Comparisons of Empty and Gross Weights of Commercial Vehicles

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The need for a uniform weight classification base for commercial vehicles and the possibility of determining such a base from available information are described in this article. Because more adequate descriptions of commercial vehicles would permit better research and planning for the highways now being planned and built for the more than 100 million vehicles expected by 1972, an analysis has been made of available information.

Comparisons were made of data samples on commercial vehicles taken from the 1957 and 1961 loadometer studies and from special California vehicle records. Each sample group of data was satisfactorily representative of the total available information and correlations from selected groups of data were made by empty weights and by registered gross weights of vehicles.

The tabulations and the accompanying graphic materials are expected to be useful as guides in the solution of many vehicle classification problems. This analysis revealed that it would be very difficult, if not impossible, to develop a usable set of weight relationships from present registration data. However, the data considered in this study tend to give mutual support and the results of the 1957 loadometer study remain generally applicable.

•A SIGNIFICANT portion of highway research is dependent on the basic data that can be obtained on the numbers and types of motor vehicles that are, or are likely to be, in use. It is somewhat of an oddity that in this Nation of highly developed motor-vehicle mobility, one of the greatest single problems of highway research is the understanding, description, and cataloging of the numbers and kinds of vehicles in use for which highways must be provided.

There are nearly 80 million vehicles in the United States, and highways are now being planned and built for the more than 100 million expected 10 years from now. Yet, although each motor vehicle is required to be registered each year with a State motor vehicle department, it is possible to describe these 80 million vehicles in only the most general terms from the basic annual records. Although considerably more uniform information would be desirable on passenger vehicles the primary concern is the lack of uniform data on the types and weights of the truck fleet that at present is comprised of more than 12 million vehicles. The problems encountered are (a) the amount and quality of the data required and recorded on the annual registration application and on the registration certificate, and (b) the different weight bases used by the States for tax purposes. It often is not possible to combine, or to compare, the information on trucks registered in two neighboring States because the weight classification for tax purposes is entirely different. One State may register vehicles on the basis of the empty weight of the power unit, and another State may register its vehicles on the basis of the owner's declared maximum gross weight of vehicle and load. Data gathering is further complicated be-

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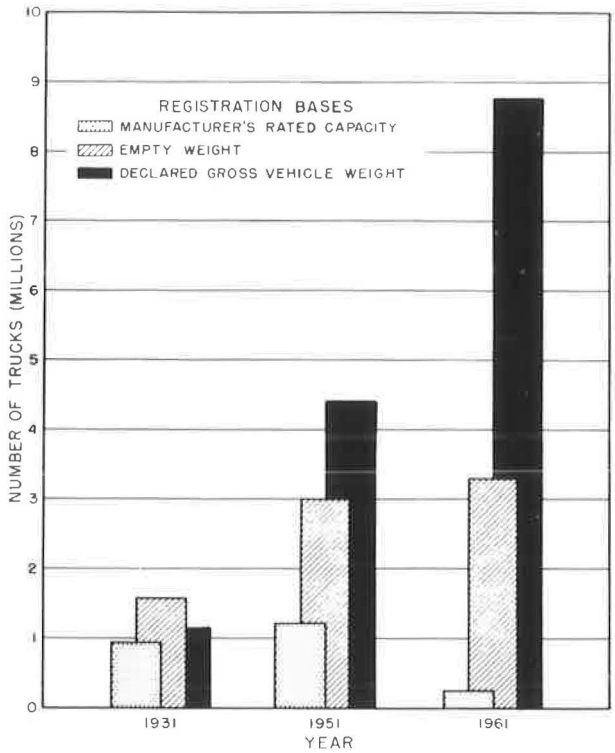

Figure 1. Number of trucks and combinations registered in 1931, 1951, and 1961, segregated by registration base; data for 1931 and 1951 are comparable but 1961 data include registrations in Alaska and Hawaii in the empty weight bar.

cause the State using empty weight has no means for gross weight identification, and the State using gross weight frequently does not require the empty weight of the power unit for its records. Any significant comparison of the effect of the bases used for truck registration should include the numbers of vehicles registered by each method. The application of the three main weight classifications employed in State registration systems to the truck fleets in 1931, 1951, and 1961 is shown in Figure 1. During the period from 1931 to 1961 truck registrations increased nearly fourfold, from 3.6 million to 12.3 million. (Data for the 1931 and 1951 comparisons were collected from 48 States and the District of Columbia; information from Alaska and Hawaii has been included in 1961 figures.)

Disparity in the methods of registration required has also been disappearing since 1931 when 26 States registered about 945,000 trucks on the basis of the manufacturers' rated capacities; 13 States registered approximately 1.6 million trucks on the basis of empty weight, and the remaining 10 States registered 1.1 million trucks on the basis of declared gross vehicle weight. By 1961 only Alabama retained the requirement for registration on the basis of manufacturers' rated capacity--239,000 trucks were registered. The rest of the States required trucks to be registered either by empty weight or by some form of declared gross weight. A total of 3.3 million trucks were registered in 14 States by empty weight, and 8.8 million trucks were registered in 36 States by declared gross weight. Except for the small 2-axle truck, commonly appearing as a pickup or panel vehicle and having characteristics similar to a passenger car, the many different types and sizes of trucks and combinations that compound the problems of classification and taxation are shown in silhouette in Figure 2.

Several samples of data that relate vehicle empty weights and declared gross weights have been compared to establish a set of usable weight correlations by visual vehicle

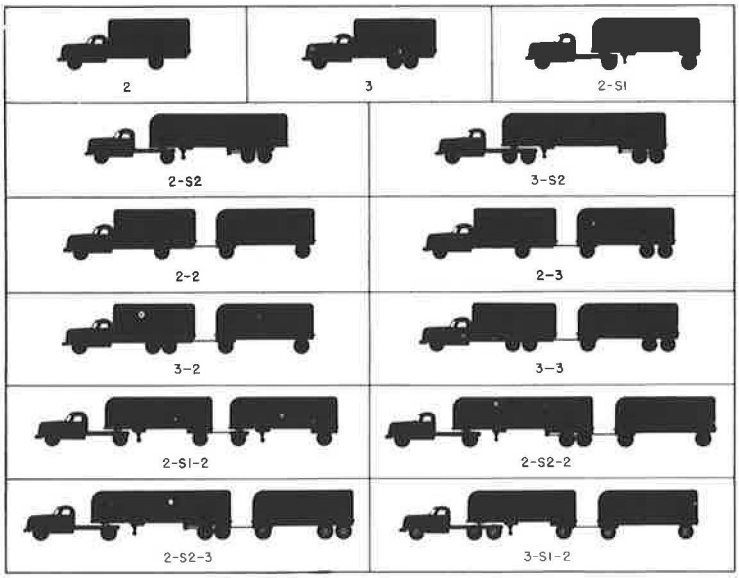

Figure 2. Commercial vehicle types as designated by code based on axle arrangement.

classes. The resultant weight comparisons are given in tabular form and both the vehicle distributions and their percentage counterparts shown. These comparisons (Tables 11-17) provide an additional classification tool for research and planning activities.

The research covered by this report will have many uses, important to the Federal and the State governments. The data presented can be used as an aid in the analysis of the application and equitability of road-user taxes, and they are expected to enhance the effectiveness of administration of motor-vehicle tax laws. They will be useful in determining the probable effects of legislation proposed, and they also will be of value to those concerned with highway planning, and to industry in materials, product, and market research.

VEHICLE CLASSIFICATION STUDIES

One of the early efforts to count and classify commercial motor vehicles was a comprehensive study of registrations and fees (1). Information for this study was compiled by the Bureau of Public Roads from State and local motor-vehicle records and from questionnaires that requested data on vehicles and taxes in considerable detail. Another study, known as the Nationwide Truck and Bus Inventory, was begun in 1940 by the Bureau of Public Roads in cooperation with the States. Although the work was eventually completed, it was expensive, and it used manufacturers' rated capacities as a uniform measure of truck weight. Since the use of that classification was rapidly waning, the study had limited value for comparing current vehicle classification data, and the results of the study have not been published.

The next major vehicle classification study was made by the Bureau of Public Roads, in cooperation with the States, to provide basic information for the highway cost allocation study that was required by Section 210 of the Highway Revenue Act of 1956. The findings of this classification study were included in the comprehensive series of highway cost allocation study reports made to the Congress, and also were published in 1960 by the Bureau of Public Roads as the "Classification of Motor Vehicles, 1956-57." This study is the most recent inventory of highway rolling stock, and it will be referred to herein as the classification study.

When the classification study was undertaken, an effort was made by Public Roads

and State authorities to obtain the needed data in each of the States. Intensive reviews were made of the existing registration records, special questions were added to some motor-vehicle registration application forms for the following year, and special questionnaires were mailed to vehicle owners by many States in an effort to obtain information to supplement the data in the registration files. A valuable lesson was learned during this study. The motor-vehicle data needed for highway research were unavailable from any public source in a usable form. Even if it had been possible to obtain a complete summary and analysis of the vehicle records of each State, the data obtained would have been so lacking in uniformity that it would have been impossible with the knowledge then available, to combine them into a workable, usable body of data for use in research. One result of these findings is the cooperative effort of the States and Public Roads to develop standard vehicle descriptions and information that will be useful to both government and industry. Substantial progress is being made under the auspices of the American Association of Motor Vehicle Administrators.

Many differences existed in the registration requirements and records of the States but the one that posed the greatest problem was the requirement of several States for registration of vehicles on the basis of empty weight or on variations of gross and empty weights. Most States registered and recorded vehicles on the basis of the owners' declared gross weight (the weight of the vehicle, fully equipped and ready for service, plus the maximum load to be carried).

When it is necessary, in studies of motor vehicles or motor-vehicle revenues, to bring the basic motor-vehicle data of all States into uniformity, a relationship must be established between the bases and all of the data must be converted to a uniform structure for analysis.

To analyze the composition of the vehicle fleet properly an understanding of the factors affecting the selection of the vehicles in use is necessary. Tax structures, terrain, kind of goods transported, and literally dozens of factors affect owners' vehicle selections. Some carriers may elect to buy lightweight power equipment to perform the same job that is done by another carrier with heavier and costlier power units. The lighter power units would depreciate more rapidly but, because of other factors, they might provide lower overall operation cost. The subject of vehicle ownership and operating costs is discussed in considerable detail in HRB Bull. 301 (2).

SOURCES OF DATA FOR WEIGHT COMPARISONS

Traffic and Loadometer Data, 1957

During the course of the extensive 1957 motor-vehicle traffic counting, classification, and loadometer operations, approximately 600,000 vehicles were weighed, and data concerning empty weight, registered weight, make, body, axle arrangement, and other items on vehicle classification and operation were obtained. More than 150,000 commercial vehicles, for which weight data were complete, were selected from the group of 600,000 for special study to relate empty and registered gross vehicle weights. Gross vehicle weight was available from the registration certificates for only vehicles registered on that basis, but it is believed that a good representative sample was obtained because States using this basis were very well distributed geographically. The data concerning the 150,000 commercial vehicles are referred to herein as the "1957 loadometer data." Information from more recent weighing studies and spot vehicle classification counts made by the States have been added to the 1957 loadometer data. The locations of the weighing stations were selected with the objective of making the data collected from them representative of the vehicles being used in that area.

Loadometer Data, 1961

Rather than wait until the 1961 loadometer study had been completed and the complete record of weighings was available for use, a special group of data was collected from a limited sample of vehicles throughout the United States. This sample was obtained as a part of the regular loadometer study, but was collected at the first station or first tow stations operated in each State at the beginning of the weighing operations. The study instructions stipulated that vehicles were to be weighed at each station until at

least 10 loaded and 10 empty vehicles of each visual type (Fig. 2) had been observed.

A field crew member was assigned to interview each driver and to obtain registration card information while the vehicle was being weighed by other members of the crew. These data were placed on punched cards, which were forwarded to the Washington office of the Bureau of Public Roads. In order to check the accuracy of the sample, Public Roads sent the record of each of these vehicles to the State in which it was registered to be verified against the registration file. It is believed that this check eliminated many of the inconsistencies, which might otherwise have gone undetected, and that data for the resultant group of vehicles identified herein as the "1961 loadometer data" have a relatively high degree of accuracy. Although the sample was not expanded, a comparison of the data with those obtained from other sources showed the information to be representative in all major weight cells. The usable sample from the 1961 loadometer data totaled approximately 14,000 vehicles, and the information gathered included empty and gross weights, vehicle type, number of axles, body type, class of use, some information on fuel used, year model, make of vehicle, and commodity carried. Only the information that applies specifically to weight comparisons has been summarized here. Processing of the remaining data is in progress and, if these data are found to be representative, they will be used in other studies.

Some unexplained differences were noted in a comparison of the 1957 and 1961 loadometer data. These differences probably were caused by the highway system coverage and the distribution of the loadometer stations. Because of the scope and purpose of the 1957 loadometer study, more urban stations were included and a greater coverage of secondary and local road systems was obtained. The 1961 loadometer data, however, are more indicative of the type of vehicles used on main rural highways.

California Data

The third group of data was obtained from the State of California for vehicles registered under the Uniform Proration Compact. California maintains an excellent file on motor-vehicle fleets that are registered in other States on different registration bases and that are operated in California under the Proration Compact. Uniform empty and gross weight data and other vehicle information were available for these vehicles. The California authorities permitted the authors to use the information and provided much assistance in interpreting it. This availability of another source of data was an important factor in the decision to present this study.

Unlike the truck samples obtained in the loadometer surveys, the California data represented principally over-the-road fleets from the Western States. The records included the declared gross vehicle weight of the vehicle or combination; the empty weight of the power unit; and the type of carrier, make, year model, and number of axles; and the type of motor fuel used. Data on approximately 8,000 vehicles were supplied by the State, and information on 6,700 has been used in the present comparisons. Information on approximately 1,300 vehicles could not be included in the study because one or more of the basic weight factors had not been included in the reports to the State.

Data from Other Sources

The State motor-vehicle registration authorities make their annual registration counts, by vehicle type, available to the Bureau of Public Roads and other interested groups. These data are consolidated (3) for use by government transportation and planning authorities, industry marketing groups, and private individuals. A few States prepare special tabulations on commercial vehicles by weight classes for their own uses, and copies of these have been supplied to the Bureau for studies of vehicle characteristics, distribution, and use.

DISCUSSION OF DATA

Registered Gross Weights by Vehicle Types

Table 1 summarizes the vehicles registered on a gross weight basis for which empty weights were available; these data were obtained in the 1957 and 1961 loadometer surveys.

Table 1.—Trucks and combinations, observed during 1957 and 1961 loadometer studies, grouped by number of axles and by registered gross vehicle weights [1]

Registered gross vehicle weight	Single-unit trucks				Combinations consisting of—											
					Tractor and semitrailer						Truck and full trailer				Tractor, semitrailer and full trailer	
	2-axles		3-axles		3-axles (2-S1)		4-axles (2-S2)		5-axles (3-S2)		3-axles (2-1)		5-axles (3-2)		5-axles (2-S1-2)	
Pounds	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*
0-3,999																
4,000-4,999	49,279	36.0														
5,000-5,999	26,846	19.6														
6,000-7,999	12,767	9.3														
8,000-9,999	6,637	4.9														
10,000-11,999	5,456	4.0														
12,000-13,999	4,560	3.3														
14,000-15,999	4,236	3.1														
16,000-17,999	6,855	5.0	152	2.1	2											
18,000-19,999	4,431	3.2	47	0.6	106	1.6					28	9.2				
20,000-21,999	5,761	4.2	65	0.9	77	1.2					14	4.6				
22,000-23,999	3,000	2.2	106	1.5	93	1.5	29	0.3			17	5.5				
24,000-25,999	4,732	3.5	193	2.6	241	3.8	35	0.4			14	4.6				
26,000-27,999	1,153	0.8	205	2.8	127	2.0	22	0.2			16	5.2				
28,000-29,999	294	0.2	214	2.9	187	3.0	11	0.1			14	4.6				
30,000-31,999	520	0.4	322	4.4	394	6.3	38	0.4			14	4.6				
32,000-35,999	103	0.1	708	9.6	1,040	16.5	47	0.5			38	12.4				
36,000-39,999	103	0.1	1,174	16.0	987	15.7	101	1.1			53	17.3				
40,000-44,999	97	0.1	1,657	22.5	2,188	34.8	280	3.2			86	28.1				
45,000-49,999	41		2,273	30.9	301	4.8	361	4.1	191	3.3	12	3.9				
50,000-54,999	21		233	3.2	376	6.0	1,843	20.8	151	2.6					1	1.5
55,000-59,999	9				66	1.0	4,061	45.9	192	3.3			17	2.4		
60,000-64,999	56				104	1.7	1,737	19.6	1,070	18.3			5	0.7	2	2.9
65,000-69,999					6	0.1	261	3.0	1,216	20.9			42	5.9	4	5.9
70,000-74,999							34	0.4	2,595	44.5			311	43.5	28	41.2
75,000-79,999									416	7.1			319	44.6	30	44.1
80,000 and over													21	2.9	3	4.4
TOTAL	136,957	100.0	7,349	100.0	6,295	100.0	8,860	100.0	5,831	100.0	306	100.0	715	100.0	68	100.0

[1] Data from 1957 and 1961 special, field - weighing reports are combined in this table. The portion of the table boxed by heavy lines represents 90 percent or more of the vehicles in each vehicle type.

Numbers and percentages of vehicles of each type are given by registered gross weights. Heavy lines in the table enclose data for approximately 90 percent of the vehicles in each visual type. The extremes, representing approximately 10 percent of the vehicles, are "fenced out" above and below the main group. Thus a visual comparison can be made of the total range of the data. This comparison shows the approximately 90 percent spread of gross weights for each of the vehicle types, and it illustrates that as the vehicles became larger the gross weight range was smaller. Registered gross weights for each vehicle type, however, overlap the weights for both adjacent vehicle types.

The 1961 loadometer data presented in this study for the 2-axle trucks cannot be separated into 4-tire and 6-tire classes. Other sources (4) have shown however that, taken as separate groups, the 2-axle, 4-tire class would show a rapid diminution of numbers over 8,000 lb and, with the greater load flexibility permitted by additional tires, the 2-axle, 6-tire class would peak at about 12,000 to 18,000 lb and would taper off slowly in numbers at approximately 28,000 lb. Within the enclosed area of the table, the data for successive vehicle types form a group of steps to the larger gross weights.

Comparison of 1957 and 1961 Loadometer Data and California Data

Table 2 shows the California data by registered gross weights and by visual vehicle types. The heavy lines enclose approximately 90 percent of the vehicles in each type. A comparison of the vehicle distributions from the loadometer weighings in Table 1 with those obtained from the California data reveals considerable disparity in the information from the two sources. Because vehicles represented in the California data were used principally in intercity service, much less dispersion in gross weights was noted in these data than in the information obtained from the loadometer studies.

Frequency distributions and least squares comparisons of empty to gross weights are shown in Figures 3 through 9 for the main visual types of vehicles. The California data, represented by the medium-length dash least squares lines in the upper panels of these figures, with certain exceptions, showed that the average empty weights of vehicles in relation to given gross weights were higher than the empty weight to gross weight relations recorded by loadometer data. A similar empty weight relationship was not recorded for the 3-S2 vehicle combinations; the slope of the line for the 1961 loadometer data (Fig. 7) suggests the effect of too small a sample. However, this relationship of the empty to gross weight probably is not entirely accurate as the Public Roads' vehicle classification counts indicate that use of the 3-S2 vehicle combinations has become more widespread geographically than in 1957, and therefore the relationship of empty to gross weight could have been different than shown by the 1961 loadometer data.

As shown in Figure 8, an exception to the higher empty weights in relation to gross weights was recorded in the 1957 loadometer data, which included information on an unusually large number of 3-2 truck-trailer combinations registered at 50,000 to 55,000-lb gross combination weight and reported as having empty weights of more than 16,000 lb for the truck alone. Such a reported distribution of so many 3-2 combinations at 55,000 pounds in 1957 was not normal because in the classification study nearly 97 percent of the 3-2 combinations were reported to have been registered at more than 60,000-lb gross combination weight.

A percentage comparison of the gross weight distribution of combined 1957 and 1961 loadometer data and of the California data with the nationwide gross weight distribution of all vehicles of each type reported in the 1956-57 classification study is given in the bottom panels of Figures 3 through 6. The loadometer data distribution by gross weight was close to that for the classification study (Fig. 3). This close relationship implies that the gross weights for vehicles sampled in the loadometer studies were relatively proportional to the gross weights for all such vehicles registered. But, as stated earlier, the California data consisting largely of registrations of over-the-road 2-axle, 6-tire vehicles showed a much larger sample for vehicles having 18,000- to 26,000-lb gross weights. The 2-axle classification given in Figure 3 includes both the 2-axle, 4-tire and the 2-axle, 6-tire vehicles. Nationwide more than 90 percent of the 2-axle, 4-tire vehicles were registered for gross weights under 8,000 lb. More than 67 percent of the 2-axle, 6-tire trucks were registered for gross weights in excess

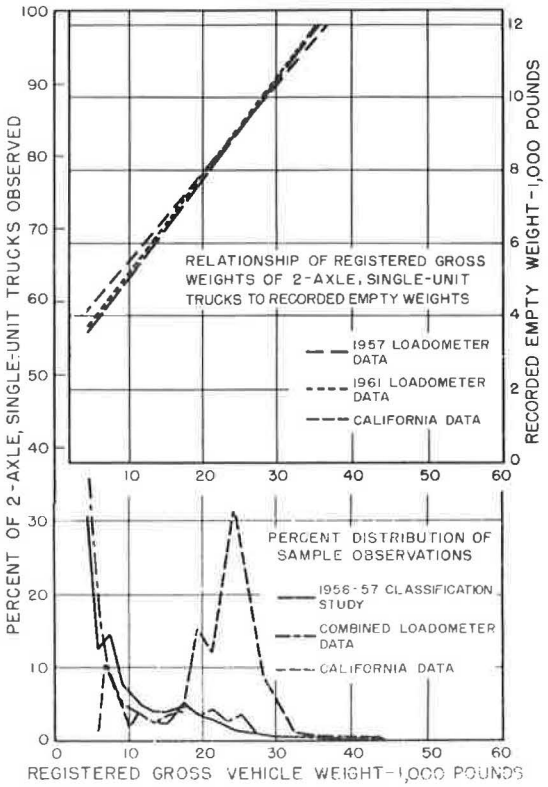

Figure 3. Empty to gross weight relationships and relative distribution of 2-axle, single-unit trucks.

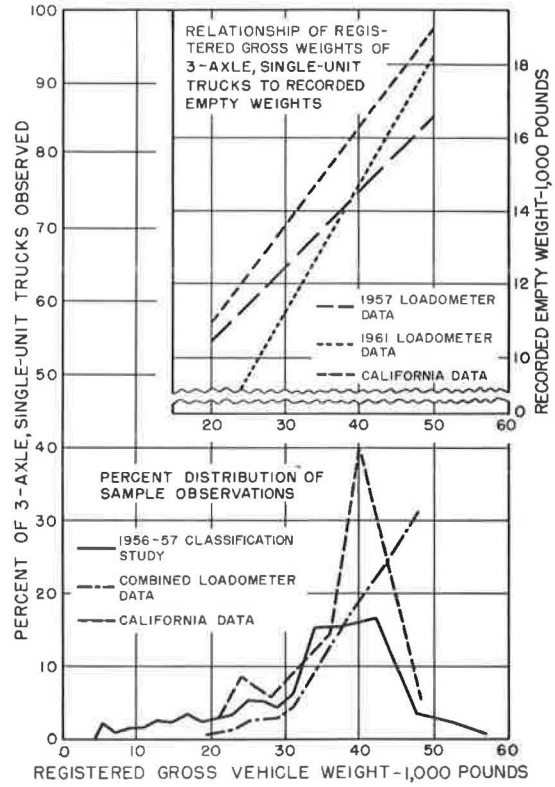

Figure 4. Empty to gross weight relationships and relative distribution of 3-axle, single-unit trucks.

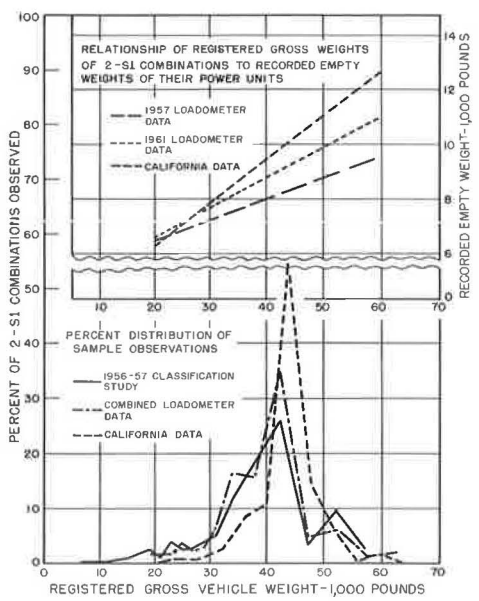

Figure 5. Empty to gross weight relationships and relative distribution of 3-axle, tractor-semitrailer combinations (2-S1).

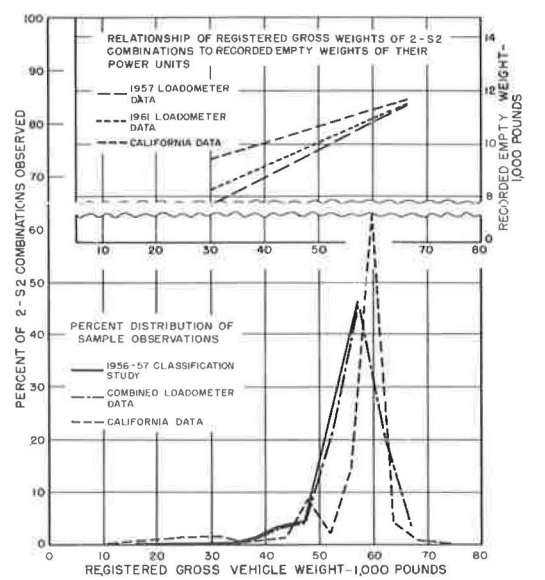

Figure 6. Empty to gross weight relationships and relative distribution of 4-axle, tractor-semitrailer combinations (2-S2).

of 12,000 lb, and nearly 47 percent was registered for gross weights in excess of 16,000 lb.

Figures 4 through 9 show that the gross weights of the sampled vehicles in the loadometer studies follow closely the gross weight distributions of the vehicle population. Gross weight comparisons for information from the classification study have not been included in Figures 7 through 9 for the 3-S2, 3-2, and the 2-S1-2 vehicle combinations because these vehicles generally are registered for the State maximum permitted gross weights of over 60,000 lb and their registrations were shown in the classification study in that maximum weight class.

Combined Loadometer Data

In Figure 10, straight lines illustrate the empty to gross weight relationships obtained by the least squares method. The lines were based on the combined data from the loadometer surveys, and they provide a quick visual comparison of relationships for five vehicle types. The lines for the single-unit trucks follow a parallel course, they overlap in the gross weights from 22,000 to 32,000 lb, and they are separated by about 1,500 lb of empty weight. This greater empty weight is accounted for largely by the third axle in the 3-axle truck. The slope of these two lines is much steeper than the slope of the lines for the tractor power units, shown in combination as 2-S-1, 2-S2, and 3-S2, because the payload carrying body is included in the empty weight for single-unit trucks but is not included for the combination vehicles. A considerable gross vehicle weight overlap is shown for the 2-S1 and 2-S2 combinations because of differences in size and weight requirements; some States require an additional axle to carry loads that can be carried by the 2-S1 combination in other States. Also, factors of terrain, power requirements, and types of loads carried are considered by operators in their choice of vehicles.

Comparison of 1957 and 1961 Loadometer Data

A percentage comparison of the distribution of gross weights of vehicles from the 1957 loadometer data with the distribution of the gross weights of vehicles from the 1961 loadometer data is given in Table 3. The 1957 study was designed to sample vehicles on all types of rural and urban

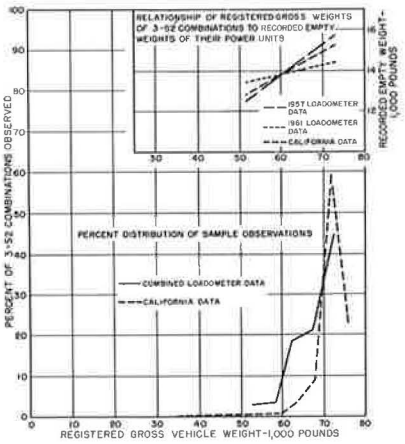

Figure 7. Empty to gross weight relationships and relative distribution of 5-axle, tractor-semitrailer combinations (3-S2).

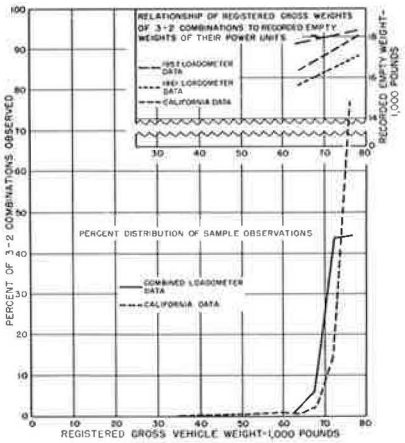

Figure 8. Empty to gross weight relationships and relative distribution of 5-axle, truck-full trailer combinations (3-2).

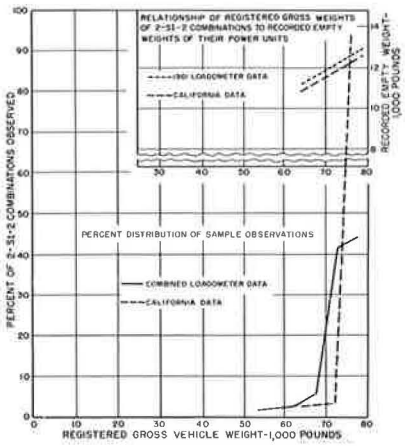

Figure 9. Empty to gross weight relationships and relative distribution of 5-axle, tractor-semitrailer, full trailer combinations (2-S1-2).

Table 2.—Trucks and combinations grouped by number of axles and by registered gross vehicle weights, from California interstate proration records [1]

Registered gross vehicle weight	Single-unit trucks				Combinations consisting of—											
					Tractor and semitrailer						Truck and full trailer				Tractor, semi-trailer and full trailer	
	2-axles		3-axles		3-axles (2-S1)		4-axles (2-S2)		5-axles (3-S2)		3-axles (2-1)		5-axles (3-2)		5-axles (2-S1-2)	
Pounds	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*
0-3,999																
4,000-4,999																
5,000-5,999	8	1.3														
6,000-7,999	70	11.2														
8,000-9,999	40	6.4														
10,000-11,999	21	3.3					1	0.1								
12,000-13,999	15	2.4					1	0.1			1	7.7				
14,000-15,999	22	3.5														
16,000-17,999	24	3.8														
18,000-19,999	96	15.2														
20,000-21,999	74	11.7	1	2.8	2	0.1										
22,000-23,999	112	17.8			1	0.1	3	0.4			4	30.8				
24,000-25,999	85	13.5	3	8.3	9	0.7	8	1.2			4	30.8				
26,000-27,999	43	6.8	1	2.8	4	0.3					1	7.7				
28,000-29,999	8	1.3	1	2.8	3	0.2	11	1.6			2	15.3				
30,000-31,999	7	1.1			24	1.8	9	1.3					1	0.2		
32,000-35,999	3	0.5			15	1.1	2	0.3								
36,000-39,999	1	0.2	11	30.6	140	10.4	3	0.4	3	0.1	1	7.7				
40,000-44,999			17	47.2	818	60.5	8	1.2	5	0.2						
45,000-49,999			2	5.5	226	16.7	64	9.3	1				2	0.4		
50,000-54,999					81	6.0	45	6.6	8	0.3			2	0.4		
55,000-59,999					22	1.7	310	45.3	16	0.5			3	0.6		
60,000-64,999					2	0.1	207	30.2	89	3.0			2	0.4	11	2.1
65,000-69,999					1	0.1	10	1.5	289	9.6			13	2.5	1	0.2
70,000-74,999					2	0.1	2	0.3	2,160	71.6			86	16.7	101	19.5
75,000-79,999					2	0.1	1	0.2	445	14.7			406	78.8	405	78.2
80,000 and over																
TOTAL	629	100.0	36	100.0	1,352	100.0	685	100.0	3,016	100.0	13	100.0	515	100.0	518	100.0

[1] The portion of the table boxed by heavy lines represents 90 percent or more of the vehicles in each vehicle type.

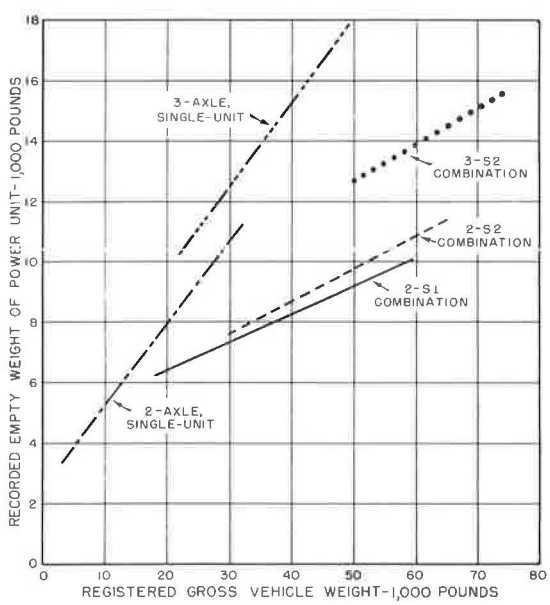

Figure 10. Relationship of the recorded empty weights of the power units to the registered gross weights of the vehicles based on combined 1957 and 1961 loadometer data.

highways as uniformly as possible, but the 1961 data were obtained to a larger extent at stations on main rural roads. The comparison indicates that the traffic on main rural roads has a much greater concentration of heavy vehicles than the total traffic on all types of rural and urban highways.

Table 4 gives a distribution of the same vehicles by empty weights of the trucks and power units for the 1957 and 1961 loadometer surveys. The information in both tables shows that the empty and gross weights were consistently heavier in the 1961 loadometer data. The percentage distributions for each weight group, within each vehicle type, have been cumulated inversely as an additional check on the differences between the 1957 and 1961 loadometer data. At first glance it might appear that trucks and combinations have gotten heavier since 1957, and to some degree this may be true. However, evidence from continuing vehicle and classification counts has led the authors to conclude that most of the difference between the two sets of data was caused by the difference in the size and scope of the samples.

To show a more complete cross-section of information on the three vehicle types given in Tables 3 and 4, a set of two-way frequency distributions of empty weight to gross vehicle weight has been given for each of the three vehicle types separately for the 1957 and 1961 loadometer samples in Tables 5 through 10. With the data arrayed in this manner it is possible to examine either the frequency distribution by empty weights of vehicles in a given class interval of registered gross weight, or the distribution by registered gross weights of vehicles in a given class interval of empty weight. Both numerical and percentage distributions are given, and heavy lines enclose approxi-

Table 3.—Comparison of relative numbers of motor vehicles observed in the 1957 and 1961 loadometer studies by gross vehicle weight groups

Registered gross vehicle weight	Single-unit trucks				Vehicle combinations							
	2-axle				3-axle (2–S1)				4-axle (2–S2)			
	1957		1961		1957		1961		1957		1961	
Pounds	*Pct.*	*Cumulated Pct.*[1]	*Pct.*	*Cumulated Pct.*[1]	*Pct.*	*Cumulated Pct.*[1]	*Pct.*	*Cumulated Pct.*[1]	*Pct.*	*Cumulated Pct.*[1]	*Pct.*	*Cumulated Pct.*[1]
Under [2] 5,000	36.1	100.0	32.8	100.0								
Under [2] 18,000					[3]	[3]	0.2	100.0				
Under [2] 24,000									0.2	100.0	0.6	100.0
5,000–5,999	19.9	63.9	13.1	67.2								
6,000–7,999	9.0	44.0	15.8	54.1								
8,000–9,999	4.7	35.0	8.0	38.3								
10,000–11,999	3.9	30.3	5.4	30.3								
12,000–13,999	3.3	26.4	4.3	24.9								
14,000–15,999	3.2	23.1	1.6	20.6								
16,000–17,999	5.1	19.9	2.2	19.0								
18,000–19,999	3.3	14.8	2.6	16.8	1.9	100.0	0.3	99.8				
20,000–21,999	4.3	11.5	2.9	14.2	1.4	98.1	0.3	99.5				
22,000–23,999	2.2	7.2	2.4	11.3	1.7	96.7	0.3	99.2				
24,000–25,999	3.4	5.0	3.9	8.9	4.3	95.0	1.3	98.9	0.5	99.8	0.2	99.4
26,000–27,999	0.8	1.6	1.7	5.0	2.3	90.7	0.4	97.6	0.3	99.3	0.1	99.2
28,000–29,999	0.2	0.8	0.6	3.3	3.3	88.4	1.4	97.2	0.1	99.0	0.1	99.1
30,000–31,999	0.4	0.6	0.9	2.7	6.9	85.1	2.8	95.8	0.5	98.9	0.1	99.0
32,000–35,999	[3]	[3]	0.9	1.8	18.2	78.2	6.8	93.0	0.6	98.4	0.3	98.9
36,000–39,999	0.1	0.2	0.4	0.9	15.7	60.0	15.3	86.2	1.3	97.8	0.6	98.6
40,000–44,999	0.1	0.1	0.2	0.5	33.6	44.3	41.2	70.9	3.4	96.5	2.3	98.0
45,000–49,999	[3]	[3]	0.1	0.3	4.0	10.7	9.4	29.7	4.6	93.1	2.1	95.7
50,000–54,999	[3]	[3]	[3]	[3]	5.6	6.7	8.1	20.3	24.4	88.5	6.8	93.6
55,000–59,999	[3]	[3]	0.1	0.2	0.7	1.1	3.0	12.2	47.6	64.1	39.2	86.8
60,000–64,999					0.4	0.4	8.6	9.2	14.2	16.5	40.5	47.6
65,000–69,999									2.1	2.3	6.2	7.1
60,000 and over [2]	[3]	[3]	0.1	0.1								
65,000 and over [2]					[3]	[3]	0.6	0.6				
70,000 and over [2]									0.2	0.2	0.9	0.9
TOTAL	100.0		100.0		100.0		100.0		100.0		100.0	

[1] Percentages in this column are an inverse cumulation of the percentages in the preceding column.
[2] Open-end weight classes are shown for each visual vehicle type at the lower end and upper end of the weight classification scale. Each open-end class applies to a specific visual vehicle type.
[3] Less than 0.1 percent.

Table 4.—Comparison of relative numbers of motor vehicles observed in the 1957 and 1961 loadometer studies by recorded empty weights of power units

Recorded empty weight of power unit	Single-unit trucks				Vehicle combinations							
	2-axle				3-axle (2–S1)				4-axle (2–S2)			
	1957		1961		1957		1961		1957		1961	
Pounds	*Pct.*	*Cumulated Pct.*[1]	*Pct.*	*Cumulated Pct.*[1]	*Pct.*	*Cumulated Pct.*[1]	*Pct.*	*Cumulated Pct.*[1]	*Pct.*	*Cumulated Pct.*[1]	*Pct.*	*Cumulated Pct.*[1]
Under [2] 3,000	1.8	100.0	1.5	100.0								
Under [2] 5,000					4.0	100.0	0.5	100.0	0.1	100.0	0.3	100.0
3,000–3,999	42.4	98.2	39.4	98.5								
4,000–4,999	22.1	55.8	24.0	59.1								
5,000–5,999	7.8	33.7	9.5	35.1	9.1	96.0	2.6	99.5	0.6	99.9	0.8	99.7
6,000–6,999	7.8	26.9	7.2	25.6	22.0	86.9	7.3	96.9	3.7	99.3	2.8	98.9
7,000–7,999	7.3	18.1	3.6	18.4	23.4	64.9	16.7	89.6	4.7	95.6	2.6	96.1
8,000–8,999	5.1	10.8	4.1	14.8	18.4	41.5	24.3	72.9	9.7	90.9	8.5	93.5
9,000–9,999	2.7	5.7	3.5	10.7	14.3	23.1	18.3	48.6	23.7	81.2	15.0	85.0
10,000–10,999	1.4	3.0	2.6	7.2	5.2	8.8	15.8	30.3	26.0	57.5	23.1	70.0
11,000–11,999	0.6	1.6	1.8	4.6	3.6	3.6	6.8	14.5	12.4	31.5	20.4	46.9
12,000–12,999	0.4	1.0	1.1	2.8					12.4	19.1	18.2	26.5
13,000–13,999									4.5	6.7	5.7	8.3
12,000 and over [2]					[3]	[3]	7.7	7.7				
13,000 and over [2]	0.6	0.6	1.7	1.7								
14,000 and over [2]									2.2	2.2	2.6	2.6
TOTAL	100.0		100.0		100.0		100.0		100.0		100.0	

[1] Percentages in this column are an inverse cumulation of the percentages in the preceding column.
[2] Open-end weight classes are shown for each visual vehicle type at the lower end and upper end of the weight classification scale. Each open-end class applies to only one visual vehicle type.
[3] Less than 0.1 percent.

Table 5.—Comparison of number and percent of 2-axle, single-unit trucks by recorded empty weights and by registered gross vehicle weights, 1957 loadometer data [1]

Recorded empty weight of truck (pounds)	Registered gross vehicle weight (pounds)																						Total	
	4,000–4,999	5,000–5,999	6,000–7,999	8,000–9,999	10,000–11,999	12,000–13,999	14,000–15,999	16,000–17,999	18,000–19,999	20,000–21,999	22,000–23,999	24,000–25,999	26,000–27,999	28,000–29,999	30,000–31,999	32,000–35,999	36,000–39,999	40,000–44,999	45,000–49,999	50,000–54,999	55,000–59,999	60,000 and over	Number	Percent of total
0–2,999:																								
Number	1,614	621	66	1	2	3	1				2	1											2,311	1.8
Percent	69.9	26.9	2.9	(2)	0.1	0.1	(2)				0.1	(2)												
3,000–3,999:																								
Number	34,176	15,530	4,804	955	123	22	11	6	4	1													55,632	42.4
Percent	61.5	27.9	8.7	1.7	0.2	(2)	(2)	(2)	(2)	(2)														
4,000–4,999:																								
Number	11,618	7,968	4,948	2,079	1,223	459	220	273	145	79	10		1		2		1	1		1			29,026	22.1
Percent	40.0	27.5	17.0	7.2	4.2	1.6	0.8	0.9	0.5	0.3	(2)		(2)		(2)		(2)	(2)		(2)				
5,000–5,999:																								
Number		1,979	1,738	1,793	1,388	945	689	893	335	208	79	109	27	5	10		3			2			10,203	7.8
Percent		19.4	17.0	17.6	13.6	9.3	6.7	8.8	3.3	2.0	0.8	1.1	0.3	(2)	0.1		(2)			(2)				
6,000–6,999:																								
Number			300	1,058	1,438	1,312	1,103	1,854	976	1,176	342	501	120	9	43	6	8	15	6	2		2	10,281	7.8
Percent			2.9	10.4	14.0	12.8	10.7	18.0	9.5	11.4	3.3	4.9	1.2	0.1	0.4	0.1	0.1	0.1	0.1	(2)		(2)		
7,000–7,999:																								
Number			10	257	758	730	967	1,832	1,107	1,672	646	1,369	160	22	80	5	12	11	13	2		1	9,654	7.3
Percent			0.1	2.7	7.8	7.6	10.0	19.0	11.5	17.3	6.7	14.2	1.7	0.2	0.8	0.1	0.1	0.1	0.1	(2)		(2)		
8,000–8,999:																								
Number				22	184	533	511	1,011	886	1,131	802	1,201	186	31	103	6	13	13	6	6		5	6,700	5.1
Percent				0.3	2.7	8.0	7.6	15.1	13.2	17.6	12.0	17.9	2.8	0.5	1.5	0.1	0.2	0.2	0.1	0.1		0.1		
9,000–9,999:																								
Number				6	23	245	321	453	474	698	414	539	177	60	75	1	5	5	1	1	1	15	3,514	2.7
Percent				0.2	0.7	7.0	9.2	12.9	13.5	19.9	11.8	15.4	5.0	1.7	2.1	(2)	0.1	0.1	(2)	(2)	(2)	0.4		
10,000–10,999:																								
Number					7	51	246	214	154	288	291	311	136	37	38	2	13	5	3	3	1	23	1,823	1.4
Percent					0.4	2.8	13.5	11.7	8.4	15.8	15.9	17.1	7.5	2.0	2.1	0.1	0.7	0.3	0.2	0.2	(2)	1.3		
11,000–11,999:																								
Number						8	63	117	62	94	132	137	81	20	34	5	3	3	3			6	818	0.6
Percent						1.0	7.7	14.3	7.6	11.5	16.1	22.9	9.9	2.4	4.1	0.6	0.4	0.4	0.4			0.7		
12,000–12,999:																								
Number						4	12	51	53	88	71	91	79	35	23	11	6	1	4				534	0.4
Percent						0.7	2.2	9.6	10.9	16.5	13.3	17.0	14.8	6.6	4.3	2.1	1.1	0.2	0.7					
13,000 and over:																								
Number						1	2	23	79	109	76	201	87	39	61	16	19	32		3	4		752	0.6
Percent						0.1	0.3	3.1	10.5	14.5	10.1	26.7	11.6	5.2	8.1	2.1	2.5	4.3		0.4	0.5			
TOTAL:																								
Number	47,408	26,098	11,866	6,131	5,146	4,313	4,146	6,727	4,280	5,594	2,865	4,510	1,054	258	469	52	83	86	36	20	6	52	131,250	100.0
Percent	36.1	19.9	9.0	4.7	3.9	3.3	3.2	5.1	3.3	4.3	2.2	3.4	0.8	0.2	0.4	(2)	0.1	0.1	(2)	(2)	(2)	(2)		

[1] The portion of the table boxed by heavy lines represents 90 percent or more of the vehicles in each empty weight group.
[2] Less than 0.1 percent.

Table 6.—Comparison of number and percent of 2-axle, single-unit trucks by recorded empty weights and by registered gross vehicle weights, 1961 loadometer data [1]

Recorded empty weight of truck (pounds)	Registered gross vehicle weight (pounds)																					Total number	Percent of total
	4,000–4,999	5,000–5,999	6,000–7,999	8,000–9,999	10,000–11,999	12,000–13,999	14,000–15,999	16,000–17,999	18,000–19,999	20,000–21,999	22,000–23,999	24,000–25,999	26,000–27,999	28,000–29,999	30,000–31,999	32,000–35,999	36,000–39,999	40,000–44,999	45,000–49,999	50,000–54,999	55,000–59,999	60,000 and over		
0–2,999:																							
Number	64	18	5					1														88	1.5
Percent	72.7	20.5	5.7					1.1															
3,000–3,999:																							
Number	1,348	445	365	73	9	2	2	2	1			1									1	2,249	39.4
Percent	60.0	19.8	16.2	3.3	0.4	0.1	0.1	0.1	(2)			(2)									(2)		
4,000–4,999:																							
Number	459	228	376	159	86	34	9	1	4	9	2	4									1	1,372	24.0
Percent	33.4	16.6	27.4	11.6	6.3	2.5	0.6	0.1	0.3	0.7	0.1	0.3									0.1		
5,000–5,999:																							
Number		57	132	137	97	71	8	17	6	3	5	4		1		3						541	9.5
Percent		10.5	24.4	25.3	17.9	13.1	1.5	3.2	1.1	0.6	0.9	0.7		0.2		0.6							
6,000–6,999:																							
Number			23	82	101	99	20	27	19	11	8	12	3	3		1						409	7.2
Percent			5.6	20.1	24.7	24.2	4.9	6.6	4.7	2.7	2.0	2.9	0.7	0.7		0.2							
7,000–7,999:																							
Number				2	10	17	12	28	28	29	24	44	8		3	1	1				1	208	3.6
Percent				1.0	4.8	8.2	5.8	13.5	13.5	13.9	11.5	21.1	3.8		1.4	0.5	0.5				0.5		
8,000–8,999:																							
Number				2	2	13	20	19	36	35	33	54	8	6	5	2	1					236	4.1
Percent				0.8	0.8	5.5	8.5	8.1	15.3	14.8	14.0	22.9	3.4	2.6	2.1	0.8	0.4						
9,000–9,999:																							
Number					2	6	12	13	30	26	30	36	23	5	8	4	1	1				197	3.5
Percent					1.0	3.1	6.1	6.6	15.2	13.2	15.2	18.3	11.7	2.5	4.1	2.0	0.5	0.5					
10,000–10,999:																							
Number					1	2	4	7	12	25	15	29	28	4	6	7	3	1	1		1	146	2.6
Percent					0.7	1.4	2.7	4.8	8.2	17.1	10.3	19.9	19.2	2.7	4.1	4.8	2.0	0.7	0.7		0.7		
11,000–11,999:																							
Number				1	2	2	1	5	11	14	7	18	12	7	8	7	2	3			1	101	1.8
Percent				1.0	2.0	2.0	1.0	4.9	10.9	13.9	6.9	17.8	11.9	6.9	7.9	6.9	2.0	3.0			1.0		
12,000–12,999:																							
Number						1	1	5	1	9	3	7	12	7	6	7	2		2			63	1.1
Percent						1.6	1.6	7.9	1.6	14.3	4.8	11.1	19.0	11.1	9.5	11.1	3.2		3.2				
13,000 and over:																							
Number							1	3	3	6	8	13	5	3	15	19	10	6	2	1	2	97	1.7
Percent							1.0	3.1	3.1	6.2	8.2	13.4	5.1	3.1	15.5	19.6	10.3	6.2	2.1	1.0	2.1		
TOTAL:																							
Number	1,871	748	901	456	310	247	90	128	151	167	135	222	99	36	51	51	20	11	5	1	3	4	5,707	100
Percent	32.8	13.1	15.8	8.0	5.4	4.3	1.6	2.2	2.6	2.9	2.4	3.9	1.7	0.6	0.9	0.9	0.4	0.2	0.1	0.0	0.1	0.1	

[1] The portion of the table boxed by heavy lines represents 90 percent or more of the vehicles in each empty weight group.
[2] Less than 0.1 percent.

mately 90 percent of the vehicles in each empty weight group. When special consideration is given to the 90 percent portion of the sample in each table, the array of each vehicle type is much more compact. Although an appreciable number of vehicles are shown at the extremes, those having heavy empty weights and light gross weights and

Table 7.—Comparison of number and percent of 3-axle, tractor-semitrailer combinations (2–S1) by tractor recorded empty weights a by registered gross vehicle weights, 1957 loadometer data [1]

Recorded empty weight of tractor (pounds)	Registered gross combination weight (pounds)															Total number	Percen of tota
	0–17,999	18,000–19,999	20,000–21,999	22,000–23,999	24,000–25,999	26,000–27,999	28,000–29,999	30,000–31,999	32,000–35,999	36,000–39,999	40,000–44,999	45,000–49,999	50,000–54,999	55,000–59,999	60,000–64,999		
0–4,999:																	
Number		28	4	6	18	12	10	17	20	36	58	3	1		1	214	4.0
Percent		13.1	1.9	2.8	8.4	5.6	4.7	7.9	9.3	16.8	27.1	1.4	0.5		0.5		
5,000–5,999:																	
Number		25	15	39	48	16	32	40	88	64	97	12	10	1	2	489	9.1
Percent		5.1	3.1	8.0	9.8	3.3	6.5	8.2	18.0	13.1	19.8	2.5	2.0	0.2	0.4		
6,000–6,999:																	
Number		23	14	13	79	32	51	78	317	219	282	24	17			1,182	22.0
Percent		1.9	1.2	1.1	6.7	2.7	4.6	6.6	29.4	18.5	23.9	2.0	1.4				
7,000–7,999:																	
Number		17	28	18	34	20	25	146	315	263	336	24	28	1	2	1,257	23.4
Percent		1.4	2.2	1.4	2.7	1.6	2.0	11.6	25.1	20.9	26.7	1.9	2.2	0.1	0.2		
8,000–8,999:																	
Number		8	8	8	36	28	33	47	93	146	457	60	51	7	3	985	18.4
Percent		0.8	0.8	0.8	3.7	2.8	3.4	1.8	9.4	14.8	46.4	6.1	5.2	0.7	0.3		
9,000–9,999:																	
Number		2	5	4	8	10	11	26	70	68	360	67	120	14	2	767	14.3
Percent		0.3	0.7	0.5	1.1	1.3	1.4	3.4	9.1	8.9	46.9	8.7	15.6	1.8	0.3		
10,000–10,999:																	
Number				1	3	3	5	6	29	30	129	16	40	8	7	277	5.2
Percent				0.4	1.1	1.1	1.8	2.1	10.5	10.8	46.6	5.8	14.4	2.9	2.5		
11,000–11,999:																	
Number				1	3	2	1	8	15	19	86	8	34	7	7	194	3.6
Percent				0.5	1.6	1.0	2.1	4.1	7.8	9.8	44.3	4.1	17.5	3.6	3.6		
TOTAL:																	
Number		103	74	90	229	123	174	368	977	845	1,805	214	301	38	24	5,365	100.0
Percent		1.9	1.4	1.7	4.3	2.3	3.3	6.9	18.2	15.7	33.6	4.0	5.6	0.7	0.4		

[1] The portion of the table boxed by heavy lines represents 90 percent or more of the vehicles in each empty weight group.

Table 8.—Comparison of number and percent of 3-axle, tractor-semitrailer combinations (2–S1) by tractor recorded empty weights a by registered gross vehicle weights, 1961 loadometer data [1]

Recorded empty weight of tractor (pounds)	Registered gross combination weight (pounds)																Total number	Percen of tota
	0–17,999	18,000–19,999	20,000–21,999	22,000–23,999	24,000–25,999	26,000–27,999	28,000–29,999	30,000–31,999	32,000–35,999	36,000–39,999	40,000–44,999	45,000–49,999	50,000–54,000	55,000–59,999	60,000–64,999	65,000 and over		
0–4,999:																		
Number		2	1								2						5	0.5
Percent		40.0	20.0								40.0							
5,000–5,999:																		
Number							1	1	8	5	7	1	1				24	2.6
Percent							4.2	4.2	33.3	20.8	29.1	4.2	4.2					
6,000–6,999:																		
Number		1		1	1	2	1	5	14	10	32	1					68	7.3
Percent		1.5		1.5	1.5	2.9	1.5	7.3	20.6	14.7	47.0	1.5						
7,000–7,999:																		
Number				1	3	1	6	5	14	47	68	3	3	4			155	16.7
Percent				0.7	1.9	0.7	3.9	3.2	9.0	30.3	43.9	1.9	1.9	2.6				
8,000–8,999:																		
Number	2		1	1	4	1	3	7	14	37	115	17	17	3	3	1	226	24.3
Percent	0.9		0.4	0.5	1.8	0.5	1.3	3.1	6.2	16.4	50.9	7.5	7.5	1.3	1.3	0.4		
9,000–9,999:																		
Number			1		3			5	7	24	77	21	14	5	13		170	18.3
Percent			0.6		1.8			3.0	4.1	14.1	45.3	12.4	8.2	2.9	7.6			
10,000–10,999:																		
Number					1		1	2	2	10	44	25	26	6	28	2	147	15.8
Percent					0.7		0.7	1.4	1.4	6.8	29.9	17.0	17.7	4.1	19.0	1.3		
11,000–11,999:																		
Number									4	3	22	5	6	4	17	2	63	6.8
Percent									6.4	4.8	34.9	7.9	9.5	6.3	27.0	3.2		
12,000 and over:																		
Number							1	1		6	16	14	8	6	19	1	72	7.7
Percent							1.4	1.4		8.3	22.2	19.5	11.1	8.3	26.4	1.4		
TOTAL:																		
Number	2	3	3	3	12	4	13	26	63	142	383	87	75	28	80	6	930	100.0
Percent	0.2	0.3	0.3	0.3	1.3	0.4	1.4	2.8	6.8	15.3	41.2	9.4	8.1	3.0	8.6	0.6		

[1] The portion of the table boxed by heavy lines represents 90 persent or more of the vehicles in each empty weight group.

Table 9.—Comparison of number and percent of 4-axle, tractor-semitrailer combinations (2-S2) by tractor recorded empty weights and by registered gross vehicle weights, 1957 loadometer data [1]

Recorded empty weight of tractor (pounds)	Registered gross combination weight (pounds)														Total number	Percent of total
	0-23,999	24,000-25,999	26,000-27,999	28,000-29,999	30,000-31,999	32,000-35,999	36,000-39,999	40,000-44,999	45,000-49,999	50,000-54,999	55,000-59,999	60,000-64,999	65,000-69,999	70,000 and over		
0-4,999:																
Number	2							3	2						7	0.1
Percent	28.6							42.8	28.6							
5,000-5,999:																
Number	1	3	7	2	2	1	1	2	7	13	2	1			42	0.6
Percent	2.4	7.1	16.6	4.8	4.8	2.4	2.4	4.8	16.6	30.9	4.8	2.4				
6,000-6,999:																
Number	6	16	3	2	6	7	23	31	71	50	38	6			259	3.7
Percent	2.3	6.2	1.1	0.8	2.3	2.7	8.9	12.0	27.4	19.3	14.7	2.3				
7,000-7,999:																
Number	1	3	2	3	10	8	11	43	32	118	70	27		1	329	4.7
Percent	0.3	0.9	0.6	0.9	3.0	2.4	3.4	13.1	9.7	35.9	21.3	8.2		0.3		
8,000-8,999:																
Number	2	1	4	1	1	8	18	56	53	264	182	95			685	9.7
Percent	0.3	0.1	0.6	0.1	0.1	1.2	2.6	8.2	7.7	38.6	26.6	13.9				
9,000-9,999:																
Number	4	3	2	1	11	12	27	54	79	546	648	279	4	2	1,672	23.7
Percent	0.2	0.2	0.1	0.1	0.7	0.7	1.6	3.2	4.7	32.7	38.8	16.7	0.2	0.1		
10,000-10,999:																
Number	1	2	1	1	2	4	5	28	42	417	985	310	35	2	1,835	26.0
Percent	0.1	0.1	0.1	0.1	0.1	0.2	0.3	1.5	2.3	22.7	53.6	16.9	1.9	0.1		
11,000-11,999:																
Number			1		4	1	3	11	8	190	505	107	40	2	872	12.4
Percent			0.1		0.5	0.1	0.3	1.3	0.9	21.8	57.9	12.3	4.6	0.2		
12,000-12,999:																
Number	1	1					1	7	13	83	650	91	21	5	873	12.4
Percent	0.1	0.1					0.1	0.8	1.5	9.5	74.5	10.4	2.4	0.6		
13,000-13,999:																
Number		3					1	3	7	18	206	41	39		318	4.5
Percent		0.9					0.3	0.9	2.2	5.7	64.8	12.9	12.3			
14,000 and over:																
Number								1	8	21	64	44	9	5	152	2.2
Percent								0.7	5.3	13.8	42.1	28.9	5.9	3.3		
TOTAL:																
Number	18	32	20	10	36	41	90	239	322	1,720	3,350	1,001	148	17	7,044	100.0
Percent	0.2	0.5	0.3	0.1	0.5	0.6	1.3	3.4	4.6	24.4	47.6	14.2	2.1	0.2		

[1] The portion of the table boxed by heavy lines represents 60 percent or more of the vehicles in each empty weight group.

Table 10.—Comparison of number and percent of 4-axle, tractor-semitrailer combinations (2-S2) by tractor recorded empty weights and by registered gross vehicle weights, 1961 loadometer data [1]

Recorded empty weight of tractor (pounds)	Registered gross combination weight (pounds)														Total number	Percent of total
	0-23,999	24,000-25,999	26,000-27,999	28,000-29,999	30,000-31,999	32,000-35,999	36,000-39,999	40,000-44,999	45,000-49,999	50,000-54,999	55,000-59,999	60,000-64,999	65,000-69,999	70,000 and over		
0-4,999:																
Number		1							1	2		1		1	6	0.3
Percent		16.6							16.7	33.3		16.7		16.7		
5,000-5,999:																
Number	2	1							1	4	5	1			14	0.8
Percent	14.3	7.1							7.2	28.6	35.7	7.1				
6,000-6,999:																
Number	2	1			1			1	5	14	22	4			50	2.8
Percent	4.0	2.0			2.0			2.0	10.0	28.0	44.0	8.0				
7,000-7,999:																
Number							4		3	9	21	11			48	2.6
Percent							8.3		6.3	18.8	43.7	22.9				
8,000-8,999:																
Number	1					1	4	5	5	27	87	22	1	1	154	8.5
Percent	0.6					0.6	2.6	3.3	3.3	17.5	56.5	14.3	0.7	0.6		
9,000-9,999:																
Number						2	3	6	8	27	136	82	9		273	15.0
Percent						0.7	1.1	2.2	2.9	9.9	49.8	30.1	3.3			
10,000-10,999:																
Number	4			1	1	2		6	5	22	139	205	31	3	419	23.1
Percent	1.0			0.2	0.2	0.5		1.4	1.2	5.3	33.2	48.9	7.4	0.7		
11,000-11,999:																
Number						1		8	2	7	147	167	37	2	371	20.4
Percent						0.3		2.2	0.5	1.9	39.6	45.0	10.0	0.5		
12,000-12,999:																
Number	2		2					5	6	9	109	169	24	5	331	18.2
Percent	0.6		0.6					1.5	1.8	2.7	32.9	51.1	7.3	1.5		
13,000-13,999:																
Number								10	3	2	25	50	10	3	103	5.7
Percent								9.7	2.9	2.0	24.3	48.5	9.7	2.9		
14,000 and over:																
Number											20	24	1	2	47	2.6
Percent											42.5	51.1	2.1	4.3		
TOTAL:																
Number	11	3	2	1	2	6	11	41	39	123	711	736	113	17	1,816	100.0
Percent	0.6	0.2	0.1	0.1	0.1	0.3	0.6	2.3	2.1	6.8	39.2	40.5	6.2	0.9		

The portion of the table boxed by heavy lines represents 90 percent or more of the vehicles in each empty weight group.

Table 11.—Table for estimating the distribution of 2-axle, single-unit trucks grouped by recorded empty weights, by groups of probable registered gross vehicle weights

Recorded empty weight of truck (pounds)	Registered gross vehicle weight (pounds)																						Total number	Percent of total
	4,000–4,999	5,000–5,999	6,000–7,999	8,000–9,999	10,000–11,999	12,000–13,999	14,000–15,999	16,000–17,999	18,000–19,999	20,000–21,999	22,000–23,999	24,000–25,999	26,000–27,999	28,000–29,999	30,000–31,999	32,000–35,999	36,000–39,999	40,000–44,999	45,000–49,999	50,000–54,999	55,000–59,999	60,000 and over		
0–2,999:																								
Number	1,678	639	71	1	2	3	1	1			2	1											2,399	1.8
Percent	70.0	26.7	3.0	(1)	0.1	0.1	(1)	(1)			0.1	(1)												
3,000–3,999:																								
Number	35,524	15,975	5,169	1,028	132	24	13	8	5	1		1									1		57,881	42.3
Percent	61.4	27.6	9.0	1.8	0.2	(1)	(1)	(1)	(1)	(1)		(1)									(1)			
4,000–4,999:																								
Number	12,077	8,196	5,324	2,238	1,309	493	229	274	149	88	12	4	1		2		1	1		1		1	30,400	22.2
Percent	39.7	27.0	17.5	7.4	4.3	1.6	0.8	0.9	0.5	0.3	(1)	(1)	(1)		(1)		(1)	(1)		(1)		(1)		
5,000–5,999:																								
Number		2,036	1,870	1,930	1,485	1,016	697	910	341	211	84	113	27	6	10	3	3			2			10,744	7.8
Percent		19.0	17.4	18.0	13.8	9.5	6.5	8.5	3.2	2.0	0.8	1.1	0.2	(1)	(1)	(1)	(1)			(1)				
6,000–6,999:																								
Number			323	1,150	1,539	1,411	1,123	1,881	995	1,187	350	513	123	12	43	7	8	15	6	2		2	10,690	7.8
Percent			3.0	10.8	14.4	13.2	10.5	17.6	9.3	11.1	3.3	4.8	1.2	0.1	0.4	0.1	0.1	0.1	(1)	(1)		(1)		
7,000–7,999:																								
Number			10	259	768	747	979	1,860	1,135	1,701	670	1,413	168	22	83	6	13	11	13	2	1	1	9,862	7.2
Percent			0.1	2.6	7.8	7.6	9.9	18.9	11.5	17.3	6.8	14.3	1.7	0.2	0.9	0.1	0.1	0.1	0.1	(1)	(1)	(1)		
8,000–8,999:																								
Number				24	186	546	531	1,030	922	1,216	835	1,255	194	37	108	8	14	13	6	6		5	6,936	5.1
Percent				0.3	2.7	7.9	7.7	14.9	13.3	17.5	12.0	18.1	2.8	0.5	1.6	0.1	0.2	0.2	0.1	0.1		(1)		
9,000–9,999:																								
Number				6	25	251	333	466	504	724	444	575	200	65	83	5	6	6	1	1	1	15	3,711	2.7
Percent				0.2	0.7	6.7	9.0	12.6	13.6	19.5	12.0	15.5	5.4	1.7	2.2	0.1	0.2	0.2	(1)	(1)	(1)	0.4		
10,000–10,999:																								
Number					8	53	250	221	166	313	306	340	164	41	44	9	16	6	4	3	1	24	1,969	1.4
Percent					0.4	2.7	12.7	11.2	8.4	15.9	15.5	17.3	8.3	2.1	2.2	0.5	0.8	0.3	0.2	0.2	0.1	1.2		
11,000–11,999:																								
Number				1	2	10	64	122	73	108	139	205	93	27	42	12	5	6	3		1	6	919	0.7
Percent				0.1	0.2	1.1	7.0	13.3	7.9	11.8	15.1	22.3	10.1	2.9	4.6	1.3	0.5	0.7	0.3		0.1	0.7		
12,000–12,999:																								
Number						5	13	56	59	97	74	98	91	42	29	18	8	1	6				597	0.4
Percent						0.8	2.2	9.4	9.9	16.3	12.4	16.4	15.2	7.0	4.9	3.0	1.3	0.2	1.0					
13,000 and over:																								
Number						1	3	26	82	115	84	214	92	42	76	35	29	38	2	4	4	2	849	0.6
Percent						0.1	0.4	3.1	9.7	13.5	9.9	25.2	10.8	4.9	9.0	4.1	3.4	4.5	0.2	0.5	0.5	0.2		
TOTAL:																								
Number	49,279	26,846	12,767	6,637	5,456	4,560	4,236	6,855	4,431	5,761	3,000	4,732	1,153	294	520	103	103	97	41	21	9	56	136,957	100.0
Percent	36.0	19.6	9.3	4.9	4.0	3.3	3.1	5.0	3.2	4.2	2.2	3.5	0.8	0.2	0.4	0.1	0.1	0.1	(1)	(1)	(1)	(1)		

[1] Less than 0.1 percent.

Table 12.—Table for estimating the distribution of 3-axle, single-unit trucks grouped by recorded empty weights, by groups of probable registered gross vehicle weights

Recorded empty weight of truck (pounds)	Registered gross vehicle weight (pounds)													Total number	Percent of total
	Under 18,000	18,000–19,999	20,000–21,999	22,000–23,999	24,000–25,999	26,000–27,999	28,000–29,999	30,000–31,999	32,000–35,999	36,000–39,999	40,000–44,999	45,000–49,999	50,000 and over		
Under 9,000:															
Number	99	33	34	29	63	42	42	58	51	54	99	9	1	614	8.3
Percent	16.1	5.4	5.5	4.7	10.3	6.8	6.8	9.5	8.3	8.8	16.1	1.5	0.2		
9,000–9,999:															
Number	21	3	11	16	52	17	32	51	93	69	42	2	2	411	5.6
Percent	5.1	0.7	2.7	3.9	12.7	4.1	7.8	12.4	22.6	16.8	10.2	0.5	0.5		
10,000–10,999:															
Number	11	4	6	9	23	41	30	36	145	137	63	4	----------	509	6.9
Percent	2.1	0.8	1.2	1.8	4.5	8.0	5.9	7.1	28.5	26.9	12.4	0.8	----------		
11,000–11,999:															
Number	8	1	5	19	19	20	38	28	70	133	72	7	4	424	5.7
Percent	1.9	0.2	1.2	4.5	4.5	4.7	9.0	6.6	16.5	31.4	17.0	1.6	0.9		
12,000–12,999:															
Number	7	1	2	4	11	12	15	18	63	134	140	101	21	529	7.2
Percent	1.3	0.2	0.4	0.7	2.1	2.3	2.8	3.4	11.9	25.3	26.5	19.1	4.0		
13,000–13,999:															
Number	1	1	2	10	7	11	21	33	74	72	99	104	3	438	6.0
Percent	0.2	0.2	0.5	2.3	1.6	2.5	4.8	7.5	16.9	16.4	22.6	23.8	0.7		
14,000–14,999:															
Number	2	2	2	2	5	9	7	26	40	124	119	153	13	504	6.9
Percent	0.4	0.4	0.4	0.4	1.0	1.8	1.4	5.1	7.9	24.6	23.6	30.4	2.6		
15,000–15,999:															
Number	1	----------	1	3	1	11	7	23	27	50	212	470	12	818	11.1
Percent	0.1	----------	0.1	0.4	0.1	1.3	0.9	2.8	3.3	6.1	25.9	57.5	1.5		
16,000–16,999:															
Number	1	----------	----------	9	6	9	10	15	29	32	144	204	27	486	6.6
Percent	0.2	----------	----------	1.8	1.2	1.8	2.1	3.1	6.0	6.6	29.6	42.0	5.6		
17,000–17,999:															
Number	1	----------	----------	1	3	2	7	5	42	99	173	15	18	366	5.0
Percent	0.3	----------	----------	0.3	0.8	0.5	1.9	1.4	11.5	27.0	47.3	4.1	4.9		
18,000–18,999:															
Number	----------	2	2	1	1	12	3	5	14	111	118	156	14	439	6.0
Percent	----------	0.5	0.5	0.2	0.2	2.7	0.7	1.1	3.2	25.3	26.9	35.5	3.2		
19,000–19,999:															
Number	----------	----------	----------	1	----------	3	1	3	50	47	212	108	43	468	6.4
Percent	----------	----------	----------	0.2	----------	0.6	0.2	0.6	10.7	10.1	45.3	23.1	9.2		
20,000 and over:															
Number	----------	----------	----------	2	2	16	1	21	10	112	164	940	75	1,343	18.3
Percent	----------	----------	----------	0.1	0.1	1.2	0.1	1.6	0.8	8.3	12.2	70.0	5.6		
TOTAL:															
Number	152	47	65	106	193	205	214	322	708	1,174	1,657	2,273	233	7,349	100.0
Percent	2.1	0.6	0.9	1.5	2.6	2.8	2.9	4.4	9.6	16.0	22.5	30.9	3.2		

Table 13.—Table for estimating the distribution of 3-axle, tractor-semitrailer combinations (2-S1) grouped by recorded empty weig by groups of probable registered gross vehicle weights

Recorded empty weight of tractor (pounds)	Registered gross combination weight (pounds)															Total number	Perc of to
	Under 18,000	18,000–19,999	20,000–21,999	22,000–23,999	24,000–25,999	26,000–27,999	28,000–29,999	30,000–31,999	32,000–35,999	36,000–39,999	40,000–44,999	45,000–49,999	50,000–54,000	55,000–59,999	60,000–64,999	65,000 and over	
Under 5,000:																	
Number	.....	30	5	6	18	12	10	17	20	36	60	3	1	.....	1	.....	219
Percent	.....	13.7	2.3	2.7	8.2	5.5	4.6	7.8	9.1	16.4	27.4	1.3	0.5	.....	0.5	.....	3.
5,000–5,999:																	
Number	.....	25	15	39	48	16	33	41	96	69	104	13	11	1	2	.....	513
Percent	.....	4.9	2.9	7.6	9.4	3.1	6.4	8.0	18.7	13.5	20.3	2.5	2.1	0.2	0.4	.....	8.
6,000–6,999:																	
Number	.....	24	14	14	80	34	55	83	361	229	314	25	17	.....	.....	.....	1,250
Percent	.....	1.9	1.1	1.1	6.4	2.7	4.4	6.7	28.9	18.3	25.1	2.0	1.4	.....	.....	.....	19.
7,000–7,999:																	
Number	.....	17	28	19	37	21	31	151	329	310	404	27	31	5	2	.....	1,412
Percent	.....	1.2	2.0	1.3	2.6	1.5	2.2	10.7	23.3	22.0	28.6	1.9	2.2	0.4	0.1	.....	22.
8,000–8,999:																	
Number	2	8	9	9	40	29	36	54	107	183	572	77	68	10	6	1	1,211
Percent	0.2	0.7	0.7	0.7	3.3	2.4	3.0	4.5	8.9	15.1	47.2	6.4	5.6	0.8	0.5	(1)	19.
9,000–9,999:																	
Number	.....	2	6		11	10	11	31	77	92	437	88	134	19	15	.....	937
Percent	.....	0.2	0.6	0.4	1.2	1.1	1.2	3.3	8.2	9.8	46.7	9.4	14.3	2.0	1.6	.....	14.
10,000–10,999:																	
Number	.....	.....	.....	1	4	3	6	8	31	40	173	41	66	14	35	2	424
Percent	.....	.....	.....	0.2	0.9	0.7	1.4	1.9	7.3	9.4	40.8	9.7	15.6	3.3	8.3	0.5	6.
11,000–11,999:																	
Number	.....	.....	.....	1	3	2	4	8	19	22	108	13	40	11	24	2	257
Percent	.....	.....	.....	0.3	1.1	0.8	1.6	3.1	7.4	8.6	42.0	5.1	15.6	4.3	9.3	0.8	4.
12,000 and over:																	
Number	.....	.....	.....	.....	.....	.....	1	1	.....	6	16	14	8	6	19	1	72
Percent	.....	.....	.....	.....	.....	.....	1.4	1.4	.....	8.3	22.2	19.5	11.1	8.3	26.4	1.4	1.
TOTAL:																	
Number	2	106	77	93	241	127	187	394	1,040	987	2,188	301	376	66	104	6	6,295
Percent	(1)	1.6	1.2	1.5	3.8	2.0	3.0	6.3	16.5	15.7	34.8	4.8	6.0	1.0	1.7	0.1	100.

[1] Less than 0.1 percent.

Table 14.—Table for estimating the distribution of 4-axle, tractor-semitrailer combinations (2-S2) grouped by recorded empty weig by groups of probable registered gross vehicle weights

Recorded empty weight of tractor (pounds)	Registered gross combination weight (pounds)													Total number	Perce of tot
	Under 24,000	24,000–25,999	26,000–27,999	28,000–29,999	30,000–31,999	32,000–35,999	36,000–39,999	40,000–44,999	45,000–49,999	50,000–54,999	55,000–59,999	60,000–64,999	65,000–69,999	70,000 and over	
Under 5,000:															
Number	2	1	.....	.....	.....	.....	.....	3	3	2	.....	1	.....	1	13
Percent	15.4	7.7	.....	.....	.....	.....	.....	23.1	23.1	15.3	.....	7.7	.....	7.7	0.
5,000–5,999:															
Number	3	4	7	2	2	1	1	2	8	17	7	2	.....	.....	56
Percent	5.3	7.1	12.5	3.6	3.6	1.8	1.8	3.6	14.2	30.4	12.5	3.6	.....	.....	0.
6,000–6,999:															
Number	8	17	3	2	7	7	23	32	76	64	60	10	.....	.....	309
Percent	2.6	5.5	1.0	0.6	2.3	2.3	7.4	10.4	24.6	20.7	19.4	3.2	.....	.....	3.
7,000–7,999:															
Number	1	3	2	3	10	8	15	43	35	127	91	38	.....	1	377
Percent	0.3	0.8	0.5	0.8	2.7	2.1	3.9	11.4	9.3	33.7	24.1	10.1	.....	0.3	4.
8,000–8,999:															
Number	3	1	4	1	1	9	22	61	58	201	269	117	1	1	839
Percent	0.4	0.1	0.5	0.1	0.1	1.1	2.6	7.3	6.9	34.7	32.1	13.9	0.1	0.1	9.
9,000–9,999:															
Number	4	3	2	1	11	14	30	60	87	573	784	361	13	2	1,945
Percent	0.2	0.2	0.1	0.1	0.5	0.7	1.5	3.0	4.5	29.5	40.3	18.6	0.7	0.1	22.
10,000–10,999:															
Number	5	2	1	2	3	6	5	34	47	439	1,124	515	66	5	2,254
Percent	0.2	0.1	(1)	0.1	0.1	0.3	0.2	1.5	2.1	19.5	49.9	22.9	2.9	0.2	25.
11,000–11,999:															
Number	.....	.....	1	.....	4	2	3	19	10	197	652	274	77	4	1,243
Percent	.....	.....	0.1	.....	0.3	0.2	0.2	1.5	0.8	15.9	52.5	22.0	6.2	0.3	14.
12,000–12,999:															
Number	3	1	2	.....	.....	.....	1	12	19	92	759	260	45	10	1,204
Percent	0.3	0.1	0.2	.....	.....	.....	0.1	1.0	1.6	7.6	63.0	21.6	3.7	0.8	13.
13,000–13,999:															
Number	.....	3	.....	.....	.....	.....	1	13	10	20	231	91	49	3	421
Percent	.....	0.7	.....	.....	.....	.....	0.2	3.1	2.4	4.8	54.9	21.6	11.6	0.7	4.
14,000 and over:															
Number	.....	.....	.....	.....	.....	.....	.....	1	8	21	84	68	10	7	199
Percent	.....	.....	.....	.....	.....	.....	.....	0.5	4.0	10.6	42.2	31.2	5.0	3.5	2.
TOTAL:															
Number	29	35	22	11	38	47	101	280	361	1,843	4,061	1,737	261	34	8,860
Percent	0.3	0.4	0.2	0.1	0.4	0.5	1.1	3.2	4.1	20.8	45.9	19.6	3.0	0.4	100.

[1] Less than 0.1 percent.

Table 15.—Table for estimating the distribution of 5-axle, tractor-semitrailer combinations (3–S2) grouped by recorded empty weights, by groups of probable registered gross vehicle weights

Recorded empty weight of tractor (pounds)	Registered gross combination weight (pounds)							Total number	Percent of total
	Under 50,000	50,000–54,999	55,000–59,999	60,000–64,999	65,000–69,999	70,000–74,999	75,000 and over		
Under 12,000:									
Number	136	48	55	197	129	172	5	742	12.7
Percent	18.3	6.5	7.4	26.5	17.4	23.2	0.7		
12,000–12,999:									
Number	27	57	42	215	316	207	8	872	15.0
Percent	3.1	6.6	4.8	24.7	36.2	23.7	0.9		
13,000–13,999:									
Number	12	20	42	164	183	234	5	660	11.3
Percent	1.8	3.0	6.4	24.8	27.7	35.5	0.8		
14,000–14,999:									
Number	11	16	36	199	145	438	13	858	14.7
Percent	1.3	1.9	4.2	23.2	16.9	51.0	1.5		
15,000–15,999:									
Number	2	7	8	167	154	345	45	728	12.5
Percent	0.3	1.0	1.1	22.9	21.1	47.4	6.2		
16,000–16,999:									
Number	2	2	2	93	211	205	34	549	9.4
Percent	0.4	0.4	0.4	16.9	37.3	38.4	6.2		
17,000–17,999:									
Number	1	----	3	17	37	712	49	819	14.1
Percent	0.1	----	0.4	2.1	4.5	86.9	6.0		
18,000 and over:									
Number	----	1	4	18	41	282	257	603	10.3
Percent	----	0.2	0.7	3.0	6.8	46.7	42.6		
TOTAL:									
Number	191	151	192	1,070	1,216	2,595	416	5,831	100.0
Percent	3.3	2.6	3.3	18.3	20.9	44.5	7.1		

Table 16.—Table for estimating the distribution of 5-axle truck, full-trailer combinations (3–2) grouped by recorded empty weights, by groups of probable registered gross vehicle weights

Recorded empty weight of truck (pounds)	Registered gross combination weight (pounds)						Total number	Percent of total
	Under 60,000	60,000–64,999	65,000–69,999	70,000–74,999	75,000–79,999	80,000 and over		
Under 14,000:								
Number	10	2	3	14	7	----	36	5.0
Percent	27.8	5.6	8.3	38.9	19.4	----		
14,000–14,999:								
Number	----	----	2	21	7	1	31	4.3
Percent	----	----	6.5	67.7	22.6	3.2		
15,000–15,999:								
Number	1	1	5	11	28	1	47	6.6
Percent	2.1	2.1	10.7	23.4	59.6	2.1		
16,000–16,999:								
Number	----	----	5	31	57	5	98	13.7
Percent	----	----	5.1	31.6	58.2	5.1		
17,000–17,999:								
Number	1	----	11	52	52	2	118	16.5
Percent	0.8	----	9.3	44.1	44.1	1.7		
18,000–18,999:								
Number	----	1	11	87	54	5	158	22.1
Percent	----	0.6	7.0	55.0	34.2	3.2		
19,000–19,999:								
Number	----	1	5	75	56	3	140	19.6
Percent	----	0.7	3.6	53.6	40.0	2.1		
20,000–20,999:								
Number	5	----	----	10	40	4	59	8.3
Percent	8.5	----	----	16.9	67.8	6.8		
21,000–21,999:								
Number	----	----	----	2	18	----	20	2.8
Percent	----	----	----	10.0	90.0	----		
22,000 and over:								
Number	----	----	----	8	----	----	8	1.1
Percent	----	----	----	100.0	----	----		
TOTAL:								
Number	17	5	42	317	319	21	715	100.0
Percent	2.4	0.7	5.9	43.5	44.6	2.9		

Table 17.—Table for estimating the distribution of 5-axle, tractor-semitrailer full trailer combinations (2–S1–2) grouped by recorded empty weights, by groups of probable registered gross vehicle weights

Recorded empty weight of tractor (pounds)	Registered gross combination weight (pounds)						Total number	Percent of total
	50,000–54,999	55,000–59,999	60,000–64,999	65,000–69,999	70,000–74,999	75,000–79,999	80,000 and over		
Under 10,000:									
Number	1	----	----	----	----	1	----	2	3.0
Percent	50.0	----	----	----	----	50.0	----		
10,000–10,999:									
Number	----	----	----	1	6	2	----	9	13.2
Percent	----	----	----	11.1	66.7	22.2	----		
11,000–11,999:									
Number	----	----	1	2	6	4	1	14	20.6
Percent	----	----	7.1	14.3	42.9	28.6	7.1		
12,000–12,999:									
Number	----	----	1	1	14	9	2	27	39.7
Percent	----	----	3.7	3.7	51.9	33.3	7.4		
13,000–13,999:									
Number	----	----	----	----	----	7	----	7	10.3
Percent	----	----	----	----	----	100.0	----		
14,000 and over:									
Number	----	----	----	----	2	7	----	9	13.2
Percent	----	----	----	----	22.2	77.8	----		
TOTAL:									
Number	1	----	2	4	28	30	3	68	100.0
Percent	1.5	----	2.9	5.9	41.2	44.1	4.4		

those having light empty weights and heavy gross weights constituted only a small proportion of all vehicles in that class. A large proportion of some vehicles of a given empty weight were concentrated in two or three gross-weight intervals.

Conversion Tables

Tables 11 through 17 give the comparisons of empty weights to gross weights of the combined 1957 and 1961 loadometer data for seven of the most commonly used types of vehicles. Information on all the vehicles for which the weight data collected was usable for this article has been included. The numbers and percentages (horizontally) of the gross weight distribution of these vehicles are given. The numbers of vehicles that had unusual empty to gross weight relationships have been included even though they represent a very small percentage. The 166,000 vehicles that are classified by weights are representative of the national distribution of vehicles and their classification provides a tool for the solution of problems of weight conversions. These data will be useful for making revenue estimates, as well as being a working tool in many areas of market research.

The process of conversion is illustrated as follows. Assume that Table 13 was considered appropriate, in a given situation, for converting 3-axle, tractor-semitrailer (2-S1) combinations registered by empty tractor weights into an array representing their probable distribution by registered gross weight of combination in a State requiring that method of registration. The number of vehicles in each class interval of empty weight should be multiplied by the corresponding horizontal percentages in Table 13, and the numbers so obtained should be added vertically to obtain the distribution by registered gross weights. Conversely, a conversion from registered gross weight of combination to empty weight of tractor can be performed by distributing the number of vehicles in each gross weight class interval proportionate to the corresponding vertical distribution of vehicles by empty weights in Table 13 and then adding the numbers so obtained horizontally.

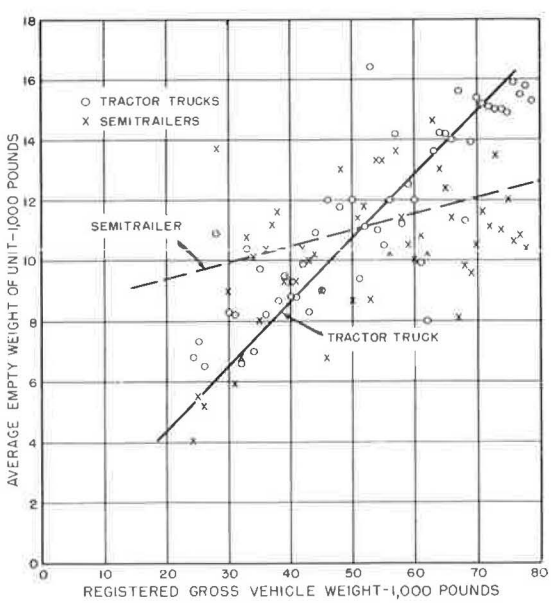

Figure 11. Scattergram of average empty weight of tractor trucks and of semitrailers by registered gross combination weight, and lines of best fit (California data).

Weight Relationship of Trailer and Combination

In Figure 11, a scattergram of the mean average empty weights and the lines of best

Table 18.—Empty weight to gross weight ratios of single-unit trucks and tractor-semitrailers, at selected gross vehicle weights

Vehicle type	Ratio of gross vehicle weight to—	
	Empty weight of power unit only	Empty weight of entire vehicle
Single-unit trucks:		
2-axle		
4,000 pounds GVW	1.2	----------
32,000 pounds GVW	2.7	----------
3-axle		
22,000 pounds GVW	2.2	----------
50,000 pounds GVW	2.8	----------
Vehicle combinations:		
3-axle (2-S1)		
20,000 pounds GVW	3.2	1.3
50,000 pounds GVW	5.5	2.5
4-axle (2-S2)		
30,000 pounds GVW	3.9	1.7
65,000 pounds GVW	5.8	2.8
5-axle (3-S2)		
50,000 pounds GVW	4.0	2.1
75,000 pounds GVW	4.8	2.7

fit reflects the approximate empty to gross weight relationship of tractors and semitrailers shown in the California data. Straight lines were computed for 1- and 2-axle, semitrailers and for the 2- and 3-axle tractor trucks used with them. The scattergram shows a wide range of empty weights of semitrailers in each type of tractor-semitrailer combination and at all gross weight levels. However, regardless of the type of combination, whether 2-S1, 2-S2, or 3-S2, even with substantial increases in gross combination weights, only moderate increases were noted in the semitrailer average empty weight. But for the tractor truck power units a much steeper gradation in empty weight in relation to gross weight is shown.

Empty Weight to Gross Weight Ratios

Employing the power unit relationship used in Figure 10 and the data from the semitrailer line in Figure 11, empty weight to gross weight ratios given in Table 18 indicate

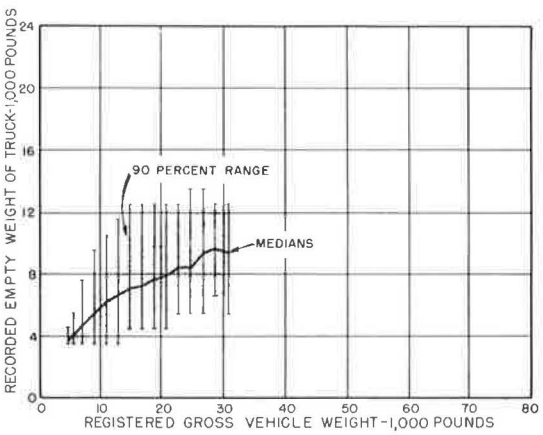

Figure 12. Range of recorded empty weights of 2-axle trucks registered by gross vehicle weights, based on the combined 1957 and 1961 loadometer data.

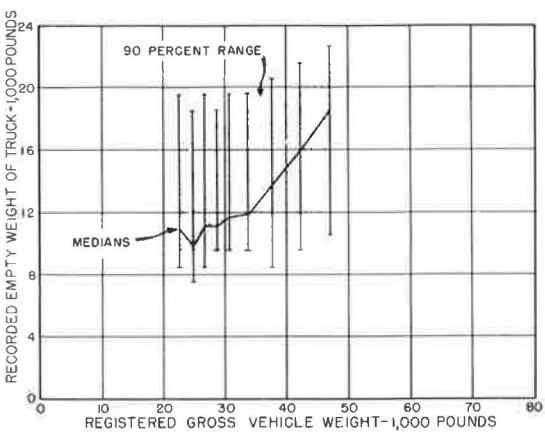

Figure 13. Range of recorded empty weights of 3-axle trucks registered by gross vehicle weights, based on the combined 1957 and 1961 loadometer data.

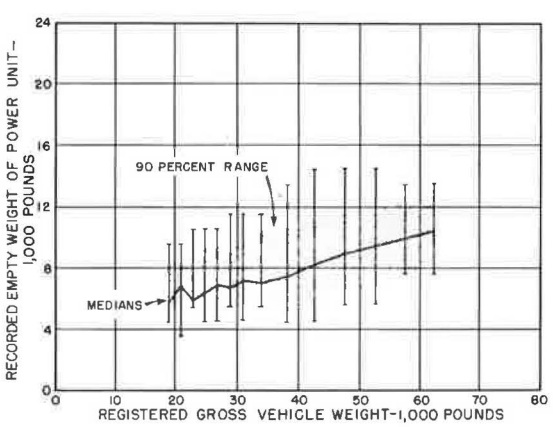

Figure 14. Range of recorded tractor empty weights of 3-axle, tractor-semitrailer combinations (2-S1) registered by gross vehicle weights, based on the combined 1957 and 1961 loadometer data.

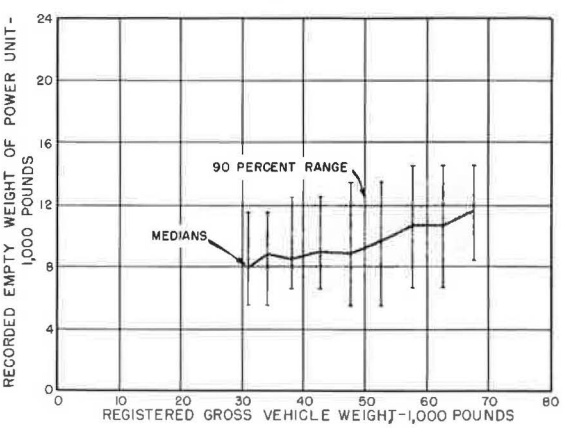

Figure 15. Range of recorded tractor empty weights of 4-axle, tractor-semitrailer combinations (2-S2) registered by gross vehicle weights, based on the combined 1957 and 1961 loadometer data.

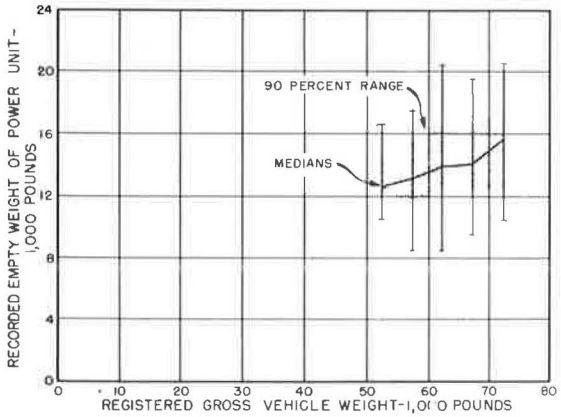

Figure 16. Range of recorded tractor empty weights of 5-axle, tractor-semitrailer combinations (3-S2) registered by gross vehicle weights, based on the combined 1957 and 1961 loadometer data.

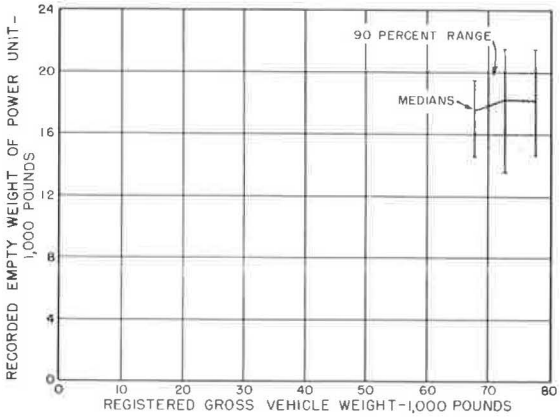

Figure 17. Range of recorded truck empty weights of 5-axle, truck full-trailer combinations (3-2) registered by gross vehicle weights, based on the combined 1957 and 1961 loadometer data.

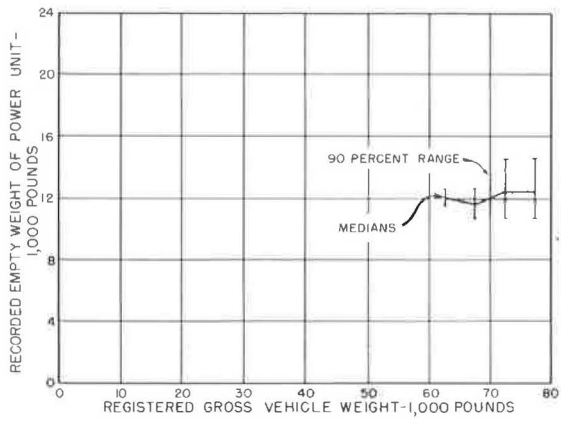

Figure 18. Range of recorded tractor empty weights of 5-axle, tractor-semitrailer full trailer combinations (2-S1-2) registered by gross vehicle weights, based on the combined 1957 and 1961 loadometer data.

that vehicle gross weights ranged from 1.2 times the empty weight at the low-weight interval of the smallest vehicle to a high of 2.8 at the high-weight interval for the larger vehicles. It may be of significance that a vehicle type selected and registered at near the maximum weight of its class is capable of operating with the most favorable empty weight to gross weight ratio. The results for the upper gross weight limit of each vehicle type are similar for all five vehicle types.

Range of Conversion

Figures 12 through 18 show both the wide range of empty weights for each gross weight, and the range that contained approximately 90 percent of the vehicles. Although the 90 percent range eliminates the extremes, the band of weight comparison is still too wide to allow the use of a point of conversion. It would be very difficult, if not impossible, to develop a usable set of weight relationships that would permit a point, or even a narrow band, of weight conversion to be used for any purpose.

CONCLUSIONS

In general, data from the vehicle weight comparison series included in "Classification of Motor Vehicles, 1956-57," the information from the 1957 and 1961 loadometer data, and the California data tend to give strong mutual support. Therefore, the results of the 1957 loadometer study remain generally applicable, and this study is a further refinement of the data. In applying weight comparison factors from any of the data, however, some caution should be exercised to allow for the increasing trend toward use of diesel-powered vehicles and for the anticipated effects of any changes in vehicle size and weight laws.

The 1961 loadometer data and the California data have provided information that permits the addition of another large vehicle combination to the vehicle weight comparison series—the 2-S1-2. This combination was not covered in earlier studies. Additional investigation in this area is warranted, not only to obtain more data on the vehicle weight relationships, but also to keep the findings from these investigations up-to-date. Comprehensive studies of vehicles on a carefully tailored regional basis would provide information even more usable. In the selection of regions for these studies, the State size and weight restrictions, the geographic features, and the predominance of certain types of vehicles favored for their adaptability to commerce or terrain of the region should be considered.

Tables 11 through 17 give a reasonable nationwide picture of the relationship between recorded empty and declared gross weights of different vehicle types. These comparisons demonstrate clearly that it would not be practicable to try to develop a set of weight relationships that would permit a point, or even a narrow band, of weight conversion to be used for any purpose. Conditions in individual States may be such that modifications or adaptations of the data may be required before they can be applied. However, the data provide a useful tool that can serve as a guide, or reference point, for local conversion problems. The local situation would have to dictate any adjustment factors necessary to make the data in these tables applicable to the problems being considered.

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