South Coast Air Quality Management District

AQMD

Supplemental Instructions for Liquid Organic Storage Tanks and References

June 2005

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INTRODUCTION

The purpose of this supplemental manual is to provide facilities instructions for estimating emissions from liquid organic storage tanks.

Storage tanks containing organic liquids can be found in many industries, including:

- petroleum production and refining,
- petrochemical and chemical manufacturing,
- bulk storage and transfer operations, and
- other industries consuming organic liquids.

Organic liquids in the petroleum industry, usually called petroleum products, generally are mixtures of hydrocarbons having different true vapor pressures (for example, gasoline and crude oil). Organic liquids in the chemical industry are composed of pure chemicals or mixtures of chemicals with similar true vapor pressures (for example, benzene or a mixture of isopropyl and butyl alcohol).

Typically, liquid organic storage tanks are categorized in two types: floating roof and fixed roof. There are five basic designs for organic liquid storage tanks:

- external floating roof,
- internal floating roof,
- above-ground vertical fixed roof,
- above-ground horizontal fixed roof, and
- underground fixed roof tank

Tank emissions associated with each design are briefly described here. A detail description and emission calculation procedure of each tank design is provided in Chapter 7 of EPA's Compilation of Air Pollutant Emission Factors (AP-42). The scope of this manual is to provide users a simple procedure to calculate emissions from storage tanks. The methodologies presented in AP-42 are simplified based on the assumptions and conditions applicable to the South Coast Air Basin to assist users to calculate and report tank emissions on Form B6, B7 and B7U of the District's Annual Emission Reporting (AER) Program.

Alternatively, facilities may use this simplified calculation methodology to report emissions on Form B6, B7 and B7U using the PC based reporting software. However, facilities with computer capability are encouraged to calculate and report tank emissions using a software program entitled "TANKS" available from the U. S. Environmental Protection Agency (US EPA). The results from TANKS calculation can then be imported to fill in Form B6, B7 and B7U of the District AER Program via PC based reporting software (You may contact the Hotline to get update on the latest version of the TANKS program compatible with the import function).

TANKS is a Windows-based computer software program that estimates organic compound and hazardous air pollutant (HAP) emissions from fixed- and floating-roof storage tanks. The TANKS program employs a chemical database of over 100 organic liquids, and a meteorological database of over 240 cities in the United States. The program allows the addition of more chemicals and cities, if desired. TANKS is capable of calculating individual component emissions from known mixtures and estimating emissions from crude oils and selected refined petroleum products using liquid concentration HAP profiles supplied with the program. The TANKS is based on the emission estimation procedures from Chapter 7 of EPA's Compilation of Air Pollutant Emission Factors (AP-42). The user's manual explains the many features and options of TANKS. The program includes on-line help for every screen. To get a copy of TANKS, please contact Info CHIEF at (919) 541-1000.

EXTERNAL FLOATING ROOF TANKS

A typical external floating roof tank consists of an open-topped cylindrical steel shell equipped with a roof that floats on the surface of the stored liquid. The floating roof consists of a deck, fittings, and rim seal system. Floating decks that are currently in use are constructed of welded steel plate and are of two general types: pontoon or double-deck. With all types of external floating roof tanks, the roof rises and falls with the liquid level in the tank. External floating decks are equipped with a rim seal system, which is attached to the deck perimeter and contacts the tank wall. The purpose of the floating roof and rim seal system is to reduce evaporative loss of the stored liquid. Some annular space remains between the seal system and the tank wall. The seal system slides against the tank wall as the roof is raised and lowered. The floating deck is also equipped with fittings that penetrate the deck and serve operational functions. The external floating roof design is such that evaporative losses from the stored liquid are limited to losses from the rim seal system and deck fittings (standing storage loss) and any exposed liquid on the tank walls (working loss).

INTERNAL FLOATING ROOF TANKS

An internal floating roof tank has both a permanent fixed roof and a floating roof inside. There are two basic types of internal floating roof tanks: tanks in which the fixed roof is supported by vertical columns within the tank, and tanks with a self-supporting fixed roof and no internal support columns. Fixed roof tanks that have been retrofitted to use a floating roof are typically of the first type. External floating roof tanks that have been converted to internal floating roof tanks typically have a self-supporting roof. Newly constructed internal floating roof tanks may be of either type. The deck in internal floating roof tanks rises and falls with the liquid level and either floats directly on the liquid surface (contact deck) or rests on pontoons several inches above the liquid surface (non-contact deck). The majority of aluminum internal floating roofs currently in service have non-contact decks.

FIXED ROOF TANKS

A typical vertical fixed roof tank consists of a cylindrical steel shell with a permanently affixed roof, which may vary in design from cone- or dome-shaped to flat. Losses from fixed roof tanks are caused by changes in temperature, pressure, and liquid level.

Fixed roof tanks are either freely vented or equipped with a pressure/vacuum vent. The latter allows the tanks to operate at a slight internal pressure or vacuum to prevent the release of vapors during very small changes in temperature, pressure, or liquid level. Of current tank designs, the fixed roof tank is the least expensive to construct and is generally considered the minimum acceptable equipment for storing organic liquids.

Horizontal fixed roof tanks are constructed for both above-ground and underground service and are usually constructed of steel, steel with a fiberglass overlay, or fiberglass-reinforced polyester. Horizontal tanks are generally small storage tanks with capacities of less than 40,000 gallons. Horizontal tanks are constructed such that the length of the tank is not greater than six times the diameter to ensure structural integrity.

The potential emission sources for above-ground horizontal tanks are the same as those for vertical fixed roof tanks. Emissions from underground storage tanks are associated mainly with changes in the liquid level in the tank. Losses due to changes in temperature or barometric pressure are minimal for underground tanks because the surrounding earth limits the diurnal temperature change, and changes in the barometric pressure result in only small losses.

EMISSIONS

Emissions from organic liquids storage tanks occur because of evaporative loss of the liquid during its storage and as a result of changes in the liquid level.

Emissions from fixed roof tanks are a result of evaporative losses during storage (known as breathing losses or standing storage losses) and evaporative losses during filling and emptying operations (known as working losses).

Storage loss is the expulsion of vapor from a tank through vapor expansion and contraction, which are the results of changes in temperature and barometric pressure. This loss occurs without any liquid level change in the tank.

The combined loss from filling and emptying is called working loss. Evaporation during filling operations is a result of an increase in the liquid level in the tank. As the liquid level increases, the pressure inside the tank exceeds the relief pressure and vapors are expelled from the tank. Evaporative loss during emptying occurs when air drawn into the tank during liquid removal becomes saturated with organic vapor and expands, thus exceeding the capacity of the vapor space.

For floating roof tanks, standing storage losses are a result of evaporative losses through rim seals, deck fittings, including deck seams losses, in case of internal floating roof tanks, for construction other than welded decks.

Withdrawal losses occur as the liquid levels, and thus the floating roof is lowered. Some liquid remains on the inner tank wall surface and evaporates. For an internal floating roof tank that has a column supported fixed roof, some liquid also clings to the columns and evaporates. Evaporative loss occurs until the tank is filled and the exposed surfaces are again covered.

ASSUMPTIONS

The calculation methodologies provided in this document are the simplified versions of those outlined in the AP-42. This simplification is needed to assist users who choose to calculate and report tank emissions directly on Form B6, B7 and B7U (either through paper forms or PC based reporting software), and based on the following assumptions:

- Average ambient temperature: 520 degree R
- Daily ambient temperature range: 17.9 degree R
- Atmospheric pressure: 14.7 psia
- Tank color: White
- Shell condition: Light rust
- Other default assumed in the EPA AP-42 document

Other parameters needed for calculating emissions from storage tanks are tabulated in Appendix 1 and 2. Appendix 1 contains parameters associated with the properties of the stored material such as vapor or liquid molecular weights and true vapor pressure. Appendix 2 provides parameters associated with the diameter of the storage vessel for different types of tanks. From minimal process data such as tank type, size, and type of stored material, users can look up related parameters in the appendices, fill in the forms, and calculate emissions. This manual also provides an alternate emissions calculation for underground tanks and above-ground small tanks (less than 10,000 gallons capacity). Some parameters are modified to accommodate special cases such as horizontal, square, or rectangular tanks. Emissions of toxic air contaminants or other components of stored liquid mixture can also be calculated using equation 16 and 17.

Line-by-line instructions and examples for using Form B6, B7 and B7U are provided in Appendix 4 of this document.

EMISSIONS FROM FLOATING ROOF TANKS

Total emissions or losses from floating roof tanks may be calculated using the following equation:

$$L_T = L_W + L_R + L_F + L_D + L_X \qquad (Eq.\ 1)$$

where: L_T = total loss, lbs/yr
L_W = working loss, lbs/yr
L_R = rim seal loss, lbs/yr
L_F = deck fitting loss, lbs/yr
L_D = deck seam loss, lbs/yr *(applicable to internal floating roof tanks only)*
L_X = loss from process upset, lbs/yr

<u>Working Loss</u>

The working loss from floating roof tanks can be estimated using Equation 2.

$$L_W = (1 + N_C) \times \left(\frac{22.45 \times Q \times S_C \times W_L}{D} \right) \qquad (Eq.\ 2)$$

where: L_W = working loss, lbs/yr
N_C = roof support factor, dimensionless
For **<u>external</u>** floating roof tank, $N_C = 0$
For **<u>internal</u>** floating roof tanks, depending on tank diameter
[see Appendix 2 for selected roof support factors]
Q = annual throughput in 1,000 gallons unit, Mgal/yr
S_C = shell clinage factor is defined as follows:
For **<u>crude oil,</u>** $S_C = 0.006$ and for **<u>other materials,</u>** $S_C = 0.0015$
W_L = average organic liquid density, lbs/gal
[see Appendix 1 for average organic liquid density of selected materials]
D = tank diameter, ft

<u>Rim Seal Loss</u>

Rim seal loss from floating roof tanks can be estimated using the following equation:

$$L_R = K_R \times D \times F_P \times M_V \times K_C \qquad (Eq.\ 3)$$

where: L_R = rim seal loss, lbs/yr
K_R = rim seal loss factor, lb-mole/ft-yr, is defined as:
For **<u>external</u>** floating roof tanks, $K_R = 20.1$
For **<u>internal</u>** floating roof tanks, $K_R = 6.7$
D = tank diameter, ft
F_P = vapor pressure function, dimensionless
[see Appendix 1 for vapor pressure function of selected materials]
M_V = average vapor molecular weight, lb/lb-mole
[see Appendix 1 for vapor molecular weight of selected materials]
K_C = product factor:
For **<u>crude oil</u>**, $K_C = 0.4$ and for all **<u>other materials,</u>** $K_C = 1$

Deck Fitting Loss

Deck fitting loss from floating roof tanks can be estimated using the following equation:

$$L_F = F_F \times F_P \times M_V \times K_C \qquad (Eq.\ 4)$$

where: L_F = deck fitting loss, lb/yr
F_F = total deck fitting loss factor, lb-mole/yr, depending on tank diameter and type of roof deck *[see Appendix 2 for selected deck fitting loss factors]*
F_P = vapor pressure function, dimensionless
[see Appendix 1 for vapor pressure function of selected materials]
M_V = average vapor molecular weight, lb/lb-mole
[see Appendix 1 for vapor molecular weight of selected materials]
K_C = product factor:
For **crude oil**, $K_C = 0.4$ and for all **other materials,** $K_C = 1$

Deck Seam Loss

Deck seam loss, L_D is applicable only to **internal floating roof tanks with bolted decks** and can be estimated by the following equation:

$$L_D = S_D \times K_D \times D^2 \times F_P \times M_V \times K_C \qquad (Eq.\ 5)$$

where: L_F = deck seam loss, lbs/yr
S_D = deck seam length factor, ft/ft^2
for bolted deck S_D = 0.2
for others S_D = 0.0
K_D = deck seam loss per unit seam length factor, lb-mole/ft-yr
for bolted deck K_D = 0.14
for others K_D = 0.0
D = tank diameter, ft
F_P = vapor pressure function, dimensionless
[see Appendix 1 for vapor pressure function of selected materials]
M_V = average vapor molecular weight, lb/lb-mole
[see Appendix 1 for vapor molecular weight of selected materials]
K_C = product factor:
For **crude oil**, $K_C = 0.4$ and for all **other materials,** $K_C = 1$

EMISSIONS FROM FIXED ROOF TANKS

Total emissions or losses from fixed roof tanks are equal to the sum of the working loss, standing loss and losses from process upset:

$$L_T = L_W + L_S + L_X \qquad \textit{(Eq. 6)}$$

where: L_T = total loss, lbs/yr
L_W = working loss, lbs/yr
L_S = standing loss, lbs/yr
L_X = loss from process upset, lbs/yr

If the tank is vented to a vapor recovery system, or a thermal oxidizer, with control efficiency, calculate total loss with control system as follows:

$$L_T = \{(L_W + L_S) \times [1 - (\text{efficiency in decimal fraction})]\} + L_X \qquad \textit{(Eq. 6-a)}$$

You must enclose supporting documentation for the control system efficiency.

Working Loss

The working loss from fixed roof tanks can be estimated from:

$$L_W = 0.024 \times M_V \times P_{VA} \times Q \times K_N \times K_P \qquad \textit{(Eq. 7)}$$

where: L_W = working loss, lbs/yr
M_V = average vapor molecular weight, lb/lb-mole
[see Appendix 1 for vapor molecular weight of selected materials]
P_{VA} = true vapor pressure of stored liquid at average liquid surface temperature, psia
[see Appendix 1 for true vapor pressure of selected materials]
Q = annual throughput in 1,000 gallons unit, Mgal/yr
K_N = turn over factor, dimensionless, dependent of annual throughput, Q (Mgal/yr or 1,000 gallons/yr), and tank capacity, C (Mgal or 1,000 gallons). K_N is calculated as follows:

If $Q/C \leq 36$ then $K_N = 1.0$

If $Q/C > 36$ then

$$K_N = \frac{(180 \times C) + Q}{6 \times Q} \qquad (\textit{Eq.}\ 8)$$

K_P = working loss product factor, dimensionless
For **crude oil**, $K_P = 0.75$ and for **other materials,** $K_P = 1.0$

Standing Loss

Fixed roof tank standing loss can be estimated from:

$$L_S \quad = \quad U \times V_V \times W_V \times K_E \times K_S \qquad (Eq. \quad 9)$$

where: L_S = standing storage loss, lbs/yr

U = number of days of the year that the tank is used to store liquid material. This number must not be more than 365 days. If not known, assume 365 days.

V_V = vapor space volume can be calculated as illustrated by Equation 10 below (for horizontal and rectangular tank see next page):

$$V_V = (66.84 \times C) + V_F \qquad (Eq. \ 10)$$

where: C = tank capacity, Mgal or 1,000 gallons

V_F = vapor space function, depending on tank diameter *[see Appendix 2 for selected vapor space function]*

W_V = vapor density, lb/ft^3 *[see Appendix 1 for vapor density of selected materials]*

K_E = vapor space expansion factor, dimensionless *[see Appendix 1 for vapor space expansion factors for selected materials]*

K_S = vented vapor saturation factor, dimensionless, can be calculated as illustrated by Equation 11 bellow (for horizontal and rectangular tank see next page):

$$K_S = \frac{1}{1 + (S_A \times H) + (S_B \times D)} \qquad (Eq. \quad 11)$$

where: S_A, S_B = vapor saturation functions *[see Appendix 1 for vapor saturation function of selected materials]*

D = tank diameter, ft

H = tank height, ft

SPECIAL CASES

For **horizontal tank**:

$$V_V = \frac{H \times D^2}{2} \qquad (Eq.\ 10-a)$$

and

$$K_S = \frac{1}{1 + (0.0265 \times P_{VA} \times D)} \qquad (Eq.\ 11-a)$$

For **rectangular tank**:

$$V_V = \frac{0.393 \times H \times L_1 \times L_2}{(L_1 + L_2)} \qquad (Eq.\ 10-b)$$

and

$$K_S = \frac{1}{1 + (0.0133 \times P_{VA} \times H)} \qquad (Eq.\ 11-b)$$

where: L_1, L_2 = side 1 and side 2 of rectangular tank, ft
D = tank diameter, ft
H = tank height, ft
P_{VA} = true vapor pressure of stored liquid at average liquid surface temperature, psia [see Appendix 1 for true vapor pressure of selected materials]

The equivalent diameter for rectangular and square tanks:

For rectangular tank, substitute D with the equivalent diameter (D_E) which is defined as:

$$D_E = \frac{2 * L_1 * L_2}{(L_1 + L_2)} \qquad (Eq.\ 12)$$

where:

L_1 = side 1 of rectangular tank (feet)
L_2 = side 2 of rectangular tank (feet)

For square tank, $L = L_1 = L_2$ then D_E becomes:

$$D_E = \frac{2 * L * L}{(L + L)} = L \qquad (Eq.\ 13)$$

where L = side of square tank (feet)

FUEL DISPENSING AND SMALL LIQUID ORGANIC STORAGE TANKS

Small liquid storage tank is defined as a tank with ***a storage capacity of less than 10,000 gallons and operated at ambient temperature and pressure***. VOC emission can be calculated using the following equation:

$$E = EF * Q \qquad (Eq. 14)$$

where:

where:	E	=	VOC emissions (lb)
	Q	=	annual throughput (Mgal or 1,000 gallons)
	EF	=	emission factor (lb/Mgal)

A. Fuel Dispensing and Underground StorageTanks (including non-retail service stations)

Gasoline :	EF =	1.8	lb/Mgal or lb/1,000 gallons (controlled)
Diesel:	EF =	0.028	lb/Mgal or lb/1,000 gallons

B. Small Liquid Organic Storage Tanks

Under-Ground tank: EF = loss factor ***f***

Above-Ground tank

$$EF = \frac{a * (C / Q)}{[1 + (b * H)]} + f \qquad (Eq. 15)$$

where:	C	=	tank size or capacity (Mgal or 1,000 gallons)
	Q	=	annual throughput (Mgal or 1,000 gallons)
	H	=	tank height (feet)
	a, b, f	=	small tank loss factors ***a, b, f*** (see Appendix 1)

TOXIC AIR CONTAMINANT (TAC) CALCULATION

Toxic air contaminant emissions associated with storage tanks must be calculated and reported. In general, the emission factor and emission rate for each component can be estimated by:

$$EF_{TAC} = Z_{TAC} * EF \qquad (Eq. \quad 16)$$

$$E_{TAC} = Z_{TAC} * E_T \qquad (Eq. \quad 17)$$

where:

where:	EF_{TAC}	=	emission factor for TAC component, lbs/1,000 gallons
	EF	=	VOC emission factor, lbs/1,000 gallons
	Z_{TAC}	=	weight fraction of TAC component
	E_{TAC}	=	emission rate of TAC component, lbs/yr
	E_T	=	total tank VOC emissions, lbs/yr

For products containing numerous TAC components, it's advantageous to utilize EPA's TANKS program to calculate emissions for each TAC component. One of the key features of TANKS program is the ability to build and store the speciation profile (weight fraction of TAC components) of the mixture. The results from TANKS (both VOC and individual TAC emissions) can then be imported to the District's AER PC-based reporting software. Otherwise, emission for each TAC component must be calculated and reported individually on Form TAC. Some typical (default) TAC profile in precent by weight (%W) for selected petroleum products are listed in Appendix 3 of this booklet.

APPENDIX 1: PROPERTIES AND PARAMETERS FOR SELECT MATERIALS

Product		Chemical Name	CAS	Vapor		Liquid Density	P_{VA}	F_P	K_E	S_A	S_B	Small Tank Loss Factors		
Category	Code			M_V	W_V	W_L						a	b	f
Crude Oils	001	Crude oil (RVP 5)		50	0.028	7.10	3.181	0.061	0.094	0.0843	0.0115	0.064	0.084	2.863
Petroleum Dist	002	Distillate fuel oil #2		130	0.00018	7.10	0.0077	0.00013	0.034	0.0002	0.00003	0.00015	0.00020	0.0241
Petroleum Dist	003	Residual oil #6		190	0.000002	7.90	0.00005	0.000001	0.034	0.000001	0.0000002	0.000001	0.000001	0.000241
Petroleum Dist	004	Jet naphtha (JP-4)		80	0.02	6.40	1.419	0.025	0.056	0.0376	0.0052	0.028	0.038	2.725
Petroleum Dist	005	Jet kerosene		130	0.0002	7.00	0.0098	0.00017	0.034	0.0003	0.00004	0.00019	0.00026	0.0306
Petroleum Dist	006	Gasoline (RVP 6)		69	0.04	5.60	3.275	0.063	0.091	0.0868	0.0119	0.089	0.087	5.423
Petroleum Dist	007	Gasoline (RVP 7)		68	0.047	5.60	3.880	0.076	0.106	0.1028	0.0141	0.122	0.103	6.332
Petroleum Dist	008	Gasoline (RVP 8)		68	0.054	5.60	4.494	0.091	0.118	0.1191	0.0163	0.156	0.119	7.334
Petroleum Dist	009	Gasoline (RVP 9)		67	0.061	5.60	5.116	0.107	0.134	0.1356	0.0186	0.199	0.136	8.226
Petroleum Dist	010	Gasoline (RVP 10)		66	0.067	5.60	5.744	0.123	0.143	0.1522	0.0209	0.235	0.152	9.099
Petroleum Dist	011	Gasoline (RVP 11)		65	0.074	5.60	6.379	0.141	0.174	0.1691	0.0232	0.312	0.169	9.952
Petroleum Dist	012	Gasoline (RVP 12)		64	0.08	5.60	7.020	0.161	0.199	0.1860	0.0255	0.387	0.186	10.783
Petroleum Dist	013	Gasoline (RVP 13)		62	0.084	5.60	7.667	0.182	0.229	0.2032	0.0278	0.470	0.203	11.408
Organic Liquids	014	Acetaldehyde	75070	44.0	0.106	6.58	13.568	0.566	2.542	0.3596	0.0493	6.572	0.360	14.328
Organic Liquids	015	Acetic acid	64197	60.1	0.0021	8.79	0.200	0.0034	0.039	0.0053	0.0007	0.00201	0.00531	0.289
Organic Liquids	016	Acetic anhydride	108247	102.1	0.0012	9.01	0.0650	0.0011	0.036	0.0017	0.0002	0.00102	0.00172	0.159
Organic Liquids	018	Acetonitrile	75058	41.1	0.0094	6.56	1.296	0.023	0.058	0.0343	0.0047	0.013	0.034	1.277
Organic Liquids	019	Acrylamide	79061	71.1	0.000001	9.36	0.00012	0.000002	0.034	0.000003	0.0000004	0.000001	0.000003	0.0002
Organic Liquids	020	Acrylic acid	79107	72.1	0.0007	8.86	0.0538	0.00092	0.035	0.0014	0.0002	0.00059	0.00143	0.0932
Organic Liquids	021	Acrylonitrile	107131	53.1	0.015	6.76	1.607	0.029	0.066	0.0426	0.0058	0.024	0.043	2.047
Organic Liquids	022	Allyl alcohol	107186	58.1	0.0033	7.13	0.324	0.0056	0.043	0.0086	0.0012	0.00347	0.00859	0.452
Organic Liquids	023	Allyl chloride	107051	76.5	0.073	7.86	5.406	0.114	0.163	0.1433	0.0196	0.291	0.143	9.929
Organic Liquids	024	Aniline	62533	93.1	0.00013	8.53	0.0078	0.00013	0.034	0.0002	0.00003	0.00011	0.00021	0.0173
Organic Liquids	025	Benzene	71432	78.1	0.019	7.37	1.340	0.024	0.060	0.0355	0.0049	0.027	0.036	2.512

APPENDIX 1: PROPERTIES AND PARAMETERS FOR SELECT MATERIALS

Product		Chemical Name	CAS	Vapor		Liquid Density	P_{VA}	F_P	K_E	S_A	S_B	Small Tank Loss Factors		
Category	Code			M_V	W_V	W_L						a	b	f
Organic Liquids	026	Butanol-(1)	71363	74.1	0.00093	6.76	0.0710	0.0012	0.036	0.0019	0.0003	0.00082	0.00188	0.126
Organic Liquids	027	Butyl alcohol (-tert)	75650	74.1	0.0070	6.60	0.532	0.0092	0.049	0.0141	0.0019	0.00833	0.014	0.945
Organic Liquids	028	Butyl chloride (-n)	109693	92.6	0.025	7.43	1.530	0.027	0.065	0.0405	0.0056	0.040	0.041	3.399
Organic Liquids	029	Carbon disulfide	75150	76.1	0.073	10.59	5.378	0.113	0.158	0.1425	0.0195	0.280	0.143	9.826
Organic Liquids	030	Carbon tetrachloride	56235	153.8	0.045	13.37	1.650	0.030	0.063	0.0437	0.0060	0.069	0.044	6.091
Organic Liquids	031	Chlorobenzene	108907	112.6	0.0032	9.24	0.158	0.0027	0.037	0.0042	0.0006	0.00288	0.00418	0.426
Organic Liquids	032	Chloroform	67663	119.4	0.059	12.49	2.778	0.052	0.093	0.0736	0.0101	0.134	0.074	7.959
Organic Liquids	033	Chloroprene	126998	88.5	0.049	8.05	3.100	0.059	0.098	0.0821	0.0113	0.116	0.082	6.587
Organic Liquids	034	Cresol (-m)	108394	108.1	0.00003	8.63	0.00180	0.000031	0.034	0.00005	0.00001	0.00003	0.00005	0.0047
Organic Liquids	035	Cresol (-o)	95487	108.1	0.00005	8.74	0.0024	0.000040	0.034	0.0001	0.00001	0.00004	0.00006	0.0061
Organic Liquids	036	Cresol (-p)	106445	108.1	0.00002	8.63	0.00086	0.000015	0.034	0.00002	0.000003	0.00001	0.00002	0.0022
Organic Liquids	037	Cyclohexane	110827	84.2	0.021	6.52	1.385	0.025	0.063	0.0367	0.0050	0.032	0.037	2.798
Organic Liquids	038	Cyclohexanol	108930	100.2	0.00004	8.03	0.0024	0.000041	0.034	0.0001	0.00001	0.00004	0.00006	0.0058
Organic Liquids	039	Cyclohexanone	108941	98.2	0.0011	7.91	0.0637	0.0011	0.035	0.0017	0.0002	0.00096	0.00169	0.150
Organic Liquids	040	Cyclohexene	110838	82.2	0.018	6.75	1.256	0.022	0.059	0.0333	0.0046	0.026	0.033	2.477
Organic Liquids	041	Cyclopentane	287923	70.1	0.059	6.25	4.709	0.096	0.138	0.1248	0.0171	0.198	0.125	7.925
Organic Liquids	042	Cyclopentanone	120923	84.1	0.0023	7.90	0.155	0.0027	0.037	0.0041	0.0006	0.00211	0.00412	0.314
Organic Liquids	043	Cyclopentene	142290	68.1	0.045	6.43	3.693	0.072	0.115	0.0979	0.0134	0.125	0.098	6.037
Organic Liquids	044	Decane (-n)	124185	142.3	0.0009	6.09	0.0375	0.00064	0.034	0.0010	0.0001	0.00080	0.00099	0.128
Organic Liquids	045	Dichloroethane (1,1)	75343	99.0	0.059	9.86	3.336	0.064	0.109	0.0884	0.0121	0.156	0.088	7.924
Organic Liquids	046	Dichloroethane (1,2)	107062	99.0	0.019	10.50	1.090	0.019	0.063	0.0289	0.0040	0.030	0.029	2.589
Organic Liquids	047	Dichloroethylene (cis-1,2)	540590	97.0	0.053	10.76	3.065	0.058	0.101	0.0812	0.0111	0.130	0.081	7.130
Organic Liquids	048	Dichloroethylene (-trans-1,2)	156605	97.0	0.084	10.52	4.877	0.100	0.152	0.1292	0.0177	0.311	0.129	11.348
Organic Liquids	049	Diethoxymethane		104.2	0.017	6.99	0.934	0.016	0.053	0.0248	0.0034	0.022	0.025	2.336
Organic Liquids	050	Diethyl (n,n) anilin	91667	149.2	0.0001	7.76	0.0022	0.00004	0.034	0.0001	0.00001	0.00005	0.00006	0.0077
Organic Liquids	051	Diethyl ether	60297	74.1	0.105	5.99	7.959	0.192	0.279	0.2109	0.0289	0.712	0.211	14.158
Organic Liquids	052	Diethyl ketone	96220	86.1	0.0072	6.78	0.472	0.0082	0.044	0.0125	0.0017	0.00779	0.013	0.975

APPENDIX 1: PROPERTIES AND PARAMETERS FOR SELECT MATERIALS

Product		Chemical Name	CAS	Vapor		Liquid Density W_L	P_{VA}	F_P	K_E	S_A	S_B	Small Tank Loss Factors		
Category	Code			M_V	W_V							a	b	f
Organic Liquids	053	Diethyl sulfide	352932	90.2	0.013	6.97	0.808	0.014	0.050	0.0214	0.0029	0.016	0.021	1.749
Organic Liquids	054	Diethylamine	109897	73.1	0.044	5.91	3.365	0.065	0.121	0.0892	0.0122	0.129	0.089	5.906
Organic Liquids	055	Di-isopropyl ether	108203	102.2	0.044	6.08	2.437	0.045	0.084	0.0646	0.0088	0.090	0.065	5.974
Organic Liquids	056	Dimethyl formamide	68122	73.1	0.0006	7.58	0.0492	0.0008	0.035	0.0013	0.0002	0.00055	0.00130	0.086
Organic Liquids	057	Dimethyl hydrazine (1,1)	57147	60.1	0.023	7.88	2.185	0.040	0.082	0.0579	0.0079	0.047	0.058	3.151
Organic Liquids	058	Dimethyl phthalate	131113	194.2	$2x10^{-9}$	9.97	$1x10^{-7}$	$1x10^{-9}$	0.034	$2x10^{-9}$	$1x10^{-10}$	$2x10^{-9}$	$2x10^{-9}$	$3x10^{-7}$
Organic Liquids	059	Dioxane (1,4)	123911	88.1	0.008	8.66	0.510	0.0088	0.047	0.0135	0.0019	0.009	0.014	1.078
Organic Liquids	060	Dipropyl ether	111433	102.2	0.018	6.26	0.967	0.017	0.053	0.0256	0.0035	0.023	0.026	2.370
Organic Liquids	061	Di-t-butyl ether	6163662	130.2	0.017	6.40	0.743	0.013	0.048	0.0197	0.0027	0.020	0.020	2.321
Organic Liquids	062	Epichlorohydrin	106898	92.5	0.0037	9.85	0.227	0.0039	0.039	0.0060	0.0008	0.00354	0.00603	0.505
Organic Liquids	063	Ethanolamine (mono-)	141435	61.1	0.00004	8.34	0.0033	0.00006	0.034	0.0001	0.00001	0.00003	0.00009	0.0048
Organic Liquids	064	Ethyl acetate	141786	88.1	0.02	7.55	1.309	0.023	0.062	0.0347	0.0048	0.031	0.035	2.768
Organic Liquids	065	Ethyl acrylate	140885	100.1	0.01	7.75	0.553	0.0096	0.046	0.0147	0.0020	0.011	0.015	1.330
Organic Liquids	066	Ethyl alcohol	64175	46.1	0.0064	6.61	0.780	0.014	0.052	0.0207	0.0028	0.00805	0.021	0.862
Organic Liquids	067	Ethyl chloride	75003	64.5	0.210	7.68	18.357	0.312	0.038	0.4865	0.0666	0.195	0.486	28.425
Organic Liquids	068	Ethylamine	75047	45.1	0.126	5.69	15.778	0.268	0.038	0.4181	0.0573	0.117	0.418	17.070
Organic Liquids	069	Ethylbenzene	100414	106.2	0.0024	7.23	0.129	0.0022	0.037	0.0034	0.0005	0.00219	0.00342	0.329
Organic Liquids	070	Ethylcyclopentane		98.2	0.010	6.38	0.550	0.0095	0.045	0.0146	0.0020	0.011	0.015	1.296
Organic Liquids	071	Ethyleneoxide	75218	44.0	0.155	7.23	19.802	0.337	0.038	0.5248	0.0719	0.143	0.525	20.911
Organic Liquids	072	Fluorobenzene	462066	96.1	0.018	8.52	1.076	0.019	0.055	0.0285	0.0039	0.025	0.029	2.482
Organic Liquids	073	Formic acid	64186	46.0	0.0049	10.18	0.600	0.010	0.046	0.0159	0.0022	0.00545	0.016	0.662
Organic Liquids	074	Freon 11	75694	137.4	0.296	12.48	12.126	0.410	0.951	0.3213	0.0440	6.863	0.321	39.980
Organic Liquids	075	Furan	110009	68.1	0.108	7.82	8.919	0.229	0.374	0.2363	0.0324	0.984	0.236	14.573
Organic Liquids	076	Furfural	96011	96.1	0.0003	9.65	0.0175	0.0003	0.034	0.0005	0.0001	0.00025	0.00046	0.0404
Organic Liquids	077	Heptane (-n)	142825	100.2	0.011	5.73	0.638	0.011	0.048	0.0169	0.0023	0.013	0.017	1.534
Organic Liquids	078	Hexane (-n)	110543	86.2	0.033	5.53	2.177	0.040	0.078	0.0577	0.0079	0.063	0.058	4.501
Organic Liquids	079	Hexanol (-1)	111273	102.2	0.0002	6.76	0.0090	0.0002	0.034	0.0002	0.00003	0.00014	0.00024	0.022

APPENDIX 1: PROPERTIES AND PARAMETERS FOR SELECT MATERIALS

Product		Chemical Name	CAS	Vapor		Liquid Density W_L	P_{VA}	F_P	K_E	S_A	S_B	Small Tank Loss Factors		
Category	Code			M_V	W_V							a	b	f
Organic Liquids	080	Hydrogen cyanide	74908	27.0	0.053	5.77	11.084	0.337	0.668	0.2937	0.0402	0.867	0.294	7.191
Organic Liquids	081	Iso-butyl alcohol	78831	74.1	0.0029	6.71	0.222	0.0038	0.040	0.0059	0.0008	0.00285	0.00588	0.395
Organic Liquids	082	Isooctane	26635643	114.2	0.014	5.79	0.696	0.012	0.050	0.0184	0.0025	0.017	0.018	1.908
Organic Liquids	083	Isopentane	78784	72.2	0.144	5.20	11.268	0.348	0.756	0.2986	0.0409	2.662	0.299	19.511
Organic Liquids	084	Isoprene	78795	68.1	0.105	5.71	8.673	0.219	0.358	0.2298	0.0315	0.917	0.230	14.176
Organic Liquids	085	Isopropyl alcohol	67630	60.1	0.0061	6.57	0.576	0.010	0.047	0.0153	0.0021	0.007	0.015	0.830
Organic Liquids	086	Isopropyl benzene	98828	120.2	0.0013	7.21	0.0615	0.001	0.035	0.0016	0.0002	0.00114	0.00163	0.177
Organic Liquids	087	Methacrylonitrile	126987	67.1	0.012	6.74	1.015	0.018	0.055	0.0269	0.0037	0.016	0.027	1.634
Organic Liquids	088	Methyl acetate	79209	74.1	0.041	7.83	3.082	0.059	0.114	0.0817	0.0112	0.113	0.082	5.479
Organic Liquids	089	Methyl acrylate	96333	86.1	0.018	8.00	1.190	0.021	0.058	0.0315	0.0043	0.026	0.032	2.458
Organic Liquids	090	Methyl alcohol	67561	32.0	0.010	6.63	1.686	0.030	0.075	0.0447	0.0061	0.018	0.045	1.296
Organic Liquids	091	Methyl ethyl ketone	78933	72.1	0.016	6.75	1.256	0.022	0.055	0.0333	0.0046	0.022	0.033	2.173
Organic Liquids	092	Methyl isobutyl ketone	108101	100.2	0.0045	6.68	0.252	0.0043	0.040	0.0067	0.0009	0.00434	0.00667	0.605
Organic Liquids	093	Methyl methacrylate	80626	100.1	0.009	7.91	0.491	0.0085	0.047	0.0130	0.0018	0.010	0.013	1.179
Organic Liquids	094	Methyl propyl ether	557175	74.1	0.089	6.17	6.762	0.153	0.162	0.1792	0.0245	0.351	0.179	12.029
Organic Liquids	095	Methyl styrene (alpha)	98839	118.0	0.0006	7.59	0.0297	0.0005	0.035	0.0008	0.0001	0.00053	0.00079	0.084
Organic Liquids	096	Methylcyclohexane	108872	98.2	0.011	6.44	0.644	0.011	0.046	0.0171	0.0023	0.013	0.017	1.519
Organic Liquids	097	Methylcyclopentane	96377	84.2	0.030	6.27	1.976	0.036	0.071	0.0524	0.0072	0.051	0.052	3.992
Organic Liquids	098	Methyldichlorosilane		129.1	0.147	8.91	6.397	0.142	0.202	0.1695	0.0232	0.724	0.170	19.816
Organic Liquids	099	Methylene chloride	75092	84.9	0.095	11.12	6.334	0.140	0.193	0.1679	0.0230	0.449	0.168	12.912
Organic Liquids	100	Methyl-tert-butyl ether (MTBE)	1634044	88.2	0.057	6.20	3.665	0.072	0.113	0.0971	0.0133	0.158	0.097	7.754
Organic Liquids	101	Mineral Spirits	8052413	125.0	0.0005	6.5	0.023	0.0004	0.035	0.0006	0.0001	0.00043	0.00061	0.069
Organic Liquids	102	Nitrobenzene	98953	123.1	0.0001	10.06	0.0029	0.00005	0.034	0.0001	0.0000	0.00005	0.00008	0.0087
Organic Liquids	103	Nitromethane	75525	61.0	0.005	9.54	0.426	0.0073	0.045	0.0113	0.0015	0.00502	0.011	0.623
Organic Liquids	104	Nonane (-n)	111842	128.3	0.0017	5.99	0.0742	0.0013	0.035	0.0020	0.0003	0.00145	0.00197	0.228
Organic Liquids	105	n-Propyl nitrate	627134	105.1	0.0058	8.78	0.309	0.0053	0.041	0.0082	0.0011	0.00574	0.00818	0.778
Organic Liquids	106	o-Chlorotoluene	95498	126.6	0.001	9.02	0.0462	0.0008	0.035	0.0012	0.0002	0.00089	0.00122	0.140

APPENDIX 1: PROPERTIES AND PARAMETERS FOR SELECT MATERIALS

Product		Chemical Name	CAS	Vapor		Liquid Density	P_{VA}	F_P	K_E	S_A	S_B	Small Tank Loss Factors		
Category	Code			M_V	W_V	W_L						a	b	f
Organic Liquids	107	Octane (-n)	111659	114.2	0.0034	5.87	0.167	0.0029	0.037	0.0044	0.0006	0.00304	0.00442	0.457
Organic Liquids	108	Pentachloroethane	76017	202.3	0.0015	13.95	0.0424	0.0007	0.035	0.0011	0.0002	0.00130	0.00112	0.206
Organic Liquids	109	Pentane (-n)	109660	72.2	0.098	5.25	7.631	0.181	0.257	0.2022	0.0277	0.612	0.202	13.213
Organic Liquids	110	Phosgene	75445	98.9	0.383	11.50	21.834	0.371	0.038	0.5786	0.0793	0.355	0.579	51.836
Organic Liquids	111	Picoline (-2)	108996	93.1	0.0024	7.93	0.145	0.0025	0.037	0.0038	0.0005	0.00219	0.00385	0.325
Organic Liquids	112	Propylamine (-n)	107108	59.1	0.049	6.03	4.704	0.096	0.141	0.1246	0.0171	0.170	0.125	6.673
Organic Liquids	113	Propylene glycol	57556	76.1	0.00002	8.65	0.00124	0.00002	0.034	0.00003	0.000005	0.00001	0.00003	0.0023
Organic Liquids	114	Propylene oxide	75669	58.1	0.078	7.17	7.571	0.179	0.295	0.2006	0.0275	0.562	0.201	10.558
Organic Liquids	115	Pyridine	110861	79.1	0.0039	8.16	0.275	0.0047	0.040	0.0073	0.0010	0.00377	0.00729	0.522
Organic Liquids	116	Resorcinol	108463	110.1	0.000002	10.62	0.00010	0.000002	0.034	0.000003	0.0000004	0.000002	0.000003	0.0003
Organic Liquids	117	Styrene	100425	104.2	0.0016	7.56	0.085	0.0015	0.036	0.0023	0.0003	0.00138	0.00226	0.214
Organic Liquids	118	Tetrachloroethane (1,1,1,2)	630206	167.9	0.0047	13.34	0.157	0.0027	0.038	0.0042	0.0006	0.00428	0.00416	0.632
Organic Liquids	119	Tetrachloroethane (1,1,2,2)	79345	167.9	0.0016	13.24	0.0528	0.0009	0.035	0.0014	0.0002	0.00136	0.00140	0.213
Organic Liquids	120	Tetrachloroethylene	127184	165.8	0.0072	13.55	0.243	0.0042	0.039	0.0065	0.0009	0.00686	0.00645	0.969
Organic Liquids	121	Tetrahydrofuran	109999	72.1	0.030	7.42	2.322	0.043	0.081	0.0615	0.0084	0.059	0.062	4.019
Organic Liquids	122	Toluene	108883	92.1	0.0063	7.26	0.385	0.0066	0.042	0.0102	0.0014	0.00644	0.01021	0.852
Organic Liquids	123	Trichloro(1,1,2)trifluoroethane	76131	187.4	0.164	13.18	4.924	0.102	0.149	0.1305	0.0179	0.597	0.130	22.145
Organic Liquids	124	Trichloroethane (1,1,1)	71556	133.4	0.045	11.22	1.889	0.034	0.068	0.0501	0.0069	0.074	0.050	6.048
Organic Liquids	125	Trichloroethane (1,1,2)	79005	133.4	0.0068	11.16	0.289	0.0050	0.040	0.0077	0.0010	0.00674	0.00766	0.925
Organic Liquids	126	Trichloroethylene	79016	131.4	0.022	12.27	0.950	0.017	0.055	0.0252	0.0034	0.030	0.025	2.996
Organic Liquids	127	Trichloropropane (1,2,3)	96184	147.4	3.925	11.58	149.998	2.55	0.038	3.9749	0.5446	3.639	3.975	530.740
Organic Liquids	128	Trimethylchorosilane		108.6	0.066	7.13	3.420	0.066	0.105	0.0906	0.0124	0.168	0.091	8.918
Organic Liquids	129	Vinyl acetate	108054	86.1	0.025	7.82	1.607	0.029	0.066	0.0426	0.0058	0.039	0.043	3.320
Organic Liquids	130	Vinylidene chloride	75354	96.5	0.155	10.38	9.039	0.234	0.359	0.2395	0.0328	1.355	0.240	20.935
Organic Liquids	131	Xylene (-m)	1330207	106.2	0.0020	7.24	0.108	0.0018	0.036	0.0029	0.0004	0.00180	0.00285	0.274
Organic Liquids	132	Xylene (-o)	95476	106.2	0.002	7.35	0.085	0.0014	0.036	0.0022	0.0003	0.00140	0.00225	0.216
Organic Liquids	133	1,1-Diethoxyethane	105577	118.2	0.010	6.92	0.461	0.008	0.044	0.0122	0.0017	0.010	0.012	1.306

APPENDIX 1: PROPERTIES AND PARAMETERS FOR SELECT MATERIALS

Product		Chemical Name	CAS	Vapor		Liquid Density	P_{VA}	F_P	K_E	S_A	S_B	Small Tank Loss Factors		
Category	Code			M_V	W_V	W_L						a	b	f
Organic Liquids	134	1,1-Dimethylcyclopentane		87.5	0.017	6.29	1.068	0.019	0.055	0.0283	0.0039	0.022	0.028	2.243
Organic Liquids	135	1,2,4-Trimethylbenzene	95636	120.2	0.0005	7.29	0.0249	0.00042	0.035	0.0007	0.0001	0.00045	0.00066	0.072
Organic Liquids	136	1,2-Dibromopropane	78751	201.9	0.0038	16.10	0.105	0.0018	0.036	0.0028	0.0004	0.00334	0.00278	0.509
Organic Liquids	137	1,2-Diethylbenzene		134.2	0.0003	7.33	0.0117	0.0002	0.034	0.0003	0.00004	0.00023	0.00031	0.038
Organic Liquids	138	1,2-Dimethoxyethane	110714	90.1	0.039	7.22	2.446	0.045	0.085	0.0648	0.0089	0.081	0.065	5.291
Organic Liquids	139	1,2-Pentadiene		68.1	0.066	5.77	5.425	0.115	0.167	0.1438	0.0197	0.267	0.144	8.869
Organic Liquids	140	1,3-Dibromopropane	109648	201.9	0.0012	16.51	0.0330	0.00056	0.035	0.0009	0.0001	0.00100	0.00087	0.160
Organic Liquids	141	1,3-Diethylbenzene		134.2	0.0003	7.17	0.0128	0.0002	0.034	0.0003	0.00005	0.00025	0.00034	0.041
Organic Liquids	142	1,4-Diethylbenzene		134.2	0.0003	7.18	0.0119	0.0002	0.034	0.0003	0.00004	0.00024	0.00031	0.038
Organic Liquids	143	1,4-Pentadiene		68.1	0.135	5.49	11.132	0.340	0.672	0.2950	0.0404	2.207	0.295	18.199
Organic Liquids	144	1,5-Hexadiene		82.2	0.048	5.73	3.261	0.063	0.101	0.0864	0.0118	0.117	0.086	6.429
Organic Liquids	145	1-Chlorobutane	109639	92.6	0.024	7.38	1.444	0.026	0.063	0.0383	0.0052	0.036	0.038	3.207
Organic Liquids	146	1-Heptene		98.2	0.014	5.81	0.782	0.014	0.050	0.0207	0.0028	0.017	0.021	1.842
Organic Liquids	147	1-Methyl-2-isopropylbenzene	527844	134.2	0.0004	7.30	0.0173	0.00029	0.034	0.0005	0.0001	0.00035	0.00046	0.056
Organic Liquids	148	1-Octanol	111875	130.2	0.00002	6.89	0.00108	0.00002	0.034	0.00003	0.000004	0.00002	0.00003	0.0034
Organic Liquids	149	1-Pentene	109671	70.1	0.120	5.33	9.662	0.261	0.430	0.2560	0.0351	1.261	0.256	16.265
Organic Liquids	150	1-Pentyne		68.1	0.077	5.76	6.366	0.141	0.208	0.1687	0.0231	0.390	0.169	10.408
Organic Liquids	151	1-Propanethiol		76.2	0.030	7.01	2.210	0.041	0.079	0.0586	0.0080	0.057	0.059	4.040
Organic Liquids	152	1-Propanol	71238	60.1	0.0027	6.70	0.257	0.0044	0.041	0.0068	0.0009	0.003	0.007	0.371
Organic Liquids	153	2,2,3-Trimethylpentane		114.2	0.0089	5.97	0.439	0.0076	0.043	0.0116	0.0016	0.009	0.012	1.204
Organic Liquids	154	2,2,4-Trimethylpentane	540841	114.2	0.014	5.76	0.687	0.0120	0.048	0.0182	0.0025	0.016	0.018	1.884
Organic Liquids	155	2,2-Dimethylpentane		100.2	0.027	5.61	1.501	0.027	0.063	0.0398	0.0054	0.041	0.040	3.609
Organic Liquids	156	2,3,3-Trimethylpentane		114.2	0.0075	6.05	0.369	0.0063	0.041	0.0098	0.0013	0.00757	0.0098	1.011
Organic Liquids	157	2,3-Dimethylbutane		86.2	0.053	5.51	3.444	0.067	0.105	0.0913	0.0125	0.135	0.091	7.124
Organic Liquids	158	2,3-Dimethylpentane		100.2	0.017	5.79	0.966	0.017	0.053	0.0256	0.0035	0.022	0.026	2.324
Organic Liquids	159	2,3-Pentadiene		68.1	0.057	5.79	4.690	0.096	0.143	0.1243	0.0170	0.198	0.124	7.668
Organic Liquids	160	2,4-Dimethylpentane		100.2	0.030	5.60	1.661	0.030	0.066	0.0440	0.0060	0.048	0.044	3.994

APPENDIX 1: PROPERTIES AND PARAMETERS FOR SELECT MATERIALS

Product		Chemical Name	CAS	Vapor		Liquid Density	P_{VA}	F_P	K_E	S_A	S_B	Small Tank Loss Factors		
Category	Code			M_V	W_V	W_L						a	b	f
Organic Liquids	161	2-Chlorobutane	78864	92.6	0.037	7.27	2.275	0.042	0.079	0.0603	0.0083	0.072	0.060	5.055
Organic Liquids	162	2-Methyl-1-butene		70.1	0.062	5.42	4.958	0.102	0.136	0.1314	0.0180	0.205	0.131	8.345
Organic Liquids	163	2-Methylhexane		100.2	0.016	5.66	0.920	0.016	0.052	0.0244	0.0033	0.021	0.024	2.212
Organic Liquids	164	2-Methylpentane		86.2	0.047	5.44	3.086	0.059	0.097	0.0818	0.0112	0.112	0.082	6.384
Organic Liquids	165	2-Propanethiol		76.2	0.055	6.83	4.054	0.080	0.123	0.1074	0.0147	0.165	0.107	7.410
Organic Liquids	166	3,3-Dimethylpentane		100.2	0.021	5.78	1.176	0.021	0.057	0.0312	0.0043	0.029	0.031	2.828
Organic Liquids	167	3,4-Dichlorotoluene		161.0	0.0001	10.47	0.0037	0.0001	0.034	0.0001	0.00001	0.00009	0.0001	0.014
Organic Liquids	168	3-Ethylpentane		100.2	0.014	5.82	0.808	0.014	0.050	0.0214	0.0029	0.018	0.021	1.942
Organic Liquids	169	3-Methylhexane		100.2	0.015	5.72	0.858	0.015	0.051	0.0227	0.0031	0.019	0.023	2.063
ADDED CHEMICALS														
Organic Liquids	170	Trimethylphosphite		124.0	0.005	8.72	0.220	0.004	0.034	0.0058	0.0008	0.004	0.006	0.655
Organic Liquids	171	MAA		116.1	0.0004	9.01	0.017	0.0003	0.034	0.0005	0.0001	0.0003	0.0005	0.047
Organic Liquids	172	Chloral		147.4	0.0106	12.59	0.4040	0.0070	0.034	0.0107	0.0015	0.0087	0.0107	1.429
Organic Liquids	173	Monomethylamine 50%		31.1	0.034	5.50	6.207	0.136	0.031	0.1645	0.0225	0.026	0.164	4.627
Organic Liquids	174	Dimethylamine 40%		45.1	0.0200	7.51	2.496	0.046	0.033	0.0661	0.0091	0.016	0.066	2.700
Organic Liquids	175	Dichlorvos		221.0	0.000275	11.88	0.00700	0.000119	0.034	0.000186	0.0000254	0.00023	0.000186	0.0371
Organic Liquids	176	Dicrotophos		237.2	0.0093	10.17	0.2200	0.00377	0.034	0.0058	0.0008	0.0077	0.0058	1.2525
Organic Liquids	177	Metam Sodium		129.2	0.000	10.09	0.001	0.000	0.034	0.0000	0.0000	0.00002	0.00003	0.003
Organic Liquids	178	Dimethylchloroacetoacetate		149.5	0.0121	10.01	0.456	0.0079	0.034	0.0121	0.0017	0.010	0.0121	1.636
Organic Liquids	179	Dimethylformamide		73.1	0.006	8.34	0.456	0.008	0.034	0.0121	0.0017	0.0049	0.012	0.800
Organic Liquids	180	Nitrochlorobenzene		157.6	0.00003	10.79	0.0010	0.00002	0.034	0.0000	0.00000	0.00002	0.00003	0.0038
Organic Liquids	181	Aromatic 150 Fluid	64742945	142.0	0.01233	7.50	0.4890	0.00846	0.034	0.0130	0.00178	0.0102	0.01296	1.6665
Organic Liquids	182	Texanol	25265774	216	0.00005	7.92	0.001	0.00002	0.034	0.0000	0.00000	0.00004	0.00003	0.0068
Organic Liquids	183	Morpholine	110918	87.1	0.0020	8.34	0.130	0.0022	0.037	0.0034	0.0005	0.00181	0.00344	0.271
Organic Liquids	184	Naphthalene	91203	128.2	0.00006	11.08	0.0025	0.0000	0.034	0.0001	0.0000	0.008	0.00005	0.00007

APPENDIX 2: STORAGE TANK FACTORS BY DIAMETER

TANK DIAMETER (ft)	FLOATING											FIXED ROOF
	External Roof					Internal Roof						
			F_F					F_F		K_D	S_D	
	N_C	K_R	Pontoon	Double	K_D	N_C	K_R	Bolted	Welded	Bolted	Bolded	V_F
10	0.0	20.1	1628.6	1634.5	0.0	0.100	6.7	245.5	244.5	0.14	0.2	54
12	0.0	20.1	1630.2	1634.8	0.0	0.083	6.7	245.3	243.9	0.14	0.2	93
14	0.0	20.1	1631.8	1635.1	0.0	0.071	6.7	245.6	243.7	0.14	0.2	148
16	0.0	20.1	1633.4	1635.5	0.0	0.063	6.7	246.4	243.9	0.14	0.2	220
18	0.0	20.1	1635.1	1635.8	0.0	0.056	6.7	247.6	244.5	0.14	0.2	314
20	0.0	20.1	1636.8	1636.2	0.0	0.050	6.7	249.3	245.5	0.14	0.2	430
22	0.0	20.1	1638.5	1636.6	0.0	0.045	6.7	251.5	246.8	0.14	0.2	573
24	0.0	20.1	1640.2	1637.1	0.0	0.042	6.7	254.1	248.6	0.14	0.2	744
26	0.0	20.1	1641.9	1637.6	0.0	0.038	6.7	257.2	250.8	0.14	0.2	946
28	0.0	20.1	1643.7	1638.1	0.0	0.036	6.7	260.8	253.3	0.14	0.2	1181
30	0.0	20.1	1645.5	1638.7	0.0	0.033	6.7	264.9	256.2	0.14	0.2	1453
32	0.0	20.1	1647.3	1639.2	0.0	0.031	6.7	269.4	259.6	0.14	0.2	1763
34	0.0	20.1	1649.1	1639.8	0.0	0.029	6.7	274.4	263.3	0.14	0.2	2115
36	0.0	20.1	1650.9	1640.5	0.0	0.028	6.7	279.9	267.4	0.14	0.2	2510
38	0.0	20.1	1652.8	1641.2	0.0	0.026	6.7	285.8	271.9	0.14	0.2	2952
40	0.0	20.1	1654.7	1641.9	0.0	0.025	6.7	292.2	276.9	0.14	0.2	3443
42	0.0	20.1	1656.6	1642.6	0.0	0.024	6.7	299.1	282.2	0.14	0.2	3986
44	0.0	20.1	1658.5	1643.4	0.0	0.023	6.7	306.4	287.9	0.14	0.2	4583
46	0.0	20.1	1660.4	1644.2	0.0	0.022	6.7	314.3	293.9	0.14	0.2	5237
48	0.0	20.1	1662.4	1645.0	0.0	0.021	6.7	322.5	300.4	0.14	0.2	5950
50	0.0	20.1	1664.4	1645.8	0.0	0.020	6.7	331.3	307.3	0.14	0.2	6725
52	0.0	20.1	1666.4	1646.7	0.0	0.019	6.7	340.5	314.6	0.14	0.2	7565
54	0.0	20.1	1668.4	1647.6	0.0	0.019	6.7	350.2	322.2	0.14	0.2	8472
56	0.0	20.1	1670.4	1648.6	0.0	0.018	6.7	360.4	330.3	0.14	0.2	9448

APPENDIX 2: STORAGE TANK FACTORS BY DIAMETER

TANK DIAMETER (ft)	FLOATING											FIXED ROOF
	External Roof					Internal Roof						
			F_F					F_F		K_D	S_D	
	N_C	K_R	Pontoon	Double	K_D	N_C	K_R	Bolted	Welded	Bolted	Bolded	V_F
58	0.0	20.1	1672.5	1649.6	0.0	0.017	6.7	371.0	338.7	0.14	0.2	10497
60	0.0	20.1	1674.5	1650.6	0.0	0.017	6.7	382.1	347.6	0.14	0.2	11621
62	0.0	20.1	1676.6	1651.6	0.0	0.016	6.7	393.7	356.8	0.14	0.2	12822
64	0.0	20.1	1678.7	1652.7	0.0	0.016	6.7	405.8	366.5	0.14	0.2	14103
66	0.0	20.1	1680.9	1653.8	0.0	0.015	6.7	418.3	376.5	0.14	0.2	15467
68	0.0	20.1	1683.0	1654.9	0.0	0.015	6.7	431.3	386.9	0.14	0.2	16916
70	0.0	20.1	1685.2	1656.1	0.0	0.014	6.7	444.8	397.7	0.14	0.2	18453
72	0.0	20.1	1687.4	1657.2	0.0	0.014	6.7	458.7	408.9	0.14	0.2	20081
74	0.0	20.1	1689.6	1658.5	0.0	0.014	6.7	473.1	420.5	0.14	0.2	21801
76	0.0	20.1	1691.8	1659.7	0.0	0.013	6.7	488.0	432.5	0.14	0.2	23617
78	0.0	20.1	1694.1	1661.0	0.0	0.013	6.7	503.3	444.9	0.14	0.2	25531
80	0.0	20.1	1696.3	1662.3	0.0	0.013	6.7	519.1	457.7	0.14	0.2	27546
82	0.0	20.1	1698.6	1663.7	0.0	0.012	6.7	535.4	470.9	0.14	0.2	29664
84	0.0	20.1	1700.9	1665.0	0.0	0.012	6.7	552.2	484.4	0.14	0.2	31887
86	0.0	20.1	1703.2	1666.4	0.0	0.070	6.7	569.4	498.4	0.14	0.2	34220
88	0.0	20.1	1705.6	1667.9	0.0	0.068	6.7	587.1	512.7	0.14	0.2	36663
90	0.0	20.1	1707.9	1669.3	0.0	0.067	6.7	605.3	527.5	0.14	0.2	39220
92	0.0	20.1	1710.3	1670.8	0.0	0.065	6.7	623.9	542.6	0.14	0.2	41893
94	0.0	20.1	1712.7	1672.4	0.0	0.064	6.7	643.0	558.2	0.14	0.2	44685
96	0.0	20.1	1715.2	1673.9	0.0	0.063	6.7	662.6	574.1	0.14	0.2	47599
98	0.0	20.1	1717.6	1675.5	0.0	0.061	6.7	682.6	590.4	0.14	0.2	50636
100	0.0	20.1	1720.1	1677.1	0.0	0.070	6.7	703.1	607.1	0.14	0.2	53800
102	0.0	20.1	1722.5	1678.8	0.0	0.069	6.7	724.1	624.3	0.14	0.2	57093
104	0.0	20.1	1725.0	1680.4	0.0	0.067	6.7	745.6	641.8	0.14	0.2	60518
106	0.0	20.1	1727.6	1682.2	0.0	0.066	6.7	767.5	659.7	0.14	0.2	64077

APPENDIX 2: STORAGE TANK FACTORS BY DIAMETER

TANK DIAMETER (ft)	FLOATING											FIXED ROOF
	External Roof					Internal Roof						
			F_F					F_F		K_D	S_D	
	N_C	K_R	Pontoon	Double	K_D	N_C	K_R	Bolted	Welded	Bolted	Bolded	V_F
108	0.0	20.1	1730.1	1683.9	0.0	0.065	6.7	789.9	677.9	0.14	0.2	67773
110	0.0	20.1	1732.7	1685.7	0.0	0.064	6.7	812.8	696.6	0.14	0.2	71608
112	0.0	20.1	1735.2	1687.5	0.0	0.063	6.7	836.1	715.7	0.14	0.2	75585
114	0.0	20.1	1737.8	1689.3	0.0	0.061	6.7	859.9	735.2	0.14	0.2	79707
116	0.0	20.1	1740.5	1691.2	0.0	0.060	6.7	884.2	755.0	0.14	0.2	83976
118	0.0	20.1	1743.1	1693.1	0.0	0.059	6.7	909.0	775.3	0.14	0.2	88395
120	0.0	20.1	1745.8	1695.0	0.0	0.067	6.7	934.2	796.0	0.14	0.2	92966
122	0.0	20.1	1748.4	1696.9	0.0	0.066	6.7	959.9	817.0	0.14	0.2	97693
124	0.0	20.1	1751.1	1698.9	0.0	0.065	6.7	986.1	838.4	0.14	0.2	102576
126	0.0	20.1	1753.8	1700.9	0.0	0.063	6.7	1012.7	860.3	0.14	0.2	107620
128	0.0	20.1	1756.6	1703.0	0.0	0.063	6.7	1039.8	882.5	0.14	0.2	112827
130	0.0	20.1	1759.3	1705.1	0.0	0.062	6.7	1067.4	905.1	0.14	0.2	118199
132	0.0	20.1	1762.1	1707.2	0.0	0.061	6.7	1095.4	928.1	0.14	0.2	123738
134	0.0	20.1	1764.9	1709.3	0.0	0.060	6.7	1123.9	951.6	0.14	0.2	129448
136	0.0	20.1	1767.7	1711.5	0.0	0.066	6.7	1152.9	975.4	0.14	0.2	135332
138	0.0	20.1	1770.5	1713.7	0.0	0.065	6.7	1182.4	999.5	0.14	0.2	141390
140	0.0	20.1	1773.4	1715.9	0.0	0.064	6.7	1212.3	1024.1	0.14	0.2	147627
142	0.0	20.1	1776.3	1718.2	0.0	0.063	6.7	1242.7	1049.1	0.14	0.2	154045
144	0.0	20.1	1779.2	1720.4	0.0	0.063	6.7	1273.6	1074.5	0.14	0.2	160646
146	0.0	20.1	1782.1	1722.8	0.0	0.062	6.7	1304.9	1100.3	0.14	0.2	167433
148	0.0	20.1	1785.0	1725.1	0.0	0.061	6.7	1336.7	1126.4	0.14	0.2	174408
150	0.0	20.1	1788.0	1727.5	0.0	0.107	6.7	1369.0	1153.0	0.14	0.2	181575
152	0.0	20.1	1790.9	1729.9	0.0	0.105	6.7	1401.7	1179.9	0.14	0.2	188935
154	0.0	20.1	1793.9	1732.4	0.0	0.104	6.7	1434.9	1207.3	0.14	0.2	196492
156	0.0	20.1	1796.9	1734.8	0.0	0.103	6.7	1468.6	1235.0	0.14	0.2	204247

APPENDIX 2: STORAGE TANK FACTORS BY DIAMETER

TANK DIAMETER (ft)	FLOATING											FIXED ROOF
	External Roof					Internal Roof						
			F_F					F_F		K_D	S_D	
	N_C	K_R	Pontoon	Double	K_D	N_C	K_R	Bolted	Welded	Bolted	Bolded	V_F
158	0.0	20.1	1799.9	1737.3	0.0	0.101	6.7	1502.8	1263.1	0.14	0.2	212204
160	0.0	20.1	1803.0	1739.9	0.0	0.100	6.7	1537.4	1291.7	0.14	0.2	220365
162	0.0	20.1	1806.1	1742.4	0.0	0.099	6.7	1572.5	1320.6	0.14	0.2	228732
164	0.0	20.1	1809.1	1745.0	0.0	0.098	6.7	1608.1	1349.9	0.14	0.2	237309
166	0.0	20.1	1812.2	1747.7	0.0	0.096	6.7	1644.1	1379.6	0.14	0.2	246097
168	0.0	20.1	1815.4	1750.3	0.0	0.095	6.7	1680.7	1409.7	0.14	0.2	255100
170	0.0	20.1	1818.5	1753.0	0.0	0.112	6.7	1717.6	1440.2	0.14	0.2	264319
172	0.0	20.1	1821.7	1755.7	0.0	0.110	6.7	1755.1	1471.1	0.14	0.2	273759
174	0.0	20.1	1824.9	1758.5	0.0	0.109	6.7	1793.0	1502.4	0.14	0.2	283420
176	0.0	20.1	1828.1	1761.2	0.0	0.108	6.7	1831.4	1534.0	0.14	0.2	293306
178	0.0	20.1	1831.3	1764.0	0.0	0.107	6.7	1870.3	1566.1	0.14	0.2	303419
180	0.0	20.1	1834.5	1766.9	0.0	0.106	6.7	1909.6	1598.6	0.14	0.2	313762
182	0.0	20.1	1837.8	1769.8	0.0	0.104	6.7	1949.4	1631.4	0.14	0.2	324337
184	0.0	20.1	1841.1	1772.7	0.0	0.103	6.7	1989.7	1664.7	0.14	0.2	335147
186	0.0	20.1	1844.4	1775.6	0.0	0.102	6.7	2030.4	1698.3	0.14	0.2	346195
188	0.0	20.1	1847.7	1778.6	0.0	0.101	6.7	2071.6	1732.3	0.14	0.2	357483
190	0.0	20.1	1851.0	1781.5	0.0	0.116	6.7	2113.3	1766.8	0.14	0.2	369014
192	0.0	20.1	1854.4	1784.6	0.0	0.115	6.7	2155.5	1801.6	0.14	0.2	380790
194	0.0	20.1	1857.8	1787.6	0.0	0.113	6.7	2198.1	1836.8	0.14	0.2	392814
196	0.0	20.1	1861.2	1790.7	0.0	0.112	6.7	2241.2	1872.4	0.14	0.2	405089
198	0.0	20.1	1864.6	1793.8	0.0	0.111	6.7	2284.8	1908.4	0.14	0.2	417617
200	0.0	20.1	1868.0	1797.0	0.0	0.110	6.7	2328.8	1944.8	0.14	0.2	430400

APPENDIX 3: DEFAULT TAC PROFILE FOR SELECT PETROLEUM PRODUCTS

Toxic Chemicals	CAS Number	Crude Oil (%W)	Distillate Fuel Oil (Diesel) (%W)	Gasoline (%W)	Jet Kerosene (Jet A) (%W)	Jet Naphtha (JP-4) (%W)
Benzene (*)	71432	0.60	0.0008	1.00	0.004	0.60
n-Hexane	110543	0.40	0.0001	1.00	0.005	1.50
Toluene	108883	1.00	0.032	7.00	0.133	2.00
Ethylbenzene	100414	0.40	0.013	1.40	0.127	0.50
m-Xylene	1330207	1.40	0.29	7.00	0.31	2.50
1,2,4-Thimethylbenzene	95636	0.33	1.00	2.50	-	-

(*) Non-AB2588 company only needs to report **benzene** in the petroleum products.

APPENDIX 4: INSTRUCTIONS AND EXAMPLES

> ***NOTE*: IN ADDITION TO VOC EMISSIONS, YOU MUST CALCULATE AND REPORT EMISSIONS OF TOXIC AIR CONTAMINANTS AND/OR OZONE DEPLETING COMPOUNDS (TAC/ODC) CONTAINED IN THE MIXTURE.**
>
> **IF THE SOLVENT IN THE PRODUCT IS 100% TAC/ODC AND NOT VOC, USE THE TANK FORMS AS A WORKSHEET TO *CALCULATE* EMISSIONS AND *ONLY REPORT* TOTAL EMISSIONS ON FORM TAC.**
>
> **IF THE PRODUCT CONTAINS SOME TAC/ODC, REPORT THE VOC EMISSIONS ON THE TANK FORMS AND THE TAC/ODC PORTIONS ON FORM TAC.**

The examples starting on the next page will assist users in calculating and reporting emissions from storage tanks. The following examples are listed:

1. External floating roof tank with 75.5 ft in diameter. Tank is made of welded steel with a capacity of 175,000 gallons with a pontoon-type roof. The tank was used all year to store 6,500,000 barrels of gasoline (MTBE blend and RVP 7).
2. Internal floating roof tank with a vapor-mounted resilient seal (primary seal) and rim-mounted secondary seal in good condition; 64 ft diameter. The tank is lightly rusted and covered by a bolted steel deck. Stored product: Crude Oil; 7.1 lb/gal liquid density; no vapor or liquid composition given; 593,125 bbl throughput for the reporting period. Maximum Tank Capacity for this tank is 2,800,000 gallons. The tank was used to store crude oil all year.
3. A fixed roof dome tank; 20 ft diameter and 18 ft tall, is in good condition and stores 3,990,000 gallons of gasoline (RVP 10) for the reporting period. Tank capacity is 42,000 gallons (42 Mgallons). The tank was used to store gasoline 256 days in a year and controlled by a vapor recovery unit at 96.7 % efficient. During this reporting period, an upset in the process caused an evaporation loss of 1,200 lbs of gasoline.

External or Internal Floating Roof Tanks (Form B6):

Example 1: *External floating roof tank with 75.5 ft in diameter. Tank is made of welded steel with a capacity of 175,000 gallons with a pontoon-type roof. The tank was used all year to store 6,500,000 barrels of gasoline (MTBE blend and RVP 7)*

Line 1.	enter tank ID	E1
Line 2.	enter three-digit product code [see Appendix 1]	007
Line 3.	describe tank and material: welded pontoon tank for gasoline with MTBE	
Line 4.	enter tank capacity, C, in 1,000 of gallons (Mgal)	175.0
Line 5.	enter tank diameter, D, (ft)	75.5
Line 6.	enter annual throughput, Q, in 1,000 gallons (Mgal)	
	6,500,000 barrels * 42 gals/barrel = 273,000,000 gallons or	273,000 Mgal
Line 7.	enter vapor molecular weight, M_V [see Appendix 1]	68
Line 8.	enter stored liquid density, W_L [see Appendix 1]	5.6
Line 9.	enter true vapor pressure, P_{VA} [see Appendix 1]	3.88
Line 10.	enter vapor pressure function, F_P [see Appendix 1]	0.076
Line 11.	select tank shell clingage factor, S_C	0.0015
Line 12.	select product factor, K_C	1.0
Line 13.	enter roof support factor, N_C [see Appendix 2]	0.0
Line 14.	enter rim-seal loss factor, K_R [see Appendix 2]	20.1
Line 15.	enter total roof fitting loss factor, F_F [see Appendix 2]	1691.8
Line 16.	enter deck seam loss factor, K_D [see Appendix 2]	0.0
Line 17.	enter deck seam length factor, S_D [see Appendix 2]	0.0
Line 18.	calculate working loss, L_W using Equation 2	
	(1 + 0.0) * (22.45 * 273,000 * 0.0015 * 5.6) / 75.5 =	681.89
Line 19.	calculate rim-seal loss, L_R using Equation 3	
	20.1 * 75.5 * 0.076 * 68 * 1.0 =	7,842.70
Line 20.	calculate deck fitting loss, L_F using Equation 4	
	1691.8 * 0.076 * 68 * 1.0 =	8,743.22
Line 21.	calculate deck seam loss, L_D using Equation 5	0.0
	(welded tank: S_D and K_D are zeros)	
Line 22.	enter excess loss from upset, L_X	0.0
	(no upset losses)	
Line 23.	calculate tank total losses, L_T using Equation 1	
	681.89 + 7,842.70 + 8,743.22 =	17,267.81

Example 2: *Internal floating roof tank with a vapor-mounted resilient seal (primary seal) and rim-mounted secondary seal in good condition; 64 ft diameter. The tank is lightly rusted and covered by a bolted steel deck. Stored product: Crude Oil; 7.1 lb/gal liquid density; no vapor or liquid composition given; 593,125 bbl throughput for the reporting period. Maximum Tank Capacity for this tank is 2,800,000 gallons. The tank was used to store crude oil all year.*

Line 1. enter Tank ID	E2
Line 2. enter three-digit product code [see Appendix 1]	001
Line 3. describe the tank: internal floating roof with bolted deck	
Line 4. enter tank capacity, C, in 1,000 of gallons (Mgal)	2,800
Line 5. enter tank diameter, D, (ft)	64.0
Line 6. enter annual throughput, Q, in 1,000 gallons (Mgal)	
593,125 barrels * 42 gals / barrel = 24,911,250 gallons or	24,911.25
Line 7. enter vapor molecular weight, M_V [see Appendix 1]	50
Line 8. enter stored liquid density, W_L [see Appendix 1]	7.1
Line 9. enter true vapor pressure, P_{VA} [see Appendix 1]	3.181
Line 10. enter vapor pressure function, F_P [see Appendix 1]	0.061
Line 11. select tank shell clingage factor, S_C	0.006
Line 12. select product factor, K_C (crude oil)	0.4
Line 13. enter roof support factor, N_C [see Appendix 2]	0.016
Line 14. enter rim-seal loss factor, K_R [see Appendix 2]	6.7
Line 15. enter total roof fitting loss factor, F_F [see Appendix 2]	405.8
Line 16. enter deck seam loss factor, K_D [see Appendix 2]	0.14
Line 17. enter deck seam length factor, S_D [see Appendix 2]	0.20
Line 18. calculate working loss, L_W using Equation 2	
(1 + 0.016)*(22.45 * 24,911.25 * 0.006 * 7.1)/64.0 =	378.21
Line 19. calculate rim-seal loss, L_R using Equation 3	
6.7 * 64.0 * 0.061 * 50 * 0.4 =	523.14
Line 20. calculate deck fitting loss, L_F using Equation 4	
405.8 * 0.061 * 50 * 0.4 =	495.08
Line 21. calculate deck seam loss, L_D using Equation 5	
$0.20 * 0.14 * (64)^2 * 0.061 * 50 * 0.4$	139.92
Line 22. enter excess loss from upset, L_X (no upset)	0.0
Line 23. calculate tank total losses, L_T using Equation 1	
378.21 + 523.14 + 495.08 + 139.92 + 0.0 =	1,536.35

Fixed Roof Tanks (Form B7 or B7U):

Example 3: *A fixed roof dome tank; 20 ft diameter and 18 ft tall, is in good condition and stores 3,990,000 gallons of gasoline (RVP 10) for the reporting period. Tank capacity is 42,000 gallons (42 Mgallons). The tank was used to store gasoline 256 days in a year and controlled by a vapor recovery unit at 96.7 % efficient. During this reporting period, an upset in the process caused an evaporation loss of 1,200 lbs of gasoline.*

Line 1. enter Tank ID	E3
Line 2. enter three-digit product code [see Appendix 1]	010
Line 3. describe tank or mixture: dome fixed roof tank	
Line 4. enter tank capacity, C, in 1,000 of gallons (Mgal)	42.00
Line 5. enter tank diameter, D (ft)	20.0
Line 6. enter tank height, H (ft)	18.0
Line 7. enter annual throughput, Q, in 1,000 gallons (Mgal)	3,990.00
TO CONVERT BARREL TO GALLON, MULTIPLY BY 42	
Line 8. enter number of days tank is in use, U.	256
Line 9. enter vapor molecular weight, M_V [see Appendix 1]	66
Line 10. enter vapor density, W_V [see Appendix 1]	0.067
Line 11. enter material true vapor pressure, P_{VA} [see Appendix 1]	5.744
Line 12. enter vapor space expansion factor, K_E [see Appendix 1]	0.143
Line 13. enter vapor saturation A, S_A [see Appendix 1]	0.1522
Line 14. enter vapor saturation B S_B [see Appendix 1]	0.0209
Line 15. select working loss product factor, K_P	1.0
Line 16. enter vapor space function, V_F [see Appendix 2]	430
Line 17. calculate throughput/capacity (Q/C) ratio	3,990 / 42 = 95
Line 18. calculate turnover factor, K_N	
[(180 * 42) + 3,990] / (6 * 3,990) =	0.482
Line 19. calculate vapor space volume, V_V using Equation 10	
66.84 * 42 + 430	3,237.28
Line 20. calculate vapor saturation factor, K_S, using Equation 11	
1 / [1 + (0.1522 * 18) + (0.0209 * 20)] =	0.2405
Line 21. calculate working loss, L_W using Equation 7	
0.024 * 66 * 5.744 * 3,990 * 0.482 * 1.0 =	17,498.05
Line 22. calculate standing loss, L_S using Equation 9	
256 * 3,237.28 * 0.067 * 0.143 * 0.2405 =	1,909.62
Line 23. enter excess loss from upset, L_X	1,200.00
Line 24. calculate tank total losses, L_T using Equation 6	
17,498.05 + 1,909.62 + 1,200.00 =	20,607.67
Line 25. enter control equipment % efficiency in decimal fraction	0.967
Line 26. calculate controlled total losses	
[(17,498.05 + 1,909.62) * (1 - 0.967)] + 1,200.00 =	1,840.45