

**§ 92.120 NDIR analyzer calibration and checks.**

(a) *NDIR water rejection ratio check.*

(1) Zero and span the analyzer on the lowest range that will be used.

(2) Introduce a saturated mixture of water and zero gas at room temperature directly to the analyzer.

(3) Determine and record the analyzer operating pressure (GP) in absolute units in Pascal. Gauges G3 and G4 may be used if the values are converted to the correct units.

(4) Determine and record the temperature of the zero-gas mixture.

(5) Record the analyzers' response (AR) in ppm to the saturated zero-gas mixture.

(6) For the temperature recorded in paragraph (a)(4) of this section, determine the saturation vapor pressure.

(7) Calculate the water concentration (Z) in the mixture from:

$$Z=(PWB/GP)(10^6)$$

(8) Calculate the water rejection ratio (WRR) from:

$$WRR=(Z/AR)$$

(b) *NDIR CO<sub>2</sub> rejection ratio check.* (1) Zero and span the analyzer on the lowest range that will be used.

(2) Introduce a CO<sub>2</sub> calibration gas of at least 10 percent CO<sub>2</sub> or greater to the analyzer.

(3) Record the CO<sub>2</sub> calibration gas concentration in ppm.

(4) Record the analyzers' response (AR) in ppm to the CO<sub>2</sub> calibration gas.

(5) Calculate the CO<sub>2</sub> rejection ratio (CO<sub>2</sub>RR) from:

$$CO_2RR=(ppm\ CO_2)/AR$$

(c) *NDIR analyzer calibration.* (1) Detector optimization. If necessary, follow the manufacturer's instructions for initial start-up and basic operating adjustments.

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

(i) Zero the analyzer.

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

(iii) Recheck the zero response. If it has changed more than 0.5 percent of full scale, repeat steps in paragraphs (c)(2)(i) and (c)(2)(ii) of this section.

(iv) Record the response of calibration gases having nominal concentrations of 15, 30, 45, 60, 75, and 90 percent of full-scale concentration.

(v) 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. Equations (1) and (2) follow:

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

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

where:

y = concentration.

x = chart deflection.

(vi) Option. A new calibration curve need not be generated if:

(A) A calibration curve conforming to paragraph (c)(2)(v) of this section exists;

(B) The responses generated in paragraph (c)(2)(iv) of this section 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 paragraph (c)(2)(iv) of this section.

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

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

(i) 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.

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

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

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

(iv) 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

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form  $y=mx$  is to be used. The slope ( $m$ ) is defined for each range by the spanning process.

### § 92.121 Oxides of nitrogen analyzer calibration and check.

(a) *Quench checks; NO<sub>x</sub> analyzer.* (1) Perform the reaction chamber quench check for each model of high vacuum reaction chamber analyzer prior to initial use.

(2) Perform the reaction chamber quench check for each new analyzer that has an ambient pressure or "soft vacuum" reaction chamber prior to initial use. Additionally, perform this check prior to reusing an analyzer of this type any time any repairs could potentially alter any flow rate into the reaction chamber. This includes, but is not limited to, sample capillary, ozone capillary, and if used, dilution capillary.

(3) Quench check as follows:

(i) Calibrate the NO<sub>x</sub> analyzer on the lowest range that will be used for testing.

(ii) Introduce a mixture of CO<sub>2</sub> calibration gas and NO<sub>x</sub> calibration gas to the CL analyzer. Dynamic blending may be used to provide this mixture. Dynamic blending may be accomplished by analyzing the CO<sub>2</sub> in the mixture. The change in the CO<sub>2</sub> value due to blending may then be used to determine the true concentration of the NO<sub>x</sub> in the mixture. The CO<sub>2</sub> concentration of the mixture shall be approximately equal to the highest concentration experienced during testing. Record the response.

(iii) Recheck the calibration. If it has changed more than  $\pm 1$  percent of full scale, recalibrate and repeat the quench check.

(iv) Prior to testing, the difference between the calculated NO<sub>x</sub> response and the response of NO<sub>x</sub> in the presence of CO<sub>2</sub> (step in paragraph (a)(3)(ii) of this section must not be greater than 3.0 percent of full-scale. The calculated NO<sub>x</sub> response is based on the calibration performed in step in paragraph (a)(3)(i) this section.

(b) *Oxides of nitrogen analyzer calibration.* (1) Every 30 days, perform a converter-efficiency check (see paragraph (b)(2) of this section) and a linearity

check (see paragraph (b)(3) of this section).

(2) Converter-efficiency check. The apparatus described and illustrated in Figure B121-1 of this section 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:

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

(ii) Zero the oxides of nitrogen analyzer.

(iii) 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.

(iv) 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. The NO<sub>2</sub> content of the gas mixture shall be less than 5 percent of the NO<sub>x</sub> concentration.

(v) With the oxides of nitrogen analyzer in the NO Mode, record the concentration of NO indicated by the analyzer.

(vi) 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 in paragraph (b)(2)(v) of this section. Record the concentration of NO in this NO+O<sub>2</sub> mixture.

(vii) Switch the NO<sub>x</sub> generator to the generation mode and adjust the generation rate so that the NO measured on the analyzer is 20 percent of that measured in step in paragraph (b)(2)(v) of this section. There must be at least 10 percent unreacted NO at this point. Record the concentration of residual NO.

(viii) Switch the oxides of nitrogen analyzer to the NO<sub>x</sub> mode and measure total NO<sub>x</sub>. Record this value.

(ix) Switch off the NO<sub>x</sub> generation, but maintain gas flow through the system. The oxides of nitrogen analyzer will indicate the total NO<sub>x</sub> in the NO+O<sub>2</sub> mixture. Record this value.

(x) Turn off the NO<sub>x</sub> generator O<sub>2</sub> (or air) supply. The analyzer will now indicate the total NO<sub>x</sub> in the original NO