

- (ii)  $FID_{ppm}$  = FID reading, ppmC.
- (iii)  $SAM_{ppm}$  = methanol concentration in the sample bag, or gas bottle, in ppmC.  $SAM_{ppm}$  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 101.3 kPa (29.92 in. Hg) and 20 °C (68 °F),  $m^3$ .
- (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,  $m^3$
- (viii) Mol. Wt.  $CH_3OH$  = 32.04

(e) *FID response factor to methane.* When the FID analyzer is to be used for the analysis of natural gas-fueled motorcycle 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:

$$r_{CH_4} = FID_{ppm} / SAM_{ppm}$$

Where:

- (1)  $r_{CH_4}$  = FID response factor to methane.
- (2)  $FID_{ppm}$  = FID reading in ppmC.
- (3)  $SAM_{ppm}$  = the known methane concentration in ppmC.

[54 FR 14546, Apr. 11, 1989, as amended at 59 FR 48514, Sept. 21, 1994; 60 FR 34355, June 30, 1995]

**§ 86.522-78 Carbon monoxide analyzer 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  $CO_{2\leq}$

(1) Follow the manufacturer's instructions for instrument startup and operation. Adjust the analyzer to optimize performance on the most sensitive range.

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

(3) Bubble a mixture of 3 percent  $CO_2$  in  $N_2$  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 of more than 3 ppm on ranges below 300 ppm full scale will require 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.

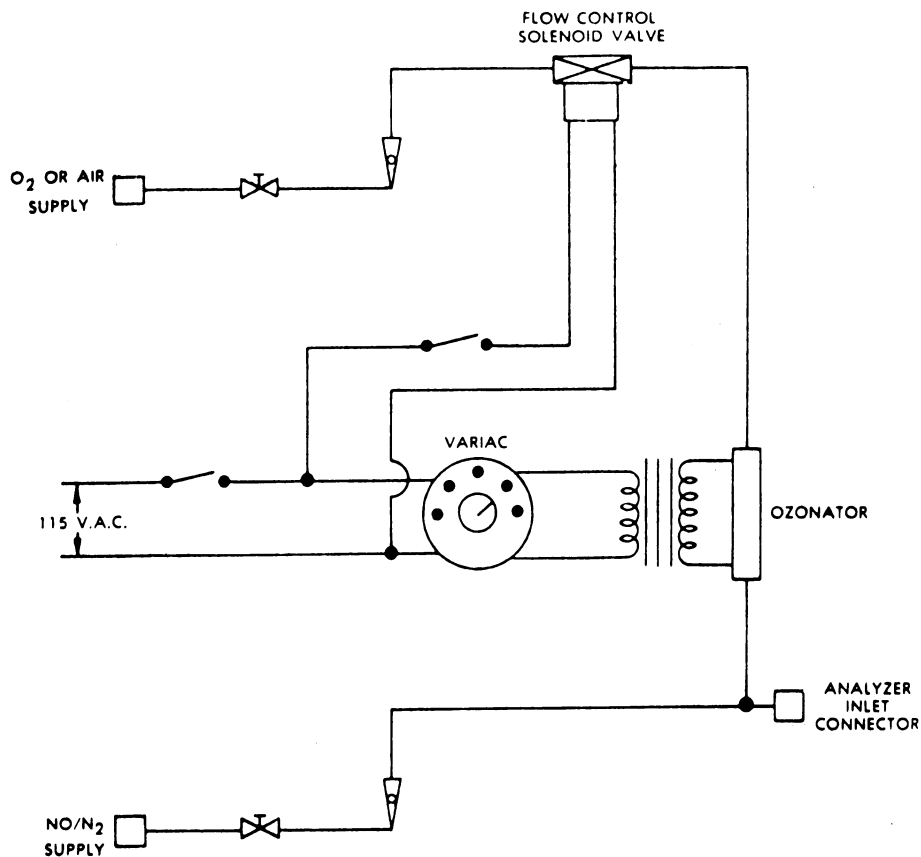
(1) Adjust the analyzer to optimize performance.

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

(3) Calibrate on each normally used operating range with carbon monoxide in  $N_2$  calibration gases having nominal concentrations of 15, 30, 45, 60, 75, and 90 percent of that range. Additional calibration points may be generated. For each range calibrated, if the deviation from a least-squares best-fit straight line is 2 percent or less of the value at each data point, concentration values may be calculated by use of a single calibration factor for that range. If the deviation exceeds 2 percent at any point, the best-fit non-linear equation which represents the data to within 2 percent of each test point shall be used to determine concentration.

**§ 86.523-78 Oxides of nitrogen analyzer calibration.**

(a) Prior to introduction into service and at least monthly thereafter, if oxides of nitrogen are measured, the chemiluminescent oxides of nitrogen analyzer must be checked for  $NO_2$  to NO converter efficiency. Figure F78-8 is a reference for paragraphs (a) (1) through (11) of this section.



(SEE FIG F78-3 FOR SYMBOL LEGEND)

FIGURE F78-8—NO<sub>x</sub> CONVERTER EFFICIENCY DETECTOR

(1) Follow the manufacturer's instructions for instrument startup 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 a NO in nitrogen (N<sub>2</sub>) mixture with a 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.

(5) With the oxides of nitrogen analyzer in the NO mode, record the concentration 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 step 5. 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

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the analyzer is 20 percent of that measured in step 5. 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> generation 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 step 4.

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

$$\text{Percent Efficiency} = [1 + (a - b)/(c - d)] \times 100$$

where:

- a = concentration obtained in step (8).
- b = concentration obtained in step (9).
- c = concentration obtained in step (6).
- d = concentration obtained in step (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, if oxides of nitrogen are measured, 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 normally used operating range with NO in N<sub>2</sub> calibration gases with nominal concentrations of 50 and 100 percent of that range. Additional calibration points may be generated.

(c) When testing methanol-fueled motorcycles, it may be necessary to clean the analyzer frequently to prevent in-

terference with NO<sub>x</sub> measurements (see EPA/600/S3-88/040).

[42 FR 1137, Jan. 5, 1977, as amended at 52 FR 47870, Dec. 16, 1987; 58 FR 58423, Nov. 1, 1993; 60 FR 34357, June 30, 1995]

**§ 86.524-78 Carbon dioxide analyzer calibration.**

(a) Prior to its introduction into service and monthly thereafter the NDIR carbon dioxide analyzer shall be calibrated:

(1) Follow the manufacturer's instructions for instrument startup and operation. Adjust the analyzer to optimize performance.

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

(3) Calibrate on each normally used operating range with carbon dioxide in N<sub>2</sub> calibration gases with nominal concentrations of 15, 30, 45, 60, 75, and 90 percent of that range. Additional calibration points may be generated. For each range calibrated, if the deviation from a least-squares best-fit straight line is 2 percent or less of the value at each data point, concentration values may be calculated by use of a single calibration factor for that range. If the deviation exceeds 2 percent at any point, the best-fit non-linear equation which represents the data to within 2 percent of each test point shall be used to determine concentration.

(b) [Reserved]

**§ 86.526-90 Calibration of other equipment.**

Other test equipment used for testing shall be calibrated as often as required by the manufacturer or as necessary according to good practice. Specific equipment requiring calibration is the gas chromatograph and flame ionization detector used in measuring methanol and the high pressure liquid chromatograph (HPLC) and ultraviolet detector for measuring formaldehyde.

[54 FR 14551, Apr. 11, 1989]

**§ 86.527-90 Test procedures, overview.**

(a) The procedures described in this and subsequent sections are used to determine the conformity of motorcycles with the standards set forth in subpart E of this part.