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# Survey of Gasoline Tank Trucks and Rail Cars

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by

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## SUMMARY

Tank vehicles and rail cars used in the gasoline marketing industry were briefly surveyed. Data were obtained from relevant trade associations and journals, equipment and tank manufacturers, tank operators, and the U.S. Bureau of Census.

Based on available information, there are currently an estimated 85,000 tank vehicles in gasoline service. Of these, about 26,500 are tank trucks and 58,500 are tank trailers.

Over 200 contacts, mostly by telephone, were made with those presumed to have knowledge concerning tank vehicles used in gasoline marketing. Descriptions of tank vehicles, population data, equipment, retrofit requirement for vapor recovery and cost data were obtained from these sources and are provided.

Information on loading methods and the presence or absence of vapor recovery systems was gathered for approximately 1,900 tank vehicles. More than 50 percent of tanks owned by these respondents contained or had been retrofitted with vapor recovery systems and bottom loading.

Very little information was available with respect to tank cars in gasoline service. Tank cars are, apparently, not used in dedicated service, and vapor collection systems are not common.

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# 1.0 INTRODUCTION

## 1.1 SCOPE

In gasoline marketing operations, most of the gasoline is transported between the terminal, bulk plant, and service station by tank vehicles. A small portion of gasoline is transferred by rail car. Up to the present time, transport of gasoline had not been specifically addressed with respect to types, equipment, and population of gasoline tank vehicles and rail cars. Such data were found to be of importance to the Emission Standards and Engineering Division (ESED) of the U.S. Environmental Protection Agency (EPA) in their current investigation of hydrocarbon and benzene emissions from gasoline marketing operations.

A survey was, therefore, conducted to gather information regarding the current population of gasoline delivery tanks (both tank vehicles and rail cars), the ages and types of tanks currently in service, industry trends, requirements for retrofitting existing vehicles with vapor collection systems, and costs required for retrofitting existing vehicles. It is expected that the data presented will be useful in the preparation of future standards and guideline documents for benzene and other volatile organic compounds. Aircraft refuelers and tanks transporting materials other than gasoline were not included in this study.

## 1.2 GASOLINE DISTRIBUTION

An overview of the tank vehicle industry and the types of truck operators are shown in Figure 1-1. The major distributors of gasoline are the "for-hire" carriers and the "private carriers." The "for-hire" carrier, which accounts for 28 percent of the gasoline delivery tanks, operates as a common or a contract carrier. This type of carrier transports products of manufacturers and

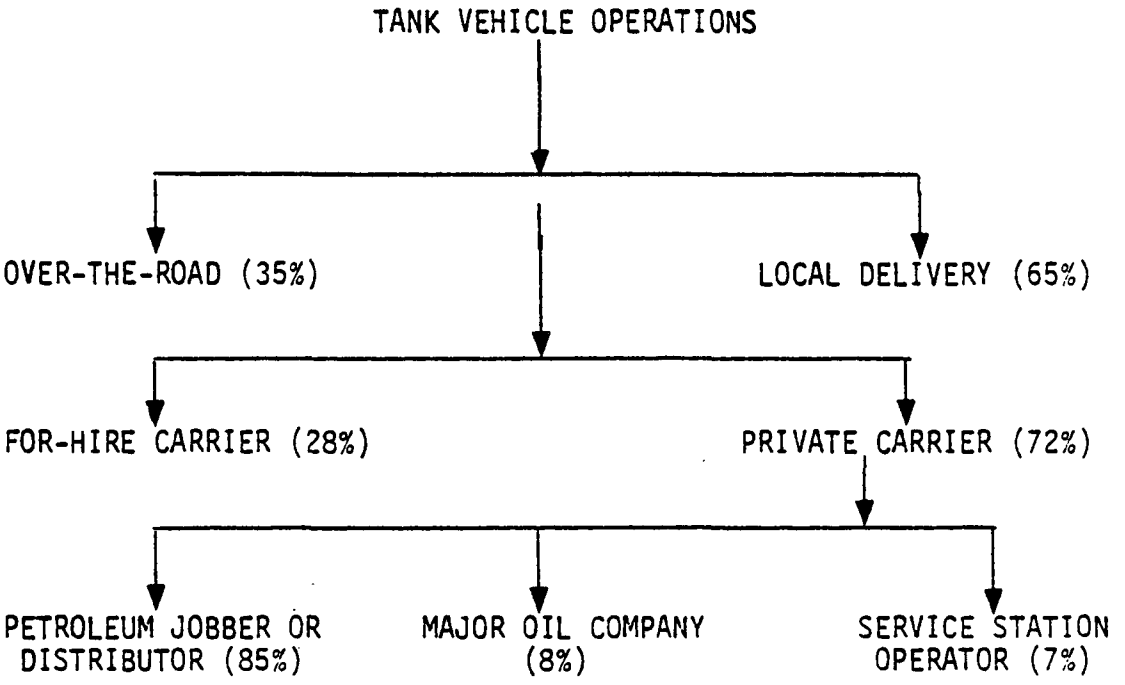



Figure 1-1. Petroleum Delivery Tank Vehicle Operations[1]

other shippers of liquid or dry bulk commodities. In other words, the "for-hire" carrier acquires its profit by hauling for others. The private carrier hauls its own products. These carriers and the percentage of gasoline delivery tanks operated are petroleum jobbers or distributors (61 percent), major oil companies (6 percent), and service station operators (5 percent).[1]

Gasoline distribution between terminals, bulk plants, and service stations can be divided into "over-the-road" and "local delivery" operations. "Over-the-road" is also known as the intercity type of operation. As the name implies, the tank vehicles operate between terminals and redistribution points. Both "for-hire" carriers and private carriers deliver gasoline over-the road. The types of tank vehicles employed are mainly semitrailers, semitrailer-full trailers, or straight truck-full trailer units. The latter two types are known as double bottom units.

"Local delivery" operation is engaged in local delivery of products from terminals or bulk plants to industrial consumers, homes, farms, and service stations. For small quantity deliveries, the types of tank vehicles employed are primarily straight trucks (Bob tail) or small semitrailers.

Practically all of the gasoline transported by delivery tank from a terminal or bulk plant to a bulk plant or service station is by tank vehicles. Less than 2 percent of bulk plants were stated to receive products by rail cars.[2] Much of the information gathered and presented in this report will thus be concerned with tank vehicles.

# 2.0 GASOLINE DELIVERY TANKS

## 2.1 DESCRIPTION

Gasoline tanks are generally built of aluminum alloys, although stainless steel is sometimes used. The advantage of an aluminum alloy tank is its lighter weight as compared to other materials. Aluminum tanks can haul more gallons at an equivalent gross vehicular weight which means fewer trips to haul the same amount of gasoline. These tanks, which range in size from 1,200 to 10,000 gallons, are usually divided into several compartments with different sizes to meet the operator's specific requirements. Thus, one delivery tank can carry several different grades of gasoline or several different products, if necessary.

Tank vehicles which operate between cities are usually equipped with hoses, several types of valves, and connections. It is reported that approximately two-thirds of the vehicles are equipped with pumps and more than one-third with meters.[3] The local delivery tanks are equipped with meters, valves, pumps, hoses, and hose reels.

The Modern Bulk Transporter[1] reports that the average vehicle life span is about 13 years for tanks or trailers, and 8 years for straight trucks. Major carriers will generally use tank vehicles for less than the average vehicle life span, and a small marketer may use them for longer than the average life span.

### 2.1.1 TANK VEHICLE NOMENCLATURE

Tank vehicles are classified into three types: straight truck (tank truck), semitrailer, and full trailer. A straight truck is a single self-propelled motor vehicle equipped with cargo tank. As a single unit, the straight truck is also known as a "Bob Tail" or "Body Load" truck.

Additional definitions of tank vehicles are as follows:

1. Semitrailer - Any vehicle equipped with a cargo tank that is drawn by a tractor by means of a fifth wheel connection. Some part of the semitrailer's weight and load rests upon the towing vehicle.

2. Full Trailer - Any vehicle equipped with a cargo tank and is constructed so that practically all of its weight and load rests on its own wheels.

3. Double Bottom Unit - A unit comprised of either a semi-trailer or a straight truck and a full trailer. In this arrangement, the semitrailer or straight truck functions as the towing vehicle.

4. Tank Vehicle - Any tank truck, full trailer, or tractor and semitrailer combination.

### 2.1.2 TANK VEHICLE EQUIPMENT

Manholes, compartment markers, emergency valves (also called internal valves), and unloading adaptors are essential equipment for a typical top loading tank vehicle (Figure 2-1).

Manholes are installed on the top of each compartment. They function as a product inlet during top loading operation and provide entry for cleaning or repair. The manhole cover is fitted with pressure vacuum vents for normal venting requirements. Also, it is spring loaded and is used for emergency venting. In bottom loading systems, the cover is commonly used as positive back-up protection against tank rupture due to overfilling.

When the normal tank vent is mechanically operated, the vents are installed directly over the internal valves (within one-half inch[4]) to which they are mechanically interconnected. The vent then opens and closes in unison with the valve.

During a bottom loading operation, the internal valve is opened for product flow, and the vent is open to permit an exit for vapors which are displaced by the incoming product. The internal valve

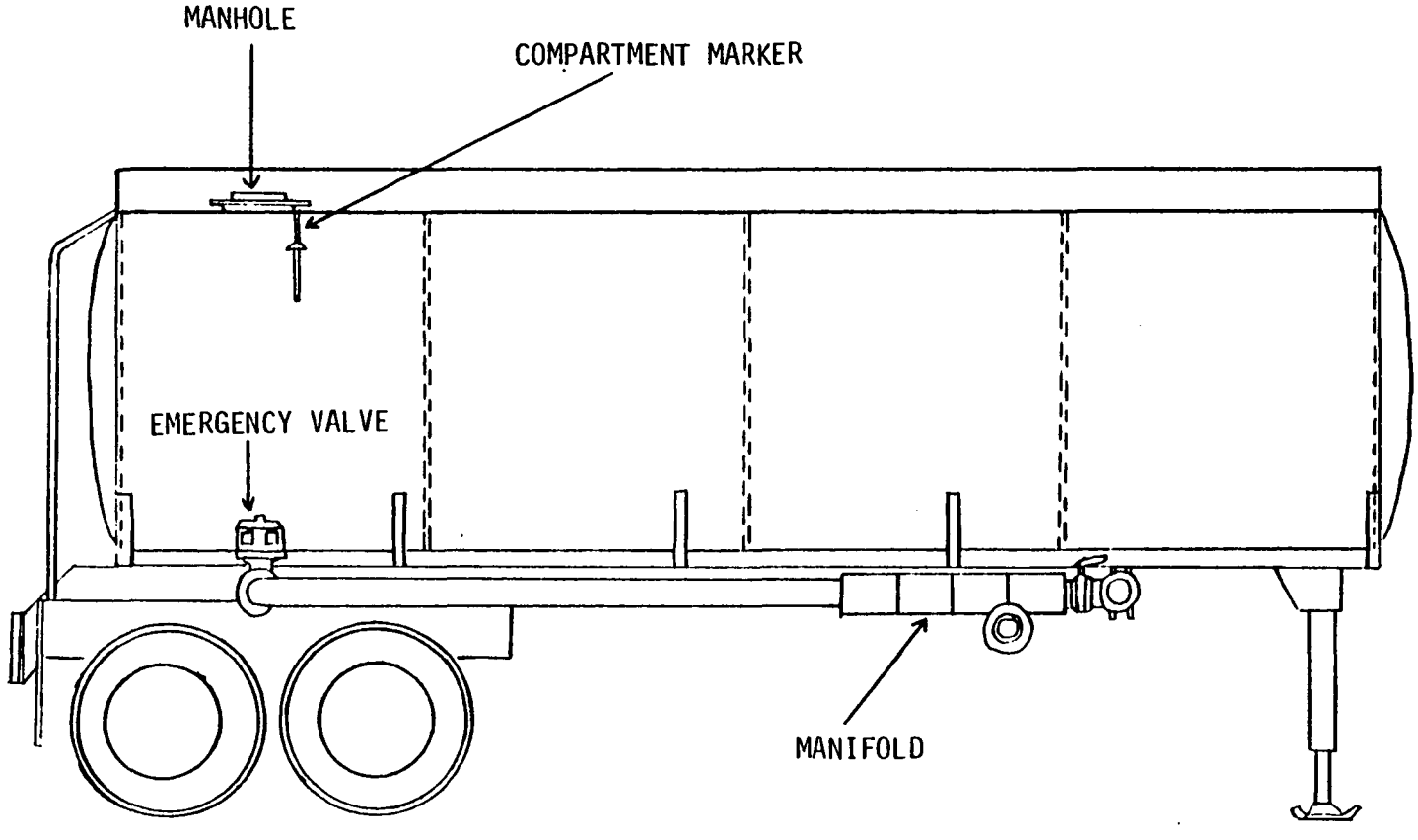



Figure 2-1. Top Loading Tank

and vent reopen to draw in air as the product leaves the tank during unloading. Many of these vents are air or hydraulically operated and normally located near the center of the compartment. These vents can be opened or closed independently of the internal valve.

The compartments can be unloaded through a manifold by one single adaptor when mixed products are allowed. Otherwise, a separate adaptor is installed on each compartment. A double bulkhead and a separate delivery system are required when compartments contain different classes of products. This would insure no mixing between compartments.

The liquid level in the compartment can be visually checked by a compartment marker. These markers are visible only from the top and cannot stop the flow of products. Thus, for bottom loading, secondary level control systems are required.

### 2.1.3 OVERFILL SHUT-OFF

The overfill shut-off devices function as a secondary level control system. It will automatically shut-off the incoming flow of products when the maximum allowable liquid level has been reached in the compartment. These devices prevent product overflow due to meter failure and incorrect meter setting by the operator.

### 2.1.4 TANK CARS

Very little information was available concerning the use of tank (rail) cars for gasoline service. However, less than 2 percent of bulk plants receive gasoline via rail cars[2], and other deliveries by tank cars are negligible in the gasoline marketing operations. Therefore, emissions from tank cars used in gasoline distribution were assumed to be insignificant.

Typically, tank cars used for gasoline delivery range from 10,000 to 20,000 gallons in capacity.[5] Tank cars are, however,

not normally used in dedicated service (i.e., products carried by tank cars normally vary from trip to trip). Therefore, the various sources contacted would not venture an estimate on the number of tank cars used in flammable liquid service but stated that the number would fluctuate substantially.

Tank cars are most commonly loaded through the manhole or through a closed loading system located on the top. Unloading is through the bottom fittings which are sometimes used for loading.

The Association of American Railroads also indicated that vapor collection systems are not commonly found on tank cars.[5]

## 2.2 TANK VEHICLE CATEGORIES

Tank vehicles are categorized in this document according to age, type and size, and method of loading (Table 2-1).

Table 2-1. TANK VEHICLE CATEGORIES

| Age | |
|---|---|
| Pre - 1967 | May not be economical to retrofit to bottom loading and/or vapor recovery |
| 1967 - 1975 | |
| 1976 - 1979 | Generally built with provisions for vapor recovery and bottom loading |
| **Type and Size** | |
| Single Unit Straight Trucks (also called body load or bob tail) | 1,200 - 5,000 gal |
| Tank Semitrailers | 5,000 -10,000 gal |
| Full Tank Trailers | 4,000 - 7,000 gal |
| **Loading Method** | |
| Top Load | Top Tight Submerged |
| Bottom Load | |

### 2.2.1 AGE OF TANK VEHICLES

Contacts with manufacturers of delivery tanks indicated a substantial number of tanks currently in service were built prior to 1967. In that year, either due to establishment of motor carrier regulations or other reasons, changes were made in tank construction. These changes permit the retrofit of tanks with bottom loading and/or vapor recovery systems without the higher costs required of the pre-1967 tanks.

Several of the problem areas with retrofitting the pre-1967 tanks include: a smaller manhole, free flowing vents, the use of single wall instead of double wall overturn protection rails, pressure-vacuum valves which do not meet current EPA requirements, 3-inch instead of 4-inch discharge line, and the construction of the tank which makes it difficult to install an internal/emergency valve.

Since 1976, most delivery tanks for flammable liquids have been built with provisions for bottom loading and vapor recovery. These include a taller double-walled overturn rail, which can be used as a conduit in addition to protecting the vapor recovery hoods. Specified sites are also designated for and blanked off for future installation of vents, hoods, vapor recovery lines, internal valves, and secondary shut-off systems. A few firms had incorporated these provisions into tanks fabricated since 1974.

Thus, the age category was divided into three periods: (1) for the pre-1967 tanks, difficulty may be encountered in retrofitting with vapor recovery; (2) for tanks built during 1967 to 1975, retrofitting can be done at some cost; and (3) in the post-1975 period, most tanks shipped had provisions for addition of vapor recovery and bottom loading without the need for cutting or welding of the tank.

### 2.2.2 TYPE/SIZE

The types of delivery vehicles employed in gasoline marketing operations are straight truck, semitrailer, and full trailer. Contacts with tank vehicle manufacturers indicated that ranges of capacities for each type of delivery tank were as follows: straight truck ranged from 1,200 to 5,000 gallons, semitrailer ranged from 5,000 to 10,000 gallons, and full trailer ranged from 4,000 to 7,000 gallons. The total capacity of delivery vehicles including double bottom units normally do not exceed 10,000 gallons.

### 2.2.3 LOADING TECHNIQUES

Delivery tanks can either be loaded from the top or the bottom of the tank according to the systems installed on the tank and at the loading rack. Tank and rack systems must be compatible.

#### 2.2.3.1 Top Loading

Top loading is divided into open top, with and without vapor recovery, and top tight submerged fill. Open top involves loading of products into the compartment via the manhole which is located on top of the tank. Gasoline can be loaded directly into the compartment through a top loading head (splash fill). Attachment of a fixed or extensible downspout to the loading head provides a means of introducing the product near the bottom of the tank (submerged fill). A deflector at the outlet of the downspout provides for uniform spreading of the product and eliminates both static buildup and product splash.

In addition to submerged fill, the top loading head can be designed for vapor recovery. This top loading vapor head must be compatible with the truck hatch opening, and a vapor tight seal is required between the head and the hatch to minimize vapor leakage during transfer of product.

These top loading systems, which require opening of the hatch (Figure 2-1), must be equipped with a separate vapor recovery system for delivery to customers with vapor balance systems.

Provisions for top tight submerged fill have been installed in tank trucks primarily in Texas. This installation permits the loading of product through a vapor tight loading adaptor mounted on top of each compartment (Figure 2-2) and attached to a submerged fill pipe. For vapor recovery, the vapor spaces of each compartment are manifolded to the overturn rail or to a vapor return line.

One advantage of this permanently affixed top tight submerged fill is that the hatch/dome covers remain closed at all times except for clean up and repair. No vapor loss is, therefore, attributable to opening of the hatch. The top tight and vapor head system can collect vapors expelled from the tank during product loading.

#### 2.2.3.2 Bottom Loading

Bottom loading permits the operator to stand on the ground for loading the tank through connectors at the side of the tank. Since the discharge opening of the tank is used for loading, submerged fill occurs naturally. Some of the advantages cited for bottom loading are: (1) improved safety, (2) faster loading, and (3) reduced labor costs. Off-loading and on-loading adaptors, a single valve for both in and out service or Y-valves, must be provided for individual compartment loading and unloading (Figure 2-3). Additionally, an emergency or internal valve is required as well as a vent valve when gasoline is being loaded. A means to prevent gasoline spraying into the tank must be included, and a liquid high level sensor is necessary for secondary automatic shut-off purposes. Tanks with bottom loading provisions can normally be top loaded from an open hatch.

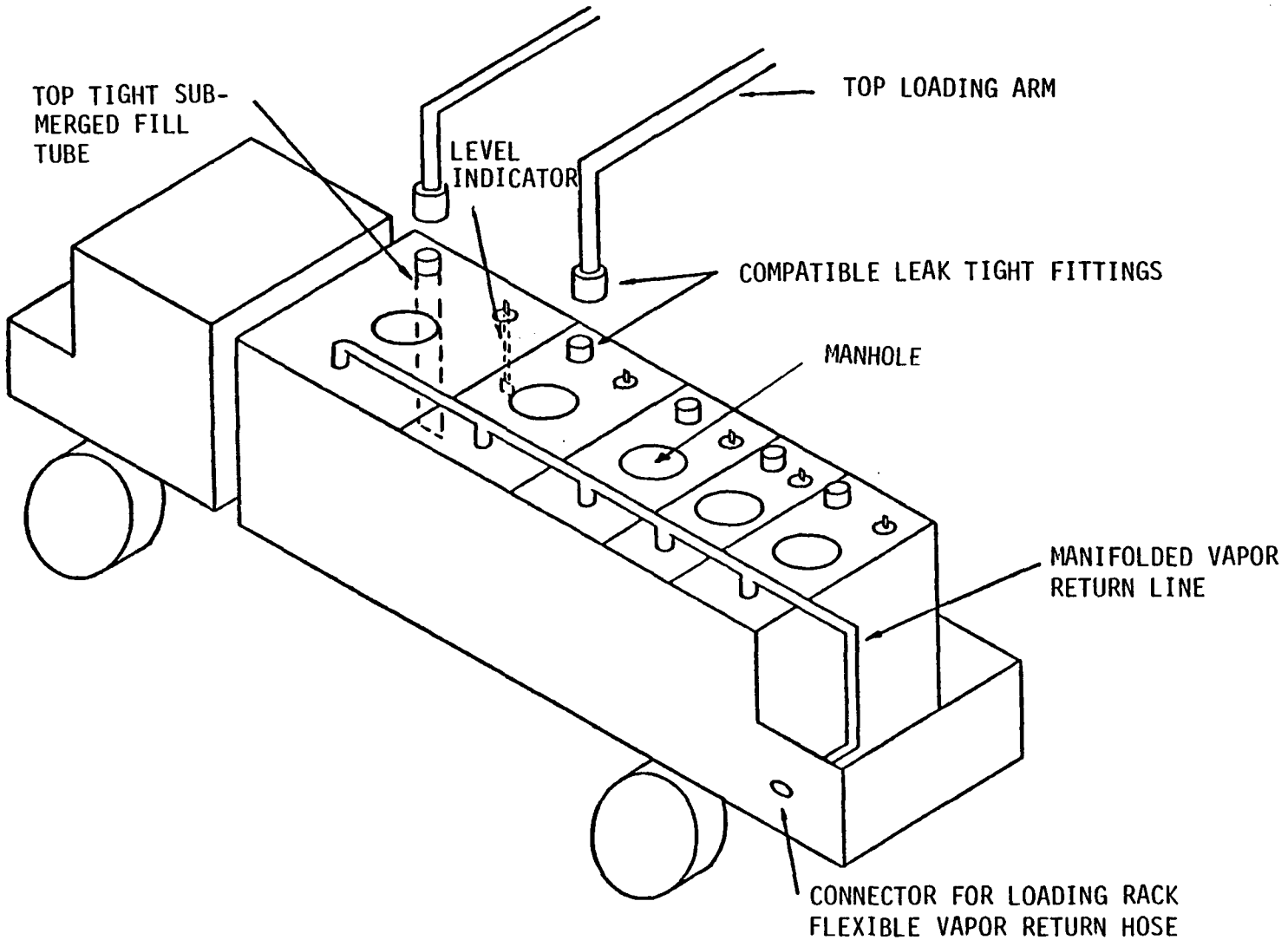



Figure 2-2. Top Tight Submerged Fill Tank

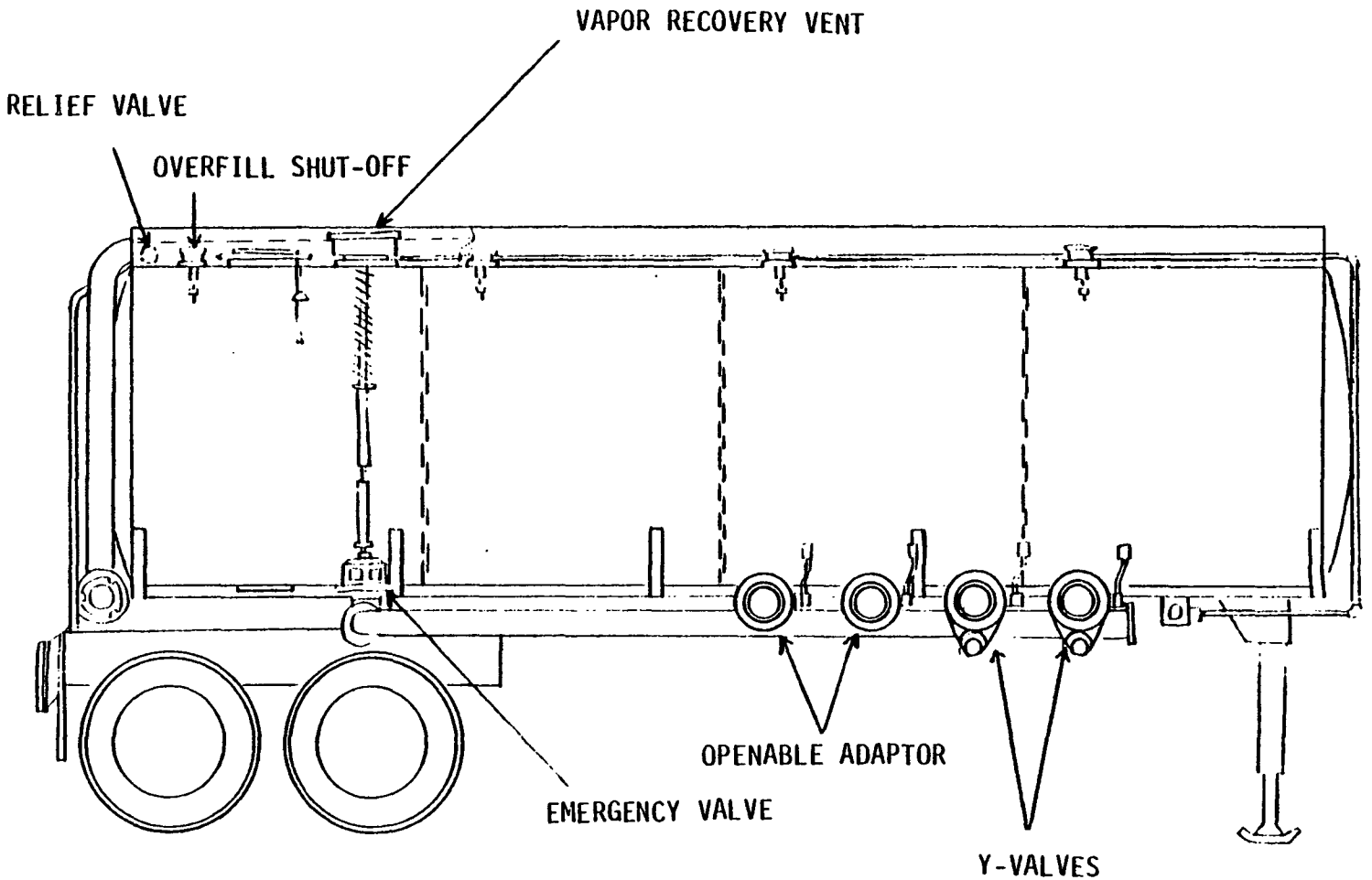



Figure 2-3. Bottom Loading Tank

## 2.3 POPULATION AND TRENDS

### 2.3.1 POPULATION ESTIMATES OF GASOLINE DELIVERY VEHICLES

On the basis of tabulations compiled by the Truck Trailer Manufacturers Association, there were 7,415 truck trailer tank shipments (tanks manufactured) for flammable liquids in 1976 and 1977; 26,280 tank shipments for the years 1967 through 1975; and 34,373 tank shipments for the years 1957 through 1966. The total shipment was 68,068 units during the 21 year period (Table 2-2). These data were originally obtained from the U.S. Bureau of Census' Current Industrial Reports. As a comparison, a total of 124,143 tank trailers for liquid service was shipped during the same period.

Table 2-2. GASOLINE TANK VEHICLE POPULATION ESTIMATE

| Estimates From Several Sources | |
|---|---|
| Total tanks/liquid trailers in use[a] | 131,920 |
| Number in flammable liquid service[b] (excludes LPG, fuel oil, asphalt, etc.) | |
| Trailers (semi and full) | 67,523 |
| Tank trucks | 30,295 |
| Total | 97,818 |
| Trailer shipments[c] (all flammable liquids) | |
| 1976 - 1977 | 7,415 |
| 1967 - 1975 | 26,280 |
| 1957 - 1966 | 34,373 |
| 1954 - 1956 | 16,113 |
| Total (1954 - 1977) | 84,181 |
| Total (1957 - 1977) | 68,068 |

[a] Commercial Car Journal, p. 138, June 1978

[b] Modern Bulk Transporter, "The 1978-1979 Tank Trucking Industry Market Report," Sutherland Publications, Inc., Washington, D.C.

[c] Truck Trailer Manufacturers Association, tabulated data from Current Industrial Reports of U.S. Bureau of Census, Washington, D.C.

According to the Commercial Car Journal, there are an estimated 131,920 liquid tank trailers in current use.[6] Based on information obtained from personnel at the Heil Company, approximately 55 percent of these trailers are used to deliver flammable liquids. This value (55 percent) is near the number which can be calculated from the tank trailer shipment data. Also, estimates were made that determine that the percentage of flammable tanks used in gasoline service ranged from 70 to 90 percent.[7,8] Taking an intermediate estimate of 80 percent of the flammable liquid tanks as being used for gasoline delivery, approximately 44 percent of the total 131,920 liquid tank trailers or 58,000 tank trailers are used for the delivery of gasoline.

Additionally, "The 1978-1979 Tank Trucking Industry Report"[1] estimates that a total of 97,818 tank vehicles are currently carrying flammable liquids (gasoline, etc.) excluding fuel oils and LPG. Of the total, 30,295 are straight trucks and 67,523 are trailers.

Using the current supply and demand figures for petroleum products,[9] and excluding those products for which a separate listing of delivery tanks was presented, approximately 87 percent of the delivery tanks listed under this source for flammable liquids are used in gasoline service. Estimated numbers are then 26,400 straight trucks and 58,700 trailers, which total 85,000 tank vehicles in gasoline service. In both approximations, the total number of trailers in gasoline service is estimated to be 58,000.

### 2.3.2 POPULATION OF RAIL TANK CARS

Of the many contacts made to gather information concerning rail cars, only the Association of American Railroads provided population data. There are approximately 100,000 - 111A tank cars of which a half or more is estimated to be in flammable liquid

service. The total number of cars fluctuates because flammable liquid cars are not in dedicated service.

## 2.4 TANK CATEGORIES AND QUANTITY ESTIMATES

### 2.4.1 AGE

Only gross estimates were made of the distribution of tank vehicles according to age. Data used included: (1) estimates of flammable tank vehicles in use of 97,800 for 1978[1] and 83,800 for 1974;[10] (2) the annual tank trailer shipments (Appendix Table A-1); and (3) the Bureau of Census' surveys of trucks and trailers for 1972 (Appendix, Table A-2).

Assuming a linear extrapolation of tank vehicles, there would have been some 75,000 tanks for flammable liquids use in 1972. The census data were used to estimate the number of tanks built prior to 1967 and during 1967 to 1972 by using ratios of surveyed tanks. Subsequently, tank losses of 20 and 10 percent were assumed for the pre-1967 and 1967 to 1972 tanks, respectively. This resulted in an estimate of 64,100 tanks built in and before 1972. The balance of 33,700 tanks was assumed proportionate to the trailer shipments for the periods 1973 through 1975 and 1976 through 1977 (Appendix A-3).

Taking 87 percent of these as being in gasoline service, then using these age distributions and the tank trailer shipment data as guidelines, the population distribution as a function of age was estimated. The results are shown in Table 2-3.

### 2.4.2 BODY TYPE

Telephone contacts were made with as many gasoline transporters as possible. Those from whom information was obtained and the data obtained are given in Table 2-4. Over 1,900 delivery tanks were accounted for in this brief survey. Although this number represents

Table 2-3. ESTIMATED POPULATION OF TANKS IN GASOLINE SERVICE AS A FUNCTION OF AGE[a]

| A g e | Truck | Trailers | Total |
|---|---|---|---|
| 1976 - 1977 | 5,000 | 7,000 | 12,000 |
| 1967 - 1975 | 20,500 | 23,000 | 43,500 |
| Pre - 1967 | 1,000 | 28,500 | 29,500 |
| Total | 26,500 | 58,500 | 85,000 |

[a] These values are only intended as estimates.

only a small percentage of delivery tanks, it is assumed that distribution of tanks in the respective categories are representative of the whole. These values may be improved with additional data.

Descriptions of the pulling units were not generally available from the sources contacted. From the total capacity of the double bottom units and the capacity ranges of the tank types (Table 2-1), it was assumed that combinations, whose total capacity was 9,000 gallons or less, were pulled by straight trucks. This resulted in 182 straight trucks and 227 still unclassified pulling units. Taking the entire range of 182 to 409 pulling units as straight trucks, 17 to 29 percent of the surveyed tank vehicles are straight trucks, 27 percent are full trailers, and 44 to 56 percent are semitrailers.

### 2.4.3 LOADING METHOD

From the data obtained and given in Table 2-4, approximately 7.4 percent of tanks were specified as being bottom loaded only, although all tanks can be top loaded through the hatch. An additional 69.8 percent had top and bottom loading, 0.1 percent had top tight submergible loading, and 22.7 percent had only top loading. This distribution is subject to change with additional data.

# Table 2-4. TANK VEHICLE SURVEY DATA

| Company | Quantity | | Size Range (gallons) | Age Range (year) | Loading Technique[c] | | | | Bottom Load Adaptor[c] | | | Secondary Automatic Shut-off[c] | | | | Vapor Recovery System[c] | | | Annual Gasoline Throughput (gallons) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Double Bottom Unit[a] | Single Unit[b] | | | Open Top | Submerged | Bottom | Top And Bottom | on Individual Line: Y Valve | on Individual Line: Openable | On Manifold | Jet Level Sensor | Float Sensor | Dyna-Probe | None | Individual Compartment | Manifolded | None | |
| Acme Transport | 6 | | 9,000 | 1971 - 1978 | 6 | | 6 | | | | 6 | | | | | 10 | 2 | | |
| ADA Resources | | 3 (s) | 8,000 - 8,500 | 1964 - 1977 | | | | 3 | | 3 | | 3 | | | | 3 | | | |
| Aero Oil | 30 | | 2,500 - 8,000 | 1971 - 1978 | 60 | | | | | | | | | | 60 | | | 60 | |
| Aero Oil | | 8 (s) | 7,000 - 8,000 | 1971 - 1978 | 8 | | | | | | | | | | 8 | | | 8 | |
| American Transfer | 19 | | | | 8 | | 12 | | | | | | | | | 12 | | 26 | |
| Amospost | | 3 (s) | 8,600 | 1975 - 1977 | 3 | | | | | | | | | | 3 | | | 3 | |
| Armour Oil | 55 | | 9,500 | 1964 - 1978 | | | | 110 | | | | | | | | 110 | | | |
| Asbury System | 100 | | 9,000 - 10,000 | 1968 - 1978 | | | | 200 | | 200 | | 200 | | | | 60 | | 140 | |
| Atlantic Richfield | | 148 (s) | 8,000 | 1971 & older - 1976 | 8 | | | 140 | | | | | 148 | | | | 140 | 8 | |
| Atlantic Richfield | | 55 (s) | 9,000 | 1977 - 1978 | | | | 55 | | | | | 55 | | | | 55 | | |
| Atlantic Richfield | | 143 (b) | 4,000 | 1972 - 1978 | | | | 143 | | | | | 143 | | | | 143 | | |
| Atlantic Richfield | | 103 (f) | 5,000 | 1972 - 1978 | | | | 103 | | | | | 103 | | | | 103 | | |
| Augsburg Corporation | | 15 (s) | 8,000 - 8,500 | 1967 - 1973 | | | 15 | | 15 | | | 15 | | | | | | 15 | |
| Carlos R. Leffler | | 12 (s) | 8,000 - 9,000 | 1970 - 1978 | 6 | | 6 | | 3 | 3 | | | 9 | 3 | | 6 | | 6 | |
| C F Tank Lines | 10 | | 9,000 | 1968 - 1973 | 20 | | | | | | | | | | 20 | | | 20 | |
| Continental Oil | 20 | | 8,000 | 1975 - 1978 | | | | 40 | | | | | | | | | | | |
| Continental Oil | | 258 (s) | 8,000 | 1975 - 1978 | | | | 258 | | | | | | | | | | | |
| Cook and Cooley | 3 | | 9,000 | 1973 - 1978 | 6 | | | | | | | | | | 6 | | 6 | | |
| Cook and Cooley | | 1 (s) | 9,000 | 1973 | 1 | | | | | | | | | | 1 | | 1 | | |
| Crown Central Petroleum | | 10 (s) | 7,800 | 1972 - 1976 | | | 10 | | 10 | | | 10 | | | | | 10 | | |
| Cumberland Oil | | 2 (s) | 9,200 | 1968 - 1976 | 1 | | | 1 | | | | 1 | | | 1 | | 1 | 1 | 0.5 MM - 1.5 MM |
| Cumberland Oil | | 1 (b) | 2,000 | 1966 | 1 | | | | | | | | | | 1 | | | 1 | 0.5 MM |
| Delta Oil | | 8 (s) | 8,000 | 1973 - 1975 | | | 8 | | | | 8 | | | | 8 | 8 | | | |
| Desert Oil | | 4 (s) | 9,500 - 10,000 | 1966 - 1978 | | | | 4 | | 4 | | | | | 4 | | | 4 | |

# Table 2-4. TANK VEHICLE SURVEY DATA (CONTINUED)

| Company | Quantity | | Size Range (gallons) | Age Range (year) | Loading Technique[c] | | | | Bottom Load Adaptor[c] | | | Secondary Automatic Shut-off[c] | | | | Vapor Recovery System[c] | | | Annual Gasoline Throughput (gallons) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Double Bottom Unit[a] | Single Unit[b] | | | Open Top | Submerged | Bottom | Top And Bottom | On Individual Line | | On Manifold | Jet Level Sensor | Float Sensor | Dyna-probe | None | Individual Compartment | Manifolded | None | |
| | | | | | | | | | V Valve | Openable | | | | | | | | | |
| Diamond Tank Lines | 10 | | 8,000 - 9,000 | 1963 - 1978 | | | | 20 | 20 | | | 20 | | | | | 20 | | |
| Franko Oil | 5 | | 9,500 | 1963 - 1978 | | | | 10 | | | | | | | | 10 | | | |
| Gasco Incorporated | 7 | | 9,000 | 1973 - 1977 | | | | 14 | | | | | | | 14 | 14 | | | 5.0 MM |
| Godwin Oil | | 3 (s) | 6,700 - 9,400 | | 3 | | | | | | | | | | | | | 3 | |
| Gulf Refining and Marketing | | 13 (s) | 8,600 | 1972 - 1974 | 9 | | 4 | | | 9 | | | | | | | 13 | | |
| Hercules Oil | 12 | | 8,800 | 1967 - 1978 | | | | 24 | | 12 | 12 | | | | | 24 | | | |
| Husky Oil | | 2 (s) | 9,000 | 1978 | | | | 2 | | | | | | | | 2 | | | |
| Husky Oil | | 1 (b) | 4,000 | 1978 | | | | 1 | | | | | | | | | | 1 | |
| Horn Distributor | | 1 (s) | 9,000 | 1978 | | | | | | | | | | | | | | | |
| Horn Distributor | | 1 (b) | 1,680 | 1964 | 1 | | | | | | | | | | | | | | |
| Kellam Distributor | 2 | | 8,000 | 1969 - 1971 | | 2 | 2 | | 2 | | | | | | | | 4 | | |
| Kellam Distributor | | 3 (b) | 2,000 | 1972 - 1977 | 3 | | | | | | | | | | | | | 3 | |
| Kickapoo Oil | | 14 (s) | 9,300 | 1972 - 1977 | | | | 14 | | 14 | | | | 3 | 11 | | | 14 | 6.0 MM |
| Land O'Lakes, Incorporated | | 5 (s) | 9,800 | 1977 - 1978 | | | | 5 | | 5 | | 5 | | | | | 4 | 1 | 4.0 MM |
| Lehigh Oil | | 6 (s) | 8,600 - 9,300 | 1975 - 1978 | 2 | | | 4 | | | | | | 6 | | 6 | | | |
| Lerner Oil | 8 | | 8,700 - 9,000 | 1971 - 1977 | | | | 16 | | 16 | | | | | | 16 | | | |
| Marshall Oil | | 4 (s) | 8,500 | 1968 - 1973 | | | | 4 | | 4 | | | | | | 4 | | | |
| M. F. A. | | 19 (s) | 8,500 | 1968 - 1978 | 19 | | | | | | | | | | 19 | 1 | | 18 | |
| Mid Continent | | 6 (s) | 9,000 | 1973 - 1977 | | | | 6 | | 6 | | | | | | | 6 | | |
| Miles Tank Lines | 7 | 18 (s) | | 1965 - 1973 | 17 | | 15 | | 7 | | 8 | 15 | | | 17 | | 15 | 17 | |
| Miller Oil | | 8 (s) | 7,700 - 9,000 | 1972 - 1975 | 7 | | 1 | | | | 1 | 1 | | | 7 | 8 | | | |
| Naph-Sol Refining | | 2 (s) | 14,000 | 1975 | 2 | | | | | | | | | | | | | | |
| Oilfield Trucking | 40 | | 8,800 | 1968 - 1975 | | | | 80 | | 80 | | | 80 | | | 80 | | | |
| Osage Oil and Transportation | | 5 (s) | 8,500 | 1975 | | | | 5 | | | | | | | | | | | |

# Table 2-4. TANK VEHICLE SURVEY DATA (CONCLUDED)

| Company | Quantity | | Size Range (gallons) | Age Range (year) | Loading Technique[c] | | | | Bottom Load Adaptor[c] | | | Secondary Automatic Shut-off[c] | | | | Vapor Recovery System[c] | | | Annual Gasoline Throughput (gallons) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Double Bottom Unit[a] | Single Unit[b] | | | Open Top | Submerged | Bottom | Top And Bottom | On Individual Line: V Valve | On Individual Line: Openable | On Manifold | Jet Level Sensor | Float Sensor | Dynaprobe | None | Individual Compartment | Manifolded | None | |
| Peerless Distributor | | 1-2 (s) | 8,000 - 14,000 | 1968 - 1976 | | | | 1-2 | | | | | | | | | | 1-2 | |
| Phillips Petroleum | | 150 (s) | 9,000 | 1968 - 1978 | 135 | | 15 | | | | | | | | | | 17 | | |
| Rich Distributor | | 3 (s) | 8,600 - 9,000 | 1972 - 1974 | 2 | | 1 | | | 1 | | | 1 | | | | 3 | | |
| Rockwood Oil | | 1 (s) | 8,450 | 1966 | | | | 1 | 1 | | | | | | | | | | |
| Rockwood Oil | | 1 (s) | 8,600 | 1968 | | | | 1 | 1 | | | | | | | | | | |
| Rockwood Oil | | 1 (s) | 9,000 | 1978 | | | | 1 | 1 | | | 1 | | | | | 1 | | |
| Smith Tank Lines | 2 | 3 (f) | 8,800 - 9,450 | 1958 - 1965 | 1 | | 6 | | | | | | | | | | 6 | 1 | |
| Southern Fuel Distributor | | 1 (s) | 8,450 | 1970 | 1 | | | | | | | | | | | | | 1 | |
| Southern Fuel Distributor | | 1 (b) | 1,800 | 1969 | 1 | | | | | | | | | | | | | 1 | |
| Thomas Petroleum | | 66 (s) | 8,000 - 9,250 | 1964 - 1978 | 46 | | 20 | | | | | | | 20 | | | 20 | | |
| Transit Oil | | 4 (s) | 9,000 | 1976 | | | 4 | | | | | | | 4 | | | 4 | | |
| V. B. Morgan | 10 | | 8,800 | | 4 | | 16 | | | | | | | | | | 16 | | |
| Ventura Transfer | 9 | | 7,500 | 1954 - 1973 | | | | 18 | | 18 | | | | | 18 | | | 18 | |
| Western Hyway Distributors | 14 | | 8,700 | 1973 - 1978 | | | | 28 | | | 28 | | | | 28 | | 28 | | |
| Western Hyway Distributors | | 1 (s) | 8,300 | 1965 | 1 | | | | | | | | | | 1 | | | 1 | |
| Western Marketing Distributors | | 1 (s) | 8,200 | 1973 | | | | 1 | | | | | | | | | | 1 | |
| Western Marketing Distributors | | 1 (s) | 9,190 | 1977 | | | | 1 | | | | | | | | 1 | | | |
| Widing Transport | 40 | | 8,700 - 9,450 | 1964 - 1973 | 62 | | | 18 | | 18 | | | 18 | | | | 18 | 62 | |
| | | | | | | | | | | | | | | | | | | | |
| Total | 409 | 1,120 | 1,680 - 14,000 | 1954 - 1978 | 444 | 2 | 141 | 1,333 | 60 | 389 | 63 | 271 | 557 | 36 | 227 | 375 | 636 | 436 | |
| Percent | | | | | 23 | .1 | 7 | 69 | 11.7 | 76.0 | 12.3 | 24.8 | 51.1 | 3.3 | 20.8 | 26 | 44 | 30 | |

[a] Double bottom unit can be either straight truck - full trailer or semitrailer - full trailer. Therefore, each unit will contain two tanks.

[b] (s) Semitrailer (f) Full trailer
(b) Bob tail (single unit straight truck)

[c] Numbers of tank indicated under the categories of Loading Technique, Bottom Load Adaptor, Secondary Automatic Shut-off, and Vapor Recovery System. The number in each category does not necessarily sum up to the total tanks in the company because some of the information was not given.

Table 2-5 shows the percentage of bottom loading tanks found in the survey as a function of company size. Most tanks in all categories as subdivided have bottom loading capabilities.

Table 2-5. TANKS WITH BOTTOM LOADING AND VAPOR RECOVERY AS A FUNCTION OF COMPANY SIZE[a]

| Number of Tanks in Company | Total Tanks | Bottom Loading | | | Vapor Recovery | | |
|---|---|---|---|---|---|---|---|
| | | With | Without | Percent With | With | Without | Percent With |
| 1 - 4 | 43 | 27 | 15 | 64 | 19 | 18 | 51 |
| 5 - 10 | 79 | 57 | 22 | 72 | 69 | 5 | 93 |
| 11 - 49 | 316 | 208 | 90 | 70 | 177 | 135 | 57 |
| ≥ 50 | 1,501 | 1,182 | 319 | 79 | 746 | 278 | 73 |
| Total | 1,939 | 1,474 | 446 | 77 | 1,011 | 436 | 70 |
| Total Tank Basis[b] | | | | 76 | | | 52 |

[a] Data were not available for all tanks counted.

[b] Percentages assuming that tanks for which data were not available did not have bottom loading or vapor recovery capabilities.

## 2.5 ADDITIONAL SURVEY INPUT

### 2.5.1 VAPOR RECOVERY SYSTEMS

The overall survey value indicates that 70 percent of those tanks for which data were available had vapor recovery systems. Assuming that tanks for which data were not provided did not have vapor recovery capabilities, the overall percentage drops to 52 percent (Table 2-5).

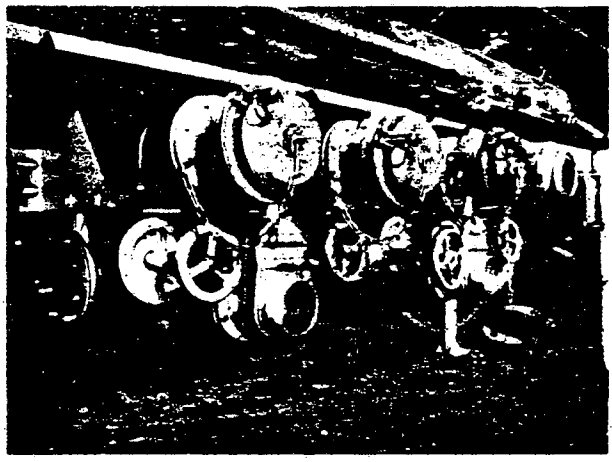
### 2.5.2 BOTTOM LOADING ADAPTOR

The three most common bottom loading discharge arrangements are shown on Figure 2-4. "Y" valves and openable adaptors are installed on the tank when individual compartment loading and unloading are required by the state. When the compartments are manifolded, API type and Buckeye adaptors are installed. The latter type of adaptor is only used on some old tanks and is not commonly found (Figure 2-5). As evidenced by Table 2-4, approximately 87.7 percent of tanks are equipped with individual lines for each compartment, and 12.3 percent with two or more compartments manifolded. The percentage of "Y" valves and openable adaptors installed on compartments with individual lines are 11.7 and 76.0. These percentages are based on 512 tanks for which this specific information was available.

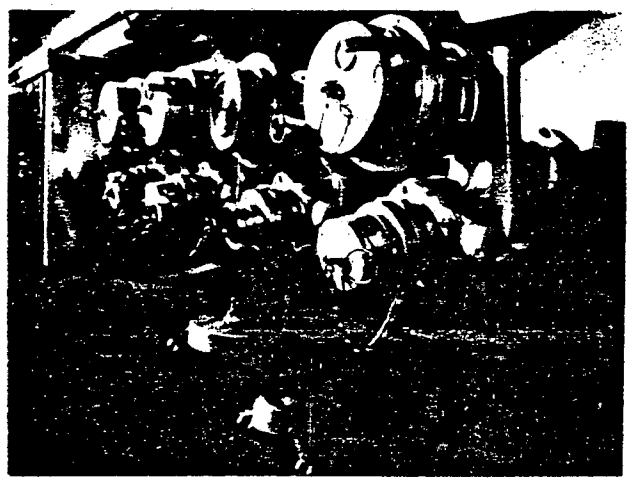
### 2.5.3 SECONDARY AUTOMATIC SHUT-OFF DEVICES

There were three secondary automatic shut-off devices found to be in use. These devices include the jet level sensor, float switch, and Dynaprobe. As estimated from the survey (Table 2-4), approximately 24.8 percent of tanks were reported to have jet level sensors, 51.1 percent to have float switches, and 3.3 percent to have Dynaprobes. These percentages are based on 1,091 tanks for which this specific information was available.

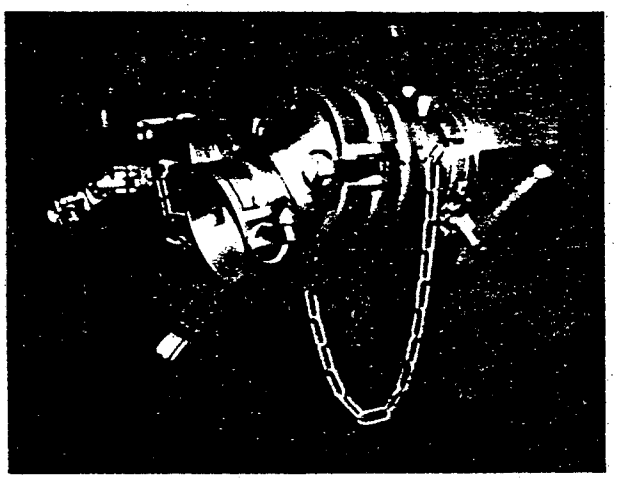
From comments received from the API and Fruehauf Corporation,[11,12] the percentage of jet level sensors in use appeared excessive. A review of the survey data showed that one large tank operator used jet level sensors exclusively and may have skewed the results. Further, the API[11] feels that less than 10 percent of tanks use jet level sensors. Furthermore, Fruehauf has experienced more interest in Dynaprobes and fiber optic systems than jet level sensors.[12]



BOTTOM LOAD ADAPTORS
ON MANIFOLD



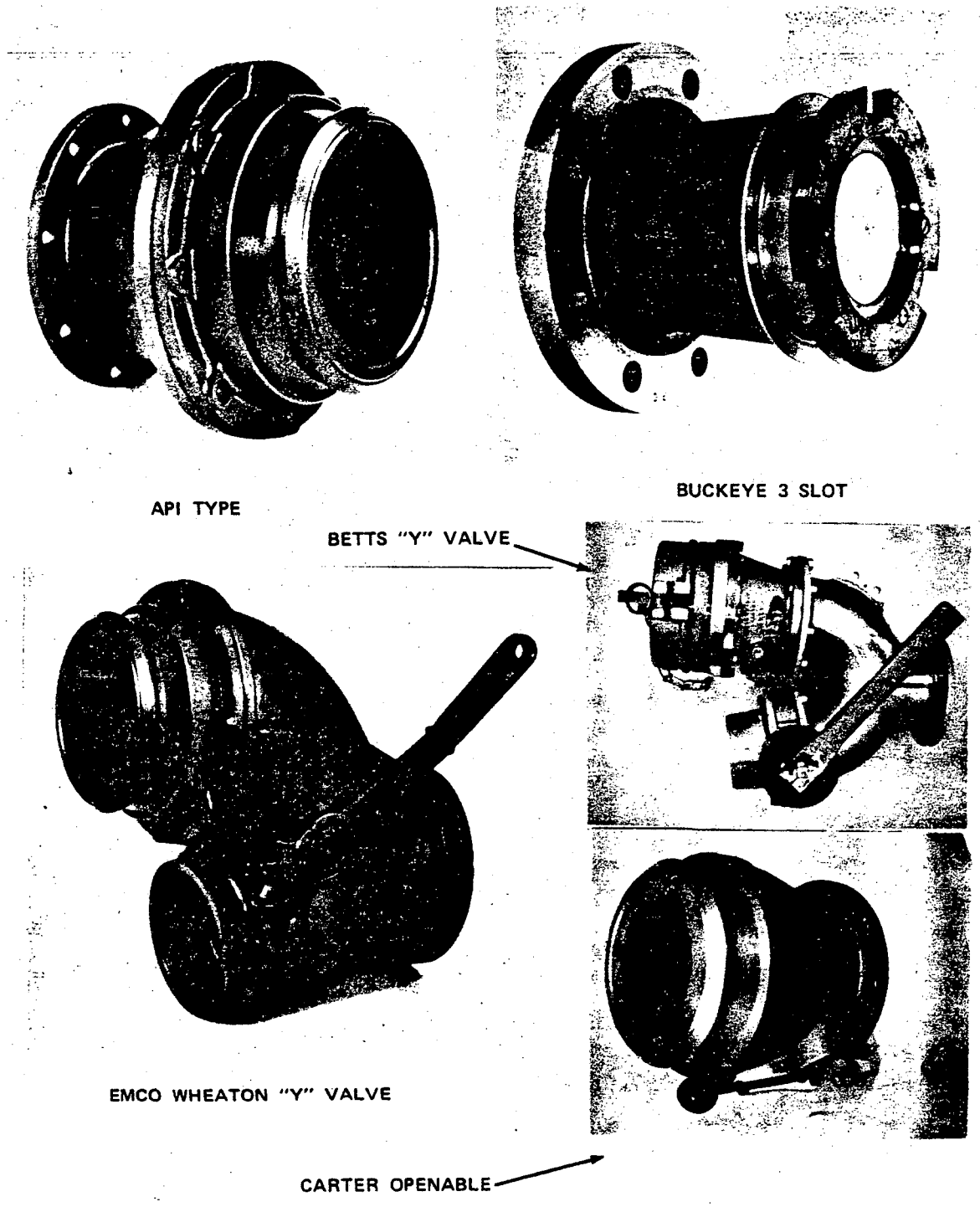
"Y" VALVES ON
INDIVIDUAL LINES



OPENABLE ADAPTORS ON
INDIVIDUAL LINES

COURTESY
THE HEIL CO.

Figure 2-4. Bottom Loading Discharge Arrangements




COURTESY
THE HEIL CO.

Figure 2-5. Bottom Load Adaptors

# 3.0 VAPOR RECOVERY SYSTEMS

PES conducted a telephone survey which included over 1,900 tanks owned by tank vehicle operators throughout the United States. Vapor recovery information was obtained for 1,446 tanks. Of these tanks, 70.5 percent were indicated to be fitted with vapor recovery systems. Assuming that those tanks without vapor recovery information did not contain a recovery system, over half the surveyed tanks would still have capability for vapor recovery. Thus, there are indications that a significant number of tanks have been retrofitted with vapor recovery capability.

## 3.1 TYPES OF VAPOR RECOVERY SYSTEMS

Four possible arrangements are described for the installation of vapor recovery systems on tank trucks.[13] Each of the vapor recovery systems is described in subsequent paragraphs.

The first arrangement consists of vapor recovery hoods equipped with vapor lines. They are usually manifolded to the right side of the overturn rail. A flange connection is installed on either end of the rail for connnection to the vapor collector. In the most common arrangement, the connection to the vapor collection line is at the rear of the tank. Other possible connections to vapor collectors can be made at the bottom of the tank. This requires a vapor line with a flange connection which runs through the tank from top to bottom (Figure 3-1).

The second arrangement is generally applied to tanks with single- or double-wall flashings. They are not completely welded at their attachment points. A 4 inch, or a U-shaped 3 inch vapor line is connected to the vapor recovery hood and is manifolded by a 4 inch pipe. The 4 inch pipe terminates at the rear of the tank with a vent valve and a vapor recovery valve. These valves are interlocked with one valve open, the other closed (Figure 3-2).

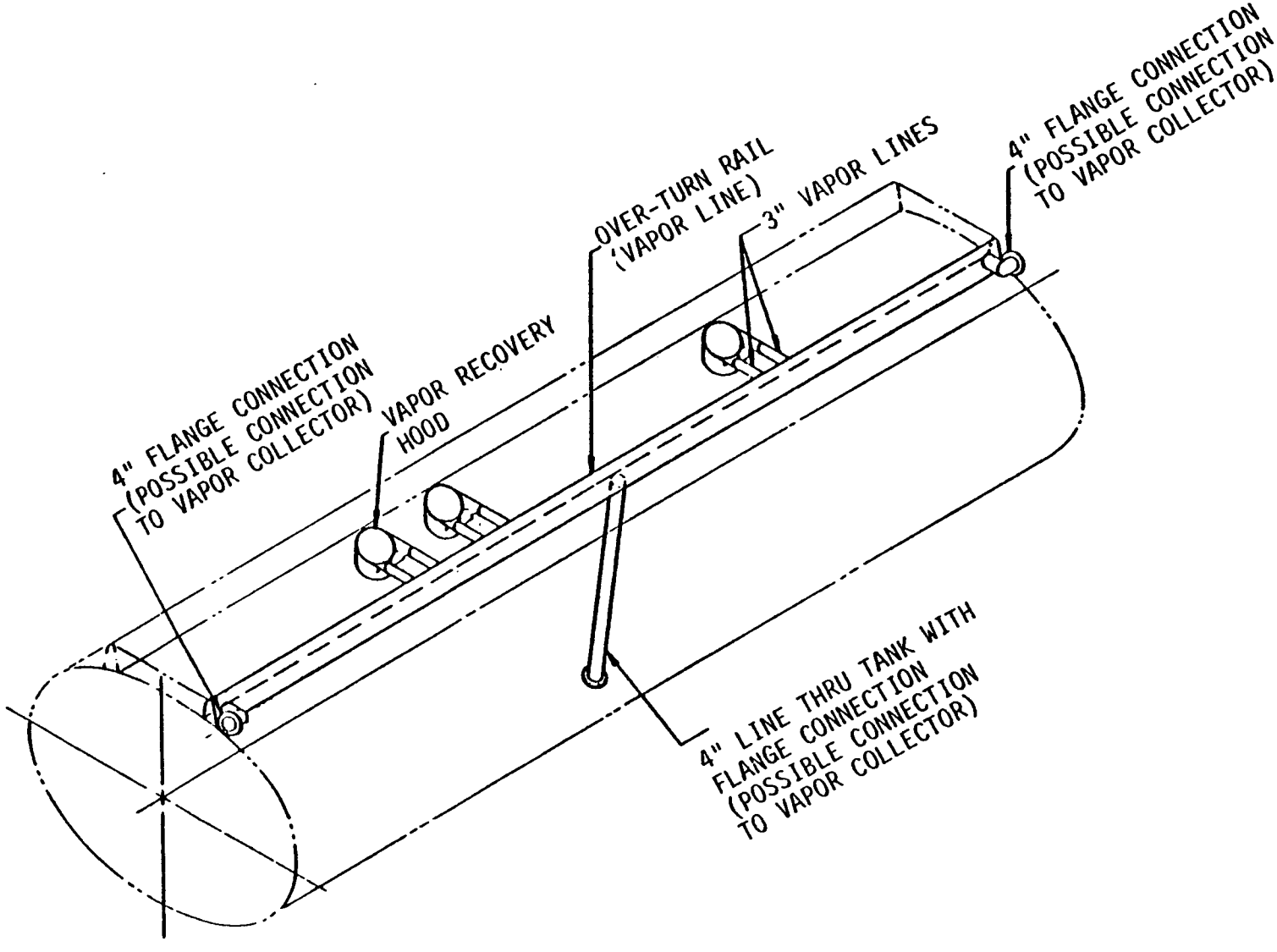



Figure 3-1. Vapor Recovery System Using Overturn Rail

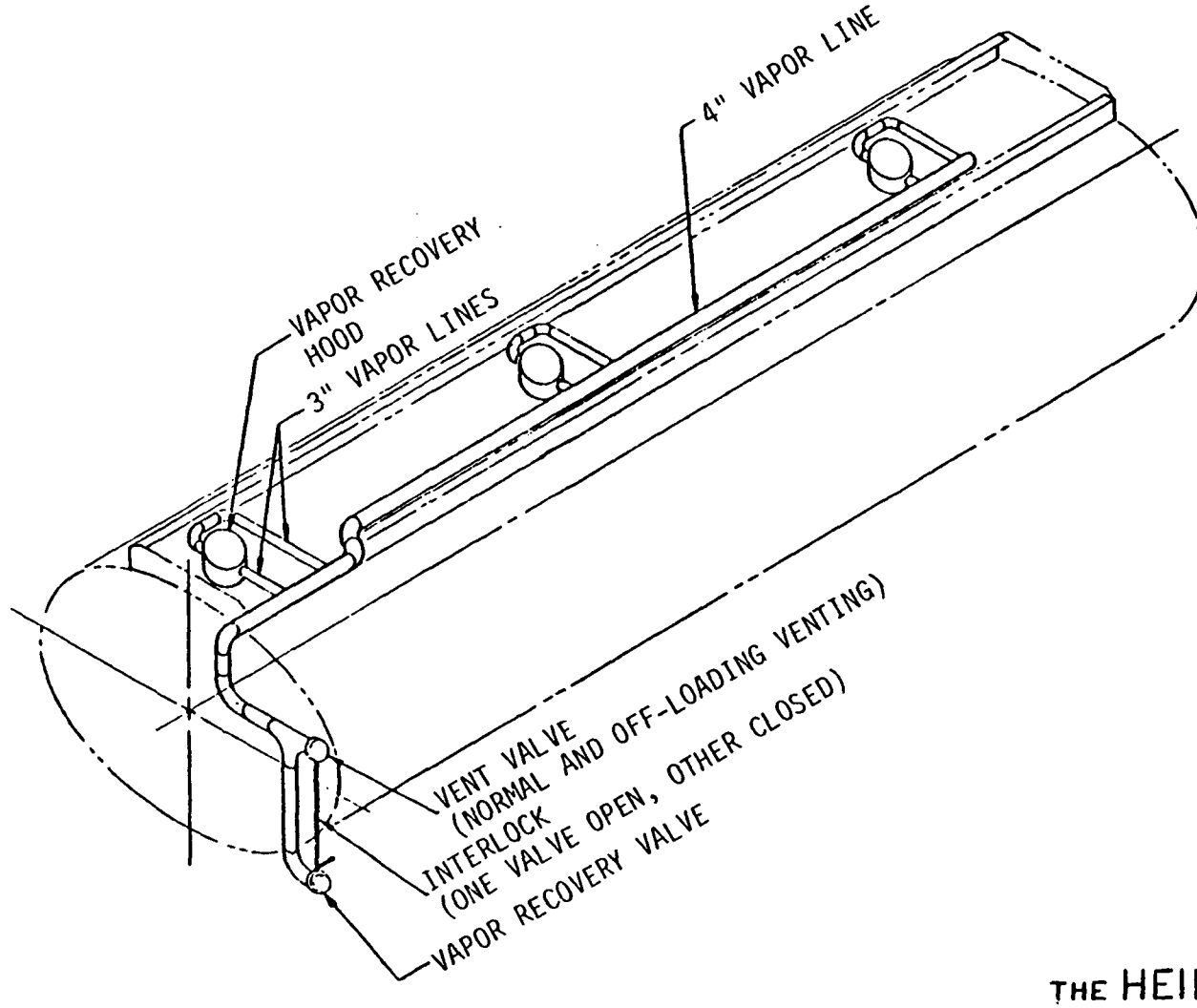



Figure 3-2. Vapor Recovery System, Overturn Rail Cannot Be Used as Vapor Conduit

The third arrangement employs both sides of the turnover rail as manifolded vapor lines. A channel ring around the tank is connected to the rails, and a flange connection is installed at the bottom. The flange connection connects to the vapor collector during loading operations (Figure 3-3).

The fourth arrangement also utilizes both sides of the rail as vapor lines. The vapor from each compartment is manifolded into the vapor collection compartment. This compartment is located at the rear of the tank. The vapor collection compartment is equipped with a vent on the top for normal venting and off-loading. A vapor recovery valve at the bottom connects to a vapor collector (Figure 3-4).

## 3.2 REQUIREMENTS FOR VAPOR RECOVERY SYSTEMS

### 3.2.1 EXISTING TANKS WITHOUT PROVISIONS FOR VAPOR RECOVERY

The equipment required for retrofitting the tank vehicle with vapor recovery depends on the existing tank equipment. If auxiliary vents are present, a vapor recovery hood is installed on each vent to recover vapor. If no vents are available or the existing vent does not meet requirements, then new vents are added. Vapor lines are connected to hoods and manifolded to turnover rails, or a separate tube is laid along the top of the tank, as shown in Figure 3-2. This main vapor collection pipe is routed along the curb side and terminates in a suitable coupling. The coupling must be closed or covered when not in use.

Recommended practices for bottom loading and vapor recovery for gasoline tank vehicles are provided by the American Petroleum Institute in their bulletin "Bottom Loading and Vapor Recovery for MC-306 Tank Motor Vehicles" (API RP 1004).[14]

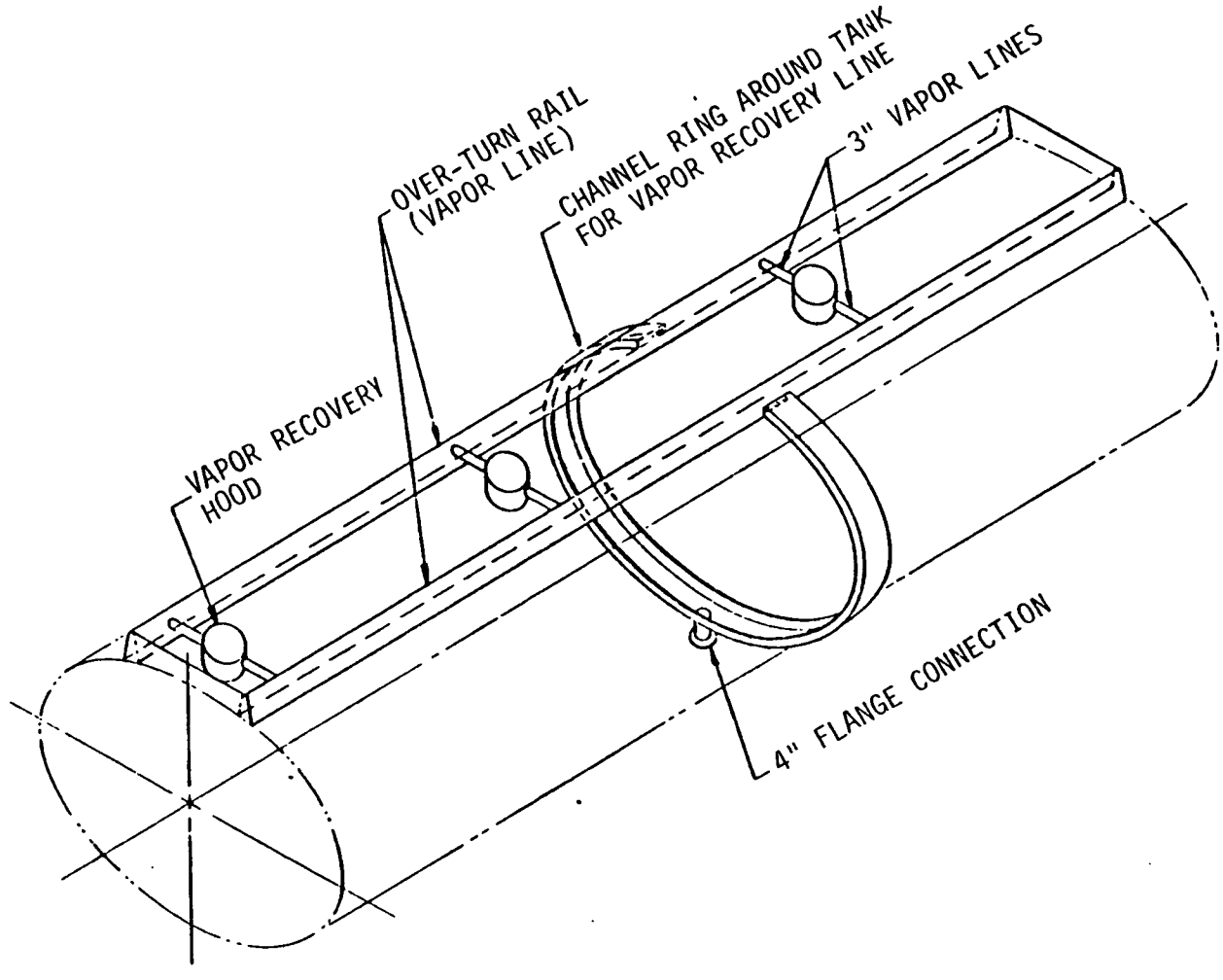



Figure 3-3. Vapor Recovery System, Channel Ring

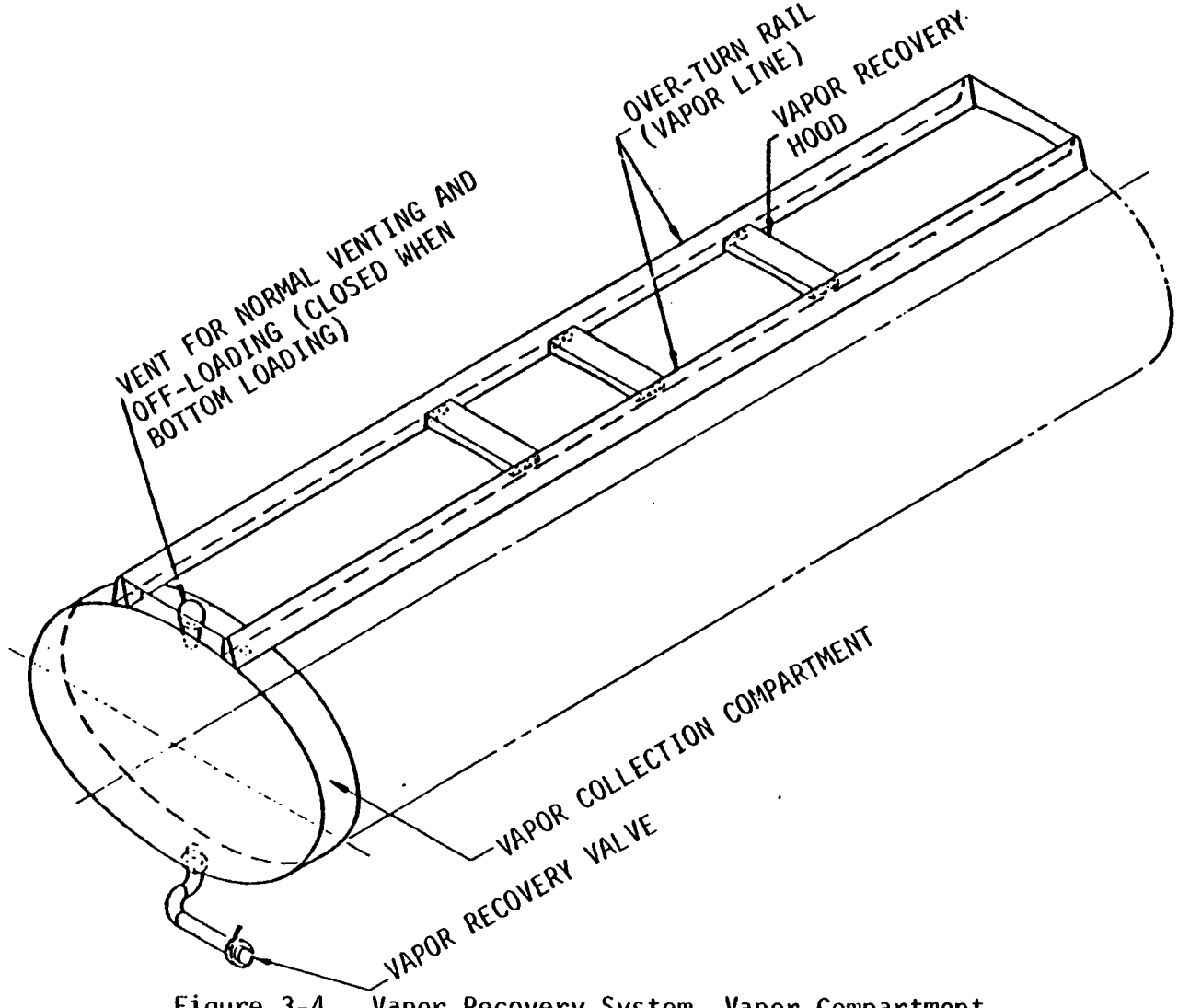



Figure 3-4. Vapor Recovery System, Vapor Compartment

THE HEIL CO

Most pre-1967 tanks require replacement of the old manhole cover by a current spring-loaded cover. These old covers are adjusted by the use of shims and are not generally leak tight. This requirement may create the need to enlarge the manhole to accept current manhole cover assemblies. Some older tanks do not have internal or emergency valves installed, or the configuration is such that the installation of this internal valve is difficult and time-consuming. These and other considerations make it more expensive to retrofit many pre-1967 tanks than tanks built more recently.

### 3.2.2 TANKS WITH RETROFIT PROVISIONS

Currently, most new tank vehicles delivered for gasoline use include provisions for bottom loading and vapor recovery. These include the installation of pilots and mounting brackets to facilitate the future installation of internal valves and secondary automatic shut-off devices. Blanked off ports are provided in the manhole covers and the overturn rail for easy addition of vapor hoods and piping. The liquid line is also blanked off for the future installation of loading adaptors. In effect, no welding or cutting of the tank will be required to retrofit newer tanks. As a result, the tank is easily and economically converted to bottom loading with vapor recovery systems and secondary automatic shut-off devices.

## 3.3 RETROFIT CONSIDERATION

Many factors are considered when a decision is made as to whether or not modification of equipment on an existing tank is the effective and economical way to meet requirements for gasoline marketing operations. Key factors in determining the economic advantages for purchasing a new tank are age and condition of the existing tank with respect to performance, safety, and repair costs.

# 4.0 COST ESTIMATES FOR TANK RETROFIT

## 4.1 CAPITAL COSTS

Equipment costs from the major tank truck equipment manufacturers are listed in Table 4-1. These costs are current listed prices. A certain percentage discount is generally given to oil companies, tank truck manufacturers, and carriers.

Associated labor costs for retrofitting the vehicle with bottom loading, vapor recovery system, and liquid level sensor are identified in Table 4-2 as a percentage of equipment cost.

Costs to convert existing top loading (open top) tanks to bottom loading with a vapor recovery system and secondary automatic shut-off depend on the construction of the tank and the type of components being installed. Both labor costs and the necessary equipment can be influenced by the tank construction. Some older tanks require extensive modification. Newer tanks, some fabricated up to 4 years ago, have provisions preinstalled to permit conversion to bottom loading and vapor recovery without welding or cutting.

Cost ranges for specific conversions are given in Table 4-3. Typical retrofit costs per compartment as a function of the age of the tank are presented in Table 4-4. Retrofitting cost differences between tank trucks and trailers are not significant.

## 4.2 MAINTENANCE COSTS

Maintenance costs for vapor recovery equipment are estimated by the National Tank Truck Carriers, Inc., to be nearly $500 per year for each tank. This value is estimated to be nearly 9 percent higher than the maintenance cost for tanks without vapor recovery equipment.[15]

Table 4-1. MANUFACTURER'S PRICE FOR TANK RETROFIT EQUIPMENT[a]

FOR BOTTOM LOADING

| Equipment | 1978 Cost ($) |
|---|---|
| Float Switch Controls | |
| With fixed shut-off level | 53.40 - 79.50 |
| With adjustable shut-off level | 58.97 - 79.55 |
| Vapor Vents | |
| Air actuated 3 inch | 145.39 - 146.55 |
| Air actuated 5 inch | 303.65 |
| Mechanically operated 3 inch | 131.66 - 145.45 |
| Mechanically operated 5 inch | 187.25 - 204.90 |
| Internal (Emergency) Valve | |
| Air actuated | 87.35 |
| Mechanically operated | 80.55 |
| Adaptors | |
| "Y" Valve | 300.00 - 450.00 |
| Openable | 202.20 - 249.23 |
| Adaptor on manifold | 97.75 - 123.50 |
| Pressure Actuated Manhole Cover | 75.00 |

FOR VAPOR RECOVERY

| Equipment | 1978 Cost ($) |
|---|---|
| Vapor Recovery Hood, P-V Vent and Vapor Recovery Lines | 250.00 |
| Drybreak | 150.00 |

[a] Sources: OPW, Emco Wheaton, Parker Hannifin

Table 4-2. INSTALLATION LABOR COSTS ESTIMATED AS A PERCENTAGE OF PURCHASED EQUIPMENT COST

| Conversion | Percent of Equipment Cost |
|---|---|
| Top load (open top) to Bottom load<br>Vapor recovery system<br>Liquid level sensor | 40 - 50 |
| Top load (open top) to Bottom load only | 30 |
| Top load (open top) to Top Tight Submerged fill | 30 |
| Installation of vapor recovery system (tank equipped with air/mechanically operated emergency valve) | 30 |
| Installation of emergency valves | 30 |

Source(s): Ruan Trucking Company, Des Moines, Iowa
Smith Tank & Equipment, Waco, Texas
Reliable Tank Company, Waco, Texas

The Heil Company, Wisconsin, estimates costs of $200 to $300 every 2 years for seal and gasket replacement and an additional $200 or more to replace internal valves and manholes in 8 to 10 years.[13] This could result in annual replacement costs of approximately $600 to $700. Since vapor recovery systems have not been used extensively for a sufficient duration, users of tanks equipped with vapor recovery were reluctant to provide estimates of maintenance costs.

Table 4-3. COST RANGES FOR SPECIFIED TANK CONVERSIONS

| Conversion | Dollars Per Compartment (includes Labor) | |
|---|---|---|
| | (Tank Manufacturers)[a] | (Tank Operators) |
| Open top to bottom load, vapor recovery, automatic shut-off | 900 - 2,000 | 800 - 2,000[b] |
| Open top to top tight submerged fill with vapor recovery | 700 - 750 | - |
| Open top to bottom load only | 300 - 400 | 420[c] |
| Installation of vapor recovery system | 450 - 750 | 320[c] |
| Installation of liquid level sensor (automatic shut-off) | 60 - 200 | 138[c] |

[a] Sources: J&L Tank, Weld-It, Clough Incorporated, Heil Company, Fruehauf Corporation, Smith Tool and Equipment, Emco Wheaton, Reliable Tank Company, Onnen Tank and Trailer, C&W Equipment.

[b] Sources: Western Marketing, Incorporated; Southern Fuel Distributors; Continental Oil; Rich Distributors; Rockwood Oil; Mid Continent; Ruan Trucking.

[c] Source: Ruan Trucking, Des Moines, Iowa

Table 4-4. TYPICAL COSTS TO RETROFIT TANKS OF DIFFERENT AGE GROUPS WITH BOTTOM LOADING AND VAPOR RECOVERY

| A g e | Equipment Cost | Percent Added for Labor | Total Cost per Compartment |
|---|---|---|---|
| Pre - 1967 | $1,160[a] | 50 | $1,740 |
| 1967 - 1975 | 1,085[b] | 40 | 1,520 |
| 1976 - 1978 | 445[c] | 30 | 580 |

[a] Equipment includes an adjustable shut-off level float switch, 5 inch air-actuated vent, Y valve, manhole cover and internal valve replacement, vapor recovery hood, P-V vent and vapor recovery lines. Add drybreak at $150 per tank.

[b] Equipment includes an adjustable shut-off level float switch, 5 inch air-actuated vent, air-actuated internal valve, Y valve, vapor recovery hood, P-V vents, and vapor recovery lines. Add drybreak at $150 per tank.

[c] Equipment includes an adjustable shut-off level float switch, Y valve, and vapor lines. Add drybreak at $150 per tank.

# 5.0 REFERENCES


1. "The 1978-1979 Tank Trucking Industry Market Report," Modern Bulk Transporter, Sutherland Publications, Inc., Washington, D.C.

2. U.S. Department of Commerce, Bureau of Census "1972 Census of Wholesale Trade, Methods of Receiving Bulk Liquid Products"

3. "Media and Market Fact File," Modern Bulk Transporter, Sutherland Publications, Inc., Washington, D.C.

4. "Petroleum Handling Systems and Components," Parker Hannifin, Irvine, California, 1973

5. Personal communication with Guinan, Ms. D.K., Association of American Railroads, Washington, D.C., October 1978

6. "Estimated Total Trailers in Use by Body Type," by Commercial Car Journal, June 1978

7. Personal communication with Richard J. McCarthy, Arthur D. Little, Inc., Cambridge, Massachusetts, October 1978

8. Personal communication with Dave Fellows, Heil Company, Milwaukee, Wisconsin, October 1978

9. National Petroleum News, Factbook Issue, June 1978

10. "The 1974-1975 Tank Trucking Industry Market Report," Modern Bulk Transporter, Sutherland Publications, Inc., Washington D.C.

11. Miller, W.M., American Petroleum Institute, Letter to S.A. Shedd of EPA, January 9, 1979

12. Botkin, L.A., Fruehauf Corporation, Letter to R.T. Walsh of EPA, December 22, 1978

13. Personal communication with Ken Williams, Heil Company, Milwaukee Wisconsin, October 1978

14. American Petroleum Institute, "Bottom Loading and Vapor Recovery for MC-306 Tank Motor Vehicles" (API RP 1004) Fourth ed., Washington, D.C., September 1977

15. Personal communication with Albert B. Rosenbaum III, National Tank Truck Carriers, Inc., September 1978

# APPENDIX

Table A-1. TRUCK TRAILER TANK SHIPMENTS[a]

| Year | Flammable Liquids | Total Tanks |
|---|---|---|
| 1977 | 3,099 | 8,766 |
| 1976 | 4,316 | 6,556 |
| 1975 | 3,093 | 4,875 |
| 1974 | 4,450 | 8,610 |
| 1973 | 3,041 | 6,211 |
| 1972 | 2,743 | 5,341 |
| 1971 | 2,572 | 4,736 |
| 1970 | 2,487 | 4,537 |
| 1969 | 2,757 | 5,114 |
| 1968 | 2,210 | 4,862 |
| 1967 | 2,927 | 7,197 |
| 1966 | 3,379 | 6,481 |
| 1965 | 2,936 | 5,359 |
| 1964 | 2,548 | 4,755 |
| 1963 | 3,452 | 5,777 |
| 1962 | 2,855 | 5,463 |
| 1961 | 2,639 | 4,855 |
| 1960 | 3,470 | 5,694 |
| 1959 | 4,542 | 6,976 |
| 1958 | 3,942 | 5,624 |
| 1957 | 4,610 | 6,354 |
| 1956 | 5,511 | 6,584 |
| 1955 | 5,125 | 5,843 |

[a] From tables compiled by Truck Trailer Manufacturers Association, Washington, D. C. (Original source: current industrial reports of U.S. Bureau of Census).

Table A-2. TANK VEHICLE SURVEY, PETROLEUM TANK TRUCKS OR COMBINATIONS[a]

| Code | State | (Year of Manufacture) 1941-1960 | 1961-1963 | 1964-1966 | 1967-1969 | 1970-1972 | Totals |
|---|---|---|---|---|---|---|---|
| 1 | Alabama | 7 | 5 | 18 | 19 | 21 | 70 |
| 2 | Alaska | 24 | 6 | 19 | 31 | 23 | 103 |
| 4 | Arizona | 10 | 7 | 7 | 6 | 8 | 38 |
| 5 | Arkansas | 3 | 3 | 10 | 22 | 21 | 59 |
| 6 | California | 34 | 14 | 12 | 25 | 9 | 94 |
| 8 | Colorado | 12 | 16 | 10 | 12 | 8 | 58 |
| 9 | Connecticut | 16 | 18 | 30 | 44 | 31 | 139 |
| 10 | Delaware | 10 | 12 | 11 | 22 | 20 | 75 |
| 11 | Washington, D.C. | 0 | 2 | 5 | 7 | 9 | 23 |
| 12 | Florida | 7 | 12 | 22 | 21 | 26 | 88 |
| 13 | Georgia | 7 | 14 | 16 | 30 | 27 | 94 |
| 15 | Hawaii | 26 | 4 | 3 | 10 | 6 | 49 |
| 16 | Idaho | 20 | 10 | 11 | 18 | 13 | 72 |
| 17 | Illinois | 10 | 16 | 22 | 38 | 27 | 113 |
| 18 | Indiana | 7 | 6 | 20 | 19 | 11 | 63 |
| 19 | Iowa | 17 | 7 | 21 | 42 | 27 | 114 |
| 20 | Kansas | 10 | 2 | 16 | 22 | 19 | 69 |
| 21 | Kentucky | 5 | 4 | 16 | 21 | 20 | 66 |
| 22 | Louisiana | 4 | 7 | 14 | 28 | 24 | 77 |
| 23 | Maine | 10 | 16 | 36 | 61 | 61 | 184 |
| 24 | Maryland | 11 | 9 | 16 | 14 | 12 | 62 |
| 25 | Massachusetts | 23 | 11 | 32 | 40 | 26 | 132 |
| 26 | Michigan | 4 | 6 | 8 | 21 | 25 | 64 |
| 27 | Minnesota | 28 | 11 | 18 | 42 | 45 | 144 |
| 28 | Mississippi | 6 | 6 | 17 | 30 | 21 | 80 |
| 29 | Missouri | 9 | 7 | 13 | 10 | 17 | 56 |
| 30 | Montana | 10 | 6 | 6 | 13 | 15 | 50 |
| 31 | Nebraska | 17 | 10 | 30 | 43 | 45 | 145 |
| 32 | Nevada | 31 | 6 | 11 | 8 | 8 | 64 |
| 33 | New Hampshire | 11 | 22 | 40 | 57 | 34 | 164 |
| 34 | New Jersey | 13 | 17 | 24 | 25 | 34 | 113 |
| 35 | New Mexico | 9 | 9 | 16 | 18 | 22 | 74 |
| 36 | New York | 31 | 24 | 31 | 52 | 48 | 186 |
| 37 | North Carolina | 10 | 15 | 30 | 50 | 37 | 142 |
| 38 | North Dakota | 7 | 3 | 5 | 19 | 4 | 38 |
| 39 | Ohio | 6 | 6 | 19 | 19 | 25 | 75 |
| 40 | Oklahoma | 12 | 12 | 23 | 26 | 25 | 98 |
| 41 | Oregon | 27 | 7 | 18 | 15 | 19 | 86 |
| 42 | Pennsylvania | 25 | 16 | 16 | 38 | 24 | 119 |
| 44 | Rhode Island | 35 | 27 | 35 | 41 | 30 | 168 |
| 45 | South Carolina | 16 | 12 | 28 | 30 | 21 | 107 |
| 46 | South Dakota | 9 | 10 | 15 | 22 | 17 | 73 |
| 47 | Tennessee | 3 | 5 | 17 | 25 | 33 | 83 |
| 48 | Texas | 18 | 18 | 26 | 51 | 52 | 165 |
| 49 | Utah | 17 | 11 | 15 | 20 | 22 | 85 |
| 50 | Vermont | 3 | 3 | 26 | 39 | 38 | 109 |
| 51 | Virginia | 6 | 7 | 19 | 26 | 27 | 85 |
| 53 | Washington | 14 | 4 | 7 | 7 | 4 | 36 |
| 54 | West Virginia | 10 | 14 | 13 | 17 | 14 | 68 |
| 55 | Wisconsin | 6 | 12 | 27 | 33 | 33 | 111 |
| 56 | Wyoming | 26 | 17 | 15 | 22 | 25 | 105 |
| | Totals | 692 | 524 | 935 | 1,371 | 1,213 | 4,735 |

[a] 1972 Census of Transportation Truck Inventory and Use Survey, U.S. Department of Commerce, Bureau of Census, 1973. Data retrieved for petroleum or petroleum products.

Table A-3. ESTIMATE OF NUMBERS OF VEHICLES IN AGE CATEGORIES

| | Tank Data | |
|---|---|---|
| | Year Built | Number |
| Vehicles surveyed by Census Bureau (petroleum products handling) | Pre-1967<br>1967 - 1972<br>Total | 2,151<br>2,584<br>4,735 |
| Adjusted total for 1972 (basis 75,000 tanks in flammable liquid service in 1972) | Pre-1967<br>1967 - 1972<br>total | 34,070<br>40,930<br>75,000 |
| Corrected for assumed depletion to 1977<br>20 percent<br>10 percent | Pre-1967<br>1967 - 1972<br>total | 27,300<br>36,800<br>64,100 |
| 1977 estimated total tanks<br>Tanks accounted for to 1972<br>Balance | | 97,800<br>64,100<br>33,700 |
| Estimated using direct ratios of tank trailer shipment data for the relevant years | 1973 - 1975<br>1976 - 1977 | 19,800<br>13,900 |

## TECHNICAL REPORT DATA
*(Please read Instructions on the reverse before completing)*

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16. ABSTRACT

This informational document provides the basic and current use of tank trucks and rail cars in the gasoline marketing industry. Information contained in this document includes population, type and age of equipment, industry trends and costs for retrofitting existing vehicles to bottom loading and/or vapor recovery.

17. KEY WORDS AND DOCUMENT ANALYSIS

| a. DESCRIPTORS | b. IDENTIFIERS/OPEN ENDED TERMS | c. COSATI Field/Group |
|---|---|---|
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