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abbreviations used in this subpart are listed in table B–5 of appendix A to this subpart.

§ 53.21 Test conditions.

(a) *Set-up and start-up* of the test analyzer shall be in strict accordance with the operating instructions specified in the manual referred to in § 53.4(b)(3). Allow adequate warm-up or stabilization time as indicated in the operating instructions before beginning the tests. The test procedures assume that the test analyzer has a conventional analog measurement signal output that is connected to a suitable strip chart recorder of the servo, null-balance type. This recorder shall have a chart width of at least 25 centimeters, chart speeds up to 10 cm per hour, a response time of 1 second or less, a deadband of not more than 0.25 percent of full scale, and capability either of reading measurements at least 5 percent below zero or of offsetting the zero by at least 5 percent. If the test analyzer does not have an analog signal output, or if a digital or other type of measurement data output is used for the tests, an alternative measurement data recording device (or devices) may be used for recording the test data, provided that the device is reasonably suited to the nature and purposes of the tests, and an analog representation of the analyzer measurements for each test can be plotted or otherwise generated that is reasonably similar to the analog measurement recordings that would be produced by a conventional chart recorder connected to a conventional analog signal output.

(b) *Calibration* of the test analyzer shall be carried out prior to conducting the tests described in this subpart. The calibration shall be as indicated in the manual referred to in § 53.4(b)(3) and as follows: If the chart recorder or alternative data recorder does not have below zero capability, adjust either the controls of the test analyzer or the chart or data recorder to obtain a + 5% offset zero reading on the recorder chart to facilitate observing negative response or drift. If the candidate method is not capable of negative response, the test analyzer (not the data recorder) shall be operated with a similar offset zero. Construct and submit a calibration curve showing a plot of recorder scale readings or other measurement output readings (vertical or y-axis) against pollutant concentrations presented to the analyzer for measurement (horizontal or x-axis). If applicable, a plot of base analog output units (volts, millivolts, milliamps, *etc.*) against pollutant concentrations shall also be obtained and submitted. All such calibration plots shall consist of at least seven (7) approximately equally spaced, identifiable points, including 0 and 90 ±5 percent of the upper range limit (URL).

(c) Once the test analyzer has been set up and calibrated and the tests started, manual adjustment or normal periodic maintenance is permitted only every 3 days. Automatic adjustments which the test analyzer performs by itself are permitted at any time. The submitted records shall show clearly when any manual adjustment or periodic maintenance was made during the tests and describe the specific operations performed.

(d) If the test analyzer should malfunction during any of the performance tests, the tests for that parameter shall be repeated. A detailed explanation of the malfunction, remedial action taken, and whether recalibration was necessary (along with all pertinent records and charts) shall be submitted. If more than one malfunction occurs, all performance test procedures for all parameters shall be repeated.

(e) Tests for all performance parameters shall be completed on the same test analyzer; however, use of multiple test analyzers to accelerate testing is permissible for testing additional ranges of a multi-range candidate method.

§ 53.22 Generation of test atmospheres.

(a) Table B–2 to subpart B of part 53 specifies preferred methods for generating test atmospheres and suggested methods of verifying their concentrations. Only one means of establishing the concentration of a test atmosphere is normally required, provided that that means is adequately accurate and credible. If the method of generation can produce accurate, reproducible concentrations, verification is optional. If the method of generation is

not reproducible or reasonably quantifiable, then establishment of the concentration by some credible verification method is required.

(b) The test atmosphere delivery system shall be designed and constructed so as not to significantly alter the test atmosphere composition or concentration during the period of the test. The system shall be vented to insure that test atmospheres are presented to the test analyzer at very nearly atmospheric pressure. The delivery system shall be fabricated from borosilicate glass, FEP Teflon, or other material that is inert with regard to the gas or gases to be used.

(c) The output of the test atmosphere generation system shall be sufficiently stable to obtain stable response readings from the test analyzer during the required tests. If a permeation device is used for generation of a test atmosphere, the device, as well as the air passing over it, shall be controlled to 0.1 °C.

(d) All diluent air shall be zero air free of contaminants likely to react with the test atmospheres or cause a detectable response on the test analyzer.

(e) The concentration of each test atmosphere used shall be quantitatively established and/or verified before or during each series of tests. Samples for verifying test concentrations shall be collected from the test atmosphere delivery system as close as feasible to the sample intake port of the test analyzer.

(f) The accuracy of all flow measurements used to calculate test atmosphere concentrations shall be documented and referenced to a primary flow rate or volume standard (such as a spirometer, bubble meter, *etc.*). Any corrections shall be clearly shown. All flow measurements given in volume units shall be standardized to 25 °C and 760 mm Hg.

(g) Schematic drawings, photos, descriptions, and other information showing complete procedural details of the test atmosphere generation, verification, and delivery system shall be provided. All pertinent calculations shall be clearly indicated.

§ 53.23 Test procedures.

(a) *Range*—(1) *Technical definition.* The nominal minimum and maximum concentrations that a method is capable of measuring.

NOTE TO § 53.23(a)(1): The nominal range is given as the lower and upper range limits in concentration units, for example, 0–0.5 parts per million (ppm).

(2) *Test procedure.* Determine and submit a suitable calibration curve, as specified in § 53.21(b), showing the test analyzer's measurement response over at least 95 percent of the required or indicated measurement range.

NOTE TO § 53.23(a)(2): A single calibration curve for each measurement range for which an FRM or FEM designation is sought will normally suffice.

(b) *Noise*—(1) *Technical definition.* Spontaneous, short duration deviations in measurements or measurement signal output, about the mean output, that are not caused by input concentration changes. Measurement noise is determined as the standard deviation of a series of measurements of a constant concentration about the mean and is expressed in concentration units.

(2) *Test procedure.* (i) Allow sufficient time for the test analyzer to warm up and stabilize. Determine measurement noise at each of two fixed concentrations, first using zero air and then a pollutant test gas concentration as indicated below. The noise limit specification in table B–1 to subpart B of part 53 shall apply to both of these tests.

(ii) For an analyzer with an analog signal output, connect an integrating-type digital meter (DM) suitable for the test analyzer's output and accurate to three significant digits, to determine the analyzer's measurement output signal.

NOTE TO § 53.23(b)(2): Use of a chart recorder in addition to the DM is optional.

(iii) Measure zero air with the test analyzer for 60 minutes. During this 60-minute interval, record twenty-five (25) test analyzer concentration measurements or DM readings at 2-minute intervals. (See Figure B–2 in appendix A of this subpart.)

(iv) If applicable, convert each DM test reading to concentration units (ppm) or adjust the test readings (if