

$$x_{\text{NMHC}} = x_{\text{THC}} - \text{RF}_{\text{CH}_4} \cdot x_{\text{CH}_4} - x_{\text{NMHC}_{\text{init}}} \quad \text{Eq. 1065.660-3}$$

Example:

$$\begin{aligned} x_{\text{THC}} &= 145.6 \text{ } \mu\text{mol/mol} \\ \text{RF}_{\text{CH}_4} &= 0.970 \\ x_{\text{CH}_4} &= 18.9 \text{ } \mu\text{mol/mol} \\ x_{\text{NMHC}_{\text{init}}} &= 1.1 \text{ } \mu\text{mol/mol} \\ x_{\text{NMHC}} &= 145.6 - 0.970 \cdot 18.9 - 1.1 \\ x_{\text{NMHC}} &= 126.2 \text{ } \mu\text{mol/mol} \end{aligned}$$

§ 1065.665 THCE and NMHCE determination.

(a) If you measured an oxygenated hydrocarbon's mass concentration (per mole of exhaust), first calculate its

molar concentration by dividing its mass concentration by the effective molar mass of the oxygenated hydrocarbon, then multiply each oxygenated hydrocarbon's molar concentration by its respective number of carbon atoms per molecule. Add these C₁-equivalent molar concentrations to the molar concentration of NOTHC. The result is the molar concentration of THCE. Calculate THCE concentration using the following equations:

$$x_{\text{THCE}} = x_{\text{NOTHC}} + \sum_{i=1}^N x_{\text{OHC}_i} - x_{\text{THCE}_{\text{init}}} \quad \text{Eq. 1065.665-1}$$

$$x_{\text{NOTHC}} = x_{\text{THC}} - \sum_{i=1}^N \left(x_{\text{OHC}_i} \cdot \text{RF}_{\text{OHC}_i} \cdot C^{\#} \right) \quad \text{Eq. 1065.665-2}$$

$$x_{\text{OHC}_i} = \frac{M_{\text{exhOHC}_i} \cdot m_{\text{dexhOHC}}}{M_{\text{OHC}_i} \cdot m_{\text{dexh}}} = \frac{n_{\text{dexhOHC}}}{n_{\text{dexh}}} \quad \text{Eq. 1065.665-3}$$

Where:

x_{OHC_i} = The C₁-equivalent concentration of oxygenated species *i* in diluted exhaust.
 x_{THC} = The C₁-equivalent FID response to NOTHC and all OHC in diluted exhaust.

RF_{OHC_i} = The response factor of the FID to species *i* relative to propane on a C₁-equivalent basis.

$C^{\#}$ = the mean number of carbon atoms in the particular compound.

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

$$x_{\text{NMHCE}} = x_{\text{THCE}} - x_{\text{CH}_4} \cdot \text{RF}_{\text{CH}_4} \quad \text{Eq. 1065.665-4}$$

(c) The following example shows how to determine NMHCE emissions based on ethanol (C₂H₅OH) and methanol (CH₃OH) molar concentrations, and acetaldehyde (C₂H₄O) and formaldehyde (HCHO) as mass concentrations:

$$\begin{aligned} x_{\text{NMHC}} &= 127.3 \text{ } \mu\text{mol/mol} \\ x_{\text{C}_2\text{H}_5\text{OH}} &= 100.8 \text{ } \mu\text{mol/mol} \\ x_{\text{CH}_3\text{OH}} &= 25.5 \text{ } \mu\text{mol/mol} \\ M_{\text{exhC}_2\text{H}_4\text{O}} &= 0.841 \text{ mg/mol} \\ M_{\text{exhHCHO}} &= 39.0 \text{ } \mu\text{g/mol} \\ M_{\text{C}_2\text{H}_4\text{O}} &= 44.05256 \text{ g/mol} \\ M_{\text{HCHO}} &= 30.02598 \text{ g/mol} \\ x_{\text{C}_2\text{H}_4\text{O}} &= 0.841/44.05256 \text{ } 1000 \\ x_{\text{C}_2\text{H}_4\text{O}} &= 19.1 \text{ } \mu\text{mol/mol} \end{aligned}$$

$$x_{\text{HCHO}} = 39/30.02598$$

$$x_{\text{HCHO}} = 1.3 \text{ } \mu\text{mol/mol}$$

$$x_{\text{NMHCE}} = 127.3 + 2 \cdot 100.8 + 25.5 + 2 \cdot 19.1 + 1.3$$

$$x_{\text{NMHCE}} = 393.9 \text{ } \mu\text{mol/mol}$$

§ 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 quantity calculated from the diluted exhaust flow and the

flow-weighted mean fraction of dilution air in diluted exhaust, \bar{x}_{dil} . Multiply the total flow of dilution air by the mean concentration of a background emission. This may be a time-weighted mean or a flow-weighted mean (e.g., a proportionally sampled background). The product of n_{dil} and the mean concentration of a background emission is the total amount of a background emission. If this is a molar quantity, convert it to a mass by multiplying it by its molar mass, M . The result is the mass of the background emission, m . In the case of PM, where the mean PM concentration is already in units of mass per mole of sample, M_{PM} , multiply it by the total amount of dilution air, and the result is the total background mass of PM, m_{PM} . Subtract total background masses from total mass to correct for background emissions.

(b) You may determine the total flow of dilution air by a direct flow measurement. In this case, calculate the total mass of background as described in §1065.650(b), using the dilution air flow, n_{dil} . Subtract the background mass from the total mass. Use the result in brake-specific emission calculations.

(c) You may determine the total flow of dilution air from the total flow of diluted exhaust and a chemical balance of the fuel, intake air, and exhaust as described in §1065.655. In this case, calculate the total mass of background as described in §1065.650(b), using the total flow of diluted exhaust, n_{dexh} , then

multiply this result by the flow-weighted mean fraction of dilution air in diluted exhaust, \bar{x}_{dil} . Calculate \bar{x}_{dil} using flow-weighted mean concentrations of emissions in the chemical balance, as described in §1065.655. You may assume 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 balances in §1065.655 correct 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 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.

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

$$m_{bkngnd} = \bar{x}_{dil} \cdot m_{bkngnddexh} \quad \text{Eq. 1065.667-1}$$

$$m_{bkngnddexh} = M \cdot \bar{x}_{bkngnd} \cdot n_{dexh} \quad \text{Eq. 1065.667-2}$$

Example:

$M_{NOx} = 46.0055 \text{ g/mol}$
 $\bar{x}_{bkngnd} = 0.05 \text{ } \mu\text{mol/mol} = 0.05 \cdot 10^{-6} \text{ mol/mol}$
 $n_{dexh} = 23280.5 \text{ mol}$
 $\bar{x}_{dil} = 0.843$
 $m_{bkngndNOxdexh} = 46.0055 \cdot 0.05 \cdot 10^{-6} \cdot 23280.5$
 $m_{bkngndNOxdexh} = 0.0536 \text{ g}$
 $m_{bkngndNOx} = 0.843 \cdot 0.0536$
 $m_{bkngndNOx} = 0.0452 \text{ g}$

§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