THE INFLUENCE OF PERIODIC MOTOR VEHICLE INSPECTION ON MECHANICAL CONDITION

by

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HIGHWAY SAFETY RESEARCH INSTITUTE • THE UNIVERSITY OF MICHIGAN

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ABSTRACT

This study describes the influence of periodic motor vehicle inspection on the mechanical condition of selected populations of motor vehicles. Data were collected by Highway Safety Research Institute observers at the municipally operated safety inspection lanes in Washington, D.C., and Cincinnati, Ohio, where vehicle inspections are required annually and biannually, respectively. Data were also collected at a vehicle inspection lane specifically set up for this purpose in Ann Arbor, Michigan, a jurisdiction in which inspections are not required. Additional data were obtained from the city-operated vehicle inspection lanes in Memphis, Tennessee, where inspection is required triannually. The findings indicate that vehicle populations subject to periodic inspection are in substantially better mechanical condition than populations not subject to inspection. It was found that the mechanical condition of a vehicle population is substantially improved as the frequency of inspections increases, and that the number of defects per rejected vehicle decreases as the frequency of inspection increases.

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INTRODUCTION

Periodic Motor Vehicle Inspection (PMVI) is a major mechanism by which some political jurisdictions, principally states, attempt to control the mechanical condition of their indigenous vehicle populations. PMVI programs are not universally accepted, however, and since PMVI came into being in 1927, various positions (1, 2, 3) have been taken as to the extent to which PMVI influences the highway-accident rate. Current pressures for nationwide adoption of PMVI continue to be among the most controversial issues within the highway safety scene.

The crux of the PMVI controversy is whether inspections really influence highway accident rates one way or the other. Since others have attempted to answer that question with mixed results, this study was focused upon a question both more fundamental and more tractable—whether, and to what extent, PMVI influences the mechanical condition of cars. To that end, this report documents an investigation designed to measure the influence of selected PMVI programs on the mechanical condition of the vehicle populations subject to these inspection programs.

The report discusses at some length the background and rationale for making many of the decisions that are determinants of the validity of the results. Following the section on the methodology used in this study are a brief description of the techniques employed in handling and processing the data and a presentation, in summary form, of the general findings of the study. A more detailed presentation of the findings is given in the appendix.

BACKGROUND AND RATIONALE

To measure the influence of PMVI on the mechanical condition of motor vehicles, it was first necessary to construct acceptable definitions of certain variables. Most important among these are: the mechanical condition of a vehicle; a standard for and a method of vehicle comparison; appropriate vehicle populations; and statistically significant samples of those populations.

Variations in design, complexity, and size of motor vehicles make it necessary to assume an arbitrary basis for comparison of mechanical condition. One approach is to utilize those conditions, systems, and components ordinarily examined in the course of a motor vehicle inspection as reliable indicators of vehicle mechanical condition. Another approach is to select judiciously vehicle components or systems which most affect the safe operation of a motor vehicle and use the inspection results of these items as indicators. After combining these two approaches, brake, steering, suspension, and lighting systems, front wheel alignment, tires, exhaust system, glazing, windshield washers and wipers, rearview mirrors, and horns were selected as the criteria for defining and evaluating the mechanical condition of a vehicle population. Most inspection jurisdictions also inspect a variety of other items which determine whether or not a vehicle passes inspection, and for the purpose of this study, these items were grouped in a miscellaneous category.

Among inspection programs, standards and methods of inspection differ considerably. Most of these standards and methods reflect to some degree various SAE standards, the D7.1 Standard (4), the AMA inspection handbook (5), and the Uniform Vehicle Code. For reasons of uniformity, it appeared desirable to select the D7.1 Standard to provide the basic guidelines for the pass-fail criteria of this study.

In the states and municipalities that require PMVI, three basic types of inspection are currently in general use: garage inspections, lane inspections, and spot inspections (random sampling). The garage inspection is performed by a licensed automotive service facility. The safety inspection lane is used in

municipalities and in some states in which the population density is great enough to make it economically feasible. Both systems periodically inspect all of the motor vehicles within their respective jurisdictions. Spot inspection is used in some states, and is customarily performed by law enforcement officers. In the latter scheme, inspection locations vary from day to day and the operating circumstances tend to make the inspections rather superficial. In addition to the various inspection methods, jurisdictions vary in the number of inspections required per year (e.g., three times a year, twice a year, or once a year).

Although garage-inspection programs offered the greatest opportunity to make accurate measurements of the wear and degradation of discrete parts such as brake linings, collecting sufficient data would have been long, arduous, and expensive, since one inspection bay in a garage averages only about 600 vehicle inspections a year. Random spot-inspection programs, on the other hand, tend to apply minimal inspection standards, and thus did not seem to offer the degree of discrimination required by the study. Lane-type inspection, however, could satisfy the need for a variety of mechanical-condition indicators, and, held to the parameters of the D7.1 Standard, could assure the level of reliability essential to a valid comparative study. Hence, HSRI elected to restrict its investigation to a lane-type inspection technique,* and the study reported herein was structured to this end.

Since extreme variations in geography, climate, and demographic circumstances (including socioeconomic factors) could conceivably bias the findings, it was desirable to select vehicle populations with reasonably similar mileage, use, and exposure histories. It was concluded that Washington, D. C., Cincinnati, Ohio, and Ann Arbor, Michigan, would present reasonably comparable vehicle populations; data from the Memphis, Tennessee, inspection-lane program were subsequently included in the study for reasons explained later in this report.

*Brief descriptions of the inspection lane facilities at each of the locations selected for this study, along with their respective inspection requirements, are given in the appendix.

METHODOLOGY

The number of vehicles required to assure an adequate sample size from each jurisdiction was determined from statistical considerations (6). It appeared that a particular component (e.g., brakes) might show a failure rate of about 15% in one population and about 20% in another. This anticipated difference could be considered significant at the 0.05 confidence level in a sample of 500. Such a sample could be observed within a week, a reasonable effort in the context of the present study. Thus it was decided to take a minimum sample of 500 vehicles from each jurisdiction used in this study.

Statistical significance also implies randomness, and some consideration had to be given to this aspect of the problem. It was apparent, from preliminary observation of the inspection facilities, that specific vehicles are not scheduled to appear for inspection at a specified time. Thus there is no systematic pattern or sequence upon which to base a structured random sampling, and the application of a table of random numbers appeared to be impractical, if not impossible. It was concluded that limiting the data gathering to a single lane at each of the inspection facilities and selecting eligible vehicles in the order of their arrival at that lane would preserve an acceptable degree of randomness. Since vehicles appear at a particular inspection lane in a truly random fashion, both intentional and unintentional bias in selecting individual subjects could thus be avoided.

In order to facilitate the gathering of data in a standardized format from the selected localities, HSRI personnel were familiarized with the data gathering techniques and requirements, as well as the scope and purpose, of the study. These personnel did not perform any actual vehicle inspection in Washington and Cincinnati; they functioned strictly as data recorders.

The duties of the data recorder were to complete the inspection-form heading as each vehicle entered the inspection lane building and to follow the vehicle through the lane, recording meter readings and inspection particulars as they were called out by the regular inspectors. After following one car through the

lane, the observer would return to the lane entrance and select the next eligible vehicle in line. Confining the data gathering to one specific lane minimized interference with the inspection lane operation and preserved random sampling.

It should be noted that eligible vehicles were defined as passenger cars making their first appearances for inspection in the current inspection period. Buses, taxicabs, and commercial vehicles were excluded, since, in the study jurisdictions, different inspection laws and standards apply to them than apply to private passenger vehicles.

Since periodic inspection of vehicles is not required in Ann Arbor, the procedures employed to gather data in Washington and Cincinnati were not applicable. Before outlining the modifications introduced to obtain inspection data in Ann Arbor, several of the pertinent circumstances should be reviewed. The successful execution of the study hinged upon an ability to ascertain the mechanical condition of motor vehicles in a "noninspected" population. Thus it was necessary to devise a scheme for securing and measuring a representative sample of "noninspected" vehicles. The practical problems involved were neither simple nor straightforward.

Fortunately, the Michigan State Police had recently initiated Michigan's Spot Check Vehicle Inspection program. Further, the Ann Arbor Police Department was planning to start a spot check program of its own, under the provisions of the state law and with the encouragement of the State Police. Hence an arrangement was worked out whereby HSRI provided inspection lane equipment, the Ann Arbor Police Department provided the means of securing vehicles at random from the streets, and the State Police provided the legal authority for stopping and inspecting vehicles.

Through the courtesy of the Bear Manufacturing Company, HSRI obtained and set up the necessary equipment for a temporary safety inspection lane in Ann Arbor. This equipment was either identical with or equivalent to equipment installed in the lanes in Washington and Cincinnati. Thus, by application of the D7.1 Standard, data derived from the Ann Arbor lane were directly comparable to the data generated in Washington and Cincinnati.

The observers who had served in Washington and Cincinnati were now cast in the role of driver-inspectors* in Ann Arbor. Having had the benefit of two weeks of intensive training in inspection lane operations, they experienced no difficulty in adapting to the new job. The observers continued to record the data and, in addition, carried out a substantial portion of the actual inspections.

Front-end and underbody inspections were performed by student automotive mechanics working under the close supervision of a highly qualified automotive mechanics instructor. Representatives of the Bear Manufacturing Company were on hand to advise and assist in the operation of the inspection equipment.

Thus the Ann Arbor project was able to satisfy the noninspected vehicle-population requirements of the study. The data generated by the Ann Arbor inspection lane are technically equivalent (as nearly as possible) to the Washington and Cincinnati data. Representativeness was obtained on an equal basis with the other two cities. Vehicles were flagged off the street by the Ann Arbor police in order of appearance as places became available in the line of automobiles awaiting inspection, thus adhering to the random-sampling plan.

*A driver-inspector drives the vehicle through the inspection lane, meanwhile checking some of the pertinent equipment and functions.

THE DATA

The first group of data were collected in a one-week period in Cincinnati, where the complete inspection facility is housed in one building. Since all data were gathered at one location, a realistic cross-section of the total vehicle population was obtained.

Data were then gathered for one week in Washington. Since Washington's inspection facilities are housed in two buildings at different locations in the city, it was necessary to divide the observers into two teams. One team was assigned to each building to minimize the bias that might result from drawing too heavily from one segment of the city's total vehicle population.

The Ann Arbor project also covered a one-week period. Since Ann Arbor is considerably smaller in area than either Washington or Cincinnati, it was concluded that a single inspection lane adjacent to a major thoroughfare would provide a satisfactorily representative sample of the area's vehicle population.

Subsequent to the collection of data in these three cities, inspection cards were received from the vehicle inspection lanes at Memphis, Tennessee, where inspections are required three times a year. Although investigators had observed some differences in inspection standards and procedures during a visit to the Memphis inspection lane building, it was decided that data produced by that facility would conform to the overall requirements of the study. The number of cards received from Memphis appeared to assure a random cross-section of that vehicle population. Since the triannual-inspection data would add an important dimension to the results, these data were included as a useful adjunct to the original study.

The assembled data were encoded and transferred to IBM cards. The Memphis cards, arriving too late to be fitted into the IBM schedule, were hand-tabulated. The data from each city were then sorted, by pass-fail criteria and type of defect, according to both vehicle age and vehicle mileage groups.

Tabulations of these counts were compiled,* and curves and bar graphs illustrating the results were prepared. The curves and bar graphs, with a detailed explanation of each, are included with the detailed presentation of the findings.

*Complete data tabulations are in the appendix.

THE FINDINGS AND ANALYSIS

It should be reiterated that, in this study, mechanical condition is equated with the inspection status of a vehicle. Thus, "accepted," "passed," and "good mechanical condition" are synonymous, as are "rejected," "failed," and "poor mechanical condition." A vehicle is "rejected" if one or more inspection items fail to meet the minimum inspection standards established within the particular jurisdiction.

Since the data were gathered under a controlled measurement program, they are accepted as bona fide evidence of the inspection status of the four vehicle populations, and the observed rejection rates are accepted as valid measurements of the mechanical condition of each of these vehicle populations. Consequently, the following statistical descriptions are offered to substantiate the hypothesis that vehicle inspections do, in fact, influence the overall mechanical condition of a vehicle population.

The results of the study in terms of the percentage of vehicles rejected and the frequency of inspection are shown in Table I and Figure 1(a).

Table I

VEHICLE REJECTION RATES

Inspections Per Year	Vehicles Inspected	Vehicles Rejected	Rejection Rate - %
0	591	555	93.9
1	1249	532	42.6
2	1665	568	34.1
3	1379	171	12.4

The apparent differences between these rejection rates were confirmed as statistically significant upon applying appropriate statistical tests (6). If the problem is stated as a null hypothesis, "Vehicles subject to safety inspections will not have a lower failure rate than noninspected vehicles," the hypothesis is rejected on the strength of a chi-squared test at the 0.01 confidence level. Therefore, it may be deduced that inspected vehicles will have a lower failure rate.

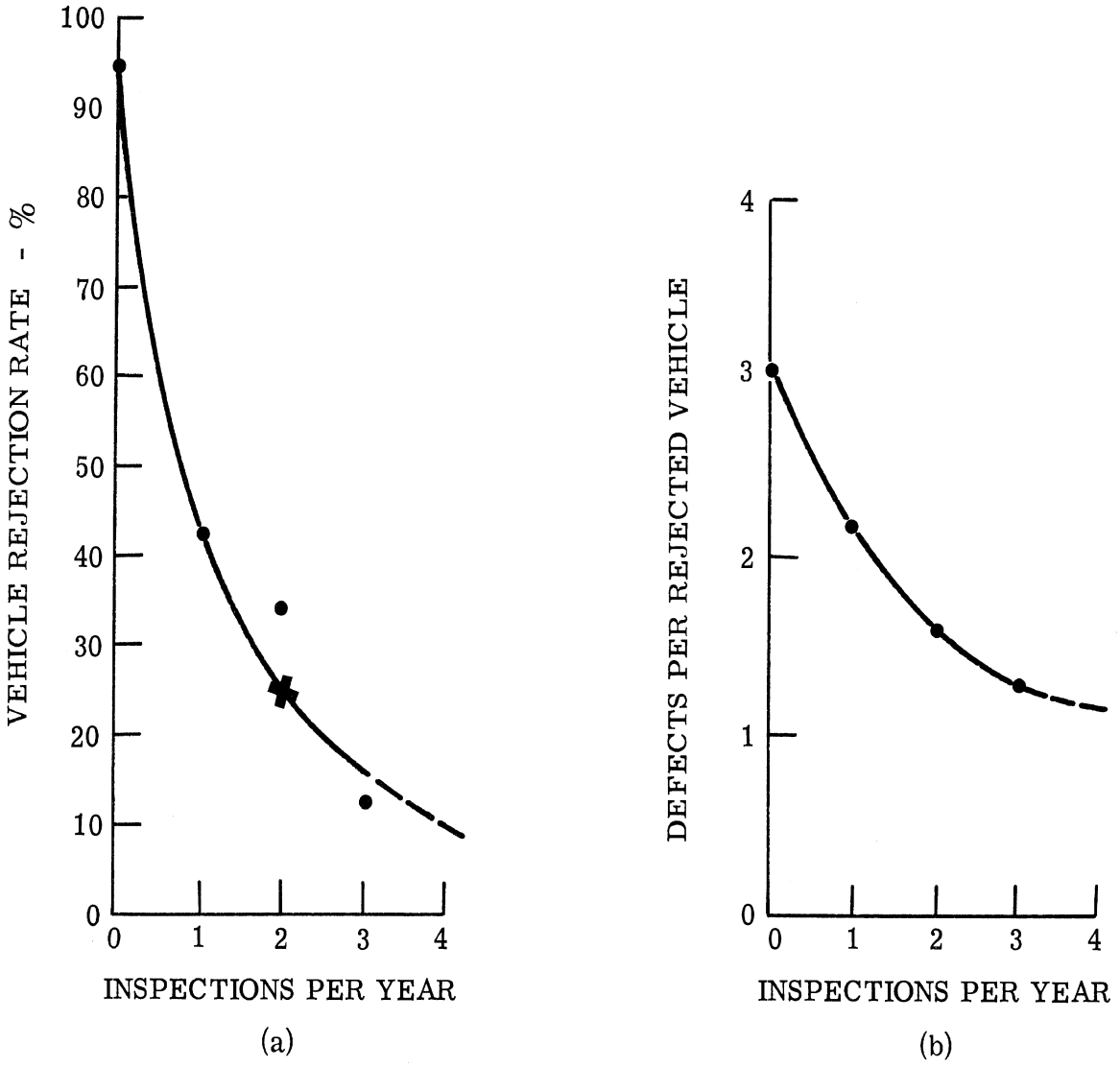

FIGURE 1. INSPECTION RESULTS VS. INSPECTION FREQUENCY

A word of caution is in order, however, since the accuracy of the measurement of inspection influence is dependent upon holding all other variables constant. It is recognized that uncontrolled or undetected variables in any jurisdiction could account for some of the observed differences. However, since the tests indicate that the rejection rates are significantly different, it is concluded that the proportion of rejections will be lower as the frequency of inspection is increased.

Thus, it can be stated that PMVI will influence a vehicle population toward a lower rejection rate and, given a constant level of inspection discrimination, will reduce the rejection rate as inspections become more frequent.

Another aspect of the PMVI influence is illustrated in Table II and Figure 1(b). In this case, the number of defects per rejected vehicle is correlated with inspection frequency.

Table II

DEFECTS PER REJECTED VEHICLE

Inspections Per Year	Vehicles Rejected	Total Defects	Defects Per Rejected Vehicle
0	555	1684	3.02
1	532	1155	2.17
2	568	891	1.57
3	171	219	1.28

Although these rates usefully index the effects of PMVI, they are an indirect measurement. Student t-test of significance showed that the rates are not significantly different; the apparent differences could have occurred by chance, rather than as a result of genuine differences in the mechanical condition of the populations.

As a second method of analysis, the defect counts were compared to the number of possible defects* in each population. (See Table III.) The number of observed defects in the noninspected jurisdiction was found to be significantly different from the pooled defects of the inspected jurisdictions (when compared with the number of possible defects) upon applying a chi-squared test at the 0.01 confidence level. In other words, there is less than 1 chance in 100 that the observed differences are due to random variations in the mechanical condition of the vehicle population samples.

Table III

VEHICLE DEFECT RATE

Inspections Per Year	Vehicles Inspected	Inspection Categories	Possible Defects	Detected Defects	Defect Rate - %
0	591	18	10,638	1684	15.83
1	1249	18	22,842	1155	5.05
2	1665	18	29,970	891	2.97
3	1379	14	19,306	219	1.13

*The number of possible defects equals the number of defect categories times the number of vehicles inspected.

Thus the data indicate that PMVI influences vehicle populations toward fewer defects per rejected vehicle and, given consistent inspection, will reduce the number of defects per rejected vehicle as inspections become more frequent.

Two sets of curves were drawn from the data in Tables I and II to demonstrate the effects of inspection frequency. Figure 1(a) is a plot of vehicle rejection rate against frequency of inspection, and Figure 1(b) is a plot of defects per rejected vehicle against inspection frequency.

The observed rejection rate for each of the four inspection frequencies was examined for validity. The data points both for the noninspected population and for the annually inspected population were supported by other known data* and were accepted as being valid. However, the observed rejection rate for biannually inspected populations was higher than the 13-year average rejection rate reported in statistical inspection summaries received from Cincinnati. Since the 13-year average could be considered to reflect greated stability, it was used as the rejection rate for biannually inspected populations and is indicated by an "x" on the plot.

Because Memphis does not inspect tires, parking lights, windows, and windshield wipers, the rejection rate produced in that jurisdiction is likely to be lower than would be expected from a triannually inspected population. Accordingly, it seems logical that a smooth curve drawn through the data points for the noninspected, annually inspected and biannually inspected populations should pass above the rejection-rate figure produced in Memphis, Tennessee. A reasonable extrapolation of the curve passing through the points established for zero, one, and two inspections per year indicates a rejection rate of about 15.5 percent for a triannually inspected population, and approximately 9.5 percent for a quarterly inspection period, employing comparable inspection practices. The main point to be made is that increasing inspection frequency to more than four times a year probably would not appreciably reduce rejection rates any further.

*Data collected by the Clayton Manufacturing Company in a survey of diagnostic centers using their equipment in noninspection locations supported the observed noninspection data of this study. Statistical inspection summaries for 1964-66 from Washington, D. C., support the observed annual rejection rate.

Defects per rejected vehicle, Figure 1(b), can be examined in a similar manner. Unlike the rejection rates, there is no reason to suspect the validity of the defects per rejected vehicle established in this study. (It is found, for example, that the 13-year average of 1.64 defects per rejected vehicle in Cincinnati is in excellent agreement with the rate (1.57) obtained in this study.) Accordingly, upon extrapolating the curve to quarterly inspections, we would expect approximately 1.15 defects per rejected vehicle. The extrapolated rate seems reasonable, since it clearly meets the definitional requirement of at least one defect per rejected vehicle.

Thus the data indicate that the number of defects per rejected vehicle will decline very gradually as inspection frequency is increased to more than four times per year. As with the previous graph, Figure 1(b) indicates that the mechanical condition of a vehicle population will be improved only slightly as inspection frequency is increased beyond a certain point.

CONCLUSIONS

The major hypothesis of this study is that PMVI influences the overall mechanical condition of a vehicle population. The logic of the study was based on the assumptions that:

(1) The set of items, components, and systems considered in the D7.1 Standard constitutes an acceptable description of the mechanical characteristics of a vehicle.

(2) The condition of operation of the same set of items, components, and systems (as measured on a consistent pass-fail basis) constitutes an acceptable description of the mechanical condition of a vehicle.

(3) Given a specific set of these inspection parameters, it is possible to compare various vehicle populations and thus to make judgments of the efficacy of various inspection techniques.

Assuming the validity of these statements and of the experimental methodology, the data from this study show that PMVI significantly influences the overall mechanical condition of vehicle populations. In the vehicle populations examined, it was found that:

(1) Vehicle populations subject to PMVI are in measurably better mechanical condition than vehicle populations not subject to PMVI.

(2) The mechanical condition of a vehicle population is measurably improved as the frequency of inspection increases.

(3) The number of mechanical defects per rejected vehicle decreases as the frequency of inspection increases.

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Appendix A

DETAILED PRESENTATION OF FINDINGS

The inspection data, recorded on a specially prepared form (Fig. 2), were subsequently encoded and transferred to IBM cards. A separate deck of data cards was produced for each inspection jurisdiction, and then machine sorted to produce counts* of the following characteristics for each vehicle population:

Population distribution by vehicle age group and mileage group

Rejection rate by vehicle age group and mileage group

Defects per rejected vehicle by vehicle age group and mileage group

POPULATION DIFFERENCES

Statistics describing the vehicle populations in terms of age groups, mileage groups, and per capita income were prepared. For example, the distribution of inspected vehicle population by age group is shown in Figure 3(a)**, and the cumulative percentage distribution of these populations is shown in Figure 3(b). Figure 3(a) illustrates that, in addition to the input of new cars and the run out of older models, each of the populations exhibits a slightly different mix of car ages. The median age of the vehicles in these populations can be determined from the curves presented in Figure 3(b); these median ages are tabulated in Table IV.

It is postulated that these variations in median age can be explained in part by differences in the per capita income for each location and in part by the differences in topography and weather. Per capita income data have also been presented in Table IV.

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*Complete tabulations of these counts are presented following the appendix.

**All curves shown in this appendix are smooth curves fitted to the observed data.

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MOTOR VEHICLE SAFETY INSPECTION

Date__/__/67 Location: Cin DC-1 DC-2 AA

Vehicle Year_____ Make_____ Style_____

Model_____ Mileage_____

____Wheel Alignment: R_____ In Out

L_____ In Out

____Steering Operation

____Tires

____Exhaust System

____Brake Force LF_____ RF_____

LR_____ RR_____

____Parking Brake_____

____Headlamps

____Aim

____Parking Lights

____Turn Signals

____Tail Lights

____Stop Lights

____Windshield

____Windows

____Wipers

____Horn

____Mirrors

____Vehicle

HSRI Form 11

FIGURE 2. HSRI INSPECTION FORM

Table IV

MEDIAN VEHICLE AGE AND PER CAPITA INCOME

City and State	Med. Veh. Age	Per Capita Income
Ann Arbor, Michigan	2.8 years	$3,728
Washington, D. C.	3.3 years	$3,367
Cincinnati, Ohio	3.0 years	$2,639
Memphis, Tennessee	3.7 years	$2,227

The question must be raised as to how these observed differences in median age have influenced the results of this study. It appears reasonable to assume that, all other things being equal, a "new" population would produce a lower rejection rate than an "old" population. If the proportion of "new" vehicles were to be increased in a noninspected vehicle population, the "newness" effect would tend to reduce the rejection rate found in the noninspected population. Conversely, by increasing the mix of "old" vehicles in a triannually inspected vehicle population, the "oldness" effect should tend to increase the rejection rate found in that population. Thus, in this study, the differences in median age of the four populations tend to minimize rather than exaggerate the effects of PMVI.

The distribution by mileage groups and the cumulative percentage distribution within the inspected vehicle populations are shown, respectively, in Figures 4(a) and 4(b). Since mileage is not recorded in the inspections performed at Memphis, no curves are given for that city. It is apparent, from Figure 4(a), that the mileage characteristics of the populations under study are similar. It may be presumed that vehicle usage rates are similar in each of the vehicle populations under study. Median mileages can be determined from Figure 4(b) and are tabulated in Table V. Since the spread of the medians is not large, it was concluded that the test populations do not differ significantly with respect to mileage characteristics.

Table V

MEDIAN VEHICLE MILEAGE

Inspect. Loc.	Med. Veh. Age	Med. Veh. Mileage	Med. Miles/Yr.
Ann Arbor	2.8 years	29,500	10,536
Washington	3.3 years	26,500	8,030
Cincinnati	3.0 years	28,500	9,000
Memphis	3.7 years	no data	no data

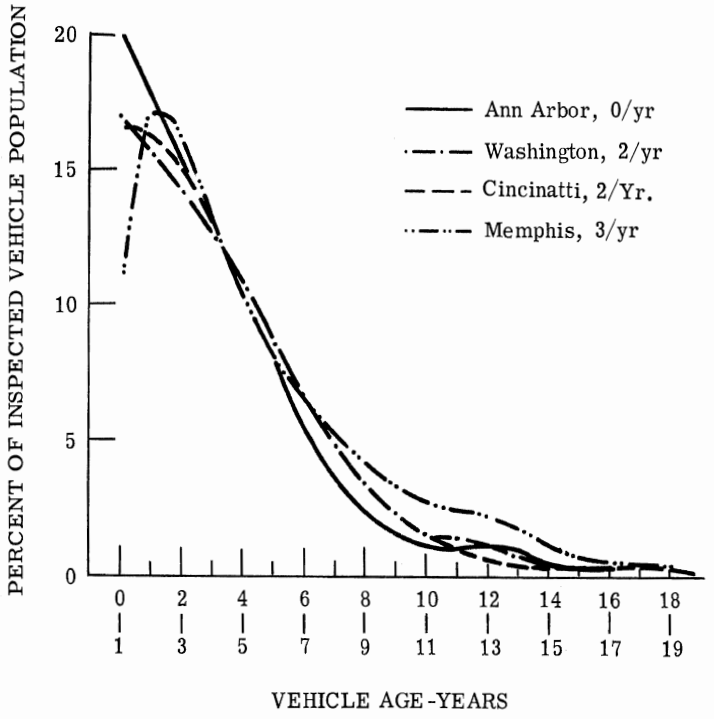


FIGURE 3(a). DISTRIBUTION OF INSPECTED VEHICLE POPULATION BY AGE GROUP

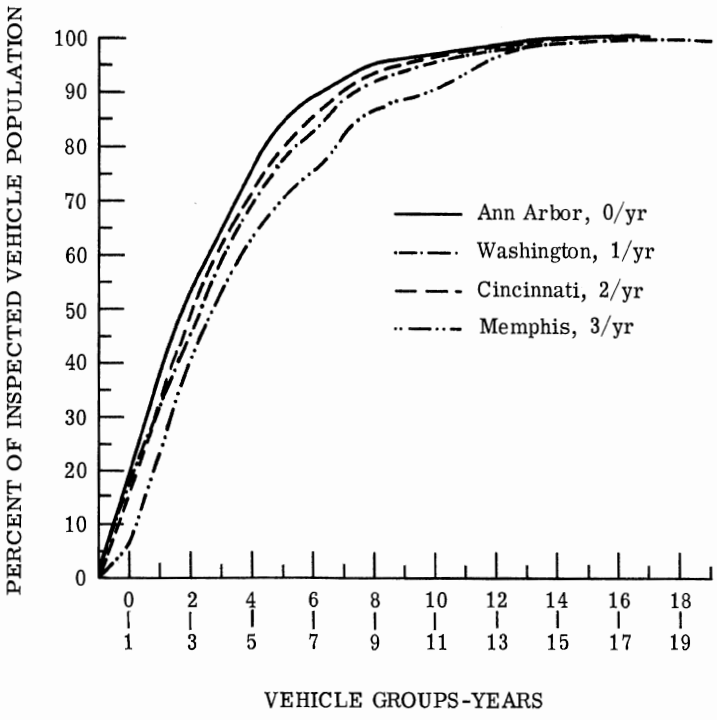


FIGURE 3(b). CUMULATIVE PERCENTAGE DISTRIBUTION OF INSPECTED VEHICLE POPULATION BY VEHICLE AGE GROUP

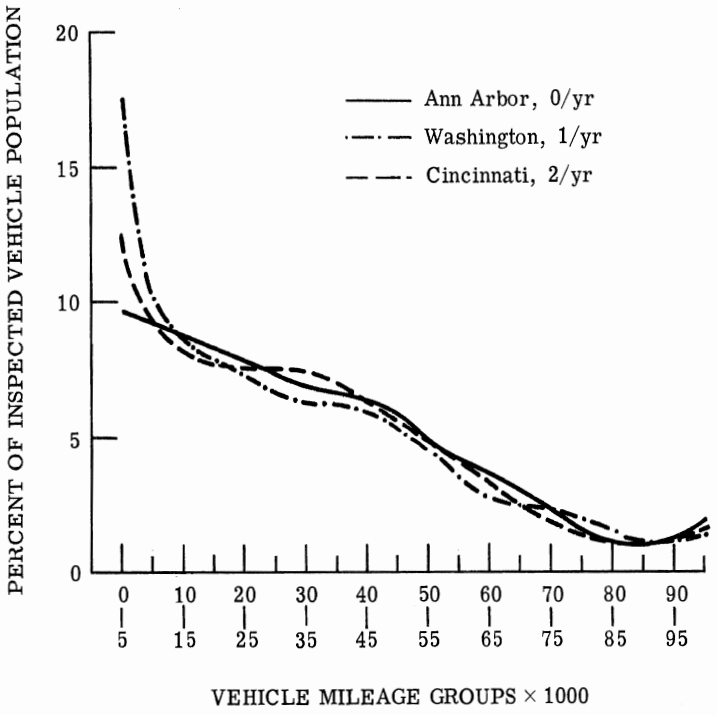


FIGURE 4(a). DISTRIBUTION OF INSPECTED VEHICLE POPULATION BY MILEAGE GROUP

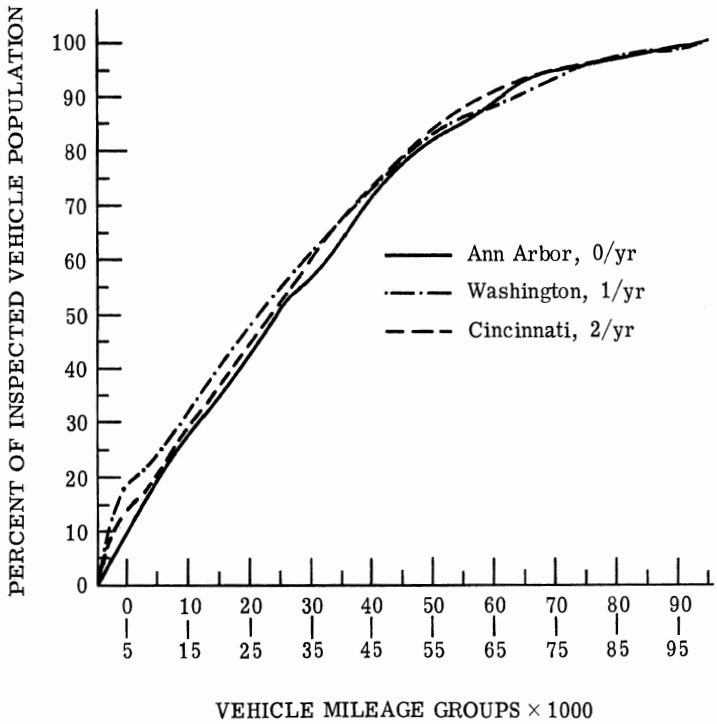


FIGURE 4(b). CUMULATIVE PERCENTAGE DISTRIBUTION OF INSPECTED VEHICLE POPULATION BY VEHICLE MILEAGE GROUP

VEHICLE REJECTION RATES

The vehicle rejection rate is the percentage of vehicles from the sample populations that were rejected during inspection. For analysis the vehicle rejection rate has been considered as a function of both the vehicle age groups and the mileage groups.

Figure 5 is a plot of the percentage of vehicles rejected in each age group for each inspection location (frequency). The dashed horizontal lines represent the overall average rejection rates. It should be noted (see Fig. 3) that beyond

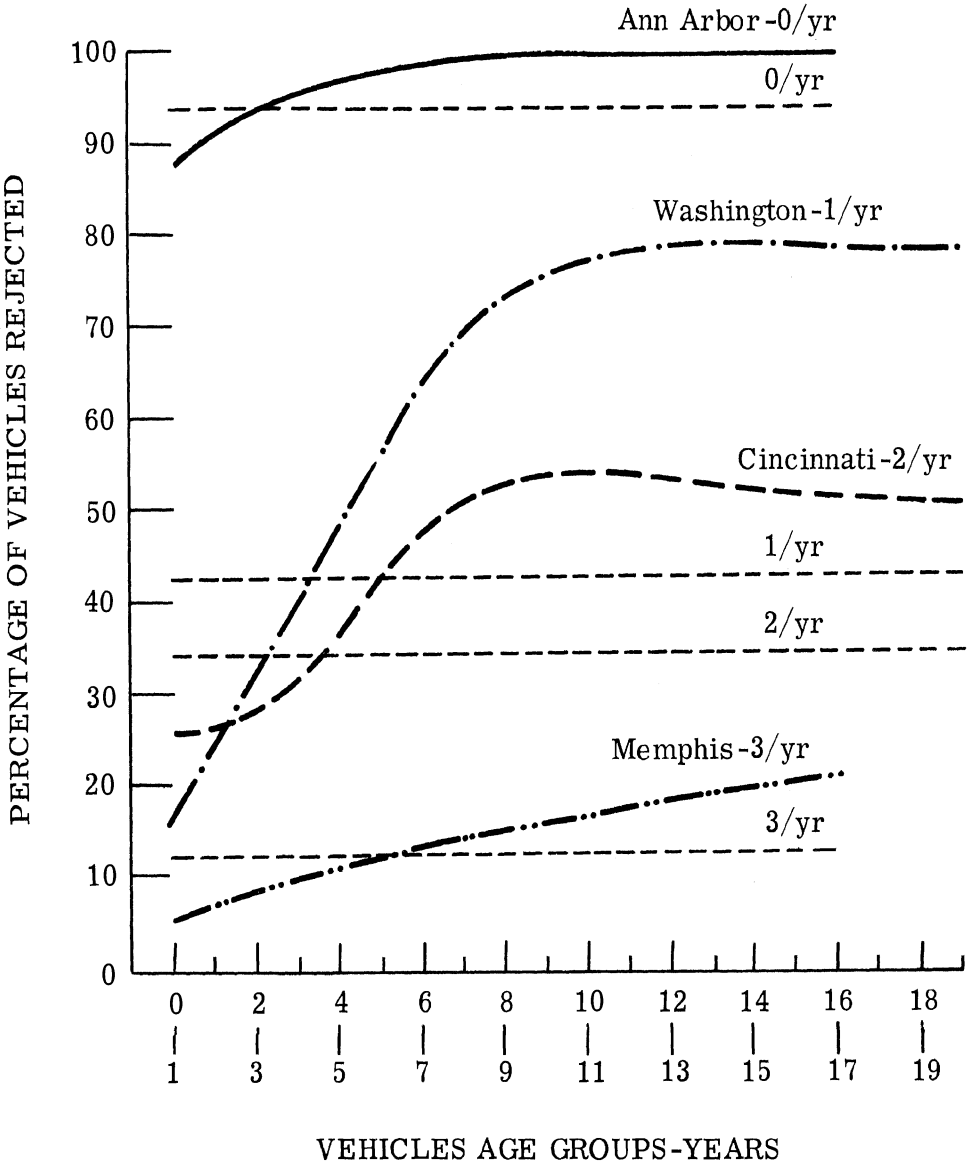


FIGURE 5. DISTRIBUTION OF VEHICLES REJECTED BY AGE GROUP

the age of ten years the sample size of the individual age groups becomes quite small, resulting in great variations in the corresponding rejection percentages. Since vehicles older than ten years represent only about 5% of the total population (except Memphis), the shape and slope of the curves beyond that point are not particularly meaningful. Each curve shows a relatively constant increase in rejection rate up to about nine years, where a peak seems to occur.

The curves in Figure 6 present the distribution of rejected vehicles by age group in percentages of the total population. It can be seen, for example, that

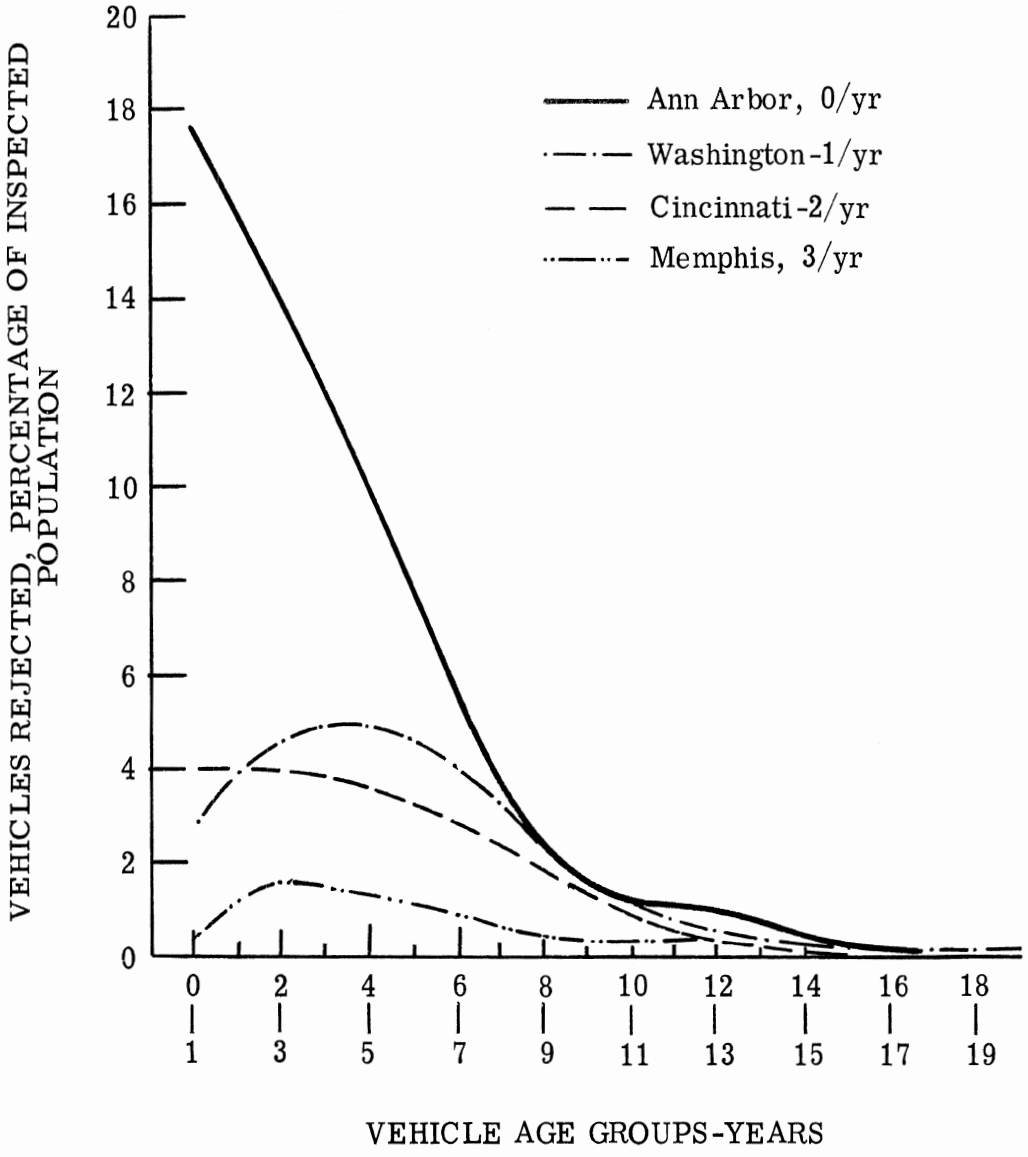


FIGURE 6. DISTRIBUTION OF VEHICLES REJECTED AS A PERCENTAGE OF TOTAL INSPECTED POPULATION BY AGE GROUP

rejected vehicles in the 0- to 1-year age group comprise almost 18% of the vehicles inspected in Ann Arbor. In Memphis, where triannual inspections are in force, rejected vehicles in the 0- to 1-year age group constitute only about 1.5% of the total vehicle population.

In Ann Arbor, rejected vehicles in the 8- to 9-year age group represent slightly over 2% of the total population, whereas in Memphis the rejected vehicles in this same age group constitute about 0.25% of the total population. The annually and semiannually inspected populations fall between these extremes, the annually inspected population showing the higher rejection rate of the two.

The relationship of rejection rate to vehicle mileage groups for each inspection location is illustrated in Figure 7. Figure 8 shows the distribution of rejected vehicles by mileage group in percentages of the total population. Examination of the curves in Figure 8 shows a pattern similar to that depicted in Figure 6.

VEHICLE DEFECTS

Defects per rejected vehicle are plotted as a function of vehicle age and mileage groups in Figures 9(a) and 9(b), respectively. These plots were constructed by applying a least-squares formula to the data points, thereby generating straight lines whose slope reflects the effects of aging and mileage on defects per rejected vehicle. The vertical separations of the lines indicate the influence of inspection frequency.

DISTRIBUTION OF DEFECTS

The distribution of defects by component are charted in Figures 10, 11 and 12. Figure 10 shows the number of defects per rejected vehicle in each component category for each inspection location. Figure 11 shows defects in a given component category as a percentage of the total defects detected in each inspection location. Figure 12 shows the distribution of defects in each component category as a percentage of the total defects detected from all inspection locations. In Figure 12, each category is shown in descending order.

The charts reveal that defects are concentrated in six of the eighteen inspection categories. Headlight aim accounts for the largest percentage, followed by wheel alignment, brake force, miscellaneous, steering operation, and headlamp operation, which are within 1 or 2 percent of each other. The remaining 12 categories of defects are about evenly divided between those that reflect some influence

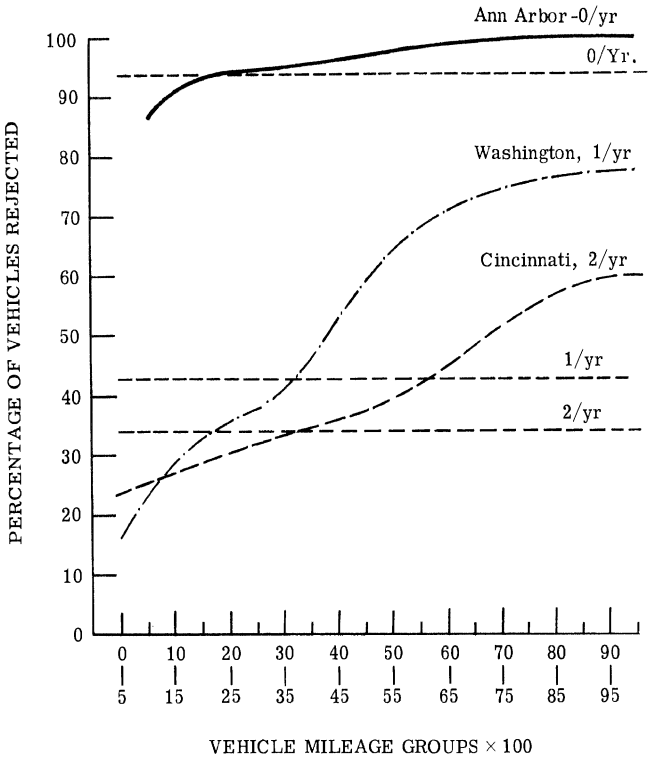


FIGURE 7. DISTRIBUTION OF VEHICLES REJECTED BY MILEAGE GROUP

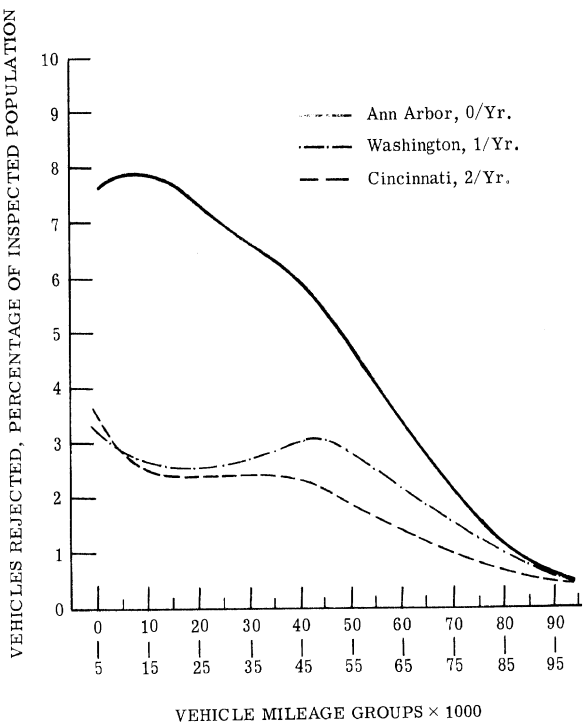
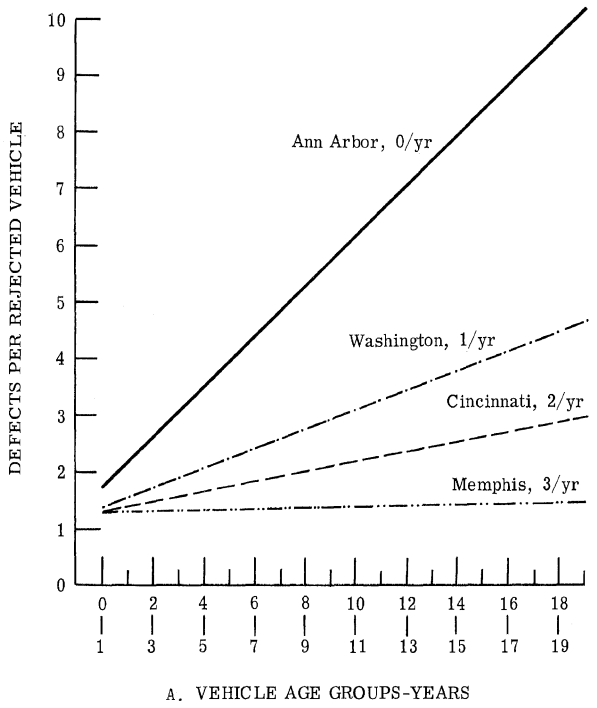


FIGURE 8. DISTRIBUTION OF VEHICLES REJECTED AS A PERCENTAGE OF TOTAL INSPECTED POPULATION BY MILEAGE GROUP



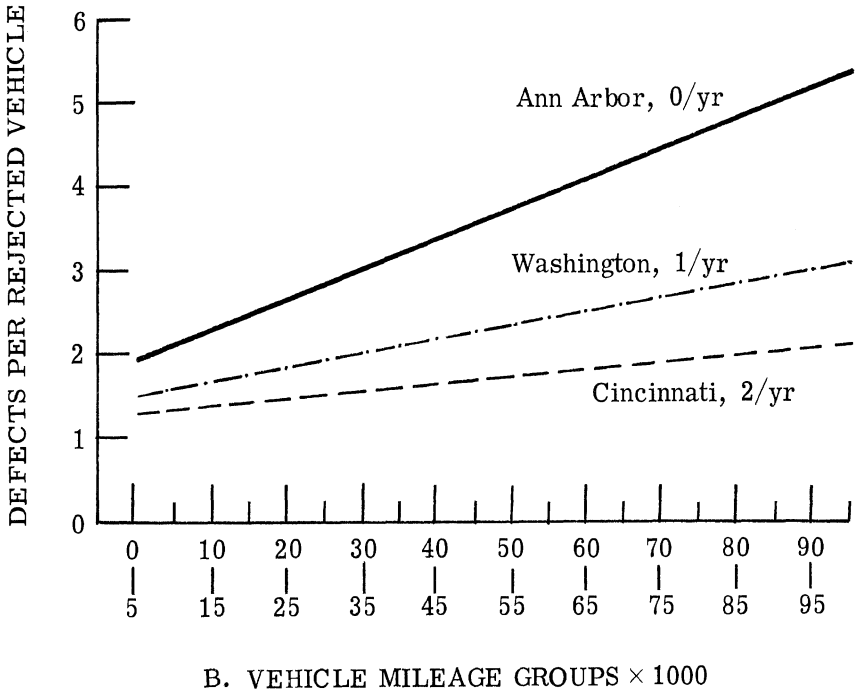


FIGURE 9. DISTRIBUTION OF DEFECTS PER REJECTED VEHICLE: (a) BY AGE GROUPS; (b) BY MILEAGE GROUPS

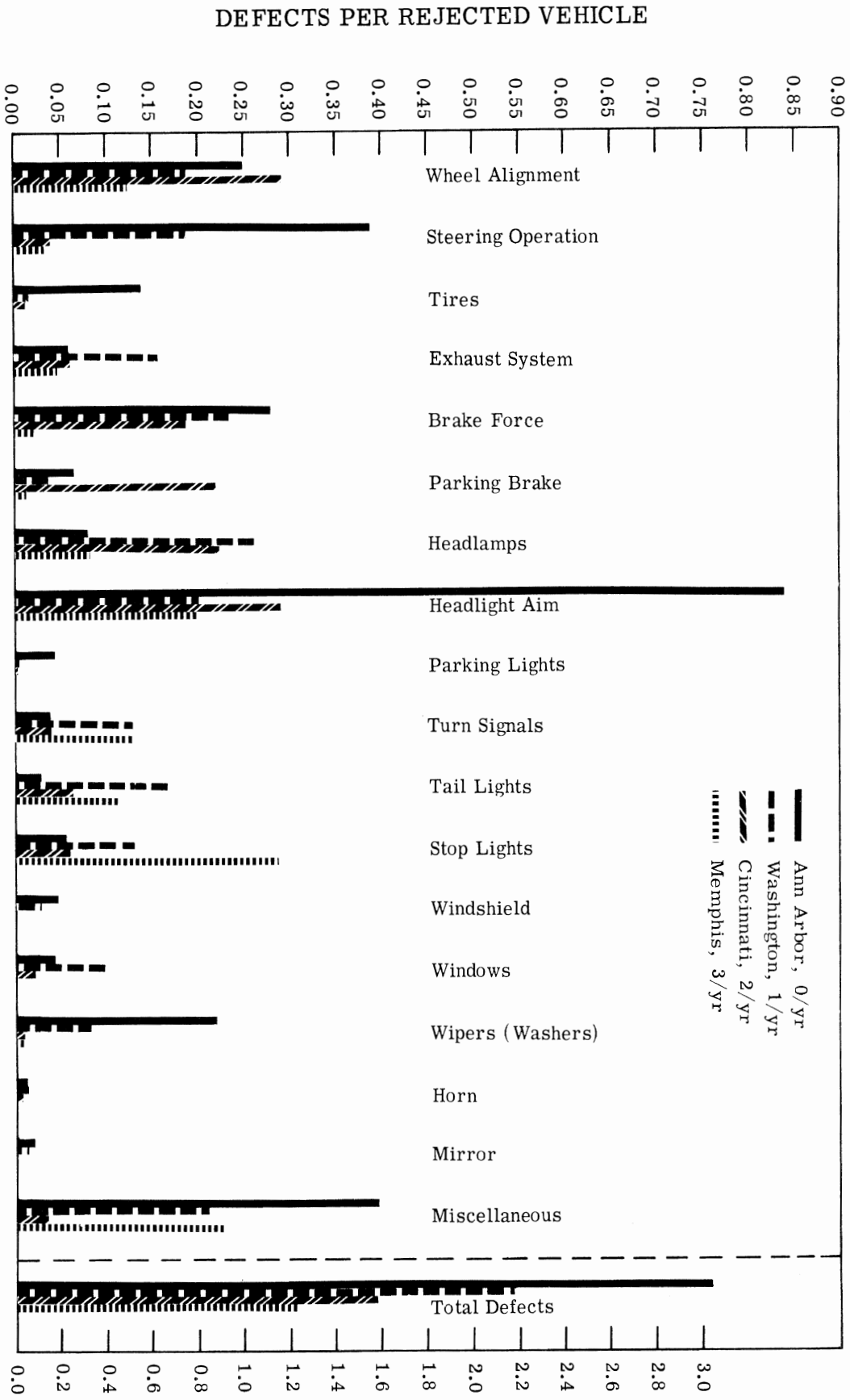


FIGURE 10. DEFECTS PER REJECTED VEHICLE

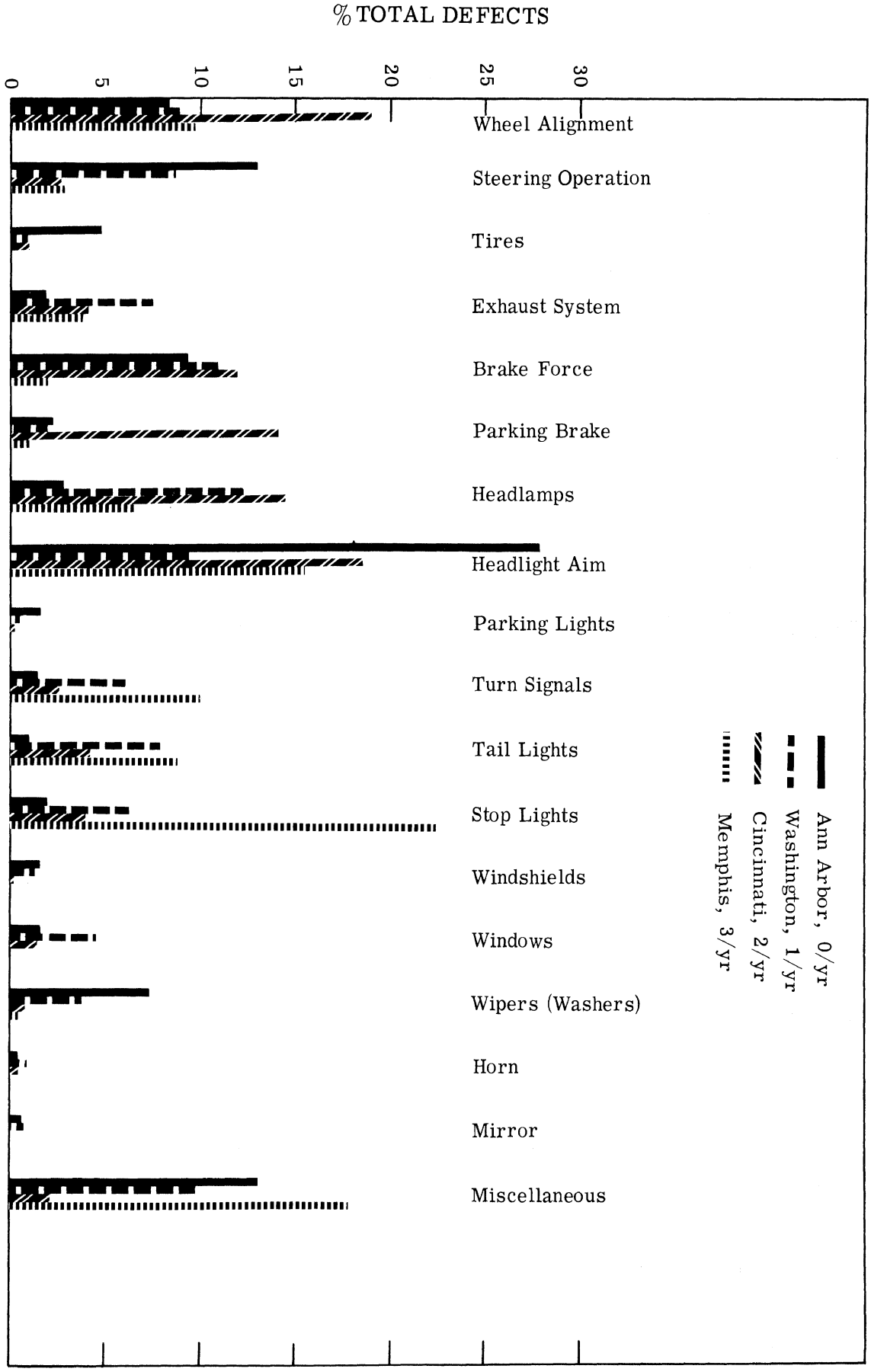


FIGURE 11. DEFECT OCCURRENCE IN VEHICLE POPULATIONS

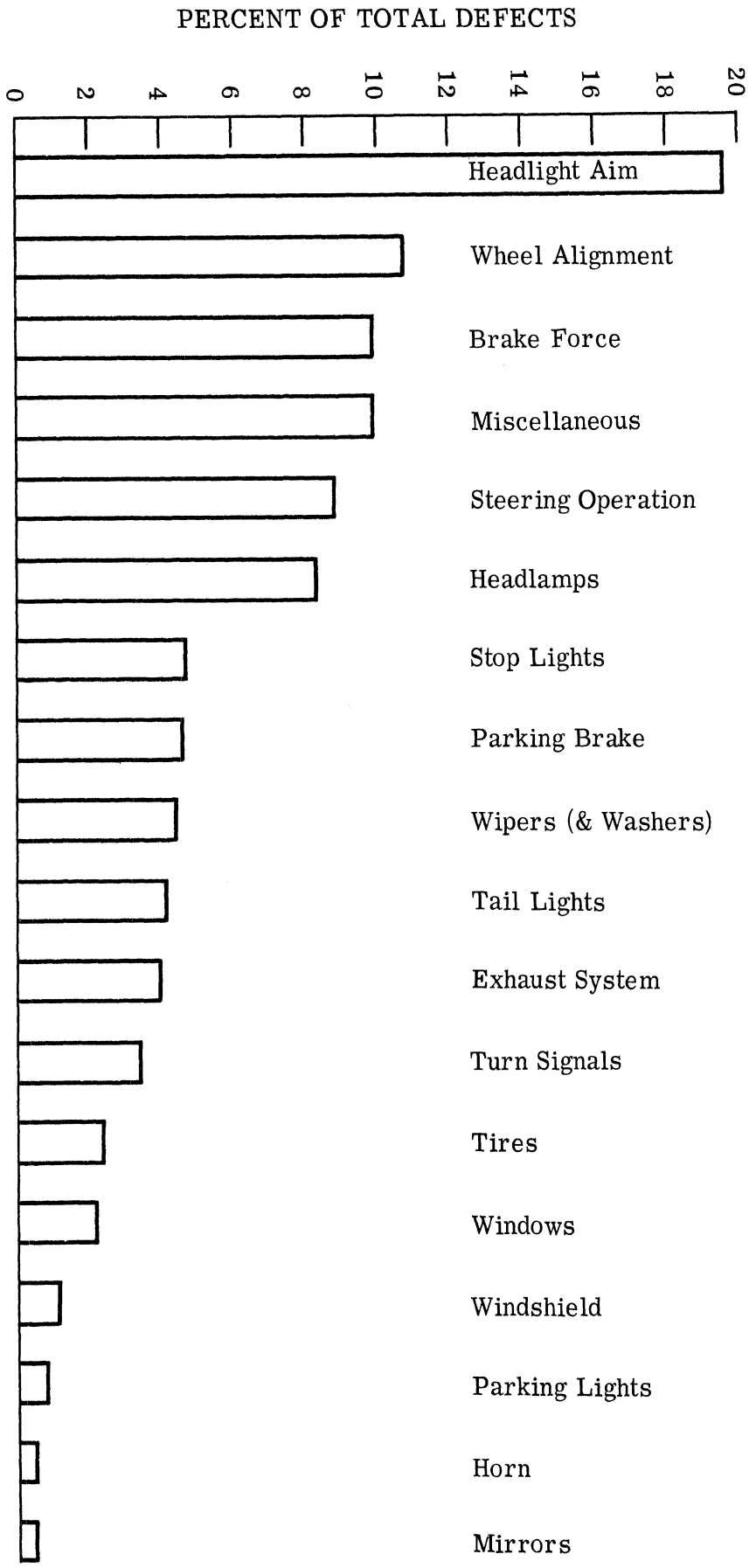


FIGURE 12. DISTRIBUTION OF ALL DEFECTS DETECTED

of inspection frequency and those that do not. It is noted that there is no consistent relationship between frequency of inspection and the proportion of defects in a given category. This is probably accounted for by the differences in driving environment and/or inspection emphasis.

SUMMARY

This study assumes that the mechanical condition of a motor vehicle can be defined and measured by a standardized motor vehicle safety inspection, wherein "mechanical condition" is measured by the rejection rate of a vehicle population. The study indicates that:

(1) Vehicle populations subject to PMVI will be in substantially better mechanical condition than vehicle populations not subject to PMVI.

(2) The mechanical condition of a vehicle population will be substantially improved as the frequency of inspection is increased.

(3) The number of mechanical defects per rejected vehicle will decrease as the frequency of inspection is increased.

CONCLUDING REMARKS

The data also indicate that the bulk of rejections occur in that segment of a vehicle population encompassing the first few years of automobile life. Conversely, even though they suffer the highest rejection rate, older vehicles account for a small proportion of total rejections.

While the rejection rates of certain inspection items do not seem to be greatly influenced by inspection frequency, other items appear to be very sensitive in this regard. In addition, the defect distribution indicates a concentration of defects among these "sensitive" inspection items. Thus, it appears that the mechanical condition of a motor vehicle population might be more effectively improved by emphasizing the inspection of a relatively few items. On the other hand, some inspection items, although they are not significant determinants of the rejection rate, are nevertheless important determinants of the safety of a motor vehicle population.

APPENDIX B

Data Tables

by

Vehicle Age Groups

LANE LOCATION: #1 Cincinnati, Ohio

Vehicle Age-Years	Model Year	Vehicles Inspected	% Vehicles Inspected	Vehicles Passed	Vehicles Rejected	% Vehicles Rejected/Group	% Vehicles Rejected/Total	Wheel Alignment	Steering Operation	Tires	Exhaust System	Brake Force	Parking Brake	Headlamps	Headlight Aim	Parking Lights	Turn Signals	Tail Lights	Stop Lights	Windshield	Windows	Wipers (and Washers)	Horn	Mirrors	Miscellaneous	TOTAL DEFECTS	% TOTAL DEFECTS	Defects Per Rejected Vehicle
0-1	67	261	15.7	195	66	25.3	4.0	14	0	0	1	7	15	20	24	0	2	1	2	0	0	0	0	0	2	88	9.9	1.33
1-2	66	305	18.3	221	84	27.5	5.0	31	0	0	1	11	13	18	27	0	1	3	3	0	0	0	0	0	0	108	12.1	1.29
2-3	65	261	15.7	193	68	26.1	4.1	23	0	2	0	12	17	14	20	0	1	5	2	0	0	0	0	0	3	99	11.1	1.46
3-4	64	206	12.3	144	62	30.1	3.7	22	2	0	3	11	16	11	15	1	1	5	3	0	0	0	0	0	0	90	10.1	1.45
4-5	63	173	10.4	118	55	31.8	3.3	14	0	2	5	9	12	10	16	0	0	6	2	1	0	0	2	0	0	79	8.9	1.44
5-6	62	120	7.2	59	61	50.8	3.7	19	2	0	7	12	9	8	14	0	4	3	4	0	1	1	0	0	5	89	10.0	1.46
6-7	61	100	6.0	56	44	44.0	2.6	9	6	1	6	9	10	12	9	0	4	4	4	0	0	2	0	0	2	78	8.7	1.77
7-8	60	91	5.5	47	44	48.3	2.6	11	7	0	5	10	14	14	14	0	3	2	6	0	1	1	1	0	2	91	10.2	2.07
8-9	59	56	3.4	22	34	60.7	2.1	9	2	1	2	7	8	10	12	0	2	0	2	0	5	1	1	0	2	64	7.2	1.88
9-10	58	20	1.2	7	13	65.0	0.8	4	1	1	0	6	1	6	7	0	1	3	2	0	0	0	0	0	0	32	3.6	2.46
10-11	57	16	1.0	11	5	31.3	0.3	0	0	1	2	1	3	0	0	0	0	2	1	0	0	0	0	0	0	10	1.1	2.00
11-12	56	26	1.6	8	18	69.2	1.1	7	2	0	2	7	3	1	4	0	1	2	1	0	4	0	0	0	2	36	4.0	2.00
12-13	55	8	0.5	4	4	50.0	0.2	1	1	0	1	1	1	2	2	0	1	0	1	0	1	0	0	0	0	12	1.4	3.00
13-14	54	6	0.3	3	3	50.0	0.2	1	0	0	0	2	1	1	0	0	0	0	0	0	0	1	0	0	0	6	0.7	2.00
14-15	53	6	0.3	4	2	53.3	0.1	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	3	0.3	1.50
15-16	52	1	0.1	1	0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.00
16-17	51	4	0.2	2	2	50.0	0.1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0.2	1.00
17-18	50	3	0.2	1	2	66.7	0.1	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	3	0.3	1.50
18-19	49	2	0.1	1	1	50.0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0.1	1.00
19-20	48	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	1665	100.0	1097	568	34.1	34.1	167	23	8	35	106	125	127	165	1	22	36	34	1	12	6	4	0	19	891	100.0	1.57

LANE LOCATION: #2 & 3 Washington, D. C.

Vehicle Age-Years	Model Year	Vehicles Inspected	% Vehicles Inspected	Vehicles Passed	Vehicles Rejected	% Vehicles Rejected/Group	% Vehicles Rejected/Total	Wheel Alignment	Steering Operation	Tires	Exhaust System	Brake Force	Parking Brake	Headlamps	Headlight Aim	Parking Lights	Turn Signals	Tail Lights	Stop Lights	Windshield	Windows	Wipers (and Washers)	Horn	Mirrors	Miscellaneous	TOTAL DEFECTS	% TOTAL DEFECTS	Defects Per Rejected Vehicle
0-1	67	213	17.1	177	37	17.3	3.0	5	2	0	1	4	1	13	13	0	4	3	3	0	0	0	1	0	2	52	4.5	1.41
1-2	66	181	14.5	130	51	28.2	4.1	13	6	1	2	6	0	13	9	1	7	6	4	0	3	2	0	1	2	76	6.6	1.49
2-3	65	187	15.0	122	65	34.8	5.2	13	7	1	9	10	2	18	13	0	4	10	6	2	5	2	0	1	6	109	9.4	1.68
3-4	64	157	12.6	98	59	37.6	4.7	12	9	1	6	15	2	13	12	1	3	9	7	1	5	2	2	1	13	114	9.8	1.93
4-5	63	128	10.3	66	64	50.0	5.1	10	6	2	9	20	0	14	11	0	7	11	15	1	4	6	1	1	9	127	11.1	2.00
5-6	62	114	9.1	49	65	57.0	5.2	16	17	1	12	11	1	18	10	0	12	10	9	3	2	8	3	2	15	150	12.9	2.31
6-7	61	64	5.1	24	40	62.5	3.2	9	8	0	8	11	2	11	9	0	4	5	8	1	5	4	1	0	7	93	8.0	2.33
7-8	60	72	5.8	21	52	72.2	4.2	6	15	1	10	21	3	15	8	0	7	10	8	1	7	1	0	2	16	131	11.3	2.52
8-9	59	34	2.7	7	27	79.4	2.2	4	11	0	10	8	3	8	7	1	4	6	1	4	5	5	1	0	15	93	8.0	3.44
9-10	58	22	1.8	2	20	90.9	1.6	2	6	0	3	6	2	3	3	0	4	6	1	1	4	1	1	0	7	50	4.3	2.50
10-11	57	18	1.4	3	15	83.3	1.2	2	6	1	4	4	1	8	5	0	5	4	1	0	4	3	1	0	4	53	4.6	3.53
11-12	56	16	1.3	7	9	56.3	0.7	2	2	0	4	4	2	2	1	0	1	3	2	1	3	1	0	0	8	36	3.1	4.00
12-13	55	13	1.0	4	9	69.2	0.7	0	1	0	3	1	0	0	0	0	2	3	2	0	1	5	0	0	2	20	1.8	2.33
13-14	54	8	0.6	2	6	75.0	0.4	2	3	0	1	2	0	1	1	0	0	0	0	0	1	1	0	0	2	14	1.2	2.33
14-15	53	6	0.5	0	6	100.0	0.4	2	1	0	0	2	0	1	2	0	1	2	0	0	1	0	0	0	3	15	1.3	2.50
15-16	52	1	0.1	0	1	100.0	0.1	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	3	0.3	3.00
16-17	51	5	0.4	2	3	60.0	0.2	0	0	0	1	0	0	1	1	0	0	0	1	0	0	1	0	0	0	5	0.4	1.67
17-18	50	5	0.4	2	3	60.0	0.2	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1	0	0	0	5	0.4	1.67
18-19	49	2	0.2	1	1	50.0	0.1	1	0	0	1	0	1	0	0	0	1	1	1	0	1	0	0	0	1	8	0.7	8.00
19-20	48	1	0.1	0	1	100.0	0.1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0.1	1.00
Total	—	1249	100.0	717	532	42.6	42.6	100	100	8	84	125	120	139	106	3	68	90	71	15	52	43	11	8	112	1155	100.0	2.17

LANE LOCATION: #4 Ann Arbor, Michigan

Vehicle Age-Years	Model Year	Vehicles Inspected	% Vehicles Inspected	Vehicles Passed	Vehicles Rejected	% Vehicles Rejected/Group	% Vehicles Rejected/Total	Wheel Alignment	Steering Operation	Tires	Exhaust System	Brake Force	Parking Brake	Headlamps	Headlight Aim	Parking Lights	Turn Signals	Tail Lights	Stop Lights	Windshield	Windows	Wipers (and Washers)	Horn	Mirrors	Miscellaneous	TOTAL DEFECTS	% TOTAL DEFECTS	Defects Per Rejected Vehicle
0-1	67	118	20.0	15	103	87.3	17.4	18	20	4	1	26	1	2	85	0	0	1	2	1	3	7	0	0	11	182	10.9	1.77
1-2	66	104	17.6	5	99	95.2	16.7	25	23	12	0	24	1	9	89	2	0	1	0	6	3	11	1	0	26	233	13.9	2.35
2-3	65	94	15.9	8	86	91.5	14.6	24	26	12	2	24	2	5	67	3	3	1	3	4	1	20	0	1	32	232	13.7	2.67
3-4	64	70	11.9	3	67	95.7	11.3	9	31	10	4	17	6	4	51	5	2	0	3	2	4	11	1	0	29	189	11.3	2.82
4-5	63	62	10.5	3	59	95.2	10.0	20	25	6	3	18	4	8	47	3	4	2	5	3	5	17	0	2	26	198	11.8	3.36
5-6	62	54	9.1	1	53	98.1	9.0	16	32	10	6	17	6	1	47	5	2	4	4	2	1	14	0	1	27	195	11.6	3.68
6-7	61	23	3.9	0	23	100.0	3.9	8	14	5	1	11	4	3	21	1	3	1	2	1	1	11	0	2	14	103	6.2	4.48
7-8	60	22	3.7	1	21	95.0	3.6	7	15	4	0	1	4	1	17	2	0	0	1	1	1	10	0	1	19	84	5.0	4.00
8-9	59	16	2.7	0	16	100.0	2.7	2	12	8	7	4	4	6	15	4	3	2	2	2	1	8	2	2	13	97	5.8	6.06
9-10	58	2	0.3	0	2	100.0	0.3	0	2	1	0	1	2	1	2	0	1	1	1	1	0	1	0	0	2	16	1.0	8.00
10-11	57	7	1.2	0	7	100.0	1.2	3	2	1	1	2	1	1	7	0	2	0	2	0	0	3	1	0	7	33	2.0	4.71
11-12	56	5	0.8	0	5	100.0	0.8	1	4	2	2	4	0	2	5	0	0	2	1	1	3	3	0	1	6	37	2.2	7.40
12-13	55	7	1.2	0	7	100.0	1.2	3	5	2	2	2	0	1	7	0	0	0	2	2	1	3	1	0	4	35	2.1	5.00
13-14	54	5	0.8	0	5	100.0	0.8	1	3	0	2	2	1	0	5	0	0	0	2	0	0	2	0	0	2	20	1.2	4.00
14-15	53	1	0.2	0	1	100.0	0.2	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	2	18	1.1	18.00
15-16	52	0	0.0	0	0	100.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.00
16-17	51	1	0.2	0	1	100.0	0.2	0	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0.2	4.00
17-18	50	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18-19	49	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
19-20	48	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	591	100.0	36	555	93.9	93.9	138	216	79	32	155	36	45	467	26	21	16	31	27	25	122	7	11	220	1674	100.0	3.02

LANE LOCATION: #5 Memphis, Tennessee

Vehicle Age-Years	Model Year	Vehicles Inspected	% Vehicles Inspected	Vehicles Passed	Vehicles Rejected	% Vehicles Rejected/Group	% Vehicles Rejected/Total	Wheel Alignment	Steering Operation	Tires	Exhaust System	Brake Force	Parking Brake	Headlamps	Headlight Aim	Parking Lights	Turn Signals	Tail Lights	Stop Lights	Windshield	Windows	Wipers (and Washers)	Horn	Mirrors	Miscellaneous	TOTAL DEFECTS	% TOTAL DEFECTS	Defects Per Rejected Vehicle
0-1	67	91	6.6	85	6	6.6	0.4	0	0		1	0	0	1	2		0	0	2	0		0		0	2	8	3.6	1.33
1-2	66	245	17.8	223	22	9.0	1.6	4	0		0	0	0	1	5		3	3	2	0		0		0	5	23	10.4	1.05
2-3	65	224	16.3	201	23	10.3	1.7	5	0		0	0	0	1	6		3	3	6	0		0		0	2	26	11.8	1.13
3-4	64	182	13.2	160	22	12.1	1.6	2	1		0	1	0	1	6		3	3	4	0		0		0	5	26	11.8	1.18
4-5	63	140	10.2	125	15	10.7	1.1	1	2		1	1	0	1	2		2	2	5	0		0		0	3	20	9.1	1.33
5-6	62	91	6.6	73	18	19.8	1.3	0	0		2	0	0	1	3		3	1	5	0		0		0	6	21	9.5	1.17
6-7	61	75	5.4	61	14	18.7	1.0	0	0		0	1	0	4	2		2	1	5	0		1		0	4	20	9.1	1.43
7-8	60	86	6.2	81	5	5.8	0.4	2	1		0	0	0	0	1		1	1	2	0		0		0	1	9	4.1	1.80
8-9	59	61	4.4	54	7	11.5	0.5	3	1		1	0	0	0	1		0	1	1	0		0		0	2	10	4.5	1.43
9-10	58	21	1.5	18	3	14.3	0.2	0	0		1	0	0	0	0		0	2	1	0		0		0	1	5	2.3	1.67
10-11	57	30	2.2	24	6	20.0	0.4	0	0		0	1	0	0	2		0	0	2	0		0		0	3	8	3.6	1.33
11-12	56	114	3.2	38	6	13.6	0.4	1	0		1	0	0	1	2		3	0	3	0		0		0	1	12	5.5	2.00
12-13	55	42	3.0	32	10	23.8	0.8	2	1		0	0	2	0	1		2	1	5	0		0		0	0	14	6.4	1.40
13-14	54	18	1.3	15	3	16.7	0.2	0	0		0	0	0	1	1		0	0	0	0		0		0	1	3	1.4	1.00
14-15	53	10	0.7	6	4	40.0	0.3	0	0		1	0	0	1	0		0	0	1	0		0		0	1	4	1.8	1.00
15-16	52	7	0.5	6	1	14.3	0.1	0	0		0	0	0	0	0		0	0	0	0		0		0	1	1	0.5	1.00
16-17	51	4	0.3	1	3	75.0	0.2	0	0		0	0	0	0	0		0	1	3	0		0		0	1	5	2.3	1.67
17-18	50	8	0.6	5	3	37.5	0.2	1	0		0	0	0	1	0		0	0	2	0		0		0	0	4	1.8	1.33
18-19	49	—	—	—	—	—	—	—	—		—	—	—	—	—		—	—	—	—		—		—	—	—	—	—
19-20	50	—	—	—	—	—	—	—	—		—	—	—	—	—		—	—	—	—		—		—	—	—	—	—
Total	—	1379	100.0	1208	171	12.4	12.4	21	6	—	8	4	2	14	34	—	22	19	49	0	—	1	—	0	39	219	100.0	1.28

APPENDIX C

Data Tables

by

Vehicle Mileage Groups

LANE LOCATION: #1 Cincinnati, Ohio

Vehicle Mileage × 1000	Vehicles Inspected	% Vehicles Inspection	Vehicles Passed	Vehicles Rejected	% Vehicles Rejected/Group	% Vehicles Rejected/Total		Wheel Alignment	Steering Operation	Tires	Exhaust System	Brake Force	Parking Brake	Headlamps	Headlight Aim	Parking Lights	Turn Signals	Tail Lights	Stop Lights	Windshield	Windows	Wipers (and Washers)	Horn	Mirrors	Miscellaneous	TOTAL DEFECTS	% TOTAL DEFECTS	Defects Per Rejected Vehicle
0-5	215	12.9	157	58	27.0	3.5		11	1	0	0	8	17	14	18	0	1	1	3	0	0	0	0	0	2	76	8.5	1.31
5-10	126	7.6	97	29	23.0	1.7		7	1	0	1	3	5	9	16	0	1	1	0	0	0	0	0	0	1	45	5.0	1.55
10-15	149	9.0	117	32	21.5	1.9		9	0	0	0	6	5	7	10	0	1	0	2	0	0	0	0	0	0	40	4.5	1.25
15-20	117	7.0	74	43	36.8	2.6		19	0	0	1	4	6	7	11	0	1	3	1	0	0	1	0	0	0	54	6.1	1.26
20-25	127	7.6	85	42	33.1	2.6		19	2	1	0	5	8	7	10	0	1	1	2	0	1	0	0	0	1	58	6.5	1.38
25-30	135	8.2	96	39	29.4	2.3		12	1	0	1	8	9	13	11	0	0	4	1	1	0	0	0	0	1	62	7.0	1.59
30-35	120	7.2	84	36	30.0	2.2		4	0	2	5	8	5	8	10	0	1	3	2	0	0	0	1	0	2	51	5.7	1.42
35-40	128	7.7	84	44	34.4	2.6		13	0	1	1	11	11	10	14	1	0	2	0	0	0	0	1	0	0	65	7.3	1.48
40-45	103	6.2	61	42	40.8	2.5		17	0	0	6	6	11	9	6	0	4	2	1	0	1	3	0	0	4	70	7.9	1.67
45-50	85	5.1	50	35	41.2	2.1		10	1	0	1	9	6	8	12	0	2	2	3	0	1	0	0	0	2	57	6.4	1.63
50-55	74	4.4	44	30	40.5	1.8		8	2	1	3	8	6	4	7	0	1	0	3	0	0	0	1	0	1	45	5.0	1.50
55-60	74	4.4	49	25	33.8	1.5		9	2	2	2	4	4	4	10	0	1	4	5	0	2	0	0	0	1	50	5.6	2.00
60-65	60	3.6	35	25	41.7	1.5		9	3	0	3	6	4	5	8	0	1	3	3	0	3	0	0	0	1	49	5.5	1.96
65-70	34	2.0	13	21	61.8	1.3		3	4	0	2	6	6	3	5	0	1	3	1	0	0	0	0	0	0	34	3.8	1.62
70-75	25	1.5	13	12	48.0	0.7		3	2	0	2	3	3	3	2	0	1	2	2	0	0	1	0	0	1	25	2.8	2.08
75-80	21	1.3	10	11	52.4	0.7		1	1	1	1	3	3	3	2	0	2	1	0	0	0	0	0	0	0	18	2.0	1.64
80-85	22	1.3	7	15	68.4	0.9		8	1	0	2	1	5	5	5	0	1	0	1	0	1	0	0	0	1	31	3.5	2.07
85-90	12	0.7	6	6	50.0	0.3		0	0	0	1	2	3	1	2	0	0	0	1	0	2	0	1	0	0	13	1.5	2.17
90-95	10	0.6	3	7	70.0	0.4		2	1	0	1	1	4	2	2	0	1	0	0	0	0	1	0	0	0	15	1.7	2.14
95-99+	28	1.7	12	16	57.1	1.0		3	1	0	2	4	4	5	4	0	1	4	3	0	1	0	0	0	1	33	3.7	2.06
Total	1665	100.0	1097	568	34.1	34.1		167	23	8	35	106	125	127	165	1	22	36	34	1	12	6	4	0	19	891	100.0	1.57

LANE LOCATION: #2 & 3 Washington, D. C.

Vehicle Mileage × 1000	Vehicles Inspected	% Vehicles Inspected	Vehicles Passed	Vehicles Rejected	% Vehicles Rejected/Group	% Vehicles Rejected/Total		Wheel Alignment	Steering Operation	Tires	Exhaust System	Brake Force	Parking Brake	Headlamps	Headlight Aim	Parking Lights	Turn Signals	Tail Lights	Stop Lights	Windshield	Windows	Wipers (and Washers)	Horn	Mirrors	Miscellaneous	TOTAL DEFECTS	% TOTAL DEFECTS	Defects Per Rejected Vehicle
0-5	122	17.8	183	39	17.6	3.1		5	3	0	3	7	1	13	11	0	4	4	3	0	1	0	1	1	4	60	5.2	1.54
5-10	80	6.4	57	23	28.8	1.8		6	4	1	3	2	0	5	6	0	2	2	4	0	3	2	0	0	7	47	4.1	2.04
10-15	99	7.9	69	30	30.3	2.4		4	2	0	6	4	2	5	3	1	2	3	4	0	2	3	0	0	1	42	3.6	1.40
15-20	112	9.0	76	37	33.0	3.0		8	5	1	2	6	1	14	9	0	5	8	5	1	0	0	2	2	5	72	6.2	1.95
20-25	84	6.7	53	32	38.0	2.6		3	6	1	4	8	2	8	5	0	2	4	3	0	3	0	0	0	7	56	4.9	1.75
25-30	90	7.2	59	30	33.3	2.4		5	2	0	1	8	1	5	5	0	6	5	4	1	3	6	0	0	3	56	4.9	1.87
30-35	67	5.4	39	28	41.7	2.2		4	3	0	5	10	1	9	8	0	3	5	3	2	2	0	0	0	6	62	5.4	2.21
35-40	77	6.2	46	31	40.3	2.5		8	8	1	3	9	0	7	6	1	4	4	2	0	4	2	3	3	5	69	6.0	2.23
40-45	84	6.7	38	46	54.8	3.7		11	5	0	9	7	0	9	9	1	3	7	5	2	3	2	2	2	12	88	7.6	1.91
45-50	63	5.0	18	45	71.4	3.6		10	6	0	6	11	2	12	5	0	7	5	7	0	5	3	0	0	10	89	7.7	1.98
50-55	60	4.8	27	33	55.0	2.6		9	5	1	8	4	0	12	8	0	5	5	4	1	2	6	0	0	4	75	6.5	2.27
55-60	42	3.4	9	33	78.0	2.6		9	13	2	9	8	1	5	5	0	5	8	4	2	4	3	2	2	7	87	7.5	2.64
60-65	29	2.3	9	20	69.0	1.6		2	8	0	4	5	3	5	1	0	3	7	5	1	2	1	0	0	8	55	4.8	2.75
65-70	33	2.6	7	26	78.8	2.1		1	10	0	7	8	1	5	9	0	3	5	5	1	4	7	0	0	4	72	6.2	2.77
70-75	28	2.2	6	22	78.6	1.8		6	4	1	3	7	0	8	5	0	4	3	4	0	3	2	0	0	10	60	5.2	2.73
75-80	24	1.9	12	12	50.0	1.0		2	2	0	4	2	1	5	1	0	2	1	1	0	4	2	0	0	4	31	2.7	2.58
80-85	17	1.4	2	15	88.2	1.2		2	4	0	2	8	1	3	2	0	4	6	5	2	0	0	1	1	2	42	3.6	2.80
85-90	11	0.9	1	10	90.9	0.8		3	3	0	0	3	1	3	5	0	1	1	0	0	3	0	0	0	5	28	2.4	2.80
90-95	8	0.7	2	6	75.0	0.5		0	3	0	0	2	0	3	2	0	1	3	1	2	1	0	0	0	2	20	1.7	3.33
95-99+	19	1.5	5	14	73.7	1.1		2	4	0	5	6	2	3	1	0	2	4	2	0	3	4	0	0	6	44	3.8	3.14
Total	1249	100.0	717	532	42.6	42.6		100	100	8	84	125	120	139	106	3	68	90	71	15	52	43	11	8	112	1155	100.0	2.17

LANE LOCATION: #4 Ann Arbor, Michigan

Vehicle Mileage × 1000	Vehicles Inspected	% Vehicles Inspected	Vehicles Passed	Vehicles Rejected	% Vehicles Rejected/Group	% Vehicles Rejected/Total		Wheel Alignment	Steering Operation	Tires	Exhaust System	Brake Force	Parking Brake	Headlamps	Headlight Aim	Parking Lights	Turn Signals	Tail Lights	Stop Lights	Windshield	Windows	Wipers (and Washers)	Horn	Mirrors	Miscellaneous	TOTAL DEFECTS	% TOTAL DEFECTS	Defects Per Rejected Vehicle
0-5	56	9.5	11	45	80.4	7.6		8	5	2	1	8	1	0	34	0	0	0	0	0	2	4	0	0	5	70	4.2	1.56
5-10	56	9.5	5	51	91.1	8.6		9	13	0	0	15	0	2	44	0	0	1	1	1	1	5	0	0	10	102	6.1	2.00
10-15	49	8.3	1	48	98.0	8.1		7	14	6	0	11	0	2	45	2	0	0	1	3	1	3	1	0	9	105	6.3	2.19
15-20	50	8.5	4	46	92.0	7.8		11	12	6	1	12	1	4	39	0	0	0	1	1	1	9	0	0	14	112	6.7	2.43
20-25	46	7.8	4	42	91.3	7.1		12	20	6	2	15	1	1	37	1	1	1	2	2	2	5	0	0	18	126	7.5	3.00
25-30	46	7.8	3	43	93.5	7.3		11	14	8	1	7	1	2	38	1	1	1	2	1	0	13	0	1	23	125	7.5	2.91
30-35	35	5.9	1	34	97.1	5.8		11	11	4	2	11	0	4	29	1	2	2	2	3	0	2	0	0	12	96	5.7	2.82
35-40	41	6.9	2	39	95.1	6.6		9	15	8	8	10	4	7	25	2	1	0	0	1	2	12	0	2	14	120	7.2	3.08
40-45	46	7.8	3	43	93.5	7.3		14	20	7	1	14	4	3	34	5	4	0	5	2	0	11	1	2	20	147	8.8	3.42
45-50	32	5.4	0	32	100.0	5.4		11	17	4	0	8	5	1	25	3	0	3	1	1	2	7	0	0	18	106	6.3	3.31
50-55	24	4.1	1	23	95.8	3.9		8	11	3	1	7	1	2	20	3	3	0	1	3	1	5	0	1	8	78	4.6	3.39
55-60	25	4.2	1	24	96.0	4.1		5	14	5	2	10	1	3	21	2	1	1	1	0	2	8	0	1	10	87	5.2	3.63
60-65	19	3.2	0	19	100.0	3.2		7	12	3	3	4	3	2	17	1	1	1	1	1	2	5	2	0	13	78	4.6	4.11
65-70	23	3.9	0	23	100.0	3.9		4	16	4	4	10	6	1	19	2	1	1	4	2	3	9	0	1	17	104	6.2	4.52
70-75	8	1.4	0	8	100.0	1.4		2	5	4	2	2	1	4	7	1	1	0	0	0	1	5	0	0	3	38	2.3	4.75
75-80	5	0.8	0	5	100.0	0.8		1	4	1	1	3	1	1	5	0	0	0	1	1	1	2	0	1	5	28	1.7	5.60
80-85	10	1.7	0	10	100.0	1.7		1	5	4	0	3	2	2	9	0	2	1	4	2	1	6	0	1	8	51	3.0	5.10
85-90	5	0.8	0	5	100.0	0.8		2	3	2	0	1	1	1	4	1	1	1	1	0	0	1	0	0	2	21	1.3	4.20
90-95	3	0.5	0	3	100.0	0.5		0	1	0	1	0	0	1	3	0	1	0	1	0	0	2	1	0	2	13	0.8	4.33
95-99+	12	2.0	0	12	100.0	2.0		5	4	2	2	4	3	2	12	1	1	3	2	3	3	8	2	1	9	67	4.0	5.58
Total	591	100.0	36	555	93.9	93.9		138	216	79	32	155	36	45	467	26	21	16	31	27	25	122	7	11	220	1674	100.0	3.02

APPENDIX D

Miscellaneous Data Tables

PAST YEAR INSPECTION SUMMARIES

Inspection Year	Washington, D. C.*			Cincinnati, Ohio**				
	Vehicles Inspected	Vehicles Rejected	% Rejected	Vehicles Inspected	Vehicles Rejected	% Rejected	Defects Detected	Defects Per Rejection Vehicle
1966	244,526	100,846	41.2	273,340	67,960	25.9	116,950	1.72
1965	246,506	101,204	41.1	277,515	65,637	23.7	110,310	1.62
1964	238,824	101,697	42.6	271,180	70,291	25.9	119,722	1.70
1963	228,434	107,844	47.2	265,635	63,883	24.0	102,422	1.60
1962	224,922	111,988	49.8	249,749	63,480	25.4	101,462	1.60
1961	220,871	110,818	50.2	250,374	71,410	28.5	105,775	1.48
1960	207,690	109,997	53.0	255,407	69,525	27.2	110,734	1.59
1959	212,548	109,478	51.5	258,576	69,357	26.8	112,184	1.62
1958	203,557	101,146	49.7	248,716	55,653	22.4	89,453	1.61
1957	198,832	101,672	51.1	251,753	59,208	23.5	96,731	1.63
1956				245,668	51,124	20.8	86,434	1.69
1955				236,324	55,371	23.4	96,796	1.75
1954				219,484	49,847	22.7	82,474	1.65
Total	2,226,710	1,056,792	117.5	3,303,721	812,746	24.6	1,331,447	1.64

Sources

*Department of Motor Vehicles, Washington, D. C.

**Municipal Garage & Inspection Lanes, Cincinnati, Ohio.

DEFECT CATEGORY ANALYSIS

Location	ANN ARBOR			WASHINGTON			CINCINNATI			MEMPHIS			ALL		
Inspections/Year	0			1			2			3			—		
Rejected Vehicles (RV)	555			532			568			171			1826		
Total Defects (≦D)	1674			1155			891			219			3939		
Defects (D)	D	D/RV	D/ΣD	D	D/RV	D/ΣD	D	D/RV	D/ΣD	D	D/RV	D/ΣD	D	D/RV	D/ΣD
Wheel Alignment	138	0.25	0.082	100	0.19	0.087	167	0.29	0.188	21	0.12	0.096	426	0.23	0.108
Steering Operation	216	0.39	0.129	100	0.19	0.087	23	0.04	0.026	6	0.04	0.027	345	0.19	0.088
Tires	79	0.14	0.047	8	0.02	0.007	8	0.01	0.009	NI	—	—	95	0.05	0.024
Exhaust System	32	0.06	0.019	84	0.16	0.073	35	0.06	0.039	8	0.05	0.037	159	0.09	0.040
Brake Forces	155	0.28	0.093	125	0.24	0.108	106	0.19	0.119	4	0.02	0.018	390	0.21	0.099
Parking Brake	36	0.07	0.022	20	0.04	0.017	125	0.22	0.140	2	0.01	0.009	183	0.10	0.046
Headlamps	45	0.08	0.027	139	0.26	0.120	127	0.22	0.143	14	0.08	0.064	325	0.18	0.083
Headlight Aim	467	0.84	0.279	106	0.20	0.092	165	0.29	0.185	34	0.20	0.155	772	0.42	0.196
Parking Lights	26	0.05	0.016	3	0.01	0.003	1	0.00	0.001	NI	—	—	30	0.02	0.008
Turn Signals	21	0.04	0.013	68	0.13	0.059	22	0.04	0.025	22	0.13	0.100	133	0.07	0.034
Tail Lights	16	0.03	0.009	90	0.17	0.078	36	0.06	0.041	19	0.11	0.087	161	0.09	0.041
Stop Lights	31	0.06	0.019	71	0.13	0.061	34	0.06	0.038	49	0.29	0.224	185	0.10	0.047
Windshields	27	0.05	0.016	15	0.03	0.013	1	0.00	0.001	0	0.00	0.000	43	0.02	0.011
Windows	25	0.05	0.015	52	0.10	0.045	12	0.02	0.013	NI	—	—	89	0.05	0.022
Wipers (and Washers)	122	0.22	0.073	43	0.08	0.037	6	0.01	0.007	1	0.01	0.005	172	0.09	0.044
Horn	7	0.01	0.004	11	0.02	0.090	4	0.01	0.004	NI	—	—	22	0.01	0.005
Mirrors	11	0.02	0.006	8	0.02	0.007	0	0.00	0.000	0	0.00	0.000	19	0.01	0.005
Miscellaneous	220	0.40	0.131	112	0.21	0.097	19	0.03	0.021	39	0.23	0.178	390	0.21	0.099
Totals	1674	3.02	1.000	1155	2.17	1.000	891	1.57	1.000	219	1.28	1.000	3939	2.16	1.000

NI - Not Inspected

APPENDIX E

Descriptions of Inspection Lane Facilities

at

Cincinnati, Ohio
Washington, D. C.
Ann Arbor, Michigan
Memphis, Tennessee

CINCINNATI, OHIO

The vehicle inspection lane was established by Council Ordinance in 1936 and the Inspection Lane Building was opened in January, 1940. It was the first such endeavor in the state of Ohio and ranks as a pioneer in the nation in the field of motor vehicle inspection.

The Inspection Lane Building is equipped with five lanes, four for use on passenger cars and one for large vehicles, buses and trucks. Figure 13 shows the interior layout of the building. One of the passenger car lanes is modified to inspect small foreign cars and motorcycles. The equipment in these lanes consists of Bendix-Feragen scuff gauge, Bendix-Cowdry roller-type brake tester, and Bendix (Kent-Moore) Model J1220 Robot headlight tester.

All of the vehicles (except road rollers) operating on the streets of Cincinnati are required to be inspected biannually. All inspections are conducted in the one building, which is open from 8 a.m. to 8 p.m., Monday through Friday. Two overlapping shifts of inspectors are utilized to cover this period. During slack inspection periods, the inspectors also perform equipment maintenance.

The safety items inspected are listed in Exhibit I along with other inspection information and the reasons for rejection of each item. As the safety items are inspected the inspector punches out the appropriate space on the inspection card, which is illustrated in Figure 14.

The fee for each biannual inspection is $1.25.

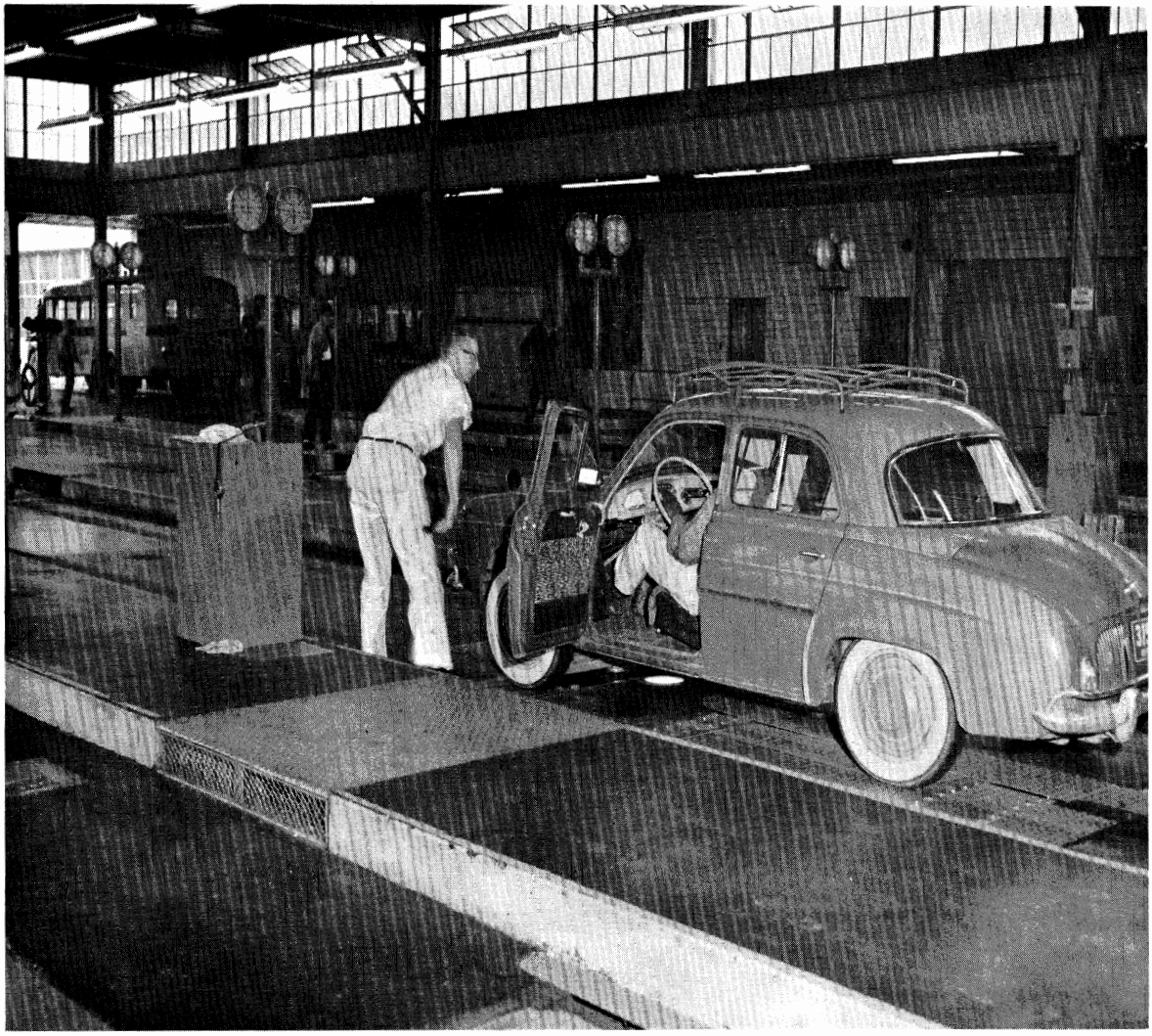


FIGURE 13. INTERIOR OF INSPECTION LANE BUILDING, CINCINNATI, OHIO

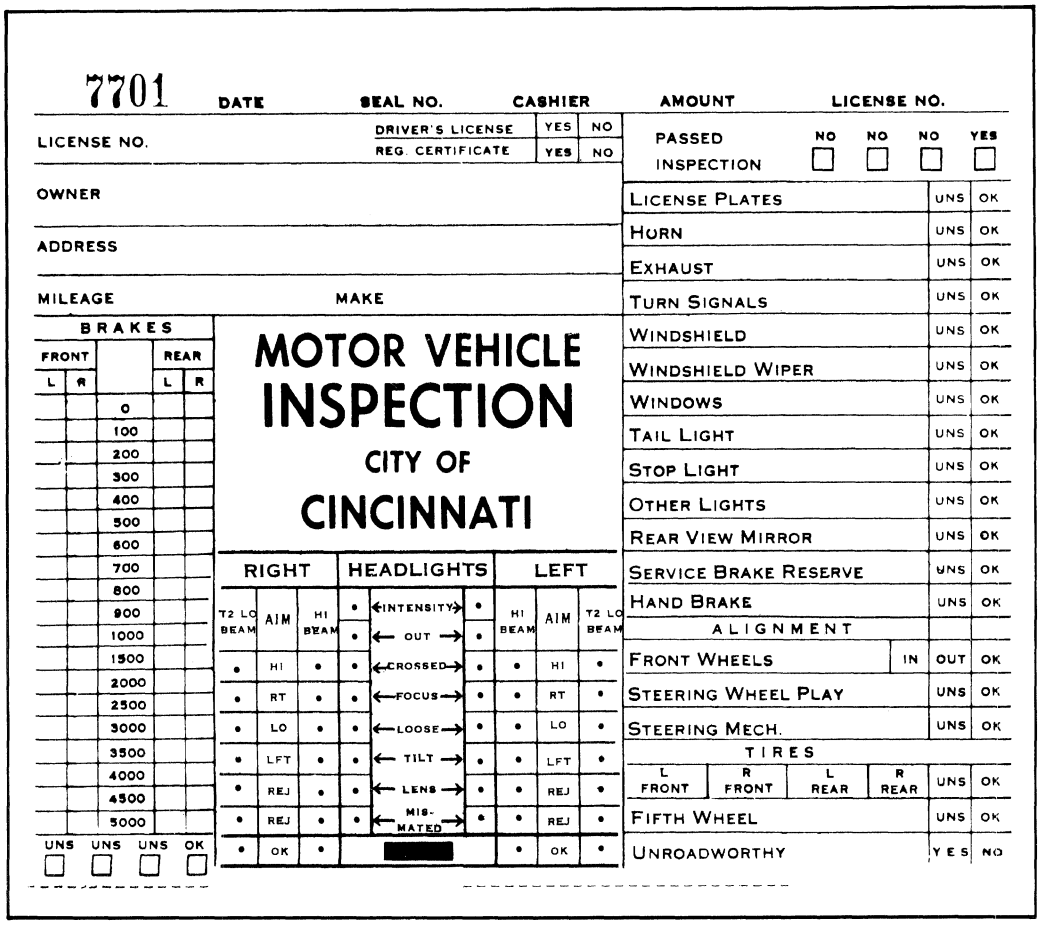


FIGURE 14. INSPECTION CHECK-OFF CARD, CINCINNATI, OHIO

CITY OF CINCINNATI
MOTOR VEHICLE INSPECTION

Information to Motor Vehicle Owners and Operators
Instructions to Motor Vehicle Inspectors
Safety Suggestions and Ordinance

Issued under Authority of Ordinance 269-1936 and Revisions Thereto

Information to Motor Vehicle Owners and Operators

1. Compulsory inspection of all motor vehicles, except road rollers. (Ordinance No. 269-1936 and revisions thereto.)

2. Location of inspection and testing station—on west side of Central Parkway north of Bates Avenue.
   Entrance to testing lanes:
   For Passenger Cars—West side of Central Parkway north of building: exit at south end of building on Bates Avenue.
   For Trucks—At Colerain Ave. and Monmouth St. (north line City Workhouse): exit at south end of building on Bates Ave.

3. Number of inspections: Two (2) times each year, or once (1) every six months. Additional inspections: After a collison and within twenty-four (24) hours after the vehicle is returned to service; or by order of a Police Officer when the vehicle does not have affixed to the windshield the official inspection seal or the vehicle does not meet the prescribed safety requirements.

4. Inspection fee: One dollar for each inspection period. Exceptions to fee payment: Vehicles owned by United States Government, State of Ohio and any political subdivision of Ohio. Additional inspections shall be made without charge, of any motor vehicle bearing an unexpired approved seal, but such additional inspections without charge shall not extend the inspection period.

5. Inspections and tests will be made of brakes, lights, horns, signaling devices, windshields, wipers, rear vision mirrors, tires, steering mechanism, license plates, exhaust systems, wheel alignment, wiring, fifth wheels, towing devices, wheel flaps and manufacturer's specifications.

6. The vehicle operator's time will be reduced to a minimum at the Inspection Lane Building if the following suggestions are observed prior to time of presenting the vehicle for inspection and test:
   (a) Have corrected and repaired all known defective, damaged, or worn parts of the vehicle, including the lights.
   (b) Have all tires inflated to full pressure recommended by tire manufacturer for weight of vehicle and tire size.
   (c) Have windshields clean and all stickers (except official seal) removed therefrom, unless same is authorized by law.
   (d) Have your current year's Driver's License.
   (e) Have your Ohio State Vehicle Registration Certificate.
   Note: If the owner of more than one vehicle, make certain that the Registration Certificate license number and the license plate numbers attached to the vehicle are the same.

7. Upon passing inspection, do not deface, destroy or lose the Offical Seal attached to your windshield. It is your badge of approval, good for six months vehicle operation and will save you the annoyance of having to be stopped by a Police Officer. Ordinance 504-20.

8. Upon failure to pass inspection a temporary sticker will be attached to the windshield as an indication that the owner has presented the vehicle for inspection and test. The owner of the vehicle must have the defects corrected and the vehicle submitted for reinspection as soon as possible. Temporary stickers will not be recognized by Police Officers for a longer period. than one month.

9. Do not make inquiry of City's employees where defective vehicle parts or repairs may be obtained or made. Minor adjustments cannot and will not be made by the City.

10. Should conversation be necessary or desirable, it should be limited to that relating to inspection and testing. Remember you are the operator of only one of a thousand or more vehicles that must receive inspection service each day.

Instructions to Motor Vehicle Innspectors

Stop 1—Registration

The duties of the Inspector at the Registration Stop are to obtain the following information and record it on the inspection card:

1. Name and address of owner.

2. State vehicle registration number. (Registration certification numbers should be the same. In case front and rear license plate and registration card numbers do not agree, call the Lane Supervisor.)

3. Make and type of vehicle, also fleet number.

4. Speedometer reading at time of inspection.

5. Driver's license.

6. In the event the Inspector at the Registration Stop believes that the tires are not properly inflated, he should suggest that the driver have them checked, informing him that improper inflation may affect the brakes, wheel alignment, and lights enough to cause rejection.

7. The absence of State License plates is not cause for refusing a test, but a rejection sticker will be issued.

8. If the State License is not available, the inspector shall record the factory serial number of vehicle in the space for State License.

9. Check trucks for wheel flaps.

10. License Plates:
    (a) Must be clean and their visability not obstructed by other parts of the vehicle.
    (b) Front and rear license plates required on all passenger cars and trucks; rear only on motorcycles, trailers and semi-trailers.
    (c) License shall be properly illuminated by white light for night driving.
    (d) Must be mounted solidly.

Stop 2—Wheel Alignment and Steering

This Inspector shall walk to Stop 1, secure inspection card from Registration Inspector, and drive the vehicle to Stop 2. He shall remain with the vehicle for Stops 2, 3, 4, and 5.

1. Check windshield wipers:
   (a) Blade shall not be cracked, dried out, or edges worn down. It must keep glass clear.
   (b) Wiper or wipers shall operate properly. Power driven or hand operated wipers are acceptable.

2. Check for clear vision:
   (a) Windshield shall be clear and free of all stickers and other non-transparent material not required by or authorized by law.
   (b) Operator's view through windshield or any window shall not be obstructed.

3. Rear vision mirror is required (except on motorcycles) and must be so mounted as to enable the operator to view the roadway to his rear.

4. Check exhaust system:
   (a) Muffler is required to dampen exhaust discharges from the motor.
   (b) Muffler shall be free from emission of excessive or unusual smoke or fumes, and shall not cause excessive noise, especially on trucks and motorcycles.

5. Left front window must operate freely unless turn signals are provided.

6. Turn signals when installed on equipment shall be rejected for not complying with the following:
   (a) All parts must be in good repair.
   (b) Check to see that all parts operate properly.
   (c) Shall be visible and clearly understood for 100 feet.

7. The horn shall be in good operating order and shall be capable of being heard for a distance of 200 feet and shall not be rancorous in tone. No siren, exhaust whistle, compressed air whistle or horn, or any other device simulating emergency signals are allowed.

8. Examine inspection card for possible omissions.

9. Steering:
   (a) Check steering wheel and see that it does not have more than three inches of play.
   (b) Inspector will drive slowly over wheel alignment tester, being careful not to turn front wheels from straight ahead position.
   (c) as each front wheel passes over the wheel alignment testers, side slippage is automatically recorded by indicators. Inspector will enter side slippage per mile on inspection card.
   (d) Procedure for testing rear wheel and semi-trailer wheel alignment is the same as for front wheels.
   (e) Tolerances:
      1. The "Toe-in" must not be more than 44 feet per mile.
      2. The "Toe-out" must not be more than 36 feet per mile.

10. Punch inspection card for alignment and for steering as determined from test results, and proceed to the next stop.

EXHIBIT I

Stop 3—Steering Mechanism

1. Inspector shall drive vehicle on lift and raise front end of the vehicle approximately fifteen inches.
2. After the front end has been placed in an elevated position, inspector shall test for loose tie rods, drag links, king pins, spindle bearings and other parts of the steering mechanism.
3. Tolerances for spindle play as measured at the tires of the front wheels shall be:
   (a) For passenger cars and light trucks - not more than 1¼ degrees.
   (b) For trucks 1½ tons and up - not more than 1½ degrees.
   (c) For front wheel sway or wabble - not more than 1 degree.
4. Tires:
   (a) Must be in a safe operating condition.
   (b) Reject if the outer tread is worn down to the breaker strip or if tire is not free from bulges or breaks caused by broken fabrics.
   (c) Cupped, feather edged or scuffed tires indicate misalignment of front end.
5. Inspector will punch inspection card as determined from test results, lower vehicle to floor, and advance vehicle until front wheels rest on brake tester.

Stop 4—Brake Inspection

At this stop the Inspector will check the braking effort, equalization of service brakes, and the parking brakes.

1. Depress foot brake pedal until gauges indicate maximum reading without locking front wheels.
2. Advance vehicle until rear wheels are on brake tester. Rear brakes shall be tested in the same manner as front brakes. Inspector must record individual reading for each wheel brake.
3. Tolerances:
   (a) The brakes shall be capable of stopping the vehicle from a speed of twenty miles per hour on a hard, dry, level road, free from loose material within the following distances:
      1. In the case of passenger vehicles, buses and trucks of 1¼ tons capacity, or less, twenty-five feet. (Requires a total brake poundage of 50 per cent of gross weight of vehicle.)
      2. In the case of other vehicles with normal load, thirty seven and one-half feet. (Requires a total brake poundage of 35 per cent of gross weight of vehicle.)
   (b) The braking force on opposite wheels shall not vary more than 25 per cent.
   (c) The total braking effort of the rear wheels shall not be less than one-half of the total braking effort of the front wheels.
   (d) Pedal reserve shall be not less than one inches.
   (e) Some vehicles were originally manufactured with a two wheel braking system. On these vehicles a total brake poundage of 35 per cent of the gross weight of vehicle is acceptable.
4. Hand Brakes:
   (a) The brake poundage for hand or parking brake on all vehicles should be not less than fifty (50) percent of the brake poundage of the foot brake.
   (b) See that the brake lever has adequate reserve action.
   (c) See that the action of lever is good and that it does not slip.
5. Trucks are not to be inspected when loaded unless the load is of a permanent nature such as power company trucks with ladders, trucks on which compressors are mounted, etc.
6. Trailers, semi-trailers, and similar vehicles not having independent or individual brakes shall be tested as a single unit.
7. Trailers, semi-trailers, and similar vehicles not having independent or individual brakes shall be considered as a single unit and the total weight of the entire unit will be the basis of the brake computation.
8. Check for towing devices on vehicles. If any are found, check to see that they are a "safe" type. The ball and socket, tongue and groove, and similar types are considered safe.
9. If vehicle is so equipped, check turntable or fifth wheel. It shall be in good working condition and free from broken or worn parts that would affect the safe operation of the vehicle.
10. All towed vehicles shall be attached to the tractor by safety chains which are capable of withstanding the full drag of the trailer and its load.
11. The inspector will punch the inspection card, proceed to the next stop, leave the vehicle in position for head light inspection, and give inspection card to head light inspector. When head light test is completed, he will drive car to exit door, then walk to Stop 1 and accept the next registered vehicle for inspection.

Stop 5—Head Lights and Other Lighting Devices

1. The Inspector shall first check the head light lenses to see that they are properly installed.
2. Lenses:
   (a) Lenses on head lights, auxiliary lamps, tail and stop lights, signal devices and other lamps that are in working order shall not be cracked or missing.
   (b) Green or red lenses, except on clearance lamps, not permitted on front of vehicle unless officially approved.
   (c) Left and right lenses should be installed on their respective lamps as viewed from the driver's seat.
   (d) Multibeam lenses on cars previous to 1936 have the word "left" or "right" cast in the top of the lens, while those after 1936 are cast in the bottom. The newer lenses are not interchangeable with the earlier models. A poor and unsafe light will result in this case.
3. Beams:
   (a) Check and see that all bulbs and all filaments burn.
   (b) Switch must light proper filaments.
   (c) Lamps must be securely fastened.
   (d) Reflectors shall be properly matched and securely fastened to the frame or shell of the lamp assembly. If the pattern on the screen is divided, that is, if it has one or more hot spots or a dark spot in the center, the assembly is at fault, the bulb is improperly focused or installed, or the lens is of the wrong type.
   (e) Reflectors shall be clean and untarnished.
   (f) Lights must be in focus. Appearance of pattern will indicate this.
   (g) On 1938 and later cars an indicator lamp must be provided that is "on" with all high beam positions.
   (h) Auxiliary lamps must not be mounted lower than 12 inches or higher than 42 inches.
   (i) All automatic beam changers must be in good working order.
4. Head Light Test:
   (a) See that vehicle is properly located. Proper distance between headlight and tester is 18 inches.
   (b) Check vertical and horizontal beams. See that rays are within the limits of the factory specifications.
5. Other lighting devices:
   (a) Tail light:
      1. Shall burn steadily and not blink or flash and shall be visible for 200 feet.
      2. Shall have a clean unbroken lens.
      3. Shall be firmly mounted.
      4. Only a red light may be used. No other color is permissable.
      5. On the newer vehicles equipped with two tail lights, it is required that the one on the left side be operating. Right tail light inoperative will not be cause for rejection.
   (b) Stop light:
      1. Shall be visible for 200 feet.
      2. Flashing bulb may be used.
   (c) Parking lights:
      1. Red lamp in rear, white in front required.
      2. License must be illuminated by white light.
   (d) If vehicle exceeds 80 inches in width, two green marker lights must be displayed at the front of the vehicle, one at each side at the point of greatest width.
   (e) Trailers and semi-trailers require a white light under the body thereof, so placed as to be visible from every side.
   (f) All lighting devices shall be in working order.
6. Punch the inspection card as determined from test results.
7. With the inspection completed, the entire inspection card is checked and punched either "OK" or "Unsatisfactory". If "OK" meaning that the vehicle has passed inspection, the motorist should be commended for the condition in which he keeps his automobile. If "Unsatisfactory", the final inspector shall explain reasons for not passing and give advice as to safety, but shall not verbally indicate what work should be performed, how it should be performed, or where it should be performed.
8. The final inspector will direct the driver of the vehicle to the cashier who will collect the inspection fee, receipt the inspection card, give duplicate card to driver, and retain original card for permanent record of inspection. If "OK" an approved seal is affixed to his windshield. If "Unsatisfactory", meaning that the vehicle has not passed inspection, a temporary sticker is affixed to the windshield.

Outline of Motor Vehicle Inspection

Points of Inspection	Reject for Following	Warn Motorist of Following
1. Driver's License		Not available
2. Horn	Not capable of being heard for 200 feet	
3. License plates	Missing — not securely mounted — not legible — not properly illuminated — visibility obstructed	Do not match registration card
4. Steering wheel slack	More than 3" or binding	
5. Wheel alignment	"Toe-in" and "Toe-out" more than 44 feet and 36 feet respectively of side slippage per mile	
6. Steering mechanism	Loose tie rod, drag link, king pin, spindle bearing or other parts	
7. Spindle play as measured at tires (a) Passenger cars and light trucks (b) Trucks 1½ tons and up (c) Front wheel sway or wabble	(a) More than 1¼ degrees (b) More than 1½ degrees (c) More than 1 degree	
8. Tires	Outer tread worn down to breaker strip—not free from bulges or breaks caused by broken fabrics	Tread worn smooth
9. Brakes (a) Braking effort (b) Left and right equalization (c) Rear brakes (d) Pedal reserve (e) Parking brake	(a) 1. Up to 1¼ tons capacity: less than 50 per cent of gross weight or vehicle. 2. Over 1¼ tons capacity: less than 35 per cent of gross weight of vehicle. 3. For two-wheel braking systems: less than 35 percent of gross weight of vehicle. (b) Varies more than 25 percent (c) Less than 50 per cent of front brakes (d) Less than 1" (e) Does not hold 50 per cent of total required brake poundage	
10. Towing devices	Not a "safe" type (ball and socket, tongue and groove, and similar makes considered safe)	
11. Fifth wheel	Brokn or worn parts	
12. Towed vehicle	Safety chain missing	
13. Lenses on all lights	Missing — cracked — dirty — rotated — wrong type — incorrectly installed	
14. Lights (general)	Burned out filament — not securely fastened — switch lights improper filaments — refectors improperly matched — out of focus	Auxiliary lamps mounted lower than 12" or higher than 42"
15. Head lights	Vertical and horizontal beams do not meet factory specifications	
16. Tail lights	Blinks or flashes — dirty or broken lens — not firmly mounted — not colored red — left of dual tail lights out	Right of dual tail lights out
17. Stop lights	Not visible for 200 feet	
18. Marker lights for vehicles over 80" wide	Too few — wrong color — improperly mounted	
19. Parking light	Wrong color — improperly mounted	
20. White light under body of trailer or semi-trailer	Missing — wrong color —not visible from every side	
21. Wndshield wiper	Left windshield wiper inoperative — blade cracked, dried out, or worn down	Right windshield wiper inoperative
22. Clear vision (a) All glass (b) Windshield	(a) Operator's view obstructed (b) Not clear-containing stickers not authorized by law	(a) Cracked
23. Rear vision mirror	Missing — not clear — improperly mounted	
24. Exhaust system	Too noisy Emitting excessive smoke or fumes	
25. Left front window (when turn signals are not used)	Does not operate freely	
26. Turn signals (Required on 1954 and later models)	Do not operate — not visible or clearly understood for 100 feet	
27. Wheel flaps	Missing (If required)	Wrong type or size
28. Other items not listed	If they affect the safe operation of the vehicle	

Sec. 503-29 Road Worthiness. (a) No person shall drive or move or cause or knowingly permit to be driven or moved on any highway, any vehicle, trackless trolley, or combination of vehicles which is in such unsafe condition as to endanger any person.

(b) Nothing contained in the Traffic Code shall be construed to prohibit the use of additional parts and accessories on any vehicles or trackless trolleys not in consistent with the Traffic Code.

(c) The provisions of the Traffic Code with respect to equipment on vehicles or trackless trolleys shall not apply to implements of husbandry, road machinery, road rollers, or agricultural tractors except as herein made applicable..

Sec. 504-8. Citation by Police. The city manager is hereby authorized and directed to supply police officers with special safety-lane citation tags for the purpose of giving notice to persons violating any provisions of Sections 504-1 to 504-25, inclusive. Notice of such violation may be given by delivering the safety-lane citation tag to the violator, or by affixing it to the offending motor vehicle. Such safety-lane tag shall direct the violator to present the motor vehicle at a Cincinnati testing station for inspection within seventy-two (72) hours after the date and hour specfied thereon.

After the expiration of such seventy-two (72) hour period, it shall be unlawful for the owner or other person having possession or control of such tagged motor vehicle to operate the same upon the streets of the city unless the same bears a certificate indicating that it has been inspected in accordance with the citation.

Upon failure of the owner or person having possession or control of such tagged motor vehicle to present the same for inspection as directed by the citation tag; or if such motor vehicle does not bear an inspection seal indicating that it previously had been inspected and approved at an approved testing station; or if such motor vehicle bears an inspection seal indicating that more than six weeks had elapsed since the expiration date of the last previous inspection, a copy of such citation tag shall be forwarded to the municipal court and such owner or person shall be subject to arrest and upon conviction shall be liable to the penalties provided in Section 504-25.

If the owner or person having possession or control of such tagged motor vehicle bearing an expired inspection seal which indicates that not more than six weeks have elapsed since its expiration shall present the same for inspection at a Cincinnati testing station within the seventy-two (72) hour period after citation and said motor vehicle shall be found to meet the required standards of safety, and upon payment of a fee in addition to the inspection fee provided in Section 504-2 as follows: if not more than two weeks overdue since the expiration of the previous inspection, 25c; if not more than four weeks overdue, 50c; if not more than six weeks overdue, 75c, the director of public works or his authorized subordinate at the testing station shall endorse such facts upon the testing station tag and forward the same to the police department. Upon receipt by the police department of such citation tag from the testing station, properly endorsed, the same and all copies thereof shall by duly cancelled.
(aC 74-28e, Ord. 390-1943)

Sec. 504-12. Details of Inspection. Inspection shall be made of brakes, lights, signaling devices, windshields, windshield wipers, rear vision mirrors, tires, steering gear, drawbars, fifth-wheels and towing devices, and all other parts upon which the safe opeation of such vehicle may depend.

The inspection requirements herein set forth are intended to provide safety in the operation of any motor vehicle approved in accordance with this section. No motor vehicle shall be approved by any official inspection station unless such motor vehicle meets the requirements hereinafter provided.

(a) License Plates (503-51)

(b) Horns (503-39)

(c) Rear Vision Mirror (503-41)

(d) Stop Light. Every motor vehicle shall be equipped with a stop light which is in good working order.

(e) Lights. (503-1, 503-2, 503-3, 503-4, 503-7, 503-9, 503-10, and 503-11)

(f) Windshield and Windshield Wiper, (503-54, 503-55, 503-56)

(g) Front End Assembly. The front end assembly shall be free from worn, broken, loose, or missing parts.

(h) Wheel Alignment and Steering Mechanism. The steering arms, tie rods, drags links, and other associated parts of the steering mechanism must be secure and free from excessive play or wear. The play in the steering wheel shall not be in excess of three (3) inches. The error in toe-in should not be more than forty-four (44) feet and for toe-out not more than thirty-six (36) feet of side slippage per mile or equivalent.

(i) Tires. Every motor vehicle shall be equipped with tires as required by Section 503-31. Such tires shall be in a safe operating condition. It shall be prima facia evidence that a tire is unsafe if the outer tread is worn down to the breaker rubber or if such tire is not free from bulges or breaks caused by broken fabrics.

Every solid tire shall have rubber or other resilent material on its entire traction surface at least one inch thick above the edge of the flanges on the entire periphery as required by Section 503-32.

(j) Brakes (503-34)

(k) Turn Tables. Turn tables or fifth-wheels shall be in good working condition and free from broken or worn parts that would affect the safe operation of the vehicle.

(l) Towing Devices. Drawbars or other towing devices and the couplings thereof shall be free from excess wear or broken parts.

All towed vehicles which are not connected to a commercial tractor by means of a fifth-wheel shall be attached to the tractor by safety chains which are capable of withstanding the full drag of the trailer and its load. (506-31 c)

(m) Signal Devices. Signal device shall be in good working condition when required to be on vehicles by Section 506-80, and 503-59.

(n) Splash Guards (503-58)

(o) Directional Signals (503-59)

The other devices or parts herein listed shall conform to the requirements of law and all autherized rules and regulations.

Sec. 504-20. Removing Inspection Seal. It shall be unlawful to remove, obliterate, deface or obscure an inspection seal as herein described; or to place such a seal upon a motor vehicle for which said seal was not issued; or to operate a motor vehicle bearing such a seal issued for a different vehicle; or to operate a motor vehicle bearing a facsimile or imitation of such a seal (aC 74-28m, Ord. 363-1937)

WASHINGTON, D. C.

Compulsory motor vehicle inspection was inaugurated June 15, 1939, under a program provided in Public Law #431, enacted by the 75th U. S. Congress on February 18, 1938. This act grants authority to the Commissioners of the District of Columbia to promulgate such rules and regulations as in their judgment are necessary for the proper administration of such a program. The pertinent regulations are patterned after the Uniform Vehicle Code and the inspection procedures, policies, and tolerances are comparable to the USA Standards Institute's D7.1 (1963) and Z26.1 (1950) Standards, and the Society of Automotive Engineer's recommended practices.

The inspection information and safety items are listed in Exhibit II.

The two inspection stations, located in the northeast and southwest sections of Washington, are owned and operated by the D. C. government. Each station has four lanes equipped with a front end hoist, Bear headlight tester, Weaver scuff gauge and a Weaver brake testing machine (see Figure 15). These stations are open from 7 a.m. to 5 p.m., Monday through Friday, and employ overlapping shifts of 52 Civil Service inspectors.

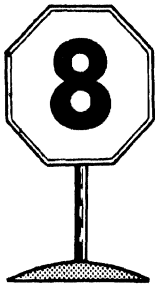
Each vehicle registered in the District of Columbia, including U. S. Government-owned vehicles, is required to be inspected and approved annually, while taxicabs and livery vehicles must be inspected biannually or each time ownership changes and the vehicle is registered by the new owner. The inspection requirement also covers passenger motorcycles, motor driven cycles and all standard type vehicles except combat or special-purpose vehicles owned and operated by foreign governments within the District of Columbia.

As each safety item is checked, the inspector punches out the appropriate space on the inspection checkoff card which is illustrated in Figure 16.

The inspection fee is included in the annual vehicle license fee. This precludes the need to handle funds at each inspection station.

TRAFFIC SAFETY LEAFLET

Vehicle Safety Inspection



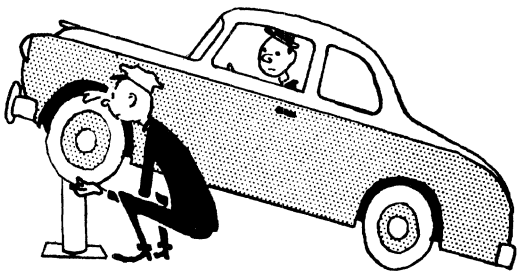
Government of the District of Columbia
DEPARTMENT OF MOTOR VEHICLES
Office of Traffic Safety Education

INSPECTION OF YOUR CAR

You cannot be a really safe driver, unless your vehicle is in top mechanical condition. An Act of Congress (February 18, 1938) requires that your car be inspected once a year. This safety inspection is made by the Inspection Section of the Department of Motor Vehicles.

The District of Columbia operates two safety inspection stations. They are located at: 1001 Half St., S.W. (between K and M Sts.) and 1827 West Virginia Avenue, N.E.

The stations are open from 7:00 A.M. to 5:00 P.M., five days a week—Monday through Friday.



After the initial vehicle registration, vehicles are inspected on the date indicated on the approved inspection sticker.

You cannot renew your registration plates unless your car has been officially inspected and APPROVED. Tags will be issued only to those vehicles which meet the requirements of the Inspection Law and, as a result, display a current approval sticker, issued to the vehicle, on the windshield.

As an owner, you must maintain your vehicle in safe operating condition. Required equipment must conform with the specifications contained in the Traffic and Motor Vehicle Regulations of the District of Columbia.

Following is a general outline of items which will be inspected. They are numbered as they appear on the official inspection record card which the inspector fills out. This list is intended to serve as a helpful guide to owners in preparing their vehicles for inspection.

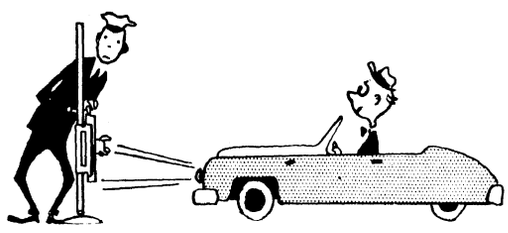
ITEMS INSPECTED

1. **Registration Card**—Your registration card must be with your vehicle at all times. The only exception is when you renew your registration plates: then the registration must be attached to your application for renewal of registration.
2. **Identification Numbers**—Your car's serial number must check with the number on your certificate of title. Any discrepancy must be corrected within 120 hours following inspection.
3. **Identification Tags**—License plates must be securely bolted to brackets front and rear and license numbers must correspond with those on registration card.
4. **Rear Lights**—All rear lights (tail, stop and signal) must operate. Tail lights must be visible at 500 feet. The tag light must reveal license numbers at 50 feet.
5. **Reflex Reflectors**—Reflex reflectors are required on all commercial vehicles, house trailers, luggage trailers, buses and motorcycle side-cars.
6. **Glass-Controls**—Approved type safety glass is required in all openings. No cracks, scratches, rough edges or frosted areas are permitted.
7. **Doors-Body-Hood**—Doors must open and close at all times. Inside and outside handles and regulators must be in place. Body bolts must be tight and the hood must fasten securely.
8. **Fenders-Grille-Bumpers**—Your car must have all fenders in place, with none broken or torn. Front and rear bumpers shall be in good condition, securely bolted to the chassis. Grille must be secure and have no sharp or protruding parts.
9. **Headlamps**—There must be at least two headlamps of approved type, aimed and focused according to type.

EXHIBIT II

The high intensity portion of the beam should be aimed two (2) inches below the lamp level. A beam indicator light is required with all headlamps. Intensity output must be at least 4,000 beam candlepower, and not over 37,000 beam candlepower. Lenses and bulbs must be of approved type. All wiring must conform to manufacturers' specifications. Wire shall be in good condition with all terminals tight.

10. **Auxiliary Lamps**—Auxiliary lights of approved type are permitted; they must be wired to comply with District regulations, however.
11. **Clearance-Marker Lamps**—Clearance and marker lamps are required on commercial vehicles and buses 80 inches or more in width.
12. **Directional Signal**—Directional signals are required on all vehicles manufactured after September 15, 1955.
13. **Steering Alignment**—Wheel alignment must be maintained according to manufacturers' specifications.
14. **Steering Operations**—All parts of the steering mechanism, including wheel bearings, tie rods, king pins and bushings, center control assembly, worm and sector, drag-link, control arms, shock-absorbers, springs and shackles, shall be maintained in safe operating condition.
15. **Tires**—Tires must be in good condition with no fabric showing and no cuts or breaks in sidewalls.
16. **Exhaust System-Excessive Smoke**—There shall be no exhaust leaks in muffler, manifold or tail-pipe. There shall not be an excessive emission of smoke from the engine.
17. **Seat Belts**—Must be installed in the front seat of 1964 model year and all subsequent model year passenger cars.
18. **Windshield and Wipers**—Laminated safety glass is required for windshields. Glass in all other openings must be of an approved type. Two mechanically-operated wipers are required. Wiper blades must be maintained in good condition.
19. **Obstruction to Vision**—The operator's vision must not be obstructed by signs, posters, stickers (other than those authorized by law) or other material on the windshields, wings or vents, front side glass or rear glass.

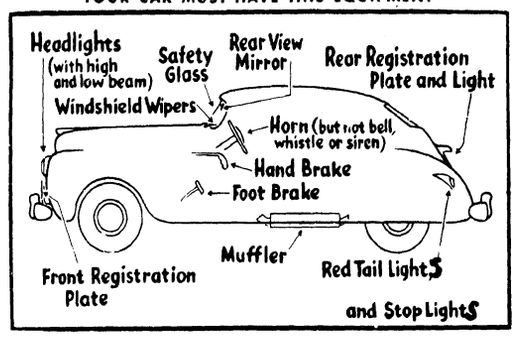


20. **Mirrors and Horn**—A rear view mirror is required, so located as to reflect a view 200 feet to the rear. The horn must be in working order, capable of emitting sound audible under normal conditions from a distance of not less than 200 feet. Horns of more than two tones or notes are prohibited.
21. **Speedometer**—A speedometer is required in operating condition at all times.
22. **Brake Equalization**—Brakes must be adjusted and all wheels equalized to stop the vehicle traveling at 20 miles per hour within 25 feet.
23. **Brake Mechanism**—All linkage, shoes and lining, drums, master and wheel cylinders, and brake hoses are to be properly adjusted and maintained in good condition. Pedal pads are required. There shall be at least 2 inches of pedal reserve.
24. **Auxiliary Brake**—The auxiliary brake shall be adjusted to hold the vehicle stationary under any condition of loading on any upgrade or downgrade upon which it is operated.
25. **Flooring**—Flooring and floor-covering must fit tightly and be free of holes.
26. **Miscellaneous**—In general, there shall be no condition which may become a hazard in driving. For example, there shall be no body damage which may interfere with safety equipment or safe operation of the vehicle. The driver's seat shall be rigidly anchored. The car heater and radio must be securely bolted. There shall be no gas or oil leaks.

IMPROVED ACCIDENT RECORD

Our compulsory inspection program has resulted in a distinct improvement in Washington's accident record. Figures for the first five years of the program's operation compared with the five-year period prior to its beginning in 1939 show that traffic accidents involving the automobile were reduced 13.3 per cent, while the traffic death toll fell 24.4 per cent.

YOUR CAR MUST HAVE THIS EQUIPMENT



12-65—100M

FIGURE 15. INTERIOR OF NORTHEAST INSPECTION STATION, WASHINGTON, D.C.

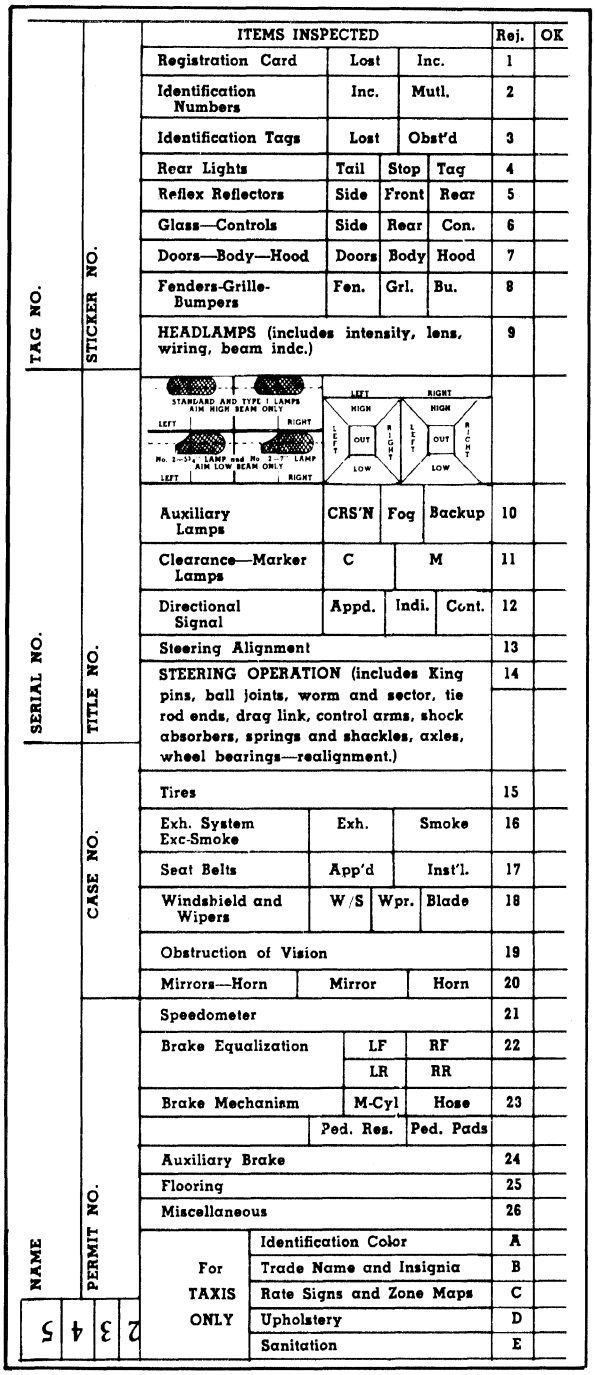


FIGURE 16. INSPECTION CHECK-OFF, WASHINGTON, D.C.: OWNER'S COPY

ANN ARBOR, MICHIGAN

The motor vehicle safety inspection lane was set up and operated by the staff of the Highway Safety Research Institute under the auspices of the Ann Arbor Police Department with equipment provided through the cooperation of the Bear Manufacturing Company, Rock Island, Illinois. The Ann Arbor Polic Department was authorized by the Director of the Michigan State Police to conduct motor vehicle inspections under the Michigan Vehicle Check Lane Law (Public Act No. 214). With this authority the AAPD were authorized to stop passing vehicles and wave them into the lane for inspection. After checking vehicle registration, license plates, proof of insurance, and the driver's license, the vehicle was turned over to the HSRI staff, who performed the necessary inspections and recorded the results on the data form. Upon completion of the inspection, the data form was turned over to a police officer at the end of the lane for evaluation of results. If the vehicles had passed the inspection* a safety sticker was issued, and any defects were explained to the driver so that they could be corrected.

The lane was set up on a side street adjacent to a main thoroughfare. Vehicles were arbitrarily waved into the lane by a traffic officer, but only enough vehicles were stopped to keep the lane full at all times. It was desired that vehicles not be stopped any longer than necessary to perform the inspection. A mean delay time of about fifteen minutes was experienced.

The lane was staffed in the following manner:

Flagman:	Police Officer
Greeter:	HSRI Staff
4-Driver/Inspectors:	HSRI Staff
5-Underbody Inspectors:	HSRI Staff
Underbody Supervisor:	HSRI Staff
Data Collector:	HSRI Staff
Police Clerk:	Meter Maid
Inspection Evaluator:	Police Sergeant
2-Lane Supervisors:	HSRI Staff
Equipment Representative:	Bear Mfg. Co.
Police Supervisor:	Police Lieutenant

*The HSRI inspection covered items not required under Public Act No. 214, however, vehicles were not held to these additional items for compliance with the law. Exhibit III shows the pamphlet given to each motorist listing the inspection items.

EXHIBIT III

As an owner, you must maintain your vehicle in safe operating condition. Required equipment must conform with specifications contained in the Motor Vehicle Code of the State of Michigan.

Following is a general outline of items which will be inspected. This list is intended to serve as a helpful guide to owners in maintaining their cars in a safe condition.

ITEMS INSPECTED

1. Tail lights--Each vehicle shall have at least one red tail light which is plainly visible for at least 500 feet.

2. Stop lights--Each vehicle (except those manufactured prior to January 1, 1965) shall be equipped with two rear red or amber stop lights visible for at least 100 feet.

3. Plate lights--Each vehicle shall be equipped with a white light to render legible the rear registration plate from a distance of at least 50 feet.

4. Parking lights--Each vehicle shall have one or more white or amber lights visible from a distance of 500 feet in front in conjunction with tail lights to the rear.

5. Windshield--Shall be of Type-1 safety glass. Vehicles shall not be operated with any sign, poster or other non-transparent material on the windshield which obstructs the driver's clear view of the highway nor with any dangling ornament or other suspended object which obstructs the driver's view.

6. Windows--Shall be of at least Type-2 safety glass wherever glass is used, and there shall be no obstructions to vision as enumerated above for windshields.

7. Windshield Wipers--Every motor vehicle shall be equipped with a device controlled by the vehicle operator for cleaning rain, snow or other moisture from the windshield. If the vehicle is equipped with more than one device, they must all be in working order. The wiper blades must not be hardened or missing and the wiper arms must hold the wiper firmly against the windshield.

8. Windshield washers--Vehicles manufactured after January 1, 1956 shall be equipped with a windshield washer and maintained in operable condition.

9. Headlight beam indicator--Every vehicle equipped with multiple beam headlamps shall be equipped with a beam indicator, which shall be lighted in view of the driver whenever the high beam is in use.

10. Directional Signals--Each vehicle manufactured after January 1, 1955 (except motorcycles) shall be equipped with mechanical or electrical turn signals.

11. Parking brake--Every motor vehicle shall be equipped with parking brakes capable of holding the vehicle on any grade under all conditions of loading.

*12. Steering alignment--Wheel alignment should be maintained according to manufacturer's specifications. An indication of this is minimum side-slip causing excessive tire wear.

*13. Steering operation--All parts of the steering mechanism, including wheel bearings, ball joints, tie rods, kingpins and bushings, central control assembly, worm and sector, draglink, control arms, shock-absorbers, springs and shackles, should be in good operating condition.

MOTOR VEHICLE SAFETY INSPECTION

conducted by

Highway Safety Research Institute
The University of Michigan

under auspices of
Ann Arbor Police Department

with cooperation of
Bear Manufacturing Company

Your car is now undergoing an inspection under the Michigan Vehicle Check Lane Law (Public Act No. 214). The purpose of this law is to detect defective equipment or other violations of law governing the use of public highways by motor vehicles or their operators. The purpose of the motor vehicle inspection lane is to augment the official accident prevention program by giving attention to the vehicle as well as to the human factors and to the environmental elements of the traffic problem.

The inspection that your car is receiving is a more comprehensive inspection that it would normally receive at a spot inspection. The purpose for this is to provide vehicle data for a research program being conducted by the Highway Safety Research Institute to compare the general overall mechanical condition of motor vehicles in an area (Ann Arbor) which does not have a compulsory vehicle inspection program with vehicles from an area where compulsory vehicle inspection has been in force for some time.

If your vehicle meets the requirements of the Michigan Motor Vehicle Code, you will be issued a windshield sticker by the Ann Arbor Police Department to indicate compliance with these requirements and to preclude rechecking of the same vehicle, causing unnecessary delay to the motorist. If your vehicle does not meet the requirements, the defects will be explained so that they may be corrected. However, a summons may be issued to motorists where violations disclose a wilful disregard for the law governing vehicle equipment, driving in violation of registration, driver's license, and insurance provisions of the Vehicle Code.

14. Steering lash--There shall be no more than 2" of lash in the steering wheel.

15. Tires--Should be in good condition with at least 2/32" of tread, no cuppy wear, bulges, or deep cuts or breaks in the tread face or sidewall.

16. Horn--Every motor vehicle shall be equipped with a horn in good working order and capable of being heard at a distance of at least 200 feet, but it shall not emit an unreasonably loud or harsh sound.

17. Rear view mirror--No vehicle shall be operated with vision to the rear by the driver obscured unless the vehicle is provided with a rear view mirror.

18. Exhaust system--Shall include exhaust pipe, adequate muffler and tailpipe. There shall not be emitted excessive or unusual noise nor annoying smoke.

19. Headlights--Every motor vehicle (except motorcycles) shall be equipped with at least two headlamps with at least one on each side of the vehicle in front. Every headlamp shall be mounted at a height measured from the center of the headlamp of not more than 54 inches nor less than 24 inches above the level surface upon which the vehicle stands. High-beams must be of such intensity as to reveal objects at a distance of at least 350 feet and low-beams 100 feet ahead for all loading conditions.

20. Brake reserve--Every motor vehicle shall be equipped with service brakes which are capable of stopping the vehicle within specified distances under all conditions and loadings. There shall be a pedal reserve of at least 2", or 1" on power assisted brakes.

21. Brake equalization--The service brakes must be adjusted and maintained in good working order and shall operate equally with respect to the wheels on the opposite side of the vehicle.

22. Seat belts--All private passenger vehicles manufactured after January 1, 1965 shall be equipped with seat belts for the driver and one front seat passenger. All seat belts and anchorages should be free from excessive wear.

23. Operator's license--Every driver of a motor vehicle must have in his possession a valid operator's license.

24. Registration certificate--Every vehicle must have a current registration certificate which indicates the year, make, model, body style and identification number of the vehicle, and the name and address of the registered owner. The registration (license) plates must agree with the registration certificate.

25. Insurance certificate--Every vehicle operator must display a certificate of insurance indicating a policy currently in force or shall have paid the uninsured motorist fee when receiving the vehicle registration certificate

*Inspection items not required by Michigan law.

The lane configuration is shown in Figure 17 and is depicted in the accompanying photographs (Figures 18 through 27). The functions of the various lane stations as noted in Figure 17 are as follows:

Station #1: Police Officer checks vehicle registration, license plates, insurance certificate and operator's license.

Station #2: Vehicle is inspected for exterior lights, visibility obstructions, windshield wiper blades and arms, external rear view mirrors. Inspector-driver checks inside of car for headlight beam indicator light, windshield washer, interior rear view mirror and parking brake.

Station #3: Headlight aim is checked by headlight tester.

Station #4: Front wheel sideslip (scuff) is checked by scuff gauge.

Station #5: Steering operation and underbody components are checked after raising front end on hand jacks.

Station #6: Brakes are checked with a two-pad drive on and stop brake tester.

Station #7: Police officer evaluates inspection report, explains any defects to vehicle driver, issues inspection sticker if vehicle passed or issues summons for some infraction or defect.

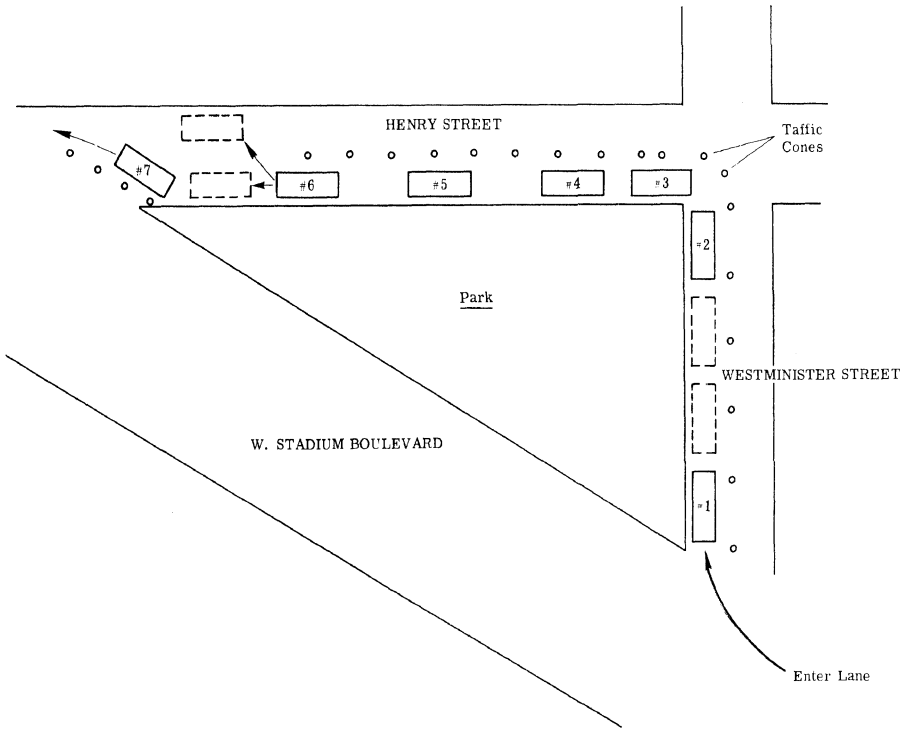


FIGURE 17. INSPECTION LANE LAYOUT, ANN ARBOR, MICHIGAN

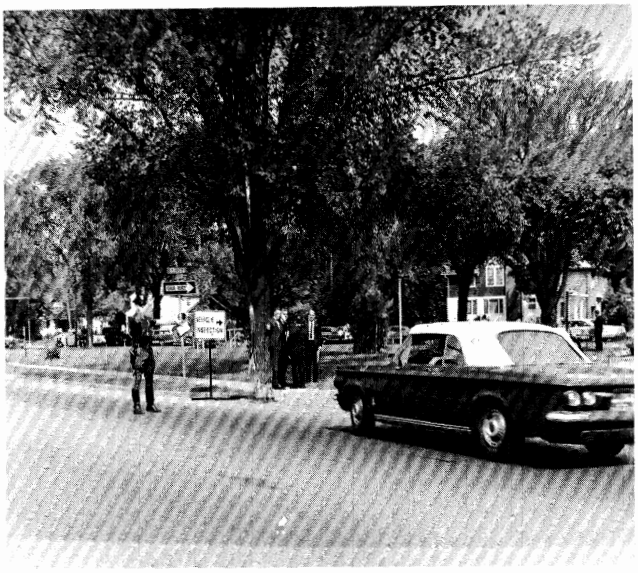


FIGURE 18. INSPECTION LANE ENTRANCE, ANN ARBOR, MICHIGAN

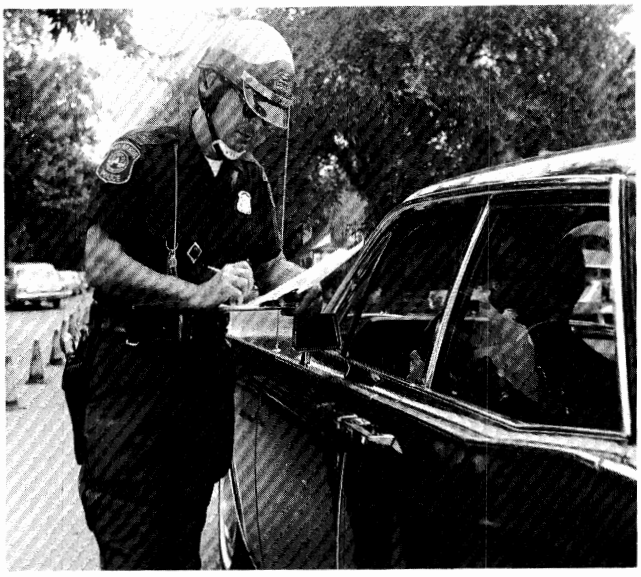


FIGURE 19. INSPECTION LANE STATION NO. 1, ANN ARBOR, MICHIGAN

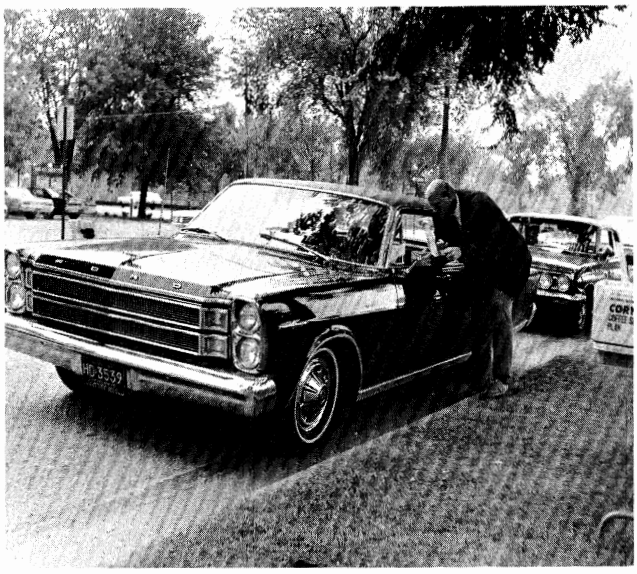


FIGURE 20. GREETER EXPLAINS PURPOSE OF INSPECTION, ANN ARBOR, MICHIGAN

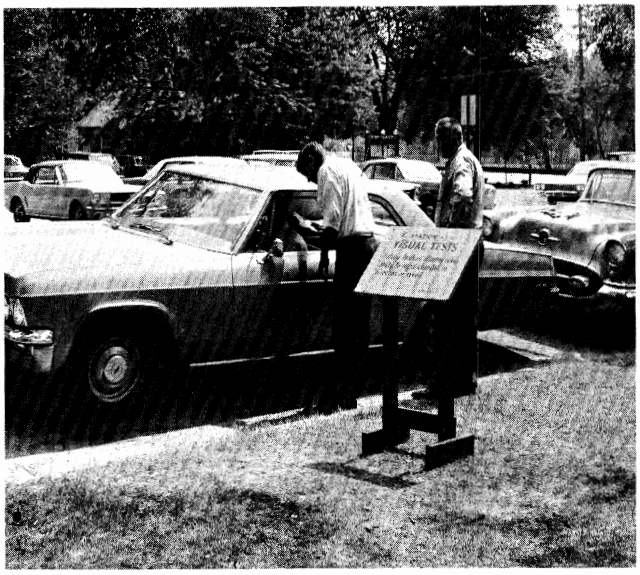


FIGURE 21. INSPECTION LANE STATION NO. 2, ANN ARBOR, MICHIGAN

FIGURE 22. INSPECTION LANE STATION NO. 3, ANN ARBOR, MICHIGAN

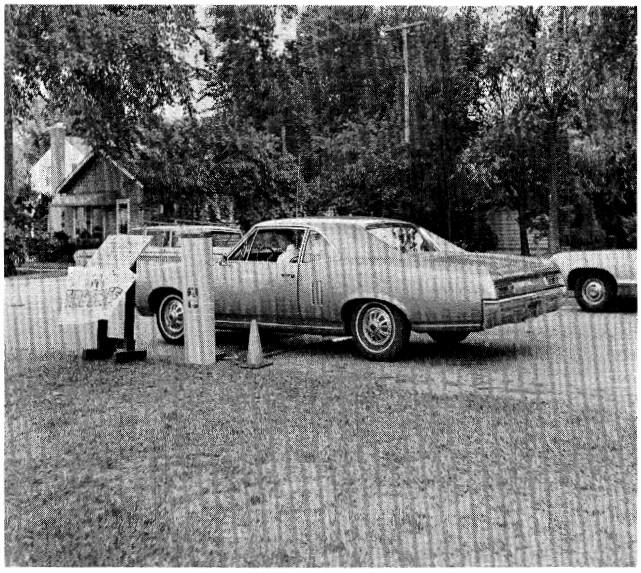


FIGURE 23. INSPECTION LANE STATION NO. 4, ANN ARBOR, MICHIGAN

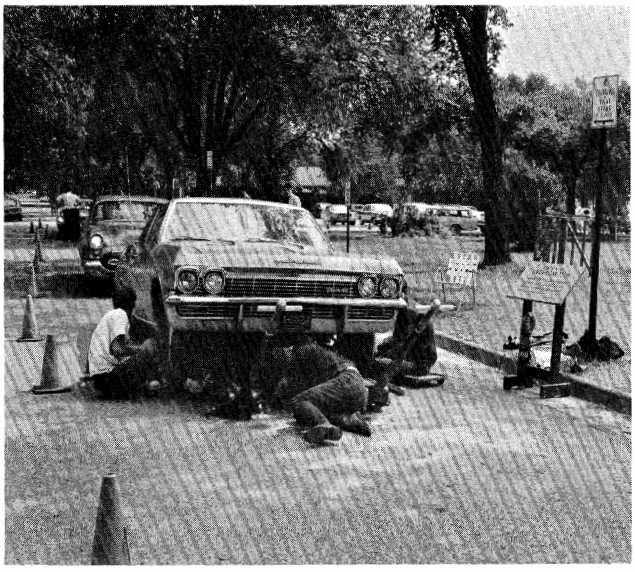


FIGURE 24. INSPECTION LANE STATION NO. 5, ANN ARBOR, MICHIGAN

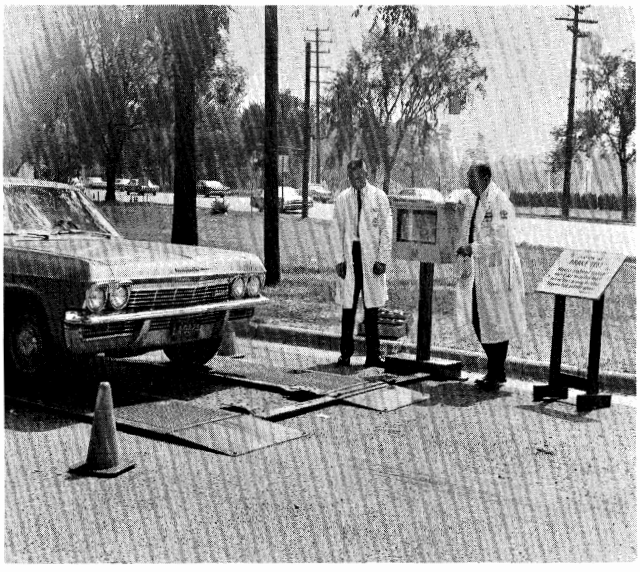


FIGURE 25. INSPECTION LANE STATION NO. 6, ANN ARBOR, MICHIGAN

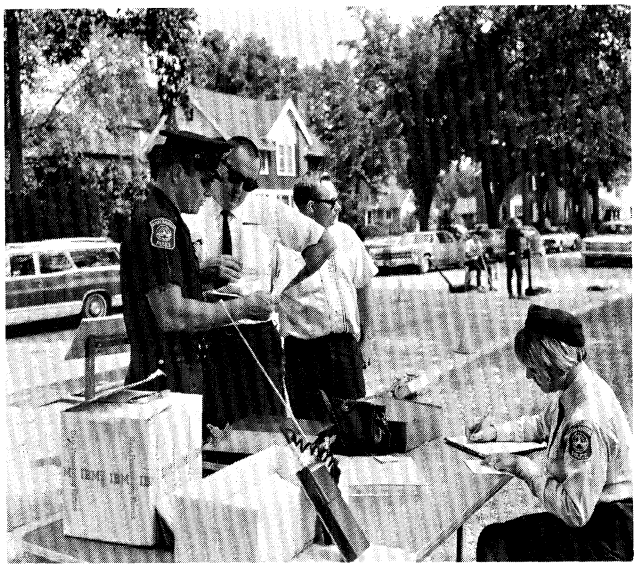


FIGURE 26. EVALUATION OF INSPECTION RESULTS, ANN ARBOR, MICHIGAN

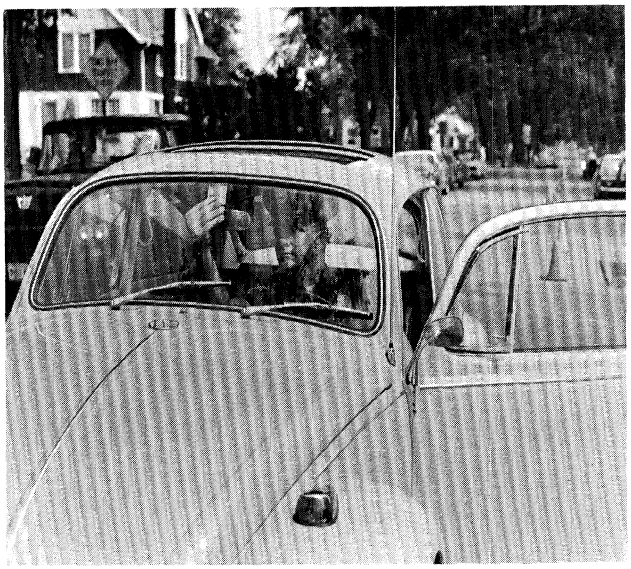


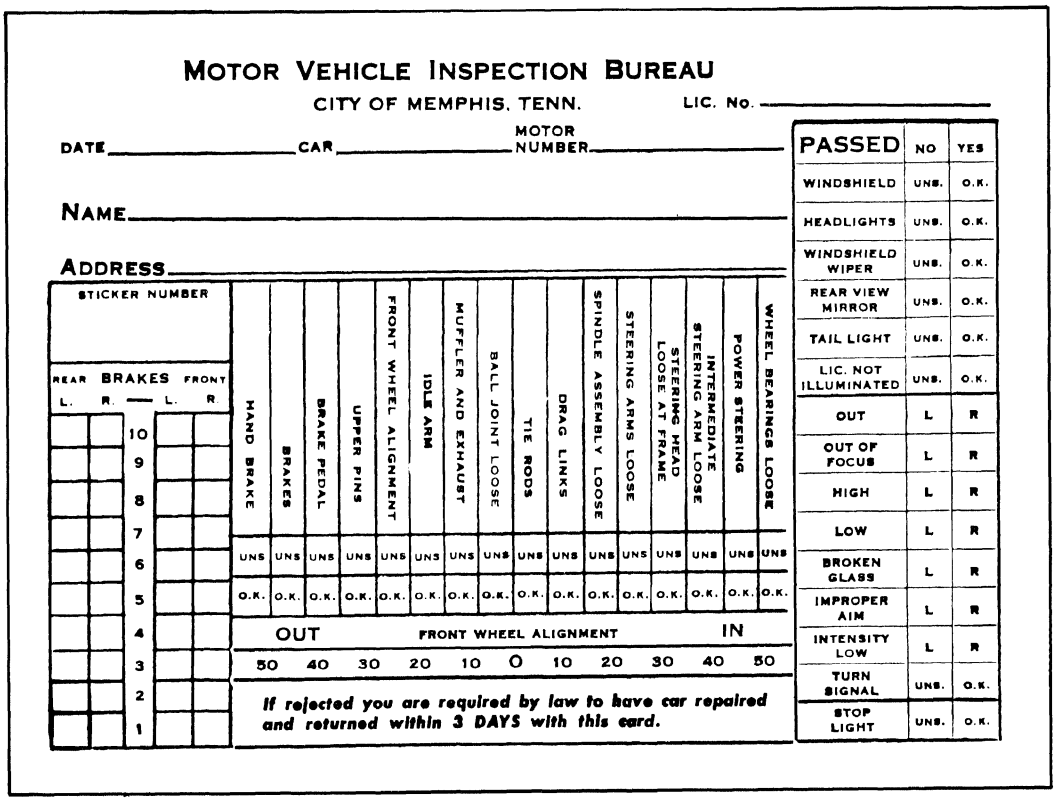
FIGURE 27. APPLYING INSPECTION STICKER TO APPROVED VEHICLE, ANN ARBOR, MICHIGAN

MEMPHIS, TENNESSEE

All vehicles which use the streets of Memphis more than four times per year are required to be inspected. The city has been conducting triannual vehicle inspections since 1935, which makes it one of the oldest inspection systems in the United States.

Memphis operates five inspection lanes in one building, which is located near the center of the city. The inspection lanes are open from 7 a.m. to 9 p.m. Monday through Friday. To operate the lanes, two overlapping shifts of inspectors are employed. The inspection lane layout is very similar to those in Washington, D. C. The lanes are equipped with Weaver manufactured headlight and brake testing machines. Each inspection item is punched out by the inspector on the inspection check-off card illustrated in Figure 28. Figures 29(a) and 29(b) show the interior layout of the inspection lane building. The safety items inspected and their causes for rejection are shown in Exhibit IV.

The inspection fee is $1.00 per inspection.



MOTOR VEHICLE INSPECTION BUREAU

CITY OF MEMPHIS, TENN. LIC. No. _____

DATE _____ CAR _____ MOTOR NUMBER _____

NAME _____

ADDRESS _____

STICKER NUMBER	REAR BRAKES L.	REAR BRAKES R.		FRONT BRAKES L.	FRONT BRAKES R.
			10		
			9		
			8		
			7		
			6		
			5		
			4		
			3		
			2		
			1		

	HAND BRAKE	BRAKES	BRAKE PEDAL	UPPER PINS	FRONT WHEEL ALIGNMENT	IDLE ARM	MUFFLER AND EXHAUST	BALL JOINT LOOSE	TIE RODS	DRAG LINKS	SPINDLE ASSEMBLY LOOSE	STEERING ARMS LOOSE	STEERING HEAD LOOSE AT FRAME	INTERMEDIATE STEERING ARM LOOSE	POWER STEERING	WHEEL BEARINGS LOOSE
UNS	UNS	UNS	UNS	UNS	UNS	UNS	UNS	UNS	UNS	UNS	UNS	UNS	UNS	UNS	UNS	UNS
O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.

OUT — FRONT WHEEL ALIGNMENT — IN

50 40 30 20 10 0 10 20 30 40 50

If rejected you are required by law to have car repaired and returned within 3 DAYS with this card.

PASSED	NO	YES
WINDSHIELD	UNS.	O.K.
HEADLIGHTS	UNS.	O.K.
WINDSHIELD WIPER	UNS.	O.K.
REAR VIEW MIRROR	UNS.	O.K.
TAIL LIGHT	UNS.	O.K.
LIC. NOT ILLUMINATED	UNS.	O.K.
OUT	L	R
OUT OF FOCUS	L	R
HIGH	L	R
LOW	L	R
BROKEN GLASS	L	R
IMPROPER AIM	L	R
INTENSITY LOW	L	R
TURN SIGNAL	UNS.	O.K.
STOP LIGHT	UNS.	O.K.

FIGURE 28. INSPECTION CHECK-OFF CARD, MEMPHIS, TENNESSEE

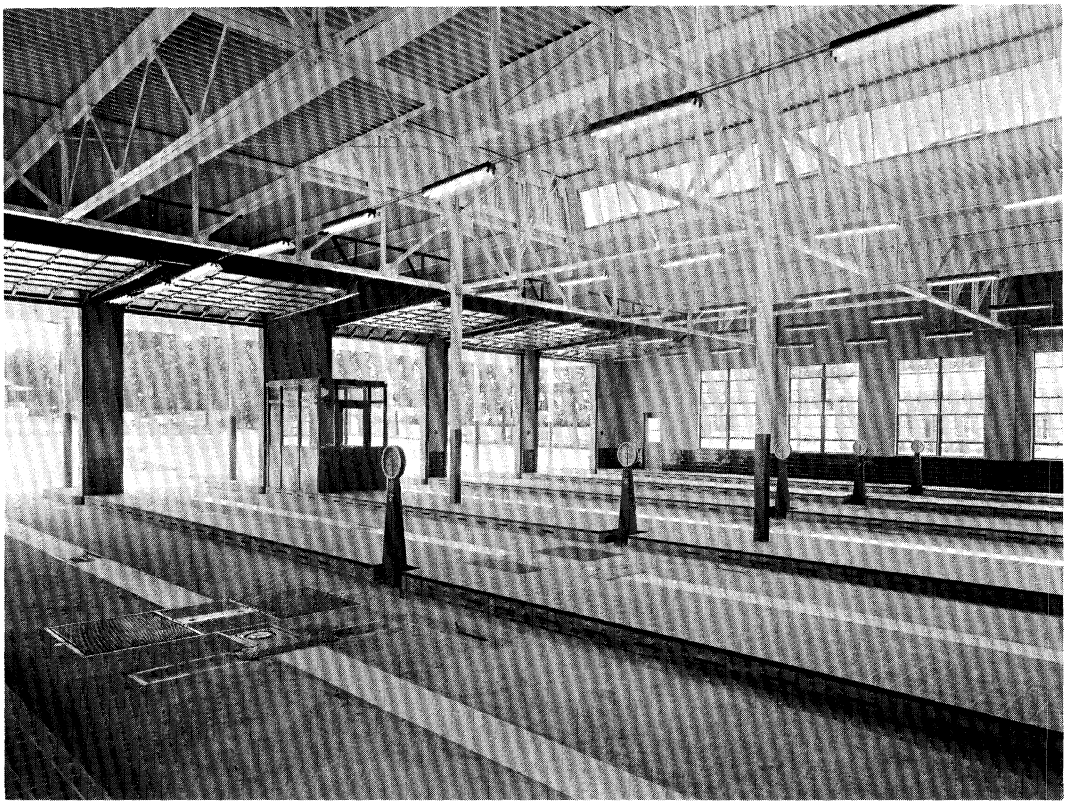


FIGURE 29(a). ENTRANCE OF INSPECTION BUILDING, MEMPHIS, TENNESSEE

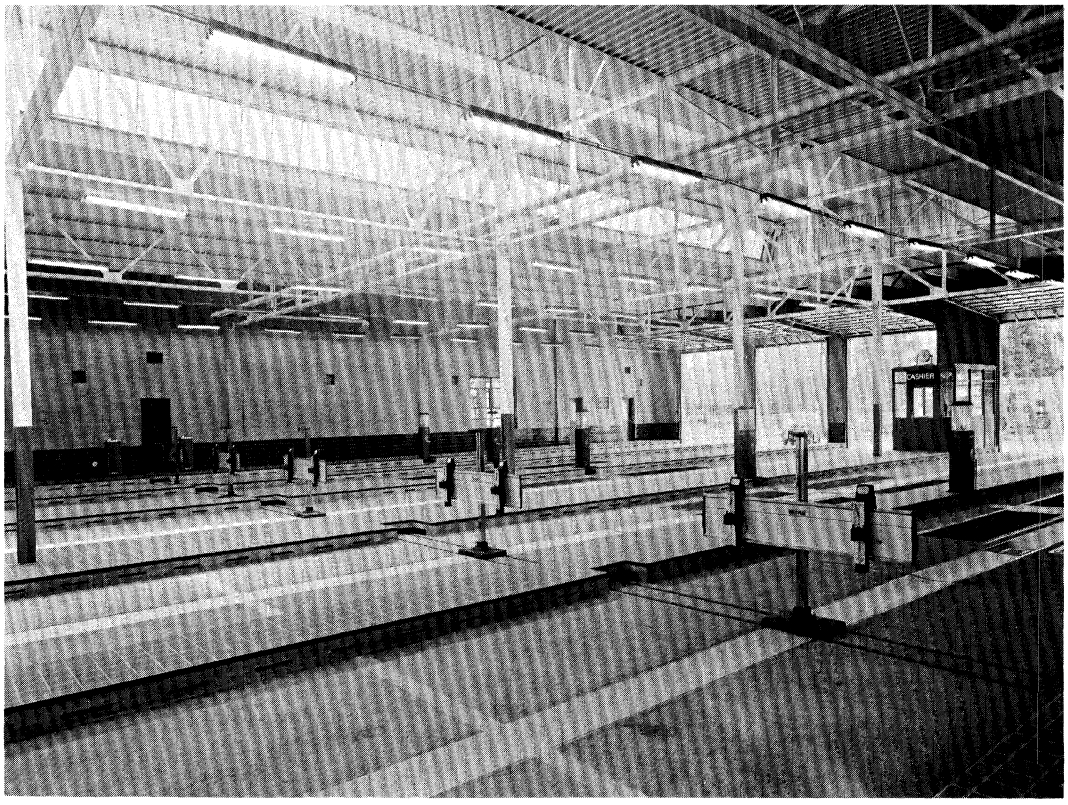


FIGURE 29(b). EXIT OF INSPECTION LANE BUILDING, MEMPHIS, TENNESSEE

EXHIBIT IV

Digest of City of Memphis Official Traffic Code, together with applicable paragraph number, is listed as a standard guide for auto inspectors at station number two (2).

1. Steering Wheel & Wheel Alignment: (Par 1743)

Free play or movement in steering wheel when measured at rim, shall not exceed three (3) inches. The steering arms, tie rod, drag link, or other mechanism by which the vehicle is steered, and the associated parts, must be secure and free from excessive "play" or wear. Any unusual mechanical condition that would cause difficult or uncertain steering will be cause for rejection. Broken main or secondary spring leaves or shackle bolts will be cause for rejection.

The Tow-In or Tow-Out (side slip misalignment between right and left front wheels) shll not exceed thirty (30) feet per mile as indicated by alignment tester.

2. Rear Wheel Alignment: (Par 1743)

Side-slip (misalignment between right and left rear wheels) must not exceed twenty (20) feet per mile as indicated by the Alignment Tester.

3. Exhaust System: (Par 1731)

All motor vehicles shall at all times be equipped with a muffler in good working order to prevent excessive or unusual noise. The entire exhaust system, including manifolds, exhaust pipes, mufflers and tailpipes shall be leak proof. Cut-outs must be welded, bolted securely, or have a screw on plug or tap. Cans wired on, or stuck in the exhaust pipe, or any hastily improved method of containing exhausts, are cause for rejection. Factory installed exhaust systems are acceptable.

4. Rear View Mirror: (Par 1726.1)

Rear view mirrors are required when vehicle is so constructed or loaded, as to prevent the driver from obtaining a view of the street to the rear, by looking backward from the driver's position.

5. Windshield Wiper: (Par 1725.1)

Vehicles other than motorcycles shall be equipped with a device on the driver's side for cleaning rain, snow or other moisture from windshield. This device shall be in good working order and so constructed as to be controlled and operated by the operator of the vehicle.

6. Hand Brake: (Par 1735.1)

All motor vehicles shall be equipped with a hand brake maintained in good working order and properly adjusted. Hand brake shall be adequate to hold such vehicle stationary on any grade upon which operated.

7. Headlights: (Par 1737)

Every motor vehicle other than motorcycles shall be equipped with at least two (2) headlights placed on opposite sides of the front of such vehicle. Lights on both sides are required to operate on high and low beam and to be in good working order. City Traffic Ordinances specifies that headlights shall not project glaring or dazzling lights to persons in front of such headlights and further provides that headlights comply with the foregoing beams rise above a horizontal plane passing through the lamp center parallel to the highway or street upon which the motor vehicle stands.

The standard guide lines listed below will be used by inspectors to check headlights.

(a) High Beam Maximum Height:

High or driving beam maximum allowable height on light board (after centering and leveling) is for the center of the high intensity portion of the beam to be more than two (2) inches above head light center level or seven (7) inches below headlight center level; or no more than six (6) inches to left of straight ahead.

(b) Low or Depressed Beam Maximum Height:

Low or depressed beam maximum allowable height on light board (after proper centering and leveling) is for the center of high intensity portion of the beam to be no higher than seven (7) inches below head light center level or eighteen (18) inches below headlight center level; or no more than six (6) inches to left of straight ahead.

Light meters will be used to check decisions of inspectors in cases where visual inspection is questionable or where allowable tolerance is exceeded.

8. Red or Green Front Lights: (Par 1741)

Red or green lights visible from frontarecause for rejection on any private passenger vehicle. Exception is made for Police Fire or other unauthorized emergency vehicle.

9. Motorcycle Lights: (Par 1736.1)

Motorcycles, motor-drive cycles and motor scooters shall have affixed at least two lights, one to show white when viewed from the front and one to show red when viewed from rear. Foregoing specifications for adequate headlights shall apply.

10. Tail Lights: (Par 1738)

Motor vehicles shall be equipped with at least one red light on rear of the vehicle which shall be visible to the rear from a distance. Factory installed red lens with white center are permissible. Any tail light defaced or with lens broken so as to allow white light to show when viewed from the rear is cause for rejection.

11. License Plate Illumination: (Par 1738)

License plate on the rear of each motor vehicle shall be illuminated by a white light, shielded when viewed from the rear.

12. Stop Lights: (Par 1736.3)

All motor vehicles shall be equipped with at least one red stop light on the rear of such vehicle. The stop light shall be so arranged as to be actuated by the application of the foot or service brakes and shall be capable of being seen at a distance in normal day light, but shall not project a glaring or dazzling light. Stop light may be incorporated with the tail light.

13. Light Switch & Wiring: (No ordinance)

All motor vehicle headlight switches and wiring shall comply with the approved assembly requirements and shall be in good working order.

14. Brake Equipment Required: (Par 1732)

All motor vehicles shall be equipped with two separate means of applying brakes, except motor cycles which shall be equipped with at least one brake.

15. Performance Ability Required: (Par 1735)

Service brakes on any motor vehicle to be adequate to stop vehicle within a distance of thirty (30) feet when traveling at twenty (20) miles per hour on dry and relatively clean paved surfaces. Equivalent to (Total braking effort capable of producing not less than 54% of total vehicle weight).

16. Brake Equalization: (Par 1735.2)

All brakes will be maintained in good working order and shall be so adjusted as to operate as equally as practicable with respect to wheels on opposite side of vehicle.

(a) Front & Rear Braking Effort: (No ordinance)

Front wheel braking effort shall be not less than one half (50%) of rear wheel braking effort or vice versa. As indicated by brake tester equipment.

(b) Right to Left Braking Effort: (No ordinance)

Braking effort on one front wheel shall be no less than approximately two thirds (64%) of the other front wheel. As indicated by brake tester equipment. Braking effort on one rear wheel shall be not less than approximately two thirds (64%) of the other rear wheel. As indicated by brake tester equipment.

17. Judgment:

Inconsistency and inaccuracy of equipment during bad weather (snow, ice, rain, etc) or the inspection of light weight vehicles, will not be substituted for experience and the good judgment of the inspector.