TANKS Problems That Are Resolved In TankESP

TANKS 4.09d (TANKS) and TankESP are both intended to be based on AP-42 methodology, however, there are numerous problems associated with the use of TANKS as summarized below. **The EPA website for TANKS now has a warning in bold red font which states that the program is "outdated [and] not reliably functional," and that they no longer provide assistance in its use and it is to be used "at your own risk**."

Monthly Emissions Estimates. TANKS applies monthly ambient temperature data when calculating monthly emissions, but the annual average value for the liquid bulk temperature. It would be more appropriate to calculate the liquid bulk temperature on a monthly basis as well. [Because of this error, EPA does not allow the use of TANKS for calculating the maximum true vapor pressure to be used for rule applicability determinations – per ADI 0500035.] **The EPA website now has a note expressly stating that TANKS should not be used to estimate monthly emissions.**

Fixed-Roof Tank Working Loss. When temperatures are well above 63°F, TANKS tends to overestimate emissions from unheated fixed-roof tanks (and, conversely, underestimates emissions when temperatures are well below 63°F). This is because TANKS uses an algorithm for estimating working losses that incorporates a temperature of 63°F, rather than treating the temperature as a variable.

API, in cooperation with EPA, developed a more general form of the working loss equation that treats temperature as a variable. API included this general form of the equation in the Third Edition of API 19.1, and EPA revised AP-42 Section 7.1 in 2006 to include it. It is this form of the working loss equation that is incorporated into TankESP. This improvement to the method for estimating working loss, however, has not been incorporated into EPA's TANKS program (and it likely never will be).

Liquid Bulk Temperature. TANKS does not accommodate tanks that receive warmer-than-ambient stock, but which are not heated. Such tanks should have the elevated stock temperature entered for the liquid bulk temperature, and then the AP-42 equations applied in order to determine the vapor space and liquid surface temperature ranges. In order to enter an other-than-ambient temperature in TANKS, however, the tank must be designated as heated, which introduces additional problems in TANKS (and is not even available for floating-roof tanks).

Heated Fixed-Roof Tanks. TANKS contains several default routines that hinder it from properly applying the equations of AP-42 to heated fixed-roof tanks. These include:

- TANKS requires the breather vent settings of heated tanks to be set at zero (*i.e.*, as if the tank were freely vented). This obviously introduces error for those tanks which have vent settings at other than zero.
- TANKS caps the calculated stock true vapor pressure at the value corresponding to 100°F when it uses vapor pressure Option 1, regardless of how high the temperature is that the user enters. For example, if the user selects 'Residual oil no. 6' as the stock, and enters a temperature of 300°F, TANKS will calculate the same true vapor pressure as at 100°F. This is obviously not correct.
- TANKS does not compute the vapor space and liquid surface temperature ranges for heated tanks – the user must enter these values. In order to properly determine these values, however, the user should perform calculations as indicated in AP-42. These calculations are quite tedious, and the user is often not familiar with them. The user then enters 'best-guess' values, and gets 'best-guess' results.
- TANKS automatically sets the vapor space temperature range for a heated tank equal to the liquid surface temperature range. This may be a reasonable assumption for tanks that are not only heated, but which are also insulated and have high vent settings (so that there is limited communication of the vapor space with ambient air, which TANKS doesn't even allow to be modeled, in that it requires the vent settings to be set at zero). This temperature range assumption, however, introduces significant error for tanks that are designated as heated, but which are not both insulated and equipped with high vent settings (in that the methodology of AP-42 results in a calculated vapor space temperature range that is twice that of the liquid surface temperature range – see AP-42 Figure 7.1-17).

Fixed-Roof Tank Working Capacity. TANKS calculates the tank capacity, and thereby the number of turnovers, on the basis of the shell height at the maximum liquid level. Most tanks, however, have a heel of liquid remaining in the bottom of the tank when emptied. The resulting overstatement of the tank capacity, and associated understatement of the number of turnovers, causes TANKS to overstate the turnover factor for fixed-roof tanks with a high turnover rate.

Validation of TankESP

The issues listed above are examples of calculations which are done in accordance with AP-42 by TankESP, but which have deviations from AP-42 in TANKS. It would be more appropriate, then, to validate TankESP by comparison to AP-42 rather than by comparison to TANKS.

Additional TANKS Issues

TANKS Issue	Resolution in TankESP
Guidepole. TANKS allows defaulting the guidepole configuration (with the default assumption being an uncontrolled, unslotted guidepole). The potential emissions from a guidepole in an EFRT, however, are such that any default for this fitting may result in a large error in the overall estimate of emissions.	Both TANKS and TankESP require the user to enter the rim seal configuration, rather than offering a default entry, due to the potential magnitude of the resulting emissions. TankESP similarly requires the user to make entries for the guidepole quantity and status (while allowing defaults for all other deck fittings).
Recalculate Deck Fittings. When a change has been made to the tank diameter, TANKS only recalculates deck fitting quantities if the deck fittings are shown as "Typical." Furthermore, if a change is made to the type of deck, TANKS only adjusts the deck fitting selections if "Typical" is shown. If a change has been made to any deck fitting (such as changing the control status from Ungasketed to Gasketed), then none of the deck fitting quantities will recalculate with a change in tank diameter, and none of the deck fitting selections will adjust with a change in the deck type.	When a change is made to the tank diameter, TankESP recalculates the quantity of each deck fitting that has not had an override entered for the quantity of that particular deck fitting. When a change is made to the type of deck, TankESP adjusts each deck fitting selection and quantity that does not have an override entry.
IFRT Deck Support Legs. TANKS allows changing the IFR deck support legs from "Roof Leg or Hanger Well" to "Roof Leg (3-in. Diameter)" without explaining that the latter is only appropriate for EFR-type deck legs {the 3-inch diameter is not the critical parameter, it is the 30-inch long or longer leg housing of an EFR-type deck (versus the 12-inch long housing typical of an IFR-type deck leg) that matters}.	TankESP does not allow combining EFR-type deck legs with an IFR-type deck. In order to model the deck legs as the taller EFR-type, the user must select an EFR-type deck (*i.e.*, a steel pontoon or double-deck type, which are available options for a tank with a fixed roof, resulting in the configuration that TANKS labels "Domed External Floating-Roof Tank").
EFRT Deck Support Legs. TANKS does not explain that deck legs for double-deck EFRs are similar to the center-area legs of pontoon EFRs (*i.e.*, an assumed 48-inch housing length), and thus the factors for "center area, sock" may be used when a double-deck EFR is equipped with leg socks (*cf.* API MPMS 19.2 Table 6).	TankESP allows selecting leg socks as a control level for a double-deck EFR, and appropriately applies the same emission factor as for a center-area leg of a pontoon-type EFR.
Change of Tank Type. If an alteration to a tank changes the tank type (*e.g.*, installing an IFR in a Fixed-Roof Tank, or installing a dome on an EFRT), TANKS requires the creation of a new tank record.	TankESP allows changing the type of fixed roof or floating roof within a tank record, and automatically recognizes the change in all calculations of future emissions (while retaining records for prior emissions based on the prior tank details).
Current Emission Factors. The following changes were made to emission factors in the September 2003 Edition of MPMS 19.2 and are now incorporated into AP-42 Table 7.1-12, but these changes have not been incorporated into TANKS: Deck Fitting — Old Factor — New Factor Uncontrolled Ladder Well — 76 — 98 Uncontrolled Column Well — 47 — 51 {The higher factor for the uncontrolled ladder well can be approximated in TANKS by including both a gasketed ladder well (emission factor = 56) and an uncontrolled slotted guidepole (emission factor = 43), rather than selecting an uncontrolled ladder well. This would also be appropriate for a ladder well that has a gasketed cover, but also has a slotted pipe for one leg of the ladder with no control of the slotted pipe.} Alternatively, the new factors can be added as a separate control status in TANKS, but the user will then need to know to not select the control status with the old factor.	TankESP uses the current emission factors.

Default Speciation Profiles. Version 4.09d of TANKS intended to change the name of the chemical previously listed as 2,2,4 trimethylpentane to iso-octane. An error in how this change was programmed, however, corrupted the default speciation profiles. EPA has issued a page of instructions for correcting this.	TankESP shows the name of this chemical as iso-octane, with 2,2,4 trimethylpentane shown in parentheses as a synonym. The default speciation profiles work just fine.
Solar Absorptance Factors. TANKS has not been updated to include the solar absorptance factors added in the 3rd Edition of API MPMS 19.1 and now incorporated into AP-42 Table 7.1-6, which include additional paint colors as well as a value for mill-finish aluminum (for use with aluminum geodesic domes). In the absence of these factors, the user has to pick from a menu of factors which may not apply to the tank in question.	TankESP includes all of the factors from the 3rd Edition of API MPMS 19.1 (now published in the 2006 revision to AP-42), which include mill-finish aluminum. This is helpful not only for aluminum domes, but also for insulated tanks (in which case the cladding is typically mill-finish aluminum). In that the insulation itself is typically even more effective than the paint color in impeding solar heat absorption into the tank, the mill-finish aluminum factor should always be applied for insulated tanks.
Bolted decks with dimensions other than those listed. TANKS does not automatically calculate the length of bolted deck seams unless the sheet width or panel dimensions match one of the options listed. For sheets or panels with differing dimensions, the user must calculate the total length of deck seam, then select an option that does not match the actual dimensions and override the length of deck seams calculated by TANKS.	TankESP allows the user to enter any dimensions for the sheet width or panel dimensions of bolted decks, and TankESP then automatically calculates the total length of deck seams. No side calculations by the user are required.
Fixed-roof tank volume. TANKS has an entry box for the Working Volume, even though the user has already entered the liquid height and diameter (for which an issue was noted above (under Working Capacity on page 1) concerning not accounting for the depth of heel). Working Volume is automatically calculated by TANKS, if the user enters data in the order anticipated by TANKS. If the user makes a change to a previously entered data entry, however, TANKS doesn't always recalculate the volume. If TANKS then doesn't like the value entered for volume, it gives an error message that the "volume, maximum shell height, and diameter" do not agree within 10%. This is confusing, because the error message is actually based on the maximum liquid height, not the shell height – so adjusting the volume to match the shell height will not make the error message go away.	TankESP calculates the working volume directly from the diameter, maximum liquid height, and depth of heel – and always recalculates the volume automatically when a change is made to any of these data entries. The user never calculates and enters the volume separately, and thus there is no potential for conflicting data entries.
Saving changes. TANKS prompts the user for whether changes are to be saved when closing a tank record. This allows the user to run "what-if" scenarios without overwriting the existing tank record, as long as the user does not save the changes – or so the user may think. In actuality, if the user runs a report of the what-if scenario, then TANKS automatically saves the changes to that tank record. The user may then click "No" to the "Save changes?" prompt and think that the original tank record has been preserved, when in fact it has been overwritten.	Any manner of what-if scenarios can be run in TankESP, and the original record will be maintained if the user simply closes the file without saving it. Should the user want to retain both the original and the edited versions, then the edited version simply needs to be saved to a different file name.
Monthly emissions. TANKS does not account for the actual number of days in each month, but rather simply divides the annual period by 12. This causes emissions for February to be overestimated by about 10%, with smaller errors in the other months.	TankESP bases monthly emission estimates on the actual number of days in the month.

Vent settings. TANKS does not account for fixed-roof tank vent settings in the calculation of working loss. API, in cooperation with EPA, revised the working loss equation to account for the vent settings. This revision is included in the Third Edition of API 19.1 and in the 2006 revisions to AP-42 Section 7.1, but it has not been incorporated into EPA's TANKS program.	TankESP includes the vent setting term in the calculation of fixed-roof tank working loss.
Riveted tanks. TANKS does not have Tank Construction as a variable for IFRTs, thereby not accommodating a selection of "Riveted" with a Mechanical-shoe seal.	TankESP allows the selection of the Riveted factor for Mechanical-shoe seals for all types of floating-roof tanks.
Sample Pipe or Well. This Fitting Type in TANKS is not found in AP-42, and it poses unnecessary confusion. Two of the options refer to "Slotted Pipe," and are duplications of "Slotted Guide-Pole" options. The other option, "Slit Fabric Seal," should be an option under "Gauge-Hatch/Sample Well."	TankESP lists deck fitting options that clearly correspond to the selections provided in AP-42.
Horizontal Tanks. TANKS incorrectly calculates the height of the vapor space, Hvo, in a horizontal tank as (D/2), rather than as (He/2) per AP-42 Equation 1-15.	TankESP correctly calculates Hvo as (He/2) for horizontal tanks.
IFRT-Type Deck Fittings. Deck fittings with only a K_{Fa} factor and no K_{Fb} or m factor should not be applied to external floating roof tanks because the emission factor for such deck fittings does not account for wind effects. Yet TANKS allows selecting these deck fittings for EFRTs.	TankESP does not allow selecting deck fittings that have no K_{Fb} or m factor for EFRTs.