USER'S GUIDE
TO
TANKS 5.1
(released September 2024)

Storage Tank Emissions Calculation Application
Version 5.1

September 2024

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Sector Policies and Programs Division
Measurement Policy Group
Research Triangle Park, NC 27711

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Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
°R	degrees Rankine
bbl	barrels
ft	feet
ft/yr	feet per year
gal	gallons
gal/yr	gallons per year
in	inches
K	Kelvin
lb/lb-mole	pound per pound mole
mmHg	millimeters mercury
ppmv	parts per million by volume
psia	pounds per square inch absolute
psig	pounds per square inch gauge
R	Rankine
yr	year

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 5.1 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 5.1 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 5.1 of TANKS, hereafter referred to as TANKS 5.1, represents an upgrade to TANKS 5.0 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 5.1 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.

Questions and comments can be sent at any time to: https://www.epa.gov/chief/forms/contact-us-about-clearinghouse-inventories-and-emissions-factors.

1.1 Accessing TANKS 5.1

TANKS 5.1 is available here: https://www.tanks.app.cloud.gov

More information about TANKS 5.1, 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.

1.2 TANKS 5.1 Main Menu

There are four pages on the TANKS 5.1 main menu.

Tank Data. The page includes a description, links to references and resources (including this User's Guide), a summary of tanks that you have created or imported, and the form to create a new tank. [See Section 2.0 "Tank Data" for more information.]

Routine Losses. The page is used to calculate routine losses for your tank or multiple tanks. [See Section 3.0 "Routine Losses" for more information.]

Non-Routine Losses. The page is used to calculate roof landing losses for a floating roof tank or to calculate cleaning losses from any type of tank. [See Section 4.0 "Non-Routine Losses" for more information.]

Customize. The page is used to create custom chemicals that are not included in AP-42 Chapter 7 or custom meteorological locations that are not included in AP-42 Chapter 7, click on the "Customize" page. [See Section 5.0 "Customize" for more information.]

Note that fields marked with a red asterisk (*) are required fields.

See Section 8.0 for a list of Error Messages.

2.0 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:

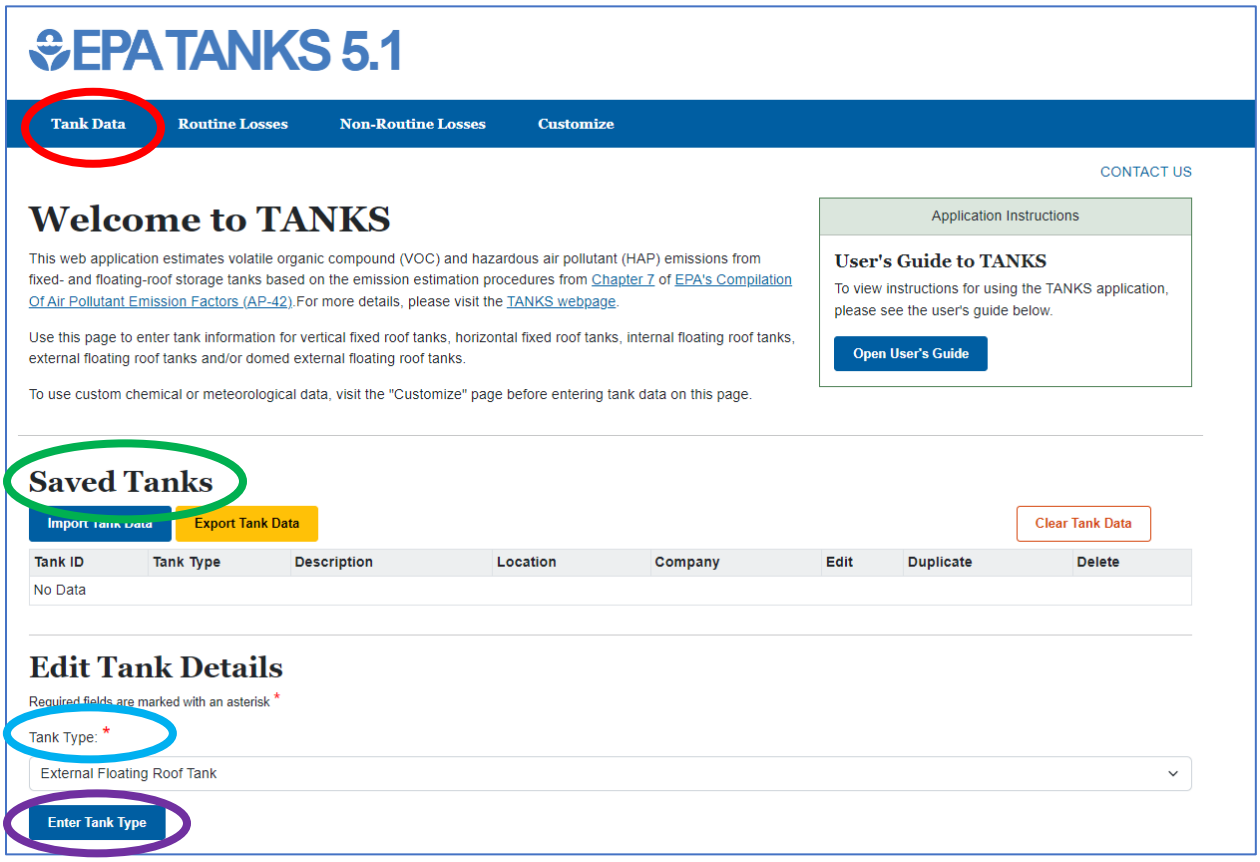

Figure 1. Screenshot of TANKS 5.1 “Tank Data” page

2.1 Importing 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 5.1.

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 2.4 for "Exporting Tank Data" to export data (or save) from TANKS 5.1 to your computer.

TANKS 5.1 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.

2.2 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 5.0 "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.

2.2.1 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 5.0 "Customize" for guidance on adding custom meteorological data]
      - AP-42 Meteorological Locations [See Section 9.0 "AP-42 Meteorological Locations" for the list of locations] [See Section 10. "Cities with Alternate Meteorological Data" for the cities where monthly wind speed data or solar insolation factors were not available]

2.2.2 Tank Characteristics by Tank Type

Each tank type has slightly different characteristics. See Section 7.0 for a list of definitions used in this section and throughout the document and see page 4 for a list of abbreviations used. 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.**

2.2.2.1 Vertical Fixed Roof Tanks

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

The "Tank Bottom Type" for tanks can be "flat or nominally flat bottom" or "cone-shaped bottom." According to Table 7.1-4 and Figure 7.1-20 of AP-42, Chapter 7, partial liquid heel occurs on tanks with a cone-down bottom. The equations for partial liquid heel in Table 7.1-4 will not work if the slope is zero, which is the case for a flat or nominally flat bottom tank.

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
        - 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 (°R)
    ii) Partially Insulated
        - Liquid Bulk Temperature (°R)
    iii) Not Insulated
        - Liquid Bulk Temperature Calculation Method
            1. User Input
                - Liquid Bulk Temperature (°R)
            2. AP-42 Calculation [using Equation 1-33 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) Good
        ii) Average
        iii) Aged
3) Roof Characteristics
    a) Roof Color/Shade [see AP-42 Chapter 7; Table 7.1-6]
    b) Roof Condition
        i) Good

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

2.2.2.2 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
- Liquid Bulk Temperature (°R)

ii) Partially Insulated
- Liquid Bulk Temperature (°R)

iii) Not Insulated and Not Underground

- Liquid Bulk Temperature Calculation Method
  (a) User Input
    - Liquid Bulk Temperature (°R)
  (b) AP-42 Calculation [using Equation 1-33 of AP-42 Chapter 7]

2) Shell Characteristics (only if tank is "Partially Insulated" or " Not Insulated and Not Underground")
   a) Shell Color/Shade [see AP-42 Chapter 7; Table 7.1-6]
   b) Shell Condition
      i) Good
      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

2.2.2.3 Internal Floating Roof Tanks

This type of tank has both a permanent fixed roof and a floating deck. There are two basic types of internal floating roof tanks: tanks in which the fixed roof is supported by vertical columns within the tank, and tanks with a self-supporting fixed roof and no internal support columns.

Under "Tank Construction and Rim Seal System," you are required to enter the primary seal type. 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.

Deck fittings are required for internal floating roof tanks. However, none of the individual Deck Fittings are marked as required fields; the combination of deck fittings used are unique for each internal floating roof tank. Please check your data to ensure that the correct information has been entered.

For each deck fitting, choose the appropriate cover from the drop-down menu. The corresponding loss factors from AP-42 Chapter 7, Table 7.1-12 will be applied within TANKS 5.1. For a list of typical deck fittings by tank type, see Section 6.0.

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) Gunite Lining
e) External Shell Color/Shade [see AP-42 Chapter 7; Table 7.1-6]
f) External Shell Condition
    i) Good
    ii) Average
    iii) Aged
g) Roof Color/Shade [see AP-42 Chapter 7; Table 7.1-6]
h) Roof Paint Condition
    i) Good
    ii) Average
    iii) Aged
i) Liquid Bulk Temperature Calculation Method
    i) User Input
        - Liquid Bulk Temperature (°R)
    ii) AP-42 Calculation [using Equation 1-33 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) Primary Only / 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

Ladder-slotted Guidepole Combination Well

2.2.2.4 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.

Under "Tank Construction and Rim Seal System," you are required to enter the primary seal type. 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.

Deck fittings are required for external floating roof tanks. However, none of the individual Deck Fittings are marked as required fields; the combination of deck fittings used are unique for each external floating roof tank. Please check your data to ensure that the correct information has been entered.

For each deck fitting, choose the appropriate cover from the drop-down menu. The corresponding loss factors from AP-42 Chapter 7, Table 7.1-12 will be applied within TANKS 5.1. For a list of typical deck fittings by tank type, see Section 6.0.

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) Good
    ii) Average
    iii) Aged
g) Roof Color/Shade [see AP-42 Chapter 7; Table 7.1-6]
h) Roof Paint Condition
    i) Good
    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) Primary Only / 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

2.2.2.5 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.

Under "Tank Construction and Rim Seal System," you are required to enter the primary seal type. 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.

Deck fittings are required for domed external floating roof tanks. However, none of the individual Deck Fittings are marked as required fields; the combination of deck fittings used are unique for each domed external floating roof tank. Please check your data to ensure that the correct information has been entered.

For each deck fitting, choose the appropriate cover from the drop-down menu. The corresponding loss factors from AP-42 Chapter 7, Table 7.1-12 will be applied within TANKS 5.1. For a list of typical deck fittings by tank type, see Section 6.0.

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) Gunite Lining
e) External Shell Color/Shade [see AP-42 Chapter 7; Table 7.1-6]
f) External Shell Condition
  i) Good
  ii) Average
  iii) Aged
g) Roof Color/Shade [see AP-42 Chapter 7; Table 7.1-6]
h) Roof Paint Condition
  i) Good
  ii) Average
  iii) Aged
i) Liquid Bulk Temperature Calculation Method
  i) User Input
    (1) Liquid Bulk Temperature (°R)
  ii) AP-42 Calculation [using Equation 1-33 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) Primary Only / 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) Primary Only / 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

2.2.3 Contents

This is for the entry of the tank contents. The information required varies by tank type and by input type (i.e., annual or monthly).

2.2.3.1 Fixed Roof Tanks

2.2.3.1.1 Annual Input

1) Enter Annual Values
a) Chemical Category of Liquid
i) AP-42 Organic Liquids [see 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 per year [ft/yr])
(b) AP-42 Calculation [using Equation 1-39 of AP-42 Chapter 7]
(i) Chemical Name
(ii) Annual Throughput (gallons per year [gal/yr])

ii) Custom Organic Liquids [See Section 5.0 “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 1-39 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 1-39 of AP-42 Chapter 7]
    (i) Chemical Name
    (ii) Annual Throughput (gal/yr)

iv) Custom Petroleum Liquids [See Section 5.0 "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 1-39 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 5.0 "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 1-39 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, $K_N = 1$

2.2.3.1.2 Monthly Input

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 1-39 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 5.0 "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 1-39 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 1-39 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 5.0 "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
   - Chemicals to Speciate
3. Full Speciation

(b) AP-42 Calculation [using Equation 1-39 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 5.0 "Customize" for adding custom mixtures]

- 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
   - Chemicals to Speciate
3. Full Speciation

(b) AP-42 Calculation [using Equation 1-39 of AP-42 Chapter 7 for month instead of year]
(i) Chemical Name by month
(ii) Throughput (gal) by month
(iii) Speciation
1. None
2. Partial Speciation
   - Chemicals to Speciate
3. Full Speciation

b) Working Loss Turnover Factor 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, $K_N = 1$

2.2.3.2 Floating Roof Tanks

2.2.3.2.1 Annual Input

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 5.0 "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 5.0 "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 5.0 "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)

2.2.3.2.2 Monthly Input

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 5.0 "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 5.0 "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 5.0 "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 all validation errors are corrected.

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

2.3 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.

2.4 Exporting Tank Data

TANKS 5.1 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 2.1 for “Importing Tank Data.”

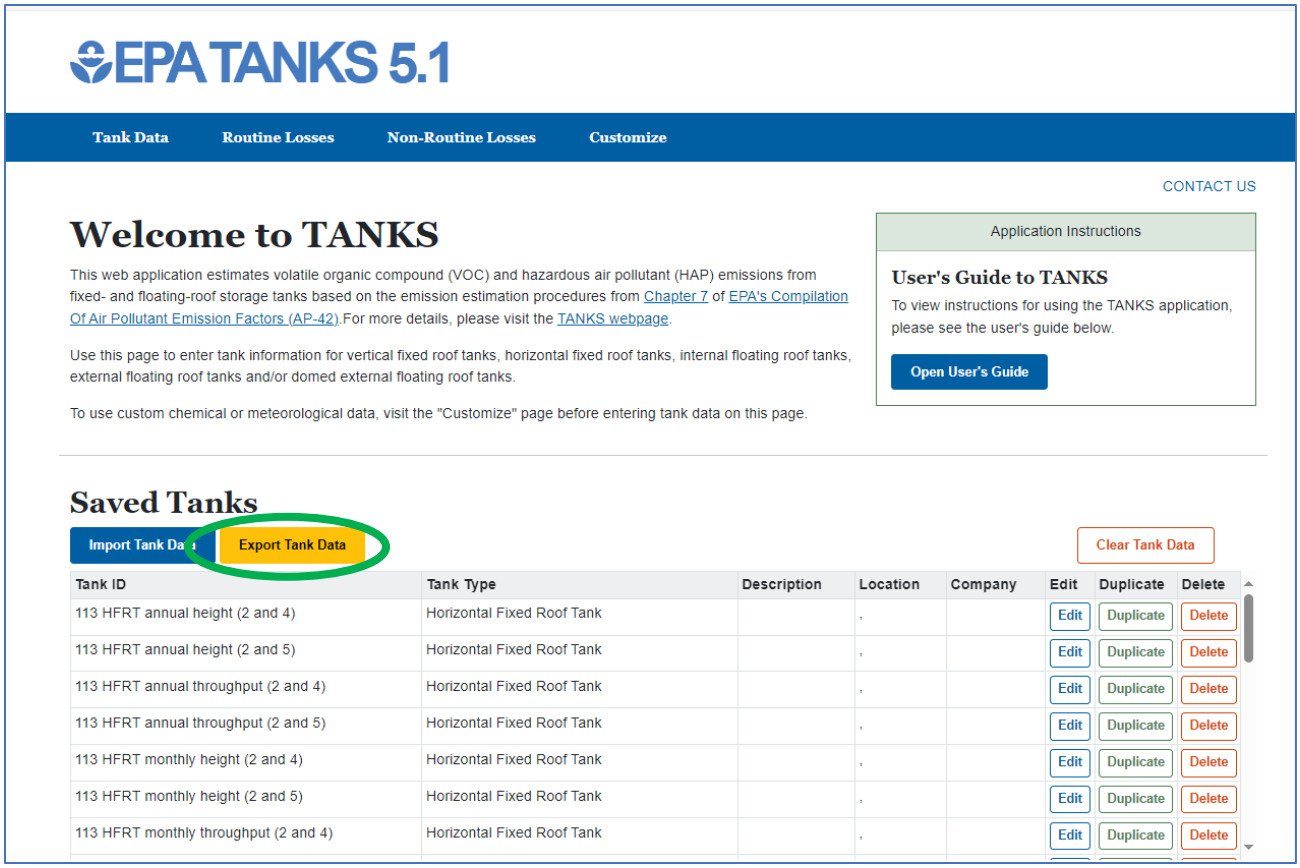

Figure 2. Screenshot of TANKS 5.1 "Tank Data" Page: Export Tank Data

3.0 Routine Losses

To calculate routine losses, defined as 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.

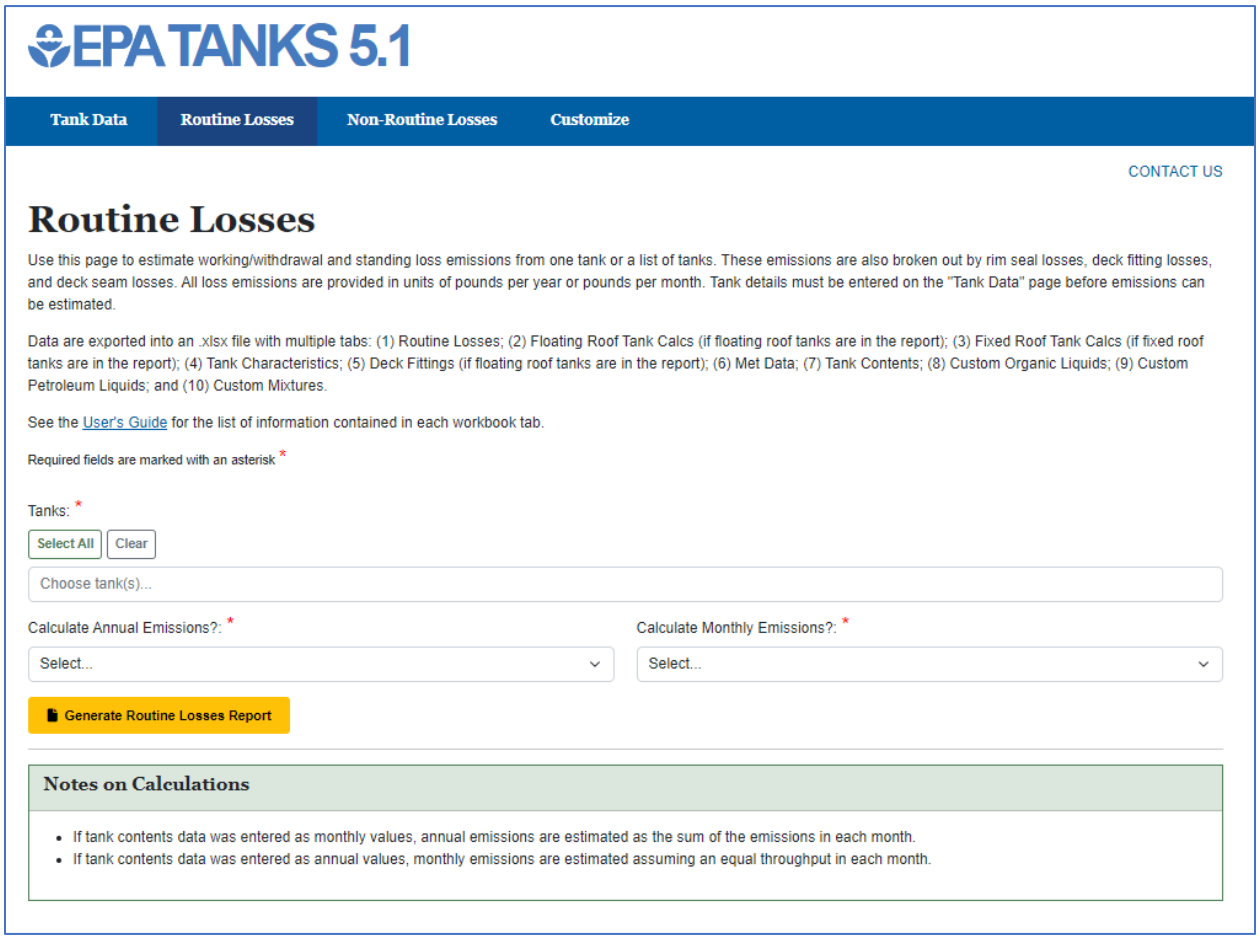

Figure 3. Screenshot of TANKS 5.1 "Routine Losses" Page

3.1 Data Entry

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).

If you choose tanks individually, either click outside of the tank selection window or click "Tab" to close the tank selection window. Then, choose "Yes" or "No" for "Calculate Annual Emissions?" and choose "Yes" or "No" for "Calculate Monthly Emissions?" Note that you will receive an Error message if you 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 contains standing losses, working losses, and total losses in pounds per year for each tank. You can save the file to your computer at any location. TANKS 5.1 does not save this information.

Data are exported into an .xlsx file with multiple tabs: (1) Routine Losses; (2) Floating Roof Tank Calcs (if floating roof tanks are in the report); (3) Fixed Roof Tank Calcs (if fixed roof tanks are in the report); (4) Tank Characteristics; (5) Deck Fittings (if floating roof tanks are in the report); (6) Met Data; and (7) Tank Contents.

When reviewing the exported data, note how the output data will appear in the .xlsx file:

Input Type on Tank Data page	Output type on Routine Losses page	Output Data in Routine Losses tab	Output Data in Floating Roof Tank Calcs and/or Fixed Roof Tank Calcs tabs
Monthly	Annual and Monthly	Annual and Monthly	Annual and Monthly
Monthly	Monthly	Monthly (Annual columns are blank)	Annual and Monthly
Monthly	Annual	Annual	Annual
Annual	Annual and Monthly	Annual and Monthly	Annual and Monthly
Annual	Monthly	Monthly (Annual columns are blank)	Annual and Monthly
Annual	Annual	Annual	Annual

3.2 Routine Losses Report

3.2.1 Routine Losses

- Tank ID
- Tank Type
- Description
- City, State
- Company
- Meteorological Location
- Chemical Name
- Annual and monthly emissions, as applicable, by tank
    - Standing Losses
    - Rim Seal Losses

- Deck Seam Losses
- Deck Fitting losses
- Working Losses
- Total Losses

3.2.2 Floating Roof Tank Calcs

Annual

- Tank ID
- Tank Type
- Description
- City, State
- Company
- Chemical Name
- Annual Rim Seal Losses (lb/yr)
- Seal Factor A (lb-mole/ft-yr)
- Seal Factor B (lb-mole/ft-yr (mph^n))
- Annual Average Wind Speed (mph)
- Seal-related Wind Speed Exponent
- Annual Average Value of Vapor Pressure Function
- Annual Average Daily Avg. Liquid Surface Temp. (R)
- Annual Average Vapor Pressure at Daily Average Liquid Surface Temperature (psia)
- Liquid Bulk Temperature (°R)
- Tank Paint Solar Absorptance (Shell)
- Tank Paint Solar Absorptance (Roof)
- Annual Average Vapor Molecular Weight (lb/lb-mole)
- Annual Product Factor
- Number of Columns
- Effective Column Diameter (ft)
- Annual Net Throughput (gal/yr)
- Annual Sum of Decreases in Liquid Level (ft/yr)
- Annual Average Shell Clingage Factor (bbl/1000 sqft)
- Annual Average Organic Liquid Density (lb/gal)
- Annual Tot. Deck Fitting Loss Fact. (lb-mole/yr)
- Deck Seam Length (ft)
- Deck Seam Loss per Unit Length Factor (lb-mole/ft-yr)
- Deck Seam Length Factor (ft/sqft)
- Annual Withdrawal Losses (lb/yr)
- Annual Deck Fitting Losses (lb/yr)
- Annual Deck Seam Losses (lb/yr)

Monthly

- Tank ID
- Tank Type
- Description
- City, State
- Company
- Chemical Name

- Annual Rim Seal Losses (lb/yr)
- Seal Factor A (lb-mole/ft-yr)
- Seal Factor B (lb-mole/ft-yr (mph^n))
- Annual Average Wind Speed (mph)
- Seal-related Wind Speed Exponent
- Annual Average Value of Vapor Pressure Function
- Annual Average Daily Avg. Liquid Surface Temp. (°R)
- Annual Average Vapor Pressure at Daily Average Liquid Surface Temperature (psia)
- Liquid Bulk Temperature (°R)
- Tank Paint Solar Absorptance (Shell)
- Tank Paint Solar Absorptance (Roof)
- Annual Average Vapor Molecular Weight (lb/lb-mole)
- Annual Product Factor
- By month
    - Rim Seal Losses (lb/mo)
    - Wind Speed (mph)
    - Average Value of Vapor Pressure Function
    - Average Liquid Surface Temp. (°R)
    - Average Vapor Pressure at Daily Average Liquid Surface Temperature (psia)
    - Average Vapor Molecular Weight (lb/lb-mole)
- Annual Withdrawal Losses (lb/yr)
- Annual Deck Fitting Losses (lb/yr)
- Annual Deck Seam Losses (lb/yr)
- Deck Seam Length (ft)
- Deck Seam Loss per Unit Length Factor (lb-mole/ft-yr)
- Deck Seam Length Factor (ft/sqft)
- Annual Tot. Deck Fitting Loss Fact. (lb-mole/yr)
- Number of Columns
- Effective Column Diameter (ft)
- Annual Net Throughput (gal/yr)
- Annual Sum of Decreases in Liquid Level (ft/yr)
- Annual Average Shell Clingage Factor (bbl/1000 sqft)
- Annual Average Organic Liquid Density (lb/gal)
    - By month:
        - Withdrawal Losses (lb/mo)
        - Throughput (gal/mo)
        - Sum of Decreases in Liquid Level (ft/yr)
        - Shell Clingage Factor (bbl/1000 sqft)
        - Organic Liquid Density (lb/gal)
        - Deck Fitting Losses (lb/mo)
        - Tot. Deck Fitting Loss Fact. (lb-mole/mo)
        - Deck Seam Losses (lb/mo)

3.2.3 Fixed Roof Tank Calcs

Annual

- Tank ID

- Tank Type
- Description
- City, State
- Company
- Chemical Name
- Annual Standing Losses (lb/yr)
- Annual Working Losses (lb/yr)
- Annual Vapor Space Volume (cu ft)
- Annual Stock Vapor Density (lb/cu ft)
- Annual Average Vapor Space Expansion Factor
- Annual Average Vented Vapor Saturation Factor
- Effective Diameter (ft)
- Vapor Space Outage (ft)
- Tank Shell Height (ft)
- Tank Shell Length (ft)
- Average Liquid Height (ft)
- Roof Outage (ft)
- Dome Radius (ft)
- Shell Radius (ft)
- Tank Cone Roof Slope (ft/ft)
- Annual Average Vapor Molecular Weight (lb/lb-mole)
- Annual Average Vapor Pressure at Daily Average Liquid Surface Temperature (psia)
- Annual Average Liquid Surface Temp (°R)
- Annual Average Ambient Temp (°R)
- Liquid Bulk Temperature (°R)
- Tank Paint Solar Absorptance (Shell)
- Tank Paint Solar Absorptance (Roof)
- Annual Average Vapor Temperature Range (°R)
- Annual Average Daily Vapor Pressure Range (psia)
- Breather Vent Press. Setting Range (psia)
- Annual Average Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia)
- Annual Average Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia)
- Annual Average Min. Liquid Surface Temp. (°R)
- Annual Average Max. Liquid Surface Temp. (°R)
- Annual Average Daily Ambient Temp. Range (°R)
- Vapor Space Pressure at Normal Operating Conditions (psig)
- Annual Throughput (gal/yr)
- Annual Turnovers
- Working Loss Turnover Factor
- Maximum Liquid Height (ft)
- Minimum Liquid Height (ft)
- Working Loss Product Factor Vent Setting Correction Factor
- Annual Sum of Increases in Liquid Level (ft/yr)

Monthly

- Tank Type
- Description
- City, State
- Company
- Chemical Name
- Annual Standing Losses (lb/yr)
- Annual Working Losses (lb/yr)
- Annual Vapor Space Volume (cu ft)
- Annual Stock Vapor Density (lb/cu ft)
- Annual Average Vapor Space Expansion Factor
- Annual Average Vented Vapor Saturation Factor
- By month
    - Standing Losses (lb/mo)
    - Stock Vapor Density (lb/cu ft)
    - Vapor Space Expansion Factor
    - Vented Vapor Saturation Factor
- Effective Diameter (ft)
- Vapor Space Outage (ft)
- Average Liquid Height (ft)
- Roof Outage (ft)
- Dome Radius (ft)
- Shell Radius (ft)
- Tank Cone Roof Slope (ft/ft)
- Annual Average Vapor Molecular Weight (lb/lb-mole)
- Annual Average Vapor Pressure at Daily Average Liquid Surface Temperature (psia)
- Annual Average Liquid Surface Temp (°R)
- Annual Average Ambient Temp (°R)
- Liquid Bulk Temperature (°R)
- Tank Paint Solar Absorptance (Shell)
- Tank Paint Solar Absorptance (Roof)
- By month
    - Vapor Molecular Weight (lb/lb-mole)
    - Vapor Pressure at Daily Average Liquid Surface Temperature (psia)
    - Daily Avg. Liquid Surface Temp. (°R)
    - Average Ambient Temp (°R)
- Annual Average Vapor Temperature Range (°R)
- Annual Average Daily Vapor Pressure Range (psia)
- Breather Vent Press. Setting Range (psia)
- Annual Average Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia)
- Annual Average Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia)
- Annual Average Min. Liquid Surface Temp. (°R)
- Annual Average Max. Liquid Surface Temp. (°R)
- Annual Average Daily Ambient Temp. Range (°R)
- Vapor Space Pressure at Normal Operating Conditions (psig)

- By month
    - Daily Vapor Temperature Range (°R)
    - Daily Vapor Pressure Range (psia)
    - Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia)
    - Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia)
    - Daily Min. Liquid Surface Temp. (°R)
    - Daily Max. Liquid Surface Temp. (°R)
    - Daily Ambient Temp. Range (°R)
- Annual Throughput (gal/yr)
- Annual Turnovers
- Working Loss Turnover Factor
- Annual Sum of Increases in Liquid Level (ft/yr)
- Maximum Liquid Height (ft)
- Minimum Liquid Height (ft)
- Working Loss Product Factor
- Vent Setting Correction Factor
- By month
    - Working Losses (lb/mo)
    - Standing Losses (lb/mo)
    - Throughput (gal/mo)
    - Sum of Increases in Liquid Level (ft/yr)

3.2.4 Tank Characteristics

- Tank ID
- Tank Type
- Description
- City, State
- Company
- Meteorological Location
- Shell Length (ft) *[used only for horizontal fixed roof tanks]*
- Shell Side Length (ft) *[used only for square vertical fixed roof tanks]*
- Shell Side 1 Length (ft) *[used only for rectangular vertical fixed roof tanks]*
- Shell Side 2 Length (ft) *[used only for rectangular vertical fixed roof tanks]*
- Shell Height (ft)
- Shell Diameter (ft)
- Maximum Liquid Height (ft)
- Average Liquid Height (ft)
- Minimum Liquid Height (ft)
- Is Tank Heated?
- Typical Maximum Liquid Bulk Temperature in Heating Cycle (degrees R)
- Typical Average Liquid Bulk Temperature in Heating Cycle (degrees R)
- Typical Minimum Liquid Bulk Temperature in Heating Cycle (degrees R)
- Number of Heating Cycles per Year
- Roof Type
- Vacuum Setting (psig)

- Pressure Setting (psig)
- Vapor Space Pressure at Normal Operating Conditions (psig)
- Is Tank Insulated?
- Is Tank Insulated or Underground? *[used only for horizontal fixed roof tanks]*
- Tank Cone Roof Slope (ft/ft)
- Tank Dome Roof Radius (ft)
- Is Tank Equipped with a Control Device?
- Control Device Efficiency (%)
- Tank Shape *[used only for vertical fixed roof tanks]*
- Liquid Bulk Temperature Calculation Method
- Liquid Bulk Temperature (degrees R)
- Tank Bottom Type
- Cone-Shaped Bottom Slope (ft/ft)
- Liquid Heel Type at Tank Minimum
- Minimum Liquid Heel Height (ft)
- Self Supporting Roof?
- Number of Columns
- Effective Column Diameter
- Internal Shell Condition
- Primary Seal
- Secondary Seal
- Seal Fit
- Deck Type
- Tank Construction
- Deck Construction
- Deck Seam
- Panel/Sheet Width (ft)
- Panel Length (ft)
- Shell Color/Shade
- Shell Condition
- Roof Color/Shade
- Roof Condition

3.2.5 Deck Fittings *[used only for floating roof tanks]*

- Tank ID
- Tank Type
- Description
- City, State
- Company
- Access Hatch fitting type and count
- Fixed Roof Support Column Well fitting type and count
- Unslotted Guidepole and Well fitting type and count
- Slotted Guidepole/Sample Well fitting type and count
- Gauge-float Well (Automatic Gauge) fitting type and count
- Gauge-hatch/Sample Port fitting type and count
- Vacuum Breaker fitting type and count

- Deck Drain fitting type and count
- Deck Leg fitting type and count
- Deck Leg or Hanger (No opening through deck) fitting type and count
- Rim Vent fitting type and count
- Ladder Well fitting type and count
- Ladder-slotted Guidepole Combination Well fitting type and count
- Deck Leg (Pontoon area of pontoon roofs) fitting type and count
- Deck Leg (Double-deck roofs and center area of pontoon roofs) fitting type and count

3.2.6 Met Data

- Tank ID
- Meteorological Location
- By month
    - Average Maximum Ambient Temperature (°F)
    - Average Minimum Ambient Temperature (°F)
    - Average Wind Speed (mph)
    - Average Daily Total Isolation Factor (Btu/ft^2/day)
- Annual Average Maximum Ambient Temperature (°F)
- Annual Average Minimum Ambient Temperature (°F)
- Annual Average Wind Speed (mph)
- Annual Average Total Insolation Factor (Btu/ft^2/day)
- Annual Average Atmospheric Pressure (psi)

3.2.7 Tank Contents

- Tank ID
- Input Type
- Chemical Category of Liquid
- Sum of Increases/Decreases in Liquid Level Method
- Working Loss Turnover Factor Method
- By month:
    - Chemical Name
    - Speciation Option
    - Components to Speciate
    - Throughput
    - Sum of Increases/Decreases in Liquid Level (ft/yr)
- Annual Chemical Name
- Annual Speciation Option
- Annual Components to Speciate
- Annual Throughput
- Annual Sum of Increases/Decreases in Liquid Level (ft/yr)

3.2.8 Custom Organic Liquids

- Tank ID
- Input Type

- Chemical Name
- Molecular Weight
- Liquid Density (lb/gal)
- Antoine's Equation Constant A
- Antoine's Equation Constant B (°C)
- Antoine's Equation Constant C (°C)

3.2.9 Custom Petroleum Liquids

- Tank ID
- Input Type
- Chemical Name
- Vapor Molecular Weight (lb/lb-mole)
- Liquid Molecular Weight (lb/lb-mole)
- Liquid Density (lb/gal)
- Vapor Pressure Equation Constant A
- Vapor Pressure Equation Constant B (°R)
- Is this a crude oil?
- Component Mole Fraction Type
- Chemical Component Name
- Mole Fraction

3.2.10 Custom Mixtures

- Tank ID
- Input Type
- Mixture Name
- Chemical Name
- Liquid Mole Fraction
- Molecular Weight
- Liquid Density (lb/gal)
- Antoine's Equation Constant A
- Antoine's Equation Constant B (°C)
- Antoine's Equation Constant C (°C)

4.0 Non-Routine Losses

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 "Non-Routine Losses" tab as shown by the red oval in Figure 4 and Figure 5.

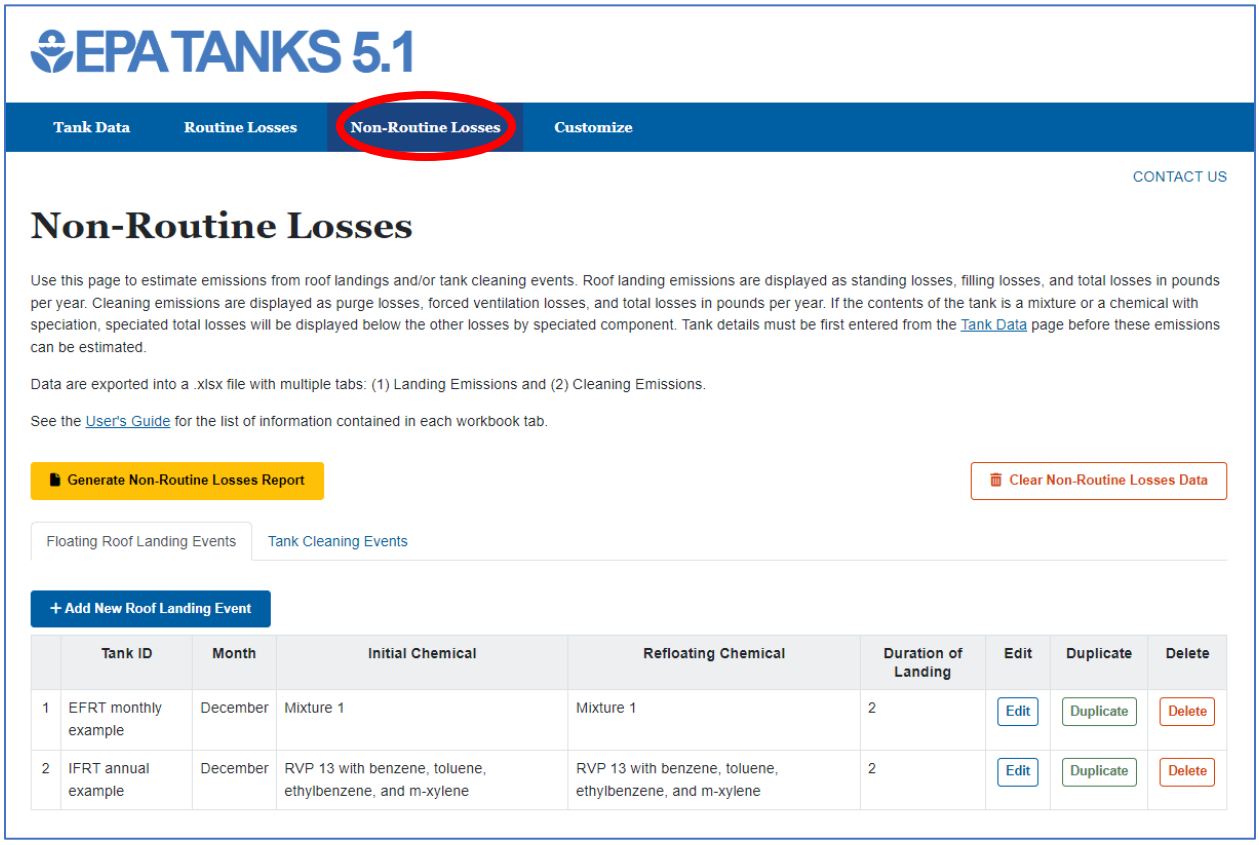

Figure 4. Screenshot of TANKS 5.1 "Non-Routine Losses" Page—Floating Roof Landing Events

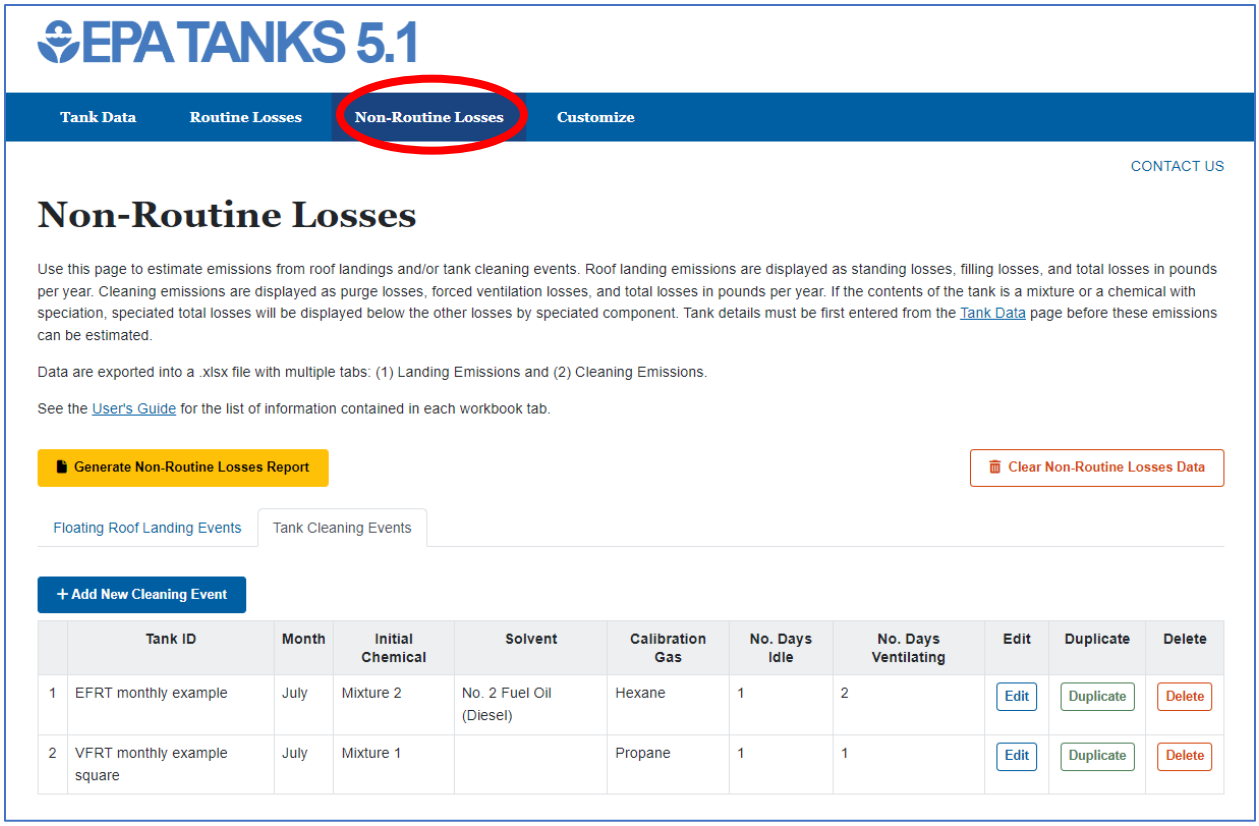

Figure 5. Screenshot of TANKS 5.1 "Non-Routine Losses" Page—Tank Cleaning Events

4.1 Landing Loss Data Entry

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

4.2 Cleaning Loss Data Entry

For tank cleaning, the emissions are displayed as purge losses, forced ventilation losses, and total losses in pounds per year. Note that the day 1 sludge depth should be the height of the chemical in the tank at the beginning of ventilation, NOT including the depth of solvent added or the equivalent additional height from the sump (if any).

4.2.1 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) **** See Note below**
    - 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 (ft^3/min)
- Calibration Gas Used During Continued Forced Ventilation
    - Methane
    - Ethane
    - Propane
    - Butane
    - Pentane
    - Hexane
    - Heptane

** Note: The day 1 sludge depth should be the height of the chemical in the tank at the beginning of ventilation, NOT including the depth of solvent added or the equivalent additional height from the sump (if any).

4.2.1 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) **** See Note below**

    - 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 (ft^3/min)
- Calibration Gas Used During Continued Forced Ventilation
    - Methane
    - Ethane
    - Propane
    - Butane
    - Pentane
    - Hexane
    - Heptane

** Note: The day 1 sludge depth should be the height of the chemical in the tank at the beginning of ventilation, NOT including the depth of solvent added or the equivalent additional height from the sump (if any).

4.3 Non-Routine Losses Report

4.3.1 Landing Emissions

- Tank ID
- Tank Type
- Description
- City
- State
- Company
- Number of Days
- Month
- Floating Roof Leg Height
- Roof Landing Heel Height
- Roof Landing Heel Type
- Landing Chemical
- Refill Chemical
- Standing Losses (lb)
- Filling Losses (lb)
- Total Losses (lb)

4.3.2 Cleaning Emissions

- Tank ID

- Tank Type
- Description
- City
- State
- Company
- Month Cleaning Occurred
- Number of Days Idle
- Number of Days Cleaning
- Number of Days Ventilation
- Cleaning Heel Type
- Floating Roof Leg Height
- Liquid Height
- Has Sump?
- Sump Diameter
- Sump Depth
- Solvent Added?
- Solvent Category
- Solvent Name
- Solvent Density
- Solvent Molecular Weight
- Solvent Antoine A
- Solvent Antoine B
- Solvent Antoine C
- Solvent Depth
- Average Ventilation Rate
- Control Efficiency
- Calibration Gas
- Purge Controlled?
- Cleaning Chemical
- Total Purge Losses (lb)
- Total Controlled Forced Ventilation Losses (lb)
- Total Losses (lb)
- Day 1 - Average Concentration (ppmv)
- Day 1 - Ventilation Time (hr/day)
- Day 1 - Average Sludge Depth (in)
- Day 1 - Was Ventilation Stopped?
- Day 1 - Were Emissions Routed to a Control Device?
- Information for Day 1 continues for the number of days in which forced ventilation was used

5.0 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 6.

If data for a custom mixture, custom petroleum liquid, or custom organic liquid are changed after being added to a tank, you will need to edit the Contents in the Tank Data page to reselect the custom mixture, custom petroleum liquid, or custom organic liquid before calculating emissions. This is a known issue that will be corrected in a future version.

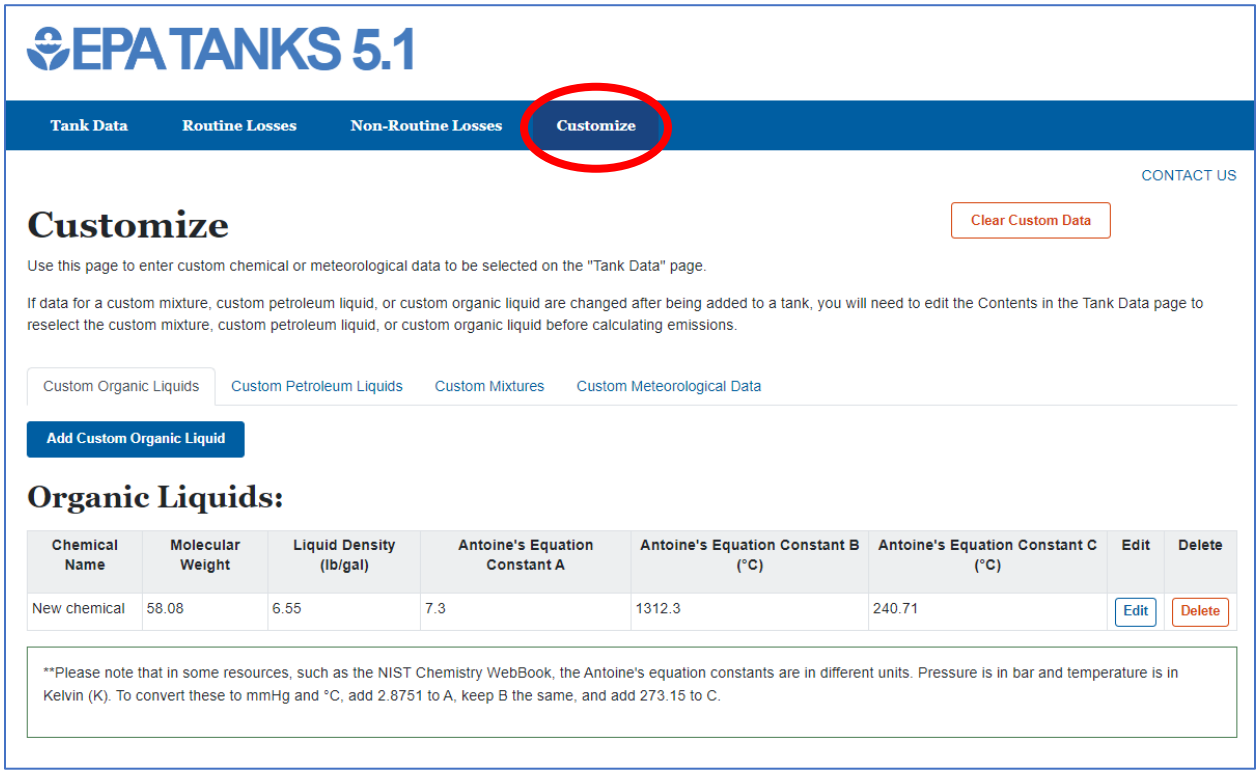

Figure 6. Screenshot of TANKS 5.1 "Customize" Page

Note that clicking "Clear Custom Data" removes the custom entries from all categories. This cannot be undone. However, if you have a Tank Data file that uses these custom entries, you can simply go back to the "Tank Data" tab and click "Import Tank Data" again.

5.1 Entering Custom Data

5.1.1 Custom Organic Liquids

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 selecting the chemical from the drop-down list using Template Chemical. You can then adjust the required fields as needed.

5.1.2 Custom Petroleum Liquids

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)
- Whether the petroleum liquid is a crude oil
- 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.

5.1.3 Custom Mixtures

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.

5.1.4 Custom Meteorological Data

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

- Location Name
- Monthly Data:
  - Average Maximum Ambient Temperature (°F)
  - Average Minimum Ambient Temperature (°F)
  - Average Wind Speed (mph)
  - Average Daily Total Insolation Factor (Btu/ft^2/day)
- Annual Data:
  - Average Maximum Ambient Temperature (°F)
  - Average Minimum Ambient Temperature (°F)
  - Average Wind Speed (mph)
  - Average Daily Total Insolation Factor (Btu/ft^2/day)
  - Average Atmospheric Pressure (psi)

5.2 Sources for Custom Data

5.2.1 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*.
  - Boublík, 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 WebBook, which is available online at: http://webbook.nist.gov/chemistry/.

****Please note that in some resources, such as the NIST Chemistry WebBook, 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.**

5.2.2 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/.

6.0 Typical Deck Fittings by Tank Type

Deck Fitting	Fitting/Cover Type	Quantity	Typical for EFRT?	Typical for DEFRT?	Typical for IFRT?	Notes
Access Hatch	Bolted Cover, Gasketed	1	Y	Y	N	
Access Hatch	Unbolted Cover, Gasketed	1	N	N	N	
Access Hatch	Unbolted Cover, Ungasketed	1	N	N	Y	
Fixed Roof Support Column Well	Built-Up Column, Gasketed Sliding Cover	1	N	N	N	A
Fixed Roof Support Column Well	Built-Up Column, Ungasketed Sliding Cover	1	N	N	Y	A
Fixed Roof Support Column Well	Round pipe, Flexible Fabric Sleeve Seal	1	N	N	N	A
Fixed Roof Support Column Well	Round pipe, gasketed sliding cover	1	N	N	N	A
Fixed Roof Support Column Well	Round pipe, ungasketed sliding cover	1	N	N	N	A
Unslotted Guidepole and Well	Ungasketed Sliding Cover	1	Y	Y	N	
Unslotted Guidepole and Well	Ungasketed Sliding Cover with pole sleeve	1	N	N	N	
Unslotted Guidepole and Well	Gasketed Sliding Cover	1	N	N	N	
Unslotted Guidepole and Well	Gasketed Sliding Cover with pole wiper	1	N	N	N	
Unslotted Guidepole and Well	Gasketed Sliding Cover with pole sleeve	1	N	N	N	
Slotted Guidepole/Sample Well	Ungasketed or gasketed Sliding Cover	1	N	N	N	
Slotted Guidepole/Sample Well	Ungasketed or gasketed Sliding Cover, with float	1	N	N	N	
Slotted Guidepole/Sample Well	Gasketed sliding cover, with pole wiper	1	N	N	N	
Slotted Guidepole/Sample Well	Gasketed sliding cover, with pole sleeve	1	N	N	N	
Slotted Guidepole/Sample Well	Gasketed sliding cover, with pole sleeve and pole wiper	1	N	N	N	
Slotted Guidepole/Sample Well	Gasketed sliding cover, with float and pole wiper	1	N	N	N	
Slotted Guidepole/Sample Well	Gasketed sliding cover, with float, pole sleeve, and pole wiper	1	N	N	N	
Slotted Guidepole/Sample Well	Flexible enclosure	1	N	N	N	
Gauge-float Well (Automatic Gauge)	Bolted Cover, Gasketed	1	N	N	N	
Gauge-float Well (Automatic Gauge)	Unbolted Cover, Gasketed	1	N	N	N	
Gauge-float Well (Automatic Gauge)	Unbolted Cover, Ungasketed	1	Y	Y	Y	
Gauge-hatch/Sample Port	Weighted Mech. Actuation, Gask.	1	Y	Y	N	
Gauge-hatch/Sample Port	Weighted Mech. Actuation, Ungask.	1	N	N	N	
Gauge-hatch/Sample Port	Slit Fabric Seal 10% Open area	1	N	N	Y	
Vacuum Breaker	Weighted Mech. Actuation, Gask.	1	Y	Y	Y	

Notes:
IFRT = Internal Floating Roof Tan
EFRT = External Floating Roof Tank
DEFRT = Domed Floating Roof Tank
A = Not used with self-supporting roofs.
B = Not used on welded internal floating roof tanks.
C = Not used on pontoon floating roof tanks, only double deck roofs
D = Used only with mechanical shoe primary seals

Deck Fitting	Fitting/Cover Type	Quantity	Typical for EFRT?	Typical for DEFRT?	Typical for IFRT?	Notes
Vacuum Breaker	Weighted Mech. Actuation, Ungask.	1	N	N	N	
Deck Drain	Stub drain (1 inch diameter)	1	N	N	Y	B
Deck Drain	Open	1	Y	Y	N	
Deck Drain	90% closed	1	N	N	N	
Deck Leg	Adjustable	1	N	N	Y	
Deck Leg (Pontoon area of pontoon roofs)	Adjustable - ungasketed	1	Y	Y	N	
Deck Leg (Pontoon area of pontoon roofs)	Adjustable - gasketed	1	N	N	N	
Deck Leg (Pontoon area of pontoon roofs)	Adjustable - sock	1	N	N	N	
Deck Leg (Double-deck roofs and center area of pontoon roofs)	Adjustable - ungasketed	1	Y	Y	N	C
Deck Leg (Double-deck roofs and center area of pontoon roofs)	Adjustable - gasketed	1	N	N	N	
Deck Leg (Double-deck roofs and center area of pontoon roofs)	Adjustable - sock	1	N	N	N	
Deck Leg or Hanger (No opening through deck)	Fixed	1	N	N	N	
Rim Vent	Weighted Mech. Actuation, Gask.	1	Y	Y	N	D
Rim Vent	Weighted Mech. Actuation, Ungask.	1	N	N	N	D
Ladder Well	Sliding Cover, Gasketed	1	N	N	N	A
Ladder Well	Sliding Cover, Ungasketed	1	N	N	Y	A
Ladder-slotted Guidepole Combination Well	Sliding cover, ungasketed	1				
Ladder-slotted Guidepole Combination Well	Ladder sleeve, ungasketed sliding cover	1				
Ladder-slotted Guidepole Combination Well	Ladder sleeve, gasketed sliding cover	1				

Notes:
IFRT = Internal Floating Roof Tan
EFRT = External Floating Roof Tank
DEFRT = Domed Floating Roof Tank
A = Not used with self-supporting roofs.
B = Not used on welded internal floating roof tanks.
C = Not used on pontoon floating roof tanks, only double deck roofs
D = Used only with mechanical shoe primary seals

7.0 Definitions

Antoine's Equation. A correlation between vapor pressure and temperature for organic liquids. The pressure unit is mmHg and the temperature unit is degrees Celsius.

$$\log P_{VA} = A - \left(\frac{B}{T_{LA} + C} \right)$$

where:

log = log 10
A = constant in vapor pressure equation, dimensionless
B = constant in vapor pressure equation, °C
C = constant in vapor pressure equation, °C
T_{LA} = average daily liquid surface temperature, °C
P_{VA} = vapor pressure at average daily liquid surface temperature, mm Hg

Antoine's Equation Constant A. The A constant used in the Antoine's equation. It is dimensionless.

Antoine's Equation Constant B. The B constant used in the Antoine's equation. The unit is degrees Celsius.

Antoine's Equation Constant C. The C constant used in the Antoine's equation. The unit is degrees Celsius.

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 loss calculations.

City. This is an optional field used to identify the city in which the storage tank is located. This may be different from the City chosen for Meteorological Location.

Company. This is an optional field used to identify the company which owns or uses the storage tank.

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

Deck Fittings. For each fitting type, choose the appropriate cover from the drop-down menu and enter the count. The corresponding loss factors from AP-42 Chapter 7, Table 7.1-12 will be applied within TANKS 5.1. For a list of typical deck fittings by tank type, see Section 6.0.

Deck Roof Type. Choose Double-deck or Pontoon from the drop-down menu. This is only for external floating roof tanks.

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. There is also an option to add custom sheet width or custom panel length and custom panel width. This is only for internal floating roof tanks.

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

Description. This is an optional field where you may enter any information about a tank record.

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.

Effective Column Diameter. This is the average column diameter in feet. Once you choose the type of column from the drop-down menu, TANKS 5.1 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 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.

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.

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.

Internal Floating Roof Tanks. This type of tank has both a permanent fixed roof and a floating deck. There are two basic types of internal floating roof tanks: tanks in which the fixed roof is supported by vertical columns within the tank, and tanks with a self-supporting fixed roof and no internal support columns.

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 Gunite 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 5.1 will calculate the liquid bulk temperature using the appropriate equation in AP-42 Chapter 7.

Liquid Density. This is a measure of a material's mass per unit of volume. The liquid density of the mixture should be given in pounds per gallon at 60°F.

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

Liquid Molecular Weight. The molecular weight of the component or mixture should be given in pound per pound mole (lb/lb-mole). When a chemical from the chemical database is used, the program provides this weight from the chemical database.

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.

Meteorological Location.. This is the meteorological location of the tank. You can choose from Chapter 7 of AP-42 locations or custom locations. [See section 6.1.4.]

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

Molecular Weight. The sum of the atomic masses of all atoms in a molecule, based on a scale in which the atomic masses of hydrogen, carbon, nitrogen, and oxygen are 1, 12, 14, and 16, respectively.

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 fixed roof 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.

Rankine. To convert temperatures in degrees Fahrenheit (°F) to Rankine, add 459.67 to the temperature in Fahrenheit.

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 Primary Only / 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. It is not appropriate to use the values for tight-fitting seals unless the seal is known to be maintained with gaps no greater than 1/8 inch through the full range of liquid level in the tank.

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 should be at least 5 feet.

Shell Height. This is the actual height of the tank in feet. This should be between 5 and 80 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.

Speciation Option: Full Speciation. Selecting this option means that you will provide the names of each chemical component. The program will calculate the vapor pressure and other data for the entire mixture. After selecting Full Speciation, click on “Chemicals to Speciate”. The program uses Raoult’s Law for calculating speciated estimates. These calculations assume that the mixture is homogenous and made up of components with similar true vapor pressures; they also assume that the mixture behaves ideally.

Speciation Option: None. Selecting this option means that you will not specify any chemical components. When using this option, you will not be able to obtain emissions estimates for individual components.

Speciation Option: Partial Speciation. Selecting this option means that you will identify any chemical components for which an emissions estimate is required. For each component that you list and provide the concentration, the report will calculate the air emissions for the component in

addition to calculating emissions of the total mixture. For example, use this option if you know your gasoline (RVP 7) has 4 percent benzene (or a mole fraction of 0.04) and want to know the emissions of gasoline and of benzene.

State. This is an optional field used to identify the state in which the tank is located. This may be different from the State chosen for Meteorological Location.

Tank ID. This field is the user-defined unique identifier for the tank. The ID can consist of any combination of letters, numbers, symbols, or spaces.

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 Molecular Weight. The molecular weight of the vapor should be given in lb/lb-mole.

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

Vapor Pressure Equation. A correlation describing the relation between vapor pressure and temperature for petroleum liquid stocks. The pressure unit is psia and the temperature unit is degrees Rankine.

$$P_{VA} = \exp\left[A - \left(\frac{B}{T_{LA}}\right)\right]$$

where:

exp	=	exponential function
A	=	constant in the vapor pressure equation, dimensionless
B	=	constant in the vapor pressure equation, °R
T_{LA}	=	average daily liquid surface temperature, °R

P_{VA} = true vapor pressure, psia

Vapor Pressure Equation Constant A. The A constant used in the vapor pressure equation. It is dimensionless.

Vapor Pressure Equation Constant B. The B constant used in the vapor pressure equation. The unit is degrees Rankine**.**

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.

8.0 Error Messages

Average Liquid Height. Values must be greater than zero, less than or equal to the maximum liquid height, and rounded to the nearest thousandths.

Maximum Liquid Height. Values must be greater than zero, less than or equal to the tank shell height, and rounded to the nearest thousandth.

Minimum Liquid Height. Values must be greater than or equal to zero, less than or equal to the maximum liquid height, and rounded to the nearest thousandths.

Number of Days in which Forced Ventilation was Used. Values must be greater than zero, less than or equal to 31, and rounded to the nearest integer.

Shell Diameter. Values must be greater than or equal to five and rounded to the nearest thousandth.

Shell Height: Values must be greater than or equal to 5, less than or equal to 80, and rounded to the nearest thousandth.

Shell Length. Values must be greater than or equal to 5, less than or equal to 6 times the shell diameter, and rounded to the nearest thousandth. [for horizontal fixed roof tanks]

Shell Side 1 Length. Values must be greater than or equal to 5, less than or equal to 6 times the shell diameter, and rounded to the nearest thousandth. [for rectangular vertical fixed roof tanks]

Shell Side 2 Length. Values must be greater than or equal to 5, less than or equal to 6 times the shell diameter, and rounded to the nearest thousandth. [for rectangular vertical fixed roof tanks]

Shell Side Length. Values must be greater than or equal to 5, less than or equal to 6 times the shell diameter, and rounded to the nearest thousandth. [for square vertical fixed roof tanks]

Vapor Space Pressure at Normal Operating Conditions. Values must be 0 to 15 psig rounded to the nearest thousandth.

9.0 Meteorological Locations by State

CITY	STATE
Birmingham	Alabama
Huntsville	Alabama
Mobile	Alabama
Montgomery	Alabama
Anchorage	Alaska
Annette	Alaska
Barrow	Alaska
Bethel	Alaska
Bettles	Alaska
Big Delta	Alaska
Cold Bay	Alaska
Fairbanks	Alaska
Gulkana	Alaska
Homer	Alaska
Juneau	Alaska
King Salmon	Alaska
Kodiak	Alaska
Kotzebue	Alaska
Mcgrath	Alaska
Nome	Alaska
St. Paul Island	Alaska
Talkeetna	Alaska
Unalakleet	Alaska
Valdez	Alaska
Yakutat	Alaska
Phoenix	Arizona
Prescott	Arizona
Tucson	Arizona
Fort Smith	Arkansas
Little Rock	Arkansas
Arcata	California
Bakersfield	California
Bishop	California
Daggett	California
Fresno	California
Long Beach	California
Los Angeles AP	California
Redding	California
Sacramento	California
San Diego	California
San Francisco AP	California
Santa Barbara	California
Santa Maria	California
Stockton	California
Alamosa	Colorado
Colorado Springs	Colorado
Denver	Colorado
Grand Junction	Colorado
Limon	Colorado
Pueblo	Colorado
Bridgeport	Connecticut
Hartford	Connecticut
Wilmington	Delaware
Daytona Beach	Florida
Fort Myers	Florida
Gainesville	Florida
Jacksonville	Florida
Key West	Florida
Miami	Florida
Orlando	Florida
Pensacola	Florida
Tallahassee	Florida
Tampa	Florida
Vero Beach	Florida
West Palm Beach	Florida
Athens	Georgia
Atlanta	Georgia
Augusta	Georgia
Columbus	Georgia
Macon	Georgia
Savannah	Georgia
Hilo	Hawaii
Honolulu	Hawaii
Kahului	Hawaii
Lihue	Hawaii
Boise	Idaho
Lewiston	Idaho
Pocatello	Idaho
Chicago	Illinois
Moline	Illinois
Peoria	Illinois
Rockford	Illinois
Springfield	Illinois
Evansville	Indiana
Fort Wayne	Indiana
Indianapolis	Indiana
South Bend	Indiana
Des Moines	Iowa
Dubuque	Iowa
Mason City	Iowa
Sioux City	Iowa
Waterloo	Iowa
Concordia	Kansas
Dodge City	Kansas
Goodland	Kansas
Russell	Kansas
Topeka	Kansas
Wichita	Kansas
Cincinnati	Kentucky
Jackson	Kentucky
Lexington	Kentucky
Louisville	Kentucky
Paducah	Kentucky
Baton Rouge	Louisiana
Lake Charles	Louisiana
New Orleans	Louisiana
Shreveport	Louisiana
Bangor	Maine
Caribou	Maine
Portland	Maine
Baltimore	Maryland
Boston	Massachusetts
Worcester	Massachusetts

CITY	STATE
Alpena	Michigan
Detroit Metro AP	Michigan
Detroit	Michigan
Flint	Michigan
Grand Rapids	Michigan
Houghton Lake	Michigan
Lansing	Michigan
Muskegon	Michigan
Sault St. Marie	Michigan
Traverse City	Michigan
Duluth	Minnesota
International Falls	Minnesota
Minneapolis-St. Paul	Minnesota
Rochester	Minnesota
St. Cloud	Minnesota
Jackson	Mississippi
Meridian	Mississippi
Tupelo	Mississippi
Columbia	Missouri
Kansas City	Missouri
Springfield	Missouri
St. Louis - Lambert	Missouri
St. Louis - Sprit	Missouri
Billings	Montana
Glasgow	Montana
Great Falls	Montana
Harve City	Montana
Helena	Montana
Kalispell	Montana
Missoula	Montana
Grand Island	Nebraska
Lincoln	Nebraska
Norfolk	Nebraska
North Platte	Nebraska
Omaha	Nebraska
Scotts Bluff	Nebraska
Valentine	Nebraska

CITY	STATE
Ely	Nevada
Las Vegas	Nevada
Lovelock	Nevada
Mercury	Nevada
Reno	Nevada
Tonopah	Nevada
Winnemucca	Nevada
Concord	New Hampshire
Atlantic City	New Jersey
Newark	New Jersey
Albuquerque	New Mexico
Gallup	New Mexico
Roswell	New Mexico
Albany	New York
Binghamton	New York
Buffalo	New York
New York - LaGuardia AP	New York
Long Island	New York
Massena	New York
New York - Kennedy	New York
Rochester	New York
Syracuse	New York
Asheville	North Carolina
Charlotte	North Carolina
Greensboro	North Carolina
Raleigh-Durham	North Carolina
Wilmington	North Carolina
Bismarck	North Dakota
Fargo	North Dakota
Minot	North Dakota
Williston	North Dakota
Akron	Ohio
Cleveland	Ohio
Columbus	Ohio
Dayton	Ohio
Mansfield	Ohio
Toledo	Ohio
Youngstown	Ohio

CITY	STATE
Oklahoma City	Oklahoma
Tulsa	Oklahoma
Astoria	Oregon
Burns	Oregon
Eugene	Oregon
Medford	Oregon
Pendleton	Oregon
Salem	Oregon
Allentown	Pennsylvania
Bradford	Pennsylvania
Erie	Pennsylvania
Middletown	Pennsylvania
Philadelphia	Pennsylvania
Pittsburgh	Pennsylvania
Scranton	Pennsylvania
Williamsport	Pennsylvania
Providence	Rhode Island
Charleston	South Carolina
Columbia	South Carolina
Greer	South Carolina
Aberdeen	South Dakota
Huron	South Dakota
Pierre	South Dakota
Rapid City	South Dakota
Sioux Falls	South Dakota
Bristol	Tennessee
Chattanooga	Tennessee
Knoxville	Tennessee
Memphis	Tennessee
Nashville	Tennessee
Abilene	Texas
Amarillo	Texas
Austin	Texas
Brownsville	Texas
Corpus Christi	Texas
Dallas-Fort Worth	Texas
El Paso	Texas
Houston	Texas
Lubbock	Texas

CITY	STATE
Lufkin	Texas
Midland	Texas
Port Arthur	Texas
San Angelo	Texas
San Antonio	Texas
Victoria	Texas
Waco	Texas
Cedar City	Utah
Salt Lake City	Utah
Burlington	Vermont
DC - Dulles	Virginia
DC-Reagan	Virginia
Lynchburg	Virginia

CITY	STATE
Norfolk	Virginia
Richmond	Virginia
Roanoke	Virginia
Olympia	Washington
Quillayute	Washington
Seattle	Washington
Spokane	Washington
Stampede Pass	Washington
Yakima	Washington
Beckley	West Virginia
Charleston	West Virginia
Elkins	West Virginia
Huntington	West Virginia

CITY	STATE
Eau Claire	Wisconsin
Green Bay	Wisconsin
La Crosse	Wisconsin
Madison	Wisconsin
Milwaukee	Wisconsin
Casper	Wyoming
Cheyenne	Wyoming
Lander	Wyoming
Rock Springs	Wyoming
Sheridan	Wyoming

10.0 Cities with Alternate Meteorological Data

For some of the cities in the Meteorological Database, monthly wind speed data or solar insolation factors were not available. For each of these cities, meteorological data from another city were used. The following is a list of these cities and the corresponding city from which the missing data were taken:

City	City used for Insolation Factors
Unakleet, AK	Nome, AK
Valdez, AK	Yakutat, AK
Bishop, CA	Fresno, CA
Redding, CA	Sacramento, CA
Santa Barbara, CA	Santa Maria, CA
Stockton, CA	Sacramento, CA
Fort Myers, FL	Tampa, FL
Gainsville, FL	Tallahassee, FL
Pensacola, FL	Mobile, AL
Vero Beach, FL	West Palm Beach, FL
Columbus, GA	Macon, GA
Dubuque, IA	Moline, IL
Concordia, KS	Grand Island, NE
Jackson, KY	Lexington, KY
Paducah, KY	Evansville, IN
Muskegon, MI	Grand Rapids, MI
Sault St. Marie, MI	MI Green Bay, WI
Tupelo, MS	Memphis, TN
Lincoln, NE	Omaha, NE
Valentine, NE	North Platte, NE
Williston, ND	Glasgow, MT
Aberdeen, SD	Sioux Falls, SD
Beckley, WV	Charleston, WV

City	City used for Wind Speed Data
Unakleet, AK	Nome, AK
Bishop, CA	Fresno, CA
Lewiston, ID	Boise, ID
Dubuque, IA	Moline, IA