

(2) *Capillary flow analyzers.* This procedure is applicable only to analyzers that have sample capillaries such as the HFID and CL analyzers. It is also assumed that the system has sample/span valves that perform the function of valves V9 and V13 in Figure D79-1.

(i) Operate the analyzer(s) at the in-use capillary pressure.

(ii) Adjust the bypass flow rate to the flow rate recorded in paragraph (b)(1)(ii) of this section.

(iii) Measure and record the response time from the sample/span valve(s) per paragraph (a) of this section.

(iv) The response time (step (iii)) can be determined by switching from the "sample" position to the "span" position of the sample/span valve and observing the analyzer response on a chart recorder. Normally, the "sample" position would select a "room air" sample and the "span" position would select a span gas.

(v) Adjust the bypass flow rate to the normal in-use value.

(vi) Measure and record the response time from the sample/span valve(s) per paragraph (a) of this section.

(vii) Determine the slowest response time (step (iii) or step (iv)) and add 2 seconds to it.

§ 86.330-79 NDIR analyzer calibration.

(a) *Detector optimization.* If necessary, follow the manufacturer's instructions for initial start-up and basic operating adjustments.

(b) *Calibration curve.* Develop a calibration curve for each range used as follows:

(1) Zero the analyzer.

(2) Span the analyzer to give a response of approximately 90 percent of full-scale chart deflection.

(3) *Recheck the zero response.* If it has changed more than 0.5 percent of full scale, repeat steps (1) and (2).

(4) Record the response of calibration gases having nominal concentrations of

15, 30, 45, 60, 75, and 90 percent of full-scale concentration.

(5) *Generate a calibration curve.* The calibration curve shall be of fourth order or less, have five or fewer coefficients, and be of the form of equation (1) or (2). Include zero as a data point. Compensation for known impurities in the zero gas can be made to the zero-data point. The calibration curve must fit the data points within 2 percent of point or 1 percent of full scale, whichever is less.

$$y = Ax^4 + Bx^3 + Cx^2 + Dx + E \quad (1)$$

$$y = \frac{x}{Ax^4 + Bx^3 + Cx^2 + Dx + E} \quad (2)$$

where:

y = concentration

x = chart deflection

(6) *Option.* A new calibration curve need not be generated if: (i) A calibration curve conforming to step (5) exists; (ii) The responses generated in step (4) are within 1 percent of full scale or 2 percent of point, whichever is less, of the responses predicted by the calibration curve for the gases used in step (4).

(7) If multiple range analyzers are used, only the lowest range must meet the curve fit requirements below 15 percent of full scale.

(c) If any range is within 2 percent of being linear a linear calibration may be used. To determine if this criterion is met:

(1) Perform a linear least-square regression on the data generated. Use an equation of the form $y = mx$, where x is the actual chart deflection and y is the concentration.

(2) Use the equation $z = y/m$ to find the linear chart deflection (z) for each calibration gas concentration (y).

(3) Determine the linearity (%L) for each calibration gas by:

$$\text{Percent } L = \frac{(z - x)}{\text{Full-scale linear chart deflection}} (100)$$

(4) The linearity criterion is met if the %L is less than ± 2 percent for each data point generated. For each emission test, a calibration curve of the form $Y = mx$ is to be used. The slope (m) is defined for each range by the spanning process.

[42 FR 45154, Sept. 8, 1977, as amended at 46 FR 50495, Oct. 13, 1981; 47 FR 49807, Nov. 2, 1982]

§ 86.331-79 Hydrocarbon analyzer calibration.

The following steps are followed in sequence to calibrate the hydrocarbon analyzer. It is suggested, but not required, that efforts be made to minimize relative response variations.

(a) If necessary, follow manufacturer's instructions for instrument start-up and basic operating adjustments.

(b) Set the oven temperature 5 °C hotter than the required sample-line temperature. Allow at least one-half hour after the oven has reached temperature for the system to equilibrate.

(c) *Initial fuel flow adjustment.* With the fuel and air-flow rates set at the manufacturer's recommendations, introduce a 350 ppmC \pm 75 ppmC span gas to the detector. Determine the response at a given fuel flow 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 response versus fuel flow will be similar to the one shown in Fig. D79-3.

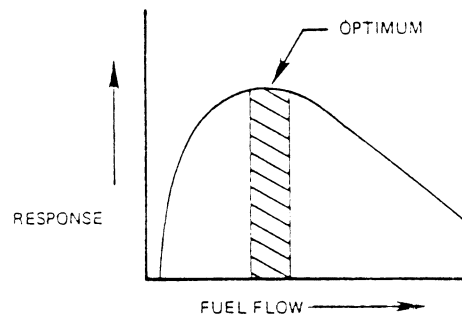


Figure D79-3 RESPONSE VS. FUEL FLOW

Adjust the fuel-flow rate to the rich side of the curve, as shown. This is initial flow-rate setting and may not be the final optimized flow rate.

(d) *Oxygen interference optimization.* Choose a range where the oxygen interference check gases (see § 86.308) will fall in the upper 50 percent. Conduct this test with the oven temperature set as required. Oxygen interference check gas specifications are found in § 86.308.

(1) Zero the analyzer.

(2) Span the analyzer with the zero-percent oxygen blend for gasoline-fueled engines. Diesel engine instru-

ments shall be spanned with the 21-percent oxygen blend.

(3) *Recheck zero response.* If it has changed more than 0.5 percent of full scale repeat paragraphs (d) (1) and (2) of this section.

(4) Introduce the 5 percent and 10 percent oxygen interference check gases.

(5) *Recheck the zero response.* If it has changed more ± 1 percent of full scale, repeat the test.

(6) Calculate the percent of oxygen interference (%O₂I) for each mixture in step (4).