

Measurement Quality Objectives and Validation Templates

Critical Criteria Table: These criteria *must* be met to ensure the quality of the data. An example criterion is that the average flow rate for the sampling period must be maintained to within 5% of 16.67 liters per minute. Each datum not meeting all critical criteria should be invalidated unless there are compelling reason and justification for not doing so.

Operational Evaluations Table: Criteria pertaining to the quality of the data collection *system* are included on the Operational Evaluations Table. Data that do not meet these criteria indicate that there *might* be a problem and further investigation is warranted before making a determination about their validity. The decision should consider other quality control information that may or may not indicate the data are acceptable. Therefore, the sample or group of samples for which one or more of these criteria are not met is suspect unless other quality control information demonstrates otherwise. The reason for not meeting the criteria **MUST** be investigated, mitigated or justified.

Systematic Issues Table: Criteria which are important for the correct interpretation of the data but do not usually impact the validity of a sample or group of samples. An example criterion is that at least 75% of the scheduled samples for each quarter should be successfully collected and validated. The data quality objectives are included in this table. If the data quality objectives are not met, this does not invalidate any of the samples but it may impact the error rate associated with the attainment/non-attainment decision.

Due to the potential misuse of invalid data, data that are invalidated will not be uploaded to AQS but should be retained on the monitoring organizations local database.

PM₁₀ Note of Caution:

The validation templates for PM₁₀ get complicated because PM₁₀ is required to be reported at standard temperature and pressure (STP) for comparison to the NAAQS (and follow 40 CFR Part 50 App J) and at local conditions if using it to monitor for PM_{10-2.5} (and follow 40 CFR Part 50 App O); in addition PM₁₀ is measured with filter based sampling techniques as well as with automated methods. The validation templates developed for PM₁₀ try to accommodate these differences but monitoring organizations are cautioned to review the operations manual for the monitors/samplers they use and *augment the validation template with QC information specific to their method.*

10.3 CFR Related Quality Control Samples

40 CFR Part 58, Appendix A identifies a number of quality control samples that must be implemented for the SLAMS (and NCore) SPM and PSD networks. By 2009, any special purpose monitors that use FRMs or FEMs will be required to follow these requirements unless granted a waiver by the Regional Administrator. Table 10-3 provides a summary of the QC checks for the criteria pollutants and the CFR reference where an explanation of each check is described. The reader should distinguish the requirements that are related to automated and manual methods since there are some differences.

Table 10-3 Ambient Air Monitoring Measurement Quality Samples

Method	CFR Reference	Coverage (annual)	Minimum frequency	MQOs*
Automated Methods				
One-Point QC: for SO ₂ , NO ₂ , O ₃ , CO	Section 3.2.1	Each analyzer	Once per 2 weeks	O ₃ Precision 7%, Bias ± 7%. SO₂, NO₂, CO Precision 10% , Bias ± 10%
Annual performance evaluation for SO ₂ , NO ₂ , O ₃ , CO	Section 3.2.2	Each analyzer	Once per year	≤ 15 % for each audit concentration
Flow rate verification PM ₁₀ , PM _{2.5} , PM _{10-2.5} , TSP	Section 3.2.3	Each sampler	Once every month	≤ 4% of standard and 5% of design value
Semi-annual flow rate audit PM ₁₀ , PM _{2.5} , PM _{10-2.5} , TSP	Section 3.2.4	Each sampler	Once every 6 months	≤ 4% of standard and 5% of design value
Collocated sampling PM _{2.5} , PM _{10-2.5} , TSP	Section 3.2.5	15% within PQAQO	Every twelve days	PM _{2.5} , - 10% precision PM _{10-2.5} , - 15% precision TSP – 10% precision
PM Performance evaluation program PM _{2.5} , PM _{10-2.5}	Section 3.2.7	1. 5 valid audits for primary QA orgs, with ≤ 5 sites 2. 8 valid audits for primary QA orgs, with > 5 sites 3. All samplers in 6 years	over all 4 quarters	PM _{2.5} , - ± 10% bias PM _{10-2.5} , - ± 15% bias
Manual Methods				
Collocated sampling PM ₁₀ , TSP, PM _{10-2.5} , PM _{2.5}	3.3.1 and 3.3.5	15% within PQAQO	Every 12 days PSD every 6 days	PM ₁₀ , TSP, PM _{2.5} , - 10% precision PM _{10-2.5} , - 15% precision
Flow rate verification PM ₁₀ (low Vol), PM _{10-2.5} , PM _{2.5} , TSP	3.3.2	Each sampler	Once every month	≤ 4% of standard and 5% of design value
Flow rate verification PM ₁₀ (High-Vol), TSP	3.3.2	Each sampler	Once every quarter	≤ 10% of standard and design value
Semi-annual flow rate audit PM ₁₀ (low Vol), PM _{10-2.5} , PM _{2.5} , TSP	3.3.3	Each sampler, all locations	Once every 6 months	≤ 4% of standard and 5% of design value
Semi-annual flow rate audit PM ₁₀ (High-Vol), TSP	3.3.3	Each sampler, all locations	Once every 6 months	≤ 10% of standard and design value
Manual Methods Lead	3.3.4	1. Each sampler 2. Analytical (lead strips)	1. Include with TSP 2. Each quarter	1. Same as for TSP. 2. - ± 10% bias
Performance evaluation program PM _{2.5} , PM _{10-2.5}	3.3.7 and 3.3.8	1. 5 valid audits for primary QA orgs, with ≤ 5 sites 2. 8 valid audits for primary QA orgs, with ≥ 5 sites 3. All samplers in 6 years	Over all 4 quarters	PM _{2.5} , ± 10% bias PM _{10-2.5} , ± 15% bias

* Some of the MQOs are found in CFR and others in Appendix D of this guidance document.

Ozone Validation Template

Requirement	Frequency	Acceptance Criteria	Information /Action
CRITICAL CRITERIA-Ozone			
One Point QC Check Single analyzer	1/ 2 weeks	$\leq \pm 7\%$ (percent difference)	0.01 - 0.10 ppm Relative to routine concentrations 40 CFR Part 58 App A Sec 3.2
Zero/span check	1/ 2 weeks	Zero drift $\leq \pm 2\%$ of full scale Span drift $\leq \pm 7\%$	
OPERATIONAL CRITERIA - Ozone			
Shelter Temperature			
Temperature range	Daily (hourly values)	20 to 30° C. (Hourly ave) or per manufacturers specifications if designated to a wider temperature range	Generally the 20-30 ° C range will apply but the most restrictive operable range of the instruments in the shelter may also be used as guidance
Temperature Control	Daily (hourly values)	$\leq \pm 2^\circ \text{C}$ SD over 24 hours	
Temperature Device Check	2/year	$\pm 2^\circ \text{C}$ of standard	
Precision(using 1-point QC checks)	Calculated annually and as appropriate for design value estimates	90% CL CV $\leq 7\%$	90% Confidence Limit of coefficient of variation. 40 CFR Part 58 App A sec 4.1.2
Bias (using 1-point QC checks)	Calculated annually and as appropriate for design value estimates	95% CL $\leq \pm 7\%$	95% Confidence Limit of absolute bias estimate. 40 CFR Part 58 App A sec 4.1.3
Annual Performance Evaluation			
Single analyzer	Every site 1/year 25 % of sites quarterly	Percent difference of each audit level $\leq 15\%$	3 consecutive audit concentration not including zero. 40 CFR Part 58 App A sec 3.2.2
Primary QA Organization (PQAO)	annually	95% of audit percent differences fall within the one point QC check 95% probability intervals at PQAO level of aggregation	40 CFR Part 58 App A sec 4.1.4
Federal Audits (NPAP)	1/year at selected sites 20% of sites audited	Mean absolute difference $\leq 10\%$	40 CFR Part 58 App A sec 2.4
State audits	1/year	State requirements	
Verification/Calibration	Upon receipt/adjustment/repair/ installation/moving 1/6 months if manual zero/span performed biweekly 1/year if continuous zero/span performed daily	All points within $\pm 2\%$ of full scale of best-fit straight line Linearity error $<5\%$	Multi-point calibration (0 and 4 upscale points) 40 CFR Part 50 App D sec 5.2.3
Zero Air		Concentrations below LDL	
Gaseous Standards		NIST Traceable (e.g., EPA Protocol Gas)	40 CFR Part 58 App A sec 2.6.1
Zero Air Check	1/year	Concentrations below LDL	

Requirement	Frequency	Acceptance Criteria	Information /Action
Ozone Local primary standard			
Certification/recertification to Standard Reference Photometer	1/year	single point difference $\leq \pm 3\%$	Primary Standards usually transported to EPA Regions SRP for comparison
(if recertified via a transfer standard)	1/year	Regression slopes = 1.00 ± 0.03 and two intercepts are 0 ± 3 ppb	
Ozone Transfer standard			
Qualification	Upon receipt of transfer standard	$\pm 4\%$ or ± 4 ppb (whichever greater)	Transfer Standard Doc EPA 600/4-79-056 Section 6.4
Certification	After qualification and upon receipt/adjustment/repair	RSD of six slopes $\leq 3.7\%$ Std. Dev. of 6 intercepts 1.5	Transfer Standard Doc EPA 600/4-79-056 Section 6.6
Recertification to local primary standard	Beginning and end of O3 season or 1/6 months whichever less	New slope = ± 0.05 of previous and RSD of six slopes $\leq 3.7\%$ Std. Dev. of 6 intercepts 1.5	1 recertification test that then gets added to most recent 5 tests. If does not meet acceptability certification fails
Lower detectable level	1/year	0.003 ppm	
SYSTEMATIC CRITERIA- Ozone			
Requirement	Frequency	Acceptance Criteria	Information /Action
Standard Reporting Units	All data	ppm (final units in AQS)	
Completeness (seasonal)	Daily	75% of hourly averages for the 8-hour period	8-Hour Average
Sample Residence Times		< 20 seconds	
Sample Probe, Inlet, Sampling train		Borosilicate glass (e.g., Pyrex®) or Teflon®	40 CFR Part 58 App E
Siting		Un-obstructed probe inlet	40 CFR Part 58 App E
EPA Standard Ozone Reference Photometer (SRP) Recertification	1/year	Regression slope = 1.00 ± 0.01 and intercept < 3 ppb	This is usually at a Regional Office and is compared against the traveling SRP

CO Validation Template

Requirement	Frequency	Acceptance Criteria	Information /Action
CRITICAL CRITERIA-CO			
One Point QC Check Single analyzer	1/ 2 weeks	$\leq \pm 10\%$ (percent difference)	1 - 10 ppm Relative to routine concentrations 40 CFR Part 58 App A Sec 3.2
Zero/span check	1/ 2 weeks	Zero drift $\leq \pm 2\%$ of full scale Span drift $\leq \pm 10\%$	
OPERATIONAL CRITERIA-CO			
Shelter Temperature			
Temperature range	Daily (hourly values)	20 to 30° C. (Hourly ave) or per manufacturers specifications if designated to a wider temperature range	Generally the 20-30 ° C range will apply but the most restrictive operable range of the instruments in the shelter may also be used as guidance
Temperature Control	Daily (hourly values)	$\leq \pm 2^{\circ}$ C SD over 24 hours	
Temperature Device Check	2/year	$\pm 2^{\circ}$ C of standard	
Precision(using 1-point QC checks)	Calculated annually and as appropriate for design value estimates	90% CL CV $\leq 10\%$	90% Confidence Limit of coefficient of variation. 40 CFR Part 58 App A sec 4.1.2
Bias (using 1-point QC checks)	Calculated annually and as appropriate for design value estimates	95% CL $\leq \pm 10\%$	95% Confidence Limit of absolute bias estimate 40 CFR Part 58 App A sec 4.1.3
Annual Performance Evaluation			
Single analyzer	Every site 1/year 25 % of sites quarterly	Percent difference of each audit level $\leq 15\%$	3 consecutive audit concentration not including zero. 40 CFR Part 58 App A sec 3.2.2
Primary QA Organization (PQAO)	annually	95% of audit percent differences fall within the one point QC check 95% probability intervals at PQAO level of aggregation	40 CFR Part 58 App A sec 4.1.4
Federal Audits (NPAP)	1/year at selected sites 20% of sites audited	Mean absolute difference $\leq 15\%$	40 CFR Part 58 App A sec 2.4
State audits	1/year	State requirements	
Verification/Calibration	Upon receipt/adjustment/repair/ installation/moving 1/6 months if manual zero/span performed biweekly 1/year if continuous zero/span performed daily	All points within $\pm 2\%$ of full scale of best-fit straight line	Multi-point calibration (0 and 4 upscale points)
Gaseous Standards		NIST Traceable (e.g., EPA Protocol Gas)	Vendor must participate in EPA Protocol Gas Verification Program 40 CFR Part 58 App A sec 2.6.1
Zero Air/Zero Air Check	1/year	Concentrations below LDL	

Requirement	Frequency	Acceptance Criteria	Information /Action
Gas Dilution Systems	1/3 months	Accuracy \pm 2 %	
Detection			
Noise	NA	0.50 ppm	40 CFR Part 53.20
Lower detectable level	1/year	1.0 ppm	40 CFR Part 53.20
SYSTEMATIC CRITERIA-CO			
Standard Reporting Units	All data	ppm (final units in AQS)	
Completeness (seasonal)	Hourly	75% of hourly averages for the 8-hour period	8-Hour average
Sample Residence Times		< 20 seconds	
Sample Probe, Inlet, Sampling train		Borosilicate glass (e.g., Pyrex [®]) or Teflon [®]	40 CFR Part 58 App E
Siting		Un-obstructed probe inlet	40 CFR Part 58 App E

NO₂ Validation Template

Requirement	Frequency	Acceptance Criteria	Information /Action
CRITICAL CRITERIA- NO₂			
One Point QC Check Single analyzer	1/ 2 weeks	≤ ±10% (percent difference)	0.01 - 0.10 ppm Relative to routine concentrations 40 CFR Part 58 App A Sec 3.2
Zero/span check	1/ 2 weeks	Zero drift ≤ ± 3% of full scale Span drift ≤ ± 10 %	
OPERATIONAL CRITERIA- NO₂			
Shelter Temperature			
Temperature range	Daily (hourly values)	20 to 30° C. (Hourly ave) or per manufacturers specifications if designated to a wider temperature range	Generally the 20-30 ° C range will apply but the most restrictive operable range of the instruments in the shelter may also be used as guidance
Temperature Control	Daily (hourly values)	≤ ± 2° C SD over 24 hours	
Temperature Device Check	2/year	± 2°C of standard	
Precision (using 1-point QC checks)	Calculated annually and as appropriate for design value estimates	90% CL CV ≤ 10%	90% Confidence Limit of coefficient of variation. 40 CFR Part 58 App A sec 4.1.2
Bias (using 1-point QC checks)	Calculated annually and as appropriate for design value estimates	95% CL ≤ ± 10%	95% Confidence Limit of absolute bias estimate. 40 CFR Part 58 App A sec 4.1.3
Annual Performance Evaluation			
Single analyzer	Every site 1/year 25 % of sites quarterly	Percent difference of each audit level ≤ 15%	3 consecutive audit concentration not including zero. 40 CFR Part 58 App A sec 3.2.2
Primary QA Organization (PQAO)	annually	95% of audit percent differences fall within the one point QC check 95% probability intervals at PQAO level of aggregation	40 CFR Part 58 App A sec 4.1.4
Federal Audits (NPAP)	1/year at selected sites 20% of sites audited	Mean absolute difference ≤ 15%	40 CFR Part 58 App A sec 2.4
State audits	1/year	State requirements	
Verification/Calibration	Upon receipt/adjustment/repair/ installation/moving 1/6 months if manual zero/span performed biweekly 1/year if continuous zero/span performed daily	Intrument residence time ≤ 2 min Dynam. parameter ≥ 2.75 ppm-min All points within ± 2 % of full scale of best-fit straight line	Multi-point calibration (0 and 4 upscale points) 40 CFR Part 50 App F
Converter Efficiency	During multi-point calibrations, span and audit 1/ 2 weeks	96%	
Gaseous Standards		NIST Traceable	Vendor must participate in EPA Protocol Gas

Requirement	Frequency	Acceptance Criteria	Information /Action
		(e.g., EPA Protocol Gas)	Verification Program 40 CFR Part 58 App A sec 2.6.1
Zero Air/ Zero Air Check	1/year	Concentrations below LDL	
Gas Dilution Systems	1/3 months	Accuracy \pm 2 %	
Detection			
Noise	NA	0.005 ppm	40 CFR Part 53.20
Lower detectable level	1/year	0.01 ppm	40 CFR Part 53.20
SYSTEMATIC CRITERIA- NO₂			
Standard Reporting Units	All data	ppm (final units in AQS)	
Completeness (seasonal)	Quarterly	75%	Annual standard (hourly data)
Sample Residence Times		< 20 seconds	
Sample Probe, Inlet, Sampling train		Borosilicate glass (e.g., Pyrex [®]) or Teflon [®]	40 CFR Part 58 App E
Siting		Un-obstructed probe inlet	40 CFR Part 58 App E

SO₂ Validation Template

Requirement	Frequency	Acceptance Criteria	Information /Action
CRITICAL CRITERIA- SO₂			
One Point QC Check Single analyzer	1/ 2 weeks	≤ ±10% (percent difference)	0.01 - 0.10 ppm Relative to routine concentrations 40 CFR Part 58 App A Sec 3.2
Zero/span check	1/ 2 weeks	Zero drift ≤ ± 3% of full scale Span drift ≤ ± 10 %	
OPERATIONAL CRITERIA- SO₂			
Shelter Temperature			
Temperature range	Daily (hourly values)	20 to 30° C. (Hourly ave) or per manufacturers specifications if designated to a wider temperature range	Generally the 20-30 ° C range will apply but the most restrictive operable range of the instruments in the shelter may also be used as guidance
Temperature Control	Daily (hourly values)	≤ ± 2° C SD over 24 hours	
Temperature Device Check	2/year	± 2° C of standard	
Precision (using 1-point QC checks)	Calculated annually and as appropriate for design value estimates	90% CL CV ≤ 10%	90% Confidence Limit of coefficient of variation 40 CFR Part 58 App A sec 4.1.2
Bias (using 1-point QC checks)	Calculated annually and as appropriate for design value estimates	95% CL ≤ ± 10%	95% Confidence Limit of absolute bias estimate 40 CFR Part 58 App A sec 4.1.3
Annual Performance Evaluation			
Single analyzer	Every site 1/year 25 % of sites quarterly	Percent difference of each audit level ≤ 15%	3 consecutive audit concentrations not including zero 40 CFR Part 58 App A sec 3.2.2
Primary QA Organization (PQAO)	annually	95% of audit percent differences fall within the one point QC check 95% probability intervals at PQAO level of aggregation	40 CFR Part 58 App A sec 4.1.4
Federal Audits (NPAP)	1/year at selected sites 20% of sites audited	Mean absolute difference ≤ 15%	40 CFR Part 58 App A sec 2.4
State audits	1/year	State requirements	
Verification/Calibration	Upon receipt/adjustment/repair/ installation/moving 1/6 months if manual zero/span performed biweekly 1/year if continuous zero/span performed daily	All points within ± 2 % of full scale of best-fit straight line	Multi-point calibration (0 and 4 upscale points)
Zero Air		Concentrations below LDL	
Gaseous Standards		NIST Traceable (e.g., EPA Protocol Gas)	Vendor must participate in EPA Protocol Gas Verification Program 40 CFR Part 58 App A sec 2.6.1

Requirement	Frequency	Acceptance Criteria	Information /Action
Zero Air/ Zero Air Check	1/year	Concentrations below LDL	
Gas Dilution Systems	1/3 months	Accuracy ± 2 %	
Detection			
Noise	NA	0.005 ppm	40 CFR Part 53.20
Lower detectable level	1/year	0.01 ppm	40 CFR Part 53.20
SYSTEMATIC CRITERIA- SO₂			
Standard Reporting Units	All data	ppm (final units in AQS)	
Completeness (seasonal)	Quarterly	75%	Annual standard
	24 hours	75%	24-hour standard
	3 hours	75%	3-hour standard
Sample Residence Times		< 20 seconds	
Sample Probe, Inlet, Sampling train		Borosilicate glass (e.g., Pyrex [®]) or Teflon [®]	40 CFR Part 58 App E
Siting		Un-obstructed probe inlet	40 CFR Part 58 App E

PM_{2.5} Filter Based Local Conditions Validation Template

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.12)
CRITICAL CRITERIA- PM_{2.5} Filter Based Local Conditions			
Filter Holding Times			
Sample Recovery	all filters	≤ 7 days 9 hours from sample end date	Part 50 App L Sec 10.10
Post-sampling Weighing	all filters	≤ 10 days from sample end date if shipped at ambient temp, or ≤ 30 days if shipped below ave ambient (or 4° C or below for ave sampling temps < 4° C) from sample end date	Part 50 App L Sec 8..3.6
Sampling Period (including multiple power failures)	all filters	1380-1500 minutes, or value if < 1380 and exceedance of NAAQS ^{1/} midnight to midnight	Part 50 App L Sec 3.3 Part 50, App.L Sec 7.4.15
Sampling Instrument			
Average Flow Rate	every 24 hours of op	average within 5% of 16.67 liters/minute	Part 50 App L Sec 7.4
Variability in Flow Rate	every 24 hours of op	CV ≤ 2%	Part 50, App.L Sec 7.4.3.2
Filter			
Visual Defect Check (unexposed)	all filters	see reference	Part 50, App.L Sec 10.2
Filter Conditioning Environment			
Equilibration	all filters	24 hours minimum	Part 50, App.L Sec 8.2
Temp. Range	all filters	24-hr mean 20-23° C	Part 50, App.L Sec 8.2
Temp.Control	all filters	± 2° C SD* over 24 hr	Part 50, App.L Sec 8.2
Humidity Range	all filters	24-hr mean 30% - 40% RH or ≤ 5% sampling RH but > 20%RH	Part 50, App.L Sec 8.2
Humidity Control	all filters	± 5% SD* over 24 hr.	Part 50, App.L Sec 8.2
Pre/post Sampling RH	all filters	difference in 24-hr means ≤ ± 5% RH	Part 50, App.L Sec 8.3.3
Balance	all filters	located in filter conditioning environment	Part 50, App.L Sec 8.3.2
Verification/Calibration			
One-point Flow Rate Verification	1/4 weeks	± 4% of transfer standard	Part 50, App.L, Sec 9.2.5 Part 58, Appendix A Sec 3.2.3 & 3.3.2
OPERATIONAL EVALUATIONS TABLE PM_{2.5} Filter Based Local Conditions			
Filter Checks			
Lot Blanks	9 filters per lot	less than 15 μg change between weighings	Method 2.12 Sec. 7.7
Exposure Lot Blanks	3 filters per lot	less than 15 μg change between weighings	Method 2.12 Sec. 7.7
Filter Integrity (exposed)	each filter	no visual defects	Method 2.12 Sec. 8.2
Filter Holding Times			
Pre-sampling	all filters	< 30 days before sampling	Part 50, App.L Sec 8.3
Lab QC Checks			
Field Filter Blank	10% or 1 per weighing session	± 30 μg change between weighings	Part 50, App.L Sec 8.3
Lab Filter Blank	10% or 1 per weighing session	± 15 μg change between weighings	Part 50, App.L Sec 8.3
Balance Check	beginning, 10th sample, end	≤ 3 μg	Method Sec. 7.9
Duplicate Filter Weighing	1 per weighing session	± 15 μg change between weighings	Method Sec 7.11
Sampling Instrument			

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.12)
Individual Flow Rates	every 24 hours of op	no flow rate excursions > ±5% for > 5 min. ^{1/}	Part 50, App.L Sec 7.4.3.1
Filter Temp Sensor	every 24 hours of op	no excursions of > 5° C lasting longer than 30 min ^{1/}	Part 50, App.L Sec 7.4
Verification/Calibration			
Routine Verifications			
External Leak Check	every 5 sampling events	< 80 mL/min	Part 50, App.L, Sec 7.4
Internal Leak Check	every 5 sampling events	< 80 mL/min	Part 50, App.L, Sec 7.4
One-point Temp Verification	1/4 weeks	± 2° C	Part 50, App.L, Sec 9.3
Pressure Verification	1/4 weeks	± 10 mm Hg	Part 50, App.L, Sec 9.3
Lab Temperature	1/6 months	± 2° C	Method Sec 3.3
Lab Humidity	1/6 months	± 2%	Method Sec 3.3
Annual Multi-point Verifications /Calibrations			
Temperature multi-point Verification/Calibration	1/yr	± 2° C	Part 50, App.L, Sec 9.3
Pressure Verification/Calibration	on installation, then 1/yr	± 10 mm Hg	Part 50, App.L, Sec 9.3
Flow Rate Multi-point Verification/Calibration	1/yr	± 2% of transfer standard	Part 50, App.L, Sec 9.2
Design Flow Rate Adjustment	at one-point or multi-point	± 2% of design flow rate	Part 50, App.L, Sec 9.2.6
Other Monitor Calibrations	per manufacturers' op manual	per manufacturers' operating manual	
Mirobalance Calibration	1/yr	Manufacturer's specification	Part 50, App.L, Sec 8.1
Precision			
Collocated Samples	every 12 days for 15% of sites	CV ≤ 10% of samples > 3 µg/m ³	Part 58 App A Sec 3.2.5
Accuracy			
Temperature Audit	2/yr	± 2° C	Method Sec. 10.2
Pressure Audit	2/yr	± 10 mm Hg	Method Sec. 10.2
Balance Audit	1/yr	± 0.050 mg or manufacturers specs, whichever is tighter	Method Sec. 10.2
Semi Annual Flow Rate Audit	2/yr	± 4% of audit standard ± 5% of design flow rate	Part 58, App A, Sec 3.3.3
Calibration & Check Standards -			
Field Thermometer	1/yr	± 0.1° C resolution, ± 0.5° C accuracy	Method Sec 4.2 & 6.4
Field Barometer	1/yr	± 1 mm Hg resolution, ± 5 mm Hg accuracy	Method Sec 4.2 & 6.5
Working Mass Stds. (compare to primary standards)	1/3 mo.	0.025 mg	Method Sec 4.3 and 7.3
Monitor Maintenance			
Impactor (WINS) Very Sharp Cut Cyclone	every 5 sampling events Every 30 days	cleaned/changed	Method Sec 9.2
Inlet/downtube Cleaning	every 15 sampling events	cleaned	Method Sec 9.3
Filter Chamber Cleaning	1/4 weeks	cleaned	Method Sec 9.3

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.12)
Leak Check [@]		see <i>Verification/Calibration</i>	
Circulating Fan Filter Cleaning	1/4 weeks	cleaned/changed	Method Sec 9.3
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	
SYSTEMATIC CRITERIA -PM_{2.5} Filter Based Local Conditions			
Data Completeness	quarterly	≥ 75%	Part 50, App. N, Sec. 4.1 (b) 4.2 (a)
Reporting Units	all filters	μg/m ³ at ambient temp/pressure (PM _{2.5})	Part 50.3
Rounding Convention			
Annual 3-yr average	quarterly	nearest 0.1 μg/m ³ (≥ 0.05 round up)	Part 50, App. N Sec 2.3
24-hour, 3-year average	quarterly	nearest 1 μg/m ³ (≥ 0.5 round up)	Part 50, App. N Sec 2.3
Detection Limit			
Lower DL	all filters	≤ 2 μg/m ³	Part 50, App.L Sec 3.1
Upper Conc. Limit	all filters	≥ 200 μg/m ³	Part 50, App.L Sec 3.2
Verification/Calibration Standards Recertifications – All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	1/yr	± 2% of NIST-traceable Std.	Part 50, App.L Sec 9.1 & 9.2
Field Thermometer	1/yr	± 0.1° C resolution, ± 0.5° C accuracy	Method Sec 4.2.2
Field Barometer	1/yr	± 1 mm Hg resolution, ± 5 mm Hg accuracy	Method Sec 4.2.2
Primary Mass Stds. (compare to NIST-traceable standards)	1/yr	0.025 mg	Method Sec 4.3.7
Microbalance			
Readability	at purchase	1 μg	Part 50, App.L Sec 8.1
Repeatability	1/yr	1 μg	
Calibration & Check Standards			
Flow Rate Transfer Std.	1/yr	± 2% of NIST-traceable Std.	Part 50, APP L, Sec 9.1 & 9.2
Verification/Calibration			
Clock/timer Verification	1/4 weeks	1 min/mo	Part 50, App.L, Sec 7.4
Precision			
Single analyzer	1/3 mo.	Coefficient of variation (CV) ≤ 10%	
Single analyzer	1/ yr	CV ≤ 10%	
Primary Quality Assurance Org.	Annual and 3 year estimates	90% CL of CV ≤ 10%	Part 58, App A, Sec 4.3.1
Bias			
Performance Evaluation Program (PEP)	5 audits for PQAOs with ≤ 5 sites 8 audits for PQAOs with > 5 sites	± 10%	Part 58, App A, Sec 3.2.7, 4.3.2

1/ value must be flagged * SD= standard deviation CV= coefficient of variation [@] = Scheduled to occur immediately after impactor cleaned/changed.

NOTE: There may be a number of continuous monitors that may be designated as an FEM or an ARM. These monitors may have different measurement or sampling attributes that cannot be identified in this validation template. Monitoring organizations should review specific instrument operating manuals to augment this validation template as necessary. In general, 40 CFR Part 58 App A and 40 CFR part 50 App L requirements apply to Continuous PM2.5

Continuous PM2.5 Local Conditions Validation Template

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.12)
CRITICAL CRITERIA- PM_{2.5} Continuous, Local Conditions			
Sampling Period 24 hour estimate	every sample period	1380-1500 minutes, or value if < 1380 and exceedance of NAAQS ^{1/} midnight to midnight	Part 50 App L Sec 3.3 Part 50, App.L Sec 7.4.15
Hour estimate	Every hour	Instrument dependent	See operators manual
Sampling Instrument			
Average Flow Rate	every 24 hours of op	average within 5% of 16.67 liters/minute	Part 50 App L Sec 7.4
Variability in Flow Rate	every 24 hours of op	CV ≤ 2%	Part 50, App.L Sec 7.4.3.2
Verification/Calibration			
One-point Flow Rate Verification	1/4 weeks	± 4% of transfer standard	Part 50, App.L, Sec 9.2.5 Part 58, Appendix A Sec 3.2.3 & 3.3.2
Reference Membrane Verification (BAM)	Hourly	± 4% of ABS Value	
OPERATIONAL CRITERIA- PM_{2.5} Continuous, Local Conditions			
Verification/Calibration			
Leak Check	every 30 days	Instrument dependent	Part 50, App.L, Sec 7.4
Temperature Calibration	if multi-point failure	± 2°C	Part 50, App.L, Sec 9.3
Temp M-point Verification	on installation, then 1/yr	± 2°C	Part 50, App.L, Sec 9.3
One-point Temp Check	1/4 weeks	± 2°C	Part 50, App.L, Sec 9.3
Pressure Calibration	on installation, then 1/yr	± 10 mm Hg	Part 50, App.L, Sec 9.3
Pressure Verification	1/4 weeks	± 10 mm Hg	Part 50, App.L, Sec 9.3
Other Monitor Calibrations	per manufacturers' op manual	per manufacturers' operating manual	
Flow Rate (FR) Calibration	if multi-point verification failure	± 2%	Part 50, App.L, Sec 9.2
FR Multi-point Verification	1/yr	± 2%	Part 50, App.L, Sec 9.2
Design Flow Rate Adjustment	at one-point or multi-point	± 2% of design flow rate	Part 50, App.L, Sec 9.2.6
Precision			
Collocated Samples	every 12 days for 15% of sites	CV ≤ 10% of samples > 3 µg/m ³	Part 58 App A Sec 3.2.5

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.12)
Accuracy			
Temperature Audit	2/yr	± 2°C	Method 2.12 Sec. 10.2
Pressure Audit	2/yr	± 10 mm Hg	Method 2.12 Sec. 10.2
Semi Annual Flow Rate Audit	2/yr	± 4% of audit standard ± 5% of design flow rate	Method 2.12 Sec. 10.2
Calibration & Check Standards (working standards)			
Field Thermometer	1/yr	± 0.1° C resolution, ± 0.5° C accuracy	Method 2.12 Sec 4.2 & 6.4
Field Barometer	1/yr	± 1 mm Hg resolution, ± 5 mm Hg accuracy	Method 2.12 Sec 4.2 & 6.5
Shelter Temperature			
Temperature range	Daily (hourly values)	20 to 30° C. (Hourly ave) or per manufacturers specifications if designated to a wider temperature range	Generally the 20-30 ° C range will apply but the most restrictive operable range of the instruments in the shelter may also be used as guidance
Temperature Control	Daily (hourly values)	≤ ± 2° C SD over 24 hours	
Temperature Device Check	2/year	± 2°C	
Monitor Maintenance			
Virtual Impactor Very Sharp Cut Cyclone	Every 30 days	cleaned/changed	Method 2.12 Sec 9.2
Inlet Cleaning	Every 30 days	cleaned	Method 2.12 Sec 9.3
Filter Chamber Cleaning	1/4 weeks	cleaned	Method 2.12 Sec 9.3
Circulating Fan Filter Cleaning	1/4 weeks	cleaned/changed	Method 2.12 Sec 9.3
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	
SYSTEMATIC CRITERIA- PM_{2.5} Continuous, Local Conditions			
Data Completeness	quarterly	≥ 75%	Part 50, App. N, Sec. 4.1 (b) 4.2 (a)
Reporting Units		µg/m ³ at ambient temp/pressure (PM _{2.5})	Part 50.3
Rounding Convention			
Annual 3-yr average	quarterly	nearest 0.1 µg/m ³ (≥ 0.05 round up)	Part 50, App. N Sec 2.3
24-hour, 3-year average	quarterly	nearest 1 µg/m ³ (≥ 0.5 round up)	Part 50, App. N Sec 2.3
Detection Limit			
Lower DL	all filters	≤ 2 µg/m ³	Part 50, App.L Sec 3.1
Upper Conc. Limit	all filters	≥ 200 µg/m ³	Part 50, App.L Sec 3.2
Verification/Calibration Standards Recertifications - All standards should have multi-point certifications against NIST Traceable standards			

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.12)
Flow Rate Transfer Std.	1/yr	± 2% of NIST-traceable Std.	Part 50, App.L Sec 9.1 & 9.2
Field Thermometer	1/yr	± 0.1° C resolution, ± 0.5° C accuracy	Method 2.12 Sec 4.2.2
Field Barometer	1/yr	± 1 mm Hg resolution, ± 5 mm Hg accuracy	Method 2.12 Sec 4.2.2
Calibration & Check Standards			
Flow Rate Transfer Std.	1/yr	± 2% of NIST-traceable Std.	Part 50, APP L, Sec 9.1 & 9.2
Verification/Calibration			
Clock/timer Verification	1/4 weeks	1 min/mo**	Part 50, App.L, Sec 7.4
Precision			
Single analyzer	1/3 mo.	Coefficient of variation (CV) ≤ 10%	
Single analyzer	1/ yr	CV ≤ 10%	
Primary Quality Assurance Org.	Annual and 3 year estimates	90% CL of CV ≤ 10%	Part 58, App A, Sec 4.3.1
Bias			
Performance Evaluation Program (PEP)	5 audits for PQAOs with ≤ 5 sites 8 audits for PQAOs with > 5 sites	±10%	Part 58, App A, Sec 3.2.7, 4.3.2

1/ value must be flagged due to current implementation of BAM (sampling 42 minute/hour) only 1008 minutes of sampling in 24 hour period

*= not defined in CFR

SD= standard deviation

CV= coefficient of variation

@ = Scheduled to occur immediately after impactor cleaned/changed.

** = need to ensure data system stamps appropriate time period with reported sample value

NOTE: The following validation template was constructed for use of PM₁₀ at **local conditions** where PM₁₀ is used in the calculation of the PM_{10-2.5} measurement or for objectives other than comparison to the PM₁₀ NAAQS. Although the PM_{10-2.5} method is found in 40 CFR Part 50 Appendix O, Appendix O references Appendix L (the PM_{2.5} Method) for the QC requirements listed below. Monitoring organizations using PM₁₀ data for a NAAQS comparison purposes should refer to the PM₁₀ validation template for **STP** (standard temperature and pressure correction).

PM₁₀ Filter Based Local Conditions Validation Template

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.12)
CRITICAL CRITERIA- PM₁₀ Filter Based Local Conditions			
Filter Holding Times			
Sample Recovery	all filters	≤ 7 days 9 hours from sample end date	Part 50 App L Sec 10.10
Post-sampling Weighing	all filters	≤ 10 days from sample end date if shipped at ambient temp, or ≤ 30 days if shipped below ave ambient (or 4° C or below for ave sampling temps < 4° C) from sample end date	Part 50 App L Sec 8.3.6
Sampling Period (including multiple power failures)	all filters	1380-1500 minutes, or value if < 1380 and exceedance of NAAQS ^{1/} midnight to midnight	Part 50 App L Sec 3.3 Part 50, App.L Sec 7.4.15
Sampling Instrument			
Average Flow Rate	every 24 hours of op	average within 5% of 16.67 liters/minute	Part 50 App L Sec 7.4
Variability in Flow Rate	every 24 hours of op	CV ≤ 2%	Part 50, App.L Sec 7.4.3.2
Filter			
Visual Defect Check (unexposed)	all filters	see reference	Part 50, App.L Sec 10.2
Filter Conditioning Environment			
Equilibration	all filters	24 hours minimum	Part 50, App.L Sec 8.2
Temp. Range	all filters	24-hr mean 20-23° C	Part 50, App.L Sec 8.2
Temp.Control	all filters	± 2° C SD* over 24 hr	Part 50, App.L Sec 8.2
Humidity Range	all filters	24-hr mean 30% - 40% RH or ≤ 5% sampling RH but > 20%RH	Part 50, App.L Sec 8.2
Humidity Control	all filters	± 5% SD* over 24 hr.	Part 50, App.L Sec 8.2
Pre/post Sampling RH	all filters	difference in 24-hr means ≤ ± 5% RH	Part 50, App.L Sec 8.3.3
Balance	all filters	located in filter conditioning environment	Part 50, App.L Sec 8.3.2
Verification/Calibration			

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.12)
One-point Flow Rate Verification	1/4 weeks	± 4% of transfer standard	Part 50, App.L, Sec 9.2.5 Part 58, Appendix A Sec 3.2.3 & 3.3.2
OPERATIONAL EVALUATIONS TABLE PM₁₀ Filter Based Local Conditions			
Filter Checks			
Lot Blanks	9 filters per lot	less than 15 µg change between weighings	Method 2.12 Sec. 7.7
Exposure Lot Blanks	3 filters per lot	less than 15 µg change between weighings	Method 2.12 Sec. 7.7
Filter Integrity (exposed)	each filter	no visual defects	Method 2.12 Sec. 8.2
Filter Holding Times			
Pre-sampling	all filters	< 30 days before sampling	Part 50, App.L Sec 8.3
Lab QC Checks			
Field Filter Blank	10% or 1 per weighing session	± 30 µg change between weighings	Part 50, App.L Sec 8.3
Lab Filter Blank	10% or 1 per weighing session	± 15 µg change between weighings	Part 50, App.L Sec 8.3
Balance Check	beginning, 10th sample, end	≤ 3 µg	Method Sec. 7.9
Duplicate Filter Weighing	1 per weighing session	± 15 µg change between weighings	Method Sec 7.11
Sampling Instrument			
Individual Flow Rates	every 24 hours of op	no flow rate excursions > ± 5% for > 5 min. ^{1/}	Part 50, App.L Sec 7.4.3.1
Filter Temp Sensor	every 24 hours of op	no excursions of > 5° C lasting longer than 30 min ^{1/}	Part 50, App.L Sec 7.4
Verification/Calibration			
Routine Verifications			
External Leak Check	every 5 sampling events	< 80 mL/min	Part 50, App.L, Sec 7.4
Internal Leak Check	every 5 sampling events	< 80 mL/min	Part 50, App.L, Sec 7.4
One-point Temp Verification	1/4 weeks	± 2° C	Part 50, App.L, Sec 9.3
Pressure Verification	1/4 weeks	± 10 mm Hg	Part 50, App.L, Sec 9.3
Lab Temperature	1/6 months	± 2° C	Method Sec 3.3
Lab Humidity	1/6 months	± 2%	Method Sec 3.3
Annual Multi-point Verifications /Calibrations			
Temperature multi-point Verification/Calibration	1/yr	± 2° C	Part 50, App.L, Sec 9.3
Pressure Verification/Calibration	on installation, then 1/yr	± 10 mm Hg	Part 50, App.L, Sec 9.3
Flow Rate Multi-point Verification/ Calibration	1/yr	± 2% of transfer standard	Part 50, App.L, Sec 9.2

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.12)
Design Flow Rate Adjustment	at one-point or multi-point	± 2% of design flow rate	Part 50, App.L, Sec 9.2.6
Other Monitor Calibrations	per manufacturers' op manual	per manufacturers' operating manual	
Mirobalance Calibration	1/yr	Manufacturer's specification	Part 50, App.L, Sec 8.1
Precision			
Collocated Samples	every 12 days for 15% of sites	CV ≤ 10% of samples > 3 µg/m ³	Part 58 App A Sec 3.2.5
Accuracy			
Temperature Audit	2/yr	± 2°C	Method Sec. 10.2
Pressure Audit	2/yr	± 10 mm Hg	Method Sec. 10.2
Balance Audit	1/yr	± 0.050 mg or manufacturers specs, whichever is tighter	Method Sec. 10.2
Semi Annual Flow Rate Audit	2/yr	± 4% of audit standard ± 5% of design flow rate	Part 58, App A, Sec 3.3.3
Calibration & Check Standards (working standards)			
Field Thermometer	1/yr	± 0.1° C resolution, ± 0.5° C accuracy	Method Sec 4.2 & 6.4
Field Barometer	1/yr	± 1 mm Hg resolution, ± 5 mm Hg accuracy	Method Sec 4.2 & 6.5
Working Mass Stds. (compare to primary standards)	1/3 mo.	0.025 mg	Method Sec 4.3 and 7.3
Monitor Maintenance			
Inlet/downtube Cleaning	every 15 sampling events	cleaned	Method Sec 9.3
Filter Chamber Cleaning	1/4 weeks	cleaned	Method Sec 9.3
Leak Check [®]		see <i>Verification/Calibration</i>	
Circulating Fan Filter Cleaning	1/4 weeks	cleaned/changed	Method Sec 9.3
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	
SYSTEMATIC CRITERIA -PM₁₀ Filter Based Local Conditions			
Data Completeness	quarterly	≥ 75%	Part 50, App. N, Sec. 2.1
Reporting Units	all filters	µg/m ³ at ambient temp/pressure (PM _{2.5})	Part 50.3
Rounding Convention			
Annual 3-yr average	quarterly	nearest 0.1 µg/m ³ (≥ 0.05 round up)	Part 50, App. N Sec 2.3
24-hour, 3-year average	quarterly	nearest 1 µg/m ³ (≥ 0.5 round up)	Part 50, App. N Sec 2.3
Detection Limit			
Lower DL	all filters	≤ 2 µg/m ³	Part 50, App.L Sec 3.1

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.12)
Upper Conc. Limit	all filters	$\geq 200 \mu\text{g}/\text{m}^3$	Part 50, App.L Sec 3.2
Verification/Calibration Standards Recertifications- All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	1/yr	$\pm 2\%$ of NIST-traceable Std.	Part 50, App.L Sec 9.1 & 9.2
Field Thermometer	1/yr	$\pm 0.1^\circ \text{C}$ resolution, $\pm 0.5^\circ \text{C}$ accuracy	Method Sec 4.2.2
Field Barometer	1/yr	$\pm 1 \text{ mm Hg}$ resolution, $\pm 5 \text{ mm Hg}$ accuracy	Method Sec 4.2.2
Primary Mass Stds. (compare to NIST-traceable standards)	1/yr	0.025 mg	Method Sec 4.3.7
Microbalance			
Readability	at purchase	1 μg	Part 50, App.L Sec 8.1
Repeatability	1/yr	1 μg	
Calibration & Check Standards			
Flow Rate Transfer Std.	1/yr	$\pm 2\%$ of NIST-traceable Std.	Part 50, APP L, Sec 9.1 & 9.2
Verification/Calibration			
Clock/timer Verification	1/4 weeks	1 min/mo	Part 50, App.L, Sec 7.4
Precision			
Single analyzer	1/3 mo.	Coefficient of variation (CV) $\leq 10\%$	
Single analyzer	1/ yr	CV $\leq 10\%$	
Primary Quality Assurance Org.	Annual and 3 year estimates	90% CL of CV $\leq 10\%$	Part 58, App A, Sec 4.3.1
Bias			
Performance Evaluation Program (PEP)	5 audits for PQAOs with ≤ 5 sites 8 audits for PQAOs with > 5 sites	$\pm 10\%$	Part 58, App A, Sec 3.2.7, 4.3.2

1/ value must be flagged

SD= standard deviation

CV= coefficient of variation

@ = Scheduled to occur immediately after impactor cleaned/changed.

PM₁₀ Filter Based Dichot **STP Conditions Validation Template**

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.10)
CRITICAL CRITERIA- PM₁₀ Filter Based Dichot			
Filter Holding Times			
Sample Recovery	all filters	ASAP	Part 50 App J sec 9.16
Sampling Period	all filters	1440 minutes ± 60 minutes midnight to midnight	Part 50 App J sec 7.1.5
Sampling Instrument			
Average Flow Rate	every 24 hours of op	average 16.67 liters/minute	Method 2.10 sec 2.1
Filter			
Visual Defect Check (unexposed)	all filters	see reference	Method 2.10 sec 4.2
Collection efficiency	all filters	99 %	Part 50, App J sec 7.2.2
Integrity	all filters	± 5 µg/m ³	Part 50, App J sec 7.2.3
Alkalinity	all filters	< 25.0 microequivalents/gram	Part 50, App J sec 7.2.4
Filter Conditioning Environment			
Equilibration	all filters	24 hours minimum	Part 50, App.J sec 9.3
Temp. Range	all filters	15-30° C	Part 50, App.J sec 7.4.1
Temp.Control	all filters	± 3° C SD* over 24 hr	Part 50, App.J sec 7.4.2
Humidity Range	all filters	20% - 45% RH	Part 50, App.J sec 7.4.3
Humidity Control	all filters	± 5% SD* over 24 hr	Part 50, App.J sec 7.4.4
Pre/post Sampling RH	all filters	difference in 24-hr means ≤ ± 5% RH	Part 50, App.L sec 8.3.3
Balance	all filters	located in filter conditioning environment	Part 50, App.L sec 8.3.2
Verification/Calibration			
One-point Flow Rate Verification	1/4 weeks	± 7% of transfer standard and 10% from design	Method 2.10 sec Table 3-1
OPERATIONAL EVALUATIONS TABLE PM₁₀ Filter Based Dichot			
Lab QC Checks			
Balance Check	beginning, 10th sample, end	≤4 µg of true zero ≤2 µg of 10 mg check weight	Method 2.10 sec 4.5
“Standard” filter QC check	10%	± 20 µg change from original value	Method 2.10 sec 4.5 From standard non-routine filter
“Routine” duplicate weighing	5-7 per weighing session	± 20 µg change from original value	Method 2.10 sec 4.5 From routine filter set
Verification/Calibration			
System Leak Check	During precalibration check	Vacuum of 10 to 15 in. with decline to 0 >60 seconds	Method 2.10 sec 2.2.1
FR Multi-point Verification/Calibration	1/yr	± 2%	Part 50, App.L, sec 9.2
Field Temp M-point Verification	on installation, then 1/yr	± 2° C	
Lab Temperature	1/6 months	± 2° C	recommendation
Lab Humidity	1/6 months	± 2%	recommendation
Microbalance Calibration	1/yr	Manufacturer’s specification	
Precision			

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.10)
Collocated Samples	every 12 days for 15% of sites	$CV \leq 10\%$ of samples $> 3 \mu\text{g}/\text{m}^3$	Part 58 App A sec 3.2.5
Audits			
Filter Weighing	1/yr	$\pm 20 \mu\text{g}$ change from original value	Method 2.10 Table 7-1
Balance Audit	1/yr	Observe weighing technique and check balance with ASTM Class 1 standard	Method 2.10 Table 7-1 section 7.2.2
Semi Annual Flow Rate Audit	2/yr	$\pm 4\%$ of audit standard $\pm 5\%$ of design flow rate	Part 58, App A, sec 3.3.3
Monitor Maintenance			
Impactor	1/3 mo	cleaned/changed	Method 2.10 sec 6.1.2
Inlet/downtube Cleaning	1/3 mo	cleaned	Method 2.10 sec 6.1.2
Vacuum pump	1/yr	Replace diaphragm and flapper valves	Method 2.10 sec 6.1.3
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	
SYSTEMATIC CRITERIA - PM₁₀ Filter Based Dichot			
Data Completeness	quarterly	$\geq 75\%$	Part 50 App. K, sec. 2.3
Reporting Units	all filters	$\mu\text{g}/\text{m}^3$ at standard temperature and pressure (STP)	Part 50 App K
Rounding Convention			
24-hour, 3-year average	quarterly	nearest $10 \mu\text{g}/\text{m}^3$ (≥ 5 round up)	Part 50 App K sec 1
Verification/Calibration Standards and Recertifications - All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	1/yr	$\pm 2\%$ of NIST-traceable Std.	Part 50, App.J sec 7.3
Field Thermometer	1/yr	$\pm 0.1^\circ \text{C}$ resolution, $\pm 0.5^\circ \text{C}$ accuracy	
Field Barometer	1/yr	$\pm 1 \text{ mm Hg}$ resolution, $\pm 5 \text{ mm Hg}$ accuracy	
Primary Mass Stds. (compare to NIST-traceable standards)	1/yr	NIST traceable (e.g., ANSI/ASTM Class 1, 1.1 or 2)	Method 2.10 sec 9
Microbalance			
Readability	at purchase	$1 \mu\text{g}$	Method 2.10 sec 4.4
Repeatability	1/yr	$1 \mu\text{g}$	Method 2.10 sec 4.4
Calibration & Check Standards			
Flow Rate Transfer Std.	1/yr	$\pm 2\%$ of NIST-traceable Std.	Method 2.10 sec 9
Verification/Calibration			
Clock/timer Verification	4/year	5 min/mo	recommendation
Precision			
Single analyzer	1/3 mo.	Coefficient of variation (CV) $\leq 10\%$	recommendation
Single analyzer	1/ yr	$CV \leq 10\%$	recommendation
Primary Quality Assurance Org.	Annual and 3 year estimates	90% CL of $CV \leq 10\%$	Part 58, App A, sec 4.3.1

SD= standard deviation CV= coefficient of variation

PM₁₀ Filter Based High Volume (HV) STP Conditions Validation Template

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.11)
CRITICAL CRITERIA- PM₁₀ Filter Based Hi-Vol			
Filter Holding Times			
Sample Recovery	all filters	ASAP	Part 50 App J sec 9.16
Sampling Period	all filters	1440 minutes ± 60 minutes midnight to midnight	Part 50 App J sec 7.1.5
Sampling Instrument			
Average Flow Rate	every 24 hours of op	~1.13 m ³ /min (varies with instrument)	Method 2.11
Filter			
Visual Defect Check (unexposed)	all filters	see reference	Method 2.10 sec 4.2
Collection efficiency	all filters	99 %	Part 50, App J sec 7.2.2
Integrity	all filters	± 5 µg/m ³	Part 50, App J sec 7.2.3
Alkalinity	all filters	< 25.0 microequivalents/gram	Part 50, App J sec 7.2.4
Filter Conditioning Environment			
Equilibration	all filters	24 hours minimum	Part 50, App.J sec 9.3
Temp. Range	all filters	15-30° C	Part 50, App.J sec 7.4.1
Temp.Control	all filters	± 3° C SD* over 24 hr	Part 50, App.J sec 7.4.2
Humidity Range	all filters	20% - 45% RH	Part 50, App.J sec 7.4.3
Humidity Control	all filters	± 5% SD* over 24 hr	Part 50, App.J sec 7.4.4
Pre/post Sampling RH	all filters	difference in 24-hr means ≤ ± 5% RH	recommendation
Balance	all filters	located in filter conditioning environment	recommendation
Verification/Calibration			
One-point Flow Rate Verification	1/3 mo	± 7% of transfer standard and 10% from design	Method 2.10 sec Table 3-1
OPERATIONAL EVALUATIONS TABLE PM₁₀ Filter Based Hi-Vol			
Lab QC Checks			
Balance Check	beginning, 10th sample, end	± 0.5 mg of true zero and ± 0.5 mg 1-5 g check weight	Method 2.11 sec 4.5
“Routine” duplicate weighing	5-7 per weighing session	± 2.8 mg change from original value	Method 2.11 sec 4.5.3 From routine filter set
Verification/Calibration			
System Leak Check	During precalibration check	Auditory inspection with faceplate blocked	Method 2.11 sec 2.3.2
FR Multi-point Verification/Calibration	1/yr	3 of 4 cal points within ± 10% of design	Method 2.11 sec 2.3.2

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.11)
Field Temp M-point Verification	on installation, then 1/yr	± 2°C	
Lab Temperature	1/6 months	± 2°C	recommendation
Lab Humidity	1/6 months	± 2%	recommendation
Microbalance Calibration	1/yr	Manufacturer's specification	
Precision			
Collocated Samples	every 12 days for 15% of sites	CV ≤ 10% of samples > 15 µg/m ³	Part 58 App A sec 3.2.5
Audits			
Filter Weighing	1/yr	± 5 mg change from original value	Method 2.11 Table 7-1
Balance Audit	1/yr	Observe weighing technique and check balance with ASTM Class 1 standard	Method 2.10 Table 7-1
Semi Annual Flow Rate Audit	2/yr	± 10% of audit standard and design value	Part 58, App A, sec 3.3.3
Monitor Maintenance			
Inlet/downtube Cleaning	1/3 mo	cleaned	Method 2.11 sec 6
Motor/housing gaskets	1/3 mo	Inspected replaced	Method 2.11 sec 6
Blower motor brushes	600-1000 hours	Replace	Method 2.11 sec 6
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	
SYSTEMATIC CRITERIA - PM₁₀ Filter Based Hi-Vol			
Data Completeness	quarterly	≥ 75%	Part 50 App. K, sec. 2.3
Reporting Units	all filters	µg/m ³ at standard temperature and pressure (STP)	Part 50 App K
Rounding Convention			
24-hour, 3-year average	quarterly	nearest 10 µg/m ³ (≥ 5 round up)	Part 50 App K sec 1
Verification/Calibration Standards and Recertifications - All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	1/yr	± 2% of NIST-traceable Std.	Part 50, App.J sec 7.3
Field Thermometer	1/yr	± 0.1° C resolution, ± 0.5° C accuracy	
Field Barometer	1/yr	± 1 mm Hg resolution, ± 5 mm Hg accuracy	
Primary Mass Stds. (compare to NIST-traceable standards)	1/yr	NIST traceable (e.g., ANSI/ASTM Class 1, 1.1 or 2)	Method 2.11 sec 9
Microbalance			
Readability	at purchase	0.1 mg	Method 2.11 sec 4.4
Repeatability	1/yr	0.5 mg (HV)	Method 2.11 sec 4.4
Calibration & Check Standards			

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.11)
Flow Rate Transfer Std.	1/yr	± 2% of NIST-traceable Std.	Method 2.10 sec 9
Verification/Calibration			
Clock/timer Verification	4/year	5 min/mo	recommendation
Precision			
Single analyzer	1/3 mo.	Coefficient of variation (CV) ≤ 10%	recommendation
Single analyzer	1/ yr	CV ≤ 10%	recommendation
Primary Quality Assurance Org.	Annual and 3 year estimates	90% CL of CV ≤ 10%	Part 58, App A, sec 4.3.1

SD= standard deviation

CV= coefficient of variation

Continuous PM10 STP Conditions Validation Template

NOTE: There are a number of continuous PM10 monitors that are designated as FEM. These monitors may have different measurement or sampling attributes that cannot be identified in this validation template. Monitoring organizations should review specific instrument operating manuals to augment this validation template as necessary. In general, 40 CFR Part 58 App A and 40 CFR part 50 App J requirements apply to Continuous PM10. Since a guidance document was never developed for continuous PM10, many of the requirements reflect a combination of manual and continuous PM2.5 requirements and are therefore considered recommendations.

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.11)
CRITICAL CRITERIA- PM₁₀ Continuous			
Sampling Period	all filters	1440 minutes \pm 60 minutes midnight to midnight	Part 50 App J sec 7.1.5
Sampling Instrument			
Average Flow Rate	every 24 hours of op	Average within \pm 5% of design	recommendation
Verification/Calibration			
One-point Flow Rate Verification	1/mo	\pm 7% of transfer standard and 10% from design	Part 58, App A, sec 3.2.3
OPERATIONAL EVALUATIONS TABLE PM₁₀ Continuous			
Verification/Calibration			
System Leak Check	During precalibration check	Auditory inspection with faceplate blocked	Method 2.11 sec 2.3.2
FR Multi-point Verification/Calibration	1/yr	3 of 4 cal points within \pm 10% of design	Method 2.11 sec 2.3.2
Audits			
Semi Annual Flow Rate Audit	1/6 mo	\pm 10% of audit standard and design value	Part 58, App A, sec 3.2.4
Monitor Maintenance			
Inlet/downtube Cleaning	1/3 mo	cleaned	Method 2.11 sec 6
Motor/housing gaskets	1/3 mo	Inspected replaced	Method 2.11 sec 6
Blower motor brushes	600-1000 hours	Replace	Method 2.11 sec 6
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	
SYSTEMATIC CRITERIA - PM₁₀ Continuous			
Data Completeness	quarterly	\geq 75%	Part 50 App. K, sec. 2.3
Reporting Units	all filters	$\mu\text{g}/\text{m}^3$ at standard temperature and pressure (STP)	Part 50 App K
Rounding Convention			

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.11)
24-hour, 3-year average	quarterly	nearest 10 $\mu\text{g}/\text{m}^3$ (≥ 5 round up)	Part 50 App K sec 1
Verification/Calibration Standards and Recertifications - All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	1/yr	$\pm 2\%$ of NIST-traceable Std.	Part 50, App.J sec 7.3
Field Thermometer	1/yr	$\pm 0.1^\circ\text{C}$ resolution, $\pm 0.5^\circ\text{C}$ accuracy	recommendation
Field Barometer	1/yr	$\pm 1\text{ mm Hg}$ resolution, $\pm 5\text{ mm Hg}$ accuracy	recommendation
Calibration & Check Standards			
Flow Rate Transfer Std.	1/yr	$\pm 2\%$ of NIST-traceable Std.	Method 2.10 sec 9
Verification/Calibration			
Clock/timer Verification	4/year	5 min/mo	recommendation

Pb High Volume (TSP) Validation Template

Note: in 2008, the NAAQS was lowered for Pb and new monitoring rules were promulgated which allowed for the use of federal equivalent analytical methods and the use of PM₁₀ sampling in certain circumstances. The following information is guidance based on the current FRM which is sampling by TSP and analysis by atomic absorption. Information in this table is derived from the TSP sampling method in 40 CFR Part 50 App B, and QA Handbook Method 2.2 (1977). The analytical requirements/guidance is derived from 40 CFR Part 50, App G and QA Handbook Method 2.8 (1981). Monitoring for Pb based on the new NAAQS requirements will begin in calendar year 2010. **In 2009, new guidance related to analytical FEM (ICP-MS, XRF, etc.) will be developed and included as additional guidance for Pb. Revised and/or additional Pb validation templates will be included in this section and posted on AMTIC.**

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.2 or 2.8)
CRITICAL CRITERIA- Pb in TSP			
Filter Holding Times			
Sample Recovery	all filters	ASAP	Part 50 App B
Sampling Period	all filters	1440 minutes ± 60 minutes midnight to midnight	Part 50 App B sec 8.15
Sampling Instrument			
Average Flow Rate	every 24 hours of op	1.1-1.70 m ³ /min (varies with instrument)	Part 50 App B sec 8.8
Filter			Part 50 App B sec 7.1
Visual Defect Check (unexposed)	all filters	see reference	Part 50 App B sec 8.2
Collection Efficiency	all filters	99 %	Part 50 App B sec 7.1.4
Pressure Drop Range	all filters	42-54 mm Hg	Part 50 App B sec 7.1.5
pH	all filters	6-10	Part 50, App B sec 7.1.6
Pb Content	all filters pre-sampling batch check	<75 µg/filter	Part 50, App G sec 6.1.1 Method 2.8 sec 6.2.1
Verification/Calibration			
One-point Flow Rate Verification	1/3 mo	±7% from design transfer standard ±10% from design	Part 58 App A Method 2.2 sec 2.6
Calibration Reproducibility Checks	Beginning, every 10 samples and end	± 5% of value predicted by calibration curve	Part 50, App G Sec 9.3
Reagent Blank	Every analytical batch	< LDL	recomendation
Daily Calibration	Daily	until good agreement is obtained among replicates	Method 2.8 sec 2.8.5
OPERATIONAL EVALUATIONS TABLE Pb in TSP			
Verification/Calibration			
System Leak Check	During precalibration check	Auditory inspection with faceplate blocked	Method 2.2 sec 2.0

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.2 or 2.8)
FR Multi-point Verification/Calibration	After receipt, after motor maintenance or failure of 1-point check and 1/yr	5 points over range of 1.1 to 1.7 m ³ /min within ± 5% limits of linearity	Method 2.2 sec 2.6
Precision			
Collocated Samples	15% of each method code in PQAQ Frequency - every 12 days	CV ≤ 20% of samples > 0.02 μg/m ³ (cutoff value)	Part 58 App A sec 3.2.5
Audits			
Semi Annual Flow Rate Audit	2/yr	± 10% of audit standard and design value	Part 58, App A, sec 3.3.3
Lead Strip Analysis	6 strips/quarter 3/conc.	10% (percent difference)	Part 58, App A, sec 3.3.3
Blanks			
Field Filter Blank	1/quarter	< LDL	recommendation
Monitor Maintenance			
Inlet cleaning	1/3 mo	cleaned	recommendation
Motor/housing gaskets	~400 hours	Inspected replaced	Method 2.2 sec 7
Blower motor brushes	400-500	Replace	Method 2.2 sec 7
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	NA
SYSTEMATIC CRITERIA - Pb Filter Based Hi-Vol			
Data Completeness	quarterly	three -month mean (i.e., the 3-month data capture rate) ≥ 75%	Part 50 App. R, sec. 4
Reporting Units	all filters	μg/m ³ at local temperature and pressure.	Part 50 App R
Rounding Convention			
3-month arithmetic mean	quarterly	Report data to 3 decimal places (data after 3 are truncated.	Part 50 App R
Lower Detectable Limit			
Atomic Absorption		0.07 μg/m ³	Part 50 App G sec 2.3
Verification/Calibration Standards and Recertifications - All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	1/yr	Resolution 0.02 m ³ /min ± 2% reproducibility	Part 50, App.B sec 7.8
Field Thermometer	1/yr	2° C resolution	Part 50, App.B sec 7.5
Field Barometer	1/yr	± 5 mm Hg resolution	Part 50, App.B sec 7.6
Analytical Standards			

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.2 or 2.8)
Reagents (HNO ₃ and HCL)		ACS reagent grade	Part 50 App G sec.6.2
Pb nitrate Pb (NO ₃) ₂		ACS reagent grade (99.0% purity)	Part 50 App G sec.6.2
Verification/Calibration			
Clock/timer Verification	4/year	5 min/mo	recommendation
Precision			
Single analyzer	1/3 mo.	Coefficient of variation (CV) ≤ 20%	recommendation
Single analyzer	1/ yr	CV ≤ 20%	recommendation
Primary Quality Assurance Org.	Annual and 3 year estimates	90% CL of CV ≤ 20%	Part 58, App A, sec 4.3.1
Bias Performance Evaluation Program (PEP)	5 audits for PQAOs with ≤ 5 sites 8 audits for PQAOs with > 5 sites	95% CL Absolute bias ±15%	Part 58, App A, Sec 2.3.1

SD= standard deviation

CV= coefficient of variation