

Environmental Protection Agency

§ 89.411

section, the 4-mode test cycle described in Table 4 of Appendix B of this subpart shall be used for propulsion marine diesel engines.

(5) Notwithstanding the provisions of paragraphs (a)(1) through (a)(4) of this section:

(i) Manufacturers may use the 8-mode test cycle described in Table 1 of Appendix B of this subpart for:

(A) Constant speed engines, or variable speed engines rated under 19 kW; or

(B) Propulsion marine diesel engines, provided the propulsion marine diesel engines are certified in an engine family that includes primarily non-marine diesel engines, and the manufacturer obtains advance approval from the Administrator.

(ii) The Administrator may use the 8-mode test cycle specified in Table 1 of Appendix B of this subpart during testing of any engine which was certified based on emission data collected from that test cycle.

(b) During each non-idle mode, hold the specified load to within 2 percent of the engine maximum value and speed to within ± 2 percent of point. During each idle mode, speed must be held within the manufacturer's specifications for the engine, and the throttle must be in the fully closed position and torque must not exceed 5 percent of the peak torque value of mode 5.

(c) For any mode except those involving either idle or full-load operation, if the operating conditions specified in paragraph (b) of this section cannot be maintained, the Administrator may authorize deviations from the specified load conditions. Such deviations shall not exceed 10 percent of the maximum torque at the test speed. The minimum deviations above and below the specified load necessary for stable operation shall be determined by the manufacturer and approved by the Administrator prior to the test run.

(d) Power generated during the idle mode may not be included in the calculation of emission results.

(e) Manufacturers may optionally use the ramped-modal duty cycles corresponding to the discrete-mode duty

cycles specified in this section, as described in 40 CFR 1039.505.

[59 FR 31335, June 17, 1994. Redesignated and amended at 63 FR 56996, 57016, Oct. 23, 1998; 70 FR 40445, July 13, 2005]

§ 89.411 Exhaust sample procedure—gaseous components.

(a) *Automatic data collection equipment requirements.* The analyzer response may be read by automatic data collection (ADC) equipment such as computers, data loggers, and so forth. If ADC equipment is used, the following is required:

(1) For bag sample 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.

(2) For continuous analysis systems, 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 (a)(2) of this section may be stored on long-term computer storage devices such as computer tapes, storage discs, punch cards, and so forth, 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 ADC equipment is used to interpret analyzer values, the ADC equipment is subject to the calibration specifications of the analyzer as if the ADC equipment is part of analyzer system.

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

(c) *Bag sample analysis.* 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), and so forth, as necessary.

(2) Obtain a stable zero reading.

(3) Zero and span the analyzers with zero and span gases. The span gases must 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) Recheck zero response. If this zero response differs from the zero response recorded in paragraph (c)(3) of this section by more than 1 percent of full scale, then paragraphs (c)(2), (c)(3), and (c)(4) of this section must 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, CO, CO₂, and NO_x background concentrations in the sample bag(s) with approximately the same flow rates and pressures used in paragraph (c)(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-analysis checks is not specified. However, the difference between pre-analysis zero and span values (recorded in paragraph (c)(5) or (c)(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.

(d) *Continuous sample analysis.* 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), and so forth, 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, and so forth to stabilize at operating temperature.

(3) Optional: Perform a hangup 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, hangup is indicated and corrective action must be taken.

(iv) The complete system hangup check specified in paragraph (e) 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 operated prior to the beginning of the test 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 either through the overflow sampling system or through the analyzer port.

(6) Re-check zero response. If this zero response differs from the zero response recorded in paragraph (d)(5) of this section by more than 1 percent of full scale, then paragraphs (d)(4), (d)(5), and (d)(6) of this section must 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) Collect background HC, CO, CO₂, and NO_x in a sample bag (for dilute exhaust sampling only, see § 89.420).

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

(11) 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 hangup is likely.)

(12) Determine background levels of NO_x, CO, or CO₂ (for dilute exhaust

sampling only) by the bag sample technique outlined in paragraph (c) of this section.

(e) *Hydrocarbon hangup*. If HC hangup is indicated, the following sequence may be performed:

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

(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 greater than or equal to 2 percent of 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 (e)(1) through (e)(6) of this section.

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§ 89.412 Raw gaseous exhaust sampling and analytical system description.

(a) *Schematic drawing*. An example of a sampling and analytical system which may be used for testing under this subpart is shown in Figure 1 in appendix B to subpart D. All components or parts of components that are wetted by the sample or corrosive calibration gases shall be either chemically cleaned stainless steel or inert material, for example, polytetrafluoroethylene resin. The use of "gauge savers" or "protectors" with nonreactive diaphragms to reduce dead volumes is permitted.

(b) *Sample probe*. (1) The sample probe shall be a straight, closed-end, stainless steel, multi-hole probe. The inside diameter shall not be greater than the inside diameter of the sample line plus 0.03 cm. The wall thickness of the probe shall not be greater than 0.10 cm. The fitting that attaches the probe to the exhaust pipe shall be as small as practical in order to minimize heat loss from the probe.

(2) The probe shall have a minimum of three holes. The spacing of the radial planes for each hole in the probe must be such that they cover approximately equal cross-sectional areas of

the exhaust duct. See Figure 1 in appendix A to this subpart. The angular spacing of the holes must be approximately equal. The angular spacing of any two holes in one plane may not be $180^\circ \pm 20^\circ$ (that is, section view C-C of Figure 1 in appendix A to this subpart). The holes should be sized such that each has approximately the same flow. If only three holes are used, they may not all be in the same radial plane.

(3) The probe shall extend radially across the exhaust duct. The probe must pass through the approximate center and must extend across at least 80 percent of the diameter of the duct.

(c) *Sample transfer line*. (1) The maximum inside diameter of the sample line shall not exceed 1.32 cm.

(2) If valve V2 is used, the sample probe must connect directly to valve V2. The location of optional valve V2 may not be greater than 1.22 m from the exhaust duct.

(3) The location of optional valve V16 may not be greater than 61 cm from the sample pump.

(d) *Venting*. All vents, including analyzer vents, bypass flow, and pressure relief vents of regulators, should be vented in such a manner to avoid endangering personnel in the immediate area.

(e) Any variation from the specifications in this subpart including performance specifications and emission detection methods may be used only with prior approval by the Administrator.

(f) Additional components, such as instruments, valves, solenoids, pumps, switches, and so forth, may be employed to provide additional information and coordinate the functions of the component systems.

(g) The following requirements must be incorporated in each system used for raw testing under this subpart.

(1) [Reserved]

(2) The sample transport system from the engine exhaust pipe to the HC analyzer and the NO_x analyzer must be heated as indicated in Figure 1 in appendix B of subpart D.

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