U.S. Department of Transportation
Federal Highway Administration

Notice

Subject

TRAFFIC MONITORING GUIDE

Classification Code	Date
N 5600.7	September 5, 1985

Par. 1. Purpose
2. Cancellation
3. Scope
4. Comments
5. Action
6. Distribution

1. PURPOSE. To transmit the Federal Highway Administration (FHWA) Traffic Monitoring Guide, which provides the procedures for the collection and analysis of traffic volume data, vehicle classification data, and truck weight data.

2. CANCELLATION. The 1970 Guide for Traffic Volume Counting Manual is cancelled effective immediately and the 1971 Guide for Truck Weight Study Manual is cancelled effective December 31, 1985.

3. SCOPE. The provisions of the subject Guide are applicable to all FHWA offices.

4. COMMENTS

a. This Guide is an advisory document, i.e., it is intended to be a statement of good practice for the FHWA management of data collection and analysis of traffic volume data, vehicle classification data, and truck weight data. It is not to be considered a Federal Standard.

b. Data collection agencies are encouraged to consider the methods presented here in their administration of a data collection program and to compare the cost-effectiveness of this methodology to procedures they presently use.

5. ACTION. Effective January 1, 1986, data gathered in support of the FHWA Truck Weight Study should be formatted in accordance with the Traffic Monitoring Guide.

DISTRIBUTION: Headquarters
Special: Regions
Divisions

OPI: HHP-44

6. DISTRIBUTION. Sufficient copies of the Guide are being distributed to provide a minimum of five copies for each regional office and two copies for each division office and seven copies for each State highway agency. Direct distribution is being made to the division offices. A limited supply of additional copies are available from the Office of Highway Planning, Highway Statistics Division and may be obtained by memorandum through the regional offices.

Kevin E Heanue

Kevin E. Heanue
Director, Office of Highway Planning

TRAFFIC MONITORING GUIDE

Procedures for the collection and analysis of

- **Traffic volume data**
- **Vehicle classification data**
- **Truck weight data**

U.S. Department
of Transportation

Federal Highway Administration

**Office of Highway Planning
Highway Statistics Division**

TRAFFIC MONITORING GUIDE

June 1985

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
OFFICE OF HIGHWAY PLANNING

TRAFFIC MONITORING GUIDE

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SECTION 1

Introduction

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CHAPTER 1

Overview of this Guide

The following discussion provides a synopsis of the material covered in the following sections.

In Section 2 of this Guide, the reader will find a discussion of the structure of traffic characteristics monitoring; how traffic counting, vehicle classification, and truck weighing relate to the overall monitoring effort; and how this effort is structured through the sample design.

In Section 3, traffic counting is discussed. This chapter focuses on the development of the statistical scheme. The sample is critical to both the reliability of information on traffic volumes and to the later development of samples for vehicle classification and vehicle weighing.

Section 4 covers vehicle classification. This section includes aspects of sample development pertinent to obtaining vehicle classification information along with a description of the FHWA vehicle categories.

Section 5 covers truck weighing and contains information on collection and summarizing data obtained at truck weigh sites. Also included are discussions of the various types of eauipment available for weighing vehicles and the specification of the traffic characteristics sample design for obtaining truck weight information.

This Guide is intended to be a statement of good practice. It is not to be considered a Federal standard. Data collection agencies are encouraged to consider the methods presented here in their administration of a data collection program and to compare the cost-effectiveness of this methodology to procedures they presently use.

CHAPTER 3

Data Uses

This Guide provides direction on the monitoring of traffic characteristics. Traffic characteristics are those data obtained through a coordinated program of traffic counting, vehicle classification, and truck weighing. This Guide provides direction for persons interested in conducting a statistically based monitoring of traffic characteristics. Information on traffic characteristics is used in all phases of highway transportation. Exhibit 1-3-1 shows examples of how the traffic characteristic data derived from traffic counting, vehicle classification, and truck weighing can be applied in highway engineering, economic studies, finance, legislation, planning, research, safety, statistics, and by the private sector. Exhibit 1-3-1 is not intended as a comprehensive listing of data uses but rather to portray the extensive utility of the data.

Exhibit 1-3-1
Examples of Studies Making Use of Traffic Characteristic Data

Highway Management Phase	Traffic Counting	Vehicle Classification	Truck Weighing
Engineering	Highway Geometry	Pavement Design	Structural Design
Engineering Economy	Benefit of Highway Improvements	Cost of Vehicle Operation	Benefit of Truck Climbing Lane
Finance	Estimates of Road Revenue	Highway Cost Allocation	Weight Distance Taxes
Legislation	Selection of State Highway Routes	Speed Limits	Permit Policy for Oversize Vehicles
Planning	Location and Design Of Highway Systems	Forecasts of Travel by Vehicle Type	Resurfacing Forecasts
Research	Methods of Improving Highway Usage Efficiency	Traffic Simulation	Pavement and Structural Design
Safety	Design of Traffic Control Systems	Safety Conflicts Due to Vehicle Mix	Posting of Bridges for Load Limits
Statistics	Average Daily Traffic	Travel by Vehicle Type	Ton-miles of Travel
Private Sector	Location of Service Areas	Marketing Keyed to Particular Vehicle Types	Trends in Freight Movement

SECTION 2

An Integrated Sample Design for Traffic Monitoring

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References

1. Peat, Marwick, Mitchell & Company, "Development of a Statewide Traffic Counting Program Based on the Highway Performance Monitoring System," Contract #DTFH61-82-6-0009, March 1984.

2. Federal Highway Administration, "Highway Performance Monitoring System - Field Manual for the Continuing Analytical and Statistical Data Base," U.S. DOT, January 1984 and earlier versions.

3. Federal Highway Administration, "Highway Performance Monitoring System - Vehicle Classification Case Study", U.S. DOT, August 1982.

4. Federal Highway Administration, "Highway Performance Monitoring System - Truck Weight Case Study", U.S. DOT, June 1982.

5. Cochran, William G., "Sampling Technioues," Third Edition, New York, Wiley, 1977.

CHAPTER 1

Introduction

This chapter outlines procedures for the development of a statistical sampling program for the estimation of traffic volume, annual vehicle miles of travel (AVMT), annual average daily traffic (AADT), vehicle classification, and truck weight with known levels of reliability. The procedures emphasize the use of statistical sampling tied to the Highway Performance Monitoring System (HPMS) sample and the complete integration of the estimation and data collection processes at every level to produce reliable, directly-linked estimates which minimize data collection and eliminate duplication. The proposed program does not ignore the reality of practical considerations and the procedures allow flexibility beyond the theoretical constraints. The integration of the sampling program favors the development of the samples in a sequential or top-down format, i.e., volume samples are taken from the existing HPMS sample, vehicle classification samples are taken from the volume samples, and truck weight samples are taken from the classification samples.

The philosophical approach to the program development follows the system analysis concepts of holism and parsimony.

> Holism is a system analysis term expressing the idea that the whole is much more than the sum of the parts, that is, program integration is far superior to program separation. However, it also implies that deficiencies in any part of the system will affect the whole system.
>
> Parsimony in a systems sense is defined as the belief that the simplest, most economical, valid solution is the best. Complex solutions, difficult to comprehend and apply, fall apart during implementation. The reduction in complexity resulting from a simple solution is many times worth the relatively small losses of efficiency or information.

The emphasis on the use of statistical sampling results in estimates with known reliability levels, which are directly estimable from the data. By using the HPMS sample, which is already available and well understood, the need to redesign and implement a new sampling design is eliminated. Furthermore, the tie-in to the HPMS results in directly coordinated programs to address State as well as Federal information needs while eliminating the redundancy of separate programs.

One of the major disadvantages of a sampling program is the fact that sampling produces estimates for an aggregation of elements rather than estimates for specific elements. In context, this translates to the production of system estimates rather than of specific points in the system. Therefore, sampling leaves a gap which must be addressed in a separate manner. This aspect is discussed in Section 3. The use of sampling, on the other hand, allows very precise estimates of the reliability of estimates and of the relationship between reliability and number of samples or cost of the program.

Decisionmakers are then able to judge the cost of programs versus the reliability of the estimates provided. Since the relationship between reliability and sample size is exponential, the implications of very precise estimates can be directly translated to the costs of the needed programs. In cases where existing programs are pseudo-randomized (approximate or assume randomness) it becomes possible to approximate the reliability of estimates derived from those programs.

The development of a sampling program has clearly defined steps:

1. Definition of desired objectives.
2. Establishment of cost limits or precision requirements.
3. Definition of the universe to be sampled.
4. Definition of sampling element.
5. Determination of reporting stratification desired.
6. Estimation of sampling element variability.
7. Development of sample design.
8. Implementation of sample design.
9. Development of estimation procedures.

However, this task can, in reality, be enormously complex. The definition of desired objectives is usually difficult. Sample size estimation procedures are only applicable to a single data item, while most data collection programs must address a wide variety of needs and purposes. The need to provide estimates for subsets of the data (reporting strata) create constraints which may greatly reduce the overall efficiency of the sample. Sampling element definition can be subject to numerous constraints and require great skill. Finally, as previously mentioned, sampling is concerned with the whole rather than the parts. The development of a real-life probability sample design is an art as much as a science. Even though great efforts are expended to maintain the theoretical constraints, the point is usually reached where practical considerations outweigh theory.

The structure of the traffic monitoring sample design proposed in this Guide consists of three major elements as shown below:

Traffic Monitoring Sample Design

1. Continuous (ATR) element

2. HPMS (coverage) element

    a. HPMS sample subelement
    b. Traffic volume subelement
    c. Vehicle classification subelement
    d. Truck weight subelement

3. Special Needs Element

Each of these areas are discussed in detail in the following sections.

CHAPTER 2

The Highway Performance Monitoring System (HPMS)

A basic understanding of the HPMS sampling base must precede a generalized discussion of the procedures in this Guide. The HPMS universe consists of all public highways or roads within a State with the exception of roads functionally classified as local. The reporting strata for the HPMS include type of area (rural, small urban, and individual or collective urbanized areas) and functional class (in rural areas these are Interstate, Other Principal Arterial, Minor Arterial, Major Collector, and Minor Collector. In urban areas these are Interstate, Other Freeway or Expressway, Other Principal Arterial, Minor Arterial, and Collector). A third level of stratification based on volume was added as a statistical device to reduce sample size and insure the inclusion of higher volume sections in the sample. For a complete definition of the stratification levels refer to Appendix F of the HPMS Field Manual, January 1984 or later versions.

The HPMS sample design is a stratified simple random sample (for statistical definitions, refer to any of the sampling texts listed as references). The HPMS sample size estimation process was tied to AADT, although near 100 data items are collected. The decision for using AADT was partly based on the fact that AADT is perhaps the most variable data item in the HPMS. Therefore, the reliability of most other characteristics would be expected to exceed that of AADT.

The spatial sampling element in the HPMS could have been defined as a point or a section of road. The use of a point approach would have resulted in more samples (there are an infinite number of points in the universe, but a finite number of sections), and would have required a definition of what constitutes a point, which in the end would have required a conversion to short sections. The use of sections or links acts to reduce sample size, to increase the precision of estimates, and to allow the use of existing State highway inventories. Traditionally, roads have been thought of in terms of sections and the use of this concept as the sampling element allows a simple translation to road construction and traffic engineering terminology. However, the use of road sections introduces additional constraints which include the assumption that traffic volume and other characteristics or data elements remain constant within the defined section. The fact that some characteristics other than volume may not meet the assumption outright, and that other characteristics may change drastically over time within the section, requires the subdivision of sample sections.

The HPMS sampling element was defined on the basis of road sections which include both directions of travel and all travel lanes within the section. Direction of travel further complicates the definition because characteristics can change drastically depending on the direction of travel. The same problems exist in the case of multilane facilities where characteristics change by lane of travel. In the interest of simplicity, direction of travel and travel lane were excluded from the sample design with the consequential loss of information.

The AADT variability was estimated based on data from the 1976 National Highway Inventory and Performance Study (NHIPS). The sample was selected as a simple random sample within strata according to predetermined levels of precision presented in the HPMS Field Manual. The HPMS expansion factors are computed as the ratio of universe mileage to sample mileage within strata, thereby insuring that mileage estimates at design stratification categories match the reported universe mileage. This method of expansion deviates from standard theory and may introduce bias if the length of sample sections within strata differs greatly. The estimation procedures for the HPMS are mostly ratio estimation based on length of section which result in higher reliability estimates and reduce bias.

The HPMS sample has now been implemented in every State, the District of Columbia, and Puerto Rico; and it provides a statistically valid, reliable, and consistent data base for analysis within States, between States, and for any aggregation of States up to the national level. For information purposes, Exhibit 2-2-1 presents the 1982 HPMS sample sizes by State and type of area.

Since the HPMS sample provides the basic framework for the traffic monitoring sample, it would be very appropriate for a State to reanalyze its HPMS sample prior to developing the traffic monitoring samples to insure an adequate, up-to-date base. Procedures to reevaluate the HPMS sample are provided in Appendix G of the HPMS Field Manual.

Exhibit 2-2-1
NUMBER OF SAMPLE SECTIONS
1982 HPMS DATA

STATE	SAMPLE SIZE — TYPE OF AREA: RURAL	SMALL URBAN	URBANIZED	STATEWIDE
ALABAMA	806	549	713	2,068
ALASKA	268	78	83	429
ARIZONA	616	322	374	1,312
ARKANSAS	553	472	554	1,579
CALIFORNIA	884	455	1,191	2,530
COLORADO	946	423	1,020	2,389
CONNECTICUT	393	185	983	1,561
DELAWARE	158	57	149	364
DISTRICT OF COLUMBIA	0	0	219	219
FLORIDA	820	322	1,352	2,494
GEORGIA	873	426	637	1,936
HAWAII	277	161	323	761
IDAHO	988	268	208	1,464
ILLINOIS	550	534	1,860	2,944
INDIANA	677	467	1,229	2,373
IOWA	1,115	865	700	2,680
KANSAS	875	544	596	2,015
KENTUCKY	976	654	638	2,268
LOUISIANA	612	294	411	1,317
MAINE	852	343	640	1,835
MARYLAND	520	356	616	1,492
MASSACHUSETTS	538	182	1,431	2,151
MICHIGAN	933	469	1,492	2,894
MINNESOTA	816	540	817	2,173
MISSISSIPPI	746	493	296	1,535
MISSOURI	642	280	316	1,238
MONTANA	755	350	235	1,340
NEBRASKA	701	449	332	1,482
NEVADA	488	120	457	1,065
NEW HAMPSHIRE	514	146	267	927
NEW JERSEY	380	134	937	1,451
NEW MEXICO	561	303	240	1,104
NEW YORK	778	563	1,383	2,724
NORTH CAROLINA	690	575	1,024	2,289
NORTH DAKOTA	568	192	203	963
OHIO	948	695	1,349	2,992
OKLAHOMA	834	485	448	1,767
OREGON	832	480	596	1,908
PENNSYLVANIA	1,026	672	2,058	3,756
RHODE ISLAND	326	63	326	715

Exhibit 2-2-1 (Cont.)
NUMBER OF SAMPLE SECTIONS
1982 HPMS DATA-Continued

STATE	SAMPLE SIZE			
	TYPE OF AREA			
	RURAL	SMALL URBAN	URBANIZED	STATEWIDE
SOUTH CAROLINA......	612	352	318	1,282
SOUTH DAKOTA........	656	278	199	1,133
TENNESSEE...........	665	518	700	1,883
TEXAS...............	861	512	1,693	3,066
UTAH................	615	209	385	1,209
VERMONT.............	474	219	81	774
VIRGINIA............	715	300	953	1,968
WASHINGTON..........	861	385	1,465	2,711
WEST VIRGINIA.......	640	324	703	1,667
WISCONSIN...........	864	405	1,624	2,893
WYOMING.............	572	360	225	1,157
PUERTO RICO.........	403	277	336	1,016
Total...............	34,773	19,105	37,385	91,263

CHAPTER 3

Development of a Volume Estimation Sample Based on the HPMS

A statistically valid sample design could be developed independently of the HPMS, but the availability of the clearly defined and implemented HPMS sample design results in an enormous reduction of effort. This fact, combined with the gigantic analysis capability offered by the direct linkage of traffic estimates to the data items collected by the HPMS, makes it unrealistic to consider an alternative design.

The conversion, staging, or incorporation of the volume sample into the HPMS framework presents several difficulties. Temporal variation and equipment error were ignored in the HPMS design by examining only sampling error using AADT figures which were assumed to be exact numbers. If the assumption is correct, no adjustments are needed. However, this assumption must now be compared to the reality of the situation. AADT numbers are based on factored short counts subject to error, be it due to equipment or to estimation procedures. These errors must be considered in an overall reliability assessment which goes beyond sampling error.

Traffic volume estimation can be subdivided into two basic categories: annual vehicle miles of travel (AVMT) estimation, and annual average daily traffic (AADT) estimation. AVMT estimation presents a much simpler approach than AADT estimation because AVMT is basically a system measure while AADT is a point-specific measure.

Annual Vehicle Miles Traveled Estimation Based on the HPMS

The existing AVMT estimation procedure used to expand the HPMS sample involves multiplying each section's AADT, section length, and expansion factor and summing the product for all sample sections of interest to yield any desired aggregation level. Estimation of sampling reliability based on this procedure ignores the fact that the AADT values reported are not exact, and this may introduce significant error. The problem can be eliminated by using exact measurements (assuming no equipment bias or compensating for equipment bias) rather than AADT figures and introducing a temporal sampling component.

Given that the spatial sample is already defined by the HPMS, only the temporal aspects remain to be incorporated into the plan. Many possible definitions of the universe and sample elements can be considered to address temporal variation. The recommended definition is that of link-days, which combine the spatial (HPMS section or link) and temporal components.

Within each HPMS stratum, the number of link-days equals the number of sections in the universe times 365. For 48-hour periods, the universe of link-days equals the number of sections times 365 divided by 2. Definitions for other time periods would be similarly derived. The variability of link-day volume can be roughly estimated and sample size specifications derived. Theoretically, the resulting sample would require a fairly complex randomized schedule which may result in multiple counts for a section.

A simpler procedure is to arbitrarily assume that daily (24-hour) VMT is the characteristic of interest and to distribute the measurement of sections systematically throughout the year (equivalent to a systematic sample). This procedure would result in a single volume measurement for each section during the year, and the measurements would be equally distributed throughout the months or seasons of the year. The daily estimates resulting from this approach would be multiplied by 365 to convert to AVMT. Available data indicate that application of this process to the full Interstate HPMS sample would result in AVMT estimates of approximately ± 2 percent precision with 95 percent confidence for Interstate statewide estimates. The same process taking one-third of the HPMS sample for the remaining functional classes (excluding Interstate) would result in statewide AVMT estimates with an approximate ± 5 percent precision with 95 percent confidence. The actual reliability achieved by each State could be directly estimated after the program has been in operation a full year, and a new assessment of sample vs. precision made using the latest data. The proposed program would cover the full HPMS sample every three years through a rotating schedule.

Traditionally, traffic volume counts under the coverage program have been tied to short periods of time with 24 hours being the predominant period. The usage of a 24-hour period in the previous discussion was arbitrary. Longer periods (say 48 hours) can provide more accurate information but tie-up equipment twice as long and double the data collection. As will be discussed later, AADT requirements may necessitate the use of a 48-hour period of monitoring, but the point that 24-hour periods would be sufficient for AVMT estimation is clearly made. This Guide emphasizes the need to discuss alternatives and to provide minimum guidelines. States wishing to expand on the minimum procedures are encouraged to do so and the procedures can be easily modified to incorporate changes.

The procedures for AVMT estimation discussed in detail in Section 3 will recommend the development of an AADT estimate for each HPMS sample section. This section AADT estimate will consist of a short volume count (48 hours) adjusted as needed for seasonality, axle correction, day-of-week or growth. The summation of the section AADT estimates multiplied by the section lengths and the HPMS expansion factors will then provide the total AVMT estimate.

A basic assumption made in the development of these procedures is that automatic equipment can collect accurate 48-hour volumes. Equipment error introduces bias which is not affected by sample size. For example, if counters undercount by 10 percent, then system estimates will be 10 percent low whether 300 or 3,000 sections are sampled. Since we assume that equipment bias is normally distributed with a zero mean, then no adjustment is required. If on the other hand, the equipment consistently undercounts or overcounts, then an adjustment should be made. The magnitude of this adjustment could be estimated based on an experimental comparison between the equipment counters and manual counts or between different types of equipment.

Annual Average Daily Traffic (AADT) Estimation Based on the HPMS

The estimation of AADT based on short counts presents a very complex problem. Statistical approaches are designed to estimate system rather than section characteristics, yet AADT estimates may be desired for each individual section. The only statistical way to estimate AADT for each section is to actually take measurements on every section of road. While this would be an expensive process, States may desire this type of program for their day-to-day management and administrative responsibility for these roads.

Present procedures for estimation of AADT are based on the application of the appropriate adjustment factors to the actual short term counts. The temporal or seasonal factors are usually estimated based on small samples of continuous traffic recorders (ATR's). Day-of-week and axle correction factors should also be incorporated into this process as needed, although at the present time, they are ignored by many States. The existing procedures for allocating short counts to seasonal factor groups are vague and largely based on engineering judgment.

The central problem with the existing factorization procedure is that it ignores random day-to-day variability which in many cases is larger than the combined factors applied to the short count. The following example illustrates the situation:

Example 2-3-1

Let's assume that a 24-hour count was taken on Monday and a volume of 2,000 axles recorded. The AADT would be estimated by multiplying the count by a seasonal factor (say 1.06), a day-of-week factor (say 1.1), and an axle correction factor (say 0.45). This would result in an AADT estimate of 1,050. Now let's assume that a 24-hour count was taken on Tuesday and a volume of 2,400 axles recorded. By the same procedure, 2400 times a seasonal factor (1.06), a day-of-week factor (1.08), and an axle correction factor (0.45) results in an AADT estimate of 1,237. The difference of 20 percent in the initial volume measurements remains basically unchanged by the factors.

This example explains the reason why a statistical approach to estimate AADT requires several measurements at the specific point of interest. The factors account only for what they are intended to measure, i.e., seasonal, day-of-week, and axle correction variability; but they do not address random variation in volume at the specific points. Analysis of ATR data have shown the coefficient of variation of daily volume to be in the 10 to 15 percent range. This translates to a variation of $\pm$ 20 to 30 percent within the 95 percent confidence band. With this knowledge, daily variations of 20 percent would be expected to be the rule rather than the exception.

One method of addressing the problem of random variation is to take several measurements at each point and take an average. After all, AADT stands for annual average daily traffic. However, such a procedure would be very costly. Many alternatives can be considered to account for or reduce random variation, such as measuring over longer periods such as 48 hours, 72 hours, 7 days, or taking several randomly selected 24-hour period counts each season or month. The cost implications of these alternatives must be explored as well as the need for the higher accuracy achieved.

The proposed FHWA guidelines for the development of a traffic volume estimation program consist of three major parts or elements:

1. Continuous (ATR) element
2. HPMS (coverage) element and
3. Special Needs element.

The procedures proposed in this Guide revolve around using the previous volume monitoring counts needed for VMT estimation to provide a minimum, basic systemwide AADT coverage framework which could be expanded and supplemented by the individual States depending on their philosophical approach or needs. The VMT sample based on the HPMS provides a basic framework, randomly selected, consistent, and well distributed throughout the State. In some cases, one year's data would be sufficient to develop a rough, annual flow map. For others, 2 or 3 years may be needed. For some States, particularly heavily populated urbanized States, significantly more counting may be required which can be handled as part of the Special Needs element, justified and supported by the specific State needs. The Special Needs element is an integral part of the program.

The continuous (ATR) element (Chapter 2 of Section 3) discusses the procedures for establishing statistical (pseudo-randomized) interpretations of the reliability of seasonal factorization and groupings. The term pseudo-randomized means that randomization is assumed although the ATR locations were not randomly selected. Based on these procedures, the number of ATRs needed to achieve desired reliability levels will be determined and fixed. Seasonal factors and estimation of precision levels require a reassessment of the ATR programs. The result is a clear evaluation of the number of seasonal groups needed by a State, of the composition of those groups, and of the number of locations needed to achieve desired levels of precision within these groups.

The HPMS element provides a minimum coverage framework of Statewide short counts for AVMT and AADT estimation. The guidelines on the HPMS (coverage) element recommend the use of 48-hour counts on the full sample of HPMS sections over a 3-year cycle. This proposal reduces the effect of the random variation, although it does not eliminate the problem. The procedures streamline the development of factors to compensate for seasonal (monthly) variation, day-of-week variation, axle correction, and growth factors.

Day-of-week factors will compensate for day-of-week travel differences identifiable from data collected by the continuous counters. Axle correction factors are used to compensate for equipment counting axles rather than vehicles, i.e., to account for vehicles with more than two axles. The direct tie-in to the vehicle classification element in Section 4 will provide estimates for axle correction. Growth factors are used to convert the 3-year cycle counts to annual estimates, i.e., sections not counted during the year are estimated by multiplying earlier counts by growth factors. All of these procedures will be discussed in detail in Section 3.

It is recognized that the proposed HPMS element of the traffic monitoring program cannot possibly address all data needs. The Special Needs element allows each State to devise traffic procedures or strategies to supplement the recommended framework to compensate for special requirements.

In addition to special data needs of the States, the administration of the I4R program by FHWA requires augmenting the basic travel data collection cycle for the Interstate System. Supplementing the three-year cycle of reporting of the Interstate System sample sections, the non-sampled portion of the Interstate universe is to have travel monitored by field observations on a cycle not exceeding six years. This special monitoring activity is described further in Appendix K of the HPMS Field Manual.

CHAPTER 4

Vehicle Classification Based on the HPMS Volume Sample

The proposed vehicle classification sample is selected as a subset of the volume estimation sample using simple random selection procedures within the defined strata. This approach eliminates duplication and directly ties the volume and vehicle classification estimation procedures. Duplication is eliminated because classification equipment also collects total volume. Therefore, the sections in the classification subsample are excluded from counting in the HPMS volume element. Direct linking of classification and volume eliminates the need for axle correction factors at the sampled section, and provides a direct procedure for the development of axle correction factors for the remaining sections in the volume sample. The standard vehicle classification categories are provided in Section 4. The estimation procedures will combine the classification estimates from the classification sample with the AVMT or AADT estimates from the volume sample to produce system AVMT or AADT estimates by classification categories. The HPMS sample and the volume sample are stratified by type of area, functional class, and volume group. The full HPMS stratification approach is inefficient for vehicle classification. It would result in an unnecessarily large sample because a positive number of samples would be needed in each strata. Also, most of the HPMS sample is concentrated in lower volume sections while the interest and priority of higher volume sections is paramount. Therefore, a procedure that insures an adequate presence or distribution of high volume sections in the classification sample was developed.

The proposed stratification for vehicle classification consists of type of area (rural and urban) and functional class (HPMS categories). As an option, States willing to apply larger samples than this Guide recommends may wish to apply the full HPMS area stratification (rural, small urban, and individual urbanized areas). The vehicle classification sample would be allocated to HPMS strata proportional to AVMT or DVMT. For example, if the rural Interstate system of a State carries 30 percent of the AVMT, then 30 percent of the classification sample will be allocated to that system. Other possible candidates for the sample distribution were examined including road mileage, truck AVMT, or truck volume. Total AVMT or DVMT provides the best result since it accounts for both mileage and travel, and can be easily estimated from the HPMS sample data. Truck AVMT was discarded because of its close relationship to total AVMT, and the present lack of reliable truck AVMT estimates for the desired stratification levels.

The estimation of vehicle classification variability needed to determine sample size versus precision is quite poor due to the present lack of data. A FHWA-sponsored research study (Reference 1) analyzed the available data and proposed procedures for estimating the required sample sizes in each stratum. The following stratification groups were defined:

1. Rural Interstate
2. Rural Other Principal Arterial
3. Rural Minor Arterial
4. Rural Collector
5. Urban Interstate
6. Urban Other Freeways and Expressways
7. Urban Other Principal Arterial
8. Urban Minor Arterial
9. Urban Collector

These categories represent reporting strata. When following a direct sampling approach, each category reouires basically the same number of samples, and total sample size is approximated as the number of samples in a stratum times the number of strata. It is ouite easy to see that sample size is directly proportional to the number of strata. Therefore, the best way to minimize the sample is to reduce the number of reporting strata or not to specify target precision levels for reporting strata.

The recommended sample selection procedures (proportional to AVMT) will insure that some sample sections fall in every strata, but the subdomain reporting precision reouirements will not be maintained. The procedures used to estimate sample size are based on standard statistical theory. Estimates of variability from the HPMS Vehicle Classification Case Study are used. Exhibit 2-4-1 presents an example (using Interstate Rural data) of the relationship between sample size and precision at the 95 percent confidence level. The graph shows that an accurate estimate of the percentage of standard automobiles in the system reouires a small number of sites. However, the percentage of vehicles in truck categories reouire much larger samples.

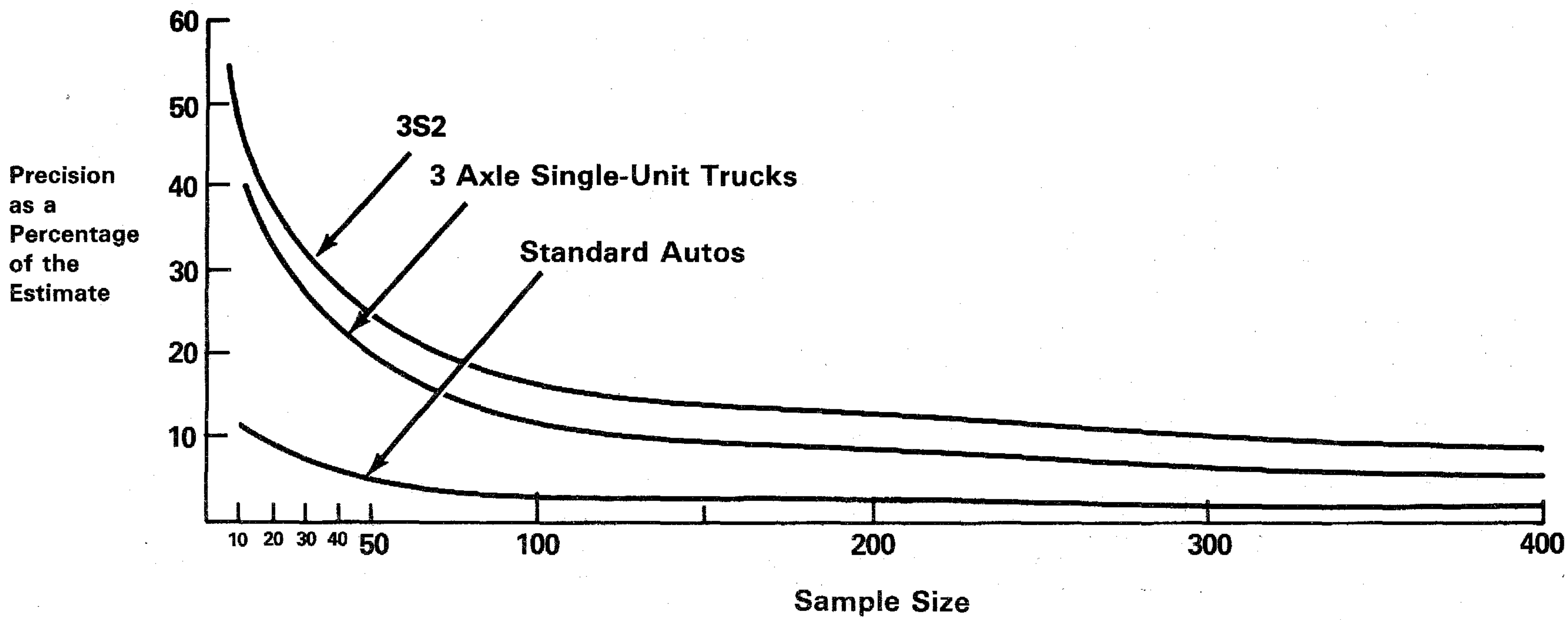
The eouation used to estimate the sample size needed to achieve a specified reliability (precision) for a sample random sample is:

$$n = \frac{(Z_{d/2})^2 C^2}{D^2} \qquad 2\text{-}4\text{-}1$$

where

	n	=	sample size,
	$Z_{d/2}$	=	value of the two-sided normal distribution for d level of significance (value eouals 1.96 for 95% confidence),
	C	=	coefficient of variation, and
	D	=	desired accuracy as a percentage of the estimate.

Exhibit 2-4-1
Rural Interstate Sample Size vs. Precision (Vehicle Classification Percentages at the 95% Confidence Level)



The coefficients of variation estimates used in Exhibit 2-4-1 were taken from page A.2, Reference 1 and are shown below.

VEHICLE CATEGORY	VEHICLE PERCENTAGE	STANDARD DEVIATION (% OF ESTIMATE)	COEFFICIENT OF VARIATION (%)
Standard Auto	41.5	7.4	18%
3-Axle Single	.6	.4	67%
3S2	14.8	12.6	85%

These data present generalized information and will not be applicable to each State. States that have vehicle classification data bases available are encouraged to develop their own specific estimates.

The following table examines the precision vs. sample size relationships:

VEHICLE CATEGORY	SAMPLE SIZE	PRECISION ACHIEVED WITH 95% CONFIDENCE
Standard Auto	10	11
	20	8
	30	6
	100	4
	300	2
3-Axle Single	10	42
	20	29
	30	24
	100	13
	300	8
3S2	10	53
	20	37
	30	30
	100	17
	300	10

Several interpretations can be made based on this table. First, statistical precision is tied only to the variability of the characteristic under consideration. Basically, 10 samples would be expected to approximate a 10 percent of the estimate precision for standard autos, but 53 percent for 3S2's.

Second, in the table precision is presented as a percentage of the estimate. For example, the percentage of 3S2 vehicles in the Rural Interstate is 14.9 and the 95 percent confidence precision is 14.9 ± 1.5 or between 13.4 and 16.4 of the traffic stream. Third, the analysis examines only the Rural Interstate, which means that to achieve the 3S2 target precision would necessitate 300 measurements.

As was mentioned, the estimates of variability based on the generalized data can be expected to differ considerably from State to State. Small States with less variability may achieve the target precision with a much smaller sample. On the other hand, States with large roadway networks, heavy industry, or trucking concentrations may show more variability. To reduce the overall burden and because precise truck information is not needed on an annual basis, the sample has been spread out over a 3-year cycle.

Based on the analysis conducted, we estimate that 300 measurements taken over a 3-year cycle and distributed by functional class would result in statewide estimates of the percentage of 3S2's in the traffic stream with an approximate reliability of + or - 10 percent of the estimate with 95 percent confidence. Estimates for each of the vehicle classification categories will be possible, but estimates for rare vehicle categories (i.e., six-axle multitrailer trucks) will be much less reliable. Actual reliability estimates can be computed for any desired vehicle class category after the sample is in place. Adjustments (increases or decreases) to the sample to meet desired reliability levels can then be made based on a valid sample design and using the latest available data.

As a result of the foregoing discussion, this Guide recommends a minimum of 300 vehicle classification measurements over a 3-year cycle. This represents 100 measurements each year. Under the recommended program, the reliability of system percentages of 3S2 vehicles would be expected to approximate a precision of 95-17 on an annual basis and 95-10 after a 3-year cycle. A halving of the recommended program to 150 measurements would result in an annual target precision (3S2 percentages) of 95-24 and 3-year cycle precision of 95-14. Since the sample is subdivided by functional class VMT, functional class estimates would deteriorate enormously. Under the recommended program and assuming 20 percent VMT, the Interstate sample size would be 60 measurements resulting in target precisions of 95-20 for the 3-year cycle and 95-38 annually. The one-half reduction would result in target precisions of 95-30 for the 3-year cycle and 95-53 annually. The inferences that could be made from the core program for site specific concerns would be significantly reduced by the sparser sample. The linking of truck weight, vehicle classification, and volume estimates would be significantly affected since the magnitude of collective error would be larger. The size of the Special Needs part of the program may necessitate substantial increases.

In summary, the graph in Exhibit 2-4-1 presents a deceptively simple picture. Traffic monitoring is a very complex issue which requires adequate consideration of many interrelated concerns. Decisions on the appropriate level of effort vs. cost should not be based on simplistic assessments. The value of incorrect decisions made on the basis of incorrect information and the need for or planned use of the information collected merit adequate review.

Once selected, the classification sample would become a permanent panel or fixed sample, as in the case for the HPMS sample or the volume sample. This is intended to introduce stability and to allow the installation of permanent equipment at any desired sites. The rotating sample would be monitored completely every 3 years. Although proposed as a panel (fixed) sample, changes or modifications must be expected to occur for one reason or another. The recommended approach is to establish a fixed sample where modifications would be made only when sufficient justification exists to require such modification.

Because of the lack of specific State information (results are based on the HPMS Vehicle Classification Case Study data) and the cost of data collection, an implementation schedule in stages is recommended. A small number of measurements would be scheduled during one year and analysis of the data conducted prior to adding locations. The process would be continued until the specified reliability or the recommended sample is reached. This type of implementation would allow feedback to insure a State-specific answer to the precision vs. cost question. Small States with limited mileage and variability may be able to achieve the desired precision levels with sample sizes substantially below those in the recommended program.

The period of monitoring also requires trade-offs. Longer periods increase the accuracy of the data by reducing random variation, but increase data collection cost. A 48-hour period was selected as the recommended monitoring period. Analysis of the available data have shown that the number of vehicles for several vehicle types vary widely with daily coefficients of variation of about 100 percent (by comparison ATR total daily volume coefficients of variation are in the range of 10 to 15 percent). The use of a 48-hour period would help to stabilize this variation, would not extend beyond the capability of portable classification equipment, and would tie directly to the period recommended for the volume sample. Although a 48-hour period is the goal, shorter periods of 24 hours may have to be used until automatic classification equipment can bridge the gap from the present manual procedures.

The distribution of traffic by direction of travel and travel lane for multilane facilities also demands consideration. We recommend classification by travel lane, although, travel lane is ignored in our sample guidelines and is not a reporting specification. Direction of travel can be handled in a number of ways. We recommend monitoring both directions of travel and maintaining separate figures for each direction. Other possible alternatives include 24 hours in each direction or selecting the direction of monitoring by the flip of a fair coin. These alternatives present trade-offs. The objectives of the data collection should guide the decision.

As discussed previously for the volume sample, the process is designed to provide system estimates of a specified reliability. Direct section estimates are only provided for sections in the vehicle classification sample. For others, stratum inferences are made. As before, only guidelines are specified. States wishing to expand the recommended samples or to measure specific sections or points under the Special Needs element are encouraged to do so.

Temporal variation of vehicle classification is the last item to be discussed. Classification volume is affected by seasonal effects, although in some cases truck volume may not be as affected as passenger vehicle volume. The monitoring must be distributed throughout the year, otherwise seasonal adjustment procedures may be necessary. Alternatives include random selection of periods or a consistent systematic schedule throughout the year. We recommend the latter.

The estimation procedures vary depending on whether sections are in or out of the sample. Sections in the sample have direct (section specific) estimates. Sections not in the sample are estimated by assigning the stratum averages from their specific stratum. Stratum estimates of classification AVMT are simply derived by multiplying the stratum average classified category percentage by the total stratum AVMT from the volume sample. Aggregation of classification AVMT strata to any level can be accomplished by summation of classification AVMT over strata. Aggregated percentages of classification are computed by dividing the aggregated classification category AVMT by the total AVMT. Specific procedures, formulas, and examples are provided in Section 4.

CHAPTER 5

Truck Weight Sample Based on Vehicle Classification Sample

The proposed truck weight sample is selected as a subset of the vehicle classification sample. This eliminates duplication and directly ties the estimates on weight, classification, and volume. Since automatic vehicle weighing eauipment classifies and counts, and the recommended period of measurement is the same (48 hours); sample sections in the weight sample do not reauire a separate classification or volume count. This combination further reduces the level of effort reauired by the recommended program.

The stratification categories will remain the same as those in the classification element. However, the reporting categories are simplified by collapsing categories to insure that sample sizes reduce to realistic numbers. As in the classification element, the distribution of the sample within the combined strata will remain proportional to AVMT. The minimum recommended reporting strata are:

1. Interstate
2. All other roads

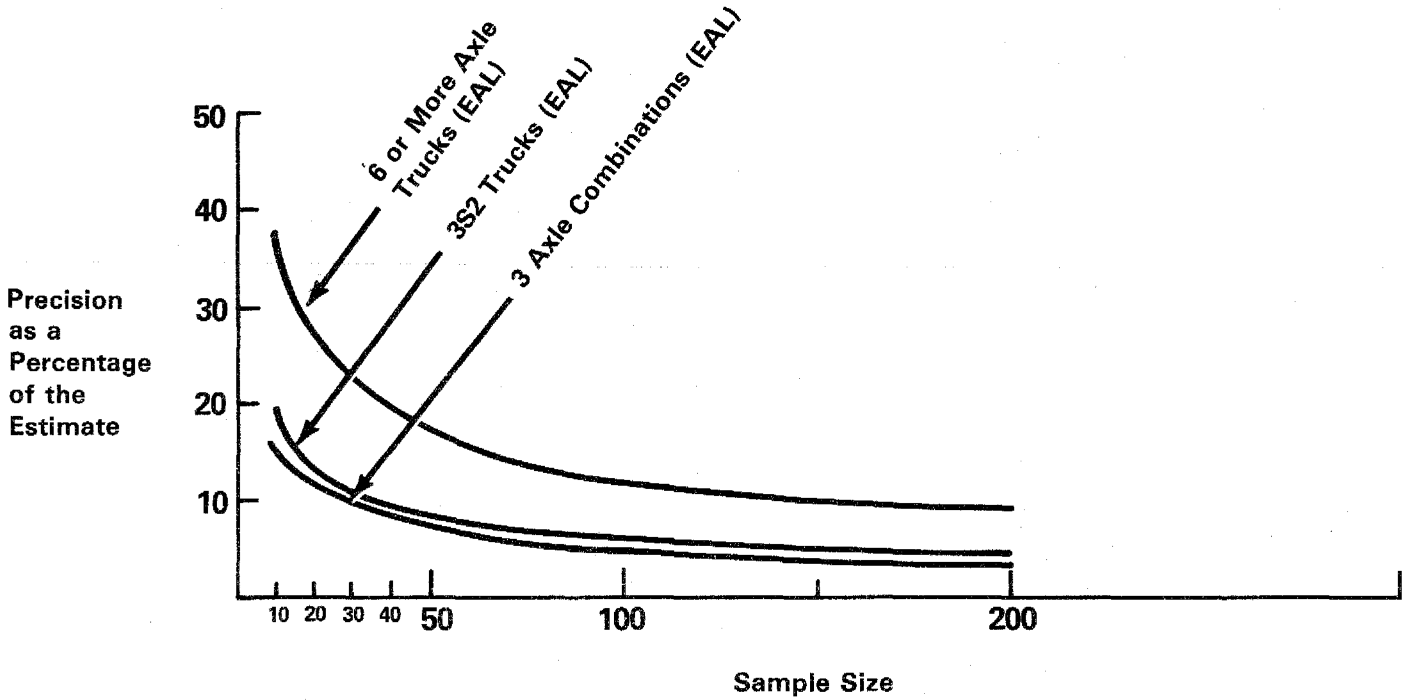
The estimation of sample size for the truck weight sample was based on the characteristic Eauivalent Axle Loadings or Loads (EAL). The variability of EAL's was estimated from the HPMS Vehicle Classification and Truck Weight Case Studies. Since 3S2 (18-wheelers) carry a high proportion of the loadings, this vehicle type was selected as the one to guide the sample estimation process. It should be noted that the EAL variability of 3S2's is significantly less than for most other vehicle types, therefore, the decision also reduced the number of samples needed. Research work conducted for the FHWA (Reference 1) provided estimates of the EAL's and their variability by vehicle type and functional class of highway. Exhibit 2-5-1 illustrates the sample size and precision relationships at the 95 percent confidence level for the total Interstate system.

The procedure is the same as used in Chapter 4. Eauation 2-4-1 is used to estimate the sample size and the following table presents the estimated EAL coefficients of variation:

EAL COEFFICIENTS OF VARIATION (% OF ESTIMATE)

VEHICLE CATEGORY	URBAN (%)	RURAL (%)	AVERAGE (%)
3-Axle Combination	26	24	25
3S2	35	25	30
6 or more axles	68	54	61

Exhibit 2-5-1
Interstate Sample Size vs. Precision
(Equivalent Axle Loads at the 95% Confidence Level)



The exhibit shows that a target precision of 3S2 EAL estimates on the Interstate system of + or - 10 percent of the estimate (95-10) necessitates 30 measurements. The remaining functional classes show more variability than the Interstate, and the combination of all other roads (excluding local) is necessary to bring the sample size to realistic levels.

A halving of the sample size to 15 would reduce total 3S2 Interstate estimates to 95-15, which is not a large reduction for the corresponding halving of the cost. However, lower subdivisions of the Interstate category would degrade much quicker. Assuming a one-half sample of 8 measurements (corresponding to a 50% break in VMT between urban and rural) on the Interstate Rural system, the target precision of 3S2 EAL would approximate 95-26 over a 3-year cycle and 95-45 for annual data. Regardless of precision figures, statistical samples this small are inadequate. Small samples are also more likely to miss changes occurring in the system and to greatly reflect the effects of atypical occurrences, equipment problems, or other biases. Development of the sample in stages and followed by analysis as described in Chapter 4 would serve to provide State-specific data to better guide the precision vs. cost decision process.

The analysis conducted shows that about 30 measurements (over a 3-year cycle) are needed to estimate equivalent axle loadings (EAL) on the Interstate system for 3S2 trucks (18-wheelers) with a precision of $\pm$ 10 percent with 95 percent confidence. The 3-year cycle acts to further reduce the sample needed annually. If the reporting strata were Interstate Rural and Interstate Urban, and the same precision levels were desired in each; then a sample of 60 locations, 30 in the rural and 30 in the urban, would be needed.

Using the single Interstate reporting stratum would necessitate 30 measurements, and these would be distributed to urban and rural as well as to HPMS volume subgroups proportional to AVMT as estimated from the HPMS for the vehicle classification sample and considering existing installations (Section 4). In this manner, sufficient urban and rural measurements would be available to produce estimates for these subgroups, although, reliability levels for non-reporting subdomains would be much wider. This procedure will also allow future expansion or reduction of the program to other desired reliability levels.

The same sampling procedure would be applied to the second highway category "all other roads." However, since the variability of the data is much greater as is the mileage, a sample of 60 measurements (over a 3-year cycle) would be needed to estimate 3S2 truck EAL's with approximately $\pm$ 10 to 20 percent precision with 95 percent confidence. As before, these samples would be distributed based on AVMT from the HPMS and selected by a simple random sample procedure.

The recommended program consists of 90 measurements over a 3-year cycle (30 per year) and results in statewide 3-year EAL estimates of 3S2 trucks with approximately + or - 10 percent precision with 95 percent confidence. Although, so far only EAL's have been discussed, it will also be possible to estimate the reliability of any estimate derived from the sample, including the number of overweight trucks or overweight AVMT in the system. The procedures for making such estimates will be discussed in Section 5. The proposal is, of course, presented as a minimum specification. Options to expand the system based on States' desires are encouraged and can be easily accommodated on a case by case basis.

The recommended period of monitoring is 48 hours. This is the established goal. The data analysis have shown so much variability, particularly for the less common vehicle categories, that anything less would make the reliability of estimates extremely questionable. All the temporal problems present and discussed in the volume estimation section are compounded in the vehicle classification and truck weight samples. The use of a 48-hour period, however, depends on the availability of automatic equipment. Shorter periods of 24 hours may be used in the interim.

The distribution of the sample to cover temporal aspects requires judgment. Obviously, a totally statistical procedure would specify a random sample. However, the fixing of sample size on 3S2 EAL variability has ignored the difference in size (mileage and travel) between the systems of different States. This is particularly a problem for the Interstate system. Since the differences between spatial (distribution over locations) and temporal (distribution at a point in time) variation have not been clearly identified, both must be incorporated into the sample. Here is where judgment must play a part. For example, a State with very limited Interstate mileage could propose to take the 30 weight-classification-volume measurements over a 3-year cycle or 10 per year, at a small number of locations. Rather than single 48-hour measurements during the 3-year cycle at 30 separate locations, multiple measurements would be taken at a small sample of locations. That is, due to the limited system mileage, the distribution of the sample of measurements would be made over time (temporal) rather than location (spatial). At the opposite extreme, very large States would be better served by establishing 30 separate locations of monitoring over a 3-year cycle. A combination of approaches between the two extremes should also be considered. As with previous parts of the program, once selected the sites would become permanent (fixed sample) until events produced sufficient justification to require change.

The previous discussion makes it clear that equipment portability is a critical need. Collecting five 48-hour periods of data at a single point is far less efficient statistically than collecting 48 hours at five different points in the system. In terms of information gain, very little is accrued after data have been collected at a point for periods longer than 7 days (except for specific objectives that require it, such as seasonality, 30th highest hourly volume, etc.). If seasonal differences are present in vehicle classification and truck weight data, the rudimentary temporal distribution over the year would detect it. In States where truck weight seasonality is expected to be high, special strategies could be devised.

Finally, complete truck weight information is difficult to capture given the enormous cost constraints presented. Although the average weight of loaded trucks may not have changed much over time; the bimodal distribution of weights due to loaded and empty trucks combined with the changing vehicle fleets and the difficulties involved in truck weighing operations, make the assessment of actual loads supported by the system a somewhat arduous task. The spatial differences caused by concentration of certain kinds of vehicles on certain routes and the effect of measurement on truck travel behavior further complicate the situation. The program proposed in this Guide presents a sensible solution to the information needs faced by most agencies. It will not, however, provide an answer to every question that will be asked. Special studies or supplementary information will always be needed.

CHAPTER 6

Summary of Recommendations

The proposed traffic monitoring program described in this section integrates traffic volume, vehicle classification, and truck weight. The traffic volume part of the program consists of three major elements:

1. Continuous (ATR) element
2. HPMS (coverage) element
3. Special Needs element

The sampling guidelines which are the main topic of this section are applicable to the HPMS (coverage) element. The basic sampling framework for traffic volume, vehicle classification, and truck weight data is then expanded and supplemented by the Special Needs element.

The sample design incorporated into the HPMS element consists of four major samples:

1. HMPS sample
2. Traffic volume sample
3. Vehicle classification sample
4. Truck weight sample

The HPMS sample is already defined and implemented in each State. The volume sample corresponds to the HPMS sample at the completion of each 3-year cycle. The vehicle classification sample consists of a subsample of the volume sample. The truck weight sample consists of a subsample of the vehicle classification sample. A diagram of the sample structure is presented in Exhibit 2-6-1, and a brief description of the sample design is presented in Exhibit 2-6-2.

The traffic volume sample consists of 48-hour measurements systematically distributed throughout the year and the State, annually covering a randomly selected one-third of the HPMS sample sections. The vehicle classification sample consists of 300 48-hour measurements over a 3-year cycle. These measurements are systematically distributed throughout the year and the State, and are taken at randomly selected volume sample sections which have been distributed based on HPMS AVMT to provide a fully balanced sample. The recommended truck weight sample consists of 90 48-hour measurements over a 3-year cycle designed to place added emphasis on the Interstate system. The locations are randomly selected from the vehicle classification sample and are allocated to strata based on AVMT. The measurements are distributed systematically throughout the year and the State.

The guidelines are presented as minimum specifications which can be expanded and supplemented to any degree desired by the States. The Special Needs element allows each State flexibility to address additional concerns.

Exhibit 2-6-1
TRAFFIC MONITORING SAMPLE STRUCTURE

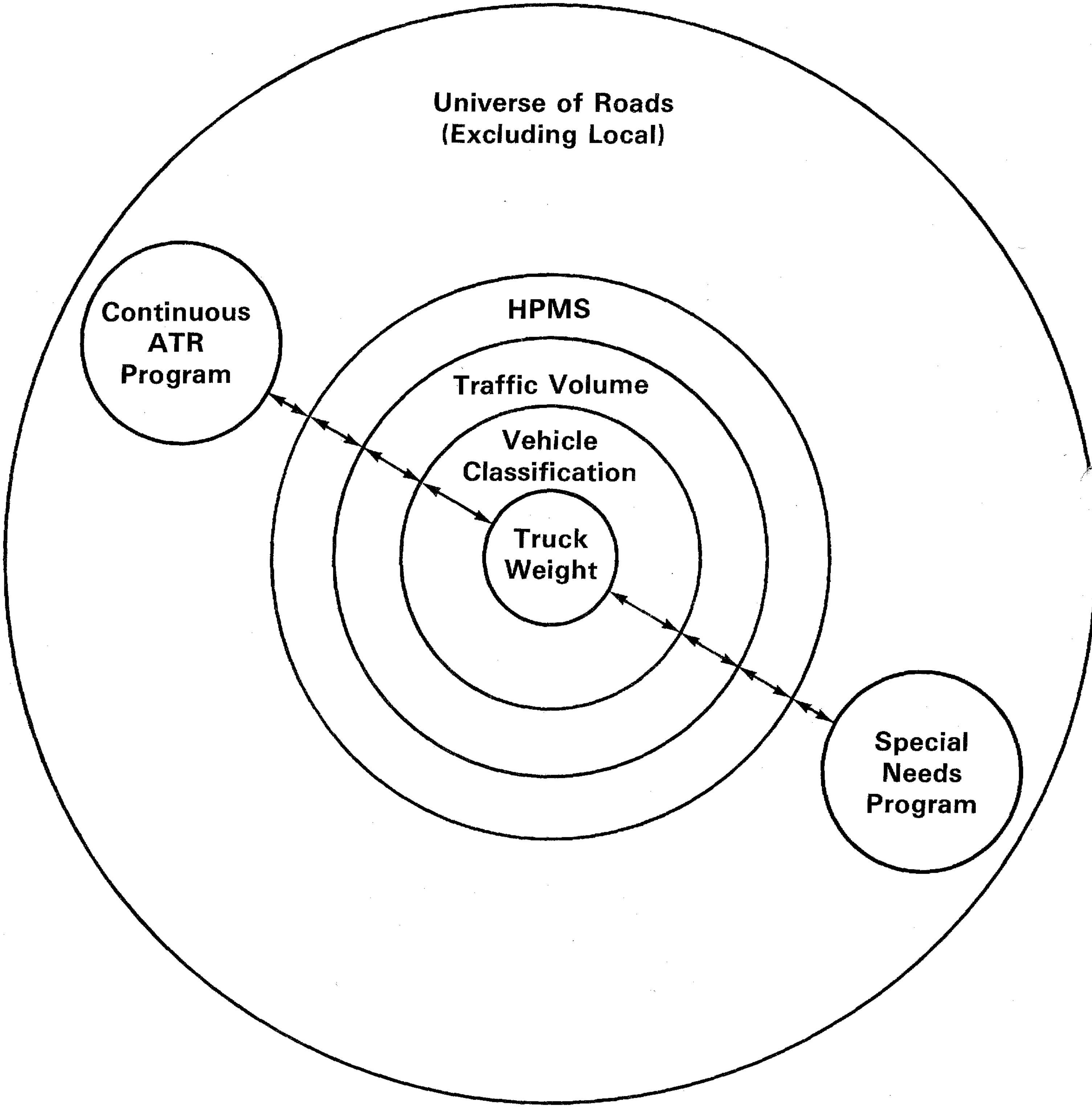


Exhibit 2-6-2
Recommended Traffic Monitoring Sample Design

Program Element	Sample Subelement	Period	Number	Products	Design (Target) Precision
1. Continuous	—	365 Days	40 to 60 (Average State)	Seasonality Growth Temporal Distribution	Annual Seasonal Factors 95-10
2. HPMS	HPMS Sample	—	HPMS Sample	System Estimates By Functional Class	Stratum AADT (See HPMS Field Manual)
	Traffic Volume	48 Hours	Annual—⅓ of HPMS Sample 3-Year Cycle -Full HPMS Sample	System AVMT By Functional Class AADT At Sample Points	Annual AVMT (95-5) (Excluding Local)
	Vehicle Classification	48 Hours	Annual - 100 3-Year Cycle - 300	Classified AVMT Axle Correction Factor Percentage Distribution of Vehicles	Statewide Percentage of 3S2's 95-10 (3-Year)
	Truck Weight	48 Hours	Annual-30 Measurements: 10 Interstate 20 Others 3-Year Cycle - 90 Measurements: 30 Interstate 60 Others	Weight + EAL by Classification Category	Interstate EAL for 3S2 95-10 (3-Year) Other Roads EAL for 3S2 95-20 (3-Year)
3. Special Needs (State Needs and Others)	—	—	At State Discretion	Site Specific Information Project Information I4R Truck Routes Pick-up/Auto Split Local Roads Any Others	—

Although the emphasis is on volume, the Special Needs element also concerns vehicle classification and truck weight. Great emphasis has been placed on the use of portable automatic equipment as the most effective and cost-efficient means of achieving statistical validity. The following sections provide more detailed discussions of the traffic volume, vehicle classification, and truck weight procedures.

SECTION 3

Traffic Volume Monitoring

Table of Contents

SECTION 3

Traffic Volume Monitoring

Table of Contents (Continued)

References

1. "Guide for Traffic Volume Counting Manual", U.S. DOT, Federal Highway Administration, March 1970.

2. Hallenbeck, M.E, and Bowman, L.A., "Development of a Statewide Traffic Counting Program based on the Highway Performance Monitoring System", U.S. DOT, Federal Highway Administration, March 1984.

3. "SAS User's Guide: BASICS", 1982 Edition, SAS Institute, Inc., Cary, North Carolina.

4. "SAS User's Guide: STATISTICS", 1982 Edition, SAS Institute Inc., Cary, North Carolina.

5. Cochran, William G., "Sampling Techniques", third edition, Wiley, 1977.

6. Mactavish, Douglas and Neumann, Donald L., "Vehicle Classification Case Study for the Highway Performance Monitoring System", U.S. DOT, Federal Highway Administration, August 1982.

7. Neumann, Donald, L., and Savage, Patricia, "Truck Weight Case Study for the Highway Performance Monitoring System (HPMS)", U.S. DOT, Federal Highway Administration, June 1982.

8. "Highway Performance Monitoring System, Field Manual for the Continuing Analytical and Statistical Data Base", U.S. DOT, FHWA, January 1984.

CHAPTER 1

Introduction and General Summary

The measurement of traffic volumes is one of the most basic functions of highway planning and management. For many years, the traditional approach to the development of annual average daily traffic (AADT) has consisted of three different but complementary types of traffic counts: continuous, control, and coverage (Reference 1).

Continuous counts are taken 365 days a year on a small number of points. These counts provide the most useful information and, usually, imply the use of the most sophisticated permanent counting equipment available to the planning organizations. Because these counts are most consistent from State to State and are maintained at permanent locations, the FHWA summarizes the information on a monthly basis for the development of national travel trends. Continuous counts are the backbone of contemporary State traffic counting programs.

Control or seasonal counts are much more difficult to characterize because of the many alternatives in use by the State planning organizations. These counts are usually taken from 2 to 12 times a year, for periods of time ranging from 24 hours to two weeks. The main purpose of control counts is to provide a seasonal assignment linkage for factoring short counts to AADT.

Coverage counts are short duration counts, ranging from 6 hours to 7 days, distributed throughout the system to provide point-specific information. Coverage count programs vary considerably from State to State. Several States have implemented coverage programs as system tools with limited numbers of counts, lengthy count cycles, and efficient computerized analysis capability. Other States have emphasized complete and detailed coverage of the highway systems resulting in a very large number of counts taken on short cycles and stored in manual form. Obviously the diverse requirements and constraints faced by State planning organizations have translated into very divergent programs.

Previous sections of this report have presented general discussions of the need for a more rigorous statistical procedure, the tie in to the Highway Performance Monitoring System (HPMS), the emphasis on program integration, and the dependence on technological advances in monitoring equipment.

The program as presented in this section consists of 3 major elements:

1. A limited Continuous Count element,

2. A more extensive HPMS framework as the traffic volume sample, and

3. A very flexible Special Needs element.

The procedures are intended to combine system and point estimation in an efficient manner. The proposed program does not make use of control or seasonal count programs.

Chapter 2 presents the recommended approach for the restructuring of continuous ATR programs. The objectives of the recommended programs are to develop adequate and reliable seasonal factors based on a cost-efficient approach; to provide limited statistical rigor; to integrate the continuous program with the overall traffic monitoring program; to minimize modifications to existing continuous programs; to emphasize the development of a consistent approach for national analysis; to establish minimum precision levels for seasonal factors; and to make available a powerful, flexible, analytical tool through the use of computer technology.

Chapter 2 begins with a general introduction, followed by seven subsections. The following is a brief summary of the seven subsections:

- Seasonality Analysis of Existing Continuous ATR Data

  The need to analyze available data to guide the development of the procedures is discussed. A cluster analysis procedure to gain insight into existing patterns of seasonality is described.

- Seasonality Procedures Based on Functional Class

  One of the major recommendations of the Guide is the establishment of seasonal patterns based on functional class to allow a simple and direct identification and assignment of locations to pattern groups.

- Establishing the Seasonal Pattern Groups

  The procedures for the establishment of seasonal pattern groups are presented. The methodology is guided by the analysis of each State's data and the knowledge of specific travel characteristics. The procedures are designed to be tailored for each State.

  The minimum seasonal groups recommended are:

  1. Interstate Rural
  2. Other Rural
  3. Interstate Urban
  4. Other Urban
  5. Recreational

Additional groups for regional or other particular concerns are optional. The determination of recreational patterns is based on substantial judgement and is treated as an exception.

- Determining the Appropriate Number of Continuous ATR Locations

  Statistical procedures to tie precision to number of locations in each seasonal group are presented. In general, 5 to 8 locations per seasonal group are sufficient to achieve the desired target precision (+ or - 10 percent with 95 percent confidence) of average monthly seasonal factors.

- Modifications to the Existing Continuous ATR Program

  A discussion of how to modify present programs to bring them in line with the recommended procedures is presented.

- Computation of Monthly Factors

  The methodology for the development of the monthly factors for the appropriate seasonal groups is presented. The application of the factors to expand short counts and the assignment of location to groups are discussed.

- Hardware and Software for Data Management and Analyses

  A brief discussion of computer technology and its application to traffic data is presented. The emphasis is on the development of fully computerized data processing and analytical tools.

Chapter 3 discusses the HPMS element of the Traffic Monitoring Program.

It begins with a general introduction followed by eleven subsections which completely describe the recommended approach.

The following summarizes the Chapter subsections:

- Monitoring Period Specification

  A 48-hour period of monitoring is recommended to provide reliable estimates of AADT at the specific locations.

- Monitoring Cycle Specification

  A 3-year cycle of monitoring is recommended as the most appropriate alternative for the HPMS core sample.

- Selection of the Core Interstate Sample

  The procedures for defining and selecting the Interstate samples are described. The annual sample consists of a rotating one-third of the HPMS sample. Exhibit 3-3-1 lists the 1982 HPMS Interstate sample by State.

- Selection of the Core Sample for the Remaining HPMS Functional Classes

  The procedures for defining and selecting the core non-Interstate sample are described. The annual sample consists of a rotating one-third of the HPMS sample. Exhibit 3-3-2 lists the 1982 HPMS non-Interstate sample by State.

- Spatial and Temporal Distribution of Core Counts

  The distribution of counts over the system (spatial) and the year (temporal) are discussed. The spatial considerations are covered by the HPMS distribution. A temporal distribution over the complete year or the appropriate months of the year is recommended.

- AADT Estimation for HPMS Core Sample Sections

  AADT is used as the basic starting point for the estimation process. The procedures for AADT estimation are presented.

- AVMT Estimation

  The procedures for expanding the AADT estimates to system AVMT are presented.

- Computation of Growth Factors

  Procedures for the development of growth factors are presented, including a discussion of several alternative methodologies.

- Estimation of Day-of-Week Factors

  A discussion of procedures for the development of day-of-week factors is presented.

- Estimation of Axle Correction Factors

  The recommended procedures for estimation of axle correction factors are presented. Estimates by functional class from the vehicle classification sample are used to adjust coverage counts taken by axle counting equipment.

o Data Collection and Processing Considerations

Several concerns including the use of hourly breakdowns, missed counts, imputation, computer processes, and the use of unique section identification numbers (HPMS) are mentioned.

The different topics discussed have a common basis, which results in similar procedural development. This makes the process easy to understand and very effective in terms of learning or training. Similarly, extension of the procedures to related travel data can be easily accomplished.

Chapter 4 discusses the Special Needs element of the program. The main focus is on defining additional needs beyond those addressed in earlier chapters. Since the focus of the earlier two elements is system information which can be addressed with a limited amount of coverage, the focus of this chapter is on point-specific information beyond the capabilities of the earlier parts of the program. Because of the great differences existing between States, the presentation is intended to allow maximum flexibility to address any issues of concern to the States. The chapter consists of an introduction followed by limited discussions of system needs beyond the continuous and HPMS core elements, of point-specific needs, of related programs, and of data processing considerations.

Appendix A presents an example of the continuous ATR procedures and a table of the student's T distribution.

CHAPTER 2

The Continuous Count Element

Background and Introduction

The continuous count programs are the most common and consistent traffic data collection programs existing in the States today. These programs have strong historical ties and have become the most basic planning data collection tools in most states. In terms of statistical rigor, most continuous programs lack a firm statistical base. Their design can best be characterized as evolutionary and incremental. These programs, however, have provided the data to guide the development of most of the highway programs in existence today. By providing a permanent, data-intensive method of operation, continuous Automated Traffic Recorders (ATR) have made available a large periodic data base with enormous utility potential to the trained analyst. Indeed one of the purposes of this Guide is to emphasize the need to establish a strong, integrated, and effective analysis capability through the use of analytical computer tools.

Because of the enormous expenditures made to implement existing continuous programs and their present utility in terms of the data base provided, the intent of this chapter is more towards modifying than redoing. By using as much as possible of the existing framework, cost-effectiveness is improved and modifications to existing programs minimized. On the other hand, utilizing existing locations causes statistical rigor to suffer because of the lack of a strict probability sampling approach.

The objectives of continuous ATR programs are many and varied. These objectives should translate directly to the number and location of the counters, the type of equipment used, the analysis procedures, etc. It is, then, of the utmost importance for each organization responsible for the implementation of the continuous ATR program to establish, document, and analyze the objectives of the program. Only by thoroughly defining the objectives and designing the program to meet those objectives will it be possible to develop an effective and cost-efficient program. It is also important to anticipate future requirements, if at all possible, and to build in flexibility to allow incorporation of future modifications.

One of the contentions of this Guide is that the development of seasonal factors to expand short-term counts to annual average daily traffic (AADT) is the most important objective of the continuous ATR program and the one that should guide the establishment of sample size. This assessment does not in any way imply that it is the only objective, and sufficient flexibility is built-in to address other objectives as needed. Nevertheless, the first objective of the continuous program recommended in this Guide is then to provide a cost-effective approach for the development of seasonal factors. The second objective is to allow a direct tie-in or grounding of the continuous program to the integrated traffic monitoring program based on the HPMS, thereby providing a strong statistical framework and estimation linkage. The third objective, as mentioned earlier, is to minimize modifications to existing continuous ATR programs, thereby emphasizing incremental rather than revolutionary change. Since the second and third objectives are not independent or exhaustive, compromises must be made.

The development of the following procedures is itself the result of compromises between many competing factors. The major emphases are on: 1) the development of data driven procedures, that is, allowing information extracted from available data to guide the formation of the program; 2) the complete integration of related traffic programs; 3) the continuing dependence on technological advances in automated monitoring equipment; and 4) the development of programs that provide an effective and efficient analysis tool.

Seasonality Analysis of Existing Continuous ATR Data

The first step is to define, analyze, and document the present continuous ATR program. A clear understanding of the present program will increase the confidence placed on later decisions to modify the program. The review should explore the historical design, procedures, equipment, personnel, and uses of the information. In most cases, the traffic data is available in computerized form resulting in easy access for statistical data analyses. Many types of analyses are possible and encouraged depending on the desired objectives. One such method of extracting information from the data is presented here.

The cluster analysis carried out is intended to assess the degree of seasonal (monthly variation) existing in each State as detected from the existing ATR program, and to corroborate or examine the validity of the existing grouping procedures used by the States. The analysis consists of examining the monthly variation (attributed to seasonality) of traffic volume at the existing ATR locations, followed by an attempt to group these locations into clusters or patterns of variation. An understanding of the monthly variation of traffic at the different points (ATR's) within the State and of the similarities of this variation as shown by the pattern groupings will help to ascertain the assignment of the ATR locations according to the recommended procedures.

The analysis begins by computing the monthly average daily traffic (MADT) at each ATR location. The MADT's are then used as input to a computerized cluster analysis procedure (a variety of statistical packages are available to perform this work). The seasonal analysis is carried out on a monthly basis because other studies have shown that patterns based on weekly or daily variation reduce the veracity of the resulting seasonal factors (Reference 2). The results of the clustering program are then used to roughly identify seasonal patterns detectable from the existing data. If the planning organization responsible for the counting program has developed seasonal patterns based on manual or computer procedures, a direct comparison is now possible.

Application of these procedures to a number of State programs has produced very reasonable results. In most cases, the patterns of variation that stand out are those of rural, urban and recreational areas. However, there are exceptions where clear patterns have failed to emerge. Plotting the resulting groups on a map is sometimes helpful to discern the reasons for patterns which are obviously influenced by the ATR locations. The advantage of this type of analysis is that it provides early evidence of the existence or validity of established seasonal traffic patterns.

The cluster procedure is illustrated by an example using actual data in Appendix A. The example as presented in the appendix uses MADT's. An alternative, which will reduce the influence of volume differences between locations on cluster formation, is to use the monthly factors (ratio of AADT to MADT) as input to the procedure.

An understanding of the computer programs used or of statistical clustering procedures is helpful but not required to make an adequate interpretation of the program results. The major weakness of clustering procedures is the lack of theoretical guidelines for establishing the optimal number of groups. Therefore, a subjective assessment is needed to establish what is appropriate. However, the objective of this analysis is to identify patterns based on available ATR data rather than to provide an optimal solution. In the context of continuous ATR's, 3 to 6 groups are usually sufficient to identify the specific patterns. If a State uses a fixed number of groups in its existing seasonal grouping methodology, then it is appropriate to compare those groups with those resulting from the clustering procedure as described in this Guide (using the same number of groups in both procedures).

Seasonality Procedures Based on Functional Class

The earlier FHWA procedures(Reference 1) for establishing seasonal patterns were based on random variation, that is, locations showing similar patterns of variation are grouped into a pattern. The weakness of the approach is that no clear, definable characteristic exists to guide the development of these seasonal patterns.

The statistical approach recommended in this Guide defines seasonal patterns based on functional class or a combination of functional classes according to the actual variability as shown in the existing data. Exceptions to the rule do exist and provision is made to address regional differences or recreational patterns. The decision on the appropriate number of groups is based on the actual data analysis results and the analyst's knowledge of specific, relevant conditions.

The definition of these seasonal patterns based on functional class provides a consistent national framework for comparisons between States and, more important, provides a simple procedure for allocating coverage counts to the factor groups for estimation of annual average daily traffic (AADT).

The statistical procedure emphasizes the use of composite (mean) factors for each seasonal group rather than the subjective allocation of specific counts based on nearness to continuous ATR's. The use of mean factors allows the incorporation of statistical theory to tie factor precision levels to sample size (number of locations). The resulting factors are generalized system factors. Maintaining an awareness of the individual factors at each ATR location will allow a judicious determination of the effects of using system factors for point-specific concerns. In cases where the ATR sample provides insufficient information, special counts may be desirable.

Establishing the Seasonal Pattern Groups

The previously described clustering analysis can be used to extract traffic pattern information from ATR data. The following descriptive analysis presents a more direct approach to examine existing data from continuous ATR's or alternatively, from control or seasonal programs. The combined result of both analyses provides the information needed to establish the groups.

The descriptive analysis is carried out by sorting the ATR locations by functional class, computing the percent coefficient of variation of monthly average daily traffic (MADT) at each location, and interpreting the results. As before, the SAS package is used, but other statistical packages would be quite appropriate. An example of the descriptive analysis of the continuous ATR data is presented in Appendix A.

The interpretation of the descriptive analysis is fairly straightforward. The seasonality peaks can be identified by examining the MADT's. The typical pattern shows an increase of travel during the summer months with a peak during July or August. The actual variability is shown by the standard deviation (MSD) and the percent coefficient of variation (MCV). The percent coefficient of variation, the ratio of the standard deviation to the mean times 100, is a standardized measure that allows direct comparison between locations. In general, the descriptive analysis accounts for the variation of monthly values during the year, but it does not necessarily account for variation patterns. This is to say that locations with completely different monthly patterns may show the same variability as measured by the standard deviation or the coefficient of variation. However, descriptive analysis combined with the clustering of volumes or factors, an examination of monthly factors at the ATR's, and the knowledge of State characteristics provide adequate information to establish the appropriate seasonal groups by functional class. It is important to realize that hardly any two points in a road system show the same pattern of variation. The aggregation of points (ATR location) into seasonal groups is solidified into a functional class assignment process, which will always remain tempered by judgement. Locations showing very distinct patterns are easily grouped, but many borderline cases exist where assignment is difficult. The saving point is that correct identification or assignment is much more important for the distinct pattern locations than for the borderline cases.

Typical seasonal (monthly variation) patterns for urban areas have a percent coefficient of variation under 10%, while those of rural areas range between 10 and 25%. Values higher than 25% are indicative of highly variable travel patterns, which we term recreational patterns but which may be due to other reasons. The existence of a recreational pattern should be verified by knowledge of the specific locations and the presence of a recreational travel generator. The typical patterns identifiable in most States are then urban, rural, and recreational. An examination of the descriptive and cluster analysis should be sufficient to identify the recreational locations and the general variation patterns as detected from the data. An example is provided in Appendix A.

Because of the importance assigned to the Interstate system, it is recommended that separate groups be maintained for the Interstate categories. The Interstate system because of its national emphasis will always be subject to higher data constraints. Programs, such as the I4R, which require the use of Interstate VMT as apportionment factors provide sufficient justification for the separation. The determination to separate the Interstate groups is, however, an administrative recommendation justified by the importance of the system, not because the data show that separate groups are needed. An exception to the specification of separate Interstate groups may apply for States with very limited mileage in either the Interstate rural or urban categories where the level of effort necessary to establish reliable groups factors would not be justifiable.

This Guide recommends the following groups as a minimum:

RECOMMENDED GROUP	HPMS FUNCTIONAL CLASS
INTERSTATE RURAL	1
OTHER RURAL	2, 6, 7, 8
INTERSTATE URBAN	11
OTHER URBAN	12, 14, 16, 17
RECREATIONAL	ANY

The first 4 groups are self-defining. The recreational group requires the use of subjective judgement and knowledge of the travel characteristics of the State. Usually, the recreational pattern is identifiable from an examination of the continuous ATR data. Sometimes the continuous data are insufficient and, if a control program exists, the data should also be analyzed. The minimum specification can be expanded, as desired by each State, to account for regional variation or other concerns. However, data support should be one of the prerequisites for establishing additional groups. Additional groups will require additional ATR locations and increase cost.

Determining the Appropriate Number of Continuous ATR Locations

Having analyzed the data, extracted the relevant interpretations, established the appropriate seasonal groups, and allocated the existing locations to those groups; the next step is to determine the number of locations needed to achieve the desired precision level of the composite group factors. To carry out the task, a grounding on statistical sampling procedures is needed. Since the continuous ATR locations in existing programs have not been randomly selected, assumptions must be made. The basic assumption made in the procedure is that the existing locations are equivalent to a simple random sample selection (pseudo-random assumption). Once this assumption is made, the normal distribution theory provides the appropriate methodology. The standard for estimating the confidence intervals for a simple random sample is:

$$B = \bar{X} \pm T_{1-d/2,\, n-1} \frac{S}{\sqrt{n}} \qquad \text{3-2-1}$$

Where

B = upper and lower boundaries of the confidence interval,

$\bar{X}$ = mean factor,

T = value of Student's T distribution with 1-d/2 level of confidence and n-1 degrees of freedom,
n = number of locations
d = significance level, and
S = standard deviation of the factors.

The precision interval is:

$$D = T_{1-d/2,\, n-1} \frac{S}{\sqrt{n}} \qquad 3\text{-}2\text{-}2$$

Where

D = absolute precision interval,

S = standard deviation of the factors.

Since the coefficient of variation is the ratio of the standard deviation to the mean, the equation can be simplified to express the interval as a proportion or a percentage of the estimate. The equation becomes:

$$D = T_{1-d/2,\, n-1} \frac{C}{\sqrt{n}} \qquad 3\text{-}2\text{-}3$$

Where D = precision interval as a proportion or percentage of the mean, and

C = coefficient of variation of the factors.

Note that a percentage is equal to a proportion times 100, i.e., 10 percent is equivalent to a proportion of .10.

Using this last formula it is now possible to estimate the sample size needed to achieve any desired precision intervals or confidence levels. Specifying the level of precision desired can be a very difficult undertaking. Very tight precision requires large sample sizes which translates to expensive programs. Very loose precision reduces the usefulness of the data for decisionmaking purposes. Traditionally, traffic estimates of this nature have been thought of as having a precision of $\pm$ 10 percent. A precision of 10 percent can be established with a high confidence level or a low confidence level. The higher the confidence level desired the higher the sample size required. Further, the precision requirement could be applied individually to each seasonal group or to an aggregate statewide estimate based on more complex stratified random sampling procedures.

The reliability levels recommended in this Guide are 10 percent precision with 95 percent confidence, 95-10, for each individual seasonal group excluding recreational groups where no precision requirement is specified.

The procedure begins by examining the monthly average seasonal factors for each group using the existing ATR's, anchoring the design criteria (number of groups), using the formula to establish the number of points, and determining the modifications needed in the existing program. An example is presented in Appendix A. When applying this procedure, the number of locations needed is usually 5 to 8 per seasonal group, although cases where more locations are needed have surfaced. The only exception is the recreational group where a subjective assignment is recommended.

Distinct recreational patterns can not be defined simply on the basis of functional class or area boundaries. Recreational patterns are very obvious for some locations but non-existent for other, almost adjacent, locations. The boundaries of these recreational groups must be defined based on subjective knowledge. Due to the high variability of the factors, blind application of the statistical procedure presented would result in too many locations and not be cost-efficient. The existence of different patterns, summer vs. winter, further complicates the situation. Therefore, the recommendation is to use a strategic approach, that is, subjectively determine the routes or general areas where the pattern is clearly identifiable, establish a set of locations, and subjectively allocate factors to short counts based on the judgement and knowledge of the analyst. While this may appear to be a capitulation to ad hoc procedures, it is actually a realistic assessment that statistical procedures are not directly applicable in all cases. However, recreational areas or patterns are usually confined to limited areas of the State and, in terms of total VMT, are very small in most cases. The statistical approach will suffice for the large majority of cases.

The procedure for recreational areas is then to define the areas or routes based on available data (as shown by the analysis of continuous and control data) and knowledge of the highway systems and to subjectively determine which short counts will be factored by which continuous ATR (recreational) location. The remaining short counts would be assigned on the basis of the functional class groups as defined in this Guide. A maximum of six continuous ATR locations in the recreational group is recommended depending on the importance assigned by the planning agency to the monitoring of recreational travel and the different recreational patterns identified.

Modifications to the Existing Continuous ATR Program

Once the number of groups and locations per group are established, the existing program must be modified.

The first step is to distribute the existing locations according to the defined groups. In general from 5 to 8 locations are needed in each of the 5 groups, usually resulting in a total of 30 to 40 locations in the State. Exceptions to this rule of thumb are expected; but since the procedures are directly driven by the analysis of each State's data, the results will be justifiable and directly applicable to each State.

If the distribution of existing locations results in a surplus of locations for a group, then redundant locations are candidates for discontinuation. If the surplus is large, reduction should be planned in stages and after adequate analysis to insure that the cuts do not affect reliability in unexpected ways. For example if 12 locations are available and six are needed then the reduction may be carried out by discontinuing 2 locations annually over a period of 3 years. The sample size analysis would be recomputed each of the 3 years prior to the annual discontinuation to insure that the desired precision was maintained.

If the distribution of present locations results in a shortage of locations, additional locations should be selected and added to the group. Since the number of additional locations is expected to be small, the recommendation is to select and include them as soon as possible.

Because of the small number of locations under consideration, extensive criteria for discontinuation or selection of additional sites will not be presented. Several important considerations are:

1. Other uses of existing information or importance assigned to sites. -- As mentioned before, seasonality is not the only objective or use of continuous ATR data. Each state should insure that these other criteria are met before discontinuation. It should also be clear that additional locations increase the reliability of the data.
2. Existing locations -- Available locations from control or other programs may be candidates for upgrading to continuous status.
3. Location on or near HPMS sites. -- Because of the direct linkage to the randomly selected HPMS sample sections, these locations should be given priority.
4. Tie-in to the classification, speed, or weight programs as mentioned in other sections of this Guide. -- Coordination with other programs is essential.
5. Distribution over geographical areas of the state.
6. Distribution by functional class system.
7. Random selection to reduce bias. -- New location should be randomly selected, if possible, from HPMS sample sections.
8. Quality of ATR equipment of sites. -- Older or malfunctioning equipment should be given higher priority for discontinuation.

Computation of Monthly Factors

The procedures for the development and use of monthly factors to adjust short volume counts to produce AADT estimates follow directly from the structure of the program. The individual monthly factors for each ATR station are the ratio of the AADT to MADT.

Group monthly factors are derived for each of the seasonal groups (with the exception of recreational or other optional groups) as the average of the factors of all the locations within the group. In the development of data processing or storage specifications, provision should be made for producing a table of factors to be used in the computerized expansion of short counts.

The individual annual factors for the specific ATR locations are exact, that is, there is no sampling variability (assuming a 100 percent sample). The reliability also depends on bias such as equipment error or missing data due to equipment malfunction, etc. The precision of annual group factors has been estimated by using equation 3-2-3 with the procedure described earlier for estimating the number of locations per group.

The recommended statistical approach defines seasonality based on functional class or a combination of functional classes according to the variability shown in each state's continuous ATR data. For system estimation, the average monthly factors for each group are then used to expand all short counts within the established boundaries of the group. For example, if a short count is taken on the Interstate Rural system during the month of March, then the March factor from the Interstate Rural group is used in the expansion of the short count to AADT. The only exception is for clearly different patterns, such as recreational, which have been defined during the data analysis stage. In these cases, a subjective allocation based on knowledge of conditions must be made.

The individual factors are best for each continuous location, but the application of these individual factors to short counts subjectively based on knowledge of conditions ignores the myriad of unidentifiable dynamic characteristics (weather, random variation, growth, economic conditions, etc.) affecting the patterns. The use of statistical average factors will not produce exact results (there are no exact figures in traffic counting), but on the average will compensate and balance out the many sources of variation. The statistical approach is not without disadvantages. Knowledge of very different conditions may in some circumstances result in better estimates. Recreational areas are a case in point, but other exceptions are always possible.

The recommended procedure breaks down to the application of the average group monthly factors as the default value for generalized (system) AADT estimates for all functional class groups, with the exception of other identifiable patterns outside of the norm (recreational for example) where subjective knowledge would indicate the use of either the generalized group value or the specific value of an appropriate continuous ATR location.

The specific ATR factors for each location should also be computerized. When developing site-specific information, the default values can be compared with the specific factors of nearby ATR locations to provide a sensitivity type of analysis. If the information available is judged insufficient for the desired objective, then a special count can be scheduled.

To estimate AVMT the use of annual factors would be preferable because direct representation of the year in question is provided (assuming no problems with equipment, construction, etc.). On the other hand, random occurrences such as a cold winter or a rainy summer can substantially distort the annual factors at a specific ATR (the group factors are not usually affected because of the averaging procedure). In most cases, however, historical factors computed over a number of years provide a better indication of seasonality. The procedures previously described can be applied either on an annual basis or over a number of years. Each State should determine which procedures to apply depending on specific analysis of available data.

Hardware and Software for Data Management and Analysis

The management and analysis of continuous ATR data require the use of computers. The basic data management functions including input, editing, manipulation, and report generation could be performed using mainframes or microcomputers. Analysis functions could also be carried out on both types of computers, but the use of complex statistical analysis packages and extensive data bases may be beyond the capacity of existing microcomputers.

The advantages of larger machines are high speed, capacity, and package availability. The disadvantages of mainframes are the expense involved and the lack of user control. With the advent of very powerful mini and microcomputers with large memories, the cost-effectiveness of these machines has greatly increased. Because of the large expenditures on computer processing related to the management of the several interrelated databases of the proposed traffic monitoring program, it has become cost-efficient to explore the acquisition of dedicated microcomputers with the capability to handle the desired functions.

Software for data management and analysis for the micro machines is available from a number of sources. Careful assessment of the capabilities of both hardware and software is of the utmost importance before final acquisition. Software needs beyond the available packages can be developed through the use of language compilers, or through contracts with appropriate sources. In general, because of the costs, required skills, and problems in developing software; it is usually more efficient to find third-party software that can perform the desired functions.

Finally, the ability to communicate directly and transfer files between micro and mainframe would allow the transfer of existing mainframe files to the micro. It would also provide an escape route should the capabilities of the micro be exceeded by future requirements.

The development of the Traffic Monitoring Guide procedures are intended to spur the use of efficient computer capabilities emphasizing storage and analysis on a cost-effective basis. A fully computerized operation would allow early preparation of reports and reduce the existing information lag.

CHAPTER 3

The HPMS Traffic Volume Sample

Introduction

The major purpose of the HPMS element as defined in this chapter is to provide a limited core framework or structure of randomly selected HPMS sample sections throughout the state. This core is, first, a systems tool that will completely satisfy the needs for statewide information such as system vehicle miles of travel (VMT). Second, it will provide an adequate statistical base for the development of adjustment factors for coverage counts. Third, it will provide a well balanced, geographically distributed, and statistically sound framework for AADT estimation. Fourth, the framework serves as the base for the selection of the vehicle classification and truck weight samples.

A clear understanding of the HPMS sample approach must precede the application of the procedures in this chapter. The HPMS has a direct, statistical link between the sample and the universe of roads in each State. Through this link, estimation procedures tying any of the HPMS collected variables to volume estimates (later to vehicle classification, and truck weight information) can be developed. Because of this connection, it will be possible to make reliability statements for any estimates derived by following the appropriate estimation procedures. Maps showing the location of existing HPMS samples would be sufficient to realize the degree of coverage provided by the sample in each specific state. Maps will also help to pinpoint voids which may require filling by the Special Needs element in Chapter 4.

Monitoring Period Specification

This guide recommends a 48-hour monitoring period for volume, classification, and truck weight monitoring. The selection of a time period for monitoring requires many trade-offs. This selection is a complex decision affected by many other considerations such as cycle of monitoring, cost, specific State characteristics, volume differentials, equipment, specific location characteristics, growth, and data collection constraints. The recommendations made in this guide are based on research conducted for the FHWA (Reference 2), work done by FHWA staff, reviews of existing State programs, and the redefinition of specific objectives to produce an integrated program. Although manual counting procedures may be extensively used today, the recommendations in this Guide are designed for automatic monitoring equipment.

Information available to the FHWA have indicated that the most common monitoring periods for volume counting in use today are 24 hours followed by 48 hours. The recommendation of a 48-hour monitoring period is a compromise given various alternatives and designed to maximize data validity subject to cost and equipment limitation constraints. As discussed in Chapter 3 of Section 2, the use of a 48-hour period is related to the reliability of AADT estimates. VMT system estimation is less influenced by the length of monitoring periods.

The research conducted (Reference 2) clearly showed that the magnitude of daily traffic variation is much larger than the long term growth trend of most locations. This assessment supports the emphasis on longer monitoring periods taken on longer cycles rather than shorter monitoring periods taken on shorter cycles.

Exhibit 3-3-1 taken from page IV-23 of Reference 2 compares cost versus precision for several alternatives ranging from 24 hour annual counts to 72 hours on a 5 year cycle. The implicit assumptions of this exhibit are discussed in the reference. The authors recommended a 48-hour, 3-year cycle as the most cost-effective alternative.

Costs also play an important part. The use of longer periods of time reduces the cost-effectiveness of the program by reducing the number of counts per machine. However, the objectives and validity of the counts should take precedence. There is a direct trade-off between the collection of a smaller number of more reliable counts versus a larger number of less reliable counts. This Guide emphasizes the former.

State characteristics such as organization of the program, emphasis areas, specific requirements, and staffing have a direct effect on the selection of an appropriate period of monitoring.

Volume differentials affect the reliability of the counts and the importance of decisions made based on the counts. Exhibit 3-3-2 taken from the 1970 FHWA Traffic Volume Counting Manual (Reference 1) compared the precision of three monitoring periods versus weekday traffic volumes. Information on how the graph was derived was not provided and the referenced document was developed in the late 1950's. The exhibit indicates that reliable precision can be obtained with 24 hour counts for sections with AADT's higher than 500. No information is provided on the effects of factorization or equipment error.

Location characteristics can greatly influence the length of monitoring period as well as the cycle, the equipment, and the data collection concerns. Analysis of ATR data has shown that volume variability differs based on rural or urban locations. Urban areas because of lower variability may be better served by shorter periods. Recreational areas because of much higher variability would benefit by longer counts. Analysis of ATR locations shows standard deviations of 24-hour monitoring periods in the 10 to 15 percent range, indicating that periods longer than 24 hours are needed if estimates with lower than 10 percent precision are desired. The analysis also shows that

Exhibit 3-3-1
RELATIVE COST AND ACCURACY OF COUNT DURATION
AND FREQUENCY

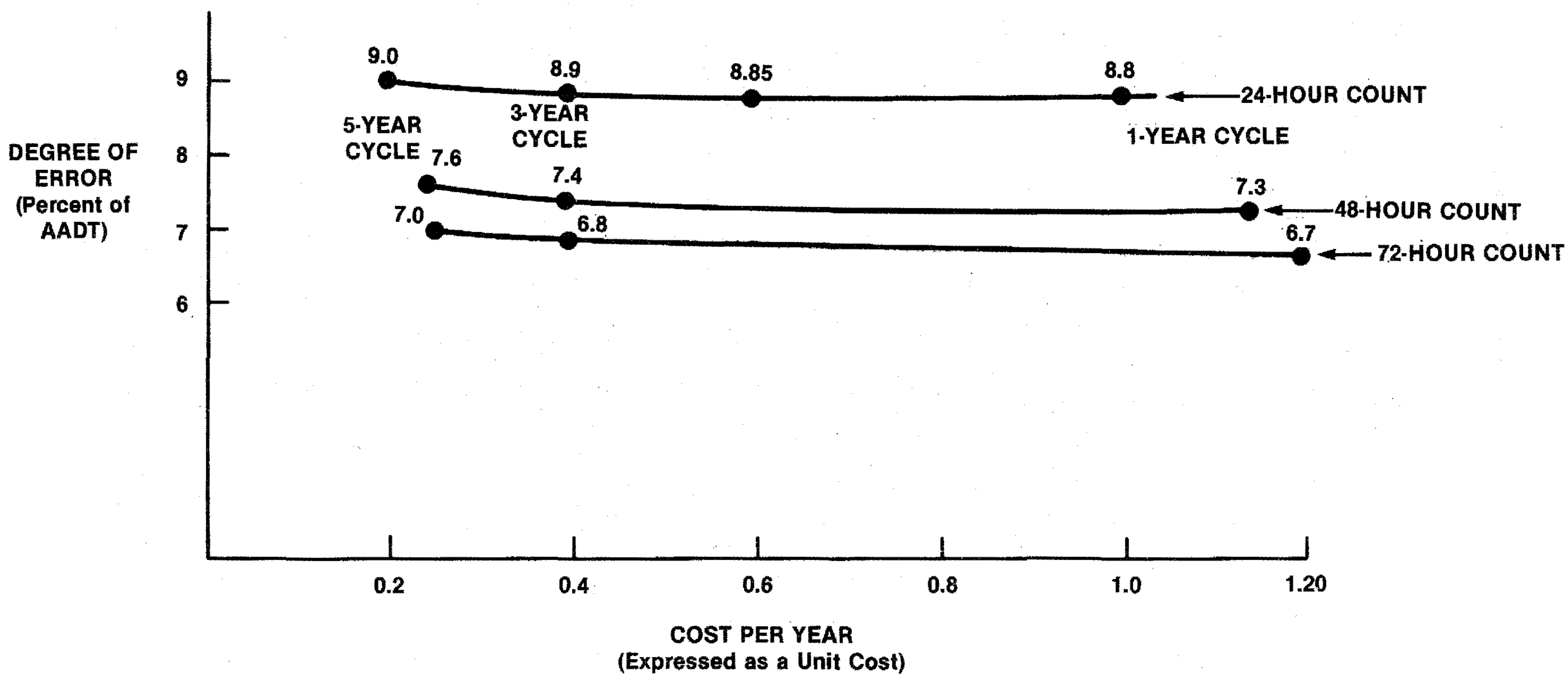
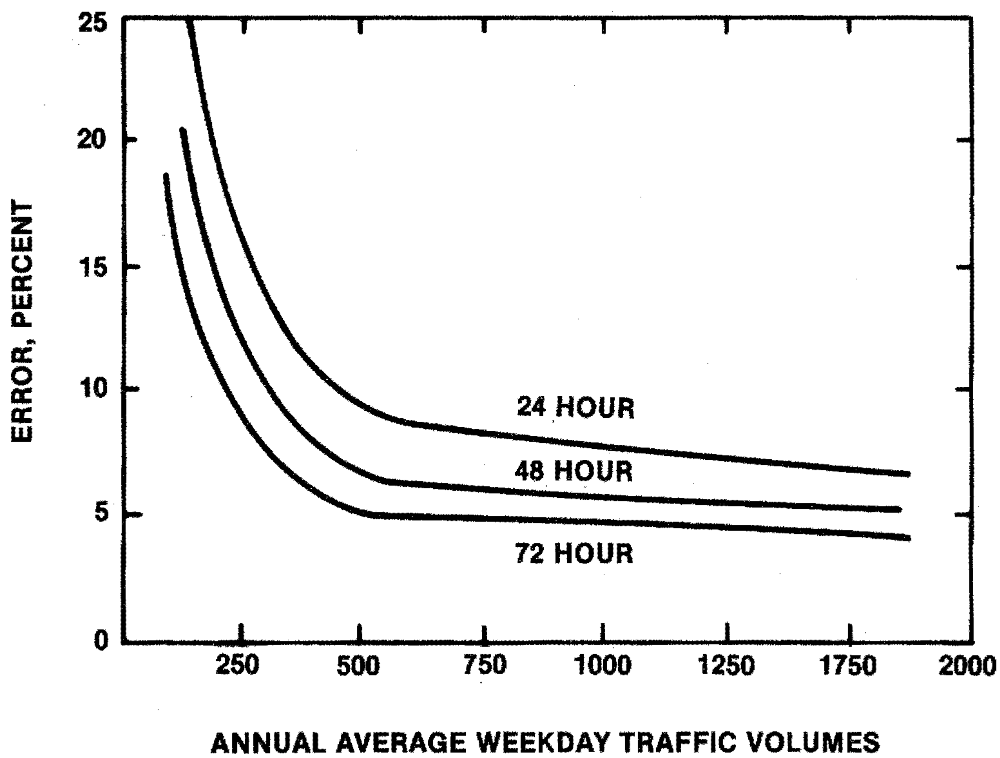


Exhibit 3-3-2



25
20
15
10
5
0
ERROR, PERCENT
24 HOUR
48 HOUR
72 HOUR
250
500
750
1000
1250
1750
2000
ANNUAL AVERAGE WEEKDAY TRAFFIC VOLUMES

the gains produced by increasing the length of monitoring periods quickly diminish; the well-known economic principle of diminishing returns is applicable in this context.

Equipment also plays an important role. Obviously, equipment based on loops is not affected by the determination of monitoring period, but equipment based on pneumatic tubes is directly affected. The assessment made is that a 48-hour monitoring period approaches the maximum limit to the use of pneumatic tubes for collecting volume or classification information.

The coordination or integration of the complete program also introduces restrictions. Analysis of vehicle classification information from the HPMS Vehicle Classification Case study (Reference 6) showed the standard deviations of daily volume for most truck classification categories to be in the vicinity of 100 percent. Although the data on which the assessment is based is tenuous at best, it clearly indicates that the numbers of vehicles in a number of classification categories can halve on double from day to day. Given this variability, the collection of reliable classification information requires the use of monitoring periods of longer than 24-hour duration. Analysis of manual truck weight operations have brought out the issue of bias introduced through station bypassing, waiting out, or the shifting of the travel patterns of heavier trucks to periods when the monitoring has stopped. The need for longer monitoring periods to reduce these effects and produce valid estimates is apparent.

Since the framework established consists of a limited number of annual counts, the advantages of a 48-hour period are believed to surpass the disadvantages. The recommendation of a 48-hour period for volume, classification, and truck weight monitoring apply only to the HPMS framework or core element of the program. The Special Needs element, since it is guided by each State's own specific objectives, has no such requirement although the results presented here are directly applicable and worthy of consideration. It is clear that although the program's foundation is based on automation, situations will always arise where automation may not be possible. Exceptions to the arguments made in defense of the 48-hour monitoring period would not be difficult to find given the enormous differences in travel characteristics, highway systems, and methods of operation in the 50 states. There may be clear circumstances where the use of shorter or longer periods of monitoring may be more effective. It is important, however, to adequately explore, assess, and document alternative options to insure that all avenues have been considered and that the final decision is, indeed, responsive to the specific situation.

Finally the basic foundation of State programs and of the procedures recommended in this chapter is to collect reliable and unbiased information. Alternatives and constraints can be analyzed and modifications made where applicable, however, it is important to maintain perspective to insure retaining the basic premise of reliable data.

Monitoring Cycle Specification

This guide recommends a 3-year cycle for traffic volume, vehicle classification and truck weight monitoring. The recommendation also presents trade-offs between a number of options and is intended to produce reliable information in a cost-effective manner.

As discussed earlier, the analytical work (Reference 2) indicated that, generally growth is less influential than daily variation. It was determined that on the average a 48-hour count taken every three years would be more cost-effective and reliable than an annual 24-hour count in estimating AADT. The reasoning being that the daily variability of volume is in the 10 to 15 percent range while annual growth would be in the range of 1 to 4 percent. On the average this is quite correct. However, traffic characteristics at specific locations can change quite rapidly by causes such as the opening of a new traffic generator such as a shopping center. Growth areas within States can easily surpass 2 percent annual growth rates.

Another concern pulling in the opposite direction is how far to extend the cycle. If a 3-year cycle is better than a one-year cycle, would a 5-year cycle surpass a 3-year cycle? Solely on a cost basis, a 10-year cycle is more cost-effective than a 5-year cycle. The law of diminishing returns also applies here. Three-year cycles produce, on the average, slightly less reliable information than annual cycles when using the same monitoring period length, but at substantial cost savings. Five year cycles would further reduce the cost at an additional reliability penalty. However, the growth area factor mentioned earlier works heavily against these gains. At 5-year cycles, a compounded 2 percent average growth rate approaches and confounds the daily volume variability of 10 to 15 percent.

The use of cycles can also be used to reduce the sample size needed annually to achieve the desired target precision of a sampling program. Tying the precision of estimates to longer cycles reduces the size of the annual program. For example, establishing the precision levels on a 3-year cycle on a rotating sample of HPMS sections results in one-third of the sample needed each year, thereby, reducing the annual effort by a factor of 3. The selection of a cycle could be combined with the length of the monitoring period to produce a two-dimension optimization problem. Evaluation of all possibilities considering the different characteristics, personnel, equipment, and cost constraints of different States is well beyond the scope of this Guide. The emphasis then becomes the selection of a consistent approach which will meet adequate reliability needs in a reasonable cost-effective manner. The decision made is to recommend the use of 48-hour counts on a 3-year cycle for traffic volume,vehicle classification and truck weight monitoring.

As before, there may be clear circumstances where the use of different cycles may be appropriate. In those cases, it is important to adequately consider the objectives and constraints, and to document in detail the reasoning process behind the decision.

Selection of the Core Interstate Sample

The Interstate System has top priority from a national or State perspective. On a national basis, it consists of 1 percent of the mileage, yet it carries an estimated 20 percent of the travel. The enormous investment and the magnitude of the programs to maintain that investment will always require a higher level of information. The HPMS sampling rate is far higher for the Interstate than for any other highway system. Similarly, the development of the Traffic Monitoring Guide places the Interstate System in a category second to none.

A brief description of the HPMS was provided in Chapter 2 of Section 2. The HPMS ratio of sample mileage to universe mileage for the Interstate varies by State from 11 to 100 percent with a national average of 50 percent. There are approximately 9,000 Interstate sample sections or a ratio of 1 sample per 4 miles of road. Although sample sections may represent up to several miles of road, it is quite apparent that for most States the large sample is sufficient to provide very adequate spatial coverage of the system. Given the controlled access and egress build into the system, a count between interchanges would provide 100 percent coverage of the spatial requirements. In many cases, the existing HPMS sample provides sufficient coverage to interpolate estimates of points located between samples. However, points where such interpretation would be judged inadequate would be monitored as a part of the Special Needs element. Because of the large HPMS Interstate sample framework, the need for special counts should be minimal.

In summary, the framework of spatial coverage provided by the HPMS sample for the Interstate system is sufficient to provide very reliable system estimates and most point-specific needs. Any remaining needs for information can be addressed through the Special Needs element described in the next chapter.

The HPMS sample is then the starting point for the selection of the volume core sample. The Interstate HPMS sample is substratified into urban, rural, and urbanized areas and by volume group within these areas. The HPMS Manual (Reference 8) provides a complete description of the stratification of the sample. The selection of the annual Interstate subsample of volume sectios is carried out by randomly assigning 1/3 of the sections in each HPMS Interstate strata. The procedure is described in more detail in the next section.

Since the sample was selected as a simple random sample within strata, equation 3-2-3 can be used to estimate the reliability of system AADT estimates. VMT estimates require more work because the estimation procedures involve the use of section lengths. Simple random sample procedures could have been used, but more reliable procedures based on ratio estimation (using length of sample sections) are used instead. Sample section DVMT is computed by multiplying section AADT by section length. Stratum DVMT estimates are derived by summing section DVMT and multiplying by the HPMS stratum expansion factor. Annual Vehicle Miles of Travel (AVMT) equals DVMT times 365. Aggregate DVMT estimates are derived by summing the appropriate HPMS strata DVMT estimates. For example, to obtain estimates of Interstate Rural DVMT, sum the DVMT estimates for the volume group strata within the Interstate Rural system.

The HPMS sample sizes were defined in terms of AADT within strata (refer to the HPMS Manual, Reference 8, for a complete description). The HPMS procedures for AADT (described in the HPMS Manual) are better than using equation 3-2-3 because they account for the case of limited numbers of universe sections (the finite population correction). To estimate the precision of DVMT estimates, a more complex procedure is needed to account for the variation in AADT and also for the variation in section length. The equation to estimate the sampling variability of aggregate DVMT estimates is given on page 164 of Reference 5. Studies conducted by the FHWA have shown the precision of statewide estimates of Interstate DVMT to approximate plus or minus 2 to 3 percent with 95 percent confidence. These results, however, consider only sampling variability and ignore other sources of error.

The number of HPMS sample sections in the Interstate system in 1982 are shown in Exhibit 3-3-3. The recommended procedure covers the HPMS sample over a 3-year cycle, therefore 1/3 of the sample is to be counted annually. This, however, does not translate to an actual count at every HPMS sample. Judgement is necessary when determining the exact number of counts. Subdivided sample sections in the HPMS sense (see discussion of item 29 on page IV-18 of reference 8) may not need separate counts. Adjacent sample sections, without separation by interchanges or access/egress points, do not need separate counts. HPMS sample sections on or adjacent to continuous ATR locations or other related monitoring (speed, vehicle classification, truck weight, etc.) do not need separate counts. Considerations of this nature will, obviously, be more pronounced for States having higher sampling rates.

The development of an annual Interstate traffic counting plan requires an examination of the locations of the HPMS sample and those of related programs. A determination would then be made as to whether a separate count is needed. Several locations will be judged to have the available information without taking a separate count. However, the majority of the HPMS Interstate sample locations will need a separate count.

Exhibit 3-3-3
NUMBER OF INTERSTATE SAMPLE SECTIONS
1982 HPMS DATA

STATE	SAMPLE SIZE			
	TYPE OF AREA			
	RURAL	SMALL URBAN	URBANIZED	STATEWIDE
ALABAMA	65	11	47	123
ALASKA	121	8	26	155
ARIZONA	106	20	39	165
ARKANSAS	38	16	55	109
CALIFORNIA	153	32	142	327
COLORADO	163	7	69	239
CONNECTICUT	32	7	120	159
DELAWARE	4	0	16	20
DISTRICT OF COLUMBIA	0	0	13	13
FLORIDA	112	9	134	255
GEORGIA	113	31	52	196
HAWAII	5	12	32	49
IDAHO	115	27	20	162
ILLINOIS	83	20	130	233
INDIANA	82	13	68	163
IOWA	214	55	119	388
KANSAS	74	21	93	188
KENTUCKY	125	21	63	209
LOUISIANA	75	6	69	150
MAINE	71	12	48	131
MARYLAND	32	12	57	101
MASSACHUSETTS	58	7	209	274
MICHIGAN	161	17	138	316
MINNESOTA	61	5	65	131
MISSISSIPPI	62	17	35	114
MISSOURI	72	10	42	124
MONTANA	147	20	21	188
NEBRASKA	31	4	29	64
NEVADA	85	6	61	152
NEW HAMPSHIRE	32	13	13	58
NEW JERSEY	29	0	76	105
NEW MEXICO	102	10	22	134
NEW YORK	85	20	180	285
NORTH CAROLINA	74	15	70	159
NORTH DAKOTA	79	8	21	108
OHIO	117	30	242	389
OKLAHOMA	93	21	48	162
OREGON	114	19	53	186
PENNSYLVANIA	143	21	184	348
RHODE ISLAND	16	0	27	43

Exhibit 3-3-3 (Cont.)
NUMBER OF INTERSTATE SAMPLE SECTIONS
1982 HPMS DATA-Continued

STATE	SAMPLE SIZE			
	TYPE OF AREA			
	RURAL	SMALL URBAN	URBANIZED	STATEWIDE
SOUTH CAROLINA.......	72	0	36	108
SOUTH DAKOTA.......	74	7	17	98
TENNESSEE..........	92	18	117	227
TEXAS..............	132	38	84	254
UTAH...............	108	14	59	181
VERMONT............	73	10	7	90
VIRGINIA...........	90	13	125	228
WASHINGTON.........	87	11	96	194
WEST VIRGINIA.......	86	15	81	182
WISCONSIN..........	102	11	100	213
WYOMING............	69	24	24	117
Total...............	4,329	744	3,694	8,767

It is apparent from Exhibit 3-3-3 that the size of the State, the Interstate mileage, or the degree of urbanization are reflected in the number of needed counts as, indeed, they should be. Therefore, smaller States or States with limited Interstate mileage require no special procedures.

States with low HPMS sample rates may need to take additional counts under the Special Needs program element to allow the preparation of detailed flow maps or to address point-specific concerns. This determination would be made based on the need for the additional information after the establishment of the desired objectives and an assessment that the HPMS Coverage counts were insufficient for the purpose.

Selection of the Core Sample for the Remaining HPMS Functional Classes

The level of coverage by functional class provided by the HPMS sample ranges, on a national average, from about 50 percent of total mileage for the Interstate System to 3 percent for rural major collectors. This indicates that for the lower systems the core structure or HPMS-based coverage framework may be very sparse. For overall system information this presents no problem at all. However, for point-specific needs the voids or gaps in the HPMS-based framework will be larger for the lower systems necessitating more extensive coverage or potential coverage in the Special Needs element.

The HPMS sample design specifications lower the precision requirements of AADT estimates for lower functional class systems (refer to Appendix F of the HPMS Manual, Reference 8). This, of course, translates to smaller sample sizes and lower sampling rates. Exhibit 2-2-1 has presented the complete 1982 HPMS sample and Exhibit 3-3-3 the Interstate sample sections.

Exhibit 3-3-4 presents the 1982 HPMS sample excluding the Interstate in each State. Procedures for estimating the precision of AADT estimates within HPMS strata are defined in the HPMS Manual. Procedures to estimate the precision of aggregate DVMT estimates from the HPMS have been alluded to earlier in this chapter. Analysis conducted by FHWA has shown the precision of statewide DVMT estimates (excluding local functional class) to be in the range of 1 to 5 percent with 95 percent confidence. The analysis assumed that AADT values reported for the HPMS sample sections were exact. Because of the assumptions made, it would be realistic to target the achievable precision towards the 5 percent range. Therefore, the spatial target precision levels in this Guide have been specified in terms of the HPMS statewide DVMT estimates as plus or minus 5 percent with 95 percent confidence. Computation of annual DVMT estimates using the complete HPMS sample by expanding the AADT figure from each HPMS sample would be expected to achieve the stated precision.

Exhibit 3-3-4
NUMBER OF SAMPLE SECTIONS EXCLUDING INTERSTATE
1982 HPMS DATA

STATE	SAMPLE SIZE			
	TYPE OF AREA			
	RURAL	SMALL URBAN	URBANIZED	STATEWIDE
ALABAMA.............	741	538	666	1,945
ALASKA..............	147	70	57	274
ARIZONA.............	510	302	335	1,147
ARKANSAS............	515	456	499	1,470
CALIFORNIA..........	731	423	1,049	2,203
COLORADO............	783	416	951	2,150
CONNECTICUT.........	361	178	863	1,402
DELAWARE............	154	57	133	344
DISTRICT OF COLUMBIA	0	0	206	206
FLORIDA.............	708	313	1,218	2,239
GEORGIA.............	760	395	585	1,740
HAWAII..............	272	149	291	712
IDAHO...............	873	241	188	1,302
ILLINOIS............	467	514	1,730	2,711
INDIANA.............	595	454	1,161	2,210
IOWA................	901	810	581	2,292
KANSAS..............	801	523	503	1,827
KENTUCKY............	851	633	575	2,059
LOUISIANA...........	537	288	342	1,167
MAINE...............	781	331	592	1,704
MARYLAND............	488	344	559	1,391
MASSACHUSETTS.......	480	175	1,222	1,877
MICHIGAN............	772	452	1,354	2,578
MINNESOTA...........	755	535	752	2,042
MISSISSIPPI.........	684	476	261	1,421
MISSOURI............	570	270	274	1,114
MONTANA.............	608	330	214	1,152
NEBRASKA............	670	445	303	1,418
NEVADA..............	403	114	396	913
NEW HAMPSHIRE.......	482	133	254	869
NEW JERSEY..........	351	134	861	1,346
NEW MEXICO..........	459	293	218	970
NEW YORK............	693	543	1,203	2,439
NORTH CAROLINA......	616	560	954	2,130
NORTH DAKOTA........	489	184	182	855
OHIO................	831	665	1,107	2,603
OKLAHOMA............	741	464	400	1,605
OREGON..............	718	461	543	1,722
PENNSYLVANIA........	883	651	1,874	3,408
RHODE ISLAND........	310	63	299	672

Exhibit 3-3-4 (Cont.)
NUMBER OF SAMPLE SECTIONS EXCLUDING INTERSTATE
1982 HPMS DATA-Continued

STATE	SAMPLE SIZE			
	TYPE OF AREA			
	RURAL	SMALL URBAN	URBANIZED	STATEWIDE
SOUTH CAROLINA......	540	352	282	1,174
SOUTH DAKOTA........	582	271	182	1,035
TENNESSEE...........	573	500	583	1,656
TEXAS...............	729	474	1,609	2,812
UTAH................	507	195	326	1,028
VERMONT.............	401	209	74	684
VIRGINIA............	625	287	828	1,740
WASHINGTON..........	774	374	1,369	2,517
WEST VIRGINIA.......	554	309	622	1,485
WISCONSIN...........	762	394	1,524	2,680
WYOMING.............	503	336	201	1,040
PUERTO RICO.........	403	277	336	1,016
Total...............	30,444	18,361	33,691	82,496

The procedures used to develop the AADT estimates at each sample section consider a variety of factors. The research work (Reference 2) provided statistical procedures to incorporate or aggregate some of the known or tractable errors that affect AADT and consequently DVMT estimates. This study indicated the use of a 48-hour period tied to a 3-year cycle as the most realistic procedure considering all alternatives. The recommended procedure uses a 48-hour count taken on a 3-year cycle. This recommendation reduces the level of effort to 1/3 of the HPMS sample annually. The procedures can be carried out by the use of strict simple random sample procedures using a table of random numbers to divide the sample in each stratum into three random subsets. One of the three subsets would be counted annually on a rotating basis. Following the procedures insures the complete counting of the HPMS sample every three years. HPMS sample sections not counted during the year would be expanded by procedures described later in this chapter, and the annual DVMT or AVMT estimates would be based on the complete sample.

Tables of random numbers to be used in the random selection are available from a variety of sources as are computerized random number generators. Since the stratum sample sizes are not all divisible by 3, the 3 subsets need not be exactly equal. For example, a stratum with 8 sample sections may be subdivided as 3, 3, and 2. Other strata may have less than 3 sample sections, but the same procedures apply. For example, a stratum with 1 sample section could be subdivided alternatively as 1,0,0 or 0,1,0 or 0,0,1. A certain degree of reconcilement will be necessary after the subsetting to insure that the annual subsamples are approximately equal. Organizing the full sample as shown in the following table would help to make the determination:

HPMS SAMPLE

Area Type	Functional Class	Volume Group	Full Sample	Annual Subsets 1	2	3
Rural	Minor Arterial	1	125	42	42	41
Rural	Minor Arterial	2	73	24	24	25
Rural	Minor Arterial	3	15	5	5	5
	Total		213	71	71	71

After the sample is subdivided, a determination as to the actual number of counts needed would be made. As before, several of the locations may be coordinated with other programs (ATR, vehicle classification, speed monitoring) and have actual counts available for use. The remaining sections would be scheduled for counting.

Spatial and Temporal Distribution of Core Counts

Theoretically, the selection and distribution of the sample must be conducted randomly to maintain statistical validity. Statistical validity requires random spatial (geographical) and temporal (calendar year) distribution. The HPMS sample by virtue of its extensive stratification and random selection already provides a balanced spatial distribution. However, bias can be easily introduced by improper temporal selection or scheduling procedures. On the other hand, scheduling operations are very dependent on effective use of personnel and equipment. Compromises will be necessary to insure that all important considerations are adequately addressed.

Because of the emphasis on statistical validity, the recommendation is to provide an adequate distribution over the two dimensions (spatial and temporal) even if this implies a loss of scheduling efficiency. This applies only to core counts. By coordinating the core and special counts, it may be possible to minimize or reduce the scheduling problems. The manner of operation and organizational structure of different States may turn the scheduling question into a major problem for some States and no problem at all for others. Because of these constraints, latitude is given while emphasizing the recommendation. However, scheduling considerations should not completely dictate or dominate the procedures.

The procedures for distribution of counts are to subdivide the annual subsample by the HPMS stratification categories and as many months of the year as possible in a random manner. That is, the counts should not be concentrated in one area of the State during a certain time of the year. Although the seasonal factoring procedure based on continuous ATR's will provide monthly factors to adjust counts, events specific to an area of the State or time of the year could easily bias the estimates. Valid statistical inference procedures require an appropriate distribution.

A random procedure to incorporate both dimensions can be designed by assigning a unique sequential number to each of the annual sample sections up to 365 (the number of days in the year) and selecting a random number between 1 and 365 which would indicate the HPMS sample section and the day the 48-hour monitoring period would begin. If the annual sample is greater than 365 then the process would be continued with the next 365 sections or until the sample were exhausted. Many other similar procedures could be developed based on the specific circumstances. For example, in cases where counting must be restriced to several months of the year the applicable number of days would replace 365; or in cases were counting operations are organized by districts, the process could be applied independently to each district. Alternative procedures developed by highway agencies to satisfy specific requirements are encouraged.

Once the schedule or complete counting plan is developed, the recommendation is to maintain the same schedule for use in the next cycle three years in the future. Although minor modifications are expected for one reason or another, maintaining the schedule would provide stability and begin to provide time-series data at the specific sample sections.

AADT Estimation for HPMS Core Sample Sections

The development of AADT estimates from the structure described in this Guide is a straightforward procedure. The 48-hour count taken at the sample sections during the current year may require adjustment by monthly (seasonal), day-of-week, and axle correction factors. For sections not counted during the current year, growth factors are also required. A description of the procedures to develop the factors and/or the need to use them is presented later in this chapter.

The equation used to estimate AADT at the sample sections is:

$$AADT_{hi} = \frac{1}{2} Vol_{hi} \times M_h \times D_h \times A_h \times G_h \qquad 3\text{-}3\text{-}1$$

where $AADT_{hi}$ = the annual average daily travel at location i of functional class h,

Vol_{hi} = the 48-hour axle volume at location i of functional class h,

M_h = the applicable monthly factor for functional class h,

D_h = the applicable day-of week factor for functional class h (if needed),

A_h = the applicable axle-correction factor for functional class h (if needed), and

G_h = the applicable growth factor for functional class h (if needed).

NOTE: For equipment units that automatically divide by two to produce a "vehicle' count, the number of axles can be estimated by multiplying by 2 or by modifying the software to report axles.

For one reason or another (as discussed in the appropriate section), the application of some of the factors may be unnecessary. For example, automatic equipment which counts vehicles does not require axle correction. In these cases, the inappropriate factors would be assigned a value of one in the equation.

An approximate estimate of the relative variance coefficient as a percentage of the AADT is given by the following formula:

$$C = \sqrt{CV^2 + CM^2 + CD^2 + CA^2 + CG^2} \qquad 3\text{-}3\text{-}2$$

where C = relative variance coefficient as a percentage of the AADT, CV = relative variance coefficient of the 48-hour volume,

CM = relative variance coefficient of the monthly factor,

CD = relative variance coefficient of the day-of-week factor,

CA = relative variance coefficient of the axle correction factor, and

CG = relative variance coefficient of the growth factor.

The relative variance coefficient is defined as the standard error divided by the estimate. As before, any unnecessary terms are set equal to zero in the equation.

Annual Vehicle Miles of Travel (AVMT) Estimation

The procedures for developing daily vehicle miles of travel (DVMT) use the standard HPMS procedures for sample expansion. The first step is to compute an AADT estimate for each HPMS sample section. Next, the section AADT is multiplied by the section length and by the stratum expansion factor. Finally, the expanded stratum DVMT estimate is the sum of the expanded section DVMT estimates of all the sample sections within the stratum. In the same manner, aggregate estimates at any level can be derived by the sum of the appropriate strata. Annual vehicle miles of Travel (AVMT) are computed by multiplying any resulting DVMT values by 365. Estimates of DVMT or AVMT for specific vehicle classes or categories are derived by multiplying the strata numbers by the appropriate percentages derived from the vehicle classification or weight sample subsets.

An estimate of the standard error of a stratum DVMT estimate is given by the following formula:

$$s_h = \sqrt{\frac{N_h (N_h - n_h)}{n_h (n_h - 1)} \left[\Sigma \; D^2_{hi} + \left(\frac{\Sigma D_{hi}}{\Sigma l_{hi}} \right)^2 (\Sigma l^2_{hi}) - 2 \left(\frac{\Sigma D_{hi}}{\Sigma l_{hi}} \right) \Sigma D_{hi} \, l_{hi} \right]} \qquad \text{3-3-3}$$

where

s_h = standard error of DVMT estimate in stratum h,

N_h = number of universe sections in stratum h,

n_h = number of sample sections in stratum h,

D_{hi} = DVMT of section i in stratum h, and

l_{hi} = length of section i in stratum h.

This formula is presented in page 155 of Reference 5. A complete discussion of ratio estimation procedures is included in the reference.

The errors introduced by the use of factors to develop AADT estimates have been ignored. The assumption made is that these errors are normally distributed and therefore cancel out. The reason for ignoring these errors is that VMT estimates could be derived independent of AADT, i.e., directly expanding the 48-hour short counts adjusted only for axle correction or measurement error. The procedures have been tied to AADT for consistency and to integrate the point-specific and system estimation aspects.

Estimates of the standard error of aggregate VMT estimates are derived by summing the squared standard errors of the appropriate strata and taking the square root of the total. Coefficients of variation and confidence intervals can be derived by standard statistical procedures.

Computation of Growth Factors

The development of growth factors again brings to the surface the difference between point and system estimation. Growth factors at a point can be best estimated based on the presence of a continuous ATR assuming the differences found from year to year can be attributed to growth. Since it is well known that many extraneous effect contribute to these differences, the assumption would be incorrect in many cases. It should be clear that even with continuous ATR's the point-specific growth factor may be questionable. System growth estimates can be developed from all the continuous ATR's and this averaging effect compensates for the extraneous effects. However, the number of continuous ATR counters is very limited and may be insufficient to develop accurate system figures. The selection of ATR locations becomes very important in this context since growth occurs in some areas and not in others.

Growth factors can also be developed from the coverage program if structured in the manner recommended in this guide. Since AADT estimates will be developed annually at each HPMS sample, the AADT ratios from year to year should provide point-specific growth ratios. If continuous ATR factors were considered questionable, point specific estimates based on coverage counts would be expected to be less reliable by orders of magnitude. Another approach would be to use the cycle repetition (every 3 years) to develop these factors. System growth estimates can be developed from the rotating 3 year coverage counts and, since the number of counts is large, the averaging effect would be expected to reduce the variability considerably. Since the three rotating panels are independent of each other and randomly selected, independent verification of the growth estimates would be available.

The point of this discussion is to emphasize that there is not a best procedure that would be applicable in all cases. Instead of concentrating on a specific procedure, a better approach is to use all the tools available to examine the question from several perspectives. Rather than develop a single estimate, the different programs should be used to provide a number of alternatives from which appropriate growth ranges can be derived.

The procedure recommended in this Guide is based on the coverage program because it is believed that the large spatial sample size in the coverage program is superior to the large temporal sample size in the continuous ATR program. However, both procedures will be presented because of the importance for adequate verification and the examination of alternatives.

The estimation of annual growth factors based on continuous ATR's requires a minimum of two continuous years of data. Estimates can be developed by specific location, aggregation of specific locations, seasonal factor groups, and aggregation of groups. Location estimates are simply the ratio of AADT for the latest year to AADT for the previous year. Aggregations require the averaging of all appropriate locations. The aggregation would be most appropriate by the established seasonal groups defined using the procedures in Chapter 2. Statewide estimates should be weighted by the VMT carried by each of the seasonal groups.

The procedures for the development of growth factors based on continuous ATR's are as follows:

Annual growth factor at a location:

$$G_n = AADT_t / AADT_{t-1} \qquad 3\text{-}3\text{-}4$$

where G_n = growth factor at location n,

$AADT_t$ = Annual average daily traffic (AADT) for year t, and

$AADT_{t-1}$ = AADT for year t-1.

Annual growth factor for a seasonal group:

$$G_h = \Sigma G_n / n_h \qquad 3\text{-}3\text{-}5$$

where G_h = growth factor for seasonal group h, and

G_n = growth factor of location n within group h, and

n_h = number of locations in seasonal group h.

Standard error of annual growth factor for a seasonal group:

$$s_h = \sqrt{\frac{1}{n_h} \sum (G_n - G_h)^2/(n_h - 1)} \qquad 3\text{-}3\text{-}6$$

where s_h = standard error

Annual statewide growth factor:

$$G = \Sigma V_h G_h / V \qquad 3\text{-}3\text{-}7$$

where G = statewide growth factor

V_h = VMT or DVMT for the seasonal group h, and

V = statewide VMT or DVMT (excluding local functional class).

A rough estimate of the variability (standard error) of the statewide growth factor is obtained by adding the square of the standard errors of the seasonal groups used in the computation of the statewide growth factor and taking the square root of the total. More complex formulas which account for VMT error could be developed, but the many uncertainties and assumptions in the estimation process would hardly justify the additional effort.

The procedures for the estimation of growth factors based on the HPMS core framework are recommended in this Guide, as stated earlier, because of the belief that the large spatial sample size of the coverage program is superior to the temporal sample size of the limited continuous program. Several different procedures can be used to estimate growth rates and the procedure presented here is just one of many possible. The annual counts could be used directly, converted to AADT, or converted to system VMT through the HPMS procedures before proceeding to estimate growth rates. Because of the emphasis on point-specific estimation and to provide a firm starting base, the recommended procedure is to convert to AADT before developing the growth factors (growth factors are not needed for sections actually counted during the year). This will allow the development of point-specific, system, and statewide estimates starting from the one basic building block in traffic counting - AADT. The computation of growth factors will require the program to have been in operation for a full 3 year cycle. However, even with one year's data very rough estimates could be derived based on historical or earlier AADT estimates at the corresponding sample sections.

The first step of the procedure is then to compute the AADT at each of the sections counted during the current year. A direct point-specific growth estimate can be derived based on the ratio of present AADT to past AADT (3 years ago). Aggregations by HPMS strata or combination of strata could be developed as needed. The recommendation is to develop factors at the functional class level for use in the expansion of sections not counted during the current year to AADT. The reason for the recommended procedure is that extraneous effects will be averaged out resulting in a better estimate of system growth. In this context, it is relevant to mention that computation of point-specific growth estimates would indicate whether the point values differ significantly from the system value and whether the system value may be inappropriate for point-specific concerns. Plotting the location information on a map would be invaluable in estimating pockets or patterns of growth and in the detection of errors.

The procedure for developing functional class growth factors is to estimate AADT for the current year sections, expand these estimates to functional class DVMT, divide the resulting estimate by the corresponding estimate from the previous 3-year cycle counts, and divide by three to average the growth over the 3 years. For the first and second years, the use of available AADT's for HPMS sample sections could be used to derive rough estimates (in these cases, the appropriate number of years would be used as the divisor).

The estimation procedures for section AADT and functional class DVMT have already been described. The equation for estimating functional class growth factors based on the 3-year cycle HPMS Coverage program is:

$$G_h = 1 + \frac{1}{3}\left(DVMT_h/DVMT_{h-3} \;\; -1\right) \qquad \text{3-3-8}$$

where

G_h = growth factor for functional class h,

$DVMT_h$ = daily vehicle miles of travel (DVMT) for functional class h during current year, and

$DVMT_{h-3}$ = DVMT for functional class h from previous 3-year cycle.

Since the complete sample consists of 3 rotating fixed panels, independent verification of growth factors will be provided each of the 3 years. If the differences between years is larger than twice the precision of the growth factors, then it may be necessary to smooth out the time-series by, perhaps, a moving average procedure. Growth factors from alternative procedures (continuous ATR's) would also help to confirm the validity of the values derived from the coverage procedures.

The precision of coverage growth factors can be estimated by the following equation:

$$C_h = \sqrt{CV^2_h + CV^2_{h-3}} \qquad \text{3-3-9}$$

where

C_h = the relative variance coefficient of growth factor G_h expressed as a percentage of the factor,

CV_h = the relative variance coefficient of the DVMT in functional class h during the current year, and

CV_{h-3} = the relative variance coefficient of the DVMT in functional class h during the previous 3-year count cycle.

The relative variance coefficients would be estimated from standard procedures similar to those presented for the continuous ATR's.

The resulting system growth factors by functional class would be used to expand the remaining two-thirds of the HPMS sample not counted during the current year. The result would be that all HPMS sample sections would have a current AADT value (estimate).

Estimation of Day-of-Week Factors

The statistical procedures described in this Guide recommend the use of day-of-week factors only if such use is shown to be necessary. The use of these factors may serve to improve both AADT and VMT estimates depending on the manner by which the counting procedures are structured and implemented.

Statistical sampling procedures require that each unit in the universe have a positive chance of selection. Excluding weekends from the temporal sampling frame would act to bias the procedures in unmeasurable ways. This in the reason for recommending full inclusion of the 7 days of the week. On the other hand, it is known that in many cases the work-week days are more consistent than the weekend days for AADT estimation. Many State programs have preferred the use of work-week days. The cost of using personnel outside of normal working schedules has restricted the use of weekend counts in the past. The development of automatic equipment which can be placed and retrieved during normal working schedules may eliminate or reduce the restriction in future programs.

Data from the continuous ATR program would be used to develop the day-of-week factors. Because of the potential differences between functional classes, the analysis would be carried out using the established seasonal groups as described earlier in Chapter 2 of this section. If no significant or large differences are detected, then statewide aggregation would be appropriate.
Since the use of monthly factors has already accounted for month to month variation, the development of day-of-week factors would be carried out for each month. It is very likely that monthly differences will be insignificant, in which case aggregation of several months or the use of the combined factors for the full year would be appropriate.

The factors can be computed on an individual basis (7 daily factors) or a combined weekday (Monday, Tuesday, Wednesday, and Thursday) versus weekend (Friday, Saturday, and Sunday) factor. This decision depends on the data analysis and the State's perspective. If the computation of daily factors results in very similar figures then the simpler combined approach would be preferable.

So far, the discussion has considered an extensive number of possible actions including the determination of individual or combined day-of-week factors, by seasonal group, and by month. It is highly unlikely that all of these effects will be judged significant; indeed, since the procedures recommend the use of 48-hour periods which dilute the daily differences, daily factors may not be needed at all. Another consideration is introduced by the fact that examining all the possibilities mentioned will dilute the available ATR data, thereby introducing small sample discrepancies. In the final analysis, the judgement of the analyst guided by the knowledge of State conditions and supported by the interpretations derived from the data must be the deciding factor. Adequate documentation should be maintained to support the decisions made and to allow future reexamination.

The daily factors for a single continuous ATR location by month and seasonal group are computed as the ratio of MADT to monthly average day-of-week volume. For example, the Monday factor in January is the January MADT divided by the average volume of the Mondays in January. The seasonal daily factor for a seasonal group would be the average of all the continuous locations within the seasonal factor group. For example, the Monday factors in January for the Interstate Rural seasonal group is the average of the Monday factors of the Interstate Rural continuous ATR locations in January. The standard error and relative variance coefficient are estimated using standard procedures assumming a simple random sample (the same procedures used in the seasonal factor discussion in Chapter 2 of this section).

Since the procedures recommend the use of 48-hour periods, the application of the factors would require the averaging of the appropriate daily factors. For example, a 48-hour period including Monday and Tuesday would require averaging the Monday and Tuesday factors. Alternatively, the factoring procedure could be carried out as the combination of two days and would result in factors for the 7 possible combinations of 2 contiguous days. Other complications could arise such as a 48-hour period including the last day of one month and the first day of the next month. All these considerations can be easily handled based on a commonsense analytical interpretation.

The procedures are, indeed, data driven and to be successful require the use of flexible, computerized, analytical tools; and the skill to use effectively the available tools.

Estimation of Axle Correction Factors

The application of axle correction factors is dependent on the type of equipment in use. Obviously, vehicle detectors do not require the adjustment. However, the preponderance of equipment dependent on pneumatic tube detectors in counting operations makes the development of these factors a virtual necessity. To represent vehicles, counts taken by axle counting equipment require adjustment by axle correction factors. The magnitude of the problem will obviously depend on the traffic characteristics at the point or system. For the system purposes of this Guide, axle correction factors by functional class are considered sufficient. For point-specific concerns, the judgement of the analyst and knowledge of specific conditions are of primary importance. If the system factor is not considered appropriate, then a special count may be required. This condition is likely to surface for specific situations such as truck routes or truck traffic generators.

The structure of the Traffic Monitoring Guide provides a simple process for estimating these factors for the specific points in the classification sample and for the system in general. The adjustment factor at a point is simply the ratio of vehicles to axles as determined by a classification count. Since most classification equipment provides both a vehicle and axle count directly, very specific procedures are unnecessary. If the AADT is estimated based on axles and the axle correction factor is multiplicative (the recommended procedures), then the ratio of vehicles to axles (axle correction factor) must be positive and range between the values of 0.2 and 0.5. A functional class factor is derived as the average of the individual factors of all the classification locations within the specific functional class. Standard errors and relative variance coefficients are estimated based on standard procedures assumming a simple random sample (the same procedure used in Chapter 2 of this section).

The application of the factors is a straightforward procedure. Sample sections where classification counts are taken or where vehicle detecting equipment is used require no adjustment since the number of vehicles are known. Sample sections where axle counts are taken are assigned the factors on the basis of functional class and these are applied in the computation of section AADT.

Data Collection and Processing Considerations

Many concerns must be addressed when implementing a program of this magnitude. Only some of the most salient considerations are addressed here. So far, no mention has been made of actual detail of data to be collected. Obviously much depends on equipment capability and the objectives of the program. In general, hourly breakdowns are recommended for the truck weight and classification sample sections. This would allow examination of other concerns such as peak-hour volume and design-hour factors. Urban locations may be desired by 15 minute intervals. Rural volume locations not tied to classification or weight may need only daily volumes for the monitoring period. Although the Guide recommends the use of 48-hour period a break or subtotal for each

24-hour period is recommended for all locations. The daily (24-hour) break in very useful for analysis of daily variation and is required for the factoring procedures. Furthermore, it may be very desirable to structure the full HPMS coverage element on an hourly basis (equipment permitting). This would allow addressing other related concerns such as peak-hour periods or examination of traffic conditions during specific hours, and provide sufficient records to detect equipment malfunctions or to input missing periods due to equipment malfunction.

Missed counts due to equipment failures, bad weather, or other reasons should be made up during the year. Partial counts could be adjusted based on hourly imputation procedures or retaken. Abnormal situations such as major construction, etc., should be handled based on the judgement of the responsible official. The typical procedures in use by each State should be applied and documented.

Data processing procedures should be designed to allow efficient utilization of computerized data. All procedures for data editing, the calculation of AADT estimates, and the development of factors should be fully computerized. Documentation on the processes including tables of the factors used should be maintained for historical purposes and to allow future reviews. Computerized data management and analysis procedures should allow the use of both mainframes and microcomputers and provide a connection to other relevant data bases. Since the HPMS requires reporting of AADT information, the use of unique HPMS sample section identification numbers in the data base would allow a direct connection between all the related programs (HPMS, volume, classification, weight, and any other). These numbers would also allow a tie-in to future developments such as computerized mapping tools.

CHAPTER 4

The Special Needs Element

Introduction

The development of a sampling approach for volume estimation can be predicated on two related but different concepts: Vehicle Miles of Travel (VMT) and Annual Average Daily Traffic (AADT). VMT estimates are more relevant to the systems and usually referred to as system estimates. AADT refers to specific locations and is, therefore, termed point-estimation. The procedures for developing these estimates are dependent on multidimensional effects which include temporal variation, spatial variation, equipment error, and adjustment factors. The two major concerns in VMT estimation, excluding equipment, are the temporal and spatial dimensions. AADT estimation presents a somewhat different problem since spatial considerations become immaterial. AADT estimation is concerned with temporal variation at the specific point in question. The only way to obtain an exact AADT (ignoring equipment error) is to install a continuous ATR at the desired point and count 365 days a year. Lacking an ATR, a number of short counts distributed throughout the year and averaged would provide an estimate. Sampling theory could then be used to define the length of counts and the number needed to achieve a desired precision. If the temporal periods of measurement were strictly defined and randomly selected, the reliability of the AADT estimate could be directly estimated. The less costly and less reliable approach is to take a short count and use a variety of adjustment factors to develop the AADT estimate (less reliable because extraneous factors are imputed to the specific location). Since this latter approach is, by far, the most common today; it is clear that cost considerations take precedence over reliability. The reliability of AADT estimates does not appear to be an overriding concern judging from the majority of existing State programs. It is apparent that the major need is to quantify the traffic at specific points roughly rather than in a strictly accurate manner. The concerns are then to detect changes of a large nature presenting an order of magnitude problem rather that one of detecting minute differences. This definition, as presented, allows a simple tie-in of AADT to VMT since system VMT estimates do not require accuracy at the point level.

It should be clear from this discussion that it is AADT (point - specific) estimation that complicates traffic counting programs. VMT estimation, by itself, would require small samples of short duration randomly distributed over the geographical (spatial) system and the calendar (temporal). The adjustment factor approach would be unnecessary. In fact, for generalized VMT estimation, the continuous ATR or Special Needs elements would not be needed. The combination of

AADT and VMT requirements into a statistical program has been described in the previous two chapters, and it is accomplished by establishing a sample framework (HPMS core) and beefing up the procedures to insure reliable AADT estimation at the sample points. What remains to be done is to tie points not included in the HPMS core sample into the program to provide a general measure of AADT.

In the case of the Interstate system, the higher precision HPMS reliability requirements for VMT result in a large HPMS core sample which should easily address most needs for AADT or VMT. The lower functional classes, due to lower VMT reliability requirements and far greater system extent, have a smaller, sparse HPMS core sample framework. These non-Interstate samples are sufficient for VMT estimation and for AADT estimation at the sample locations. However, the wide dispersion of the non-Interstate sample leaves enormous gaps which can be filled to the degree desired by each State by the Special Needs element of the program.

Chapters 2 and 3 have described the Continuous ATR element needed to adjust short counts to AADT estimates; and the HPMS coverage sample framework to produce VMT estimates, AADT at the specific sample points, and the statistical tie to vehicle classification and truck weight. This chapter describes the Special Needs element of the program. This is the last element of the three-tiered volume counting program. The Special Needs element is designed to complement and complete the program by providing sufficient flexibility to address any additional needs.

There is no question that after the first two elements are in place additional traffic data needs remain. However, these remaining needs vary enormously from State to State. A comprehensive discussion of all needs is impossible. The needs and the circumstances requiring them are too diverse. The programs, philosophies, and constraints faced by each of the 50 States are too different for complete coverage in one report or to be dealt with specifically. Therefore, these needs are described in general terms. The philosophy of the Special Needs element is then to provide wide flexibility, to encompass the diversity of situations, and to allow each State to design its program in accordance with its self-defined needs and priorities. The Special Needs program can range from minimal, limited coverage to a full, 100 percent inventory of the system depending on the desires and needs of each State. In general, judging by the size of existing programs, needs, and data requirements; the Special Needs element is expected to become the largest of the 3 elements of the program in most States.

The discussion of the Special Needs program in this chapter concentrates only on volume considerations. Although the initial direction and immediate needs may be more concerned with volume aspects, other parts of the overall program also have special needs.

The Special Needs element should then be inclusive to incorporate needs in related programs such as vehicle classification, truck weight, speed monitoring, etc. The integration of these separate needs will require mote emphasis on initial planning and coordination but will result in a more efficient and effective program.

Special needs can be generally subdivided into 2 major categories: system needs and point needs. System needs reflect those concerns that affect the overall highway system, while point needs refer to specific concerns needed for a decision at a single point in the system.

System Needs

Some of the most important needs of this nature are the development of volume flow maps on a periodic basis, the determination of volume group strata for the HPMS and the development of subunit VMT estimates.

Flow maps have been traditionally developed by most highway agencies to serve a variety of purposes. FHWA purposes that require flow map information include the HPMS, the National Bridge Inspection Program, and the National Railroad-Highway Crossing Program. Obviously, the first considerations are the level of detail desired by each State in terms of geography and highway system, and the tolerances desired in terms of accuracy of AADT. For the Interstate system, the HPMS core coverage should in many cases be sufficient to develop adequate and accurate flow maps. Plotting of the HPMS sample sections on maps will allow a decision as to how many additional counts are needed to satisfy the State's desires. In general, because of the controlled access on the Interstate, only changes in traffic volume of a large magnitude such as major interchanges not already covered require counting. Concerns at a much finer level of detail such as interchange or ramp volumes are beyond the capability of the defined procedures and would require special coverage. Concerns of this nature may be more applicable to point than to system estimation.

For systems other than the Interstate, the HPMS coverage structure is extremely limited and may be insufficient in many States for adequate flow maps even those of a general nature. Plots of the existing HPMS sample locations will allow a determination of the number of additional counts needed to satisfy the State's needs.

The manner and procedures for these additional counts are left to the individual State's discretion. The recommendations for the core program are not applicable here. Accurate and reliable procedures for the development of AADT estimates have been presented in Chapter 3. It is unlikely that the level of accuracy needed for flow maps would approach that presented for the HPMS core. Procedures that generally quantify the traffic volumes at specific points to a plus or minus 50 percent for low volume sections (under 5,000 AADT) and plus or minus 20 percent for high volume sections (greater than 5,000 AADT) can be easily derived with few constraints based on 24 hours or shorter monitoring periods and limited adjustment for seasonality. Adjustment procedures have been presented in Chapters 2 and 3 for expanding short counts to AADT. Those procedures should be considered, but less reliable procedures are applicable particularly if wide tolerance levels are all that is required.

The determination of volume group strata for the HPMS is of key importance in insuring that the HPMS sample remains attuned to changes in the highway systems. With the passage of time, the traffic volumes on the HPMS universe and sample sections change. These changes must be monitored and the sample updated on a periodic basis to insure that representativeness is indeed maintained over time. Since the changes in the system are not, in general, of a drastic nature and the HPMS by virtue of its statistical design provides a self-correcting mechanism for minor deviations; the tolerance of needed estimates is fairly wide. Minor departures from volume group strata specifications have little or no effect. Indeed, the HPMS would be in great trouble if the converse were true. Therefore, results from a wide tolerance, up-to-date flow map are quite adequate for the purpose of establishing and updating HPMS volume group strata, and no additional requirements beyond the development of rough flow maps are needed.

The development of subunit VMT estimates is a very important concern to a number of States; since apportionment of highway funds to lower jurisdictions such as counties, urban areas, or towns may be based on travel estimates. If only VMT estimates by subunit are desired, very simple procedures based on the existing framework can be developed. First of all, short monitoring periods are quite adequate for VMT estimation. Second, the HPMS provides a complete universe definition of the State's road systems with the exception of the local functional class which is excluded from the HPMS and would require separate development. For all functional classes except local, the HPMS sampling procedures as described in the HPMS Manual can be used to develop the necessary sample sizes for the desired reliability levels of subunit VMT estimates. All available samples, whether from the HPMS core or other special purposes would be used in the scheme. Any additional samples would be randomly selected from the remaining universe sections within the subunits. Adjustment procedures to convert short counts to AADT could be used before expansion to VMT or, alternatively, direct expansion (requiring a random spatial and temporal distribution of the count schedule) of the short counts to VMT requiring no adjustment could be carried out. It should be intuitively obvious that if high reliability estimates for a large number of subunits within a State are desired, the sample sizes will be enormous.

Point-Specific Needs

One of the most basic concerns for traffic information is the need for highway project information. This is perhaps the most important concern from the point of view of State management of highway programs. It is unlikely that available information from the continuous or HPMS coverage elements will be sufficient to address this need, however, available information should be exhausted before additional data is collected. The manner by which this need has been met in the past differs markedly by State. In some States the information provided by the planning department through its regular count program is judged adequate and no special counts are taken. In others, the planning information is disregarded no matter how current and a special count is made whenever requested. It is debatable which procedure is best. However, it is a waste of resources to disregard reliable information no matter how current. It should also be very clear that taking a special count by no means insures an accurate estimate at the point in question. The reliability of a special count, particularly a very short one, may be no better than plus or minus 50 percent. Yet, this may be quite sufficient to support the intended decision. Project counts depend on the importance of the project and of the decisions that will be made based on the count and should be justifiable on that basis. Many projects may be adequately supported based on existing information, while an important project in a major urban area may require taking hundreds of special volume and classification counts.

The recommended procedure is to examine the available information (maps) from the continuous, HPMS core, classification, and any other special need programs to determine whether sufficient information is available. Even if the specific location is not directly available, extrapolation from or interpolation between existing points may be sufficient to address the need and may be even more reliable than a special count. If in the judgment of the analyst, the available information is sufficient, then special counts should not be scheduled. The adjustment procedures previously described could be used to estimate AADT or other appropriate procedures substituted. Since the number of projects considered during an annual program is not very large, the described methodology would seem far more efficient than a blanket coverage of the complete State system which may still necessitate supplementary special counts and the maintenance of an enormous data base. The decision on what is required is, obviously, best made close to the source, thus complete flexibility is emphasized for this level of the Traffic Monitoring Program.

Other Related Programs

Other concerns can also be at least partially addressed by the defined structure. Studies of a special nature, urbanized area transportation studies, intersection studies, turning movements, traffic signalization, etc., can make use of any available information. Otherwise, special counts can be taken justified by the importance assigned to the study. If all or most of the specific needs can be defined at an early stage, it may be possible to coordinate the data collection to address as many concerns as possible. It is, however, unlikely that one program will be able to address all needs. Some redundancy and duplication will always exist and may actually be beneficial.

Growth areas and other areas where traffic variability is large, such as recreational areas, should receive a high level of priority in the planning of a Special Needs program. This is a basic consideration because fixed samples (continuous ATR and HPMS core elements) tend to be impervious to changes that occur away from the sample points. This is particularly important for the continous ATR element which consists of a very limited sample. Growth areas are identifiable based on knowledge of the highway systems and by monitoring available information on travel generators, construction projects, highway construction, highway maintenance, zoning laws, building permits, population growth, etc. Maintaining a higher level of attention in these areas should also serve to indicate when seasonal patterns or use of growth factors developed as a part of the general program require revision or modification. Obviously, a periodic review of the procedures will be needed to keep them up-to-date.

Future programs and studies can present a challenge to the organization of any program. The maintenance of a clearly defined yet limited structure (the continuous ATR and the HPMS coverage core) combined with a very flexible Special Needs program should provide adequate leeway for the use of existing information as well as the future implementation of any needed modifications.

Data Processing Considerations

The effectiveness of a data base depends on the ability to extract information quickly. This in turn depends on the computer systems where the data is stored and the skills of the analyst. The integrated traffic monitoring program requires an effective data base management function that permits easy access to the data base for information, update, and control purposes. Capacity and processing speeds must be carefully considered before a hardware determination is made. The emphasis of the Traffic Monitoring Guide is on the use of user-controlled micro or mini-computers, although larger machines may be necessary is some cases. The sizes of the continuous and HPMS core elements are well suited for small computer processing. However, the Special Needs element since it depends on State definition requires careful analysis.

Software must include a capable data base management package with report or quick inquiry functions. A distributed data base operation, where different purpose data bases are stored separately but can be easily linked through common identifiers, may allow independent operation of the different sub-programs without sacrificing overall program integration.

The intricacies of a fully computerized program must be explored early in the planning stage. The development of an integrated program is totally dependent on the efficiency of a computerized operation.

APPENDIX A

The computer printout tables included in this appendix were produced by the SAS (Statistical Analysis System) package. For a description of SAS procedures refer to the SAS User's Guides (References 3 and 4). The procedures used were run in batch mode with standard Job Control Language (JCL) through IBM's Time Sharing Option (TSO) at the Transportation Computer Center (TCC) of the U.S. Department of Transportation. Job submission through other methods, such as batch using cards or interactive processing, is quite feasible depending on the SAS installation specification of the computer facility used.

Other statistical packages can also be used to conduct the analysis on a variety of machines ranging from mainframes to microcomputers. Statistical software for microcomputers capable of conducting these types of analysis is beginning to appear. Although the capability and processing power of any such packages may require examination, the option would provide a very cost-effective alternative to organizations owning or having access to high level microcomputers.

The appendix contains four major application or example routines and a table of the student's T distribution which are described below:

1. Cluster Analysis Example - Pages 3-A-10 to 3-A-12.

   Page 3-A-10 describes the ATR data used in the example. The first column presents the observation number (OBS). The second column presents the station number (STNUM). The next twelve columns present the monthly average daily traffic from January thru December (M1 to M12). The last column presents the functional class (FUNC).

   Page 3-A-11 describes statistical information used to evaluate the cluster formation. An understanding of this page is helpful but not necessary to interpret the results of the clustering. A complete explanation of the statistical terminology is provided in the SAS Users Guide (Reference 4).

   Page 3-A-12 presents a dendogram or graph of the cluster formation. An understanding of this graph is necessary to select the clusters. The columns represent the location numbers (STNUM). The rows represent the clusters ranging from 1 to 20. The first row (row 1) shows a single cluster consisting of all the locations indicated by the solid line (made of x's). The second row shows the first cluster break (two clusters) indicated by the break (spaces) in the solid line. The first cluster consists of 14 locations, those with numbers between 600 and 1200. The second cluster consists of 6 locations identified as those between 900 and 2200. The third row shows 3 clusters composed of 6, 8, and 6 respectively (indicated by the breaks in the solid line). The process continues until row 20 where 20 clusters each with a single location are shown. The first four cluster breaks are indicated in the printout by vertical lines with the sequential number at each break.

The example consists of the three printouts presented and an interpretation of the results. The MADT's are used as input. To eliminate the effects of volume differences between ATR locations, the factors themselves (ratio of AADT to MADT) should be used instead. A rule-of-thumb for determining the appropriate number of clusters is to stop when the cubic clustering criterion (CCC) reaches a minimum. Another is to stop the cluster selection at the point beyond which the coefficient of determination (R squared) gains become insignificant. In this example, the CCC points to 3 clusters and the R squared to four.

It should be remembered that these are rule-of-thumb criteria and continuing the process is sometimes effective. Since the intent of the cluster analysis is to examine variation patterns and identify recreational (high variation) locations, the simplest approach is to examine the clusters until the known variation patterns in the State stand out. If a grouping procedures is currently used, a comparison of both procedures with the same number of groups should be carried out.

The following table presents the four cluster break:

Cluster 1		Cluster 2		Cluster 3		Cluster 4	
ATR Number	Func Class	ATR Number	Func Class	ATR Number	Func Class	ATR Number	Func Class
600,1800	1	200,500	6	900	1	2200	11
1500,2000	2	14000	7	2600,6000	11		
700	11	100,300	14	1900,8000	12		
1600	12	400,1300	16				
		1200					

The interpretation of the defined patterns requires knowledge of the location of the ATR's. Plotting the locations on a map is sometimes helpful in identifying or distinguishing the characteristics of the patterns.

In this example, the interpretation was unclear. The main result was a separation of the higher and lower functional classes. Interpretation at this stage is sometimes difficult and must be aided by the knowledge of State characteristics.

Clustering procedures are adequate to identify patterns but are usually insufficient for a complete determination of what groups are appropriate. Since theory does not provide an optimal solution, no clear answer to the question of what the appropriate number of groups is can be provided. The answer usually depends on actual differences between groups and on individual interpretation of results. Therefore, an alternative procedure becomes necessary.

2. <u>Descriptive Analysis of ATR Data</u> - Page 3-A-13

Page 3-A-13 presents the ATR data sorted by functional class and station number. The columns represent the observation number (OBS), the station number (STNUM), the monthly average daily traffic (MADT) from January to December (M1 to M12), the functional class (FUNC), the annual average daily traffic (AADT), the standard deviation of the MADT's (MSD), and the percent coefficient of variation of the MADT's (MCV). In the printout, check marks indicate the traffic peaks at each location.

In the example, the rural pattern (functional classes 1, 2, 6, and 7) is quite distinct from the urban pattern (functional classes 11, 12, 14, and 16) as shown by the MCV's. Several locations (1500, 2000, 200, 14000, and 700) can be examined for the presence of recreational patterns. Two of these locations (200 and 1400) may be discarded because of low AADT which reduces the importance of the differences. Knowledge of an important travel generator served by the ATR locations may reverse the decision. Location 700 exhibits more of a rural than urban or recreational pattern and is also discarded. Exceptions of this nature (see also location 400) are very often found due to the lack of precise definitional boundaries between categories of functional classification. Similarly, urban and rural areas are defined by boundary lines that inadequately reflect the actual character of continuous highways. The two locations remaining (1500 and 2000) do exhibit a summer recreational type of pattern with the July traffic peaks almost 3 times the January troughs. Verification of the location patterns would require a reason or explanation such as the presence of an established recreational traffic generator. In the determination of recreational area patterns, the data provide only an indication. Knowledge of the presence of recreational travel generators is essential when establishing the recreational pattern.

The following table describes the three groups directly indentifiable from the data provided:

SEASONAL GROUP	LOCATION NUMBER	FUNCTIONAL CLASS
1. RURAL	600,900,1900,	1
	200,500,	6
	14000	7
2. URBAN	700,2200,2600,6000,	11
	1600,1900,8000,	12
	100,300,400,1300,	14
	1200	16
3. RECREATIONAL	1500,2000	2

In this case, the data have not shown a need for regional breaks, although, the very limited number of points (20) may mask or impede the detection of all possible differences existing in the State. The point is that the existing data, in this case, do not support the need for regional breaks. Still, the decision to develop regional breaks rests ultimately on the analyst's knowledge, data support being one of the prerequisites.

Descriptive Analysis of Control Data - Pages 3-A-14 and 3-A-15.

Pages 3-A-14 and 3-A-15 present the control data sorted by functional class and station number. The format is the same as that of page 3-A-13. The check marks show the monthly traffic peaks at each location.

In the previous example, 20 ATR locations are basically insufficient to detect or quantify the complete seasonal pattern picture in the State. Therefore, an analysis of the control location data was undertaken.

The variability of these locations should be similar to that of the continuous locations and support the patterns shown there. However, since seasonal control data are collected for shorter periods of time, usually one or two weeks each month or quarter, additional variability is to be expected. The particular control program shown in this example consisted of 2-week counts taken monthly. Each control ATR had basically one-half the data of a continuous ATR.

As the check marks indicate, summer or early fall peaks remain the norm but several noticeable exceptions exist.

The first step in examining the control data printout is to identify recreational pattern locations, i.e., locations with a percent coefficient of variation larger than say 20 or 25 percent. The following locations show such a pattern:

RECREATIONAL LOCATIONS	FUNCTIONAL CLASS
70800	2
20500,70400,70500,71200,73800	6
18900,70600,72600	7
50000,71300	11
71000,71500	12
70900,71600	14

Some of the locations with high variability (20200,33600,12500, etc.) are not included due to questionable entries for one or two of the monthly entries and/or low AADT's. Several others are borderline (70100). Plotting the locations on a State map should clearly indicate the areas of the state where high seasonal variability (recreational patterns) exist. In this example, the numbering system makes it apparent that locations in the 70,000 range are in the pattern. Also, notice that recreational patterns transcend functional class (the locations are distributed over all functional systems). However, it is also apparent that some locations with 70,000 numbers do not reflect the pattern (see locations 70300, 73300, 75000), therefore, the assignment of points or locations to the recreational group is not automatic and can not be based completely on geographical definition.

Another important distinction is that the type of recreational pattern is not universal. Although most of the locations identified as recreational show a summer recreational pattern, location 20500 shows a distinct winter (recreational) pattern with traffic peaks during the winter months. It should be quite clear from this discussion why the need exists for the exercise of judgement in the assignment of factors to short counts when dealing with recreational patterns even in the geographical areas where the recreational patterns are concentrated. This is, however, the exception to the rule. It is also quite obvious from the data that the majority of locations fall within the variability ranges of their assigned groups by functional class.

The next topic of interest is whether sufficient differences exist by functional class to justify separate groups. Similar questions could also be posed regarding regional areas. The following table examines the variability of control locations within functional class excluding recreational locations already identified.

	PERCENT COEFFICIENT OF VARIATION (MCV)			
FUNCTIONAL CLASS	MINIMUM VALUE	AVERAGE VALUE	MAXIMUM VALUE	NUMBER OF LOCATIONS
2	7.6979	16.7622	27.7114	6
6	6.4447	15.3495	26.8586	14
7	8.1241	17.9500	34.3637	11
11	7.7349	10.8694	15.4683	8
12	4.3861	8.0987	18.2506	23
14	3.6853	9.7941	17.3832	37
16	4.9034	11.8040	20.7685	8

The differences between the functional classes (2, 6, and 7) within the rural group do not appear to justify deviating from the established groups. Minor differences will always exist when analyzing statistical data as shown by the averages for the three functional classes (2, 6, and 7) within rural areas, and borderline locations will create minor distortions. The important aspect is to distinguish the characteristics which identify the major differences in the variation. In this example, urban functional classes consistently show less variability than those in rural areas; but once this break is made, the differences become almost negligible.

Regional differences could be probed in a similar manner if regional categories are considered important by the analyst. It is also important not to overclassify because the total sample size (number of locations) is dependent on the number of groups established.

Once the recreational patterns are identified, either by specific areas or as individual locations, a subjective determination is made regarding the allocation of continuous counters to the recreational groups. The remaining locations are assigned to the appropriate groups solely on the basis of functional class definition and region, if regional breaks have been defined. Based on the analysis conducted, the continuous ATR locations have been allocated to the seasonal groups as shown in the following table:

SEASONAL GROUP	LOCATION NUMBER	FUNCTIONAL CLASS
1. INTERSTATE RURAL	600,900,1900	1
2. OTHER RURAL	200,500,14000	6
3. INTERSTATE URBAN	700,2200,2600,6000	7
4. OTHER URBAN	1600,1900,8000, 100,300,400,1300, 1200	12 14 16
5. RECREATIONAL	1500,2000	2

4. Monthly Factor Analysis - Pages 3-A-16 to 3-A-18.

Page 3-A-16 shows the monthly factors for each ATR station. The factors are computed as the ratio of AADT to MADT. The table presents the number of observations (OBS), the factor group (Group), the station number, (STNUM), the individual montly factors from January to December (F1 to F12), the functional class (FUNC), and the AADT. The check marks indicate the month where average traffic is closest to annual average traffic (factor is nearest to unity).

Pages 3-A-17 and 3-A-18 present statistical information on the monthly factors by seasonal group. The information includes the months of the year (F1 to F12), the group sample size (N), the average monthly factor (MEAN), the standard deviation of the monthly factor, the minimum value, the maximum value, the standard error of the mean, the sum of the values, the variance, and the percentage coefficient of variation (CV). The five seasonal groups are Interstate Rural (1), Other Rural (2), Interstate Urban (3), Other Urban (4), and Recreational (5).

The example builds on the previously described group assignments. The check marks in the printout (3-A-16) indicate the month whose average is closest to AADT. Several studies have indicated that a good estimate of AADT could be obtained from counts during a specific month of the year. While this is true in some cases, the check marks clearly indicate that caution should be exercised when following that procedure. An analysis of historical information would be necessary since individual locations vary significantly. What holds for one location may not hold for another. A determination as to whether the difference is due to random effects can only be determined based on a time-series analysis.

Pages 3-A-17 and 3-A-18 present the monthly group factors (F1 to F12) and statistical information about the factors. The seasonal groups are defined in the previous section. The average (MEAN) monthly factors provide the group factors for each month (F1 to F12). The following table presents a brief summary of the Interstate Rural group:

INTERSTATE RURAL GROUP

MONTH	N	MEAN FACTOR	CV (%)	PRECISION (%)
JAN	3	1.280	5.640	95 + or - 14
FEB	3	1.198	11.101	95 + or - 28
MAR	3	1.179	3.326	95 + or - 8
APR	3	1.100	5.993	95 + or - 15
MAY	3	.985	8.054	95 + or - 20
JUN	3	.924	8.234	95 + or - 20
JUL	3	.823	7.987	95 + or - 20
AUG	3	.811	8.381	95 + or - 20
SEP	3	.927	7.395	95 + or - 18
OCT	3	.934	10.060	95 + or - 25
NOV	3	1.020	5.877	95 + or - 15
DEC	3	1.105	1.052	95 + or - 3
AVERAGE	-	1.000	6.925	95 + or - 17

The precision of the monthly factor is determined by the use of equation 3-2-3. Values of the T distribution are given on page 3-A-19. For the January factor the 95% two-sided precision is given by 4.303 (the T value) times 5.64 (CV) divided by the square root of 3 and equals 14.

As the last column shows, the precision varies for each monthly estimate. The design precision criteria could be tied to individual monthly factor estimates or to a general annual average encompassing all factors. The recommendation is to use the average of the twelve monthly values. Under these criteria, the average precision achieved by the use of the existing 3 locations is approximately 95-17.

To estimate the number of locations needed to reduce the precision to the desired 95-10, an iterative process using equation 3-2-3 is used. The process involves using the average coefficient of variation and substituting values of T and n in equation 3-2-3.

The following table presents estimates of precision for the Interstate Rural Group:

INTERSTATE RURAL

n	T	CV	ESTIMATED PRECISION
3	4.303	6.925	95 + - 17
4	3.182	6.925	95 + - 11
5	2.776	6.925	95 + - 9
6	2.571	6.925	95 + - 8
7	2.447	6.925	95 + - 7
8	2.365	6.925	95 + - 6

Under the assumptions made, 5 locations would be sufficient to achieve the target 95-10 criteria in the example. This same procedure would be applied to all the defined groups with the exception of recreational groups.

5. Table of Student's T Distribution

Page 3-A-19 presents a one-sided table of the T distribution. The arrow indicates the values to be used in estimating 95 percent two-sided confidence intervals as used in the sample size analysis. The values of n represent the degrees of freedom.

For example, the T value with 95 percent (2 sided) confidence and a sample size of 4 is 3.182:

$$T_{95,3} = 3.182$$

1983 CONTINUOUS ATR DATA

OBS	STNUM	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	FUNC
1	600	15333	17594	16111	16131	17668	18311	20981	21460	20809	22114	17929	16867	1
2	900	32804	34095	36175	41362	47371	49410	50445	50431	42124	41530	44345	38398	1
3	1800	25424	26269	28001	30186	33693	37683	45575	46661	38521	36077	31847	30643	1
4	1500	16480	19060	20797	24846	28779	37099	48206	45510	37253	28074	20789	20824	2
5	2000	11372	11627	13529	15827	18847	22660	28528	19564	15411	13354	11978	14471	2
6	200	2820	2902	2953	3359	4054	4566	5990	5910	4398	4033	3450	3059	6
7	500	3785	3188	4206	3147	4671	4872	4572	4781	4835	4768	4445	3772	6
8	14000	1570	1778	1013	1070	2650	2668	2768	2742	2590	2545	2180	1975	7
9	700	13230	13076	14694	16721	18969	21338	24895	26296	22159	19101	17303	16024	11
10	2200	63980	66140	71135	75364	77357	77706	75087	77275	76569	76368	73924	68590	11
11	2600	43544	45043	45822	46704	47865	49329	51554	45851	47108	43581	46240	49501	11
12	6000	34276	33817	37513	40193	43226	45610	46000	46528	46499	42912	40973	39138	11
13	1600	20370	19204	21015	21657	22618	24109	24797	25618	25341	23777	22923	22024	12
14	1900	37879	37977	40989	41970	41753	45023	43756	45391	44822	46168	43325	41780	12
15	8000	49576	49554	54095	54992	56945	59423	57404	60159	57560	58489	56035	55045	12
16	100	8067	8259	8846	9165	10183	10155	9466	10026	9851	9745	9413	9374	14
17	300	6574	6497	7175	7624	7629	7936	7600	8670	7909	7686	7561	7418	14
18	400	4494	5390	5531	6061	7021	6157	7739	7728	7653	7995	6619	5528	14
19	1300	7244	7305	7848	8183	8589	8765	8570	8885	9039	8895	7724	8090	14
20	1200	5416	5379	6220	6574	6804	7265	6572	6709	7054	6803	6219	6070	16

WARD'S MINIMUM VARIANCE HIERARCHICAL CLUSTER ANALYSIS

SIMPLE STATISTICS

	MEAN	STD DEV	SKEWNESS	KURTOSIS	BIMODALITY
M1	20211.90	17873.90	1.04	0.25	0.55
M2	20707.70	18227.33	1.05	0.38	0.54
M3	22183.40	19526.98	1.06	0.45	0.53
M4	23556.80	20485.73	1.01	0.44	0.51
M5	25335.10	21047.13	0.93	0.19	0.50
M6	27004.25	21805.06	0.73	-0.35	0.48
M7	28525.25	21969.50	0.46	-0.99	0.47
M8	28309.75	22120.02	0.57	-0.73	0.47
M9	26375.25	21153.65	0.75	-0.23	0.47
M10	25200.75	20805.54	0.92	0.18	0.49
M11	23761.10	20562.95	0.97	0.10	0.53
M12	22929.55	19645.49	0.91	-0.16	0.54

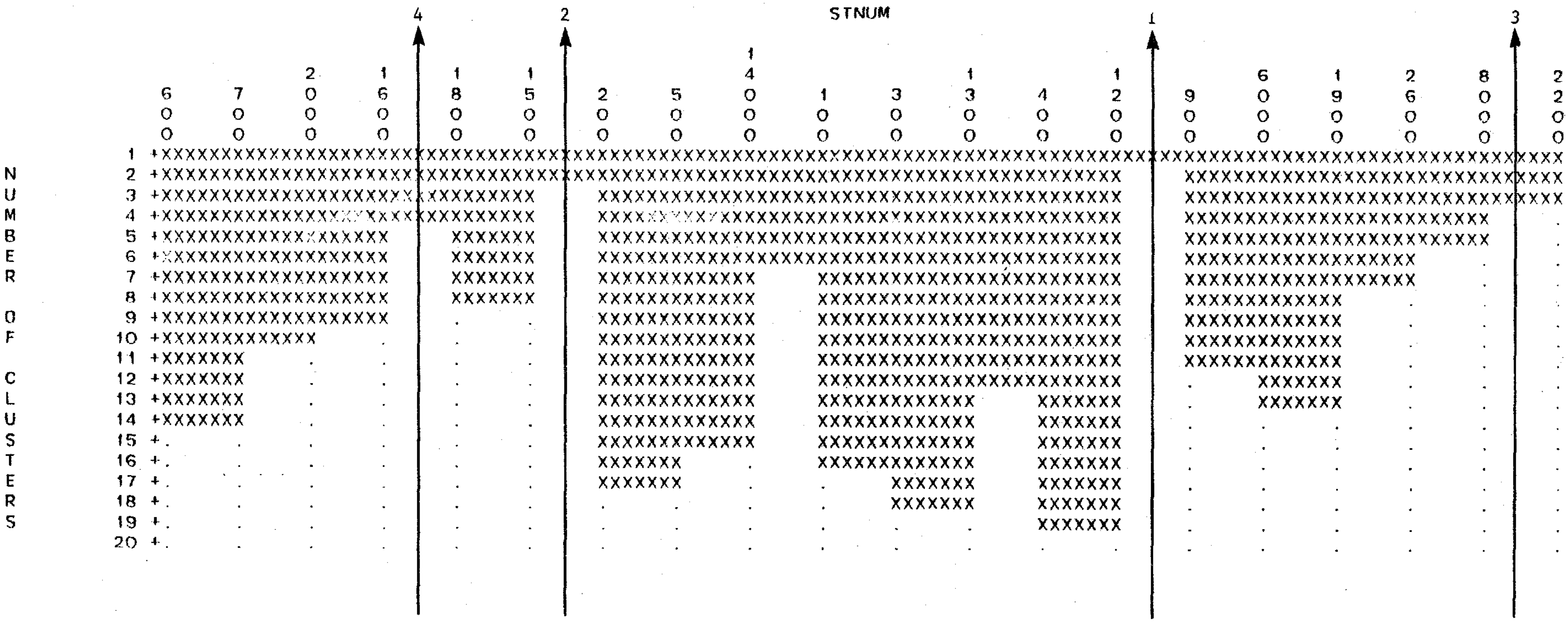
EIGENVALUES OF THE CORRELATION MATRIX

EIGENVALUE	DIFFERENCE	PROPORTION	CUMULATIVE
11.81062	11.65996	0.98422	0.98422
0.15067	0.13164	0.01256	0.99677
0.01903	0.00917	0.00159	0.99836
0.00986	0.00544	0.00082	0.99918
0.00442	0.00223	0.00037	0.99955
0.00219	0.00073	0.00018	0.99973
0.00145	0.00059	0.00012	0.99985
0.00086	0.00050	0.00007	0.99993
0.00037	0.00012	0.00003	0.99996
0.00024	0.00004	0.00002	0.99998
0.00021	0.00014	0.00002	0.99999
0.00007		0.00001	1.00000

ROOT-MEAN-SQUARE TOTAL-SAMPLE STANDARD DEVIATION = 1
ROOT-MEAN-SQUARE DISTANCE BETWEEN OBSERVATIONS = 3.4641

NUMBER OF CLUSTERS	FREQUENCY OF NEW CLUSTER	RMS STD OF NEW CLUSTER	SEMIPARTIAL R-SQUARED	R-SQUARED	APPROXIMATE EXPECTED R-SQUARED	CUBIC CLUSTERING CRITERION
10	3	0.133995	0.001425	0.995416	0.993611	1.4942
9	4	0.172967	0.002834	0.992582	0.991476	0.6271
8	2	0.239244	0.003013	0.989570	0.988688	0.2597
7	4	0.180559	0.003706	0.985864	0.984715	0.2515
6	8	0.121475	0.004185	0.981680	0.978614	0.5015
5	5	0.31787	0.016124	0.965555	0.968338	-0.2765
4	6	0.373453	0.028966	0.936590	0.948739	-0.7156
3	6	0.620936	0.080192	0.856398	0.904066	-1.4378
2	14	0.501091	0.129662	0.726736	0.767384	-0.6986
1	20	1	0.726736	0.000000	0.000000	0.0000

MONTHLY AVERAGE DAILY TRAFFIC
1983 CONTINUOUS ATR DATA



MONTHLY AVERAGE DAILY TRAFFIC
1983 CONTINUOUS*ATR DATA

OBS	STNUM	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	FUNC	AADT	MSD	MCV
1	600	15333	17594	16111	16131	17668	18311	20981	21460	20809	22114✓	17929	16867	1	18442.3	2319.1	12.5749
2	900	32804	34095	36175	41362	47371	49410	50445✓	50431	42124	41530	44345	38398	1	42374.2	6212.7	14.6616
3	1800	25424	26269	28001	30186	33693	37683	45575	46661✓	38521	36077	31847	30643	1	34215.0	6953.7	20.3236
4	1500	15480	19060	20797	24846	28779	37099	48206✓	45510	37253	28074	20789	20824	2	28976.4	10661.8	36.7949
5	2000	11372	11627	13529	15827	18847	22660	28528✓	19564	15411	13354	11978	14471	2	16430.7	5156.0	31.3804
6	200	2820	2902	2953	3359	4054	4566	5990✓	5910	4398	4033	3450	3059	6	3957.8	1102.2	27.8480
7	500	3785	3188	4206	3147	4671	4872✓	4572	4781	4835	4768	4445	3772	6	4253.5	631.7	14.8510
8	14000	1570	1778	1013	1070	2650	2668	2768✓	2742	2590	2545	2180	1975	7	2129.1	643.9	30.2427
9	700	13230	13076	14694	16721	18969	21338	24895	26296✓	22159	19101	17303	16024	11	18650.5	4325.7	23.1937
10	2200	63980	66140	71135	75364	77367	77706✓	75087	77275	76569	76368	73924	68590	11	73292.1	4716.5	6.4351
11	2600	43544	45043	45822	46704	47865	49329	51554✓	45851	47108	43581	46240	49501	11	46845.2	2406.9	5.1381
12	6000	34276	33817	37513	40193	43226	45610	46000	46528✓	46499	42912	40973	39138	11	41390.4	4541.9	10.9733
13	1600	20370	19204	21015	21657	22618	24109	24797	25618✓	25341	23777	22923	22024	12	22787.8	2023.3	8.8789
14	1900	37879	37977	40989	41970	41753	45023	43756	45391	44822	46168✓	43325	41780	12	42569.4	2717.3	6.3832
15	8000	49576	49554	54095	54992	56945	59423	57404	60159✓	57560	58489	56035	55045	12	55773.1	3414.8	6.1226
16	100	8067	8259	8846	9165	10183✓	10155	9466	10026	9851	9745	9413	9374	14	9379.2	696.6	7.4275
17	300	6574	6497	7175	7624	7629	7936	7600	8670✓	7909	7686	7561	7418	14	7523.3	585.9	7.7877
18	400	4494	5390	5531	6061	7021	6157	7739	7728	7653	7995✓	6619	5528	14	6493:0	1141.9	17.5863
19	1300	7244	7305	7848	8183	8589	8765	8570	8885	9039✓	8895	7724	8090	14	8261.4	624.9	7.5647
20	1200	5416	5379	6220	6574	6804	7265✓	6572	6709	7054	6803	6219	6070	16	6423.8	590.4	9.1916

1983 CONTROL DATA

OBS	STNUM	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	FUNC	AADT	MSD	MCV
1	16400	5126	5487	5346	5798	6604	7026	7963	7760	7405	6713	6168	5420	2	6401.3	989.9	15.4635
2	19100	1929	1794	2184	2223	2558	2393	2517	2340	2758	2924	2494	2136	2	2354.2	325.5	13.8264
3	20200	6622	6696	7271	7599	8617	8276	9192	9236	9195	10349	4126	3425	2	7550.3	2092.3	27.7114
4	61700	12751	11508	13600	13781	14095	14683	14493	14998	15400	14921	14425	14664	2	14109.9	1086.2	7.6979
5	70700	18686	24156	20882	21009	22105	26970	29685	30787	26997	21940	19099	17000	2	23276.3	4448.6	19.1119
6	70800	19526	20352	23472	27771	33017	39604	48788	47121	37836	31284	27227	24341	2	31694.9	9844.8	31.0611
7	10100	4280	4430	4436	4971	6343	5903	6691	7579	6324	8132	5133	4728	6	5745.8	1288.8	22.4301
8	20500	9777	10611	4892	5529	7619	6751	4624	4557	7500	7800	6900	7500	6	7005.0	1920.4	27.4146
9	20900	21089	23832	23594	24654	25141	24103	22519	23816	25079	25571	25295	21106	6	23816.6	1534.9	6.4447
10	29200	2055	2801	2526	2978	3137	3082	2935	3273	4244	3211	2837	2850	6	2994.1	513.7	17.1571
11	29300	6556	7790	7743	8297	8673	8277	8094	8142	9131	9216	8990	7880	6	8232.4	735.2	8.9310
12	30100	1240	1266	1476	1544	1609	1561	1576	1580	1594	1751	1500	1437	6	1511.2	143.6	9.5052
13	30200	2787	2695	3178	3328	3770	3998	4210	4294	3893	4238	3437	3316	6	3595.3	553.7	15.4017
14	33600	4301	4718	4748	5286	6014	6231	8976	6272	9336	5388	5215	5211	6	5974.7	1604.7	26.8586
15	50900	5193	5032	5130	5325	5597	7251	7141	8070	8041	6043	6314	6340	6	6289.8	1107.4	17.6061
16	51000	7129	7200	7482	8437	9089	10234	9937	9897	9825	8964	8424	7100	6	8643.2	1193.6	13.8095
17	70400	8830	12207	9687	12352	13076	21505	23042	23000	21000	14410	13048	14000	6	15513.1	5168.1	33.3143
18	70500	6598	7950	9101	12344	12300	22822	28880	29621	22000	12521	12634	9000	6	15480.9	8152.1	52.6588
19	71200	9053	9932	9913	11744	12530	15000	18000	17291	16489	12213	11751	10516	6	12869.3	3075.6	23.8984
20	73800	3952	4400	4800	6915	7032	13700	21465	22000	17000	6469	6085	4195	6	9834.4	6826.5	69.4139
21	12500	492	463	585	596	792	708	1145	1135	922	1000	533	497	7	739.0	253.9	34.3637
22	13000	1193	1591	1562	1883	2090	2140	2660	2178	2153	2100	1900	1550	7	1916.7	391.0	20.3996
23	15500	2085	2581	2110	2252	2640	3416	3798	3472	3218	2524	2416	2280	7	2732.7	588.0	21.5157
24	18900	1284	1322	1129	1465	1881	1830	2755	3572	1885	1843	1692	1425	7	1840.3	691.4	37.5718
25	19000	1239	1378	1307	1600	1643	1736	1672	1961	1832	1436	1313	1324	7	1536.8	236.0	15.3559
26	20300	1246	1256	1429	1433	1706	1692	1831	1822	1627	1798	1512	1418	7	1564.2	210.7	13.4729
27	21100	4709	5004	5458	5190	5698	6574	6375	6434	6639	6683	5706	5375	7	5820.4	695.6	11.9518
28	30300	4838	5270	5194	5888	5395	5173	4551	5100	5026	5900	5800	5723	7	5321.5	432.3	8.1241
29	32100	2176	2295	2844	2918	3430	3424	4064	3769	3380	3528	2883	2730	7	3120.1	574.6	18.4165
30	70600	22683	21480	29167	30287	37920	35425	49371	48282	38144	34581	29423	26582	7	33612.1	8899.9	26.4783
31	72600	4815	5272	5021	6650	7500	9937	10939	11200	9600	6779	6242	5641	7	7466.3	2344.3	31.3979
32	31600	13727	15356	16393	17030	17566	17715	16387	17605	18219	18938	18179	17123	11	17019.8	1414.2	8.3093
33	39000	19597	19601	22353	23782	25586	27148	28374	29650	27593	27731	25457	22938	11	24984.2	3349.8	13.4078
34	50000	23085	24928	27019	31554	36138	47623	58910	53943	40625	32863	29613	26606	11	36075.6	11801.2	32.7124
35	51100	62514	59100	59498	49837	65166	67446	68000	70212	69700	71971	56452	52513	11	62700.8	7258.8	11.5769
36	60100	24487	24185	26855	29180	31690	33959	36405	39386	36441	33526	30200	29065	11	31281.6	4838.7	15.4683
37	65000	37198	36388	39910	40864	42318	43514	42299	45466	44800	46194	46304	42233	11	42290.7	3271.1	7.7349
38	69100	70933	68658	80090	82924	85482	90967	88044	92048	88418	87404	85027	83706	11	83641.8	7293.4	8.7198
39	71300	11476	11333	15359	16633	24360	24228	30000	30000	18267	19121	17401	15000	11	19431.5	6390.3	32.8861
40	28000	8106	8521	8452	8788	8994	9161	8469	8580	8546	8957	9004	7640	12	8601.5	427.5	4.9699
41	30600	16497	16439	16229	16127	18347	17985	18193	18231	18118	20257	16644	15120	12	17348.9	1404.7	8.0969
42	30700	26317	26405	28103	29462	30826	31343	28963	30040	30212	30993	30089	28559	12	29276.0	1672.4	5.7124
43	31000	8073	8324	8994	10615	10831	11199	10833	13455	12847	10800	10316	9500	12	10482.3	1623.0	15.4835
44	40100	33759	34220	34895	35398	34141	37803	35622	35047	38572	36110	34362	37384	12	35609.4	1564.6	4.3937
45	40500	39577	40000	40300	40431	42704	44431	45646	45902	44208	46903	42759	40221	12	42756.8	2627.3	6.1447
46	50200	21320	20547	21472	22473	23737	24556	22789	22711	24700	26200	22002	21933	12	22870.0	1640.6	7.1735
47	50400	40068	44644	44876	49254	51407	58856	55400	58800	53365	50469	49138	50940	12	50601.4	5640.6	11.1471
48	50500	26800	30400	30007	29952	31438	34796	29310	33572	33411	29813	28503	28329	12	30527.6	2375.4	7.7813
49	55000	25024	26523	27002	30164	31432	32955	30404	32493	32157	30538	27835	26981	12	29459.0	2667.3	9.0542
50	61300	29470	34118	35014	38463	38531	41779	32580	40658	37564	34619	30502	27000	12	35024.8	4578.5	13.0721
51	61400	54250	53795	58685	60070	62295	60519	57398	61525	59668	58229	58000	56231	12	58388.8	2666.8	4.5673
52	70100	42824	43100	52275	53970	60937	70345	71211	73889	59810	59325	57817	46770	12	57689.4	10528.6	18.2506
53	71000	6946	11240	10188	13063	13874	24774	28077	25686	21252	11344	9179	8000	12	15301.9	7520.6	49.1481
54	71500	27193	27057	29944	33546	38272	48579	55343	54299	45317	40054	36717	35430	12	39312.6	9747.0	24.7935
55	82000	41154	39471	43058	41848	44129	45235	45832	45462	43834	43857	42000	44000	12	43323.3	1900.2	[illegible]

OBS	STNUM	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	FUNC	AADT	MSD	MCV
56	82100	46058	43976	44075	49544	49086	51038	45557	46882	45516	46866	45576	51185	12	47113.3	2512.17	5.3322
57	82200	48000	48183	50145	51042	52106	50455	45811	50000	46000	53000	53000	47372	12	49592.8	2513.87	5.0690
58	94100	19384	19293	22087	21139	20945	22703	27141	22519	25490	23984	25805	22177	12	22722.3	2478.87	10.9094
59	94200	8098	8397	9517	9586	8947	9460	9338	9599	8923	9425	9738	8963	12	9165.9	511.47	5.5801
60	94300	16219	16046	17858	17732	15928	16346	15024	15931	15778	15223	14635	15978	12	16058.2	956.34	5.9555
61	94400	7695	8240	9493	9037	9408	10424	10576	10857	9539	10546	10191	11082	12	9757.3	1053.25	10.7945
62	94500	24727	23829	26271	25936	27892	28500	27865	27590	24392	24907	28051	27249	12	26434.1	1638.54	6.1986
63	10500	7103	7763	8127	9316	10096	11057	11396	9556	10021	7985	7578	8967	14	9080.4	1397.77	15.3933
64	10700	12876	11461	13410	13465	14993	15536	17815	17628	15378	16156	13928	14072	14	14726.5	1898.09	12.8889
65	10800	5783	5370	6474	6666	7634	7652	8179	8554	7551	7952	6906	6256	14	7081.4	993.20	14.0255
66	10900	10005	9340	11917	9687	12330	11704	12739	13035	13304	13202	11766	11680	14	11725.8	1369.35	11.6781
67	12600	2007	1845	2296	2377	2723	2668	3082	3228	2634	2854	2350	2004	14	2505.7	435.56	17.3832
68	16200	10964	11471	12527	13095	13090	13196	12123	13901	13531	13859	12317	12855	14	12744.1	907.78	7.1232
69	22900	8138	8734	8929	9972	10365	10783	9700	10082	10105	9540	9335	8564	14	9520.6	799.40	8.3966
70	25700	9534	9998	10167	9907	.	12351	11313	.	.	.	.	.	14	10545.0	1069.83	10.1454
71	27200	7191	7920	7822	8448	8995	9673	9662	10025	10041	9335	8870	7987	14	8830.8	951.95	10.7800
72	28100	6375	7281	7087	8080	8630	8986	8802	8860	8546	8684	7800	7002	14	8011.1	881.63	11.0051
73	30400	14217	15346	15163	16455	17252	17514	16183	16971	16853	16996	16689	15458	14	16258.1	1001.78	6.1618
74	30500	4547	4483	5166	5348	5566	6027	5887	5762	5940	5834	5220	5480	14	5438.3	514.87	9.4674
75	30800	8015	8383	8523	9108	9698	9744	10743	9500	9060	9724	7287	8400	14	9015.4	940.90	10.4365
76	30900	12377	13495	13730	13487	14691	14673	14575	14619	14825	15115	14638	13019	14	14103.7	854.60	6.0594
77	40200	19000	19000	19810	19773	20849	22506	20210	20677	21565	20193	21400	20626	14	20467.4	1036.05	5.0620
78	40300	32700	34000	33300	33945	37269	26294	35687	34779	34000	37735	33435	34905	14	34004.1	2872.96	8.4489
79	40600	13324	13103	12243	12283	15316	14177	14548	14815	14966	15292	13078	13451	14	13883.0	1112.49	8.0134
80	40700	19300	19400	20167	19766	21212	21865	20339	20632	20768	19869	19890	20604	14	20317.7	748.76	3.6853
81	40900	11700	11400	9300	10094	10604	14073	12336	11000	15420	11331	12600	13330	14	11932.3	1730.73	14.5046
82	41000	11412	11922	12377	12475	12308	13320	12521	12409	12942	12393	12293	13522	14	12491.2	567.67	4.5446
83	41100	5528	5528	5669	5634	6233	6405	5815	5869	6294	6079	5807	6065	14	5910.5	301.03	5.0931
84	44000	9184	9400	9897	10021	10422	10982	10125	9698	10795	10161	9898	10147	14	10060.8	516.25	5.1313
85	49100	11600	11300	12383	17573	14262	14784	14012	14300	14263	13943	13505	11283	14	13600.7	1783.52	13.1135
86	50300	14000	12800	14792	11619	15734	16484	16483	16441	16795	16666	14499	15722	14	15169.6	1672.12	11.0229
87	52600	4600	4600	4599	4764	6675	6811	5914	5294	5197	5444	4949	4671	14	5293.2	789.65	14.9184
88	53400	8100	8100	9818	10484	9600	9200	11093	11146	11714	11650	10614	11253	14	10231.0	1270.73	12.4204
89	60700	25177	24600	25000	28316	30046	35380	34094	32984	32437	27322	26199	26300	14	28987.9	3859.17	13.3130
90	61500	9004	8936	9594	9567	10098	10713	9667	10957	10800	10800	9123	9863	14	9926.8	740.07	7.4553
91	61600	6413	5745	6700	6631	6845	7191	6432	6386	7070	6694	6266	6800	14	6597.8	386.30	5.8550
92	65200	14652	15566	16103	17117	17903	18747	16771	17936	17282	17892	17219	17500	14	17057.3	1140.87	6.6884
93	66000	5100	4895	4876	6119	6974	7017	5412	6669	7357	7179	4792	6180	14	6047.5	989.99	16.3703
94	70300	9409	10869	11245	11463	10701	11721	11683	12000	11900	11600	11200	11000	14	11232.6	704.49	6.2719
95	70900	13174	15131	14530	17814	17793	24641	21415	22672	21689	16047	15215	13813	14	17827.8	3856.36	21.6311
96	71600	9432	7937	9770	10078	11215	11755	12405	13893	12700	11550	5099	5552	14	10115.5	2754.67	27.2322
97	73300	9900	9932	10143	10491	10601	10801	9647	10704	10805	11567	11047	9500	14	10428.2	614.15	5.8893
98	75000	13125	12700	13268	13939	18000	18690	18187	17338	17130	14902	14366	14300	14	15495.4	2208.74	14.2541
99	75000	13125	12700	13268	13939	18000	18690	18187	17338	17130	14902	14366	14300	14	15495.4	2208.74	14.2541
100	36900	3540	3162	3962	4312	4904	5194	4982	5033	4968	4894	4241	4089	16	4440.1	658.17	14.8234
101	39300	4560	4781	4800	4978	5455	5831	5085	5105	5433	5707	4973	3715	16	5035.3	565.87	11.2381
102	44300	10277	9796	10348	10993	11762	11288	8884	10000	10600	10976	10484	10500	16	10492.3	746.06	7.1105
103	47500	6600	6600	5375	6900	7937	8717	6902	6852	9110	9100	7716	9562	16	7614.3	1287.67	16.9114
104	56000	1851	2138	2077	2506	2700	3595	3914	3530	3480	2371	2253	2168	16	2715.3	714.96	26.3312
105	61900	5397	5442	5746	5950	6779	7605	9815	8435	6476	5926	5630	5884	16	6590.4	1368.73	20.7685
106	69500	11330	11696	11824	11871	11264	13161	12700	12320	12945	12500	11779	14154	16	12295.3	845.09	6.8732
107	82500	18740	19799	20088	20719	21337	21806	19685	21189	20701	22421	21000	20122	16	20633.9	1011.76	4.9034

OBS	GROUP	STNUM	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	FUNC	AADT
1	1	600	1.20279	1.04822	1.14470	1.14329	1.04383	1.00717	0.879002	0.85938	0.88627	0.83397	1.02863	1.09340	1	18442.3
2	1	900	1.29174	1.24283	1.17137	1.02447	0.89452	0.85760	0.840007	0.84024	1.00594	1.02033	0.95556	1.10355	1	42374.2
3	1	1800	1.34578	1.30249	1.22192	1.13347	1.01549	0.90797	0.750741	0.73327	0.88822	0.94839	1.07436	1.11657	1	34215.0
4	2	200	1.40349	1.36383	1.34028	1.17828	0.97628	0.86681	0.660740	0.66968	0.89992	0.98136	1.14720	1.29383	6	3957.8
5	2	500	1.12378	1.33422	1.01129	1.35160	0.91062	0.87305	0.930337	0.88967	0.87973	0.89209	0.95692	1.12765	6	4253.5
6	2	14000	1.35610	1.19746	2.10176	1.98980	0.80343	0.79801	0.769178	0.77647	0.82204	0.83657	0.97664	1.07802	7	2129.1
7	3	700	1.40971	1.42632	1.26926	1.11539	0.98321	0.87405	0.749166	0.70925	0.84167	0.97641	1.07788	1.16391	11	18650.5
8	3	2200	1.14555	1.10814	1.03032	0.97251	0.94733	0.94320	0.976096	0.94846	0.95720	0.95972	0.99145	1.06855	11	73292.1
9	3	2600	1.07581	1.04001	1.02233	1.00302	0.97869	0.94965	0.908662	1.02168	0.99442	1.07490	1.01309	0.94635	11	46845.2
10	3	6000	1.20756	1.22395	1.10336	1.02979	0.95754	0.90749	0.899792	0.88958	0.89014	0.96454	1.01019	1.05755	11	41390.4
11	4	100	1.16266	1.13563	1.06027	1.02337	0.92106	0.92360	0.990827	0.93548	0.95210	0.96246	0.99641	1.00055	14	9379.2
12	4	300	1.14439	1.15796	1.04854	0.98679	0.98614	0.94799	0.989901	0.86773	0.95123	0.97883	0.99501	1.01419	14	7523.3
13	4	400	1.44482	1.20464	1.17393	1.07128	0.92480	1.05457	0.838997	0.84019	0.84843	0.81213	0.98096	1.17457	14	6493.0
14	4	1200	1.18607	1.19423	1.03276	0.97714	0.94411	0.88421	0.977442	0.95748	0.91065	0.94425	1.03292	1.05828	16	6423.8
15	4	1300	1.14045	1.13093	1.05268	1.00958	0.96186	0.94255	0.963993	0.92982	0.91397	0.92877	1.06958	1.02119	14	8261.4
16	4	1600	1.11869	1.18661	1.08436	1.05221	1.00751	0.94520	0.918972	0.88952	0.89924	0.95839	0.99410	1.03468	12	22787.8
17	4	1900	1.12383	1.12093	1.03856	1.01428	1.01955	0.94550	0.972882	0.93784	0.94974	0.92205	0.98256	1.01889	12	42569.4
18	4	8000	1.12500	1.12550	1.03102	1.01420	0.97942	0.93858	0.971589	0.92709	0.96896	0.95357	0.99533	1.01323	12	55773.1
19	5	1500	1.75828	1.52027	1.39330	1.16624	1.00686	0.78106	0.601096	0.63670	0.77783	1.03214	1.39383	1.39149	2	28976.4
20	5	2000	1.44484	1.41315	1.21448	1.03814	0.87179	0.72510	0.575949	0.83984	1.06616	1.23039	1.37174	1.13542	2	16430.7

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN	SUM	VARIANCE	C.V.
GROUP=1									
F1	3	1.28010015	0.07220120	1.20278702	1.34577565	0.04168538	3.84030046	0.00521301	5.640
F2	3	1.19784314	0.13296900	1.04821720	1.30248582	0.07676969	3.59352943	0.01768075	11.101
F3	3	1.17933038	0.03921936	1.14470445	1.22192065	0.02264331	3.53799114	0.00153816	3.326
F4	3	1.10040953	0.06594752	1.02447093	1.14328519	0.03807482	3.30122859	0.00434908	5.993
F5	3	0.98461225	0.07930047	0.89451704	1.04382688	0.04578415	2.95383675	0.00628856	8.054
F6	3	0.92424818	0.07610192	0.85760305	1.00717237	0.04393746	2.77274453	0.00579150	8.234
F7	3	0.82324981	0.06575208	0.75074054	0.87900164	0.03796198	2.46974944	0.00432334	7.987
F8	3	0.81096329	0.06796368	0.73326761	0.85938180	0.03923885	2.43288987	0.00461906	8.381
F9	3	0.92680760	0.06853658	0.88626716	1.00593882	0.03956961	2.78042279	0.00469726	7.395
F10	3	0.93422709	0.09398371	0.83396642	1.02032667	0.05426152	2.80268126	0.00883294	10.060
F11	3	1.01951459	0.05992179	0.95555681	1.07435551	0.03459586	3.05854377	0.00359062	5.877
F12	3	1.10450566	0.01161487	1.09339736	1.11656822	0.00670585	3.31351699	0.00013491	1.052
GROUP=2									
F1	3	1.29445637	0.14969835	1.12377807	1.40348700	0.08642838	3.88336910	0.02240960	11.565
F2	3	1.29850377	0.08875010	1.19745969	1.36382954	0.05123989	3.89551132	0.00787658	6.835
F3	3	1.48444309	0.55934590	1.01129339	2.10176045	0.32293851	4.45332926	0.31286784	37.681
F4	3	1.50655983	0.42737524	1.17827727	1.98979751	0.24674521	4.51967948	0.18264959	28.368
F5	3	0.89677499	0.08725305	0.80342767	0.97627857	0.05037557	2.69032496	0.00761309	9.730
F6	3	0.84595423	0.04164054	0.79800725	0.87305008	0.02404118	2.53786270	0.00173393	4.922
F7	3	0.78675149	0.13565482	0.66074012	0.93033683	0.07832035	2.36025446	0.01840223	17.242
F8	3	0.77860751	0.11000720	0.66968415	0.88966743	0.06351269	2.33582253	0.01210158	14.129
F9	3	0.86722922	0.04041559	0.82203990	0.89991663	0.02333395	2.60168765	0.00163342	4.660
F10	3	0.90334340	0.07304624	0.83657498	0.98136210	0.04217327	2.71003020	0.00533575	8.086
F11	3	1.02691989	0.10462985	0.95691789	1.14719807	0.06040807	3.08075968	0.01094741	10.189
F12	3	1.16650013	0.11303106	1.07801688	1.29383241	0.06525851	3.49950040	0.01277602	9.690
GROUP=3									
F1	4	1.20965860	0.14381846	1.07581221	1.40971277	0.07190923	4.83863439	0.02068375	11.889
F2	4	1.19960344	0.16914262	1.04000992	1.42631539	0.08457131	4.79841377	0.02860923	14.100
F3	4	1.10631862	0.11458321	1.02232916	1.26925956	0.05729160	4.42527446	0.01312931	10.357
F4	4	1.03017899	0.06144142	0.97250787	1.11539382	0.03072071	4.12071594	0.00377505	5.964
F5	4	0.96669206	0.01708406	0.94733004	0.98320945	0.00854203	3.86676824	0.00029187	1.767
F6	4	0.91859535	0.03501010	0.87405099	0.94964760	0.01750505	3.67438138	0.00122571	3.811
F7	4	0.88342895	0.09577395	0.74916650	0.97609551	0.04788697	3.53371579	0.00917265	10.841
F8	4	0.89224341	0.13342585	0.70925236	1.02168255	0.06671293	3.56897362	0.01780246	14.954
F9	4	0.92085660	0.06818479	0.84166704	0.99442062	0.03409239	3.68342638	0.00464917	7.404
F10	4	0.99389448	0.05445657	0.95972244	1.07489885	0.02722829	3.97557791	0.00296552	5.479
F11	4	1.02315090	0.03772294	0.99145181	1.07787667	0.01886147	4.09260359	0.00142302	3.687
F12	4	1.05909060	0.08905059	0.94634789	1.16391038	0.04452530	4.23636238	0.00793001	8.408

MONTHLY FACTORS BY SEASONAL GROUP
1983 CONTINUOUS ATR DATA

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN	SUM	VARIANCE	C.V.
GROUP=4									
F1	8	1.18073835	0.10904215	1.11869170	1.44481531	0.03855222	9.44590677	0.01189019	9.235
F2	8	1.15705270	0.03372840	1.12092626	1.20463822	0.01192479	9.25642158	0.00113760	2.915
F3	8	1.06526340	0.04717477	1.03102104	1.17392877	0.01667880	8.52210716	0.00222546	4.428
F4	8	1.01860668	0.03111540	0.97714481	1.07127537	0.01100095	8.14885346	0.00096817	3.055
F5	8	0.96805617	0.03655877	0.92106125	1.01955349	0.01292548	7.74444936	0.00133654	3.777
F6	8	0.94777403	0.04804004	0.88420509	1.05457203	0.01698472	7.58219223	0.00230785	5.069
F7	8	0.95307536	0.05127815	0.83899729	0.99082682	0.01812956	7.62460287	0.00262945	5.380
F8	8	0.91064525	0.04042568	0.84019151	0.95748249	0.01429264	7.28516203	0.00163424	4.439
F9	8	0.92429084	0.03931034	0.84842545	0.96895558	0.01389831	7.39432676	0.00154530	4.253
F10	8	0.93255689	0.05197154	0.81213258	0.97882514	0.01837472	7.46045509	0.00270104	5.573
F11	8	1.00585793	0.03026427	0.98096389	1.06957751	0.01070003	8.04686341	0.00091593	3.009
F12	8	1.04194654	0.05628831	1.00055117	1.17456585	0.01990092	8.33557235	0.00316837	5.402
GROUP=5									
F1	2	1.60155649	0.22163728	1.44483527	1.75827771	0.15672122	3.20311298	0.04912308	13.839
F2	2	1.46671063	0.07574962	1.41314756	1.52027370	0.05356307	2.93342126	0.00573800	5.165
F3	2	1.30388773	0.12644510	1.21447754	1.39329791	0.08941018	2.60777545	0.01598836	9.698
F4	2	1.10219114	0.09057977	1.03814157	1.16624071	0.06404957	2.20438228	0.00820469	8.218
F5	2	0.93932595	0.09550721	0.87179215	1.00685975	0.06753380	1.87865190	0.00912163	10.168
F6	2	0.75307608	0.03957035	0.72509562	0.78105654	0.02798046	1.50615216	0.00156581	5.254
F7	2	0.58852221	0.01778152	0.57594878	0.60109565	0.01257343	1.17704442	0.00031618	3.021
F8	2	0.73827314	0.14363990	0.63670439	0.83984189	0.10156875	1.47654627	0.02063242	19.456
F9	2	0.92199630	0.20388514	0.77782774	1.06616486	0.14416856	1.84399260	0.04156915	22.113
F10	2	1.13126855	0.14018298	1.03214421	1.23039289	0.09912434	2.26253711	0.01965127	12.392
F11	2	1.38278558	0.01562494	1.37173707	1.39383408	0.01104850	2.76557115	0.00024414	1.130
F12	2	1.26345583	0.18106963	1.13542027	1.39149139	0.12803556	2.52691165	0.03278621	14.331

ONE-SIDED STUDENT'S T DISTRIBUTION

.95 Level (2 sided)

n \ F	.60	.75	.90	.95	.975	.99	.995	.9995
1	.325	1.000	3.078	6.314	12.706	31.821	63.657	636.619
2	.289	.816	1.886	2.920	4.303	6.965	9.925	31.598
3	.277	.765	1.638	2.353	3.182	4.541	5.841	12.941
4	.271	.741	1.533	2.132	2.776	3.747	4.604	8.610
5	.267	.727	1.476	2.015	2.571	3.365	4.032	6.859
6	.265	.718	1.440	1.943	2.447	3.143	3.707	5.959
7	.263	.711	1.415	1.895	2.365	2.998	3.499	5.405
8	.262	.706	2.397	1.860	2.306	2.896	3.355	5.041
9	.261	.703	1.383	1.833	2.262	2.821	3.250	4.781
10	.260	.700	1.372	1.812	2.228	2.764	3.169	4.587
11	.260	.697	1.363	1.796	2.201	2.718	3.106	4.437
12	.259	.695	1.356	1.782	2.179	2.681	3.055	4.318
13	.259	.694	1.350	1.771	2.160	2.650	3.012	4.221
14	.258	.692	1.345	1.761	2.145	2.624	2.977	4.140
15	.258	.691	1.341	1.753	2.131	2.602	2.947	4.073
16	.258	.690	1.337	1.746	2.120	2.583	2.921	4.015
17	.257	.689	1.333	1.740	2.110	2.567	2.898	3.965
18	.257	.688	1.330	1.734	2.101	2.552	2.878	3.922
19	.257	.688	1.328	1.729	2.093	2.539	2.861	3.883
20	.257	.687	1.325	1.725	2.086	2.528	2.845	3.850
21	.257	.686	1.323	1.721	2.080	2.518	2.831	3.819
22	.256	.686	1.321	1.717	2.074	2.508	2.819	3.792
23	.256	.685	1.319	1.714	2.069	2.500	2.807	3.767
24	.256	.685	1.318	1.711	2.064	2.492	2.797	3.745
25	.256	.684	1.316	1.708	2.060	2.485	2.787	3.725
26	.256	.684	1.315	1.706	2.056	2.479	2.779	3.707
27	.256	.684	1.314	1.703	2.052	2.473	2.771	3.690
28	.256	.683	1.313	1.701	2.048	2.467	2.763	3.674
29	.256	.683	1.311	1.699	2.045	2.462	2.756	3.659
30	.256	.683	1.310	1.697	2.042	2.457	2.750	3.646
40	.255	.681	1.303	1.684	2.021	2.423	2.704	3.551
60	.254	.679	1.296	1.671	2.000	2.390	2.660	3.460
120	.254	.677	1.289	1.658	1.980	2.358	2.617	3.373
∞	.253	.674	1.282	1.645	1.960	2.326	2.576	3.291

.95 Level (2 sided)

F = confidence level
n = degrees of freedom

SECTION 4

Vehicle Classification

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References

1. Wyman, John ; Braley, Gary A. and Stevens, Robert I., "Field Evaluation of FHWA Vehicle Classification Categories," Maine Department of Transportation, Final Report under contract DTFH-71-80-54-ME-03 for U.S. Department of Transportation, Federal Highway Administration; Office of Highway Planning, January 1985.

2. Davies, Peter and David R. Salter, "Reliability of Classified Traffic Count Data" in Transportation Research Record 905.

CHAPTER 1

Introduction

Vehicle classification is the observation of highway vehicles and the subseauent sorting of the resulting data into a fixed set of categories. As with any classification scheme, the one for highway vehicles attempts to provide structure to the reporting of the multitude of vehicles observed while providing a scheme of logical relationships between categories.

Vehicle classification data are of considerable use to agencies involved in almost any aspect of transportation planning and engineering. Some examples include the following:

- pavement design;
- scheduling resurfacing, reconditioning, and reconstructing of highways based on projected pavement life remaining;
- predicting commodity flows and freight movements;
- providing design input relative to current and predicted capacity of highways;
- developing weight enforcement strategies;
- accident record analysis;
- environmental impact analysis; and
- analysis of alternative highway regulatory and investment policies.

In short, vehicle classification data are extremely important as transportation agencies and State legislatures grapple with the need to determine and allocate the costs associated with maintaining the highway system and in selecting the improvements that will be programmed.

CHAPTER 2

Procedures for the Vehicle Classification Sample

The purpose of this chapter is to provide guidelines on practical procedures the States may use to develop the vehicle classification sample. Similar procedures are also applicable to the truck weight sample and can be used for that purpose.

The FHWA recognizes that States have a considerable investment in equipment, expertise, and historical data trends at fixed locations in each State. Data collected at these locations may historically include volume, speed, classification, and weight; States generally return to the same sites annually for the latter three items. Many of these sites have instrumented equipment in place. From a cost and an efficiency viewpoint, it would be wise wherever possible to incorporate these existing sites into an expanded sample of sites based upon the HPMS structure. This is because the financial investment in these sites is substantial and this incorporation would allow continuation of long-term trend series at these locations. This chapter provides guidelines on how to incorporate existing sites into the broader design, thus achieving the joint objectives of maintaining continuity and limiting additional capital cost investments as well as achieving the representativeness necessary for estimation of State-level totals.

An overview of the existing programs shows that States already have the HPMS sections identified. These HPMS sections have been selected to represent the highway network in each State. In addition to the HPMS sample, States will also have in place a varying number of automatic traffic recorders (ATR's), speed, weight, and classification sites at which they had been obtaining data historically. These sites may or may not conform to the HPMS samples; generally, some sites will conform exactly, others will be quite close to existing HPMS sites, and others will not match. The objective is to describe the procedures whereby these existing fixed sites can be augmented by an additional number of sites, such that the group when taken together is representative of the HPMS sites and of the State system as a whole.

The methodology is as follows:

1. Identify the distribution and number of desired sites by HPMS functional class and volume group.

2. Determine the distribution of existing sites by HPMS functional class and volume group.

3. Determine the distribution of additional needed sites by HPMS functional class and volume group.

4. Identify the specific locations of the additional needed sites.

5. Check the combined distribution of existing and additional sites against the overall distribution of HPMS samples to insure an adequate distribution of samples.

STAGE 1. Identify the Desired Distribution of Sites

As described in Section 2, this Guide recommends that the HPMS samples be used as the sampling frame from which the smaller groups of volume, classification, and weight sites should be drawn.

The distribution of sites should conform to the distribution of HPMS annual VMT by area type and functional class. The steps necessary to achieve this are as follows:

Step 1A: Summarize HPMS Statistics by Area, Functional Class, and Volume Group

The first step is to prepare basic summaries of expanded traffic, mileage, the number of HPMS samples, and existing fixed sites by area, functional class, and volume group. Exhibit 4-2-1 shows such a summary based on the 1982 HPMS submittal for a State.

Step 1B: Estimate the Total Sample Size Required

Procedures for estimating the total sample size are given in Chapter 4 of Section 2.

Based on the analysis shown, a sample size of 300 classification sites, to be sampled for 48 hours over a 3-year period, would be sufficient to achieve a 95-10 reliability for key parameters such as the proportion of 3S2's in the statewide population. Smaller sample sizes will, of course, have greater error. For purposes of the following example, we will assume a sample size of 300 spread over a 3-year period, or 100 annually.

Step 1C: Determine the Desired Distribution of the Sample by Area, Functional Class, and Volume Group

This step is a straightforward allocation of the total sample size to each of the cells of the HPMS area/functional class/volume group matrix. If additional samples are ultimately to be drawn within a volume group in simple random sample fashion, then this allocation must be made to each of the volume groups within each of the cells shown in Exhibit 4-2-1.

Exhibit 4-2-1

Example of distribution of HPMS samples, travel, mileage, and ATR's by area, functional class, and HPMS volume group.

RURAL FUNCTIONAL CLASS

HPMS Volume Group	Data Type	INT	OPA	MA	Major Collectors	Minor Collectors
1	A	48	173	93	82	135
	B	2,186	3,010	3,464	5,929	2,866
	C	338	1,076	2,350	4,924	6,884
	D	0	0	2	0	0
2	A	26	35	36	21	37
	B	6,423	3,470	4,749	3,793	4,507
	C	444	534	1,484	1,175	3,100
	D	4	2	5	2	0
3	A	4	7	19	11	4
	B	1,807	1,424	4,873	1,941	1,408
	C	70	128	719	282	611
	D	0	3	4	4	0
4	A	6	5	10	--	8
	B	722	827	1,564	--	1,404
	C	20	52	127	--	378
	D	2	1	3	--	0
5	A	1	14	1	--	1
	B	40	557	77	--	225
	C	1	23	3	--	31
	D	0	1	0	--	0
6	A	--	1	--	--	--
	B	--	94	--	--	--
	C	--	3	--	--	--
	D	--	0	--	--	--

LEGEND A - Number of HPMS Sections
B - DVMT (Expanded) in Thousands
C - Mileage (Expanded)
D - Fixed Existing Sites

States that may decide to use a sample of their own design are advised to consult with FHWA Headquarters (HHP-44) in order to determine the effect of any alternative design on the procedures in this Guide.

Exhibit 4-2-2 presents an example of the simple random sample procedure to the full stratification of the HPMS. In the table, it is assumed that the Interstate Rural system carries 6 percent of the VMT according to the HPMS. Therefore, 6 percent of the proposed 300 sample sections corresponds to 18 samples or six per year. The sections are then distributed to the volume groups based on the percentage of VMT. To insure a positive chance of selection for every section in the HPMS sample, one section has been moved from group 2 to group 5. This type of minor adjustment will occur often. An alternative may be to combine groups 4 and 5.

Several advantages of the simple random procedures are:

1. It allocates eoual probability of selection to sample sections within each strata. Combined with the distribution to strata proportional to VMT, this results in a self-weighting sample, i.e., an average can be derived directly by summing the sample characteristics and dividing by the sample size.

2 It provides a well-balanced sample insuring a full distribution on the basis of volume.

3. It insures that higher volume sections are included in the classification sample in proportion to their representation in the universe.

One disadvantage is the fact that minor adjustments will be needed because of the large number of strata in the HPMS sample.

The allocation of the sample proportional to VMT or DVMT was made to distribute the sample in proportion to travel not mileage. An additional advantage is that systems (strata) with a limited proportion of travel do not receive an inordinate number of samples. This type of application, while ouite appropriate for statewide estimation, may not account fully for the perceived importance of portions of the statewide highway system. The case in point is the Interstate system. In the example presented, the Interstate Rural system carried 6 percent of HPMS VMT (excludes local functional class) resulting in an annual classification sample of 6 sections. Although the statewide sampling on all functional classifications will approximate the target reliability, the 6 samples attributable to the Rural Interstate strata are insufficient to provide very reliable estimates of VMT by vehicle classes for the Interstate rural strata. Even though, many of the fixed sites on the Interstate will be incorporated into the vehicle classification sample, thereby, providing the capability of monitoring classification in ATR fashion and much more reliably than with 48-hour short counts; the States may desire to specify individual target reliability levels on the Interstate strata. Two alternatives are

EXHIBIT 4-2-2

Example of Full Stratification Simple Random Sample Procedure for the Interstate Rural System Described in Exhibit 4-2-1.

	STAGE 1 DESIRED DISTRIBUTION			STAGE 2 EXISTING SITES				STAGE 3 REMAINING SITES			STAGE 4 SAMPLING FRAME	
	1	2	3	4	5	6	7	8	9	10	11	12
Volume Group	DVMT (000)	Percent	Desired Sample Sections	HPMS Match	Close Match	No Match	Total	Usable Existing Sites	Additional Sites Needed	HPMS Samples	Existing Sites	Samples Available
1	2,186	20	4	0	0	0	0	0	4	48	0	48
2	6,423	57	(10) 9*	2	1	1	4	3	6	26	3	23
3	1,807	16	3	0	0	0	0	0	3	4	0	4
4	722	6	1	0	1	1	2	1	0	6	1	5
5	40	1	0 (1)*	0	0	0	0	0	1	1	0	1
TOTAL	11,178	100%	18	2	2	2	6	4	14	85	4	81

* One section from Group 2 has been added to Group 5.

provided to address this situation: (1) increase the sample sizes in the affected strata (Interstate) to establish individual target reliabilities (resulting in an increase in the overall sample); or (2) arbitrarily assign a percentage of the sample to the Interstate. This second alternative is used in the truck weight sample (Section 5), without increasing the overall sample reauired. For example, assigning one-third of the classification sample to the Interstate would result in an annual sample of 33 sections in the Interstate and these would be distributed to urban and rural based on VMT.

Because of the importance of the Interstate system, either of these alternatives are recommended for States with extensive Interstate mileage, regardless of system travel.

STAGE 2: Determine the Distribution of Existing Sites

The purpose of this exercise is to maximize the opportunities for using existing sites as part of the recommended desired distribution. The reason for this focus is FHWA's recognition that the States have invested considerable funds and effort and have obtained considerable knowledge from these existing locations; to the maximum extent possible, therefore, this investment should not be lost. The methodology described below allows for the maximum integration of the existing sites into the revised sampling plan. Examples of the application are continued on Exhibit 4-2-2.

The procedures to allow the use of existing sites in the sampling approach may change the structure of the program. The use of fixed sites may allow the collection of classification data on a continuous basis. The structure of the proposed program is then changed from a sample of short (48-hour) classification counts to a combination of continuous (ATR) and short classification counts. This gain can result in much better estimates of seasonality of classification data and allow the future development of seasonal factors in a manner similar to that used in the volume counting program.

Step 2A: Locate the Existing Sites

The next step is to describe each of the existing sites by area, functional class, and HPMS volume group. These are locations which have installed eauipment (ATR's) or locations at which speeds, classifications or weights have been taken historically. The distribution of these sites by area, functional class, and volume group should be developed. Exhibit 4-2-2, column 7, shows an example of such a distribution of the six fixed sites in our example. These six fixed sites were chosen for this example because they each contain physical eauipment which can be modified for classification purposes and, thus, form the basic fixed investment which is possibly usable. In each State, of course, the analyst may wish to include ATR sites, weight, classification, and speed sites.

Step 2B: Assess Usefulness of each Site for Inclusion in the Sampling Distribution

In this step, the analyst determines the degree to which each site identified can possibly be used as a portion of the desired distribution. The basic criteria on which the assessment should be made is whether or not the site matches exactly, is close to, or does not match an existing HPMS sample. This determination requires knowledge of the location of the HPMS sample sections and of the fixed sites. In Exhibit 4-2-2, our example shows that the existing sites in column 7 are subdivided into those that "match HPMS sections" (column 4), are "close to HPMS sections" (column 5), or "do not match" (column 6).

Obviously, some judgment is necessary to determine whether a site is "close to" or "does not match" an HPMS section. Generally, if the existing site is so close to the section that either the total volume or the classification of traffic by type and weight is not judged to be substantially different between the site and the HPMS section close to it, then the site can be considered for practical purposes to be at the HPMS section. Only in the case where no match occurs would a site be considered for relocation. However, there may be many other reasons for retaining such sites as part of the Special Needs element.

The procedures recommended in Section 3 (volume) of this Guide which are used to streamline the seasonal factor program and the number of ATR's needed by seasonal group should also be addressed when considering the use of existing fixed sites.

The HPMS samples constitute, overall, about 5 percent of highway mileage, but this proportion can vary substantially for higher volume facilities for which the proportion may be as high as 50 percent. Thus, on higher facilities, many sites will in fact coincide with HPMS samples, while for lower facilities this match will be much smaller and most sites will not correspond to HPMS sections. One may, therefore, expect that additional investments will largely be necessary on the lower level facilities.

STAGE 3: Determine the Distribution of Additional Needed Sites

The purpose of this stage is to determine additional site investment costs necessary to bring the existing distribution of sites into line with the desired distribution. To achieve this the following steps are necessary. (The example is continued on Exhibit 4-2-2).

Step 3A: Determine the Distribution of Existing Usable Sites

The existing usable sites are defined as those which presently fall exactly on HPMS sections and those which have been determined to be sufficiently close to HPMS sections to be considered to fall on them.

In the example in Exhibit 4-2-2, this is column 8 or the sum of the sites in columns 4 and 5. The example shows that four of the six existing sites were deemed to be usable as a portion of the desired distribution.

Step 3B: Determine the Distribution of Additional Needed Sites

This distribution is obtained by subtraction of the existing usable sites from the desired distribution. In Exhibit 4-2-2, this is shown in column 9. The proposed program recommends only portable, short classification counts (48 hours). Therefore, a determination would have to be made, after the selection of the additional sites, regarding how many of the sites could be monitored with portable equipment versus installation of fixed equipment.

Application of the recommended procedure may, of course, leave a number of existing sites for which no match with the HPMS sample is achievable. A number of alternatives are possible on how to handle these remaining sites:

(1) The sites may already be justified by another purpose, i.e., speed monitoring or truck weight enforcement site, in which case the locations would be retained.

(2) The State may wish to maintain the location to continue historical trends at these locations and to augment the information obtained from the HPMS-based program.

(3) The State may wish to eliminate these locations if no justification exists to maintain them.

(4) The State may wish to relocate these locations over a period of time to conform with the desired distributions and improve the sampling and estimation processes.

(5) The oversampling implied by these sites can be incorporated into the desired distribution by the use of weighting factors although the surplus sites will always lack a direct tie-in to the HPMS.

(6) In the particularly sensitive case in which an existing heavily outfitted location does not fall on an HPMS site, an HPMS sample could be added at the location (this would be considered an exception applicable only to a very limited number of sites).

The decision on which, if any, of these "no match" sites to retain must be made on a case-by-case basis. Careful comparison of the characteristics of these sites with respect to such factors as need for data, ease of administration, stability of trends in the data, accuracy of eauipment, local concerns for a continuous effort, degree to which the site can be integrated into future plans, and prospects for upcoming construction which may destroy the location, etc., should all be considered for each location.

STAGE 4: Identify Specific Locations for Additional Needed Sites

This stage consists of the actual sampling effort necessary to identify the HPMS sections which will be added to the existing locations to form the desired distribution. The steps necessary are as follows:

Step 4A: Establish the Sampling Frame

The sampling frame consists of the HPMS samples minus any samples already used as existing fixed sites. An example is presented in Exhibit 4-2-2. In the exhibit, column 10 presents the number of samples in the HPMS sample. Column 11 presents the number of existing sites which are matched to HPMS sites. Column 12 presents the remaining samples available for further sampling.

Step 4B: Draw the Vehicle Classification Subsample

In this step, the sites needed for addition to the sample are selected from the available HPMS samples. The method used is simple random sampling from each HPMS strata.

Exhibit 4-2-3 presents an example using data from Exhibits 4-2-1 and 4-2-2. The exhibit presents the percentage VMT, the HPMS samples remaining after accounting for the fixed sites, the additional samples needed, and the final sample including the fixed sites. The selection is made by assigning a uniaue seauential number to each section within a single stratum and randomly (by a table of random numbers or computer-generated random numbers) selecting the desired sample.

For example, in volume group 1 of Exhibit 4-2-3, assign to each of the 48 available HPMS samples a uniaue number ranging from 1 to 48. Randomly select four uniaue numbers within the range of 1 to 48 (disregard duplicates). These would become the sample.

EXHIBIT 4-2-3

Example of Simple Random Sample Selection for the Interstate Rural System of One State

Functional Class	Volume Group	1 Percent VMT	2 HPMS Samples Available	3 Additional Samples Needed	4 Final Sample
Interstate Rural	1	20	48	4	4
	2	57	23	6	9
	3	16	4	3	3
	4	6	5	0	1
	5	1	1	1	1
	Total	100	81	14	18

Step 4C: Evaluate the Feasibility of New Sites

Once the particular locations of new sites have been identified, they must be carefully assessed with respect to other features which include:

(1) Location characteristics - site geometry, physical safety for crews and equipment, equipment installation constraints, etc.

(2) Administrative concerns - difficulty in outfitting site, type of equipment to be used, availability of land, etc.

(3) System concerns - proximity to other sites (geographically, functionally or otherwise), overall coverage patterns, etc.

It is possible that some of the new randomly selected sites will not meet the test of practicality. In this case, non-practical selections should be discarded and additional sites randomly selected by the same procedures previously described. However, these modifications should be undertaken with great care, since sites which may be satisfactory on all the practical factors may be unique in other respects and reduce the representativeness of the resulting distribution. In general, new sites selected initially for inclusion should not be discarded unless sufficient reasons exist for doing so. It is of the utmost importance to maintain the statistical validity and representativeness of the sample.

STAGE 5: Check to Insure Representativeness

Once the final samples have been identified, the final step is to review the total distribution to insure that the sample as a whole is, indeed, representative of the HPMS sample and HPMS universe. The check should proceed by comparing the percentage distribution of the final sample against the percent distribution of the HPMS sample and/or universe over several dimensions. These may include:

(1) The DVMT or VMT by area, functional class, or volume group. Because of its design, the sample should match these characteristics.

(2) Federal-Aid class.

(3) Area type (urban, suburban, rural).

(4) Pavement type.

(5) Region of the State.

The distribution will not match exactly and due to the small sample and design constraints, differences should not be considered exceptional. Statistical tests to detect significant differences exist but these must be applied following the design constraints (stratification and selection procedure). In case major differences are detected, special procedures that modify the selection procedures can be considered. Additionally, as data is collected and begins to flow in, the data itself should be checked for reasonableness and representativeness against other parameters that may be available.

Summary

The purpose of this chapter has been to describe procedures whereby the sampling plan for the vehicle classification element can be developed with maximum efficiency. The chapter showed how the desired distribution of sites can be obtained by beginning with existing site distributions and adding additional sites necessary to achieve the desired layout. In this way, the necessary investments by the State in achieving the desired distribution will be kept to a minimum, and historical trends will be continued to the maximum extent possible.

CHAPTER 4

Data Collection Equipment and Data Reporting

To obtain classification data many States use manual observation and recording techniques, while some States use automated vehicle classification devices as a method of overcoming the high cost of manual procedures and as a means to gather more comprehensive vehicle classification data. In order to support the number and duration of classification sessions called for in this Guide, automation should be given serious consideration.

Automatic vehicle classification is a rapidly improving technology. An FHWA sponsored evaluation of various automated vehicle classification systems was published in 1985. The evaluation found equipment to be 90 to 95 percent accurate. This compares well with manually obtained information which has been found to have a ten percent error on total vehicle flows with errors above 30 percent for certain specific vehicle types.

In general, each automated vehicle classification system has a common set of components:

1. the sensing device (sensor) which provides the system with the raw data of presence or passage of the vehicle to be classified;

2. the detector which receives the signals from the sensors, and amplifies and/or interprets them and passes them on to a recorder;

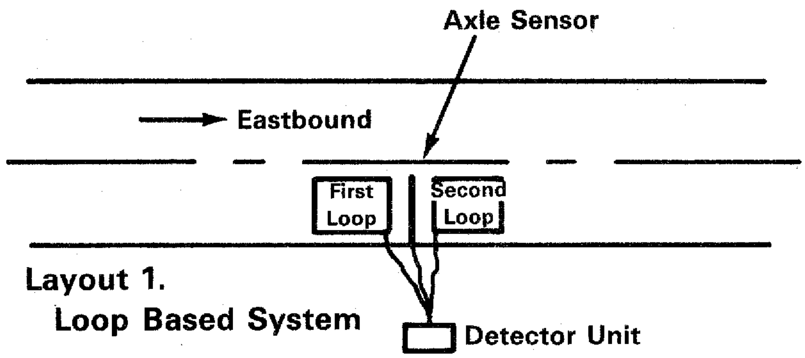
3. the recorder which performs the basic calculation of vehicle length, number of axles, or whatever data is being produced; and

4. the information processor which manipulates the basic data into the presentation format.

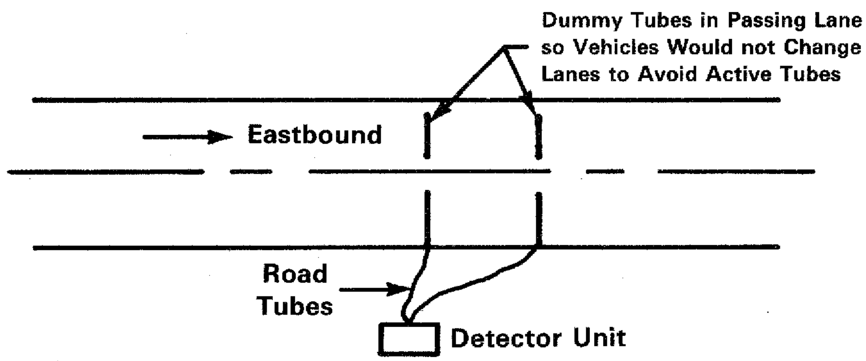
Typically, the last three components are not separable or interchangeable among systems from different manufacturers.

The typical installation of an automated vehicle classification system consists of sensing devices on the road connected to a roadside unit which contains the detector(s) and recording device. In some instances the roadside unit is self-contained (i.e., all data are recorded and/or displayed there), while in others it is only a temporary repository for the raw data which is transferred to another unit for ultimate processing, printing out, etc. Exhibit 4-4-1 shows two possible layouts for collecting classification data via automated equipment.

Exhibit 4-4-1
Typical Layouts for Vehicle Sensing on a Multilane Facility



Layout 1.
Loop Based System



Layout 2.
Tube Based System

While the sensing devices used for data acquisition vary from manufacturer to manufacturer, current equipment generally records both axle count and vehicle speed. The method of calculating vehicle speed uses a pair of inductance loops or pneumatic tubes. If loops are used, the speed calculation involves dividing the distances from the leading edge of the first loop to the leading edge of the second loop by the time it takes the vehicle to travel the known distance. A similar calculation is made if tubes are used instead of loops. Since the tubes are narrow, they can also be used to simultaneously count the number of axles passing over them.

Loops systems alone are not able to distinguish individual axles and must be augmented by an axle sensing device. Such devices may be simple tubes or more elaborate devices such as capacitance pads whose resonant circuit frequency changes under pressure or magnetic sensors enclosed in a steel frame and permanently installed in the roadway.

Reporting

At the present time, site specific vehicle classification information is requested for submission to FHWA only for those vehicle classification operations carried on in conjunction with truck weight surveys. Section 5 discusses coding and editing of vehicle classification data for submission to FHWA.

The Highway Performance Monitoring System (HPMS) requires VMT data for the functional highway classes differentiated by various vehicle types. Application of the sampling scheme recommended in this manual would provide data compatible with the HPMS.

Finally, FHWA Headquarters (HHP-44) is interested in receiving single copies of all vehicle classification reports developed by the States whether or not they are based on the procedures recommended in this manual.

SECTION 5

Truck Weighing and Data Collection at Truck Weigh Sites

Table of Contents

CHAPTER 1

Introduction

Purpose of Truck Weight Data Collection

Information about the distribution and weight of the various vehicle types in the traffic stream is essential to the administration of the highway program at both the State and national levels. Decisions concerning such matters as pavement design criteria, equitable tax bases, and revenue projections require a knowledge of the volumes of traffic using highway facilities and the proportion of vehicles of each type. It is also fundamental to know the range and frequencies of the loads imposed upon the facilities and the dimensions of the vehicles.

Truck weight and vehicle classification count data are the bases for estimating frequencies of each type of truck and year-to-year changes in axle and gross weights and for comparison of the characteristics of actual usage with administrative policies. The results are used at the State and national levels in the consideration of transportation policy, allocation of highway costs and revenue, size and weight regulations, establishment of geometric design criteria related to the size and weight of vehicles, pavement design for the establishment of procedures and design criteria, and a variety of special administrative, planning, design and research studies. At the State level, truck weight data are used in calculating pavement loadings in 18-kip equivalents or another comparable procedure, and in bridge loading analysis in terms of both bending moment and shear. Planning, program budgeting, and administrative studies require axle and total weight distribution data which can be related to operational characteristics, taxation rates, incremental construction and maintenance cost responsibility, and enforcement effectiveness.

Objectives of the Truck Weighing Section of the Guide

This section of the Guide describes procedures that may be used in obtaining truck weight and vehicle classification count data at truck weigh sites. It has been developed to accomplish the following four objectives:

1. To provide guidance in the selection of truck weigh sites based on a statistically-based sampling scheme.

2. To provide information on current and emerging techniques for gathering truck weight data.

3. To document the instructions for coding, editing and submitting the truck weight and associated vehicle classification information to the Highway Statistics Division, FHWA.

4. To give examples of the types of useful analysis and summaries that can be produced from the truck weight and vehicle classification information.

The objectives are covered in subsequent chapters of this section as follows:

Chapter 2 presents the suggested sampling method for monitoring truck weights based on locating weigh sites on HPMS sample sections.

Chapter 3 describes the various types of equipment available for weighing trucks.

Chapter 4 gives some general guidelines for setting up and operating a truck weigh site.

Chapter 5 discusses the data items that the FHWA requests the States to collect at truck weigh sites.

Chapter 6 contains the instructions for coding the truck weight and associated vehicle classification data in the format required for submission to the FHWA.

Chapter 7 details the use of the FHWA-produced computer edit program which the States are encouraged to use in identifying and correcting coding errors in the truck weight and vehicle classification data.

Chapter 8 describes and gives examples of each of the FHWA W-Tables that are used to summarize the truck weight and vehicle classification data submitted to the FHWA by the States.

Chapter 9 contains examples of additional analysis and summary tables which are available to the States from the FHWA.

CHAPTER 2

Procedures for the Truck Weight Sample

Introduction

The development of an integrated sample framework based on the HPMS for monitoring truck weights to estimate pavement loads is the last link in the chain of the HPMS element of the recommended traffic monitoring program. The basic framework of the HPMS element is the HPMS sample followed by the volume sample, the vehicle classification sample, and the truck weight sample. This chapter describes the procedures to be used in selecting the truck weight monitoring sample, and discusses the implications of such an approach.

Statistical validity is a very desirable and well-understood quality, however, there is a price to be paid in achieving it. One of the results of the work undertaken to develop this Guide has been a much clearer assessment of the lack of reliable truck weight information on which to base policy decisions, whose effects may last for many years. Since the loads which the highway systems support are a major factor in the determination of pavement life, then it is important to develop reliable estimates of these loads. The sampling guidelines differ from earlier practices, procedures, and levels of effort. As was mentioned before, statistical validity and reliability sometimes carry a significant cost in terms of level of effort and investment. It is our belief that the results will translate into better, more informed decisions; more effective and efficient construction and maintenance programs; and, in the end, better highway service.

Recommended Traffic Monitoring Program

Section 2 describes the objectives and the development of the sample design for an integrated traffic monitoring program based on the HPMS. The program consists of the major elements:

1. Continuous Count element,
2. HPMS element, and
3. Special Needs element.

The HPMS element consists of four sample subsets:

1. HPMS sample,
2. Traffic Volume sample,
3. Vehicle Classification sample, and
4. Truck Weight sample.

The recommended development of the HPMS element framework should be conducted in the sequential order presented. To maintain consistency a complete plan comprising the four samples should be prepared prior to implementation of any of the specific parts of the program . However, the actual implementation need not follow any specific order, although the integrated estimation process requires all elements to be effective.

The HPMS sample requires limited effort since the sample is already defined and implemented. It is essential to reevaluate the HPMS sample to insure that the reliability requirements in the HPMS manual are being met, that all Census-designated urbanized areas are included, and that the sample is efficient to the satisfaction of the State. There is no substitute for an initial HPMS sample that is up-to-date. The traffic volume sample has also been clearly defined. On an annual basis, it constitutes a rotating one-third of the HPMS sample.

The vehicle classification sample presents a straightforward sampling scheme. It basically consists of 100 measurements annually.

The truck weight sample follows an approach very similar to the vehicle classification scheme. The information needed to develop the vehicle classification sample will also be needed to develop the truck weight sample. The truck weight sample consists of 90 measurements taken over a 3-year cycle with 1/3 of the sample concentrated on the Interstate system. A number of options are discussed to allow application to very different State systems.

The guidelines are presented as suggested minimums. The efforts required by parts of the program may be below those actually expended by existing programs. Large States may logically opt to expand on the minimum level of effort. The overall efforts required may also be beyond existing expenditures. Hopefully, the savings incurred in the reduction or streamlining of the excesses will compensate for the added cost of any increase.

The statistical process allows direct estimation of the reliabilities involved. Therefore, after the program has been fully implemented for 3 years, it will be possible to reevaluate the State's sampling plans using the data collected by each individual State. Options on cost versus reliability can then be more clearly assessed. Finally, it would be naive to assume that changes and alterations will not be made in the future. We live in a dynamic world and circumstances, which are unpredictable today or beyond our control, will conspire to force change tomorrow. Future changes can be dealt with on a case by case basis or as needed.

<u>Selection of the Truck Weight Sample</u>

The sample consists of 90 measurements taken over a 3-year cycle. This corresponds to about 30 per year. An arbitrary decision to allocate 1/3 of the 3-year sample to the Interstate system was made to insure higher precision estimates and focus the program on this system. The Interstate sample should result, after 3 years of data collection, in 3S2 truck (18 wheeler) EAL estimates with an approximate precison of 10 percent with 95 percent confidence. In layman's terms this means that if 100 independent samples were taken, the estimates derived from 95 of the 100 samples will be $\pm$ 10 percent of the population value. These precision levels are based on a research study sponsored by the FHWA. The study makes it clear that the estimates are based on limited information.

The remaining 60 measurements are distributed over the remaining roads (with the exception of roads functionally classified as local which are excluded from the HPMS). The precison of 3S2 EAL estimates is expected to approach + 10 to 20 percent with 95 percent confidence. The following table describes the truck weight sample:

STRATA	Number of Measurements (3-year)	Annual Measurements	Expected Precison of 3S2 EAL System Estimates (3-year Cycle)
Interstate	30	10	95-10
Other Roads	60	20	95-10 to 20

Only two reporting stratification levels are used:

1. Interstate
2. Other Roads (excluding local functional class)

This is done to reduce the sample size required. Other types of stratification are likely to result in increased sample sizes. Large States may opt to expand the stratification to increase reliability or provide more information. For example, separating the Interstate into rural and urban portions would require 60 measurements, 30 in the rural and 30 in the urban strata, to approximately achieve the precision levels in both strata. Approximate curves relating precison levels to sample size are presented in Section 2.

The distribution and selection of the sample section within strata could be carried out in a variety of ways. The most theoretically correct would be a procedure which accounts for the probability of selection of HPMS sections, the traffic volume sample sections, and the vehicle classification sample sections. The simplest would be a simple random sample of vehicle classification sample sections. The first procedure is enormously complex. The second procedure would not allow control over the selected sections. For example, since there are many more low volume sections in the road universe and HPMS sample, chances are that very few high volume sections would be included in the subsample. Also, the geometric characteristics of some sections may not allow weighing operations. The recommended procedure allocates the sample to type of area, functional class, and volume groups based on the proportion of AVMT those systems carry (HPMS AVMT) relative to other systems. The procedure will be explained by an application using actual 1982 HPMS data for one State. The results can be clearly applied to any State.

Given the need to have 10 Interstate truck weight samples in a year, the following example is presented to explain the procedure.

Example 5-2-1

Interstate System
1982 HPMS DATA

Type of Area	HPMS Expanded Mileage	HPMS Expanded DVMT (Millions)	DVMT %	Unadjusted Truck Weight Sample	Adjusted Truck Weight Sample
Rural	642	6.9	57.0	6	5
Small Urban	37	0.3	2.5	0	1
Urbanized	143	4.9	40.5	4	4
STATE TOTAL	822	12.1	100%	10	10

The unadjusted sample is derived by multiplying the area DVMT percentage times the total number of samples. In order to have at least one sample in each area, one sample is taken from the largest group, i.e., Rural, and used in the small urban.

For a State with this much Interstate mileage, the recommendation would be to select 30 different locations (3-year cycle), or ten different locations each year. Once selected, the locations would become fixed and sampled each 3-year cycle. Since the travel distribution is not expected to change much over 3 years, the DVMT distribution shown above could be used for 3 years. Alternatively, the computation could be carried out annually. Since 10 locations are needed annually, the area distribution would be five rural, one small urban, and four urbanized locations.

The volume group distribution would be made in the same manner on the basis of HPMS DVMT, as shown below for the Rural Interstate:

Rural Interstate
1982 HPMS Data

Volume Group	HPMS Expanded DVMT (Millions)	DVMT Percentage	Annual Truck Weight Sample
1	2.2	31.9	2
2	4.2	60.9	3
3	0.5	7.2	0
TOTAL	6.9	100%	5

Since the truck weight sample in this example is much too small for the extensive HPMS stratification and to insure that every vehicle classification sample has a positive selection probability, the sections in volume group 3 have been combined with those of volume group 2. Two of the sections could be selected from the first volume group and three from the second and third groups.

The sample procedure can be applied to the Interstate urban portion and to the remaining strata. Urbanized areas will present problems because of the large number of strata and exercising judgment will be required when applying the described procedure. It may be appropriate to group the urbanized areas when selecting the samples. Application of this process should result in a very balanced sample. The selection of the sample for a stratum should follow simple random sampling procedures using a table of random numbers. Existing fixed sites would be incorporated in the program by the same procedure used in the vehicle classification sample.

The following table continues the example. Assume there are three volume groups, from which 15 vehicle classification samples were selected, and for which we need to select five truck weight samples.

Number of Classification Volume Group	Number of Weight Samples	Existing Fixed Samples	Remaining Selection Sites	Sites
1	6	2	1	1
2	8	3	1	2
3	1	0	0	0

The fixed sites would be subtracted from the desired sample and any remaining samples randomly selected. The six vehicle classification sections would be assigned a unique sequential number 1 to 6. Using a table of random numbers, a unique number between 1 and 6 would be selected, and the selected vehicle classification sample section would become the truck weight sample section. The same procedure would be applied to volume groups 2 and 3 combined. In this case, the nine sections could be assigned unique numbers between 1 and 9, two random numbers would be selected and become the sample. The combination of volume groups ensures, as before, a positive probability of selection for each section.

As discussed extensively in the vehicle classification section, practical considerations also play a role. If the randomly selected sections are not amenable to weighing operations due to geometric requirements of automatic equipment, safety of crews, or other reasons; then another random location from the vehicle classification sample should be examined. If none of the sections in the vehicle classification sample are suitable for weight monitoring, then it will be necessary to randomly substitute sections in the vehicle classification sample, or alternatively to add additional sections to the vehicle classification sample to include vehicle class sample sections which can be used for weighing operations. This is another reason for emphasizing that the integration of the procedures requires very close coordination, and that a problem in one part of the program may require changes in other parts of the program as well.

For States with very limited mileage, the 30 measurements could be taken at fewer than 30 locations. For example, one eastern State has 41 miles of Interstate, and it would be ridiculous to sample at 30 different points in the 3-year cycle. Alternatives would be to annually take two measurements scheduled at different times of the year at five different locations or five annual measurements at two different locations. Under the first alternative, the locations would be maintained during the 3-year cycle resulting in 30 measurements at five locations. Under the second alternative, different locations would be sampled each year of the 3-year cycle resulting in 30 measurements at six different locations. Data analysis would be carried out using the procedures in this Guide to determine if a smaller sample was statistically justified given the circumstances.

It should be clear from the discussion that judgment is needed at this level. The truck weight sample has been designed to provide maximum flexibility to insure adequate application given varied circumstances. It is appropriate, however, to caution that flexibility may well result in the introduction of bias and error. Care should be exercised when applying these procedures to insure that statistical objectives are maintained.

The recommended period of monitoring has been set at 48 hours to reduce the effects of random variation and for direct combination with the volume and classification samples. As discussed in Section 2, research has shown the coefficients of variation of EAL's of vehicles can be as high as 100 percent. Longer periods would reduce these effects, but further complicate other facets. The use of a 48-hour period was selected as the best compromise among all possible alternatives given present data. This recommendation implies the use of accurate automatic classification and weight monitoring equipment. Since such equipment may not be available, 24-hour periods may be substituted in the interim. However, the stated precision levels are unlikely to be achieved.

The emphasis on automatic equipment is unavoidable. Equipment that counts, classifies, and weighs at the same time is needed to avoid duplication and directly tie the resulting data. Such equipment is available today. The techniques and procedures to effectively develop the equipment and allow the development of this Guide's program await only a determined effort. Once the equipment to collect this data is available, the truck weight data collection sessions would eliminate the need for a separate vehicle classification session at the truck weight sample sections. In the same manner, sections in the vehicle classification sample eliminate the need for separate volume counts.

Estimation Procedures

The procedures described in this section are used to develop statistical estimates and the reliability of these estimates. In the truck weight sample sections where truck weight data are collected, the estimates are direct. For the remaining sample sections (HPMS, volume, or vehicle classification) or universe sections in general, statistical inferences based on stratum data are used to generate estimates involving weight information. This process is termed the statistical or "system" approach.

For the development of site-specific estimates three alternatives are presented:

1) the statistical "system" approach just described;

2) the collection of additional information under the Special Needs element; and

3) the application of judgment procedures based on expert knowledge or subjective inference based on other characteristics.

Alternatives 1 and 2 need no additional explanation. Alternative 3 represents the use of common sense and traditional traffic engineering procedures. The recommended sample will provide a very balanced sample, well-distributed over the areas, functional classes, and traffic volumes. Obviously, if correctly selected, a very representative sample should be available. Since the samples are HPMS sections, a wealth of information is available on the characteristics of those sections. Site-specific information or estimates could be derived by selecting sample sections with characteristics similar or equivalent to those of the section for which the point-specific inferences are desired. For example, if inferences on EAL's are desired for a four-lane Interstate section with high truck percentages and high volume in an urbanized area, the sample can be easily screened to find sample locations in close proximity to the desired location or with similar characteristics. Inferences would then be based on the results of the search.

For truck monitoring locations, the percentage of vehicles in any category (assuming a single 48-hour session) is simply the number of vehicles in that category divided by the total 48-hour volume for all vehicle types. The equation is:

$$P_{ijh} = \frac{v_{ijh}}{v_{jh}} \times 100 \qquad 5\text{-}2\text{-}1$$

where

P_{ijh} = percent of vehicles in category i of location j in stratum h,

i = one of the 13 vehicle classification categories,

j = location number

h = stratum number

v_{ijh} = number of vehicles in category i, and

v_{jh} = 48-hour volume for all vehicles types (total volume).

Notice that the sum of all the P_{ijh}'s must equal 100 percent.

The section AVMT is estimated by multiplying the section AADT by the section length (from the HPMS). The classification AVMT at each section is estimated by multiplying the total AVMT by the P_i's. Since we are addressing vehicle classification, the procedure is the same used for sections in the vehicle classification sample.

Truck weight information is similarly derived. Assuming that axle weights have been collected; total axle load, average axle load, equivalent axle load, average truck weight, total truck weight, number of overloaded axles, number of overloaded trucks, weight overload, etc., could be directly computed for each vehicle classification category and any derived aggregation. The statewide AVMT estimates for any of the vehicle classification categories are derived by simply multiplying the percent estimate by the AVMT in each strata and then summing. Standard error estimates for any of these point estimates could be derived using cluster sampling procedures, since the 48-hour session constitutes a 48-hour cluster of vehicles randomly selected from a universe of 365/2 such periods; or, alternatively, by simple random sampling procedures assuming that the trucks constitute a simple random sample of the truck population at that point.

It should be obvious that this analysis has ignored seasonality. Due to the limited truck weight sample, seasonality of weight information is not considered. Limited procedures could be developed as part of the Special Needs element if desired by the States.

Example 5-2-2

Assume the following data were collected from a single 48-hour measurement on the Rural Interstate system:

48-hour volume	:	48,000 vehicles
Number of 3S2's (18 wheeler)	:	4,800 vehicles
Average weight of 3S2's	:	55,000 pounds

The following estimates are derived:

$$\text{Percentage of 3S2's in 48-hour measurement} = \frac{4,800}{48,000} \times 100 = 10\%$$

Assuming a seasonal factor of 1.1 (seasonal and other factors are discussed in Section 3):

$$\text{Estimated AADT} = \frac{48,000}{2} \times \text{seasonal factor} = \frac{48,000}{2} \times 1.1 = 26,400.$$

Estimated annual average daily number of 3S2's in traffic stream

$$= 26,400 \times 10\% = 2,640$$

Notice that seasonality has introduced an additional effect. The average daily number of 3S2's measured from the sample was 2,400, but the annual average daily number of 3S2's estimated, after the AADT seasonality factor (an external factor) is included, becomes 2,640. When developing annual estimates involving number of vehicles it is important to consider the effects of any factor applied to the sample estimates.

$$\text{Estimated daily VMT} = \text{AADT} \times \text{length of section (assume 1.0 miles)}$$
$$= 26,400 \times 1 = 26,400$$

The estimated section AVMT for 3S2's

$$= \text{DVMT} \times \text{percentage of 3S2 } (P_{ijh}) \times 365$$
$$= 26,400 \times 10\% \times 365 = 963,600$$

The section estimated annual gross ton-miles for 3S2's

$$= \frac{\text{average 3S2 weight}}{2,000} \times \text{3S2 AVMT}$$

$$= \frac{55,000}{2,000} \times 963,600 = 26,499,000$$

The estimated daily average 3S2 load on the sample section for the 48-hour measurement period (disregarding seasonality)

= average weight of 3S2's x average number of 3S2's

$$= 55,000 \times \frac{4,800}{2} = 132,000,000$$

The estimated annual daily average 3S2 load on the sample section (after seasonality) = average weight of 3S2 x annual estimate of 3S2's

= 55,000 x 2,640
= 145,200,000

The question that cannot be answered based on a single sample estimate is whether volume (AADT) seasonal factors apply to 3S2's. This question will be partly answered later when aggregated estimates are derived, and this is one of the reasons why measurement sessions must be distributed throughout the year.

To develop estimates for stratum characteristics, inferences from the sample are made. In the truck weight sample, only two strata are defined. However, since the sample was allocated proportionally to the HPMS strata, estimates for lower strata can be derived by applying the procedures using only the points (sample sections) within the desired lower strata.

An estimate of average percentages of vehicles within strata for a vehicle classification category is derived by the equation:

$$P_{ih} = \frac{1}{n_h} \sum_{j=1}^{n_h} P_{ijh} \qquad \text{5-2-2}$$

where P_{ih} = average percentage of vehicles in vehicle classification category i and stratum h,

P_{ijh} = the percentages of vehicles in vehicle classification i in location j of stratum h

i = index of vehicle classification category (i = 1, ...,13),
j = index of measurements with strata (j = 1, ..., n_h),
h = index of strata, and
n_h = number of measurements within stratum h.

An estimate of the standard error is derived by the equation:

$$S_{ih} = \sqrt{\frac{1}{n_h(n_h-1)} \sum_{j=1}^{n_h} (P_{ijh} - P_{ih})^2} \qquad \text{5-2-3}$$

where S_{ih} = the standard error of the percentage of vehicles in vehicle classification category i in stratum h.

The relative variance coefficient is defined as the ratio of the standard error to the mean:

$$C_{ih} = S_{ih}/P_{ih} \qquad 5\text{-}2\text{-}4$$

A two-sided 95 percent confidence interval for the percentage of vehicles in vehicle classification category i in stratum h is given by:

$$P_{ih} \pm 1.96\ S_{ih} \qquad 5\text{-}2\text{-}5$$

and the two-sided precison interval in percentages is 1.96 C_{ih}.

Stratum estimates for any desired truck weight characteristics are derived by the same procedure by substituting the desired characteristic into the equations. For example, to estimate average truck weight in vehicle classification category i, compute the average weight for that classification at each measurement location and begin the process in equation 5-2-2.

1/ NOTE: The relative variance coefficient is the ratio of the standard error to the estimate while the coefficient of variation is the ratio of the standard deviation to the estimate.

Example 5-2-3

An example using data from two Interstate Rural measurements at different locations will be used to illustrate the procedure. Assume that the following data were collected or derived from the actual measurements:

System	:Interstate Rural
48-hour volume at location 1	:48,000
48-hour volume at location 2	:20,000
Number of 3S2's at location 1 (48-hour)	: 4,800
Number of 3S2's at location 2 (48-hour)	: 5,000
Average weight of 3S2's at location 1 (48-hour)	:55,000
Average weight of 3S2's at location 2 (48-hour)	:50,000

Percentage of 3S2's at location 1 during 48-hour (P_1): 10%
(Example 5-2-2)

Percentage of 3S2's at location 2 during 48-hour (P_2): 25%

Estimated Interstate Rural percentage of 3S2's (equation 5-2-2)

P_{ih} = 1/2 (10 + 25) = 17.5%
where i = 3S2 and h = Interstate Rural.

Estimated standard error of percentage of 3S2's in the Interstate Rural stratum (equation 5-2-3)

$$S_{ih} = \sqrt{\frac{1}{2(2-1)}\left((10-17.5)^2 + (25-17.5)^2\right)} = 7.5\%$$

Estimated relative variance coefficient (equation 5-2-4)

$$C_{ih} = \frac{7.5}{17.5} = .43$$

A 95 percent confidence interval is given by (equation 5-2-5)

$$17.5 \pm 1.96\ (7.5) = 17.5 \pm 14.7$$

The precision interval is 84 percent (1.96 x .43) which shows the 95 percent confidence to be ± 84 percent. The precision in short form is 95-84 based on these data. A simple interpretation of the results is that based on the information provided the true percentage is between 2.8 and 32.2 with 95 percent confidence. Obviously, the estimate is very poor as would be expected from such a limited sample.

Estimates of average weights by system are computed using the same procedure.

The estimated Interstate Rural average 3S2 weight is

$$1/2\ (55{,}000 + 50{,}000) = 52{,}500.$$

Its standard error is

$$\sqrt{½\ (55{,}000-52{,}500)^2 + (50{,}000-52{,}500)^2} = 2{,}500$$

The relative variance coefficient is .05 (2,500/52,500).

A 95 percent confidence interval is given by 52,500 + or - 1.96 x 2,500 and the precision interval is 10 percent (1.96 x .05).

Therefore, the precision of the system average weight based on these data is 95-10. The interpretation is that based on the information provided the true average 3S2 Interstate weight is between 47,600 and 57,400 with 95 percent confidence. This is a simplification, since due to the small sample size (n = 2) the procedures would require modification and the value of the normal distribution (1.96) in the confidence interval calculation would have to be replaced by the student's distribution value. Even then, results based on very small samples are open to question. No implied judgment of the reliability of the sampling approach should be attempted based on any of these examples. We fully expect the recommended sample to achieve or approximate the sample design criteria, although differences from State to State are anticipated. Once data are available on the recommended program from any State, then full assessment of the procedures for that State will be possible.

The above example is presented to show the computational procedure only. The procedure presented to estimate the average weight is the simplest and not the most efficient. Cluster procedures which consider the weight of every truck and take into account the volumes of trucks at each location would be more efficient but much more complex. These will not be discussed in this guide, but the sample design allows future use of improved estimation procedures.

Estimates of stratum AVMT for any of the estimates by vehicle classification categories are derived by multiplying the vehicle classification category estimate by the stratum AVMT. In the case of the Interstate system, the vehicle classification AVMT of vehicle category "i" is computed by multiplying the HPMS AVMT estimate for the Interstate times the average stratum classification (P_{ih}). A percent estimate of the two-sided precision interval of this estimate is given by 1.96 times the square root of the sum of the squared relative variance coefficients of stratum AVMT and average classification category. The equation is:

$$1.96 \sqrt{C^2_{AVMT} + C^2_{ih}} \qquad 5\text{-}2\text{-}6$$

where C_{AVMT} = relative variance coefficient of stratum AVMT estimate (from traffic volume chapter), and

C_{ih} = relative variance coefficient of classification category i in stratum h (equation 5-2-4).

The terms within the square root represent the relative variance coefficient of the combined estimate. As can be seen from this equation, the more terms involved in the estimation, the larger the reliability band.

Example 5-2-4

Based on the previous example, the estimated percentages of 3S2's on the Interstate Rural system is 17.5 percent with a relative variance coefficient of .43. For the purposes of this example, assume that the Interstate Rural DVMT estimated from the HPMS is 6.6 million with a relative variance coefficient of 0.10. The estimate of 3S2 DVMT on the Interstate Rural system is 1.16 million (.175 x 6.6 million) and the relative variance coefficient of this estimate is $.44 \left(\sqrt{.43^2 + .1^2}\right)$ The precision interval is 86 percent (1.96 x .44) and in short form is expressed as 95-86. Based on these data, the Interstate Rural estimate of 3S2 AVMT is 423 million (1.16 x 365) with a 95 percent precison of $\pm$ 86 percent. Obviously, this is an estimate of minimal value because of its lack of precision, but is just what would be expected based on a sample of two locations.

Aggregation of estimates by stratum up to statewide estimates is done by weighting the estimates by AVMT or DVMT. Therefore, an estimate of statewide percentage of vehicles in vehicle classification category i is given by:

$$P_i = \frac{1}{PAVMT} \sum_{h=1}^{2} (PAVMT_h \times P_{ih}) \qquad 5\text{-}2\text{-}7$$

where P_i = average statewide percent of vehicles in vehicle classification category i,

$PAVMT_h$ = AVMT in stratum h for all vehicles

P_{ih} = average percentage of vehicles in vehicle classification category i in stratum h,

PAVMT = statewide AVMT,

i = index of vehicles classes (1,...,13), and

h = index of strata.

Example 5-2-5

Compute the average percentage of 3S2 vehicles in the Interstate stratum given the following data:

System	DVMT (000,000)	Percentage of 3S2's
Interstate Rural	6.6	17.5
Interstate Urban	2.0	7.3

The percentage is estimated using equation 5-2-7.

$$P_i = \frac{1}{8.6} (6.6\ (17.5) + 2.0\ (7.3)) = 15.1$$

Obviously, these are contrived examples. Given the obvious differences between the two systems, it would be more appropriate to maintain separate numbers for each system than to provide an average system number. Aggregation of estimates should be carried out only when it makes sense to do so or when it serves a desired objective.

Estimates of statewide AVMT for any weight or classification categories are aggregated by summing strata. Precison intervals are estimated by summing the squares of the coefficient of variation of the appropriate estimates and taking the square root. The process is the same as shown in equation 5-2-6, except that the appropriate estimates are used.

CHAPTER 3

Equipment for Weighing Trucks

Basically, there are two methods of weighing trucks. One involves stopping a vehicle and weighing it statically, and the other allows a vehicle to be weighed while in motion, or dynamically. There is a variety of equipment associated with each method of weighing. Several types of equipment and the advantages and disadvantages of each are discussed in this chapter.

Static Weighing Equipment

The three types of static weighing equipment most commonly used by the State highway agencies are permanent platform scales, semi-portable scales, and lightweight portable scales.

Permanent platform scales appear in a variety of sizes. While some States use large platforms, usually up to 50 feet in length, otners still rely on a smaller platform about 10-15 feet long. The larger platforms are generally segmented into three independent scales, each capable of weighing a portion of the vehicle. For example, in weighing a tractor-semitrailer combination, the first segment would weigh the steering axle, the second segment would weigh the drive axles of the tractor, and the third segment would weigh the trailer axles. The smaller, single segment platform scales must rely on the repositioning of the vehicle in order to get the individual axle weights.

The portaole and semi-portable static weighing equipment are scales that can be transported from one location to another in an automobile, a pickup truck, or a small trailer. The portable scale weighs from 40-100 pounds and is capable of weighing only one end of an axle. In order to weigh both ends of an axle, or all axles of a vehicle simultaneously, two or more portable scales must be used in combination. The semi-portaole scale is somewhat larger and weighs as much as 500 pounds. It is capable of weighing both ends of an axle simultaneously when placed transversely on the weighing site, or one end of all axles of a group when placed longitudinally. Various combinations of this type of scale can be used to weigh virtually all types of vehicles.

There are several disadvantages associated with weighing trucks statically. The conventional weigh station is located at a fixed off-road location on a major highway and, therefore, occupies valuable real estate. The stopping of trucks causes trucker delays and motivates some truckers to bypass the station. It can also cause safety problems due to the queue of trucks on the highway. This generally results in trucks being allowed to pass the station until they can safely be stopped again.

The basic advantage of the static weighing system is the system's capability to acquire axle weights and spacings within tolerances acceptable to various weight and measure standards. It also allows sufficient time to determine the vehicle's characteristics such as the body type, whether or not the vehicle is loaded, and other related information that can only be ascertained by observation or driver interview.

Weigh-in-Motion (WIM) Equipment

WIM scales are dynamic weighing systems which determine weights while vehicles are in motion. It enables vehicles to be weighed with little or no interruption to their travel.

WIM scales have been designed to sense the weights of the axles passing over the instrument through the use of strain gauges or hydraulic or pneumatic pressure transducers. The readings are transmitted to a receiving unit where they are converted to actual weights.

The three main categories of WIM operation are:

1. Low speed WIM - Vehicles are weighed at selected roadside areas at speeds of about 3-5 miles per hour on either portable WIM scales or where portable scales are placed in preconstructed pits.

2. Low to moderate speed WIM - Vehicles pass over WIM equipment located in the ramp as they enter a permanent weign station site at speeds of up to 35 miles per hour.

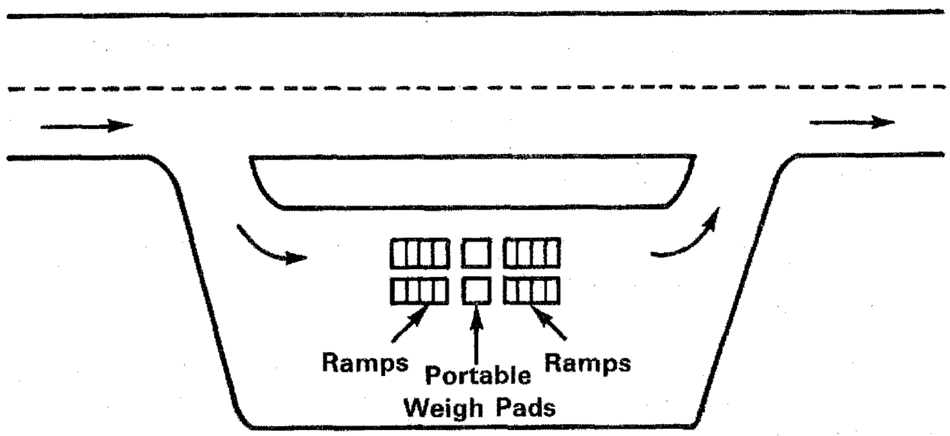
3. High speed WIM - Vehicles are weighed at prevailing highway speeds by either: (a) specially-built load platforms placed in preconstructed frames embedded in the roadway, (b) portable load sensors attached directly to the pavement, or (c) strain transducers attached to bridge girders.

Examples of these three types of WIM equipment are shown on pages 5-3-3 and 5-3-4.

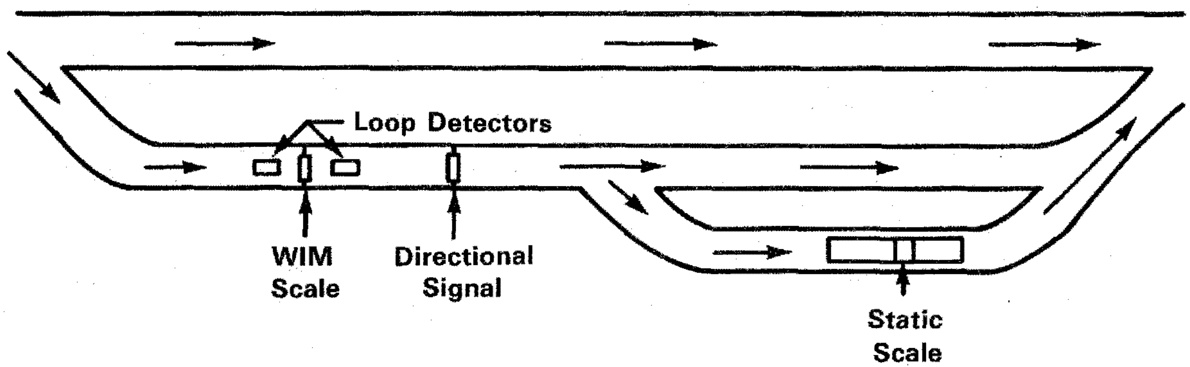
The advantages of using a WIM system are many. It offers a method (high-speed WIM) of recording and processing weight data automatically and without disruption to the truck driver. It has a degree of concealment which enhances data credibility since vehicles in violation, that might normally have deliberately bypassed a known weighing operation, are recorded at WIM sites. This could provide highway planners, researchers, and enforcement officials with more representative statistical data. Also, since WIM does not interrupt the traffic flow, it is capable of weighing high volumes of traffic, such as in urban areas where it is difficult to obtain weight data using static weighing equipment.

Exhibit 5-3-1

1. Low Speed WIM

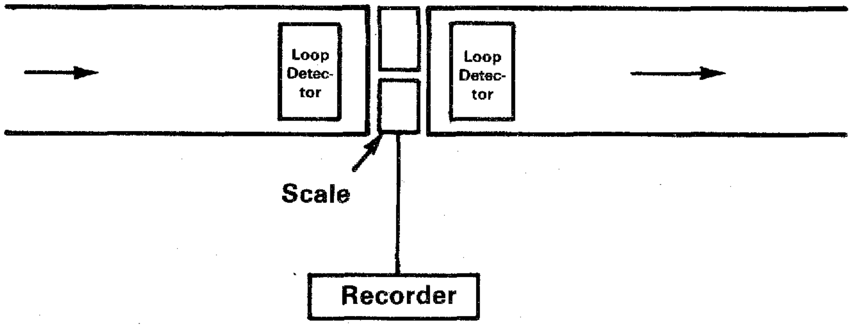


2. Low to Moderate Speed WIM (For Screening)

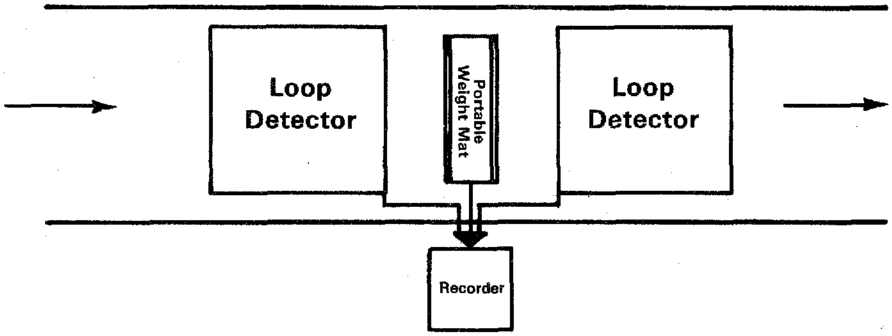


3. High Speed WIM

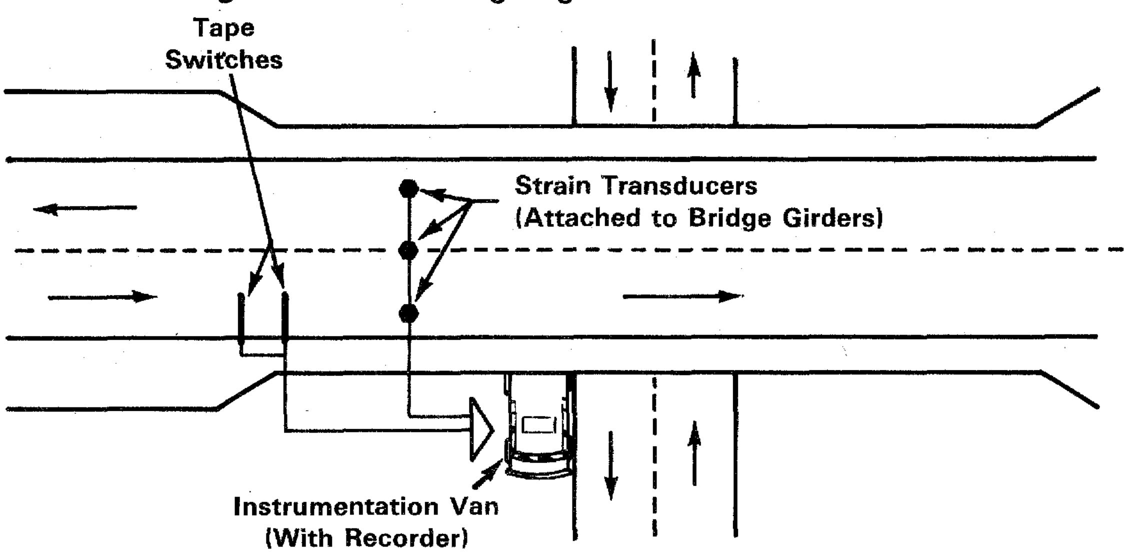
(a) In-Pavement Load Platforms



(b) On-Pavement Portable Load Sensor



(c) Bridge Used as a Weighing Platform



CHAPTER 4

Operating Weigh Stations

Introduction

Many factors must be considered before a truck weigh station can be put into operation. The safety aspect is a major consideration along with the need to ensure that the data collected is as accurate and reliable as possible. This chapter addresses some of the pertinent factors to consider and includes suggestions on how each factor can be handled. (For more specific guidelines on the proper use of scales at a weighing site, refer to the National Bureau of Standards Handbook 44, 1983, entitled, "Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices.")

The operation of each station is dependent on whether static or WIM scales are being used. Such activities as sampling trucks from the traffic stream, conducting driver interviews, and manually measuring axle spacings need only be considered in reference to the static weigh stations where each vehicle must be stopped to be weighed. Methods of signalization to ensure that trucks do not stop in the station but only reduce their speed through the station apply only to low and moderate speed WIM.

The one requirement that all off-highway weigh stations have in common is some form of roadside signing to direct truck drivers into the station. As a minimum, signs should instruct drivers concerning speed reduction, turn-off points and the presence of flagmen, if any. In addition to the standard signing for safety purposes, an indication that the weighing will be conducted for planning purposes would be appropriate so that all truck types can be sampled, and not just the heavier vehicles. (Guidance on the proper size, color, and placement of appropriate warning signs may be found in the "Manual on Uniform Traffic Control Devices for Streets and Highways," 1978.)

The remainder of the discussion on weigh station operation will distinguish the operation of a static weigh station from that at a WIM site.

Static Weighing Sites

A properly installed and adjusted platform scale is probably the most accurate and dependable method of obtaining static weights of trucks. However, in order to obtain the weights of the individual axles, the repositioning of the vehicle is required. Because research has shown that the total weight carried by the axle group is not evenly distributed among the individual axles of the group, it is important to obtain the weights of the individual axles of a tandem or tridem group. To accomplish this, the vehicle must be positioned so that only one axle of the group is on the scale at any one time. The brakes on the vehicle should be released before taking the weight reading.

Weighing trucks with portable wheel-weigher scales presents a number of problems that are not encountered in platform scale operations. There are a number of variations in the set-up of the portable scale operation that can affect the accuracy due to weight transfer. Ideally, the vehicle should be kept in a reasonably level plane. This can be accomplished through the use of recesses cut into the pavement so that the scales are at roadway level, or through the use of planks placed on the pavement surface to raise the vehicle to the height of the scale. It is especially critical to weigh axle groups with all axles of the group on the same plane. The reliability and usefulness of truck weight data depend on the care with which the vehicles are weighed. Available data have shown that for the greatest consistency, all wheels of the vehicle should be on the same horizontal plane with brakes released at the time of weighing. If the brakes must be set when weighing with portable scales, they should be released after the vehicle has stopped on the scales and then reset. To provide reliable data for all axles, the weight of each axle of a tandem or tridem group should be determined separately since available design and weight information indicate that a large proportion of these assemblies place an appreciably greater load on one axle of the tandem, and on two axles of the tridem.

The distance between axles for each vehicle weighed should be measured to permit accurate calculation of pavement and bridge loadings, as well as the bridge formula. Axle spacings should be measured with the vehicle components in a straight line.

Until the time that WIM equipment replaces static equipment at planning sites, a critical issue relating to the safety of operations at a static weighing site is the availability of storage area for trucks waiting to be weighed. For example, a station having an average time for weighing and measuring of 1 minute would have a theoretical capacity of 60 trucks per hour. If the number of trucks arriving at the station is greater that 60 per hour, some form of sampling technique will be required to avoid excessive storage requirements and delays to the vehicle operators. If sampling is necessary, care should be taken to ensure that all the types of trucks common to the site are represented in the sample.

<u>Weigh-in-Motion (WIM) Sites</u>

At sites where high speed WIM scales are utilized, proper setup of the scales and the safety of the setup crew are the primary considerations. The safety procedures prescribed for maintenance or other activities taking place on an active facility should be adhered to by the WIM field crew.

Ideally, a station using low or moderate speed WIM equipment should be designed to minimize the change of path and speed of vehicles as they are weighed in motion and proceed through the station area. Since the primary purpose of WIM is to weigh more vehicles safely while minimizing the vehicles' time in the station, the station's operation and design should not result in vehicles backing up onto the through lanes.

It has been noted that many drivers are not accustomed to WIM equipment and tend to stop on the scales, sometimes causing backups under high-volume conditions. The use of adequate traffic control devices can help to alleviate this problem. Advance guide signs at WIM sites are essential. Trucks should be instructed to slow to the indicated speed and to maintain at least a 100 foot interval between vehicles as they approach the scales. Flexible pylons or traffic cones may be used to guide the trucks over the WIM scales. Overhead directional signals, in conjunction with supplemental signing, should be positioned beyond the WIM scales so that the signals will direct the trucks back onto the highway. In some cases where a lane is closed to provide a buffer area for weighing on the shoulder, advance guide signs together with traffic control devices should be employed. Shoulder operations should be limited to low-volume routes.

CHAPTER 5

Truck Weight Data Collection for FHWA

Introduction

The data collected during truck weight surveys can be separated into three distinct groups--the identification data, the interview data, and the axle weight and spacing data. The identification data consist of those items that are necessary to identify a particular vehicle and the time and place that it was weighed. The interview data are the characteristics of the vehicle that can only be collected through a driver interview while a truck is stopped in a static weigh station. The axle weight and spacing data are collected and recorded for each individual vehicle.

The data items included in the FHWA data format can be grouped in the following manner:

A. Identification Data

1. State
2. Functional classification of the highway
3. Station number
4. Direction in which vehicle is traveling
5. Year of weighing
6. Month of weighing
7. Date of weighing
8. Hour of weighing
9. Type of vehicle weighed

B. Interview Data (Vehicle Characteristics)

1. Body type
2. Engine type (fuel type)
3. Registered weight
4. Basis of registration
5. Commodity carried
6. Load status

C. Axle Data

1. Individual axle weights
2. Spacings between each set of adjacent axles
3. Sum of all axle weights (total weight of vehicle)
4. Sum of all axle spacings (total wheelbase)

The detailed definitions and coding schemes for these data items are given in Chapter 6.

Because of the various types of truck weight data collection equipment currently available, it is necessary to be flexible in the data items requested by FHWA. Since each weighing procedure has different data collection capabilities, each must be considered individually as to the data items that can feasibly be obtained. The following paragraphs give alternatives based on the weighing method employed.

Static Weighing

Based on the very nature of this method of weighing, it is possible for all the data (identification, interview and axle) to be obtained. However, from a survey conducted in all the State offices, it was concluded that the States needed freedom in determining which data items are justified in terms of the time and effort involved in collecting them. Since the identification and axle data are basic to truck weight surveys and are, by far, the most useful items, only the interview data remain to be scrutinized by each State as to their utility. The interview data are an optional part of the data requested for the FHWA truck weight survey and may be collected at the discretion of the State.

On the basis of the States' responses to the survey and FHWA review, the following interview data items seem to be of the greatest value at both the State and Federal levels:

1. Body type
2. Load status
3. Commodity carried

Weigh-in-Motion

The majority of the WIM equipment has the capability of acquiring all of the identification and axle data automatically. However, since the vehicles are not stopped, interview data cannot be collected. Therefore, at WIM sites, the interview items cannot be entered in the FHWA format. In their place, the State should code the default values as indicated in the coding scheme in Chapter 6.

Combination of Static Weighing and Weigh-in-Motion

States using a mix of WIM and static scales may collect the data at each site according to the instructions previously given based on the type of weighing procedure being employed at the site.

Enforcement Weighing

The States have the option to conduct their truck weight surveys at enforcement locations. Where WIM equipment is being operated at an enforcement site, the conversion from enforcement weighing only to collecting the data for this truck weight survey should be fairly simple and should not affect the station's operation. However, at a static weighing site the conversion to data collection will be more difficult due to the additional trained personnel required to obtain the axle spacing and, at the State's discretion, the interview data and to record all the data.

CHAPTER 6

Coding Instructions for the FHWA Truck Weight Survey

Introduction

This chapter contains detailed instructions for coding the field data in the requested FHWA format. The record formats and coding instructions have been developed to provide input to the battery of computer programs utilized by the Highway Statistics Division in summarizing the data submitted by the States.

The data requested are divided into three types: the station description data, the vehicle classification data, and the truck weight data. Each type of data has its own individualized record format. The coding instructions and record layouts are discussed separately for each type of data, except for the description of those data items which are common to all the record formats.

On the record format descriptions on pages 5-6-6, 5-6-13, 5-6-17, and 5-6-18, page references have been provided for each data item for easy reference to the appropriate coding schemes.

Data Items Common to all Record Formats

Certain data items are common to all three types of records. These items are located in the first 11 columns of every data record and are part of the identification information used to correlate the different types of records.

1. Record Identification
   (Column 1)

Code	Record Type
2	Station description record
4	Vehicle classification record
7	Truck weight record

2. FIPS State Codes
   (Columns 2-3)

Name	Code	Name	Code
Alabama	01	Montana	30
Alaska	02	Nebraska	31
Arizona	04	Nevada	32
Arkansas	05	New Hampshire	33
California	06	New Jersey	34
Colorado	08	New Mexico	35
Connecticut	09	New York	36
Delaware	10	North Carolina	37
District of Columbia	11	North Dakota	38
Florida	12	Ohio	39
Georgia	13	Oklahoma	40
Hawaii	15	Oregon	41
Idaho	16	Pennsylvania	42
Illinois	17	Rhode Island	44
Indiana	18	South Carolina	45
Iowa	19	South Dakota	46
Kansas	20	Tennessee	47
Kentucky	21	Texas	48
Louisiana	22	Utah	49
Maine	23	Vermont	50
Maryland	24	Virginia	51
Massachusetts	25	Washington	53
Michigan	26	West Virginia	54
Minnesota	27	Wisconsin	55
Mississippi	28	Wyoming	56
Missouri	29	Puerto Rico	72

3. Functional Classification
(Columns 4-5)

Code	Functional Classification
RURAL	
01	Principal Arterial - Interstate
02	Principal Arterial - Other
06	Minor Arterial
07	Major Collector
08	Minor Collector
09	Local System
URBAN	
11	Principal Arterial - Interstate
12	Principal Arterial - Other Freeways or Expressways
14	Principal Arterial - Other
16	Minor Arterial
17	Collector
19	Local System

4. Station Identification
(Columns 6-8)

This three-digit field should contain an alphanumeric designation for the station where the survey data are collected. Station identification field entries must be identical in all records for a station. Differences in characters, including spaces, blanks, hyphens, etc., prevent proper match. This applies to all three types of records which must be matched during various stages of the processing. Station identification numbers should be right justified, filled with leading zeros. Only the numbers 0 through 9 and the 26 letters of the alphabet should be used.

5. Direction of Travel
(Column 9)

Code	Direction
1	North
2	Northeast
3	East
4	Southeast
5	South
6	Southwest
7	West
8	Northwest
9	North-South (or Northeast-Southwest) combined
0	East-West (or Southeast-Northwest) combined

6. Year of Current Data
(Columns 10-11)

Code the last two digits of the year in which the data were collected.

Station Description Records

1. General Comments

   The purpose of the station description records is to provide a means of locating the weighing sites on a standard highway map and to provide some general information about the site. The station description information should be submitted along with any submittal of the vehicle classification and truck weight data. This is necessary because the average annual daily traffic (AADT) figure must be current to ensure the valid comparison of the counts and weights to the average traffic stream at a site. Since the AADT will probably be the only data item that will require annual updating, the annual submittal process should require minimal additional effort.

2. Record Format

   Enter data in the following manner:

   a. All records must contain a "2" in column 1.

   b. All data fields in columns 1-20 and 34-45 must contain the appropriate code for each data item and be filled with leading zeros.

   c. Columns 1-3 and 10-11 should be the same on every record.

Station Description Record

Columns	No. of Columns	Description	Ref. Page
1	1	Station description record code (2)	
2-3	2	State code	5-6-2
4-5	2	Functional classification	5-6-3
6-8	3	Station identification number	5-6-3
9	1	Direction of travel	5-6-3
10-11	2	Year of data	5-6-4
12	1	Posted route number category	5-6-7
13-17	5	Posted route number	5-6-7
18-20	3	County code	5-6-7
21-32	12	HPMS sample number	5-6-7
33	1	HPMS sample section subdivision number	5-6-7
34-35	2	Year station was established	5-6-8
36	1	Type of site	5-6-8
37	1	Type of weighing equipment	5-6-8
38	1	Method of vehicle classification counting	5-6-8
39	1	Coordination with enforcement activities	5-6-8
40-45	6	AADT most current figure	5-6-9
46-80	35	Location of station (distance and direction from nearest major intersecting route)	5-6-9

3. Coding Schemes (Columns 12-80)

a. Posted Route Number Category
(Column 12)

Code	Category
1	Interstate
2	U.S.
3	State
4	County
0	Other

b. Posted Route Number
(Columns 13-17)

Code the route number of the principal route on which the station is located. Right justify number and enter leading zeros if necessary. For example, to identify the route I-80, enter a "1" in column 12 and the number "00080" in columns 13-17.

If the station is located on a city street, zero-fill this field.

c. County Code
(Columns 18-20)

Use the three-digit FIPS county code (see Federal Information Processing Standards Publication 6, "Counties of the States of the United States").

d. HPMS Sample Number
(Columns 21-32)

If a station is located on an HPMS sample section, code the sample section identifier used for this section in the original HPMS submission or a unique number for a new sample section. This number may be route-milepoint or A-node, B-node, Segment, but will be considered as a unique number that may not change in the future. It will be assigned to all subdivided portions of the sample sections.

If the station is not on an HPMS sample section, leave this field blank.

e. HPMS Sample Section Subdivision Number
(Column 33)

For those stations located on an HPMS sample section that is subdivided, enter the appropriate subdivision number from 0-9 as assigned to this portion of the section for the HPMS submission. For stations not on an HPMS sample section, leave this column blank.

f. Year Station was Established
(Columns 34-35)

Code the last two digits of the year data was first collected at this location.

g. Type of Site
(Column 36)

Code	Site
1	Station located on pavement (traveled lane)
2	Station located on shoulder
3	Safety rest area
4	Frontage road
5	Off-ramp
6	On-ramp
7	Other public land
8	Privately owned land
9	Turnoff for study station which removes traffic from through lanes (example: permanent scale site)
0	Other

h. Type of Weighing Equipment Used for Study
(Column 37)

Code	Equipment
1	Portable static scales
2	Chassis-mounted, towed
3	Platform or pit
4	Weigh-in-Motion

i. Method of Vehicle Classification Counting
(Column 38)

Code	Method
1	Manual
2	Automated

j. Coordination with Enforcement Activities
(Column 39)

Code	
1	Planning and enforcement activities are conducted simultaneously at this site.
2	Planning and enforcement activities are conducted separately or only planning activities are conducted at this site.

k. AADT
(Columns 40-45)

Code the most current AADT for the roadway on which the station is located. Right justify figure in field and enter leading zeros if necessary.

l. Location of Station
(Columns 46-80)

For stations located on a numbered route, enter the distance and direction of the station from the nearest major intersecting route. Abbreviate wherever necessary while ensuring the information remains clear. For example, a location could be coded:

5 MILES WEST OF U.S. 283

or

5 MI. W. OF US 283

If the station is located on a city street, enter the city and street name.

Vehicle Classification Records

1. General Comments

   Vehicle classification data collected at truck weigh sites are necessary to expand the truck weight information to the distribution of the various types of trucks in the traffic stream. The FHWA vehicle classification categories are discussed in Section 4 and the definitions are repeated here as a reference for the vehicle classification record format immediately following them.

Type Name and Description

1. Motorcycles (Optional)--All two- or three-wheeled motorized vehicles. Typical vehicles in this category have saddle-type seats and are steered by handle bars rather than a wheel. This category includes motorcycles, motor scooters, mopeds, motor-powered bicycles, and three-wheel motorcycles. This vehicle type may be reported at the option of the State.

2. Passenger Cars--All sedans, coupes, and station wagons manufactured primarily for the purpose of carrying passengers and including those passenger cars pulling recreational or other light trailers.

3. Other Two-Axle, Four-Tire Single Unit Vehicles--All two-axle, four-tire vehicles, other than passenger cars. Included in this classification are pickups, panels, vans and other vehicles such as campers, motor homes, ambulances, hearses, and carryalls. Other two-axle, four-tire single unit vehicles pulling recreational or other light trailers are included in this classification.

4. Buses--All vehicles manufactured as traditional passenger-carrying buses with two axles and six tires or three or more axles. This category includes only traditional buses (including school buses) functioning as passenger-carrying vehicles. All two-axle, four-tire minibuses should be classified as other two-axle, four-tire single unit vehicles. Modified buses should be considered to be a truck and be appropriately classified.

   NOTE: In reporting information on trucks the following criteria should be used:

   a. Truck tractor units traveling without a trailer will be considered single unit trucks.

   b. A truck tractor unit pulling other such units in a "saddle mount" configuration will be considered as one single unit truck and will be defined only by the axles on the pulling unit.

   c. Vehicles shall be defined by the number of axles in contact with the roadway. Therefore, "floating" axles are counted only when in the down position.

d. The term "trailer" includes both semi- and full trailers.

5. Two-Axle, Six-Tire, Single Unit Trucks--All vehicles on a single frame including trucks, camping and recreation vehicles, motor homes, etc., having two axles and dual rear wheels.

6. Three-Axle Single Unit Trucks--All vehicles on a single frame including trucks, camping and recreational vehicles, motor homes, etc., having three axles.

7. Four or More Axle Single Unit Trucks--All trucks on a single frame with four or more axles.

8. Four or Less Axle Single Trailer Trucks--All vehicles with four or less axles consisting of two units, one of which is a tractor or straight truck power unit.

9. Five-Axle Single Trailer Trucks--All five-axle vehicles consisting of two units, one of which is a tractor or straight truck power unit.

10. Six or More Axle Single Trailer Trucks--All vehicles with six or more axles consisting of two units, one of which is a tractor or straight truck power unit.

11. Five or Less Axle Multi-Trailer Trucks--All vehicles with five or less axles consisting of three or more units, one of which is a tractor or straight truck power unit.

12. Six-Axle Multi-Trailer Trucks--All six-axle vehicles consisting of three or more units, one of which is a tractor or straight truck power unit.

13. Seven or More Axle Multi-Trailer Trucks--All vehicles with seven or more axles consisting of three or more units, one of which is a tractor or straight truck power unit.

2. Record Format

Enter data in the following manner:

a. All records must contain a "4" in column 1.

b. All data fields in columns 1-17 must contain an appropriate code for each data item and be filled with leading zeros.

c. Columns 1-3 and 10-11 should be the same on every record.

d. Each count field in columns 18-48 must contain a number or zeros.

e. Passenger cars and single-unit trucks pulling light trailers should be entered in the field of the pulling unit.

Vehicle Classification Record

Columns	No. of Columns	Description	Ref. Page
1	1	Vehicle classification record code (4)	
2-3	2	State code	5-6-2
4-5	2	Functional classification	5-6-3
6-8	3	Station identification number	5-6-3
9	1	Direction of travel	5-6-3
10-11	2	Year of data	5-6-4
12-13	2	Month of data	5-6-14
14-15	2	Date of month	5-6-14
16-17	2	Hour of day	5-6-14
18-19	2	Number of motorcycles (optional)	5-6-14
20-23	4	Number of passenger cars <u>or</u> all 2-axle, 4-tire single unit vehicles	5-6-14
24-26	3	Number of other 2-axle, 4-tire single unit vehicles	5-6-14
27-28	2	Number of buses	5-6-14
29-31	3	Number of 2-axle, 6-tire single unit trucks	5-6-14
32-33	2	Number of 3-axle single unit trucks	5-6-14
34-35	2	Number of 4 or more axle single unit trucks	5-6-14
36-37	2	Number of 4 or less axle single trailer trucks	5-6-14
38-40	3	Number of 5-axle single trailer trucks	5-6-14
41-42	2	Number of 6 or more axle single trailer trucks	5-6-14
43-44	2	Number of 5 or less axle multi-trailer trucks	5-6-14
45-46	2	Number of 6-axle multi-trailer trucks	5-6-14
47-48	2	Number of 7 or more axle multi-trailer trucks	5-6-14
49	1	Motorcycle reporting indicator	5-6-14
50	1	Vehicle class combination indicator	5-6-15
51-80	32	Blank or optional State data	5-6-15

3. Coding Schemes
(Columns 12-80)

a. Month of Data
(Columns 12-13)

01 = January...12 = December

b. Date of Month
(Columns 14-15)

Code the day of the month. 01-31 are the valid codes.

c. Hour of Day
(Columns 16-17)

Code the beginning of the hour in which the count was taken, i.e.:

Midnight-1:00 a.m.	= 00
1:00 a.m.-2:00 a.m.	= 01
.	
.	
.	
10:00 p.m.-11:00 p.m.	= 22
11:00 p.m.-Midnight	= 23

d. Vehicle Counts
(Columns 18-48)

Code the number of vehicles counted during the hour based on the vehicle type. Right justify the counts in the appropriate fields and zero-fill each field. If the vehicles in the two vehicle type categories "passenger cars" and "other two-axle single unit vehicles" are counted as one vehicle type, enter the combined count of the two categories in columns 20-23 and enter zeroes in columns 24-26.

e. Motorcycle Reporting Indicator
(Column 49)

Reporting motorcycle counts is optional. Indicate whether or not it was decided to count motorcycles.

Code	
0	Motorcycles are not reported
1	Motorcycles are reported

f. Vehicle Class Combination Indicator
(Column 50)

<u>Code</u>

0 Passenger cars and 2-axle, 4-tire single unit trucks are reported separately.

1 Passenger cars and 2-axle, 4-tire single unit trucks are combined.

g. (Columns 51-80)

These columns may be used to enter any information the State wishes to include on the vehicle classification record. If no additional information is necessary, leave these columns blank.

Truck Weight Records

1. General Comments

   In Chapter 5 the three truck weight data groups (identification data, interview data and axle data) contained in the truck weight record format are discussed. The interview data items may be entered at the States' discretion. These items include body type, engine type, registered weight, basis of registration, commodity and load status.

   Special coding problems which have arisen in the past are discussed on page 5-6-33.

2. Record Format

   Enter data in the following manner:

   a. All records must contain a "7" in column 1.

   b. For vehicles having five or less axles, only the "face record" will be coded and column 80 will contain a zero.

   c. Vehicles having 6-13 axles will have the weights and spacings for the first 5 axles coded on the face record and the remaining weights and spacings coded on the continuation record. Column 80 will be a "1" on the face record and a "9" on the continuation record.

   d. Vehicles with more that 13 axles will have the weights and spacings for first 5 axles coded on the face record (Column 80 = 1), the weights and spacings for the 6th-13th axles coded on the first continuation record (Column 80 = 2), and the remaining weights and spacings coded on the last continuation record (Column 80 = 9).

   e. Columns 1-28 and 77-79 of the face and continuation records describing one vehicle must contain the same data.

   f. Columns 1-3 and 10-11 should be the same on every record.

   g. All data fields in columns 1-26 on all records and columns 29-32 and 36-41 on the face card must contain an appropriate code for each data item and be filled with leading zeros.

   h. All of the axle weight and spacing data fields must contain a number or zeros.

Truck Weight Record

FACE RECORD

Columns	No. of Columns	Description		Ref. Page
1	1	Truck weight record code (7)		
2-3	2	State code		5-6-2
4-5	2	Functional classification		5-6-3
6-8	3	Station identification number		5-6-3
9	1	Direction of travel		5-6-3
10-11	2	Year of data		5-6-4
12-13	2	Month of data		5-6-19
14-15	2	Date of month		5-6-19
16-17	2	Hour of day		5-6-19
18-23	6	Vehicle type code		5-6-19
24-25	2	Body type (optional)*		5-6-22
26	1	Engine type (optional)*		5-6-25
27-28	2	(open)		5-6-26
29-31	3	Registered weight (thousands of pounds)	Optional, if one is coded, both must be coded*	5-6-26
32	1	Basis of registration		5-6-26
33-35	3	(open)		5-6-26
36-40	5	Commodity code (optional)*		5-6-27
41	1	Load status code (optional)*		5-6-32
42-45	4	Total weight of truck or combination		5-6-32
46-48	3	A-axle weight (hundreds of pounds)		5-6-32
49-51	3	B-axle weight " " "		5-6-32
52-54	3	C-axle weight " " "		5-6-32
55-57	3	D-axle weight " " "		5-6-32
58-60	3	E-axle weight " " "		5-6-32
61-63	3	(A-B) axle spacing (feet and tenths)		5-6-32
64-66	3	(B-C) axle spacing " " "		5-6-32
67-69	3	(C-D) axle spacing " " "		5-6-32
70-72	3	(D-E) axle spacing " " "		5-6-32
73-76	4	Total wheelbase " " "		5-6-32
77-79	3	Record serial number (same for continuation record)		5-6-32
80	1	Continuation indicator (0 = no continuation record 1 = has a continuation record)		5-6-32

*Each interview data item has a default value which must be entered when the data item is not collected.

CONTINUATION RECORD*

Columns	No. of Columns	Description	Ref. Page
1-28	28	Same as columns 1-28 of the face record	
29-31	3	F-axle weight (hundreds of pounds)	5-6-32
32-34	3	G-axle weight " " "	5-6-32
35-37	3	H-axle weight " " "	5-6-32
38-40	3	I-axle weight " " "	5-6-32
41-43	3	J-axle weight " " "	5-6-32
44-46	3	K-axle weight " " "	5-6-32
47-49	3	L-axle weight " " "	5-6-32
50-52	3	M-axle weight " " "	5-6-32
53-55	3	(E-F) axle spacing (feet and tenths)	5-6-32
56-58	3	(F-G) axle spacing " " "	5-6-32
59-61	3	(G-H) axle spacing " " "	5-6-32
62-64	3	(H-I) axle spacing " " "	5-6-32
65-67	3	(I-J) axle spacing " " "	5-6-32
68-70	3	(J-K) axle spacing " " "	5-6-32
71-73	3	(K-L) axle spacing " " "	5-6-32
74-76	3	(L-M) axle spacing " " "	5-6-32
77-79	3	Record serial number (same as face record)	5-6-32
80	1	Continuation indicator (2 = first continuation record for a vehicle with more than 13 axles; 9 = last continuation record)	5-6-32

*Used only for truck combinations having six or more axles and immediately follows the face record.

3. Coding Schemes
(Columns 12-80)

a. Month of Data
(Columns 12-13)

01 = January...12 = December

b. Date of Month
(Columns 14-15)

Code the day of the month. 01-31 are the valid codes.

c. Hour of Day
(Columns 16-17)

Code the beginning of the hour in which the truck was weighed, i.e.:

Midnight-1:00 a.m.	= 00
1:00 a.m.-2:00 a.m.	= 01
.	
.	
.	
10:00 p.m.-11:00 p.m.	= 22
11:00 p.m.-Midnight	= 23

d. Vehicle Type
(Columns 18-23)

This six-digit code has been designed to allow maximum flexibility in identifying specific vehicle types and axle configurations. The next two pages contain the vehicle type coding chart that illustrates the six-digit coding scheme for this field. The passenger car and bus categories have been included for those States that are using WIM equipment and choose to weigh all vehicles.

When entering the vehicle type code, no columns should be left blank. Leading and trailing zeros should be entered to fill out the field as indicated on the chart.

Vehicle Type Coding Chart*

	1st Character	2nd Character	3rd Character	4th Character	5th Character	6th Character
Personal passenger vehicles	basic vehicle type = 0	9	0	Table A-light trailer modifier	0	0
Buses	basic vehicle type = 1	9	0	Table B-axle & tire modifier	0	0
Single-unit trucks or tractors	basic vehicle type = 2	Table C-total axles	0	Table A-light trailer modifier	0	0
Tractor + semitrailer	basic vehicle type = 3	total axles on power unit	Table D-total axles on first trailer	0	0	0
Truck + full trailer	basic vehicle type = 4	total axles on power unit	Table D-total axles on first trailer	0	0	0
Tractor + semitrailer + full trailer**	basic vehicle type = 5	total axles on power unit	Table D-total axles on first trailer	Table D-total axles on second trailer	0	0
Truck + full trailer + full trailer	basic vehicle type = 6	total axles on power unit	Table D-total axles on first trailer	Table D-total axles on second trailer	0	0
Tractor + semitrailer + 2 full trailers**	basic vehicle type = 7	total axles on power unit	Table D-total axles on first trailer	Table D-total axles on second trailer	Table D-total axles on third trailer	0
Truck + 3 full trailers	basic vehicle type = 8	total axles on power unit	Table D-total axles on first trailer	Table D-total axles on second trailer	Table D-total axles on third trailer	0

*See next page for table references.

**Semitrailers pulled by other semitrailers will be considered full trailers.

Table A - Light Trailer Modifier

0 No trailer
1 Camp trailer
2 Travel or mobile home
3 Cargo or livestock trailer
4 Boat trailer
5 Towed equipment
6 Towed auto
7 Towed truck
8 "Saddle mount" (Tractors or trailers with front axles on unit ahead)
9 Type trailer not determined

Table B - Axle and Tire Modifier

0 Axle arrangement not recorded
1 Two-axle, four-tire
2 Two-axle, six-tire
3 Three-axle
4 Four or more axles

Table C - Total Axles

0 Panel and pickup
1 Heavy two-axle, four-tire
2 Two-axle, six-tire
3 Three-axle
4 Four-axle
5 Five-axle
6 Six-axle
7 Seven-axle
8 Eight axles or more

Table D - Total Axles on Trailer

1 Single-axle trailer
2 Two-axle trailer
3 Three-axle trailer
4 Four-axle trailer
5 Five-axle trailer
6 Six-axle trailer
7 Two-axle trailer with axles in spread tandem configuration
8 Three-axle trailer including a spread tandem configuration
9 Four-axle trailer including a spread tandem configuration

VEHICLE TYPE CODING EXAMPLES:

	Vehicle	Code
1.	Car	090000
2.	3-axle bus	190300
3.	3-axle tractor without trailer (bobtail)	230000
4.	3-axle tractor + 2-axle semitrailer	332000
5.	2-axle tractor + 1-axle semitrailer + 2-axle full trailer	521200

e. Body Type
(Columns 24-25)

Recording the body type is optional. Enter "99" in this field when the body type is not determined.

Light truck

These bodies are found primarily on light trucks. Where other bodies, such as multistop delivery, are encountered on light trucks, the correct body type code should be used.

Code	Body Type
11	Panel--A fully enclosed body of limited capacity which includes driver's compartment.
12	Pickup--A small open box or express body.
13	Light utility--A body designed to carry readily accessible tools, equipment, and supplies in integrally constructed compartments, with or without other cargo spaces.
14	Personnel and cargo--A body with large integral enclosed passenger compartment and a separate open box or express body.
15	Carryall or minibus--An enclosed utility body with side windows and one or more removable seats designed for transporting either passengers, light cargo, or both. (Station wagons are considered to be passenger cars and are not included in this category).

General truck and semitrailer bodies

21	Platform, flat, or stake--A body having a floor without sides or roof, with or without readily removable stakes which may be tied together with chains, slats, or panels.
22	Low-bed trailer--A truck trailer with a platform body constructed to provide a low loading height and designed for the transportation of extremely heavy or bulky property.
23	Rack--A body with fixed slatted sides and headboard.
24	Livestock rack--A rack body with or without roof designed primarily for transportation of livestock.

25 Riggers or oil field--A platform body of heavy construction equipped with a rear end roller or bullnose adapted for loading by winch or crane mounted on the vehicle and designed primarily for rigging, construction, or work in oil fields.

26 Lumber--A platform body usually with transverse rollers designed primarily for the transportation of sawed lumber.

27 Log, or pipe--A body comprised of sill, bolsters, with or without headboard, with provision for uprights, and designed primarily for the transportation of logs, poles, pipes, or other loads which may be boomed. (Use body type codes 21 or 23 for trucks hauling pulpwood).

28 Canopy--An express body with fixed or removable uprights and roof which may be integral or separate from cab.

31 Express--An open box body with or without flareboards.

32 Open top box or van--A body with high closed sides and ends and a movable top, which usually is a tarpaulin cover.

33 Grain--A low-side open box primarily designed to transport dry fluid commodities in bulk.

34 Dump--A low-side open box designed primarily to transport dry fluid commodities in bulk, which can be tilted or otherwise manipulated to discharge its load by gravity.

35 Hopper--A body which is capable of discharging its load by gravity or mechanical power through means other than tilting, and usually loaded from the top.

41 Van--A fully enclosed body designed primarily for the transportation of packaged commodities.

42 Insulated van--A van body designed primarily for the transportation of commodities or the vending of food, beverages, or confections at controlled temperatures. It may be provided with equipment for refrigeration or heating.

43 Furniture or moving van--A van body designed primarily for transportation of furniture or household goods. Customarily, when truck-mounted, it includes an integral driver's compartment.

51 Tank--A body designed for bulk liquid commodities other than petroleum.

52 Petroleum tank--A tank body designed for transportation of petroleum products.

53 Bituminous material distributor--A tank body provided with means for distributing hot bituminous material under pressure, usually equipped with means for heating the material.

54 Bottler--A body designed primarily for the transportation of cased bottled beverages on open or closed shelves, A-frames, or pallets.

61 Multistop or standup delivery--A fully enclosed body with driver's compartment integral and designed for easy access.

62 Automobile transporter--A body designed primarily for the transportation of other vehicles.

63 Armored car (not military)--An enclosed cargo body with integral driver's compartment so constructed as to protect cargo and crew from overt attack.

64 Boat carrier--A body designed to transport two or more boats.

71 Concrete mixer or agitator--A body designed and equipped to mix or agitate concrete.

72 Wrecker--A body designed primarily for transportation of equipment for salvaging disabled vehicles and equipped with means for hoisting and towing such vehicles.

73 Utilities--A body designed primarily for the transportation of tools, equipment, and supplies for construction, maintenance, and repair purposes.

74 Garbage and refuse--A dump body designed primarily for the collection of garbage and refuse.

75 Container--A body designed to transport bundled, stacked, or palletized commodities or special containers, with special lifting, locking, or loading devices.

76 <u>Equipment</u>--Any truck-mounted or other self-propelled wheeled equipment designed for highway travel, such as truck-mounted cranes, well drills, compressors, etc.

77 <u>Base chassis</u>--A cargo type vehicle with no provision for carrying load. This code should be used also for the body type when one truck, without a body, is transporting a second without a body, where the front wheels of the second rest on the first.

78 <u>Shop</u>--A body constructed for use as a shop, laboratory, office, or for a similar purpose with tools, equipment, or supplies to be used, operated, or dispensed from inside the body. Insulated bodies designed for vending hot or cold foods, beverages, or confections should be coded 42, insulated van body.

79 <u>Dwelling body</u>--A body, other than a shop body, designed for use as an abode with bunk(s), including house body and camper body.

88 <u>Truck-tractor without semitrailer or trailer</u>--Any vehicle constructed primarily to pull a semitrailer, full trailer, pole trailer, house trailer, or equipment.

89 <u>Empty log truck carrying pole trailer</u>

91 <u>Bus</u>--A long body constructed with seats for transporting passengers.

99 <u>Not determined</u>

f. Engine Type
(Column 26)

This is an optional data item and may be collected and coded at the States' discretion. Enter a "9" if the engine type is not determined.

Code	Engine
1	Gasoline
2	Diesel
3	Propane
4	Turbine
8	Other
9	Not determined

g. (Columns 27-28)

This field may be left blank or it may be used to code any data the State may wish to include on the truck weight record.

h. Registered Weight
(Columns 29-31, Face Record Only)

This data item is optional. If a State chooses to collect this data, the basis of registration (Column 32) must also be coded.

If the weight is coded, it must be the appropriate weight for the basis of registration in the "home" State of the vehicle whether gross weight or empty weight. The sum of the registered weights for all units of the combination should be used. The weight should be expressed in thousands of pounds, right-justified in the field and filled with leading zeros.

If registered weight is not determined, this field should be filled with zeros.

i. Basis of Registration
(Column 32, Face Record Only)

This data item is needed only if the registered weight (Columns 29-31) is reported. Enter a "9" in the field if the basis of registration is not determined.

For States listed below, code as shown, for others code "1". Vehicles from Canada or Mexico, where parts of a combination are registered in different States having different bases of registration or other cases when the basis of registration is not determined, code "9".

Alaska	3
California	3
Colorado	3
D.C.	3
Hawaii	3
Maryland	5
Montana	2
Nevada	3
Ohio	3
Oregon	2
South Carolina	7
Wyoming	3

Legend

1 = Gross weight of combination
2 = Gross weight of units separately
3 = Empty weight of units separately
5 = Chassis weight
7 = Pay load
9 = Not determined

j. (Columns 33-35, Face Record Only)

This field may be left blank or it may be used to code any data the State may wish to include on the truck weight record.

k. Commodity Code
(Columns 36-40, Face Record Only)

Coding the commodity carried is optional. The following codes apply when no commodity is recorded:

		Code
a.	Empty vehicle	00000
b.	Loaded, commodity not determined	46000
c.	Load status not determined	99999

The five-digit commodity code used for this study was developed by the Bureau of the Census for use in the Commodity Transportation Survey portion of the 1977 Census of Transportation. It is an adaptation of the Standard Industrial Classification. For the listing of the commodities and their associated five-digit codes, see Appendix C.

For the purposes of this study, the commodity code should indicate, at minimum, the major category into which the commodity falls. This requires the coding of at least the first two digits of the five-digit code. The commodity code should always be left-justified in this field and filled with trailing zeros if blanks occur. For example, the commodity code for apples could be either 01221 to identify the specific commodity or 01000 to identify the commodity as a farm product.

For those State that choose to classify the commodities by their major categories, the following alphabetical listing of these categories may be helpful. If it is not clear which category a commodity belongs in, the major category codes on this listing may be referenced in Appendix C to determine which commodities are in a specific category.

Major Categories of Commodities

APPAREL AND OTHER FINISHED TEXTILE PRODUCTS, INCLUDING KNIT 23
- Apparel
- Hats, millinery, and gloves
- Fur goods
- Miscellaneous apparel and accessories
- Miscellaneous fabricated textile products

CHEMICALS OR ALLIED PRODUCTS 28
- Alkalies and chlorine
- Industrial gases
- Industrial organic chemicals
- Inorganic color pigments
- Fertilizers and agricultural chemicals
- Industrial inorganic chemicals
- Plastic materials
- Synthetic rubber
- Synthetic fibers
- Drugs and medicines
- Soap, glycerine, cleaning, polishing, and related products
- Surface active agents
- Toilet preparations and cosmetics
- Paints, varnishes, lacquers, enamels, and allied products
- Gum and wood chemicals
- Phosphatic fertilizers
- Adhesives and sealants
- Explosives
- Printing ink
- Chemical preparations, not elsewhere classified
- Carbon black

COAL 11
- Anthracite coal
- Bituminous coal or lignite

CONTAINERS, SHIPPING, RETURNED EMPTY 42
- Shipping containers, returned empty
- Shipping devices, returned empty

CRUDE PETROLEUM, NATURAL GAS, AND NATURAL GASOLINE 13
- Crude petroleum or natural gas
- Natural gasoline

ELECTRICAL MACHINERY, EQUIPMENT OR SUPPLIES 36
- Electrical generating, transmission, distribution, and industrial apparatus
- Household appliances
- Electric lighting and wiring equipment
- Radio, TV, and other communication equipment and related products
- Electronic components and accessories
- Other electrical machinery and equipment

FABRICATED METAL PRODUCTS, EXCEPT ORDNANCE, MACHINERY OR TRANSPORTATION EQUIPMENT 34
- Metal cans
- Cutlery, hand tools, and hardware
- Heating equipment (except electric) and plumbers supplies
- Fabricated structural metal products, including doors
- Boiler shop and sheet metal products
- Prefabricated metal buildings and miscellaneous metal work
- Miscellaneous fabricated metal products
- Metal forgings and stampings, coating and engraving
- Fabricated wire products
- Shipping containers

FARM PRODUCTS 01
- Field crops
- Fresh fruits or tree nuts
- Fresh vegetables
- Livestock or livestock products
- Dairy farm products, except pasteurized
- Poultry or poultry products
- Miscellaneous farm products

FOOD AND KINDRED PRODUCTS 20
- Meat, poultry, and byproducts
- Dairy products
- Canned and preserved fruits, vegetables, and seafoods
- Frozen and fresh fish or other seafoods
- Frozen fruits, vegetables and prepared foods
- Mixed loads
- Grain mill products and animal feed products
- Bakery products, except frozen
- Sugar and related products
- Confectionery, chocolate, and chewing gum
- Beverages, flavoring, and related products
- Miscellaneous foods and kindred products

FOREST PRODUCTS 08
- Barks or gums, crude
- Miscellaneous forest products

FRESH FISH AND OTHER MARINE PRODUCTS 09
- Fresh fish and other marine products

FURNITURES OR FIXTURES 25
- Household and office furniture
- Bedding products
- Public building, restaurant, and other furniture
- Partitions, shelving, lockers, and office and store fixtures - metal and wood
- Window shades and venetian blinds

INSTRUMENTS, PHOTOGRAPHIC AND MEDICAL GOODS, WATCHES, AND CLOCKS 38
- Instruments
- Surgical, medical, dental, optical, and ophthalmic goods
- Photographic equipment and supplies
- Watches, clocks, and watchcases

LEATHERS OR LEATHER PRODUCTS 31
- Finished leather
- Boot and shoe cut stock and findings
- Footwear
- Leather gloves and mittens
- Luggage, handbags, and small leather goods
- Leather goods, not elsewhere classified

LUMBER OR WOOD PRODUCTS, EXCEPT FURNITURE 24
- Lumber and timber basic products
- Lumber and dimension stock
- Millwork, plywood, and structural members
- Wood buildings and mobile homes
- Wood containers, pallets, and skids
- Miscellaneous wood products

MACHINERY, EXCEPT ELECTRICAL 35
- Engines and turbines
- Farm machines and tractors
- Construction, mining, and oil-field machinery
- Elevators, hoists, and materials handling machinery and equipment
- Machine tools
- Metalworking machinery
- Special industry machinery
- Pumps and compressors
- General industrial machinery
- Office and store machines and service industry machines
- Miscellaneous service industry machines
- Miscellaneous machinery and parts

METALLIC ORES 10
- Iron ores
- Copper ores
- Lead or zinc ores
- Gold or silver ores
- Bauxite or other aluminum ores
- Manganese ores
- Tungsten ores
- Chromium ores
- Miscellaneous metal ores

MISCELLANEOUS MIXED SHIPMENTS 46
- Loaded, commodity not determined

MISCELLANEOUS PRODUCTS OF MANUFACTURING 39

- Jewelry, silverware, and plated ware
- Musical instruments and parts
- Toys, sporting, and athletic goods
- Pens, pencils, and other office and artists' supplies
- Miscellaneous manufactured products, including costume jewelry

NONMETALLIC MINERALS, EXCEPT FUELS 14

- Dimension, stone, quarry
- Crushed or broken stone, including riprap
- Sand or gravel
- Clay, ceramic or refractory minerals
- Chemical or fertilizer minerals
- Miscellaneous nonmetallic minerals, except fuels

ORDNANCE AND ACCESSORIES 19

- Guns, howitzers, mortars, or related equipment, over 30 mm
- Ammunition, except for small arms, over 30 mm
- Full tracked combat vehicles or parts
- Sighting or fire control equipment
- Small arms, 30 mm and under
- Small arms ammunition, 30 mm and under
- Miscellaneous ordnance or accessories

PETROLEUM OR COAL PRODUCTS 29

- Petroleum refining products
- Paving and roofing materials
- Asphalt felts and coatings
- Lubricating oils and greases
- Petroleum and coal products, not elsewhere classified

PRIMARY METAL PRODUCTS 33

- Steel mill products including coke and blast furnace products
- Ferroalloys
- Wire and wire products
- Iron and steel castings
- Primary smelting of nonferrous ores, concentrates, or other primary materials
- Nonferrous metal basic shapes
- Nonferrous wire drawing and insulating
- Nonferrous castings
- Miscellaneous primary metal products

PRINTED MATTER 27

- Newspapers
- Periodicals
- Books
- Miscellaneous printed matter
- Manifold business forms
- Blankbooks, loose leaf binders, or devices
- Products of service industries for the printing trades
- Greeting cards, seals, labels or tags

PULP, PAPER, AND ALLIED PRODUCTS 26

- Products of pulp mills
- Paper and board mills
- Paper and board products
- Containers or boxes
- Building paper or building board

RUBBER OR MISCELLANEOUS PLASTICS PRODUCTS 30

- Tires and inner tubes
- Rubber and plastic footwear
- Reclaimed rubber
- Fabricated rubber products, not elsewhere classified
- Plastics products, not elsewhere classified

STONE, CLAY, GLASS, OR CONCRETE PRODUCTS 32

- Glass and glass products
- Cement and structural clay products
- Pottery and related products
- Concrete, gypsum, cut-stone, and plaster products
- Abrasives, asbestos, and miscellaneous nonmetallic products
- Gaskets, packing, and sealing devices
- Nonmetallic earths or minerals, ground
- Mineral wool
- Miscellaneous nonmetallic mineral products

TEXTILE MILL PRODUCTS 22

- Cotton broad woven fabrics
- Manmade fiber broad woven fabrics
- Wool broad woven fabrics
- Narrow fabrics
- Knitting mill products
- Carpets, rugs, and other floor coverings
- Yarn
- Thread
- Miscellaneous textile goods

l. Load Status
(Column 41, Face Record Only)

Code	Status
0	Empty or not carrying a payload
1	Loaded with a payload, no overload permit
2	Equipment movement*
3	Loaded with a payload, overload permit
9	Not determined

*The code "2" is to be used for vehicles which are not empty but could not be considered as transporting a commodity. Examples are trucks with permanently or semipermanently mounted equipment such as compressors, cranes, generators, augers, well drilling rigs, etc., and utility trucks such as those used by gas, telephone and power companies, and by electrical, plumbing and heating contractors. If a "2" is coded, there must be a commodity code in Columns 36-40 indicating the type of equipment being transported. See page 5-6-33 under "Special Coding Problems" for the appropriate commodity codes.

m. Axle Weights and Spacings
(Columns 42-76, Face Record Only)
(Columns 29-76, Continuation Record)

The weights and spacings should be entered in the appropriate columns as indicated on the truck weight record format on pages 5-6-17 and 5-6-18. The weights will be expressed in hundreds of pounds and the spacings will be to the nearest tenth of a foot. Each figure must be right justified in its field with zeros entered where blanks occur. Any weight or spacing field that is unused should be zero-filled.

n. Record Serial Number
(Columns 77-79)

Serial numbering should start with "001" for the first truck weighed at each station. An entry of "000" is not a valid code. If the number of trucks exceeds "999," restart the serial number at "001."

A continuation record should always contain the same serial number as the face record it supplements.

o. Continuation Indicator
(Column 80)

Code	Continuation Status
0	This is the face record describing a vehicle with five or less axles.
1	This is the face record describing a vehicle with six or more axles.
2	This is the first of two continuation records describing a vehicle with more than 13 axles.
9	This is the last continuation record describing a vehicle with six or more axles.

. Special Coding Problems

a. Trucks Carrying Equipment

For trucks carrying permanently mounted equipment such as air compressors, cranes, welding units, and drilling rigs, code body type "76" in Columns 24-25. The appropriate commodity code from the 35 or 36 categories (pages 5-6-26 and 5-6-27) should be coded in Columns 36-40. For example, truck-mounted construction equipment would be coded "76" in Columns 24-25, "35000" in Columns 36-40, and "2" in Column 41.

b. Retractable Axles

Any axles that are retracted at the time a vehicle is weighed should not be considered when measuring the axle weights and spacings.

c. Fifth Wheel

Semitrailers being pulled by other semitrailers by way of a fifth wheel will be treated as full trailers.

d. Saddle-mounted Vehicles

If one or more vehicles are saddle-mounted on another vehicle, only the axles on the pulling vehicle should be weighed and the pulling vehicle should be classified as a single unit truck/tractor.

e. Determination of Load Status

Any vehicle carrying materials that are being moved or delivered should be considered loaded. However, in the case of a vehicle carrying shipping containers or pallets which were used in the delivery of other goods, the vehicle should be considered empty. Only if a vehicle is carrying these articles as a payload should it be coded as loaded.

Data Submittals to FHWA

When a State has completed one calendar year's truck weighing and vehicle classification operation, the data can be submitted to FHWA for analysis. The address is:

> Federal Highway Administration
> Highway Statistics Division, HHP-40
> 400 7th Street, SW
> Washington, D.C. 20590
>
> Attention: Truck Weight Survey

(The data must be in the record formats described in this chapter for further processing into the various summary tables.)

The information on the following page should be included with each data submittal.

Truck Weight Data Submittal To FHWA

1. State Name:

2. Year of Data:

3. Tape Characteristics (Check Appropriate Boxes)

   Volume Name:

   Tape Density: ☐ 3

   ☐ 4

   Type of Labels: ☐ SL

   ☐ NL

   File Description:

Record Types in File

File Number	Station Description	Vehicle Classification	Truck Weight	Record Length	Block Length
1	☐	☐	☐		
2	☐	☐	☐		
3	☐	☐	☐		

4. Special Requests

   Specify Any Additional Summaries Desired. Indicate a Contact Person and Telephone Number in Case Further Clarification is Necessary.

CHAPTER 7

Editing of Truck Weight Data

Introduction

Prior to the submission of truck weight survey data to the Federal Highway Administration, the vehicle classification and truck weight records should be edited by the States using the computer edit program provided by FHWA. This chapter describes the edit program and identifies the data checks that can be made.

General Description

This truck weight edit program was written by Federal Highway Administration personnel and is usable by States able to execute American National Standard COBOL software on their computer.

The function of the program is to edit the vehicle classification and truck weight data according to the specifications indicated in Chapter 6. The program can edit records either in the number 4 record format or the number 7 record format, representing one year's data for any one State. It accepts card images on tape or disk, or punched data cards as input and produces a master file on tape or disk of the records passing all edit checks. Any records containing one or more errors are not written on the master file. All records input are listed and, in addition, error messages for records containing errors are listed preceding those records to which they apply.

The edit program requires only one parameter card. This card indicates the record code (4 or 7), the FIPS State code and the last two digits of the year of the data to be edited. The values on this card are compared to the same data items in the truck weight or vehicle classification records to ensure that the proper type of data for the proper State and year are being edited.

This software also includes an updating process which can be used to correct any errors identified in the initial edit of the data. It allows individual records to be deleted, new records to be added, and records containing errors to be replaced with corrected records.

The Edit Process

The edit program has the capability to perform the following important functions:

1. Ensures that the vehicle classification and truck weight data records are complete, in sequential order and free of coding errors.

2. Creates an edited data file which is ready for processing into the various analysis and summary tables.

3. Updates an existing file with additions, deletions, or corrections and creates a new or updated classification or weight file.

The edit checks performed on the data are indicated on the following pages. The checks are divided into those that apply to the vehicle classification data and those that apply to the truck weight data since the two files are processed individually.

1. Classification Record Valid Edit Values

Columns	Field Description	Valid Values
1	Record Type Code	must agree with Column 1 on parameter card (=4)
2-3	State Code	must agree with Columns 2-3 on parameter card
4-5	Functional Class.	01, 02, 06-09, 11, 12, 14, 16, 17, 19
6-8	Station ID Number	numeric or alpha (not blank)
9	Direction	0-9
10-11	Year	must agree with Columns 4-5 on parameter card
12-13	Month	01-12 and must be compatible with Columns 14-15
14-15	Date	01-31 and must be compatible with Columns 12-13
16-17	Hour	00-23
18-19	Vehicle count	numeric
20-23	Vehicle count	numeric
24-26	Vehicle count	numeric
27-28	Vehicle count	numeric
29-31	Vehicle count	numeric
32-33	Vehicle count	numeric
34-35	Vehicle count	numeric
36-37	Vehicle count	numeric
38-40	Vehicle count	numeric
41-42	Vehicle count	numeric
43-44	Vehicle count	numeric
45-46	Vehicle count	numeric
47-48	Vehicle count	numeric
49	Motorcycle Reporting Indicator	0-1 and must be compatible with Columns 18-19
50	Vehicle Class Combination Indicator	0-1 and must be compatible with Columns 24-26
51-80	Blank or optional data	(no edit check)

2. Weight Record Valid Edit Values

Face Record

Columns	Field Description	Valid Values
1	Record Type Code	must agree with Column 1 on parameter card (=7)
2-3	State Code	must agree with Columns 2-3 on parameter card
4-5	Functional Class.	01, 02, 06-09, 11, 12, 14, 16, 17, 19
6-8	Station ID Number	numeric or alpha (not blank)
9	Direction	0-9
10-11	Year	must agree with Columns 4-5 on parameter card
12-13	Month	01-12 and must be compatible with Columns 14-15
14-15	Date	01-31 and must be compatible with Columns 12-13
16-17	Hour	00-23
18-23	Vehicle Type Code	See Vehicle Code Checks (page 5-7-7)
24-25	Body Type	>10
26	Engine Type	1-4, 8, 9
27-28	(open)	(no edit check)
29-31	Registered Weight	numeric
32	Basis of Regis.	1, 2, 3, 5, 7, 9
33-35	(open)	(no edit check)
36-40	Commodity Code	See Commodity Code Checks (page 5-7-8)
41	Load Status Code	
42-45	Total Weight	must = sum of all axle weights
46-48	Axle Weight	numeric
49-51	Axle Weight	numeric
52-54	Axle Weight	numeric
55-57	Axle Weight	numeric

58-60	Axle Weight	numeric
61-63	Axle Spacing	zeros or (numeric and > 1.9 ft.)
64-66	Axle Spacing	zeros or (numeric and > 1.9 ft.)
67-69	Axle Spacing	zeros or (numeric and > 1.9 ft.)
70-72	Axle Spacing	zeros or (numeric and > 1.9 ft.)
73-76	Total Wheelbase	must = sum of all axle spacings
77-79	Record Serial No.	numeric and > zero
80	Continuation Code	= 0 and followed by another face record <u>or</u>
		= 1 and followed by a continuation record

Continuation Record

Columns	Field Description	Valid Values
1-28	Same as Face Record	Same as face record 1 preceding it
29-31	Axle Weight	numeric
32-34	Axle Weight	numeric
35-37	Axle Weight	numeric
38-40	Axle Weight	numeric
41-43	Axle Weight	numeric
44-46	Axle Weight	numeric
47-49	Axle Weight	numeric
50-52	Axle Weight	numeric
53-55	Axle Spacing	zeros or (numeric and > 1.9 ft.)
56-58	Axle Spacing	zeros or (numeric and > 1.9 ft.)
59-61	Axle Spacing	zeros or (numeric and > 1.9 ft.)
62-64	Axle Spacing	zeros or (numeric and > 1.9 ft.)
65-67	Axle Spacing	zeros or (numeric and > 1.9 ft.)
68-70	Axle Spacing	zeros or (numeric and > 1.9 ft.)
71-73	Axle Spacing	zeros or (numeric and > 1.9 ft.)
74-76	Axle Spacing	zeros or (numeric and > 1.9 ft.)
77-79	Record Serial No.	Same as face record 1 preceding it
80	Continuation Code	= 2 and followed by a continuation record <u>or</u> = 9 and followed by a face record

a. Vehicle Code Checks

For the purpose of this explanation, the following definitions will be used:

Digit 1 = 1st digit of the vehicle code
Digit 2 = 2nd digit of the vehicle code
Digit 3 = 3rd digit of the vehicle code
Digit 4 = 4th digit of the vehicle code
Digit 5 = 5th digit of the vehicle code
Digit 6 = 6th digit of the vehicle code

The vehicle code edit checks are:

(1) must be numeric

(2) Digit 1 = 0-8

(3) Digit 1 = 0 ⟹ Digit 2 = 9
Digit 3 = 0
Digit 5 = 0
Digit 6 = 0

(4) Digit 1 = 1 ⟹ Digit 2 = 9
Digit 3 = 0
Digit 4 = 0-4
Digit 5 = 0
Digit 6 = 0

(5) Digit 1 = 2 ⟹ Digit 2 = 0-8
Digit 3 = 0
Digit 5 = 0
Digit 6 = 0

(6) Digit 1 = 3 or 4 ⟹ Digit 2 = 2-9
Digit 3 = 1-9
Digit 4 = 0
Digit 5 = 0
Digit 6 = 0

(7) Digit 1 = 5 or 6 ⟹ Digit 2 = 2-9
Digit 3 = 1-9
Digit 4 = 1-9
Digit 5 = 0
Digit 6 = 0

(8) Digit 1 = 7 or 8 ⟹ Digit 2 = 2-9
Digit 3 = 1-9
Digit 4 = 1-9
Digit 5 = 1-9
Digit 6 = 0

(9) The number of axles indicated in the vehicle code must equal the number of axle weights coded for that vehicle.

b. Commodity Code Checks

Cross checks between the commodity code and the load status are preformed based on the valid commodity codes as follows:

	Commodity Code	Load Status
(1)	Columns 36-37 = 01, 08-11, 13, 14, 19-40, 42, 46	Column 41 = 1, 2, or 3
(2)	Columns 36-40 = 00000	Column 41 = 0
(3)	Columns 36-40 = 99999	Column 41 = 9

c. Axle Weights and Spacings

The number of axle weights coded for a vehicle must correspond to the number of axle spacings.

CHAPTER 8

Truck Weight Data Summaries (FHWA W-Tables)

Introduction

In order for the results of the truck weight surveys to be of value, summaries of the data must be made available in an appropriate form. The W-Tables were designed to provide a standard format for presenting the outcome of the vehicle weighing and classification efforts at truck weigh sites. These summary tables have been produced by FHWA for each submittal of a State's data and returned to the States for their use. This chapter provides a brief description of each of the W-Tables along with a sample of each as produced by the current software.

Table W-1

This table displays the characteristics of each weigh station based on the information contained in the station description records. The characteristics presently include a brief description of the location of the station along with various information on the adjoining roadway, the scale and its hours of operation, the attending personnel, the surrounding environment, and the prevailing weather conditions. A sample of the table is shown on page 5-8-3.

TABLE W-1 FOR 1984

STATION NUMBER : 309 DIRECTION OF TRAVEL : SOUTH TOTAL VEHICLES WEIGHED 1983 : 236
ROUTE NUMBER : INTST 00083 FUNC. CLASS. : 01 • AVG DAILY TRAFFIC 1983 : 26449 SPEED LIMIT - CARS : 55 MPH
YEAR ESTABLISHED : 1974 AVG DAILY LOAD 1983 : 4720 18-KIP EQ. SPEED LIMIT - TRUCKS : 55 MPH

ROADWAY AND PAVEMENT CHARACTERISTICS :
MAIN ROADWAY LANES : 4 PAVEMENT TYPE - NORTH OR EAST BOUND ROADWAY : 18 MEDIAN TYPE : 5 MEDIAN WIDTH : 4 FT
TOTAL WIDTH : 48 FT PAVEMENT TYPE - SOUTH OR WEST BOUND ROADWAY : 18 CONTROL OF ACCESS CODE : 2
CROSS-SECTION CODE : 14 PAVEMENT THICKNESS : 14 IN FEDERAL-AID SYSTEM CODE : 02
PAVEMENT CONDITION RATING SYSTEM CODE : 4 PAVEMENT CONDITION - NORTH OR EAST BOUND ROADWAY : 3.2
PAVEMENT CONDITION - SOUTH OR WEST BOUND ROADWAY : 3.2

STATION ENVIRONMENT :
TYPE OF SITE : 3 LAND USE ABUTTING NORTH OR EAST BOUND ROADWAY : 9900
LAND USE ABUTTING SOUTH OR WEST BOUND ROADWAY : 9900
COUNTY CODE : 133 CITY CODE : 4300 RURAL - URBAN - MUNICIPAL - METROPOLITAN CATEGORY CODE : 50
NEAREST TRAFFIC CONTROL DEVICES - NORTH OR EAST FROM STATION : 000/00
NEAREST TRAFFIC CONTROL DEVICES - SOUTH OR WEST FROM STATION : 000/00

TIME OF OPERATIONS : SHIFT 1 OF 1 START ON 08 / 08 AT 1300 END ON 08 / 08 AT 2100

SCALE TYPE AND PERSONNEL :
TYPE OF EQUIPMENT : 01 LENGTH OF SCALE : 2 FT
CLASSIFICATION COUNTERS : 02 INTERVIEWERS : 01 LOADOMETER OPERATORS : 06
TAPEMEN : 06 RECORDERS : 01 WEIGH MASTERS : 00
SUPERVISORS : 01 POLICE : 02 FLAGMEN : 01
OTHER (UNCLASSIFIED) : 00

WEATHER CONDITIONS :
GENERAL WEATHER CODE : 0 TEMPERATURE : 0 DEGREES ROAD SURFACE CONDITION CODE : 0 AVG WIND VELOCITY : 0 MPH

OTHER COMMENTS :
NB REST AREA N OF EXIT 13 SB REST AREA S OF EXIT 15 YORK CO EST

Table W-2

This table includes a summary of the number of vehicles counted and the number of vehicles weighed in each State by each functional classification of the highway, individual station location, and vehicle type. It also compares the figures for the current year to those for the year of the previous data submittal.

Several additional figures are provided in the table and are calculated in the following manner:

1. "Ratio" $= \dfrac{\text{Current year figure for this category}}{\text{Previous year figure for this category}}$

2. "Percent Distribution Total Vehicles" $= \dfrac{\text{"Number Counted" of a specific vehicle type}}{\text{"Total of All Vehicles"}} \times 100$

3. "Percent Distribution Trucks & Comb." $= \dfrac{\text{"Number Counted" of a specific truck type}}{\text{"Total Truck \& Comb."}} \times 100$

4. "Percent Dist. of Number Weighed" $= \dfrac{\text{"Number Weighed" of a specific truck type}}{\text{"Total Truck \& Comb."}} \times 100$

5. "Weighed as a Percent of Counted" $= \dfrac{\text{"Number Weighed" of a specific truck type}}{\text{"Number Counted" of a specific truck type}} \times 100$

TABLE W-2 FOR 1982-84

FUNC. CLASS 01
ALL STATIONS

	NUMBER COUNTED 1984	NUMBER COUNTED 1982	NUMBER COUNTED RATIO	PERCENTAGE DISTRIBUTION TOTAL VEHICLES 1984	TOTAL VEHICLES 1982	TOTAL VEHICLES RATIO	TRUCKS & COMB. 1984	TRUCKS & COMB. 1982	TRUCKS & COMB. RATIO	NUMBER WEIGHED 1984	NUMBER WEIGHED 1982	PERCENT DIST. OF NUMBER WEIGHED 1984	PERCENT DIST. OF NUMBER WEIGHED 1982	WEIGHED AS A PERCENT OF COUNTED 1984	WEIGHED AS A PERCENT OF COUNTED 1982
PASSENGER VEHICLES															
MOTORCYCLE SCOOTER	809	1173	0.69	0.38	0.58	0.66									
PASSENGER CARS															
SMALL IN STATE	12942	667	19.40	6.12	0.33	18.66									
SMALL OUT OF STATE	0	354	0.00	0.00	0.17	0.00									
SUBTOTAL SMALL	12942	1021	12.68	6.12	0.50	12.19									
STD-COMP IN STATE	82804	79664	1.04	39.15	39.17	1.00									
STD-COMP OUT STATE	27695	44063	0.63	13.10	21.66	0.60									
SUBTOTAL STD-COMP	110499	123727	0.89	52.25	60.83	0.86									
IN STATE ALL CARS	95746	80331	1.19	45.27	39.49	1.15									
OUT STATE ALL CARS	27695	44417	0.62	13.10	21.84	0.60									
SUBTOTAL PASS. CARS	123441	124748	0.99	58.37	61.33	0.95									
BUSES															
COMMERCIAL BUSES	339	428	0.79	0.16	0.21	0.76									
SCHOOL,NON-REV BUS	135	172	0.78	0.06	0.08	0.75									
SUBTOTAL ALL BUSES	474	600	0.79	0.22	0.29	0.76									
TOTAL ALL PASS VEH	124724	126521	0.99	58.97	62.20	0.95									
SINGLE UNIT TRUCKS															
PANEL AND PICKUP	23112	20072	1.15	10.93	9.87	1.11	26.64	26.11	1.02	0	0	0.00	0.00	0.00	0.00
2-AXLE, 4 TIRE	119	568	0.21	0.06	0.28	0.20	0.14	0.74	0.19	0	1	0.00	0.02	0.00	0.18
2-AXLE, 6 TIRE	8047	7383	1.09	3.80	3.63	1.05	9.27	9.60	0.97	693	646	10.58	11.19	8.61	8.75
3-AXLE, OR MORE	974	1328	0.73	0.46	0.65	0.71	1.12	1.73	0.65	447	213	6.82	3.69	45.89	16.04
SUBTOTL SINGLE-UNIT	32252	29351	1.10	15.25	14.43	1.06	37.17	38.18	0.97	1140	860	17.40	14.89	3.53	2.93
COMBINATIONS															
TRACTOR + SEMITRAILER															
2 AXLE TRCTR	4685	4463	1.05	2.22	2.19	1.01	5.40	5.80	0.93	456	538	6.96	9.32	9.73	12.05
3 AXLE TRCTR	48568	42686	1.14	22.96	20.99	1.09	55.98	55.52	1.01	4813	4375	73.46	75.76	9.91	10.25
4 AXLE TRCTR	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1	2	0.02	0.03	0.00	0.00
SUBTOTAL	53253	47149	1.13	25.18	23.18	1.09	61.38	61.32	1.00	5270	4915	80.43	85.11	9.90	10.42
TRUCK + FULL TRAILER															
2 AXLE TRCTR	26	100	0.26	0.01	0.05	0.25	0.03	0.13	0.23	1	0	0.02	0.00	3.85	0.00
3 AXLE TRCTR	0	285	0.00	0.00	0.14	0.00	0.00	0.37	0.00	1	0	0.02	0.00	0.00	0.00
SUBTOTAL	26	385	0.07	0.01	0.19	0.06	0.03	0.50	0.06	2	0	0.03	0.00	7.69	0.00
TRACTOR + SEMITRAILER + FULL TRAILER															
2 AXLE TRCTR	1133	0	0.00	0.54	0.00	0.00	1.31	0.00	0.00	122	0	1.86	0.00	10.77	0.00
3 AXLE TRCTR	99	0	0.00	0.05	0.00	0.00	0.11	0.00	0.00	18	0	0.27	0.00	18.18	0.00
SUBTOTAL	1232	0	0.00	0.58	0.00	0.00	1.42	0.00	0.00	140	0	2.14	0.00	11.36	0.00
TRUCK + FULL TRAILER + FULL TRAILER															
2 AXLE TRCTR	1	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0.00	0.00
SUBTOTAL	1	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0.00	0.00
TOTAL COMBINATIONS	54512	47534	1.15	25.78	23.37	1.10	62.83	61.82	1.02	5412	4915	82.60	85.11	9.93	10.34
TOTAL TRUCK & COMB.	86764	76885	1.13	41.03	37.80	1.09	100.00	100.00	1.00	6552	5775	100.00	100.00	7.55	7.51
TOTAL ALL VEHICLES	211488	203406	1.04	100.00	100.00	1.00									

NOTE: VEHICLES HAVING LOAD STATUS = 2' ARE NOT INCLUDED IN THE W2 TABLES.

Table W-3

This table provides information on the average weights of empty, loaded and all trucks and their average carried loads. This information is broken down by vehicle type, station location and functional classification and is provided for both the current year and the year of the previous data submittal.

The various figures in the table are calculated in the following manner:

1. "Aver Gross Wt. Lbs." $= \dfrac{\text{Total weight of all trucks weighed in this category}}{\text{Number of trucks weighed in this category}}$

2. "Percent Loaded" $= \dfrac{\text{Number of loaded trucks}}{\text{Total number of trucks}} \times 100$

3. "Estimated No. Loaded" $=$ "Number Counted" $\times \dfrac{\text{"Percent Loaded"}}{100}$

4. "Aver Load Wt. Lbs." $= \dfrac{\text{Total weight of loaded trucks in this category}}{\text{Number of loaded trucks in this category}}$

5. "Percent Empty" $= \dfrac{\text{Number of empty trucks}}{\text{Total number of trucks}} \times 100$

6. "Estimated No. Empty" $=$ "Number Counted" $\times \dfrac{\text{"Percent Empty"}}{100}$

7. "Aver Empty Wt. Lbs." $= \dfrac{\text{Total weight of empty trucks in this category}}{\text{Number of empty trucks in this category}}$

8. "Carried Load Wtd. Avg Lbs." = "Aver Load Wt. Lbs." - "Aver Empty Wt. Lbs."

9. "Ratio" $= \dfrac{\text{Current year figure for this category}}{\text{Previous year figure for this category}}$

TABLE W-3 FOR 1982-84
NUMBER OF LOADED AND EMPTY VEHICLES, AVER. WEIGHT, AND AVER. LOADS BY VEHICLE TYPE

FUNC. CLASS 01
ALL STATIONS

		TOTAL VEHICLES		LOADED VEHICLES			EMPTY VEHICLES			
VEHICLE TYPE	YEAR OF SURVEY	NUMBER COUNTED	AVER GROSS WT. LBS.	PERCENT LOADED	ESTIMATED NO. LOADED	AVER LOAD WT. LBS.	PERCENT EMPTY	ESTIMATED NO. EMPTY	AVER EMPTY WT. LBS.	CARRIED LOAD WTD. AVG LBS
SINGLE UNIT TRUCKS										
PANEL AND PICKUP	1984	23,112	0	0.00	0	0	0.00	0	0	0
	1982	20,072	0	0.00	0	0	0.00	0	0	0
	RATIO	1.151	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2-AXLE, 4 TIRE	1984	119	0	0.00	0	0	0.00	0	0	0
	1982	568	7,400	100.00	568	7,400	0.00	0	0	0
	RATIO	0.210	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2-AXLE, 6 TIRE	1984	8,047	14,775	61.04	4,912	15,918	38.96	3,135	12,984	2,933
	1982	7,383	14,786	66.25	4,891	15,860	33.75	2,492	12,678	3,181
	RATIO	1.090	0.999	0.921	1.004	1.004	1.154	1.258	1.024	0.922
3-AXLE, OR MORE	1984	974	45,840	71.14	693	52,986	28.86	281	28,225	24,760
	1982	1,328	30,261	47.89	636	37,895	52.11	692	23,245	14,649
	RATIO	0.733	1.515	1.485	1.090	1.398	0.554	0.406	1.214	1.690
COMBINATIONS										
TRACTOR + SEMITRAILER										
2 AXLE TRCTR	1984	4,685	33,088	68.64	3,216	36,005	31.36	1,469	26,704	9,300
	1982	4,463	33,949	70.26	3,136	36,684	29.74	1,327	27,488	9,196
	RATIO	1.050	0.975	0.977	1.026	0.981	1.054	1.107	0.972	1.011
3 AXLE TRCTR	1984	48,568	51,441	76.36	37,087	57,315	23.64	11,481	32,470	24,845
	1982	42,686	50,449	75.02	32,023	56,593	24.98	10,663	32,001	24,592
	RATIO	1.138	1.020	1.018	1.158	1.013	0.946	1.077	1.015	1.010
TRUCK + FULL TRAILER										
2 AXLE TRCTR	1984	26	61,500	100.00	26	61,500	0.00	0	0	0
	1982	100	0	0.00	0	0	0.00	0	0	0
	RATIO	0.260	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3 AXLE TRCTR	1984	0	51,800	0.00	0	0	0.00	0	0	0
	1982	285	0	0.00	0	0	0.00	0	0	0
	RATIO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TRACTOR + SEMITRAILER + FULL TRAILER										
2 AXLE TRCTR	1984	1,133	58,448	97.54	1,105	59,174	2.46	28	29,633	29,541
	1982	0	0	0.00	0	0	0.00	0	0	0
	RATIO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3 AXLE TRCTR	1984	99	61,944	94.44	93	63,564	5.56	6	34,400	29,164
	1982	0	0	0.00	0	0	0.00	0	0	0
	RATIO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TRUCK + FULL TRAILER + FULL TRAILER										
2 AXLE TRCTR	1984	1	0	0.00	0	0	0.00	0	0	0
	1982	0	0	0.00	0	0	0.00	0	0	0
	RATIO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

NOTE: FOR VEHICLE [illegible]ES THAT WERE COUNTED BUT NOT WEIGHED, THE NUMBER COUNTED IS GIVEN AND WEIGHT RELATED FIELDS ARE ZERO FILLED.
VEH[illegible] HAVING LOAD STATUS = '2' ARE NOT INCLUDED IN THE W3 TABLES.

Table W-4

This table is most commonly used in pavement design since it contains information on truck axle loadings and their effect on flexible and rigid pavements based on 18-KIP equivalent axle loads. It also provides the number of single, tandem, and total axles weighed that fall into particular weight ranges and gives the resulting 18-KIP equivalent axle loads on the two types of pavement. All of the information is produced by truck type and can be shown for each station location and/or functional classification.

The 18-KIP axle equivalence factors used in the calculation of the 18-KIP equivalent axle loads are those recommended by the American Association of State Highway Transportation Officials. The 18-KIP values most commonly used in the W-4 table are associated with the following pavement conditions:

1. Rigid Pavement, P = 2.5, D = 9

   This is concrete pavement with a serviceability value of 2.5 and a depth of 9 inches. (Serviceability values range from 0.0 to 5.0 with 0.0 representing the worst possible pavement condition and 5.0 representing the best possible pavement condition.)

2. Flexible Pavement, P = 2.5, SN = 5

   This is asphalt pavement with a serviceability value of 2.5 and a structural number of 5. (The structural number is calculated from the depth and layer coefficient of the subbase, base and surface courses.)

   The 18-KIP axle equivalence factors for pavement depths of 6 inches through 11 inches, a serviceability rating of 2.0, and structural numbers of 1 through 6 may be used in the table if desired.

   An example of the Table W-4 is given on pages 5-8-11 through 5-8-20. The majority of the figures in the table are the numbers of axles weighed that fall into particular categories. The remaining figures are calculated from this information. The following definitions for determining these figures and examples of their derivation based on the example table are intended to help those using this table to better understand its contents.

   1. "Probable No." = The product of the number of axles weighed in a specific weight range for a specific truck type and the ratio of total axles counted to total axles weighed for that truck type, summed for each truck type in the category.

      e.g., (see page 5-8-13),

$$A10 = \frac{A1}{A2} \times A3 + \frac{A4}{A5} \times A6 + \frac{A7}{A8} \times A9$$

2. "18 K Eqv for All Trucks Weighed" = By truck type, the summation of 18-KIP equivalent axle loads calculated from the product of the number of axles in each weight range and the 18-KIP axle equivalence factor for that weight range.

e.g., (see pages 5-8-13 and 5-8-14),

$$B100 = (B1xC1) + (B2xC2) + (B3xC3) + \ldots (B12xC12) + (B13xC13) + (D1xE1) + (D2xE2) + (D3xE3) + \ldots (D15xE15) + (D16xE16)$$

and

$$F100 = (F1xC1) + (F2xC2) + (F3xC3) + \ldots (F12xC12) + (F13xC13) + (G1xE1) + (G2xE2) + (G3xE3) + \ldots (G15xE15) + (G16xE16)$$

3. "18 K Eqv per 1000 Trucks Weighed" = Average 18-KIP equivalent axle load per truck multiplied by 1,000.

e.g., (see pages 5-8-13 and 5-8-14),

$$H1 = H2 \; / \; \frac{H3}{H4} \times 1{,}000 \qquad \text{or} \qquad \frac{H2 \times H4 \times 1000}{H3}$$

NOTE: While H4 is nominally equal to the column heading, it is in fact calculated from the number of axles coded on the individual truck records.

4. "18 K Eqv for All Trucks Counted" = The ratio of the number of axles counted to the number of axles weighed multiplied by the 18-KIP equivalent axle load for all trucks weighed.

e.g., (see page 5-8-14),

$$J1 = \frac{J2}{H3} \times H2$$

5. "Percent Distribution of 18 K Eqv" = The 18-KIP equivalent axle load for all trucks counted in a particular truck type divided by the same figure under "Total All Trucks and Combinations Probable No." (on Part 5 of Table W-4).

e.g., (see pages 5-8-14 and 5-8-20),

$$K1 = (J1/K2) \times 100$$

6. "Total All Combinations Probable No." (Part 5 only) = The sum of the probable numbers from Parts 2-4 of this table.

e.g., (see pages 5-8-13, 5-8-15, 5-8-17, and 5-8-19),

$$\underset{\text{(Part 5)}}{L1} = \underset{\text{(Part 2)}}{L2} + \underset{\text{(Part 3)}}{L3} + \underset{\text{(Part 4)}}{L4}$$

7. "Total All Trucks and Combinations Probable No." (Part 5 only) = The sum of the probable numbers from Parts 1-4 of this table.

e.g., (see pages 5-8-11, 5-8-13, 5-8-15, 5-8-17, and 5-8-19),

$$\underset{\text{(Part 5)}}{M1} = \underset{\text{(Part 1)}}{M2} + \underset{\text{(Part 2)}}{L2} + \underset{\text{(Part 3)}}{L3} + \underset{\text{(Part 4)}}{L4} = M2 + L1$$

8. "Percent Heavier Than Low Weight Interval" (Part 5 only) = 100 percent minus the percentage of the probable number of axles in a lower weight group.

e.g., (see page 5-8-19),

$$N1 = 100 - \frac{(N2 + N3 + N4 + N5) \times 100}{N6}$$

9. "Axles per 1,000 Trucks and Combinations" (Part 5 only) = The ratio of the probable number of trucks in a weight range to the probable number of total trucks counted, multiplied by 1,000.

e.g., (see pages 5-8-19 and 5-8-20),

$$P1 = (M1/P2) \times 1{,}000$$

10. "Ratio 1980/1979" = The ratio of the probable number of axles per 1,000 trucks for 1980 to the same figure for 1979.

e.g., (see page 5-8-19),

$$Q1 = Q2/Q3$$

INTST RURAL
INCLUDES 12 STATIONS

TABLE W-4

NUMBER OF AXLE LOADS OF VARIOUS MAGNITUDES OF LOADED AND EMPTY TRUCKS AND TRUCK COMBINATIONS OF EACH TYPE WEIGHED, THE PROBABLE NUMBER OF SUCH LOADS AND THE EIGHTEEN KIP AXLE EQUIVALENTS OF EACH GENERAL TYPE AND OF ALL TYPES COUNTED DURING 1984 COMPARED TO CORRESPONDING DATA FOR 1982

AXLE LOADS IN POUNDS AND EIGHTEEN KIP AXLE EQUIVALENCY ITEMS	18 KIP AXLE EQUIVALENCY FACTOR: RIGID PAVEMENT P=2.5, D=9"	18 KIP AXLE EQUIVALENCY FACTOR: FLEXIBLE PAVEMENT P=2.5, SN=5	SINGLE-UNIT TRUCKS: PANEL AND PICKUP (UNDER 1 TON) 1984	1982	2 AXLE 4 TIRE 1984	1982	2 AXLE 6 TIRE 1984	1982	3 AXLE OR MORE 1984	1982	SINGLE-UNIT TRUCKS PROBABLE NO. 1984	1982
SINGLE AXLES												
UNDER 3,000	0.0002	0.0002	0	0	0	1	63	53	16	8	765	1211
3,000 - 6,999	0.0050	0.0050	0	0	0	1	647	621	131	50	7799 M2	7824
7,000 - 7,999	0.0260	0.0320	0	0	0	0	155	168	40	45	1887	2157
8,000 - 11,999	0.0820	0.0870	0	0	0	0	386	338	265	133	5060	4603
12,000 - 15,999	0.3410	0.3600	0	0	0	0	97	99	103	76	1351	1577
16,000 - 18,000	0.7830	0.7960	0	0	0	0	23	24	35	12	343	342
18,001 - 18,500	1.0650	1.0600	0	0	0	0	4	2	4	1	55	28
18,501 - 20,000	1.3360	1.3070	0	0	0	0	2	10	4	2	32	124
20,001 - 21,999	1.9260	1.8260	0	0	0	0	7	4	5	4	92	70
22,000 - 23,999	2.8180	2.5830	0	0	0	0	1	1	5	1	23	17
24,000 - 25,999	3.9760	3.5330	0	0	0	0	0	0	0	0	0	0
26,000 - 29,999	6.2890	5.3890	0	0	0	0	1	0	1	0	14	0
30,000 OR OVER	11.3950	9.4320	0	0	0	0	0	0	0	0	0	0
TOTAL SINGLE AXLES WEIGHED			0	0	0	2	1386	1320	609	332		
TOTAL SINGLE AXLES COUNTED			23112	20072	119	1136	16094	14766	1327	2051	17421	17953
TANDEM AXLE GROUPS												
UNDER 6,000	0.0100	0.0100	0	0	0	0	0	0	6	4	13	25
6,000 - 11,999	0.0100	0.0100	0	0	0	0	0	0	115	65	251	402
12,000 - 17,999	0.0620	0.0440	0	0	0	0	0	0	146	57	318	352
18,000 - 23,999	0.2530	0.1480	0	0	0	0	0	0	150	23	327	142
24,000 - 29,999	0.7290	0.4260	0	0	0	0	0	0	109	22	238	136
30,000 - 32,000	1.3050	0.7530	0	0	0	0	0	0	58	2	126	12
32,001 - 32,500	1.5420	0.8850	0	0	0	0	0	0	9	2	20	12
32,501 - 33,999	1.7510	1.0020	0	0	0	0	0	0	36	4	78	25
34,000 - 35,999	2.1650	1.2300	0	0	0	0	0	0	29	5	63	31
36,000 - 37,999	2.7210	1.5330	0	0	0	0	0	0	11	4	24	25
38,000 - 39,999	3.3730	1.8850	0	0	0	0	0	0	6	2	13	12
40,000 - 41,999	4.1290	2.2890	0	0	0	0	0	0	0	1	0	6
42,000 - 43,999	4.9970	2.7490	0	0	0	0	0	0	0	0	0	0
44,000 - 45,999	5.9870	3.2690	0	0	0	0	0	0	1	0	2	0
46,000 - 49,999	7.7250	4.1700	0	0	0	0	0	0	0	0	0	0
50,000 OR OVER	10.1600	5.1000	0	0	0	0	0	0	2	0	4	0
TOTAL TANDEM AXLES WEIGHED			0	0	0	0	0	0	678	191		

TOTAL TANDEM AXLES COUNTED	23112	20072	119	0	0	0	1477	1180	1477	1180
					ALL AXLES					
UNDER 3,000	0	0	0	1	63	53	63	50	870	1469
3,000 - 6,999	0	0	0	1	647	621	421	165	8430	8534
7,000 - 7,999	0	0	0	0	155	168	152	95	2131	2466
8,000 - 11,999	0	0	0	0	386	338	623	224	5840	5165
12,000 - 15,999	0	0	0	0	97	99	417	125	2035	1879
16,000 - 16,250	0	0	0	0	6	7	65	5	212	109
16,251 - 17,999	0	0	0	0	17	17	157	26	539	351
18,000 - 18,500	0	0	0	0	4	2	19	6	87	59
18,501 - 19,999	0	0	0	0	2	9	19	5	64	132
20,000 - 21,999	0	0	0	0	7	5	15	10	114	118
22,000 - 23,999	0	0	0	0	1	1	8	3	29	30
24,000 - 25,999	0	0	0	0	0	0	1	0	2	0
26,000 - 29,999	0	0	0	0	1	0	4	0	21	0
30,000 OR OVER	0	0	0	0	0	0	1	0	2	0
TOTAL AXLES WEIGHED	0	0	0	2	1386	1320	1965	714		
TOTAL AXLES COUNTED	23112	20072	119	1136	16094	14766	4282	4410	20376	20312
TOTAL VEHICLES COUNTED	23112	20072	119	568	8047	7383	974	1328	32252	29351
					18 KIP AXLE EQUIVALENTS					
RIGID PAVEMENT, P=2.5, D=9"										
18 K EQV FOR ALL TRUCKS WEIGHED	0.0	0.0	0.0	0.0	119.5	113.8	545.1	133.3	664.6	247.1
18 K EQV PER 1000 TRUCKS WEIGHED	0.0	0.0	0.0	5.2	172.5	172.4	1219.5	619.8	79.8	71.4
18 K EQV FOR ALL TRUCKS COUNTED	0.0	0.0	0.0	3.0	1388.0	1272.6	1187.8	823.1	2575.8	2098.7
PERCENT DISTRIBUTION OF 18 K EQV	0.01	0.0	0.0	0.01	2.18	2.65	1.86	1.71	4.05	4.37
FLEXIBLE PAVEMENT, P=2.5, SN=5										
18 K EQV FOR ALL TRUCKS WEIGHED	0.0	0.0	0.0	0.0	122.6	117.7	368.1	105.3	490.7	223.0
18 K EQV PER 1000 TRUCKS WEIGHED	0.0	0.0	0.0	5.2	176.9	178.4	823.5	489.9	69.0	67.1
18 K EQV FOR ALL TRUCKS COUNTED	0.0	0.0	0.0	3.0	1423.9	1316.8	802.1	650.6	2226.0	1970.4
PERCENT DISTRIBUTION OF 18 K EQV	0.0	0.0	0.0	0.01	3.35	4.05	1.89	2.00	5.24	6.06

INTST RURAL
INCLUDES 12 STATIONS

TABLE W-4

AXLE LOADS IN POUNDS AND EIGHTEEN KIP AXLE EQUIVALENCY ITEMS		18 KIP AXLE EQUIVALENCY FACTOR: RIGID PAVEMENT P=2.5, D=9"	18 KIP AXLE EQUIVALENCY FACTOR: FLEXIBLE PAVEMENT P=2.5, SN=5		TRACTOR SEMI-TRAILER COMBINATIONS: H4 3 AXLE 1984	H4 3 AXLE 1982	4 AXLE 1984		4 AXLE 1982	5 AXLE OR MORE 1984	5 AXLE OR MORE 1982	TRACTOR SEMI-TRAILER COMBINATIONS PROBABLE NO. 1984	TRACTOR SEMI-TRAILER COMBINATIONS PROBABLE NO. 1982
SINGLE AXLES													
UNDER 3,000	B1	0.0002	0.0002	F1	1	0	4	C1	3	40	23	453	247
3,000 - 6,999	B2	0.0050	0.0050	F2	78	31	92	C2	112	912	503	10955 L2	6085
7,000 - 7,999	B3	0.0260	0.0320	F3	43	29	88	C3	128	376	347	5148	4663
8,000 - 11,999	•	0.0820	0.0870	•	131	133 A3	372	•	508 A6	3593	3746 A9	41434	41813 A10
12,000 - 15,999	•	0.3410	0.3600	•	31	47	126	•	133	639	523	8070	6603
16,000 - 18,000	•	0.7830	0.7960	•	8	3	20	•	26	137	111	1671	1313
18,001 - 18,500	•	1.0650	1.0600	•	3	1	5	•	5	18	8	264	126
18,501 - 20,000	•	1.3360	1.3070	•	2	0	2	•	3	17	16	213	179
20,001 - 21,999	•	1.9260	1.8260	•	1	0	6	•	5	9	15	163	184
22,000 - 23,999	•	2.8180	2.5830	•	0	0	3	•	0	3	5	61	49
24,000 - 25,999	•	3.9760	3.5330	•	0	0	0	•	1	1	1	10	18
26,000 - 29,999	B12	6.2890	5.3890	F12	0	0	0	C12	0	0	2	0	20
30,000 OR OVER	B13	11.3950	9.4320	F13	0	0	0	C13	0	1	1	10	10
TOTAL SINGLE AXLES WEIGHED					298	244 A2	718		924 A5	5746	5301 A8		
TOTAL SINGLE AXLES COUNTED					3084	2484 A1	7445		7085 A4	57923	51741 A7	68452	61310
TANDEM AXLE GROUPS													
UNDER 6,000	D1	0.0100	0.0100	G1	0	1	3	E1	2	38	35	415	365
6,000 - 11,999	D2	0.0100	0.0100	G2	0	0	124	E2	146	1589	1567	17304	16415
12,000 - 17,999	D3	0.0620	0.0440	G3	0	1	136	E3	166	2040	1843	21974	19272
18,000 - 23,999	•	0.2530	0.1480	•	1	2	61	•	92	1900	1775	19796	18052
24,000 - 29,999	•	0.7290	0.4260	•	0	0	13	•	21	2087	2060	21173	20268
30,000 - 32,000	•	1.3050	0.7530	•	0	0	2	•	2	733	567	7410	5549
32,001 - 32,500	•	1.5420	0.8850	•	0	0	0	•	0	111	98	1119	957
32,501 - 33,999	•	1.7510	1.0020	•	0	0	3	•	1	297	196	3025	1921
34,000 - 35,999	•	2.1650	1.2300	•	0	0	1	•	2	216	141	2187	1391
36,000 - 37,999	•	2.7210	1.5330	•	0	0	2	•	1	91	41	938	408
38,000 - 39,999	•	3.3730	1.8850	•	0	0	0	•	0	41	9	413	88
40,000 - 41,999	•	4.1290	2.2890	•	0	0	0	•	0	15	8	151	78
42,000 - 43,999	•	4.9970	2.7490	•	0	0	0	•	0	17	3	171	29
44,000 - 45,999	•	5.9870	3.2690	•	0	0	0	•	0	[illegible]	2	40	20
46,000 - 49,999	D15	7.7250	4.1700	G15	0	0	0	E15	1	10	0	[illegible]	8
50,000 OR OVER	D16	10.1600	5.1000	G16	0	0	0	E16	0	8	1	81	10
TOTAL TANDEM AXLES WEIGHED					1	4	345		434	9197	8346		

TOTAL TANDEM AXLES COUNTED	10	41	3577	3328	92711	81462	96298	84831
					ALL AXLES			
UNDER 3,000	1	1	18	15	257	212	2787	2191
3,000 - 6,999	78	33	442	501	5697	4990	62819	52884
7,000 - 7,999	43	30	172	226	1591	1481	18267	16494
8,000 - 11,999	133	136	564	819	8517	8366	93081	89323
12,000 - 15,999	31	48	163	176	5719	5459	59662	55122
16,000 - 16,250	0	1	4	7	409	314	4164	3129
16,251 - 17,999	8	2	19	24	1290	835	13284	8354
18,000 - 18,500	3	1	9	11	239	127	2533	1334
18,501 - 19,999	2	0	4	6	221	129	2290	1305
20,000 - 21,999	1	0	10	5	131	52	1435	546
22,000 - 23,999	0	0	3	0	38	15	414	146
24,000 - 25,999	0	0	0	1	14	4	141	47
26,000 - 29,999	0	0	0	0	8	7	81	68
30,000 OR OVER	0	0	0	1	9	2	91	28
TOTAL AXLES WEIGHED	300 H3	252	1408	1792	24140	21993		
TOTAL AXLES COUNTED	3105 J2	2565	14600	13740	243344	214666	261049	230971
TOTAL VEHICLES COUNTED	1035	855	3650	3435	48568	42859	53253	47149
					18 KIP AXLE EQUIVALENTS			
RIGID PAVEMENT, P=2.5, D=9"								
18 K EQV FOR ALL TRUCKS WEIGHED	37.1 H2	31.8	170.0 B100	203.7	5692.7	4517.5	5899.8	4753.0
18 K EQV PER 1000 TRUCKS WEIGHED	371.3 H1	379.0	482.9	454.7	1181.6	1028.8	1117.8	975.5
18 K EQV FOR ALL TRUCKS COUNTED	384.3 J1	324.0	1762.4	1561.8	57385.6	44093.4	59532.3	45979.2
PERCENT DISTRIBUTION OF 18 K EQV	0.60 K1	0.67	2.76	3.25	89.98	91.71	93.34	95.63
FLEXIBLE PAVEMENT, P=2.5, SN=5								
18 K EQV FOR ALL TRUCKS WEIGHED	38.5	33.4	154.2 F100	181.3	3629.9	2948.5	3822.6	3163.2
18 K EQV PER 1000 TRUCKS WEIGHED	384.6	397.3	438.0	404.8	753.4	671.5	724.6	647.3
18 K EQV FOR ALL TRUCKS COUNTED	398.1	339.7	1598.6	1390.3	36591.4	28779.1	38588.1	30509.1
PERCENT DISTRIBUTION OF 18 K EQV	0.94	1.05	3.76	4.28	86.09	88.61	90.79	93.94

INTST RURAL
INCLUDES 12 STATIONS

TABLE W-4

AXLE LOADS IN POUNDS AND EIGHTEEN KIP AXLE EQUIVALENCY ITEMS	18 KIP AXLE EQUIVALENCY FACTOR RIGID PAVEMENT P=2.5, D=8''	18 KIP AXLE EQUIVALENCY FACTOR FLEXIBLE PAVEMENT P=2.5, SN=5	SEMI-TRAILER TRAILER 5 AXLE 1984	SEMI-TRAILER TRAILER 5 AXLE 1982	SEMI-TRAILER TRAILER 6 AXLE OR MORE 1984	SEMI-TRAILER TRAILER 6 AXLE OR MORE 1982	SEMI-TRAILER TRAILER COMBINATIONS PROBABLE NO. 1984	SEMI-TRAILER TRAILER COMBINATIONS PROBABLE NO. 1982
SINGLE AXLES								
UNDER 3,000	0.0002	0.0002	3	0	0	0	28	0
3,000 - 6,999	0.0050	0.0050	71	0	12	0	$\boxed{728}$ L3	0
7,000 - 7,999	0.0260	0.0320	19	0	6	0	209	0
8,000 - 11,999	0.0820	0.0870	233	0	33	0	2354	0
12,000 - 15,999	0.3410	0.3600	179	0	14	0	1749	0
16,000 - 18,000	0.7830	0.7960	62	0	6	0	612	0
18,001 - 18,500	1.0650	1.0600	8	0	1	0	80	0
18,501 - 20,000	1.3360	1.3070	15	0	0	0	140	0
20,001 - 21,999	1.9260	1.8260	3	0	0	0	28	0
22,000 - 23,999	2.8180	2.5830	0	0	0	0	0	0
24,000 - 25,999	3.9760	3.5330	0	0	0	0	0	0
26,000 - 29,999	6.2890	5.3890	0	0	0	0	0	0
30,000 OR OVER	11.3950	9.4320	0	0	0	0	0	0
TOTAL SINGLE AXLES WEIGHED			593	0	72	0		
TOTAL SINGLE AXLES COUNTED			5553	0	375	0	5928	0
TANDEM AXLE GROUPS								
UNDER 6,000	0.0100	0.0100	0	0	0	0	0	0
6,000 - 11,999	0.0100	0.0100	0	0	2	0	11	0
12,000 - 17,999	0.0620	0.0440	2	0	6	0	49	0
18,000 - 23,999	0.2530	0.1480	2	0	9	0	66	0
24,000 - 29,999	0.7290	0.4260	2	0	2	0	29	0
30,000 - 32,000	1.3050	0.7530	0	0	1	0	5	0
32,001 - 32,500	1.5420	0.8850	0	0	0	0	0	0
32,501 - 33,999	1.7510	1.0020	0	0	0	0	0	0
34,000 - 35,999	2.1650	1.2300	0	0	1	0	5	0
36,000 - 37,999	2.7210	1.5330	0	0	0	0	0	0
38,000 - 39,999	3.3730	1.8850	0	0	0	0	0	0
40,000 - 41,999	4.1290	2.2890	0	0	0	0	0	0
42,000 - 43,999	4.9970	2.7490	0	0	0	0	0	0
44,000 - 45,999	5.9870	3.2690	0	0	0	0	0	0
46,000 - 49,999	7.7250	4.1700	0	0	0	0	0	0
50,000 OR OVER	10.1600	5.1000	0	0	0	0	0	0
TOTAL TANDEM AXLES WEIGHED			6	0	21	0		

TOTAL TANDEM AXLES COUNTED	56	0	109	0	165	0
			ALL AXLES			
UNDER 3,000	3	0	1	0	34	0
3,000 - 6,999	73	0	16	0	767	0
7,000 - 7,999	20	0	13	0	255	0
8,000 - 11,999	239	0	56	0	2530	0
12,000 - 15,999	182	0	18	0	1798	0
16,000 - 16,250	8	0	2	0	85	0
16,251 - 17,999	53	0	5	0	522	0
18,000 - 18,500	9	0	1	0	89	0
18,501 - 19,999	13	0	0	0	122	0
20,000 - 21,999	5	0	1	0	52	0
22,000 - 23,999	0	0	1	0	5	0
24,000 - 25,999	0	0	0	0	0	0
26,000 - 29,999	0	0	0	0	0	0
30,000 OR OVER	0	0	0	0	0	0
TOTAL AXLES WEIGHED	605	0	114	0		
TOTAL AXLES COUNTED	5665	0	594	0	6259	0
TOTAL VEHICLES COUNTED	1133	0	99	0	1232	0
			18 KIP AXLE EQUIVALENTS			
RIGID PAVEMENT, P=2.5, D=9"						
18 K EQV FOR ALL TRUCKS WEIGHED	166.0	0.0	21.1	0.0	187.1	0.0
18 K EQV PER 1000 TRUCKS WEIGHED	1371.6	0.0	1108.2	0.0	1349.2	0.0
18 K EQV FOR ALL TRUCKS COUNTED	1554.1	0.0	109.7	0.0	1663.8	0.0
PERCENT DISTRIBUTION OF 18 K EQV	2.44	0.0	0.17	0.0	2.61	0.0
FLEXIBLE PAVEMENT, P=2.5, SN=5						
18 K EQV FOR ALL TRUCKS WEIGHED	169.8	0.0	18.4	0.0	188.2	0.0
18 K EQV PER 1000 TRUCKS WEIGHED	1403.5	0.0	971.1	0.0	1367.8	0.0
18 K EQV FOR ALL TRUCKS COUNTED	1590.2	0.0	96.1	0.0	1686.3	0.0
PERCENT DISTRIBUTION OF 18 K EQV	3.74	0.0	0.23	0.0	3.97	0.0

INTST RURAL
INCLUDES 12 STATIONS

TABLE W-4

AXLE LOADS IN POUNDS AND EIGHTEEN KIP AXLE EQUIVALENCY ITEMS	18 KIP AXLE EQUIVALENCY FACTOR RIGID PAVEMENT P=2.5, D=9''	18 KIP AXLE EQUIVALENCY FACTOR FLEXIBLE PAVEMENT P=2.5, SN=5	TRUCK AND TRAILER 3 AXLE 1984	3 AXLE 1982	4 AXLE 1984	4 AXLE 1982	5 AXLE OR MORE 1984	5 AXLE OR MORE 1982	TRUCK AND TRAILER COMBINATIONS PROBABLE NO. 1984	TRUCK AND TRAILER COMBINATIONS PROBABLE NO. 1982
SINGLE AXLES										
UNDER 3,000	0.0002	0.0002	0	0	0	0	1	0	0	0
3,000 - 6,999	0.0050	0.0050	0	0	0	0	1	0	$\boxed{1}$ L4	0
7,000 - 7,999	0.0260	0.0320	0	0	0	0	0	0	0	0
8,000 - 11,999	0.0820	0.0870	0	0	0	0	1	0	1	0
12,000 - 15,999	0.3410	0.3600	0	0	0	0	2	0	1	0
16,000 - 18,000	0.7830	0.7960	0	0	0	0	0	0	0	0
18,001 - 18,500	1.0650	1.0600	0	0	0	0	0	0	0	0
18,501 - 20,000	1.3360	1.3070	0	0	0	0	0	0	0	0
20,001 - 21,999	1.9260	1.8260	0	0	0	0	0	0	0	0
22,000 - 23,999	2.8180	2.5830	0	0	0	0	0	0	0	0
24,000 - 25,999	3.9760	3.5330	0	0	0	0	0	0	0	0
26,000 - 29,999	6.2890	5.3890	0	0	0	0	0	0	0	0
30,000 OR OVER	11.3950	9.4320	0	0	0	0	0	0	0	0
TOTAL SINGLE AXLES WEIGHED			0	0	0	0	5	0		
TOTAL SINGLE AXLES COUNTED			0	0	26	87	3	298	3	0
TANDEM AXLE GROUPS										
UNDER 6,000	0.0100	0.0100	0	0	0	0	0	0	0	0
6,000 - 11,999	0.0100	0.0100	0	0	0	0	0	0	0	0
12,000 - 17,999	0.0620	0.0440	0	0	0	0	0	0	0	0
18,000 - 23,999	0.2530	0.1480	0	0	0	0	2	0	1	0
24,000 - 29,999	0.7290	0.4260	0	0	0	0	1	0	1	0
30,000 - 32,000	1.3050	0.7530	0	0	0	0	0	0	0	0
32,001 - 32,500	1.5420	0.8850	0	0	0	0	0	0	0	0
32,501 - 33,999	1.7510	1.0020	0	0	0	0	0	0	0	0
34,000 - 35,999	2.1650	1.2300	0	0	0	0	0	0	0	0
36,000 - 37,999	2.7210	1.5330	0	0	0	0	0	0	0	0
38,000 - 39,999	3.3730	1.8850	0	0	0	0	0	0	0	0
40,000 - 41,999	4.1290	2.2890	0	0	0	0	0	0	0	0
42,000 - 43,999	4.9970	2.7490	0	0	0	0	0	0	0	0
44,000 - 45,999	5.9870	3.2690	0	0	0	0	0	0	0	0
46,000 - 49,999	7.7250	4.1700	0	0	0	0	0	0	0	0
50,000 OR OVER	10.1600	5.1000	0	0	0	0	0	0	0	0
TOTAL TANDEM AXLES WEIGHED			0	0	0	0	3	0		

TOTAL TANDEM AXLES COUNTED	0	0	26	87	2	298	2	0
				ALL AXLES				
UNDER 3,000	0	0	0	0	1	0	0	0
3,000 - 6,999	0	0	0	0	1	0	1	0
7,000 - 7,999	0	0	0	0	0	0	0	0
8,000 - 11,999	0	0	0	0	4	0	2	0
12,000 - 15,999	0	0	0	0	5	0	3	0
16,000 - 16,250	0	0	0	0	0	0	0	0
16,251 - 17,999	0	0	0	0	0	0	0	0
18,000 - 18,500	0	0	0	0	0	0	0	0
18,501 - 19,999	0	0	0	0	0	0	0	0
20,000 - 21,999	0	0	0	0	0	0	0	0
22,000 - 23,999	0	0	0	0	0	0	0	0
24,000 - 25,999	0	0	0	0	0	0	0	0
26,000 - 29,999	0	0	0	0	0	0	0	0
30,000 OR OVER	0	0	0	0	0	0	0	0
TOTAL AXLES WEIGHED	0	0	0	0	11	0		
TOTAL AXLES COUNTED	0	0	26	87	6	298	6	0
TOTAL VEHICLES COUNTED	0	0	26	87	1	298	27	385
				18 KIP AXLE EQUIVALENTS				
RIGID PAVEMENT, P=2.5, D=9"								
18 K EQV FOR ALL TRUCKS WEIGHED	0.0	0.0	0.0	0.0	2.0	0.0	2.0	0.0
18 K EQV PER 1000 TRUCKS WEIGHED	0.0	0.0	0.0	0.0	1002.1	0.0	52.2	0.0
18 K EQV FOR ALL TRUCKS COUNTED	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0
PERCENT DISTRIBUTION OF 18 K EQV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FLEXIBLE PAVEMENT, P=2.5, SN=5								
18 K EQV FOR ALL TRUCKS WEIGHED	0.0	0.0	0.0	0.0	1.5	0.0	1.5	0.0
18 K EQV PER 1000 TRUCKS WEIGHED	0.0	0.0	0.0	0.0	767.1	0.0	38.0	0.0
18 K EQV FOR ALL TRUCKS COUNTED	0.0	0.0	0.0	0.0	0.8	0.0	0.8	0.0
PERCENT DISTRIBUTION OF 18 K EQV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

INTST RURAL
INCLUDES 12 STATIONS

TABLE W-4

AXLE LOADS IN POUNDS AND EIGHTEEN KIP AXLE EQUIVALENCY ITEMS	18 KIP AXLE EQUIVALENCY FACTOR RIGID PAVEMENT P=2.5, D=9''	FLEXIBLE PAVEMENT P=2.5, SN=5	TOTAL ALL COMBINATIONS PROBABLE NO. 1984	1982	TOTAL ALL TRUCKS AND COMBINATIONS PROBABLE NO. 1984	1982	PERCENT HEAVIER THAN LOW WEIGHT INTERVAL 1984	1982	AXLES PER 1000 TRUCKS AND COMBINATIONS 1984	1982	RATIO 1984 1982
SINGLE AXLES											
UNDER 3,000	0.0002	0.0002	481	247	1246	1458 N2	100.00	100.00	14.36	18.96	0.757
3,000 - 6,999	0.0050	0.0050	11684 L1	6085	19483 M1	13909 N3	98.64	98.16	224.55 P1	180.91	1.241
7,000 - 7,999	0.0260	0.0320	5357	4663	7244	6820 N4	77.42	80.61	83.49	88.70	0.941
8,000 - 11,999	0.0820	0.0870	43789	41813	48849	46416 N5	69.53	72.01	563.01	603.71	0.933
12,000 - 15,999	0.3410	0.3600	9820	6603	11171	8180	16.32	13.45 N1	128.75	106.39	1.210
16,000 - 18,000	0.7830	0.7960	2283	1313	2626	1655	4.15	3.13	30.27	21.53	1.406
18,001 - 18,500	1.0650	1.0600	344	126	399	154	1.29	1.04	4.60	2.00	2.296
18,501 - 20,000	1.3360	1.3070	353	179	385	303	0.86	0.85	4.44 Q2	3.94 Q3	1.126 Q1
20,001 - 21,999	1.9260	1.8260	191	184	283	254	0.44	0.46	3.26	3.30	0.987
22,000 - 23,999	2.8180	2.5830	61	49	84	66	0.13	0.14	0.97	0.86	1.128
24,000 - 25,999	3.9760	3.5330	10	18	10	18	0.04	0.06	0.12	0.23	0.492
26,000 - 29,999	6.2890	5.3890	0	20	14	20	0.03	0.04	0.16	0.26	0.620
30,000 OR OVER	11.3950	9.4320	10	10	10	10	0.01	0.01	0.12	0.13	0.886
TOTAL SINGLE AXLES WEIGHED											
TOTAL SINGLE AXLES COUNTED			74383	61310	91804	79263 N6	100.00	100.00	0.0	0.0	0.0
TANDEM AXLE GROUPS											
UNDER 6,000	0.0100	0.0100	415	365	428	390	100.00	100.00	4.93	5.07	0.972
6,000 - 11,999	0.0100	0.0100	17315	16415	17566	16817	99.56	99.55	202.46	218.73	0.926
12,000 - 17,999	0.0620	0.0440	22023	19272	22341	19624	81.63	79.99	257.49	255.24	1.009
18,000 - 23,999	0.2530	0.1480	19863	18052	20190	18194	58.82	57.18	232.70	236.64	0.983
24,000 - 29,999	0.7290	0.4260	21203	20268	21441	20404	38.20	36.03	247.12	265.38	0.931
30,000 - 32,000	1.3050	0.7530	7415	5549	7541	5561	16.31	12.30	86.91	72.33	1.202
32,001 - 32,500	1.5420	0.8850	1119	957	1139	969	8.61	5.84	13.13	12.60	1.042
32,501 - 33,999	1.7510	1.0020	3025	1921	3103	1946	7.45	4.71	35.76	25.31	1.413
34,000 - 35,999	2.1650	1.2300	2192	1391	2255	1422	4.28	2.45	25.99	18.50	1.405
36,000 - 37,999	2.7210	1.5330	938	408	962	433	1.98	0.80	11.09	5.63	1.969
38,000 - 39,999	3.3730	1.8850	413	88	426	100	1.00	0.29	4.91	1.30	3.775
40,000 - 41,999	4.1290	2.2890	151	78	151	84	0.56	0.18	1.74	1.09	1.593
42,000 - 43,999	4.9970	2.7490	171	29	171	29	0.41	0.08	1.97	0.38	5.225
44,000 - 45,999	5.9870	3.2690	40	20	42	20	0.23	0.04	0.48	0.26	1.861
46,000 - 49,999	7.7250	4.1700	101	8	101	8	0.19	0.02	1.16	0.10	11.188
50,000 OR OVER	10.1600	5.1000	81	10	85	10	0.09	0.01	0.98	0.13	7.532
TOTAL TANDEM AXLES WEIGHED											

TOTAL TANDEM AXLES COUNTED	96465	84831	97942	86011	100.00	100.00	0.0	0.0	0.0

ALL AXLES

UNDER 3,000	2821	2191	3691	3660	100.00	100.00	42.54	47.60	0.894
3,000 - 6,999	63587	52884	72017	61418	98.72	98.54	830.03	798.83	1.039
7,000 - 7,999	18522	16494	20653	18960	73.68	74.10	238.04	246.60	0.965
8,000 - 11,999	95613	89323	101453	94488	66.51	66.56	1169.30	1228.95	0.951
12,000 - 15,999	61463	55122	63498	57001	31.24	28.95	731.85	741.38	0.987
16,000 - 16,250	4249	3129	4461	3238	9.17	6.27	51.42	42.11	1.221
16,251 - 17,999	13806	8354	14345	8705	7.62	4.98	165.33	113.22	1.460
18,000 - 18,500	2622	1334	2709	1393	2.63	1.52	31.22	18.12	1.723
18,501 - 19,999	2412	1305	2476	1437	1.69	0.96	28.54	18.69	1.527
20,000 - 21,999	1487	546	1601	664	0.83	0.39	18.45	8.64	2.137
22,000 - 23,999	419	146	448	176	0.27	0.13	5.16	2.29	2.256
24,000 - 25,999	141	47	143	47	0.12	0.06	1.65	0.61	2.696
26,000 - 29,999	81	68	102	68	0.07	0.04	1.18	0.88	1.329
30,000 OR OVER	91	28	93	28	0.03	0.01	1.07	0.36	2.943

TOTAL AXLES WEIGHED

TOTAL AXLES COUNTED	267314	230971	287690	251283	100.00	100.00	0.0	0.0	0.0
TOTAL VEHICLES COUNTED	54512	47534	$\boxed{86764}$ P2	76885	0.0	0.0	0.0	0.0	0.0

18 KIP AXLE EQUIVALENTS

RIGID PAVEMENT, P=2.5, D=9"

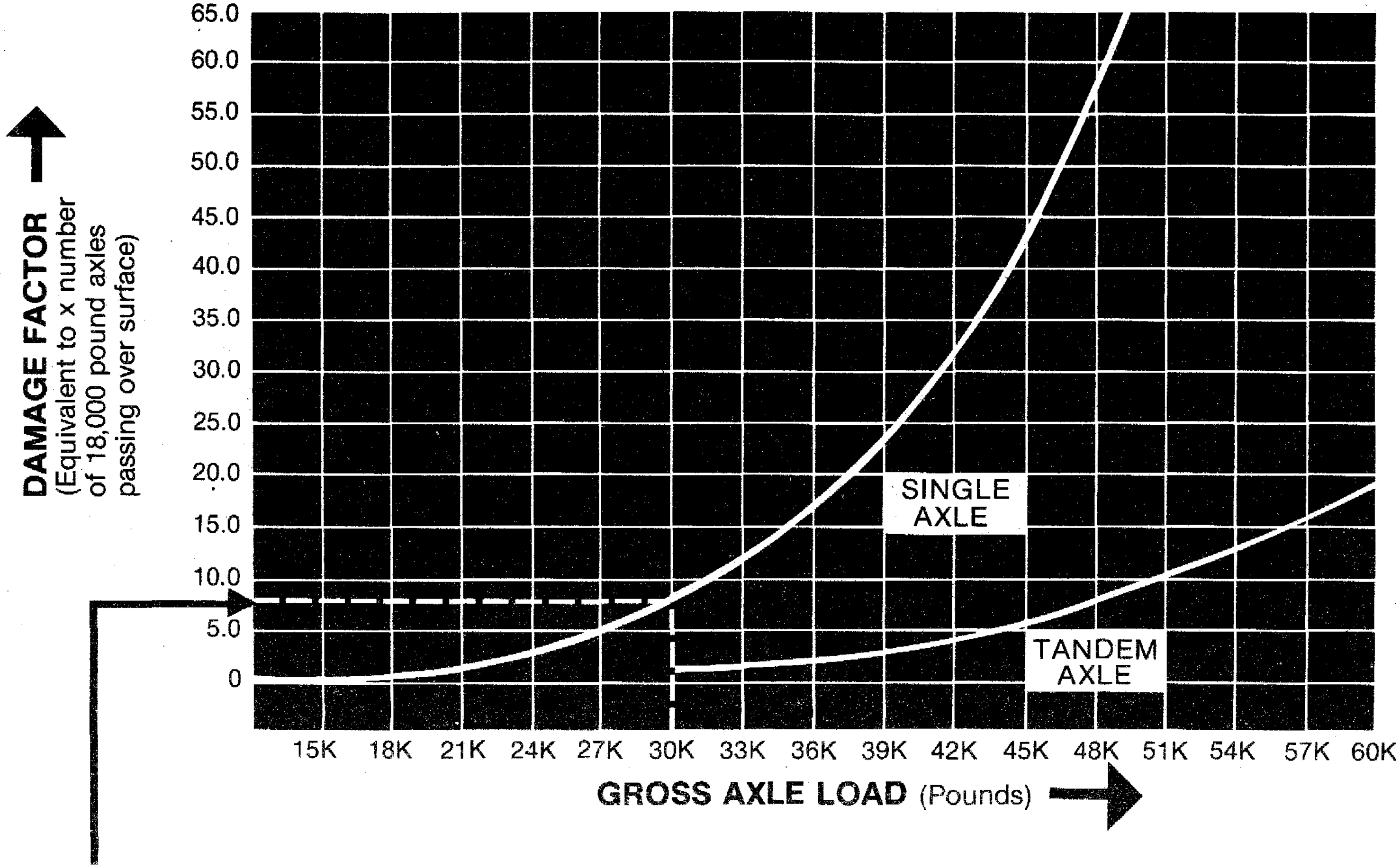
18 K EQV FOR ALL TRUCKS WEIGHED	6088.9	4753.0	6753.5	5000.1
18 K EQV PER 1000 TRUCKS WEIGHED	1122.5	967.6	734.9 K2	625.5
18 K EQV FOR ALL TRUCKS COUNTED	61197.1	45979.2	$\boxed{63772.9}$	48077.9
PERCENT DISTRIBUTION OF 18 K EQV	95.95	95.63	100.00	100.00

FLEXIBLE PAVEMENT, P=2.5, SN=5

18 K EQV FOR ALL TRUCKS WEIGHED	4012.3	3163.2	4503.0	3386.2
18 K EQV PER 1000 TRUCKS WEIGHED	738.7	642.0	489.8	422.5
18 K EQV FOR ALL TRUCKS COUNTED	40275.2	30509.1	42501.2	32479.5
PERCENT DISTRIBUTION OF 18 K EQV	94.76	93.94	100.00	100.00

The two illustrations on pages 5-8-22 and 5-8-23 have been provided to show the relationship between the weight applied by the load on an axle and the effect on the pavement. Each axle load is equated to the number of 18,000 pound axles necessary to do the same damage to the road surface.

Road Damage VS Axle Load



***EXAMPLE**
1 each 30,000 lb. single axle is equivalent to 8 each 18,000 lb. axles passing over surface

NOTES: 1. Residual Performance Value P=2.5
2. Slab thickness for rigid pavement D=9″
3. Reference—these curves derived from A.A.S.H.T.O. data

Road Damage VS Axle Load

ROAD DESIGN AND DAMAGE CRITERIA ARE BASED ON AXLE LOAD

Data from American Association State Highway Transportation Officials Studies (A.A.S.H.T.O.)
U.S. Government Data - Washington, D.C., U.S.A.

SINGLE AXLE

Gross weight on single axle ▶▶▶ Equivalent to — Number of axles passing over road surface at 18,000 lbs. each

Each axle equals 18,000 lbs.

18,000 LBS. WEIGHT ▶▶▶ Equivalent to — Each axle equals 18,000 lbs.

30,000 LBS. WEIGHT ▶▶▶ Equivalent to — Each axle equals 18,000 lbs.

*(See example on chart)

42,000 LBS. WEIGHT ▶▶▶ Equivalent to — Each axle equals 18,000 lbs.

TANDEM AXLE

Gross weight on tandem axle ▶▶▶ Equivalent to — Number of axles passing over road surface at 18,000 lbs. each

Each axle equals 18,000 lbs.

36,000 LBS. WEIGHT ▶▶▶ Equivalent to — Each axle equals 18,000 lbs.

42,000 LBS. WEIGHT ▶▶▶ Equivalent to — Each axle equals 18,000 lbs.

61,000 LBS. WEIGHT ▶▶▶ Equivalent to — Each axle equals 18,000 lbs.

Table W-5

This table shows the number of trucks weighed in various gross weight ranges and the probable number of trucks in each range in the traffic stream. These figures are produced by truck type and can be shown for each station or functional classification. An example of this table is shown on pages 5-8-25 through 5-8-29.

On Part 5 of this table the probable numbers and the remaining figures, which are all calculated from these numbers, are determined in the same manner as for Table W-4. For definitions and examples of how each is calculated, refer to the explanation of Table W-4.

INTST RURAL
INCLUDES 12 STATIONS

TABLE W-5

NUMBER OF LOADED AND EMPTY TRUCKS AND TRUCK COMBINATIONS OF EACH TYPE OF VARIOUS TOTAL WEIGHTS DURING 1984 COMPARED TO CORRESPONDING DATA FOR 1982

SINGLE-UNIT TRUCKS

GROSS OPERATING WEIGHT IN POUNDS	PANEL AND PICKUP (UNDER 1 TON)		2 AXLE 4 TIRE		2 AXLE 6 TIRE		3 AXLE OR MORE		SINGLE UNIT TRUCKS PROBABLE NO.	
	1984	1982	1984	1982	1984	1982	1984	1982	1984	1982
UNDER 3,999	0	0	0	0	1	1	0	0	10	12
4,000 - 9,999	0	0	0	1	155	147	0	0	1800	2212
10,000 - 13,499	0	0	0	0	161	124	0	2	1870	1400
13,500 - 19,999	0	0	0	0	253	269	25	38	2992	3244
20,000 - 21,999	0	0	0	0	42	46	12	16	514	614
22,000 - 23,999	0	0	0	0	27	23	17	17	351	362
24,000 - 25,999	0	0	0	0	18	23	19	24	250	405
26,000 - 27,999	0	0	0	0	17	15	19	33	238	372
28,000 - 29,999	0	0	0	0	12	6	23	12	189	141
30,000 - 31,999	0	0	0	0	3	4	18	8	74	94
32,000 - 33,999	0	0	0	0	2	1	27	9	82	67
34,000 - 35,999	0	0	0	0	0	1	17	7	37	54
36,000 - 37,999	0	0	0	0	1	0	16	6	47	37
38,000 - 39,999	0	0	0	0	1	0	7	5	27	31
40,000 - 44,999	0	0	0	0	0	0	31	8	68	49
45,000 - 49,999	0	0	0	0	0	0	28	7	61	43
50,000 - 54,999	0	0	0	0	0	0	32	6	70	37
55,000 - 59,999	0	0	0	0	0	0	32	5	70	31
60,000 - 64,999	0	0	0	0	0	0	31	4	68	25
65,000 - 69,999	0	0	0	0	0	0	21	5	46	31
70,000 - 72,000	0	0	0	0	0	0	16	2	35	12
72,001 - 74,999	0	0	0	0	0	0	24	1	52	6
75,000 - 79,999	0	0	0	0	0	0	26	0	57	0
80,000 - 84,999	0	0	0	0	0	0	4	0	9	0
85,000 - 89,999	0	0	0	0	0	0	1	0	2	0
90,000 - 94,999	0	0	0	0	0	0	0	0	0	0
95,000 - 99,999	0	0	0	0	0	0	0	0	0	0
100,000 - 104,999	0	0	0	0	0	0	0	0	0	0
105,000 - 109,999	0	0	0	0	0	0	1	0	2	0
110,000 OR OVER	0	0	0	0	0	0	0	0	0	0
TOTAL VEHICLES WEIGHED	0	0	0	1	693	660	447	215		
TOTAL VEHICLES COUNTED	23112	20072	119	568	8047	7383	974	1328	9021	9279

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INTST RURAL
INCLUDES 12 STATIONS

TABLE W-5

TRACTOR SEMI-TRAILER COMBINATIONS

GROSS OPERATING WEIGHT IN POUNDS	3 AXLE		4 AXLE		5 AXLE OR MORE		TRACTOR SEMI-TRAILER COMBINATIONS PROBABLE NO.	
	1984	1982	1984	1982	1984	1982	1984	1982
UNDER 3,999	0	0	0	0	0	0	0	0
4,000 - 9,999	0	0	0	0	0	0	0	0
10,000 - 13,499	0	0	0	1	0	0	0	7
13,500 - 19,999	14	7	3	5	5	3	225	137
20,000 - 21,999	10	4	9	7	12	11	317	202
22,000 - 23,999	15	5	18	26	50	34	846	582
24,000 - 25,999	7	7	26	35	81	73	1159	1052
26,000 - 27,999	20	11	27	43	144	173	1939	2131
28,000 - 29,999	8	13	33	34	236	256	2804	2892
30,000 - 31,999	4	12	35	39	261	244	3035	2803
32,000 - 33,999	5	8	36	34	204	207	2481	2362
34,000 - 35,999	2	5	30	41	175	156	2096	1888
36,000 - 37,999	6	7	27	31	157	119	1925	1471
38,000 - 39,999	2	0	20	35	164	137	1881	1605
40,000 - 44,999	7	5	42	58	424	358	4782	3990
45,000 - 49,999	0	0	21	36	389	350	4139	3692
50,000 - 54,999	0	0	13	15	369	382	3855	3844
55,000 - 59,999	0	0	10	5	429	388	4429	3825
60,000 - 64,999	0	0	1	1	459	472	4637	4615
65,000 - 69,999	0	0	1	1	481	470	4859	4596
70,000 - 72,000	0	0	0	1	219	181	2208	1775
72,001 - 74,999	0	0	0	0	219	204	2208	1991
75,000 - 79,999	0	0	0	0	243	134	2450	1308
80,000 - 84,999	0	0	0	0	57	25	575	244
85,000 - 89,999	0	0	0	0	25	12	252	117
90,000 - 94,999	0	0	0	0	4	1	40	10
95,000 - 99,999	0	0	0	0	7	0	71	0
100,000 - 104,999	0	0	0	0	2	1	20	10
105,000 - 109,999	0	0	0	0	0	0	0	0
110,000 OR OVER	0	0	0	0	2	0	20	0
TOTAL VEHICLES WEIGHED	100	84	352	448	4818	4391		
TOTAL VEHICLES COUNTED	1035	855	3650	3435	48568	42859	53253	47149

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INTST RURAL
INCLUDES 12 STATIONS

TABLE W-5

SEMI-TRAILER TRAILER

GROSS OPERATING WEIGHT IN POUNDS	5 AXLE		6 AXLE OR MORE		SEMI-TRAILER TRAILER COMBINATIONS PROBABLE NO.	
	1984	1982	1984	1982	1984	1982
UNDER 3,999	0	0	0	0	0	0
4,000 - 9,999	0	0	0	0	0	0
10,000 - 13,499	0	0	0	0	0	0
13,500 - 19,999	0	0	0	0	0	0
20,000 - 21,999	0	0	0	0	0	0
22,000 - 23,999	1	0	0	0	10	0
24,000 - 25,999	2	0	0	0	19	0
26,000 - 27,999	0	0	0	0	0	0
28,000 - 29,999	2	0	0	0	19	0
30,000 - 31,999	0	0	0	0	0	0
32,000 - 33,999	0	0	0	0	0	0
34,000 - 35,999	3	0	1	0	35	0
36,000 - 37,999	0	0	0	0	0	0
38,000 - 39,999	2	0	0	0	19	0
40,000 - 44,999	2	0	1	0	24	0
45,000 - 49,999	14	0	1	0	136	0
50,000 - 54,999	12	0	2	0	122	0
55,000 - 59,999	23	0	1	0	220	0
60,000 - 64,999	17	0	5	0	185	0
65,000 - 69,999	24	0	5	0	251	0
70,000 - 72,000	8	0	1	0	80	0
72,001 - 74,999	6	0	0	0	56	0
75,000 - 79,999	4	0	0	0	37	0
80,000 - 84,999	1	0	2	0	19	0
85,000 - 89,999	0	0	0	0	0	0
90,000 - 94,999	0	0	0	0	0	0
95,000 - 99,999	0	0	0	0	0	0
100,000 - 104,999	0	0	0	0	0	0
105,000 - 109,999	0	0	0	0	0	0
110,000 OR OVER	0	0	0	0	0	0
TOTAL VEHICLES WEIGHED	121	0	19	0		
TOTAL VEHICLES COUNTED	1133	0	99	0	1232	0

INTST RURAL
INCLUDES 12 STATIONS

TABLE W-5

TRUCK AND TRAILER

GROSS OPERATING WEIGHT IN POUNDS	3 AXLE		4 AXLE		5 AXLE OR MORE		TRUCK AND TRAILER COMBINATIONS PROBABLE NO.	
	1984	1982	1984	1982	1984	1982	1984	1982
UNDER 3,999	0	0	0	0	0	0	0	0
4,000 - 9,999	0	0	0	0	0	0	0	0
10,000 - 13,499	0	0	0	0	0	0	0	0
13,500 - 19,999	0	0	0	0	0	0	0	0
20,000 - 21,999	0	0	0	0	0	0	0	0
22,000 - 23,999	0	0	0	0	0	0	0	0
24,000 - 25,999	0	0	0	0	0	0	0	0
26,000 - 27,999	0	0	0	0	0	0	0	0
28,000 - 29,999	0	0	0	0	0	0	0	0
30,000 - 31,999	0	0	0	0	0	0	0	0
32,000 - 33,999	0	0	0	0	0	0	0	0
34,000 - 35,999	0	0	0	0	0	0	0	0
36,000 - 37,999	0	0	0	0	0	0	0	0
38,000 - 39,999	0	0	0	0	0	0	0	0
40,000 - 44,999	0	0	0	0	0	0	0	0
45,000 - 49,999	0	0	0	0	0	0	0	0
50,000 - 54,999	0	0	0	0	1	0	0	0
55,000 - 59,999	0	0	0	0	0	0	0	0
60,000 - 64,999	0	0	0	0	1	0	1	0
65,000 - 69,999	0	0	0	0	0	0	0	0
70,000 - 72,000	0	0	0	0	0	0	0	0
72,001 - 74,999	0	0	0	0	0	0	0	0
75,000 - 79,999	0	0	0	0	0	0	0	0
80,000 - 84,999	0	0	0	0	0	0	0	0
85,000 - 89,999	0	0	0	0	0	0	0	0
90,000 - 94,999	0	0	0	0	0	0	0	0
95,000 - 99,999	0	0	0	0	0	0	0	0
100,000 - 104,999	0	0	0	0	0	0	0	0
105,000 - 109,999	0	0	0	0	0	0	0	0
110,000 OR OVER	0	0	0	0	0	0	0	0
TOTAL VEHICLES WEIGHED	0	0	0	0	2	0		
TOTAL VEHICLES COUNTED	0	0	26	87	1	298	1	0

INTST RURAL
INCLUDES 12 STATIONS

TABLE W-5

GROSS OPERATING WEIGHT IN POUNDS	TOTAL ALL COMBINATIONS PROBABLE NO. 1984	1982	TOTAL ALL TRUCKS AND COMBINATIONS PROBABLE NO. 1984	1982	PERCENT HEAVIER THAN LOW WEIGHT INTERVAL 1984	1982	VEHICLES PER 1000 TRUCKS AND COMBINATIONS 1984	1982	RATIO 1984 1982
UNDER 3,999	0	0	10	12	100.00	100.00	0.2	0.2	0.740
4,000 - 9,999	0	0	1800	2212	99.98	99.98	28.3	39.2	0.723
10,000 - 13,499	0	7	1870	1407	97.15	96.06	29.4	24.9	1.181
13,500 - 19,999	225	137	3217	3381	94.21	93.57	50.7	59.9	0.845
20,000 - 21,999	317	202	831	816	89.14	87.57	13.1	14.5	0.905
22,000 - 23,999	856	582	1207	944	87.83	86.13	19.0	16.7	1.136
24,000 - 25,999	1178	1052	1428	1457	85.93	84.45	22.5	25.8	0.871
26,000 - 27,999	1939	2131	2177	2503	83.68	81.87	34.3	44.4	0.773
28,000 - 29,999	2823	2892	3012	3033	80.25	77.44	47.4	53.7	0.882
30,000 - 31,999	3035	2803	3109	2897	75.51	72.06	49.0	51.3	0.954
32,000 - 33,999	2481	2362	2563	2429	70.62	66.93	40.4	43.0	0.938
34,000 - 35,999	2131	1888	2168	1942	66.58	62.62	34.1	34.4	0.992
36,000 - 37,999	1925	1471	1972	1508	63.17	59.18	31.1	26.7	1.162
38,000 - 39,999	1900	1605	1927	1636	60.06	56.51	30.3	29.0	1.047
40,000 - 44,999	4806	3990	4874	4039	57.03	53.61	76.7	71.6	1.072
45,000 - 49,999	4275	3692	4336	3735	49.35	46.45	68.3	66.2	1.032
50,000 - 54,999	3977	3844	4047	3881	42.52	39.83	63.7	68.8	0.927
55,000 - 59,999	4649	3825	4719	3856	36.15	32.96	74.3	68.3	1.087
60,000 - 64,999	4823	4615	4891	4640	28.72	26.12	77.0	82.2	0.937
65,000 - 69,999	5110	4596	5156	4627	21.02	17.90	81.2	82.0	0.990
70,000 - 72,000	2288	1775	2323	1787	12.90	9.70	36.6	31.7	1.155
72,001 - 74,999	2264	1991	2316	1997	9.24	6.53	36.5	35.4	1.030
75,000 - 79,999	2487	1308	2544	1308	5.60	2.99	40.1	23.2	1.728
80,000 - 84,999	594	244	603	244	1.59	0.68	9.5	4.3	2.196
85,000 - 89,999	252	117	254	117	0.64	0.24	4.0	2.1	1.929
90,000 - 94,999	40	10	40	10	0.24	0.04	0.6	0.2	3.554
95,000 - 99,999	71	0	71	0	0.18	0.02	1.1	0.0	0.0
100,000 - 104,999	20	10	20	10	0.07	0.02	0.3	0.2	1.777
105,000 - 109,999	0	0	2	0	0.03	0.0	0.0	0.0	0.0
110,000 OR OVER	20	0	20	0	0.03	0.0	0.3	0.0	0.0
TOTAL VEHICLES WEIGHED									
TOTAL VEHICLES COUNTED	54486	47149	63507	56428	100.00	100.00	0.0	0.0	0.0

Table W-6

Table W-6 is actually a listing showing the characteristics of the trucks weighed during the time the truck weight survey was being conducted whose axle or gross weights exceeded Federal or State weight laws. This information is useful in formulating revised weight limits or modifying design standards on specific highway sections.

An example of this table is shown on pages 5-8-32 and 5-8-33. Each line of the listing, representing one vehicle, is split onto two pages. The vehicles are sorted by functional classification, vehicle type, the percent in excess of AASHTO weight limits and the percent in excess of the State weight limits.

Column 1 titled "Func Class" (Functional classification), column 2 titled "Vehicle Type," column 7 titled "Class Oper." (Class of Operation), column 8 titled "Commodity Carried," and column 9 titled "Body Type" contain the numeric codes indicated in the coding instructions in Chapter 6. The functional classification, vehicle type and class of operation codes and the station number (column 10) are used to identify the location and type of truck concerned. The commodity and body type codes indicate factors that may be contributing to the overload.

All of the axle loads (columns 12-18) and spacings (columns 19-24) and the gross weight (column 11) and total wheelbase (column 25) of each vehicle are shown to determine where an overweight occurs. The axles are identified by alphabetic codes as follows:

A = 1st axle
B = 2nd axle
C = 3rd axle
D = 4th axle
E = 5th axle
F = 6th axle
G = 7th axle

e.g., the axle spacing under the column heading "D-E" (column 22) is the distance to the nearest tenth of a foot between the 4th and 5th axles.

The overweight conditions for which each vehicle is examined are:

1. Single Axle Overweight
2. Tandem Axle Overweight
3. Axle Configuration Overweight (In most cases according to the Bridge Formula)
4. Gross Weight Overweight

Under the column groupings "Percentage Over AASHTO Recommendations" (columns 26-34) and "Percentage Over State Recommendations" (columns 35-43), any excesses are identified for each individual axle, the most overweight axle grouping and the gross weight. The most overweight axle grouping is determined by checking every grouping of axles, including tandem axles, against the bridge formula or the State-specified weight limits by number of axles. The percent of excess for each identified overweight is indicated to the nearest tenth of a percent.

Column 3 titled "Maximum in Excess of AASHTO" shows the greatest percentage of excess of all the overweight conditions. For example, if a vehicle has a single axle that is 5 percent overweight, a tandem axle that is 10 percent overweight, and a gross weight that is 8 percent in excess, the tandem axle's 10 percent will be shown in this column. The same procedure is applied to determine the values for column 4 titled "Maximum in Excess of State."

The "Type of Excess" (columns 5 and 6) indicates which overweight condition had the highest percentage in excess. The alphabetic codes used for these conditions are:

1. SA = Single Axle
2. AG = Axle Group (Includes Tandem Axle)
3. GW = Gross Weight

For the preceding example, since the tandem axle was determined to be the greatest percentage in excess, the column under "AASHTO" would contain an "AG."

TABLE W-6. LISTING SHOWING TOTAL WEIGHT, AXLE LOADS, AND AXLE SPACING OF TRUCKS AND TRUCK COMBINATIONS WEIGHING IN EXCESS

FUNC CLASS	VEHICLE TYPE	MAXIMUM IN EXCESS OF AASHTO	STATE	TYPE OF EXCESS AASHTO	STATE	CLASS OPER.	COMMODITY CARRIED	BODY TYPE	STATION	TOTAL WT	AXLE LOADS IN 100 LBS A	B	C	D	E	F	G	AXLE SPACINGS IN FEET A-B	B-C	C-D	D-E	E-F	F-G
1	221000	16.5	4.0	SA	SA	9	34000	21	402	339	106	233	0	0	0	0	0	16.1	0.0	0.0	0.0	0.0	0.0
1	221000	7.0	0.0	SA	A	9	29000	52	401	368	154	214	0	0	0	0	0	12.6	0.0	0.0	0.0	0.0	0.0
1	221000	3.0	0.0	SA	A	9	20000	42	401	268	62	206	0	0	0	0	0	15.2	0.0	0.0	0.0	0.0	0.0
1	221000	3.0	0.0	SA	A	9	20000	42	402	316	110	206	0	0	0	0	0	12.7	0.0	0.0	0.0	0.0	0.0
1	221000	3.0	0.0	SA	A	9	46000	51	406	275	69	206	0	0	0	0	0	14.6	0.0	0.0	0.0	0.0	0.0
1	221000	3.0	0.0	SA	A	9	34000	41	309	268	62	206	0	0	0	0	0	16.4	0.0	0.0	0.0	0.0	0.0
1	221000	3.0	0.0	SA	A	9	1000	41	303	328	122	206	0	0	0	0	0	18.6	0.0	0.0	0.0	0.0	0.0
1	222000	39.5	24.6	SA	SA	9	1000	41	301	397	118	279	0	0	0	0	0	17.2	0.0	0.0	0.0	0.0	0.0
1	222000	0.5	0.0	SA	A	9	20000	42	301	279	78	201	0	0	0	0	0	15.8	0.0	0.0	0.0	0.0	0.0
1	231000	35.0	32.4	SA	AG	9	1000	41	404	550	100	180	270	0	0	0	0	15.0	4.3	0.0	0.0	0.0	0.0
1	231000	10.3	10.3	AG	AG	9	33000	34	402	492	117	195	180	0	0	0	0	13.8	4.1	0.0	0.0	0.0	0.0
1	231000	9.4	9.4	AG	AG	9	32000	71	315	505	133	181	191	0	0	0	0	13.0	4.0	0.0	0.0	0.0	0.0
1	231000	7.6	4.6	AG	AG	9	32000	21	309	527	161	181	185	0	0	0	0	16.0	4.5	0.0	0.0	0.0	0.0
1	231000	3.5	0.6	AG	AG	9	40000	51	402	458	106	174	178	0	0	0	0	16.0	4.5	0.0	0.0	0.0	0.0
1	231000	2.9	2.9	AG	AG	9	32000	76	309	460	110	178	172	0	0	0	0	18.5	4.2	0.0	0.0	0.0	0.0
1	231000	2.5	0.0	SA	A	9	0	42	301	408	128	205	75	0	0	0	0	19.2	4.4	0.0	0.0	0.0	0.0
1	231000	1.0	0.0	SA	A	9	20000	32	309	436	144	202	90	0	0	0	0	16.9	4.1	0.0	0.0	0.0	0.0
1	241000	97.4	97.4	AG	AG	9	32000	34	312	1066	237	280	269	280	0	0	0	10.4	4.4	3.9	0.0	0.0	0.0
1	241000	45.8	45.8	AG	AG	9	11000	34	301	788	164	144	251	229	0	0	0	12.3	4.5	4.4	0.0	0.0	0.0
1	241000	42.9	42.9	AG	AG	9	29000	34	301	735	135	164	218	218	0	0	0	12.2	4.1	4.3	0.0	0.0	0.0
1	241000	40.8	40.8	AG	AG	9	41000	32	301	770	192	192	207	179	0	0	0	9.5	4.3	4.8	0.0	0.0	0.0
1	241000	39.5	39.5	AG	AG	9	14000	34	301	750	153	183	194	220	0	0	0	10.2	4.4	4.2	0.0	0.0	0.0
1	241000	38.3	38.3	AG	AG	9	32000	34	404	741	149	158	218	216	0	0	0	12.0	4.6	4.5	0.0	0.0	0.0
1	241000	28.5	28.5	AG	AG	9	32000	32	315	639	129	73	226	211	0	0	0	11.4	3.9	4.2	0.0	0.0	0.0
1	241000	22.8	22.8	AG	AG	9	11000	41	301	692	148	196	126	222	0	0	0	11.0	4.3	6.2	0.0	0.0	0.0
1	241000	22.2	22.2	AG	AG	9	11000	34	305	650	127	183	172	168	0	0	0	12.0	4.3	4.5	0.0	0.0	0.0
1	241000	18.2	18.2	AG	AG	9	32000	76	312	668	162	156	173	177	0	0	0	14.2	4.3	4.5	0.0	0.0	0.0
1	241000	15.9	15.9	AG	AG	9	32000	76	401	648	152	171	173	152	0	0	0	16.4	4.6	4.5	0.0	0.0	0.0
1	241000	14.8	14.8	AG	AG	9	11000	34	305	628	170	140	159	159	0	0	0	10.4	4.6	4.3	0.0	0.0	0.0
1	241000	12.6	12.6	AG	AG	9	40000	34	402	615	142	136	170	167	0	0	0	12.7	4.0	4.4	0.0	0.0	0.0
1	241000	11.7	11.7	AG	AG	9	14000	34	402	573	95	167	163	148	0	0	0	13.3	4.2	4.5	0.0	0.0	0.0
1	241000	11.7	11.7	AG	AG	9	24000	21	309	560	82	180	161	137	0	0	0	15.7	4.3	4.2	0.0	0.0	0.0
1	241000	10.6	10.6	AG	AG	9	32000	34	404	573	92	105	176	200	0	0	0	10.6	5.3	4.3	0.0	0.0	0.0
1	241000	9.2	9.2	AG	AG	9	40000	34	309	619	161	129	189	140	0	0	0	13.3	4.5	4.4	0.0	0.0	0.0
1	241000	9.0	0.0	SA	A	9	32000	34	301	554	153	172	11	218	0	0	0	13.6	4.6	4.6	0.0	0.0	0.0
1	241000	7.0	7.0	AG	AG	9	24000	34	402	566	108	129	206	123	0	0	0	12.7	4.3	4.4	0.0	0.0	0.0
1	241000	5.8	5.8	AG	AG	9	34000	34	401	587	134	144	144	165	0	0	0	14.4	4.4	4.2	0.0	0.0	0.0
1	241000	5.7	5.7	AG	AG	9	14000	34	406	592	168	121	162	141	0	0	0	11.9	4.5	4.3	0.0	0.0	0.0
1	241000	3.0	3.0	AG	AG	9	32000	21	315	559	118	118	166	157	0	0	0	11.4	4.3	4.9	0.0	0.0	0.0
1	241000	2.4	0.0	AG	A	9	0	34	303	435	87	87	87	174	0	0	0	9.9	3.4	4.0	0.0	0.0	0.0
1	241000	1.9	1.9	AG	AG	9	32000	21	402	568	140	123	146	159	0	0	0	15.5	4.1	4.1	0.0	0.0	0.0
1	242000	3.5	3.5	AG	AG	9	34000	34	402	496	53	146	174	123	0	0	0	12.0	4.4	4.6	0.0	0.0	0.0
1	251300	165.0	136.6	SA	SA	9	39000	41	402	861	64	530	108	47	112	0	0	14.1	4.1	4.4	30.7	0.0	0.0
1	251300	15.6	15.6	AG	AG	9	46000	41	312	820	99	168	160	171	222	0	0	12.2	4.0	28.2	4.3	0.0	0.0
1	251300	14.7	14.7	AG	AG	9	11000	41	404	760	80	175	175	165	165	0	0	11.0	4.2	17.6	4.0	0.0	0.0
1	251300	13.5	13.5	AG	AG	9	39000	41	402	647	102	66	93	195	191	0	0	10.7	4.4	25.8	4.2	0.0	0.0
1	251300	10.0	10.0	AG	AG	9	20000	41	312	798	106	156	162	199	175	0	0	11.8	4.0	23.8	4.2	0.0	0.0
1	251300	1.5	1.5	AG	AG	9	41000	41	306	751	74	163	156	176	182	0	0	11.4	4.5	23.6	9.1	0.0	0.0
1	252300	15.0	15.0	AG	AG	9	41000	41	312	691	65	149	86	177	214	0	0	9.7	4.0	32.3	4.0	0.0	0.0
1	252300	8.8	8.8	AG	AG	9	41000	41	312	690	99	119	102	173	197	0	0	9.5	4.0	30.9	4.2	0.0	0.0
COLUMN 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

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OF AASHTO RECOMMENDATIONS OR STATE LAW AT 28 STATIONS

WHEEL BASE	PERCENTAGE OVER AASHTO RECOMMENDATIONS									PERCENTAGE OVER STATE RECOMMENDATIONS								
	AXLES							MAXIMUM		AXLES							MAXIMUM	
	B	C	D	E	F	G	GROSS WEIGHT	AXLE GROUP	GROUP PERCENT	B	C	D	E	F	G	GROSS WEIGHT	AXLE GROUP	GROUP PERCENT
16.1	16.5	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
12.6	7.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
15.2	3.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
12.7	3.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
14.6	3.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
16.4	3.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
18.6	3.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
17.2	39.5	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	24.6	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
15.8	0.5	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
19.3	0.0	35.0	0.0	0.0	0.0	0.0	9.3	B-C	32.4	0.0	20.5	0.0	0.0	0.0	0.0	9.3	B-C	32.4
17.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	B-C	10.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	B-C	10.3
17.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	B-C	9.4	0.0	0.0	0.0	0.0	0.0	0.0	3.5	B-C	9.4
20.5	0.0	0.0	0.0	0.0	0.0	0.0	1.7	B-C	7.6	0.0	0.0	0.0	0.0	0.0	0.0	1.7	B-C	4.6
20.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	B-C	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	B-C	0.6
22.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	B-C	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	B-C	2.9
23.6	2.5	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
21.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
18.7	40.0	34.5	40.0	0.0	0.0	0.0	33.3	B-D	97.4	25.0	20.1	25.0	0.0	0.0	0.0	33.3	B-D	97.4
21.2	0.0	25.5	14.5	0.0	0.0	0.0	40.7	B-D	45.8	0.0	12.1	2.2	0.0	0.0	0.0	40.7	B-D	45.8
20.6	0.0	9.0	9.0	0.0	0.0	0.0	31.3	B-D	42.9	0.0	0.0	0.0	0.0	0.0	0.0	31.3	B-D	42.9
18.6	0.0	3.5	0.0	0.0	0.0	0.0	40.8	A-D	40.8	0.0	0.0	0.0	0.0	0.0	0.0	40.8	A-D	40.8
18.8	0.0	0.0	10.0	0.0	0.0	0.0	37.1	B-D	39.5	0.0	0.0	0.0	0.0	0.0	0.0	37.1	B-D	39.5
21.1	0.0	9.0	8.0	0.0	0.0	0.0	32.3	B-D	38.3	0.0	0.0	0.0	0.0	0.0	0.0	32.3	B-D	38.3
19.5	0.0	13.0	5.5	0.0	0.0	0.0	15.6	C-D	28.5	0.0	0.9	0.0	0.0	0.0	0.0	15.6	C-D	28.5
21.5	0.0	0.0	11.0	0.0	0.0	0.0	22.0	B-D	22.8	0.0	0.0	0.0	0.0	0.0	0.0	22.0	B-D	22.8
20.8	0.0	0.0	0.0	0.0	0.0	0.0	16.1	B-D	22.2	0.0	0.0	0.0	0.0	0.0	0.0	16.1	B-D	22.2
23.0	0.0	0.0	0.0	0.0	0.0	0.0	16.6	B-D	18.2	0.0	0.0	0.0	0.0	0.0	0.0	16.6	B-D	18.2
25.5	0.0	0.0	0.0	0.0	0.0	0.0	9.3	B-D	15.9	0.0	0.0	0.0	0.0	0.0	0.0	9.3	B-D	15.9
19.3	0.0	0.0	0.0	0.0	0.0	0.0	14.8	A-D	14.8	0.0	0.0	0.0	0.0	0.0	0.0	14.8	A-D	14.8
21.1	0.0	0.0	0.0	0.0	0.0	0.0	9.8	B-D	12.6	0.0	0.0	0.0	0.0	0.0	0.0	9.8	B-D	12.6
22.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	B-D	11.7	0.0	0.0	0.0	0.0	0.0	0.0	1.1	B-D	11.7
24.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	B-D	11.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	B-D	11.7
20.2	0.0	0.0	0.0	0.0	0.0	0.0	3.6	C-D	10.6	0.0	0.0	0.0	0.0	0.0	0.0	3.6	C-D	10.6
22.2	0.0	0.0	0.0	0.0	0.0	0.0	9.2	A-D	9.2	0.0	0.0	0.0	0.0	0.0	0.0	9.2	A-D	9.2
22.8	0.0	0.0	9.0	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
21.4	0.0	3.0	0.0	0.0	0.0	0.0	1.1	B-D	7.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	B-D	7.0
23.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	B-D	5.8	0.0	0.0	0.0	0.0	0.0	0.0	2.4	B-D	5.8
20.7	0.0	0.0	0.0	0.0	0.0	0.0	5.7	A-D	5.7	0.0	0.0	0.0	0.0	0.0	0.0	5.7	A-D	5.7
20.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	B-D	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	B-D	3.0
17.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	B-D	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
23.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	B-D	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	B-D	1.9
21.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	B-D	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	B-D	3.5
53.3	165.0	0.0	0.0	0.0	0.0	0.0	7.6	B-C	87.6	136.6	0.0	0.0	0.0	0.0	0.0	7.6	B-C	87.6
48.7	0.0	0.0	0.0	11.0	0.0	0.0	2.5	D-E	15.6	0.0	0.0	0.0	0.0	0.0	0.0	2.5	D-E	15.6
36.8	0.0	0.0	0.0	0.0	0.0	0.0	6.9	B-E	14.7	0.0	0.0	0.0	0.0	0.0	0.0	6.9	B-E	14.7
45.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	D-E	13.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	D-E	13.5
43.8	0.0	0.0	0.0	0.0	0.0	0.0	5.7	D-E	10.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	D-E	10.0
48.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	B-E	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	B-E	1.5
50.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	D-E	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	D-E	15.0
48.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	D-E	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	D-E	8.8
COLUMN 25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43

Table W-7

The number and percent of overweight and legal weight vehicles are summarized in this table for each functional classification, vehicle type, and year of the data. Vehicles that violate Federal weight laws are distinguished from those that violate State weight laws and the number ("No") and percent ("Pt") of overweight vehicles ("All in Excess") and legal weight vehicles ("Not in Excess") are indicated for each. Also included are the accumulated numbers and percentages of vehicles exceeding the weight laws by specified percentages. An example of this table is shown on pages 5-8-35 through 5-8-37.

The columns under the title "Excess by Percent or More" are a frequency distribution of the maximum overweight percentages by vehicle taken from Table W-6. The five percentage categories are defined in the following manner:

1. "5" - Violations exceeding the legal limit by 5 percent or more
2. "10" - Violations exceeding the legal limit by 10 percent or more
3. "20" - Violations exceeding the legal limit by 20 percent or more
4. "30" - Violations exceeding the legal limit by 30 percent or more
5. "50" - Violations exceeding the legal limit by 50 percent or more

Therefore, the same vehicle could exist in several of the above categories. For example, a truck that exceeds a legal weight limit by 11 percent would be shown in both the first and second categories, while a truck that exceeds a legal weight limit by 50 percent would be shown in all of the categories. If a vehicle does not exceed the weight limit by at least 5 percent, it will not be shown in this distribution.

TABLE W-7 FUNCTIONAL CLASS: PRINCIPAL ARTERIAL, INTERSTATE, RURAL
NUMBER AND ACCUMULATIVE PERCENTAGE OF VEHICLES NOT IN EXCESS AND IN EXCESS BY SPECIFIED PERCENTAGES OF LAW AND AASHTO RECOMMENDATIONS WEIGHED AT 12 STATIONS DURING 1982 AND AT 12 STATIONS DURING 1984

TYPE OF VEHICLE	NO OR PT	YR	WEIGHD	AASHTO RECOMMENDATIONS ALL IN EXCESS	NOT IN EXCESS	EXCESS BY PERCENT OR MORE 5	10	20	30	50	LAW ALL IN EXCESS	NOT IN EXCESS	EXCESS BY PERCENT OR MORE 5	10	20	30	50
SINGLE-UNIT TRUCKS																	
PANEL AND PICKUP	NO	84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PT	84	100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		82	100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-AXLE, 4 TIRE	NO	84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		82	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0
	PT	84	100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		82	100.00	0.0	100.00	0.0	0.0	0.0	0.0	0.0	0.0	100.00	0.0	0.0	0.0	0.0	0.0
2-AXLE, 6 TIRE	NO	84	693	9	684	3	2	1	1	0	2	691	1	1	1	0	0
		82	659	4	655	1	1	0	0	0	0	659	0	0	0	0	0
	PT	84	100.00	1.30	98.70	0.43	0.29	0.14	0.14	0.0	0.29	99.71	0.14	0.14	0.14	0.0	0.0
		82	100.00	0.61	99.39	0.15	0.15	0.0	0.0	0.0	0.0	100.00	0.0	0.0	0.0	0.0	0.0
3-AXLE, OR MORE	NO	84	445	62	383	37	24	11	8	2	57	388	34	24	11	8	2
		82	212	23	189	15	13	9	2	0	21	191	14	12	8	2	0
	PT	84	100.00	13.93	86.07	8.31	5.39	2.47	1.80	0.45	12.81	87.19	7.64	5.39	2.47	1.80	0.45
		82	100.00	10.85	89.15	7.08	6.13	4.25	0.94	0.0	9.91	90.09	6.60	5.66	3.77	0.94	0.0
SUBTOTL SINGLE UNIT	NO	84	1138	71	1067	40	26	12	9	2	59	1079	35	25	12	8	2
		82	872	27	845	16	14	9	2	0	21	851	14	12	8	2	0
	PT	84	100.00	6.24	93.76	3.51	2.28	1.05	0.79	0.18	5.18	94.82	3.08	2.20	1.05	0.70	0.18
		82	100.00	3.10	96.90	1.83	1.61	1.03	0.23	0.0	2.41	97.59	1.61	1.38	0.92	0.23	0.0
COMBINATION																	
TRACTOR-SEMITRAILER																	
2 AXLE TRCTR	NO	84	456	15	441	10	3	0	0	0	5	451	2	0	0	0	0
		82	532	9	523	4	2	2	1	1	5	527	3	1	1	1	1
	PT	84	100.00	3.29	96.71	2.19	0.66	0.0	0.0	0.0	1.10	98.90	0.44	0.0	0.0	0.0	0.0
		82	100.00	1.69	98.31	0.75	0.38	0.38	0.19	0.19	0.94	99.06	0.56	0.19	0.19	0.19	0.19
3 AXLE TRCTR	NO	84	4778	419	4359	251	138	51	23	7	388	4390	229	129	49	21	7
		82	4330	274	4056	133	54	15	7	3	243	4087	115	44	11	4	3
	PT	84	100.00	8.77	91.23	5.25	2.89	1.07	0.48	0.15	8.12	91.88	4.79	2.70	1.03	0.44	0.15
		82	100.00	6.33	93.67	3.07	1.25	0.35	0.16	0.07	5.61	94.39	2.66	1.02	0.25	0.09	0.07
4 AXLE TRCTR	NO	84	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0
		82	2	0	2	0	0	0	0	0	0	2	0	0	0	0	0
	PT	84	100.00	0.0	100.00	0.0	0.0	0.0	0.0	0.0	0.0	100.00	0.0	0.0	0.0	0.0	0.0
		82	100.00	0.0	100.00	0.0	0.0	0.0	0.0	0.0	0.0	100.00	0.0	0.0	0.0	0.0	0.0
5 AXLE TRCTR	NO	84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PT	84	100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6 AXLE TRCTR	NO	84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PT	84	100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

7 AXLE TRCTR	NO	84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PT	84	100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8 AXLE TRCTR	NO	84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PT	84	100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUBTOTAL	NO	84	5235	434	4801	261	141	51	23	7	393	4842	231	129	49	21	7
		82	4864	283	4581	137	56	17	8	4	248	4616	118	45	12	5	4
	PT	84	100.00	8.29	91.71	4.99	2.69	0.97	0.44	0.13	7.51	92.49	4.41	2.46	0.94	0.40	0.13
		82	100.00	5.82	94.18	2.82	1.15	0.35	0.16	0.08	5.10	94.90	2.43	0.93	0.25	0.10	0.08
TRUCK-FULL TRAILER																	
2 AXLE TRCTR	NO	84	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0
		82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PT	84	100.00	0.0	100.00	0.0	0.0	0.0	0.0	0.0	0.0	100.00	0.0	0.0	0.0	0.0	0.0
		82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3 AXLE TRCTR	NO	84	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0
		82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PT	84	100.00	0.0	100.00	0.0	0.0	0.0	0.0	0.0	0.0	100.00	0.0	0.0	0.0	0.0	0.0
		82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 AXLE TRCTR	NO	84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PT	84	100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 AXLE TRCTR	NO	84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PT	84	100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6 AXLE TRCTR	NO	84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PT	84	100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7 AXLE TRCTR	NO	84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PT	84	100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8 AXLE TRCTR	NO	84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PT	84	100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUBTOTAL	NO	84	2	0	2	0	0	0	0	0	0	2	0	0	0	0	0
		82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PT	84	100.00	0.0	100.00	0.0	0.0	0.0	0.0	0.0	0.0	100.00	0.0	0.0	0.0	0.0	0.0
		82	100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRACTOR,SEMI & 1 TRL																	
2 AXLE TRCTR	NO	84	122	4	118	2	0	0	0	0	0	122	0	0	0	0	0
		82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PT	84	100.00	3.28	96.72	1.64	0.0	0.0	0.0	0.0	0.0	100.00	0.0	0.0	0.0	0.0	0.0
		82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3 AXLE TRCTR	NO	84	17	2	15	1	1	0	0	0	2	15	0	0	0	0	0
		82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PT	84	100.00	11.76	88.24	5.88	5.88	0.0	0.0	0.0	11.76	88.24	0.0	0.0	0.0	0.0	0.0
		82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUBTOTAL	NO	84	139	6	133	3	1	0	0	0	2	137	0	0	0	0	0
		82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PT	84	100.00	4.32	95.68	2.16	0.72	0.0	0.0	0.0	1.44	98.56	0.0	0.0	0.0	0.0	0.0
		82	100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRUCK & 2 TRAILERS																	

SUBTOTAL	NO	84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PT	84	100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		82	100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRACTOR,SEMI & 2 TRL																	
SUBTOTAL	NO	84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PT	84	100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		82	100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRUCK & 3 TRAILERS																	
SUBTOTAL	NO	84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PT	84	100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		82	100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL COMBINATIONS	NO	84	5376	440	4936	264	142	51	23	7	395	4981	231	129	49	21	7
		82	4864	283	4581	137	56	17	8	4	248	4616	118	45	12	5	4
	PT	84	100.00	8.18	91.82	4.91	2.64	0.95	0.43	0.13	7.35	92.65	4.30	2.40	0.91	0.39	0.13
		82	100.00	5.82	94.18	2.82	1.15	0.35	0.16	0.08	5.10	94.90	2.43	0.93	0.25	0.10	0.08
TOTAL TRUCK & COMB.	NO	84	6514	511	6003	304	168	63	32	9	454	6060	266	154	61	29	9
		82	5736	310	5426	153	70	26	10	4	269	5467	132	57	20	7	4
	PT	84	100.00	7.84	92.16	4.67	2.58	0.97	0.49	0.14	6.97	93.03	4.08	2.36	0.94	0.45	0.14
		82	100.00	5.40	94.60	2.67	1.22	0.45	0.17	0.07	4.69	95.31	2.30	0.99	0.35	0.12	0.07
TOTAL ALL VEHICLES	NO	84	6514	511	6003	304	168	63	32	9	454	6060	266	154	61	29	9
		82	5736	310	5426	153	70	26	10	4	269	5467	132	57	20	7	4
	PT	84	100.00	7.84	92.16	4.67	2.58	0.97	0.49	0.14	6.97	93.03	4.08	2.36	0.94	0.45	0.14
		82	100.00	5.40	94.60	2.67	1.22	0.45	0.17	0.07	4.69	95.31	2.30	0.99	0.35	0.12	0.07

CHAPTER 9

Other Analyses of Truck Weight Survey Data

Introduction

Although the W-Tables cover the most commonly utilized data relationships, there are other summaries that could be of value in analyzing data relationships or specific data items not referenced in the W-Tables. Several summaries have already been developed and are generally produced for each submittal of a State's data. These tables can be separated into two basic categories; those that provide more detailed analysis of the vehicle classification data and those that cover other data relationships in the truck weight data.

Other Vehicle Classification Data Analyses

Although Table W-2 provides vehicle classification counts by functional classification, station and vehicle type group, more detailed analysis might be needed such as the change in the counts by hour or the percent distribution of counts by vehicle type. The tables that currently show further analysis of the vehicle classification data are described here.

1. Annual Vehicle Count (See page 5-9-3)

   This is a one-page statewide summary of the counts by functional classification and the vehicle type categories as indicated on the table.

2. Classification Count Summary (See pages 5-9-4 through 5-9-7)

   This summary shows three separate figures for each functional classification and vehicle type code:

   a. The total count
   b. The average count per station within a functional classification
   c. The percent distribution of the vehicle types

   Eight subtotal columns are shown between the vehicle types in the table and are defined as follows:

a.	SB-TOT #1 - (After vehicle type 062000)	The number of passenger cars
b.	SB-TOT #2 - (After vehicle type 180000)	The number of motorcycles and buses
c.	SB-TOT #3 - (After SB-TOT #2)	The number of cars, buses and motorcycles

d.	SB-TOT #4 - (After vehicle types 240000+)	The number of single-unit trucks
e.	SB-TOT #5 - (After vehicle type 532200)	The number of tractor/trailer combinations
f.	SB-TOT #6 - (After vehicle type 433000)	The number of truck/trailer combinations
g.	SB-TOT #7 - (After SB-TOT #6)	The total number of combinations
h.	SB-TOT #8 - (After SB-TOT #7)	The total number of trucks (with or without trailers)

There are also two columns titled "OTHER" which include the following vehicles:

a.	OTHER #1 - (Before SB-TOT #5)	All the tractor/trailer combinations that are not specifically defined in the previous vehicle type codes.
b.	OTHER #2 - (Before SB-TOT #6)	All the truck/trailer combinations that are not specifically defined in the previous vehicle type codes.

3. Hourly Classification Count Summary (See pages 5-9-8 through 5-9-9)

This summary is a more detailed version of the previously-described Classification Count Summary. Besides the counts and percent distribution by vehicle type and functional classification, it also provides the percentage distribution by hour for a specific vehicle type.

The example table shows the information for only one functional classification.

ANNUAL VEHICLE COUNT

1984

FUNC. CLASS — VEHICLE TYPE

FUNC. CLASS	01	02	03	04	05	06	07	08	09	10	11	12	13	14	TOTAL
01	23112	119	8047	974	1035	3650	49800	0	26	1	123441	809	339	135	211488
02	16028	85	4022	489	719	1290	10251	0	25	0	76828	837	142	118	110834
06	4136	38	796	130	146	220	2405	0	5	0	18045	252	10	11	26194
07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	8587	30	1778	144	132	217	1371	0	0	0	50087	237	90	76	62749
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALL	51863	272	14643	1737	2032	5377	63827	0	56	1	268401	2135	581	340	411265

VEHICLE TYPES

01 PANEL + PICKUP S-U
02 OTHER 4 TIRE S-U
03 2 AX 6 TIRE S-U
04 3 AX OR MORE S-U
05 TRACTOR-TLR 3 AX
06 TRACTOR-TLR 4 AX
07 TRACTOR-TLR 5 AX +
08 TRUCK-TLR 3 AX
09 TRUCK-TLR 4 AX
10 TRUCK-TLR 5 AX +
11 PASSENGER CAR
12 CYCLES
13 COMMERCIAL BUS
14 OTHER BUS

FUNCTIONAL CLASSIFICATION CODES

RURAL

01 PRINCIPAL ARTERIAL-INTERSTATE
02 PRINCIPAL ARTERIAL-OTHER
06 MINOR ARTERIAL
07 MAJOR COLLECTOR
08 MINOR COLLECTOR
09 LOCAL SYSTEMS

URBAN

11 PRINCIPAL ARTERIAL-INTERSTATE
12 PRIN. ART.-OTHER FRWYS. & EXPWYS.
14 PRINCIPAL ARTERIAL-OTHER
16 MINOR ARTERIAL
17 COLLECTOR
19 LOCAL SYSTEMS

NOTE: SOURCE IS THE NUMBER-4CARDS FOR THE DATA YEAR 1984 AS OF 04/09/85

CLASSIFICATION COUNT SUMMARY FOR 1984

	VEHICLE TYPES 071000	061000	072000	062000	#1 SB-TOT	030000	150000	180000	#2 SB-TOT	#3 SB-TOT
01 PRIN. ART.-I/R	82,804	12,942	27,695	0	123,441	809	339	135	1,283	124,724
AVG. FOR 12 STATIONS	6,900	1,079	2,308	0	10,287	67	28	11	107	10,394
DISTRIBUTION BY %	39.15	6.12	13.10	0.00	58.37	0.38	0.16	0.06	0.61	58.97
02 PRIN. ART.-O/R	65,772	3,423	7,633	0	76,828	837	142	118	1,097	77,925
AVG. FOR 10 STATIONS	6,577	342	763	0	7,683	84	14	12	110	7,793
DISTRIBUTION BY %	59.34	3.09	6.89	0.00	69.32	0.76	0.13	0.11	0.99	70.31
06+07+08+09 ALL O/R	17,206	266	573	0	18,045	252	10	11	273	18,318
AVG. FOR 3 STATIONS	5,735	89	191	0	6,015	84	3	4	91	6,106
DISTRIBUTION BY %	65.69	1.02	2.19	0.00	68.89	0.96	0.04	0.04	1.04	69.93
11 PRIN. ART.-I/U	0	0	0	0	0	0	0	0	0	0
AVG. FOR 0 STATIONS	0	0	0	0	0	0	0	0	0	0
DISTRIBUTION BY %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12+14 PRIN. ART.-O/U	47,911	1,549	627	0	50,087	237	90	76	403	50,490
AVG. FOR 3 STATIONS	15,970	516	209	0	16,696	79	30	25	134	16,830
DISTRIBUTION BY %	76.35	2.47	1.00	0.00	79.82	0.38	0.14	0.12	0.64	80.46
16+17+19 ALL O/U	0	0	0	0	0	0	0	0	0	0
AVG. FOR 0 STATIONS	0	0	0	0	0	0	0	0	0	0
DISTRIBUTION BY %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ALL RURAL	165,782	16,631	35,901	0	218,314	1,898	491	264	2,653	220,967
AVG. FOR 25 STATIONS	6,631	665	1,436	0	8,733	76	20	11	106	8,839
DISTRIBUTION BY %	47.57	4.77	10.30	0.00	62.64	0.54	0.14	0.08	0.76	63.40
ALL URBAN	47,911	1,549	627	0	50,087	237	90	76	403	50,490
AVG. FOR 3 STATIONS	15,970	516	209	0	16,696	79	30	25	134	16,830
DISTRIBUTION BY %	76.35	2.47	1.00	0.00	79.82	0.38	0.14	0.12	0.64	80.46
ALL FUNCTIONAL CLASSES	213,693	18,180	36,528	0	268,401	2,135	581	340	3,056	271,457
AVG. FOR 28 STATIONS	7,632	649	1,305	0	9,586	76	21	12	109	9,695
DISTRIBUTION BY %	51.96	4.42	8.88	0.00	65.26	0.52	0.14	0.08	0.74	66.01

VEHICLE TYPES

	200000	210000	220000	230000	240000+	#4 SB-TOT	321000	322000	323000	331000
01 PRIN. ART.-I/R	23,112	119	8,047	709	265	32,252	1,035	3,650	0	0
AVG. FOR 12 STATIONS	1,926	10	671	59	22	2,688	86	304	0	0
DISTRIBUTION BY %	10.93	0.06	3.80	0.34	0.13	15.25	0.49	1.73	0.00	0.00
02 PRIN. ART.-O/R	16,028	85	4,022	350	139	20,624	719	1,290	0	0
AVG. FOR 10 STATIONS	1,603	9	402	35	14	2,062	72	129	0	0
DISTRIBUTION BY %	14.46	0.08	3.63	0.32	0.13	18.61	0.65	1.16	0.00	0.00
06+07+08+09 ALL O/R	4,136	38	796	113	17	5,100	146	220	0	0
AVG. FOR 3 STATIONS	1,379	13	265	38	6	1,700	49	73	0	0
DISTRIBUTION BY %	15.79	0.15	3.04	0.43	0.06	19.47	0.56	0.84	0.00	0.00
11 PRIN. ART.-I/U	0	0	0	0	0	0	0	0	0	0
AVG. FOR 0 STATIONS	0	0	0	0	0	0	0	0	0	0
DISTRIBUTION BY %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12+14 PRIN. ART.-O/U	8,587	30	1,778	113	31	10,539	132	217	0	0
AVG. FOR 3 STATIONS	2,862	10	593	38	10	3,513	44	72	0	0
DISTRIBUTION BY %	13.68	0.05	2.83	0.18	0.05	16.80	0.21	0.35	0.00	0.00
16+17+19 ALL O/U	0	0	0	0	0	0	0	0	0	0
AVG. FOR 0 STATIONS	0	0	0	0	0	0	0	0	0	0
DISTRIBUTION BY %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ALL RURAL	43,276	242	12,865	1,172	421	57,976	1,900	5,160	0	0
AVG. FOR 25 STATIONS	1,731	10	515	47	17	2,319	76	206	0	0
DISTRIBUTION BY %	12.42	0.07	3.69	0.34	0.12	16.64	0.55	1.48	0.00	0.00
ALL URBAN	8,587	30	1,778	113	31	10,539	132	217	0	0
AVG. FOR 3 STATIONS	2,862	10	593	38	10	3,513	44	72	0	0
DISTRIBUTION BY %	13.68	0.05	2.83	0.18	0.05	16.80	0.21	0.35	0.00	0.00
ALL FUNCTIONAL CLASSES	51,863	272	14,643	1,285	452	68,515	2,032	5,377	0	0
AVG. FOR 28 STATIONS	1,852	10	523	46	16	2,447	73	192	0	0
DISTRIBUTION BY %	12.61	0.07	3.56	0.31	0.11	16.66	0.49	1.31	0.00	0.00

VEHICLE TYPES

	332000	333000	521100	521200	522200	531200	532200	#1 OTHERS	#5 SB-TOT	421000
01 PRIN. ART.-I/R	48,156	412	0	1,133	0	93	6	0	54,485	0
AVG. FOR 12 STATIONS	4,013	34	0	94	0	8	1	0	4,540	0
DISTRIBUTION BY %	22.77	0.19	0.00	0.54	0.00	0.04	0.00	0.00	25.76	0.00
02 PRIN. ART.-O/R	10,008	173	0	64	0	6	0	0	12,260	0
AVG. FOR 10 STATIONS	1,001	17	0	6	0	1	0	0	1,226	0
DISTRIBUTION BY %	9.03	0.16	0.00	0.06	0.00	0.01	0.00	0.00	11.06	0.00
06+07+08+09 ALL O/R	2,310	26	0	68	0	1	0	0	2,771	0
AVG. FOR 3 STATIONS	770	9	0	23	0	0	0	0	924	0
DISTRIBUTION BY %	8.82	0.10	0.00	0.26	0.00	0.00	0.00	0.00	10.58	0.00
11 PRIN. ART.-I/U	0	0	0	0	0	0	0	0	0	0
AVG. FOR 0 STATIONS	0	0	0	0	0	0	0	0	0	0
DISTRIBUTION BY %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12+14 PRIN. ART.-O/U	1,317	23	0	31	0	0	0	0	1,720	0
AVG. FOR 3 STATIONS	439	8	0	10	0	0	0	0	573	0
DISTRIBUTION BY %	2.10	0.04	0.00	0.05	0.00	0.00	0.00	0.00	2.74	0.00
16+17+19 ALL O/U	0	0	0	0	0	0	0	0	0	0
AVG. FOR 0 STATIONS	0	0	0	0	0	0	0	0	0	0
DISTRIBUTION BY %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ALL RURAL	60,474	611	0	1,265	0	100	6	0	69,516	0
AVG. FOR 25 STATIONS	2,419	24	0	51	0	4	0	0	2,781	0
DISTRIBUTION BY %	17.35	0.18	0.00	0.36	0.00	0.03	0.00	0.00	19.95	0.00
ALL URBAN	1,317	23	0	31	0	0	0	0	1,720	0
AVG. FOR 3 STATIONS	439	8	0	10	0	0	0	0	573	0
DISTRIBUTION BY %	2.10	0.04	0.00	0.05	0.00	0.00	0.00	0.00	2.74	0.00
ALL FUNCTIONAL CLASSES	61,791	634	0	1,296	0	100	6	0	71,236	0
AVG. FOR 28 STATIONS	2,207	23	0	46	0	4	0	0	2,544	0
DISTRIBUTION BY %	15.02	0.15	0.00	0.32	0.00	0.02	0.00	0.00	17.32	0.00

VEHICLE TYPES

	422000	423000	431000	432000	433000	#2 OTHERS	#6 SB-TOT	#7 SB-TOT	#8 SB-TOT	GR-TOT
01 PRIN. ART.-I/R	26	0	0	0	0	1	27	54,512	86,764	211,488
AVG. FOR 12 STATIONS	2	0	0	0	0	0	2	4,543	7,230	17,624
DISTRIBUTION BY %	0.01	0.00	0.00	0.00	0.00	0.00	0.01	25.78	41.03	100.00
02 PRIN. ART.-O/R	25	0	0	0	0	0	25	12,285	32,909	110,834
AVG. FOR 10 STATIONS	3	0	0	0	0	0	3	1,229	3,291	11,083
DISTRIBUTION BY %	0.02	0.00	0.00	0.00	0.00	0.00	0.02	11.08	29.69	100.00
06+07+08+09 ALL O/R	5	0	0	0	0	0	5	2,776	7,876	26,194
AVG. FOR 3 STATIONS	2	0	0	0	0	0	2	925	2,625	8,731
DISTRIBUTION BY %	0.02	0.00	0.00	0.00	0.00	0.00	0.02	10.60	30.07	100.00
11 PRIN. ART.-I/U	0	0	0	0	0	0	0	0	0	0
AVG. FOR 0 STATIONS	0	0	0	0	0	0	0	0	0	0
DISTRIBUTION BY %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12+14 PRIN. ART.-O/U	0	0	0	0	0	0	0	1,720	12,259	62,749
AVG. FOR 3 STATIONS	0	0	0	0	0	0	0	573	4,086	20,916
DISTRIBUTION BY %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.74	19.54	100.00
16+17+19 ALL O/U	0	0	0	0	0	0	0	0	0	0
AVG. FOR 0 STATIONS	0	0	0	0	0	0	0	0	0	0
DISTRIBUTION BY %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ALL RURAL	56	0	0	0	0	1	57	69,573	127,549	348,516
AVG. FOR 25 STATIONS	2	0	0	0	0	0	2	2,783	5,102	13,941
DISTRIBUTION BY %	0.02	0.00	0.00	0.00	0.00	0.00	0.02	19.96	36.60	100.00
ALL URBAN	0	0	0	0	0	0	0	1,720	12,259	62,749
AVG. FOR 3 STATIONS	0	0	0	0	0	0	0	573	4,086	20,916
DISTRIBUTION BY %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.74	19.54	100.00
ALL FUNCTIONAL CLASSES	56	0	0	0	0	1	57	71,293	139,808	411,265
AVG. FOR 28 STATIONS	2	0	0	0	0	0	2	2,546	4,993	14,688
DISTRIBUTION BY %	0.01	0.00	0.00	0.00	0.00	0.00	0.01	17.34	33.99	100.00

HOURLY CLASSIFICATION COUNT SUMMARY FOR 1984

	VEHICLE TYPES									
	071000	061000	072000	062000	SB-TOT	030000	150000	180000	SB-TOT	SB-TOT
01 PRIN. ART.-I/R COUNT FOR 12 STATIONS	82804	12942	27695	0	123441	809	339	135	1283	124724
DISTRIBUTION BY PCT.	39.15	6.12	13.10	.00	58.37	.38	.16	.06	.61	58.97
PCT. OF TOTAL BY HOUR 00	2.33	.57	1.96	.00	2.07	2.72	2.65	2.22	2.65	2.07
01	1.89	.93	2.46	.00	1.92	2.35	4.13	5.19	3.12	1.93
02	1.89	.70	2.11	.00	1.81	2.72	2.95	1.48	2.65	1.82
03	1.97	.70	2.63	.00	1.99	1.98	2.06	5.93	2.42	1.99
04	2.40	1.10	2.61	.00	2.31	2.97	1.47	5.93	2.88	2.32
05	2.74	2.11	2.74	.00	2.67	3.46	5.31	4.44	4.05	2.69
06	4.28	2.70	3.08	.00	3.84	3.83	5.01	7.41	4.52	3.85
07	5.67	3.88	3.37	.00	4.96	5.07	5.90	2.96	5.07	4.96
08	5.34	3.48	4.28	.00	4.90	3.58	5.31	3.70	4.05	4.90
09	5.92	6.22	5.88	.00	5.94	3.83	5.01	3.70	4.13	5.93
10	5.54	6.77	7.65	.00	6.15	5.93	9.73	7.41	7.09	6.16
11	6.28	8.43	8.28	.00	6.95	8.65	5.31	8.89	7.79	6.96
12	6.07	7.49	7.94	.00	6.64	7.29	6.78	.00	6.39	6.64
13	4.64	7.87	6.24	.00	5.34	5.44	4.42	5.19	5.14	5.34
14	5.19	8.83	6.18	.00	5.79	6.55	3.24	2.22	5.22	5.79
15	5.21	7.98	6.42	.00	5.78	6.67	2.65	7.41	5.69	5.78
16	5.56	7.27	5.65	.00	5.76	3.09	3.54	3.70	3.27	5.73
17	6.43	6.37	6.67	.00	6.47	8.78	7.96	7.41	8.42	6.49
18	4.49	4.03	4.56	.00	4.46	3.21	3.83	1.48	3.20	4.44
19	3.93	3.72	3.20	.00	3.74	5.19	2.95	3.70	4.44	3.75
20	3.79	3.28	1.95	.00	3.32	1.36	1.77	1.48	1.48	3.30
21	3.16	2.06	1.78	.00	2.74	1.85	4.13	3.70	2.65	2.74
22	3.00	1.98	1.46	.00	2.55	2.47	1.77	.74	2.10	2.54
23	2.29	1.51	.91	.00	1.90	.99	2.06	3.70	1.56	1.89

	VEHICLE TYPES									
	200000	210000	220000	230000	240000	SB-TOT	321000	322000	323000	331000
01 PRIN. ART.-I/R COUNT FOR 12 STATIONS	23112	119	8047	709	265	32252	1035	3650	0	0
DISTRIBUTION BY PCT.	10.93	.06	3.80	.34	.13	15.25	.49	1.73	.00	.00
PCT. OF TOTAL BY HOUR 00	1.68	.00	2.29	3.10	1.51	1.85	2.32	3.42	.00	.00
01	1.66	.00	2.40	2.26	.75	1.84	1.93	3.73	.00	.00
02	1.87	.84	1.98	1.69	.00	1.88	2.51	3.40	.00	.00
03	2.45	.00	2.83	2.68	.00	2.52	2.71	3.37	.00	.00
04	2.31	5.04	3.70	2.12	1.51	2.66	2.51	3.45	.00	.00
05	3.19	1.68	3.63	2.26	.75	3.25	3.19	4.38	.00	.00
06	5.64	3.36	4.51	3.53	2.64	5.28	7.25	5.62	.00	.00
07	5.89	5.04	4.47	4.37	6.79	5.51	6.28	4.90	.00	.00
08	5.21	5.04	5.88	3.81	4.15	5.34	4.93	5.70	.00	.00
09	5.64	7.56	5.55	7.62	10.57	5.71	5.99	6.03	.00	.00
10	5.68	5.88	5.80	5.64	9.81	5.74	5.80	4.55	.00	.00
11	7.02	5.88	6.85	9.45	7.17	7.03	3.77	5.04	.00	.00
12	7.13	3.36	6.87	9.17	5.66	7.08	4.25	5.10	.00	.00
13	5.53	8.40	5.03	7.90	5.66	5.47	5.51	5.40	.00	.00
14	5.65	6.72	5.57	6.49	16.23	5.74	4.44	5.29	.00	.00
15	5.45	3.36	5.67	5.78	4.91	5.50	9.76	5.07	.00	.00
16	5.67	2.52	6.06	4.94	7.92	5.76	6.09	3.92	.00	.00
17	5.82	3.36	5.16	4.09	4.53	5.59	5.41	4.27	.00	.00
18	4.14	5.04	3.49	3.67	3.77	3.97	3.77	3.51	.00	.00
19	3.54	7.56	3.04	3.67	2.26	3.43	4.25	3.59	.00	.00
20	2.80	14.29	2.55	1.27	1.13	2.73	3.19	2.93	.00	.00
21	2.41	5.04	2.15	1.27	1.13	2.32	2.03	2.14	.00	.00
22	2.06	.00	2.60	.99	.38	2.15	.87	2.96	.00	.00
23	1.57	.00	1.91	2.26	.75	1.66	1.26	2.25	.00	.00

HOURLY CLASSIFICATION COUNT SUMMARY FOR 1984

	VEHICLE TYPES									
	332000	333000	521100	521200	522200	531200	532200	OTHERS	SB-TOT	421000
01 PRIN. ART.-I/R COUNT FOR 12 STATIONS	48156	412	0	1133	0	93	6	0	54485	0
DISTRIBUTION BY PCT.	22.77	.19	.00	.54	.00	.04	.00	.00	25.76	.00
PCT. OF TOTAL BY HOUR 00	4.28	1.70	.00	3.44	.00	2.15	.00	.00	4.14	.00
01	4.28	4.61	.00	4.50	.00	3.23	.00	.00	4.20	.00
02	4.09	1.46	.00	3.35	.00	6.45	.00	.00	3.98	.00
03	3.77	3.64	.00	2.74	.00	2.15	.00	.00	3.70	.00
04	4.44	9.71	.00	4.68	.00	.00	.00	.00	4.37	.00
05	4.32	2.18	.00	4.06	.00	3.23	.00	.00	4.28	.00
06	4.56	3.16	.00	4.94	.00	3.23	.00	.00	4.68	.00
07	4.44	4.61	.00	5.21	.00	10.75	.00	.00	4.54	.00
08	4.27	4.85	.00	4.24	.00	7.53	33.33	.00	4.39	.00
09	4.42	4.37	.00	2.82	.00	1.08	.00	.00	4.52	.00
10	4.90	2.67	.00	6.00	.00	4.30	.00	.00	4.90	.00
11	5.45	6.07	.00	4.06	.00	8.60	.00	.00	5.37	.00
12	4.39	6.07	.00	6.53	.00	12.90	.00	.00	4.51	.00
13	3.66	4.37	.00	5.12	.00	2.15	.00	.00	3.85	.00
14	3.63	3.40	.00	4.15	.00	1.08	.00	.00	3.76	.00
15	3.90	2.18	.00	4.06	.00	.00	.00	.00	4.08	.00
16	3.90	3.40	.00	3.27	.00	6.45	.00	.00	3.93	.00
17	3.97	6.31	.00	3.71	.00	3.23	50.00	.00	4.03	.00
18	3.72	15.05	.00	2.47	.00	2.15	.00	.00	3.77	.00
19	4.29	4.13	.00	5.38	.00	11.83	.00	.00	4.27	.00
20	4.02	1.70	.00	3.88	.00	2.15	.00	.00	3.91	.00
21	4.01	1.70	.00	4.15	.00	1.08	.00	.00	3.82	.00
22	3.74	1.21	.00	4.77	.00	3.23	16.67	.00	3.63	.00
23	3.53	1.46	.00	2.47	.00	1.08	.00	.00	3.36	.00

	VEHICLE TYPES									
	422000	423000	431000	432000	433000	OTHERS	SB-TOT	SB-TOT	SB-TOT	GR-TOT
01 PRIN. ART.-I/R COUNT FOR 12 STATIONS	26	0	0	0	0	1	27	54512	86764	211488
DISTRIBUTION BY PCT.	.01	.00	.00	.00	.00	.00	.01	25.78	41.03	100.00
PCT. OF TOTAL BY HOUR 00	.00	.00	.00	.00	.00	.00	.00	4.14	3.29	2.57
01	.00	.00	.00	.00	.00	.00	.00	4.20	3.33	2.50
02	.00	.00	.00	.00	.00	.00	.00	3.98	3.20	2.38
03	.00	.00	.00	.00	.00	.00	.00	3.70	3.26	2.51
04	.00	.00	.00	.00	.00	.00	.00	4.37	3.74	2.90
05	11.54	.00	.00	.00	.00	100.00	14.81	4.29	3.90	3.19
06	11.54	.00	.00	.00	.00	.00	11.11	4.68	4.91	4.28
07	.00	.00	.00	.00	.00	.00	.00	4.53	4.90	4.94
08	3.85	.00	.00	.00	.00	.00	3.70	4.39	4.74	4.83
09	26.92	.00	.00	.00	.00	.00	25.93	4.53	4.97	5.53
10	3.85	.00	.00	.00	.00	.00	3.70	4.90	5.21	5.77
11	.00	.00	.00	.00	.00	.00	.00	5.37	5.99	6.56
12	.00	.00	.00	.00	.00	.00	.00	4.50	5.46	6.16
13	.00	.00	.00	.00	.00	.00	.00	3.85	4.45	4.97
14	3.85	.00	.00	.00	.00	.00	3.70	3.76	4.50	5.26
15	.00	.00	.00	.00	.00	.00	.00	4.07	4.60	5.29
16	3.85	.00	.00	.00	.00	.00	3.70	3.93	4.61	5.27
17	.00	.00	.00	.00	.00	.00	.00	4.03	4.61	5.72
18	.00	.00	.00	.00	.00	.00	.00	3.76	3.84	4.20
19	.00	.00	.00	.00	.00	.00	.00	4.27	3.96	3.84
20	.00	.00	.00	.00	.00	.00	.00	3.91	3.47	3.37
21	34.62	.00	.00	.00	.00	.00	33.33	3.84	3.27	2.96
22	.00	.00	.00	.00	.00	.00	.00	3.63	3.08	2.76
23	.00	.00	.00	.00	.00	.00	.00	3.36	2.73	2.24

Other Weight Data Analyses

There are many truck weight data relationships that could be useful beyond those covered in the W-Tables. The relationships between the weights by vehicle type and the various interview items, such as load status or commodity carried, could provide valuable information for a specific site or functional classification. Further analysis of individual axle weights and axle spacings could also be of interest.

Because of requests for additional analysis, several tables have been developed to display the information. Each of the tables represents one State's data submittal for 1 year. A representative portion of each table is provided here along with an explanation of its contents.

1. Violations by Vehicle Type and Commodity Group (See pages 5-9-13 through 5-9-19)

   This is a listing of the number of vehicles weighed by the type of commodity carried, vehicle type and functional classification. It also indicates any violation of the weight laws by the type of violation. The violation types are defined as follows:

   a. SA = Single Axle
   b. AG = Axle Group (by Bridge Formula)
   c. GW = Gross Weight
   d. TA = Tandem Axle

   The example listing shows the information for one functional classification.

2. Trucks Exceeding Legal Weight Limits by Vehicle Type at Various Tolerances (See pages 5-9-20 and 5-9-21)

   This summary provides station by station information on the frequency of trucks exceeding the legal gross or axle weight limits for various vehicle types. The distribution of overweight trucks is shown in terms of the percentage of excess. For example, any truck that is overweight will appear under the proper vehicle type in the row titled "00." The "00" indicates that the vehicle is greater than 0 percent overweight. The remaining rows include those trucks that are greater than the indicated percentage overweight. Therefore, a truck that has a gross weight or axle weight that exceeds the legal limit by 10 percent with appear under the appropriate vehicle type in all the rows from "00" to "09."

   The information for each station is printed on two separate pages; one showing the percent tolerances of 00 to 20, and the other showing the percent tolerances of 21 to 100. The example summary shows only the total for all the stations of one state.

Also shown on each table are the total number of trucks weighed at that station and the legal weight limits used to determine if a truck was overweight.

3. Percentages of Axle Weights, Tandem Weights, and Gross Weights Exceeding 50 Weight Categories (See page 5-9-22)

   As indicated by the title, this table contains the percentage of single axle, tandem axle, and gross weights that exceed a particular weight for eight of the most common truck types. The weights range from 0 to 100,000 pounds in 2,000 pound intervals. Also shown are the total number of single axles, tandem groups, and trucks for each vehicle type. The table is normally four pages long with two vehicle types on each page.

4. Count of Loaded (or Unloaded) Axles by Weight Group and Vehicle Type (See pages 5-9-23 through 5-9-26)

   This is a set of two tables with one showing the frequency of loaded axles by weight and the other showing the frequency of unloaded axles by weight. Counts are given for each individual axle of the most common vehicle types. The axle positions are indicated with the following alphabetic codes:

B	=	2nd axle
C	=	3rd axle
D	=	4th axle
E	=	5th axle
F	=	6th axle

   The steering axle is not included in this table since it is relatively unaffected by the presence of a load.

   The weights indicated in the row headings are in thousands of pounds and range from 0 to 30,000 pounds. One axle could appear in more than one row, e.g., a 20,000 pound axle would appear in all the rows from 0 to 20. All of the axles for a particular axle position will appear in the first row since all the weights will be greater than zero.

5. Weight Distribution Summary (See pages 5-9-27 and 5-9-28)

   This summary determines the average gross weight and average axle weights for each vehicle type by each load status. The average weights are also given by specified weight intervals. In addition, within each interval, the number of vehicles in the sample from which the average weights are calculated, the percent of the vehicles of a particular type that are in that interval, and the percent distribution of the axle weights are shown. The example represents this information for one vehicle type.

6. Body Type Analysis (See page 5-9-29)

   This is a listing of the various body types that exist for each vehicle type based on the load status. For each body type in a specific category, average gross and axle weights are shown along with the number of vehicles involved in the calculation of the average weights and the minimum and maximum gross weights of the trucks in this sample. The example shows the information for one vehicle type.

   Each body type indicated in the body type coding instructions in Chapter 6 will appear individually in this table except those represented by the codes 14, 63, 79 and those greater than 88. These codes are grouped into a category called "All Other Types."

7. Average (or Minimum or Maximum) Axle Spacing by Vehicle Type (See pages 5-9-30 through 5-9-32).

   This is a set of three tables of information on axle spacings by vehicle type. One table shows the average axle spacings for a specific sample of vehicles and the other two tables show the minimum or maximum axle spacings found in the same sample.

   The spacings are provided to the tenth of a foot and are shown under the axles between which they were measured in the following manner:

   A-B = Distance between 1st and 2nd axle
   B-C = Distance between 2nd and 3rd axle
   C-D = Distance between 3rd and 4th axle
   .
   .
   .
   K-L = Distance between 11th and 12th axle
   L-M = Distance between 12th and 13th axle

Availability of Data and Technical Assistance from FHWA

Many types of analyses of vehicle classification and truck weight data have been discussed in Chapters 8 and 9, however, there may still be data relationships that were not covered in these tables or that were not displayed in enough detail for a particular State's use. Obviously, analysis of this data is not limited to these specific tables. Other analysis may be performed at the State level and, if necessary, technical assistance is available from the Highway Statistics Division (HSD), FHWA. Also, the HSD maintains a state master file of vehicle classification data and a state master file of truck weight data for every year from 1966 to present. Selected states for selected years may be drawn from the master files for the State's use at the State's request.

VIOLATIONS BY VEHICLE TYPE AND COMMODITY GROUP
1984

FUNCTIONAL CLASS 01 INTERSTATE RURAL

VEHICLE TYPE	# OF VEHICLES WEIGHED	NUMBER WEIGHED THAT WERE IN VIOLATION				PERCENT OF THOSE WEIGHED THAT WERE IN VIOLATION				AVERAGE PERCENT OF EXCESS OVER THE STATE LIMIT FOR THE INTERSTATE SYSTEMS			
		SA	AG	GW	TA	SA	AG	GW	TA	SA	AG	GW	TA
SINGLE UNIT (2AXLE-6TIRE)													
FARM PRODUCTS	22	1	0	0	0	4.5	0.0	0.0	0.0	24.6	0.0	0.0	0.0
COAL/NON-METALLIC MINERALS	2	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD + KINDRED PRODUCTS	75	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LUMBER + WOOD PRODUCTS	16	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM OR COAL PRODUCTS	3	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRIMARY METAL PRODUCTS	7	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MACHINERY	32	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	43	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER COMMODITIES	493	1	0	0	0	0.2	0.0	0.0	0.0	4.0	0.0	0.0	0.0
TOTAL ALL COMMODITIES	693	2	0	0	0	0.3	0.0	0.0	0.0	14.3	0.0	0.0	0.0
SINGLE UNIT (3-AXLE)													
FARM PRODUCTS	5	0	1	0	0	0.0	20.0	0.0	0.0	0.0	32.4	0.0	0.0
COAL/NON METALLIC MINERALS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD + KINDRED PRODUCTS	17	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LUMBER + WOOD PRODUCTS	2	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM OR COAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRIMARY METAL PRODUCTS	2	0	1	0	0	0.0	50.0	0.0	0.0	0.0	10.3	0.0	0.0
MACHINERY	3	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	7	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER COMMODITIES	61	0	4	0	0	0.0	6.6	0.0	0.0	0.0	4.3	0.0	0.0
TOTAL ALL COMMODITIES	97	0	6	0	0	0.0	6.2	0.0	0.0	0.0	10.0	0.0	0.0
SINGLE UNIT (4AX OR MORE)													
FARM PRODUCTS	1	0	1	0	0	0.0	100.0	0.0	0.0	0.0	4.5	0.0	0.0
COAL/NON-METALLIC MINERALS	11	0	8	0	0	0.0	72.7	0.0	0.0	0.0	22.1	0.0	0.0
FOOD + KINDRED PRODUCTS	53	0	8	0	0	0.0	15.1	0.0	0.0	0.0	3.4	0.0	0.0
LUMBER + WOOD PRODUCTS	6	0	2	0	0	0.0	33.3	0.0	0.0	0.0	9.3	0.0	0.0
PETROLEUM OR COAL PRODUCTS	7	0	1	0	0	0.0	14.3	0.0	0.0	0.0	42.9	0.0	0.0
PRIMARY METAL PRODUCTS	16	0	5	0	0	0.0	31.3	0.0	0.0	0.0	4.0	0.0	0.0
MACHINERY	4	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	13	0	1	0	0	0.0	7.7	0.0	0.0	0.0	15.6	0.0	0.0
OTHER COMMODITIES	237	1	24	0	0	0.4	10.1	0.0	0.0	136.6	14.3	0.0	0.0
TOTAL ALL COMMODITIES	348	1	50	0	0	0.3	14.4	0.0	0.0	136.6	13.0	0.0	0.0
SINGLE UNIT (SUBTOTAL)													
FARM PRODUCTS	28	1	2	0	0	3.6	7.1	0.0	0.0	24.6	18.4	0.0	0.0
COAL/NON-METALLIC MINERALS	13	0	8	0	0	0.0	61.5	0.0	0.0	0.0	22.1	0.0	0.0
FOOD + KINDRED PRODUCTS	145	0	8	0	0	0.0	5.5	0.0	0.0	0.0	3.4	0.0	0.0
LUMBER + WOOD PRODUCTS	24	0	2	0	0	0.0	8.3	0.0	0.0	0.0	9.3	0.0	0.0
PETROLEUM OR COAL PRODUCTS	10	0	1	0	0	0.0	10.0	0.0	0.0	0.0	42.9	0.0	0.0
PRIMARY METAL PRODUCTS	25	0	6	0	0	0.0	24.0	0.0	0.0	0.0	5.0	0.0	0.0
MACHINERY	39	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	63	0	1	0	0	0.0	1.6	0.0	0.0	0.0	15.6	0.0	0.0
OTHER COMMODITIES	791	2	28	0	0	0.3	3.5	0.0	0.0	70.3	12.9	0.0	0.0
TOTAL ALL COMMODITIES	1,138	3	56	0	0	0.3	4.9	0.0	0.0	55.0	12.6	0.0	0.0

NOTE: FOR ALL VEHICLES HAVING MULTIPLE VIOLATIONS, ONLY THE VIOLATION WITH THE HIGHEST PERCENTAGE OF EXCESS WAS TABULATED. ALSO FROM THE DATA COLLECTED, IT WAS NOT POSSIBLE TO DETERMINE IF ANY OF THE VEHICLES IN EXCESS WERE OPERATING UNDER SPECIAL PERMIT.

VIOLATIONS BY VEHICLE TYPE AND COMMODITY GROUP
1984

FUNCTIONAL CLASS 01 INTERSTATE RURAL

VEHICLE TYPE	# OF VEHICLES WEIGHED	NUMBER WEIGHED THAT WERE IN VIOLATION				PERCENT OF THOSE WEIGHED THAT WERE IN VIOLATION				AVERAGE PERCENT OF EXCESS OVER THE STATE LIMIT FOR THE INTERSTATE SYSTEMS			
		SA	AG	GW	TA	SA	AG	GW	TA	SA	AG	GW	TA
TRACTOR + 1 TRLR (321000)													
FARM PRODUCTS	2	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COAL/NON-METALLIC MINERALS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD + KINDRED PRODUCTS	6	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LUMBER + WOOD PRODUCTS	1	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM OR COAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRIMARY METAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MACHINERY	2	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	8	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER COMMODITIES	81	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL ALL COMMODITIES	100	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRACTOR + 1 TRLR (322000)													
FARM PRODUCTS	2	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COAL/NON METALLIC MINERALS	1	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD + KINDRED PRODUCTS	27	1	0	0	0	3.7	0.0	0.0	0.0	1.8	0.0	0.0	0.0
LUMBER + WOOD PRODUCTS	7	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM OR COAL PRODUCTS	1	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRIMARY METAL PRODUCTS	6	1	0	0	0	16.7	0.0	0.0	0.0	3.1	0.0	0.0	0.0
MACHINERY	15	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	47	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER COMMODITIES	240	1	2	0	0	0.4	0.8	0.0	0.0	3.6	8.1	0.0	0.0
TOTAL ALL COMMODITIES	346	3	2	0	0	0.9	0.6	0.0	0.0	2.8	8.1	0.0	0.0
TRACTOR + 1 TRLR (323000)													
FARM PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COAL/NON-METALLIC MINERALS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD + KINDRED PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LUMBER + WOOD PRODUCTS	1	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM OR COAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRIMARY METAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MACHINERY	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	1	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER COMMODITIES	8	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL ALL COMMODITIES	10	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRACTOR + 1 TRLR (331000)													
FARM PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COAL/NON-METALLIC MINERALS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD + KINDRED PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LUMBER + WOOD PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM OR COAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRIMARY METAL PRODUCTS	1	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MACHINERY	1	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER COMMODITIES	4	0	1	0	0	0.0	25.0	0.0	0.0	0.0	10.7	0.0	0.0
TOTAL ALL COMMODITIES	6	0	1	0	0	0.0	16.7	0.0	0.0	0.0	10.7	0.0	0.0

NOTE: FOR ALL VEHICLES HAVING MULTIPLE VIOLATIONS, ONLY THE VIOLATION WITH THE HIGHEST PERCENTAGE OF EXCESS WAS TABULATED. ALSO FROM THE DATA COLLECTED, IT WAS NOT POSSIBLE TO DETERMINE IF ANY OF THE VEHICLES IN EXCESS WERE OPERATING UNDER SPECIAL PERMIT.

VIOLATIONS BY VEHICLE TYPE AND COMMODITY GROUP
1984

FUNCTIONAL CLASS 01 INTERSTATE RURAL

VEHICLE TYPE	# OF VEHICLES WEIGHED	NUMBER WEIGHED THAT WERE IN VIOLATION				PERCENT OF THOSE WEIGHED THAT WERE IN VIOLATION				AVERAGE PERCENT OF EXCESS OVER THE STATE LIMIT FOR THE INTERSTATE SYSTEMS			
		SA	AG	GW	TA	SA	AG	GW	TA	SA	AG	GW	TA
TRACTOR + 1 TRLR (332000)													
FARM PRODUCTS	110	0	10	0	0	0.0	9.1	0.0	0.0	0.0	9.4	0.0	0.0
COAL/NON-METALLIC MINERALS	49	0	19	0	0	0.0	38.8	0.0	0.0	0.0	6.1	0.0	0.0
FOOD + KINDRED PRODUCTS	564	4	59	0	0	0.7	10.5	0.0	0.0	9.0	10.0	0.0	0.0
LUMBER + WOOD PRODUCTS	120	1	8	0	1	0.8	6.7	0.0	0.8	52.7	14.5	0.0	2.2
PETROLEUM OR COAL PRODUCTS	47	0	8	0	0	0.0	17.0	0.0	0.0	0.0	6.1	0.0	0.0
PRIMARY METAL PRODUCTS	279	2	45	0	0	0.7	16.1	0.0	0.0	4.2	10.3	0.0	0.0
MACHINERY	184	0	13	0	0	0.0	7.1	0.0	0.0	0.0	9.3	0.0	0.0
MIXED FREIGHT (ALL KINDS)	353	0	24	0	0	0.0	6.8	0.0	0.0	0.0	6.1	0.0	0.0
OTHER COMMODITIES	3,018	4	176	0	1	0.1	5.8	0.0	0.0	122.7	10.5	0.0	2.8
TOTAL ALL COMMODITIES	4,724	11	362	0	2	0.2	7.7	0.0	0.0	53.4	9.8	0.0	2.5
TRACTOR + 1 TRLR (333000)													
FARM PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COAL/NON-METALLIC MINERALS	5	0	1	0	0	0.0	20.0	0.0	0.0	0.0	3.8	0.0	0.0
FOOD + KINDRED PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LUMBER + WOOD PRODUCTS	1	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM OR COAL PRODUCTS	1	0	1	0	0	0.0	100.0	0.0	0.0	0.0	3.5	0.0	0.0
PRIMARY METAL PRODUCTS	5	0	3	0	0	0.0	60.0	0.0	0.0	0.0	17.6	0.0	0.0
MACHINERY	7	0	3	0	0	0.0	42.9	0.0	0.0	0.0	22.9	0.0	0.0
MIXED FREIGHT (ALL KINDS)	4	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER COMMODITIES	25	0	4	0	0	0.0	16.0	0.0	0.0	0.0	15.3	0.0	0.0
TOTAL ALL COMMODITIES	48	0	12	0	0	0.0	25.0	0.0	0.0	0.0	15.8	0.0	0.0
TRACTOR + 1 TRLR (OTHERS)													
FARM PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COAL/NON-METALLIC MINERALS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD + KINDRED PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LUMBER + WOOD PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM OR COAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRIMARY METAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MACHINERY	1	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER COMMODITIES	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL ALL COMMODITIES	1	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRACTOR + 1 TRLR(SUBTOTAL)													
FARM PRODUCTS	114	0	10	0	0	0.0	8.8	0.0	0.0	0.0	9.4	0.0	0.0
COAL/NON-METALLIC MINERALS	55	0	20	0	0	0.0	36.4	0.0	0.0	0.0	6.0	0.0	0.0
FOOD + KINDRED PRODUCTS	597	5	59	0	0	0.8	9.9	0.0	0.0	7.5	10.0	0.0	0.0
LUMBER + WOOD PRODUCTS	130	1	8	0	1	0.8	6.2	0.0	0.8	52.7	14.5	0.0	2.2
PETROLEUM OR COAL PRODUCTS	49	0	9	0	0	0.0	18.4	0.0	0.0	0.0	5.8	0.0	0.0
PRIMARY METAL PRODUCTS	291	3	48	0	0	1.0	16.5	0.0	0.0	3.8	10.7	0.0	0.0
MACHINERY	210	0	16	0	0	0.0	7.6	0.0	0.0	0.0	11.9	0.0	0.0
MIXED FREIGHT (ALL KINDS)	413	0	24	0	0	0.0	5.8	0.0	0.0	0.0	6.1	0.0	0.0
OTHER COMMODITIES	3,376	5	183	0	1	0.1	5.4	0.0	0.0	98.9	10.6	0.0	2.8
TOTAL ALL COMMODITIES	5,235	14	377	0	2	0.3	7.2	0.0	0.0	42.6	10.0	0.0	2.5

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VIOLATIONS BY VEHICLE TYPE AND COMMODITY GROUP
1984

FUNCTIONAL CLASS 01 INTERSTATE RURAL

VEHICLE TYPE	# OF VEHICLES WEIGHED	NUMBER WEIGHED THAT WERE IN VIOLATION				PERCENT OF THOSE WEIGHED THAT WERE IN VIOLATION				AVERAGE PERCENT OF EXCESS OVER THE STATE LIMIT FOR THE INTERSTATE SYSTEMS			
		SA	AG	GW	TA	SA	AG	GW	TA	SA	AG	GW	TA
TRUCK + 1 TRLR (421000)													
FARM PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COAL/NON-METALLIC MINERALS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD + KINDRED PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LUMBER + WOOD PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM OR COAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRIMARY METAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MACHINERY	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER COMMODITIES	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL ALL COMMODITIES	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRUCK + 1 TRLR (422000)													
FARM PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COAL/NON-METALLIC MINERALS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD + KINDRED PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LUMBER + WOOD PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM OR COAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRIMARY METAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MACHINERY	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER COMMODITIES	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL ALL COMMODITIES	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRUCK + 1 TRLR (423000)													
FARM PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COAL/NON-METALLIC MINERALS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD + KINDRED PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LUMBER + WOOD PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM OR COAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRIMARY METAL PRODUCTS	1	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MACHINERY	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER COMMODITIES	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL ALL COMMODITIES	1	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRUCK + 1 TRLR (431000)													
FARM PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COAL/NON-METALLIC MINERALS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD + KINDRED PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LUMBER + WOOD PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM OR COAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRIMARY METAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MACHINERY	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER COMMODITIES	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL ALL COMMODITIES	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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VIOLATIONS BY VEHICLE TYPE AND COMMODITY GROUP
1984

FUNCTIONAL CLASS 01 INTERSTATE RURAL

VEHICLE TYPE	# OF VEHICLES WEIGHED	NUMBER WEIGHED THAT WERE IN VIOLATION				PERCENT OF THOSE WEIGHED THAT WERE IN VIOLATION				AVERAGE PERCENT OF EXCESS OVER THE STATE LIMIT FOR THE INTERSTATE SYSTEMS			
		SA	AG	GW	TA	SA	AG	GW	TA	SA	AG	GW	TA
TRUCK + 1 TRLR (432000)													
FARM PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COAL/NON-METALLIC MINERALS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD + KINDRED PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LUMBER + WOOD PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM OR COAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRIMARY METAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MACHINERY	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER COMMODITIES	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL ALL COMMODITIES	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRUCK + 1 TRLR (433000)													
FARM PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COAL/NON-METALLIC MINERALS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD + KINDRED PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LUMBER + WOOD PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM OR COAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRIMARY METAL PRODUCTS	1	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MACHINERY	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER COMMODITIES	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL ALL COMMODITIES	1	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRUCK + 1 TRLR (OTHERS)													
FARM PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COAL/NON-METALLIC MINERALS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD + KINDRED PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LUMBER + WOOD PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM OR COAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRIMARY METAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MACHINERY	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER COMMODITIES	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL ALL COMMODITIES	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRUCK + 1 TRLR (SUBTOTAL)													
FARM PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COAL/NON-METALLIC MINERALS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD + KINDRED PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LUMBER + WOOD PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM OR COAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRIMARY METAL PRODUCTS	2	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MACHINERY	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER COMMODITIES	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL ALL COMMODITIES	2	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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VIOLATIONS BY VEHICLE TYPE AND COMMODITY GROUP
1984

FUNCTIONAL CLASS 01 INTERSTATE RURAL

VEHICLE TYPE	# OF VEHICLES WEIGHED	NUMBER WEIGHED THAT WERE IN VIOLATION				PERCENT OF THOSE WEIGHED THAT WERE IN VIOLATION				AVERAGE PERCENT OF EXCESS OVER THE STATE LIMIT FOR THE INTERSTATE SYSTEMS			
		SA	AG	GW	TA	SA	AG	GW	TA	SA	AG	GW	TA
TRACTOR + 2 TRLRS (521200)													
FARM PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COAL/NON-METALLIC MINERALS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD + KINDRED PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LUMBER + WOOD PRODUCTS	1	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM OR COAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRIMARY METAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MACHINERY	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	33	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER COMMODITIES	87	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL ALL COMMODITIES	121	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRACTOR + 2 TRLRS (522200)													
FARM PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COAL/NON-METALLIC MINERALS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD + KINDRED PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LUMBER + WOOD PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM OR COAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRIMARY METAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MACHINERY	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER COMMODITIES	1	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL ALL COMMODITIES	1	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TRACTOR + 2 TRLRS (531200)													
FARM PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COAL/NON-METALLIC MINERALS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD + KINDRED PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LUMBER + WOOD PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM OR COAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRIMARY METAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MACHINERY	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	3	1	0	0	0	33.3	0.0	0.0	0.0	4.5	0.0	0.0	0.0
OTHER COMMODITIES	14	0	1	0	0	0.0	7.1	0.0	0.0	0.0	0.1	0.0	0.0
TOTAL ALL COMMODITIES	17	1	1	0	0	5.9	5.9	0.0	0.0	4.5	0.1	0.0	0.0
TRACTOR + 2 TRLRS (OTHERS)													
FARM PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COAL/NON-METALLIC MINERALS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD + KINDRED PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LUMBER + WOOD PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM OR COAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRIMARY METAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MACHINERY	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER COMMODITIES	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL ALL COMMODITIES	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

NOTE: FOR ALL VEHICLES HAVING MULTIPLE VIOLATIONS, ONLY THE VIOLATION WITH THE HIGHEST PERCENTAGE OF EXCESS WAS TABULATED. ALSO FROM THE DATA COLLECTED, IT WAS NOT POSSIBLE TO DETERMINE IF ANY OF THE VEHICLES IN EXCESS WERE OPERATING UNDER SPECIAL PERMIT.

VIOLATIONS BY VEHICLE TYPE AND COMMODITY GROUP

1984

FUNCTIONAL CLASS 01 INTERSTATE RURAL

VEHICLE TYPE	# OF VEHICLES WEIGHED	NUMBER WEIGHED THAT WERE IN VIOLATION				PERCENT OF THOSE WEIGHED THAT WERE IN VIOLATION				AVERAGE PERCENT OF EXCESS OVER THE STATE LIMIT FOR THE INTERSTATE SYSTEMS			
		SA	AG	GW	TA	SA	AG	GW	TA	SA	AG	GW	TA
TRACTOR +2 TRLRS(SUBTOTAL)													
FARM PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COAL/NON-METALLIC MINERALS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD + KINDRED PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LUMBER + WOOD PRODUCTS	1	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM OR COAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRIMARY METAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MACHINERY	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	36	1	0	0	0	2.8	0.0	0.0	0.0	4.5	0.0	0.0	0.0
OTHER COMMODITIES	102	0	1	0	0	0.0	1.0	0.0	0.0	0.0	0.1	0.0	0.0
TOTAL ALL COMMODITIES	139	1	1	0	0	0.7	0.7	0.0	0.0	4.5	0.1	0.0	0.0
OTHER COMBINATIONS													
FARM PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COAL/NON-METALLIC MINERALS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD + KINDRED PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LUMBER + WOOD PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM OR COAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRIMARY METAL PRODUCTS	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MACHINERY	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIXED FREIGHT (ALL KINDS)	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER COMMODITIES	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL ALL COMMODITIES	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL ALL COMBINATIONS													
FARM PRODUCTS	114	0	10	0	0	0.0	8.8	0.0	0.0	0.0	9.4	0.0	0.0
COAL/NON-METALLIC MINERALS	55	0	20	0	0	0.0	36.4	0.0	0.0	0.0	6.0	0.0	0.0
FOOD + KINDRED PRODUCTS	597	5	59	0	0	0.8	9.9	0.0	0.0	7.5	10.0	0.0	0.0
LUMBER + WOOD PRODUCTS	131	1	8	0	1	0.8	6.1	0.0	0.8	52.7	14.5	0.0	2.2
PETROLEUM OR COAL PRODUCTS	49	0	9	0	0	0.0	18.4	0.0	0.0	0.0	5.8	0.0	0.0
PRIMARY METAL PRODUCTS	293	3	48	0	0	1.0	16.4	0.0	0.0	3.8	10.7	0.0	0.0
MACHINERY	210	0	16	0	0	0.0	7.6	0.0	0.0	0.0	11.9	0.0	0.0
MIXED FREIGHT (ALL KINDS)	449	1	24	0	0	0.2	5.3	0.0	0.0	4.5	6.1	0.0	0.0
OTHER COMMODITIES	3,478	5	184	0	1	0.1	5.3	0.0	0.0	98.9	10.5	0.0	2.8
TOTAL ALL COMMODITIES	5,376	15	378	0	2	0.3	7.0	0.0	0.0	40.0	9.9	0.0	2.5
GRAND TOTAL ALL TYPES													
FARM PRODUCTS	142	1	12	0	0	0.7	8.5	0.0	0.0	24.6	10.9	0.0	0.0
COAL/NON-METALLIC MINERALS	68	0	28	0	0	0.0	41.2	0.0	0.0	0.0	10.6	0.0	0.0
FOOD + KINDRED PRODUCTS	742	5	67	0	0	0.7	9.0	0.0	0.0	7.5	9.2	0.0	0.0
LUMBER + WOOD PRODUCTS	155	1	10	0	1	0.6	6.5	0.0	0.6	52.7	13.5	0.0	2.2
PETROLEUM OR COAL PRODUCTS	59	0	10	0	0	0.0	16.9	0.0	0.0	0.0	9.5	0.0	0.0
PRIMARY METAL PRODUCTS	318	3	54	0	0	0.9	17.0	0.0	0.0	3.8	10.1	0.0	0.0
MACHINERY	249	0	16	0	0	0.0	6.4	0.0	0.0	0.0	11.9	0.0	0.0
MIXED FREIGHT (ALL KINDS)	512	1	25	0	0	0.2	4.9	0.0	0.0	4.5	6.5	0.0	0.0
OTHER COMMODITIES	4,269	7	212	0	1	0.2	5.0	0.0	0.0	90.7	10.8	0.0	2.8
TOTAL ALL COMMODITIES	6,514	18	434	0	2	0.3	6.7	0.0	0.0	42.5	10.3	0.0	2.5

NOTE: FOR ALL VEHICLES HAVING MULTIPLE VIOLATIONS, ONLY THE VIOLATION WITH THE HIGHEST PERCENTAGE OF EXCESS WAS TABULATED. ALSO FROM THE DATA COLLECTED, IT WAS NOT POSSIBLE TO DETERMINE IF ANY OF THE VEHICLES IN EXCESS WERE OPERATING UNDER SPECIAL PERMIT.

TRUCKS EXCEEDING LEGAL WEIGHT LIMITS BY VEHICLE TYPE AT VARIOUS TOLERANCES

STATION ALL

1984 DATA FROM
THE ANNUAL TRUCK WEIGHT STUDY

		SINGLE UNIT TRUCKS					TRACTOR-SEMI-TRAILER COMB.				TRUCK-FULL-TRAILER COMB.			
PCT. TOL.	TOTAL TRUCKS	2 AXLE 4 TIRE	2 AXLE 6 TIRE	THREE AXLES	4 AXLES OR >	SU WITH TRLR	THREE AXLES	FOUR AXLES	FIVE AXLES	6 AXLES OR >	THREE AXLES	FOUR AXLES	FIVE AXLES	6 AXLES OR >
00	278	0	15	6	57	7	0	10	165	18	0	0	0	0
01	247	0	12	5	55	6	0	9	145	15	0	0	0	0
02	218	0	11	2	54	4	0	8	125	14	0	0	0	0
03	196	0	9	2	50	2	0	7	112	14	0	0	0	0
04	175	0	7	1	49	2	0	5	99	12	0	0	0	0
05	157	0	6	1	49	1	0	4	85	11	0	0	0	0
06	136	0	6	1	46	1	0	3	68	11	0	0	0	0
07	123	0	6	1	46	1	0	3	56	10	0	0	0	0
08	110	0	5	1	44	1	0	3	47	9	0	0	0	0
09	104	0	4	1	44	1	0	3	42	9	0	0	0	0
10	93	0	4	1	42	1	0	3	36	6	0	0	0	0
11	82	0	4	1	41	1	0	2	28	5	0	0	0	0
12	75	0	4	1	39	1	0	2	23	5	0	0	0	0
13	71	0	4	1	37	1	0	2	21	5	0	0	0	0
14	69	0	4	1	36	1	0	2	20	5	0	0	0	0
15	66	0	4	1	35	1	0	1	19	5	0	0	0	0
16	63	0	4	1	34	1	0	0	18	5	0	0	0	0
17	62	0	4	1	34	1	0	0	17	5	0	0	0	0
18	60	0	3	1	34	1	0	0	17	4	0	0	0	0
19	56	0	3	1	31	1	0	0	16	4	0	0	0	0
20	55	0	3	1	31	1	0	0	16	3	0	0	0	0

TOTAL NUMBER OF TRUCKS SAMPLED: 11,794

LEGAL LIMITS USED:
2 AXLE SINGLE UNIT TRUCKS- 44,800 #
3 AXLE OR MORE S-U TRUCKS- 58,400 #
3 AXLE COMBINATION TRUCKS- 67,200 #
4 AXLE COMBINATION TRUCKS- 73,300 #
5 AXLE COMBINATION TRUCKS- 80,000 #
OTHER COMBINATION TRUCKS- 80,000 #

INDIVIDUAL AXLE LIMIT- 22,400 #

5-9-20

TRUCKS EXCEEDING LEGAL WEIGHT LIMITS BY VEHICLE TYPE AT VARIOUS TOLERANCES

STATION ALL

1984 DATA FROM
THE ANNUAL TRUCK WEIGHT STUDY

		SINGLE UNIT TRUCKS					TRACTOR-SEMI-TRAILER COMB.				TRUCK-FULL-TRAILER COMB.			
PCT. TOL.	TOTAL TRUCKS	2 AXLE 4 TIRE	2 AXLE 6 TIRE	THREE AXLES	4 AXLES OR >	SU WITH TRLR	THREE AXLES	FOUR AXLES	FIVE AXLES	6 AXLES OR >	THREE AXLES	FOUR AXLES	FIVE AXLES	6 AXLES OR >
21	47	0	2	0	29	1	0	0	12	3	0	0	0	0
22	41	0	2	0	25	1	0	0	11	2	0	0	0	0
23	38	0	2	0	23	1	0	0	11	1	0	0	0	0
24	31	0	1	0	18	1	0	0	10	1	0	0	0	0
25	28	0	0	0	16	1	0	0	10	1	0	0	0	0
26	24	0	0	0	13	1	0	0	9	1	0	0	0	0
27	23	0	0	0	12	1	0	0	9	1	0	0	0	0
28	22	0	0	0	12	1	0	0	8	1	0	0	0	0
29	17	0	0	0	8	1	0	0	8	0	0	0	0	0
30	16	0	0	0	7	1	0	0	8	0	0	0	0	0
35	12	0	0	0	4	1	0	0	7	0	0	0	0	0
40	9	0	0	0	1	1	0	0	7	0	0	0	0	0
45	8	0	0	0	1	1	0	0	6	0	0	0	0	0
50	8	0	0	0	1	1	0	0	6	0	0	0	0	0
55	7	0	0	0	1	1	0	0	5	0	0	0	0	0
60	7	0	0	0	1	1	0	0	5	0	0	0	0	0
65	6	0	0	0	1	1	0	0	4	0	0	0	0	0
70	6	0	0	0	1	1	0	0	4	0	0	0	0	0
75	5	0	0	0	1	1	0	0	3	0	0	0	0	0
80	5	0	0	0	1	1	0	0	3	0	0	0	0	0
100	4	0	0	0	0	1	0	0	3	0	0	0	0	0

TOTAL NUMBER OF TRUCKS SAMPLED: 11,794

LEGAL LIMITS USED:
2 AXLE SINGLE UNIT TRUCKS- 44,800 #
3 AXLE OR MORE S-U TRUCKS- 58,400 #
3 AXLE COMBINATION TRUCKS- 67,200 #
4 AXLE COMBINATION TRUCKS- 73,300 #
5 AXLE COMBINATION TRUCKS- 80,000 #
OTHER COMBINATION TRUCKS- 80,000 #

INDIVIDUAL AXLE LIMIT- 22,400 #

DATA YEAR: 1984

PERCENTAGE OF AXLE WEIGHTS, TANDEM WEIGHTS, AND GROSS WEIGHTS EXCEEDING 50 WEIGHT CATEGORIES.

	VEHICLE TYPE: 332000			VEHICLE TYPE: 337000		
WEIGHT IN POUNDS	PERCENT OF AXLE WEIGHTS EXCEEDING	PERCENT OF TANDEM WEIGHTS EXCEEDING	PERCENT OF GROSS WEIGHTS EXCEEDING	PERCENT OF AXLE WEIGHTS EXCEEDING	PERCENT OF TANDEM WEIGHTS EXCEEDING	PERCENT OF GROSS WEIGHTS EXCEEDING
0	100.00	100.00	100.00			
2,000	99.70	100.00	100.00			
4,000	94.92	99.96	100.00			
6,000	80.90	99.44	100.00			
8,000	65.33	95.37	100.00			
10,000	46.38	87.42	100.00			
12,000	31.56	78.80	100.00			
14,000	20.87	70.16	100.00			
16,000	9.59	63.26	100.00			
18,000	2.79	56.68	99.97			
20,000	0.79	50.39	99.92			
22,000	0.24	44.25	99.59			
24,000	0.09	38.36	98.44			
26,000	0.05	32.18	96.57			
28,000	0.03	24.86	92.82			
30,000	0.03	16.99	86.92			
32,000	0.02	9.74	80.91			
34,000	0.02	4.66	76.06			
36,000	0.02	2.22	72.05			
38,000	0.02	1.04	68.56			
40,000	0.02	0.52	65.16			
42,000	0.02	0.35	62.03			
44,000	0.02	0.20	58.86			
46,000	0.02	0.11	55.42			
48,000	0.01	0.07	52.36			
50,000	0.01	0.05	49.61			
52,000	0.01	0.05	46.72			
54,000	0.01	0.04	43.96			
56,000	0.01	0.03	40.95			
58,000	0.01	0.03	37.90			
60,000	0.01	0.03	34.82			
62,000	0.01	0.03	31.84			
64,000	0.01	0.03	28.08			
66,000	0.01	0.02	24.61			
68,000	0.00	0.02	20.68			
70,000	0.00	0.02	16.23			
72,000	0.00	0.02	12.13			
74,000	0.00	0.02	8.54			
76,000	0.00	0.02	5.33			
78,000	0.00	0.02	3.33			
80,000	0.00	0.02	1.82			
82,000	0.00	0.02	1.19			
84,000	0.00	0.02	0.80			
86,000	0.00	0.02	0.42			
88,000	0.00	0.02	0.22			
90,000	0.00	0.02	0.15			
92,000	0.00	0.02	0.12			
94,000	0.00	0.02	0.11			
96,000	0.00	0.01	0.09			
98,000	0.00	0.01	0.04			
100,000	0.00	0.01	0.04			

TOTAL NUMBER IN SAMPLE:
36,900 SINGLE AXLES   14,760 TANDEM GROUPS   7,380 TRUCKS   0 SINGLE AXLES   0 TANDEM GROUPS   0 TRUCKS

1 9 8 4 COUNT OF LOADED AXLES BY WEIGHT GROUP AND VEHICLE TYPE

VEHICLE TYPES AND AXLE POSITIONS

AXLES> OR = (IN K)	220000	230000		240000			321000		322000			323000				331000		
	B	B	C	B	C	D	B	C	B	C	D	B	C	D	E	B	C	D
0	0	0	0	0	0	0	123	123	552	552	552	30	30	30	30	14	14	14
1	0	0	0	0	0	0	123	123	552	551	552	30	30	30	30	14	14	14
2	0	0	0	0	0	0	123	123	552	550	551	30	30	30	30	14	14	14
3	0	0	0	0	0	0	123	123	551	545	542	27	30	30	30	14	14	14
4	0	0	0	0	0	0	122	123	549	516	513	27	30	30	30	14	13	13
5	0	0	0	0	0	0	121	111	541	470	460	27	29	30	30	12	12	13
6	0	0	0	0	0	0	119	103	528	397	379	27	29	28	29	11	10	13
7	0	0	0	0	0	0	115	86	506	311	296	27	28	27	26	9	8	11
8	0	0	0	0	0	0	99	72	483	231	232	27	25	27	26	6	8	10
9	0	0	0	0	0	0	86	55	440	163	168	27	21	24	24	4	6	6
10	0	0	0	0	0	0	74	42	400	109	112	27	19	20	21	3	5	5
11	0	0	0	0	0	0	58	32	339	72	77	27	18	17	16	2	2	5
12	0	0	0	0	0	0	45	22	289	46	52	25	15	9	12	0	2	2
13	0	0	0	0	0	0	38	14	245	35	32	23	14	6	11	0	2	1
14	0	0	0	0	0	0	26	9	194	19	22	19	10	4	6	0	1	0
15	0	0	0	0	0	0	22	8	142	15	18	17	5	2	5	0	1	0
16	0	0	0	0	0	0	14	5	93	10	9	16	4	1	2	0	1	0
17	0	0	0	0	0	0	11	3	72	8	9	15	2	0	1	0	1	0
18	0	0	0	0	0	0	7	3	50	5	6	12	2	0	0	0	1	0
19	0	0	0	0	0	0	5	1	35	2	5	10	0	0	0	0	1	0
20	0	0	0	0	0	0	3	0	28	0	3	8	0	0	0	0	1	0
21	0	0	0	0	0	0	2	0	17	0	2	3	0	0	0	0	1	0
22	0	0	0	0	0	0	0	0	12	0	0	3	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	8	0	0	3	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	2	0	0	3	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	123	123	552	552	552	30	30	30	30	14	14	14

AXLES> OR = (IN K)	332000				333000					521200				432000			
	B	C	D	E	B	C	D	E	F	B	C	D	E	B	C	D	E
0	5,297	5,297	5,297	5,297	60	60	60	60	60	132	132	132	132	2	2	2	2
1	5,293	5,296	5,296	5,297	60	59	59	60	60	132	132	132	132	2	2	2	2
2	5,288	5,294	5,291	5,293	60	59	59	60	60	132	132	132	131	2	2	2	2
3	5,279	5,284	5,267	5,263	60	59	59	60	60	131	132	131	131	2	2	2	2
4	5,247	5,257	5,188	5,189	60	59	58	60	60	130	130	130	131	2	2	2	2
5	5,162	5,178	5,005	5,003	60	58	58	59	59	129	126	126	123	2	2	2	2
6	5,054	5,041	4,783	4,809	59	57	56	54	57	126	122	120	119	2	2	2	2
7	4,802	4,822	4,463	4,456	57	57	49	51	55	124	119	116	111	2	2	2	2
8	4,510	4,548	4,176	4,144	54	54	44	49	51	119	118	112	107	2	2	2	2
9	4,101	4,149	3,833	3,790	52	51	41	48	46	117	115	100	96	2	2	1	2
10	3,673	3,768	3,453	3,419	51	48	35	42	44	114	106	89	82	2	2	1	2
11	3,220	3,385	3,017	3,063	45	45	29	35	38	106	96	68	70	2	2	1	1
12	2,805	2,987	2,661	2,692	37	43	22	29	33	96	83	55	61	2	2	1	1
13	2,388	2,596	2,296	2,330	35	36	18	23	28	88	77	43	47	2	2	1	1
14	1,877	2,078	1,868	1,926	30	29	13	19	21	77	70	33	29	1	2	0	0
15	1,386	1,520	1,367	1,418	22	20	11	15	15	63	53	22	16	1	1	0	0
16	826	949	900	951	17	15	8	10	9	40	41	14	7	1	1	0	0
17	425	482	533	597	8	10	7	5	7	29	25	8	5	1	1	0	0
18	206	231	285	330	3	5	4	3	5	16	13	3	1	1	1	0	0
19	94	108	161	173	2	1	2	2	4	10	8	1	0	1	1	0	0
20	54	60	92	99	0	0	0	2	3	4	4	0	0	1	0	0	0
21	30	27	59	52	0	0	0	1	2	2	2	0	0	0	0	0	0
22	13	11	32	32	0	0	0	0	2	0	0	0	0	0	0	0	0
23	12	8	14	22	0	0	0	0	2	0	0	0	0	0	0	0	0
24	8	4	8	14	0	0	0	0	1	0	0	0	0	0	0	0	0
25	5	3	5	9	0	0	0	0	0	0	0	0	0	0	0	0	0
26	4	3	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0
27	4	2	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
28	4	2	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0
29	3	2	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0
30	3	2	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	5,297	5,297	5,297	5,297	60	60	60	60	60	132	132	132	132	2	2	2	2

1984 COUNT OF UNLOADED AXLES BY WEIGHT GROUP AND VEHICLE TYPE

VEHICLE TYPES AND AXLE POSITIONS

AXLES> OR = (IN K)	220000 B	230000 B	230000 C	240000 B	240000 C	240000 D	321000 B	321000 C	322000 B	322000 C	322000 D	323000 B	323000 C	323000 D	323000 E	331000 B	331000 C	331000 D
0	0	0	0	0	0	0	72	72	230	230	230	15	15	15	15	5	5	5
1	0	0	0	0	0	0	72	72	230	229	230	15	11	15	15	5	4	5
2	0	0	0	0	0	0	72	72	230	227	229	15	11	15	13	5	4	5
3	0	0	0	0	0	0	71	71	229	219	219	15	8	13	13	5	4	5
4	0	0	0	0	0	0	71	67	228	190	183	15	6	8	9	5	3	5
5	0	0	0	0	0	0	70	58	222	124	116	14	5	5	6	5	3	5
6	0	0	0	0	0	0	66	45	207	71	62	14	3	2	3	3	2	5
7	0	0	0	0	0	0	56	32	186	42	32	14	2	1	3	2	2	5
8	0	0	0	0	0	0	37	21	146	29	19	11	2	0	2	2	1	4
9	0	0	0	0	0	0	24	11	94	16	14	5	2	0	1	1	1	2
10	0	0	0	0	0	0	13	2	50	9	6	2	0	0	0	0	0	1
11	0	0	0	0	0	0	3	0	30	4	6	1	0	0	0	0	0	1
12	0	0	0	0	0	0	1	0	15	2	5	1	0	0	0	0	0	1
13	0	0	0	0	0	0	1	0	9	2	4	1	0	0	0	0	0	1
14	0	0	0	0	0	0	1	0	3	0	3	1	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	72	72	230	230	230	15	15	15	15	5	5	5

AXLES> OR = (IN K)	332000 B	332000 C	332000 D	332000 E	333000 B	333000 C	333000 D	333000 E	333000 F	521200 B	521200 C	521200 D	521200 E	432000 B	432000 C	432000 D	432000 E
0	2,083	2,083	2,083	2,083	27	27	27	27	27	4	4	4	4	0	0	0	0
1	2,056	2,074	2,080	2,079	27	27	21	25	27	4	4	4	4	0	0	0	0
2	2,053	2,070	2,065	2,067	27	27	21	25	27	4	4	4	4	0	0	0	0
3	2,035	2,049	1,936	1,990	27	27	19	22	26	4	4	3	4	0	0	0	0
4	1,970	1,994	1,483	1,582	27	27	11	14	21	4	4	3	4	0	0	0	0
5	1,798	1,793	844	862	25	25	8	11	11	4	2	3	2	0	0	0	0
6	1,378	1,248	458	478	20	22	5	7	8	2	0	0	1	0	0	0	0
7	758	655	297	269	10	9	3	5	3	1	0	0	0	0	0	0	0
8	448	365	200	185	4	3	3	2	2	0	0	0	0	0	0	0	0
9	266	212	132	118	1	1	1	2	1	0	0	0	0	0	0	0	0
10	161	147	91	86	1	1	1	1	0	0	0	0	0	0	0	0	0
11	79	81	67	67	1	1	0	0	0	0	0	0	0	0	0	0	0
12	62	61	53	50	1	1	0	0	0	0	0	0	0	0	0	0	0
13	46	51	40	34	1	0	0	0	0	0	0	0	0	0	0	0	0
14	34	39	33	24	0	0	0	0	0	0	0	0	0	0	0	0	0
15	26	27	27	20	0	0	0	0	0	0	0	0	0	0	0	0	0
16	19	17	16	8	0	0	0	0	0	0	0	0	0	0	0	0	0
17	16	12	14	6	0	0	0	0	0	0	0	0	0	0	0	0	0
18	6	8	11	3	0	0	0	0	0	0	0	0	0	0	0	0	0
19	2	5	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0
20	1	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	2,083	2,083	2,083	2,083	27	27	27	27	27	4	4	4	4	0	0	0	0

WEIGHT DISTRIBUTION SUMMARY FOR DATA YEAR 1984

VEHICLE TYPE 332000 — EMPTY VEHICLES — VEHICLE TYPE 332000

GROSS WEIGHT GROUP	AVERAGE GROSS WEIGHT	VEHICLES IN SAMPLE	% OF TOTAL SAMPLE	AVERAGE AXLE WEIGHTS (IN 100#) (1)	(2)	(3)	(4)	(5)	(6)	(7)	AVERAGE AXLE WT AS % OF AVERAGE GROSS WT (1)	(2)	(3)	(4)	(5)	(6)	(7)
16K - 18K	17,800	1		30	55	30	25	38			16.9	30.9	16.9	14.0	21.3		
18K - 20K	19,467	3	.1	63	44	37	28	22			32.5	22.6	19.0	14.6	11.3		
20K - 25K	23,316	135	6.5	63	50	47	37	37			27.0	21.4	20.3	15.7	15.7		
25K - 30K	27,932	688	33.0	82	58	56	41	42			29.5	20.7	20.2	14.5	15.2		
30K - 35K	32,114	751	36.1	91	68	66	48	49			28.3	21.2	20.5	14.8	15.2		
35K - 40K	37,221	292	14.0	97	78	76	61	60			26.0	21.0	20.5	16.4	16.1		
40K - 45K	42,117	99	4.8	96	82	87	82	76			22.7	19.4	20.6	19.4	17.9		
45K - 50K	47,013	48	2.3	101	96	96	89	87			21.5	20.5	20.5	18.9	18.6		
50K - 55K	52,148	21	1.0	101	110	103	105	103			19.3	21.2	19.8	20.1	19.7		
55K - 60K	57,383	12	.6	96	119	110	122	128			16.6	20.7	19.2	21.2	22.2		
60K - 65K	61,757	7	.3	84	115	113	160	145			13.5	18.7	18.4	25.9	23.5		
65K - 70K	67,750	8	.4	132	143	157	122	124			19.5	21.1	23.1	17.9	18.3		
70K - 75K	71,621	14	7	104	138	159	174	141			14.5	19.2	22.2	24.3	19.7		
75K - 80K	77,875	4	.2	110	169	166	171	163			14.1	21.7	21.3	22.0	20.9		
ALL WGTS	32,609	2,083	100.0	88	68	67	52	52			27.0	20.8	20.4	15.8	15.9		

5-9-27

VEHICLE TYPE 332000 — LOADED VEHICLES — VEHICLE TYPE 332000

GROSS WEIGHT GROUP	AVERAGE GROSS WEIGHT	VEHICLES IN SAMPLE	% OF TOTAL SAMPLE	AVERAGE AXLE WEIGHTS (IN 100#) (1)	(2)	(3)	(4)	(5)	(6)	(7)	AVERAGE AXLE WT AS % OF AVERAGE GROSS WT (1)	(2)	(3)	(4)	(5)	(6)	(7)
16K - 18K	17,900	1		32	34	41	36	36			17.9	19.0	22.9	20.1	20.1		
18K - 20K	19,100	1		54	33	39	30	35			28.3	17.3	20.4	15.7	18.3		
20K - 25K	23,083	23	.4	51	49	53	39	38			22.2	21.2	23.1	17.0	16.5		
25K - 30K	28,223	82	1.5	70	59	57	48	48			24.9	20.8	20.1	17.1	17.1		
30K - 35K	32,736	227	4.3	80	71	68	53	56			24.5	21.6	20.6	16.1	17.1		
35K - 40K	37,602	351	6.6	86	81	79	65	65			22.7	21.5	21.0	17.4	17.4		
40K - 45K	42,555	504	9.5	88	90	91	78	79			20.7	21.2	21.4	18.3	18.5		
45K - 50K	47,421	503	9.5	92	99	100	92	92			19.3	20.8	21.1	19.4	19.4		
50K - 55K	52,398	494	9.3	94	109	114	104	103			17.9	20.7	21.7	19.9	19.7		
55K - 60K	57,430	559	10.6	95	120	125	117	116			16.6	20.9	21.8	20.4	20.3		
60K - 65K	62,623	625	11.8	97	131	134	132	132			15.5	21.0	21.4	21.1	21.0		
65K - 70K	67,584	718	13.6	101	142	145	143	145			14.9	21.0	21.5	21.2	21.4		
70K - 75K	72,291	685	12.9	104	152	155	155	157			14.4	21.1	21.5	21.4	21.7		
75K - 80K	76,997	385	7.3	109	163	165	166	167			14.2	21.1	21.5	21.5	21.6		
80K - 85K	82,249	93	1.8	113	168	172	183	187			13.7	20.5	20.9	22.3	22.7		
85K - 90K	86,761	33	.6	111	184	171	196	206			12.8	21.2	19.7	22.6	23.8		
90K - 95K	92,225	4	.1	96	181	175	241	230			10.4	19.6	19.0	26.1	24.9		
95K - 100K	96,400	4	.1	108	189	210	223	235			11.2	19.6	21.7	23.2	24.4		
100K-105K	101,700	1		108	280	269	209	151			10.6	27.5	26.5	20.6	14.8		
120K OR >	200,800	2		54	442	648	726	139			2.7	22.0	32.3	36.1	6.9		
ALL WGTS	57,677	5,295	100.0	96	121	124	118	118			16.6	21.0	21.4	20.4	20.5		

VEHICLE TYPE 332000 — VEHICLES WITH PERMITTED OVERLOAD — VEHICLE TYPE 332000

GROSS WEIGHT GROUP	AVERAGE GROSS WEIGHT	VEHICLES IN SAMPLE	% OF TOTAL SAMPLE	AVERAGE AXLE WEIGHTS (IN 100#) (1)	(2)	(3)	(4)	(5)	(6)	(7)	AVERAGE AXLE WT AS % OF AVERAGE GROSS WT (1)	(2)	(3)	(4)	(5)	(6)	(7)
40K - 45K	44,500	1	50.0	59	113	119	87	67			13.3	25.4	26.7	19.6	15.1		
70K - 75K	71,000	1	50.0	91	141	143	192	143			12.8	19.9	20.1	27.0	20.1		
ALL WGTS	57,750	2	100.0	75	127	131	140	105			13.0	22.0	22.7	24.2	18.2		

VEHICLE TYPE 332000 — TOTAL FOR ALL VEHICLES — VEHICLE TYPE 332000

GROSS WEIGHT GROUP	AVERAGE GROSS WEIGHT	VEHICLES IN SAMPLE	% OF TOTAL SAMPLE	AVERAGE AXLE WEIGHTS (IN 100#) (1)	(2)	(3)	(4)	(5)	(6)	(7)	AVERAGE AXLE WT AS % OF AVERAGE GROSS WT (1)	(2)	(3)	(4)	(5)	(6)	(7)
16K - 18K	17,850	2		31	45	36	31	37			17.4	24.9	19.9	17.1	20.7		
18K - 20K	19,375	4	.1	61	41	38	29	25			31.5	21.3	19.4	14.8	13.0		
20K - 25K	23,282	158	2.1	61	50	48	37	37			26.3	21.3	20.7	15.9	15.8		
25K - 30K	27,963	770	10.4	81	58	56	41	43			29.0	20.7	20.2	14.8	15.4		
30K - 35K	32,258	978	13.3	89	69	66	49	50			27.4	21.3	20.5	15.1	15.6		
35K - 40K	37,429	643	8.7	91	80	78	63	63			24.2	21.3	20.8	16.9	16.8		
40K - 45K	42,486	604	8.2	89	89	90	78	78			21.0	20.9	21.2	18.5	18.4		
45K - 50K	47,386	551	7.5	92	98	100	92	92			19.5	20.8	21.0	19.4	19.3		
50K - 55K	52,388	515	7.0	94	109	113	104	103			18.0	20.8	21.7	19.9	19.7		
55K - 60K	57,429	571	7.7	95	120	125	117	117			16.6	20.9	21.8	20.4	20.3		
60K - 65K	62,613	632	8.6	97	131	134	132	132			15.5	20.9	21.4	21.1	21.1		
65K - 70K	67,586	726	9.8	101	142	146	143	145			14.9	21.0	21.5	21.2	21.4		
70K - 75K	72,275	700	9.5	104	152	155	155	156			14.4	21.1	21.5	21.4	21.6		
75K - 80K	77,006	389	5.3	109	163	165	166	167			14.2	21.2	21.5	21.6	21.6		
80K - 85K	82,249	93	1.3	113	168	172	183	187			13.7	20.5	20.9	22.3	22.7		
85K - 90K	86,761	33	.4	111	184	171	196	206			12.8	21.2	19.7	22.6	23.8		
90K - 95K	92,225	4	.1	96	181	175	241	230			10.4	19.6	19.0	26.1	24.9		
95K -100K	96,400	4	.1	108	189	210	223	235			11.2	19.6	21.7	23.2	24.4		
100K-105K	101,700	1		108	280	269	209	151			10.6	27.5	26.5	20.6	14.8		
120K OR >	200,800	2		54	442	648	726	139			2.7	22.0	32.3	36.1	6.9		
ALL WGTS	50,601	7,380	100.0	93	106	108	99	100			18.5	21.0	21.3	19.6	19.7		

1984 DATA

BODY TYPE ANALYSIS
VEHICLE TYPE: 332000

BODY TYPE	NUMBER OF VEHICLES	AVERAGE GROSS WEIGHT	MINIMUM GROSS WEIGHT	MAXIMUM GROSS WEIGHT	AVERAGE WEIGHT OF INDIVIDUAL AXLES (WEIGHT IN HUNDREDS OF POUNDS) A	B	C	D	E	F	G	H	I	J	K
EMPTY VEHICLES															
PLATFORM	365	307	178	770	87	66	63	45	47						
LOW BED TRAILER	36	329	230	450	86	70	72	52	49						
RACK	2	291	286	295	90	60	58	44	41						
LIVESTOCK RACK	1	348	348	348	116	71	71	49	41						
LOG / PIPE	5	288	258	315	81	61	55	44	47						
CANOPY	12	327	263	383	96	70	65	49	46						
OPEN TOP BOX / VAN	227	328	207	790	87	71	65	53	53						
DUMP	50	338	250	716	90	71	68	53	56						
HOPPER	55	323	222	703	88	71	68	49	47						
VAN	813	327	197	770	88	68	65	52	53						
INSULATED VAN	164	358	223	785	89	76	75	60	58						
FURNITURE / MOVING VAN	9	369	289	465	96	76	67	64	65						
TANK	200	319	213	728	87	67	65	49	50						
PETROLEUM TANK	94	306	203	726	84	65	63	49	45						
AUTOMOBILE TRANSPORTER	48	390	237	680	102	42	102	69	74						
EQUIPMENT	2	331	291	371	89	84	48	65	46						
TOTAL - ALL BODY TYPES	2083	326	178	790	88	68	67	52	52						
LOADED VEHICLES															
PLATFORM	760	605	211	1017	95	127	128	128	127						
LOW-BED TRAILER	68	604	291	967	97	128	129	124	127						
RACK	11	592	462	726	91	114	144	124	120						
LIVESTOCK RACK	8	674	374	768	115	131	126	146	155						
LOG / PIPE	10	536	234	795	93	104	114	107	118						
CANOPY	22	642	367	840	99	135	133	142	133						
OPEN TOP BOX / VAN	365	609	250	947	94	126	127	130	133						
DUMP	57	693	361	827	96	141	143	155	158						
HOPPER	32	652	304	812	100	134	136	139	143						
VAN	2856	548	179	2051	95	116	117	110	110						
INSULATED VAN	574	594	240	904	97	126	130	120	120						
FURNITURE / MOVING VAN	21	495	340	730	91	92	103	102	107						
TANK	257	644	206	962	96	140	140	133	136						
PETROLEUM TANK	132	675	223	965	95	145	147	141	146						
AUTOMOBILE TRANSPORTER	121	564	284	846	103	99	141	111	110						
EQUIPMENT	1	643	643	643	98	98	174	131	142						
TOTAL - ALL BODY TYPES	5295	577	179	2051	96	121	124	118	118						
VEHICLES CARRYING PERMITTED OVERLOAD															
PLATFORM	1	710	710	710	91	141	143	192	143						
INSULATED VAN	1	445	445	445	59	113	119	87	67						
TOTAL - ALL BODY TYPES	2	578	445	710	75	127	131	140	105						

AVERAGE AXLE SPACING BY VEHICLE TYPE

1984

TYPE OF VEHICLE	NUMBER IN SAMPLE	AVERAGE AXLE SPACING IN FEET												AVERAGE TOTAL WHEEL BASE
		A-B	B-C	C-D	D-E	E-F	F-G	G-H	H-I	I-J	J-K	K-L	L-M	
220000	2286	14.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.8
230000	252	15.4	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0
240000	187	12.8	4.4	4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.6
321000	195	11.6	26.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.3
322000	782	11.6	28.2	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.3
323000	45	12.8	22.1	4.7	4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.1
331000	19	10.9	4.2	22.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.0
332000	7380	11.6	4.4	28.3	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.7
333000	87	12.8	4.4	22.4	4.8	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.2
342000	2	9.9	4.3	4.3	29.6	4.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.1
423000	1	11.6	14.9	14.3	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.3
432000	2	17.7	4.0	20.8	9.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.6
433000	1	17.7	4.5	18.8	9.1	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54.7
521200	136	10.9	20.0	9.7	20.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.5
522200	1	10.0	4.3	19.4	19.4	12.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	65.8
531200	18	9.9	4.2	19.5	8.7	21.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	63.6

MINIMUM AXLE SPACING BY VEHICLE TYPE

1984

TYPE OF VEHICLE	NUMBER IN SAMPLE	MINIMUM AXLE SPACING IN FEET											
		A-B	B-C	C-D	D-E	E-F	F-G	G-H	H-I	I-J	J-K	K-L	L-M
220000	2286	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
230000	252	10.1	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
240000	187	8.1	3.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
321000	195	8.6	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
322000	782	7.5	3.9	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
323000	45	11.4	4.3	3.5	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
331000	19	9.6	3.2	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
332000	7380	2.7	2.0	2.3	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
333000	87	7.5	3.2	12.4	2.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
342000	2	9.0	4.2	4.2	28.5	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
423000	1	11.6	14.9	14.3	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
432000	2	10.6	3.9	10.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
433000	1	17.7	4.5	18.8	9.1	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
521200	136	9.0	3.4	2.5	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
522200	1	10.0	4.3	19.4	19.4	12.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
531200	18	9.2	3.1	18.5	2.1	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

MAXIMUM AXLE SPACING BY VEHICLE TYPE

1984

TYPE OF VEHICLE	NUMBER IN SAMPLE	MAXIMUM AXLE SPACING IN FEET											
		A-B	B-C	C-D	D-E	E-F	F-G	G-H	H-I	I-J	J-K	K-L	L-M
220000	2286	41.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
230000	252	21.4	24.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
240000	187	18.9	11.1	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
321000	195	18.2	41.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
322000	782	19.0	74.1	84.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
323000	45	15.4	32.8	26.0	14.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
331000	19	15.6	4.5	37.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
332000	7380	96.7	82.5	58.8	44.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
333000	87	19.2	8.4	44.2	10.6	24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
342000	2	10.8	4.3	4.4	30.6	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
423000	1	11.6	14.9	14.3	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
432000	2	24.7	4.1	31.6	14.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
433000	1	17.7	4.5	18.8	9.1	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
521200	136	15.3	30.1	59.5	38.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
522200	1	10.0	4.3	19.4	19.4	12.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
531200	18	11.0	4.5	24.3	11.4	24.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

APPENDIX A

Glossary of Terms

AXLE:	A shaft on which or with which two or more wheels on a vehicle revolve.
AXLE GROUP:	Two or more consecutive axles considered together in determining their combined load effect on a bridge or pavement structure.
AXLE LOAD:	The weight carried by one axle of a vehicle.
AXLE SPACING:	The distance between two consecutive axles of a truck or combination, usually measured from the point of ground contact of one tire to the same point on the other tire or from a point on an axle hub to the same point on the other axle hub.
AXLE WEIGHT:	See SINGLE AXLE WEIGHT or TANDEM AXLE WEIGHT.
BOBTAIL:	A tractor on the road without a semitrailer.
BRIDGE FORMULA:	Refer to APPENDIX B
COMBINATION:	A truck or tractor coupled to one or more trailers (including semitrailers).
COMMODITY:	The items or freight to be moved including items placed on or in a vehicle.
CONTINUATION RECORD:	The 80-character truck weight data record that contains the axle weights and spacings for the 6th through the 13th axles of a vehicle with more than 5 axles.
DYNAMIC WEIGHT:	The weight of a vehicle or an individual axle as measured while the vehicle is in motion.
EQUIVALENT AXLE LOAD (EAL):	The damage per pass to a pavement caused by a specific axle load relative to the damage per pass of a standard 18,000 pound axle load moving on the same pavement.
FACE RECORD:	The 80-character truck weight data record that contains the axle weights and spacings for up to the first five axles of every vehicle weighted.
FIFTH WHEEL:	A coupling device located on a vehicle's rear frame used to connect the vehicle to a semitrailer. It can sometimes be moved forward or backward on the vehicle to obtain the desired distribution of weight between the trailer axles and the pulling vehicle.

FLEXIBLE PAVEMENT: Road construction of a bituminous material, generally asphalt, which has little tensile strength.

FULL TRAILER: A truck trailer with wheels on the front and rear (as opposed to a semitrailer in which the front rests on the rear of the tractor).

GROSS WEIGHT: The weight of a vehicle and/or vehicle combination together with the weight of its load.

KIP: A kilopound or 1,000 pounds.

OVERWEIGHT: Over the Federal or State legal restrictions for single axle weight, tandem axle weight or gross weight.

PAYLOAD: The cargo or freight that a truck or truck combination hauls.

PORTABLE SCALE: A scale of such size and weight as to be readily transportable from station to station.

RIGID PAVEMENT: Road construction of Portland cement concrete.

SADDLE MOUNT: A vehicle configuration using a tractor to transport other tractors or trailers by mounting the front axle of the vehicles to be transported on the rear of the tractor or the preceding mounted vehicle. Only the rear axle of the mounted vehicles are on the ground.

SEMITRAILER: A vehicle designed for carrying persons or property and drawn by another vehicle on which part of its weight and load rests.

SINGLE AXLE: An axle on a vehicle that is separated from any previous or succeeding axle by more than 96 inches.

SINGLE AXLE WEIGHT: The total weight transmitted to the road by a single axle.

SPREAD TANDEM: Two axles that are articulated from a common attachment but are considered as two single axles rather than one tandem axle because they are separated by more than 96 inches.

STATIC SCALE: A scale that requires that a vehicle be stopped to be weighed.

STEERING AXLE:	The axle to which a vehicle's steering mechanism is affixed.
STRAIGHT TRUCK:	A self-propelled vehicle designed and used for the transportation of property and not including tractors.
TANDEM AXLE:	Two consecutive axles that are more than 40 inches but not more than 96 inches apart and are articulated from a common attachment.
TANDEM AXLE WEIGHT:	The total weight transmitted to the road by a tandem axle.
TOWED VEHICLE:	A vehicle drawn or towed by another vehicle supplying the motive power.
TRACTOR:	A vehicle designed and used primarily as the power unit for drawing a semitrailer or trailer.
TRAILER:	A vehicle without motive power designed to be drawn by another vehicle and so constructed that no part of its weight rests upon or is carried by the pulling unit.
TRUCK:	A motor vehicle designed, used, or maintained primarily for the transportation of property.
VEHICLE:	Any conveyance of any type operated on a highway, whether self-propelled or drawn by another vehicle.
WEIGH-IN-MOTION SCALE:	A scale that allows vehicle weights to be electronically recorded as the vehicle passes over the scale without stopping.
WEIGH STATION:	A location equipped with weigh scales at which the axle weights and gross weights of vehicles are determined.
WEIGH VIOLATION:	A single axle weight, axle group weight, or gross weight of a vehicle exceeding the maximum allowed weight for that vehicle.
WHEELBASE:	The distance between the front and rear axles of a vehicle, or the center point of contact of the front and rear wheels with the ground.

APPENDIX B

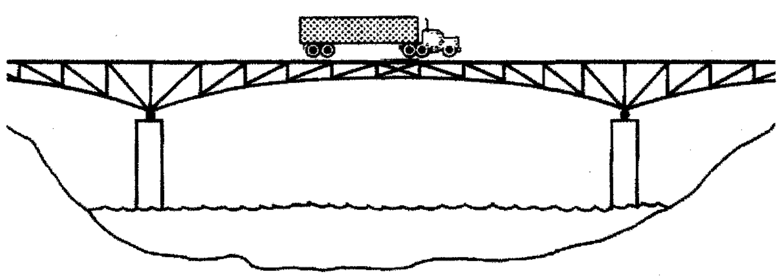
Bridge Gross Weight Formula

BRIDGE GROSS WEIGHT FORMULA

U.S. Department
of Transportation
Federal Highway
Administration

April 1984

$$W = 500\left[\frac{LN}{N-1} + 12N + 36\right]$$



Three questions are addressed by this pamphlet with regard to the Bridge Formula. *What is it? Why is it necessary? How is it used?*

WHAT IS IT?

The bridge gross weight formula provides a standard to control the spacing of truck axles on vehicles that use highway bridges.

W = the maximum weight in pounds that can be carried on a group of two or more axles to the nearest 500 pounds.

L = spacing in feet between the outer axles of any two or more consecutive axles.

N = number of axles being considered.

WHY IS THE FORMULA NECESSARY?

An individual set of bridge design computations cannot be completed for every type truck that may use the highways; to do this for every type truck would take years. Consequently, the Nation's bridge engineers have selected what is referenced as a design vehicle. This one vehicle is considered to be representative of *all vehicles* that will use a bridge during the 40 to 50-year life of the structure. A more common description would be to call the design truck an umbrella loading, as shown below:

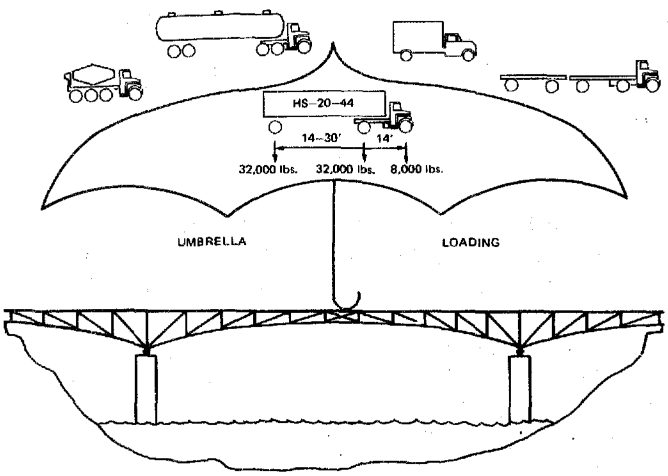


Figure 1

Assuming that the umbrella loading illustrated above creates the most severe situation as a bridge is designed, bridge members are built strong enough to handle the umbrella loading and in effect the bridge is protected from being overstressed by any future truck that may use the structure.

The umbrella loading described in Figure 1, which is used for Interstate highway bridge design, was adopted in 1944 with specific axle weights and spacing as shown. For years enforcement officials have worked to check truck weights to keep the axle loads and gross loads within legal limits. With the passage of the Federal-aid Amendments of 1974, the States also had to become concerned with the spacing of axles when enforcing weight laws on the Interstate System.

The axle spacing is equally as important in design of the bridges as the axle weights. This is illustrated by what happens when a person tries to walk across ice that is hardly thick enough to support his/her weight; the person is likely to fall through. If that person stretched out prone on the same ice and scooted across, it is unlikely that he/she would break through. This is true because the load, or weight, is spread over a larger area in the latter situation. A similar comparison can be made between trucks crossing a bridge:

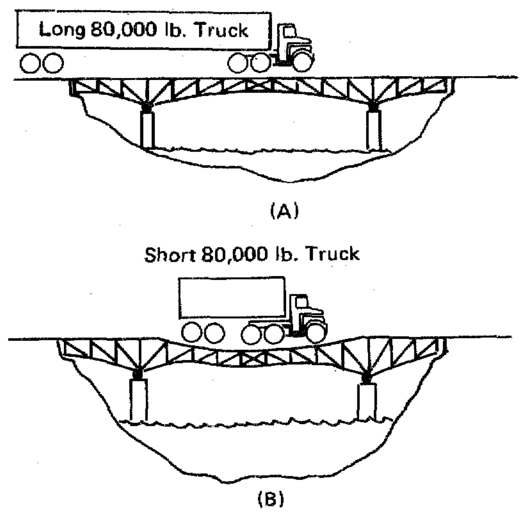


Figure 2

In view (A) of Figure 2, the stress on bridge members as the long truck rolls across is much less than that caused by the short truck in view (B), even though the trucks have the same total weight and individual axle weights. One can see that an extremely long truck would have its load spread out like the person scooting across the ice. Whereas, the short truck is similar to a person standing up on ice with the total load placed in a limited area.

After the umbrella loading was adopted in 1944, many Interstate bridges were built during the late 1950s and 1960s. Simultaneously, bigger and heavier trucks were being placed into use than had been anticipated in 1944. It was not practical to consider rebuilding all bridges for the newer trucks that either had been or could be placed on the road. The logical and economical action not only was to control the gross and axle weights of trucks but also to control the spacing of the axles. The U.S. Congress concurred with this approach. In 1974, when the higher axle and gross weight limits were adopted for the Interstate System (20,000 pounds—single axle, 34,000 pounds—tandem axle, 80,000 pounds—gross), the Bridge Formula was written into Section 127 of the *United States Code,* Title 23. The Bridge Formula assures that allowable weight of heavy trucks is correlated with the spacing of axles to prevent overstressing of highway bridges; in other words, preventing an effect similar to a person standing erect on thin ice. The overstressing can occur even when the gross weight and each individual axle weight of a truck are within lawful limits.

HOW IS THE FORMULA USED?

Some definitions are needed before completing example applications of the Bridge Formula.

- **Gross Weight***—the weight of a vehicle and/or vehicle combination without load plus the weight of any load thereon. The Federal gross weight limit on the Interstate is 80,000 pounds.
- **Single Axle Weight** *—the total weight transmitted by all wheels whose centers may be included between two parallel transverse vertical planes 40 inches apart, extending across the full width of the vehicle. The Federal single axle weight limit on the Interstate is 20,000 pounds.
- **Tandem Axle Weight***—the total weight transmitted to the road by two or more consecutive axles whose centers may be included between parallel vertical planes spaced more than 40 inches and not more than 96 inches apart, extending across the full width of the vehicle. The Federal tandem axle weight limit on the Interstate is 34,000 pounds.

** AASHTO definitions. These weight limits may vary from State-to-State depending on local laws and limits in effect before the Federal limits were established in 1956.*

A distinction is made at the 8-foot distance in Table B (pages 6-7) due to the tandem axle weight definition causing a considerable difference in the axle load, depending on whether the spacing of the axles is *8 feet and less* or *more than 8 feet.* The axle weight limit for any spacing greater than 8 feet (96 inches) shall be in accordance with the bridge formula. The tandem axle weight definition is not applicable when the axle spacing exceeds 96 inches. For example, *three axles* with an extreme spacing of 97 inches (more than 8 feet) can carry a load of 42,000 pounds as shown in Figure 3.

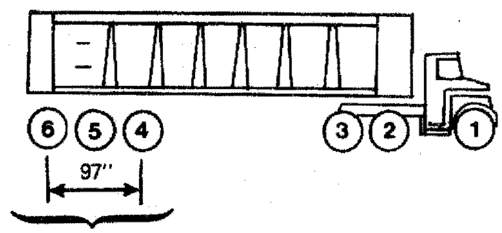


Figure 3

The Federal law states that any consecutive two or more axles may not exceed the weight as computed by the formula even though the single axles, tandem axles, and gross weights are within legal requirements.

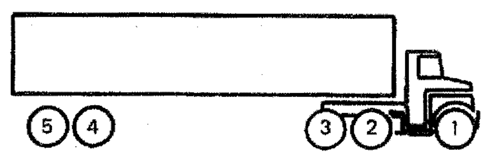


Figure 4

The most common vehicle (axle arrangement) checked for weight limit requirements is shown in Figure 4. While the Bridge Formula law applies to each combination of two or more axles, experience shows that axle combinations numbers 1 through 3, numbers 1 through 5, and numbers 2 through 5 are the critical combinations that must be checked. If these are found satisfactory, others will be satisfactory.

Permissible gross loads for vehicles in regular operation

Based on weight formula $W = 500\left(\frac{LN}{N-1} + 12N + 36\right)$ modified [1]

[Bridge table B]

Distance in feet between the extremes of any group of 2 or more consecutive axles	Maximum load in pounds carried on any group of 2 or more consecutive axles [2]							
	2 axles	3 axles	4 axles	5 axles	6 axles	7 axles	8 axles	9 axles
4 (Tandem Axle Weight (see pages 4 & 5))	34,000							
5	34,000							
6	34,000							
7	34,000							
8 and less	34,000	34,000						
More than 8	38,000	42,000						
9	39,000	42,500						
10	40,000	43,500						
11		44,000						
12		45,000	50,000					
13		45,500	50,500					
14		46,500	51,500					
15		47,000	52,000					
16		48,000	52,500	58,000				
17		48,500	53,500	58,500				
18		49,500	54,000	59,000				
19		50,000	54,500	60,000				
20 (Example)		51,000	55,500	60,500	66,000			
21 (see page 9)		51,500	56,000	61,000	66,500			
22		52,500	56,500	61,500	67,000			
23		53,000	57,500	62,500	68,000			
24		54,000	58,000	63,000	68,500	74,000		
25		54,500	58,500	63,500	69,000	74,500		
26		55,500	59,500	64,000	69,500	75,000		
27		56,000	60,000	65,000	70,000	75,500		
28		57,000	60,500	65,500	71,000	76,500	82,000	
29		57,500	61,500	66,000	71,500	77,000	82,500	
30		58,500	62,000	66,500	72,000	77,500	83,000	
31		59,000	62,500	67,500	72,500	78,000	83,500	
32		60,000	63,500	68,000	73,000	78,500	84,500	90,000
33			64,000	68,500	74,000	79,000	85,000	90,500
34			64,500	69,000	74,500	80,000	85,500	91,000
35			65,500	70,000	75,000	80,500	86,000	91,500
36 (Exception (see page 10))			66,000	70,500	75,500	81,000	86,500	92,000
37			66,500	71,000	76,000	81,500	87,000	93,000
38			67,500	71,500	77,000	82,000	87,500	93,500
39			68,000	72,500	77,500	82,500	88,500	94,000
40			68,500	73,000	78,000	83,500	89,000	94,500
41			69,500	73,500	78,500	84,000	89,500	95,000
42			70,000	74,000	79,000	84,500	90,000	95,500
43			70,500	75,000	80,000	85,000	90,500	96,000
44			71,500	75,500	80,500	85,500	91,000	96,500
45			72,000	76,000	81,000	86,000	91,500	97,500
46			72,500	76,500	81,500	87,000	92,500	98,000
47			73,500	77,500	82,000	87,500	93,000	98,500
48			74,000	78,000	83,000	88,000	93,500	99,000
49			74,500	78,500	83,500	88,500	94,000	99,500
50			75,500	79,000	84,000	89,000	94,500	100,000
51			76,000	80,000	84,500	89,500	95,000	100,500
52			76,500	80,500	85,000	90,500	95,500	101,000
53			77,500	81,000	86,000	91,000	96,500	102,000
54			78,000	81,500	86,500	91,500	97,000	102,500
55			78,500	82,500	87,000	92,000	97,500	103,000
56 (Interstate Gross Weight Limit (see page 4))			79,500	83,000	87,500	92,500	98,000	103,500
57			80,000	83,500	88,000	93,000	98,500	104,000
58				84,000	89,000	94,000	99,000	104,500
59				85,000	89,500	94,500	99,500	105,000
60				85,500	90,000	95,000	100,500	105,500

[1] The permissible loads are computed to the nearest 500 pounds. The modification consists in limiting the maximum load on any single axle to 20,000 pounds.

[2] The following loaded vehicles must not operate over H15–44 bridges: 3-S2 (5 axles) with wheelbase less than 38 feet; 2-S1-2 (5 axle) with wheelbase less than 45 feet; 3-3 (6 axle) with wheelbase less than 45 feet; and 7-, 8-, and 9-axle vehicles regardless of wheelbase.

The vehicle with weights and axle dimensions as shown in Figure 5 will be used to illustrate a Bridge Formula check.

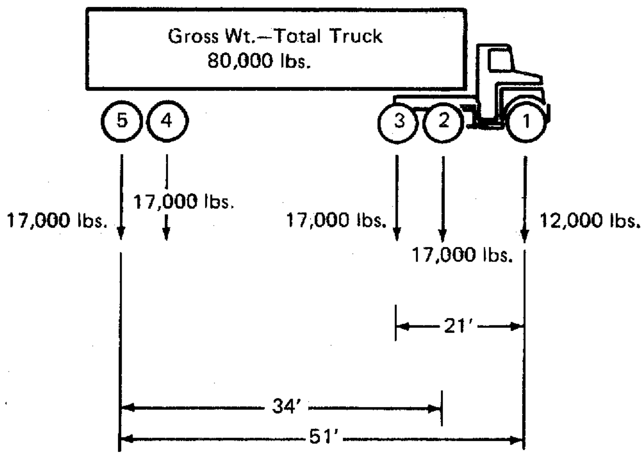


Figure 5

Before checking the axle 1 through 3 combination, a check should be made to see that single, tandem and gross weights are satisfied. The single axle Number 1 does not exceed 20,000 pounds, tandems 2-3 and 4-5 do not exceed 34,000 pounds, and the gross weight does not exceed 80,000 pounds. Thus, these requirements are satisfied so the first Bridge Formula combination is checked as follows:

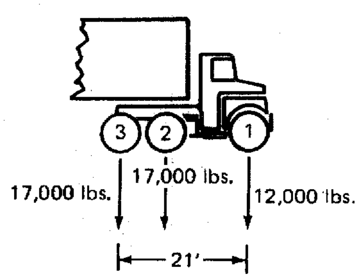


Figure 6

Check of 1 thru 3

W (actual weight) = 12,000 + 17,000 + 17,000 = 46,000 pounds (Figure 6).

N = 3 axles.

L = 21 feet.

$$W \text{ maximum} = 500\left(\frac{LN}{N-1} + 12N + 36\right)$$

$$= 500\left[\frac{(21 \times 3)}{(3-1)} + (12 \times 3) + 36\right] = 51{,}500\#.$$

W maximum = 51,500# which is more than the actual weight of 46,000# so the Bridge Formula requirement is satisfied.

Example—Bridge Table B

This same number (51,500#) could have been obtained from Bridge Table B as shown by reading down the left side to L = 21 and across to the right where N = 3.

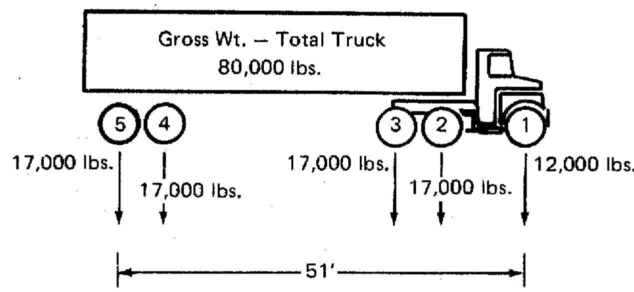


Figure 7

Now check axles 1 thru 5

W (actual) = 12,000 + 17,000 + 17,000 + 17,000 + 17,000 = 80,000# (Figure 7).

W maximum, from Table B for L of 51 feet and N of 5 = 80,000#.

Therefore, this axle spacing is satisfactory.

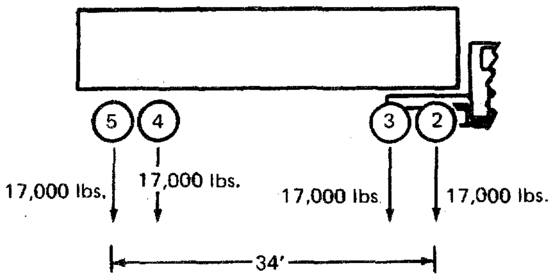


Figure 8

Now check axles 2 thru 5

W (actual) = 17,000 + 17,000 + 17,000 + 17,000 = 68,000# (Figure 8).

W maximum, from Table B for "L" of 34 feet and "N" of 4 = 64,500#.

This is a *"TILT"* or violation in that the actual weight exceeds the maximum allowed weight for the given axle spacing. To correct the situation, some load must be removed from the truck or the axle spacing (34-foot dimension) increased.

Exception to Formula and Table B

There is one exception to use of the formula or Table B—two consecutive sets of tandem axles may carry a gross load of 34,000 pounds each providing the overall distance between the first and last axles of such consecutive sets of tandem axles is 36 feet or more. For example, a 5 axle truck tractor semi-trailer may be used to haul a full 34,000 pounds on the tandem of the tractor (axles 2 and 3) and the tandem of the trailer (axles 4 and 5) provided there is a spacing of 36 feet or more between axles 2 and 5. A spacing of 36 feet or more for axles 2 through 5 is satisfactory for an actual W of 68,000 pounds even though the formula or Table B computes W maximum to be 66,000 to 67,500 pounds for spacings of 36 to 38 feet. This special exception is stated in the Federal law.

Bridge Formula Application to Single Unit Trucks

The same procedure described above can be used to check any axle combinations but as a general rule several axles spaced closely together will usually give the most critical situation.

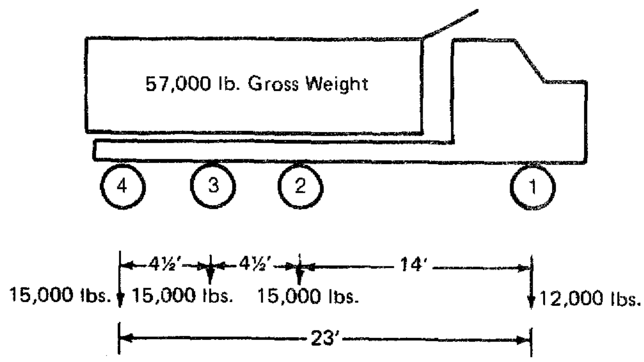


Figure 9

The truck in Figure 9 satisfies single axle restrictions (12,000# is less than 20,000#), tandem axle restrictions (30,000# is less than 34,000#) and gross limits (57,000# is less than 80,000#). With these restrictions satisfied a check will be made for Bridge Formula requirements, axles 1 through 4.

W (actual) = 12,000 + 15,000 + 15,000 + 15,000 = 57,000#.

W maximum for "N" of 4 and "L" of 23 feet = 57,500 from Table "B".

Since axles 1 thru 4 are satisfactory, check axles 2 thru 4:

W (actual) = 15,000 + 15,000 + 15,000 = 45,000#.

W maximum for "N" of 3 and "L" of 9 feet = 42,500# (From Table B).

This a *TILT* or a violation. The load would have to be reduced, axles added, or spacing changed to meet requirements.

CAUTION

This pamphlet has attempted to explain the purpose of the bridge formula and Federal requirements applicable to the Interstate System, but procedures to determine the related weight limits and axle spacing requirements for specific vehicles may vary from State to State.

APPENDIX C

Commodity Coding Instructions

(Taken from the "Instructions for Completing the Commodity Transportation Survey 1977 Census of Transportation," U.S. Department of Commerce, Bureau of the Census)

COMMODITY CODING INSTRUCTIONS

Commodity Classification Reference List

The codes and commodity descriptions appearing in this booklet are based on the "Commodity Classification for Transportation Statistics" (CCTS), which was established by the Office of Management and Budget primarily for use in the Census of Transportation. The CCTS conforms to the first five digits of the "Standard Transportation Commodity Code" issued by the Association of American Railroads.

How to Use this Reference List

Commodity codes can be readily located by reference to the index beginning on page 6. The list is presented in two parts. Section A consists of products manufactured or processed. Section B includes non-manufactured commodities, ordnance, and scrap. Most establishments will find use for selected "waste and scrap materials" codes and some will have occasional use for other codes in Sections A and B, eventhough the establishment is "not in the business" of producing or shipping those items.

To enable us to classify entries, it is important to enter BOTH the commodity code (col. f) taken from this list, and the detailed commodity description (col. g). Commodity descriptions should be as specific as possible. For example, an entry "household washing machines" can be coded, but "household appliances" is too broad for classification.

INDEX FOR
Section A – MANUFACTURED COMMODITIES

INDEX FOR
Section A — MANUFACTURED COMMODITIES — Continued

LEATHER OR LEATHER PRODUCTS

STONE, CLAY, GLASS, OR CONCRETE PRODUCTS

PRIMARY METAL PRODUCTS

FABRICATED METAL PRODUCTS, EXCEPT ORDNANCE, MACHINERY, OR TRANSPORTATION EQUIPMENT

MACHINERY, EXCEPT ELECTRICAL

ELECTRICAL MACHINERY, EQUIPMENT OR SUPPLIES

TRANSPORTATION EQUIPMENT

INSTRUMENTS, PHOTOGRAPHIC AND MEDICAL GOODS, WATCHES, AND CLOCKS

MISCELLANEOUS PRODUCTS OF MANUFACTURING

INDEX FOR
Section B – NONMANUFACTURED COMMODITIES, ORDNANCE, AND SCRAP

FOOD AND KINDRED PRODUCTS

MEAT, POULTRY, AND BYPRODUCTS

20111 Carcasses (whole or parts), fresh or chilled

20119 Meat, fresh or chilled, not elsewhere classified, except fresh sausage (see 20133)

20121 Carcasses (whole or part), fresh-frozen

20129 Meat, fresh-frozen, not elsewhere classified

20131 Lard

20132 Meats or sausage: cooked, cured, or dried including preserved, salted, or smoked

20133 Sausage, fresh

20134 Canned meat

20139 Meat products, not elsewhere classified

20141 Hides, pelts, skins, not tanned, cattle (including goats, horse, mule, sheep, swine)

20143 Grease or inedible tallow

20144 Animal refuse: tankage, meat meal, dried blood, or related animal byproducts

20149 Animal byproducts, inedible, not elsewhere classified

20151 Dressed poultry or small game, fresh or chilled

20158 Poultry or small game byproducts, fresh or chilled

20161 Dressed poultry or small game, fresh-frozen

20168 Poultry or small game byproducts, fresh-frozen

20171 Canned poultry or small game

DAIRY PRODUCTS

20172 Eggs: canned, dried, frozen, liquid, or otherwise processed

20211 Creamery butter

20231 Dry milk products

20233 Evaporated or condensed milk products

20234 Ice cream mix or ice milk mix

20241 Ice cream or related frozen desserts

20251 Cheese

20252 Cottage Cheese

20258 Casein products

20259 Special dairy products, not elsewhere classified

20261 Bulk fluid milk, including skim milk or cream in bulk

20262 Packaged (glass or paper) fluid milk, including skim milk or cream

20264 Buttermilk, chocolate milk, or other flavored milk drinks

FOOD AND KINDRED PRODUCTS – Continued

CANNED AND PRESERVED FRUITS, VEGETABLES, AND SEAFOODS

20311 Canned fish or other seafood, including soups

20314 Smoked, salted, pickled, or dried fish

20321 Canned baby foods

20322 Canned soups, except canned seafood soups (see 20311), frozen soups (see 20381), or frozen seafood soups (see 20361)

20323 Canned bean specialties

20329 Canned specialties, not elsewhere classified

20331 Canned fruits

20332 Canned vegetables

20333 Canned hominy or mushrooms

20334 Canned fruit juices, except cider (see 20996)

20335 Canned vegetable juices

20336 Catsup or other tomato sauces

20338 Jams, jellies, or preserves

20339 Canned fruits or vegetables, not elsewhere classified, including fruit or vegetable byproducts

20341 Dehydrated or dried fruits

20342 Dehydrated or dried vegetables, or soups, including soup mix, except field dried ripe vegetable food seeds (see 01341-01349)

20343 Dehydrated or dried potatoes or potato products, except potato chips (see 20992)

20352 Pickles or other pickled products

20354 Salad dressings, including mayonnaise or sandwich spreads

20359 Sauces or seasonings, not elsewhere classified, except spices (see 20997), and catsup or tomato sauces (see 20336)

FROZEN AND FRESH FISH OR OTHER SEAFOODS

20361 Frozen processed (packaged) fish or other seafoods

20362 Fresh processed (packaged) fish or other seafoods

FROZEN FRUITS, VEGETABLES, AND PREPARED FOODS

20371 Frozen fruits

20372 Frozen juices or ades

20373 Frozen vegetables

20379 Frozen fruits, fruit juices, vegetables in mixed loads without separate weights

20381 Frozen prepared foods or soups, except seafoods (see 20361)

20389 Frozen specialties, not elsewhere classified

FOOD AND KINDRED PRODUCTS – Continued

MIXED LOADS

20391 Mixed loads of canned or preserved fruits, vegetables, or sea foods without separate weights

GRAIN MILL PRODUCTS AND ANIMAL FEED PRODUCTS

20411 Wheat flour, except blended or prepared (see 20451–20452)

20412 Wheat bran, middlings, or shorts

20413 Corn meal or corn flour, except animal or poultry feed (see 20421–20423)

20414 Rye flour or meal

20415 Buckwheat flour or meal

20416 Oatmeal or oat flour

20418 Grain mill byproducts

20419 Flour or other grain mill products, not elsewhere classified

20421 Prepared feed: animal, fish, or poultry, except canned (see 20423) or chopped, ground or pulverized hay, straw, or related products (see 01991–01992)

20423 Canned feeds; animal, fish, or poultry

20431 Cooked cereals: flaked, shredded, popped, puffed, rolled, granulated, roasted

20432 Cereals, uncooked

20441 Rice, cleaned

20442 Rice flour, bran, or meal

20443 Brewers rice

20449 Milled rice or byproducts, not elsewhere classified

20451 Prepared flour (phosphated, self-rising)

20452 Prepared flour mixes (pancake, biscuit, cake, pie crusts, etc.)

20461 Corn syrup

20462 Corn starch

20463 Corn sugar

20464 Dextrine (corn, tapioca, or other)

20465 Corn oil

20466 Starch (potato, wheat, rice, etc.) except corn (see 20462)

20467 Wet process corn byproducts

20469 Wet process corn milling products, not elsewhere classified

BAKERY PRODUCTS (EXCLUDING FROZEN)

20511 Bread or other bakery products

20521 Biscuits, crackers, or pretzels

20529 Dry bakery products, not elsewhere classified

FOOD AND KINDRED PRODUCTS – Continued

SUGAR AND RELATED PRODUCTS

20611 Raw cane or beet sugar

20616 Sugar molasses

20617 Blackstrap molasses

20618 Bagasse

20619 Sugar mill products, not elsewhere classified

20621 Sugar, granulated or powdered

20622 Sugar, liquid or syrup

20625 Sugar refining byproducts

20626 Molasses beet pulp

20629 Sugar, refined, cane or beet, in mixed loads without separate weights

CONFECTIONERY, CHOCOLATE, AND CHEWING GUM

20711 Candy or candy bars, bulk or packaged

20712 Nuts, blanched, coated, cooked or roasted, including salted

20713 Chocolate or cocoa products, or byproducts, including syrups

20714 Chewing gum

20719 Confectionery or related products, not elsewhere classified

BEVERAGES, FLAVORING, AND RELATED PRODUCTS

20821 Beer, in bottles, cans, barrels, or kegs, including ale, porter, stout, or other fermented malt liquor

20823 Malt extract or brewers' spent grains

20831 Malt

20832 Malt flour or sprouts

20839 Malt products or byproducts, not elsewhere classified

20841 Wines, brandy, or brandy spirits

20851 Distilled, rectified, or blended liquors

20859 Byproducts of liquor distilling

20861 Soft drinks, bottled, canned, or in bulk

20871 Miscellaneous flavoring extracts or syrups, except chocolate syrups (see 20713)

MISCELLANEOUS FOODS AND KINDRED PRODUCTS

20911 Cottonseed oil, crude or refined, except edible cooking oils (see 20961)

20914 Cottonseed cake, meal, or byproducts, except fatty acids (see 28994)

20915 Cotton linters

20921 Soybean oil, crude or refined, except edible cooking oils (see 20961)

20923 Soybean cake, meal, flour, grits, etc.

FOOD AND KINDRED PRODUCTS – Continued

MISCELLANEOUS FOODS AND KINDRED PRODUCTS - Con.

20931 Linseed oil, crude or refined, except edible cooking oils (see 20961)

20933 Nut or vegetable oils

20939 Nut or vegetable oil seed cake, meal, not elsewhere classified

20941 Marine oil mill products

20942 Marine oil mill byproducts (meal, scrap or tankage)

20951 Roasted coffee, including instant coffee

20961 Shortening, cooking, or salad oils, except corn oil (see 20465)

20962 Margarine

20971 Ice, natural or manufactured

20981 Macaroni, spaghetti, vermicelli, or noodles, dry, except canned (see 20329)

20991 Desserts (ready to mix)

20992 Chips (potato, corn, etc.)

20993 Sweetening syrups or molasses

20994 Baking powder or yeast

20995 Shipments identified only as "Groceries" (mixed shipments of food and kindred products without separate weights)

20996 Vinegar or cider

20997 Spices

20998 Tea, including instant tea

20999 Food preparations or byproducts, not elsewhere classified

TOBACCO PRODUCTS

21111 Cigarettes

21211 Cigars

21311 Chewing tobacco

21312 Smoking tobacco

21313 Snuff

21411 Tobacco, stemmed or redried

21419 Tobacco byproducts, leaf

TEXTILE MILL PRODUCTS

COTTON BROAD WOVEN FABRICS

22111 Cotton duck or allied fabrics

22112 Cotton sheetings, unfinished (grey goods)

22113 Cotton, or chiefly cotton blankets

22119 Cotton broad woven fabrics or specialties not elsewhere classified, except carpets, mats, or rugs (see 22711 or 22721), or tire cord or fabrics (see 22961)

TEXTILE MILL PRODUCTS – Continued

MANMADE FIBER BROAD WOVEN FABRICS

22211 Manmade fiber, broad woven fabrics, including glass fiber, except blankets (see 22213), carpets, mats, or rugs (see 22711 or 22721), or tire cord or fabrics (see 22961)

22213 Manmade fiber blankets

22221 Silk broad woven fabrics, except carpets, mats, or rugs (see 22711 or 22721), or tire cord or fabrics (see 22961)

WOOL BROAD WOVEN FABRICS

22311 Wool broad woven fabrics, except blankets (see 22313), or carpets, mats, or rugs (see 22711 or 22721)

22313 Wool, or chiefly wool, blankets

NARROW FABRICS

22411 Narrow fabrics, cotton, silk, or wool including glass or other manmade fibres

KNITTING MILL PRODUCTS

22511 Knit fabrics

CARPETS, RUGS, AND OTHER FLOOR COVERINGS

22711 Woven carpets, mats, or rugs, textile yard

22721 Tufted carpets or rugs, textile fibre, including mats

22799 Carpets, mats, or rugs, not elsewhere classified, all materials except cork (see 24941), rubber (see 30614), or hard surface floor coverings (see 39921)

YARN

22811 Cotton yarn

22813 Wool thread or yarn

22819 Yarn, not elsewhere classified (including manmade fiber and silk yarn), except hemp, jute, linen, or ramie (see 22999)

THREAD

22841 Thread, except hemp, jute, linen, ramie (see 22999) or wool (see 22813)

MISC. TEXTILE GOODS

22911 Felt goods, except woven felts (see 22311), or hats (see 23511 or 23521)

22921 Lace goods, including dyed or finished, except embroideries (see 23951)

TEXTILE MILL PRODUCTS – Continued

MISCELLANEOUS TEXTILE GOODS - Continued

22931 Paddings or upholstery fillings, except foam or sponge rubber (see 30613), expanded plastics (see 30716), or wood excelsior pads or wrappers (see 24294)

22941 Textile waste, garnetted or processed

22951 Artificial leather and oilcloth

22961 Tire cord or fabrics, including fuel cell, industrial belting, or for similar uses

22971 Wool or mohair, scoured or carbonized

22972 Tops, all fibers, processed, including combed or converted

22973 Textile fibers prepared for spinning, including combed or converted (laps, noils, nubs, slubs, sliver, or roving)

22974 Wool or mohair grease

22981 Cordage or twine

22991 Bonded fiber fabrics, except felts woven (see 22311) or unwoven (see 22911)

22992 Jute goods, except bags (see 23931)

22994 Packing or wiping cloths or rags (processed textile wastes)

22995 Vegetable fibers, except cotton (see 20915 or 22999)

22999 Textile goods, not elsewhere classified

APPAREL AND OTHER FINISHED TEXTILE PRODUCTS, INCLUDING KNIT

APPAREL

23111 Men's, youths', and boys' clothing, including uniforms, except raincoats, (see 23851) and leather or sheep lined clothing (see 23861)

23311 Women's, misses', children's, or infants' clothing

HATS, MILLINERY, AND GLOVES

23511 Millinery, except fur (see 23711) or braids or trimmings (see 23961)

23521 Hats or caps, also hat bodies

23811 Dress gloves, mittens, or linings, except all leather (see 31511), plastic (see 30719), or fur linings (see 23711)

23812 Work gloves or mittens, except all leather (see 31511), asbestos (see 32929), plastic (see 30719), or rubber (see 30619)

FUR GOODS

23711 Fur goods, except sheep lined clothing (see 23861)

APPAREL AND OTHER FINISHED TEXTILE PRODUCTS, INCLUDING KNIT – Continued

MISCELLANEOUS APPAREL AND ACCESSORIES

23841 Robes or dressing gowns, except children's or infants' (see 23311)

23851 Raincoats or other waterproof outer garments, except oiled fabric (see 23111), or vulcanized rubber (see 30619)

23861 Leather or sheep lined clothing, except leather gloves or mittens (see 31511), or fur garments (see 23711)

23871 Apparel belts

23891 Apparel, not elsewhere classified

MISCELLANEOUS FABRICATED TEXTILE PRODUCTS

23911 Window curtains, except lace (see 22921)

23912 Draperies or tapestries

23921 Bedspreads or bed sets, except embroidered (see 23951), or lace (see 22921)

23922 Sheets or pillow cases, except embroidered (see 23951)

23923 Towels or wash cloths, except embroidered (see 23951)

23924 Tablecloths, napkins, or related textile articles, except lace (see 22921), or embroidered (see 23951)

23925 Pillows

23926 Mops or dusters

23927 Slip covers, except embroidered (see 23951)

23928 Comforters or quilts, except embroidered (see 23951)

23929 Textile housefurnishings, not elsewhere classified, except embroidered (see 23951), or lace (see 22921)

23931 Textile bags, except garment or laundry (see 23929 or 26431)

23941 Tents

23942 Awnings or shades

23943 Tarpaulins

23944 Sails

23949 Canvas products, not elsewhere classified, except bags (see 23931)

23951 Textile products, pleated, quilted or embroidered

23961 Textile apparel findings, automotive trimmings, or related products

23991 Automobile seat covers

23993 Sleeping bags

23994 Parachutes

23999 Fabricated textile products, not elsewhere classified

LUMBER OR WOOD PRODUCTS, EXCEPT FURNITURE

LUMBER AND TIMBER BASIC PRODUCTS

24111 Sawlogs
24112 Hewn railroad or mine ties
24113 Short logs or wood bolts
24114 Pulpwood logs
24115 Pulpwood or other wood chips
24116 Wood posts, poles, or piling
24117 Fuelwood, hogfuel, or cordwood
24118 Wood mine props or mine timbers
24119 Primary forest products or wood raw materials, not elsewhere classified

LUMBER AND DIMENSION STOCK

24211 Lumber, rough or dressed; softwood cut stock or flooring
24212 Sawed ties (railroad, mine, etc.)
24214 Hardwood dimension stock, furniture parts or vehicle stock
24215 Flooring, hardwood
24219 Lumber or dimension stock, not elsewhere classified
24291 Shingles
24292 Cooperage stock
24293 Shavings or sawdust
24294 Excelsior, baled or bulk
24299 Sawmill or planing mill products, not elsewhere classified, except box springs or boxes (see 24416), millwork (see 24311 - 24319), plywood or veneer (see 24321), or textile machinery wood shapes or turnings (see 35522)

MILLWORK, PLYWOOD, AND STRUCTURAL MEMBERS

24311 Window units, wood
24312 Window sash, wood, including combination screen and storm sash, except window screens, wood framed
24313 Window or door frames or jambs, wood
24314 Doors or shutters, wood, or door units
24316 Wood mouldings
24319 Millwork products, not elsewhere classified, including cabinet work to be built-in
24321 Plywood, veneer, or built-up wood, except plywood or veneer containers (see 24411 - 24414), wood particle board (see 24996), hardboard (see 24993)
24341 Kitchen cabinets, wood

LUMBER OR WOOD PRODUCTS, EXCEPT FURNITURE – Con.

WOOD BUILDINGS AND MOBILE HOMES

24332 Prefabricated buildings, wood
24333 Ready-cut wood buildings, and panels or sections for prefabricated buildings
24391 Prefabricated structural members or wood laminates

WOOD CONTAINERS, PALLETS, AND SKIDS

24411 Boxes, cases, crates, or carriers, except animal or poultry
24412 Carriers or coops, animal or poultry, also crates
24413 Fruit or vegetable baskets or hampers, wooden
24414 Baskets or hampers, except fruit or vegetable (see 24413), toy (see 39411), bait or fish (see 39491), or ambulance or undertaker (see 39941)
24415 Cooperage
24416 Box shooks
24419 Wooden containers or container accessories, not elsewhere classified
24992 Pallets, skids, or platforms, wood except used, returned empty (see 42112)

MISCELLANEOUS WOOD PRODUCTS

24911 Wooden piling, posts, timbers, props, etc., creosoted or oil treated
24912 Wooden ties (railroad, mine, etc.), creosoted or oil treated
24919 Wood products, creosoted or treated with other preservatives, not elsewhere classified
24921 Rattan, bamboo, or willow ware, except furniture (see 25---), baskets, or hampers (see 24413-4)
24931 Lasts or related products, all materials
24941 Cork products
24951 Hand tool handles
24961 Scaffolding equipment
24962 Ladders or ladder parts
24971 Wooden ware
24972 Wooden novelties or flatware
24981 Poles, rods, or stakes, wood, finished
24982 Billboards or sign frames, or related articles, wood
24983 Bath tub seats, toilet seats, laundry tub covers, radiator covers or guards, sink drain boards, or related articles, wood
24985 Bottle stoppers, ice cream sticks, paint paddles, or pencil slats, wood

LUMBER OR WOOD PRODUCTS, EXCEPT FURNITURE – Con.

MISCELLANEOUS WOOD PRODUCTS – Continued

24987 Quilting frames or curtain stretchers, wood

24988 Ironing boards or tables, wood

24993 Hardboard

24994 Masts, spars, oars, or related boat accessories, wood

24995 Pipe, conduit, or fittings, wooden

24996 Wood particle board

24997 Fencing or gates, wood

24998 Reels or spools, wood, except textile machinery spools (see 35522)

24999 Wood products, not elsewhere classified, except containers (see 24411 – 24414 or 24419)

FURNITURE OR FIXTURES

HOUSEHOLD AND OFFICE FURNITURE

25111 Chairs, rockers, benches, or stools, household or office, except concrete (see 32719), stone (see 32819), or terra cotta (see 32699)

25121 Tables or desks, household or office, except concrete (see 32719), stone (see 32819), or terra cotta (see 32699)

25131 Sofas, couches, settees, davenports, or love seats, household or office

25141 Buffets, servers, china or corner closets, household

25161 Dressers, vanities, chests of drawers, and beds, household or office, except hospital beds (see 25991)

25171 Radio, phonograph, or television cabinets

25173 Filing cabinets or cases

25174 Kitchen cabinets, except wood (see 24341)

25179 Cabinets or cases, not elsewhere classified, except china cabinets (see 25141), or display cases (see 25411 – 25421), or kitchen cabinets (see 24341 or 25174)

25181 Infants' or children's furniture

25199 Household or office furniture, not elsewhere classified, except concrete (see 32719), stone (see 32819), or terra cotta (see 32699)

BEDDING PRODUCTS

25151 Mattresses, bed or box springs, assembled springs or spring cushions, except auto seats or backs (see 25312), or padding or upholstery fillings (see 22931)

25153 Studio couches, convertible sofas, sofa beds, or chair beds

FURNITURE OR FIXTURES – Continued

PUBLIC BUILDING, RESTAURANT, AND OTHER FURNITURE

25311 School furniture, except stone (see 32819), concrete (see 32719), or terra cotta (see 32699)

25312 Seats for public conveyances: automobiles, trucks, aircraft, school buses, or railroad cars

25314 Seats, auditorium, bleacher, circus, theatre or stadium

25991 Hospital beds

25999 Furniture or fixtures, not elsewhere classified, including restaurant furniture, except table arm chairs (see 25311), dental, hospital, operating room, or opticians' furniture (see 38412), hospital beds (see 25991), concrete furniture (see 32719), stone furniture (see 32819), or terra cotta furniture (see 32699)

25319 Public building furniture, not elsewhere classified, except concrete (see 32719), stone (see 32819), or terra cotta (see 32699)

PARTITIONS, SHELVING, LOCKERS, AND OFFICE AND STORE FIXTURES – METAL AND WOOD

25411 Wood partitions, shelving, lockers, office or store fixtures, except refrigerated cabinets, cases, or lockers (see 35853)

25421 Metal partitions, shelving, lockers, office or store fixtures, except refrigerated cabinets, cases, or lockers (see 35853), or safes or vaults (see 34921)

WINDOW SHADES AND VENETIAN BLINDS

25911 Venetian blinds, awnings or shades, including curtain rods or accessories, except canvas (see 23942)

PULP, PAPER, AND ALLIED PRODUCTS

PRODUCTS OF PULP MILLS

26111 Pulp

26112 Pulp mill byproducts

PAPER AND BOARD MILLS

26211 Newsprint

26212 Groundwood paper, uncoated

26213 Printing paper, coated or uncoated, including groundwood papers, coated; groundwood paper containing less than 60% groundwood, coated or uncoated; or writing paper

26214 Wrapping paper, wrappers, or coarse papers

PULP, PAPER, AND ALLIED PRODUCTS – Continued

PAPER AND BOARD MILLS – Continued

26217 Special industrial paper, including paper car liners

26218 Sanitary tissue stock

26219 Paper, not elsewhere classified, except building paper (see 26611 – 26619)

26311 Paperboard, pulpboard, or fiberboard, except insulating building board (see 26611 – 26619)

PAPER AND BOARD PRODUCTS

26421 Envelopes, except stationery (see 26491)

26431 Paper bags

26441 Wallpaper

26451 Office supplies

26452 Coated paperboard

26453 Closures for bottles, jars, cans (caps, covers, tops, etc.)

26459 Die-cut paper or paperboard products, or cardboard, not elsewhere classified

26461 Bituminous fiber pipe, sewer or drainage; and conduit, including fittings

26462 Egg cartons, cases, or related articles

26469 Pressed or molded pulp goods, not elsewhere classified

26471 Sanitary tissues or health products

26472 Sanitary napkins or tampons, paper or cotton

26491 Stationery, tablets, envelopes, or related products

26492 Wrapping products (gift wrap, etc.)

26495 Business machine supplies

26497 Packing cushions, covers, liners, or related articles

26499 Converted paper products or paperboard products, not elsewhere classified

CONTAINERS OR BOXES

26511 Paperboard boxes, fiberboard, or pulpboard boxes or containers, except butter, frozen food, ice cream or margarine boxes or containers (see 26542 – 26549)

26514 Baskets, hampers, or till boxes – paperboard or fiberboard

26515 Pallets, skids, or platforms, paperboard

26542 Bottles or cartons, and other liquid-tight food containers

PULP, PAPER AND ALLIED PRODUCTS – Continued

CONTAINERS OR BOXES – Continued

26543 Cans, pails, tubs, cups, covers, or straws: paperboard, fiberboard, or pulpboard

26545 Paper plates, dishes, spoons, forks, etc.

26549 Sanitary food containers, not elsewhere classified

26551 Fiber cans, tubes, or drums, or similar products, except sanitary food containers (see 26542 – 26549)

BUILDING PAPER OR BUILDING BOARD

26611 Insulating board

26612 Construction paper

26613 Wallboard, except hardboard (see 24993)

26614 Insulating materials, except insulating board (see 26611)

26615 Construction panels, partitions, siding, or forms

26619 Building paper or building board, not elsewhere classified

PRINTED MATTER

27111 Newspapers

27211 Periodicals

27311 Books

27411 Catalogues, directories, business service publication, or advertising materials

27415 Cards or tickets, except greeting cards (see 27711)

27417 Seals, labels, tags, or wrappers, except government stamped (see 27419) or greeting (see 27711)

27419 Printed matter, not elsewhere classified, including blueprints, building plans, or commercial designs

27611 Manifold business forms

27711 Greeting cards, seals, labels, or tags

27811 Blankbooks, pads, or tablets

27812 Loose leaf binders or devices

27911 Service industries for the printing trades, including electrotype, engravers, lithographic, or stereotype plates, shells, blocks, or bars

CHEMICALS OR ALLIED PRODUCTS

ALKALIES AND CHLORINE

28122 Sodium alkalies

28124 Potassium alkalies

28128 Chlorine

28129 Alkalies, not elsewhere classified

CHEMICALS OR ALLIED PRODUCTS – Continued

INDUSTRIAL GASES

28132 Acetylene

28133 Carbon dioxide

28134 Elemental gases

28139 Industrial gases, not elsewhere classified, compressed, liquefied, or solid, except chemical warfare gases (see 28188), ammonia or ammonia compounds (see 28191 or 28198), chlorine (see 28128) fluorine (see 28199)

INDUSTRIAL ORGANIC CHEMICALS

28141 Crude products from coal tar, petroleum, or natural gas, except asphalt, tar, or pitches (see 29116)

28151 Cyclic intermediates derived from benzene, toluene, naphthalene, anthracene, pyridine, carbazole, or other cyclic chemical products

28156 Organic dyes

28158 Organic pigments (lakes or toners)

28182 Miscellaneous acyclic organic chemical products, except organic dyes (see 28156)

28183 Miscellaneous cyclic chemical products

28184 Alcohols

28185 Glycols or glycerine

28186 Organic acids or salts, except acid dyes (see 28151 - 28518), or fatty acids (see 28994)

28188 Chemical warfare gases

28189 Industrial organic chemicals, not elsewhere classified, except grain alcohol for beverage purposes (see 20851 - 20859) paints or allied products (see 28511 - 28519), plastics materials plasticizers, or synthetic fibers, resins or rubber (see 28211 - 28213), or specialty cleaning or sanitation preparations (see 28422 - 28423)

INORGANIC COLOR PIGMENTS

28161 Titanium pigments

28162 Lead pigments

28163 Zinc pigments

28169 Inorganic pigments, not elsewhere classified, except blacks (see 28996), or organic color pigments (see 28158)

CHEMICALS OR ALLIED PRODUCTS – Continued

FERTILIZERS AND AGRICULTURAL CHEMICALS

28191 Ammonia or ammonia compounds, except anhydrous ammonia (see 28198)

28192 Nitric acid

28198 Anhydrous ammonia

INDUSTRIAL INORGANIC CHEMICALS

28193 Sulphuric acid

28194 Industrial inorganic acids, except nitric (see 28192) or sulphuric (see 28193)

28195 Cobalt, copper, iron, nickel, or zinc compounds

28196 Aluminum compounds

28197 Radioactive or nuclear chemicals

28199 Industrial inorganic chemicals not elsewhere classified, except mining, milling or otherwise preparing natural boron, sodium or potassium compounds (see 14713) or household bleaches (see 28422)

28121 Inorganic bleaching compounds, except chlorine (see 28128)

28123 Sodium compounds, except sodium alkalies (see 28122)

28125 Potassium compounds, except potassium alkalies (see 28124)

28126 Barium, calcium, magnesium, or strontium compounds, except bleaches (see 28121 or 28422)

PLASTICS MATERIALS

28211 Plastics materials, synthetic resins, or nonvulcanizable elastomers, except fabricated plastic products (see 30711 - 30719)

SYNTHETIC RUBBER

28212 Synthetic rubbers (vulcanizable elastomers), except fabricated rubber products (see 30613 - 30619)

SYNTHETIC FIBERS

28213 Synthetic fibers, except glass (see 32293)

DRUGS AND MEDICINES

28311 Drugs for human use

28312 Drugs for veterinary use

CHEMICALS OR ALLIED PRODUCTS – Continued

SOAP, GLYCERINE, CLEANING, POLISHING, AND RELATED PRODUCTS

28411 Synthetic organic detergents, except synthetic glycerin (see 28185)

28419 Soap or other detergents, except shampoos or shaving products (see 28441) specialty cleaners (see 28422 - 28423) or synthetic organic detergents (see 28411)

28422 Specialty cleaning or sanitation preparations, household bleaches, except pesticidal preparations (see 28799)

28423 Waxes or polishing preparations or related products

SURFACE ACTIVE AGENTS

28431 Surface active agents, finishing agents, sulfonated oils or assistants

TOILET PREPARATIONS AND COSMETICS

28441 Perfumes, cosmetics, or other toilet preparations, except essential oils (see 28999), or synthetic flavoring or perfume materials (see 28189)

PAINTS, VARNISHES, LACQUERS, ENAMELS, AND ALLIED PRODUCTS

28511 Paints, varnishes, lacquers, shellacs and enamels

28512 Paint oil, thinners, solvents, or paint drying ingredients and related products

28513 Putty

28519 Paints, varnishes, lacquers, shellacs, enamels, or allied products, not elsewhere classified, including mixed shipments except calking compounds (see 28911). For bone, carbon, or lamp blacks see 28996; inorganic color pigments (see 28161 - 28169); organic color pigments (see 28151 - 28158); plastic materials, (see 28211 - 28213) or printers' ink (see 28931)

GUM AND WOOD CHEMICALS

28612 Gum or wood chemicals, except synthetic dyes (see 28151 - 28158), or synthetic organic chemicals or tanning materials (see 28182 - 28189)

PHOSPHATIC FERTILIZERS

28712 Superphosphate

28713 Ammoniating or nitrogen fertilizer solutions

CHEMICALS OR ALLIED PRODUCTS – Continued

PHOSPHATIC FERTILIZERS - Continued

28714 Miscellaneous fertilizer compounds

28719 Fertilizers, not elsewhere classified, except manufactured urea (see 28182), or milling, mining, or otherwise preparing natural boron, sodium, or potassium compounds (see 14713)

28799 Agricultural chemicals, not elsewhere classified, including fungicides, herbicides or plant hormones, household or industrial pesticidal preparations or agricultural disinfectants, insecticides or pesticides except pest control chemicals, not formulated (see 281--) or agricultural lime products (see 14211 or 32959)

ADHESIVES AND SEALANTS

28911 Adhesives, cements, glues or sizes, calking compounds, or sealants, except asbestos cements (see 32921 - 32929)

EXPLOSIVES

28921 Explosives, except ammunition (see 1929 - 1961) or fireworks and pyrotechnics (see 28993)

PRINTING INK

28931 Printing ink

CHEMICAL PREPARATIONS, NOT ELSEWHERE CLASSIFIED

28991 Salt, common

28993 Fireworks or pyrotechnics

28994 Fatty acids

28995 Water treated compounds

28999 Chemical products, not elsewhere classified, except sealants (see 28911)

CARBON BLACK

28996 Blacks

PETROLEUM OR COAL PRODUCTS

PETROLEUM REFINING PRODUCTS

29111 Gasoline, jet fuels, or other high volatile petroleum fuels, except natural gas or gasoline (see 13121 or 13211)

29112 Kerosene, except jet fuels (see 29111)

29113 Distillate fuel oil

PETROLEUM OR COAL PRODUCTS – Continued

PETROLEUM REFINING PRODUCTS – Continued

29114 Petroleum lubricating or similar oils, compounds or derivatives

29115 Petroleum lubricating greases

29116 Asphalt, tar, or pitches from petroleum, coke oven, coal tar, or natural gas

29117 Petroleum residual fuel oils including other low volatile petroleum fuels

29119 Products of petroleum refining, not elsewhere classified, except liquefied petroleum gases (see 29121) or petroleum coke (see 29913)

29121 Liquefied petroleum or coal gases

PAVING AND ROOFING MATERIALS

29511 Asphalt paving mixtures or blocks, including creosoted wood, tar or composition of asphalt or tar with other materials

ASPHALT FELTS AND COATINGS

29521 Asphalt or tar saturated felts, boards, or roofing

29522 Asphalt or tar coatings, cements, or pitches, except linoleum or tile cement (see 28911)

29523 Asphalt shingles, siding, or sheathing

29529 Asphalt felts or coatings, not elsewhere classified, except paint (see 28511 – 28519), linoleum or tile cement (see 28911) roofing (see 29522)

LUBRICATING OILS AND GREASES

29912 Lubricants or similar compounds, except petroleum refining (see 29114 or 29115)

PETROLEUM AND COAL PRODUCTS, NOT ELSEWHERE CLASSIFIED

29911 Coke or coal briquettes, anthracite culm (fuel brick) including bituminous slack, charcoal, peat or sawdust

29913 Petroleum coke, except briquettes (see 29911)

29914 Coke produced from coal, except briquettes (see 29911)

29919 Petroleum or coal products, not elsewhere classified, except dyes, dye (cyclic) intermediates (see 28151 – 28158) or petroleum refinery products (see 29111 – 29119)

RUBBER OR MISCELLANEOUS PLASTICS PRODUCTS

TIRES AND INNER TUBES

30111 Pneumatic tires

30114 Inner tubes

30115 Thread rubber, tire sundries, or repair materials

30119 Tires or related products, not elsewhere classified

RUBBER AND PLASTIC FOOTWEAR

30211 Rubber footwear (including rubber, rubber soled fabric, including canvas with rubber soled or plastic with rubber or leather with vulcanized soles)

30212 Plastic footwear (including fabric with plastic soles)

RECLAIMED RUBBER

30311 Reclaimed rubber

30411 Rubber or plastic belts or belting

30412 Rubber or plastic hose

FABRICATED RUBBER PRODUCTS, NOT ELSEWHERE CLASSIFIED

30613 Sponge or foam rubber goods

30614 Rubber floor or wall coverings

30618 Fabricated rubber products, not elsewhere classified, except elastic webbing (see 22411), elastic webbing products or rubberized fabric garments (see 23_ _ _), synthetic rubbers (see 28212), rubber cement (see 28911), rubber packing (see 32932), rubber belting (see 30411), or rubber hose (see 30412)

PLASTICS PRODUCTS, NOT ELSEWHERE CLASSIFIED

30711 Plastic dinnerware or housewares

30712 Plastic pipes, tubing, or fittings

30713 Industrial (molded) plastic products

30714 Unsupported vinyl or polyethylene film or sheeting

30715 Unsupported plastic floor or wall coverings

30716 Expanded or foamed plastics

30717 Plastic laminated sheets, rods, or tubes

30718 Plastic packaging and shipping containers (baskets, bottles, boxes, cans, drums, cups, tumblers, jars, tubs, tubes, caps, closures, inserts, or liners for containers)

RUBBER OR MISCELLANEOUS PLASTICS PRODUCTS – Con.

PLASTICS PRODUCTS, NOT ELSEWHERE CLASSIFIED - Con.

30719 Miscellaneous fabricated plastic products, not elsewhere classified, except artificial leather (see 22951), plastic materials (see 28211), plastic footwear (see 30212), plastic belting (see 30411), or plastic hose (see 30412)

LEATHER OR LEATHER PRODUCTS

FINISHED LEATHER

31111 Leather, tanned or finished

31211 Industrial leather belting

BOOT AND SHOE CUT STOCK AND FINDINGS

31311 Boot or shoe cut stock, all materials, including boot or shoe findings

FOOTWEAR

31411 Footwear - Leather or other material except rubber (see 30211), plastic (see 30212), or house slippers (see 31421)

31421 House slippers, leather or other materials

LEATHER GLOVES AND MITTENS

31511 Dress or work gloves or mittens, all leather except cloth and leather combined - (see 23811 - 23812) athletic or sporting (see 39499)

LUGGAGE, HANDBAGS, AND SMALL LEATHER GOODS

31611 Luggage, handbags, leather or other materials, or other personal leather goods, except hat boxes, paper or paperboard (see 26511) or precious metal (see 39111)

LEATHER GOODS, NOT ELSEWHERE CLASSIFIED

31999 Leather goods, not elsewhere classified

STONE, CLAY, GLASS OR CONCRETE PRODUCTS

GLASS AND GLASS PRODUCTS

32111 Sheet (window) glass

32112 Plate glass

32113 Laminated glass, including safety glass

32119 Flat glass, not elsewhere classified

32211 Glass containers and glass caps or covers, except glass bottles (see 32212)

32212 Glass bottles

32219 Glass containers, not elsewhere classified

STONE, CLAY, GLASS OR CONCRETE PRODUCTS – Con.

GLASS AND GLASS PRODUCTS - Continued

32291 Table, kitchen, art, or novelty glassware

32292 Lighting glassware, except complete electric light bulbs (see 36411)

32293 Glass fiber

32294 Glass mirrors

32295 Glass bricks, blocks, or related products, including skylights

32296 Electronic glassware, except complete electronic tubes (see 36711)

32299 Glass or glassware, blown or pressed, not elsewhere classified, except flat glass (see 32111 - 32119), glass containers (see 32211 - 32219), glass wool insulation products (mineral wool) (see 32961) or optical lenses (see 38311)

CEMENT AND STRUCTURAL CLAY PRODUCTS

32411 Hydraulic cement: portland, natural, including masonry

32412 Ready-mix cement or concrete, dry

32511 Brick or blocks, clay or shale, except refactory (see 32551 - 32552), glass (see 32295), or sandlime (see 32999)

32512 Glazed brick or block

32531 Ceramic wall or floor tile

32551 Clay refractories

32552 Nonclay refractories, except dead-burned magnesia or magnesite (see 32953)

32591 Clay culverts, conduit, pipe, or fittings

32592 Clay drain tile

32593 Clay terra cotta (architectural)

32594 Clay roofing tile

32595 Clay tile beams, channels, girders, double trees, or joists (reinforced)

32599 Structural clay products, not elsewhere classified

POTTERY AND RELATED PRODUCTS

32611 Vitreous china plumbing fixtures, including vitreous china or earthenware bathroom accessories or fittings

32621 Vitreous china kitchen or table articles, including fine earthenware (semivitreous or whiteware)

32641 Porcelain, steatite, or other ceramic electrical supplies

32699 Pottery products, not elsewhere classified

STONE, CLAY, GLASS OR CONCRETE PRODUCTS – Con.

CONCRETE, GYPSUM, CUT-STONE, AND PLASTER PRODUCTS

32711 Concrete brick or blocks

32713 Concrete posts, poles, piling

32714 Concrete conduit, culverts or drains, or pipe or tile

32715 Concrete structural shapes, reinforced

32719 Concrete products, not elsewhere classified

32731 Ready-mixed concrete, wet

32741 Lime or lime plaster

32751 Gypsum lath

32752 Gypsum plaster

32753 Gypsum building materials except lath (see 32751), wallboard (see 32754), or plaster (see 32752)

32754 Gypsum wallboard

32759 Gypsum products, except building materials (see 32751 - 32753)

32811 Cut granite or granite products

32812 Cut limestone or limestone products

32813 Cut marble or marble products

32814 Cut slate, soapstone, or talc, or related products

32819 Cut stone or stone products, not elsewhere classified

ABRASIVES, ASBESTOS, AND MISCELLANEOUS NONMETALLIC PRODUCTS

32911 Nonmetallic artificial (synthetic) abrasives - sized grains, powders, or flour

32912 Nonmetallic bonded abrasive products or nonmetallic coated abrasives or diamond abrasives

32914 Metal abrasives, including metal scouring pads, soap impregnated

32919 Abrasive products, not elsewhere classified

32921 Asbestos friction material

32922 Asbestos cement products

32923 Asphalt or vinyl asbestos floor tile, except linoleum, asphalted felt base or other hard surface floor coverings (see 39921), or cork tile (see 24941)

32924 Asbestos insulation

32929 Asbestos products, not elsewhere classified, except asbestos paper (see 26612), gaskets or packing (see 32931 - 32932)

STONE, CLAY, GLASS OR CONCRETE PRODUCTS – Con.

GASKETS, PACKING, AND SEALING DEVICES

32931 Gaskets, all types

32932 Packing, all types

NONMETALLIC EARTHS OR MINERALS, GROUND

32951 Vermiculite, exfoliated, loose

32952 Lightweight aggregates, ground, including treated in any other manner or clays or slags, except ground or otherwise treated at mine site (see 14911 - 14919) or diatomaceous or infusorial earth (see 14918)

32953 Magnesia or magnesite, calcined, dead-burned or ground

32954 Pyrophillite, ground or otherwise treated, including steatite (soapstone) or talc

32955 Feldspar, ground or otherwise treated

32956 Crushed or ground uncalcined gypsum (including gypsite or anhydrite)

32957 Mica, ground or otherwise treated

32958 Natural graphite (black lead), ground, refined, pulverized, or blended

32959 Nonmetallic minerals or earths, ground or otherwise treated

MINERAL WOOL

32961 Mineral wool, except asbestos insulation products (see 32924), or textile glass fibers (see 32293)

MISCELLANEOUS NONMETALLIC MINERAL PRODUCTS

32996 Nonmetallic mineral insulating materials, except asbestos (see 32924), gypsum (see 32753), mineral wool (see 32961), or paper (see 26614)

32999 Nonmetallic mineral products, not elsewhere classified, including papier-mâché art goods, statuary goods, urns, or vases

PRIMARY METAL PRODUCTS

STEEL MILL PRODUCTS INCLUDING COKE AND BLAST FURNACE PRODUCTS

33111 Pig iron

33112 Furnace slag, except ground or otherwise treated (see 32952)

33115 Metalizing plant products

33119 Coke oven or blast furnace products, not elsewhere classified, except asphalt, pitches or tars (see 29116), crude tar products, or chemicals (see 28---), metallic ores (see 10----), or oils (see 29114 or 29912)

PRIMARY METAL PRODUCTS – Continued

STEEL MILL PRODUCTS INCLUDING COKE AND BLAST FURNACE PRODUCTS - Continued

33121 Steel ingot or semi-finished shapes

33122 Iron or steel plates

33123 Iron or steel sheet or strip, except tin mill products (see 33127)

33124 Iron or steel bars, bar shapes, or rods

33126 Iron or steel pipe, tubes, or fittings

33127 Tin mill products

33128 Railway track material (rails, rail guards, tie plates, or related materials)

33129 Primary iron or steel products, not elsewhere classified

FERROALLOYS

33131 Ferromanganese

33132 Ferrochrome

33133 Ferrosilicon

33139 Ferroalloys, not elsewhere classified

WIRE AND WIRE PRODUCTS

33151 Noninsulated ferrous wire rope, cable, or strand nonferrous wire (see 33571 - 33574)

33152 Steel nails, staples, tacks, or brads, spikes, except railway (see 33128)

33155 Steel wire, except miscellaneous fabricated wire products (see 34812 - 34819)

IRON AND STEEL CASTINGS

33211 Iron or steel cast pipe or fittings

33219 Iron or steel castings, not elsewhere classified

PRIMARY SMELTING OF NONFERROUS ORES, CONCENTRATES, OR OTHER PRIMARY MATERIALS

33311 Primary copper or copper base alloy pig, slab, or ingots, etc., including copper base alloy

33312 Copper matte, speiss, flue dust, residue, etc.

33321 Lead pig, slab, ingots, bullion and lead base alloy, except solder babbit or type metal (see 33567)

33322 Lead matte, speiss, flue dust, dross, etc.

33331 Primary zinc or zinc base alloy smelter products, spelter, pig, slab, or ingots

33332 Zinc dross, residues, ashes, etc.

33341 Primary aluminum or aluminum base alloy pig, slab, ingot, billets, blooms, etc.

PRIMARY METAL PRODUCTS – Continued

PRIMARY SMELTING OF NONFERROUS ORES, CONCENTRATES, OR OTHER PRIMARY MATERIALS - Continued

33342 Aluminum residues, etc.

33391 Magnesium or magnesium base alloy pig, slab, ingot, etc.

33392 Manganese or manganese base alloy pig, slab, ingot, etc.

33393 Molybdenum or molybdenum base alloy pig, slab, ingot, etc.

33394 Nickel or nickel base alloy pig, slab, ingot, etc.

33395 Tin or tin base alloy pig, slab, ingot, etc., except solder, babbitt, or type metal (see 33567)

33396 Titanium or titanium base alloy pig, slab, ingot, etc.

33398 Miscellaneous nonferrous or nonferrous base alloy metal residues, including solder, babbitt, or type metal residues

33399 Primary nonferrous or nonferrous base alloy metal slab, pig, ingot, etc., not elsewhere classified

NONFERROUS METAL BASIC SHAPES

33511 Copper, brass, bronze, or other copper base alloy rods or bars

33512 Copper, brass, bronze, or other copper base alloy plate, sheet, or strip

33513 Copper, brass, bronze, or other copper base alloy pipe or tube

33519 Copper, brass, bronze, or other copper base alloy shapes, not elsewhere classified

33521 Aluminum or aluminum base alloy plate or sheet

33523 Aluminum or aluminum base alloy rods or bars

33524 Aluminum or aluminum base alloy pipe or tube

33529 Aluminum or aluminum base alloy basic shapes, not elsewhere classified, except foil or foil stock (see 34992)

33561 Magnesium or magnesium base alloy basic shapes

33562 Lead or lead base alloy basic shapes, except solder, babbitt, or type metal (see 33567)

33563 Nickel or nickel base alloy basic shapes

33564 Zinc or zinc base alloy basic shapes

33565 Titanium basic shapes

33566 Welding rods, bars, or wire

PRIMARY METAL PRODUCTS – Continued

NONFERROUS METAL BASIC SHAPES – Continued

33567 Solder, babbitt, or type metal shapes

33569 Nonferrous metal basic shapes, not elsewhere classified, except residues included in primary industries (see 33398)

NONFERROUS WIRE DRAWING AND INSULATING

33571 Aluminum or aluminum base alloy wire, strand, or cable, bare

33572 Copper or copper base alloy wire, strand, or cable, bare

33573 Nonferrous metal or nonferrous base alloy wire, bare, except aluminum or copper (see 33571 – 33572)

33574 Wire or cable, insulated, all types, including enameled or covered

NONFERROUS CASTINGS

33612 Aluminum or aluminum base alloy castings

33621 Brass, bronze, copper, or other copper base alloy castings

33691 Magnesium or magnesium base alloy castings

33692 Zinc or zinc base alloy castings

33693 Lead or lead zinc alloy castings, including babbitt or white metal

33699 Nonferrous metal castings, not elsewhere classified

MISCELLANEOUS PRIMARY METAL PRODUCTS

33911 Iron or steel forgings

33921 Nonferrous metal forgings

33991 Metal powder, flakes, or paste

33992 Nonferrous metal nails, brads, spikes, or staples

33999 Primary metal products, not elsewhere classified

FABRICATED METAL PRODUCTS, EXCEPT ORDNANCE, MACHINERY, OR TRANSPORTATION EQUIPMENT

METAL CANS

34111 Metal cans (including mixed shipments of cans, tops, and bottoms)

CUTLERY, HAND TOOLS, AND HARDWARE

34211 Table or kitchen cutlery or related cutting appliances, other than electrical

34213 Scissors or shears, other than electrical

34215 Razor blades or razors, other than electrical

FABRICATED METAL PRODUCTS, EXCEPT ORDNANCE, MACHINERY, OR TRANSPORTATION EQUIPMENT – Con.

CUTLERY, HAND TOOLS, AND HARDWARE – Continued

34219 Cutlery, not elsewhere classified, other than electrical

34231 Mechanics' hand service tools, including light forged hammers

34232 Edge tools

34233 Files, rasps, or file accessories

34234 Shovels, spades, scoops, or scrapers

34235 Heavy forged tools (sledges, picks, mattocks, mauls, tampers, or bars)

34236 Agricultural hand tools or parts, including forks, hoes, huskers, rakes, rollers, weeders, etc., except edged tools (see 34232) wheeled transportation equipment (see 3799)

34239 Hand tools, not elsewhere classified, except hand saws or saw blades (see 34251) or machine tools, (see 35412 or 35421)

34251 Hand saws, saw blades, or saw accessories

34281 Door or window hardware

34282 Fireplace equipment (dampers, irons, fire screens, etc.)

34283 Hinges, hasps, or butts, except cabinet (see 34284)

34284 Cabinet hardware, including cabinet hinges or locks

34285 Hooks, clamps, clips, fasteners, shelf hardware, or hangers, except door or window hangers (see 34281)

34289 Builders hardware, not elsewhere classified

34291 Transportation equipment hardware

34292 Furniture hardware, including hardware for office or household furniture

34293 Vacuum or insulated bottles, jugs, or chests

34294 Hose fittings, couplings, nozzles, or hose reels

34299 Hardware, not elsewhere classified

HEATING EQUIPMENT (EXCLUDE ELECTRIC) AND PLUMBERS' SUPPLIES

34311 Cast iron sanitary ware, including enameled

34312 Metal sanitary ware, including enameled, except cast iron

34321 Plumbing fixture fittings or trim, including bath, shower, sink or lavatory fittings, lavatory legs, strainers, etc. (brass goods)

34331 Oil burners, residential or industrial

FABRICATED METAL PRODUCTS, EXCEPT ORDNANCE, MACHINERY, OR TRANSPORTATION EQUIPMENT – Con.

HEATING EQUIPMENT (EXCLUDE ELECTRIC) AND PLUMBERS' SUPPLIES – Continued

34332 Warm air furnaces, except floor or wall (see 34339)

34333 Cast iron heating boilers, radiators, or convectors

34334 Domestic heating stoves, except electric

34335 Steel heating boilers

34336 Parts for nonelectric heating equipment

34339 Heating equipment, except electric, not elsewhere classified

FABRICATED STRUCTURAL METAL PRODUCTS, INCLUDING DOORS

34411 Fabricated structural metal products, iron or steel

34412 Fabricated structural metal products, except iron or steel (see 34411)

34421 Metal doors or door frames, except screen or storm doors (see 34425)

34422 Metal window sash or frames, except storm sash or screen and storm sash (see 34425)

34423 Metal molding or trim or store fronts except motor vehicle body trim (see 34613)

34425 Metal window or door screens including screen or storm doors, storm windows, combination screen and storm door or windows or metal weather strip

BOILER SHOP AND SHEET METAL PRODUCTS

34431 Heat exchangers or steam condensers

34432 Fabricated steel plate for pipe including penstocks, tunnel linings, etc.

34433 Steel power boilers, parts, or attachments

34434 Gas cylinders (pressure tanks)

34435 Metal tanks, except pressure tanks (see 34434)

34439 Fabricated plate products, not elsewhere classified

34441 Sheet metal roofing, ceiling, or siding

34442 Sheet metal culverts, flumes, irrigation pipe, or similar products

34443 Sheet metal cornices, skylights, or roof ventilators

34444 Sheet metal stove, furnace, or chimney pipe, elbows, ducts, or fittings

34445 Sheet metal roof drainage equipment

34446 Sheet metal bins, vats, or tubs, including metal covered

FABRICATED METAL PRODUCTS, EXCEPT ORDNANCE, MACHINERY, OR TRANSPORTATION EQUIPMENT – Con.

BOILER SHOP AND SHEET METAL PRODUCTS – Continued

34447 Sheet metal awnings or canopies

34449 Sheet metal products, not elsewhere classified

34461 Ornamental metal work (trellises, lattice work, porch or lamp posts, window guards, etc.)

34464 Stairs, staircases, balconies, fire escapes, or railings (including portable gangways, platforms, or stairways)

34469 Architectural metal work, not elsewhere classified

PREFABRICATED METAL BUILDINGS AND MISCELLANEOUS METAL WORK

34492 Prefabricated or portable metal buildings or parts

34499 Metal construction materials, not elsewhere classified

MISCELLANEOUS FABRICATED METAL PRODUCTS

34521 Bolts, except toggle or expansion bolts (see 34529), nuts, screws, rivits, or washers

34462 Scaffolding or ladders, or related articles

34529 Industrial fasteners, not elsewhere classified (dowels, cotter pins, toggle or expansion bolts, etc.)

34921 Metal safes or vaults

34931 Steel springs, except wire springs (see 34812)

34941 Metal valves for piping, plumbing, or heating systems

34942 Metal fittings or unions for piping systems

34943 Metal pipe coils

34944 Fabricated metal pipe or pipe fittings

34991 Collapsible metal tubes (toothpaste, cosmetic, etc.)

34992 Metal leaf or foil, or products therefrom except foil sanitary food containers (see 34996)

34993 Furniture parts, metal

34994 Coating of metals or metal products includes anodizing, coloring electro plating, engraving, plating or polishing, etc., except galvanizing (see 33---)

34996 Foil sanitary food containers

34999 Fabricated metal products, not elsewhere classified

FABRICATED METAL PRODUCTS, EXCEPT ORDNANCE, MACHINERY, OR TRANSPORTATION EQUIPMENT – Con.

METAL FORGINGS AND STAMPINGS, COATING AND ENGRAVING

34611 Vitreous enameled metal products (cooking or kitchen utensils, refrigerator parts, washing machine parts, etc.)

34612 Stamped or spun hospital utensils, cooking or kitchen household utensils

34613 Automobile stampings

34614 Metal closures (caps, covers, tops, or bottoms)

34615 Metal boxes, baskets, buckets, pails, or crates except shipping (see 34912 - 34919) or (34997)

34616 Dispensers, holders, or containers for tissues, towels, napkins, etc.

34619 Metal stampings, not elsewhere classified

FABRICATED WIRE PRODUCTS

34812 Wire springs

34813 Wire fencing, fence posts, gates, or fittings

34814 Wire cloth or other woven wire products

34815 Wire chain

34816 Barbed or twisted wire

34817 Welded wire fabric or mesh

34819 Fabricated wire products, not elsewhere classified

SHIPPING CONTAINERS

34912 Steel shipping barrels, cans, drums, kegs, pails, etc.

34913 Metal reels

34919 Metal shipping barrels, cans, drums, kegs, and pails, etc., not elsewhere classified

34997 Metal shipping containers, except barrels, cans, drums, kegs, pails, or reels (see 34912 - 34919)

MACHINERY, EXCEPT ELECTRICAL

ENGINES AND TURBINES

35112 Steam engines, turbines, turbine generator sets, or parts

35195 Outboard motors or parts

35199 Internal combustion engines, not elsewhere classified, except aircraft missile, or space vehicle (see 37221 - 37222), or motor vehicle (see 37144)

MACHINERY, EXCEPT ELECTRICAL – Continued

FARM MACHINES AND TRACTORS

35222 Wheel tractors, parts or attachments, except garden or lawn equipment (see 35241), or contractors off-highway tractors (see 35311)

35223 Planting, seeding, or fertilizing machinery or parts

35224 Plows, listers, harrows, rollers, pulverizers, stalk cutters, or parts

35225 Harvesting or haying machinery or parts

35227 Machines for preparing crops for market or for use

35228 Barn, barnyard, or poultry equipment

35229 Farm machinery or equipment, not elsewhere classified

35241 Garden and lawn equipment, including snow blowers, and garden and lawn tractors.

CONSTRUCTION, MINING, AND OIL-FIELD MACHINERY

35311 Contractors' off-highway wheel tractors or tracked tractors

35312 Railway maintenance machinery, equipment, or parts (locomotive cranes, rail layers, ballast spreaders, etc.)

35313 Parts or attachments for tracklaying or contractors' off-highway wheel or tracked tractors

35314 Power cranes, draglines, shovels, tractor-shovel-loaders, or parts

35316 Mixers, pavers, or related equipment

35318 Scrapers, graders, rollers, off-highway trucks, trailors, or wagons

35319 Construction machinery or equipment, not elsewhere classified

35321 Underground mining machinery, equipment, or parts

35322 Mining machinery, crushing, pulverizing, or screening plants or parts

35329 Mining machinery, equipment, or parts, not elsewhere classified, except oil field machinery, equipment, or parts (see 35331 - 35339)

35331 Oil or gas field drilling or production machinery, equipment or parts

35339 Oil or gas field machinery, not elsewhere classified, including oil or gas field tools

MACHINERY, EXCEPT ELECTRICAL – Continued

ELEVATORS, HOISTS, AND MATERIALS HANDLING MACHINERY AND EQUIPMENT

35341 Elevators or moving stairways, equipment, or parts

35351 Conveyors, conveying equipment, or parts, except hoists (see 35361) or farm elevators (see 35229)

35361 Hoists

35362 Overhead traveling cranes or monorail systems

35371 Industrial trucks, tractors, trailers, stackers, or parts

35373 Industrial pallets or platforms, metal or skids, excluding wood and iron combined (see 24992)

MACHINE TOOLS

35412 Machine tools or parts, metal cutting types

35421 Machine tools or parts, metal forming types

35441 Special dies or tools, die sets, jigs, fixtures, industrial molds, or patterns

35451 Machine tool accessories, including measuring devices

METALWORKING MACHINERY

35481 Rolling mill machinery or equipment

35484 Automotive maintenance equipment, including automobile lifts or runways

35489 Metalworking machinery, not elsewhere classified, except machine tools (see 35412 or 35421)

SPECIAL INDUSTRY MACHINERY

35511 Dairy or milk products plant machinery or equipment

35512 Bakery machinery or equipment

35513 Meat or poultry packing plant machinery

35514 Fruit or vegetable canning or packing machinery

35515 Bottling machinery, except dairy (see 35511)

35516 Flour mill or grain mill machinery

35519 Food products machinery, not elsewhere classified

35522 Textile machinery, parts, or attachments

35531 Woodworking machinery

35541 Paper industries machinery, parts, or attachments

MACHINERY, EXCEPT ELECTRICAL – Continued

SPECIAL INDUSTRY MACHINERY – Continued

35552 Printing trades machinery or equipment, except printers' matrices or plates (see 27911)

35591 Chemical manufacturing industries machinery or equipment

35592 Foundry machinery or equipment, except metal furnaces (see 35671), or industrial molds or patterns (see 35441)

35594 Rubber or plastics working machinery or equipment, except industrial molds or patterns (see 35441)

35595 Petroleum refinery machinery or equipment

35596 Cotton ginning machinery or equipment

35597 Clay working machinery, including brick tile, or ceramic

35599 Special industry machinery, not elsewhere classified

PUMPS AND COMPRESSORS

35611 Industrial pumps, pumping equipment, or parts

35614 Air or gas compressors or parts, except refrigeration compressors or parts (see 35854)

35619 Industrial pumps, air or gas compressors, pumping equipment, or parts, not elsewhere classified

GENERAL INDUSTRIAL MACHINERY

35621 Ball or roller bearings, complete or parts, or mounted bearings

35641 Industrial fans or blowers

35642 Dust collection or air purification equipment, or air washers or filters

35661 Plain bearings

35669 Mechanical power transmission equipment, not elsewhere classified

35671 Industrial process furnaces or ovens

35691 Miscellaneous general industrial machinery or equipment, not elsewhere classified

OFFICE AND STORE MACHINES AND SERVICE INDUSTRY MACHINES

35721 Typewriters or parts

35731 Electronic data processing machines or associated equipment, except typewriters or parts (see 35721)

35741 Calculating or accounting machines, or cash registers

MACHINERY, EXCEPT ELECTRICAL – Continued

OFFICE AND STORE MACHINES AND SERVICE INDUSTRY MACHINES – Continued

35761	Scales or balances, except laboratory (see 38113)
35791	Addressing, dictating, or duplicating machines
35799	Office machines, not elsewhere classified
35811	Automatic merchandising machines (coin operated only)
35821	Commercial laundry equipment or laundry presses
35822	Commercial dry cleaning equipment and clothes presses
35851	Heat transfer equipment
35853	Commercial refrigeration equipment
35854	Compressors or compressor units, all refrigerants
35855	Condensing units, all refrigerants
35856	Ice making machinery or equipment
35857	Air conditioning, cooling, or dehumidifying equipment
35859	Refrigerators or refrigeration machinery, not elsewhere classified

MISCELLANEOUS SERVICE INDUSTRY MACHINES

35891	Commercial cooking or food warming equipment
35892	Commercial or industrial vacuum cleaners, parts or attachments
35899	Service industries machines, not elsewhere classified (water softeners, water purifiers, carpet sweepers, dishwashing machines, floor scrubbing machines, etc.)

MISCELLANEOUS MACHINERY AND PARTS

35921	Carburetors, pistons, or piston rings
35922	Valves (intake or exhaust) for internal combustion engines
35993	Flexible metal hose or tubing, except flexible electric conduit (see 36442)
35994	Amusement or carnival machines or equipment, except coin operated (see 39992)
35999	Machinery or parts, not elsewhere classified, except electrical (see 36---) carburetors, pistons, rings or valves (see 35921 and 35922)

ELECTRICAL MACHINERY, EQUIPMENT OR SUPPLIES

ELECTRICAL GENERATING, TRANSMISSION, DISTRIBUTION, AND INDUSTRIAL APPARATUS

36111	Watt-hour, ampere-hour, demand, or other electrical integrating meters or parts
36112	Test equipment for testing electrical, radio, or communication circuits, or motors
36113	Indicating, recording, or measuring instruments (electrical qualities or characteristics)
36121	Transformers or parts, or fluorescent ballasts
36123	Power regulators, boosters, or reactors
36129	Power, distribution, or specialty transformers, not elsewhere classified (radio or voice frequency chokes, coils, or transformers - see 36791, resistor welding transformers - see 36231)
36131	Switchgear or switchboard apparatus, including power switchgear assemblies, or other switching or interrupting devices
36132	Circuit breakers, fuses, or fuse equipment
36211	Motors
36212	Generators, except for land transportation (see 36213)
36213	Land transportation motors, generators, control equipment, or parts
36214	Prime mover generator sets, except steam or hydraulic turbine (see 35112)
36215	Motor generator sets, electric
36216	Parts or supplies for motors, generators, or motor generator sets, except land transportation (see 36213)
36219	Motors or generators, not elsewhere classified
36221	Industrial controls or parts
36231	Arc or resistance welding machines, components, or accessories, except electrodes (see 36232)
36232	Arc welding electrodes, except carbon electrodes (see 36241)
36241	Carbon or graphite products for electrical application, including carbon electrodes
36291	Capacitors for industrial use, except for electronic application (see 36791)
36292	Rectifying apparatus or parts
36299	Electrical industrial apparatus, not elsewhere classified

ELECTRICAL MACHINERY, EQUIPMENT OR SUPPLIES – Con.

HOUSEHOLD APPLIANCES

36311 Household ranges, ovens, surface cooking equipment, or parts, all types

36321 Household refrigerators, home or farm freezers, all types

36331 Household washing machines, dryers, washer-dryer combinations, or parts

36332 Other household laundry equipment, including ironing machines and equipment, wringers, or laundry equipment parts

36341 Electric fans, except attic fans or commercial or industrial exhaust or ventilating fans or blowers (see 35641)

36343 Small household type electric cooking or heating appliances, except water heaters (see 36392)

36346 Small household electrical appliances, attachments, or parts, except household fans (see 36341), and cooking or heating appliances (see 36343)

36347 Personal electric appliances, parts, or attachments (toothbrushes, portable hairdriers, manicure sets, razors, dry shavers, etc.)

36349 Electric housewares, not elsewhere classified (can openers, shoe shining machines, knife sharpeners, vaporizers, etc.)

36351 Household vacuum cleaners, parts, or attachments

36361 Sewing machines or parts, except cabinets or cases separately (see 25179)

36392 Household water heaters, all types

36393 Household dishwashing machines

36399 Household appliances, not elsewhere classified (floor waxing or polishing machines, garbage disposal units, etc.)

ELECTRIC LIGHTING AND WIRING EQUIPMENT

36411 Electric lamps (bulbs only), or sealed beam lamps

36421 Residential, commercial, institutional, or industrial type electric fixtures

36424 Vehicular lighting equipment, electrical

36425 Outdoor lighting equipment, all types (flood lighting or area lighting)

36429 Lighting fixtures or parts, not elsewhere classified (flashlights, lanterns, miners' lights, emergency warning lights, mercury or sodium vapor lighting equipment, or related equipment)

ELECTRICAL MACHINERY, EQUIPMENT OR SUPPLIES – Con.

ELECTRIC LIGHTING AND WIRING EQUIPMENT – Continued

36432 Convenience or power outlets or sockets

36433 Switches, except knife, time, solenoid, or automotive (see 36131)

36434 Lightning rods

36435 Overhead trolley line material, except poles, wire or cable, pole line hardware, or expansion shells or plugs for roof bolting in mines (see 36441)

36439 Current carrying wiring devices, not elsewhere classified

36441 Pole line or transmission hardware

36442 Electric conduit or conduit fittings, including flexible conduit

36449 Noncurrent carrying wiring devices, not elsewhere classified

RADIO, TV, AND OTHER COMMUNICATION EQUIPMENT AND RELATED PRODUCTS

36511 Household or automotive radios, radio phonograph combinations

36512 Household television receivers, including television combinations

36521 Phonograph records, record blanks, or prerecorded tapes

36611 Telephone switching or switchboard equipment

36612 Telephone or telegraph equipment, except switching or switchboard equipment (see 36611)

36621 Radio or television transmitting, signaling, or detection equipment or apparatus

ELECTRONIC COMPONENTS AND ACCESSORIES

36711 Electronic tubes, except X-ray tubes (see 36931)

36741 Solid state semi-conductor devices (diodes, thermistors, transistors, etc.)

36791 Miscellaneous electronic components or accessories

OTHER ELECTRICAL MACHINERY AND EQUIPMENT

36911 Storage batteries or plates

36921 Primary batteries (dry or wet)

36931 Radiographic X-ray, fluoroscopic X-ray, therapeutic X-ray, or other X-ray apparatus or X-ray tubes

36941 Electrical equipment for internal combustion engines

36999 Electrical machinery, equipment, supplies or lamp bulb components, not elsewhere classified, except glass blanks (see 32292)

TRANSPORTATION EQUIPMENT

MOTOR VEHICLES, EQUIPMENT, AND PARTS

37111 Motor passenger cars, assembled, including air cars

37112 Motor trucks or truck tractors, assembled

37113 Motor coaches, assembled (including trolley busses), or fire department vehicles, except chemical fire extinguishing equipment or parts (see 39991)

37114 Combat motor vehicles, except tracked (see 19311 - 19313)

37115 Motor passenger cars, knocked down or chassis

37116 Motor buses or trucks, truck tractors, motor coaches, or fire department vehicles, knocked down or chassis

37119 Motor vehicles, not elsewhere classified, including golf carts

37121 Passenger motor car bodies

37142 Motor vehicle accessories

37143 Motor vehicle gear frames

37144 Motor vehicle internal combustion engines or parts, except aircraft or missile engines or parts (see 37221 - 37222)

37145 Motor vehicle brakes or parts

37146 Motor vehicle steering gears or parts

37147 Motor vehicle body parts

37148 Motor vehicle wheels or parts

37149 Motor vehicle parts or accessories, not elsewhere classified, including mixed loads

MOTOR VEHICLE BODIES AND TRAILERS

37131 Motor truck bodies

37132 Motor bus bodies

37151 Truck trailers

AIRCRAFT, MISSILES, SPACE VEHICLES, AND MISSILE OR SPACE VEHICLE ENGINES

37211 Complete military aircraft

37213 Complete commercial transport type aircraft (passenger or cargo), including personal and utility types

37221 Aircraft engines or engine parts

37222 Missile engines or parts includes space vehicle engines or parts

37231 Aircraft propellers or parts

37299 Aircraft parts or auxiliary equipment, not elsewhere classified

37691 Guided missile parts, not elsewhere classified, including space vehicle and auxiliary equipment

TRANSPORTATION EQUIPMENT – Continued

BOATS AND SHIPS

37321 Inboard motor boats

37322 Outboard motor boats

37323 Nonpropelled ships (barges, dredges)

37324 Car floats, pontoon or portable bridges

37329 Ships, boats, parts, not elsewhere classified

RAILROAD AND OTHER TRANSPORTATION EQUIPMENT

37411 Locomotives or tenders

37413 Parts for locomotives, all types

37421 Passenger train cars

37422 Freight train cars

37423 Street cars or self-propelled railroad cars

37424 Maintenance or repair cars (weed burners, inspection, etc.)

37426 Railroad car wheels

37428 Railroad or street car parts or accessories, except wheels (see 37426)

37511 Motorcycles, motorscooters, or motorbikes, including bodies, chassis, or side cars

37512 Bicycles

37513 Parts or accessories for motorcycles, motorscooters, motorbikes, or bicycles

37911 Trailer coaches, housing type

37912 Travel trailers or campers

37992 Horsedrawn or similar vehicles, except sleighs or sleds (see 37995)

37993 Hand carts, wagons, wheelbarrows, or related articles or parts

37994 Horsedrawn or similar vehicle parts, except sleigh or sled (see 37995)

37995 Sleighs, sleds, or parts, horsedrawn

37999 Transportation equipment, parts, or accessories, not elsewhere classified, except industrial trucks, tractors, trailers, stackers, or parts (see 35371)

INSTRUMENTS, PHOTOGRAPHIC AND MEDICAL GOODS, WATCHES, AND CLOCKS

INSTRUMENTS

38111 Aircraft flight, nautical, or navigational instruments or automatic pilots

38112 Surveying or drafting instruments

38113 Laboratory or scientific instruments or laboratory furniture

INSTRUMENTS, PHOTOGRAPHIC AND MEDICAL GOODS, WATCHES, AND CLOCKS – Continued

INSTRUMENTS - Continued

38119 Engineering, instruments, not elsewhere classified

38212 Gas, water, or other liquid meters or recording devices

38213 Weather measuring instruments or gauges

38219 Mechanical measuring or controlling instruments, not elsewhere classified

38221 Automatic temperature controls

SURGICAL, MEDICAL, DENTAL, OPTICAL, AND OPHTHALMIC GOODS

38311 Optical instruments or lenses, range or height finders, for sight or fire control equipment, except military (see 19411)

38411 Surgical or medical instruments or apparatus

38412 Hospital, dental, opticians', or operating room furniture, except hospital beds (see 25991)

38421 Orthopedic, prosthetic, or surgical appliances or supplies

38431 Dental instruments, supplies, or equipment, except furniture (see 38412)

38511 Spectacles, eyeglasses, sunglasses, or related ophthalmic or opticians' goods

PHOTOGRAPHIC EQUIPMENT AND SUPPLIES

38612 Photographic developing, photocopy, microfilming, blueprinting, Van Dyke, or white printing equipment

38613 Photographic equipment for still motion pictures, including film magazines

38615 Photographic sensitized film, plates, paper, or cloth

38618 Prepared photographic chemicals

38619 Photographic equipment or supplies, not elsewhere classified

WATCHES, CLOCKS, AND WATCHCASES

38711 Watches, clocks, clockwork operated devices, or parts

MISCELLANEOUS PRODUCTS OF MANUFACTURING

JEWELRY, SILVERWARE, AND PLATED WARE

39111 Jewelry, precious metal; jewelers' findings, materials, or scrap, including lapidary work and cut or polished diamonds

39141 Silverware, plated ware, stainless steel ware, or flatware

MISCELLANEOUS PRODUCTS OF MANUFACTURING – Con.

MUSICAL INSTRUMENTS AND PARTS

39311 Pianos

39312 Organs

39313 Piano or organ parts

39319 Musical instruments, parts, or accessories, except pianos or organs (instrument benches – see 25111, or instrument cases – see 31611)

TOYS, SPORTING, AND ATHLETIC GOODS

39411 Games or toys, except dolls (see 39421), or children's vehicles (see 39431 – 39439)

39421 Dolls or stuffed toy animals

39431 Baby or doll carriages, strollers, or walkers

39439 Children's vehicles or parts, not elsewhere classified, except bicycles, motorcycles, or parts (see 37511 – 37513)

39491 Fishing tackle, equipment, or parts

39492 Billiard or pool tables or playing supplies, including balls

39493 Bowling alleys or bowling alley playing supplies, including balls

39494 Golf clubs, golf balls, golf equipment, or supplies

39496 Tennis, baseball, cricket, softball, football, basketball, badminton, or soccer equipment or supplies, including balls

39497 Playground or gymnasium equipment or parts

39499 Sporting or athletic goods or parts, not elsewhere classified

PENS, PENCILS, AND OTHER OFFICE AND ARTISTS' SUPPLIES

39511 Pens or parts

39521 Pencils or crayons

39522 Artists' materials

39531 Marking devices

39551 Carbon or stencil paper, or inked ribbons

MISCELLANEOUS MANUFACTURED PRODUCTS

39611 Costume jewelry or novelties, except precious metal (see 39111)

39621 Feathers, plumes, and artificial, decorative, or preserved flowers or fruits, except glass (see 32299), or decorative greens or live Christmas trees (see 08611 – 08613)

MISCELLANEOUS PRODUCTS OF MANUFACTURING – Con.

MISCELLANEOUS MANUFACTURED PRODUCTS – Continued

39631 Buttons or parts, except precious or semiprecious metals or precious or semiprecious stones

39641 Zippers or slide fasteners

39642 Needles, pins, fasteners or similar notions, except slide fasteners (see 39641)

39911 Brooms or brushes

39921 Asphalted – felt base floor coverings, including linoleum or wall coverings, except vinyl asbestos (see 32923), cork (see 24941), or rubber (see 30614)

39931 Luminous tubing or bulb signs

39932 Nonelectric advertising signs, advertising displays or novelties

39934 Nonelectric road or traffic signs

39941 Morticians' goods

MISCELLANEOUS PRODUCTS OF MANUFACTURING – Con.

MISCELLANEOUS MANUFACTURED PRODUCTS – Continued

39961 Matches

39971 Furs, dressed or dyed

39991 Chemical fire extinguishing equipment or parts

39992 Coin operated amusement or service machines

39993 Beauty or barber shop furniture or equipment

39994 Hair work, switches, toupees, wigs, etc.

39995 Tobacco pipes or cigarette holders, accessories, or parts

39996 Christmas tree or holiday decorations, except Christmas tree bulbs or sets (see 36999)

39999 Miscellaneous manufactured products, not elsewhere classified

Section B - NONMANUFACTURED COMMODITIES, ORDNANCE, AND SCRAP

FARM PRODUCTS

01121 Raw cotton in bales

01129 Raw cotton, not elsewhere classified

01131 Barley

01132 Corn, except popcorn (see 01152) or sweet corn (see 01393)

01133 Oats

01134 Rice, rough

01135 Rye

01136 Sorghum grains

01137 Wheat, except buckwheat (see 01139)

01139 Grain, not elsewhere classified, including grain screenings, unground

01141 Cottonseeds

01142 Flaxseeds (linseeds)

01143 Raw peanuts, edible, not salted

01144 Soybeans (soya beans)

01149 Oil seeds, oil nuts, and oil kernels, not elsewhere classified (edible tree nuts – see 01298 or 20712)

01151 Lawn grass seed

01152 Popcorn, not popped

01159 Field seeds, except oil seeds, not elsewhere classified (oil seeds – see 01141 – 00149)

01191 Hay, fodder, or roughage, except chopped, ground, or pulverized (see 01991 – 01992)

FARM PRODUCTS – Continued

01192 Hops

01193 Leaf tobacco

01194 Potatoes, sweet

01195 Potatoes, other than sweet

01196 Straw, except chopped, ground, or pulverized (see 01991).

01197 Sugar beets

01198 Sugar cane

01199 Field crops, not elsewhere classified

01211 Grapefruit

01212 Lemons

01214 Oranges

01215 Tangerines

01219 Citrus fruits, not elsewhere classified

01221 Apples

01222 Apricots

01223 Cherries

01224 Grapes

01225 Nectarines

01226 Peaches

01227 Pears

01228 Plums or prunes, except marmalade plums (see 01239)

01229 Deciduous fruits, not elsewhere classified

FARM PRODUCTS – Continued

01231 Avocados

01232 Bananas

01233 Pineapples

01239 Tropical fruits, not elsewhere classified, except citrus (see 01211 - 01219)

01291 Cane or bush berries

01292 Cranberries

01293 Strawberries

01294 Cocoa beans

01295 Coffee, green

01298 Nuts, edible, in the shell, except peanuts (see 01143)

01299 Fresh fruits or tree nuts, not elsewhere classified

01311 Fresh beets, with or without tops, except sugar beets (see 01197)

01312 Fresh carrots, with or without tops

01313 Fresh green onions, with tops

01315 Fresh radishes, with or without tops

01317 Fresh turnips, with or without tops

01318 Onions, dry, without tops

01319 Bulbs, roots, or tubers, with or without tops, not elsewhere classified, except potatoes (see 01194 - 01195)

01331 Broccoli, fresh or green

01332 Brussels sprouts, fresh or green

01333 Cabbage, fresh or green

01334 Celery, fresh or green

01335 Lettuce or romaine, fresh or green

01336 Spinach, kale, chards, or collards, fresh

01337 Cauliflower, fresh or green

01339 Leafy fresh vegetables, not elsewhere classified

01341 Beans, dried ripe

01342 Peas or split peas, dried

01343 Lentils, lupines, or cowpeas, dried

01349 Dry ripe vegetable seeds used as food not elsewhere classified, except artifically dried (see 20342 - 20343)

01391 Beans (green, string, lima, wax) or peas, green or fresh

01392 Watermelons, fresh

01393 Sweet corn, in the husk

01394 Tomatoes, fresh or green

01395 Cucumbers, fresh or green, or not further processed than pickled in brine

FARM PRODUCTS – Continued

01396 Peppers, fresh or green

01397 Pumpkins, squash, or cymlings, fresh or green

01398 Cantaloupes, muskmelons, or melons, except watermelons (see 01392)

01399 Fresh vegetables, not elsewhere classified

01411 Cattle (bulls, cows, heifers, oxen, or steers), except calves

01412 Calves

01413 Swine (barrows, boars, hogs, pigs, or sows)

01414 Sheep (ewes, lambs, rams, or wethers)

01415 Goats or kids

01419 Livestock, not elsewhere classified, except horses or mules (see 01921)

01421 Dairy farm products (fresh milk, cream, etc.), except pasteurized (see 20261 - 20264)

01431 Wool, except scoured (see 22971)

01432 Mohair (angora goat hair), except scoured (see 22971)

01439 Animal fibers, not elsewhere classified, including silk fibers

01511 Live chickens, except baby chicks

01512 Live turkeys, except poults

01513 Live baby chicks, poults, etc.

01519 Live poultry, not elsewhere classified

01521 Eggs, market

01522 Hatching eggs, chicken

01523 Hatching eggs, turkey

01529 Poultry eggs, not elsewhere classified

01911 Cut flowers

01912 Nursery stock (flower plants, bulbs, or tubers; shrubs; vines; fruit or shade trees, etc.)

01915 Herbs (seeds, leaves, roots, etc.)

01916 Mushrooms, fresh

01917 Vegetable or berry plants

01918 Flower or vegetable seeds

01919 Horticultural specialties, not elsewhere classified

01921 Horses, ponies, mules, asses, or burros, live

01923 Hides, skins, or pelts, not tanned, except cattle, pig, goat, sheep, mule, horse (see 20141), or marine animal (see 09132)

01928 Animal or poultry manure

FARM PRODUCTS – Continued

01929 Animal specialties, not elsewhere classified

01991 Chopped, ground, or pulverized straw, hay, or related agricultural products, except alfalfa

01992 Chopped, ground, or pulverized alfalfa

01999 Farm products, not elsewhere classified

FOREST PRODUCTS

08422 Barks or gums, crude, except latex or allied gums (crude rubber)

08423 Latex or allied gums (crude natural rubber)

08611 Christmas trees

08612 Decorative evergreens, mistletoe, holly

08613 Ferns

08619 Forest products, not elsewhere classified, including inedible tree seeds, except oil seeds (see 01141 – 01149)

FRESH FISH AND OTHER MARINE PRODUCTS

09121 Finfish

09122 Shellfish

09123 Whale products

09131 Shells: oyster, crab, clam, etc.

09132 Marine animal skins, untanned, except whale skins (see 09123)

09139 Miscellaneous marine products, not elsewhere classified

09891 Tropical fish hatcheries or farms

METALLIC ORES

10111 Iron direct-shipping ores, crude

10112 Iron beneficiating-grade ores, crude

10113 Iron concentrates and agglomerates

10211 Copper ores, crude

10212 Copper concentrates or precipitates

10311 Lead ores, crude

10312 Lead concentrates

10321 Zinc ores, crude

10322 Zinc concentrates

10331 Lead and zinc ores combined, crude

10332 Lead and zinc concentrates combined

10411 Gold ore or tailings, crude

10412 Gold concentrates, precipitates, or gold mill bullion

10421 Silver ore or tailings, crude

METALLIC ORES – Continued

10422 Silver concentrates or silver mill bullion

10511 Bauxite ores, crude

10513 Bauxite ores, calcined or activated

10514 Aluminum ores, except bauxite

10611 Manganese direct-shipping ores, crude

10612 Manganese beneficiating-grade ores, crude

10613 Manganese concentrates and agglomerates

10711 Tungsten ores, crude

10712 Tungsten concentrates

10811 Chromium ores, crude

10812 Chromium concentrates

10923 Radioactive ores (uranium, radium, etc.)

10929 Metal ores, not elsewhere classified

COAL

11111 Raw anthracite

11112 Cleaned or prepared anthracite (crushed, screened, or sized), except ground or pulverized for other than fuel or steam purposes (see 29919)

11119 Anthracite coal wastes

11211 Raw bituminous coal

11212 Cleaned or prepared bituminous coal (crushed, screened, or sized), except ground or pulverized for other than fuel or steam purposes (see 29919)

11219 Bituminous coal wastes

11221 Lignite, raw or prepared (crushed, screened, or sized), except ground or pulverized for other than fuel or steam purposes (see 29919)

CRUDE PETROLEUM, NATURAL GAS, AND NATURAL GASOLINE

13111 Petroleum, crude

13121 Gas, natural

13211 Gasoline, natural, except liquefied petroleum gases (see 29121)

NONMETALLIC MINERALS, EXCEPT FUELS

14111 Dimension stone, quarry, except dressed, polished, shaped or otherwise finished (see 32811 – 32819)

14211 Agricultural limestone, broken or crushed, except ground or otherwise treated (see 32959)

14212 Fluxing stone, including fluxing limestone, broken or crushed

NONMETALLIC MINERALS, EXCEPT FUELS – Con.

14213 Dolomite, raw, broken or crushed

14219 Crushed or broken stone, including riprap, not elsewhere classified

14411 Sand (aggregate or ballast)

14412 Gravel (aggregate or ballast)

14413 Industrial sand, crude, including ground or pulverized, except otherwise treated (see 32952)

14511 Bentonite, crude, except ground or otherwise treated (see 32952)

14512 Fireclay, crude, except ground or otherwise treated (see 32952)

14513 Fullers' earth, crude, except ground or otherwise treated (see 32952)

14514 Kaoline or ball clay, crude, except ground or otherwise treated (see 32952)

14515 Feldspar, crude, except ground or otherwise treated (see 32955)

14516 Magnesite or brucite, crude, except ground or otherwise treated (see 32953 or 32959)

14519 Clay, ceramic or refractory minerals, not elsewhere classified, crude, except ground or otherwise treated (see 32951 – 32959)

14711 Barite, crude, except ground or otherwise treated (see 32959)

14712 Fluorspar, crude, except ground or otherwise treated (see 32959)

14713 Potash, soda, or borate, crude, except ground or otherwise treated (see 32959 or 28121 – 28129)

14714 Apatite or phosphate rock, clay or sand, crude, except ground or otherwise treated (see 28194 or 28712 – 28719)

14715 Rock salt, crushed, lump or screened, except sodium chloride (see 28991)

14716 Sulphur, crude, liquid, molten or solid, except ground or otherwise treated (see 32959)

14719 Chemical or fertilizer minerals, not elsewhere classified, except ground or otherwise treated (see 28712 – 28719 or 32951 – 32959)

14911 Gypsum or anhydrite, crude, except crushed or ground (see 32956)

14912 Mica, crude, except ground or otherwise treated (see 32957)

14913 Native asphalt or bitumens

14914 Pumice or pumicite, crude, except ground or otherwise treated (see 32959)

14915 Talc, soapstone, or pyrophyllite, crude, except ground or otherwise treated (see 32954)

NONMETALLIC MINERALS, EXCEPT FUELS – Con.

14916 Natural abrasives, flour or sized grains, including powders, except sand or industrial diamonds (see 32912 or 14411 – 14413)

14917 Peat, natural, except ground or otherwise treated (see 32959)

14918 Diatomaceous or infusorial earths, crude, including ground or otherwise treated, except fuller's earth (see 14513 or 32952)

14919 Nonmetallic minerals, not elsewhere classified, including soil, loam topsoil, earth, fill dirt, etc., except fuels or ground or otherwise treated (see 32951 – 32959)

14921 Water, raw, for construction or irrigation purposes

14922 Water, drinking, except carbonated or mineral (see 20861)

ORDNANCE AND ACCESSORIES

19111 Guns, howitzers, mortars, or related equipment, over 30 mm.

19251 Guided missiles, completely assembled

19291 Artillery ammunition or related parts

19293 Military bombs, mines, or parts

19299 Ammunition or related parts, not elsewhere classified (including torpedos, chemical warfare projectiles, depth charges, grenades, or rockets other than guided missiles)

19311 Military tanks and parts, except tank engines (see 35199)

19312 Military self-propelled combat weapons or parts

19313 Full tracked combat vehicles or parts, except tanks or self-propelled weapons (see 37114)

19411 Military sighting and fire control equipment, except optical lenses or prisms (see 38311)

19511 Machine guns, 30 mm. or under

19512 Small arms, 30 mm. or under, except machine guns

19611 Small arms ammunition, 30 mm. or under except blasting or detonating caps or safety fuses (see 28921), or fireworks (see 28993)

19911 Miscellaneous ordnance, accessories, or parts

Section B - NONMANUFACTURED COMMODITIES, ORDNANCE, AND SCRAP—Continued

WASTE AND SCRAP MATERIALS

40112 Ashes

40211 Iron or steel scrap, wastes, or tailings

40212 Brass, bronze, copper, or other copper base alloy scrap, wastes, or tailings

40213 Lead, zinc, or lead and zinc alloy scrap, wastes, or tailings

40214 Aluminum or aluminum base alloy scrap, wastes or tailings

40219 Nonferrous metal or nonferrous metal alloy waste, scrap, or tailings, not elsewhere classified

40221 Textile waste, scrap, or sweepings

40231 Wood scrap or waste

40241 Paper waste or scrap

40251 Chemical or petroleum waste, including spent

WASTE AND SCRAP MATERIALS – Continued

40261 Rubber or plastic scrap or waste

40271 Stone, clay, or glass waste or scrap

40281 Leather waste or scrap

40291 Waste or scrap, not elsewhere classified

CONTAINERS, SHIPPING, RETURNED EMPTY

42111 Shipping containers, returned empty, barrels, bottles, bags, boxes, crates, cores, drums, kegs, reels, tubes or carriers, not elsewhere classified

42112 Shipping devices, returned empty, blocking, bolsters, cradles, pallets, racks, skids, etc.

MISCELLANEOUS MIXED SHIPMENTS

46000 Loaded, commodity not determined

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