

3745-76-09

Test methods and procedures.

[Comment: For dates of non-regulatory government publications, publications of recognized organizations and associations, federal rules, and federal statutory provisions referenced in this rule, see ~~the last~~ paragraph (C) of rule 3745-76-01 of the Administrative Code titled "~~Incorporation by reference~~[referenced materials](#)."]]

(A)

- (1) [NMOC emission rate](#). The landfill owner or operator shall calculate the NMOC emission rate using either the equation provided in paragraph (A)(1)(a) of this rule or the equation provided in paragraph (A)(1)(b) of this rule. Both equations may be used if the actual year-to-year solid waste acceptance rate is known, as specified in paragraph (A)(1)(a) of this rule, for part of the life of the landfill and the actual year-to-year solid waste acceptance rate is unknown, as specified in paragraph (A)(1)(b) of this rule, for part of the life of the landfill. The values to be used in both equations are 0.05 per year for k , one hundred seventy cubic meters per megagram for L_o , and four thousand parts per million by volume as hexane for the C_{NMOC} . For landfills located in geographical areas with a thirty year annual average precipitation of less than twenty five inches, as measured at the nearest representative official meteorologic site, the k value to be used is 0.02 per year.

- (a) The following equation shall be used if the actual year-to-year solid waste acceptance rate is known.

$$M_{NMOC} = \sum_{i=1}^n 2kL_oM_i(e^{-kt_i})(C_{NMOC})(3.6 \times 10^{-9})$$

Where: ~~M_{NMOC} = total NMOC emission rate from the landfill, megagrams per year~~

[\$M_{NMOC}\$ = total NMOC emission rate from the landfill, megagrams per year](#)

k = methane generation rate constant, year⁻¹

L_o = methane generation potential, cubic meters per megagram solid waste

M_i = mass of solid waste in the i^{th} section, megagrams

t_i = age of the i^{th} section, years

$C_{\text{NMOC hexane}}$ = concentration of NMOC, parts per million by volume as hexane

3.6×10^{-9} = conversion factor

The mass of nondegradable solid waste may be subtracted from the total mass of solid waste in a particular section of the landfill when calculating the value for M_i if documentation of the nature and amount of such wastes is maintained.

- (b) The following equation shall be used if the actual year-to-year solid waste acceptance rate is unknown.

$$M_{\text{NMOC}} = 2L_o R (e^{-kc} - e^{-kt}) (C_{\text{NMOC}}) (3.6 \times 10^{-9})$$

Where:

M_{NMOC} = mass emission rate of NMOC, megagrams per year

L_o = methane generation potential, cubic meters per megagram solid waste

R = average annual acceptance rate, megagrams per year

k = methane generation rate constant, year⁻¹

t = age of landfill, years

$C_{\text{NMOC hexane}}$ = concentration of NMOC, parts per million by volume as hexane

c = time since closure, years. For active landfill $c = 0$ and $e^{-kc} = 1$

3.6×10^{-9} = conversion factor

The mass of nondegradable solid waste may be subtracted from the average annual acceptance rate when calculating a value for R , if documentation of the nature and amount of such wastes is maintained.

- (2) Tier 1. The owner or operator shall compare the calculated NMOC mass emission rate to the standard of ~~fifty~~thirty-four megagrams per year.

- (a) If the NMOC emission rate calculated in paragraph (A)(1) of this rule is less than ~~fifty~~thirty-four megagrams per year, then the landfill owner or operator shall submit ~~an~~a NMOC emission rate report as provided in

paragraph ~~(B)(1)(C)~~ of rule 3745-76-12 of the Administrative Code, and shall recalculate the NMOC mass emission rate annually as required under paragraph ~~(B)(1)(H)~~ of rule ~~3745-76-07~~3745-76-03 of the Administrative Code.

- (b) If the calculated NMOC emission rate is equal to or greater than ~~fifty~~thirty-four megagrams per year, then the landfill owner shall ~~either do one of the following: comply with paragraph (B)(2) of rule 3745-76-07 of the Administrative Code, or determine a site-specific NMOC concentration and recalculate the NMOC emission rate using the procedures provided in paragraph (A)(3) of this rule.~~

(i) Submit a gas collection and control system design plan within one year as specified in paragraph (D) of rule 3745-76-12 of the Administrative Code and install and operate a gas collection and control system within thirty months according to paragraphs (C) through (F) of rule 3745-76-03 of the Administrative Code.

(ii) Determine a site-specific NMOC concentration and recalculate the NMOC emission rate using the Tier 2 procedures provided in paragraph (A)(3) of this rule.

(iii) Determine a site-specific methane generation rate constant and recalculate the NMOC emission rate using the Tier 3 procedures provided in paragraph (A)(4) of this rule.

- (3) Tier 2. The landfill owner or operator shall determine the NMOC concentration using the following sampling procedure. The landfill owner or operator shall install at least two sample probes per hectare, evenly distributed over the ~~of~~ landfill surface that has retained waste for at least two years. If the landfill is larger than twenty ~~five~~ hectares in area, only fifty samples are required. The probes should be evenly distributed across the sample area. The sample probes should be located to avoid known areas of nondegradable solid waste. The owner or operator shall collect and analyze one sample of landfill gas from each probe to determine the NMOC concentration using USEPA Method~~method~~ 25 or Method~~method~~ 25C of Appendix~~appendix~~ A of 40 CFR Part~~part~~ 60. Taking composite samples from different probes into a single cylinder is allowed; however, equal sample volumes shall be taken from each probe. For each composite, the sampling rate, collection times, beginning and ending cylinder vacuums, or alternative volume measurements shall be recorded to verify that composite volumes are equal. Composite sample volumes should not be less than one liter, unless evidence can be provided to substantiate the accuracy of smaller volumes. Terminate compositing before the cylinder approaches ambient pressure where measurement accuracy diminishes. ~~Method 18 of Appendix A of 40 CFR Part 60 may be used to~~

~~analyze the samples collected by the Method 25 or 25C sampling procedure.~~
If more than the required number of samples are taken, all samples shall be used in the analysis. The landfill owner or operator shall divide the NMOC concentration from USEPA Methodmethod 25 or Methodmethod 25C of Appendixappendix A of 40 CFR part 60 by six to convert from C_{NMOC} as carbon to C_{NMOC} as hexane. If the landfill has an active or passive gas removal system in place, USEPA method 25 or method 25C samples may be collected from these systems instead of surface probes, provided the removal system can be shown to provide sampling as representative as the two sampling probe per hectare requirement. For active collection systems, samples may be collected from the common header pipe before any gas moving, condensate removal, or treatment system equipment. For active collection systems, a minimum of three samples shall be collected from the header pipe.

~~(a) Taking composite samples from different probes into a single cylinder is allowed; however, equal sample volumes must be taken from each probe. For each composite, the sampling rate, collection times, beginning and ending cylinder vacuums, or alternative volume measurements must be recorded to verify that composite volumes are equal. Composite sample volumes should not be less than one liter, unless evidence can be provided to substantiate the accuracy of smaller volumes. The compositing shall be terminated before the cylinder approaches ambient pressure where measurement accuracy diminishes.~~

~~(b) If using Method 18, the owner or operator must identify all compounds in the sample, and, at a minimum, test for those compounds published in the most recent "Compilation of Air Pollutant Emission Factors (AP-42)", minus carbon monoxide, hydrogen sulfide, and mercury. At a minimum, the instrument must be calibrated for each of the compounds on the list. The concentration of each Method 18 compound shall be converted to C_{NMOC} as hexane by multiplying it by the ratio of its carbon atoms divided by six.~~

~~(c) If the landfill has an active or passive gas removal system in place, Method 25 or Method 25C samples may be collected from these systems instead of surface probes, provided the removal system can be shown to provide sampling as representative as the two sampling probe per hectare requirement. For active collection systems, samples may be collected from the common header pipe before the gas moving or condensate removal equipment. For these systems, a minimum of three samples must be collected from the header pipe.~~

(a) Within sixty days after the date of determining the NMOC concentration and corresponding NMOC emission rate, the owner or operator shall submit the results according to the rule 3745-76-12 of the

Administrative Code.

~~(d)~~(b) The landfill owner or operator shall recalculate the NMOC mass emission rate using the equations provided in paragraph (A)(1)(a) or (A)(1)(b) of this rule and using the average NMOC concentration from the collected samples instead of the default value in the equation provided in paragraph (A)(1) of this rule.

(c) If the resulting NMOC mass emission rate is less than thirty four megagrams per year, then the owner or operator shall submit a periodic estimate of NMOC emissions in an NMOC emission rate report according to paragraph (C) of rule 3745-76-12 of the Administrative Code, and shall recalculate the NMOC mass emission rate annually as required under paragraph (H) of rule 3745-76-03 of the Administrative Code. The site-specific NMOC concentration shall be retested every five years using the methods specified in this rule.

~~(e)~~(d) If the ~~resulting NMOC~~ mass emission rate calculated using the Tier 2 site-specific NMOC concentration is equal to or greater than ~~fifty~~thirty-four megagrams per year, then the landfill owner or operator shall ~~either comply with paragraph (B)(2) of rule 3745-76-07 of the Administrative Code, or determine the site-specific methane generation rate constant and recalculate the NMOC emission rate using the site-specific methane generation rate using the procedure specified in paragraph (A)(4) of this rule.~~do one of the following:

(i) Submit a gas collection and control system design plan within one year as specified in paragraph (D) of rule 3745-76-12 of the Administrative Code and install and operate a gas collection and control system within thirty months according to paragraphs (C) through (F) of rule 3745-76-03 of the Administrative Code.

(ii) Determine a site-specific methane generation rate constant and recalculate the NMOC emission rate using the site-specific methane generation rate using the Tier 3 procedures specified in paragraph (A)(4) of this rule.

(iii) Conduct a surface emission monitoring demonstration using the Tier 4 procedures specified in paragraph (A)(6) of this rule.

~~(f) If the resulting NMOC mass emission rate is less than fifty megagrams per year, the owner or operator shall submit a periodic estimate of the emission rate report as provided in paragraph (B)(1) of rule 3745-76-12 of the Administrative Code and retest the site-specific NMOC concentration every five years using the methods specified in this rule.~~

- (4) Tier 3. The site-specific methane generation rate constant shall be determined using the procedures provided in [USEPA Method method 2E of Appendixappendix A of 40 CFR Partpart 60](#). The landfill owner or operator shall estimate the NMOC mass emission rate using equations in paragraph (A)(1)(a) or (A)(1)(b) of this rule and using a site-specific methane generation rate constant k , and the site-specific NMOC concentration as determined in paragraph (A)(3) of this rule instead of the default values provided in paragraph (A)(1) of this rule. The landfill owner or operator shall compare the resulting NMOC mass emission rate to the standard of [fiftythirty-four](#) megagrams per year.
- (a) If the NMOC mass emission rate as calculated using the [Tier 2](#) site-specific ~~methane generation rate and concentration of~~ NMOC [concentration and Tier 3 site-specific methane generation rate](#) is equal to or greater than [fiftythirty-four](#) megagrams per year, the owner or operator shall ~~comply with paragraph (B)(2) of rule 3745-76-07 of the Administrative Code~~ [do one of the following](#):
- (i) [Submit a gas collection and control system design plan within one year as specified in paragraph \(D\) of rule 3745-76-12 of the Administrative Code and install and operate a gas collection and control system within thirty months according to paragraphs \(C\) through \(F\) of rule 3745-76-03 of the Administrative Code.](#)
- (ii) [Conduct a surface emission monitoring demonstration using the Tier 4 procedures specified in paragraph \(A\)\(6\) of this rule.](#)
- (b) If the NMOC mass emission rate is less than [fiftythirty-four](#) megagrams per year, then the owner or operator ~~shall submit a periodic emission rate report as provided in paragraph (B)(1) of rule 3745-76-12 of the Administrative Code and~~ shall recalculate the NMOC mass emission rate annually, ~~as provided in paragraph (B)(1) of rule 3745-76-12 of the Administrative Code~~ using the equations in paragraph (A)(1) ~~or (A)(2)~~ of this rule and using the site-specific ~~methane generation rate constant~~ [and Tier 2](#) NMOC concentration obtained in paragraph (A)(3) of this rule [and Tier 3 methane generation rate constant and submit a periodic NMOC emission rate report as provided in paragraph \(C\) of rule 3745-76-12 of the Administrative Code](#). The calculation of the methane generation rate constant is performed only once, and the value obtained from this test shall be used in all subsequent annual NMOC emission rate calculations.
- (5) [Other methods](#). The owner or operator may use other methods to determine the NMOC concentration or a site-specific [methane generation rate constant \$k\$](#) as

an alternative to the methods required in paragraphs (A)(3) and (A)(4) of this rule if the method has been approved by the director.

(6) Tier 4. The landfill owner or operator shall demonstrate that surface methane emissions are below five hundred parts per million.

Surface emission monitoring shall be conducted on a quarterly basis using the following procedures. Tier 4 is allowed only if the landfill owner or operator can demonstrate that NMOC emissions are greater than or equal to thirty-four megagrams per year but less than fifty megagrams per year using Tier 1 or Tier 2. If both Tier 1 and Tier 2 indicate NMOC emissions are fifty megagrams per year or greater, then Tier 4 cannot be used. In addition, the landfill shall meet the criteria in paragraph (A)(6)(h) of this rule.

(a) The owner or operator shall measure surface concentrations of methane along the entire perimeter of the landfill and along a pattern that traverses the landfill at no more than thirty-meter intervals using an organic vapor analyzer, flame ionization detector, or other portable monitor meeting the specifications provided in paragraph (D) of rule 3745-76-10 of the Administrative Code.

(b) The background concentration shall be determined by moving the probe inlet upwind and downwind at least thirty meters from the waste mass boundary of the landfill.

(c) Surface emission monitoring shall be performed in accordance with section 8.3.1 of USEPA method 21 of appendix A-7 of 40 CFR part 60, except that the probe inlet shall be placed no more than five centimeters above the landfill surface; the constant measurement of distance above the surface should be based on a mechanical device such as with a wheel on a pole.

(i) The owner or operator shall use a wind barrier, similar to a funnel, when on-site average wind speed exceeds four miles per hour or two meters per second or gust exceeding ten miles per hour. Average on-site wind speed shall also be determined in an open area at five-minute intervals using an on-site anemometer with a continuous recorder and data logger for the entire duration of the monitoring event. The wind barrier shall surround the surface emission monitoring monitor, and shall be placed on the ground, to ensure wind turbulence is blocked. Surface emission monitoring cannot be conducted if average wind speed exceeds twenty-five miles per hour.

(ii) Landfill surface areas where visual observations indicate elevated concentrations of landfill gas, such as distressed vegetation and

cracks or seeps in the cover, and all cover penetrations shall also be monitored using a device meeting the specifications provided in paragraph (D) of rule 3745-76-10 of the Administrative Code.

- (d) Each owner or operator seeking to comply with the Tier 4 provisions in paragraph (A)(6) of this rule shall maintain records of surface emission monitoring as provided in paragraph (G) of rule 3745-76-13 of the Administrative Code and submit a Tier 4 surface emissions report as provided in paragraph (D)(4)(c) of rule 3745-76-12 of the Administrative Code.
- (e) If there is any measured concentration of methane of five hundred parts per million or greater from the surface of the landfill, the owner or operator shall submit a gas collection and control system design plan within one year of the first measured concentration of methane of five hundred parts per million or greater from the surface of the landfill according to paragraph (D) of rule 3745-76-12 of the Administrative Code and install and operate a gas collection and control system according to paragraphs (C) through (F) of rule 3745-76-03 of the Administrative Code within thirty months of the most recent NMOC emission rate report in which the NMOC emission rate equals or exceeds thirty-four megagrams per year based on Tier 2.
- (f) If after four consecutive quarterly monitoring periods at a landfill, other than a closed landfill, there is no measured concentration of methane of five hundred parts per million or greater from the surface of the landfill, the owner or operator shall continue quarterly surface emission monitoring using the methods specified in this rule.
- (g) If after four consecutive quarterly monitoring periods at a closed landfill there is no measured concentration of methane of five hundred parts per million or greater from the surface of the landfill, the owner or operator shall conduct annual surface emission monitoring using the methods specified in this rule.
- (h) If a landfill has installed and operates a collection and control system that is not required by this chapter, then the collection and control system shall meet the following criteria:

 - (i) The gas collection and control system shall have operated for at least six thousand five hundred seventy out of eight thousand seven hundred sixty hours preceding the Tier 4 surface emission monitoring demonstration.
 - (ii) During the Tier 4 surface emission monitoring demonstration, the gas collection and control system shall operate as normally to

collect and control as much landfill gas as possible.

- (B) After the installation and start-up of a collection and control system in compliance with rule ~~3745-76-10~~3745-76-03 of the Administrative Code, the owner or operator shall calculate the NMOC emission rate for purposes of determining when the system can be capped, removed, or decommissioned as provided in paragraph ~~(B)(2)(e)(I)~~(I) of rule ~~3745-76-07~~3745-76-03 of the Administrative Code, using the following equation:

$$M_{\text{NMOC}} = 1.89 \times 10^{-3} Q_{\text{LFG}} C_{\text{NMOC}}$$

Where:

M_{NMOC} = mass emission rate of NMOC, megagrams per year

Q_{LFG} = flow rate of landfill gas, cubic meters per minute

C_{NMOC} = NMOC concentration, parts per million by volume as hexane

- (1) The flow rate of landfill gas, Q_{LFG} shall be determined by measuring the total landfill gas flow rate at the common header pipe that leads to the control device using a gas flow measuring device calibrated according to the provisions of section 410 of USEPA Method method 2E of Appendix appendix A of 40 CFR Part part 60.
- (2) The average NMOC concentration, C_{NMOC} , shall be determined by collecting and analyzing landfill gas sampled from the common header pipe before the gas moving or condensate removal equipment using the procedures in USEPA Method method 25 or method 25C or Method 18 of Appendix appendix A-7 of 40 CFR Part part 60. ~~If using Method 18 of Appendix A of 40 CFR Part 60, the minimum list of compounds to be tested shall be those published in the most recent "Compilation of Air Pollutant Emission Factors (AP-42)".~~ The sample location on the common header pipe shall be before any condensate removal or other gas refining units. The landfill owner or operator shall divide the NMOC concentration from USEPA Method method 25 or method 25C of Appendix appendix A of 40 CFR Part part 60 by six to convert from C_{NMOC} as carbon to C_{NMOC} as hexane.
- (3) The owner or operator may use another method to determine landfill gas flow rate and NMOC concentration if the method has been approved by the director.

(a) Within sixty days after the date of calculating the NMOC emission rate for purposes of determining when the system can be capped or removed, the owner or operator shall submit the results according to

paragraph (J)(2) of rule 3745-76-12 of the Administrative Code.

(C) When calculating emissions for PSD purposes, the owner or operator of each MSW landfill subject to the provisions of this chapter shall estimate the NMOC emission rate for comparison to the PSD major stationary source and ~~significant~~significance levels in rule 3745-31-01 of the Administrative Code using "Compilation of Air Pollutant Emission Factors," AP-42 or other approved measurement procedures. ~~If a collection system, which complies with the provisions in paragraph (B)(2) of rule 3745-76-07 of the Administrative Code is already installed, the owner or operator shall estimate the NMOC emission rate using the procedures provided in paragraph (B) of this rule.~~

(D) For the performance test required in paragraph (F)(1) of rule 3745-76-03 of the Administrative Code, the net heating value of the combusted landfill gas as determined in rule 3745-76-15 of the Administrative Code is calculated from the concentration of methane in the landfill gas as measured by USEPA method 3C of appendix A-2 of 40 CFR part 60. A minimum of three thirty-minute USEPA method 3C samples are determined. The measurement of other organic components, hydrogen, and carbon monoxide is not applicable. USEPA method 3C may be used to determine the landfill gas molecular weight for calculating the flare gas exit velocity under rule 3745-76-15 of the Administrative Code.

(1) Within sixty days after the date of completing each performance test, the owner or operator shall submit the results of the performance tests required by paragraph (D) of this rule, including any associated fuel analyses, according to rule 3745-76-12 of the Administrative Code.

~~(D)~~(E) For the performance test required in paragraph (B)(2)(e)(ii)(F)(2) of rule 3745-76-073745-76-03 of the Administrative Code, USEPA method 25, Method~~method~~25C or Method~~method~~18 of (USEPA method 25C may be used at the inlet only) appendixes A-6 and 7 of 40 CFR ~~Part~~part 60 shall be used to determine compliance with ninety eight weight-per cent efficiency or the twenty parts per million volume outlet NMOC concentration level, unless another method to demonstrate compliance has been approved by the director as provided by paragraph ~~(B)(2)(a)(ii)(D)(2)~~ of rule ~~3745-76-07~~3745-76-12 of the Administrative Code. If using USEPA Method~~method~~18 of Appendix~~appendix~~A of 40 CFR ~~Part~~part 60, the minimum list of compounds to be tested shall be those published in the most recent "Compilation of Air Pollutant Emission Factors, ~~(AP-42)~~". USEPA method 3, method 3A, or method 3C of appendix A-2 of 40 CFR part 60 shall be used to determine oxygen for correcting the NMOC concentration as hexane to three per cent. In cases where the outlet concentration is less than fifty parts per million NMOC as carbon (eight parts per million NMOC as hexane), USEPA method 25A should be used in place of USEPA method 25. USEPA method 18 may be used in conjunction with USEPA method 25A on a limited basis (compound specific, for example, methane) or USEPA method 3C may be used to

determine methane. The methane as carbon should be subtracted from the USEPA method 25A total hydrocarbon value as carbon to give NMOC concentration as carbon. The landfill owner or operator shall divide the NMOC concentration as carbon by six to convert the CNMOC as carbon to CNMOC as hexane. The following equation shall be used to calculate efficiency:

$$\text{Control efficiency} = (\text{NMOC}_{\text{IN}} - \text{NMOC}_{\text{OUT}}) / (\text{NMOC}_{\text{IN}})$$

Where:

NMOC_{IN} = mass of NMOC entering control device

NMOC_{OUT} = mass of NMOC exiting control device

(1) Within sixty days after the date of completing each performance test, the owner or operator shall submit the results of the performance tests, including any associated fuel analyses, to the director.