

with good laboratory practice, and that the results are consistent with the results of calibration testing conducted by the Administrator.

[54 FR 14546, Apr. 11, 1989, as amended at 60 FR 34355, June 30, 1995]

**§ 86.521-90 Hydrocarbon analyzer calibration.**

(a) The FID hydrocarbon analyzer shall receive the following initial and periodic calibration. The HFID used with methanol-fueled vehicles shall be operated at 235 °F±15 °F (113 °C±8 °C).

(b) *Initial and periodic optimization of detector response.* Prior to its introduction into service and at least annually thereafter, the FID hydrocarbon analyzer shall be adjusted for optimum hydrocarbon response. Analyzers used with petroleum fuels and liquefied petroleum gas-fuel shall be optimized using propane. Analyzers used with natural gas-fuel for measurement of hydrocarbons shall be optimized using methane. If a single analyzer is used for all measurements, it shall be optimized using propane and its response factor for methane shall be determined and accounted for in measurements of total hydrocarbons from natural gas-fuel. Alternate methods yielding equivalent results may be used, if approved in advance by the Administrator.

(1) Follow the manufacturer's instructions or good engineering practice for instrument startup and basic operating adjustment using the appropriate FID fuel and zero-grade air.

(2) Optimize on the most common operating range. Introduce into the analyzer a propane (methane as appropriate) in air mixture (methanol in air mixture for methanol-fueled vehicles when optional methanol calibrated FID procedure is used during the 1990 through 1994 model year) with a propane (or methane or methanol as appropriate) concentration equal to approximately 90 percent of the most common operating range.

(3) Select an operating FID fuel flow rate that will give near maximum response and least variation in response with minor fuel flow variations.

(4) To determine the optimum air flow, use the FID fuel flow setting determined above and vary air flow.

(5) After the optimum flow rates have been determined, record them for future reference.

(c) *Initial and periodic calibration.* Prior to its introduction into service and monthly thereafter the FID hydrocarbon analyzer shall be calibrated on all normally used instrument ranges, and, if applicable, the methanol response factor shall be determined (paragraph (d) of this section). Use the same flow rate as when analyzing sample.

(1) Adjust analyzer to optimize performance.

(2) Zero the hydrocarbon analyzer with zero grade air.

(3) Calibrate on each normally used operating range with propane in air (or methanol or methane in air as appropriate) calibration gases having nominal concentrations of 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 two 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 two percent at any point, the best-fit non-linear equation which represents the data to within two percent of each test point shall be used to determine concentration.

(d) *FID response factor to methanol.* When the FID analyzer is to be used for the analysis of hydrocarbon samples containing methanol, the methanol response factor of the analyzer shall be established. The methanol response factor shall be determined at several concentrations in the range of concentrations in the exhaust sample, using either bag samples or gas bottles meeting the requirements of § 86.514.

(1) The bag sample, if used, of methanol for analysis in the FID shall be prepared using the apparatus shown in Figure F90-4. A known volume of methanol is injected, using a microliter syringe, into the heated mixing zone (250 °F (121 °C)) of the apparatus. The methanol is vaporized and swept into the sample bag with a known volume of zero grade air measured by a gas flow meter meeting the performance requirements of § 86.120.

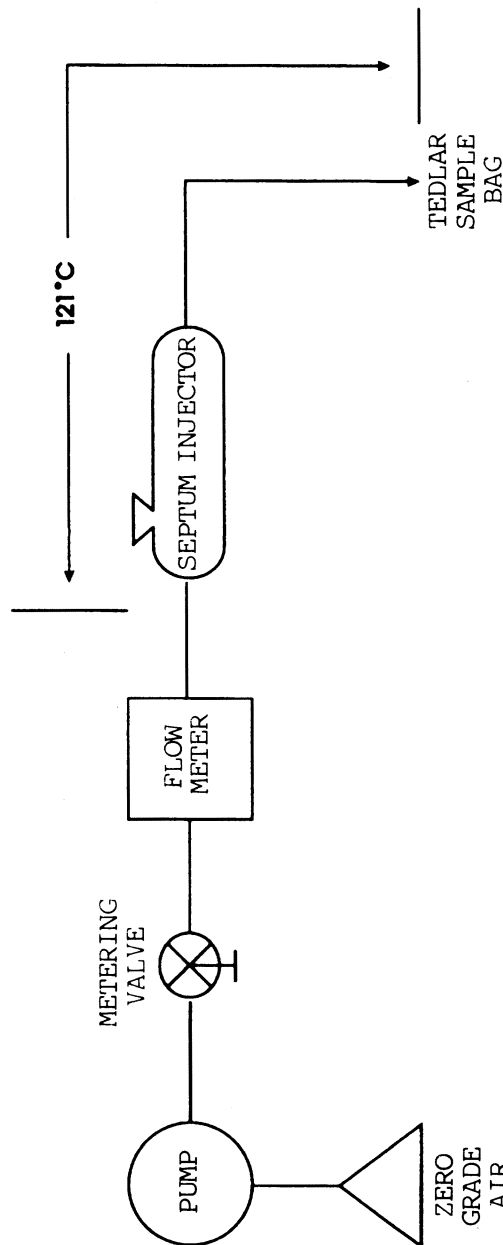


FIGURE F90-4 APPARATUS FOR PREPARATION OF FID METHANOL RESPONSE CALIBRATION MIX

- (2) The bag sample is analyzed using the FID.
- (3) The FID response factor,  $r$ , is calculated as follows:

$$r = \text{FID}_{\text{ppm}} / \text{SAM}_{\text{ppm}}$$

Where:

- (i)  $r$  = FID response factor.

- (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<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

(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<sub>2</sub>≡

(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<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 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<sub>2</sub> 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<sub>2</sub> to NO converter efficiency. Figure F78-8 is a reference for paragraphs (a) (1) through (11) of this section.