EPA-460/2-74-001

February 1974

AUTOMOBILE EXHAUST EMISSION SURVEILLANCE-ANALYSIS OF THE FY 72 PROGRAM

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Water Programs
Office of Mobile Source Air Pollution Control
Certification and Surveillance Division
Ann Arbor, Michigan 48105

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Publication No. EPA-460/2-74-001

ABSTRACT

The Environmental Protection Agency has recognized that a realistic assessment of the effectiveness of Federal air pollution regulations requires the measurement of emissions from production vehicles in the hands of the motoring public. Accordingly, the Emission Factor Program has been developed to obtain this needed information by testing fleets of consumer-owned vehicles in six major cities.

This report summarizes the results of the FY72 Emission Factor Program and compares these results with those obtained in the FY71 Emission Factor Program. The report discusses the following topics

A. The exhaust emissions of current model-year vehicles are compared to the Federal standards.

B. The emissions from light-duty motor vehicles are characterized by vehicle model-year.

C. The effects of the more restrictive California emissions regulations are investigated.

D. Vehicle deterioration due to mileage accumulation and age is examined.

This report interfaces with APTD-1544, _Automobile Exhaust Emission Surveillance - A Summary_, which analyzes the FY71 Emission Factor Program and the earlier surveillance programs which were performed using cold-start 7-mode test procedures.

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1. SUMMARY, CONCLUSIONS AND BACKGROUND

The purpose of this report is to summarize information on emissions from light-duty vehicles. State and local agencies, Federal air pollution officials, automobile manufacturers and concerned citizens can use this report to estimate the impact that light-duty vehicle emissions have on air quality and to determine conformity of vehicles to the standards under which they were certified.

This report summarizes the findings and results of the individual contractor reports which were prepared as part of the FY72 EPA Emission Factor Program. More detailed information on specific vehicle tests or the results thereof can be obtained from the appropriate contractor's report [see references (1), (2), (3)]. Whenever possible, results from the FY72 Emission Factor Program are compared with the corresponding results from the FY71 Emission Factor Program [see references (4), (5)].

The FY72 EPA Emission Factor Program consisted of exhaust emissions tests performed on 170 1966 through 1972 model-year in-use automobiles and light trucks (under 6000 pounds gross weight) in each of six cities: Denver, St. Louis, Chicago, Los Angeles, Houston, and Washington, D. C. These test locations represent some of the nation's most populated areas as well as the most diverse areas in terms of climate and terrain -- Los Angeles representing the temperate, warm western part of the nation; Denver at a mile high elevation representing mountainous metropolitan areas; Chicago for the Great Lakes and northest sector, typical of cities with long winter seasons; St. Louis in the Great Plains with moderate winters; Houston in the Great Plains with a very warm, humid climate; and Washington, D. C., typical of cities on the eastern seaboard.

Exhaust emissions tests were performed in accordance with the 1975 Federal Test Procedure which allowed calculation of grams-per-mile results with both the 1972 and 1975 Federal Test Procedure (FTP) weighting factors. Evaporative emissions were measured in accordance with the Sealed Housing for Evaporative Determinations (SHED) technique described in SAE Standard J171. Analysis of evaporative emission data from the FY72 Emission Factor Program is not presented in this report. A separate analysis will be prepared which analyzes evaporative emission data collected in the FY71 and FY72 Emission Factor Programs.

This analysis will examine fuel type, vehicle soak time and other procedure parameters which can vary from vehicle to vehicle and site to site. Before accurate comparisons can be made between vehicles and sites, corrections must be included to account for the effect of these parameters on evaporative emissions.

The EPA Emission Factor Program is an on-going study which obtains current emission data on in-use vehicles. The vehicles tested in the program are randomly selected to represent the national population of in-use vehicles. This on-going effort up-dates emissions data first obtained in 1971 by the 1972/75 FTP and adds new data from the latest model-year. The result of this effort is that over a period of several years, the contribution made by light-duty vehicles to atmospheric pollution can be quantified. The acquisition of emission factors on a regularly scheduled basis will assist in comparing control strategies with control results. Also, this information will help in the prediction of serious air pollution episodes in densely populated areas, and quantify the urgency of the vehicle pollution problem in comparison to the many other environmental and energy related problems.

1.1 SUMMARY

Hydrocarbon (HC), carbon monoxide (CO), oxides of nitrogen (NO_x) and carbon dioxide (CO_2) emissions were measured for each of the 1020 vehicles tested in the FY72 Emission Factor Program.

In an effort to assess the extent to which local climate, terrain, driving practices and other geographical factors affect emissions, vehicles were sampled in several cities, selected to span the range of such factors. Only small differences were observed in the emission levels measured in the cities included in the survey, the notable exceptions being Denver and Los Angeles. Significantly higher carbon monoxide and hydrocarbon emissions and lower NO_x emissions were observed in Denver than in the other cities, presumably because of the effect of increased altitude on enriching air-fuel ratios. For 1970-1972 model-year vehicles, carbon monoxide emissions were significantly higher in Los Angeles than they were in the four other cities: Chicago, Houston, St. Louis, and Washington. A possible explanation is that California vehicles were subject to state emission standards which did not apply to vehicles sold in the other 49 states. 1970 California vehicles were required to meet evaporative emission standards (all vehicles were required to meet such standards in 1971); however based on current EPA data, the effect of evaporative controls on CO emissions cannot be isolated.

In 1971 and 1972, California established state standards for oxides of nitrogen. Based upon previous data on in-use vehicles, NO_x emissions have been negatively correlated with HC and CO emissions. One possible explanation for this is that the methods chosen by the manufacturers to control HC and CO emissions (before NO_x emissions were controlled) tended to increase NO_x emissions. Given that the HC and CO control systems tend to increase NO_x emissions, a reduction in NO_x emissions due to the imposition of an NO_x standard might be expected to result in some increase in HC and CO, especially if the same control systems were just recalibrated.

Since the FY72 Emission Factor Program was the second year of a major surveillance program which used the CVS test procedure to test in-use vehicles, meaningful comparisons can be made between the two studies. A major question of interest focuses on the question of whether 1972 model-year in-use vehicles had lower emissions in their first year of operation than 1971 model-year vehicles had in their first year of operation. The average mileage for the two model-year groups differ by at most 11% for any of the three city breakdowns. This difference in mileage is not statistically significant due to the high variability associated with mileage for each model-year group. In addition, if EPA deterioration factors are applied to correct for the mileage differences, the correction is less than one percent in all cases. The comparison of emissions from 1971 and 1972 model-year vehicles is given in the following table based on the 1972 FTP.

Comparison of Mean Emission Results from
FY71 and FY72 Emission Factor Programs

(1972 FTP)

Locations	Average Mileage (in thousands)	HC (in gms per mi)	CO (in gms per mi)	NO_{xc} (in gms per mi)
Four Cities				
1971 Program: 1971 model-year vehicles	15.6	3.42	46.33	4.99
1972 Program: 1972 model-year vehicles	14.8	3.42	43.79	4.52
Percent Reduction		0%	5%	9%
Los Angeles				
1971 Program: 1971 model-year vehicles	15.8	3.51	51.90	3.81
1972 Program: 1972 model-year vehicles	17.6	4.07	55.77	3.83
Percent Reduction		-16%	-7%	0%
Denver				
1971 Program: 1971 model-year vehicles	15.2	6.73	100.04	3.04
1972 Program: 1972 model-year vehicles	14.1	5.61	90.42	3.00
Percent Reduction		17%	10%	1%

The results of this table should be examined in light of two major factors. First, vehicles sold in California were required to meet NO_x emission standards in 1971 and more stringent NO_x emission standards in 1972 while vehicles sold in other states were not required to meet any NO_x standards during these two years. Second, 1972 was the first year when national HC standards were 3.4 gm/mi and CO standards were 39 gm/mi. With the new more stringent standards, many manufacturers completely redesigned their pollution control systems for the 1972 model year production. These two factors may partially explain why mean HC and CO emissions increased in Los Angeles and decreased only slightly in the other low altitude cities from 1971 to 1972. However, it should be noted that due to the variability in the emission measurements, none of the changes in HC or CO emissions between 1971 and 1972 model-year vehicles are statistically significant at the 95% confidence level. The reduction in NO_x in the four combined cities from 1971 model-year vehicles to 1972 model-year vehicles is statistically significant at the 95% confidence level.

1.2 CONCLUSIONS

Results of the FY72 EPA Emission Factor Program summarized in this report reveal that:

1. Exhaust emission levels depend on a number of factors peculiar to a specific vehicle, including its weight, its engine displacement, and its accumulated mileage.

2. Two city effects of appreciable engineering magnitude were observed. Carbon monoxide and hydrocarbon emissions tended to be higher in Denver than in other cities, whereas oxides of nitrogen tended to be lower. The observed differences are believed to be attributable to the effect of altitude on air-fuel ratios. For 1970-1972 model-year vehicles, carbon monoxide emissions were significantly higher in Los Angeles than in other low altitude cities. This observed difference may possibly be related to the California imposed standards on evaporative emissions starting in 1970 and California imposed standards on NO_x starting in 1971.

3. Individual vehicles of a particular category show wide dispersion in exhaust emissions. Consequently, two categories of vehicles, for example populations of vehicles tested in two different cities, may show considerable overlap of their statistical distributions even though the mean emissions for the two categories are appreciably different. Generalizations with regard to make, city or other categories of interest, therefore, are often not applicable to comparison of individual vehicles or small subsets of vehicles drawn from the two categories.

4. Tests of light duty vehicles tested in 1972 show a downward trend in HC and CO emissions from 1966-1967 (pre-control in all cities except Los Angeles) to 1972 and an increasing trend for NO_x emissions. This trend is shown by the following average emission levels based upon the 1972 CVS Test Procedure.

Emission Levels (gm/mi)
1972 CVS Test Procedure

	HC	CO	NO_{xc}
Four City Total			
1966-1967 vehicles	9.56	106.46	3.24
1972 vehicles	3.42	43.79	4.52
Percent Reduction	64%	59%	-39%
Denver			
1966-1967 vehicles	13.16	152.93	2.02
1972 vehicles	5.61	90.42	3.00
Percent Reduction	57%	41%	-48%
Los Angeles			
1966-1967 vehicles	7.09	93.13	3.56
1972 vehicles	4.07	55.77	3.83
Percent Reduction	42%	40%	-8%

It is important to remember that these figures reflect any deterioration which occurred on the vehicles and therefore, these figures should only be used to estimate the impact of various model years on current air quality.

5. Tests of 1972 model-year light duty vehicles indicate that the following percent of vehicles were at or below the 1972 Federal Standards for HC and CO. That is, the percentage of 1972 vehicles which met the 1972 CVS standards were:

Pollutant	Four Cities	Denver	Los Angeles
HC	60%	14%	57%
CO	52%	9%	31%
Both	42%	3%	29%

Comparison of the FY72 Emission Factor Program with the FY71 Emission Factor Program reveals that

6. In the four low altitude cities, HC and CO emissions increase with increasing mileage for model years 1968-1971. In addition to this mileage effect, a significant age or program effect is indicated for model-years 1970-1971. An age or program effect results when a significant difference in the emissions of the same model-year vehicles tested in the FY71 and FY72 Emission Factor Programs occurs even though the two groups of vehicles have been statistically corrected to the same mileage point. Before the magnitude of the age or program effect can be computed, it will be necessary to examine the results from the FY73 Emission Factor Program which is currently in progress.

1.3 BACKGROUND

The Congress, through the enactment of the Clean Air Act of 1963 and amendments thereto, provided for a national air pollution program to monitor and control emissions from new motor vehicles. Administrative responsibility for the air pollution control program is vested with the U. S. Environmental Protection Agency (EPA). The first nationwide standards for exhaust emissions, together with the testing and certification procedures were issued in 1966 and were applicable to 1968 model-year passenger vehicles and light-duty trucks sold within the United States. Levels for maximum allowable exhaust emissions were imposed initially on HC and CO emittants only. Hydrocarbons were restricted to 275 parts per million concentration and carbon monoxide was restricted to 1.5 percent*. These emittants were measured using the 7-mode cold-start test procedure. More stringent standards on a mass equivalent basis were introduced for 1970 and 1971 model vehicles. The Federal standards based on the 7-mode procedure, expressed in mass equivalents, were 2.2 grams/mile for HC and 23 grams/mile for CO. In 1972, a change was made to a new test procedure. This procedure contained a new sampling method, the Constant Volume Sampling Procedure (CVS), and a new driving sequence. At that time the standards were again strengthened. HC was restricted to 3.4 grams/mile and CO was restricted to 39.0 grams/mile. The numerical increase in the standards from 1971 to 1972 reflects the increased stringency of the testing procedures. In terms of

*These were the standards for vehicles with engines greater than 140 cubic inches displacement. Vehicles with engines which did not exceed 100 cubic inches displacement were restricted to 410 ppm HC and 2.3 percent CO.

the 1972 test procedure, the 1971 standards were equivalent to approximately 4.6 grams/mile for HC and 47 grams/mile for CO. The first Federal Standards applicable to oxides of nitrogen were promulgated for 1973 model-year light-duty vehicles and were set at 3.0 grams/mile. The first Federal evaporative emission standards were introduced for 1971 model-year vehicles.

Under the Clean Air Act, manufacturers are required to submit applications containing data gathered during both phases of a two-part test program in order to qualify for certificates of conformity. For model years 1968 through 1971, the first phase of testing provides data on exhaust emissions which show the performance of the control equipment after the engine has been broken in, but before substantial mileage has been accumulated. These data are known as 4,000 mile emission data. The second phase of the test program provides data on the durability of the emission control system. These data are known as 50,000 mile durability data. For 1968-1971 model-year vehicles, compliance was demonstrated whenever the mean emission level from a specified sample of emission-data prototypes of each engine displacement, weighted according to projected sales volume, was within the applicable standard. This mean incorporates a deterioration factor determined from a sample of durability-data prototypes representative of at least 70% of the manufacturer's engine displacement/transmission options. Inherent in this method of certification is the fact that mean values for HC or CO near the standard make it possible for 50% of certification or in-use vehicles to be above the standard for either pollutant. (The 50% figure assumes that emissions of prototype vehicles are normally distributed. In the case of lognormality, less than 50% of the vehicles would be above the standard.)

For 1972 and subsequent model-year vehicles, every vehicle tested in the certification sample must have emissions below the level of the applicable standard. The certification prototypes are tested with vehicle parameter settings, e.g. engine timing, at or near the mean of the allowable production range. Therefore, to the extent that emissions vary within the allowable range of parameter settings, some percentage of production vehicles might be expected to emit pollutants above the certified standard. At the present time, no data exist to quantify this percentage.

EPA has recognized that a realistic assessment of the effectiveness of Federal air pollution regulations requires the measurement of emissions from production vehicles in the hands of the motoring public. Accordingly, a series of exhaust emission surveillance programs has been administered by the EPA during the past several years to obtain such definitive information. Test fleets of consumer-owned vehicles within various major cities were selected by make, model, engine size, transmission, and carburetor categories in such proportion as to be representative of the normal production vehicles sold (or projected to be sold) for that model year in the United States.

The principal objectives of such surveillance programs have been to establish the relationship of emissions from in-use production vehicles to certification emission levels and to assess the effects on emission levels resulting from the test locale (i.e., the influence of climate, topography and urban development), vehicle mileage accumulation and vehicle make/model/engine differences. Using the data from the surveillance programs, the Surveillance Branch works with the National Air Data Branch (NADB) and the Land Use Planning Branch (LUPB) to develop appropriate in-use vehicle emission factors from which emission source inventories, vehicle emission control strategies, and emergency episode pollution abatement procedures can be developed. In addition, the data are used to model the effect of automobile emissions under arbitrary traffic and road network conditions in order to evaluate transportation control systems.

2. EMISSION FACTOR PROGRAM DESIGN

Since the Emission Factor Program is designed to accurately determine emission factors from in-use vehicles, the vehicles tested are selected at random to represent the national distribution of vehicle miles travelled by in-use vehicles. The vehicles selected are in customer use and are tested as received in order to reflect differences in usage, maintenance and repair. In order to obtain a valid statistical sample of vehicles, the number of vehicle miles travelled by model-year vehicle is considered. Within each model year, the vehicle sample is selected based upon vehicle sales by vehicle make, engine size, carburetor type and transmission type. An important consideration in support of any program objective is orderly accumulation, processing, and reporting of data. Precision test equipment, well-defined procedures, rigorous qualification, calibration and cross-check techniques were used. Standardized data reporting procedures and flow routines were established and quality audits, which checked and verified each data point, were performed. In short, rigid test sample requirements were established, individual vehicles were selected by a carefully designed procurement and selection plan, accurate testing procedures and calibrations were established and maintained, and all data were subjected to rigid quality inspection and verification routines to ensure the overall accuracy and validity of the study.

2.1 FY72 TEST VEHICLE SELECTION PROCEDURE

The objective of the test vehicle procurement task was to obtain test vehicles in the appropriate model year, make, carburetor, and transmission categories so that the total sample would be representative of the nationwide vehicle population profile. To satisfy this goal the contractors used the selection procedure shown in Figure 1.

In each of the cities, a sample of 1966 through 1972 automobiles registered within each site boundary was obtained from a private listing. From this listing, a subsample of vehicles which best fit the required vehicle population profile was selected. Introductory letters were mailed to vehicle owners selected in the subsample and follow-up contacts were made when necessary. After contractor procurement personnel were sufficiently satisfied with the validity of candidate vehicle information files, suitable vehicles were scheduled for testing. Upon delivery of test vehicles to the laboratory, all vehicles were inspected for compliance with established criteria prior to final acceptance. Vehicles which were not safe to run on the dynamometer and vehicles with faulty exhaust systems were rejected.

2.2 FY72 TEST VEHICLE HANDLING PROCEDURE

Test vehicles were scheduled for testing at each of the laboratories in accordance with the respective laboratory work load and manpower capabilities. To encourage participation, incentives were provided to each vehicle owner. Virtually all of the participants were given fully insured loan cars while their cars were being tested. In addition to the loan car, each participant was given a $25 U. S. Savings Bond.

Figure 2 shows the routing of test vehicles from acceptance through return to participants at the completion of testing. The constant volume sampling technique by the 1975 Federal Test Procedure was utilized for determination of exhaust emissions. The Sealed Housing for Evaporative Determinations (SHED) technique was performed to determine levels of evaporative hydrocarbon losses in general accordance with SAE Technical Report J171.

Upon completion of testing, engine diagnostic procedures were performed (basic timing, point dwell, idle rpm and mixture). The vehicle was then returned to the participant.

3. STATISTICAL ANALYSIS

The frequency distribution of exhaust emissions of current automobiles is governed by constraints which make it unlikely that the emission measurements will follow a normal (Gaussian) distribution. In particular, mass emission data are necessarily non-negative and are therefore more strictly bounded on the low end of the distribution than on the high end of the distribution. This fact, and the fact that errors of measurement tend to be proportional to the concentration being measured, combine to cause the frequency distribution of exhaust measurements to be skewed toward the high side of the range of emission values. Furthermore, experience as well as theoretical statistical arguments suggest that the frequency distribution of exhaust emissions is essentially lognormal. In other words, if the logarithms of the emission quantities are used to compile a frequency distribution or histogram, the resulting distribution tends to be symmetric and is approximated by a normal distribution with appropriate mean and standard deviation. These quantities, computed in logarithmic units, can be transformed back to antilogarithms, but the transformed values are not to be confused with the mean and standard deviation computed from the original data as expressed in grams per mile. Mean values computed from logarithmically transformed data represent geometric means, whereas mean values computed from the original data represent arithmetic means.

Due to the theoretical and empirical evidence of lognormality, geometric means and standard deviations as well as arithmetic means and standard deviations are presented in several of the tables of this report.

A word of explanation is in order with regard to the geometric mean and standard deviation and their interpretation in an emissions context. If the geometric mean is <u>multiplied</u> by the geometric standard deviation, one obtains a quantity which represents approximately the 84th percentile of the distribution, in much the same way as one obtains this percentile in a normal distribution by <u>adding</u> the standard deviation to the mean. Similarly, by multiplying the geometric mean by the geometric standard deviation <u>squared</u>, one obtains approximately the 95th percentile of the distribution in much the same way as one obtains this percentile in a normal distribution by adding two standard deviations to the mean.

The distributions of the pollutants collected in the FY72 Emission Factor Program, when examined by city and model year, are found for the most part to be lognormally distributed, although in some cases they are normally distributed.* Table 1 shows the appropriate statistical distribution by pollutant, city and model year. A few of the pollutant-city-model year populations do not appear to be either lognormally or normally distributed. For this reason the standard statistical methods, which assume normality, are not immediately applicable to these data. Therefore, nonparametric or "distribution free" methods have been used, whenever possible, to analyze the data.

If the distribution were symmetrical and fifty percent of the vehicles met the standard, the mean of all the vehicles would also meet the standard. This relationship does not apply, however, with a skewed distribution. If an indication of total mean emissions is desired and the vehicle population has a skewed distribution, the mean emission level of a group of vehicles must be looked at independently of the percent of these vehicles which conform to the standard. Thus, the arithmetic means are useful in assessing the impact of groups of vehicles on air quality. The geometric means are indicative of central tendancy. In a lognormal distribution, the geometric mean indicates the 50th percentile point of the distribution.

3.1 CITY EFFECTS

Two city effects are detected in the FY72 Emission Factor data. The first effect involves Denver. Denver vehicles produced significantly higher levels of hydrocarbons and carbon monoxide and lower nitrogen oxide emissions than the emissions which were produced by the vehicles in the other cities. The principal consideration distinguishing Denver is its altitude, which affects carburetion and tends to produce excessively rich fuel mixtures. The second city effect is associated with Los Angeles and appears in the model years of 1970 through 1972. Carbon monoxide emissions are significantly higher in Los Angeles than in the model-years of 1970 through 1972. Carbon monoxide emissions are significantly higher in Los Angeles than they are in the four other cities Chicago, Houston, St. Louis, and Washington. Odometer readings tend to be higher on Los

*To determine the statistical form of a distribution, a null hypothesis is formed and tested. The null hypothesis is stated in the positive. Therefore, statistically, the null hypothesis (for example, the distribution is normal) can be rejected but can never be accepted. Due to the small number of observations in each sample, more than one null hypothesis may not be rejected. This explains why some populations can be characterized by more than one distribution.

Angeles vehicles than vehicles from other cities. Inasmuch as variation in mileage could contribute to variation in emissions, both groups were adjusted by regression analysis to a common mileage point as a prerequisite to assessment of a city effect. The higher carbon monoxide emissions in Los Angeles for 1970-1972 remained significant after the adjustment was made. This effect is thought to be related to California's emission standards for the model years in question. In 1970, California vehicles were required to meet state evaporative emissions standards while vehicles from other cities did not have evaporative standards until 1971. California vehicles were required to meet state emissions standards on oxides of nitrogen starting in 1971 while vehicles from other cities did not have to meet NO_x standards until the 1973 model year. Therefore, in the following analyses, Los Angeles and Denver are considered separately from the other four cities.

3.2 EMISSION DATA AND RESULTS

The results of the FY72 Emission Factor Program are summarized in Tables 2 through 13. For each set of tables, Los Angeles and Denver are treated separately. Individual tables appear for the cold transient, hot transient, and cold stabilized portions of the Federal Test Procedure as well as the 1972 FTP result. The individual bag results are given in Tables 2 through 10 so that any users who wish to assign their own weighting factors can do so. Results based on the 1975 weighting factors are given in Appendix I. In Appendix II, the corresponding set of 1972 FTP tables and 1975 FTP tables, based on the data collected in the FY71 Emission Factor Program, are given. These data have previously been analyzed (4). However, they are presented here for ease of comparison.

Data from the hot stabilized portion of the FTP have, in the past, been assumed to be similar to the results from the cold stabilized portion and therefore hot stabilized data are not presented in this report. Nevertheless, an analysis was performed to detect statistical differences between the hot and cold stabilized emissions collected during the FY72 Emission Factor Program and the FY71 Emission Factor Program. There are large differences betwen hot and cold stabilized data for many vehicles. However, when an average of all vehicles was considered, no pollutant demonstrated a statistically significant difference in both programs. Thus, the differences could be due to the maintenance status of the vehicles or some unknown factor. Overall, the analysis gives little indication that would refute the assumption that vehicles produce similar emissions under cold stabilized and hot stabilized operating conditions.

Tables 11 through 13 and I-1 through I-3, present the 1972 and 1975 results obtained in the FY72 Emission Factor Program. These tables contain three columns with the heading "Percent Below Level". These columns give the percentage of vehicles with emissions which are no greater than the 1972 Federal Standards of 3.4 gm/mile for HC and 39.0 gm/mile for CO, and the 1973 Federal Standards of 3.0 gm/mile for NO_x. The HC and CO standards are applicable only to the 1972 FTP results for 1972 model-year vehicles. These same levels are compared to the 1975 FTP emission results and to model years other than 1972 merely to illustrate time trends.

Tables 14 through 20 give the 1972 Federal Test Procedure results by model year, engine displacement, and inertia weight for the combined data of Chicago, Houston, St. Louis and Washington. Similar tables based on the 1975 FTP weighting factors are given in Appendix I. There are tables for each of the model years 1966 through 1972. The tables contain the arithmetic means and standard deviations of the 1972 FTP emission results in grams/mile. The engine displacements are broken down into classes which represent four cylinder, six cylinder, and small, medium, and large sized eight cylinder vehicles. The inertia weights are those that are assigned to vehicles in the table provided in the Federal Register. In this report, five hundred pound increments are used to establish class boundaries from 2000 to 5000 pounds. This classification of data by year, CID, and inertia weight is not particularly informative for an individual city since the number of observations per cell becomes extremely small. Therefore, individual tables based on Los Angeles and Denver data are not presented.

The data in Tables 14 through 20 indicate that NO_x tends to increase as inertia weight increased for all model-year vehicles. However, no trends are clearly definable over all model years for HC and CO. Efforts to relate HC and CO emissions to inertia weight by using regression analysis did not result in significant reduction of variability.

Three histograms were constructed for each of the three pollutants, showing Denver data, Los Angeles data, and the pooled data from the other four cities, for 1972 model-year vehicles as shown in Figures 3 through 5. The intervals of each histogram were chosen so that the 1972 FTP standard for a pollutant would form one of the class boundaries. In this way, the percent of vehicles above and below standard can be determined easily. However, due to the fact that the lower limit of pollutants is zero, the fixing of a class boundary at the 1972 standard may make the first class interval shorter than the other intervals.

3.3 FUEL ECONOMY

The purpose of this report is not to predict fuel economy (or fuel consumption) for individual vehicles based upon vehicle parameters. This subject has been treated extensively in reference (6). Also, the purpose of this report is not to find the average mpg of a sample of vehicles for the purpose of predicting the mpg response of a particular vehicle. This application would treat mpg as a single response, not a ratio quantity, and therefore, the arithmetic mean would be the appropriate quantity to examine. This report addresses itself to characterizing the fuel economy of groups of vehicles. Fuel economy is inversely related to fuel consumption. For this application, therefore, fuel consumption (gallons of gasoline used) could have been considered directly. However, fuel economy expressed in mpg, to represent fuel consumption, has been proposed as an appropriate alternative in the current literature. Based upon this definition, the data shown in Tables 14 through 20 indicate that there are not significant differences between the fuel economies exhibited by the different model years in the study if the fuel economy for each model year is averaged over all inertia weight and engine displacement groups. From these tables, it can be seen that fuel economy is highly dependent on inertia weight and engine displacement and that inertia weight and engine displacement are highly correlated. Thus, fuel economy decreases (fuel consumption increases) with increasing inertia weight and increasing engine displacement. Tables 21 through 23 display fuel economy by model year averaged over a sales weighted selection of vehicles for the 1972 FTP, the 1975 FTP and the cold transient, hot transient, and stabilized portions of the Federal Test Procedure. It should be noted that each model-year group of vehicles is sales-weighted separately according to sales in each individual model year. Therefore, changing inertia weight trends with model year confound attempts to isolate model year differences in fuel economy due to emission control systems. It can be noted that the results of the FY71 Emission Factor Program (Table II-7) in the four combined cities indicate a linearly decreasing trend in fuel economy. The 1971 model-year vehicles appear to have approximately 7% poorer fuel economy than 1966-1967 model-year vehicles. Although such a decrease could be expected based on engineering analysis, the measured 95% confidence intervals around the fuel economy for a given model year (four cities combined) have a width of approximately ten percent. The results of the FY72 Emission Factor Program (Table 21) in the four combined cities do not indicate the same linearly decreasing trend in fuel economy, although 1972 model-year vehicles have approximate 5% poorer fuel economy than 1966-1967 model-year vehicles. Again, this difference is not statistically significant. Statistically, the null hypothesis of no model year trends cannot be rejected.

3.4 DETERIORATION FACTORS

A deterioration factor reflects the degree by which a vehicle's engine and ancillary control equipment depreciate with accumulated age and mileage resulting in changes in the vehicle's emissions. Deterioration factors were calculated for Denver, Los Angeles, and the four combined cities. This analysis provided overall mileage deterioration information and is not indicative of individual vehicle deterioration with accumulated mileage. Linear regressions versus mileage were performed on the pooled emissions of the FY71 and FY72 Emission Factor Programs for each model year and for each of the three city groups. The data collected in the two studies were combined so that a broader range of mileages per model year would be obtained. The resulting regression lines were used to calculate predicted emissions at a particular mileage. The deterioration factors were then defined as:

$$\text{d.f.} = \frac{\text{Predicted value at X mileage}^{*}}{\text{Predicted value at 4,000 miles.}}$$

The use of a linear regression model to calculate deterioration factors is not an extremely accurate method for it masks any trends of varying deterioration rates. For example, this technique would conceal more rapid deterioration at the lower mileages if such a trend occurs. The California Air Resources Board (CARB) avoids this particular problem by performing a regression of log emissions versus mileage which results in a prediction curve that is exponential. The CARB technique was not used in preparing this report because there is little evidence that the behavior of emissions over a mileage range is more adequately represented by an exponential curve than by a straight line. In addition, the straight line fit is the method the EPA uses in the Certification Program and is therefore the method used in this report. Further analysis needs to be performed by studying repetitive tests on individual vehicles to determine the most appropriate model. At present, different vehicles tested at different mileages are the basis for inferences about mileage effects. Factors, such as maintenance, that distinguish one vehicle from another confound the mileage effect

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* The deterioration factors for 1966-1967 model-year vehicles used a baseline value of 50,000 miles instead of 4,000 miles due to a lack of low mileage data on these vehicles.

in this type of analysis. Repeated measurements of emissions over mileage on the same in-use vehicle would eliminate these confounding factors.

Deterioration factors for the 15,000 - 60,000 mile range are displayed by 15,000 mile intervals in Tables 24 through 26. The 50,000 mile figure is also presented because it is the reference deterioration value that is defined by the Federal Register. Caution should be used in interpreting the CARB factors used in this report. These factors were calculated using values read from CARB regression curves. The factors, as given in the tables, were not directly computed by CARB.

The EPA deterioration factors stated in the tables are the best available estimates. However, a lot of variability exists in the emission results for any given mileage point and most of the regression equations are not statistically significant due to this large variability. A statistically significant regression line is one in which the slope is tested to be equal to zero and this assumption is rejected. The statistically significant regressions are noted in Tables 24 - 26. A deterioration factor of 1.0 implies that the slope of the regression line of emissions vs. mileage is zero. It should be noted that these two possibilities are not the same. That is, a regression line can have a best estimate slope which is non-zero and still not be statistically significant. Also, a regression line can have very little variability and still have a slope of zero if there is no linear relationship between emissions and mileage.

Generally, the deterioration factors indicate that HC and CO emissions increase with increasing mileage while NO_{xc} either decreases or remains constant with mileage accumulation. However, Denver and Los Angeles deterioration values are more erratic than are those of the other groups. Due to the large variability of emission results which occur during vehicle testing and vehicle-to-vehicle differences in deterioration, the small sample sizes which result from considering just one city group can lead to an inability to accurately determine deterioration factors. CO emissions decrease for some model years and increase for other years in Denver. For Los Angeles and the four combined cities, hydrocarbon deterioration factors are greater for the EPA data than are the hydrocarbon deterioration factors computed from the CARB data. The opposite trend occurs among carbon monoxide factors.

3.5 COMPARISON OF DATA FROM THE FY71 EMISSION FACTOR PROGRAM WITH DATA FROM THE FY72 EMISSION FACTOR PROGRAM

By conducting Emission Factor Programs on a yearly basis, it is possible to isolate what happens to a given model-year group of vehicles as it ages and to compare different model-year groups of vehicles at the same point in their age-mileage cycle.

3.5.1 Mileage and Program Effects

An analysis of the combined FY71 and FY72 Emission Factor Program data was performed in order to investigate mileage effects and program effects. These results are given in Table 27. The data from both programs were blocked into groups of vehicles that were subject to similar emission standards. Consequently, the emissions were analyzed in groups separated by the model years 1966-67, 1968-69, 1970-71.

The term "mileage effects" when used with reference to emissions may have several connotations and may therefore be subject to misinterpretation. Ideally, an investigation of "mileage effects" should only be concerned with the deterioration of emission control performance with increasing mileage. Practically, however, a variety of factors such as the state of engine adjustment or repair hinder any attempt to isolate this fundamental mileage effect. Pollutant levels were established for each vehicle in an "as received" condition regardless of its operating condition. Consequently, in the context of this report, mileage effects are used to describe trends other than aging which become increasingly prominent as the vehicle accumulates mileage or receives inadequate maintenance. Significant mileage effects are detected among the 1968-1969 and the 1970-1971 model-year groups.

Program effects are found primarily among the 1970-1971 model-year vehicles. Program effects in this analysis are two-fold. They are a measure of the effect of one year of aging on vehicles since the comparison is between vehicles of the same model year tested one year apart. Thus, an age effect will measure emission deterioration which can occur with increasing age regardless of any mileage increase (such as deterioration due to rusting of the exhaust system) as well as deterioration due to rate of mileage accumulation. In addition to age effects, program effects measure contractor or study design differences. Program effects, as defined, are not a major component of emission deterioration on older vehicles.

An analysis of deterioration due to age only was performed on the sample of pre-controlled (1957-1967 model years) vehicles taken in the FY71 Emission Factor Program. Although a significant mileage effect was found, no age effect was indicated among the 1957-1967 vehicles. These findings suggest that for precontrolled vehicles, deterioration is a result of factors, other than aging, such as mileage accumulation or maintenance.

3.5.2 Performance of Vehicles in Their First Year of Operation

A major question of interest focuses on the question of whether 1972 model-year vehicles have lower levels of emissions in their first year of operation than the 1971 vehicles had in their first year of operation. Table 28 displays the mean emission levels for these two groups of vehicles.

The results of this table should be examined in light of several factors. In Denver, where HC and CO emission levels have been extremely high as a result of the altitude, improvements have been made. HC emissions have been reduced 17%, and CO emissions have been reduced 10%. NO_x emission levels which have been controlled in the state of California since the 1971 model-year, remained unchanged and are lower than the mean NO_x emissions in other low altitude cities. Although no data are available to isolate its cause, the increase in HC and CO emissions observed for 1972 model-year cars in Los Angeles may possibly be attributable to design changes made by the manufacturers in response to changes in the Federal HC and CO standards and California NO_x standards in that year. Because of the combination of more stringent California NO_x standards than in 1971, and adoption of more stringent Federal HC and CO standards employing new testing procedures, many manufacturers redesigned their emission control systems for 1972 models sold in California. In a number of cases, manufacturers switched from engine modification as the sole means of emission control to engine modification coupled with exhaust gas recirculation (EGR). It is possible that the new systems introduced on the 1972 models reflected trade-offs of HC and CO control for NO_x control or simply a lack of design optimization. Yet another possibility is that the more stringent controls employed in California and the accompanying deterioration in vehicle driveability have led to a greater incidence of engine maladjustment in the field in attempts to achieve driveability improvements.

Mean HC emissions remained unchanged and mean CO emissions were reduced by 5% when new 1972 model-year vehicles were compared with new 1971 model-year vehicles in low altitude cities. It is significant that NO_x emissions, which were not subject to Federal emission standards in model-year 1971 and model-year 1972, decreased in 1972 models for the first time since emission controls were established in 1968. Although sufficient data are not available to determine why NO_x emissions improved outside of California in 1972 model-year vehicles, a possible explanation is that some manufacturers chose to make one version of vehicle to be sold in all 50 states. Thus, many vehicles sold outside of California did, in fact, have NO_x controls. In 1971, California had less stringent NO_x standards than in 1972. Some manufacturers also sold 50 state vehicles in 1971. However, the manufacturers selling 50 state vehicles and the NO_x control systems on the 50 state vehicles were not necessarily the same in 1971 and 1972. Therefore, the magnitude of the 50 state vehicle effect could likely be different for the two years, 1971 and 1972.

It should be pointed out that the HC emissions of in-use 1972 vehicles have mean emission levels equal to the 1972 Federal standard of 3.4 gm/mi and CO emission levels 12% above the 1972 Federal standard of 39 gm/mi.

Table 29 examines the percentage of 1971 vehicles tested in the FY71 Emission Factor Program and 1972 vehicles tested in the FY72 Emission Factor Program which met the 1971 and 1972 Federal standards for HC and CO. These results substantiate the results displayed in Table 28.

3.6 MILEAGE DATA

Although the primary purpose of the Emission Factor Program is to obtain accurate emission factors for use in calculating the exact contribution of light-duty vehicles to total atmospheric pollution, the data collected in the program can be used to characterize the mileage distribution of vehicles by model year and age.

Data points can be plotted to show the frequency distribution using mileage as the independent variable. If the distribution curve were known, then it would be possible to define mathematically the probability that a randomly selected vehicle of a given model year and age has a given mileage. In particular, the percent of vehicles with mileages above any given point can be calculated. A very useful distribution curve was suggested in 1950 by Weibull to be used in analyzing product reliability or conformity. This system of analysis is based on the Weibull equation

$$F(t) = 1 - \exp\left(\frac{t - t_o}{\eta}\right)^{\beta}$$

where

$F(t)$ = Cumulative probability from t_o to t

β = Weibull slope

η = Characteristic life (63% of the distribution is to the left of this point)

t = Random variable

t_o = Origin of the distribution.

Figures 6 through 12 show the cumulative Weibull distributions and the Weibull density functions,

$$\frac{dF(t)}{dt},$$

for model years covered in the FY72 Emission Factor Program. For model years 1966-1971, the Weibull distributions of vehicles tested in the FY71 Emission Factor Program are also shown. These figures can be used to estimate the percentage of vehicles in any model year-age-mileage grouping.

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TABLES

TABLE 1

Statistical Distribution* of Emission Data from FY72 Emission Factor Program - by City, Year, and Pollutant

	Chicago	Denver	Houston	Los Angeles	St. Louis	Washington
1966						
HC	L	U	N,L	U	N,L	L
CO	N,L	N,L	N	N,L	N,L	N,L
NO_{xc}	N,L	N,L	N,L	N,L	N,L	N,L
1967						
HC	N,L	L	N,L	L	N,L	L
CO	N,L	N,L	L	N,L	N,L	N,L
NO_{xc}	N,L	N,L	N,L	N,L	N,L	N,L
1968						
HC	L	L	L	L	L	L
CO	N,L	N,L	N,L	N,L	N,L	N,L
NO_{xc}	N,L	N,L	N,L	N,L	N,L	N,L
1969						
HC	L	N,L	N,L	L	L	N,L
CO	N,L	N,L	N,L	N,L	L	N,L
NO_{xc}	N,L	N,L	N,L	N,L	N,L	N,L
1970						
HC	N,L	N,L	L	U	L	U
CO	N,L	N,L	L	N,L	N,L	L
NO_{xc}	N,L	N,L	N,L	N,L	N,L	N,L
1971						
HC	U	N,L	N,L	L	L	L
CO	L	N,L	L	N,L	L	L
NO_{xc}	N	N,L	N,L	N,L	N,L	N,L
1972						
HC	N,L	L	L	L	N,L	N,L
CO	N,L	N,L	N,L	N,L	N,L	N,L
NO_{xc}	N,L	N,L	N,L	N,L	N,L	N,L

*N = Normal
L = Lognormal
U = Uncharacterized

TABLE 2

FY72 EMISSION FACTOR PROGRAM

COMPOSITE EMISSION LEVELS FOR ALL CITIES EXCLUDING DENVER AND LOS ANGELES

COLD TRANSIENT DATA

			HYDROCARBONS-GRAMS				CARBON MONOXIDE-GRAMS				NOX-GRAMS			
			ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC	
YEAR	N	MEAN MILES (K)	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
1966	68	71.7	42.23	29.65	35.97	1.70	445.05	261.23	386.26	1.71	13.01	6.55	11.07	1.89
1967	72	67.0	33.55	20.01	30.04	1.56	406.86	185.19	367.89	1.59	14.35	6.76	12.72	1.69
TOTAL	140	69.3	37.77	25.44	32.78	1.64	425.41	225.34	376.70	1.65	13.70	6.67	11.89	1.79
1968	84	57.9	28.19	24.10	23.26	1.73	310.90	196.44	261.01	1.84	16.84	6.96	15.31	1.58
1969	88	51.2	23.84	14.59	21.32	1.54	330.98	193.55	285.14	1.73	20.00	8.22	17.76	1.75
1970	108	36.8	25.29	26.41	20.39	1.75	294.99	205.77	243.24	1.86	17.37	6.47	16.11	1.51
1971	120	26.4	18.16	9.52	16.56	1.50	257.97	165.47	216.48	1.84	18.46	7.11	16.82	1.62
1972	140	14.8	14.89	10.50	13.20	1.62	188.45	112.96	157.98	1.86	20.19	6.89	18.93	1.47
TOTAL	540	34.4	21.22	16.31	17.86	1.70	267.48	180.21	219.89	1.90	18.69	7.20	17.09	1.58

NOX CORRECTED FOR HUMIDITY

TABLE 3

FY72 EMISSION FACTOR PROGRAM

COMPOSITE EMISSION LEVELS FOR ALL CITIES EXCLUDING DENVER AND LOS ANGELES

HOT TRANSIENT DATA

YEAR	N	MEAN MILES (K)	HYDROCARBONS-GRAMS ARITHMETIC MEAN	HYDROCARBONS-GRAMS ARITHMETIC SD	HYDROCARBONS-GRAMS GEOMETRIC MEAN	HYDROCARBONS-GRAMS GEOMETRIC SD	CARBON MONOXIDE-GRAMS ARITHMETIC MEAN	CARBON MONOXIDE-GRAMS ARITHMETIC SD	CARBON MONOXIDE-GRAMS GEOMETRIC MEAN	CARBON MONOXIDE-GRAMS GEOMETRIC SD	NOX-GRAMS ARITHMETIC MEAN	NOX-GRAMS ARITHMETIC SD	NOX-GRAMS GEOMETRIC MEAN	NOX-GRAMS GEOMETRIC SD
1966	68	71.7	29.25	29.33	22.81	1.88	263.56	165.38	216.68	1.96	14.32	7.36	12.09	1.95
1967	72	67.0	23.04	14.71	20.62	1.53	246.26	107.50	225.52	1.53	15.71	7.40	14.02	1.65
TOTAL	140	69.3	26.06	23.13	21.66	1.71	254.66	138.43	221.19	1.75	15.03	7.39	13.05	1.80
1968	84	57.9	19.44	17.33	15.37	1.99	162.99	97.81	134.99	1.91	19.48	7.44	17.82	1.58
1969	88	51.2	14.54	8.74	13.11	1.53	142.14	82.15	119.50	1.87	22.64	8.77	20.71	1.57
1970	108	36.8	15.42	14.71	12.90	1.66	124.88	81.26	104.31	1.84	19.92	7.60	17.93	1.82
1971	120	26.4	12.04	5.70	11.11	1.47	135.77	128.12	102.64	2.11	19.29	7.30	17.61	1.61
1972	140	14.8	9.67	6.68	8.71	1.57	97.50	82.22	75.13	2.07	20.58	7.47	19.10	1.51
TOTAL	540	34.4	13.66	11.44	11.61	1.69	128.94	98.59	101.59	2.03	20.33	7.73	18.57	1.62

NOX CORRECTED FOR HUMIDITY

TABLE 4

FY72 EMISSION FACTOR PROGRAM

COMPOSITE EMISSION LEVELS FOR ALL CITIES EXCLUDING DENVER AND LOS ANGELES

COLD STABILIZED DATA

YEAR	N	MEAN MILES (K)	HYDROCARBONS-GRAMS ARITHMETIC MEAN	HYDROCARBONS-GRAMS ARITHMETIC SD	HYDROCARBONS-GRAMS GEOMETRIC MEAN	HYDROCARBONS-GRAMS GEOMETRIC SD	CARBON MONOXIDE-GRAMS ARITHMETIC MEAN	CARBON MONOXIDE-GRAMS ARITHMETIC SD	CARBON MONOXIDE-GRAMS GEOMETRIC MEAN	CARBON MONOXIDE-GRAMS GEOMETRIC SD	NOX-GRAMS ARITHMETIC MEAN	NOX-GRAMS ARITHMETIC SD	NOX-GRAMS GEOMETRIC MEAN	NOX-GRAMS GEOMETRIC SD
1966	68	71.7	36.81	37.25	28.94	1.86	375.88	187.14	324.02	1.81	10.20	5.69	8.58	1.88
1967	72	67.0	31.25	20.16	27.63	1.58	370.39	145.17	336.61	1.63	11.02	6.05	9.53	1.75
TOTAL	140	69.3	33.95	29.73	28.26	1.72	373.06	166.29	330.44	1.72	10.62	5.87	9.06	1.81
1968	84	57.9	23.16	19.59	18.62	1.94	257.92	155.05	211.85	1.96	14.04	6.86	12.37	1.70
1969	88	51.2	17.70	10.68	16.03	1.50	244.52	149.95	199.30	1.99	16.58	7.03	14.88	1.65
1970	108	36.8	17.02	14.55	14.41	1.67	201.16	176.38	150.52	2.19	13.80	6.24	12.45	1.60
1971	120	26.4	14.92	12.73	12.91	1.61	195.15	154.49	149.69	2.14	13.32	5.35	12.08	1.62
1972	140	14.8	10.75	8.86	9.11	1.79	139.98	112.57	98.81	2.46	13.70	5.31	12.61	1.53
TOTAL	540	34.4	15.99	13.85	13.22	1.80	199.86	154.38	148.81	2.28	14.16	6.14	12.76	1.62

NOX CORRECTED FOR HUMIDITY

TABLE 5

FY72 EMISSION FACTOR PROGRAM

EMISSION LEVELS FOR DENVER

COLD TRANSIENT DATA

			HYDROCARBONS-GRAMS				CARBON MONOXIDE-GRAMS				NOX-GRAMS			
		MEAN MILES	ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC	
YEAR	N	(K)	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
1966	17	60.6	44.92	31.87	39.47	1.58	517.90	213.12	476.43	1.54	9.95	5.95	8.08	2.08
1967	18	69.8	59.68	31.76	53.57	1.58	669.33	179.08	647.33	1.31	6.46	2.77	5.80	1.68
TOTAL	35	65.3	52.51	32.23	46.19	1.61	595.78	208.10	557.78	1.47	8.15	4.86	6.81	1.91
1968	21	51.4	38.71	25.82	33.09	1.71	556.64	341.39	478.66	1.73	9.95	4.91	8.45	1.93
1969	22	46.1	30.41	8.55	29.22	1.34	502.20	205.71	461.27	1.54	10.66	4.74	9.70	1.57
1970	27	31.6	28.32	6.91	27.19	1.33	456.15	192.39	418.65	1.54	12.46	4.74	11.53	1.52
1971	30	18.2	26.24	11.45	24.36	1.46	402.58	220.61	356.12	1.64	11.58	5.86	10.31	1.62
1972	35	14.1	26.32	29.09	21.96	1.62	385.98	164.50	348.53	1.63	12.31	6.35	10.90	1.66
TOTAL	135	29.6	29.30	19.70	26.19	1.53	449.19	228.95	399.49	1.63	11.54	5.47	10.27	1.66

NOX CORRECTED FOR HUMIDITY

TABLE 6

FY72 EMISSION FACTOR PROGRAM

EMISSION LEVELS FOR DENVER

HOT TRANSIENT DATA

			HYDROCARBONS-GRAMS				CARBON MONOXIDE-GRAMS				NOX-GRAMS			
		MEAN MILES	ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC	
YEAR	N	(K)	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
1966	17	60.6	29.28	20.76	25.59	1.61	397.18	181.85	362.18	1.55	8.67	6.18	6.52	2.32
1967	18	69.8	42.50	29.28	36.08	1.73	478.86	184.64	446.97	1.47	7.81	5.22	6.33	2.00
TOTAL	35	65.3	36.08	26.01	30.53	1.71	439.19	185.27	403.56	1.52	8.22	5.64	6.42	2.13
1968	21	51.4	21.14	6.57	20.16	1.38	292.38	113.39	269.57	1.54	12.59	5.59	11.58	1.51
1969	22	46.1	18.68	3.94	18.27	1.25	290.76	134.24	263.08	1.58	12.52	5.82	11.15	1.68
1970	27	31.6	17.70	5.60	17.01	1.32	253.12	97.02	235.59	1.48	14.34	4.84	13.51	1.45
1971	30	18.2	17.04	4.94	16.36	1.34	248.33	116.60	225.31	1.57	11.38	5.17	10.36	1.54
1972	35	14.1	15.05	4.54	14.36	1.37	253.64	111.80	228.20	1.63	13.30	6.43	11.87	1.64
TOTAL	135	29.6	17.56	5.42	16.77	1.36	264.43	114.17	240.53	1.56	12.84	5.64	11.66	1.57

NOX CORRECTED FOR HUMIDITY

TABLE 7

FY72 EMISSION FACTOR PROGRAM

EMISSION LEVELS FOR DENVER

COLD STABILIZED DATA

			HYDROCARBONS-GRAMS				CARBON MONOXIDE-GRAMS				NOX-GRAMS			
		MEAN MILES	ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC	
YEAR	N	(K)	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
1966	17	60.6	37.33	26.06	31.69	1.70	477.58	232.03	427.96	1.63	8.06	6.21	5.85	2.41
1967	18	69.8	54.51	42.05	43.82	1.91	620.65	243.65	577.11	1.48	6.04	4.45	4.63	2.16
TOTAL	35	65.3	46.16	35.77	37.56	1.83	551.16	245.52	499.10	1.59	7.02	5.40	5.19	2.27
1968	21	51.4	22.99	15.29	20.32	1.58	354.68	318.28	281.31	1.93	10.01	4.85	8.91	1.67
1969	22	46.1	21.07	4.73	20.52	1.28	352.17	146.64	316.59	1.67	10.23	6.11	8.71	1.83
1970	27	31.6	19.39	6.70	18.53	1.34	315.95	120.64	296.15	1.44	11.40	4.01	10.71	1.46
1971	30	18.2	17.93	7.34	16.99	1.36	287.73	146.48	254.55	1.69	9.08	4.93	8.04	1.64
1972	35	14.1	15.72	5.13	14.90	1.40	292.15	134.76	259.03	1.70	10.22	4.82	9.11	1.65
TOTAL	135	29.6	18.95	8.47	17.72	1.42	315.44	177.03	277.38	1.68	10.17	4.92	9.05	1.65

NOX CORRECTED FOR HUMIDITY

TABLE 8

FY72 EMISSION FACTOR PROGRAM

EMISSION LEVELS FOR LOS ANGELES

COLD TRANSIENT DATA

YEAR	N	MEAN MILES (K)	HYDROCARBONS-GRAMS				CARBON MONOXIDE-GRAMS				NOX-GRAMS			
			ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC	
			MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
1966	17	73.0	28.90	26.00	23.65	1.78	400.90	163.37	361.01	1.67	14.89	8.30	12.39	2.00
1967	18	66.7	27.12	18.19	22.32	1.89	366.98	245.98	309.07	1.80	16.14	7.02	14.36	1.72
TOTAL	35	69.7	27.99	22.01	22.95	1.83	383.46	207.63	333.29	1.74	15.54	7.58	13.37	1.85
1968	21	65.0	29.84	19.12	26.60	1.56	313.66	143.93	284.60	1.58	21.46	8.56	19.73	1.54
1969	22	49.5	26.37	17.32	22.44	1.77	346.88	98.11	332.49	1.36	19.60	6.04	18.80	1.34
1970	27	40.2	31.82	29.80	25.41	1.83	362.98	166.69	327.79	1.59	19.32	5.86	18.32	1.42
1971	30	32.1	19.32	6.26	18.35	1.39	284.33	104.99	268.15	1.41	17.51	4.97	16.85	1.33
1972	35	17.6	17.82	18.59	14.84	1.66	233.43	83.60	218.11	1.47	18.12	4.97	17.48	1.31
TOTAL	135	37.9	24.22	20.09	20.29	1.71	301.62	128.65	276.57	1.52	18.98	6.05	18.05	1.38

NOX CORRECTED FOR HUMIDITY

TABLE 9

FY72 EMISSION FACTOR PROGRAM

EMISSION LEVELS FOR LOS ANGELES

HOT TRANSIENT DATA

			HYDROCARBONS-GRAMS				CARBON MONOXIDE-GRAMS				NOX-GRAMS			
		MEAN MILES	ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC	
YEAR	N	(K)	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
1966	17	73.0	22.22	34.36	14.89	2.06	244.30	152.14	201.17	1.95	15.17	7.52	12.64	2.05
1967	18	66.7	15.39	11.98	12.70	1.82	203.96	141.46	164.19	1.99	17.10	7.80	14.99	1.79
TOTAL	35	69.7	18.70	25.28	13.72	1.93	223.56	146.00	181.21	1.97	16.16	7.62	13.80	1.91
1968	21	65.0	21.13	16.50	17.47	1.80	159.88	78.45	140.80	1.71	21.05	8.39	19.15	1.61
1969	22	49.5	15.63	13.50	13.39	1.61	180.45	80.13	164.14	1.58	20.72	6.58	19.72	1.39
1970	27	40.2	20.40	20.15	16.13	1.84	209.54	108.34	185.19	1.67	19.46	6.84	18.06	1.52
1971	30	32.1	12.00	4.52	11.30	1.41	156.31	81.08	139.72	1.61	18.05	5.12	17.33	1.34
1972	35	17.6	11.08	10.28	9.15	1.75	113.87	56.45	99.46	1.74	17.82	5.84	16.94	1.39
TOTAL	135	37.9	15.46	14.03	12.64	1.77	160.44	86.92	139.12	1.74	19.17	6.51	18.02	1.44

NOX CORRECTED FOR HUMIDITY

TABLE 10

FY72 EMISSION FACTOR PROGRAM

EMISSION LEVELS FOR LOS ANGELES

COLD STABILIZED DATA

			HYDROCARBONS-GRAMS				CARBON MONOXIDE-GRAMS				NOX-GRAMS			
		MEAN MILES	ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC	
YEAR	N	(K)	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
1966	17	73.0	30.87	59.49	17.84	2.24	340.13	197.60	284.30	1.92	10.68	7.03	8.38	2.17
1967	18	66.7	19.76	20.68	14.66	2.10	291.27	182.05	233.93	2.06	11.61	6.73	9.82	1.85
TOTAL	35	69.7	25.15	43.76	16.14	2.15	315.00	188.57	257.17	1.99	11.16	6.79	9.10	2.00
1968	21	65.0	27.41	25.69	20.30	2.15	224.37	137.86	179.36	2.14	15.62	6.64	14.06	1.66
1969	22	49.5	20.43	26.68	14.61	2.23	285.09	183.11	225.97	2.13	14.88	6.67	13.75	1.49
1970	27	40.2	24.51	25.05	18.67	1.93	313.04	168.89	265.70	1.88	14.02	5.92	12.62	1.66
1971	30	32.1	14.71	8.81	13.00	1.61	236.08	126.14	199.88	1.88	10.87	3.63	10.23	1.45
1972	35	17.6	12.72	18.20	8.89	2.12	184.86	126.06	147.59	2.01	10.64	3.99	10.04	1.40
TOTAL	135	37.9	19.06	21.55	13.83	2.11	244.36	152.73	196.21	2.04	12.83	5.62	11.71	1.55

NOX CORRECTED FOR HUMIDITY

TABLE 11

FY72 EMISSION FACTOR PROGRAM

COMPOSITE EMISSION LEVELS FOR ALL CITIES EXCLUDING DENVER AND LOS ANGELES

1972 FTP

YEAR	N	MEAN MILES (K)	% BELOW LEVEL *			HYDROCARBONS GM/MI				CARBON MONOXIDE GM/MI				NOX GM/MI			
						ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC	
			HC	CO	NOX	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
1966	68	71.7	0	1	47	10.54	8.64	8.81	1.72	109.46	53.59	97.82	1.63	3.09	1.54	2.67	1.82
1967	72	67.0	0	3	49	8.64	5.16	7.76	1.54	103.63	39.26	95.95	1.51	3.38	1.64	3.02	1.64
TOTAL	140	69.3	0	2	48	9.56	7.11	8.25	1.63	106.46	46.69	96.85	1.57	3.24	1.59	2.84	1.73
1968	84	57.9	10	14	32	6.85	5.49	5.73	1.72	75.84	41.35	65.27	1.78	4.12	1.67	3.75	1.57
1969	88	51.2	17	13	17	5.54	3.14	5.04	1.48	76.73	41.94	67.23	1.69	4.88	1.90	4.43	1.62
1970	108	36.8	21	24	21	5.64	5.04	4.71	1.68	66.15	45.67	55.16	1.82	4.16	1.61	3.85	1.51
1971	120	26.4	37	26	22	4.41	2.50	4.00	1.50	60.42	39.45	50.94	1.81	4.24	1.57	3.89	1.58
1972	140	14.8	60	52	17	3.42	2.50	3.03	1.63	43.79	25.84	36.31	1.91	4.52	1.55	4.23	1.47
TOTAL	540	34.4	32	28	21	4.96	3.95	4.22	1.69	62.31	40.40	51.55	1.89	4.38	1.66	4.03	1.55

NOX CORRECTED FOR HUMIDITY

*
LEVELS
HC 3.4 GM/MI
CO 39.0 GM/MI
NOX 3.0 GM/MI

NOTE: SEE TEXT ON PAGE 14

TABLE 12

FY72 EMISSION FACTOR PROGRAM

EMISSION LEVELS FOR DENVER

1972 FTP

YEAR	N	MEAN MILES (K)	% BELOW LEVEL *			HYDROCARBONS GM/MI				CARBON MONOXIDE GM/MI				NOX GM/MI			
						ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC	
			HC	CO	NOX	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
1966	17	60.6	0	0	71	10.97	7.41	9.64	1.59	132.73	55.71	122.91	1.49	2.40	1.57	1.92	2.07
1967	18	69.8	0	0	83	15.23	9.55	13.16	1.70	172.00	51.43	165.08	1.34	1.67	0.90	1.43	1.81
TOTAL	35	65.3	0	0	77	13.16	8.73	11.31	1.68	152.93	56.39	143.04	1.46	2.02	1.31	1.65	1.95
1968	21	51.4	0	0	62	8.23	5.22	7.22	1.62	121.51	83.14	103.60	1.74	2.66	1.20	2.37	1.71
1969	22	46.1	5	0	73	6.86	1.60	6.67	1.29	113.92	42.50	105.81	1.50	2.79	1.38	2.50	1.60
1970	27	31.6	0	0	48	6.36	1.72	6.15	1.30	102.95	37.78	96.49	1.45	3.18	1.09	3.00	1.44
1971	30	18.2	3	7	63	5.89	2.18	5.59	1.37	92.04	44.15	83.11	1.58	2.76	1.34	2.48	1.58
1972	35	14.1	14	9	49	5.61	4.34	4.97	1.53	90.42	35.79	82.84	1.56	3.00	1.37	2.71	1.60
TOTAL	135	29.6	5	4	58	6.43	3.41	5.92	1.46	101.95	49.79	92.10	1.57	2.90	1.28	2.62	1.58

NOX CORRECTED FOR HUMIDITY

* LEVELS
HC 3.4 GM/MI
CO 39.0 GM/MI
NOX 3.0 GM/MI

NOTE: SEE TEXT ON PAGE 14

TABLE 13

FY72 EMISSION FACTOR PROGRAM

EMISSION LEVELS FOR LOS ANGELES

1972 FTP

YEAR	N	MEAN MILES (K)	% BELOW LEVEL *			HYDROCARBONS GM/MI				CARBON MONOXIDE GM/MI				NOX GM/MI			
						ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC	
			HC	CO	NOX	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
1966	17	73.0	12	6	47	7.97	11.31	5.66	1.96	98.81	42.27	88.84	1.67	3.41	1.97	2.81	2.03
1967	18	66.7	28	11	28	6.25	4.75	5.03	1.94	87.77	52.25	74.25	1.84	3.70	1.75	3.27	1.72
TOTAL	35	69.7	20	9	37	7.09	8.50	5.33	1.93	93.13	47.30	81.01	1.76	3.56	1.84	3.04	1.87
1968	21	65.0	14	19	19	7.63	5.54	6.39	1.77	71.74	32.31	64.77	1.61	4.94	1.96	4.54	1.55
1969	22	49.5	18	9	14	6.24	5.50	5.07	1.86	84.26	32.63	77.95	1.53	4.60	1.65	4.36	1.39
1970	27	40.2	11	11	15	7.51	7.18	5.94	1.84	90.14	42.49	81.01	1.62	4.44	1.50	4.15	1.49
1971	30	32.1	33	10	27	4.54	1.77	4.24	1.44	69.39	26.88	65.12	1.43	3.78	1.02	3.65	1.33
1972	35	17.6	57	31	31	4.07	4.87	3.24	1.75	55.77	25.41	50.51	1.58	3.83	1.15	3.68	1.33
TOTAL	135	37.9	30	17	22	5.77	5.32	4.65	1.82	72.80	33.97	65.53	1.60	4.24	1.48	4.00	1.42

NOX CORRECTED FOR HUMIDITY

* LEVELS
HC 3.4 GM/MI
CO 39.0 GM/MI
NOX 3.0 GM/MI

NOTE: SEE TEXT ON PAGE 14

TABLE 14

FY72 EMISSION FACTOR PROGRAM

1972 FTP RESULTS BY INERTIA WEIGHT AND ENGINE DISPLACEMENT FOR ALL CITIES, EXCLUDING DENVER AND LOS ANGELES

EMISSIONS IN GM/MI - GAS MILEAGE IN MI/GAL

MODEL YEAR=1966

ENGINE DISPLACEMENT (CID)

INERTIA WT. (LBS)	≤150		151-250		251-339		340-399		≥ 400		TOTAL	
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
≤ 2000	N= 4		N= 0		N= 0		N= 0		N= 0		N= 4	
HC	19.65	27.11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.65	27.11
CO	88.96	21.15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	88.96	21.15
NOX	1.73	0.62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.73	0.62
GAS MILEAGE	19.76	2.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.76	2.99
2001-2500	N= 0		N= 1		N= 0		N= 0		N= 0		N= 1	
HC	0.0	0.0	12.55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.55	0.0
CO	0.0	0.0	153.57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	153.57	0.0
NOX	0.0	0.0	1.07	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.07	0.0
GAS MILEAGE	0.0	0.0	12.70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.70	0.0
2501-3000	N= 0		N= 13		N= 4		N= 0		N= 0		N= 17	
HC	0.0	0.0	8.21	5.79	13.47	9.41	0.0	0.0	0.0	0.0	9.45	6.86
CO	0.0	0.0	95.75	44.73	90.89	45.99	0.0	0.0	0.0	0.0	94.60	43.61
NOX	0.0	0.0	2.90	1.25	4.23	1.87	0.0	0.0	0.0	0.0	3.21	1.47
GAS MILEAGE	0.0	0.0	16.31	2.13	15.33	1.61	0.0	0.0	0.0	0.0	16.07	1.99
3001-3500	N= 0		N= 2		N= 7		N= 0		N= 0		N= 9	
HC	0.0	0.0	5.70	2.45	7.74	2.58	0.0	0.0	0.0	0.0	7.28	2.56
CO	0.0	0.0	96.11	31.44	72.88	42.31	0.0	0.0	0.0	0.0	78.04	39.64
NOX	0.0	0.0	3.63	0.13	3.83	1.28	0.0	0.0	0.0	0.0	3.79	1.12
GAS MILEAGE	0.0	0.0	16.44	1.41	13.59	1.72	0.0	0.0	0.0	0.0	14.14	1.99
3501-4000	N= 0		N= 0		N= 12		N= 11		N= 0		N= 23	
HC	0.0	0.0	0.0	0.0	11.45	3.32	9.49	3.57	0.0	0.0	10.51	3.51
CO	0.0	0.0	0.0	0.0	118.92	31.05	139.17	85.89	0.0	0.0	128.60	62.79
NOX	0.0	0.0	0.0	0.0	3.26	1.26	2.33	1.62	0.0	0.0	2.82	1.49
GAS MILEAGE	0.0	0.0	0.0	0.0	13.04	1.07	12.23	2.99	0.0	0.0	12.64	2.30
4001-4500	N= 0		N= 0		N= 2		N= 8		N= 2		N= 12	
HC	0.0	0.0	0.0	0.0	8.66	0.33	13.72	12.71	6.75	0.47	11.72	10.58
CO	0.0	0.0	0.0	0.0	125.61	12.81	104.44	52.26	122.82	34.75	111.03	44.25
NOX	0.0	0.0	0.0	0.0	2.86	0.58	4.08	2.12	3.12	1.45	3.71	1.84
GAS MILEAGE	0.0	0.0	0.0	0.0	11.88	1.68	12.07	1.94	11.96	1.47	12.02	1.68
4501-5000	N= 0		N= 0		N= 0		N= 0		N= 1		N= 1	
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.61	0.0	5.61	0.0
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.75	0.0	100.75	0.0
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.34	0.0	3.34	0.0
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.60	0.0	10.60	0.0
>5000	N= 0		N= 0		N= 0		N= 0		N= 1		N= 1	
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.26	0.0	11.26	0.0
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	232.02	0.0	232.02	0.0
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.04	0.0	1.04	0.0
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.30	0.0	9.30	0.0
TOTAL	N= 4		N= 16		N= 25		N= 19		N= 4		N= 68	
HC	19.65	27.11	8.17	5.41	10.51	4.71	11.27	8.63	7.59	2.52	10.54	8.64
CO	88.96	21.15	99.41	43.30	102.08	40.23	124.54	73.96	144.60	62.51	109.46	53.59
NOX	1.73	0.62	2.87	1.24	3.55	1.33	3.06	2.00	2.66	1.37	3.09	1.54
GAS MILEAGE	19.76	2.99	16.04	2.18	13.41	1.57	12.16	2.52	10.84	1.51	13.61	2.84

NOX CORRECTED FOR HUMIDITY

TABLE 15

FY72 EMISSION FACTOR PROGRAM

1972 FTP RESULTS BY INERTIA WEIGHT AND ENGINE DISPLACEMENT FOR
ALL CITIES, EXCLUDING DENVER AND LOS ANGELES

EMISSIONS IN GM/MI - GAS MILEAGE IN MI/GAL

MODEL YEAR=1967

ENGINE DISPLACEMENT (CID)

INERTIA WT. (LBS)	≤150		151-250		251-339		340-399		≥ 400		TOTAL	
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
≤ 2000	N= 3		N= 0		N= 0		N= 0		N= 0		N= 3	
HC	6.05	3.08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.05	3.08
CO	62.42	10.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.42	10.49
NOX	1.62	1.18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.62	1.18
GAS MILEAGE	27.35	4.96	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.35	4.96
2001-2500	N= 1		N= 0		N= 0		N= 0		N= 0		N= 1	
HC	5.85	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.85	0.0
CO	49.42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.42	0.0
NOX	1.54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.54	0.0
GAS MILEAGE	22.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.60	0.0
2501-3000	N= 0		N= 6		N= 7		N= 0		N= 0		N= 13	
HC	0.0	0.0	7.15	4.80	10.28	5.81	0.0	0.0	0.0	0.0	8.84	5.40
CO	0.0	0.0	89.32	34.08	111.40	23.88	0.0	0.0	0.0	0.0	101.21	30.01
NOX	0.0	0.0	3.29	1.23	2.25	0.75	0.0	0.0	0.0	0.0	2.73	1.10
GAS MILEAGE	0.0	0.0	16.86	2.56	14.71	0.72	0.0	0.0	0.0	0.0	15.63	1.88
3001-3500	N= 0		N= 0		N= 15		N= 1		N= 0		N= 16	
HC	0.0	0.0	0.0	0.0	9.00	3.58	6.71	0.0	0.0	0.0	8.86	3.50
CO	0.0	0.0	0.0	0.0	105.46	44.55	126.27	0.0	0.0	0.0	106.76	43.35
NOX	0.0	0.0	0.0	0.0	3.69	1.42	2.64	0.0	0.0	0.0	3.62	1.40
GAS MILEAGE	0.0	0.0	0.0	0.0	13.23	1.22	12.50	0.0	0.0	0.0	13.18	1.18
3501-4000	N= 0		N= 2		N= 19		N= 6		N= 2		N= 29	
HC	0.0	0.0	8.10	0.99	10.04	8.16	6.49	0.92	7.28	1.39	8.98	6.74
CO	0.0	0.0	100.52	18.50	108.72	37.88	97.46	49.32	79.36	4.36	103.80	37.92
NOX	0.0	0.0	2.04	0.02	3.51	1.14	3.40	1.60	6.15	1.94	3.57	1.44
GAS MILEAGE	0.0	0.0	14.78	0.71	12.78	1.75	12.32	1.34	13.19	0.57	12.83	1.64
4001-4500	N= 0		N= 0		N= 2		N= 6		N= 2		N= 10	
HC	0.0	0.0	0.0	0.0	9.12	0.86	7.25	1.66	9.64	2.79	8.10	1.93
CO	0.0	0.0	0.0	0.0	126.86	1.92	112.23	58.22	131.90	40.11	119.09	46.30
NOX	0.0	0.0	0.0	0.0	2.71	0.49	4.56	3.22	3.76	1.94	4.03	2.61
GAS MILEAGE	0.0	0.0	0.0	0.0	13.15	0.07	12.20	1.01	11.37	1.68	12.20	1.15
4501-5000	N= 0		N= 0		N= 0		N= 0		N= 0		N= 0	
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
>5000	N= 0		N= 0		N= 0		N= 0		N= 0		N= 0	
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	N= 4		N= 8		N= 43		N= 13		N= 4		N= 72	
HC	6.00	2.51	7.39	4.10	9.67	6.16	6.86	1.28	8.46	2.26	8.64	5.16
CO	59.17	10.75	92.12	30.09	108.86	37.13	106.49	50.16	105.63	38.24	103.63	39.26
NOX	1.60	0.96	2.98	1.19	3.33	1.26	3.88	2.42	4.96	2.10	3.38	1.64
GAS MILEAGE	25.99	4.48	16.28	2.28	13.24	1.57	12.28	1.09	12.21	1.55	13.64	2.45

NOX CORRECTED FOR HUMIDITY

TABLE 16

FY72 EMISSION FACTOR PROGRAM

1972 FTP RESULTS BY INERTIA WEIGHT AND ENGINE DISPLACEMENT FOR ALL CITIES, EXCLUDING DENVER AND LOS ANGELES

EMISSIONS IN GM/MI - GAS MILEAGE IN MI/GAL

MODEL YEAR=1968

ENGINE DISPLACEMENT (CID)

INERTIA WT. (LBS)	≤150		151-250		251-339		340-399		≥ 400		TOTAL	
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
≤ 2000	N= 3		N= 0		N= 0		N= 0		N= 0		N= 3	
HC	11.48	9.74	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.48	9.74
CO	102.06	47.18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	102.06	47.18
NOX	1.55	0.37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.55	0.37
GAS MILEAGE	18.93	3.28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.93	3.28
2001-2500	N= 1		N= 1		N= 0		N= 0		N= 0		N= 2	
HC	27.02	0.0	8.21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.61	13.30
CO	113.87	0.0	94.61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	104.24	13.62
NOX	2.03	0.0	2.14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.08	0.08
GAS MILEAGE	15.90	0.0	17.20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.52	0.92
2501-3000	N= 0		N= 4		N= 7		N= 0		N= 0		N= 11	
HC	0.0	0.0	4.13	1.58	5.45	1.96	0.0	0.0	0.0	0.0	4.97	1.87
CO	0.0	0.0	44.98	19.80	50.01	14.99	0.0	0.0	0.0	0.0	48.18	16.09
NOX	0.0	0.0	3.65	1.25	3.67	1.08	0.0	0.0	0.0	0.0	3.67	1.09
GAS MILEAGE	0.0	0.0	18.25	1.05	15.44	1.18	0.0	0.0	0.0	0.0	16.35	1.76
3001-3500	N= 0		N= 2		N= 14		N= 7		N= 1		N= 24	
HC	0.0	0.0	10.88	7.37	4.82	2.04	5.84	1.45	8.78	0.0	5.79	2.91
CO	0.0	0.0	112.65	19.63	52.12	37.33	83.56	25.62	127.01	0.0	69.46	39.06
NOX	0.0	0.0	5.10	1.03	3.92	1.24	2.72	1.24	1.19	0.0	3.55	1.44
GAS MILEAGE	0.0	0.0	13.81	2.57	15.48	2.48	13.59	1.31	11.50	0.0	14.53	2.26
3501-4000	N= 0		N= 2		N= 11		N= 12		N= 4		N= 29	
HC	0.0	0.0	4.40	3.41	7.21	7.73	7.09	4.50	11.88	12.77	7.61	7.12
CO	0.0	0.0	55.23	18.67	63.58	25.13	85.72	36.92	78.85	30.16	74.27	31.64
NOX	0.0	0.0	5.91	0.16	4.51	1.53	4.97	1.63	5.15	0.94	4.89	1.45
GAS MILEAGE	0.0	0.0	15.68	1.96	14.52	1.96	12.16	1.02	11.98	1.21	13.15	1.85
4001-4500	N= 0		N= 0		N= 3		N= 4		N= 4		N= 11	
HC	0.0	0.0	0.0	0.0	8.69	3.15	6.39	0.84	6.74	2.25	7.15	2.17
CO	0.0	0.0	0.0	0.0	95.70	47.45	115.59	36.78	136.67	88.59	117.83	59.18
NOX	0.0	0.0	0.0	0.0	5.18	2.92	4.60	1.11	3.96	2.31	4.53	1.98
GAS MILEAGE	0.0	0.0	0.0	0.0	12.25	1.42	11.60	0.56	10.22	2.09	11.22	1.75
4501-5000	N= 0		N= 0		N= 0		N= 0		N= 4		N= 4	
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.13	0.79	3.13	0.79
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.29	24.34	52.29	24.34
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.95	2.22	4.95	2.22
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.88	2.10	10.88	2.10
>5000	N= 0		N= 0		N= 0		N= 0		N= 0		N= 0	
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	N= 4		N= 9		N= 35		N= 23		N= 13		N= 84	
HC	15.37	11.12	6.15	4.25	6.03	4.71	6.59	3.34	7.37	7.44	6.85	5.49
CO	105.01	38.97	67.81	33.64	59.03	32.44	90.26	34.46	92.17	60.73	75.84	41.35
NOX	1.67	0.38	4.31	1.53	4.16	1.48	4.22	1.72	4.42	2.00	4.12	1.67
GAS MILEAGE	18.07	2.94	16.37	2.53	14.83	2.19	12.46	1.23	11.02	1.85	13.64	2.69

NOX CORRECTED FOR HUMIDITY

TABLE 17

FY72 EMISSION FACTOR PROGRAM

1972 FTP RESULTS BY INERTIA WEIGHT AND ENGINE DISPLACEMENT FOR
ALL CITIES, EXCLUDING DENVER AND LOS ANGELES

EMISSIONS IN GM/MI - GAS MILEAGE IN MI/GAL

MODEL YEAR=1969

ENGINE DISPLACEMENT (CID)

INERTIA WT. (LBS)	≤150		151-250		251-339		340-399		≥ 400		TOTAL	
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
≤ 2000	N= 4		N= 1		N= 0		N= 0		N= 0		N= 5	
HC	4.29	0.37	3.25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.08	0.56
CO	38.77	18.68	33.25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.67	16.36
NOX	2.55	0.94	1.97	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.44	0.85
GAS MILEAGE	24.08	3.73	19.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.89	3.87
2001-2500	N= 0		N= 1		N= 0		N= 0		N= 0		N= 1	
HC	0.0	0.0	4.55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.55	0.0
CO	0.0	0.0	76.69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	76.69	0.0
NOX	0.0	0.0	3.69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.69	0.0
GAS MILEAGE	0.0	0.0	19.90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.90	0.0
2501-3000	N= 0		N= 7		N= 4		N= 2		N= 0		N= 13	
HC	0.0	0.0	4.78	2.50	5.95	0.45	6.29	1.55	0.0	0.0	5.37	1.96
CO	0.0	0.0	45.45	12.69	68.28	20.25	91.81	53.49	0.0	0.0	59.61	27.13
NOX	0.0	0.0	5.16	1.37	4.62	1.24	4.18	0.56	0.0	0.0	4.85	1.22
GAS MILEAGE	0.0	0.0	16.47	1.56	14.24	1.57	13.43	1.75	0.0	0.0	15.21	1.98
3001-3500	N= 0		N= 1		N= 11		N= 8		N= 0		N= 20	
HC	0.0	0.0	5.79	0.0	6.08	5.36	5.48	1.65	0.0	0.0	5.83	4.02
CO	0.0	0.0	112.48	0.0	68.20	57.99	89.36	28.17	0.0	0.0	78.88	47.27
NOX	0.0	0.0	1.59	0.0	5.75	2.13	3.89	1.69	0.0	0.0	4.80	2.21
GAS MILEAGE	0.0	0.0	15.20	0.0	14.11	1.46	13.07	1.13	0.0	0.0	13.72	1.40
3501-4000	N= 0		N= 1		N= 7		N= 13		N= 6		N= 27	
HC	0.0	0.0	2.85	0.0	6.57	4.05	5.68	2.40	7.57	6.74	6.23	4.03
CO	0.0	0.0	52.83	0.0	92.48	76.97	83.80	33.98	103.35	47.92	89.25	49.56
NOX	0.0	0.0	3.50	0.0	5.51	2.50	4.56	1.31	4.24	1.48	4.69	1.72
GAS MILEAGE	0.0	0.0	19.10	0.0	13.26	2.15	12.69	0.94	11.84	1.03	12.79	1.62
4001-4500	N= 0		N= 0		N= 0		N= 9		N= 9		N= 18	
HC	0.0	0.0	0.0	0.0	0.0	0.0	4.64	1.16	5.66	1.67	5.15	1.49
CO	0.0	0.0	0.0	0.0	0.0	0.0	74.64	38.11	87.41	30.57	81.03	34.15
NOX	0.0	0.0	0.0	0.0	0.0	0.0	6.27	1.82	4.98	2.06	5.62	2.00
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	12.63	1.09	11.91	2.45	12.26	1.95
4501-5000	N= 0		N= 0		N= 0		N= 0		N= 3		N= 3	
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.02	1.21	4.02	1.21
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	69.64	13.49	69.64	13.49
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.93	0.40	6.93	0.40
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.73	0.29	10.73	0.29
>5000	N= 0		N= 0		N= 0		N= 0		N= 1		N= 1	
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.19	0.0	3.19	0.0
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	58.01	0.0	58.01	0.0
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.59	0.0	5.59	0.0
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.70	0.0	9.70	0.0
TOTAL	N= 4		N= 11		N= 22		N= 32		N= 19		N= 88	
HC	4.29	0.37	4.54	2.10	6.21	4.29	5.38	1.88	5.87	4.00	5.54	3.14
CO	38.77	18.68	53.95	24.17	75.94	59.05	83.11	33.61	88.09	35.47	76.73	41.94
NOX	2.55	0.94	4.26	1.74	5.47	2.09	4.85	1.75	5.08	1.83	4.88	1.90
GAS MILEAGE	24.08	3.73	17.04	1.90	13.85	1.74	12.81	1.04	11.55	1.77	13.45	2.53

NOX CORRECTED FOR HUMIDITY

TABLE 18

FY72 EMISSION FACTOR PROGRAM

1972 FTP RESULTS BY INERTIA WEIGHT AND ENGINE DISPLACEMENT FOR ALL CITIES, EXCLUDING DENVER AND LOS ANGELES

EMISSIONS IN GM/MI - GAS MILEAGE IN MI/GAL

MODEL YEAR=1970

ENGINE DISPLACEMENT (CID)

INERTIA WT. (LBS)	≤150		151-250		251-339		340-399		≥ 400		TOTAL	
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
≤ 2000	N= 8		N= 0		N= 0		N= 0		N= 0		N= 8	
HC	2.99	0.96	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.99	0.96
CO	34.58	15.06	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.58	15.06
NOX	3.58	0.97	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.58	0.97
GAS MILEAGE	23.23	2.84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.23	2.84
2001-2500	N= 4		N= 2		N= 0		N= 0		N= 0		N= 6	
HC	4.64	3.38	3.56	0.80	0.0	0.0	0.0	0.0	0.0	0.0	4.28	2.70
CO	46.03	29.22	34.95	19.59	0.0	0.0	0.0	0.0	0.0	0.0	42.34	24.93
NOX	3.04	0.42	3.24	1.39	0.0	0.0	0.0	0.0	0.0	0.0	3.10	0.71
GAS MILEAGE	21.95	3.65	21.61	1.97	0.0	0.0	0.0	0.0	0.0	0.0	21.83	2.95
2501-3000	N= 0		N= 13		N= 1		N= 1		N= 0		N= 15	
HC	0.0	0.0	3.76	1.23	3.93	0.0	6.43	0.0	0.0	0.0	3.95	1.33
CO	0.0	0.0	42.54	17.38	39.26	0.0	114.06	0.0	0.0	0.0	47.09	24.55
NOX	0.0	0.0	3.97	1.37	3.03	0.0	2.33	0.0	0.0	0.0	3.80	1.36
GAS MILEAGE	0.0	0.0	19.13	2.64	14.50	0.0	14.00	0.0	0.0	0.0	18.30	3.08
3001-3500	N= 0		N= 2		N= 9		N= 9		N= 1		N= 21	
HC	0.0	0.0	4.54	1.49	5.05	3.42	6.66	4.85	13.28	0.0	6.09	4.20
CO	0.0	0.0	78.97	84.32	61.20	29.36	83.03	47.94	168.85	0.0	77.38	46.59
NOX	0.0	0.0	4.45	4.13	3.93	1.21	3.49	0.83	1.82	0.0	3.69	1.41
GAS MILEAGE	0.0	0.0	14.51	3.11	14.29	1.30	12.78	1.21	9.10	0.0	13.28	2.01
3501-4000	N= 0		N= 0		N= 11		N= 17		N= 1		N= 29	
HC	0.0	0.0	0.0	0.0	4.60	1.22	8.55	10.07	6.49	0.0	6.98	7.88
CO	0.0	0.0	0.0	0.0	54.07	21.98	82.43	42.61	115.93	0.0	72.83	38.35
NOX	0.0	0.0	0.0	0.0	5.69	1.64	4.12	1.96	2.17	0.0	4.65	1.99
GAS MILEAGE	0.0	0.0	0.0	0.0	13.36	1.04	12.37	1.61	12.80	0.0	12.75	1.49
4001-4500	N= 0		N= 0		N= 1		N= 9		N= 14		N= 24	
HC	0.0	0.0	0.0	0.0	8.23	0.0	4.70	1.06	5.57	3.10	5.36	2.53
CO	0.0	0.0	0.0	0.0	38.43	0.0	70.50	21.99	84.18	83.96	77.14	65.31
NOX	0.0	0.0	0.0	0.0	5.11	0.0	4.21	0.94	4.21	1.36	4.25	1.18
GAS MILEAGE	0.0	0.0	0.0	0.0	12.40	0.0	12.11	1.38	11.00	1.53	11.45	1.55
4501-5000	N= 0		N= 0		N= 0		N= 0		N= 5		N= 5	
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.29	7.12	8.29	7.12
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	63.86	30.37	63.86	30.37
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.10	2.17	6.10	2.17
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.48	2.45	11.48	2.45
>5000	N= 0		N= 0		N= 0		N= 0		N= 0		N= 0	
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	N= 12		N= 17		N= 22		N= 36		N= 21		N=108	
HC	3.54	2.09	3.83	1.18	4.92	2.41	7.06	7.38	6.63	4.48	5.64	5.04
CO	38.40	20.22	45.93	29.26	55.60	24.49	80.48	39.08	84.89	72.65	66.15	45.67
NOX	3.40	0.85	3.94	1.64	4.82	1.65	3.94	1.51	4.45	1.86	4.16	1.61
GAS MILEAGE	22.79	3.06	18.68	3.33	13.73	1.20	12.44	1.46	11.08	1.75	13.80	3.43

NOX CORRECTED FOR HUMIDITY

TABLE 19

FY72 EMISSION FACTOR PROGRAM

1972 FTP RESULTS BY INERTIA WEIGHT AND ENGINE DISPLACEMENT FOR
ALL CITIES, EXCLUDING DENVER AND LOS ANGELES

EMISSIONS IN GM/MI - GAS MILEAGE IN MI/GAL

MODEL YEAR=1971

ENGINE DISPLACEMENT (CID)

INERTIA WT. (LBS)	≤150		151-250		251-339		340-399		≥ 400		TOTAL	
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
	N= 13		N= 0		N= 0		N= 0		N= 0		N= 13	
≤ 2000												
HC	4.49	2.42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.49	2.42
CO	48.86	43.48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.86	43.48
NOX	2.61	1.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.61	1.02
GAS MILEAGE	22.73	4.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.73	4.50
	N= 14		N= 1		N= 0		N= 0		N= 0		N= 15	
2001-2500												
HC	3.61	1.87	2.23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.52	1.84
CO	48.96	26.39	14.78	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.68	26.91
NOX	2.97	1.37	3.19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.98	1.32
GAS MILEAGE	21.89	3.10	20.80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.81	2.98
	N= 1		N= 8		N= 2		N= 1		N= 0		N= 12	
2501-3000												
HC	3.45	0.0	2.88	0.40	3.38	0.04	3.53	0.0	0.0	0.0	3.06	0.42
CO	28.22	0.0	45.08	20.71	47.15	9.60	61.49	0.0	0.0	0.0	45.39	18.23
NOX	3.43	0.0	4.75	1.29	2.89	0.25	2.06	0.0	0.0	0.0	4.11	1.43
GAS MILEAGE	21.40	0.0	19.32	1.62	13.64	2.64	14.60	0.0	0.0	0.0	17.75	3.45
	N= 0		N= 3		N= 10		N= 9		N= 0		N= 22	
3001-3500												
HC	0.0	0.0	3.89	0.52	5.19	2.69	6.85	5.45	0.0	0.0	5.69	3.95
CO	0.0	0.0	54.93	11.66	46.11	19.56	106.19	70.45	0.0	0.0	71.89	54.12
NOX	0.0	0.0	5.13	0.39	4.24	1.01	3.18	0.85	0.0	0.0	3.93	1.11
GAS MILEAGE	0.0	0.0	17.54	1.58	13.75	1.09	10.69	2.15	0.0	0.0	12.65	2.90
	N= 0		N= 0		N= 1		N= 18		N= 2		N= 21	
3501-4000												
HC	0.0	0.0	0.0	0.0	2.56	0.0	4.80	2.76	6.85	3.60	4.89	2.79
CO	0.0	0.0	0.0	0.0	33.94	0.0	69.44	46.79	75.43	25.63	68.32	44.26
NOX	0.0	0.0	0.0	0.0	5.09	0.0	4.60	1.36	5.07	1.76	4.67	1.32
GAS MILEAGE	0.0	0.0	0.0	0.0	13.60	0.0	12.49	1.86	11.66	0.99	12.45	1.76
	N= 0		N= 0		N= 1		N= 8		N= 15		N= 24	
4001-4500												
HC	0.0	0.0	0.0	0.0	4.27	0.0	4.55	1.33	4.05	1.56	4.22	1.44
CO	0.0	0.0	0.0	0.0	59.70	0.0	77.21	31.35	60.65	34.90	66.13	33.23
NOX	0.0	0.0	0.0	0.0	5.45	0.0	5.42	1.12	4.94	1.33	5.12	1.23
GAS MILEAGE	0.0	0.0	0.0	0.0	11.30	0.0	10.93	1.27	11.56	0.88	11.33	1.05
	N= 0		N= 0		N= 0		N= 1		N= 10		N= 11	
4501-5000												
HC	0.0	0.0	0.0	0.0	0.0	0.0	4.67	0.0	4.05	1.09	4.10	1.05
CO	0.0	0.0	0.0	0.0	0.0	0.0	57.89	0.0	58.32	33.12	58.28	31.42
NOX	0.0	0.0	0.0	0.0	0.0	0.0	7.36	0.0	5.65	1.65	5.81	1.65
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	10.50	0.0	10.53	0.61	10.53	0.58
	N= 0		N= 0		N= 0		N= 0		N= 2		N= 2	
>5000												
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.44	0.74	3.44	0.74
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.64	20.01	62.64	20.01
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.74	0.33	4.74	0.33
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.48	0.56	10.48	0.56
	N= 28		N= 12		N= 14		N= 37		N= 29		N=120	
TOTAL												
HC	4.01	2.12	3.08	0.65	4.68	2.42	5.20	3.39	4.20	1.63	4.41	2.49
CO	48.18	34.50	45.02	20.19	46.36	17.25	79.53	50.79	61.00	31.89	60.42	39.45
NOX	2.82	1.18	4.72	1.16	4.20	1.08	4.44	1.51	5.18	1.42	4.24	1.57
GAS MILEAGE	22.25	3.66	18.95	1.78	13.52	1.37	11.64	2.00	11.11	0.90	13.77	4.01

NOX CORRECTED FOR HUMIDITY

TABLE 20

FY72 EMISSION FACTOR PROGRAM

1972 FTP RESULTS BY INERTIA WEIGHT AND ENGINE DISPLACEMENT FOR ALL CITIES, EXCLUDING DENVER AND LOS ANGELES

EMISSIONS IN GM/MI - GAS MILEAGE IN MI/GAL

MODEL YEAR=1972

ENGINE DISPLACEMENT (CID)

INERTIA WT. (LBS)	≤150		151-250		251-339		340-399		≥ 400		TOTAL	
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
≤ 2000	N= 4		N= 0		N= 0		N= 0		N= 0		N= 4	
HC	2.96	0.75	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.96	0.75
CO	39.87	14.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39.87	14.10
NOX	2.97	0.43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.97	0.43
GAS MILEAGE	20.28	2.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.28	2.02
2001-2500	N= 18		N= 0		N= 1		N= 0		N= 0		N= 19	
HC	2.89	0.80	0.0	0.0	0.69	0.0	0.0	0.0	0.0	0.0	2.77	0.92
CO	32.32	13.63	0.0	0.0	8.60	0.0	0.0	0.0	0.0	0.0	31.08	14.32
NOX	3.43	1.27	0.0	0.0	1.33	0.0	0.0	0.0	0.0	0.0	3.32	1.32
GAS MILEAGE	21.34	2.55	0.0	0.0	20.70	0.0	0.0	0.0	0.0	0.0	21.31	2.47
2501-3000	N= 2		N= 6		N= 7		N= 0		N= 0		N= 15	
HC	2.98	0.84	2.74	0.53	3.41	1.13	0.0	0.0	0.0	0.0	3.09	0.90
CO	24.56	2.72	41.22	18.99	45.17	34.12	0.0	0.0	0.0	0.0	40.84	25.99
NOX	4.37	0.83	5.41	1.24	3.40	0.96	0.0	0.0	0.0	0.0	4.33	1.38
GAS MILEAGE	21.80	0.03	17.50	1.47	14.74	3.15	0.0	0.0	0.0	0.0	16.49	3.45
3001-3500	N= 0		N= 0		N= 10		N= 8		N= 1		N= 19	
HC	0.0	0.0	0.0	0.0	3.03	0.52	4.25	1.02	4.50	0.0	3.62	0.98
CO	0.0	0.0	0.0	0.0	27.24	16.41	57.67	32.69	32.60	0.0	40.34	27.97
NOX	0.0	0.0	0.0	0.0	4.74	1.19	3.15	0.74	2.34	0.0	3.94	1.30
GAS MILEAGE	0.0	0.0	0.0	0.0	14.40	0.98	12.68	0.88	9.50	0.0	13.28	1.74
3501-4000	N= 0		N= 0		N= 2		N= 24		N= 4		N= 30	
HC	0.0	0.0	0.0	0.0	3.66	0.78	3.61	1.28	3.35	1.38	3.58	1.24
CO	0.0	0.0	0.0	0.0	37.95	13.28	52.27	29.04	43.49	11.82	50.14	26.64
NOX	0.0	0.0	0.0	0.0	4.74	0.88	4.86	1.37	5.33	1.12	4.91	1.29
GAS MILEAGE	0.0	0.0	0.0	0.0	12.53	0.64	11.65	1.26	11.93	1.52	11.74	1.26
4001-4500	N= 0		N= 0		N= 0		N= 16		N= 23		N= 39	
HC	0.0	0.0	0.0	0.0	0.0	0.0	3.90	0.94	4.36	5.61	4.17	4.31
CO	0.0	0.0	0.0	0.0	0.0	0.0	60.54	22.44	51.02	29.54	54.92	26.95
NOX	0.0	0.0	0.0	0.0	0.0	0.0	4.52	1.22	5.27	1.68	4.97	1.54
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	11.22	0.77	11.37	2.22	11.31	1.74
4501-5000	N= 0		N= 0		N= 0		N= 1		N= 10		N= 11	
HC	0.0	0.0	0.0	0.0	0.0	0.0	3.35	0.0	1.82	0.76	1.96	0.86
CO	0.0	0.0	0.0	0.0	0.0	0.0	26.73	0.0	23.12	15.93	23.45	15.15
NOX	0.0	0.0	0.0	0.0	0.0	0.0	5.33	0.0	5.36	2.01	5.36	1.90
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	10.70	0.0	9.78	1.04	9.86	1.03
>5000	N= 0		N= 0		N= 0		N= 0		N= 3		N= 3	
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.41	0.34	2.41	0.34
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.47	4.36	32.47	4.36
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.85	0.42	5.85	0.42
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.95	1.11	9.95	1.11
TOTAL	N= 24		N= 6		N= 20		N= 49		N= 41		N=140	
HC	2.91	0.76	2.74	0.53	3.11	0.97	3.81	1.13	3.50	4.34	3.42	2.50
CO	32.94	13.35	41.22	18.99	33.66	24.70	55.33	27.37	41.67	26.33	43.79	25.84
NOX	3.43	1.17	5.41	1.24	4.10	1.36	4.48	1.35	5.27	1.68	4.52	1.55
GAS MILEAGE	21.19	2.35	17.50	1.47	14.52	2.24	11.64	1.14	10.83	1.87	12.90	3.31

NOX CORRECTED FOR HUMIDITY

TABLE 21

FY72 EMISSION FACTOR PROGRAM

FUEL ECONOMY IN MILES PER GALLON

ALL CITIES EXCEPT DENVER AND LOS ANGELES

YEAR	N	COLD TRANSIENT		STABILIZED		HOT TRANSIENT		1972 FTP		1975 FTP	
		MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
1966	68	12.9	3.4	14.1	2.8	16.0	3.4	13.6	2.8	14.4	2.8
1967	72	13.2	2.8	13.9	2.3	16.3	2.9	13.6	2.4	14.4	2.5
1968	84	13.2	3.0	13.9	2.5	16.1	2.9	13.6	2.7	14.4	2.6
1969	88	12.9	2.8	13.8	2.5	16.3	3.2	13.4	2.5	14.3	2.6
1970	108	13.3	3.5	14.1	3.6	16.2	3.8	13.8	3.4	14.5	3.5
1971	120	13.5	4.1	13.9	4.0	16.4	4.7	13.8	4.0	14.5	4.1
1972	140	12.7	3.4	12.9	3.3	15.3	3.9	12.9	3.3	13.5	3.4

TABLE 22

FY72 EMISSION FACTOR PROGRAM

FUEL ECONOMY IN MILES PER GALLON

DENVER

YEAR	N	COLD TRANSIENT		STABILIZED		HOT TRANSIENT		1972 FTP		1975 FTP	
		MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
1966	17	12.0	2.6	12.9	2.7	15.1	3.2	12.5	2.5	13.3	2.6
1967	18	11.5	2.2	12.4	2.5	14.1	2.6	12.0	2.2	12.7	2.3
1968	21	10.9	2.7	12.6	2.9	14.6	2.7	11.8	2.7	12.7	2.7
1969	22	12.0	3.1	13.4	3.0	15.4	3.7	12.8	3.0	13.7	3.1
1970	27	11.9	2.3	13.2	2.8	15.1	2.7	12.6	2.5	13.5	2.6
1971	30	12.5	3.7	13.5	3.5	15.7	4.2	13.1	3.6	13.9	3.7
1972	35	11.7	3.1	12.2	3.0	14.2	3.5	12.1	3.0	12.7	3.1

TABLE 23

FY72 EMISSION FACTOR PROGRAM

FUEL ECONOMY IN MILES PER GALLON

LOS ANGELES

YEAR	N	COLD TRANSIENT		STABILIZED		HOT TRANSIENT		1972 FTP		1975 FTP	
		MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
1966	17	11.9	2.5	12.9	1.9	14.3	1.9	12.5	2.1	13.1	2.0
1967	18	12.0	2.6	13.1	2.4	14.3	2.6	12.6	2.4	13.2	2.4
1968	21	12.2	2.0	13.5	1.8	15.2	2.2	12.9	1.9	13.7	2.0
1969	22	11.4	2.5	12.4	2.7	14.3	2.9	12.0	2.6	12.7	2.7
1970	27	11.8	2.6	12.7	2.9	14.6	3.0	12.3	2.7	13.1	2.8
1971	30	12.4	3.3	12.8	3.5	15.0	3.6	12.7	3.4	13.3	3.5
1972	35	11.2	2.7	11.4	2.8	13.7	3.1	11.4	2.8	12.0	2.9

TABLE 24

Hydrocarbon Deterioration Factors by Vehicle Model-Year+

Mileages	Four Cities	Los Angeles	Denver	CARB*
		1966-1967 Model-Year Vehicles		
Statistically Significant	NO	YES	NO	
60,000	1.03	1.00	1.00	1.00
75,000	1.06	1.44	1.00	1.00
90,000	1.10	1.71	1.00	1.00
105,000	1.14	1.98	1.00	1.00
		1968 Model-Year Vehicles		
Statistically Significant	YES	NO	NO	
15,000	1.21	1.21	1.04	1.15
30,000	1.50	1.50	1.09	1.23
45,000	1.79	1.79	1.13	1.25
50,000	1.89	1.89	1.15	1.26
60,000	2.08	2.08	1.18	1.27
		1969 Model-Year Vehicles		
Statistically Significant	NO	NO	NO	
15,000	1.00	1.05	1.02	1.09
30,000	1.00	1.12	1.04	1.13
45,000	1.00	1.19	1.07	1.15
50,000	1.00	1.22	1.08	1.16
60,000	1.00	1.26	1.09	1.16
		1970 Model-Year Vehicles		
Statistically Significant	YES	NO	NO	
15,000	1.14	1.12	1.04	1.12
30,000	1.34	1.30	1.10	1.17
45,000	1.54	1.48	1.15	1.21
50,000	1.60	1.54	1.17	1.22
60,000	1.73	1.65	1.21	1.25

TABLE 24 (cont'd)

Hydrocarbon Deterioration Factors by Vehicle Model-Year+

Mileages	Four Cities	Los Angeles	Denver	CARB*
	1971 Model-Year Vehicles			
Statistically Significant	YES	YES	NO	
15,000	1.11	1.07	1.02	1.09
30,000	1.26	1.17	1.05	1.15
45,000	1.41	1.27	1.08	1.19
50,000	1.46	1.31	1.09	1.20
60,000	1.56	1.37	1.11	1.21
	1972 Model-Year Vehicles			
Statistically Significant	YES	NO	NO	
15,000	1.17	1.00	1.02	1.11
30,000	1.41	1.00	1.06	1.22
45,000	1.65	1.00	1.09	1.28
50,000	1.73	1.00	1.10	1.28
60,000	1.89	1.00	1.12	1.32

*"Exhaust Emissions from Privately Owned 1966-1972 California Automobiles - A Statistical Evaluation of Surveillance Data." California Air Resources Laboratory. October 19, 1973.

+Baseline emissions for 1966-1967 deterioration factors are 50,000 mile figures. For all other model-years, baseline emissions are 4,000 mile figures.

TABLE 25

Carbon Monoxide Deterioration Factors by Vehicle Model-Year+

Mileages	Four Cities	Los Angeles	Denver	CARB*
1966-1967 Model-Year Vehicles				
Statistically Significant	YES	YES	YES	
60,000	1.03	1.07	1.07	1.00
75,000	1.08	1.18	1.18	1.00
90,000	1.13	1.29	1.28	1.00
105,000	1.19	1.40	1.39	1.00
1968 Model-Year Vehicles				
Statistically Significant	NO	NO	NO	
15,000	1.04	1.04	1.07	1.15
30,000	1.09	1.11	1.18	1.24
45,000	1.14	1.18	1.28	1.31
50,000	1.15	1.20	1.31	1.31
60,000	1.19	1.25	1.38	1.37
1969 Model-Year Vehicles				
Statistically Significant	NO	NO	NO	
15,000	1.03	1.04	1.00	1.21
30,000	1.07	1.10	0.99	1.30
45,000	1.11	1.16	0.99	1.40
50,000	1.12	1.18	0.98	1.42
60,000	1.15	1.22	0.98	1.48
1970 Model-Year Vehicles				
Statistically Significant	YES	NO	NO	
15,000	1.08	1.06	1.09	1.15
30,000	1.19	1.15	1.21	1.27
45,000	1.29	1.24	1.33	1.32
50,000	1.33	1.27	1.37	1.34
60,000	1.40	1.33	1.45	1.42

TABLE 25 (cont'd)

Carbon Monoxide Deterioration Factors by

Vehicle Model-Year+

Mileages	Four Cities	Los Angeles	Denver	CARB*
	1971 Model-Year Vehicles			
Statistically Significant	NO	YES	NO	
15,000	1.00	1.12	0.97	1.06
30,000	1.02	1.27	0.93	1.13
45,000	1.03	1.43	0.89	1.16
50,000	1.03	1.48	0.88	1.17
60,000	1.04	1.59	0.85	1.17
	1972 Model-Year Vehicles			
Statistically Significant	YES	NO	NO	
15,000	1.18	1.09	1.04	1.20
30,000	1.42	1.21	1.09	1.33
45,000	1.67	1.33	1.14	1.43
50,000	1.75	1.37	1.16	1.46
60,000	1.91	1.45	1.19	1.50

*"Exhaust Emissions from Privately Owned 1966-1972 California Automobiles - A Statistical Evaluation of Surveillance Data." California Air Resources Laboratory. October 19, 1973.

+Baseline emissions for 1966-1967 deterioration factors are 50,000 mile figures. For all other model-years, baseline emissions are 4,000 mile figures.

TABLE 26

Oxides of Nitrogen Deterioration Factors by Vehicle Model-Year+

Mileages	Four Cities	Los Angeles	Denver	CARB*
1966-1967 Model-Year Vehicles				
Statistically Significant	NO	NO	NO	
60,000	1.00	1.00	0.95	**
75,000	1.00	1.00	0.87	
90,000	1.00	1.00	0.82	
105,000	1.00	1.00	0.75	
1968 Model-Year Vehicles				
Statistically Significant	NO	NO	NO	
15,000	1.00	0.98	1.04	
30,000	1.00	0.95	1.09	
45,000	1.00	0.92	1.15	
50,000	1.00	0.91	1.16	
60,000	1.00	0.89	1.20	
1969 Model-Year Vehicles				
Statistically Significant	NO	YES	NO	
15,000	1.00	0.95	1.00	
30,000	1.00	0.88	1.00	
45,000	1.00	0.81	1.00	
50,000	1.00	0.79	1.00	
60,000	1.00	0.74	1.00	
1970 Model-Year Vehicles				
Statistically Significant	NO	NO	NO	
15,000	0.98	0.98	1.00	
30,000	0.95	0.95	1.00	
45,000	0.92	0.92	1.00	
50,000	0.91	0.90	1.00	
60,000	0.89	0.88	1.00	

TABLE 26 (cont'd)

Oxides of Nitrogen Deterioration Factors by

Vehicle Model-Year[+]

Mileages	Four Cities	Los Angeles	Denver	CARB[*]
	1971 Model-Year Vehicles			
Statistically Significant	NO	NO	NO	
15,000	0.98	1.00	0.96	1.04
30,000	0.95	1.00	0.92	1.07
45,000	0.92	1.00	0.97	1.08
50,000	0.90	1.00	0.85	1.09
60,000	0.88	1.00	0.82	1.10
	1972 Model-Year Vehicles			
Statistically Significant	NO	NO	NO	
15,000	1.05	1.00	1.08	1.03
30,000	1.12	1.00	1.18	1.07
45,000	1.19	1.00	1.23	1.10
50,000	1.21	1.00	1.32	1.11
60,000	1.25	1.00	1.40	1.13

[*] "Exhaust Emissions from Privately Owned 1966-1972 California Automobiles - A Statistical Evaluation of Surveillance Data." California Air Resources Laboratory. October 19, 1973.

[+] Baseline Emissions for 1966-1967 deterioration factors are 50,000 mile figures. For all other model-years, baseline emissions are 4,000 mile figures.

[**] CARB NO_x deterioration data are not available before model-year 1971.

TABLE 27

Mileage and Program Effects
(based upon FY71 and FY72 data from four cities)

	Model-Year Vehicles			
	1957-1965	1966-1967	1968-1969	1970-1971
Mileage Effects				
HC	X		X	X
CO			X	X
NO_x				
Program Effects				
HC				X
CO				
NO_x				X

An X indicates that a test of the hypothesis of "no effects" is rejected at the .05 level of confidence.

TABLE 28

Comparison of New Vehicles in the FY71 and FY72 Emission Factor Programs - Mean Emission Levels

1972 FTP (grams/mi)

		Four Cities		Denver		Los Angeles	
		Mean	S.D.	Mean	S.D.	Mean	S.D.
HC	1971 vehicles	3.42	1.47	6.73	2.10	3.51	0.99
	1972 vehicles	3.42	2.50	5.61	4.34	4.07	4.87
CO	1971 vehicles	46.33	28.29	100.04	39.72	51.90	22.49
	1972 vehicles	43.79	25.84	90.42	35.79	55.77	25.41
NO_{xc}	1971 vehicles	4.99	1.79	3.04	1.55	3.81	1.09
	1972 vehicles	4.52	1.55	3.00	1.37	3.83	1.15

1975 FTP (grams/mi)

		Four Cities		Denver		Los Angeles	
		Mean	S.D.	Mean	S.D.	Mean	S.D.
HC	1971 vehicles	3.07	1.36	5.59	1.42	3.02	0.79
	1972 vehicles	3.02	2.22	4.75	2.42	3.56	4.24
CO	1971 vehicles	39.56	25.62	88.13	35.96	42.26	19.91
	1972 vehicles	36.88	24.04	80.36	32.46	46.68	24.06
NO_{xc}	1971 vehicles	5.06	1.84	3.05	1.59	3.83	1.10
	1972 vehicles	4.55	1.59	3.08	1.39	3.81	1.21

TABLE 29

Comparison of New Vehicles in the FY71 and FY72 Emission Factor Programs - Percent of Vehicles at or Below Standards

1971 Vehicles
FY71 Emission Factor Program

Percent at or Below 1971 Standards*

	Four Cities	Denver	Los Angeles
HC	81	10	81
CO	60	5	43

1972 Vehicles
FY72 Emission Factor Program

Percent at or Below 1972 Standards**

	Four Cities	Denver	Los Angeles
HC	60	14	57
CO	52	9	31

1971 Vehicles
FY71 Emission Factor Program

Percent at or Below 1972 Standards**

	Four Cities	Denver	Los Angeles
HC	61	0	62
CO	49	5	33

1972 Vehicles
FY72 Emission Factor Program

Percent at or Below 1971 Standards*

	Four Cities	Denver	Los Angeles
HC	87	43	86
CO	61	11	46

*HC - 4.6 gm/mi
CO - 47.0 gm/mi

(Approximate equivalents in terms of the 1972 FTP)

**HC - 3.4 gm/mi
CO - 39.0 gm/mi

FIGURES

FIGURE 1

Vehicle Selection Procedure

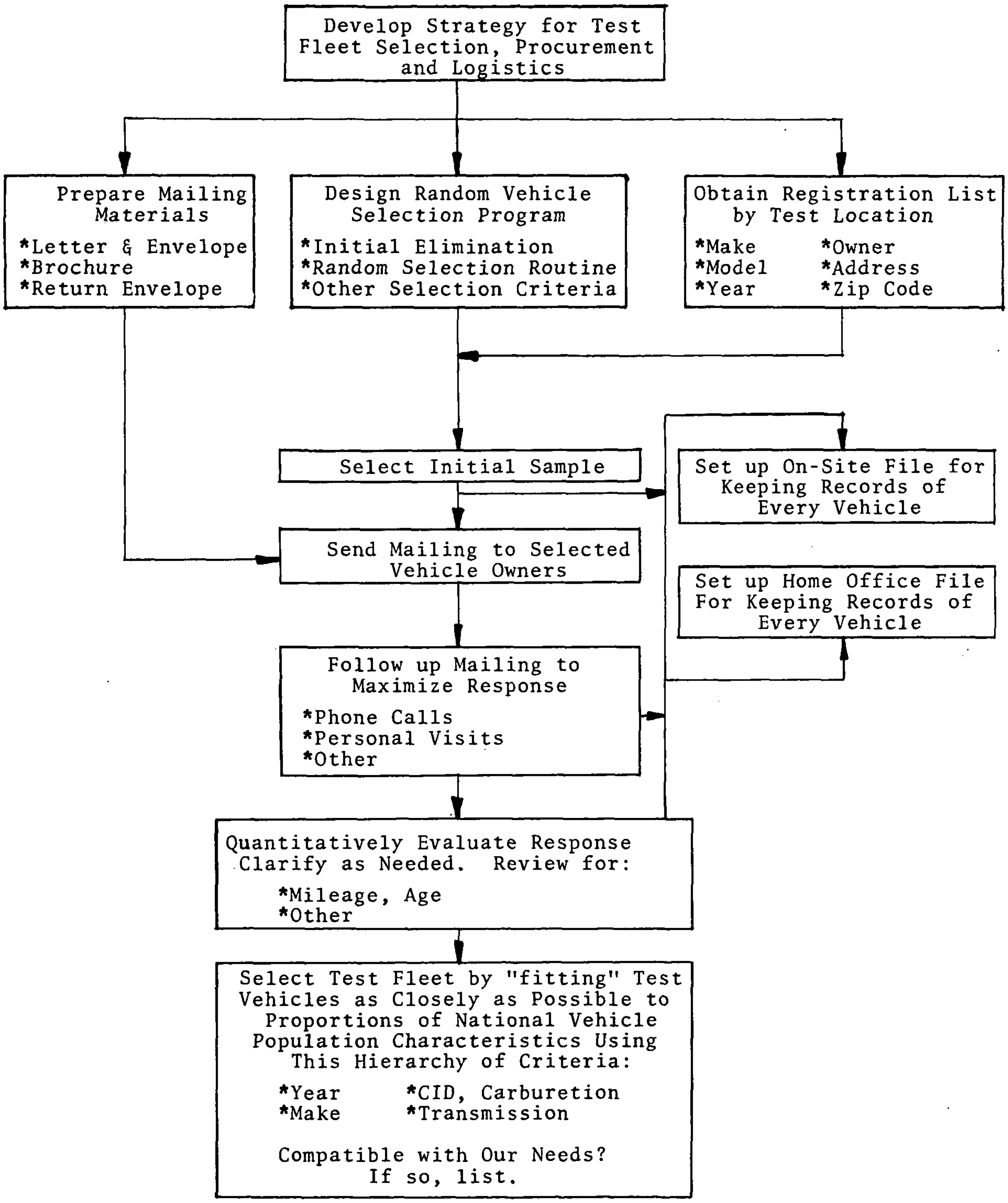
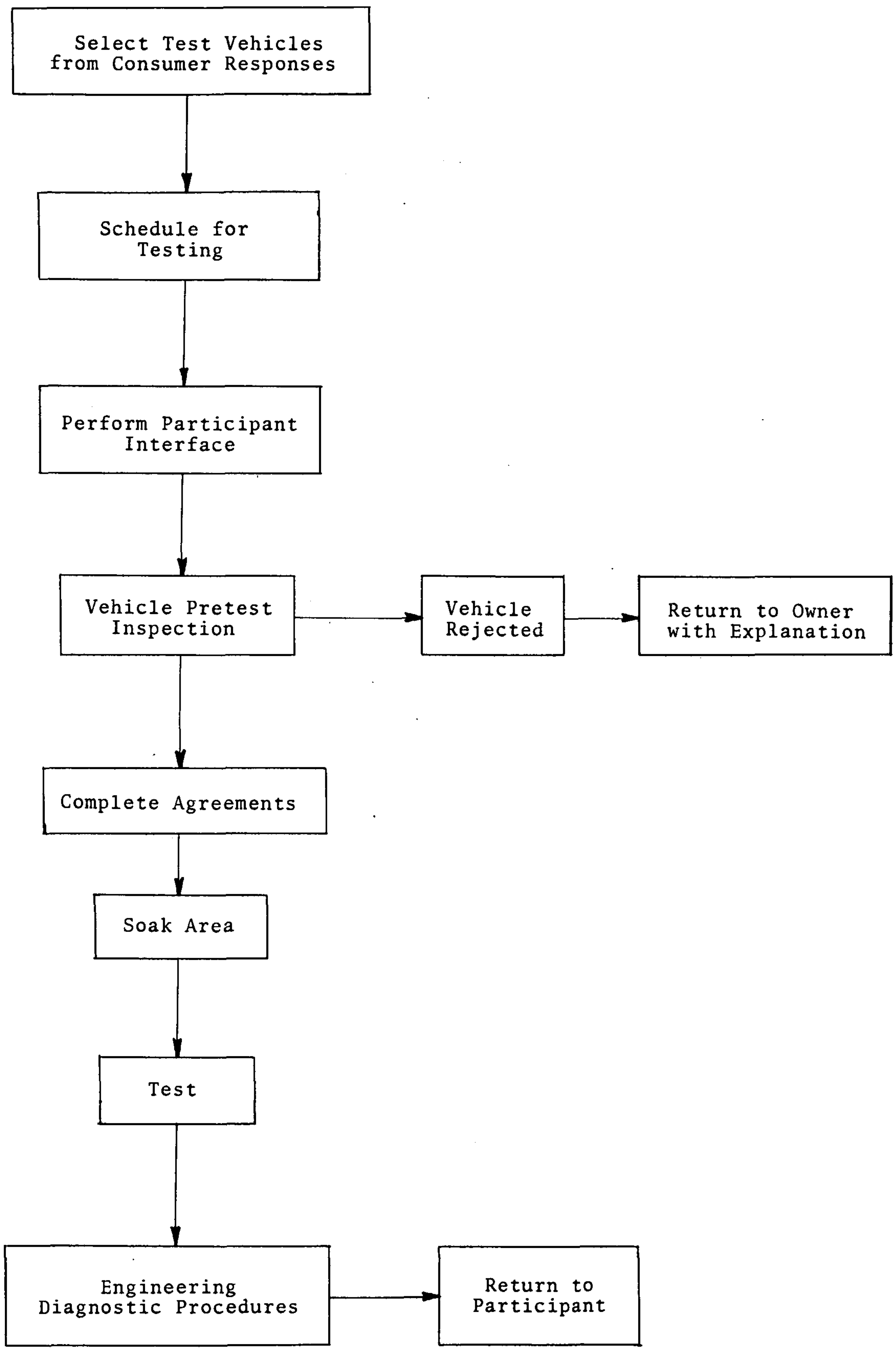
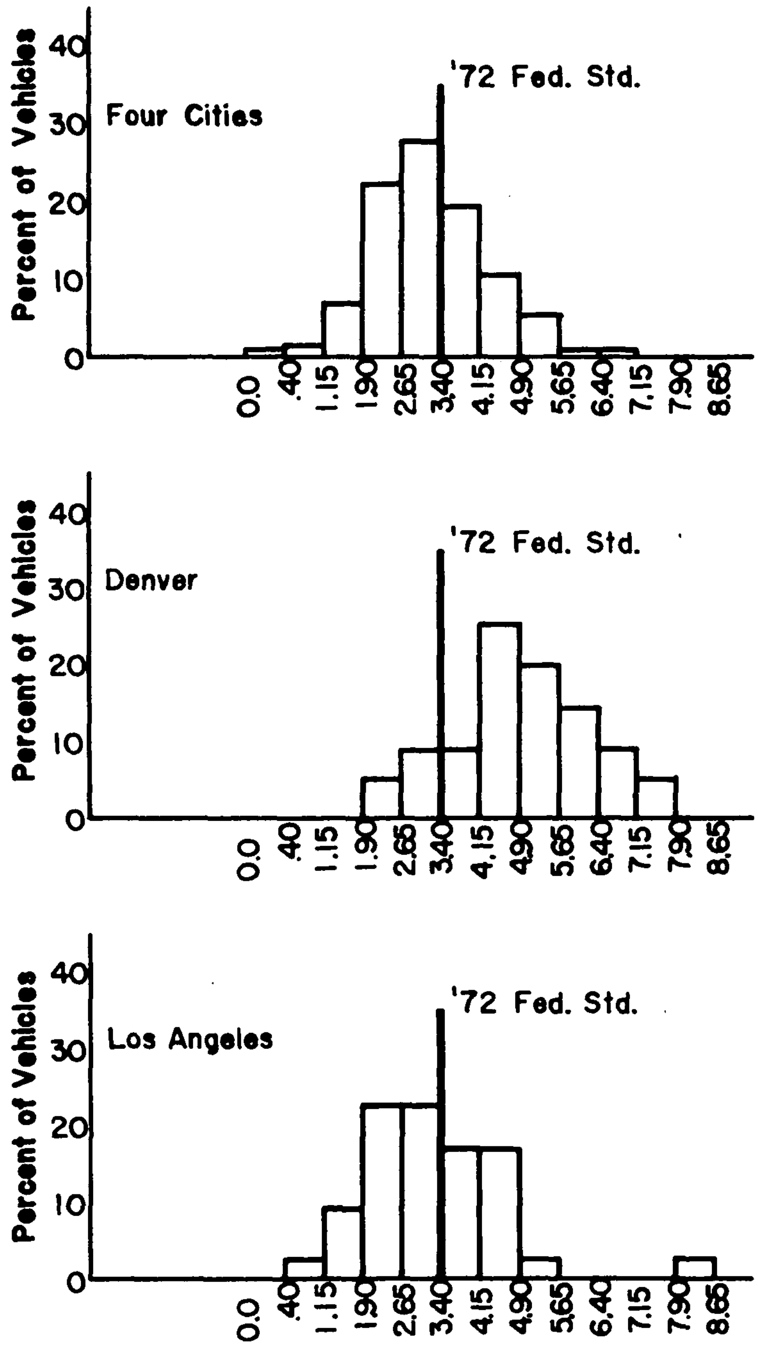


FIGURE 2

Vehicle Handling Procedure



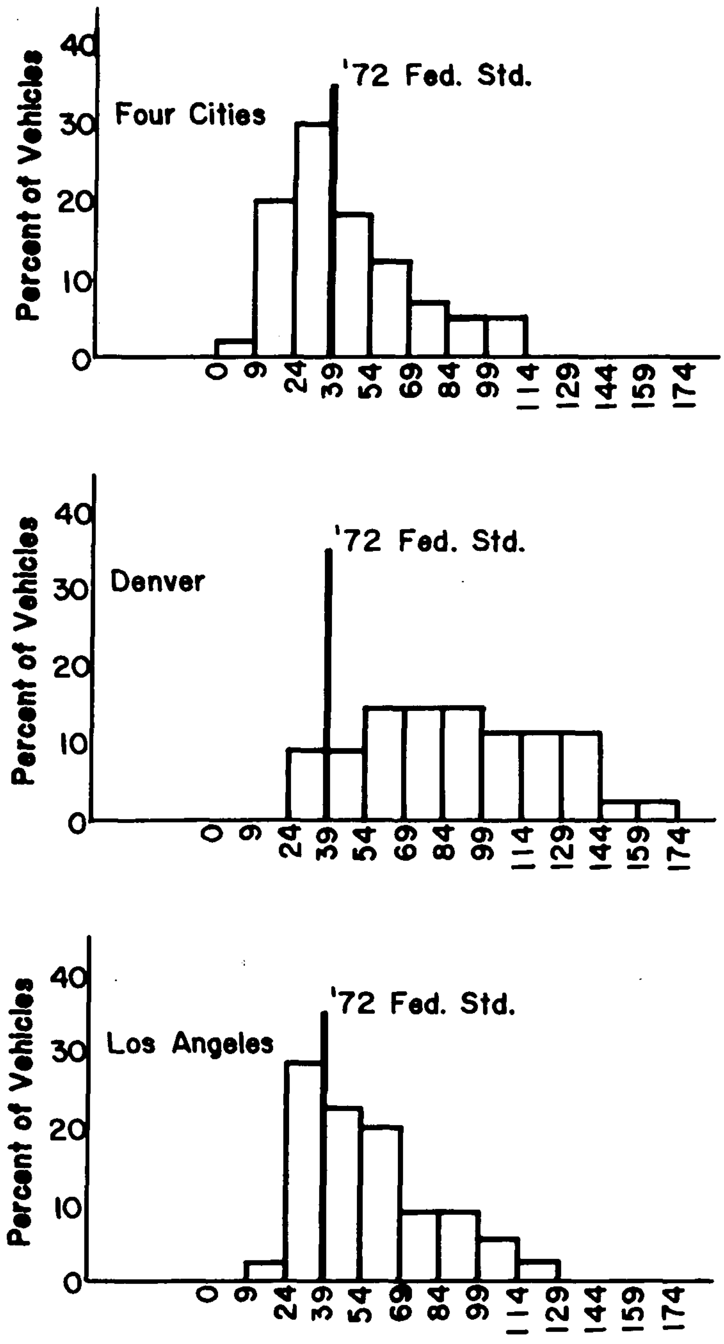
FY72 Emission Factors Program



Hydrocarbons In Grams Per Mile
1972 Vehicles

Figure 3

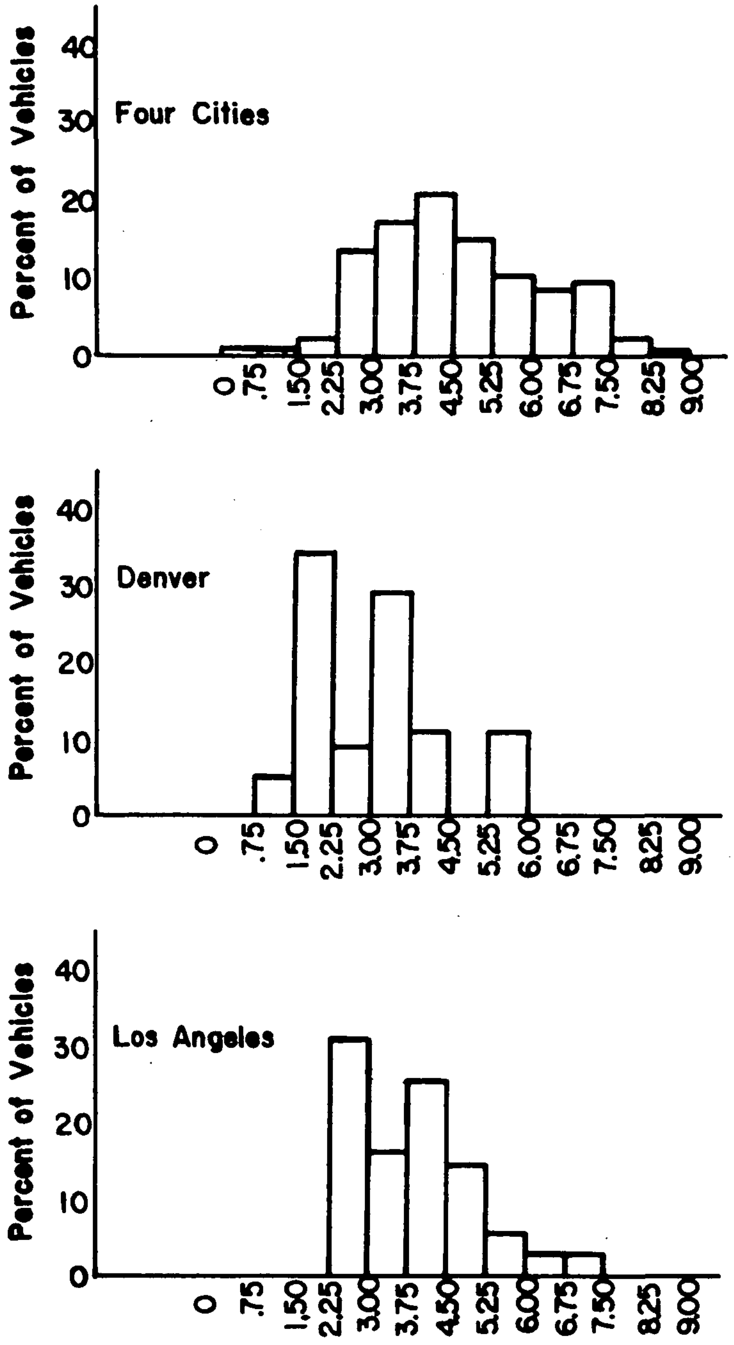
FY72 Emission Factors Program



Carbon Monoxide In Grams Per Mile
1972 Vehicles

Figure 4

FY72 Emission Factors Program



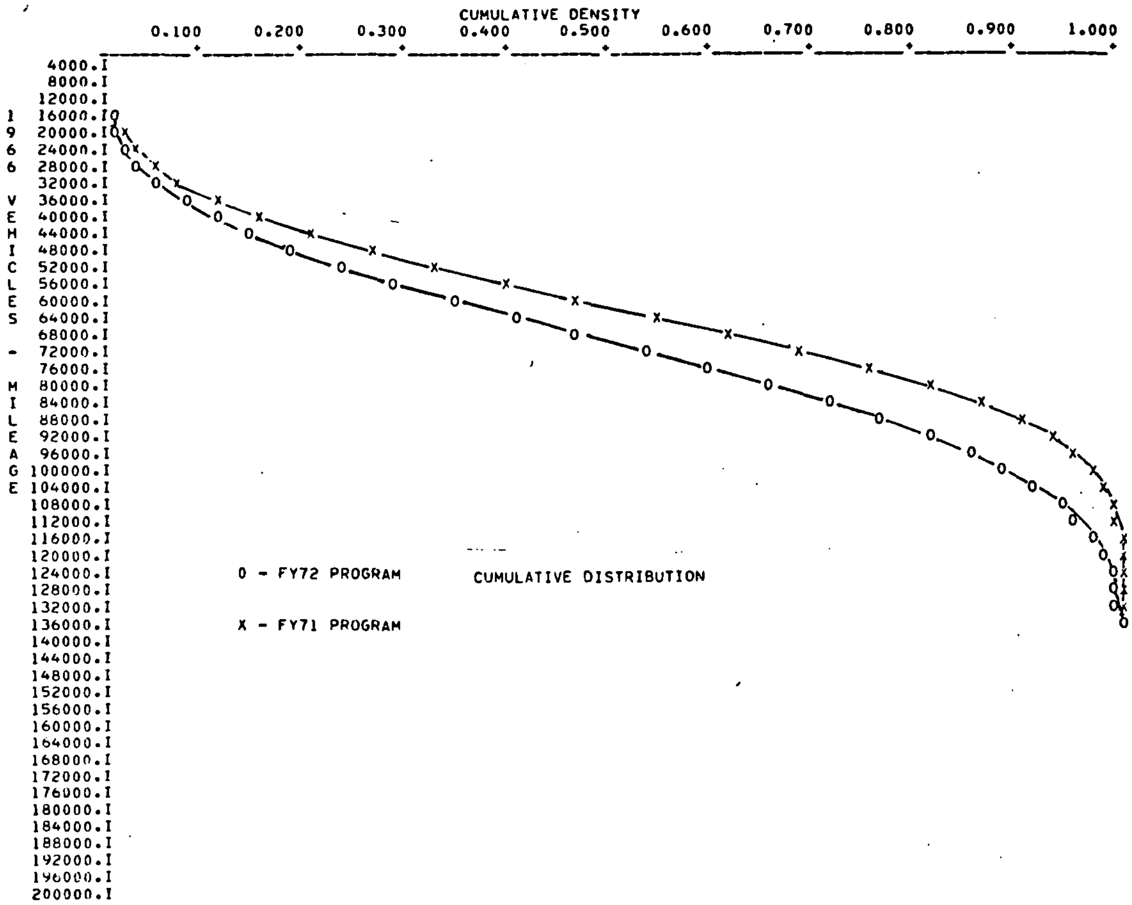
Oxides Of Nitrogen In Grams Per Mile
(Corrected For Humidity)
1972 Vehicles

Figure 5

FIGURE 6

STATISTICAL DISTRIBUTION OF MILEAGE

1966 MODEL YEAR VEHICLES



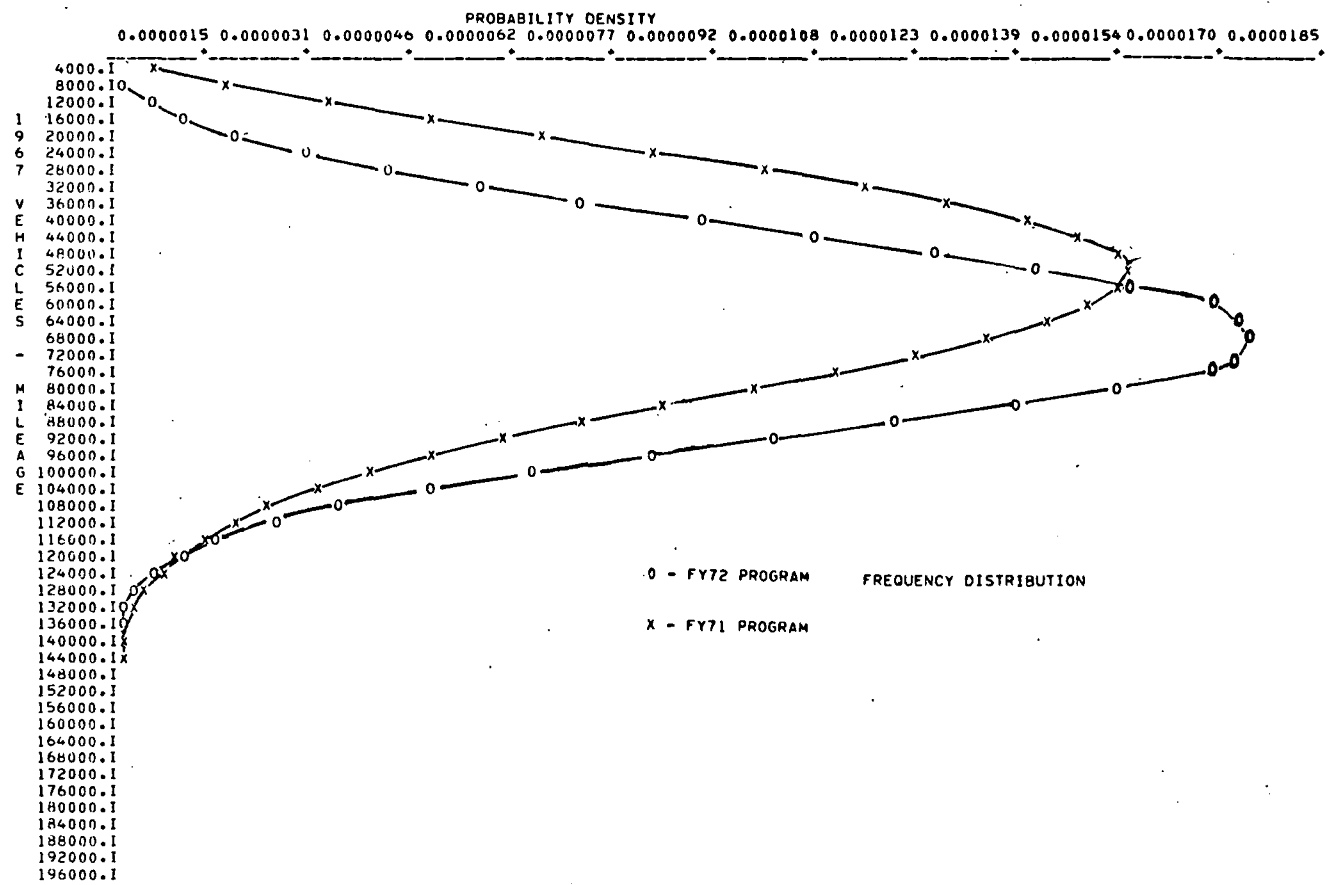
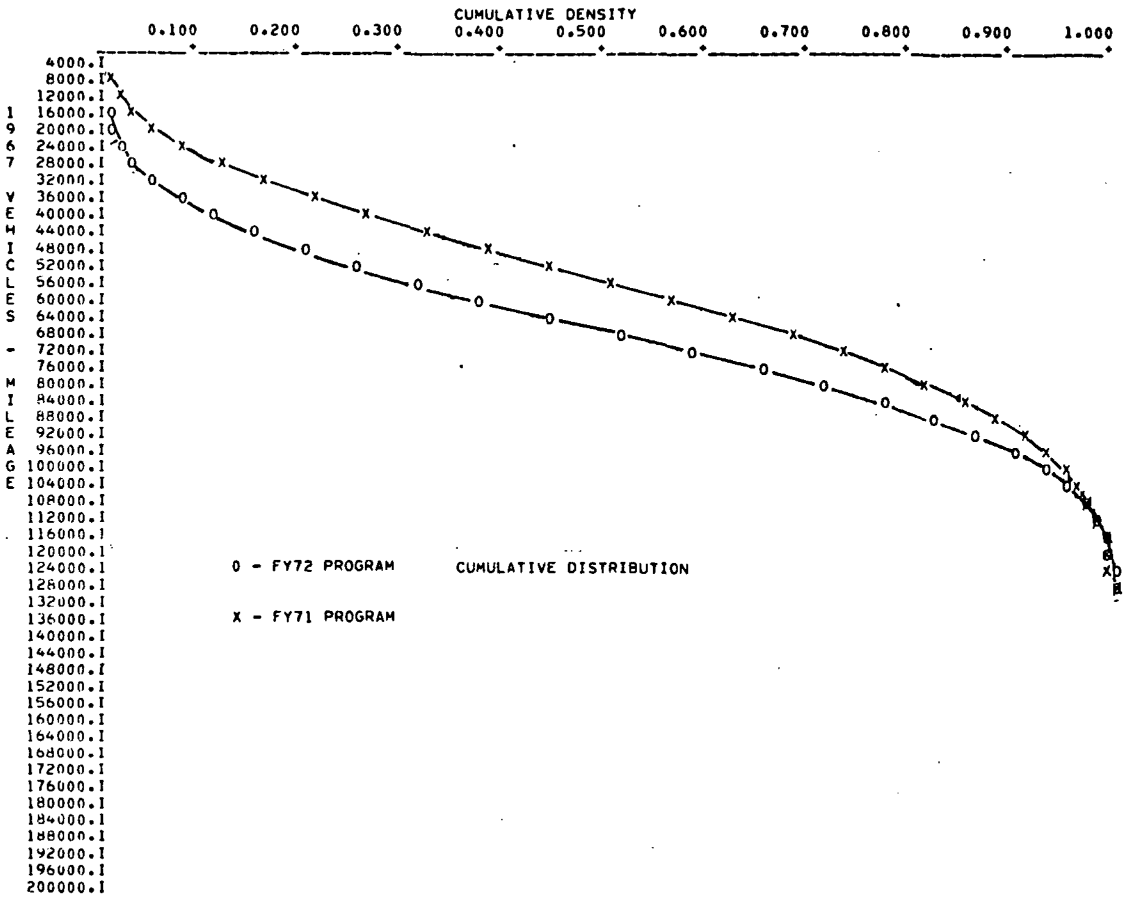


FIGURE 7

STATISTICAL DISTRIBUTION OF MILEAGE

1967 MODEL YEAR VEHICLES



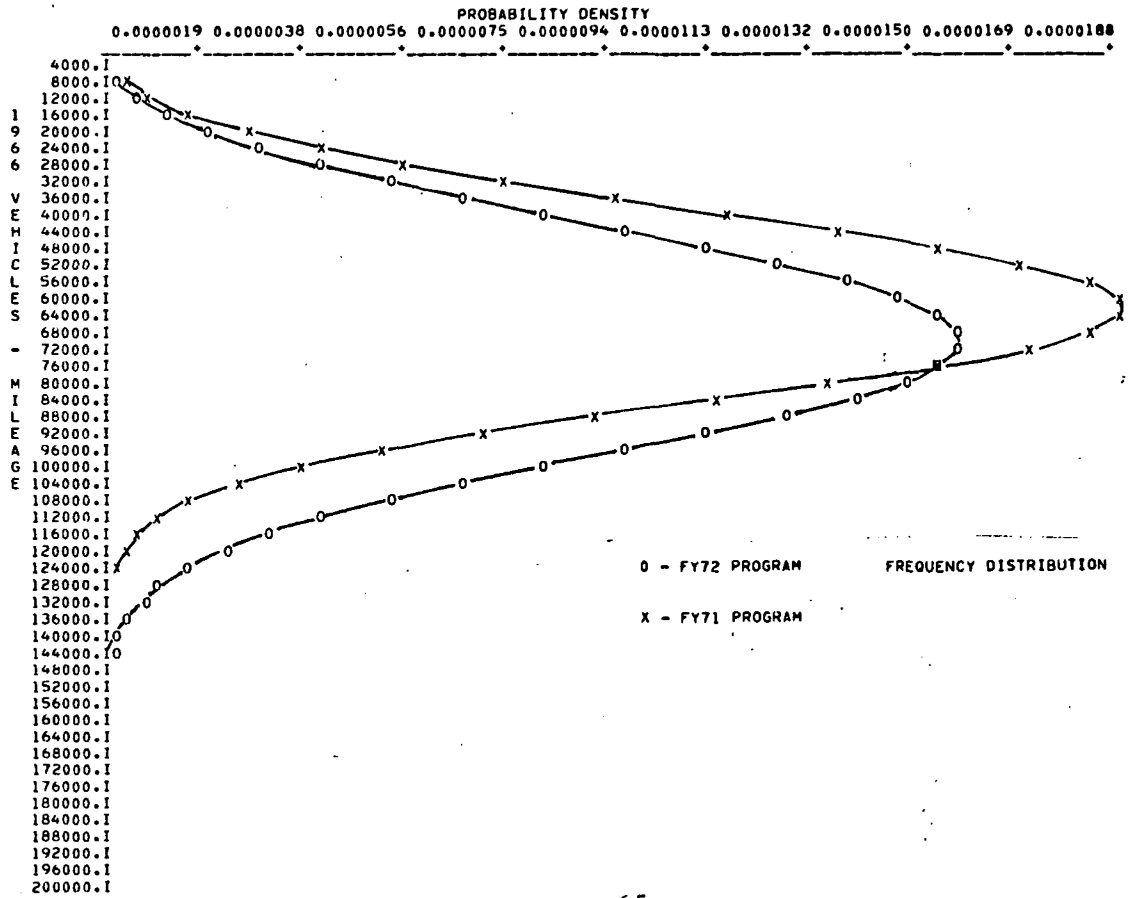
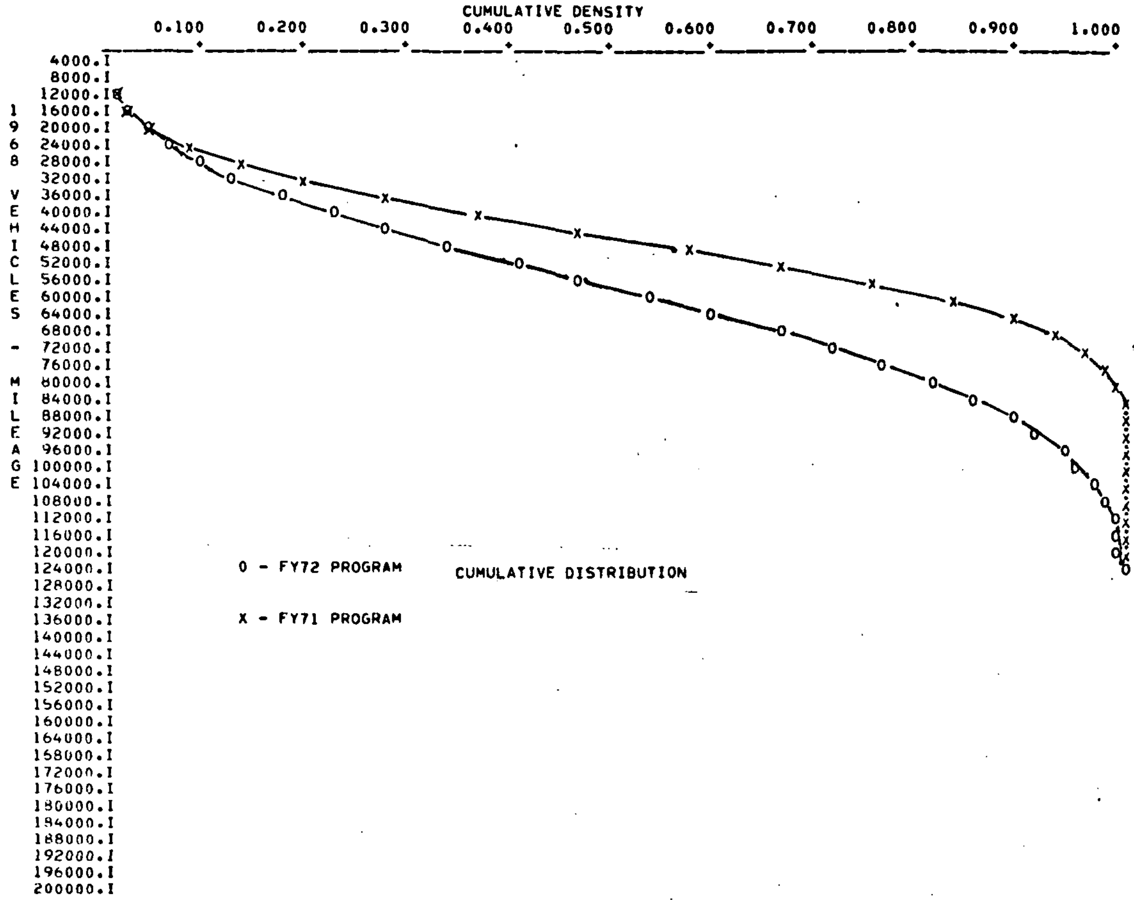


FIGURE 8

STATISTICAL DISTRIBUTION OF MILEAGE

1968 MODEL YEAR VEHICLES



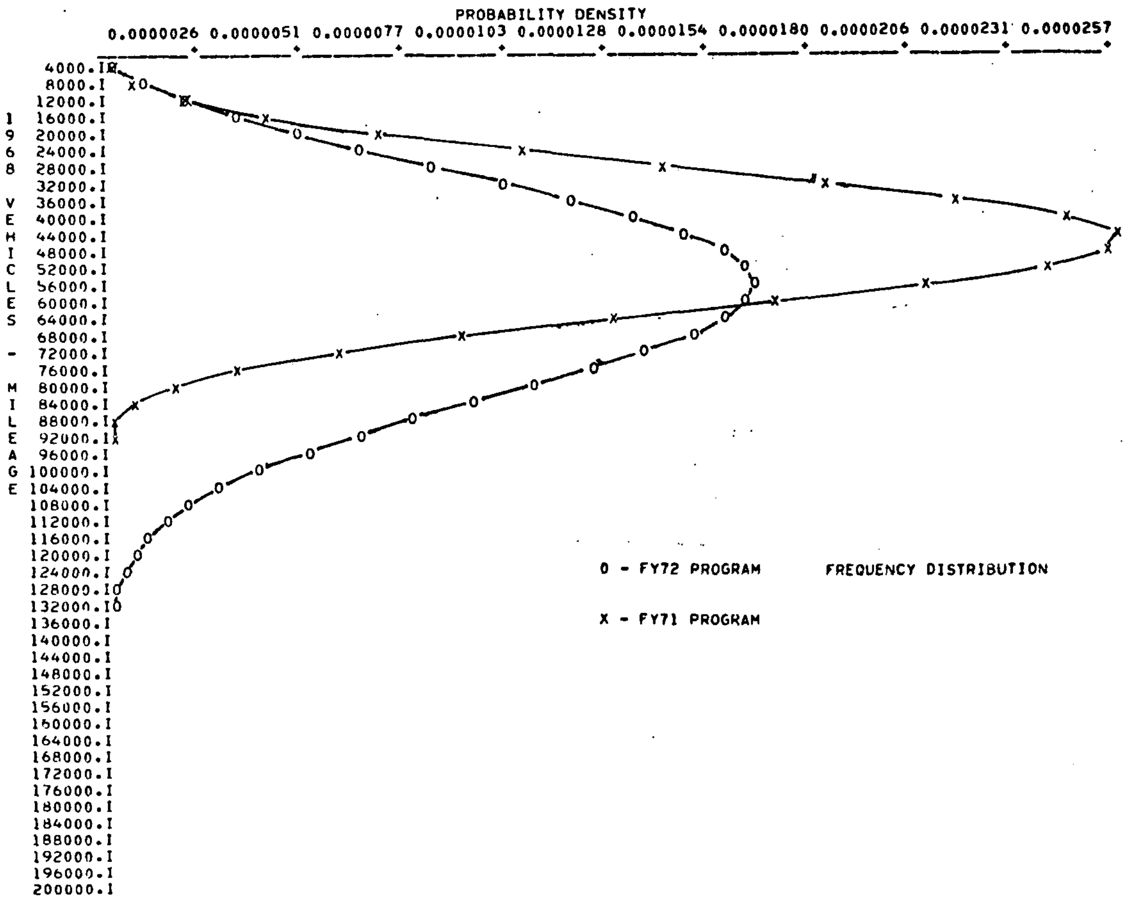
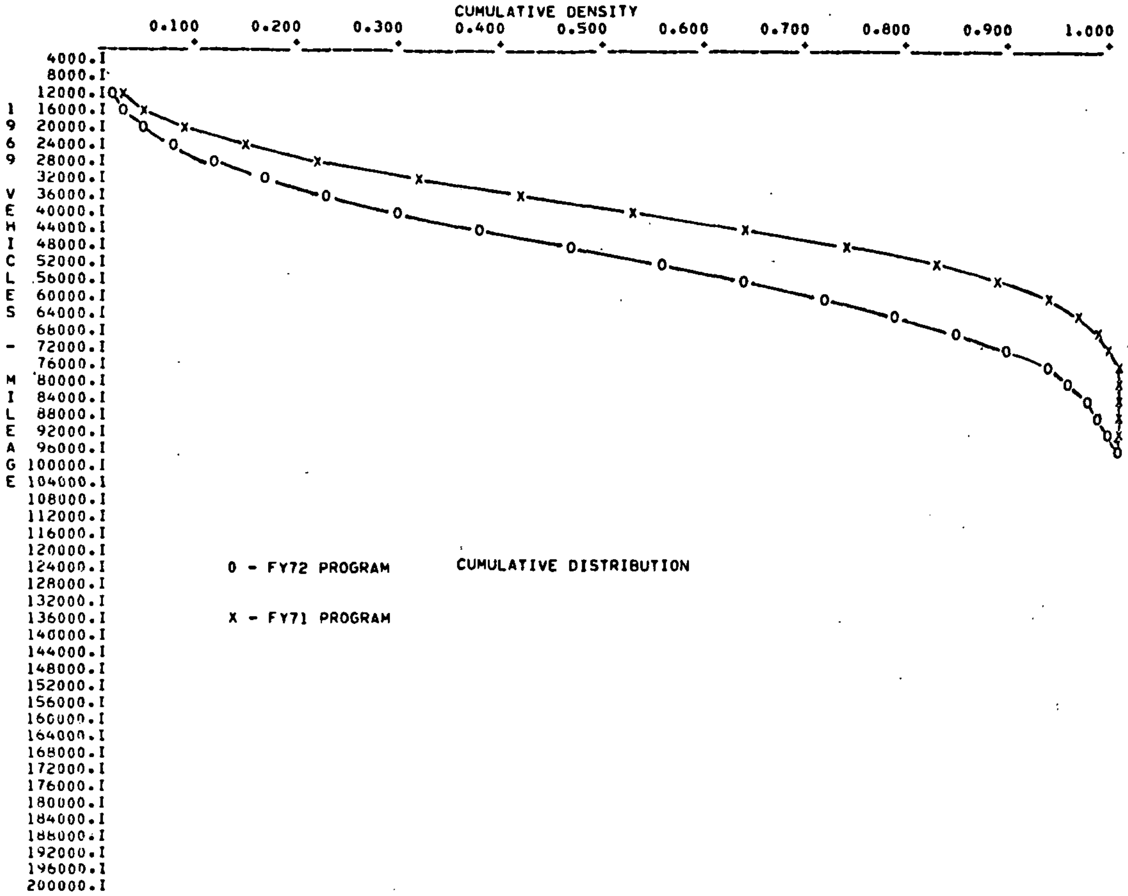


FIGURE 9

STATISTICAL DISTRIBUTION OF MILEAGE

1969 MODEL YEAR VEHICLES



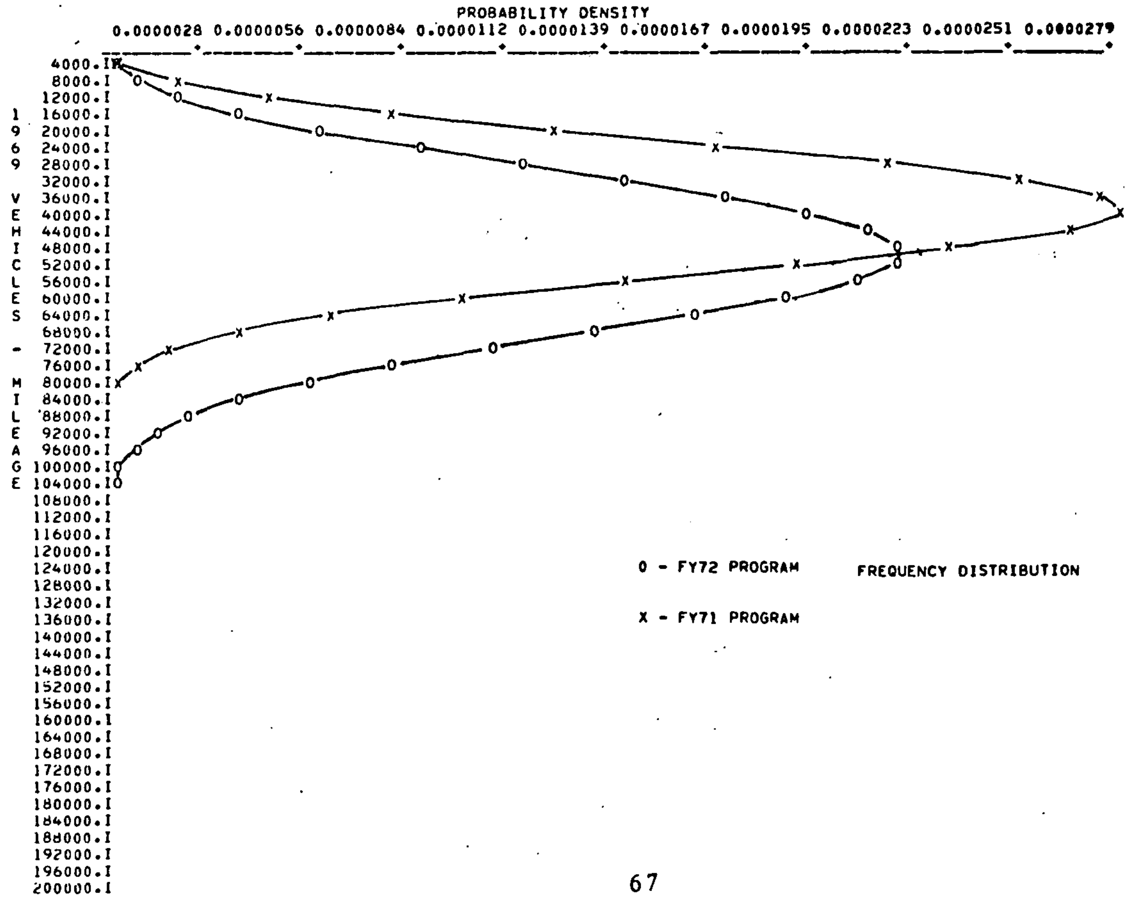
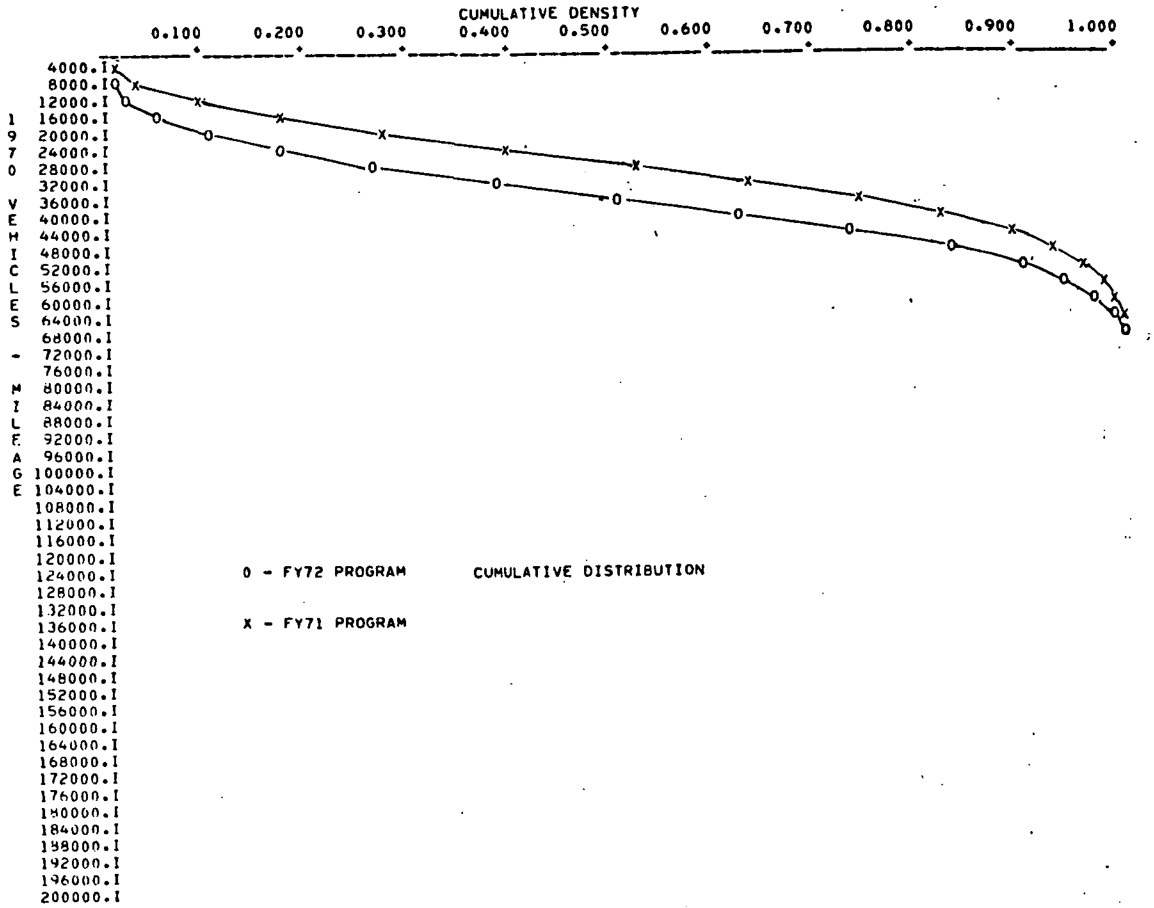


FIGURE 10

STATISTICAL DISTRIBUTION OF MILEAGE

1970 MODEL YEAR VEHICLES



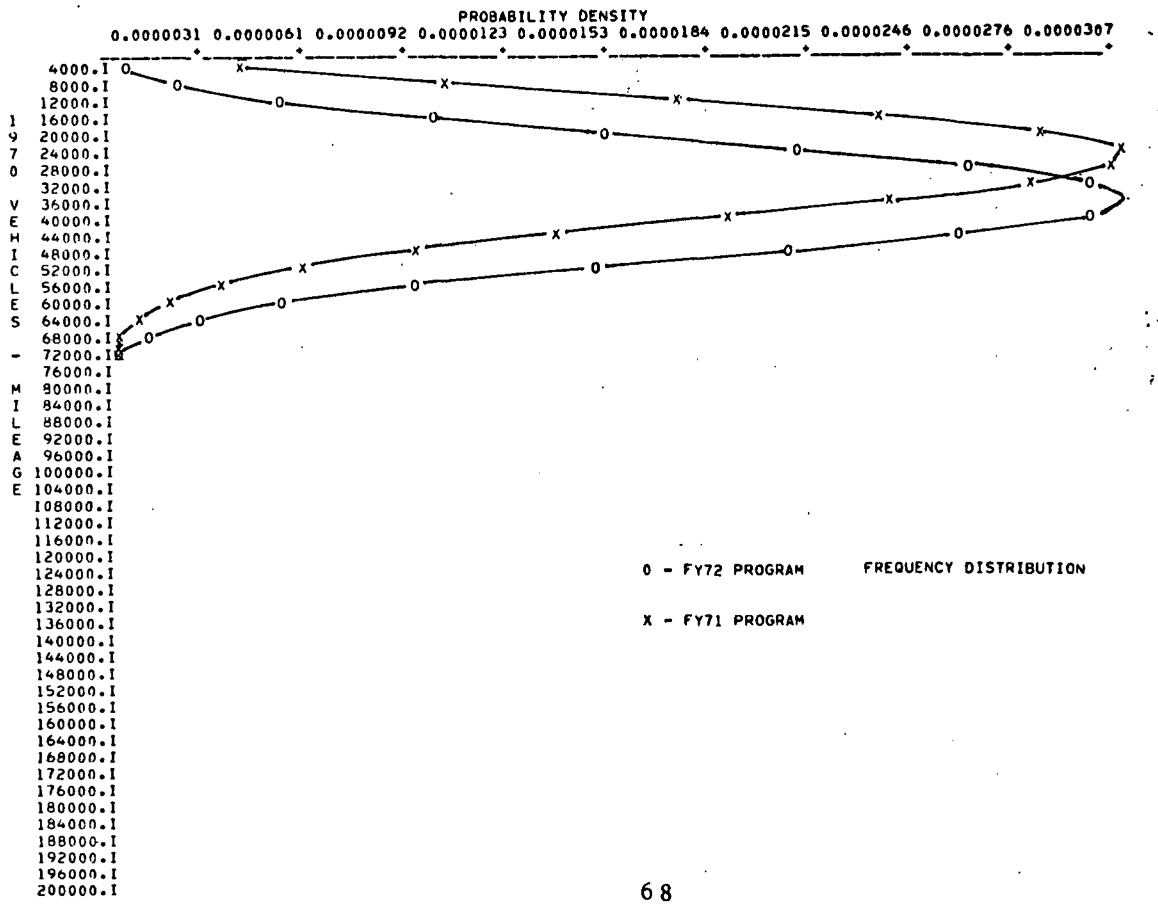
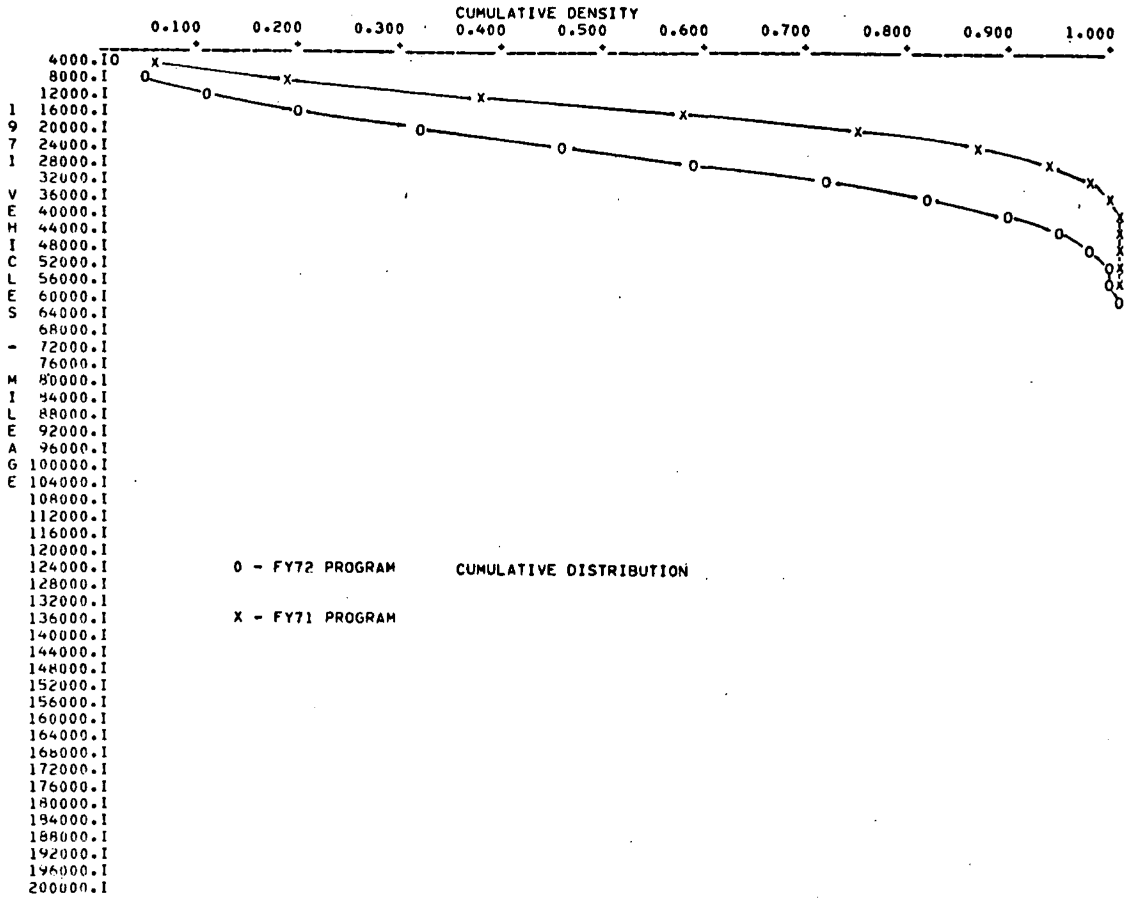


FIGURE 11

STATISTICAL DISTRIBUTION OF MILEAGE

1971 MODEL YEAR VEHICLES



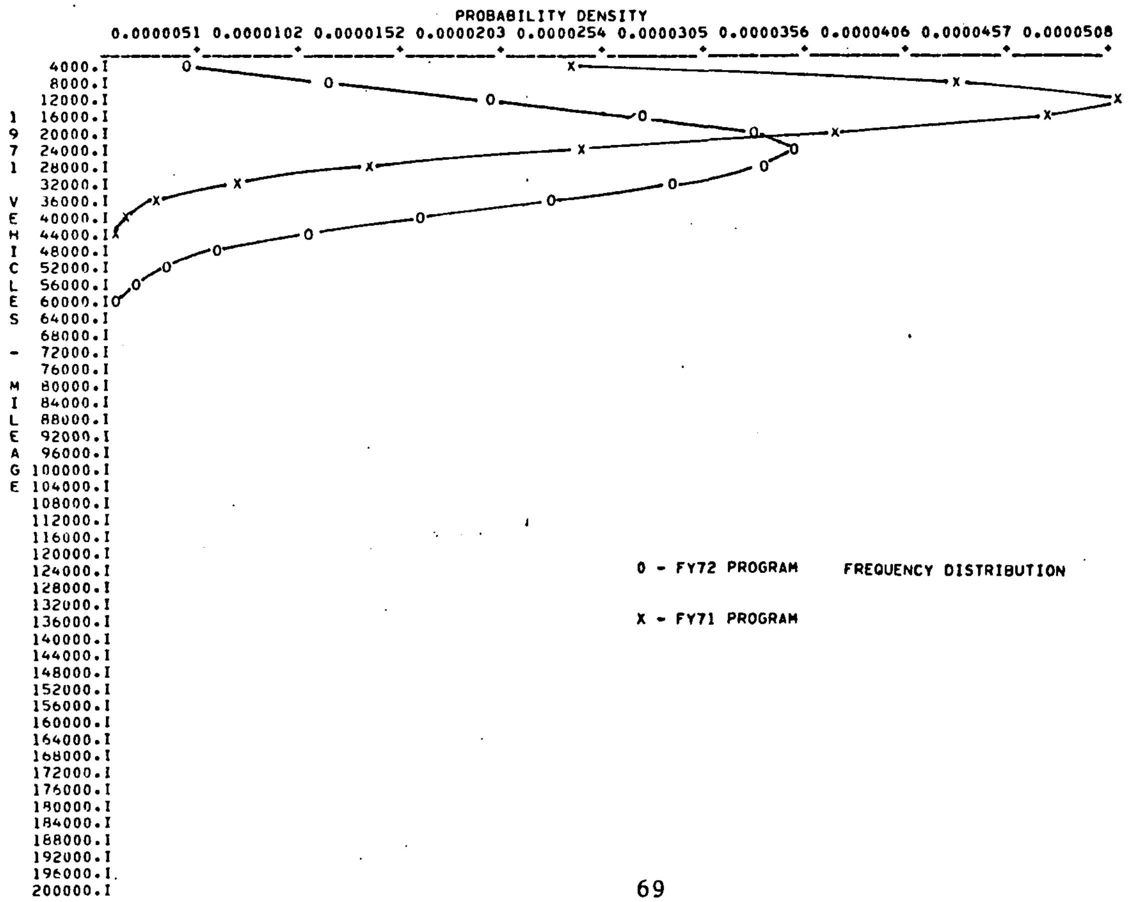
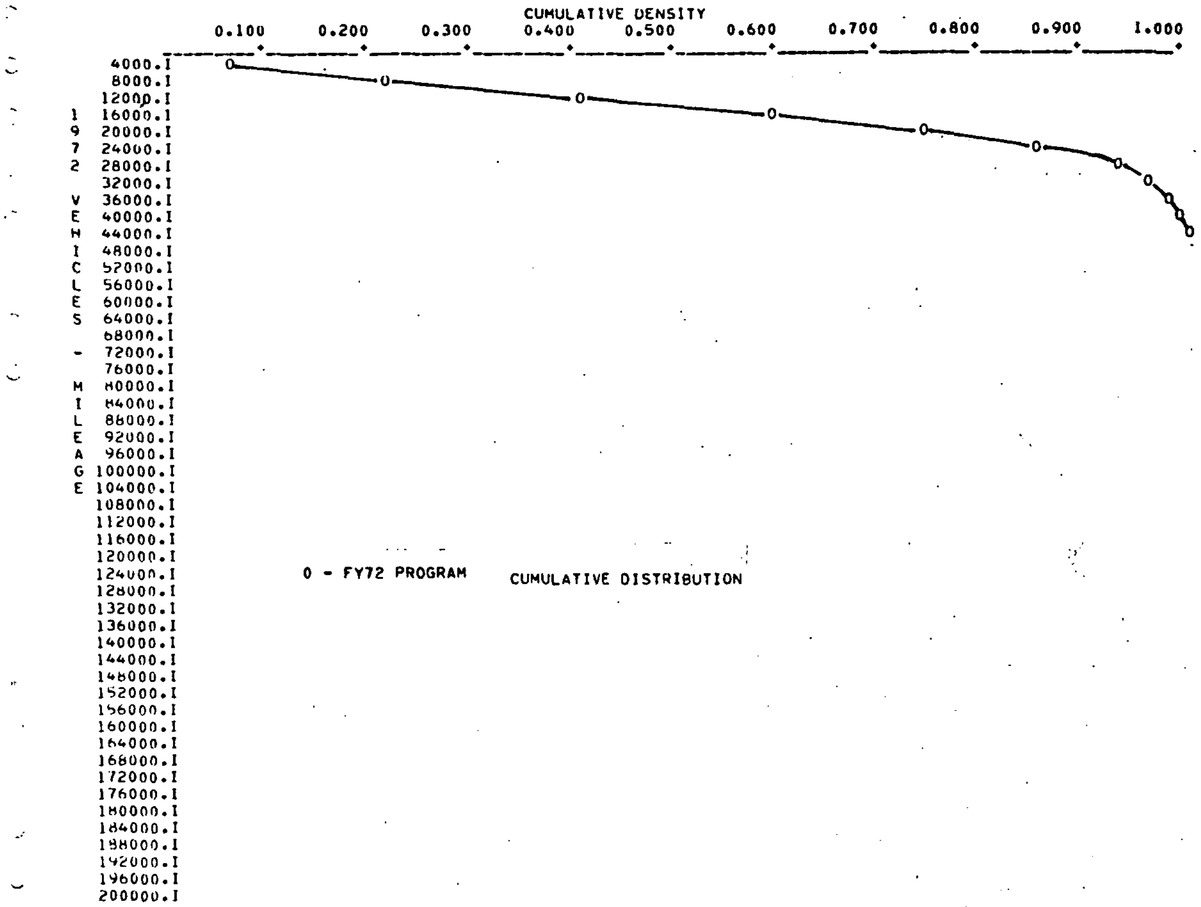
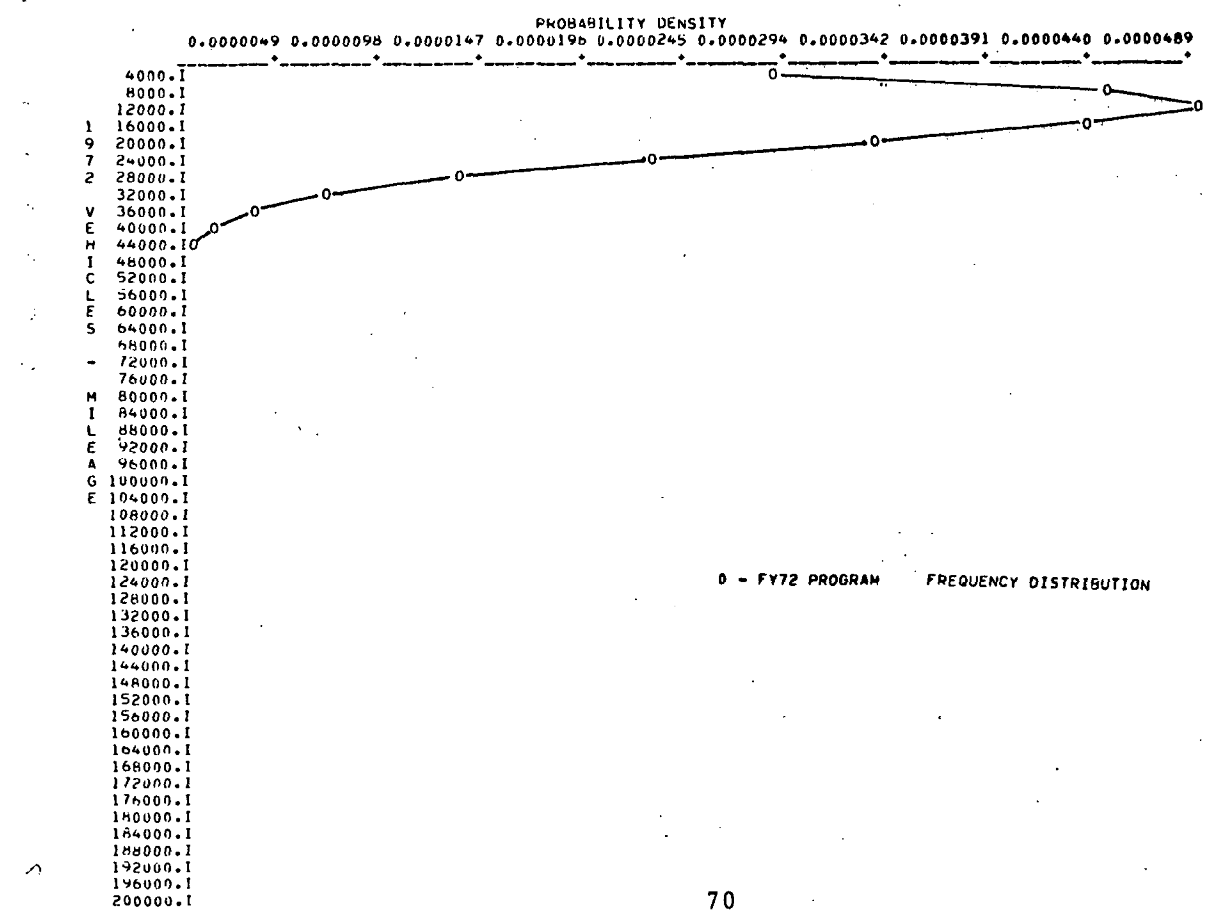


FIGURE 12

STATISTICAL DISTRIBUTION OF MILEAGE

1972 MODEL YEAR VEHICLES





APPENDIX I

FY72 Emission Factor Results Based on the 1975 Federal Test Procedure Weighting Factors

TABLE I- 1

FY72 EMISSION FACTOR PROGRAM

COMPOSITE EMISSION LEVELS FOR ALL CITIES EXCLUDING DENVER AND LOS ANGELES

1975 FTP

YEAR	N	MEAN MILES (K)	% BELOW LEVEL *			HYDROCARBONS GM/MI				CARBON MONOXIDE GM/MI				NOX GM/MI			
						ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC	
			HC	CO	NOX	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
1966	68	71.7	3	3	50	9.55	8.65	7.80	1.77	95.66	45.86	85.03	1.66	3.19	1.61	2.75	1.82
1967	72	67.6	3	3	50	7.84	4.81	7.03	1.54	91.43	34.17	84.70	1.52	3.48	1.69	3.11	1.64
TOTAL	140	69.3	3	3	50	8.67	6.97	7.40	1.65	93.48	40.18	84.86	1.58	3.34	1.65	2.93	1.73
1968	64	57.9	14	27	26	6.18	5.01	5.14	1.75	64.60	34.94	55.35	1.80	4.32	1.71	3.94	1.58
1969	58	51.2	23	27	17	4.83	2.53	4.44	1.47	62.38	34.18	54.27	1.72	5.08	1.93	4.66	1.56
1970	108	36.8	29	41	18	4.69	4.21	4.14	1.65	53.23	36.87	44.22	1.84	4.35	1.67	4.04	1.48
1971	120	26.4	54	36	22	3.94	2.22	3.59	1.49	51.13	37.02	42.18	1.86	4.30	1.58	3.95	1.58
1972	140	14.8	73	64	17	3.02	2.22	2.69	1.60	36.88	24.04	29.74	1.99	4.55	1.59	4.25	1.48
TOTAL	540	34.4	43	42	20	4.39	3.45	3.75	1.67	51.78	34.64	42.27	1.93	4.50	1.70	4.15	1.53

NOX CORRECTED FOR HUMIDITY

* LEVELS
HC 3.4 GM/MI
CO 39.0 GM/MI
NOX 3.0 GM/MI

TABLE I- 2

FY72 EMISSION FACTOR PROGRAM

EMISSION LEVELS FOR DENVER

1975 FTP

YEAR	N	MEAN MILES (K)	% BELOW LEVEL * HC	CO	NOX	HYDROCARBONS GM/MI ARITHMETIC MEAN	SD	GEOMETRIC MEAN	SD	CARBON MONOXIDE GM/MI ARITHMETIC MEAN	SD	GEOMETRIC MEAN	SD	NOX GM/MI ARITHMETIC MEAN	SD	GEOMETRIC MEAN	SD
1966	17	60.6	0	0	71	9.78	6.60	8.58	1.60	123.56	54.33	113.58	1.52	2.30	1.60	1.79	2.17
1967	18	69.8	0	0	83	13.92	9.46	11.78	1.76	157.52	51.83	149.66	1.39	1.77	1.10	1.47	1.92
TOTAL	35	65.3	0	0	77	11.91	8.35	10.10	1.71	141.03	55.03	130.89	1.48	2.03	1.37	1.62	2.03
1968	21	51.4	0	10	62	6.89	3.70	6.28	1.51	101.43	65.83	87.81	1.70	2.86	1.25	2.62	1.54
1969	22	46.1	5	5	73	5.97	1.28	5.83	1.26	97.85	38.11	90.31	1.53	2.93	1.47	2.61	1.65
1970	27	31.6	4	0	41	5.56	1.56	5.37	1.30	87.52	31.24	82.39	1.43	3.32	1.11	3.14	1.43
1971	30	18.2	7	7	63	5.19	1.74	4.97	1.34	80.32	37.27	72.93	1.57	2.74	1.31	2.48	1.56
1972	35	14.1	20	14	49	4.75	2.42	4.39	1.45	80.36	32.46	73.45	1.57	3.08	1.39	2.78	1.60
TOTAL	135	29.6	8	7	56	5.54	2.33	5.20	1.41	87.91	41.28	79.79	1.56	2.99	1.31	2.72	1.56

NOX CORRECTED FOR HUMIDITY

*
LEVELS
HC 3.4 GM/MI
CO 39.0 GM/MI
NOX 3.0 GM/MI

TABLE I- 3

FY72 EMISSION FACTOR PROGRAM

EMISSION LEVELS FOR LOS ANGELES

1975 FTP

			% BELOW LEVEL *			HYDROCARBONS GM/MI				CARBON MONOXIDE GM/MI				NOX GM/MI			
						ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC	
YEAR	N	MEAN MILES (K)	HC	CO	NOX	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
1966	17	73.0	24	12	47	7.46	11.96	4.97	2.03	86.90	43.27	76.30	1.74	3.43	1.90	2.82	2.05
1967	18	66.7	44	17	28	5.36	4.44	4.29	1.92	75.38	45.21	63.01	1.89	3.77	1.81	3.32	1.74
TOTAL	35	69.7	34	14	37	6.38	8.86	4.60	1.97	80.98	44.01	69.15	1.81	3.61	1.84	3.07	1.69
1968	21	65.0	19	24	14	6.97	5.50	5.66	1.86	60.05	29.10	53.06	1.70	4.91	1.81	4.53	1.55
1969	22	49.5	27	14	14	5.42	5.35	4.39	1.81	71.61	33.01	64.43	1.63	4.68	1.69	4.43	1.40
1970	27	40.2	30	19	22	6.64	6.45	5.25	1.84	78.47	38.32	69.91	1.65	4.46	1.59	4.13	1.53
1971	30	32.1	40	23	27	3.98	1.73	3.69	1.47	59.66	26.48	54.73	1.52	3.83	1.05	3.68	1.34
1972	35	17.6	66	49	29	3.56	4.24	2.80	1.80	46.68	24.06	41.16	1.67	3.81	1.21	3.65	1.35
TOTAL	135	37.9	39	27	22	5.10	4.92	4.05	1.84	62.07	31.84	54.56	1.68	4.26	1.50	4.00	1.44

NOX CORRECTED FOR HUMIDITY

*
LEVELS
HC 3.4 GM/MI
CO 39.0 GM/MI
NOX 3.0 GM/MI

TABLE I- 4

FY72 EMISSION FACTOR PROGRAM

1975 FTP RESULTS BY INERTIA WEIGHT AND ENGINE DISPLACEMENT FOR ALL CITIES, EXCLUDING DENVER AND LOS ANGELES

EMISSIONS IN GM/MI - GAS MILEAGE IN MI/GAL

MODEL YEAR=1966

ENGINE DISPLACEMENT (CID)

INERTIA WT. (LBS)	≤150		151-250		251-339		340-399		≥ 400		TOTAL	
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
≤ 2000	N= 4		N= 0		N= 0		N= 0		N= 0		N= 4	
HC	19.41	27.95	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.41	27.95
CO	84.36	24.93	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	84.36	24.93
NOX	1.65	0.63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.65	0.63
GAS MILEAGE	20.33	3.55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.33	3.55
2001-2500	N= 0		N= 1		N= 0		N= 0		N= 0		N= 1	
HC	0.0	0.0	10.91	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.91	0.0
CO	0.0	0.0	115.25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	115.25	0.0
NOX	0.0	0.0	1.46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.46	0.0
GAS MILEAGE	0.0	0.0	12.90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.90	0.0
2501-3000	N= 0		N= 13		N= 4		N= 0		N= 0		N= 17	
HC	0.0	0.0	7.31	5.59	12.51	9.02	0.0	0.0	0.0	0.0	8.53	6.63
CO	0.0	0.0	82.99	49.58	80.66	45.46	0.0	0.0	0.0	0.0	82.44	47.24
NOX	0.0	0.0	2.98	1.46	4.52	1.90	0.0	0.0	0.0	0.0	3.34	1.65
GAS MILEAGE	0.0	0.0	17.27	2.45	15.96	1.92	0.0	0.0	0.0	0.0	16.94	2.33
3001-3500	N= 0		N= 2		N= 7		N= 0		N= 0		N= 9	
HC	0.0	0.0	5.35	2.58	7.03	2.34	0.0	0.0	0.0	0.0	6.66	2.34
CO	0.0	0.0	88.31	34.86	66.40	39.33	0.0	0.0	0.0	0.0	71.27	37.49
NOX	0.0	0.0	3.62	0.02	3.82	1.30	0.0	0.0	0.0	0.0	3.78	1.13
GAS MILEAGE	0.0	0.0	17.17	1.62	14.52	1.74	0.0	0.0	0.0	0.0	15.04	1.98
3501-4000	N= 0		N= 0		N= 12		N= 11		N= 0		N= 23	
HC	0.0	0.0	0.0	0.0	9.87	3.03	8.32	3.77	0.0	0.0	9.13	3.42
CO	0.0	0.0	0.0	0.0	102.14	28.27	113.81	59.95	0.0	0.0	107.72	45.48
NOX	0.0	0.0	0.0	0.0	3.39	1.22	2.59	1.75	0.0	0.0	3.01	1.52
GAS MILEAGE	0.0	0.0	0.0	0.0	13.82	1.29	13.43	2.77	0.0	0.0	13.63	2.13
4001-4500	N= 0		N= 0		N= 2		N= 8		N= 2		N= 12	
HC	0.0	0.0	0.0	0.0	7.54	0.79	12.79	12.23	6.38	0.11	10.85	10.18
CO	0.0	0.0	0.0	0.0	103.29	12.14	95.44	46.04	119.69	36.72	100.79	39.64
NOX	0.0	0.0	0.0	0.0	2.93	0.58	4.15	2.24	3.07	1.56	3.77	1.94
GAS MILEAGE	0.0	0.0	0.0	0.0	12.80	2.23	12.38	1.38	12.38	1.68	12.45	1.39
4501-5000	N= 0		N= 0		N= 0		N= 0		N= 1		N= 1	
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.29	0.0	5.29	0.0
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	98.59	0.0	98.59	0.0
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.98	0.0	2.98	0.0
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.00	0.0	11.00	0.0
>5000	N= 0		N= 0		N= 0		N= 0		N= 1		N= 1	
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.58	0.0	10.58	0.0
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	223.81	0.0	223.81	0.0
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.94	0.0	0.94	0.0
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.70	0.0	9.70	0.0
TOTAL	N= 4		N= 16		N= 25		N= 19		N= 4		N= 68	
HC	19.41	27.95	7.29	5.18	9.31	4.41	10.20	8.44	7.16	2.34	9.55	8.65
CO	84.36	24.93	85.67	45.97	88.79	35.79	106.07	53.93	140.45	60.31	95.66	45.86
NOX	1.65	0.63	2.97	1.38	3.65	1.33	3.24	2.07	2.51	1.38	3.19	1.61
GAS MILEAGE	20.33	3.55	16.90	2.55	14.23	1.70	12.96	2.21	11.25	1.57	14.40	2.85

NOX CORRECTED FOR HUMIDITY

TABLE I- 5

FY72 EMISSION FACTOR PROGRAM

1975 FTP RESULTS BY INERTIA WEIGHT AND ENGINE DISPLACEMENT FOR ALL CITIES, EXCLUDING DENVER AND LOS ANGELES

EMISSIONS IN GM/MI - GAS MILEAGE IN MI/GAL

MODEL YEAR=1967

ENGINE DISPLACEMENT (CID)

INERTIA WT. (LBS)	≤150		151-250		251-339		340-399		≥ 400		TOTAL	
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
≤ 2000	N= 3		N= 0		N= 0		N= 0		N= 0		N= 3	
HC	5.73	2.72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.73	2.72
CO	61.42	9.39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.42	9.39
NOX	1.56	1.04	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.56	1.04
GAS MILEAGE	27.23	5.33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.23	5.33
2001-2500	N= 1		N= 0		N= 0		N= 0		N= 0		N= 1	
HC	5.78	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.78	0.0
CO	48.96	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.96	0.0
NOX	1.53	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.53	0.0
GAS MILEAGE	23.30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.30	0.0
2501-3000	N= 0		N= 6		N= 7		N= 0		N= 0		N= 13	
HC	0.0	0.0	6.45	4.55	10.04	6.41	0.0	0.0	0.0	0.0	8.38	5.72
CO	0.0	0.0	79.68	29.68	101.59	25.75	0.0	0.0	0.0	0.0	91.47	28.77
NOX	0.0	0.0	3.35	1.15	2.29	0.58	0.0	0.0	0.0	0.0	2.78	1.01
GAS MILEAGE	0.0	0.0	17.65	2.51	15.44	0.92	0.0	0.0	0.0	0.0	16.39	1.94
3001-3500	N= 0		N= 0		N= 15		N= 1		N= 0		N= 16	
HC	0.0	0.0	0.0	0.0	8.10	3.12	5.70	0.0	0.0	0.0	7.95	3.08
CO	0.0	0.0	0.0	0.0	91.67	37.30	108.74	0.0	0.0	0.0	92.74	36.28
NOX	0.0	0.0	0.0	0.0	3.73	1.36	2.64	0.0	0.0	0.0	3.66	1.34
GAS MILEAGE	0.0	0.0	0.0	0.0	14.11	1.22	13.30	0.0	0.0	0.0	14.06	1.19
3501-4000	N= 0		N= 2		N= 19		N= 6		N= 2		N= 29	
HC	0.0	0.0	7.31	1.39	9.00	7.38	5.78	1.10	6.24	1.22	8.03	6.11
CO	0.0	0.0	96.93	19.99	93.88	29.89	83.79	53.46	70.29	2.86	90.38	33.89
NOX	0.0	0.0	2.05	0.21	3.61	1.14	3.72	1.92	6.23	1.90	3.70	1.51
GAS MILEAGE	0.0	0.0	15.26	1.13	13.56	1.73	12.90	1.51	14.05	0.21	13.56	1.65
4001-4500	N= 0		N= 0		N= 2		N= 6		N= 2		N= 10	
HC	0.0	0.0	0.0	0.0	8.51	0.74	6.46	1.22	8.34	1.99	7.25	1.53
CO	0.0	0.0	0.0	0.0	115.58	5.00	98.08	50.57	118.02	25.30	105.57	39.86
NOX	0.0	0.0	0.0	0.0	2.77	0.70	4.89	3.39	3.83	1.76	4.26	2.75
GAS MILEAGE	0.0	0.0	0.0	0.0	13.85	0.21	12.79	0.92	12.24	1.61	12.87	1.06
4501-5000	N= 0		N= 0		N= 0		N= 0		N= 0		N= 0	
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
>5000	N= 0		N= 0		N= 0		N= 0		N= 0		N= 0	
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	N= 4		N= 8		N= 43		N= 13		N= 4		N= 72	
HC	5.74	2.22	6.66	3.91	8.83	5.74	6.09	1.12	7.29	1.81	7.84	4.81
CO	58.30	9.88	83.99	27.39	95.37	31.20	92.31	48.29	94.16	31.23	91.43	34.17
NOX	1.55	0.85	3.03	1.14	3.40	1.23	4.18	2.62	5.03	2.04	3.48	1.69
GAS MILEAGE	26.13	4.53	16.99	2.35	14.04	1.56	12.88	1.15	13.08	1.49	14.40	2.46

NOX CORRECTED FOR HUMIDITY

TABLE I- 6

FY72 EMISSION FACTOR PROGRAM

1975 FTP RESULTS BY INERTIA WEIGHT AND ENGINE DISPLACEMENT FOR
ALL CITIES, EXCLUDING DENVER AND LOS ANGELES

EMISSIONS IN GM/MI - GAS MILEAGE IN MI/GAL

MODEL YEAR=1968

ENGINE DISPLACEMENT (CID)

INERTIA WT. (LBS)	≤150		151-250		251-339		340-399		≥ 400		TOTAL	
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
	N= 3		N= 0		N= 0		N= 0		N= 0		N= 3	
≤ 2000												
HC	11.57	10.24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.57	10.24
CO	98.12	48.43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	98.12	48.43
NOX	1.44	0.37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.44	0.37
GAS MILEAGE	19.50	3.62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.50	3.62
	N= 1		N= 1		N= 0		N= 0		N= 0		N= 2	
2001-2500												
HC	19.41	0.0	7.37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.39	8.51
CO	119.31	0.0	91.59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	105.45	19.60
NOX	1.78	0.0	2.18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.98	0.28
GAS MILEAGE	16.30	0.0	17.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.93	0.92
	N= 0		N= 4		N= 7		N= 0		N= 0		N= 11	
2501-3000												
HC	0.0	0.0	3.77	1.26	4.99	1.84	0.0	0.0	0.0	0.0	4.55	1.69
CO	0.0	0.0	38.98	16.32	45.09	17.08	0.0	0.0	0.0	0.0	42.87	16.26
NOX	0.0	0.0	4.21	2.12	3.68	1.24	0.0	0.0	0.0	0.0	3.87	1.53
GAS MILEAGE	0.0	0.0	19.06	0.63	16.16	1.46	0.0	0.0	0.0	0.0	17.10	1.90
	N= 0		N= 2		N= 14		N= 7		N= 1		N= 24	
3001-3500												
HC	0.0	0.0	9.21	5.15	4.53	1.82	5.24	1.43	8.26	0.0	5.28	2.37
CO	0.0	0.0	94.76	13.64	43.60	30.01	68.97	22.22	115.52	0.0	58.26	32.71
NOX	0.0	0.0	4.91	1.82	4.07	1.27	2.96	1.22	1.19	0.0	3.70	1.45
GAS MILEAGE	0.0	0.0	14.90	1.69	16.19	2.53	14.43	1.15	12.00	0.0	15.31	2.23
	N= 0		N= 2		N= 11		N= 12		N= 4		N= 29	
3501-4000												
HC	0.0	0.0	3.15	3.04	6.66	7.35	6.24	4.15	10.74	12.37	6.81	6.79
CO	0.0	0.0	41.37	11.72	51.55	17.15	71.05	30.20	62.74	18.65	60.46	24.73
NOX	0.0	0.0	5.88	0.41	4.85	1.29	5.22	1.54	5.78	0.93	5.20	1.32
GAS MILEAGE	0.0	0.0	16.73	2.04	15.21	1.62	12.90	0.92	12.73	1.05	13.89	1.74
	N= 0		N= 0		N= 3		N= 4		N= 4		N= 11	
4001-4500												
HC	0.0	0.0	0.0	0.0	8.56	3.46	5.83	0.83	5.97	1.14	6.63	2.13
CO	0.0	0.0	0.0	0.0	87.58	42.74	105.48	33.40	113.15	57.39	103.39	42.46
NOX	0.0	0.0	0.0	0.0	5.61	2.57	4.73	0.99	3.99	1.82	4.70	1.75
GAS MILEAGE	0.0	0.0	0.0	0.0	12.95	1.22	12.22	0.64	10.94	1.79	11.90	1.56
	N= 0		N= 0		N= 0		N= 0		N= 4		N= 4	
4501-5000												
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.64	1.04	2.64	1.04
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.15	22.76	40.15	22.76
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.09	2.47	5.09	2.47
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.42	1.75	11.42	1.75
	N= 0		N= 0		N= 0		N= 0		N= 0		N= 0	
>5000												
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	N= 4		N= 9		N= 35		N= 23		N= 13		N= 84	
TOTAL												
HC	13.53	9.23	5.24	3.43	5.64	4.49	5.87	3.07	6.59	7.08	6.18	5.01
CO	103.42	40.94	57.76	29.48	50.17	27.15	76.41	30.49	75.36	46.01	64.60	34.94
NOX	1.52	0.35	4.51	1.83	4.37	1.45	4.45	1.66	4.67	2.05	4.32	1.71
GAS MILEAGE	18.59	3.20	17.29	2.15	15.54	2.13	13.20	1.20	11.68	1.62	14.37	2.63

NOX CORRECTED FOR HUMIDITY

TABLE I- 7

FY72 EMISSION FACTOR PROGRAM

1975 FTP RESULTS BY INERTIA WEIGHT AND ENGINE DISPLACEMENT FOR ALL CITIES, EXCLUDING DENVER AND LOS ANGELES

EMISSIONS IN GM/MI - GAS MILEAGE IN MI/GAL

MODEL YEAR=1969

ENGINE DISPLACEMENT (CID)

INERTIA WT. (LBS)	≤150		151-250		251-339		340-399		≥ 400		TOTAL	
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
	N= 4		N= 1		N= 0		N= 0		N= 0		N= 5	
≤ 2000												
HC	3.84	0.38	2.93	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.66	0.52
CO	33.21	16.51	26.53	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.88	14.61
NOX	2.46	0.84	1.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.36	0.76
GAS MILEAGE	24.83	3.70	20.40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.79	3.68
	N= 0		N= 1		N= 0		N= 0		N= 0		N= 1	
2001-2500												
HC	0.0	0.0	4.56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.56	0.0
CO	0.0	0.0	69.41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	69.41	0.0
NOX	0.0	0.0	3.33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.33	0.0
GAS MILEAGE	0.0	0.0	20.90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.90	0.0
	N= 0		N= 7		N= 4		N= 2		N= 0		N= 13	
2501-3000												
HC	0.0	0.0	4.15	2.48	5.08	0.40	5.34	0.71	0.0	0.0	4.62	1.86
CO	0.0	0.0	34.12	7.73	54.22	18.67	75.69	30.95	0.0	0.0	46.70	21.17
NOX	0.0	0.0	5.35	1.36	4.81	0.99	4.47	0.23	0.0	0.0	5.05	1.14
GAS MILEAGE	0.0	0.0	17.31	1.79	15.33	1.60	14.30	1.20	0.0	0.0	16.14	1.96
	N= 0		N= 1		N= 11		N= 8		N= 0		N= 20	
3001-3500												
HC	0.0	0.0	5.32	0.0	5.52	4.90	4.67	1.48	0.0	0.0	5.17	3.69
CO	0.0	0.0	97.77	0.0	56.94	49.12	68.24	24.35	0.0	0.0	63.50	39.81
NOX	0.0	0.0	1.50	0.0	5.94	2.14	4.17	1.64	0.0	0.0	5.01	2.20
GAS MILEAGE	0.0	0.0	16.00	0.0	14.85	1.36	14.06	1.19	0.0	0.0	14.57	1.33
	N= 0		N= 1		N= 7		N= 13		N= 6		N= 27	
3501-4000												
HC	0.0	0.0	2.43	0.0	5.39	2.48	4.88	2.03	5.99	4.20	5.17	2.69
CO	0.0	0.0	44.02	0.0	73.41	54.37	68.75	29.76	88.59	37.62	73.45	38.21
NOX	0.0	0.0	3.65	0.0	5.88	2.41	4.81	1.53	4.32	1.31	4.94	1.77
GAS MILEAGE	0.0	0.0	20.00	0.0	14.05	1.77	13.59	1.23	12.61	0.87	13.64	1.61
	N= 0		N= 0		N= 0		N= 9		N= 9		N= 18	
4001-4500												
HC	0.0	0.0	0.0	0.0	0.0	0.0	4.50	1.62	5.22	1.48	4.86	1.55
CO	0.0	0.0	0.0	0.0	0.0	0.0	60.74	31.62	73.83	26.12	67.29	28.93
NOX	0.0	0.0	0.0	0.0	0.0	0.0	6.41	1.91	5.33	2.06	5.87	2.01
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	13.41	1.01	12.56	2.53	12.97	2.01
	N= 0		N= 0		N= 0		N= 0		N= 3		N= 3	
4501-5000												
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.09	0.51	3.09	0.51
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.15	6.96	53.15	6.96
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.95	0.31	6.95	0.31
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.43	0.06	11.43	0.06
	N= 0		N= 0		N= 0		N= 0		N= 1		N= 1	
>5000												
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.48	0.0	2.48	0.0
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.81	0.0	29.81	0.0
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.07	0.0	6.07	0.0
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.40	0.0	10.40	0.0
	N= 4		N= 11		N= 22		N= 32		N= 19		N= 88	
TOTAL												
HC	3.84	0.38	4.03	2.07	5.40	3.64	4.75	1.68	4.99	2.69	4.83	2.53
CO	33.21	16.51	43.33	22.09	61.69	45.95	66.80	27.99	72.91	30.86	62.38	34.18
NOX	2.46	0.84	4.36	1.83	5.72	2.04	5.08	1.80	5.31	1.78	5.08	1.93
GAS MILEAGE	24.83	3.70	17.92	2.10	14.67	1.56	13.70	1.14	12.25	1.80	14.28	2.59

NOX CORRECTED FOR HUMIDITY

TABLE I- 8

FY72 EMISSION FACTOR PROGRAM

1975 FTP RESULTS BY INERTIA WEIGHT AND ENGINE DISPLACEMENT FOR ALL CITIES, EXCLUDING DENVER AND LOS ANGELES

EMISSIONS IN GM/MI - GAS MILEAGE IN MI/GAL

MODEL YEAR=1970

ENGINE DISPLACEMENT (CID)

INERTIA WT. (LBS)	≤150		151-250		251-339		340-399		≥ 400		TOTAL	
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
	N= 8		N= 0		N= 0		N= 0		N= 0		N= 8	
≤ 2000												
HC	2.77	0.84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.77	0.84
CO	29.71	11.97	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.71	11.97
NOX	3.52	0.97	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.52	0.97
GAS MILEAGE	24.09	2.81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.09	2.81
	N= 4		N= 2		N= 0		N= 0		N= 0		N= 6	
2001-2500												
HC	4.06	3.17	3.49	1.15	0.0	0.0	0.0	0.0	0.0	0.0	3.87	2.53
CO	40.84	27.63	28.43	16.89	0.0	0.0	0.0	0.0	0.0	0.0	36.71	23.58
NOX	2.79	0.79	3.36	1.44	0.0	0.0	0.0	0.0	0.0	0.0	2.98	0.94
GAS MILEAGE	22.75	3.82	22.24	1.69	0.0	0.0	0.0	0.0	0.0	0.0	22.58	3.03
	N= 0		N= 13		N= 1		N= 1		N= 0		N= 15	
2501-3000												
HC	0.0	0.0	3.32	1.19	3.79	0.0	5.27	0.0	0.0	0.0	3.48	1.21
CO	0.0	0.0	33.56	13.91	27.70	0.0	109.26	0.0	0.0	0.0	38.22	23.55
NOX	0.0	0.0	4.08	1.45	3.15	0.0	2.04	0.0	0.0	0.0	3.88	1.46
GAS MILEAGE	0.0	0.0	19.97	2.45	15.30	0.0	13.40	0.0	0.0	0.0	18.96	3.31
	N= 0		N= 2		N= 9		N= 9		N= 1		N= 21	
3001-3500												
HC	0.0	0.0	4.04	1.41	4.24	2.43	5.60	3.78	11.88	0.0	5.17	3.32
CO	0.0	0.0	70.98	77.68	45.44	18.44	67.25	31.62	170.43	0.0	63.17	39.60
NOX	0.0	0.0	4.40	4.15	4.18	1.32	3.77	0.87	1.83	0.0	3.92	1.46
GAS MILEAGE	0.0	0.0	15.11	2.91	15.05	0.94	13.47	0.95	9.60	0.0	13.98	1.92
	N= 0		N= 0		N= 11		N= 17		N= 1		N= 29	
3501-4000												
HC	0.0	0.0	0.0	0.0	4.15	1.08	7.16	8.45	5.56	0.0	5.97	6.59
CO	0.0	0.0	0.0	0.0	44.44	20.87	67.25	32.19	95.79	0.0	59.58	30.34
NOX	0.0	0.0	0.0	0.0	5.88	1.61	4.44	2.04	2.35	0.0	4.91	2.01
GAS MILEAGE	0.0	0.0	0.0	0.0	14.03	1.10	13.17	1.73	13.70	0.0	13.50	1.56
	N= 0		N= 0		N= 1		N= 9		N= 14		N= 24	
4001-4500												
HC	0.0	0.0	0.0	0.0	7.49	0.0	4.04	1.08	4.91	2.59	4.69	2.17
CO	0.0	0.0	0.0	0.0	28.44	0.0	50.14	14.15	67.39	65.95	59.30	51.40
NOX	0.0	0.0	0.0	0.0	5.14	0.0	4.50	0.95	4.49	1.15	4.52	1.04
GAS MILEAGE	0.0	0.0	0.0	0.0	13.00	0.0	12.89	1.44	11.69	1.47	12.17	1.54
	N= 0		N= 0		N= 0		N= 0		N= 5		N= 5	
4501-5000												
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.33	6.30	7.33	6.30
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.90	23.93	47.90	23.93
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.47	2.32	6.47	2.32
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.11	2.68	12.11	2.68
	N= 0		N= 0		N= 0		N= 0		N= 0		N= 0	
>5000												
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	N= 12		N= 17		N= 22		N= 36		N= 21		N=108	
TOTAL												
HC	3.20	1.89	3.43	1.15	4.32	1.82	5.94	6.15	5.85	3.91	4.89	4.21
CO	33.42	18.15	37.36	26.52	43.36	19.02	64.14	29.39	69.01	60.04	53.23	36.87
NOX	3.28	0.94	4.03	1.69	5.03	1.66	4.22	1.58	4.74	1.85	4.35	1.67
GAS MILEAGE	23.63	3.12	19.47	3.24	14.43	1.15	13.18	1.46	11.75	1.80	14.55	3.48

NOX CORRECTED FOR HUMIDITY

TABLE I- 9

FY72 EMISSION FACTOR PROGRAM

1975 FTP RESULTS BY INERTIA WEIGHT AND ENGINE DISPLACEMENT FOR
ALL CITIES, EXCLUDING DENVER AND LOS ANGELES

EMISSIONS IN GM/MI - GAS MILEAGE IN MI/GAL

MODEL YEAR=1971

ENGINE DISPLACEMENT (CID)

INERTIA WT. (LBS)	≤150		151-250		251-339		340-399		≥ 400		TOTAL	
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
≤ 2000	N= 13		N= 0		N= 0		N= 0		N= 0		N= 13	
HC	4.16	2.04	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.16	2.04
CO	46.23	41.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.23	41.49
NOX	2.57	0.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.57	0.99
GAS MILEAGE	23.32	4.14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.32	4.14
2001-2500	N= 14		N= 1		N= 0		N= 0		N= 0		N= 15	
HC	3.16	1.55	2.06	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.08	1.52
CO	39.46	21.28	11.79	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.62	21.72
NOX	3.12	1.36	3.06	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.12	1.31
GAS MILEAGE	23.20	3.34	21.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.09	3.22
2501-3000	N= 1		N= 8		N= 2		N= 1		N= 0		N= 12	
HC	3.01	0.0	2.66	0.40	2.90	0.13	2.99	0.0	0.0	0.0	2.76	0.35
CO	21.47	0.0	39.94	19.34	38.50	8.89	48.01	0.0	0.0	0.0	38.84	16.77
NOX	3.37	0.0	4.77	1.32	2.67	0.74	2.11	0.0	0.0	0.0	4.08	1.50
GAS MILEAGE	22.70	0.0	20.17	1.43	14.37	3.04	15.60	0.0	0.0	0.0	18.64	3.55
3001-3500	N= 0		N= 3		N= 10		N= 9		N= 0		N= 22	
HC	0.0	0.0	3.37	0.48	4.81	2.48	6.29	5.17	0.0	0.0	5.22	3.72
CO	0.0	0.0	46.57	6.82	40.02	20.44	94.09	73.52	0.0	0.0	63.04	54.29
NOX	0.0	0.0	5.18	0.47	4.28	0.98	3.30	0.87	0.0	0.0	4.00	1.08
GAS MILEAGE	0.0	0.0	18.37	1.65	14.28	1.13	11.33	2.15	0.0	0.0	13.27	2.89
3501-4000	N= 0		N= 0		N= 1		N= 18		N= 2		N= 21	
HC	0.0	0.0	0.0	0.0	2.46	0.0	4.20	2.14	5.11	1.67	4.20	2.07
CO	0.0	0.0	0.0	0.0	28.44	0.0	59.40	42.22	65.10	20.34	58.47	39.82
NOX	0.0	0.0	0.0	0.0	5.25	0.0	4.62	1.30	5.12	1.80	4.70	1.28
GAS MILEAGE	0.0	0.0	0.0	0.0	14.40	0.0	13.16	1.90	12.32	0.92	13.13	1.80
4001-4500	N= 0		N= 0		N= 1		N= 8		N= 15		N= 24	
HC	0.0	0.0	0.0	0.0	3.79	0.0	3.85	1.01	3.78	1.66	3.81	1.41
CO	0.0	0.0	0.0	0.0	44.45	0.0	56.89	28.42	50.83	33.52	52.59	30.68
NOX	0.0	0.0	0.0	0.0	5.52	0.0	5.58	1.33	5.04	1.22	5.24	1.23
GAS MILEAGE	0.0	0.0	0.0	0.0	12.30	0.0	11.61	1.34	12.17	0.91	11.98	1.08
4501-5000	N= 0		N= 0		N= 0		N= 1		N= 10		N= 11	
HC	0.0	0.0	0.0	0.0	0.0	0.0	4.25	0.0	3.55	1.00	3.61	0.97
CO	0.0	0.0	0.0	0.0	0.0	0.0	55.16	0.0	46.89	29.84	47.64	28.41
NOX	0.0	0.0	0.0	0.0	0.0	0.0	7.56	0.0	5.76	1.71	5.92	1.71
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	10.90	0.0	11.19	0.71	11.16	0.67
>5000	N= 0		N= 0		N= 0		N= 0		N= 2		N= 2	
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.88	0.50	2.88	0.50
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.74	10.18	51.74	10.18
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.65	0.14	4.65	0.14
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.64	0.35	10.64	0.35
TOTAL	N= 28		N= 12		N= 14		N= 37		N= 29		N=120	
HC	3.62	1.81	2.79	0.54	4.30	2.24	4.60	3.05	3.73	1.42	3.94	2.22
CO	41.96	31.79	39.25	18.16	39.30	17.52	66.88	49.49	50.52	29.77	51.13	37.02
NOX	2.87	1.19	4.73	1.21	4.21	1.14	4.52	1.54	5.27	1.40	4.30	1.58
GAS MILEAGE	23.24	3.60	19.80	1.70	14.14	1.37	12.30	2.04	11.71	0.95	14.48	4.14

NOX CORRECTED FOR HUMIDITY

TABLE I-10

FY72 EMISSION FACTOR PROGRAM

1975 FTP RESULTS BY INERTIA WEIGHT AND ENGINE DISPLACEMENT FOR ALL CITIES, EXCLUDING DENVER AND LOS ANGELES

EMISSIONS IN GM/MI - GAS MILEAGE IN MI/GAL

MODEL YEAR=1972

ENGINE DISPLACEMENT (CID)

INERTIA WT. (LBS)	≤150		151-250		251-339		340-399		≥ 400		TOTAL	
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
	N= 4		N= 0		N= 0		N= 0		N= 0		N= 4	
≤ 2000												
HC	2.73	0.68	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.73	0.68
CO	37.82	15.39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.82	15.39
NOX	2.87	0.44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.87	0.44
GAS MILEAGE	20.74	2.44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.74	2.44
	N= 18		N= 0		N= 1		N= 0		N= 0		N= 19	
2001-2500												
HC	2.46	0.68	0.0	0.0	0.93	0.0	0.0	0.0	0.0	0.0	2.38	0.75
CO	27.72	13.07	0.0	0.0	7.82	0.0	0.0	0.0	0.0	0.0	26.67	13.50
NOX	3.38	1.29	0.0	0.0	1.67	0.0	0.0	0.0	0.0	0.0	3.29	1.31
GAS MILEAGE	22.33	2.61	0.0	0.0	21.70	0.0	0.0	0.0	0.0	0.0	22.29	2.53
	N= 2		N= 6		N= 7		N= 0		N= 0		N= 15	
2501-3000												
HC	2.51	0.52	2.40	0.38	3.00	0.91	0.0	0.0	0.0	0.0	2.70	0.71
CO	20.18	3.78	32.51	16.75	34.08	23.51	0.0	0.0	0.0	0.0	31.60	18.98
NOX	4.19	0.66	5.54	1.15	3.59	0.92	0.0	0.0	0.0	0.0	4.45	1.32
GAS MILEAGE	22.65	0.21	18.30	1.21	15.45	2.85	0.0	0.0	0.0	0.0	17.25	3.27
	N= 0		N= 0		N= 10		N= 8		N= 1		N= 19	
3001-3500												
HC	0.0	0.0	0.0	0.0	2.75	0.48	3.90	1.04	4.00	0.0	3.30	0.94
CO	0.0	0.0	0.0	0.0	24.11	16.56	51.06	29.95	26.04	0.0	35.56	25.90
NOX	0.0	0.0	0.0	0.0	4.70	1.22	3.16	0.72	2.20	0.0	3.92	1.31
GAS MILEAGE	0.0	0.0	0.0	0.0	14.99	0.87	13.14	0.85	9.90	0.0	13.80	1.77
	N= 0		N= 0		N= 2		N= 24		N= 4		N= 30	
3501-4000												
HC	0.0	0.0	0.0	0.0	3.24	0.67	3.22	0.99	2.87	1.13	3.17	0.97
CO	0.0	0.0	0.0	0.0	28.72	10.01	46.28	26.97	30.86	9.75	43.05	25.17
NOX	0.0	0.0	0.0	0.0	4.83	0.87	4.84	1.29	5.47	1.20	4.92	1.25
GAS MILEAGE	0.0	0.0	0.0	0.0	13.09	0.57	12.20	1.13	12.70	1.59	12.32	1.17
	N= 0		N= 0		N= 0		N= 16		N= 23		N= 39	
4001-4500												
HC	0.0	0.0	0.0	0.0	0.0	0.0	3.45	0.77	3.82	5.04	3.67	3.87
CO	0.0	0.0	0.0	0.0	0.0	0.0	51.31	22.24	42.27	30.52	45.98	27.48
NOX	0.0	0.0	0.0	0.0	0.0	0.0	4.53	1.27	5.36	1.81	5.02	1.64
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	11.74	0.72	12.07	2.37	11.93	1.83
	N= 0		N= 0		N= 0		N= 1		N= 10		N= 11	
4501-5000												
HC	0.0	0.0	0.0	0.0	0.0	0.0	2.76	0.0	1.64	0.62	1.74	0.68
CO	0.0	0.0	0.0	0.0	0.0	0.0	17.04	0.0	18.32	10.35	18.20	9.82
NOX	0.0	0.0	0.0	0.0	0.0	0.0	5.38	0.0	5.41	2.04	5.41	1.93
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	11.40	0.0	10.24	0.93	10.34	0.95
	N= 0		N= 0		N= 0		N= 0		N= 3		N= 3	
>5000												
HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.05	0.14	2.05	0.14
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.43	3.78	23.43	3.78
NOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.14	0.22	6.14	0.22
GAS MILEAGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.50	0.99	10.50	0.99
	N= 24		N= 6		N= 20		N= 49		N= 41		N=140	
TOTAL												
HC	2.51	0.65	2.40	0.38	2.80	0.78	3.40	0.93	3.07	3.88	3.02	2.22
CO	28.77	13.39	32.51	16.75	27.24	18.77	48.11	25.70	33.54	25.61	36.88	24.04
NOX	3.36	1.17	5.54	1.15	4.18	1.29	4.48	1.32	5.36	1.77	4.55	1.59
GAS MILEAGE	22.07	2.50	18.30	1.21	15.16	2.13	12.17	1.04	11.44	1.98	13.54	3.40

NOX CORRECTED FOR HUMIDITY

APPENDIX II

FY71 Emission Factor Results Based on the 1972 and 1975 Federal Test Procedure Weighting Factors

TABLE II- 1

FY71 EMISSION FACTOR PROGRAM

COMPOSITE EMISSION LEVELS FOR ALL CITIES EXCLUDING DENVER AND LOS ANGELES

1972 FTP

YEAR	N	MEAN MILES (K)	% BELOW LEVEL * HC	CO	NOX	HYDROCARBONS GM/MI ARITHMETIC MEAN	SD	GEOMETRIC MEAN	SD	CARBON MONOXIDE GM/MI ARITHMETIC MEAN	SD	GEOMETRIC MEAN	SD	NOX GM/MI ARITHMETIC MEAN	SD	GEOMETRIC MEAN	SD
1966	67	61.6	1	3	45	9.20	6.18	8.08	1.61	103.27	43.19	94.27	1.56	3.44	1.71	3.01	1.75
1967	54	54.6	0	2	46	8.19	3.61	7.51	1.51	103.48	47.69	94.51	1.54	3.26	1.45	2.90	1.71
TOTAL	121	58.6	1	2	45	8.75	5.19	7.82	1.57	103.37	45.06	94.38	1.55	3.36	1.60	2.96	1.73
1968	69	48.5	22	28	29	6.40	7.82	5.10	1.75	78.91	62.98	62.59	1.92	4.31	1.85	3.85	1.70
1969	72	39.9	15	13	11	5.99	5.22	5.07	1.65	70.73	37.73	62.42	1.66	5.29	2.00	4.90	1.50
1970	70	29.5	31	36	9	4.22	1.99	3.91	1.45	55.16	26.72	48.88	1.66	5.02	1.63	4.77	1.38
1971	80	19.6	61	49	11	3.42	1.47	3.16	1.49	46.33	28.29	38.89	1.84	4.99	1.79	4.65	1.48
TOTAL	291	32.7	33	32	15	4.96	4.91	4.19	1.65	62.22	42.81	51.71	1.83	4.91	1.85	4.53	1.53

NOX CORRECTED FOR HUMIDITY

*

LEVELS
HC 3.4 GM/MI
CO 39.0 GM/MI
NOX 3.0 GM/MI

NOTE: SEE TEXT ON PAGE 14

TABLE II- 2

FY71 EMISSION FACTOR PROGRAM

EMISSION LEVELS FOR DENVER

1972 FTP

YEAR	N	MEAN MILES (K)	% BELOW LEVEL * HC	% BELOW LEVEL * CO	% BELOW LEVEL * NOX	HYDROCARBONS GM/MI ARITHMETIC MEAN	HYDROCARBONS GM/MI ARITHMETIC SD	HYDROCARBONS GM/MI GEOMETRIC MEAN	HYDROCARBONS GM/MI GEOMETRIC SD	CARBON MONOXIDE GM/MI ARITHMETIC MEAN	CARBON MONOXIDE GM/MI ARITHMETIC SD	CARBON MONOXIDE GM/MI GEOMETRIC MEAN	CARBON MONOXIDE GM/MI GEOMETRIC SD	NOX GM/MI ARITHMETIC MEAN	NOX GM/MI ARITHMETIC SD	NOX GM/MI GEOMETRIC MEAN	NOX GM/MI GEOMETRIC SD
1966	16	57.1	0	0	81	10.06	3.23	9.60	1.37	150.34	63.95	137.61	1.55	2.05	1.54	1.65	1.97
1967	15	57.6	0	0	87	10.06	3.03	9.69	1.32	137.43	34.78	132.65	1.34	1.81	0.86	1.62	1.65
TOTAL	31	57.3	0	0	84	10.06	3.09	9.64	1.34	144.09	51.50	135.19	1.45	1.94	1.24	1.64	1.80
1968	18	42.1	0	0	83	8.74	4.08	8.00	1.53	122.92	66.05	109.88	1.60	2.38	1.11	2.19	1.50
1969	17	38.9	12	6	65	7.74	4.89	6.49	1.89	92.62	57.72	79.72	1.72	2.52	1.21	2.20	1.78
1970	17	26.0	6	0	59	7.85	4.23	6.91	1.70	110.18	39.76	103.44	1.45	2.72	1.13	2.48	1.59
1971	20	15.2	0	5	55	6.73	2.10	6.44	1.35	100.04	39.72	92.16	1.54	3.04	1.55	2.73	1.59
TOTAL	72	30.1	4	3	65	7.74	3.89	6.93	1.62	106.40	52.00	95.63	1.59	2.68	1.27	2.40	1.61

NOX CORRECTED FOR HUMIDITY

* LEVELS
HC 3.4 GM/MI
CO 39.0 GM/MI
NOX 3.0 GM/MI

NOTE: SEE TEXT ON PAGE 14

TABLE II- 3

FY71 EMISSION FACTOR PROGRAM

EMISSION LEVELS FOR LOS ANGELES

1972 FTP

			% BELOW LEVEL *			HYDROCARBONS GM/MI				CARBON MONOXIDE GM/MI				NOX GM/MI			
						ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC	
YEAR	N	MEAN MILES (K)	HC	CO	NOX	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
1966	16	65.7	19	19	38	8.72	8.64	6.62	2.00	78.12	38.29	70.25	1.61	3.23	1.45	2.91	1.64
1967	17	56.4	12	6	53	6.22	3.52	5.52	1.63	81.43	38.01	74.56	1.52	3.30	1.45	2.98	1.61
TOTAL	33	60.9	15	12	45	7.43	6.55	6.03	1.81	79.83	37.58	72.43	1.56	3.26	1.43	2.95	1.61
1968	15	37.3	13	13	60	5.65	2.21	5.29	1.45	78.00	39.77	69.87	1.61	3.76	1.99	3.34	1.64
1969	17	38.1	0	0	12	5.86	1.21	5.75	1.22	87.07	25.37	83.86	1.32	5.45	2.12	5.06	1.50
1970	16	25.2	25	19	13	5.22	2.78	4.76	1.51	62.59	29.45	56.20	1.63	4.51	1.69	4.20	1.49
1971	21	15.8	62	33	19	3.51	0.99	3.39	1.30	51.90	22.49	46.91	1.62	3.81	1.09	3.63	1.41
TOTAL	69	28.1	28	17	25	4.95	2.08	4.60	1.46	68.72	31.88	61.55	1.63	4.37	1.82	4.00	1.53

NOX CORRECTED FOR HUMIDITY

*

LEVELS
HC 3.4 GM/MI
CO 39.0 GM/MI
NOX 3.0 GM/MI

NOTE: SEE TEXT ON PAGE 14

TABLE II- 4

FY71 EMISSION FACTOR PROGRAM

COMPOSITE EMISSION LEVELS FOR ALL CITIES EXCLUDING DENVER AND LOS ANGELES

1975 FTP

			% BELOW LEVEL *			HYDROCARBONS GM/MI				CARBON MONOXIDE GM/MI				NOX GM/MI			
						ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC	
YEAR	N	MEAN MILES (K)	HC	CO	NOX	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
1966	67	61.8	4	10	42	8.26	5.48	7.21	1.63	90.96	38.93	82.29	1.60	3.57	1.82	3.13	1.72
1967	54	54.6	2	8	48	7.38	3.28	6.75	1.52	93.56	44.87	85.11	1.55	3.28	1.46	2.93	1.68
TOTAL	121	58.6	3	8	45	7.87	4.63	7.00	1.58	92.12	41.53	83.54	1.57	3.44	1.67	3.04	1.70
1968	69	48.5	32	36	23	5.73	7.80	4.46	1.77	69.33	61.37	52.61	2.02	4.44	1.89	3.95	1.72
1969	72	39.9	24	25	10	5.25	4.72	4.47	1.62	59.99	32.57	52.77	1.67	5.45	2.02	5.06	1.50
1970	70	29.5	44	44	9	3.77	1.83	3.50	1.44	47.55	24.41	41.37	1.73	5.15	1.67	4.89	1.38
1971	80	15.6	70	63	14	3.07	1.36	2.83	1.48	39.56	25.62	32.46	1.92	5.06	1.84	4.71	1.49
TOTAL	291	32.7	43	43	14	4.41	4.71	3.72	1.64	53.60	39.95	43.51	1.90	5.03	1.89	4.64	1.54

NOX CORRECTED FOR HUMIDITY

*
LEVELS
HC 3.4 GM/MI
CO 39.0 GM/MI
NOX 3.0 GM/MI

NOTE: SEE TEXT ON PAGE 14

TABLE II- 5

FY71 EMISSION FACTOR PROGRAM

EMISSION LEVELS FOR DENVER

1975 FTP

YEAR	N	MEAN MILES (K)	% BELOW LEVEL * HC	CO	NOX	HYDROCARBONS GM/MI ARITHMETIC MEAN	SD	GEOMETRIC MEAN	SD	CARBON MONOXIDE GM/MI ARITHMETIC MEAN	SD	GEOMETRIC MEAN	SD	NOX GM/MI ARITHMETIC MEAN	SD	GEOMETRIC MEAN	SD
1966	16	57.1	0	0	81	8.74	2.98	8.32	1.38	129.25	52.79	119.41	1.51	2.07	1.60	1.64	2.03
1967	15	57.6	0	0	80	9.12	2.93	8.75	1.34	128.23	31.55	124.16	1.32	1.77	0.89	1.56	1.72
TOTAL	31	57.3	0	0	81	8.92	2.91	8.53	1.35	128.76	43.11	121.68	1.42	1.93	1.29	1.60	1.86
1968	18	42.1	0	0	83	7.34	2.73	6.87	1.46	109.20	52.45	99.71	1.53	2.20	0.80	2.07	1.43
1969	17	38.9	18	12	65	6.31	3.47	5.43	1.84	76.42	47.67	65.61	1.74	2.59	1.24	2.27	1.76
1970	17	26.0	12	0	53	6.71	3.85	5.93	1.66	94.78	33.80	89.30	1.43	2.78	1.11	2.54	1.57
1971	20	15.2	5	5	50	5.59	1.42	5.42	1.29	88.13	35.96	80.67	1.57	3.05	1.59	2.73	1.62
TOTAL	72	30.1	8	4	63	6.46	2.97	5.88	1.57	92.20	43.74	82.98	1.60	2.67	1.25	2.40	1.60

NOX CORRECTED FOR HUMIDITY

*
LEVELS
HC 3.4 GM/MI
CO 39.0 GM/MI
NOX 3.0 GM/MI

NOTE: SEE TEXT ON PAGE 14

TABLE II- 6

FY71 EMISSION FACTOR PROGRAM

EMISSION LEVELS FOR LOS ANGELES

1975 FTP

YEAR	N	MEAN MILES (K)	% BELOW LEVEL *			HYDROCARBONS GM/MI				CARBON MONOXIDE GM/MI				NOX GM/MI			
						ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC		ARITHMETIC		GEOMETRIC	
			HC	CO	NOX	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
1966	16	65.7	19	25	31	7.84	8.34	5.81	2.03	65.16	36.59	56.84	1.72	3.40	1.54	3.04	1.68
1967	17	56.4	24	12	41	5.33	3.52	4.60	1.70	67.18	36.99	59.68	1.63	3.42	1.50	3.08	1.65
TOTAL	33	60.9	21	18	36	6.55	6.36	5.15	1.86	66.20	36.23	58.29	1.66	3.41	1.50	3.06	1.65
1968	15	37.3	27	27	40	4.71	1.87	4.37	1.50	62.43	37.60	54.31	1.70	3.86	2.04	3.40	1.68
1969	17	38.1	6	6	12	4.92	1.07	4.80	1.25	68.70	22.87	65.13	1.41	5.46	2.06	5.10	1.47
1970	16	25.2	25	44	19	4.45	2.39	4.08	1.48	50.83	26.40	44.69	1.70	4.62	1.64	4.33	1.46
1971	21	15.8	71	48	19	3.02	0.79	2.93	1.28	42.26	19.91	37.83	1.64	3.83	1.10	3.65	1.41
TOTAL	69	28.1	35	32	22	4.19	1.75	3.90	1.45	55.15	28.25	48.63	1.67	4.42	1.81	4.06	1.53

NOX CORRECTED FOR HUMIDITY

*
LEVELS
HC 3.4 GM/MI
CO 39.0 GM/MI
NOX 3.0 GM/MI

[illegible] TEXT ON PAGE 14

TABLE II- 7

FY71 EMISSION FACTOR PROGRAM

FUEL ECONOMY IN MILES PER GALLON

ALL CITIES EXCEPT DENVER AND LOS ANGELES

YEAR	N	COLD TRANSIENT		STABILIZED		HOT TRANSIENT		1972 FTP		1975 FTP	
		MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
1966	67	13.0	2.8	14.0	2.5	15.8	3.4	13.5	2.6	14.3	2.6
1967	54	13.3	3.2	13.4	3.3	15.7	3.6	13.5	3.1	14.0	3.1
1968	69	12.8	3.1	13.0	3.4	15.3	3.8	13.0	3.1	13.6	3.3
1969	72	12.6	3.1	13.3	2.9	15.3	3.4	13.1	2.9	13.7	2.9
1970	70	12.6	3.2	13.3	3.5	15.0	3.9	13.0	3.3	13.7	3.5
1971	80	12.4	3.8	12.8	4.5	14.9	5.6	12.7	3.9	13.3	4.4

TABLE II- 8

FY71 EMISSION FACTOR PROGRAM

FUEL ECONOMY IN MILES PER GALLON

DENVER

YEAR	N	COLD TRANSIENT		STABILIZED		HOT TRANSIENT		1972 FTP		1975 FTP	
		MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
1966	16	11.2	2.9	13.6	2.6	14.7	3.0	12.4	2.6	13.4	2.6
1967	15	12.1	2.4	13.1	2.5	14.2	2.5	12.7	2.4	13.2	2.4
1968	18	11.3	4.1	12.6	3.5	15.0	3.4	12.0	3.8	12.9	3.5
1969	17	12.3	3.2	13.8	3.0	15.5	3.1	13.2	3.1	14.0	3.0
1970	17	11.4	2.6	12.9	2.7	14.2	3.3	12.2	2.6	13.0	2.7
1971	20	10.9	2.3	12.0	2.4	13.5	3.2	11.5	2.3	12.2	2.5

TABLE II- 9

FY71 EMISSION FACTOR PROGRAM

FUEL ECONOMY IN MILES PER GALLON

LOS ANGELES

YEAR	N	COLD TRANSIENT		STABILIZED		HOT TRANSIENT		1972 FTP		1975 FTP	
		MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
1966	16	13.2	4.5	12.3	3.1	14.7	4.1	12.8	3.2	13.1	3.3
1967	17	12.0	3.1	12.6	2.8	15.1	3.5	12.4	2.9	13.2	3.0
1968	15	13.0	2.7	14.4	2.3	16.9	2.5	13.8	2.4	14.8	2.4
1969	17	11.3	2.6	12.5	2.5	14.9	3.3	11.9	2.6	12.8	2.6
1970	16	12.5	2.8	12.3	2.9	15.1	3.5	12.5	2.8	13.1	3.0
1971	21	13.2	4.2	12.8	4.8	14.7	7.5	13.1	4.5	13.5	5.0

APPENDIX III

Statistical Aspects of Fuel Economy Calculations

APPENDIX III

Statistical Aspects of Fuel Economy Calculations

The carbon balance method of calculating fuel economy in miles per gallon (mpg) is given below:

$$mpg = \frac{\text{grams of carbon/gallon of fuel}}{\text{grams of carbon in exhaust/mile}} \qquad [1]$$

$$mpg = \frac{2423}{.866\ (\text{gm/mile HC}) + .429\ (\text{gm/mi CO}) + .273\ (\text{gm/mi } CO_2)}$$

The grams-per-mile values for the 1972 FTP, the 1975 FTP (a weighted fuel economy) and the individual portions of the FTP are used to calculate the corresponding mpg figures. The corresponding fuel consumption value of gallons per mile (gpm) is simply 1/mpg. For purposes of developing confidence intervals around fuel economy figures, it should be noted that equation [1] is actually a calculation of the gallons of gasoline used over a particular driving sequence. This is converted to gallons per mile by dividing by the number of miles in the driving sequence and further converted to miles per gallon by taking the reciprocal of gallons per mile. The quantity gallons per mile can be thought of as the fuel consumption over a standardized representative one mile course.

It is of interest to quantify the fuel economy of a group of vehicles. This is defined as

$$\frac{\text{total miles driven}}{\text{total gallons of gas used}} .$$

Thus, fuel economy is a measure of amount of fuel consumed. It turns out that with a sample of n vehicles, this quantity is the harmonic mean of mpg values for those n vehicles since, by definition:

$$H = \frac{n}{\sum_i \frac{1}{z_i}}$$

where z_i = miles per gallon of each vehicle in the sample

$$= \frac{1}{\frac{\text{gallons}_1}{\text{miles}_1} + \frac{\text{gallons}_2}{\text{miles}_2} + \ldots + \frac{\text{gallons}_n}{\text{miles}_n}} \; .$$

But all vehicles are driven the same number of miles over the Federal Test Procedure and $\text{miles}_1 = \text{miles}_2 = \ldots = \text{miles}_n$. Therefore,

$$H = \frac{(\text{miles})(n)}{\sum_i \text{gallons}_i} \; ,$$

[2]

$$H = \frac{\text{total miles}}{\text{total gallons}} \; .$$

Statistically, the problem can be formulated as a problem of estimation. Given $z_1, z_2, \ldots z_n$ which are independent and identically distributed random variables representing miles per gallon, then

$$z_i = \frac{x_i}{y_i}$$

where

x_i = miles driven by i^{th} vehicle,

y_i = gallons used by i^{th} vehicle over x_i miles.

However, x_i is not a stochastic quantity and can be represented by the constant c. Thus,

$$z_i = \frac{c}{y_i} ,$$

where c can be set equal to one and y_i adjusted accordingly. The y_i are independent and identically distributed random variables (gallons of fuel consumed) with distribution function G(y) and

$$E(y_i) = \mu_y$$

$$V(y_i) = \sigma_y^2$$

where E is the expected value and V is the variance.

The ability to compute a confidence interval around the population equivalent of H, which is itself a function of μ_y, is desired. Since

$$\frac{\text{total miles}}{\text{total gallons}}$$

can be expressed as

$$\frac{1}{\frac{1}{n} \sum_i \frac{1}{z_i}} = \frac{1}{\frac{1}{n} \sum_i y_i} = \frac{1}{\bar{y}} ,$$

$\frac{1}{\bar{y}}$ is used as an estimator for $\frac{1}{\mu_y}$,

the fuel economy as defined in [2].

The derivation of the hypothesis testing procedure is given in reference (7). The resulting estimator is

$$H_n = \frac{1}{\bar{y}} \quad . \tag{3}$$

The two-sided confidence interval is

$$H_n \pm \left(Z_{1-\frac{\alpha}{2}}\right) \cdot \left(\frac{s_y}{\bar{y}^2 \sqrt{n}}\right) \tag{4}$$

or

$$P\left[H_n + Z_{\frac{\alpha}{2}} \cdot \left(\frac{s_y}{\bar{y}^2 \sqrt{n}}\right) \leq \frac{1}{\mu_y} \leq H_n + Z_{1-\frac{\alpha}{2}} \cdot \left(\frac{s_y}{\bar{y}^2 \sqrt{n}}\right)\right] = \alpha$$

where Z_β is the 100β percent point of a N(0,1) random variable. It is often of interest to test a hypothesis concerning the equality of fuel economies from two different groups of vehicles. An appropriate test of the null hypothesis to compare

$$\frac{1}{\mu_1} \text{ with } \frac{1}{\mu_2} \text{ is}$$

$$G_n = \left(\frac{1}{\bar{y}_1} - \frac{1}{\bar{y}_2}\right)^2 \cdot \left(\frac{1}{\left(\frac{s_1^{\,2}}{n_1 \bar{y}_1^{\,4}} + \frac{s_2^{\,2}}{n_2 \bar{y}_2^{\,4}}\right)}\right) \tag{5}$$

where G_n is distributed as a chi-square with α level of confidence and 1 degree of freedom. This can be extended to more than two groups as discussed in reference [7].

The fuel economy tables given in this report present the quantity

$$H = \frac{\text{total miles travelled}}{\text{total gallons used}} ,$$

the harmonic mean. The standard deviation reported in the fuel economy tables is

$$\frac{s_y}{\bar{y}^2}$$

as derived above.

BIBLIOGRAPHIC DATA SHEET	1. Report No. EPA-460/2-74-001	2.	3. Recipient's Accession No.
4. Title and Subtitle Automobile Exhaust Emission Surveillance - Analysis of the FY72 Program			5. Report Date February, 1974
			6.
7. Author(s) M. Williams, J. White, L. Platte, C. Domke			8. Performing Organization Rept. No.
9. Performing Organization Name and Address Environmental Protection Agency Office of Air and Water Programs Office of Mobile Source Air Pollution Control Certification & Surveillance Division Ann Arbor, Michigan 48105			10. Project/Task/Work Unit No.
			11. Contract/Grant No.
12. Sponsoring Organization Name and Address Environmental Protection Agency Office of Air and Water Programs Office of Mobile Source Air Pollution Control Certification and Surveillance Division Ann Arbor, Michigan 48105			13. Type of Report & Period Covered
			14.
15. Supplementary Notes			

16. Abstracts

The Emission Factor Program provides a realistic assessment of the effectiveness of Federal air pollution regulations by testing production vehicles in the hands of the motoring public. This report summarizes the results of the FY72 Emission Factor Program and compares these results with those obtained in the FY71 Emission Factor Program. The FY72 Program tested 1,020 1966-1972 model-year vehicles in six cities.

17. Key Words and Document Analysis. 17a. Descriptors

air pollution
motor vehicles
surveillance

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group 13B

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
Unlimited	UNCLASSIFIED	114
	20. Security Class (This Page)	22. Price
	UNCLASSIFIED	

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Automobile Exhaust Emission Surveillance
Analysis of the FY72 Program

ERRATA SHEET

The following two sentences should be added to the last paragraph on page 14.

> The largest data point is not included in each of the histograms of Figure 3. The excluded hydrocarbon values are 29.22 gm/mi for the four cities, 29.35 gm/mi for Denver, and 31.0 gm/mi for Los Angeles.

Distribution graphs on bottoms of pages 64 and 65 have correct ordinates but have been interchanged on the pages.