Subpart D—National Air Monitoring Stations (NAMS)

§ 58.30 Special considerations for data comparisons to the NAAQS.

(a) Comparability of PM\textsubscript{2.5} data. (1) There are two forms of the PM\textsubscript{2.5} NAAQS described in part 50 of this chapter. The PM\textsubscript{2.5} monitoring site characteristics (see appendix D to this part, section 4.7.1) impact how the resulting PM\textsubscript{2.5} data can be compared to the annual PM\textsubscript{2.5} NAAQS form. PM\textsubscript{2.5} data that are representative, not of areawide but rather, of relatively unique population-oriented microscale, or localized hot spot, or unique population-oriented middle-scale impact sites are only eligible for comparison to the 24-hour PM\textsubscript{2.5} NAAQS. For example, if the PM\textsubscript{2.5} monitoring site is adjacent to a unique dominating local PM\textsubscript{2.5} source or can be shown to have average 24-hour concentrations representative of a smaller than neighborhood spatial scale, then data from a monitor at the site would only be eligible for comparison to the 24-hour PM\textsubscript{2.5} NAAQS.

(2) There are cases where certain population-oriented microscale or middle scale PM\textsubscript{2.5} monitoring sites are determined by the Regional Administrator to collectively identify a larger region of localized high ambient PM\textsubscript{2.5} concentrations. In those cases, data from these population-oriented sites would be eligible for comparison to the annual PM\textsubscript{2.5} NAAQS.

(b) Reporting is required for all individual MSA with a population exceeding 350,000.

(c) The population of a MSA for purposes of index reporting is the most recent decennial U.S. census population.

[71 FR 61302, Oct. 17, 2006]

Subpart E [Reserved]

Subpart F—Air Quality Index Reporting

§ 58.50 Index reporting.

(a) The State or where applicable, local agency shall report to the general public on a daily basis through prominent notice an air quality index that complies with the requirements of appendix G to this part.

(b) Reporting is required for all individual MSA with a population exceeding 350,000.

(c) The population of a MSA for purposes of index reporting is the most recent decennial U.S. census population.

[71 FR 61302, Oct. 17, 2006]
Environmental Protection Agency

which also meet the requirements of Appendix E of this part. Monitoring organizations are encouraged to develop and maintain quality systems more extensive than the required minimums. The permit-granting authority for PSD may require more frequent or more stringent requirements. Monitoring organizations may, based on their quality objectives, develop and maintain quality systems beyond the required minimum. Additional guidance for the requirements reflected in this appendix can be found in the “Quality Assurance Handbook for Air Pollution Measurement Systems”, volume II, part 1 (see reference 10 of this appendix) and at a national level in references 1, 2, and 3 of this appendix.

1.1 Similarities and Differences Between SLAMS and PSD Monitoring. In most cases, the quality assurance requirements for SLAMS, SPMs if applicable, and PSD are the same. Affected SPMs are subject to all the SLAMS requirements, even where not specifically stated in each section. Table A–1 of this appendix summarizes the major similarities and differences of the requirements for SLAMS and PSD. Both programs require:

(a) The development, documentation, and implementation of an approved quality system;
(b) The assessment of data quality;
(c) The use of reference, equivalent, or approved methods. The requirements of this appendix do not apply to a SPM that does not use a FRM, FEM, or ARM;
(d) The use of calibration standards traceable to NIST or other primary standard;
(e) Performance evaluations and systems.

1.1.1 The monitoring and quality assurance responsibilities for SLAMS are with the State or local agency, hereafter called the monitoring organization, whereas for PSD they are with the owner/operator seeking the permit. The monitoring duration for SLAMS is indefinite, whereas for PSD the duration is usually 12 months. Whereas the reporting period for precision and accuracy data is on an annual or calendar quarter basis for SLAMS, it is on a continuing sampler quarter basis for PSD, since the monitoring may not commence at the beginning of a calendar quarter.

1.1.2 The annual performance evaluations (described in section 3.2.2 of this appendix) for PSD must be conducted by personnel different from those who perform routine span checks and calibrations, whereas for SLAMS, it is the preferred but not the required condition. For PSD, the evaluation rate is 100 percent of the sites per reporting quarter whereas for SLAMS it is 25 percent of the sites or instruments quarterly. Monitoring for sulfur dioxide (SO\textsubscript{2}) and nitrogen dioxide (NO\textsubscript{2}) for PSD must be done with automated analyzers—the manual bubbler methods are not permitted.

1.1.3 The requirements for precision assessment for the automated methods are the same for both SLAMS and PSD. However, for manual methods, only one collocated site is required for PSD.

1.1.4 The precision, accuracy and bias data for PSD are reported separately for each sampler (site), whereas for SLAMS, the report may be by sample site, by primary quality assurance organization, or nationally, depending on the pollutant. SLAMS data are required to be reported to the AQS; PSD data are required to be reported to the permit-granting authority. Requirements in this appendix, with the exception of the differences discussed in this section, and in Table A–1 of this appendix will be expected to be followed by both SLAMS and PSD networks unless directly specified in a particular section.

1.2 Measurement Uncertainty. Measurement uncertainty is a term used to describe deviations from a true concentration or estimate that are related to the measurement process and not to spatial or temporal population attributes of the air being measured. Monitoring organizations must develop quality assurance project plans (QAPP) which describe how the organization intends to control measurement uncertainty to an appropriate level in order to achieve the objectives for which the data are collected. The process by which one determines the quality of data needed to meet the monitoring objective is sometimes referred to the Data Quality Objectives Process. Data quality indicators associated with measurement uncertainty include:

(a) Precision. A measurement of mutual agreement among individual measurements of the same property usually under prescribed similar conditions, expressed generally in terms of the standard deviation.
(b) Bias. The systematic or persistent distortion of a measurement process which causes errors in one direction.
(c) Accuracy. The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (imprecision) and systematic error (bias) components which are due to sampling and analytical operations.
(d) Completeness. A measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions.
(e) Detectability. The low critical range value of a characteristic that a method specific procedure can reliably discern.

1.3 Measurement Quality Checks. The SLAMS measurement quality checks described in sections 3.2 and 3.3 of this appendix shall be reported to AQS and are included in the data required for certification. The PSD network is required to implement the measurement quality checks and submit this
information quarterly along with assessment information to the permit-granting authority.

1.4 Assessments and Reports. Periodic assessments and documentation of data quality are required to be reported to EPA or to the permit granting authority (PSD). To provide national uniformity in this assessment and reporting of data quality for all networks, specific assessment and reporting procedures are prescribed in detail in sections 3, 4, and 5 of this appendix. On the other hand, the selection and extent of the quality assurance and quality control activities used by a monitoring organization depend on a number of local factors such as field and laboratory conditions, the objectives for monitoring, the level of data quality needed, the expertise of assigned personnel, the cost of control procedures, pollutant concentration levels, etc. Therefore, quality system requirements in section 2 of this appendix are specified in general terms to allow each monitoring organization to develop a quality system that is most efficient and effective for its own circumstances while achieving the data quality objectives required for the SLAMS sites.

2. QUALITY SYSTEM REQUIREMENTS

A quality system is the means by which an organization manages the quality of the monitoring information it produces in a systematic, organized manner. It provides a framework for planning, implementing, assessing and reporting work performed by an organization and for carrying out required quality assurance and quality control activities.

2.1 Quality Management Plans and Quality Assurance Project Plans. All monitoring organizations must develop a quality system that is described and approved in a monitoring organization's quality assurance management function - that aspect of the overall management system of the organization that determines and implements the quality policy defined in a monitoring organization's QMP. Quality management includes strategic planning, allocation of resources and other systematic planning activities (e.g., planning, implementation, assessing and reporting) pertaining to the quality system. The quality assurance management function must have sufficient technical expertise and management authority to conduct independent oversight and assure the implementation of the organization's quality system relative to the ambient air quality monitoring program and should be organizationally independent of environmental data generation activities.

2.3 Data Quality Performance Requirements.

2.3.1 Data Quality Objectives. Data quality objectives (DQO) or the results of other systematic planning processes are statements that define the appropriate type of
data to collect and specify the tolerable levels of potential decision errors that will be used as a basis for establishing the quality and quantity of data needed to support the objectives of the monitoring programs. QA/QC will be developed by EPA to support the primary objectives of these programs. QA/QC will be made by a flow measuring instrument that is traceable to an authoritative volume or other applicable standard. Guidance for certifying some types of flowmeters is provided in reference 10 of this appendix. Vendors advertising certification with the procedures provided in reference 4 of this appendix for guidance on primary and transfer standards for O₃ must be obtained in accordance with the ultra violet photometric calibration procedure specified in appendix D to part 50 of this chapter, or by means of a certified O₃ transfer standard. Consult references 7 and 8 of this appendix for guidance on primary and transfer standards for O₃. Flow rate measurements must be made by a flow measuring instrument that is traceable to an authoritative volume or other applicable standard. Guidance for certifying some types of flowmeters is provided in reference 18 of this appendix.

2.3.1.1 Measurement Uncertainty for Automated and Manual PM₃, Methods. The goal for acceptable measurement uncertainty is defined as 10 percent coefficient of variation (CV) for total precision and plus or minus 10 percent for total bias.

2.3.1.2 Measurement Uncertainty for Automated Ozone Methods. The goal for acceptable measurement uncertainty is defined as an upper 90 percent confidence limit for the absolute bias of 15 percent.

2.3.1.3 Measurement Uncertainty for PM₁₀⁻₂.₅ Methods. The goal for acceptable measurement uncertainty is defined as an upper 90 percent confidence limit for the coefficient variation (CV) of 15 percent and for bias as an upper 95 percent confidence limit for the absolute bias of 7 percent.

2.3.1.4 Measurement Uncertainty for PM₂.₅ Methods. The goal for acceptable measurement uncertainty is defined for precision as an upper 90 percent confidence limit for the coefficient variation (CV) of 20 percent and for bias as an upper 95 percent confidence limit for the absolute bias of 7 percent.

2.3.1.5 Measurement Uncertainty for NO₂. The goal for acceptable measurement uncertainty is defined for precision as an upper 90 percent confidence limit for the coefficient of variation (CV) of 15 percent and for bias as an upper 95 percent confidence limit for the absolute bias of 15 percent.

2.3.1.6 Measurement Uncertainty for SO₂. The goal for acceptable measurement uncertainty is defined for precision as an upper 90 percent confidence limit for the coefficient of variation (CV) of 15 percent and for bias as an upper 95 percent confidence limit for the absolute bias of 15 percent.

2.3.2 Measurement Uncertainty for NO, CO, and H₂S. Monitoring plans or the QAPP shall provide for the implementation of a program of independent and adequate audits of all monitors providing data for SLAMS and PSD including the provision of adequate resources for such audit programs. A monitoring plan (or QAPP) which provides for monitoring organization participation in EPA’s National Performance Audit Program (NPAP) and the PM Performance Evaluation Program (PEP) program and which indicates the consent of the monitoring organization for monitoring activities, will be deemed by EPA to meet this requirement. For clarification and to participate, monitoring organizations should contact either the appropriate EPA Regional Quality Assurance (QA) Coordinator at the appropriate EPA Regional Office location, or the NPAP Coordinator at the Air Quality Assessment Division, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency in Research Triangle Park, North Carolina.

2.5 Technical Systems Audit Program. Technical systems audits of each ambient air monitoring organization shall be conducted at least every 3 years by the appropriate EPA Regional Office and reported to the AQS. Systems audit programs are described in reference 10 of this appendix. For further instructions, monitoring organizations should contact the appropriate EPA Regional QA Coordinator.

2.6 Gaseous and Flow Rate Audit Standards.

2.6.1 Gaseous pollutant concentration standards (permeation devices or cylinders of compressed gas) used to obtain test concentrations for carbon monoxide (CO), sulfur dioxide (SO₂), nitrogen oxide (NO), and nitrogen dioxide (NO₂) must be traceable to either a National Institute of Standards and Technology (NIST) Traceable Reference Material (NTRM) or a NIST-certified Gas Manufacturer’s Internal Standard (GMIS), certified in accordance with one of the procedures given in reference 4 of this appendix. Vendors advertising certification with the procedures provided in reference 4 of this appendix and distributing gases as “EPA Protocol Gas” must participate in the EPA Protocol Gas Verification Program or not use “EPA” in any form of advertising.

2.6.2 Test concentrations for ozone (O₃) must be obtained in accordance with the ultra violet photometric calibration procedure specified in appendix D to part 50 of this chapter, or by means of a certified O₃ transfer standard. Consult references 7 and 8 of this appendix for guidance on primary and transfer standards for O₃.

2.6.3 Flow rate measurements must be made by a flow measuring instrument that is traceable to an authoritative volume or other applicable standard. Guidance for certifying some types of flowmeters is provided in reference 18 of this appendix.
2.7 Primary Requirements and Guidance. Requirements and guidance documents for developing the quality system are contained in references 1 through 10 of this appendix, which also contain listings of procedures, checks, and control specifications. Reference 10 of this appendix describes specific guidance for the development of a quality system for SLAMS. Many specific quality control checks and specifications for methods are included in the respective reference methods described in part 50 of this chapter or in the respective equivalent method descriptions available from EPA (reference 6 of this appendix). Similarly, quality control procedures related to specifically designated reference and equivalent method analyzers are contained in the respective operation or instruction manuals associated with those analyzers.

3. MEASUREMENT QUALITY CHECK REQUIREMENTS

This section provides the requirements for primary quality assurance organizations (PQAOs) to perform the measurement quality checks that can be used to assess data quality. With the exception of the flow rate verifications (sections 3.2.3 and 3.3.2 of this appendix), data from these checks are required to be submitted to the AQS within the same time frame as routine ambient concentration data. Section 3.2 of this appendix describes checks of automated or continuous instruments while section 3.3 describe checks associated with manual sampling instruments. Other quality control samples are identified in the various references described earlier and can be used to control certain aspects of the measurement system.

3.1 Primary Quality Assurance Organization. A primary quality assurance organization is defined as a monitoring organization or a coordinated aggregation of such organizations that is responsible for a set of stations that monitors the same pollutant and for which data quality assessments can logically be pooled. Each criteria pollutant sampler/monitor at a monitoring station in the SLAMS network must be associated with one, and only one, primary quality assurance organization.

3.1.1 Each primary quality assurance organization shall be defined such that measurement uncertainty among all stations in the organization can be expected to be reasonably homogeneous, as a result of common factors. Common factors that should be considered by monitoring organizations in defining primary quality assurance organizations include:

(a) Operation by a common team of field operators according to a common set of procedures;
(b) Use of a common QAPP or standard operating procedures;
(c) Common calibration facilities and standards;
(d) Oversight by a common quality assurance organization; and
(e) Support by a common management, laboratory or headquarters.

3.1.2 Primary quality assurance organizations are not necessarily related to the organization reporting data to the AQS. Monitoring organizations having difficulty in defining the primary quality assurance organizations or in assigning specific sites to primary quality assurance organizations should consult with the appropriate EPA Regional Office. All definitions of primary quality assurance organizations shall be subject to final approval by the appropriate EPA Regional Office during scheduled network reviews or systems audits.

3.1.3 Data quality assessment results shall be reported as specified in section 5 of this appendix.

3.2 Measurement Quality Checks of Automated Methods. Table A–2 of this appendix provides a summary of the types and frequency of the measurement quality checks that will be described in this section.

3.2.1 One-Point Quality Control Check for $SO_2$, $NO_2$, $O_3$, and $CO$. A one-point quality control (QC) check must be performed at least once every 2 weeks on each automated analyzer used to measure $SO_2$, $NO_2$, $O_3$, and $CO$. The frequency of QC checks may be reduced based upon review, assessment and approval of the EPA Regional Administrator. However, with the advent of automated calibration systems more frequent checking is encouraged. See Reference 10 of this appendix for guidance on the review procedure. The QC check is made by challenging the analyzer with a QC check gas of known concentration (effective concentration for open path analyzers) between 0.01 and 0.10 parts per million (ppm) for $SO_2$, $NO_2$, and $O_3$, and between 1 and 10 ppm for $CO$ analyzers. The ranges allow for appropriate check gas selection for SLAMS sites that may be sampling for different objectives, i.e., trace gas monitoring vs. comparison to National Ambient Air Quality Standards (NAAQS). The QC check gas concentration related to the routine concentrations normally measured at sites within the monitoring network in order to appropriately reflect the precision and bias at these routine concentration ranges. To check the precision and bias of SLAMS analyzers operating at ranges either above or below the levels identified, use check gases of appropriate concentrations as approved by the appropriate EPA Regional Administrator or their designee. The standards from which check concentrations are obtained must meet the specifications of section 2.6 of this appendix.

3.2.1.1 Except for certain CO analyzers described below, point analyzers must operate in their normal sampling mode during the
QC check, and the test atmosphere must pass through all filters, scrubbers, conditioners and other components used during normal ambient sampling and as much of the ambient air inlet system as is practicable. If permitted by the associated operation or instruction manual, a CO point analyzer may be temporarily modified during the QC check to reduce vent or purge flows, or the test atmosphere may enter the analyzer at a point other than the normal sample inlet, provided that the analyzer’s response is not likely to be altered by these deviations from the normal operational mode. If a QC check is made in conjunction with a zero or span adjustment, it must be made prior to such zero or span adjustments.

3.2.1.2 Open path analyzers are tested by inserting a test cell containing a QC check gas concentration into the optical measurement beam of the instrument. If possible, the normally used transmitter, receiver, and as appropriate, reflecting devices should be used during the test and the normal monitoring configuration of the instrument should be altered as little as possible to accommodate the test cell for the test. However, if permitted by the associated operation or instruction manual, an alternate local light source or an alternate optical path that does not include the normal atmospheric monitoring path may be used. The actual concentration of the QC check gas in the test cell must be selected to produce an effective concentration in the range specified earlier in this section. Generally, the QC test concentration measurement will be the sum of the atmospheric pollutant concentration and the QC test concentration. If so, the result must be corrected to remove the atmospheric concentration contribution. The corrected concentration is obtained by subtracting the average of the atmospheric concentrations measured by the open path instrument under test immediately before and immediately after the QC test from the QC check gas concentration measurement. If the difference between these before and after measurements is greater than 20 percent of the effective concentration of the test gas, discard the test result and repeat the test. If possible, open path analyzers should be tested during periods when the atmospheric pollutant concentrations are relatively low and steady.

3.2.1.3 Report the audit concentration (effective concentration for open path analyzers) of the QC gas and the corresponding measured concentration (corrected concentration, if applicable, for open path analyzers) indicated by the analyzer. The percent differences between these concentrations are used to assess the precision and bias of the monitoring data as described in sections 4.1.2 (precision) and 4.1.3 (bias) of this appendix.

3.2.2 Annual performance evaluation for SO\(_2\), NO\(_x\), O\(_3\), or CO. Each calendar quarter (during which analyzers are operated), evaluate at least 25 percent of the SLAMS analyzers that monitor for SO\(_2\), NO\(_x\), O\(_3\), or CO such that each analyzer is evaluated at least once per year. If there are fewer than four analyzers for a pollutant within a primary quality assurance organization, it is suggested to randomly evaluate one or more analyzers so that at least one analyzer for that pollutant is evaluated each calendar quarter. The evaluation should be conducted by a trained experienced technician other than the routine site operator.

3.2.2.1 (a) The evaluation is made by challenging the analyzer with audit gas standard of known concentration (effective concentration for open path analyzers) from at least three consecutive audit levels. The audit levels selected should represent or bracket 80 percent of ambient concentrations measured by the analyzer being evaluated:

<table>
<thead>
<tr>
<th>Audit level</th>
<th>Concentration range, ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>O(_3)</td>
</tr>
<tr>
<td>1</td>
<td>0.02–0.05</td>
</tr>
<tr>
<td>2</td>
<td>0.06–0.10</td>
</tr>
<tr>
<td>3</td>
<td>0.11–0.20</td>
</tr>
<tr>
<td>4</td>
<td>0.21–0.30</td>
</tr>
<tr>
<td>5</td>
<td>0.31–0.80</td>
</tr>
</tbody>
</table>

(b) An additional 4th level is encouraged for those monitors that have the potential for exceeding the concentration ranges described by the initial three selected.

3.2.2.2 (a) NO\(_2\) audit gas for chemiluminescence-type NO\(_x\) analyzers must also contain at least 0.08 ppm NO. NO concentrations substantially higher than 0.08 ppm, as may occur when using some gas phase titration (GPT) techniques, may lead to evaluation errors in chemiluminescence analyzers due to inevitable minor NO–NO\(_2\) channel imbalance. Such errors may be atypical of routine monitoring errors to the extent that such NO concentrations exceed typical ambient NO concentrations at the site. These errors may be minimized by modifying the GPT technique to lower the NO concentrations remaining in the NO\(_x\)
audit gas to levels closer to typical ambient NO concentrations at the site.

(b) To evaluate SLAMS analyzers operating on ranges higher than 0 to 1.0 ppm for \( \text{SO}_2 \), 0 to 10 ppm for \( \text{NO}_2 \), and 0 to 50 ppm for CO, use audit gases of appropriately higher concentration as approved by the appropriate EPA Regional Administrator or the Administrator’s designee.

3.2.2.3 The standards from which audit gas test concentrations are obtained must meet the specifications of section 2.6 of this appendix. The gas standards and equipment used for evaluations must not be the same as the standards and equipment used for calibration or calibration span adjustments. For SLAMS sites, the auditor should not be the operator or analyst who conducts the routine monitoring, calibration, and analysis. For PSD sites the auditor must not be the operator or analyst who conducts the routine monitoring, calibration, and analysis.

3.2.2.4 For point analyzers, the evaluation shall be carried out by allowing the analyzer to analyze the audit gas test atmosphere in its normal sampling mode such that the test atmosphere passes through all filters, scrubbers, conditioners, and other sample inlet components used during normal ambient sampling and as much of the ambient air inlet system as practicable. The exception provided in section 3.2.1 of this appendix for certain CO analyzers does not apply for evaluations.

3.2.2.5 Open path analyzers are evaluated by inserting a test cell containing the various audit gas concentrations into the optical measurement beam of the instrument. If possible, the normally used transmitter, receiver, and, as appropriate, reflecting devices should be used during the evaluation, and the normal monitoring configuration of the instrument should be modified as little as possible to accommodate the test cell for the evaluation. However, if permitted by the associated operation or instruction manual, an alternate local light source or an alternate optical path that does not include the normal atmospheric monitoring path may be used. The actual concentrations of the audit gas in the test cell must be selected to produce effective concentrations in the evaluation level ranges specified in this section of this appendix. Generally, each evaluation concentration measurement result will be the sum of the atmospheric pollutant concentration and the evaluation test concentration. If so, the result must be corrected to remove the atmospheric concentration contribution. The corrected concentration is obtained by subtracting the average of the atmospheric concentrations measured by the open path instrument under test immediately before and immediately after the evaluation test (or preferably before and after each evaluation concentration level) from the evaluation concentration measurement. If the difference between the before and after measurements is greater than 20 percent of the effective concentration of the test gas standard, discard the test result for that concentration level and repeat the test for that level. If possible, open path analyzers should be evaluated during periods when the atmospheric pollutant concentrations are relatively low and steady. Air flow rates should be compared to historical data or if the open path instrument is not installed in a permanent manner, the monitoring path length must be reverified to within plus or minus 3 percent to validate the evaluation, since the monitoring path length is critical to the determination of the effective concentration.

3.2.2.6 Report both the evaluation concentrations (effective concentrations for open path analyzers) of the audit gases and the corresponding measured concentration (corrected concentrations, if applicable, for open path analyzers) indicated or produced by the analyzer being tested. The percent differences between these concentrations are used to assess the quality of the monitoring data as described in section 4.1.4 of this appendix.

3.2.3 Flow Rate Verification for Particulate Matter. A one-point flow rate verification check must be performed at least once every month on each automated analyzer used to measure \( \text{PM}_{10} \), \( \text{PM}_{0.5} \), and \( \text{PM}_{2.5} \). The verification is made by checking the operational flow rate of the analyzer. If the verification is made in conjunction with a flow rate adjustment, it must be made prior to such flow rate adjustment. Randomization of the flow rate verification with respect to time of day, day of week, and routine service and adjustments is encouraged where possible. For the standard procedure, use a flow rate transfer standard certified in accordance with section 2.6 of this appendix to check the analyzer’s normal flow rate. Care should be used in selecting and using the flow rate measurement device such that it does not alter the normal operating flow rate of the analyzer. Report the flow rate of the transfer standard and the corresponding flow rate measured (indicated) by the analyzer. The percent differences between the audit and measured flow rates are used to assess the bias of the monitoring data as described in section 4.2.3 of this appendix (using flow rates in lieu of concentrations).

3.2.4 Semi-Annual Flow Rate Audit for Particulate Matter. Every 6 months, audit the flow rate of the \( \text{PM}_{10} \), \( \text{PM}_{0.5} \), and \( \text{PM}_{2.5} \) particulate analyzers. Where possible, EPA strongly encourages more frequent auditing. The audit should (preferably) be conducted by a trained experienced technician other than the routine site operator. The audit is made by measuring the analyzer’s normal operating flow rate using a flow rate transfer standard certified in accordance with section 2.6 of this appendix. The flow rate standard
used for auditing must not be the same flow rate standard used to calibrate the analyzer. However, both the calibration standard and the audit standard may be referenced to the same primary flow rate or volume standard. Great care must be used in auditing the flow rate to be certain that the flow measurement device does not alter the normal operating flow rate of the analyzer. Report the audit flow rate of the transfer standard and the corresponding flow rate measured (indicated) by the analyzer. The percent differences between these flow rates are used to validate the one-point flow rate verification checks used to estimate bias as described in section 4.2.3 of this appendix.

3.2.5 Collocated Sampling Procedures for PM$_{2.5}$. For each pair of collocated monitors, designate one sampler as the primary monitor whose concentrations will be used to report air quality for the site, and designate the other as the audit monitor.

3.2.5.1 Each EPA designated Federal reference method (FRM) or Federal equivalent method (FEM) within a primary quality assurance organization must:

(a) Have 15 percent of the monitors collocated (values of 0.5 and greater round up); and
(b) Have at least 1 collocated monitor (if the total number of monitors is less than 9). The first collocated monitor must be a designated FRM monitor.

3.2.5.2 In addition, monitors selected for collocation must also meet the following requirements:

(a) A primary monitor designated as an EPA FRM shall be collocated with an audit monitor having the same EPA FRM method designation.
(b) For each primary monitor model designated as an EPA FEM used by the PQAO, 50 percent of the monitors designated for collocation shall be collocated with an audit monitor having the same method designation and 50 percent of the monitors shall be collocated with an FRM audit monitor. If the primary quality assurance organization only has one FEM monitor it shall be collocated with an FRM audit monitor. If there are an odd number of collocated monitors required, the additional monitor shall be an FRM audit monitor. An example of this procedure is found in Table A–3 of this appendix.

3.2.5.3 The collocated monitors should be deployed according to the following protocol:

(a) 80 percent of the collocated audit monitors should be deployed at sites with annual average or daily concentrations estimated to be within ±20 percent of the applicable NAAQS and the remainder at what the monitoring organizations designate as high value sites;

(b) If an organization has no sites with annual average or daily concentrations within ±20 percent of the annual NAAQS (or 24-hour NAAQS if that is affecting the area), 60 percent of the collocated audit monitors should be deployed at those sites with the annual mean concentrations (or 24-hour NAAQS if that is affecting the area) among the highest 20 percent for all sites in the network.

3.2.5.4 In determining the number of collocated sites required for PM$_{2.5}$, monitoring networks for visibility assessments should not be treated independently from networks for particulate matter, as the separate networks may share one or more common samplers. However, for Class I visibility areas, EPA will accept visibility aerosol mass measurement instead of a PM$_{2.5}$ measurement if the latter measurement is unavailable. Any PM$_{2.5}$ monitoring site which does not have a monitor which is an EPA FRM, FEM or ARM is not required to be included in the number of sites which are used to determine the number of collocated monitors.

3.2.5.5 For each PSD monitoring network, one site must be collocated. A site with the predicted highest 24-hour pollutant concentration must be selected.

3.2.5.6 The two collocated monitors must be within 4 meters of each other and at least 2 meters apart for flow rates greater than 200 liters/min or at least 1 meter apart for samplers having flow rates less than 200 liters/min to preclude airflow interference. Calibration, sampling, and analysis must be the same for both collocated samplers and the same for all other samplers in the network.

3.2.5.7 Sample the collocated audit monitor for SLAMS sites on a 12-day schedule; sample PSD sites on a 6-day schedule or every third day for PSD daily monitors. If a primary quality assurance organization has only one collocated monitor, higher sampling frequencies than the 12-day schedule may be needed in order to produce about 25 valid sample pairs a year. Report the measurements from both primary and collocated audit monitors at each collocated sampling site. The calculations for evaluating precision between the two collocated monitors are described in section 4.3.1 of this appendix.

3.2.6 Collocated Sampling Procedures for PM$_{10-2.5}$. For the PM$_{10-2.5}$ network, all automated methods must be designated as Federal equivalent methods (FEMs). For each pair of collocated monitors, designate one sampler as the primary monitor whose concentrations will be used to report air quality for the site, and designate the other as the audit monitor.

3.2.6.1 The EPA shall ensure that each EPA designated FEM within the national PM$_{10-2.5}$ monitoring network must:

(a) Have 15 percent of the monitors collocated (values of 0.5 and greater round up); and

(b) Have at least 2 collocated monitors (if the total number of monitors is less than 10).
The first collocated monitor must be a designated FRM monitor and the second must be a monitor of the same method designation. Both collocated FRM and FEM monitors can be located at the same site.

3.2.6.2 The Regional Administrator for the EPA Regions where the FEMs are implemented will select the sites for collocated monitors. The site selection process shall consider giving priority to sites at primary quality assurance organizations or States with more than one PM$_{10}$-2.5 site, sites considered important from a regional perspective, and sites needed for an appropriate distribution among rural and urban NCORE sites. Depending on the speed at which the PM$_{10}$-2.5 network is deployed, the first sites implementing FEMs shall be required to perform collocation until there is a larger distribution of FEM monitors implemented in the network.

3.2.6.3 The two collocated monitors must be within 4 meters of each other and at least 2 meters apart for flow rates greater than 200 liters/min or at least 1 meter apart for samplers having flow rates less than 200 liters/min to preclude airflow interference. Calibration, sampling, and analysis must be the same for both collocated samplers and the same as for all other samplers in the network.

3.2.6.4 Sample the collocated audit monitor for SLAMS sites on a 12-day schedule. Report the measurements from both primary and collocated audit monitors at each collocated sampling site. The calculations for evaluating precision between the two collocated monitors are described in section 4.3.1 of this appendix.

3.2.7 PM$_{10}$ Performance Evaluation Program (PEP) Procedures. The PEP is an independent assessment used to estimate total measurement system bias. These evaluations will be performed under the PM Performance Evaluation Program (PEP) (section 2.4 of this appendix) or a comparable program. Performance evaluations will be performed on the SLAMS monitors annually within each primary quality assurance organization. For primary quality assurance organizations with less than or equal to five monitoring sites, five valid performance evaluation audits must be collected and reported each year. For primary quality assurance organizations with greater than five monitoring sites, eight valid performance evaluation audits must be collected and reported each year. A valid performance evaluation audit means that both the primary monitor and PEP audit concentrations are valid and above 3 μg/m$^3$. Additionally, each year, every designated FRM or FEM within a primary quality assurance organization must:

1. Have each method designation evaluated each year; and,
2. Have all FRM or FEM samplers subject to a PEP audit at least once every six years; which equates to approximately 15 percent of the monitoring sites audited each year.

(b) Additional information concerning the Performance Evaluation Program is contained in reference 10 of this appendix. The calculations for evaluating bias between the primary monitor and the performance evaluation monitor for PM$_{10}$ are described in section 4.3.2 of this appendix.

3.2.8 PM$_{10}$-2.5 Performance Evaluation Program. For the PM$_{10}$-2.5 network, all automated methods will be designated as federal equivalent methods (FEMs). One performance evaluation audit, as described in section 3.2.7 must be performed at one PM$_{10}$-2.5 site in each primary quality assurance organization each year. The calculations for evaluating bias between the primary monitor(s) and the performance evaluation monitors for PM$_{10}$-2.5 are described in section 4.1.3 of this appendix.

3.3 Measurement Quality Checks of Manual Methods. Table A–2 of this appendix provides a summary of the types and frequency of the measurement quality checks that will be described in this section.

3.3.1 Collocated Sampling Procedures for PM$_{10}$. For each network of manual PM$_{10}$ methods, select 15 percent (or at least one) of the monitoring sites within the primary quality assurance organization for collocated sampling. For purposes of precision assessment, networks for measuring total suspended particulate (TSP) and PM$_{10}$ shall be considered separately from one another. However, PM$_{10}$ samplers used in the PM$_{10}$-2.5 network, may be counted along with the PM$_{10}$ samplers in the PM$_{10}$ network as long as the PM$_{10}$ samplers in both networks are the same method designation. PM$_{10}$ and TSP sites having annual mean particulate matter concentrations among the highest 25 percent of the annual mean concentrations for all the sites in the network must be selected or, if such sites are impractical, alternative sites approved by the EPA Regional Administrator may be selected.

3.3.1.1 In determining the number of collocated sites required for PM$_{10}$, monitoring networks for lead (Pb) should be treated independently from networks for particulate matter (PM), even though the separate networks may share one or more common samplers. However, a single pair of samplers collocated at a common-sampler monitoring site that meets the requirements for both a collocated Pb site and a collocated PM site may serve as a collocated site for both networks.

3.3.1.2 The two collocated monitors must be within 4 meters of each other and at least 2 meters apart for flow rates greater than 200 liters/min or at least 1 meter apart for samplers having flow rates less than 200 liters/min to preclude airflow interference. Calibration, sampling, analysis and verification/validation procedures must be the same for
both collocated samplers and the same as for all other samplers in the network.

3.3.1.3 For each pair of collocated samplers, designate one sampler as the primary sampler whose samples will be used to report air quality for the site, and designate the other as the audit sampler. Sample SLAMS sites on a 12-day schedule; sample PSD sites on a 6-day schedule or every third day for PSD daily samplers. If a primary quality assurance organization has only one collocated monitor, higher sampling frequencies than the 12-day schedule may be needed in order to produce approximately 25 valid sample pairs a year. Report the measurements from both samplers at each collocated sampling site. The calculations for evaluating precision between the two collocated samplers are described in section 4.2.1 of this appendix.

3.3.2 Flow Rate Verification for Particulate Matter. Follow the same procedure as described in section 3.2.3 of this appendix for PM
d, PM
d, high-volume PM
d, and TSP instruments. The percent differences between the audit and measured flow rates are used to test the bias of the monitoring data as described in section 4.2.2 of this appendix.

3.3.3 Semi-Annual Flow Rate Audit for Particulate Matter. Follow the same procedure as described in section 3.2.4 of this appendix for PM
d, PM
d, high-volume PM
d, and TSP instruments. The percent differences between these flow rates are used to validate the one-point flow rate verification checks used to estimate bias as described in section 4.2.3 of this appendix. Great care must be used in auditing high-volume particulate matter samplers having flow regulators because the introduction of resistance plates in the audit flow standard device can cause abnormal flow patterns at the point of flow sensing. For this reason, the flow audit standard should be used with a normal filter in place and without resistance plates in auditing flow-regulated high-volume samplers, or other steps should be taken to assure that flow patterns are not perturbed at the point of flow sensing.

3.3.4 Pb Methods.

3.3.4.1 Flow Rates. For the Pb Reference Methods (40 CFR Part 50, appendix G and appendix Q) and associated PEPs, the flow rates of the Pb samplers shall be verified and audited using the same procedure described in sections 3.3.2 and 3.3.3 of this appendix.

3.3.4.2 Pb Analysis Audits. Each calendar quarter or sampling quarter (PSD), audit the Pb Reference Method analytical procedure using filters containing a known quantity of Pb. These audit filters are prepared by depositing a Pb solution on unexposed filters and allowing them to dry thoroughly. The audit samples must be prepared using batches of reagents different from those used to calibrate the Pb analytical equipment being audited. Prepare audit samples in the following concentration ranges:

<table>
<thead>
<tr>
<th>Range</th>
<th>Equivalent ambient Pb concentration, μg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30–100% of Pb NAAQS</td>
</tr>
<tr>
<td>2</td>
<td>200–300% of Pb NAAQS</td>
</tr>
</tbody>
</table>

(a) Audit samples must be extracted using the same extraction procedure used for exposed filters.

(b) Analyze three audit samples in each of the two ranges each quarter samples are analyzed. The audit sample analyses shall be distributed as much as possible over the entire calendar quarter.

(c) Report the audit concentrations (in μg Pb/filter or strip) and the corresponding measured concentrations (in μg Pb/filter or strip) using AQS unit code 077. The percent differences between the concentrations are used to calculate analytical accuracy as described in section 4.1.3 of this appendix.

(d) The audits of an equivalent Pb method are conducted and assessed in the same manner as for the reference method. The flow auditing device and Pb analysis audit samples must be compatible with the specific requirements of the equivalent method.

3.3.4.3 Collocated Sampling, PQAO that have a combination of source and non-source-oriented sites (unless the only non-source-oriented site is an NCore site) will follow the procedures described in sections 3.3.1 of this appendix with the exception that the first collocated Pb site selected must be the site measuring the highest Pb concentrations in the network. If the site is impractical, alternative sites, approved by the EPA Regional Administrator, may be selected. If additional colocated sites are necessary, colocated sites may be chosen that reflect average ambient air Pb concentrations in the network. The colocated sampling requirements for PQAO that only have Pb monitoring at a non-source-oriented NCore site for sampling required under 40 CFR 58, Appendix D, paragraph 4.5(b) shall be implemented as described in section 3.2.6 of this appendix with the exception that the colocated monitor will be the same method designation as the primary monitor.
than 5 sites must be sent to an independent laboratory, the same laboratory as the performance evaluation audit, for analysis.

3.3.5 Collocated Sampling Procedures for PM$_{10}$. Follow the same procedure as described in section 3.2.5 of this appendix. PM$_{2.5}$ samplers used in the PM$_{10-2.5}$ network, may be counted along with the PM$_{2.5}$ samplers in the PM$_{2.5}$ network as long as the PM$_{2.5}$ samplers in both networks are the same method designation.

3.3.6 Collocated Sampling Procedures for PM$_{10-2.5}$. All designated FRMs within the PM$_{10-2.5}$ monitoring network must have 15 percent of the monitors collocated (values of 0.5 and greater round up) at the PM$_{10-2.5}$ sites. All FRM method designations can be aggregated.

3.3.6.1 The EPA shall ensure that each designated FRM within the PM$_{10-2.5}$ monitoring network must:

(a) Have 15 percent of the monitors collocated (values of 0.5 and greater round up); and

(b) Have at least 2 collocated monitors (if the total number of monitors is less than 10). The first collocated monitor must be a designated FRM monitor and the second must be a monitor of the same method designation. Both collocated FRM and FEM monitors can be located at the same site.

3.3.6.2 The Regional Administrator for the EPA Region where the FRM or FEMs are implemented will select the sites for collocated monitoring. The collocation site selection process shall consider sites at primary quality assurance organizations or States with more than one PM$_{10-2.5}$ site; primary quality assurance organizations already monitoring for PM$_{10}$ and PM$_{2.5}$ using FRMs or FEMs; and an appropriate distribution among rural and urban NCORE sites. Monitoring organizations implementing PM$_{10}$ samplers and PM$_{2.5}$, FRM samplers of the same method designation as the PM$_{10-2.5}$ FRM can include the PM$_{10-2.5}$ monitors in their respective PM$_{10}$ and PM$_{2.5}$ counts. Follow the same procedures as described in sections 3.2.6.2 and 3.2.6.3 of this appendix.

3.3.7 PM$_{2.5}$ Performance Evaluation Program (PEP) Procedures. Follow the same procedure as described in section 3.2.7 of this appendix.

3.3.8 PM$_{10-2.5}$ Performance Evaluation Program (PEP) Procedures. One performance evaluation audit, as described in section 3.2.7 of this appendix must be performed at one PM$_{10-2.5}$ site in each primary quality assurance organization each year. Monitoring organizations implementing PM$_{2.5}$ FRM samplers of the same method designation in both the PM$_{2.5}$ and PM$_{10-2.5}$ networks can include the PM$_{10-2.5}$ performance evaluation audit in their respective PM$_{2.5}$ performance evaluation count as long as the performance evaluation is conducted at the PM$_{10-2.5}$ site. The calculations for evaluating bias between the primary monitor(s) and the performance evaluation monitors for PM$_{10-2.5}$ are described in section 4.1.3 of this appendix.

4. Calculations for Data Quality Assessment

(a) Calculations of measurement uncertainty are carried out by EPA according to the following procedures. Primary quality assurance organizations should report the data for all appropriate measurement quality checks as specified in this appendix even though they may elect to perform some or all of the calculations in this section on their own.

(b) The EPA will provide annual assessments of data quality aggregated by site and primary quality assurance organization for SO$_2$, NO$_2$, O$_3$ and CO and by primary quality assurance organization for PM$_{10}$, PM$_{2.5}$, PM$_{10-2.5}$ and Pb.

(c) At low concentrations, agreement between the measurements of collocated samplers, expressed as relative percent difference or percent difference, may be relatively poor. For this reason, collocated measurement pairs are selected for use in the precision and bias calculations only when both measurements are equal to or above the following limits:

1. TSP: 20 g/m$^3$.
2. Pb: 0.02 µg/m$^3$.
3. PM$_{2.5}$ (Hi-Vol): 15 µg/m$^3$.
4. PM$_{2.5}$ (Lo-Vol): 3 µg/m$^3$.
5. PM$_{10-2.5}$ and PM$_{2.5}$: 3 µg/m$^3$.

4.1 Statistics for the Assessment of QC Checks for SO$_2$, NO$_2$, O$_3$, and CO.

4.1.1 Percent Difference. For each single point check, calculate the percent difference, $d$, as follows:

$$d_i = \frac{\text{meas} - \text{audit}}{\text{audit}} \times 100$$

where, meas is the concentration indicated by the monitoring organization’s instrument and audit is the audit concentration of the standard used in the QC check being measured.

4.1.2 Precision Estimate. The precision estimator is used to assess the one-point QC checks for SO$_2$, NO$_2$, O$_3$, or CO described in section 3.2.1 of this appendix. The precision estimator is the coefficient of variation upper bound and is calculated using equation 2 of this section.
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\[ CV = \sqrt{\frac{n \sum d_i^2 - \left( \sum d_i \right)^2}{n(n-1)}} \cdot \frac{n-1}{X^2_{0.1,n-1}} \]

where, \( X^2_{0.1,n-1} \) is the 10th percentile of a chi-squared distribution with \( n-1 \) degrees of freedom.

4.1.3 Bias Estimate. The bias estimate is calculated using the one-point QC checks for \( SO_2, NO_2, O_3, \) or CO described in section 3.2.1 of this appendix and the performance evaluation program for \( PM_{10-2.5} \) described in sections 3.2.8 and 3.3.8 of this appendix. The bias estimator is an upper bound on the mean absolute value of the percent differences as described in equation 3 of this section:

\[ |AB| = AB + t_{0.95,n-1} \cdot \frac{AS}{\sqrt{n}} \]

where, \( n \) is the number of single point checks being aggregated; \( t_{0.95,n-1} \) is the 95th quantile of a t-distribution with \( n-1 \) degrees of freedom; the quantity \( AB \) is the mean of the absolute values of the \( d_i \)'s and is calculated using equation 4 of this section:

\[ AB = \frac{1}{n} \cdot \sum_{i=1}^{n} |d_i| \]

and the quantity \( AS \) is the standard deviation of the absolute value of the \( d_i \)'s and is calculated using equation 5 of this section:

\[ AS = \sqrt{\frac{n \cdot \sum d_i^2 - \left( \sum d_i \right)^2}{n(n-1)}} \]

4.1.3.1 Assigning a sign (positive/negative) to the bias estimate. Since the bias statistic as calculated in equation 3 of this appendix uses absolute values, it does not have a tendency (negative or positive bias) associated with it. A sign will be designated by rank ordering the percent differences of the QC check samples from a given site for a particular assessment interval.

4.1.3.2 Calculate the 25th and 75th percentiles of the percent differences for each site. The absolute bias upper bound should be flagged as positive if both percentiles are positive and negative if both percentiles are negative. The absolute bias upper bound would not be flagged if the 25th and 75th percentiles are of different signs.

4.1.4 Validation of Bias Using the one-point QC Checks. The annual performance evaluations for \( SO_2, NO_2, O_3, \) or CO described in section 3.2.2 of this appendix are used to verify the results obtained from the one-point QC checks and to validate those results across a range of concentration levels. To quantify this annually at the site level and at the 3-year primary quality assurance organization level, probability limits will be calculated from the one-point QC checks using equations 6 and 7 of this appendix:

\[ \text{Upper Probability Limit} = m + 1.96 \cdot S \]

\[ \text{Lower Probability Limit} = m - 1.96 \cdot S \]

where, \( m \) is the mean (equation 8 of this appendix):

\[ m = \frac{1}{k} \cdot \sum_{i=1}^{k} d_i \]

where, \( k \) is the total number of one point QC checks for the interval being evaluated and \( S \) is the standard deviation of the percent differences (equation 9 of this appendix) as follows:

\[ S = \sqrt{\frac{k \cdot \sum d_i^2 - \left( \sum d_i \right)^2}{k(k-1)}} \]

4.1.5 Percent Difference. Percent differences for the performance evaluations, calculated using equation 1 of this appendix can be compared to the probability intervals for the respective site or at the primary quality assurance organization level. Ninety-five percent of the individual percent differences (all audit concentration levels) for the performance evaluations should be captured within the probability intervals for the primary quality assurance organization.

4.2 Statistics for the Assessment of \( PM_{10} \).

4.2.1 Precision Estimate from Collocated Samplers. Precision is estimated via duplicate measurements from collocated samplers of the same type. It is recommended that the
precise quantity be aggregated at the primary quality assurance organization level quarterly, annually, and at the 3-year level. The data pair would only be considered valid if both concentrations are greater than the minimum values specified in section 4(c) of this appendix. For each collocated data pair, calculate the relative percent difference, $d_i$, using equation 10 of this appendix:

$$d_i = \frac{X_i - Y_i}{(X_i + Y_i)/2} \times 100$$

where, $X_i$ is the concentration from the primary sampler and $Y_i$ is the concentration value from the audit sampler. The coefficient of variation upper bound is calculated using the equation 11 of this appendix:

$$CV = \sqrt{\frac{\sum_{i=1}^{n} d_i^2 - \left(\sum_{i=1}^{n} d_i\right)^2}{2n(n-1)}} \times \frac{\sqrt{n-1}}{X^2_{0.1, n-1}}$$

where, $n$ is the number of valid data pairs being aggregated, and $X^2_{0.1, n-1}$ is the 10th percentile of a chi-squared distribution with n-1 degrees of freedom. The factor of 2 in the denominator adjusts for the fact that each $d_i$ is calculated from two values with error.

4.2.2 Bias Estimate Using One-Point Flow Rate Verifications. For each one-point flow rate verification described in sections 3.2.3 and 3.2.2 of this appendix, calculate the percent difference in volume using equation 1 of this appendix where $meas$ is the value indicated by the sampler’s volume measurement and $audit$ is the actual volume indicated by the auditing flow meter. To quantify this annually and at the 3-year primary quality assurance organization level, probability limits are calculated from the percent differences using equations 6 and 7 of this appendix where $m$ is the mean described in equation 8 of this appendix and $k$ is the total number of one-point flow rate verifications for the year and $S$ is the standard deviation of the percent differences as described in equation 9 of this appendix.

4.2.4 Percent Difference. Percent differences for the annual flow rate audit concentration, calculated using equation 1 of this appendix, can be compared to the probability intervals for the one-point flow rate verifications for the respective primary quality assurance organization. Ninety-five percent of the individual percent differences (all audit concentration levels) for the performance evaluations should be captured within the probability intervals for primary quality assurance organization.

4.3 Statistics for the Assessment of $PM_{10-2.5}$

4.3.1 Precision Estimate. Precision for collocated instruments for $PM_{10-2.5}$ may be estimated where both the primary and collocated instruments are the same method designation and when the method designations are not similar. Follow the procedure described in section 4.2.1 of this appendix. In addition, one may want to perform an estimate of bias when the primary monitor is an FEM and the collocated monitor is an FRM. Follow the procedure described in section 4.1.3 of this appendix in order to provide an estimate of bias using the collocated data.

4.3.2 Bias Estimate. Follow the procedure described in section 4.1.3 of this appendix for the bias estimate of $PM_{10-2.5}$. The $PM_{10-2.5}$ bias estimate is calculated using the paired routine and the PEP monitor data described in section 3.2.6 of this appendix. Calculate the percent difference, $d_i$, using equation 1 of this appendix, where $meas$ is the measured concentration from agency’s primary monitor and audit is the concentration from the PEP monitor. The data pair would only be considered valid if both concentrations are greater than the minimum values specified in section 4(c) of this appendix. Estimates of bias are presented for various levels of aggregation, sometimes aggregating over time, sometimes aggregating over samplers, and sometimes aggregating over both time and samplers. These various levels of aggregation are achieved using the same basic statistic.

4.3.2.1 This statistic averages the individual biases described in equation 1 of this appendix.
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appendix to the desired level of aggregation using equation 12 of this appendix:

\[ D = \frac{1}{n_j} \sum_{i=1}^{n_j} d_i \]

where, \( n_j \) is the number of pairs and \( d_i \), \(* * *, d_{n_j} \) are the biases for each of the pairs to be averaged.

4.3.2.2 Confidence intervals can be constructed for these average bias estimates in equation 12 of this appendix using equations 13 and 14 of this appendix:

\[ \text{Upper 90\% Confidence Interval} = D + t_{0.95,df} \cdot \frac{s}{\sqrt{n_j}} \]

\[ \text{Lower 90\% Confidence Interval} = D - t_{0.95,df} \cdot \frac{s}{\sqrt{n_j}} \]

Where, \( t_{0.95,df} \) is the 95th quantile of a t-distribution with degrees of freedom \( df = n_j - 1 \) and \( s \) is an estimate of the variability of the average bias calculated using equation 15 of this appendix:

\[ s = \sqrt{\frac{\sum_{i=1}^{n_j} (d_i - D)^2}{n_j - 1}} \]

4.4 Statistics for the Assessment of Pb.

4.4.1 Precision Estimate. Follow the same procedures as described for PM\(_{10}\) in section 4.2.1 of this appendix using the data from the collocated instruments. The data pair would only be considered valid if both concentrations are greater than the minimum values specified in section 4(c) of this appendix.

4.4.2 Bias Estimate. For the Pb analysis audits described in section 3.3.4.2 and the Pb Performance Evaluation Program described in section 3.3.4.4, follow the same procedure as described in section 4.1.3 for the bias estimate.

4.4.3 Flow rate calculations. For the one point flow rate verifications, follow the same procedures as described for PM\(_{10}\) in section 4.2.2; for the flow rate audits, follow the same procedures as described in section 4.2.3.

5. REPORTING REQUIREMENTS

5.1 SLAMS Reporting Requirements. For each pollutant, prepare a list of all monitoring sites and their AQS site identification codes in each primary quality assurance organization and submit the list to the appropriate EPA Regional Office, with a copy to AQS. Whenever there is a change in this list of monitoring sites in a primary quality assurance organization, report this change to the EPA Regional Office and to AQS.

5.1.1 Quarterly Reports. For each quarter, each primary quality assurance organization shall report to AQS directly (or via the appropriate EPA Regional Office for organizations not direct users of AQS) the results of all valid measurement quality checks it has carried out during the quarter. The quarterly reports must be submitted consistent with the data reporting requirements specified for air quality data as set forth in § 58.16. The EPA strongly encourages early submission of the quality assurance data in order to assist the monitoring organizations control and evaluate the quality of the ambient air data.

5.1.2 Annual Reports.

5.1.2.1 When the monitoring organization has certified relevant data for the calendar year, EPA will calculate and report the measurement uncertainty for the entire calendar year.

5.2 PSD Reporting Requirements. At the end of each sampling quarter, the organization must report the appropriate statistical assessments in section 4 of this appendix for the pollutants measured. All data used to calculate reported estimates of precision and bias including span checks, collocated sampler and audit results must be made available to the permit granting authority upon request.

6.0 REFERENCES

(1) American National Standard—Specifications and Guidelines for Quality Systems


<table>
<thead>
<tr>
<th>Topic</th>
<th>SLAMS</th>
<th>PSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirements</td>
<td>1. The development, documentation, and implementation of an approved quality system.</td>
<td>Source owner/operator.</td>
</tr>
<tr>
<td></td>
<td>2. The assessment of data quality</td>
<td>Usually up to 12 months.</td>
</tr>
<tr>
<td></td>
<td>3. The use of reference, equivalent, or approved methods.</td>
<td>Personnel, standards and equipment different from those used for spanning, calibration, and verifications.</td>
</tr>
<tr>
<td></td>
<td>4. The use of calibration standards traceable to NIST or other primary standard.</td>
<td>100% per quarter.</td>
</tr>
<tr>
<td></td>
<td>5. The participation in EPA performance evaluations and the permission for EPA to conduct system audits.</td>
<td>100% per quarter.</td>
</tr>
<tr>
<td>Monitoring and QA Responsibility</td>
<td>State/local agency via the “primary quality assurance organization”.</td>
<td>One point QC check biweekly.</td>
</tr>
<tr>
<td>Monitoring Duration</td>
<td>Indefinitely</td>
<td>One site: 1 every 6 days or every third day for daily monitoring (TSP and Pb).</td>
</tr>
<tr>
<td>Annual Performance Evaluation (PE)</td>
<td>Standards and equipment different from those used for spanning, calibration, and verifications.</td>
<td></td>
</tr>
<tr>
<td>PE audit rate:</td>
<td>Varies depending on pollutant. See Table A–2 of this appendix.</td>
<td>By site—source owner/operator performs calculations each sampling quarter.</td>
</tr>
<tr>
<td>—Automated</td>
<td>100% per year</td>
<td></td>
</tr>
<tr>
<td>—Manual</td>
<td>Varies depending on pollutant. See Table A–2 of this appendix.</td>
<td></td>
</tr>
<tr>
<td>Precision Assessment:</td>
<td>One-point QC check biweekly but data quality dependent.</td>
<td></td>
</tr>
<tr>
<td>—Automated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>—Manual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reporting</td>
<td>By site—EPA performs calculations annually</td>
<td>By site—source owner/operator performs calculations each sampling quarter.</td>
</tr>
</tbody>
</table>
## Table A–1 of Appendix A to Part 58—Difference and Similarities Between SLAMS and PSD Requirements—Continued

<table>
<thead>
<tr>
<th>Topic</th>
<th>SLAMS</th>
<th>PSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>—Manual</td>
<td>By reporting organization—EPA performs calculations annually.</td>
<td>By site—source owner/operator performs calculations each sampling quarter.</td>
</tr>
</tbody>
</table>

## Table A–2 of Appendix A to Part 58—Minimum Data Assessment Requirements for SLAMS Sites

<table>
<thead>
<tr>
<th>Method</th>
<th>Assessment method</th>
<th>Coverage</th>
<th>Minimum frequency</th>
<th>Parameters reported</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Automated Methods</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-Point QC for SO₂, NOₓ, O₃, CO</td>
<td>Response check at concentration 0.01–0.1 ppm SO₂, NOₓ, O₃, and 1–10 ppm CO.</td>
<td>Each analyzer</td>
<td>Once per 2 weeks</td>
<td>Audit concentration ¹ and measured concentration ².</td>
</tr>
<tr>
<td>Annual performance evaluation for SO₂, NOₓ, O₃, CO.</td>
<td>See section 3.2.2 of this appendix.</td>
<td>Each analyzer</td>
<td>Once per year</td>
<td>Audit concentration ¹ and measured concentration ² for each level.</td>
</tr>
<tr>
<td>Flow rate verification PM₁₀, PM₂·₅, PM₁₀–₂·₅.</td>
<td>Check of sampler flow rate.</td>
<td>Each sampler</td>
<td>Once every month</td>
<td>Audit flow rate and measured flow rate indicated by the sampler.</td>
</tr>
<tr>
<td>Semi-annual flow rate audit PM₁₀, PM₂·₅, PM₁₀–₂·₅.</td>
<td>Check of sampler flow rate using independent standard.</td>
<td>Each sampler</td>
<td>Once every 6 months</td>
<td>Audit flow rate and measured flow rate indicated by the sampler.</td>
</tr>
<tr>
<td>Collocated sampling PM₁₀, PM₂·₅.</td>
<td>Collocated samplers</td>
<td>15%</td>
<td>Every 12 days</td>
<td>Primary sampler concentration and duplicate sampler concentration.</td>
</tr>
<tr>
<td>Performance evaluation program PM₁₀, PM₂·₅.</td>
<td>Collocated samplers</td>
<td>1. 5 valid audits for primary QA orgs, with ≤5 sites.</td>
<td>Over all 4 quarters</td>
<td>Primary sampler concentration and performance evaluation sampler concentration.</td>
</tr>
<tr>
<td>2. 8 valid audits for primary QA orgs, with &gt;5 sites.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. All samplers in 6 years.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Manual Methods</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collocated sampling PM₁₀, TSP, PM₂·₅, PM₁₀–₂·₅, Pb-TSP, Pb-PM₁₀.</td>
<td>Collocated samplers</td>
<td>15%</td>
<td>Every 12 days PSD—every 6 days.</td>
<td>Primary sampler concentration and duplicate sampler concentration.</td>
</tr>
<tr>
<td>Flow rate verification PM₁₀ (low Vol), PM₂·₅, PM₁₀–₂·₅, Pb-PM₁₀.</td>
<td>Check of sampler flow rate.</td>
<td>Each sampler</td>
<td>Once every month</td>
<td>Audit flow rate and measured flow rate indicated by the sampler.</td>
</tr>
<tr>
<td>Flow rate verification PM₁₀ (High-Vol), TSP, Pb-TSP.</td>
<td>Check of sampler flow rate.</td>
<td>Each sampler</td>
<td>Once every quarter</td>
<td>Audit flow rate and measured flow rate indicated by the sampler.</td>
</tr>
<tr>
<td>Semi-annual flow rate audit PM₁₀, TSP, PM₂·₅, PM₁₀–₂·₅, Pb-TSP, Pb-PM₁₀.</td>
<td>Check of sampler flow rate using independent standard.</td>
<td>Each sampler, all locations.</td>
<td>Once every 6 months</td>
<td>Audit flow rate and measured flow rate indicated by the sampler.</td>
</tr>
<tr>
<td>Pb audit strips Pb-TSP, Pb-PM₁₀.</td>
<td>Check of analytical system with Pb audit strips.</td>
<td>Analytical</td>
<td>Each quarter</td>
<td>Actual concentration and audit concentration.</td>
</tr>
</tbody>
</table>
TABLE A–2 OF APPENDIX A TO PART 58—MINIMUM DATA ASSESSMENT REQUIREMENTS FOR SLAMS SITES—Continued

<table>
<thead>
<tr>
<th>Method Assessment method</th>
<th>Coverage</th>
<th>Minimum frequency</th>
<th>Parameters reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance evaluation program PM&lt;sub&gt;2.5&lt;/sub&gt;, PM&lt;sub&gt;10–2.5&lt;/sub&gt;. Collocated samplers ...</td>
<td>1. 5 valid audits for primary QA orgs, with ≤5 sites. 2. 8 valid audits for primary QA orgs, with &gt;5 sites. 3. All samplers in 6 years.</td>
<td>Over all 4 quarters ......</td>
<td>Primary sampler concentration and performance evaluation sampler concentration.</td>
</tr>
<tr>
<td>Performance evaluation program Pb-TSP, Pb-PM&lt;sub&gt;10&lt;/sub&gt;. Collocated samplers ...</td>
<td>1. 1 valid audit and 4 collocated samples for primary QA orgs, with &gt;5 sites. 2. 2 valid audits and 6 collocated samples for primary QA orgs, with &gt;5 sites.</td>
<td>Over all 4 quarters ......</td>
<td>Primary sampler concentration and performance evaluation sampler concentration. Primary sampler concentration and duplicate sampler concentration.</td>
</tr>
</tbody>
</table>

1 Effective concentration for open path analyzers.
2 Corrected concentration, if applicable, for open path analyzers.

TABLE A–3 OF APPENDIX A TO PART 58—SUMMARY OF PM<sub>2.5</sub> NUMBER AND TYPE OF COLLOCATION (15% COLLOCATION REQUIREMENT) NEEDED AS AN EXAMPLE OF A PRIMARY QUALITY ASSURANCE ORGANIZATION THAT HAS 54 MONITORS AND PROCURED FRMs AND THREE OTHER EQUIVALENT METHOD TYPES

<table>
<thead>
<tr>
<th>Primary sampler method designation</th>
<th>Total no. of monitors</th>
<th>Total no. collocated</th>
<th>No. of collocated FRM</th>
<th>No. of collocated monitors of same method designation as primary</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRM ................................</td>
<td>20</td>
<td>3</td>
<td>3</td>
<td>n/a</td>
</tr>
<tr>
<td>FEM (A) ..........................</td>
<td>20</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>FEM (C) ..........................</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>FEM (D) ..........................</td>
<td>12</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>


EDITORIAL NOTE: At 72 FR 32211, June 13, 2007, the last sentence in section 4.2.2.2, was amended in Appendix A to Part 58; however, the amendment could not be incorporated due to inaccurate amendatory instruction.

APPENDIX B TO PART 58 [RESERVED]

APPENDIX C TO PART 58—AMBIENT AIR QUALITY MONITORING METHODOLOGY

1.0 Purpose
2.0 SLAMS Ambient Air Monitoring Network
3.0 NCore Ambient Air Monitoring Stations
4.0 Photochemical Assessment Monitoring Stations (PAMS)
5.0 Particulate Matter Episode Monitoring
6.0 References

2.0 SLAMS AMBIENT AIR MONITORING NETWORK

1.0 Purpose

This appendix specifies the criteria pollutant monitoring methods (manual methods or automated analyzers) which must be used in SLAMS and NCore stations that are a subset of SLAMS.

2.0 SLAMS AMBIENT AIR MONITORING NETWORK

1.0 Purpose

This appendix specifies the criteria pollutant monitoring methods (manual methods or automated analyzers) which must be used in SLAMS and NCore stations that are a subset of SLAMS.

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