

USER'S GUIDE

to

TANKS 5.0

Storage Tank Emissions Calculation Application
Version 5.0

February 2024

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Office of Air Quality Planning and Standards
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1.0 Introduction

The TANKS application is designed to estimate air emissions from organic liquids and petroleum distillates in storage tanks. The United States (U.S.) Environmental Protection Agency's (EPA) Office of Air Quality Planning and Standards (OAQPS) develops and maintains emissions estimating tools to support Federal, State, and local agencies, consultants, and industry with estimating air emissions from various sources. This manual provides general use instructions for the TANKS application. It is not intended to document how to estimate air emissions from storage tanks. Documentation of emission factors and calculations used to estimate air emissions can be found in "Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources" (AP-42), Section 7.1, Organic Liquid Storage Tanks.

TANKS allows users to enter specific information about a storage tank (dimensions, construction, paint condition, etc.), the liquid contents (chemical components and liquid temperature), and the meteorological conditions and location of the tank (nearest city, ambient temperature, etc.) to generate an air emissions report. Report features include estimates of monthly, annual, or partial year emissions for each chemical or mixture of chemicals stored in the tank.

Version 5.0 of TANKS, hereafter referred to as TANKS 5.0, represents an upgrade to all previous versions of the software and includes several new features and revisions to maintain consistency with EPA emissions calculation methodologies and to respond to users' comments.

Please note that the emissions estimating equations that form the basis of the TANKS 5.0 software program were developed by the American Petroleum Institute (API). API retains the copyright to these equations. API has granted permission for the nonexclusive, noncommercial distribution of this material to governmental and regulatory agencies. However, API reserves its rights regarding all commercial duplication and distribution of its material. Therefore, the TANKS application is available for public use, but the program cannot be sold without written permission from API and the U.S. EPA.

2.0 Accessing TANKS 5.0

TANKS 5.0 is available here: <https://www.tanks.app.cloud.gov>

More information about TANKS 5.0, including frequently asked questions, is available here: <https://www.epa.gov/air-emissions-factors-and-quantification/tanks-emissions-estimation-software-version-50>

AP-42 Chapter 7 is available here: <https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-fifth-edition-volume-i-chapter-7-liquid-storage-0>.

3.0 Tank Data

The “Tank Data” page includes a description, links to references and resources, a summary of tanks that you have created or imported, and the form to create a new tank.

Select “Tank Data,” as shown by the red oval in Figure 1:

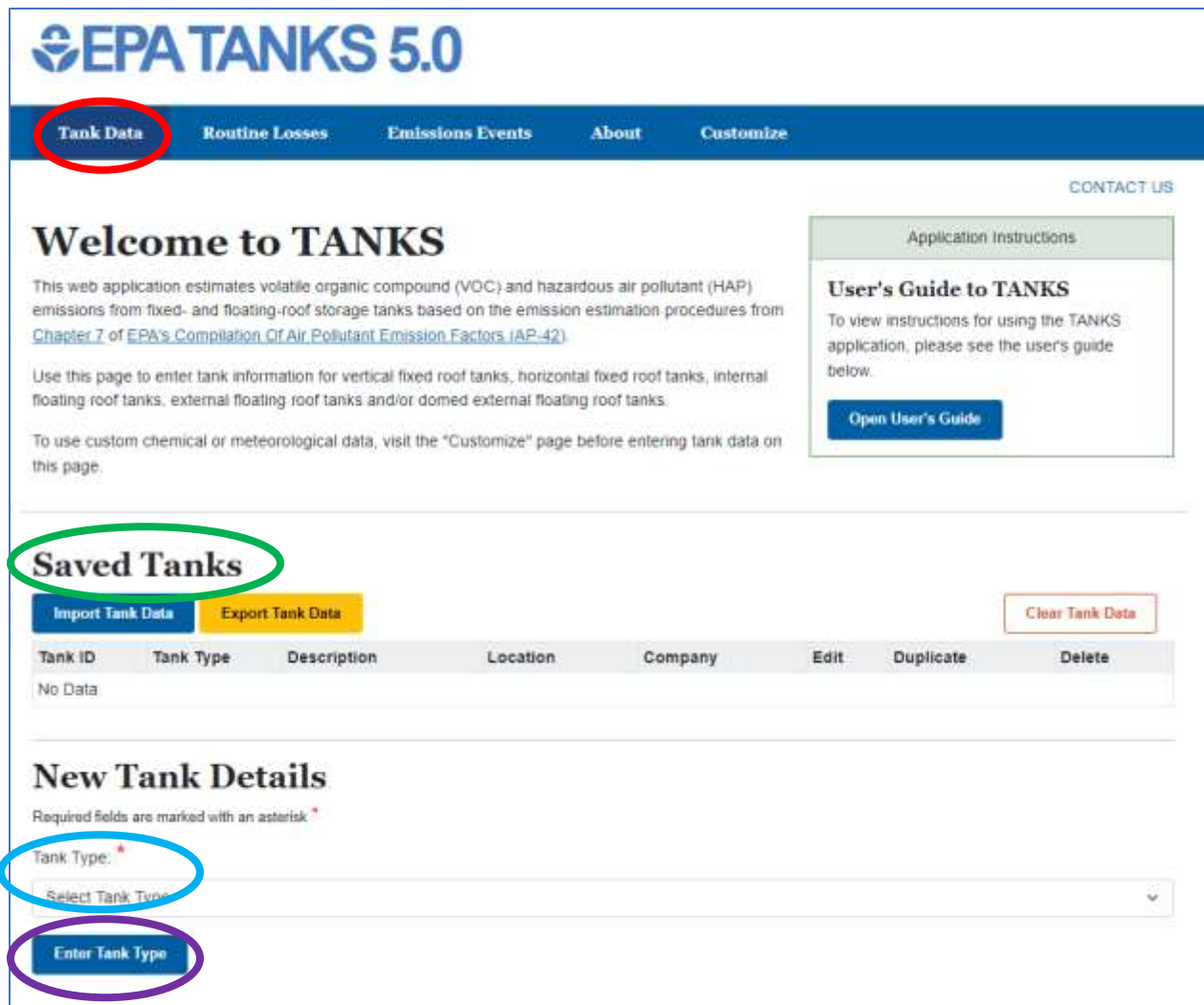


Figure 1. Screenshot of TANKS 5.0 “Tank Data” page

3.1 Import Tank Data

If you have previously worked with tank data, saved the exported tank data file to your computer, and want to edit the data or generate emissions reports, select “Import Tank Data.” Open the appropriate folder and choose the file you want to import into TANKS 5.0.

Once imported, those tanks will be listed underneath “Saved Tanks” (see green oval in Figure 1). Note that importing tank data replaces the entire tank data library and all custom data.

See Section 3.4 “Export Tank Data” to export data (or save) from TANKS 5.0 to your computer. TANKS 5.0 does not store your data within the application, all data is stored within your browser’s local storage. The data will remain within your browser until you clear your local storage. In order to save your data long term, you should export your tank data to your computer.

3.2 Adding New Tanks

If you have no previously saved storage tanks or want to create a new set of tanks, tanks can be created using the form below the “New Tank Details” heading. First, choose the appropriate “Tank Type” underneath “New Tank Details” (see blue oval in Figure 1) from the following list:

- Vertical Fixed Roof Tank
- Horizontal Fixed Roof Tank
- Internal Floating Roof Tank
- External Floating Roof Tank
- Domed Floating Roof Tank

Then, click the “Enter Tank Type” button (see purple oval in Figure 1) to proceed with creating the selected type of tank.

If you want to use custom data that are not included in AP-42 Chapter 7, such as custom organic liquids, custom petroleum liquids, custom mixtures, or custom meteorological data, see Section 6.0 “Customize” before you begin adding new tanks.

Regardless of the tank type selected, there are three sections to complete: (1) Identification (*e.g.*, name and location); (2) Characteristics (*e. g.*, shell height, shell diameter, roof characteristics, tank/shell color, and deck fittings); and (3) Contents (*e.g.*, organic or petroleum liquids stored in your tank, sum of increases/decreases in liquid level, and throughput). The section headings can be expanded or collapsed by clicking on them (only one section will be expanded at a time). The input fields for the Identification and Contents sections are the same for all tank types, but the input fields for the Characteristics section vary by tank type. Required input fields are indicated with a red asterisk.

3.2.1 Identification

- 1) Tank Identification
 - a) Tank ID
 - b) Tank Description
 - c) Tank City
 - d) Tank State
 - e) Company
- 2) Meteorological Data
 - a) Meteorological Location
 - Custom Locations (See Section 6.0 “Customize” for guidance on adding custom meteorological data)
 - AP-42 Meteorological Locations

3.2.2 Tank Characteristics by Tank Type

Each tank type has slightly different characteristics. See Section 3.2.3 for the definitions of each characteristic. Note that the temperatures on the Tank Data page are in degrees Rankine (°R). To convert temperatures in degrees Fahrenheit (°F) to °R, add 459.67 to the temperature in °F.

3.2.2.1 Vertical Fixed Roof Tanks

These tanks consist of cylindrical shells with permanently affixed roofs; the tank axis is perpendicular to the foundation. The fixed roof may be dome-shaped, cone-shaped, or flat. Vertical fixed roof tank shells are usually constructed of steel.

- 1) Tank Characteristics
 - a) Tank Shape
 - i) Cylinder
 - ii) Rectangle
 - iii) Square
 - b) Shell Height (feet [ft])
 - c) Shell Diameter (ft)
 - d) Maximum Liquid Height (ft)
 - e) Average Liquid Height (ft)
 - f) Tank Bottom Type
 - i) Flat or Nominally Flat Bottom
 - o Liquid Heel Type
 1. Full Liquid Heel
 - Liquid Heel Height (ft)
 2. No Liquid Heel
 - ii) Cone-Shaped Bottom

- Cone-Shaped Bottom Slope (ft/ft)
 - Liquid Heel Type
 1. Full Liquid Heel
 - Height of Liquid at the Tank Shell (ft)
 2. Partial Liquid Heel
 - Vertical Distance from the Bottom of the Shell Down to the Liquid Surface (ft)
 3. No Liquid Heel
 - g) Vapor Space Pressure at Normal Operating Conditions (pounds per square inch gauge [psig])
 - h) Is Tank Insulated?
 - i) Fully Insulated
 - Is Tank Heated?
 1. Heated
 - a. Typical Maximum Liquid Bulk Temperature in Heating Cycle (degrees Rankine [°R])
 - b. Typical Average Liquid Bulk Temperature in Heating Cycle (°R)
 - c. Typical Minimum Liquid Bulk Temperature in Heating Cycle (°R)
 - d. Number of Heating Cycles per Year
 2. Not Heated
 - Liquid Bulk Temperature Calculation Method
 - a. User Input
 - Liquid Bulk Temperature (°R)
 - b. AP-42 Calculation (using Equation 1-31 of AP-42 Chapter 7)
 - ii) Partially Insulated
 - Liquid Bulk Temperature Calculation Method
 1. User Input
 - Liquid Bulk Temperature (°R)
 2. AP-42 Calculation (using Equation 1-31 of AP-42 Chapter 7)
 - iii) Not Insulated
 - Liquid Bulk Temperature Calculation Method
 1. User Input
 - Liquid Bulk Temperature (°R)
 2. AP-42 Calculation (using Equation 1-31 of AP-42 Chapter 7)
- 2) Shell Characteristics
 - a) Shell Color/Shade (see AP-42 Chapter 7; Table 7.1-6)
 - b) Shell Condition
 - i) New
 - ii) Average
 - iii) Aged
- 3) Roof Characteristics
 - a) Roof Color/Shade (see AP-42 Chapter 7; Table 7.1-6)
 - b) Roof Condition
 - i) New

- ii) Average
- iii) Aged
- c) Roof Type
 - i) Cone
 - Tank Cone Roof Slope (ft/ft)
 - ii) Dome
 - Tank Dome Roof Radius (ft)
 - iii) Flat
- 4) Breather Vent Settings
 - a) Vacuum Setting (psig)
 - b) Pressure Setting (psig)
- 5) Control Device Settings
 - a) Is Tank Equipped with a Control Device?
 - i) Control Device
 - Control Device Efficiency (%)
 - ii) No Control Device

3.2.2.2 Horizontal Fixed Roof Tanks

These tanks are constructed for both above ground and underground storage with the axis parallel to the foundation. Horizontal fixed roof shells may be steel, steel with a fiberglass overlay, or fiberglass-reinforced polyester.

- 1) Tank Characteristics
 - a) Shell Length (ft)
 - b) Shell Diameter (ft)
 - c) Maximum Liquid Height (ft)
 - d) Minimum Liquid Height (ft)
 - e) Vapor Space Pressure at Normal Operating Conditions (psig)
 - f) Is Tank Insulated or Underground?
 - i) Fully Insulated or Underground
 - Is Tank Heated?
 - (a) Heated
 - (i) Typical Maximum Liquid Bulk Temperature in Heating Cycle (°R)
 - (ii) Typical Average Liquid Bulk Temperature in Heating Cycle (°R)
 - (iii) Typical Minimum Liquid Bulk Temperature in Heating Cycle (°R):
 - (iv) Number of Heating Cycles per Year
 - (b) Not Heated
 - (i) Liquid Bulk Temperature Calculation Method
 - 1. User Input
 - Liquid Bulk Temperature (°R)
 - 2. AP-42 Calculation (using Equation 1-31 of AP-42 Chapter 7)

- ii) Partially Insulated
 - Liquid Bulk Temperature Calculation Method
 - (a) User Input
 - Liquid Bulk Temperature (°R)
 - (b) AP-42 Calculation (using Equation 1-31 of AP-42 Chapter 7)
 - iii) Not Insulated and Not Underground
 - Liquid Bulk Temperature Calculation Method
 - (a) User Input
 - Liquid Bulk Temperature (°R)
 - (b) AP-42 Calculation (using Equation 1-31 of AP-42 Chapter 7)
- 2) Shell Characteristics
 - a) Shell Color/Shade (see AP-42 Chapter 7; Table 7.1-6)
 - b) Shell Condition
 - i) New
 - ii) Average
 - iii) Aged
 - 3) Breather Vent Settings
 - a) Vacuum Setting (psig)
 - b) Pressure Setting (psig)
 - 4) Control Device Settings
 - Is Tank Equipped with a Control Device?
 - i) Control Device
 - Control Device Efficiency (%)
 - ii) No Control Device

3.2.2.3 Internal Floating Roof Tanks

This type of tank has both a permanent fixed roof and a floating deck.

- 1) Tank Characteristics
 - a) Shell Diameter (ft)
 - b) Shell Height (ft)
 - c) Tank Bottom Type
 - i) Flat or Nominally Flat Bottom
 - Liquid Heel Type
 - (a) Full Liquid Heel
 - Liquid Heel Height (ft)
 - (b) No Liquid Heel
 - ii) Cone-Shaped Bottom
 - Cone-Shaped Bottom Slope (ft/ft)
 - Liquid Heel Type
 - (i) Full Liquid Heel
 - Height of Liquid at the Tank Shell (ft)

- (ii) Partial Liquid Heel
 - Vertical Distance from the Bottom of the Shell Down to the Liquid Surface (ft)
 - (iii) No Liquid Heel
 - d) Internal Shell Condition
 - i) Light Rust
 - ii) Dense Rust
 - iii) Guniting Lining
 - e) External Shell Color/Shade (see AP-42 Chapter 7; Table 7.1-6)
 - f) External Shell Condition
 - i) New
 - ii) Average
 - iii) Aged
 - g) Roof Color/Shade (see AP-42 Chapter 7; Table 7.1-6)
 - h) Roof Paint Condition
 - i) New
 - ii) Average
 - iii) Aged
 - i) Liquid Bulk Temperature Calculation Method
 - i) User Input
 - Liquid Bulk Temperature (°R)
 - ii) AP-42 Calculation (using Equation 1-31 of AP-42 Chapter 7)
- 2) Tank Construction and Rim Seal System
- a) Tank Construction
 - i) Riveted
 - ii) Welded
 - b) Self Supporting Roof?
 - i) Yes
 - ii) No
 - (1) Number of Columns
 - (2) Effective Column Diameter
 - (a) 9 inch by 7 inch built-up column
 - (b) 8 inch diameter pipe
 - (c) Unknown
 - c) Primary Seal
 - i) Mechanical Shoe
 - ii) Liquid-mounted
 - iii) Vapor-mounted
 - d) Secondary Seal
 - i) None
 - ii) Rim-mounted
 - e) Seal Fit
 - i) Average-fitting
 - ii) Tight-fitting

- 3) Deck Characteristics
 - a) Deck Type
 - i) Bolted
 - (1) Deck Construction
 - (a) Sheet
 - Deck Seam
 - 1. Sheet: 5 ft wide
 - 2. Sheet: 6 ft wide
 - 3. Sheet: 7 ft wide
 - 4. Custom
 - Sheet Width (ft)
 - (b) Panel
 - Deck Seam
 - 1. Panel: 5 by 7.5 ft
 - 2. Panel: 5 by 12 ft
 - 3. Custom
 - Panel Length (ft)
 - Panel Width (ft)
 - ii) Welded
- 4) Deck Fittings and Count of Each Deck Fitting (see AP-42 Chapter 7, Table 7.1-12)
 - a) Access Hatch
 - b) Fixed Roof Support Column Well
 - c) Unslotted Guidepole and Well
 - d) Slotted Guidepole/Sample well
 - e) Gauge-float Well (Automatic Gauge)
 - f) Gauge-hatch/Sample Port
 - g) Vacuum Breaker
 - h) Deck Drain
 - i) Deck Leg
 - j) Deck Leg or Hanger (No opening through deck)
 - k) Rim Vent
 - l) Ladder Well
 - m) Ladder-slotted Guidepole Combination Well

3.2.2.4 External Floating Roof Tanks

This type of tank consists of a cylindrical steel shell equipped with a roof that floats on the surface of the stored liquid.

- 1) Tank Characteristics
 - a) Shell Diameter (ft)
 - b) Shell Height (ft)

- c) Tank Bottom Type
 - i) Flat or Nominally Flat Bottom
 - Liquid Heel Type
 - (a) Full Liquid Heel
 - Liquid Heel Height (ft)
 - (b) No Liquid Heel
 - ii) Cone-Shaped Bottom
 - Cone-Shaped Bottom Slope (ft/ft)
 - Liquid Heel Type
 - 1. Full Liquid Heel
 - Height of Liquid at the Tank Shell (ft)
 - 2. Partial Liquid Heel
 - Vertical Distance from the Bottom of the Shell Down to the Liquid Surface (ft)
 - 3. No Liquid Heel
 - d) Internal Shell Condition
 - i) Light Rust
 - ii) Dense Rust
 - iii) Gunite Lining
 - e) External Shell Color/Shade (see AP-42 Chapter 7; Table 7.1-6)
 - f) External Shell Condition
 - i) New
 - ii) Average
 - iii) Aged
 - g) Roof Color/Shade (see AP-42 Chapter 7; Table 7.1-6)
 - h) Roof Paint Condition
 - i) New
 - ii) Average
 - iii) Aged
 - i) Liquid Bulk Temperature Calculation Method
 - i) User Input
 - Liquid Bulk Temperature (°R)
 - ii) AP-42 Calculation
 - (1) Using Equation 2-11 of AP-42 Chapter 7 for double deck roofs or
 - (2) Using Equation 2-8 of AP-42 Chapter 7 for pontoon deck roofs
- 2) Tank Construction and Rim Seal System
- a) Tank Construction
 - i) Riveted
 - (1) Primary Seal
 - Mechanical Shoe
 - (2) Secondary Seal
 - (a) None
 - (b) Weather shield
 - (c) Rim-mounted

- (3) Seal Fit
 - Average-fitting
 - ii) Welded
 - (1) Primary Seal
 - (a) Mechanical Shoe
 - (b) Liquid-mounted
 - (c) Vapor-mounted
 - (2) Secondary Seal
 - (a) None
 - (b) Weather shield
 - (c) Rim-mounted
 - (3) Seal Fit
 - (a) Average-fitting
 - (b) Tight-fitting
- 3) Deck Characteristics
 - a) Deck Type
 - Welded
 - b) Roof Type
 - i) Double-deck
 - ii) Pontoon
- 4) Deck Fittings and Count of Each Deck Fitting (see AP-42 Chapter 7, Table 7.1-12)
 - a) Access Hatch
 - b) Unslotted Guidepole and Well
 - c) Slotted Guidepole/Sample well
 - d) Gauge-float Well (automatic gauge)
 - e) Gauge-hatch/Sample Port
 - f) Vacuum Breaker
 - g) Deck Drain
 - h) Deck Leg (Pontoon area of pontoon roofs)
 - i) Deck Leg (Double-deck roofs and center area of pontoon roofs)
 - j) Deck Leg or Hanger (No opening through deck)
 - k) Rim Vent

3.2.2.5 Domed External Floating Roof Tanks

This type of tank is typically an external floating roof tank that has been retrofit with a domed fixed roof.

- 1) Tank Characteristics
 - a) Shell Diameter (ft)
 - b) Shell Height (ft)
 - c) Tank Bottom Type

- i) Flat or Nominally Flat Bottom
 - Liquid Heel Type
 - (a) Full Liquid Heel
 - Liquid Heel Height (ft)
 - (b) No Liquid Heel
 - ii) Cone-Shaped Bottom
 - Cone-Shaped Bottom Slope (ft/ft)
 - Liquid Heel Type
 - (i) Full Liquid Heel
 - Height of Liquid at the Tank Shell (ft)
 - (ii) Partial Liquid Heel
 - Vertical Distance from the Bottom of the Shell Down to the Liquid Surface (ft)
 - (iii) No Liquid Heel
 - d) Internal Shell Condition
 - i) Light Rust
 - ii) Dense Rust
 - iii) Guniting Lining
 - e) External Shell Color/Shade (see AP-42 Chapter 7; Table 7.1-6)
 - f) External Shell Condition
 - i) New
 - ii) Average
 - iii) Aged
 - g) Roof Color/Shade (see AP-42 Chapter 7; Table 7.1-6)
 - h) Roof Paint Condition
 - i) New
 - ii) Average
 - iii) Aged
 - i) Liquid Bulk Temperature Calculation Method
 - i) User Input
 - (1) Liquid Bulk Temperature (°R)
 - ii) AP-42 Calculation (using Equation 1-31 of AP-42 Chapter 7)
- 2) Tank Construction and Rim Seal System
- Tank Construction
 - i) Riveted
 - (1) Primary Seal
 - Mechanical Shoe
 - (2) Secondary Seal
 - (a) None
 - (b) Weather shield
 - (c) Rim-mounted
 - (3) Seal Fit
 - Average-fitting
 - ii) Welded

- (1) Primary Seal
 - (a) Mechanical Shoe
 - (b) Liquid-mounted
 - (c) Vapor-mounted
- (2) Secondary Seal
 - (a) None
 - (b) Weather shield
 - (c) Rim-mounted
- (3) Seal Fit
 - (a) Average-fitting
 - (b) Tight-fitting
- 3) Deck Characteristics
 - a) Deck Type
 - Welded
 - b) Roof Type
 - i) Double-deck
 - ii) Pontoon
- 4) Deck Fittings and Count of Each Deck Fitting (see AP-42 Chapter 7, Table 7.1-12)
 - a) Access Hatch
 - b) Unslotted Guidepole and Well
 - c) Slotted Guidepole/Sample well
 - d) Gauge-float Well (automatic gauge)
 - e) Gauge-hatch/Sample Port
 - f) Vacuum Breaker
 - g) Deck Drain
 - h) Deck Leg (Pontoon area of pontoon roofs)
 - i) Deck Leg (Double-deck roofs and center area of pontoon roofs)
 - j) Deck Leg or Hanger (No opening through deck)
 - k) Rim Vent

3.2.3 Definitions of Tank Characteristics

Average Liquid Height. This is the average height in feet of the liquid within the tank shell. This must be less than or equal to the maximum liquid height. The average liquid height is used in the standing storage loss calculations.

Deck Construction. This applies only to bolted decks. Choose either Sheet or Panel from the drop-down list.

Deck Fittings. These are shown in Table 7.1-12 of AP-42 Chapter 7.

Deck Roof Type. Choose Double-deck or Pontoon from the drop-down menu.

Deck Seam. Based on the choice of Deck Construction, choose the appropriate deck seam from the drop-down menu. Typical deck seam length factors are shown in Table 7.1-16 of AP-42 Chapter 7.

Deck Type. Deck Type is either Welded or Bolted. Bolted is only used for Internal Floating Roof Tanks.

Effective Column Diameter. This is the average column diameter in feet. Once you choose the type of column from the drop-down menu, TANKS 5.0 will use the correct column diameter. As shown in Section 7.1.3.2 of AP-42 Chapter 7, the column diameter is equal to 1.1 feet for 9 x 7 inch built-up columns, 0.7 feet for 8-inch diameter pipe columns, and 1.0 feet if no column construction details are known.

External Shell Color/Shade. This is the color and shade combination of the paint on the shell of the tank (i.e., the sides). To view the list of available options, use the drop-down menu. If the shell paint color does not appear on the list of options, choose the color/shade combination that most closely approximates it. If the shell color is unknown, use White as the default.

External Shell Condition. This is the condition of the paint on the external tank shell. To view the list of available options, use the drop-down menu. If the shell paint condition is unknown, use Average.

Internal Shell Condition. This is the condition of the paint on the internal tank shell. To view the list of available options, use the drop-down menu. If the tank is sludge-lined, choose Guniting Lining.

Is Tank Heated? If the tank is regulated such that the ambient temperature conditions are not the sole factors that affect the surface temperature of the liquid, answer “Yes” to this question.

Liquid Bulk Temperature Calculation Method. You can either enter the liquid bulk temperature or choose “AP-42 Calculation” and TANKS 5.0 will calculate the liquid bulk temperature using the appropriate equation in AP-42 Chapter 7.

Liquid Heel Type. The choices are Full Liquid Heel, Partial Liquid Heel, and No Liquid Heel.

Maximum Liquid Height. This is the maximum height in feet of the liquid within the tank shell, measured from the bottom of the tank shell. This must be less than or equal to the shell height.

Minimum Liquid Height. This is the minimum height in feet of the liquid within the tank shell.

Net Throughput. This is the annual net throughput in gallons per year. If the net throughput of the tank is measured in barrels, you may convert barrels to gallons by multiplying the number of barrels by 42.

Pressure Setting. This is the storage tank pressure setting in psig. The pressure setting must be between 0 and 1 psig. The default pressure setting is 0.03 psig.

Primary Seal. Primary rim seals close the annular space between the edge of the floating roof and the tank wall. There are three basic types of rim seals in use on internal floating roof tanks: mechanical shoe, liquid mounted, and vapor mounted. Both are resilient-filled nonmetallic seals. If no specific information is available, a welded tank with an average-fitting mechanical-shoe primary seal can be used to represent the most common or typical construction and rim-seal system in use for external and domed external floating roof tanks. If no specific information is available, a welded tank with an average-fitting vapor-mounted primary seal can be used to represent the most common or typical construction and rim-seal system in use for internal floating roof tanks. See Table 7.1-8 of AP-42 Chapter 7.

Mechanical Shoe Seal -- A metallic shoe seal.

Liquid Mounted -- A seal that is mounted in contact with the liquid in the tank.

Vapor Mounted -- A seal that is mounted a few inches above the liquid in the tank.

Roof Color/Shade. This is the color and shade combination of the paint on the roof. To view the list of available options, use the drop-down menu. The color/shade combination must be chosen from this list, since these are the only combinations for which there are paint factors in Table 7.1-6 of AP-42 Chapter 7. If the color of the roof paint does not appear on the list of options, use the color/shade combination that most closely approximates it. If the roof color is unknown, choose White.

Roof Paint Condition. This is the condition of the paint on the tank roof, from Table 7.1-6 of AP-42 Chapter 7. To view the list of available options, use the drop-down menu. If the roof paint condition is unknown, choose Average.

Roof Height. This is the height of the tank roof in feet, not including the tank shell itself (the vertical distance from the top of the shell to the top of the roof).

Roof Radius. This is the radius in feet of the arc of a domed roof. This field is used only for tanks which have a domed roof. The tank dome roof radius typically varies between a minimum of (0.8 x tank diameter) and a maximum of (1.2 x tank diameter). If the roof radius is not known, assume the dome roof radius is equivalent to the shell diameter.

Roof Slope. This is the slope of a cone roof in feet/feet. The program will calculate this value based on height and diameter values. This only applies if the roof is cone-shaped. Assume a value of 0.0625 ft/ft if the roof slope is unknown.

Roof Type. The roof type may be either Dome or Cone. Choose either using the drop-down menu.

Secondary Seal. There are three options for secondary seals: rim-mounted, shoe mounted (when mechanical shoe seals are identified as primary seals), and none. Choose the appropriate option from the drop-down menu.

Seal Fit. Choose Average-fitting or Tight-fitting from the drop-down menu. Tight-fitting seals are only available for welded tanks.

Self Supporting Roof. Most fixed roof tanks converted to an internal floating roof tank will have columns. Newly constructed internal floating roof tanks may be of either type. Tanks with columns have marginally higher emissions because of evaporation of liquid that clings to the column surface area.

Shell Color/Shade. This is the color and shade combination of the paint on the shell of the tank (i.e., the sides). To view the list of available options, use the drop-down menu. The color/shade combination must be chosen from the available options, since these are the only combinations for which there are paint factors in AP-42 Chapter 7. If the shell paint color does not appear on the list of options, choose the color/shade combination that most closely approximates it. If the shell color is unknown, use White as the default.

Shell Condition. This is the condition of the paint on the tank shell. To view the list of available options, use the drop-down menu. If the shell paint condition is unknown, use Average as the default condition.

Shell Diameter. This is the width in feet of a vertical, cylindrical shell. This is usually at least 5 feet.

Shell Height. This is the actual height of the tank in feet.

Shell Length. This is the total length of the tank shell in feet. The length of the tank is usually less than six times the diameter to ensure structural integrity.

Tank Bottom Type. The choices are Flat or Nominally Flat or Cone-Shaped Bottom.

Tank Construction. The choices are Riveted or Welded.

Tank Shape. The choices are Cylinder, Rectangle, or Square. This determines how the standing and working losses are determined for fixed roof tanks.

Vacuum Setting. This is the storage tank vacuum setting in pounds per square inch gauge (psig). The vacuum setting must be between 0 and -1 psig. The program will automatically change the value of the number from positive to negative. The default vacuum setting is -0.03 psig. Note that the fixed roof tank emissions estimation procedures do not apply to low- or high-pressure tanks.

Vapor Space Pressure. The pressure at normal operating conditions within the fixed roof tank. The approximate range of pressures is from zero (atmospheric pressure) to 15 psig.

3.2.4 Contents

3.2.4.1 Fixed Roof Tanks

Input Type

- 1) Enter Annual Values
 - a) Chemical Category of Liquid
 - i) AP-42 Organic Liquids (Table 7.1-3 of AP-42 Chapter 7)
 - Sum of Increases in Liquid Level Method
 - (a) User Input
 - (i) Chemical Name
 - (ii) Annual Sum of Increases in Liquid Level (ft/yr)
 - (b) AP-42 Calculation (using Equation 1-37 of AP-42 Chapter 7)
 - (i) Chemical Name
 - (ii) Annual Throughput (gal/yr)
 - ii) Custom Organic Liquids (See Section 6.0 “Customize” for guidance on adding custom organic liquids)
 - Sum of Increases in Liquid Level Method
 - (a) User Input
 - (i) Chemical Name
 - (ii) Annual Sum of Increases in Liquid Level (ft/yr)
 - (b) AP-42 Calculation (using Equation 1-37 of AP-42 Chapter 7)
 - (c) Chemical Name
 - (d) Annual Throughput (gal/yr)
 - iii) AP-42 Petroleum Liquids (Table 7.1-2 of AP-42 Chapter 7)
 - Sum of Increases in Liquid Level Method
 - (1) User Input
 - (a) Chemical Name
 - (i) Annual Sum of Increases in Liquid Level (ft/yr)
 - (b) AP-42 Calculation (using Equation 1-37 of AP-42 Chapter 7)
 - (i) Chemical Name
 - (ii) Annual Throughput (gal/yr)
 - iv) Custom Petroleum Liquids (See Section 6.0 “Customize” for guidance on adding custom petroleum liquids)
 - Sum of Increases in Liquid Level Method
 - (a) User Input

- (i) Chemical Name
 - (ii) Speciation Option
 - 1. None
 - 2. Partial Speciation
 - Components to Speciate
 - 3. Full Speciation
 - (iii) Annual Sum of Increases in Liquid Level (ft/yr)
 - (b) AP-42 Calculation (using Equation 1-37 of AP-42 Chapter 7)
 - (i) Chemical Name
 - (ii) Speciation Option
 - 1. None
 - 2. Partial Speciation
 - Components to Speciate
 - 3. Full Speciation
 - (iii) Annual Throughput (gal/yr)
- v) Custom Mixtures (See Section 6.0 “Customize” for guidance on adding custom mixtures)
 - Sum of Increases in Liquid Level Method
 - (a) User Input
 - (i) Chemical Name
 - (ii) Speciation Option
 - 1. None
 - 2. Partial Speciation
 - Components to Speciate
 - 3. Full Speciation
 - (iii) Annual Sum of Increases in Liquid Level (ft/yr)
 - (b) AP-42 Calculation (using Equation 1-37 of AP-42 Chapter 7)
 - (i) Chemical Name
 - (ii) Speciation Option
 - 1. None
 - 2. Partial Speciation
 - Components to Speciate
 - 3. Full Speciation
 - (iii) Annual Throughput (gal/yr)
- b) Working Loss Turnover Factor (K_N) Method
 - i) Set to 1
 - ii) AP-42 Calculation
 - (1) for turnovers > 36 , $K_N = (180 + N)/6N$, where N is the number of turnovers per year
 - (2) for turnovers ≤ 36 , $K_N = 1$

2) Enter Monthly Values

a) Chemical Category of Liquid

i) AP-42 Organic Liquids (Table 7.1-3 of AP-42 Chapter 7)

- Sum of Increases in Liquid Level Method

(a) User Input

(i) Chemical Name by month

(ii) Sum of Increases in Liquid Level (ft) by month

(b) AP-42 Calculation (using Equation 1-37 of AP-42 Chapter 7 by month instead of annually)

(i) Chemical Name by month

(ii) Throughput (gal) by month

ii) Custom Organic Liquids (See Section 6.0 “Customize” for guidance on adding custom organic liquids)

- Sum of Increases in Liquid Level Method

(a) User Input

(i) Chemical Name by month

(ii) Sum of Increases in Liquid Level (ft) by month

(b) AP-42 Calculation (using Equation 1-37 of AP-42 Chapter 7 by month instead of annually)

(i) Chemical Name by month

(ii) Throughput (gal) by month

iii) AP-42 Petroleum Liquids (Table 7.1-2 of AP-42 Chapter 7)

- Sum of Increases in Liquid Level Method

(a) User Input

(i) Chemical Name by month

(ii) Sum of Increases in Liquid Level (ft) by month

(b) AP-42 Calculation (using Equation 1-37 of AP-42 Chapter 7 by month instead of annually)

(i) Chemical Name by month

(ii) Throughput (gal) by month

iv) Custom Petroleum Liquids (See Section 6.0 “Customize” for guidance on adding custom petroleum liquids)

- Sum of Increases in Liquid Level Method

(a) User Input

(i) Chemical Name by month

(ii) Sum of Increases in Liquid Level (ft) by month

(iii) Speciation

1. None

2. Partial Speciation

3.2.4.2 Floating Roof Tanks

Input Type

- 1) Enter Annual Values
 - a) Chemical Category of Liquid
 - i) AP-42 Organic Liquids (Table 7.1-3 of AP-42 Chapter 7)
 - Sum of Decreases in Liquid Level Method
 - (a) User Input
 - (i) Chemical Name
 - (ii) Annual Sum of Decreases in Liquid Level (ft/yr)
 - (b) AP-42 Calculation (using Equation 2-20 of AP-42 Chapter 7)
 - (i) Chemical Name
 - (ii) Annual Throughput (gal/yr)
 - ii) Custom Organic Liquids (See Section 6.0 “Customize” for adding custom organic liquids)
 - Sum of Decreases in Liquid Level Method
 - (a) User Input
 - (i) Chemical Name
 - (ii) Annual Sum of Decreases in Liquid Level (ft/yr)
 - (b) AP-42 Calculation (using Equation 2-20 of AP-42 Chapter 7)
 - (i) Chemical Name
 - (ii) Annual Throughput (gal/yr)
 - iii) AP-42 Petroleum Liquids (Table 7.1-2 of AP-42 Chapter 7)
 - Sum of Decreases in Liquid Level Method
 - (a) User Input
 - (i) Chemical Name
 - (ii) Annual Sum of Decreases in Liquid Level (ft/yr)
 - (b) AP-42 Calculation (using Equation 2-20 of AP-42 Chapter 7)
 - (i) Chemical Name
 - (ii) Annual Throughput (gal/yr)
 - iv) Custom Petroleum Liquids (See Section 6.0 “Customize” for guidance on adding custom petroleum liquids)
 - Sum of Decreases in Liquid Level Method
 - (a) User Input
 - (i) Chemical Name
 - (ii) Speciation Option
 1. None
 2. Partial Speciation
 - Components to Speciate
 3. Full Speciation

- 4. Annual Sum of Decreases in Liquid Level (ft/yr)
- (b) AP-42 Calculation (using Equation 2-20 of AP-42 Chapter 7)
 - (i) Chemical Name
 - (ii) Speciation Option
 - 1. None
 - 2. Partial Speciation
 - Components to Speciate
 - 3. Full Speciation
 - (iii) Annual Throughput (gal/yr)
- v) Custom Mixtures (See Section 6.0 “Customize” for guidance on entering custom mixtures)
 - Sum of Decreases in Liquid Level Method
 - (a) User Input
 - (i) Chemical Name
 - (ii) Speciation Option
 - 1. None
 - 2. Partial Speciation
 - Components to Speciate
 - 3. Full Speciation
 - (iii) Annual Sum of Decreases in Liquid Level (ft/yr)
 - (b) AP-42 Calculation (using Equation 2-20 of AP-42 Chapter 7)
 - (i) Chemical Name
 - (ii) Speciation Option
 - 1. None
 - 2. Partial Speciation
 - Components to Speciate
 - 3. Full Speciation
 - (iii) Annual Throughput (gal/yr)

2) Enter Monthly Values

a) Chemical Category of Liquid

i) AP-42 Organic Liquids (Table 7.1-3 of AP-42 Chapter 7)

- Sum of Decreases in Liquid Level Method

(a) User Input

(i) Chemical Name by month

(ii) Annual Sum of Decreases in Liquid Level (ft) by month

(b) AP-42 Calculation (using Equation 2-20 of AP-42 Chapter 7 by month instead of annually)

(i) Chemical Name by month

- (ii) Annual Throughput (gal) by month
- ii) Custom Organic Liquids (See Section 6.0 “Customize” for guidance on adding custom organic liquids)
 - Sum of Decreases in Liquid Level Method
 - (a) User Input
 - (i) Chemical Name by month
 - (ii) Annual Sum of Decreases in Liquid Level (ft) by month
 - (b) AP-42 Calculation (using Equation 2-20 of AP-42 Chapter 7 by month instead of annually)
 - (i) Chemical Name by month
 - (ii) Annual Throughput (gal) by month
- iii) AP-42 Petroleum Liquids (Table 7.1-2 of AP-42 Chapter 7)
 - Sum of Decreases in Liquid Level Method
 - (a) User Input
 - (i) Chemical Name by month
 - (ii) Annual Sum of Decreases in Liquid Level (ft) by month
 - (b) AP-42 Calculation (using Equation 2-20 of AP-42 Chapter 7 by month instead of annually)
 - (i) Chemical Name by month
 - (ii) Annual Throughput (gal) by month
- iv) Custom Petroleum Liquids (See Section 6.0 “Customize” for adding custom petroleum liquids)
 - Sum of Decreases in Liquid Level Method
 - (a) User Input
 - (i) Chemical Name by month
 - (ii) Sum of Decreases in Liquid Level (ft) by month
 - (iii) Speciation
 1. None
 2. Partial Speciation
 - Chemicals to Speciate
 3. Full Speciation
 - (b) AP-42 Calculation (using Equation 2-20 of AP-42 Chapter 7 by month instead of annually)
 - (i) Chemical Name by month
 - (ii) Throughput (gal) by month
 - (iii) Speciation
 1. None
 2. Partial Speciation
 - Chemicals to Speciate
 3. Full Speciation

- v) Custom Mixtures (See Section 6.0 “Customize” for guidance on adding custom mixtures)
 - Sum of Decreases in Liquid Level Method
 - (a) User Input
 - (i) Chemical Name by month
 - (ii) Sum of Decreases in Liquid Level (ft) by month
 - (iii) Speciation
 - 1. None
 - 2. Partial Speciation
 - Chemicals to Speciate
 - 3. Full Speciation
 - (b) AP-42 Calculation (using Equation 2-20 of AP-42 Chapter 7 by month instead of annually)
 - (i) Chemical Name by month
 - (ii) Throughput (gal) by month
 - (iii) Speciation
 - 1. None
 - 2. Partial Speciation
 - Chemicals to Speciate
 - 3. Full Speciation

You can click “Save Tank” at any time during entry. If validation checks trigger, the errors will show on the screen. You cannot save your tank until the validation error is corrected.

Once saved, your tank will be added to the list underneath the “Saved Tanks” heading (see green circle in Figure 1).

3.3 Editing Tank Data

Once you have entered tank data, you can choose to Edit, Duplicate, or Delete each tank.

Choosing Edit allows you to edit the tank. Choose the appropriate drop-down list, make changes and click “Save Tank” when you are finished. Because each tank type has different characteristics, you cannot change the tank type. If you attempt to change the Tank Type, it will create a new tank with that tank type.

Choosing Duplicate will open a copy of the chosen tank. Then you can change the identification, characteristics, or contents. Clicking “Save Tank” adds a new tank to the list underneath the “Saved Tanks”. Because each tank type has different characteristics, you cannot change the tank type. If you attempt to change the Tank Type, it will create a new tank with that tank type.

Choosing Delete will delete the tank. This cannot be undone.

If you want to clear all tank data, choose “Clear Tank Data”. This cannot be undone.

3.4 Export Tank Data

TANKS 5.0 will save your data locally within your browser. The data will remain within your browser until you clear your local storage. To save your tank data long term, you should export the tank data for later use. Click “Export Tank Data” as shown by the green oval in Figure 2. Check the “Downloads” page of your web browser to find the file. Open and save the Excel spreadsheet file to your computer, in a location of your choice.

See Section 3.1 to “Import Tank Data.”

Welcome to TANKS

This web application estimates volatile organic compound (VOC) and hazardous air pollutant (HAP) emissions from fixed- and floating-roof storage tanks based on the emission estimation procedures from [Chapter 7](#) of [EPA's Compilation Of Air Pollutant Emission Factors \(AP-42\)](#).

Use this page to enter tank information for vertical fixed roof tanks, horizontal fixed roof tanks, internal floating roof tanks, external floating roof tanks and/or domed external floating roof tanks.

To use custom chemical or meteorological data, visit the "Customize" page before entering tank data on this page.

Application Instructions

User's Guide to TANKS

To view instructions for using the TANKS application, please see the user's guide below.

[Open User's Guide](#)

Saved Tanks

[Import Tank Data](#)[Export Tank Data](#)[Clear Tank Data](#)

Tank ID	Tank Type	Description	Location	Company	Edit	Duplicate	Delete
DEFRT example	Domed External Floating Roof Tank		,		Edit	Duplicate	Delete
EFRT example	External Floating Roof Tank		,		Edit	Duplicate	Delete
HFRT example	Horizontal Fixed Roof Tank		,		Edit	Duplicate	Delete
IFRT example	Internal Floating Roof Tank		,		Edit	Duplicate	Delete
VFRT example	Vertical Fixed Roof Tank		,		Edit	Duplicate	Delete

Figure 2. Screenshot of TANKS 5.0 "Tank Data" Page: Export Tank Data

4.0 Routine Losses

To calculate working and standing losses for your tank or multiple tanks, click on the “Routine Losses” tab as shown by the red oval in Figure 3.

You can choose all tanks by choosing “Select All” or choose individual tanks by clicking “Choose tank(s)”. All tanks from the Tank Data tab will be shown. Tanks can be searched by tank ID and tank location (city, state).

After choosing your tank or tanks, choose “Yes” or “No” for “Calculate Annual Emissions?” and choose “Yes” or “No” for “Calculate Monthly Emissions?” Note that you cannot choose “No” for both.

If monthly values were entered for a tank within Tank Data, annual emissions will be estimated as the sum of the emissions in each month.

If annual values were entered for a tank within Tank Data, monthly emissions will be estimated assuming an equal throughput in each month.

Click “Export Routine Losses.” The resulting xlsx file will contain standing losses, working losses, and total losses in pounds per year for each tank. You can save the file to your computer. TANKS 5.0 does not save this information.

Routine Losses

Use this page to estimate routine loss emissions from one tank or a list of tanks. Routine emissions are exported into an .xlsx file and are displayed as standing losses, working losses, and total losses in pounds per year. Tank details must be first entered on the "Tank Data" page.

Required fields are marked with an asterisk *

Tanks: *

Choose tank(s)...

Calculate Annual Emissions?: *

Select...



Calculate Monthly Emissions?: *

Select...



[Export Routine Losses](#)

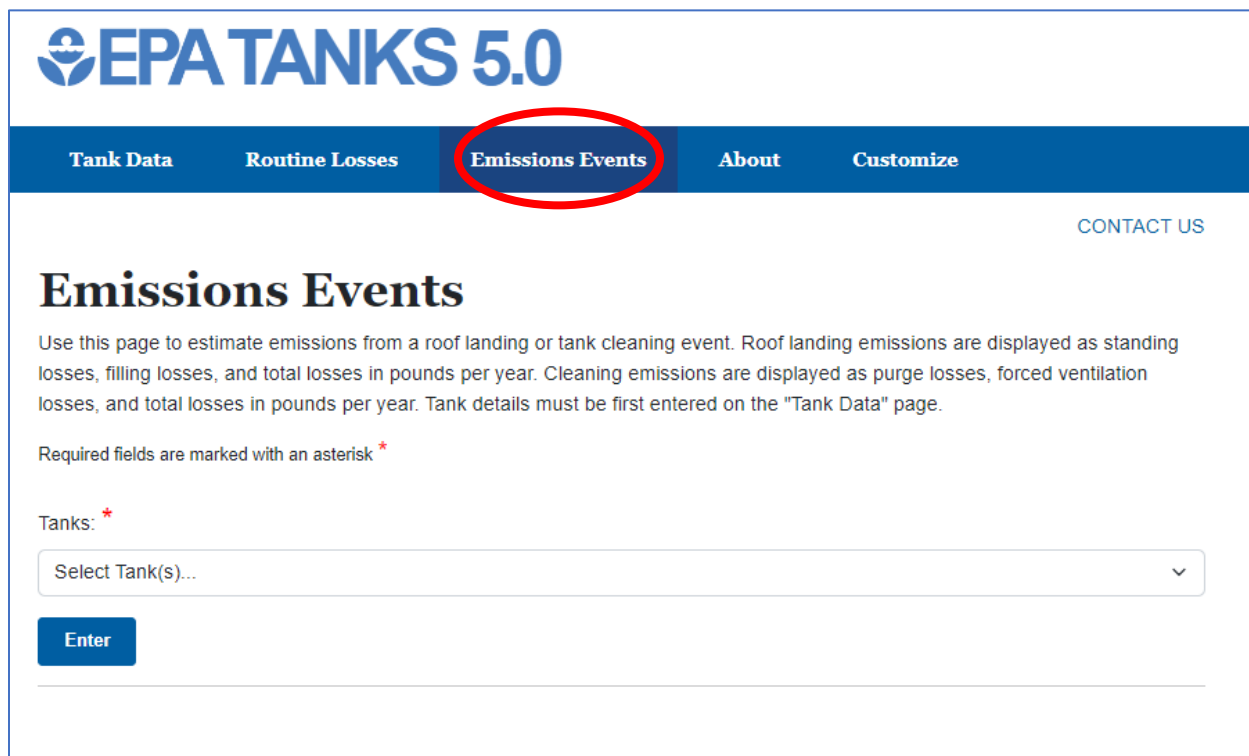
Notes on Calculations

- If tank contents data was entered as monthly values, annual emissions are estimated as the sum of the emissions in each month.
- If tank contents data was entered as annual values, monthly emissions are estimated assuming an equal throughput in each month.

Figure 3. Screenshot of TANKS 5.0 "Routine Losses" Page

5.0 Emissions Events

If you want to calculate roof landing losses for a floating roof tank or calculate cleaning losses from any type of tank, click on the “Emissions Events” tab as shown by the red oval in Figure 4.



The screenshot shows the EPA TANKS 5.0 interface. At the top, the logo 'EPA TANKS 5.0' is displayed. Below it is a navigation bar with five tabs: 'Tank Data', 'Routine Losses', 'Emissions Events', 'About', and 'Customize'. The 'Emissions Events' tab is circled in red. To the right of the navigation bar is a 'CONTACT US' link. The main heading is 'Emissions Events'. Below the heading is a paragraph explaining the page's purpose: 'Use this page to estimate emissions from a roof landing or tank cleaning event. Roof landing emissions are displayed as standing losses, filling losses, and total losses in pounds per year. Cleaning emissions are displayed as purge losses, forced ventilation losses, and total losses in pounds per year. Tank details must be first entered on the "Tank Data" page.' Below this is a note: 'Required fields are marked with an asterisk *'. The form includes a label 'Tanks: *' followed by a dropdown menu with the text 'Select Tank(s)...' and a downward arrow. Below the dropdown is a blue 'Enter' button.

Figure 4. Screenshot of TANKS 5.0 “Emissions Events” Page

These emissions can only be calculated for one tank and one emission event at a time. The emissions are displayed on the screen.

5.1 Landing Losses

For floating roof landings, the emissions are displayed as standing losses, filling losses, and total losses in pounds per year.

For floating roof landing events, you will need the following information:

- Tank
- Month During Which the Landing Event Occurred
- Chemical in Tank During Roof Landing (can also be “Empty”)
 - All chemicals entered into the tank within “Tank Data” will be listed in the drop-down list

- Chemical Added to Tank during Refilling (can also be “No Refill”)
 - All chemicals entered into the tank within “Tank Data” will be listed in the drop-down list
- Landed Roof Leg Height (ft)
- Type of Liquid Heel Present during Roof Landing
 - Full Liquid Heel
 - Height of Liquid at the Tank Shell (ft)
 - Partial Liquid Heel
 - Vertical Distance from the Bottom of the Shell Down to the Liquid Surface (ft)
 - Note: This option is not available for tanks with flat or nominally flat bottoms
 - No Liquid Heel
- Number of Days the Tank Is Standing Idle

5.2 Cleaning Losses

For tank cleaning, the emissions are displayed as purge losses, forced ventilation losses, and total losses in pounds per year.

5.2.1 Fixed Roof Tanks

For tank cleaning events for fixed roof tanks, you will need the following information:

- Tank
- Month During Which the Tank Cleaning Occurred
- Chemical Stored at the Start of Cleaning
- Type of Liquid Heel Present at the Start of Cleaning
 - Full Liquid Heel
 - Height of the Stock Liquid and Sludge at the Tank Shell at the Start of Cleaning (ft)
 - Partial Liquid Heel
 - Vertical Distance from the Bottom of the Shell Down to the Liquid Surface at the Start of Cleaning (ft)
 - Note: This option is not available for tanks with flat or nominally flat bottoms
 - No Liquid Heel
- Does the Tank Have a Sump?
 - Sump Diameter (inches [in])
 - Depth of Liquid Remaining in the Sump (in)
- Number of Days that the Tank is Standing Idle After Emptying and Before Forced Ventilation Begins
- Were Emissions Routed to a Control Device Prior to Starting Ventilation?
- Number of Days in which Forced Ventilation Was Used
- For Each Day with Forced Ventilation:

- Average Concentration (parts per million by volume [ppmv])
- Vent Time (hr/day)
- Average Sludge Depth (in)
- Was Ventilation Stopped?
- Were Emissions Routed to a Control Device?
- Control Device Efficiency (%)
 - if a control device is indicated above
- Was Tank Bottom Flooded with Solvent at the Start of the Cleaning?
 - Chemical Category of Solvent
 - Solvent Name
 - Equivalent Depth of Solvent that was Added to the Tank for Cleaning (in)
- Average Ventilation Rate During Continued Forced Ventilation (ft³/min)
- Calibration Gas Used During Continued Forced Ventilation
 - Methane
 - Ethane
 - Propane
 - Butane
 - Pentane
 - Hexane
 - Heptane

5.2.1 Floating Roof Tanks

For tank cleaning events for floating roof tanks, you will need the following information:

- Tank
- Month During Which the Tank Cleaning Occurred
- Chemical Stored at the Start of Cleaning
- Floating Roof Leg Height (ft)
- Type of Liquid Heel Present at the Start of Cleaning
 - Full Liquid Heel
 - Height of the Stock Liquid and Sludge at the Tank Shell at the Start of Cleaning (ft)
 - Partial Liquid Heel
 - Vertical Distance from the Bottom of the Shell Down to the Liquid Surface at the Start of Cleaning (ft)
 - Note: This option is not available for tanks with flat or nominally flat bottoms
 - No Liquid Heel
- Does the Tank Have a Sump?
 - Sump Diameter (in)
 - Depth of Liquid Remaining in the Sump (in)
- Were Emissions Routed to a Control Device Prior to Starting Ventilation?
- Number of Days in which Forced Ventilation Was Used

- For Each Day with Forced Ventilation:
 - Average Concentration (ppmv)
 - Vent Time (hr/day)
 - Average Sludge Depth (in)
 - Was Ventilation Stopped?
 - Were Emissions Routed to a Control Device?
- Control Device Efficiency (%)
 - if a control device is indicated above
- Was Tank Bottom Flooded with Solvent at the Start of the Cleaning?
 - Chemical Category of Solvent
 - Solvent Name
 - Equivalent Depth of Solvent that was Added to the Tank for Cleaning (in)
- Average Ventilation Rate During Continued Forced Ventilation (ft³/min)
- Calibration Gas Used During Continued Forced Ventilation
 - Methane
 - Ethane
 - Propane
 - Butane
 - Pentane
 - Hexane
 - Heptane

6.0 Customize

If you want to create tanks that contain custom contents (chemicals that are not included in AP-42 Chapter 7) or your tank is located in a city and state that is not included in AP-42 Chapter 7, click on the “Customize” tab as shown by the red oval in Figure 5.

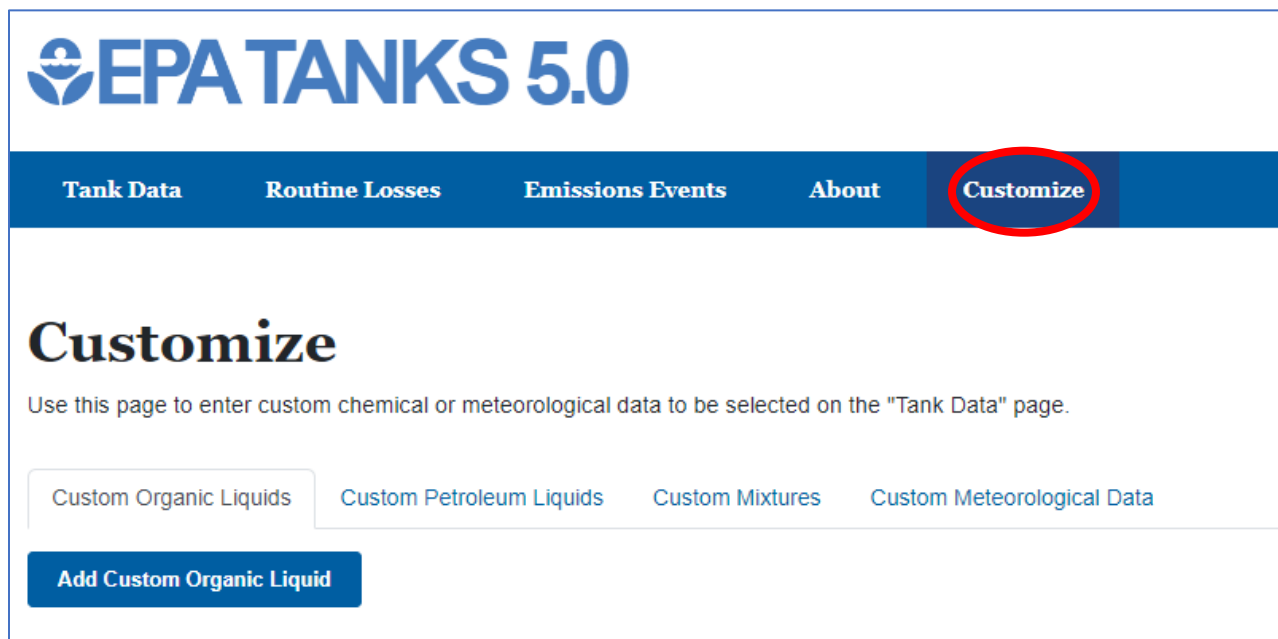


Figure 5. Screenshot of TANKS 5.0 “Customize” Page

6.1 Entering Custom Data

For custom organic liquids, you will need the following information:

- Chemical Name
- Molecular weight
- Liquid density (lb/gal)
- Antoine’s Equation Constant A (dimensionless)
- Antoine’s Equation Constant B (°C)
- Antoine’s Equation Constant C (°C)
- You also have the option to use the chemical data in AP-42 Table 7.1-3 as a template by collecting the chemical from the drop-down list using Template Chemical. You can then adjust the required fields as needed.

For custom petroleum liquids, you will need the following information:

- Chemical Name

- Vapor Molecular Weight (lb/lb-mole)
- Liquid Molecular Weight (lb/lb-mole)
- Vapor Pressure Equation Constant A (dimensionless)
- Vapor Pressure Equation Constant B (°R)
- You can also add one or more components in order to speciate emissions:
 - Component Mole Fraction Type
 - Liquid Mole Fraction
 - Vapor Mole Fraction
 - Chemical Name
 - Mole Fraction
- You also have the option to use the chemical data in AP-42 Table 7.1-2 as a template by collecting the chemical from the drop-down list using Template Chemical. You can then adjust the required fields as needed.

For custom mixtures, you will need the following information:

- Mixture Name
- Chemical Category of Each Liquid Component
- Organic Liquid Name of Each Component
- Liquid Mole Fraction of Each Component
 - Note that the sum of all liquid mole fractions must be 1.
- You cannot create a mixture containing multiple petroleum liquids, but you can create a mixture using the organic liquid components that are known to be contained in a specific petroleum liquid. You can also create a custom petroleum liquid using the option above.

For custom meteorological data, you will need the following information:

- Location Name
- Monthly Data:
 - Hourly Average Maximum Ambient Temperature (°F)
 - Hourly Average Minimum Ambient Temperature (°F)
 - Average Wind Speed (mph)
 - Average Daily Total Insolation Factor (Btu/ft²/day)
- Annual Data:
 - Hourly Average Maximum Ambient Temperature (°F)
 - Hourly Average Minimum Ambient Temperature (°F)
 - Average Wind Speed (mph)
 - Average Daily Total Insolation Factor (Btu/ft²/day)
 - Average Atmospheric Pressure (psi)

6.2 Sources for Custom Data

6.2.1 Chemical Data

- These reference books are available at most public and university libraries (in person or online) with an appropriate library card or user account:
 - *CRC Handbook of Chemistry and Physics.*
 - *Perry's Chemical Engineers' Handbook.*
 - Reid, Prausnitz and Sherwood, *Properties of Liquids and Gases*, McGraw Hill.
 - Yaws and Yang, *Property Data: To Estimate Vapor Pressure Easily, Hydrocarbon Processing.*
 - Boublik, Fried and Hála, *The Vapor Pressures of Pure Substances, Selected Values of the Temperature Dependence of the Vapor Pressures of Some Pure Substances in the Normal and Low Pressure Region*, Elsevier Science Publishers.
- NIST Chemistry workbook, which is available online at:
<http://webbook.nist.gov/chemistry/>.

**Please note that in some resources, such as the NIST Chemistry Workbook, the Antoine's equation constants are in different units. Pressure is in bar and temperature is in Kelvin (K). To convert these to mmHg and °C, add 2.8751 to A, keep B the same, and add 273.15 to C.

6.2.2 Meteorological Data

- United States: National Solar Radiation Data Base. Available at <https://nsrdb.nrel.gov/about/u-s-data.html>.
- International: NASA Surface Meteorology and Solar Energy Data Set. Available at <https://power.larc.nasa.gov/>.