA	7	E-W	3004	1.14	0.056
05/23/91	11:07:07	1EHA995	NISSAN SENTRA	8	E-W	3005	3.75	0.080
05/23/91	11:07:15	1EHA995	NISSAN SENTRA	8	E-W	3002	2.42	0.074
05/23/91	11:07:18	1EHA995	NISSAN SENTRA	8	E-W	3004	4.41	0.074
05/23/91	11:08:25	1EHA995	NISSAN SENTRA	9	E-W	3005	0.25	-0.002
05/23/91	11:08:34	1EHA995	NISSAN SENTRA	9	E-W	3002	0.37	0.096
05/23/91	11:08:37	1EHA995	NISSAN SENTRA	9	E-W	3004	0.00	-0.002
05/23/91	11:09:28	1EHA995	NISSAN SENTRA	10	E-W	3005	0.16	1.060
05/23/91	11:09:37	1EHA995	NISSAN SENTRA	10	E-W	3002	1.08	0.038
05/23/91	11:09:40	1EHA995	NISSAN SENTRA	10	E-W	3004	0.00	-0.002
05/23/91	11:35:42	850VNV	’78 TOYOTA COROLLA	1	W-E	3005	0.24	0.094
05/23/91	11:35:36	850VNV	’78 TOYOTA COROLLA	1	W-E	3002	0.15	-0.002
05/23/91	11:35:25	850VNV	’78 TOYOTA COROLLA	1	W-E	3004	0.30	0.080
05/23/91	11:37:29	850VNV	’78 TOYOTA COROLLA	2	W-E	3005	0.10	-0.002
05/23/91	11:37:24	850VNV	’78 TOYOTA COROLLA	2	W-E	3002	0.17	0.066
05/23/91	11:37:12	850VNV	’78 TOYOTA COROLLA	2	W-E	3004	0.20	-0.002
05/23/91	11:39:02	850VNV	’78 TOYOTA COROLLA	3	W-E	3005	0.21	0.136
05/23/91	11:39:04	850VNV	’78 TOYOTA COROLLA	3	W-E	3002	0.29	-0.072
05/23/91	11:39:01	850VNV	’78 TOYOTA COROLLA	3	W-E	3004	0.50	0.410
05/23/91	11:40:15	850VNV	’78 TOYOTA COROLLA	4	W-E	3005	0.33	-0.002
05/23/91	11:40:19	850VNV	’78 TOYOTA COROLLA	4	W-E	3002	0.19	-0.034
05/23/91	11:40:18	850VNV	’78 TOYOTA COROLLA	4	W-E	3004	0.11	0.118
05/23/91	11:41:22	850VNV	’78 TOYOTA COROLLA	5	W-E	3005	0.09	-0.002
05/23/91	11:41:27	850VNV	’78 TOYOTA COROLLA	5	W-E	3002	-0.01	-0.112
05/23/91	11:41:26	850VNV	’78 TOYOTA COROLLA	5	W-E	3004	0.04	-0.002
05/23/91	11:42:29	850VNV	’78 TOYOTA COROLLA	6	W-E	3005	0.38	0.116
05/23/91	11:42:32	850VNV	’78 TOYOTA COROLLA	6	W-E	3002	0.24	0.006
05/23/91	11:42:28	850VNV	’78 TOYOTA COROLLA	6	W-E	3004	0.17	-0.036
05/23/91	11:43:15	850VNV	’78 TOYOTA COROLLA	7	W-E	3005	3.27	2.434
05/23/91	11:43:18	850VNV	’78 TOYOTA COROLLA	7	W-E	3002	0.36	0.018
05/23/91	11:43:15	850VNV	’78 TOYOTA COROLLA	7	W-E	3004	0.24	-0.030
05/23/91	11:44:04	850VNV	’78 TOYOTA COROLLA	8	W-E	3005	3.88	0.098
05/23/91	11:44:07	850VNV	’78 TOYOTA COROLLA	8	W-E	3002	1.09	0.060

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/23/91	11:44:05	850VNV	’78 TOYOTA COROLLA	8	W-E	3004	4.02	-0.126
05/23/91	11:45:14	850VNV	’78 TOYOTA COROLLA	9	W-E	3005	0.34	-0.002
05/23/91	11:45:17	850VNV	’78 TOYOTA COROLLA	9	W-E	3002	-0.04	-0.002
05/23/91	11:45:16	850VNV	’78 TOYOTA COROLLA	9	W-E	3004	0.00	-0.002
05/23/91	11:46:17	850VNV	’78 TOYOTA COROLLA	10	W-E	3005	0.00	-0.002
05/23/91	11:46:20	850VNV	’78 TOYOTA COROLLA	10	W-E	3002	0.42	0.286
05/23/91	11:46:19	850VNV	’78 TOYOTA COROLLA	10	W-E	3004	0.00	-0.002
05/23/91	11:46:44	850VNV	’78 TOYOTA COROLLA	1	E-W	3005	0.37	-0.024
05/23/91	11:47:01	850VNV	’78 TOYOTA COROLLA	1	E-W	3002	0.20	-0.022
05/23/91	11:47:13	850VNV	’78 TOYOTA COROLLA	1	E-W	3004	0.23	0.000
05/23/91	11:47:52	850VNV	’78 TOYOTA COROLLA	2	E-W	3005	0.23	0.012
05/23/91	11:48:09	850VNV	’78 TOYOTA COROLLA	2	E-W	3002	0.17	-0.020
05/23/91	11:48:21	850VNV	’78 TOYOTA COROLLA	2	E-W	3004	0.17	-0.002
05/23/91	11:49:10	850VNV	’78 TOYOTA COROLLA	3	E-W	3005	0.15	-0.002
05/23/91	11:49:20	850VNV	’78 TOYOTA COROLLA	3	E-W	3002	0.22	-0.004
05/23/91	11:49:25	850VNV	’78 TOYOTA COROLLA	3	E-W	3004	0.16	0.012
05/23/91	11:50:19	850VNV	’78 TOYOTA COROLLA	4	E-W	3005	0.20	0.008
05/23/91	11:50:27	850VNV	’78 TOYOTA COROLLA	4	E-W	3002	0.17	0.078
05/23/91	11:50:30	850VNV	’78 TOYOTA COROLLA	4	E-W	3004	0.29	0.504
05/23/91	11:51:24	850VNV	’78 TOYOTA COROLLA	5	E-W	3005	0.00	-0.002
05/23/91	11:51:32	850VNV	’78 TOYOTA COROLLA	5	E-W	3002	0.05	-0.092
05/23/91	11:51:34	850VNV	’78 TOYOTA COROLLA	5	E-W	3004	0.10	0.162
05/23/91	11:52:13	850VNV	’78 TOYOTA COROLLA	6	E-W	3005	0.11	-0.002
05/23/91	11:52:23	850VNV	’78 TOYOTA COROLLA	6	E-W	3002	0.33	0.054
05/23/91	11:52:27	850VNV	’78 TOYOTA COROLLA	6	E-W	3004	0.16	-0.056
05/23/91	11:52:54	850VNV	’78 TOYOTA COROLLA	7	E-W	3005	0.16	-0.002
05/23/91	11:53:03	850VNV	’78 TOYOTA COROLLA	7	E-W	3002	0.34	0.070
05/23/91	11:53:07	850VNV	’78 TOYOTA COROLLA	7	E-W	3004	-0.00	0.130
05/23/91	11:53:36	850VNV	’78 TOYOTA COROLLA	8	E-W	3005	3.00	0.276
05/23/91	11:53:45	850VNV	’78 TOYOTA COROLLA	8	E-W	3002	0.86	0.046
05/23/91	11:53:48	850VNV	’78 TOYOTA COROLLA	8	E-W	3004	4.33	0.034
05/23/91	11:54:39	850VNV	’78 TOYOTA COROLLA	9	E-W	3005	0.05	-0.002
05/23/91	11:54:47	850VNV	’78 TOYOTA COROLLA	9	E-W	3002	0.40	0.178
05/23/91	11:54:50	850VNV	’78 TOYOTA COROLLA	9	E-W	3004	0.00	-0.002
05/23/91	11:55:37	850VNV	’78 TOYOTA COROLLA	10	E-W	3005	0.25	-0.002
05/23/91	11:55:45	850VNV	’78 TOYOTA COROLLA	10	E-W	3002	0.31	0.084
05/23/91	11:55:48	850VNV	’78 TOYOTA COROLLA	10	E-W	3004	0.63	0.598
05/23/91	12:05:22	686YIH	’79 TOYOTA CELICA	1	W-E	3005	3.41	0.184
05/23/91	12:05:10	686YIH	’79 TOYOTA CELICA	1	W-E	3002	3.41	0.120
05/23/91	12:04:51	686YIH	’79 TOYOTA CELICA	1	W-E	3004	3.67	0.142
05/23/91	12:06:54	686YIH	’79 TOYOTA CELICA	2	W-E	3005	0.04	0.070
05/23/91	12:06:51	686YIH	’79 TOYOTA CELICA	2	W-E	3002	0.04	0.104
05/23/91	12:06:42	686YIH	’79 TOYOTA CELICA	2	W-E	3004	0.04	0.054
05/23/91	12:08:46	686YIH	’79 TOYOTA CELICA	3	W-E	3005	0.06	0.066
05/23/91	12:08:48	686YIH	’79 TOYOTA CELICA	3	W-E	3002	0.05	0.066
05/23/91	12:08:44	686YIH	’79 TOYOTA CELICA	3	W-E	3004	0.20	0.076
05/23/91	12:10:01	686YIH	’79 TOYOTA CELICA	4	W-E	3005	0.75	-0.002
05/23/91	12:10:04	686YIH	’79 TOYOTA CELICA	4	W-E	3002	0.80	0.096
05/23/91	12:10:03	686YIH	’79 TOYOTA CELICA	4	W-E	3004	0.72	0.048
05/23/91	12:11:06	686YIH	’79 TOYOTA CELICA	5	W-E	3005	1.21	-0.002
05/23/91	12:11:10	686YIH	’79 TOYOTA CELICA	5	W-E	3002	1.18	0.080
05/23/91	12:11:10	686YIH	’79 TOYOTA CELICA	5	W-E	3004	1.73	0.074
05/23/91	12:12:17	686YIH	’79 TOYOTA CELICA	6	W-E	3005	1.57	0.104
05/23/91	12:12:20	686YIH	’79 TOYOTA CELICA	6	W-E	3002	1.17	0.072
05/23/91	12:12:16	686YIH	’79 TOYOTA CELICA	6	W-E	3004	0.56	0.062
05/23/91	12:13:20	686YIH	’79 TOYOTA CELICA	7	W-E	3005	0.76	0.100
05/23/91	12:13:24	686YIH	’79 TOYOTA CELICA	7	W-E	3002	1.03	0.072
05/23/91	12:13:22	686YIH	’79 TOYOTA CELICA	7	W-E	3004	1.08	0.098
05/23/91	12:14:19	686YIH	’79 TOYOTA CELICA	8	W-E	3005	4.75	0.112
05/23/91	12:14:23	686YIH	’79 TOYOTA CELICA	8	W-E	3002	2.85	0.064

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/23/91	12:14:21	686YIH	’79 TOYOTA CELICA	8	W-E	3004	0.98	0.002
05/23/91	12:15:49	686YIH	’79 TOYOTA CELICA	9	W-E	3005	3.44	0.742
05/23/91	12:15:52	686YIH	’79 TOYOTA CELICA	9	W-E	3002	1.81	1.094
05/23/91	12:15:51	686YIH	’79 TOYOTA CELICA	9	W-E	3004	1.04	0.326
05/23/91	12:17:23	686YIH	’79 TOYOTA CELICA	10	W-E	3005	3.45	0.582
05/23/91	12:17:27	686YIH	’79 TOYOTA CELICA	10	W-E	3002	1.86	1.160
05/23/91	12:17:25	686YIH	’79 TOYOTA CELICA	10	W-E	3004	1.33	0.852
05/23/91	12:08:11	2WFC709	’72 MERCEDES	1	W-E	3005	2.57	0.154
05/23/91	12:08:05	2WFC709	’72 MERCEDES	1	W-E	3002	2.68	0.240
05/23/91	12:07:52	2WFC709	’72 MERCEDES	1	W-E	3004	3.09	0.226
05/23/91	12:09:28	2WFC709	’72 MERCEDES	2	W-E	3005	0.24	0.088
05/23/91	12:09:25	2WFC709	’72 MERCEDES	2	W-E	3002	0.26	0.170
05/23/91	12:09:17	2WFC709	’72 MERCEDES	2	W-E	3004	0.33	0.152
05/23/91	12:10:35	2WFC709	’72 MERCEDES	3	W-E	3005	0.10	0.090
05/23/91	12:10:34	2WFC709	’72 MERCEDES	3	W-E	3002	0.18	0.130
05/23/91	12:10:29	2WFC709	’72 MERCEDES	3	W-E	3004	0.11	0.090
05/23/91	12:11:43	2WFC709	’72 MERCEDES	4	W-E	3005	0.17	0.252
05/23/91	12:11:46	2WFC709	’72 MERCEDES	4	W-E	3002	0.17	0.054
05/23/91	12:11:45	2WFC709	’72 MERCEDES	4	W-E	3004	0.16	0.054
05/23/91	12:12:49	2WFC709	’72 MERCEDES	5	W-E	3005	0.00	-0.002
05/23/91	12:12:54	2WFC709	’72 MERCEDES	5	W-E	3002	0.52	0.150
05/23/91	12:12:53	2WFC709	’72 MERCEDES	5	W-E	3004	0.46	0.100
05/23/91	12:13:55	2WFC709	’72 MERCEDES	6	W-E	3005	0.10	0.082
05/23/91	12:13:57	2WFC709	’72 MERCEDES	6	W-E	3002	0.12	0.050
05/23/91	12:13:52	2WFC709	’72 MERCEDES	6	W-E	3004	0.07	0.082
05/23/91	12:15:10	2WFC709	’72 MERCEDES	7	W-E	3005	0.14	0.134
05/23/91	12:15:14	2WFC709	’72 MERCEDES	7	W-E	3002	0.22	0.094
05/23/91	12:15:11	2WFC709	’72 MERCEDES	7	W-E	3004	0.45	0.156
05/23/91	12:16:38	2WFC709	’72 MERCEDES	8	W-E	3005	5.07	0.432
05/23/91	12:16:43	2WFC709	’72 MERCEDES	8	W-E	3002	3.89	0.156
05/23/91	12:16:41	2WFC709	’72 MERCEDES	8	W-E	3004	4.90	0.170
05/23/91	12:18:25	2WFC709	’72 MERCEDES	9	W-E	3005	2.41	0.280
05/23/91	12:18:25	2WFC709	’72 MERCEDES	9	W-E	3002	3.29	0.250
05/23/91	12:18:22	2WFC709	’72 MERCEDES	9	W-E	3004	4.47	0.240
05/23/91	12:19:50	2WFC709	’72 MERCEDES	10	W-E	3005	4.15	0.358
05/23/91	12:19:51	2WFC709	’72 MERCEDES	10	W-E	3002	5.29	1.416
05/23/91	12:19:49	2WFC709	’72 MERCEDES	10	W-E	3004	1.77	0.438
05/23/91	12:20:27	686YIH	’79 TOYOTA CELICA	1	E-W	3005	5.52	0.300
05/23/91	12:20:49	686YIH	’79 TOYOTA CELICA	1	E-W	3002	4.10	0.158
05/23/91	12:21:05	686YIH	’79 TOYOTA CELICA	1	E-W	3004	5.08	0.170
05/23/91	12:22:45	686YIH	’79 TOYOTA CELICA	2	E-W	3005	0.72	0.206
05/23/91	12:23:00	686YIH	’79 TOYOTA CELICA	2	E-W	3002	0.91	0.068
05/23/91	12:23:11	686YIH	’79 TOYOTA CELICA	2	E-W	3004	0.79	0.088
05/23/91	12:24:35	686YIH	’79 TOYOTA CELICA	3	E-W	3005	0.30	-0.002
05/23/91	12:24:46	686YIH	’79 TOYOTA CELICA	3	E-W	3002	1.14	0.100
05/23/91	12:24:51	686YIH	’79 TOYOTA CELICA	3	E-W	3004	0.61	0.088
05/23/91	12:26:02	686YIH	’79 TOYOTA CELICA	4	E-W	3005	0.91	0.028
05/23/91	12:26:10	686YIH	’79 TOYOTA CELICA	4	E-W	3002	1.21	0.116
05/23/91	12:26:14	686YIH	’79 TOYOTA CELICA	4	E-W	3004	0.88	0.258
05/23/91	12:27:23	686YIH	’79 TOYOTA CELICA	5	E-W	3005	1.48	-0.002
05/23/91	12:27:30	686YIH	’79 TOYOTA CELICA	5	E-W	3002	1.21	0.168
05/23/91	12:27:33	686YIH	’79 TOYOTA CELICA	5	E-W	3004	1.56	0.202
05/23/91	12:28:47	686YIH	’79 TOYOTA CELICA	6	E-W	3005	1.32	0.066
05/23/91	12:28:57	686YIH	’79 TOYOTA CELICA	6	E-W	3002	1.10	0.102
05/23/91	12:29:01	686YIH	’79 TOYOTA CELICA	6	E-W	3004	1.60	0.088
05/23/91	12:29:56	686YIH	’79 TOYOTA CELICA	7	E-W	3005	2.11	0.052
05/23/91	12:30:06	686YIH	’79 TOYOTA CELICA	7	E-W	3002	1.35	0.122
05/23/91	12:30:09	686YIH	’79 TOYOTA CELICA	7	E-W	3004	0.20	0.110
05/23/91	12:31:05	686YIH	’79 TOYOTA CELICA	8	E-W	3005	1.03	0.092
05/23/91	12:31:14	686YIH	’79 TOYOTA CELICA	8	E-W	3002	2.09	0.070

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/23/91	12:31:18	686YIH	’79 TOYOTA CELICA	8	E-W	3004	3.55	0.114
05/23/91	12:32:28	686YIH	’79 TOYOTA CELICA	9	E-W	3005	0.00	-0.002
05/23/91	12:32:37	686YIH	’79 TOYOTA CELICA	9	E-W	3002	2.52	0.872
05/23/91	12:32:41	686YIH	’79 TOYOTA CELICA	9	E-W	3004	0.00	-0.002
05/23/91	12:33:42	686YIH	’79 TOYOTA CELICA	10	E-W	3005	1.00	-0.002
05/23/91	12:33:50	686YIH	’79 TOYOTA CELICA	10	E-W	3002	2.04	0.876
05/23/91	12:33:54	686YIH	’79 TOYOTA CELICA	10	E-W	3004	0.00	-0.002
05/23/91	12:21:35	2WFC709	’72 MERCEDES	1	E-W	3005	2.39	0.148
05/23/91	12:21:53	2WFC709	’72 MERCEDES	1	E-W	3002	1.01	0.174
05/23/91	12:22:06	2WFC709	’72 MERCEDES	1	E-W	3004	0.72	0.102
05/23/91	12:23:47	2WFC709	’72 MERCEDES	2	E-W	3005	0.28	0.114
05/23/91	12:24:00	2WFC709	’72 MERCEDES	2	E-W	3002	0.23	0.378
05/23/91	12:24:10	2WFC709	’72 MERCEDES	2	E-W	3004	0.27	0.154
05/23/91	12:25:20	2WFC709	’72 MERCEDES	3	E-W	3005	0.16	0.062
05/23/91	12:25:32	2WFC709	’72 MERCEDES	3	E-W	3002	0.07	0.060
05/23/91	12:25:38	2WFC709	’72 MERCEDES	3	E-W	3004	0.12	0.130
05/23/91	12:26:54	2WFC709	’72 MERCEDES	4	E-W	3005	0.20	-0.002
05/23/91	12:27:02	2WFC709	’72 MERCEDES	4	E-W	3002	0.10	0.120
05/23/91	12:27:06	2WFC709	’72 MERCEDES	4	E-W	3004	0.22	0.304
05/23/91	12:28:18	2WFC709	’72 MERCEDES	5	E-W	3005	1.57	0.150
05/23/91	12:28:26	2WFC709	’72 MERCEDES	5	E-W	3002	0.34	0.078
05/23/91	12:28:29	2WFC709	’72 MERCEDES	5	E-W	3004	0.52	0.262
05/23/91	12:29:28	2WFC709	’72 MERCEDES	6	E-W	3005	0.13	0.110
05/23/91	12:29:40	2WFC709	’72 MERCEDES	6	E-W	3002	0.07	0.080
05/23/91	12:29:46	2WFC709	’72 MERCEDES	6	E-W	3004	0.11	0.086
05/23/91	12:30:34	2WFC709	’72 MERCEDES	7	E-W	3005	0.86	0.170
05/23/91	12:30:43	2WFC709	’72 MERCEDES	7	E-W	3002	0.55	0.110
05/23/91	12:30:46	2WFC709	’72 MERCEDES	7	E-W	3004	0.00	-0.002
05/23/91	12:31:41	2WFC709	’72 MERCEDES	8	E-W	3005	3.95	0.268
05/23/91	12:31:50	2WFC709	’72 MERCEDES	8	E-W	3002	4.66	0.170
05/23/91	12:31:52	2WFC709	’72 MERCEDES	8	E-W	3004	5.21	0.164
05/23/91	12:33:11	2WFC709	’72 MERCEDES	9	E-W	3005	5.41	0.936
05/23/91	12:33:21	2WFC709	’72 MERCEDES	9	E-W	3002	3.67	0.318
05/23/91	12:33:28	2WFC709	’72 MERCEDES	9	E-W	3004	2.30	0.166
05/23/91	12:34:28	2WFC709	’72 MERCEDES	10	E-W	3005	2.80	0.458
05/23/91	12:34:38	2WFC709	’72 MERCEDES	10	E-W	3002	2.94	0.612
05/23/91	12:34:44	2WFC709	’72 MERCEDES	10	E-W	3004	2.66	0.124
05/23/91	12:43:07	403XWL	’79 CADILLAC	1	W-E	3005	0.91	0.158
05/23/91	12:43:06	403XWL	’79 CADILLAC	1	W-E	3002	0.93	0.046
05/23/91	12:42:59	403XWL	’79 CADILLAC	1	W-E	3004	2.88	0.168
05/23/91	12:45:15	403XWL	’79 CADILLAC	2	W-E	3005	0.46	-0.002
05/23/91	12:45:14	403XWL	’79 CADILLAC	2	W-E	3002	0.28	0.022
05/23/91	12:45:07	403XWL	’79 CADILLAC	2	W-E	3004	0.48	0.086
05/23/91	12:46:44	403XWL	’79 CADILLAC	3	W-E	3005	0.35	0.032
05/23/91	12:46:45	403XWL	’79 CADILLAC	3	W-E	3002	0.23	0.034
05/23/91	12:46:42	403XWL	’79 CADILLAC	3	W-E	3004	0.39	0.072
05/23/91	12:47:59	403XWL	’79 CADILLAC	4	W-E	3005	0.72	0.252
05/23/91	12:48:03	403XWL	’79 CADILLAC	4	W-E	3002	0.76	0.042
05/23/91	12:48:01	403XWL	’79 CADILLAC	4	W-E	3004	1.06	0.096
05/23/91	12:49:20	403XWL	’79 CADILLAC	5	W-E	3005	0.80	-0.002
05/23/91	12:49:25	403XWL	’79 CADILLAC	5	W-E	3002	0.72	0.002
05/23/91	12:49:24	403XWL	’79 CADILLAC	5	W-E	3004	1.04	0.100
05/23/91	12:50:26	403XWL	’79 CADILLAC	6	W-E	3005	0.32	0.074
05/23/91	12:50:29	403XWL	’79 CADILLAC	6	W-E	3002	0.28	0.028
05/23/91	12:50:26	403XWL	’79 CADILLAC	6	W-E	3004	0.27	0.028
05/23/91	12:51:20	403XWL	’79 CADILLAC	7	W-E	3005	0.50	0.036
05/23/91	12:51:24	403XWL	’79 CADILLAC	7	W-E	3002	0.60	0.032
05/23/91	12:51:22	403XWL	’79 CADILLAC	7	W-E	3004	0.33	0.046
05/23/91	12:52:24	403XWL	’79 CADILLAC	8	W-E	3005	5.79	0.156
05/23/91	12:52:29	403XWL	’79 CADILLAC	8	W-E	3002	4.56	0.110

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/23/91	12:52:27	403XWL	’79 CADILLAC	8	W-E	3004	2.61	0.024
05/23/91	12:53:52	403XWL	’79 CADILLAC	9	W-E	3005	0.75	0.556
05/23/91	12:53:55	403XWL	’79 CADILLAC	9	W-E	3002	0.41	0.094
05/23/91	12:53:54	403XWL	’79 CADILLAC	9	W-E	3004	0.95	0.414
05/23/91	12:55:06	403XWL	’79 CADILLAC	10	W-E	3005	0.95	0.770
05/23/91	12:55:10	403XWL	’79 CADILLAC	10	W-E	3002	2.60	0.178
05/23/91	12:55:09	403XWL	’79 CADILLAC	10	W-E	3004	1.38	0.120
05/23/91	12:44:05	1GXH362	’82 NISSAN STANZA	1	W-E	3005	2.80	0.158
05/23/91	12:44:03	1GXH362	’82 NISSAN STANZA	1	W-E	3002	2.03	0.092
05/23/91	12:43:55	1GXH362	’82 NISSAN STANZA	1	W-E	3004	2.53	0.154
05/23/91	12:46:09	1GXH362	’82 NISSAN STANZA	2	W-E	3005	1.62	0.054
05/23/91	12:46:08	1GXH362	’82 NISSAN STANZA	2	W-E	3002	1.73	0.160
05/23/91	12:46:00	1GXH362	’82 NISSAN STANZA	2	W-E	3004	2.93	0.184
05/23/91	12:47:25	1GXH362	’82 NISSAN STANZA	3	W-E	3005	0.05	0.192
05/23/91	12:47:27	1GXH362	’82 NISSAN STANZA	3	W-E	3002	0.00	0.092
05/23/91	12:47:23	1GXH362	’82 NISSAN STANZA	3	W-E	3004	0.15	0.096
05/23/91	12:48:41	1GXH362	’82 NISSAN STANZA	4	W-E	3005	0.05	-0.002
05/23/91	12:48:45	1GXH362	’82 NISSAN STANZA	4	W-E	3002	-0.01	0.030
05/23/91	12:48:43	1GXH362	’82 NISSAN STANZA	4	W-E	3004	0.14	0.168
05/23/91	12:49:58	1GXH362	’82 NISSAN STANZA	5	W-E	3005	1.56	0.382
05/23/91	12:50:03	1GXH362	’82 NISSAN STANZA	5	W-E	3002	0.00	-0.002
05/23/91	12:50:02	1GXH362	’82 NISSAN STANZA	5	W-E	3004	1.39	0.136
05/23/91	12:50:58	1GXH362	’82 NISSAN STANZA	6	W-E	3005	0.34	0.026
05/23/91	12:51:01	1GXH362	’82 NISSAN STANZA	6	W-E	3002	0.10	0.044
05/23/91	12:50:57	1GXH362	’82 NISSAN STANZA	6	W-E	3004	1.94	0.068
05/23/91	12:51:55	1GXH362	’82 NISSAN STANZA	7	W-E	3005	2.46	0.090
05/23/91	12:51:59	1GXH362	’82 NISSAN STANZA	7	W-E	3002	1.51	0.044
05/23/91	12:51:57	1GXH362	’82 NISSAN STANZA	7	W-E	3004	0.28	0.022
05/23/91	12:52:55	1GXH362	’82 NISSAN STANZA	8	W-E	3005	9.18	0.166
05/23/91	12:52:59	1GXH362	’82 NISSAN STANZA	8	W-E	3002	7.91	0.130
05/23/91	12:52:57	1GXH362	’82 NISSAN STANZA	8	W-E	3004	4.25	0.084
05/23/91	12:54:28	1GXH362	’82 NISSAN STANZA	9	W-E	3005	3.03	0.152
05/23/91	12:54:31	1GXH362	’82 NISSAN STANZA	9	W-E	3002	2.53	0.194
05/23/91	12:54:29	1GXH362	’82 NISSAN STANZA	9	W-E	3004	1.28	0.312
05/23/91	12:55:53	1GXH362	’82 NISSAN STANZA	10	W-E	3005	3.73	0.132
05/23/91	12:55:56	1GXH362	’82 NISSAN STANZA	10	W-E	3002	2.61	0.146
05/23/91	12:55:54	1GXH362	’82 NISSAN STANZA	10	W-E	3004	1.96	0.240
05/23/91	12:56:25	403XWL	’79 CADILLAC	1	E-W	3005	0.52	-0.002
05/23/91	12:56:39	403XWL	’79 CADILLAC	1	E-W	3002	0.30	0.048
05/23/91	12:56:47	403XWL	’79 CADILLAC	1	E-W	3004	0.35	0.064
05/23/91	12:57:46	403XWL	’79 CADILLAC	2	E-W	3005	0.43	0.018
05/23/91	12:57:59	403XWL	’79 CADILLAC	2	E-W	3002	0.15	0.020
05/23/91	12:58:07	403XWL	’79 CADILLAC	2	E-W	3004	0.27	0.062
05/23/91	12:58:56	403XWL	’79 CADILLAC	3	E-W	3005	0.41	0.068
05/23/91	12:59:07	403XWL	’79 CADILLAC	3	E-W	3002	0.14	-0.036
05/23/91	12:59:13	403XWL	’79 CADILLAC	3	E-W	3004	0.37	0.098
05/23/91	13:00:04	403XWL	’79 CADILLAC	4	E-W	3005	0.57	0.080
05/23/91	13:00:13	403XWL	’79 CADILLAC	4	E-W	3002	0.47	0.050
05/23/91	13:00:16	403XWL	’79 CADILLAC	4	E-W	3004	0.48	0.062
05/23/91	13:01:24	403XWL	’79 CADILLAC	5	E-W	3005	1.08	0.594
05/23/91	13:01:32	403XWL	’79 CADILLAC	5	E-W	3002	0.62	0.046
05/23/91	13:01:34	403XWL	’79 CADILLAC	5	E-W	3004	0.66	0.092
05/23/91	13:02:44	403XWL	’79 CADILLAC	6	E-W	3005	0.47	0.132
05/23/91	13:02:55	403XWL	’79 CADILLAC	6	E-W	3002	0.42	0.058
05/23/91	13:02:59	403XWL	’79 CADILLAC	6	E-W	3004	0.41	0.058
05/23/91	13:03:54	403XWL	’79 CADILLAC	7	E-W	3005	0.28	0.154
05/23/91	13:04:03	403XWL	’79 CADILLAC	7	E-W	3002	0.10	-0.002
05/23/91	13:04:07	403XWL	’79 CADILLAC	7	E-W	3004	0.12	0.042
05/23/91	13:05:06	403XWL	’79 CADILLAC	8	E-W	3005	4.06	0.186
05/23/91	13:05:15	403XWL	’79 CADILLAC	8	E-W	3002	5.04	0.046

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/23/91	13:05:18	403XWL	'79 CADILLAC	8	E-W	3004	5.84	0.070
05/23/91	13:06:33	403XWL	'79 CADILLAC	9	E-W	3005	0.55	-0.002
05/23/91	13:06:41	403XWL	'79 CADILLAC	9	E-W	3002	0.28	0.074
05/23/91	13:06:45	403XWL	'79 CADILLAC	9	E-W	3004	0.45	0.132
05/23/91	13:07:52	403XWL	'79 CADILLAC	10	E-W	3005	0.48	0.074
05/23/91	13:08:01	403XWL	'79 CADILLAC	10	E-W	3002	0.20	0.050
05/23/91	13:08:04	403XWL	'79 CADILLAC	10	E-W	3004	0.33	0.106
05/23/91	12:57:10	1GXH362	'82 NISSAN STANZA	1	E-W	3005	4.57	0.242
05/23/91	12:57:24	1GXH362	'82 NISSAN STANZA	1	E-W	3002	3.67	0.144
05/23/91	12:57:34	1GXH362	'82 NISSAN STANZA	1	E-W	3004	4.40	0.254
05/23/91	12:58:28	1GXH362	'82 NISSAN STANZA	2	E-W	3005	3.06	0.178
05/23/91	12:58:41	1GXH362	'82 NISSAN STANZA	2	E-W	3002	2.39	0.132
05/23/91	12:58:48	1GXH362	'82 NISSAN STANZA	2	E-W	3004	2.89	0.130
05/23/91	12:59:37	1GXH362	'82 NISSAN STANZA	3	E-W	3005	0.78	0.064
05/23/91	12:59:47	1GXH362	'82 NISSAN STANZA	3	E-W	3002	0.85	0.098
05/23/91	12:59:52	1GXH362	'82 NISSAN STANZA	3	E-W	3004	1.54	0.124
05/23/91	13:00:54	1GXH362	'82 NISSAN STANZA	4	E-W	3005	2.51	-0.002
05/23/91	13:01:03	1GXH362	'82 NISSAN STANZA	4	E-W	3002	1.30	0.138
05/23/91	13:01:07	1GXH362	'82 NISSAN STANZA	4	E-W	3004	0.44	0.168
05/23/91	13:02:16	1GXH362	'82 NISSAN STANZA	5	E-W	3005	1.42	0.052
05/23/91	13:02:24	1GXH362	'82 NISSAN STANZA	5	E-W	3002	0.78	0.050
05/23/91	13:02:27	1GXH362	'82 NISSAN STANZA	5	E-W	3004	0.83	0.358
05/23/91	13:03:17	1GXH362	'82 NISSAN STANZA	6	E-W	3005	0.11	0.024
05/23/91	13:03:29	1GXH362	'82 NISSAN STANZA	6	E-W	3002	0.19	0.026
05/23/91	13:03:33	1GXH362	'82 NISSAN STANZA	6	E-W	3004	0.06	0.060
05/23/91	13:04:37	1GXH362	'82 NISSAN STANZA	7	E-W	3005	1.23	0.076
05/23/91	13:04:47	1GXH362	'82 NISSAN STANZA	7	E-W	3002	1.47	0.054
05/23/91	13:04:51	1GXH362	'82 NISSAN STANZA	7	E-W	3004	2.11	0.080
05/23/91	13:05:48	1GXH362	'82 NISSAN STANZA	8	E-W	3005	4.13	0.116
05/23/91	13:05:57	1GXH362	'82 NISSAN STANZA	8	E-W	3002	7.55	0.114
05/23/91	13:06:00	1GXH362	'82 NISSAN STANZA	8	E-W	3004	9.44	0.158
05/23/91	13:07:26	1GXH362	'82 NISSAN STANZA	9	E-W	3005	1.31	0.078
05/23/91	13:07:35	1GXH362	'82 NISSAN STANZA	9	E-W	3002	2.94	0.212
05/23/91	13:07:40	1GXH362	'82 NISSAN STANZA	9	E-W	3004	0.00	-0.002
05/23/91	13:08:51	1GXH362	'82 NISSAN STANZA	10	E-W	3005	2.20	-0.028
05/23/91	13:09:00	1GXH362	'82 NISSAN STANZA	10	E-W	3002	3.36	0.184
05/23/91	13:09:05	1GXH362	'82 NISSAN STANZA	10	E-W	3004	3.82	0.306
05/23/91	13:27:06	1PXT969	'85 DODGE COLT	1	W-E	3005	0.82	-0.002
05/23/91	13:26:56	1PXT969	'85 DODGE COLT	1	W-E	3002	1.12	0.156
05/23/91	13:26:40	1PXT969	'85 DODGE COLT	1	W-E	3004	0.00	-0.002
05/23/91	13:28:30	1PXT969	'85 DODGE COLT	2	W-E	3005	0.44	0.102
05/23/91	13:28:25	1PXT969	'85 DODGE COLT	2	W-E	3002	0.08	0.062
05/23/91	13:28:13	1PXT969	'85 DODGE COLT	2	W-E	3004	0.19	-0.012
05/23/91	13:29:35	1PXT969	'85 DODGE COLT	3	W-E	3005	0.27	-0.008
05/23/91	13:29:37	1PXT969	'85 DODGE COLT	3	W-E	3002	0.24	0.036
05/23/91	13:29:33	1PXT969	'85 DODGE COLT	3	W-E	3004	0.52	0.206
05/23/91	13:30:53	1PXT969	'85 DODGE COLT	4	W-E	3005	0.20	0.220
05/23/91	13:30:57	1PXT969	'85 DODGE COLT	4	W-E	3002	-0.05	0.006
05/23/91	13:30:56	1PXT969	'85 DODGE COLT	4	W-E	3004	0.36	0.364
05/23/91	13:32:18	1PXT969	'85 DODGE COLT	5	W-E	3005	0.08	-0.002
05/23/91	13:32:23	1PXT969	'85 DODGE COLT	5	W-E	3002	0.00	0.020
05/23/91	13:32:22	1PXT969	'85 DODGE COLT	5	W-E	3004	0.30	0.164
05/23/91	13:33:20	1PXT969	'85 DODGE COLT	6	W-E	3005	0.29	0.120
05/23/91	13:33:23	1PXT969	'85 DODGE COLT	6	W-E	3002	0.01	0.070
05/23/91	13:33:20	1PXT969	'85 DODGE COLT	6	W-E	3004	0.15	0.076
05/23/91	13:34:16	1PXT969	'85 DODGE COLT	7	W-E	3005	-0.04	-0.002
05/23/91	13:34:20	1PXT969	'85 DODGE COLT	7	W-E	3002	0.52	0.054
05/23/91	13:34:18	1PXT969	'85 DODGE COLT	7	W-E	3004	1.86	0.184
05/23/91	13:35:20	1PXT969	'85 DODGE COLT	8	W-E	3005	3.05	0.114
05/23/91	13:35:24	1PXT969	'85 DODGE COLT	8	W-E	3002	3.04	0.104

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/23/91	13:35:22	1PXT969	’85 DODGE COLT	8	W-E	3004	2.39	0.018
05/23/91	13:36:48	1PXT969	’85 DODGE COLT	9	W-E	3005	0.00	-0.002
05/23/91	13:36:52	1PXT969	’85 DODGE COLT	9	W-E	3002	0.00	-0.002
05/23/91	13:36:51	1PXT969	’85 DODGE COLT	9	W-E	3004	0.00	-0.002
05/23/91	13:38:02	1PXT969	’85 DODGE COLT	10	W-E	3005	0.00	-0.002
05/23/91	13:38:06	1PXT969	’85 DODGE COLT	10	W-E	3002	-0.05	-0.134
05/23/91	13:38:05	1PXT969	’85 DODGE COLT	10	W-E	3004	0.00	-0.002
05/23/91	13:38:37	1PXT969	’85 DODGE COLT	1	E-W	3005	1.86	0.208
05/23/91	13:38:59	1PXT969	’85 DODGE COLT	1	E-W	3002	1.27	0.146
05/23/91	13:39:16	1PXT969	’85 DODGE COLT	1	E-W	3004	0.96	0.068
05/23/91	13:40:06	1PXT969	’85 DODGE COLT	2	E-W	3005	0.10	0.096
05/23/91	13:40:24	1PXT969	’85 DODGE COLT	2	E-W	3002	0.44	0.070
05/23/91	13:40:37	1PXT969	’85 DODGE COLT	2	E-W	3004	0.13	0.048
05/23/91	13:41:31	1PXT969	’85 DODGE COLT	3	E-W	3005	1.58	0.050
05/23/91	13:41:43	1PXT969	’85 DODGE COLT	3	E-W	3002	0.57	0.102
05/23/91	13:41:49	1PXT969	’85 DODGE COLT	3	E-W	3004	0.23	0.052
05/23/91	13:42:36	1PXT969	’85 DODGE COLT	4	E-W	3005	0.31	-0.002
05/23/91	13:42:44	1PXT969	’85 DODGE COLT	4	E-W	3002	-0.05	-0.046
05/23/91	13:42:48	1PXT969	’85 DODGE COLT	4	E-W	3004	0.00	-0.002
05/23/91	13:43:42	1PXT969	’85 DODGE COLT	5	E-W	3005	1.79	-0.002
05/23/91	13:43:50	1PXT969	’85 DODGE COLT	5	E-W	3002	0.17	0.332
05/23/91	13:43:53	1PXT969	’85 DODGE COLT	5	E-W	3004	0.06	0.002
05/23/91	13:44:45	1PXT969	’85 DODGE COLT	6	E-W	3005	0.02	-0.002
05/23/91	13:44:56	1PXT969	’85 DODGE COLT	6	E-W	3002	0.02	0.074
05/23/91	13:45:00	1PXT969	’85 DODGE COLT	6	E-W	3004	0.12	0.138
05/23/91	13:45:32	1PXT969	’85 DODGE COLT	7	E-W	3005	0.34	0.084
05/23/91	13:45:42	1PXT969	’85 DODGE COLT	7	E-W	3002	1.07	0.066
05/23/91	13:45:45	1PXT969	’85 DODGE COLT	7	E-W	3004	4.51	0.164
05/23/91	13:46:16	1PXT969	’85 DODGE COLT	8	E-W	3005	5.88	0.150
05/23/91	13:46:25	1PXT969	’85 DODGE COLT	8	E-W	3002	2.99	0.060
05/23/91	13:46:29	1PXT969	’85 DODGE COLT	8	E-W	3004	3.06	0.114
05/23/91	13:47:34	1PXT969	’85 DODGE COLT	9	E-W	3005	0.00	-0.002
05/23/91	13:47:42	1PXT969	’85 DODGE COLT	9	E-W	3002	0.23	0.134
05/23/91	13:47:46	1PXT969	’85 DODGE COLT	9	E-W	3004	0.19	0.158
05/23/91	13:48:35	1PXT969	’85 DODGE COLT	10	E-W	3005	0.00	-0.002
05/23/91	13:48:44	1PXT969	’85 DODGE COLT	10	E-W	3002	0.40	0.096
05/23/91	13:48:48	1PXT969	’85 DODGE COLT	10	E-W	3004	0.00	-0.002
05/23/91	15:07:47	1CTH703	’81 HONDA CIVIC	1	W-E	3005	0.33	0.130
05/23/91	15:07:46	1CTH703	’81 HONDA CIVIC	1	W-E	3002	0.59	0.094
05/23/91	15:07:38	1CTH703	’81 HONDA CIVIC	1	W-E	3004	0.46	0.118
05/23/91	15:09:38	1CTH703	’81 HONDA CIVIC	2	W-E	3005	0.09	0.032
05/23/91	15:09:37	1CTH703	’81 HONDA CIVIC	2	W-E	3002	0.01	0.023
05/23/91	15:09:30	1CTH703	’81 HONDA CIVIC	2	W-E	3004	0.09	0.164
05/23/91	15:11:02	1CTH703	’81 HONDA CIVIC	3	W-E	3005	0.03	-0.002
05/23/91	15:11:04	1CTH703	’81 HONDA CIVIC	3	W-E	3002	0.11	0.038
05/23/91	15:11:01	1CTH703	’81 HONDA CIVIC	3	W-E	3004	0.17	0.176
05/23/91	15:12:32	1CTH703	’81 HONDA CIVIC	4	W-E	3005	0.03	0.058
05/23/91	15:12:37	1CTH703	’81 HONDA CIVIC	4	W-E	3002	0.00	0.042
05/23/91	15:12:35	1CTH703	’81 HONDA CIVIC	4	W-E	3004	0.05	0.058
05/23/91	15:13:57	1CTH703	’81 HONDA CIVIC	5	W-E	3005	-0.01	-0.002
05/23/91	15:14:03	1CTH703	’81 HONDA CIVIC	5	W-E	3002	-0.01	0.026
05/23/91	15:14:02	1CTH703	’81 HONDA CIVIC	5	W-E	3004	0.13	0.140
05/23/91		1CTH703	’81 HONDA CIVIC	6	W-E	3005	0.02	0.066
05/23/91	15:15:07	1CTH703	’81 HONDA CIVIC	6	W-E	3002	-0.02	0.024
05/23/91	15:15:03	1CTH703	’81 HONDA CIVIC	6	W-E	3004	0.04	0.082
05/23/91	15:16:15	1CTH703	’81 HONDA CIVIC	7	W-E	3005	0.04	-0.002
05/23/91	15:16:19	1CTH703	’81 HONDA CIVIC	7	W-E	3002	0.01	0.044
05/23/91	15:16:16	1CTH703	’81 HONDA CIVIC	7	W-E	3004	0.01	-0.088
05/23/91	15:17:36	1CTH703	’81 HONDA CIVIC	8	W-E	3005	1.97	-0.002
05/23/91	15:17:41	1CTH703	’81 HONDA CIVIC	8	W-E	3002	1.65	0.076

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/23/91	15:17:39	1CTH703	’81 HONDA CIVIC	8	W-E	3004	0.05	0.066
05/23/91	15:19:00	1CTH703	’81 HONDA CIVIC	9	W-E	3005	0.10	-0.002
05/23/91	15:19:04	1CTH703	’81 HONDA CIVIC	9	W-E	3002	0.19	0.032
05/23/91	15:19:03	1CTH703	’81 HONDA CIVIC	9	W-E	3004	0.00	-0.002
05/23/91	15:20:18	1CTH703	’81 HONDA CIVIC	10	W-E	3005	0.08	0.240
05/23/91	15:20:22	1CTH703	’81 HONDA CIVIC	10	W-E	3002	0.05	0.196
05/23/91	15:20:20	1CTH703	’81 HONDA CIVIC	10	W-E	3004	0.00	-0.002
05/23/91	15:08:30	1GXM762	’75 DODGE DART	1	W-E	3005	5.24	0.184
05/23/91	15:08:26	1GXM762	’75 DODGE DART	1	W-E	3002	6.46	0.208
05/23/91	15:08:16	1GXM762	’75 DODGE DART	1	W-E	3004	5.88	0.136
05/23/91	15:10:15	1GXM762	’75 DODGE DART	2	W-E	3005	4.11	0.120
05/23/91	15:10:13	1GXM762	’75 DODGE DART	2	W-E	3002	3.54	0.066
05/23/91	15:10:06	1GXM762	’75 DODGE DART	2	W-E	3004	3.14	0.046
05/23/91	15:11:23	1GXM762	’75 DODGE DART	3	W-E	3005	1.59	0.162
05/23/91	15:11:26	1GXM762	’75 DODGE DART	3	W-E	3002	1.58	0.082
05/23/91	15:11:23	1GXM762	’75 DODGE DART	3	W-E	3004	1.95	0.044
05/23/91	15:12:58	1GXM762	’75 DODGE DART	4	W-E	3005	1.39	-0.056
05/23/91	15:13:03	1GXM762	’75 DODGE DART	4	W-E	3002	1.40	0.066
05/23/91	15:13:02	1GXM762	’75 DODGE DART	4	W-E	3004	1.20	0.016
05/23/91	15:14:22	1GXM762	’75 DODGE DART	5	W-E	3005	1.13	0.184
05/23/91	15:14:28	1GXM762	’75 DODGE DART	5	W-E	3002	1.21	0.114
05/23/91	15:14:27	1GXM762	’75 DODGE DART	5	W-E	3004	1.34	0.024
05/23/91		1GXM762	’75 DODGE DART	6	W-E	3005	1.58	0.108
05/23/91	15:15:28	1GXM762	’75 DODGE DART	6	W-E	3002	1.90	0.056
05/23/91	15:15:25	1GXM762	’75 DODGE DART	6	W-E	3004	2.81	0.076
05/23/91	15:16:36	1GXM762	’75 DODGE DART	7	W-E	3005	1.59	0.118
05/23/91	15:16:41	1GXM762	’75 DODGE DART	7	W-E	3002	1.75	0.030
05/23/91	15:16:38	1GXM762	’75 DODGE DART	7	W-E	3004	0.00	-0.002
05/23/91	15:17:57	1GXM762	’75 DODGE DART	8	W-E	3005	11.41	0.416
05/23/91	15:18:02	1GXM762	’75 DODGE DART	8	W-E	3002	12.09	0.328
05/23/91	15:18:01	1GXM762	’75 DODGE DART	8	W-E	3004	11.99	0.182
05/23/91	15:19:29	1GXM762	’75 DODGE DART	9	W-E	3005	3.40	-0.002
05/23/91	15:19:34	1GXM762	’75 DODGE DART	9	W-E	3002	3.15	0.028
05/23/91	15:19:33	1GXM762	’75 DODGE DART	9	W-E	3004	1.24	0.204
05/23/91	15:20:57	1GXM762	’75 DODGE DART	10	W-E	3005	3.07	0.156
05/23/91	15:21:01	1GXM762	’75 DODGE DART	10	W-E	3002	2.68	0.132
05/23/91	15:21:00	1GXM762	’75 DODGE DART	10	W-E	3004	0.92	-0.026
05/23/91	15:21:56	1CTH703	’81 HONDA CIVIC	1	E-W	3005	0.02	0.024
05/23/91	15:22:13	1CTH703	’81 HONDA CIVIC	1	E-W	3002	0.04	0.120
05/23/91	15:22:26	1CTH703	’81 HONDA CIVIC	1	E-W	3004	0.07	0.130
05/23/91	15:23:30	1CTH703	’81 HONDA CIVIC	2	E-W	3005	0.02	0.042
05/23/91	15:23:43	1CTH703	’81 HONDA CIVIC	2	E-W	3002	0.02	0.008
05/23/91	15:23:50	1CTH703	’81 HONDA CIVIC	2	E-W	3004	0.01	-0.014
05/23/91	15:24:54	1CTH703	’81 HONDA CIVIC	3	E-W	3005	0.01	-0.008
05/23/91	15:25:05	1CTH703	’81 HONDA CIVIC	3	E-W	3002	0.02	0.026
05/23/91	15:25:10	1CTH703	’81 HONDA CIVIC	3	E-W	3004	0.04	-0.010
05/23/91	15:26:17	1CTH703	’81 HONDA CIVIC	4	E-W	3005	0.08	0.060
05/23/91	15:26:26	1CTH703	’81 HONDA CIVIC	4	E-W	3002	0.04	0.088
05/23/91	15:26:30	1CTH703	’81 HONDA CIVIC	4	E-W	3004	0.15	0.230
05/23/91	15:27:36	1CTH703	’81 HONDA CIVIC	5	E-W	3005	0.00	-0.002
05/23/91	15:27:44	1CTH703	’81 HONDA CIVIC	5	E-W	3002	0.20	0.038
05/23/91	15:27:47	1CTH703	’81 HONDA CIVIC	5	E-W	3004	0.13	0.140
05/23/91	15:28:41	1CTH703	’81 HONDA CIVIC	6	E-W	3005	0.02	0.078
05/23/91	15:28:52	1CTH703	’81 HONDA CIVIC	6	E-W	3002	0.01	0.022
05/23/91	15:28:58	1CTH703	’81 HONDA CIVIC	6	E-W	3004	0.04	0.020
05/23/91	15:29:47	1CTH703	’81 HONDA CIVIC	7	E-W	3005	0.03	0.038
05/23/91	15:29:57	1CTH703	’81 HONDA CIVIC	7	E-W	3002	0.01	0.028
05/23/91	15:30:01	1CTH703	’81 HONDA CIVIC	7	E-W	3004	0.04	0.030
05/23/91	15:30:51	1CTH703	’81 HONDA CIVIC	8	E-W	3005	0.03	0.060
05/23/91	15:31:01	1CTH703	’81 HONDA CIVIC	8	E-W	3002	2.03	0.070

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/23/91	15:31:05	1CTH703	’81 HONDA CIVIC	8	E-W	3004	1.45	0.072
05/23/91	15:32:13	1CTH703	’81 HONDA CIVIC	9	E-W	3005	-0.01	-0.002
05/23/91	15:32:23	1CTH703	’81 HONDA CIVIC	9	E-W	3002	0.92	0.388
05/23/91	15:32:27	1CTH703	’81 HONDA CIVIC	9	E-W	3004	0.00	-0.002
05/23/91	15:33:29	1CTH703	’81 HONDA CIVIC	10	E-W	3005	0.06	-0.002
05/23/91	15:33:38	1CTH703	’81 HONDA CIVIC	10	E-W	3002	0.75	0.238
05/23/91	15:33:43	1CTH703	’81 HONDA CIVIC	10	E-W	3004	0.43	0.210
05/23/91	15:22:32	1GXM762	’75 DODGE DART	1	E-W	3005	5.75	0.008
05/23/91	15:22:48	1GXM762	’75 DODGE DART	1	E-W	3002	4.95	0.082
05/23/91	15:22:59	1GXM762	’75 DODGE DART	1	E-W	3004	4.13	0.094
05/23/91	15:23:55	1GXM762	’75 DODGE DART	2	E-W	3005	3.89	0.184
05/23/91	15:24:11	1GXM762	’75 DODGE DART	2	E-W	3002	3.65	0.048
05/23/91	15:24:21	1GXM762	’75 DODGE DART	2	E-W	3004	3.17	0.098
05/23/91	15:25:18	1GXM762	’75 DODGE DART	3	E-W	3005	1.86	-0.002
05/23/91	15:25:29	1GXM762	’75 DODGE DART	3	E-W	3002	2.04	0.100
05/23/91	15:25:35	1GXM762	’75 DODGE DART	3	E-W	3004	3.04	0.078
05/23/91	15:26:41	1GXM762	’75 DODGE DART	4	E-W	3005	1.45	0.016
05/23/91	15:26:50	1GXM762	’75 DODGE DART	4	E-W	3002	1.04	0.010
05/23/91	15:26:54	1GXM762	’75 DODGE DART	4	E-W	3004	1.09	-0.002
05/23/91	15:27:56	1GXM762	’75 DODGE DART	5	E-W	3005	2.85	0.114
05/23/91	15:28:04	1GXM762	’75 DODGE DART	5	E-W	3002	2.49	0.142
05/23/91	15:28:07	1GXM762	’75 DODGE DART	5	E-W	3004	2.14	0.160
05/23/91	15:29:05	1GXM762	’75 DODGE DART	6	E-W	3005	3.38	0.454
05/23/91	15:29:16	1GXM762	’75 DODGE DART	6	E-W	3002	1.87	0.044
05/23/91	15:29:21	1GXM762	’75 DODGE DART	6	E-W	3004	1.33	-0.078
05/23/91	15:30:05	1GXM762	’75 DODGE DART	7	E-W	3005	2.76	0.208
05/23/91	15:30:15	1GXM762	’75 DODGE DART	7	E-W	3002	1.84	0.084
05/23/91	15:30:19	1GXM762	’75 DODGE DART	7	E-W	3004	1.23	0.044
05/23/91	15:31:10	1GXM762	’75 DODGE DART	8	E-W	3005	11.51	0.426
05/23/91	15:31:20	1GXM762	’75 DODGE DART	8	E-W	3002	12.41	0.338
05/23/91	15:31:23	1GXM762	’75 DODGE DART	8	E-W	3004	10.92	0.292
05/23/91	15:32:35	1GXM762	’75 DODGE DART	9	E-W	3005	1.94	-0.002
05/23/91	15:32:45	1GXM762	’75 DODGE DART	9	E-W	3002	3.41	0.112
05/23/91	15:32:48	1GXM762	’75 DODGE DART	9	E-W	3004	3.83	0.150
05/23/91	15:33:51	1GXM762	’75 DODGE DART	10	E-W	3005	1.53	0.050
05/23/91	15:34:00	1GXM762	’75 DODGE DART	10	E-W	3002	3.11	0.156
05/23/91	15:34:03	1GXM762	’75 DODGE DART	10	E-W	3004	2.65	-0.002
05/23/91	15:43:02	2CPU143	’79 PONTIAC CATALINA	1	W-E	3005	0.08	0.068
05/23/91	15:43:01	2CPU143	’79 PONTIAC CATALINA	1	W-E	3002	0.06	0.224
05/23/91	15:42:51	2CPU143	’79 PONTIAC CATALINA	1	W-E	3004	0.08	0.204
05/23/91	15:45:20	2CPU143	’79 PONTIAC CATALINA	2	W-E	3005	0.05	0.054
05/23/91	15:45:20	2CPU143	’79 PONTIAC CATALINA	2	W-E	3002	0.10	0.226
05/23/91	15:45:14	2CPU143	’79 PONTIAC CATALINA	2	W-E	3004	0.04	0.156
05/23/91	15:47:29	2CPU143	’79 PONTIAC CATALINA	3	W-E	3005	0.04	0.042
05/23/91	15:47:31	2CPU143	’79 PONTIAC CATALINA	3	W-E	3002	0.06	0.062
05/23/91	15:47:28	2CPU143	’79 PONTIAC CATALINA	3	W-E	3004	0.08	0.156
05/23/91	15:49:44	2CPU143	’79 PONTIAC CATALINA	4	W-E	3005	0.09	-0.032
05/23/91	15:49:49	2CPU143	’79 PONTIAC CATALINA	4	W-E	3002	0.07	0.074
05/23/91	15:49:49	2CPU143	’79 PONTIAC CATALINA	4	W-E	3004	0.12	0.080
05/23/91	15:52:00	2CPU143	’79 PONTIAC CATALINA	5	W-E	3005	0.40	-0.002
05/23/91	15:52:06	2CPU143	’79 PONTIAC CATALINA	5	W-E	3002	0.30	0.176
05/23/91	15:52:05	2CPU143	’79 PONTIAC CATALINA	5	W-E	3004	2.32	0.088
05/23/91	15:54:03	2CPU143	’79 PONTIAC CATALINA	6	W-E	3005	0.09	0.038
05/23/91	15:54:08	2CPU143	’79 PONTIAC CATALINA	6	W-E	3002	0.09	0.060
05/23/91	15:54:05	2CPU143	’79 PONTIAC CATALINA	6	W-E	3004	0.23	0.036
05/23/91	15:55:54	2CPU143	’79 PONTIAC CATALINA	7	W-E	3005	0.89	0.050
05/23/91	15:55:59	2CPU143	’79 PONTIAC CATALINA	7	W-E	3002	1.31	0.034
05/23/91	15:55:57	2CPU143	’79 PONTIAC CATALINA	7	W-E	3004	0.01	0.078
05/23/91	15:57:33	2CPU143	’79 PONTIAC CATALINA	8	W-E	3005	11.51	0.156
05/23/91	15:57:39	2CPU143	’79 PONTIAC CATALINA	8	W-E	3002	10.02	0.066

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/23/91	15:57:37	2CPU143	'79 PONTIAC CATALINA	8	W-E	3004	11.68	0.122
05/23/91	15:59:29	2CPU143	'79 PONTIAC CATALINA	9	W-E	3005	0.17	0.128
05/23/91	15:59:34	2CPU143	'79 PONTIAC CATALINA	9	W-E	3002	0.11	0.092
05/23/91	15:59:33	2CPU143	'79 PONTIAC CATALINA	9	W-E	3004	0.24	0.166
05/23/91	16:01:41	2CPU143	'79 PONTIAC CATALINA	10	W-E	3005	0.11	-0.002
05/23/91	16:01:46	2CPU143	'79 PONTIAC CATALINA	10	W-E	3002	0.23	0.012
05/23/91	16:01:46	2CPU143	'79 PONTIAC CATALINA	10	W-E	3004	0.46	0.150
05/23/91	15:44:28	BSYSGNL	'68 CHEVROLET IMPALA	1	W-E	3005	0.13	-0.002
05/23/91	15:44:22	BSYSGNL	'68 CHEVROLET IMPALA	1	W-E	3002	0.21	0.618
05/23/91	15:44:11	BSYSGNL	'68 CHEVROLET IMPALA	1	W-E	3004	0.14	0.668
05/23/91	15:46:46	BSYSGNL	'68 CHEVROLET IMPALA	2	W-E	3005	0.22	0.438
05/23/91	15:46:46	BSYSGNL	'68 CHEVROLET IMPALA	2	W-E	3002	0.15	0.846
05/23/91	15:46:40	BSYSGNL	'68 CHEVROLET IMPALA	2	W-E	3004	0.25	0.738
05/23/91	15:49:03	BSYSGNL	'68 CHEVROLET IMPALA	3	W-E	3005	0.34	0.444
05/23/91	15:49:05	BSYSGNL	'68 CHEVROLET IMPALA	3	W-E	3002	0.25	0.504
05/23/91	15:49:01	BSYSGNL	'68 CHEVROLET IMPALA	3	W-E	3004	0.36	0.786
05/23/91	15:51:10	BSYSGNL	'68 CHEVROLET IMPALA	4	W-E	3005	0.13	0.770
05/23/91	15:51:14	BSYSGNL	'68 CHEVROLET IMPALA	4	W-E	3002	0.10	0.926
05/23/91	15:51:12	BSYSGNL	'68 CHEVROLET IMPALA	4	W-E	3004	0.10	1.192
05/23/91	15:53:17	BSYSGNL	'68 CHEVROLET IMPALA	5	W-E	3005	0.20	-0.002
05/23/91	15:53:23	BSYSGNL	'68 CHEVROLET IMPALA	5	W-E	3002	0.12	0.730
05/23/91	15:53:22	BSYSGNL	'68 CHEVROLET IMPALA	5	W-E	3004	0.15	-0.002
05/23/91	15:55:06	BSYSGNL	'68 CHEVROLET IMPALA	6	W-E	3005	0.14	0.208
05/23/91	15:55:09	BSYSGNL	'68 CHEVROLET IMPALA	6	W-E	3002	0.06	0.288
05/23/91	15:55:05	BSYSGNL	'68 CHEVROLET IMPALA	6	W-E	3004	0.10	1.038
05/23/91	15:56:52	BSYSGNL	'68 CHEVROLET IMPALA	7	W-E	3005	0.32	0.208
05/23/91	15:56:56	BSYSGNL	'68 CHEVROLET IMPALA	7	W-E	3002	0.28	0.112
05/23/91	15:56:54	BSYSGNL	'68 CHEVROLET IMPALA	7	W-E	3004	0.24	0.212
05/23/91	15:58:20	BSYSGNL	'68 CHEVROLET IMPALA	8	W-E	3005	0.00	0.000
05/23/91	15:58:25	BSYSGNL	'68 CHEVROLET IMPALA	8	W-E	3002	2.28	0.270
05/23/91	15:58:24	BSYSGNL	'68 CHEVROLET IMPALA	8	W-E	3004	2.34	0.126
05/23/91	16:00:49	BSYSGNL	'68 CHEVROLET IMPALA	9	W-E	3005	0.14	0.590
05/23/91	16:00:53	BSYSGNL	'68 CHEVROLET IMPALA	9	W-E	3002	0.12	0.658
05/23/91	16:00:51	BSYSGNL	'68 CHEVROLET IMPALA	9	W-E	3004	0.52	0.874
05/23/91	16:03:18	BSYSGNL	'68 CHEVROLET IMPALA	10	W-E	3005	0.21	-0.002
05/23/91	16:03:21	BSYSGNL	'68 CHEVROLET IMPALA	10	W-E	3002	0.26	1.452
05/23/91	16:03:19	BSYSGNL	'68 CHEVROLET IMPALA	10	W-E	3004	0.30	0.488
05/23/91	16:08:46	2CPU143	'79 PONTIAC CATALINA	1	E-W	3005	0.02	-0.002
05/23/91	16:09:01	2CPU143	'79 PONTIAC CATALINA	1	E-W	3002	0.08	0.098
05/23/91	16:09:09	2CPU143	'79 PONTIAC CATALINA	1	E-W	3004	0.08	0.204
05/23/91	16:10:39	2CPU143	'79 PONTIAC CATALINA	2	E-W	3005	0.06	0.034
05/23/91	16:10:53	2CPU143	'79 PONTIAC CATALINA	2	E-W	3002	0.10	0.182
05/23/91	16:11:01	2CPU143	'79 PONTIAC CATALINA	2	E-W	3004	0.07	0.080
05/23/91	16:12:31	2CPU143	'79 PONTIAC CATALINA	3	E-W	3005	0.12	-0.002
05/23/91	16:12:42	2CPU143	'79 PONTIAC CATALINA	3	E-W	3002	0.06	0.054
05/23/91	16:12:47	2CPU143	'79 PONTIAC CATALINA	3	E-W	3004	0.16	0.108
05/23/91	16:14:09	2CPU143	'79 PONTIAC CATALINA	4	E-W	3005	0.82	-0.002
05/23/91	16:14:18	2CPU143	'79 PONTIAC CATALINA	4	E-W	3002	0.43	0.050
05/23/91	16:14:21	2CPU143	'79 PONTIAC CATALINA	4	E-W	3004	0.31	0.124
05/23/91	16:15:57	2CPU143	'79 PONTIAC CATALINA	5	E-W	3005	1.52	0.538
05/23/91	16:16:05	2CPU143	'79 PONTIAC CATALINA	5	E-W	3002	0.67	0.070
05/23/91	16:16:08	2CPU143	'79 PONTIAC CATALINA	5	E-W	3004	0.55	0.086
05/23/91	16:18:10	2CPU143	'79 PONTIAC CATALINA	8	E-W	3005	11.46	0.174
05/23/91	16:18:19	2CPU143	'79 PONTIAC CATALINA	8	E-W	3002	10.51	0.084
05/23/91	16:18:23	2CPU143	'79 PONTIAC CATALINA	8	E-W	3004	11.81	0.122
05/23/91	16:19:29	2CPU143	'79 PONTIAC CATALINA	9	E-W	3005	1.44	-0.002
05/23/91	16:19:38	2CPU143	'79 PONTIAC CATALINA	9	E-W	3002	1.08	0.196
05/23/91	16:19:42	2CPU143	'79 PONTIAC CATALINA	9	E-W	3004	1.06	-0.002
05/23/91	16:09:49	BSYSGNL	'68 CHEVROLET IMPALA	1	E-W	3005	-0.20	0.578
05/23/91	16:10:08	BSYSGNL	'68 CHEVROLET IMPALA	1	E-W	3002	0.03	0.958

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/23/91	16:10:22	BSYSGNL	’68 CHEVROLET IMPALA	1	E-W	3004	0.05	0.764
05/23/91	16:11:39	BSYSGNL	’68 CHEVROLET IMPALA	2	E-W	3005	0.00	-0.002
05/23/91	16:11:55	BSYSGNL	’68 CHEVROLET IMPALA	2	E-W	3002	0.27	0.796
05/23/91	16:12:03	BSYSGNL	’68 CHEVROLET IMPALA	2	E-W	3004	0.49	1.398
05/23/91	16:13:23	BSYSGNL	’68 CHEVROLET IMPALA	3	E-W	3005	0.16	0.802
05/23/91	16:13:34	BSYSGNL	’68 CHEVROLET IMPALA	3	E-W	3002	0.19	0.752
05/23/91	16:13:40	BSYSGNL	’68 CHEVROLET IMPALA	3	E-W	3004	0.31	1.048
05/23/91	16:15:11	BSYSGNL	’68 CHEVROLET IMPALA	4	E-W	3005	0.06	0.646
05/23/91	16:15:21	BSYSGNL	’68 CHEVROLET IMPALA	4	E-W	3002	0.12	1.464
05/23/91	16:15:25	BSYSGNL	’68 CHEVROLET IMPALA	4	E-W	3004	0.13	1.136
05/23/91	16:17:12	BSYSGNL	’68 CHEVROLET IMPALA	5	E-W	3005	0.31	0.618
05/23/91	16:17:21	BSYSGNL	’68 CHEVROLET IMPALA	5	E-W	3002	0.15	1.090
05/23/91	16:17:24	BSYSGNL	’68 CHEVROLET IMPALA	5	E-W	3004	0.14	-0.002
05/23/91	16:23:29	E383185	’83 FORD ESCORT M-40	1	W-E	3005	6.59	0.212
05/23/91	16:23:28	E383185	’83 FORD ESCORT M-40	1	W-E	3002	7.11	0.258
05/23/91	16:23:20	E383185	’83 FORD ESCORT M-40	1	W-E	3004	0.00	-0.002
05/23/91	16:25:38	E383185	’83 FORD ESCORT M-40	2	W-E	3005	6.87	0.388
05/23/91	16:25:37	E383185	’83 FORD ESCORT M-40	2	W-E	3002	6.71	0.248
05/23/91	16:25:30	E383185	’83 FORD ESCORT M-40	2	W-E	3004	7.22	0.430
05/23/91	16:27:47	E383185	’83 FORD ESCORT M-40	3	W-E	3005	2.25	0.256
05/23/91	16:27:49	E383185	’83 FORD ESCORT M-40	3	W-E	3002	1.83	0.202
05/23/91	16:27:46	E383185	’83 FORD ESCORT M-40	3	W-E	3004	2.56	0.172
05/23/91	16:29:47	E383185	’83 FORD ESCORT M-40	4	W-E	3005	1.88	-0.002
05/23/91	16:29:52	E383185	’83 FORD ESCORT M-40	4	W-E	3002	1.65	0.272
05/23/91	16:29:51	E383185	’83 FORD ESCORT M-40	4	W-E	3004	1.57	0.474
05/23/91	16:31:53	E383185	’83 FORD ESCORT M-40	5	W-E	3005	0.52	-0.002
05/23/91	16:31:59	E383185	’83 FORD ESCORT M-40	5	W-E	3002	0.57	0.234
05/23/91	16:31:59	E383185	’83 FORD ESCORT M-40	5	W-E	3004	0.00	-0.002
05/23/91	16:33:40	E383185	’83 FORD ESCORT M-40	6	W-E	3005	0.58	0.338
05/23/91	16:33:44	E383185	’83 FORD ESCORT M-40	6	W-E	3002	0.07	0.080
05/23/91	16:33:41	E383185	’83 FORD ESCORT M-40	6	W-E	3004	1.53	0.180
05/23/91	16:35:29	E383185	’83 FORD ESCORT M-40	7	W-E	3005	6.06	0.142
05/23/91	16:35:34	E383185	’83 FORD ESCORT M-40	7	W-E	3002	0.26	0.116
05/23/91	16:35:31	E383185	’83 FORD ESCORT M-40	7	W-E	3004	0.96	0.156
05/23/91	16:37:05	E383185	’83 FORD ESCORT M-40	8	W-E	3005	10.08	0.214
05/23/91	16:37:11	E383185	’83 FORD ESCORT M-40	8	W-E	3002	11.28	0.278
05/23/91	16:37:09	E383185	’83 FORD ESCORT M-40	8	W-E	3004	11.59	0.308
05/23/91	16:39:12	E383185	’83 FORD ESCORT M-40	9	W-E	3005	4.66	-0.002
05/23/91	16:39:17	E383185	’83 FORD ESCORT M-40	9	W-E	3002	3.21	0.424
05/23/91	16:39:16	E383185	’83 FORD ESCORT M-40	9	W-E	3004	1.08	0.422
05/23/91	16:41:36	E383185	’83 FORD ESCORT M-40	10	W-E	3005	4.38	-0.002
05/23/91	16:41:41	E383185	’83 FORD ESCORT M-40	10	W-E	3002	2.00	0.090
05/23/91	16:41:39	E383185	’83 FORD ESCORT M-40	10	W-E	3004	0.00	-0.002
05/23/91	16:24:44	2LQL052	’84 TOYOTA CRESSIDA	1	W-E	3005	0.03	0.036
05/23/91	16:24:37	2LQL052	’84 TOYOTA CRESSIDA	1	W-E	3002	0.06	0.068
05/23/91	16:24:24	2LQL052	’84 TOYOTA CRESSIDA	1	W-E	3004	0.03	0.044
05/23/91	16:26:55	2LQL052	’84 TOYOTA CRESSIDA	2	W-E	3005	0.01	0.044
05/23/91	16:26:54	2LQL052	’84 TOYOTA CRESSIDA	2	W-E	3002	0.05	0.050
05/23/91	16:26:47	2LQL052	’84 TOYOTA CRESSIDA	2	W-E	3004	0.02	0.052
05/23/91	16:28:57	2LQL052	’84 TOYOTA CRESSIDA	3	W-E	3005	0.05	0.042
05/23/91	16:29:01	2LQL052	’84 TOYOTA CRESSIDA	3	W-E	3002	0.08	0.112
05/23/91	16:28:57	2LQL052	’84 TOYOTA CRESSIDA	3	W-E	3004	0.14	0.164
05/23/91	16:30:58	2LQL052	’84 TOYOTA CRESSIDA	4	W-E	3005	0.05	0.154
05/23/91	16:31:03	2LQL052	’84 TOYOTA CRESSIDA	4	W-E	3002	-0.01	-0.106
05/23/91	16:31:02	2LQL052	’84 TOYOTA CRESSIDA	4	W-E	3004	0.04	0.066
05/23/91	16:32:55	2LQL052	’84 TOYOTA CRESSIDA	5	W-E	3005	0.02	0.004
05/23/91	16:33:01	2LQL052	’84 TOYOTA CRESSIDA	5	W-E	3002	0.03	0.002
05/23/91	16:33:01	2LQL052	’84 TOYOTA CRESSIDA	5	W-E	3004	0.03	0.064
05/23/91	16:34:34	2LQL052	’84 TOYOTA CRESSIDA	6	W-E	3005	0.03	-0.006
05/23/91	16:34:38	2LQL052	’84 TOYOTA CRESSIDA	6	W-E	3002	0.03	0.038

Date	Time	LICENSE	VEHICLE	OPCON	DIR	FEAT	%CO	%HC
05/23/91	16:34:34	2LQL052	’84 TOYOTA CRESSIDA	6	W-E	3004	0.26	0.094
05/23/91	16:36:21	2LQL052	’84 TOYOTA CRESSIDA	7	W-E	3005	-0.02	0.048
05/23/91	16:36:26	2LQL052	’84 TOYOTA CRESSIDA	7	W-E	3002	0.08	0.020
05/23/91	16:36:24	2LQL052	’84 TOYOTA CRESSIDA	7	W-E	3004	0.01	0.032
05/23/91	16:38:07	2LQL052	’84 TOYOTA CRESSIDA	8	W-E	3005	6.63	0.126
05/23/91	16:38:13	2LQL052	’84 TOYOTA CRESSIDA	8	W-E	3002	5.55	0.070
05/23/91	16:38:11	2LQL052	’84 TOYOTA CRESSIDA	8	W-E	3004	4.46	0.134
05/23/91	16:40:33	2LQL052	’84 TOYOTA CRESSIDA	9	W-E	3005	0.06	0.050
05/23/91	16:40:37	2LQL052	’84 TOYOTA CRESSIDA	9	W-E	3002	0.10	0.226
05/23/91	16:40:36	2LQL052	’84 TOYOTA CRESSIDA	9	W-E	3004	0.16	0.146
05/23/91	16:42:41	2LQL052	’84 TOYOTA CRESSIDA	10	W-E	3005	0.10	-0.002
05/23/91	16:42:45	2LQL052	’84 TOYOTA CRESSIDA	10	W-E	3002	0.10	-0.046
05/23/91	16:42:43	2LQL052	’84 TOYOTA CRESSIDA	10	W-E	3004	0.03	-0.002
05/23/91	16:53:26	1S55445	FORD F250 RANGER	1	W-E	3005	3.20	0.376
05/23/91	16:53:24	1S55445	FORD F250 RANGER	1	W-E	3002	2.10	0.216
05/23/91	16:53:14	1S55445	FORD F250 RANGER	1	W-E	3004	0.69	-0.002
05/23/91	16:54:48	1S55445	FORD F250 RANGER	2	W-E	3005	0.04	-0.002
05/23/91	16:54:50	1S55445	FORD F250 RANGER	2	W-E	3002	0.03	-0.020
05/23/91	16:54:45	1S55445	FORD F250 RANGER	2	W-E	3004	0.04	-0.102
05/23/91	16:56:34	1S55445	FORD F250 RANGER	3	W-E	3005	0.01	0.072
05/23/91	16:56:37	1S55445	FORD F250 RANGER	3	W-E	3002	-0.01	0.062
05/23/91	16:56:34	1S55445	FORD F250 RANGER	3	W-E	3004	0.00	0.078
05/23/91	16:58:12	1S55445	FORD F250 RANGER	4	W-E	3005	-0.01	0.006
05/23/91	16:58:17	1S55445	FORD F250 RANGER	4	W-E	3002	-0.03	-0.048
05/23/91	16:58:16	1S55445	FORD F250 RANGER	4	W-E	3004	-0.06	-0.002
05/23/91	17:01:11	1S55445	FORD F250 RANGER	5	W-E	3005	0.13	-0.002
05/23/91	17:01:17	1S55445	FORD F250 RANGER	5	W-E	3002	0.04	0.034
05/23/91	17:01:17	1S55445	FORD F250 RANGER	5	W-E	3004	0.05	0.032
05/23/91	17:03:37	1S55445	FORD F250 RANGER	6	W-E	3005	0.08	0.062
05/23/91	17:03:41	1S55445	FORD F250 RANGER	6	W-E	3002	0.08	0.030
05/23/91	17:03:37	1S55445	FORD F250 RANGER	6	W-E	3004	0.09	0.034
05/23/91	17:05:10	1S55445	FORD F250 RANGER	7	W-E	3005	0.07	0.024
05/23/91	17:05:15	1S55445	FORD F250 RANGER	7	W-E	3002	0.08	-0.008
05/23/91	17:05:13	1S55445	FORD F250 RANGER	7	W-E	3004	0.04	0.024
05/23/91	17:06:36	1S55445	FORD F250 RANGER	8	W-E	3005	0.20	0.032
05/23/91	17:06:41	1S55445	FORD F250 RANGER	8	W-E	3002	1.03	0.052
05/23/91	17:06:40	1S55445	FORD F250 RANGER	8	W-E	3004	0.85	0.042
05/23/91	17:08:31	1S55445	FORD F250 RANGER	9	W-E	3005	0.03	0.064
05/23/91	17:08:35	1S55445	FORD F250 RANGER	9	W-E	3002	0.08	0.072
05/23/91	17:08:33	1S55445	FORD F250 RANGER	9	W-E	3004	0.05	-0.010
05/23/91	17:10:25	1S55445	FORD F250 RANGER	10	W-E	3005	0.06	0.074
05/23/91	17:10:29	1S55445	FORD F250 RANGER	10	W-E	3002	0.07	0.054
05/23/91	17:10:27	1S55445	FORD F250 RANGER	10	W-E	3004	0.00	-0.004

APPENDIX C: Rosemead High Emitter Pullover Data

Vehicles identified by remote sensing and subsequently stopped and inspected by a conventional Smog Check and a limited number of vehicles were tested under load by the proposed IM240 dynamometer procedure.

Smog Check data is presented in percent for CO and ppm hexane for hydrocarbon. Bar90 measurements have upper limits which for CO are limited to a maximum of 9.99% while the hydrocarbon measurements are limited to 2999 ppm. The underhood inspection is divided between the Visual (V) and Functional (F) tests and are scored as T=Tampered, N=Non-Conforming and P=Pass (meets all requirements). Additional Smog Check information includes the results of the Emissions test (E) which is either P=Pass or F=Fail depending on the vehicles emissions requirements and the Overall (O) score on the Smog Check. Any failure in the three requirements of Visual, Functional or Emissions results in an Overall failure.

University of Denver remote sensing data is reported in percent of CO and HC with the hydrocarbon values reported as propane equivalents. The General Motors remote sensor reports hydrocarbon values as percent hexane equivalents. The EPA dynamometer data is reported in grams of pollutant per mile driven for each of the three species.

#	License	Model Year	Make	Date	SMOG CHECK Data: Low Idle %CO	Low Idle HC, ppm	High Idle %CO	High Idle HC, ppm	V/F/E/O	University of Denver Remote Sensing: FEAT 1 %CO	FEAT 1 %HC	FEAT 2 %CO	FEAT 2 %HC	FEAT Idle %CO	FEAT Idle %HC	General Motors: GM RSD %CO	GM RSD %HC	EPA Dynamometer: IM240 HC g/mile	IM240 CO g/mile	IM240 NOx g/mile
1	2VEU840	76	CHRYS	6/3	4.57	125	0.16	7	T/N/F/F	3.41	0.035	2.80	0.125	****	*****	****	*****	4.50	81.50	7.70
2	2HYP573	83	OLDSM	6/3	9.47	651	4.23	198	N/N/F/F	5.50	0.477	1.79	0.000	****	*****	****	*****	****	****	****
3	1HTH195	84	MAZDA	6/3	4.38	221	3.41	93	P/P/F/F	3.94	0.125	5.05	0.279	****	*****	****	*****	****	****	****
4	1KBZ448	82	CHEVR	6/3	6.94	247	8.76	227	T/N/F/F	7.29	0.108	7.51	0.574	****	*****	****	*****	****	****	****
5	679DVI	71	PLYMO	6/3	5.92	285	6.62	197	T/P/F/F	7.26	0.235	4.32	0.152	****	*****	****	*****	****	****	****
6	1FRC940	82	BUICK	6/3	0.00	7	0.00	14	T/N/N/F	7.18	0.112	5.86	0.036	****	*****	****	*****	****	****	****
7	ONEHAIR	74	VOLKS	6/3	4.40	346	2.97	103	N/N/P/F	7.77	0.356	6.53	0.586	****	*****	****	*****	****	****	****
8	IDYT537	77	CHEVR	6/3	9.99	756	0.39	39	P/N/F/F	6.30	0.397	3.25	0.000	****	*****	****	*****	3.80	21.10	1.60
9	1KVR894	73	MERCE	6/3	9.99	491	7.59	182	T/P/F/F	4.51	0.121	2.69	0.158	****	*****	****	*****	****	****	****
10	2VLG862	80	PLYMO	6/3	2.47	434	1.61	290	T/P/F/F	5.09	0.036	3.80	0.311	****	*****	****	*****	4.00	32.20	3.00
11	2TAN659	82	BUICK	6/3	9.65	471	2.21	84	T/T/F/F	4.35	0.244	8.31	0.490	****	*****	****	*****	****	****	****
12	1FGD896	82	MAZDA	6/4	3.09	162	5.05	126	N/N/F/F	4.40	0.096	3.76	0.158	****	*****	****	*****	****	****	****
13	2PNS888	82	NISSA	6/4	0.02	16	0.05	39	P/P/P/P	3.32	0.090	3.31	0.143	****	*****	****	*****	****	****	****
14	621VBM	78	OLDSM	6/4	1.79	418	3.14	119	T/N/F/F	4.01	0.083	2.10	0.192	****	*****	****	*****	****	****	****
15	2NVK763	80	PONTI	6/4	7.26	370	8.10	104	T/T/F/F	5.56	0.092	11.61	0.403	****	*****	****	*****	****	****	****
16	1SDZ081	85	CADIL	6/4	4.72	363	4.88	208	T/N/F/F	5.73	*****	6.78	*****	****	*****	****	*****	****	****	****
17	NONE	84	CHEVR	6/4	0.07	41	0.16	9	P/N/P/F	6.22	0.107	3.46	0.159	****	*****	****	*****	1.70	18.90	2.70
18	2KEM752	75	MERCE	6/4	0.47	47	8.46	238	P/P/P/P	6.06	0.096	4.75	0.174	****	*****	****	*****	****	****	****
19	2WBU803	84	CHEVR	6/4	4.19	126	6.44	89	T/T/F/F	6.32	0.040	6.90	0.134	****	*****	****	*****	****	****	****
20	2LKJ845	79	MERC	6/4	9.99	615	3.33	62	T/T/F/F	5.47	-0.001	3.02	0.179	****	*****	****	*****	****	****	****
21	2GWF467	82	PONTI	6/4	1.68	128	8.22	195	T/T/F/F	8.85	0.262	6.22	0.519	****	*****	****	*****	4.90	88.90	1.30
22	1M32206	74	FORD	6/4	1.98	1091	2.43	1316	T/N/F/F	3.72	0.431	3.62	0.452	****	*****	****	*****	****	****	****
23	2HPN273	86	NISSA	6/4	8.46	391	3.44	174	N/N/F/F	4.37	0.076	4.36	0.041	****	*****	****	*****	****	****	****
24	441KYA	74	CADIL	6/4	1.39	18	0.74	7	T/T/P/F	3.76	0.184	4.37	0.279	****	*****	****	*****	****	****	****
25	2EIJ033	87	NISSA	6/4	6.06	286	9.99	397	P/P/F/F	6.89	0.109	4.56	0.077	****	*****	****	*****	****	****	****
26	2AZS360	84	CHEVR	6/4	2.44	196	9.01	228	P/P/F/F	4.41	0.125	3.37	0.182	****	*****	****	*****	3.50	72.90	0.30
27	2CUE571	86	MAZDA	6/4	2.12	214	2.09	181	P/P/F/F	5.21	0.111	4.66	*****	****	*****	****	*****	****	****	****
28	1PVE513	86	TOYOT	6/5	5.48	299	4.14	193	P/P/F/F	3.32	0.133	4.95	0.173	4.32	0.088	****	*****	****	****	****
29	065DXG	71	CHEVR	6/5	2.67	531	7.79	158	P/P/F/F	5.72	0.122	9.57	0.536	****	*****	****	*****	****	****	****
30	440SZL	77	NISSA	6/5	0.13	42	3.38	76	P/N/P/F	6.16	0.098	7.68	0.194	1.76	0.055	****	*****	****	****	****
31	1GIN592	78	FORD	6/5	8.45	385	0.38	33	N/N/F/F	8.02	0.148	5.11	0.243	6.41	0.087	****	*****	7.10	66.00	5.90
32	2RKF885	88	MERCE	6/5	1.71	829	5.98	862	P/N/F/F	2.82	0.099	5.11	0.600	0.70	0.164	****	*****	****	****	****
33	1F93071	77	TOYOT	6/5	9.99	191	9.99	114	P/P/F/F	4.31	0.121	3.77	0.267	3.24	0.012	****	*****	****	****	****
34	1MJX109	85	NISSA	6/5	9.99	831	9.99	533	P/P/F/F	5.12	0.107	11.59	0.618	****	*****	****	*****	****	****	****
35	912UPW	78	TOYOT	6/5	3.57	202	3.65	91	P/P/F/F	5.51	0.098	5.31	0.264	4.85	0.101	****	*****	****	****	****
36	2ARU344	83	OLDSM	6/5	9.62	704	9.99	1003	T/N/F/F	5.78	0.542	5.34	0.351	9.47	0.250	****	*****	10.40	172.20	0.60
37	3E68555	79	TOYOT	6/5	3.26	125	9.99	178	P/P/F/F	5.55	0.054	8.70	0.256	5.95	*****	7.80	0.051	****	****	****
38	2CAK257	85	MAZDA	6/5	2.32	55	0.38	32	P/P/F/F	3.80	0.124	6.55	0.192	10.17	0.137	****	*****	****	****	****
39	1EVR627	82	CHEVR	6/5	7.05	240	5.05	152	T/P/F/F	6.68	0.109	4.43	0.201	6.06	0.145	****	*****	****	****	****
40	3N32124	79	TOYOT	6/5	4.58	306	9.99	297	P/P/F/F	8.84	0.136	6.57	1.344	3.84	0.086	****	*****	****	****	****
41	618VZU	78	FORD	6/5	9.99	2080	9.99	536	T/N/F/F	6.83	0.103	0.86	1.418	****	*****	****	*****	****	****	****
42	1ASM535	80	TOYOT	6/5	5.43	1047	0.92	63	N/N/F/F	5.30	1.127	6.93	0.489	4.63	0.096	****	*****	****	****	****
43	1NBY291	77	NISSA	6/5	0.88	71	0.22	11	P/N/P/F	5.90	0.107	2.89	0.111	0.58	-0.033	****	*****	****	****	****
44	2BMA508	84	OLDSM	6/5	2.83	296	9.99	187	P/P/F/F	5.20	0.077	5.17	0.131	0.55	0.095	****	*****	2.80	91.40	1.10

Vehicle Information					SMOG CHECK Data					University of Denver Remote Sensing						General Motors		EPA Dynamometer		
#	License	Model Year	Make	Date	Low Idle %CO	Low Idle HC, ppm	High Idle %CO	High Idle HC, ppm	V/F/E/O	FEAT 1 %CO	FEAT 1 %HC	FEAT 2 %CO	FEAT 2 %HC	FEAT Idle %CO	FEAT Idle %HC	GM RSD %CO	GM RSD %HC	IM240 HC g/mile	IM240 CO g/mile	IM240 NOx g/mile
45	XHB309	66	FORD	6/5	5.60	176	0.46	934	P/P/F/F	6.10	0.125	7.81	0.350	7.86	0.135	****	*****	****	****	****
46	2KEV961	74	NISSA	6/5	1.75	162	0.11	5	T/T/P/F	3.27	0.093	2.69	*****	2.36	0.046	****	*****	****	****	****
47	3A74365	79	CHEVR	6/5	5.82	214	0.71	66	P/N/F/F	4.70	0.092	6.31	*****	2.42	0.055	****	*****	****	****	****
48	633UEM	77	DODGE	6/5	9.99	494	0.68	12	T/N/F/F	5.08	0.391	1.51	0.122	1.04	0.062	****	*****	****	****	****
49	738NJV	74	CHEVR	6/5	2.54	103	0.47	11	P/P/F/F	7.04	1.268	4.19	0.522	3.99	0.040	****	*****	****	****	****
50	806EJW	69	BUICK	6/5	7.23	212	3.62	98	P/P/F/F	4.78	0.046	3.90	0.109	****	*****	****	*****	****	****	****
51	2RCK542	85	BUICK	6/5	5.03	1307	9.99	1944	N/N/F/F	8.17	0.918	7.33	1.492	11.18	1.076	****	*****	24.40	224.20	0.20
52	1HBU675	84	DODGE	6/5	8.95	694	9.96	321	N/P/F/F	5.33	0.118	8.05	0.147	0.39	0.057	****	*****	****	****	****
53	321YBC	79	PLYMO	6/5	3.04	1021	2.83	284	T/N/F/F	4.54	0.196	3.99	0.234	****	*****	****	*****	****	****	****
54	2JVK097	78	TOYOT	6/5	6.53	208	8.88	155	T/P/F/F	6.88	0.113	9.16	0.313	7.02	0.132	****	*****	6.30	110.60	0.80
55	961RJZ	77	PONTI	6/5	6.75	231	1.24	20	P/P/F/F	4.29	0.344	5.91	0.287	2.18	*****	****	*****	****	****	****
56	2S0V639	80	FORD	6/5	1.52	75	0.66	51	T/T/F/F	3.90	0.069	2.93	0.194	1.99	0.036	****	*****	****	****	****
57	1GLG877	83	PONTI	6/5	8.93	388	0.98	20	P/P/F/F	9.63	0.470	9.52	0.575	****	*****	****	*****	****	****	****
58	2CFE091	84	RENAU	6/5	6.18	643	5.74	383	P/P/F/F	6.17	0.169	7.64	0.286	9.74	0.160	****	*****	3.40	46.80	4.70
59	1F1C799	79	OLDSM	6/5	8.09	509	3.30	80	T/T/F/F	3.23	0.090	4.74	0.148	1.79	0.024	****	*****	5.80	91.80	3.50
60	044XUZ	79	MERCU	6/5	7.53	380	4.36	209	T/P/F/F	7.74	0.297	7.92	0.319	6.68	0.153	****	*****	6.50	93.80	2.70
61	514NRA	76	BUICK	6/5	7.03	380	9.99	374	T/T/F/F	7.41	0.207	5.68	0.225	****	*****	****	*****	9.30	134.40	0.30
62	1MTE765	85	JEEP	6/6	6.84	251	1.87	91	N/N/F/F	5.18	0.126	2.40	0.299	1.34	0.101	****	*****	****	****	****
63	1A1F060	80	CHEVR	6/6	5.20	343	9.19	124	T/T/F/F	6.75	0.246	7.31	0.190	7.65	0.280	****	*****	****	****	****
64	1EAN293	82	MAZDA	6/6	5.31	270	8.05	203	T/T/F/F	5.61	0.118	8.50	0.283	7.54	0.133	****	*****	3.50	47.80	0.90
65	2FYW206	78	NISSA	6/6	7.98	399	7.88	217	P/P/F/F	7.63	0.101	7.84	0.376	8.57	0.159	****	*****	10.00	136.10	1.00
66	1GLN451	77	CADIL	6/6	9.99	1412	2.18	140	P/P/F/F	8.42	0.120	5.78	0.103	8.85	0.203	****	*****	****	****	****
67	1SID946	81	CADIL	6/6	1.83	85	0.94	72	P/P/F/F	4.73	0.083	4.50	0.136	3.83	0.061	****	*****	****	****	****
68	2VZK771	84	CHEVR	6/6	4.39	321	3.65	175	T/N/F/F	4.49	0.116	5.20	0.122	****	*****	****	*****	****	****	****
69	1GLF386	82	CHEVR	6/6	2.02	157	9.55	207	N/P/F/F	4.89	0.241	9.68	*****	8.26	0.154	****	*****	****	****	****
70	1PZD325	82	AUDI	6/6	5.00	342	4.80	213	P/P/F/F	5.73	0.117	5.33	0.123	7.18	0.099	****	*****	2.20	56.90	1.60
71	2GOW798	78	OLDSM	6/6	9.99	291	4.91	199	P/N/F/F	6.11	0.097	3.71	*****	6.48	0.107	****	*****	****	****	****
72	4A98835	79	MAZDA	6/6	0.19	210	9.99	1309	N/P/F/F	****	*****	****	*****	****	*****	****	*****	****	****	****
73	2APW289	83	MAZDA	6/6	0.09	38	4.45	54	T/T/F/F	5.45	0.157	5.23	*****	6.52	0.174	****	*****	****	****	****
74	NONE	86	MERCE	6/6	5.29	304	1.92	112	P/P/F/F	3.25	0.074	3.16	0.122	****	*****	****	*****	****	****	****
75	665WSS	79	FORD	6/6	5.81	234	3.09	67	T/T/F/F	3.36	0.066	4.36	0.096	****	*****	****	*****	****	****	****
76	1FSJ727	81	PONTI	6/6	5.08	139	9.99	78	T/T/F/F	10.00	0.106	7.41	0.136	11.55	0.293	****	*****	****	****	****
77	926YNU	80	FORD	6/6	0.07	90	0.05	34	P/N/P/F	6.35	0.181	2.44	0.187	2.80	-0.050	****	*****	****	****	****
78	NAL656--	78	TOYOT	6/6	7.87	144	2.58	4	N/P/F/F	7.36	0.093	8.77	0.269	6.97	0.211	****	*****	****	****	****
79	406NYD	76	NISSA	6/6	4.61	200	1.94	78	P/P/F/F	5.33	0.228	3.69	0.141	6.29	0.223	****	*****	****	****	****
80	1JDK553	84	NISSA	6/6	8.02	368	4.68	192	P/P/F/F	4.68	0.181	4.88	0.200	5.61	0.161	****	*****	****	****	****
81	662TMV	76	TOYOT	6/6	6.25	317	0.22	6	P/N/F/F	7.55	0.149	6.36	0.231	6.43	0.108	****	*****	****	****	****
82	710PKS	76	MERCU	6/6	2.32	173	2.12	82	N/P/F/F	4.51	0.110	3.74	0.144	4.83	0.132	****	*****	****	****	****
83	2AKT850	78	FORD	6/6	8.72	272	1.56	51	N/N/F/F	3.87	0.089	2.79	0.162	3.42	0.166	****	*****	1.10	19.60	0.50
84	1PBP182	80	CHEVR	6/6	6.14	200	3.67	86	T/N/F/F	7.65	0.210	7.32	0.148	5.93	0.252	****	*****	****	****	****
85	1JUN471	84	CHEVR	6/6	5.47	331	9.99	276	T/P/F/F	4.67	0.151	8.06	0.136	****	*****	****	*****	****	****	****
86	714WWD	79	TOYOT	6/6	0.47	116	6.52	121	T/P/P/F	5.46	0.333	6.41	0.191	3.49	0.150	****	*****	****	****	****
87	1EJC602	82	FORD	6/6	0.75	12	0.10	1	P/N/P/F	3.90	0.309	6.19	0.627	2.44	0.108	****	*****	5.30	65.50	****
88	357YTB	80	CHEVR	6/6	0.58	1430	0.48	1745	P/P/F/F	2.78	0.350	1.97	0.628	****	*****	****	*****	****	****	****

Vehicle Information					SMOG CHECK Data					University of Denver Remote Sensing						General Motors		EPA Dynamometer		
#	License	Model Year	Make	Date	Low Idle %CO	Low Idle HC, ppm	High Idle %CO	High Idle HC, ppm	V/F/E/O	FEAT 1 %CO	FEAT 1 %HC	FEAT 2 %CO	FEAT 2 %HC	FEAT Idle %CO	FEAT Idle %HC	GM RSD %CO	GM RSD %HC	IM240 HC g/mile	IM240 CO g/mile	IM240 NOx g/mile
89	865WWU	79	OLDS	6/6	9.99	2081	2.98	144	T/T/F/F	8.09	0.791	5.37	0.228	****	*****	****	*****	****	****	****
90	148VFG	78	CHRYS	6/6	3.16	1155	2.74	1171	T/N/F/F	3.49	0.443	4.65	0.475	3.01	0.300	****	*****	16.70	38.80	2.50
91	2RIG511	84	OLDSM	6/6	7.68	280	8.51	174	P/N/F/F	5.00	0.150	6.92	0.430	****	*****	****	*****	****	****	****
92	145KZV	74	FORD	6/6	6.46	446	1.12	68	P/N/F/F	5.62	0.236	5.67	0.388	5.12	0.120	****	*****	****	****	****
93	2TVS186	85	JEEP	6/6	1.40	151	0.23	30	T/P/F/F	0.55	0.347	0.47	0.516	0.67	0.119	****	*****	****	****	****
94	2C88945	82	OLDSM	6/6	2.04	806	3.85	81	T/T/F/F	1.08	0.415	0.99	1.001	3.12	*****	****	*****	****	****	****
95	1FZN547	82	CHEVR	6/6	0.41	19	0.11	5	P/P/P/P	3.67	0.942	3.00	0.931	0.06	-0.043	****	*****	****	****	****
96	O/S?	83	CHEVR	6/6	9.99	2065	9.99	848	T/T/F/F	5.48	0.243	8.33	1.933	10.73	0.275	****	*****	****	****	****
97	697KXZ	74	NISSA	6/6	9.99	1174	9.99	1466	T/P/F/F	7.03	0.531	7.05	0.852	9.11	0.404	****	*****	****	****	****
98	1NSX968	81	TOYOT	6/6	2.35	192	4.42	127	P/N/F/F	2.10	0.462	1.98	0.592	5.79	*****	****	*****	****	****	****
99	2ERY027	79	CHEVR	6/6	0.52	2999	1.92	2999	T/P/F/F	0.32	0.515	1.27	0.641	****	*****	****	*****	****	****	****
100	2AKE761	76	FORD	6/6	0.14	577	4.06	1634	T/T/F/F	5.61	0.597	6.94	0.693	3.78	*****	****	*****	****	****	****
101	1EHD667	82	LINCO	6/6	7.73	204	0.01	40	P/P/F/F	7.87	0.122	7.42	0.420	9.98	0.338	****	*****	****	****	****
102	399DDG	71	NISSA	6/7	7.34	2999	1.18	63	P/P/F/F	7.09	0.189	2.52	0.213	11.67	0.269	****	*****	****	****	****
103	2AHP896	73	AMC	6/7	5.49	101	1.35	28	P/P/P/P	6.51	0.147	5.19	0.041	4.62	0.055	4.69	0.005	****	****	****
104	249ZEA	80	CHRYS	6/7	5.47	478	5.11	2999	T/T/F/F	5.44	0.251	2.55	0.113	****	*****	6.00	0.096	7.70	107.20	4.40
105	1HCN521	78	CHEVR	6/7	9.81	387	9.99	108	T/T/F/F	7.61	0.178	4.51	0.093	6.51	0.140	6.75	0.041	8.30	174.00	0.90
106	1FNX093	78	FORD	6/7	6.12	210	3.52	147	T/T/F/F	4.57	0.103	4.88	0.187	****	*****	****	*****	****	****	****
107	2WVR248	81	FORD	6/7	4.51	133	7.56	82	T/T/F/F	5.52	0.102	6.52	0.314	****	*****	****	*****	****	****	****
108	ICHEATM	79	CADIL	6/7	2.20	238	3.10	132	T/T/P/F	3.15	0.097	7.52	0.307	****	*****	****	*****	****	****	****
109	2UNC759	78	OLDSM	6/7	6.43	244	4.56	137	T/N/F/F	7.13	0.434	8.27	0.271	7.88	*****	****	*****	****	****	****
110	1GIG287	81	MAZDA	6/7	2.79	223	4.34	126	P/P/F/F	7.21	0.110	7.10	0.134	1.35	*****	****	*****	****	****	****
111	1LFE383	84	FORD	6/7	9.99	2015	9.99	2013	N/P/F/F	9.02	0.504	12.52	0.776	13.72	0.516	****	*****	****	****	****
112	911SEM	76	DODGE	6/7	2.87	337	3.69	141	N/N/F/F	6.25	0.551	2.53	0.211	****	*****	****	*****	****	****	****
113	2CTK957	76	FORD	6/7	9.99	376	1.70	62	T/T/F/F	5.67	0.126	7.35	0.254	8.59	0.155	****	*****	****	****	****
114	1HTU601	84	MAZDA	6/7	2.65	160	3.02	97	P/P/F/F	4.65	0.222	3.97	0.277	4.99	0.151	3.61	0.061	****	****	****
115	1MOJ738	85	DODGE	6/7	0.01	9	2.71	51	N/P/F/F	5.67	0.136	4.54	0.253	****	*****	****	*****	****	****	****
116	166GPZ	73	CHEVR	6/7	1.31	170	0.90	1195	T/T/P/F	2.53	0.258	0.17	0.522	4.36	*****	****	*****	****	****	****
117	313UDT	77	FIAT	6/7	2.65	119	6.97	134	T/T/F/F	7.50	0.094	9.83	0.617	6.96	0.165	****	*****	****	****	****
118	2TVN517	80	AUDI	6/7	7.71	353	8.85	223	P/P/F/F	9.05	0.378	5.75	0.114	8.23	0.116	****	*****	****	****	****
119	E455080	83	CHEVR	6/7	9.99	1084	0.28	35	P/P/F/F	5.21	0.185	6.96	0.252	6.32	0.087	****	*****	****	****	****
120	3B12226	84	NISSA	6/7	6.18	292	5.06	2090	P/P/F/F	3.90	0.200	6.79	0.408	6.66	0.265	****	*****	****	****	****
121	2BTC247	85	HONDA	6/7	2.37	268	9.38	162	P/P/F/F	5.53	0.055	6.25	*****	6.53	0.076	****	*****	2.50	94.00	0.40
122	109SWK	77	CHEVR	6/7	4.43	197	4.17	120	T/N/F/F	7.42	0.434	4.76	0.031	****	*****	****	*****	****	****	****
123	1GBW859	83	FORD	6/7	3.68	167	5.12	164	T/P/F/F	3.23	0.103	5.03	0.229	3.63	0.135	****	*****	4.30	76.50	0.50
124	1FOD224	82	BUICK	6/7	9.99	556	1.36	26	T/P/F/F	3.75	0.104	4.40	*****	****	*****	****	*****	****	****	****
125	1CIC648	81	OLDSM	6/7	4.91	229	9.18	206	T/T/F/F	4.25	0.136	4.41	0.764	2.37	*****	****	*****	****	****	****
126	160YZZ	79	CHEVR	6/7	0.00	22	0.00	21	P/N/?/F	3.71	0.369	4.08	0.257	5.50	*****	****	*****	4.10	116.50	0.80
127	2J58633	84	CHEVR	6/7	6.42	679	8.36	346	P/N/F/F	9.05	0.265	9.42	0.220	8.49	0.192	****	*****	8.80	186.70	0.90
128	1EXY788	75	VOLKS	6/7	4.31	2999	3.65	2999	T/P/F/F	13.59	2.586	0.70	1.285	5.33	0.985	11.24	0.691	****	****	****
129	JYOTIS	87	NISSA	6/7	0.00	5	0.00	4	P/P/P/P	6.85	0.059	2.53	0.094	4.05	0.047	****	*****	1.40	43.90	1.20
130	1HBV838	72	CHEVR	6/7	9.82	419	2.52	1698	N/P/F/F	5.71	0.216	5.73	0.334	5.93	0.134	****	*****	****	****	****
131	2TME790	76	FORD	6/7	7.96	519	0.96	67	T/N/F/F	7.67	0.209	3.96	0.104	****	*****	****	*****	****	****	****
132	2WBD661	81	FORD	6/10	8.83	636	7.24	310	N/N/F/F	7.18	0.112	6.94	0.149	9.58	0.297	6.20	0.036	7.20	152.70	0.70

Vehicle Information					SMOG CHECK Data					University of Denver Remote Sensing						General Motors		EPA Dynamometer		
#	License	Model Year	Make	Date	Low Idle %CO	Low Idle HC, ppm	High Idle %CO	High Idle HC, ppm	V/F/E/O	FEAT 1 %CO	FEAT 1 %HC	FEAT 2 %CO	FEAT 2 %HC	FEAT Idle %CO	FEAT Idle %HC	GM RSD %CO	GM RSD %HC	IM240 HC g/mile	IM240 CO g/mile	IM240 NOx g/mile
133	1GXR993	83	MERCU	6/10	9.99	473	9.90	182	N/N/F/F	9.50	0.144	6.87	0.131	9.64	0.382	5.90	0.030	7.50	156.70	1.10
134	3S73322	88	CHEVR	6/10	3.69	334	2.34	358	P/P/F/F	4.80	0.147	4.51	0.140	9.31	0.272	6.27	0.003	****	****	****
135	052YIU	79	OLDSM	6/10	3.39	2092	0.98	1460	T/N/F/F	2.02	0.433	3.21	0.492	3.55	0.595	****	*****	****	****	****
136	4D26415	73	FORD	6/10	5.53	498	9.67	501	T/T/F/F	11.22	0.193	11.70	0.147	8.87	0.289	****	*****	****	****	****
137	2HYK016	78	MAZDA	6/10	2.36	776	5.20	1149	T/T/F/F	5.08	0.200	4.57	0.122	****	*****	****	*****	****	****	****
138	2RQK389	90	CHEVR	6/10	0.00	2	0.01	3	P/P/P/P	3.25	0.188	6.12	0.075	0.08	0.038	2.98	0.009	****	****	****
139	483TZL	78	BUICK	6/10	0.19	1928	0.18	2999	N/N/F/F	0.44	0.898	0.03	1.219	0.27	0.727	****	*****	****	****	****
140	1AEC810	81	PONTI	6/10	5.41	243	6.96	179	T/N/F/F	4.42	0.357	5.86	0.167	5.15	0.201	6.05	0.101	****	****	****
141	2VFY700	83	MAZDA	6/10	0.68	206	0.58	129	N/P/F/F	4.94	0.297	4.74	0.222	0.62	0.094	3.46	0.067	****	****	****
142	1PWA284	86	FORD	6/10	0.40	33	1.33	61	P/P/F/F	7.87	0.113	2.29	0.045	3.90	0.171	2.51	0.027	****	****	****
143	995YKJ	80	MAZDA	6/10	0.27	64	2.53	60	P/N/F/F	5.21	0.061	3.30	0.094	6.25	0.175	****	*****	3.30	46.90	4.30
144	1EBY227	82	FORD	6/10	7.59	321	5.00	249	T/N/F/F	7.54	0.133	3.57	*****	****	*****	****	*****	3.20	76.00	4.20
145	2BNN069	84	CHEVR	6/10	2.85	143	6.09	102	T/N/F/F	4.52	0.080	5.57	0.043	3.83	0.131	6.80	0.012	****	****	****
146	871TJZ	71	CHEVR	6/10	0.16	1273	0.14	291	T/T/F/F	0.22	0.995	0.51	1.242	0.10	0.291	1.06	0.653	****	****	****
147	1AJV934	80	TOYOT	6/10	3.51	121	5.76	91	T/T/F/F	5.72	0.087	5.72	0.048	5.88	0.075	6.31	0.009	2.90	88.90	2.00
148	1PFP792	74	CHEVR	6/10	1.45	2999	3.27	2999	T/T/F/F	2.23	0.730	2.17	0.639	1.62	0.844	2.61	0.306	****	****	****
149	1DTN743	81	BUICK	6/10	0.23	20	0.26	6	N/P/P/F	5.46	0.106	6.22	0.102	7.06	0.286	4.36	0.013	****	****	****
150	4B50436	81	GMC	6/10	6.38	262	2.92	51	T/T/F/F	6.52	0.154	6.32	0.100	****	*****	5.30	0.013	****	****	****
151	1MBL272	85	HONDA	6/10	1.09	237	7.30	179	P/P/F/F	7.00	0.110	8.67	0.119	5.84	0.212	****	*****	****	****	****
152	1DNC510	77	CHEVR	6/10	5.16	511	5.49	251	P/N/F/F	5.74	0.116	4.49	0.090	6.72	0.298	4.16	0.006	****	****	****
153	1MBS307	85	OLDSM	6/10	0.07	13	0.00	5	P/P/P/P	6.27	0.066	9.53	0.101	7.45	0.113	8.69	0.011	4.10	113.60	0.70
154	1RKY063	86	HONDA	6/10	3.52	176	9.99	188	P/P/F/F	4.98	0.069	5.76	0.096	****	*****	5.69	0.007	****	****	****
155	INTL940	81	TOYOT	6/10	0.42	15	0.73	13	P/P/P/P	0.57	0.911	0.95	0.540	0.20	0.094	****	*****	****	****	****
156	1JJV166	80	HONDA	6/10	0.28	2112	1.25	2120	P/P/F/F	0.42	0.617	0.67	0.870	****	*****	****	*****	****	****	****
157	1JBZ531	84	JEEP	6/10	1.05	172	2.56	86	N/P/F/F	6.74	0.094	3.90	0.256	5.48	0.187	4.03	0.018	****	****	****
158	2WFK082	76	FORD	6/10	8.81	771	5.69	229	T/N/F/F	7.76	0.550	7.15	0.309	9.40	1.408	6.80	0.061	****	****	****
159	2AFC772	73	CADIL	6/10	9.99	350	7.74	116	N/N/F/F	7.02	0.164	6.08	0.259	9.30	0.752	****	*****	****	****	****
160	29228Y	74	CHEVR	6/10	0.28	2999	3.73	99	T/T/F/F	7.02	0.276	5.60	0.313	1.81	2.475	3.82	0.286	****	****	****
161	610YBX	78	TOYOT	6/10	3.02	191	3.51	127	T/P/F/F	3.64	0.087	5.22	0.268	5.79	0.072	****	*****	****	****	****
162	185ZOU	80	OLDSM	6/10	8.21	479	8.72	243	N/N/F/F	7.55	0.375	4.22	0.433	7.36	0.410	****	*****	12.70	113.40	1.40
163	1FQT064	81	DODGE	6/10	4.99	413	9.10	371	N/P/F/F	7.43	0.117	8.42	0.236	7.64	0.379	9.15	0.040	****	****	****
164	2NZH036	87	YUGO	6/10	4.45	1231	4.50	278	P/P/F/F	5.87	0.156	7.47	0.242	7.98	0.434	****	*****	3.90	51.80	1.60
165	1JJB278	67	CHEVR	6/10	6.09	788	2.60	268	T/T/F/F	3.52	0.164	5.82	0.567	6.30	0.537	4.13	0.031	****	****	****
166	792NCH	75	CHEVR	6/11	4.53	2999	0.89	1723	N/N/F/F	1.40	0.651	0.82	0.487	1.65	0.708	1.29	0.356	24.10	76.10	3.00
167	2BVB448	77	JEEP	6/11	9.99	1433	9.99	289	T/N/F/F	9.50	0.247	11.88	0.497	9.66	0.630	****	*****	****	****	****
168	4A50490	79	TOYOT	6/11	1.56	265	7.77	205	T/N/F/F	6.29	0.083	6.05	0.178	0.76	*****	****	*****	****	****	****
169	2WCE665	82	MERCU	6/11	2.34	278	3.11	160	P/P/F/F	5.88	0.057	3.76	0.072	0.80	0.105	****	*****	2.90	45.40	1.20
170	2KFV112	77	CHEVR	6/11	0.37	1494	0.19	1166	T/T/F/F	0.47	0.449	0.11	0.578	0.09	0.495	0.15	0.217	****	****	****
171	1W59896	80	FORD	6/11	9.99	271	9.99	157	N/N/F/F	7.64	0.242	6.63	0.257	8.07	0.261	****	*****	****	****	****
172	2GFA748	81	NISSA	6/11	6.86	764	2.82	213	P/P/F/F	7.37	0.309	9.23	0.294	****	*****	****	*****	****	****	****
173	1ADF014	79	DODGE	6/11	0.23	1441	8.41	2174	T/N/F/F	8.63	0.519	8.87	0.526	8.42	0.664	6.65	0.238	****	****	****
174	1ANX270	80	BUICK	6/11	6.45	493	8.15	151	T/T/F/F	7.40	0.098	4.66	0.173	5.68	0.271	****	*****	****	****	****
175	2ABR399	83	JAGUA	6/11	2.82	130	1.41	35	P/P/F/F	10.49	0.369	6.59	0.130	1.77	0.141	****	*****	****	****	****
176	96668P	73	GMC	6/11	4.53	601	6.96	169	T/T/F/F	4.45	0.316	5.08	0.375	6.72	0.221	****	*****	****	****	****

Vehicle Information					SMOG CHECK Data					University of Denver Remote Sensing						General Motors		EPA Dynamometer		
#	License	Model Year	Make	Date	Low Idle %CO	Low Idle HC, ppm	High Idle %CO	High Idle HC, ppm	V/F/E/O	FEAT 1 %CO	FEAT 1 %HC	FEAT 2 %CO	FEAT 2 %HC	FEAT Idle %CO	FEAT Idle %HC	GM RSD %CO	GM RSD %HC	IM240 HC g/mile	IM240 CO g/mile	IM240 NOx g/mile
177	484WPL	79	BUICK	6/11	9.99	318	9.99	190	T/T/F/F	6.76	*****	5.82	0.208	9.98	0.208	5.00	0.092	****	****	****
178	2BVT350	85	PEUGE	6/11	7.29	317	5.14	126	P/N/F/F	4.16	0.082	3.88	0.097	5.61	0.133	3.14	0.033	****	****	****
179	CFE288--	84	PEUGE	6/11	7.87	224	3.81	98	P/P/F/F	4.41	0.193	5.19	*****	6.36	0.190	****	*****	0.70	17.10	5.30
180	2BSM501	85	HONDA	6/11	0.06	42	6.19	75	P/P/F/F	4.83	0.109	6.84	0.092	4.54	0.149	****	*****	****	****	****
181	2T78432	72	CHEVR	6/11	3.27	111	1.42	26	P/P/P/P	6.32	0.140	6.89	0.157	****	*****	****	*****	****	****	****
182	982KSZ	74	PLYMO	6/11	5.41	162	9.06	304	N/P/P/F	4.69	0.059	6.62	0.146	10.94	0.185	7.72	0.074	****	****	****
183	3K94478	86	FORD	6/11	9.99	463	3.43	110	T/P/F/F	8.43	0.720	9.83	0.968	****	*****	****	*****	****	****	****
184	2KFW803	80	CHEVR	6/11	3.36	230	1.42	74	T/T/F/F	6.54	0.084	7.13	0.140	5.20	0.323	****	*****	****	****	****
185	1BEY294	81	OLDSM	6/11	7.05	540	8.82	183	T/N/F/F	4.88	0.122	5.96	0.109	****	*****	6.30	0.036	****	****	****
186	2RMH123	83	MERCE	6/11	0.60	263	0.39	40	N/N/F/F	0.77	1.195	0.72	0.658	****	*****	0.85	0.209	****	****	****
187	3AO4537	83	FORD	6/11	5.34	484	4.48	187	P/P/F/F	5.13	0.542	7.62	*****	4.14	*****	5.43	0.051	****	****	****
188	526YLF	74	OLDSM	6/11	0.18	2088	0.39	2057	T/P/F/F	0.82	0.775	0.53	0.604	1.64	0.808	0.74	0.276	29.20	6.90	13.60
189	1LNB796	85	NISSA	6/11	0.01	9	5.77	338	P/P/F/F	4.24	0.108	6.01	0.114	4.52	0.132	6.02	0.024	2.40	79.90	0.80
190	476ZSD-	74	CHEVR	6/11	0.14	1354	0.19	70	T/N/F/F	0.75	0.433	0.32	0.431	0.27	0.427	****	*****	****	****	****
191	1DHB132	82	CADIL	6/11	2.88	153	4.51	104	N/N/F/F	5.60	0.143	6.99	0.209	8.43	0.187	****	*****	****	****	****
192	2RID849	83	CHEVR	6/11	4.82	87	3.75	44	N/N/F/F	7.64	0.190	4.90	0.125	6.55	0.188	2.89	0.016	****	****	****
193	2VER368	77	TOYOT	6/11	6.88	2999	9.99	2999	T/T/F/F	8.87	1.723	13.35	1.512	12.97	3.112	11.19	0.580	****	****	****
194	22298	86	JEEP	6/11	2.85	132	3.30	89	P/P/F/F	3.87	-0.017	3.93	0.033	****	*****	****	*****	2.40	58.20	5.40
195	307ZEA	80	CHEVR	6/11	8.93	474	9.99	177	N/P/F/F	9.66	0.224	8.86	0.130	6.11	0.164	8.56	0.034	****	****	****
196	1JGR337	84	CHEVR	6/11	1.13	82	9.99	137	P/P/F/F	6.25	0.044	8.40	0.041	1.34	0.102	****	*****	****	****	****
197	124VMC	78	CADIL	6/11	5.07	299	2.15	49	P/N/F/F	5.23	0.126	4.34	0.213	4.96	0.228	6.15	0.026	****	****	****
198	071JJL	73	DODGE	6/11	0.24	44	7.02	202	P/P/P/P	5.42	0.081	6.96	0.252	****	*****	****	*****	4.50	142.40	0.90
199	985LTY	75	OLDSM	6/11	5.10	120	0.04	10	P/T/F/F	4.70	0.340	5.48	*****	5.13	0.128	7.33	0.032	****	****	****
200	1JKK160	76	CHEVR	6/11	8.31	2045	0.69	999	T/T/F/F	4.75	0.120	3.14	0.216	7.59	0.367	****	*****	****	****	****
201	2VBM286	82	CHEVR	6/11	9.99	546	9.99	335	T/T/F/F	5.76	0.119	11.32	0.263	11.19	0.652	10.60	0.122	****	****	****
202	950WPV	79	CHEVR	6/11	4.59	434	0.19	39	T/N/F/F	3.27	0.143	4.50	0.166	6.72	*****	3.82	0.054	****	****	****
203	2JYT419	81	PONTI	6/11	9.99	246	9.99	111	N/P/F/F	5.66	0.191	5.31	0.311	8.74	0.216	****	*****	****	****	****
204	670YLF	79	LINCO	6/12	9.99	413	2.40	39	T/T/F/F	5.10	0.102	4.20	0.096	8.39	0.397	****	*****	****	****	****
205	2NHS459	89	OLDSM	6/12	0.03	16	0.00	2	P/P/P/P	6.04	0.081	6.89	0.083	0.76	0.034	4.44	0.024	****	****	****
206	2BNL632	79	CHEVR	6/12	0.09	253	2.27	148	P/P/F/F	6.30	0.315	9.96	0.355	0.28	0.088	****	*****	****	****	****
207	1CTV991	81	FORD	6/12	9.99	204	9.99	291	T/T/F/F	7.13	0.112	7.77	0.103	2.45	*****	4.95	0.064	****	****	****
208	1LLY988	83	PONTI	6/12	9.99	434	5.10	177	T/N/F/F	5.28	0.173	4.80	0.141	****	*****	3.04	0.021	****	****	****
209	1DGE222	81	NISSA	6/12	8.20	342	6.06	213	P/P/F/F	4.68	0.088	7.27	0.097	5.90	0.188	****	*****	****	****	****
210	2KJS061	80	CHEVR	6/12	3.31	321	6.58	324	T/P/F/F	3.45	0.080	7.66	0.127	3.77	0.261	5.84	0.027	****	****	****
211	1ERT394	80	PONTI	6/12	3.03	2999	1.71	2083	T/P/F/F	2.66	0.809	1.99	0.928	****	*****	2.69	0.289	25.10	56.70	2.80
212	3U48121	89	MAZDA	6/12	2.42	360	6.18	359	T/P/F/F	4.85	0.179	4.80	0.131	2.95	0.335	****	*****	****	****	****
213	2L95214	84	CHEVR	6/12	3.06	1266	6.36	1875	P/P/F/F	4.26	0.222	5.77	0.260	5.56	0.694	3.99	0.095	****	****	****
214	2GMN340	87	FORD	6/12	2.92	316	1.59	112	P/P/F/F	3.72	0.121	4.87	0.261	6.80	0.386	****	*****	5.60	107.90	1.50
215	408JLQ	73	PONTI	6/12	0.19	1635	0.13	921	P/P/F/F	0.14	0.598	0.13	0.434	****	*****	****	*****	****	****	****
216	2LEG933	66	FORD	6/12	0.00	9	0.01	12	T/P/P/F	9.65	1.050	10.56	1.223	11.66	0.435	****	*****	****	****	****
217	2MFX421	82	NISSA	6/12	9.99	1154	9.99	1357	P/P/F/F	10.69	0.216	12.37	0.281	11.29	0.781	****	*****	20.70	207.10	0.10
218	2TMW527	85	DODGE	6/12	9.99	1633	9.99	462	N/P/F/F	4.60	0.114	3.99	0.254	8.89	0.483	4.83	0.094	8.00	147.60	1.50
219	2SJK060	80	BUICK	6/12	7.50	366	9.64	366	T/T/F/F	8.88	0.168	7.79	0.275	9.60	0.328	****	*****	9.10	236.60	0.70
220	2FKB454	80	VOLKS	6/12	9.99	263	3.39	149	P/P/F/F	7.24	0.120	6.76	0.161	7.82	0.238	****	*****	****	****	****

Vehicle Information					SMOG CHECK Data					University of Denver Remote Sensing						General Motors		EPA Dynamometer		
#	License	Model Year	Make	Date	Low Idle %CO	Low Idle HC, ppm	High Idle %CO	High Idle HC, ppm	V/F/E/O	FEAT 1 %CO	FEAT 1 %HC	FEAT 2 %CO	FEAT 2 %HC	FEAT Idle %CO	FEAT Idle %HC	GM RSD %CO	GM RSD %HC	IM240 HC g/mile	IM240 CO g/mile	IM240 NOx g/mile
221	1CGD841	77	DODGE	6/12	4.89	967	0.94	105	N/N/F/F	4.24	0.536	5.43	0.459	7.05	0.499	4.87	0.116	6.10	35.80	10.30
222	2EBC307	85	FORD	6/12	0.05	13	3.73	61	P/N/F/F	6.52	0.093	2.71	0.189	0.25	0.101	****	*****	****	****	****
223	2CBN582	85	VOLKS	6/12	0.02	3	0.02	1	P/P/P/P	7.04	0.155	7.96	0.441	****	*****	****	*****	****	****	****
224	1FHH240	82	TOYOT	6/12	7.57	307	4.97	256	P/P/F/F	4.07	0.129	3.87	0.143	1.84	0.155	****	*****	****	****	****
225	1JOM555	84	CHEVR	6/12	8.79	1537	6.84	1141	N/P/F/F	4.73	0.477	4.99	0.801	6.58	*****	****	*****	****	****	****
226	2BSZ484	86	HONDA	6/12	1.31	203	2.55	202	P/P/F/F	3.80	0.074	2.22	0.088	3.31	0.276	1.36	0.047	****	****	****
227	2AFK725	82	FORD	6/12	9.99	1944	5.55	232	N/P/F/F	6.51	0.182	5.85	0.073	10.47	0.618	4.27	0.053	****	****	****
228	2MMK703	80	TOYOT	6/12	2.24	182	5.42	59	T/P/F/F	6.67	0.098	8.62	0.160	7.50	0.114	7.46	0.055	****	****	****
229	1V14401	80	TOYOT	6/12	9.99	1426	9.99	499	T/T/F/F	6.84	0.107	8.99	-0.080	****	*****	****	*****	****	****	****
230	2RIR616	82	CHEVR	6/12	5.72	579	4.74	279	P/P/F/F	8.16	0.242	9.99	0.372	9.65	0.345	****	*****	****	****	****
231	1LWH102	81	BUICK	6/13	9.99	531	9.99	191	T/T/F/F	9.39	0.219	7.33	0.185	9.81	0.430	****	*****	6.90	107.90	3.50
232	2EHC081	87	MITSU	6/13	0.89	119	2.77	89	P/P/F/F	5.07	0.065	9.01	0.094	2.49	0.117	****	*****	****	****	****
233	2NES581	80	CHEVR	6/13	9.99	208	0.00	0	P/P/F/F	4.79	0.026	4.18	0.106	3.63	0.122	****	*****	0.70	10.80	1.90
234	701TKQ	77	CHEVR	6/13	9.99	165	1.92	62	T/N/F/F	5.05	0.064	5.70	0.048	6.34	0.200	5.45	0.021	****	****	****
235	2PFV992	84	DODGE	6/13	2.91	277	2.29	70	N/N/F/F	5.00	0.008	5.23	*****	1.99	*****	****	*****	****	****	****
236	1ATG261	79	NISSA	6/13	6.01	167	4.99	96	P/P/F/F	5.60	0.077	8.41	2.640	3.69	0.112	****	*****	****	****	****
237	2KGG962	83	BUICK	6/13	6.40	232	9.99	158	N/P/F/F	4.31	0.157	6.27	0.245	5.68	0.205	7.11	0.025	****	****	****
238	2AUT337	80	PLYMO	6/13	4.59	2999	1.06	218	T/T/F/F	6.70	1.910	8.91	1.364	8.72	0.831	****	*****	3.20	5.80	5.00
239	2BKJ152	83	FORD	6/13	4.22	264	3.03	175	P/P/F/F	6.18	0.233	1.94	0.431	4.03	0.152	3.70	0.049	4.40	28.50	5.20
240	2LTZ296	79	PONTI	6/13	0.49	1463	0.16	1033	P/P/F/F	0.10	0.400	0.13	0.703	0.60	0.458	0.10	0.166	****	****	****
241	022WWJ	79	FORD	6/13	8.81	1040	0.50	152	T/T/F/F	7.10	0.477	10.19	0.591	7.32	0.838	11.30	0.138	****	****	****
242	2WIV988	78	CHEVR	6/13	9.99	1884	9.99	2032	T/T/F/F	6.54	0.605	6.89	0.665	5.44	0.713	4.57	0.232	****	****	****
243	967ZXP	80	TOYOT	6/13	9.99	374	9.99	199	N/P/F/F	3.45	0.130	3.76	0.178	5.73	0.132	2.77	0.054	****	****	****
244	1AOC749	80	NISSA	6/13	0.24	78	0.32	13	P/P/P/P	0.24	0.470	0.21	0.896	0.19	*****	0.38	0.284	1.20	11.10	3.20
245	1PCK688	85	CHEVR	6/13	9.31	2999	6.92	2999	T/P/F/F	8.65	0.367	11.06	0.457	7.87	0.452	9.76	0.077	****	****	****
246	1NOK766	85	NISSA	6/13	4.83	403	5.68	279	P/N/F/F	3.38	0.116	3.76	0.168	4.24	*****	****	*****	****	****	****
247	764VYA	78	FORD	6/13	0.00	0	2.85	63	N/?/?/F	8.58	0.133	10.78	0.232	5.92	0.267	10.11	0.038	****	****	****
248	2VMH126	82	CHEVR	6/13	2.76	123	2.23	48	T/P/F/F	3.16	0.105	5.70	0.261	****	*****	****	*****	****	****	****
249	1RAC114	87	NISSA	6/13	2.65	174	7.78	193	T/P/F/F	5.63	0.108	8.24	0.187	2.52	0.225	7.46	0.036	****	****	****
250	2NBR092	78	TOYOT	6/13	5.40	242	2.92	30	P/P/F/F	6.00	0.109	4.42	0.118	3.99	0.148	3.97	0.019	****	****	****
251	2UOA410	85	BUICK	6/13	0.09	304	8.26	606	T/T/F/F	2.73	0.255	4.66	0.439	1.75	0.112	****	*****	****	****	****
252	1ERG364	82	PONTI	6/13	1.64	178	9.99	349	P/P/F/F	4.14	0.128	8.58	0.186	1.46	0.151	****	*****	2.90	84.10	0.70
253	2FYV076	83	BUICK	6/13	3.64	129	1.70	34	T/T/F/F	4.01	0.070	5.59	0.447	4.89	0.225	****	*****	****	****	****
254	1EHJ040	77	CADIL	6/13	3.84	414	6.00	110	P/N/F/F	5.30	0.023	6.22	0.303	5.54	0.133	****	*****	****	****	****
255	2RQH759	79	CHEVR	6/13	9.99	1018	2.97	230	P/N/F/F	3.73	0.104	5.27	0.105	7.52	0.302	4.59	0.031	****	****	****
256	2BSS772	85	VOLVO	6/13	4.09	149	3.37	60	N/P/F/F	3.58	0.087	3.86	0.111	4.21	0.051	3.12	0.007	1.60	70.50	1.80
257	2RIS269	84	VOLKS	6/13	0.07	569	6.87	290	T/T/F/F	2.61	0.072	8.44	0.153	0.76	0.080	5.07	0.030	****	****	****
258	2MTL545	80	OLDSM	6/13	5.59	824	5.95	140	P/P/F/F	4.37	0.111	5.56	0.113	3.07	0.143	4.96	0.026	****	****	****
259	2CID376	85	NISSA	6/14	9.99	651	9.90	380	P/P/F/F	3.37	0.200	3.67	0.144	5.96	0.173	****	*****	4.10	77.70	0.80
260	NONE	82	OLDSM	6/14	9.99	666	9.99	317	P/N/F/F	5.43	0.236	8.35	0.262	8.31	0.821	****	*****	8.10	150.90	1.70
261	1DHN460	81	BUICK	6/14	0.21	47	0.26	11	P/P/P/P	3.35	0.141	5.08	0.160	0.00	0.120	****	*****	****	****	****
262	242WHX	76	PONTI	6/14	9.99	506	2.22	75	T/P/F/F	5.92	0.195	3.83	0.111	5.35	0.150	****	*****	****	****	****
263	1RRH640	86	PONTI	6/14	0.48	310	9.99	1970	P/P/F/F	3.66	0.279	4.68	0.073	0.15	-0.038	****	*****	0.10	1.40	2.20
264	1DMJ956	81	OLDSM	6/14	9.99	370	9.99	213	T/N/F/F	8.05	0.158	10.91	0.149	10.53	0.297	****	*****	****	****	****

Vehicle Information					SMOG CHECK Data					University of Denver Remote Sensing						General Motors		EPA Dynamometer		
#	License	Model Year	Make	Date	Low Idle %CO	Low Idle HC, ppm	High Idle %CO	High Idle HC, ppm	V/F/E/O	FEAT 1 %CO	FEAT 1 %HC	FEAT 2 %CO	FEAT 2 %HC	FEAT Idle %CO	FEAT Idle %HC	GM RSD %CO	GM RSD %HC	IM240 HC g/mile	IM240 CO g/mile	IM240 NOx g/mile
265	2VER644	84	PONTI	6/14	0.24	525	0.51	31	N/P/F/F	0.39	1.463	0.40	1.686	0.21	0.256	****	*****	****	****	****
266	DANNYGN	77	CHEVR	6/14	0.15	1994	0.24	1993	T/T/F/F	1.67	1.681	0.11	1.532	0.27	1.782	****	*****	****	****	****
267	962MWH	76	MERCU	6/14	4.63	200	2.38	66	T/T/F/F	5.66	0.168	5.80	0.134	5.86	0.158	****	*****	****	****	****
268	1LIY281	82	CHEVR	6/14	9.99	878	0.56	521	N/N/F/F	2.63	0.048	8.55	0.182	7.45	0.207	****	*****	****	****	****
269	2SWW507	90	MITSU	6/14	0.07	45	0.10	10	N/P/P/F	2.96	0.087	3.60	0.077	0.12	0.050	****	*****	****	****	****
270	1SJL275	77	OLDSM	6/14	0.00	0	0.00	3	T/?/?/F	8.62	0.180	9.53	0.197	6.86	0.318	****	*****	****	****	****
271	1MIE978	85	CHEVR	6/14	0.27	165	2.06	355	P/P/F/F	3.56	0.113	4.50	0.099	1.05	0.285	****	*****	****	****	****
272	613PXQ	76	OLDSM	6/14	4.70	111	0.01	0	P/P/F/F	4.77	0.098	6.10	0.092	6.40	0.333	****	*****	****	****	****
273	2HHJ692	67	FORD	6/14	9.99	1105	0.22	2016	T/T/F/F	6.24	0.302	6.55	0.404	6.31	0.635	****	*****	****	****	****
274	1PON211	85	JEEP	6/14	0.74	160	0.23	46	N/N/F/F	5.42	0.079	2.55	0.102	1.33	0.209	****	*****	****	****	****
275	2N14556	85	CHEVR	6/14	1.81	221	0.85	70	N/P/F/F	8.01	0.113	4.73	0.340	2.41	0.211	****	*****	****	****	****
276	1DAU917	78	CHEVR	6/14	1.96	1146	0.17	879	T/T/F/F	2.88	0.528	0.34	0.504	3.37	0.720	****	*****	****	****	****
277	939MKA	75	CHEVR	6/14	2.74	263	2.38	64	P/P/F/F	3.81	0.549	5.86	0.264	1.91	0.169	****	*****	****	****	****
278	2CMA798	85	ISUZU	6/14	0.34	188	0.45	95	P/P/F/F	7.41	0.139	6.20	0.118	0.05	0.030	****	*****	0.30	7.40	0.60
279	4A22851	80	DODGE	6/14	2.99	402	2.71	1173	T/T/F/F	5.50	0.258	2.75	0.169	0.17	0.397	****	*****	****	****	****
280	3V58659	86	NISSA	6/14	2.45	2999	1.52	182	T/T/F/F	4.83	0.201	3.19	0.229	****	*****	****	*****	****	****	****
281	605ZIA	80	OLDSM	6/14	9.99	893	9.99	373	T/T/F/F	6.70	0.289	8.87	0.198	10.73	0.695	****	*****	****	****	****

Vehicle Information					SMOG CHECK Data					University of Denver Remote Sensing						General Motors		EPA Dynamometer		
#	License	Model Year	Make	Date	Low Idle %CO	Low Idle HC, ppm	High Idle %CO	High Idle HC, ppm	V/F/E/O	FEAT 1 %CO	FEAT 1 %HC	FEAT 2 %CO	FEAT 2 %HC	FEAT Idle %CO	FEAT Idle %HC	GM RSD %CO	GM RSD %HC	IM240 HC g/mile	IM240 CO g/mile	IM240 NOx g/mile
282	2WGB667	91	HONDA	6/7	0.02	3	0.02	4	P/P/P/P	0.17	0.017	0.16	0.068	0.34	0.037	0.21	-0.012	****	****	****
283	2CIJ633	86	ISUZU	6/10	0.16	81	0.48	74	P/P/P/P	1.06	0.051	****	*****	****	*****	****	*****	1.00	10.20	7.00
284	1MKS036	85	TOYOT	6/10	0.01	15	0.01	11	P/P/P/P	0.07	0.017	0.02	0.057	****	*****	****	*****	****	****	****
285	SHIRAZS	85	MAZDA	6/12	0.02	12	0.02	12	P/P/P/P	2.65	*****	0.10	0.048	0.09	0.089	****	*****	****	****	****

Note: These vehicles were stopped and inspected by mistake.

#	License	Model Year	Make	Date	Low Idle %CO	Low Idle HC, ppm	High Idle %CO	High Idle HC, ppm	V/F/E/O	FEAT 1 %CO	FEAT 1 %HC	FEAT 2 %CO	FEAT 2 %HC	FEAT Idle %CO	FEAT Idle %HC	GM RSD %CO	GM RSD %HC	IM240 HC g/mile	IM240 CO g/mile	IM240 NOx g/mile
Vehicle Information					SMOG CHECK Data					University of Denver Remote Sensing						General Motors		EPA Dynamometer		
286	2PLM313	89	OLDSM	6/14	0.03	77	0.01	2	P/P/P/P	1.49	0.109	1.15	0.397	1.78	0.093	****	*****	****	****	****
287	1BLX125	81	FORD	6/3	1.97	89	2.05	63	T/T/F/F	4.16	0.041	0.44	0.052	****	*****	****	*****	****	****	****
288	1EPW978	82	OLDSM	6/10	0.23	70	9.99	156	T/P/F/F	0.22	0.068	4.36	0.086	0.54	0.130	****	*****	****	****	****
289	1JWB133	80	BMW	6/10	9.95	802	8.96	548	P/P/F/F	8.82	0.267	0.14	0.049	10.80	2.938	****	*****	****	****	****
290	1GSW988	83	TOYOT	6/11	0.12	135	0.11	134	P/P/F/F	0.41	1.794	0.18	0.105	0.55	0.089	****	*****	****	****	****
291	1RJU358	86	SAAB	6/11	4.71	256	2.89	135	P/P/F/F	0.26	0.046	4.80	0.203	****	*****	****	*****	3.70	29.60	1.30
292	1EXD357	81	NISSA	6/13	9.99	705	6.22	196	P/P/F/F	0.34	0.055	7.83	0.155	10.49	0.541	5.23	0.028	****	****	****
293	735RJQ	76	BUICK	6/3	9.99	474	0.18	6	N/P/F/F	****	*****	2.40	0.382	****	*****	****	*****	****	****	****
294	2BFZ658	80	TOYOT	6/5	9.99	891	9.99	663	P/P/F/F	7.83	1.332	****	*****	8.19	0.495	****	*****	****	****	****
295	970FBI	72	TOYOT	6/5	1.99	320	1.30	232	N/N/P/F	****	*****	3.84	0.778	1.84	0.144	****	*****	****	****	****
296	894MJB	74	FORD	6/7	9.99	2057	9.99	431	T/N/F/F	7.04	2.930	****	*****	9.03	0.234	****	*****	****	****	****
297	1DSJ151	74	MAZDA	6/10	7.32	2077	6.82	680	T/T/F/F	7.12	1.696	****	*****	7.73	0.996	****	*****	****	****	****
298	2CHJ476	79	DODGE	6/11	9.23	358	0.02	7	T/N/F/F	****	*****	8.01	0.406	7.23	0.244	8.36	0.056	****	****	****
299	275X10	79	PLYMO	6/12	9.99	565	2.14	61	N/N/F/F	6.04	0.590	****	*****	10.33	0.360	7.98	0.062	3.90	27.60	3.40
300	1RWB018	86	HYUND	6/14	9.66	1399	9.82	701	N/P/F/F	6.03	0.160	****	*****	8.22	0.401	****	*****	****	****	****
301	2NRM423	84	HONDA	6/14	7.40	749	7.11	279	P/P/F/F	8.26	0.217	****	*****	8.96	0.281	****	*****	****	****	****

Note: Only 1 excessive reading from the remote senors. Two were required.

Vehicle Information					SMOG CHECK Data					University of Denver Remote Sensing						General Motors		EPA Dynamometer		
#	License	Model Year	Make	Date	Low Idle %CO	Low Idle HC, ppm	High Idle %CO	High Idle HC, ppm	V/F/E/O	FEAT 1 %CO	FEAT 1 %HC	FEAT 2 %CO	FEAT 2 %HC	FEAT Idle %CO	FEAT Idle %HC	GM RSD %CO	GM RSD %HC	IM240 HC g/mile	IM240 CO g/mile	IM240 NOx g/mile
302	2P01857	85	NISSA	6/6	0.00	3	0.28	16	P/P/P/P	6.00	-0.027	6.70	0.031	6.34	0.034	****	*****	****	****	****
303	ERNSMOM	84	BMW	6/7	0.01	0	0.01	3	P/P/P/P	2.93	0.078	6.52	0.341	6.30	0.130	****	*****	****	****	****
304	2SKP845	86	CHEVR	6/7	0.00	6	0.03	22	P/P/P/P	9.21	0.966	8.86	0.873	6.52	0.186	****	*****	****	****	****
305	2JDC505	81	FORD	6/7	0.50	52	0.01	71	P/P/P/P	6.09	0.305	3.07	0.115	****	*****	****	*****	****	****	****
306	2VVL663	91	FORD	6/10	0.01	0	0.01	0	P/P/P/P	-0.01	-0.033	0.28	0.991	0.01	0.039	0.07	0.012	****	****	****
307	1FHJ457	82	TOYOT	6/11	0.00	11	0.16	22	P/P/P/P	5.73	0.410	****	*****	0.64	0.225	2.43	0.026	****	****	****
308	1LWN152	85	CHEVR	6/11	0.00	24	0.01	10	P/P/P/P	4.48	0.228	4.66	0.185	1.57	0.212	****	*****	****	****	****
309	2LHR030	88	CHEVR	6/13	0.48	52	0.00	1	P/P/P/P	4.40	0.151	****	*****	0.99	1.957	5.89	0.087	****	****	****
310	1FUM277	82	CADIL	6/13	0.17	92	0.48	27	P/P/P/P	3.42	0.432	3.41	0.161	****	*****	1.35	0.031	****	****	****
311	2NYL821	89	HYUND	6/14	0.01	2	0.12	11	P/P/P/P	3.55	0.131	2.80	0.743	0.19	0.059	****	*****	****	****	****

Note: Cars identified by the driver as being driven less than 5 minutes.

Vehicle Information					SMOG CHECK Data					University of Denver Remote Sensing						General Motors		EPA Dynamometer		
#	License	Model Year	Make	Date	Low Idle %CO	Low Idle HC, ppm	High Idle %CO	High Idle HC, ppm	V/F/E/O	FEAT 1 %CO	FEAT 1 %HC	FEAT 2 %CO	FEAT 2 %HC	FEAT Idle %CO	FEAT Idle %HC	GM RSD %CO	GM RSD %HC	IM240 HC g/mile	IM240 CO g/mile	IM240 NOx g/mile
312	1MXN025	85	CADIL	6/4	0.01	24	0.01	0	P/P/P/P	****	*****	****	*****	****	*****	****	*****	****	****	****
313	2MQV695	88	FORD	6/4	0.02	4	0.02	5	P/P/P/P	****	*****	****	*****	****	*****	****	*****	****	****	****
314	1JFC654	84	MAZDA	6/4	0.01	15	0.25	41	P/P/P/P	****	*****	****	*****	****	*****	****	*****	****	****	****
315	1EIX015	82	SAAB	6/4	0.05	83	0.48	30	P/P/P/P	****	*****	****	*****	****	*****	****	*****	****	****	****
316	2AXT763	84	FORD	6/4	0.10	196	0.05	54	T/N/F/F	****	*****	****	*****	****	*****	****	*****	****	****	****
317	2MFJ549	78	PONTI	6/4	0.22	1531	0.36	1269	N/N/F/F	****	*****	****	*****	****	*****	****	*****	****	****	****
318	509YBG	79	MAZDA	6/4	4.18	1474	2.22	404	T/N/F/F	****	*****	****	*****	****	*****	****	*****	****	****	****
319	000TCL	77	PONTI	6/4	0.10	465	0.44	1153	N/N/F/F	****	*****	****	*****	****	*****	****	*****	****	****	****
320	1GBY375	83	BUICK	6/4	7.60	618	4.14	223	P/N/F/F	****	*****	****	*****	****	*****	****	*****	****	****	****
321	1BDC030	80	MAZDA	6/4	1.04	174	2.60	535	T/T/F/F	****	*****	****	*****	****	*****	****	*****	****	****	****
322	2BXZ984	85	NISSA	6/4	2.18	301	7.53	252	P/P/F/F	****	*****	****	*****	****	*****	****	*****	****	****	****
323	2TVS969	83	MAZDA	6/4	1.71	1856	9.99	326	T/N/F/F	****	*****	****	*****	****	*****	****	*****	5.70	82.40	****
324	2DSN822	75	FORD	6/4	7.82	141	1.26	22	N/N/F/F	****	*****	****	*****	****	*****	****	*****	****	****	****
325	1FRJ363	82	BUICK	6/4	5.81	288	8.47	262	T/N/F/F	****	*****	****	*****	****	*****	****	*****	4.10	105.40	4.40
326	2LIM508	84	CHEVR	6/4	5.71	721	9.99	700	P/P/F/F	****	*****	****	*****	****	*****	****	*****	****	****	****
327	1RKM673	78	TOYOT	6/4	9.99	458	9.99	214	P/P/F/F	****	*****	****	*****	****	*****	****	*****	****	****	****
328	1SKY324	86	HYUND	6/4	1.76	156	5.14	157	N/P/F/F	****	*****	****	*****	****	*****	****	*****	2.50	62.20	0.60
329	2GSA938	87	NISSA	6/4	0.01	24	9.99	211	P/P/F/F	****	*****	****	*****	****	*****	****	*****	****	****	****
330	4E41148	73	FORD	6/13	3.28	217	0.09	22	N/P/F/F	****	*****	****	*****	5.08	0.220	****	*****	****	****	****

Note: Vehicles stopped and inspected without video comfirmation check. On the afternoon of the 4th all of the video tape units attached to the remote sensors were not properply activated to record the information.

Vehicle Information					SMOG CHECK Data					University of Denver Remote Sensing						General Motors		EPA Dynamometer		
#	License	Model Year	Make	Date	Low Idle %CO	Low Idle HC, ppm	High Idle %CO	High Idle HC, ppm	V/F/E/O	FEAT 1 %CO	FEAT 1 %HC	FEAT 2 %CO	FEAT 2 %HC	FEAT Idle %CO	FEAT Idle %HC	GM RSD %CO	GM RSD %HC	IM240 HC g/mile	IM240 CO g/mile	IM240 NOx g/mile
331	E420927	87	FORD	6/12	0.01	3	0.02	8	P/P/P/P	0.02	0.030	0.03	0.048	0.93	0.314	****	*****	0.60	2.60	1.30
332	2UEJ886	90	MITSU	6/14	0.00	0	0.00	0	P/P/P/P	0.00	0.049	0.05	0.057	****	*****	****	*****	0.00	0.10	****
333	E404366	83	FORD	6/12	0.05	64	2.82	91	N/P/F/F	0.15	-0.002	****	*****	1.70	0.299	6.72	0.035	1.20	51.70	0.60
334	E383185	83	FORD	6/12	9.18	132	1.46	89	P/P/F/F	4.94	0.133	****	*****	7.27	0.323	****	*****	1.10	32.20	1.00

Note: These are M85 fueled vehicles volunteered by CARB.

#	License	Model Year	Make	Date	Low Idle %CO	Low Idle HC, ppm	High Idle %CO	High Idle HC, ppm	V/F/E/O	FEAT 1 %CO	FEAT 1 %HC	FEAT 2 %CO	FEAT 2 %HC	FEAT Idle %CO	FEAT Idle %HC	GM RSD %CO	GM RSD %HC	IM240 HC g/mile	IM240 CO g/mile	IM240 NOx g/mile
Vehicle Information					SMOG CHECK Data					University of Denver Remote Sensing						General Motors		EPA Dynamometer		
335	301UQG	80	OLDS	6/5	****	***	****	***	*/*/*/*	3.43	0.112	6.37	0.379	****	*****	****	*****	3.50	85.60	1.20
336	090JOV	73	DODGE	6/5	****	***	****	***	*/*/*/*	4.81	0.123	8.22	0.381	****	*****	****	*****	8.70	170.10	0.90
337	136WRQ	79	TOYOT	6/6	****	***	****	***	*/*/*/*	6.50	0.077	6.63	0.199	****	*****	****	*****	4.40	117.90	0.40
338	1EXW629	82	PONTI	6/7	****	***	****	***	*/*/*/*	1.24	0.517	0.59	0.741	****	*****	****	*****	24.50	37.30	2.20
339	2NOH746	74	MERCU	6/10	****	***	****	***	*/*/*/*	9.76	0.340	3.22	0.120	****	*****	****	*****	9.30	76.20	10.40
340	1NCS413	85	TOYOT	6/11	****	***	****	***	*/*/*/*	3.27	0.101	4.17	0.166	****	*****	****	*****	2.20	55.50	2.40
341	1KRZ843	81	TOYOT	6/13	****	***	****	***	*/*/*/*	5.48	0.154	7.06	0.210	****	*****	****	*****	1.90	73.20	0.30
342	1MKP779	85	NISSA	6/14	****	***	****	***	*/*/*/*	7.72	0.187	9.85	0.144	****	*****	****	*****	3.20	81.70	0.40

Note: These vehicles were identified by remote sensing and tested using IM240 prior to the SMOG CHECK inspection teams availability.