

A MANAGEMENT SYSTEM FOR EVALUATING THE VIRGINIA PERIODIC  
MOTOR VEHICLE INSPECTION PROGRAM

by

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A Report Prepared by the Virginia Highway and Transportation  
Research Council Under the Sponsorship of the  
Highway Safety Division of Virginia

(The opinions, findings, and conclusions expressed in this  
report are those of the author and not necessarily those of  
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Virginia Highway & Transportation Research Council  
(A Cooperative Organization Sponsored Jointly by the Virginia  
Department of Highways & Transportation and  
the University of Virginia)

Charlottesville, Virginia

October 1977  
VHTRC 78-R19

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## ABSTRACT

A system for management evaluation of Virginia's periodic motor vehicle inspection (PMVI) program was developed which is similar to that currently in use by the Virginia Department of State Police, except for changes in the sample size of inspection receipts and a modification of the procedure for sampling inspection receipts. Using the procedure described in this report State Police will be required to sample fewer receipts than in previous evaluations and this method should also allow for more suitable statewide inferences concerning Virginia's periodic motor vehicle inspection program.

A total of 35,016 approval receipts were sampled and analyzed from the 6,325,485 inspection receipts issued during 1975, and it was found that 22.62% of the vehicles inspected and approved, immediately or after repair at the time of inspection, were defective in some way. Other findings included: (1) The percentages of defective vehicles were similar for passenger vehicles, trucks, and school buses; (2) private inspection stations had a somewhat higher percentage of defective vehicles than unlimited or small exemption stations; (3) headlights, other lights, brakes, and tires were among the items most often reported as defective; (4) for most inspection items there was a slightly greater failure rate for low volume stations than for medium or high volume stations; and (5) there was generally an increase in defects as vehicle age and mileage increased.

Limitations noted to result from the design of the current inspection receipt are that: (1) the specific component which is defective and the severity of the defect are not indicated, (2) charges for repairs for individual items are not noted, and (3) there is no assurance of an accurate recording of vehicle mileage.



## SUMMARY OF FINDINGS

1. A total of 35,016 approval receipts were sampled from the 6,325,485 inspection receipts issued in Virginia in 1975, and it was found that 22.62% of the vehicles sampled were defective in some way.
2. The percentages of defective vehicles were found to be similar for all types of vehicles, except for commercial buses, which had a rather high percentage of defects (52.84%).
3. Stations classified as "private" were found to have a higher percentage of defective vehicles than the other classifications.
4. For most inspection items there appeared to be a slightly greater failure rate for low volume stations than for medium or high volume stations.
5. Headlights, other lights, and brakes were found to be the items most likely to be defective.
6. A greater volume of defects was found for vehicles as vehicle age increased. This was found to be particularly true for brakes, other lights, and signal lights.
7. There was generally an increase in defects as vehicle mileage increased. Increases in defects due to vehicle mileage were found for brakes, exhaust lines, and other lights.
8. The distributions of defects for defective domestic and foreign passenger vehicles were found to be similar for most items inspected.



## CONCLUSIONS AND RECOMMENDATIONS

A management system for evaluating Virginia's periodic motor vehicle inspection program was developed based on a sample size of approximately 36,000 inspection receipts and a sampling procedure based on stratifying the sample according to station classification (private, small exemption, and unlimited) and station volume (low, medium, and high). Since the use of this procedure will permit the Department of State Police to sample fewer receipts than sampled in previous evaluations and this method should also allow for more suitable statewide inferences concerning Virginia's periodic motor vehicle inspection program, it is recommended that State Police adopt this evaluation procedure.

A tabulation of data items obtained from inspection receipts sampled in the present study revealed that headlights, other lights, and brakes were among those items most likely to be defective, and that there was generally an increase in defects as vehicle age and/or mileage increased. Even some of the new model vehicles (1976) and relatively new vehicles (1975) were found, upon inspection, to be defective in some way. Approximately 6.0% of the 1976 vehicles sampled were defective, and over 9.0% of the 1975 vehicles sampled were defective.

A limitation which exists due to the design of the current inspection receipt is that no space is provided to record charges for repairs for individual items. Unless this form is redesigned, an analysis of the costs for rectifying any defects found during inspection is not possible.



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INTRODUCTION

An awareness of the importance of motor vehicle inspection has been evident since the second decade of this century. The relationship between vehicle defects and motor vehicle accidents was recognized as early as 1916 when a wheel fell off McPherson's automobile, tossing Mrs. McPherson out of the vehicle; she sued the Buick Motor Company and won the case.<sup>(1)</sup>

In 1922 a mandatory annual motor vehicle inspection program was begun in Finland, and soon afterwards motor vehicle inspection programs were mandatory in several Western European countries.<sup>(2)</sup>

Interest in motor vehicle inspection programs was shown in the United States in 1927 when voluntary inspection programs were set up in special garages in Maryland, New York, and Massachusetts in "Save-A-Life" campaigns.<sup>(3)</sup> Legislation was enacted two years later which mandated motor vehicle inspection in these states.<sup>(1)</sup> The first such law enacted in the United States, however, was in Pennsylvania in 1928, when a voluntary pilot inspection program demonstrated the need for such legislation.<sup>(3)</sup> By 1930 vehicle inspection programs had been instituted in all six New England states, and gradually such programs have spread throughout most of the United States.<sup>(3)</sup>

In 1966 federal guidelines for state programs were established by the Highway Safety Act, which required each state to have a traffic safety program, including vehicle inspection, approved by the U. S. Secretary of Transportation. Highway Safety Program Standard 4.4.1., Periodic Motor Vehicle Inspection, was issued a year later and required each state to operate a motor vehicle inspection system under which "every vehicle registered in the state is inspected ... at the time of initial registration and at least annually thereafter...."<sup>(1)</sup>

Currently, periodic motor vehicle inspection is mandatory in twenty-eight states, and in the District of Columbia, Puerto Rico, the Virgin Islands, American Samoa, and Guam. Eleven states have approved trial substitute programs, and nine states have no periodic inspection requirement nor trial substitute programs (see Figure 1).

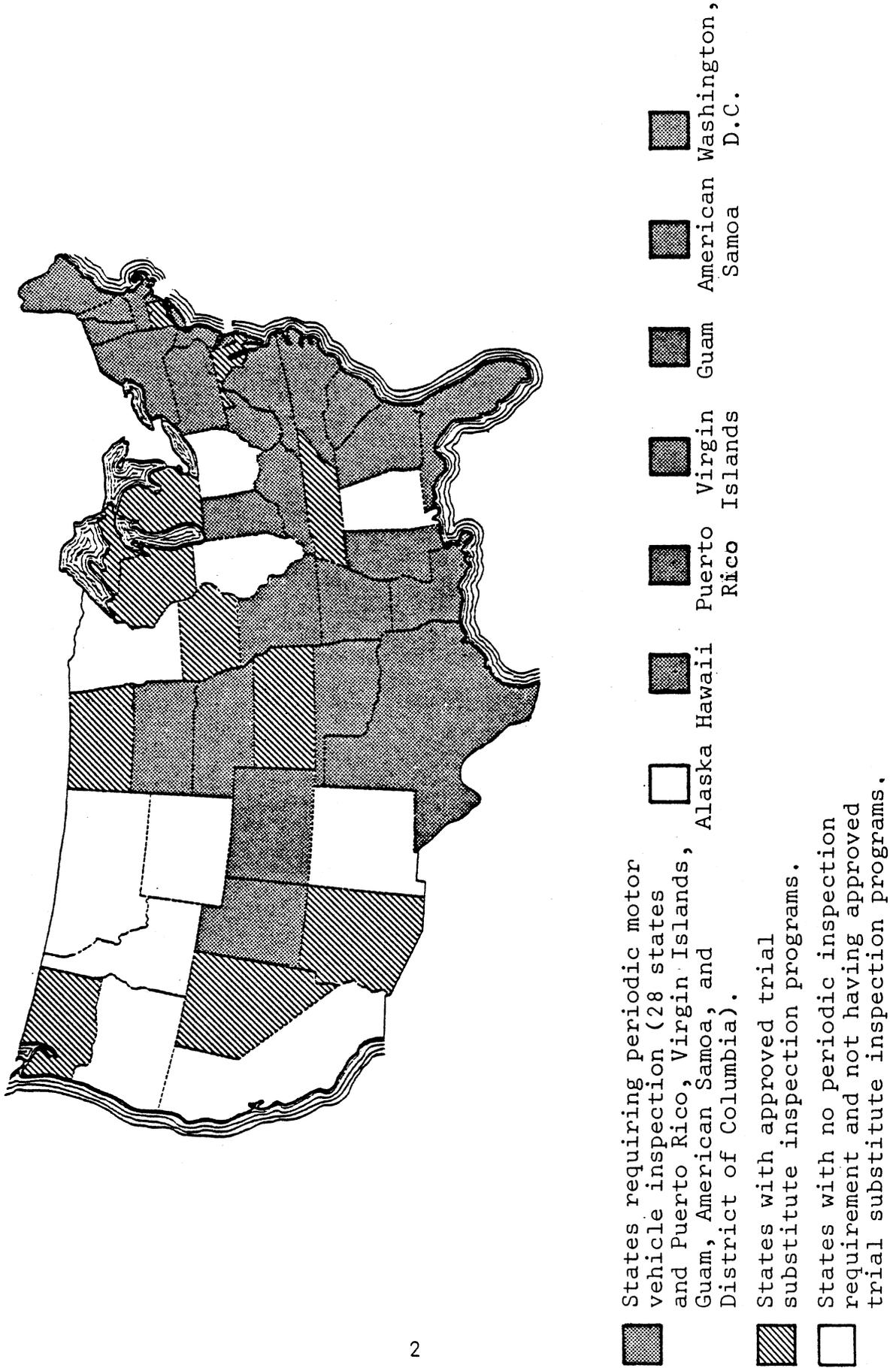


Figure 1. States requiring periodic motor vehicle inspection by law.

In Virginia the periodic motor vehicle inspection program (PMVI) was implemented in 1932. The system uses privately owned stations, which are authorized and supervised by the Department of State Police to conduct inspections. Currently inspections are conducted throughout the year, and vehicle owners are required to have their vehicles inspected twice a year, with a period of no more than six months between inspections. Under Virginia law it is a misdemeanor "to make an improper inspection, to misuse inspection materials or to operate without a valid inspection sticker."<sup>(4)</sup> The Virginia PMVI system is additionally controlled by the authority of the Superintendent of State Police to suspend inspection privileges of stations or individual mechanics.<sup>(4)</sup>

Each inspection station is classified according to one of the following five categories: (1) unlimited - stations qualified to inspect all vehicles presented; (2) small exemption - stations limited to inspecting vehicles not exceeding 10 feet in height or 35 feet in length; (3) large exemption - stations limited to inspecting vehicles exceeding 10 feet in height and 35 feet in length; (4) motorcycle - stations qualified to inspect only motorcycles; and (5) private - stations permitted to inspect only private or company owned vehicles.<sup>(5)</sup>

Under the Virginia periodic motor vehicle inspection (PMVI) program, 15 safety-related vehicle components are inspected (see Appendix A). Each of the 15 items on the approval receipt is checked "o.k.," "adjust," or "install." The following information is also included on the approval receipt: the date of inspection; the vehicle license number; the vehicle's make, body type, year built, and odometer reading; and the inspection station's name and number. A copy of each inspection receipt is filed at State Police Headquarters in Richmond.

In 1974 the Department of State Police expressed an interest in developing a system for administratively evaluating individual stations. It was reasoned that the establishment of a statewide failure rate\* for each item inspected per vehicle type would indicate which types of defects occur most frequently, or which type of vehicles or what age vehicles experience the greatest number of defects, and with this information, State Police would be able to determine which stations, if any, deviate to a statistically significant degree from statewide averages.<sup>(6)</sup>

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\*It should be noted that "failure rate" does not necessarily refer to a vehicle that received a rejection receipt. In the case of an approval receipt, the only type of receipt analyzed in the study, "failure rate" refers to an item checked "adjust" or "install" before the vehicle was repaired and issued an approval receipt.

## PURPOSE AND SCOPE

The purpose of this project was to develop a system for evaluating inspection stations in Virginia. Failure rates were to be determined for inspection items by vehicle type and station classification to allow for inspection station evaluation by the Department of State Police.

It was not considered within the scope of the project to determine the validity of the items chosen for inspection, or to determine the effectiveness of the inspection program in terms of reduced accidents.

## METHOD

Copies of the inspection receipts are filed according to inspection station number on a monthly basis at State Police Headquarters in Richmond. Since over 6 million inspection receipts are involved each year — in 1975, for example, 2,915 inspection stations issued 6,325,485 receipts — a sampling procedure is necessary for selecting receipts for analysis.

State Police currently analyze inspection receipts by selecting inspection stations for a yearly sample on a systematic basis. Stations are selected monthly and all inspection receipts for each station selected are included in the sample for the month for which the station is selected. The Department of State Police analyzed approximately 60,000 inspection receipts in 1971 and 1972, 24,000 in 1973; and almost 50,000 in 1975. From these analyses it was found that most inspection items have a failure rate of about 5.0%, with the minimum rate for most items being about 1.5%.

The method of sampling which seems most likely to produce results suitable for use in drawing inferences about Virginia's periodic motor vehicle inspection program involves sampling stations monthly at random, according to their relative volumes and according to station classification.

The appropriate annual sample size necessary to enable detection of a 10.0% change and 1.5% failure rate was determined to be 35,591 inspection receipts. This was based on the formula

$$N = \frac{2t^2 \times pq}{d^2},$$

where

N = annual sample size,

p = probability of a defective item,

q = (1-p),

t = statistical precision as a standard normal interval value, and

d = expected change (in percentage points).

This sample size was calculated for a confidence level of 95% of predicting the true value (i.e., percentage defective), and the failure rate of 1.5% was based on results reported in the Virginia State Police's 1975 evaluation of the PMVI program.<sup>(5)</sup> It should be noted that these figures apply only to one type of inspection receipt; namely, the approval receipt that is used for passenger vehicles, trucks, and buses. Rejection receipts and motorcycle/trailer decals are not included in this sample and should be sampled and analyzed in separate studies. Examples of approval and rejection receipts, and motorcycle/trailer decals are shown in Appendices A, B, and C.

The sample drawn in the current study was from approval receipts issued in 1975. The first step in the sampling procedure was to determine the number of monthly inspections performed by each station. Each station was then classified according to volume as high, medium, or low to ensure that the sample would be representative of inspection stations throughout the state. The Department of State Police keeps a record of monthly volumes of each station. After calculating the monthly averages, the volume categories were defined as follows:

1. Low volume stations — stations which issue a monthly average of 99 receipts or less.
2. Medium volume stations — stations which issue between 100 and 299 receipts per month.
3. High volume stations — stations which issue a monthly average of 300 receipts or more.

A listing was made of all stations included in each cell according to the stratifications in Figure 2.

Classification of Station

	Private	Small Exemption	Large Exemption	Unlimited
Volume of Station	Low			
	Medium			
	High			

Figure 2. Classifications and volume categories of inspection stations sampled.

Percentages were calculated for the contribution of each group of stations to the total number of approval receipts issued. Since large exemption stations contributed only 0.03% of the total number of receipts issued by all stations, this category was excluded from the sampling procedure (see Table 1).

Table 1

Number and Percentage of Approval Receipts Issued During 1975

Station Volume	Station Classification		
	Private	Small Exemption	Unlimited
Low	64,000 (1.20%)	259,696 (4.89%)	230,857 (4.34%)
Medium	37,680 (0.70%)	1,347,503 (25.38%)	1,092,050 (20.57%)
High	17,744 (0.33%)	1,278,174 (24.08%)	980,236 (18.46%)

Printouts for each of the nine categories of stations (private-low volume, small exemption-low volume, unlimited-low volume, private-medium volume, etc.) were generated with

a random listing of the stations belonging in each group. An example of one of the pages of the printout is shown in Appendix D. Each page of the printout also included instructions for sampling and the number of receipts to be sampled from each group each month. The yearly and monthly sample size figures used for each group of stations may be seen in Table 2.

Table 2  
Yearly and Monthly Sample Size Figures

Station Volume	Station Classification					
	Private		Small Exemption		Unlimited	
	Yearly	Monthly	Yearly	Monthly	Yearly	Monthly
Low	432	36	1,760	147	1,562	130
Medium	252	21	9,137	761	7,405	617
High	119	10	8,669	722	6,646	554

Inspection receipts were sampled and items of information from the receipts were coded according to the form currently in use by State Police (see Appendix E).

#### LIMITATIONS

Due to the design of the current inspection receipt certain limitations are imposed on the data that may be extracted. First, the items inspected are listed generically. For example, when a defect is discovered in the vehicle's braking system, the item "brakes" is checked "adjust" or "install." Such a notation, however, does not indicate which component of the braking system is responsible for the problem; it does not indicate whether the problem is in the brake lines, in the brake pads or linings, or in other components. In addition, there is no information on the severity of the defects found. If an inspection item is marked "install," the defect may be considered sufficiently serious to warrant replacement of the component. If an inspection item is marked "adjust," however, little can be inferred other than that replacement of the defective component is not necessary.<sup>(6)</sup>

Another limitation resulting from the design of the inspection receipt is that while the receipt has a blank space to record the charges for the inspection (the inspection fee and the charges for the necessary repairs), no space is provided to record charges for repairs for individual items. In the case of one repair, it may be possible to separate the cost of the repair from the inspection fee; however, when more than one repair is involved, the repair cost for each item involved cannot be obtained from the receipt. It is also possible for all costs except the inspection fee itself to be on a separate bill; and even in the case of only one repair, the cost for the repair is not available from the inspection receipt. Thus, an analysis of the costs for rectifying any defects found during inspection is not possible.

The acquisition of an accurate record of vehicle mileage presents another problem. The inspector may not note when the odometer "turns over" at reaching 100,000 miles and begins recording mileage at 0. This is a prevalent problem because the coding sheet does not contain spaces for recording more than five digits.

Despite these limitations, the data available provide considerable information on which types of vehicles are most likely to be defective in some way. Again, while the correlation of vehicle defects and accident causation was not considered within the scope of the study, as Stoke suggested,<sup>(6)</sup> findings indicating that vehicles of certain ages or mileages have disproportionate numbers of particular defects would be useful in the management and evaluation of a motor vehicle inspection program.

## ANALYSIS

A total of 35,970 approval receipts were sampled, however, after those receipts which had missing data items which were unrecoverable were excluded, a total of 35,016 receipts remained for analysis. The distribution of receipts according to category of station is shown in Table 3.

A defective vehicle is defined as one in which one or more items on the approval receipt are checked "adjust" or "install." The statewide distribution of defective vehicles according to vehicle type is shown in Table 4. The category "passenger vehicles" included both domestic and foreign cars, and the category "trucks" included pickup trucks, vans, panel trucks, tractor trucks, and those included under "other" trucks. The percentages of defective vehicles were fairly close for all types of vehicles except commercial buses, which had a rather high defect rate (52.84%).

Table 3

Distribution of Receipts Sampled

Station Volume	Station Classification					
	Private		Small Exemption		Unlimited	
	No.	Percent	No.	Percent	No.	Percent
Low	395	1.13	1,693	4.83	1,495	4.27
Medium	219	0.63	9,016	25.75	7,272	20.77
High	118	0.34	8,449	24.13	6,359	18.16

Table 4

Statewide Distribution of Defective Vehicles

Vehicle Type	Number Sampled	Number Defective	Percent Defective
Passenger Vehicles	28,635	6,177	21.57
Trucks	6,206	1,668	26.88
School Buses	52	14	26.92
Commercial Buses	123	65	52.84
TOTAL	35,016	7,924	22.62

The distribution of defective vehicles by station classification is presented in Table 5. It may be seen that private stations had a somewhat higher percentage of defective vehicles than the other types of stations. This is not surprising in view of the finding that commercial buses had a relatively high defective rate (see Table 4) since these commercial vehicles and others inspected by private stations may be in use more than other vehicles and the inspection procedure may be a part of routine maintenance.

Table 5  
Distribution of Defective Vehicles by Station Classification and Vehicle Type

Station Classification	Type of Vehicle											
	Passenger Vehicles		Trucks		School Buses		Commercial Buses		Total Vehicles			
	No. Sampled	No. Defective (%)	No. Sampled	No. Defective (%)	No. Sampled	No. Defective (%)	No. Sampled	No. Defective (%)	No. Sampled	No. Defective (%)		
Private-Low Volume	120	71(59.16)	210	106(50.47)	31	1(3.22)	34	29(85.29)	395	207(52.40)		
Private-Medium Volume	66	19(28.78)	144	81(56.25)	1	0(0.00)	8	7(87.50)	219	107(48.85)		
Private-High Volume	85	48(56.47)	13	10(76.92)	16	10(62.50)	4	2(50.00)	118	70(59.32)		
Small Exemption-Low Volume	1,351	475(35.15)	338	112(33.13)	0	0(0.00)	4	1(25.00)	1,693	588(34.73)		
Small Exemption-Medium Volume	7,596	1,675(22.05)	1,406	352(25.03)	0	0(0.00)	14	8(57.14)	9,016	2,035(22.57)		
Small Exemption-High Volume	7,435	994(13.36)	1,001	164(16.38)	0	0(0.00)	13	4(30.76)	8,449	1,162(13.75)		
Unlimited-Low Volume	1,036	400(38.61)	452	164(36.28)	0	0(0.00)	7	1(14.28)	1,495	565(37.79)		
Unlimited-Medium Volume	5,448	1,329(24.39)	1,789	443(24.76)	4	3(75.00)	31	10(32.25)	7,272	1,785(24.54)		
Unlimited-High Volume	5,498	1,166(21.20)	853	236(27.66)	0	0(0.00)	8	3(37.50)	6,359	1,405(22.09)		

Failure rates are shown in Table 6 by vehicle type and defective item. For the category of total vehicles the highest failure rate was for the item "other lights" (8.44%), that is, for all vehicles sampled, 8.44% had defective "other lights." This is especially evident in those vehicles with several secondary lights (i.e., clearance lights, flashers, etc.) and which experience a high usage rate (trucks and buses). Headlights had the next highest failure rate, with 7.34% of all vehicles sampled having defective headlights.

The three items with the highest failure rates for defective passenger vehicles were headlights (7.16%), other lights (7.13%), and brakes (3.90%). There was a similar trend for trucks. Other lights with a failure rate of 14.11%, headlights (7.96%), and brakes (5.25%) led the list of defective items. As may also be seen in Table 6, brakes, other lights, and headlights were those items most often found to be defective for school buses and commercial buses.

A comparison was made of the percentages of defects for different types of inspection stations (see Table 7). Percentages were also calculated for passenger vehicles, trucks, and commercial buses,\* and are shown in Appendices F, G, and H. For most items there was a slightly greater failure rate for low volume stations than for medium or high volume stations. Small exemption-low volume stations reported more defects than small exemption-medium volume or small exemption-high volume stations, and unlimited-low volume stations reported more defects than unlimited-medium volume or unlimited-high volume stations. It is possible that stations with fewer vehicles to inspect may conduct more thorough inspections than those with a greater number of vehicles to inspect; however, this does not seem to be true of private stations.

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\*School buses were not included since they are inspected at only one type of station.

Table 6  
 Percentage of Defects by Vehicle Type and Defect Type

Type of Defect	Type of Vehicle					Total Vehicles
	Passenger Vehicles	Trucks	School Buses	Commercial Buses		
Brakes	3.90	5.25	15.38	33.33		4.26
Headlights	7.16	7.96	13.46	16.26		7.34
Other Lights	7.13	14.11	21.15	19.51		8.44
Signal Lights	2.30	5.06	0.00	7.32		2.81
Horn	0.36	0.95	0.00	1.63		0.47
Steering	1.32	1.69	3.85	9.76		1.42
Mirror	0.05	0.34	0.00	0.81		0.11
Windshield	0.13	0.37	1.92	0.81		0.18
Other Glass	0.07	0.39	0.00	1.63		0.13
Windshield Wiper	2.02	2.21	0.00	1.63		2.05
Tag Mounting	0.27	0.63	0.00	0.00		0.33
Exhaust Line	2.99	3.38	5.77	8.94		3.08
Tires	2.67	2.11	13.46	6.50		2.60
Seat Belts	0.02	0.05	0.00	0.00		0.03
Hood Latch	0.02	0.05	0.00	0.00		0.03

Table 7  
 Percentage of Defects by Station Classification and Defect Type  
 (n = number of vehicles sampled from each type of station)

Type of Defect	Station Classification									
	Private- Low Volume n = 395	Private- Medium Volume n = 219	Private- High Volume n = 118	Small Exemp.- Low Volume n = 1,693	Small Exemp.- Medium Volume n = 9,016	Small Exemp.- High Volume n = 8,449	Unlimited- Low Volume n = 1,495	Unlimited- Medium Volume n = 7,272	Unlimited- High Volume n = 6,359	
Brakes	19.49	22.37	15.25	7.85	4.11	1.25	9.30	3.91	4.95	
Headlights	26.07	9.13	33.90	11.81	6.31	4.08	10.30	9.29	7.30	
Other Lights	21.77	23.74	28.81	13.29	7.91	5.19	14.58	8.73	8.68	
Signal Lights	10.38	10.50	5.08	5.79	2.76	1.48	4.75	3.03	2.36	
Horn	2.03	2.74	1.69	0.95	0.54	0.11	0.67	0.51	0.44	
Steering	5.32	5.02	4.24	2.01	1.21	0.58	4.01	1.77	1.24	
Mirror	0.51	1.37	1.69	0.18	0.05	0.06	0.13	0.10	0.14	
Windshield	1.52	0.46	2.54	0.35	0.17	0.06	0.67	0.18	0.05	
Other Glass	0.25	0.00	1.69	0.12	0.15	0.11	0.07	0.10	0.17	
Windshield Wiper	2.78	4.57	0.85	3.72	2.32	1.10	4.75	2.09	1.68	
Tag Mounting	1.27	1.83	0.85	0.89	0.31	0.17	1.00	0.30	0.17	
Exhaust Line	4.56	6.85	6.78	6.32	3.46	1.49	7.69	3.23	2.26	
Tires	6.33	11.87	11.86	4.78	2.87	2.18	3.61	2.47	1.37	
Seat Belts	0.00	0.00	0.00	0.00	0.02	0.03	0.07	0.04	0.01	
Hood Latch	0.25	0.46	0.00	0.06	0.01	0.01	0.13	0.00	0.03	

A secondary objective of the study involved comparing defects experienced by vehicles of particular ages and mileages. Previous investigators, for instance, had found an increase in the percentage of rejected vehicles as vehicle age increased.<sup>(7,8)</sup> In Figures 3 and 4, the percentages of defects according to vehicle age are shown for several inspection items. As can be seen in Figure 3, there was generally an increase in defective brakes as vehicle age increased. As shown in Figure 4, failure rates for other lights and signal lights increased as vehicle age increased. Percentages of defects according to year built are shown separately for passenger vehicles, trucks, school buses, and commercial buses in Appendices I, J, K, and L.

Besides findings that indicate vehicle condition deteriorates with vehicle age, several investigators have reported findings that suggest vehicle condition deteriorates as mileage increases. A study conducted by Reinfurt, House, and Levine<sup>(9)</sup> in North Carolina, for example, found that a higher percentage of vehicles failed inspection as both vehicle age and vehicle mileage increased. A tabulation of vehicle defects by vehicle mileage yielded similar results in the current study. Percentages of defects according to mileage of vehicle are presented for several inspection items in Figures 5 and 6. There was generally an increase in defects in brakes, exhaust lines, and other lights with an increase in mileage. Percentages of defects according to mileage are shown separately for passenger vehicles, trucks, school buses, and commercial buses in Appendices M, N, O, and P.

A comparison of defects for domestic and foreign passenger vehicles may be seen in Table 8. While the percentages of defects for defective domestic and foreign passenger vehicles were similar for several items, no conclusions were possible due to the small number of foreign vehicles sampled.

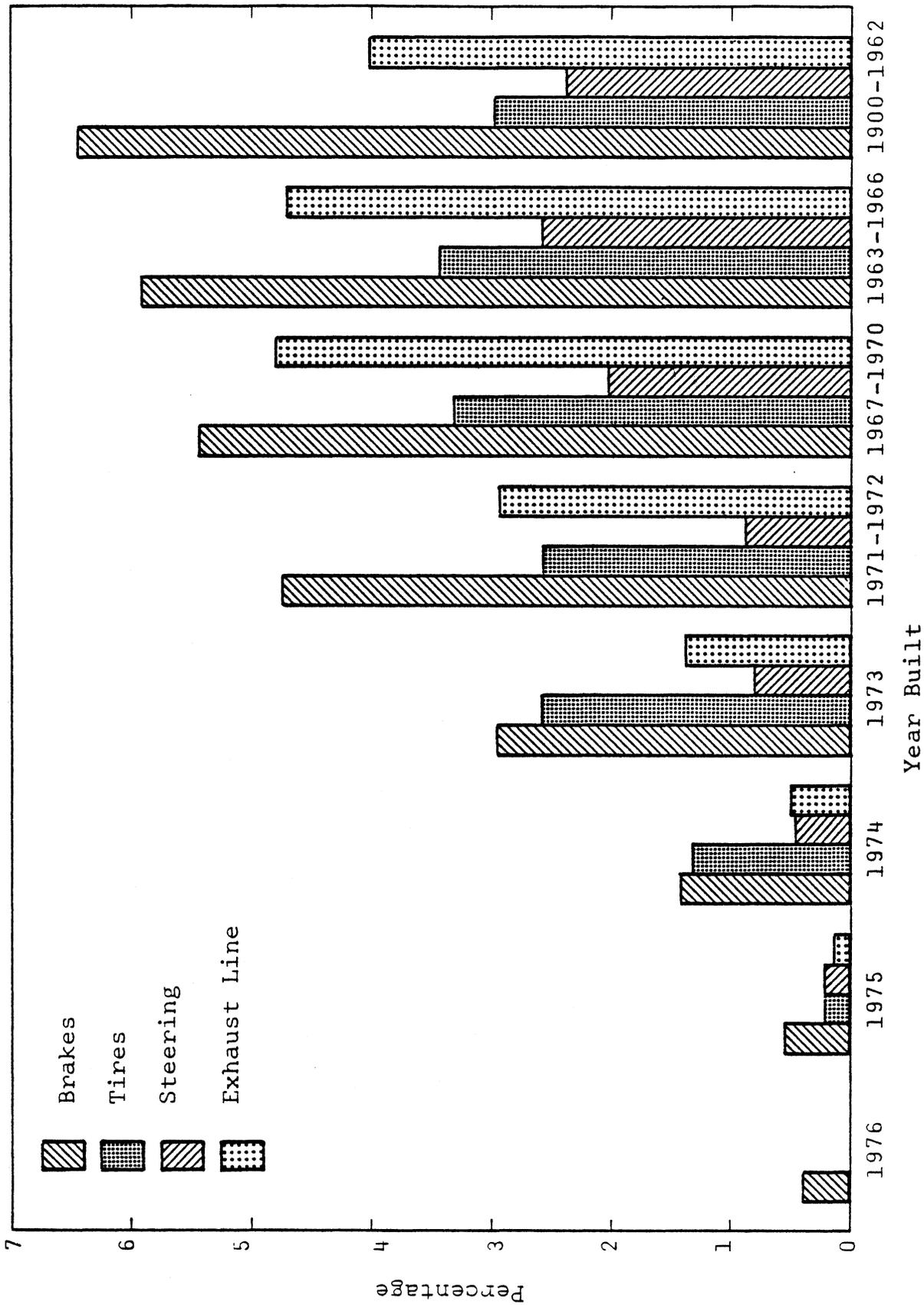


Figure 3. Percentage of vehicles with defective brakes, tires, steering, and exhaust lines by year built.

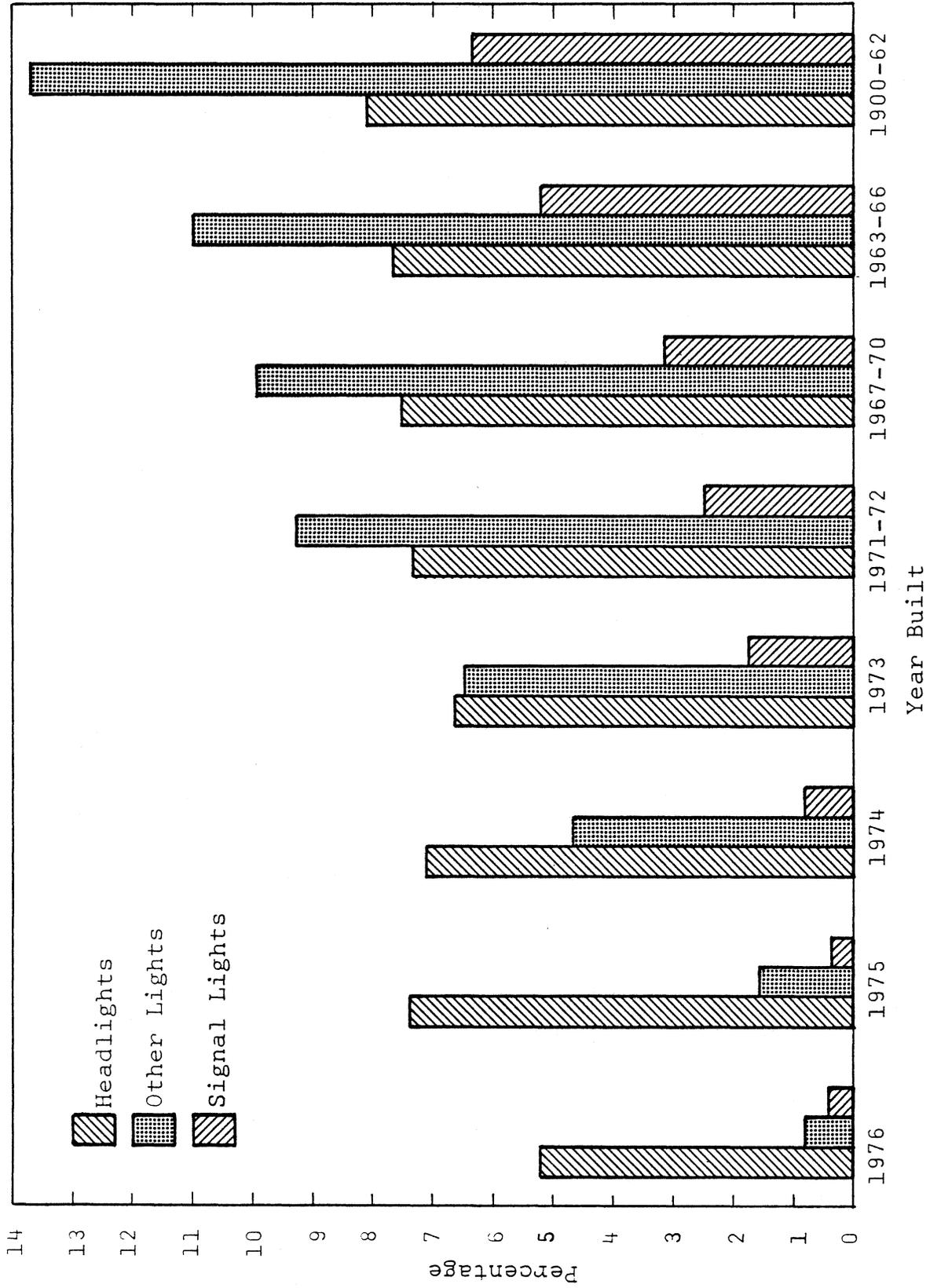


Figure 4. Percentage of vehicles with defective headlights, other lights, and signal lights by year built.

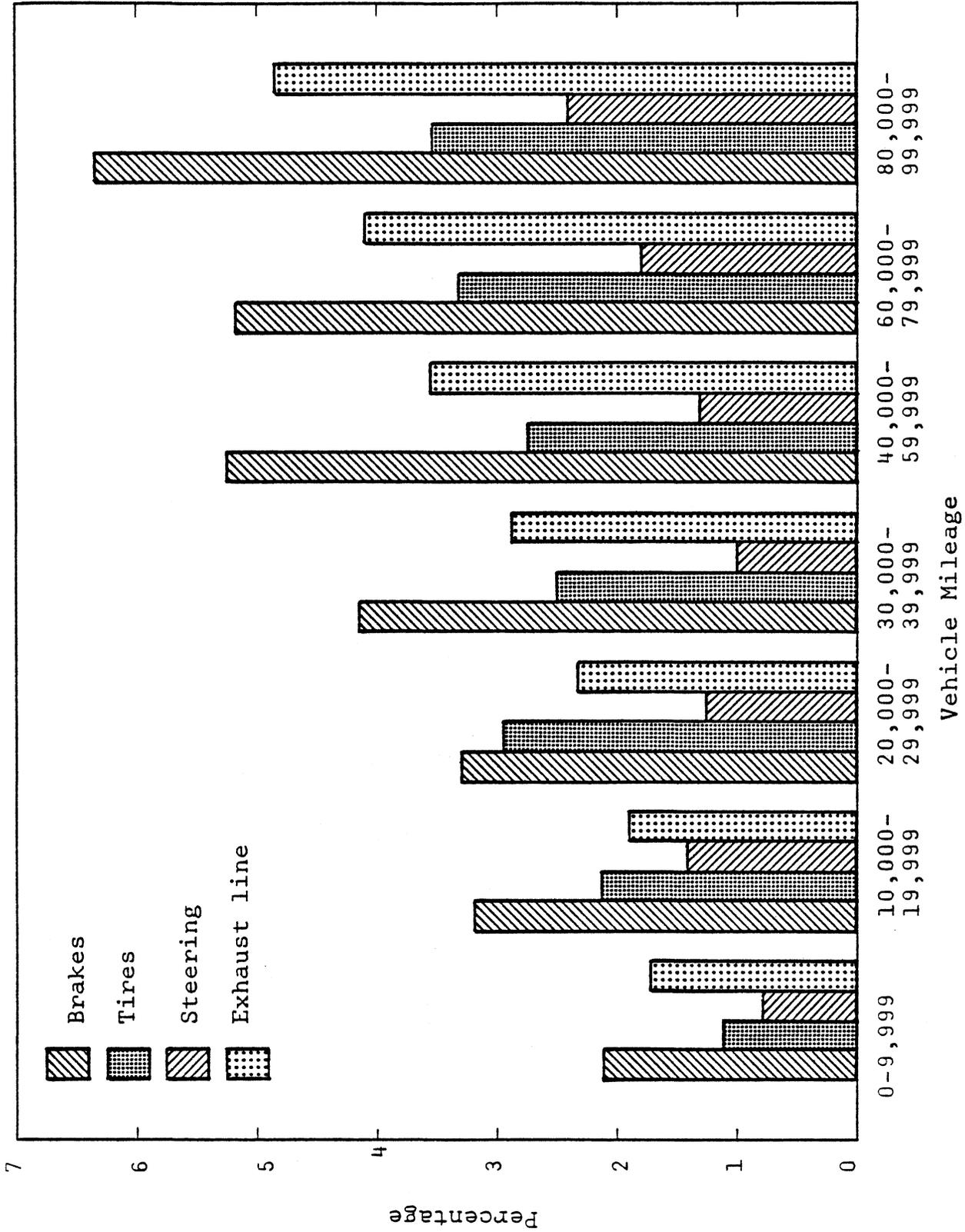


Figure 5. Percentage of vehicles with defective brakes, tires, steering, and exhaust lines by vehicle mileage.

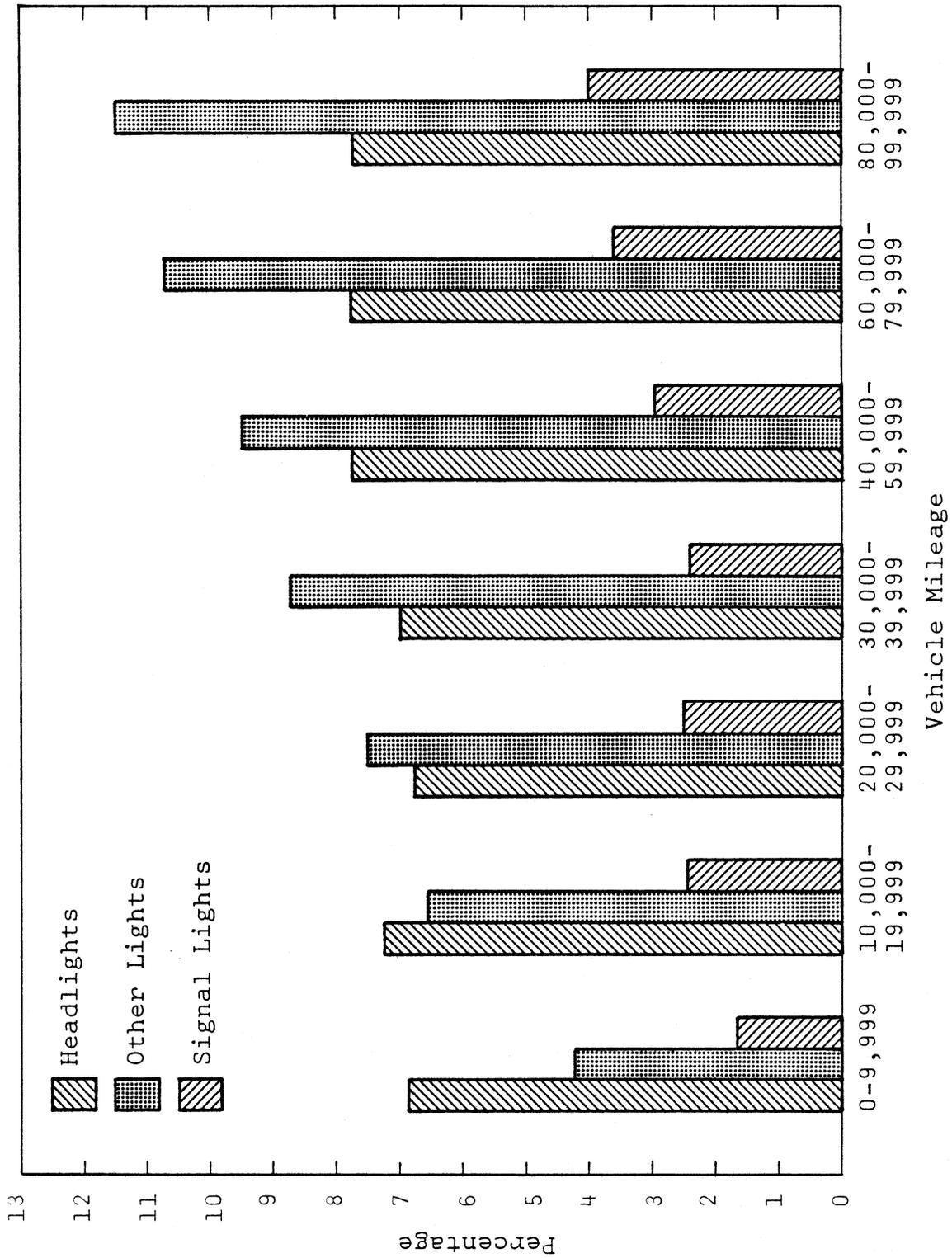


Figure 6. Percentage of vehicles with defective headlights, other lights, and signal lights by vehicle mileage.

Table 8

Percentage of Defects for Domestic and Foreign  
Passenger Vehicles  
(n = No. of Vehicles Sampled)

<u>Type of Defect</u>	<u>Passenger Vehicles</u>	
	<u>Domestic</u> n = 24,953	<u>Foreign</u> n = 3,682
Brakes	3.98	3.37
Headlights	7.05	7.90
Other Lights	7.20	6.68
Signal Lights	2.36	1.93
Horn	0.28	0.90
Steering	1.38	0.90
Mirror	0.06	0.05
Windshield	0.12	0.19
Other Glass	0.07	0.08
Windshield Wiper	1.91	2.77
Tag Mounting	0.24	0.43
Exhaust Line	3.05	2.55
Tires	2.75	2.15
Seat Belts	0.02	0.03
Hood Latch	0.01	0.08

#### IMPLEMENTATION

The system for management evaluation of the Virginia periodic motor vehicle inspection program proposed here was adapted from and is very similar to the system currently in use by State Police. The two basic differences involve (1) sample size and (2) sampling procedure.

The annual sample size used by State Police varies from year to year; however, it usually consists of about 50,000 inspection receipts and sometimes as many as 60,000. Although approval receipts only were used in the present study, it is expected that even with the inclusion of rejection receipts and motorcycle/trailer decals as separate programs, State Police use of the procedure developed here will require the sampling of fewer receipts than in previous evaluations.

The sampling procedure currently in use by State Police is systematic rather than random and does not sample proportionately according to station classification or station volume. The procedure used in the present study involved sampling according to station classification (unlimited, small exemption, and private) and station volume (low, medium, and high). Information was obtained on station classification and station volume by consolidating data from various files at State Police Headquarters. After information was obtained on the volume of receipts issued monthly by each station, a classification according to high, medium, or low volume was defined and determined for each station. Listings were made of the stations included in these categories and station numbers were listed in a random order.

Since the procedure described above was rather lengthy and involved a major effort, several steps have been taken to make this system easier for implementation by State Police. First, volume worksheets have been prepared for use by State Police personnel on a monthly basis. These forms include information such as station number, station classification, and volume of receipts issued by each station. At the end of the calendar year these data may be used to determine sample size based on the number of receipts issued the previous year. Random listings of the stations belonging in each category according to station classification and station volume, and the proportion of receipts to be sampled from each category each month, also may be determined from the previous year's data. Computer programs will be provided for (1) the detection of errors in the forms which have been coded for the receipts sampled; (2) the detection of source document errors, i.e., errors that result from incorrect or missing information on the inspection receipt itself; and (3) the tabulation of the data variables obtained from the inspection receipt.

## ACKNOWLEDGEMENTS

The author expresses appreciation to C. B. Stoke for his assistance and advice throughout the project, and to Wayne Ferguson and Cheryl Lynn for their suggestions. Thanks are expressed to Captain Roy Terry, Lieutenant Bernie Chisholm, and Marie Morano of the Virginia Department of State Police for their assistance in familiarizing the author with the Virginia periodic motor vehicle inspection program and the system of filing inspection receipts, and for their cooperation in the sampling of receipts for the current project. Appreciation is also due Jerry Korf and Philip Harris of the Virginia Highway and Transportation Research Council, who prepared the computer programs and assisted in the modification of the working plan and clarification of the data items from the inspection receipts to be analyzed. Thanks go to Virginia Sned and Christine Bass for the coding of the inspection receipts sampled, and to Louise Hill and the personnel at State Police who scanned the data sheets. Thanks are also expressed to Toni Thompson for typing the draft report and to Jean Vanderbilt for typing the final manuscript.



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APPENDIX A  
CURRENT APPROVAL RECEIPT

**INSPECTION CERTIFICATE**  
ISSUED UNDER THE DIRECTION OF  
**VIRGINIA STATE POLICE** E 196426

FORM S.P. 121

Equipment Inspected	O. K.	Adjust	Install	Date
BRAKES				JULY
HEADLIGHTS				
OTHER LIGHTS				
SIGNAL LIGHTS				
HORN				
STEERING				
MIRROR				
WINDSHIELD				
OTHER GLASS				
WINDSHIELD WIPER				
TAG MOUNTING				
EXHAUST LINE				
TIRES				
SEAT BELTS				
HOOD LATCH				

Identifying No. \_\_\_\_\_  
Exp. Removed \_\_\_\_\_ Sta. No. \_\_\_\_\_  
Station Name \_\_\_\_\_  
INSPECTOR \_\_\_\_\_

CARRY THIS RECEIPT WITH YOU AT ALL TIMES WHILE OPERATING THIS VEHICLE (Over)

**THIS STICKER EXPIRES JANUARY 31**

**WHAT THIS RECEIPT MEANS TO YOU**

This receipt is issued to show that on the date indicated your vehicle complied with the requirements of the Motor Vehicle Code, as determined by the inspection just performed.

This receipt does not, however, mean that the owner is relieved of the responsibility of maintaining this vehicle in the same good condition at all times. An accident, or even ordinary use, may cause headlights, brakes, or other parts to become out of adjustment. It is desirable therefore to have your vehicle checked at frequent intervals.

Please report in writing to the State Police any discourtesy or improper inspection on the part of any Official Inspection Station.

ALL OFFICIAL INSPECTION STATIONS  
ARE SUPERVISED BY THE  
**VIRGINIA STATE POLICE**  
BOX 27472 RICHMOND 23261

E 196426

**1**

**APPROVED**  
JULY

DEPARTMENT OF STATE POLICE  
*A. M. Burgess*  
SUPERINTENDENT  
1974 1975 1976 1977



**1**

This vehicle must be reinspected within 6 months from the month of issuance of this sticker and not later than

E 196426 **JANUARY 31**

APPENDIX B  
CURRENT REJECTION RECEIPT

**REJECTION**      **D 948982**

LIC. NO. \_\_\_\_\_

IDENTIFICATION NO. \_\_\_\_\_

MAKE \_\_\_\_\_ MILEAGE \_\_\_\_\_

STA. NAME \_\_\_\_\_ NO. \_\_\_\_\_

REJECTED FOR: \_\_\_\_\_ INSPECTOR \_\_\_\_\_

BRAKES	
HEADLIGHTS	
OTHER LIGHTS	
SIGNAL LIGHTS	
HORN	
STEERING	
MIRROR	
WINDSHIELD	
OTHER GLASS	
WINDSHIELD WIPER	
TAG MOUNTING	
EXHAUST LINE	
TIRES	
SEAT BELTS	
HOOD LATCH	

**READ CAREFULLY!**

THIS VEHICLE MUST BE REINSPECTED AND APPROVED WITHIN (7) DAYS.

ANY OPERATION OF THE VEHICLE WILL BE AT THE OPERATORS RISK AND MUST BE IN ACCORDANCE WITH LAW.

VIRGINIA STATE POLICE

S.P. 133

**VIRGINIA STATE POLICE**

THIS VEHICLE INSPECTED AND

**REJECTED**

THIS VEHICLE MUST BE REINSPECTED AND APPROVED BY AN OFFICIAL INSPECTION STATION WITHIN SEVEN (7) DAYS OF THE DATE REJECTED.

JAN.	'76
FEB.	'77
MAR.	'78
APR.	'79
MAY	
JUNE	
JULY	
AUG.	
SEPT.	
OCT.	
NOV.	
DEC.	

1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31
2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	

APPENDIX C

CURRENT MOTORCYCLE/TRAILER DECAL

**INSPECTION CERTIFICATE** FORM SP 131A

ISSUED UNDER THE DIRECTION OF  
**VIRGINIA STATE POLICE** T/M 157389

Equipment Inspected	O.K.	Adjus	Date
BRAKES			
HEADLIGHTS			
SIGNAL LIGHTS			
STOP LIGHTS			
TAIL LIGHTS			
LICENSE LIGHTS			
CLEARANCE LIGHTS			
REFLECTORS			
HORN			
STEER'G/SUSPEN'N			
MIRROR			
WINDSHIELD			
TAG MOUNTING			
EXHAUST LINE			
TIRES			

Identification No. \_\_\_\_\_  
 Equip. Removed \_\_\_\_\_  
 Station Name \_\_\_\_\_

**INSPECTOR** \_\_\_\_\_  
 CARRY THIS RECEIPT WITH YOU AT ALL TIMES WHILE OPERATING THIS VEHICLE (Over)  
 THIS STICKER EXPIRES JAN. 31

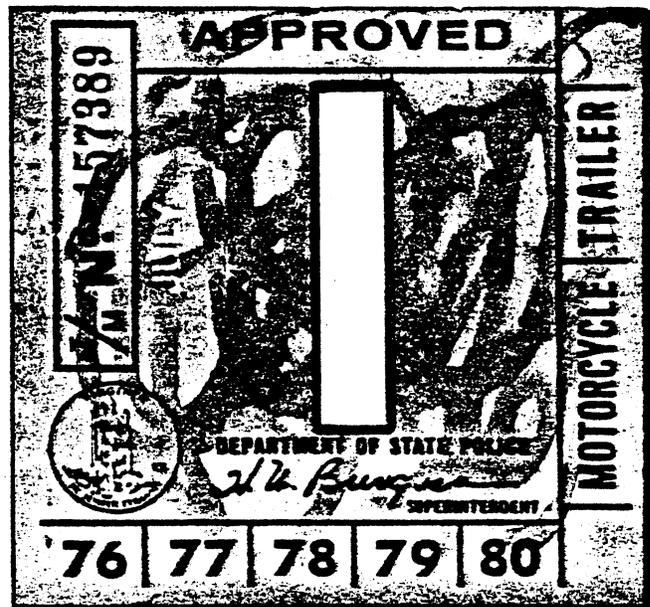
**WHAT THIS RECEIPT MEANS TO YOU**

This receipt is issued to show that on the date indicated your vehicle complied with the requirements of the Motor Vehicle Code, as determined by the inspection just performed.

This receipt does not, however, mean that the owner is relieved of the responsibility of maintaining this vehicle in the same good condition at all times. An accident, or even ordinary use, may cause headlights, brakes, or other parts to become out of adjustment. It is desirable therefore to have your vehicle checked at frequent intervals.

Please report in writing to the State Police any discourtesy or improper inspection on the part of any Official Inspection Station.

ALL OFFICIAL INSPECTION STATIONS  
ARE SUPERVISED BY THE  
**VIRGINIA STATE POLICE**  
BOX 27472 RICHMOND (23261)



**1166** APPENDIX D — EXAMPLE OF PRINTOUT OF SAMPLING INSTRUCTIONS

CATEGORY: PRIVATE - LOW

PAGE 1

INSTRUCTIONS: SAMPLE 36 RECEIPTS FROM THIS LIST OF STATIONS  
FOR EACH MONTH IN THE ORDER LISTED.

<u>ORDER</u>	<u>STATION NO.</u>	<u>SAMPLE MONTH</u>	<u>NO. OF RECEIPTS SAMPLED</u>
1	1181		
2	3107		
3	2415		
4	2880		
5	2372		
6	640		
7	2332		
8	1544		
9	1131		
10	2352		
11	731		
12	2701		
13	559		
14	3068		
15	1651		
16	2411		
17	1115		
18	2810		
19	1816		
20	3502		
21	2707		
22	2371		
23	3420		
24	1250		
25	373		

APPENDIX E

VIRGINIA STATE POLICE INSPECTION TABULATION

INSPECTION CERTIFICATE NUMBER												1													2
TIME												3	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	4		
DAY												5													6
YEAR												7	1980	1981	1982	1983	1984	IDENTIFICATION NUMBER						8	
												9													10
												11													12
												13													14
												15													16
												17													18
												19													20
												21													22
												23													24
												25													26
												27													28
												29													30
												31													32
												33													34
												35													36
CHARGES												37													38
												39													40
												41													42
												43													44
												45													46
BRAKES												47													48
OTHER LIGHTS												49													50
HORN												51													52
MIRROR												53													54
OTHER GLASS												55													56
TAG MOUNTING												57													58
TIRES												59													60
AIR CONDITIONER												61													62
INSPECTOR NUMBER												63													64
												65													66
												67													68
												69													70
												71													72
												73													74
												75													76
												77													78
												79													80

APPENDIX F

PERCENTAGES OF DEFECTS FOUND FOR PASSENGER VEHICLES BY DEFECT TYPE AND STATION CLASSIFICATION  
(n = number of passenger vehicles sampled from each type of station)

Type of Defect	Station Classification									
	Private-Low Volume n = 120	Private-Medium Volume n = 66	Private-High Volume n = 85	Small Exemp.-Low Volume n = 1,351	Small Exemp.-Medium Volume n = 7,596	Small Exemp.-High Volume n = 7,435	Unlimited-Low Volume n = 1,036	Unlimited-Medium Volume n = 5,448	Unlimited-High Volume n = 5,498	
Brakes	6.67	12.12	5.88	7.70	4.12	1.26	9.46	4.15	4.75	
Headlights	40.83	3.03	38.82	12.73	6.25	3.98	11.49	9.42	7.11	
Other Lights	15.00	10.61	20.00	12.07	7.17	4.77	12.45	7.21	7.57	
Signal Lights	5.83	4.55	3.53	5.11	2.66	1.30	3.57	2.42	2.00	
Horn	1.67	0.00	2.35	0.81	0.43	0.08	0.58	0.46	0.35	
Steering	4.17	0.00	2.35	1.85	1.20	0.63	4.73	1.76	1.15	
Mirror	0.00	1.51	2.35	0.07	0.07	0.01	0.10	0.07	0.02	
Windshield	0.00	0.00	2.35	0.37	0.16	0.05	0.58	0.11	0.04	
Other Glass	0.00	0.00	0.00	0.00	0.13	0.04	0.10	0.05	0.07	
Windshield Wiper	1.67	0.00	1.18	4.29	2.26	1.09	5.21	2.24	1.60	
Tag Mounting	0.83	1.51	0.00	0.96	0.30	0.13	0.67	0.26	0.13	
Exhaust Line	5.83	4.55	2.35	6.88	3.54	1.40	7.82	3.30	2.13	
Tires	5.83	13.64	5.88	5.55	3.04	2.21	4.34	2.73	1.44	
Seat Belts	0.00	0.00	0.00	0.00	0.01	0.01	0.10	0.05	0.02	
Hood Latch	0.00	0.00	0.00	0.07	0.01	0.01	0.19	0.00	0.02	

## APPENDIX G

PERCENTAGES OF DEFECTS FOUND FOR TRUCKS BY  
DEFECT TYPE AND STATION CLASSIFICATION

(n = number of trucks sampled from each type of station)

Type of Defect	Station Classification									
	Private- Low Volume n = 210	Private- Medium Volume n = 144	Private- High Volume n = 13	Small Exemp.- Low Volume n = 338	Small Exemp.- Medium Volume n = 1,406	Small Exemp.- High Volume n = 1,001	Unlimited- Low Volume n = 452	Unlimited- Medium Volume n = 1,789	Unlimited- High Volume n = 853	
Brakes	19.05	24.31	30.77	8.58	3.98	1.20	9.07	3.19	6.10	
Headlights	20.00	12.50	7.69	7.99	6.69	4.69	7.52	8.94	8.32	
Other Lights	28.09	30.55	46.15	18.34	11.73	8.19	19.69	13.13	15.71	
Signal Lights	14.76	11.81	23.08	8.58	3.34	2.80	7.52	4.75	4.69	
Horn	2.38	3.47	0.00	1.48	1.14	0.30	0.88	0.67	1.05	
Steering	2.86	7.64	15.38	2.66	1.21	0.20	2.43	1.73	1.87	
Mirror	0.95	1.39	0.00	0.59	0.00	0.40	0.22	0.17	0.82	
Windshield	2.38	0.69	7.69	0.29	0.21	0.10	0.88	0.33	0.12	
Other Glass	0.48	0.00	7.69	0.59	0.28	0.60	0.00	0.22	0.70	
Windshield Wiper	3.81	6.94	0.00	1.48	2.63	1.20	3.76	1.62	2.23	
Tag Mounting	1.90	2.08	7.69	0.59	0.35	0.40	1.77	0.45	0.47	
Exhaust Line	2.86	8.33	23.08	4.14	2.84	2.10	7.52	3.07	2.93	
Tires	5.71	10.42	15.38	1.77	1.99	2.00	1.99	1.73	0.94	
Seat Belts	0.00	0.00	0.00	0.00	0.07	0.20	0.00	0.00	0.00	
Hood Latch	0.48	0.69	0.00	0.00	0.00	0.00	0.00	0.00	0.12	

APPENDIX H

PERCENTAGES OF DEFECTS FOUND FOR COMMERCIAL BUSES  
 BY DEFECT TYPE AND STATION CLASSIFICATION  
 (n = number of commercial buses sampled from each type of station)

Type of Defect	Station Classification									
	Private- Low Volume n = 34	Private- Medium Volume n = 8	Private- High Volume n = 4	Small Exemp.- Low Volume n = 4	Small Exemp.- Medium Volume n = 14	Small Exemp.- High Volume n = 13	Unlimited- Low Volume n = 7	Unlimited- Medium Volume n = 31	Unlimited- High Volume n = 8	
Brakes	82.35	75.00	50.00	0.00	14.29	0.00	0.00	3.23	25.00	
Headlights	35.29	0.00	0.00	25.00	0.00	15.38	14.29	6.45	25.00	
Other Lights	26.47	12.50	25.00	0.00	21.43	15.38	0.00	19.35	25.00	
Signal Lights	8.82	37.50	0.00	0.00	0.00	0.00	0.00	9.68	0.00	
Horn	2.94	12.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Steering	29.41	0.00	0.00	0.00	7.14	0.00	0.00	3.23	0.00	
Mirror	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.50	
Windshield	2.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Other Glass	0.00	0.00	25.00	0.00	0.00	0.00	0.00	0.00	12.50	
Windshield Wiper	2.94	0.00	0.00	0.00	0.00	0.00	0.00	3.23	0.00	
Tag Mounting	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Exhaust Line	14.71	0.00	0.00	0.00	21.43	7.69	0.00	0.00	25.00	
Tires	17.65	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Seat Belts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Hood Latch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

APPENDIX I  
PERCENTAGES OF DEFECTS FOR PASSENGER VEHICLES BY YEAR BUILT

Type of Defect	Year Built									
	1976	1975	1974	1973	1971-1972	1967-1970	1963-1966	1900-1962		
Brakes	0.26	0.30	1.13	2.56	4.31	5.18	5.36	6.40		
Headlights	4.88	7.65	7.11	6.57	7.16	7.39	7.17	7.29		
Other Lights	0.51	1.15	3.20	5.13	7.71	9.21	9.56	9.75		
Signal Lights	0.26	0.25	0.52	1.27	1.86	2.94	4.74	3.45		
Horn	0.00	0.05	0.10	0.11	0.34	0.47	0.62	0.99		
Steering	0.00	0.25	0.52	0.82	0.71	1.92	2.43	2.07		
Mirror	0.00	0.00	0.03	0.08	0.05	0.06	0.09	0.00		
Windshield	0.00	0.00	0.03	0.14	0.17	0.14	0.19	0.10		
Other Glass	0.00	0.00	0.03	0.03	0.05	0.12	0.09	0.20		
Windshield Wiper	0.00	0.10	0.77	1.13	1.72	2.72	3.53	3.15		
Tag Mounting	0.00	0.05	0.13	0.14	0.27	0.28	0.43	0.79		
Exhaust Line	0.00	0.05	0.35	1.24	2.79	4.69	4.67	4.14		
Tires	0.00	0.10	1.29	2.68	2.48	3.53	3.53	3.25		
Seat Belts	0.00	0.00	0.00	0.06	0.02	0.02	0.02	0.10		
Hood Latch	0.00	0.00	0.00	0.03	0.03	0.01	0.02	0.10		

APPENDIX J  
 PERCENTAGES OF DEFECTS FOR TRUCKS BY YEAR BUILT

Type of Defect	Year Built									
	1976	1975	1974	1973	1971-1972	1967-1970	1963-1966	1900-1962		
Brakes	0.94	1.37	2.60	3.98	6.41	6.19	7.25	6.03		
Headlights	6.60	5.48	7.06	7.20	8.01	8.17	9.45	8.96		
Other Lights	1.89	3.29	10.41	12.47	17.08	13.82	17.25	19.94		
Signal Lights	0.94	0.82	1.98	3.73	5.78	4.15	7.58	10.82		
Horn	0.00	0.00	0.99	0.51	0.35	1.23	1.98	1.08		
Steering	0.00	0.00	0.25	0.77	1.69	2.11	3.19	2.78		
Mirror	0.94	0.27	0.00	0.26	0.35	0.48	0.44	0.31		
Windshield	0.00	0.00	0.37	0.39	0.27	0.88	0.00	0.15		
Other Glass	0.00	0.27	0.00	0.90	0.27	0.34	0.44	0.62		
Windshield Wiper	0.00	0.00	0.49	1.41	2.31	2.99	3.30	3.40		
Tag Mounting	0.94	0.00	0.25	0.13	0.53	0.82	1.10	1.08		
Exhaust Line	0.00	0.55	0.99	2.06	3.56	5.24	4.73	3.71		
Tires	0.00	0.82	1.49	2.06	2.76	1.97	2.53	2.63		
Seat Belts	0.00	0.00	0.12	0.00	0.00	0.00	0.11	0.15		
Hood Latch	0.94	0.00	0.12	0.13	0.00	0.00	0.00	0.00		

APPENDIX K

PERCENTAGES OF DEFECTS FOR SCHOOL BUSES BY YEAR BUILT

Type of Defect	Year Built									
	1976	1975	1974	1973	1971-1972	1967-1970	1963-1966	1900-1962		
Brakes	0.00	0.00	0.00	16.67	14.29	8.33	26.31	0.00		
Headlights	0.00	33.33	0.00	0.00	28.57	8.33	15.79	0.00		
Other Lights	0.00	66.67	0.00	0.00	28.57	16.67	26.31	0.00		
Signal Lights	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Horn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Steering	0.00	0.00	0.00	0.00	0.00	8.33	5.26	0.00		
Mirror	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Windshield	0.00	0.00	0.00	16.67	0.00	0.00	0.00	0.00		
Other Glass	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Windshield Wiper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Tag Mounting	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Exhaust Line	0.00	0.00	0.00	0.00	0.00	0.00	15.79	0.00		
Tires	0.00	0.00	0.00	0.00	14.29	8.33	26.31	0.00		
Seat Belts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Hood Latch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		

APPENDIX L  
PERCENTAGES OF DEFECTS FOR COMMERCIAL BUSES BY YEAR BUILT

Type of Defect	Year Built									
	1976	1975	1974	1973	1971-1972	1967-1970	1963-1966	1900-1962		
Brakes	0.00	50.00	0.00	62.50	38.09	40.00	39.13	18.52		
Headlights	0.00	25.00	12.50	0.00	14.29	16.67	21.74	18.52		
Other Lights	0.00	0.00	0.00	12.50	28.57	23.33	26.09	14.81		
Signal Lights	0.00	0.00	0.00	25.00	4.76	13.33	0.00	7.41		
Horn	0.00	0.00	0.00	0.00	0.00	6.67	0.00	0.00		
Steering	0.00	0.00	0.00	0.00	9.52	26.67	4.35	3.70		
Mirror	0.00	0.00	0.00	0.00	4.76	0.00	0.00	0.00		
Windshield	0.00	0.00	0.00	0.00	4.76	0.00	0.00	0.00		
Other Glass	0.00	0.00	0.00	12.50	4.76	0.00	0.00	0.00		
Windshield Wiper	0.00	0.00	0.00	0.00	4.76	0.00	0.00	3.70		
Tag Mounting	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Exhaust Line	0.00	0.00	0.00	0.00	14.29	16.67	4.35	7.41		
Tires	0.00	0.00	0.00	12.50	14.29	10.00	4.35	0.00		
Seat Belts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Hood Latch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		

APPENDIX M  
PERCENTAGES OF DEFECTS FOR PASSENGER VEHICLES BY VEHICLE MILEAGE

Type of Defect	Mileage							
	0 to 9,999	10,000-19,999	20,000-29,999	30,000-39,999	40,000-59,999	60,000-79,999	80,000-99,999	80,000-99,999
Brakes	1.78	2.26	2.96	4.01	4.91	5.08	5.72	5.72
Headlights	6.94	6.61	6.66	7.09	7.40	7.71	7.35	7.35
Other Lights	3.28	5.01	6.20	6.90	8.21	9.43	10.31	10.31
Signal Lights	1.36	1.55	2.01	1.83	2.26	3.34	3.60	3.60
Horn	0.13	0.17	0.33	0.19	0.29	0.59	0.84	0.84
Steering	0.71	1.23	1.19	0.84	1.19	1.70	2.44	2.44
Mirror	0.07	0.00	0.06	0.06	0.07	0.04	0.09	0.09
Windshield	0.04	0.06	0.09	0.19	0.14	0.16	0.23	0.23
Other Glass	0.00	0.09	0.06	0.00	0.05	0.16	0.15	0.15
Windshield Wiper	0.89	1.60	1.59	1.93	2.11	2.75	3.19	3.19
Tag Mounting	0.13	0.23	0.18	0.22	0.29	0.32	0.46	0.46
Exhaust Line	1.69	1.52	2.17	2.86	3.42	3.97	4.94	4.94
Tires	1.05	2.23	3.05	2.52	2.83	3.46	3.57	3.57
Seat Belts	0.00	0.00	0.09	0.03	0.02	0.00	0.06	0.06
Hood Latch	0.02	0.03	0.00	0.03	0.02	0.04	0.00	0.00

APPENDIX N  
 PERCENTAGES OF DEFECTS FOR TRUCKS BY VEHICLE MILEAGE

Type of Defect	Mileage							
	0 to 9,999	10,000-19,999	20,000-29,999	30,000-39,999	40,000-59,999	60,000-79,999	80,000-99,999	80,000-99,999
Brakes	3.05	6.07	4.12	4.19	6.21	4.94	8.57	8.57
Headlights	6.11	9.33	6.77	6.09	9.28	7.97	9.90	9.90
Other Lights	8.35	12.60	12.88	16.64	15.16	16.85	17.13	17.13
Signal Lights	2.85	5.95	4.65	4.74	6.21	4.94	6.06	6.06
Horn	0.51	1.63	0.80	1.22	0.66	0.81	1.33	1.33
Steering	0.92	2.22	1.46	1.76	1.74	2.02	1.77	1.77
Mirror	0.20	0.23	0.66	0.13	0.00	0.81	0.44	0.44
Windshield	0.31	0.23	0.00	0.27	0.33	0.50	1.03	1.03
Other Glass	0.31	0.47	0.27	0.27	0.41	0.30	0.74	0.74
Windshield Wiper	1.02	1.52	1.46	2.71	2.49	2.72	3.84	3.84
Tag Mounting	0.31	0.47	0.80	0.54	0.58	0.91	0.89	0.89
Exhaust Line	1.63	3.38	2.79	2.84	4.06	4.64	4.13	4.13
Tires	1.22	1.52	2.26	2.17	2.15	2.32	3.55	3.55
Seat Belts	0.00	0.00	0.00	0.00	0.00	0.20	0.15	0.15
Hood Latch	0.20	0.00	0.00	0.13	0.00	0.00	0.00	0.00

APPENDIX 0  
 PERCENTAGES OF DEFECTS FOR SCHOOL BUSES BY VEHICLE MILEAGE

Type of Defect	Mileage						
	0 to 9,999	10,000-19,999	20,000-29,999	30,000-39,999	40,000-59,999	60,000-79,999	80,000-99,999
Brakes	11.11	25.00	25.00	25.00	14.29	16.67	0.00
Headlights	11.11	0.00	25.00	37.50	0.00	16.67	0.00
Other Lights	33.33	25.00	25.00	25.00	14.29	16.67	10.00
Signal Lights	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Horn	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Steering	0.00	0.00	0.00	0.00	0.00	16.67	10.00
Mirror	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Windshield	0.00	0.00	0.00	12.50	0.00	0.00	0.00
Other Glass	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Windshield Wiper	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tag Mounting	0.00	0.00	0.00	0.00	0.00	-0.00	0.00
Exhaust Line	0.00	25.00	12.50	12.50	0.00	0.00	0.00
Tires	11.11	25.00	12.50	25.00	14.29	16.67	0.00
Seat Belts	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hood Latch	0.00	0.00	0.00	0.00	0.00	0.00	0.00

APPENDIX P  
PERCENTAGES OF DEFECTS FOR COMMERCIAL BUSES BY VEHICLE MILEAGE

Type of Defect	Mileage						
	0 to 9,999	10,000-19,999	20,000-29,999	30,000-39,999	40,000-59,999	60,000-79,999	80,000-99,999
Brakes	22.73	31.82	42.86	25.00	38.09	35.00	42.11
Headlights	22.73	22.73	28.57	8.33	14.29	10.00	10.53
Other Lights	9.09	13.64	14.29	0.00	38.09	25.00	26.31
Signal Lights	9.09	4.55	0.00	8.33	9.52	5.00	10.53
Horn	4.55	0.00	0.00	0.00	0.00	5.00	0.00
Steering	9.09	0.00	14.29	0.00	14.29	15.00	15.79
Mirror	0.00	0.00	0.00	0.00	0.00	5.00	0.00
Windshield	0.00	0.00	0.00	0.00	4.76	0.00	0.00
Other Glass	4.55	0.00	0.00	0.00	0.00	5.00	0.00
Windshield Wiper	0.00	0.00	0.00	0.00	9.52	0.00	0.00
Tag Mounting	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exhaust Line	9.09	0.00	14.29	0.00	14.29	10.00	15.79
Tires	4.55	4.55	14.29	0.00	9.52	15.00	0.00
Seat Belts	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hood Latch	0.00	0.00	0.00	0.00	0.00	0.00	0.00