TCEQ REGULATORY GUIDANCE
Air Permits Division
RG-657 ● September 2025

Tank Truck Loading of Petroleum Liquids

The transportation and marketing of petroleum liquids involve many distinct operations, each of which represents a potential source of evaporation loss. Crude oil or condensate is transported from oil and gas sites to a refinery by tankers, barges, rail tank cars, tank trucks, and pipelines.

Loading losses are the primary source of evaporative emissions from rail tank car, tank truck, and marine vessel operations (for marine loading please review Air Permit Technical Guidance for New Source Review Loading Operations, APD-ID 3v1[1]). Loading losses occur as organic vapors in "empty" cargo tanks are displaced to the atmosphere by the liquid being loaded into the tanks. These vapors are a composite of:

- Vapors formed in the empty tank by evaporation of residual product from previous loads,
- Vapors transferred to the tank in vapor balance systems as product is being unloaded, and
- Vapors generated in the tank as the new product is being loaded.

The quantity of evaporative losses from loading operations is, therefore, a function of the following parameters:

- Physical and chemical characteristics of the previous cargo,
- Method of unloading the previous cargo,
- Operations to transport the empty carrier to a loading terminal,
- Method of loading the new cargo, and
- Physical and chemical characteristics of the new cargo.

Tank truck loading operations can be divided into three general categories:

- atmospheric trucks,
- pressure trucks, and
- pressure trucks used in atmospheric service.

Generally, simple clamp style "quick connects" are used for atmospheric tank truck loading connections. Hard-piped connections that are bolted or flanged to the receiving vessel are required for pressure tank truck loading. Tank trucks must be leak checked and certified annually for the associated collection efficiency to be claimed.

[1] www.tceq.texas.gov/downloads/permitting/air/guidance/nsr/loading-guidance.pdf/view

Tank Truck Loading Authorizations

All stationary facilities, or groups of facilities, at a site which handle gases and liquids associated with the production, conditioning, processing, and pipeline transfer of fluids or gases found in geologic formations on or beneath the earth's surface including, but not limited to, crude oil, natural gas, condensate, and produced water that satisfy the general conditions of Title 30, Texas Administrative Code (30 TAC), Section 106.4, and the specific conditions of 30 TAC Section 106.352 are permitted by rule.

For all new projects and dependent facilities not located in the Barnett Shale counties, the current 106.352 subsection (l) is applicable, which contains the previous requirements of 106.352.

For projects located in one of the Barnett Shale counties which are constructed or modified on or after April 1, 2011, subsections (a)-(k) apply.

Other permits by rule which may be used for tank truck loading but are not commonly seen are 106.261, 106.262, 106.472, and 106.473.

If a site does not qualify for a PBR, it may be authorized by a standard permit. Sites constructed prior to April 1, 2011, may be authorized using the Oil and Gas Standard Permit (30 TAC 116.620, effective Jan. 11, 2000). For sites in one of the Barnett Shale counties constructed or modified on or after April 1, 2011, the site is subject to the requirements of the Air Quality Standard Permit for Oil and Gas Handling and Production Facilities.

Section I: Emission Calculations

Loading Loss Equation

Loading calculations are listed in AP-42, Chapter 5, Section 5.2: Transportation and Marketing of Petroleum Liquids[2].

Emissions from loading petroleum liquid can be estimated (with a probable error of ±30 percent) using the following equation:

$$L_L = 12.46\frac{SPM}{T}$$

Where:

- LL = loading loss, pounds per 1000 gallons (lb/103 gal) of liquid loaded
- S = a saturation factor (see Table 5.2-1 in AP-42, Chapter 5, Section 5.2, and the discussion below)
- P = true vapor pressure of liquid loaded, pounds per square inch absolute (psia) (see Section 7.1, "Organic Liquid Storage Tanks" of AP-42)
- M = molecular weight of vapors, pounds per pound-mole (lb/lb-mole) (see Section 7.1, "Organic Liquid Storage Tanks" of AP-42)

[2] www.epa.gov/air-emissions-factors-and-quantification/ap-42-fifth-edition-volume-i-chapter-5-petroleum-1

- T = temperature of bulk liquid loaded, °R (°F + 460)

Short-term emission rates should be estimated by using the maximum expected vapor pressure and temperature of the compound being loaded and the maximum expected pumping rate being used to fill the container (loading tank truck). Annual emissions should be estimated by using the average annual temperature and corresponding vapor pressure of the compound and the expected annual throughput of the compound.

We recommend using a maximum temperature of 95°F or the maximum operating temperature (whichever is greater) and corresponding vapor pressure of the compound being loaded to calculate short-term emissions. If the maximum temperature is less than 95°F, please provide detailed justification for the maximum temperature and corresponding vapor pressure used in short-term emission rate calculation.

Saturation Factor

Submerged tank truck loading is the minimum level of control required. The two types of submerged loading are the submerged fill pipe method and the bottom loading method. In the submerged fill pipe method, the fill pipe extends almost to the bottom of the cargo tank. In the bottom loading method, a permanent fill pipe is attached to the cargo tank bottom. During most of submerged loading by both methods, the fill pipe opening is below the liquid surface level. Liquid turbulence is controlled significantly during submerged loading, resulting in much lower vapor generation than encountered during splash loading.

The saturation factor, S, represents the expelled vapor's fractional approach to saturation, and it accounts for the variations observed in emission rates from the different unloading and loading methods. The loading calculation requires the use of a saturation factor (S factor) listed in Table 5.2-1[3], Saturation (S) Factors for Calculating Petroleum Liquid Loading Losses.

The S factor of 0.6 should be used if the tank truck is in "dedicated normal service." Dedicated normal service means the tank truck is used to transport only one product or products with similar characteristics, such as petroleum products with similar API gravity, molecular weight, or vapor pressure.

Submerged loading: dedicated normal service, S factor = 0.6

An S factor of 1.0 should be used if the loading vapors are returned back to the tank truck when it is unloaded to a storage tank or other vessel.

Submerged loading: dedicated vapor balance, S factor = 1.0

[3] www.epa.gov/air-emissions-factors-and-quantification/ap-42-fifth-edition-volume-i-chapter-5-petroleum-1

Capture/Collection Techniques and Efficiency

The overall reduction efficiency should account for the capture efficiency of the collection system as well as both the control efficiency and any downtime of the control device. Measures to reduce loading emissions include selection of alternate loading methods and application of vapor recovery equipment.

Not all of the displaced vapors reach the control device, because of leakage from both the tank truck and collection system. The following are the acceptable capture or collection efficiencies to be used in the emission calculations:

- 70% capture or collection efficiency for trucks that are not leak tested.
- 98.7% capture or collection efficiency for trucks that are leak-tested based on EPA standards (NSPS Subpart XX).
- 99.2% capture or collection efficiency for trucks that pass MACT-level annual leak test—not more than a 1-inch water column pressure change in five minutes after pressurizing to 18 inches of water followed by pulling a vacuum of 6 inches water.
- 100% capture or collection efficiency if a blower system is installed, which will produce a vacuum in the tank truck during all loading operations. A pressure or vacuum gauge shall be installed on the suction side of the loading rack blower system adjacent to the truck being loaded to verify a vacuum in that vessel. Loading shall not occur unless there is a vacuum of at least a 1.5-inch water column being maintained by the vacuum-assist vapor collection system when loading trucks. The vacuum shall be recorded every 15 minutes during loading.

Uncollected Loading Emissions

Uncollected loading emissions are referred to as loading fugitives and are listed as a separate emission point or source. Uncollected loading emissions (L_{LF}) can be estimated using the following expression:

$$L_{LF} = (L_L) \times \frac{(1 - Collection\ Efficiency)}{100}$$

Control Techniques and Control Efficiencies

Emissions from controlled loading operations can be calculated by multiplying the uncontrolled emission rate calculated in the loading loss equation (L_L) by an overall reduction efficiency term:

$$Emissions = (L_L) \times \frac{(Collection\ Efficiency)}{100} \times \frac{(1 - Control\ Efficiency)}{100}$$

- Flares – Flares must meet the applicable state and/or federal requirements in order to claim the associated control efficiency.
- Thermal Oxidizers – must be designed for the variability of the waste gas stream and basic monitoring which consists of temperature monitoring that indicates the device is achieving a satisfactory minimum temperature. Justification needs to be provided for control efficiencies claimed > 99%.

- Carbon Systems – Control efficiency is a function of the breakthrough concentration. The carbon system must have an alarm system that will prevent breakthrough.
- Vapor Recovery Units (VRU) – Can claim up to 100% control. Designed systems claiming 100% control must submit the requirements found in the Vapor Recovery Unit Capture/Control Guidance[4].

Note: Vapor balancing is NOT a form of control; it is only a capture technique.

Sample Calculation:

Annual Loading Losses

The following example is based on truck loading 5,500,000 gallons of crude oil (RVP 5) per year at a loading rack. It is submerged loading with dedicated normal service. The true average vapor pressure of the liquid loaded is 3.4 psia; the vapor molecular weight is 50 lb/lbmol; and the annual average temperature of the bulk liquid loaded is 70°F.

$$L_L = 12.46 \frac{SPM}{T}$$

Where:

- S = 0.6 for submerged loading, dedicated normal service
- P = 3.4 psia
- M = 50 lb/lb-mol
- T = 530°R (70°F)

$$L_L = 12.46 \frac{(0.6)(3.4)(50)}{530} = 2.4\ lb/10^3\ gallons\ liquid\ loaded$$

Total annual crude oil uncontrolled emissions =

$$\frac{(2.40\ lb)}{(1000\ gal)} \times \frac{(5{,}500{,}000\ gal)}{yr} \times \frac{ton}{(2000\ lb)} = 6.60\ tons/yr$$

Assume loading into trucks that are leak-tested based on NSPS Subpart XX with capture efficiency of 98.7% and captured emissions are routed to a flare with a control efficiency of 98%.

Annual uncollected loading loss emissions (at the loading terminal) =

$$(6.60\ tons/yr) \times (1 - 0.987) = 0.09\ tons/yr$$

Annual controlled loading loss emissions =

$$(6.60\ tons/yr) * (0.987) * (1 - 0.98) = 0.13\ tons/yr$$

Short-Term Loading Losses

Use the maximum filling rate, maximum temperature and corresponding true vapor pressure to calculate the maximum short-term emissions. At 100°F, the maximum vapor pressure is 5.70 psia. At this terminal, 50,000 gallons of crude oil (RVP 5) can be loaded in one hour.

[4] www.tceq.texas.gov/permitting/air/newsourcereview/chemical/oil_and_gas_sp.html

$$L_L = 12.46\,\frac{(0.6)(5.70)(50)}{560} = 3.80\ lb/\ 10^3\ gallons\ liquid\ loaded$$

Total short term uncontrolled emissions =

$$\frac{(3.80\ lb)}{(1000\ gal)} \times \frac{(50{,}000\ gal)}{hr} = 190\ lb/hr$$

Assume loading into trucks that are leak tested based on NSPS Subpart XX with capture efficiency of 98.7% and captured emissions are routed to flare with control efficiency of 98%.

Short-term uncollected loading loss emissions (at the loading terminal) =

$$(190\ lb/hr\ ) * (1 - 0.987) = 2.47\ lb/hr$$

Short-term controlled loading loss emissions =

$$(190\ lb/hr) * (0.987) * (1 - 0.98) = 3.75\ lb/hr$$