

(g) * * *
 (2)(i) * * *

Equation 26

$$C_{ave,j} = \frac{1}{3} \times \sum_{i=1}^3 C_{i,j}$$

* * * * *

§ 53.59 Aerosol transport test for Class I equivalent method samplers.

(a) *Overview.* This test is intended to verify adequate aerosol transport through any modified or air flow splitting components that may be used in a Class I candidate equivalent method sampler such as may be necessary to achieve sequential sampling capability. This test is applicable to all Class I candidate samplers in which the aerosol flow path (the flow path through which sample air passes upstream of sample collection filter) differs significantly from that specified for reference method samplers as specified in 40 CFR part 50, appendix L or appendix O, as applicable. The test requirements and performance specifications for this test are summarized in table E-1 of this subpart.

(b) *Technical definitions.* (1) Aerosol transport is the percentage of a laboratory challenge aerosol which penetrates to the active sample filter of the candidate equivalent method sampler.

(2) The active sample filter is the exclusive filter through which sample air is flowing during performance of this test.

(3) A no-flow filter is a sample filter through which no sample air is intended to flow during performance of this test.

(4) A channel is any of two or more flow paths that the aerosol may take, only one of which may be active at a time.

(5) An added component is any physical part of the sampler which is different in some way from that specified for a reference method sampler in 40 CFR part 50, appendix L or appendix O, as applicable, such as a device or

means to allow or cause the aerosol to be routed to one of several channels.

(c) *Required facilities and test equipment.* (1) Aerosol generation system, as specified in § 53.62(c)(2).

(2) Aerosol delivery system, as specified in § 53.64(c)(2).

(3) Particle size verification equipment, as specified in § 53.62(c)(3).

(4) Fluorometer, as specified in § 53.62(c)(7).

(5) Candidate test sampler, with the inlet and impactor or impactors removed, and with all internal surfaces of added components electroless nickel coated as specified in § 53.64(d)(2).

(6) Filters that are appropriate for use with fluorometric methods (e.g., glass fiber).

(d) *Calibration of test measurement instruments.* Submit documentation showing evidence of appropriately recent calibration, certification of calibration accuracy, and NIST-traceability (if required) of all measurement instruments used in the tests. The accuracy of flow rate meters shall be verified at the highest and lowest pressures and temperatures used in the tests and shall be checked at zero and at least one flow rate within ±3 percent of 16.7 L/min within 7 days prior to use for this test. Where an instrument's measurements are to be recorded with an analog recording device, the accuracy of the entire instrument-recorder system shall be calibrated or verified.

(e) *Test setup.* (1) The candidate test sampler shall have its inlet and impactor or impactors removed. The lower end of the down tube shall be reconnected to the filter holder, using an extension of the downtube, if necessary. If the candidate sampler has a separate impactor for each channel, then for this test, the filter holder assemblies must be connected to the physical location on the sampler where the impactors would normally connect.

(2) The test particle delivery system shall be connected to the sampler downtube so that the test aerosol is introduced at the top of the downtube.

(f) *Test procedure.* (1) All surfaces of the added or modified component or components which come in contact with the aerosol flow shall be thoroughly washed with 0.01 N NaOH and then dried.

(2) Generate aerosol. (i) Generate aerosol composed of oleic acid with a uranine fluorometric tag of $3 \pm 0.25 \mu\text{m}$ aerodynamic diameter using a vibrating orifice aerosol generator according to conventions specified in §53.61(g).

(ii) Check for the presence of satellites and adjust the generator to minimize their production.

(iii) Calculate the aerodynamic particle size using the operating parameters of the vibrating orifice aerosol generator. The calculated aerodynamic diameter must be $3 \pm 0.25 \mu\text{m}$ aerodynamic diameter.

(3) Verify the particle size according to procedures specified in §53.62(d)(4)(i).

(4) Collect particles on filters for a time period such that the relative error of the resulting measured fluorometric concentration for the active filter is less than 5 percent.

(5) Determine the quantity of material collected on the active filter using a calibrated fluorometer. Record the mass of fluorometric material for the active filter as $M_{\text{active } (i)}$ where i = the active channel number.

(6) Determine the quantity of material collected on each no-flow filter using a calibrated fluorometer. Record

the mass of fluorometric material on each no-flow filter as $M_{\text{no-flow}}$.

(7) Using 0.01 N NaOH, wash the surfaces of the added component or components which contact the aerosol flow. Determine the quantity of material collected using a calibrated fluorometer. Record the mass of fluorometric material collected in the wash as M_{wash} .

(8) Calculate the aerosol transport as:

EQUATION 29

$$T_{(i)} = \frac{M_{\text{active}}}{M_{\text{active}} + M_{\text{wash}} + \sum M_{\text{no-flow}}} \times 100\%$$

where:

i = the active channel number.

(9) Repeat paragraphs (f)(1) through (8) of this section for each channel, making each channel in turn the exclusive active channel.

(g) *Test results.* The candidate Class I sampler passes the aerosol transport test if $T_{(i)}$ is at least 97 percent for each channel.

[62 FR 38799, July 18, 1997, as amended at 71 FR 61293, Oct. 17, 2006]

TABLE E-1 TO SUBPART E OF PART 53—SUMMARY OF TEST REQUIREMENTS FOR REFERENCE AND CLASS I EQUIVALENT METHODS FOR $\text{PM}_{2.5}$ AND $\text{PM}_{10-2.5}$.

Subpart E procedure	Performance test	Performance specification	Test conditions	Part 50, appendix L reference
§ 53.52 Sample leak check test.	Sampler leak check facility.	External leakage: 80 mL/min, max. Internal leakage: 80 mL/min, max.	Controlled leak flow rate of 80 mL/min.	Sec. 7.4.6.
§ 53.53 Base flow rate test.	Sample flow rate 1. Mean 2. Regulation 3. Meas accuracy 4. CV accuracy 5. Cut-off	1. $16.67 \pm 5\%$ L/min 2. 2%, max 3. 2%, max 4. 0.3%, max 5. Flow rate cut-off if flow rate deviates more than 10% from design flow rate for $>60 \pm 30$ seconds.	(a) 6-hour normal operational test plus flow rate cut-off test. (b) Normal conditions .. (c) Additional 55 mm Hg pressure drop to simulate loaded filter. (d) Variable flow restriction used for cut-off test.	Sec. 7.4.1, Sec. 7.4.2 Sec. 7.4.3 Sec. 7.4.4 Sec. 7.4.5.
§ 53.54 Power interruption test.	Sample flow rate: 1. Mean 2. Regulation 3. Meas. accuracy 4. CV accuracy 5. Occurrence time of power interruptions. 6. Elapsed sample time 7. Sample volume	1. $16.67 \pm 5\%$ L/Min .. 2. 2%, max 3. 2%, max 4. 0.3% max 5. 7 ± 2 min if >60 seconds. 6. 7 ± 20 seconds 7. $\pm 2\%$, max	(a) 6-hour normal operational test. (b) Nominal conditions (c) Additional 55 mm Hg pressure drop to simulate loaded filter. (d) 6 power interruptions of various durations.	Sec. 7.4.1, Sec. 7.4.2 Sec. 7.4.3 Sec. 7.4.5 Sec. 7.4.12 Sec. 7.4.13 Sec. 7.4.15.4 Sec. 7.4.15.5.

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Subpart E procedure	Performance test	Performance specification	Test conditions	Part 50, appendix L reference
§ 53.55 Temperature and line voltage test.	Sample flow rate 1. Mean 2. Regulation 3. Meas. accuracy 4. CV accuracy 5. Temperature meas. accuracy. 6. Proper operation	1. $16.6 \pm 5\%$ L/min 2. 2%, max 3. 2%, max 4. 0.3% max 5. 2 °C	(a) 6-hour normal operational test. (b) Normal conditions .. (c) Additional 55 mm Hg pressure drop to simulate loaded filter. (d) Ambient temperature at -20 and +40 °C. (e) Line voltage: 105 Vac to 125 Vac.	Sec. 7.4.1, Sec. 7.4.2 Sec. 7.4.3 Sec. 7.4.5 Sec. 7.4.8 Sec. 7.4.15.1.
§ 53.56 Barometric pressure effect test.	Sample flow rate 1. Mean 2. Regulation 3. Meas. accuracy 4. CV accuracy 5. Pressure meas. accuracy. 6. Proper operation	1. $16.67 \pm 5\%$ L/min 2. 2%, max 3. 2%, max 4. 0.3%, max 5. 10 mm Hg	(a) 6-hour normal operational test. (b) Normal conditions .. (c) Additional 55 mm Hg pressure drop to simulate loaded filter. (d) Barometric pressure at 600 and 800 mm Hg.	Sec. 7.4.1, Sec. 7.4.2 Sec. 7.4.3 Sec. 7.4.5 Sec. 7.4.9.
§ 53.57 Filter temperature control test.	1. Filter temp meas. accuracy. 2. Ambient temp. meas. accuracy. 3. Filter temp. control accuracy, sampling and non-sampling.	1. 2 °C 2. 2 °C 3. Not more than 5 °C above ambient temp. for more than 30 min..	(a) 4-hour simulated solar radiation, sampling. (b) 4-hour simulated solar radiation, non-sampling. (c) Solar flux of 1000 ± 50 W/m ² .	Sec. 7.4.8 Sec. 7.4.10 Sec. 7.4.11.
§ 53.58 Field precision test.	1. Measurement precision. 2. Storage deposition test for sequential samplers.	1. $P_j < 2 \mu\text{g}/\text{m}^3$ or $RP_j < 5\%$. 2. 50 μg max. average weight gain/blank filter.	(a) 3 collocated samplers at 1 site for at least 10 days. (b) $PM_{2.5}$ conc. $> 3 \mu\text{g}/\text{m}^3$. (c) 24- or 48-hour samples. (d) 5- or 10-day storage period for inactive stored filters.	Sec. 5.1 Sec. 7.3.5 Sec. 8 Sec. 9 Sec. 10.
The Following Requirement Is Applicable to Class I Candidate Equivalent Methods Only				
§ 53.59 Aerosol transport test.	Aerosol transport	97%, min. for all channels.	Determine aerosol transport through any new or modified components with respect to the reference method sampler before the filter for each channel.	

[71 FR 61294, Oct. 17, 2006]

EFFECTIVE DATE NOTE: At 72 FR 32208, June 12, 2007, Table E-1 to subpart E of part 53 was

revised, effective Sept. 10, 2007. For the convenience of the user, the revised text is set forth as follows:

TABLE E-1 TO SUBPART E OF PART 53.—SUMMARY OF TEST REQUIREMENTS FOR REFERENCE AND CLASS I EQUIVALENT METHODS FOR $PM_{2.5}$ AND $PM_{10-2.5}$

Subpart E procedure	Performance test	Performance specification	Test conditions	Part 50, appendix L reference
§ 53.52 Sample leak check test.	Sampler leak check facility.	External leakage: 80 mL/min, max. Internal leakage: 80 mL/min, max.	Controlled leak flow rate of 80 mL/min.	Sec. 7.4.6.

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Subpart E procedure	Performance test	Performance specification	Test conditions	Part 50, appendix L reference
§ 53.53 Base flow rate test.	Sample flow rate 1. Mean 2. Regulation 3. Meas accuracy 4. CV accuracy 5. Cut-off	1. $16.67 \pm 5\%$, L/min ... 2. 2%, max 3. 2%, max 4. 0.3% max 5. Flow rate cut-off if flow rate deviates more than 10% from design flow rate for $>60 \pm 30$ seconds.	(a) 6-hour normal operational test plus flow rate cut-off test. (b) Normal conditions .. (c) Additional 55 mm Hg pressure drop to simulate loaded filter. (d) Variable flow restriction used for cut-off test.	Sec. 7.4.1. Sec. 7.4.2. Sec. 7.4.3. Sec. 7.4.4. Sec. 7.4.5.
§ 53.54 Power interruption test.	Sample flow rate 1. Mean 2. Regulation 3. Meas. accuracy 4. CV accuracy 5. Occurrence time of power interruptions. 6. Elapsed sample time 7. Sample volume	1. $16.67 \pm 5\%$, L/min ... 2. 2%, max 3. 2%, max 4. 0.3% max 5. ± 2 min if >60 seconds.. 6. ± 20 seconds 7. $\pm 2\%$, max	(a) 6-hour normal operational test. (b) Nominal conditions (c) Additional 55 mm Hg pressure drop to simulate loaded filter. (d) 6 power interruptions of various durations.	Sec. 7.4.1. Sec. 7.4.2. Sec. 7.4.3. Sec. 7.4.5. Sec. 7.4.12. Sec. 7.4.13. Sec. 7.4.15.4. Sec. 7.4.15.5.
§ 53.55 Temperature and line voltage test.	Sample flow rate 1. Mean 2. Regulation 3. Meas. accuracy 4. CV accuracy 5. Temperature meas. accuracy. 6. Proper operation.	1. $16.67 \pm 5\%$, L/min ... 2. 2%, max 3. 2%, max 4. 0.3% max 5. 2 °C	(a) 6-hour normal operational test. (b) Normal conditions .. (c) Additional 55 mm Hg pressure drop to simulate loaded filter. (d) Ambient temperature at -20 and $+40$ °C. (e) Line voltage: 105 Vac to 125 Vac.	Sec. 7.4.1. Sec. 7.4.2. Sec. 7.4.3. Sec. 7.4.5. Sec. 7.4.8. Sec. 7.4.15.1.
§ 53.56 Barometric pressure effect test.	Sample flow rate 1. Mean 2. Regulation 3. Meas. accuracy 4. CV accuracy 5. Pressure meas. accuracy. 6. Proper operation.	1. $16.67 \pm 5\%$, L/min ... 2. 2%, max 3. 2%, max 4. 0.3% max 5. 10 mm Hg	(a) 6-hour normal operational test. (b) Normal conditions .. (c) Additional 55 mm Hg pressure drop to simulate loaded filter. (d) Barometric pressure at 600 and 800 mm Hg.	Sec. 7.4.1. Sec. 7.4.2. Sec. 7.4.3. Sec. 7.4.5. Sec. 7.4.9.
§ 53.57 Filter temperature control test.	1. Filter temp. meas. accuracy. 2. Ambient temp. meas. accuracy. 3. Filter temp. control accuracy, sampling and non-sampling.	1. 2 °C 2. 2 °C 3. Not more than 5 °C above ambient temp. for more than 30 min.	(a) 4-hour simulated solar radiation, sampling. (b) 4-hour simulated solar radiation, non-sampling. (c) Solar flux of 1000 ± 50 W/m ² .	Sec. 7.4.8. Sec. 7.4.10. Sec. 7.4.11.
§ 53.58 Field precision test.	1. Measurement precision. 2. Storage deposition test for sequential samplers.	1. $P_j < 2 \mu\text{g}/\text{m}^3$ or $RP_j < 5\%$. 2. 50 μg max. average weight gain/blank filter.	(a) 3 collocated samplers at 1 site for at least 10 days. (b) $PM_{2.5}$ conc. $> 3 \mu\text{g}/\text{m}^3$. (c) 24- or 48-hour samples. (d) 5- or 10-day storage period for inactive stored filters.	Sec. 5.1. Sec. 7.3.5. Sec. 8. Sec. 9. Sec. 10.
The Following Requirement Is Applicable to Class I Candidate Equivalent Methods Only				
§ 53.59 Aerosol transport test.	Aerosol transport	97%, min. for all channels..	Determine aerosol transport through any new or modified components with respect to the reference method sampler before the filter for each channel.	

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TABLE E-2 TO SUBPART E OF PART 53—SPECTRAL ENERGY DISTRIBUTION AND PERMITTED TOLERANCE FOR CONDUCTING RADIATIVE TESTS

Characteristic	Spectral Region			
	Ultraviolet		Visible	Infrared
Bandwidth (µm)	0.28 to 0.32	0.32 to 0.40	0.40 to 0.78	0.78 to 3.00
Irradiance (W/m ²)	5	56	450 to 550	439
Allowed Tolerance	±35%	±25%	±10%	±10%

[62 FR 38799, July 18, 1997; 63 FR 7714, Feb. 17, 1998]

FIGURE E-1 TO SUBPART E OF PART 53—DESIGNATION TESTING CHECKLIST

DESIGNATION TESTING CHECKLIST

Auditee			Auditor signature	Date	
Compliance Status:			Y = Yes	N = No	NA = Not applicable/Not available
Verification			Verified by Direct Observation of Process or of Documented Evidence: Performance, Design or Application Spec. Corresponding to Sections of 40 CFR Part 53 or 40 CFR Part 50, Appendix L		
Y	N	NA	Verification Comments (Includes documentation of who, what, where, when, why) (Doc. #, Rev. #, Rev. Date)		
			Performance Specification Tests		
			Sample flow rate coefficient of variation (§ 53.53) (L-7.4.3)		
			Filter temperature control (sampling) (§ 53.57) (L-7.4.10)		
			Elapsed sample time accuracy (§ 53.54) (L-7.4.13)		
			Filter temperature control (post sampling) (§ 53.57) (L-7.4.10)		
			Application Specification Tests		
			Field Precision (§ 53.58) (L-5.1)		
			Meets all Appendix L requirements (part 53, subpart A, § 53.2(a)(3)) (part 53, subpart E, § 53.51(a),(d))		
			Filter Weighing (L-8)		
			Field Sampling Procedure (§ 53.30, .31, .34)		
			Design Specification Tests		
			Filter (L-6)		
			Range of Operational Conditions (L-7.4.7)		
The Following Requirements Apply Only to Class I Candidate Equivalent Methods					
			Aerosol Transport (§ 53.59)		

FIGURE E-2 TO SUBPART E OF PART 53—PRODUCT MANUFACTURING CHECKLIST

PRODUCT MANUFACTURING CHECKLIST

Auditee			Auditor signature	Date	
Compliance Status:			Y = Yes	N = No	NA = Not applicable/Not available
Verification			Verified by Direct Observation of Process or of Documented Evidence: Performance, Design or Application Spec. Corresponding to Sections of 40 CFR Part 53 or 40 CFR Part 50, Appendix L		
Y	N	NA	Verification Comments (Includes documentation of who, what, where, when, why) (Doc. #, Rev. #, Rev. Date)		
			Performance Specification Tests		
			Assembled operational performance (Burn-in test) (§ 53.53)		

Compliance Status: Y = Yes N = No NA = Not applicable/Not available			Verification Comments (Includes documentation of who, what, where, when, why) (Doc. #, Rev. #, Rev. Date)
Verification			
Y	N	NA	Verified by Direct Observation of Process or of Documented Evidence: Performance, Design or Application Spec. Corresponding to Sections of 40 CFR Part 53 or 40 CFR Part 50, Appendix L
			Sample flow rate (§ 53.53) (L-7.4.1, L-7.4.2)
			Sample flow rate regulation (§ 53.53) (L-7.4.3)
			Flow rate and average flow rate measurement accuracy (§ 53.53) (L-7.4.5)
			Ambient air temperature measurement accuracy (§ 53.55) (L-7.4.8)
			Ambient barometric pressure measurement accuracy (§ 53.56) (L-7.4.9)
			Sample flow rate cut-off (§ 53.53) (L-7.4.4)
			Sampler leak check facility (§ 53.52) (L-7.4.6)
			Application Specification Tests
			Flow rate calibration transfer standard (L-9.2)
			Operational /Instructional manual (L-7.4.18)
			Design Specification Tests
			Impactor (jet width) (§ 53.51(d)(1)) (L-7.3.4.1)
			Surface finish (§ 53.51(d)(2)) (L-7.3.7)

APPENDIX A TO SUBPART E OF PART 53—
REFERENCES

(1) American National Standard Quality Systems—Model for Quality Assurance in Design, Development, Production, Installation, and Servicing, ANSI/ISO/ASQC Q9001-1994. Available from American Society for Quality, P.O. Box 3005, Milwaukee, WI 53202 (<http://qualitypress.asq.org>).

(2) American National Standard Quality Systems for Environmental Data and Technology Programs—Requirements with guidance for use, ANSI/ASQC E4-2004. Available from American Society for Quality, P.O. Box 3005, Milwaukee, WI 53202 (<http://qualitypress.asq.org>).

(3) Quality Assurance Guidance Document 2.12. Monitoring PM_{2.5} in Ambient Air Using Designated Reference or Class I Equivalent Methods. U.S. EPA, National Exposure Research Laboratory, Research Triangle Park, NC, November 1998 or later edition. Currently available at <http://www.epa.gov/ttn/amtic/pmqaif.html>.

(4) Military standard specification (mil. spec.) 8625F, Type II, Class 1 as listed in Department of Defense Index of Specifications and Standards (DODISS), available from DODSSP-Customer Service, Standardization Documents Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 1911-5094.

(5) Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV:

Meteorological Measurements. Revised March, 1995. EPA-600/R-94-038d. Available from National Technical Information Service, Springfield, VA 22161, (800-553-6847, <http://www.ntis.gov>). NTIS number PB95-199782INZ.

(6) Military standard specification (mil. spec.) 810-E as listed in Department of Defense Index of Specifications and Standards (DODISS), available from DODSSP-Customer Service, Standardization Documents Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 1911-5094.

[62 FR 38799, July 18, 1997, as amended at 71 FR 61295, Oct. 17, 2006]

Subpart F—Procedures for Testing Performance Characteristics of Class II Equivalent Methods for PM_{2.5}

SOURCE: 62 FR 38814, July 18, 1997, unless otherwise noted.

§ 53.60 General provisions.

(a) This subpart sets forth the specific requirements that a PM_{2.5} sampler associated with a candidate Class II equivalent method must meet to be designated as an equivalent method for PM_{2.5}. This subpart also sets forth the explicit test procedures that must be