PART 58—AMBIENT AIR QUALITY SURVEILLANCE

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§ 58.1 Definitions.

As used in this part, all terms not defined herein have the meaning given them in the Act:

Act means the Clean Air Act as amended (42 U.S.C. 7401, et seq.).

Administrator means the Administrator of the Environmental Protection Agency (EPA) or his or her authorized representative.

Aerometric Information Retrieval System (AIRS)-Air Quality Subsystem (AQS) is EPA’s computerized system for storing and reporting of information relating to ambient air quality data.

Annual State air monitoring report is an annual report, prepared by control agencies and submitted to EPA for approval, that consists of an annual data summary report for all pollutants and a detailed report describing any proposed changes to their air quality surveillance network.

CO means carbon monoxide.

Community Monitoring Zone (CMZ) means an optional averaging area with established, well defined boundaries, such as county or census block, within a MPA that has relatively uniform concentrations of annual PM$_{2.5}$ as defined by appendix D of this part. Two or more core SLAMS and other monitors within a CMZ that meet certain requirements as set forth in Appendix D of this part may be averaged for making comparisons to the annual PM$_{2.5}$ NAAQS.

Consolidated Metropolitan Statistical Area (CMSA) means the most recent area as designated by the U.S. Office of Management and Budget and population figures from the Bureau of the Census. The Department of Commerce provides that within metropolitan complexes of 1 million or more population, separate component areas are defined if specific criteria are met. Such areas are designated primary metropolitan statistical areas (PMSAs; and any area containing PMSAs is designated CMSA.

Core PM$_{2.5}$ SLAMS means community-oriented monitoring sites representative of community-wide exposures that are the basic component sites of the PM$_{2.5}$ SLAMS regulatory network. Core PM$_{2.5}$ SLAMS include community-oriented SLAMS monitors, and sites collocated at PAMS.

Corrected concentration pertains to the result of an accuracy or precision assessment test of an open path analyzer in which a high-concentration test or audit standard gas contained in a short test cell is inserted into the optical measurement beam of the instrument. When the pollutant concentration measured by the analyzer in such a test includes both the pollutant concentration in the test cell and the concentration in the atmosphere, the atmospheric pollutant concentration must be subtracted from the test measurement to obtain the corrected concentration test result. The corrected concentration is equal to the measured concentration minus the average of the atmospheric pollutant concentrations measured (without the test cell) immediately before and immediately after the test.

Correlated acceptable continuous (CAC) PM analyzer means an optional fine particulate matter analyzer that can be used to supplement a PM$_{2.5}$ reference or equivalent sampler, in accordance with the provisions of § 58.13(f).

Effective concentration pertains to testing an open path analyzer with a high-concentration calibration or audit standard gas contained in a short test cell inserted into the optical measurement beam of the instrument. Effective concentration is the equivalent ambient-level concentration that would produce the same spectral absorbance over the actual atmospheric monitoring path length as produced by the high-concentration gas in the short test cell. Quantitatively, effective concentration is equal to the actual concentration of the gas standard in the test cell multiplied by the ratio of the path length of the test cell to the actual atmospheric monitoring path length.

Equivalent method means a method of sampling and analyzing the ambient
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air for an air pollutant that has been designated as an equivalent method in accordance with part 53 of this chapter; it does not include a method for which an equivalent method designation has been canceled in accordance with § 53.11 or § 53.16 of this chapter.

Indian Governing Body means the governing body of any tribe, band, or group of Indians subject to the jurisdiction of the United States and recognized by the United States as possessing power of self-government.

Indian Reservation means any Federally recognized reservation established by treaty, agreement, executive order, or act of Congress.

Local agency means any local government agency, other than the State agency, which is charged with the responsibility for carrying out a portion of the plan.

Meteorological measurements means measurements of wind speed, wind direction, barometric pressure, temperature, relative humidity, and solar radiation.

Metropolitan Statistical Area (MSA) as designated by the most recent decennial U.S. Census of Population Report.

Monitor is a generic term for an instrument, sampler, analyzer, or other device that measures or assists in the measurement of atmospheric air pollutants and which is acceptable for use in ambient air surveillance under the provisions of appendix C to this part, including both point and open path analyzers that have been designated as either reference or equivalent methods under part 53 of this chapter.

Monitoring path for an open path analyzer is the actual path in space between two geographical locations over which the pollutant concentration is measured and averaged.

Monitoring path length of an open path analyzer is the length of the monitoring path in the atmosphere over which the average pollutant concentration measurement (path-averaged concentration) is determined. See also, optical measurement path length.

Monitoring Planning Area (MPA) means a contiguous geographic area with established, well defined boundaries, such as a metropolitan statistical area, county or State, having a common area that is used for planning monitoring locations for PM$_{2.5}$. MPAs may cross State boundaries, such as the Philadelphia PA-NJ MSA, and be further subdivided into community monitoring zones. MPAs are generally oriented toward areas with populations greater than 200,000, but for convenience, those portions of a State that are not associated with MSAs can be considered as a single MPA. MPAs must be defined, where applicable, in a State PM monitoring network description.

NAMS means National Air Monitoring Station(s). Collectively the NAMS are a subset of the SLAMS ambient air quality monitoring network.

NO$_2$ means nitrogen dioxide. NO means nitrogen oxide. NO$_X$ means oxides of nitrogen and is defined as the sum of the concentrations of NO$_2$ and NO.

O$_3$ means ozone.

Open path analyzer is an automated analytical method that measures the average atmospheric pollutant concentration in situ along one or more monitoring paths having a monitoring path length of 5 meters or more and that has been designated as a reference or equivalent method under the provisions of part 53 of this chapter.

Optical measurement path length is the actual length of the optical beam over which measurement of the pollutant is determined. The path-integrated pollutant concentration measured by the analyzer is divided by the optical measurement path length to determine the path-averaged concentration. Generally, the optical measurement path length is:

1. Equal to the monitoring path length for a (bistatic) system having a transmitter and a receiver at opposite ends of the monitoring path;
2. Equal to twice the monitoring path length for a (monostatic) system having a transmitter and receiver at one end of the monitoring path and a mirror or retroreflector at the other end; or
3. Equal to some multiple of the monitoring path length for more complex systems having multiple passes of
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the measurement beam through the monitoring path.

PAMS means Photochemical Assessment Monitoring Stations.

Particulate matter monitoring network description, required by § 58.20(f), means a detailed plan, prepared by control agencies and submitted to EPA for approval, that describes their PM<sub>2.5</sub> and PM<sub>10</sub> air quality surveillance network.

Pb means lead.

Plan means an implementation plan, approved or promulgated pursuant to section 110 of the Clean Air Act.

PM<sub>2.5</sub> means particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers as measured by a reference method based on 40 CFR part 50, Appendix L, and designated in accordance with part 53 of this chapter or by an equivalent method designated in accordance with part 53 of this chapter.

PM<sub>10</sub> means particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers as measured by a reference method based on Appendix J of part 50 of this chapter and designated in accordance with part 53 of this chapter or by an equivalent method designated in accordance with part 53 of this chapter.

Point analyzer is an automated analytical method that measures pollutant concentration in an ambient air sample extracted from the atmosphere at a specific inlet probe point and that has been designated as a reference or equivalent method in accordance with part 53 of this chapter.

Population-oriented monitoring (or sites) applies to residential areas, commercial areas, recreational areas, industrial areas, and other areas where a substantial number of people may spend a significant fraction of their day.

Primary Metropolitan Statistical Area (PMSA) is a separate component of a consolidated metropolitan statistical area. For the purposes of this part, PMSA is used interchangeably with MSA.

Probe is the actual inlet where an air sample is extracted from the atmosphere for delivery to a sampler or point analyzer for pollutant analysis.

PSD station means any station operated for the purpose of establishing the effect on air quality of the emissions from a proposed source for purposes of prevention of significant deterioration as required by § 51.24(n) of part 51 of this chapter.

Reference method means a method of sampling and analyzing the ambient air for an air pollutant that will be specified as a reference method in an appendix to part 50 of this chapter, or a method that has been designated as a reference method in accordance with this part; it does not include a method for which a reference method designation has been canceled in accordance with § 53.11 or § 53.16 of this chapter.

Regional Administrator means the Administrator of one of the ten EPA Regional Offices or his or her authorized representative.

SAROAD site identification form is one of the several forms in the SAROAD system. It is the form which provides a complete description of the site (and its surroundings) of an ambient air quality monitoring station.

SLAMS means State or Local Air Monitoring Station(s). The SLAMS make up the ambient air quality monitoring network which is required by § 58.20 to be provided for in the State's implementation plan. This definition places no restrictions on the use of the physical structure or facility housing the SLAMS. Any combination of SLAMS and any other monitors (Special Purpose, NAMS, PAMS, PSD) may occupy the same facility or structure without affecting the respective definitions of those monitoring station.

SO<sub>2</sub> means sulfur dioxide.

Special Purpose Monitor (SPM) is a generic term used for all monitors other than SLAMS, NAMS, PAMS, and PSD monitors included in an agency's monitoring network for monitors used in a special study whose data are officially reported to EPA.

State agency means the air pollution control agency primarily responsible for development and implementation of a plan under the Act.

Storage and Retrieval of Aerometric Data (SAROAD) system is a computerized system which stores and reports information relating to ambient air quality. The SAROAD system has been replaced with the AIRS-AQS system; however, the SAROAD data reporting...
§ 58.11 Monitoring methods.

Appendix C to this part contains the criteria to be followed in determining acceptable monitoring methods or instruments for use in SLAMS.

§ 58.12 Purpose.

(a) This part contains criteria and requirements for ambient air quality monitoring and requirements for reporting ambient air quality data and information. The monitoring criteria pertain to the following areas:

(1) Quality assurance procedures for monitor operation and data handling.

(2) Methodology used in monitoring stations.

(3) Operating schedule.

(4) Siting parameters for instruments or instrument probes.

(b) The requirements pertaining to provisions for an air quality surveillance system in the State Implementation Plan are contained in this part.

(c) This part also acts to establish a national ambient air quality monitoring network for the purpose of providing timely air quality data upon which to base national assessments and policy decisions. This network will be operated by the States and will consist of certain selected stations from the States' SLAMS networks. These selected stations will remain as SLAMS and will continue to meet any applicable requirements on SLAMS. The stations, however, will also be designated as National Air Monitoring Stations (NAMS) and will be subject to additional data reporting and monitoring methodology requirements as contained in subpart D of this part.

(d) This section also acts to establish a Photochemical Assessment Monitoring Stations (PAMS) network as a subset of the State's SLAMS network for the purpose of enhanced monitoring in O₃ nonattainment areas listed as serious, severe, or extreme. The PAMS network will be subject to the data reporting and monitoring methodology requirements as contained in subpart E of this part.

(e) Requirements for the daily reporting of an index of ambient air quality, to insure that the population of major urban areas are informed daily of local air quality conditions, are also included in this part.

[44 FR 27571, May 10, 1979, as amended at 58 FR 8467, Feb. 12, 1993]

§ 58.3 Applicability.

This part applies to:

(a) State air pollution control agencies.

(b) Any local air pollution control agency or Indian governing body to which the State has delegated authority to operate a portion of the State's SLAMS network.

(c) Owners or operators of proposed sources.

Subpart B—Monitoring Criteria

§ 58.10 Quality assurance.

(a) Appendix A to this part contains quality assurance criteria to be followed when operating the SLAMS network.

(b) Appendix B to this part contains the quality assurance criteria to be followed by the owner or operator of a proposed source when operating a PSD station.

§ 58.11 Monitoring methods.

Appendix C to this part contains the criteria to be followed in determining acceptable monitoring methods or instruments for use in SLAMS.
§ 58.12 Siting of instruments or instrument probes.

Appendix E to this part contains criteria for siting instruments or instrument probes for SLAMS.

§ 58.13 Operating schedule.

Ambient air quality data collected at any SLAMS must be collected as follows:

(a) For continuous analyzers—consecutive hourly averages except during:
   (1) Periods of routine maintenance,
   (2) Periods of instrument calibration, or
   (3) Periods or seasons exempted by the Regional Administrator.

(b) For manual methods (excluding PM$_{10}$ samplers, PM$_{2.5}$ samplers, and PAMS VOC samplers), at least one 24-hour sample must be obtained every sixth day except during periods or seasons exempted by the Regional Administrator.

(c) For PAMS VOC samplers, samples must be obtained as specified in sections 4.3 and 4.4 of appendix D to this part. Area-specific PAMS operating schedules must be included as part of the network description required by §58.40 and must be approved by the Administrator.

(d) For PM$_{10}$ samplers—a 24-hour sample must be taken a minimum of every third day, except during periods or seasons exempted by the Regional Administrator.

(e) For PM$_{2.5}$ samplers, a 24-hour sample is required everyday for certain core SLAMS, including certain PAMS, as described in section 2.8.1.3 of appendix D of this part, except during seasons or periods of low PM$_{2.5}$ as otherwise exempted by the Regional Administrator. A waiver of the everyday sampling schedule for SLAMS may be granted by the Regional Administrator or designee, and for NAMS by the Administrator or designee, for 1 calendar year from the time a PM$_{2.5}$ sequential sampler (FRM or Class I equivalent) has been approved by EPA. A 24-hour sample must be taken a minimum of every third day for all other SLAMS, including NAMS, as described in section 2.8.1.3 of appendix D of this part, except when exempted by the Regional Administrator or designee, for 1 calendar year from the time a PM$_{2.5}$ sequential sampler (FRM or Class I equivalent) has been approved by EPA. During periods for which exemptions to every third day or every day sampling are allowed for core PM$_{2.5}$ SLAMS, a minimum frequency of one in 6-day sampling is still required. However, alternative sampling frequencies are allowed for SLAMS sites that are principally intended for comparisons to the 24-hour NAAQS. Such modifications must be approved by the Regional Administrator.

(f) Alternatives to everyday sampling at sites with correlated acceptable continuous analyzers. (1) Certain PM$_{2.5}$ core SLAMS sites located in monitoring planning areas (as described in section 2.8 of appendix D of this part) are required to sample every day with a reference or equivalent method operating in accordance with part 53 of this chapter and section 2 of appendix C of this part. However, in accordance with the monitoring priority as defined in paragraph (f)(2) of this section, established by the control agency and approved by EPA, a core SLAMS monitor may operate with a reference or equivalent method on a 1 in 3-day schedule and produce data that may be compared to the NAAQS, provided that it is collocated with an acceptable continuous fine particulate PM analyzer that is correlated with the reference or equivalent method. If the alternative sampling schedule is selected by the control agency and approved by EPA, the alternative schedule shall be implemented on January 1 of the year in which everyday sampling is required. The selection of correlated acceptable continuous PM analyzers and procedures for correlation with the intermittent reference or equivalent method shall be in accordance with procedures approved by the Regional Administrator. Unless the continuous fine particulate analyzer satisfies the requirements of section 2 of appendix C of this part, however, the data derived from the correlated acceptable continuous monitor are not eligible for direct comparisons to the NAAQS in accordance with part 50 of this chapter.

(2) A Metropolitan Statistical Area (MSA) (or primary metropolitan statistical area) with greater than 1 million population and high concentrations of PM$_{2.5}$ (greater than or equal to 80 percent of the NAAQS) shall be a Priority
1 PM monitoring area. Other monitoring planning areas may be designated as Priority 2 PM monitoring areas.

(3) Core SLAMS having a correlated acceptable continuous analyzer collocated with a reference or equivalent method in a Priority 1 PM monitoring area may operate on the 1 in 3 sampling frequency only after reference or equivalent data are collected for at least 2 complete years.

(4) In all monitoring situations, with a correlated acceptable continuous alternative, FRM samplers or filter-based equivalent analyzers should preferably accompany the correlated acceptable continuous monitor.

§ 58.14 Special purpose monitors.

(a) Except as specified in paragraph (b) of this section, any ambient air quality monitoring station other than a SLAMS or PSD station from which the State intends to use the data as part of a demonstration of attainment or nonattainment or in computing a design value for control purposes of the National Ambient Air Quality Standards (NAAQS) must meet the requirements for SLAMS as described in § 58.22 and, after January 1, 1983, must also meet the requirements for SLAMS described in § 58.13 and Appendices A and E of this part.

(b) Based on the need, in transitioning to a PM_{2.5} standard that newly addresses the ambient impacts of fine particles, to encourage a sufficiently extensive geographical deployment of PM_{2.5} monitors and thus hasten the development of an adequate PM_{2.5} ambient air quality monitoring infrastructure, PM_{2.5} NAAQS violation determinations shall not be exclusively based on data produced at a population-oriented SPM site during the first 2 complete calendar years of its operation. However, a notice of NAAQS violations resulting from population-oriented SPMs shall be reported to EPA in the State’s annual monitoring report and be considered by the State in the design of its overall SLAMS network; these population-oriented SPMs should be considered to become a permanent SLAMS during the annual network review in accordance with § 58.25.

(c) Any ambient air quality monitoring station other than a SLAMS or PSD station from which the State intends to use the data for SIP-related functions other than as described in paragraph (a) of this section is not necessarily required to comply with the requirements for a SLAMS station under paragraph (a) of this section but must be operated in accordance with a monitoring schedule, methodology, quality assurance procedures, and probe or instrument-siting specifications approved by the Regional Administrator.

§ 58.20 Air quality surveillance: plan content.

By January 1, 1980, the State shall adopt and submit to the Administrator a revision to the plan which will:

(a) Provide for the establishment of an air quality surveillance system that consists of a network of monitoring stations designated as State and Local Air Monitoring Stations (SLAMS) which measure ambient concentrations of those pollutants for which standards have been established in part 50 of this chapter. SLAMS (including NAMS) designated as PAMS will also obtain ambient concentrations of speciated VOC and NO_{X} and meteorological measurements. PAMS may therefore be located at existing SLAMS or NAMS sites when appropriate.

(b) Provide for meeting the requirements of appendices A, C, D, and E to this part.

(c) Provide for the review of the air quality surveillance system on an annual basis to determine if the system meets the monitoring objectives defined in appendix D of this part. Such
review must identify needed modifications to the network such as termination or relocation of unnecessary stations or establishment of new stations that are necessary. For PM$_{2.5}$, the review must identify needed changes to core SLAMS, monitoring planning areas, the chosen community monitoring approach including optional community monitoring zones, SLAMS, or SPMs.

(e) Provide for having a SLAMS network description available for public inspection and submission to the Administrator upon request. The network description must be available at the time of plan revision submittal and must contain the following information for each SLAMS:

1. The AIRS site identification form for existing stations.
2. The proposed location for scheduled stations.
3. The sampling and analysis method.
4. The operating schedule.
5. The monitoring objective, spatial scale of representativeness, and additionally for PM$_{2.5}$, the monitoring planning area, optional community monitoring zone, and the site code designation to identify which site will be identified as core SLAMS; and SLAMS or population-oriented SPMs, if any, that are microscale or middle scale in their representativeness as defined in appendix D of this part.
6. A schedule for:
   i. Locating, placing into operation, and making available the AIRS site identification form for each SLAMS which is not located and operating at the time of plan revision submittal.
   ii. Implementing quality assurance procedures of appendix A of this part for each SLAMS for which such procedures are not implemented at the time of plan revision submittal.
   iii. Resiting each SLAMS which does not meet the requirements of appendix E of this part at the time of plan revision submittal.

(f) Provide for having a PM monitoring network description available for public inspection which must provide for monitoring planning areas, and the community monitoring approach involving core monitors and optional community monitoring zones for PM$_{2.5}$. The PM monitoring network description for PM$_{10}$ and PM$_{2.5}$ must be submitted to the Regional Administrator for approval by July 1, 1996, and must contain the following information for each PM SLAMS and PM$_{2.5}$ SPM:

1. The AIRS site identification form for existing stations.
2. The proposed location for scheduled stations.
3. The sampling and analysis method.
4. The operating schedule.
5. The monitoring objective, spatial scale of representativeness, and additionally for PM$_{2.5}$, the monitoring planning area, optional community monitoring zone, and the site code designation to identify which site will be identified as core SLAMS; and SLAMS or population-oriented SPMs, if any, that are microscale or middle scale in their representativeness as defined in appendix D of this part.
6. A schedule for:
   i. Locating, placing into operation, and making available the AIRS site identification form for each SLAMS which is not located and operating at the time of plan revision submittal.
   ii. Implementing quality assurance procedures of appendix A of this part for each SLAMS for which such procedures are not implemented at the time of plan revision submittal.
   iii. Resiting each SLAMS which does not meet the requirements of appendix E of this part at the time of plan revision submittal.

(g) Provide for having a list of all PM$_{2.5}$ monitoring locations including SLAMS, NAMS, PAMS and population-oriented SPMs, that are included in the State's PM monitoring network description and are intended for comparison to the NAAQS, available for public inspection.

(h) Within 9 months after:

1. February 12, 1993; or
2. Date of redesignation or reclassification of any existing O$_3$ nonattainment area to serious, severe, or extreme; or
3. The designation of a new area and classification to serious, severe, or extreme, affected States shall adopt and submit a plan revision to the Administrator.

(i) The plan revision will provide for the establishment and maintenance of PAMS. Each PAMS site will provide for the monitoring of ambient concentrations of criteria pollutants (O$_3$, NO$_2$), and non-criteria pollutants (NO$_x$, NO, and speciated VOC) as stipulated in section 4.2 of appendix D, and meteorological measurements. The PAMS
§ 58.26 Annual State air monitoring report.

(a) The State shall submit to the Administrator (through the appropriate Regional Office) an annual summary report of all the ambient air quality monitoring data from all monitoring stations designated State and Local Air Monitoring Stations (SLAMS). The annual report must be submitted by July 1 of each year for data collected from January 1 to December 31 of the previous year.
§ 58.27 Compliance date for air quality data reporting.

The annual air quality data reporting requirements of §58.26 apply to data collected after December 31, 1980. Data collected before January 1, 1981, must be reported under the reporting procedures in effect before the effective date of subpart C of this part.

§ 58.28 SLAMS data submittal.

The State shall submit all of the SLAMS data according to the same data submittal requirements as defined for NAMS in section 58.35. The State shall also submit any portion or all of the SLAMS data to the appropriate Regional Administrator upon request.

[59 FR 41628, Aug. 12, 1994]

Subpart D—National Air Monitoring Stations (NAMS)

§ 58.30 NAMS network establishment.

(a) By January 1, 1980, with the exception of PM10 and PM2.5 samplers, which shall be by July 1, 1998, the State shall:

(1) Establish, through the operation of stations or through a schedule for locating and placing stations into operation, that portion of a National Ambient Air Quality Monitoring Network which is in that State, and
(2) Submit to the Administrator (through the appropriate Regional Office) a description of that State's portion of the network.

(b) Hereinafter, the portion of the national network in any State will be referred to as the NAMS network.

(c) The stations in the NAMS network must be stations from the SLAMS network required by §58.20.

(d) The requirements of appendix D to this part must be met when designing the NAMS network. The process of designing the NAMS network must be part of the process of designing the SLAMS network as explained in appendix D to this part.

§ 58.31 NAMS network description.

The NAMS network description required by §58.30 must contain the following for all stations, existing or scheduled:

(a) The AIRS site identification number for existing stations.

(b) The proposed location for scheduled stations.

(c) Identity of the urban area represented.

(d) The sampling and analysis method.

(e) The operating schedule.

(f) The monitoring objective, spatial scale of representativeness, and for PM$_{2.5}$, the monitoring planning area and community monitoring zones, as defined in appendix D of this part.

(g) A schedule for:

(1) Locating, placing into operation, and submitting the AIRS site identification form for each NAMS which is not located and operating at the time of network description submittal,

(2) Implementing quality assurance procedures of appendix A to this part for each NAMS for which such procedures are not implemented at the time of network description submittal, and

(3) Resiting each NAMS which does not meet the requirements of appendix E to this part at the time of network description submittal.

§ 58.32 NAMS approval.

The NAMS network required by §58.30 is subject to the approval of the Administrator. Such approval will be contingent upon completion of the network description as outlined in §58.31 and upon conformance to the NAMS design criteria contained in appendix D to this part.

§ 58.33 NAMS methodology.

Each NAMS must meet the monitoring methodology requirements of appendix C to this part applicable to NAMS at the time the station is put into operation as a NAMS.

§ 58.34 NAMS network completion.

With the exception of PM$_{10}$ samplers, which shall be by 1 year after September 16, 1997, and PM$_{2.5}$, which shall be by 3 years after September 16, 1997:

(a) Each NAMS must be in operation, be sited in accordance with the criteria in Appendix E to this part, and be located as described in the AIRS database; and

(b) The quality assurance requirements of appendix A to this part must be fully implemented for all NAMS.

§ 58.35 NAMS data submittal.

(a) The requirements of this section apply to those stations designated as both SLAMS and NAMS by the network description required by §§58.20 and 58.30.

(b) The State shall report to the Administrator all ambient air quality data for SO$_2$, CO, O$_3$, NO$_2$, Pb, PM$_{10}$, and PM$_{2.5}$, and information specified by the AIRS Users Guide (Volume II, Air Quality Data Coding, and Volume III, Air Quality Data Storage) to be coded into the AIRS-AQS format. Such air quality data and information must be submitted directly to the AIRS-AQS via either electronic transmission or magnetic tape, in the format of the AIRS-AQS, and in accordance with the quarterly schedule described in paragraph (c) of this section.

(c) The specific quarterly reporting periods are January 1-March 31, April
§ 58.36 System modification.

During the annual SLAMS Network Review specified in §58.20, any changes to the NAMS network identified by the EPA and/or proposed by the State and agreed to by the EPA will be evaluated. These modifications should address changes invoked by a new census and changes to the network due to changing air quality levels, emission patterns, etc. The State shall be given one year (until the next annual evaluation) to implement the appropriate changes to the NAMS network.

§ 58.36 System modification.

During the annual SLAMS Network Review specified in §58.20, any changes to the NAMS network identified by the EPA and/or proposed by the State and agreed to by the EPA will be evaluated. These modifications should address changes invoked by a new census and changes to the network due to changing air quality levels, emission patterns, etc. The State shall be given one year (until the next annual evaluation) to implement the appropriate changes to the NAMS network.

§ 58.37 System modification.

During the annual SLAMS Network Review specified in §58.20, any changes to the NAMS network identified by the EPA and/or proposed by the State and agreed to by the EPA will be evaluated. These modifications should address changes invoked by a new census and changes to the network due to changing air quality levels, emission patterns, etc. The State shall be given one year (until the next annual evaluation) to implement the appropriate changes to the NAMS network.

§ 58.38 System modification.

During the annual SLAMS Network Review specified in §58.20, any changes to the NAMS network identified by the EPA and/or proposed by the State and agreed to by the EPA will be evaluated. These modifications should address changes invoked by a new census and changes to the network due to changing air quality levels, emission patterns, etc. The State shall be given one year (until the next annual evaluation) to implement the appropriate changes to the NAMS network.

§ 58.39 System modification.

During the annual SLAMS Network Review specified in §58.20, any changes to the NAMS network identified by the EPA and/or proposed by the State and agreed to by the EPA will be evaluated. These modifications should address changes invoked by a new census and changes to the network due to changing air quality levels, emission patterns, etc. The State shall be given one year (until the next annual evaluation) to implement the appropriate changes to the NAMS network.

§ 58.40 PAMS network establishment.

(a) In addition to the plan revision, the State shall submit a photochemical assessment monitoring network description including a schedule for implementation to the Administrator within 6 months after:

(1) February 12, 1993; or
(2) Date of redesignation or reclassification of any existing O\textsubscript{3} nonattainment area to serious, severe, or extreme; or
(3) The designation of a new area and classification to serious, severe, or extreme O\textsubscript{3} nonattainment.

The network description will apply to all serious, severe, and extreme O\textsubscript{3} nonattainment areas within the State. Some O\textsubscript{3} nonattainment areas may extend beyond State or Regional boundaries. In instances where PAMS network design criteria as defined in appendix D to this part require monitoring stations located in different States and/or Regions, the network description and implementation schedule should be submitted jointly by the States involved. When appropriate, such cooperation and joint network design submittals are preferred. Network descriptions shall be submitted through the appropriate Regional Office(s). Alternative networks, including different monitoring schedules, periods, or methods, may be submitted, but they must include a demonstration that they satisfy the monitoring data uses and fulfill the PAMS monitoring objectives described in sections 4.1 and 4.2 of appendix D to this part.

(b) For purposes of plan development and approval, the stations established or designated as PAMS must be stations from the SLAMS network or become part of the SLAMS network required by §58.20.

(c) The requirements of appendix D to this part applicable to PAMS must be met when designing the PAMS network.

§ 58.41 PAMS network description.

The PAMS network description required by §58.40 must contain the following:

(a) Identification of the monitoring area represented.
(b) The AIRS site identification number for existing stations.
(c) The proposed location for scheduled stations.
(d) Identification of the site type and location within the PAMS network design for each station as defined in appendix D to this part except that during any year, a State may choose to submit detailed information for the site scheduled to begin operation during that year's PAMS monitoring season, and defer submittal of detailed information on the remaining sites until succeeding years. Such deferred network design phases should be submitted to EPA for approval no later than January 1 of the first year of scheduled operation. As a minimum, general information on each deferred site should be submitted each year until final approval of the complete network is obtained from the Administrator.

(e) The sampling and analysis method for each of the measurements.

(f) The operating schedule for each of the measurements.

(g) An \( \text{O}_3 \) event forecasting scheme, if appropriate.

(h) A schedule for implementation. This schedule should include the following:

(1) A timetable for locating and submitting the AIRS site identification form for each scheduled PAMS that is not located at the time of submittal of the network description;

(2) A timetable for phasing-in operation of the required number and type of sites as defined in appendix D to this part; and

(3) A schedule for implementing the quality assurance procedures of appendix A to this part for each PAMS.

§ 58.43 PAMS methodology.

PAMS monitors must meet the monitoring methodology requirements of appendix C to this part applicable to PAMS.

§ 58.44 PAMS network completion.

(a) The complete, operational PAMS network will be phased in as described in appendix D to this part over a period of 5 years after:

(1) February 12, 1993; or

(2) Date of redesignation or reclassification of any existing \( \text{O}_3 \) nonattainment area to serious, severe, or extreme; or

(3) The designation of a new area and classification to serious, severe, or extreme \( \text{O}_3 \) nonattainment.

(b) The quality assurance criteria of appendix A to this part must be implemented for all PAMS.

§ 58.45 PAMS data submittal.

(a) The requirements of this section apply only to those stations designated as PAMS by the network description required by § 58.40.

(b) All data shall be submitted to the Administrator in accordance with the format, reporting periods, reporting deadlines, and other requirements as specified for NAMS in § 58.35.

(c) The State shall report \( \text{NO} \) and \( \text{NO}_x \) data consistent with the requirements of § 58.35 for criteria pollutants.

(d) The State shall report VOC data and meteorological data within 6 months following the end of each quarterly reporting period.

§ 58.46 System modification.

(a) Any proposed changes to the PAMS network description will be evaluated during the annual SLAMS Network Review specified in § 58.20. Changes proposed by the State must be approved by the Administrator. The State will be allowed 1 year (until the next annual evaluation) to implement the appropriate changes to the PAMS network.

(b) PAMS network requirements are mandatory only for serious, severe, and extreme \( \text{O}_3 \) nonattainment areas. When any such area is redesignated to attainment, the State may revise its PAMS monitoring program subject to approval by the Administrator.
Subpart F—Air Quality Index Reporting

§ 58.50 Index reporting.

(a) The State shall report to the general public through prominent notice an air quality index in accordance with the requirements of appendix G to this part.

(b) Reporting is required by all Metropolitan Statistical Areas with a population exceeding 350,000.

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

[64 FR 42547, Aug. 4, 1999]

Subpart G—Federal Monitoring


§ 58.60 Federal monitoring.

The Administrator may locate and operate an ambient air monitoring station if the State fails to locate, or schedule to be located, during the initial network design process or as a result of the annual review required by §58.20(d):

(a) A SLAMS at a site which is necessary in the judgment of the Regional Administrator to meet the objectives defined in appendix D to this part, or

(b) A NAMS at a site which is necessary in the judgment of the Administrator for meeting EPA national data needs.

§ 58.61 Monitoring other pollutants.

The Administrator may promulgate criteria similar to that referenced in subpart B of this part for monitoring a pollutant for which a National Ambient Air Quality Standard does not exist. Such an action would be taken whenever the Administrator determines that a nationwide monitoring program is necessary to monitor such a pollutant.

APPENDIX A TO PART 58—QUALITY ASSURANCE REQUIREMENTS FOR STATE AND LOCAL AIR MONITORING STATIONS (SLAMS)

1. General Information.
Environmental Protection Agency

(a) Meet a well-defined need, use, or purpose.
(b) Satisfy customers' expectations.
(c) Comply with applicable standards specifications.
(d) Comply with statutory (and other) requirements of society.
(e) Reflect consideration of cost and economics.
(f) Implement a quality assurance program consisting of policies, procedures, specifications, standards, and documentation necessary to:
   (1) Provide data of adequate quality to meet monitoring objectives, and
   (2) Minimize loss of air quality data due to malfunctions or out-of-control conditions. This quality assurance program must be described in detail, suitably documented in accordance with Agency requirements (reference 4 of this appendix), and approved by the appropriate Regional Administrator, or the Regional Administrator's designee. The Quality Assurance Program will be reviewed during the systems audits described in section 2.5 of this appendix.

2.2 Primary requirements and guidance documents for developing the quality assurance program are contained in references 2 through 7 of this appendix, which also contain many suggested and required procedures, checks, and control specifications. Reference 7 of this appendix describes specific guidance for the development of a QA Program 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 8 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. Quality assurance guidance for meteorological systems at PAMS is contained in reference 9 of this appendix. Quality assurance procedures for VOC, NO, (including NO and NO2), O3, and carbonyl measurements at PAMS must be consistent with reference 15 of this appendix. Reference 4 of this appendix includes requirements for the development of quality assurance project plans, and quality assurance and control programs, and systems audits demonstrating attainment of the requirements.

2.3 Pollutant Concentration and Flow Rate Standards

2.3.1 Gaseous pollutant concentration standards (permeation devices or cylinders of compressed gas) used to obtain test concentrations for CO, SO2, NO, and NO2 must be traceable to either a National Institute of Standards and Technology (NIST) 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 10 of this appendix.

2.3.2 Test concentrations for O3 must be obtained in accordance with the UV photometric calibration procedure specified in 40 CFR part 50, appendix D, or by means of a certified ozone transfer standard. Consult references 11 and 12 of this appendix for guidance on primary and transfer standards for O3.

2.3.3 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 7 of this appendix.

2.4 National Performance Audit Program (NPAP). Agencies operating SLAMS are required to participate in EPA's NPAP. These audits are described in reference 7 of this appendix. For further instructions, agencies should contact either the appropriate EPA Regional QA Coordinator at the appropriate EPA Regional Office location, or the NPAP Coordinator, Emissions Monitoring and Analysis Division (MD-34), U.S. Environmental Protection Agency, Research Triangle Park, NC 27711.

2.5 Systems Audit Programs. Systems audits of the ambient air monitoring programs of agencies operating SLAMS shall be conducted at least every 3 years by the appropriate EPA Regional Office. Systems audit programs are described in reference 7 of this appendix. For further instructions, agencies should contact either the appropriate EPA Regional QA Coordinator or the Systems Audit Coordinator, Office of Air Quality Planning and Standards, Emissions Monitoring and Analysis Division (MD-34), U.S. Environmental Protection Agency, Research Triangle Park, NC 27711.

3. Data Quality Assessment Requirements

3.0.1 All ambient monitoring methods or analyzers used in SLAMS shall be tested periodically, as described in this section, to quantitatively assess the quality of the SLAMS data. Measurement uncertainty is estimated for both automated and manual methods. Terminology associated with measurement uncertainty are found within this appendix and includes:
   (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) Accuracy. The degree of agreement between an observed value and an accepted reference value, accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations;
   (c) Bias. The systematic or persistent distortion of a measurement process which causes errors in one direction. The individual
results of these tests for each method or analyzer shall be reported to EPA as specified in section 4 of this appendix. EPA will then calculate quarterly assessments of measurement uncertainty applicable to the SLAMS data as described in section 5 of this appendix. Data assessment results should be reported to EPA only for methods and analyzers approved for use in SLAMS monitoring under appendix C of this part.

3.0.2 Estimates of the data quality will be calculated on the basis of single monitors and reporting organizations and may also be calculated for each region and for the entire Nation. A reporting organization is defined as a subordinate organization within a State, or other organization that is responsible for a set of stations that monitors the same pollutant and for which data quality assessments can be pooled. States must define one or more reporting organizations for each pollutant such that each monitoring station in the State SLAMS network is included in one, and only one, reporting organization.

3.0.3 Each reporting 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.

(a) Common factors that should be considered by States in defining reporting organizations include:

(1) Operation by a common team of field operators.

(2) Common calibration facilities.

(3) Oversight by a common quality assurance organization.

(4) Support by a common laboratory or headquarters.

(b) Where there is uncertainty in defining the reporting organizations or in assigning specific sites to reporting organizations, States shall consult with the appropriate EPA Regional Office. All definitions of reporting organizations shall be subject to final approval by the appropriate EPA Regional Office.

3.0.4 Assessment results shall be reported as specified in section 4 of this appendix. Table A-1 of this appendix provides a summary of the minimum data quality assessment requirements, which are described in more detail in the following sections.

3.1 Precision of Automated Methods Excluding PM$_{2.5}$

3.1.1 Methods for SO$_2$, NO$_x$, O$_3$, and CO. A one-point precision check must be performed at least once every 2 weeks on each automated analyzer used to measure SO$_2$, NO$_x$, O$_3$, and CO. The precision check is made by challenging the analyzer with a precision check gas of known concentration (effective for open path analyzers) between 0.08 and 0.10 ppm for SO$_2$, NO$_x$, and O$_3$ analyzers, and between 8 and 10 ppm for CO analyzers. To check the precision of SLAMS analyzers operating on ranges higher than 0 to 10 ppm SO$_2$, NO$_x$, and O$_3$, or 0 to 100 ppm for CO, use precision check gases of appropriately higher concentration as approved by the appropriate Regional Administrator or their designee. However, the results of precision checks at concentration levels other than those specified above need not be reported to EPA. The standards from which precision check test concentrations are obtained must meet the specifications of section 2.3 of this appendix.

3.1.1.1 Except for certain CO analyzers described below, point analyzers must operate in their normal sampling mode during the precision 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 precision 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 precision check is made in conjunction with a zero or span adjustment, it must be made prior to such zero or span adjustments. Randomization of the precision check with respect to time of day, day of week, and routine service and adjustments is encouraged where possible.

3.1.1.2 Open path analyzers are tested by inserting a test cell containing a precision 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 precision check gas in the test cell must be selected to produce an effective concentration in the range specified in section 3.1.1. Generally, the precision test concentration measurement will be the sum of the atmospheric pollutant concentration and the precision 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 precision check test from the precision test.
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 these results and repeat the test. If possible, open path analyzers should be tested during periods when the atmospheric pollutant concentrations are relatively low and steady.

3.1.3 Report the actual concentration (effective concentration for open path analyzers) of the precision check gas and the corresponding concentration measurement (corrected concentration, if applicable, for open path analyzers) indicated by the analyzer. The percent differences between these concentrations are used to assess the precision of the monitoring data as described in section 5.1 of this appendix.

3.1.4 Auditing a single automation analyzer. A single one-point precision check must be performed at least once every 2 weeks on each automated analyzer used to measure PM$_{2.5}$. The precision check is made by checking the operational flow rate of the analyzer. If a precision flow rate check is made in conjunction with a flow rate adjustment, it must be made prior to such flow rate adjustment. Randomization of the precision check with respect to time of day, day of week, and routine service and adjustments is encouraged where possible.

3.1.5 Methods for Particulate Matter Excluding PM$_{2.5}$. A one-point precision check must be performed at least once every 2 weeks on each automated analyzer used to measure PM$_{10}$. The precision check is made by checking the operational flow rate of the analyzer. If a precision flow rate check is made in conjunction with a flow rate adjustment, it must be made prior to such flow rate adjustment. Randomization of the precision check with respect to time of day, day of week, and routine service and adjustments is encouraged where possible.

3.1.6 For either procedure, the percent differences between the actual and indicated flow rates are used to assess the precision of the monitoring data as described in section 5.1 of this appendix (using flow rates in lieu of concentrations). The percent differences between these concentrations are used to assess the precision of the monitoring data as described in section 5.1 of this appendix.

3.2 Accuracy of Automated Methods Excluding PM$_{10}$.

3.2.1 Methods for SO$_2$, NO$_2$, O$_3$, or CO.

3.2.1.1 Each calendar quarter (during which analyzers are operated), audit at least 25 percent of the SLAMS analyzers that monitor SO$_2$, NO$_2$, O$_3$, or CO such that each analyzer is audited at least once per year. If there are fewer than four analyzers for a pollutant within a reporting organization, randomly reaudit one or more analyzers so that at least one analyzer for that pollutant is audited each calendar quarter. Where possible, EPA strongly encourages more frequent auditing, up to an audit frequency of once per quarter for each SLAMS analyzer.

3.2.1.2 (a) The audit is made by challenging the analyzer with at least one audit gas of known concentration (effective concentration for open path analyzers) from each of the following ranges applicable to the analyzer being audited:

<table>
<thead>
<tr>
<th>Audit Level</th>
<th>Concentration Range, PPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.03–0.08</td>
</tr>
<tr>
<td>2</td>
<td>0.15–0.20</td>
</tr>
<tr>
<td>3</td>
<td>0.35–0.45</td>
</tr>
<tr>
<td>4</td>
<td>0.80–0.90</td>
</tr>
</tbody>
</table>

3.2.1.3 NO concentrations substantially higher than 0.08 ppm, as may occur when using some gas phase titration (GPT) techniques, may lead to audit 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$_2$ audit gas to levels closer to typical ambient NO concentrations at the site.

3.2.1.4 To audit SLAMS analyzers operating on ranges higher than 0 to 10 ppm for SO$_2$, NO$_2$, and O$_3$ or 0 to 100 ppm for CO, use audit gases of appropriately higher concentration as approved by the appropriate Regional Administrator or the Administrator’s designee. The results of audits at concentration levels other than those shown in the above table need not be reported to EPA.

3.2.1.5 The standards from which audit gas test concentrations are obtained must meet

3.2.2 Alternative procedure:

3.2.2.1 It is permissible to obtain the precision check flow rate data from the analyzer’s internal flow meter without the use of an external flow rate transfer standard, provided that:

3.2.2.1.1 The flow meter is audited with an external flow rate transfer standard at least every 6 months.

3.2.2.1.2 Records of at least the three most recent flow audits of the instrument’s internal flow meter over at least several weeks confirm that the flow meter is stable, verifiable, and accurate to ±4%.

3.2.2.1.3 The instrument and flow meter give no indication of improper operation.

3.2.2.2 With suitable communication capability, the precision check may thus be carried out remotely. For this procedure, report the set-point flow rate as the actual flow rate along with the flow rate measured or indicated by the analyzer flow meter.

3.2.2.3 For either procedure, the percent differences between the actual and indicated concentrations are used to assess the precision of the monitoring data as described in section 5.1 of this appendix.
the specifications of section 2.3 of this appendix. The gas standards and equipment used for auditing must not be the same as the standards and equipment used for calibration or other routine operation. The auditor should not be the operator or analyst who conducts the routine monitoring, calibration, and analysis.

3.2.1.6 For open path analyzers, the audit shall be carried out by allowing the analyzer to analyze the audit 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 is practicable. The exception provided in section 3.1 of this appendix for certain CO analyzers does not apply for audits.

3.2.1.7 Open path analyzers are audited 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 audit, and the normal monitoring configuration of the instrument should be modified as little as possible to accommodate the test cell for the audit. 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 ranges specified in this section 3.2 of this appendix. Generally, each audit concentration measurement result will be the sum of the atmospheric pollutant concentration and the audit 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 audit test (or preferably before and after each audit concentration level) from the audit 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 audited during periods when the atmospheric pollutant concentrations are relatively low and steady. Also, the monitoring path length must be reverified to within ±3 percent to validate the audit, since the monitoring path length is critical to the determination of the effective concentration.

3.2.1.8 Report both the actual concentrations (effective concentrations for open path analyzers) of the audit gases and the corresponding concentration measurements (corrected concentrations, if applicable, for open path analyzers) indicated or produced by the analyzer being audited. The percent differences between these concentrations are used to assess the accuracy of the monitoring data as described in section 5.2 of this appendix.

3.2.2 Methods for Particulate Matter Excluding PM$_{10}$

3.2.2.1 Each calendar quarter, audit the flow rate of at least 25 percent of the SLAMS PM$_{10}$ analyzers such that each PM$_{10}$ analyzer is audited at least once per year. If there are fewer than four PM$_{10}$ analyzers within a reporting organization, randomly re-audit one or more analyzers so that at least one analyzer is audited each calendar quarter. Where possible, EPA strongly encourages more frequent auditing, up to an audit frequency of once per quarter for each SLAMS analyzer.

3.2.2.2 The audit is made by measuring the analyzer’s normal operating flow rate, using a flow rate transfer standard certified in accordance with section 2.3.3 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 (actual) flow rate and the corresponding flow rate indicated or assumed by the sampler. The percent differences between these flow rates are used to calculate accuracy (PM$_{10}$) as described in section 5.2 of this appendix.

3.3 Precision of Manual Methods Excluding PM$_{10}$

3.3.1 For each network of manual methods other than for PM$_{10}$, select one or more monitoring sites within the reporting organization for duplicate, collocated sampling as follows: for 1 to 5 sites, select 1 site; for 6 to 20 sites, select 2 sites; and for over 20 sites, select 3 sites. Where possible, additional collocated sampling is encouraged. For purposes of precision assessment, networks for measuring TSP and PM$_{10}$ shall be considered separately from one another. 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 Regional Administrator may be selected.

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

3.3.3 The two collocated samplers must be within 4 meters of each other, and particulate matter samplers must be at least 2 meters apart 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.

3.4 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 duplicate sampler. Each duplicate sampler must be operated concurrently with its associated routine sampler at least once per week. The operation schedule should be selected so that the sampling days are distributed evenly over the year and over the seven days of the week. A six-day sampling schedule is required. 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 5.3 of this appendix.

3.4 Accuracy of Manual Methods Excluding PM10. The accuracy of manual sampling methods is assessed by auditing a portion of the measurement process.

3.4.1 Procedures for PM10 and TSP.

3.4.1.1 Procedures for flow rate audits for PM10. Each calendar quarter, audit the flow rate of at least 25 percent of the PM10 samplers such that each PM10 sampler is audited at least once per year. If there are fewer than four PM10 samplers within a reporting organization, randomly reaudit one or more samplers so that one sampler is audited each calendar quarter. Audit each sampler at its normal operating flow rate, using a flow rate transfer standard certified in accordance with section 2.3.3 of this appendix. The flow rate standard used for auditing must not be the same flow rate standard used to calibrate the sampler. However, both the calibration standard and the audit standard may be referenced to the same primary flow rate standard. The flow audit should be scheduled so as to avoid interference with a scheduled sampling period. Report the audit (actual) flow rate and the corresponding flow rate indicated by the sampler’s normally used flow indicator. The percent differences between these flow rates are used to calculate accuracy and bias as described in section 5.4.1 of this appendix.

3.4.1.2 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.

3.4.2 SO2 Methods.

3.4.2.1 Prepare audit solutions from a working sulfite-tetrachloromercurate (TCM) solution as described in section 10.2 of the SO2 Reference Method (40 CFR part 50, appendix A). These audit samples must be prepared independently from the standardized sulfite solutions used in the routine calibration procedure. Sulfite-TCM audit samples must be stored between 0 and 5 °C and expire 30 days after preparation.

3.4.2.2 Prepare audit samples in each of the concentration ranges of 0.2-0.3, 0.5-0.6, and 0.8-0.9 µg SO2/ml. Analyze an audit sample in each of the three ranges at least once each day that samples are analyzed and at least twice per calendar quarter. Report the audit concentrations (in µg SO2/ml) and the corresponding indicated concentrations (in µg SO2/ml). The percent differences between these concentrations are used to calculate accuracy as described in section 5.4.2 of this appendix.

3.4.3 NO2 Methods. Prepare audit solutions from a working sodium nitrite solution as described in the appropriate equivalent method (see reference 8 of this appendix). These audit samples must be prepared independently from the standardized nitrite solutions used in the routine calibration procedure. Sodium nitrite audit samples expire in 3 months after preparation. Prepare audit samples in each of the concentration ranges of 0.2-0.3, 0.5-0.6, and 0.8-0.9 µg NO2/ml. Analyze an audit sample in each of the three ranges at least once each day that samples are analyzed and at least twice per calendar quarter. Report the audit concentrations (in µg NO2/ml) and the corresponding indicated concentrations (in µg NO2/ml). The percent differences between these concentrations are used to calculate accuracy as described in section 5.4.2 of this appendix.

3.4.4 Pb Methods.

3.4.4.1 For the Pb Reference Method (40 CFR part 50, appendix G), the flow rates of the high-volume Pb samplers shall be audited as part of the TSP network using the same procedures described in section 3.4.1 of this appendix. For agencies operating both TSP and Pb networks, 25 percent of the total number of high-volume samplers are to be audited each quarter.

3.4.4.2 Each calendar quarter, audit the Pb Reference Method analytical procedure using glass fiber filter strips containing a known quantity of Pb. These audit sample strips are prepared by depositing a Pb solution on unexposed glass fiber filter strips of dimensions...
1.9 cm by 20.3 cm (3/4 inch by 8 inch) and allowing them to dry thoroughly. The audit samples must be prepared using batches of reagents different from those used to calibrate the equipment being audited. Prepare audit samples in the following concentration ranges:

<table>
<thead>
<tr>
<th>Range</th>
<th>Pb Concentration, µg/Strip</th>
<th>Equivalent Ambient Pb Concentration, µg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100–300</td>
<td>0.5–1.5</td>
</tr>
<tr>
<td>2</td>
<td>600–1000</td>
<td>3.0–5.0</td>
</tr>
</tbody>
</table>

*Equivalent ambient Pb concentration in µg/m³ is based on sampling rates of 1.7 m³/min for 24 hours on a 20.3 cm x 25.4 cm (8 inch x 10 inch) glass fiber filter.

3.4.4.3 Audit samples must be extracted using the same extraction procedure used for exposed filters.

3.4.4.4 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. Report the audit concentrations (in µg Pb/strip) and the corresponding measured concentrations (in µg Pb/strip) using unit code 7. The percent differences between the concentrations are used to calculate analytical accuracy as described in section 5.4.2 of this appendix.

3.4.4.5 The accuracy of an equivalent Pb method is 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.

3.5 Measurement Uncertainty for Automated and Manual Methods of PM₁₀. The goal for acceptable measurement uncertainty has been defined as 10 percent coefficient of variation (CV) for total precision and ± 10 percent for total bias (reference 14 of this appendix).

3.5.1 Flow Rate Audits.

3.5.1.1 Automated methods for PM₁₀. A one-point precision check must be performed at least once every 2 weeks on each automated analyzer used to measure PM₁₀. The precision check is made by checking the operational flow rate of the analyzer. If a precision flow rate check is made in conjunction with a flow rate adjustment, it must be made prior to such flow rate adjustment. Randomization of the precision check with respect to time of day, day of week, and routine service and adjustments is encouraged where possible.

3.5.1.1.1 Standard procedure: Use a flow rate transfer standard certified in accordance with section 2.3.3 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 actual analyzer flow rate measured by the transfer standard and the corresponding flow rate measured, indicated, or assumed by the analyzer.

3.5.1.1.2 Alternative procedure: It is permissible to obtain the precision check flow rate data from the analyzer’s internal flow meter without the use of an external flow rate transfer standard, provided that the flow meter is audited with an external flow rate transfer standard at least every 6 months; records of at least the three most recent flow audits of the instrument’s internal flow meter over at least several weeks confirm that the flow meter is stable, verifiable and accurate to ±4%; and the instrument and flow meter give no indication of improper operation. With suitable communication capability, the precision check may thus be carried out remotely. For this procedure, report the set-point flow rate as the actual flow rate along with the flow rate measured or indicated by the analyzer flow meter.

3.5.1.1.3 For either procedure, the differences between the actual and indicated flow rates are used to assess the precision of the monitoring data as described in section 5.5 of this appendix.

3.5.1.2 Manual methods for PM₁₀. Each calendar quarter, audit the flow rate of each SLAMS PM₁₀ analyzer. The audit is made by measuring the analyzer’s normal operating flow rate, using a flow rate transfer standard certified in accordance with section 2.3.3 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 (actual) flow rate and the corresponding flow rate indicated or assumed by the sampler. The procedures used to calculate measurement uncertainty PM₁₀ are described in section 5.5.2 of this appendix.

3.5.2 Measurement of Precision using Collocated Procedures for Automated and Manual Methods of PM₁₀.

(a) For PM₁₀ sites within a reporting organization each EPA designated Federal Reference Method (FRM) or Federal equivalent method (FEM) must:

(1) Have 25 percent of the monitors collocated (values of .5 and greater round up).

(2) Have at least 1 collocated monitor (if the total number of monitors is less than 4). The first collocated monitor must be a designated FRM monitor.

(b) In addition, monitors selected must also meet the following requirements:

(1) A monitor designated as an EPA FEM shall be collocated with a monitor having the same EPA FEM designation.

(2) For each monitor designated as an EPA FEM, 50 percent of the designated monitors...
shall be collocated with a monitor having the same method designation and 50 percent of the monitors shall be collocated with an F R M monitor. If there are an odd number of collocated monitors required, the additional monitor shall be an F R M. An example of this procedure is found in table A–2 of this appendix.

(c) For PM$_{2.5}$ sites during the initial deployment of the SLAMS network, special emphasis should be placed on those sites in areas likely to be in violation of the NAAQS. Once areas are initially determined to be in violation, the collocated monitors should be deployed according to the following protocol:

1. Eighty percent of the collocated monitors should be deployed at sites with concentrations ≥ ninety percent of the annual PM$_{2.5}$ NAAQS (or 24-hour NAAQS if that is affecting the area); one hundred percent if all sites have concentrations above either NAAQS, and each area determined to be in violation should be represented by at least one collocated monitor. (2) The remaining 20 percent of the collocated monitors should be deployed at sites with concentrations < ninety percent of the annual PM$_{2.5}$ NAAQS (or 24-hour NAAQS if that is affecting the area).

3. If an organization has no sites at concentrations ≥ ninety percent of the annual PM$_{2.5}$ NAAQS (or 24-hour NAAQS if that is affecting the area), 60 percent of the collocated monitors should be deployed at sites with the annual mean PM$_{2.5}$ concentrations (or 24-hour NAAQS if that is affecting the area) among the highest 25 percent for all PM$_{2.5}$ sites in the network.

5.2.1 In determining the number of collocated sites required for PM$_{2.5}$, monitoring networks for visibility 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 federal reference or equivalent method is not required to be included in the number of sites which are used to determine the number of collocated monitors.

5.2.2 The two collocated samples must be within 4 meters of each other, and particulate matter samplers must be at least 2 meters apart (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.

5.2.3 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 duplicate sampler. Each duplicate sampler must be operated concurrently with its associated primary sampler. The operation schedule should be selected so that the sampling days are distributed evenly over the year and over the 7 days of the week and therefore, a 6-day sampling schedule is required. 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 5.5 of this appendix.

5.3 Measurement of Bias using the FRM Audit Procedures for Automated and Manual Methods of PM$_{2.5}$

5.3.1 The FRM audit is an independent assessment of the total measurement system bias. These audits will be performed under the National Performance Audit Program (section 2.4 of this appendix) or a comparable program. Twenty-five percent of the SLAMS monitors within each reporting organization will be assessed with an FRM audit each year. Additionally, every designated FRM or FEM within a reporting organization must:

a) Have at least 25 percent of each method designation audited, including collocated sites (even those collocated with FRM instruments), (values of .5 and greater round up).

b) Have at least one monitor audited.

c) Be audited at a frequency of four audits per year.

d) Have all FRM or FEM samplers subject to an FRM audit at least once every 4 years. Table A–2 illustrates the procedure mentioned above.

5.3.2 For PM$_{2.5}$ sites during the initial deployment of the SLAMS network, special emphasis should be placed on those sites in areas likely to be in violation of the NAAQS. Once areas are initially determined to be in violation, the FRM audit program should be implemented according to the following protocol:

a) Eighty percent of the FRM audits should be deployed at sites with concentrations ≥ ninety percent of the annual PM$_{2.5}$ NAAQS (or 24-hour NAAQS if that is affecting the area); one hundred percent if all sites have concentrations above either NAAQS, and each area determined to be in violation should be represented by at least one monitor within that area.

b) The remaining 20 percent of the FRM audits should be implemented at sites with concentrations < ninety percent of the annual PM$_{2.5}$ NAAQS (or 24-hour NAAQS if that is affecting the area).

c) If an organization has no sites at concentrations ≥ ninety percent of the annual PM$_{2.5}$ NAAQS (or 24-hour NAAQS if that is affecting the area), 60 percent of the FRM audits should be implemented at those sites with the annual mean PM$_{2.5}$ concentrations (or 24-hour NAAQS if that is affecting the area) among the highest 25 percent for all sites in the network.

5.5.2 The remaining 20 percent of the FRM audits should be deployed at sites with concentrations < ninety percent of the annual PM$_{2.5}$ NAAQS (or 24-hour NAAQS if that is affecting the area); one hundred percent if all sites have concentrations above either NAAQS, and each area determined to be in violation should be represented by at least one monitor within that area.
PM$_{2.5}$ sites in the network. Additional information concerning the FRM audit program is contained in reference 7 of this appendix. The calculations for evaluating bias between the primary monitors and the FRM audit are described in section 5.5.

4. Reporting Requirements.

(a) For each pollutant, prepare a list of all monitoring sites and the AIRS site identification codes in each reporting organization and submit the list to the appropriate EPA Regional Office, with a copy to AIRS-AQS. Whenever there is a change in this list of monitoring sites in a reporting organization, report this change to the Regional Office and to AIRS-AQS.

4.1 Quarterly Reports. For each quarter, each reporting organization shall report to AIRS-AQS directly (or via the appropriate EPA Regional Office for organizations not direct users of AIRS) the results of all valid precision, bias and accuracy tests it has carried out during the quarter. The quarterly reports of precision, bias and accuracy data must be submitted consistent with the data reporting requirements specified for air quality data as set forth in §58.35(c). EPA strongly encourages early submittal of the data in order to assist the State and Local agencies in controlling and evaluating the quality of the ambient air SLAMS data. Each organization shall report all QA/QC measurements. Report results from invalid tests, from tests carried out during a time period for which ambient data immediately prior or subsequent to the tests were invalidated for appropriate reasons, and from tests of methodologies or analyzers not approved for use in SLAMS monitoring networks under appendix C of this part. Such data should be flagged so that it will not be utilized for quantitative assessment of precision, bias and accuracy.

4.2 Annual Reports.

4.2.1 When precision, bias and accuracy estimates for a reporting organization have been calculated for all four quarters of the calendar year, EPA will calculate and report the calculation of measurement uncertainty for the entire calendar year. These limits will then be associated with the data submitted in the annual SLAMS report required by §58.26.

4.2.2 Each reporting organization shall submit, along with its annual SLAMS report, a listing by pollutant of all monitoring sites in the reporting organization.

5. Calculations for Data Quality Assessment.

(a) Calculations of measurement uncertainty are carried out by EPA according to the following procedures. Reporting organizations should report the data for individual precision, bias and accuracy tests as specified in sections 3 and 4 of this appendix even though they may elect to perform some or all of the calculations in this section on their own.

5.1 Precision of Automated Methods Excluding PM$_{2.5}$. Estimates of the precision of automated methods are calculated from the results of biweekly precision checks as specified in section 3.1 of this appendix. At the end of each calendar quarter, an integrated precision probability interval for all SLAMS analyzers in the organization is calculated for each pollutant.

5.1.1 Single Analyzer Precision.

5.1.1.1 The percent difference ($d_i$) for each precision check is calculated using equation 1, where $Y_i$ is the concentration indicated by the analyzer for the $i$-th precision check and $X_i$ is the known concentration for the $i$-th precision check, as follows:

$$d_i = \frac{Y_i - X_i}{X_i} \times 100$$

Equation 1

5.1.1.2 For each analyzer, the quarterly average ($d_i$) is calculated with equation 2, and the standard deviation ($S_d$) with equation 3, where $n$ is the number of precision checks on the instrument made during the calendar quarter. For example, $n$ should be 6 or 7 if precision checks are made biweekly during a quarter. Equation 2 and 3 follow:

$$d_i = \frac{1}{n} \sum_{i=1}^{n} d_i$$

Equation 2

$$S_d = \sqrt{\frac{1}{n-1} \left[ \sum_{i=1}^{n} d_i^2 - \frac{1}{n} \left( \sum_{i=1}^{n} d_i \right)^2 \right]}$$

Equation 3

5.1.2 Precision for Reporting Organization.

5.1.2.1 For each pollutant, the average of averages ($D$) and the pooled standard deviation ($S_D$) are calculated for all analyzers audited for the pollutant during the quarter, using either equations 4 and 5 or 4a and 5a, where $k$ is the number of analyzers audited within the reporting organization for a single pollutant, as follows:

$$D = \frac{1}{k} \sum_{j=1}^{k} d_j$$

Equation 4

$$D = \frac{n_1 d_1 + n_2 d_2 + \ldots + n_j d_j + \ldots + n_k d_k}{n_1 + n_2 + \ldots + n_j + \ldots + n_k}$$

Equation 4a
5.1.2.2 Equations 4 and 5 are used when the same number of precision checks are made for each analyzer. Equations 4a and 5a are used to obtain a weighted average and a weighted standard deviation when different numbers of precision checks are made for the analyzers.

5.1.2.3 For each pollutant, the 95 Percent Probability Limits for the precision of a reporting organization are calculated using equations 6 and 7, as follows:

Equation 6
Upper 95 Percent Probability Limit = D + 1.96 S_a
Equation 7
Lower 95 Percent Probability Limit = D - 1.96 S_a

5.2 Accuracy of Automated Methods Excluding PM_2.5. Estimates of the accuracy of automated methods are calculated from the results of independent audits as described in section 3.2 of this appendix. At the end of each calendar quarter, an integrated accuracy probability interval for all SLAMS analyzers audited in the reporting organization is calculated for each pollutant. Separate probability limits are calculated for each audit concentration level in section 3.2 of this appendix.

5.2.1 Single Analyzer Accuracy. The percentage difference (d_i) for each audit concentration is calculated using equation 1, where Y_i is the analyzer’s indicated concentration measurement from the I-th audit check and X_i is the actual concentration of the audit gas used for the I-th audit check.

5.2.2 Accuracy for Reporting Organization. 5.2.2.1 For each audit concentration level of a particular pollutant, the average (D) of the individual percentage differences (d_i) for all n analyzers audited during the quarter is calculated using equation 8, as follows:

Equation 8
D = \frac{1}{n} \sum_{i=1}^{n} d_i

5.2.2.2 For each concentration level of a particular pollutant, the standard deviation (S_a) of all the individual percentage differences for all n analyzers audited during the quarter is calculated, using equation 9, as follows:

Equation 9
S_a = \sqrt{\frac{1}{n-1} \sum_{i=1}^{n} d_i^2 - \left( \frac{1}{n} \sum_{i=1}^{n} d_i \right)^2}

5.2.2.3 For reporting organizations having four or fewer analyzers for a particular pollutant, only one audit is required each quarter. For such reporting organizations, the audit results of two consecutive quarters are required to calculate an average and a standard deviation, using equations 8 and 9. Therefore, the reporting of probability limits shall be on a semiannual (instead of a quarterly) basis.

5.2.2.4 For each pollutant, the 95 Percent Probability Limits for the accuracy of a reporting organization are calculated at each audit concentration level using equations 6 and 7.

5.3 Precision of Manual Methods Excluding PM_2.5. Estimates of precision of manual methods are calculated from the results obtained from collocated samplers as described in section 3.3 of this appendix. At the end of each calendar quarter, an integrated precision probability interval for all collocated samplers operating in the reporting organization is calculated for each manual method network.

5.3.1 Single Sampler Precision.
5.3.1.1 At low concentrations, agreement between the measurements of collocated samplers, expressed as percent differences,
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may be relatively poor. For this reason, collocated measurement pairs are selected for use in the precision calculations only when both measurements are above the following limits:

(a) TSP: 20 µg/m³.
(b) SO₂: 45 µg/m³.
(c) NO₂: 30 µg/m³.
(d) Pb: 0.15 µg/m³.
(e) PM₁₀: 20 µg/m³.

5.3.1.2 For each selected measurement pair, the percent difference (d) is calculated, using equation 10, as follows:

\[ d = \left( \frac{Y_i - X_i}{(Y_i + X_i)/2} \right) \times 100 \]

where:

- Yᵢ is the pollutant concentration measurement obtained from the primary sampler; and
- Xᵢ is the concentration measurement obtained from the duplicate sampler designated for reporting air quality for the site.

(a) For each site, the quarterly average percent difference (d) is calculated from equation 2 and the standard deviation (Sᵢ) is calculated from equation 3, where nₘ is the number of selected measurement pairs at the site.

5.3.2 Precision for Reporting Organization.

5.3.2.1 For each pollutant, the average percent difference (D) of the individual percent differences for all similar particulate matter samplers audited during the calendar quarter is calculated using equation 8. The standard deviation (S₃) of the percentage differences for all of the similar particulate matter samplers audited during the calendar quarter is calculated using equation 9. The 95 Percent Probability Limits for the integrated accuracy for the reporting organization are calculated using equations 6 and 7. For reporting organizations having four or fewer particulate matter samplers of one type, only one audit is required each quarter, and the audit results of two consecutive quarters are required to calculate an average and a standard deviation. In that case, probability limits shall be reported semi-annually rather than quarterly.

5.3.2.2 The 95 Percent Probability Limits for the integrated precision for a reporting organization are calculated using equations 11 and 12, as follows:

\[ \text{Equation 11} \]

Upper 95 Percent Probability

Limit = D + 1.96 S₃

\[ \text{Equation 12} \]

Lower 95 Percent Probability

Limit = D - 1.96 S₃

5.4 Accuracy of Manual Methods Excluding PM₁₀. Estimates of the accuracy of manual methods are calculated from the results of independent audits as described in section 3.4 of this appendix. At the end of each calendar quarter, an integrated accuracy probability interval is calculated for each manual method operated by the reporting organization.

5.4.1 Particulate Matter Samplers other than PM₁₀. (including reference method Pb samplers).

5.4.1.1 Single Sampler Accuracy. For the flow rate audit described in section 3.4.1 of this appendix, the percentage difference (d) for each audit is calculated using equation 1, where Xᵢ represents the known flow rate and Yᵢ represents the flow rate indicated by the sampler.

5.4.1.2 Accuracy for Reporting Organization. For each type of particulate matter measured (e.g., TSP/Pb), the average (D) of the individual percent differences for all similar particulate matter samplers audited during the calendar quarter is calculated using equation 8. The standard deviation (S₃) of the percentage differences for all of the similar particulate matter samplers audited during the calendar quarter is calculated using equation 9. The 95 Percent Probability Limits for the integrated accuracy for the reporting organization are calculated using equations 6 and 7. For reporting organizations having four or fewer particulate matter samplers of one type, only one audit is required each quarter, and the audit results of two consecutive quarters are required to calculate an average and a standard deviation. In that case, probability limits shall be reported semi-annually rather than quarterly.

5.4.2 Analytical Methods for SO₂, NO₂, and Pb.

5.4.2.1 Single Analysis-Day Accuracy. For each of the audits of the analytical methods for SO₂, NO₂, and Pb described in sections 3.4.2, 3.4.3, and 3.4.4 of this appendix, the percentage difference (d) at each concentration level is calculated using equation 1, where Xᵢ represents the known value of the audit sample and Yᵢ represents the value of SO₂, NO₂, or Pb indicated by the analytical method.

5.4.2.2 Accuracy for Reporting Organization. For each analytical method, the average (D) of the individual percent differences at each concentration level for all audits during the calendar quarter is calculated using equation 8. The standard deviation (S₃) of the percentage differences at each concentration level for all audits during the calendar quarter is calculated using equation 9. The 95 Percent Probability Limits for the accuracy for the reporting organization are calculated using equations 6 and 7.

5.5 Precision, Accuracy and Bias for Automated and Manual PM₁₀ Methods.

(a) Reporting organizations are required to report the data that will allow assessments of the following individual quality control checks and audits:

(1) Flow rate audit.

(2) Collocated samplers, where the duplicate sampler is not an FRM device.

(3) Collocated samplers, where the duplicate sampler is an FRM device.
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(4) FRM audits.

(b) EPA uses the reported results to derive precision, accuracy and bias estimates according to the following procedures.

5.5.1 Flow Rate Audits. The reporting organization shall report both the audit standard flow rate and the flow rate indicated by the sampling instrument. These results are used by EPA to calculate flow rate accuracy and bias estimates.

5.5.1.1 Accuracy of a Single Sampler - Single Check (Quarterly) Basis (\(d_i\)). The percent- age difference (\(d_i\)) for a single flow rate audit is calculated using equation 13, where \(X_i\) represents the audit standard flow rate (known) and \(Y_i\), represents the indicated flow rate, as follows:

\[
\text{Equation 13} \quad d_i = \frac{Y_i - X_i}{X_i} \times 100
\]

5.5.1.2 Bias of a Single Sampler - Annual Basis (\(D_j\)). For an individual particulate sampler \(j\), the average (\(D_j\)) of the individual percentage differences (\(d_i\)) during the calendar year is calculated using equation 14, where \(n_j\) is the number of individual percentage differences produced for sampler \(j\) during the calendar year, as follows:

\[
\text{Equation 14} \quad D_j = \frac{1}{n_j} \times \sum_{i=1}^{n_j} d_i
\]

5.5.1.3 Bias for Each EPA Federal Reference and Equivalent Method Designation Employed by Each Reporting Organization - Quarterly Basis (\(D_{k,q}\)). For method designation \(k\) used by the reporting organization, quarterly \(q\)'s single sampler percentage differences (\(d_i\)) are averaged using equation 15, where \(n_{k,q}\) is the number of individual percentage differences produced for method designation \(k\) in quarter \(q\), as follows:

\[
\text{Equation 15} \quad D_{k,q} = \frac{1}{n_{k,q}} \times \sum_{i=1}^{n_{k,q}} d_i
\]

5.5.1.4 Bias for Each Reporting Organization - Quarterly Basis (\(D_q\)). For each reporting organization, quarter \(q\)'s single sampler percentage differences (\(d_i\)) are averaged using equation 16, to produce a single average for each reporting organization, where \(n_q\) is the total number of single sampler percentage differences for all federal reference or equivalent methods of samplers in quarter \(q\), as follows:

\[
\text{Equation 16} \quad D_q = \frac{1}{n_q} \times \sum_{i=1}^{n_q} d_i
\]

5.5.1.5 Bias for Each EPA Federal Reference and Equivalent Method Designation Employed by Each Reporting Organization - Annual Basis (\(D_k\)). For method designation \(k\) used by the reporting organization, the annual average percentage difference, \(D_k\), is derived using equation 17, where \(D_{k,q}\) is the average reported for method designation \(k\) during the \(q\)th quarter, and \(n_{k,q}\) is the number of the method designation \(k\)'s monitors that were deployed during the \(q\)th quarter, as follows:

\[
\text{Equation 17} \quad D_k = \frac{1}{n_{k,q}} \sum_{q=1}^{n_{k,q}} D_{k,q}
\]

5.5.1.6 Bias for Each Reporting Organization - Annual Basis (\(D\)). For each reporting organization, the annual average percentage difference, \(D\), is derived using equation 18, where \(D_q\) is the average reported for the reporting organization during the \(q\)th quarter, and \(n_q\) is the total number monitors that were deployed during the \(q\)th quarter. A single annual average is produced for each reporting organization. Equation 18 follows:

\[
\text{Equation 18} \quad D = \frac{1}{n_q} \sum_{q=1}^{n_q} D_q
\]

5.5.2 Collocated Samplers, Where the Duplicate Sampler is not an FRM Device. (a) At low concentrations, agreement between the measurements of collocated samplers may be relatively poor. For this reason, collocated measurement pairs are selected for use in the precision calculations only when both measurements are above the following limits:

- \(\text{PM}_{2.5} \geq 6 \mu g/m^3\)

(b) Collocated sampler results are used to assess measurement system precision. A collocated sampler pair consists of a primary sampler (used for routine monitoring) and a duplicate sampler (used as a quality control check). Quarterly precision estimates are
calculated by EPA for each pair of collocated samplers and for each method designation employed by each reporting organization. Annual precision estimates are calculated by EPA for each primary sampler, for each EPA Federal reference method and equivalent method designation employed by each reporting organization, and nationally for each EPA Federal reference method and equivalent method designation.

5.5.2.1 Percent Difference for a Single Check \( d_i \). The percentage difference, \( d_i \), for each check is calculated by EPA using equation 19, where \( X_i \) represents the concentration produced from the primary sampler and \( Y_i \) represents concentration reported for the duplicate sampler, as follows:

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

5.5.2.2 Coefficient of Variation (CV) for a Single Check \( CV_i \). The coefficient of variation, \( CV_i \), for each check is calculated by EPA by dividing the absolute value of the percentage difference, \( d_i \), by the square root of two as shown in equation 20, as follows:

\[
CV_i = \frac{|d_i|}{\sqrt{2}}
\]

5.5.2.3 Precision of a Single Sampler - Quarterly Basis \( CV_{j,q} \).

(a) For particulate sampler \( j \), the individual coefficients of variation \( CV_{j,s} \) during the quarter are pooled using equation 21, where \( n_{j,q} \) is the number of pairs of measurements from collocated samplers during the quarter, as follows:

\[
CV_{j,q} = \sqrt{\frac{n_{j,q}}{1} CV_{j,s}^2}
\]

(b) The 90 percent confidence limits for the single sampler’s CV are calculated by EPA using equations 22 and 23, where \( X_{0.05,df} \) and \( X_{0.95,df} \) are the 0.05 and 0.95 quantiles of the chi-square \( (X^2) \) distribution with \( n_{j,q} \) degrees of freedom.

5.5.2.4 Precision of a Single Sampler - Annual Basis. For particulate sampler \( j \), the individual coefficients of variation \( CV_{j,s} \), produced during the calendar year are pooled using equation 21, where \( n_i \) is the number of checks made during the calendar year. The 90 percent confidence limits for the single sampler’s CV are calculated by EPA using equations 22 and 23, where \( X_{0.05,df} \) and \( X_{0.95,df} \) are the 0.05 and 0.95 quantiles of the chi-square \( (X^2) \) distribution with \( n_i \) degrees of freedom.

5.5.2.5 Precision for Each EPA Federal Reference Method and Equivalent Method Designation Employed by Each Reporting Organization - Quarterly Basis \( CV_{k,q} \).

(a) For each method designation \( k \) used by the reporting organization, the quarter’s single sampler coefficients of variation, \( CV_{j,s} \), obtained from equation 21, are pooled using equation 24, where \( n_{k,q} \) is the number of collocated primary monitors for the designated method (but not collocated with FRM samplers) and \( n_{j,q} \) is the number of degrees of freedom associated with \( CV_{j,s} \) as follows:

\[
CV_{k,q} = \sqrt{\frac{n_{k,q}}{n_{j,q}} \left( \sum_{j=1}^{n_{k,q}} CV_{j,s}^2 n_{j,q} \right)}
\]

(b) The number of method CVs produced for a reporting organization will equal the number of different method designations having more than one primary monitor employed by the organization during the quarter. (When exactly one monitor of a specified designation is used by a reporting organization, it will be collocated with an FRM sampler.)

5.5.2.6 Precision for Each Method Designation Employed by Each Reporting Organization - Annual Basis \( CV_{k} \). For each method
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designation k used by the reporting organization, the quarterly estimated coefficients of variation, CV\(_{k,q}\), are pooled using equation 25, where \(n_{k,q}\) is the number of collocated primary monitors for the designated method during the qth quarter and also the number of degrees of freedom associated with the quarter’s precision estimate for the method designation, CV\(_{k,q}\), as follows:

Equation 25

\[
CV_k = \sqrt{\frac{\sum_{q=1}^{4} \left( CV_{k,q}^2 n_{k,q} \right)}{\sum_{q=1}^{4} n_{k,q}}}
\]

5.5.3 Collocated Samplers, Where the Duplicate Sampler is an FRM Device. At low concentrations, agreement between the measurements of collocated samplers may be relatively poor. For this reason, collocated measurement pairs are selected for use in the precision calculations only when both measurements are above the following limits: PM\(_{2.5}\) : 6 \(\mu g/m^3\). These duplicate sampler results are used to assess measurement system bias. Quarterly bias estimates are calculated by EPA for each primary sampler and for each method designation employed by each reporting organization. Annual precision estimates are calculated by EPA for each primary monitor, for each method designation employed by each reporting organization, and nationally for each method designation.

5.5.3.1 Accuracy for a Single Check (\(d'_i\)). The percentage difference, \(d'_i\), for each check is calculated by EPA using equation 26, where \(X_i\) represents the concentration produced from the FRM sampler taken as the true value and \(Y_i\) represents concentration reported for the primary sampler, as follows:

Equation 26

\[
d'_i = \frac{Y_i - X_i}{X_i} \times 100\%
\]

5.5.3.2 Bias of a Single Sampler - Quarterly Basis (\(D'_{j,q}\)).

(a) For particulate sampler j, the average of the individual percentage differences during the quarter q is calculated by EPA using equation 27, where \(n_{j,q}\) is the number of checks made for sampler j during the calendar quarter, as follows:

Equation 27

\[
D_{j,q} = \frac{1}{n_{j,q}} \times \sum_{i=1}^{n_{j,q}} d'_i
\]

(b) The standard error, \(s'_{j,q}\), of sampler j’s percentage differences for quarter q is calculated using equation 28, as follows:

Equation 28

\[
s'_{j,q} = \left( \frac{1}{n_{j,q} - 1} \left( \frac{\sum_{i=1}^{n_{j,q}} d'_i^2 - \left( \frac{\sum_{i=1}^{n_{j,q}} d'_i \overline{D}'_{j,q}^2}{n_{j,q}} \right) \times \frac{1}{n_{j,q}} \right)}{\sum_{i=1}^{n_{j,q}} d'_i^2} \right)
\]

(c) The 95 Percent Confidence Limits for the single sampler’s bias are calculated using equations 29 and 30 where \(t_{0.975,df}\) is the 0.975 quantile of Student’s t distribution with \(df = n_{j,q} - 1\) degrees of freedom, as follows:

Equation 29

\[
\text{Lower Confidence Limit} = D_{j,q} - t_{0.975,df} \times s'_{j,q}
\]

Equation 30

\[
\text{Upper Confidence Limit} = D_{j,q} + t_{0.975,df} \times s'_{j,q}
\]

5.5.3.3 Bias of a Single Sampler - Annual Basis (\(D'_j\)).

(a) For particulate sampler j, the mean bias for the year is derived from the quarterly bias estimates, \(D'_{j,q}\), using equation 31, where the variables are as defined for equations 27 and 28, as follows:

Equation 31

\[
D'_j = \frac{\sum_{q=1}^{4} \left( n_{j,q} D'_{j,q} \right)}{\sum_{q=1}^{4} n_{j,q}}
\]

(b) The standard error of the above estimate, \(se'_j\), is calculated using equation 32, as follows:

Equation 32

\[
se'_j = \sqrt{\frac{\sum_{q=1}^{4} \left( n_{j,q} (D'_{j,q})^2 \right)}{\sum_{q=1}^{4} n_{j,q}} - \left( \frac{\sum_{q=1}^{4} n_{j,q} D'_{j,q}}{\sum_{q=1}^{4} n_{j,q}} \right)^2}
\]
Equation 32

\[ se_j = \sqrt{\frac{4}{\sum_{q=1}^{4} \left( n_j,q - 1 \right)}} \]

(c) The 95 Percent Confidence Limits for the single sampler’s bias are calculated using equations 33 and 34, where \( t_{0.975, df} \) is the 0.975 quantile of Student’s t distribution with \( df = (n_j + n_{i2} + n_{i3} + n_{i4} - 4) \) degrees of freedom, as follows:

Equation 33

\[ \text{Lower Confidence Limit} = D_j - t_{0.975, df} \times se_j \]

Equation 34

\[ \text{Upper Confidence Limit} = D_j + t_{0.975, df} \times se_j \]

5.5.4 FRM Audits. FRM Audits are performed once per quarter for selected samplers. The reporting organization reports concentration data from the primary sampler. Calculations for FRM Audits are similar to those for collocated samplers having FRM samplers as duplicates. The calculations differ because only one check is performed per quarter.

5.5.4.1 Accuracy for a Single Sampler, Quarterly Basis (d). The percentage difference, \( d_i \), for each check is calculated using equation 26, where \( X_i \) represents the concentration produced from the FRM sampler and \( Y_i \) represents the concentration reported for the primary sampler. For quarter \( q \), the mean bias for the year is derived from the quarterly bias estimates, \( D_{i,q} \), using equation 31, where \( n_{i,q} \) equals 1 because one FRM audit is performed per quarter.

5.5.4.2 Bias of a Single Sampler - Annual Basis (D\(^a\)). For particulate sampler \( j \), the mean bias for the year is calculated using equation 35, where variables are as defined in equations 31 and 32.

5.5.4.3 Bias for a Single Reporting Organization - Annual Basis (D\(^a\)). The reporting organizations mean bias is calculated using equation 35, where variables are as defined in equations 31 and 32.

REFERENCES IN APPENDIX A OF PART 58


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### Table A–1 to Appendix A—Minimum Data Assessment Requirements

<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>Precision:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automated Methods for SO$_2$, NO$_2$, O$_3$, and CO</td>
<td>Response check at concentration between .08 and .10 ppm (8 &amp; 10 ppm for CO)</td>
<td>Each analyzer</td>
<td>Once per 2 weeks</td>
<td>Actual concentration and measured concentration</td>
</tr>
<tr>
<td>Manual Methods: All methods except PM$_{2.5}$</td>
<td>Collocated samplers</td>
<td>1 site for 1–5 sites 2 sites for 6–20 sites 3 sites &gt;20 sites (sites with highest conc.)</td>
<td>Once every six days</td>
<td>Particle mass concentration indicated by sampler and by collocated sampler</td>
</tr>
<tr>
<td><strong>Accuracy:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automated Methods for SO$_2$, NO$_2$, O$_3$, and CO</td>
<td>Response check at .03–.08 ppm$^{1,2}$ .15–.20 ppm$^{1,2}$ .35–.45 ppm$^{1,2}$ 80–90 ppm$^{1,2}$ (if applicable)</td>
<td>1. Each analyzer 2. 25% of analyzers (at least 1)</td>
<td>1. Once per year 2. Each calendar quarter</td>
<td>Actual concentration and measured (indicated) concentration for each level</td>
</tr>
<tr>
<td>Manual Methods for SO$_2$, NO$_2$, and O$_3$</td>
<td>Check of analytical procedure with audit standard solutions</td>
<td>Analytical system</td>
<td>Each day samples are analyzed; at least twice per quarter</td>
<td>Actual concentration and measured (indicated) concentration for each audit solution</td>
</tr>
<tr>
<td>TSP, PM$_{10}$</td>
<td>Check of sampler flow rate</td>
<td>1. Each sampler 2. 25% of samplers (at least 1)</td>
<td>1. Once per year 2. Each calendar quarter</td>
<td>Actual flow rate and flow rate indicated by the sampler</td>
</tr>
<tr>
<td>Lead</td>
<td>1. Check of sample flow rate as for TSP 2. Check of analytical system with Pb audit strips</td>
<td>1. Each sampler</td>
<td>1. Include with TSP 2. Analytical system</td>
<td>1. Same as for TSP 2. Actual concentration and measured (indicated) concentration of audit samples (µg Pb/strip)</td>
</tr>
<tr>
<td>PM$_{2.5}$</td>
<td>Manual and Automated Methods—Precision</td>
<td>Collocated samplers</td>
<td>25% of SLAMS (monitors with Conc affecting NAAQS violation status)</td>
<td>Once every six days</td>
</tr>
<tr>
<td></td>
<td>Manual and Automated Methods—Accuracy and Bias</td>
<td>1. Check of sampler flow rate</td>
<td>Every SLAMS monitor</td>
<td>1. Automated—once every 2 weeks; Manual—each calendar quarter (4/year)</td>
</tr>
</tbody>
</table>
TABLE A-1 TO APPENDIX A—MINIMUM DATA ASSESSMENT REQUIREMENTS—Continued

<table>
<thead>
<tr>
<th>Method Assessment Method</th>
<th>Coverage</th>
<th>Minimum Frequency Parameters Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Audit with reference method</td>
<td>2. Minimum 4 measurements per year</td>
<td>2. Particle mass concentration indicated by sampler and by audit reference sampler</td>
</tr>
</tbody>
</table>

1 Concentration times 100 for CO.  
2 Effective concentration for open path analyzers.  
3 Corrected concentration, if applicable, for open path analyzers.

TABLE A-2 TO APPENDIX A—SUMMARY OF PM2.5 COLLOCATION AND AUDITS PROCEDURES AS AN EXAMPLE OF A TYPICAL REPORTING ORGANIZATION NEEDING 43 MONITORS, HAVING PROCURED FRMs AND THREE OTHER EQUIVALENT METHOD TYPES

<table>
<thead>
<tr>
<th>Method Designation</th>
<th>Total # of Monitors</th>
<th>Total # Collocated</th>
<th># of Collocated FRMs</th>
<th># of Collocated Monitors of Same Type</th>
<th># of Independent FRM Audits</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRM</td>
<td>25</td>
<td>6</td>
<td>6</td>
<td>n/a</td>
<td>6</td>
</tr>
<tr>
<td>Type A</td>
<td>10</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Type C</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Type D</td>
<td>6</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>


APPENDIX B TO PART 58—QUALITY ASSURANCE REQUIREMENTS FOR PREVENTION OF SIGNIFICANT DETERIORATION (PSD) AIR MONITORING

1. General Information

This appendix specifies the minimum quality assurance requirements for the control and assessment of the quality of the PSD ambient air monitoring data submitted to EPA by an organization operating a network of PSD stations. Such organizations are encouraged to develop and maintain quality assurance programs more extensive than the required minimum.

Quality assurance of air monitoring systems includes two distinct and important interrelated functions. One function is the control of the measurement process through the implementation of policies, procedures, and corrective actions. The other function is the assessment of the quality of the monitoring data (the product of the measurement process). In general, the greater the effort and effectiveness of the control of a given monitoring system, the better will be the resulting quality of the monitoring data. The results of data quality assessments indicate whether the control efforts need to be increased.

Documentation of the quality assessments of the monitoring data is important to data users, who can then consider the impact of the data quality in specific applications (see Reference 1). Accordingly, assessments of PSD monitoring data quality are required to be made and reported periodically by the monitoring organization.

To provide national uniformity in the assessment and reporting of data quality among all PSD networks, specific assessment and reporting procedures are prescribed in detail in sections 3, 4, 5, and 6 of this appendix.

In contrast, the control function encompasses a variety of policies, procedures, specifications, standards, and corrective measures which affect the quality of the resulting data. The selection and extent of the quality control activities—as well as additional quality assessment activities—used by a monitoring organization depend on a number of local factors such as the field and laboratory conditions, the objectives of the monitoring, the level of the data quality needed, the expertise of assigned personnel, the cost of control procedures, pollutant concentration levels, etc. Therefore, the quality assurance requirements, in section 2 of this appendix, are specified in general terms to allow each organization to develop a quality control system that is most efficient and effective for its own circumstances.

For purposes of this appendix, “organization” is defined as a source owner/operator, a government agency, or their contractor that operates an ambient air pollution monitoring network for PSD purposes.

2. Quality Assurance Requirements

2.1 Each organization must develop and implement a quality assurance program consisting of policies, procedures, specifications, standards and documentation necessary to:

(1) Provide data of adequate quality to meet monitoring objectives and quality assurance requirements of the permit-granting authority, and
(2) Minimize loss of air quality data due to
malfuctions or out-of-control conditions.

This quality assurance program must be
described in detail, suitably documented,
and approved by the permit-granting author-
ity. The Quality Assurance Program will be
reviewed during the system audits described
in section 2.4.

2.2 Primary guidance for developing the
Quality Assurance Program is contained in
References 2 and 3, which also contain many
suggested procedures, checks, and control
specifications. Section 2.0.9 of Reference 3
describes specific guidance for the develop-
ment of a Quality Assurance Program for
automated analyzers. Many specific quality
control checks and specifications for manual
methods are included in the respective ref-
ence methods described in part 50 of this
chapter or in the respective equivalent
method descriptions available from EPA (see
Reference 4). Similarly, quality control pro-
cedures related to specifically designated
reference and equivalent analyzers are con-
tained in their respective operation and in-
struction manuals. This guidance, and any
other pertinent information from approp-
riate sources, should be used by the organi-
zation in developing its quality assurance
program.

As a minimum, each quality assurance pro-
gram must include operational procedures
for each of the following activities:

(1) Selection of methods, analyzers, or
samplers;
(2) Training;
(3) Installation of equipment;
(4) Selection and control of calibration
standards;
(5) Calibration;
(6) Zero/span checks and adjustments of
automated analyzers;
(7) Control checks and their frequency;
(8) Control limits for zero, span and other
control checks, and respective corrective ac-
tions when such limits are surpassed;
(9) Calibration and zero/span checks for
multiple range analyzers (see section 2.6 of
appendix C of this part);
(10) Preventive and remedial maintenance;
(11) Recording and validating data;
(12) Date quality assessment (precision and
accuracy);
(13) Documentation of quality control in-
formation.

2.3 Pollutant Standards.

2.3.1 Gaseous standards (permeation tubes,
permeation devices or cylinders of com-
pressed gas) used to obtain test concentra-
tions for CO, SO2, and NO2 must be traceable
to either a National Institute of Standards
and Technology (NIST) gaseous Standard
Reference Material (SRM) or an NIST/EPA-
approved commercially available Certified
Reference Material (CRM). CRM’s are de-
scribed in Reference 5, and a list of CRM
sources is available from Quality Assurance
Division (MD-77), Atmospheric Research and
Exposure Assessment Laboratory, U.S. Envi-
ronmental Protection Agency, Research Tri-
gle Park, NC 27711. A recommended pro-
tocol for certifying gaseous standards
against an SRM or CRM is given in section
2.0.7 of Reference 3. Direct use of a CRM as
a working standard is acceptable, but direct
use of an NIST SRM as a working standard
is discouraged because of the limited supply
and expense of SRM.’s.

2.3.2 Test concentrations for ozone must be
obtained in accordance with the UV pho-
tometric calibration procedure specified in
appendix D of part 50 of this chapter, or by
means of a certified ozone transfer standard.
Consult References 6 and 7 for guidance on
primary and transfer standards for ozone.

2.3.3 Flow measurement must be made by
a flow measuring instrument that is trace-
able to an authoritative volume or other
standard. Guidance for certifying various
types of flowmeters is provided in Reference
3.

2.4 Performance and System Audit Pro-
grams. The organization operating a PSD
monitoring network must participate in
EPA’s national performance audit program.
The permit granting authority, or EPA, may
conduct system audits of the ambient air
monitoring programs of organizations oper-
ating PSD networks. See section 1.4.16 of ref-
ence 2 and section 2.0.11 of reference 3 for
additional information about these pro-
grams. Organizations should contact either
the appropriate EPA Regional Quality Con-
tral Coordinator or the Quality Assurance
Branch, AREAL/RTP, at the address given in
reference 3 for instructions for participation.

3. Data Quality Assessment Requirements

All ambient monitoring methods or ana-
yzers used in PSD monitoring shall be test-
ed periodically, as described in this section
3, to quantitatively assess the quality of the
data being routinely collected. The results
of these tests shall be reported as specified in
section 6. Concentration standards used for
the tests must be as specified in section 2.3.
Additional information and guidance in the
technical aspects of conducting these tests
may be found in Reference 3 or in the oper-
ation or instruction manual associated with
the analyzer or sampler. Concentration
measurements reported from analyzers or
analytical systems must be derived by means
of the same calibration curve and data pro-
cessing system used to obtain the routine air
monitoring data. Table B-1 provides a sum-
mary of the minimum data quality assess-
ment requirements, which are described in
more detail in the following sections.

3.1 Precision of Automated Methods. A
one-point precision check must be carried
out at least once every two weeks on each
automated analyzer used to measure SO2,
NOx, O3, and CO. The precision check is made

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by challenging the analyzer with a precision check gas of known concentration (effective concentration for open path analyzers) between 0.08 and 0.20 ppm for SO\textsubscript{2}, NO\textsubscript{2}, and O\textsubscript{3} analyzers and between 0.03 and 0.5 ppm for CO analyzers. The standards from which precision check test concentrations are obtained must meet the specifications of section 2.3. Except for certain CO analyzers described below, point analyzers must operate in their normal sampling mode during the precision 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 practical. If permitted by the associated operation or instruction manual, a CO point analyzer may be temporarily modified during the precision 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.

Open path analyzers are tested by inserting a test cell containing a precision 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 precision check gas in the test cell must be selected to produce an “effective concentration” in the range specified above. Generally, the precision test concentration measurement will be the sum of the atmospheric pollutant concentrations and the precision 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 precision check test from the precision test 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.

If a precision check is made in conjunction with a zero or span adjustment, it must be made prior to such zero or span adjustment. The difference between the actual concentration (effective concentration for open path analyzers) of the precision check gas and the corresponding concentration measurement (corrected concentration, if applicable, for open path analyzers) indicated by the analyzer is used to assess the precision of the monitoring data as described in section 4.1. Report data only from automated analyzers that are approved for use in the PSD network.

### 3.2 Accuracy of Automated Methods
Each sampling quarter, audit each analyzer that monitors for SO\textsubscript{2}, NO\textsubscript{2}, O\textsubscript{3} or CO at least once. The audit is made by challenging the analyzer with at least one audit gas of known concentration (effective concentration for open path analyzers) from each of the following ranges that fall within the measurement range of the analyzer being audited:

<table>
<thead>
<tr>
<th>Audit level</th>
<th>Concentration range, ppm</th>
<th>CO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SO\textsubscript{2}, O\textsubscript{3}, NO\textsubscript{2}</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.03–0.08</td>
<td>0.03–0.08</td>
</tr>
<tr>
<td>2</td>
<td>0.15–0.20</td>
<td>0.15–0.20</td>
</tr>
<tr>
<td>3</td>
<td>0.35–0.45</td>
<td>0.35–0.45</td>
</tr>
<tr>
<td>4</td>
<td>0.80–0.90</td>
<td>0.80–0.90</td>
</tr>
</tbody>
</table>

For point analyzers, the audit shall be carried out by allowing the analyzer to analyze the test atmosphere in the same manner as described for precision checks in section 3.1. The exception given in section 3.1 for certain CO analyzers does not apply for audits.
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Open path analyzers are audited by inserting a test cell containing an audit 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 audit, and the normal monitoring configuration of the instrument should be modified as little as possible to accommodate the test cell for the audit. 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 range specified in this section 4.2. Generally, each audit concentration measurement result will be the sum of the atmospheric pollutant concentration and the audit 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 audit test (or preferably before and after each audit concentration level) from the audit concentration measurement result. If the difference between these before and after measurements is greater than 20 percent of the effective concentration of the test gas standards, discard the test result for that concentration level and repeat the test for that level. If possible, open path analyzers should be audited during periods when the atmospheric pollutant concentrations are relatively low and steady. Also, the monitoring path length must be reverified to within ±3 percent to validate the audit, since the monitoring path length is critical to the determination of the effective concentration.

The differences between the actual concentrations (effective concentrations for open path analyzers) of the audit test gas and the corresponding concentration measurements (corrected concentrations, if applicable for open path analyzers) indicated by the analyzer are used to assess the accuracy of the monitoring data as described in section 4.2. Report data only from automated analyzers that are approved for use in the PSD network.

3.3 Precision of Manual Methods.
3.3.1 TSP and PM<sub>10</sub> Methods. For a given organization’s monitoring network, one sampling site must have collocated samplers. A site with the highest expected 24-hour pollutant concentration must be selected. The two samplers must be within 4 meters of each other but at least 2 meters apart to preclude airflow interference. Calibration, sampling and analysis must be the same for both collocated samplers as well as for all other samplers in the network. The collocated samplers must be operated as a minimum every third day when continuous sampling is used. When a less frequent sample schedule is used, the collocated samplers must be operated at least once each week. For each pair of collocated samplers, designate one sampler as the sampler which will be used to report air quality for the site and designate the other as the duplicate sampler. The differences in measured concentration (µg/m<sup>3</sup>) between the two collocated samplers are used to calculate precision as described in section 5.1.

3.3.2 Pb Method. The operation of collocated samplers at one sampling site must be used to assess the precision of the reference or an equivalent Pb method. The procedure to be followed for Pb methods is the same as described in 3.3.1 for the TSP method. If approved by the permit granting authority, the collocated TSP samplers may serve as the collocated lead samplers.

3.4 Accuracy of Manual Methods.
3.4.1 TSP and PM<sub>10</sub> Methods. Each sampling quarter, audit the flow rate of each sampler at least once. Audit the flow at the normal flow rate, using a certified flow transfer standard (see reference 2). The flow transfer standard used for the audit must not be the same one used to calibrate the flow of the sampler being audited, although both transfer standards may be referenced to the same primary flow or volume standard. The difference between the audit flow measurement and the flow indicated by the sampler’s flow indicator is used to calculate accuracy, as described in paragraph 5.2.

Great care must be used in auditing high-volume samplers having flow regulators because the introduction of resistance plates in the audit device can cause abnormal flow patterns at the point of flow sensing. For this reason, the orifice of the flow audit device should be used with a normal glass fiber 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.

3.4.2 Pb Method. For the reference method (appendix G of part 50 of this chapter) during each sampling quarter audit the flow rate of each high-volume Pb sampler at least once. The procedure to be followed for lead methods is the same as described in section 3.4.1 for the TSP method.

For each sampling quarter, audit the Pb analysis using glass fiber filter strips containing a known quantity of lead. Audit samples are prepared by depositing a Pb solution on 1.9 cm by 20.3 cm (¾ inch by 8 inch) unexposed glass fiber filter strips and allowing to dry thoroughly. The audit samples must be prepared using 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>Ranges</th>
<th>Pb concentration µg/m³</th>
<th>Equivalent ambient Pb concentration¹ µg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100 to 300</td>
<td>0.5 to 1.5</td>
</tr>
<tr>
<td>2</td>
<td>600 to 1000</td>
<td>3.0 to 5.0</td>
</tr>
</tbody>
</table>

¹ Equivalent ambient Pb concentration in µg/m³ is based on sampling at 1.7 m³/min for 24 hours on 20.3 cm (8 inch) glass fiber filter.

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

Analyze at least one audit sample in each of the two ranges each day that samples are analyzed. The difference between the audit concentration (in µg Pb/strip) and the analyst’s measured concentration (in µg Pb/strip) is used to calculate accuracy as described in section 5.4.

The accuracy of an equivalent method is assessed in the same manner as the reference method. The flow auditing device and Pb analysis audit samples must be compatible with the specific requirements of the equivalent method.

4. Calculations for Automated Methods

4.1 Single Analyzer Precision. Each organization, at the end of each sampling quarter, shall calculate and report a precision probability interval for each analyzer audited during the quarter. Directions for calculations are given below (directions for reporting are given in section 6).

For the paired measurements obtained as described in sections 3.3.1 and 3.3.2, calculate the percentage difference (d_i) for each audit concentration for each auditor audited during the quarter. Directions for calculations are given below (directions for reporting are given in section 6).

Calculate and report the percentage difference (d_i) for each audit concentration using equation 1 where Y_i is the analyzer’s indicated concentration from the i-th audit check and X_i is the known concentration of the audit gas used for the i-th audit check.

5. Calculations for Manual Methods

5.1 Single Instrument Precision for TSP, Pb and PM_{10}. Estimates of precision for ambient air quality particulate measurements are calculated from results obtained from collocated samplers as described in section 3.3. At the end of each sampling quarter, calculate and report a precision probability interval, using weekly result from the collocated samplers. Directions for calculations are given below, and directions for reporting are given in section 6.

For the paired measurements obtained as described in sections 3.3.1 and 3.3.2, calculate the percent difference (d_i) using equation 1a, where Y_i is the concentration of pollutant measured by the duplicate sampler, and X_i is the concentration measured by the sampler reporting air quality for the site. Calculate the quarterly average percent difference (d_j), equation 2; standard deviation (S_j), equation 3; and upper and lower 95 percent probability limits for precision, equations 6 and 7.

\[
\begin{align*}
\text{Upper 95 percent probability limit} &= d_j + 1.96 S_j/\sqrt{n} \\
\text{Lower 95 percent probability limit} &= d_j - 1.96 S_j/\sqrt{n}
\end{align*}
\]

where \(n\) is the number of precision checks on the instrument made during the sampling quarter. For example, \(n\) should be 6 or 7 if span checks are made biweekly during a quarter.

Calculate the 95 percent probability limits for precision using equation 4 and 5.

\[
\begin{align*}
\text{Upper 95 Percent Probability Limit} &= d_j + 1.96 S_j \\
\text{Lower 95 Percent Probability Limit} &= d_j - 1.96 S_j
\end{align*}
\]

4.2 Single Analyzer Accuracy. Each organization, at the end of each sampling quarter, shall calculate and report the percentage difference for each audit concentration for each analyzer audited during the quarter. Directions for calculations are given below (directions for reporting are given in section 6).

Calculate and report the percentage difference (d_i) for each audit concentration using equation 1 where Y_i is the analyzer’s indicated concentration from the i-th audit check and X_i is the known concentration of the audit gas used for the i-th audit check.

5. Calculations for Manual Methods

5.1 Single Instrument Precision for TSP, Pb and PM_{10}. Estimates of precision for ambient air quality particulate measurements are calculated from results obtained from collocated samplers as described in section 3.3. At the end of each sampling quarter, calculate and report a precision probability interval, using weekly result from the collocated samplers. Directions for calculations are given below, and directions for reporting are given in section 6.

For the paired measurements obtained as described in sections 3.3.1 and 3.3.2, calculate the percent difference (d_i) using equation 1a, where Y_i is the concentration of pollutant measured by the duplicate sampler, and X_i is the concentration measured by the sampler reporting air quality for the site. Calculate the quarterly average percent difference (d_j), equation 2; standard deviation (S_j), equation 3; and upper and lower 95 percent probability limits for precision, equations 6 and 7.

\[
\begin{align*}
\text{Upper 95 percent probability limit} &= \left(\frac{Y_i - X_i}{Y_i + X_i}\right) \times 100 \\
\text{Lower 95 percent probability limit} &= \left(\frac{Y_i - X_i}{Y_i + X_i}\right) \times 100
\end{align*}
\]

where \(n\) is the number of precision checks on the instrument made during the sampling quarter. For example, \(n\) should be 6 or 7 if span checks are made biweekly during a quarter.

Calculate the 95 percent probability limits for precision using equation 4 and 5.

\[
\begin{align*}
\text{Upper 95 Percent Probability Limit} &= d_j + 1.96 S_j \\
\text{Lower 95 Percent Probability Limit} &= d_j - 1.96 S_j
\end{align*}
\]
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the quarter. Directions for calculation are given below and directions for reporting are given in section 6.

For the flow rate audit described in section 3.4, let \( X_i \) represent the known flow rate and \( Y_i \) represent the indicated flow rate. Calculate the percentage difference (\( d_i \)) using equation 1.

5.3 Single Instrument Accuracy for Pb.

Each organization, at the end of each sampling quarter, shall calculate and report the percentage difference for each high-volume lead sampler audited during the quarter. Directions for calculation are given in 5.2 and directions for reporting are given in section 6.

5.4 Single-Analysis-Day Accuracy for Pb.

Each organization, at the end of each sampling quarter, shall calculate and report the percentage difference for each Pb analysis audit during the quarter. Directions for calculations are given below and directions for reporting are given in section 6.

For each analysis audit for Pb described in section 3.4.2, let \( X_i \) represent the known value of the audit sample and \( Y_i \) the indicated value of Pb. Calculate the percentage difference (\( d_i \)) for each audit at each concentration level using equation 1.

6. Organization Reporting Requirements.

At the end of each sampling quarter, the organization must report the following data assessment information:

1. For automated analyzers—precision probability limits from section 4.1 and percentage differences from section 4.2, and
2. For manual methods—precision probability limits from section 5.1 and percentage differences from sections 5.2 and 5.3. The precision and accuracy information for the entire sampling quarter must be submitted with the air monitoring data. All data used to calculate reported estimates of precision and accuracy including span checks, collocated sampler and audit results must be made available to the permit granting authority upon request.

### Table B-1—Minimum PSD Data Assessment Requirements

<table>
<thead>
<tr>
<th>Method</th>
<th>Assessment method</th>
<th>Coverage</th>
<th>Frequency</th>
<th>Parameters reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precision: Automated Methods for SO(_2), NO(_x), O(_3), and CO.</td>
<td>Response check at concentration between .08 &amp; .10 ppm (8 &amp; 10 ppm for CO)</td>
<td>Each analyzer</td>
<td>Once per 2 weeks</td>
<td>Actual concentration &amp; measured concentration.</td>
</tr>
<tr>
<td>TSP, PM(_{10}), Lead</td>
<td>Collocated samplers</td>
<td>Highest concentration site in monitoring network</td>
<td>Once per week or every 3rd day for continuous sampling</td>
<td>Two concentration measurements.</td>
</tr>
<tr>
<td>Accuracy: Automated Methods for SO(_2), NO(_x), O(_3), and CO.</td>
<td>Response check at: .03–.08 ppm(^1), 15–.20 ppm(^1), 35–.45 ppm(^1), 90–.90 ppm(^1) (if applicable).</td>
<td>Each analyzer</td>
<td>Once per sampling quarter</td>
<td>Actual concentration &amp; measured (indicated) concentration for each level.</td>
</tr>
<tr>
<td>TSP, PM(_{10})</td>
<td>Sampler flow check</td>
<td>Each sampler</td>
<td>Once per sampling quarter</td>
<td>Actual flow rate and flow rate indicated by the sampler.</td>
</tr>
<tr>
<td>Lead</td>
<td>1. Sample flow rate check. 2. Check analytical system with Pb audit strips.</td>
<td>1. Each sampler. 2. Analytical system</td>
<td>1. Once/quarter. 2. Each quarter Pb samples are analyzed.</td>
<td></td>
</tr>
</tbody>
</table>

\(^1\) Concentration shown times 100 for CO. 
\(^2\) Effective concentration for open path analyzers. 
\(^3\) Corrected concentration, if applicable, for open path analyzers.

References

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APPENDIX C TO PART 58—AMBIENT AIR QUALITY MONITORING METHODOLOGY

1. Purpose

This appendix specifies the monitoring methods (manual methods or automated analyzers) which must be used in State ambient air quality monitoring stations.

2. State and Local Air Monitoring Stations (SLAMS)

2.1 Except as otherwise provided in this appendix, a monitoring method used in a SLAMS must be a reference or equivalent method as defined in §50.1 of this chapter.

2.2 Substitute PM\(_{10}\) samplers.

2.2.1 For purposes of showing compliance with the NAAQS for particulate matter, a high volume TSP sampler described in 40 CFR part 50, appendix B, may be used in a SLAMS in lieu of a PM\(_{10}\) monitor as long as the ambient concentrations of particles measured by the TSP sampler are below the PM\(_{10}\) NAAQS. If the TSP sampler measures a single value that is higher than the PM\(_{10}\) 24-hour standard, or if the annual average of its measurements is greater than the PM\(_{10}\) annual standard, the TSP sampler operating as a substitute PM\(_{10}\) sampler must be replaced with a PM\(_{10}\) monitor. For a TSP measurement above the 24-hour standard, the TSP sampler should be replaced with a PM\(_{10}\) monitor before the end of the calendar quarter following the quarter in which the high concentration occurred. For a TSP annual average above the annual standard, the PM\(_{10}\) monitor should be operating by June 30 of the year following the exceedance.

2.2.2 In order to maintain historical continuity of ambient particulate matter trends and patterns for PM\(_{10}\) NAMS that were previously TSP NAMS, the TSP high volume sampler must be operated concurrently with the PM\(_{10}\) monitor for one-year period beginning with the PM\(_{10}\) NAMS start-up date. The operating schedule for the TSP sampler must be at least once every 6 days regardless of the PM\(_{10}\) sampling frequency.

2.3 Any manual method or analyzer purchased prior to cancellation of its reference or equivalent method designation under §53.11 or §53.16 of this chapter may be used in a SLAMS following cancellation for a reasonable period of time to be determined by the Administrator.

2.4 Approval of non-designated PM\(_{2.5}\) methods operated at specific individual sites. A method for PM\(_{2.5}\) that has not been designated as a reference or equivalent method as defined in §50.1 of this chapter may be approved for use for purposes of section 2.1 of this appendix at a particular SLAMS under the following stipulations.

2.4.1 The method must be demonstrated to meet the comparability requirements (except as provided in this section 2.4.1) set forth in §53.34 of this chapter in each of the four seasons at the site at which it is intended to be used. For purposes of this section 2.4.1, the requirements of §53.34 of this chapter shall apply except as follows:

2.4.1.1 The method shall be tested at the site at which it is intended to be used, and there shall be no requirement for tests at any other test site.

2.4.1.2 For purposes of this section 2.4, the seasons shall be defined as follows: Spring shall be the months of March, April, and May; summer shall be the months of June, July, and August; fall shall be the months of September, October, and November; and winter shall be the months of December, January, and February; when alternate seasons are approved by the Administrator.

2.4.1.3 No PM\(_{10}\) samplers shall be required for the test, as determination of the PM\(_{2.5}\)/PM\(_{10}\) ratio at the test site shall not be required.

2.4.1.4 The specifications given in table C-4 of part 53 of this chapter for Class I methods shall apply, except that there shall be no requirement for any minimum number of sample sets with Rj greater than 40 µg/m\(^3\) for 24-hour samples or greater than 35 µg/m\(^3\), average concentration collected over a 48-hour period.

2.4.2 The monitoring agency wishing to use the method must develop and implement appropriate quality assurance procedures for the method.
2.4.3 The monitoring agency wishing to use the method must develop and implement appropriate procedures for assessing and reporting the precision and accuracy of the method comparable to the procedures set forth in appendix A of this part for designated reference and equivalent methods.

2.4.4 The assessment of network operating precision using collocated measurements with reference method "audit" samplers required under section 3 of appendix A of this part shall be carried out semi-annually rather than annually (i.e., monthly audits with assessment determinations each 6 months).

2.4.5 Requests for approval under this section must meet the general submittal requirements of sections 2.7.1 and 2.7.2 of this appendix and must include the requirements in sections 2.4.5.1 through 2.4.5.7 of this appendix.

2.4.5.1 A clear and unique description of the site at which the method or sampler will be used and tested, and a description of the nature or character of the site and the particular matter that is expected to occur there.

2.4.5.2 A detailed description of the method and the nature of the sampler or analyzer upon which it is based.

2.4.5.3 A brief statement of the reason or rationale for requesting the approval.

2.4.5.4 A detailed description of the quality assurance procedures that have been developed and that will be implemented for the method.

2.4.5.5 A detailed description of the procedures for assessing the precision and accuracy of the method that will be implemented for reporting to AIRS.

2.4.5.6 Test results from the comparability tests as required in section 2.4.1 through 2.4.1.4 of this appendix.

2.4.5.7 Further supplemental information as may be necessary or helpful to support the required statements and test results.

2.4.6 Within 120 days after receiving a request for approval of the use of a method at a particular site under this section 2.4 and such further information as may be requested for purposes of the decision, the Administrator may approve or disapprove the method by letter to the person or agency requesting such approval.

2.5 Approval of non-designated methods under §58.13(f). An automated (continuous) method for PM_{2.5} that is not designated as either a reference or equivalent method as defined in §50.1 of this chapter may be approved under §58.13(f) for use at a SLAMS for the limited purposes of §58.13(f). Such an analyzer that is approved for use at a SLAMS under §58.13(f), identified as correlated acceptable continuous (CAC) monitors, shall not be considered a reference or equivalent method as defined in §50.1 of this chapter by virtue of such approval for use under §50.13(f), and the PM_{2.5} monitoring data obtained from such a monitor shall not be otherwise used for purposes of part 50 of this chapter.

2.6 Use of Methods With Higher, Nonconforming Ranges in Certain Geographical Areas.

2.6.1 [Reserved]

2.6.2 Nonconforming Ranges. An analyzer may be used (indefinitely) on a range which extends to concentrations higher than two times the upper limit specified in table B-1 of part 53 of this chapter if:

2.6.2.1 The analyzer has more than one selectable range and has been designated as a reference or equivalent method on at least one of its ranges, or has been approved for use under section 2.5 (which applies to analyzers purchased before February 18, 1975);

2.6.2.2 The pollutant intended to be measured with the analyzer is likely to occur in concentrations more than two times the upper range limit specified in table B-1 of part 53 of this chapter in the geographical area in which use of the analyzer is proposed; and

2.6.2.3 The Administrator determines that the resolution of the range or ranges for which approval is sought is adequate for its intended use. For purposes of this section (2.6), "resolution" means the ability of the analyzer to detect small changes in concentration.

2.6.3 Requests for approval under section 2.6.2 must meet the submittal requirements of section 2.7. Except as provided in subsection 2.7.3, each request must contain the information specified in subsection 2.7.2 in addition to the following:

2.6.3.1 The range or ranges proposed to be used;

2.6.3.2 Test data, records, calculations, and test results as specified in subsection 2.7.2.2 for each range proposed to be used;

2.6.3.3 An identification and description of the geographical area in which use of the analyzer is proposed;

2.6.3.4 Data or other information demonstrating that the pollutant intended to be measured with the analyzer is likely to occur in concentrations more than two times the upper range limit specified in table B-1 of part 53 of this chapter in the geographical area in which use of the analyzer is proposed; and

2.6.3.5 Test data or other information demonstrating the resolution of each proposed range that is broader than that permitted by section 2.5.

2.6.4 Any person who has obtained approval of a request under this section (2.6.2) shall assure that the analyzer for which approval was obtained is used only in the geographical area identified in the request and only while operated in the range or ranges specified in the request.

2.7 Requests for Approval; Withdrawal of Approval. 241
2.8.2 Requests for approval under this section (2.8) must meet the requirements of sections 2.7.1 and 2.7.2.1 of this appendix.

2.8.3 Each request submitted under this section (2.8) must include:

2.8.3.1 A description, in such detail as may be appropriate, of the desired modification;

2.8.3.2 A brief statement of the purpose(s) of the modification, including any reasons for considering it necessary or advantageous;

2.8.3.3 A brief statement of belief concerning the extent to which the modification will or may affect the performance characteristics of the method; and

2.8.3.4 Such further information as may be necessary to explain and support the statements required by sections 2.8.3.2 and 2.8.3.3.

2.8.4 Within 75 days after receiving a request for approval under this section (2.8) and such further information as he may request for purposes of his decision, the Administrator will approve or disapprove the modification in question by letter to the person or agency requesting such approval.

2.8.5 A temporary modification that will or might alter the performance characteristics of a reference, equivalent, or alternative method may be made without prior approval under section (2.8) if the method is not functioning or is malfunctioning, provided that parts necessary for repair in accordance with the applicable operation manual cannot be obtained within 45 days. Unless such temporary modification is later approved under section 2.8, the temporarily modified method shall be repaired in accordance with the applicable operation manual as quickly as practicable but in no event later than 4 months after the temporary modification was made, unless an extension of time is granted by the Administrator. Unless and until the temporary modification is approved, air quality data obtained with the method as temporarily modified must be clearly identified as such when submitted in accordance with §58.28 or §58.35 of this chapter and must be accompanied by a report containing the information specified in section 2.8.3.

2.8.6 A request that the Administrator approve a temporary modification may be submitted in accordance with sections 2.8.3 through 2.8.4. In such cases the request will be considered as if a request for prior approval had been made.

2.9 Use of IMPROVE Samplers at a SLAMS. “IMPROVE” samplers may be used in SLAMS for monitoring of regional background and regional transport concentrations of fine particulate matter. The IMPROVE samplers were developed for use in the Interagency Monitoring of Protected Visual Environments (IMPROVE) network to characterize all of the major components and...
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many trace constituents of the particulate matter that impair visibility in Federal Class I Areas. These samplers are routinely operated at about 70 locations in the United States. IMPROVE samplers consist of four sampling modules that are used to collect twice weekly 24-hour duration simultaneous samples. Modules A, B, and C collect PM_{2.5} on three different filter substrates that are compatible with a variety of analytical techniques, and module D collects a PM_{10} sample. PM_{2.5} mass and elemental concentrations are determined by analysis of the 25mm diameter stretched Teflon filters from module A. More complete descriptions of the IMPROVE samplers and the data they collect are available elsewhere (references 4, 5, and 6 of this appendix).

3.0 National Air Monitoring Stations (NAMS)

3.1 Methods used in those SLAMS which are also designated as NAMS to measure SO_{2}, CO, NO_{2}, or O_{3} must be automated reference or equivalent methods (continuous analyzers).

4.0 Photochemical Assessment Monitoring Stations (PAMS)

4.1 Methods used for O_{3} monitoring at PAMS must be automated reference or equivalent methods as defined in §50.1 of this chapter.

4.2 Methods used for NO, NO_{2}, and NO_{x} monitoring at PAMS should be automated reference or equivalent methods as defined for NO_{2} in §50.1 of this chapter. If alternative NO, NO_{2}, or NO_{x} monitoring methodologies are proposed, such techniques must be detailed in the network description required by §58.40 and subsequently approved by the Administrator.

4.3 Methods for meteorological measurement and speciated VOC monitoring are included in the guidance provided in references 2 and 3. If alternative VOC monitoring methodology (including the use of new or innovative technologies), which is not included in the guidance, is proposed, it must be detailed in the network description required by §58.40 and subsequently approved by the Administrator.

5.0 Particulate Matter Episode Monitoring

5.1 For short-term measurements of PM_{10} during air pollution episodes (see §51.152 of this chapter) the measurement method must be:

5.1.1 Either the “Staggered PM_{10}” method or the “PM_{10} Sampling Over Short Sampling Times” method, both of which are based on the reference method for PM_{10} and are described in reference 1; or

5.1.2 Any other method for measuring PM_{10}.

5.1.2.1 Which has a measurement range or ranges appropriate to accurately measure air pollution episode concentration of PM_{10},

5.1.2.2 Which has a sample period appropriate for short-term PM_{10} measurements, and

5.1.2.3 For which a quantitative relationship to a reference or equivalent method for PM_{10} has been established at the use site. Procedures for establishing a quantitative site-specific relationship are contained in reference 1.

5.2 Quality Assurance. PM_{10} methods other than the reference method are not covered under the quality assessment requirements of appendix A. Therefore, States must develop and implement their own quality assessment procedures for those methods allowed under this section 4. These quality assessment procedures should be similar or analogous to those described in section 3 of appendix A for the PM_{10} reference method.

6.0 References


APPENDIX D TO PART 58—NETWORK DESIGN FOR STATE AND LOCAL AIR MONITORING STATIONS (SLAMS), NATIONAL AIR MONITORING STATIONS (NAMS), AND PHOTOCHEMICAL ASSESSMENT MONITORING STATIONS (PAMS)

1. SLAMS Monitoring Objectives and Spatial Scales
2. SLAMS Network Design Procedures
2.1 Background Information for Establishing SLAMS
2.2 Substantive Changes in SLAMS/NAMS Network Design Elements
2.3 Sulfur Dioxide (SO2) Design Criteria for SLAMS
2.4 Carbon Monoxide (CO) Design Criteria for SLAMS
2.5 Ozone (O3) Design Criteria for SLAMS
2.6 Nitrogen Dioxide (NO2) Design Criteria for SLAMS
2.7 Lead (Pb) Design Criteria for SLAMS
2.8 Particulate Matter Design Criteria for SLAMS
3. Network Design for National Air Monitoring Stations (NAMS)
3.1 [Reserved]
3.2 Sulfur Dioxide (SO2) Design Criteria for NAMS
3.3 Carbon Monoxide (CO) Design Criteria for NAMS
3.4 Ozone (O3) Design Criteria for NAMS
3.5 Nitrogen Dioxide (NO2) Design Criteria for NAMS
3.6 Lead (Pb) Design Criteria for NAMS
3.7 Particulate Matter Design Criteria for NAMS
4. Network Design for Photochemical Assessment Monitoring Stations (PAMS)
5. Summary
6. References
1. SLAMS Monitoring Objectives and Spatial Scales

The purpose of this appendix is to describe monitoring objectives and general criteria to be applied in establishing the State and Local Air Monitoring Stations (SLAMS) networks and for choosing general locations for new monitoring stations. It also describes criteria for determining the number and location of National Air Monitoring Stations (NAMS), Photochemical Assessment Monitoring Stations (PAMS), and core Stations for PM10. These criteria will also be used by EPA in evaluating the adequacy of the

The network of stations that comprise SLAMS should be designed to meet a minimum of six basic monitoring objectives. These basic monitoring objectives are:

1. To determine highest concentrations expected to occur in the area covered by the network.
2. To determine representative concentrations in areas of high population density.
3. To determine the extent of Regional pollutant transport among populated areas; and in support of secondary standards.
4. To determine the welfare-related impacts in more rural and remote areas (such as visibility impairment and effects on vegetation).
5. To determine the extent of Regional pollutant transport among populated areas; and in support of secondary standards.
6. To determine the welfare-related impacts in more rural and remote areas (such as visibility impairment and effects on vegetation).

It should be noted that this appendix contains no criteria for determining the total number of stations in SLAMS networks, except in areas where Pb concentrations currently exceed or have exceeded the Pb NAAQS during any one quarter of the most recent eight quarters. The optimum size of a particular SLAMS network involves trade-offs among data needs and available resources that EPA believes can best be resolved during the network design process.

This appendix focuses on the relationship between monitoring objectives and the geographical location of monitoring stations. Included are a rationale and set of general criteria for identifying candidate station locations in terms of physical characteristics which most closely match a specific monitoring objective. The criteria for more specifically siting the monitoring station, including spacing from roadways and vertical and horizontal probe and path placement, are described in appendix E of this part.

To clarify the nature of the link between general monitoring objectives and the physical location of a particular monitoring station, the concept of spatial scale of representativeness of a monitoring station is defined. The goal in siting stations is to correctly match the spatial scale represented by the sample of monitored air with the spatial scale most appropriate for the monitoring objective of the station.

Thus, spatial scale of representativeness is described in terms of the physical dimensions of the air parcel nearest to a monitoring station throughout which actual pollutant concentrations are reasonably similar. The scale of representativeness of most interest for the monitoring objectives defined above are as follows:

Microscale—defines the concentrations in air volumes associated with area dimensions
ranging from several meters up to about 100 meters.

Middle Scale—defines the concentration typical of areas up to several city blocks in size, with dimensions ranging from about 100 meters to 0.5 kilometer.

Neighborhood Scale—defines concentrations within some extended area of the city that has relatively uniform land use with dimensions in the 0.5 to 4.0 kilometers range.

Urban Scale—defines the overall, citywide conditions with dimensions on the order of 4 to 50 kilometers. This scale would usually require more than one site for definition.

Regional Scale—defines usually a rural area of reasonably homogeneous geography and extends from tens to hundreds of kilometers.

National and Global Scales—these measurement scales represent concentrations characterizing the nation and the globe as a whole.

Proper siting of a monitoring station requires precise specification of the monitoring objective which usually includes a desired spatial scale of representativeness. For example, consider the case where the objective is to determine maximum CO concentrations in areas where pedestrians may reasonably be exposed. Such areas would most likely be located within major street canyons of large urban areas and near traffic corridors. Stations located in these areas are most likely to have a microscale of representativeness since CO concentrations typically peak nearest roadways and decrease rapidly as the monitor is moved from the roadway. In this example, physical location was determined by consideration of CO emission patterns, pedestrian activity, and physical characteristics affecting pollutant dispersion. Thus, spatial scale of representativeness was not used in the selection process but was a result of station location.

In some cases, the physical location of a station is determined from joint consideration of both the basic monitoring objective, and a desired spatial scale of representativeness. For example, to determine CO concentrations which are typical over a reasonably broad geographic area having relatively high CO concentrations, a neighborhood scale station is more appropriate. Such a station would likely be located in a residential or commercial area having a high overall CO emission density but not in the immediate vicinity of any single roadway. Note that in this example, the desired scale of representativeness was an important factor in determining the physical location of the monitoring station.

In either case, classification of the station by its intended objective and spatial scale of representativeness is necessary and will aid in interpretation of the monitoring data.

Table 1 illustrates the relationship between the four basic monitoring objectives and the scales of representativeness that are generally most appropriate for that objective.

<table>
<thead>
<tr>
<th>Monitoring Objective</th>
<th>Appropriate Siting Scales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest concentration</td>
<td>Micro, Middle, neighborhood</td>
</tr>
<tr>
<td>Population</td>
<td>Neighborhood, urban</td>
</tr>
<tr>
<td>Source impact</td>
<td>Micro, middle, neighborhood</td>
</tr>
<tr>
<td>General/background</td>
<td>Neighborhood, urban, regional</td>
</tr>
<tr>
<td>Regional transport</td>
<td>Urban/Regional</td>
</tr>
<tr>
<td>Welfare-related impacts</td>
<td>Urban/Regional</td>
</tr>
</tbody>
</table>

1 Urban denotes a geographic scale applicable to both cities and rural areas.

Open path analyzers can often be used effectively and advantageously to provide better monitoring representation for population exposure monitoring and general or background monitoring in urban and neighborhood scales of representation. Such analyzers may also be able to provide better area coverage or operational advantages in high concentration and source-impact monitoring in middle scale and possibly microscale areas. However, siting of open path analyzers for the latter applications must be carried out with proper regard for the specific monitoring objectives and for the path-averaging nature of these analyzers. Monitoring path lengths need to be commensurate with the intended scale of representativeness and located carefully with respect to local sources or potential obstructions. For short-term/high-concentration or source-oriented monitoring, the monitoring path may need to be further restricted in length and be oriented approximately radially with respect to the source in the downwind direction, to provide adequate peak concentration sensitivity. Alternatively, multiple (e.g., orthogonal) paths may be used advantageously to obtain both wider area coverage and peak concentration sensitivity. Further discussion on this topic is included in section 2.2 of this appendix.

Subsequent sections of this appendix describe in greater detail the most appropriate scales of representativeness and general monitoring locations for each pollutant.

2. SLAMS Network Design Procedures

The preceding section of this appendix has stressed the importance of defining the objectives for monitoring a particular pollutant. Since monitoring data are collected to "represent" the conditions in a section or subregion of a geographical area, the previous section included a discussion of the scale of representativeness of a monitoring station. The use of this physical basis for locating stations allows for an objective approach to network design.
The discussion of scales in sections 2.3 through 2.8 of this appendix does not include all of the possible scales for each pollutant. The scales that are discussed are those that are felt to be most pertinent for SLAMS network design.

In order to evaluate a monitoring network and to determine the adequacy of particular monitoring stations, it is necessary to examine each pollutant monitoring station individually by stating its monitoring objective and determining its spatial scale of representativeness. This will do more than insure compatibility among stations of the same type. It will also provide a physical basis for the interpretation and application of the data. This will help to prevent mismatches between what the data actually represent and what the data are interpreted to represent. It is important to note that SLAMS are not necessarily sufficient for completely describing air quality. In many situations, diffusion models must be applied to complement ambient monitoring, e.g., determining the impact of point sources or defining boundaries of nonattainment areas.

Information such as emissions density, housing density, climatological data, geographical information, traffic counts, and the results of modeling will be useful in designing regulatory networks. Air pollution control agencies have shown the value of screening studies, such as intensive studies conducted with portable samplers, in designing networks. In many cases, in selecting sites for core PM$_{10}$ or carbon monoxide SLAMS, and for defining the boundaries of PM$_{2.5}$, optional community monitoring zones, air pollution control agencies will benefit from using such studies to evaluate the spatial distribution of pollutants.

2.1 Background Information for Establishing SLAMS. Background information that must be considered in the process of selecting SLAMS from the existing network and in establishing new SLAMS includes emission inventories, climatological summaries, and local geographical characteristics. Such information is to be used as a basis for the judgmental decisions that are regarding the station selection process. For new stations, the background information should be used to decide on the actual location considering the monitoring objective and spatial scale while following the detailed procedures in References 1 through 4.

Emission inventories are generally the most important type of background information needed to design the SLAMS network. The emission data provide valuable information concerning the size and distribution of large point sources. Area source emissions are usually available for counties but should be subdivided into smaller areas or grids where possible, especially if diffusion modeling is to be used as a basis for determining where stations should be located. Sometimes this must be done rather crudely, for example, on the basis of population or housing units. In general, the grids should be smaller in areas of dense population than in less densely populated regions.

Emission inventory information for point sources should be generally available for any area of the country for annual and seasonal averaging times. Specific information characterizing the emissions from large point sources for the shorter averaging times (diurnal variations, load curves, etc.) can often be obtained from the source. Area source emission data by season, although not available from the EPA, can be generated by apportioning annual totals according to degree days.

Detailed area source data are also valuable in evaluating the adequacy of an existing station in terms of whether the station has been located in the desired spatial scale of representativeness. For example, it may be the desire of an agency to have an existing CO station measuring in the neighborhood scale.

By examining the traffic data for the area and examining the physical location of the station with respect to the roadways, a determination can be made as to whether or not the station is indeed measuring the air quality on the desired scale.

The climatological summaries of greatest use are the frequency distributions of wind speed and direction. The wind rose is an easily interpreted graphical presentation of the directional frequencies. Other types of useful climatological data are also available, but generally are not as directly applicable to the site selection process as are the wind statistics.

In many cases, the meteorological data originating from the most appropriate (not necessarily the nearest) national weather service (NWS) airport station in the vicinity of the prospective siting area will adequately reflect conditions over the area of interest, at least for annual and seasonal averaging times. In developing data in complex meteorological and terrain situations, diffusion meteorologists should be consulted. NWS stations can usually provide most of the relevant weather information in support of network design activities anywhere in the country. Such information includes joint frequency distributions of winds and atmospheric stability (stability-wind roses).

The geographical material is used to determine the distribution of natural features, such as forests, rivers, lakes, and manmade features. Useful sources of such information may include road and topographical maps, aerial photographs, and even satellite photographs. This information may include the terrain and land-use setting of the prospective monitor siting area, the proximity of larger water bodies, the distribution of pollutant sources in the area, the location of...
NWS airport stations from which weather data may be obtained, etc. Land use and topographical characteristics of specific areas of interest can be determined from U.S. Geological Survey (USGS) maps and land use maps. Detailed information on urban physiography (building/street dimensions, etc.) can be obtained by visual observations, aerial photography, and also surveys which supplement the information available from those sources. Such information could be used in determining the location of local pollutant sources in and around the prospective station locations.

2.2 Substantive Changes in SLAMS/NAMS Network Design Elements. Two important purposes of the SLAMS monitoring data are to examine and evaluate overall air quality within a certain region, and to assess the trends in air pollutant levels over several years. The EPA believes that one of the primary tools for providing these characterizations is an ambient air monitoring program which implements technically representative networks. The design of these networks must be carefully evaluated not only at their outset, but at relatively frequent intervals thereafter, using an appropriate combination of other important technical tools, including: dispersion and receptor modeling, saturation studies, point and area source emissions analyses, and meteorological assessments. The impetus for these subsequent re-examinations of monitoring network adequacy stems not only from the need to evaluate the effect that changes in the environment may pose, but also from the recognition that new and/or refined tools and techniques for use in impact assessments are continually emerging and available for application.

Substantive changes to an ambient air monitoring network are both inevitable and necessary; however, any changes in any substantive aspect of an existing SLAMS network or monitoring site that might affect the continuity or comparability of pollutant measurements over time must be carefully and thoroughly considered. Such substantive changes would include cessation of monitoring at an existing site, relocation of an existing site, a change in the type of monitoring method used, any change in the probe or path height or orientation that might affect pollutant measurements, any significant changes in calibration procedures or standards, any significant change in operational or quality assurance procedures, any significant change in the sources or the character of the area in the vicinity of a monitoring site, or any other change that could potentially affect the continuity or comparability of monitoring data obtained before and after the change.

In general, these types of changes should be made cautiously with due consideration given to the impact of such changes on the network/site’s ability to meet its intended goals. Some of these changes will be inevitable (such as when a monitoring site will no longer be available and the monitor must be relocated, for example). Other changes may be deemed necessary and advantageous, after due consideration of their impact, even though they may have a deleterious effect on the long-term comparability of the monitoring data. In these cases, an effort should be made to quantify, if possible, or at least characterize, the nature or extent of the effects of the change on the monitoring data. In all cases, the changes and all information pertinent to the effect of the change should be properly and completely documented for evaluation by trends analysts.

The introduction of open path methods to the SLAMS monitoring network may seem relatively straightforward, given the kinds of technical analyses required in this appendix. However, given the uncertainties attendant to these analyses and the critical nature and far-reaching regulatory implications of some sites in the current SLAMS network composed of point monitors, there is a need to ‘bridge’ between databases generated by these different candidate methods to evaluate and promote continuity in understanding of the historical representativeness of the database.

Concurrent, nominally collocated monitoring must be conducted in all instances where an open path analyzer is effectively intended to replace a criteria pollutant point monitor which meets either of the following:

1. Data collected at the site represents the maximum concentration for a particular nonattainment area; or
2. Data collected at the site is currently used to characterize the development of a nonattainment area State implementation plan.

The Regional Administrator, the Administrator, or their appropriate designee may also require collocated monitoring at other sites which are, based on historical technical data, significant in assessing air quality in a particular area. The term of this requirement is determined by the Regional Administrator (for SLAMS), Administrator (for NAMS), or their appropriate designee. The recommended minimum term consists of one year (or one season of maximum pollutant concentration) with a maximum term indexed to the subject pollutant NAAQS compliance interval (e.g., three calendar years for ozone). The requirement involves concurrent monitoring with both the open path analyzer and the existing point monitor during this term. Concurrent monitoring with more than one point analyzer with an open path analyzer using one or more measurement paths may also be advantageous to confirm adequate peak concentration sensitivity or to optimize the location and length of the monitoring path or paths.
All or some portion of the above requirement may be waived by the Regional Administrator for SLAMS, the Administrator for NAMS, or their designee in response to a request, based on accompanying technical information and analyses, or in certain unavoidable instances caused by logistical circumstances.

These requirements for concurrent monitoring also generally apply to situations where the relocation of any SLAMS site, using either a point monitor or an open path analyzer, within an area is being contemplated.

2.3 Sulfur Dioxide (SO2) Design Criteria for SLAMS. The spatial scales for SO2 SLAMS monitoring are the middle, neighborhood, urban, and regional scales. Because of the nature of SO2 distributions over urban areas, the middle scale is the most likely scale to be represented by a single measurement in an urban area, but only if the undue effects from local sources (minor or major point sources) can be eliminated. Neighborhood scales would be those most likely to be represented by single measurements in suburban areas where the concentration gradients are less steep. Urban scales would represent areas where the concentrations are uniform over a larger geographical area. Regional scale measurements would be associated with rural areas.

Middle Scale—Some data uses associated with middle scale measurements for SO2 include assessing the effects of control strategies to reduce urban concentrations (especially for the 3-hour and 24-hour averaging times) and monitoring air pollution episodes.

Neighborhood Scale—This scale applies in areas where the SO2 concentration gradient is relatively flat (mainly suburban areas surrounding the urban center) or in large sections of small cities and towns. In general, these areas are quite homogeneous in terms of SO2 emission rates and population density. Thus, neighborhood scale measurements may be associated with baseline concentrations in areas of projected growth and in studies of population responses to exposure to SO2. Also concentration maxima associated with air pollution episodes may be uniformly distributed over areas of neighborhood scale, and measurements taken within such an area would represent neighborhood, and to a limited extent, middle scale concentrations.

Urban Scale—Data from this scale could be used for the assessment of air quality trends and the effect of control strategies on urban scale air quality.

Regional Scale—These measurements would be applicable to large homogeneous areas, particularly those which are sparsely populated. Such measurements could provide information on background air quality and interregional pollutant transport.

After the spatial scale has been selected to meet the monitoring objectives for each station location, the procedures found in reference 2 should be used to evaluate the adequacy of each existing SO2 station and must be used to relocate an existing station or to locate any new SLAMS stations. The background material for these procedures should consist of emission inventories, meteorological data, wind roses, and maps for population and topographical characteristics of specific areas of interest. Isopleth maps of SO2 air quality as generated by dispersion models are useful for the general determination of a prospective area within which the station is eventually placed.

2.4 Carbon Monoxide (CO) Design Criteria for SLAMS. Micro, middle, and neighborhood scale measurements are necessary station classifications for SLAMS since most people are exposed to CO concentrations in these scales. Carbon monoxide maxima occur primarily in areas near major roadways and intersections with high traffic density and poor atmospheric ventilation. As these maxima can be predicted by ambient air quality modeling, a large fixed network of CO monitors is not required. Long-term CO monitoring should be confined to a limited number of micro and neighborhood scale stations in large metropolitan areas to measure maximum pollution levels and to determine the effectiveness of control strategies.

Microscale—Measurements on this scale would represent distributions within street canyons, over sidewalks, and near major roadways. The measurements at a particular location in a street canyon would be typical of one high concentration area which can be shown to be a representation of many more areas throughout the street canyon or other similar locations in a city. This is a scale of measurement that would provide valuable information for devising and evaluating “hot spot” control measures.

Middle Scale—This category covers dimensions from 100 meters to 0.5 kilometer. In certain cases discussed below, it may apply to regions that have a total length of several kilometers. In many cases of interest, sources and land use may be reasonably homogeneous for long distances along a street, but very inhomogeneous normal to the street. This is the case with strip development and freeway corridors. Included in this category are measurements to characterize the CO concentrations along the urban features just enumerated. When a location is chosen to represent conditions in a block of street development, then the characteristic dimensions of this scale are tens of meters by hundreds of meters. If an attempt is made to characterize street-side conditions throughout the downtown area or along an extended stretch of freeway, the dimensions may be tens of meters by kilometer.
The middle scale would also include the parking lots and feeder streets associated with indirect sources which attract significant numbers of pollutant emitters, particularly autos. Shopping centers, stadia, and office buildings are examples of indirect sources.

Neighborhood Scale—Measurements in this category would represent conditions throughout some reasonably homogeneous urban subregions, with dimensions of a few kilometers and generally more regularly shaped than the middle scale. Homogeneity refers to CO concentration, but it probably also applies to land use. In some cases, a location carefully chosen to provide neighborhood scale data, might represent not only the immediate neighborhood, but also neighborhoods of the same type in other parts of the city. These kinds of stations would provide information relating to health effects because they would represent conditions in areas where people live and work. Neighborhood scale data would provide valuable information for developing, testing, and revising concepts and models that describe the larger scale concentration patterns, especially those models relying on spatially smoothed emission fields for inputs. These types of measurements could also be used for inter-neighborhood comparisons within or between cities.

After the spatial scale has been determined to meet the monitoring objectives for each location, the location selection procedures, as shown in reference 3 should be used to evaluate the adequacy of each existing CO station and must be used to relocate an existing station or to locate any new SLAMS stations. The background material necessary for these procedures may include the average daily traffic on all streets in the area, wind roses for different hours of the day, and maps showing one-way streets, street widths, and building heights. If the station is to typify the area with the highest concentrations, the streets with the greatest daily traffic should be identified. If some streets are one-way, those streets that have the greatest traffic during the afternoon and evening hours should be selected as tentative locations, because the periods of high traffic volume are usually of greatest duration through the evening hours. However, the strength of the morning inversion has to be considered along with the traffic volume and pattern when seeking areas with the highest concentrations. Traffic counters near the stations will provide valuable data for interpreting the observed CO Concentrations.

Monitors should not be placed in the vicinity of possible anomalous source areas. Examples of such areas include toll gates on turnpikes, metered freeway ramps, and drawbridge approaches. Additional information on network design may be found in reference 3.

2.5 Ozone (O₃) Design Criteria for SLAMS.

Ozone is not directly emitted into the atmosphere, but results from complex photochemical reactions involving organic compounds, oxides of nitrogen, and solar radiation.

The relationships between primary emissions (precursors) and secondary pollutants (O₃) tend to produce large separations spatially and temporally between the major sources and the areas of high oxidant pollution. This suggests that the meteorological transport process and the relationships between sources and sinks need to be considered in the development of the network design criteria and placement of monitoring stations, especially in measuring peak concentration levels.

The principal spatial scales for SLAMS purposes based on the monitoring objectives are neighborhood, urban, regional, and to a lesser extent, middle scale. Since ozone requires appreciable formation time, the mixing of reactants and products occurs over large volumes of air, and this reduces the importance of monitoring small scale spatial variability.

Middle Scale—Measurement in this scale would represent conditions close to sources of NOx such as roads where it would be expected that suppression of O₃ concentrations would occur. Trees also may have a strong scavenging effect on O₃ and may tend to suppress O₃ concentrations in their immediate vicinity. Measurements at these stations would represent conditions over relatively small portions of the urban area.

Neighborhood Scale—Measurements in this category represent conditions throughout some reasonably homogeneous urban subregion, with dimensions of a few kilometers. Homogeneity refers to pollutant concentrations. Neighborhood scale data will provide valuable information for developing, testing, and revising concepts and models that describe urban/regional concentration patterns. They will be useful to the understanding and definition of processes that take periods of hours to occur and hence involve considerable mixing and transport. Under stagnation conditions, a station located in the neighborhood scale may also experience peak concentration levels within the urban areas.

Urban Scale—Measurement in this scale will be used to estimate concentrations over large portions of an urban area with dimensions of several kilometers to 50 or more kilometers. Such measurements will be used for determining trends, and designing area-wide control strategies. The urban scale stations would also be used to measure high concentrations downwind of the area having the highest precursor emissions.

Regional Scale—This scale of measurement will be used to typify concentrations over large portions of a metropolitan area and...
even larger areas with dimensions of as much as hundreds of kilometers. Such measurements will be useful for assessing the ozone that is transported into an urban area. Data from such stations may be useful in accounting for the ozone that cannot be reduced by control strategies in that urban area.

The location selection procedure continues after the spatial scale is selected based on the monitoring objectives. The appropriate network design procedures as found in reference 4, should be used to evaluate the adequacy of each existing O3 monitor and must be used to relocate an existing station or to locate any new O3 SLAMS stations. The first step in the siting procedure would be to collect the necessary background material, which may consist of maps, emission inventories for nonmethane hydrocarbons and oxides of nitrogen (NOx), climatological data, and existing air quality data for ozone, nonmethane hydrocarbons, and NOx/NO.

For locating a neighborhood scale station to measure typical city concentrations, a reasonably homogenous geographical area near the center of the region should be selected which is also removed from the influence of major NOx sources. For an urban scale station to measure high concentrations, the emission inventories should be used to define the extent of the area of important nonmethane hydrocarbons and NOx emissions. The most frequent wind speed and direction for periods of important photochemical activity should be determined. Then the prospective monitoring area should be selected in a direction from the city that is most frequently downwind during periods of photochemical activity. The distance from the station to the upwind edge of the city should be about equal to the distance traveled by air moving for 5 to 7 hours at wind speeds prevailing during periods of photochemical activity. Prospective areas for locating O3 monitors should always be outside the area of major NOx.

In locating a neighborhood scale station which is to measure high concentrations, the same procedures used for the urban scale are followed except that the station should be located closer to the areas bordering on the center city or slightly further downwind in an area of high density population.

For regional scale background monitoring stations, the most frequent wind associated with important photochemical activity should be determined. The prospective monitoring area should be upwind for the most frequent direction and outside the area of city influence.

Since ozone levels decrease significantly in the colder parts of the year in many areas, ozone is required to be monitored at NAMS and SLAMS monitoring sites only during the "ozone season" as designated in the AIRS files on a State by State basis and described below:

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<tr>
<th>State</th>
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<th>End month</th>
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<td>Virgin Islands</td>
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</table>

Additional discussion on the procedures for siting ozone stations may be found in reference 4.

2.6 Nitrogen Dioxide (NO2) Design Criteria for SLAMS. The typical spatial scales of representativeness associated with nitrogen dioxide monitoring based on monitoring objectives are middle, neighborhood, and urban. Since nitrogen dioxide is primarily formed in
the atmosphere from the oxidation of NO, large volumes of air and mixing times usually reduce the importance of monitoring on small scale spatial variability especially for long- and short- term averages. In some situations where NO2 measurements would be made on the middle scale for both long- and short-term averages.

Middle Scale—Measurements on this scale would cover dimensions from about 100 meters to 0.5 kilometer. These measurements would characterize the public exposure to NO2 in populated areas. Also monitors that are located closer to roadways than the minimum distances specified in Table 3 of Appendix E of this part, would be represented by measurements on this scale.

Neighborhood and Urban Scales—The same considerations as discussed in section 2.5 for O3 would also apply to NO2.

After the spatial scale is selected based on the monitoring objectives, then the siting procedures as found in reference 4 should be used to evaluate the adequacy of each existing NO2 station and must be used to relocate an existing station or to locate any new NO2 stations. The siting procedures begin with collecting the background material. This background information may include the characteristics of the area and its sources under study, climatological data to determine where concentration maxima are most likely to be found, and any existing monitoring data for NO2.

For neighborhood or urban scales, the emphasis in site selection will be in finding those areas where long-term averages are expected to be the highest. Nevertheless, it should be expected that the maximum NO2 concentrations will occur in approximately the same locations as the maximum total oxides of nitrogen concentrations. The best course would be to locate the station some what further downwind beyond the expected point of maximum total oxides of nitrogen to allow more time for the formation of NO2. The dilution of the emissions further downwind from the source should be considered along with the need for reaction time for NO2 formation in locating stations to measure peak concentration. If dispersion is favorable, maximum concentrations may occur closer to the emission sources than the locations predicted from oxidation of NO to NO2 alone. This will occur downwind of sources based on winter wind direction or in areas where there are high ozone concentrations and high density NO2 emissions such as on the fringe of the central business district or further downwind. The distance and direction downwind would be based on ozone season wind patterns.

Once the major emissions areas and wind patterns are known, areas of potential maximum NO2 levels can be determined. Nitrogen dioxide concentrations are likely to decline rather rapidly outside the urban area.

Therefore, the best location for measuring NO2 concentrations will be in neighborhoods near the edge of the city.

2.7 Lead (Pb) Design Criteria for SLAMS

Presently, less than 1 percent of the Nation's Pb air pollution emissions originate from on-road mobile source exhaust. The majority of Pb emissions come from point sources, such as metals processing facilities, waste disposal and recycling, and fuel combustion (reference 19 of this appendix). The SLAMS networks are used to assess the air quality impacts of Pb point sources, and to determine the broad population exposure from any Pb source. The most important spatial scales to effectively characterize the emissions from point sources are the micro, middle, and neighborhood scales. For purposes of establishing monitoring stations to represent large homogeneous areas other than the above scales of representativeness, urban or regional scale stations may also be needed.

Microscale—This scale would typify areas in close proximity to lead point sources. Emissions from point sources such as primary and secondary lead smelters, and primary copper smelters may under fumigation conditions likewise result in high ground level concentrations at the microscale. In the latter case, the microscale would represent an area impacted by the plume with dimensions extending up to approximately 100 meters. Data collected at microscale stations provide information for evaluating and developing "hot-spot" control measures.

Middle Scale—This scale generally represents Pb air quality levels in areas up to several city blocks in size with dimensions on the order of approximately 100 meters to 500 meters. The middle scale may for example, include schools and playgrounds in center city areas which are close to major Pb point sources. Pb monitors in such areas are desirable because of the higher sensitivity of children to exposures of elevated Pb concentrations (reference 7 of this appendix). Emissions from point sources frequently impact on areas at which single sites may be located to measure concentrations representing middle spatial scales.

Neighborhood Scale—The neighborhood scale would characterize air quality conditions throughout some relatively uniform land use areas with dimensions in the 0.5 to 4.0 kilometer range. Stations of this scale would provide monitoring data in areas representing conditions where children live and play. Monitoring in such areas is important since this segment of the population is more susceptible to the effects of Pb. Where a neighborhood site is located away from immediate Pb sources, the site may be very useful in representing typical air quality values for a larger residential area, and therefore suitable for population exposure and trends analyses.
Urban Scale—Such stations would be used to present ambient Pb concentrations over an entire metropolitan area with dimensions in the 4 to 50 kilometer range. An urban scale station would be useful for characterizing trends in citywide air quality and the effectiveness of larger scale air pollution control strategies.

Regional Scale—Measurements from these stations would characterize air quality levels over areas having dimensions of 50 to hundreds of kilometers. This large scale of representativeness, rarely used in Pb monitoring, would be most applicable to sparsely populated areas and could provide information on background air quality and inter-regional pollutant transport.

Monitoring for ambient Pb levels is required for all major urbanized areas where Pb levels have been shown or are expected to be of concern due to the proximity of Pb point source emissions. Sources emitting five tons per year or more of actual point and fugitive Pb emissions would generally be candidates for lead ambient air monitoring. Modeling may be needed to determine if a source has the potential to exceed the quarterly lead National Ambient Air Quality Standards (NAAQS). The total number and type of stations for SLAMS are not prescribed but must be determined on a case-by-case basis. As a minimum, there must be two stations in any area where Pb concentrations currently exceed or have exceeded the Pb NAAQS during any one quarter of the most recent eight quarters. Where the Pb air quality violations are widespread or the emissions density, topography, or population locations are complex and varied, there may be a need to establish more than two Pb ambient air monitoring stations. The EPA Regional Administrator may specify more than two monitoring stations if it is found that two stations are insufficient to adequately determine if the Pb standard is being attained and maintained. The Regional Administrator may also specify that stations be located in areas outside the boundaries of the urbanized areas.

Concerning the previously discussed required minimum of two stations, at least one of the stations must be a category (a) type station and the second may be either category (a) or (b) depending upon the extent of the point source’s impact and the existence of residential neighborhoods surrounding the source. When the source is located in an area that is subject to NAMS requirements as in Section 3 of this Appendix, it is preferred that the NAMS site be used to describe the population’s exposure and the second SLAMS site be used as a category (a) site. Both of these categories of stations are defined in section 3.

To locate monitoring stations, it will be necessary to obtain background information such as point source emissions inventories, climatological summaries, and local geographical characteristics. Such information should be used to identify areas that are most suitable to the particular monitoring objective and spatial scale of representativeness desired. References 9 & 10 of this appendix provide additional guidance on locating sites to meet specific urban area monitoring objectives and should be used in locating new stations or evaluating the adequacy of existing stations.

After locating each Pb station and, to the extent practicable, taking into consideration the collective impact of all Pb sources and surrounding physical characteristics of the siting area, a spatial scale of representativeness must be assigned to each station.

2.8 Particulate Matter Design Criteria for SLAMS

As with other pollutants measured in the SLAMS network, the first step in designing the particulate matter network is to collect the necessary background information. Various studies in references 11, 12, 13, 14, 15, and 16 of section 6 of this appendix have documented the major source categories of particulate matter and their contribution to ambient levels in various locations throughout the country.

2.8.0.1 Sources of background information

Sources of background information would be regional and traffic maps, and aerial photographs showing topography, settlements, major industries and highways. These maps and photographs would be used to identify areas of the type that are of concern to the particular monitoring objective. After determining the potential suitable monitoring areas for particulate matter have been identified on a map, modeling may be used to provide an estimate of particulate matter concentrations throughout the area of interest. After completing the first step, existing particulate matter stations should be evaluated to determine their potential as candidates for SLAMS designation. Stations meeting one or more of the six basic monitoring objectives described in section 1 of this appendix must be classified into one of the five scales of representativeness (micro, middle, neighborhood, urban and regional) if the stations are to become SLAMS. In siting and classifying particulate matter stations, the procedures in references 17 and 18 of section 6 of this appendix should be used.

2.8.0.2 The most important spatial scales to effectively characterize the emissions of particulate matter from both mobile and stationary sources are the mobile scales for PM₂.₅ and PM₁₀ and neighborhood scales for both PM₂.₅ and PM₁₀. For purposes of establishing monitoring stations to represent large homogeneous areas other than the above scales of representativeness and to characterize regional transport, urban or regional scale stations would also be needed. Most PM₂.₅ monitoring in urban areas should be representative of a neighborhood scale.
2.8.0.3 Microscale—This scale would typify areas such as downtown street canyons and traffic corridors where the general public would be exposed to maximum concentration levels. In some circumstances, the microscale is appropriate for particulate stations; core SLAMS on the microscale should, however, be limited to urban sites that are representative of long-term human exposure and of many such microenvironments in the area. In general, microscale particulate matter sites should be located near inhabited buildings or locations where the general public can be expected to be exposed to the concentration measured. Emissions from stationary sources such as primary and secondary smelters, power plants, and other large industrial processes may, under certain plume conditions, likewise result in high ground level concentrations at the microscale. In the latter case, the microscale would represent an area impacted by the plume with dimensions extending up to approximately 100 meters. Data collected at microscale stations provide information for evaluating and developing hot spot control measures. Unless these sites are indicative of population-oriented monitoring, they may be more appropriately classified as SPMs.

2.8.0.4 Middle Scale—Much of the measurement of short-term public exposure to coarse fraction particles (PM10) is on this scale and on the neighborhood scale; for fine particles, much of the measurement is on the neighborhood scale. People moving through downtown areas, or living near major roadways, encounter particles that would be adequately characterized by measurements of this spatial scale. Thus, measurements of this type would be appropriate for the evaluation of possible short-term exposure public health effects of particulate matter pollution. In many situations, monitoring sites that are representative of micro-scale or middle-scale impacts are not unique and are representative of many similar situations. This can occur along traffic corridors or other locations in a residential district. In this case, one location is representative of a neighborhood of small scale sites and is appropriate for evaluation of long-term or chronic effects. This scale also includes the characteristic concentrations for other areas with dimensions of a few hundred meters such as the parking lot and feeder streets associated with shopping centers, stadia, and office buildings. In the case of PM2.5, unpaved or seldom swept parking lots associated with these sources could be an important source in addition to the vehicular emissions themselves.

2.8.0.5 Neighborhood Scale—Measurements in this category would represent conditions throughout some reasonably homogeneous urban subregion with dimensions of a few kilometers and of generally more regular shape than the middle scale. Homogeneity refers to the particulate matter concentrations, as well as the land use and land surface characteristics. Much of the PM2.5 exposures are expected to be associated with this scale of measurement. In some cases, a location carefully chosen to provide neighborhood scale data would represent not only the immediate neighborhood but also neighborhoods of the same type in other parts of the city. Stations of this kind provide good information about trends and compliance with standards because they often represent conditions in areas where people commonly live and work for periods comparable to those specified in the NAAQS. In general, most PM2.5 monitoring in urban areas should have this scale. A PM2.5 monitoring location is assumed to be representative of a neighborhood scale unless the monitor is adjacent to a recognized PM2.5 emissions source and is otherwise demonstrated to be representative of a smaller spatial scale by an intensive monitoring study. This category also may include industrial and commercial neighborhoods especially in districts of diverse land use where residences are interspersed.

2.8.0.6 Neighborhood scale data could provide valuable information for developing, testing, and revising models that describe the larger-scale concentration patterns, especially those models relying on spatially smoothed emission fields for inputs. The neighborhood scale measurements could also be used for neighborhood comparisons within or between cities. This is the most likely scale of measurements to meet the needs of planners.

2.8.0.7 Urban Scale—This class of measurement would be made to characterize the particulate matter concentration over an entire metropolitan or rural area ranging in size from 4 to 50 km. Such measurements would be useful for assessing trends in area-wide air quality, and hence, the effectiveness of large scale air pollution control strategies. Core PM2.5 SLAMS may have this scale.

2.8.0.8 Regional Scale—These measurements would characterize conditions over areas with dimensions of as much as hundreds of kilometers. As noted earlier, using representative conditions for an area implies some degree of homogeneity in that area. For this reason, regional scale measurements would be most applicable to sparsely populated areas with reasonably uniform ground cover. Data characteristics of this scale would provide information about larger scale processes of particulate matter emissions, losses and transport. Especially in the case of PM2.5, transport contributes to particulate concentrations and may affect multiple urban and State entities with large populations such as in the Eastern United States. Development of effective pollution control strategies requires an understanding
at regional geographical scales of the emission sources and atmospheric processes that are responsible for elevated PM\(_{2.5}\) levels and may also be associated with elevated ozone and regional haze.

2.8.1 Specific Design Criteria for PM\(_{2.5}\).
2.8.1.1 Monitoring Planning Areas.

Monitoring planning areas (MPAs) shall be used to conform to the community-oriented monitoring approach used for the PM\(_{2.5}\) NAAQS given in part 50 of this chapter. MPAs are required to correspond to all metropolitan statistical areas (MSAs) with population greater than 200,000, and all other areas determined to be in violation of the PM\(_{2.5}\) NAAQS. MPAs for other designated parts of the State are optional. All MPAs shall be defined on the basis of existing, delineated mapping data such as State boundaries, county boundaries, zip codes, census block groups, or census block groups.

2.8.1.2 PM\(_{2.5}\) Monitoring Sites within the State's PM Monitoring Network Description.
2.8.1.2.1 The minimum required number, type of monitoring sites, and sampling requirements for PM\(_{2.5}\) are based on monitoring planning areas described in the PM monitoring network description and proposed by the State in accordance with §58.20.
2.8.1.2.2 Comparisons to the PM\(_{2.5}\) NAAQS may be based on data from SPMs in addition to SLAMS (including NAMS, core SLAMS and colocated PM\(_{2.5}\) sites at PAMS), that meet the requirements of §58.13 and Appendices A, C and E of this part, that are included in the PM monitoring network description. For comparison to the annual NAAQS, the monitors should be neighborhood scale community-oriented locations. Special purpose monitors that meet part 58 requirements will be exempt from NAAQS comparisons with the PM\(_{2.5}\) NAAQS for the first 2 calendar years of their operation to encourage PM\(_{2.5}\) monitoring initially. After this time, however, any SPM that records a violation of the PM\(_{2.5}\) NAAQS must be seriously considered as a potential SLAMS site during the annual SLAMS network review in accordance with §58.25. If such SPMs are not established as a SLAMS, the agency must document in its annual report the technical basis for excluding it as a SLAMS.
2.8.1.2.3 The health-effects data base that served as the basis for selecting the new PM\(_{2.5}\) standards relied on a spatial average approach that reflects average community-oriented area-wide PM exposure levels. Under this approach, the most effective way to reduce total population risk is by lowering the annual distributions of ambient 24-hour PM\(_{2.5}\) concentrations, as opposed to controlling peak 24-hour concentrations on individual days. The annual standard selected by EPA will generally be the controlling standard for lowering both short- and long-term PM\(_{2.5}\) concentrations on an area-wide basis and will achieve this result. In order to be consistent with this rationale, therefore, PM\(_{2.5}\) data collected from SLAMS and special purpose monitors that are representative, not of area-wide 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 only to the 24-hour PM\(_{2.5}\) NAAQS. However, in instances where certain population-oriented micro- or middle-scale PM\(_{2.5}\) monitoring sites are determined by the EPA Regional Administrator to collectively identify a larger region of localized high ambient PM\(_{2.5}\) concentrations, data from these population-oriented sites would be eligible for comparison to the annual NAAQS.

2.8.1.2.4 Within each MPA, the responsible air pollution control agency shall install core SLAMS, other required SLAMS and as many PM\(_{2.5}\) stations judged necessary to satisfy the SLAMS requirements and monitoring objectives of this appendix.
2.8.1.3 Core Monitoring Stations for PM\(_{2.5}\).

Core monitoring stations or sites are a subset of the SLAMS network for PM\(_{2.5}\) that are sited to represent community-wide air quality. These core sites include sites to be colocated at PAMS.

2.8.1.3.1 Within each monitoring planning area, the responsible air pollution control agency shall install the following core PM\(_{2.5}\) SLAMS:
(a) At least two core PM\(_{2.5}\) SLAMS per MSA with population greater than 500,000 sampling everyday, unless exempted by the Regional Administrator, including at least one station in a population-oriented area of expected maximum concentration and at least one station in an area of poor air quality and at least one additional core monitor colocated at a PAMS site in each PAMS area;
(b) At least one core PM\(_{2.5}\) SLAMS per MSA with population greater than 200,000 and less than or equal to 500,000 sampling every third day.
(c) Additional core PM\(_{2.5}\) SLAMS per MSA with population greater than 1 million, sampling every third day, as specified in the following table:

<table>
<thead>
<tr>
<th>MSA Population</th>
<th>Sampling Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100,000</td>
<td>Daily</td>
</tr>
<tr>
<td>100,000–500,000</td>
<td>2x/week</td>
</tr>
<tr>
<td>500,000–100,000</td>
<td>3x/week</td>
</tr>
<tr>
<td>&gt;100,000</td>
<td>4x/week</td>
</tr>
</tbody>
</table>

The core monitor to be colocated at a PAMS site shall not be considered a part of the PAMS as described in section 4 of this appendix, but shall instead be considered to be a component of the particular MPA PM\(_{2.5}\) network.
2.5 concentrations in areas of high average PM
across a "category a" core site is strongly preferred
ccluded in a MPA or optional CMZ, however,
When only one core monitor for PM
fections are less than 80 percent of the NAAQS).
low concentrations (e.g., highest concentra-
tions representative of maximum population impact, or areas with
the same location as the area of maximum or
highest concentration is expected to occur at
This may be appropriate in areas where the
area, one or more required core SLAMS may
be exempted by the Regional Administrator.

2.8.1.3.3 Those MPAs that are substantially
impacted by several different and geographi-
cally disjoint local sources of fine particu-
late should have separate core sites to mon-
itor each influencing source region.
2.8.1.3.4 Within each monitoring planning area,
the minimum number of SLAMS may be
exempted by the Regional Administrator.
This may be appropriate in areas where the
highest concentration is expected to occur at
the same location as the area of maximum or
sensitive population impact, or areas with
low concentrations (e.g., highest concentrations are less than 80 percent of the NAAQS). When
only one core monitor for PM$_{2.5}$ is in-
cluded in a MPA or optional CMZ, however,
a "category a" core site is strongly preferred
to determine community-oriented PM$_{2.5}$ con-
centrations in areas of high average PM$_{2.5}$
concentration.

2.8.1.3.5 More than the minimum number of
core SLAMS should be deployed as necessary
in all MPAs. Except for the core SLAMS de-
scribed in section 2.8.1.3.1 of this appendix,
the additional core SLAMS must only com-
ply with the minimum sampling frequency
for SLAMS specified in §58.13(e).
2.8.1.3.6 A subset of the core PM$_{2.5}$, SLAMS
shall be designated NAMS as discussed in
section 3.7 of this appendix. The selection of
core monitoring sites in relation to MPAs
and CMZs is discussed further in section 2.8.3
of this appendix.

TABLE 1—REQUIRED NUMBER OF CORE SLAMS
ACCORDING TO MSA POPULATION

<table>
<thead>
<tr>
<th>MSA Population</th>
<th>Minimum Required No. of Core Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;1 M</td>
<td>3</td>
</tr>
<tr>
<td>&gt;2 M</td>
<td>4</td>
</tr>
<tr>
<td>&gt;4 M</td>
<td>6</td>
</tr>
<tr>
<td>&gt;6 M</td>
<td>8</td>
</tr>
<tr>
<td>&gt;8 M</td>
<td>10</td>
</tr>
</tbody>
</table>

1Core SLAMS at PAMS are in addition to these numbers.

2.8.1.3.7 Core monitoring sites shall rep-
resent neighborhood or larger spatial scales.
A monitor that is established in the ambient
air that is in or near a populated area, and
meets appropriate 40 CFR part 58 criteria
(i.e., meets the requirements of §58.13 and
§58.14, Appendices A, C, and E of this part)
can be presumed to be representative of at
least a neighborhood scale, is eligible to be
called a core site and shall produce data that
are eligible for comparison to both the 24-
hour and annual PM$_{2.5}$, NAAQS. If the site is
adjacent to a dominating local source or can
be shown to have average 24-hour concentra-
tions representative of a smaller spatial scale,
then the site would only be compared to the 24-hour PM$_{2.5}$, NAAQS.

2.8.1.3.8 Continuous fine particulate moni-
toring at core SLAMS. At least one contin-
uous fine particulate analyzer (e.g., beta at-
tenuation analyzer; tapered-element, oscil-
lating microbalance (TEOM); transmis-
someter; nephelometer; or other acceptable
continuous fine particulate monitor) shall be
located at a core monitoring PM$_{2.5}$ site in
each metropolitan area with a population
greater than 1 million. These analyzers shall
be used to provide improved temporal resolu-
tion to better understand the processes and
causes of elevated PM$_{2.5}$ concentrations and
to facilitate public reporting of PM$_{2.5}$ air
quality and will be in accordance with appro-
priate methodologies and QA/QC procedures
approved by the Regional Administrator.

2.8.1.4 Other PM$_{2.5}$ SLAMS Locations.
In addition to the required core sites de-
scribed in section 2.8.1.3 of this appendix,
the State shall also install and operate on an
every third day sampling schedule at least
one SLAMS to monitor for regional back-
ground. These monitoring sta-
tions may be at a community-oriented site
and their requirement may be satisfied by a
corresponding SLAMS monitor in an area
having similar air quality in another State.
The State shall also be required to establish
additional SLAMS sites based on the total
population outside the MSA(s) associated
with monitoring planning areas that contain
required core SLAMS. There shall be one
such additional SLAMS for each 200,000 peo-
p. The minimum number of SLAMS may be
deployed anywhere in the State to satisfy
the SLAMS monitoring objectives including
monitoring of small scale impacts which
may not be community-oriented or for re-
gional transport as described in section 1 of
this appendix. Other SLAMS may also be es-
tablished and are encouraged in a State
PM$_{2.5}$ network.

2.8.1.5 Additional PM$_{2.5}$ Analysis Require-
ments.
(a) Within 1 year after September 16, 1997,
chemical speciation will be required at ap-
proximately 25 PM$_{2.5}$ core sites collocated
at PAMS sites (1 type 2 site per PAMS area)

The measured maximum concentrations
at core population-oriented sites should be
consistent with the averaging time of the
NAAQS. Therefore, sites only with high con-
centrations for shorter averaging times (say
1-hour) should not be category "a" core
SLAMS monitors.
and at approximately 25 other core sites for a total of approximately 50 sites. The selection of these sites will be performed by the Administrator in consultation with the Regional Administrator and the States. Chemical speciation is encouraged at additional sites. At a minimum, chemical speciation to be conducted will include analysis for elements, selected anions and cations, and carbon. Samples for required speciation will be collected using appropriate monitoring methods and sampling schedule in accordance with procedures approved by the Administrator.

(b) Air pollution control agencies shall archive PM$_{2.5}$ samples from all other SLAMS sites for a minimum of one year after collection. These filters shall be made available for supplemental analyses at the request of EPA or to provide information to States and local agencies on the composition for PM$_{2.5}$. The filters shall be archived in accordance with procedures approved by the Administrator.

2.8.1.6 Community Monitoring Zones.

2.8.1.6.1 The CMZs describe areas within which two or more core monitors may be averaged for comparison with the annual PM$_{2.5}$ NAAQS. This averaging approach as specified in 40 CFR part 50, appendix N, is directly related to epidemiological studies used as the basis for the PM$_{2.5}$ NAAQS. A CMZ should characterize an area of relatively similar annual average air quality (i.e., the average concentrations at individual sites shall not exceed the spatial average by more than 20 percent) and exhibit similar day to day variability (e.g., the monitoring sites should not have low correlations, say less than 0.6). Moreover, the entire CMZ should principally be affected by the same major emission sources of PM$_{2.5}$.

2.8.1.6.2 Each monitoring planning area may have at least one CMZ, that may or may not cover the entire MPA. In metropolitan statistical areas (MSAs) for which MPAs are required, the CMZs may completely cover the entire MSA. When more than one CMZ is described within an MPA, CMZs shall not overlap in their geographical coverage. All areas in the ambient air may become a CMZ.

2.8.1.6.3 As PM$_{2.5}$ networks are first established, core sites would be used individually for making comparisons to the annual PM$_{2.5}$ NAAQS. As these networks evolve, individual monitors may not be adequate by themselves to characterize the annual average community-wide air quality. This is especially true for areas with sharp gradients in annual average air quality. Therefore, CMZs with multiple core SLAMS or other eligible sites as described in accordance with section 2.8.1.2 to this appendix, may be established for the purposes of providing improved estimates of community-wide air quality and for making comparisons to the annual NAAQS. This CMZ approach is subject to the constraints of section 2.8.1.6.1 to this appendix.

2.8.1.6.4 The spatial representativeness of individual monitoring sites or monitoring networks should be considered in the design of the network and in establishing the boundaries of CMZs. Communities within the MPA with the highest PM$_{2.5}$ concentrations must have a high priority for PM$_{2.5}$ monitoring. Until a sufficient number of monitoring stations or CMZs are established, however, the monitored air quality in all parts of the MPA may not be precisely known. It would be desirable, however, to design the placement of monitors so that those portions of the MPAs without monitors could be characterized as having average concentrations less than the monitored portions of the network.

2.8.1.7 Selection of Monitoring Locations Within MPAs or CMZs.

2.8.1.7.1 Figure 1 of this appendix illustrates a hypothetical monitoring planning area and shows the location of monitors in relation to population and areas of poor air quality. Figure 2 of this appendix shows the same hypothetical MPA as Figure 1 of this appendix and illustrates potential community monitoring zones and the location of core monitoring sites within them.

2.8.1.7.2 In Figure 1 of this appendix, a hypothetical monitoring planning area is shown representing a typical Eastern US urban areas. The ellipses represent zones with relatively high population and poor air quality, respectively. Concentration isopleths are also depicted. The highest population density is indicated by the urban icons, while the area of worst air quality is presumed to be near the industrial symbols. The monitoring area should have at least one core monitor to represent community-wide air quality in each sub-area affected by different emission sources. Each monitoring planning area with population greater than 500,000 is required to have at least two core population-oriented monitors that will sample everyday (with PAMS areas requiring three) and may have as many other core SLAMS, other SLAMS, and SPMs as necessary. All SLAMS should generally be population-oriented, while the SPMs can focus more on other monitoring objectives, e.g., identifying source impacts and the area boundaries with maximum concentration. CMZ denotes “category a” core SLAMS site (community-oriented site in area of expected maximum concentration); it is shown within the populated area and closest to the area with highest concentration. C denotes a "category b" core SLAMS site (area of poor air quality with high population density or representative of maximum population impact); it is shown in the area of poor air quality, closest to highest population density. All other core SLAMS in this MPA are denoted by “C.” S denotes other SLAMS.
sites (monitoring for any objective: Max concentration, population exposure, source-oriented, background, or regional transport or in support of secondary NAAQS). P denotes a Special Purpose Monitor (a specialized monitor that, for example, may use a non-reference sampler). Finally, note that all SPMs would be subject to the 2-year moratorium against data comparison to the NAAQS for the first 2 complete calendar years of its operation.

2.8.1.7.3 A Monitoring Planning Area may have one or more community monitoring zones (CMZ) for aggregation of data from eligible SLAMS and SPM sites for comparison to the annual NAAQS. The planning area has large gradients of average air quality and, as shown in Figure 2 may be assigned three CMZs: An industrial zone, a downtown central business district (CBD), and a residential area. (If there is not a large difference between downtown concentrations and other residential areas, a separate CBD zone would not be appropriate).
Figure 1. Hypothetical Monitoring Planning Area

Eastern Urban Model - showing location of monitors in relation to population and area of poor air quality.

Area of Poor Air Quality

Area of High Population

C = Core site
S = Other SLAMS site
p = Special Purpose Monitor
Figure 2. Hypothetical Monitoring Planning Area

Potential Community Monitoring Zones

C=Core site
S=other SLAMS site
p=Special Purpose Monitor

2.8.1.7.4 Figure 3 of this appendix illustrates how CMZs and PM$_{2.5}$ monitors might be located in a hypothetical MPA typical of a Western State. Western States with more localized sources of PM and larger geographic area could require a different mix of SLAMS and SPM monitors and may need
more total monitors. As the networks are deployed, the available monitors may not be sufficient to completely represent all geographic portions of the Monitoring Planning Area. Due to the distribution of pollution and population and because of the number and spatial representativeness of monitors, the MPAs and CMZs may not cover the entire State.

2.8.1.7.5 Figure 4 of this appendix shows how the MPAs, CMZs, and PM$_{2.5}$ monitors might be distributed within a hypothetical State. Areas of the State included within MPAs are shown within heavy solid lines. Two MPAs are illustrated. Areas in the State outside the MPAs will also include monitors, but this monitoring coverage may be limited. This portion of the State may also be represented by CMZs (shown by areas enclosed within dotted lines). The monitors that are intended for comparison to the NAAQS are indicated by X. Furthermore, eligible monitors within a CMZ could be averaged for comparison to the annual NAAQS or examined individually for comparison to both NAAQS. Both within the MPAs and in the remainder of the State, some special study monitors might not satisfy applicable 40 CFR part 58 requirements and will not be eligible for comparison to the NAAQS.
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2.8.2 Substitute PM Monitoring Sites
2.8.2.1 Section 2.2 of appendix C of this part describes conditions under which TSP samplers can be used as substitutes for \( \text{PM}_{10} \). This provision is intended to be used when \( \text{PM}_{10} \) concentrations are expected to be very low and substitute TSP samplers can be used to satisfy the minimum number of \( \text{PM}_{10} \) samplers needed for an adequate \( \text{PM}_{10} \) network.

2.8.2.2 If data produced by substitute PM samplers exceed the concentration levels described in appendix C of this part, then the need for this sampler to be converted to a \( \text{PM}_{10} \) or \( \text{PM}_{2.5} \) sampler shall be considered in the PM monitoring network review. If the State does not believe that a \( \text{PM}_{10} \) or \( \text{PM}_{2.5} \) sampler should be sited, the State shall submit documentation to EPA as part of its annual PM report to justify this decision. If a PM site is not designated as a substitute site in the PM monitoring network description, then high concentrations at this site would not necessarily cause this site to become a \( \text{PM}_{2.5} \) or \( \text{PM}_{10} \) site, whichever is indicated.

2.8.2.3 Consistent with §58.1, combinations of SLAMS \( \text{PM}_{10} \) or \( \text{PM}_{2.5} \) monitors and other monitors may occupy the same structure without any mutual effect on the regulatory definition of the monitors.

3. Network Design for National Air Monitoring Stations (NAMS)

The NAMS must be stations selected from the SLAMS network with emphasis given to urban and multisource areas. Areas to be monitored must be selected based on urbanized population and pollutant concentration levels. Generally, a larger number of NAMS are needed in more polluted urban and multisource areas. The network design criteria discussed below reflect these concepts. However, it should be emphasized that deviations from the NAMS network design criteria may be necessary in a few cases. Thus, these design criteria are not a set of rigid rules but rather a guide for achieving a proper distribution of monitoring sites on a national scale.

The primary objective for NAMS is to monitor in the areas where the pollutant concentration and the population exposure are expected to be the highest consistent with the averaging time of the NAAQS. Accordingly, the NAMS fall into two categories:

Category (a): Stations located in area(s) of expected maximum concentrations, generally microscale for CO, microscale or middle scale for Pb, middle scale or neighborhood scale for population-oriented particulate matter, urban or regional scale for Regional transport \( \text{PM}_{1.0} \), neighborhood scale for \( \text{SO}_2 \), \( \text{NO}_2 \), and \( \text{O}_3 \), and urban scale for \( \text{PM}_{10} \).
For each urban area where NAMS are required, both categories of monitoring stations must be established. In the case of Pb and SO$_2$ if only one NAMS is needed, then category (a) must be used. The analysis and interpretation of data from NAMS should consider the distinction between these types of stations as appropriate.

For each MSA where NAMS are required, both categories of monitoring stations must be established. In the case of SO$_2$ if only one NAMS is needed, then category (a) must be used. The analysis and interpretation of data from NAMS should consider the distinction between these types of stations as appropriate.

The concept of NAMS is designed to provide data for national policy analyses/trends and for reporting to the public on major metropolitan areas. It is not the intent to monitor in every area where the NAAQS are violated. On the other hand, the data from SLAMS should be used primarily for attainment decisions/analyses in specific geographical areas. Since the NAMS are stations from the SLAMS network, station locating procedures for NAMS are part of the SLAMS network design process.

3.1 Sulfur Dioxide (SO$_2$) Design Criteria for NAMS

It is desirable to have a greater number of NAMS in the more polluted and densely populated urban and multisource areas. The data in Table 3 show the approximate number of permanent stations needed in urban areas to characterize the national and regional SO$_2$ air quality trends and geographical patterns. These criteria require that the number of NAMS in areas where urban populations exceed 1,000,000 and concentrations also exceed the primary NAAQS may range from 6 to 10 and that in areas where the SO$_2$ problem is minor, only one or two (or no) monitors are required. For those cases where more than one station is required for an urban area, there should be at least one station for category (a) and category (b) objectives as discussed in section 3.

Where three or more stations are required, the mix of category (a) and (b) stations is determined on a case-by-case basis. The actual number and location of the NAMS must be determined by EPA Regional Offices and the State Agency, subject to the approval of EPA Headquarters, Office of Air Quality Planning and Standards (OAQPS).

### Table 3 — SO$_2$ National Air Monitoring Station Criteria

<table>
<thead>
<tr>
<th>Population category</th>
<th>High concentration$^1$</th>
<th>Medium concentration$^1$</th>
<th>Low concentration$^1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;1,000,000</td>
<td>6–10</td>
<td>4–8</td>
<td>2–4</td>
</tr>
<tr>
<td>500,000 to 1,000,000</td>
<td>4–8</td>
<td>2–4</td>
<td>1–2</td>
</tr>
<tr>
<td>250,000 to 500,000</td>
<td>3–4</td>
<td>1–2</td>
<td>0–1</td>
</tr>
<tr>
<td>100,000 to 250,000</td>
<td>1–2</td>
<td>0–1</td>
<td>0–0</td>
</tr>
</tbody>
</table>

$^1$Selection of urban areas and actual number of stations per area will be jointly determined by EPA and the State agency.

$^2$High concentration—exceeding level of the primary NAAQS.

$^3$Medium concentration—exceeding 60 percent of the level of the primary or 100% of the secondary NAAQS.

$^4$Low concentration—less than 60 percent of the level of the primary or 100% of the secondary NAAQS.

The estimated number of SO$_2$ NAMS which would be required nationwide ranges from approximately 200 to 300. This number of NAMS SO$_2$ monitors is sufficient for national trend purposes due to the low background SO$_2$ levels, and the fact that air quality is very sensitive to SO$_2$ emission changes. The actual number of stations in any specific area depends on local factors such as meteorology, topography, urban and regional air quality gradients, and the potential for significant air quality improvements or degradation. The greatest density of stations should be where urban populations are large and where pollution levels are high. Fewer NAMS are necessary in the western States since concentrations are seldom above the NAAQS in their urban areas. Exceptions to this are in the areas where an expected shortage of clean fuels indicates that ambient air quality may be degraded by increased SO$_2$ emissions. In such cases, a minimum number of NAMS is required to provide EPA with a proper national perspective on significant changes in air quality.

Like TSP, the worst air quality in an urban area is to be used as the basis for determining the required number of SO$_2$ NAMS. The actual number of SO$_2$ air quality levels within populated parts of urbanized areas, that are affected by one or two point sources of SO$_2$ if the impact of the source(s) extends over a reasonably broad geographic scale (neighborhood or larger). Maximum SO$_2$ air quality levels in remote unpolluted areas should be excluded as a basis for selecting NAMS regardless of the sources affecting the concentration levels. Such remote areas are more appropriately monitored by SLAMS or SPM networks or characterized by diffusion model calculations as necessary.

3.3 Carbon Monoxide (CO) Design Criteria for NAMS

Information is needed on ambient CO levels in major urbanized areas where CO levels have been shown or inferred to be a significant concern. At the national level, EPA will not routinely require data from as many stations as are required for PM-10, and
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perhaps SO₂, since CO trend stations are principally needed to assess the overall air quality progress resulting from the emission controls required by the Federal motor vehicle control program (FMVCP) and other local controls.

Although State and local air programs may require extensive monitoring to document and measure the local impacts of CO emissions and emission controls, an adequate national perspective is possible with as few as two stations per major urban area. The two categories for which CO NAMS would be required are: (a) Peak concentration areas such as are found around major traffic arteries and near heavily traveled streets in downtown areas (micro scale); and (b) neighborhoods where concentration exposures are significant (middle scale, neighborhood scale).

The peak concentration station (micro scale) is usually found near heavily traveled downtown streets (street canyons), but could be found along major arterials (corridors), either near intersections or at low elevations which are influenced by downslope drainage patterns under low inversion conditions. The peak concentration station should be located so that it is representative of several similar source configurations in the urban area, where the general population has access. Thus, it should reflect one of many potential peak situations which occur throughout the urban area. It is recognized that this does not measure air quality which represents large geographical areas. Thus, a second type of station on the neighborhood scale is necessary to provide data representative of the high concentration levels which exist over large geographical areas. Thus, a second type of station on the neighborhood scale is necessary to provide data representative of the high concentration levels which exist over large geographical areas.

The category (b) (middle scale or neighborhood scale) should be located in areas with a stable, high population density, projected continuity of neighborhood character, and high traffic density. The stations should be located where no major zoning changes, new highways, or new shopping centers are being considered. The station should be where a significant CO pollution problem exists, but not be unduly influenced by any one line source. Rather, it should be more representative of the overall effect of the sources in a significant portion of the urban area.

Because CO is generally associated with heavy traffic and population clusters, an urbanized area with a population greater than 500,000 is the principal criterion for identifying the urban areas for which pairs of NAMS for this pollutant will be required. The criterion is based on judgment that stations in urban areas with greater than 500,000 population would provide sufficient data for national analysis and national reporting to Congress and the public. Also, it has generally been shown that major CO problems are found in areas greater than 500,000 population.

3.4 Ozone (O₃) Design Criteria for NAMS. The criterion for selecting locations for ozone NAMS is any urbanized area having a population of more than 200,000. This population cut off is used since the sources of hydrocarbons are both mobile and stationary and are more diverse. Also, because of local and national control strategies and the complex chemical process of ozone formation and transport, more sampling stations than for CO are needed on a national scale to better understand the ozone problem. This selection criterion is based entirely on population and will include those relatively highly populated areas where most of the oxidant precursors originate.

Each urban area will generally require only two ozone NAMS. One station would be representative of maximum ozone concentrations (category (a), urban scale) under the wind transport conditions as discussed in section 2.5. The exact location should balance local factors affecting transport and buildup of peak O₃ levels with the need to represent population exposure. The second station (category (b), neighborhood scale), should be representative of high density population areas on the fringes of the central business district along the predominant summer/fall daytime wind direction. This latter station should measure peak O₃ levels under light and variable or stagnant wind conditions. Two ozone NAMS stations will be sufficient in most urban areas since spatial gradients for ozone generally are not as sharp as for other criteria pollutants.

3.5 Nitrogen Dioxide (NO₂) Criteria for NAMS. Nitrogen dioxide NAMS will be required in those areas of the country which have a population greater than 1,000,000. These areas will have two NO₂ NAMS. It is felt that stations in these major metropolitan areas would provide sufficient data for a national analysis of the data, and also because NO₂ problems occur in areas of greater than 1,000,000 population.

Within urban areas requiring NAMS, two permanent monitors are sufficient. The first station (category (a), middle scale or neighborhood scale) would be to measure the photochemical production of NO₂ and would best be located in part of the urban area where the emission density of NOₓ is the highest. The second station (category (b) urban scale), would be to measure the NO₂ produced from the reaction of NO with O₃ and should be downwind of the area of peak NOₓ emission areas.

3.6 Lead (Pb) Design Criteria for NAMS. In order to achieve the national monitoring objective, one NAMS site must be located in one of the two cities with the greatest population in the following ten regions of the country (the choice of which of the two metropolitan areas should have the lead NAMS requirement is made by the Administrator or
the Administrator's designee to characterize national and regional number of permanent stations required in these situations, the total minimum number requirement based upon its population. For same MSA/CMSA subject to the lead NAMS due to a violating point source will be the subject to the latter lead NAMS requirement Pb NAAQS. In some cases, the MSA/CMSA related areas as a marker for national trends, tions for large MSA/CMSAs and other popu-site will be used to assess general condi-tions. Data from these section of the MSA/CMSA or county where is located in a highly populated residential neighborhood scale category (b) station that to a major roadway (e.g., >30,000 ADT), or a A NAMS site may be a microscale or middle roadside ambient lead monitors should be contributing to lead NAAQS violations, emissions may continue to be verified as not directly affected from a single Pb point source. Further, in order that on-road mobile source efforts can vary from one part of the country to another and therefore, some flexibility is allowed in selecting the actual number of stations in any one locale. In addition, one NAMS site must be located in each of the MSA/CMSAs where one or more violations of the quarterly Pb NAAQS have been recorded over the previous eight quarters. If a violation of the quarterly Pb NAAQS is measured at a monitoring site outside of a MSA/CMSA, one NAMS site must be located within the county in a populated area, apart from the Pb source, to assess area wide Pb air pollution levels. These NAMS sites should represent the maximum Pb concentrations measured within the MSA/CMSA, city, or county that is not di-recally affected from a single Pb point source. Further, in order that on-road mobile source emissions may continue to be verified as not contributing to lead NAAQS violations, roadside ambient lead monitors should be considered as viable NAMS site candidates. A NAMS site may be a microscale or middle scale category (a) station, located adjacent to a major roadway (e.g., >30,000 ADT), or a neighborhood scale category (b) station that is located in a highly populated residential section of the MSA/CMSA or county where the traffic density is high. Data from these sites will be used to assess general conditions for large MSA/CMSAs and other populated areas as a marker for national trends, and to confirm continued attainment of the Pb NAAQS. In some cases, the MSA/CMSA subject to the latter lead NAMS requirement due to a violating point source will be the same MSA/CMSA subject to the lead NAMS requirement based upon its population. For these situations, the total minimum number of required lead NAMS is one. 3.7 Particulate Matter Design Criteria for NAMS. 3.7.1 Table 4 indicates the approximate number of permanent stations required in MSAs to characterize national and regional PM$_{10}$ air quality trends and geographical patterns. The number of PM$_{10}$ stations in areas where MSA populations exceed 1,000,000 must be in the range from 2 to 10 stations, while in low population urban areas, no more than two stations are required. A range of monitoring stations is specified in table 4 because sources of pollutants and local control efforts can vary from one part of the country to another and therefore, some flexibility is allowed in selecting the actual number of stations in any one locale.
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and will consider factors such as total number or type of sources, ambient concentrations of particulate matter, and regional transport.

3.7.5 The approach for PM$_{2.5}$ NAMS is intended to give State and local agencies maximum flexibility while apportioning a limited national network. By advancing a range of monitors per Region, EPA intends to balance the network with respect to geographic area and population. Table 5 presents the target number of PM$_{2.5}$ NAMS per Region to meet the national goal of 200 to 300 stations. These numbers consider a variety of factors such as Regional differences in metropolitan population, population density, land area, sources of particulate emissions, and the numbers of PM$_{10}$ NAMS.

3.7.6 States will be required to establish approximately 50 NAMS sites for routine chemical speciation of PM$_{2.5}$. These sites will include those colocated at approximately 25 PAMS sites and approximately 25 other core SLAMS sites to be selected by the Administrator. After 5 years of data collection, the Administrator may exempt some sites from collecting speciated data. The number of NAMS sites at which speciation will be performed each year and the number of samples per year will be determined by the Administrator.

3.7.7 Since emissions associated with the operation of motor vehicles contribute to urban area particulate matter levels, consideration of the impact of these sources must be included in the design of the NAMS network, particularly in MSAs greater than 500,000 population. In certain urban areas particulate emissions from motor vehicles are a significant source of particulate matter ambient levels. The actual number of NAMS and their locations must be determined by EPA Regional Offices and the State agencies, subject to the approval of the Administrator as required by §58.32. The Administrator’s approval is necessary to ensure that individual stations conform to the NAMS selection criteria and that the network as a whole is sufficient in terms of number and location for purposes of national analyses.

**Table 4**—PM$_{10}$ NATIONAL AIR MONITORING STATION CRITERIA (Approximate Number of Stations per MSA)$^1$

<table>
<thead>
<tr>
<th>Population Category</th>
<th>High Concentration$^2$</th>
<th>Medium Concentration$^3$</th>
<th>Low Concentration$^4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;1,000,000</td>
<td>6-10</td>
<td>4-8</td>
<td>2-4</td>
</tr>
<tr>
<td>500,000-1,000,000</td>
<td>4-8</td>
<td>2-4</td>
<td>1-2</td>
</tr>
<tr>
<td>250,000-500,000</td>
<td>3-4</td>
<td>1-2</td>
<td>0-1</td>
</tr>
<tr>
<td>100,000-250,000</td>
<td>1-2</td>
<td>0-1</td>
<td>0</td>
</tr>
</tbody>
</table>

1 Selection of urban areas and actual number of stations per area will be jointly determined by EPA and the State agency.

2 High concentration areas are those for which ambient PM$_{10}$ data show ambient concentrations exceeding either PM$_{10}$ NAAQS by 20 percent or more.

3 Medium concentration areas are those for which ambient PM$_{10}$ data show ambient concentrations exceeding 80 percent of the PM$_{10}$ NAAQS.

4 Low concentration areas are those for which ambient PM$_{10}$ data show ambient concentrations less than 80 percent of the PM$_{10}$ NAAQS.

3.7.7.1 Selection of urban areas and actual number of stations per area will be jointly determined by EPA and the State agency.

3.7.7.2 High concentration areas are those for which Ambient PM$_{10}$ data show ambient concentrations exceeding either PM$_{10}$ NAAQS by 20 percent or more.

3.7.7.3 Medium concentration areas are those for which: Ambient PM$_{10}$ data show ambient concentrations exceeding 80 percent of the PM$_{10}$ NAAQS.

3.7.7.4 Low concentration areas are those for which: Ambient PM$_{10}$ data show ambient concentrations less than 80 percent of the PM$_{10}$ NAAQS.

**Table 5—Goals for Number of PM$_{2.5}$ NAMS by Region**

<table>
<thead>
<tr>
<th>EPA Region</th>
<th>Number of NAMS$^1$</th>
<th>Percent of National Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15 to 20</td>
<td>6 to 8</td>
</tr>
<tr>
<td>2</td>
<td>20 to 30</td>
<td>8 to 12</td>
</tr>
<tr>
<td>3</td>
<td>20 to 25</td>
<td>8 to 10</td>
</tr>
<tr>
<td>4</td>
<td>35 to 50</td>
<td>14 to 20</td>
</tr>
<tr>
<td>5</td>
<td>35 to 50</td>
<td>14 to 20</td>
</tr>
<tr>
<td>6</td>
<td>25 to 35</td>
<td>10 to 14</td>
</tr>
<tr>
<td>7</td>
<td>10 to 15</td>
<td>4 to 6</td>
</tr>
<tr>
<td>8</td>
<td>10 to 15</td>
<td>4 to 6</td>
</tr>
<tr>
<td>9</td>
<td>25 to 40</td>
<td>10 to 16</td>
</tr>
<tr>
<td>10</td>
<td>10 to 15</td>
<td>4 to 6</td>
</tr>
</tbody>
</table>

1 Each region will have one to three NAMS having the monitoring of regional transport as a primary objective.

4. Network Design for Photochemical Assessment Monitoring Stations (PAMS)

In order to obtain more comprehensive and representative data on O$_3$ air pollution, the 1990 Clean Air Act Amendments require enhanced monitoring for ozone (O$_3$), oxides of nitrogen (NO, NO$_2$, and NO$_x$), and monitoring for VOC in O$_3$ nonattainment areas classified as serious, severe, or extreme. This will be accomplished through the establishment of a network of Photochemical Assessment Monitoring Stations (PAMS).

4.1 PAMS Data Uses. Data from the PAMS are intended to satisfy several coincident needs related to attainment of the National Ambient Air Quality Standards (NAAQS), SIP control strategy development and evaluation, corroboration of emissions tracking, preparation of trends appraisals, and exposure assessment.

a) NAAQS attainment and control strategy development. Like SLAMS and NAMS data, PAMS data will be used for monitoring O$_3$ exceedances and providing input for attainment/nonattainment decisions. In addition,
PAMS data will help resolve the roles of transported and locally emitted \( \text{O}_3 \) precursors in producing an observed exceedance and may be utilized to identify specific source emission contributions of \( \text{O}_3 \) precursors and potentially contributing to observed exceedances of the \( \text{O}_3 \) NAAQS. The PAMS data will enhance the characterization of \( \text{O}_3 \) concentration and provide critical information on the precursors which cause \( \text{O}_3 \), therefore extending the database available for future attainment demonstrations. These demonstrations will be based on photochemical grid modeling and other approved analytical methods and will provide a basis for prospective mid-course control strategy corrections. PAMS data will provide information concerning (1) which areas and episodes to model to develop appropriate control strategies; (2) boundary conditions required by the models to produce quantifiable estimates of needed emissions reductions; and (3) the evaluation of the predictive capability of the models used.

(b) SIP control strategy evaluation. The PAMS will provide data for SIP control strategy evaluation. Long-term PAMS data will be used to evaluate the effectiveness of these control strategies. Data may be used to evaluate the impact of VOC and \( \text{NO}_x \) emission reductions on air quality levels for \( \text{O}_3 \) if data is reviewed following the time period during which control measures were implemented. Speciation of measured VOC data will allow determination of which organic species are most affected by the emissions reductions and assist in developing cost-effective, selective VOC reductions and control strategies. A State or local air pollution control agency can therefore ensure that strategies which are implemented in their particular nonattainment area are those which are best suited for that area and achieve the most effective emissions reductions (and therefore largest impact) at the least cost.

(c) Emissions tracking. PAMS data will be used to corroborate the quality of VOC and \( \text{NO}_x \) emission inventories. Although a perfect mathematical relationship between emission inventories and ambient measurements does not yet exist, a qualitative assessment of the relative contributions of various compounds to the ambient air can be roughly compared to current emission inventory estimates to evaluate the accuracy of the emission inventories. In addition, PAMS data which are gathered year round will allow tracking of VOC and \( \text{NO}_x \) emission reductions, provide additional information necessary to support Reasonable Further Progress (RFP) calculations, and corroborate emissions trends analyses. While the regulatory assessments of progress will be made in terms of emission inventory estimates, the ambient data can provide independent trends analyses and corroboration of these assessments which either verify or highlight possible errors in emissions trends indicated by inventories. The ambient assessments, using speciated data, can gauge the accuracy of estimated changes in emissions. The speciated data can also be used to assess the quality of the VOC speciated and \( \text{NO}_x \) emission inventories for input during photochemical grid modeling exercises and identify potential urban air toxic pollutant problems which deserve closer scrutiny.

The speciated VOC data will be used to determine changes in the species profile, resulting from the emission control program, particularly those resulting from the reformulation of fuels.

(d) Trends. Long-term PAMS data will be used to establish speciated VOC, \( \text{NO}_x \), and limited toxic air pollutant trends, and supplement the \( \text{O}_3 \) trends database. Multiple statistical indicators will be tracked, including \( \text{O}_3 \) and its precursors during the events encompassing the days during each year with the highest \( \text{O}_3 \) concentrations, the seasonal means for these pollutants, and the annual means at representative locations.

The more PAMS that are established in and near nonattainment areas, the more effective the trends data will become. As the spatial distribution and number of \( \text{O}_3 \) and \( \text{NO}_x \) precursor monitors improves, trends analyses will be less influenced by instrument or site location anomalies. The requirement that surface meteorological monitoring be established at each PAMS will help maximize the utility of these trends analyses by comparisons with meteorological trends, and transport influences. The meteorological data can also help interpret the ambient air pollution trends by taking meteorological factors into account.

(e) Exposure assessment. PAMS data will be used to better characterize \( \text{O}_3 \) and toxic air pollutant exposure to populations living in serious, severe, or extreme areas. Annual mean toxic air pollutant concentrations will be calculated to help estimate the average risk to the population associated with individual VOC species, which are considered toxic, in urban environments.

42 PAMS Monitoring Objectives. Unlike the SLAMS and NAMS design criteria which are pollutant specific, PAMS design criteria are site specific. Concurrent measurements of \( \text{O}_3 \), \( \text{NO}_x \), speciated VOC, and meteorology are obtained at PAMS. Design criteria for the PAMS network are based on selection of an array of site locations relative to \( \text{O}_3 \), precursor source areas and predominant wind directions associated with high \( \text{O}_3 \) events. Specific monitoring objectives are associated with each location. The overall design should enable characterization of precursor emission sources within the area, transport of \( \text{O}_3 \) and its precursors into and out of the area, and the photochemical processes related to \( \text{O}_3 \) nonattainment, as well as developing an
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initial, though limited, urban air toxic pollutant database. Specific objectives that must be addressed include assessing ambient trends in O\textsubscript{3}, NO, NO\textsubscript{2}, NO\textsubscript{x}, VOC (including canister), and NO\textsubscript{x} species, determining spatial and diurnal variability of O\textsubscript{3}, NO, NO\textsubscript{2}, NO\textsubscript{x}, and VOC species and assessing changes in the VOC species profiles that occur over time. Monitoring of those occurring due to the reformulation of fuels. A maximum of five PAMS sites are required in an affected nonattainment area depending on the population of the Metropolitan Statistical Area (MSA/CMSA) or nonattainment area, whichever is larger. Specific monitoring objectives associated with each of these sites result in four distinct site types. Note that detailed guidance for the locating of these sites may be found in reference 19.

Type (1) sites are established to characterize upwind background and transported O\textsubscript{3} and its precursor concentrations entering the area and will identify those areas which are subjected to overwhelming transport. Type (1) sites are located in the predominant morning upwind direction from the local area of maximum precursor emissions during the O\textsubscript{3} season and at a distance sufficient to obtain urban scale measurements as defined in section 1 of this appendix. Typically, type (1) sites will be located near the edge of the photochemical grid model domain in the predominant morning upwind direction from the area limits or fringe of the urbanized area. Depending on the boundaries and size of the nonattainment area and the orientation of the grid, this site may be located outside of the nonattainment area. The appropriate predominant morning wind direction should be determined from historical wind data occurring during the period 7 a.m. to 10 a.m. on high O\textsubscript{3} days or on those days which exhibit the potential for producing high O\textsubscript{3} levels, i.e., O\textsubscript{3}-conducive days as described in reference 25. Alternate schemes for specifying this morning wind direction may be submitted as a part of the network description required by §§58.40 and 58.41. Data measured at type (1) sites will be used principally for the following purposes:

- Future development and evaluation of control strategies,
- Identification of incoming pollutants,
- Corroboration of NO\textsubscript{x} and VOC emission inventories,
- Establishment of boundary conditions for future photochemical grid modeling and mid-course control strategy changes, and
- Development of incoming pollutant trends.

Type (2) sites are established to monitor the magnitude and type of precursor emissions in the area where maximum precursor emissions are expected to impact and are suited for the monitoring of urban air toxic pollutants. Type (2) sites are located immediately downwind of the area of maximum precursor emissions and are typically placed near the downwind boundary of the central business district to obtain neighborhood scale measurements. The appropriate downwind direction should be obtained similarly to that for type (1) sites. Additionally, a second type (2) site may be required depending on the size of the area, and should be placed in the second-most predominant morning wind direction as noted previously. Data measured at type (2) sites will be used principally for the following purposes:

- Development and evaluation of imminent and future control strategies,
- Corroboration of NO\textsubscript{x} and VOC emission inventories,
- Augmentation of RFP tracking,
- Verification of photochemical grid model performance,
- Characterization of O\textsubscript{3} and toxic air pollutant exposures (appropriate site for measuring toxic emissions impact),
- Development of pollutant trends, particularly toxic air pollutants and annual ambient speciated VOC trends to compare with trends in annual VOC emission estimates, and
- Determination of attainment with the NAAQS for NO\textsubscript{2} and O\textsubscript{3}.

Type (3) sites are intended to monitor maximum O\textsubscript{3} concentrations occurring downwind from the area of maximum precursor emissions. Locations for type (3) sites should be chosen so that urban scale measurements are obtained. Typically, type (3) sites will be located 10 to 30 miles downwind from the fringe of the urban area. The downwind direction should also be determined from historical wind data, but should be identified as those afternoon winds occurring during the period 1 p.m. to 4 p.m. on high O\textsubscript{3} days or on those days which exhibit the potential for producing high O\textsubscript{3} levels. Alternate schemes for specifying this afternoon wind direction may also be submitted as a part of the network description required by §§58.40 and 58.41. Data measured at type (3) sites will be used principally for the following purposes:

- Determination of attainment with the NAAQS for O\textsubscript{3} (this site may coincide with an existing maximum concentration O\textsubscript{3} monitoring site),
- Evaluation of future photochemical grid modeling applications,
- Future development and evaluation of control strategies,
- Development of pollutant trends, and
- Characterization of O\textsubscript{3} pollutant exposures.

Type (4) sites are established to characterize the extreme downwind transported O\textsubscript{3} and its precursor concentrations exiting the area and will identify those areas which are potentially contributing to overwhelming transport in other areas. Type (4) sites are
located in the predominant afternoon downwind direction, as determined for the type (3) site, from the local area of maximum precursor emissions during the O₃ season and at a distance sufficient to obtain urban scale measurements as defined elsewhere in this appendix. Typically, type (4) sites will be located near the downwind edge of the photochemical grid model domain. Alternate schemes for specifying the location of this site may be submitted as a part of the network description required by §§58.40 and 58.41. Data measured at type (4) sites will be used principally for the following purposes:

- Development and evaluation of O₃ control strategies,
- Identification of emissions and photochemical products leaving the area,
- Establishment of boundary conditions for photochemical grid modeling,
- Development of pollutant trends,
- Background and upwind information for other downwind areas, and
- Evaluation of photochemical grid model performance.

States choosing to submit an individual network description for each affected nonattainment area, irrespective of its proximity to other affected areas, must fulfill the requirements for isolated areas as described in section 4 of this appendix, as an example, and illustrated by Figure 5. States containing areas which experience significant impact from long-range transport or are proximate to other nonattainment areas (even in other States) should collectively submit a network description which contains alternative sites to those that would be required for an isolated area. Such a submittal should, as a guide, be based on the example provided in Figure 6, but must include a demonstration that the design satisfies the monitoring data uses and fulfills the PAMS monitoring objectives described in sections 4.1 and 4.2 of this appendix.
FIGURE 5 - Isolated Area Network Design

LEGEND:
- A circle denotes a PAMS Site. The number inside describes the Site number.
- U1 - High ozone day predominant morning wind direction
- U2 - Second most predominant high ozone day morning wind direction
- U3 - High ozone day predominant afternoon wind direction
Alternative PAMS network designs should, on a site-by-site basis, provide those data necessary to enhance the attainment/non-attainment database for criteria pollutants and explain the origins of overwhelming O
\(_3\) transport. The alternative PAMS data should be usable for the corroboration and verification of O
\(_3\) precursor emissions inventories and should comprise a qualitative (if not quantitative) measure of the accuracy of RFP calculations. The data should be sufficient to evaluate the effectiveness of the implemented O
\(_3\) control strategies and should provide data necessary to establish photochemical grid modeling boundary conditions and necessary inputs including appropriate meteorological parameters, and provide measurements which can serve as model evaluation tools. Further, utilizing its PAMS database (alternative or not), a State should be able to draw conclusions regarding population exposure and conduct trends analyses for both criteria and non-criteria pollutants. Overall, the PAMS network should serve as one of several complementary means, together with modeling and analysis of other data bases (e.g., inventories) and availability of control technology, etc., for States to justify the modification of existing control programs, design
new programs, and evaluate future courses of actions for O3 control.

4.3 Monitoring Period. PAMS precursor monitoring will be conducted annually through the months of June, July, and August (as a minimum) when peak O3 values are expected in each area; however, precursor monitoring during the entire O3 season for the area is preferred. Alternate precursor monitoring periods may be submitted for approval as a part of the PAMS network description required by §58.40. Changes to the PAMS monitoring period must be identified during the annual SLAMS Network Review specified in §58.20. PAMS O3 monitors must adhere to the O3 monitoring season specified in section 2.5 of appendix D. To ensure a degree of national consistency, monitoring for the 1993 season should commence as follows:

One in 3-day sampling—June 3, 1993.
One in 6-day sampling—June 6, 1993.

These monitoring dates will thereby be coincident with the previously-established, intermittent schedule for particulate matter. States initiating sampling earlier (or later) than June 3, 1993 should adjust their schedules to coincide with this national schedule.

4.4 Minimum Monitoring Network Requirements. The minimum required number and type of monitoring sites and sampling requirements are based on the population of the affected MSA/CMSA or nonattainment area (whichever is larger). The MSA/CMSA basis for monitoring network requirements was chosen because it typically is the most representative of the area which encompasses the emissions sources contributing to nonattainment. The MSA/CMSA emissions density can also be effectively and conveniently portrayed by the surrogate of population. Therefore, the use of smaller geographical units (such as counties or nonattainment areas which are smaller than the MSA/CMSA) for monitoring network design purposes is inappropriate. Various sampling requirements are imposed according to the size of the area to accommodate the impact of transport on the smaller MSAs/CMSAs, to account for the spatial variations inherent in large areas, to satisfy the differing data needs of large versus small areas due to the intractability of the O3 nonattainment problem, and to recognize the potential economic impact of implementation on state and local government. Population figures must reflect the most recent decennial U.S. census population report. Specific guidance on determining network requirements is provided in reference 19. Minimum network requirements are outlined in table 2.

### Table 2—PAMS Minimum Monitoring Network Requirements

<table>
<thead>
<tr>
<th>Population of MSA/CMSA or nonattainment area</th>
<th>Required site type</th>
<th>Minimum required VOC sampling frequency</th>
<th>Minimum carbon monoxide sampling frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 500,000</td>
<td>A or C</td>
<td>1</td>
<td>O or F</td>
</tr>
<tr>
<td>500,000 to 1,000,000</td>
<td>A or C</td>
<td>1</td>
<td>E</td>
</tr>
<tr>
<td>1,000,000 to 2,000,000</td>
<td>A or C</td>
<td>1</td>
<td>E</td>
</tr>
<tr>
<td>More than 2,000,000</td>
<td>A or C</td>
<td>1</td>
<td>E</td>
</tr>
</tbody>
</table>

1. O3 and NOx (including NO and NO2) monitoring should be continuous measurements.
2. Whichever area is larger.
3. See Figure 5.
4. Frequency Requirements are as follows: A—Eight 3-hour samples every third day and one additional 24-hour sample every sixth day during the monitoring period; B—Eight 3-hour samples, every day during the monitoring period and one additional 24-hour sample every sixth day year-round; C—Eight 3-hour samples on the 5 peak O3 days plus each previous day, eight 3-hour samples every sixth day, and one additional 24-hour sample every sixth day, during the monitoring period; D—Eight 3-hour samples every third day during the monitoring period; E—Eight 3-hour samples every day during the monitoring period; F—Eight 3-hour samples on the 5 peak O3 days plus each previous day and eight 3-hour samples every sixth day during the monitoring period. (NOTE: multiple samples taken on a daily basis must begin at midnight and consist of sequential, non-overlapping sampling periods.)
5. Carbonyl sampling frequency must match the chosen speciated VOC frequency.

Note that the use of Frequencies C or F requires the submission of an ozone event forecasting scheme.

For purposes of network implementation and transition, EPA recommends the following priority order for the establishment of sites:

- **The type (2) site** which provides the most comprehensive data concerning O3 precursor emissions and toxic air pollutants,
- **The type (3) site** which provides a maximum O3 measurement and total conversion of O3 precursors,
- **The type (1) site** which delineates the effect of incoming precursor emissions and concentrations of O3 and provides upwind boundary conditions,
- **The type (4) site** which provides extreme downwind boundary conditions, and
- The second type (2) site which provides comprehensive data concerning O3 precursor emissions and toxic air pollutants in the second-most predominant morning wind direction on high O3 days.

Note also that O3 event (peak day) monitoring will require the development of a scheme for forecasting such high O3 days or will necessitate the stipulation of what meteorological conditions constitute a potential high O3 day; monitoring could then be...
triggered only via meteorological projections. The \( \text{O}_3 \) event forecasting and monitoring scheme should be submitted as a part of the network description required by §§58.40 and 58.41 and should be reviewed during each annual SLAMS Network Review specified in §58.20.

4.5 Transition Period. A variable period of time is proposed for phasing in the operation of all required PAMS. Within 1 year after (1) February 12, 1993, (2) or date of redesignation or reclassification of any existing \( \text{O}_3 \) nonattainment area to serious, severe, or extreme, or (3) the designation of a new area and classification to serious, severe, or extreme \( \text{O}_3 \) nonattainment. A minimum of one type (2) site must be operating. Operation of the remaining sites must, at a minimum, be phased in at the rate of one site per year during subsequent years as outlined in the approved PAMS network description provided by the State.

4.6 Meteorological Monitoring. In order to support monitoring objectives associated with the need for various air quality analyses, model inputs and performance evaluations, meteorological monitoring including wind measurements at 30 meters above ground is required at each PAMS site. Monitoring should begin with site establishment. In addition, upper air meteorological monitoring is required for each PAMS area. Upper air monitoring should be initiated as soon as possible, but no later than 2 years after (1) February 12, 1993, (2) or date of redesignation or reclassification of any existing \( \text{O}_3 \) nonattainment area to serious, severe, or extreme, or (3) the designation of a new area and classification to serious, severe, or extreme \( \text{O}_3 \) nonattainment. The upper air monitoring site may be located separately from the type (1) through (4) sites, but the location should be representative of the upper air data in the nonattainment area. Upper air meteorological data must be collected during those days specified for monitoring by the sampling frequencies in Table 2 of section 4.4 of this appendix D in accordance with current EPA guidance.

5. Summary.

Table 6 of this appendix shows by pollutant, all of the spatial scales that are applicable for SLAMS and the required spatial scales for NAMS. There may also be some situations, as discussed later in appendix E of this part, where additional scales may be allowed for NAMS purposes.

<table>
<thead>
<tr>
<th>TABLE 6—SUMMARY OF SPATIAL SCALES FOR SLAMS AND REQUIRED SCALES FOR NAMS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spatial Scale</strong></td>
</tr>
<tr>
<td>Micro</td>
</tr>
<tr>
<td>Middle</td>
</tr>
<tr>
<td>Neighborhood</td>
</tr>
<tr>
<td>Urban</td>
</tr>
<tr>
<td>Regional</td>
</tr>
</tbody>
</table>

1. Only permitted if representative of many such micro-scale environments in a residential district (for middle scale, at least two).
2. Either urban or regional scale for regional transport sites.

6. References


5. Guideline on Air Quality Models. OAQPS, U.S. Environmental Protection


[44 FR 27571, May 10, 1979]

EDITORIAL NOTE: For Federal Register citations affecting appendix D to part 58, see the List of CFR Sections Affected in the Finding Aids section of this volume.

EFFECTIVE DATE NOTE: At 60 FR 52323, October 6, 1995, appendix D to part 58 was amended in part by adding Section 2.2. This section contains information collection and recordkeeping requirements and will not become effective until approval has been given by the Office of Management and Budget.

APPENDIX E TO PART 58—PROBE AND MONITORING PATH SITING CRITERIA FOR AMBIENT AIR QUALITY MONITORING

1. Introduction

2. Sulfur Dioxide (SO_{2}), Ozone (O_{3}), and Nitrogen Dioxide (NO_{2}).

2.1 Horizontal and Vertical Placement

2.2 Spacing from Minor Sources (Applicable to SO_{2} and O_{3}, Monitoring Only)

2.3 Spacing from Obstructions

2.4 Spacing from Trees

2.5 Spacing from Roadways (Applicable to O_{3} and NO_{2}, Only)

2.6 Cumulative Interferences on a Monitoring Path

2.7 Maximum Monitoring Path Length

3. [Reserved]

4. Carbon Monoxide (CO)

4.1 Horizontal and Vertical Placement

4.2 Spacing from Obstructions

4.3 Spacing from Roadways

4.4 Spacing from Trees and Other Considerations

4.5 Cumulative Interferences on a Monitoring Path

4.6 Maximum Monitoring Path Length

5. [Reserved]

6. Lead(Pb)

7. Vertical Placement

7.1 Vertical Placement

7.2 Spacing from Obstructions

7.3 Spacing from Roadways

7.4 Spacing from Trees and Other Considerations

8. Particulate Matter (PM_{10} and PM_{2.5})

8.1 Vertical Placement
8.2 Spacing From Obstructions
8.3 Spacing From Roadways
8.4 Other Considerations
9. Probe Material and Pollutant Sample Collection
10. Photochemical Assessment Monitoring Stations (PAMS)
10.1 Horizontal and Vertical Placement
10.2 Spacing From Obstructions
10.3 Spacing From Roadways
10.4 Spacing From Trees
11. Discussion and Summary
12. Summary
13. References

1. Introduction

This appendix contains specific location criteria applicable to ambient air quality monitoring probes and monitoring paths. After the general station siting has been selected based on the monitoring objectives and the scale of representation discussed in appendix D of this part, adherence to these siting criteria is necessary to ensure the uniform collection of compatible and comparable air quality data.

The probe and monitoring path siting criteria discussed below must be followed to the maximum extent possible. It is recognized that there may be situations where some deviation from the siting criteria may be necessary. In any such case, the reasons must be thoroughly documented in a written request for a waiver that describes how and why the proposed siting deviates from the criteria.

This documentation should help to avoid later questions about the validity of the resulting monitoring data. Conditions under which the EPA would consider an application for waiver from these siting criteria are discussed in section 11 of this appendix.

The spatial scales of representation used in this appendix, i.e., micro, middle, neighborhood, urban, and regional, are defined and discussed in appendix D of this part. The pollutant-specific probe and monitoring path siting criteria generally apply to all spatial scales except where noted otherwise. Specific siting criteria that are phrased with a “must” are defined as requirements and exceptions must be approved through the waiver process. However, siting criteria that are phrased with a “should” are defined as goals to meet for consistency but are not requirements.

2. Sulfur Dioxide (SO₂), Ozone (O₃), and Nitrogen Dioxide (NO₂)

Open path analyzers may be used to measure SO₂, O₃, and NO₂ at SLAMS/NAMS sites for middle, neighborhood, urban, and regional scale measurement applications. Additional information on SO₂, NO₂, and O₃ monitoring or site siting criteria may be found in sections 11 and 13.

2.1 Horizontal and Vertical Placement

The probe or at least 90 percent of the monitoring path must be located between 3 and 15 meters above ground level. The probe or at least 90 percent of the monitoring path must be at least 1 meter vertically or horizontally away from any supporting structure, walls, parapets, penthouses, etc., and away from dusty or dirty areas. If the probe or a significant portion of the monitoring path is located near the side of a building, then it should be located on the windward side of the building relative to the prevailing wind direction during the season of highest concentration potential for the pollutant being measured.

2.2 Spacing from Minor Sources (Applicable to SO₂ and O₃ Monitoring Only)

Local minor sources of SO₂ can cause inappropriately high concentrations of SO₂ in the vicinity of probes and monitoring paths for SO₂. Similarly, local sources of nitric oxide (NO) and ozone-reactive hydrocarbons can have a scavenging effect causing unrepresentatively low concentrations of O₃ in the vicinity of probes and monitoring paths for O₃. To minimize these potential interferences, the probe or at least 90 percent of the monitoring path must be away from furnace or incineration flues or other minor sources of SO₂ or NO, particularly for open path analyzers because of their potential for greater exposure over the area covered by the monitoring path. The separation distance covered by the probe or monitoring path should take into account the heights of the flues, type of waste or fuel burned, and the sulfur content of the fuel. It is acceptable, however, to monitor for SO₂ near a point source of SO₂ when the objective is to assess the effect of this source on the represented population.

2.3 Spacing From Obstructions

Buildings and other obstacles may possibly scavenge SO₂, O₃, or NO₂. To avoid this interference, the probe or at least 90 percent of the monitoring path must have unrestricted airflow and be located away from obstacles so that the distance from the probe or monitoring path is at least twice the height that the obstacle protrudes above the probe or monitoring path. Generally, a probe or monitoring path located near or along a vertical wall is undesirable because air moving along the wall may be subject to possible removal mechanisms. A probe must have unrestricted airflow in an arc of at least 270 degrees around the inlet probe, or 180 degrees if the probe is on the side of a building. This arc must include the predominant wind direction for the season of greatest pollutant concentration potential. A sampling station having a probe located closer to an obstacle than this criterion allows should be classified as middle scale rather than neighborhood or urban scale, since the measurements from such a station would more closely represent the middle scale. A monitoring path must be clear of all trees, brush, buildings, plumes, dust, or other optical obstructions, including potential obstructions that may
move due to wind, human activity, growth of vegetation, etc. Temporary optical obstructions, such as rain, particles, fog, or snow should be considered when siting an open path analyzer. While some of these temporary obstructions that are of sufficient density to obscure the light beam will affect the ability of the open path analyzer to continuously measure pollutant concentrations, special consideration must be devoted to the use of open path analyzers due to their inherent potential sensitivity to certain types of interferences, or optical obstructions. While some of these potential interferences are comparable to those to which point monitors are subject, there are additional sources of potential interferences which are altogether different in character. Transient, but significant obstruction of especially longer measurement paths could be expected to occur as a result of certain prevailing meteorological conditions (e.g., heavy fog, rain, snow) and/or aerosol levels. If these levels are of sufficient density to prevent the open path analyzer’s light transmission. If certain compensating measures are not otherwise implemented at the onset of monitoring (e.g., shorter path lengths, higher light source intensity), data recovery during periods of greatest primary pollutant potential could be compromised. For instance, if heavy fog or high particulate levels are coincident with periods of projected NAAQS-threatening pollutant potential, the representativeness of the resulting data record in reflecting maximum pollutant concentration may be substantially impaired despite the fact that the site may otherwise exhibit an acceptable, even exceedingly high overall valid data capture rate.

In seeking EPA approval for inclusion of a site using an open path analyzer into the formal SLAMS/NAMS or PSD network, monitoring agencies must submit an analysis which evaluates both obscuration potential for a proposed path length for the subject area and the effect this potential is projected to have on the representativeness of the data record. This analysis should include one or more of the following elements, as appropriate for the specific circumstance: climatological information, historical pollutant and aerosol information, modeling analysis results, and any related special study results. Special consideration must be given to locating an O\textsubscript{3} probe or monitoring path to avoid this problem.

2.5 Spacing From Roadways. In siting an O\textsubscript{3} analyzer, it is important to minimize destructive interferences from sources of NO, since NO readily reacts with O\textsubscript{3}. In siting NO\textsubscript{2} analyzers for neighborhood and urban scale monitoring, it is important to minimize interferences from automotive sources. Table 1 provides the required minimum separation distances between a roadway and a probe and between a roadway and at least 90 percent of a monitoring path for various ranges of daily roadway traffic. A sampling site using an open path analyzer into the formal SLAMS/NAMS or PSD network, monitoring analyzers must not cross over a roadway with an average daily traffic count of 10,000 vehicles per day or more. For those situations where a monitoring path crosses a roadway with fewer than 10,000 vehicles per day, one must consider the entire segment of the monitoring path in the area of potential atmospheric interference from automobile emissions. Therefore, this calculation must include the length of the monitoring path over the roadway plus any segments of the monitoring path that lie in the area between the roadway and the minimum separation distance, as determined from Table 1. The sum of these distances must not exceed 10 percent of the total monitoring path length.

<table>
<thead>
<tr>
<th>Roadway average daily traffic, vehicles per day</th>
<th>Minimum separation distance, meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤10,000</td>
<td>10</td>
</tr>
<tr>
<td>15,000-20,000</td>
<td>30</td>
</tr>
<tr>
<td>40,000-70,000</td>
<td>50</td>
</tr>
<tr>
<td>≥110,000</td>
<td>250</td>
</tr>
</tbody>
</table>

1 Distance from the edge of the nearest traffic lane. The distance for intermediate traffic counts should be interpolated from the table values based on the actual traffic count.

2.6 Cumulative Interferences on a Monitoring Path. The cumulative length or portion of a monitoring path that is affected by minor sources, obstructions, trees, or roadways must not exceed 10 percent of the total monitoring path length.

2.7 Maximum Monitoring Path Length. The monitoring path length must not exceed 1...
kilometer for analyzers in neighborhood, urban, or regional scale. For middle scale monitoring sites, the monitoring path length must not exceed 300 meters. In areas subject to frequent episodes of dust, fog, rain, or snow, consideration should be given to a shortened monitoring path length to minimize loss of monitoring data due to these temporary air monitoring scenarios using open path analyzers, shorter path lengths may be needed in order to ensure that the monitoring station meets the objectives and spatial scales defined for SLAMS in appendix D. Therefore, the Regional Administrator or the Regional Administrator’s designee may require shorter path lengths, as needed on an individual basis, to ensure that the SLAMS meet the appendix D requirements. Likewise, the Administrator or the Administrator’s designee may specify the maximum path length used at monitoring stations designated as NAMS or PAMS as needed on an individual basis.

3. [Reserved]

4. Carbon Monoxide (CO)

Open path analyzers may be used to measure CO at SLAMS/NAMS sites for middle or neighborhood scale measurement applications. Additional information on CO monitoring site selection criteria may be found in reference 12.

4.1 Horizontal and Vertical Placement. Because of the importance of measuring population exposure to CO concentrations, air should be sampled at average breathing heights. However, practical factors require that the inlet probe be higher. The required height of the inlet probe for CO monitoring must be clear of all trees, brush, buildings, plumes, dust, or other optical obstructions, including potential obstructions that may move due to wind, human activity, growth of vegetation, etc. Temporary optical obstructions, such as rain, particles, fog, or snow, should be considered when siting an open path analyzer. Any of these temporary obstructions that are of sufficient density to obscure the light beam will affect the ability of the open path analyzer to continuously measure pollutant concentrations.

Special consideration must be devoted to the use of open path analyzers due to their inherent potential sensitivity to certain types of interferences, or optical obstructions. Since the predominant wind direction for the season of greatest pollutant concentration potential, a monitoring path must be clear, for instance, shorter path lengths, higher light source intensity), data recovery during periods of greatest primary pollutant potential could be compromised. For instance, if heavy fog or high particulate levels are coincident with periods of projected NAAQS-threatening pollutant potential, the representativeness of the resulting data record in reflecting maximum pollutant concentrations may be substantially impaired despite the fact that the site may otherwise exhibit
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In determining the minimum separation between a neighborhood scale monitoring station and a specific line source, the pre-
sumption is made that measurements should not be substantially influenced by any one roadway. Computations were made to deter-
mine the separation distance, and table 2 provides the required minimum separation distance between roadways and a probe or
90% of a monitoring path. Probes or monitoring paths that are located closer to roads than this criterion allows should not be clas-
sified as a neighborhood scale, since the measurements from such a station would closely represent the middle scale. Therefore,
stations not meeting this criterion should be classified as middle scale.

4.3 Spacing From Roadways. Street canyon and traffic corridor stations (microscale) are intended to provide a measurement of the in-
fluence of the immediate source on the pollution exposure of the population. In order to provide some reasonable consistency and comparability in the air quality data from microscale stations, a minimum distance of 2 meters and a maximum distance of 10 me-
ters from the edge of the nearest traffic lane must be maintained for these CO monitoring inlet probes. This should give consistency to the data, yet still allow flexibility of finding suitable locations.

Street canyon/corridor (microscale) inlet probes must be located at least 10 meters from an intersection and preferably at a midblock location. Midblock locations are preferable to intersection locations because intersections represent a much smaller portion of downtown space than do the streets between them. Pedestrian exposure is probably also greater in street canyon/corridors than at intersections. Also, the practical dif-
culty of positioning sampling inlets is less at midblock locations than at the intersection. However, the final siting of the monitor must meet the objectives and intent of appendix D, sections 2.4, 3.3. and appendix E, section 4.

4.4 Spacing From Trees and Other Considerations. Since CO is relatively nonreactive, the major factor concerning trees is as ob-
structions to normal wind flow patterns. For middle and neighborhood scale stations, trees should not be located between the
major sources of CO, usually vehicles on a heavily traveled road, and the monitor. The probe or at least 90 percent of the monitor-
ing path must be 10 meters or more from the drip line of trees which are between the probe or the monitoring path and the road
and which extend at least 5 meters above the probe or monitoring path. For microscale stations, no trees or shrubs should be located
between the probe and the roadway.

4.5 Cumulative Interferences on a Monitoring Path. The cumulative length or portion of a monitoring path that is affected by
obstructions, trees, or roadways must not exceed 10 percent of the total monitoring path length.

4.6 Maximum Monitoring Path Length. The monitoring path length must not exceed 1 kilometer for analyzers used for neighbor-
hood scale monitoring applications, or 300 meters for middle scale monitoring applications. In areas subject to frequent periods of
dust, fog, rain, or snow, consideration should be given to a shortened monitoring path length to minimize loss of monitoring data due to these temporary optical obstructions. For certain ambient air monitoring sce-
narios using open path analyzers, shorter path lengths may be needed in order to ensure that the monitoring station meets the
objectives and spatial scales defined for SLAMS in appendix D. Therefore, the Regional Administrator or the Regional Ad-
ministrator’s designee may require shorter path lengths, as needed on an individual basis, to ensure that the SLAMS meet the appendix D requirements. Likewise, the Administraor or the Administrator’s designee may specify the maximum path length used

<table>
<thead>
<tr>
<th>Roadway average daily traffic, vehicles per day</th>
<th>Minimum separation distance (meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤10,000</td>
<td>10</td>
</tr>
<tr>
<td>15,000</td>
<td>25</td>
</tr>
<tr>
<td>20,000</td>
<td>45</td>
</tr>
<tr>
<td>30,000</td>
<td>80</td>
</tr>
<tr>
<td>40,000</td>
<td>115</td>
</tr>
<tr>
<td>50,000</td>
<td>155</td>
</tr>
<tr>
<td>≥60,000</td>
<td>150</td>
</tr>
</tbody>
</table>

1. Distance from the edge of the nearest traffic lane. The dis-
tance for intermediate traffic counts should be interpolated from the table values based on the actual traffic count.

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at monitoring stations designated as NAMS or PAMS as needed on an individual basis.

5.±6. [Reserved]

7. Lead (Pb)

7.1 Vertical Placement. Optimal placement of the sampler inlet for Pb monitoring should be at breathing height level. However, practical factors such as prevention of vandalism, security, and safety precautions must also be considered when siting a Pb monitor. Given these considerations, the sampler inlet for microscale Pb monitors must be 2–7 meters above ground level. The lower limit was based on a compromise between ease of servicing the sampler and the desire to avoid unrepresentative conditions due to re-entrainment from dusty surfaces. The upper limit represents a compromise between the desire to have measurements which are most representative of population exposures and a consideration of the practical factors noted above.

For middle or larger spatial scales, increased diffusion results in vertical concentration gradients which are not as great as for the small scales. Thus, the required height of the air intake for middle or larger scales is 2–15 meters.

7.2 Spacing From Obstructions. The sampler must be located away from obstacles such as buildings, so that the distance between obstacles and the sampler is at least twice the height that the obstacle protrudes above the sampler.

A minimum of 2 meters of separation from walls, parapets, and penthouses is required for rooftop samplers. No furnace or incinerator flues should be nearby. The height and type of flues and the type, quality, and quantity of waste or fuel burned determine the separation distances. For example, if the emissions from the chimney have high lead content and there is a high probability that the plume would impact on the sampler during most of the sampling period, then other buildings/locations in the area that are free from the described sources should be chosen for the monitoring site.

There must be unrestricted airflow in an arc of at least 270° around the sampler. Since the intent of the category (a) site is to measure the maximum concentrations from a road or point source, there must be no significant obstruction between a road or point source and the monitor, even though other spacing from obstruction criteria are met. The predominant direction for the season with the greatest pollutant concentration potential must be included in the 270° arc.

7.3. Spacing from Roadways. This criteria applies only to those Pb sites designed to assess lead concentrations from mobile sources. Numerous studies have shown that ambient Pb levels near mobile sources are a function of the traffic volume and are most pronounced at ADT >30,000 within the first 15 meters on the downwind side of the roadways. Numberous studies have shown that ambient lead levels near mobile source are a function of the traffic volume and are most pronounced at ADT >30,000 within the first 15 meters, on the downwind side of the roadways. (1, 16–19) Therefore, stations to measure the peak concentration from mobile sources should be located at the distance most likely to produce the highest concentrations. For the microscale station, the location must be between 5 and 15 meters from the major roadway. For the middle scale station, a range of acceptable distances from the major roadway is shown in table 4.

This table also includes separation distances between a roadway and neighborhood or larger scale station. These distances are based upon the data of reference 16 which illustrates that lead levels remain fairly constant after certain horizontal distances from the roadway. As depicted in the above reference, this distance is a function of the traffic volume.

### Table 3—Separation Distance Between Pb Stations and Roadways (Edge of Nearest Traffic Lane)

<table>
<thead>
<tr>
<th>Roadway average daily traffic vehicles per day</th>
<th>Separation distance between roadways and stations, meters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Microscale</td>
</tr>
<tr>
<td>&lt;10,000</td>
<td>5–15</td>
</tr>
<tr>
<td>20,000</td>
<td>5–15</td>
</tr>
<tr>
<td>&gt;40,000</td>
<td>5–15</td>
</tr>
</tbody>
</table>

1 Distances should be interpolated based on traffic flow.

7.4. Spacing from trees and other considerations. Trees can provide surfaces for deposition or adsorption of Pb particles and obstruct normal wind flow patterns. For microscale and middle scale category (a) sites there must not be any tree(s) between the source of the Pb and the sampler. For neighborhood scale category (b) sites, the sampler should be at least 20 meters from the drip line of trees which could be classified as an obstruction, i.e., the distance between the tree(s) and the sampler is less than the height that the tree protrudes above the sampler.

8. Particulate Matter (PM10 and PM2.5)

8.1 Vertical Placement. Although there are limited studies on the PM10 concentration gradients around roadways or other ground level sources, References 1, 2, 4, 18 and 19 of this appendix show a distinct variation in the distribution of TSP and Pb levels near roadways, TSP, which is greatly affected by gravity, has large concentration gradients, both horizontal and vertical, immediately
The sampler must also be located away from obstacles such as buildings, so that the distance between obstacles and the sampler is at least twice the height that the obstacle protrudes above the sampler, except for street canyon sites. Sampling stations that are located closer to obstacles than this criterion allows should not be classified as neighborhood, urban, or regional scale. Since the measurements from such a station would closely represent middle scale stations. Therefore, stations not meeting the criterion should be classified as middle scale.

There must be unrestricted airflow in an arc of at least 270° around the sampler except for street canyon sites. The criterion allows should not be classified as neighborhood, urban, or regional scale. Since the measurements from such a station would closely represent middle scale stations. Therefore, stations not meeting the criterion should be classified as middle scale.

8.3 Spacing From Roads. Since emissions associated with the operation of motor vehicles contribute to urban area particulate matter ambient levels, spacing from roadway criteria are necessary for ensuring national consistency in PM sampler siting.

The intent is to locate category (a) NAMS sites in areas of highest concentrations whether it be from mobile or multiple stationary sources. If the area is primarily affected by mobile sources and the maximum concentration area(s) is judged to be a traffic corridor or street canyon location, then the monitors should be located near roadways with the highest traffic volume and at separation distances most likely to produce the highest concentrations. For the microscale traffic corridor station, the location must be between 5 and 15 meters from the major roadway. For the microscale street canyon site the location must be between 2 and 10 meters from the roadway. For the middle scale station, a range of acceptable distances from the roadway is shown in Figure 2. This figure also includes separation distances between a roadway and neighborhood or larger scale stations by default. Any station, 2 to 15 meters high, and further back than the middle scale requirements will generally be neighborhood, urban or regional scale. For example, according to Figure 2, if a PM sampler is primarily influenced by roadway emissions and that sampler is set back 10 meters from a 30,000 ADT road, the station should be classified as a micro scale, if the sampler height is between 2 and 7 meters. If the sampler height is between 7 and 15 meters, the station should be classified as middle scale. If the sample is 20 meters from the same road, it will be classified as middle scale; if 40 meters, neighborhood scale; and if 110 meters, an urban scale.
It is important to note that the separation distances shown in Figure 2 are measured from the edge of the nearest traffic lane of the roadway presumed to have the most influence on the site. In general, this presumption is an oversimplification of the usual urban settings which normally have several streets that impact a given site. The effects...
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of surrounding streets, wind speed, wind direction and topography should be considered along with Figure 2 before a final decision is made on the most appropriate spatial scale assigned to the sampling station.

8.4 Other Considerations. For those areas that are primarily influenced by stationary source emissions as opposed to roadway emissions, guidance in locating these areas may be found in the guideline document Optimum Network Design and Site Exposure Criteria for Particulate Matter.

Stations should not be located in an unpaved area unless there is vegetative ground cover year round, so that the impact of wind blown dusts will be kept to a minimum.

9. Probe Material and Pollutant Sample Residence Time

For the reactive gases, SO\textsubscript{2}, NO\textsubscript{2}, and O\textsubscript{3}, special probe material must be used for point analyzers. Studies\textsuperscript{20-24} have been conducted to determine the suitability of materials such as polypropylene, polyethylene, polyvinyl chloride, Tygon, aluminum, brass, stainless steel, copper, Pyrex glass and Teflon for use as intake sampling lines. Of the above materials, only Pyrex glass and Teflon have been found to be acceptable for use as intake sampling lines for all the reactive gaseous pollutants. Furthermore, the EPA\textsuperscript{25} has specified borosilicate glass or FEP Teflon as the only acceptable probe materials for delivering test atmospheres in the determination of reference or equivalent methods. Therefore, borosilicate glass, FEP Teflon, or their equivalent must be used for existing and new NAMS or SLAMS.

For VOC monitoring at those SLAMS designated as PAMS, FEP teflon is unacceptable as the probe material because of VOC adsorption and desorption reactions on the FEP teflon. Borosilicate glass, stainless steel, or its equivalent are the acceptable probe materials for VOC and carbonyl sampling. Care must be taken to ensure that the sample residence time is 20 seconds or less.

No matter how nonreactive the sampling probe material is initially, after a period of use reactive particulate matter is deposited on the probe walls. Therefore, the time it takes the gas to transfer from the probe inlet to the sampling device is also critical. Ozone in the presence of NO will show significant losses even in the most inert probe material when the residence time exceeds 20 seconds.\textsuperscript{26} Other studies\textsuperscript{27-28} indicate that a 10-second or less residence time is easily achievable. Therefore, sampling probes for reactive gas monitors at SLAMS or NAMS must have a sample residence time less than 20 seconds.

10. Photochemical Assessment Monitoring Stations (PAMS)
in reflecting maximum pollutant concentrations may be substantially impaired despite the fact that the site may otherwise exhibit an acceptable, even exceedingly high overall valid data capture rate.

In seeking EPA approval for inclusion of a site using an open path analyzer into the formal SLAMS/NAMS or PSD network, monitoring agencies must submit an analysis which evaluates both obscuration potential for a proposed path length for the subject area as well as the effect this potential is projected to have on the representativeness of the data record. This analysis should include one or more of the following elements, as appropriate for the specific circumstance: climatological information, historical pollutant and aerosol information, modeling analysis results, and any related special study results.

10.3 Spacing From Roadways. It is important in the probe and monitoring path siting process to minimize destructive interferences from sources of NO since NO readily reacts with O3. Table 4 below provides the required minimum separation distances between roadways and PAMS (excluding upper air measuring stations):

**Table 4—Separation Distance Between PAMS and Roadways**

<table>
<thead>
<tr>
<th>Roadway average daily traffic, vehicles per day</th>
<th>Minimum separation distance between roadways and stations in meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10,000</td>
<td>&gt;10</td>
</tr>
<tr>
<td>15,000</td>
<td>20</td>
</tr>
<tr>
<td>20,000</td>
<td>30</td>
</tr>
<tr>
<td>40,000</td>
<td>50</td>
</tr>
<tr>
<td>70,000</td>
<td>100</td>
</tr>
<tr>
<td>&gt;100,000</td>
<td>250</td>
</tr>
</tbody>
</table>

1 Distance from the edge of the nearest traffic lane. The distance for intermediate traffic counts should be interpolated from the table based on the actual traffic flow.

10.4 Spacing From Trees. Trees can provide surfaces for adsorption and/or reactions to occur and can obstruct normal wind flow patterns. To minimize these effects at PAMS, the probe or at least 90 percent of the monitoring path should be placed at least 20 meters from the drip line of trees. Since the scavenging effect of trees is greater for O3 than for the other criteria pollutants, strong consideration of this effect must be given in locating the PAMS probe or monitoring path to avoid this problem. Therefore, the probe or at least 90 percent of the monitoring path must be at least 10 meters from the drip line of trees.


It is believed that most sampling probes or monitors can be located so that they meet the requirements of this appendix. New stations with rare exceptions, can be located within the limits of this appendix. However, some existing stations may not meet these requirements and yet still produce useful data for some purposes. EPA will consider a written request from the State Agency to waive one or more siting criteria for some monitoring stations providing that the State can adequately demonstrate the need (purpose) for monitoring or establishing a monitoring station at that location. For establishing a new station, a waiver may be granted only if both of the following criteria are met:

The site can be demonstrated to be as representative of the monitoring area as it would be if the siting criteria were being met.

The monitor or probe cannot reasonably be located so as to meet the siting criteria because of physical constraints (e.g., inability to locate the required type of station the necessary distance from roadways or obstructions).

However, for an existing station, a waiver may be granted if either of the above criteria are met.

Cost benefits, historical trends, and other factors may be used to add support to the above, however, they in themselves, will not be acceptable reasons for granting a waiver. Written requests for waivers must be submitted to the Regional Administrator. For those SLAMS also designated as NAMS, the request will be forwarded to the Administrator. For those SLAMS also designated as NAMS or PAMS, the request will be forwarded to the Administrator.

12. Summary

Table 5 presents a summary of the general requirements for probe and monitoring path siting criteria with respect to distances and heights. It is apparent from Table 5 that different elevation distances above the ground are shown for the various pollutants. The discussion in the text for each of the pollutants describes reasons for elevating the monitor, probe, or monitoring path. The differences in the specified range of heights are based on the vertical concentration gradients. For CO, the gradients in the vertical direction are very large for the microscale, so a small range of heights has been used. The upper limit of 15 meters was specified for consistency between pollutants and to allow the use of a single manifold monitoring path for monitoring more than one pollutant.
1. Bryan, R.J., R.J., Gordon, and H. Menck. Comparison of High Volume Air Filter Samples at Varying Distances from Los Angeles Freeway. University of Southern California, School of Medicine, Los Angeles, CA. (Presented at 66th Annual Meeting of Air Pollution Control Association, Chicago, IL.), June 24-28, 1973. APCA 73-156.)


Texas State Department of Health, Air Control Section, Austin, TX. 1970 p.7.
Environmental Protection Agency


APPENDIX F TO PART 58—ANNUAL SLAMS AIR QUALITY INFORMATION

1. General
2. Required Information
2.1 Sulfur Dioxide (SO2)
2.1.1 Site and Monitoring Information
2.1.2 Annual Summary Statistics
2.2 Nitrogen Dioxide (NO2)
2.2.1 Site and Monitoring Information
2.2.2 Annual Summary Statistics
2.2.3 Episode and Other Unscheduled Sampling Data
2.2.4 Other还会 [2] Annual Summary Statistics
2.3 Carbon Monoxide (CO)
2.3.1 Site and Monitoring Information
2.3.2 Annual Summary Statistics
2.4 Lead (Pb)
2.4.1 Site and Monitoring Information
2.4.2 Annual Summary Statistics
2.5 Ozone (O3)
2.5.1 Site and Monitoring Information
2.5.2 Annual Summary Statistics
2.6 Episodic and Other Unscheduled Sampling Data
2.7 Particulate Matter (PM10)
2.7.1 Site and Monitoring Information
2.7.2 Annual Summary Statistics
2.7.3 Annual Summary Statistics
2.7.4 Episode and Other Unscheduled Sampling Data
1. General

This appendix describes information to be compiled and submitted annually to EPA for each ambient monitoring station in the SLAMS Network in accordance with §58.26. The annual summary statistics that are described in section 2 below shall be construed as only the minimum necessary statistics needed by EPA to overview national air quality status. They will be used by EPA to convey information to a variety of interested parties including environmental groups, Federal agencies, the Congress, and private citizens upon request. As the need arises, EPA may issue modifications to these minimum requirements to reflect changes in EPA policy concerning the National Ambient Air Quality Standards (NAAQS).

As indicated in §58.26(c), the contents of the SLAMS annual report shall be certified by the senior air pollution control officer in the State to be accurate to the best of his knowledge. In addition, the manner in which the data were collected must be certified to have conformed to the applicable quality assurance, air monitoring methodology, and probe siting criteria given in appendices A, C, and E to this part. A certified statement to this effect must be included with the annual report. As required by §58.26(a), the report must be submitted by July 1 of each year for data collected during the period January 1 to December 31 of the previous year.

EPA recognizes that most air pollution control agencies routinely publish air quality statistical summaries and interpretive reports. EPA encourages State and local agencies to continue publication of such reports and recommends that they be expanded, where appropriate, to include analysis of air quality trends, population exposure, and pollutant distributions. At their discretion, State and local agencies may wish to integrate the SLAMS report into routine agency publications.

2. Required Information

This paragraph describes air quality monitoring information and summary statistics which must be included in the SLAMS annual report. The required information is itemized below by pollutant. Throughout this appendix, the time of occurrence refers to the ending hour. For example, the ending hour of an 8-hour CO average from 12:01 a.m. to 8:00 a.m. would be 8:00 a.m.

For the purposes of range assignments the following rounding convention will be used. The air quality concentration should be rounded to the number of significant digits used in specifying the concentration intervals. The digit to the right of the last significant digit determines the rounding process.

If this digit is greater than or equal to 5, the last significant digit is rounded up. For example, 100.5 ppm rounds to 101.0 ppm and 0.1245 ppm rounds to 0.12 ppm.

2.1 Sulfur Dioxide (SO2)
2.1.1 Site and Monitoring Information. City name (when applicable), county name and street address of site location. AIRS-AQS site code. AIRS-AQS monitoring method code. Number of hourly observations. (1) Number of daily observations. (2)
2.1.2 Annual Summary Statistics. Annual arithmetic mean (ppm). Highest and second highest 24-hour averages (3) (ppm) and dates and times of occurrence. Highest and second highest 3-hour averages (1, 3) (ppm) and times of occurrence. Number of exceedances of the 24-hour primary
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NAAQS. (3) Number of exceedances of the hourly secondary NAAQS. (3) Number of 24-hour average concentrations (4) in ranges:

<table>
<thead>
<tr>
<th>Range</th>
<th>Number of values</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00 to 0.04 (ppm)</td>
<td></td>
</tr>
<tr>
<td>0.05 to 0.08</td>
<td></td>
</tr>
<tr>
<td>0.09 to 0.12</td>
<td></td>
</tr>
<tr>
<td>0.13 to 0.16</td>
<td></td>
</tr>
<tr>
<td>0.17 to 0.20</td>
<td></td>
</tr>
<tr>
<td>0.21 to 0.24</td>
<td></td>
</tr>
<tr>
<td>0.25 to 0.28</td>
<td></td>
</tr>
<tr>
<td>Greater than .28</td>
<td></td>
</tr>
</tbody>
</table>

2.2 Total Suspended Particulates (TSP)

2.2.1 Site and Monitoring Information. City name (when applicable), county name, and street address of site location. AIRS-AQS site code. Number of daily observations.

2.2.2 Annual Summary Statistics. Annual arithmetic mean (µg/m³) as specified in appendix K of part 50. Daily TSP values exceeding the level of the 24-hour PM₁₀ NAAQS and dates of occurrence. If more than 10 occurrences, list only the 10 highest daily values. Sampling schedule used such as once every six days, once every three days, etc. Number of additional sampling days beyond sampling schedule used. Number of 24-hour average concentrations in ranges:

<table>
<thead>
<tr>
<th>Range</th>
<th>Number of values</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 50 (µg/m³)</td>
<td></td>
</tr>
<tr>
<td>51 to 100</td>
<td></td>
</tr>
<tr>
<td>101 to 150</td>
<td></td>
</tr>
<tr>
<td>151 to 200</td>
<td></td>
</tr>
<tr>
<td>201 to 250</td>
<td></td>
</tr>
<tr>
<td>251 to 300</td>
<td></td>
</tr>
<tr>
<td>301 to 400</td>
<td></td>
</tr>
<tr>
<td>Greater than 400</td>
<td></td>
</tr>
</tbody>
</table>

2.2.3 Episode and Other Unscheduled Sampling Data. List episode measurements, other unscheduled sampling data, and dates of occurrence. List the regularly scheduled sample measurements and date of occurrence that preceded the episode or unscheduled measurement.

2.3 Carbon Monoxide (CO)

2.3.1 Site and Monitoring Information. City name (when applicable), county name, and street address of site location. AIRS-AQS site code. AIRS-AQS monitoring method code. Number of hourly observations.

2.3.2 Annual Summary Statistics. Highest and second highest 1-hour values (ppm) and date and time of occurrence. Highest and second highest 8-hour averages (3) (ppm) and date and time of occurrence (ending hour). Number of exceedances of the 1-hour primary NAAQS. Number of exceedances of the 8-hour average primary NAAQS. (3) Number of 8-hour average concentrations (4) in ranges:

<table>
<thead>
<tr>
<th>Range</th>
<th>Number of values</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 4 (ppm)</td>
<td></td>
</tr>
<tr>
<td>5 to 8 (ppm)</td>
<td></td>
</tr>
<tr>
<td>Greater than 8</td>
<td></td>
</tr>
</tbody>
</table>

4.2 Nitrogen Dioxide (NO₂)

2.4.1 Site and Monitoring Information. City name (when applicable), county name, and street address of site location. AIRS-AQS site code. AIRS-AQS monitoring method code. Number of hourly observations. (1) Number of daily observations. (2)

2.4.2 Annual Summary Statistics. Annual arithmetic mean (ppm). Highest and second highest hourly averages (3) (ppm) and their dates and time of occurrence. Highest and second highest 24-hour averages (2) and their date of occurrence (ppm). Number of hourly average concentrations in ranges. (1)

<table>
<thead>
<tr>
<th>Range</th>
<th>Number of values</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 to .04 (ppm)</td>
<td></td>
</tr>
<tr>
<td>.05 to .08</td>
<td></td>
</tr>
<tr>
<td>.09 to .12</td>
<td></td>
</tr>
<tr>
<td>.13 to .16</td>
<td></td>
</tr>
<tr>
<td>.17 to .20</td>
<td></td>
</tr>
<tr>
<td>.21 to .24</td>
<td></td>
</tr>
<tr>
<td>.25 to .28</td>
<td></td>
</tr>
<tr>
<td>Greater than .28</td>
<td></td>
</tr>
</tbody>
</table>

2.5 Ozone (O₃)

2.5.1 Site and Monitoring Information. City name (when applicable), county name, and street address of site location. AIRS-AQS site code. AIRS-AQS monitoring method code. Number of hourly observations.

2.5.2 Annual Summary Statistics. Four highest daily maximum hour values (ppm) and their dates and time of occurrence. Number of exceedances of the daily maximum 1-hour primary NAAQS. Number of daily maximum hour concentrations in ranges:

<table>
<thead>
<tr>
<th>Range</th>
<th>Number of values</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to .04 (ppm)</td>
<td></td>
</tr>
<tr>
<td>.05 to .08</td>
<td></td>
</tr>
<tr>
<td>.09 to .12</td>
<td></td>
</tr>
<tr>
<td>.13 to .16</td>
<td></td>
</tr>
<tr>
<td>.17 to .20</td>
<td></td>
</tr>
<tr>
<td>.21 to .24</td>
<td></td>
</tr>
<tr>
<td>.25 to .28</td>
<td></td>
</tr>
<tr>
<td>Greater than .28</td>
<td></td>
</tr>
</tbody>
</table>

2.6 Lead (Pb)

2.6.1 Site and Monitoring Information. City name (when applicable), county name, and street address of site location. AIRS-AQS site code. AIRS-AQS monitoring method code. Sampling interval of submitted data, e.g., twenty-four hour or quarterly composites.

2.6.2 Annual Summary Statistics. The four quarterly arithmetic averages given to two decimal places for the year together with the
Environmental Protection Agency

number of twenty-four hour samples included in the average, as in the following format:

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Number of 24-hour samples</th>
<th>Quarterly arithmetic average (µg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan.–March</td>
<td>...........................</td>
<td>.......................................</td>
</tr>
<tr>
<td>April–June</td>
<td>...........................</td>
<td>.......................................</td>
</tr>
<tr>
<td>July–Sept.</td>
<td>...........................</td>
<td>.......................................</td>
</tr>
<tr>
<td>Oct.–Dec.</td>
<td>...........................</td>
<td>.......................................</td>
</tr>
</tbody>
</table>

2.7 Particulate Matter (PM₁₀)

2.7.1 Site and Monitoring Information. City name (when applicable), county name, and street address of site location. AIRS-AQS site code. Number of daily observations. Sampling schedule used such as once every six days, once every three days, etc. Number of additional sampling days beyond sampling schedule used. Number of 24-hour average concentrations in ranges:

<table>
<thead>
<tr>
<th>Range</th>
<th>Number of values</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 25 (µg/m³)</td>
<td>..................................</td>
</tr>
<tr>
<td>26 to 50</td>
<td>..................................</td>
</tr>
<tr>
<td>51 to 75</td>
<td>..................................</td>
</tr>
<tr>
<td>76 to 100</td>
<td>..................................</td>
</tr>
<tr>
<td>101 to 125</td>
<td>..................................</td>
</tr>
<tr>
<td>126 to 150</td>
<td>..................................</td>
</tr>
<tr>
<td>151 to 175</td>
<td>..................................</td>
</tr>
<tr>
<td>176 to 200</td>
<td>..................................</td>
</tr>
<tr>
<td>Greater than 200</td>
<td>..................................</td>
</tr>
</tbody>
</table>

2.7.2 Annual Summary Statistics. Annual arithmetic mean (µg/m³) as specified in 40 CFR part 50, appendix N. All daily PM₁₀ values above the level of the 24-hour PM₁₀ NAAQS and dates of occurrence. Sampling schedule used such as once every six days, once every three days, etc. Number of additional sampling days beyond sampling schedule used. Number of 24-hour average concentrations in ranges:

<table>
<thead>
<tr>
<th>Range</th>
<th>Number of values</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 15 (µg/m³)</td>
<td>..................................</td>
</tr>
<tr>
<td>16 to 30</td>
<td>..................................</td>
</tr>
<tr>
<td>31 to 50</td>
<td>..................................</td>
</tr>
<tr>
<td>51 to 70</td>
<td>..................................</td>
</tr>
<tr>
<td>71 to 90</td>
<td>..................................</td>
</tr>
<tr>
<td>91 to 110</td>
<td>..................................</td>
</tr>
<tr>
<td>Greater than 110</td>
<td>..................................</td>
</tr>
</tbody>
</table>

2.7.3 Annual Summary Statistics. Annual arithmetic mean (µg/m³) as specified in 40 CFR part 50, appendix N. All daily PM₁₀ values above the level of the 24-hour PM₁₀ NAAQS and dates of occurrence. Sampling schedule used such as once every six days, everyday, etc. Number of 24-hour average concentrations in ranges:

<table>
<thead>
<tr>
<th>Range</th>
<th>Number of values</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 25 (µg/m³)</td>
<td>..................................</td>
</tr>
<tr>
<td>26 to 50</td>
<td>..................................</td>
</tr>
<tr>
<td>51 to 75</td>
<td>..................................</td>
</tr>
<tr>
<td>76 to 100</td>
<td>..................................</td>
</tr>
<tr>
<td>101 to 125</td>
<td>..................................</td>
</tr>
<tr>
<td>126 to 150</td>
<td>..................................</td>
</tr>
<tr>
<td>151 to 175</td>
<td>..................................</td>
</tr>
<tr>
<td>176 to 200</td>
<td>..................................</td>
</tr>
<tr>
<td>Greater than 200</td>
<td>..................................</td>
</tr>
</tbody>
</table>

2.7.4 Episode and Other Unscheduled Sampling Data. List episode measurements, other unscheduled sampling data, and dates of occurrence. List the regularly scheduled sample measurements and date of occurrence that preceded the episode or unscheduled measurement.

Footnotes:
1. Continuous methods only.
2. Manual or intermittent methods only.

3. Based on nonoverlapping values computed according to procedures described in reference (1) or on individual intermittent measurements.
4. Based on overlapping running averages for continuous measurements as described in reference (1) or on individual measurement for intermittent methods.

Reference

APPENDIX G TO PART 58—UNIFORM AIR QUALITY INDEX (AQI) AND DAILY REPORTING

GENERAL REQUIREMENTS

1. What is the AQI?
2. Why report the AQI?
3. Must I report the AQI?
4. What goes into my AQI report?
5. Is my AQI report for my MSA only?
6. How do I get my AQI report to the public?
7. How often must I report the AQI?
8. May I make exceptions to these reporting requirements?

Calculation
9. How does the AQI relate to air pollution levels?
10. Where do I get the pollutant concentrations to calculate the AQI?
11. Do I have to forecast the AQI?
12. How do I calculate the AQI?

BACKGROUND AND REFERENCE MATERIALS

13. What additional information should I know?

GENERAL REQUIREMENTS

1. What is the AQI?

The AQI is a tool that simplifies reporting air quality to the general public. The AQI incorporates into a single index concentrations of 5 criteria pollutants: ozone (O₃), particulate matter (PM), carbon monoxide (CO), sulfur dioxide (SO₂), and nitrogen dioxide (NO₂). The scale of the index is divided into general categories that are associated with health messages.

2. Why Report the AQI?

The AQI offers various advantages:
a. It is simple to create and understand.
b. It conveys the health implications of air quality.
3. Must I Report the AQI?
You must report the AQI daily if yours is a metropolitan statistical area (MSA) with a population over 350,000.

4. What Goes Into My AQI Report?

i. Your AQI report must contain the following:
   a. The reporting area(s) (the MSA or sub-division of the MSA).
   b. The reporting period (the day for which the AQI is reported).
   c. The critical pollutant (the pollutant with the highest index value).
   d. The AQI (the highest index value).
   e. The category descriptor and index value associated with the AQI and, if you choose to report in a color format, the associated color. Use only the following descriptors and colors for the six AQI categories:

<table>
<thead>
<tr>
<th>AQI Range</th>
<th>Category Descriptor</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 50</td>
<td>&quot;Good&quot;</td>
<td>Green</td>
</tr>
<tr>
<td>51 to 100</td>
<td>&quot;Moderate&quot;</td>
<td>Yellow</td>
</tr>
<tr>
<td>101 to 150</td>
<td>&quot;Unhealthy for Sensitive Groups&quot;</td>
<td>Orange</td>
</tr>
<tr>
<td>151 to 200</td>
<td>&quot;Unhealthy&quot;</td>
<td>Red</td>
</tr>
<tr>
<td>201 to 300</td>
<td>&quot;Very Unhealthy&quot;</td>
<td>Purple</td>
</tr>
<tr>
<td>301 and above</td>
<td>&quot;Hazardous&quot;</td>
<td>Maroon</td>
</tr>
</tbody>
</table>

   f. The pollutant specific sensitive groups for any reported index value greater than 100. Use the following sensitive groups for each pollutant:

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Sensitive Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ozone</td>
<td>Children and people with asthma are the groups most at risk.</td>
</tr>
<tr>
<td>PM&lt;sub&gt;2.5&lt;/sub&gt;</td>
<td>People with respiratory or heart disease, the elderly and children are the groups most at risk.</td>
</tr>
<tr>
<td>PM&lt;sub&gt;10&lt;/sub&gt;</td>
<td>People with respiratory disease are the group most at risk.</td>
</tr>
<tr>
<td>CO</td>
<td>People with heart disease are the group most at risk.</td>
</tr>
<tr>
<td>SO&lt;sub&gt;2&lt;/sub&gt;</td>
<td>People with asthma are the group most at risk.</td>
</tr>
<tr>
<td>NO&lt;sub&gt;2&lt;/sub&gt;</td>
<td>Children and people with respiratory disease are the groups most at risk.</td>
</tr>
</tbody>
</table>

   ii. When appropriate, your AQI report may also contain the following:
   a. Appropriate health and cautionary statements.
   b. The name and index value for other pollutants, particularly those with an index value greater than 100.
   c. The index values for sub-areas of your MSA.
   d. Causes for unusual AQI values.
   e. Actual pollutant concentrations.

5. Is My AQI Report for My MSA Only?
Generally, your AQI report applies to your MSA only. However, if a significant air quality problem exists (AQI greater than 100) in areas significantly impacted by your MSA but not in it (for example, O<sub>3</sub> concentrations are often highest downwind and outside an urban area), you should identify these areas and report the AQI for these areas as well.

6. How Do I Get My AQI Report to the Public?
You must furnish the daily report to the appropriate news media (radio, television, and newspapers). You must make the daily report publicly available at one or more places of public access, or by any other means, including a recorded phone message, a public Internet site, or facsimile transmission. When the AQI value is greater than 100, it is particularly critical that the reporting to the various news media be as extensive as possible. At a minimum, it should include notification to the media with the largest market coverages for the area in question.

7. How Often Must I Report the AQI?
You must report the AQI at least 5 days per week. Exceptions to this requirement are in section 8 of this appendix.

8. May I Make Exceptions to These Reporting Requirements?

i. If the index value for a particular pollutant remains below 50 for a season or year, then you may exclude the pollutant from your calculation of the AQI in section 12.
ii. If all index values remain below 50 for a year, then you may report the AQI at your discretion. In subsequent years, if pollutant
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levels rise to where the AQI would be above 50, then the AQI must be reported as required in sections 3, 4, 6, and 7 of this appendix.

CALCULATION

9. How Does the AQI Relate to Air Pollution Levels?

For each pollutant, the AQI transforms ambient concentrations to a scale from 0 to 500. The AQI is keyed as appropriate to the national ambient air quality standards (NAAQS) for each pollutant. In most cases, the index value of 100 is associated with the numerical level of the short-term standard (i.e., averaging time of 24-hours or less) for each pollutant. Different approaches are taken for NO₂, for which no short-term standard has been established, and for PM₂.₅, for which the annual standard is the principal vehicle for protecting against short-term concentrations. The index value of 50 is associated with the numerical level of the annual standard for a pollutant, if there is one, at one-half the level of the short-term standard for the pollutant, or at the level at which it is appropriate to begin to provide guidance on cautionary language. Higher categories of the index are based on increasingly serious health effects and increasing proportions of the population that are likely to be affected. The index is related to other air pollution concentrations through linear interpolation based on these levels. The AQI is equal to the highest of the numbers corresponding to each pollutant. For the purposes of reporting the AQI, the sub-indexes for PM₁₀ and PM₂.₅ are to be considered separately. The pollutant responsible for the highest index value (the reported AQI) is called the “critical” pollutant.

10. Where Do I Get the Pollutant Concentrations To Calculate the AQI?

You must use concentration data from population-oriented State/Local Air Monitoring Station (SLAMS) or parts of the SLAMS required under 40 CFR 58.20 for each pollutant except PM. For PM, you need only calculate and report the AQI on days for which you have measured air quality data (e.g., particulate monitors often report values only every sixth day). You may use particulate measurements from monitors that are not reference or equivalent methods (for example, continuous PM₁₀ or PM₂.₅ monitors) if you can relate these measurements by statistical linear regression to reference or equivalent method measurements.

11. Do I Have to Forecast the AQI?

You should forecast the AQI to provide timely air quality information to the public, but this is not required. If you choose to forecast the AQI, then you may consider both long-term and short-term forecasts. You can forecast the AQI at least 24-hours in advance using the most accurate and reasonable procedures considering meteorology, topography, availability of data, and forecasting expertise. The document “Guideline for Developing an Ozone Forecasting Program” (the Forecasting Guidance) will help you start a forecasting program. You can also issue short-term forecasts by predicting 8-hour ozone values from 1-hour ozone values using methods suggested in the Reporting Guidance, “Guideline for Public Reporting of Daily Air Quality.”

12. How Do I Calculate the AQI?

i. The AQI is the highest value calculated for each pollutant as follows:
   a. Identify the highest concentration among all of the monitors within each reporting area and truncate the pollutant concentration to one more than the significant digits used to express the level of the NAAQS for that pollutant. This is equivalent to the rounding conventions used in the NAAQS.
   b. Using Table 2, find the two breakpoints that contain the concentration.
   c. Using Equation 1, calculate the index.
   d. Round the index to the nearest integer.
TABLE 2.—BREAKPOINTS FOR THE AQI

<table>
<thead>
<tr>
<th>Category</th>
<th>O₃ ppm (8-hour)</th>
<th>O₃ ppm (1-hour)</th>
<th>PM₁₀ (µg/m³)</th>
<th>PM₂.₅ (µg/m³)</th>
<th>CO ppm</th>
<th>SO₂ ppm</th>
<th>NOₓ ppm</th>
<th>AQI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>0.00±0.064</td>
<td>0.0±15.4</td>
<td>0.0±5</td>
<td>0.0±4.4</td>
<td>0.000±0.034</td>
<td></td>
<td></td>
<td>0–50</td>
</tr>
<tr>
<td>Moderate</td>
<td>0.065±0.084</td>
<td>15.5±40.4</td>
<td>55±154</td>
<td>4.5±9.4</td>
<td>0.035±0.144</td>
<td></td>
<td></td>
<td>51–100</td>
</tr>
<tr>
<td>Unhealthy for sensitive groups</td>
<td>0.085±0.104</td>
<td>40.5±65.4</td>
<td>155±254</td>
<td>9.5±12.4</td>
<td>0.145±0.224</td>
<td></td>
<td></td>
<td>101–150</td>
</tr>
<tr>
<td>Unhealthy</td>
<td>0.105±0.124</td>
<td>465.9±150.4</td>
<td>255±354</td>
<td>12.5±15.4</td>
<td>0.225±0.304</td>
<td></td>
<td></td>
<td>151–200</td>
</tr>
<tr>
<td>Very unhealthy</td>
<td>0.125±0.374</td>
<td>4 150.5±250.4</td>
<td>355±424</td>
<td>15.5±30.4</td>
<td>0.305±0.604</td>
<td>0.65–1.24</td>
<td>201–300</td>
<td></td>
</tr>
<tr>
<td>Hazardous</td>
<td>0.165±0.404</td>
<td>4 250.5±350.4</td>
<td>425±504</td>
<td>30.5±40.4</td>
<td>0.605±0.804</td>
<td>1.25–1.64</td>
<td>301–400</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.205±0.604</td>
<td>4 350.5±500.4</td>
<td>505±604</td>
<td>40.5±50.4</td>
<td>0.805±1.004</td>
<td>1.65–2.04</td>
<td>401–500</td>
<td></td>
</tr>
</tbody>
</table>

1 Areas are generally required to report the AQI based on 8-hour ozone values. However, there are a small number of areas where an AQI based on 1-hour ozone values would be more precautionary. In these cases, in addition to calculating the 8-hour ozone index value, the 1-hour ozone index value may be calculated, and the maximum of the two values reported.

2 NOₓ has no short-term NAAQS and can generate an AQI only above an AQI value of 200.

3 8-hour O₃ values do not define higher AQI values (> 301). AQI values of 301 or higher are calculated with 1-hour O₃ concentrations.

4 If a different SHL for PM₂.₅ is promulgated, these numbers will change accordingly.
ii. If the concentration is equal to a breakpoint, then the index is equal to the corresponding index value in Table 2. However, Equation 1 can still be used. The results will be equal. If the concentration is between two breakpoints, then calculate the index of that pollutant with Equation 1. You must also note that in some areas, the AQI based on 1-hour $O_3$ will be more precautionary than using 8-hour values (see footnote 1 to Table 2). In these cases, you may use 1-hour values as well as 8-hour values to calculate index values and then use the maximum index value as the AQI for $O_3$.

\[ I_p = I_{hi} - \frac{I_{lo} - (C_p - BP_{hi})}{BP_{hi} - BP_{lo}} (C_p - BP_{lo}) + I_{lo} \]

(Equation 1)

Where:
- $I_p$: the index value for pollutant $p$
- $C_p$: the truncated concentration of pollutant $p$
- $BP_{hi}$: the breakpoint that is greater than or equal to $C_p$
- $BP_{lo}$: the breakpoint that is less than or equal to $C_p$
- $I_{hi}$: the AQI value corresponding to $BP_{hi}$
- $I_{lo}$: the AQI value corresponding to $BP_{lo}$.

iii. If the concentration is larger than the highest breakpoint in Table 2 then you may use the last two breakpoints in Table 2 when you apply Equation 1.

**Example**

iv. Using Table 2 and Equation 1, calculate the index value for each of the pollutants measured and select the one that produces the highest index value for the AQI. For example, if you observe a PM$_{10}$ value of 210 $\mu g/m^3$, a 1-hour $O_3$ value of 0.156 ppm, and an 8-hour $O_3$ value of 0.130 ppm, then do this:

a. Find the breakpoints for PM$_{10}$ at 210 $\mu g/m^3$, corresponding to index values 101 and 150.

b. Find the breakpoints for 1-hour $O_3$ at 0.156 ppm as 0.125 ppm and 0.164 ppm, corresponding to index values 101 and 150.

c. Find the breakpoints for 8-hour $O_3$ at 0.130 ppm as 0.125 ppm and 0.374 ppm, corresponding to index values 201 and 300.

d. Apply Equation 1 for 210 $\mu g/m^3$, PM$_{10}$:

\[ \frac{150 - 101}{254 - 155} (210 - 155) + 101 = 128. \]

e. Apply Equation 1 for 0.156 ppm, 1-hour $O_3$:

\[ \frac{150 - 101}{0.164 - 0.125} (0.156 - 0.125) + 101 = 140. \]

f. Apply Equation 1 for 0.130 ppm, 8-hour $O_3$:

\[ \frac{300 - 201}{0.374 - 0.125} (0.130 - 0.125) + 201 = 203. \]

g. Find the maximum, 203. This is the AQI. The minimal AQI report would read:

v. Today, the AQI for my city is 203 which is very unhealthy, due to ozone. Children and people with asthma are the groups most at risk.

**Background and Reference Materials**

13. What Additional Information Should I Know?

The EPA has developed a computer program to calculate the AQI for you. The program works with Windows 95, it prompts for inputs, and it displays all the pertinent information for the AQI (the index value, color, category, sensitive group, health effects, and cautionary language). The EPA has also prepared a brochure on the AQI that explains the index in detail (The Air Quality Index), Reporting Guidance (Guideline for Public Reporting of Daily Air Quality) that provides associated health effects and cautionary statements, and Forecasting Guidance (Guideline for Developing an Ozone Forecasting Program) that explains the steps necessary to start an air pollution forecasting program. You can download the program and the guidance documents at www.epa.gov/airnow.

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