

(4) The linearity criterion is met if the %L is less than  $\pm 2$  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.

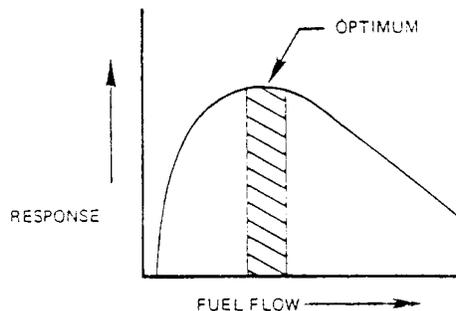


Figure D79-3 RESPONSE VS. FUEL FLOW

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  $\pm 1$  percent of full scale, repeat the test.

(6) Calculate the percent of oxygen interference (%O<sub>2</sub>I) for each mixture in step (4).

$$\text{Percent O}_2I = \frac{B - \text{Analyzer response (ppmC)}}{B} (100)$$

$$\text{Analyzer response} = \frac{A}{\text{Percent of full-scale analyzer response due to A}} \times (\text{Percent of full-scale analyzer response due to B})$$

A = hydrocarbon concentration (ppmC) of the span gas used in step (2).

B = hydrocarbon concentration (ppmC) of the oxygen interference check gases used in step (4).

(7) The percent of oxygen interference (%O<sub>2</sub>I) must be less than ±3.0 percent for all required oxygen interference check gases prior to testing.

(8) If the oxygen interference is greater than the specifications, incrementally adjust the air flow above and below the manufacturer's specifications, repeating paragraphs (d) (1) through (7) of this section for each flow.

(9) If the oxygen interference is greater than the specification after adjusting the air flow, vary the fuel flow and thereafter the sample flow, repeating paragraphs (d) (1) through (7) of this section for each new setting.

(10) If the oxygen interference is still greater than the specifications, repair or replace the analyzer, FID fuel, or burner air prior to testing. Repeat this section with the repaired or replaced equipment or gases.

(e) *Linearity check.* For each range used, check linearity as follows:

(1) With the fuel flow, air flow and sample flow adjust to meet the oxygen interference specification, zero the analyzer.

(2) Span the analyzer using a calibration gas that will provide a response of approximately 90 percent of full-scale concentration.

(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 30, 60, and 90 percent of full-scale concentration. It is permitted to use additional concentrations.

(5) 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.

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

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

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

(8) The linearity criterion is met if the %L is less than ±2 percent for each data point generated. Below 40 ppmC the linearity criterion may be expanded to ±4 percent. 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.

(9) If the %L for any point exceeds the specifications in step (8), the air, fuel, and sample-flow rates may be var-

ied within the boundaries of the oxygen interference specifications.

(10) If the %L for any data point still exceeds the specifications, repair or replace the analyzer, FID fuel, burner air, or calibration bottles prior to testing. Repeat the procedures of this section with the repaired or replaced equipment or gases.

(f) *Optimized flow rates.* The fuel-flow rate, air-flow rate and sample-flow rate

are defined as "optimized" at this point.

**§ 86.332-79 Oxides of nitrogen analyzer calibration.**

(a) At least monthly during testing, perform a converter efficiency check as described in paragraph (b) of this section. Perform a monthly linearity check as described in paragraph (c) of this section.

(b) *Converter-efficiency check.* The apparatus described and illustrated in Figure D79-4 is to be used to determine the conversion efficiency of devices that convert NO<sub>2</sub> to NO. The following procedure is to be used in determining

the values to be used in the equation below:

(1) Follow the manufacturer's instructions for instrument startup and operation.

(2) Zero the oxides of nitrogen analyzer.

(3) Connect the outlet of the NO<sub>x</sub> generator (see Figure D79-4) 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 span gas with a NO concentration equal to approximately 80 percent of the most common operating range.

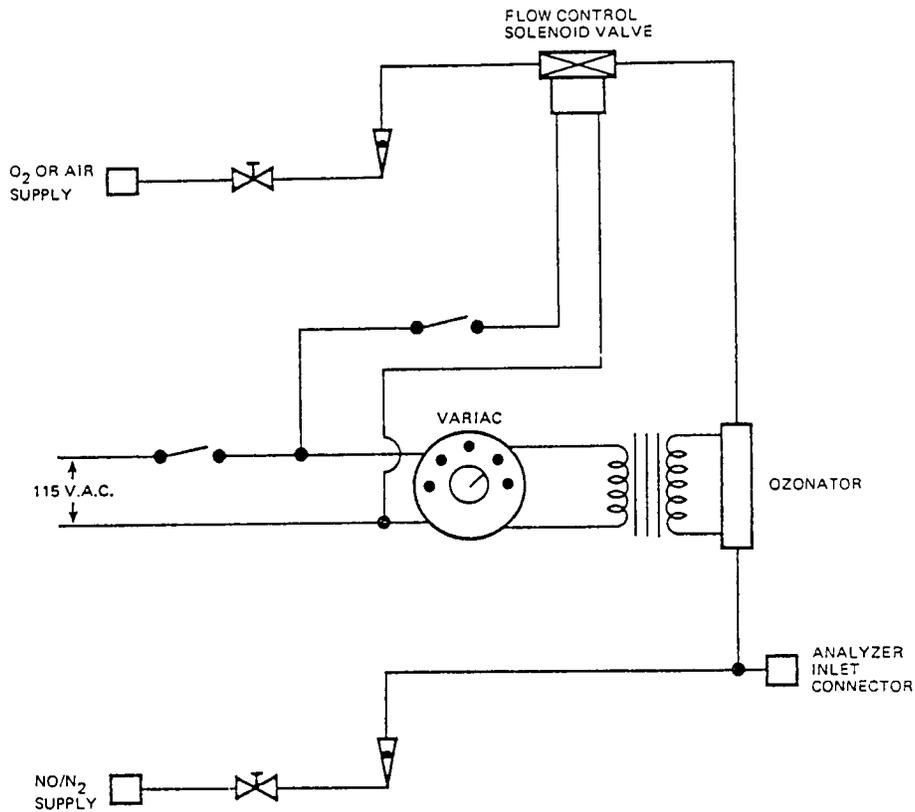


FIGURE D79-4 NO<sub>x</sub> CONVERTER EFFICIENCY DETECTOR