

GASOLINE STORAGE AND DISPENSING

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PROCESS DESCRIPTION:

Gasoline storage and dispensing operations, also referred to as Gasoline Dispensing Facilities (GDFs), at retail service stations, as well as non-retail (private) dispensing facilities, release gaseous vapors containing both Volatile Organic Compounds (VOCs), other products of combustion criteria pollutants, and toxic air contaminants (TACs) into the atmosphere. These emissions occur during underground storage tank loading, breathing, spillage, vehicle refueling, and hose permeation and some of the controls such as afterburners or incinerators used to combust the VOCs prior to release into the atmosphere. Emission rates are highly dependent upon the installation and performance of Phase I and Phase II vapor recovery equipment and associated controls. Also Onboard Refueling Vapor Recovery (ORVR) is an emission control system that captures fuel vapors from the vehicle gas tanks during vehicle refueling operations. The primary components of gasoline vapor are benzene, hexane, toluene, xylenes, and a mixture of other nonmethane hydrocarbons, collectively referred to as VOCs. Actual vapor concentrations of each component may vary depending upon the composition and temperature of the gasoline.

Emission estimation techniques are based upon values published by the EPA (AP-42), California Air Resources Board (CARB), and the San Diego Air Pollution Control District. Annual emissions are assumed to be proportional to annual throughputs. Maximum hourly emissions are assumed to occur during bulk loading of the underground tanks combined with simultaneous vehicle fueling. The standard District estimation techniques for emission inventory purposes are as follows.

CARB has set control requirements based on tank type, operations type, and tank capacity as follows:

- Standing Loss Control (SLC) is required for tanks with a capacity of 250 gallons or greater.
- Phase I Enhanced Vapor Recovery (EVR) is required at retail GDFs with a capacity of 260 gallons or greater and at non-retail GDFs with a capacity greater than 550 gallons.
- Phase II is required at retail GDFs with a capacity of 250 gallons or more and where more than 2,000 gallons are transferred into motor vehicle tanks in any calendar month.
- Phase II is required at non-retail GDFs with a capacity greater than 550 gallons and where more than 2,000 gallons are transferred into motor vehicle tanks in any calendar month.
- Phase II EVR is required for sites with remote dispensing meeting the above criteria for Phase II.

Underground Storage Tanks (USTs)

$$E_a = U_a \times E_{Ft} \times C_i$$

$$E_h = T \times E_{Fh} \times C_i$$

Where:

$$E_a = \text{Annual emissions of gasoline vapor } \left(\frac{\text{lb}}{\text{year}} \right)$$

$$E_h = \text{Hourly emissions of gasoline vapor } \left(\frac{\text{lb}}{\text{hour}} \right)$$

$$U_a = \text{Annual gasoline throughput } \left(\frac{\text{Kgal}}{\text{year}} \right)$$

T = One hour bulk gasoline delivery (Kgal)

E_{Ft} = Combined emission factor: refueling, loading, breathing, spillage, & hose permeation $\left(\frac{\text{lb}}{\text{Kgal}} \right)$

E_{Fh} = Phase I bulk transfer loss factor $\left(\frac{\text{lb}}{\text{Kgal}} \right)$

C_i = Concentration of each listed substance in the gasoline vapor $\left(\frac{\text{lb}}{\text{lb}} \right)$

Table 1 – Uncontrolled and Controlled Emission Factors for GDFs With USTs

Category	Uncontrolled lb/Kgal	Pre- EVR lb/Kgal	EVR lb/Kgal
Phase II Fueling (Refueling)			
Non-ORVR Vehicles	8.4	2.4	0.42
ORVR Vehicles	0.42	0.12	0.021
Phase I Bulk Transfer Losses (Loading)	7.7	0.38	0.15
Pressure Driven Losses (Breathing)	0.76	0.092	0.024
Spillage	0.61	0.42	0.24
Hose Permeation	0.062	0.062	0.062

Notes:

Emission Factors from CARB's 'Revised Emission Factors for Gasoline Marketing Operations at California Gasoline Dispensing Facilities', December 23, 2013.

Aboveground Storage Tanks (ASTs)

$$E_a = \left\{ U_a \times E_{Ft} + \left[\left(\frac{T_C}{2} \right) \times 365 \times E_{Fsl} \right] \right\} \times C_i$$

$$E_h = T \times E_{Fh} \times C_i$$

Where:

$$E_a = \text{Annual emissions of gasoline vapor } \left(\frac{\text{lb}}{\text{year}} \right)$$

$$E_h = \text{Hourly emissions of gasoline vapor } \left(\frac{\text{lb}}{\text{hour}} \right)$$

$$U_a = \text{Annual gasoline throughput } \left(\frac{\text{Kgal}}{\text{year}} \right)$$

T = One hour bulk gasoline delivery (Kgal)

T_C = Tank Capacity (Kgal)

E_{Fsl} = Emission factor for pressure driven losses $\left(\frac{lb}{Kgal}\right)$

E_{Ft} = Combined emission factor: refueling, loading, spillage, & hose permeation $\left(\frac{lb}{Kgal}\right)$

E_{Fh} = Phase I bulk transfer loss factor $\left(\frac{lb}{Kgal}\right)$

C_i = Concentration of each listed substance in the gasoline vapor $\left(\frac{lb}{lb}\right)$

Table 2 – Emission Factors for GDFs With ASTs

Category	SLC Only lb/Kgal	Phase I EVR lb/Kgal	Phase II Pre-EVR lb/Kgal	Phase II EVR lb/Kgal
Phase II Fueling (Refueling)	8.4	8.4	0.63	0.38
Phase I Bulk Transfer Losses (Loading)	8.4	0.15	0.15	0.15
Pressure Driven Losses (Breathing) New Tanks	0.57	0.57	0.57	0.57
Pressure Driven Losses (Breathing) Retrofit Tanks	2.26	2.26	2.26	2.26
Spillage	0.61	0.61	0.42	0.24
Hose Permeation	0.062	0.062	0.062	0.062

Notes:

Emission Factors from CARB’s CP-206, Certification Procedures for Vapor Recovery Systems at Gasoline Dispensing Facilities Using Aboveground Storage Tanks, Amended July 25, 2019

Underground Storage Tank Sites with Bulk & Vehicle Dispensing

For fixed roof gasoline storage facilities used as bulk terminal distribution points the following emission factors best approximate release.

Table 3 – Emission Factors for GDFs With USTs with Bulk & Vehicle Dispensing

Category	Pre-EVR lb/Kgal
Non-ORVR Vehicles	2.4
Tanker Reloading	0.38
Phase I Bulk Transfer Losses (Loading)	0.38
Pressure Driven Losses (Breathing)	0.092
Spillage	0.42
Hose Permeation	0.062

Notes:

Emission Factors from CARB’s ‘Revised Emission Factors for Gasoline Marketing Operations at California Gasoline Dispensing

Facilities', December 23, 2013.

Gasoline speciation is based on the EPA NESHAPS Document for the Gasoline Distribution Industry and the CAPCOA Industry wide Risk Assessment Guidelines.

Table 4 – Gasoline Constituents (Percent by Weight)

Gasoline Speciation Data	Weight % Vapor	Weight % Liquid
Benzene	0.4 %	1.0 %
Ethyl Benzene	0.1 %	1.6 %
Hexane, Isomers of	1.4 %	1.8 %
Toluene	1.1 %	8.0 %
Xylene, Isomers of	0.4 %	2.4 %
2,2,4-Trimethylpentane	0.7 %	0.8 %

ASSUMPTIONS / LIMITATIONS:

- Emission factors are based on the level of installed controls with no adjustment for specific makes and models. Annual emissions are based on the gasoline throughput over the reporting period utilizing the specific emission factors for underground tank loading, breathing, vehicle refueling, spillage, and hose permeation.
- Maximum hourly emissions are assumed to occur during loading of the underground tanks combined with simultaneous vehicle fueling. Tank ullage, which is the volume left empty in the tank during loading, is assumed to be 50% of the tank's capacity.
- Emissions of organic vapors containing listed substances from tanks storing diesel, distillate oil, kerosene, jet fuel, motor oil, lubricants, machining oils, and residual oil are assumed to be below reporting levels. Aviation gas, however, should be considered equivalent to gasoline unless site specific information indicates otherwise. (Please note that combustion products of some types of Aviation Gas used in small planes may include lead, as well.)
- Bulk storage gasoline terminals with floating and fixed roof tanks, vapor processors, and tanker truck loading racks should not be evaluated with these estimation techniques. Separate calculation procedures have been developed for these processes and equipment.