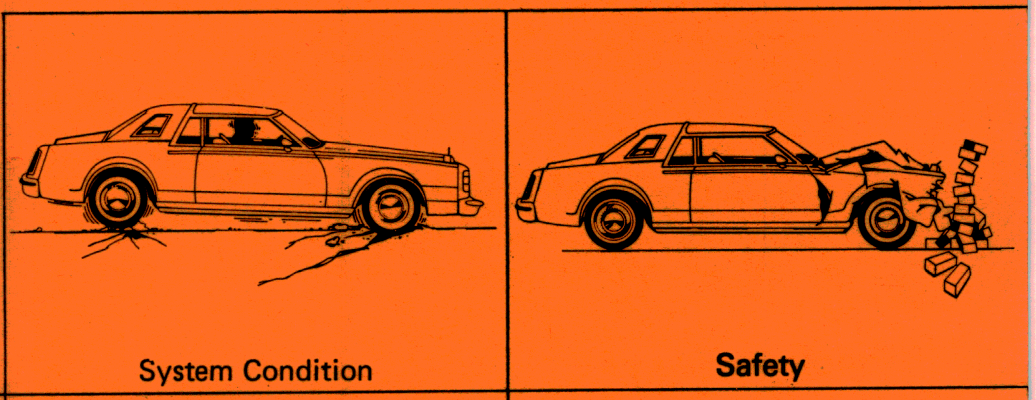
Highway Performance Monitoring System

Case Study Procedural Manual - Truck Weight



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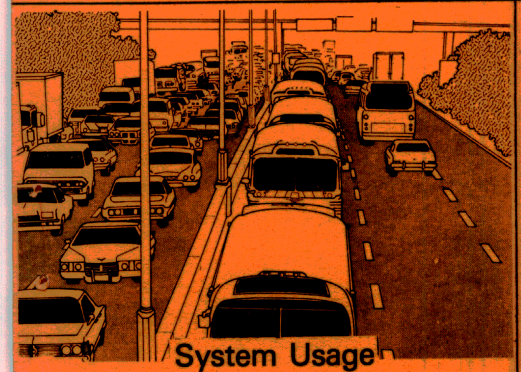

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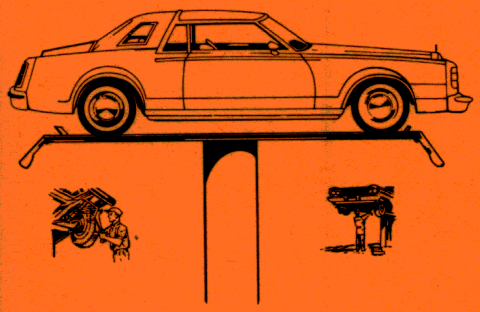

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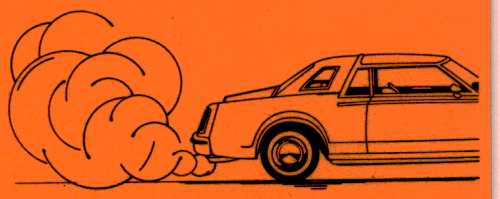

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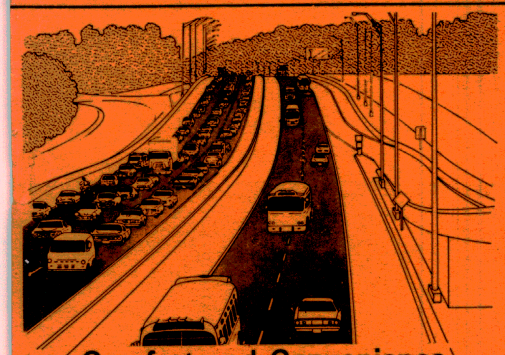

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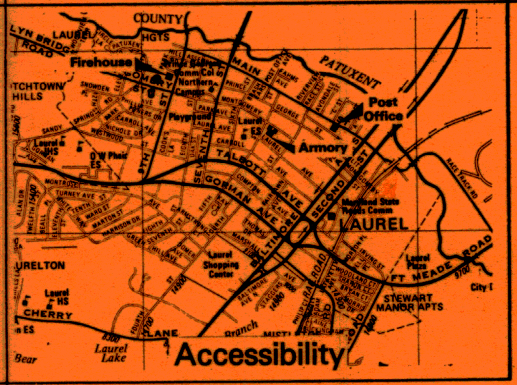


DEPARTMENT OF TRANSPORTATION
UNITED STATES OF AMERICA

U.S. DEPARTMENT OF TRANSPORTATION

Federal Highway Administration

Program Management Division

January 1980

HIGHWAY PERFORMANCE MONITORING SYSTEM

Case Study

TRUCK WEIGHT

January 1980

TRUCK WEIGHT

BACKGROUND

The Highway Performance Monitoring System (HPMS) has been designed and implemented as a continuing information system encompassing data collection, extensive data analysis and modeling, and historical recordkeeping. Basically, the HPMS will provide the Federal Highway Administration (FHWA) with the capability to: (1) periodically assess the extent and condition of the highway system, (2) monitor the performance of the highway systems on a continuing basis, (3) calculate the impacts of existing highway programs and policies, and (4) forecast potential impacts of future alternative programs and policies. In addition HPMS will serve a host of other activities such as supporting various reports to the Congress; supporting day-to-day program and policy evaluations; satisfying routine planning data needs; responding to continuing inquiries and requests from the Administration, the Congress, and the public; and providing the nucleus for national studies such as the Highway Cost Allocation Study (HCAS).

The data requirements for HPMS were established using a "top down" approach in which program and policy impacts of interest were identified, performance measures for each impact area were established and a minimum set of data necessary to derive the performance measures and describe the highway systems was defined. Having defined the required dataset, the most efficient and practical means of obtaining the required information was sought.

It was decided that certain information such as mileage, travel, capital investments, bus usage and service, land area and population had to be obtained on a universe summary basis as general information and as control totals for sample expansion. Existing planning data reporting systems have been or are being modified to provide the required universe data. Required summaries are being reported on an interim basis as a part of the initial implementation of HPMS. Likewise it was decided that data describing most of the physical and operational characteristics of the highway systems could best be obtained by statistically sampling sections and expanding the values for these sections to represent the universe of mileage. To this end, each State was asked to establish rural, small urban and individual urbanized area panels of sections and to report a majority of the required section specific data and all interim areawide data summaries by December 31, 1979.[1]

While the reporting of section specific data required for the panels of sections satisfies most of the HPMS need for section specific data, there is a limited amount of equally important and necessary cost/labor intensive data impractical to get on a section by section basis. This type of data will be obtained through case studies in which "typical" or representative values will be established which can be applied to like sections in the panels of sections. Case studies to provide this type of data are concerned with vehicle occupancy, truck weight, and vehicle classification. Other case studies will be concerned with detailed data for analytical model development.

[1] "Highway Performance Monitoring System, Field Implementation Manual". FHWA, January 1979

INTRODUCTION

The Truck Weight case study is concerned with obtaining truck weight and loading characteristics data in addition to that available through the biennial Truck Weight Study (TWS). This truck weight data along with vehicle classification data from a similar case study will define the traffic streams on HPMS sections in terms of 13 representative vehicle categories and both gross and axle weight distributions for eight of the truck categories and buses. While the primary use of this data for HPMS will be to calculate ton-miles of freight moved, this data also will enable HPMS to better assess such things as pavement damage and energy consumption.

In addition to satisfying HPMS needs, this effort will provide some of the fundamental input to the HCAS which is currently underway. The case study will provide the information necessary for the HCAS to address the assessment of cost responsibility and pavement deterioration. The FHWA will also use the data to fully assess the Federal interest in reporting a minimum set of weight data on a continuing basis.

The purpose of this manual is to provide detailed instructions to be used by the States which agree to collect this data.

SCOPE

The companion Vehicle Classification Case Study [1] is designed to provide a representative sample of the vehicle distribution for traffic on all rural and urban functional highway systems except local roads and streets. This will permit the disaggregation of the total estimated travel on these systems into the 13 observed vehicle categories. The sample design of that study is intended to measure variations in vehicle distributions across functional highway systems, season, day of week, and time of day. In contrast, this case study on vehicle weight is primarily designed to measure the variations in truck operating weights. Consequently the sampling design provides for representation of each vehicle category. As a secondary concern the variation of loading practices across functional highway systems, time of day, season, and day of the week will be tested. Vehicles classified in one of the basic truck categories listed in Table 1 shall be weighed. Note that 2-axle, 4-tired trucks with or without trailers will not be weighed.

The biennial Truck Weight Study normally conducted by the States provides data similar to that which is required in this case study. However, due to the nature of that study, there are certain voids in the data:

1. TWS is generally reflective of rural intercity truck movements. Urban data is very sparse.
2. TWS does not measure seasonal or day of the week truck loading pattern variations.
3. Due to the type of information which is gathered (e.g. axle spacings), it is a time consuming operation which tends to make heavy truck operators avoid being stopped. Therefore the sample of data collected by the TWS may not be representative of all trucks.

[1] Case Study Procedural Manual - Vehicle Classification, FHWA, January 1980

TABLE 1

VEHICLE CATEGORIES

HPMS Vehicle Category Number	TWS Code 1/ (Samples)	Description 2/
4	1100nn 3/	Buses (e.g. intercity, commercial)
6	2200nn 3/	2-Axle, 6-Tire Single Unit Truck
7	2300nn 3/	3 or More Axle Single Unit Truck
8	321000 421000	3-Axle Combinations (e.g. 2S1, or 2-1)
9	322000	2-Axle Tractor w/2-Axle Semi-Trailer (2S2)
10	331000 431000	Other 4-Axle Combination Trucks (e.g. 3S1 or 3-1)
11	332000	3-Axle Tractor w/2-Axle Semi-Trailer (3S2)
12	432000 521200	Other 5-Axle Combinations (e.g. 2S1-2, or 3-2)
13	521300 532200	6 or More Axle Combinations (e.g. 2S1-3, or 3S2-2)

1/ States will utilize the 6-digit TWS coding scheme for reporting vehicle category. See Appendix B.

2/ See Appendix A for detailed descriptions of these vehicle categories.

3/ For case study purposes these last two columns may be coded "00" unless "State of Registration" for buses and single unit trucks is desired by participating States.

The purpose of this case study is to augment the TWS and to provide a more extensive set of truck weight data than has been collected since the 1956 Highway Cost Allocation Study (sometimes referred to as the "210 Study").

In addition to providing the data to estimate ton-miles of freight moved, one of the principal uses of the data which will result from this study will be to monitor pavement loadings and to aid in the quantification of vehicle category responsibility for pavement deterioration. Since pavement loading and deterioration relationships are known to be very sensitive, it is necessary to have the vehicles stratified by a fine series of operating weight strata; the reliability of this data must be as high as possible given the available resources.

The States which undertake this case study are requested to innovate ways of avoiding the traditional problems with obtaining a truly representative sample. All available technologies should be employed to overcome these biases.

Three major approaches to obtaining truck weight data exist:

1. Data collected via permanent pit and portable static weighing scales,
2. Data collected via weigh-in-motion scales in States having that type of equipment, and
3. Data collected at enforcement weigh stations.

We anticipate that static weighing will provide the bulk of the data. A static weighing process is needed so that the required information on registered weight, class of operation, commodity type, etc., can be obtained by interviewing the truck drivers. Data from weight-in-motion and enforcement scales will best serve in defining temporal variations (seasonal,day of the week, and hourly). This manual establishes a framework of what is desired from this case study. Specific work plans will be negotiated with each participating State.

In situations where permanent weighing installations do not exist, temporary weighing locations and portable scales will be used. Ideally, data collection will be scheduled to provide data representative of all 24 hours of the day (particularly on the higher functional systems), weekdays and weekends, and seasons of the year.

The established TWS data format and coding scheme will be utilized for this case study. The number of data items required has been reduced from the normal TWS submissions. For example, the measuring of axle spacing is not required.

Generally, the completion of the truck weight case study supplemented by the 1980 TWS effort will provide a representative sample of data to fill all cells in the matrix in Figure 1. Over representation in some cells, e.g. Interstate, should be avoided by considering TWS activities when planning case study work.

As a part of the weighing case study the weights of a sample of intercity buses shall be collected. This can either be done as a part of the roadside weighing operation or at such high density locations as terminals and amusement parks. Plans for this aspect of the case study will be approved by FHWA on an individual State basis.

HPMS

TRUCK WEIGHT DISTRIBUTION MATRIX

HPMS VEHICLE CATEGORY	RURAL			URBAN		
	INTERSTATE	OTHER PRINCIPAL ARTERIALS	MINOR ARTERIALS & COLLECTORS	INTERSTATE & OTHER FWYS & EXPWYS	OTHER PRINCIPAL ARTERIALS	MINOR ARTERIALS & COLLECTORS
Buses						
2-Axle, 6-Tire Single Unit						
3 or More Axle Single Unit						
3-Axle Combinations						
2S2 Combinations						
Other 4-Axle Combinations						
3S2 Combinations						
Other 5-Axle Combinations						
6 or More Axle Combinations						

Sample in each cell is representative of all temporal variations.

Figure 1

DISTRIBUTION OF WEIGHING SITES AND WORK SHIFTS

It will be necessary to collect data for the same sites over time to measure temporal varations (hour of the day, weekday versus weekend, and season of the year), one of the main areas of concern. Weight data must also be collected in rural and urban areas to define differences in rural and urban loading characteristics for each vehicle category. Within rural and urban areas, weight data representative of three strata of the arterial and collector mileage - (1) Interstate (plus other freeways and expressways in urban areas), (2) other principal arterials, and (3) minor arterials and collectors - will be collected to test whether there are significant differences by functional highway type.

Each strata should be represented by a minimum of two (2) sites. Because only two sites per strata are being required it is very important that the sites selected be representative of the truck traffic using the particular strata and capture trucks in as many of the 8 HPMS truck categories as possible. Sites should be avoided which will capture a known biased truck population, i.e., a site next to a concrete plant. However, in the event that such a site cannot be avoided, care should be taken to sample a limited number of the recurring truck category.

Sufficient data should be collected at each weighing site to identify hour of day, weekday versus weekend, and season of the year variations. To establish seasonal variation, weight data should be collected for one weekday per weighing site per quarter. In the interest of obtaining representative weekday coverage, weight data for the two sites assigned to each strata should be collected on different dates.

To establish weekday versus weekend differences, weight data for one Saturday or Sunday should be collected each quarter (two Saturdays and two Sundays in four quarters) at one of the two sites in each strata. Available data indicates that a relatively high percentage of VMT occurs on weekends when there is a sharp decrease in truck travel. It is important to know if the loading characteristics of these weekend trucks are different so that they can be given the proper consideration in ton-miles of freight moved, pavement damage and cost responsibility calculations.

Ideally, 24 hours of weight data should be collected to establish hourly variation. While there is a definite need for such hourly data on the Interstate and other principal arterial systems where there will likely be a significant number of trucks to weigh around the clock, it is recognized that truck traffic on the minor arterials and collectors is greatly reduced during nighttime hours. For this reason weight data representative of 16 hours should be obtained for minor arterials and collectors. While data collection for the full weigh period (24 hours or 16 hours) is preferable, the required hourly data may be collected in eight or more hour shifts. At least seven hours of weighing should be done in the typical eight hour shift. When data are collected in shifts rather than for 24 continuous hours, the shifts should be scheduled so that the quarterly data collection for a site is accomplished within 30 days. Shifts for sites within a given strata should be distributed over the appropriate days to give representative weekday or weekend coverage. An alternative schedule should be proposed to FHWA Headquarters personnel where collection of data for the full weighing period —24 or 16 hours— is not possible.

Table 2 shows the minimum desired distribution of sites and shifts by area and functional class within each area.

TABLE 2

REQUIRED DISTRIBUTION OF SITES AND SHIFTS

AREA/ FUNCTIONAL CLASS	WEIGHING SITES REQUIRED	SHIFTS/QUARTER	
		WEEKDAY (2 SITES)	WEEKEND (1 SITE)
Rural			
Interstate	2	6	3
Other Principal Arterials	2	6	3
Major and Collectors	2	4	2
Urban			
Interstate	2	6	3
Other Principal Arterials	2	6	3
Major and Collectors	2	4	2
	12	32	16

48 Shifts Total

DATA COLLECTION METHODS

Appendix B details the data items to be collected and coding scheme for reporting. The three approaches for gathering data- Static weighing, weighing-in-motion, and observing enforcement weighing- are discussed in this section. The weighing of buses and weighing in urban areas present special problems which are also discussed later in this section.

Static Weighing

The major source of data for this case study will be static weighing operations using either portable scales or permanent platform scales. Current TWS field weighing procedures will adequately serve the purposes of this case study.

It is important that a representative sample of each vehicle type be weighed at each station. A procedure which has been used successfully in several States to assure unbiased probability sampling at locations where volumes are so great that all passing trucks cannot be weighed is suggested. Using this procedure, each shift of operation is subdivided into short intervals of 10 or 15 minutes. These intervals are then employed to control the sampling of the traffic stream in order to assure that it is systematic and representative.

Rare or infrequent vehicles are weighed during all intervals. Less rare vehicles are assigned fewer intervals and highly common vehicles are weighed only during occasional intervals to avoid "over sampling".

As an example:

TRUCK CATEGORY	All Intervals	Every 2nd Interval	Every 3rd Interval
4 - Buses	x		
6 - Single Unit. 2 Axle 6 tired		x	
7 - Single unit 3 or more axles		x	
8 - Combinations with three axles		x	
9 - Combination 2S2			x
10 - Combinations with 4 axles		x	
11 - Combination 3S2			x
12 - Combinations with 5 axles	x		
13 - Combinations with 6 or more axles	x		

At lower volume locations, it would be desirable to weigh the entire traffic stream. The virtue in this scheme is flexibility and optimization of the sample to collect the maximum of useful data.

When a single vehicle passes a station several times a day it need be weighed only twice, once empty and once loaded.

Alternative Urban Weighing Approach

It is important to obtain representative weight data for each visual vehicle category in a manner which is as safe and efficient as possible for all concerned. However, in some urban areas it may seem impossible to locate weighing sites at ideal locations such as natural barriers, major bridges, railroad crossings, ports of entry, etc., where a representative portion of the truck population can be weighed conveniently. In these cases innovative solutions must be used to counteract the problems of establishing a safe weighing operation and of trucks by-passing the weighing operation easily. These solutions will require ingenuity and considerable thought in order to locate sites where a representative sample of trucks may be stopped and weighed safely.

One scheme which has been used successfully in a large urban area to weigh trucks from a major surface street for which there are no convenient bypass routes and on which there is no possibility for safely weighing trucks on the traveled way is as follows:

1. Set up the weighing station on a convenient local side street where there is little or no traffic flow. If parking is normally allowed it should be temporarily prohibited to gain the space required to weigh and maneuver trucks.

2. Use flagmen on the major street to direct the required sample of trucks to the weighing site. Additional flagmen and/or signing should be used to facilitate left turn movements by trucks entering or leaving the local street.

Another possibility is to draw an imaginary line through all possible by-pass routes and to position the line in such a manner that would allow the diversion of trucks from the intersected routes to a common weighing site or sites. This would require the use of law enforcement personnel to assure that vehicles comply with the detour signing. The physical separation of the intersected routes will also be a factor in determining the success of this kind of an operation. If a screenline approach is used it will be necessary to maintain the identity of the functional class of the street from which the truck was sampled. It will also be necessary to devote the same weighing effort to the screenline as would have been devoted to individual sites in order to measure temporal variation.

In the case of an urban freeway, it may be possible to divert truck traffic to a convenient service road for weighing. Easy return to the freeway would be mandatory however.

While the foregoing ideas may not contain a viable solution to all urban situations, they are mentioned here only to indicate that a deviation from traditional thinking will be necessary to gather the sample of urban truck weight data this study requires.

Bus Weighing

The need for information on loading characteristics stems from the problem of allocating pavement wear to this category of vehicle. In general, three categories of buses are of interest:

1. Intercity
2. Transit (Intracity)
3. School

The only bus type which presents a problem in estimating the average loading is the intercity bus. Otherwise passenger statistics are generally available with which to compute an average load. Intercity bus loadings are a special case because they consist of both passenger and cargo weights. It is felt that since a significant amount of cargo is carried by the intercity buses, it is necessary to obtain a representative sample of their weights. Transit and school buses need not be weighed.

There is a reluctance on the part of State highway agencies to weigh buses because of safety considerations and passenger delays. The personnel of the truck weighing crew must be specially instructed with regard to buses so that they are weighed as expeditiously as possible. Special signing must be used to instruct bus drivers to stop. Traditionally these vehicles have not been weighed. This departure from tradition will require special traffic control and safety precautions.

An alternative to roadside weighing of buses is to make a special survey of bus weights at locations where buses are concentrated, e.g. bus terminals. If it is decided to weigh buses at or near a bus terminal, it would be advisable to seek the cooperation of the bus operating company and the local law enforcement agency for traffic control assistance.

Weighing-in-Motion

Weighing-in-motion data may be acquired to supplement the temporal data obtained through static weighing operations.

The suggested minimum number of sites is 4, 2 rural sites and 2 urban sites. A more extensive coverage such as that suggested for static weighing would be more desirable. The individual sites within the rural and urban areas should not be in the same functional class categories (i.e. (1) Interstate, (2) other principal arterials and (3) minor arterials and collectors). Additional sites should be added based on negotiations between participating States and FHWA.

At each site 24 hours of data should be obtained for two weekdays and one weekend day per quarter. Data should be collected for two Saturdays and two Sundays in a year. Such data collection will more fully define hourly, weekday versus weekend, and seasonal variations in weight data.

The data items to be collected via this means are as follows:

State Code
Functional Class

Station Identification
Year
Month
Date
Hour of the day
Vehicle Type Code[1]
Total Weight
Axle Weights
Axle Spacing and Wheelbase [2]

Enforcement Weighing

Weight data collected by observation at enforcement weighing stations may be used to supplement the temporal data obtained through static weighing operations. While weigh-in-motion operations tend to be limited to southern States, enforcement weighing sites provide a source of temporal data in all States. Obtaining temporal data via this means may be particularily important in those areas where weigh-in-motion operations do not exist. Data should be recorded by a highway agency observer while not interfering with enforcement operations.

Data collection at a minimum of four sites, two rural and two urban, would be desirable. The individual sites within the rural and urban areas should not be in the same functional class categories (i.e., (1) Interstate, (2) other principal arterials, and (3) minor arterials and collectors). Including additional sites is a matter to be negotiated between participating States and FHWA headquarters personnel.

At each site 24 hours of data should be collected for two weekdays and one weekend day per quarter. (In four quarters data should be obtained for two Saturdays and two Sundays). Data in this detail will more fully define hourly, weekday versus weekend day and seasonal variations in weight data. Because of the time and daily coverage requested, permanent pit scale locations that are operated frequently for extended periods of time are particularly appropriate for this case study.

The data items to be collected via this means are as follows:

State Code
Functional Class
Station Identification
Year
Month
Date
Hour of the Day
Vehicle Type Code [1]
Total Weight
Axle Weights

[1]Determined by observation. Definitions and coding instructions for these items are contained in Appendix B.

[2]Axle spacing and wheelbase are not required HPMS data items but they should be reported as W-I-M- data items as they are machine produced.

REPORTING TRUCK WEIGHT DATA

Data collected for this case study will be submitted quarterly to the Federal Highway Administration (HHP-12) on magnetic computer tape utilizing the data format and coding scheme described in Appendix B. As is the case with the normal Truck Weight Study, data will be edited in the field prior to submission using software provided by FHWA. Edited data should be submitted within 30 days of the end of a calendar quarter. Only collection and submission of truck weight data are required; station description (Number 2) and vehicle classification (Number 4) cards are not required. However, we would like to receive a narrative description of each weighing site including station designation, functional system, AADT, number of lanes, city and/or county, and any other significant features of the site or weighing conditions.

Data should be submitted on a 2400 foot reel with data recorded at a density of 1600 bytes per inch. Other requested tape characteristics include standard labels, 80 character records, records blocked by 10, and a tape serial number consisting of six characters. (Tapes will be returned to States after the data are copied.)

The case study data format for truck weights will closely resemble the normal Truck Weight Study number 7 cards. (Note: case study data will have a "9" in column 1.) Some data items will not be collected or will be optional making execution of the current edit program impossible. To compensate for this, the following three new computer programs will be made available to participating States for use in preparing case study data for submission to FHWA:

1- Program 'Defaults' will fill any optional or not required data fields in which no information has been given. The program uses standard default values which will be acceptable to the edit program.

2- Program 'Spacer' will supply axle spacing information if not provided according to the vehicle type code supplied in columns 18-23 of the case study data. This information will be based on average axle spacing data from previus Truck Weight Study data.

3- Program 'Tkwtedit' is a new version of the truck weight study edit program. It will be used for the case study data only. The final output from the edit program, once all corrections have been made, will be forwarded to the Federal Highway Administration.

Truck Weight Case Study

Appendix A

Vehicle Type Definitions

General

The HPMS Vehicle Classification Case Study Manual contains a detailed discussion of what vehicles are to be counted, how they are to be classified, and instructions for classifying unusual trucks and combinations. For HPMS purposes, 13 vehicle types were identified. This truck weight case study is concerned with obtaining weights for 9 of these categories (categories 4 and 6 through 13). This appendix contains the detailed vehicle category definitions adopted for HPMS use.

Vehicle Categories - Specific

1. Standard and Compact Passenger Cars - All sedans, coupes, and station wagons manufactured primarily for the purpose of carrying passengers which in general meet the following criteria: shipping weights of 3,000 pounds or greater, overall lengths of 15 feet or more and wheelbases of 100 inches or more.

2. Subcompact (Small) Passenger Cars - All sedans, coupes and station wagons manufactured primarily for the purpose of carrying passengers which in general meet the following criteria: shipping weights of less than 3,000 pounds, overall lengths of less than 15 feet, and wheelbases less than 100 inches.

   The following list gives examples of makes and models which would fall into this group:

   AMC-Spirit, Gremlin; Buick-Skyhawk; Chevrolet-Chevette, Vega, Monza; Dodge-Challenger, Colt, Omni; Ford-Pinto, Mustang II, Fiesta; Mercury-Bob Cat; Oldsmobile-Starfire; Plymouth-Arrow, Champ, Horizon, Sappora; Pontiac-Sunbird, Astre; Toyota; Datsun; Volkswagon; Honda; Fiat; Subaru; Mazda; Audi; Opel; Saab; Renault; Alfa Romeo; and Austin.

   Passenger cars not included in the list that meet the weight, wheelbase and length criteria would, of course, also fall into this group.

3. Motorcycles - All 2 or 3 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.

4. Buses - All vehicles manufactured as traditional passenger carrying buses with 2 axles and 6 tires or 3 or more axles. This category includes only traditional buses functioning as passenger carrying vehicles. All 2-axle, 4-tire mini-buses should be classified as vans (category 5). Modified buses should be considered to be a truck and be appropriately classified.

5. Pickups, Panels, Vans, and Other 2-Axle, 4-Tire Trucks - All 2-axle, 4-tire vehicles not classified in categories 1-4. This category includes all 2-axle, 4-tire camping vehicles, motor homes, vans, El Caminos, Rancheros, ambulances, hearses, carryalls, and 4-wheel drive vehicles such as Jeep , Scout, Bronco, Blazer and Ramcharger, power wagons, etc.

6. 2-Axle, 6-Tire Single Unit Trucks - This category includes all trucks, camping and recreation vehicles, motor homes, etc., having 2-axles and dual rear wheels.

7. 3 or More Axle Single Unit Trucks - All vehicles on a single frame with 3 or more axles in any configuration. This category includes concrete mixer trucks, heavy dump trucks, large motor homes, etc., having 3 axles or more.

8. 3-Axle Combination Trucks - All vehicles consisting of two units, one of which is a power unit, which have a total of 3 axles. This category includes all 2-axle tractors with 1-axle semi-trailers (2S1) and all 2-axle single unit trucks with 1-axle trailers (2-1).

9. 2-Axle Tractor With 2-Axle Semi-trailer Trucks (2S2) - Only those vehicles consisting of a 2-axle tractor, and a 2-axle semi-trailer. All other 4-axle combination trucks are included in category 10.

10. Other 4-Axle Combination Trucks - All vehicles consisting of two or more units having a total of 4 axles in any configuration except the 2S2 which is independently classified as category 9. This category includes 2-axle trucks with 2-axle trailers (2-2), 3-axle trucks with 1-axle trailers (3-1), 3-axle tractors with 1-axle semi-trailers (3S1) and 2-axle tractors with 1-axle semi-trailer and 1-axle trailer (2S1-1).

11. 3-Axle Tractor with 2-Axle Semi-trailer Trucks (3S2) - Only those vehicles consisting of a 3-axle tractor with a 2-axle semi-trailer. All other 5-axle combination trucks are included in category 12.

12. Other 5-Axle Combination Trucks - All vehicles consisting of two or more units with 5 axles in any configuration except the 3S2 which is independently classified as category 11.

13. 6 or More Axle Combination Trucks - All vehicles consisting of two or more units with six or more axles in any configuration.

Truck Weight Case Study
Appendix B
Coding Instructions

Truck weight data are to be reported on computer tape in accordance with the instructions on page 12. Data should be in the format shown in this appendix using the indicated coding scheme. Each truck weighed will require the coding of at least one 80-column record. Trucks or combinations having six through thirteen axles will require two records with appropriate codes in column 80.

The data format and coding scheme utilized for this case study are generally the same as those currently in use for the Truck Weight Study Number 7 cards. Columns 9 (Direction of Travel), 24-25 (Body Type) and 33-34 (Model Year) are not being used in the case study and data for these fields may be omitted. Data for columns 61-72 (Axle Spacing) and 73-76 (Total Wheelbase) may be collected at the option of participating States but are not necessary for the case study.

The coding scheme for the first three fields is different than that documented in the "Guide for Truck Weight Study Manual". Card number in Column 1 will be coded "9" for this case study. State Code (Columns 2-3) will be reported using the coding scheme in this appendix which is based on Federal Information Processing Standards (FIPS). These State codes are currently used in FHWA studies, including the TWS. Columns 4-5 will be used for reporting functional highway class rather than Federal-aid or administrative system This is consistent with the Mileage Facilities Reporting System (MFRS) and other HPMS reporting procedures.

Changes have also been made in "Basis of Registration" (column 23), and the weight ranges and coding for "Gross Registered Weight Group" (columns 27-28).

HPMS

Truck Weight Case Study

Data Record Formats

01	Card Number = 9	01	Same as Face Card	01
02	State Code	02		02
03		03		03
04	Functional Class	04		04
05		05		05
06	Station Identification Number	06		06
07		07		07
08		08		08
09	not used	09	not used	09
10	Year Data Collected	10	Same as Face Card	10
11		11		11
12	Month	12		12
13		13		13
14	Date	14		14
15		15		15
16	Hour of Day	16		16
17		17		17
18	Vehicle Type	18		18
19		19		19
20		20		20
21		21		21
22		22		22
23		23		23
24	not used	24	not used	24
25		25		25
26	Fuel Type	26	Same as Face Card	26
27	Gross Registered Weight Group	27		27
28		28		28
29	Registered Weight	29	F-axle Weight	29
30		30		30
31		31		31
32	Basis of Registration	32	G-axle Weight	32
33	not used	33		33
34		34		34
35	Class of Operation	35	H-axle Weight	35
36	Commodity Code	36		36
37		37		37
38		38	I-axle Weight	38
39		39		39
40		40		40
41	Empty or Loaded	41	J-axle Weight	41
42	Total Weight	42		42
43		43		43
44		44	K-axle Weight	44
45		45		45
46	A-axle Weight	46	L-axle Weight	46
47		47		47
48		48		48
49	B-axle Weight	49	M-axle Weight	49
50		50		50
51		51		51
52	C-axle Weight	52	(E-F) axle Spacing	52
53		53		53
54		54		54
55	D-axle Weight	55	(F-G) axle Spacing	55
56		56		56
57		57		57
58	E-axle Weight	58	(G-H) axle Spacing	58
59		59		59
60		60		60
61	(A-B) axle Spacing	61	(H-I) axle Spacing	61
62		62		62
63		63		63
64	(B-C) axle Spacing	64	(I-J) axle Spacing	64
65		65		65
66		66		66
67	(C-D) axle Spacing	67	(J-K) axle Spacing	67
68		68		68
69		69		69
70	(D-E) axle Spacing	70	(K-L) axle Spacing	70
71		71		71
72		72		72
73	Total Wheel Base	73	(L-M) axle Spacing	73
74		74		74
75		75		75
76		76		76
77	Card Serial Number	77	Card Serial Number	77
78		78		78
79		79		79
80	Continuation Card Indicator	80	Continuation Card Indicator	80

FACE CARD

CONTINUATION CARD

TRUCK WEIGHT CASE STUDY
CODING SCHEME

Card Number (column 1)

"9" is the only valid code for this case study

State Code (columns 2-3)

See page B-7

Functional Class (columns 4-5)[1]

Rural:

01 - Interstate
02 - Other Principal Arterials
06 - Minor Arterials
07 - Major Collectors
08 - Minor Collectors

Urban:

11 - Interstate
12 - Other Freeways and Expressways
14 - Other Principal Arterials
16 - Minor Arterials
17 - Collectors

"00" is not a valid code

Station Identification (columns 6-8)

This designation may be alphabetic, numeric or mixed alphabetic numeric. The station identification field must be identical for all data records from a station. Data from Truck Weight Study locations should bear the normal TWS designation.

Year Data Collected (columns 10-11)

Record the last two digits of the year.
1980 is coded "80".

Month (columns 12-13)

01 = January; 12 = December

Date (Columns 14-15)

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

[1] For sampling purposes the following systems are grouped; 1) 06,07and 08; 2) 11 and 12; 3) 16 and 17. Enter the system code where data are actually collected.

Hour of Day (columns 16-17)

Midnight - 1:00 AM = 00 ; 11:00 PM - Midnight = 23

Vehicle Type Code (columns 18-23)

Utilize the 6-digit TWS coding scheme. Pages B-8 through B-10 illustrate the use of this scheme.

Fuel Type (column 26)

1 Gasoline
2 Diesel
3 Propane
4 Turbine
8 Other
9 Not determined

At weigh-in-motion and enforcement locations when fuel type cannot be determined reliably, the field should be left blank.

Gross Registered Weight Group (columns 27-28)

If registered weight (columns 29-31) can be obtained, code "99" (See page B-12 for detailed instructions.) If not, use coding scheme below:

Code	Weight Range (lbs.)
02	0 - 3,999
05	4,000 - 5,999
07	6,000 - 8,499
09	8,500 - 9,999
11	10,000 - 11,999
14	12,000 - 15,999
18	16,000 - 19,999
23	20,000 - 25,999
29	26,000 - 31,999
36	32,000 - 39,999
45	40,000 - 49,999
55	50,000 - 59,999
65	60,000 - 79,999
85	80,000 - 99,999
95	100,000 - and more
99	Not determined

Registered Weight (columns 29-31)

The weight used for registering the single unit truck or combination should be coded in thousands of pounds. (See page B-12 for detailed instructions.) Code zeros if undetermined.

Basis of Registration (column 32)

For States listed below code as shown, for all others code "1". Vehicles from Canada or Mexico, or where parts of a combination are registered in different States having different bases of registration 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 = Chasis Weight
7 = Pay Load

Class of Operation (column 35)

1 = private, 2 = hire under ICC, 3 = other for hire
9 = does not apply or not available

At weigh-in-motion, enforcement and other locations where data is not readily obtainable, code "9". (See page 52-c of "Guide for Truck Weight Study Manual" for a more detailed description of these codes.)

Commodity Code (columns 36-40)

The coding scheme used in the Truck Weight Study will also be used for this case study. For purposes of the case study, the first two digits in the field are significant and are left justified in the field. Columns 38-40 should generally be coded "000" unless a participating State wishes to record the additional detail. Page B-11 presents a listing of the standard commodity codes. If column 41 is coded "0" for an empty vehicle, columns 36-40 must be coded "00000'. At weigh-in-motion sites or where commodity type cannot be determined, this field should be left blank. This field must be either completely blank or filled with numbers.

Empty or Loaded (column 41)

When the empty or loaded condition cannot be determined the field should be left blank. Otherwise use the following codes:

0 Empty
1 Loaded with a product
2 Non-commodity movement (utility or mounted equipment, etc.)

Total Weight of Truck or Combination (columns 42-45)

Code the total weight of the truck or combination in hundreds of pounds.

Axle Weights (columns 46-60)

Three-column fields are available for recording axle weights in hundreds of pounds for five axles. If a truck or combination has six or more axles the weights will be recorded on a "Continuation" card. Unused axle weight fields should be left blank.

Axle Spacing (columns 61-72)

Axle spacing data are not required for this case study and these 3-column fields may be left blank. Participating States may wish to collect this data in which case the spacing should be recorded in feet and tenths.

Total Wheel Base (columns 73-76)

This data item is not required for the case study and the field may be left blank. Participating States may wish to collect this data in which case the spacing should be recorded in feet and tenths.

Card Serial Number (columns 77-79)

The serial number should start with "001" for the first truck weighed at each station each shift. Continuation cards must have the same number as the cards they supplement. Any entry of "000" is not a valid code.

Continuation Card Indicator (column 80)

For vehicles having no more than 5 axles only one record is required and a "0" should be coded in this column. If the vehicle has 6-12 axles, code "1" in column 80 of the first record and "9" on the second record indicating the last record for the vehicle. For vehicles having 13 or more axles code "1" in column 80 of first record, "2" on the second, and "9" on the third record.

TABLE OF STANDARD CODES FOR STATES, DISTRICT OF COLUMBIA AND PUERTO RICO

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

Vehicle Type Coding Chart

	1st Character	2nd Character	3rd Character	4th Character	5th Character	6th Character
Buses	basic vehicle type = 1	(D) vehicle type	(A) registration modifier	(E) axle & tire modifier	State of registration	
Single-unit trucks	basic vehicle type = 2	(F) total axles	(A) registration modifier	(B) light trailer modifier	State of registration	
Tractor + semitrailer	basic vehicle type = 3	total axles on power unit	(G) total axles on first trailer	code = 0	code = 0	(H) special modifier
Truck + full trailer	basic vehicle type = 4	total axles on power unit	(G) total axles on first trailer	code = 0	code = 0	(H) special modifier
Tractor + semitrailer + full trailer	basic vehicle type = 5	total axles on power unit	(G) total axles on first trailer	(G) total axles on second trailer	code = 0	(H) special modifier
Truck + full trailer + full trailer	basic vehicle type = 6	total axles on power unit	(G) total axles on first trailer	(G) total axles on second trailer	code = 0	(H) special modifier
Tractor - semitrailer + 2 full trailers	basic vehicle type = 7	total axles on power unit	(G) total axles on first trailer	(G) total axles on second trailer	(G) total axles on third trailer	(H) special modifier
Truck + 3 full trailers	basic vehicle type = 8	total axles on power unit	(G) total axles on first trailer	(G) total axles on second trailer	(G) total axles on third trailer	(H) special modifier

Letter in block refers to a table on the following page.

Table A

0 State registration not recorded
1 In-State, all
2 Out-of-State, all
3 In-State, nongovernment owned
4 In-State, government owned
5 Out-of-State, nongovernment owned
6 Out-of-State, government owned
7 Federal government owned

Table B

0 No trailer
1 Camp trailer
2 Mobile home
3 Cargo trailer
4 Boat trailer
6 Towed auto
7 Towed truck
8 "Slantback"
9 Any or all types trailed vehicles

Table D

1 Bus, intercity, commercial
2 Bus, transit, commercial

Table E

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

Table F

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 G

0 No 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 one spread tandem
8 Three-axle trailer with one spread tandem
9 Four-axle trailer with one spread tandem

Table H

0 No special modification
1 One spread tandem on pavement in addition to any indicated by 7, 8, 9 in C3, C4, C5.
2 Two spread tandems on pavement in addition to any indicated by 7, 8, 9 in C3, C4, C5.
3 Three spread tandems on pavement in addition to any indicated by 7, 8, 9 in C3, C4, C5.
4 One trailer piggyback and no spread tandems except those indicated by 7, 8, 9 in C3, C4, C5.
5 One trailer piggyback and one spread tandem on pavement in addition to any indicated by 7, 8, 9 in C3, C4, C5.
6 One trailer piggyback and two sets of spread tandems on pavement in addition to any indicated by 7, 8, 9 in C3, C4, C5.
7 Two trailers piggyback and no spread tandems except those indicated by 7, 8, 9 in C3, C4, C5.
8 Two trailers piggyback and one spread tandem on pavement in addition to any indicated by 7, 8, 9 in C3, C4, C5.
9 Two trailers piggyback and two sets of spread tandems on pavement in addition to any indicated by 7, 8, 9 in C3, C4, C5.

Typical Vehicle Type and Codes

Trucks

2 Axle, 6 Tire

2200nn

2 Axle, 6 Tire

2200nn

3 Axle

2300nn

Trucks and Trailers

421000
2-1

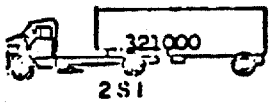
422000
2-2

423000
2-3

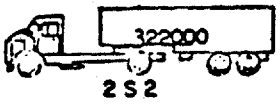
3-2
432000

3-3
433000

Trucks and Semi-Trailers



2S1

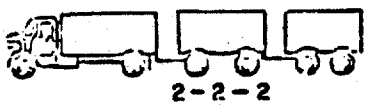


2S2

3S1

3S2

Trucks and Trailers

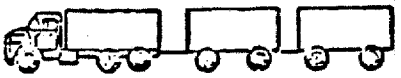


2-2-2
622200

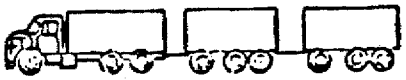
2-3-3
623300

3-3-2
633200

2-3-2
623200

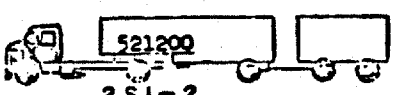


3-2-2
632200

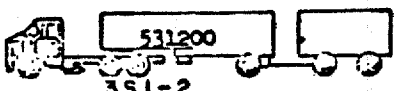


3-3-3
633300

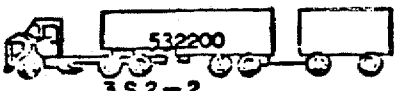
Tractors and Semi-Trailers



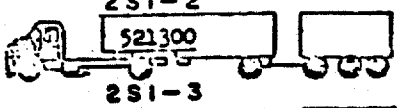
2S1-2



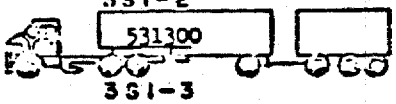
3S1-2



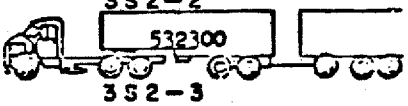
3S2-2



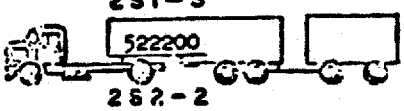
2S1-3



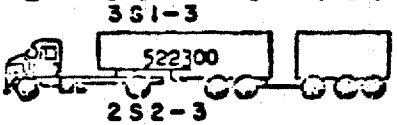
3S1-3



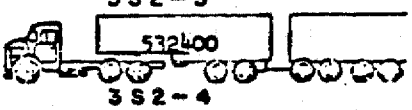
3S2-3



2S2-2



2S2-3



3S2-4

STANDARD COMMODITY CODES FOR REPORTING PURPOSES [1]

Code	Description	Code	Description
00000	Empty	36000	Electrical Machinery Equipment and Supplies
01000	Farm Products	37000	Transportation Equipment
08000	Forest Products	38000	Instruments, Photographic and Optical Goods, Watches and Clocks
09000	Fresh Fish and Other Marine Products	39000	Miscellaneous Products of Manufacturing
10000	Metallic Ores	40000	Waste and Scrap Metals
11000	Coal	41000	Miscellaneous Freight Shipments
13000	Crude Petroleum, Natural Gas, and Natural Gasoline	42000	Containers, Shipping, Returned Empty
14000	Nonmetalic Minerals, Except Fuels	44000	Freight Forwarder Traffic
19000	Ordnance and Accessories	45000	Shipper Association or Similar Traffic
20000	Food and Kindred Products	46000	Miscellaneous Mixed Shipments Except Forwarder, Shipper Association
21000	Tobacco Products	47000	Small Packaged Freight Shipments
22000	Basic Textiles	43000	Passenger Transportation
23000	Apparel and Other Finished Textile Products, Including Knit	48000	Communication, Mixed Tools and Service Equipment
24000	Lumber and Wood Products, Except Furniture	49000	Electric, Gas and Sanitary Service
25000	Furniture and Fixtures	72000	Personal Services
26000	Pulp, Paper and Allied Products	73000	Miscellaneous Business Services
27000	Printed Matter		
28000	Chemicals and Allied Products		
29000	Petroleum or Coal Products		
30000	Rubber and Miscellaneous Plastic Products		
31000	Leather and Leather Products		
32000	Stone, Clay and Glass Products		
33000	Primary Metal Products		
34000	Fabricated Metal Products Except Ordanance, Machinery, and Transportation Equipment		
35000	Machinery, Except Electrical		

[1] See "Guide for Truck Weight Study Manual," FHWA, April 1971, for details of all 5 digits of commodity coding scheme.

Special Considerations for Obtaining "Registered Gross Vehicle Weight"

This data is required by the Highway Cost Allocation Study, because it relates to each vehicle's capacity. The majority of the States use the gross weight of the vehicle (or combination of vehicles in the case of tractor-trailers). A few States register by the "unladen" weight of the vehicle while one State uses load carrying capacity. Also, the interviewer should understand that this information (Registered gross weight) is contained on the "cab card" of the vehicle. Sample cab cards are shown in Figure B-1.

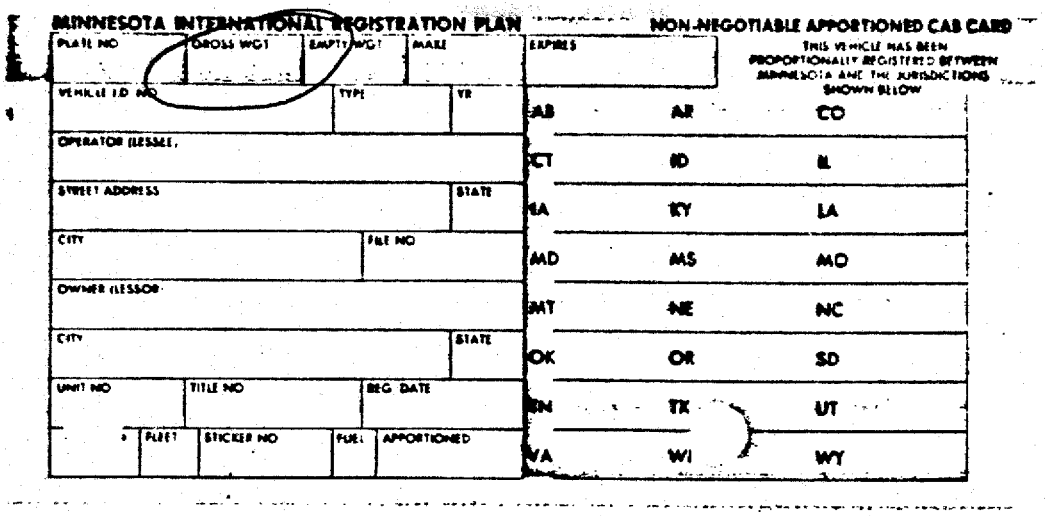
Due to the complexities which arise from differences in State vehicle registration laws some difficulties have been experienced in past studies in encoding this data. In order to cover these difficulties, and provide meaningful alternative data, there are three data fields which are to be used to provide the information:

1. Columns 27 and 28 - Gross Registered Weight Group
2. Columns 29 through 31 - Gross Registered Weight
3. Column 32 - Basis of Registration

The use of the fields is as follows: Under most circumstances, the gross weight from the vehicle's registration card (the "cab card") would be coded in columns 29 through 31 and a "1" coded in column 32. Gross registered weight group is not required in this case so columns 27 and 28 should be coded with "99". Since twelve States do not use a gross combination weight concept in registration of vehicles, it may be impossible to obtain the gross registered weight; consequently and entry in column 32 is needed to indicate the basis for this registration. As an example, Colorado registers by the "unladen weight" of the vehicle. If the vehicle in question was registered only in Colorado, it would be necessary to code its unladen weight in columns 29 through 31 and indicate the basis of that registration weight by coding a "3" in column 32. All means should be employed to avoid this, however.

It would be preferable to indicate the gross registered weight from another State (not the truck's home State if the truck is registered in more than one State). This information is also normally available from the "cab card". In case of a Colorado truck also being registered in Nebraska, code the gross registered weight for the latter State and indicate "1" for basis of registration (which refers to Nebraska).

As a last resort, in a case where the vehicle is registered only in one of the twelve States not using gross combination weight as the basis for registration, it will be necessary to use columns 27 and 28. In other words, if a gross registered combination weight cannot be obtained from the cab card, and another weight less than the weight of the complete vehicle is coded in columns 29 through 31, it is requested that an estimated registered gross weight group (the group corresponding to the legal weight at which the overall vehicle is licensed to operate) be coded in columns 27 and 28. The appropriate weight group should be determined through discussion with the driver. Although the request may sound ambiguous an estimate of gross vehicle weight will be helpful in the absence of other information. For example, the interviewer should ask the driver simply"What is the maximum legal weight for this vehicle?" or "What is the maximum gross weight for this vehicle?"



MINNESOTA INTERNATIONAL REGISTRATION PLAN — NON-NEGOTIABLE APPORTIONED CAB CARD

PLATE NO | GROSS WGT | EMPTY WGT | MAKE | EXPIRES

THIS VEHICLE HAS BEEN PROPORTIONALLY REGISTERED BETWEEN MINNESOTA AND THE JURISDICTIONS SHOWN BELOW

VEHICLE I.D. NO. | TYPE | YR

OPERATOR (LESSEE)

STREET ADDRESS | STATE

CITY | FILE NO

OWNER (LESSOR)

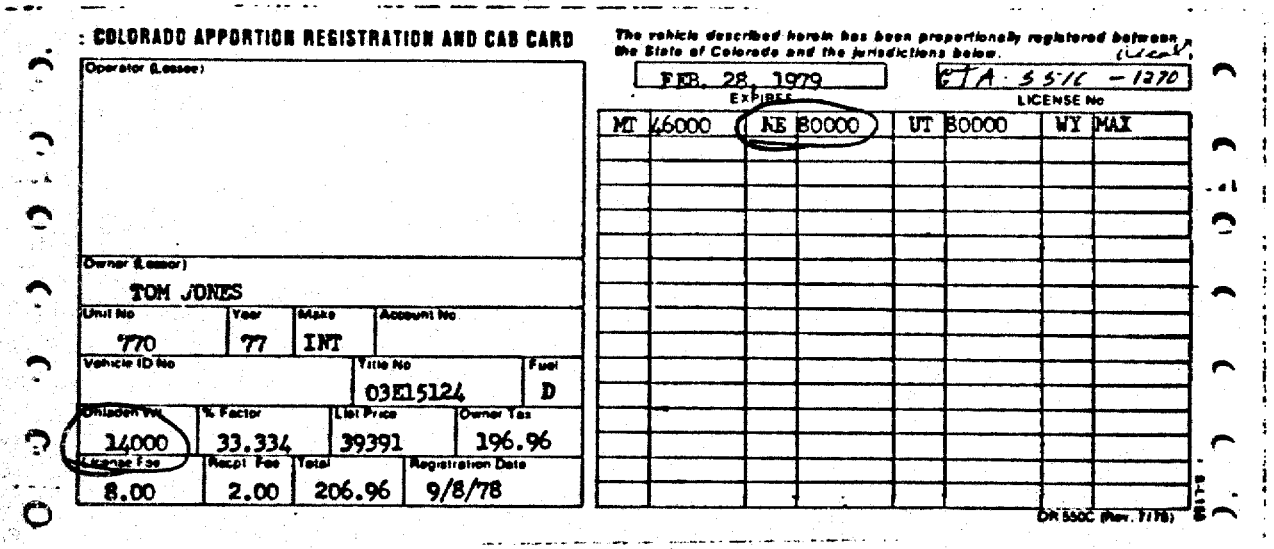
CITY | STATE

UNIT NO | TITLE NO | REG. DATE

FLEET | STICKER NO | FUEL | APPORTIONED

AB	AR	CO
CT	ID	IL
IA	KY	LA
MD	MS	MO
MT	NE	NC
OK	OR	SD
TN	TX	UT
VA	WI	WY

Ex. 1 - Home State registers by gross weight.



: COLORADO APPORTION REGISTRATION AND CAB CARD

The vehicle described herein has been proportionally registered between the State of Colorado and the jurisdictions below.

Operator (Lessee)

Owner (Lessor)

TOM JONES

Unit No	Year	Make	Account No
770	77	INT	

Vehicle ID No	Title No	Fuel
	03E15124	D

Unladen Wt.	% Factor	List Price	Owner Tax
14000	33.334	39391	196.96

License Fee	Recpt Fee	Total	Registration Date
8.00	2.00	206.96	9/8/78

EXPIRES: FEB. 28 1979

LICENSE No: CTA 55-16 -1370

MT	46000	NE	80000	UT	80000	WY	MAX

DR 550C (Rev. 7/78)

Ex. 2 - Home State registers by unladen weight. In this case code a registered weight from another State. Where there are multiple States to choose from, use the State of highest gross weight on the list.

Figure B-1

Examples of Cab Cards