

Environmental Protection Agency

§ 86.1340-90

one-half of the average NO_x concentration determined in paragraph (a)(1) of this section shall be measured by the oxides of nitrogen analyzer following the analyzer's monthly periodic calibration. This measurement must be made to ensure the accuracy of the calibration curve to within ± 2 percent of point accuracy of the appropriate least-squares fit, at less than or equal to one half of the average expected diluted NO_x concentration determined in paragraph (a)(1) of this section.

(b) *Measurement accuracy—Bag sampling.* Analyzers used for bag analysis must be operated such that the measured concentration falls between 15 and 100 percent of full scale, with the following exception: concentrations below 15 percent of full scale may be used if the minimum limit of the analyzer within the range meets the requirement of paragraph (a) of this section.

(c) *Measurement accuracy—Continuous measurement.* (1) Analyzers used for continuous analysis must be operated such that the measured concentration falls between 15 and 100 percent of full scale, with the following exceptions:

(i) Concentrations below 15 percent of full scale may be used if the minimum limit of the analyzer within the range meets the requirement of paragraph (a) of this section.

(ii) Analyzer response over 100% of full scale may be used if it can be shown that readings in this range are accurate.

(2) If the analyzer response exceeds the level allowed by paragraph (c)(1)(ii) of this section, the test must be repeated using a higher range and both results must be reported. The Administrator may waive this requirement.

(d) If a gas divider is used, the gas divider shall conform to the accuracy requirements specified in § 86.1314-84(g), and shall be used according to the procedures contained in paragraphs (a) and (b) of this section.

[66 FR 5187, Jan. 18, 2001]

§ 86.1339-90 Particulate filter handling and weighing.

(a) At least 1 hour before the test, place a filter pair in a closed (to eliminate dust contamination) but unsealed (to permit humidity exchange) petri dish and place in a weighing chamber

meeting the specifications of § 86.1312 for stabilization.

(b) At the end of the stabilization period, weigh each filter pair on a balance having a precision of 20 micrograms and a readability of 10 micrograms. This reading is the tare weight of the filter pair and must be recorded (see § 86.1344(e)(18)).

(c) The filter pair shall then be stored in a covered petri dish or a sealed filter holder, either of which shall remain in the weighing chamber until needed for testing.

(d) If the filter pair is not used within 1 hour of its removal from the weighing chamber, it must be re-weighed before use. This limit of 1 hour may be replaced by an 8-hour limit if either of the following three conditions are met:

(1) A stabilized filter pair is placed and kept in a sealed filter holder assembly with the ends plugged; or

(2) A stabilized filter pair is placed in a sealed filter holder assembly, which is then immediately placed in a sample line through which there is no flow; or

(3) A combination of the conditions specified in paragraphs (d) (1) and (2) of this section.

(e) After the emissions test, remove the filters from the filter holder and place them face to face in a covered but unsealed petri dish. They must then be conditioned in the weighing chamber for at least one hour. The filters are then weighed as a pair. This reading is the gross weight of the filters (Pf) and must be recorded (see § 86.1344-90(e)(19)).

(f) The net particulate weight (Pf) on each filter pair is the gross weight minus the tare weight. Should the sample on the filters (exhaust or background) contact the petri dish or any other surface, the test is void and must be rerun.

(g) Static neutralizers shall be used on petri dishes in accordance with good engineering judgement.

(h) This section does not apply for tests conducted according to the provisions of § 86.1312-2007.

[62 FR 47134, Sept. 5, 1997, as amended at 66 FR 5187, Jan. 18, 2001]

§ 86.1340-90 Exhaust sample analysis.

(a) The analyzer response may be read by automatic data collection

(ADC) equipment such as computers, data loggers, etc. If ADC equipment is used the following is required:

(1) For bag analysis, the analyzer response must be stable at greater than 99 percent of the final reading for the dilute exhaust sample bag. A single value representing the average chart deflection over a 10-second stabilized period shall be stored. For the background bag, all readings taken during the 10-second interval must be stable at the final value to within ± 1 percent of full scale.

(2) For continuous analysis systems, the ADC system must read at least two analyzer readings per second. A single value representing the average integrated concentration over a cycle shall be stored.

(3) The chart deflections or average integrated concentrations required in paragraphs (a) (1) and (2) of this section may be stored on long-term computer storage devices such as computer tapes, storage discs, punch cards, or they may be printed in a listing for storage. In either case a chart recorder is not required and records from a chart recorder, if they exist, need not be stored.

(4) If the data from ADC equipment is used as permanent records, the ADC equipment and the analyzer values as interpreted by the ADC equipment are subject to the calibration specifications in §§ 86.1316 through 86.1326, as if the ADC equipment were part of the analyzer.

(b) Data records from any one or a combination of analyzers may be stored as chart recorder records.

(c) *Software zero and span.* (1) The use of "software" zero and span is permitted. The process of software zero and span refers to the technique of initially adjusting the analyzer zero and span responses to the calibration curve values, but for subsequent zero and span checks the analyzer response is simply recorded without adjusting the analyzer gain. The observed analyzer response recorded from the subsequent check is mathematically corrected back to the calibration curve values for zero and span. The same mathematical correction is then applied to the analyzer's response to a sample of exhaust

gas in order to compute the true sample concentration.

(2) The maximum amount of software zero and span mathematical correction is ± 10 percent of full scale chart deflection.

(3) Software zero and span may be used to switch between ranges without adjusting the gain of the analyzer.

(4) The software zero and span technique may not be used to mask analyzer drift. The observed chart deflection before and after a given time period or event shall be used for computing the drift. Software zero and span may be used after the drift has been computed to mathematically adjust any span drift so that the "after" span check may be transformed into the "before" span check for the next segment.

(d) For bag sample analysis perform the following sequence:

(1) Warm-up and stabilize the analyzers; clean and/or replace filter elements, conditioning columns (if used), etc., as necessary.

(2) Obtain a stable zero reading.

(3) Zero and span the analyzers with zero and span gases. The span gases shall have concentrations between 75 and 100 percent of full-scale chart deflection. The flow rates and system pressures during spanning shall be approximately the same as those encountered during sampling. A sample bag may be used to identify the required analyzer range.

(4) Re-check zero response. If this zero response differs from the zero response recorded in paragraph (d)(3) of this section by more than 1 percent of full scale, then paragraphs (d) (2), (3), and (4) of this section should be repeated.

(5) If a chart recorder is used, identify and record the most recent zero and span response as the pre-analysis values.

(6) If ADC equipment is used, electronically record the most recent zero and span response as the pre-analysis values.

(7) Measure HC (except diesels), CO, CO₂, and NO_x sample and background concentrations in the sample bag(s) with approximately the same flow rates and pressures used in paragraph (d)(3) of this section. (Constituents

measured continuously do not require bag analysis.)

(8) A post-analysis zero and span check of each range must be performed and the values recorded. The number of events that may occur between the pre and post checks is not specified. However, the difference between pre-analysis zero and span values (recorded in paragraph (d) (5) or (6) of this section) versus those recorded for the post-analysis check may not exceed the zero drift limit or the span drift limit of 2 percent of full scale chart deflection for any range used. Otherwise the test is void.

(e) For continuous sample analysis perform the following sequence:

(1) Warm-up and stabilize the analyzers; clean and/or replace filter elements, conditioning columns (if used), etc., as necessary.

(2) Leak check portions of the sampling system that operate at negative gauge pressures when sampling, and allow heated sample lines, filters, pumps, etc., to stabilize at operating temperature.

(3) *Optional*: Perform a hang-up check for the HFID sampling system:

(i) Zero the analyzer using zero air introduced at the analyzer port.

(ii) Flow zero air through the overflow sampling system. Check the analyzer response.

(iii) If the overflow zero response exceeds the analyzer zero response by 2 percent or more of the HFID full-scale deflection, hang-up is indicated and corrective action must be taken.

(iv) The complete system hang-up check specified in paragraph (f) of this section is recommended as a periodic check.

(4) Obtain a stable zero reading.

(5) Zero and span each range to be used on each analyzer used prior to the beginning of the cold cycle. The span gases shall have a concentration between 75 and 100 percent of full scale chart deflection. The flow rates and system pressures shall be approximately the same as those encountered during sampling. The HFID analyzer shall be zeroed and spanned through the overflow sampling system.

(6) Re-check zero response. If this zero response differs from the zero response recorded in paragraph (e)(5) of

this section by more than 1 percent of full scale, then paragraphs (e) (4), (5), and (6) of this section should be repeated.

(7) If a chart recorder is used, identify and record the most recent zero and span response as the pre-analysis values.

(8) If ADC equipment is used, electronically record the most recent zero and span response as the pre-analysis values.

(9) Measure the emissions (HC required for diesels; NO_x, CO, CO₂ optional) continuously during the cold start cycle. Indicate the start of the test, the range(s) used, and the end of the test on the recording medium (chart paper or ADC equipment). Maintain approximately the same flow rates and system pressures used in paragraph (e)(5) of this section.

(10) Collect background HC, CO, CO₂, and NO_x in a sample bag.

(11) Perform a post-analysis zero and span check for each range used at the conditions specified in paragraph (e)(5) of this section. Record these responses as the post-analysis values.

(12) Neither the zero drift nor the span drift between the pre-analysis and post-analysis checks on any range used may exceed 3 percent for HC, or 2 percent for NO_x, CO, and CO₂, of full scale chart deflection, or the test is void. (If the HC drift is greater than 3 percent of full-scale chart deflection, hydrocarbon hang-up is likely.)

(13) Determine HC background levels for the cold start cycle by introducing the background sample into the overflow sample system.

(14) Determine background levels of NO_x, CO, or CO₂ (if necessary) by the bag technique outlined in paragraph (d) of this section.

(15) Repeat paragraphs (e) (4) through (14) of this section for the hot cycle. The post-analysis zero and span check for the cold start (or previous hot start) cycle may be used for the pre-analysis zero and span for the following hot start cycle.

(f) *HC hang-up*. If HC hang-up is indicated, the following sequence may be performed:

(1) Fill a clean sample bag with background air.

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(2) Zero and span the HFID at the analyzer ports.

(3) Analyze the background air sample bag through the analyzer ports.

(4) Analyze the background air through the entire sample probe system.

(5) If the difference between the readings obtained is 2 percent or more of the HFID full scale deflection, clean the sample probe and the sample line.

(6) Reassemble the sample system, heat to specified temperature, and repeat the procedure in paragraphs (f) (1) through (6) of this section.

(g) For CH₃OH (where applicable), introduce test samples into the gas chromatograph and measure the concentration. This concentration is C_{MS} in the calculations.

(h) For HCHO (where applicable), introduce test samples into the high pressure liquid chromatograph and measure the concentration of formaldehyde as a dinitrophenylhydrazine derivative in acetonitrile. This concentration is C_{FS} in the calculations.

[54 FR 14602, Apr. 11, 1989, as amended at 60 FR 34375, June 30, 1995]

§ 86.1340-94 Exhaust sample analysis.

Section 86.1340-94 includes text that specifies requirements that differ from § 86.1340-90. Where a paragraph in § 86.1340-90 is identical and applicable to § 86.1340-94, this may be indicated by specifying the corresponding paragraph and the statement “[Reserved]. For guidance see § 86.1340-90.”

(a) through (d)(6) [Reserved]. For guidance see § 86.1340-90.

(d)(7) Measure HC (except diesels), CH₄ (natural gas-fueled engines only), CO, CO₂, and NO_x sample bag(s) with approximately the same flow rates and pressures used in § 86.1340-90(d)(3). (Constituents measured continuously do not require bag analysis.)

(d)(8) through (h) [Reserved]. For guidance see § 86.1340-90.

[59 FR 48534, Sept. 21, 1994, as amended at 60 FR 34375, June 30, 1995]

§ 86.1341-90 Test cycle validation criteria.

(a) To minimize the biasing effect of the time lag between the feedback and reference cycle values, the entire engine speed and torque feedback signal

sequence may be advanced or delayed in time with respect to the reference speed and torque sequence. If the feedback signals are shifted, both speed and torque must be shifted the same amount in the same direction.

(b) Brake horsepower-hour calculation.

(1) Calculate the brake horsepower-hour for each pair of engine feedback speed and torque values recorded. Also calculate the reference brake horsepower-hour for each pair of engine speed and torque reference values. Calculations shall be to five significant digits.

(2) In integrating the reference and the feedback horsepower-hour, all negative torque values shall be set equal to zero and included. If integration is performed at a frequency of less than 5 Hz, and if during a given time segment, the torque value changes from positive to negative or negative to positive, then the negative portion must be computed by linear interpolation and set equal to zero and the positive portion included. The same methodology shall be used for integrating both reference and actual brake horsepower-hour.

(c) Regression line analysis to calculate validation statistics. (1) Linear regressions of feedback value on reference value shall be performed for speed, torque and brake horsepower on 1 Hz data after the feedback shift has occurred (see paragraph (a) of this section). The method of least squares shall be used, with the best fit equation having the form:

y=mx+b

Where:

y = The feedback (actual) value of speed (rpm), torque (ft-lbs), or brake horsepower.

m = Slope of the regression line.

x = The reference value (speed, torque, or brake horsepower).

b = The y-intercept of the regression line.

(2) The standard error of estimate (SE) of y on x and the coefficient of determination (r²) shall be calculated for each regression line.

(3) For a test to be considered valid, the criteria in Figure N90-11 must be met for both cold and hot cycles individually. Point deletions from the regression analyses are permitted where noted in Figure N90-11.