

**Environmental Protection Agency**

**§ 1065.672**

corrections specified in the standard-setting part instead of the NO<sub>x</sub> intake-air humidity correction specified in this part 1065. If the standard-setting part allows correcting NO<sub>x</sub> emissions for intake-air humidity according to this part 1065, first apply any NO<sub>x</sub> cor-

rections for background emissions and water removal from the exhaust sample, then correct NO<sub>x</sub> concentrations for intake-air humidity using one of the following approaches:

(a) Correct for intake-air humidity using the following equation:

$$x_{\text{NOxcor}} = x_{\text{NOxuncor}} \cdot (9.953 \cdot x_{\text{H}_2\text{O}} + 0.832) \quad \text{Eq. 1065.670-1}$$

*Example:*

$x_{\text{NOxuncor}} = 700.5 \text{ } \mu\text{mol/mol}$   
 $x_{\text{H}_2\text{O}} = 0.022 \text{ mol/mol}$   
 $x_{\text{NOxcor}} = 700.5 \cdot (9.953 \cdot 0.022 + 0.832)$   
 $x_{\text{NOxcor}} = 736.2 \text{ } \mu\text{mol/mol}$

(b) Develop your own correction, based on good engineering judgment.

**§ 1065.672 Drift correction.**

(a) *Scope and frequency.* Perform the calculations in this section to determine if gas analyzer drift invalidates the results of a test interval. If drift does not invalidate the results of a test interval, correct that test interval's gas analyzer responses for drift according to this section. Use the drift-corrected gas analyzer responses in all subsequent emission calculations. Note that the acceptable threshold for gas analyzer drift over a test interval is specified in §1065.550 for both laboratory testing and field testing.

(b) *Correction principles.* The calculations in this section utilize a gas analyzer's responses to reference zero and span concentrations of analytical gases, as determined sometime before and after a test interval. The calcula-

tions correct the gas analyzer's responses that were recorded during a test interval. The correction is based on an analyzer's mean responses to reference zero and span gases, and it is based on the reference concentrations of the zero and span gases themselves. Validate and correct for drift as follows:

(c) *Drift validation.* After applying all the other corrections—except drift correction—to all the gas analyzer signals, calculate brake-specific emissions according to §1065.650. Then correct all gas analyzer signals for drift according to this section. Recalculate brake-specific emissions using all of the drift-corrected gas analyzer signals. Validate and report the brake-specific emission results before and after drift correction according to §1065.550.

(d) *Drift correction.* Correct all gas analyzer signals as follows:

(1) Correct each recorded concentration,  $x_i$ , for continuous sampling or for batch sampling,  $\bar{x}$ .

(2) Correct for drift using the following equation:

$$x_{\text{drift corrected}} = x_{\text{refzero}} + \frac{2 \cdot x_{\text{refspan}}}{x_{\text{prespan}} + x_{\text{postspan}}} \cdot \left( x_i - \frac{x_{\text{prezero}} + x_{\text{postzero}}}{2} \right) \quad \text{Eq. 1065.672-1}$$

Where:

$x_{\text{driftcorrected}}$  = concentration corrected for drift.  
 $x_{\text{refzero}}$  = reference concentration of the zero gas, which is usually zero unless known to be otherwise.  
 $x_{\text{refspan}}$  = reference concentration of the span gas.  
 $x_{\text{prespan}}$  = pre-test interval gas analyzer response to the span gas concentration.

$x_{\text{postspan}}$  = post-test interval gas analyzer response to the span gas concentration.  
 $x_i$  or  $\bar{x}$  = concentration recorded during test, before drift correction.  
 $x_{\text{prezero}}$  = pre-test interval gas analyzer response to the zero gas concentration.  
 $x_{\text{postzero}}$  = post-test interval gas analyzer response to the zero gas concentration.

*Example:*

$x_{\text{refzero}} = 0 \text{ } \mu\text{mol/mol}$

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$x_{\text{refspan}} = 1800.0 \text{ } \mu\text{mol/mol}$   
 $x_{\text{prespan}} = 1800.5 \text{ } \mu\text{mol/mol}$   
 $x_{\text{postspan}} = 1695.8 \text{ } \mu\text{mol/mol}$

$x_i$  or  $\bar{x} = 435.5 \text{ } \mu\text{mol/mol}$   
 $x_{\text{prezero}} = 0.6 \text{ } \mu\text{mol/mol}$   
 $x_{\text{postzero}} = -5.2 \text{ } \mu\text{mol/mol}$

$$x_{\text{idrift corrected}} = 0 + \frac{2 \cdot 1800.0}{1800.5 + 1695.8} \cdot \left( 435.5 - \frac{0.6 + (-5.2)}{2} \right)$$

$x_{\text{idrift corrected}} = 450.8 \text{ } \mu\text{mol/mol}$

(3) For any pre-test interval concentrations, use concentrations determined most recently before the test interval. For some test intervals, the most recent pre-zero or pre-span might have occurred before one or more previous test intervals.

(4) For any post-test interval concentrations, use concentrations determined most recently after the test interval. For some test intervals, the most recent post-zero or post-span might have occurred after one or more subsequent test intervals.

(5) If you do not record any pre-test interval analyzer response to the span gas concentration,  $x_{\text{prespan}}$ , set  $x_{\text{prespan}}$  equal to the reference concentration of the span gas:

$$x_{\text{prespan}} = x_{\text{refspan}}$$

(6) If you do not record any pre-test interval analyzer response to the zero gas concentration,  $x_{\text{prezero}}$ , set  $x_{\text{prezero}}$  equal to the reference concentration of the zero gas:

$$x_{\text{prezero}} = x_{\text{refzero}}$$

(7) Usually the reference concentration of the zero gas,  $x_{\text{refzero}}$ , is zero:  $x_{\text{refzero}} = 0 \text{ } \mu\text{mol/mol}$ . However, in some

cases you might know that  $x_{\text{refzero}}$  has a non-zero concentration. For example, if you zero a CO<sub>2</sub> analyzer using ambient air, you may use the default ambient air concentration of CO<sub>2</sub>, which is 375  $\mu\text{mol/mol}$ . In this case,  $x_{\text{refzero}} = 375 \text{ } \mu\text{mol/mol}$ . Note that when you zero an analyzer using a non-zero  $x_{\text{refzero}}$ , you must set the analyzer to output the actual  $x_{\text{refzero}}$  concentration. For example, if  $x_{\text{refzero}} = 375 \text{ } \mu\text{mol/mol}$ , set the analyzer to output a value of 375  $\mu\text{mol/mol}$  when the zero gas is flowing to the analyzer.

§ 1065.675 CLD quench verification calculations.

Perform CLD quench-check calculations as follows:

(a) Calculate the amount of water in the span gas,  $x_{\text{H}_2\text{Ospan}}$ , assuming complete saturation at the span-gas temperature.

(b) Estimate the expected amount of water and CO<sub>2</sub> in the exhaust you sample,  $x_{\text{H}_2\text{Oexp}}$  and  $x_{\text{CO}_2\text{exp}}$ , respectively, by considering the maximum expected amounts of water in combustion air, fuel combustion products, and dilution air concentrations (if applicable).

(c) Calculate water quench as follows:

$$\text{quench} = \left( \frac{x_{\text{NOwet}} / (1 - x_{\text{H}_2\text{Omeas}})}{x_{\text{NOdry}}} - 1 \right) \cdot \frac{x_{\text{H}_2\text{Oexp}}}{x_{\text{H}_2\text{Omeas}}} + \frac{x_{\text{NO,CO}_2} - x_{\text{NO,N}_2}}{x_{\text{NO,N}_2}} \cdot \frac{x_{\text{CO}_2\text{exp}}}{x_{\text{CO}_2\text{meas}}} \quad \text{Eq. 1065.672-1}$$

Where:  
*quench* = amount of CLD quench.

$x_{\text{NOdry}}$  = measured concentration of NO upstream of a bubbler, according to § 1065.370.