

CHAPTER 3

TRUCKING FLEET AND OPERATIONS

INTRODUCTION

The Nation's truck fleet may be described as non-homogenous, with truck configurations and operations evolving within a dynamic environment that includes: multi-jurisdictional TS&W regulations, safety regulations, freight characteristics, shipper and customer needs, economic forces, international trade and the innovation of truck and trailer manufacturers.

TRUCKING INDUSTRY STRUCTURE

The trucking industry serves many different markets. Each segment of the industry is characterized by different operating features and equipment utilization practices. Broadly, the industry may be divided into either private or for-hire carriers. In the for-hire sector, two types of services are provided: Truckload (TL) or less-than-truckload (LTL). Additionally, TL and LTL services can be segmented into either short-haul or long-haul.

PRIVATE VERSUS FOR-HIRE CARRIERS

Many private business have internalized all aspects of the logistics function; they own and operate their own fleet of trucks. Common examples of private carriers include grocery stores, retail chains, and food processing companies. Information concerning the operations of private carriers is limited, partially because these carriers have been traditionally less subject to government reporting regulations. The following table (Table III-1) indicates that private carrier operations constitute a large share of trucking in the Nation.

**TABLE III-1
PRIVATE CARRIER PROFILE**

<p style="text-align: center;">TONNAGE AND VALUE OF SHIPMENTS</p> <ul style="list-style-type: none">• Private carriers handled approximately 3.56 billion tons of the total 6.5 billion tons (55 percent) handled by the trucking industry in 1993.• The average length of haul for private carriers is 51 miles, resulting in 240 billion ton-miles handled in 1993.• The value of freight handled by private carriers was \$1.8 trillion in 1993, \$1.0 trillion lower than the for-hire carriers. <p style="text-align: center;">REVENUE</p> <ul style="list-style-type: none">• In 1994 private carriers captured approximately 54 percent (\$178 billion) of total truck revenue in the Nation.• The \$178 billion in revenue was split between intercity and local freight movements, approximately \$90/\$88 billion, respectively.• Overall, private carriers captured 70 percent of local revenues.
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Source: 1993 Commodity Flow Survey database

For-hire carriers transport goods for others as their primary business. This segment of the trucking industry includes a large and growing number of single vehicle owner/operators. Information on share of freight handled by the for-hire segment in 1993 is provided in Table III-2.

**TABLE III-2
FOR-HIRE CARRIER PROFILE**

<p style="text-align: center;">TONNAGE AND VALUE OF SHIPMENTS</p> <ul style="list-style-type: none">• The for-hire carriers' share of total truck freight movements (6.5 billion tons) was 2.9 billion tons--45 percent.• The average length of haul of for-hire carriers is 470 miles.• The value of shipments for for-hire carriers equaled \$2.8 trillion in 1993. <p style="text-align: center;">REVENUE HIGHLIGHTS</p> <ul style="list-style-type: none">• For-hire carriers captured approximately 56 percent of total intercity market revenues in 1993.

TRUCKLOAD VERSUS LESS-THAN-TRUCKLOAD

TRUCKLOAD OPERATIONS

Carriers with TL operations generally pick up a load in a truck or truck combination at the shipper's dock and transport it directly to the consignee in the same vehicle. TL operations may be categorized according to the type of freight handled, either general or specialized. General freight is transported in enclosed van trailers and specialized freight is transported by specialized equipment, such as refrigerated van trailers, automobile transporters, tank trailers, dump trucks, and hopper-bottom grain trailers. Many TL carriers depend on the services of owner-operators for equipment and drivers.

While there were more specialized carriers (613) than general freight carriers (547) in 1993, the revenue generated from general freight (\$11.7 billion) was slightly higher than that generated by specialized freight carriers (\$11.4 billion). It is notable that in the late 1980s, a small number of “mega” carriers emerged from within the large TL carriers. These mega carriers now dominate the general freight segment of TL operations. Additionally, since the early 1990s, some of the general freight TL carriers have become major intermodal carriers with large domestic container fleets.

LESS-THAN-TRUCKLOAD OPERATIONS

LTL carriers specialize in transporting small shipments of freight, generally in units of between 250 pounds and 12,000 pounds. A LTL shipment is generally composed of general freight from several shippers and has many different destinations. An example of a LTL carrier is a package delivery service provider. In most instances, LTL carriers are constrained more by cubic capacity than weight limitations. One exception is the LTL carrier that transports international containers from a port to a break-bulk terminal. These potentially overweight containers, often are moved to the terminal under special permit, are then stripped and replaced for line-haul movements at 80,000 pounds or less.

To reduce line-haul miles and handling of freight, LTL carriers generally maintain extensive networks of strategically located terminals, operating truck combinations between terminals on regularly scheduled line-haul routes.

SHORT-HAUL VERSUS LONG-HAUL OPERATIONS

Short-haul operations are defined in this Study as freight movements of 200 miles or less from point of origin to point of destination. Consequently, the majority of truck operations, on a Nationwide basis, are considered short-haul, being regional or local in nature. Single unit trucks operate almost exclusively within their home State (intrastate), as do truck combinations where approximately 80 percent of their VMT is within the State of registration. This also applies to the operation of LCVs.

Typically, trucks and truck combinations operating in local, short-haul operations tend to have lower annual VMT than those in long-haul. However, this varies greatly according to type of truck configuration. In general, single unit trucks average much lower VMT than truck combinations. For example, average VMT for two-axle single unit trucks is 11,000 miles, or about 30 miles per day. Three- and four-axle single unit trucks are slightly higher at about 40 miles and 60 miles per day, respectively. This low VMT for single unit trucks reflects the local, short-haul, intrastate nature of their operations.

Annual average VMT for long-haul operators is substantially higher. For example, large tractor-semitrailer combinations average between 100 miles and 200 miles per day. The STAA double-trailer combinations average 220 miles per day, or about 80,000 miles per year.

EQUIPMENT CHARACTERISTICS

The most general distinction among truck configurations is whether they are single unit trucks whose cargo carrying units are part of the same chassis as the engine, or whether they are combination vehicles that have separate cargo carrying trailers or semi-trailers that are pulled by a truck or truck-tractor. Nationally, the distribution of the fleet by configuration is approximately:

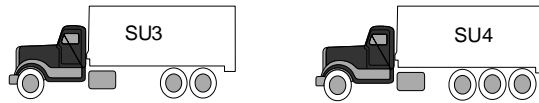
- Single unit trucks - 68 percent
- Truck-trailer combinations - 4 percent
- Tractor-semitrailer combinations (primarily 5-axle combinations) - 26 percent
- Double-trailer combinations - 2 percent
- Triple-trailer combinations - less than one tenth of one percent

The distribution of large truck configurations, those combinations with five- or more axles, varies between States and regions of the Nation. For example, in California 18 percent of the truck fleet are truck-trailer combinations and 39 percent are STAA twin-trailer combinations, whereas in Florida, only 2 percent of the truck fleet are truck-trailer combinations and 1.6 percent are double-trailer combinations.¹ Figure III-1 presents the different types of configurations in the National fleet.

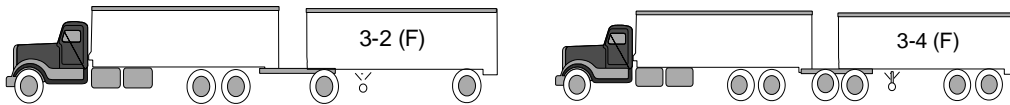
¹ 1992 TIUS database.

**FIGURE III-1
ILLUSTRATIVE TRUCK CONFIGURATIONS OF U.S. FLEET**

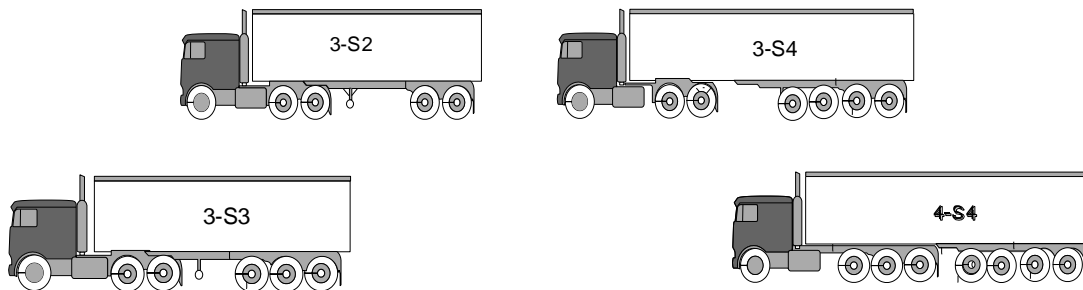
Single Unit Trucks



Truck-Trailer Combinations



Tractor-Semitrailer Combinations

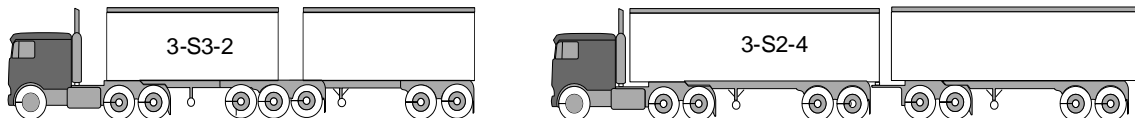


STAA Double-Trailer Combination

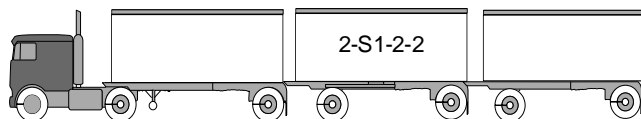


Longer Combination Vehicles (LCVs)

Double-Trailer Combinations

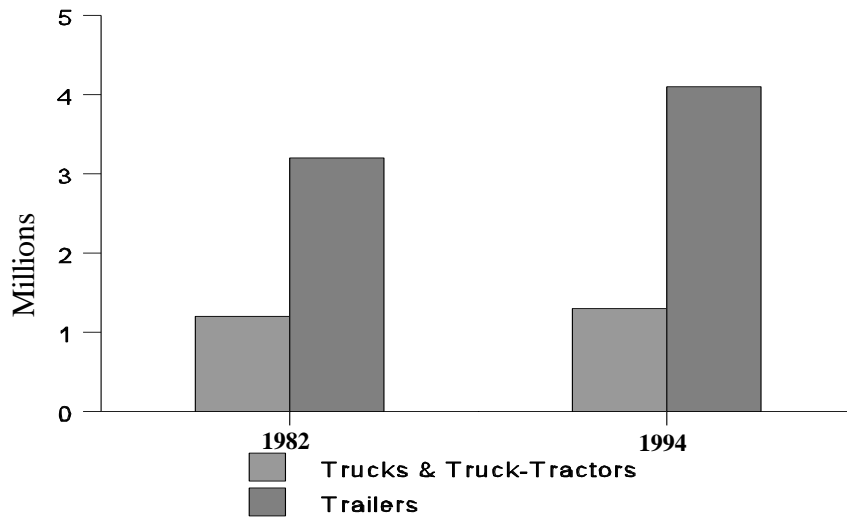


Triple-Trailer Combination



The size of the Nation's trailer fleet increased significantly during the decade following passage of the STAA of 1982. The number of trucks and truck-tractors increased only marginally (see Figure III-2). In 1994, the total commercial truck fleet consisted of approximately 1.3 million truck-tractors and 4.1 million trailers, including semitrailers. The increase in the number of trailers was commensurate with an increase in the number of STAA doubles and longer combination vehicles (LCVs) (that is, double- and triple-trailer combinations).

**FIGURE III-2
FLEET SIZE AND GROWTH
1982 TO 1994**



SINGLE UNIT TRUCKS

The most common single unit trucks in the commercial fleet are dump trucks, cement mixer trucks, tank trucks, and waste hauling trucks. These vehicles are designed to provide specialized services and are commonly referred to as specialized hauling vehicles (SHVs), having between two and four axles. SHVs represent approximately 46 percent of single unit trucks operating in the United States with three or more axles.

SHVs are typically used in local and intrastate, short-haul operations. The most common commodities that are hauled Nationally include construction materials, gravel, ready-mix cement, grain, milk, petroleum products, and garbage or waste. Dump trucks are primarily used to transport construction materials and tank trucks are primarily used to transport liquids or gases.

The total number of commercial single unit trucks (10,000 pounds or more) remained constant at approximately 2.75 million between 1982 and 1994. However, the number of two-axle single unit trucks decreased over this period by about 14 percent. During that same period of time, the number of four-axle single unit trucks more than doubled to approximately 84,000 due to the substitution of three-axle garbage, dump and concrete trucks with four-axle units.

TRUCK-TRAILER AND TRACTOR-SEMITRAILER COMBINATIONS

Combination vehicles in the National truck fleet consist of a towing unit, either a truck or tractor, and one or more trailers or semitrailers. Truck-trailer combinations account for approximately 14 percent of all combination vehicles. Approximately 33 percent of the truck-trailer combinations are five-axle combinations.

TRACTOR-SEMITRAILERS

Tractor-semitrailer combinations are the most common combination truck configuration operating on U.S. highways. They account for more than 82 percent of all combinations trucks. The most common combination, constituting 90 percent of the tractor-semitrailer combinations, is the so-called "18-wheeler," a three-axle tractor with a two-axle semitrailer. Tractor-semitrailer combinations vary in size and configuration depending on axle configurations, State semitrailer length limits, and State kingpin setting laws.

The number of tractor-semitrailer combinations has increased an average of 2.5 percent per year between 1982 and 1994. Increases in long-haul operations following the STAA of 1982, and the market for sleeper cab tractors resulted in a shift away from two-axle tractors, such as the cab-over models of the early 1980s, toward longer wheelbase three- and four-axle tractors.

A number of tractor-semitrailer combinations are considered SHVs, in that the semitrailer is designed to transport a specific commodity in one direction and is operated empty on the return trip. End-dump trailers, cargo tank trailer, bottom-dump trailers, and automobile transporters are all examples of SHV trailers.

MULTI-TRAILER COMBINATIONS

There are four types of multi-trailer combinations operating in the United States: (1) STAA doubles (twin 28-foot trailers); (2) Rocky Mountain doubles (RMD); (3) turnpike doubles (TPD); and (4) triples. The RMD, TPD, and triple-trailer combinations are generally grouped together under a common category referred to as longer combination vehicles (LCVs). In aggregate, double- and triple-trailer combinations represent a very small number in relation to the total truck combination fleet, approximately 20,000 in 1994 or 0.05 percent. Like single unit trucks and other combinations, multi-trailer combinations are used to haul a variety of commodities and trailers are specialized for the commodities being carried.

Surface Transportation Assistance Act Doubles

The 1982 STAA provided for the unrestricted use of two-trailer combinations (two 28 foot to 28.5-foot trailers) on the National Network (NN). The NN consists of the Interstate System and routes designated by FHWA in consultation with the States. Prior to 1982 the operation of double trailers of any length was primarily limited to States West of the Mississippi River and turnpikes in a few Eastern States.

Since 1982, growth in the use of STAA doubles in relation to the size of the total truck fleet as been relatively small Nationwide, with the exception of California and many States in the East where they were prohibited prior to 1982. Nationwide, STAA doubles represent approximately 2.5 percent of all truck combinations. Generally, the industry segment where the STAA double is important is the LTL segment where tare weight is not a consideration.

Longer Combination Vehicles

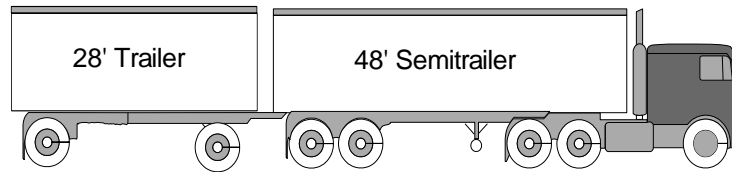
Figure III-3 illustrates the common LCV combinations: RMD, TPD and triples. The RMD consists of a truck-tractor and one long front trailer, ranging in length from 40 feet to 48 feet, towing a shorter 20-foot to 28-foot trailer. The RMD combinations are currently allowed to operate on turnpikes in six States and on other routes in 14 States and since the mid-1950s on three of the six turnpikes (Indiana, Massachusetts and New York).

The TPD combinations consist of a truck-tractor towing two long trailers of equal length, typically two 40-foot, 45-foot, 48-foot or 53-foot trailers. The TPD combination is allowed in all but three (Oregon, Washington, and Wyoming) of the States in which RMDs are allowed to operate. However, the allowable weights and the extent of highway networks upon which these vehicles may operate vary among the States.

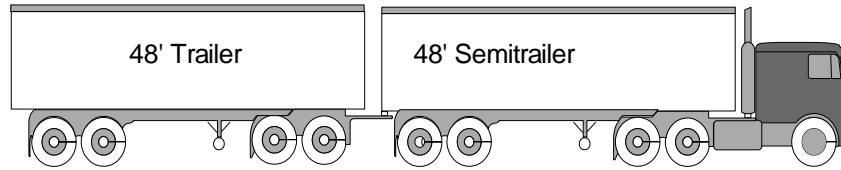
A triple-trailer combination consists of a truck-tractor and three trailers in tow--typically three 28-foot to 28.5-foot trailers. Triple-trailer combinations are allowed to operate on limited highway networks in fourteen States under permit with restrictions. Triple-trailer combinations have been operating in four States since the 1960s (Idaho, Nevada, Oregon, and Kansas).

**FIGURE III-3
LONGER COMBINATION VEHICLES**

ROCKY MOUNTAIN DOUBLE



TURNPIKE DOUBLE



TRIPLES

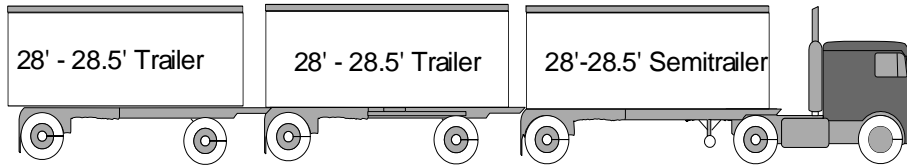


Table III-3 provides a list of the States where LCVs are allowed to operate, by configuration. Also indicated is the first year of operation.

**TABLE III-3
LONGER COMBINATION VEHICLES
STATES AND CONFIGURATIONS PERMITTED**

States	Triples	Turnpike Doubles	Rocky Mtn. Doubles
Alaska	Not permitted	1984	1984
Arizona	1976	1976	1976
Colorado	1983	1983	1983
Idaho	1968	1968	1968
Montana	1987	1972	1968
Nebraska	1984	1984	1984
Nevada	1969	1969	1969
North Dakota	1983	1983	1983
Oklahoma	1987	1986	1986
Oregon	1967	Not permitted	1982
South Dakota	1988	1984	1981
Utah	1975	1974	1974
Washington	Not permitted	Not permitted	1983
Wyoming	Not permitted	Not permitted	1983
Turnpike Authority			
Florida	Not permitted	1968	1968
Indiana	1986	1956	1956
Kansas	1960	1960	1960
Massachusetts	Not permitted	1959	1959
New York	Not permitted	1959	1959
Ohio	1990	1960	1960

Source: GAO *Longer Combination Trucks*, 1994

INFLUENCE OF SIZE AND WEIGHT POLICY ON FLEET CHARACTERISTICS

Federal and State TS&W regulations define the weight and dimensional envelope into which the truck fleet must fit, and this influences the characteristics of the National fleet. Other factors also influence truck characteristics, such as: freight and logistical considerations (commodity, shipment size, package, fragility, temperature control, origin-destination patterns, delivery time requirements); infrastructure considerations (terminals and route options between origin-destination pairs); truck economic considerations (replacement cycles, re-sale markets, fuel economy, driver flexibility); truck operating strategies and company structures; special permitting policies and practices; regulation enforcement; and intermodal requirements.

Sometimes a truck is operated within only one TS&W regulatory regime or envelope, typically however, the envelope is a composite of various limits established by Federal and State regulations. Additionally, for trucks operating across international borders with Canada and Mexico, Canadian provincial law and Mexican Federal law applies. A trucker confronted with multiple TS&W regimes and interested in operating at one or all of the boundaries of the composite envelope must either select a “least common denominator” vehicle and operating strategy, or a vehicle and operating strategy that can be modified in route (for example, removing a trailer, reducing the load, moving an axle).

The primary commodity groups transported by combination trucks are processed foods; building materials, logs and forest products, and petroleum and farm products. It is interesting to note that beginning in the late 1980s an industry trend began to emerge: the mean average loaded weights (tare weight plus payload) were decreasing while the tare weights of trucks increased. Commodities transported, such as electronic equipment and more highly processed goods, are becoming lighter.

Table III-4 provides information on average payload and loaded weights for the five major truck and combination body types operating Nationwide in 1994.

TABLE III-4²
MEAN AVERAGE PAYLOAD AND LOADED WEIGHT OF COMMON TRUCK TYPES
(pounds)

Body Type	5-Axle Truck-Trailer		5-Axle Tractor- Semitrailer		STAA Double	
	Payload	Loaded	Payload	Loaded	Payload	Loaded
Platform/Flatbed	30,715	56,900	36,780	65,350	45,330	64,470
Van	34,890	60,340	30,555	61,550	33,935	65,100
Grain Body	48,970	63,340	48,030	74,570	56,380	80,140
Dump Truck	34,760	59,460	42,580	72,160	*	*
Tank Body	47,980	72,390	46,410	74,490	*	*

* Indicates very small sample size.

Under the current 80,000 pound Federal GVW limit the following observations are noted:

- On average, none of these combinations utilizes the maximum weight allowed; and
- Five-axle tractor-semitrailer combinations with specialized body types (dump, tank, grain) use about 93 percent of available GVW.

WEIGHT LIMITS

Current Federal weight limits apply to GVW and axle weights. The GVW limit is 80,000 pounds and axle weight limits are 20,000 pounds for single axles and 34,000 pounds for tandem axles. One or both of the Federal axle limits are surpassed by the laws of 25 States, through the exercise of grandfather rights on the Interstate in 12 States, and permit policies in most. Weight limits for other axle groupings are determined through the application of the Federal bridge formula and/or State regulation.

Current Federal axle weight limits were established to minimize infrastructure damage under a Federal bridge formula with a maximum GVW limit. Consequently, various innovative arrangements of axles and tires have evolved to increase load capacity within the GVW limit and not exceed axle limits. Three of these innovative arrangements are “super-single” tires, split tandem axles, and lift axles.

TIRE LOAD LIMITS

The increasing use of wide-base “super-single” tires in the United States is an innovation that originated in Europe. Federal law and most State laws do not discourage or prohibit the use of wide-base single tires. Benefits to industry include reduced energy use, emissions, tare weights,

² *Truck Inventory and Use Survey (TIUS) 1992 database.*

and truck operating costs. As with tire pressure and tire loads, there are conflicting views concerning the public benefits and costs and whether the use of wide-base tires should be regulated.

AXLE CONFIGURATIONS

Axle types and configurations frequently observed on single unit trucks, particularly SHVs include lift axles, split-tandem axles, tridem axles and quadrem axles. Use of these axles and configurations have evolved over the last two decades as the industry adapted to Federal and State TS&W limits.

Split Tandem Axles

A split tandem axle is created by increasing the spacing between the two axles in a tandem axle group from a typical standard of approximately 4 feet to 8 feet, 9 feet or 10 feet. Split tandem axles are an increasingly common feature of trucking throughout the United States. The operational advantage to the carrier of split tandems is two-fold: (1) increasing GVW within the allowable limit; and (2) increased flexibility in load distribution. By increasing the spacing, rather than being considered a tandem axle with an axle weight limit of 34,000 pounds, the split tandem is considered as two single axles with a total weight limit of between 38,000 pounds and 40,000 pounds depending on the spacing. Under Federal Bridge Formula B, the combined weights allowed on a split tandem axle are: (1) 38,000 pounds at more than 8 feet; (2) 39,000 pounds at 9 feet; and (3) 40,000 pounds at 10 feet or more.

Tridem Axles

Tractor-semitrailer combinations with a tridem axle on the semitrailer are operating in all States, as are single unit trucks with tridem axles. Tridem axle semitrailers are used in about 5 percent of the truck combinations operating Nationwide and are most common in the Northeast region and least common in the South Atlantic region. On tractor-semitrailers, tridem axles offer the same advantages offered by split tandem axles, namely higher gross loads (especially in those States not limited by the 80,000-pound Federal weight limit). This is particularly important for movement of commodities such as heavy machinery and transportation equipment on tractor-semitrailer combinations.

Lift Axles

Lift axles are one innovation utilized by carriers to allow maximum use of capacity without exceeding weight limits. Generally, a truck operates with the axle down when the truck is loaded to increase its weight limit, and up when empty to increase maneuverability and handling of the vehicle. The concern with lift axles arises when a truck is loaded and the lift axle is raised by the driver during operation on the highway resulting in redistribution of the weight over fewer axles.

Throughout the country, lift axles are routinely used on single unit trucks such as dump trucks and cement mixers throughout the country, as well as on semitrailers and trailers operating where GVWs over 80,000 pounds are permitted. Lift axles are used on 6 percent of all three-axle and 77 percent of all four-axle single unit trucks. In a number of States five-, six- and seven-axle single unit trucks with two to four lift axles are operated. Federal TS&W laws, as well as most State laws, do not address the use of lift axles.

GROSS VEHICLE WEIGHT AND IMPACT OF THE BRIDGE FORMULA

Nationally, the average loaded weight for five-axle tractor-semitrailers operating on the Interstate System between 57,000 pounds and 75,000 pounds depending on trailer body type. Most trucks and combinations operate at or below the GVW limits, although many do not reach their weight limit because of volume capacity. Tank trucks and trailers operate at average load levels that reach their maximum weight limit and “weigh-out” over 80 percent of the time, while this occurs less than 20 percent of the time for enclosed van trailer combinations. Enclosed van trailers, in many instances, are used to transport commodities that have low density and as a consequence the cubic capacity of the trailer is filled before the maximum weight allowed is reached. This is referred to as “cube-out.”

The mandated implementation of the Federal bridge formula in 1982 led to the creation of a variety of vehicle configurations and characteristics not initially envisioned. Such configurations and characteristics are typically directed at increasing the potential payload weight for configurations.

Examples of “bridge formula” trucks and truck characteristics that have emerged are: (1) four-axle tractors with a pusher lift axle (to provide more axles within a given outer bridge limit); (2) very long “tongues” on truck-trailer and double-trailer combinations (to increase the distance from the first axle to the last axle, and therefore a higher gross weight limit); and (3) split tandem axles--a now common feature of five-axle tractor-semitrailers, carrying heavy commodities.

DIMENSIONAL LIMITS

SEMITRAILER LENGTH

Federal law concerning semitrailer length (48 feet) and trailer length for standard STAA doubles (28 feet to 28.5 feet) is a facilitating law, specifying the minimum lengths that States must permit on the NN for trucks. As a result, semitrailer lengths throughout the country are largely controlled by State laws specifying maximum semitrailer lengths and/or tractor-semitrailer combination lengths.

Van body trailers are designed to maximize payload within the length limits of the States in which the vehicle will be operating. For example, van trailers for hauling grain are often designed with drop-bottoms to increase cubic capacity without exceeding State height limits. On the other hand, flatbed trailers often do not need to utilize the entire available length or width limits. In certain States semitrailer lengths and operating properties are also influenced by kingpin requirements. Such laws set a specified distance from the kingpin trailer connection to specified axles(s).

Semitrailers have undergone major changes in the last 30 years in response to changes in Federal and State regulations, such as the shift from the industry standard 45-foot semitrailers to current use of many 53-foot semitrailers. The historic trend has been incremental growth in the length of the semitrailer fleet with each new length taking about 10 years to 12 years to become the new standard. For example, the 45-foot semitrailers introduced in 1970 were the industry standard for van trailers until the 1980s when the 48-foot semitrailer became the standard. The new market share for the 53-foot semitrailer in 1994 was 30 percent. The 53-foot semitrailer offer an 18 percent increase in volumetric capacity over the 45-foot semitrailer.

The distribution of 53-foot semitrailers by trailer body type is: (1) 90 percent of the automobile transporter fleet; (2) 30 percent to 40 percent of all types of van trailers; (3) 15 percent to 20 percent of the flatbed fleet; and (4) less than 10 percent of specialized truck body types. Currently, semitrailers longer than 53 feet are permitted to operate in 11 States (on most State NN facilities)--Alabama, Arkansas, Arizona (Interstate only), Colorado, Kansas, Louisiana, Montana (under a readily available permit), New Mexico, Oklahoma, Texas Wyoming. The extent of their use is unknown, although it is believed to be relatively small at the present time.

WIDTH

The STAA of 1982 was a facilitating law providing for the free movement of 102-inch wide equipment on the NN. Although the STAA of 1982 provided for uniformity on the Interstate and NN, several States have a 96-inch width limit for commercial vehicles on non-NN routes. As a consequence, 96-inch wide equipment remains common place.

HEIGHT

Height limits have been established over the years to assure clearance of vehicles under rail or highway overpasses. The clearance standard for bridges constructed over the Interstate System is a minimum of 14 feet. Some State constructed turnpikes built prior to 1956 do not meet the Federal standard and the clearances must be posted. Most Western States limit vehicle and load heights to 14 feet or more, while the Eastern States, except Maine, limit vehicle and load heights to 13.5 feet.

DOMESTIC FLEET OPERATIONS

The relative intensity of trucking traffic, as well as traffic patterns and activity throughout the Nation, can be measured by: the volume of truck flows on major highways and the truck vehicle-miles-of-travel (VMT) in each State.

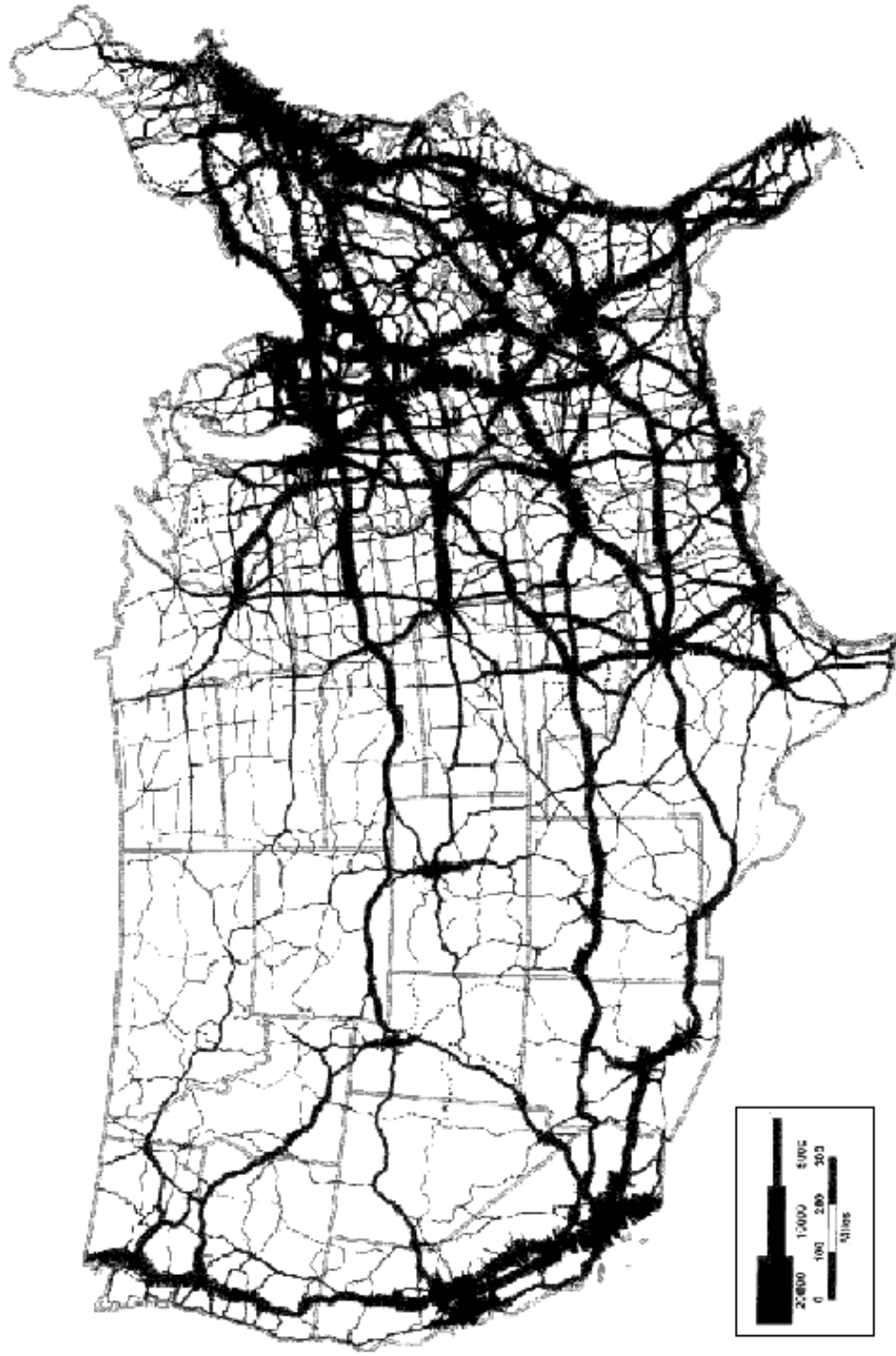
TRUCK FLOWS

Truck volumes operating on the National Highway System (NHS) are illustrated in Figure III-4. Flows range from fewer than 100 trucks per day on rural corridor highways to over 25,000 trucks per day on the Interstate in and around major urban centers.

General observations regarding the flow of trucks include:

- Truck traffic per mile of NHS highway varies widely throughout the country--ranging from an annual average of one truck or two trucks per hour in each direction to more than 500 trucks per hour.
- Truck volume on most of the NHS mileage in the Western region is relatively low. Exceptions include major North-South routes in the Interstate Route 5 coastal corridor, and major East-West corridors associated with Interstate Route 80, Route 40, Route 10 and Route 20.
- Truck volumes east of the Mississippi on much of the NHS mileage range from modest in the New England States to very high in the mid-Atlantic region.
- Many of the highways in the North-South, mid-Continent I-35 corridor have relatively low to modest truck volumes. The lowest truck volumes in this corridor are at the Northern and Southern ends, and in the middle of the corridor through Kansas. Dominant trucking activity in the corridor includes East-West trips, and travel between most corridor States and the North Central region of the United States.

FIGURE III-4
TRUCK TRAFFIC FLOW ON THE NATIONAL HIGHWAY SYSTEM BY STATE



TRUCK VEHICLE MILES OF TRAVEL

Total truck VMT in 1994 was approximately 168 billion; distribution as measured by VMT in each State, is shown in Table III-5. As indicated, California had the highest truck VMT (16.8 billion), equal to approximately ten percent of National truck VMT. Regional distribution of total truck VMT is approximately 25 percent in the North Central region, 20 percent in each of the South Atlantic, South Gulf and Western regions and 15 percent in the Northeastern region as previously shown in Figure III-4.

SINGLE UNIT TRUCK VEHICLE MILES OF TRAVEL

Single unit trucks account for approximately 42 percent of the total truck VMT. Two- and three-axle trucks account for the majority of the single unit truck VMT, approximately 85 percent and 12 percent, respectively. Although the number of four- or more axle single unit trucks has more than doubled since 1982, their share of the annual VMT, 3 percent, is an indication that their use is primarily short-haul or interstate.

SINGLE-TRAILER COMBINATIONS VEHICLE MILES OF TRAVEL

Tractor-semitrailer combinations are the most common combination operation in the Nation, accounting for over 25 percent of all registered trucks and 82 percent of all truck combinations. They include combinations of a two-, three- or four-axle tractor with a semitrailer having one or more axles. In some instances, as many as eleven axles are seen on semitrailers. In 1994, tractor-semitrailers accounted for approximately 53 percent of the total truck VMT, or 89.6 billion VMT.

Truck-trailer combinations are the second most common combination in the Nation, accounting for approximately 14 percent of the truck combination fleet. This use increased significantly since 1982, primarily in the North Central region of the Nation. Truck-trailer combinations however, with 3.1 billion VMT, account for less than 2 percent of the total truck VMT. Over 50 percent of this VMT is attributed to the five-axle combination.

**TABLE III-5
1994 TRUCK VMT BY STATE
(000s)**

STATE	TOTAL VMT	TOTAL TRUCK VMT ³	STATE	TOTAL VMT	TOTAL TRUCK VMT
Alabama	48,955,998	3,618,154	Montana	9,116,001	764,175
Alaska	4,149,989	195,239	Nebraska	15,465,999	1,572,777
Arizona	38,773,999	3,932,615	Nevada	13,019,000	1,224,392
Arkansas	24,947,997	3,015,746	New Hampshire	10,501,000	598,353
California	271,942,998	16,769,280	New Jersey	60,465,998	3,584,790
Colorado	33,704,999	2,484,491	New Mexico	20,479,999	1,758,453
Connecticut	27,138,000	1,195,570	New York	112,970,002	5,235,286
Delaware	7,025,000	396,163	North Carolina	71,928,001	8,874,775
Dist of Col	3,448,000	114,106	North Dakota	6,337,999	583,377
Florida	121,989,000	6,282,027	Ohio	98,199,997	7,208,332
Georgia	82,821,999	5,490,345	Oklahoma	36,979,997	3,151,269
Hawaii	7,934,999	279,371	Oregon	29,453,000	2,116,079
Idaho	11,652,000	907,409	Pennsylvania	92,347,001	8,104,688
Illinois	92,316,001	6,200,093	Rhode Island	7,095,000	326,770
Indiana	62,108,001	5,740,501	South Carolina	37,245,001	2,033,429
Iowa	25,736,997	3,004,366	South Dakota	7,630,998	551,802
Kansas	24,678,000	1,714,820	Tennessee	54,524,001	3,699,589
Kentucky	39,822,001	2,894,242	Texas	178,347,999	14,471,141
Louisiana	37,430,000	4,875,763	Utah	18,078,002	1,376,369
Maine	12,469,001	779,987	Vermont	6,152,000	405,991
Maryland	44,164,999	3,291,562	Virginia	67,608,999	4,988,220
Massachusetts	46,989,999	1,723,840	Washington	47,428,000	3,444,500
Michigan	85,182,998	4,551,583	West Virginia	17,112,001	1,569,653
Minnesota	43,317,002	2,444,670	Wisconsin	50,273,000	3,175,214
Mississippi	28,548,000	2,313,672	Wyoming	6,688,998	827,671
Missouri	57,288,000	4,534,102	TOTAL	23,599,983,970	170,396,812

Source: 1997 DOT Highway Cost Allocation Study

³ Excluded: auto, bus and light trucks

MULTI-TRAILER COMBINATIONS VEHICLE MILES OF TRAVEL

Surface Transportation Assistance Act Doubles

Total annual VMT for the STAA double (twin 28-foot) is approximately 4.5 billion mile per year, or 2.6 percent of all truck VMT. It accounts for 4.5 percent of all truck combinations VMT, and 71.3 percent of all VMT operated by double trailers.

Longer Combination Vehicles

LCVs are permitted in 20 States and include RMD, TPD and triple-trailer combinations (See Table III-6 for a listing of where these vehicles are permitted to operate).

Rocky Mountain and Turnpike Doubles

Total VMT by longer double-trailer combinations was 1.8 billion VMT in 1994, equal to approximately one percent of all truck VMT and less than two percent of truck combinations VMT.

Triple-Trailer Combinations

The number of triple-trailer combinations is relatively small in comparison to the total truck combination fleet. In 1994, total VMT for triple-trailer combinations was 108 million distributed among the 14 States where they operate. On average each triple combination travels approximately 89,701 miles per year. Total triple-trailer VMT was approximately 0.1 percent of the total VMT for all combinations, with approximately half of the VMT split between two States, Utah and Oregon.

MULTI-TRAILER HIGHWAY NETWORK

The highway network for operation of STAA doubles and LCVs is limited when taken as a percentage of the total public road mileage in each State. This is in contrast to total public road mileage of 3,906,544. Table III-6, Table III-7, and Table III-8 summarize the network mileage for STAA doubles, RMD and TPD, and triple-trailers by State of operation.

**TABLE III-6
NETWORK MILES BY STATE FOR STAA DOUBLES⁴**

State	Miles	% of Total State Miles ⁵	State	Miles	% of Total State Miles	State	Miles	% of Total State Miles
Alabama	2,182	2.34	Kentucky	2,714	3.72	North Dakota	2,230	2.57
Alaska	481	3.36	Louisiana	3,984	6.64	Ohio	8,138	7.11
Arizona	4,482	8.24	Maine	378	1.68	Oklahoma	6,238	5.55
Arkansas	5,777	7.49	Maryland	788	2.68	Oregon	4,970	5.92
California	9,141	5.41	Massachusetts	653	2.13	Pennsylvania	3,307	2.79
Colorado	5,400	6.41	Michigan	6,608	5.62	Rhode Island	95	1.59
Connecticut	470	2.31	Minnesota	4,841	3.72	South Carolina	2,035	3.17
Delaware	225	4.02	Mississippi	6,456	8.85	South Dakota	6,472	7.77
Dist. of Col	16	1.45	Missouri	3,998	3.27	Tennessee	7,254	8.48
Florida	9,470	8.36	Montana	6,610	9.53	Texas	20,029	6.80
Georgia	1,844	1.66	Nebraska	7,670	8.27	Utah	3,553	8.70
Hawaii	544	13.25	Nevada	2,370	5.13	Vermont	350	2.47
Idaho	2,744	4.60	New Hampshire	234	1.56	Virginia	3,121	4.53
Illinois	2,104	1.54	New Jersey	439	1.24	Washington	5,786	7.25
Indiana	6,145	6.64	New Mexico	3,645	5.95	West Virginia	1,093	3.14
Iowa	8,006	7.10	New York	3,933	3.51	Wisconsin	6,191	5.58
Kansas	8,913	6.69	North Carolina	3,213	3.33	Wyoming	3,901	10.68
						TOTAL	211,241	5.41

⁴ Table HM-43, National Network for Trucks, *Highway Statistics 1991*.

⁵ Public Road Mileage, from Table HM-14, *1994 Highway Statistics*.

**TABLE III-7
NETWORK MILES BY STATE FOR ROCKY MOUNTAIN AND TURNPIKE DOUBLES**

State	RMD	TPD	% of Total State Miles ⁶		State	RMD	TPD	% of Total State Miles	
			RMD	TPD				RMD	TPD
Arizona	139	29	0.3	0.1	Nevada	4,152	4,152	9.0	9.0
Colorado	814	814	1.0	1.0	New York	562	562	0.5	0.5
Florida	256	256	0.2	0.2	North Dakota	2,487	2,487	2.9	2.9
Idaho	303	3,030	0.5	5.1	Ohio	242	242	0.2	0.2
Indiana	135	135	0.2	0.2	Oklahoma	1,878	1,878	1.7	1.7
Iowa	36	36	0.03	0.03	Oregon	4,584	0	5.5	0
Kansas	256	256	0.2	0.2	South Dakota	6,471	1,037	7.8	1.2
Massachusetts	134	134	0.4	0.4	Utah	3,563	949	8.7	2.3
Missouri	243	243	0.2	0.2	Washington	5,616	0	7.0	0
Montana	6,711	1,192	9.7	1.7	Wyoming	4,098	0	11.2	0
Nebraska	443	443	0.5	0.5	TOTAL	43,123	17,875	2.45	1.0

**TABLE III-8
NETWORK MILES BY STATE FOR TRIPLE-TRAILER COMBINATIONS⁷**

State	Miles	% of Total State Miles ⁸	State	Miles	% of Total State Miles
Arizona	25	0.05	Oklahoma	1,828	1.70
Colorado	650	0.80	Oregon	3,500	4.20
Idaho	612	1.00	South Dakota	997	1.20
Montana	1,191	1.70	Utah	951	2.30
Nebraska ⁹	481	0.50	Indiana	157	0.20
Nevada	4,872	10.60	Kansas	247	0.20
North Dakota	2,170	2.50	Ohio	242	0.20
			TOTAL	17,923	1.60

⁶ Public Road Mileage, Table HM-14, 1994 *Highway Statistics*.

⁷ "Report of the Subcommittee on Truck Size and Weight of the AASHTO Joint Committee on Domestic Freight Policy," 1995 and Strate contact.

⁸ Public Road Mileage, Table HM-14, 1994 *Highway Statistics*.

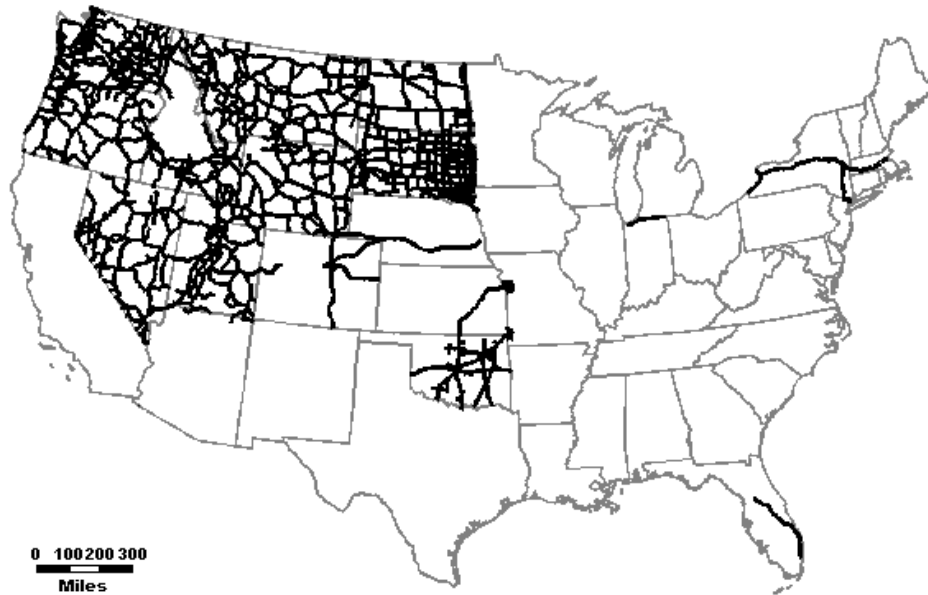
⁹ Nebraska allows triples only when trailers are empty.

While STAA doubles are allowed in all States, longer combination doubles in excess of 28 feet are only allowed in only 21 States. Indeed, ISTEA of 1991 enforced a freeze limiting the use of the longer, heavier double- and triple-trailer combinations to those States in which they were already operating in 1991. The TS&W limits that were included in the 1991 grandfather provision are summarized in Appendix __. Consequently, two-thirds of all double-trailer combinations are STAA doubles. Of the 21 States allowing longer combination doubles, all but five are West of the Mississippi River. Figure III-5 and Figure III-6 provide maps of the Turnpike and Rocky Mountain Double highway networks.

**FIGURE III-5
HIGHWAY NETWORK MAP FOR DOUBLE-TRAILERS
Turnpike Doubles**

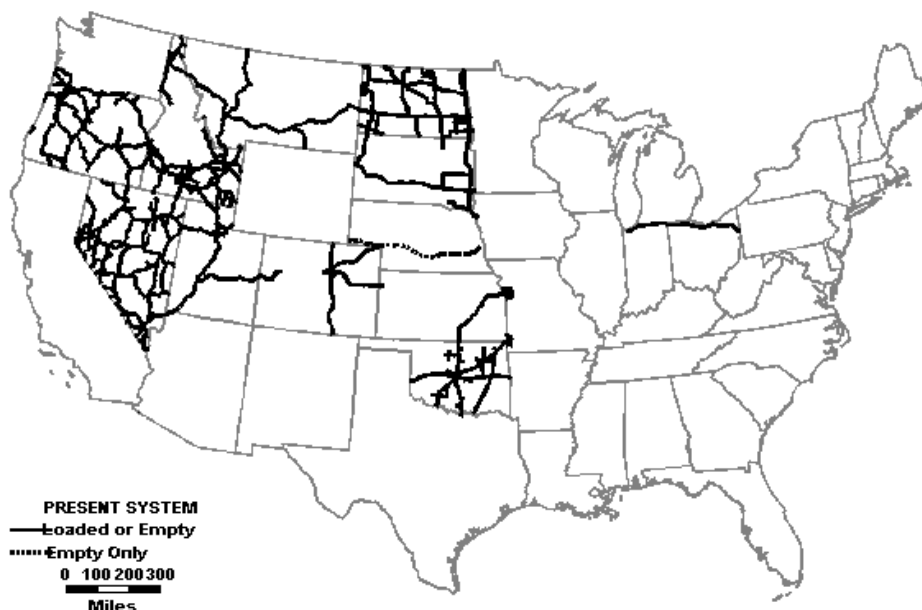


FIGURE III-6
HIGHWAY NETWORK MAP FOR DOUBLE-TRAILERS
Rocky Mountain Doubles



A triple-trailer combination consists of a tractor and three trailers in tow--typically three 28- to 28.5 foot trailers. Triple-trailer combinations are permitted to operate in thirteen States under restrictive circumstances and on limited networks. The total network miles available for triple-trailer combinations is shown in Table III-11. Figure III-7 provides a map of the triple-trailer highway network.

FIGURE III-7
HIGHWAY NETWORK MAP FOR TRIPLE-TRAILERS



CROSS-BORDER TRUCKING AND INTERNATIONAL COMMERCE

There are 77 highway crossings between Canada and the ten border States in the contiguous United States--11 of the highway crossings are Interstate, 15 are on other NHS routes, and 51 are on other highways. There are 38 highway crossings between Mexico and four Southwestern States--four are Interstate, nine are on other NHS routes, and 25 are on other highways.

The volume of truck traffic from Canada into the United States is twice as high as truck traffic from Mexico into the United States. In 1995, an average of 14,008 trucks entered the United States every day from Canada compared with 7,943 trucks per day from Mexico. In fiscal year 1996 the weekday average number of trucks crossing from Mexico increased to 11,906.¹⁰ Between 1991 and 1995, inbound truck traffic from Canada grew by 9 percent per year and traffic from Mexico grew 11 percent per year.

The four States experiencing the highest volume of truck traffic from Canada, in descending order of number of trucks per day are: Michigan, New York, Washington and Maine. The two States experiencing the highest volume of truck traffic per day from Mexico are Texas and California.

¹⁰ *Commercial Trucking: Safety Concerns About Mexican Trucks Remain Even as Inspection Activity Increases*, GAO/RCED-97-68, April 1997.

SIZE AND WEIGHT LIMITS DIFFER

TS&W limits governing trucking operations across the two borders are very different. In crossing to Canada all but one crossing involving the NHS has GVW limits of more than 99,000 pounds and 9 of the 11 Interstate crossings have GVW limits of more than 105,000 pounds. In crossing to Mexico, all four Interstate crossings are limited to GVWs of 80,000 pounds and six of nine other crossings on the NHS have a GVW of 84,000 pounds (with a permit from the State of Texas).

TRUCK CHARACTERISTICS

The characteristics of trucks operating across the U.S. borders are affected by: type of trade, commodity, and the TS&W regulations of three countries. The majority of trucking across the Canadian border is conducted with five-axle tractor-semitrailer combinations, although a few single unit trucks are used. Commonly used tractor-semitrailer combinations in the cross-border operations on the Canadian border include: (1) seven- and eight-axle combinations with lift axles moving containers between British Columbia and Washington; (2) seven- and eight-axle A-train and B-train doubles, RMD and triple-trailer combinations between the Western provinces and Northwestern States; and (4) various heavy combinations with multiple axle groups limited by Michigan and Ontario bridge formulas.

Different TS&W limits between Canada and the United States result in unique situations. For example, an eight-axle tractor-semitrailer crossing into British Columbia from Washington converts to a six-axle by lifting axles on the tractor and semitrailer) and a wide variety of combinations having as many as 11 axles with one or more being liftable, operate between Michigan and Ontario.

A large portion of truck traffic between Mexico and the United States is dominated by the two- and three-axle single unit truck, and tractor-semitrailer combinations limited to 80,000 pounds. Very few double-trailer combinations are used.

DOMESTIC AND INTERNATIONAL CONTAINER TRANSPORT

Very few ports and rail facilities are capable of direct intermodal transfer of maritime containers. As a consequence, containerized freight transportation has grown rapidly in recent years, resulting in an increased number of maritime shipping containers traveling on the transportation system. These containers may be loaded at weights that cause trucks to exceed Federal, State, or local vehicle weight limits. Additional information on container characteristics and trends is included in Appendix ___.

In general, containerized cargo refers to freight being transported in either domestic or international (maritime) containers. The significant difference between domestic and international marine containers is the structural standard for stacking endurance. Domestic containers are only required to have the structural strength to be stacked two high such as on a train, whereas international marine containers are required to have the strength to be stacked up to seven containers high. Another difference, domestic containers can be 102 inches wide, but international containers are limited to 96 inches.

The dimensions of standard dry domestic containers in the United States are lengths of 45-feet, 48-feet, and 53-feet, width of 8.5 feet and height of 9.5 feet. The 28-foot container is also common in the United States. These dimensions have developed to take full advantage of the dimensional opportunities available from TS&W regulations.