# HIGH ALTITUDE VEHICULAR EMISSION CONTROL PROGRAM

# VOLUME XI STUDY OF EMISSION DETERIORATION AND ENGINE DEGRADATION

6

MONTHS

REPORT

JUNE 1974

PREPARED FOR:

STATE OF COLORADO
DEPARTMENT OF HEALTH
DENVER, COLORADO 80220

ATL / AUTOMOTIVE TESTING LABORATORIES

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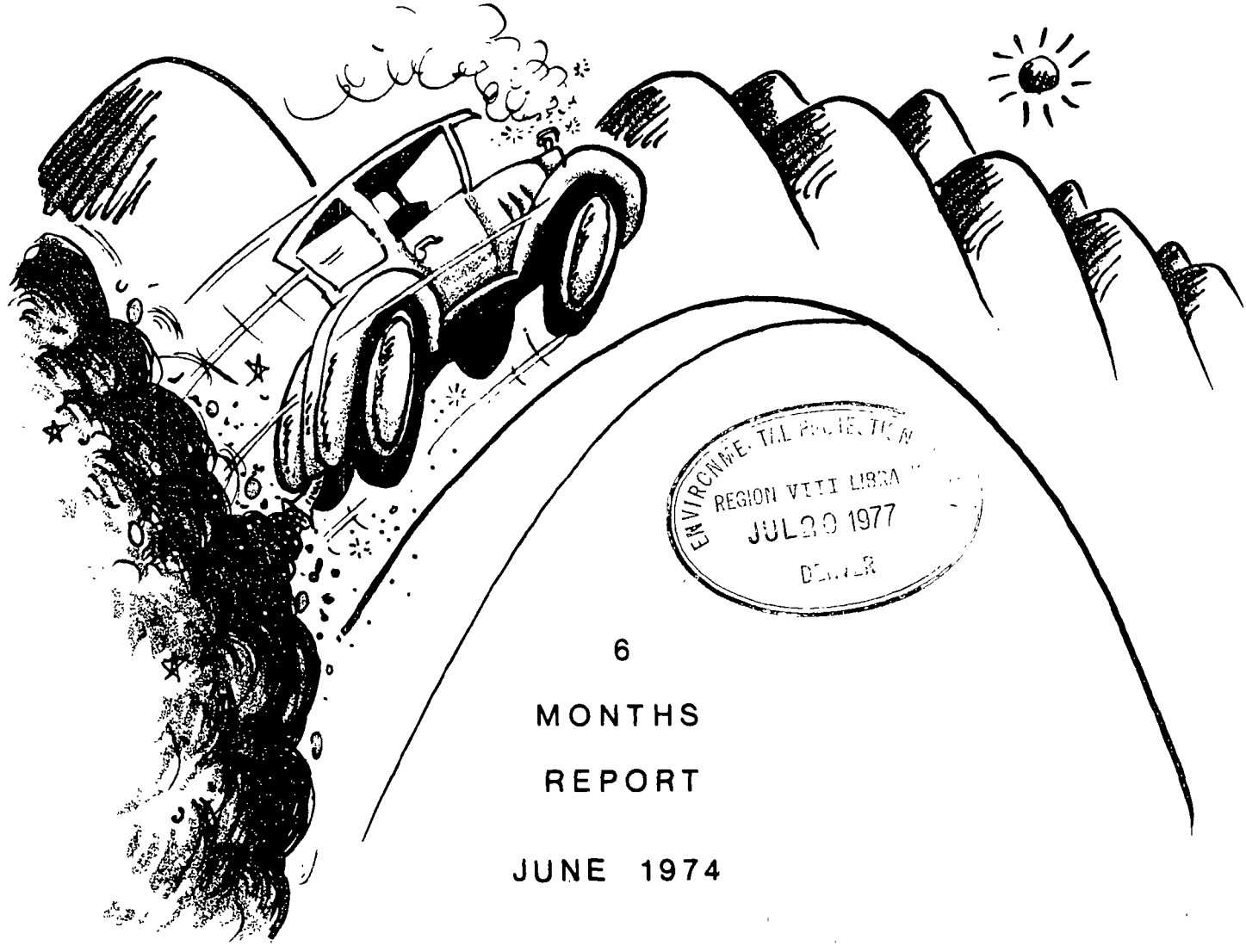



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# REPORT

on

# Emission Deterioration

and

# Engine Degradation

Six Month Report

for

State of Colorado
Department of Health

June, 1974

prepared by

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# 1. INTRODUCTION

In accordance with the requirements of the Colorado Department of Health, a High Altitude Vehicular Emission Control Program has been initiated. The objective of the program is to develop and implement a plan for the control of motor vehicle emissions.

As part of the overall program, a project involving a sample of 1964-1973 model-year vehicles was begun in July of 1973. The project was designed to evaluate several strategies for the control of emissions from motor vehicles. Investigations included emission inspection and engine maintenance, emission control retrofit, modification to engine tune-up specifications and mandatory engine maintenance. As the project developed, it became apparent that much of the data generated by the program could be utilized for purposes outside the initial scope of the project. A program to evaluate emission deterioration and engine degradation was subsequently designed and implemented. The project, involving the re-test of vehicles available at the conclusion of two consecutive six month intervals, recently progressed beyond mid-point.

This report has been prepared to present in summary form the results of testing to date. A more comprehensive report prepared through the joint efforts of TRW, Inc. and Automotive Testing Laboratories, Inc. is forthcoming.

## 2. TECHNICAL DISCUSSION

### 2.1 PROGRAM OBJECTIVES

The primary objective of the study is to develop emission deterioration factors which are to be utilized to evaluate the long term benefits of a mandatory idle inspection and maintenance program. In this respect, data derived from the study are to be applied to define a cost-effective idle inspection and maintenance frequency. A secondary objective is to determine the extent of owner tampering as may impact on the effectiveness of an inspection/maintenance program and to determine possible legislative requirements to maintain overall effectiveness of a mandatory program.

### 2.2 PROGRAM DESIGN

The program was designed to utilize a preconditioned and pretested sample of vehicles from which various data, pertinent to program objectives, could be obtained.

A sample of three-hundred 1964 through 1973 model-year vehicles, selected to represent that segment of the Colorado light-duty vehicle (under 6000 lbs GVW) population, were used initially to evaluate idle inspection and maintenance, emission control retrofit and mandatory engine maintenance. This segment represented about 90% of the light-duty vehicle population. All vehicles in the sample were initially subjected to inspection and maintenance. Idle emission inspections were performed at ten selected state licensed motor vehicle safety inspection stations. Station personnel were trained in advance and were required to perform inspection and maintenance of vehicles in accordance with specific procedures. All vehicles were laboratory tested in the as-received condition

before delivery to the stations. Vehicles which failed station inspection and were subsequently repaired were re-tested by laboratory procedures to determine the effectivenss of station performance. A segment of the vehicle sample was then utilized to evaluate emission control retrofit and modified tune-up specifications.

Following the laboratory evaluation of inspection/maintenance procedures, selected vehicles were inspected more extensively. Repairs were performed by laboratory personnel as dictated by inspection results, and engine control parameters were adjusted to the specifications recommended by the vehicle manufacturer. One subsample of vehicles was used to evaluate emission control retrofit systems; another was used to evaluate modified tuning specifications. Subsequently, data derived as a result of further testing on both subsamples were used to evaluate effectiveness of a concept of mandatory engine maintenance. All vehicles, including those used exclusively for evaluation of idle inspection and maintenance (I/M) and those used for I/M evaluation and evaluation of mandatory engine maintenance (M/M) were then set-up in preparation for the emission deterioration and engine degradation phase of the project.

After initial-phase testing was completed on a given vehicle, the vehicle was moved to a staging area where post-test engine adjustment sealing and engine component marking operations were performed. A bead of quick drying enamel paint was applied by means of a syringe and plunger assembly to screw and nut type engine adjustments. Using the same apparatus, a spot of paint was applied to

identify certain emission related component parts. Subsequently, final engine diagnostic procedures were performed and outgoing engine data were recorded. The completed vehicle was then turned back to its owner accompanied by a letter of appreciation for participation and a request for continued cooperation during the deterioration phase of the project. In addition, the letter contained a description of the follow-on study, a commitment by Automotive Testing Laboratories, Inc. to perform emission related engine maintenance for a six month interval and a list of engine parts, components and adjustments which were covered by the maintenance commitment. Details of the sealing and identification procedure and a copy of the letter of commitment are presented in Appendix 1.

Although three-hundred vehicles comprised the initial sample, the potential size of the sample available for re-test was reduced to about two-hundred and fifty vehicles. This reduction, numbering about fifty vehicles, came about as a result of an initial loss of several vehicles which had been tested and released to owners prior to start-up of the deterioration study. A number of other vehicles comprising the initial sample were determined to be unsuited for deterioration study purposes for various other reasons.

During the time interval following initial testing, vehicles comprising the test sample were presumably operated in a typical manner although several existing factors undoubtedly had some impact on mid-point results. Weather conditions during the interval (August, 1973 through May, 1984), for example, were for the most part seasonably cold and presumably had an indirect effect on engine warm-up characteristics, mileage accumulation and maintenance requirements. Additionally, the fuel crisis and attendant factors,

were predominant thoughout much of the study interval and are believed to have potentially biasing effects on study results by altering mileage accumulation patterns, fuel preference and overall vehicle useage. The effects of these variables are virtually impossible to evaluate. In any case, however, the project proceeded according to design.

In planning for the interval which followed initial testing, procedures for handling test vehicles exhibiting undesirable operating characteristics or component failure were devised. A maintenance commitment was estabished and communicated to the vehicle owner via the letter agreement described earlier. A vehicle prematurely returned to the laboratory for repair work was subjected to an on-the-spot inspection to establish the validity of a request for repair. In certain situations, owner disatisfaction with some aspect of vehicle performance proved to be unfounded. In other situations, a legitimate requirement for maintenance did in fact exist. In the latter case, a loan car was issued and the test vehicle w s retained for further testing and maintenance. In this case, a series of tests, identical to those performed initially, was conducted, repairs to the vehicle were completed and the vehicle was returned to its owner. Data developed as a result of these procedures were retained for subsequent processing and reporting.

As reported earlier, two hundred and fifty vehicles of the original sample were judged suitable for retest. It was originally anticipated that a significant number of vehicles would be lost to the program for various reasons incuding transfer of ownership, owner relocation, accidents and negative owner reaction

or loss of interest. In this respect an attrition rate of 40 percent was allowed.

After the nominal interval of six months had elapsed, vehicles were recalled for deterioration and degradation testing. An attempt to maintain an initial tolerance of 180 $\pm$ 5 days proved to be impractical. The tolerance was subsequently relaxed to 180 $\pm$ 10 days to maintain a high retest rate.

At the appropriate time, one or more attempts to contact owners whose vehicles qualified for retest were made. As anticipated, a significant number of owners had moved outside the area, had sold the test vehicle, had expressed dissatisfaction with some aspect of the program or had simply became disinterested. On the other hand, a significant number of vehicles remained available. The remaining vehicles, numbered at 165, were recalled and retested. Testing procedures, identical to those performed initially, were then applied. At test completion seals applied to engine adjustments and identification marks applied to emission related components were inspected and the incoming status of each adjustment and component part was recorded. Data were then processed and compiled.

Throughout the retest phase of the program laboratory instrumentation and equipment calibration and operating procedures were maintained in accordance with standards applied in the initial program. Quality control tolerances were similarly maintained and procedures relating to data auditing were applied.

## 2.3 TEST VEHICLES

Three hundred vehicles were initially selected and utilized to represent the 1964 through 1973 Colorado motor vehicle population.

Approximately two hundred and fifty were prepared for the deterioration study phase. As anticipated, a significant level of attrition occured during the six month period and one-hundred and sixty-five vehicles were actually submitted for retest.

2.3.1 Vehicle Sample Composition

Table 1 shows the distribution of vehicles subjected to retest.

| | Model-Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Make | 73 | 72 | 71 | 70 | 69 | 68 | 67 | 66 | 65 | 64 | Total |
| Ammo | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 6 |
| Buic | 0 | 0 | 1 | 0 | 0 | 2 | 1 | 0 | 1 | 1 | 6 |
| Cadi | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 1 | 4 |
| Chev | 6 | 4 | 3 | 3 | 2 | 2 | 5 | 5 | 5 | 5 | 40 |
| Chry | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 5 |
| Dodg | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 8 |
| Ford | 4 | 4 | 6 | 3 | 2 | 4 | 6 | 5 | 7 | 2 | 43 |
| Merc | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 5 |
| Olds | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 7 |
| Plym | 1 | 3 | 1 | 2 | 2 | 1 | 1 | 1 | 0 | 1 | 13 |
| Pont | 1 | 1 | 1 | 1 | 1 | 0 | 3 | 2 | 2 | 0 | 12 |
| Volk | 0 | 1 | 1 | 2 | 0 | 2 | 0 | 2 | 1 | 0 | 9 |
| Toyo | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 4 |
| Dats | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Opel | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Total | 16 | 18 | 17 | 17 | 10 | 15 | 20 | 18 | 20 | 14 | 165 |

Table 1. Distribution of Sample after 6 Months

In a comparison of the initial sample (Table 2. Volume II) versus the sample shown in Table 1., above, it can be seen that the retested sample approximates the initial sample by a factor of 0.5 by both make and model-year. From this comparison it can be concluded that the retested sample approximates the distribution of light-duty vehicles in Colorado.

2.3.2 Vehicle Preparation and Handling

Upon receipt of the vehicle for retest, an inspection of the vehicle exterior, interior and exhaust system was performed to

determine incoming status. A loan car was issued to replace the test vehicle and the necessary vehicle agreement forms were completed. The vehicle was then moved to the laboratory for temperature soaking prior to emission testing and engine inspection.

After a minimum soak period of twelve hours, the vehicle fuel supply system was disconnected and reconnected to a laboratory fuel supply system. A batch of summer-grade fuel, utilized for initial testing had been retained and was used to perform the retests. Emission tests were then performed, the vehicle was relocated to another area in the laboratory and an inspection of engine components and adjustments was completed. The vehicle was then returned to its owner.

## 2.4 LABORATORY TESTING AND EVALUATION

Procedures employed for retest were identical to those applied initially.

### 2.4.1 Exhaust Emission Testing Procedures

Laboratory standard exhaust emission tests were performed in accordance with procedures outlined in Federal Register, Volume 38, Number 124, Part III, dated June 28, 1973. Standard tests were preceeded by a minimum 12 hour temperature soak at laboratory ambient conditions (68° F to 72° F).

Key mode tests were performed in accordance with procedures outlined by Clayton Manufacturing Company of El Monte, California. Key mode testing and resulting data have no direct bearing on the objectives of this phase of the study but were included in the test procedure merely to expand the data base.

Idle emission testing was performed in conjunction with key mode testing. Emission samples were taken at no load conditions of curb idle (Drive gear for automatic transmission equipped vehicles) and 2500 engine rpm. Instrumentation and operating procedures were identical to those employed during the initial phase of testing. Both laboratory and garage-type inspection equipment (listed in Table 5 of Volume II) were employed.

Instrument and equipment calibrations established in the initial testing phase were maintained throughout the retest interval. Analytical system calibrations were established using an inventory of EPA named gases. Flow calibration of the CVS was verified using the laminar flow element with calibration traceable to the National Bureau of Standards. Dynamometer calibrations were established and verified on a regular basis using the coast-down technique. In addition, propane recovery tests, $NO_x$ converter efficiency checks and analytical system leak checks were performed on a daily basis.

2.4.2 Engine Diagnostic Procedures

Diagnoses of engine conditions were performed at two points in the overall vehicle procedure. During key mode operation on the chassis dynamometer the laboratory analytical system recorders were operational for a period of about one minute. During this interval and during periods of speed changes, emission traces were observed for an indication of malfunction evidenced by abnormally high hydrocarbon (HC) or carbon monoxide (CO) levels. The HC trace also provided an indication of ignition system mis-fire. Observations were recorded. Oxides of nitrogen ($NO_x$) emission controls on applicable

vehicles were also inspected for proper operation during key mode testing. A fully operational system was indicated by the absence of vacuum to the distrubutor at low cruise conditions and the presence of vacuum to the distributor at high cruise conditions. The second point at which diagnostic procedures were applied was immediately after dynamometer tests were completed. The vehicle was removed from the dynamometer area and a more extensive diagnostic procedure was applied. Concurrently, the inspection to determine the extent of tampering and alteration or replacement of parts was performed.

## 2.5 DATA HANDLING

Data handling, processing and auditing procedures employed for the retest phase were identical to those employed for the initial test phase. These procedures are described in detail in Volume II.

# 5. ANALYSIS OF TEST RESULTS

As testing progressed it became apparent that a relatively complex situation had developed. A discussion of some of the more obvious problems with respect to the interpretation of deterioration data is presented below. Interim study report data are also presented in summary form.

## 5.1 POSSIBLE FACTORS AFFECTING EMISSION DETERIORATION

As of this date, two studies investigating the feasibility of emission inspection and maintenance have been completed at altitude.[1,2] Both studies indicate that maximum HC and CO emission reductions through normal maintenance are in the order of 15% and 10% respectively as compared to reductions in the Los Angeles area, for example, of 35% for each effluent.[3] These figures indicate that in spite of the altitude factor, Denver area vehicles are closer to an ideal state of repair than vehicles in the Los Angeles area.

As indicated in a recent study involving vehicle tests in three cities,[4] two of which (Chicago and Houston) were situated at roughly the same elevation but in differing climatological areas, climate appears to have a significant effect on emission levels. Although the sample composition was essentially the same in both sites, average HC and CO emissions were lower from vehicles operating .n the colder climate of the Chicago area than emissions from vehicles operating in the warmer climate of the Houston area. In view of this observation and the fact that higher reductions in HC vnd CO emissions can be achieved from vehicles operating in the mild Los Angeles climate than can be achieved in the colder climate of the Denver area, it can be concluded that the Denver area has

unwittingly derived benefit from its seasonably cold weather and attendant vehicle maintenance requirements. In this same regard, however, the current repair status of motor vehicles operating in the Denver area is such that emission reduction factors attained through engine maintenance are not nearly as significant as those attained in other areas of the country. For example, CO emissions from the Los Angeles car population are in the order of 74.5 grams per vehicle mile (g/m).[5] Application of a 35% reduction factor to the Los Angeles population results in a change in CO emission levels from 74.5 g/m to 48.4 g/m or about 26.1 g/m. Denver area CO emission levels, on the other hand, although significantly higher at about 112.1 g/m (Reference 5) can be reduced by about 10% to 100.9 g/m. This represents a difference of 11.2 g/m or about 60% less than absolute CO reduction in the Los Angeles area.

At this stage in the Denver emission deterioration study it would appear that deterioration on the average occurs at a constant absolute CO emission deterioration rate of about 0.80 g/m per month. This compares favorably to the Los Angeles CO emission deterioration rate of about 0.64 g/m per month (extracted from data presented in Reference 3). Although there are undoubtedly other factors to be considered, the similarity in CO deterioration rates between the two areas suggests that under similar maintenance conditions, the absolute CO deterioration rate is in the same order of magnitude, regardless of locale. However, since CO reduction on Denver area vehicles is less significant initially, the significance of the Denver area deterioration rate is more difficult to define.

Other factors, in addition to those presented above are also to be considered. For example, the preparatory phase of the study

was performed during the period from August, 1973 to November, 1973. The first phase of retest (180 ± 10 days after initial testing) was performed during the period February, 1974 to May, 1974. As a result a significant segment of mileage accumulation for the first phase of study was performed during the colder months of winter. As indicated earlier, cold weather conditions appear to have some impact on engine maintenance requirements. As yet, the data available to assess this impact on Denver area vehicles is insufficient.

To add further to the complexity of the program, the Denver area shared with the rest of the country in an unprecedented modern day fuel shortage. The impact of the shortage and the attendant alterations to mileage accumulation patterns, frequency of vehicle useage, gasoline purchasing habits and general interest in the automobile by the motoring public are virtually impossible to accurately assess. It is an established fact, however, that overall vehicle useage was reduced during the period, which undoubtedly resulted in shorter trips and fewer miles traveled at normal engine operating temperatures. This factor of itself may have accelerated failure of spark plugs, for example, which tend to fail as a result of lower than normal operating temperature and associated build-up of engine deposits.

Another area which should be discussed in some detail is the manner in which the study was designed and conducted. As mentioned earlier, each participant was alerted to the possibility of retest and to the committment of the laboratory to emission related maintenance. A surprisingly low number of participants took advantage of this situation. In addition, each participant was informed of overall program objectives, a factor which may also have introduced bias. Another area of study design which may be of some significance is

the sealing of engine adjustments and identification of engine components. The mere presence of such marks may have tended to discourage at least a minimal level of "normal" maintenance on certain of the vehicles.

In retrospect, it would appear that the problem of defining emission deterioration factors from vehicles operating in the Colorado environment is indeed complex. Moreover, the normal range in vehicular emission study data, which although tolerable with respect to certain areas of the country, Los Angeles, for example, may prove to be too great to allow a reasonable comparison of emissions over an extended time interval. Finally, it would appear that the data to be developed in the next six month period are of critical importance since many of the potentially biasing effects on the program may be minimized.

Phase III of the study, covering the interval from 6 months to 12 months after initial maintenance, is being approached in a somewhat different manner. Hopefully, gasoline will not be in short supply and the test participants will return to normal mileage accumulation patterns, maintenance schedules and fuel purchasing patterns. Secondly, the next phase will provide data covering a full year of operation, which should permit an assessment of seasonal emission and deterioration factors if they truly exist. Thirdly, the participants remaining at the end of the six month interval were not alerted to the possibility of another retest which hopefully will not have a significant influence on any aspect of vehicle operation and attention. Finally, the novelty of the experiment with respect to the car owner should diminish to a level where the identification

marks, applied to permit an assessment of engine alteration, will hopefully be of little or no significance if indeed they have been a factor.

## 5.2 EMISSION DETERIORATION DATA

A summary of mean emission data developed at three points in the study is presented in Table 2. The data are based on test results from 165 vehicles and are shown for the 1964 through 1967 model-year vehicle population and the 1968 through 1973 model-year vehicle population. A summary for all vehicles is also included.

| Population | Condition | Emissions in grams per mile | | | | | |
|---|---|---|---|---|---|---|---|
| | | HC | (%) | CO | (%) | $NO_x$ | (%) |
| 1964-1967 | As Rec'd | 10.00 | | 136.0 | | 2.24 | |
| 72 Vehicles | After Mtce. | 8.93 | -10.7 | 129.9 | -4.5 | 2.10 | -6.3 |
| | After 6 Mo. | 11.04 | 10.4 | 138.4 | 1.7 | 2.00 | -10.7 |
| 1968-1973 | As Rec'd | 6.27 | | 90.4 | | 2.85 | |
| 93 Vehicles | After Mtce. | 5.22 | -16.7 | 79.5 | -12.1 | 2.76 | -3.2 |
| | After 6 Mo. | 6.22 | - 0.9 | 81.9 | -9.5 | 2.80 | -1.8 |
| All Veh. | As Rec'd | 7.90 | | 110.3 | | 2.59 | |
| 165 Vehicles | After Mtce. | 6.84 | -13.4 | 101.5 | -8.0 | 2.48 | -4.2 |
| | After 6 Mo. | 8.32 | 5.3 | 106.5 | -3.4 | 2.45 | -5.4 |

Table 2. Summary of Emission Data from 165 Vehicles As Received, After Maintenance and After 6 Months.

As seen in Table 2, emission reductions were obtained as a result of initial inspection and maintenance for both populations. However, it would appear that about 60 percent of the initial gain in CO reduction was lost during the six month interval, primarily, due to the performance of the older segment of the car population Similarly, the older cars appear to be chiefly responsible for the high overall HC deterioration rates.

In an attempt to resolve a suspected disparity in overall HC and CO deterioration rates, the total sample of vehicles was divided into two groups. One group is comprised of vehicles

utilized solely in the initial program to evaluate inspection and maintenance. The other group is comprised of vehicles utilized not only for evaluation of inspection and maintenance but for other aspects of the program as well (mandatory maintenance). Although not totally justifiable, the basis for the division is related to the fact that practicing private sector mechanics were utilized in the I/M phase of the program and laboratory mechanics were used in the M/M phase of the program. Initial emissions reduction in the same order of magnitude were achieved by both groups.

Tables 3 and 4 were constructed to show the differences in deterioration rates between the I/M and the M/M samples. As indicated

| Population | Condition | Emission (grams per mile) | | | | | |
|---|---|---|---|---|---|---|---|
| | | HC | (%) | CO | (%) | $NO_x$ | (%) |
| I/M | As Rec'd | 8.18 | | 111.8 | | 2.64 | |
| 87 Vehicles | After Mtce. | 6.99 | -14.5 | 101.1 | -9.6 | 2.60 | -1.5 |
| | After 6 Mo. | 7.50 | -8.3 | 105.8 | -5.3 | 2.54 | -3.8 |
| M/M | As Rec'd | 7.59 | | 108.7 | | 2.53 | |
| 78 Vehicles | After Mtce. | 6.68 | -12.0 | 102.0 | -6.1 | 2.34 | -7.5 |
| | After 6 Mo. | 9.23 | 21.6 | 107.2 | -1.3 | 2.35 | -7.1 |
| All Veh. | As Rec'd | 7.90 | | 110.3 | | 2.59 | |
| 165 Veh. | After Mtce. | 6.84 | -13.4 | 101.5 | -8.0 | 2.48 | -4.2 |
| | After 6 Mo. | 8.32 | 5.3 | 106.5 | -3.4 | 2.45 | -5.4 |

Table 3. Summary of Emission data from 87 I/M Vehicles, 78 M/M Vehicles and All Vehicles.

| Population | Deterioration Rates (grams per mile per month) | | |
|---|---|---|---|
| | HC | CO | $NO_x$ |
| 87 I/M Vehicles | 0.085 | 0.783 | -0.082 |
| 78 M/M Vehicles | 0.425 | 0.867 | -0.033 |
| All Vehicles | 0.247 | 0.833 | -0.060 |

Table 4. Emission Deterioration Rates from 87 I/M Vehicles 78 M/M Vehicles and All Vehicles in grams per mile per month.

in Table 4, the HC deterioration rate for M/M Vehicles is higher than the deterioration rate for I/M Vehicles by a factor of 5. On the

other hand, CO deterioration rates for both groups are about the same. An examination of engine variables affecting the various effluents provides a simple explanation for the variations in range. The emission of CO is primarily a function of fuel/air ratio (carburetion). Changes in fuel/air ratio, which are normally in a rich direction, and associated increases in CO emissions are caused by a number of carburetor and carburetor support system failures. However, significant changes are normally related to malfunctions in the idle circuit, the main fuel circuit (changes in float bowl fuel level), or in the high speed or power circuit. It is unlikely that changes in carburetion would occur simultaneously. Changes of lesser significance are normally attributed to the gradual changes which occur in the air filter element as a result of the accumulation of dust or oil vapor or in the crankcase ventilation (PCV) valve resulting from the accumulation of dirt or oil sludge. In any case, it is highly improbable that CO emissions would change by more than a factor of 2 under normal circumstances.

HC emissions, on the other hand, can change by a factor of 10 or more through one or more simple malfunctions in the ignition system. A fouled spark plug, for example, can occur instantaneously resulting in a complete deactivation of the ignition process in the affected cylinder. This can result in a tenfold increase in HC emissions. Another factor causing high HC emission levels is frequently related to exhaust valve leakage which can develop slowly in time or quite rapidly under the proper circumstances. Exhaust valve leakage can also cause a tenfold increase in HC emissions.

The range in emissions from normal vehicles to malfunctioning vehicles is decidedly different for HC and CO as evidenced by the standard deviation for each effluent (from data presented in Appendix 2). For example, the mean HC level after maintenance of all vehicles is 2.84 grams per mile with a standard deviation of 3.37 g/m. At the other extreme the mean HC level 6 months later is 8.32 g/m with a standard deviation of 6.95 g/m. On the other hand the mean CO level after maintenance of M/M vehicles is 101.5 g/m with a standard deviation of 46.9 g/m which is in the same order of magnitude as the mean of 106.5 g/m and the corresponding standard deviation of 54.4 g/m six months later.

As a final step to determine the reason for high deterioration rates (HC deterioration in the M/M group in particular), four sets of computer generated histograms were produced (Appendix 3). These are comprised of the following histograms showing relative frequency distribution by percentage of total vehicles in the group versus emission levels by selected increments:

HC from M/M vehicles as received
" " " " after maintenance.
" " " " after 6 months.

CO from M/M vehicles as received.
" " " " after maintenance.
" " " " after 6 months.

HC from I/M vehicles as received.
" " " " after maintenance.
" " " " after 6 months.

CO from I/M vehicles as received.
" " " " after maintenance.
" " " " after 6 months.

Observation of the relative frequency distributions indicated that of the M/M vehicles as received, about two percent were found to

emit HC at a level greater than 24 g/m. After maintenance, HC emissions were reduced on those vehicles below a level of 12 g/m. In addition, no vehicles were found to emit HC at a level greater than 16 g/m. Six months later, however, about six percent of the M/M vehicles were found to emit HC above a level of 24 g/m, with one percent emitting in the 50 to 52 g/m range. A listing of M/M vehicles which emitted at a level in excess of 24 g/m HC at any of the 3 test points is shown in Table 5. Also shown are the results of a

| Vehicle | Veh. No. | HC Emissions (grams per mile) As Rec'd | After Mtce. | After 6 Mo. | Significant Tampering? |
|---|---|---|---|---|---|
| 65 Chev 327 | 59 | 26.7 | 11.3 | 18.5 | N/A |
| 66 Olds 425 | 140 | 5.8 | 9.4 | 37.2 | No |
| 70 Plym 318 | 211 | 28.9 | 4.9 | 5.7 | N/A |
| 66 Plym 318 | 272 | 8.5 | 6.7 | 43.9 | No |
| 67 Chev 327 | 280 | 13.1 | 13.1 | 51.8 | No |
| 69 Plym 318 | 291 | 6.1 | 12.7 | 36.3 | No |
| 71 Ford 302 | 314 | 8.2 | 6.9 | 28.8 | No |

Table 5. M/M vehicles which emitted HC at Levels in Excess of 24 g/m at any of the three test points.

subjective analysis of tampering. As indicated by the information shown, no significant tampering occured on vehicles which showed excessive increases in HC from After Mtce. to After 6 Mo. tests. The Veh. No. shown in Table 5 can be referenced to vehicle numbers shown in Volume II to provide additional identification.

A similar listing of M/M vehicles which emitted CO at levels in excess of 200 g/m at any of the three test points is shown in Table 6. Observation of data shown in Table 6 and graphically illustrated in the relative frequency distribution plots of Appendix 3, indicates that about 4 percent of M/M vehicles emitted in excess of 200 g/m CO initially. As a result of maintenance this quantity was reduced to about 2.5 percent of the vehicles. At the end of 6 months, however, the quantity had increased to about 8 percent. Again, tampering does not appear to be a factor.

| Vehicle | Veh No. | CO Emission (grams per mile) As Rec'd | After Mtce. | After 6 Mo. | Significant Tampering? |
|---|---|---|---|---|---|
| 64 Olds 330 | 28 | 201.9 | 181.2 | 173.6 | N/A |
| 65 Chev 327 | 59 | 302.1 | 199.9 | 244.5 | Idle Spd-No |
| 67 Chev 283 | 115 | 171.2 | 187.5 | 225.4 | PCV-No |
| 64 Chev 283 | 123 | 160.7 | 197.8 | 204.7 | No |
| 64 Chev 283 | 172 | 198.4 | 211.9 | 230.3 | No |
| 68 Buic 350 | 220 | 200.2 | 137.4 | 154.5 | No |
| 69 Dodg 318 | 293 | 115.7 | 205.2 | 260.7 | No |
| 72 Ford 351 | 137.7 | 137.7 | 154.0 | 217.9 | No |

Table 6. M/M Vehicles which Emitted CO at Levels in Excess of 200 g/m at any of the three test points.

Similar data for I/M vehicles are shown in Tables 7 and 8 and in Appendix 3. As indicated by these data, 3 percent of the I/M vehicles

| Vehicle | Veh No. | HC Emissions (grams per mile) As Rec'd | After Mtce. | After 6 Mo. | Significant Tampering? |
|---|---|---|---|---|---|
| 65 Pont 389 | 96 | 33.6 | 13.3 | 14.2 | N/A |
| 72 Chev 400 | 177 | 36.6 | 5.0 | 5.2 | N/A |
| 65 Buic 425 | 235 | 24.4 | 27.6 | 15.6 | N/A |
| 73 Dodg 225 | 268 | 3.8 | 3.8 | 31.6 | No |

Table 7. I/M Vehicles Which Emitted HC at Levels in Excess of 24 g/m at any of the Three Test Points.

| Vehicle | Veh No. | CO Emission (grams per mile) As Rec'd | After Mtce. | After 6 Mo. | Significant Tampering? |
|---|---|---|---|---|---|
| 64 Chev 361 | 24 | 221.1 | 125.5 | 174.3 | No |
| 64 Cadi 429 | 30 | 202.0 | 170.2 | 158.5 | N/A |
| 67 Buic 340 | 76 | 208.6 | 208.6 | 198.1 | N/A |
| 65 Pont 389 | 96 | 188.6 | 244.7 | 231.5 | N/A |
| 72 Chry 400 | 177 | 322.1 | 74.3 | 77.1 | N/A |
| 65 Buic 425 | 235 | 238.5 | 248.2 | 336.8 | Idle Spd. No |
| 65 Chev 327 | 236 | 208.3 | 146.7 | 171.4 | No |
| 65 Ford 390 | 258 | 156.9 | 167.5 | 232.5 | Timing-No |

Table 8. I/M Vehicles Which Emitted CO at Levels in Excess of 200 g/m at any of the Three Test Points.

were found initially to emit in excess of 24 g/m HC. Maintenance reduced this quantity to 1 percent which was precisely the quantity found to emit in excess of 24 g/m at the end of 6 months. Table 7 indicates the one vehicle accounting for the high HC level at the 6 month test point to be one which emitted at a relatively low HC level in the prior two tests. Similarly, 9.5 percent of

the I/M vehicles were found to emit CO in excess of 200 g/m initially. After maintenance the quantity was reduced to about 3.5 percent where it remained to the close of the six month interval. Tampering, again, does not appear to be a factor causing high HC and CO emissions.

## 5.3 MAINTENANCE OF VEHICLES DURING THE SIX MONTH INTERVAL AND INDICATIONS OF TAMPERING

A cursory examination was performed to determine the extent of vehicle maintenance during the interval (Appendix 4). In this regard, the following observations were derived.

Of all items sealed, the air cleaner assembly screw was the item most frequently disturbed (56% of all vehicles), presumably for the purpose of inspecting the air filter element. The percent of filter assembly disturbance on vehicles showing increased HC and CO emissions after six months is roughly equal to the percent of disturbance on vehicles showing decreases.

The second most frequent item to be disturbed was the air filter element which indicated complete replacement. In this respect there appears to be nothing to indicate an unbalance between vehicles showing increased emission and vehicles showing decreased emissions. Air filter elements were replaced on 12% of the vehicles.

The next most frequent disturbance occurred with respect to the spark plugs, which in this case indicated replacement. This occurred on 8% of the vehicles with an equal distribution between vehicles showing increased HC and CO emissions and vehicles showing decreased emissions.

Distributor cap locking screws were next in the frequency of disturbance indicating removal of the cap to service , adjust or replace ignition points and/or condensers. This occurred on 7% of all vehicles with no apparent correlation between either increased or decreased emissions.

The ignition dwell adjustment, indicating either point set replacement or an adjustment is ranked next and occurred on 5% of the vehicles. There is no apparent correlation between replacement or adjustment and either increased or decreased emissions.

Several items were next in ranking which in each case appeared to have been either adjusted or replaced on 5% of the vehicles. Included are: ignition wires, indicating complete replacement; choke adjustments; and condenser replacement.

Next in order at 4% were idle speed adjustment, timing adjustment, and rotor replacement which were followed by PCV valve replacement on 3% of the vehicles, idle mixture screw adjustment which occurred on 2% of the vehicles and coil replacement which occurred on 1% of the vehicles.

Of all items sealed for investigative purposes, some correlation between vehicles showing increased CO levels and the performance of maintenance appears to exist. Items falling into this category include idle speed adjustments, choke adjustment, timing adjustment, ignition points adjustment (or replacement), condenser replacement and distributor cap replacement. Of these, only the idle speed adjustment and choke adjustment are considered to relate to CO emissions.

Similarly, an apparent correlation between vehicles showing increased HC levels and maintenance appears to exist, but only with respect to the adjustment of ignition timing and distibutor cap replacement. In all probability, however, only the adjustment of ignition timing is significant.

From all indications, it would appear that tampering in the true sense is minimal. However there appears to be an indication that, in several cases, engine maintenance which resulted in increased HC and CO emissions was performed.

## 5.4 SUMMARY OF OBSERVATIONS.

1. In the overall sample, HC emissions appear to have deteriorated to the six month point to a level above where they were initially. CO emissions appear to have deteriorated to a point where about 60% of the initial reduction has been lost. $NO_x$ emission reductions remain essentially unchanged. HC and CO emission deteriorations appear to be traceable chiefly to the older vehicles.

2. In the M/M group of vehicles where maintenance was performed by laboratory personnel not necessarily accustomed to the rigors of dealing with customer oriented maintenance. HC emissions appear to have the most significant deterioration rate and have deteriorated to a point well above the HC levels initially measured. CO deterioration rates appear to be reasonable and $NO_x$ emissions remain unchanged. Again, the greatest HC and CO deterioration occurred with respect to the older vehicles.

3. In the I/M group of vehicles where maintenance was performed by private sector mechanics, the HC emission deterioration rate appears to be reasonable and about 60% of the initial HC reduction was retained after 6 months. The CO deterioration rate also appears to be reasonable and about 55 percent of the initial reduction was retained. $NO_x$ emissions in this group also remain unchanged.

4. The maintenance performed in the initial phase of the project whereby the immediate effects of inspections and maintenance were evaluated, apparently has had little effect in holding down the number of vehicles which tend to emit at high HC and CO levels, particularly with respect to the M/M group. This factor tends to suggest a requirement for inspection and maintenance at 6 month intervals if an effective program is to be maintained.

5. There does not appear to be strong or even moderate indications that tampering is a significant with respect to emission deterioration. However, it would appear that several vehicles which showed increased HC and CO emissions were maintained without regards to minimized emission levels. In certain respects, this type of maintenance may be regarded as tampering.

## REFERENCES


1. Environmental Protection Agency, Region VIII; Vehicle Testing to Determine Feasibility of Emission Inspection at Altitude; Automotive Testing Laboratories, Inc.; Contract No. 68-01-0439; Spetember, 1972.

2. State of Colorado, Department of Health; Volume II, Experimental Characterization of Idle Inspection, Exhaust Control Retrofit and Mandatory Engine Maintenance; Automotive Testing Laboratories, Inc., Contract No. C290526; December, 1973.

3. State of California, Air Resources Board; An Evaluation of the Effectiveness of Automobile Engine Adjustments to Reduce Exhaust Emissions; Clean Air Research Company; June, 1973.

4. Environmental Protection Agency; a Study of Emission from Light-Duty Vehicles in Denver, Houston and Chicago, Fiscal Year 1972 (APTD-1504); Automotive Testing Laboratories, Inc.; July, 1973.

5. Environmental Protection Agency; A Study of Emissions from Light-Duty Vehicles in Six Cities (APDT-1497); Automotive Environmental Systems, Inc.; March, 1973.

## APPENDICES

AUTOMOTIVE TESTING LABORATORIES, INC.
19900 East Colfax Avenue • Aurora, Colorado 80010

Dear Test Participant;

We wish to express our appreciation to you for the interest you have shown in the current Colorado Emission Study Program. Your participation is a key to the success of this program and to future vehicle related programs which may be developed to improve the quality of Colorado's air.

Unless your car is listed among the few we tested which required extensive maintenance, you may rest assured that your car will now pass an engine idle emission test. It is not known, however, how long your car will remain in this condition. As you may know, one of the objectives of the study in which you participated is to evaluate the effectiveness of emission inspection and engine maintenance in existing licensed safety inspection stations and garages. Information developed from this phase of the study will help to determine the practicality of such a plan on a state-wide level. Assuming the test data does indicate that such a plan is practical, the next question which is posed relates to the frequency of inspection and maintenance. In order to determine a reasonable inspection frequency it will be necessary to accumulate more data. In this regard, we may wish to test your vehicle six months from now. If you tentatively agree to presenting your car for a re-test, we will:

1. Provide a reasonable amount of emission related maintenance on your car for the next six months.

2. Provide you with another $10 check after the six month re-test.

3. Provide you with a late model loan car during the time your car is being re-tested.

We understand that during the next six months the car we tested may require maintenance. If it does, and you suspect that it may relate directly to the engine or to the fuel or ignition systems, please contact us before any corrective maintenance is accomplished. At that time we will advise you and arrange to make repairs within the scope of our activities. You may, of course, arrange for emergency repairs, or any repairs for that matter, without consulting us. In this regard, we wish to emphasize that we have no legal authority and that your participation is purely voluntary.

The following list is comprised of, but is not limited to, engine parts which could deteriorate:

1. PCV system
2. Carburetor including air/fuel mixture and speed adjustments
3. Air Filter and/or filter element
4. Spark Plugs
5. Distributor parts including points and condensor, and timing and dwell adjustments.
6. Spark plug wires
7. Air pump and air injection system if so equipped.
8. NOx emission control system (1973 model-year only)

Many of the usual preventive maintenance procedures have no effect on emission and may be attended to without consulting with us. These are:

1. Battery
2. Charging system
3. Oil filter replacement
4. Oil changes
5. Lubrication

If there is any doubt as to the impact maintenance may have on the program, however, please do not hesitate to call us at 343-8938. We will respond promptly.

Again, we wish to express our appreciation for your participation. Hopefully, the data which we are developing as a result of your cooperation will lead toward cleaner air in Colorado.

Gratefully yours,

Douglas R. Liljedahl
President

## Sealing Procedure

The following items are spot painted with marking pen paint (highly resistant to solvents) to allow us to determine if the car has been tampered with when we run the deterioration study.

1. Air cleaner element
2. Air cleaner screw
3. Spark plugs
4. Spark plug wires
5. Point adjustment screw
6. Timing adjustment
7. Idle mixture screw
8. Idle RPM screw
9. Rotor
10. Condenser
11. PCV valve
12. Coil
13. Choke setting
14. Distributor Cap

EXHAUST EMISSIONS BEFORE INSPECTION AND MAINTENANCE

1975 FEDERAL TEST PROCEDURE

ALL VEHICLES

| | # OF VEH. | HC MEAN | HC S.D. | CO MEAN | CO S.D. | NOX MEAN | NOX S.D. | MPG MEAN | MPG S.D. |
|---|---|---|---|---|---|---|---|---|---|
| *VEHICLE MAKE | | | | | | | | | |
| AMER. MOTORS | 6 | 7.70 | 2.18 | 101.4 | 25.9 | 3.06 | 1.45 | 15.39 | 2.74 |
| BUICK | 6 | 11.20 | 6.67 | 171.1 | 51.8 | 2.41 | 1.56 | 11.49 | 1.68 |
| CADILLAC | 4 | 8.63 | 3.75 | 157.9 | 50.6 | 3.01 | 1.14 | 10.57 | 1.62 |
| CHEVROLET | 40 | 8.04 | 4.53 | 114.2 | 55.8 | 2.14 | 1.05 | 14.12 | 2.61 |
| CHRYSLER | 5 | 13.82 | 12.91 | 190.6 | 83.1 | 1.96 | 1.41 | 10.38 | 1.33 |
| DATSUN | 1 | 4.37 | 0.00 | 42.2 | 0.0 | 3.61 | 0.00 | 22.04 | 0.00 |
| DODGE | 8 | 6.25 | 2.09 | 95.8 | 18.2 | 2.97 | 0.90 | 14.93 | 1.67 |
| FORD | 43 | 7.27 | 3.12 | 99.3 | 38.1 | 3.02 | 1.71 | 14.99 | 3.31 |
| MERCURY | 5 | 6.19 | 2.10 | 62.6 | 30.5 | 4.31 | 3.02 | 14.35 | 2.46 |
| OLDSMOBILE | 7 | 7.93 | 3.90 | 129.7 | 46.9 | 2.06 | 1.11 | 11.96 | 1.18 |
| OPEL | 2 | 5.35 | 0.76 | 86.2 | 11.2 | 1.58 | 0.26 | 21.06 | 0.81 |
| PLYMOUTH | 13 | 8.47 | 6.42 | 121.9 | 41.2 | 2.38 | 0.85 | 14.23 | 2.42 |
| PONTIAC | 12 | 9.10 | 8.21 | 108.3 | 50.3 | 2.47 | 1.04 | 12.73 | 1.21 |
| TOYOTA | 4 | 5.22 | 1.36 | 81.2 | 48.3 | 2.49 | 0.67 | 18.37 | 2.44 |
| VOLKSWAGON | 9 | 6.72 | 3.79 | 81.6 | 32.4 | 2.21 | 1.13 | 21.52 | 1.87 |
| VOLVO | 0 | | | | | | | | |
| *MODEL YEAR | | | | | | | | | |
| 1964 | 14 | 9.47 | 2.91 | 143.7 | 48.6 | 2.05 | 1.15 | 13.86 | 2.55 |
| 1965 | 20 | 11.70 | 7.71 | 145.3 | 61.1 | 2.07 | 1.20 | 14.14 | 3.97 |
| 1966 | 18 | 9.03 | 2.42 | 128.2 | 29.3 | 2.49 | 0.87 | 14.52 | 3.40 |
| 1967 | 20 | 9.56 | 3.35 | 128.4 | 45.0 | 2.33 | 1.89 | 14.47 | 2.71 |
| 1968 | 15 | 7.82 | 2.63 | 112.3 | 42.3 | 3.01 | 1.88 | 14.79 | 2.75 |
| 1969 | 10 | 5.86 | 1.52 | 94.7 | 33.5 | 2.71 | 1.12 | 14.58 | 1.50 |
| 1970 | 17 | 7.04 | 5.97 | 82.8 | 40.3 | 3.55 | 1.63 | 14.95 | 3.90 |
| 1971 | 17 | 5.64 | 1.36 | 79.2 | 36.2 | 3.06 | 1.12 | 15.65 | 4.91 |
| 1972 | 18 | 7.00 | 7.58 | 102.8 | 64.1 | 2.57 | 1.22 | 14.54 | 3.62 |
| 1973 | 16 | 4.11 | 1.03 | 73.0 | 22.0 | 2.15 | 0.97 | 14.51 | 3.63 |
| *DISPLACEMENT | | | | | | | | | |
| LESS THAN 151 | 19 | 6.00 | 2.74 | 79.6 | 30.8 | 2.23 | 0.97 | 20.86 | 2.21 |
| 151 - 250 | 27 | 5.79 | 2.91 | 79.1 | 31.0 | 2.81 | 1.43 | 17.59 | 2.51 |
| 251 - 350 | 71 | 9.04 | 4.41 | 126.5 | 47.9 | 2.25 | 1.19 | 13.65 | 1.42 |
| MORE THAN 350 | 48 | 8.16 | 6.60 | 116.1 | 57.4 | 3.10 | 1.68 | 11.84 | 1.61 |
| *INERTIA WEIGHT | | | | | | | | | |
| 1800 - 2799 | 26 | 5.76 | 2.62 | 73.7 | 29.7 | 2.61 | 1.45 | 20.66 | 2.29 |
| 2800 - 3799 | 72 | 7.20 | 3.01 | 102.3 | 39.1 | 2.41 | 1.18 | 14.80 | 1.91 |
| 3800 - 4799 | 59 | 9.76 | 6.97 | 132.2 | 59.0 | 2.76 | 1.66 | 12.19 | 1.42 |
| 4800 - 5799 | 8 | 7.43 | 2.99 | 139.8 | 44.9 | 2.87 | 1.13 | 10.89 | 1.31 |
| *POPULATIONS | | | | | | | | | |
| 1964 - 1967 | 72 | 10.00 | 4.80 | 136.0 | 47.4 | 2.24 | 1.34 | 14.27 | 3.20 |
| 1968 - 1973 | 93 | 6.27 | 4.49 | 90.4 | 43.9 | 2.85 | 1.41 | 14.86 | 3.60 |
| ALL VEHICLES | 165 | 7.90 | 4.97 | 110.3 | 50.7 | 2.59 | 1.41 | 14.60 | 3.43 |

AUTOMOTIVE TESTING LABORATORIES, INC.
19900 E. COLFAX, AURORA, COLO. 80011

EXHAUST EMISSIONS AFTER INSPECTION AND MAINTENANCE

1975 FEDERAL TEST PROCEDURE

ALL VEHICLES

| | # OF VEH. | HC MEAN | HC S.D. | CO MEAN | CO S.D. | NOX MEAN | NOX S.D. | MPG MEAN | MPG S.D. |
|---|---|---|---|---|---|---|---|---|---|
| *VEHICLE MAKE | | | | | | | | | |
| AMER. MOTORS | 6 | 6.53 | 1.79 | 73.7 | 21.8 | 3.45 | 1.18 | 15.95 | 2.32 |
| BUICK | 6 | 10.64 | 8.53 | 151.1 | 62.7 | 2.49 | 1.32 | 11.60 | 1.79 |
| CADILLAC | 4 | 8.47 | 3.73 | 149.9 | 43.3 | 3.00 | 1.16 | 10.74 | 1.52 |
| CHEVROLET | 40 | 7.11 | 3.33 | 109.2 | 50.3 | 1.95 | 1.06 | 14.29 | 2.34 |
| CHRYSLER | 5 | 6.05 | 0.98 | 113.3 | 24.2 | 2.49 | 1.21 | 11.82 | 1.43 |
| DATSUN | 1 | 4.36 | 0.00 | 46.6 | 0.0 | 2.91 | 0.00 | 21.79 | 0.00 |
| DODGE | 8 | 7.50 | 4.13 | 102.0 | 56.2 | 2.48 | 1.00 | 15.17 | 2.20 |
| FORD | 43 | 6.76 | 2.67 | 94.3 | 38.2 | 2.76 | 1.51 | 15.11 | 3.46 |
| MERCURY | 5 | 6.04 | 2.08 | 71.9 | 35.2 | 4.44 | 3.36 | 13.38 | 1.98 |
| OLDSMOBILE | 7 | 7.04 | 2.51 | 122.6 | 51.6 | 2.09 | 1.18 | 12.29 | 1.14 |
| OPEL | 2 | 4.18 | 0.84 | 68.2 | 11.9 | 1.78 | 0.00 | 21.61 | 0.29 |
| PLYMOUTH | 13 | 6.34 | 2.73 | 103.3 | 36.8 | 2.46 | 0.96 | 14.56 | 2.79 |
| PONTIAC | 12 | 6.85 | 3.21 | 104.9 | 60.3 | 2.50 | 1.11 | 12.99 | 1.12 |
| TOYOTA | 4 | 3.86 | 0.45 | 68.9 | 54.0 | 2.30 | 1.13 | 19.67 | 3.83 |
| VOLKSWAGON | 9 | 6.08 | 2.85 | 79.8 | 31.2 | 1.94 | 0.82 | 22.02 | 1.98 |
| VOLVO | 0 | | | | | | | | |
| *MODEL YEAR | | | | | | | | | |
| 1964 | 14 | 8.46 | 2.39 | 133.3 | 46.7 | 1.97 | 1.32 | 14.15 | 2.38 |
| 1965 | 20 | 9.39 | 4.99 | 139.0 | 52.3 | 1.95 | 1.05 | 14.26 | 3.66 |
| 1966 | 18 | 8.22 | 2.31 | 116.6 | 31.6 | 2.28 | 0.79 | 15.25 | 3.73 |
| 1967 | 20 | 9.46 | 2.77 | 130.5 | 42.5 | 2.19 | 1.92 | 14.39 | 2.57 |
| 1968 | 15 | 6.69 | 3.26 | 94.9 | 36.7 | 2.62 | 1.34 | 14.77 | 2.83 |
| 1969 | 10 | 6.46 | 2.92 | 99.7 | 52.0 | 2.74 | 1.83 | 14.79 | 1.61 |
| 1970 | 17 | 4.78 | 1.18 | 74.6 | 38.0 | 3.19 | 1.42 | 15.34 | 4.06 |
| 1971 | 17 | 4.88 | 0.99 | 68.9 | 30.5 | 3.01 | 1.23 | 15.94 | 5.31 |
| 1972 | 18 | 4.96 | 1.84 | 75.7 | 34.1 | 2.84 | 1.14 | 15.05 | 3.65 |
| 1973 | 16 | 4.20 | 1.05 | 73.2 | 25.4 | 2.13 | 1.07 | 14.48 | 3.63 |
| *DISPLACEMENT | | | | | | | | | |
| LESS THAN 151 | 19 | 5.18 | 2.18 | 73.7 | 32.1 | 2.04 | 0.84 | 21.50 | 2.53 |
| 151 - 250 | 27 | 5.64 | 2.96 | 75.2 | 37.6 | 2.80 | 1.42 | 17.86 | 2.05 |
| 251 - 350 | 71 | 7.74 | 2.96 | 119.1 | 43.1 | 1.97 | 0.95 | 13.77 | 1.48 |
| MORE THAN 350 | 48 | 6.84 | 3.85 | 101.4 | 50.7 | 3.22 | 1.63 | 12.12 | 1.49 |
| *INERTIA WEIGHT | | | | | | | | | |
| 1800 - 2799 | 26 | 5.04 | 2.12 | 68.3 | 31.1 | 2.46 | 1.33 | 21.10 | 2.43 |
| 2800 - 3799 | 72 | 6.81 | 2.88 | 98.1 | 40.6 | 2.25 | 1.18 | 14.91 | 2.02 |
| 3800 - 4799 | 59 | 7.58 | 3.91 | 115.6 | 52.0 | 2.71 | 1.58 | 12.56 | 1.36 |
| 4800 - 5799 | 8 | 7.48 | 3.05 | 136.7 | 41.5 | 2.84 | 1.12 | 10.84 | 1.19 |
| *POPULATIONS | | | | | | | | | |
| 1964 - 1967 | 72 | 8.93 | 3.37 | 129.9 | 43.9 | 2.10 | 1.33 | 14.53 | 3.15 |
| 1968 - 1973 | 93 | 5.22 | 2.11 | 79.5 | 36.3 | 2.76 | 1.33 | 15.10 | 3.75 |
| ALL VEHICLES | 165 | 6.84 | 3.29 | 101.5 | 46.9 | 2.48 | 1.36 | 14.85 | 3.50 |

AUTOMOTIVE TESTING LABORATORIES, INC.
19400 E. COLFAX, AURORA, COLO. 80011.

EXHAUST EMISSIONS AFTER SIX MONTHS

1975 FEDERAL TEST PROCEDURE

ALL VEHICLES

| | # OF VEH. | HC MEAN | HC S.D. | CO MEAN | CO S.D. | NOX MEAN | NOX S.D. | MPG MEAN | MPG S.D. |
|---|---|---|---|---|---|---|---|---|---|
| *VEHICLE MAKE | | | | | | | | | |
| AMER. MOTORS | 6 | 6.08 | 2.12 | 75.7 | 22.7 | 3.67 | 1.62 | 16.15 | 1.90 |
| BUICK | 6 | 8.71 | 3.92 | 166.5 | 94.3 | 2.38 | 1.20 | 11.90 | 2.39 |
| CADILLAC | 4 | 6.33 | 1.30 | 126.0 | 31.7 | 2.75 | 0.90 | 11.48 | 1.65 |
| CHEVROLET | 40 | 8.92 | 8.05 | 115.1 | 56.8 | 1.98 | 1.25 | 14.10 | 2.40 |
| CHRYSLER | 5 | 6.23 | 1.04 | 116.5 | 38.9 | 2.71 | 1.73 | 11.37 | 1.26 |
| DATSUN | 1 | 3.75 | 0.00 | 45.2 | 0.0 | 3.43 | 0.00 | 21.12 | 0.00 |
| DODGE | 8 | 10.86 | 9.08 | 114.7 | 66.0 | 2.53 | 1.30 | 14.34 | 2.03 |
| FORD | 43 | 8.30 | 4.99 | 99.8 | 49.9 | 2.73 | 1.63 | 15.13 | 3.29 |
| MERCURY | 5 | 6.41 | 3.45 | 76.1 | 49.6 | 3.50 | 2.30 | 13.45 | 1.77 |
| OLDSMOBILE | 7 | 10.60 | 11.80 | 119.0 | 49.5 | 2.00 | 1.20 | 12.49 | 1.08 |
| OPEL | 2 | 5.94 | 2.76 | 80.2 | 23.7 | 1.55 | 0.05 | 20.20 | 2.70 |
| PLYMOUTH | 13 | 11.26 | 13.00 | 116.0 | 47.1 | 2.51 | 1.29 | 13.83 | 2.94 |
| PONTIAC | 12 | 7.97 | 3.72 | 114.1 | 57.5 | 2.44 | 1.33 | 12.59 | 0.93 |
| TOYOTA | 4 | 4.35 | 1.08 | 87.3 | 51.7 | 1.69 | 0.72 | 20.05 | 3.87 |
| VOLKSWAGON | 9 | 5.15 | 3.52 | 64.7 | 30.1 | 2.23 | 0.71 | 22.04 | 1.89 |
| VOLVO | 0 | | | | | | | | |
| *MODEL YEAR | | | | | | | | | |
| 1964 | 14 | 9.72 | 3.72 | 141.3 | 52.9 | 2.03 | 1.36 | 14.05 | 2.33 |
| 1965 | 20 | 9.51 | 3.72 | 151.4 | 68.9 | 1.77 | 0.95 | 13.83 | 3.64 |
| 1966 | 18 | 13.10 | 10.38 | 132.1 | 40.0 | 2.15 | 0.95 | 14.31 | 3.60 |
| 1967 | 20 | 11.64 | 10.10 | 128.8 | 45.9 | 2.07 | 1.59 | 14.25 | 2.74 |
| 1968 | 15 | 5.81 | 1.51 | 89.0 | 40.6 | 2.83 | 1.23 | 15.31 | 3.57 |
| 1969 | 10 | 9.01 | 10.10 | 100.4 | 65.5 | 2.58 | 1.50 | 14.67 | 2.42 |
| 1970 | 17 | 5.41 | 2.45 | 82.8 | 39.0 | 3.12 | 1.46 | 15.27 | 4.02 |
| 1971 | 17 | 7.07 | 6.23 | 72.5 | 34.8 | 3.17 | 1.55 | 16.03 | 4.75 |
| 1972 | 18 | 5.27 | 2.46 | 79.8 | 45.9 | 2.86 | 1.73 | 15.16 | 3.48 |
| 1973 | 16 | 5.89 | 6.90 | 75.0 | 22.8 | 2.12 | 1.15 | 14.31 | 3.19 |
| *DISPLACEMENT | | | | | | | | | |
| LESS THAN 151 | 19 | 5.03 | 2.54 | 73.1 | 32.3 | 1.98 | 0.74 | 21.05 | 2.43 |
| 151 - 250 | 27 | 6.62 | 5.74 | 77.6 | 40.7 | 3.10 | 1.74 | 17.74 | 2.25 |
| 251 - 350 | 71 | 10.25 | 8.46 | 123.9 | 51.2 | 1.95 | 1.07 | 13.52 | 1.60 |
| MORE THAN 350 | 48 | 7.74 | 5.41 | 110.4 | 60.8 | 3.01 | 1.54 | 12.22 | 1.75 |
| *INERTIA WEIGHT | | | | | | | | | |
| 1800 - 2799 | 26 | 5.10 | 2.57 | 69.1 | 32.1 | 2.48 | 1.43 | 20.85 | 2.30 |
| 2800 - 3799 | 72 | 7.76 | 5.10 | 101.3 | 48.9 | 2.24 | 1.30 | 14.85 | 1.98 |
| 3800 - 4799 | 59 | 10.69 | 9.50 | 126.0 | 59.7 | 2.66 | 1.55 | 12.33 | 1.41 |
| 4800 - 5799 | 8 | 6.41 | 1.68 | 131.8 | 49.6 | 2.69 | 1.28 | 10.95 | 1.50 |
| *POPULATIONS | | | | | | | | | |
| 1964 - 1967 | 72 | 11.04 | 7.84 | 138.4 | 53.1 | 2.00 | 1.22 | 14.11 | 3.11 |
| 1968 - 1973 | 93 | 6.22 | 5.33 | 81.9 | 41.1 | 2.80 | 1.46 | 15.16 | 3.67 |
| ALL VEHICLES | 165 | 8.32 | 6.95 | 106.5 | 54.4 | 2.45 | 1.42 | 14.70 | 3.47 |

AUTOMOTIVE TESTING LABORATORIES, INC.
19900 E. COLFAX, AURORA, COLO. 80011

EXHAUST EMISSION REDUCTIONS AFTER INSPECTION AND MAINTENANCE

1975 FEDERAL TEST PROCEDURE

ALL VEHICLES

| | # OF VEH. | HC MEAN | HC S.D. | CO MEAN | CO S.D. | NOX MEAN | NOX S.D. | MPG MEAN | MPG S.D. |
|---|---|---|---|---|---|---|---|---|---|
| *VEHICLE MAKE | | | | | | | | | |
| AMER. MOTORS | 6 | 1.178 | 1.60 | 27.65 | 32.7 | -0.393 | 0.82 | -0.554 | 0.82 |
| BUICK | 6 | 0.566 | 2.20 | 20.04 | 26.9 | -0.086 | 0.49 | -0.114 | 0.76 |
| CADILLAC | 4 | 0.157 | 0.31 | 7.96 | 15.9 | 0.017 | 0.03 | -0.161 | 0.32 |
| CHEVROLET | 40 | 0.936 | 2.62 | 4.95 | 25.6 | 0.186 | 0.59 | -0.164 | 1.14 |
| CHRYSLER | 5 | 7.772 | 13.49 | 77.21 | 103.1 | -0.527 | 0.81 | -1.443 | 1.89 |
| DATSUN | 1 | 0.011 | 0.00 | -4.40 | 0.0 | 0.705 | 0.00 | 0.257 | 0.00 |
| DODGE | 8 | -1.253 | 3.41 | -6.13 | 45.0 | 0.483 | 1.31 | -0.232 | 1.17 |
| FORD | 43 | 0.515 | 1.95 | 5.03 | 22.9 | 0.265 | 1.05 | -0.115 | 1.05 |
| MERCURY | 5 | 0.150 | 1.36 | -9.39 | 16.8 | -0.137 | 1.22 | 0.965 | 1.44 |
| OLDSMOBILE | 7 | 0.888 | 3.47 | 7.08 | 24.4 | -0.027 | 0.35 | -0.325 | 0.38 |
| OPEL | 2 | 1.162 | 0.08 | 18.07 | 0.7 | -0.196 | 0.27 | -0.547 | 0.52 |
| PLYMOUTH | 13 | 2.123 | 6.93 | 18.55 | 16.4 | -0.087 | 0.47 | -0.326 | 0.92 |
| PONTIAC | 12 | 2.257 | 5.79 | 3.43 | 25.1 | -0.030 | 0.49 | -0.255 | 0.88 |
| TOYOTA | 4 | 1.362 | 0.96 | 12.24 | 12.5 | 0.187 | 0.52 | -1.306 | 1.60 |
| VOLKSWAGON | 9 | 0.635 | 1.32 | 1.72 | 19.3 | 0.271 | 0.93 | -0.498 | 1.31 |
| VOLVO | 0 | | | | | | | | |
| *MODEL YEAR | | | | | | | | | |
| 1964 | 14 | 1.012 | 2.47 | 10.40 | 31.2 | 0.083 | 0.37 | -0.291 | 0.87 |
| 1965 | 20 | 2.318 | 5.73 | 6.35 | 34.4 | 0.119 | 0.61 | -0.119 | 1.18 |
| 1966 | 18 | 0.812 | 1.70 | 11.59 | 19.9 | 0.213 | 0.64 | -0.734 | 1.07 |
| 1967 | 20 | 0.096 | 1.87 | -2.09 | 19.4 | 0.139 | 0.29 | 0.073 | 0.71 |
| 1968 | 15 | 1.125 | 2.96 | 17.40 | 34.3 | 0.393 | 1.17 | 0.017 | 1.46 |
| 1969 | 10 | -0.599 | 2.34 | -4.97 | 35.1 | -0.026 | 1.26 | -0.205 | 1.18 |
| 1970 | 17 | 2.255 | 5.79 | 8.24 | 20.6 | 0.365 | 1.36 | -0.400 | 1.00 |
| 1971 | 17 | 0.763 | 1.14 | 10.32 | 16.1 | 0.058 | 0.55 | -0.296 | 1.17 |
| 1972 | 18 | 2.047 | 7.45 | 27.13 | 61.1 | -0.273 | 0.91 | -0.507 | 1.46 |
| 1973 | 16 | -0.091 | 0.74 | -0.26 | 10.1 | 0.023 | 0.33 | 0.025 | 0.65 |
| *DISPLACEMENT | | | | | | | | | |
| LESS THAN 151 | 19 | 0.821 | 1.31 | 5.93 | 15.9 | 0.189 | 0.69 | -0.646 | 1.28 |
| 151 - 250 | 27 | 0.143 | 1.16 | 3.93 | 22.8 | 0.011 | 0.49 | -0.264 | 1.29 |
| 251 - 350 | 71 | 1.294 | 3.99 | 7.44 | 28.1 | 0.287 | 0.79 | -0.111 | 1.00 |
| MORE THAN 350 | 48 | 1.319 | 5.52 | 14.65 | 43.7 | -0.123 | 0.95 | -0.276 | 1.04 |
| *INERTIA WEIGHT | | | | | | | | | |
| 1800 - 2799 | 26 | 0.713 | 1.18 | 5.39 | 19.0 | 0.150 | 0.69 | -0.440 | 1.42 |
| 2800 - 3799 | 72 | 0.393 | 2.01 | 4.24 | 25.7 | 0.162 | 0.93 | -0.113 | 1.11 |
| 3800 - 4799 | 59 | 2.174 | 6.16 | 16.61 | 42.1 | 0.045 | 0.76 | -0.362 | 0.98 |
| 4800 - 5799 | 8 | -0.050 | 0.58 | 3.13 | 12.3 | 0.028 | 0.04 | 0.050 | 0.37 |
| *POPULATIONS | | | | | | | | | |
| 1964 - 1967 | 72 | 1.070 | 3.50 | 6.10 | 26.8 | 0.141 | 0.50 | -0.253 | 1.01 |
| 1968 - 1973 | 93 | 1.049 | 4.39 | 10.87 | 35.1 | 0.089 | 0.98 | -0.240 | 1.17 |
| ALL VEHICLES | 165 | 1.058 | 4.01 | 8.79 | 31.8 | 0.112 | 0.81 | -0.246 | 1.10 |

AUTOMOTIVE TESTING LABORATORIES, INC.
19900 E. COLFAX, AURORA, COLO. 80011

EXHAUST EMISSION REDUCTIONS AFTER SIX MONTHS

1975 FEDERAL TEST PROCEDURE

ALL VEHICLES

| | # OF VEH. | HC MEAN | HC S.D. | CO MEAN | CO S.D. | NOX MEAN | NOX S.D. | MPG MEAN | MPG S.D. |
|---|---|---|---|---|---|---|---|---|---|
| *VEHICLE MAKE | | | | | | | | | |
| AMER. MOTORS | 6 | 1.621 | 2.58 | 25.67 | 22.1 | -0.611 | 0.22 | -0.757 | 1.08 |
| BUICK | 6 | 2.494 | 3.40 | 4.58 | 56.8 | 0.033 | 1.01 | -0.411 | 1.55 |
| CADILLAC | 4 | 2.294 | 3.90 | 31.81 | 23.2 | 0.264 | 0.73 | -0.904 | 1.59 |
| CHEVROLET | 40 | -0.879 | 6.61 | -0.86 | 27.4 | 0.162 | 0.80 | 0.028 | 1.56 |
| CHRYSLER | 5 | 7.585 | 13.49 | 74.10 | 99.9 | -0.747 | 0.94 | -0.994 | 1.77 |
| DATSUN | 1 | 0.621 | 0.00 | -2.98 | 0.0 | 0.186 | 0.00 | 0.926 | 0.00 |
| DODGE | 8 | -4.615 | 9.57 | -18.89 | 57.1 | 0.431 | 1.48 | 0.594 | 1.52 |
| FORD | 43 | -1.028 | 4.20 | -0.54 | 36.0 | 0.287 | 1.34 | -0.137 | 1.46 |
| MERCURY | 5 | -0.222 | 3.01 | -13.52 | 21.2 | 0.808 | 1.08 | 0.895 | 1.87 |
| OLDSMOBILE | 7 | -2.671 | 13.05 | 10.70 | 29.5 | 0.058 | 0.42 | -0.533 | 0.95 |
| OPEL | 2 | -0.592 | 2.00 | 6.08 | 12.5 | 0.034 | 0.22 | 0.862 | 1.89 |
| PLYMOUTH | 13 | -2.790 | 14.77 | 5.88 | 27.2 | -0.138 | 1.05 | 0.398 | 1.36 |
| PONTIAC | 12 | 1.128 | 5.88 | -5.78 | 22.9 | 0.029 | 0.62 | 0.141 | 1.00 |
| TOYOTA | 4 | 0.874 | 0.84 | -6.09 | 19.1 | 0.802 | 0.42 | -1.686 | 1.87 |
| VOLKSWAGON | 9 | 1.564 | 4.58 | 16.86 | 33.3 | -0.014 | 1.06 | -0.523 | 2.32 |
| VOLVO | 0 | | | | | | | | |
| *MODEL YEAR | | | | | | | | | |
| 1964 | 14 | -0.257 | 3.80 | 2.40 | 31.4 | 0.025 | 0.70 | -0.190 | 1.15 |
| 1965 | 20 | 2.189 | 5.58 | -6.09 | 41.4 | 0.291 | 0.74 | 0.310 | 1.63 |
| 1966 | 18 | -4.068 | 11.03 | -3.91 | 30.8 | 0.345 | 0.89 | 0.211 | 1.40 |
| 1967 | 20 | -2.079 | 8.90 | -0.40 | 35.2 | 0.263 | 0.72 | 0.220 | 1.68 |
| 1968 | 15 | 2.008 | 3.23 | 23.36 | 29.4 | 0.188 | 1.12 | -0.519 | 1.91 |
| 1969 | 10 | -3.156 | 9.66 | -5.71 | 51.3 | 0.130 | 1.21 | -0.087 | 1.67 |
| 1970 | 17 | 1.625 | 5.95 | 0.00 | 34.7 | 0.434 | 1.53 | -0.325 | 1.27 |
| 1971 | 17 | -1.432 | 5.51 | 6.67 | 22.6 | -0.106 | 1.03 | -0.378 | 1.60 |
| 1972 | 18 | 1.736 | 7.81 | 23.01 | 64.3 | -0.295 | 1.45 | -0.620 | 1.53 |
| 1973 | 16 | -1.780 | 6.98 | -2.06 | 15.8 | -0.026 | 0.59 | 0.202 | 1.46 |
| *DISPLACEMENT | | | | | | | | | |
| LESS THAN 151 | 19 | 0.970 | 3.21 | 6.51 | 26.2 | 0.245 | 0.85 | -0.189 | 2.20 |
| 151 - 250 | 27 | -0.837 | 5.59 | 1.54 | 28.4 | -0.291 | 1.40 | -0.151 | 1.89 |
| 251 - 350 | 71 | -1.211 | 8.47 | 2.61 | 33.7 | 0.301 | 0.84 | 0.130 | 1.33 |
| MORE THAN 350 | 48 | 0.420 | 7.74 | 5.63 | 51.9 | 0.088 | 1.07 | -0.383 | 1.28 |
| *INERTIA WEIGHT | | | | | | | | | |
| 1800 - 2799 | 26 | 0.659 | 2.82 | -4.61 | 28.6 | 0.133 | 1.34 | -0.184 | 2.20 |
| 2800 - 3799 | 72 | -0.559 | 4.57 | 0.99 | 33.0 | 0.165 | 1.02 | -0.049 | 1.43 |
| 3800 - 4799 | 59 | -0.935 | 11.10 | 6.20 | 47.3 | 0.096 | 0.95 | -0.136 | 1.36 |
| 4800 - 5799 | 8 | 1.028 | 3.01 | 8.04 | 40.1 | 0.180 | 0.60 | -0.063 | 1.45 |
| *POPULATIONS | | | | | | | | | |
| 1964 - 1967 | 72 | -1.036 | 8.18 | -2.31 | 34.8 | 0.245 | 0.76 | 0.163 | 1.49 |
| 1968 - 1973 | 93 | 0.049 | 6.72 | 8.47 | 40.3 | 0.051 | 1.20 | -0.307 | 1.55 |
| ALL VEHICLES | 165 | -0.424 | 7.39 | 3.77 | 38.2 | 0.136 | 1.03 | -0.102 | 1.54 |

AUTOMOTIVE TESTING LABORATORIES, INC.
19900 E. COLFAX, AURORA, COLO. 80011

PERCENT REDUCTIONS AFTER INSPECTION AND MAINTENANCE

1975 FEDERAL TEST PROCEDURE

ALL VEHICLES

| | # OF VEH. | PERCENT REDUCTIONS HC | CO | NOX | MPG |
|---|---|---|---|---|---|
| *VEHICLE MAKE | | | | | |
| AMER. MOTORS | 6 | 15.29 | 27.28 | -12.84 | -3.60 |
| BUICK | 6 | 5.06 | 11.71 | -3.57 | -0.99 |
| CADILLAC | 4 | 1.82 | 5.04 | 0.57 | -1.53 |
| CHEVROLET | 40 | 11.63 | 4.34 | 8.70 | -1.16 |
| CHRYSLER | 5 | 56.24 | 40.52 | -26.86 | -13.91 |
| DATSUN | 1 | 0.24 | -10.42 | 19.51 | 1.16 |
| DODGE | 8 | -20.06 | -6.39 | 16.29 | -1.55 |
| FORD | 43 | 7.08 | 5.07 | 8.78 | -0.77 |
| MERCURY | 5 | 2.42 | -15.01 | -3.18 | 6.73 |
| OLDSMOBILE | 7 | 11.20 | 5.46 | -1.30 | -2.72 |
| OPEL | 2 | 21.73 | 20.96 | -12.39 | -2.60 |
| PLYMOUTH | 13 | 25.07 | 15.22 | -3.65 | -2.29 |
| PONTIAC | 12 | 24.79 | 3.17 | -1.23 | -2.00 |
| TOYOTA | 4 | 26.08 | 15.07 | 7.50 | -7.11 |
| VOLKSWAGON | 9 | 9.45 | 2.11 | 12.24 | -2.31 |
| VOLVO | 0 | | | | |
| *MODEL YEAR | | | | | |
| 1964 | 14 | 10.69 | 7.24 | 4.03 | -2.10 |
| 1965 | 20 | 19.81 | 4.37 | 5.74 | -0.84 |
| 1966 | 18 | 8.99 | 9.04 | 8.54 | -5.06 |
| 1967 | 20 | 1.01 | -1.63 | 5.95 | 0.50 |
| 1968 | 15 | 14.39 | 15.49 | 13.03 | 0.11 |
| 1969 | 10 | -10.23 | -5.25 | -0.96 | -1.41 |
| 1970 | 17 | 32.05 | 9.95 | 10.28 | -2.67 |
| 1971 | 17 | 13.53 | 13.03 | 1.89 | -1.89 |
| 1972 | 18 | 29.22 | 26.38 | -10.63 | -3.49 |
| 1973 | 16 | -2.22 | -0.36 | 1.07 | 0.17 |
| *DISPLACEMENT | | | | | |
| LESS THAN 151 | 19 | 13.67 | 7.46 | 8.47 | -3.10 |
| 151 - 250 | 27 | 2.48 | 4.97 | 0.40 | -1.50 |
| 251 - 350 | 71 | 14.32 | 5.88 | 12.75 | -0.82 |
| MORE THAN 350 | 48 | 16.17 | 12.62 | -3.96 | -2.33 |
| *INERTIA WEIGHT | | | | | |
| 1800 - 2799 | 26 | 12.39 | 7.31 | 5.73 | -2.13 |
| 2800 - 3799 | 72 | 5.45 | 4.14 | 6.71 | -0.77 |
| 3800 - 4799 | 59 | 22.28 | 12.57 | 1.63 | -2.97 |
| 4800 - 5799 | 8 | -0.68 | 2.24 | 0.97 | 0.46 |
| *POPULATIONS | | | | | |
| 1964 - 1967 | 72 | 10.70 | 4.49 | 6.27 | -1.77 |
| 1968 - 1973 | 93 | 16.73 | 12.03 | 3.12 | -1.62 |
| ALL VEHICLES | 165 | 13.40 | 7.97 | 4.31 | -1.68 |

AUTOMOTIVE TESTING LABORATORIES, INC.
19000 E. COLFAX, AURORA, COLO. 80011

PERCENT REDUCTIONS AFTER SIX MONTHS

1975 FEDERAL TEST PROCEDURE

ALL VEHICLES

| | # OF VEH. | PERCENT REDUCTIONS HC | CO | NOX | MPG |
|---|---|---|---|---|---|
| *VEHICLE MAKE | | | | | |
| AMER. MOTORS | 6 | 21.04 | 25.33 | -19.98 | -4.92 |
| BUICK | 6 | 22.26 | 2.68 | 1.35 | -3.58 |
| CADILLAC | 4 | 26.58 | 20.15 | 8.77 | -8.55 |
| CHEVROLET | 40 | -10.93 | -0.76 | 7.58 | 0.20 |
| CHRYSLER | 5 | 54.89 | 38.89 | -38.06 | -9.58 |
| DATSUN | 1 | 14.19 | -7.05 | 5.15 | 4.20 |
| DODGE | 8 | -73.88 | -19.71 | 14.54 | 3.98 |
| FORD | 43 | -14.14 | -0.54 | 9.49 | -0.91 |
| MERCURY | 5 | -3.59 | -21.61 | 18.77 | 6.24 |
| OLDSMOBILE | 7 | -33.69 | 8.25 | 2.81 | -4.45 |
| OPEL | 2 | -11.06 | 7.05 | 2.13 | 4.09 |
| PLYMOUTH | 13 | -32.96 | 4.82 | -5.83 | 2.80 |
| PONTIAC | 12 | 12.40 | -5.33 | 1.19 | 1.11 |
| TOYOTA | 4 | 16.74 | -7.50 | 32.18 | -9.18 |
| VOLKSWAGON | 9 | 23.28 | 20.68 | -0.66 | -2.43 |
| VOLVO | 0 | | | | |
| *MODEL YEAR | | | | | |
| 1964 | 14 | -2.71 | 1.67 | 1.24 | -1.37 |
| 1965 | 20 | 18.71 | -4.19 | 14.07 | 2.19 |
| 1966 | 18 | -45.04 | -3.05 | 13.84 | 1.46 |
| 1967 | 20 | -21.75 | -0.31 | 11.29 | 1.52 |
| 1968 | 15 | 25.68 | 20.80 | 6.23 | -3.51 |
| 1969 | 10 | -53.88 | -6.03 | 4.78 | -0.60 |
| 1970 | 17 | 23.09 | 0.00 | 12.22 | -2.18 |
| 1971 | 17 | -25.39 | 8.42 | -3.47 | -2.42 |
| 1972 | 18 | 24.78 | 22.38 | -11.49 | -4.26 |
| 1973 | 16 | -43.31 | -2.83 | 1.20 | 1.39 |
| *DISPLACEMENT | | | | | |
| LESS THAN 151 | 19 | 16.16 | 8.18 | 10.99 | -0.91 |
| 151 - 250 | 27 | -14.46 | 1.95 | -10.38 | -0.86 |
| 251 - 350 | 71 | -13.40 | 2.07 | 13.37 | 0.95 |
| MORE THAN 350 | 48 | 5.15 | 4.85 | 2.85 | -3.23 |
| *INERTIA WEIGHT | | | | | |
| 1800 - 2799 | 26 | 11.45 | 6.26 | 5.09 | -0.89 |
| 2800 - 3799 | 72 | -7.76 | 0.97 | 6.87 | -0.33 |
| 3800 - 4799 | 59 | -9.58 | 4.69 | 3.46 | -1.11 |
| 4800 - 5799 | 8 | 13.83 | 5.75 | 6.27 | -0.58 |
| *POPULATIONS | | | | | |
| 1964 - 1967 | 72 | -10.36 | -1.70 | 10.92 | 1.14 |
| 1968 - 1973 | 93 | 0.79 | 9.37 | 1.80 | -2.07 |
| ALL VEHICLES | 165 | -5.37 | 3.41 | 5.25 | -0.70 |

AUTOMOTIVE TESTING LABORATORIES, INC.
19900 E. COLFAX, AURORA, COLO. 80011

EXHAUST EMISSIONS BEFORE INSPECTION AND MAINTENANCE

1975 FEDERAL TEST PROCEDURE

INSPECTION AND MAINTENANCE VEHICLES

| | # OF VEH. | HC MEAN | HC S.D. | CO MEAN | CO S.D. | NOX MEAN | NOX S.D. | MPG MEAN | MPG S.D. |
|---|---|---|---|---|---|---|---|---|---|
| *VEHICLE MAKE | | | | | | | | | |
| AMER. MOTORS | 4 | 7.25 | 2.45 | 94.3 | 27.1 | 3.21 | 1.41 | 16.90 | 1.69 |
| BUICK | 4 | 13.03 | 7.68 | 172.7 | 61.4 | 2.67 | 1.88 | 12.14 | 1.52 |
| CADILLAC | 4 | 8.63 | 3.75 | 157.9 | 50.6 | 3.01 | 1.14 | 10.57 | 1.62 |
| CHEVROLET | 17 | 8.34 | 3.40 | 114.9 | 44.7 | 2.07 | 0.87 | 15.59 | 3.13 |
| CHRYSLER | 5 | 13.82 | 12.91 | 190.6 | 83.1 | 1.96 | 1.41 | 10.38 | 1.33 |
| DATSUN | 1 | 4.37 | 0.00 | 42.2 | 0.0 | 3.61 | 0.00 | 22.04 | 0.00 |
| DODGE | 5 | 5.97 | 1.78 | 88.7 | 18.3 | 3.08 | 1.06 | 14.98 | 1.62 |
| FORD | 18 | 7.24 | 3.00 | 103.0 | 39.4 | 3.07 | 1.63 | 15.63 | 3.79 |
| MERCURY | 2 | 8.15 | 1.24 | 83.7 | 39.0 | 5.36 | 5.25 | 12.09 | 1.44 |
| OLDSMOBILE | 4 | 7.58 | 2.30 | 125.5 | 41.6 | 2.55 | 1.28 | 12.29 | 1.28 |
| OPEL | 2 | 5.35 | 0.76 | 86.2 | 11.2 | 1.58 | 0.26 | 21.06 | 0.81 |
| PLYMOUTH | 5 | 6.57 | 2.81 | 101.2 | 48.7 | 2.54 | 0.78 | 16.46 | 1.93 |
| PONTIAC | 5 | 11.71 | 12.53 | 101.6 | 52.9 | 2.47 | 0.89 | 13.00 | 1.75 |
| TOYOTA | 4 | 5.22 | 1.36 | 81.2 | 48.3 | 2.49 | 0.67 | 18.37 | 2.44 |
| VOLKSWAGON | 7 | 7.26 | 4.16 | 85.8 | 36.1 | 2.24 | 1.30 | 21.51 | 2.09 |
| VOLVO | 0 | | | | | | | | |
| *MODEL YEAR | | | | | | | | | |
| 1964 | 9 | 8.04 | 1.78 | 129.9 | 52.4 | 2.42 | 1.30 | 14.38 | 3.05 |
| 1965 | 15 | 11.12 | 7.86 | 134.1 | 52.5 | 2.11 | 0.99 | 14.70 | 4.36 |
| 1966 | 11 | 9.50 | 2.85 | 128.3 | 31.2 | 2.39 | 0.92 | 15.47 | 3.99 |
| 1967 | 14 | 8.80 | 2.62 | 122.9 | 40.4 | 2.57 | 2.03 | 14.16 | 2.27 |
| 1968 | 5 | 9.24 | 4.04 | 125.4 | 14.8 | 2.34 | 1.43 | 16.11 | 3.92 |
| 1969 | 2 | 6.39 | 0.28 | 127.0 | 37.0 | 1.81 | 0.39 | 15.01 | 0.43 |
| 1970 | 11 | 5.43 | 2.19 | 80.5 | 42.9 | 3.71 | 1.69 | 15.31 | 4.20 |
| 1971 | 7 | 5.28 | 1.34 | 71.4 | 34.6 | 2.94 | 1.02 | 17.02 | 5.36 |
| 1972 | 7 | 9.20 | 12.14 | 105.8 | 98.1 | 2.91 | 1.41 | 16.48 | 4.80 |
| 1973 | 6 | 4.09 | 0.67 | 67.6 | 12.6 | 2.78 | 1.21 | 18.10 | 3.68 |
| *DISPLACEMENT | | | | | | | | | |
| LESS THAN 151 | 17 | 6.14 | 2.85 | 81.1 | 32.3 | 2.24 | 1.03 | 20.78 | 2.30 |
| 151 - 250 | 18 | 6.38 | 3.25 | 80.9 | 32.8 | 2.86 | 1.60 | 17.98 | 1.76 |
| 251 - 350 | 28 | 8.61 | 2.65 | 127.8 | 38.5 | 2.28 | 0.91 | 13.92 | 1.33 |
| MORE THAN 350 | 24 | 10.46 | 8.68 | 137.9 | 64.9 | 3.17 | 1.82 | 11.41 | 1.53 |
| *INERTIA WEIGHT | | | | | | | | | |
| 1800 - 2799 | 21 | 6.08 | 2.77 | 76.3 | 31.2 | 2.56 | 1.54 | 20.62 | 2.18 |
| 2800 - 3799 | 31 | 7.50 | 3.17 | 103.1 | 34.7 | 2.41 | 0.99 | 15.82 | 1.87 |
| 3800 - 4799 | 27 | 10.81 | 8.02 | 141.0 | 62.3 | 2.90 | 1.79 | 12.22 | 1.62 |
| 4800 - 5799 | 8 | 7.43 | 2.99 | 139.8 | 44.9 | 2.87 | 1.13 | 10.89 | 1.31 |
| *POPULATIONS | | | | | | | | | |
| 1964 - 1967 | 49 | 9.53 | 4.84 | 128.9 | 43.9 | 2.36 | 1.38 | 14.66 | 3.47 |
| 1968 - 1973 | 38 | 6.43 | 5.59 | 89.8 | 52.9 | 2.99 | 1.41 | 16.37 | 4.20 |
| ALL VEHICLES | 87 | 8.18 | 5.38 | 111.8 | 51.6 | 2.64 | 1.42 | 15.41 | 3.85 |

AUTOMOTIVE TESTING LABORATORIES, INC.
19900 E. COLFAX, AURORA, COLO. 80011

EXHAUST EMISSIONS AFTER INSPECTION AND MAINTENANCE

1975 FEDERAL TEST PROCEDURE

INSPECTION AND MAINTENANCE VEHICLES

| | # OF VEH. | HC MEAN | HC S.D. | CO MEAN | CO S.D. | NOX MEAN | NOX S.D. | MPG MEAN | MPG S.D. |
|---|---|---|---|---|---|---|---|---|---|
| *VEHICLE MAKE | | | | | | | | | |
| AMER. MOTORS | 4 | 6.30 | 1.48 | 84.8 | 17.1 | 3.24 | 1.39 | 17.34 | 1.06 |
| BUICK | 4 | 13.12 | 9.82 | 164.2 | 75.9 | 2.64 | 1.64 | 12.15 | 1.79 |
| CADILLAC | 4 | 8.47 | 3.73 | 149.9 | 43.3 | 3.00 | 1.16 | 10.74 | 1.52 |
| CHEVROLET | 17 | 7.79 | 3.35 | 110.3 | 38.5 | 1.88 | 0.92 | 15.71 | 2.65 |
| CHRYSLER | 5 | 6.05 | 0.98 | 113.3 | 24.2 | 2.49 | 1.21 | 11.82 | 1.43 |
| DATSUN | 1 | 4.36 | 0.00 | 46.6 | 0.0 | 2.91 | 0.00 | 21.79 | 0.00 |
| DODGE | 5 | 6.12 | 2.65 | 76.8 | 40.7 | 2.76 | 0.79 | 15.51 | 1.84 |
| FORD | 18 | 6.40 | 2.27 | 93.9 | 41.2 | 3.10 | 1.59 | 15.92 | 4.11 |
| MERCURY | 2 | 8.15 | 1.24 | 83.7 | 39.0 | 5.36 | 5.25 | 12.09 | 1.44 |
| OLDSMOBILE | 4 | 7.30 | 2.37 | 114.4 | 47.7 | 2.61 | 1.28 | 12.44 | 1.48 |
| OPEL | 2 | 4.18 | 0.84 | 68.2 | 11.9 | 1.78 | 0.00 | 21.61 | 0.29 |
| PLYMOUTH | 5 | 6.21 | 3.21 | 89.9 | 54.0 | 2.78 | 1.22 | 16.76 | 2.41 |
| PONTIAC | 5 | 7.88 | 4.38 | 116.2 | 76.5 | 2.30 | 1.06 | 12.90 | 1.60 |
| TOYOTA | 4 | 3.86 | 0.45 | 68.9 | 54.0 | 2.30 | 1.13 | 19.67 | 3.83 |
| VOLKSWAGON | 7 | 6.29 | 3.21 | 81.6 | 35.7 | 1.99 | 0.93 | 22.10 | 2.28 |
| VOLVO | 0 | | | | | | | | |
| *MODEL YEAR | | | | | | | | | |
| 1964 | 9 | 7.47 | 1.92 | 110.8 | 37.2 | 2.56 | 1.31 | 14.82 | 2.68 |
| 1965 | 15 | 9.18 | 5.64 | 132.7 | 56.0 | 2.05 | 1.09 | 14.66 | 4.13 |
| 1966 | 11 | 8.29 | 2.89 | 115.3 | 32.3 | 2.01 | 0.62 | 16.34 | 4.34 |
| 1967 | 14 | 9.28 | 2.42 | 128.9 | 41.0 | 2.45 | 2.11 | 13.86 | 1.91 |
| 1968 | 5 | 7.21 | 3.43 | 96.0 | 33.7 | 2.53 | 0.78 | 16.95 | 3.86 |
| 1969 | 2 | 5.13 | 1.08 | 117.8 | 42.4 | 1.58 | 0.90 | 15.42 | 0.56 |
| 1970 | 11 | 4.54 | 1.00 | 70.5 | 41.2 | 3.56 | 1.52 | 15.70 | 4.34 |
| 1971 | 7 | 4.38 | 0.85 | 63.1 | 34.9 | 2.89 | 1.37 | 17.87 | 6.36 |
| 1972 | 7 | 4.38 | 1.09 | 59.3 | 26.3 | 3.40 | 1.17 | 17.66 | 4.09 |
| 1973 | 6 | 4.05 | 1.12 | 64.6 | 12.7 | 2.78 | 1.16 | 17.94 | 3.78 |
| *DISPLACEMENT | | | | | | | | | |
| LESS THAN 151 | 17 | 5.16 | 2.29 | 73.6 | 34.0 | 2.07 | 0.88 | 21.48 | 2.68 |
| 151 - 250 | 18 | 6.42 | 3.34 | 80.9 | 40.9 | 2.78 | 1.59 | 17.99 | 1.63 |
| 251 - 350 | 28 | 7.68 | 2.51 | 114.7 | 40.2 | 2.18 | 0.88 | 14.37 | 1.47 |
| MORE THAN 350 | 24 | 7.91 | 4.92 | 119.9 | 54.6 | 3.31 | 1.77 | 11.69 | 1.46 |
| *INERTIA WEIGHT | | | | | | | | | |
| 1800 - 2790 | 21 | 5.18 | 2.29 | 70.7 | 33.5 | 2.36 | 1.35 | 21.11 | 2.56 |
| 2800 - 3790 | 31 | 7.12 | 2.92 | 96.1 | 37.9 | 2.33 | 1.04 | 16.12 | 1.82 |
| 3800 - 4790 | 27 | 8.10 | 4.67 | 120.0 | 53.8 | 3.00 | 1.80 | 12.67 | 1.60 |
| 4800 - 5790 | 8 | 7.48 | 3.05 | 136.7 | 41.5 | 2.84 | 1.12 | 10.84 | 1.19 |
| *POPULATIONS | | | | | | | | | |
| 1964 - 1967 | 49 | 8.70 | 3.70 | 123.7 | 43.6 | 2.25 | 1.40 | 14.84 | 3.45 |
| 1968 - 1973 | 38 | 4.79 | 1.74 | 72.0 | 34.8 | 3.04 | 1.30 | 16.97 | 4.34 |
| ALL VEHICLES | 87 | 6.99 | 3.57 | 101.1 | 47.4 | 2.60 | 1.41 | 15.77 | 3.98 |

AUTOMOTIVE TESTING LABORATORIES, INC.
19900 E. COLFAX, AURORA, COLO. 80011

EXHAUST EMISSIONS AFTER SIX MONTHS

1975 FEDERAL TEST PROCEDURE

INSPECTION AND MAINTENANCE VEHICLES

| | # OF VEH. | HC MEAN | HC S.D. | CO MEAN | CO S.D. | NOX MEAN | NOX S.D. | MPG MEAN | MPG S.D. |
|---|---|---|---|---|---|---|---|---|---|
| *VEHICLE MAKE | | | | | | | | | |
| AMER. MOTORS | 4 | 6.60 | 2.48 | 78.8 | 27.1 | 3.85 | 1.65 | 17.21 | 0.80 |
| BUICK | 4 | 10.40 | 3.72 | 193.7 | 103.3 | 2.30 | 1.36 | 11.94 | 2.95 |
| CADILLAC | 4 | 6.33 | 1.30 | 126.0 | 31.7 | 2.75 | 0.90 | 11.48 | 1.65 |
| CHEVROLET | 17 | 8.38 | 2.69 | 112.7 | 41.7 | 2.13 | 1.44 | 15.18 | 2.27 |
| CHRYSLER | 5 | 6.23 | 1.04 | 116.5 | 38.9 | 2.71 | 1.73 | 11.37 | 1.26 |
| DATSUN | 1 | 3.75 | 0.00 | 45.2 | 0.0 | 3.43 | 0.00 | 21.12 | 0.00 |
| DODGE | 5 | 12.04 | 11.16 | 90.7 | 38.6 | 2.52 | 1.12 | 14.59 | 0.72 |
| FORD | 18 | 7.79 | 3.33 | 108.5 | 51.2 | 2.81 | 1.58 | 15.55 | 3.68 |
| MERCURY | 2 | 9.34 | 4.35 | 115.4 | 64.6 | 3.82 | 3.99 | 11.94 | 1.31 |
| OLDSMOBILE | 4 | 6.53 | 1.79 | 110.0 | 45.1 | 2.59 | 1.27 | 12.95 | 1.07 |
| OPEL | 2 | 5.94 | 2.76 | 80.2 | 23.7 | 1.55 | 0.05 | 20.20 | 2.70 |
| PLYMOUTH | 5 | 5.35 | 1.91 | 85.7 | 39.2 | 3.17 | 1.35 | 16.34 | 2.89 |
| PONTIAC | 5 | 8.86 | 4.80 | 121.4 | 66.3 | 1.93 | 0.74 | 12.43 | 1.17 |
| TOYOTA | 4 | 4.35 | 1.08 | 87.3 | 51.7 | 1.69 | 0.72 | 20.05 | 3.87 |
| VOLKSWAGON | 7 | 5.19 | 4.03 | 63.4 | 34.5 | 2.23 | 0.79 | 22.42 | 1.99 |
| VOLVO | 0 | | | | | | | | |
| *MODEL YEAR | | | | | | | | | |
| 1964 | 9 | 7.83 | 1.81 | 117.0 | 46.5 | 2.70 | 1.22 | 14.95 | 2.48 |
| 1965 | 15 | 8.70 | 3.39 | 145.8 | 73.7 | 1.92 | 0.97 | 14.19 | 4.09 |
| 1966 | 11 | 9.84 | 3.04 | 122.8 | 39.9 | 2.04 | 0.81 | 15.64 | 3.84 |
| 1967 | 14 | 8.57 | 2.14 | 125.9 | 36.5 | 2.27 | 1.64 | 13.80 | 1.38 |
| 1968 | 5 | 5.31 | 1.82 | 84.4 | 34.7 | 2.60 | 0.40 | 17.93 | 5.49 |
| 1969 | 2 | 5.91 | 0.46 | 130.3 | 37.9 | 1.13 | 0.44 | 15.54 | 1.76 |
| 1970 | 11 | 4.67 | 1.15 | 74.0 | 31.2 | 3.53 | 1.57 | 15.57 | 4.34 |
| 1971 | 7 | 5.90 | 4.03 | 67.5 | 30.8 | 3.25 | 2.11 | 17.32 | 5.87 |
| 1972 | 7 | 5.65 | 3.31 | 65.9 | 29.8 | 3.05 | 1.34 | 17.15 | 4.07 |
| 1973 | 6 | 8.79 | 11.19 | 70.1 | 12.6 | 2.56 | 1.38 | 17.10 | 3.51 |
| *DISPLACEMENT | | | | | | | | | |
| LESS THAN 151 | 17 | 5.04 | 2.68 | 73.5 | 34.2 | 1.96 | 0.77 | 21.08 | 2.57 |
| 151 - 250 | 18 | 7.95 | 6.63 | 85.8 | 42.0 | 3.04 | 1.73 | 17.56 | 1.94 |
| 251 - 350 | 28 | 7.98 | 2.34 | 116.4 | 38.9 | 2.13 | 0.98 | 14.12 | 1.24 |
| MORE THAN 350 | 24 | 8.35 | 3.50 | 131.2 | 65.6 | 3.05 | 1.64 | 11.61 | 1.57 |
| *INERTIA WEIGHT | | | | | | | | | |
| 1800 - 2799 | 21 | 5.30 | 2.79 | 72.7 | 32.4 | 2.19 | 1.02 | 20.79 | 2.47 |
| 2800 - 3799 | 31 | 8.01 | 5.26 | 100.6 | 41.0 | 2.40 | 1.47 | 15.67 | 1.80 |
| 3800 - 4799 | 27 | 8.96 | 3.04 | 129.8 | 61.6 | 2.92 | 1.58 | 12.54 | 1.60 |
| 4800 - 5799 | 8 | 6.41 | 1.68 | 131.8 | 49.6 | 2.69 | 1.28 | 10.95 | 1.50 |
| *POPULATIONS | | | | | | | | | |
| 1964 - 1967 | 49 | 8.76 | 2.74 | 129.6 | 52.6 | 2.19 | 1.21 | 14.54 | 3.16 |
| 1968 - 1973 | 38 | 5.88 | 4.89 | 75.0 | 31.0 | 2.99 | 1.52 | 16.73 | 4.38 |
| ALL VEHICLES | 87 | 7.50 | 4.07 | 105.8 | 51.9 | 2.54 | 1.40 | 15.50 | 3.88 |

AUTOMOTIVE TESTING LABORATORIES, INC.
19900 E. COLFAX, AURORA, COLO. 80011

EXHAUST EMISSION REDUCTIONS AFTER INSPECTION AND MAINTENANCE

1975 FEDERAL TEST PROCEDURE

INSPECTION AND MAINTENANCE VEHICLES

| | # OF VEH. | HC MEAN | HC S.D. | CO MEAN | CO S.D. | NOX MEAN | NOX S.D. | MPG MEAN | MPG S.D. |
|---|---|---|---|---|---|---|---|---|---|
| *VEHICLE MAKE | | | | | | | | | |
| AMER. MOTORS | 4 | 0.948 | 1.90 | 9.59 | 19.2 | -0.026 | 0.05 | -0.445 | 0.89 |
| BUICK | 4 | -0.092 | 2.27 | 8.50 | 20.4 | 0.029 | 0.59 | -0.017 | 0.95 |
| CADILLAC | 4 | 0.157 | 0.31 | 7.96 | 15.9 | 0.017 | 0.03 | -0.161 | 0.32 |
| CHEVROLET | 17 | 0.557 | 1.16 | 4.60 | 19.7 | 0.183 | 0.36 | -0.118 | 1.15 |
| CHRYSLER | 5 | 7.772 | 13.49 | 77.21 | 103.1 | -0.527 | 0.81 | -1.443 | 1.89 |
| DATSUN | 1 | 0.011 | 0.00 | -4.40 | 0.0 | 0.705 | 0.00 | 0.257 | 0.00 |
| DODGE | 5 | -0.152 | 2.46 | 11.86 | 35.4 | 0.313 | 1.18 | -0.523 | 1.28 |
| FORD | 18 | 0.838 | 2.15 | 9.08 | 19.7 | -0.036 | 0.40 | -0.295 | 1.01 |
| MERCURY | 2 | 0.000 | 0.00 | 0.00 | 0.0 | 0.000 | 0.00 | 0.000 | 0.00 |
| OLDSMOBILE | 4 | 0.281 | 0.56 | 11.04 | 22.1 | -0.053 | 0.11 | -0.146 | 0.29 |
| OPEL | 2 | 1.162 | 0.08 | 18.07 | 0.7 | -0.196 | 0.27 | -0.547 | 0.52 |
| PLYMOUTH | 5 | 0.355 | 0.76 | 11.31 | 17.2 | -0.237 | 0.53 | -0.302 | 0.84 |
| PONTIAC | 5 | 3.831 | 9.21 | -14.61 | 23.9 | 0.163 | 0.26 | 0.091 | 0.25 |
| TOYOTA | 4 | 1.362 | 0.96 | 12.24 | 12.5 | 0.187 | 0.52 | -1.306 | 1.60 |
| VOLKSWAGON | 7 | 0.975 | 1.31 | 4.23 | 21.5 | 0.246 | 1.06 | -0.590 | 1.44 |
| VOLVO | 0 | | | | | | | | |
| *MODEL YEAR | | | | | | | | | |
| 1964 | 9 | 0.567 | 0.76 | 19.17 | 32.1 | -0.138 | 0.24 | -0.439 | 0.82 |
| 1965 | 15 | 1.933 | 5.54 | 1.42 | 27.4 | 0.060 | 0.33 | 0.036 | 1.16 |
| 1966 | 11 | 1.211 | 1.46 | 12.99 | 18.5 | 0.376 | 0.73 | -0.879 | 1.17 |
| 1967 | 14 | -0.478 | 1.51 | -5.98 | 17.5 | 0.128 | 0.27 | 0.295 | 0.63 |
| 1968 | 5 | 2.030 | 1.27 | 29.35 | 23.9 | -0.192 | 0.70 | -0.843 | 1.14 |
| 1969 | 2 | 1.260 | 1.36 | 9.16 | 5.4 | 0.231 | 0.51 | -0.410 | 0.13 |
| 1970 | 11 | 0.887 | 1.57 | 9.99 | 18.1 | 0.150 | 0.83 | -0.386 | 0.66 |
| 1971 | 7 | 0.901 | 1.31 | 8.28 | 12.2 | 0.058 | 0.58 | -0.843 | 1.51 |
| 1972 | 7 | 4.812 | 11.82 | 46.44 | 90.0 | -0.497 | 0.76 | -1.185 | 1.57 |
| 1973 | 6 | 0.037 | 0.81 | 3.01 | 8.0 | 0.005 | 0.05 | 0.159 | 0.33 |
| *DISPLACEMENT | | | | | | | | | |
| LESS THAN 151 | 17 | 0.983 | 1.29 | 7.46 | 16.1 | 0.169 | 0.72 | -0.702 | 1.32 |
| 151 - 250 | 18 | -0.030 | 0.92 | 0.06 | 17.3 | 0.073 | 0.43 | -0.008 | 1.22 |
| 251 - 350 | 28 | 0.929 | 1.96 | 13.13 | 22.9 | 0.100 | 0.55 | -0.447 | 0.81 |
| MORE THAN 350 | 24 | 2.550 | 7.54 | 18.07 | 55.8 | -0.137 | 0.51 | -0.287 | 1.07 |
| *INERTIA WEIGHT | | | | | | | | | |
| 1800 - 2799 | 21 | 0.897 | 1.20 | 5.67 | 16.9 | 0.195 | 0.67 | -0.488 | 1.51 |
| 2800 - 3799 | 31 | 0.383 | 1.83 | 6.99 | 21.5 | 0.073 | 0.55 | -0.305 | 0.90 |
| 3800 - 4799 | 27 | 2.706 | 7.07 | 21.04 | 53.2 | -0.108 | 0.54 | -0.452 | 1.06 |
| 4800 - 5799 | 8 | -0.050 | 0.58 | 3.13 | 12.3 | 0.028 | 0.04 | 0.050 | 0.37 |
| *POPULATIONS | | | | | | | | | |
| 1964 - 1967 | 49 | 0.831 | 3.32 | 5.16 | 25.2 | 0.114 | 0.45 | -0.183 | 1.05 |
| 1968 - 1973 | 38 | 1.648 | 5.15 | 17.79 | 41.8 | -0.050 | 0.67 | -0.593 | 1.11 |
| ALL VEHICLES | 87 | 1.189 | 4.21 | 10.68 | 33.9 | 0.042 | 0.56 | -0.362 | 1.09 |

AUTOMOTIVE TESTING LABORATORIES, INC.
19900 E. COLFAX, AURORA, COLO. 80011

EXHAUST EMISSION REDUCTIONS AFTER SIX MONTHS

1975 FEDERAL TEST PROCEDURE

INSPECTION AND MAINTENANCE VEHICLES

| | # OF VEH. | HC MEAN | HC S.D. | CO MEAN | CO S.D. | NOX MEAN | NOX S.D. | MPG MEAN | MPG S.D. |
|---|---|---|---|---|---|---|---|---|---|
| *VEHICLE MAKE | | | | | | | | | |
| AMER. MOTORS | 4 | 0.645 | 2.22 | 15.58 | 19.6 | -0.633 | 0.27 | -0.306 | 1.03 |
| BUICK | 4 | 2.629 | 4.31 | -21.08 | 51.7 | 0.367 | 1.09 | 0.196 | 1.59 |
| CADILLAC | 4 | 2.294 | 3.90 | 31.81 | 23.2 | 0.264 | 0.73 | -0.904 | 1.59 |
| CHEVROLET | 17 | -0.039 | 2.22 | 2.20 | 27.2 | -0.065 | 0.96 | 0.407 | 1.62 |
| CHRYSLER | 5 | 7.585 | 13.49 | 74.10 | 90.9 | -0.747 | 0.94 | -0.994 | 1.77 |
| DATSUN | 1 | 0.621 | 0.00 | -2.98 | 0.0 | 0.186 | 0.00 | 0.926 | 0.00 |
| DODGE | 5 | -6.074 | 12.23 | -2.02 | 33.7 | 0.557 | 1.18 | 0.392 | 1.39 |
| FORD | 18 | -0.547 | 3.78 | -5.53 | 33.4 | 0.256 | 1.03 | 0.081 | 1.53 |
| MERCURY | 2 | -1.183 | 5.59 | -31.75 | 25.6 | 1.542 | 1.26 | 0.154 | 2.75 |
| OLDSMOBILE | 4 | 1.044 | 1.13 | 15.45 | 30.2 | -0.032 | 0.19 | -0.661 | 1.01 |
| OPEL | 2 | -0.592 | 2.00 | 6.08 | 12.5 | 0.034 | 0.22 | 0.862 | 1.89 |
| PLYMOUTH | 5 | 1.214 | 1.08 | 15.58 | 24.4 | -0.633 | 0.94 | 0.126 | 1.64 |
| PONTIAC | 5 | 2.851 | 9.37 | -19.78 | 19.8 | 0.537 | 0.26 | 0.562 | 1.01 |
| TOYOTA | 4 | 0.874 | 0.84 | -6.09 | 19.1 | 0.802 | 0.42 | -1.686 | 1.87 |
| VOLKSWAGON | 7 | 2.071 | 5.16 | 22.43 | 36.2 | 0.007 | 1.20 | -0.908 | 2.51 |
| VOLVO | 0 | | | | | | | | |
| *MODEL YEAR | | | | | | | | | |
| 1964 | 9 | 0.213 | 2.25 | 12.94 | 27.4 | -0.285 | 0.68 | -0.570 | 1.01 |
| 1965 | 15 | 2.420 | 6.13 | -11.62 | 43.7 | 0.187 | 0.52 | 0.511 | 1.79 |
| 1966 | 11 | -0.333 | 3.04 | 5.52 | 34.4 | 0.345 | 0.95 | -0.174 | 1.39 |
| 1967 | 14 | 0.230 | 2.20 | -2.94 | 31.2 | 0.307 | 0.81 | 0.358 | 1.64 |
| 1968 | 5 | 3.921 | 5.10 | 40.97 | 32.7 | -0.268 | 1.36 | -1.817 | 2.28 |
| 1969 | 2 | 0.480 | 0.74 | -3.34 | 0.9 | 0.686 | 0.04 | -0.533 | 1.33 |
| 1970 | 11 | 0.758 | 1.87 | 6.48 | 31.1 | 0.182 | 1.28 | -0.252 | 0.96 |
| 1971 | 7 | -0.625 | 3.70 | 3.91 | 7.1 | -0.312 | 1.44 | -0.292 | 1.91 |
| 1972 | 7 | 3.544 | 12.62 | 39.83 | 91.8 | -0.140 | 1.36 | -0.674 | 1.94 |
| 1973 | 6 | -4.703 | 11.32 | -2.47 | 15.1 | 0.221 | 0.63 | 1.004 | 1.58 |
| *DISPLACEMENT | | | | | | | | | |
| LESS THAN 151 | 17 | 1.109 | 3.37 | 7.58 | 27.6 | 0.284 | 0.88 | -0.309 | 2.30 |
| 151 - 250 | 18 | -1.567 | 6.77 | -4.90 | 27.1 | -0.184 | 1.29 | 0.420 | 1.74 |
| 251 - 350 | 28 | 0.626 | 2.43 | 11.48 | 28.5 | 0.146 | 0.70 | -0.197 | 1.23 |
| MORE THAN 350 | 24 | 2.113 | 8.43 | 6.69 | 64.1 | 0.122 | 1.03 | -0.202 | 1.47 |
| *INERTIA WEIGHT | | | | | | | | | |
| 1800 - 2799 | 21 | 0.786 | 3.12 | 3.64 | 26.9 | 0.368 | 1.03 | -0.168 | 2.28 |
| 2800 - 3799 | 31 | -0.507 | 5.53 | 2.57 | 27.0 | 0.003 | 0.96 | 0.149 | 1.40 |
| 3800 - 4799 | 27 | 1.848 | 7.94 | 11.20 | 60.6 | -0.026 | 1.01 | -0.320 | 1.40 |
| 4800 - 5799 | 8 | 1.028 | 3.01 | 8.04 | 40.1 | 0.180 | 0.60 | -0.063 | 1.45 |
| *POPULATIONS | | | | | | | | | |
| 1964 - 1967 | 49 | 0.771 | 4.04 | -0.78 | 35.7 | 0.170 | 0.76 | 0.115 | 1.55 |
| 1968 - 1973 | 38 | 0.556 | 7.56 | 14.76 | 45.9 | 0.005 | 1.18 | -0.359 | 1.73 |
| ALL VEHICLES | 87 | 0.677 | 5.80 | 6.01 | 41.0 | 0.098 | 0.96 | -0.092 | 1.64 |

AUTOMOTIVE TESTING LABORATORIES, INC.
19900 E. COLFAX, AURORA, COLO. 80011

PERCENT REDUCTIONS AFTER INSPECTION AND MAINTENANCE

1975 FEDERAL TEST PROCEDURE

INSPECTION AND MAINTENANCE VEHICLES

| | # OF VEH. | PERCENT REDUCTIONS HC | CO | NOX | MPG |
|---|---|---|---|---|---|
| *VEHICLE MAKE | | | | | |
| AMER. MOTORS | 4 | 13.09 | 10.17 | -0.82 | -2.63 |
| BUICK | 4 | -0.71 | 4.92 | 1.10 | -0.14 |
| CADILLAC | 4 | 1.82 | 5.04 | 0.57 | -1.53 |
| CHEVROLET | 17 | 6.68 | 4.01 | 8.86 | -0.76 |
| CHRYSLER | 5 | 56.24 | 40.52 | -26.86 | -13.91 |
| DATSUN | 1 | 0.24 | -10.42 | 19.51 | 1.16 |
| DODGE | 5 | -2.54 | 13.37 | 10.18 | -3.49 |
| FORD | 18 | 11.58 | 8.81 | -1.16 | -1.89 |
| MERCURY | 2 | 0.00 | 0.00 | 0.00 | 0.00 |
| OLDSMOBILE | 4 | 3.71 | 8.80 | -2.06 | -1.19 |
| OPEL | 2 | 21.73 | 20.96 | -12.39 | -2.60 |
| PLYMOUTH | 5 | 5.40 | 11.18 | -9.33 | -1.84 |
| PONTIAC | 5 | 32.72 | -14.37 | 6.61 | 0.70 |
| TOYOTA | 4 | 26.08 | 15.07 | 7.50 | -7.11 |
| VOLKSWAGON | 7 | 13.43 | 4.93 | 10.98 | -2.74 |
| VOLVO | 0 | | | | |
| *MODEL YEAR | | | | | |
| 1964 | 9 | 7.06 | 14.75 | -5.73 | -3.05 |
| 1965 | 15 | 17.39 | 1.06 | 2.83 | 0.25 |
| 1966 | 11 | 12.75 | 10.12 | 15.73 | -5.69 |
| 1967 | 14 | -5.43 | -4.86 | 4.96 | 2.08 |
| 1968 | 5 | 21.98 | 23.41 | -8.20 | -5.23 |
| 1969 | 2 | 19.70 | 7.21 | 12.73 | -2.73 |
| 1970 | 11 | 16.34 | 12.41 | 4.04 | -2.52 |
| 1971 | 7 | 17.08 | 11.60 | 1.96 | -4.95 |
| 1972 | 7 | 52.33 | 43.91 | -17.09 | -7.19 |
| 1973 | 6 | 0.91 | 4.45 | 0.19 | 0.88 |
| *DISPLACEMENT | | | | | |
| LESS THAN 151 | 17 | 15.99 | 9.20 | 7.53 | -3.38 |
| 151 - 250 | 18 | -0.48 | 0.07 | 2.55 | -0.05 |
| 251 - 350 | 28 | 10.79 | 10.27 | 4.38 | -3.21 |
| MORE THAN 350 | 24 | 24.38 | 13.10 | -4.32 | -2.51 |
| *INERTIA WEIGHT | | | | | |
| 1800 - 2799 | 21 | 14.75 | 7.43 | 7.63 | -2.37 |
| 2800 - 3799 | 31 | 5.11 | 6.78 | 3.05 | -1.93 |
| 3800 - 4799 | 27 | 25.04 | 14.92 | -3.72 | -3.70 |
| 4800 - 5799 | 8 | -0.68 | 2.24 | 0.97 | 0.46 |
| *POPULATIONS | | | | | |
| 1964 - 1967 | 49 | 8.72 | 4.01 | 4.82 | -1.25 |
| 1968 - 1973 | 38 | 25.62 | 19.81 | -1.66 | -3.62 |
| ALL VEHICLES | 87 | 14.53 | 9.55 | 1.61 | -2.35 |

AUTOMOTIVE TESTING LABORATORIES, INC.
19900 E. COLFAX, AURORA, COLO. 80011

PERCENT REDUCTIONS AFTER SIX MONTHS

1975 FEDERAL TEST PROCEDURE

INSPECTION AND MAINTENANCE VEHICLES

| | # OF VEH. | PERCENT REDUCTIONS HC | CO | NOX | MPG |
|---|---|---|---|---|---|
| *VEHICLE MAKE | | | | | |
| AMER. MOTORS | 4 | 8.90 | 16.51 | -19.70 | -1.81 |
| BUICK | 4 | 20.18 | -12.21 | 13.75 | 1.61 |
| CADILLAC | 4 | 26.58 | 20.15 | 8.77 | -8.55 |
| CHEVROLET | 17 | -0.47 | 1.92 | -3.15 | 2.61 |
| CHRYSLER | 5 | 54.89 | 38.89 | -38.06 | -6.58 |
| DATSUN | 1 | 14.19 | -7.05 | 5.15 | 4.20 |
| DODGE | 5 | -101.78 | -2.28 | 18.09 | 2.62 |
| FORD | 18 | -7.55 | -5.37 | 8.36 | 0.52 |
| MERCURY | 2 | -14.50 | -37.95 | 28.77 | 1.27 |
| OLDSMOBILE | 4 | 13.78 | 12.31 | -1.24 | -5.37 |
| OPEL | 2 | -11.06 | 7.05 | 2.13 | 4.09 |
| PLYMOUTH | 5 | 18.50 | 15.38 | -24.89 | 0.76 |
| PONTIAC | 5 | 24.36 | -19.46 | 21.76 | 4.32 |
| TOYOTA | 4 | 16.74 | -7.50 | 32.18 | -9.18 |
| VOLKSWAGON | 7 | 28.52 | 26.13 | 0.33 | -4.22 |
| VOLVO | 0 | | | | |
| *MODEL YEAR | | | | | |
| 1964 | 9 | 2.65 | 9.96 | -11.81 | -3.97 |
| 1965 | 15 | 21.77 | -8.66 | 8.87 | 3.48 |
| 1966 | 11 | -3.51 | 4.31 | 14.46 | -1.13 |
| 1967 | 14 | 2.62 | -2.39 | 11.93 | 2.53 |
| 1968 | 5 | 42.46 | 32.68 | -11.46 | -11.28 |
| 1969 | 2 | 7.50 | -2.63 | 37.79 | -3.55 |
| 1970 | 11 | 13.96 | 8.04 | 4.91 | -1.64 |
| 1971 | 7 | -11.85 | 5.48 | -10.59 | -1.71 |
| 1972 | 7 | 38.55 | 37.67 | -4.81 | -4.09 |
| 1973 | 6 | -114.95 | -3.65 | 7.93 | 5.55 |
| *DISPLACEMENT | | | | | |
| LESS THAN 151 | 17 | 18.05 | 9.35 | 12.69 | -1.49 |
| 151 - 250 | 18 | -24.54 | -6.06 | -6.46 | 2.34 |
| 251 - 350 | 28 | 7.27 | 8.98 | 6.40 | -1.41 |
| MORE THAN 350 | 24 | 20.20 | 4.85 | 3.85 | -1.77 |
| *INERTIA WEIGHT | | | | | |
| 1800 - 2700 | 21 | 12.92 | 4.77 | 14.36 | -0.81 |
| 2800 - 3700 | 31 | -6.76 | 2.49 | 0.11 | 0.94 |
| 3800 - 4700 | 27 | 17.10 | 7.94 | -0.91 | -2.62 |
| 4800 - 5700 | 8 | 13.83 | 5.75 | 6.27 | -0.58 |
| *POPULATIONS | | | | | |
| 1964 - 1967 | 49 | 8.09 | -0.60 | 7.20 | 0.78 |
| 1968 - 1973 | 38 | 8.64 | 16.44 | 0.17 | -2.20 |
| ALL VEHICLES | 87 | 8.28 | 5.37 | 3.72 | -0.60 |

AUTOMOTIVE TESTING LABORATORIES, INC.
19900 E. COLFAX, AURORA, COLO. 80011

EXHAUST EMISSIONS BEFORE INSPECTION AND MAINTENANCE

1975 FEDERAL TEST PROCEDURE

MANDATORY MAINTENANCE VEHICLES

| | # OF VEH. | HC MEAN | HC S.D. | CO MEAN | CO S.D. | NOX MEAN | NOX S.D. | MPG MEAN | MPG S.D. |
|---|---|---|---|---|---|---|---|---|---|
| *VEHICLE MAKE | | | | | | | | | |
| AMER. MOTORS | 2 | 8.62 | 1.81 | 115.4 | 24.0 | 2.74 | 2.07 | 12.38 | 1.25 |
| BUICK | 2 | 7.55 | 2.34 | 168.0 | 45.5 | 1.89 | 0.86 | 10.19 | 1.44 |
| CADILLAC | 0 | | | | | | | | |
| CHEVROLET | 23 | 7.82 | 5.29 | 113.7 | 63.8 | 2.19 | 1.18 | 13.04 | 1.44 |
| CHRYSLER | 0 | | | | | | | | |
| DATSUN | 0 | | | | | | | | |
| DODGE | 3 | 6.71 | 2.91 | 107.8 | 11.8 | 2.78 | 0.74 | 14.85 | 2.12 |
| FORD | 25 | 7.29 | 3.27 | 96.6 | 37.8 | 2.99 | 1.80 | 14.54 | 2.90 |
| MERCURY | 3 | 4.88 | 1.28 | 48.5 | 19.0 | 3.60 | 1.59 | 15.85 | 1.60 |
| OLDSMOBILE | 3 | 8.39 | 6.08 | 135.3 | 62.6 | 1.40 | 0.29 | 11.52 | 1.10 |
| OPEL | 0 | | | | | | | | |
| PLYMOUTH | 8 | 9.66 | 7.88 | 134.8 | 32.6 | 2.27 | 0.92 | 12.84 | 1.47 |
| PONTIAC | 7 | 7.24 | 3.06 | 113.0 | 52.0 | 2.47 | 1.21 | 12.55 | 0.75 |
| TOYOTA | 0 | | | | | | | | |
| VOLKSWAGON | 2 | 4.81 | 1.36 | 66.6 | 1.6 | 2.11 | 0.04 | 21.56 | 1.38 |
| VOLVO | 0 | | | | | | | | |
| *MODEL YEAR | | | | | | | | | |
| 1964 | 5 | 12.04 | 2.90 | 168.6 | 31.1 | 1.40 | 0.30 | 12.94 | 0.88 |
| 1965 | 5 | 13.46 | 7.80 | 179.0 | 78.6 | 1.93 | 1.83 | 12.47 | 1.96 |
| 1966 | 7 | 8.29 | 1.41 | 128.1 | 28.6 | 2.66 | 0.84 | 13.04 | 1.44 |
| 1967 | 6 | 11.31 | 4.42 | 141.2 | 56.4 | 1.77 | 1.53 | 15.19 | 3.69 |
| 1968 | 10 | 7.11 | 1.37 | 105.8 | 50.5 | 3.35 | 2.05 | 14.13 | 1.86 |
| 1969 | 8 | 5.72 | 1.69 | 86.7 | 29.5 | 2.93 | 1.14 | 14.47 | 1.67 |
| 1970 | 6 | 9.90 | 9.40 | 87.1 | 38.5 | 3.25 | 1.62 | 14.27 | 3.53 |
| 1971 | 10 | 5.90 | 1.39 | 84.7 | 38.2 | 3.15 | 1.23 | 14.68 | 4.60 |
| 1972 | 11 | 5.61 | 1.95 | 101.0 | 34.5 | 2.35 | 1.10 | 13.31 | 2.03 |
| 1973 | 10 | 4.12 | 1.23 | 76.2 | 26.2 | 1.77 | 0.57 | 12.35 | 0.84 |
| *DISPLACEMENT | | | | | | | | | |
| LESS THAN 151 | 2 | 4.81 | 1.36 | 66.6 | 1.6 | 2.11 | 0.04 | 21.56 | 1.38 |
| 151 - 250 | 9 | 4.59 | 1.66 | 75.4 | 28.5 | 2.71 | 1.08 | 16.82 | 3.59 |
| 251 - 350 | 43 | 9.32 | 5.27 | 125.6 | 53.5 | 2.24 | 1.34 | 13.48 | 1.46 |
| MORE THAN 350 | 24 | 5.85 | 1.64 | 94.2 | 38.9 | 3.03 | 1.56 | 12.28 | 1.60 |
| *INERTIA WEIGHT | | | | | | | | | |
| 1800 - 2799 | 5 | 4.39 | 1.27 | 62.7 | 22.0 | 2.83 | 1.11 | 20.84 | 2.96 |
| 2800 - 3799 | 41 | 6.98 | 2.90 | 101.7 | 42.6 | 2.41 | 1.32 | 14.03 | 1.56 |
| 3800 - 4799 | 32 | 8.87 | 5.92 | 124.8 | 56.0 | 2.64 | 1.56 | 12.17 | 1.26 |
| 4800 - 5799 | 0 | | | | | | | | |
| *POPULATIONS | | | | | | | | | |
| 1964 - 1967 | 23 | 11.02 | 4.64 | 151.4 | 51.8 | 1.99 | 1.26 | 13.45 | 2.38 |
| 1968 - 1973 | 55 | 6.16 | 3.58 | 90.8 | 37.0 | 2.76 | 1.41 | 13.81 | 2.68 |
| ALL VEHICLES | 78 | 7.59 | 4.49 | 108.7 | 50.0 | 2.53 | 1.40 | 13.70 | 2.59 |

AUTOMOTIVE TESTING LABORATORIES, INC.
19900 E. COLFAX, AURORA, COLO. 80011

EXHAUST EMISSIONS AFTER INSPECTION AND MAINTENANCE

1975 FEDERAL TEST PROCEDURE

MANDATORY MAINTENANCE VEHICLES

| | # OF VEH. | HC MEAN | HC S.D. | CO MEAN | CO S.D. | NOX MEAN | NOX S.D. | MPG MEAN | MPG S.D. |
|---|---|---|---|---|---|---|---|---|---|
| *VEHICLE MAKE | | | | | | | | | |
| AMER. MOTORS | 2 | 6.98 | 2.97 | 51.6 | 6.2 | 3.87 | 0.75 | 13.15 | 0.33 |
| BUICK | 2 | 5.66 | 0.45 | 124.9 | 17.6 | 2.21 | 0.70 | 10.50 | 1.66 |
| CADILLAC | 0 | | | | | | | | |
| CHEVROLET | 23 | 6.60 | 3.29 | 108.5 | 58.4 | 2.01 | 1.18 | 13.24 | 1.38 |
| CHRYSLER | 0 | | | | | | | | |
| DATSUN | 0 | | | | | | | | |
| DODGE | 3 | 9.80 | 5.73 | 143.9 | 59.4 | 2.01 | 1.31 | 14.60 | 3.08 |
| FORD | 25 | 7.01 | 2.95 | 94.5 | 36.7 | 2.51 | 1.43 | 14.52 | 2.86 |
| MERCURY | 3 | 4.63 | 0.66 | 64.1 | 38.6 | 3.83 | 2.72 | 14.25 | 2.00 |
| OLDSMOBILE | 3 | 6.70 | 3.19 | 133.5 | 65.4 | 1.40 | 0.67 | 12.08 | 0.72 |
| OPEL | 0 | | | | | | | | |
| PLYMOUTH | 8 | 6.43 | 2.62 | 111.7 | 21.1 | 2.26 | 0.77 | 13.18 | 2.10 |
| PONTIAC | 7 | 6.11 | 2.14 | 96.7 | 50.7 | 2.64 | 1.20 | 13.05 | 0.77 |
| TOYOTA | 0 | | | | | | | | |
| VOLKSWAGON | 2 | 5.36 | 1.34 | 73.7 | 6.7 | 1.75 | 0.28 | 21.73 | 0.31 |
| VOLVO | 0 | | | | | | | | |
| *MODEL YEAR | | | | | | | | | |
| 1964 | 5 | 10.23 | 2.24 | 174.0 | 33.6 | 0.92 | 0.24 | 12.96 | 1.12 |
| 1965 | 5 | 9.99 | 2.56 | 157.8 | 37.7 | 1.63 | 0.96 | 13.05 | 1.24 |
| 1966 | 7 | 8.11 | 1.10 | 118.7 | 33.0 | 2.70 | 0.88 | 13.54 | 1.51 |
| 1967 | 6 | 9.88 | 3.71 | 134.2 | 49.6 | 1.60 | 1.35 | 15.63 | 3.59 |
| 1968 | 10 | 6.44 | 3.33 | 94.4 | 39.8 | 2.67 | 1.59 | 13.68 | 1.36 |
| 1969 | 8 | 6.79 | 3.19 | 95.2 | 55.7 | 3.02 | 1.93 | 14.63 | 1.78 |
| 1970 | 6 | 5.22 | 1.44 | 82.1 | 33.5 | 2.49 | 0.96 | 14.69 | 3.76 |
| 1971 | 10 | 5.23 | 0.96 | 72.9 | 28.3 | 3.09 | 1.20 | 14.60 | 4.27 |
| 1972 | 11 | 5.32 | 2.15 | 86.1 | 35.4 | 2.49 | 1.01 | 13.38 | 2.27 |
| 1973 | 10 | 4.29 | 1.05 | 78.4 | 30.0 | 1.74 | 0.84 | 12.40 | 1.10 |
| *DISPLACEMENT | | | | | | | | | |
| LESS THAN 151 | 2 | 5.36 | 1.34 | 73.7 | 6.7 | 1.75 | 0.28 | 21.73 | 0.31 |
| 151 - 250 | 9 | 4.10 | 0.92 | 63.7 | 28.4 | 2.82 | 1.08 | 17.60 | 2.80 |
| 251 - 350 | 43 | 7.79 | 3.25 | 121.9 | 45.1 | 1.83 | 0.98 | 13.37 | 1.37 |
| MORE THAN 350 | 24 | 5.77 | 1.91 | 83.0 | 39.5 | 3.13 | 1.51 | 12.54 | 1.43 |
| *INERTIA WEIGHT | | | | | | | | | |
| 1800 - 2799 | 5 | 4.45 | 1.18 | 58.5 | 16.9 | 2.87 | 1.29 | 21.08 | 1.99 |
| 2800 - 3799 | 41 | 6.58 | 2.87 | 99.5 | 42.9 | 2.18 | 1.28 | 13.99 | 1.67 |
| 3800 - 4799 | 32 | 7.15 | 3.14 | 111.9 | 51.0 | 2.47 | 1.35 | 12.46 | 1.13 |
| 4800 - 5799 | 0 | | | | | | | | |
| *POPULATIONS | | | | | | | | | |
| 1964 - 1967 | 23 | 9.44 | 2.53 | 143.3 | 42.4 | 1.80 | 1.12 | 13.85 | 2.30 |
| 1968 - 1973 | 55 | 5.52 | 2.30 | 84.7 | 36.8 | 2.57 | 1.32 | 13.80 | 2.63 |
| ALL VEHICLES | 78 | 6.68 | 2.96 | 102.0 | 46.8 | 2.34 | 1.31 | 13.82 | 2.52 |

AUTOMOTIVE TESTING LABORATORIES, INC.
19900 E. COLFAX, AURORA, COLO. 80011

EXHAUST EMISSIONS AFTER SIX MONTHS

1975 FEDERAL TEST PROCEDURE

MANDATORY MAINTENANCE VEHICLES

| | # OF VEH. | HC MEAN | HC S.D. | CO MEAN | CO S.D. | NOX MEAN | NOX S.D. | MPG MEAN | MPG S.D. |
|---|---|---|---|---|---|---|---|---|---|
| *VEHICLE MAKE | | | | | | | | | |
| AMER. MOTORS | 2 | 5.05 | 0.83 | 69.5 | 16.1 | 3.31 | 2.15 | 14.03 | 1.67 |
| BUICK | 2 | 5.32 | 1.06 | 112.1 | 59.9 | 2.53 | 1.28 | 11.81 | 1.55 |
| CADILLAC | 0 | | | | | | | | |
| CHEVROLET | 23 | 9.32 | 10.45 | 116.8 | 66.7 | 1.86 | 1.10 | 13.29 | 2.20 |
| CHRYSLER | 0 | | | | | | | | |
| DATSUN | 0 | | | | | | | | |
| DODGE | 3 | 8.90 | 5.49 | 154.8 | 91.8 | 2.56 | 1.84 | 13.92 | 3.60 |
| FORD | 25 | 8.67 | 5.94 | 93.6 | 49.0 | 2.68 | 1.70 | 14.83 | 3.02 |
| MERCURY | 3 | 4.46 | 0.34 | 49.9 | 15.9 | 3.28 | 1.56 | 14.47 | 1.25 |
| OLDSMOBILE | 3 | 16.02 | 18.33 | 130.9 | 62.7 | 1.23 | 0.57 | 11.88 | 0.68 |
| OPEL | 0 | | | | | | | | |
| PLYMOUTH | 8 | 14.95 | 15.72 | 135.0 | 43.0 | 2.10 | 1.15 | 12.27 | 1.67 |
| PONTIAC | 7 | 7.35 | 3.00 | 108.8 | 55.2 | 2.80 | 1.59 | 12.71 | 0.79 |
| TOYOTA | 0 | | | | | | | | |
| VOLKSWAGON | 2 | 5.02 | 1.28 | 69.2 | 6.7 | 2.20 | 0.53 | 20.73 | 0.56 |
| VOLVO | 0 | | | | | | | | |
| *MODEL YEAR | | | | | | | | | |
| 1964 | 5 | 13.14 | 3.96 | 185.1 | 32.4 | 0.81 | 0.37 | 12.44 | 0.57 |
| 1965 | 5 | 11.96 | 3.93 | 168.5 | 55.3 | 1.33 | 0.81 | 12.76 | 1.58 |
| 1966 | 7 | 18.23 | 15.48 | 146.9 | 38.2 | 2.31 | 1.18 | 12.22 | 1.97 |
| 1967 | 6 | 18.78 | 16.98 | 135.6 | 66.9 | 1.61 | 1.52 | 15.29 | 4.66 |
| 1968 | 10 | 6.06 | 1.37 | 91.3 | 44.8 | 2.94 | 1.49 | 14.00 | 0.58 |
| 1969 | 8 | 9.79 | 11.31 | 93.0 | 70.6 | 2.94 | 1.45 | 14.45 | 2.61 |
| 1970 | 6 | 6.77 | 3.62 | 99.0 | 49.5 | 2.36 | 0.86 | 14.73 | 3.67 |
| 1971 | 10 | 7.89 | 7.51 | 76.1 | 38.6 | 3.11 | 1.13 | 15.12 | 3.56 |
| 1972 | 11 | 5.02 | 1.89 | 88.7 | 53.2 | 2.75 | 1.99 | 13.89 | 2.46 |
| 1973 | 10 | 4.15 | 0.92 | 78.0 | 27.4 | 1.86 | 0.97 | 12.63 | 1.34 |
| *DISPLACEMENT | | | | | | | | | |
| LESS THAN 151 | 2 | 5.02 | 1.28 | 69.2 | 6.7 | 2.20 | 0.53 | 20.73 | 0.56 |
| 151 - 250 | 9 | 3.97 | 1.30 | 61.0 | 34.4 | 3.21 | 1.87 | 18.12 | 2.37 |
| 251 - 350 | 43 | 11.73 | 10.49 | 128.8 | 57.7 | 1.83 | 1.11 | 13.14 | 1.70 |
| MORE THAN 350 | 24 | 7.13 | 6.84 | 89.6 | 48.5 | 2.97 | 1.47 | 12.84 | 1.74 |
| *INERTIA WEIGHT | | | | | | | | | |
| 1800 - 2799 | 5 | 4.26 | 1.14 | 54.0 | 29.0 | 3.68 | 2.30 | 21.09 | 1.57 |
| 2800 - 3799 | 41 | 7.58 | 5.03 | 101.9 | 54.6 | 2.12 | 1.16 | 14.22 | 1.90 |
| 3800 - 4799 | 32 | 12.16 | 12.50 | 122.8 | 58.9 | 2.45 | 1.52 | 12.15 | 1.22 |
| 4800 - 5799 | 0 | | | | | | | | |
| *POPULATIONS | | | | | | | | | |
| 1964 - 1967 | 23 | 15.90 | 12.07 | 157.0 | 50.3 | 1.59 | 1.17 | 13.19 | 2.56 |
| 1968 - 1973 | 55 | 6.46 | 5.64 | 86.7 | 46.6 | 2.67 | 1.42 | 14.08 | 2.61 |
| ALL VEHICLES | 78 | 9.24 | 9.10 | 107.4 | 57.3 | 2.35 | 1.43 | 13.81 | 2.70 |

AUTOMOTIVE TESTING LABORATORIES, INC.
19900 E. COLFAX, AURORA, COLO. 80011

EXHAUST EMISSION REDUCTIONS AFTER INSPECTION AND MAINTENANCE

1975 FEDERAL TEST PROCEDURE

MANDATORY MAINTENANCE VEHICLES

| | # OF VEH. | HC MEAN | HC S.D. | CO MEAN | CO S.D. | NOX MEAN | NOX S.D. | MPG MEAN | MPG S.D. |
|---|---|---|---|---|---|---|---|---|---|
| *VEHICLE MAKE | | | | | | | | | |
| AMER. MOTORS | 2 | 1.639 | 1.16 | 63.76 | 17.8 | -1.125 | 1.31 | -0.773 | 0.92 |
| BUICK | 2 | 1.864 | 1.89 | 43.12 | 27.8 | -0.316 | 0.16 | -0.308 | 0.22 |
| CADILLAC | 0 | | | | | | | | |
| CHEVROLET | 23 | 1.215 | 3.31 | 5.22 | 29.6 | 0.188 | 0.72 | -0.199 | 1.16 |
| CHRYSLER | 0 | | | | | | | | |
| DATSUN | 0 | | | | | | | | |
| DODGE | 3 | -3.089 | 4.53 | -36.10 | 49.3 | 0.766 | 1.73 | 0.254 | 0.97 |
| FORD | 25 | 0.282 | 1.80 | 2.11 | 24.9 | 0.482 | 1.30 | 0.014 | 1.07 |
| MERCURY | 3 | 0.250 | 1.92 | -15.65 | 20.5 | -0.229 | 1.71 | 1.609 | 1.60 |
| OLDSMOBILE | 3 | 1.697 | 5.83 | 1.80 | 31.3 | 0.008 | 0.60 | -0.564 | 0.41 |
| OPEL | 0 | | | | | | | | |
| PLYMOUTH | 8 | 3.228 | 8.86 | 23.07 | 15.2 | 0.007 | 0.44 | -0.341 | 1.02 |
| PONTIAC | 7 | 1.132 | 1.18 | 16.32 | 17.5 | -0.168 | 0.58 | -0.501 | 1.10 |
| TOYOTA | 0 | | | | | | | | |
| VOLKSWAGON | 2 | -0.557 | 0.02 | -7.07 | 5.1 | 0.357 | 0.31 | -0.175 | 1.07 |
| VOLVO | 0 | | | | | | | | |
| *MODEL YEAR | | | | | | | | | |
| 1964 | 5 | 1.812 | 4.18 | -5.38 | 24.9 | 0.481 | 0.17 | -0.023 | 0.99 |
| 1965 | 5 | 3.472 | 6.78 | 21.14 | 51.2 | 0.295 | 1.15 | -0.582 | 1.24 |
| 1966 | 7 | 0.185 | 1.96 | 9.39 | 23.2 | -0.043 | 0.38 | -0.506 | 0.94 |
| 1967 | 6 | 1.437 | 2.07 | 6.98 | 22.2 | 0.165 | 0.36 | -0.445 | 0.65 |
| 1968 | 10 | 0.673 | 3.50 | 11.42 | 38.2 | 0.685 | 1.28 | 0.447 | 1.45 |
| 1969 | 8 | -1.064 | 2.35 | -8.51 | 38.9 | -0.090 | 1.41 | -0.154 | 1.33 |
| 1970 | 6 | 4.763 | 9.53 | 5.04 | 26.0 | 0.759 | 2.06 | -0.425 | 1.51 |
| 1971 | 10 | 0.667 | 1.07 | 11.74 | 18.8 | 0.058 | 0.56 | 0.087 | 0.71 |
| 1972 | 11 | 0.287 | 1.29 | 14.84 | 32.5 | -0.131 | 1.00 | -0.076 | 1.27 |
| 1973 | 10 | -0.168 | 0.72 | -2.22 | 11.1 | 0.033 | 0.43 | -0.055 | 0.80 |
| *DISPLACEMENT | | | | | | | | | |
| LESS THAN 151 | 2 | -0.557 | 0.02 | -7.07 | 5.1 | 0.357 | 0.31 | -0.175 | 1.07 |
| 151 - 250 | 9 | 0.491 | 1.55 | 11.68 | 30.7 | -0.112 | 0.60 | -0.775 | 1.32 |
| 251 - 350 | 43 | 1.531 | 4.89 | 3.74 | 30.6 | 0.410 | 0.90 | 0.107 | 1.06 |
| MORE THAN 350 | 24 | 0.088 | 1.50 | 11.24 | 27.9 | -0.108 | 1.26 | -0.264 | 1.04 |
| *INERTIA WEIGHT | | | | | | | | | |
| 1800 - 2700 | 5 | -0.060 | 0.78 | 4.22 | 28.8 | -0.041 | 0.81 | -0.240 | 1.07 |
| 2800 - 3700 | 41 | 0.400 | 2.16 | 2.15 | 28.6 | 0.228 | 1.13 | 0.031 | 1.23 |
| 3800 - 4700 | 32 | 1.724 | 5.35 | 12.88 | 30.1 | 0.174 | 0.89 | -0.286 | 0.92 |
| 4800 - 5700 | 0 | | | | | | | | |
| *POPULATIONS | | | | | | | | | |
| 1964 - 1967 | 23 | 1.580 | 3.87 | 8.11 | 30.5 | 0.198 | 0.60 | -0.402 | 0.91 |
| 1968 - 1973 | 55 | 0.635 | 3.77 | 6.09 | 29.1 | 0.185 | 1.15 | 0.003 | 1.16 |
| ALL VEHICLES | 78 | 0.914 | 3.80 | 6.68 | 29.4 | 0.189 | 1.01 | -0.116 | 1.10 |

AUTOMOTIVE TESTING LABORATORIES, INC.
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EXHAUST EMISSION REDUCTIONS AFTER SIX MONTHS

1975 FEDERAL TEST PROCEDURE

MANDATORY MAINTENANCE VEHICLES

| | # OF VEH. | HC MEAN | HC S.D. | CO MEAN | CO S.D. | NOX MEAN | NOX S.D. | MPG MEAN | MPG S.D. |
|---|---|---|---|---|---|---|---|---|---|
| *VEHICLE MAKE | | | | | | | | | |
| AMER. MOTORS | 2 | 3.575 | 2.64 | 45.87 | 8.0 | -0.567 | 0.08 | -1.657 | 0.42 |
| BUICK | 2 | 2.224 | 1.27 | 55.91 | 14.4 | -0.636 | 0.41 | -1.625 | 0.11 |
| CADILLAC | 0 | | | | | | | | |
| CHEVROLET | 23 | -1.500 | 8.54 | -3.13 | 27.9 | 0.330 | 0.63 | -0.253 | 1.50 |
| CHRYSLER | 0 | | | | | | | | |
| DATSUN | 0 | | | | | | | | |
| DODGE | 3 | -2.184 | 2.67 | -47.00 | 85.0 | 0.222 | 2.19 | 0.931 | 1.98 |
| FORD | 25 | -1.375 | 4.53 | 3.05 | 38.1 | 0.308 | 1.55 | -0.294 | 1.42 |
| MERCURY | 3 | 0.418 | 1.02 | -1.37 | 4.2 | 0.319 | 0.80 | 1.389 | 1.52 |
| OLDSMOBILE | 3 | -7.624 | 21.09 | 4.38 | 33.7 | 0.178 | 0.66 | -0.361 | 1.04 |
| OPEL | 0 | | | | | | | | |
| PLYMOUTH | 8 | -5.293 | 18.83 | -0.18 | 28.5 | 0.171 | 1.06 | 0.568 | 1.24 |
| PONTIAC | 7 | -0.102 | 0.78 | 4.23 | 20.4 | -0.333 | 0.55 | -0.160 | 0.95 |
| TOYOTA | 0 | | | | | | | | |
| VOLKSWAGON | 2 | -0.211 | 0.08 | -2.61 | 5.0 | -0.091 | 0.57 | 0.825 | 0.83 |
| VOLVO | 0 | | | | | | | | |
| *MODEL YEAR | | | | | | | | | |
| 1964 | 5 | -1.102 | 5.95 | -16.56 | 31.8 | 0.585 | 0.22 | 0.494 | 1.17 |
| 1965 | 5 | 1.497 | 3.96 | 10.47 | 31.5 | 0.601 | 1.22 | -0.295 | 0.90 |
| 1966 | 7 | -9.937 | 16.23 | -18.73 | 17.3 | 0.345 | 0.87 | 0.817 | 1.28 |
| 1967 | 6 | -7.467 | 15.44 | 5.54 | 45.9 | 0.161 | 0.50 | -0.100 | 1.89 |
| 1968 | 10 | 1.052 | 1.26 | 14.56 | 24.7 | 0.416 | 0.98 | 0.130 | 1.39 |
| 1969 | 8 | -4.064 | 10.73 | -6.30 | 58.2 | -0.009 | 1.33 | 0.024 | 1.80 |
| 1970 | 6 | 3.214 | 10.08 | -11.87 | 40.6 | 0.896 | 1.96 | -0.459 | 1.81 |
| 1971 | 10 | -1.998 | 6.64 | 8.59 | 29.4 | 0.038 | 0.66 | -0.439 | 1.46 |
| 1972 | 11 | 0.585 | 2.09 | 12.31 | 40.5 | -0.394 | 1.57 | -0.586 | 1.30 |
| 1973 | 10 | -0.026 | 0.91 | -1.82 | 17.0 | -0.091 | 0.57 | -0.279 | 1.21 |
| *DISPLACEMENT | | | | | | | | | |
| LESS THAN 151 | 2 | -0.211 | 0.08 | -2.61 | 5.0 | -0.091 | 0.57 | 0.825 | 0.83 |
| 151 - 250 | 9 | 0.623 | 0.81 | 14.43 | 27.9 | -0.505 | 1.66 | -1.294 | 1.73 |
| 251 - 350 | 43 | -2.408 | 10.59 | -3.16 | 35.8 | 0.403 | 0.91 | 0.343 | 1.36 |
| MORE THAN 350 | 24 | -1.273 | 6.73 | 4.58 | 37.3 | 0.055 | 1.14 | -0.564 | 1.05 |
| *INERTIA WEIGHT | | | | | | | | | |
| 1800 - 2799 | 5 | 0.127 | 0.70 | 8.71 | 38.3 | -0.854 | 2.10 | -0.251 | 2.09 |
| 2800 - 3799 | 41 | -0.598 | 3.76 | -0.20 | 37.2 | 0.288 | 1.07 | -0.198 | 1.44 |
| 3800 - 4799 | 32 | -3.282 | 12.85 | 1.98 | 32.7 | 0.198 | 0.90 | 0.020 | 1.32 |
| 4800 - 5799 | 0 | | | | | | | | |
| *POPULATIONS | | | | | | | | | |
| 1964 - 1967 | 23 | -4.886 | 12.56 | -5.58 | 33.1 | 0.405 | 0.76 | 0.266 | 1.37 |
| 1968 - 1973 | 55 | -0.300 | 6.11 | 4.13 | 35.8 | 0.083 | 1.21 | -0.271 | 1.43 |
| ALL VEHICLES | 78 | -1.653 | 8.70 | 1.27 | 35.1 | 0.178 | 1.10 | -0.112 | 1.42 |

AUTOMOTIVE TESTING LABORATORIES, INC.
19000 E. COLFAX, AURORA, COLO. 80011

PERCENT REDUCTIONS AFTER INSPECTION AND MAINTENANCE

1975 FEDERAL TEST PROCEDURE

MANDATORY MAINTENANCE VEHICLES

| | # OF VEH. | PERCENT REDUCTIONS HC | CO | NOX | MPG |
|---|---|---|---|---|---|
| *VEHICLE MAKE | | | | | |
| AMER. MOTORS | 2 | 19.01 | 55.25 | -40.99 | -6.24 |
| BUICK | 2 | 24.96 | 25.66 | -16.72 | -3.02 |
| CADILLAC | 0 | | | | |
| CHEVROLET | 23 | 15.54 | 4.59 | 8.58 | -1.52 |
| CHRYSLER | 0 | | | | |
| DATSUN | 0 | | | | |
| DODGE | 3 | -46.02 | -33.49 | 27.58 | 1.71 |
| FORD | 25 | 3.87 | 2.19 | 16.13 | 0.10 |
| MERCURY | 3 | 5.11 | -32.27 | -6.34 | 10.15 |
| OLDSMOBILE | 3 | 20.22 | 1.33 | 0.55 | -4.89 |
| OPEL | 0 | | | | |
| PLYMOUTH | 8 | 33.43 | 17.11 | 0.33 | -2.65 |
| PONTIAC | 7 | 15.63 | 14.43 | -6.82 | -4.00 |
| TOYOTA | 0 | | | | |
| VOLKSWAGON | 2 | -11.58 | -10.61 | 16.90 | -0.81 |
| VOLVO | 0 | | | | |
| *MODEL YEAR | | | | | |
| 1964 | 5 | 15.05 | -3.19 | 34.40 | -0.18 |
| 1965 | 5 | 25.80 | 11.81 | 15.28 | -4.67 |
| 1966 | 7 | 2.23 | 7.33 | -1.62 | -3.88 |
| 1967 | 6 | 12.70 | 4.95 | 9.31 | -2.93 |
| 1968 | 10 | 9.46 | 10.79 | 20.42 | 3.16 |
| 1969 | 8 | -18.59 | -9.81 | -3.07 | -1.06 |
| 1970 | 6 | 47.70 | 5.79 | 23.33 | -2.98 |
| 1971 | 10 | 11.31 | 13.87 | 1.85 | 0.59 |
| 1972 | 11 | 5.12 | 14.70 | -5.55 | -0.57 |
| 1973 | 10 | -4.09 | -2.91 | 1.89 | -0.45 |
| *DISPLACEMENT | | | | | |
| LESS THAN 151 | 2 | -11.58 | -10.61 | 16.90 | -0.81 |
| 151 - 250 | 9 | 10.70 | 15.49 | -4.12 | -4.60 |
| 251 - 350 | 43 | 16.44 | 2.97 | 18.31 | 0.79 |
| MORE THAN 350 | 24 | 1.50 | 11.93 | -3.58 | -2.15 |
| *INERTIA WEIGHT | | | | | |
| 1800 - 2799 | 5 | -1.36 | 6.73 | -1.45 | -1.15 |
| 2800 - 3799 | 41 | 5.73 | 2.11 | 9.48 | 0.22 |
| 3800 - 4799 | 32 | 19.43 | 10.32 | 6.58 | -2.35 |
| 4800 - 5799 | 0 | | | | |
| *POPULATIONS | | | | | |
| 1964 - 1967 | 23 | 14.34 | 5.35 | 9.95 | -2.99 |
| 1968 - 1973 | 55 | 10.31 | 6.71 | 6.70 | 0.02 |
| ALL VEHICLES | 78 | 12.04 | 6.15 | 7.46 | -0.85 |

AUTOMOTIVE TESTING LABORATORIES, INC.
19900 E. COLFAX, AURORA, COLO. 80011

PERCENT REDUCTIONS AFTER SIX MONTHS

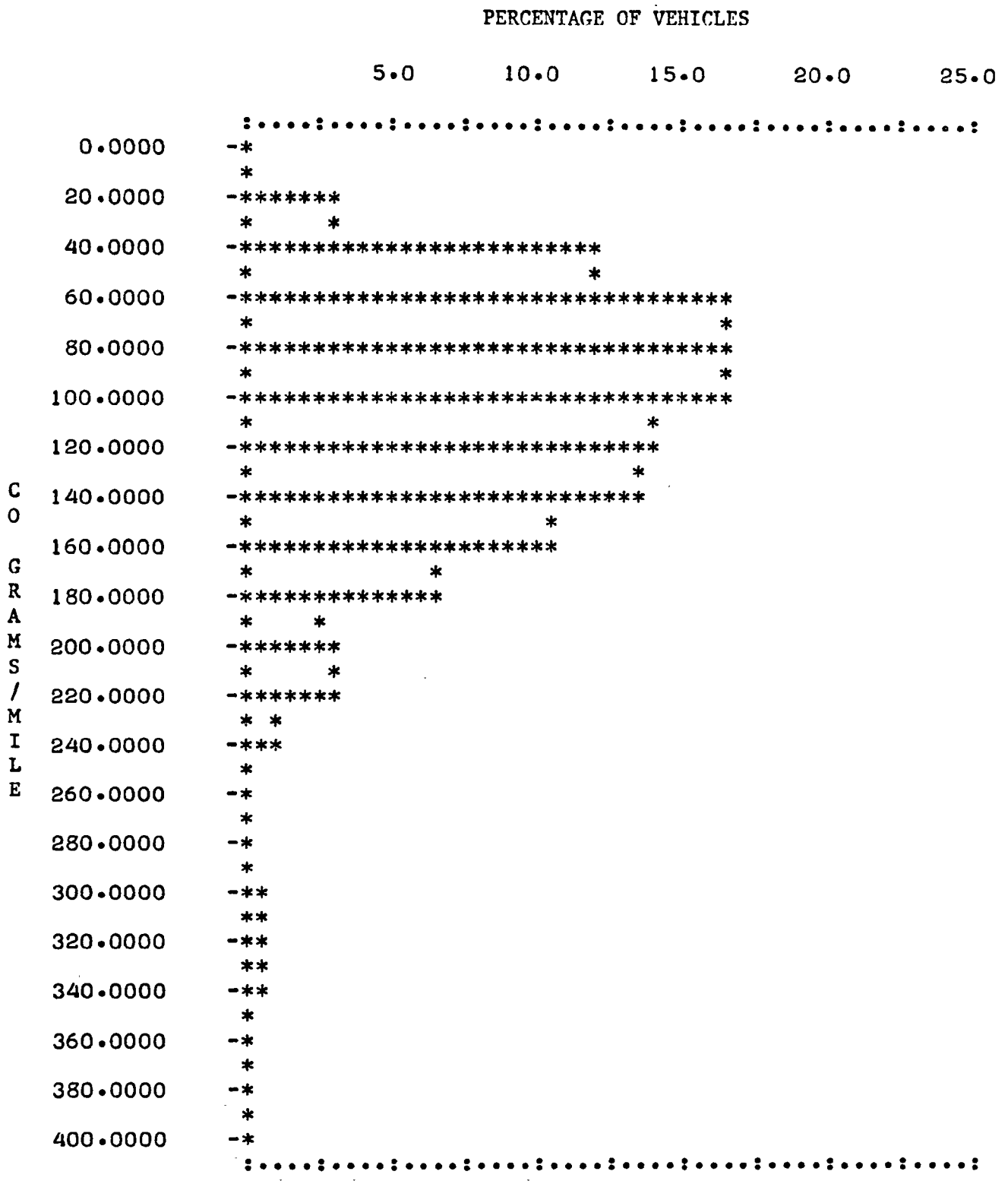
1975 FEDERAL TEST PROCEDURE

MANDATORY MAINTENANCE VEHICLES

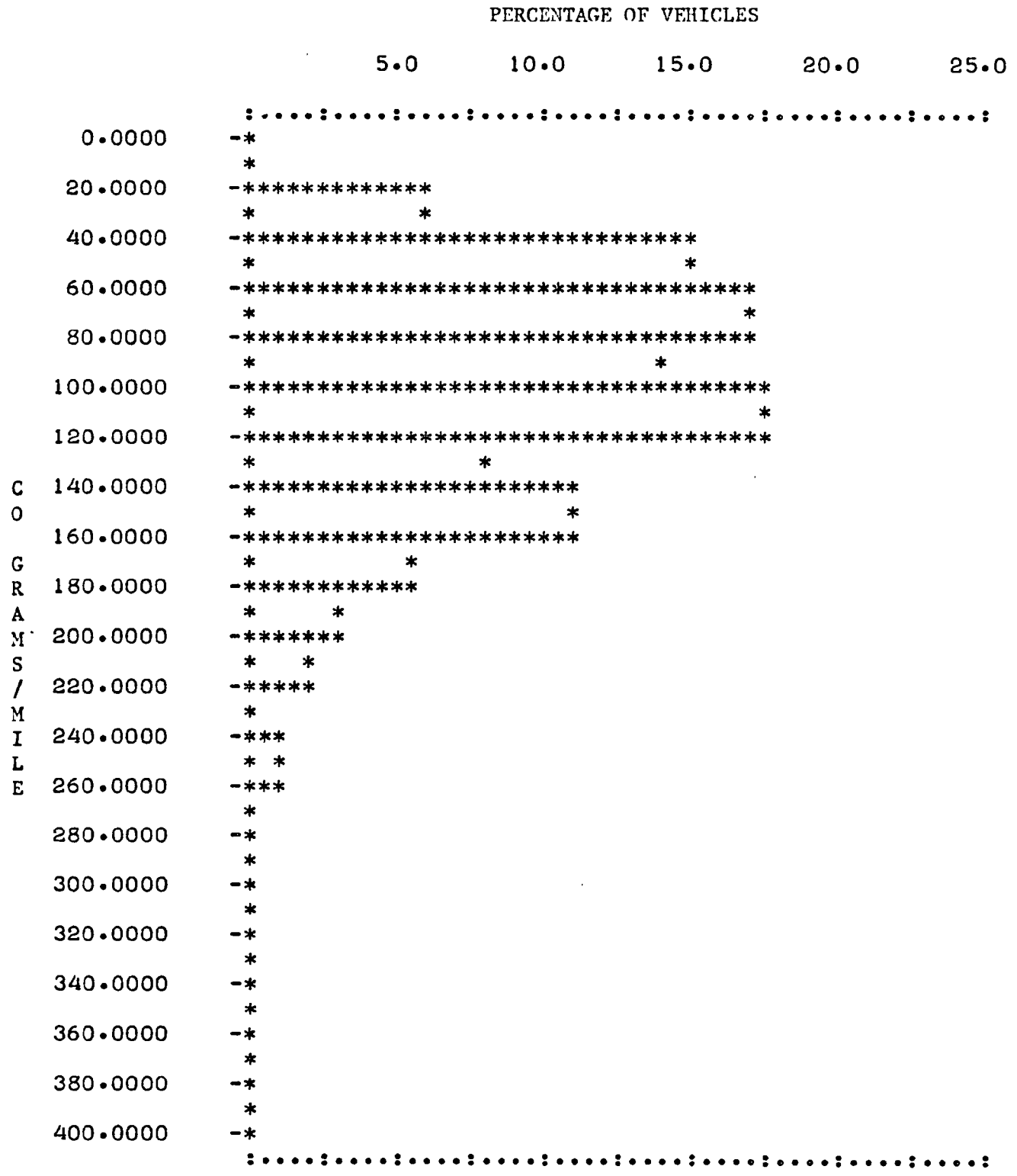
| | # OF VEH. | PERCENT REDUCTIONS HC | CO | NOX | MPG |
|---|---|---|---|---|---|
| *VEHICLE MAKE | | | | | |
| AMER. MOTORS | 2 | 41.47 | 39.75 | -20.66 | -13.39 |
| BUICK | 2 | 29.47 | 33.27 | -33.60 | -15.94 |
| CADILLAC | 0 | | | | |
| CHEVROLET | 23 | -19.18 | -2.76 | 15.05 | -1.94 |
| CHRYSLER | 0 | | | | |
| DATSUN | 0 | | | | |
| DODGE | 3 | -32.54 | -43.60 | 7.98 | 6.27 |
| FORD | 25 | -18.84 | 3.16 | 10.32 | -2.02 |
| MERCURY | 3 | 8.56 | -2.82 | 8.85 | 8.76 |
| OLDSMOBILE | 3 | -90.83 | 3.23 | 12.64 | -3.14 |
| OPEL | 0 | | | | |
| PLYMOUTH | 8 | -54.82 | -0.14 | 7.51 | 4.43 |
| PONTIAC | 7 | -1.41 | 3.74 | -13.49 | -1.27 |
| TOYOTA | 0 | | | | |
| VOLKSWAGON | 2 | -4.39 | -3.91 | -4.30 | 3.83 |
| VOLVO | 0 | | | | |
| *MODEL YEAR | | | | | |
| 1964 | 5 | -9.15 | -9.82 | 41.86 | 3.82 |
| 1965 | 5 | 11.12 | 5.85 | 31.16 | -2.37 |
| 1966 | 7 | -119.87 | -14.62 | 12.97 | 6.27 |
| 1967 | 6 | -66.00 | 3.92 | 9.13 | -0.66 |
| 1968 | 10 | 14.79 | 13.76 | 12.40 | 0.92 |
| 1969 | 8 | -71.03 | -7.27 | -0.32 | 0.17 |
| 1970 | 6 | 32.18 | -13.63 | 27.54 | -3.22 |
| 1971 | 10 | -33.89 | 10.15 | 1.20 | -2.99 |
| 1972 | 11 | 10.42 | 12.19 | -16.73 | -4.40 |
| 1973 | 10 | -0.64 | -2.39 | -5.15 | -2.26 |
| *DISPLACEMENT | | | | | |
| LESS THAN 151 | 2 | -4.39 | -3.91 | -4.30 | 3.83 |
| 151 - 250 | 9 | 13.56 | 19.14 | -18.64 | -7.69 |
| 251 - 350 | 43 | -25.84 | -2.51 | 18.00 | 2.55 |
| MORE THAN 350 | 24 | -21.75 | 4.86 | 1.80 | -4.59 |
| *INERTIA WEIGHT | | | | | |
| 1800 - 2799 | 5 | 2.88 | 13.88 | -30.20 | -1.20 |
| 2800 - 3799 | 41 | -8.57 | -0.20 | 11.98 | -1.41 |
| 3800 - 4799 | 32 | -36.99 | 1.59 | 7.50 | 0.16 |
| 4800 - 5799 | 0 | | | | |
| *POPULATIONS | | | | | |
| 1964 - 1967 | 23 | -44.35 | -3.69 | 20.31 | 1.98 |
| 1968 - 1973 | 55 | -4.88 | 4.55 | 3.03 | -1.96 |
| ALL VEHICLES | 78 | -21.77 | 1.16 | 7.04 | -0.82 |

AUTOMOTIVE TESTING LABORATORIES, INC.
19900 E. COLFAX, AURORA, COLO. 80011

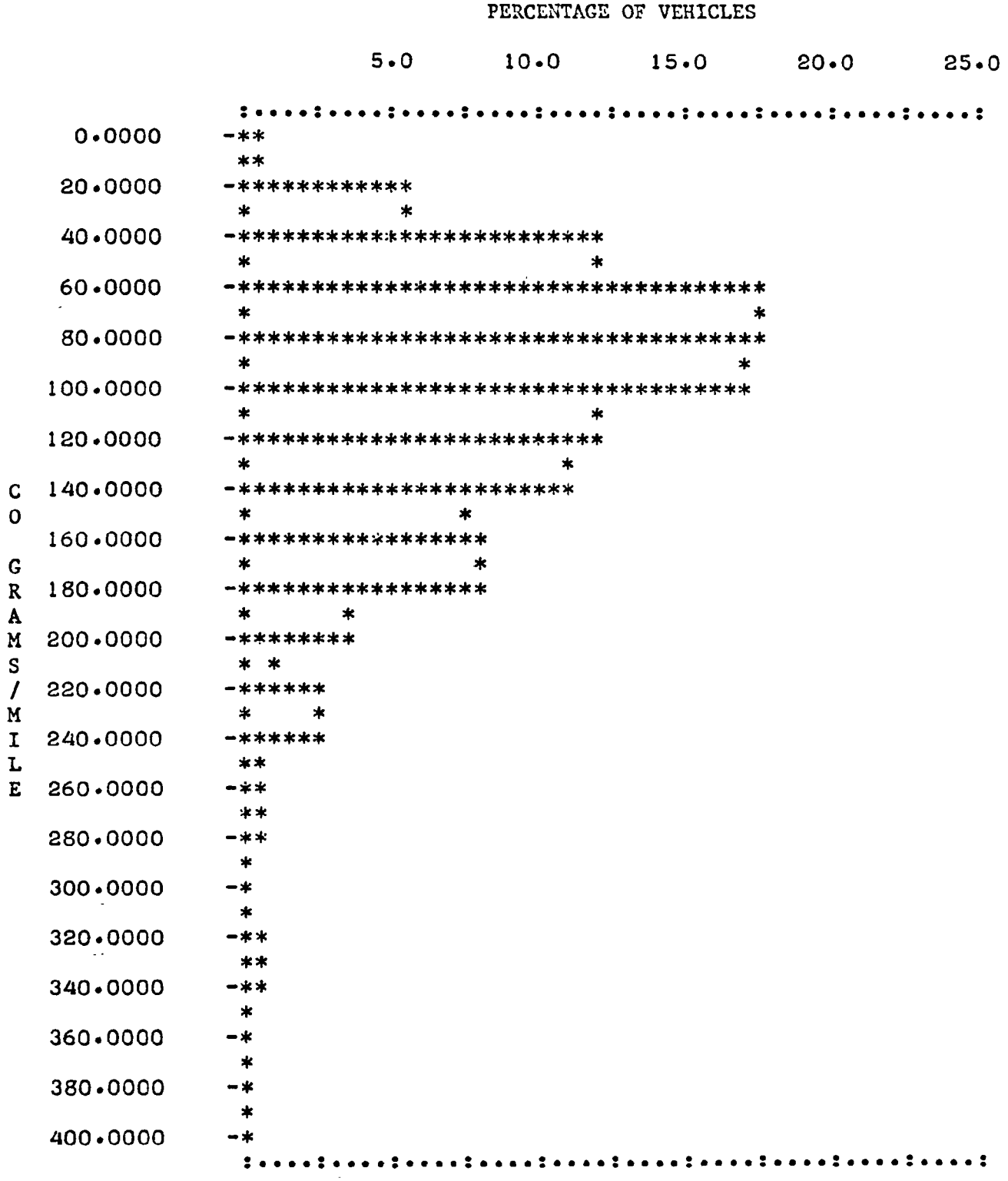
ALL VEHICLES
BEFORE INSPECTION AND MAINTENANCE



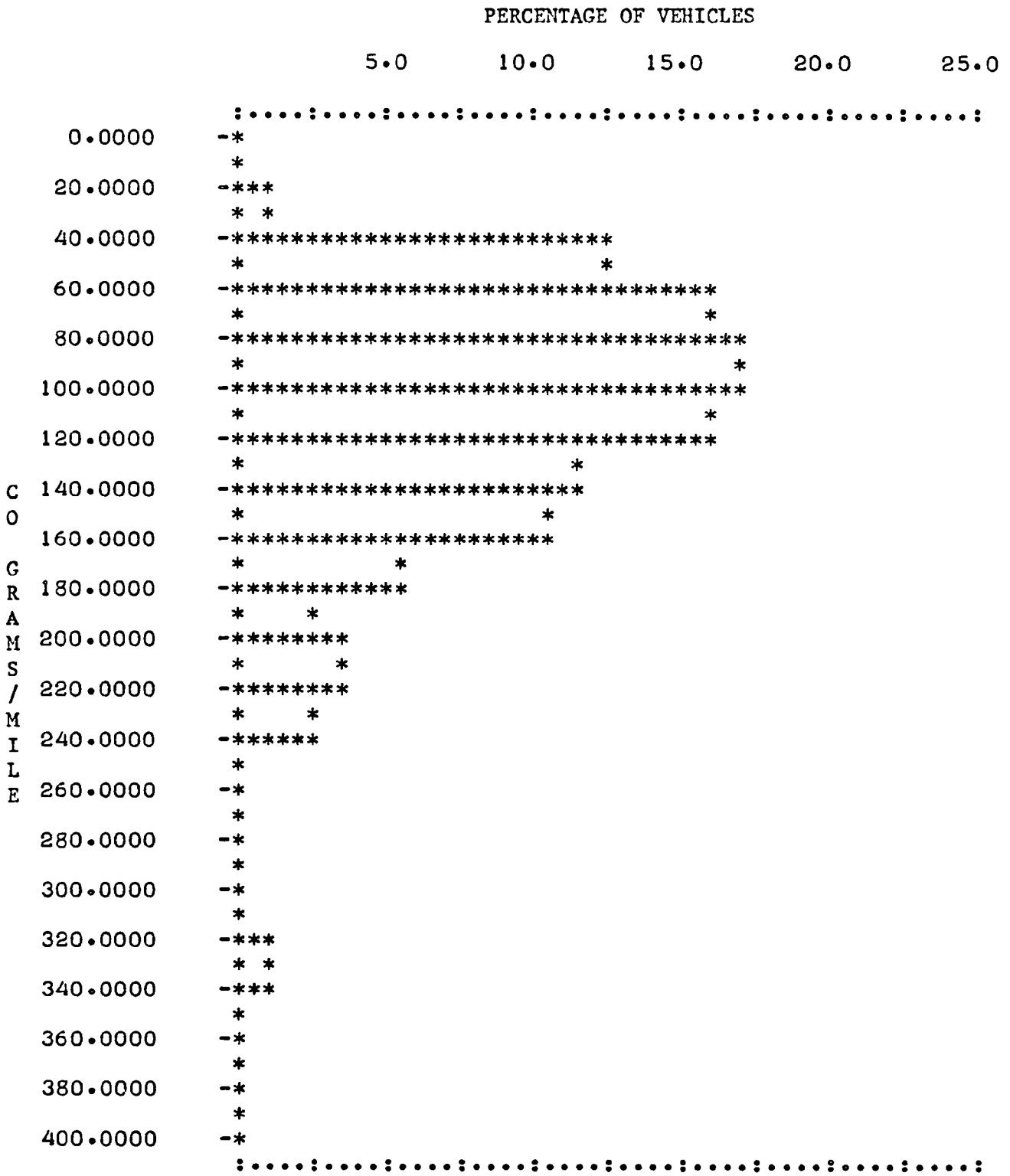
ALL VEHICLES
AFTER INSPECTION AND MAINTENANCE



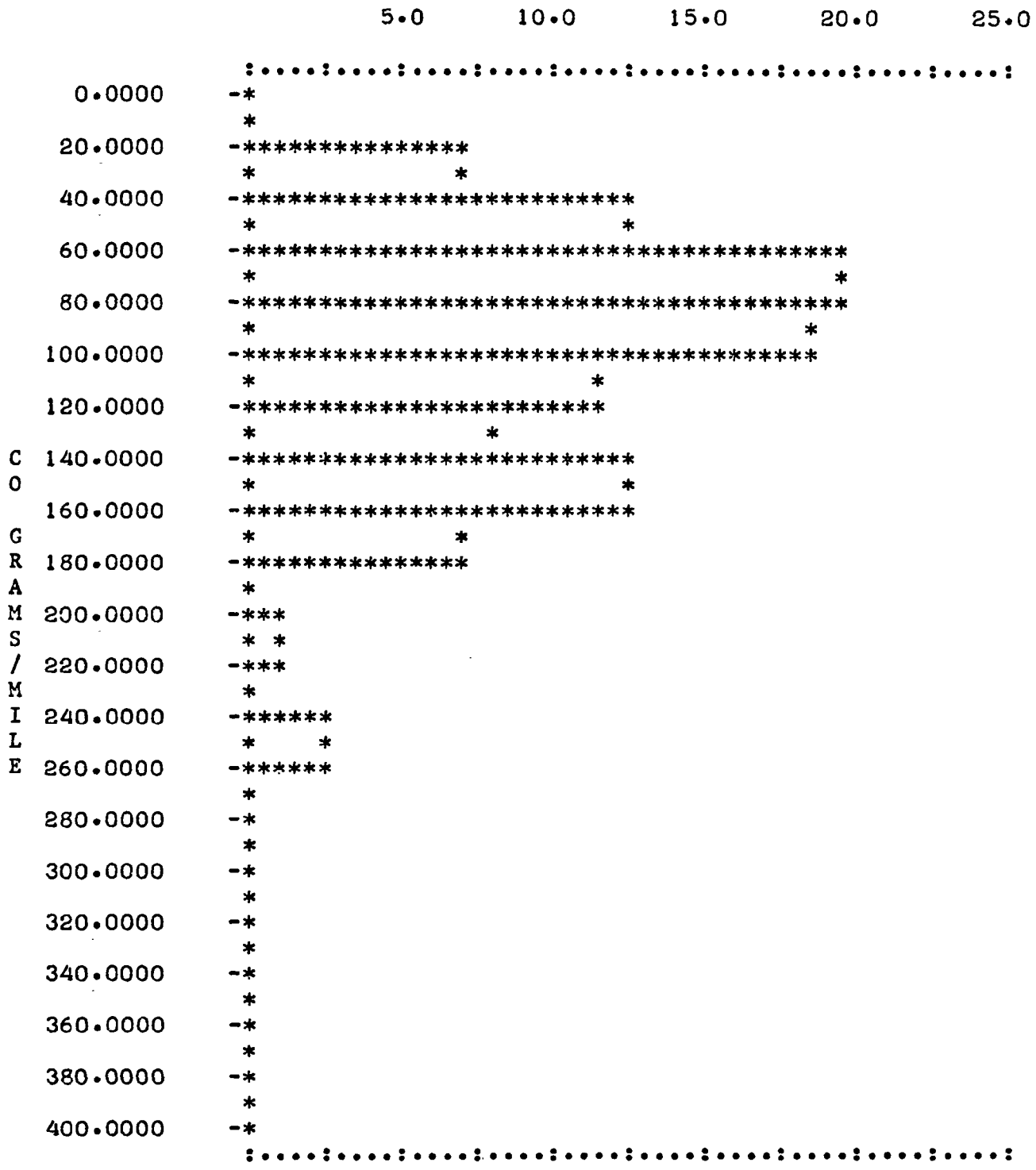
ALL VEHICLES
AFTER SIX MONTHS



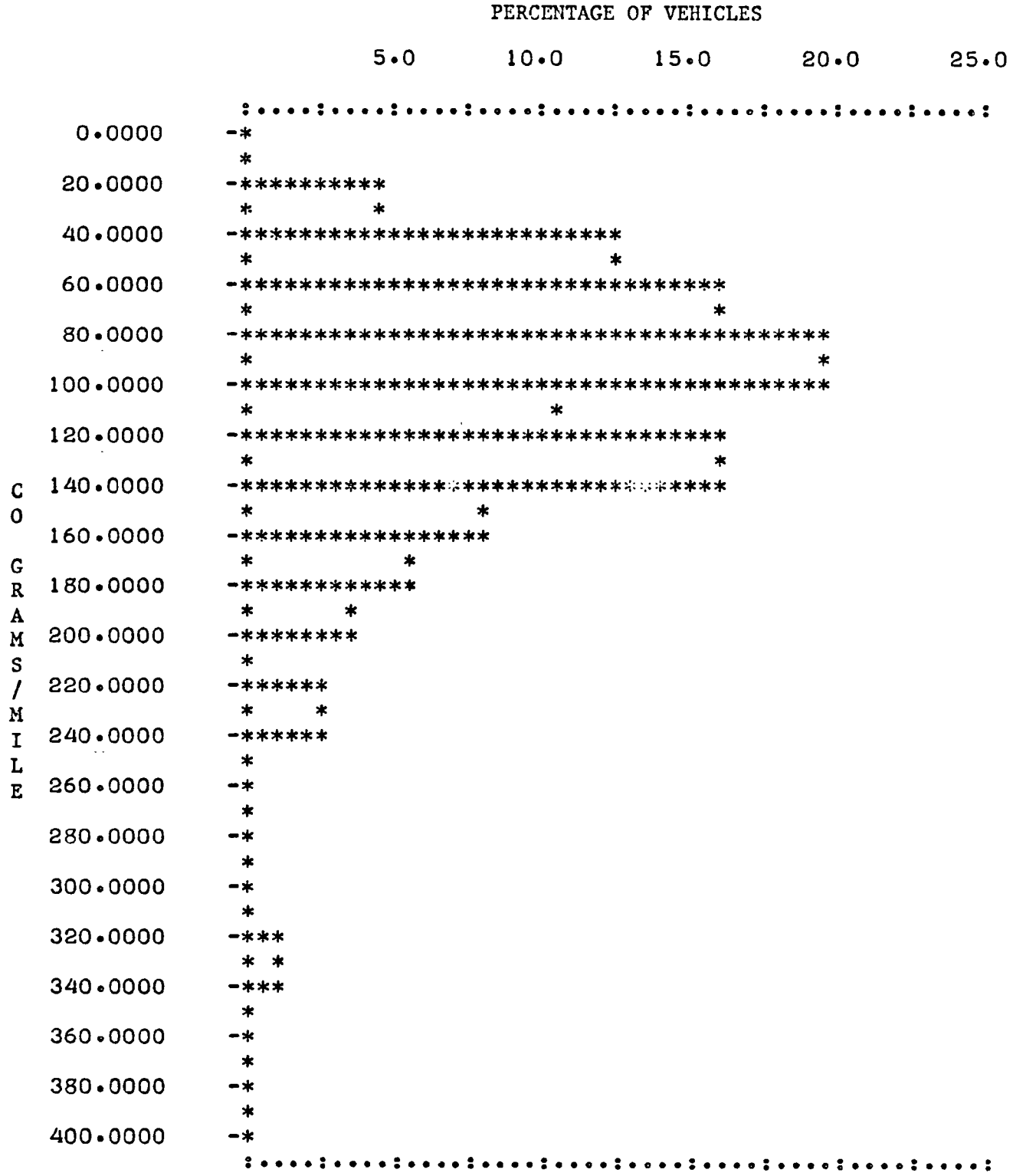
INSPECTION AND MAINTENANCE VEHICLES
BEFORE INSPECTION AND MAINTENANCE



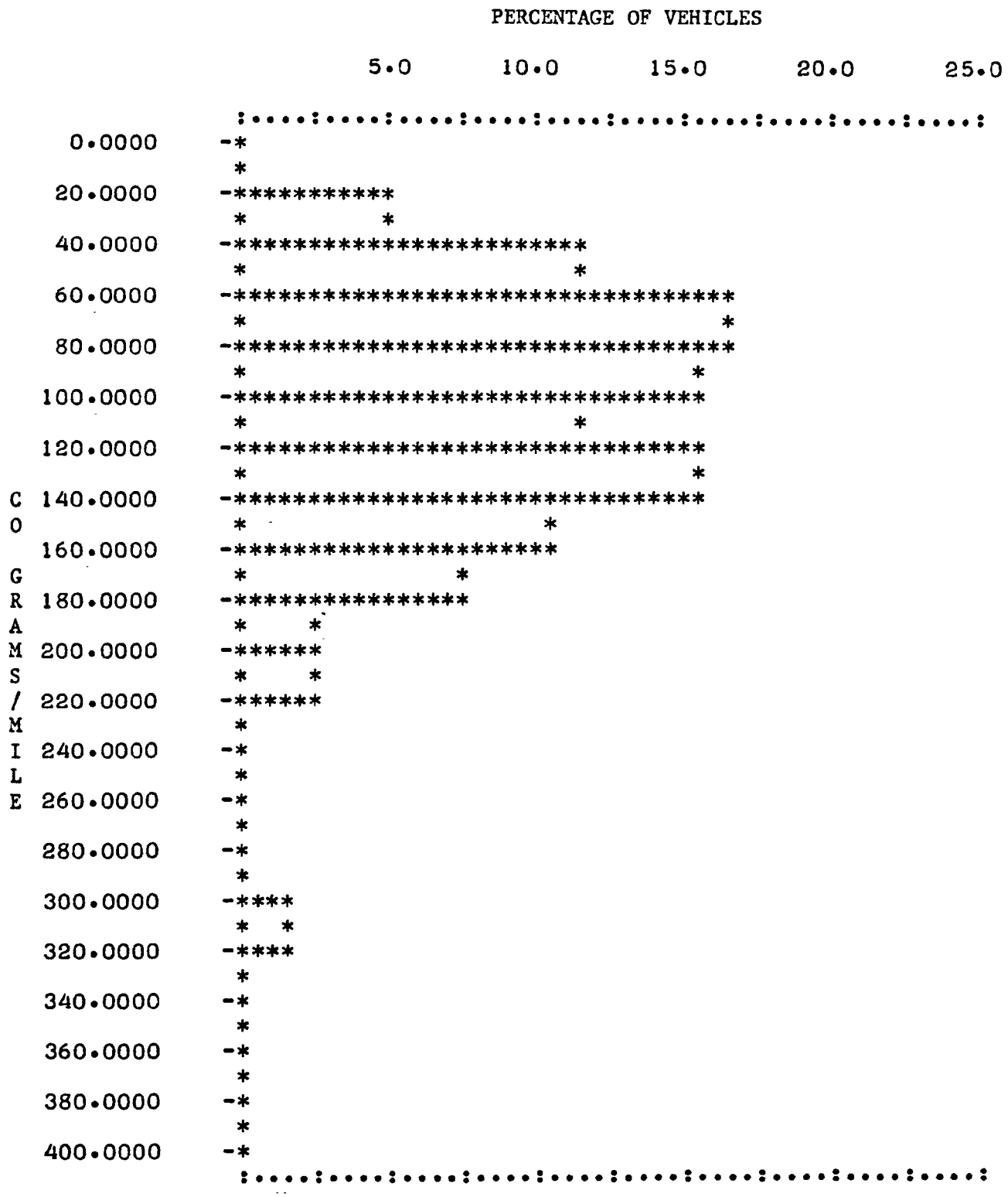
INSPECTION AND MAINTENANCE VEHICLES
AFTER INSPECTION AND MAINTENANCE



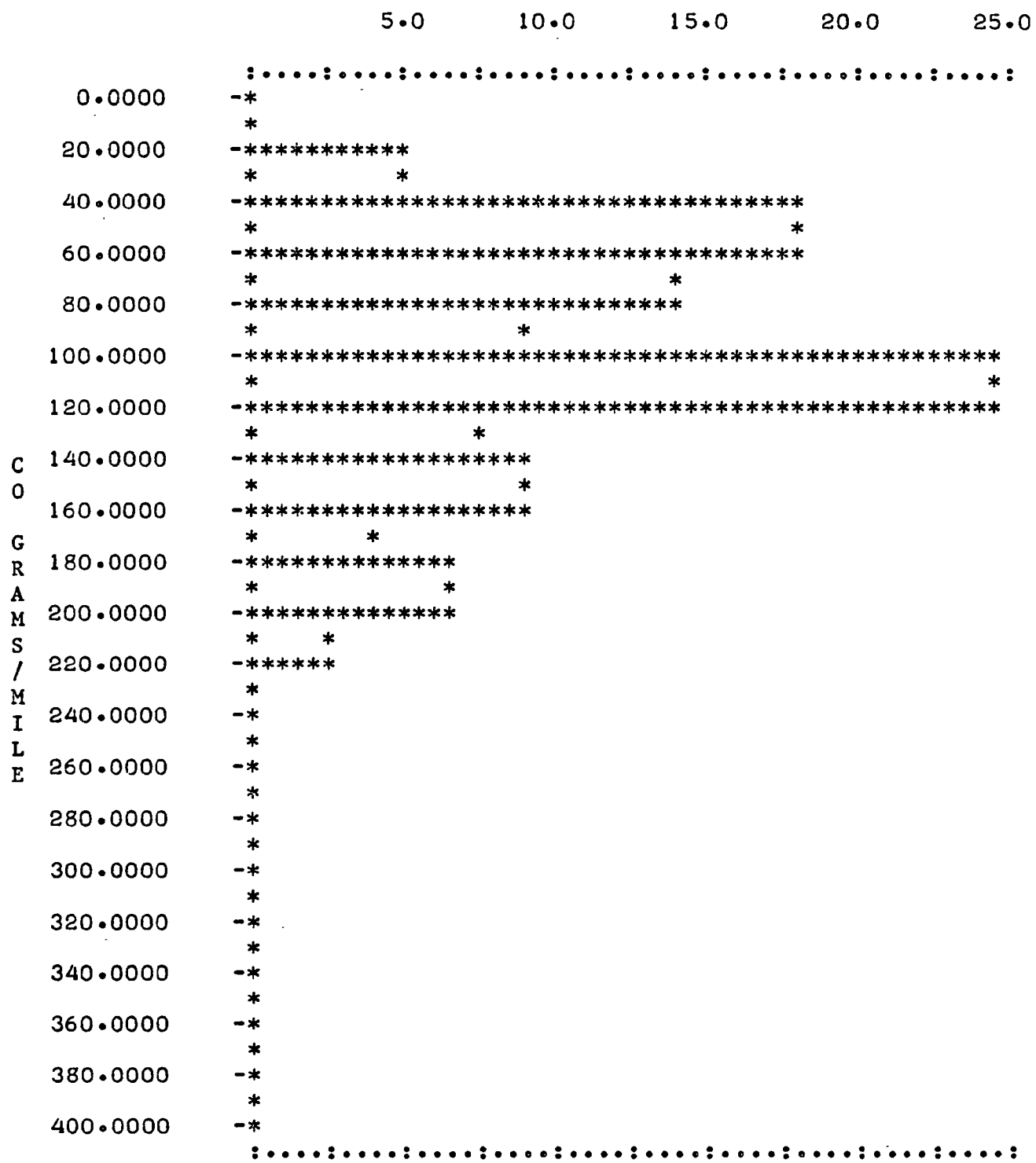
INSPECTION AND MAINTENANCE VEHICLES
AFTER SIX MONTHS



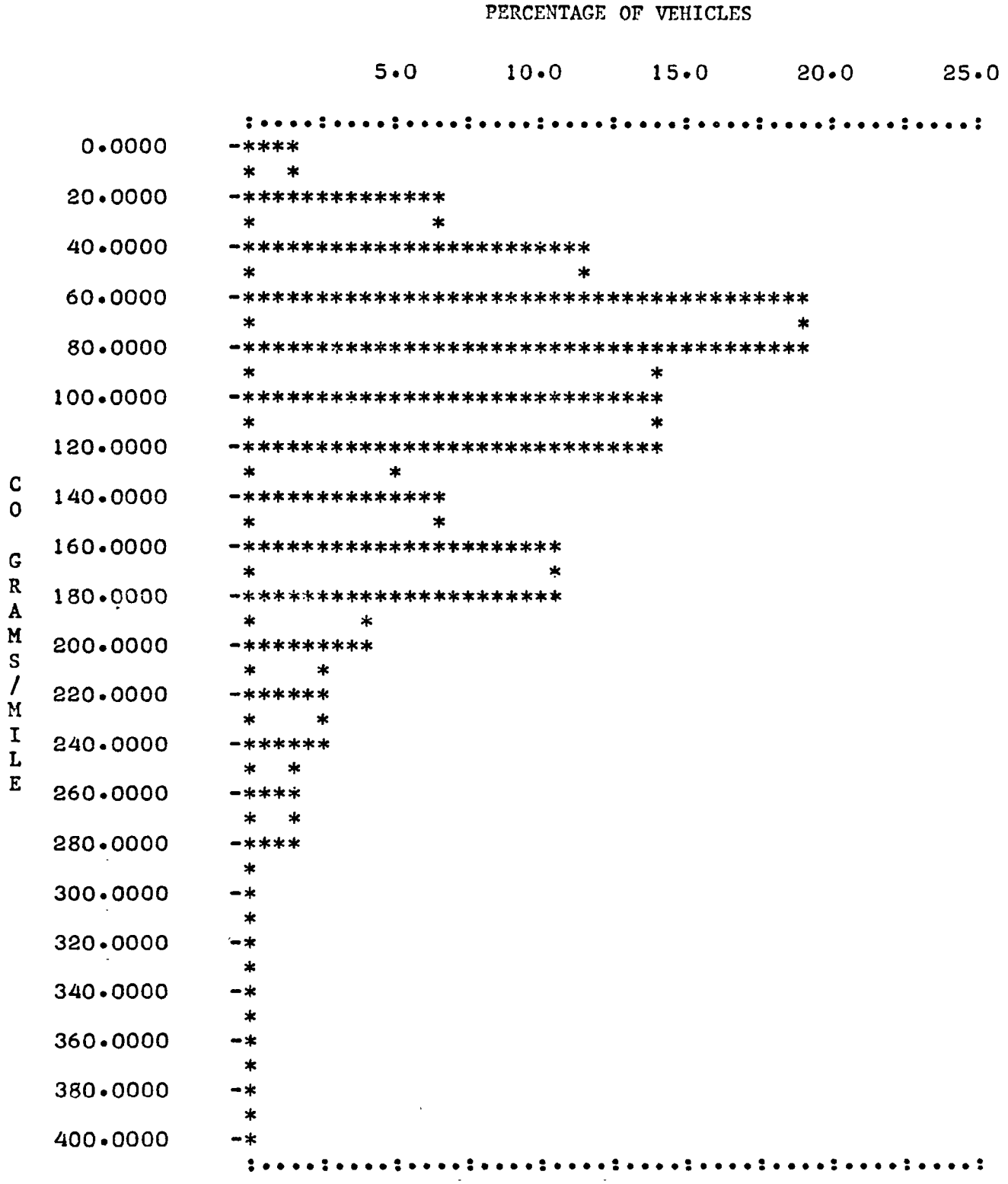
MANDATORY MAINTENANCE VEHICLES
BEFORE MAINTENANCE



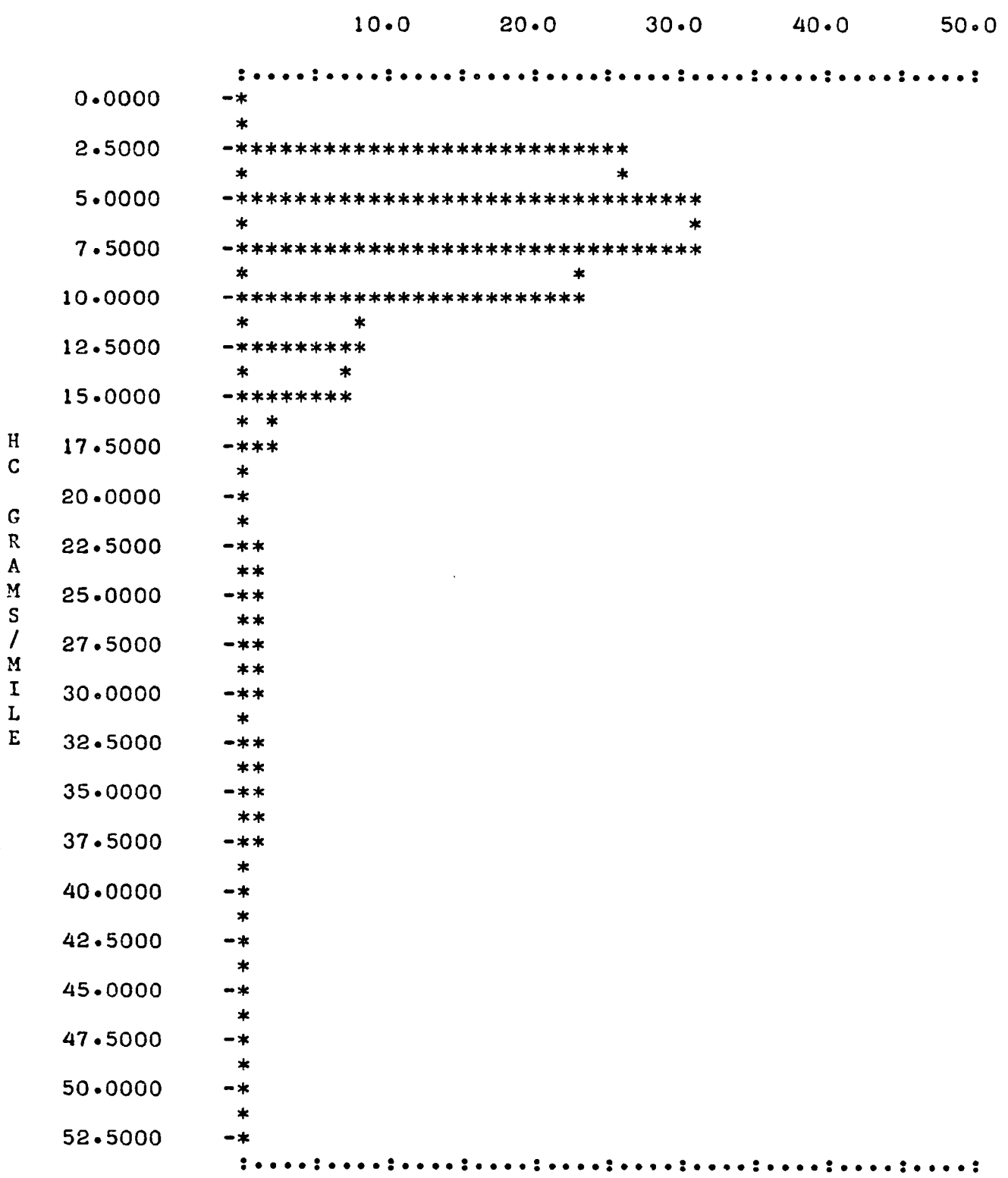
MANDOTORY MAINTENANCE VEHICLES
AFTER MAINTENANCE



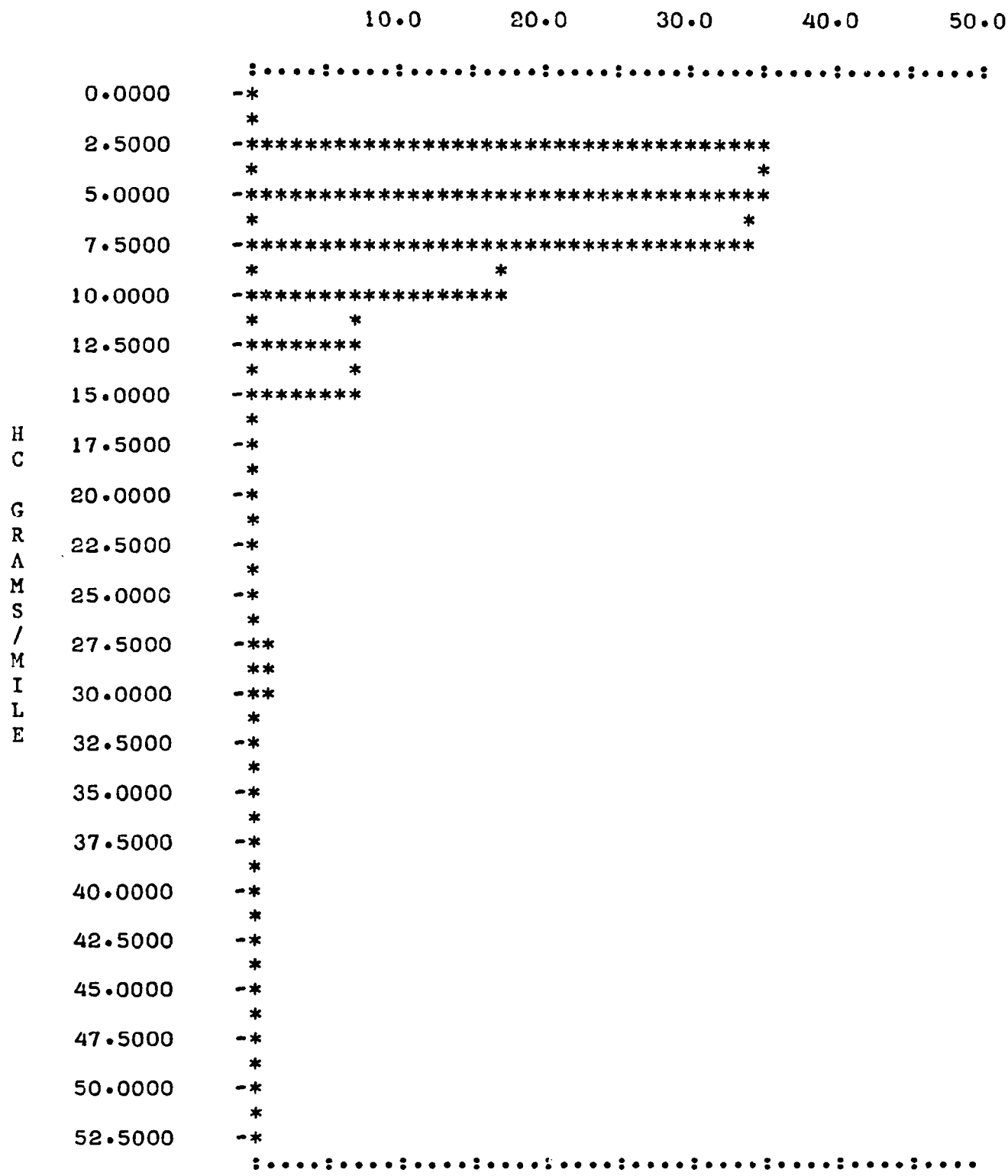
MANDATORY MAINTENANCE VEHICLES
AFTER SIX MONTHS



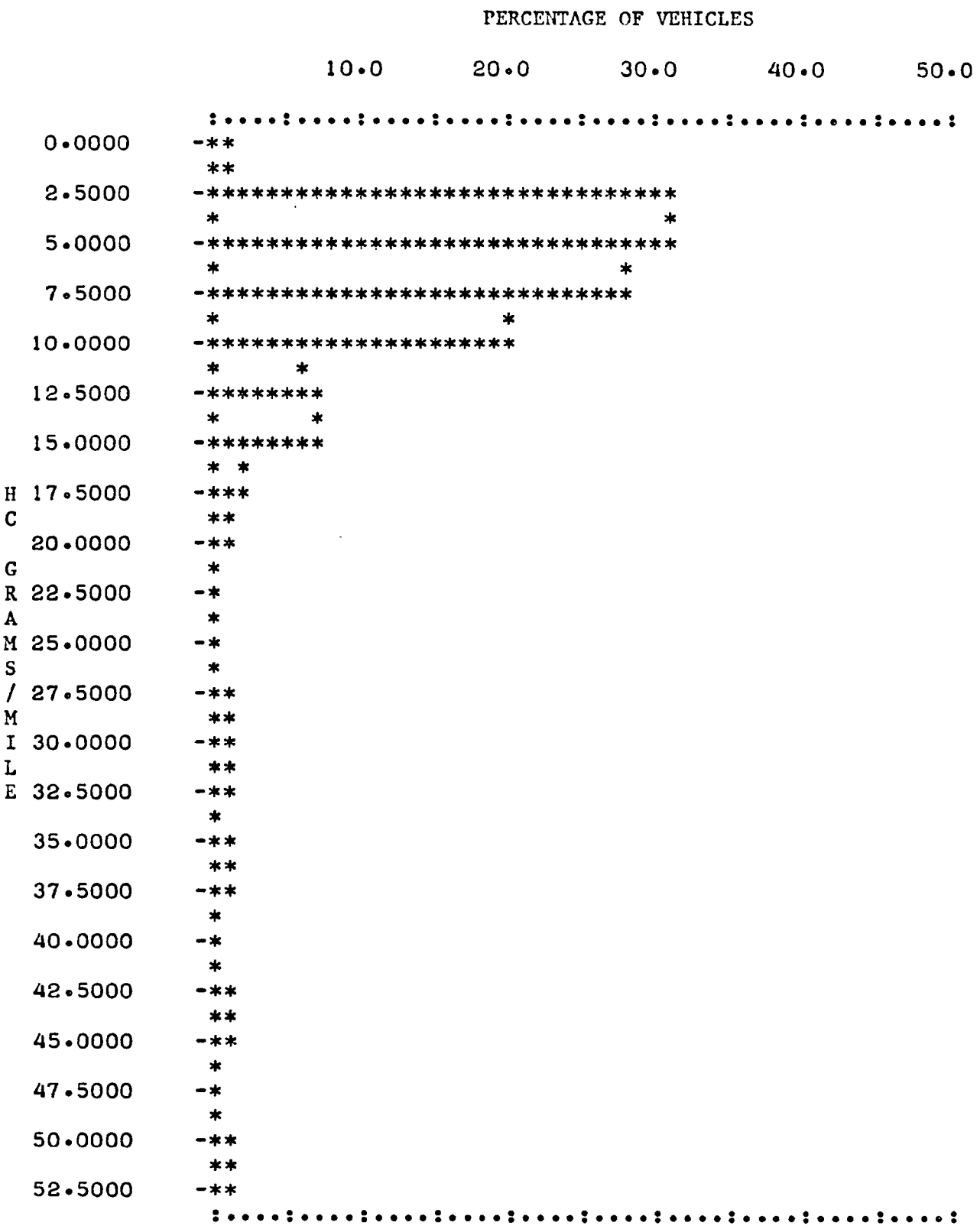
ALL VEHICLES
BEFORE INSPECTION AND MAINTENANCE



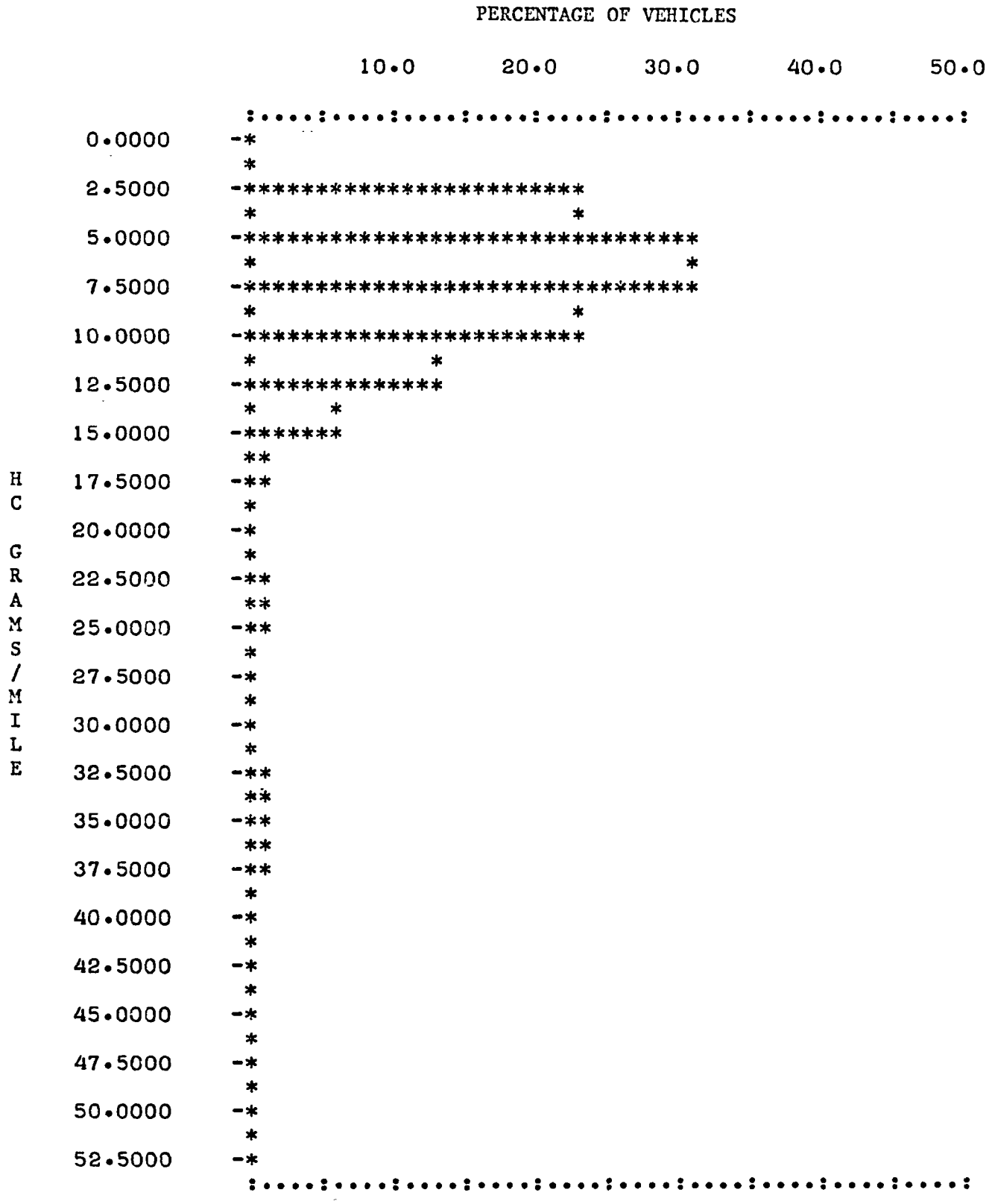
ALL VEHICLES
AFTER INSPECTION AND MAINTENANCE



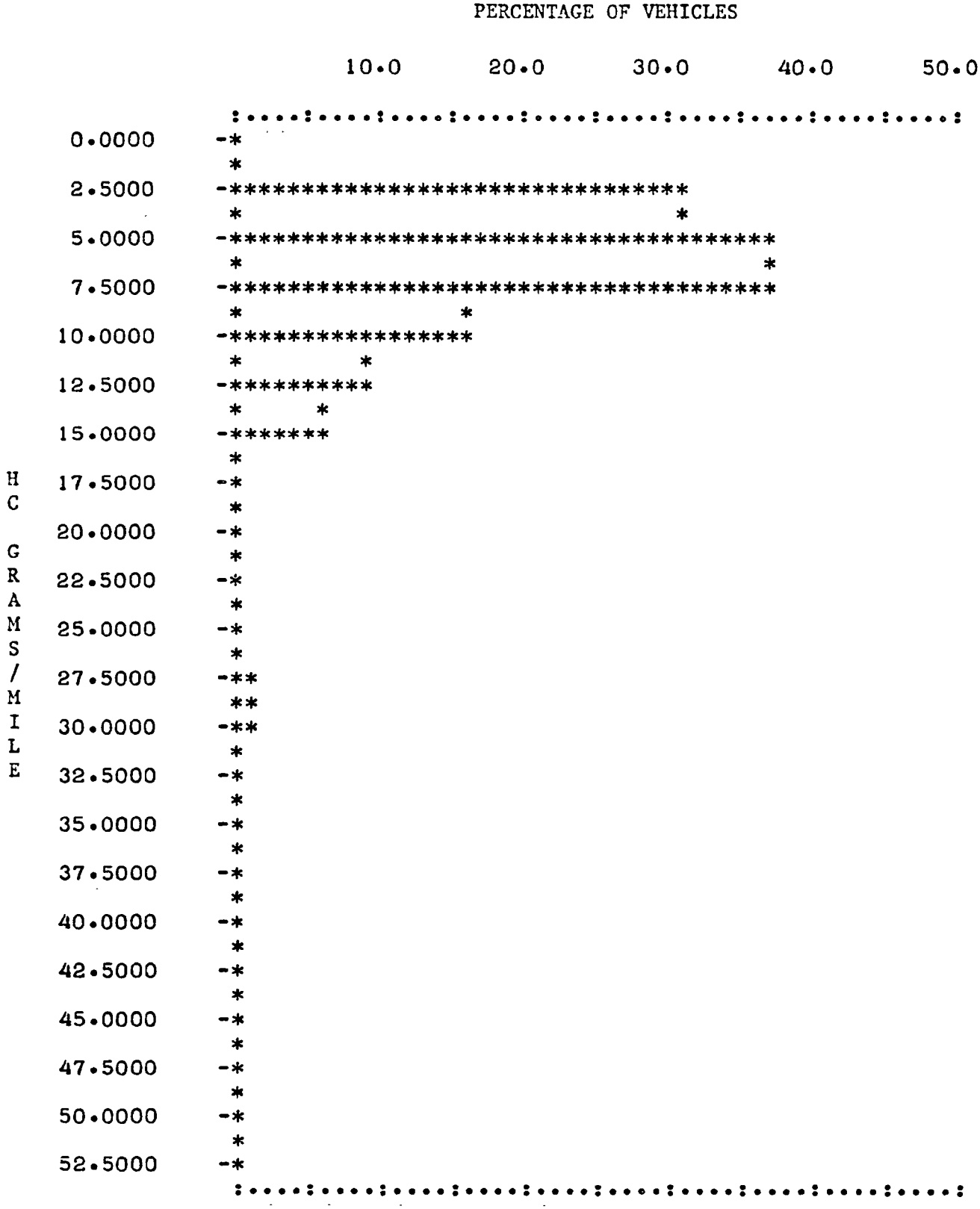
ALL VEHICLES
AFTER SIX MONTHS



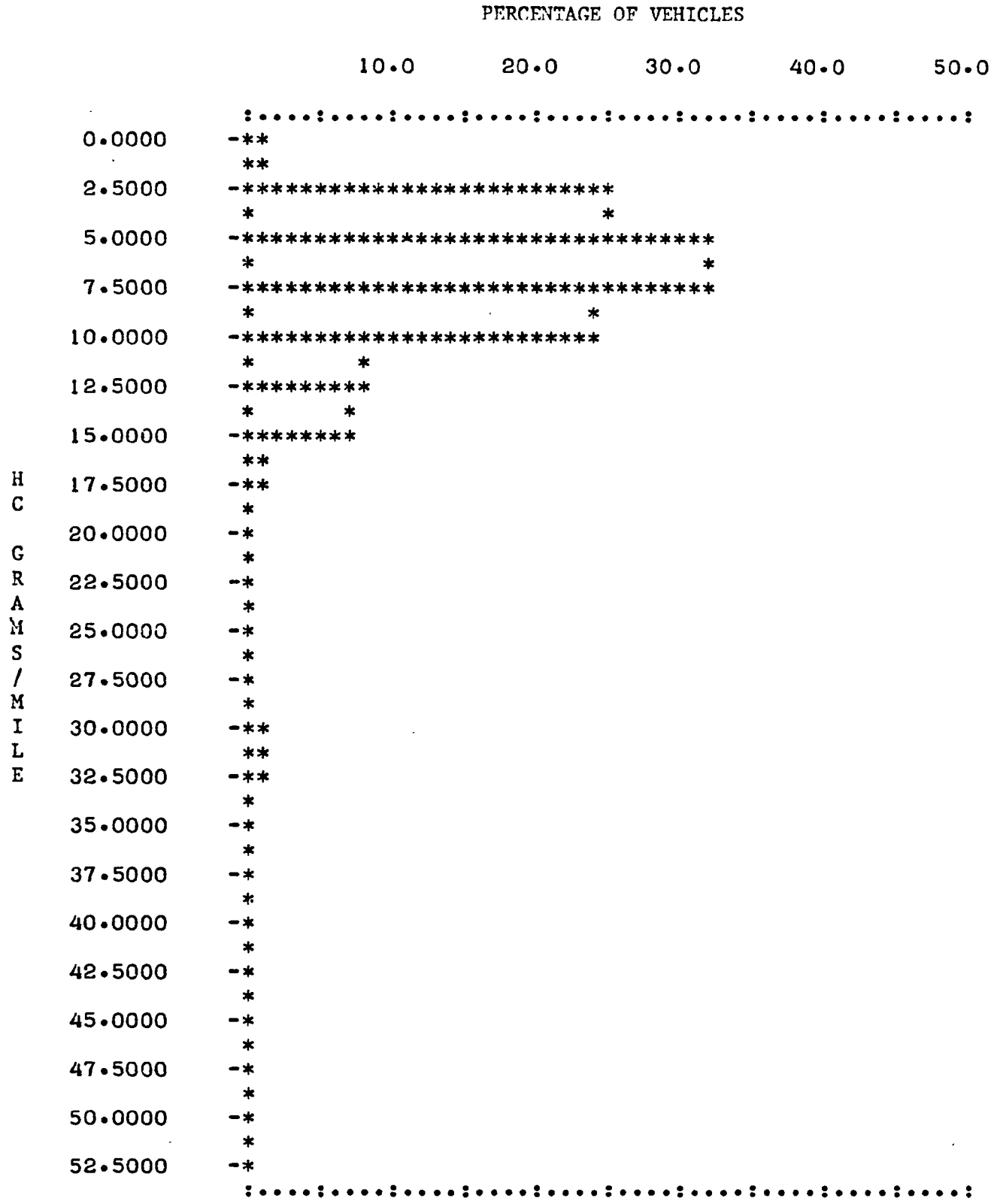
INSPECTION AND MAINTENANCE VEHICLES
BEFORE INSPECTION AND MAINTENANCE



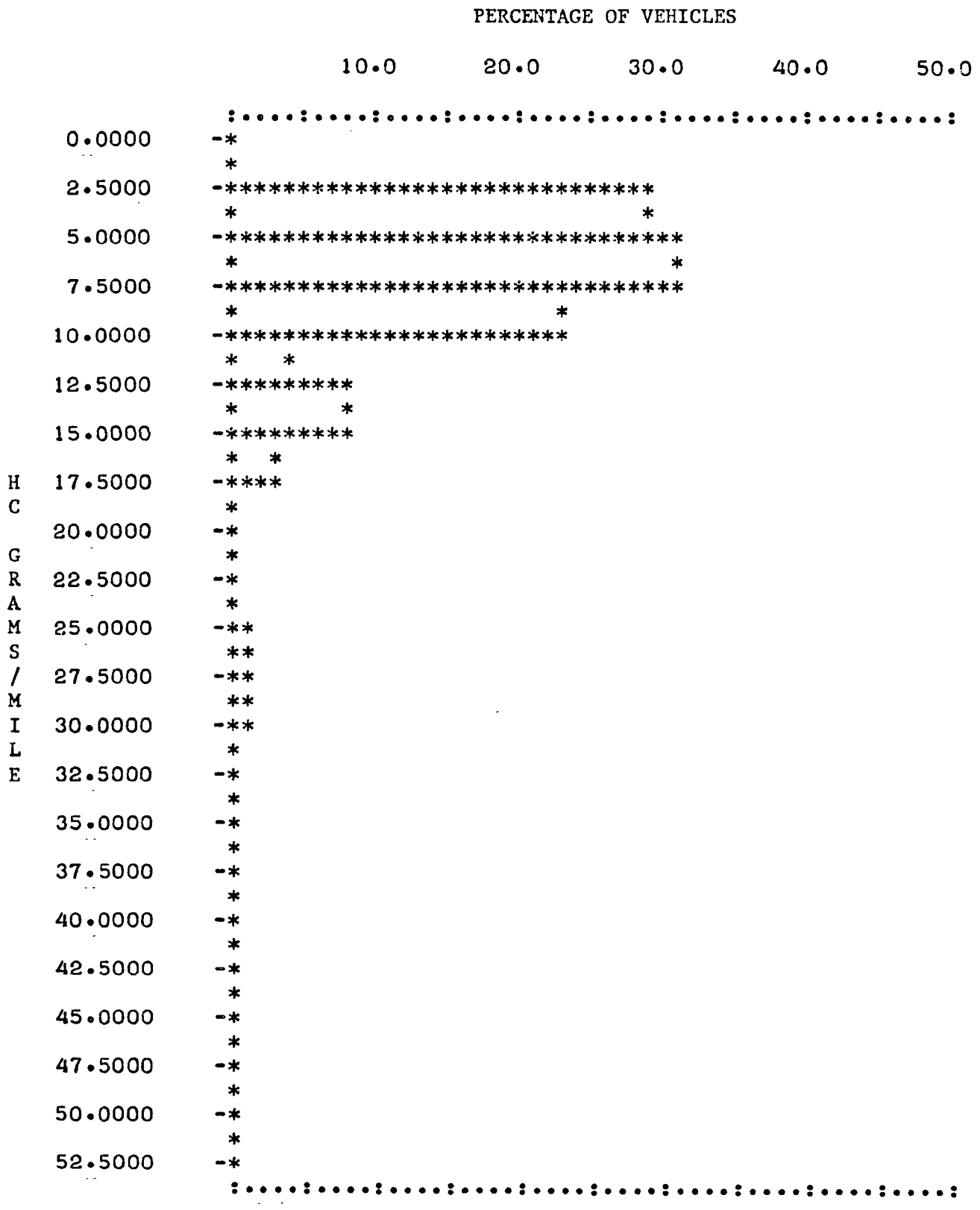
INSPECTION AND MAINTENANCE VEHICLES
AFTER INSPECTION AND MAINTENANCE



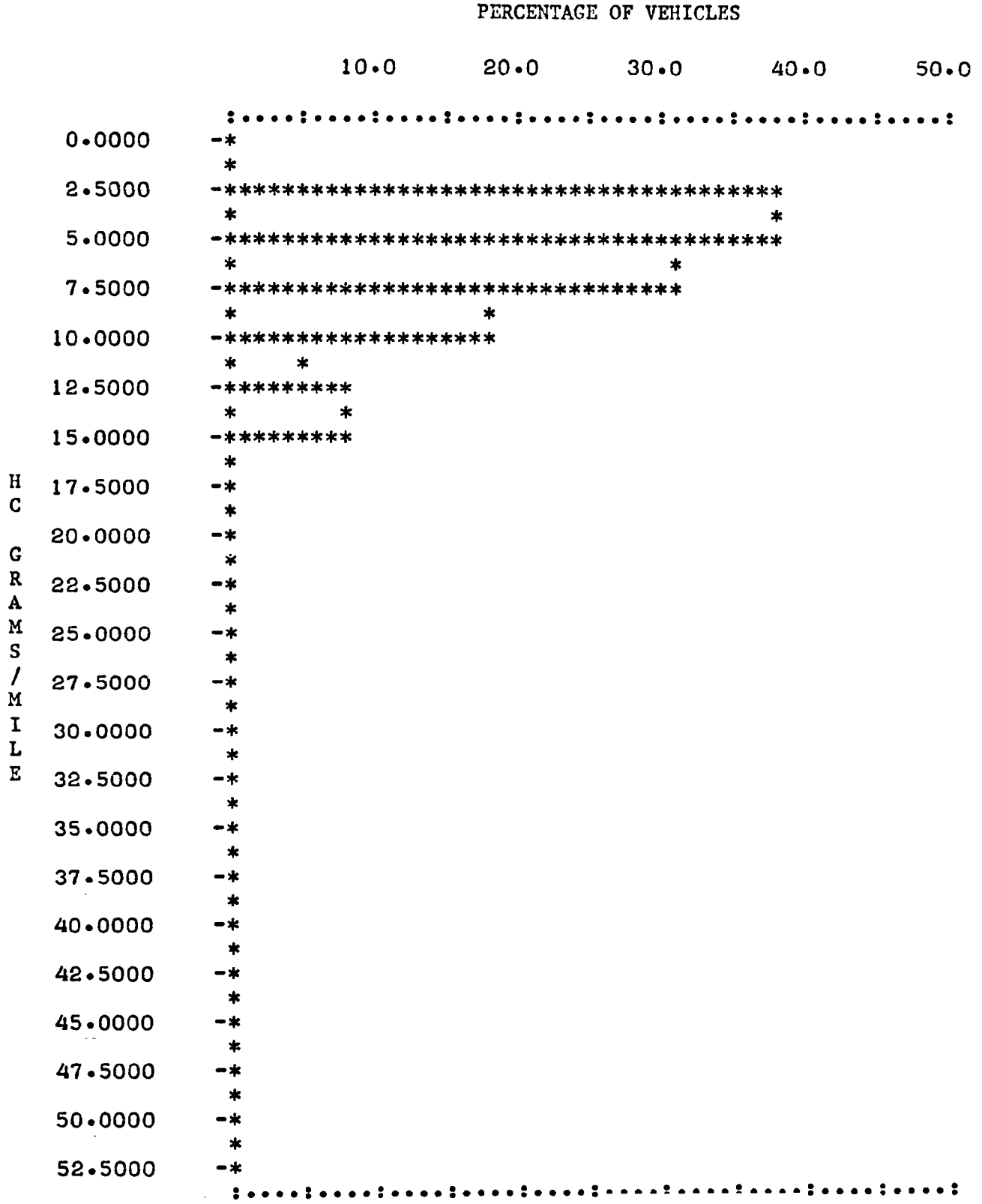
INSPECTION AND MAINTENANCE VEHICLES
AFTER SIX MONTHS



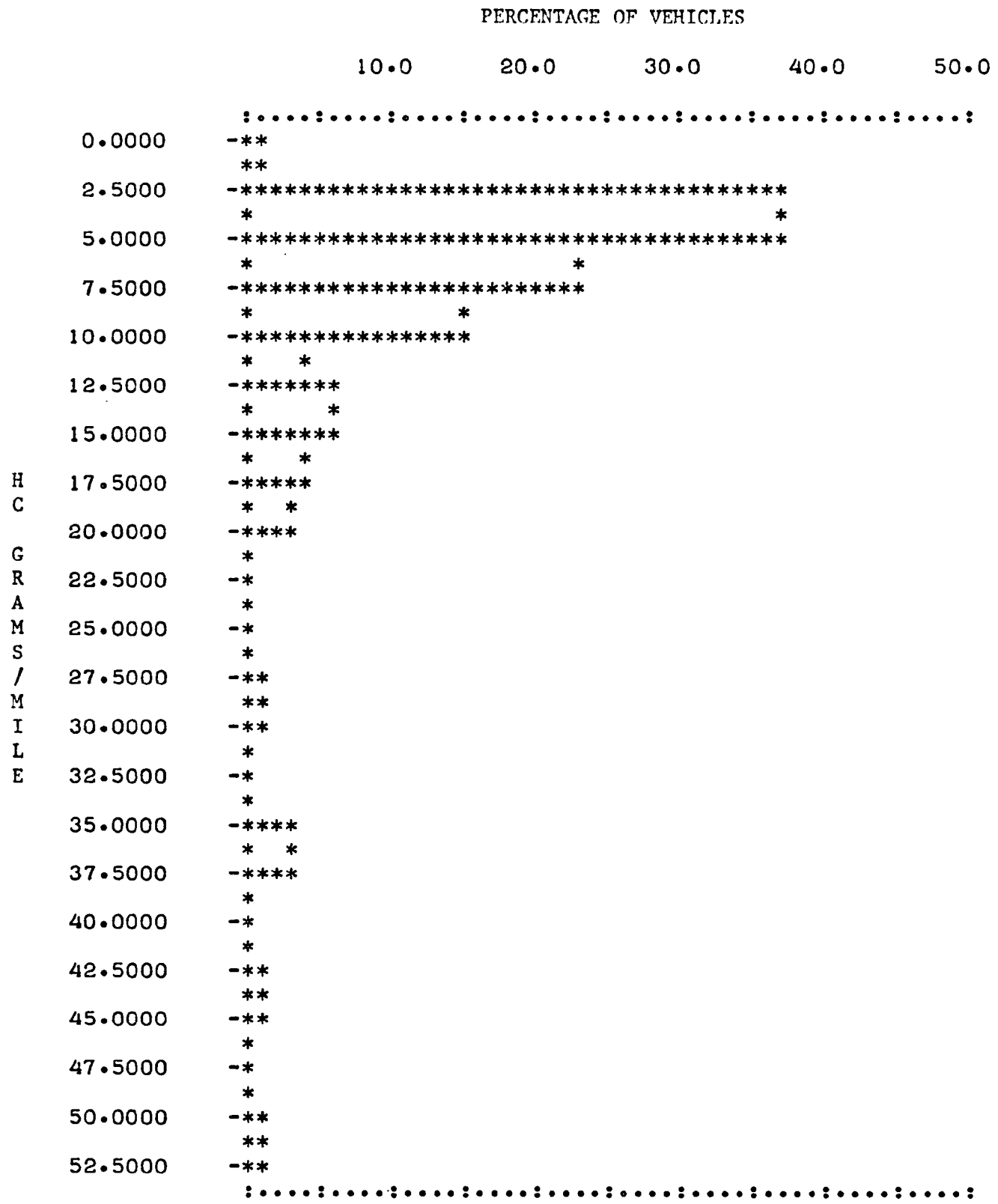
MANDATORY MAINTENANCE VEHICLES
BEFORE MAINTENANCE



MANDATORY MAINTENANCE VEHICLES
AFTER MAINTENANCE



MANDATORY MAINTENANCE VEHICLES
AFTER SIX MONTHS



SUMMARY OF VEHICLE MAINTANNCE

| ITEM INDICATING MAINTENANCE | NUMBER OF VEHICLES SHOWING MAINTENANCE | | | | |
|---|---|---|---|---|---|
| | ALL VEH | EMISSIONS -DECREASED- | | EMISSIONS -INCREASED- | |
| | | HC | CO | HC | CO |
| TOTAL VEHICLES | 165 | 75 | 73 | 90 | 92 |
| IGNITION WIRES | 8 | 4 | 3 | 4 | 5 |
| COIL | 2 | 1 | 1 | 1 | 1 |
| SPARK PLUGS | 13 | 7 | 5 | 6 | 8 |
| AIR FILTER | 19 | 10 | 9 | 9 | 10 |
| AIR CLEANER SCREW | 93 | 43 | 38 | 50 | 55 |
| IDLE MIXTURE SCREW | 3 | 2 | 1 | 1 | 2 |
| IDLE SPEED SCREW | 7 | 4 | 1 | 3 | 6 |
| CHOKE | 8 | 4 | 2 | 4 | 6 |
| DISTRIBUTOR SCREW | 7 | 2 | 2 | 5 | 5 |
| POINTS SCREW | 9 | 4 | 2 | 5 | 7 |
| CONDENSER | 8 | 3 | 2 | 5 | 6 |
| ROTOR | 7 | 3 | 3 | 4 | 4 |
| DISTRIBUTOR CAP | 11 | 5 | 3 | 6 | 8 |
| PCV VALVE | 5 | 2 | 2 | 3 | 3 |