§ 86.121–90 Hydrocarbon analyzer calibration.

The hydrocarbon analyzers shall receive the following initial and periodic calibration. The HFID used with petroleum-fueled diesel vehicles shall be operated at a temperature of 375 °F ±10 °F (191 ±6 °C). The HFID used with methanol-fueled vehicles shall be operated at 235 ±15 °F (113±8 °C).

(a) Initial and periodic optimization of detector response. Prior to its introduction into service and at least annually thereafter, the FID and HFID hydrocarbon analyzers shall be adjusted for optimum hydrocarbon response. 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 HFID procedure is used during the 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) One of the following is required for FID or HFID optimization:

(i) For all FIDs and HFIDs, the procedures specified by the applicable FID or HFID manufacturer.

(ii) For Beckman 400 FIDs only, implementation of the recommendations outlined in Society of Automotive Engineers (SAE) paper No. 770141, “Optimization of Flame Ionization Detector for Determination of Hydrocarbons in Diluted Automobile Exhaust”; author, Glenn D. Reschke.

(iii) For HFIDs only, the following peaking procedure. (A) With the fuel...
and air flow rates set in the manufacturer’s recommendations, determine
the analyzer response from the difference between the span-gas response
and the zero gas response. Incrementally adjust the fuel flow above and
below the manufacturer’s specification. Record the span and zero response at
these fuel flows. A plot of the difference between the span and zero re-
sponse versus the fuel flow will be similar to the one shown in Fig. B87–11. Ad-
just the fuel-flow rate to the highest setting that produces the maximum
analyzer response.

(B) To determine the optimum air
flow, use the fuel flow setting deter-
mined in paragraph (a)(3)(iii)(A) of this
section and vary air flow.

(iv) Alternative procedures may be
used if approved in advance by the Ad-
ministrator.

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

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

(b) Initial and periodic calibration.
Prior to its introduction into service
and monthly thereafter the FID or
HPID hydrocarbon analyzers shall be
calibrated on all normally used instru-
ment ranges, and, if testing methanol
vehicles under the procedure described
in §86.107–90(a)(2)(ii) or §86.110–90(a)(4),
the methanol response factor shall be
determined (paragraph (c) of this sec-
tion). Use the same flow rate as when
analyzing sample.

(1) Adjust analyzer to optimize per-
formance.

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

(3) Calibrate on each normally used
operating range with propane in air
calibration gases (either methanol or
methane in air as appropriate) 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 val-
ues may be calculated by use of a sin-
gle calibration factor for that range. If
the deviation exceeds two percent at
any point, the best-fit non-linear equa-
tion which represents the data to with-
in two percent of each test point shall
be used to determine concentration.

(c) FID response factor to methanol.
When the FID analyzer is to be used for
the analysis of hydrocarbon samples
containing methanol, the methanol re-
sponse factor of the analyzer shall be
established. The methanol response
factor shall be determined at several
concentrations in the range of con-
centrations in the exhaust sample,
using either bag samples or gas bottles
meeting the requirements of §86.114.

(1) The bag sample of methanol for
analysis in the FID, if used, shall be
prepared using the apparatus shown in
Figure B90–11. A known volume of
methanol is injected, using a
microliter syringe, into the heated
mixing zone (250 °F (121 °C)) of the ap-
paratus. The methanol is vaporized and
swep into the sample bag with a
known volume of zero grade air meas-
ured by a gas flow meter meeting the
performance requirements of §86.120.
(2) The bag sample is analyzed using the FID.

(3) The FID response factor, r, is calculated as follows:

\[ r = \frac{\text{FIDppm}}{\text{SAMppm}} \]

Where:

(i) \( r \) = FID response factor.

376
(ii) FIDppm = FID reading in ppmC.
(iii) $\text{SAMppm}=\text{methanol concentration in the sample bag, or gas bottle, in ppmC.}$ SAMppm for sample bags

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

Where:

(iv) 0.02406 = Volume of one mole at 29.92 in. Hg and 68 °F, m³.
(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, m³.
(viii) Mol. Wt. CH$_3$OH = 32.04.

(d) **FID response factor to methane.** When the FID analyzer is to be used for the analysis of gasoline, diesel, methanol, ethanol, liquefied petroleum gas, and natural gas-fueled vehicle hydrocarbon samples, the methane response factor of the analyzer must be established. To determine the total hydrocarbon FID response to methane, known methane in air concentrations traceable to the National Institute of Standards and Technology (NIST) must be analyzed by the FID. Several methane concentrations must 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:

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

Where:

(1) $r_{\text{CH}_4}$ = FID response factor to methane.
(2) FIDppm = FID reading in ppmC.
(3) SAMppm = the known methane concentration in ppmC.

[54 FR 14525, Apr. 11, 1989, as amended at 59 FR 48508, Sept. 21, 1994; 60 FR 34345, June 30, 1995; 70 FR 40433, July 13, 2005]

§ 86.123–78 **Oxides of nitrogen analyzer calibration.**

The chemiluminescent oxides of nitrogen analyzer shall receive the following initial and periodic calibrations:

(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$_2$.

(1) Follow the manufacturer’s instructions for instrument startup 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$_2$ 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.

§ 86.123–78 **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$_2$ to NO converter efficiency. Figure B78–9