

- (ii) FIDppm=FID reading in ppmC.
- (iii) SAMppm=methanol concentration in the sample bag, or gas bottle, in ppmC. SAMppm for sample bags:

$$= \frac{0.02406 \times \text{Fuel injected} \times \text{Fuel density}}{\text{Air volume} \times \text{Mol. Wt. CH}_3\text{OH}}$$

Where:

- (iv) 0.02406=volume of one mole at 29.92 in Hg and 68 °F, m<sup>3</sup>.
- (v) Fuel injected = volume of methanol injected, ml.
- (vi) Fuel density=density of methanol, 0.7914 g/ml.
- (vii) Air volume=volume of zero-grade air, m<sup>3</sup>.
- (viii) Mol. Wt. CH<sub>3</sub>OH=32.04.

(d) *FID response factor to methane.* When the FID analyzer is to be used for the analysis of natural gas-fueled vehicle hydrocarbon samples, the methane response factor of the analyzer shall be established. To determine the total hydrocarbon FID response to methane, known methane in air concentrations traceable to National Institute of Standards and Technology (NIST) shall be analyzed by the FID. Several methane concentrations shall be analyzed by the FID in the range of concentrations in the exhaust sample. The total hydrocarbon FID response to methane is calculated as follows:

$$r_{\text{CH}_4} = \text{FIDppm} / \text{SAMppm}$$

Where:

- (1) r<sub>CH<sub>4</sub></sub>=FID response factor to methane.
- (2) FIDppm=FID reading in ppmC.
- (3) SAMppm=the known methane concentration in ppmC.

[59 FR 48531, Sept. 21, 1994, as amended at 60 FR 34371, June 30, 1995; 62 FR 47128, Sept. 5, 1997; 70 FR 40438, July 13, 2005]

**§ 86.1322-84 Carbon monoxide analyzer calibration.**

The NDIR carbon monoxide analyzer shall receive the following initial and periodic calibration.

- (a) *Initial and periodic interference check.* Prior to its introduction into service and annually thereafter, the NDIR carbon monoxide analyzer shall be checked for response to water vapor and CO<sub>2</sub>:

- (1) Follow good engineering practices for instrument start-up and operation. Adjust the analyzer to optimize performance on the most sensitive range to be used.

- (2) Zero the carbon monoxide analyzer with either zero-grade air or zero-grade nitrogen.

- (3) Bubble a mixture of 3 percent CO<sub>2</sub> in N<sub>2</sub> through water at room temperature and record analyzer response.

- (4) An analyzer response of more than 1 percent of full scale for ranges above 300 ppm full scale or more than 3 ppm on ranges below 300 ppm full scale requires corrective action. (Use of conditioning columns is one form of corrective action which may be taken.)

- (b) *Initial and periodic calibration.* Prior to its introduction into service and monthly thereafter, the NDIR carbon monoxide analyzer shall be calibrated.

- (1) Adjust the analyzer to optimize performance.

- (2) Zero the carbon monoxide analyzer with either zero-grade air or zero-grade nitrogen.

- (3) Calibrate on each used operating range with a minimum of 6, approximately equally spaced, carbon monoxide-in-N<sub>2</sub> calibration gases (e.g., 15, 30, 45, 60, 75, and 90 percent of that range). For each range calibrated, if the deviation from a least-squares best-fit straight line is within ±2 percent of the value at each non-zero data point and within ±0.3 percent of full scale on the zero data point, then concentration values may be calculated by using the linear calibration equation for that range. If the deviation exceeds these limits, then the best-fit not-linear equation which represents the data within these limits shall be used to determine concentration values.

- (c) The initial and periodic interference, system check, and calibration test procedures specified in 40 CFR part 86, subpart D may be used in lieu of the procedures specified in this section.

[48 FR 52210, Nov. 16, 1983, as amended at 62 FR 47128, Sept. 5, 1997]

**§ 86.1323-84 Oxides of nitrogen analyzer calibration.**

The chemiluminescent oxides of nitrogen analyzer shall receive the following initial and periodic calibration.

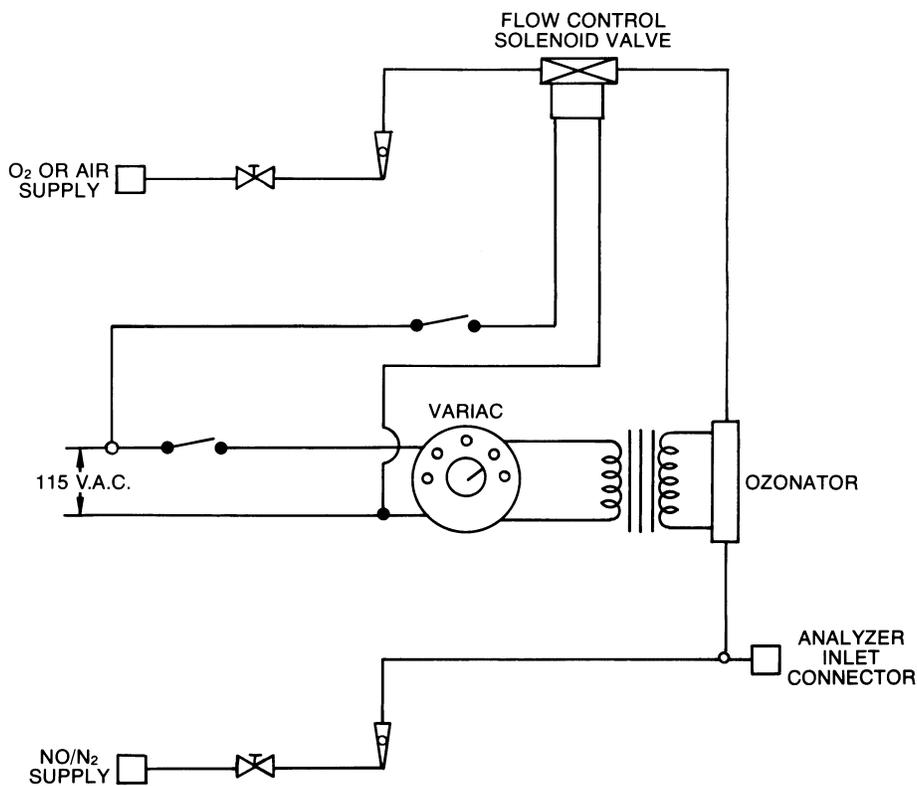
(a) Prior to introduction into service and at least monthly thereafter, the chemiluminescent oxides of nitrogen analyzer must be checked for NO<sub>2</sub> to NO converter efficiency. Figure N84-9 is a reference for paragraphs (a) (1) through (11) of this section.

(1) Follow good engineering practices for instrument start-up and operation. Adjust the analyzer to optimize performance.

(2) Zero the oxides of nitrogen analyzer with zero-grade air or zero-grade nitrogen.

(3) Connect the outlet of the NO<sub>x</sub> generator to the sample inlet of the oxides of nitrogen analyzer which has been set to the most common operating range.

(4) Introduce into the NO<sub>x</sub> generator analyzer-system an NO-in-nitrogen (N<sub>2</sub>) mixture with an NO concentration equal to approximately 80 percent of the most common operating range. The NO<sub>2</sub> content of the gas mixture shall be less than 5 percent of the NO concentration.



(SEE FIG. N84-5 FOR SYMBOL LEGEND)

FIGURE N84-9 — NO<sub>x</sub> CONVERTER EFFICIENCY DETECTOR

(5) With the oxides of nitrogen analyzer in the NO mode, record the con-

centration of NO indicated by the analyzer.

(6) Turn on the NO<sub>x</sub> generator O<sub>2</sub> (or air) supply and adjust the O<sub>2</sub> (or air) flow rate so that the NO indicated by the analyzer is about 10 percent less than indicated in paragraph (a)(5) of this section. Record the concentration of NO in this NO + O<sub>2</sub> mixture.

(7) Switch the NO<sub>x</sub> generator to the generation mode and adjust the generation rate so that the NO measured on the analyzer is 20 percent of that measured in paragraph (a)(5) of this section. There must be at least 10 percent unreacted NO at this point. Record the concentration of residual NO.

(8) Switch the oxides of nitrogen analyzer to the NO<sub>x</sub> mode and measure total NO<sub>x</sub>. Record this value.

(9) Switch off the NO<sub>x</sub> generator but maintain gas flow through the system. The oxides of nitrogen analyzer will indicate the NO<sub>x</sub> in the NO + O<sub>2</sub> mixture. Record this value.

(10) Turn off the NO<sub>x</sub> generator O<sub>2</sub> (or air) supply. The analyzer will now indicate the NO<sub>x</sub> in the original NO-in-N<sub>2</sub> mixture. This value should be no more than 5 percent above the value indicated in paragraph (a)(4) of this section.

(11) Calculate the efficiency of the NO<sub>x</sub> converter by substituting the concentrations obtained into the following equation:

$$\text{Percent efficiency} = \left( 1 + \frac{a - b}{c - d} \right) \times 100$$

Where:

a = concentration obtained in paragraph (a)(8),

b = concentration obtained in paragraph (a)(9),

c = concentration obtained in paragraph (a)(6),

d = concentration obtained in paragraph (a)(7).

If converter efficiency is not greater than 90 percent corrective action will be required.

(b) *Initial and periodic calibration.* Prior to its introduction into service and monthly thereafter, the chemiluminescent oxides of nitrogen analyzer shall be calibrated on all normally used instrument ranges. Use the same flow rate as when analyzing samples. Proceed as follows:

(1) Adjust analyzer to optimize performance.

(2) Zero the oxides of nitrogen analyzer with zero-grade air or zero-grade nitrogen.

(3) Calibrate on each used operating range with a minimum of 6, approximately equally spaced, NO-in-N<sub>2</sub> calibration gases (e.g., 15, 30, 45, 60, 75, and 90 percent of that range). For each range calibrated, if the deviation from a least-squares best-fit straight line is within ±2 percent of the value at each non-zero data point and within ±0.3 percent of full scale on the zero data point, then concentration values may be calculated using the linear calibration equation for that range. If the deviation exceeds these limits, then the best-fit non-linear equation which represents the data within these limits shall be used to determine concentration values.

(c) The initial and periodic interference, system check, and calibration test procedures specified in 40 CFR part 86, subpart D, may be used in lieu of the procedures specified in this section.

(d) When testing methanol-fueled engines it may be necessary to clean the analyzer frequently to prevent interference with NO<sub>x</sub> measurements (see EPA/60/S3-88/040).

[48 FR 52210, Nov. 16, 1983, as amended at 49 FR 48144, Dec. 10, 1984; 58 FR 58426, Nov. 1, 1993; 60 FR 34374, June 30, 1995; 62 FR 47129, Sept. 5, 1997]

#### § 86.1323-2007 Oxides of nitrogen analyzer calibration.

This section describes the initial and periodic calibration of the chemiluminescent oxides of nitrogen analyzer.

(a) Prior to introduction into service and at least monthly thereafter, the chemiluminescent oxides of nitrogen analyzer must be checked for NO<sub>2</sub> to NO converter efficiency. The Administrator may approve less frequent checks of the converter efficiency. Figure N84-9 is a reference for paragraphs (a) (1) through (11) of this section.

(1) Follow good engineering practices for instrument start-up and operation. Adjust the analyzer to optimize performance.

(2) Zero the oxides of nitrogen analyzer with zero-grade nitrogen.