Comments Received For Revisions to Chapter 7 Section 7.1

Comment Period Closed
November 26, 2018

From:	Henkes, John L (DEC)
To:	EFComments
Cc:	Cronin, Michael P (DEC)
Subject:	Proposed Revisions to Chapter 7, Section 7.1- Organic Liquid Storage Tanks
Date:	Thursday, July 26, 2018 1:14:17 PM
Attachments:	image007.png image008.png

To whom it may concern,

Are there any conclusions as to the magnitude (+ or -)these changes will have on emission estimation?

Is there any guidance on past TANK 4 estimations? Is there an urgency in recalculating emission estimations from the current 7.1 or TANKS program??

Thanks

John L Henkes, PE

Environmental Engineer II, Bureau of Stationary Sources, Division of Air Resources

New York State Department of Environmental Conservation

625 Broadway
Albany NY 12233-3254
P: (518) 402-8403 | F: (518) 402-9035 | John.Henkes@dec.ny.gov

www.dec.ny.gov | |

From:	Chakrabarty, Renu M
To:	EFComments
Subject:	RE: [chief] AP 42 Chapter 7, Section 7.1 Organic Liquid Storage Tanks; Suggested Updates
Date:	Wednesday, August 01, 2018 3:36:44 PM

This response is to express that EPA has not provided sufficient characterization what the proposed changes are, and their expected impact, to allow for informed comment and feedback.

A summary of which pollutants are changing, under which scenarios, and how (increasing or decreasing) would have provided the regulated community, regulators and the public with sufficient information to determine whether additional review or comment would be warranted. The absence of any characterization of the changes and their expected impact leaves only those with specialized knowledge of the algorithms and operating scenarios, and the resources to run them, with any way to know what the changes may be, in order to then comment on them with credibility.

Thank you,
Renu

Renu M. Chakrabarty, PE
Assistant Director of Air Monitoring, Laboratory & Air Toxics
Division of Air Quality
West Virginia Department of Environmental Protection
601 57th Street, SE
Charleston, WV 25304

Tel: (304) 926-0499, ext. 1246
Fax: (304) 926-0499

From: CHIEF Info <info.chief@epa.gov>
Sent: Wednesday, July 25, 2018 3:05 PM
To: Measurement Policy Group <chief@lists.epa.gov>
Subject: [chief] AP 42 Chapter 7, Section 7.1 Organic Liquid Storage Tanks; Suggested Updates

AP 42 Chapter 7, Section 7.1 Organic Liquid Storage Tanks; Suggested Updates for Consideration

AP 42 Section 7.1 utilizes methodologies developed by the American Petroleum Institute (API) for estimating air emissions from organic liquid storage tanks. It also contains detailed descriptions of typical varieties of such tanks, including horizontal, vertical, and underground fixed roof tanks, and internal and external floating roof tanks.

Since the last time EPA revised AP 42 Section 7.1, there have been many updates and additions to the methodologies described throughout the section. Collectively, API and EPA have worked together to propose necessary revisions to the emissions estimations methodologies for liquid storage tanks. Information pertaining to this action and supporting documentation can be accessed at the following link: https://www.epa.gov/air-emissions-factors-and-quantification/documentation-supporting-proposed-and-final-emissions

From:	Wells - CDPHE, Dale
To:	EFComments; Emmett Malone - CDPHE; Kevin Briggs; Rebecca Simpson; Darla Potter; Tom Moore; jgrant@ramboll.com
Subject:	proposed revisions to Chapter 7, Section 7.1 of AP-42.
Date:	Tuesday, August 14, 2018 4:12:34 PM

7.1.3.5 Flashing Loss is a new section on estimating flashing emissions. The section refers to pressurized liquid sampling, but does not describe it,nor how to analyze a pressurized liquid sample. Pressurized liquid sampling is used to determine the rate of flash emissions and to design controls, but is fraught with problems.

Noble Energy entered into a consent decree with EPA, DOJ and the State of Colorado that in part resulted in a study "Pressurized Hydrocarbon Liquids Sampling and Analysis Study Data Assessment and Analysis Report" that can be found here: https://jointagreement.noblecolorado.com/wp-content/uploads/2018/05/SPL_PHLSA-Study_Final-Report_020718.pdf

This document lists the difficulties in pressurized liquid sampling and analysis and makes recommendations about how to perform and use the results of such sampling. This work should be integrated into AP42.

--

Dale Wells
Modeling, and Emission Inventory Unit
Technical Services Program
Air Pollution Control Division
Colorado Department of Public Health and Environment
APCD-TS-B1
4300 Cherry Creek Drive South
Denver, CO 80246-1530
303-692-3237| dale.wells@state.co.us
To learn about ground-level ozone in Colorado visit our ozone webpage

From: Khal Rabadi
To: EFComments
Subject: AP-42 Storage Tanks section 7.1 revisions - comments
Date: Tuesday, August 21, 2018 12:34:38 AM
Attachments: image002.png
image004.png
image005.png
image001.png

Hi,
I have 3 comments so far on the proposed storage tanks calculation changes:

1/ Fixed roof tanks **equation 1-37** for calculating N (number of turnovers)
Can you please include a comment when using horizontal storage tanks? Currently, you have equation 1-37 as follows:

If ΣH_{QI} is unknown, it can be estimated from pump utilization records. Over the course of a year, the sum of increases in liquid level, ΣH_{QI}, and the sum of decreases in liquid level, ΣH_{QD}, will be approximately the same. Alternatively, ΣH_{QI} may be

7.1-28 Liquid Storage Tanks~~EMISSION FACTORS~~ ~~11~~06/~~06~~18

approximated as follows:

$$\Sigma H_{QI} = (5.614\ Q) / ((\pi/4)\ D^2) \qquad (1\text{-}37)$$

In case of horizontal storage tank, is it accurate to use DE for D? DE is calculated in equation 1-14

$$D_E = \sqrt{\frac{L\,D}{\frac{\pi}{4}}} \qquad (1\text{-}14\cancel{13})$$

2/ In the comments on calculating HLX and HLN (for calculating N using annual sum of liquid increases), you provided a comment when the tank is horizontal storage tank, but you described the diameter for the horizontal tank as DH, **shouldn't this be DE?** There is no reference to DH in the document other than in this place.

approximated as follows:

$$\Sigma H_{QI} = (5.614\ Q) / ((\pi/4)\ D^2) \qquad (1\text{-}37)$$

5.614 = the conversion of barrels to cubic feet, ft^3/bbl

$$\cancel{V_{LX} = \frac{\pi}{4} D^2\, H_{LX}} \qquad \cancel{(1\text{-}31)}$$

~~where:~~

~~D = diameter, ft~~

Q = annual net throughput, bbl/yr

H_{LX} = maximum liquid height, ft
If the maximum liquid height is unknown, for vertical tanks use one foot less than the shell height and for horizontal tanks use $(\pi/4)\ D_H$ where D_H is the diameter of the horizontal tank

H_{LN} = minimum liquid height, ft
If the minimum liquid height is unknown, for vertical tanks use 1 and for horizontal tanks use 0

3/ Net working loss throughout, equation 1-38

Similarly, can you please provide a description/comment when using this equation for horizontal storage tanks? **Is it accurate to use DE for D when calculating VQ?**

$$V_O = (\Sigma H_{OI})(\pi/4) D^2 \qquad (1\text{-}38)$$

where:

ΣH_{OI} = the annual sum of the increases in liquid level, ft/yr

Regards,

Khal Rabadi
972 814-6529

From: Janet L. Greenberg
To: EFComments
Subject: AP-42 Chapter 7.1
Date: Monday, September 17, 2018 11:49:51 AM

We have these questions about the proposed revisions to AP-42 Chapter 7.1, for estimating emissions from Tanks:

1. There are mentions of using Distillate Flooding in the text, accompanied by a statement that the vapor space will equilibrate with the new liquid heel within 24 hours. Is this time frame based upon a certain tank size? That is, if we are using distillate flooding with a relatively small tank, is there a rule-of-thumb for a lesser time frame in which we could begin cleaning and presume that the vapor space has equilibrated?

2. This statement is being removed, regarding Constant Level Tanks:
Alternatively, a default turnover rate of four could be used based on data from these type tanks.
Has it been found to be unacceptable? Was there originally a basis for the assumption of 4 turnovers, based upon calculation assumptions? We have used this for many years for constant level wastewater surge tanks and feel that the more extensive calculation procedure may be inappropriate for such tanks. We typically choose a likely floating organic that could accumulate on top of the wastewater, then assume the vapor space is 100% saturated with that organic, at 4 turnovers per year.

Thanks for your consideration.

Thanks,
Janet L. Greenberg, P.E.
GREEN Environmental Consulting, Inc.
10322 Ivyridge Rd.
Houston, TX 77043
Phone 713-932-8942
JGreen@green-envi.com
www.green-envi.com

From:	Madison Miller
To:	EFComments
Cc:	Phil Martin
Subject:	Comment on Proposed Revisions to AP-42 Chapter 7
Date:	Wednesday, September 19, 2018 5:23:46 PM
Attachments:	Comments on Proposed Revisions Chapter 7_1 (2).docx

To Whom It May Concern:

Attached, please find comments on the Proposed Revisions to AP-42 Chapter 7, Section 7.1 from the Oklahoma Department of Environmental Quality. Please let me know if you have trouble with the document, or need anything further. Thank you.

Madison Miller
Supervising Attorney, Air Quality Division
Office of General Counsel
Oklahoma Department of Environmental Quality
Office: (918) 293-1625

Proposed Revisions to AP-42 Chapter 7, Section 7.1 - Organic Liquid Storage Tanks
Comments submitted by the Oklahoma Department of Environmental Quality (ODEQ)
September 19, 2018

AP-42 Changes
The proposed revisions include emissions estimating methodologies for the following types of events and situations:

- Landing a floating roof
- Tank cleaning
- Tanks containing unstable liquids, such as tanks which have air or other gases injected into the liquid (sparging), tanks storing liquids at or above their boiling point (boiling), or tanks storing liquids which contain gases that have the potential to flash out of solution (flashing)
- Variable vapor space tanks
- Pressure tanks designed as closed systems without emissions to the atmosphere
- Time periods shorter than one year
- Internal floating roof tanks with closed vent systems

Additionally, the proposed revisions include the following guidance:

- Case-specific liquid surface temperature determination
- Adapting equations for heating cycles in fixed roof tanks
- Applying Raoult's Law to calculate the contribution of individual chemical species to the total emissions
- Worked examples (Section 7.1.5)

Finally, equations in Section 7.1.6 that have been used historically to obtain approximate values have been replaced with more accurate equations.

Comments
Meteorological Data
ODEQ recommends the meteorological data (TAX, TAN, V, I, PA) for selected U.S. locations in Table 7.1-7 be updated.

The current reference for the meteorological data in Table 7.1-7 is the 30-year averages for the years 1961 through 1990. This data has been updated and is available. The Comparative Climatic Data publication is available at: http://www.ncdc.noaa.gov/data-access/quick-links#ccd and contains data for the 30-year official Climate Normals period (1981-2010). There has also been an update for the National Solar Radiation Data Base with 20 year data from 1991-2010. Tables 7.1-7 and 7.1-9 have been combined into Table 7.1-7. Additionally the annual average atmospheric pressure was added to Table 7.1-7.

Example Comparison

Oklahoma City, OK (1981-2010)

	J	F	M	A	M	J	J	A	S	O	N	D	AVG
TAN	28.8	32.8	41.0	49.7	59.6	67.8	72.2	71.3	63.2	51.6	40.0	30.6	50.8

TAX	49.7	54.6	63.4	72.3	80.2	88.1	93.9	93.4	84.7	73.4	61.5	50.6	72.2
AVGWS	11.6	12.1	13.2	13.3	11.8	10.8	9.9	9.3	9.8	10.9	12.0	11.3	11.3

Oklahoma City, OK (Table 7.1-7)

	J	F	M	A	M	J	J	A	S	O	N	D	AVG
TAN °F	25.2	29.7	38.5	48.7	57.7	66.0	70.5	69.6	62.2	50.4	38.7	28.6	48.7
TAX °F	46.8	52.2	62.1	72.0	79.2	87.3	93.4	92.5	83.8	73.6	60.4	49.8	71.1
V mi/hr	12.3	13.0	14.1	13.6	12.5	11.0	10.7	10.3	10.7	11.4	12.3	11.9	12.1
I Btu/ft^2/day	888	1110	1458	1807	1966	2156	2188	1966	1585	1268	919	761	1522
PA lb/in2													14.07

Tulsa, OK (1981-2010)

	J	F	M	A	M	J	J	A	S	O	N	D	AVG
TAN	27.5	31.3	40.1	49.3	59.1	67.7	72.7	71.3	62.1	50.6	39.6	29.6	50.2
TAX	48.0	53.2	62.4	71.8	79.4	87.5	93.1	93.1	83.9	73.0	60.9	49.3	71.4
AVGWS	9.3	9.6	10.7	11.0	10.0	9.4	8.8	7.9	8.0	8.7	9.8	9.1	9.4

Tulsa, OK (Table 7.1-7)

	J	F	M	A	M	J	J	A	S	O	N	D	AVG
TAN °F	25.0	29.5	39.0	49.8	58.8	67.6	72.9	70.5	63.0	50.7	39.6	28.9	49.6
TAX °F	45.3	51.1	62.1	73.0	79.7	87.6	93.7	92.5	83.7	73.8	60.3	48.7	71.1
V mi/hr	10.3	10.7	11.9	12.1	11.0	9.8	9.4	9.2	9.2	9.6	10.5	10.1	10.3
I Btu/ft^2/day	793	1046	1363	1680	1871	2029	2124	1902	1490	1205	856	698	1427
PA lb/in2													14.39

<u>There is an error in the reference for Table 7.1-7.</u>

The reference for the new Table 7.1-7:
References 22. Data for this table are 30-year averages for the years 1961 through 1990, prepared by the National Renewable Energy Laboratory and distributed by the National Climatic Data Center. Similar historical averages of meteorological data from nearby National Weather Service sites or site-specific data may also be used.

However, Reference 22 is as follows:
Evaporative Loss Reference Information and Speciation Methodology, Manual of Petroleum Measurement Standards, Chapter 19.4, Third Edition, Addendum 2, American Petroleum Institute, Washington, D.C., June 2017.

The reference should have remained the same:

References 13 and 14:

13. Comparative Climatic Data Through 1990, National Oceanic and Atmospheric Administration, Asheville, NC, 1990.

14. National Solar Radiation Data Base, 1961-1990, prepared by National Renewable Energy Laboratory, Golden, CO, distributed by National Climatic Data Center, Asheville, NC, September 1992.

<u>Flashing Losses</u>

In the Laboratory GOR section of Section 7.1.3.5 it states that 379.48 is the SCF per pound-mole at standard conditions. However, this is not the value for EPA standard conditions it is the value for API standard conditions. This should be noted in the calculations since the GOR is typically determined at the API standard conditions.

<u>Other issues:</u>

1) KN – turnover factor, dimensionless
   It should be noted that when a tank is vapor balanced that the saturation factor predicted using the equation KN should remain set equal to one (1) no matter what the specific throughput is. Also, for crude oil/condensate storage tanks where flashing does occur shouldn't the turnover saturation factor be set equal to one (1) because the tank is already filled with hydrocarbon vapors.

2) KP – working loss product "saturation" factor, dimensionless
   It should be noted that the value for KP for lower MW crude oils or higher API gravity "light" crude oils should not be assigned the same value as the value for "heavy" crude oils with RVP 5 of 0.75. Condensate and "light" crude oils should be assigned a value of one (1). Also, for crude oil/condensate storage tanks where flashing does occur shouldn't the product saturation factor be set equal to one (1) because the tank is already filled with hydrocarbon vapors.

3) There should be additional crude oil specifications noted within Section 7.1 because the crude oil speciation for crude oil RVP 5 is not representative of all crude oils. As identified in 40 CFR Part 98, Subpart W, there should be at least two designations for crude oil "heavy" (API gravity <20) and "light" (API gravity >= 20). There should also be at least one specification for condensate (crude oil with API gravity > 40/50).

4) Emissions from produced water (oily water) storage tanks should be addressed.
   a. Working and breathing emissions should be calculated based on the upper or lighter layer of separated liquids (crude oil/condensate).
   b. Saturation based on amount of time needed for separation to occur.

5) The EOS process simulation programs
   a. The section on computer simulation modeling should address in some fashion the different equations of state (EOS) (i.e. Peng-Robinson (P-R), API modified P-R, company modified P-R, etc) and which is more appropriate for use in calculating emissions. 40 CFR Part 98 relies on the P-R EOS.

b. Address issue of EOS in overestimating the lower MW (C_1-C_3) component carryover in the liquids rather than estimated as being emitted.
c. Address limitations of the computer simulation models such as being valid only under equilibrium conditions and the inability of simulation to take into account undersized equipment or physical limitations leading to non-equilibrium conditions.
d. Use of site specific data or from the latest available analysis that is representative of crude oil or condensate from the sub-basin category for production or from the county for gathering and boosting.

From:	Patrick Ryan
To:	EFComments
Subject:	EPA AP-42 Section 7.1 proposed revisions for tanks.
Date:	Friday, October 19, 2018 7:47:21 PM

Good evening

I began programming the new tanks formulas into an Excel workbook this week. I completed programming an d have begun testing of the fixed storage tanks (vertical and horizontal) formulas.

I have identified two issues to date.
1. The formula for KE using equations 1-5, 1-12 and 1-13 are consistent for diesel but the value from eq 1-5 is about 10 times more than from 1-12 and 1-13 for gasoline. I request eqs. 1-12 and 1-13 be deleted as they do not have universal applicability.
2. I built a second scenario involving a tank with a fixed length and width. The value of Ks is 2x as high for a horizontal as compared to a vertical fixed roof tank with the same vapor space volume inside. This is not a physically intuitive result. Nor, do I believe it is physically correct. I think some effort in fixing this spurious outcome needs to be made.

Thank You
Pat

From:	Allen Hatfield
To:	EFComments
Subject:	Proposed Revisions to Chapter 7 (Section 7.1 - Organic Liquid Storage Tanks) - Comments on calculating the breathing emissions for horizontal storage tanks
Date:	Monday, November 05, 2018 12:50:32 PM
Attachments:	Horizontal Storage Tank 2018-11-05.pdf

Dear Sir or Madam,

The vapor space volume, V_V, and vapor space height, H_{VO}, are two variables that are calculated when determining the breathing emissions from a fixed roof storage tank. When the storage tank is a vertical cone top or dome top vessel then the calculation of V_V and H_{VO} take into account the liquid level that exist in the storage tank. On the other hand, when V_V and H_{VO} are calculated for a horizontal storage tank, then the liquid level in the storage tank are not taken into consideration. Instead, only the dimensions of the horizontal storage tank are taken into account and not the actual liquid volume that is being stored. For this reason, the breathing losses for the horizontal storage tank will be calculated to be the same whether the vessel is almost empty or almost full.

An improved approach for calculating the vapor space volume, V_V, and vapor space height, H_{VO}, in a horizontal storage tank is being submitted for your review and consideration. The existing approach that is contained in Chapter 7.1 (and earlier Chapter 7.0) for the horizontal storage tank calculations takes into account only the tank dimensions and ignores the actual liquid level height when calculating V_V and H_{VO} which can result in significant calculation errors.

The attached document (Horizontal Storage Tank 2018-11-05.pdf) provides the following discussion:

(1) The existing procedures for calculating V_V and H_{VO} are reviewed.

(2) A newer more equation for calculating V_V that is based an accurate determination of the liquid contents volume V_L is proposed.

(3) The newer approach for calculating V_V is applied to Example #2 as contained in Chapter 7.1 and the results are compared to the current methodology.

(4) A mathematical derivation of the proposed new equation for calculating the volume of liquid in the horizontal storage tank is provided.

Please feel free to contact me with any questions or clarifications that might be needed for the proposed new method for calculating the V_V and H_{VO}. Please confirm that this email and attachment have been received for your review and consideration.

Allen.

Allen Hatfield, PhD
Mitchell Scientific, Inc.
PO Box 2605
Westfield, NJ 07091-2605
Office: 908-654-9779 Ext 101
Direct: 908-468-2175

aHatfield@MitchellScientific.com

Mitchell Scientific, Inc.

PO Box 2605, Westfield, NJ 07091-2650, T 908-654-9779 Ext 101, aHatfield@MitchellScientific.com

Date: November 5, 2018

To: EPA AP-42 Review Committee
US EPA/OAQPS
109 TW Alexander Drive
Research Triangle Park, NC 27711

Subject: AP-42 Chapter 7, Section 7.1 proposed revisions: Organic Liquid Storage Tanks
Fixed Roof Horizontal Storage Tank Breathing Loss Calculation

Introduction

These comments offer a more accurate approach for calculating the breathing loss emissions for a horizontal storage tank. These new procedures take the average liquid level of the contents in the vessel into consideration through simple geometry. The existing approach offered in Chapter 7.1 takes into account only the tank dimensions and ignores the actual liquid level height in calculating V_V and H_{VO} which can result in significant calculation errors.

Summary

V_v and H_{VO} are key variables used in calculating the breathing losses for a fixed roof horizontal storage tank. The existing procedures that are contained Chapter 7.1 are first reviewed. Then, newer equations are proposed which illustrate how V_V and H_{VO} can be readily calculated using conventional geometry. Finally, Example 2 from Chapter 7.1 is recalculated using the new approach and the results of the existing and proposed approaches are compared.

Results

Chapter 7.1 contains Example #2 to illustrate the emission calculations for a fixed roof horizontal storage tank. Example #2 uses similar conditions as were used in Example #1 where both vessels have a shell diameter of 6 feet and a straight side length of 12 feet. The average liquid volume storage in both example problems is the same 1,693 gallons.

When V_V is calculated using the standard approach (Example #2 in Chapter 7.1), the results are 170 ft^3 and when the equations proposed in this document are applied, the results are 113.6 ft^3. Also, when H_{VO} is calculated using the standard approach (Example #2, Chapter 7.1), the results are 2.36 ft and when the equations proposed in this document are applied, the results are 1.63 ft. The calculated results for Vv, HVO, KS, and LS using both the standard approach (Example #2, Chapter 7.1) and using the equations proposed in this document are shown in Table 1.

Table I: Comparison between Chapter 7.1 Example 2 and Proposed Procedures

Horizontal Style Vessel	V_V	H_{VO}	K_S	L_S
Example #2, Chapter 7-1	170.0 ft^3	2.36 ft	0.899	57.0 lb/yr
Proposed Procedure	113.08 ft^3	2.205 ft	0.928	38.07 lb/yr

It is also noted that V_V was calculated for the vertical cone top tank in Example #1 (Chapter 7.1) to be 114.86 ft3 and the yearly breathing losses were 36 lb/yr.

Conclusion

Vv represents the volume of the vapor space that exists in the horizontal storage tank and H_{VO} represents the average height of the vapor space. The proposed equations enable V_V and H_{VO} to be accurately calculated since liquid height is taken into account through the use of geometry. A low liquid level in the tank would result in a high vapor space volume and a high liquid level would result in a low vapor space volume.

The equations provided in Chapter 7.1 do not take the actual liquid height into account. Instead, the vapor space volume (V_V) and average vapor height (H_{VO}) are calculated based solely on the dimensions of the horizontal storage tank. For the same vessel, this approach will always result in the same value for Vv and H_{VO} regardless of whether the horizontal storage tank has a high liquid level or a low liquid level for the same tank.

The yearly breathing losses calculated in Example #2 (Chapter 7.1) are 57 lb/yr. The breathing losses (L_S) calculated using the procedures described in this document were 39 Lb/yr which is 32% lower than the Example #2 (Chapter 7.1) results. Since the average liquid level in the horizontal storage tank is routinely measured and recorded, then the chemical operator would have all of the information needed to use the proposed calculations.

Discussion

<u>Existing Chapter 7.1 procedures for calculating V_V and H_{VO} for a horizontal storage tank</u>

Calculating the standing or breathing losses from a fixed roof storage tank is accomplished using EPA equation Eq (1-2)[1] which takes into account the vapor space volume V_V, stock vapor density W_V, vapor space expansion factor K_E, and vapor saturation factor K_S as shown in the following expression.

$$L_S = 365\, V_V\, W_V K_E K_S \tag{1-2}$$

Using the existing Chapter 7-1 approach, components W_v and K_E are calculated using equations that are independent of whether the tank is a vertical or a horizontal vessel. However, the vapor space volume V_V and vapor saturation factor K_S are calculated differently for a vertical storage tank than they are for a horizontal storage tank. V_V for the vertical tank takes into account vapor space in the vertical cylinder that is above the liquid and the vapor space that is contained by the cone or dome roof. On the other hand, V_V for the horizontal vessel is calculated using an approximate shell diameter D_E and approximate vertical height H_E. The liquid surface area of the horizontal storage tank is calculated assuming that the vessel is at 50% of capacity, where A_H =(L)(D). An imaginary vertical cylindrical tank with a flat top is considered to have the same liquid surface area A_S. An effective shell diameter D_E of the imaginary vertical cylindrical tank is then calculated using Equation (1-14)[2]:

$$D_E = \sqrt{\frac{A_H}{\pi/4}} = \sqrt{\frac{LD}{\pi/4}} \tag{1-14}$$

The effective height of the imaginary vessel, H_E, is calculated as the height of an equivalent upright cylinder using Equation (1-15)[3] as shown:

[1] AP42 Chapter 7.1, Eq (1-2), page 7.1-15
[2] AP42 Chapter 7.1, Eq (1-14), page 7.1-19
[3] AP42 Chapter 7.1, Eq (1-15), page 7.1-20

$$H_E = \frac{\pi}{4} D_E \tag{1-15}$$

H_{VO} is then approximated to be equal to ½ of H_E:

$$H_{VO} = \frac{1}{2} H_E$$

Finally, the vapor space volume V_V is calculated by multiplying the approximate liquid surface area times the approximate vapor height as shown in Eq (1-3)[4]:

$$V_V = \left(\frac{\pi}{4} D^2\right) H_{VO} = \left(\frac{\pi}{4} {D_E}^2\right)\left(\frac{H_E}{2}\right) \tag{1-3}$$

Recommended procedures for calculating V_V and H_{VO} for a horizontal storage tank

The methodology proposed in this section provides a much more accurate approach for calculating Vv and H_{VO} for a horizontal fixed roof tank than the approach described in the proposed rule. Figure 1 is a diagram of the circular end of a horizontal storage tank with diameter D and liquid height H_L. The length of the horizontal storage tank L is not shown.

Since H_L is routinely measured by the chemical operator for a horizontal storage tank as it is for a vertical storage tank, then using the known liquid height H_L and the dimensions of the vessel (L and D), it is possible to accurately calculate Vv using conventional geometry.

Radius R is calculated from the shell diameter D as shown Eq-1. The total volume of the horizontal storage tank may be calculated by multiplying the length (L) of the vessel shell times the area (A_T) of the circular end of the shell as shown in Eq-2.

Equations for calculating V_V of a horizontal storage tank are as follows:

Radius of vessel shell: $R = \frac{D}{2}$ Eq-1

Calculation of Volume V_T: $V_T = L\, A_T = L\, \pi\, R^2$ Eq-2

The volume of the liquid contents of the horizontal vessel can be calculated using Eq-3 as a function of L, R, and the liquid height H_L. An explanation for Eq-3 is provided at the end of this document.

Calculation of Liquid Volume V_L: $V_L = L\left[\, R^2 \cos^{-1}\left(\frac{R-H_L}{R}\right) - (R - H_L)\sqrt{2RH_L - {H_L}^2}\,\right]$ Eq-3

The volume of the vapor space can be calculated by subtracting the liquid volume from the total tank volume as shown in Eq-4.

Calculation of Vapor Space Volume V_V: $V_V = V_T - V_L$ Eq-4

The vapor space height may be calculated in Eq-5 by subtracting the liquid height H_L from the shell diameter D of the horizontal storage tank.

Vapor space height: $H_{VO} = \mathrm{D} - H_L$ Eq-5

[4] AP42 Chapter 7.1, Eq (1-3), page 7.1-15

Example calculation

Example #2 in Chapter 7-1 features the calculation of breathing and working loss for a horizontal storage tank. The tank has a length of 12 ft and a shell diameter of 6 ft. For this example, the same storage conditions are used as in Example 1 of the document. The average daily contents volume used in Example #1 was 8 ft which calculates to be 226.19 ft^3 (1,693.2 gal). If the horizontal vessel in this example is filled with 226.19 ft^3 or 1,693.2 gal of liquid, then the liquid height H_L would be 3.795 ft. Since H_L is normally measured by the chemical operator, this value will be known.

Given:	Shell diameter D:	6 ft
	Shell Length L:	12 ft
	Liquid height H_L:	3.795 ft

Radius of vessel shell:

$$R = \frac{6\,ft}{2} = 3\,ft \qquad \text{Eq-1}$$

Liquid Volume V_V:

$$V_L = L\left[\ R^2 \cos^{-1}\left(\frac{R-H_L}{R}\right) -\ (R-H_L)\sqrt{2RH_L - {H_L}^2}\ \right] \qquad \text{Eq-3}$$

$$V_L = 12\left[\ 9 * 1.839 -\ (-0.796)\sqrt{22.77 - 14.40}\ \right]$$

$$V_L = 12 * 18.851 = 226.21\,ft^3$$

Vapor Space Volume V_V:

$$V_V =\ V_T -\ V_L \qquad \text{Eq-4}$$

$$V_V =\ 339.29\,ft^3 -\ 226.21\,ft^3 = 113.08\,ft^3$$

Distance from liquid surface to top of tank H_{VO}:

$$H_{VO} = 6ft - 3.795\,ft = 2.205\,ft \qquad \text{Eq-5}$$

$$K_S = \frac{1}{1+(0.053)(P_{VA})(H_{VO})}$$

$$K_S = \frac{1}{1+(0.053)(0.901)(2.205)} = 0.905$$

Using the newly calculated values for V_V and K_S from the proposed equations in conjunction with the established values of W_V and K_E, the breathing losses for the horizontal storage tank can be calculated.

Vapor density (Chapter 7, Step 4b, example 2)[5]: $W_V = 1.29\ \times\ 10^{-2}\ lb/ft^3$

Expansion coefficient (Chapter 7, Step 4c, example 1)[6]: $K_E = 0.079$

Calculation of breathing loss[7]:

$$L_S = 365\ V_V\ W_V K_E K_S$$

$$L_S = 365\ (113.08)(1.29 \times 10^{-2})\ (0.079)\ (0.905)$$

$$L_S = 38.07 \text{ lb/yr}$$

Using the proposed approach outlined in this document, the yearly breathing losses for the horizontal storage tank are calculated to be 38.07 lb/yr. The yearly breathing losses that were calculated in AP-42 Chapter 7-1 for Example 2 were 57 lb/yr. The results from the Chapter 7-1 procedures are significantly greater than when actual liquid contents measurements and conventional geometry are used. This over estimation of breathing losses is primarily because the vapor space volume V_V (170 ft^3) (Chapter 7-1) is calculated using approximate vessel dimensions and V_V (113.08 ft^3) which was calculated using the

[5] AP-42 Chapter 7-1 (revisions), page 7.1-159

[6] AP-42 Chapter 7-1 (revisions), page 7.1-159

[7] AP42 Chapter 7.1, Eq (1-2), page 7.1-15

equations proposed in this document accurately reflect the true vapor space volume of the horizontal tank.

Development of the equation for calculating the liquid volume in a horizontal storage tank

The methodology proposed in this document provides a much more accurate approach for calculating Vv and H_{VO} for a horizontal fixed roof tank than the approach described in the proposed rule. Figure 1 is a diagram of the circular end of a horizontal storage tank with diameter D and liquid height H_L. The length L of the horizontal storage tank is not shown.

Using the known liquid height H_L and the dimensions of the vessel (L and D), it is possible to accurately calculate Vv using standard geometric equations.

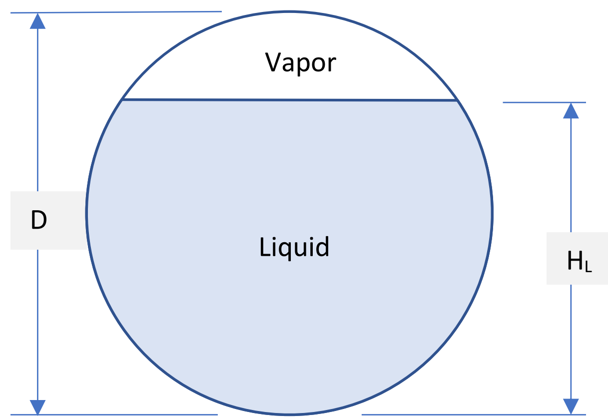

Figure 1: Circular End of a Horizontal Storage Tank

The methodology for calculating the volume of liquid in the horizontal storage tank V_L takes into account the length of the shell (L) and the area (A_L) of the circular end of the vessel that is covered by the liquid contents.

Figure 2 shows the circular end of a horizontal storage tank where the liquid height (H_L) is approximately 25% of the available height (or diameter) of the shell. The surface of the liquid intercepts the shell at points A and C. A circular sector is created by two line segments with length R that extend from the center at point A to intercept the shell at points B and C. The area of the circular sector A_S is proportional to the ratio between ϴ and the total number or radians in the circle (2 π). Therefore, if θ is known, then the area of the circular sector A_S calculated using Eq-6.

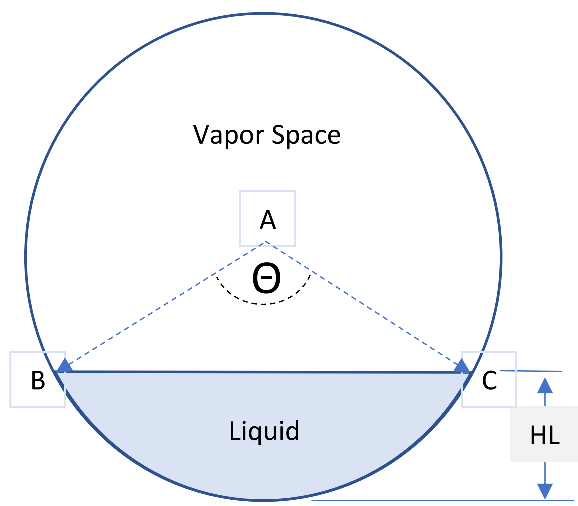

Figure 2: Circular End of a Horizontal Storage Tank

Area of the circular sector: $$A_s = \frac{\theta}{2\pi} A_c$$ Eq-6

where A_S is the area created by the circular sector ABC, ϴ is the angle created by AB and AC in radians.

Figure 3 shows the circular end of a horizontal storage tank where the liquid height (H_L) is approximately 75% of the available vessel height of the shell. In this example, the circular sector is the shaded portion of the circle that is below the liquid surface and excludes the area A_T of the triangular section created by points A, B, and C. Assuming that θ is known, then the area A_S in Figure 3 may be calculated using Eq-6 as described earlier.

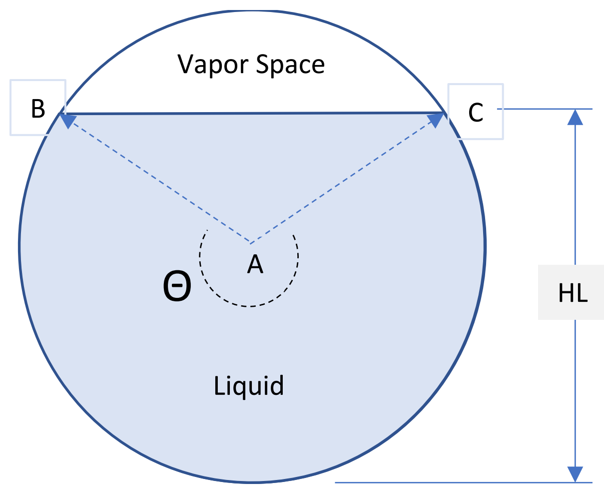

Figure 3: Circular End of a Horizontal Storage Tank

Calculation of A_S the area of the circular sector:

Area of the circular sector A_S shown in Figure 2 and Figure 3 may be calculated by multiplying the area of the circular shell by the ratio between the circular sector angle Θ (in radians) and the total number of radians in the circular shell as shown in Eq-6.

Area of the circular sector: $$A_s = \frac{\theta}{2\pi} A_c \quad \text{Eq-6}$$

Area of circular shell: $$A_C = \pi R^2 \quad \text{Eq-7}$$

The triangular section, *ΔABC,* shown in Figure 2 and Figure 3 may be subdivided into two smaller triangles using a perpendicular line that connects from the center of the liquid surface at point D to the center of the shell circle at point A. Since *ΔABC* is an isosceles triangle, then the two smaller angles ∅ that are created at point A are equal and one half the size of the original angle Θ at point A.

$$\theta = 2\,\emptyset \quad \text{Eq-8}$$

$$A_S = \frac{\theta}{2\,\pi} A_C = \frac{2\,\emptyset}{2\,\pi} \pi\, R^2 = \emptyset\, R^2 \quad \text{Eq-9}$$

The length (h) of the vertical line that runs perpendicular to the liquid surface and connects to the center of the circular shell A may be calculated by subtracting the height of the liquid surface H_L from radius R of the circular shell.

Length of vertical line $$h = R - H_L \quad \text{Eq-10}$$

∅ may be calculated as the arccosine of the ratio between h and R as shown in Eq-11 and further simplified in Eq-13 to be a function of only R and H_L.

$$\emptyset = \cos^{-1}\left(\frac{h}{R}\right) = \cos^{-1}\left(\frac{R - H_L}{R}\right) \quad \text{Eq-11}$$

Finally, the area of the circular sector A_S is calculated by substituting Eq-11 into Eq-9 as shown in Eq-13.

$$A_S = R^2 \cos^{-1}\left(\frac{R - H_L}{R}\right) \quad \text{Eq-13}$$

Calculation of the area A_T of triangle *ΔABC*.

The perpendicular distance from the center of the liquid surface to the center of the circle can be calculated by subtracting H_L from R.

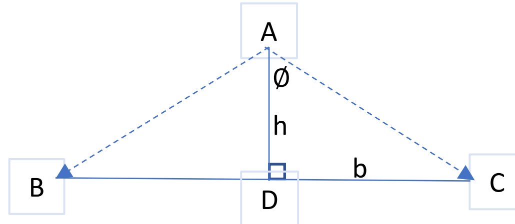

Figure 4: Triangular portion from Figure 1 and Figure 2.

Previously, two smaller triangles *ΔABD* and *ΔACD* were created from the larger triangle ΔABC when a vertical line was drawn perpendicular from the center of the liquid surface to the center of the circle at point A as shown in Figure 4.

A_T can be calculated as the sum of the two smaller triangles *ΔABD* and *ΔACD* as shown in Eq-14 where b and h are the same value for each triangle.

Area of A_T: $$A_T = 2\left(\frac{1}{2}\, b\, h\right) = b\, h \qquad \text{Eq-14}$$

Expression for *h* earlier: $$h = R - H_L \qquad \text{Eq-10}$$

Side *b* of triangles *ΔABD* and *ΔACD* may be calculated using the Pythagorean theorem for a right triangle as shown in Eq-15.

Calculation of b^2: $$b^2 = R^2 - h^2 = R^2 - (R - H_L)^2 \qquad \text{Eq-15}$$

$$b^2 = R^2 - (R^2 - 2\,R\,H_L + H_L) = +2RH_L - H_L \qquad \text{Eq-16}$$

Calculation of *b*: $$b = \sqrt{2\,R\,H_L - H_L} \qquad \text{Eq-17}$$

h as defined in Eq-10 and *b* as defined in Eq-17 are substituted into Eq-14 to create an equation to calculate the area of A_T in terms of only R and H_L as shown in Eq-18.

Calculation of A_T: $$A_T = (R - H_L)\sqrt{2RH_L - H_L} \qquad \text{Eq-18}$$

Finally, the area A_L of the portion created by the liquid at the circular end of the shell may be calculated by subtracting the area of the triangular section A_T from the area of the triangular area A_T in Eq-19.

Calculation of A_L: $$A_L = A_S - A_T \qquad \text{Eq-19}$$

Eq-19 can be further revised so that the area created by the liquid at the circular end may be calculated using only the values for R and H_L.

Calculation of A_L: $$A_L = R^2 \cos^{-1}\left(\frac{R - H_L}{R}\right) - (R - H_L)\sqrt{2RH_L - H_L} \qquad \text{Eq-20}$$

Note that if the liquid height is below the center of circular shell where H_L is lower than R (as seen in Figure 2), then the value for A_T is subtracted from the area of the circular sector. Alternatively, when the liquid height is above the center of the circular shell where H_L is greater than R (as seen in Figure 3), then the value for A_T is added to A_S.

The volume of the liquid contained in the horizontal storage tank may be calculated by multiplying the length of the shell by the area created by the liquid at the circular end of the shell as shown in Eq-21.

Calculation of V_L:

$$V_L = L \left[\; R^2 \cos^{-1}\left(\frac{R-H_L}{R}\right) - \; (R - H_L)\sqrt{2\,R\,H_L - \; H_L} \; \right] \qquad \text{Eq-20}$$

The vapor space volume may now be calculated by subtracting the liquid volume from the total volume of the horizontal storage tank as shown in Eq-21.

Calculation of V_V:

$$V_V = V_T - \; V_L \qquad \text{Eq-21}$$

Allen Hatfield, Ph.D.

From: Secrest, Cary
To: EFComments
Subject: Revisions to AP-42 Ch. 7
Date: Wednesday, November 07, 2018 2:56:22 PM

Comments from Cary Secrest, OECA Air Enforcement Division

1. Regarding references to ASTM D 2879 (for measuring the true vapor pressure of low pressure liquids), Note 2 on page 7.1-24 has the following correct statement:

"Vapor pressure is sensitive to the lightest components in a mixture, and the de-gassing step in ASTM D 2879 can remove lighter fractions from mixtures such as No. 6 fuel oil if it is not done with care (*i.e.* at an appropriately low pressure and temperature). In addition, any dewatering of a sample prior to measuring its vapor pressure must be done using a technique that has been demonstrated to not remove the lightest organic compounds in the mixture. Alternatives to the method may be developed after publication of this chapter."

However, D 2879 is referenced much later, on page 7.1-87, without the above cautionary note. I suggest that the note be included there, as well.

2. In addition, at the end of Note 2 it would be useful to include a statement to inform that ASTM has balloted method D 2879 for removal, with no replacement, because an industry study showed that the analytical precision is not acceptable.

From ASTM, July 19, 2017

"This standard is being balloted for withdrawal with no replacement because Alex Lau gave a summary of the ILS results for D2879. The ILS results clearly indicated that the method has insufficient precision for the intended purpose."

Therefore, Note 2 could be amended as follows:

"Vapor pressure is sensitive to the lightest components in a mixture, and the de-gassing step in ASTM D 2879 can remove lighter fractions from mixtures such as No. 6 fuel oil if it is not done with care (*i.e.* at an appropriately low pressure and temperature). In addition, any dewatering of a sample prior to measuring its vapor pressure must be done using a technique that has been demonstrated to not remove the lightest organic compounds in the mixture. In addition, in July 2017 ASTM balloted to remove the method due to inadequate analytical precision with no plans to replace it at the time."

Best Regards,

Mr. Cary Secrest
EPA Office of Enforcement and Compliance Assurance
Air Enforcement Division
WJ Clinton Bldg, South, Rm. 2111A

1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20004

Office: (202) 564-8661

"Be yourself. Everyone else is already taken." Oscar Wilde

From: Richard S Anderson
To: EFComments
Subject: Comments on Proposed Section 7.1 of AP-42 for Liquid Storage Tanks
Date: Wednesday, November 14, 2018 12:13:09 PM

I offer the following comments on the proposed revision of Section 7.1 of AP-42.

1. Is there any possibility that a new version of the TANKS program will ever be developed and offered by EPA? Since the early days of AP-42, this methodology has grown increasingly complicated (as evidenced by the fact that the draft version is approximately 196 pages, the 11/06 version is 123 pages, and the 9/85 version was only 35 pages). If regulated entities are forced to write their own spreadsheets or other applications to perform these calculations, it will raise the possibility of agencies questioning the correctness of our implementation and require us to expend additional effort to demonstrate correctness. This has rarely, if ever, been an issue when using the TANKS program.

2. The recommendation of one or more methods for estimating emissions of hydrogen sulfide (H2S) from crude oil, when the concentration is known in the liquid phase, would be extremely helpful. While H2S probably doesn't obey Raoult's Law generally, it appears that Raoult's Law probably gives reasonable estimates when H2S is present in crude oil at the ppm level. An undated paper co-authored by staff of the Texas Air Control Board (TACB) and Waid & Associates recommended a K-value approach, but the only K-value referenced was for one specific grade of crude, so the usefulness of this approach may be limited. (TACB ceased to exist in September 1993, so this document is at least 25 years old.) The use of process simulation software is not convenient for most people, and may not be available at all to facilities that do not involve chemical processes, such as storage facilities and terminals.

3. The footnote to Table 7.1-7, Meteorological Data, indicates that the values presented represent 30-year average values from 1961 to 1990. This is the same time period indicated for the meteorological data in the current version of Section 7.1 (dated 11/06), as well as the dataset in the TANKS program, yet the monthly and annual average temperature data do not match. Is this the correct time period for the data set, or is a newer dataset presented in the draft document?

Your consideration of these comments is appreciated.

Richard S. Anderson
Director of Air Quality Compliance
Environmental & Regulatory Compliance Dept.
Plains All American Pipeline, LP
phone: 713-646-4286
fax: 713-646-4310
email: rsanderson@paalp.com

From:	Eugene Kang
To:	EFComments
Cc:	Tracy Goss; Mani Firouzian; James Koizumi; Patrick Lee
Subject:	South Coast AQMD Comments on Proposed Changes to AP-42 Chapter 7 Section 7.1
Date:	Friday, November 16, 2018 9:20:19 PM

The South Coast Air Quality Management District (SCAQMD) staff appreciates the opportunity to provide comments on EPA's draft **Proposed Changes to AP-42 Chapter 7 Section 7.1 – Organic Liquid Storage Tanks 2018**. For questions or clarifications on the below comments, please contact Eugene Kang at (909) 396-3524 or ekang@aqmd.gov.

1. The EPA website states that the TANKS model was developed using a software that is now outdated and that the EPA can no longer provide assistance to end-users. If the EPA is not planning to update TANKS 4.09, will other tools or resources that incorporate the proposed changes be made available to government agencies and the public? Is EPA aware of any other free, publicly available tools?

2. Various SCAQMD programs, including permitting of storage tanks and checking calculations for emissions reporting and inventory, rely on the current version of AP-42 Chapter 7, Section 7.1 and U.S. EPA TANKS 4.09 software. There are also federal and state programs for GHG emissions that reference 40 CFR Chapter 1, Section 98.253(m)(1) which call for the use of the subject AP-42 section or TANKS when calculating emissions. Given all of this, has the EPA had discussions with other state and local regulatory agencies regarding how the proposed changes would impact their existing programs (e.g., changes to PTE calculations - NSR, annual emissions reporting, emission inventories for AQMPs and GHG, etc.)? Would programs and associated emission inventories need to be retroactively updated to reflect the proposed changes to emission calculations?

3. Based on the sample calculations provided in Appendix B, it appears that using revised defaults for average liquid surface temperature and vapor space temperature will result in approximately a 5%-10% difference in emissions when compared to using prior defaults. Can the emission impacts for each proposed change or addition be explained quantitatively? If so, can EPA share the range of percent changes in emissions for other revised and new defaults/equations (e.g., flashing losses, liquid surface temperatures for various steel tanks, insulated tanks, net and pump throughputs, etc.)?

4. As noted in the background section for revised temperature equations, new and revised equations more accurately reflect *theoretical* derivations due to no longer using approximations because of the accessibility of computers. A variety of instrumentation types are available to measure *actual* pollutant concentrations and may shed light on emissions coming from tanks. Have the theoretical derivations for existing, revised, and newly proposed equations been compared against actual measurements using modern monitoring technology?

5. In the 2006 version of Section 7.1, no distinction was made between inner and outer tanks diameters in emission calculation equations. Similar to the default value of 0.5 used for

Tank Height-to-Diameter ratio (H/D), this assumption seems to be due to the tendency to simplify the calculations which is unnecessary now with the present proliferation of computers. The proposed changes, such as requiring H/D to be calculated for vapor space temperature calculations and liquid levels increases and decreases to be used for working loss emission calculations as opposed to tanks throughputs, can be another reason for the need for this distinction in the calculation. The diameter used to calculate the H/D, which is used to account for tank's surface solar absorption, appears to refer to the outer diameter and should consider the inner diameter when calculating a tank's vapor space, turnovers, and liquid level increases and decreases. This does not appear to be discussed or incorporated in the proposed equations of Section 7.1. Is there guidance that EPA can point to for this?

6. On page 7.1-32, it is assumed that all external floating roof tanks only have welded decks. What is the source of this assumption?

7. It is not always clear when to use the actual diameter or the effective diameter (De) for horizontal tanks (i.e., not clear that the text always notifies the reader when De should be substituted for D). For example, in Equation 1-37 (page 7.1-26), should the actual diameter be used or the effective diameter? Also, see Example 2 (page 7.1-158), where De is estimated and used in estimating Vv, but not used to estimate Hvo.

8. The variable S appears to be used for both the "saturation factor" and the "filling saturation factor". In Equation 3-18 (page 7.1-41), the "filling saturation factor" is defined as the variable S. However, in the discussion of Equation 4-2, the text on page 7.1-48, the "saturation factor" is defined as the variable S. In Table 7.1-17 (page 7.1-142 of the June 2018 version), the "saturation factor" is defined as S for the Ks condition in the second row, and the "filling saturation factor is defined" as S in the last row of the table. In Table 7.1-20 (page 7.1-145), the "saturation factor" is defined as S and the "filling saturation" is only represented by a constant. The variable S should be used consistently. It may be helpful to rename to the filling saturation factor the filling saturation constant in addition to using a different variable to prevent confusion.

9. Page 7-1-41 includes the statement "This equation [3-18] accounts for the arrival losses and the generated losses." This statement is confusing, because it could be interpreted that the emissions estimated using this equation includes both arrival and generation losses. The text should state that the equation should be used to estimate arrival losses, then used again to estimate generation losses.

10. The internal floating roof tank with liquid heel and external floating roof tank with liquid heel subsections of Section 7.1.3.3.2 (pages 7.1-41 and 7.1-42) do not adequately detail that both arrival and generation losses should be estimated. There is no mention of arrival and generational losses in the internal floating roof tank with liquid heel subsection. The external floating roof tank with liquid heel subsection only mentions arrival losses. References to Tables 7.1-17 and 7.1-18 in the text should be added to the subsections for further clarification.

11. On page 7.1-37, it states that Ks should be “assumed to be less than or equal to the saturation factor during filling (labeled S).” It is assumed that the saturation factor during filling is the “filling saturation factor” not the “saturation factor” function (i.e., Csf x “filling saturation factor”). This is also not clear in Table 7.1-17. However, if the limit for Ks is the saturation factor function (Csf x “filling saturation factor”) not the “filling saturation factor” by itself, then there would an issue of circular references. The saturation factor function is 0.6 x Csf or 0.5 x Csf depending on the liquid heel, and Csf as defined by Equation 3-21 is estimated using Ks and S, where Ks is equal or greater than the saturation factor (i.e., equivalent to the saturation factor), which would result in circular references.

12. The text on page 7.1-38 states that “assuming that the stock properties included in the vapor pressure function (P*) will adequately account for differences in liquid product type, Kc is assumed to equal 1.” How can the user know when the vapor pressure function will adequately account for differences in liquid product type since the vapor pressure function is estimated by Equation 2-4? Is there a range where this is valid? Is the only exception to the case crude oil?

    The text quoted above provides background for simplifying Equation 3-8 into Equation 3-10. However, Equations 2-3, 2-13, 2-18 also include both the vapor pressure function and Kc, but prescribe using 0.4 as Kc for crude oils and 1.0 as Kc for all other organic liquids. If the only exception is crude oil, then consistent guidance should be given.

13. Since laboratory testing, computer simulation modeling, or direct measurement is required in Section 7.1.3.5 (page 7.1-51) to estimate flashing losses, guidance should be provided for when flashing losses should be expected.

14. In Section 7.1.3.8.2 Internal Floating Roof Tanks with Closed Vent Systems (page 7.1-56), is the five percent reduction applied to the total loss (i.e., both breathing and working losses) or only to either the breathing or working loss? If the second case, does it apply to the breathing or working loss?

15. In Example 5, on page 7.1-182, the saturation factor function (Csf x S) for arriving vapors is the Cs x S for the landed roof – the saturation factor for generated vapors (0.15 as defined in Section 7.1.3.3.2 for drain dry tanks with gasoline). The procedure used in Example 5, does not seem to be clear from the text in Chapter 7.1. It is also not clear how the user should estimate the saturation factor for generated vapors for non-gasoline products, since the methodology referred to in AP-42 Chapter 5 (Equation 3 of Chapter 5) only mentions cruel oil and gasoline (i.e., does not state if Equation 3 of Chapter 5 can be used for non-crude oil products).

16. In Example 5, step 10.a. (page 7.1-183), the stock molecular weight used is 66 lb/lb-mole. It should be 68 lb/lb-mole since the tank is refloated with gasoline with an RVP of 7 (see Table 7.1-2).

17. Questions or comments on Table 7.1-4 (page 7.1-93)

   a. It is not clear what the "condition" column in Table 7.1-4 means. The column appears to present Sb and liquid height equations.
   b. It is not clear that facility representatives would know the slope of the cone on the bottom of a tank. Is there a default value that can be used like the default slope for coned roofs of 0.0625 ft/ft given for use in Equation 1-8)? In general, the slopes of cones of tanks do not seem to be information that facility representatives typically have or use. It seems that using the shell diameter and height or depth of the cone in equations might make them more understandable to facility representatives.
   c. The terminology is also inconsistent with the text of Chapter 7.1. The height of liquid at the tank shell (hl) seems to be the height of the liquid heel. Is this correct?
   d. It is not clear that the expressions for height of the vapor space for the partial liquid heel is valid for both cone up and cone down conditions. It seems like both cone up and cone down conditions could result in a partial liquid heel; therefore, equations for both conditions should be presented.
   e. It is not clear that the volume of the heel would be known or calculated by the facility representatives for the partial liquid heel. Equations for estimating the volume of the heel should be provided for various conditions (e.g., cone up, cone down, liquid at sump level, liquid above sump level, etc.).
   f. A clear definition for "slight cone-up" should be provided. For example, cone composes less than 10 percent of the liquid surface. It is also not clear how facility operators would know this information or be able to estimate this information.
   g. Lastly, since floating roof tanks are typically very large in volume, does assuming all tanks are flat bottom with a full liquid heel for roof landing and floating roof tanks result in landing or cleaning emissions that are outside of the range of emission estimate values (i.e., estimated emissions ± error)? Since the vapor space estimates for landing and cleaning are both based on Table 7.1-4 (which means that the vapor space is the same before and after cleaning), its seem as though the emission calculations might also not warrant adjusting for partial liquid heel vapor space differences (i.e., assuming all tanks are flat bottomed with a full liquid heel).

From:	Matthew Hite
To:	EFComments
Subject:	Chapter 7, Section 7.1 of AP-42
Date:	Monday, November 19, 2018 5:33:20 PM
Attachments:	2018-11-19 GPA-Midstream-EPA-AP-42 Chapter 7 Comments FINAL.pdf

Dear EPA,

Attached are GPA Midstream Associations comments on Chapter 7, Section 7.1 of AP-42. Please email or call me if you need any more information. Thank you for your consideration of our comments.

Sincerely,

Matt

Matthew Hite
Vice President of Government Affairs
GPA Midstream Association
229 ½ Pennsylvania Avenue, SE
Washington, DC 20003
(202) 279-1664
mhite@GPAmidstream.org

GPA Midstream Association Headquarters
Sixty Sixty American Plaza, Suite 700
Tulsa, Oklahoma 74135
www.GPAmidstream.org

November 19, 2018

VIA ELECTRONIC FILING

AP-42, Section 508
Environmental Protection Agency
efcomments@epa.gov

Re: Comments on Proposed Revisions to AP-42 Chapter 7, Section 7.1 – Organic Liquid Storage Tanks

To Whom It May Concern:

The GPA Midstream Association ("GPA Midstream") respectfully submits the following comments on EPA's proposed revisions to AP-42 Chapter 7, Section 7.1 – Organic Liquid Storage Tanks published online on July 25, 2018.

GPA Midstream has served the U.S. energy industry since 1921 as an incorporated non-profit trade association. GPA Midstream is composed of nearly 100 corporate members that are engaged in the gathering and processing of natural gas into merchantable pipeline gas, commonly referred to in the industry as "midstream activities." Gathering and processing facilities include several storage vessels that hold both petroleum hydrocarbons and produced water. As such, GPA Midstream members will be directly affected by the revisions to the AP-42 emission factors for Organic Liquid Storage Tanks.

General Comments

GPA Midstream suggests EPA evaluate the overall organization of the document. It may merely be a consequence of the content additions to AP-42 Chapter 7 through the years, but the current document resembles an amalgamated reference that is difficult to follow. Given this observation and the fact that this chapter is by far the most voluminous section of AP-42, GPA Midstream believes Chapter 7 would greatly benefit from a reorganization of content. Some examples of such improvement opportunities are as follows:

- Remove "Section 7.1.1.1 Scope" as it is unnecessary and inconsistent with the format of other Chapters of AP-42.

GPA Midstream Association
Sixty Sixty American Plaza, Suite 700
Tulsa, Oklahoma 74135
(918) 493-3872

- Align figures with sections of narrative where it makes sense. For example, Section 7.1.2.1 Fixed Roof Tanks on page 8 would be prime territory to place Figure 7.1-1 Typical fixed-roof tank as an illustration of said tank. As the document is currently constructed, that figure isn't shown until page 74.

- Present final equations with a simple description of variables in the main body of the document. Move detailed discussion of how the equations or variables are derived into separate narrative preferably in an appendix to the document.

GPA Midstream suggests that EPA refrain from using the word "routine" as it pertains to emission losses with organic liquid storage tanks since it can be misleading. E.g., section 7.1.1.1 ("Sections 7.1.3.1 and 7.1.3.2 present emissions estimating methodologies for routine emissions from fixed roof tanks and floating roof tanks.") Taken out of context, the word "routine" can imply that emissions occur at a regular frequency without regard for the actual operations of a particular process. For fixed and floating roof tanks, for example, working losses are driven by withdrawal of product. If there is no withdrawal of product, then no emissions would occur. Similarly, standing losses are driven by diurnal changes in temperature. If there is no substantial change in temperature, then there would be no emissions. Furthermore, GPA Midstream fails to see the reasoning behind classifying these emissions as routine when there is no assignment of non-routine emissions from storage tanks. In sections 7.1.3.1 and 7.1.3.2, the titles would be more appropriately phrased as working and standing losses for fixed and floating roof tanks.

GPA Midstream additionally requests that EPA develop a replacement to the TANKS 4.0 software program. This free software tool has been widely used to calculate tank working and breathing loss emissions by industry and state/local agencies for many years. EPA has laid out the case for the TANK software program's shortcomings in this revision; however, the Agency presents no plans to replace the TANK program and places sole responsibility on state and local regulators and industry to ensure the agreement of 3rd party, commercial software programs with AP-42 Chapter 7.GPA Midstream urges the Agency to reconsider this approach – and encourages EPA instead to develop a replacement software program or calculation spreadsheet to provide more certainty in future emission estimations. As seen in the GHG reporting program in Part 98, EPA has the ability to develop and make available spreadsheets that involve complex emission calculations. GPA Midstream represents a number of small businesses that do not have access to expensive emission modeling software or employ the staff to run them, let alone to vet the software to ensure it complies fully with EPA's revised requirements. EPA should continue to provide a free calculation tool based on the agency's proposed AP-42 Chapter 7 revisions so that industry and state/local agencies are not required to purchase additional emission modeling software. Moreover, an EPA-developed program or spreadsheet would remove substantial uncertainty that may result if there are multiple, different commercial programs available, as opposed to an agency established standard.

Additionally, GPA Midstream requests that EPA establish a defined phase-in period for using these revised emission calculations. GPA Midstream suggests EPA provide at least 180 days from when the finalized revisions are published to allow stakeholders time to integrate these changes and for software to be revised/developed to accommodate this wholly revised standard.

The following specific comments are organized by the section, table or equation, and include the page number on the proposed revisions, clean version:

I. Equation 1-5 (pg. 7.1-16)

The discussion for the calculation of the vapor space expansion factor in equation 1-5, previously identified as 1-7, mentions that this factor, $K_{E,}$ must be between the values of zero and one if standing losses occur. The maximum value of one for this factor is a new addition in the proposed revisions, and GPA Midstream requests clarification in the equation, or an additional equation, that reflects this upper limit. One possibility would be to provide two equations as shown below:

$$0 < K_E \leq 1$$

$$K_E = \frac{\Delta T_V}{T_{LA}} + \frac{\Delta P_V - \Delta P_B}{P_A - P_{VA}}$$

II. Equation 1-6 (pg. 7.1-16)

GPA Midstream requests clarification regarding the changes to the equation previously identified as 1-8, now represented as 1-6. In the proposed revisions, EPA decided to eliminate two constants and substitute them with an equation that includes more variables for the user to define. To elaborate, the equation previously had four variables and now has seven. The new variables include tank shell height, tank diameter, tank roof surface solar absorptance and tank shell surface solar absorptance. The constants used in the original equation come from API MPMS 19.1. GPA Midstream requests confirmation that using the constants in lieu of the newly developed equations is still an acceptable methodology. GPA Midstream believes it should be acceptable to use the constants as long as they continue to reside in the API Standard. The redlined version of the proposed revision should also be reorganized to show the updated version of Equation 1-6 vs. the previous version 1-8 so it more easily displays for the reader how the equation has changed if the user continues to use 1-6 with default values for H/D and solar absorptance.

III. Equation 1-12 (pg. 7.1-18)

GPA Midstream believes that equation 1-12 on page 7.1-21 of the redlined draft was erroneously redlined. The equation and the associated text is all outlined in red as if it was new, but after reviewing the current version of the document, the same equation and some of the text is included on page 7.1-11. GPA Midstream requests EPA to maintain a public redline version of this chapter when the Agency finalizes these revisions, but only redline the parts of this section that are new to the document in its entirety. For example, the addition of "average" in front of the temperature variables and the new paragraph discussing average maximum and minimum ambient temperatures. In addition, there are slight changes to the direction on how to handle a situation if the tank location in unknown. Instead of underlining the whole paragraph in red because it is in a new place in the document, only the actual changes from the last version should be redlined. This will allow the user to better understand the actual changes to the calculation methodology.

IV. Equation 1-22 (pg. 7.1-21)

GPA Midstream requests EPA clearly indicate the new variable in equation 1-22 on page 7.1-23 is now T_V rather than T_{LA}. Although this is identified through redline in the explanation of variables, GPA Midstream also requests that it be redlined in the actual equation. An explanation as to why this variable has changed in the equation should also be included. Finally, clarification needs to be included on how these numbers will change when the new equations are adopted by a facility, perhaps using an example calculation.

V. Equation 1-24 (pg. 7.1-22)

Equation 1-24 requires the use of Raoult's law to calculate the total vapor pressure of the stored liquid. While GPA Midstream supports the use of Raoult's law as a calculation option, we believe that other options should be allowed for vapor pressure calculations in addition to Raoult's Law. Thermodynamic equations of state, while much more rigorous, are also more accurate than Raoult's Law, as they don't make many of the "ideal solution" assumptions that Raoult's law uses. Many of the other changes proposed for this document stem from the fact that computer software is now widely available and more rigorous calculations can be performed. There are several software programs commercially available that do rigorous thermodynamic calculations using equations of state like Peng-Robinson and Soave-Redlich-Kwong (SRK) that would more accurately predict vapor pressure from a given sample. However, these software packages are often expensive and can be cost prohibitive. Therefore, we support the use of Raoult's law since it provides a method of calculation that all companies have access to, and for EPA to include the option to use other software option that utilize equation of state calculations.

VI. Note 2 on True Vapor Pressure (pg. 7.1-22)

In note 2 on true vapor pressure there are calculations for true vapor pressure. Similar to comment V above, GPA Midstream would like to propose the option to use software programs to perform true vapor pressure calculations. These calculations could also be performed using rigorous thermodynamic equations of state. ASTM D2879 states "Vapor pressure, per se, is a thermodynamic property which is dependent only upon composition and temperature for stable systems. The isoteniscope method of ASTM 2879 is designed to minimize composition changes which may occur during the course of measurement." A thermodynamic equation of state is also able to calculate the thermodynamic property of True Vapor Pressure given a liquid composition and temperature, without the issue of composition changes during measurement. However, these software packages are often expensive and can be cost prohibitive. Therefore, we support the use of more simplistic calculations methods that all companies would have access to.

VII. Equation 1-39 (pg. 7.1-27) and Note 1 for Equation 2-19 (pg. 7.1-33)

On page 7.1-30, EPA added a statement to equation 1-39 stating that the "use of gross throughput to approximate the sum of increases in liquid level will significantly over estimate emissions…". GPA Midstream requests that EPA acknowledge that continued use of gross throughput is still allowed, since it is clearly a conservative estimate of emissions. Many company throughput tracking systems are based on gross throughput to truck loadout and has been used to establish throughput limits and specific permit conditions, therefore the option to continue with this process should be made to available to companies. Additionally, tracking liquid throughput at specific tanks would require additional liquid meters for each tank. This is not common practice and would require costly modifications to thousands of existing facilities.

GPA Midstream requests that EPA also add this clarification to Note 1 on page 7.1-33. The option to continue using gross throughput should be made to available to companies.

VIII. Equation 2-5 (pg.7.1-29)

On p. 7.1-29, the definition of T_B says to see note 5 for Eqn 1-22, but then other equations for T_B are given in Eqn. 2-9 and Eqn. 2-12. GPA Midstream recommends that EPA just refer to Eqn. 2-9 and 2-12 directly instead of Note 5. This will add clarity and eliminate confusion.

IX. Equations 2-6 and 2-7 (pg.7.1-30)

The draft revisions present significant changes to T_{LA}. The method for calculating T_{LA} has gone from one equation (previously 1-26) to four equations: one for fixed roof, one for internal floating roof and two for external floating roof tanks as outlined starting on page 7.1-30. The use of a single equation aligned with API MPMS Chapter 19.4 which indicates "for an IFRT with a steel pan floating roof, the liquid surface temperature would be calculated as for a fixed roof with no floating roof." Therefore, that was the standard practice for calculating T_{LA} for all tank types. None of the new equations to calculate T_{LA} match the previous, single equation. By developing all new equations for T_{LA} based on tank type, a significant effort will have to be put forth to update calculation software and spreadsheets that relied on the well-established, single equation. As such, if these changes are retained, all tank emission calculations would need to be updated to reflect this new methodology for T_{LA}. In light of these concerns, GPA Midstream requests that EPA defer these revisions to this methodology for calculating T_{LA} until the Agency further explains the proposed changes to this calculation methodology in order to allow stakeholders to comment fully on that explanation, as these proposed changes would produce a significant amount of work for the end user without any apparent benefit in the form of improved results. Indeed, the record does not indicate that EPA has considered fully how this update creates a significant change in the calculation process, the substantial burdens on stakeholders that those changes would impose, and what the repercussions would be if emissions must be recalculated using these new equations.

X. Section 7.1.3.5 Flashing Loss (pg. 7.1-51)

Despite providing reference to the Texas Commission on Environmental Quality's (TCEQ) 2016 Emissions Inventory Instructions, Section 7.1.3.5 Flashing Loss appears to borrow logic from state guidance documents on the subject. GPA Midstream believes that including such discussion in a technical reference document such as AP-42 may be misguided and result in unintended consequences. For example, language on page 62 of the draft document suggests that direct measurement should be the primary method of estimating flashing emissions; however, this method is not widely practiced by industry as it is expensive and logistically challenging (more on next comment). In addition, while the draft text briefly touches on certain limitations associated with the listed methodologies, it does not lay out the detailed considerations needed to be made when selecting a method to characterize emissions in order to achieve a satisfactory balance of cost and benefits. GPA Midstream suggests that EPA remove guidance language on estimating flashing emissions from AP-42 Chapter 7 and evaluate addressing the matter in a separate and more appropriately suited document format.

At a minimum, EPA needs to include the appropriate language to indicate the origin of this text and ensure facility owner/operators have the necessary flexibility, consistent with existing state requirements. For example, in TCEQ's "Calculating Volatile Organic Compounds (VOC) Flash Emission from Crude Oil and Condensate Tanks at Oil and Gas Production Sites" TCEQ carefully presents their guidance by stating,

> "This guidance is being provided to help evaluate flash emissions and the methodologies used to estimate those emissions…The Air Permits Division of the TCEQ is aware of the following methods to estimate emissions (seen in the table below). Each method for estimating emissions has specific constraints…. The relative accuracy of the methods shown below is a preliminary opinion only."

Additionally, in Oklahoma Department of Environmental Quality's (ODEQ) "Guidance on Estimating Flashing Losses and Guidance on Determining Process Stream Composition Data for Oil and Gas Facilities", ODEQ provides background discussion on the approaches by stating,

> "It is the philosophy of the AQD to empower the owner/operator of a facility to use whatever method he or she believes is most appropriate, providing that the method chosen is adequate to the task of providing an estimate of emissions that both parties can be reasonably confident is sufficiently accurate."

XI. Section 7.1.3.5 Flashing Loss, Direct Measurement (pg. 7.1-52)

GPA Midstream requests EPA remove the language in Section 7.1.3.5 which states direct tank measurement is the preferred option to determine flash emissions at storage tanks. EPA adds the following caveat for direct vent measurement, "if a reliable means of measurement for both the flash vapors and the amount of liquid produced during the testing period were employed." However, listing the method as preferred may still lead state and local permitting authorities to rely on it as the best option above others listed for flash emission calculations. In the experience of GPA Midstream members, direct tank vent measurement produces an unreasonable result since emissions at tanks are determined by field conditions that are variable over short time periods. For gathering compressor stations specifically, the amount and quality of hydrocarbon liquid is dependent on the upstream producer's method of operating and there can be multiple upstream producers on each gathering system. For example, during the time of direct tank vent measurement, an upstream producer may have a failure on its production separation equipment and send the gathering station more liquid than the average daily amount. The inverse could be true as well, where a producer may shut in oil and gas for a variety of reasons without the knowledge of the gathering company. In either case, the direct measurement result should not be used to determine an hourly or annual emission rate for permitting purposes. GPA Midstream is concerned state and local permitting authorities may require industry to use this "preferred" method for flash emission calculations, even though it may produce short-term results that are not representative of typical hourly or annual emissions for the facility.

Furthermore, there are safety issues that would limit the use of direct measurement on tank vents. Oil and gas operators try to limit the time employees spend on top of tank batteries to prevent exposure to either explosive environments or specific chemicals present in the gas stream, such as H_2S. Operators have installed wave guided radar systems or other tank level gauge methodology that limit the number of times employees must be on top of the tanks to hand gauge for liquid measurement. Direct measurement of the tank vents would introduce increased risk operators prefer to avoid or may be prohibited in a high H_2S area.

GPA Midstream requests EPA keep direct measurement as an option for flash emissions but remove the "preferred" language as shown below:

> "Direct measurement. Direct measurement of emissions at the tank vent ***can be utilized*** ~~would be a preferred approach~~, if a reliable means of measurement for both the flash vapors and the amount of liquid produced during the testing period were employed. Efforts at direct measurement should account for uncertainty in the field measurements of vapor concentration and flow rate through the vent and in the field measurements of volume of liquid produced during the test period, as well as variation in emission rates over time. Uncertainty may be mitigated by use of EPA Method 25A over an extended period of time."

XII. Section 7.1.3.8.1 Time Periods Shorter Than One Year (pg. 7.1-53)

AP-42 Scope Section 7.1.1.1, paragraph f, states that because certain assumptions are made in equations for routine emissions based on annual averages, adjustments are required for calculations of shorter time periods, "with the caveat that a one-month time frame is recommended as the shortest." Section 7.1.3.8.1 provides discussion on the necessary adjustments for short time periods. Further discussion is included explaining why routine emissions are "inappropriate for time period shorter than one month" included in Section 7.1.3.8.1 paragraphs a through l (hereinafter "Paragraphs a through l").

Average hourly tank emissions that are calculated based on the AP-42 methodology for annual emissions and dividing by the annual in-service hours, typically 8760 hours, is a reasonable representation of average hourly emissions. A reading of the revised AP-42 document implies, however, that such a calculation would be invalid. Yet, even recognizing that there are multiple factors that could increase or decrease emissions throughout a day, month, and year that are listed in Paragraphs a through l, it is still the case that calculating the average hour best represents the average hour and is therefore appropriate to use for the purposes of reporting and/or permitting an hourly average where that is required.

At the same time, the factors listed in Paragraph a through l do affect a calculation of a *maximum* hourly emission rate. Default factors may not be accurate based on actual meteorology data for a given year (changing tank conditions, liquid composition, etc.), and thus a maximum hourly calculation may be estimated based on a combination of worst-case estimates. The Texas

Commission of Environmental Quality (TCEQ) provides guidance documents that allow for calculating worst-case hourly emissions based on the maximum fill rate for fixed roof tanks,[1] and maximum withdrawal rate for floating roof tanks[2] combined with conservative estimates of vapor pressure and temperature. Similarly, the Bay Area Air Quality Management District (BAAQMD) provides guidance for calculating worst-case hourly emissions that assumes negligible standing losses on fixed roof tanks and negligible emissions from rim seal, deck fitting and deck seams from a floating roof tank during withdrawal.[3]

GPA Midstream supports the addition of language in Paragraphs a through l, but believes the statement that these parameter "render the equations for routine emissions inappropriate for time period short than one month" is not correct. EPA should provide guidance on preferred methodologies for maximum hourly calculations, either quantitative or qualitative. If EPA cannot provide guidance for preferred methodologies for hourly emission calculations than EPA should, at a minimum, remove language indicating that AP-42 methodologies are "inappropriate" for time periods less than one month. In this way, the AP-42 document will not invalidate maximum hourly emission calculation guidance from State or Local agencies that derive hourly calculations from the AP-42 methodology.

XIII. Table 7.1-7 (pg. 7.1-96)

GPA Midstream identified multiple changes within Table 7.1-7 that are not clearly identified. For example, in Birmingham, AL, T_{AN} in January was previously 33.0°F, while in the draft version of the document it's 31.3°F. GPA Midstream requests that any changes made within Table 7.1-7 also be identified with redline. The redline version will allow for the user to easily determine which values in the table have changed; therefore, need to be updated in related calculations. For new cities that have been added, that data should be redlined as well.

XIV. Table 7.1-12, footnote "i" (pg. 7.1-138)

GPA Midstream requests that EPA define "flexible enclosure system" as referenced in footnote "i" to match the definition that is finalized in API MPMS 19.2.

GPA Midstream has worked collaboratively with EPA for many years and appreciates the opportunity to continue working with EPA on regulations affecting the midstream industry segment. GPA Midstream is standing by to provide further information or answer any questions.

We appreciate the agency's consideration of our comments and look forward to working with the agency on the final revisions to AP-42 Chapter 7. If you have questions, please contact me at (202) 279-1664 or by email at mhite@GPAglobal.org.

[1] "Estimating Short Term Emission Rates from Fixed Roof Tanks" TCEQ APDG 6250v1, Revised 02/18
[2] "Short-term Emissions from Floating Roof Storage Tanks" TCEQ APDG 6419v1, Released 02/18
[3] "Guidance for Calculating Maximum Hourly Toxic Air Contaminant Emission Rates", BAAQMD, June 16, 2005

Sincerely,

Matthew Hite
Vice President of Government Affairs
GPA Midstream Association

From:	Khal Rabadi
To:	EFComments
Subject:	new revised Tanks calculations comments (Chapter 7)
Date:	Tuesday, November 20, 2018 12:47:22 PM
Attachments:	image001.png image002.png

A couple of more comments:

In section 7.1.3.8.1 Time Periods Shorter Than One Year; could you please include comments on questions 1 and 2 below:

1/ What is the best way to handle material change in the middle of the month when doing monthly calculations. Should we calculate for the full month twice (first time with Material A and second time for material B) or split the calculation into two?

Example; June 1st – June 20 Material A
June 21 – June 30 Material B

Scenario 1: (are we over estimating)
June 1 – June 30 Material A …. Perform calculations
June 1 – June 30 Material B …. Perform another calculation

Scenario 2: (are we being accurate)
June 1 – June 20 Material A …. Perform calculations
June 21 – June 30 Material B …. Perform calculation

2/ reference to KN equation should be added in this section, so if we are calculating monthly emissions, N will become number of turnovers per month. Since this section reference other situations when doing monthly calculations, we believe this one (KN calculation) should be inclused as well.

K_N = working loss turnover (saturation) factor, dimensionless~~; see Figure 7.1-18~~
for turnovers > 36, $K_N = (180 + N)/6N$
for turnovers ≤36, $K_N = 1$
N = number of turnovers per year, dimensionless

$$N = \Sigma H_{QI} / (H_{LX} - H_{LN}) \qquad (1\text{-}36\cancel{30})$$

Additional question on roof landing
3/ Roof Landing

Should equation 3-5 (below) be applicable to Domed External Floating as well? If yes, please add that in the section below.

Internal Floating Roof Tank with a Liquid Heel

For internal floating roof tanks with liquid heels, the amount of "standing idle loss" depends on the amount of vapor within the vapor space under the floating roof. Essentially, the mechanism is identical to the breathing losses experienced with fixed roof tanks. The mechanism shown in Equation ~~2-14~~3-5 is identical to Equation 1-2.

$$L_{SL} = 365\, V_V\, W_V\, K_E\, K_S \qquad (\cancel{2\text{-}14}3\text{-}5)$$

where

L_{SL} = annual breathing loss from standing ~~storage~~idle during roof landing, lb/yr
365 = number of days in a year, days/yr
V_V = volume of the vapor space, ft^3
W_V = stock vapor density, lb/ft^3

Regards,

Khal Rabadi
972 814-6529

From: Danielle Nesvacil
To: EFComments
Cc: Donaldson, Guy; Chikaodi Agumadu; Keisha Townsend; Daphne Mcmurrer
Subject: Comments on Proposed Revisions to AP-42, Chapter 7
Date: Monday, November 26, 2018 3:27:17 PM
Attachments: ATT00001.txt
Comments_storage tank_ap42_FINAL.pdf

Dear Madam or Sir:

On behalf of TCEQ, please find attached our letter and comments regarding the Proposed Revisions to AP-42 Chapter 7, Section 7.1 - Organic Liquid Storage Tanks.

If there are any questions concerning the TCEQ's comments, please contact Ms. Donna Huff, Director, Air Quality Division, at 512-239-6628 or donna.huff@tceq.texas.gov.

Sincerely,

Danielle Nesvacil | **Emissions Assessment Section** | **TCEQ**
12100 Park 35 Circle, Bldg. E | Austin, Texas 78753 | Mail: MC-164, P.O. Box 13087, Austin TX 78711-3087
Phone: (512) 239-2102 Fax: (512) 239-1515 | Email: danielle.nesvacil@tceq.texas.gov

Jon Niermann, *Chairman*
Emily Lindley, *Commissioner*
Toby Baker, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

November 26, 2018

United States Environmental Protection Agency

Transmitted via email to: efcomments@epa.gov

Subject: Proposed Revisions to Organic Liquid Storage Tank Emissions Factors

Dear Madam or Sir:

The Texas Commission on Environmental Quality (TCEQ) appreciates the opportunity to respond to the United States Environmental Protection Agency's (EPA) proposed action regarding storage tank emissions factors. The EPA's proposed revisions to the AP-42 section on storage tank emissions are thorough, relevant, and timely. The TCEQ has enclosed detailed comments on the proposal to assist with further improving the document.

If there are any questions concerning the TCEQ's comments, please contact Ms. Donna Huff, Director, Air Quality Division, at 512-239-6628 or donna.huff@tceq.texas.gov.

Sincerely,

Steve Hagle, P.E.,
Deputy Director, Office of Air

Enclosure

cc: Guy Donaldson (Donaldson.Guy@epa.gov)

COMMENTS BY THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY (TCEQ) REGARDING PROPOSED REVISIONS TO *COMPILATION OF AIR POLLUTANT EMISSIONS FACTORS (AP-42)*, SECTION 7.1 - ORGANIC LIQUID STORAGE TANKS; PROPOSED ACTION

I. Background

The United States Environmental Protection Agency (EPA) is proposing to update emissions estimation methods for storage tanks. The EPA's proposed additions and revisions are extensive, and address issues from storage tank emissions modes (e.g., flashing, cleaning) to estimating emissions for specialized tank types (e.g., pressurized, insulated) and guidance on estimating emissions for time periods of less than one year.

II. Comments

The TCEQ recommends clarifying that the definition of "routine emissions" as standing and working losses applies only for the purposes of this document, and not for any other air quality purposes, including New Source Review (NSR) permitting.

The term "routine emissions" is used throughout the document to refer to standing and working losses, the two most common storage tank emissions modes. However, some of the other emissions modes discussed in the document, such as flashing losses, are regarded as normal or routine emissions in other air quality contexts such as air emissions inventory reporting or NSR permitting.

The wording in the document suggests these emissions modes could be considered non-routine, which has potential implications for NSR permit authorizations and air emissions inventory reporting. Since AP-42 is primarily used for these activities, the TCEQ recommends that the EPA add a disclaimer that specifically states the definition of "routine emissions" is limited only to the context of this document and does not apply for other air quality purposes, such as air permitting or air emissions inventory reporting.

For fixed-roof storage tanks, the document should note that the saturation (turnover) factor and the product factor used in the working loss equations may need to be modified based upon site-specific circumstances.

The TCEQ emissions inventory data indicates that some oil- and gas-field storage tanks in Texas are splash-loaded. Splash- or top-loading of liquids has the potential to saturate the vapor headspace in the storage tank and consequently increase volatile organic compounds (VOC) emissions.

The AP-42 working loss equations do not instruct the user to modify the saturation and/or product factor to account for the increased turbulence and saturation that occurs when product is splash-loaded from the top of the tank. The document should be modified to instruct the user to select more appropriate (i.e., higher) saturation and product factors to account for increased emissions from splash-loading operations.

The TCEQ recommends changing the second paragraph under Subsection 7.1.3.3, "Floating Roof Landing Losses" for calculating standing idle losses for partial days.

This paragraph states that it would be reasonable to estimate standing idle emissions for a partial day by estimating emissions for a single day and pro-rating that estimate by the number of hours the roof was actually landed. As an example, the paragraph states that if the roof were landed for 6 hours, estimated standing idle losses would be 6/24 (or one-fourth) of the estimated daily standing idle losses.

One of the sources of standing idle emissions is breathing losses due to daily changes in ambient temperature. Because these breathing losses would occur as the vapor space expands during heating, they would generally only occur during daylight hours. Therefore, the TCEQ recommends that the daily standing idle losses for a partial day be calculated by multiplying the estimated daily loss by the number of daylight hours that the roof was landed and dividing by 12.

In the example given for a roof landed for six daylight hours, emissions would thus equal half the estimated daily value instead of one-fourth. In a case where a roof is landed for a period exceeding 12 continuous hours, but less than 24 hours, only the daylight portion of those hours would be used for this calculation.

The TCEQ recommends minor updates to specific measurement methods discussed in the "Flashing Loss" subsection.

The portion of the section discussing direct measurement of flashing losses recommends the use of EPA Method 25A to determine emissions rates. The text should note that this method determines total VOC emissions rates only and does not speciate emissions, particularly hazardous air pollutant (HAP) emissions. The text should further state that another measurement method that performs an extended gas analysis to identify HAP emissions would be necessary to accurately assess and quantify these emissions.

The TCEQ recommends adding the underlined text to the following sentence: "It is imperative that the sample be collected in a pressurized instrument, so as to prevent loss of light ends in the handling of the sample<u>, and that the laboratory conducting the analysis perform appropriate quality-assurance checks to verify that sample integrity has been maintained."</u>

From:	Tony Shoberg
To:	EFComments
Subject:	Comments on proposed revisions to Chapter 7, Section 7.1 of AP-42
Date:	Monday, November 26, 2018 4:04:24 PM
Attachments:	image001.png

To Whom It May Concern,

Barr Engineering Company has reviewed the proposed revisions to Chapter 7, Section 7.1 of AP-42 and submits the following comments.

1. **Clarification Regarding Rim-Seal Loss Factors for "tight-fitting seals"**

EPA has added additional rim-seal loss factors to *Table 7.1-8 Rim-Seal Loss Factors for Floating Roof Tanks* for "tight-fitting seals" with this footnote describing them:

> *"Tight-fitting" means that the rim seal is maintained with no gaps greater than 1/8 in. wide between the rim seal and the tank shell. 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 in. through the full range of liquid level in the tank.*

Please provide clarification on situations when the "tight-fitting" factors can be used. For example:

- Can the factors for "tight-fitting seals" be used on external floating roof tanks for which the primary and secondary seal gap inspections required by 40 CFR Part 60 Subpart Ka, Part 60 Subpart Kb, Part 63 Subpart G, Part 63 Subpart WW, or other storage tank regulations do not identify any gaps greater than 1/8 inch?
- Can the factors for "tight-fitting seals" be used for external floating roof storage tanks which have gaps greater than 1/8 inch but are in compliance with one of the cited regulations' maximum allowable gap and maximum allowable accumulated area of gaps? For example, Subpart Kb permits a secondary seal to have a maximum gap of 1.27 cm (0.5 inch) and a maximum allowable accumulated area of gaps of 21.2 cm^2/m of tank diameter (1 in^2/ft of tank diameter).
- Can the factors for "tight-fitting seals" be applied to an internal floating roof tank for which seal gap measurements are not required to be conducted?
- Can the factors for "tight-fitting seals" be used for an internal floating roof tank that has an approved Alternative Monitoring Procedure which requires inspections in accordance with 40 CFR 63 Subpart WW, for which we understand that US EPA is currently interpreting that the 1/8 inch gap criteria is applied to the rim-seals?

Additionally, no guidance was provided regarding whether seal gaps need to be measured at different heights, and if so, how many different heights. No guidance is provided regarding how frequently these measurements should be taken. Would an owner/operator prove that there are no gaps greater than 1/8 inch through the "full range of liquid level in the tank"? Would seal gaps need to be measured at various heights? If so, how many different heights? How frequently should these measurements be taken?

2. **Clarification Regarding Deck Fitting Loss Factors for "Ladder-guidepole combination well"**

EPA has added deck-fitting loss factors to *Table 7.1-12 Deck-Fitting Loss Factors* for "Ladder-guidepole combination well". Additional revisions elsewhere in the AP-42 chapter suggest that these new factors are intended to be used on ladder-guidepole combinations for which one or both legs of the ladder is a slotted pipe. From page 7.1-14 of the draft document:

> *Tanks are sometimes equipped with a ladder/guidepole combination, in which one or both*

legs of the ladder is a slotted pipe that serves as a guidepole for purposes such as level gauging and sampling.

EPA also shows in Figure 7.1-21 a *ladder-guidepole combination with ladder sleeve* where the guidepole is slotted.

However, the loss factor for a “ladder-guidepole combination well” with a “sliding cover, ungasketed” appears to be the same as the factor for a “ladder well” with a “sliding cover, ungasketed” where one would expect emissions to be higher if one of the ladder’s legs was slotted. The table below shows the deck fitting loss factor K_{Fa} provided in the draft version of AP-42 Chapter 7.1 table 7.1-12 for Ladder Wells and Ladder-Guidepole Combination Wells:

Fitting Type And Construction Details	**K_{Fa} (lb-mole/yr)**
Ladder well	
Sliding cover, ungasketed	98
Sliding cover, gasketed	56
Ladder-guidepole combination well	
Sliding cover, ungasketed	98
Ladder sleeve, ungasketed sliding cover	65
Ladder sleeve, gasketed sliding cover	60

Please provide clarification that the loss factors provided in table 7.1-12 for ladder wells and ladder-guidepole combination wells are correct. We would also suggest clarifying the name of the “ladder-guidepole combination well” in table 7.1-12 to “ladder-slotted guidepole combination well” to clarify that these loss factors are for the slotted guidepole arrangement.

3. Tank Cleaning Calculation Methodology

The proposed addition of Section 7.1.3.4 Tank Cleaning Emissions only includes the “vapor concentration method” which is based on the lower explosive (LEL) as measured during cleaning and degassing operations for the continued forced ventilation emissions during sludge removal (equation 4-10). The original tank cleaning and degassing document, API TR 2568 (Nov. 2007) included, in addition to the vapor concentration method, two alternative methods in Appendix A for sludge removal emissions. They are referred to as the “sludge volume method” and “air driven loss method”. The air driven loss alternative calculation method provides both increased simplicity and conservatism in emission calculations by correlating vapor pressure of the previously stored product to be representative of the vapor pressure of hydrocarbon material present in the tank at the time of cleaning despite any weathering of the product that may already have occurred. We believe the air driven loss method should be included in the revised version of AP-42.

By providing the option to use the air driven loss method as found in Appendix A of API TR 2568, it would allow owners and operators a clear and simple approach to estimating emissions from the sludge removal element of the tank cleaning and degassing process. The air driven loss method is based on existing tank emission calculations which reasonably represents a tank undergoing cleaning and degassing operations, and does not require additional ancillary inputs like blower rate, measured LEL, or estimated sludge evaporation rates. The air driven loss method is consistent and conforms to the general emission factor methodology elsewhere in AP-42 since the emission calculations are based on well-defined and available parameters (i.e. tank diameter, vapor pressure function based on previously stored product, vapor molecular weight, and number of days).

Our concerns with the proposed vapor-concentration method are as follows:

1. Regarding LEL measurement, neither API TR 2568 nor the proposed updates to Section 7.1 provide details of how to accurately measure LEL. The only specification given can be found in Appendix C of API TR 2568, to which the example forms indicate that you

should measure the LEL concentration in the headspace or vent stream. Additionally, during the sludge removal phase, personal LEL monitors may be reading 0% until a pocket of vapor would be disturbed, then a momentary high spike of LEL may occur, which is otherwise not representative of the general vapor space composition during the sludge removal process depending on how or where LEL measurements are taken and recorded.

2. While the proposed updates state that the LEL used for emission calculations is the “average of the % LEL readings during a given stage of continued forced ventilation”, it is not clear what type of average is required (i.e. how many samples per day or stage of cleaning and degassing are required?), or if continuous data logging must occur. Additionally, it is not clear if samples of the vapor space be taken at one single point, or multiple points throughout the tank when determining the average LEL reading.
3. Finally, based on the description of the “average vapor concentration by volume during continued forced ventilation”, C_V (Equation 4-10) it is implied that LEL must seemingly be measured for each stage of the cleaning and degassing process for each event. If this is the case, this approach does not appear consistent with the general emission factor methodology provided elsewhere in AP-42. General emission calculation methodologies throughout AP-42 rely on either specified emission factors or calculations based on reliable, known information (i.e. product vapor pressures and molecular weights). The vapor concentration method does not conform to this.

Additionally, the sludge volume method from API TR 2568 should not be included due to variability in evaporation rates and due to the concerns noted above for the proposed vapor-concentration method. API TR 2568 notes a possible evaporation rate of 20%, based on one event.

Thank you.

Tony

Tony Shoberg

Senior Chemical Engineer
Duluth, MN office: 218.529.8217
fax: 218.529.8202
cell: 218.208.8018
tshoberg@barr.com
www.barr.com

From:	Cathe Kalisz
To:	EFComments
Cc:	Ciolek, Michael; Garwood, Gerri
Subject:	API Comments - Proposed Revisions to AP-42 Chapter 7
Date:	Monday, November 26, 2018 4:07:17 PM
Attachments:	image001.png 11.26.18 API Comments - Proposed Revisions to AP-42 Chapter 7.pdf

Attached are API's comments on the proposed revisions to AP-42 Chapter 7, Section 7.1.

Cathe Kalisz, P.E.
Senior Policy Advisor
Regulatory and Scientific Affairs
American Petroleum Institute
1220 L Street NW
Washington, DC 20005
PH: (202) 682-8318
FAX: (202) 682-8270
kaliszc@api.org

Cathe Kalisz
Senior Policy Advisor

Regulatory and Scientific Affairs
1220 L Street, NW
Washington, DC 20005-4070
Telephone: 202-682-8318

Email: kaliszc@api.org
www.api.org

November 26, 2018

Submitted via email to efcomments@epa.gov

RE: Proposed Revisions to AP-42 Chapter 7, Section 7.1 - Organic Liquid Storage Tanks posted July 25, 2018

The American Petroleum Institute (API) submits comments on the Environmental Protection Agency's (EPA) proposed revisions to Chapter 7, Section 7.1 of AP-42. Chapter 7 addresses methodologies for estimating emissions from organic liquid storage tanks.

API supports the proposed revisions to Section 7.1 but offers a few suggested clarifications and edits as outlined in Attachment A to this letter. The emission estimating equations included in Section 7.1 reflect the most current versions of equations contained in Chapters 19.1 and 19.4 of the API Manual of Petroleum Measurement Standards (MPMS). These standards are developed by consensus of industry technical experts using procedures accredited by the American National Standards Institute (ANSI), June 2016.

While the proposed revisions improve estimating methods and better address certain scenarios such as insulated tanks, the changes also present several implementation considerations. EPA should provide implementation guidance when it posts the final revisions to Section 7.1. Issues addressed by the guidance should include the following:

<u>Permit applicability and permit emission limits</u>

Facilities may have used the tank emissions estimating methodologies in AP-42 to assess the need for an air permit or to establish tank emission permit limits. EPA should clarify that, for purposes of determining permit compliance, the emissions estimating methodologies that were current at the time of a permit application should continue to be used, or the permit limits should be adjusted in proportion to the changes resulting from the updated methodology. A change to an emissions equation or methodology does not, by itself, constitute a basis for being out of compliance with an existing permit or create a situation where a source that was previously determined to not require a permit is now considered to be out of compliance with State or Federal permitting requirements.

EPA should also address how updated AP-42 guidance should be used when renewing New Source Review (NSR) construction permits and/or Title V permits, when the best available information at that time is considered.

Transition Period
The tank emissions estimating procedures are complex, and most of the equations for standing and operating losses have been unchanged since 1997. Facilities will need time to update and quality-assure in-house tank emissions programs and systems that are based on Section 7.1, as will vendors who offer commercial products. A minimum one-year transition period is needed to allow time for programs to be updated. A transition period will also preclude any questions regarding the need to update a pending or under-review permit application that uses the current Section 7.1 provisions. A transition period is consistent with previous agency practice, such as the one-year implementation period that EPA provided when it updated its regulatory dispersion model, AERMOD.

Once EPA finalizes its revisions to Chapter 7, EPA should also provide an updated software program or other electronic tool for estimation of tank emissions. This would be helpful to both regulators and regulated sources.

API supports the development and improvement of emission factors and emissions estimating methodologies and appreciates your consideration of these comments. If you have any questions, please contact me at 202.682.8318 or at kaliszc@api.org.

Cathe Kalisz

cc:
Mike Ciolek - USEPA
Gerri Garwood - USEPA

ATTACHMENT A

Suggested Edits and Minor Corrections to Draft AP-42 Chapter 7, Section 7.1

1) **7.1.1.1 Scope.** Add a sentence at the end of the first paragraph to point the user to AP-42 Section 5.2 for estimating emissions from underground gasoline storage tanks at service stations. Suggested wording for this note is as follows:
"To estimate losses that occur from underground gasoline storage tanks at service stations, please see AP-42 Chapter 5.2, "Transportation and Marketing of Petroleum Liquids.""

2) **Equation 1-17.** Put parentheses around the (1/3) to clarify that the Hr term is not in the denominator.

3) **Equation 2-3.** Insert a second sentence that reads, "Ambient wind speed should be measured at an elevation of at least 10 meters above grade."

4) **Equation 40-3.** In the definition of terms below the equation, xi should be x_i. That is, the 'i' should be a subscript.

5) **Figures 7.1-13a, 13b, 14a, & 14b.** These figures each use the term "stock temperature." This term should be edited to read "liquid surface temperature." If the nomographs cannot be edited, this clarification could be stated in a note below the figure. In the body of the document, Note 2 under Equation 1-22 (old Equation 1-21) already indicates that the stored liquid surface temperature should be used in these figures, but the term "stock temperature" in the figures themselves sometimes misleads users into using the liquid bulk temperature.

6) **Figure 7.1-14a.** Add the following additional sentence below the table:
"However, see the cautions in Note 2 to Equation 1-22 with respect to ASTM D 2879."

7) **Table 7.1-3.** Put a superscript "d" on Liquid Density in the headings, and add a footnote "d" that reads:
"[d] The superscript denotes the temperature in ^{o}F; if no superscript is given the density is for 68^{o}F."

8) **Table 7.1-12.** Add a footnote indicating, "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."

9) **Table 7.1-12.** Add a footnote referencing Equation 2-17 for determining loss factors for deck fitting configurations not listed in the table.

10) **Table 7.1-12.** Edit the Fitting Type "Ladder-guidepole combination well" to read "Ladder/slotted-guidepole combination well".

11) **Sample Calculations – Example 1, 4.a.** For clarity, put parentheses around ($\pi/4$).

12) **Sample Calculations – Example 6, last numbered step.** The last step should be (9) rather than (6).

13) **References.** Edit Reference 24 to show a date of March 2014 rather than December 2013.

From:	Peter Lidiak
To:	EFComments
Subject:	Comments on AP-42 Chapter 7.1 Revisions
Date:	Monday, November 26, 2018 5:37:31 PM
Attachments:	18-11 ILTA Comments on AP-42 Chapter 7 Revisions Final.pdf

Please see the attached comments.

INTERNATIONAL LIQUID TERMINALS ASSOCIATION

November 26, 2018

VIA Email to: efcomments@epa.gov
Office of Air Quality Planning and Standards
U.S. Environmental Protection Agency
109 TW Alexander Drive
Research Triangle Park, NC 27711

RE: Comments on proposed revisions to Chapter 7 of AP-42; *Compilation of Air Emissions Factors*

The International Liquid Terminals Association (ILTA) is pleased to provide the following comments in response to the Environmental Protection Agency's (EPA's) proposed modifications to Chapter 7.1 of its AP-42; *Compilation of Air Emission Factors*, addressing emissions estimation methodologies for aboveground storage tanks.

ILTA is an international trade association that represents 80 commercial operators of aboveground liquid storage terminals serving various modes of bulk transportation, including tank trucks, railcars, pipelines, and marine vessels. Operating in all 50 states, these companies own more than six hundred domestic terminal facilities and handle a wide range of liquid commodities, including crude oil, refined petroleum products, chemicals, biofuels, fertilizers, and vegetable oils. Customers who store products at these terminals include oil companies, chemical manufacturers, petroleum refiners, food producers, utilities, airlines and other transportation companies, commodity brokers, government agencies, and military bases. In addition, ILTA includes in its membership nearly four hundred companies that are suppliers of products and services to the bulk liquids storage industry. EPA's emissions estimation methodology is critical for our members in estimating tank emissions for air permitting and reporting purposes.

ILTA supports the changes proposed to Chapter 7.1 of AP-42 as they reflect up-to-date information on tank emissions and add to areas that were previously unaddressed. We are very supportive of the process whereby EPA works with industry through the API Stationary Source Emissions Group to work on such changes to guidance openly and collaboratively.

<u>Guidance on Applicability to New and Existing Permits</u>

Facilities may have used the tank emissions estimating methodologies in AP-42 to assess the need for an air permit or to establish tank emission permit limits. EPA should issue guidance to its regional offices, and state and local air agencies that, for purposes of determining permit compliance and monthly, annual and Toxic Release Inventory (TRI) reporting, the emissions estimating methodologies that were current at the time of a permit application

www.ilta.org
1005 North Glebe Road, Suite 600 • Arlington VA 22201 • ph: 703-875-2011 • fx: 703-875-2018 • info@ilta.org

should continue to be usable, or optionally, the permit limits may be adjusted in proportion to the changes resulting from the updated methodology.

A change to an emissions equation or methodology does not, by itself, constitute a basis for being out of compliance with an existing permit or create a situation where a source that was previously determined to not require a permit is now considered to be out of compliance with State or Federal permitting requirements.

EPA should also address how updated AP-42 guidance should be used when renewing New Source Review (NSR) construction permits, Title V permits and/or state operating permits including synthetic minor and Federally Enforceable State Operating Permits, when the best available information at that time is considered.

Transition Period

The tank emissions estimating procedures are complex, and most of the equations for standing and operating losses have been unchanged since 1997. Facility operators will need time to update and quality-assure in-house tank emissions programs and systems that are based on Chapter 7.1, as will vendors who offer commercial products for estimating tank emissions. A transition period of two years is needed to allow for programs to be updated. A transition period will also allow pending or under-review permit applications that use the current Chapter 7.1 provisions to be completed without requiring significant rework or rereview. A transition period is consistent with previous agency practice, such as the one-year implementation period that EPA provided when it updated its regulatory dispersion model, AERMOD.

Update TANKS Model

ILTA requests that EPA update and continue to support the TANKS emission model. It provides value to the industry as a comparison tool for the many versions of emission calculating tools available.

ILTA appreciates the opportunity to comment on these revisions to AP-42, Chapter 7.1.

Sincerely,

Peter T. Lidiak

Peter T. Lidiak
Vice President of Government Affairs

From:	Todd Tamura
To:	EFComments
Subject:	comments on the proposed revisions to Chapter 7, Section 7.1 of AP-42
Date:	Monday, November 26, 2018 7:31:33 PM
Attachments:	Comments on AP-42 Section 7.1 proposed changes.pdf

Attached are my comments regarding the proposed revisions to Chapter 7, Section 7.1 of AP-42. Thank you for considering them.

Todd Tamura, QEP
Tamura Environmental, Inc.
(707) 773-3737

VIA ELECTRONIC MAIL

November 26, 2018

U.S. Environmental Protection Agency

Re: Comments on Proposed Changes to AP-42 Section 7.1

To Whom It May Concern:

Thank you for the opportunity to provide comments on the proposed changes to AP-42 Section 7.1. EPA is proposing the following:

1. To make a large number of changes to what is already by far the most complex and lengthy section of its AP-42 emission factor guidance (without providing information regarding the magnitude of the effects of these changes);
2. To refer people to commercially available storage tank emissions estimation software programs—which can cost thousands of dollars per year to license—to execute these equations, and advise people "to understand the extent of agreement with AP-42…and assume responsibility of the accuracy of the output as they have not been reviewed or approved by the EPA", rather than providing a software tool to implement the new equations (akin to the TANKS emissions software that is currently freely available from EPA's website); and
3. To insert language in AP-42 that effectively disavows results from the TANKS software program, without providing information as to the small magnitude of the differences between TANKS and the proposed methods for many tanks. A few years ago, EPA posted a comment on that website noting that the TANKS model was "outdated" and "not reliably functional on computers using certain operating systems", which caused several firms to develop their own emissions calculation tools. However, the degree of quality assurance of these tools varied, and some state and local regulatory agencies still prefer and/or request that companies use the TANKS model (or simpler alternative methods) for inventories and/or permit applications, given that (a) many users did not encounter issues with running TANKS on their operating systems, (b) discrepancies between the model and spreadsheet calculations are almost always minor, and (c) these agencies often did not have the resources to establish the veracity of various software packages that third parties had developed to do the calculations.

With respect to item #1 above, some of EPA's proposed changes (such as those regarding the input parameters for no. 6 residual fuel oil) that are based upon analyses, substantially change the calculation results, and may be important to update (and can be updated within the TANKS model). However, many of the other proposed changes (identified in detail at the end of this letter) (a) seem unnecessarily detailed given other uncertainties and relatively broad assumptions that need to be made (and therefore may or may not produce a more accurate estimate); (b) are purely theoretical, and do not appear to be supported/validated by any new data; and (c) have relatively minor impacts for most tanks[1]--which calls into question the importance of making these changes. At a minimum, at least for unheated tanks, EPA should consider identifying the proposed changes as "preferred" methods and the existing methods as "alternative" methods, similar to what it is has done in the Emission Inventory Improvement Program (EIIP) documents that are referenced by EPA's emissions inventory regulations.[2] This will help mitigate the disruption of the practices that have been generally accepted in the past by both facilities and state and local regulatory agencies for calculating emissions, and associated costs.

One general theme appears to be that the current equations in some cases made assumptions that may have been associated with limited computational power back when they were first made, and that therefore making the equations more detailed will yield a more accurate answer.[3] That is not necessarily the case when the equations themselves are based on several assumptions.[4]

Detailed section-by-section comments are identified below.

Section 7.1.3 (Emission Estimation Procedures):

1) EPA is proposing to have the following language in this section:

> "The software program entitled "TANKS" is available through the U. S. Environmental Protection Agency website. While this software does not address all of the scenarios described in this chapter, is known to have errors, and is no longer supported, it is still made available for historical purposes. There are also commercially available storage tank emissions estimation software programs. Users of these programs are advised to understand the extent of agreement with AP-42 Chapter 7 calculation methodology and assume responsibility of the accuracy of the output as they have not been reviewed or approved by the EPA."

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[1]Rob Ferry and Rahul Pendse (Trinity Consultants), "What's the Story with TANKS 4.09d and AP-42?", Air & Waste Management Association webinar, April 24, 2018. Slides 60-61 identify that the difference between some of the new methods and old methods on a sample fixed-roof tank ranged from -3.6% to +1.6%, depending on the input assumptions and selection of which of the newly proposed equations were used; slides 64-65 identified differences ranging from -4.9% to +2.9% for an example external floating roof tank.

[2] 40 CFR 51.5(a)

[3] In the revisions summary, EPA explains that "The original development of these equations took place prior to the proliferation of desktop computers, and thus there was a tendency to make approximations and substitutions that would simplify the calculations. Given the present accessibility to computers, however, such simplifications are unnecessary, and the equations have been revised to more accurately reflect the theoretical derivations."

[4] API, "Storage Tank Liquid Bulk, Liquid Surface, and Vapor Space Temperatures", Annex I to Manual of Petroleum Measurement Standards Chapter 19.4: Evaporative Loss Reference Information and Speciation Methodology, Third Edition, October 2012.

This paragraph neglects (a) the fact that for most tanks, the "errors" in the TANKS model[5] have been shown to be quite trivial, and (b) because the AP-42 Chapter 7 calculation methodology is by far the most complex methodology in all of AP-42, commercially available software is expensive and complex, and telling all persons who calculate emissions from storage tanks—of which there are many in the United States—that they have to "understand the extent of agreement with AP-42 Chapter 7 calculation methodology and assume responsibility of the accuracy of the output" is a significant request that is likely to be very burdensome in terms of labor hours associated with evaluating the software and the assumption of risk for the various software packages (for agencies and businesses that do not have the capacity to evaluate the software).

The following would seem to be more appropriate language than the language shown above:

> "The software program entitled "TANKS" is available for free from the U. S. Environmental Protection Agency website. This software does not address all of the scenarios described in this chapter, is known to have minor errors,[6] and may not run on future operating systems, but generally has been found to produce results that are quite close to those that follow the methodology identified here for storage tanks. There are also commercially available storage tank emissions estimation software programs, although users of these programs are advised to understand the extent of agreement with AP-42 Chapter 7 calculation methodology and assume responsibility of the accuracy of the output as they have not been reviewed or approved by the EPA."

Section 7.1.3.1.1 (Routine Losses From Fixed Roof Tanks/Standing Loss):

2) EPA is proposing to recommend the use of equation (1-7) for K_E. This makes sense (and the TANKS model already does this).
3) EPA is proposing various options to calculate ΔT_V, all of which differ from the existing equation (1-8). Specifically, instead of $\Delta T_V = 0.72\ \Delta T_A + 0.028\ \alpha\ I$, EPA is proposing options including $\Delta T_V = 0.7\ \Delta T_A + 0.02\ \alpha\ I$ (and $\Delta T_V = 0.6\ \Delta T_A + 0.02\ \alpha_R\ I$ for partially insulated tanks). While there are theoretical underpinnings of the new equations, there does not appear to be any new experimental data supporting them, and it is not at all clear that they improve the accuracy of the result or make a substantive enough difference to warrant the removal of the current generally

[5] The only "error" in the actual TANKS model (as opposed to inconsistencies in chemical names and factors, which were easily updated) that was specifically identified by EPA was that the model use an annual average value for bulk temperature instead of monthly values. The extent to which this was truly an "error" (rather than intended) is unclear, given that AP-42 is somewhat inconsistent/ambiguous with regard to time resolution and EPA still allows for the calculation of emissions based on annual average parameters.

[6] See EPA's "TANKS 4.09D errors and available fixes" at https://www3.epa.gov/ttn/chief/software/tanks/index.html#fixes.

accepted practice. Given that this is the case—and that EPA is proposing to still allow the use of existing equation (1-5) for K_E (under certain circumstances) and instead even the bald assumption that $K_E = 0$, both of which are likely to result in considerably larger differences from the newly proposed equations than the currently generally accepted practice—EPA should continue to allow ΔT_V to be calculated using the existing equation (1-8) that is incorporated into the TANKS model: i.e., $\Delta T_V = 0.72\ \Delta T_A + 0.028\ \alpha\ I$.

4) For tank solar absorptance α, EPA is proposing to rename the existing values in Table 7.1-6 for "good" and "poor" paint condition as being for "new" and "aged" paint condition, and to add a new "average" value which is the simply the mean of the "good" and "poor" values. Given that there does not appear to be any data to support this change nor any objective quantitative information with which to gauge what constitutes "good", "average", or "poor" condition, this change is not helpful, and may simply result in more controversy regarding how the condition should be classified rather than resulting in a more accurate estimate.
5) EPA is proposing to remove the option to use existing equation (1-10) for ΔP_V and instead recommend the use of equation (1-9). This makes sense (and the TANKS model already does this).
6) <u>Underground tanks</u>: EPA is not proposing any substantive changes, but is proposing to leave in existing language stating that "For underground horizontal tanks, assume that no breathing or standing losses occur ($L_S = 0$) because the insulating nature of the earth limits the diurnal temperature change." While the statement about temperature change is accurate, it has been previously shown that there are standing losses associated with underground tanks containing relatively volatile liquids like gasoline, as a result of dilution of the headspace and relatively fast subsequent vapor growth.[7] Therefore, it seems more appropriate to modify the language as follows: "Standing losses from underground gasoline tanks, which can experience relatively fast vapor growth after the ingestion of air and dilution of the headspace, are addressed in Section 5.2 of AP-42."
7) <u>Stock Vapor Density, W_V</u>: EPA is proposing to change the equation from $W_V = M_V P_{VA}/RT_{LA}$ (which is what is incorporated in the TANKS model) to $W_V = M_V P_{VA}/RT_V$ to reflect the fact that it should be a function of the vapor temperature T_V rather than the liquid surface temperature T_{LA}. However, given that these two temperatures are on an absolute temperature basis (i.e., degrees Rankine), differ relatively little (and to the extent that they differ, there is some question as to whether it is more appropriate to define P_{VA} as being based on $T = T_V$ instead of $T = T_{LA}$), and are both based on a number of assumptions, it does not seem necessary to completely disavow the original equation. If EPA would like to retain the proposed equation, language

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[7] Specifically, the factor of 1.0 lb per 1000 gallons of throughput originated from Chass et al., "Emissions from Underground Gasoline Storage Tanks", *Journal of the Air Pollution Control Association* **13(11)**, November 1963, pp. 524-530; additional support for the vapor growth mechanism was developed by Tamura, T. (Sonoma Technology, Inc.), letter to Prentiss Searles (API) "Re: Results of pressure monitoring at gasoline dispensing facility", Sonoma Technology Ref. No. 904820, December 9, 2005.

should be added which identifies that "The equation for W_V that has been used previously and is incorporated into the TANKS model, which is based on T_{LA} instead of T_V, is also acceptable and will typically yield a very similar result."

8) <u>True vapor pressure</u>: EPA is proposing to identify the ASTM D 6377 method for the determination of the true vapor pressure of crude oils with TVP > 3.6 psia and the ASTM D 5191 method for the determination of the Reid vapor pressure of volatile crude oil and volatile nonviscous petroleum liquids.
   a) To execute the AP-42 equations, there will be a need to have an appropriate equation for pressure as a function of temperature, not just the vapor pressure at a single temperature, and therefore running ASTM D 6377 or ASTM D 5191 at a single temperature will not be sufficient.
   b) For mixtures, vapor pressures can depend on the vapor-to-liquid (V/L) ratio. ASTM D 5191 specifies a V/L ratio of 4:1 (consistent with the V/L ratio identified in ASTM D 323 for Reid vapor pressure), but ASTM D 6377 leaves the choice of V/L up to the method user, and results are reported as $VPCR_X$ where X is the V/L ratio. For consistency (and to avoid ambiguity), where EPA specifies ASTM D 6377, may want to also specify that the method should be run at V/L = 4:1 (i.e., $VPCR_4$ results)—as opposed to, for example, a V/L of "effectively zero" (the minimum V/L identified in ASTM D 6377 is 0.02) as identified in the International Safety Guide for Oil Tankers & Terminals (ISGOTT).[8]
   c) At a recent ASTM training course on the topic of crude oil sampling and analysis, it was pointed out that ASTM D 5191 was not scoped for crude oil and the instructor stated verbally that the method should <u>*not*</u> be used to determine the RVP of crude oils.[9] EPA should therefore also not recommend ASTM D 5191 for crude oils. At a minimum, EPA should acknowledge that D 5191 results include the partial pressure of any dissolved air.
   d) EPA is also proposing to add the language "the equations in Figure 7.1-16 are known to have an upward bias" – please provide a citation for that statement and any available quantitative information.

9) <u>Average daily liquid surface temperature, T_{LA}</u>: EPA is proposing two new equations to calculate T_{LA}, including $T_{LA} = 0.4T_{AA} + 0.6T_B + 0.005\ \alpha\ I$ for uninsulated tanks, and removing the existing equation $T_{LA} = 0.44T_{AA} + 0.56T_B + 0.0079\ \alpha\ I$ for uninsulated tanks. While there are theoretical underpinnings of the new equations, there does not appear to be any new experimental data supporting them, and there does not appear to be any evidence that they improve the accuracy of the result (given that T_{AA} and I are

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[8] International Chamber of Shipping, Oil Companies International Marine Forum, and International Association of Ports and Harbors, "International Safety Guide for Oil Tankers & Terminals (ISGOTT)", 4th ed., available from http://www.idgca.org/doc/app2_290115.pdf, p. 22.

[9] Dr. Arden Strycker, at ASTM, "Crude Oil: Sampling, Testing, and Evaluation", Nov. 6, 2018. Slide 386 identified that for there are more opportunities to lose volatile components as a result of a requirement to (a) take samples with headspace (70-80% full containers) and (b) remove the sample cap momentarily, reseal it, and shake it vigorously prior to analyzing the liquid's vapor pressure, and that the method's requirement to chill the sample and analyze the chilled liquid can be impossible to follow if it brings a crude below its pour point.

monthly average values—typically from the nearest airport rather than on-site, and T_B is also a monthly average value, typically calculated from a series of assumptions) or make a substantive enough difference to warrant the removal of the current generally accepted practice. Given that this is the case—and that EPA is proposing to still allow the use of existing equation (1-5) for K_E (under certain circumstances) and instead even the bald assumption that $K_E = 0$, both of which are likely to result in considerably larger differences from the newly proposed equations than the currently generally accepted practice—EPA should continue to allow T_{LA} to be calculated using the existing equation that is incorporated into the TANKS model (at least for uninsulated tanks): i.e., $T_{LA} = 0.44T_{AA} + 0.56T_B + 0.0079\ \alpha\ I$.

10) Liquid bulk temperature, T_B: In the absence of T_B measurements, EPA is proposing to change the formula for T_B from $T_B = T_{AA} + 6\alpha - 1$ (which is incorporated into the TANKS model) to $T_B = T_{AA} + 0.003\alpha_S I$. Since no supporting data are provided for the change and neither equation accounts for the important variable of the temperature of the liquids that are delivered to the tank, it is unclear whether this change improves the accuracy by any significant extent; instead, it appears to simply be a "refinement" to a theoretical construct which is already based on several assumptions. If EPA would still like to retain the proposed equation, it would be helpful to at least add language noting that "While the theoretical basis for this equation is considered to be better than the historical equation for T_B that is incorporated into the TANKS model ($T_B = T_{AA} + 6\alpha - 1$), both rely on several assumptions that are likely to not be entirely correct and ignore the temperature of the liquids that are delivered to the tank, and no analysis of empirical data has been conducted to show the superiority of one formula over the another."

11) Average vapor temperature, T_V: As identified in comment #6 above, EPA is proposing to base certain calculations on estimates of T_V rather than T_{LA} as was done previously. As has been commented on numerous other items, these calculations seem substantially similar to the original equations and no data are identified for supporting this change.

Section 7.1.3.1.2 (Routine Losses From Fixed Roof Tanks/Working Loss):

12) Overall equation for L_W: EPA is proposing to make a change to the preferred equation; relative to the current equation that is incorporated into the TANKS model, the proposed refinements for L_W appear to consist of primarily (a) using the calculated vapor density (W_V) instead of the current factor 0.0010 $M_V\ P_{VA}$[10]—which will have a very minor effect for unheated tanks—and (b) multiplying by a vent correction factor K_B (which is also very close to 1 when (a) tanks with PV valve pressure settings that are much lower than the difference between atmospheric pressure and the vapor pressure of the stored liquid, and (b) $K_N \approx 1$, which is nearly always the case). Rather than simply indicating that the old equation is "no longer recommended" (as EPA is proposing), it would be much more technically accurate to state that the old equation will give essentially the same answer as the new equation unless (a) the absolute

[10] The factor of 0.0010 corresponds to a temperature of approximately 63 °F.

temperature of the emitted vapors that is used to correct the volume emitted is substantially different from 523 °R = 63 °F (this is the temperature that the which is the basis for the 0.0010 factor in the old equation), (b) the PV valve pressure setting is significant relative to $P_A - P_{VA}$ and/or K_N is substantially less than 1.

13) Definition of number of turnovers. While the proposed definition of N makes theoretical sense, it is different from what has often been assumed in the past: i.e., having the denominator correspond to *total* tank capacity rather than the difference between the high and low levels. Given the extremely approximate basis of the K_N equation,[11] the current procedure should still be allowed, even if it is not "preferred".

14) Net Working Loss Throughput V_Q. Thank you for clarifying that the throughput should be based on liquid level increases and that basing V_Q on Q is just an approximation; EPA had previously only clarified this in their answer to a "Frequently Asked Question" (FAQ).[12]

Section 7.1.3.2 (Routine Losses From Floating Roof Tanks):

15) Average daily liquid surface temperature, T_{LA}: Analogous to comment #9 above, EPA is proposing equations for T_{LA} that differ somewhat from equations used in the past, but again there does not appear to be any empirical data to support this, nor is there any recognition of the fact that these are all still very approximate. Use of the current equations should still be allowed.

16) Section 7.1.3.2.2. Working (withdrawal) Loss, L_W: Thank you for adding the proposed Note 1 (analogous to what is mentioned in comment #14 above, regarding the Net Working Loss Throughput V_Q).

Section 7.1.4: Speciation Methodology:

17) Raoult's Law: In general, Raoult's Law is identified as being most applicable for mixtures of similar molecules (e.g., benzene and toluene) and the actual data for a given component of the mixture are closest to those predicted by Raoult's Law when the mole fraction of that component approaches 1.[13] For EPA's proposed statement that "An assumption of ideal behavior has been found to be reasonable for most hydrocarbon mixtures", please provide a citation. Separately, with regard to the statement that the speciation of withdrawal losses for floating roof tanks should assume "that the entire film of liquid evaporates, and thus relative fractions of individual components in the vapors would be the same as for the liquid" should be amended to recognize that substances that are non-subliming solids at the storage temperature (such as most polycyclic aromatic hydrocarbons, for most tanks storing liquids at ambient temperatures) are not going to evaporate. This is important because in some cases health risk assessments are being impacted by the (erroneous) assumption that all of the PAHs in the clinging liquid are evaporating.

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[11] API, "Turnover Factor, K_N", Section 8.3.2.2 of Manual of Petroleum Measurement Standards Chapter 19.1: Evaporative Loss from Fixed-roof Tanks, Fifth Edition, June 2017.

[12] https://www3.epa.gov/ttn/chief/faq/tanksfaq.html#6.

[13] See, for example, Alberty R.A., "Physical Chemistry", 6th ed. (Wiley ,1983).

18) <u>Case 2 (Henry's Law)</u>: Henry's Law constants are strong functions of the solute, solvent, and temperature. Therefore, EPA's statement that "Section 4.3 of AP-42 presents Henry's Law constants for selected organic liquids" should be revised to say "Section 4.3 of AP-42 presents Henry's Law constants for selected organic liquids in water at 25 °C".

Thank you for consideration of these comments.

Sincerely,

TAMURA ENVIRONMENTAL, INC.

Todd Tamura, QEP
Principal