THE INFLUENCE OF PERIODIC MOTOR VEHICLE INSPECTION ON MECHANICAL CONDITION

by

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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, the AMA inspection handbook, 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.

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*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

<table>
<thead>
<tr>
<th>Inspections Per Year</th>
<th>Vehicles Inspected</th>
<th>Vehicles Rejected</th>
<th>Rejection Rate - %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>591</td>
<td>555</td>
<td>93.9</td>
</tr>
<tr>
<td>1</td>
<td>1249</td>
<td>532</td>
<td>42.6</td>
</tr>
<tr>
<td>2</td>
<td>1665</td>
<td>568</td>
<td>34.1</td>
</tr>
<tr>
<td>3</td>
<td>1379</td>
<td>171</td>
<td>12.4</td>
</tr>
</tbody>
</table>

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.
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

<table>
<thead>
<tr>
<th>Inspections Per Year</th>
<th>Vehicles Rejected</th>
<th>Total Defects</th>
<th>Defects Per Rejected Vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>555</td>
<td>1684</td>
<td>3.02</td>
</tr>
<tr>
<td>1</td>
<td>532</td>
<td>1155</td>
<td>2.17</td>
</tr>
<tr>
<td>2</td>
<td>568</td>
<td>891</td>
<td>1.57</td>
</tr>
<tr>
<td>3</td>
<td>171</td>
<td>219</td>
<td>1.28</td>
</tr>
</tbody>
</table>

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

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

*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 greater 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.
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.
REFERENCES


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.
HIGHERWAY SAFETY RESEARCH INSTITUTE
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Ann Arbor, Michigan

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

FIGURE 2. HSRI INSPECTION FORM
Table IV
MEDIAN VEHICLE AGE AND PER CAPITA INCOME

<table>
<thead>
<tr>
<th>City and State</th>
<th>Med. Veh. Age</th>
<th>Per Capita Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ann Arbor, Michigan</td>
<td>2.8 years</td>
<td>$3,728</td>
</tr>
<tr>
<td>Washington, D.C.</td>
<td>3.3 years</td>
<td>$3,367</td>
</tr>
<tr>
<td>Cincinnati, Ohio</td>
<td>3.0 years</td>
<td>$2,639</td>
</tr>
<tr>
<td>Memphis, Tennessee</td>
<td>3.7 years</td>
<td>$2,227</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ann Arbor</td>
<td>2.8 years</td>
<td>29,500</td>
<td>10,536</td>
</tr>
<tr>
<td>Washington</td>
<td>3.3 years</td>
<td>26,500</td>
<td>8,030</td>
</tr>
<tr>
<td>Cincinnati</td>
<td>3.0 years</td>
<td>28,500</td>
<td>9,000</td>
</tr>
<tr>
<td>Memphis</td>
<td>3.7 years</td>
<td>no data</td>
<td>no data</td>
</tr>
</tbody>
</table>
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
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
DEFECTS PER REJECTED VEHICLE

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 (Washers)
Horn
Mirror
Miscellaneous

Total Defects
PERCENT OF TOTAL DEFECTS

- Headlight Aim
- Wheel Alignment
- Brake Force
- Miscellaneous
- Steering Operation
- Headlamps
- Stop Lights
- Parking Brake
- Wipers (Washers)
- Tail Lights
- Exhaust System
- Turn Signals
- Tires
- Windows
- Windshield
- Parking Lights
- Horn
- Mirrors
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
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Note: The table data includes various vehicle characteristics and defects per vehicle.
APPENDIX C

Data Tables

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APPENDIX D

Miscellaneous Data Tables
### Municipal Car Care & Inspection Lanes, Cincinnati, Ohio

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

**Sources**

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**Past Year Inspection Summaries**

Cincinnati, Ohio

Washington, D.C.
## Defect Category Analysis

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<tr>
<td>Stop Lights</td>
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<td>71</td>
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<td>0.061</td>
<td>34</td>
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<td>0.038</td>
<td>34</td>
<td>0.06</td>
<td>0.038</td>
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<tr>
<td>Windshields</td>
<td>15</td>
<td>0.03</td>
<td>0.013</td>
<td>15</td>
<td>0.03</td>
<td>0.013</td>
<td>1</td>
<td>0.00</td>
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<td>Windows</td>
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<td>12</td>
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<td>0.013</td>
<td>12</td>
<td>0.02</td>
<td>0.013</td>
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<tr>
<td>Wipers (and Washers)</td>
<td>43</td>
<td>0.08</td>
<td>0.037</td>
<td>43</td>
<td>0.08</td>
<td>0.037</td>
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<td>0.01</td>
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<td>6</td>
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</tr>
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<td>Horn</td>
<td>1</td>
<td>0.01</td>
<td>0.004</td>
<td>1</td>
<td>0.01</td>
<td>0.004</td>
<td>4</td>
<td>0.01</td>
<td>0.004</td>
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<tr>
<td>Mirrors</td>
<td>8</td>
<td>0.02</td>
<td>0.007</td>
<td>8</td>
<td>0.02</td>
<td>0.007</td>
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<td>0.00</td>
<td>0.000</td>
<td>0</td>
<td>0.00</td>
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<td>Miscellaneous</td>
<td>112</td>
<td>0.21</td>
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<td>0.097</td>
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<td>0.03</td>
<td>0.021</td>
<td>19</td>
<td>0.03</td>
<td>0.021</td>
</tr>
</tbody>
</table>

| Totals               | 1674 | 3.02 | 1.000 | 1155 | 2.17 | 1.000 | 891 | 1.57 | 1.000 | 219 | 1.28 | 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**

![Inspection Check-Off Card Diagram](image-url)
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). A vehicle will not be required to have a license to be inspected and taxed.

2. Location of inspection and testing station—on west side of Central Parkway north of Bates Avenue. Entrance to testing station:
   For Passengers—East side of Central Parkway north of building; exit at north end of building on Bates Avenue. For Trucks—At Coleridge Ave. and Mose- mouse St. (south side 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 collision 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 a valid license or when the vehicle is not依法 in the inspection office. The registration office is not required to make the necessary repairs.

4. Inspection fee: One dollar for each inspection period. Exception: Fee is payable: Vehicles owned by United States Government, State of Ohio and any political subdivsion of Ohio. Additional inspections shall be made without charge, of any motor vehicle bearing an unexpired approval seal; but each additional inspection shall not exceed the inspection period.

5. Inspections and tests will be made of brakes, light, horn, signaling devices, windshield, wipers, rear view mirror, rearview mirrors, steering mechanisms, license plates, exhaust systems, wheel alignment, muffling, fifth wheels, towing equipment, frame manufacturer specifications.

6. The vehicle owner’s time will be reduced to a minimum at the inspection Division. If the following suggestions are observed prior to time of presenting the vehicle for inspection:
   (a) Have repaired and replaced all known defective, damaged, or worn parts of the vehicle, including the lights.
   (b) Have all tires inflated to full pressure recommended by the manufacturer for a weight of vehicle and tire size.
   (c) Have windshield and all stickers (except official seal) removed from side, unless same is authorized by law.
   (d) Have your current year’s Driver’s License.
   (e) Have your Ohio State Vehicle Registration Certificate.

7. Upon passing inspection, do not deface/destroy or lose the Official Stamped for your windshield. It is your badge of approval, good for six months vehicle operation, and will save you the inconvenience of having to be stopped by a Police Officer, Ordinance 269-20.

8. Upon failure to pass inspection a temporary sticker will be affixed 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 re-issued to Police Officers for a longer period than one month.

9. Do not make inquiry of City’s employees regarding vehicle permits or repairs to be made or sold. Vehicle permit is not required 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 Inspectors

Step 1—Registration

The duties of the Inspector at the Registration Section are to administer the following instructions and record it on the inspection card:

1. Note and address of owner.
2. State vehicle registration number. (Registration certificate numbers should be as same. In case front and rear license plate and registration card numbers do not agree, call the License Inspection.)
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 Section believes that the tire is 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 rejecting a test, but a rejection sticker will be issued.
8. If the State License is not available, the Inspector shall record the number of vehicle in the space for State License.
9. Check chassis for wheel stops.
10. License Plate:
   (a) Must be clean and their visibility not obstructed by other parts of the vehicle.
   (b) Front and rear license plates required on all passenger cars and trucks under only on motorcycles, trailers and semitrailers.

License plates are cut on the 1st of July. (c) License shall be properly illuminated by white light for night driving.

Must be mounted securely.

Step 2—Wheel Alignment and Steering

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

1. Check windshield wipers:
   (a) Shall not be cracked, dried out, or edges worn down. It must keep glass clean.
   (b) Wiper or wiper arm should operate properly. Power drivers or hand operated wipers are acceptable.

2. Check for clear vision:
   (a) Windshield shall be clean and free of all stickers and other transparent material not required by law, and made of glass.
   (b) Operator’s view through windshield or any window shall not be obstructed.

3. Rear view mirrors desired (except on motorcycles) and must be so installed as to enable the operator to view the road.

4. Check exhaust system:
   (a) Muffler is required to dampen exhaust discharge 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 units must be in good repair.
   (b) Check to see that all parts operate properly.
   (c) Shall be visible and clearly understand 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 excessively loud or harsh in tone, which compressed air whistle or horn, or any other device simulating emergency signals are allowed.

8. Examine inspection card for possible confu

9. Steering:
   (a) Check steering wheel and see that it does not have more than three inches of free play when turned.
   (b) Inspector will drive slowly across wheel alignment course, being careful not to turn front wheels from straight ahead position.
   (c) As each front wheel passes over the wheel alignment course, side slippage is automatically recorded by indicator. Inspector will note side slippage per mile on inspection card.

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

EXHIBIT I

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Step 3—Steering Mechanism

1. Inspector shall drive vehicle on level road and check 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, stop links, king pins, spindle bearings and other parts of the steering mechanism.

3. Tolerance for spindle play as measured at the tire of the front wheels shall be:
   (a) For passenger cars and light trucks - not more than 0.01 inch.
   (b) For trucks 15 tons and up - not more than 0.15 inches.
   (c) For front wheel away or swivel - not more than 1 degree.

4. Tire:
   (a) Must be in a safe operating condition.
   (b) Reject if the same tread is worn down to the breaker strip or if tire is not free from bulges or brake caused by broken fabric.
   (c) Capped, bandaged or straightened 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 testes.

Step 4—Brake Inspection

At this step the Inspector will check the braking effect, equalization of service brakes, and the parking brakes.

1. Brake test should be made only under conditions where the brake pedal will go down to indicate maximum travel without touch front wheels.

2. Advance vehicle until wheels are on brake testes. Brake test shall be made on service brakes only. Inspector must record individual reading for each wheel brake.

3. Tolerance:
   (a) The brake 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 11/2 tons capacity, or less, twenty-five feet. (Requirement for brake travel of 50 per cent of gross weight of vehicle)
      2. In the case of other vehicles with normal load, thirty norms and one-half inch. (Requirement for brake travel of 35 per cent of gross weight of vehicle.)
   (b) The breaking force on opposite wheels shall not vary more than 25 per cent.
   (c) The total breaking effect of the rear wheels shall not be less than one-half of the total breaking effect of the front wheels.

4. Hand Brake:
   (a) Brake pedal travel should not be excessive. (Requirement for brake pedal travel of 12 inches.)
   (b) No interferance brake pedal travel on all vehicles should be not less than fifty (50) percent of the brake pedal travel of the foot brake.
   (c) See that the brake lever has adequate return action.

5. Trains are not to be inspected when load ed unless the load is of a permanent nature such as power company tracks with insulators, tracks 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 comparison.

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 gusset, and similar types are considered safe.

9. If vehicle is so equipped, check turn signals, or brake lights. 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 trailer 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 Step 1 and accept the next registered vehicle for inspection.

Step 5—Head Lights and Other Lighting Devices

1. The Inspector shall first check the head light lenses under the assumption that they are properly installed.

2. Lenses:
   (a) Lenses on head lights, auxiliary lamps, tail and stop lights, signal devices and other lenses that are being worked on shall not be cracked or missing.
   (b) Covers or red lenses, except on clearance lamp, not permitted on front of vehicle unless officially approved.
   (c) Left and right lenses should be installed on their respective lamp as viewed from the driver's seat.
   (d) Halitecrane lenses on cars previous to 1930 have the word "left", or "right" in the top of the lens, while those after 1930 are cast in the bottom. The newer lenses are interchangeable with the older models. A poor and unsafe light will result in this case.

3. Bulbs:
   (a) Check and see that all bulbs and all filaments burn.
   (b) Switch must light properly filament.
   (c) Lamps must be securely fastened.

4. 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.

5. Auxiliary lights must not be mounted higher than 22 inches or lower than 42 inches.

6. All automatic beam changes must be in good working order.

4. Head Light Test:
   (a) See that vehicle is properly located. Proper distance between headlight and center is 30 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 permissible.
      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 inspector will not be cases for rejection.
   (b) Stop Light:
      1. Shall be visible for 200 feet.
      2. Flashing bulbs may be used.
   (c) Parking Light:
      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 of the point of greatest width.
   (e) Trailers and semi-trailers require a white running light on the rear or sides as to be visible from every side.

6. All lighting devices shall be in working order.

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 action, but shall not verbally indicate what work should be performed, nor how should be performed, or where it should be performed.

8. The final Inspector will direct the driver of the vehicle to the ranker who will collect the inspection fee, receipt the inspection card, give duplicate card to driver, and retain original, and for permanent record of inspection. If "OK" an approved and is affixed to his windshield. If "Unsatisfactory", meaning that the vehicle has not passed inspection, a temporary sticker is affixed to the windshield.

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<table>
<thead>
<tr>
<th>Points of Inspection</th>
<th>Reject for Following</th>
<th>Warn Motorist of Following</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Driver's License</td>
<td>Not capable of being held for 200 feet</td>
<td>Not available</td>
</tr>
<tr>
<td>2. Horn</td>
<td>Missing -- not securely mounted -- not lighted -- not properly illuminated -- visibility obstructed</td>
<td>Do not match registration card</td>
</tr>
<tr>
<td>3. License plates</td>
<td>More than 3° or binding</td>
<td></td>
</tr>
<tr>
<td>4. Steering wheel slack</td>
<td>&quot;Foot-in&quot; and &quot;Toe-out&quot; more than 44 feet and 20 feet respectively at side alignment per mile</td>
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</tr>
<tr>
<td>5. Wheel alignment</td>
<td>Loose tie rod, drag link, king pin, spindle housing or other parts</td>
<td></td>
</tr>
<tr>
<td>6. Steering mechanism</td>
<td>(a) More than 15° degrees</td>
<td>Tired worn smooth</td>
</tr>
<tr>
<td>7. Spindle play as measured or tires</td>
<td>(b) More than 15° degrees</td>
<td></td>
</tr>
<tr>
<td>(a) Passenger cars and light trucks</td>
<td>(c) More than 2 degree</td>
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</tr>
<tr>
<td>(b) Trucks 1/2 tons and up</td>
<td>Outer trend worn down to breaker strip—not free from bulge or breaks caused by broken fabrics</td>
<td></td>
</tr>
<tr>
<td>(c) Front wheel away or wobble</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Tires</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Brakes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Parking brake</td>
<td>(a) 1. Up to 1/2 tons capacity: less than 50 percent of gross weight of vehicle.</td>
<td></td>
</tr>
<tr>
<td>(b) Less than 1000 lbs</td>
<td>2. Over 1/2 tons capacity: less than 35 percent of gross weight of vehicle.</td>
<td></td>
</tr>
<tr>
<td>(c) Less than 3%</td>
<td>3. For two-wheel braking systems: less than 15 percent of gross weight of vehicle.</td>
<td></td>
</tr>
<tr>
<td>(d) Less than 5%</td>
<td>(b) Variation more than 25 percent</td>
<td></td>
</tr>
<tr>
<td>(e) Less than 15%</td>
<td>(c) Less than 20 percent of front brakes</td>
<td></td>
</tr>
<tr>
<td>(f) Less than 20%</td>
<td>(d) Less than 5% of rear brakes</td>
<td></td>
</tr>
<tr>
<td>(g) No bond 20% per of total required brake padings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Towing devices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Fifth wheel</td>
<td>Not a &quot;safe&quot; type (ball and socket, tongue and groove, and similar make considered safe)</td>
<td></td>
</tr>
<tr>
<td>12. Towed vehicle</td>
<td>Broken or worn parts</td>
<td></td>
</tr>
<tr>
<td>13. Lenses on all lights</td>
<td>Safety chain missing</td>
<td></td>
</tr>
<tr>
<td>14. Lights (general)</td>
<td>Missing -- cracked -- dirty -- rotated -- wrong type -- incorrectly installed</td>
<td></td>
</tr>
<tr>
<td>15. Head lights</td>
<td>Burned out filament -- not securely fastened -- switch lights improper filament -- reflector improperly matched -- out of focus</td>
<td></td>
</tr>
<tr>
<td>16. Tail lights</td>
<td>Vertical and horizontal beams do not meet factory specifications</td>
<td></td>
</tr>
<tr>
<td>17. Stop lights</td>
<td>Elihnes or flashes -- dirty or broken lens -- not firmly mounted -- not colored red -- left of dual tail lights out</td>
<td></td>
</tr>
<tr>
<td>18. Marker lights for vehicles over 80&quot; wide</td>
<td>Not visible for 200 feet</td>
<td>Right of dual tail lights out</td>
</tr>
<tr>
<td>19. Parking light</td>
<td>Too few -- wrong color -- improperly mounted</td>
<td>Right windshield wiper impractical -- blade cracked out, dried out, or worn down</td>
</tr>
<tr>
<td>20. White light under body of trailer or semi-trailer</td>
<td>Wrong color -- improperly mounted</td>
<td></td>
</tr>
<tr>
<td>21. Windshield wiper</td>
<td>Mining -- wrong color -- not visible from every side</td>
<td>(a) Cracked</td>
</tr>
<tr>
<td>22. Clear vision</td>
<td>Left windshield wiper impractical -- blade cracked out, dried out, or worn down</td>
<td></td>
</tr>
<tr>
<td>(a) All glass</td>
<td>(b) Not clear-cleaning stickers not authorized by law</td>
<td></td>
</tr>
<tr>
<td>(b) Winstachield</td>
<td>(c) Operator's view obstructed</td>
<td></td>
</tr>
<tr>
<td>23. Rear vision mirror</td>
<td>Missing -- not clear -- improperly mounted</td>
<td></td>
</tr>
<tr>
<td>24. Exhaust system</td>
<td>Too smoky Emitting excessive smoke or fumes</td>
<td></td>
</tr>
<tr>
<td>25. Left front window (when turn signals are not used)</td>
<td>Does not operate freely</td>
<td></td>
</tr>
<tr>
<td>26. Turn signals (Required on 1954 and later models)</td>
<td>Do not operate -- not visible or clearly understood for 300 foot</td>
<td></td>
</tr>
<tr>
<td>27. Wheel fuses</td>
<td>Mining (If required)</td>
<td></td>
</tr>
<tr>
<td>28. Other items not listed</td>
<td>If they affect the safe operation of the vehicle</td>
<td></td>
</tr>
</tbody>
</table>
Sec. 504-29. Road Worthiness. (a) No person shall cause or cause to be driven or moved on any highway, any vehicle, traction trolley, or combination of vehicles which is in such unsalable 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 vehicle or traction trolley not in consistent with the Traffic Code.

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

Sec. 504-4. Citation by Police. The city manager is hereby authorized and directed to supply police officers with special safety-base citation tags for the purpose of giving notice to persons violating any provision of Sections 504-1 to 504-23, inclusive. Notice of such violation may be given by delivering the safety-base citation tag to the violator, or by affixing it to the offending motor vehicle. Such safety-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 specified thereon.

After the expiration of such seventy-two (72) hour period, it shall be unlawful for the owner or person having possession or control of such tagged motor vehicle to operate the same upon the streets of the city unless the same have 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 and indicating that it has been inspected and approved at an approved testing station, or if such motor vehicle bears an inspection and indicating that more than six weeks have elapsed since the expiration date of the last previous inspection, a copy of such inspection tag shall be forwarded to the municipal court and such owner or person shall be required to appear and pay such fine as shall be fixed by the provision provided in Section 504-26.

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 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 504-26 as follows: if not more than two weeks overdue after the expiration of the previous inspection, $1.00; if not more than four weeks overdue, $2.00; if not more than six weeks overdue, the director of public works or his authorized assistant 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 inspection tag from the testing station, properly endorsed, the same and all copies thereof shall be fully cancelled. (GC 76-255, Ord. 393-343)

Sec. 504-15. Details of Inspection. Inspection shall be made of brakes, lights, signaling devices, windshield, windshield wipers, rear view mirrors, tires, steering gear, drawbars, fifth wheels and towing devices, and all other parts upon which the safe operation of such vehicle may depend.

The inspection requirements hereinafter 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 each motor vehicle meets the requirements hereinafter provided.

(a) License Plate. (504-33)

(b) Horn. (504-39)

(c) Rear View Mirror. (504-43)

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

(e) Lights. (504-1, 504-13, 504-4, 504-10, 504-13, 504-10, and 504-11)

(f) Windshield and Windshield Wipers. (504-13, 504-20, 504-26)

(g) Front End Assembly. The front end assembly shall be free from worn, broken, loose or sagging parts, and equipped with a head light which is in good working order.

(h) Wheel Alignment and Steering Mechanism. The steering, its rod, plays, links, and other

assumed 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 travel should not be more than forty-four (44) feet and for more than 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 254-31. Such tires shall be in a safe operating condition. It shall be prima facie 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 bruises or bruises caused by broken fabrics.

Every solid tire shall have rubber or other resilient material on its outer traction surface of least one such thick above the edge of the flanges on the entire periphery as required by Section 504-26.

(j) Brake. (504-34)

(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. Drawers or other towing devices and the couplings thereof shall be free from seams worn or broken parts.

All towed vehicles which are not manufactured in 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 tractor and its load. (504-21 a)

(m) Signal Devices. Signal devices shall be in good working condition when required to be on by Sections 504-26, and 504-29.

(n) Sphyra Guards. (504-46)

(o) Directional Signals. (504-39)

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

Sec. 504-32. Reversion Inspection Seal. It shall be unlawful to remove, obliterate, deface or obscure an inspection seal as herein described; or in place such a seal upon any motor vehicle which said seal was not leased; or to operate any vehicle using such a seal obtained for a different vehicle; or to operate a motor vehicle bearing a facsimile or imitation of such a seal.

Sec. 504-33. Reversion Inspection Seal. It shall be unlawful to remove, obliterate, deface or obscure an inspection seal as herein described; or in place such a seal upon any motor vehicle which said seal was not leased; or to operate any vehicle using such a seal obtained for a different vehicle; or to operate a motor vehicle bearing a facsimile or imitation of such a seal.

Sec. 504-34. Reversion Inspection Seal. It shall be unlawful to remove, obliterate, deface or obscure an inspection seal as herein described; or in place such a seal upon any motor vehicle which said seal was not leased; or to operate any vehicle using such a seal obtained for a different vehicle; or to operate a motor vehicle bearing a facsimile or imitation of such a seal.

Sec. 504-35. Reversion Inspection Seal. It shall be unlawful to remove, obliterate, deface or obscure an inspection seal as herein described; or in place such a seal upon any motor vehicle which said seal was not leased; or to operate any vehicle using such a seal obtained for a different vehicle; or to operate a motor vehicle bearing a facsimile or imitation of such a seal.

Sec. 504-36. Reversion Inspection Seal. It shall be unlawful to remove, obliterate, deface or obscure an inspection seal as herein described; or in place such a seal upon any motor vehicle which said seal was not leased; or to operate any vehicle using such a seal obtained for a different vehicle; or to operate a motor vehicle bearing a facsimile or imitation of such a seal.

Sec. 504-37. Reversion Inspection Seal. It shall be unlawful to remove, obliterate, deface or obscure an inspection seal as herein described; or in place such a seal upon any motor vehicle which said seal was not leased; or to operate any vehicle using such a seal obtained for a different vehicle; or to operate a motor vehicle bearing a facsimile or imitation of such a seal.
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.
Vehicle Safety Inspection

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.

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.
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—Wheels 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 sidewalks.

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

<table>
<thead>
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<td>Exh. Smoke 16</td>
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<td>Route Signs and Zone Maps</td>
<td>C</td>
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<tr>
<td>Upholstery</td>
<td>D</td>
</tr>
<tr>
<td>Sanitation</td>
<td>E</td>
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</table>
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 Police 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:

<table>
<thead>
<tr>
<th>Position</th>
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<tbody>
<tr>
<td>Flagman</td>
<td>Police Officer</td>
</tr>
<tr>
<td>Greeter</td>
<td>HSRI Staff</td>
</tr>
<tr>
<td>4-Driver/Inspectors</td>
<td>HSRI Staff</td>
</tr>
<tr>
<td>5-Underbody Inspectors</td>
<td>HSRI Staff</td>
</tr>
<tr>
<td>Underbody Supervisor</td>
<td>HSRI Staff</td>
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<tr>
<td>Data Collector</td>
<td>HSRI Staff</td>
</tr>
<tr>
<td>Police Clerk</td>
<td>Meter Maid</td>
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<tr>
<td>Inspection Evaluator</td>
<td>Police Sergeant</td>
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<tr>
<td>2-Lane Supervisors</td>
<td>HSRI Staff</td>
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<tr>
<td>Equipment Representative</td>
<td>Bear Mfg. Co.</td>
</tr>
<tr>
<td>Police Supervisor</td>
<td>Police Lieutenant</td>
</tr>
</tbody>
</table>

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

The 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 and two rear 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 arm must hold the wiper firmly against the windshield.
8. Windshield wipers--Every vehicle manufactured after January 1, 1958 shall be equipped with a windshield wiper and maintained in operable condition.
9. Headlight beam indicator--Every vehicle equipped with multiple beam headlamps shall be equipped with a beam indicator. Such indicators shall be 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.
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 willful 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 or 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 300 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](image)

**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
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) shall 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 guidelines 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 front are cause 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.