

§91.314

the temperature of the valves, pipe work, and so forth, must be controlled so as to maintain a wall temperature greater than 180 °C.

(iii) For the HFID analyzer, the detector, oven, and sample-handling components within the oven must be suitable for continuous operation at temperatures to 200 °C. It must be capable of maintaining temperature within ± 5.5 °C of the set point.

(iv) Fuel and burner air must conform to the specifications in §91.312.

(v) The percent of oxygen interference must be less than three percent, as specified in §91.316(d).

(5) *Oxides of nitrogen (NO_x) analysis.*

(i) This analysis device consists of the following items:

(A) A NO₂ to NO converter. The NO₂ to NO converter efficiency must be at least 90 percent.

(B) An ice bath located after the NO_x converter (optional).

(C) A chemiluminescent detector (CLD) or heated chemiluminescent detector (HCLD).

(ii) The quench interference must be less than three percent as measured in §91.325.

(b) Other gas analyzers yielding equivalent results may be used with advance approval of the Administrator.

(c) The following requirements must be incorporated as indicated in systems used for testing under this subpart.

(1) Carbon monoxide and carbon dioxide measurements must be made on a dry basis (for raw exhaust measurement only). Specific requirements for the means of drying the sample can be found in §91.313(e).

(2) Calibration or span gases for the NO_x measurement system must pass through the NO₂ to NO converter.

(d) The electromagnetic compatibility (EMC) of the equipment must be on a level as to minimize additional errors.

(e) Gas drying. Chemical dryers are not an acceptable method of removing water from the sample. Water removal by condensation is acceptable. If water is removed by condensation, the sample gas temperature or sample dew point must be monitored either within the water trap or downstream and its temperature must not exceed 7 °C. A water trap performing this function is

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an acceptable method. Means other than condensation may be used only with prior approval from the Administrator.

§91.314 Analyzer accuracy and specifications.

(a) *Measurement accuracy—general.* The analyzers must have a measuring range which allows them to measure the concentrations of the exhaust gas sample pollutants with the accuracies shown in Table 2 in appendix A to this subpart.

(1) *Precision.* The precision of the analyzer must be, at worst, ± 1 percent of full-scale concentration for each range used. The precision is defined as 2.5 times the standard deviation(s) of 10 repetitive responses to a given calibration or span gas.

(2) *Noise.* The analyzer peak-to-peak response to zero and calibration or span gases over any 10-second period may not exceed two percent of full-scale chart deflection on all ranges used.

(3) *Zero drift.* The analyzer zero-response drift during a one-hour period must be less than two percent of full-scale chart deflection on the lowest range used. The zero-response is defined as the mean response including noise to a zero-gas during a 30-second time interval.

(4) *Span drift.* The analyzer span drift during a one-hour period must be less than two percent of full-scale chart deflection on the lowest range used. The analyzer span is defined as the difference between the span-response and the zero-response. The span-response is defined as the mean response including noise to a span gas during a 30-second time interval.

(b) *Operating procedure for analyzers and sampling system.* Follow the start-up and operating instructions of the instrument manufacturer. Adhere to the minimum requirements given in §91.316 to §91.325 and §91.409.

(c) *Emission measurement accuracy—bag sampling.* (1) Good engineering practice dictates that exhaust emission sample analyzer readings below 15 percent of full scale chart deflection should generally not be used.

(2) Some high resolution read-out systems, such as computers, data

loggers, and so forth, can provide sufficient accuracy and resolution below 15 percent of full scale. Such systems may be used provided that additional calibrations are made to ensure the accuracy of the calibration curves. The following procedure for calibration below 15 percent of full scale may be used:

NOTE: If a gas divider is used, the gas divider must conform to the accuracy requirements as follows: The use of precision blending devices (gas dividers) to obtain the required calibration gas concentrations is acceptable, provided that the blended gases are accurate to within ± 1.5 percent of NIST gas standards or other gas standards which have been approved by the Administrator. This accuracy implies that primary gases used for blending must be "named" to an accuracy of at least ± 1 percent, traceable to NIST or other approved gas standards.

(i) Span the full analyzer range using a top range calibration gas. The span gases must be accurate to within ± 2 percent of NIST gas standards or other gas standards which have been approved by the Administrator.

(ii) Generate a calibration curve according to, and meeting the requirements of the sections describing analyzer calibrations which are found in §§ 91.316, 91.317, 91.318, and 91.320 of this chapter.

(iii) Select a calibration gas (a span gas may be used for calibrating the CO₂ analyzer) with a concentration between the two lowest non-zero gas divider increments. This gas must be "named" to an accuracy of ± 2 percent of NIST gas standards, or other standards approved by the Administrator.

(iv) Using the calibration curve fitted to the points generated in paragraphs (c)(2) (i) and (ii) of this section, check the concentration of the gas selected in paragraph (c)(2)(iii) of this section. The concentration derived from the curve must be within ± 2.3 percent (± 2.8 percent for CO₂ span gas) of the gas' original named concentration.

(v) Provided the requirements of paragraph (c)(2)(iv) of this section are met, use the gas divider with the gas selected in paragraph (c)(2)(iii) of this section and determine the remainder of the calibration points. Fit a calibration curve per §§ 91.316, 91.317, 91.318, and 91.320 of this chapter for the entire analyzer range.

(d) *Emission measurement accuracy—continuous sampling.* Analyzers used for

continuous analysis must be operated such that the measured concentration falls between 15 and 100 percent of full scale chart deflection. Exceptions to these limits are:

(1) The analyzer's response may be less than 15 percent or more than 100 percent of full scale if automatic range change circuitry is used and the limits for range changes are between 15 and 100 percent of full scale chart deflection;

(2) The analyzer's response may be less than 15 percent of full scale if:

(i) Alternative in paragraph (c)(2) of this section is used to ensure that the accuracy of the calibration curve is maintained below 15 percent; or

(ii) The full scale value of the range is 155 ppmC or less; or

(iii) The emissions from the engine are erratic and the integrated chart deflection value for the cycle is greater than 15 percent of full scale; or

(iv) The contribution of all data read below the 15 percent level is less than 10 percent by mass of the final test results.

§ 91.315 Analyzer initial calibration.

(a) *Warming-up time.* Follow the warm-up time according to the recommendations of the manufacturer. If not specified, a minimum of two hours should be allowed for warming up the analyzers.

(b) *NDIR and HFID analyzer.* Tune and maintain the NDIR analyzer per the instrument manufacturer recommendations. The combustion flame of the HFID analyzer must be optimized in order to meet the specifications in § 91.316(b).

(c) *Zero setting and calibration.* Using purified synthetic air (or nitrogen), set the CO, CO₂, NO_x and HC analyzers at zero. Connect the appropriate calibrating gases to the analyzers and record the values. The same gas flow rates shall be used as when sampling exhaust.

(d) *Rechecking of zero setting.* Recheck the zero setting and, if necessary, repeat the procedure described in paragraph (c) of this section.