
PRODUCTION TANK EMISSIONS MODEL

E&P TANK VERSION 2.0 USER'S MANUAL

A PROGRAM FOR ESTIMATING EMISSIONS FROM HYDROCARBON PRODUCTION TANKS

REGULATORY AND SCIENTIFIC AFFAIRS
SOFTWARE NUMBER 4697
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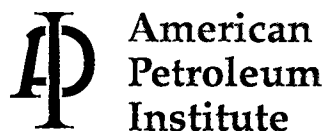
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ABSTRACT

For regulatory purposes, the petroleum industry's exploration and production (E&P) sector may be required to estimate and report certain emissions for petroleum production tank batteries currently in service. As a consequence, the American Petroleum Institute (API) and GRI jointly supported the development of a comprehensive software package for the estimation of emissions from hydrocarbon production tanks. The foundation of the software package, entitled *Production Tank Emissions Model (E&P TANK Version 2.0)*, is based upon rigorous thermodynamic principles or, in some cases, upon kinetic models well accepted by industry and the U.S. Environmental Protection Agency (USEPA). This version of E&P TANK uses a 32-bit user-friendly graphic interface to complement the established functionalities of the previous version. Special attention has been paid to the program interface design, making it user-friendly and easily understandable to those with a basic knowledge of Windows™. Validation of the models in E&P TANK Version 2.0 has been completed with good agreement between model predictions and field data.

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Chapter 1 Introduction

Welcome

Welcome to E&P TANK Version 2.0, a software program that predicts hydrocarbon emissions from production oil tanks. This version of E&P TANK uses a 32-bit user-friendly graphic interface to complement the established functionalities of the previous version.

About E&P TANK Version 2.0

There are approximately one-quarter million petroleum production tank batteries currently in service for the petroleum industry's exploration and production (E&P) sector. Tank operators may be required to quantify and report certain tank emissions. These may include both Hazardous Air Pollutants (HAPs) and Volatile Organic Compounds (VOCs). The following table shows the types of HAPs and VOCs considered in this program.

<i>HAPs</i>		<i>VOCs</i>
Benzene	Methane	Heptanes
Toluene	Ethane	Octanes
Ethyl-Benzene	Propane	Nonanes
Xylenes	n-Butane	Benzene
n-Hexane	i-Butane	Toluene
	n-Pentane	Ethyl-Benzene
	i-Pentane	Xylenes
	n-Hexane	Decanes+
	Hexanes	

A study previously undertaken by the API evaluated alternatives for quantifying the hydrocarbon emissions from petroleum production tanks [1]. The study concluded that direct field sampling and analysis from each production tank were deemed not feasible from economic and technical viewpoints. Therefore, development of a computer-based simulator for estimating emissions was recommended.

The calculation algorithm of this software follows the recommendation of a previous API study [1]. A steady-state model is used to simulate petroleum production tank operations. The contribution by flash losses to the total vent from the tanks is calculated rigorously according to thermodynamic principles. The working and standing losses are simulated differently depending upon the nature of the tank. For oil production tanks, the working and standing losses are represented by a distillation column or a flash operation, either of which will generate a certain amount of vaporization so that the characteristics of the produced liquid matches the sales oil

specifications such as Reid Vapor Pressure (RVP). In addition, a modified AP-42 method may be used instead of the Distillation Column method for calculating working and standing losses from oil production tanks. For storage tanks containing stable oil or sales oil, the work and standing losses are calculated by a modified AP-42 method.

The calculation accuracy of E&P TANK Version 2.0 has been confirmed by comparing its predictions with HYSIM[®], a commercially available simulator from Hyprotech Ltd., Calgary. This comparison confirmed the calculation procedures and algorithms of the program. In addition, plant data measurements conducted by Radian International L.L.C. further validated the accuracy of the E&P TANK program as the field data were compared with E&P TANK predictions.

Chapter 2 Installation

Installing E&P TANK Version 2.0 is a simple process. This chapter explains everything you need to know regarding installation of E&P TANK Version 2.0.

Installation Requirements

Hardware Requirements

- 486 or Higher PC Compatibles (Pentium recommended)
- 8 MB RAM
- 2 MB Free Hard Disk Space
- Printer (optional)

Software Requirements

- Microsoft Windows 95/98/NT 4.0 (or later)

Installing E&P TANK Version 2.0

Note: *If you want to install E&P TANK Version 2.0 and there is already a previous version of E&P TANK on your system, please uninstall the existing version first. For further information on uninstalling, refer to your Microsoft Windows Help system.*

To install E&P TANK Version 2.0

1. Insert the E&P TANK Version 2.0 Disk 1 into a floppy disk drive.
2. Click **Start** on the Microsoft Windows Taskbar and then click **Run**.
3. At the **Run** dialog, type **a:\Setup32** or **b:\Setup32** to execute the automatic installation process.
4. Follow the installation instructions on the screen.

After the installation process is complete, the E&P TANK program group will be created.

Technical Support

DB Robinson Research Ltd. provides technical support for E&P TANK Version 2.0. Should you have technical problems that cannot be solved using the on-line help or the user's manual, please contact our software technical support staff at:

Telephone: (780) 463-8638
Fax: (780) 450-1668
E-mail: support@dbra.com

Before contacting DB Robinson Research Ltd., it is suggested that the following information pertaining to the problem be gathered in order to identify the problem as quickly as possible.

If the problem is related to **installing E&P TANK Version 2.0**, record:

- the product version number
- the hardware configuration of your computer (e.g., Pentium 200 MHz)
- the operating system and version number (e.g., Windows 95)
- the exact wording of any error messages (if applicable)

If the problem is related to **running E&P TANK Version 2.0**, record:

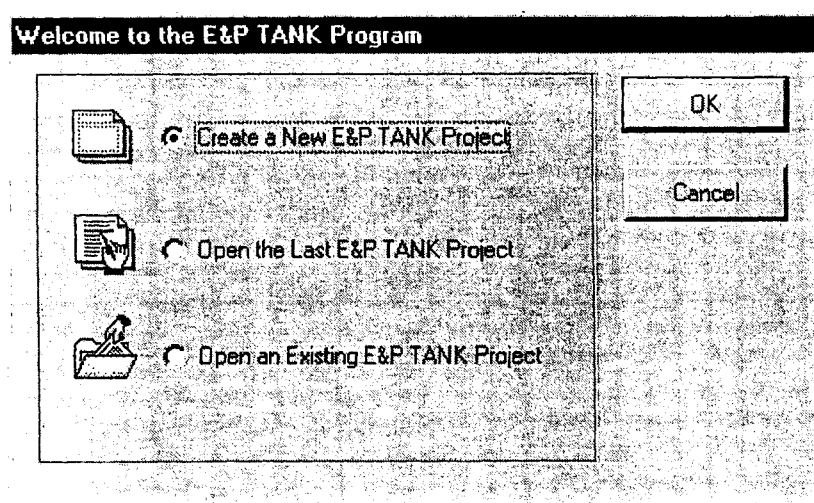
- the exact wording of any error messages (if applicable)
- the input data used
- what you were doing when the problem occurred
- your attempt in solving the problem

Chapter 3 Getting Started

Starting and Exiting E&P TANK Version 2.0

To start E&P TANK

1. From the Windows **Start** Taskbar, click **Program** and select **E&P TANK Version 2.0**.



Welcome to the E&P TANK Program

2. In the **Welcome to the E&P TANK Program** dialog, click to open a new project, the last project, or an existing project and click **OK**.

To exit E&P TANK

Do one of the following:

- Click **Exit** from the **File** menu.
- Click on the **Close Box** on the E&P TANK title bar.
- Right click on the E&P TANK title bar and select **Close**.

Accessing Online Help

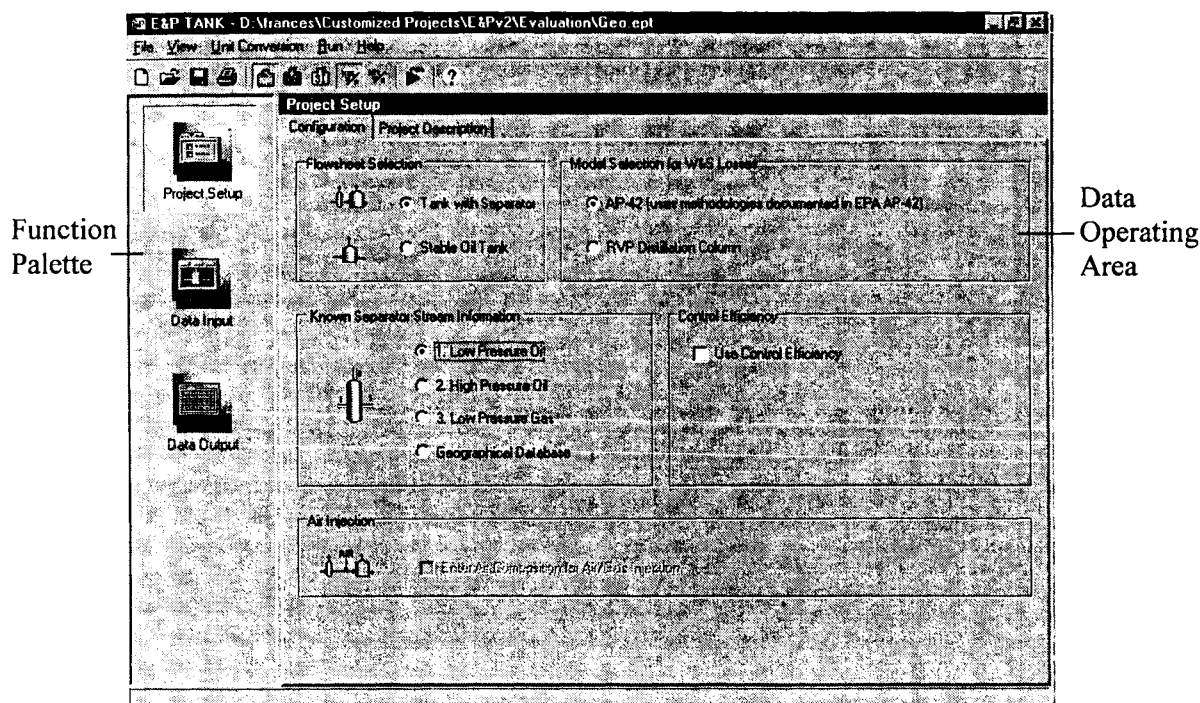
You can access the online help from the E&P TANK Help system:

- From the **Help** menu, select **Contents** or **Index**.
- Click **Help for Current Screen** on the E&P TANK toolbar.
- From within a dialog, click the **Help** button.

Application Window

There are two main working areas in the E&P TANK application window:

- Function Palette
- Data Operating Area



The E&P TANK Application Window

Located in the left pane, the Function Palette consists of navigating buttons. Upon clicking on a navigating button, the Data Operating Area to the right of the Function Palette displays the corresponding window. There are three operating windows in E&P TANK:

- Project Setup
- Data Input
- Data Output

Unit Conversions

There are two unit systems in E&P TANK: Engineering and SI units.

The two unit systems are convertible in any display windows in E&P TANK. Users can choose to view and enter data as well as to print calculation results in either of the units, regardless of which system was used in data input. Besides selecting the unit system, users may select mol % or wt % from the toolbar or the Unit Conversion menu.

Selecting & Converting Units

To select a unit system

Click on the appropriate unit buttons on the toolbar or select desired unit system from the Unit Conversion menu.

To perform unit conversions

Switch the unit systems from one unit system to another by clicking on the appropriate unit button on the toolbar. Results of unit conversions are displayed instantly upon the switch of the unit system.

Customizing a Unit System

The E&P TANK program allows you to customize your own unit combinations and save the combinations as the Customized unit.

To define a new unit in the Customized Unit systems

1. Select **Options...** from the **Unit Conversion** menu. A dialog appears.

The dialog box is titled "Unit Specification". It contains a table with four columns: Name, Eng. Unit, SI Unit, and Customized Unit. The table lists various units such as Pressure, Volume, Temperature, Distance, Density, Viscosity, Molecular Weight, Gas Productivity, Oil Productivity, GOR, API Gravity, and Heating Value. To the right of the table, there are input fields for "Engineering Unit", "SI Unit", and "Customized Unit", each with a dropdown menu and two input boxes labeled A and B. Below the table, there is a text box with instructions: "If the drop-down selection in the Customized Unit area does not have what you want, type in the desired unit and enter the conversion factors A & B into the appropriate boxes. The relationship is defined as: Customized_Unit_Value = A * Engineering_Unit_Value + B". At the bottom, there are buttons for "Default", "OK", and "Cancel".

Name	Eng. Unit	SI Unit	Customized Unit
Pressure	psi	kPa	psi
Volume	ft ³	m ³	ft ³
Temperature	F	C	F
Distance	ft	m	ft
Density	lb/ft ³	g/cm ³	g/cm ³
Viscosity	cP	mPa-s	cP
Molecular Weight	lb/lbmol	g/gmol	lb/lbmol
Gas Productivity	SCF/day	m ³ /day	SCF/day
Oil Productivity	bbl/day	m ³ /day	bbl/day
GOR	SCF/bbl	m ³ /m ³	SCF/bbl
API Gravity	API	API	API
Heating Value	BTU/SCF	MJ/m ³	BTU/SCF

Pressure
Engineering Unit: psi
SI Unit: kPa
A: 6.894740
B: 0.000000
Customized Unit: psi
A: 1.000000
B: 0.000000

If the drop-down selection in the Customized Unit area does not have what you want, type in the desired unit and enter the conversion factors A & B into the appropriate boxes.
The relationship is defined as:
$$\text{Customized_Unit_Value} = A * \text{Engineering_Unit_Value} + B$$

Default OK Cancel

Customized Units

2. In the **Unit Specification** dialog, click to select a unit name from the left pane.
3. Click on the down arrow next to the **Customized Unit** box to select a unit. If the desired unit is not listed, create it by typing the new unit over any existing unit in the list.
4. If it is a created unit, enter the conversion factors A and B in the appropriate boxes.
5. Click **OK** to exit the dialog.

Chapter 4 Using E&P TANK Version 2.0

This chapter will assist users in starting and setting up a new project, providing input data, as well as viewing and printing calculation results.

E&P TANK Basic Steps

The basic steps to create a project using E&P TANK 2.0 are as follows:

1. Open a new project.
2. In the Project Setup window:
 - Select a flowsheet and a calculation model
 - Specify necessary setup information
3. In the Data Input window, provide inputs via hotspots (devices or flow lines) on the input flowsheet.
4. Execute calculations.
5. View and print results.
6. Save the project.

Project Setup

Project Setup

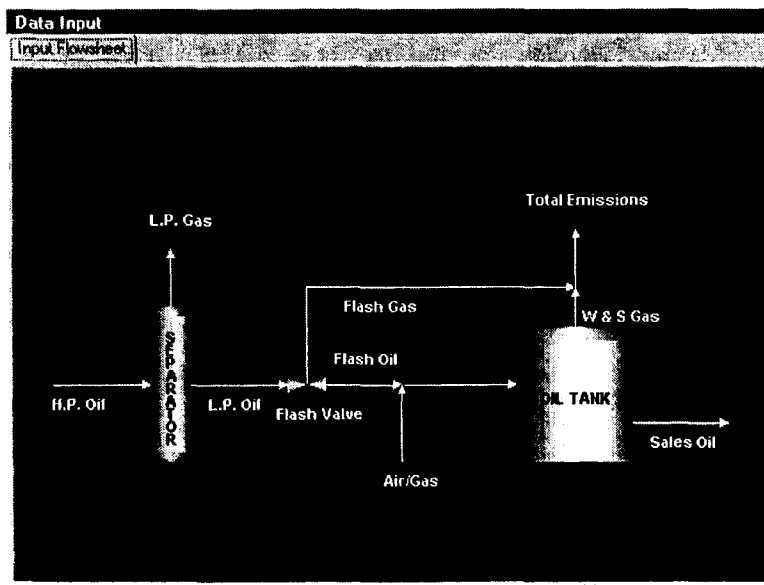
To setup a project

1. In the Project Setup window, select the flowsheet type from the **Configuration** tab.
2. Select a model to calculate working and standing (W&S) losses. Regardless of which model you select in step 2, E&P TANK uses the Peng-Robinson equation of state to calculate flash loss.
3. If the flowsheet with separator was selected in Step 1, select a separator stream in which compositional information is known.
4. Click to select **Control Efficiency** and specify the percentage, if desired.
5. If you select flowsheet with separator and RVP as calculation model, the Air Injection option will be available for you to specify the daily air injection.
6. Provide project description in the **Project Description** tab, if desired.

Note: *If Distillation Column is selected in step 2, E&P TANK will by default use multi-stage distillation to estimate W&S losses. Only when the multi-stage distillation method fails, the program switches to single-stage distillation.*

Data Input

The Data Input flowsheet is object oriented. The flowsheet changes according to your project setup. Hotspots are colored green in the flowsheet.



Input Flowsheet: Tank with Separator

Some but not all of the following inputs are required for each project:

- Separator
- Stable Oil Tank

- Stable Oil and Sales Oil
- Flash Valve Inputs
- Air Injection

Separator

Users enter the input data such as separator conditions and detailed compositional data for separator oil or gas. The input varies according to your selection of **Known Separator Stream Information** in the Project Setup window.

Data Input for Low Pressure or High Pressure Oil

If Low Pressure Oil or High Pressure Oil is selected as the known separator stream in Project Setup, an input dialog similar to the one shown in the following will appear when you click on the **Separator** hotspot.

To input data for the LP/HP Oils

1. Click on the **Separator** hotspot on the Input Flowsheet. The input dialog appears.

Low Pressure Oil Input



Separator Conditions

Pressure: 23.0 [psia] Temperature: 85.0 [F]

Compositions

No.	Component	mol. %
1	H2S	0.0508
2	O2	0.0000
3	CO2	0.2437
4	N2	0.0102
5	C1	0.9543
6	C2	0.6701
7	C3	2.1827
8	i-C4	1.1269
9	n-C4	4.6091
10	i-C5	3.1066

Total = 100.0000

C10+ Characterization

Item	Data
MW	166.0000
SG	0.8990

Normalize OK Cancel Help

Separator: Low Pressure Oil Input

2. Provide separator pressure and temperature.
3. Enter the compositions for the low-pressure or high-pressure oil.