

verification test without the sample dryer.

(2) Create a humidified test gas by bubbling a multi component span gas that incorporates the target interference species and meets the specifications in §1065.750 through distilled water in a sealed vessel. If the sample is not passed through a dryer during emission testing, control the vessel temperature to generate an H<sub>2</sub>O level at least as high as the maximum expected during emission testing. If the sample is passed through a dryer during emission testing, control the vessel temperature to generate an H<sub>2</sub>O level at least as high as the level determined in §1065.145(e)(2) for that dryer. Use interference span gas concentrations that are at least as high as the maximum expected during testing.

(3) Introduce the humidified interference test gas into the sample system. You may introduce it downstream of any sample dryer, if one is used during testing.

(4) If the sample is not passed through a dryer during this verification test, measure the water mole fraction,  $x_{\text{H}_2\text{O}}$ , of the humidified interference test gas as close as possible to the inlet of the analyzer. For example, measure dewpoint,  $T_{\text{dew}}$ , and absolute pressure,  $p_{\text{total}}$ , to calculate  $x_{\text{H}_2\text{O}}$ . Verify that the water content meets the requirement in paragraph (d)(2) of this section. If the sample is passed through a dryer during this verification test, you must verify that the water content of the humidified test gas downstream of the vessel meets the requirement in paragraph (d)(2) of this section based on either direct measurement of the water content (e.g., dewpoint and pressure) or an estimate based on the vessel pressure and temperature. Use good engineering judgment to estimate the water content. For example, you may use previous direct measurements of water content to verify the vessel's level of saturation.

(5) If a sample dryer is not used in this verification test, use good engineering judgment to prevent condensation in the transfer lines, fittings, or valves from the point where  $x_{\text{H}_2\text{O}}$  is measured to the analyzer. We recommend that you design your system

so that the wall temperatures in the transfer lines, fittings, and valves from the point where  $x_{\text{H}_2\text{O}}$  is measured to the analyzer are at least 5 °C above the local sample gas dewpoint.

(6) Allow time for the analyzer response to stabilize. Stabilization time may include time to purge the transfer line and to account for analyzer response.

(7) While the analyzer measures the sample's concentration, record its output for 30 seconds. Calculate the arithmetic mean of this data.

(8) The analyzer meets the interference verification if the result of paragraph (d)(7) of this section meets the tolerance in paragraph (c) of this section.

(9) You may also run interference procedures separately for individual interference gases. If the interference gas levels used are higher than the maximum levels expected during testing, you may scale down each observed interference value by multiplying the observed interference by the ratio of the maximum expected concentration value to the actual value used during this procedure. You may run separate interference concentrations of H<sub>2</sub>O (down to 0.025 mol/mol H<sub>2</sub>O content) that are lower than the maximum levels expected during testing, but you must scale up the observed H<sub>2</sub>O interference by multiplying the observed interference by the ratio of the maximum expected H<sub>2</sub>O concentration value to the actual value used during this procedure. The sum of the scaled interference values must meet the tolerance specified in paragraph (c) of this section.

[74 FR 56515, Oct. 30, 2009]

#### § 1065.376 Chiller NO<sub>2</sub> penetration.

(a) *Scope and frequency.* If you use a chiller to dry a sample upstream of a NO<sub>x</sub> measurement instrument, but you don't use an NO<sub>2</sub>-to-NO converter upstream of the chiller, you must perform this verification for chiller NO<sub>2</sub> penetration. Perform this verification after initial installation and after major maintenance.

(b) *Measurement principles.* A chiller removes water, which can otherwise interfere with a NO<sub>x</sub> measurement. However, liquid water remaining in an

improperly designed chiller can remove NO<sub>2</sub> from the sample. If a chiller is used without an NO<sub>2</sub>-to-NO converter upstream, it could remove NO<sub>2</sub> from the sample prior NO<sub>x</sub> measurement.

(c) *System requirements.* A chiller must allow for measuring at least 95% of the total NO<sub>2</sub> at the maximum expected concentration of NO<sub>2</sub>.

(d) *Procedure.* Use the following procedure to verify chiller performance:

(1) *Instrument setup.* Follow the analyzer and chiller manufacturers' start-up and operating instructions. Adjust the analyzer and chiller as needed to optimize performance.

(2) *Equipment setup and data collection.* (i) Zero and span the total NO<sub>x</sub> gas analyzer(s) as you would before emission testing.

(ii) Select an NO<sub>2</sub> calibration gas, balance gas of dry air, that has an NO<sub>2</sub> concentration within ±5% of the maximum NO<sub>2</sub> concentration expected during testing.

(iii) Overflow this calibration gas at the gas sampling system's probe or overflow fitting. Allow for stabilization of the total NO<sub>x</sub> response, accounting only for transport delays and instrument response.

(iv) Calculate the mean of 30 seconds of recorded total NO<sub>x</sub> data and record this value as  $x_{\text{NO}_x\text{ref}}$ .

(v) Stop flowing the NO<sub>2</sub> calibration gas.

(vi) Next saturate the sampling system by overflowing a dewpoint generator's output, set at a dewpoint of 50 °C, to the gas sampling system's probe or overflow fitting. Sample the dewpoint generator's output through the sampling system and chiller for at least 10 minutes until the chiller is expected to be removing a constant rate of water.

(vii) Immediately switch back to overflowing the NO<sub>2</sub> calibration gas used to establish  $x_{\text{NO}_x\text{ref}}$ . Allow for stabilization of the total NO<sub>x</sub> response, accounting only for transport delays and instrument response. Calculate the mean of 30 seconds of recorded total NO<sub>x</sub> data and record this value as  $x_{\text{NO}_x\text{meas}}$ .

(viii) Correct  $x_{\text{NO}_x\text{meas}}$  to  $x_{\text{NO}_x\text{dry}}$  based upon the residual water vapor that passed through the chiller at the chiller's outlet temperature and pressure.

(3) *Performance evaluation.* If  $x_{\text{NO}_x\text{dry}}$  is less than 95% of  $x_{\text{NO}_x\text{ref}}$ , repair or replace the chiller.

(e) *Exceptions.* The following exceptions apply:

(1) You may omit this verification if you can show by engineering analysis that for your NO<sub>x</sub> sampling system and your emission calculations procedures, the chiller always affects your brake-specific NO<sub>x</sub> emission results by less than 0.5% of the applicable NO<sub>x</sub> standard.

(2) You may use a chiller that you determine does not meet this verification, as long as you try to correct the problem and the measurement deficiency does not adversely affect your ability to show that engines comply with all applicable emission standards.

[73 FR 37312, June 30, 2008]

#### § 1065.378 NO<sub>2</sub>-to-NO converter conversion verification.

(a) *Scope and frequency.* If you use an analyzer that measures only NO to determine NO<sub>x</sub>, you must use an NO<sub>2</sub>-to-NO converter upstream of the analyzer. Perform this verification after installing the converter, after major maintenance and within 35 days before an emission test. This verification must be repeated at this frequency to verify that the catalytic activity of the NO<sub>2</sub>-to-NO converter has not deteriorated.

(b) *Measurement principles.* An NO<sub>2</sub>-to-NO converter allows an analyzer that measures only NO to determine total NO<sub>x</sub> by converting the NO<sub>2</sub> in exhaust to NO.

(c) *System requirements.* An NO<sub>2</sub>-to-NO converter must allow for measuring at least 95% of the total NO<sub>2</sub> at the maximum expected concentration of NO<sub>2</sub>.

(d) *Procedure.* Use the following procedure to verify the performance of a NO<sub>2</sub>-to-NO converter:

(1) *Instrument setup.* Follow the analyzer and NO<sub>2</sub>-to-NO converter manufacturers' start-up and operating instructions. Adjust the analyzer and converter as needed to optimize performance.

(2) *Equipment setup.* Connect an ozonator's inlet to a zero-air or oxygen source and connect its outlet to one port of a three-way tee fitting. Connect an NO span gas to another port, and