(v) Periods of nonoperation of the affected source (or portion thereof), resulting in cessation of the emissions to which the monitoring applies.

[65 FR 3290, Jan. 20, 2000, as amended at 65 FR 8768, Feb. 22, 2000; 71 FR 20460, Apr. 20, 2006]

§63.1414 Test methods and emission estimation equations.

(a) *Test methods.* When required to conduct a performance test, the owner or operator shall use the test methods specified in paragraphs (a)(1) through (6) of this section, except where another section of this subpart requires either the use of a specific test method or the use of requirements in another subpart containing specific test method requirements.

(1) Method 1 or 1A, 40 CFR part 60, appendix A, shall be used for selection of the sampling sites if the flow measuring device is a pitot tube, except that references to particulate matter in Method 1A do not apply for the purposes of this subpart. No traverse is necessary when Method 2A or 2D, 40 CFR part 60, appendix A is used to determine gas stream volumetric flow rate.

(2) Method 2, 2A, 2C, or 2D, 40 CFR part 60, appendix A, is used for velocity and volumetric flow rates.

(3) Method 3, 40 CFR part 60, appendix A, is used for gas analysis.

(4) Method 4, 40 CFR part 60, appendix A, is used for stack gas moisture.

(5) The following methods shall be used to determine the organic HAP concentration.

(i) Method 316 or Method 320, 40 CFR part 60, appendix A, shall be used to determine the concentration of formaldehyde.

(ii) Method 18, 40 CFR part 60, appendix A, shall be used to determine the concentration of all organic HAP other than formaldehyde.

(iii) Method 308, 40 CFR part 60, appendix A, may be used as an alternative to Method 18 to determine the concentration of methanol.

(6) When complying with the alternative standard, as specified in §63.1413(f), the owner or operator shall use a Fourier Transform Infrared Spectroscopy (FTIR) instrument following Method PS–15, 40 CFR part 60, appendix B.

(b) *Batch process vent performance testing procedures*—(1) *Average batch vent flow rate determination.* The average batch vent flow rate for a batch emission episode shall be calculated using Equation 1 of this section:

$$AFR_{episode} = \frac{\sum_{i=1}^{n} FR_i}{n} \qquad [Eq.\ 1]$$

Where:

$AFR_{episode}$=Average batch vent flow rate for the batch emission episode, scmm.

FR_i=Volumetric flow rate for individual measurement i, taken every 15 minutes using the procedures in paragraph (a)(2) of this section, scmm.

n=Number of flow rate measurements taken during the batch emission episode.

(2) *Average batch vent concentration determination using an integrated sample.* If an integrated sample is taken over the entire batch emission episode to determine the average batch vent concentration of total organic HAP, organic HAP emissions shall be calculated using Equation 2 of this section:

$$E_{episode} = K\left[\sum_{j=1}^{n}(C_j)(M_j)\right]AFR(T_h) \qquad [Eq.\ 2]$$

Where:

$E_{episode}$ = Emissions, kg/episode.

K=Constant, 2.494×10^{-6} (ppmv)$^{-1}$ (gm-mole/scm) (kg/gm) (min/hr), where standard temperature is 20 °C.

C_j=Average batch vent concentration of sample organic HAP component j of the gas stream, dry basis, ppmv.

M_j=Molecular weight of sample organic HAP component j of the gas stream, gm/gm-mole.

AFR=Average batch vent flow rate of gas stream, dry basis, scmm.

T_h=Hours/episode.

n=Number of organic HAP in stream.

(3) *Average batch vent concentration determination using grab samples.* If grab samples are taken to determine the average batch vent concentration of total organic HAP, organic HAP emissions shall be calculated as follows:

(i) For each measurement point, the emission rate shall be calculated using Equation 3 of this section:

$$\text{Epoint} = K\left[\sum_{j=1}^{n} C_j M_j\right] FR \qquad [\text{Eq. 3}]$$

Where:

E_{point}=Emission rate for individual measurement point, kg/hr.

K=Constant, 2.494×10^{-6} (ppmv)$^{-1}$ (gm-mole/scm) (kg/gm) (min/hr), where standard temperature is 20 °C.

C_j=Concentration of sample organic HAP component j of the gas stream, dry basis, ppmv.

M_j=Molecular weight of sample organic HAP component j of the gas stream, gm/gm-mole.

FR=Flow rate of gas stream for the measurement point, dry basis, scmm.

n=Number of organic HAP in stream.

(ii) The organic HAP emissions per batch emission episode shall be calculated using Equation 4 of this section:

$$E_{episode} = (DUR)\left[\sum_{i=1}^{n} \frac{E_i}{n}\right] \qquad [\text{Eq. 4}]$$

Where:

$_{episode}$=Emissions, kg/episode.

DUR=Duration of the batch emission episode, hr/episode.

E_i=Emissions for measurement point i, kg/hr.

n=Number of measurements.

(4) *Control device efficiency determination for a batch emission episode.* The control efficiency for the control device shall be calculated using Equation 5 of this section:

$$R = \frac{\sum_{i=1}^{n} E_{inlet,i} - \sum_{i=1}^{n} E_{outlet,i}}{\sum_{i=1}^{n} E_{inlet,i}} (100) \qquad [\text{Eq. 5}]$$

Where:

R=Control efficiency of control device, percent.

E_{inlet}=Mass rate of total organic HAP for batch emission episode i at the inlet to the control device as calculated under paragraph (b)(2) or (b)(3) of this section, kg/episode.

E_{outlet}=Mass rate of total organic HAP for batch emission episode i at the outlet of the control device, as calculated under paragraph (b)(2) or (b)(3) of this section, kg/episode.

n=Number of batch emission episodes in the batch cycle selected to be controlled.

(c) *Percent oxygen correction for combustion control devices.* If the control device is a combustion device, total organic HAP concentrations shall be corrected to 3 percent oxygen when supplemental combustion air is used to combust the emissions. The integrated sampling and analysis procedures of Method 3B, 40 CFR part 60, appendix A, shall be used to determine the actual oxygen concentration (%0_{20}). The samples shall be taken during the same time that the total organic HAP samples are taken. The concentration corrected to 3 percent oxygen (C_c) shall be computed using Equation 6 of this section:

$$C_c = C_m\left(\frac{17.9}{20.9 - \%O_{2d}}\right) \qquad [\text{Eq. 6}]$$

Where:

C_c=Concentration of total organic HAP corrected to 3 percent oxygen, dry basis, ppmv.

C_m=Total concentration of TOC in vented gas stream, average of samples, dry basis, ppmv.

%0_{2d}=Concentration of oxygen measured in vented gas stream, dry basis, percent by volume.

(d) *Uncontrolled organic HAP emissions.* Uncontrolled organic HAP emissions for individual reactor batch process vents or individual non-reactor batch process vents shall be determined using the procedures specified in paragraphs (d)(1) through (8) of this section. To estimate organic HAP emissions from a batch emissions episode, owners or operators may use either the emissions estimation equations in paragraphs (d)(1) through (4) of this section, or direct measurement as specified in paragraph (d)(5) of this section. Engineering assessment may be used to estimate organic HAP emissions from a batch emission episode only under the conditions described in paragraph (d)(6) of this section. In using the emissions estimation equations in paragraphs (d)(1) through (4) of this section, individual component vapor pressure and molecular weight may be obtained from standard references. Methods to determine individual HAP partial pressures in multicomponent systems are described in paragraph (d)(9) of this section. Other

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variables in the emissions estimation equations may be obtained through direct measurement, as defined in paragraph (d)(5) of this section; through engineering assessment, as defined in paragraph (d)(6)(ii) of this section; by process knowledge; or by any other appropriate means. Assumptions used in determining these variables shall be documented as specified in § 63.1417. Once organic HAP emissions for the batch emission episode have been determined using either the emissions estimation equations, direct measurement, or engineering assessment, or-

ganic HAP emissions from a single batch cycle shall be calculated in accordance with paragraph (d)(7) of this section, and annual organic HAP emissions from the batch process vent shall be calculated in accordance with paragraph (d)(8) of this section.

(1) *Emissions from purging of empty vessels.* Organic HAP emissions from the purging of an empty vessel shall be calculated using Equation 7 of this section. Equation 7 of this section does not take into account evaporation of any residual liquid in the vessel:

$$E_{episode} = \frac{(V_{ves})(P)(MW_{wavg})}{RT}(1 - 0.37^m) \quad \text{[Eq. 7]}$$

Where:

$E_{episode}$=Emissions, kg/episode.
V_{ves}=Volume of vessel, m³.
P=Total organic HAP partial pressure, kPa.
MW_{wavg}=Weighted average molecular weight of organic HAP in vapor, determined in accordance with paragraph (d)(4)(i)(D) of this section, kg/kmol.
R=Ideal gas constant, 8.314 m³·kPa/kmol·K.
T=Temperature of vessel vapor space, K.
m=Number of volumes of purge gas used.

(2) *Emissions from purging of filled vessels.* Organic HAP emissions from the purging of a filled vessel shall be calculated using Equation 8 of this section:

$$E_{episode} = \frac{(y)(V_{dr})(P^2)(MW_{wavg})}{RT\left(P - \sum_{i=1}^{n} P_i x_i\right)}(T_m) \quad \text{[Eq. 8]}$$

Where:

$E_{episode}$=Emissions, kg/episode.
y=Saturated mole fraction of all organic HAP in vapor phase.
V_{dr}=Volumetric gas displacement rate, m³/min.
P=Pressure in vessel vapor space, kPa.
MW_{wavg}=Weighted average molecular weight of organic HAP in vapor, determined in accordance with paragraph (d)(4)(i)(D) of this section, kg/kmol.
R=Ideal gas constant, 8.314 m³·kPa/kmol·K.
T=Temperature of vessel vapor space, K.
P_i=Vapor pressure of individual organic HAP i, kPa.
x_i=Mole fraction of organic HAP i in the liquid.
n=Number of organic HAP in stream.

T_m=Minutes/episode.

(3) *Emissions from vapor displacement.* Organic HAP emissions from vapor displacement due to transfer of material into or out of a vessel shall be calculated using Equation 9 of this section:

$$E_{episode} = \frac{(y)(V)(P)(MW_{wavg})}{RT} \quad \text{[Eq. 9]}$$

Where:

$E_{episode}$=Emissions, kg/episode.
y=Saturated mole fraction of all organic HAP in vapor phase.
V=Volume of gas displaced from the vessel, m³.
P=Pressure in vessel vapor space, kPa.
MW_{wavg}=Weighted average molecular weight of organic HAP in vapor, determined in accordance with paragraph (d)(4)(i)(D) of this section, kg/kmol.
R=Ideal gas constant, 8.314 m³·kPa/kmol·K.
T=Temperature of vessel vapor space, K.

(4) *Emissions from heating of vessels.* Organic HAP emissions caused by the heating of a vessel shall be calculated using the procedures in either paragraph (d)(4)(i),(ii), or (iii) of this section, as appropriate.

(i) If the final temperature to which the vessel contents is heated is lower than 50 K below the boiling point of the HAP in the vessel, then organic HAP emissions shall be calculated using the equations in paragraphs (d)(4)(i)(A) through (D) of this section.

(A) Organic HAP emissions caused by heating of a vessel shall be calculated using Equation 10 of this section. The assumptions made for this calculation are atmospheric pressure of 760 milli- meters of mercury (mm Hg) and the displaced gas is always saturated with volatile organic compounds (VOC) vapor in equilibrium with the liquid mixture:

$$E_{episode} = \left[\frac{\dfrac{\sum\limits_{i=1}^{n}(P_i)T1}{101.325 - \sum\limits_{i=1}^{n}(P_i)T1} + \dfrac{\sum\limits_{i=1}^{n}(P_i)T2}{101.325 - \sum\limits_{i=1}^{n}(P_i)T2}}{2} \right] * (\Delta\eta) \left[\frac{\left(MW_{wavg,T1} + MW_{wavg,T2}\right)}{2} \right] \quad [Eq.\ 10]$$

Where:

$E_{episode}$=Emissions, kg/episode.
$(P_i)_{T1}$, $(P_i)_{T2}$=Partial pressure (kPa) of each organic HAP i in the vessel headspace at initial (T1) and final (T2) temperature.
n=Number of organic HAP in stream.
$\Delta\eta$=Number of kilogram-moles (kg-moles) of gas displaced, determined in accordance with paragraph (d)(4)(i)(B) of this section.
101.325=Constant, kPa.
$(MW_{WAVG,T1})$, $(MW_{WAVG,T2})$=Weighted average molecular weight of total organic HAP in the displaced gas stream, determined in accordance with paragraph (d)(4)(i)(D) of this section, kg/kmol.

(B) The moles of gas displaced, Δ, is calculated using Equation 11 of this section:

$$\Delta\eta = \frac{V_{fs}}{R} \left[\left(\frac{Pa_1}{T_1} \right) - \left(\frac{Pa_2}{T_2} \right) \right] \quad [Eq.\ 11]$$

Where:

$\Delta\eta$=Number of kg-moles of gas displaced.
V_{fs}=Volume of free space in the vessel, m³.
R=Ideal gas constant, 8.314 m³·kPa/kmol·K.

Pa_1=Initial noncondensible gas partial pressure in the vessel, kPa.
Pa_2=Final noncondensible gas partial pressure in the vessel, kPa.
T_1=Initial temperature of vessel, K.
T_2=Final temperature of vessel, K.

(C) The initial and final pressure of the noncondensible gas in the vessel shall be calculated using Equation 12 of this section:

$$Pa = 101.325 - \sum_{i=1}^{n}(P_i)T \quad [Eq.\ 12]$$

Where:

Pa=Initial or final partial pressure of non- condensible gas in the vessel headspace, kPa.
101.325=Constant, kPa.
$(P_i)_T$=Partial pressure of each organic HAP i in the vessel headspace, kPa, at the initial or final temperature (T1 or T2).
n=Number of organic HAP in stream.

(D) The weighted average molecular weight of organic HAP in the displaced gas, MW_{wavg}, shall be calculated using Equation 13 of this section:

$$MW_{wavg} = \frac{\sum\limits_{i=1}^{n}(\text{mass of C})_i (\text{molecular weight of C})_i}{\sum\limits_{i=1}^{n}(\text{mass of C})_i} \quad [Eq.\ 13]$$

Where:

C=Organic HAP component

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n=Number of organic HAP components in stream.

(ii) If the vessel contents are heated to a temperature greater than 50 K below the boiling point, then organic HAP emissions from the heating of a vessel shall be calculated as the sum of the organic HAP emissions calculated in accordance with paragraphs (d)(4)(ii)(A) and (B) of this section.

(A) For the interval from the initial temperature to the temperature 50 K below the boiling point, organic HAP emissions shall be calculated using Equation 10 of this section, where T_2 is the temperature 50 K below the boiling point.

(B) For the interval from the temperature 50 K below the boiling point to the final temperature, organic HAP emissions shall be calculated as the summation of emissions for each 5 K increment, where the emissions for each increment shall be calculated using Equation 10 of this section.

(*1*) If the final temperature of the heatup is at or lower than 5 K below the boiling point, the final temperature for the last increment shall be the final temperature for the heatup, even if the last increment is less than 5 K.

(*2*) If the final temperature of the heatup is higher than 5 K below the boiling point, the final temperature for the last increment shall be the tem-perature 5 K below the boiling point, even if the last increment is less than 5 K.

(*3*) If the vessel contents are heated to the boiling point and the vessel is not operating with a condenser, the final temperature for the final increment shall be the temperature 5 K below the boiling point, even if the last increment is less than 5 K.

(iii) If the vessel is operating with a condenser, and the vessel contents are heated to the boiling point, the process condenser, as defined in §63.1402, is considered part of the process. Organic HAP emissions shall be calculated as the sum of emissions calculated using Equation 10 of this section, which calculates organic HAP emissions due to heating the vessel contents to the temperature of the gas exiting the condenser, and emissions calculated using Equation 9 of this section, which calculates emissions due to the displacement of the remaining saturated non-condensible gas in the vessel. The final temperature in Equation 10 of this section shall be set equal to the exit gas temperature of the condenser. Equation 9 of this section shall be used as written below in Equation 14 of this section, using free space volume, and T is set equal to the condenser exit gas temperature:

$$E_{episode} = \frac{(y)(V_{fs})(P)(MW_{wavg})}{RT} \quad [\text{Eq. 14}]$$

Where:

$E_{episode}$=Emissions, kg/episode.
y=Saturated mole fraction of all organic HAP in vapor phase.
V_{fs}=Volume of the free space in the vessel, m³.
P=Pressure in vessel vapor space, kPa.
MW_{wavg}=Weighted average molecular weight of organic HAP in vapor, determined in accordance with paragraph (d)(4)(i)(D) of this section, kg/kmol.
R=Ideal gas constant, 8.314 m³·kPa/kmol·K.
T=Temperature of condenser exit stream, K.

(5) *Emissions determined by direct measurement.* The owner or operator may estimate annual organic HAP emissions for a batch emission episode by direct measurement. The test methods and procedures specified in paragraphs (a) and (b) of this section shall be used for direct measurement. If direct measurement is used, the owner or operator shall perform a test for the duration of a representative batch emission episode. Alternatively, the owner or operator may perform a test during only those periods of the batch emission episode for which the emission rate for the entire episode can be determined or for which the emissions are greater than the average emission rate of the batch emission episode. The owner or operator choosing either of these options shall develop an emission profile

illustrating the emission rate (kilogram per unit time) over the entire batch emission episode, based on either process knowledge or test data, to demonstrate that test periods are representative. Examples of information that could constitute process knowledge include calculations based on material balances and process stoichiometry. Previous test results may be used to develop the emission profile provided the results are still relevant to the current batch process vent conditions. The emission profile shall be included in the site-specific test plan required by § 63.1417(h)(2).

(6) *Emissions determined by engineering assessment.* To use engineering assessment to estimate organic HAP emissions from a batch emission episode, owners or operators shall comply with paragraphs (d)(6)(i) through (iii) of this section.

(i) If the criteria specified in paragraphs (d)(6)(i)(A), (B), and (C) of this section are met for a specific batch emission episode, the owner or operator may use engineering assessment to estimate organic HAP emissions from that batch emission episode.

(A) Previous test data, where the measurement of organic HAP emissions was an outcome of the test, that show a greater than 20 percent discrepancy between the test value and the value estimated using the applicable equations in paragraphs (d)(1) through (4) of this section. Paragraphs (d)(6)(i)(A)(*1*) and (*2*) of this section describe test data that will be acceptable under this paragraph.

(*1*) Test data for the batch emission episode obtained during production of the product for which the demonstration is being made.

(*2*) Test data obtained for a batch emission episode from another process train where the test data were obtained during production of the product for which the demonstration is being made. Test data from another process train may be used only if the owner or operator can demonstrate that the data are representative of the batch emission episode for which the demonstration is being made, taking into account the nature, size, operating conditions, production rate, and sequence of process steps (e.g., reaction, distillation, etc.) of the equipment in the other process train.

(B) Previous test data for the batch emission episode with the highest organic HAP emissions on a mass basis where the measurement of organic HAP emissions was an outcome of the test, where data were obtained during the production of the product for which the demonstration is being made, and where the data show a greater than 20 percent discrepancy between the test value and the value estimated using the applicable equations in paragraphs (d)(1) through (4) of this section. If the criteria in this paragraph are met, then engineering assessment may be used for all batch emission episodes associated with that batch cycle for the batch unit operation.

(C) The owner or operator has requested and been granted approval to use engineering assessment to estimate organic HAP emissions from a batch emissions episode. The request to use engineering assessment to estimate organic HAP emissions from a batch emissions episode shall contain sufficient information and data to demonstrate to the Administrator that engineering assessment is an accurate means of estimating organic HAP emissions for that particular batch emissions episode. The request to use engineering assessment to estimate organic HAP emissions for a batch emissions episode shall be submitted in the Precompliance Report, as required by § 63.1417(d).

(ii) Engineering assessment includes, but is not limited to, the following:

(A) Previous test results, provided the tests are representative of current operating practices;

(B) Bench-scale or pilot-scale test data obtained under conditions representative of current process operating conditions;

(C) Flow rate or organic HAP emission rate specified or implied within a permit limit applicable to the batch process vent; and

(D) Design analysis based on accepted chemical engineering principles, measurable process parameters, or physical or chemical laws or properties. Examples of analytical methods include, but are not limited to:

(*1*) Use of material balances;

(*2*) Estimation of flow rate based on physical equipment design such as pump or blower capacities;

(*3*) Estimation of organic HAP concentrations based on saturation conditions; and

(*4*) Estimation of organic HAP concentrations based on grab samples of the liquid or vapor.

(iii) Data or other information used to demonstrate that the criteria in paragraph (d)(6)(i) of this section have been met shall be reported as specified in paragraphs (d)(6)(iii)(A) and (B) of this section.

(A) Data or other information used to demonstrate that the criteria in paragraphs (d)(6)(i)(A) and (B) of this section have been met shall be reported in the Notification of Compliance Status, as required by §63.1417(e)(9).

(B) The request for approval to use engineering assessment to estimate organic HAP emissions from a batch emissions episode as allowed under paragraph (d)(6)(i)(C) of this section, and sufficient data or other information for demonstrating to the Administrator that engineering assessment is an accurate means of estimating organic HAP emissions for that particular batch emissions episode shall be submitted with the Precompliance Report, as required by §63.1417(d).

(7) *Emissions for a single batch cycle.* For each batch process vent, the organic HAP emissions associated with a single batch cycle shall be calculated using Equation 15 of this section:

$$E_{cycle} = \sum_{i=1}^{n} E_{episode_i} \qquad [Eq. \ 15]$$

Where:

E_{cycle}=Emissions for an individual batch cycle, kg/batch cycle.
$E_{episode_i}$=Emissions from batch emission episode i, kg/episode.
n=Number of batch emission episodes for the batch cycle.

(8) *Annual emissions from a batch process vent.* Annual organic HAP emissions from a batch process vent shall be calculated using Equation 16 of this section:

$$AE = \sum_{i=1}^{n} \left(N_i\right)\left(E_{cycle_i}\right) \qquad [Eq. \ 16]$$

Where:

AE=Annual emissions from a batch process vent, kg/yr.
N_i=Number of type i batch cycles performed annually, cycles/year.
E_{cycle_i}=Emissions from the batch process vent associated with a single type i batch cycle, as determined in paragraph (d)(7) of this section, kg/batch cycle.
n=Number of different types of batch cycles that cause the emission of organic HAP from the batch process vent.

(9) *Partial pressures in multicomponent systems.* Individual HAP partial pressures in multicomponent systems shall be determined using the appropriate method specified in paragraphs (d)(9)(i) through (iii) of this section.

(i) If the components are miscible, use Raoult's law to calculate the partial pressures;

(ii) If the solution is a dilute aqueous mixture, use Henry's law constants to calculate partial pressures;

(iii) If Raoult's law or Henry's law is not appropriate or available, the owner or operator may use any of the options in paragraph (d)(9)(iii)(A), (B), or (C) of this section.

(A) Experimentally obtained activity coefficients, Henry's law constants, or solubility data;

(B) Models, such as group-contribution models, to predict activity coefficients; or

(C) Assume the components of the system behave independently and use the summation of all vapor pressures from the HAPs as the total HAP partial pressure.

§63.1415 Monitoring requirements.

(a) *General requirements.* Each owner or operator of an emission point located at an affected source that uses a control device to comply with the requirements of this subpart and has one or more parameter monitoring level requirement specified under this subpart, shall install the monitoring equipment specified in paragraph (b) of this section in order to demonstrate continued compliance with the provisions of this subpart. All monitoring equipment shall be installed, calibrated, maintained, and operated according to manufacturer's specifications or other written procedures that provide adequate assurance that the equipment would

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