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Tank Car Accident Data Analysis

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16. Abstract

This report presents the results of a study of accidents involving railroad tank cars. The study is part of an overall effort to provide improved safety of rail transportation at reduced life-cycle costs. A major goal of the study is to provide a technical basis for development of improved safety standards based upon performance of vehicles, components, track construction and maintenance, and vehicle/track interaction. The characteristics of individual tank cars involved and the recorded causes of accidents were examined for the years 1981 through 1985. The severity and frequency of accident involvement were determined and the data were reduced to sets of vehicle, track, and operational factors. Because the annual accident counts were generally too small in any one grouping to draw statistically significant conclusions, the 5-year data were aggregated into one 5-year sample for most of the analyses. Statistically significant correlations in the vehicle/track characteristics affecting large numbers of accidents can be used to establish priorities for future tank car safety research and testing.

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PREFACE

This report presents the results of a study of accidents involving railroad tank cars. The study is part of an overall effort to provide improved safety of rail transportation at reduced life-cycle costs. A major goal of the study is to provide a technical basis for development of improved safety standards based upon performance of vehicles, components, track construction and maintenance, and vehicle/track interaction. The characteristics of individual tank cars involved and the recorded causes of accidents were examined for the years 1981 through 1985. The severity and frequency of accident involvement were determined and the data were reduced to sets of vehicle, track, and operational factors. Because the annual accident counts were generally too small in any one grouping to draw statistically significant conclusions, the 5-year data were aggregated into one 5-year sample for most of the analyses. Statistically significant correlations in the vehicle/track characteristics affecting large numbers of accidents can be used to establish priorities for future tank car safety research and testing.

The work reported herein was sponsored by the Federal Railroad Administration (FRA) Office of Research and Development and was originally performed for the Volpe National Transportation Systems Center (VNTSC) by R. Chhatwal, S. Mittra, and G. Reed of Systems Development Corporation (SDC) under ADP Support Services Contract DOT-TSC-DTRS-57-83-C-00150. This report is based upon the report written by them and F. Bouchard of SDC. Additional work to add 1985 data to the study and incorporate that data into the report was performed by Kate Stearns of VNTSC.

METRIC / ENGLISH CONVERSION FACTORS

ENGLISH TO METRIC

LENGTH (APPROXIMATE)

1 inch (in) = 2.5 centimeters (cm)
1 foot (ft) = 30 centimeters (cm)
1 yard (yd) = 0.9 meter (m)
1 mile (mi) = 1.6 kilometers (km)

AREA (APPROXIMATE)

1 square inch (sq in, in^2) = 6.5 square centimeters (cm^2)
1 square foot (sq ft, ft^2) = 0.09 square meter (m^2)
1 square yard (sq yd, yd^2) = 0.8 square meter (m^2)
1 square mile (sq mi, mi^2) = 2.6 square kilometers (km^2)
1 acre = 0.4 hectares (he) = 4,000 square meters (m^2)

MASS - WEIGHT (APPROXIMATE)

1 ounce (oz) = 28 grams (gr)
1 pound (lb) = .45 kilogram (kg)
1 short ton = 2,000 pounds (lb) = 0.9 tonne (t)

VOLUME (APPROXIMATE)

1 teaspoon (tsp) = 5 milliliters (ml)
1 tablespoon (tbsp) = 15 milliliters (ml)
1 fluid ounce (fl oz) = 30 milliliters (ml)
1 cup (c) = 0.24 liter (l)
1 pint (pt) = 0.47 liter (l)
1 quart (qt) = 0.96 liter (l)
1 gallon (gal) = 3.8 liters (l)
1 cubic foot (cu ft, ft^3) = 0.03 cubic meter (m^3)
1 cubic yard (cu yd, yd^3) = 0.76 cubic meter (m^3)

TEMPERATURE (EXACT)

$[(x - 32)(5/9)]\ °F = y\ °C$

METRIC TO ENGLISH

LENGTH (APPROXIMATE)

1 millimeter (mm) = 0.04 inch (in)
1 centimeter (cm) = 0.4 inch (in)
1 meter (m) = 3.3 feet (ft)
1 meter (m) = 1.1 yards (yd)
1 kilometer (km) = 0.6 mile (mi)

AREA (APPROXIMATE)

1 square centimeter (cm^2) = 0.16 square inch (sq in, in^2)
1 square meter (m^2) = 1.2 square yards (sq yd, yd^2)
1 square kilometer (km^2) = 0.4 square mile (sq mi, mi^2)
1 hectare (he) = 10,000 square meters (m^2) = 2.5 acres

MASS - WEIGHT (APPROXIMATE)

1 gram (gr) = 0.036 ounce (oz)
1 kilogram (kg) = 2.2 pounds (lb)
1 tonne (t) = 1,000 kilograms (kg) = 1.1 short tons

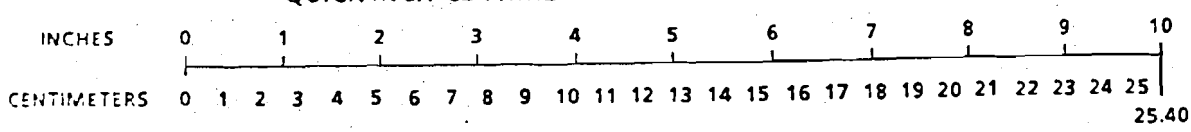
VOLUME (APPROXIMATE)

1 milliliter (ml) = 0.03 fluid ounce (fl oz)
1 liter (l) = 2.1 pints (pt)
1 liter (l) = 1.06 quarts (qt)
1 liter (l) = 0.26 gallon (gal)
1 cubic meter (m^3) = 36 cubic feet (cu ft, ft^3)
1 cubic meter (m^3) = 1.3 cubic yards (cu yd, yd^3)

TEMPERATURE (EXACT)

$[(9/5)y + 32]\ °C = x\ °F$

QUICK INCH-CENTIMETER LENGTH CONVERSION



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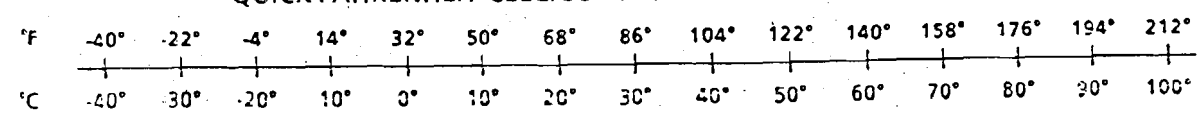

For more exact and/or other conversion factors, see NBS Miscellaneous Publication 286, Units of Weights and Measures. Price $2.50. SD Catalog No. C13 10 286.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued) PAGE

APPENDICES

PAGE

LIST OF TABLES

LIST OF TABLES (continued) PAGE

LIST OF TABLES (continued) PAGE

EXECUTIVE SUMMARY

This report presents the results of a study of railroad accidents involving tank cars. The characteristics of the accidents and of the individual tank cars involved and the recorded causes of the accidents were examined for the years 1981 through 1985. The frequency and type of accident involvement were reduced to sets of vehicle, track, and operational factors for both tank car accidents and tank car accidents involving hazardous materials. Although an attempt was made to examine trends over the 5-year period, the sample was generally too small when broken down into meaningful sets of characteristics to be able to draw any significant conclusions. Some annual accident counts are presented; however, most of the report deals with the 5-year aggregated data. The overall trend over the five years follows the general decrease in all railroad accidents from year to year.

A significant feature of this study is the matching of data from two different sources containing different kinds of information. Various studies report and categorize in detail the accident statistics contained in the Railroad Accident/Incident Reporting System (RAIRS) maintained by the Federal Railroad Administration (FRA), e.g., the annual "Accident/Incident Bulletin" issued by FRA (see items 13-17 in the Bibliography, Appendix H). RAIRS contains extensive information, reported by the railroad(s) involved, about the accident, its location, causal factors, and train involvement. However, rail car data consists of only the reporting marks and road numbers for up to two of the rail cars principally involved. They are the "first

car involved" and the "car causing" the accident. Often there is no car identified as the causing car, e.g., if the cause is track-related or operations-related. No information is recorded in RAIRS which directly identifies the type of car involved, whether it is a box car or flat car, for example, and what its dimensional and descriptive characteristics are. On the other hand, the Universal Machine Language Equipment Register (UMLER) is a dynamically maintained database of car characteristics and dimensions, including reporting marks and road numbers, maintained by the Association of American Railroads (AAR). It holds data for all railroad cars in interchange service in North America, including cars owned or operated by Mexican and Canadian interests.

There were 1876 accidents involving tank cars identified in the 5-year period 1981-1985. Of those, 654, or 35 percent, involved hazardous materials.

When the causes of these 1876 accidents are broken down into the four major groups, track-related, vehicle-related, operations-related, and miscellaneous, the largest cause of tank car accidents was operational conditions (39%) but the largest cause of hazardous materials accidents was track conditions (43%). Most of the accidents were derailments (64%), as opposed to side collisions and other types.

Accident experience for each group of cars with like characteristics was ranked by accident rate, the average annual accidents per 1000 cars of given like design. For ranking by accident rate, tank car characteristics were grouped by container specification class, tank capacity ranges, and truck design capacity.

Container specifications for tank cars have been in use since 1903, issued by various railroad and governmental regulatory bodies, including the American Railway Association (ARA), Association of American Railroads (AAR), Interstate Commerce Commission (ICC), and the Department of Transportation (DOT). Except for the earliest ARA specifications, which are identified by Roman numerals, each specification number consists of a three-digit prefix, called in this report the specification class, usually followed by a varying-length combination of alphanumeric characters to further subdivide the class by tank material, construction design features, pressurization capabilities, and commodity suitability.

In track-related accidents, specification class 111 cars had the highest accident rate of all, but in vehicle-related and operations-related accidents, class 112 cars had the highest. In general, both of these classes have considerably higher accident rates than the other classes in all major cause groups. Class 103 is consistently in last place.

The highest annual accident rate by specification class for all vehicle-related causes is 0.360 accidents per 1000 cars, in specification class 112, the result of only 44 accidents in five years. This rate is significantly lower, by a factor of 1.9, than the highest accident rates for any specification class in track-related or operations-related causes. In addition, the overall accident rate (for all classes) for vehicle-related accidents is lower by a factor of 2.7 or more than the overall accident rate for track-related or operations-related causes. These values suggest that, overall, only a small number of tank car accidents and hazardous materials accidents can be attributed to the characteristics unique to tank cars. However, the existence of certain combinations of handling procedures, car

types, and track conditions which can create unusual vehicle dynamics sufficient to cause frequent accidents may be masked by these results because the populations of those car types may be low, which would result in only a few accidents, and the dynamics causes are included in the miscellaneous causes category, which, overall, has the lowest accident rate.

In hazardous materials accidents, class 112 cars had by far the highest accident rate in all major cause groups.

When broken down by tank capacity, class 111 cars of 31,500 gallons and over capacity had a remarkably high accident rate for track-related causes and was very high in other causes as well, except miscellaneous, in which they had no accidents at all. These cars have a population (from late 1984 UMLER) of 398 and had 17 accidents, nine of which involved hazardous materials, in the 5-year period.

1 INTRODUCTION

This report presents the results of a study of accidents involving railroad tank cars. The study is part of an overall effort to provide improved safety of rail transportation at reduced life-cycle costs. A major goal of the study is to provide a technical basis for development of improved safety standards based upon performance of vehicles, components, track construction and maintenance, and vehicle/track interaction. The characteristics of individual tank cars involved and the recorded causes of accidents were examined for the years 1981 through 1985. The severity and frequency of accident involvement were determined and the data were reduced to sets of vehicle, track, and operational factors. Because the annual accident counts were generally too small in any one grouping to draw statistically significant conclusions, the 5-year data were aggregated into one 5-year sample for most of the analyses. Statistically significant correlations in the vehicle/track characteristics affecting large numbers of accidents can be used to establish priorities for future tank car safety research and testing.

1.1 Background

Railroads are required to file periodic reports with the FRA containing data about each railroad accident or incident which involves personal injury or fatality or which involves damage to railroad property in excess of a certain monetary value (the threshold value is adjusted periodically for inflation). These reports are submitted in a standard format which includes many details about the accident and environmental conditions at the

time of accident. Reporting marks of the first car involved and the car causing the accident, if there is one, as well as a three-digit code for primary cause and secondary cause, as assessed by the reporting official, are included on the form. Each report becomes a record in the Railroad Accident/Incident Reporting System (RAIRS) database maintained by FRA.

Each year the FRA compiles an extensive set of statistical tables from the accident/incident reports filed that year and publishes them in a report called "Accident/Incident Bulletin." The tables contain much useful data about accidents and their causes, environment, and damage. However, little information can be found about the railcars involved because the only identification on the reports is the reporting mark, which identifies the owner but not the characteristics of the car.

To determine the characteristics of a railcar knowing only its reporting mark, another database must be used. That is the Universal Machine Language Equipment Register (UMLER) maintained as a dynamic on-line system by the Association of American Railroads (AAR). This database contains dimensional and construction data on every railcar in interchange service in North America, a "large" database by any measure. The UMLER data available for use in this study consisted of a "snapshot" of the database as it existed some time in the fall of 1984.

The principal research need which this study fulfills is the matching of RAIRS data with UMLER data, through the car reporting marks, first to narrow the accidents to study to those only involving tank cars, and then to examine the characteristics of those tank cars to see what kind of accidents they tend to be involved in.

1.2 Objectives

The objectives of this report are to identify the types of railroad tank cars involved and the causes attributed to the accidents involving them, determine the frequency distribution by car characteristics (e.g., tank and truck capacity) of the various tank car types and to compare the severity (e.g., value of property damage, number of deaths/disabilities arising out of the accident, etc.) of each tank car type.

The study evaluates currently available railroad accident data for five years (1981-1985) and other relevant safety statistics for three purposes:

(a) To identify and categorize those current tank car types and their construction features and dimensional characteristics which may be associated with the most significant safety problem areas.

(b) To identify, if possible, time-related trends with respect to the vehicle types and characteristics identified in (a).

(c) To identify areas of research associated with track, vehicle/track interaction, vehicles, and vehicle components needed in order to resolve problem situations in a cost-effective manner.

Thus, the primary goal of the study is to identify specific accident situations in which FRA research resources may be used in the most cost-effective manner to improve railroad safety by ultimately reducing tank car accidents caused by track conditions, vehicle/track interaction, and vehicle component failure.

Data required for the study are collected and maintained regularly but not in a form which associates accident data with car characteristics. Therefore a principal activity of the study is the merging of these two kinds of data.

1.3 Approach

Data files for this study were processed on the VNTSC DECsystem-10 computer system using FORTRAN programs and System 1022, a database management system (DBMS). The following data files were used:

(a) Railroad Accident Incident Reporting System (RAIRS) datasets for calendar years 1981 through 1985.

(b) Universal Machine Language Equipment Register (UMLER) file for 1984.

The data files were examined and processed to extract only those RAIRS records of accidents which could be identified as involving tank cars and only those UMLER records which describe tank cars which could be identified as being involved in accidents in the years studied.

The tank cars were then grouped by truck design (capacity), tank capacity, and shipping container specification (DOT, AAR, ICC numbers) and the accidents were grouped by type, cause, track conditions, and damage severity to generate ranked tables. For most of the study, the 5-year accident total was used because accident counts in many categories for individual years were too small to be statistically meaningful.

UMLER was also used to obtain the population of North American tank cars in each of the car characteristic groups, irrespective of accident involvement. By dividing a group accident count by the population of its respective group, an accident rate can be calculated. This normalizes the accident involvement across groups and permits comparison of accident frequency of one group relative to another.

Detailed methodology and intermediate and supporting data can be found in the appendices.

2 FINDINGS

This section presents a summary of the findings for tank car accidents and for the subset of tank car accidents involving hazardous materials. Data supporting these findings can be found in Section 3 and in the Appendices.

In the tables which follow, percentages are rounded to whole numbers so that all percentage columns total 100 percent. The term "population" means the count of all tank cars from UMLER. All tables in this section relate to the 5-year aggregate data (1981-1985).

2.1 General Findings

There were 1,876 reported train accidents that could be identified as involving tank cars in the five years 1981 through 1985. The accident count followed the general railroad accident trend of decreasing counts from year to year. Of those 1876 accidents, 654, or 35 percent, involved hazardous materials, accidents in which 1289 cars were damaged and 129 cars released hazardous materials. Evacuation of personnel was carried out in 64 of those hazardous materials accidents.

Causes of accidents are assigned in great detail but can be summarized into four major groups: track-related, vehicle-related, operations-related, and miscellaneous. Of those groups, operational conditions were the largest cause of tank car accidents (39%) but track conditions were the largest cause of hazardous materials tank car accidents (43%).

All tank car specification classes other than 103, 105, 111, and 112 accounted for only 3 percent of the tank car accidents, 2 percent of the hazardous materials tank car accidents, and 4 percent of the population of all tank cars. Therefore, those other classes are usually lumped together as one class for purposes of this report.

2.1.1 All Tank Car Accidents

The following categories account for most of the accidents:

Type of accident:	Derailment	(64 %)	(Table 3-1)
Cause of accident:	Operations-related	(39 %)	or
	Track-related	(36 %)	(Table 3-3)
Type of track:	Yard	(62 %)	(Table 3-5)
FRA Class of track:	Class 1	(58 %)	(Table 3-6)
Traffic density:	Low, < 1 mgt/yr	(96 %)	(Table 3-8)
Speed of train:	Below 10 mph	(76 %)	(Table 3-15)
Gross trailing tons:	Under 5000 gtt	(80 %)	(Table 3-9).

Injuries were few in tank car accidents (one per 35 accidents) during the 5-year period. Only one death occurred in the period, and it was not related to hazardous materials.

The majority of tank car accidents (65%) did not involve hazardous materials.

2.1.2 Hazardous Materials Accidents

There were 654 reported train accidents that could be identified as involving tank cars and hazardous materials in the five years 1981 through 1985.

In those accidents, the most common causes were either track-related (43%) or operations-related (31%).

Most of the accidents either involved four or more cars (42%) or only one car (37%). The car specification class most often involved was 111 (72%) but that class accounts for 63 percent of the tank car population.

On average, two cars were damaged in each accident and one car in five accidents released hazardous material. However, nearly four cars per accident were involved but not damaged.

Evacuation of personnel was carried out in only 6 percent of the hazardous materials accidents.

2.2 Ranking Categories

The number of tank car accidents is small compared to the tank car population. The number of different configurations of tank cars and of different accident causes, if examined in detail, would provide a very large and unmanageable matrix of cells of accident counts, most of which would be empty. It is therefore necessary to assemble car populations and accident counts into groups in which the members share some important characteristics. The groupings chosen were by shipping container specification (ARA, AAR, DOT, or ICC), truck design capacity, tank volumetric capacity, and accident causes.

Tank cars were grouped by their specification class into five categories for purposes of this study because the accident counts were very small for some of the classes. The categories are described in Table 2-1.

TABLE 2-1

RANKING CATEGORIES: TANK CAR SPECIFICATION CLASSES

CATEGORY NUMBER	CAR SPEC CLASS	POPULATION (TANK CARS)	TANK CAR ACCIDENTS ALL	HAZMAT
1	103	8 %	3 %	2 %
2	105	13 %	10 %	15 %
3	111	65 %	72 %	61 %
4	112	11 %	13 %	20 %
5	All Others	3 %	2 %	2 %

Railroad cars can also be grouped by their nominal weight capacity, or truck design capacity, which bears heavily on their size, weight, and dynamic behavior. The truck design categories used in this study are described in Table 2-2.

TABLE 2-2

RANKING CATEGORIES: TRUCK DESIGN CAPACITY

CATEGORY NUMBER	TRUCK DESIGN (NOMINAL CAPACITY)	POPULATION (TANK CARS)	TANK CAR ACCIDENTS ALL	HAZMAT
1	50 Tons	15 %	7 %	5 %
2	70 Tons	9 %	4 %	4 %
3	100 Tons	74 %	86 %	87 %
4	125 Tons	1 %	1 %	2 %
5	All Others	1 %	2 %	2 %

Tank cars can also be grouped by the volumetric capacity of the tank as a determinant of their size, shape, and dynamic characteristics. Ten categories of tank capacity were used in the study. They correspond to ranges defined in UMLER for coding the fourth character of the car type code. They are described in Table 2-3.

TABLE 2-3

RANKING CATEGORIES: TANK VOLUMETRIC CAPACITY

CATEGORY NUMBER	CAPACITY RANGE (GALLONS)	POPULATION (TANK CARS)	TANK CAR ACCIDENTS ALL	HAZMAT
0	Not Applicable	0 %	0 %	0 %
1	0 to 7,499	1 %	1 %	1 %
2	7,500 to 9,499	4 %	2 %	1 %
3	9,500 to 11,499	16 %	8 %	8 %
4	11,500 to 18,499	23 %	28 %	25 %
5	18,500 to 21,499	24 %	22 %	15 %
6	21,500 to 24,499	12 %	14 %	9 %
7	24,500 to 27,499	4 %	5 %	8 %
8	27,500 to 31,499	4 %	5 %	10 %
9	31,500 and over	12 %	15 %	23 %
Unknown	----	0 %	0 %	0 %

Similarly, accidents can be grouped by the primary cause code assigned on each accident record. Individual cause codes are grouped into a number of component or functional areas which are then grouped into four major categories, as listed in Table 2-4. A complete list of the cause codes applicable to this study can be found in Appendix B. In some presentations to follow, the vehicle-related causes will be further broken down into specific component areas. A greater emphasis is placed upon vehicle-related accident causes because an objective of the study is to examine those characteristics of tank cars that tend to cause accidents. In general, track-related, operations-related, and miscellaneous causes have little bearing on the accident involving a tank car instead of some other car type.

Vehicle-dynamics causes, while important to the study, are difficult to separate out. Cause code 713, interaction of lateral/vertical forces, is one of the very few that explicitly describes a vehicle-dynamics cause. Often there are other conditions, such as wide gage or broken knuckle, which are

reported as causing the accident but which themselves may have been caused by a vehicle-dynamics problem, possibly, in the case of track damage, on a previous train. The subjective assessment of the accident reporter combined with the small sample size make it difficult to draw any meaningful conclusions about dynamics causes in a report of this nature. For example, all 31 accidents in cause code 713 were examined and no pattern was readily apparent.

TABLE 2-4

RANKING CATEGORIES: ACCIDENT CAUSES

CATEGORY NUMBER	ACCIDENT CAUSE	CAUSE CODES	TANK CAR ACCIDENTS ALL	HAZMAT
1	Track	101 - 209	36 %	43 %
2	Vehicle	400 - 499	14 %	16 %
3	Operations	500 - 599	39 %	31 %
4	Miscellaneous	700 - 799	11 %	10 %

2.3 Accident Rate Summary

When accident experience of a group of similar cars is compared to that of a second group of similar cars with characteristics different from the first, simply counting the accidents in each group will not suffice unless the population of each group is the same. Accident rate, calculated as the annual accidents per 1000 cars of a given like design, is therefore used as the indicator for the degree of accident involvement of groups of cars. The calculation of accident rate requires the population of the group, which is obtained from UMLER. However, UMLER does not distinguish cars carrying, or capable of carrying, hazardous material from those not carrying such material, so accident rates for hazardous materials accidents are calculated

using the same group populations as for all tank car accidents. The hazardous materials accidents and accident rates are a subset of the accidents and rates for all tank cars. Accident rates are summarized in Tables 2-5 through 2-9.

TABLE 2-5

TANK CAR ACCIDENT RATE SUMMARY BY SPECIFICATION CLASS

CONT SPEC CLASS	ACCIDENTS HAZ	ACCIDENTS OTHER	POPULATION (TANK CARS)	ACCIDENT RATES HAZMAT	ACCIDENT RATES OTHER	ACCIDENT RATES ALL
103	13	42	16,656	0.16	0.50	0.66
105	101	89	28,045	0.72	0.63	1.35
111	396	953	142,915	0.55	1.33	1.89
112	133	103	24,431	1.09	0.84	1.93
All Others	11	35	6,984	0.32	1.00	1.32
Combined	654	1222	219,031	0.60	1.12	1.71

TABLE 2-6

TANK CAR ACCIDENT RATE SUMMARY BY TANK VOLUMETRIC CAPACITY

TANK CAPACITY	ACCIDENTS HAZ	ACCIDENTS OTHER	POPULATION (TANK CARS)	ACCIDENT RATES HAZMAT	ACCIDENT RATES OTHER	ACCIDENT RATES ALL
0	1	1	251	0.80	0.80	1.59
1	3	10	2,279	0.26	0.88	1.14
2	4	43	8,831	0.09	0.97	1.06
3	54	99	34,787	0.31	0.57	0.88
4	165	352	50,275	0.66	1.40	2.06
5	100	307	52,000	0.38	1.18	1.57
6	61	202	27,041	0.45	1.49	1.95
7	50	41	8,653	1.16	0.95	2.10
8	64	39	7,682	1.67	1.02	2.68
9	152	128	26,683	1.14	0.96	2.10
Unknown	0	0	549	0.00	0.00	0.00
Combined	654	1222	219,031	0.60	1.12	1.71

TABLE 2-7

TANK CAR ACCIDENT RATE SUMMARY BY TRUCK DESIGN CAPACITY

TRUCK DES. CAPACITY	ACCIDENTS HAZ	ACCIDENTS OTHER	POPULATION (TANK CARS)	ACCIDENT RATES HAZMAT	ACCIDENT RATES OTHER	ACCIDENT RATES ALL
50 tons	33	101	32,986	0.20	0.61	0.81
70 tons	28	50	19,930	0.28	0.50	0.78
100 tons	568	1046	161,981	0.70	1.29	1.99
125 tons	12	10	1,341	1.79	1.49	3.28
All Others	13	15	2,793	0.93	1.07	2.01
Combined	654	1222	219,031	0.60	1.12	1.71

TABLE 2-8

TANK CAR ACCIDENT RATE SUMMARY FOR ACCIDENT TYPES

ACCIDENT TYPE	ACCIDENTS	POPULATION	ACCIDENT RATE
Derailment	1208	219,031	1.10
Side Collision	365	219,031	0.33
Other Types	303	219,031	0.28
Combined	1876	219,031	1.71

TABLE 2-9

TANK CAR ACCIDENT RATE SUMMARY FOR ACCIDENT CAUSES

ACCIDENT CAUSE	ACCIDENTS HAZ	ACCIDENTS OTHER	TANK CAR POPULATION	ACCIDENT RATES HAZMAT	ACCIDENT RATES OTHER	ACCIDENT RATES ALL
Track	278	396	219,031	0.25	0.36	0.62
Vehicle	105	148	219,031	0.10	0.14	0.23
Operations	203	532	219,031	0.19	0.49	0.67
Miscellaneous	68	146	219,031	0.06	0.13	0.20
Combined	654	1222	219,031	0.60	1.12	1.71

2.4 Rankings

For purpose of comparison, tank car and accident categories are ranked by their accident rate in the rest of this section. Ranking is ordered so that the highest accident rates are at the top of the list and the lowest rates are at the bottom. Some lists are arranged horizontally so that top becomes left and bottom becomes right.

Ranking tables are presented for the following combinations of categories within each major cause group:

(a) Container Specification Class;
(b) Container Specification Class and Tank Capacity; and
(c) Container Specification Class and Truck Design.

2.4.1 Ranking By Container Specification Class

Accident rates are calculated for each combination of the five container specification classes and four major cause groups. Within each cause group, except miscellaneous, the causes are further broken down into cause code groups.

2.4.1.1 All Tank Car Accidents

Car specification classes are ranked by accident rate within each cause code group for all tank car accidents in Tables 2-10 through 2-13. All ranks are shown. A blank cell means there were no accidents in that cell.

Class 111 cars had the highest accident rate of all classes in track-related accidents except in the profile cause code group (116-129) and structures and signals cause code group (180-209), where classes 105 and 112 were higher. Class 111 is followed closely by classes 112 and 105 overall in track-related accidents.

Class 112 cars have the highest accident rate for vehicle-related accidents, particularly in cause code group 440-449, truck components. Class 103 cars have a much lower accident rate than the other classes in all cause code groups.

Classes 112 and 111 rank high in operations-related causes, particularly in cause code group 530-549, rules, and "others" ranks highest, with a higher rate, in group 570-599, operations miscellaneous.

Overall (all causes), classes 112 and 111 have considerably higher accident rates than the other classes. They are the two top-ranked classes under all major cause categories. Class 103 is consistently in last place.

Table 2-13 ranks the specification classes for each of the four accident cause code groups and for all causes. The highest ranked class for vehicle-related causes is class 112, with an accident rate of 0.360, which is only about half of the value of the highest rates for track-related and operations-related causes (rates of 0.682 and 0.754, respectively). The top three ranks of track-related and the top four ranks of operations-related accidents all have accident rates higher than the highest rank of vehicle-related causes.

Vehicle-related accidents have a low accident rate. There are far fewer accidents attributed to vehicle-related causes,

about 13 percent of the 5-year total. Even when combined with the slightly fewer miscellaneous-related accidents, the combination has a far smaller accident count and accident rate than do either track-related or operations-related cause groups.

The low accident rate for vehicle-related accidents suggests that, overall, only a small number of tank car accidents can be attributed to the characteristics unique to tank cars. However, some other factors, such as special handling or routing practices, may be in effect when tank cars are present, a situation which would not be apparent in the present data.

TABLE 2-10

RANKING OF CAR SPECIFICATION CLASSES
TRACK-RELATED CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

CAUSE CODE GROUP		RANKING, BY ACCIDENT RATE 1	2	3	4	5
ROAD BED	S	111	105	112	103	
101-109	R	0.035	0.029	0.025	0.024	
	(A)	(25)	(4)	(3)	(2)	
GAGE	S	111	112	105	OTHERS	103
110-113	R	0.158	0.131	0.100	0.057	0.024
	(A)	(113)	(16)	(14)	(2)	(2)
ALIGNMENT	S	111	112	OTHERS	105	103
114-115	R	0.050	0.041	0.029	0.014	0.012
	(A)	(36)	(5)	(1)	(2)	(1)
PROFILE	S	105	112	111	103	OTHERS
116-129	R	0.185	0.180	0.077	0.060	0.057
	(A)	(26)	(22)	(55)	(5)	(2)
RAIL	S	111	112	OTHERS	105	103
130-149	R	0.161	0.123	0.115	0.107	0.036
	(A)	(115)	(15)	(4)	(15)	(3)
SWITCHES	S	111	105	112	103	OTHERS
160-179	R	0.195	0.150	0.106	0.060	0.057
	(A)	(139)	(21)	(13)	(5)	(2)
STRUCTURES &	S	105	111			
SIGNALS	R	0.014	0.006			
180-209	(A)	(2)	(4)			
ALL TRACK	S	111	112	105	OTHERS	103
RELATED	R	0.682	0.606	0.599	0.315	0.216
101-209	(A)	(487)	(74)	(84)	(11)	(18)

NOTE: S = Spec. Class; R = Accident Rate; A = Accident Count

TABLE 2-11

RANKING OF CAR SPECIFICATION CLASSES
VEHICLE-RELATED CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

CAUSE CODE GROUP		RANKING, BY ACCIDENT RATE 1	2	3	4	5
BRAKES	S	OTHERS	111	112	105	
400-410	R	0.057	0.038	0.033	0.029	
	(A)	(2)	(27)	(4)	(4)	
BODY	S	112	111	105	OTHERS	103
420-429	R	0.057	0.041	0.036	0.029	0.024
	(A)	(7)	(29)	(5)	(1)	(2)
COUPLER/	S	112	105	111	103	
DRAFT SYSTEM	R	0.057	0.036	0.034	0.012	
430-439	(A)	(7)	(5)	(24)	(1)	
TRUCK	S	112	OTHERS	105	111	
COMPONENTS	R	0.139	0.086	0.050	0.041	
440-449	(A)	(17)	(3)	(7)	(29)	
AXLES &	S	105	111	OTHERS	112	103
BEARINGS	R	0.036	0.032	0.029	0.025	0.024
450-459	(A)	(5)	(23)	(1)	(3)	(2)
WHEELS	S	OTHERS	111	112	105	
460-469	R	0.057	0.043	0.041	0.014	
	(A)	(2)	(31)	(5)	(2)	
DOORS	S	112	105	111		
480-489	R	0.008	0.007	0.003		
	(A)	(1)	(1)	(2)		
GENERAL	S	111				
MECH./ELECT.	R	0.001				
499	(A)	(1)				
ALL VEHICLE	S	112	OTHERS	111	105	103
RELATED	R	0.360	0.258	0.232	0.207	0.060
400-499	(A)	(44)	(9)	(166)	(29)	(5)

NOTE: S = Spec. Class; R = Accident Rate; A = Accident Count

TABLE 2-12

RANKING OF CAR SPECIFICATION CLASSES
OPERATIONS-RELATED CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

CAUSE CODE GROUP		RANKING, BY ACCIDENT RATE 1	2	3	4	5
USE OF BRAKES	S	111	112	OTHERS	105	103
500-509	R	0.158	0.156	0.143	0.114	0.072
	(A)	(113)	(19)	(5)	(16)	(6)
EMPLOYEE	S	111				
CONDITION	R	0.001				
510-515	(A)	(1)				
FLAGGING &	S	112	111	103		
SIGNALS	R	0.041	0.022	0.012		
517-529	(A)	(5)	(16)	(1)		
RULES	S	111	112	105	OTHERS	103
530-549	R	0.257	0.229	0.128	0.086	0.072
	(A)	(184)	(28)	(18)	(3)	(6)
SPEED	S	111	112	103	OTHERS	
550-559	R	0.057	0.057	0.048	0.029	
	(A)	(41)	(7)	(4)	(1)	
USE OF SWITCH	S	112	111	105	103	OTHERS
560-569	R	0.115	0.088	0.071	0.036	0.029
	(A)	(14)	(63)	(10)	(3)	(1)
OPERATOR MISC.	S	OTHERS	112	111	105	103
570-599	R	0.286	0.188	0.169	0.086	0.048
	(A)	(10)	(23)	(121)	(12)	(4)
ALL OPERATIONS	S	112	111	OTHERS	105	103
RELATED	R	0.786	0.754	0.573	0.399	0.288
500-599	(A)	(96)	(539)	(20)	(56)	(24)

NOTE: S = Spec. Class; R = Accident Rate; A = Accident Count

TABLE 2-13

RANKING OF CAR SPECIFICATION CLASSES
SUMMARY OF ALL CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

CAUSE CODE GROUP		RANKING, BY ACCIDENT RATE 1	2	3	4	5
ALL TRACK RELATED 101-209	S	111	112	105	OTHERS	103
	R	0.682	0.606	0.599	0.315	0.216
	(A)	(487)	(74)	(84)	(11)	(18)
ALL VEHICLE RELATED 400-499	S	112	OTHERS	111	105	103
	R	0.360	0.258	0.232	0.207	0.060
	(A)	(44)	(9)	(166)	(29)	(5)
ALL OPERATIONS RELATED 500-599	S	112	111	OTHERS	105	103
	R	0.786	0.754	0.573	0.399	0.288
	(A)	(96)	(539)	(20)	(56)	(24)
MISCELLANEOUS 700-799	S	111	112	OTHERS	105	103
	R	0.220	0.180	0.172	0.150	0.096
	(A)	(157)	(22)	(6)	(21)	(8)
TOTAL ALL CAUSES 101-799	S	112	111	105	OTHERS	103
	R	1.932	1.888	1.355	1.317	0.660
	(A)	(236)	(1349)	(190)	(46)	(55)

NOTE: S = Spec. Class; R = Accident Rate; A = Accident Count

2.4.1.2 Hazardous Materials Tank Car Accidents

Car type classes are ranked by accident rate within each cause code group in Tables 2-14 through 2-17. All ranks are shown. A blank cell means there were no accidents in that cell.

Class 112 had the highest accident rate for track related accidents involving hazardous materials, especially in the gage and profile cause code groups. Class 105 follows closely overall with highest rates in two cause code groups.

Class 112 had by far the highest accident rate for vehicle-related accidents involving hazardous materials, especially in the truck components, coupler/draft system, and body cause code groups.

Class 112 had by far the highest accident rate for operation related accidents involving hazardous materials, especially in the rules cause code group.

In all accidents involving hazardous materials, class 112 has a considerably higher accident rate than the other classes. Class 103 has consistently the lowest rate.

Table 2-17 ranks the specification classes for each of the four accident cause code groups and for all causes. The highest ranked class for vehicle-related causes is class 112, with an accident rate of 0.213, which is only slightly more than half of the value of the highest rates for track-related and operations-related causes (rates of 0.401 and 0.393, respectively, both in class 112). The top three ranks of track-related accidents all have accident rates higher than the highest rank of vehicle-related causes.

Vehicle-related accidents have a low accident rate. There are far fewer accidents attributed to vehicle-related causes, about 16 percent of the 5-year total. Even when combined with the fewer miscellaneous-related accidents, the combination has a smaller accident count and accident rate than do either track-related or operations-related cause groups.

The low accident rate for vehicle-related accidents suggests that, overall, only a small number of hazardous materials tank car accidents can be attributed to the characteristics unique to tank cars. However, some other factors, such as special handling or routing practices, may be in effect when hazardous materials and tank cars are present, a situation which would not be apparent in the present data.

TABLE 2-14

RANKING OF CAR SPECIFICATION CLASSES
TRACK-RELATED CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

CAUSE CODE GROUP		RANKING, BY ACCIDENT RATE 1	2	3	4	5
ROAD BED	S	105	112	103	111	
101-109	R	0.021	0.016	0.012	0.008	
	(A)	(3)	(2)	(1)	(6)	
GAGE	S	112	105	OTHERS	111	103
110-113	R	0.115	0.086	0.057	0.052	0.012
	(A)	(14)	(12)	(2)	(37)	(1)
ALIGNMENT	S	111	112	105		
114-115	R	0.018	0.016	0.014		
	(A)	(13)	(2)	(2)		
PROFILE	S	112	105	OTHERS	111	103
116-129	R	0.098	0.093	0.025	0.029	0.024
	(A)	(12)	(13)	(1)	(18)	(2)
RAIL	S	112	105	111	OTHERS	103
130-149	R	0.098	0.086	0.066	0.029	0.012
	(A)	(12)	(12)	(47)	(1)	(1)
SWITCHES	S	105	111	112	OTHERS	
160-179	R	0.093	0.059	0.057	0.029	
	(A)	(13)	(42)	(7)	(1)	
STRUCTURES &	S	111				
SIGNALS	R	0.001				
180-209	(A)	(1)				
ALL TRACK	S	112	105	111	OTHERS	103
RELATED	R	0.401	0.392	0.230	0.143	0.060
101-209	(A)	(49)	(55)	(164)	(5)	(5)

NOTE: S = Spec. Class; R = Accident Rate; A = Accident Count

TABLE 2-15

RANKING OF CAR SPECIFICATION CLASSES
VEHICLE-RELATED CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

CAUSE CODE GROUP		RANKING, BY ACCIDENT RATE 1	2	3	4	5
BRAKES	S	112	105	111		
400-410	R	0.025	0.021	0.010		
	(A)	(3)	(3)	(7)		
BODY	S	112	111	103	105	
420-429	R	0.041	0.014	0.012	0.007	
	(A)	(5)	(10)	(1)	(1)	
COUPLER/	S	112	105	103	111	
DRAFT SYSTEM	R	0.049	0.021	0.012	0.008	
430-439	(A)	(6)	(3)	(1)	(6)	
TRUCK	S	112	105	111		
COMPONENTS	R	0.057	0.021	0.015		
440-449	(A)	(7)	(3)	(11)		
AXLES &	S	105	OTHERS	112	111	
BEARINGS	R	0.036	0.029	0.025	0.021	
450-459	(A)	(5)	(1)	(3)	(15)	
WHEELS	S	112	111	105		
460-469	R	0.016	0.014	0.007		
	(A)	(2)	(10)	(1)		
DOORS	S	111				
480-489	R	0.001				
	(A)	(1)				
GENERAL	S					
MECH./ELECT.	R					
449	(A)					
ALL VEHICLE	S	112	105	111	OTHERS	103
RELATED	R	0.213	0.114	0.084	0.029	0.024
400-499	(A)	(26)	(16)	(60)	(1)	(2)

NOTE: S = Spec. Class; R = Accident Rate; A = Accident Count

TABLE 2-16

RANKING OF CAR SPECIFICATION CLASSES
OPERATIONS-RELATED CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

CAUSE CODE GROUP		RANKING, BY ACCIDENT RATE 1	2	3	4	5
USE OF BRAKES	S	OTHERS	103	111	112	105
500-509	R	0.057	0.036	0.035	0.033	0.029
	(A)	(2)	(3)	(25)	(4)	(4)
EMPLOYEE	S					
CONDITION	R					
510-515	(A)					
FLAGGING &	S	112	111			
SIGNALS	R	0.033	0.006			
517-529	(A)	(4)	(4)			
RULES	S	112	111	105		
530-549	R	0.164	0.055	0.050		
	(A)	(20)	(39)	(7)		
SPEED	S	112	111			
550-559	R	0.025	0.007			
	(A)	(3)	(5)			
USE OF SWITCH	S	112	105	111	103	
560-569	R	0.057	0.043	0.027	0.012	
	(A)	(7)	(6)	(19)	(1)	
OPERATOR MISC.	S	OTHERS	112	111	105	103
570-599	R	0.086	0.082	0.046	0.021	0.012
	(A)	(3)	(10)	(33)	(3)	(1)
ALL OPERATIONS	S	112	111	105	OTHERS	103
RELATED	R	0.393	0.175	0.143	0.143	0.060
500-599	(A)	(48)	(125)	(20)	(5)	(5)

NOTE: S = Spec. Class; R = Accident Rate; A = Accident Count

TABLE 2-17

RANKING OF CAR SPECIFICATION CLASSES
SUMMARY OF ALL CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

CAUSE CODE GROUP		RANKING, BY ACCIDENT RATE 1	2	3	4	5
ALL TRACK RELATED 101-209	S	112	105	111	OTHERS	103
	R	0.401	0.392	0.230	0.143	0.060
	(A)	(49)	(55)	(164)	(5)	(5)
ALL VEHICLE RELATED 400-499	S	112	105	111	OTHERS	103
	R	0.213	0.114	0.084	0.029	0.024
	(A)	(26)	(16)	(60)	(1)	(2)
ALL OPERATIONS RELATED 500-599	S	112	111	105	OTHERS	103
	R	0.393	0.175	0.143	0.143	0.060
	(A)	(48)	(125)	(20)	(5)	(5)
MISCELLANEOUS 700-799	S	112	105	111	103	
	R	0.082	0.071	0.066	0.012	
	(A)	(10)	(10)	(47)	(1)	
TOTAL ALL CAUSES 101-799	S	112	105	111	OTHERS	103
	R	1.089	0.720	0.554	0.315	0.156
	(A)	(133)	(101)	(396)	(11)	(13)

NOTE: S = Spec. Class; R = Accident Rate; A = Accident Count

2.4.2 Ranking By Specification Class and Tank Capacity

Accident rates are calculated for every combination of container specification class and tank capacity range within each major cause group. The matrix of cells is somewhat large for presentation in the format of the previous tables, so a simple list is given instead, ranked by accident rate, but showing the accident count, population, class, and capacity. Tables 2-18 through 2-21 show the rankings for all tank car accidents in each major cause group and Tables 2-22 through 2-25 show them for hazardous materials tank car accidents. The tank capacity ranges are defined in Table 2-3.

2.4.2.1 All Tank Car Accidents

Class 111 cars of tank capacity 9 (31,500 gallons and over) has a remarkably high accident rate for track-related causes. Its rate is almost four times the rate of the next lower rate, and is not artificially raised by a tiny number of accidents and population but rather results from eleven accidents.

The same class 111 cars rank highest in vehicle-related accidents, but from only two accidents.

Two car groups rank high in operations-related accidents. The highest is the same class 111 capacity 9 cars noted above, with four accidents. The second rank, class 112 of capacity 5, only involves one accident. The third and fourth ranks have a rate which is only half of that of the first rank. Even though the rate of the first rank results from only four accidents, it is probably worth further examination.

The highest ranks of miscellaneous causes result from only

one or two accidents and need no further discussion. However, the class 111 capacity 9 cars that ranked high in all the other causes had no accidents at all attributed to miscellaneous causes.

2.4.2.2 Hazardous Materials Tank Car Accidents

Class 111 capacity 9 cars again top the list of track-related causes by almost three times the rate of the second rank, resulting from six accidents.

The same car group ranks third in vehicle-related accidents, only slightly lower in rate than the two higher ranks, but from only one accident.

In operations-related accidents, class 112 capacity 5 cars have a higher rate than the class 111 capacity 9 cars, but from only one accident. The class 111 cars still have a high rate compared to the rest of the list, albeit from only two accidents.

The highest ranks of miscellaneous causes result from only one or two accidents and need no further discussion.

TABLE 2-18

RANKING OF ACCIDENT RATES FOR TANK CAPACITIES
AND CAR SPECIFICATION CLASSES
TRACK-RELATED CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

RATE	COUNT	POPULATION	CLASS	TANK CAP
5.759	11	382	111	9
1.555	24	3086	105	7
1.236	36	5823	111	8
1.227	3	489	105	6
1.149	1	174	OTHERS	8
1.099	1	182	111	1
0.991	22	4438	111	7
0.932	22	4723	105	9
0.920	178	38704	111	4
0.851	7	1646	112	8
0.797	1	251	OTHERS	0
0.771	3	778	OTHERS	9
0.724	4	1105	112	7
0.710	92	25915	111	6
0.615	1	325	103	5
0.606	63	20799	112	9
0.594	4	1346	105	5
0.578	22	7615	105	4
0.512	126	49174	111	5
0.449	2	891	103	1
0.388	2	1030	OTHERS	5
0.338	2	1184	105	1
0.265	1	756	OTHERS	2
0.235	11	9345	103	3
0.230	17	14768	111	3
0.227	4	3529	111	2
0.207	2	1932	OTHERS	4
0.181	4	4430	103	2
0.165	1	1211	OTHERS	3
0.148	7	9456	105	3
		1660	103	4
		1	103	9
		4	103	6
		107	105	2
		39	105	8
		9	112	2
		125	112	5
		376	112	6
		364	112	4
		7	112	3
		24	OTHERS	7
		22	OTHERS	1
		257	OTHERS	6
		549	UNKNOWN	UNKNOWN
TOTALS	674	219031		

TABLE 2-19

RANKING OF ACCIDENT RATES FOR TANK CAPACITIES
AND CAR SPECIFICATION CLASSES
VEHICLE-RELATED CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

RATE	COUNT	POPULATION	CLASS	TANK CAP
1.047	2	382	111	9
0.972	8	1646	112	8
0.818	2	489	105	6
0.725	7	1932	OTHERS	4
0.594	4	1346	105	5
0.549	1	364	112	4
0.406	9	4438	111	7
0.381	9	4723	105	9
0.337	35	20799	112	9
0.257	19	14768	111	3
0.257	1	778	OTHERS	9
0.253	49	38704	111	4
0.216	53	49174	111	5
0.208	27	25915	111	6
0.194	1	1030	OTHERS	5
0.172	5	5823	111	8
0.148	7	9456	105	3
0.131	5	7615	105	4
0.130	2	3086	105	7
0.113	2	3529	111	2
0.107	5	9345	103	3
		891	103	1
		1660	103	4
		4	103	6
		325	103	5
		4430	103	2
		1	103	9
		39	105	8
		107	105	2
		1184	105	1
		182	111	1
		9	112	2
		125	112	5
		1105	112	7
		376	112	6
		7	112	3
		257	OTHERS	6
		24	OTHERS	7
		174	OTHERS	8
		251	OTHERS	0
		1211	OTHERS	3
		22	OTHERS	1
		756	OTHERS	2
		549	UNKNOWN	UNKNOWN
TOTALS	253	219031		

TABLE 2-20

RANKING OF ACCIDENT RATES FOR TANK CAPACITIES
AND CAR SPECIFICATION CLASSES
OPERATIONS-RELATED CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

RATE	COUNT	POPULATION	CLASS	TANK CAP
2.094	4	382	111	9
1.600	1	125	112	5
1.099	1	182	111	1
1.020	18	3529	111	2
0.962	28	5823	111	8
0.847	164	38704	111	4
0.847	20	4723	105	9
0.841	109	25915	111	6
0.828	8	1932	OTHERS	4
0.827	86	20799	112	9
0.797	1	251	OTHERS	0
0.778	1	257	OTHERS	6
0.777	4	1030	OTHERS	5
0.724	4	1105	112	7
0.676	15	4438	111	7
0.637	47	14768	111	3
0.622	153	49174	111	5
0.608	5	1646	112	8
0.594	4	1346	105	5
0.529	2	756	OTHERS	2
0.514	2	778	OTHERS	9
0.507	3	1184	105	1
0.454	7	3086	105	7
0.394	15	7615	105	4
0.361	3	1660	103	4
0.361	8	4430	103	2
0.330	2	1211	OTHERS	3
0.257	12	9345	103	3
0.224	1	891	103	1
0.148	7	9456	105	3
		325	103	5
		1	103	9
		4	103	6
		107	105	2
		39	105	8
		489	105	6
		376	112	6
		9	112	2
		364	112	4
		7	112	3
		24	OTHERS	7
		174	OTHERS	8
		22	OTHERS	1
		549	UNKNOWN	UNKNOWN
TOTALS	735	219031		

TABLE 2-21

RANKING OF ACCIDENT RATES FOR TANK CAPACITIES
AND CAR SPECIFICATION CLASSES
MISCELLANEOUS CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

RATE	COUNT	POPULATION	CLASS	TANK CAP
5.128	1	39	105	8
1.149	1	174	OTHERS	8
1.099	1	182	111	1
0.486	4	1646	112	8
0.409	1	489	105	6
0.388	2	1030	OTHERS	5
0.338	2	1184	105	1
0.274	53	38704	111	4
0.241	2	1660	103	4
0.240	7	5823	111	8
0.226	5	4430	103	2
0.216	28	25915	111	6
0.207	51	49174	111	5
0.207	2	1932	OTHERS	4
0.173	18	20799	112	9
0.170	3	3529	111	2
0.169	4	4723	105	9
0.165	1	1211	OTHERS	3
0.163	12	14768	111	3
0.158	6	7615	105	4
0.149	1	1346	105	5
0.130	2	3086	105	7
0.090	2	4438	111	7
0.085	4	9456	105	3
0.021	1	9345	103	3
		891	103	1
		325	103	5
		4	103	6
		1	103	9
		107	105	2
		382	111	9
		1105	112	7
		7	112	3
		376	112	6
		364	112	4
		125	112	5
		9	112	2
		251	OTHERS	0
		22	OTHERS	1
		756	OTHERS	2
		24	OTHERS	7
		257	OTHERS	6
		778	OTHERS	9
		549	UNKNOWN	UNKNOWN
TOTALS	214	219031		

TABLE 2-22

RANKING OF ACCIDENT RATES FOR TANK CAPACITIES
AND CAR SPECIFICATION CLASSES
TRACK-RELATED CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

RATE	COUNT	POPULATION	CLASS	TANK CAP
3.141	6	382	111	9
1.149	1	174	OTHERS	8
1.102	17	3086	105	7
0.927	27	5823	111	8
0.818	2	489	105	6
0.797	1	251	OTHERS	0
0.608	5	1646	112	8
0.593	14	4723	105	9
0.543	3	1105	112	7
0.514	2	778	OTHERS	9
0.496	11	4438	111	7
0.446	17	7615	105	4
0.394	41	20799	112	9
0.300	58	38704	111	4
0.297	2	1346	105	5
0.265	1	756	OTHERS	2
0.170	22	25915	111	6
0.169	1	1184	105	1
0.122	30	49174	111	5
0.113	2	3529	111	2
0.108	8	14768	111	3
0.107	5	9345	103	3
0.042	2	9456	105	3
		891	103	1
		4	103	6
		1660	103	4
		325	103	5
		4430	103	2
		1	103	9
		39	105	8
		107	105	2
		182	111	1
		364	112	4
		125	112	5
		9	112	2
		376	112	6
		7	112	3
		1030	OTHERS	5
		1211	OTHERS	3
		1932	OTHERS	4
		24	OTHERS	7
		257	OTHERS	6
		22	OTHERS	1
		549	UNKNOWN	UNKNOWN
TOTALS	278	219031		

TABLE 2-23

RANKING OF ACCIDENT RATES FOR TANK CAPACITIES
AND CAR SPECIFICATION CLASSES
VEHICLE-RELATED CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

RATE	COUNT	POPULATION	CLASS	TANK CAP
0.608	5	1646	112	8
0.549	1	364	112	4
0.524	1	382	111	9
0.409	1	489	105	6
0.315	7	4438	111	7
0.297	2	1346	105	5
0.257	1	778	OTHERS	9
0.192	20	20799	112	9
0.169	4	4723	105	9
0.130	2	3086	105	7
0.122	9	14768	111	3
0.103	3	5823	111	8
0.085	4	9456	105	3
0.079	3	7615	105	4
0.078	15	38704	111	4
0.073	18	49174	111	5
0.054	7	25915	111	6
0.043	2	9345	103	3
		1660	103	4
		4430	103	2
		891	103	1
		1	103	9
		4	103	6
		325	103	5
		1184	105	1
		107	105	2
		39	105	8
		3529	111	2
		182	111	1
		1105	112	7
		125	112	5
		376	112	6
		9	112	2
		7	112	3
		22	OTHERS	1
		257	OTHERS	6
		24	OTHERS	7
		1211	OTHERS	3
		174	OTHERS	8
		1030	OTHERS	5
		1932	OTHERS	4
		756	OTHERS	2
		251	OTHERS	0
		549	UNKNOWN	UNKNOWN
TOTALS	105	219031		

TABLE 2-24

RANKING OF ACCIDENT RATES FOR TANK CAPACITIES
AND CAR SPECIFICATION CLASSES
OPERATIONS-RELATED CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

RATE	COUNT	POPULATION	CLASS	TANK CAP
1.600	1	125	112	5
1.047	2	382	111	9
0.481	14	5823	111	8
0.446	3	1346	105	5
0.413	43	20799	112	9
0.362	2	1105	112	7
0.339	8	4723	105	9
0.338	2	1184	105	1
0.330	2	1211	OTHERS	3
0.270	6	4438	111	7
0.257	1	778	OTHERS	9
0.243	2	1646	112	8
0.207	2	1932	OTHERS	4
0.202	39	38704	111	4
0.185	24	25915	111	6
0.122	30	49174	111	5
0.122	9	14768	111	3
0.107	5	9345	103	3
0.085	4	9456	105	3
0.079	3	7615	105	4
0.057	1	3529	111	2
		4	103	6
		4430	103	2
		891	103	1
		1660	103	4
		1	103	9
		325	103	5
		39	105	8
		107	105	2
		3086	105	7
		489	105	6
		182	111	1
		364	112	4
		376	112	6
		9	112	2
		7	112	3
		1030	OTHERS	5
		24	OTHERS	7
		174	OTHERS	8
		251	OTHERS	0
		756	OTHERS	2
		257	OTHERS	6
		22	OTHERS	1
		549	UNKNOWN	UNKNOWN
TOTALS	203	219031		

TABLE 2-25

RANKING OF ACCIDENT RATES FOR TANK CAPACITIES
AND CAR SPECIFICATION CLASSES
MISCELLANEOUS CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

RATE	COUNT	POPULATION	CLASS	TANK CAP
5.128	1	39	105	8
0.409	1	489	105	6
0.365	3	1646	112	8
0.119	23	38704	111	4
0.105	4	7615	105	4
0.103	3	5823	111	8
0.085	2	4723	105	9
0.067	7	20799	112	9
0.065	1	3086	105	7
0.057	14	49174	111	5
0.045	1	4438	111	7
0.031	4	25915	111	6
0.027	2	14768	111	3
0.021	1	9345	103	3
0.021	1	9456	105	3
		4	103	6
		891	103	1
		1660	103	4
		1	103	9
		4430	103	2
		325	103	5
		1184	105	1
		107	105	2
		1346	105	5
		182	111	1
		382	111	9
		3529	111	2
		364	112	4
		7	112	3
		125	112	5
		1105	112	7
		376	112	6
		9	112	2
		1211	OTHERS	3
		257	OTHERS	6
		22	OTHERS	1
		24	OTHERS	7
		251	OTHERS	0
		174	OTHERS	8
		1030	OTHERS	5
		1932	OTHERS	4
		756	OTHERS	2
		778	OTHERS	9
		549	UNKNOWN	UNKNOWN
TOTALS	68	219031		

2.4.3 Ranking By Specification Class and Truck Design

Accident rates are calculated for every combination of container specification class and truck design capacity within each major cause group. A simple list is given, as in the previous subsection, ranked by accident rate and showing also the accident count, population, class, and truck design. Tables 2-26 through 2-29 show the rankings for all tank car accidents in each major cause group and Tables 2-30 through 2-33 show them for hazardous materials tank car accidents. The truck design categories are as designated in Table 2-2.

2.4.3.1 All Tank Car Accidents

No single combination of specification class and truck design stands out in the rankings of Tables 2-26 through 2-29. Most of the highest rates result from only one or two accidents. The exceptions are class 111 of "others" truck design with eleven track-related accidents and class 111 of 125-ton and "others" truck designs with 15 operations-related accidents.

2.4.3.2 Hazardous Materials Tank Car Accidents

The only noteworthy high accident rate resulting from more than one or two accidents is class 111 of 125-ton truck design with five operations-related accidents.

TABLE 2-26

RANKING OF ACCIDENT RATES FOR TRUCK DESIGNS
AND CAR SPECIFICATION CLASSES
TRACK-RELATED CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

RATE	COUNT	POPULATION	CLASS	TRUCK DESIGN
2.757	11	798	111	OTHERS
2.151	1	93	OTHERS	125 TONS
1.223	2	327	112	125 TONS
0.862	74	17171	105	100 TONS
0.771	451	116925	111	100 TONS
0.737	2	543	105	OTHERS
0.718	2	557	103	OTHERS
0.609	72	23651	112	100 TONS
0.434	2	921	111	125 TONS
0.413	8	3871	OTHERS	100 TONS
0.287	1	696	OTHERS	70 TONS
0.256	5	3899	105	70 TONS
0.228	5	4395	103	70 TONS
0.209	14	13394	111	50 TONS
0.194	11	11341	103	50 TONS
0.165	9	10877	111	70 TONS
0.137	1	1462	OTHERS	50 TONS
0.093	3	6432	105	50 TONS
		363	103	100 TONS
		0	103	125 TONS
		0	105	125 TONS
		357	112	50 TONS
		33	112	OTHERS
		63	112	70 TONS
		862	OTHERS	OTHERS
TOTALS	674	219031		

TABLE 2-27

RANKING OF ACCIDENT RATES FOR TRUCK DESIGNS
AND CAR SPECIFICATION CLASSES
VEHICLE-RELATED CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

RATE	COUNT	POPULATION	CLASS	TRUCK DESIGN
6.061	1	33	112	OTHERS
0.560	1	357	112	50 TONS
0.434	2	921	111	125 TONS
0.413	8	3871	OTHERS	100 TONS
0.355	42	23651	112	100 TONS
0.256	5	3899	105	70 TONS
0.256	22	17171	105	100 TONS
0.251	1	798	111	OTHERS
0.236	138	116925	111	100 TONS
0.232	1	862	OTHERS	OTHERS
0.209	14	13394	111	50 TONS
0.202	11	10877	111	70 TONS
0.137	3	4395	103	70 TONS
0.062	2	6432	105	50 TONS
0.035	2	11341	103	50 TONS
		0	103	125 TONS
		363	103	100 TONS
		557	103	OTHERS
		543	105	OTHERS
		0	105	125 TONS
		63	112	70 TONS
		327	112	125 TONS
		1462	OTHERS	50 TONS
		93	OTHERS	125 TONS
		696	OTHERS	70 TONS
TOTALS	253	219031		

TABLE 2-28

RANKING OF ACCIDENT RATES FOR TRUCK DESIGNS
AND CAR SPECIFICATION CLASSES
OPERATIONS-RELATED CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

RATE	COUNT	POPULATION	CLASS	TRUCK DESIGN
1.954	9	921	111	125 TONS
1.504	6	798	111	OTHERS
0.878	17	3871	OTHERS	100 TONS
0.803	95	23651	112	100 TONS
0.794	464	116925	111	100 TONS
0.657	44	13394	111	50 TONS
0.612	1	327	112	125 TONS
0.536	46	17171	105	100 TONS
0.501	11	4395	103	70 TONS
0.368	1	543	105	OTHERS
0.359	1	557	103	OTHERS
0.294	16	10877	111	70 TONS
0.287	1	696	OTHERS	70 TONS
0.274	2	1462	OTHERS	50 TONS
0.256	5	3899	105	70 TONS
0.212	12	11341	103	50 TONS
0.124	4	6432	105	50 TONS
		363	103	100 TONS
		0	103	125 TONS
		0	105	125 TONS
		357	112	50 TONS
		33	112	OTHERS
		63	112	70 TONS
		93	OTHERS	125 TONS
		862	OTHERS	OTHERS
TOTALS	735	219031		

TABLE 2-29

RANKING OF ACCIDENT RATES FOR TRUCK DESIGNS
AND CAR SPECIFICATION CLASSES
MISCELLANEOUS CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

RATE	COUNT	POPULATION	CLASS	TRUCK DESIGN
2.151	1	93	OTHERS	125 TONS
0.737	2	543	105	OTHERS
0.651	3	921	111	125 TONS
0.612	1	327	112	125 TONS
0.551	1	363	103	100 TONS
0.234	137	116925	111	100 TONS
0.209	14	13394	111	50 TONS
0.207	4	3871	OTHERS	100 TONS
0.178	21	23651	112	100 TONS
0.163	14	17171	105	100 TONS
0.137	1	1462	OTHERS	50 TONS
0.124	4	6432	105	50 TONS
0.091	2	4395	103	70 TONS
0.088	5	11341	103	50 TONS
0.055	3	10877	111	70 TONS
0.051	1	3899	105	70 TONS
		557	103	OTHERS
		0	103	125 TONS
		0	105	125 TONS
		798	111	OTHERS
		357	112	50 TONS
		63	112	70 TONS
		33	112	OTHERS
		696	OTHERS	70 TONS
		862	OTHERS	OTHERS
TOTALS	214	219031		

TABLE 2-30

RANKING OF ACCIDENT RATES FOR TRUCK DESIGNS
AND CAR SPECIFICATION CLASSES
TRACK-RELATED CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

RATE	COUNT	POPULATION	CLASS	TRUCK DESIGN
2.151	1	93	OTHERS	125 TONS
1.253	5	798	111	OTHERS
1.223	2	327	112	125 TONS
0.737	2	543	105	OTHERS
0.594	51	17171	105	100 TONS
0.434	2	921	111	125 TONS
0.397	47	23651	112	100 TONS
0.251	147	116925	111	100 TONS
0.155	3	3871	OTHERS	100 TONS
0.137	1	1462	OTHERS	50 TONS
0.105	7	13394	111	50 TONS
0.071	4	11341	103	50 TONS
0.055	3	10877	111	70 TONS
0.051	1	3899	105	70 TONS
0.046	1	4395	103	70 TONS
0.031	1	6432	105	50 TONS
		557	103	OTHERS
		0	103	125 TONS
		363	103	100 TONS
		0	105	125 TONS
		63	112	70 TONS
		357	112	50 TONS
		33	112	OTHERS
		696	OTHERS	70 TONS
		862	OTHERS	OTHERS
TOTALS	278	219031		

TABLE 2-31

RANKING OF ACCIDENT RATES FOR TRUCK DESIGNS
AND CAR SPECIFICATION CLASSES
VEHICLE-RELATED CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

RATE	COUNT	POPULATION	CLASS	TRUCK DESIGN
6.061	1	33	112	OTHERS
0.560	1	357	112	50 TONS
0.251	1	798	111	OTHERS
0.205	4	3899	105	70 TONS
0.203	24	23651	112	100 TONS
0.147	8	10877	111	70 TONS
0.140	12	17171	105	100 TONS
0.080	47	116925	111	100 TONS
0.060	4	13394	111	50 TONS
0.052	1	3871	OTHERS	100 TONS
0.046	1	4395	103	70 TONS
0.018	1	11341	103	50 TONS
		557	103	OTHERS
		0	103	125 TONS
		363	103	100 TONS
		0	105	125 TONS
		543	105	OTHERS
		6432	105	50 TONS
		921	111	125 TONS
		63	112	70 TONS
		327	112	125 TONS
		696	OTHERS	70 TONS
		1462	OTHERS	50 TONS
		93	OTHERS	125 TONS
		862	OTHERS	OTHERS
TOTALS	105	219031		

TABLE 2-32

RANKING OF ACCIDENT RATES FOR TRUCK DESIGNS
AND CAR SPECIFICATION CLASSES
OPERATIONS-RELATED CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

RATE	COUNT	POPULATION	CLASS	TRUCK DESIGN
1.086	5	921	111	125 TONS
0.501	2	798	111	OTHERS
0.406	48	23651	112	100 TONS
0.368	1	543	105	OTHERS
0.287	1	696	OTHERS	70 TONS
0.207	4	3871	OTHERS	100 TONS
0.186	109	116925	111	100 TONS
0.163	14	17171	105	100 TONS
0.154	3	3899	105	70 TONS
0.137	3	4395	103	70 TONS
0.105	7	13394	111	50 TONS
0.062	2	6432	105	50 TONS
0.037	2	10877	111	70 TONS
0.035	2	11341	103	50 TONS
		557	103	OTHERS
		0	103	125 TONS
		363	103	100 TONS
		0	105	125 TONS
		63	112	70 TONS
		357	112	50 TONS
		33	112	OTHERS
		327	112	125 TONS
		1462	OTHERS	50 TONS
		93	OTHERS	125 TONS
		862	OTHERS	OTHERS
TOTALS	203	219031		

TABLE 2-33

RANKING OF ACCIDENT RATES FOR TRUCK DESIGNS
AND CAR SPECIFICATION CLASSES
MISCELLANEOUS CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

RATE	COUNT	POPULATION	CLASS	TRUCK DESIGN
0.612	1	327	112	125 TONS
0.368	1	543	105	OTHERS
0.217	1	921	111	125 TONS
0.093	8	17171	105	100 TONS
0.076	9	23651	112	100 TONS
0.075	44	116925	111	100 TONS
0.046	1	4395	103	70 TONS
0.031	1	6432	105	50 TONS
0.030	2	13394	111	50 TONS
		11341	103	50 TONS
		0	103	125 TONS
		557	103	OTHERS
		363	103	100 TONS
		3899	105	70 TONS
		0	105	125 TONS
		798	111	OTHERS
		10877	111	70 TONS
		357	112	50 TONS
		63	112	70 TONS
		33	112	OTHERS
		696	OTHERS	70 TONS
		1462	OTHERS	50 TONS
		3871	OTHERS	100 TONS
		93	OTHERS	125 TONS
		862	OTHERS	OTHERS
TOTALS	68	219031		

3 SUMMARY DATA

This section presents data showing the distribution of tank car accidents and population over the various categories of accident, car, and track characteristics of interest.

3.1 Annual Accident Distribution

Distribution of accidents involving tank cars over the five years of the study period is shown in Tables 3-1 through 3-18. Some tables contain data only for tank car accidents involving hazardous materials and are clearly labeled as such. Percentage values may not always add to the totals shown because of rounding.

TABLE 3-1

TANK CAR ACCIDENTS BY ACCIDENT TYPE

YEAR	1981 COUNT	%	1982 COUNT	%	1983 COUNT	%	1984 COUNT	%	1985 COUNT	%	TOTAL COUNT	%
Derailments	303	65	241	66	215	64	247	68	202	58	1208	64
Side Collisions	87	19	82	23	67	20	53	15	76	22	365	20
Other Types	74	16	42	11	52	16	63	17	72	20	303	16
Totals	464	100	365	100	334	100	363	100	350	100	1876	100
		25		19		18		19		19		100

TABLE 3-2

HAZARDOUS MATERIALS INVOLVEMENT IN TANK CAR ACCIDENTS

YEAR	1981		1982		1983		1984		1985		TOTAL	
	COUNT	%	COUNT	%	COUNT	%	COUNT	%	COUNT	%	COUNT	%
No Involvement	293	63	237	65	231	69	236	65	225	64	1222	65
Involvement	171	37	128	35	103	31	127	35	125	36	654	35
Totals	464	100	365	100	334	100	363	100	350	100	1876	100

TABLE 3-3

TANK CAR ACCIDENTS BY ACCIDENT CAUSE

YEAR / Cause	1981		1982		1983		1984		1985		TOTAL	
	COUNT	%	COUNT	%	COUNT	%	COUNT	%	COUNT	%	COUNT	%
Track	166	36	131	36	131	39	132	36	114	33	674	36
Vehicle	57	12	44	12	42	13	59	16	51	14	253	14
Operations	185	40	150	41	129	39	129	36	142	41	735	39
Miscellaneous	56	12	40	11	32	9	43	12	43	12	214	11
Totals	464	100	365	100	334	100	363	100	350	100	1876	100

TABLE 3-4

HAZARDOUS MATERIALS TANK CAR ACCIDENTS BY ACCIDENT CAUSE

YEAR / Cause	1981		1982		1983		1984		1985		TOTAL	
	COUNT	%	COUNT	%	COUNT	%	COUNT	%	COUNT	%	COUNT	%
Track	73	43	52	41	46	45	54	42	53	42	278	43
Vehicle	22	13	17	13	14	14	27	21	25	20	105	16
Operations	58	34	44	34	30	29	35	28	36	29	203	31
Miscellaneous	18	10	15	12	13	12	11	9	11	9	68	10
Totals	171	100	128	100	103	100	127	100	125	100	654	100
		26		20		16		19		19		100

TABLE 3-5

TANK CAR ACCIDENTS BY TYPE OF TRACK

YEAR / TRACK TYPE	1981 COUNT	%	1982 COUNT	%	1983 COUNT	%	1984 COUNT	%	1985 COUNT	%	TOTAL COUNT	%
Main	133	29	97	27	95	28	108	30	88	25	521	28
Yard	291	63	224	61	203	61	215	59	225	64	1158	62
Siding	18	4	13	4	13	4	10	3	13	4	67	4
Industry	21	4	26	7	14	4	23	6	19	5	103	5
Unidentified	1	0	5	1	9	3	7	2	5	2	27	1
Totals	464	100	365	100	334	100	363	100	350	100	1876	100

TABLE 3-6

TANK CAR ACCIDENTS BY CLASS OF TRACK

FRA YEAR / TRACK CLASS	1981 COUNT	%	1982 COUNT	%	1983 COUNT	%	1984 COUNT	%	1985 COUNT	%	TOTAL COUNT	%
Class 1	291	63	209	57	191	57	202	56	200	57	1093	58
Class 2	65	14	51	14	50	15	36	10	44	13	246	13
Class 3	37	8	40	11	36	11	43	12	26	7	182	10
Class 4	35	7	29	8	15	5	26	7	27	8	132	7
Class 5	3	1	3	1	1	0	3	1	4	1	14	1
Unidentified	33	7	33	9	41	12	53	14	49	14	209	11
Totals	464	100	365	100	334	100	363	100	350	100	1876	100
		25		19		18		19		19		100

TABLE 3-7

TEMPERATURE AT TANK CAR ACCIDENTS

YEAR / DEGREES F	1981	1982	1983	1984	1985	COMBINED
Highest	102	100	110	110	102	110
Lowest	-10	-28	-15	-30	-18	-30
Average	58	54	58	58	54	56

TABLE 3-8

TANK CAR ACCIDENTS BY TRACK TRAFFIC DENSITY

MILLION GROSS TONS / YEAR	1981 COUNT	1981 %	1982 COUNT	1982 %	1983 COUNT	1983 %	1984 COUNT	1984 %	1985 COUNT	1985 %	TOTAL COUNT	TOTAL %
Low (< 1)	462	100	302	83	331	99	361	99	350	100	1806	96
Medium	0	0	0	0	0	0	0	0	0	0	0	0
High (> 100)	1	0	0	0	0	0	0	0	0	0	1	0
Unidentified	1	0	63	17	3	1	2	1	0	0	69	4
Totals	464	100	365	100	334	100	363	100	350	100	1876	100

TABLE 3-9

TANK CAR ACCIDENTS BY GROSS TRAILING TONS

YEAR / GROSS TONS	1981 COUNT	1981 %	1982 COUNT	1982 %	1983 COUNT	1983 %	1984 COUNT	1984 %	1985 COUNT	1985 %	TOTAL COUNT	TOTAL %
Low*	165	36	160	44	132	39	118	33	152	43	727	39
Medium*	210	45	157	43	140	42	142	39	130	37	779	41
High*	89	19	48	13	62	19	103	28	68	20	370	20
Totals	464	100	365	100	334	100	363	100	350	100	1876	100

*Low=under 100, Medium=100 to 5000, High=over 5000.

TABLE 3-10

HAZARDOUS MATERIALS TANK CAR ACCIDENTS
BY NUMBER OF CARS INVOLVED

YEAR / Number of Cars	1981 COUNT	1981 %	1982 COUNT	1982 %	1983 COUNT	1983 %	1984 COUNT	1984 %	1985 COUNT	1985 %	TOTAL COUNT	TOTAL %
One	74	43	51	40	36	35	42	33	39	31	242	37
Two	21	12	19	15	14	13	13	10	16	13	83	13
Three	17	10	8	6	10	10	7	6	14	11	56	8
Four or more	59	35	50	39	43	42	65	51	56	45	273	42
Totals	171	100	128	100	103	100	127	100	125	100	654	100

TABLE 3-11

TANK CAR ACCIDENTS BY TANK CAR TYPE PRIMARILY INVOLVED

YEAR / Spec Class	1981 COUNT	%	1982 COUNT	%	1983 COUNT	%	1984 COUNT	%	1985 COUNT	%	TOTAL COUNT	%
103	14	3	13	4	10	3	7	2	11	3	55	3
105	51	11	44	12	35	11	25	7	35	10	190	10
111	336	72	245	67	241	72	271	74	256	73	1349	72
112	51	11	52	14	41	12	50	14	42	12	236	13
Others	12	3	11	3	7	2	10	3	6	2	46	2
Totals	464	100	365	100	334	100	363	100	350	100	1876	100

TABLE 3-12

HAZARDOUS MATERIALS TANK CAR ACCIDENTS
BY TANK CAR TYPE PRIMARILY INVOLVED

YEAR / Spec Class	1981 COUNT	%	1982 COUNT	%	1983 COUNT	%	1984 COUNT	%	1985 COUNT	%	TOTAL COUNT	%
103	3	2	3	2	2	2	3	2	2	2	13	2
105	33	19	19	15	22	21	12	9	15	12	101	15
111	106	62	72	57	60	58	76	60	82	65	396	61
112	25	15	31	24	18	18	34	27	25	20	133	20
Others	4	2	3	2	1	1	2	2	1	1	11	2
Totals	171	100	128	100	103	100	127	100	125	100	654	100

TABLE 3-13

INJURIES AND FATALITIES IN TANK CAR ACCIDENTS

YEAR	1981 COUNT	%	1982 COUNT	%	1983 COUNT	%	1984 COUNT	%	1985 COUNT	%	TOTAL COUNT	%
Injuries	20	100	11	92	5	100	8	100	10	100	54	98
Fatalities	0	0	1	8	0	0	0	0	0	0	1	2
Totals	20	100	12	100	5	100	8	100	10	100	55	100

TABLE 3-14

EVACUATION AT HAZARDOUS MATERIALS TANK CAR ACCIDENTS

YEAR	1981		1982		1983		1984		1985		TOTAL	
	COUNT	%	COUNT	%	COUNT	%	COUNT	%	COUNT	%	COUNT	%
No Evacuation	162	95	120	94	99	96	116	91	93	74	590	90
Evacuation	9	5	8	6	4	4	11	9	32	26	64	10
Totals	171	100	128	100	103	100	127	100	125	100	654	100

TABLE 3-15

TANK CAR ACCIDENTS BY SPEED AT TIME OF ACCIDENT

YEAR / SPEED, MPH	1981		1982		1983		1984		1985		TOTAL	
	COUNT	%	COUNT	%	COUNT	%	COUNT	%	COUNT	%	COUNT	%
Below 10	350	75	289	79	254	76	263	73	262	75	1418	76
10 or above	114	25	76	21	80	24	100	27	88	25	458	24
Totals	464	100	365	100	334	100	363	100	350	100	1876	100
Average Speed	9		9		8		10		9		9	

TABLE 3-16

CARS DAMAGED IN HAZARDOUS MATERIALS TANK CAR ACCIDENTS

YEAR / Number of Cars	1981		1982		1983		1984		1985		TOTAL	
	COUNT	%	COUNT	%	COUNT	%	COUNT	%	COUNT	%	COUNT	%
Damaged	305	37	285	48	194	28	255	34	250	34	1289	36
Releasing Hazmat	21	3	35	6	13	2	27	4	33	5	129	4
Undamaged	485	60	272	46	476	70	457	62	442	61	2132	60
Totals	811	100	592	100	683	100	739	100	725	100	3550	100

TABLE 3-17

EQUIPMENT DAMAGE IN TANK CAR ACCIDENTS

YEAR THOUSANDS	1981	1982	1983	1984	1985	COMBINED
Highest	$978.4	$727.5	$545.6	$979.0	$1560.1	$1560.1
Average	$24.6	$20.7	$22.0	$28.5	$32.0	

TABLE 3-18

TRACK DAMAGE IN TANK CAR ACCIDENTS

YEAR THOUSANDS	1981	1982	1983	1984	1985	COMBINED
Highest	$1000.0	$1000.0	$106.0	$215.8	$269.8	$1000.0
Average	$6.5	$6.6	$5.6	$6.2	$5.4	

3.2 Five-Year Accident Distribution

The 5-year aggregated accident data are presented in Tables 3-19 through 3-28 for both hazardous materials tank car accidents and other tank car accidents. Consecutive pairs of tables summarize accidents from track-related, vehicle-related, operations-related, and miscellaneous causes. Tables 3-27 and 3-28 summarize the data from the previous eight tables.

The tables contain accident counts for each combination of specification class and truck design (first table of a pair) and specification class and tank capacity (second table of a pair).

TABLE 3-19

TRACK-RELATED ACCIDENT SUMMARY BY CAR TYPE CLASS AND TRUCK DESIGN 1981 - 1985

TRK DES TONS	SPEC 103 HAZ	SPEC 103 OTH	SPEC 105 HAZ	SPEC 105 OTH	SPEC 111 HAZ	SPEC 111 OTH	SPEC 112 HAZ	SPEC 112 OTH	OTHERS HAZ	OTHERS OTH	TOTALS HAZ	TOTALS OTH	ALL TOTAL
50	4	7	1	2	7	7			1		13	16	29
70	1	4	1	4	3	6				1	5	15	20
100			51	23	147	304	47	25	3	5	248	357	605
125					2		2		1		5		5
OTH		2	2		5	6					7	8	15
TOT	5	13	55	29	164	323	49	25	5	6	278	396	674

TABLE 3-20

TRACK-RELATED ACCIDENT SUMMARY BY CAR TYPE CLASS AND TANK CAPACITY 1981 - 1985

TANK CAP	SPEC 103 HAZ	SPEC 103 OTH	SPEC 105 HAZ	SPEC 105 OTH	SPEC 111 HAZ	SPEC 111 OTH	SPEC 112 HAZ	SPEC 112 OTH	OTHERS HAZ	OTHERS OTH	TOTALS HAZ	TOTALS OTH	ALL TOTAL
0									1		1	0	1
1		2	1	1		1					1	4	5
2		4			2	2			1		3	6	9
3	5	6	2	5	8	9				1	15	21	36
4			17	5	58	120				2	75	127	202
5		1	2	2	30	96				2	32	101	133
6			2	1	22	70					24	71	95
7			17	7	11	11	3	1			31	19	50
8					27	9	5	2	1		33	11	44
9			14	8	6	5	41	22	2	1	63	36	99
TOT	5	13	55	29	164	323	49	25	5	6	278	396	674

TABLE 3-21

VEHICLE-RELATED ACCIDENT SUMMARY BY CAR TYPE CLASS AND TRUCK DESIGN 1981 - 1985

TRK DES TONS	SPEC 103 HAZ	SPEC 103 OTH	SPEC 105 HAZ	SPEC 105 OTH	SPEC 111 HAZ	SPEC 111 OTH	SPEC 112 HAZ	SPEC 112 OTH	OTHERS HAZ	OTHERS OTH	TOTALS HAZ	TOTALS OTH	ALL TOTAL
50	1	1		2	4	10	1				6	13	19
70	1	2	4	1	8	3					13	6	19
100			12	10	47	91	24	18	1	7	84	126	210
125						2						2	2
OTH					1		1			1	2	1	3
TOT	2	3	16	13	60	106	26	18	1	8	105	148	253

TABLE 3-22

VEHICLE-RELATED ACCIDENT SUMMARY BY CAR TYPE CLASS AND TANK CAPACITY 1981 - 1985

TANK CAP	SPEC 103 HAZ	SPEC 103 OTH	SPEC 105 HAZ	SPEC 105 OTH	SPEC 111 HAZ	SPEC 111 OTH	SPEC 112 HAZ	SPEC 112 OTH	OTHERS HAZ	OTHERS OTH	TOTALS HAZ	TOTALS OTH	ALL TOTAL
0											0	0	0
1											0	0	0
2						2					0	2	2
3	2	3	4	3	9	10					15	16	31
4			3	2	15	34	1			7	19	43	62
5			2	2	18	35				1	20	38	58
6			1	1	7	20					8	21	29
7			2		7	2					9	2	11
8					3	2	5	3			8	5	13
9			4	5	1	1	20	15	1		26	21	47
TOT	2	3	16	13	60	106	26	18	1	8	105	148	253

TABLE 3-23

OPERATIONS-RELATED ACCIDENT SUMMARY BY CAR TYPE CLASS AND TRUCK DESIGN 1981 - 1985

TRK DES TONS	SPEC 103 HAZ	SPEC 103 OTH	SPEC 105 HAZ	SPEC 105 OTH	SPEC 111 HAZ	SPEC 111 OTH	SPEC 112 HAZ	SPEC 112 OTH	OTHERS HAZ	OTHERS OTH	TOTALS HAZ	TOTALS OTH	ALL TOTAL
50	2	10	2	2	7	37				2	11	51	62
70	3	8	3	2	2	14			1		9	24	33
100			14	32	109	355	48	47	4	13	175	447	622
125					5	4		1			5	5	10
OTH		1	1		2	4					3	5	8
TOT	5	19	20	36	125	414	48	48	5	15	203	532	735

TABLE 3-24

OPERATIONS-RELATED ACCIDENT SUMMARY BY CAR TYPE CLASS AND TANK CAPACITY 1981 - 1985

TANK CAP	SPEC 103 HAZ	SPEC 103 OTH	SPEC 105 HAZ	SPEC 105 OTH	SPEC 111 HAZ	SPEC 111 OTH	SPEC 112 HAZ	SPEC 112 OTH	OTHERS HAZ	OTHERS OTH	TOTALS HAZ	TOTALS OTH	ALL TOTAL
0										1	0	1	1
1		1	2	1		1					2	3	5
2		8			1	17				2	1	27	28
3	5	7	4	3	9	38			2		20	48	68
4		3	3	12	39	125			2	6	44	146	190
5			3	1	30	123	1			4	34	128	162
6					24	85				1	24	86	110
7				7	6	9	2	2			8	18	26
8					14	14	2	3			16	17	33
9			8	12	2	2	43	43	1	1	54	58	112
TOT	5	19	20	36	125	414	48	48	5	15	203	532	735

TABLE 3-25

MISCELLANEOUS-RELATED ACCIDENT SUMMARY
BY CAR TYPE CLASS AND TRUCK DESIGN
1981 - 1985

TRK DES TONS	SPEC 103 HAZ	SPEC 103 OTH	SPEC 105 HAZ	SPEC 105 OTH	SPEC 111 HAZ	SPEC 111 OTH	SPEC 112 HAZ	SPEC 112 OTH	OTHERS HAZ	OTHERS OTH	TOTALS HAZ	TOTALS OTH	ALL TOTAL
50		5	1	3	2	12				1	3	21	24
70	1	1		1		3					1	5	6
100		1	8	6	44	93	9	12		4	61	116	177
125					1	2	1			1	2	3	5
OTH			1	1							1	1	2
TOT	1	7	10	11	47	110	10	12	0	6	68	146	214

TABLE 3-26

MISCELLANEOUS-RELATED ACCIDENT SUMMARY
BY CAR TYPE CLASS AND TANK CAPACITY
1981 - 1985

TANK CAP	SPEC 103 HAZ	SPEC 103 OTH	SPEC 105 HAZ	SPEC 105 OTH	SPEC 111 HAZ	SPEC 111 OTH	SPEC 112 HAZ	SPEC 112 OTH	OTHERS HAZ	OTHERS OTH	TOTALS HAZ	TOTALS OTH	ALL TOTAL
0											0	0	0
1				2		1					0	3	3
2		5				3					0	8	8
3	1		1	3	2	10				1	4	14	18
4		2	4	2	23	30				2	27	36	63
5				1	14	37				2	14	40	54
6			1		4	24					5	24	29
7			1	1	1	1					2	2	4
8			1		3	4	3	1		1	7	6	13
9			2	2			7	11			9	13	22
TOT	1	7	10	11	47	110	10	12	0	6	68	146	214

TABLE 3-27

ALL CAUSES ACCIDENT SUMMARY
BY CAR TYPE CLASS AND TRUCK DESIGN
1981 - 1985

TRK DES TONS	SPEC 103 HAZ	SPEC 103 OTH	SPEC 105 HAZ	SPEC 105 OTH	SPEC 111 HAZ	SPEC 111 OTH	SPEC 112 HAZ	SPEC 112 OTH	OTHERS HAZ	OTHERS OTH	TOTALS HAZ	TOTALS OTH	ALL TOTAL
50	7	23	4	9	20	66	1		1	3	33	101	134
70	6	15	8	8	13	26			1	1	28	50	78
100		1	85	71	347	843	128	102	8	29	568	1046	1614
125					8	8	3	1	1	1	12	10	22
OTH		3	4	1	8	10	1			1	13	15	28
TOT	13	42	101	89	396	953	133	103	11	35	654	1222	1876

TABLE 3-28

ALL CAUSES ACCIDENT SUMMARY
BY CAR TYPE CLASS AND TANK CAPACITY
1981 - 1985

TANK CAP	SPEC 103 HAZ	SPEC 103 OTH	SPEC 105 HAZ	SPEC 105 OTH	SPEC 111 HAZ	SPEC 111 OTH	SPEC 112 HAZ	SPEC 112 OTH	OTHERS HAZ	OTHERS OTH	TOTALS HAZ	TOTALS OTH	ALL TOTAL
0	0	0	0	0	0	0	0	0	1	1	1	1	2
1	0	3	3	4	0	3	0	0	0	0	3	10	13
2	0	17	0	0	3	24	0	0	1	2	4	43	47
3	13	16	11	14	28	67	0	0	2	2	54	99	153
4	0	5	27	21	135	309	1	0	2	17	165	352	517
5	0	1	7	6	92	291	1	0	0	9	100	307	407
6	0	0	4	2	57	199	0	0	0	1	61	202	263
7	0	0	20	15	25	23	5	3	0	0	50	41	91
8	0	0	1	0	47	29	15	9	1	1	64	39	103
9	0	0	28	27	9	8	111	91	4	2	152	128	280
TOT	13	42	101	89	396	953	133	103	11	35	654	1222	1876

3.3 Population Distribution

There were 219,031 tank cars in interchange service in North America according to UMLER. A summary by car type class and tank capacity appears in Table 3-29. Tank capacity ranges are defined in Table 2-3. A summary by car type class and truck design capacity appears in Table 3-30.

In the tables, a class XT is listed which is not really a shipping container specification class but rather is the AAR mechanical designation for a box tank car which has no applicable ARA, AAR, DOT, or ICC specification. The class is listed for completeness and because there was one hazardous materials accident in the class.

The percentages shown in the bottom row of the table are column totals and do not all add to 100 percent because of the last class listed, "Unknown Distribution."

TABLE 3-29

POPULATION DISTRIBUTION BY CAR TYPE CLASS AND TANK CAPACITY

TYPE CLASS		TANK CAPACITY CATEGORY 0	1	2	3	4	5	6	7	8	9	TOTAL
103	#		891	4,430	9,345	1,660	325	4			1	16,656
	%		0.41%	2.02%	4.27%	0.76%	0.15%	0.00%			0.00%	7.60%
104	#		11 *	236 *	198	2 *	38 *					485
	%		0.01%	0.11%	0.09%	0.00%	0.02%					0.22%
105	#		1,184	107 *	9,456	7,615	1,346	489	3,086	39	4,723	28,045
	%		0.54%	0.05%	4.32	3.48%	0.61%	0.22%	1.41%	0.02%	2.16%	12.80%
106	#	31 *										31
	%	0.01%										0.01%
107	#	166										166
	%	0.08%										0.08%
109	#				392 *		38 *					430
	%				0.18%		0.02%					0.20%
111	#		182	3,529	14,768	38,704	49,174	25,915	4,438	5,823	382	142,915
	%		0.08%	1.61%	6.74%	17.67%	22.45%	11.83%	2.03%	2.66%	0.17%	65.25%
112	#			9 *	7 *	364	125	376	1,105	1,646	20,799	24,431
	%			0.00%	0.00%	0.17%	0.06%	0.17%	0.50%	0.75%	9.50%	11.15%
113	#									54 *	85 *	139
	%									0.02%	0.04%	0.06%
114	#					33	244	28 *		29	689	1,023
	%					0.02%	0.11%	0.01%		0.01%	0.31%	0.47%
115	#			40 *	1 *	18 *	152	21 *				232
	%			0.02%	0.00%	0.01%	0.07%	0.01%				0.11%
120	#	54 *	5 *		26 *	55 *	43	2 *			4	189
	%	0.02%	0.00%		0.01%	0.03%	0.02%	0.00%			0.00%	0.09%
201	#			123 *	155 *							278
	%			0.06%	0.07%							0.13%

continued ...

TABLE 3-29 (continued)

POPULATION DISTRIBUTION BY CAR TYPE CLASS AND TANK CAPACITY

TYPE CLASS		TANK CAPACITY CATEGORY 0	1	2	3	4	5	6	7	8	9	TOTAL
203	#		4 *	159	78 *	79 *	1 *					321
	%		0.00%	0.07%	0.04%	0.04%	0.00%					0.15%
204	#			4 *		94	27		23 *			148
	%			0.00%		0.04%	0.01%		0.01%			0.07%
206	#		2 *	76 *	20 *	323	19					440
	%		0.00%	0.03%	0.01%	0.15%	0.01%					0.20%
211	#			12 *	82 *	1,065	468	206		91		1,924
	%			0.01%	0.04%	0.49%	0.21%	0.09%		0.04%		0.88%
I	#				3 *	1 *						4
	%				0.00%	0.00%						0.00%
II	#			1 *	12 *	4 *						17
	%			0.00%	0.01%	0.00%						0.01%
III	#			55 *	167 *	258 *						480
	%			0.03%	0.08%	0.12%						0.22%
IVA	#				7 *							7
	%				0.00%							0.00%
XT	#			46 *	63							109
	%			0.02%	0.03%							0.05%
Unkn.	#			4 *	7 *				1 *			12
	%			0.00%	0.00%				0.00%			0.01%
Unkn. Dist.	#											549
	%											0.25%
TOTAL	#	251	2,279	8,831	34,787	50,275	52,000	27,041	8,653	7,682	26,683	219,031
	%	0.11%	1.04%	4.03%	15.88%	22.95%	23.74%	12.35%	3.95%	3.51%	12.18%	100.00%

= Number of cars
% = Percent of total tank cars
* = No accidents in this group

TABLE 3-30

POPULATION DISTRIBUTION BY CAR TYPE CLASS AND TRUCK DESIGN

TYPE CLASS		TRUCK DESIGN CAPACITY (TONS) 50	70	100	125	OTHERS	TOTAL
103	#	11,341	4,395	363	0	557	16,656
	%	5.18%	2.01%	0.17%	0.00%	0.25%	7.60%
104	#	229	139	43	0	74	485
	%	0.10%	0.06%	0.02%	0.00%	0.03%	0.22%
105	#	6,432	3,899	17,171	0	543	28,045
	%	2.94%	1.78%	7.84%	0.00%	0.25%	12.80%
106	#	7	0	0	0	24	31
	%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
107	#	0	0	166	0	0	166
	%	0.00%	0.00%	0.08%	0.00%	0.00%	0.08%
109	#	392	0	38	0	0	430
	%	0.18%	0.00%	0.02%	0.00%	0.00%	0.20%
111	#	13,394	10,877	116,925	921	798	142,915
	%	6.12%	4.97%	53.38%	0.42%	0.36%	65.25%
112	#	357	63	23,651	327	33	24,431
	%	0.16%	0.03%	10.80%	0.15%	0.02%	11.15%
113	#	19	4	116	0	0	139
	%	0.01%	0.00%	0.05%	0.00%	0.00%	0.06%
114	#	0	16	872	30	105	1,023
	%	0.00%	0.01%	0.40%	0.01%	0.05%	0.47%
115	#	40	1	191	0	0	232
	%	0.02%	0.00%	0.09%	0.00%	0.00%	0.11%
120	#	8	23	104	0	54	189
	%	0.00%	0.01%	0.05%	0.00%	0.02%	0.09%
201	#	273	1	0	0	4	278
	%	0.12%	0.00%	0.00%	0.00%	0.00%	0.13%

continued ...

TABLE 3-30 (continued)

POPULATION DISTRIBUTION BY CAR TYPE CLASS AND TRUCK DESIGN

TYPE CLASS		TRUCK DESIGN CAPACITY (TONS) 50	70	100	125	OTHERS	TOTAL
203	#	209	26	79	0	7	321
	%	0.10%	0.01%	0.04%	0.00%	0.00%	0.15%
204	#	0	4	139	0	5	148
	%	0.00%	0.00%	0.06%	0.00%	0.00%	0.07%
206	#	69	20	350	1	0	440
	%	0.03%	0.01%	0.16%	0.00%	0.00%	0.20%
211	#	30	59	1,773	62	0	1,924
	%	0.01%	0.03%	0.81%	0.03%	0.00%	0.88%
I	#	0	1	0	0	3	4
	%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
II	#	4	0	0	0	13	17
	%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
III	#	179	293	0	0	8	480
	%	0.08%	0.13%	0.00%	0.00%	0.00%	0.22%
IVA	#	0	0	0	0	7	7
	%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
XT	#	3	106	0	0	0	109
	%	0.00%	0.05%	0.00%	0.00%	0.00%	0.05%
Unkn.	#	0	3	0	0	558	561
	%	0.00%	0.00%	0.00%	0.00%	0.25%	0.26%
TOTAL	#	32,986	19,930	161,981	1,341	2,793	219,031
	%	15.06%	9.10%	73.95%	0.61%	1.28%	100.00%

= Number of cars
% = Percent of total tank cars
* = No accidents in this group

3.4 Accident Rates

The population of tank cars is distributed nonuniformly over the various car type classes, truck designs, and tank capacities. For example, many combinations of car type class and tank capacity in Table 3-29 have zero, one, or two cars but many of the combinations have thousands of cars. It would be improper, therefore, to compare accident experience of the individual combinations with each other on the basis of accident counts alone. To "normalize" the accident counts so that comparisons are meaningful, an annual accident rate is defined as follows:

1. Let "GROUP" = any given combination of car type, shipping container specification, truck design, and tank capacity.

2. Let "ACCIDENTS" = the 5-year accident count for all vehicles in GROUP.

3. Let "POPULATION" = the population of GROUP, from UMLER.

4. Let "ANNUAL ACCIDENT RATE" = the annual accidents per 1000 cars in the population of GROUP.

5. Then ANNUAL ACCIDENT RATE = 200*(ACCIDENTS/POPULATION)

All accident rates shown in this report are calculated using the above formula. Accident rates for all tank car accidents are calculated below for the following combinations of categories within each cause group:

(a) Container Specification Class
(b) Container Specification Class and Tank Capacity
(c) Container Specification Class and Truck Design

3.4.1 Container Specification Class

Accident rates for each combination of cause code group and container specification class are calculated in Tables 3-31 through 3-38. The first four tables are for all tank car accidents and the last four are for hazardous materials tank car accidents.

TABLE 3-31

ACCIDENT RATES FOR CONTAINER SPECIFICATION CLASSES
TRACK-RELATED CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

CAUSE CODE GROUP		CAR TYPE CLASS 103	105	111	112	OTHERS	TOTALS
ROAD BED	A	2	4	25	3		34
101-109	R	0.024	0.029	0.035	0.025		0.031
GAGE	A	2	14	113	16	2	147
110-113	R	0.024	0.100	0.158	0.131	0.057	0.134
ALIGNMENT	A	1	2	36	5	1	45
114-115	R	0.012	0.014	0.050	0.041	0.029	0.041
PROFILE	A	5	26	55	22	2	110
116-129	R	0.060	0.185	0.077	0.180	0.057	0.100
RAIL	A	3	15	115	15	4	152
130-149	R	0.036	0.107	0.161	0.123	0.115	0.139
SWITCHES	A	5	21	139	13	2	180
160-179	R	0.060	0.150	0.195	0.106	0.057	0.164
STRUCTURES & SIGNALS	A		2	4			6
180-209	R		0.014	0.006			0.005
ALL TRACK RELATED	A	18	84	487	74	11	674
101-209	R	0.216	0.599	0.682	0.606	0.315	0.615
POPULATION		16656	28045	142915	24431	6984	219031

NOTE: A = Accident count
R = Accident rate

TABLE 3-32

ACCIDENT RATES FOR CONTAINER SPECIFICATION CLASSES
VEHICLE-RELATED CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

CAUSE CODE GROUP		CAR TYPE CLASS 103	105	111	112	OTHERS	TOTALS
BRAKES	A		4	27	4	2	37
400-410	R		0.029	0.038	0.033	0.057	0.034
BODY	A	2	5	29	7	1	44
420-429	R	0.024	0.036	0.041	0.057	0.029	0.040
COUPLER/DRAFT SYSTEM	A	1	5	24	7		37
430-439	R	0.012	0.036	0.034	0.057		0.034
TRUCK COMPONENTS	A		7	29	17	3	56
440-449	R		0.050	0.041	0.139	0.086	0.051
AXLES & BEARINGS	A	2	5	23	3	1	34
450-459	R	0.024	0.036	0.032	0.025	0.029	0.031
WHEELS	A		2	31	5	2	40
460-469	R		0.014	0.043	0.041	0.057	0.037
DOORS	A		1	2	1		4
480-489	R		0.007	0.003	0.008		0.004
GENERAL MECH./ELECT.	A			1			1
499	R			0.001			0.001
ALL VEHICLE RELATED	A	5	29	166	44	9	253
400-499	R	0.060	0.207	0.232	0.360	0.258	0.231
POPULATION		16656	28045	142915	24431	6984	219031

NOTE: A = Accident count
R = Accident rate

TABLE 3-33

ACCIDENT RATES FOR CONTAINER SPECIFICATION CLASSES
OPERATIONS-RELATED CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

CAUSE CODE GROUP		CAR TYPE CLASS 103	105	111	112	OTHERS	TOTALS
USE OF BRAKES	A	6	16	113	19	5	159
500-509	R	0.072	0.114	0.158	0.156	0.143	0.145
EMPLOYEE CONDITION	A			1			1
510-515	R			0.001			0.001
FLAGGING & SIGNALS	A	1		16	5		22
517-529	R	0.012		0.022	0.041		0.020
RULES	A	6	18	184	28	3	239
530-549	R	0.072	0.128	0.257	0.229	0.086	0.218
SPEED	A	4		41	7	1	53
550-559	R	0.048		0.057	0.057	0.029	0.048
USE OF SWITCH	A	3	10	63	14	1	91
560-569	R	0.036	0.071	0.088	0.115	0.029	0.083
OPERATOR MISC.,	A	4	12	121	23	10	170
570-599	R	0.048	0.086	0.169	0.188	0.286	0.155
ALL OPERATIONS RELATED	A	24	56	539	96	20	735
500-599	R	0.288	0.399	0.754	0.786	0.573	0.671
POPULATION		16656	28045	142915	24431	6984	219031

NOTE: A = Accident count
R = Accident rate

TABLE 3-34

ACCIDENT RATES FOR CONTAINER SPECIFICATION CLASSES
SUMMARY OF ALL CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

CAUSE CODE GROUP		CAR TYPE CLASS 103	105	111	112	OTHERS	TOTALS
ALL TRACK RELATED	A	18	84	487	74	11	674
101-209	R	0.216	0.599	0.682	0.606	0.315	0.615
ALL VEHICLE RELATED	A	5	29	166	44	9	253
400-499	R	0.060	0.207	0.232	0.360	0.258	0.231
ALL OPERATIONS REL.	A	24	56	539	96	20	735
500-599	R	0.288	0.399	0.754	0.786	0.573	0.671
MISCELLANEOUS	A	8	21	157	22	6	214
700-799	R	0.096	0.150	0.220	0.180	0.172	0.195
TOTAL ALL CAUSES	A	55	190	1349	236	46	1876
101-799	R	0.660	1.355	1.888	1.932	1.317	1.713
POPULATION		16656	28045	142915	24431	6984	219031

NOTE: A = Accident count
R = Accident rate

TABLE 3-35

ACCIDENT RATES FOR CONTAINER SPECIFICATION CLASSES
TRACK-RELATED CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

CAUSE CODE GROUP		CAR TYPE CLASS 103	105	111	112	OTHERS	TOTALS
ROAD BED	A	1	3	6	2		12
101-109	R	0.012	0.021	0.008	0.016		0.011
GAGE	A	1	12	37	14	2	66
110-113	R	0.012	0.086	0.052	0.115	0.057	0.060
ALIGNMENT	A		2	13	2		17
114-115	R		0.014	0.018	0.016		0.016
PROFILE	A	2	13	18	12	1	46
116-129	R	0.024	0.093	0.025	0.098	0.029	0.042
RAIL	A	1	12	47	12	1	73
130-149	R	0.012	0.086	0.066	0.098	0.029	0.067
SWITCHES	A		13	42	7	1	63
160-179	R		0.093	0.059	0.057	0.029	0.058
STRUCTURES & SIGNALS	A			1			1
180-209	R			0.001			0.001
ALL TRACK RELATED	A	5	55	164	49	5	278
101-209	R	0.060	0.392	0.230	0.401	0.143	0.254
POPULATION		16656	28045	142915	24431	6984	219031

NOTE: A = Accident count
R = Accident rate

TABLE 3-36

ACCIDENT RATES FOR CONTAINER SPECIFICATION CLASSES
VEHICLE-RELATED CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

CAUSE CODE GROUP		CAR TYPE CLASS 103	105	111	112	OTHERS	TOTALS
BRAKES	A		3	7	3		13
400-410	R		0.021	0.010	0.025		0.012
BODY	A	1	1	10	5		17
420-429	R	0.012	0.007	0.014	0.041		0.016
COUPLER/DRAFT SYSTEM	A	1	3	6	6		16
430-439	R	0.012	0.021	0.008	0.049		0.015
TRUCK COMPONENTS	A		3	11	7		21
440-449	R		0.021	0.015	0.057		0.019
AXLES & BEARINGS	A		5	15	3	1	24
450-459	R		0.036	0.021	0.025	0.029	0.022
WHEELS	A		1	10	2		13
460-469	R		0.007	0.014	0.016		0.012
DOORS	A			1			1
480-489	R			0.001			0.001
GENERAL MECH./ELECT.	A						0
499	R						0.000
ALL VEHICLE RELATED	A	2	16	60	26	1	105
400-499	R	0.024	0.114	0.084	0.213	0.029	0.096
POPULATION		16656	28045	142915	24431	6984	219031

NOTE: A = Accident count
R = Accident rate

TABLE 3-37

ACCIDENT RATES FOR CONTAINER SPECIFICATION CLASSES
OPERATIONS-RELATED CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

CAUSE CODE GROUP		CAR TYPE CLASS 103	105	111	112	OTHERS	TOTALS
USE OF BRAKES 500-509	A	3	4	25	4	2	38
	R	0.036	0.029	0.035	0.033	0.057	0.035
EMPLOYEE CONDITION 510-515	A						0
	R						0.000
FLAGGING & SIGNALS 517-529	A			4	4		8
	R			0.006	0.033		0.007
RULES 530-549	A		7	39	20		66
	R		0.050	0.055	0.164		0.060
SPEED 550-559	A			5	3		8
	R			0.007	0.025		0.007
USE OF SWITCH 560-569	A	1	6	19	7		33
	R	0.012	0.043	0.027	0.057		0.030
OPERATOR MISC. 570-599	A	1	3	33	10	3	50
	R	0.012	0.021	0.046	0.082	0.086	0.046
ALL OPERATIONS RELATED 500-599	A	5	20	125	48	5	203
	R	0.060	0.143	0.175	0.393	0.143	0.185
POPULATION		16656	28045	142915	24431	6984	219031

NOTE: A = Accident count
R = Accident rate

TABLE 3-38

ACCIDENT RATES FOR CONTAINER SPECIFICATION CLASSES
SUMMARY OF ALL CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

CAUSE CODE GROUP		CAR TYPE CLASS 103	105	111	112	OTHERS	TOTALS
ALL TRACK RELATED	A	5	55	164	49	5	278
101-209	R	0.060	0.392	0.230	0.401	0.143	0.254
ALL VEHICLE RELATED	A	2	16	60	26	1	105
400-499	R	0.024	0.114	0.084	0.213	0.029	0.096
ALL OPERATIONS REL.	A	5	20	125	48	5	203
500-599	R	0.060	0.143	0.175	0.393	0.143	0.185
MISCELLANEOUS	A	1	10	47	10		68
700-799	R	0.012	0.071	0.066	0.082		0.062
TOTAL ALL CAUSES	A	13	101	396	133	11	654
101-799	R	0.156	0.720	0.554	1.089	0.315	0.597
POPULATION		16656	28045	142915	24431	6984	219031

NOTE: A = Accident count
R = Accident rate

3.4.2 Container Specification Class and Tank Capacity

Accident rates for each combination of tank capacity and container specification class are calculated in Tables 3-39 through 3-46. The first four tables are for all tank car accidents and the last four are for hazardous materials tank car accidents. The values for each tank capacity are on three rows labeled "A" for accident count, "R" for accident rate, and "P" for population.

TABLE 3-39

ACCIDENT RATES FOR TANK CAPACITIES AND SPECIFICATION CLASSES
TRACK-RELATED CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

TANK CAPACITY		CONTAINER SPECIFICATION CLASS 103	105	111	112	OTHERS	TOTAL
0	A					1	1
	R					0.797	0.797
	P	0	0	0	0	251	251
1	A	2	2	1			5
	R	0.449	0.338	1.099		0.000	0.439
	P	891	1184	182	0	22	2279
2	A	4		4		1	9
	R	0.181	0.000	0.227	0.000	0.265	0.204
	P	4430	107	3529	9	756	8831
3	A	11	7	17		1	36
	R	0.235	0.148	0.230	0.000	0.165	0.207
	P	9345	9456	14768	7	1211	34787
4	A		22	178		2	202
	R	0.000	0.578	0.920	0.000	0.207	0.804
	P	1660	7615	38704	364	1932	50275
5	A	1	4	126		2	133
	R	0.615	0.594	0.512	0.000	0.388	0.512
	P	325	1346	49174	125	1030	52000
6	A		3	92			95
	R	0.000	1.227	0.710	0.000	0.000	0.703
	P	4	489	25915	376	257	27041
7	A		24	22	4		50
	R		1.555	0.991	0.724	0.000	1.156
	P	0	3086	4438	1105	24	8653
8	A			36	7	1	44
	R		0.000	1.236	0.851	1.149	1.146
	P	0	39	5823	1646	174	7682
9	A		22	11	63	3	99
	R	0.000	0.932	5.759	0.606	0.771	0.742
	P	1	4723	382	20799	778	26683
Unknown	P						549
TOTAL TRACK CAUSES	A	18	84	487	74	11	674
	R	0.216	0.599	0.682	0.606	0.342	0.615
	P	16656	28045	142915	24431	6435	219031

TABLE 3-40

ACCIDENT RATES FOR TANK CAPACITIES AND SPECIFICATION CLASSES
VEHICLE-RELATED CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

TANK CAPACITY		CONTAINER SPECIFICATION CLASS 103	105	111	112	OTHERS	TOTAL
0	A						0
	R					0.000	0.000
	P	0	0	0	0	251	251
1	A						0
	R	0.000	0.000	0.000		0.000	0.000
	P	891	1184	182	0	22	2279
2	A			2			2
	R	0.000	0.000	0.113	0.000	0.000	0.045
	P	4430	107	3529	9	756	8831
3	A	5	7	19			31
	R	0.107	0.148	0.257	0.000	0.000	0.178
	P	9345	9456	14768	7	1211	34787
4	A		5	49	1	7	62
	R	0.000	0.131	0.253	0.549	0.725	0.247
	P	1660	7615	38704	364	1932	50275
5	A		4	53		1	58
	R	0.000	0.594	0.216	0.000	0.194	0.223
	P	325	1346	49174	125	1030	52000
6	A		2	27			29
	R	0.000	0.818	0.208	0.000	0.000	0.214
	P	4	489	25915	376	257	27041
7	A		2	9			11
	R		0.130	0.406	0.000	0.000	0.254
	P	0	3086	4438	1105	24	8653
8	A			5	8		13
	R		0.000	0.172	0.972	0.000	0.338
	P	0	39	5823	1646	174	7682
9	A		9	2	35	1	47
	R	0.000	0.381	1.047	0.337	0.257	0.352
	P	1	4723	382	20799	778	26683
Unknown	P						549
TOTAL VEHICLE CAUSES	A	5	29	166	44	9	253
	R	0.060	0.207	0.232	0.360	0.280	0.231
	P	16656	28045	142915	24431	6435	219031

TABLE 3-41

ACCIDENT RATES FOR TANK CAPACITIES AND SPECIFICATION CLASSES
OPERATIONS-RELATED CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

TANK CAPACITY		CONTAINER SPECIFICATION CLASS 103	105	111	112	OTHERS	TOTAL
0	A					1	1
	R					0.797	0.797
	P	0	0	0	0	251	251
1	A	1	3	1			5
	R	0.224	0.507	1.099		0.000	0.439
	P	891	1184	182	0	22	2279
2	A	8		18		2	28
	R	0.361	0.000	1.020	0.000	0.529	0.634
	P	4430	107	3529	9	756	8831
3	A	12	7	47		2	68
	R	0.257	0.148	0.637	0.000	0.330	0.391
	P	9345	9456	14768	7	1211	34787
4	A	3	15	164		8	190
	R	0.361	0.394	0.847	0.000	0.828	0.756
	P	1660	7615	38704	364	1932	50275
5	A		4	153	1	4	162
	R	0.000	0.594	0.622	1.600	0.777	0.623
	P	325	1346	49174	125	1030	52000
6	A			109		1	110
	R	0.000	0.000	0.841	0.000	0.778	0.814
	P	4	489	25915	376	257	27041
7	A		7	15	4		26
	R		0.454	0.676	0.724	0.000	0.601
	P	0	3086	4438	1105	24	8653
8	A			28	5		33
	R		0.000	0.962	0.608	0.000	0.859
	P	0	39	5823	1646	174	7682
9	A		20	4	86	2	112
	R	0.000	0.847	2.094	0.827	0.514	0.839
	P	1	4723	382	20799	778	26683
Unknown	P						549
TOTAL OPER CAUSES	A	24	56	539	96	20	735
	R	0.288	0.399	0.754	0.786	0.622	0.671
	P	16656	28045	142915	24431	6435	219031

TABLE 3-42

ACCIDENT RATES FOR TANK CAPACITIES AND SPECIFICATION CLASSES
MISCELLANEOUS CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

TANK CAPACITY		CONTAINER SPECIFICATION CLASS 103	105	111	112	OTHERS	TOTAL
0	A						0
	R					0.000	0.000
	P	0	0	0	0	251	251
1	A		2	1			3
	R	0.000	0.338	1.099		0.000	0.263
	P	891	1184	182	0	22	2279
2	A	5		3			8
	R	0.226	0.000	0.170	0.000	0.000	0.181
	P	4430	107	3529	9	756	8831
3	A	1	4	12		1	18
	R	0.021	0.085	0.163	0.000	0.165	0.103
	P	9345	9456	14768	7	1211	34787
4	A	2	6	53		2	63
	R	0.241	0.158	0.274	0.000	0.207	0.251
	P	1660	7615	38704	364	1932	50275
5	A		1	51		2	54
	R	0.000	0.149	0.207	0.000	0.388	0.208
	P	325	1346	49174	125	1030	52000
6	A		1	28			29
	R	0.000	0.409	0.216	0.000	0.000	0.214
	P	4	489	25915	376	257	27041
7	A		2	2			4
	R		0.130	0.090	0.000	0.000	0.092
	P	0	3086	4438	1105	24	8653
8	A		1	7	4	1	13
	R		5.128	0.240	0.486	1.149	0.338
	P	0	39	5823	1646	174	7682
9	A		4		18		22
	R	0.000	0.169	0.000	0.173	0.000	0.165
	P	1	4723	382	20799	778	26683
Unknown	P						549
TOTAL MISC CAUSES	A	8	21	157	22	6	214
	R	0.096	0.150	0.220	0.180	0.186	0.195
	P	16656	28045	142915	24431	6435	219031

TABLE 3-43

ACCIDENT RATES FOR TANK CAPACITIES AND SPECIFICATION CLASSES
TRACK-RELATED CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

TANK CAPACITY		CONTAINER SPECIFICATION CLASS 103	105	111	112	OTHERS	TOTAL
0	A					1	1
	R					0.797	0.797
	P	0	0	0	0	251	251
1	A		1				1
	R	0.000	0.169	0.000		0.000	0.088
	P	891	1184	182	0	22	2279
2	A			2		1	3
	R	0.000	0.000	0.113	0.000	0.265	0.068
	P	4430	107	3529	9	756	8831
3	A	5	2	8			15
	R	0.107	0.042	0.108	0.000	0.000	0.086
	P	9345	9456	14768	7	1211	34787
4	A		17	58			75
	R	0.000	0.446	0.300	0.000	0.000	0.298
	P	1660	7615	38704	364	1932	50275
5	A		2	30			32
	R	0.000	0.297	0.122	0.000	0.000	0.123
	P	325	1346	49174	125	1030	52000
6	A		2	22			24
	R	0.000	0.818	0.170	0.000	0.000	0.178
	P	4	489	25915	376	257	27041
7	A		17	11	3		31
	R		1.102	0.496	0.543	0.000	0.717
	P	0	3086	4438	1105	24	8653
8	A			27	5	1	33
	R		0.000	0.927	0.608	1.149	0.859
	P	0	39	5823	1646	174	7682
9	A		14	6	41	2	63
	R	0.000	0.593	3.141	0.394	0.514	0.472
	P	1	4723	382	20799	778	26683
Unknown	P						549
TOTAL TRACK CAUSES	A	5	55	164	49	5	278
	R	0.060	0.392	0.230	0.401	0.155	0.254
	P	16656	28045	142915	24431	6435	219031

TABLE 3-44

ACCIDENT RATES FOR TANK CAPACITIES AND SPECIFICATION CLASSES
VEHICLE-RELATED CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

TANK CAPACITY		CONTAINER SPECIFICATION CLASS 103	105	111	112	OTHERS	TOTAL
0	A						0
	R					0.000	0.000
	P	0	0	0	0	251	251
1	A						0
	R	0.000	0.000	0.000		0.000	0.000
	P	891	1184	182	0	22	2279
2	A						0
	R	0.000	0.000	0.000	0.000	0.000	0.000
	P	4430	107	3529	9	756	8831
3	A	2	4	9			15
	R	0.043	0.085	0.122	0.000	0.000	0.086
	P	9345	9456	14768	7	1211	34787
4	A		3	15	1		19
	R	0.000	0.079	0.078	0.549	0.000	0.076
	P	1660	7615	38704	364	1932	50275
5	A		2	18			20
	R	0.000	0.297	0.073	0.000	0.000	0.077
	P	325	1346	49174	125	1030	52000
6	A		1	7			8
	R	0.000	0.409	0.054	0.000	0.000	0.059
	P	4	489	25915	376	257	27041
7	A		2	7			9
	R		0.130	0.315	0.000	0.000	0.208
	P	0	3086	4438	1105	24	8653
8	A			3	5		8
	R		0.000	0.103	0.608	0.000	0.208
	P	0	39	5823	1646	174	7682
9	A		4	1	20	1	26
	R	0.000	0.169	0.524	0.192	0.257	0.195
	P	1	4723	382	20799	778	26683
Unknown	P						549
TOTAL VEHICLE CAUSES	A	2	16	60	26	1	105
	R	0.024	0.114	0.084	0.213	0.031	0.096
	P	16656	28045	142915	24431	6435	219031

TABLE 3-45

ACCIDENT RATES FOR TANK CAPACITIES AND SPECIFICATION CLASSES
OPERATIONS-RELATED CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

TANK CAPACITY		CONTAINER SPECIFICATION CLASS 103	105	111	112	OTHERS	TOTAL
0	A						0
	R					0.000	0.000
	P	0	0	0	0	251	251
1	A		2				2
	R	0.000	0.338	0.000		0.000	0.176
	P	891	1184	182	0	22	2279
2	A			1			1
	R	0.000	0.000	0.057	0.000	0.000	0.023
	P	4430	107	3529	9	756	8831
3	A	5	4	9		2	20
	R	0.107	0.085	0.122	0.000	0.330	0.115
	P	9345	9456	14768	7	1211	34787
4	A		3	39		2	44
	R	0.000	0.079	0.202	0.000	0.207	0.175
	P	1660	7615	38704	364	1932	50275
5	A		3	30	1		34
	R	0.000	0.446	0.122	1.600	0.000	0.131
	P	325	1346	49174	125	1030	52000
6	A			24			24
	R	0.000	0.000	0.185	0.000	0.000	0.178
	P	4	489	25915	376	257	27041
7	A			6	2		8
	R		0.000	0.270	0.362	0.000	0.185
	P	0	3086	4438	1105	24	8653
8	A			14	2		16
	R		0.000	0.481	0.243	0.000	0.417
	P	0	39	5823	1646	174	7682
9	A		8	2	43	1	54
	R	0.000	0.339	1.047	0.413	0.257	0.405
	P	1	4723	382	20799	778	26683
Unknown	P						549
TOTAL OPER CAUSES	A	5	20	125	48	5	203
	R	0.060	0.143	0.175	0.393	0.155	0.185
	P	16656	28045	142915	24431	6435	219031

TABLE 3-46

ACCIDENT RATES FOR TANK CAPACITIES AND SPECIFICATION CLASSES
MISCELLANEOUS CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

TANK CAPACITY		CONTAINER SPECIFICATION CLASS 103	105	111	112	OTHERS	TOTAL
0	A						0
	R					0.000	0.000
	P	0	0	0	0	251	251
1	A						0
	R	0.000	0.000	0.000		0.000	0.000
	P	891	1184	182	0	22	2279
2	A						0
	R	0.000	0.000	0.000	0.000	0.000	0.000
	P	4430	107	3529	9	756	8831
3	A	1	1	2			4
	R	0.021	0.021	0.027	0.000	0.000	0.023
	P	9345	9456	14768	7	1211	34787
4	A		4	23			27
	R	0.000	0.105	0.119	0.000	0.000	0.107
	P	1660	7615	38704	364	1932	50275
5	A			14			14
	R	0.000	0.000	0.057	0.000	0.000	0.054
	P	325	1346	49174	125	1030	52000
6	A		1	4			5
	R	0.000	0.409	0.031	0.000	0.000	0.037
	P	4	489	25915	376	257	27041
7	A		1	1			2
	R		0.065	0.045	0.000	0.000	0.046
	P	0	3086	4438	1105	24	8653
8	A		1	3	3		7
	R		5.128	0.103	0.365	0.000	0.182
	P	0	39	5823	1646	174	7682
9	A		2		7		9
	R	0.000	0.085	0.000	0.067	0.000	0.067
	P	1	4723	382	20799	778	26683
Unknown	P						549
TOTAL MISC CAUSES	A	1	10	47	10	0	68
	R	0.012	0.071	0.066	0.082	0.000	0.062
	P	16656	28045	142915	24431	6435	219031

3.4.3 Container Specification Class and Truck Design

Accident rates for each combination of truck design capacity and container specification class are calculated in Tables 3-47 through 3-54. The tables are arranged in the same order as in the previous subsection.

TABLE 3-47

ACCIDENT RATES FOR TRUCK DESIGNS AND SPECIFICATION CLASSES
TRACK-RELATED CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

TRUCK DESIGN		CONTAINER SPECIFICATION CLASS 103	105	111	112	OTHERS	TOTAL
50	A	11	3	14		1	29
	R	0.194	0.093	0.209		0.137	0.176
	P	11341	6432	13394	357	1462	32986
70	A	5	5	9		1	20
	R	0.228	0.256	0.165		0.287	0.201
	P	4395	3899	10877	63	696	19930
100	A		74	451	72	8	605
	R		0.862	0.771	0.609	0.413	0.747
	P	363	17171	116925	23651	3871	161981
125	A			2	2	1	5
	R			0.434	1.223	2.151	0.746
	P	0	0	921	327	93	1341
OTH	A	2	2	11			15
	R	0.718	0.737	2.757			1.074
	P	557	543	798	33	862	2793
TOTAL TRACK CAUSES	A	18	84	487	74	11	674
	R	0.216	0.599	0.682	0.606	0.315	0.615
	P	16656	28045	142915	24431	6984	219031

A = Accident count
R = Accident rate
P = Population

TABLE 3-48

ACCIDENT RATES FOR TRUCK DESIGNS AND SPECIFICATION CLASSES
VEHICLE-RELATED CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

TRUCK DESIGN		CONTAINER SPECIFICATION CLASS 103	105	111	112	OTHERS	TOTAL
50	A	2	2	14	1		19
	R	0.035	0.062	0.209	0.560		0.115
	P	11341	6432	13394	357	1462	32986
70	A	3	5	11			19
	R	0.137	0.256	0.202			0.191
	P	4395	3899	10877	63	696	19930
100	A		22	138	42	8	210
	R		0.256	0.236	0.355	0.413	0.259
	P	363	17171	116925	23651	3871	161981
125	A			2			2
	R			0.434			0.298
	P	0	0	921	327	93	1341
OTH	A			1	1	1	3
	R			0.251	6.061	0.232	0.215
	P	557	543	798	33	862	2793
TOTAL VEHICLE CAUSES	A	5	29	166	44	9	253
	R	0.060	0.207	0.232	0.360	0.258	0.231
	P	16656	28045	142915	24431	6984	219031

A = Accident count
R = Accident rate
P = Population

TABLE 3-49

ACCIDENT RATES FOR TRUCK DESIGNS AND SPECIFICATION CLASSES
OPERATIONS-RELATED CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

TRUCK DESIGN		CONTAINER SPECIFICATION CLASS 103	105	111	112	OTHERS	TOTAL
	A	12	4	44		2	62
50	R	0.212	0.124	0.657		0.274	0.376
	P	11341	6432	13394	357	1462	32986
	A	11	5	16		1	33
70	R	0.501	0.256	0.294		0.287	0.331
	P	4395	3899	10877	63	696	19930
	A		46	464	95	17	622
100	R		0.536	0.794	0.803	0.878	0.768
	P	363	17171	116925	23651	3871	161981
	A			9	1		10
125	R			1.954	0.612		1.491
	P	0	0	921	327	93	1341
	A	1	1	6			8
OTH	R	0.359	0.368	1.504			0.573
	P	557	543	798	33	862	2793
TOTAL	A	24	56	539	96	20	735
OPER	R	0.288	0.399	0.754	0.786	0.573	0.671
CAUSES	P	16656	28045	142915	24431	6984	219031

A = Accident count
R = Accident rate
P = Population

TABLE 3-50

ACCIDENT RATES FOR TRUCK DESIGNS AND SPECIFICATION CLASSES
MISCELLANEOUS CAUSES
ALL TANK CAR ACCIDENTS, 1981 - 1985

TRUCK DESIGN		CONTAINER SPECIFICATION CLASS 103	105	111	112	OTHERS	TOTAL
50	A	5	4	14		1	24
	R	0.088	0.124	0.209		0.137	0.146
	P	11341	6432	13394	357	1462	32986
70	A	2	1	3			6
	R	0.091	0.051	0.055			0.060
	P	4395	3899	10877	63	696	19930
100	A	1	14	137	21	4	177
	R	0.551	0.163	0.234	0.178	0.207	0.219
	P	363	17171	116925	23651	3871	161981
125	A			3	1	1	5
	R			0.651	0.612		0.746
	P	0	0	921	327	93	1341
OTH	A		2				2
	R	0.000	0.737	0.000			0.143
	P	557	543	798	33	862	2793
TOTAL MISC CAUSES	A	8	21	157	22	6	214
	R	0.096	0.150	0.220	0.180	0.172	0.195
	P	16656	28045	142915	24431	6984	219031

A = Accident count
R = Accident rate
P = Population

TABLE 3-51

ACCIDENT RATES FOR TRUCK DESIGNS AND SPECIFICATION CLASSES
TRACK-RELATED CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

TRUCK DESIGN		CONTAINER SPECIFICATION CLASS 103	105	111	112	OTHERS	TOTAL
50	A	4	1	7		1	13
	R	0.071	0.031	0.105		0.137	0.079
	P	11341	6432	13394	357	1462	32986
70	A	1	1	3			5
	R	0.046	0.051	0.055			0.050
	P	4395	3899	10877	63	696	19930
100	A		51	147	47	3	248
	R		0.594	0.251	0.397	0.155	0.306
	P	363	17171	116925	23651	3871	161981
125	A			2	2	1	5
	R			0.434	1.223	2.151	0.746
	P	0	0	921	327	93	1341
OTH	A		2	5			7
	R		0.737	1.253			0.501
	P	557	543	798	33	862	2793
TOTAL TRACK CAUSES	A	5	55	164	49	5	278
	R	0.060	0.392	0.230	0.401	0.143	0.254
	P	16656	28045	142915	24431	6984	219031

A = Accident count
R = Accident rate
P = Population

TABLE 3-52

ACCIDENT RATES FOR TRUCK DESIGNS AND SPECIFICATION CLASSES
VEHICLE-RELATED CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

TRUCK DESIGN		CONTAINER SPECIFICATION CLASS 103	105	111	112	OTHERS	TOTAL
	A	1		4	1		6
50	R	0.018		0.060	0.560		0.036
	P	11341	6432	13394	357	1462	32986
	A	1	4	8			13
70	R	0.046	0.205	0.147			0.130
	P	4395	3899	10877	63	696	19930
	A		12	47	24	1	84
100	R		0.140	0.080	0.203	0.052	0.104
	P	363	17171	116925	23651	3871	161981
	A						0
125	R						0.000
	P	0	0	921	327	93	1341
	A			1	1		2
OTH	R			0.251	6.061		0.143
	P	557	543	798	33	862	2793
TOTAL	A	2	16	60	26	1	105
VEHICLE	R	0.024	0.114	0.084	0.213	0.029	0.096
CAUSES	P	16656	28045	142915	24431	6984	219031

A = Accident count
R = Accident rate
P = Population

TABLE 3-53

ACCIDENT RATES FOR TRUCK DESIGNS AND SPECIFICATION CLASSES
OPERATIONS-RELATED CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

TRUCK DESIGN		CONTAINER SPECIFICATION CLASS 103	105	111	112	OTHERS	TOTAL
	A	2	2	7			11
50	R	0.035	0.062	0.105			0.067
	P	11341	6432	13394	357	1462	32986
	A	3	3	2		1	9
70	R	0.137	0.154	0.037		0.287	0.090
	P	4395	3899	10877	63	696	19930
	A		14	109	48	4	175
100	R		0.163	0.186	0.406	0.207	0.216
	P	363	17171	116925	23651	3871	161981
	A			5			5
125	R			1.086			0.746
	P	0	0	921	327	93	1341
	A		1	2			3
OTH	R		0.368	0.501			0.215
	P	557	543	798	33	862	2793
TOTAL	A	5	20	125	48	5	203
OPER	R	0.060	0.143	0.175	0.393	0.143	0.185
CAUSES	P	16656	28045	142915	24431	6984	219031

A = Accident count
R = Accident rate
P = Population

TABLE 3-54

ACCIDENT RATES FOR TRUCK DESIGNS AND SPECIFICATION CLASSES
MISCELLANEOUS CAUSES
HAZARDOUS MATERIALS TANK CAR ACCIDENTS, 1981 - 1985

TRUCK DESIGN		CONTAINER SPECIFICATION CLASS 103	105	111	112	OTHERS	TOTAL
50	A		1	2			3
	R		0.031	0.030			0.018
	P	11341	6432	13394	357	1462	32986
70	A	1					1
	R	0.046					0.010
	P	4395	3899	10877	63	696	19930
100	A		8	44	9		61
	R		0.093	0.075	0.076		0.075
	P	363	17171	116925	23651	3871	161981
125	A			1	1		2
	R			0.217	0.612		0.298
	P	0	0	921	327	93	1341
OTH	A		1				1
	R		0.368				0.072
	P	557	543	798	33	862	2793
TOTAL MISC CAUSES	A	1	10	47	10	0	68
	R	0.012	0.071	0.066	0.082	0.000	0.062
	P	16656	28045	142915	24431	6984	219031

A = Accident count
R = Accident rate
P = Population

4 LIMITATIONS

Any study of this nature is greatly limited in the accuracy of its output by the accuracy and reliability of the data available to it (the input data). In the course of conducting this study a number of compromises and assumptions had to be made which have some effect upon the output data presented in this report. Therefore, the reader should be familiar with the limitations in order to understand the data and to put it in proper context.

The number of tank car accidents for any single year of the study is generally too small to derive any statistically meaningful conclusions once broken down into categories of interest. Therefore the study concentrated upon the 5-year aggregated data to make the sample large enough to be able to draw conclusions. Thus the examination of trends is difficult and inconclusive in most cases.

Data presented in this report should not be quoted as fact without also stating the applicable limitations. The limitations presented below apply to the entire report. Certain other limitations are described in the text where they apply.

(a) Cause codes reported on the RAIRS forms may not always represent the real cause of the accident. The assignment of cause code on the form may be the subjective opinion of the person filling out the form and may be influenced by his perspective of the accident and his or her employer's role in it.

(b) The secondary cause code reported in RAIRS tends to relate to mechanical failure and therefore may be more important to the study than the primary cause code. However, only about six percent of RAIRS records contain an entry for secondary cause code and the study methodology used it only if the primary cause code did not qualify for inclusion in the study.

(c) Only those cars which could be identified in UMLER were included in the study. There may be whole classes of cars with accidents which were not included in UMLER because of the single snapshot nature of UMLER and the spread of the study over five years. However, by picking an UMLER date close to the close of the study period, most cars that were retired from service during the study period, because of high accident rate or whatever reason, do not appear in the study. If they were retired then they automatically became unqualified for status as a problem car. On the other hand, those cars which were damaged beyond repair by accidents in the study period, and were therefore scrapped, will not show up in the study unless they appear in the UMLER file only by mistake: someone neglected to remove them from the active list.

(d) Population data by subtypes (e.g., specification class, truck design, tank capacity) may not be as accurate as desired. Subtype populations were first obtained by actual count of cars in UMLER. That count is therefore as accurate as is possible but counts North American cars reported in interchange service as of some date in the Fall of 1984. In order to estimate subtype populations for the years of the study, an important assumption had to be made, that the ratio of population of cars in any of the subtypes to the total population of all tank cars remains constant over the

period and is the same as found in UMLER. In other words, it is assumed that the subtype mix remains constant over the study period.

(e) Minor accidents, not reportable to RAIRS, are not included. Railroads are not required to report accidents which do not involve personal injury and which result in damage value under a certain threshold.

APPENDIX A

DATA PROCESSING METHODOLOGY

The following steps were performed to prepare the data for downloading to the PC:

1. The five years of RAIRS data were loaded into System 1022. A description of these datasets, including the attribute names used below is in Appendix H.

2. Car serial numbers for every RAIRS record were extracted to a data file. (Some RAIRS records only contain one car ID, others contain two "first car involved" and "causing").

3. The records were then sorted by car serial numbers and car initials using a DEC-10 utility. Duplicate records were removed.

4. The cars which can be found in UMLER are linked back to RAIRS and the corresponding RAIRS records are put in a data file (RAM**, where ** stands for 81, 82, 83, 84 and 85, indicating the five years 1981-1985). The UMLER records describing the cars extracted from RAIRS are put into a data file for each of the years.

These data files contain complete accident data (RAM**) and car characteristics data for only those tank cars involved in accidents and which can be identified by an UMLER record.

The data files were downloaded to the PC using the KERMIT error checking and correcting protocol. The files are then loaded into a dBASE III Plus data base on the PC.

The following steps are performed on a microcomputer:

1. Using the UMATCH file, all records of each year are extracted into a separate data base file TANK**, where the ** indicates the five years of the study.

2. The TANK** data files were then sorted by car initials and serial number for linking with the respective RAIRS** data.

3. A program was written to link each year of the RAIRS car records with the respective tank data files. Car initials and serial numbers (from the RAIRS data file) and car initials (INITU) and serial numbers (ILOW & IHIGH from the tank data file) were used for this purpose.

4. The datasets derived in the previous step were used to analyze the tank car accidents for cause codes of accidents, involvement of hazardous materials, and determine the frequency distribution by population, tank and truck capacity of tank car types that were involved more often in accidents. The shipping container specification was used as the primary tank car type identifier. The AAR car code was used as the car capacity identifier and the total weight on rail code was used for the truck capacity identifier.

APPENDIX B

CAUSE CODES

FRA TRAIN ACCIDENT CAUSE CODES - PARTIAL LIST

100-199 TRACK, ROADBED, AND STRUCTURE

ROADBED DEFECTS

101 Roadbed settled or soft
102 Washout/rain/slide/flood/snow/ice damage to track
109 Other roadbed defects

TRACK GEOMETRY DEFECTS

110 Wide gage (defective or missing crossties)
111 Wide gage (defective or missing spikes or other rail fasteners)
112 Wide gage (loose, broken, or defective gage rods)
113 Wide gage (worn rail)
114 Track alignment irregular
115 Track alignment irregular (buckled)
116 Track profile improper
117 Superelevation improper, excessive, or insufficient
118 Superelevation runoff improper
119 Cross level of track irregular (at joints)
120 Cross level of track irregular (not at joints)
129 Other track geometry defects

RAIL AND JOINT BAR DEFECTS

130 Bolt hole crack or break
131 Broken base of rail
132 Broken weld, field
133 Broken weld, plant
134 Detail fracture from shelling or head check
135 Engine burn fracture
136 Head and web separation (outside joint bar limits)
137 Head and web separation (within joint bar limits)
138 Horizontal split head
139 Piped rail
140 Rail defect with joint bar repair
141 Transverse/compound fissure
142 Vertical split head

143 Worn rail
144 Mismatched rail-head contour
145 Joint bar broken, compromise
146 Joint bar broken, insulated
147 Joint bar broken, noninsulated
148 Joint bolts, broken or missing
149 Other rail and joint bar defects

FROGS, SWITCHES, AND TRACK APPLIANCES

160 Guard rail loose/broken, or mislocated
161 Switch damaged or out of adjustment
162 Switch, hand operated, stand mechanism broken, loose, or worn
163 Switch connecting or operating rod broken or defective
164 Stock rail worn, broken, or disconnected
165 Switch point worn or broken
166 Switch rod worn, bent, broken, or disconnected
167 Frog (rigid) worn or broken
168 Frog (spring) worn or broken
169 Frog (self guarded) worn or broken
171 Derail defective
172 Expansion joint failed or malfunctioned
173 Retarder worn, broken, or malfunctioned
174 Spring/power switch mechanism malfunctioned
175 Retarder yard skate defective
176 Switch out of adjustment due to insufficient rail anchoring
179 Other frog, switch, or track appliance defects

OTHER WAY AND STRUCTURE

180 Bridge misalignment or failure
181 Flangeway clogged
189 Other way and structure defects

200-209 SIGNAL AND COMMUNICATIONS

200 Fixed signal improperly displayed (defective)
201 Radio communication equipment failure
202 Other communication equipment failure
203 Block signal displayed false proceed
204 Interlocking signal displayed false proceed
205 Automatic cab signal displayed false proceed
206 Automatic cab inoperative
207 Automatic train-stop device inoperative
208 Automatic train control device inoperative
209 Other signal and communication failures

400-499 EQUIPMENT

BRAKES

400 Air hose uncoupled or burst
401 Hydraulic hose uncoupled or burst
402 Broken brake pipe or connections
403 Obstructed brake pipe (closed angle cock, ice, etc.)
404 Other brake components damaged, worn, broken, or disconnected
405 Brake valve malfunction, undesired emergency
406 Brake valve malfunction, stuck brake, etc.
407 Rigging down or dragging
408 Hand brake (including gear) broken or defective
409 Hand brake linkage and/or connections broken or defective
410 Other brake defects or failures

TRAILER OR CONTAINER ON FLAT CAR

411 Broken or defective tiedown equipment
412 Broken or defective container
413 Broken or defective trailer
419 Other trailer or container defects

BODY

420 Body bolster broken or defective
421 Center sill broken or bent
422 Draft sill broken or bent
423 Center plate broken or defective
424 Center plate disengaged from truck (car off center)
425 Center pin broken or missing
426 Center plate attachment defective
427 Side sill broken
429 Other body and door defects

COUPLER AND DRAFT SYSTEM

430 Knuckle broken or defective
431 Couple mismatch, high/low
432 Coupler drawhead broken or defective
433 Coupler retainer pin/cross key missing
434 Draft gear/mechanism broken or defective (including yoke)
435 Coupler carrier broken or defective
436 Coupler shank broken or defective
439 Other coupler and draft system defects

TRUCK COMPONENTS

440 Side bearing clearance improper
441 Side bearings broken
442 Side bearings missing
443 Truck bolster broken
444 Side frame broken

445 Truck, stiff, improper lateral or, improper swiveling
446 Defective snubbing
447 Broken, missing, or otherwise defective springs
449 Other truck component defects

AXLES AND JOURNAL BEARINGS

450 Broken or bent between wheel seats
451 Journal (plain) failure from overheating
452 Journal (roller) failure from overheating
453 Journal fractured, new cold break
454 Journal fractured, cold break (previously overheated)
459 Other axle and journal bearing defects

WHEELS

460 Broken flange
461 Broken rim
462 Broken plate
463 Broken hub
464 Worn flange
465 Worn tread
466 Damaged flange or tread, thermal flat
467 Loose wheel
468 Thermal crack, flange or tread
469 Other wheel defects

LOCOMOTIVES

470 Running gear failure
471 Traction motor failure
472 Crank case or air box explosion
473 Oil fire
474 Electrically caused fire
475 Current collector system
476 Remote control equipment inoperative
477 Broken or defective swing hanger or spring plank
479 Other locomotive defect

DOORS

480 Box car plug door open
481 Box car plug door, attachment defective
482 Box car plug door, locking lever not in place
483 Box car door, other than plug, open
484 Box car door, other than plug, attachment defective
485 Bottom outlet car door open
486 Bottom outlet car door attachment defective
489 Other door defect

GENERAL MECHANICAL AND ELECTRICAL FAILURES

499 Other mechanical or electrical failures

500-599 TRAIN OPERATION - HUMAN FACTORS

USE OF BRAKES

500 Automatic brake, improper use
501 Dynamic brake, improper use
502 Failure to properly secure engine(s) (railroad employee)
503 Failure to properly secure hand brake on car(s) (railroad employee)
504 Failure to apply sufficient number of handbrakes on car(s) (railroad employees)
505 Failure to apply handbrakes on car(s) (railroad employee)
506 Failure to properly secure engine(s) or car(s) (non-railroad employee)
507 Independent (engine) brake, improper use
508 Failure to control speed of car using handbrake, (railroad employee)
509 Use of brakes, other (enter Code 509 in item 35 and explain in item 50)

EMPLOYEE PHYSICAL CONDITION

510 Impairment of efficiency and judgment because of drugs or alcohol
511 Incapacitation due to injury or illness
512 Employee restricted in work or motion
513 Employee asleep
515 Employee physical condition, other (enter code 51 in item 35 and explain in item 50)

FLAGGING, FIXED, HAND AND RADIO SIGNALS

517 Absence of fixed signal (Blue Signal)
518 Fixed signal improperly displayed (Blue Signal)
519 Fixed Signal improperly displayed
520 Fixed signal, failure to comply
521 Flagging, improper or failure to flag
522 Flagging signal, failure to comply
523 Hand signal, failure to comply
524 Hand signal improper
525 Hand signal, failure to give/receive
526 Radio communications, failure to comply
527 Radio communication, improper
528 Radio communication, failure to give/receive
529 Flagging, fixed, hand and radio signals, other (enter Code 529 in item 35 and explain in item 50)

OTHER RULES AND INSTRUCTIONS

530 Car(s) shoved out and left out of clear
531 Cars left foul
532 Derail, failure to apply or remove
533 Failure to stop train in clear

534 Hazardous materials regulations, failure to comply
535 Instruction to train/yard crew improper
536 Motor car or on-track equipment rules, failure to comply
537 Movement of engine(s) or car(s) without authority, (railroad employee)
538 Shoving movement, absence of man on or at leading end of movement, failure to control
539 Shoving movement, man on or at leading end of movement, failure to control
540 Slate, failure to remove or place
541 Special operating instruction, failure to comply (identify in item 50)
542 Train order of timetable authority, failure to comply
543 Train orders, radio, error in preparation, transmission or delivery
544 Train orders, written, error in preparation, transmission or delivery
549 Rules and instruction, other (Code 549 in item 35 and explain in item 50)

SPEED

550 Coupling speed excessive
553 Switch movement, excessive speed
554 Train inside yard limits, excessive speed
555 Train outside yard limits under clear block, excessive speed
559 Other, speed

SWITCHES, USE OF

560 Spring Switch not cleared before reversing
561 Switch improperly lined
562 Switch not latched or locked
563 Switch previously run through
569 Use of Switched, other

MISCELLANEOUS

570 Buffing or slack action excessive
571 Failure to couple
572 Lateral drawbar force on curve excessive
573 Moving cars while loading ramp or bridge plate not in proper position
574 Passed couplers
575 Retarder, improper manual operation
576 Retarder yard skate improperly applied
599 Other train operation, human factors

700-799 MISCELLANEOUS

700 Collision with highway user at grade crossing
701 Emergency brake application to avoid accident
702 Vandalism
703 Interference with railroad operations by non-railroad employee
704 Load shifted
705 Load fell from car

706 Overloaded car
707 Improperly loaded or unloaded car
708 Oversized load, misrouted
709 Object on or fouling track
710 Equipment on or fouling track
711 Trailer or container tiedown equipment improperly applied
712 Overloaded/improperly loaded container or trailer on flat car
713 Interaction of lateral/vertical forces
714 Failure to control speed of car using hand brake (non-railroad employee)
715 Snow, ice, mud, or sand on track
716 Other acts of God
799 Other miscellaneous

APPENDIX C

TANK CAR ACCIDENTS: ANNUAL COUNT BY CAUSE CODE

CAUSE CODE	1981 HAZ	1981 OTH	1982 HAZ	1982 OTH	1983 HAZ	1983 OTH	1984 HAZ	1984 OTH	1985 HAZ	1985 OTH	TOTAL HAZ	TOTAL OTH	ALL TOTAL
TRACK-RELATED CAUSES:													
Roadbed													
101	4	5	2	3	1	3	2	1		4	9	16	25
102		3	1	1			1	1		1	2	6	8
109							1				1	0	1
Sub	4	8	3	4	1	3	4	2	0	5	12	22	34
Gage													
110	11	16	8	10	7	13	9	19	9	8	44	66	110
111	7	2	1	1	3	1	6	1	3	2	20	7	27
112				1							0	1	1
113		2		1		3			2	1	2	7	9
Sub	18	20	9	13	10	17	15	20	14	11	66	81	147
Line													
114		1	2	4	2	3	5	1		1	9	10	19
115	3	4	1	4	1	5	1	3	2	2	8	18	26
Sub	3	5	3	8	3	8	6	4	2	3	17	28	45
Warp, Elevation, Profile, Other													
116			1	1				1	1		2	2	4
117		2			2			3		1	2	6	8
118							1	1			1	1	2
119	7	9	4	8	6	8	4	4	3	2	24	31	55
120	5	4	5	5	1	5	1	4	1	1	13	19	32
129		1	2	2	1	2	1				4	5	9
Sub	12	16	12	16	10	15	7	13	5	4	46	64	110

CAUSE CODE	1981 HAZ	1981 OTH	1982 HAZ	1982 OTH	1983 HAZ	1983 OTH	1984 HAZ	1984 OTH	1985 HAZ	1985 OTH	TOTAL HAZ	TOTAL OTH	ALL TOTAL
Rail & Joint Bar													
130				1	1			1			1	2	3
131	1	8	3	5	3	3	2	4	1	3	16	23	39
132										1	0	1	1
133			1								1	0	1
134	1	1	1						2		4	1	5
135											0	0	0
136	4		4	2	2	1	1	1	2		13	4	17
137	2	1	3								5	1	6
138	1			1	1			1			2	2	4
139			1								1	0	1
140	1										1	0	1
141	1	2	2	2		2	3	2	3	1	9	9	18
142	4	4	2	2	2	3		2	1	3	9	14	23
143		1			1	2	1	1		2	2	6	8
144	1		1				1			2	3	2	5
145			1								1	0	1
146											0	0	0
147		3		2	1			1			1	6	7
148		1								1	0	2	2
149	1					4	3			2	4	6	10
Sub	17	21	19	15	11	15	11	13	15	15	73	79	152
Turnout & Appliance													
160		2			1	1	1	1			2	4	6
161	3	3	1	3	2	6	1	5	5	1	12	18	30
162									1		1	0	1
163								1			0	1	1
164			1	2			1				2	2	4
165	7	9	2	10	5	10	5	12	7	12	26	53	79
166								1			0	1	1
167			1						1	1	2	1	3
168											0	0	0
169				1							0	1	1
171					1						1	0	1
172									1		1	0	1
173	1	3		4		3		1	2	4	3	15	18
174		1		1		2	1			1	1	5	6
175					2	2	1	3		3	3	8	11
176	2									1	2	1	3
179	5	4	1	2			1	1			7	7	14
Sub	18	22	6	23	11	24	11	25	17	23	63	117	180

CAUSE CODE	1981 HAZ	1981 OTH	1982 HAZ	1982 OTH	1983 HAZ	1983 OTH	1984 HAZ	1984 OTH	1985 HAZ	1985 OTH	TOTAL HAZ	TOTAL OTH	ALL TOTAL
Bridge, Signal, Communication, Other													
181						1		1			0	2	2
201						2					0	2	2
209	1	1									1	1	2
Sub	1	1	0	0	0	3	0	1	0	0	1	5	6
Total	73	93	52	79	46	85	54	78	53	61	278	396	674
VEHICLE-RELATED CAUSES:													
Brake System													
400	2						1	2	2	1	5	3	8
402								1			0	1	1
404	1			1		1					1	2	3
405		1				1					0	2	2
406				1		1				1	0	3	3
407	3	2				1		1			3	4	7
408					1		1	2	1		3	2	5
409		1		1		2			1	2	1	6	7
410								1			0	1	1
Sub	6	4	0	3	1	6	2	7	4	4	13	24	37
Body and Door													
420								1			0	1	1
421		2		1		1	1	1	1	1	2	6	8
422		1			1			1			1	2	3
423		1	1		1						2	1	3
424	2	4	1		3	2	2	4	3	4	11	14	25
425						3					0	3	3
429									1		1	0	1
Sub	2	8	2	1	5	6	3	7	5	5	17	27	44

CAUSE CODE	1981 HAZ	1981 OTH	1982 HAZ	1982 OTH	1983 HAZ	1983 OTH	1984 HAZ	1984 OTH	1985 HAZ	1985 OTH	TOTAL HAZ	TOTAL OTH	ALL TOTAL
Coupler and Draft System													
430		1	1		1		1	1	1	1	4	3	7
431		1	3	2	1	1	1	2	2		7	6	13
432		1				2		1			0	4	4
433						1		2			0	3	3
434				2							0	2	2
435			1								1	0	1
436		1		1							0	2	2
439			1				1	1	2		4	1	5
Sub	0	4	6	5	2	4	3	7	5	1	16	21	37
Truck Components													
440	2	7		1	1	2		2	4	2	7	14	21
441										1	0	1	1
442			1	1							1	1	2
443		1	1		1	1	2	1		2	4	5	9
445	2	4	2	2		2	4	3		1	8	12	20
446							1				1	0	1
449				1						1	0	2	2
Sub	4	12	4	5	2	5	7	6	4	7	21	35	56
Axles & Journal Bearings													
450										1	0	1	1
451	4	2	1	1	1	1	4			1	10	5	15
452	3		3	1	1	1	3		4	2	14	4	18
Sub	7	2	4	2	2	2	7	0	4	4	24	10	34
Wheels													
460				2		1	1				1	3	4
461				1	1		1			3	2	4	6
462	1	1				1					1	2	3
464	2	2	1	5		1	1	2	2		6	10	16
466				1				1			0	2	2
467		1				1	1	1		2	1	5	6
469						1	1		1		2	1	3
Sub	3	4	1	9	1	5	5	4	3	5	13	27	40

CAUSE CODE	1981 HAZ	1981 OTH	1982 HAZ	1982 OTH	1983 HAZ	1983 OTH	1984 HAZ	1984 OTH	1985 HAZ	1985 OTH	TOTAL HAZ	TOTAL OTH	ALL TOTAL
Doors													
481				2							0	2	2
486					1						1	0	1
489		1									0	1	1
Sub	0	1	0	2	1	0	0	0	0	0	1	3	4
General Mechanical & Electrical Failures													
499								1			0	1	1
Sub	0	0	0	0	0	0	0	1	0	0	0	1	1
Total	22	35	17	27	14	28	27	32	25	26	105	148	253
OPERATIONS-RELATED CAUSES:													
Brakes, Use of													
500	1	1		1			2	2			3	4	7
502						2		1			0	3	3
503	4	11	3	7		8		4	3	10	10	40	50
504	1	3	3	5	3	8		8	3	8	10	32	42
505	3	3	3	7		3	1	6	1	6	8	25	33
506		2				2			1		1	4	5
507								1	1		1	1	2
508		1	1			2		1	3	1	4	5	9
509				3		3	1			1	1	7	8
Sub	9	21	10	23	3	28	4	23	12	26	38	121	159
Employee Physical Condition													
515										1	0	1	1
Sub	0	0	0	0	0	0	0	0	0	1	0	1	1
Flagging, Fixed, Hand & Radio Signals													
520		1		1						1	0	3	3
521							1				1	0	1
523		1							1		1	1	2
525	2	1		1		1				1	2	4	6
526	3							1			3	1	4
527										1	0	1	1
528	1							2		1	1	3	4
529								1			0	1	1
Sub	6	3	0	2	0	1	1	4	1	4	8	14	22

CAUSE CODE	1981 HAZ	1981 OTH	1982 HAZ	1982 OTH	1983 HAZ	1983 OTH	1984 HAZ	1984 OTH	1985 HAZ	1985 OTH	TOTAL HAZ	TOTAL OTH	ALL TOTAL
Other Rules & Instructions													
530		4	1	5	2	1	1	2		1	4	13	17
531	3	13	1	12	1	6	1	7	2	12	8	50	58
532			4			1		2			4	3	7
533	2	1	2	3		3		6	2	5	6	18	24
534	1										1	0	1
535		2		2				1	2	1	2	6	8
537	1		1			1					2	1	3
538	10	21	6	12	4	8	4	10	3	10	27	61	88
539	2	2		3	2	4	1		3	3	8	12	20
540		1		1	1						1	2	3
541		1				1		1		1	0	4	4
542		1			1						1	1	2
549					1	1	1	1			2	2	4
Sub	19	46	15	38	12	26	8	30	12	33	66	173	239
Speed													
550	2	10		5		7	1	4		1	3	27	30
553		2	1			2		2		1	1	7	8
554	1	1		1				3		1	1	6	7
555		1	1								1	1	2
559		1		1	1	1			1	1	2	4	6
Sub	3	15	2	7	1	10	1	9	1	4	8	45	53
Switches, Use of													
561	5	12	4	6	4	9	5	6	3	6	21	39	60
562	1	1						1			1	2	3
563	2	5	2	3	3	4	1	3	2	2	10	17	27
569			1								1	0	1
Sub	8	18	7	9	7	13	6	10	5	8	33	58	91

CAUSE CODE	1981 HAZ	1981 OTH	1982 HAZ	1982 OTH	1983 HAZ	1983 OTH	1984 HAZ	1984 OTH	1985 HAZ	1985 OTH	TOTAL HAZ	TOTAL OTH	ALL TOTAL
Miscellaneous													
570	2	8	5	9	4	7	4	4	3	11	18	39	57
571	2	2	1	1			2			3	5	6	11
572	1	1	1	4	2	2	3	2		1	7	10	17
574	5	7	1	9		5	1	6		4	7	31	38
575	2	3	1	3	1	5	2	4	1	6	7	21	28
576		2				1				1	0	4	4
599	1	1	1	1		1	3	2	1	4	6	9	15
Sub	13	24	10	27	7	21	15	18	5	30	50	120	170
Total	58	127	44	106	30	99	35	94	36	106	203	532	735
MISCELLANEOUS CAUSES:													
700	2	2	1	1	1	3	1	3		2	5	11	16
701								2			0	2	2
702	3	6	2	2	2	4	3	6	3	3	13	21	34
703		1			1						1	1	2
704	2		1		1			2		2	4	4	8
705		1									0	1	1
707	1										1	0	1
709	1	1	1	2	2			2	1	1	5	6	11
710		3	1						2		3	3	6
713	1	6	1	6	3	2	3	4	2	3	10	21	31
714								2			0	2	2
715	1	1	1	6		1				2	2	10	12
716	1					2				2	1	4	5
718	4	8	3	4		4	1	4	1	12	9	32	41
799	2	9	4	4	3	3	3	7	2	5	14	28	42
Sub	18	38	14	26	13	19	11	32	11	32	68	146	214
Total	18	38	14	26	13	19	11	32	11	32	68	146	214
TOTAL	171	293	128	237	103	231	127	236	125	225	654	1222	1876

APPENDIX D

TANK CAR ACCIDENTS: ANNUAL COUNT
BY SHIPPING CONTAINER SPECIFICATION AND CAR TYPE

SPEC	CAR TYPE	1981 COUNT	1982 COUNT	1983 COUNT	1984 COUNT	1985 COUNT	TOTAL
103	T104		1	2	1		4
103AALW	T021					1	1
	T022		1				1
103ALW	T013	2	1	1			4
103BW	T053		2				2
103CW	T073				1		1
103W	T101	2					2
	T102	3	4	3	3	3	16
	T103	6	4	4	2	6	22
	T104					1	1
	T105	1					1
103 Subtotals		14	13	10	7	11	55
104W	T103				1	1	2
104 Subtotals		0	0	0	1	1	2
105A100W	T526		1				1
	T527					1	1
105A200ALW	T503		1			1	2
105A200W	T537	1		2			3
105A300W	T541	1	2		1	2	6
	T543	3	1	1	1	2	8
	T545		1				1
	T546	1		2	1		4
	T547	4	4			1	9
	T548			1			1
	T549	9	8	4	4	8	33

SPEC	CAR TYPE	1981 COUNT	1982 COUNT	1983 COUNT	1984 COUNT	1985 COUNT	TOTAL
105A400W	T553					1	1
	T559	4	5	4	5		18
105A500	T565	1		1			2
105A500W	T185					1	1
	T561		1				1
	T563	3	3	4	2	2	14
	T564	13	13	7	8	7	48
	T565	1	2	1	1	3	8
105A600W	T575			1			1
	T576	1					1
105J300W	T907	7	1	6	1	5	20
	T909				1	1	2
105S300W	T917	1		1			2
	T919	1	1				2
105 Subtotals		51	44	35	25	35	190
107A	T770		1			1	2
107 Subtotals		0	1	0	0	1	2
111A100ALW	T013					1	1
111A100ALW1	T013	1				1	2
111A100W1	T101		1			1	2
	T102	3	1	1	4		9
	T103	6	10	6	5	5	32
	T104	59	48	44	43	52	246
	T105	71	39	41	56	50	257
	T106	26	15	19	22	19	101
	T107	16	8	7	11	6	48
	T108	13	16	13	11	18	71
	T109	2		6	3		11
111100W2	T053	3	2	1	2	1	9
	T054	9	14	5	16	10	54
	T192			1			1
111A100W3	T102	4	2	1		1	8
	T103	6	3	6	1	6	22
	T104	23	21	30	22	25	121
	T105	9	17	14	11	10	61
	T106	32	17	11	27	15	102
	T108	1				1	2
	T183					1	1

SPEC	CAR TYPE	1981 COUNT	1982 COUNT	1983 COUNT	1984 COUNT	1985 COUNT	TOTAL
111A100W4	T525		1				1
	T526			2			2
111A100W5	T052	1					1
	T054				1		1
	T055	5	6		2	3	16
111A100W6	T065			1			1
	T076				1	1	2
111A60ALW	T015	3	2	1	2		8
	T019	1	1	2	1	1	6
111A60ALW1	T013	2	1		2	3	8
	T015	2		1	1	1	5
	T016					1	1
111A60ALW2	T012		1				1
	T013	1					1
111A60W1	T101	1					1
	T102	4			1	2	7
	T103	6	1	5	1	6	19
	T104	4	3	5	5	3	20
	T105	8	8	8	7	3	34
	T106	12	7	9	11	9	48
	T108	2			1		3
111A60W3	T104			1	1		2
111 Subtotals		336	245	241	271	256	1349
112A200W	T597			1	1		2
112A400W	T614	1					1
112J340W	T387	1	1	1	1	1	5
	T388	1	2	2			5
	T389	36	32	25	28	24	145
112J400W	T415				1		1
	T418	4	3	1	4	5	17
	T419	3	5	4	6	5	23
112S340W	T399	3	6	6	5	7	27
112S400W	T428			1			1
	T618	1					1
112T340W	T407		1				1
	T409	1			1		2
112T400W	T439		2		3		5
112 Subtotals		51	52	41	50	42	236

SPEC	CAR TYPE	1981 COUNT	1982 COUNT	1983 COUNT	1984 COUNT	1985 COUNT	TOTAL
114A340W	T644		1				1
	T645		1		1		2
114A400W	T654		1				1
	T658				2		2
114J340W	T449	2	1	1	1		5
114T340W	T469		1				1
114 Subtotals		2	5	1	4	0	12
120A300W	T545		1		1		2
120 Subtotals		0	1	0	1	0	2
203W	T102	2				1	3
203 Subtotals		2	0	0	0	1	3
204W	T764	3	1	1	1		6
	T765	1		1			2
204 Subtotals		4	1	2	1	0	8
206W	T164			1			1
206 Subtotals		0	0	1	0	0	1
211A100W1	T103					1	1
	T104	2	2	3	2	1	10
	T105	1	1		1		3
	T106					1	1
211 Subtotals		3	3	3	3	3	15
XT	T033	1					1
XT Subtotals		1	0	0	0	0	1
GRAND TOTALS		464	365	334	363	350	1876

APPENDIX E

HAZARDOUS MATERIALS TANK CAR ACCIDENTS: ANNUAL COUNT BY SHIPPING CONTAINER SPECIFICATION AND CAR TYPE

SPEC	CAR TYPE	1981 COUNT	1982 COUNT	1983 COUNT	1984 COUNT	1985 COUNT	TOTAL
103ALW	T013	1	1	1			3
103BW	T053		1				1
103CW	T073				1		1
103W	T103	2	1	1	2	2	8
103 Subtotals		3	3	2	3	2	13
104W	T103				1		1
104 Subtotals		0	0	0	1	0	1
105A100W	T526		1				1
105A200W	T537	1		2			3
105A300W	T541				1	2	3
	T543	2		1		1	4
	T545		1				1
	T546			2	1		3
	T547	1	2			1	4
	T548			1			1
	T549	5	3	4	1	2	15
105A400W	T559	4	3	2	1		10
105A500	T565	1		1			2
105A500W	T185					1	1
	T563	3	1	1	1	1	7
	T564	9	6	4	5	3	27
	T565		1			1	2
105A600W	T575			1			1
105J300W	T907	5		2	1	3	11
	T909				1		1

SPEC	CAR TYPE	1981 COUNT	1982 COUNT	1983 COUNT	1984 COUNT	1985 COUNT	TOTAL
105S300W	T917	1		1			2
	T919	1	1				2
105 Subtotals		33	19	22	12	15	101
107A	T770					1	1
107 Subtotals		0	0	0	0	1	1
111A100ALW	T013					1	1
111A100W1	T102	2					2
	T103	1	5		1	3	10
	T104	23	13	11	12	16	75
	T105	17	6	1	7	15	46
	T106	7	3	2	4	4	20
	T107	7	5	4	7	2	25
	T108	10	8	6	9	12	45
	T109	2		2	2		6
111100W2	T053	1	2	1	1		5
	T054	8	7	4	8	7	34
	T192			1			1
111A100W3	T103	4		1			5
	T104	1	3	7	4	5	20
	T105	2	3	5	5	3	18
	T106	6	5	3	6	7	27
	T108	1				1	2
111A100W4	T525		1				1
111A100W5	T054				1		1
	T055	4	4		1	3	12
111A60ALW	T015	3	2	1	1		7
	T019	1		1	1		3
111A60ALW1	T013					1	1
	T015	1			1		2
111A60ALW2	T013	1					1
111A60W1	T103	1		3		1	5
	T104	1	1	2	1		5
	T105	1	3	2			6
	T106	1	1	3	4	1	10
111 Subtotals		106	72	60	76	82	396

SPEC	CAR TYPE	1981 COUNT	1982 COUNT	1983 COUNT	1984 COUNT	1985 COUNT	TOTAL
112A200W	T597				1		1
112A400W	T614	1					1
112J340W	T387	1	1			1	3
	T388	1	2				3
	T389	16	17	15	16	15	79
112J400W	T415				1		1
	T418	1	2		4	4	11
	T419	2	4	1	5	3	15
112S340W	T399	2	2	2	3	2	11
112S400W	T618	1					1
112T340W	T407		1				1
	T409				1		1
112T400W	T439		2		3		5
112 Subtotals		25	31	18	34	25	133
114A340W	T644		1				1
114A400W	T658				1		1
114J340W	T449	1	1	1			3
114T340W	T469		1				1
114 Subtotals		1	3	1	1	0	6
203W	T102	1					1
203 Subtotals		1	0	0	0	0	1
204W	T764	1					1
204 Subtotals		1	0	0	0	0	1
XT	T033	1					1
XT Subtotals		1	0	0	0	0	1
GRAND TOTALS		171	128	103	127	125	654

APPENDIX F

TANK CAR ACCIDENTS: FIVE-YEAR COUNT
BY CAUSE CODE AND SHIPPING CONTAINER SPECIFICATION

CAUSE CODE	SPEC 103 HAZ	SPEC 103 OTH	SPEC 105 HAZ	SPEC 105 OTH	SPEC 111 HAZ	SPEC 111 OTH	SPEC 112 HAZ	SPEC 112 OTH	OTHERS HAZ	OTHERS OTH	TOTAL HAZ	TOTAL OTH	ALL TOTAL
TRACK-RELATED CAUSES:													
101-109 Roadbed													
Sub	1	1	3	1	6	19	2	1	0	0	12	22	34
110-113 Gage													
Sub	1	1	12	2	37	76	14	2	2	0	66	81	147
114-115 Line													
Sub	0	1	2	0	13	23	2	3	0	1	17	28	45
116-129 Warp, Elevation, Profile, Other													
Sub	2	3	13	13	18	37	12	10	1	1	46	64	110
130-149 Rail & Joint Bar													
Sub	1	2	12	3	47	68	12	3	1	3	73	79	152
160-179 Turnout & Appliance													
Sub	0	5	13	8	42	97	7	6	1	1	63	117	180
180-209 Bridge, Signal, Communication, Other													
Sub	0	0	0	2	1	3	0	0	0	0	1	5	6
Total	5	13	55	29	164	323	49	25	5	6	278	396	674

CAUSE CODE	SPEC 103 HAZ	SPEC 103 OTH	SPEC 105 HAZ	SPEC 105 OTH	SPEC 111 HAZ	SPEC 111 OTH	SPEC 112 HAZ	SPEC 112 OTH	OTHERS HAZ	OTHERS OTH	TOTAL HAZ	TOTAL OTH	ALL TOTAL
VEHICLE-RELATED CAUSES:													
Brake System													
400			2		2	2	1			1	5	3	8
402						1					0	1	1
404				1	1	1					1	2	3
405						2					0	2	2
406						3					0	3	3
407					1	4	2				3	4	7
408			1		2	2					3	2	5
409					1	4		1		1	1	6	7
410						1					0	1	1
Sub	0	0	3	1	7	20	3	1	0	2	13	24	37
Body and Door													
420										1	0	1	1
421	1	1		1	1	4					2	6	8
422					1	2					1	2	3
423					1	1	1				2	1	3
424			1	3	6	10	4	1			11	14	25
425						2		1			0	3	3
429					1						1	0	1
Sub	1	1	1	4	10	19	5	2	0	1	17	27	44
Coupler and Draft System													
430			1		2	3	1				4	3	7
431	1		2		2	5	2	1			7	6	13
432				1		3					0	4	4
433				1		2					0	3	3
434						2					0	2	2
435					1						1	0	1
436						2					0	2	2
439					1	1	3				4	1	5
Sub	1	0	3	2	6	18	6	1	0	0	16	21	37
Truck Components													
440				2	4	5	3	6		1	7	14	21
441								1			0	1	1
442							1	1			1	1	2
443				1	3	3	1			1	4	5	9
445			3	1	4	8	1	2		1	8	12	20
446							1				1	0	1

CAUSE CODE	SPEC 103 HAZ	SPEC 103 OTH	SPEC 105 HAZ	SPEC 105 OTH	SPEC 111 HAZ	SPEC 111 OTH	SPEC 112 HAZ	SPEC 112 OTH	OTHERS HAZ	OTHERS OTH	TOTAL HAZ	TOTAL OTH	ALL TOTAL
449						2					0	2	2
Sub	0	0	3	4	11	18	7	10	0	3	21	35	56
Axles & Journal Bearings													
450						1					0	1	1
451		2	3		6	3	1				10	5	15
452			2		9	4	2		1		14	4	18
Sub	0	2	5	0	15	8	3	0	1	0	24	10	34
Wheels													
460					1	3					1	3	4
461					1	4	1				2	4	6
462					1	2					1	2	3
464					5	8	1			2	6	10	16
466						2					0	2	2
467				1	1	1		3			1	5	6
469			1		1	1					2	1	3
Sub	0	0	1	1	10	21	2	3	0	2	13	27	40
Doors													
481				1				1			0	2	2
486					1						1	0	1
489						1					0	1	1
Sub	0	0	0	1	1	1	0	1	0	0	1	3	4
General Mechanical & Electrical Failures													
499						1					0	1	1
Sub	0	0	0	0	0	1	0	0	0	0	0	1	1
Total	2	3	16	13	60	106	26	18	1	8	105	148	253

CAUSE CODE	SPEC 103 HAZ	SPEC 103 OTH	SPEC 105 HAZ	SPEC 105 OTH	SPEC 111 HAZ	SPEC 111 OTH	SPEC 112 HAZ	SPEC 112 OTH	OTHERS HAZ	OTHERS OTH	TOTAL HAZ	TOTAL OTH	ALL TOTAL
OPERATIONS-RELATED CAUSES:													
500-509 Brakes, Use of													
Sub	3	3	4	12	25	88	4	15	2	3	38	121	159
510-515 Employee Physical Condition													
Sub	0	0	0	0	0	1	0	0	0	0	0	1	1
517-529 Flagging, Fixed, Hand & Radio Signals													
Sub	0	1	0	0	4	12	4	1	0	0	8	14	22
530-549 Other Rules & Instructions													
Sub	0	6	7	11	39	145	20	8	0	3	66	173	239
550-559 Speed													
Sub	0	4	0	0	5	36	3	4	0	1	8	45	53
560-569 Switches, Use of													
Sub	1	2	6	4	19	44	7	7	0	1	33	58	91
570-599 Miscellaneous													
Sub	1	3	3	9	32	88	10	13	3	7	50	120	170
Total	5	19	20	36	125	414	48	48	5	15	203	532	735
MISCELLANEOUS CAUSES:													
Sub	1	7	10	11	47	110	10	12	0	6	68	146	214
Total	1	7	10	11	47	110	10	12	0	6	68	146	214
TOTAL	13	42	101	89	396	953	133	103	11	35	654	1222	1876

APPENDIX G

TANK CAR ACCIDENT RATES
BY SHIPPING CONTAINER SPECIFICATION AND CAR TYPE

SHIPPING CONT. SPEC.	CAR TYPE	ACCIDENTS HAZ	ACCIDENTS OTHER	POPULATION	<== ACCIDENT RATE HAZ	OTH	ALL ==>
103	T101			32			
	T102			131			
	T103			135			
	T104		4	344		2.33	2.33
	T109			1			
103A	T051			12			
	T052			12			
	T192			1			
103AALW	T021		1	157		1.27	1.27
	T022		1	32		6.25	6.25
	T023			3			
	T024			24			
103ALW	T011			3			
	T013	3	1	926	0.65	0.22	0.86
103ANW	T041			11			
	T042			2			
	T043			1			
103AW	T051			152			
	T052			235			
	T053			405			
	T054			37			
	T181			1			
	T182			2			
	T183			6			
	T191			13			
103BW	T051			5			
	T052			173			
	T053	1	1	305	0.66	0.66	1.31
	T054			22			
103CW	T061			18			
	T062			36			
	T064			2			
	T071			1			
	T072			3			
	T073	1		5	40.00		40.00

SHIPPING CONT. SPEC.	CAR TYPE	ACCIDENTS HAZ	ACCIDENTS OTHER	POPULATION	<== ACCIDENT RATE ==> HAZ	OTH	ALL
	T082			1			
103DW	T063			10			
	T072			2			
	T073			8			
	T081			1			
	T091			1			
103EW	T062			5			
	T072			17			
	T073			1			
	T081			1			
	T091			2			
	T092			4			
103W	T101		2	446		0.90	0.90
	T102		16	3,802		0.84	0.84
	T103	8	14	7,515	0.21	0.37	0.59
	T104		1	1,231		0.16	0.16
	T105		1	325		0.62	0.62
	T106			4			
	T182			7			
	T183			25			
103 Subtotals		13	42	16,656	0.16	0.50	0.66
104	T101			1			
104W	T101			10			
	T102			236			
	T103	1	1	198	1.01	1.01	2.02
	T104			2			
	T105			38			
104 Subtotals		1	1	485	0.41	0.41	0.82
105A100ALW	T503			34			
105A100W	T523			17			
	T524			4			
	T525			16			
	T526	1		65	3.08		3.08
	T527		1	82		2.44	2.44
105A200ALW	T503		2	736		0.54	0.54
105A200W	T537	3		267	2.25		2.25
105A300	T543			2			
105A300W	T181			2			
	T541	3	3	925	0.65	0.65	1.30
	T542			80			

SHIPPING CONT. SPEC.	CAR TYPE	ACCIDENTS HAZ	ACCIDENTS OTHER	POPULATION	<== ACCIDENT RATE ==> HAZ	OTH	ALL
	T543	4	4	4,976	0.16	0.16	0.32
	T544			131			
	T545	1		500	0.40		0.40
	T546	3	1	320	1.88	0.63	2.50
	T547	4	5	1,647	0.49	0.61	1.09
	T548	1		39	5.13		5.13
	T549	15	18	3,125	0.96	1.15	2.11
105A400	T559			3			
105A400W	T553		1	339		0.59	0.59
	T554			1			
	T555			17			
	T556			73			
	T559	10	8	1,087	1.84	1.47	3.31
105A500	T561			9			
	T563			10			
	T565	2		40	10.00		10.00
105A500W	T185	1		2	100.00		100.00
	T561		1	247		0.81	0.81
	T562			27			
	T563	7	7	3,328	0.42	0.42	0.84
	T564	27	21	7,428	0.73	0.57	1.29
	T565	2	6	465	0.86	2.58	3.44
105A600W	T573			8			
	T574			36			
	T575	1		257	0.78		0.78
	T576		1	31		6.45	6.45
105J100W	T865			23			
105J300W	T903			6			
	T905			10			
	T907	11	9	1,020	2.16	1.76	3.92
	T909	1	1	173	1.16	1.16	2.31
105J400W	T929			282			
105J500W	T941			1			
	T944			15			
105S300W	T917	2		70	5.71		5.71
	T919	2		53	7.55		7.55
105S600W	T975			16			
105 Subtotals		101	89	28,045	0.72	0.63	1.35
106A500	T580			31			
106 Subtotals		0	0	31	0.00	0.00	0.00

SHIPPING CONT. SPEC.	CAR TYPE	ACCIDENTS HAZ	ACCIDENTS OTHER	POPULATION	<== ACCIDENT RATE ==> HAZ	OTH	ALL
107A	T770	1	1	166	1.20	1.20	2.41
107 Subtotals		1	1	166	1.20	1.20	2.41
109A200ALW	T503			368			
	T505			38			
109A300ALW	T503			24			
109 Subtotals		0	0	430	0.00	0.00	0.00
111A100ALW	T012			18			
	T013	1		217	0.92		0.92
111A100ALW1	T012			5			
	T013		2	365		1.10	1.10
111A100ALW2	T013			10			
	T014			5			
111A100W1	T101		2	52		7.69	7.69
	T102	2	7	1,519	0.26	0.92	1.18
	T103	10	22	4,381	0.46	1.00	1.46
	T104	75	171	19,809	0.76	1.73	2.48
	T105	46	211	33,275	0.28	1.27	1.54
	T106	20	81	10,049	0.40	1.61	2.01
	T107	25	23	4,214	1.19	1.09	2.28
	T108	45	26	5,663	1.59	0.92	2.51
	T109	6	5	279	4.30	3.58	7.89
	T183			21			
	T184			6			
	T185			1			
	T186			7			
111A100W2	T051			16			
	T052			71			
	T053	5	4	1,340	0.75	0.60	1.34
	T054	34	20	5,940	1.14	0.67	1.82
	T055			126			
	T191			1			
	T192	1		2	100.00		100.00
	T193			3			
111A100W3	T102		8	921		1.74	1.74
	T103	5	17	4,060	0.25	0.84	1.08
	T104	20	101	10,741	0.37	1.88	2.25
	T105	18	43	5,907	0.61	1.46	2.07
	T106	27	75	10,291	0.52	1.46	1.98
	T108	2		37	10.81		10.81
	T183		1	13		15.38	15.38

SHIPPING CONT. SPEC.	CAR TYPE	ACCIDENTS HAZ	ACCIDENTS OTHER	POPULATION	<== ACCIDENT RATE ==> HAZ	OTH	ALL
111A100W4	T521			7			
	T523			7			
	T524			2			
	T525	1		137	1.46		1.46
	T526		2	138		2.90	2.90
	T527			131			
111A100W5	T051			5			
	T052		1	33		6.06	6.06
	T053			198			
	T054	1		197	1.02		1.02
	T055	12	4	2,187	1.10	0.37	1.46
111A100W6	T061			2			
	T063			2			
	T065		1	39		5.13	5.13
	T067			26			
	T071			3			
	T072			3			
	T073			35			
	T074			9			
	T075			97			
	T076		2	30		13.33	13.33
	T077			43			
	T085			26			
	T094			6			
	T095			32			
	T097			10			
111A60ALW	T011			1			
	T012			30			
	T013			255			
	T015	7	1	504	2.78	0.40	3.17
	T016			14			
	T017			14			
	T019	3	3	98	6.12	6.12	12.24
111A60ALW1	T011			7			
	T012			47			
	T013	1	7	634	0.32	2.21	2.52
	T014			1			
	T015	2	3	404	0.99	1.49	2.48
	T016		1	211		0.95	0.95
111A60ALW2	T012		1	34		5.88	5.88
	T013	1		10	20.00		20.00
	T014			68			
	T015			140			
111A60W1	T101		1	88		2.27	2.27
	T102		7	840		1.67	1.67
	T103	5	14	3,211	0.31	0.87	1.18

SHIPPING CONT. SPEC.	CAR TYPE	ACCIDENTS HAZ	ACCIDENTS OTHER	POPULATION	<== ACCIDENT RATE ==> HAZ	OTH	ALL
	T104	5	15	1,864	0.54	1.61	2.15
	T105	6	28	6,298	0.19	0.89	1.08
	T106	10	38	5,175	0.39	1.47	1.86
	T108		3	123		4.88	4.88
	T109			5			
111A60W2	T052			1			
	T053			6			
	T054			1			
111A60W3	T104		2	10		40.00	40.00
	T105			1			
111A60W7	T062			5			
	T064			45			
111 Subtotals		396	953	142,915	0.55	1.33	1.89
112A200W	T596			17			
	T597	1	1	188	1.06	1.06	2.13
112A340W	T607			62			
	T609			44			
112A400W	T613			3			
	T614	1		311	0.64		0.64
	T615			85			
	T616			114			
	T617			8			
	T618			22			
	T619			1			
112J200W	T599			1			
112J340W	T386			17			
	T387	3	2	385	1.56	1.04	2.60
	T388	3	2	363	1.65	1.10	2.75
	T389	79	66	14,491	1.09	0.91	2.00
112J400W	T412			9			
	T415	1		6	33.33		33.33
	T416			44			
	T418	11	6	898	2.45	1.34	3.79
	T419	15	8	2,566	1.17	0.62	1.79
112S340W	T397			93			
	T398			47			
	T399	11	16	2,484	0.89	1.29	2.17
	T609			6			
112S400W	T423			4			
	T424			21			
	T425			34			
	T426			176			
	T428		1	111		1.80	1.80

SHIPPING CONT. SPEC.	CAR TYPE	ACCIDENTS HAZ	ACCIDENTS OTHER	POPULATION	<== ACCIDENT RATE ==> HAZ	OTH	ALL
	T429			158			
	T618	1		14	14.29		14.29
	T619			1			
112T340W	T407	1		356	0.56		0.56
	T408			1			
	T409	1	1	752	0.27	0.27	0.53
112T400W	T434			32			
	T436			8			
	T437			13			
	T438			190			
	T439	5		295	3.39		3.39
112 Subtotals		133	103	24,431	1.09	0.84	1.93
113A175W	T679			4			
113A60W2	T678			19			
113C120W	T679			55			
113C60W	T679			2			
113D120W	T678			35			
113D60W	T679			24			
113 Subtotals		0	0	139	0.00	0.00	0.00
114A340W	T644	1		29	6.90		6.90
	T645		2	175		2.29	2.29
	T649			55			
114A400W	T654		1	4		50.00	50.00
	T655			64			
	T656			28			
	T658	1	1	29	6.90	6.90	13.79
114J340W	T449	3	2	374	1.60	1.07	2.67
114S340W	T459			11			
114S400W	T485			2			
114T340W	T465			3			
	T469	1		234	0.85		0.85
114T400W	T499			15			
114 Subtotals		6	6	1,023	1.17	1.17	2.35
115A60W1	T112			4			
	T115			5			
115A60W6	T135			73			
	T136			9			

SHIPPING CONT. SPEC.	CAR TYPE	ACCIDENTS HAZ	ACCIDENTS OTHER	POPULATION	<== ACCIDENT RATE ==> HAZ	OTH	ALL
	T142			36			
	T145			52			
	T146			12			
	T153			1			
	T155			15			
	T164			18			
	T165			7			
115 Subtotals		0	0	232	0.00	0.00	0.00
120A300W	T543			12			
	T544			11			
	T545		2	37		10.81	10.81
	T546			1			
	T549			4			
120A400W	T553			14			
	T554			44			
	T556			1			
120A500W	T561			5			
120A600W	T575			6			
	T580			54			
120 Subtotals		0	2	189	0.00	2.12	2.12
201A35W	T012			20			
	T013			3			
201A70W	T012			103			
	T013			152			
201 Subtotals		0	0	278	0.00	0.00	0.00
203	T102			2			
203W	T101			4			
	T102	1	2	155	1.29	2.58	3.87
	T103			74			
	T104			79			
	T105			1			
	T182			2			
	T183			4			
203 Subtotals		1	2	321	0.62	1.25	1.87

SHIPPING CONT. SPEC.	CAR TYPE	ACCIDENTS HAZ	ACCIDENTS OTHER	POPULATION	<== ACCIDENT RATE ==> HAZ	OTH	ALL
204W	T762			4			
	T764	1	5	94	2.13	10.64	12.77
	T765		2	27		14.81	14.81
	T767			23			
204 Subtotals		1	7	148	1.35	9.46	10.81
206W	T112			1			
	T114			1			
	T132			48			
	T133			5			
	T134			1			
	T135			17			
	T142			18			
	T143			1			
	T144			46			
	T151			2			
	T152			6			
	T153			14			
	T154			22			
	T155			1			
	T162			3			
	T164		1	253		0.79	0.79
	T165			1			
206 Subtotals		0	1	440	0.00	0.45	0.45
211A100W1	T102			11			
	T103		1	76		2.63	2.63
	T104		10	1,063		1.88	1.88
	T105		3	198		3.03	3.03
	T106		1	49		4.08	4.08
	T108			91			
211A60W1	T102			1			
	T103			6			
	T104			2			
	T105			270			
	T106			157			
211 Subtotals		0	15	1,924	0.00	1.56	1.56

SHIPPING CONT. SPEC.	CAR TYPE	ACCIDENTS HAZ	ACCIDENTS OTHER	POPULATION	<== ACCIDENT RATE ==> HAZ	OTH	ALL
I	T103			3			
	T104			1			
I Subtotals		0	0	4	0.00	0.00	0.00
II	T102			1			
	T103			12			
	T104			4			
I Subtotals		0	0	17	0.00	0.00	0.00
III	T102			55			
	T103			167			
	T104			258			
I Subtotals		0	0	480	0.00	0.00	0.00
IVA	T523			7			
IVA Subtotals		0	0	7	0.00	0.00	0.00
XT	T032			46			
	T033	1		63	3.17		3.17
XT Subtotals		1	0	109	1.83	0.00	1.83
Unknown	T102			4			
	T103			7			
	T547			1			
	Unkn			549			
Unkn Subtotals		0	0	561	0.00	0.00	0.00
GRAND TOTALS		654	1,222	219,031	0.60	1.12	1.71

APPENDIX H

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