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$x_{OHCi\text{-}init}$ = The C_1-equivalent concentration of the initial system contamination (optional) of oxygenated species i, dry-to-wet corrected.

$x_{THC[THC\text{-}FID]cor}$ = The C_1-equivalent response to NOTHC and all OHC in diluted exhaust, HC contamination and dry-to-wet corrected, as measured by the THC-FID.

$RF_{OHCi[THC\text{-}FID]}$ = The response factor of the FID to species i relative to propane on a C_1-equivalent basis.

C = the mean number of carbon atoms in the particular compound.

M_{dexh} = The molar mass of diluted exhaust as determined in § 1065.340.

$m_{dexhOHCi}$ = The mass of oxygenated species i in dilute exhaust.

M_{OHCi} = The C_1-equivalent molecular weight of oxygenated species i.

m_{dexh} = The mass of diluted exhaust.

$n_{dexhOHCi}$ = The number of moles of oxygenated species i in total diluted exhaust flow.

n_{dexh} = The total diluted exhaust flow.

(b) If we require you to determine nonmethane hydrocarbon equivalent (NMHCE), use the following equation:

$$x_{NMHCE} = x_{THCE} - RF_{CH4[THC\text{-}FID]} \cdot x_{CH4}$$

Eq. 1065.665–4

Where:

x_{NMHCE} = The sum of the C_1-equivalent concentrations of nonoxygenated nonmethane hydrocarbon (NONMHC), alcohols, and aldehydes.

$RF_{CH4[THC\text{-}FID]}$ = response factor of THC-FID to CH_4.

x_{CH4} = concentration of CH_4, HC contamination (optional) and dry-to-wet corrected, as measured by the gas chromatograph FID.

(c) The following example shows how to determine NMHCE emissions based on ethanol (C_2H_5OH), methanol (CH_3OH), acetaldehyde (C_2H_4O), and formaldehyde (CH_2O) as C_1-equivalent molar concentrations:

$x_{THC[THC\text{-}FID]cor}$ = 145.6 µmol/mol

x_{CH4} = 18.9 µmol/mol

x_{C2H5OH} = 100.8 µmol/mol

x_{CH3OH} = 1.1 µmol/mol

x_{C2H4O} = 19.1 µmol/mol

x_{CH2O} = 1.3 µmol/mol

$RF_{CH4[THC\text{-}FID]}$ = 1.07

$RF_{C2H5OH[THC\text{-}FID]}$ = 0.76

$RF_{CH3OH[THC\text{-}FID]}$ = 0.74

$RF_{H2H4O[THC\text{-}FID]}$ = 0.50

$RF_{CH2O[THC\text{-}FID]}$ = 0.0

$$x_{NMHCE} = x_{THC[THC\text{-}FID]cor} - (x_{C2H5OH} \cdot RF_{C2H5OH[THC\text{-}FID]} + x_{CH3OH} \cdot RF_{CH3OH[THC\text{-}FID]} + x_{C2H4O} \cdot RF_{C2H4O[THC\text{-}FID]} + x_{CH2O} \cdot RF_{CH2O[THC\text{-}FID]}) + x_{C2H5OH} + x_{CH3OH} + x_{C2H4O} + x_{CH2O} - (RF_{CH4[THC\text{-}FID]} \cdot x_{CH4})$$

$$x_{NMHCE} = 145.6 - (100.8 \cdot 0.76 + 1.1 \cdot 0.74 + 19.1 \cdot 0.50 + 1.3 \cdot 0) + 100.8 + 1.1 + 19.1 + 1.3 - (1.07 \cdot 18.9)$$

x_{NMHCE} = 160.71 µmol/mol

[79 FR 23805, Apr. 28, 2014]

§ 1065.667 Dilution air background emission correction.

(a) To determine the mass of background emissions to subtract from a diluted exhaust sample, first determine the total flow of dilution air, n_{dil}, over the test interval. This may be a measured quantity or a calculated quantity. Multiply the total flow of dilution air by the mean mole fraction (*i.e.*, concentration) of a background emission. This may be a time-weighted mean or a flow-weighted mean (*e.g.*, a proportionally sampled background). Finally, multiply by the molar mass, M, of the associated gaseous emission constituent. The product of n_{dil} and the mean molar concentration of a background emission and its molar mass, M, is the total background emission mass, m. In the case of PM, where the mean PM concentration is already in units of mass per mole of sample, $\bar{M}_{PM}$, multiply it by the total amount of dilution air flow, and the result is the total background mass of PM, m_{PM}. Subtract total background mass from total mass to correct for background emissions.

(b) You may determine the total flow of dilution air by a direct flow measurement.

(c) You may determine the total flow of dilution air by subtracting the calculated raw exhaust molar flow as described in § 1065.655(f) from the measured dilute exhaust flow. This may be done by totaling continuous calculations or by using batch results.

(d) You may determine the total flow of dilution air from the measured dilute exhaust flow and a chemical balance of the fuel, intake air, and dilute exhaust as described in § 1065.655. For this option, the molar flow of dilution air is calculated by multiplying the dilute exhaust flow by the mole fraction of dilution gas to dilute exhaust, $x_{dil/exh}$, from the dilute chemical balance. This may be done by totaling continuous calculations or by using batch results. For example, to use batch results, the total flow of dilution air is calculated

by multiplying the total flow of diluted exhaust, n_{dexh}, by the flow-weighted mean mole fraction of dilution air in diluted exhaust, $\bar{x}_{dil/exh}$. Calculate $\bar{x}_{dil/exh}$ using flow-weighted mean concentrations of emissions in the chemical balance, as described in §1065.655. The chemical balance in §1065.655 assumes that your engine operates stoichiometrically, even if it is a lean-burn engine, such as a compression-ignition engine. Note that for lean-burn engines this assumption could result in an error in emission calculations. This error could occur because the chemical balance in §1065.655 treats excess air passing through a lean-burn engine as if it was dilution air. If an emission concentration expected at the standard is about 100 times its dilution air background concentration, this error is negligible. However, if an emission concentration expected at the standard is similar to its background concentration, this error could be significant. If this error might affect your ability to show that your engines comply with applicable standards, we recommend that you either determine the total flow of dilution air using one of the more accurate methods in paragraph (b) or (c) of this section, or remove background emissions from dilution air by HEPA filtration, chemical adsorption, or catalytic scrubbing. You might also consider using a partial-flow dilution technique such as a bag mini-diluter, which uses purified air as the dilution air.

(e) The following is an example of using the flow-weighted mean fraction of dilution air in diluted exhaust, $\bar{x}_{dil/exh}$, and the total mass of background emissions calculated using the total flow of diluted exhaust, n_{dexh}, as described in §1065.650(c):

$$m_{bkgnd} = \bar{x}_{dil/exh} \cdot m_{bkgnddexh}$$

Eq. 1065.667-1

$$m_{bkgnddexh} = M \cdot \bar{x}_{bkgnd} \cdot n_{dexh}$$

Eq. 1065.667-2

Example:

M_{NOx} = 46.0055 g/mol
$\bar{x}_{bkgnd}$ = 0.05 µmol/mol = $0.05 \cdot 10^{-6}$ mol/mol
n_{dexh} = 23280.5 mol
$\bar{x}_{dil/exh}$ = 0.843 mol/mol
$m_{bkgndNOxdexh} = 46.0055 \cdot 0.05 \cdot 10^{-6} \cdot 23280.5$
$m_{bkgndNOxdexh}$ = 0.0536 g
$m_{bkgndNOx} = 0.843 \cdot 0.0536$
$m_{bkgndNOx}$ = 0.0452 g

(f) The following is an example of using the fraction of dilution air in diluted exhaust, $x_{dil/exh}$, and the mass rate of background emissions calculated using the flow rate of diluted exhaust, $\dot{n}_{dexh}$, as described in §1065.650(c):

$$\dot{m}_{\text{bkgnd}} = x_{\text{dil/exh}} \cdot \dot{m}_{\text{bkgnddexh}}$$

Eq. 1065.667-3

$$\dot{m}_{\text{bkgnddexh}} = M \cdot x_{\text{bkgnd}} \cdot \dot{n}_{\text{dexh}}$$

Eq. 1065.667-4

Example:

M_{NOx} = 46.0055 g/mol
x_{bkgnd} = 0.05 μmol/mol = $0.05 \cdot 10^{-6}$ mol/mol
$\dot{n}_{\text{dexh}}$ = 23280.5 mol/s
$x_{\text{dil/exh}}$ = 0.843 mol/mol
$\dot{m}_{\text{bkgndNOxdexh}} = 46.0055 \cdot 0.05 \cdot 10^{-6} \cdot 23280.5$
$\dot{m}_{\text{bkgndNOxdexh}}$ = 0.0536 g/hr
$\dot{m}_{\text{bkgndNOx}} = 0.843 \cdot 0.0536$
$\dot{m}_{\text{bkgndNOx}}$ = 0.0452 g/hr

[76 FR 57465, Sept. 15, 2011]

§ 1065.670 NO_X intake-air humidity and temperature corrections.

See the standard-setting part to determine if you may correct NO_X emissions for the effects of intake-air humidity or temperature. Use the NO_X intake-air humidity and temperature corrections specified in the standard-setting part instead of the NO_X intake-air humidity correction specified in this part 1065. If the standard-setting part does not prohibit correcting NO_X emissions for intake-air humidity according to this part 1065, correct NO_X concentrations for intake-air humidity as described in this section. See § 1065.650(c)(1) for the proper sequence for applying the NO_X intake-air humidity and temperature corrections. You may use a time-weighted mean combustion air humidity to calculate this correction if your combustion air humidity remains within a tolerance of ±0.0025 mol/mol of the mean value over the test interval. For intake-air humidity correction, use one of the following approaches:

See the standard-setting part to determine if you may correct NO_X emissions for the effects of intake-air humidity or temperature. Use the NO_X intake-air humidity and temperature corrections specified in the standard-setting part instead of the NO_X intake-air humidity correction specified in this part 1065. If the standard-setting part does not prohibit correcting NO_X emissions for intake-air humidity according to this part 1065, first apply any NO_X corrections for background emissions and water removal from the exhaust sample, then correct NO_X concentrations for intake-air humidity. You may use a time-weighted mean combustion air humidity to calculate this correction if your combustion air humidity remains within a tolerance of ±0.0025 mol/mol of the mean value over the test interval. For intake-air humidity correction, use one of the following approaches:

(a) For compression-ignition engines, correct for intake-air humidity using the following equation:

$$x_{\text{NOxcor}} = x_{\text{NOxuncor}} \cdot \left(9.953 \cdot x_{\text{H20}} + 0.832\right) \qquad \text{Eq. 1065.670-1}$$

Example:

x_{NOxuncor} = 700.5 μmol/mol
x_{H2O} = 0.022 mol/mol
$x_{\text{NOxcor}} = 700.5 \cdot (9.953 \cdot 0.022 + 0.832)$
x_{NOxcor} = 736.2 μmol/mol

(b) For spark-ignition engines, correct for intake-air humidity using the following equation: